A·B QUALITY

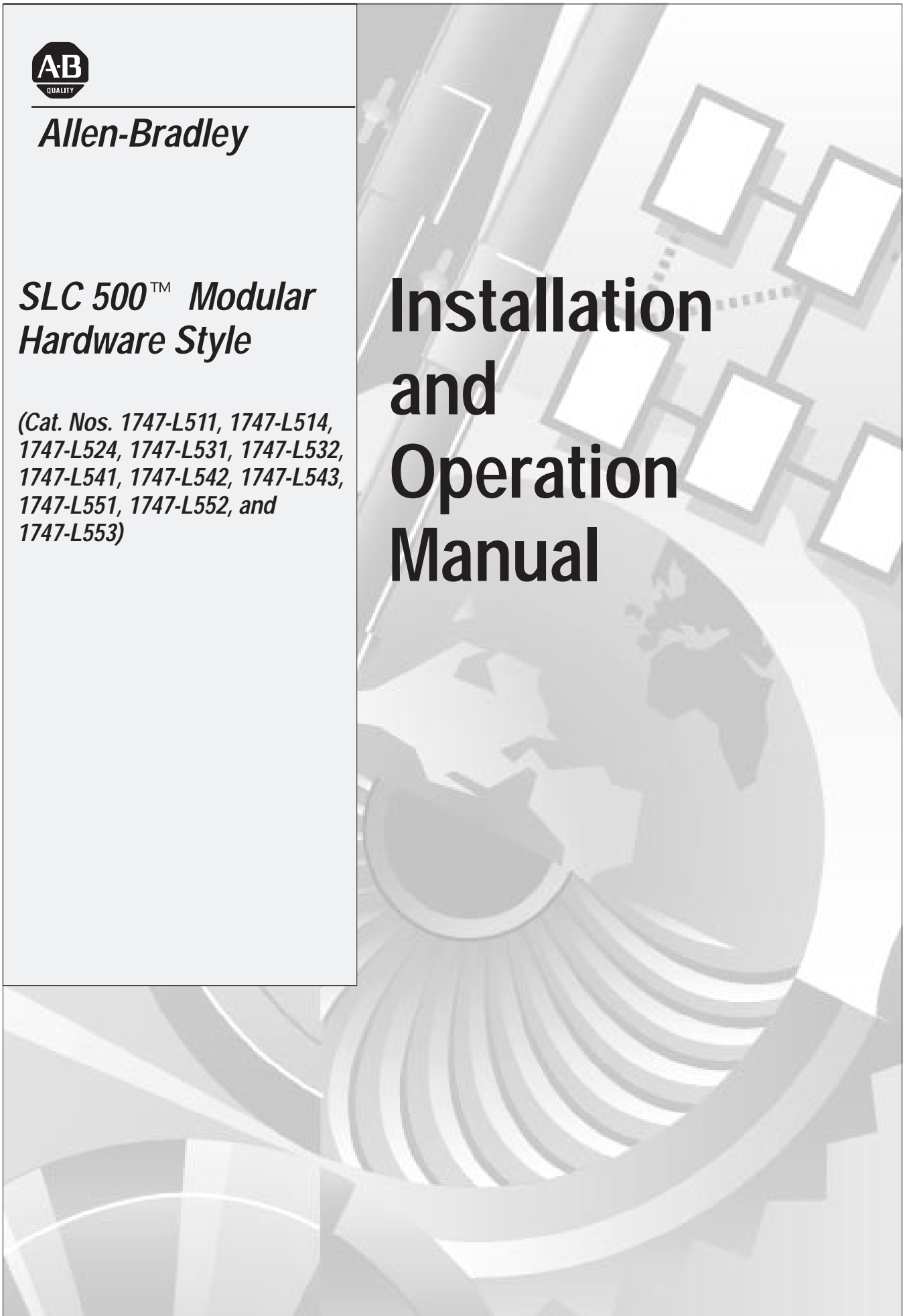*Allen-Bradley*

SLC 500™ Modular Hardware Style

(Cat. Nos. 1747-L511, 1747-L514, 1747-L524, 1747-L531, 1747-L532, 1747-L541, 1747-L542, 1747-L543, 1747-L551, 1747-L552, and 1747-L553)

Installation and Operation Manual

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

> ⚠ **ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:
- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is critical for successful application and understanding of the product.

Summary of Changes

The information below summarizes the changes to this manual since the last printing.

To help you find new information and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

New Information

The table below lists sections that document new features and additional information about existing features, and shows where to find this new information.

For This New Information	See Chapter
SLC 5/05 Ethernet Processor	1, 2, 5, 6, 8, 9, 10, 11 App. A App. B App. D App. E App. F App. G
SLC 5/03 8K Processor	1, 2, 5, 6, 10, 11 App. E App. F
1746–P5 Power Supply	1, 2, 6 App. F
Grounding Guidelines	3
Power Considerations: Isolation Transformer protection information and Power-Distribution System Diagram	3
1761-NET-AIC Advanced Interface Converter	4
1746-IC16 Discrete Input Module	7, 11 App. E App. F
1746-IH16 Discrete Input Module	7, 11 App. E App. F
1746-OB16E Discrete Output Module	App. E App. F
1746-NI8 Analog Input Module	App. E App. F

Table of Contents

System Installation Recommendations

Chapter 3

Starting Up Your Control System

Chapter 8

Maintaining Your Control System

Chapter 9

Troubleshooting

Chapter 10

Replacement Parts

Chapter 11

**Setting Up the DH-485
Network**

Appendix A

RS-232 Communication Interface

Appendix B

Setting Up the DH+ Network   **Appendix C**

Control Networks   **Appendix D**

Power Supply Worksheet   **Appendix E**

Calculating Heat Dissipation for the SLC 500 Control System

Communicating with Devices on an Ethernet Network

Glossary

Index

Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- who should use this manual
- how to use this manual
- related publications
- conventions used in this manual
- Allen-Bradley support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley small logic controllers.

You should have a basic understanding of SLC 500™ products. You should understand programmable controllers and be able to interpret the ladder logic instructions required to control your application. If you do not, contact your local Allen-Bradley representative for information on available training courses before using this product.

How to Use this Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install and operate (preliminary start-up operations) the SLC 500 modular programmable controller. This manual also provides some system design information.

Before using this manual, read the table below and familiarize yourself with the general content of the chapters and appendixes. If you already have a topic in mind that you want to find specific information about, turn to the index at the back of the manual.

Contents of this Manual

If You Want	See
An overview of the manual	the Preface
Serves as a *Quick Start Guide* for the SLC 5/01™, SLC 5/02™, SLC 5/03™, and SLC 5/04™, and SLC 5/05™ modular processors	chapter 1 — Quick Start for Experienced Users
Information on how to select certain components for your SLC 500 control system	chapter 2 — Selecting Your Hardware Components
A guide on how to prepare for the installation of your control system	chapter 3 — System Installation Recommendations
Mounting dimensions of your modular chassis, DTAM™, 1747-AIC, and 1761-NET-AIC	chapter 4 — Mounting Your SLC 500 Control System
Specification information concerning your processor	chapter 5 — Identifying the Components of Your Processor
Procedures on how to install your hardware components	chapter 6 — Installing Your Hardware Components
Information on how to wire the components of your SLC 500 control system	chapter 7 — Wiring Your I/O Modules
A guide on how to start up your control system	chapter 8 — Starting Up Your Control System
Information on how to maintain your control system	chapter 9 — Maintaining Your Control System
To identify error messages generated by your control system	chapter 10 — Troubleshooting
To replace parts of your SLC 500 control system or purchase other SLC™ components	chapter 11 — Replacement Parts
Information on setting up the DH-485 network	appendix A — Setting up the DH-485 Network
Information on using the RS-232 communication interface	appendix B — RS-232 Communication Interface
Information on setting up the DH+ network	appendix C — Setting up the DH+ Network
Information on the 1771-Remote I/O, 1746-ASB, and DeviceNet™	appendix D — Control Networks
The worksheet on selecting your power supply	appendix E — Power Supply Worksheet
Information on how to calculate the heat dissipation of your controller	appendix F — Calculating Heat Dissipation for the SLC 500 Control System
Information on Ethernet	appendix G — Communicating with Devices on an Ethernet Network
Definitions of terms used in this manual	the Glossary

Related Documentation

The table below provides a listing of publications that contain important information about Allen-Bradley Small Logic Controllers and their installation and application. You may want to reference them while you are installing the SLC 500 controller. (To obtain a copy of one of these publications, contact your local Allen-Bradley office or distributor.)

For	Read This Document	Document Number
An overview of the SLC 500 family of products	SLC 500 System Overview	1747-2.30
A description on how to install and use your *Modular* SLC 500 programmable controller	Installation & Operation Manual for Modular Hardware Style Programmable Controllers	1747-6.2
A description on how to install and use your *Fixed* SLC 500 programmable controller	Installation & Operation Manual for Fixed Hardware Style Programmable Controllers	1747-6.21
A procedural and reference manual for technical personnel who use an HHT to develop control applications	Allen-Bradley Hand-Held Terminal User Manual	1747-NP002
An introduction to HHT for first-time users, containing basic concepts but focusing on simple tasks and exercises, and allowing the reader to begin programming in the shortest time possible	Getting Started Guide for HHT	1747-NM009
In-depth information on grounding and wiring Allen-Bradley programmable controllers	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
A description on how to install a PLC-5® system	PLC-5 Family Programmable Controllers Hardware Installation Manual	1785-6.6.1
A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices	Application Considerations for Solid-State Controls	SGI-1.1
An article on wire sizes and types for grounding electrical equipment	National Electrical Code	Published by the National Fire Protection Association of Boston, MA.
A complete listing of current Allen-Bradley documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages.	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Allen-Bradley Industrial Automation Glossary	AG-7.1

Conventions Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.
- Text in `this font` indicates words or phrases you should type.

Allen-Bradley Support

Allen-Bradley offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Allen-Bradley representatives in every major country in the world.

Local Product Support

Contact your local Allen-Bradley representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Allen-Bradley for technical assistance, please review the information in the *Troubleshooting* chapter first. Then call your local Allen-Bradley representative.

Your Questions or Comments on this Manual

If you find a problem with this manual, please notify us of it on the enclosed Publication Problem Report.

If you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

Allen-Bradley Company, Inc.
Control and Information Group
Technical Communication, Dept. A602V, T122
P.O. Box 2086
Milwaukee, WI 53201-2086

Quick Start for Experienced Users

This chapter can help you to get started using the SLC 500 Modular Processors. We base the procedures here on the assumption that you have an understanding of SLC 500 products. You should understand electronic process control and be able to interpret the ladder logic instructions required to generate the electronic signals that control your application.

Because it is a start-up guide for experienced users, this chapter *does not* contain detailed explanations about the procedures listed. It does, however, reference other chapters in this book where you can get more information.

If you have any questions or are unfamiliar with the terms used or concepts presented in the procedural steps, *always read the referenced chapters* and other recommended documentation before trying to apply the information.

This chapter:
- tells you what tools and equipment you need
- lists how to install and wire your power supply
- lists how to install and apply power to your processor
- lists how to establish communications with the processor
- describes how to return the SLC 5/03, SLC 5/04, and SLC 5/05 processors to initial factory conditions if required

Required Tools and Equipment

Have the following tools and equipment ready:
- medium blade screwdriver
- programming equipment
- a 1747-PIC and 1747-CP3 programmer cable, or 1784-KT, -KTX, -KT2, or -PCMK communication interface, or standard Ethernet PC board or standard Ethernet hub (SLC 5/05 only)

Procedures

1.	Check the contents of shipping box.	Reference

Unpack the shipping boxes making sure that the contents include:

- SLC 500 Modular Processor
- installation instructions (Publication 1747-5.25 or 1747-5.27)
- SLC 500 Modular Chassis (Catalog Numbers 1746-A4, 1746-A7, 1746-A10, or 1746-A13)
- installation instructions (Publication 1746-5.8)   –
- SLC 500 Modular Power Supplies (Catalog Numbers 1746-P1, 1746-P2, 1746-P3, 1746-P4, or 1746-P5)
- installation instructions (Publication Number 1746-5.1)

If the contents are incomplete, call your local Allen-Bradley representative for assistance.

2.	Install the power supply	Reference

Follow the steps below:

Chapter 6
(Installing Your Hardware Components)

1. Align the circuit board of the power supply with the card guides on the left side of the chassis, and slide the power supply in until it is flush with the chassis.
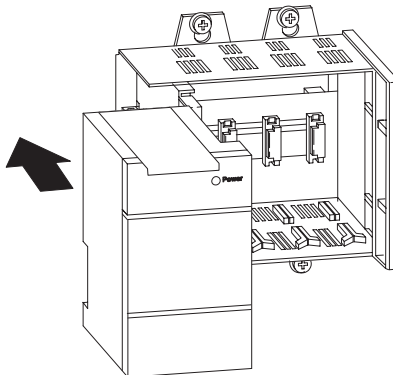
2. Fasten the power supply to the chassis.
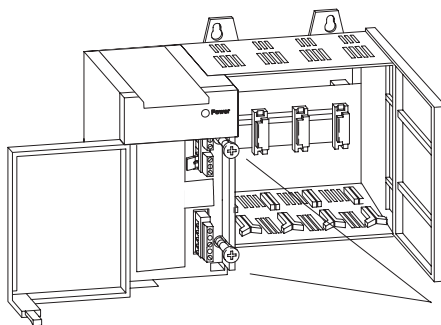
Use these screws to fasten the power supply to the chassis.

3.	**Make jumper selection for 120/240V ac on 1746-P1, 1746-P2, and 1746-P4 Power Supplies.**	Reference

Place the input voltage jumper to match the input voltage. This does not apply to the 1746-P3, or 1746-P5 which do not have jumpers.

⚠ **ATTENTION:** Set the input jumper before applying power. Hazardous voltage is present on exposed pins when power is applied; contact with the pin may cause injury to personnel.

Catalog Number 1746-P1 & P2

Catalog Number 1746-P4
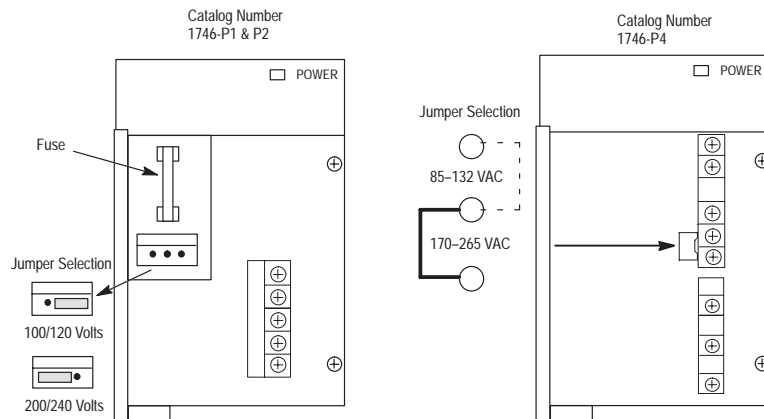
4.	Wire power to power supply.	Reference

ATTENTION: Turn off incoming power before connecting wires; failure to do so could cause injury to personnel and/or equipment.

Connect incoming power.

User Power
- ⊕ PWR OUT +24V dc
- ⊕ PWR OUT COM

Incoming Power
- ⊕ 120/240V ac
- ⊕ V ac NEUT
- ⊕ CHASSIS GROUND ⏚

1746-P1 and -P2

Incoming Power
- ⊕ NOT USED
- ⊕ NOT USED
- ⊕ + 24V dc
- ⊕ dc NEUT
- ⊕ CHASSIS GROUND ⏚

1746-P3

User Power
- ⊕ PWR OUT +24V dc
- ⊕ PWR OUT COMMON

- ⊕ 85–132V ac
- ⊕ JUMPER
- ⊕ 170–265V ac

Incoming Power
- ⊕ L1—85–132/170–265
- ⊕ L2— NEUTRAL
- ⊕ CHASSIS GROUND ⏚

1746-P4

User Power
- ⊕ PWR OUT +24V dc
- ⊕ PWR OUT COM

Incoming Power
- ⊕ +125V dc
- ⊕ dc NEUT
- ⊕ **CHASSIS GROUND** ⏚
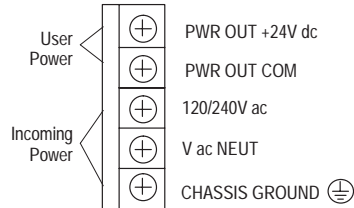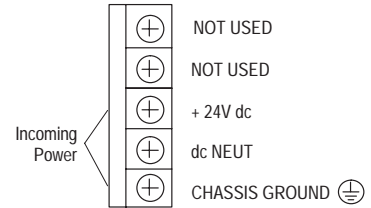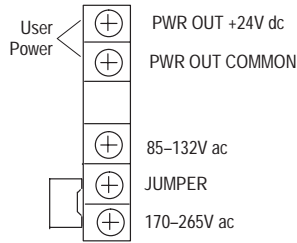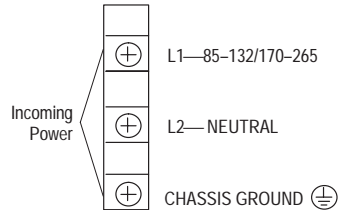
1746-P5
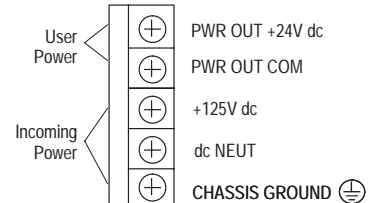
5.	**Install the processor.**	**Reference**

Make sure system power is off; then insert the processor into the 1746 chassis.

Important: The SLC 500 Modular Processors must be inserted into the left slot (slot 0), as shown below. Remove the protective label after installing the processor.
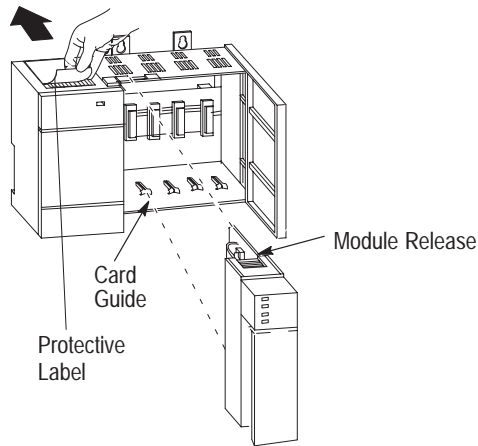
Module Release

Card Guide

Protective Label

Chapter 2
(Selecting Your Hardware Components)
Chapter 6
(Installing Your Hardware Components)

6.	**Apply power to to the processor.**	**Reference**

Follow the steps below:

1. Energize the chassis power supply.
2. Check the chassis power supply and processor LEDs. The power LED on the power supply should be on and the fault LED on the processors should be flashing.

Chapter 8
(Starting Up Your Control System)
Chapter 10
(Troubleshooting)

Power supply and SLC 5/01 and SLC 5/02 LEDs

The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.
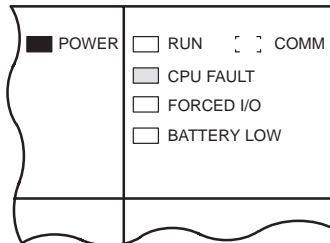
Power supply and SLC 5/03 and SLC 5/04 LEDs
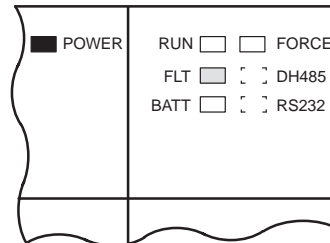
The DH485 LED on the SLC 5/03 processor is labeled "DH+" on the SLC 5/04 processor.

Power supply and SLC 5/05 LEDs
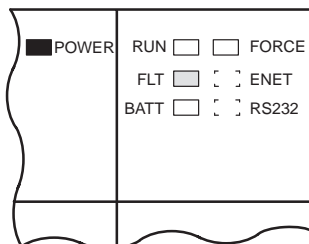
Refer to the following key to determine the status of the LED indicators:

☐ Indicates the LED is OFF.

■ Indicates the LED is ON.

▨ Indicates the LED is FLASHING.

⌐ ⌐ Status of LED does not matter.

7.	Load your software.	Reference

Refer to your software package's documentation.   –

8.	Establish communications to the processor.	Reference

Follow the steps below:

Chapter 8
(Starting Up Your
Control System)

1. Refer to the following to establish communications between the processor and your personal computer.

Processor:	Procedure:
SLC 5/01	Connect 1747-PIC from the processor to your personal computer.
SLC 5/02	Connect 1747-PIC from the processor to your personal computer.
SLC 5/03	Connect 1747-PIC from the processor to your personal computer or a 1747-CP3 cable from channel 0 of the processor to the personal computer serial port.
SLC 5/04	Connect a 1747-CP3 cable from channel 0 of the processor to the personal computer serial port or use a KT, KTX, KT2, or PCMK card.
SLC 5/05	Connect a 1747-CP3 cable from channel 0 of the processor to the personal computer serial port. For Ethernet connection, connect channel 1 of the processor and the PC Ethernet Card to an Ethernet hub using 10Base-T cable.

2. Set the communication parameters of software to match the default parameters of the processor:

- SLC 5/01, SLC 5/02, and SLC 5/03 channel 1
  DH-485
  19.2K baud
  Node Address = 1

- SLC 5/03 and SLC 5/04 only:
  channel 0 configuration:
  DF1 Full Duplex
  No Handshaking
  1200 baud
  CRC Error Check
  Duplicate Packet Detect On
  No Parity
  1 Stop Bit

- SLC 5/04 only:
  channel 1 configuration:
  DH+
  57.6K baud
  Node Address = 1

- SLC 5/05 only:
  channel 0 configuration:
  DF1 Full Duplex:
  No Handshaking
  19.2K baud
  CRC Error Check
  Duplicate Packet Detect On
  No Parity
  1 Stop Bit
  channel 1 configuration:
  Driver: Ethernet[1]

[1] Configuring with BOOTP enabled so that a BOOTP server on the network can automatically provide the SLC 5/05 with the configuration necessary to start communicating over Ethernet. See Appendix G for more information.

9.	**(Optional) Return the SLC 5/03, SLC 5/04, or SLC 5/05 processor to initial factory conditions.**	Reference

Use this procedure if the communication channels are shut down due to configuration parameters, or if you absolutely cannot establish communications with the processor.

Chapter 10 (Troubleshooting)

⚠️ **ATTENTION:** If you return the processor to the initial factory conditions, the user program and communication configurations are returned to their default settings.

1. Remove power from the SLC 500 power supply.

2. Remove the processor from the chassis.

3. *Disconnect the battery* by removing the battery connector from its socket.

4. Locate the VBB and GND connections on the right side of the motherboard.

5. Place a small bladed screwdriver across the VBB and GND connections and hold for 60 seconds. This returns the processor to the initial factory conditions.

SLC 5/03 (1747-L531 and 1747-L532)

SLC 5/04 (1747-L541, 1747-L542, and 1747-L543)
SLC 5/05 (1747-L551, 1747-L552, and 1747-L553)

Keyswitch

Mother Board

GND   VBB

Right Side View

GND

VBB

Mother Board
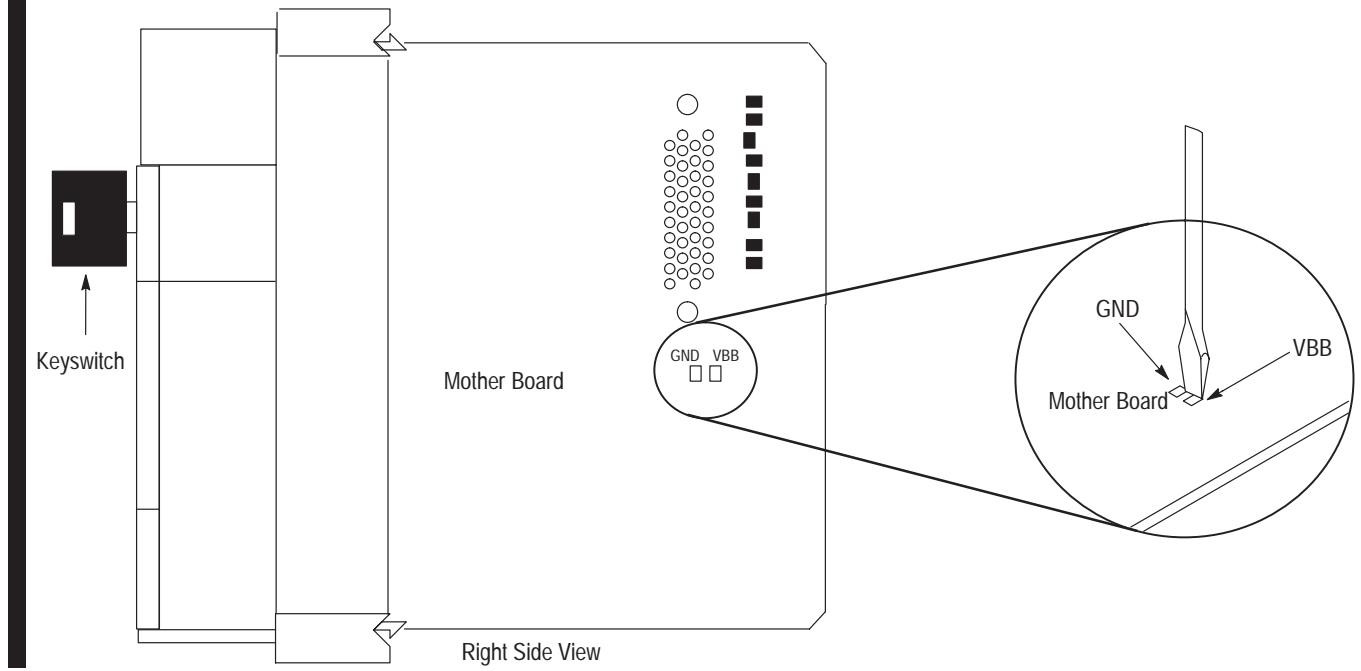
Selecting Your Hardware Components

This chapter provides general information on what your SLC 500 controller can do for you, and an overview of the modular control system. It also explains how to select:

- chassis
- modular processors
- discrete I/O modules
- specialty I/O modules
- power supplies
- enclosures
- operator interfaces
- memory modules
- isolation transformers

There is also a section on special considerations for controller installations.

This chapter does not provide you with all the information that you need to select a complete SLC 500 control system. To do this, we recommend that you use the latest version of the system overview, *SLC 500 Family of Small Programmable Controllers,* Publication Number 1747-2.30.

European Union Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC – Generic Emission Standard, Part 2 – Industrial Environment
- EN 50082-2
  EMC – Generic Immunity Standard, Part 2 – Industrial Environment

This product is intended for use in an industrial environment.

What Your SLC 500 Controller Can Do for You

The SLC 500 programmable controller has features that previously could only be found in large programmable controllers. It has the flexibility and power of a large controller with the size and simplicity of a small controller. The SLC 500 controller offers you more control options than any other programmable controller in its class.

These programmable controllers make up a technologically advanced control system having inherent flexibility and advantages characteristic of other programmable controllers, but with one important difference — simplicity!

Overview of Your Modular Control System

The basic modular controller consists of a chassis, power supply, processor (CPU), Input/Output (I/O modules), and an operator interface device for programming and monitoring. The figure below shows typical hardware components for a modular controller.

Modular Hardware Components   **Modular Controller**

Power Supply   Processor Module   Input Module   Output Module   Combination I/O Module

Programming Terminal   Programming PC

OR

Chassis
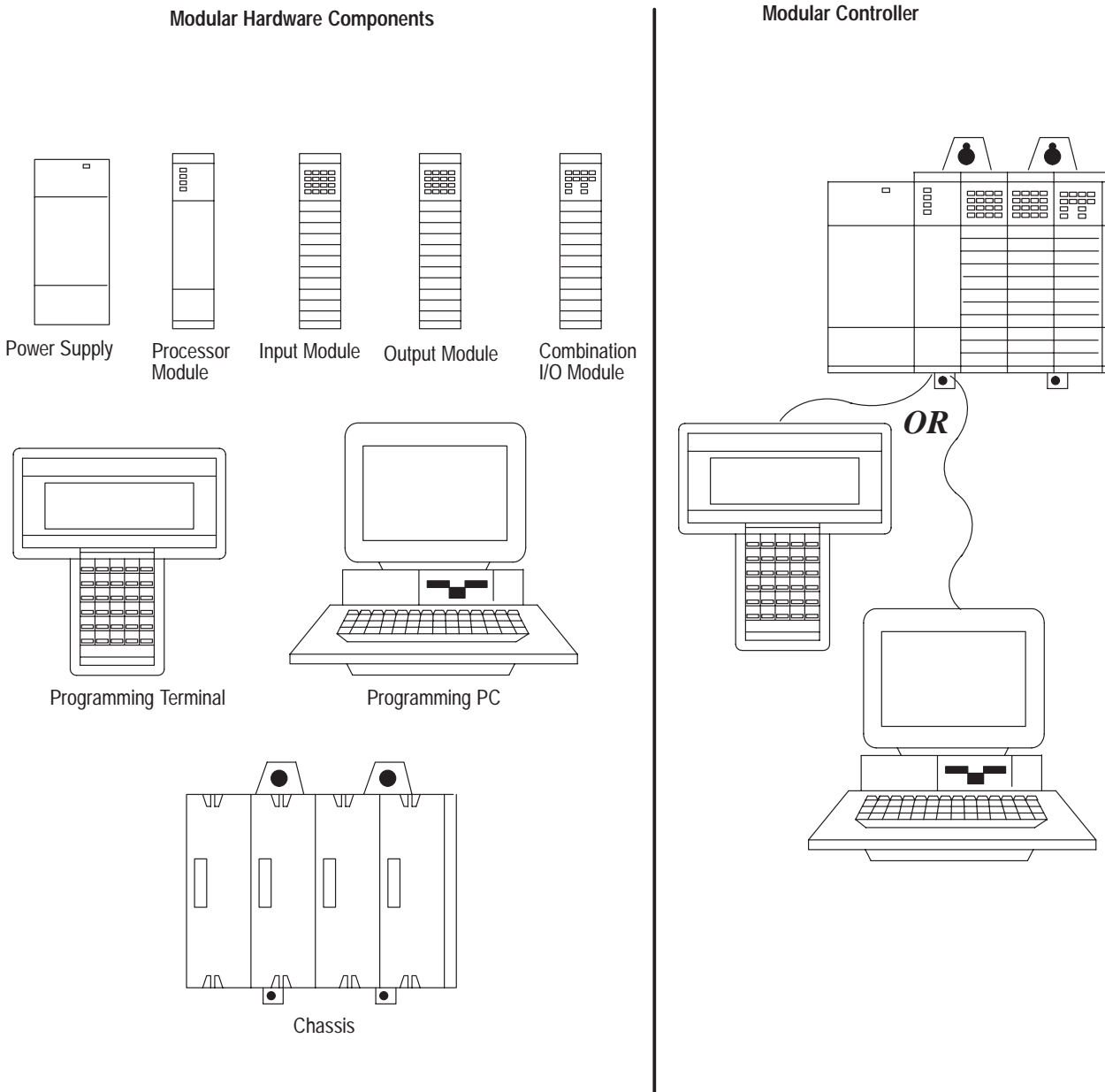
Principles of Machine Control

You enter a logic program into the controller using the software. The logic program is based on your electrical relay print diagrams. It contains instructions that direct control of your application.

With the logic program entered into the controller, placing the controller in the Run mode initiates an operating cycle. The controller's operating cycle consists of a series of operations performed sequentially and repeatedly, unless altered by your program logic.
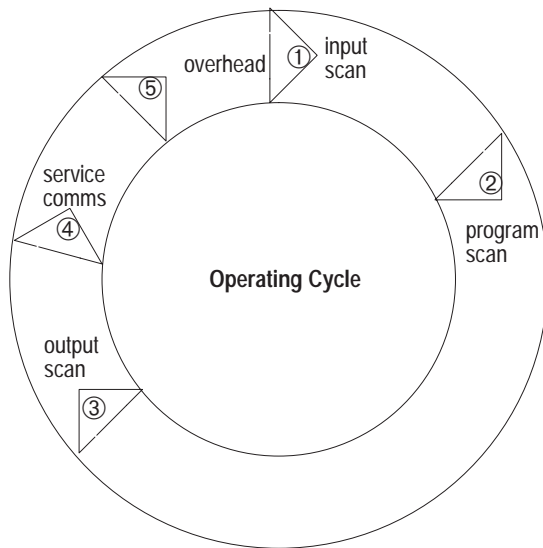
① input scan – the time required for the controller to scan and read all input data; typically accomplished within ms.

② program scan – the time required for the processor to execute the instructions in the program. The program scan time varies depending on the instructions used and each instruction's status during the scan time.

> **Important:** Subroutine and interrupt instructions within your logic program may cause deviations in the way the operating cycle is sequenced.

③ output scan – the time required for the controller to scan and write all output data; typically accomplished within ms.

④ service communications – the part of the operating cycle in which communication takes place with other devices, such as an HHT or a personal computer.

⑤ housekeeping and overhead – time spent on memory management and updating timers and internal registers.

Operating Cycle

overhead ① input scan

⑤

service comms

④

program scan

②

output scan

③

Selecting Chassis

The chassis houses the processor and I/O modules. The power supply mounts on the left side of the chassis. All components easily slide into the chassis along guides formed in the chassis. No tools are required to insert or remove the processor or I/O modules. A maximum of three chassis (30 I/O slots) may be connected in an SLC system.

There are four sizes of chassis that you can choose: 4-slot, 7-slot, 10-slot, and 13-slot. For chassis dimensions, see chapter 4.

Selecting Modular Processors

SLC 500 modular processors are designed to meet a wide range of applications, from small stand-alone to large distributed systems and from simple to complex applications.

Processor Features

Memory size — The SLC 500 modular processors memory is user configurable for either data storage or program storage. Memory size ranges from 1K to 64K.

I/O points — The SLC 5/01 processor supports addressing of up to 3940 I/O. The SLC 5/02, SLC 5/03, SLC 5/04, and SLC 5/05 processors support addressing of 4096 I/O. The SLC 500 modular processors are supported by over 60 different I/O modules including digital, analog, and intelligent I/O.

Performance — The SLC 500 modular processors are designed with throughput performance in mind. The program scan time for a typical instruction mix ranges from 0.9 ms/K to 8.0 ms/K depending on the processor. I/O scan times range from 0.25 ms to 2.6 ms depending on the processor.

Advanced instruction support — The instructions available depends on the processor used. The following table lists the type of instruction support offered by the SLC 500 modular processors.

Instruction Support	SLC 5/01	SLC 5/02	SLC 5/03	SLC 5/04	SLC 5/05
Bit	●	●	●	●	●
Timer and Counter	●	●	●	●	●
Comparison	●	●	●	●	●
Basic Math	●	●	●	●	●
Move, Copy, and Bit Shift	●	●	●	●	●
Sequencer	●	●	●	●	●
Jump and Subroutine	●	●	●	●	●
Messaging		●	●	●	●
STI		●	●	●	●
FIFO/LIFO		●	●	●	●
PID		●	●	●	●
Advanced Math and Trig			●	●	●
Indirect Addressing			●	●	●
Floating Point Math			●	●	●

Processor Communication Options

The SLC 500 processors support different types of communication options. The following sections describe the available physical connections and protocol options used by the SLC 500 processors.

Physical Connection Options

Ethernet (10Base-T) channel offers:

- 10 Mbps communication rate
- ISO/IEC 8802-3STD 802.3 (RJ45) connector for 10Base-T media
- TCP/IP communication protocol
- built-in isolation

Data Highway Plus (DH+) channel offers:

- communication rates of 57.6K, 115.2K, and 230.4K baud
- maximum network length of 3,048 m (10,000 ft) at 57.6K baud
- Belden 9463 (blue hose) cable connection between nodes (daisy chain connection)
- built-in isolation

DH-485 channel offers:

- configurable communication rates up to 19.2K baud
- electrical isolation via the 1747-AIC or 1761-NET-AIC
- maximum network length of 1219m (4,000 ft)
- RS-485 electrical specifications
- Belden 9842 or Belden 3106A cable connection between nodes (daisy chain connection)

RS-232 channel offers:

- communication rates up to 19.2K baud (38.4K baud SLC 5/05)
- maximum distance between devices is 15.24 m (50 ft)
- RS-232C (EIA-232) electrical specifications
- modem support
- built-in isolation

The table below summarizes the processor channel connections.

Processor		Physical Communication Channel			
		DH-485	**RS-232**	**DH+**	**Ethernet**
SLC 5/01 and SLC 5/02		DH-485 protocol	––	––	––
SLC 5/03	Channel 0	––	DH-485[1], DF1 Full-Duplex, DF1 Half-Duplex Master/Slave, and ASCII protocols	––	––
	Channel 1	DH-485 protocol	––	––	––
SLC 5/04	Channel 0	––	DH-485[1], DF1 Full-Duplex, DF1 Half-Duplex Master/Slave, and ASCII protocols	––	––
	Channel 1	––	––	DH+ protocol	––
SLC 5/05	Channel 0	––	DH-485[1], DF1 Full-Duplex, DF1 Half-Duplex Master/Slave, and ASCII protocols	––	––
	Channel 1	––	––	––	Ethernet TCP/IP protocol

[1] A 1761-NET-AIC (or 1747-AIC) is required when connecting to a DH-485 network.

Protocol Options

Ethernet TCP/IP Protocol — Standard Ethernet, utilizing the TCP/IP protocol, is used as the backbone network in many office and industrial buildings. Ethernet is a local area network that provides communication between various devices at 10 Mbps. This network provides the same capabilities as DH+ or DH-485 networks, plus:

- SNMP support for Ethernet network management
- optional dynamic configuration of IP addresses using a BOOTP utility
- SLC 5/05 Ethernet data rate up to 40 times faster than SLC 5/04 DH+ messaging
- ability to message entire SLC 5/05 data files
- much greater number of nodes on a single network possible compared to DH-485 (32) and DH+ (64)

Data Highway Plus (DH+) Protocol — The Data Highway Plus protocol is used by the PLC-5 family of processors and the SLC 5/04 processor. This protocol is similar to DH-485, except that it can support up to 64 devices (nodes) and runs at faster communication (baud) rates.

DH-485 Protocol — The SLC 500 processors have a DH-485 channel that supports the DH-485 communication network. This network is a multi-master, token-passing network protocol capable of supporting up to 32 devices (nodes). This protocol allows:

- monitoring of data and processor status, along with program uploading and downloading of any device on the network from one location
- SLC processors to pass data to each other (peer-to-peer communication)
- operator interface devices on the network to access data from any SLC processor on the network

DF1 Full-Duplex Protocol — DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) allows two devices to communicate with each other at the same time. This protocol allows:

- transmission of information across modems (dial-up, leased line, radio, or direct cable connections)
- communication to occur between Allen-Bradley products and third-party products

DF1 Half-Duplex Protocol (Master and Slave) — DF1 Half-Duplex protocol provides a multi-drop single master/multiple slave network capable of supporting up to 255 devices (nodes). This protocol also provides modem support and is ideal for SCADA (Supervisory Control and Data Acquisition) applications because of the network capability.

ASCII Protocol — The ASCII protocol provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices.

The following table summarizes the communication options for the SLC 500 processor family.

Communications Protocol	Processor				
	SLC 5/01	**SLC 5/02**	**SLC 5/03**	**SLC 5/04**	**SLC 5/05**
DH485 peer-to-peer	receive only	receive and initiate	receive and initiate	––	––
DH485 via RS232 port	––	––	receive and initiate [1]	receive and initiate [1]	receive and initiate [1]
DF1 via RS232 port (full-duplex or half-duplex master or slave)	receive only [2]	receive only [2]	receive and initiate	receive and initiate	receive and initiate
ASCII via RS232 port	––	––	receive and initiate	receive and initiate	receive and initiate
Data Highway Plus (DH+)	receive only [3]	receive only [3]	receive and initiate [4]	receive and initiate	receive and initiate [4]
Ethernet	––	––	––	––	receive and initiate

[1]   If using 1747-AIC for isolation, connect to DH-485 network using 1747-PIC, if using 1761-NET-AIC for isolation, directly connect to DH-485 network with 1747-CP3 serial cable (or equivalent RS-232 null-modem cable).

[2]   A 1747-KE or 1770-KF3 is required to bridge from DF1 (full-duplex or half-duplex slave only) to DH485.

[3]   A 1785-KA5 is required to bridge from DH+ to DH485.

[4]   Either a 1785-KA5 is required to bridge from DH+ to DH485 or the SLC-5/04's channel-to-channel passthru feature may be used to bridge between DH+ and DH485 or between DH+ and DF1 Full-Duplex (DH+ -to- DF1 Full-Duplex passthru available starting with OS401). Another option is to use the 1785-KE to bridge between DH+ and DF1 Full-Duplex or DH+ and a DF1 Half-Duplex Master/Slave network.

Note: The 1785-KA5 and 1785-KE modules require use of a 1771-series chassis and power supply.

SLC 500 System Test General Specifications

The table below lists SLC 500 system test specifications.

Description	Specification	Industry Standard
Temperature	Operating: 0°C to +60°C (+32°F to +140°F)	Not Applicable
	Storage: –40°C to +85°C (–40°F to +185°F)	Not Applicable
Humidity	5 to 95% without condensation	Not Applicable
Vibration	Operating: 1.0G at 5 – 2000 Hz	Not Applicable
	Non-operating: 2.5Gs at 5 – 2000 Hz	Not Applicable
Shock	Operating: (all modules except relay contact) 30.0Gs (3 pulses, 11 ms)	Not Applicable
	Operating: (relay contact modules – OW, IO combo) 10.0Gs (3 pulses, 11 ms)	Not Applicable
	Non-operating: 50.0Gs (3 pulses, 11 ms)	Not Applicable
Free Fall (drop test)	Portable, 2.268 kg (5 lbs) or less at 0.762 m (30 in.) (six drops)	Not Applicable
	Portable, 2.268 kg (5 lbs) or more at 0.1016 m (4 in.) (three flat drops)	Not Applicable
Electromagnetic Compatibility	Showering Arc: 1.5 KV	NEMA ICS 2-230/NEMA ICS 3-304
	Surge Withstand Capability: 3 KV	IEEE Std. 472-1974/ANSI C37.90/90A-1974
	Fast Transient Burst (impulse): 2KV for 1746 power supplies, 1KV for 1746 I/O and communication lines over 10m (32.84 ft), 5 ns rise time	Internal Allen-Bradley standard[1]
	Electrostatic Discharge (ESD): 15 KV, 100 pF/1.5 Kohm model	Internal Allen-Bradley standard[1]
	Radiated Electromagnetic Susceptibility: 5W walkie-talkie at 464.5 MHz and 153.05 MHz	Internal Allen-Bradley standard[1]
Safety	Dielectric Withstand: 1500V ac	UL 508, CSA C22.2 No. 142
	Isolation between Communication Circuits: 500V dc	Not Applicable
	Isolation between Backplane and I/Os: 1500V ac	Not Applicable
	Flammability and Electrical Ignition: UL94V-0	Not Applicable
Certification	UL listed/CSA approved Class 1, Groups A, B, C or D, Division 2 CE compliant for all applicable directives	Not Applicable

[1] Internal Allen-Bradley standards are based on Allen-Bradley's extensive experience in industrial controls. It is also based partly on industry and/or military specifications.

Processor General Specifications

The table below lists general specifications for SLC 500 modular processors.

Specification (1747-)	SLC 5/01		SLC 5/02	SLC 5/03		SLC 5/04			SLC 5/05		
	L511	L514	L524	L531	L532	L541	L542	L543	L551	L552	L553
Program Memory (words)	1K	4K	4K	8K	16K	16K	32K	64K	16K	32K	64K
I/O Capacity	3940 Discrete		4096 Discrete								
Remote I/O Capacity	Not Applicable		Processor memory and chassis power limit up to 4096 inputs and 4096 outputs								
Maximum Chassis/Slots	3/30										
Standard RAM	Capacitor – 2 weeks [1] Optional Lithium Battery – 5 years		Lithium Battery 2 years								
Memory Back-up Options	EEPROM or UVPROM		EEPROM or UVPROM	Flash EPROM							
LED Indicators	Run CPU Fault Forced I/O Battery Low		Run CPU Fault Forced I/O Battery Low COMM	Run CPU Fault Forced I/O Battery Low RS-232 DH-485		Run CPU Fault Forced I/O Battery Low RS-232 DH+			Run CPU Fault Forced I/O Battery Low RS-232 Ethernet		
Typical Scan Time [2]	8 ms/K		4.8 ms/K	1 ms/K		0.9 ms/K					
Bit Execution (XIC)	4 µs		2.4 µs	.44 µs		.37 µs					
Power Supply Loading	350 mA at 5V dc					500 mA at 5V dc		1A at 5V dc			
	105 mA at 24V dc					175 mA at 24V dc		200 mA at 24V dc			
Clock/Calendar Accuracy	Not Applicable			±54 sec/month at +25°C (+77°F); ±81 sec/month at +60°C (+140°F)							
Program Scan Hold-up Time after Loss of Power	20 milliseconds to 3 seconds (dependent on power supply loading)										
Noise Immunity	NEMA Standard ICS 2-230										
Temperature Rating	Operating: 0°C to +60°C (+32°F to +140°F); Storage: –40°C to +85°C (–40°F to +185°F)										
Humidity	5 to 95% without condensation										
Shock (operating)	30Gs										
Vibration	Displacement: .015 in., peak-to-peak at 5 - 57 Hz										
	Acceleration: 2.5Gs at 57 - 2000 Hz										
Certification	UL listed/CSA approved; Class 1, Groups A, B, C or D, Division 2; CE compliant for all applicable directives										

[1] See Capacitor Memory Backup vs. Temperature Curve on page 2–10.

[2] The scan times are typical for a 1K ladder logic program consisting of simple ladder logic and communication servicing. Actual scan times depend on your program size, instructions used, and communication protocol.

Memory Backup for the 1747-L511, SLC 5/01 Processor

The curve below illustrates the ability of the memory back-up capacitor to maintain the contents of the RAM in a 1747-L511. To back up the memory for a longer period of time, a lithium battery, Catalog Number 1747-BA, is required.

Capacitor Memory Back-up Time
VS
Temperature

Time (Days) vs Temperature °C (°F)

Temperature axis: 0, 10, 20 (77°), 30 (86°), (95°), 40 (104°), (113°), 50 (122°), (131°), 60 (140°)
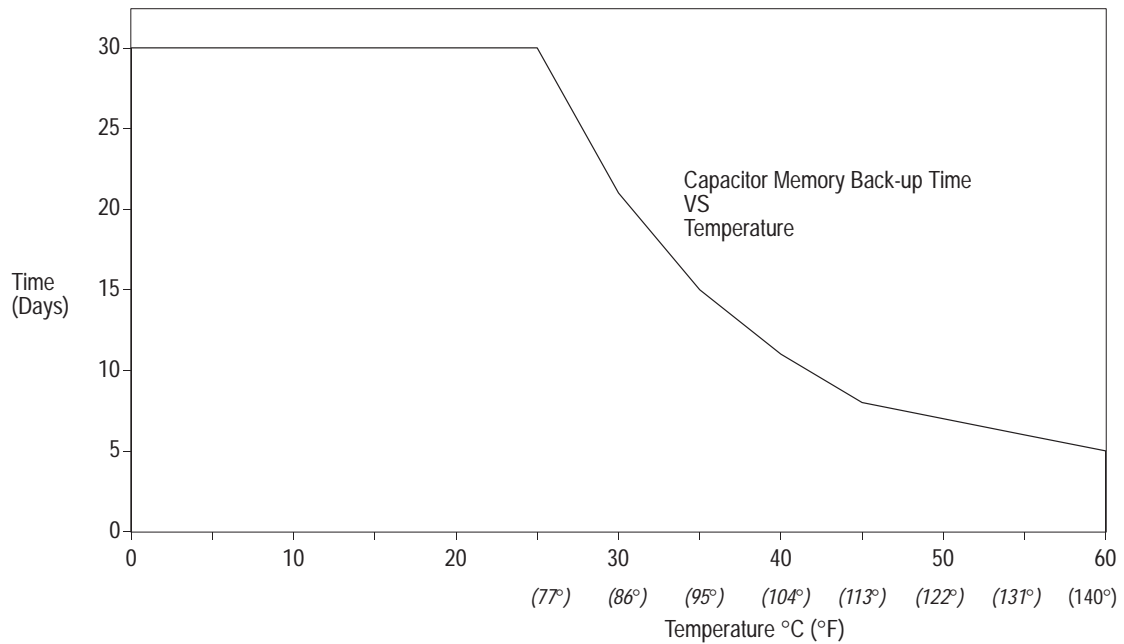
Selecting Discrete I/O Modules

There are three types of I/O modules: input, output, and combination. They are available in a wide variety of densities including 4, 8, 16, and 32 point and can interface to AC, DC, and TTL voltage levels. Output modules are available with solid-state AC, solid-state DC, and relay contact type outputs.

For a complete listing of discrete I/O modules and specifications, contact your Allen-Bradley sales office for the latest product data entitled *Discrete Input and Output Modules,* publication 1746-2.35.

Selecting Specialty I/O Modules

The SLC 500 family offers specialty I/O modules that enhance your control system. Modules range in function from analog interface to motion control, from communication to high-speed counting.

For a complete listing of specialty I/O modules and their specifications, contact your Allen-Bradley sales office for the latest system overview entitled *SLC 500 Family of Small Programmable Controllers,* publication 1747-2.30, or for a related product data.

Selecting Power Supplies

To select a power supply, you need the following documents:

- power supply worksheet (see appendix E) one for each chassis
- *SLC 500 Family of Small Programmable Controllers System Overview,* publication 1747-2.30, or *SLC 500 Modular Chassis and Power Supplies Product Data,* publication 1746-2.38.

When configuring a modular system, you must have a power supply for each chassis. Careful system configuration will result in the best performance. Excessive loading of the power supply outputs can cause a power supply shutdown or premature failure.

There are three different AC power supplies and two DC power supplies. For AC power supplies, the 120/240V selection is made by a jumper. Place the jumper to match the input voltage. The power supply has an LED that illuminates when the power supply is functioning properly. Below are the general specifications for the power supplies.

Power Supply Specifications

Description	1746-P1	1746-P2	1746-P3	1746-P4	1746-P5
Line Voltage	85-132/170-265V ac 47-63 Hz	85-132/170-265V ac 47-63 Hz	19.2-28.8V dc	85-132/170-265V ac 47-63 Hz	90–146V dc
Typical Line Power Requirement [1]	135 VA	180 VA	90 VA	240 VA	85 VA
Maximum Inrush Current	20A	20A	20A	45A	20A
Internal Current Capacity	2A at 5V dc 0.46A at 24V dc	5A at 5V dc 0.96A at 24V dc	3.6A at 5V dc 0.87A at 24V dc	10.0A at 5V dc 2.88A at 24V dc [3]	5.0A at 5V dc 0.96A at 24V dc
Fuse Protection [2]	1746-F1 or equivalent: 250V-3A Fuse Nagasawa ULCS-61ML-3 or BUSSMANN AGC 3	1746-F2 or equivalent: 250V-3A Fuse SANO SOC SD4 or BUSSMANN AGC 3	1746-F3 or equivalent: 125V-5A Fuse Nagasawa ULCS-61ML-5 or BUSSMAN AGC 5	Non-replaceable fuse is soldered in place.	Non-replaceable fuse is soldered in place.
24V dc User Power Current Capacity	200 mA	200 mA	Not Applicable	1A [3]	200 mA
24V dc User Power Voltage Range	18-30V dc	18-30V dc	Not Applicable	20.4-27.6V dc	18–30V dc
Operating Temperature	0°C to +60°C (+32°F to +140°F) Current capacity derated 5% above +55°C.			0°C to +60°C (+32°F to +140°F) no derating	0°C to +60°C (+32°F to +140°F) Current capacity derated 5% above +55°C.
Storage Temperature	–40°C to +85°C (–40°F to +185°F)				
Humidity Rating	5-95% (non-condensing)				
Wiring	two #14 AWG wires per terminal (maximum)				
Certification	UL listed, CSA certified, CE compliant for all applicable directives, Class I Division 2 Hazardous Environment Certification				

[1] Refer to appendix F to determine line power requirements for your configuration.

[2] Fuse is intended to guard against fire hazard due to short circuit conditions and may not protect the supply from damage under overload conditions.

[3] The combination of all output power (5 volt backplane, 24 volt backplane, and 24 volt user source) cannot exceed 70 Watts.

Example for Selecting Power Supplies

Select a power supply for chassis 1 and chassis 2 in the control system below.
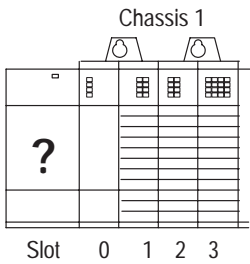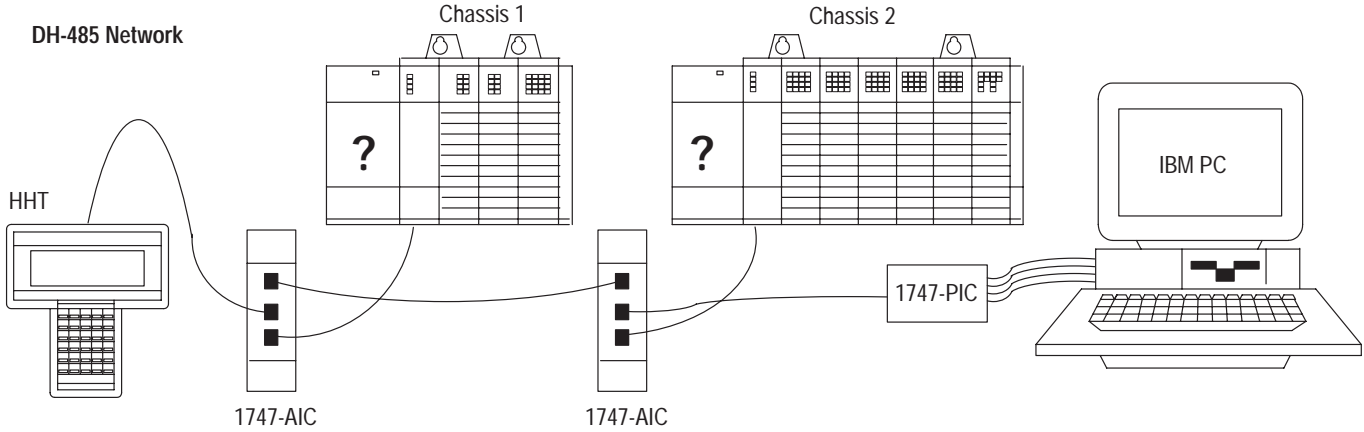
Slot Numbers	Description	Catalog Number	Power Supply at 5V dc (Amps)	Power Supply at 24V dc (Amps)
0	Processor Unit	1747-L511	0.35	0.105
1	Input Module	1747-IV8	0.05	Not Applicable
2	Transistor Output Module	1746-OB8	0.135	Not Applicable
3	Triac Output Module	1746-OA16	0.37	Not Applicable
Peripheral device	Hand-Held Terminal	1747-PT1	Not Applicable	Not Applicable
Peripheral device	Isolated Link Coupler	1747-AIC	Not Applicable	0.085
Total Current:			0.905	0.190[1]

[1] Power Supply 1746-P1 is sufficient for Chassis #1. The "Internal Current Capacity" for this power supply is 2 Amps at 5V dc, 0.46 Amps at 24V dc.
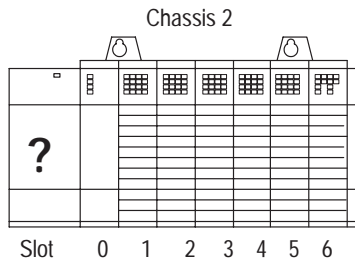
Chassis 2

Slot   0   1   2   3   4   5   6

Slot Numbers	Description	Catalog Number	Power Supply at 5V dc (Amps)	Power Supply at 24V dc (Amps)
0	Processor Unit	1747-L514	0.35	0.105
1	Output Module	1746-OW16	0.17	0.180
2	Combination Module	1746-IO12	0.09	.07
3, 4, 5, 6	Analog Output Modules	1746-NO4I	0.22 (4 x 0.055)	0.780 (4 x 0.195)
Peripheral device	Isolated Link Coupler	1747-AIC	Not Applicable	0.085
Peripheral device	Interface Converter	1746-PIC	Not Applicable	Not Applicable
Total Current:			0.83	1.22 [1]

[1] Power Supply 1746-P4 is sufficient for Chassis #2. The "Internal Current Capacity" for this power supply is 10 Amps at 5V dc, 2.88 Amps at 24V dc; not to exceed 70 Watts.

Example — Worksheet for Selecting a 1746 Power Supply

If you have a multiple chassis system, make copies of the *Power Supply Worksheet* found on page E-1. For a detailed list of device load currents, refer to the *SLC 500 Modular Chassis and Power Supplies,* Publication Number 1746-2.

Procedure

1. **For each slot of the chassis that contains a module, list the slot number, the catalog number of the module, and its 5V and 24V maximum currents. Also include the power consumption of any peripheral devices that may be connected to the processor other than a DTAM™, HHT, or PIC — the power consumption of these devices is accounted for in the power consumption of the processor.**

Chassis Number: _1_	Catalog Number	Maximum Currents 5V	24V
slot _0_	L511	0.350	0.105
slot _1_	IV8	0.050	–
slot _2_	OB8	0.135	–
slot _3_	OA16	0.370	–
slot ___			
slot ___			
slot ___			
slot ___			
Peripheral Device:	_AIC_	–	0.085

2. **Add the power supply loading currents of all the system devices (at 5V and 24V).**

Total Current: **0.905** | **0.190**

Chassis Number: _2_	Catalog Number	Maximum Currents 5V	24V
slot _0_	L514	0.350	0.105
slot _1_	OW16	0.170	0.180
slot _2_	NO4I	0.055	0.195
slot _3_	NO4I	0.055	0.195
slot _4_	NO4I	0.055	0.195
slot _5_	NO4I	0.055	0.195
slot _6_	IO12	0.090	0.070
slot ___			
Peripheral Device:	_AIC_	–	0.085

Total Current: **0.830** | **1.220**

When using the 1746-P4 power supply, use the formula below to calculate total power consumption of all the system devices (at 5V and 24V). Note that the 1746-P4 Chassis total power supply loading currents cannot exceed 70 Watts. If you are not using a 1746-P4 power supply, proceed to step 3.

The user current at 24V listed below is for example only. The current required depends on the application.

Total current at 5V | Total current at 24V | User Current at 24V | Total Power

(0.905 x 5V) + (0.190 x 24V) + (0.500 x 24V) = 21.085 W

(0.830 x 5V) + (1.220 x 24V) + (0.500 x 24V) = 45.43

3. **Compare the Total Current required for the chassis with the Internal Current Capacity of the power supplies**.
   To select the proper power supply for your chassis, make sure that the power supply loading current for the chassis is *less than* the internal current capacity for the power supply, for both 5V and 24V loads.

	Internal Current Capacity 5V	24V
Catalog Number 1746-P1	2.0A	0.46A
Catalog Number 1746-P2	5.0A	0.96A
Catalog Number 1746-P3	3.6A	0.87A
Catalog Number 1746-P4	10.0A	2.88A (70 Watts maximum)

Required Power Supply for this Chassis: 1746- **P1**   **Required Power Supply for this Chassis:**   1746- **P4**

Consider future system expansion when selecting a power supply.

Selecting Enclosures

The enclosure protects the equipment from atmospheric contamination. Standards established by the National Electrical Manufacturer's Association (NEMA) define enclosure types, based on the degree of protection an enclosure will provide. Use a fan to circulate the air of sealed enclosures that use convection cooling to dissipate heat. Select a NEMA-rated enclosure that suits your application and environment. The enclosure should be equipped with a disconnect device. To calculate the heat dissipation of your controller, see appendix F.

Selecting Operator Interfaces

Use an operator interface to program and/or monitor your SLC 500 controller. You can choose from several Allen-Bradley operator interface devices.

Programming with a Hand-Held Terminal

Use the Hand-Held Terminal (HHT) to configure the SLC 500 controller, enter/modify a user program, download/upload programs, monitor control operation, and test/troubleshoot. When equipped with a battery (1747-BA), the HHT retains a user program in memory for storage and later use.

The display area accommodates 8 lines x 40 characters. You can display five rungs of a user program. The top row of keys are the menu function keys.

Important: Using the HHT, you can program the SLC 5/01 and SLC 5/02 processors and the SLC 500 fixed controllers. You cannot, however, program SLC 5/03, SLC 5/04, or SLC 5/05 processors.

Programming with an IBM® Compatible Computer

Contact Rockwell Software or your local Allen-Bradley distributor for specifications and availability of software packages available to program the SLC 500 Modular Controllers.

AIC+ Advanced Interface Converter (1761-NET-AIC)

The AIC+ advanced interface converter provides communication links between various networked devices. It has three communication ports: one for DH-485 and two for RS-232. The AIC+ is compatible with a variety of SLC and MicroLogix controllers and peripherals.

DH-485 Interface Converter

For communication, use an RS-232/DH-485 Interface Convertor (Catalog Number 1747-PIC) between the computer and SLC controller. The converter includes a 279.4 mm (11 in.) ribbon cable, already attached to the converter, for connection to the computer serial port and a Catalog Number 1746-C10 cable for connection to the controller.

If you are using an SLC 5/03, SLC 5/04, or SLC 5/05 processor, you do not need the 1747-PIC. You can program via the RS-232 channel using DF1 full-duplex protocol or DH485 protocol and RS-232 Program Cable (Catalog Number 1747-CP3).

Monitoring with a Data Table Access Module

The Data Table Access Module (DTAM) is a plant floor device that lets you access data file information, change operating modes, monitor and clear processor faults, and transfer the user program between RAM and an EEPROM memory module with any SLC 500 family processor. You cannot use it to create new programs.

Important features of DTAM include:
- shorthand addressing, which provides easier access to data files
- display prompts in six, user-selectable languages: English, French, German, Italian, Spanish, and Japanese
- UL listed, CSA Certified
- NEMA type 12 and 13 enclosures
- point-to-point interface to an SLC family processor, or as a network device on a DH-485 network

Monitoring with a DTAM Plus

The DTAM Plus provides a highly functional operator interface for the SLC 500 family of processors. This device features a 4 line x 20 character display window for viewing data table information and operator prompts. Display screens are created using an Offline Development Software Package. Screens can depict register information, prompt for operator data entry, or facilitate downloading of recipes, allowing modification of multiple registers with a single keystroke. Alarm screens monitor critical data table registers, prompting the operator for action when out-of-range conditions exist.

A configurable communications port on the interface supports RS-485 and RS-232. Use DH-485 to communicate point-to-point with the SLC processor or over the network via Catalog Number 1747-AIC Isolated Link Couplers. The point-to-point connection allows for faster communication throughput and less DH-485 network loading.

Monitoring with a DTAM Micro

The DTAM Micro extends the DTAM Plus product line by providing another operator interface to the SLC 500 family of processors. DTAM Micro is a low cost operator interface and is physically smaller than the DTAM Plus. This device features a 2 line x 20 character display window for viewing data table information and operator prompts. Up to fifty application screens can be stored in memory.

DTAM Micro is available with either an RS-485 port or an RS-232 port. The RS-232 port is used to communicate point-to-point with the SLC 5/03. Use the RS-485 port to communicate point-to-point with the SLC processor or over the DH-485 network via Catalog 1747-AIC Isolated Link Couplers. The point-to-point connection allows for faster communication throughput and less DH-485 network loading.

Monitoring with a PanelView Operator Terminal

The PanelView Operator Terminals provide operator interface capabilities in space-saving, flat-panel designs. Offering optimum viewing angles, these electronic operator interfaces feature pixel graphics and high-performance functionality in both color and monochrome displays. The PanelView Operator Terminals allow you to enter input using function keys or a touch screen.

PanelView Operator Terminals are available in DH-485 and RS-232 versions. With the DH-485 version, you can connect the PanelView to a single SLC 500 processor or multiple SLC 500 processors on the DH-485 network. The PanelView Operator Terminal supports DH-485 point-to-point or network transfers.

With the RS-232 version, you connect directly to channel 0 of an SLC 5/03, SLC 5/04, or SLC 5/05 processor using DH485 protocol. This gives you dedicated DH485 connection for high priority data. The RS-232 channel supports passthru from the DH+ network to the PanelView 550 through channel 0 of an SLC 5/04 processor.

Selecting a Memory Module for the SLC 5/01 and SLC 5/02 Processors

You can plug these optional EEPROM (Electrically Erasable Programmable Read Only Memory) and UVPROM (UV-erasable PROM) memory modules into the SLC 500 controller. With a memory module, you can:

• save the contents of the processor RAM for storage purposes

• load the contents of the EEPROM and UVPROM memory into the processor RAM

• use the UVPROM memory module when program security is required because the program in the UVPROM cannot be altered when it is installed in the controller

Adapter sockets are required when inserting UVPROMs into the programming and erasing equipment. The UVPROM fits into the adapter socket and then into the UVPROM programmer.

To program a memory module, see the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual.

EEPROM and UVPROM Memory Modules

These optional memory modules provide a non-volatile memory back-up in a convenient modular form. The modules plug into a socket on the controller.

You can store (save) your program in the EEPROM by inserting it into the processor and using either the Hand-Held Terminal or programming software.

Use of the UVPROM provides you with an extra degree of program security because the user program cannot be altered while it is installed in the controller. You can program the UVPROM with commercially available UVPROM programming and erasing equipment. You can use an EEPROM module as a master, or you can use an archived processor file as the source by using the software PROM translator utility.

Adapter sockets are required when inserting memory modules into commercially available PROM programmer. The memory module fits into the adapter socket and then into a PROM programmer.

!   **ATTENTION:** Make sure the adapter is inserted properly or damage could result.

The following table lists the types of memory modules that are available for the SLC 5/01 and SLC 5/02 processors. Also listed are the manufacturer part numbers for determining compatibility with an external PROM programmer.

Description	Catalog Number	Manufacturer	Manufacturer's Part Number	Use with This Processor Type: 1747-
1K User Words EEPROM	1747-M1	NEC	uPD28C64ACZ - 20	L511, L514, L524
		OKI	MSM28C64ARS - 20	
		XICOR	X28C64BP - 25	
		SEEQ	PE28C64 - 250	
4K User Words EEPROM	1747-M2	XICOR	X28C256DI - 25	L511, L514, L524
			X28256DI - 25	
1K User Words UVPROM	1747-M3	Fujitsu	MBM27C64 - 25	L511, L514, L524
			MBM27C64 - 20	
4K User Words UVPROM	1747-M4	Fujitsu	MBM27C256 - 25	L514, L524
			MBM27C256A - 20	
		NEC	uPD27C256AD - 20	
		Mitsubishi	M5M27C256K - 25	
		Hitachi	HN27C256DG - 25	
Adapter Socket	1747-M5	NA	NA	L511, L514, L524

NA (Not Applicable)

Selecting a Memory Module for SLC 5/03, SLC 5/04, and SLC 5/05 Processors

The memory module for the SLC 5/03, SLC 5/04, and SLC 5/05 processors is called Flash EPROM (Flash Erasable Programmable Read Only Memory). Flash EPROMs combine the programming versatility of EEPROMs with the security precautions of UVPROMs. This means that you have the option of leaving your EPROM programs write protected or unprotected. Write protect the EPROM using either your software or a PROM programmer.

The memory modules consist of a Flash EPROM mounted on a circuit board with a connector and plastic housing. There are 2 memory modules available that backup up to 32K or 64K user memory.

See the table below for details on the Flash EPROM and adapter socket.

Adapter sockets are required when inserting memory modules into commercially available PROM programmer. The memory module fits into the adapter socket and then into a PROM programmer.

> ⚠ **ATTENTION:** Make sure the adapter is inserted properly or damage could result.

Description	Catalog Number	Manufacturer	Manufacturer's Part Number
Supports up to 32K of user **memory backup**	1747-M11, Series B[1]	Intel	TN28F010-90SB48
		Intel	TN728F010-90SB48
		AMD	Am28F010-90JI
Supports up to 64K of user memory backup	1747-M12[2]	AMD	Am28F020-90JI
Adapter Socket for the 1747-M11 and 1747-M12	1747-M15	Not Applicable	Not Applicable

[1] The 1747-M11 Series A memory module can only be used in either an SLC 5/03 Series A processor or in an SLC 5/03 Series B processor. The 1747-M11 Series B memory module can only be used in either an SLC 5/03 OS302 or higher, an SLC 5/04 OS401 or higher, or an SLC 5/05 processor.

[2] The 1747-M12 memory module can only be used in either an SLC 5/03 OS302 or higher, an SLC 5/04 OS401 or higher, or an SLC 5/05 processor.

To program a memory module, refer to your programming software user manual.

EEPROM Burning Options

You can burn a program into an EEPROM memory module using a processor that is the same or different from the one used to run the program. When burning EEPROMs, keep the following conditions in mind:

- The program size cannot exceed the processor memory size. For instance, an SLC 5/01 1K processor can burn an EEPROM for a SLC 5/01 4K processor as long as the program does not exceed 1K.
- The I/O and chassis configuration of the burning processor does not have to match the I/O configuration of the program being burned.
- You do not have to enter the Run mode when burning an EEPROM. If the run mode is entered and the chassis configuration does not match, a major fault will occur. If you burn an EEPROM while in the fault mode, the fault will also be saved in the EEPROM.

The following table summarizes the above conditions as to the type of processor you can use to burn EEPROMs for other processors.

Use these processors	To burn EEPROMs for these processors:										
	SLC 5/01 (1K)	SLC 5/01 (4K)	SLC 5/02 (4K)	SLC 5/03 (8K)	SLC 5/03 (16K)	SLC 5/04 (16K)	SLC 5/04 (32K)	SLC 5/04 (64K)	SLC 5/05 (16K)	SLC 5/05 (32K)	SLC 5/05 (64K)
SLC 5/01 (1K)	●	1K max.									
SLC 5/01 (4K)	1K max.	●									
SLC 5/02 (4K)			●								
SLC 5/03 (8K)				●	8K max.						
SLC 5/03 (16K)				8K max.	●						
SLC 5/04 (16K)						●	16K max.	16K max.			
SLC 5/04 (32K)						16K max.	●	32K max.			
SLC 5/04 (64K)						16K max.	32K max.	●			
SLC 5/05 (16K)									●	16K max.	16K max.
SLC 5/05 (32K)									16K max.	●	32K max.
SLC 5/05 (64K)									16K max.	32K max.	●

● valid combination

Selecting Isolation Transformers

If there is high frequency conducted noise in or around your distribution equipment, we recommend the use of an isolation transformer in the AC line to the power supply. This type of transformer provides isolation from your power distribution system and is often used as a "step down" transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. This power rating is generally expressed in voltamperes (VA).

To select an appropriate isolation transformer, you must calculate the power required by the chassis power supply (or supplies if more than one chassis in system) and any input circuits and output loads that are connected through this transformer.

You can find the power requirement (VA rating) for the chassis power supplies in the specifications on page 2–11. The power requirement for the input circuits is determined by the number of inputs, the operating voltage, and the nominal input current. The power requirement for output loads is determined by the number of outputs, the load voltage, and load current.

For example, if you have a 1746-P1 power supply, 1746-IA16 16-point AC input module (12 mA at 120V ac) and a 1746-OA16 16-point AC triac output module (0.5A at 120V ac), the power consumed would be:

$$135 \text{ VA} + (16)(120\text{V})(0.012\text{A}) + (16)(120\text{V})(0.5\text{A}) = 1{,}118 \text{ VA}$$

Important: In this case, 0.5A is the maximum rating of the triac output (at 30° C). If your load draws less than 0.5A this figure may be reduced accordingly. The output portion of the VA calculation should reflect the current requirements of your loads.

In general, we recommend that the transformer is oversized to provide some margin for line voltage variations and other factors. Typically a transformer that is 25% larger than the calculated VA is sufficient.

Most industrial environments are susceptible to power transients or spikes. To help insure fault free operation and protection of equipment, we recommend suppression devices on power to the equipment in addition to the isolation equipment.

Special Considerations

The recommendations given previously provide favorable operating conditions for most controller installations. Your application may involve one or more of the following adverse conditions. Additional measures can be taken to minimize the effect of these conditions.

Class I, Division 2 Applications

Important: When installing peripheral devices (for example, push buttons, lamps) into a hazardous environment, ensure that they are Class I, Division 2 certified, or determined to be safe for the environment.

Excessive Line Voltage Variations

The best solution for excessive line voltage variation is to correct any feeder problems in your distribution system. Where this does not solve the line variation problem, or in certain critical applications, use a constant voltage transformer. If you require a constant voltage transformer, connect it to the power supply *and* all input devices connected to the SLC 500 controller.

Connect output devices on the same power line, but their connection along the power line is normally made before the constant voltage transformer. A constant voltage transformer must have a sufficient power rating for its load.

Excessive Noise

When you operate the SLC 500 controller in a "noise polluted" industrial environment, special consideration should be given to possible electrical interference.

The following reduces the effect of electrical interference:
- SLC 500 controller design features
- proper mounting of controller within an enclosure
- proper equipment grounding
- proper routing of wiring
- proper suppression added to noise generating devices

Potential noise generators include inductive loads, such as relays, solenoids, and motor starters when operated by "hard contacts" like push buttons or selector switches. Suppression may be necessary when such loads are connected as output devices or when connected to the same supply line that powers the controller.

Lack of surge suppression on inductive loads may contribute to processor faults and sporadic operation, RAM can be corrupted (lost) and I/O modules may appear to be faulty or reset themselves.

For extremely noisy environments, use a memory module and program it for auto loading on processor fault or power cycle for quick recovery.

Selecting Surge Suppressors

Most output modules have built-in surge suppression to reduce the effects of high voltage transients. However, we recommend that you use an additional suppression device if an output module is being used to control an inductive device such as:

- relays
- solenoids
- motor starters
- motors

Additional suppression is especially important if your inductive device is in series with or parallel to a hard contact such as:

- push buttons
- selector switches

By adding a suppression device directly across the coil of an inductive device, you will reduce the effects of voltage transients caused by interrupting the current to that inductive device and prolong the life of the switch contacts. You will also prevent electrical noise from radiating into system wiring. The diagram below shows an output module with a suppression device.
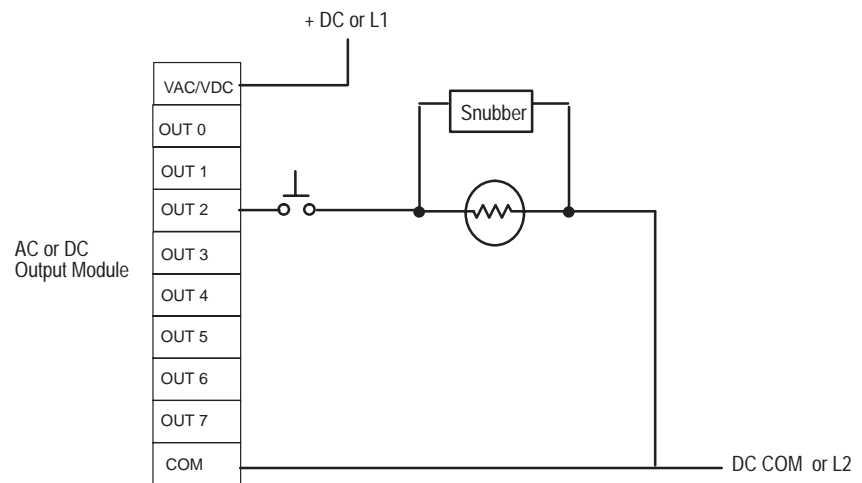
If you connect an SLC 500 controller triac output to control an inductive load, we recommend that you use varistors to suppress noise. Choose a varistor that is appropriate for the application. The surge suppressors we recommend for triac outputs when switching 120V ac inductive loads are a Harris MOV, part number V220 MA2A, or an Allen-Bradley MOV, Catalog Number 599-K04 or 599-KA04, Series C or later.

Consult the varistor manufacturer's data sheet when selecting a varistor for your application.

⚠ **ATTENTION:** Damage could occur to SLC 500 triac outputs if you use suppressors having RC networks. Allen-Bradley AC surge suppressors *not recommended* for use with triacs include Catalog Numbers 199-FSMA1, 199-FSMA2, 1401-N10, and 700-N24.

Allen-Bradley surge suppressors recommended for use with Allen-Bradley relays, contactors, and starters are shown in the table below.

Device	Coil Voltage	Suppressor Catalog Number
Bulletin 509 Motor Starter Bulletin 509 Motor Starter	120V ac 240V ac	599-K04 [1] 599-KA04 [1]
Bulletin 100 Contactor Bulletin 100 Contactor	120V ac 240V ac	199-FSMA1 [2] 199-F5MA2 [2]
Bulletin 709 Motor Starter	120V ac	1401-N10 [2]
Bulletin 700 Type R, RM Relays	AC coil	None Required
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	12V dc 12V dc	700-N22 700-N28
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	24V dc 24V dc	700-N10 700-N13
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	48V dc 48V dc	700-N16 700-N17
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	115-125V dc 115-125V dc	700-N11 700-N14
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	230-250V dc 230-250V dc	700-N12 700-N15
Bulletin 700 Type N, P, or PK Relay	150V max, AC or DC	700-N24 [2]
Miscellaneous electromagnetic devices limited to 35 sealed VA	150V max, AC or DC	700-N24 [2]

[1] Series C or later of these catalog numbers do not contain capacitors. They are recommended for use with SLC 500 triac outputs.

[2] Not recommended for use with triac outputs.

Selecting Contact Protection

Inductive load devices such as motor starters and solenoids may require the use of some type of surge suppression to protect the controller output contacts. Switching inductive loads without surge suppression can *significantly* reduce the lifetime of relay contacts. The figure below shows the use of surge suppression devices.

Surge Suppression for Inductive AC Load Devices

Output Device

Varistor

Output Device

RC Network

Output Device

Surge Suppressor

Surge Suppression for Inductive DC Load Devices

Output Device

Diode (A surge suppressor can also be used.)
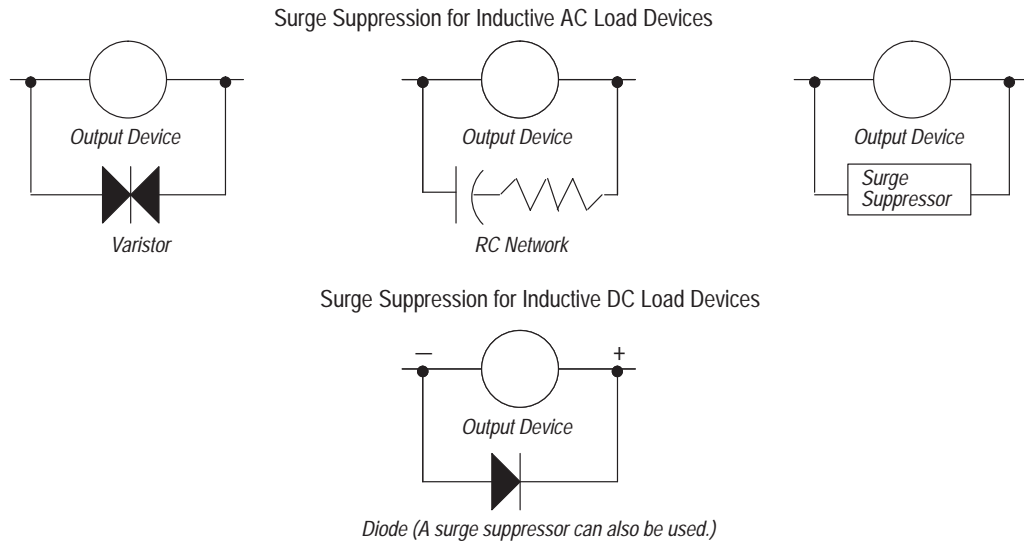
Contact protection methods for inductive AC and DC output devices.

These surge suppression circuits connect directly across the load device. This reduces arcing of the output contacts. (High transient can cause arcing that occurs when switching off an inductive device.) Suitable surge suppression methods for inductive AC load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor. These components must be appropriately rated to suppress the switching transient characteristic of the particular inductive device.

For inductive DC load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See table on page 2–25.

We recommend that you locate the suppression device as close as possible to the load device.

Transistor Output Transient Pulses

This section applies to the following SLC 500 fixed I/O processors and SLC 500 I/O modules that have transistor outputs.

Fixed I/O Processors	I/O Modules
1747-L20E	1746-OB8
	1746-OBP8
1747-L20G	1746-OV8
1747-L20L	1746-OB16
1747-L20N	1746-OBP16
1747-L30L	1746-OV16
1747-L40E	1746-OVP16
1747-L40L	1746-OB32
	1746-OV32

For the SLC 500 products listed above, the maximum duration of the transient pulse occurs when minimum load is connected to the output. However, for most applications the energy of the transient pulse is not sufficient to energize the load.

⚠ **ATTENTION:** A transient pulse occurs in transistor outputs when the external DC supply voltage is applied to the common output terminals (e.g., via the master control relay). The sudden application of voltage creates this transient pulse. (See the following graph.) This condition is inherent in transistor outputs and is common to solid state devices. A transient pulse can occur regardless of the processor having power or not.

(On-State Load Current)

Current Transient (I)

Duration of Transient (T)
Time
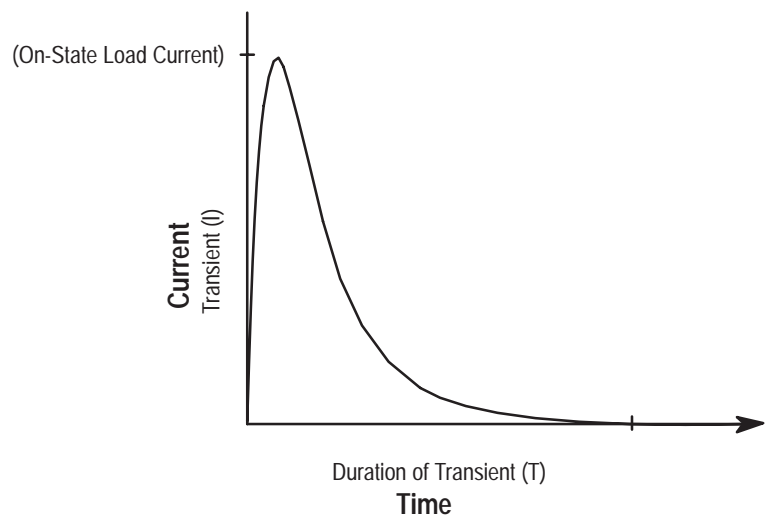
To reduce the possibility of inadvertent operation of devices connected to transistor outputs, adhere to the following guidelines:

- Either ensure that any programmable device connected to the transistor output is programmed to ignore all output signals until after the transient pulse has ended,

- or add an external resistor in parallel to the load to increase the on-state load current. The duration of the transient pulse is reduced when the on-state load current is increased.

The duration of the transient pulse is proportional to the load impedance. This is illustrated in the following graph.
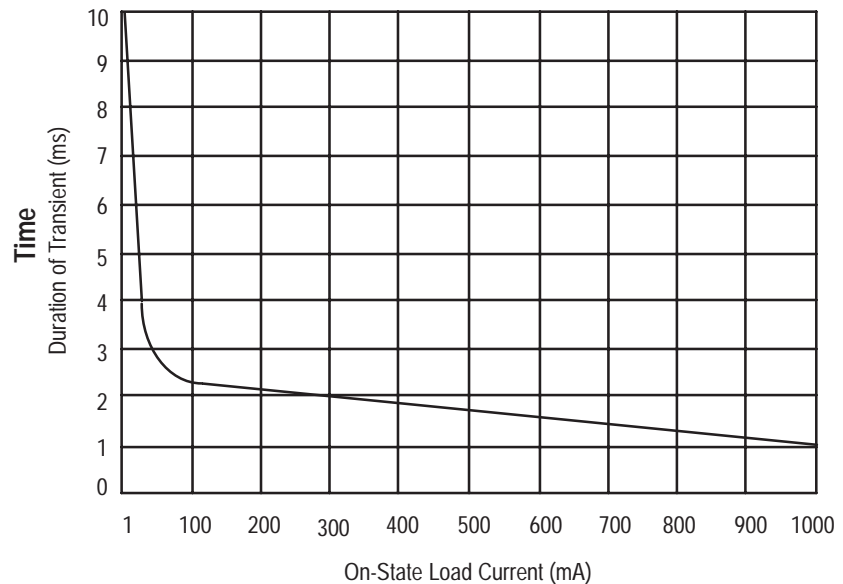
Example

Increasing the load current by 100 mA decreases the transient time from approximately 7 ms to less than 2.5 ms. To calculate the size of the resistor added in parallel to increase the current, use the following information:

24V = your applied voltage
Need 100 mA of load current to reduce the transient to < 2.5 ms. (taken from graph above)

$$R \text{ (Ohms)} = \frac{V \text{ (Volts)}}{I \text{ (Amps)}}$$

Resistor value (Ohms) = Applied voltage (Volts) / Desired current (Amps)
= 24 / 0.1 = 240 (Ohms)

$$P \text{ (Watts)} = I^2 \text{ (Amps)} \times R \text{ (Ohms)}$$

Actual Power (Watts) = (Desired Current)^2 x Resistor Value
= $(0.1)^2$ x 240 = 2.4 (Watts)

Resistor size = 2 x Actual power (Watts) = 4.8W $\cong$ 5W

Use a resistor rated for 240 Ohms at 5 Watts to decrease the transient time from approximately 7 ms to less than 2.5 ms.

System Installation Recommendations

To help you install the SLC 500 programmable controller as safely and securely as possible, we have set up a few specific recommendations for you to follow. For general installation guidelines, also refer to the requirements specific to your region.

- *Europe:* Reference the standards found in EN 60204 and your national regulations.
- *United States:* Refer to article 70E of the National Fire Protection Association (NFPA). It describes electrical safety requirements for employee workplaces.

This chapter covers the following:
- typical installation
- spacing your controllers
- preventing excessive heat
- grounding guidelines
- master control relay
- power considerations
- safety considerations
- preventive maintenance

Typical Installation

The figure below consists of some components that make up a typical installation. The following symbols are used:

① NEMA rated enclosure suitable for your application and environment that shields your controller from electrical noise and airborne contaminants.

② Disconnect, to remove power from the system

③ Fused isolation transformer or a constant voltage transformer, as your application requires

④ Master control relay/emergency-stop circuit

⑤ Terminal blocks or wiring ducts

⑥ Suppression devices for limiting EMI (electromagnetic interference) generation
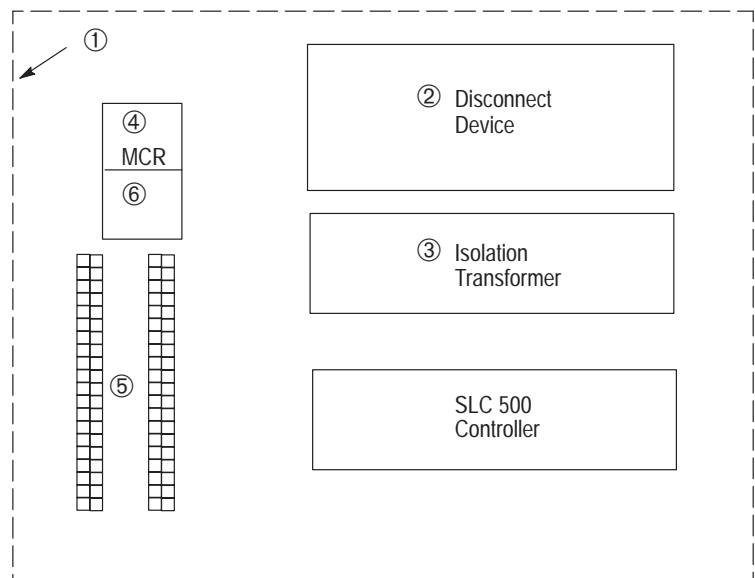
Spacing Your Controllers

The figure below depicts acceptable layouts. Follow the recommended minimum spacing to allow for convection cooling within the enclosure. Cooling air in the enclosure must be kept within a range of 0° C to +60° C (32° F to +140° F).

Important: Be careful of metal chips when drilling mounting holes for the controllers. Do not drill holes above a mounted SLC 500 controller.
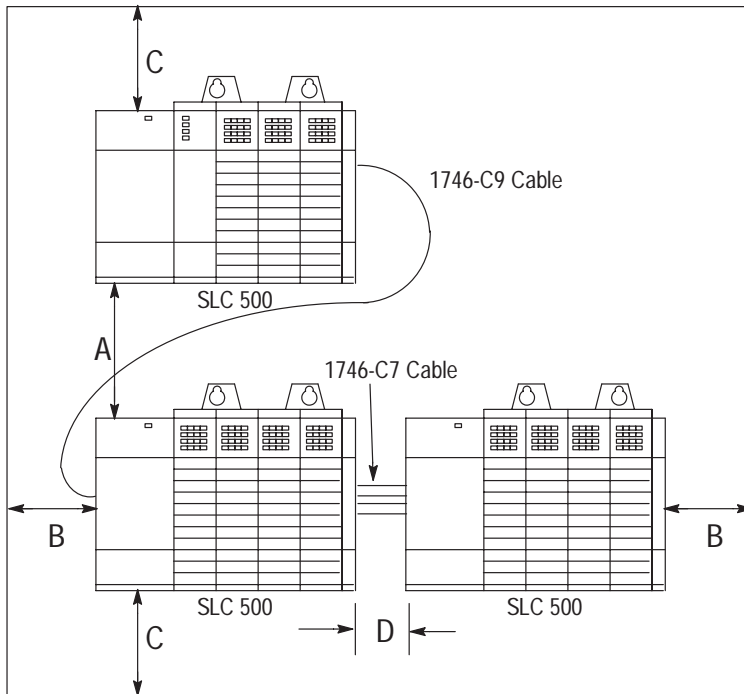
Recommended Spacing

A. 15.3 to 20.0 cm (6 to 8 in.) when using the 1746-C9 cable. If you mount two 13-slot chassis above each other, the distance cannot exceed 10.2 to 12.7 cm (4 to 5 in.).

B. Greater than 10.2 cm (4 in.)

C. Greater than 15.3 cm (6 in.)

D. 7.7 to 10.2 cm (3 to 4 in.) when using the 1746-C7 cable.
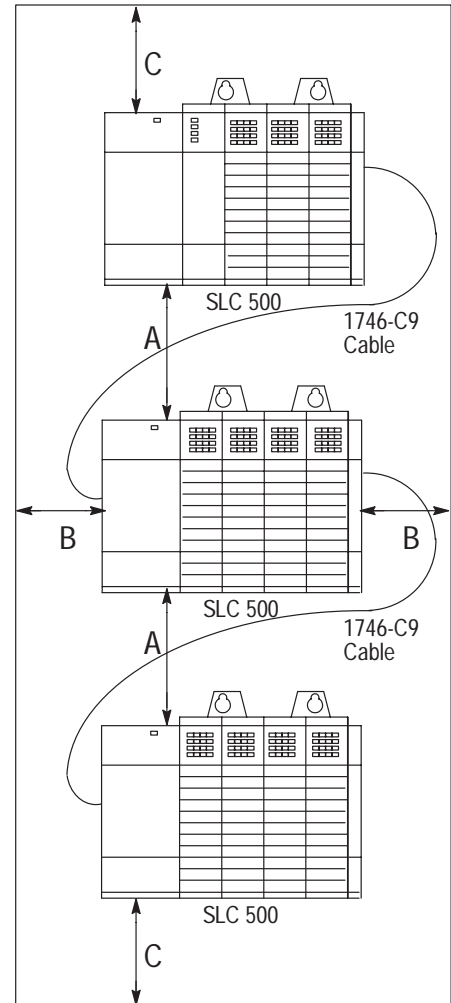
Preventing Excessive Heat

For most applications, normal convection cooling will keep the adapter components within the specified operating range of 0° C to +60° C (+32° F to +140° F). Proper spacing of components within the enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce "hot spots" near the adapter.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

Important: Do not bring in unfiltered outside air. It may introduce harmful contaminants of dirt that could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Grounding Guidelines

In solid-state control systems, grounding helps limit the effects of electrical noise due to electromagnetic interference (EMI). The ground path for the adapter and its enclosure is provided by the equipment grounding conductor.

Normal Electrical Noise Conditions   **Severe Electrical Noise Conditions**
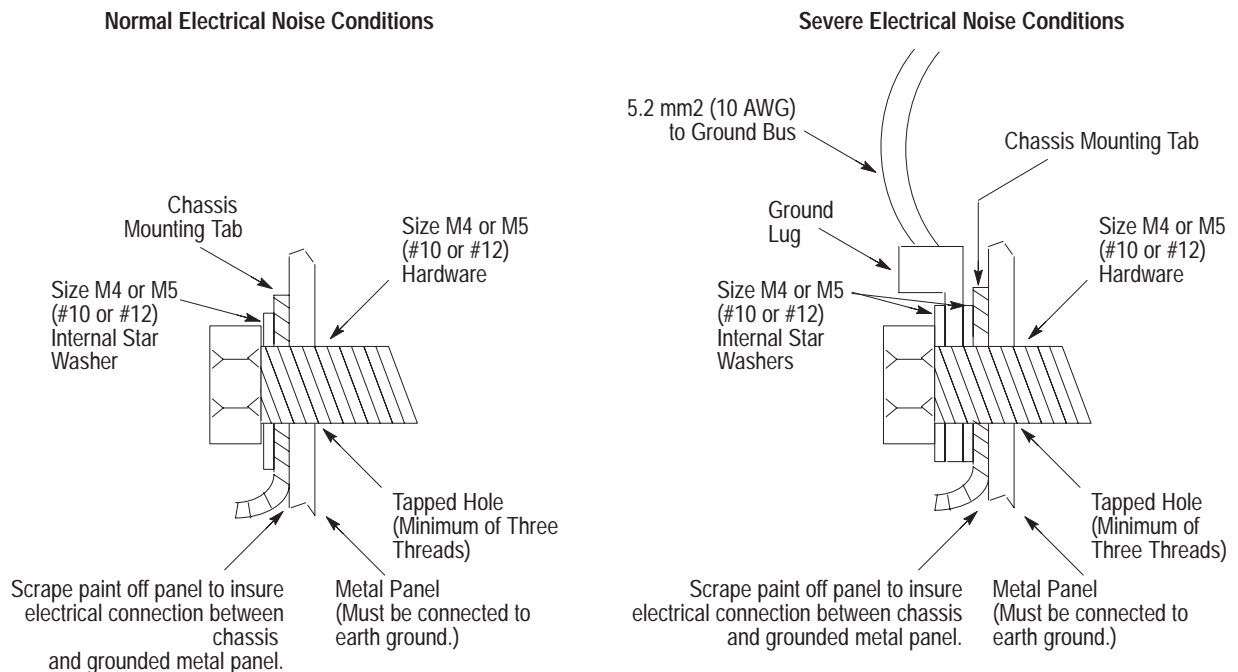
⚠ **ATTENTION:** The 1746 chassis, the enclosure, and other control devices must be properly grounded. All applicable codes and ordinances must be observed when wiring the adapter system.

Ground connections should run from the chassis and power supply on each adapter and expansion unit to the ground bus. Exact connections will differ between applications.

Europe: Reference EN 60204 for safety information on grounding. Also, refer to *Allen-Bradley Programmable Controller Grounding and Wiring Guidelines*, Publication Number 1770-4.1.

United States: An authoritative source on grounding requirements for most installations is the National Electrical Code. Also, refer to *Allen-Bradley Programmable Controller Grounding and Wiring Guidelines*, Publication Number 1770-4.1.

In addition to the grounding required for the adapter and its enclosure, you must also provide proper grounding for all controlled devices in your application. Care must be taken to provide each device with an acceptable grounding path.

This figure shows you how to run ground connections from the chassis to the ground bus. Two acceptable grounding methods are shown; we recommend using a ground bus because it reduces the electrical resistance at the connection.
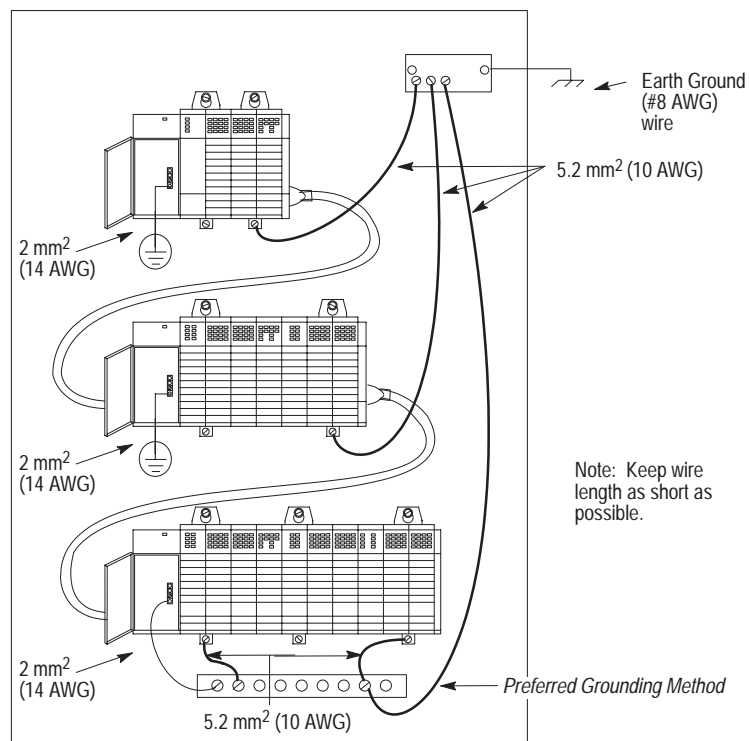
Special Grounding Considerations for DC Applications using 1746-P3

> ⚠ **ATTENTION:** Any voltage applied to the 1746-P3 DC NEUT terminal will be present at the SLC logic ground and the processor DH-485 port. To prevent unwanted potentials across the logic ground of the controller and/or damage to the SLC chassis, the DC NEUTRAL of the external DC power source must be either isolated from the SLC chassis ground, or connected to earth ground. See the figure below:
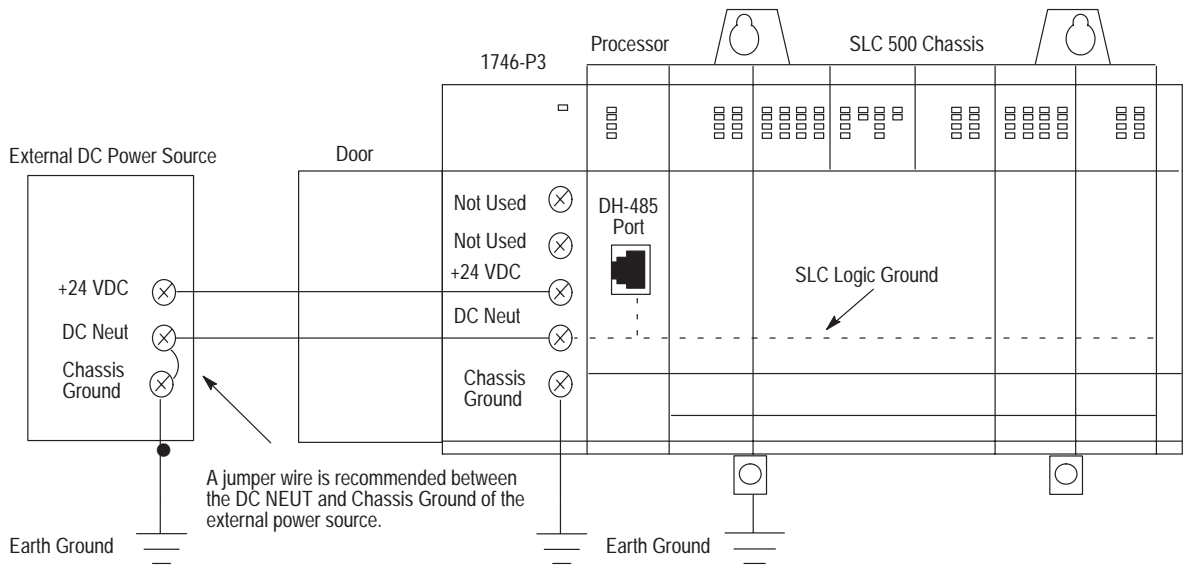
Modification to the SLC 500 Chassis

SLC 500 chassis (1746-A4, -A7, -A10, and -A13) manufactured *before* November 1992 have a resistor between the logic ground and chassis ground. This resistor could be damaged if the wiring recommendation described within the attention box on the previous page is not followed. See the figure below for the location of the resistor. SLC 500 chassis (1746-A4, -A7, -A10, and -A13) with a manufacture date of November 1992 or later do not have this resistor.
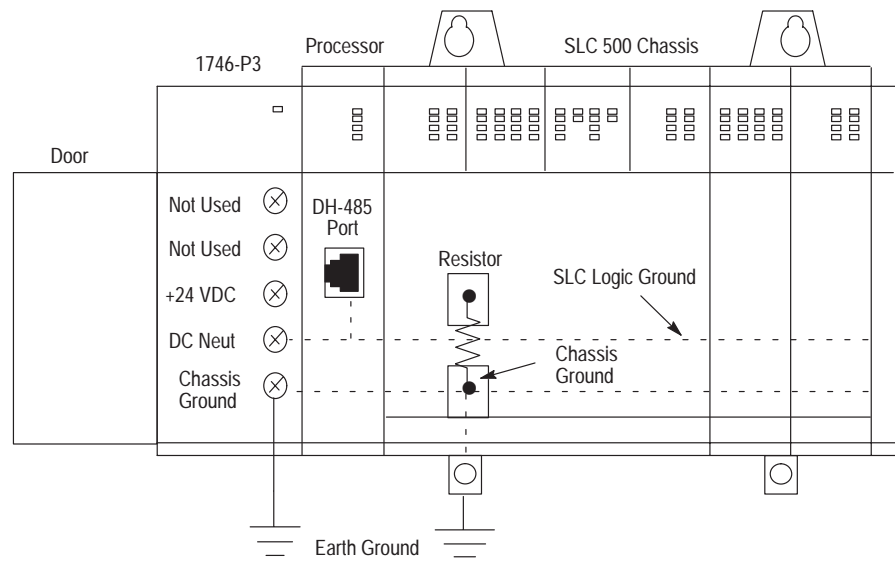
Determining the Date of the SLC 500 Chassis

The date of the chassis is found within the serial number imprinted on the chassis nameplate, located on the right side of the chassis. See the figure below:
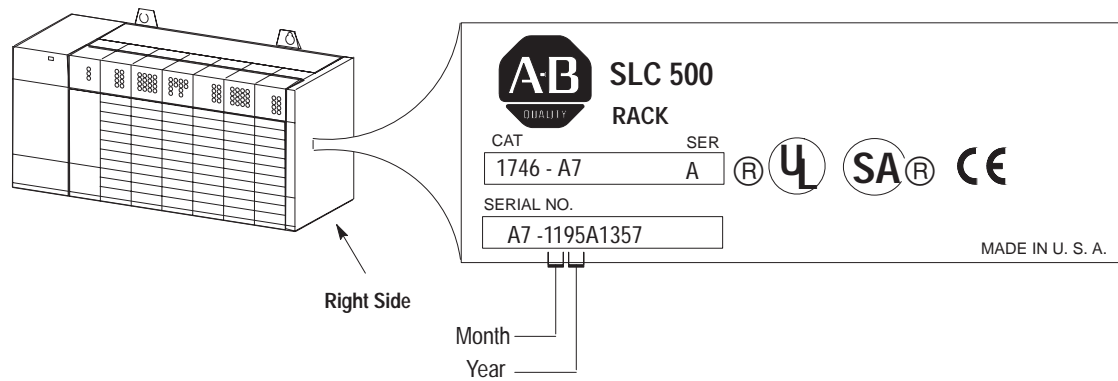
Master Control Relay

A hard-wired master control relay (supplied by you) provides a convenient means for emergency controller shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits.

> ⚠️ **ATTENTION:** Never alter these circuits to defeat their function, since serious injury and/or machine damage could result.

Important: If you are using a DC power supply, interrupt the DC side rather than the AC side to avoid the additional delay of power supply turn-on and turn-off. The DC power supply should receive its power directly from the fused secondary of the transformer. Connect the power to the DC input and output circuits through a set of master control relay contacts.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices is stopped.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

Important: The operator must not control the master control relay with the processor. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Emergency-Stop Switches

Adhere to the following points concerning emergency-stop switches:

- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.

- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.

- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach. See the following schematics.

Power Considerations

The following explains power considerations for the SLC 500 processor.

Common Power Source

We strongly recommend that all chassis power supplies have the same power source as the input and output devices. This helps reduce the chance of electrical interference due to multiple sources and grounds as well as helps maintain system integrity if power is interrupted.

The processor detects the absence of power to any chassis in the system. If power to any chassis is lost (or not yet applied), the CPU FAULT LED turns on and all controller outputs are de-energized.

This fault detection makes it necessary that you apply power to the expansion chassis *before* you apply power to the chassis containing the processor to avoid an unwanted fault. Of course, applying power in sequence is unnecessary if all chassis have a common power source.

Isolation Transformer

In many industrial applications, a step-down transformer is required to reduce line voltage to 120 or 240V ac. This transformer also provides isolation to protect equipment from high voltage transients that may be generated on your power distribution system.

> ⚠️ **ATTENTION:** Your SLC 500 power supply can be damaged by voltage surges when switching inductive loads such as motors, motor starters, solenoids, and relays. To avoid damage to your SLC 500 power supply in these applications, it is strongly recommended that an isolation transformer be used to isolate the power supply from harmful voltage surges.

Grounded ac Power-Distribution System with Master-Control Relay

The I/O circuits form a net inductive load switched by the CRM contacts. Therefore, a **suppressor is needed** across the line at the load side of the CRM contacts.
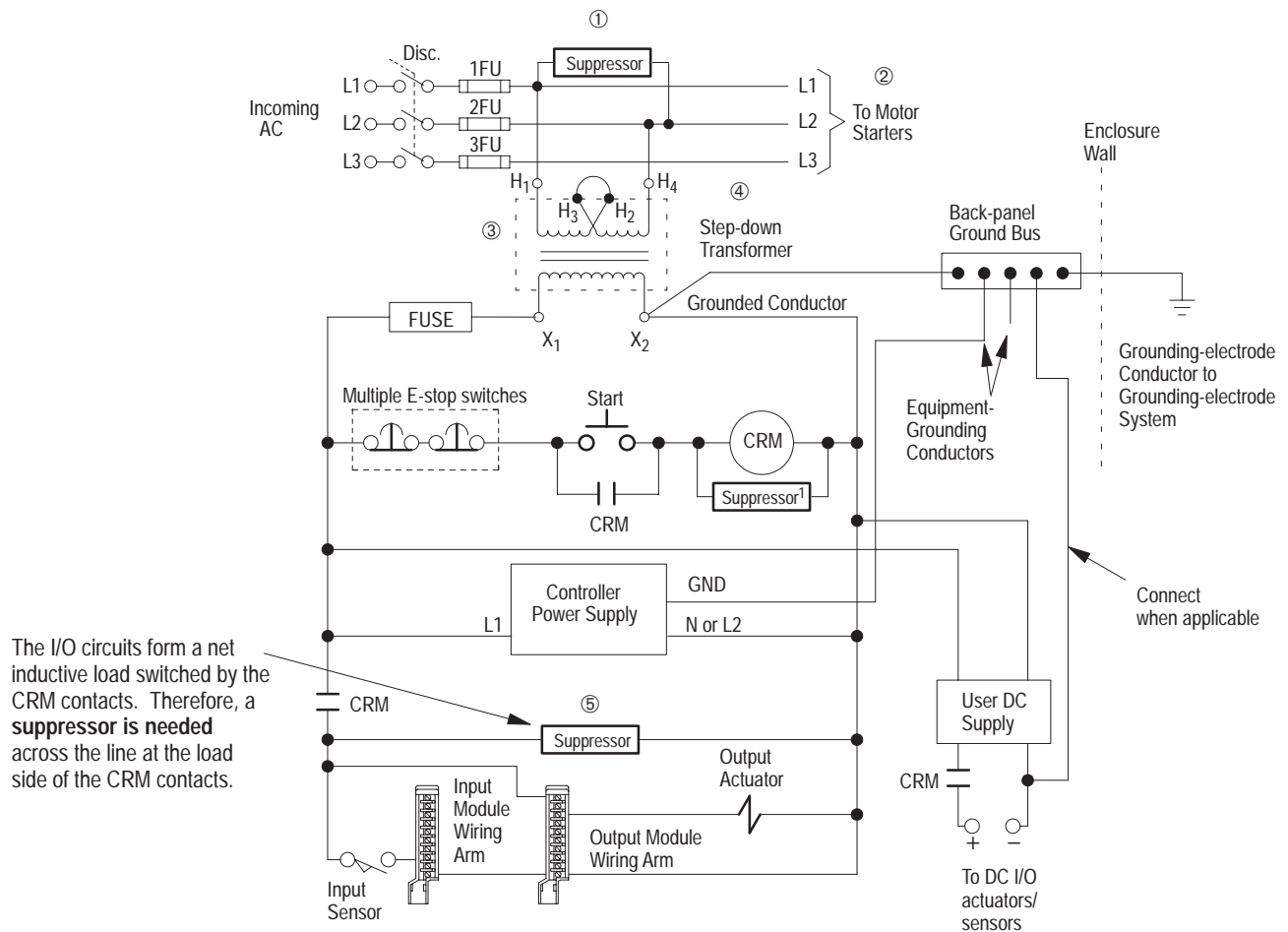
[1] To minimize EMI generation, connect a suppressor across an inductive load. For more information on selecting surge suppressors, see page 2–24.

[2] Contact motor manufacturer for recommended surge supression for motors.

[3] In applications where severe energy is re-generated by motors when power is removed, use an isolation/constant-voltage transformer in place of the step-down transformer.

[4] In many applications, a second transformer provides power to the input circuits and power supplies for isolation from the output circuits.

[5] Connect a suppressor here to minimize EMI generation from the net inductive load switched by the CRM contacts.   For more information on selecting surge suppressors, see page 2–24.

Loss of Power Source

The chassis power supplies are designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called "program scan hold-up time after loss of power." The duration of the power supply hold-up time depends on the number, type and state of the I/O modules, but is typically between 20 ms and 3 seconds. When the duration of power loss reaches a limit, the power supply signals the processor that it can no longer provide adequate DC power to the system. This is referred to as a power supply shutdown. The power supply LED is turned off.

In multi-chassis systems, power outages of 20 to 300 ms in duration can cause a remote power fail error to occur. You can clear this error by cycling power to your system or by using a programming device.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the input modules. Because of this, the input state change from On to Off that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account. For example, hard wire power to one spare input. In the user program, check to be sure that one input is on; otherwise, jump to the end of the program and avoid scanning the logic. Use of a common power source as recommended in the previous section is assumed.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. Several safety areas are discussed below.

Disconnecting Main Power

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. Ideally, the disconnect switch is mounted on the outside of the enclosure, so that it can be accessed without opening the enclosure. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by an SLC controller.

Safety Circuits

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should be aware of. First, the master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized.

Second, if you are using a DC power supply, interrupt the load side rather than the AC line power. This avoids the additional delay of power supply turn-on and turn-off. The DC power supply should be powered directly from the fused secondary of the transformer. Power to the DC input and output circuits is connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Preventive Maintenance

The printed circuit boards of the controller must be protected from dirt, oil, moisture and other airborne contaminants. To protect these boards, the controller must be installed in an enclosure suitable for the environment. The interior of the enclosure should be kept clean and the enclosure door should be kept closed whenever possible.

Regularly inspect your terminal connections for tightness. Loose connections may cause improper functioning of the controller or damage the components of the system.

> ⚠ **ATTENTION:** To ensure personal safety and to guard against damaging equipment, inspect connections with incoming power off.

The National Fire Protection Association (NFPA) provides recommendations for electrical equipment maintenance. Refer to article 70B of the NFPA for general requirements regarding safety related work practices.

Mounting Your SLC 500 Control System

This chapter provides mounting dimensions for:

- 4, 7, 10, and 13-slot chassis
- link coupler (AIC)
- Data Terminal Access Module (DTAM)
- DTAM Plus Operator Interface
- DTAM Micro Operator Interface
- AIC+ Advanced Interface Converter

Mounting Modular Hardware Style Units

You can mount the modular hardware style units directly to the back panel of your enclosure using the mounting tabs and #10 and #12 screws. The torque requirement is 3.4 N-m (30 in-lbs) maximum.

4-Slot Modular Chassis

Front View

**millimeters
(inches)**

Left Side View

① Dimensions for power supply catalog number 1746-P1

② Dimensions for power supply catalog number 1746-P2 & 1746-P3

③ Dimensions for power supply catalog number 1746-P4

7-Slot Modular Chassis

11 Dia.
(0.433)

175
(6.89)

5.5 Dia.
(0.217)

1.0
(0.04)

③ ② ①

158
(6.22)

140
(5.51)

171
(6.73)

140
(5.51)

171
(6.73)

14
(0.55)

5.5 Dia
(0.217)

45
(1.77)

320
(12.60)

340
(13.39)

366
(14.41)

145
(5.71)

Front View

**millimeters
(inches)**

Left Side View

10-Slot Modular Chassis

Front View

millimeters (inches)

Left Side View

① Dimensions for power supply catalog number 1746-P1

② Dimensions for power supply catalog number 1746-P2 & 1746-P3

③ Dimensions for power supply catalog number 1746-P4

13-Slot Modular Chassis
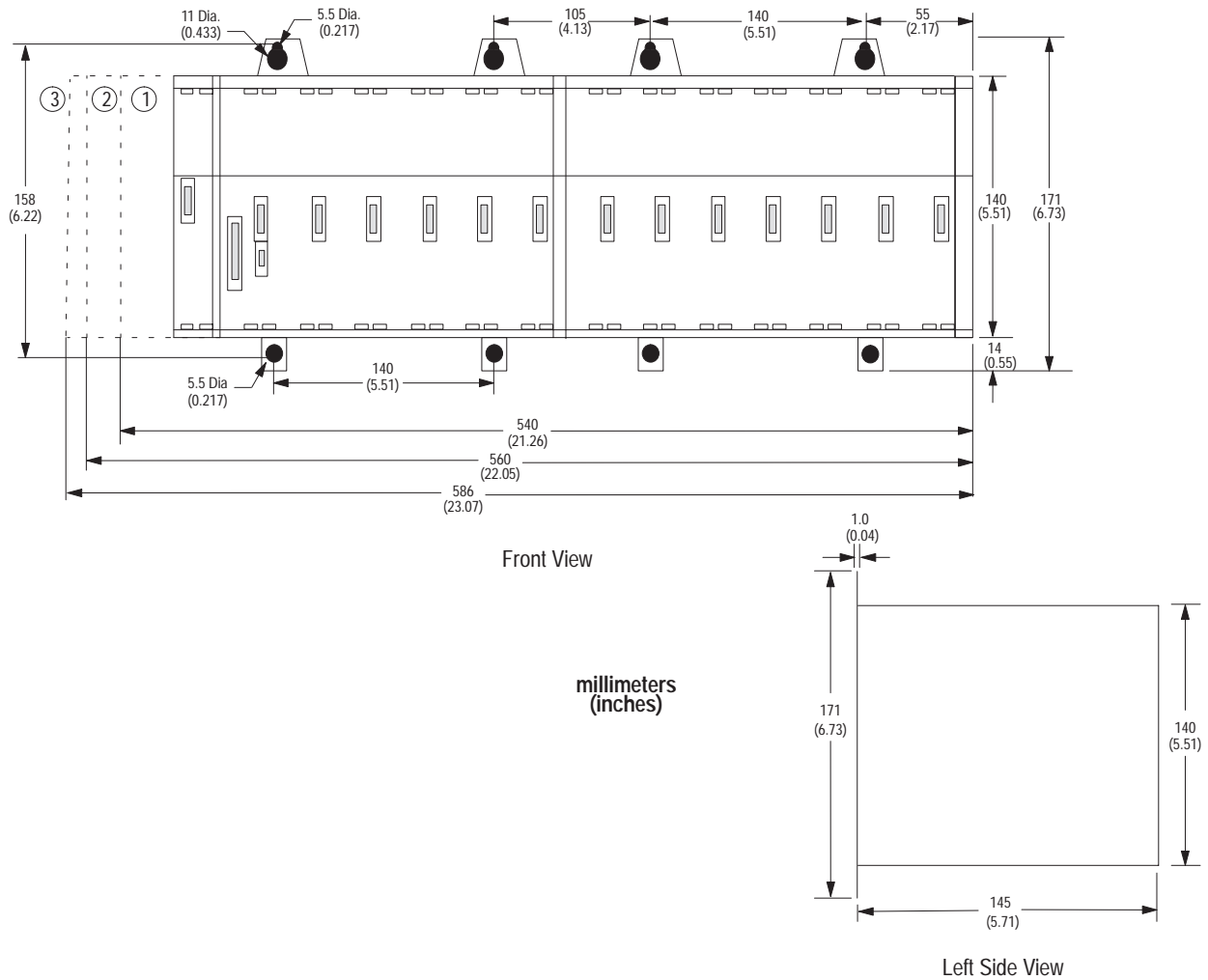
Front View

millimeters
(inches)

Left Side View

① Dimensions for power supply catalog number 1746-P1

② Dimensions for power supply catalog number 1746-P2 & 1746-P3

③ Dimensions for power supply catalog number 1746-P4

Link Coupler (AIC)

R 2.74
(0.11)

R 5.5
(0.22)

159
(6.24)

137
(5.41)

14
(0.55)

7.1
(0.28)

38
(1.50)

5.5 Dia.
(0.216)

Front View

146
(5.75)

172
(6.75)

**millimeters
(inches)**

4.3
(0.17)

Right Side View
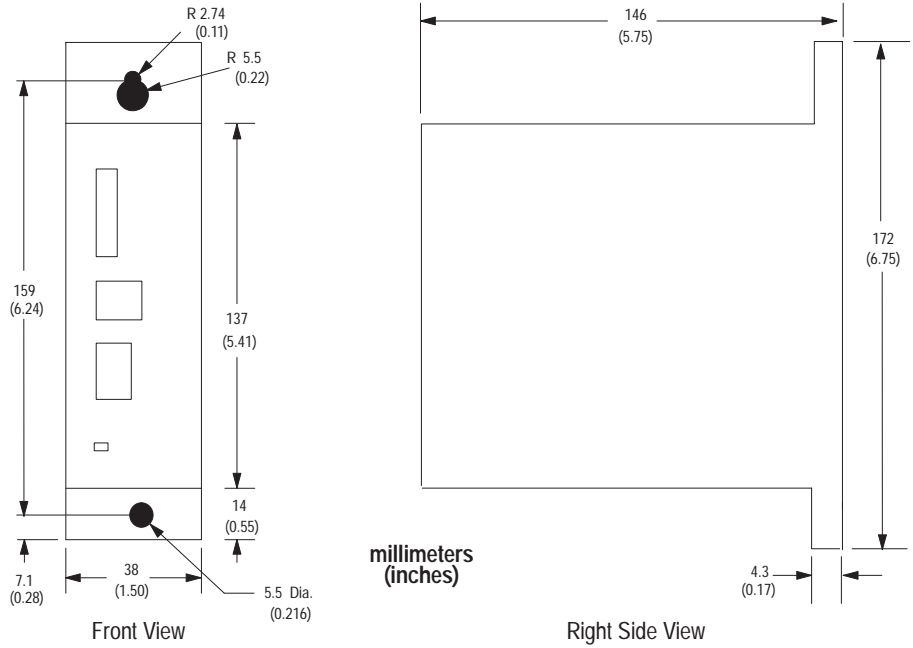
Data Table Access Module (DTAM, DTAM Plus, and DTAM Micro)

● *Comm*

A

B

C

D

Front View

Right Side View
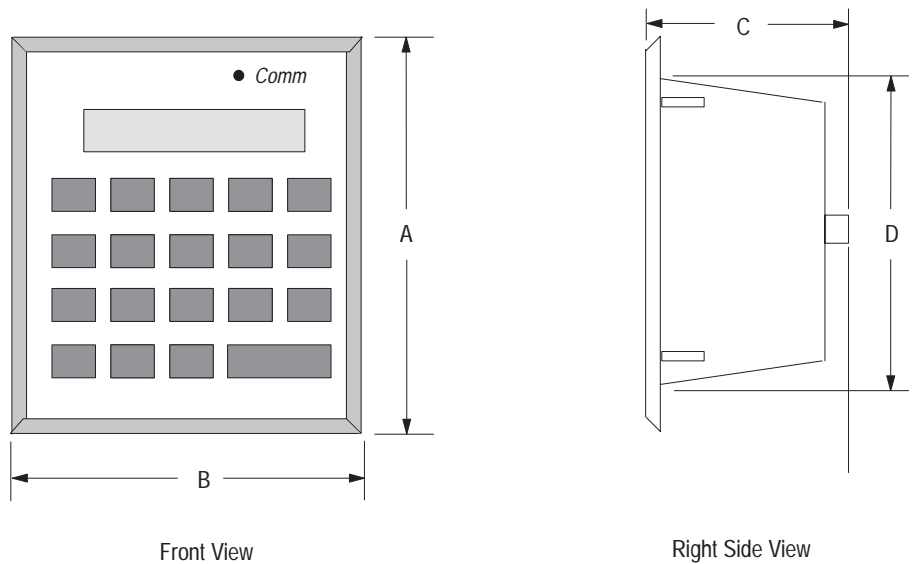
	A	B	C	D
DTAM	152 (6.0)	140 (5.5)	69 (2.76)	127 (5.0)
DTAM Plus	215.9 (8.5)	165.1 (6.5)	45.7 (1.8)	193 (7.6)
DTAM Micro	137.2 (5.4)	175.3 (6.9)	45.7 (1.8)	99.1 (3.9)

**millimeters
(inches)**

AIC+ Advanced Interface Converter (1761-NET-AIC)

52.07 mm
(2.05 in.)

118 mm
(4.64 in.)

107 mm
(4.20 in.)

6.6 mm
(0.26 in.)

Allow 15 mm (0.6 in.) clearance
for DIN rail latch movement during
installation and removal.

27.7 mm
(1.09 in.)

71.4 mm
(2.81 in.)
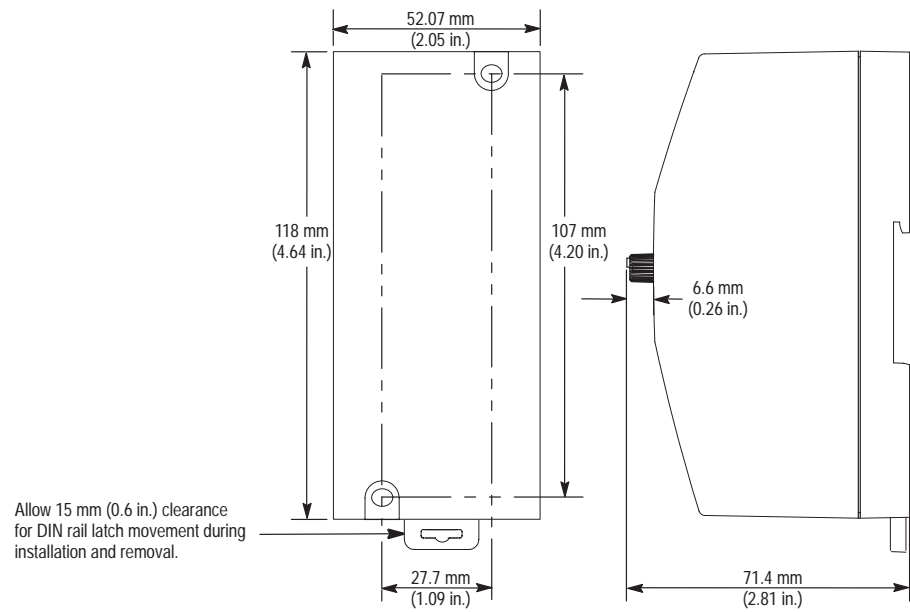
Identifying the Components of Your Processor

This chapter covers the following:

- SLC 5/01 hardware features
- SLC 5/02 hardware features
- SLC 5/03 hardware features
- SLC 5/04 hardware features
- SLC 5/05 hardware features
- keyswitch for the SLC 5/03, SLC 5/04, and SLC 5/05 processors

SLC 5/01 Processor Hardware Features

The SLC 5/01 processor provides:

- two choices of program memory size – 1K or 4K instructions
- control of up to 3840 input and output points
- powerful ladder logic programming instruction set
- subroutines
- a DH-485 communication channel (peer-to-peer communication response to message commands only)
- capacitor backup for the -L511; battery backup for the -L514
- program using the Hand-Held Terminal (HHT) or programming software
- UL listed, CSA approved, CE compliant

The figure below shows the hardware components of the SLC 5/01 processor (1747-L511 and 1747-L514).

Memory Module and Socket

SLC 5/01 CPU

☐ PC RUN
☐ CPU FAULT
☐ FORCED I/O
☐ BATTERY LOW

Battery (Provides Back-up Power for the CMOS RAM)

DH-485 Channel 1

Left Side View

Location of Serial and Catalog Numbers

Front View
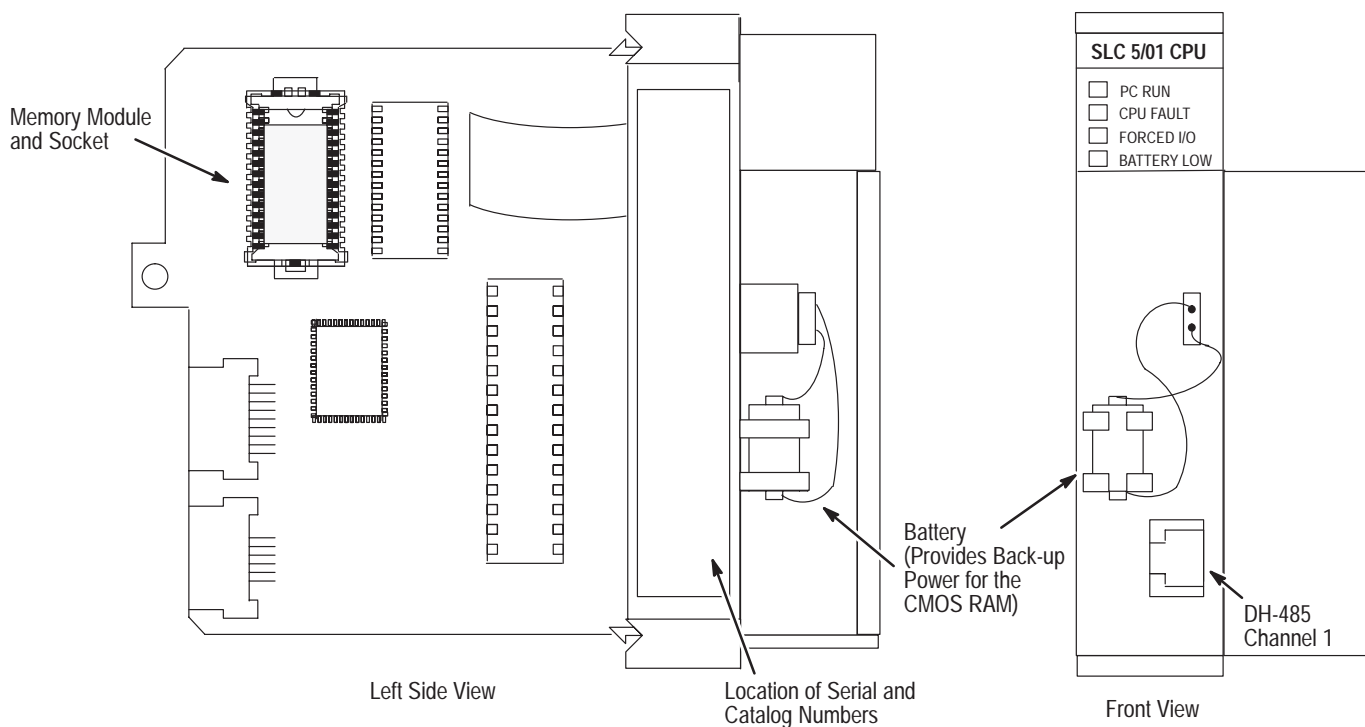
The table below provides a general explanation of the SLC 5/01 processor LEDs.[1]

Processor LED	When It Is	Indicates that
PC RUN (Color: red)	On (steadily)	The processor is in the Run mode.
	Off	The processor is in a mode other than Run.
CPU FAULT (Color: red)	Flashing (at power up)	The processor has not been configured.
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory.
	On (steadily)	A fatal error is present (no communication).
	Off	There are no errors.
FORCED I/O (Color: red)	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled.
	On (steadily)	The forces have been enabled.
	Off	No forces are present or enabled.
BATTERY LOW (Color: red)	On (steadily)	The battery voltage has fallen below a threshold level or the battery and the battery jumper are missing.
	Off	The battery is functional, or the battery jumper is present.

[1] See chapter 10 for more information on LED status.

SLC 5/02 Processor Hardware Features

The SLC 5/02 processor offers an enhanced instruction set, increased diagnostic capabilities, and expanded communication capabilities beyond the SLC 5/01 processors and fixed controllers. The SLC 5/02 provides:

- program memory size of 4K instructions
- control of up to 4096 input and output points
- PID – used to provide closed loop process control
- indexed addressing
- interrupt capability
- user fault routines
- ability to handle 32-bit signed math functions
- built-in DH-485 communication channel (initiation of peer-to-peer communication)
- battery-backed RAM
- communication LED; when on, the LED indicates that there is communication activity on the DH-485 network
- program using the Hand-Held Terminal (HHT) or programming software
- UL listed, CSA approved, CE compliant

The table below provides a general explanation of each processor status LED (for both the SLC 5/02 Series B and C).[1]

Processor LED	When It Is	Indicates that
RUN (Color: red)	On (steadily)	The processor is in the Run mode.
	Off	The processor is in a mode other than Run.
CPU FAULT (Color: red)	Flashing (at power up)	The processor has not been configured.
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory.
	On (steadily)	A fatal error is present (no communication).
	Off	There are no errors.
FORCED I/O (Color: red)	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled.
	On (steadily)	The forces have been enabled.
	Off	No forces are present or enabled.
BATTERY LOW (Color: red)	On (steadily)	The battery voltage has fallen below a threshold level or the battery and the battery jumper are missing.
	Off	The battery is functional, or the battery jumper is present.
COMM (Color: red)	On (steadily)	The SLC 5/02 is receiving data.
	Off	The SLC 5/02 is not receiving data.

[1] See chapter 10 for more information on LED status.

The figure below shows some of the hardware components of the SLC 5/02 processor (1747-L524 Series B and Series C).

1747-L524 Series B

Left Side View

1747-L524 Series C

Left Side View

Memory Module and Socket

Location of Serial and Catalog Numbers

Battery (Battery Provides Back-up Power for the CMOS RAM)

SLC 5/02 CPU

RUN ☐ COMM
CPU FAULT
FORCED I/O
BATTERY LOW

Front View
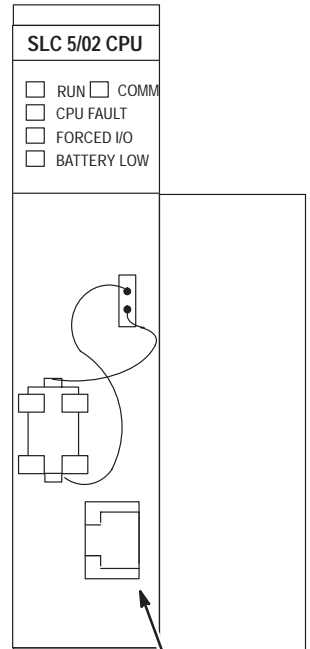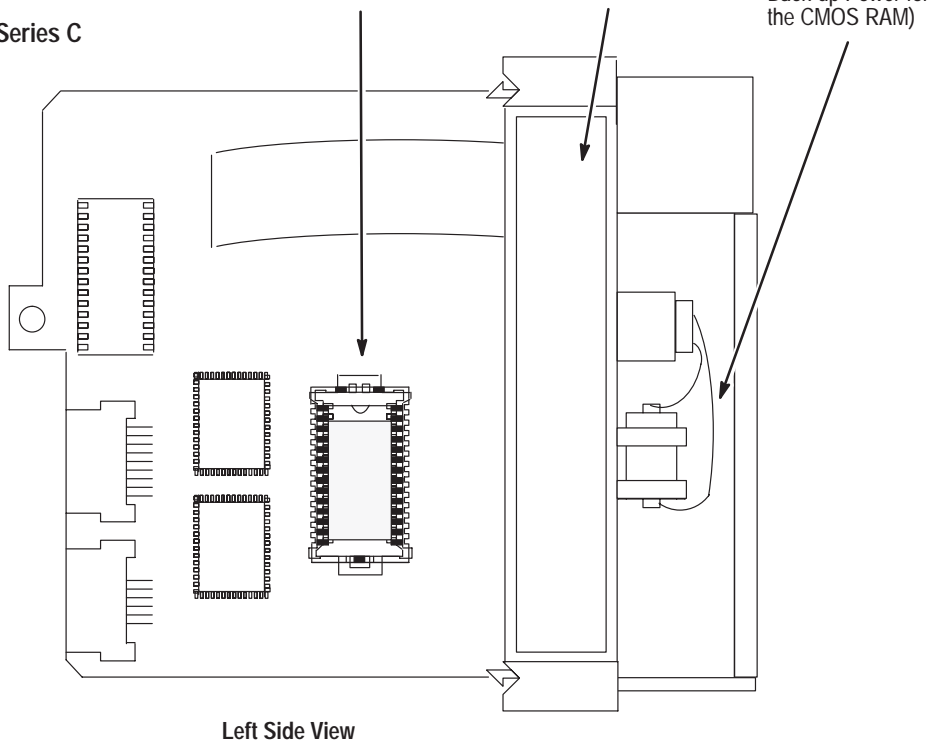
DH-485 Channel 1

SLC 5/03 Processor Hardware Features

The SLC 5/03 processor offers the following:

- program memory size of 8K or 16K
- control of up to 4096 input and output points
- online programming (includes runtime editing)
- built-in DH-485 channel
- built-in RS-232 channel, supporting:
  - DF1 Full-Duplex for point-to-point communication; remotely via a modem, or direct connection to programming or operator interface devices. (Use a 1747-CP3 cable for direct connection.)
  - DF1 Half-Duplex Master/Slave for SCADA type (point-to-multipoint) communication
  - DH-485 (Serves as a second DH-485 channel. Use a 1761-NET-AIC with a 1747-CP3 cable to connect to the DH-485 network.)
  - ASCII I/O for connection to other ASCII devices, such as bar code readers, serial printers, and weigh scales
- remote I/O passthru
- built-in real-time clock/calendar
- 2 ms Selectable Timed Interrupt (STI)
- 0.50 ms Discrete Input Interrupt (DII)
- advanced math features – trigonometric, PID, exponential, floating point, and the compute instruction
- indirect addressing
- flash PROM provides firmware upgrades without physically changing EPROMS
- optional flash EPROM memory module available
- keyswitch – RUN, REMote, PROGram (clear faults)
- battery-backed RAM
- additional instructions such as swap and scale with parameters (SLC 5/03 OS302 processor or higher)
- multi-point list (SLC 5/03 OS302 processor or higher)
- UL listed, CSA approved, CE compliant

The figure below shows some of the hardware components of the SLC 5/03 processors (1747-L531 and 1747-L532).

Battery
(Battery Provides
Back-up Power for
the CMOS RAM)

Memory Module

Keyswitch

Operating System
Memory Module
Download Protection
Jumper

Left Side View

Location of Serial and
Catalog Numbers

SLC 5/03 CPU

RUN ☐ ☐ FORCE
FLT ☐ ☐ DH485
BATT ☐ ☐ RS232

RUN   REM PROG

DH485
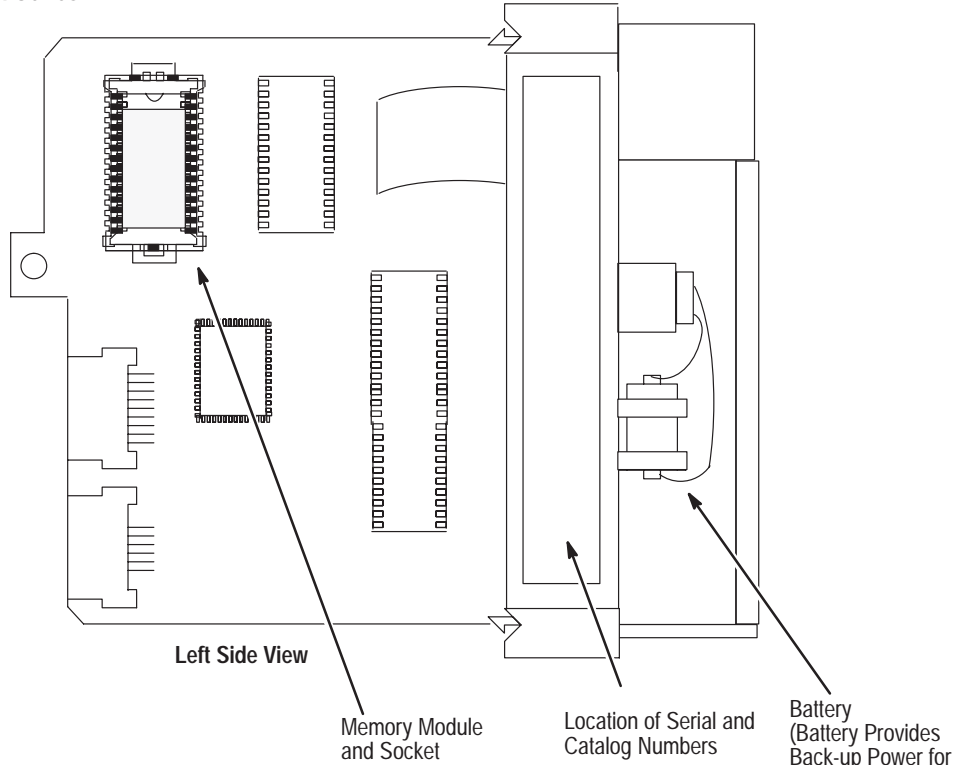Channel 1

DH485,
DF1, or
ASCII
Channel 0

Front View
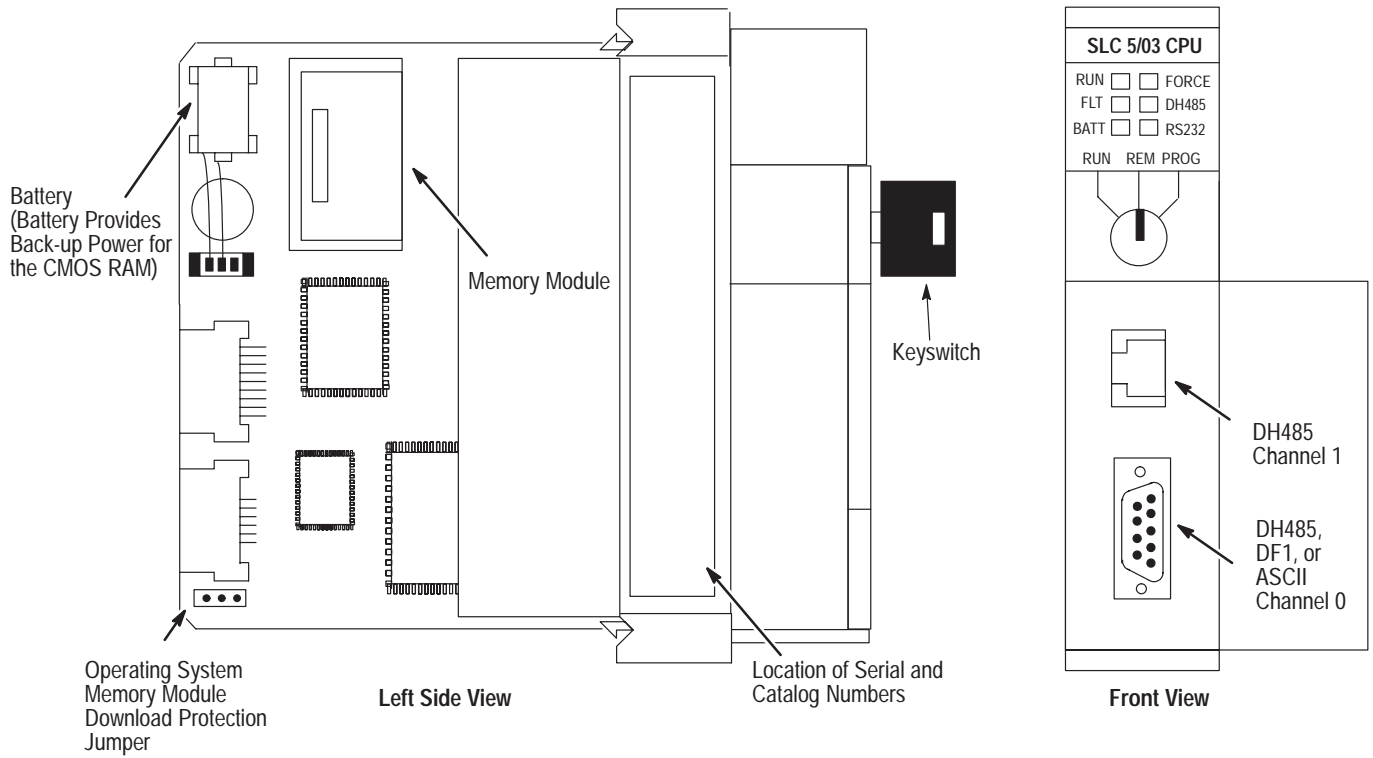
The table below provides a general explanation of each processor status LED on the SLC 5/03 processor.[1][2]

Processor LED	When It Is	Indicates that
RUN (Color: green)	On (steadily)	The processor is in the Run mode.
	Flashing (during operation)	The processor is transferring a program from RAM to the memory module.
	Off	The processor is in a mode other than Run.
FLT (Color: red)	Flashing (at power up)	The processor has not been configured.
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory.
	On (steadily)	A fatal error is present (no communications).
	Off	There are no errors.
BATT (Color: red)	On (steadily)	The battery voltage has fallen below a threshold level, or the battery or the battery jumper is missing or not connected.
	Off	The battery is functional, or the battery jumper is present.
FORCE (Color: amber)	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled.
	On (steadily)	The forces have been enabled.
	Off	No forces are present or enabled.
DH485 (Color: green)	On (steadily)	The Communications Active Bit (S:1/7) is set in the System Status file and processor is actively communicating on the network.
	Flashing	There are no other active nodes on the network.
	Off	A fatal error is present (no communications).
RS232 (Color: green)	On (flashing) *DF1 Mode*	The SLC 5/03 is transmitting on the network.
	Off *DF1 Mode*	The SLC 5/03 processor is *not* transmitting on the network.
	On (steadily) *DH485 Mode*	The Communications Active Bit (S:1/7) is set in the System Status file and the processor is actively communicating on the network.
	Flashing *DH485 Mode*	The processor is trying to establish communications, but there are no other active nodes on the network.
	Off *DH485 Mode*	A fatal error is present (no communications).

[1]   If the LEDs on the SLC 5/03 turn on in a predefined sequence, the SLC 5/03 is in the process of downloading a new operating system.

[2]   See chapter 10 for more information on LED status.

SLC 5/04 Processor Hardware Features

The SLC 5/04 processors offer the following:

- program memory sizes of 16K, 32K, or 64K
- high-speed performance – 0.90 ms/K typical
- control of up to 4096 input and output points
- online programming (includes runtime editing)
- built-in DH+ channel, supporting:
  - high-speed communication (57.6K, 115.2K, and 230.4K baud)
  - messaging capabilities with SLC 500, PLC-2®, PLC-5®, and PLC-5/250 processors
- built-in RS-232 channel, supporting:
  - DF1 Full-Duplex for point-to-point communication; remotely via a modem, or direct connection to programming or operator interface devices. (Use a 1747-CP3 cable for direct connection.)
  - DF1 Half-Duplex Master/Slave for SCADA type (point-to-multipoint) communication
  - DH-485 (Use a 1761-NET-AIC with a 1747-CP3 cable to connect to the DH-485 network.)
  - ASCII I/O for connection to other ASCII devices, such as bar code readers, serial printers, and weigh scales
- channel-to-channel (DH+ to DH-485) passthru capability to operator interface devices
- channel-to-channel (DF1 Full-Duplex to DH+) passthru (OS401 and later only)
- remote I/O passthru
- built-in real-time clock/calendar
- 1 ms Selectable Timed Interrupt (STI)
- 0.50 ms Discrete Input Interrupt (DII)
- advanced math features – trigonometric, PID, exponential, floating point, and the compute instruction
- indirect addressing
- flash PROM provides firmware upgrades without physically changing EPROMS
- optional flash EPROM memory module available
- keyswitch – RUN, REMote, PROGram (clear faults)
- battery-backed RAM
- additional instructions such as swap and scale with parameters (SLC 5/04 OS401 processor or higher)
- multi-point list (SLC 5/04 OS401 processor or higher)
- UL listed, CSA approved, CE compliant

This figure below shows some of the hardware components of the SLC 5/04 processors (1747-L541, 1747-L542, or 1747-L543).

Battery
(Battery Provides
Back-up Power for
the CMOS RAM)

Memory Module

Keyswitch

Operating System
Memory Module
Download Protection
Jumper

Left Side View

Location of Serial and
Catalog Numbers

SLC 5/04 CPU

RUN ☐ ☐ FORCE
FLT ☐ ☐ DH+
BATT ☐ ☐ RS232

RUN   REM PROG

DH+
Channel 1

DH485,
DF1, or
ASCII
Channel 0

Front View

The table below provides a general explanation of each processor status LED on the SLC 5/04 processors.[1][2]

Processor LED	When It Is	Indicates that
RUN (Color: green)	On (steadily)	The processor is in the Run mode.
	Flashing (during operation)	The processor is transferring a program from RAM to the memory module.
	Off	The processor is in a mode other than Run.
FLT (Color: red)	Flashing (at power up)	The processor has not been configured.
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory.
	On (steadily)	A fatal error is present (no communications).
	Off	There are no errors.
BATT (Color: red)	On (steadily)	The battery voltage has fallen below a threshold level, or the battery or the battery jumper is missing or not connected.
	Off	The battery is functional, or the battery jumper is present.
FORCE (Color: amber)	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled.
	On (steadily)	The forces have been enabled.
	Off	No forces are present or enabled.
DH+ (Color: green or red)	On (steadily)	The Communications Active Bit (S:1/7) is set in the System Status file and processor is actively communicating on the network.
	Flashing Green	There are no other active nodes on the network.
	Flashing Red	There are duplicate nodes on the link with the same node address.
RS232 (Color: green)	On (steadily) *DF1 Mode*	The SLC 5/04 processor is transmitting on the network.
	Off *DF1 Mode*	The SLC 5/04 processor is *not* transmitting on the network.
	On (steadily) *ASCII Mode*	The SLC 5/04 processor is transmitting on the network.
	Off *ASCII Mode*	The SLC 5/04 processor is *not* transmitting on the network.
	On (steadily) *DH485 Mode*	The Communications Active Bit (S:1/7) is set in the System Status file and the processor is actively communicating on the network.
	Flashing *DH485 Mode*	The processor is trying to establish communications, but there are no other active nodes on the network.
	Off *DH485 Mode*	A fatal error is present (no communications).

[1] If the LEDs on the SLC 5/04 turn on in a predefined sequence, the SLC 5/04 is in the process of downloading a new operating system.
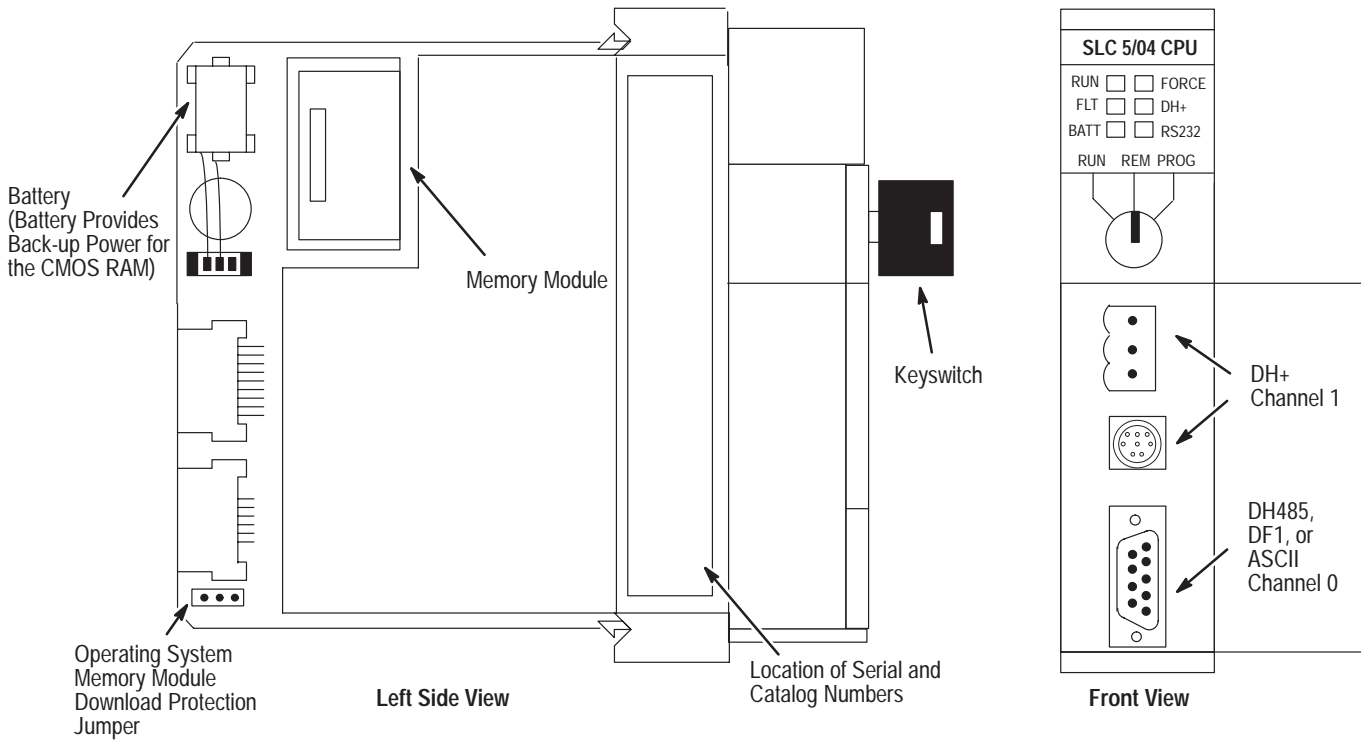
[2] See chapter 10 for more information on LED status.

SLC 5/05 Processor Hardware Features

The SLC 5/05 processors offer the following:

- program memory sizes of 16K, 32K, or 64K
- high-speed performance – 0.90 ms/K typical
- control of up to 4096 input and output points
- online programming (includes runtime editing)
- built-in 10Base-T Ethernet channel, supporting:
    - high-speed computer communication using TCP/IP
    - messaging capabilities with SLC 5/05, PLC-5, and PLC-5/250 processors on Ethernet
    - SNMP for standard Ethernet network management
    - BOOTP for optional dynamic IP address assignment
- built-in RS-232 channel, supporting:
    - DF1 Full-Duplex for point-to-point communication; remotely via a modem, or direct connection to programming or operator interface devices. (Use a 1747-CP3 cable for direct connection.)
    - DF1 Half-Duplex Master/Slave for SCADA type (point-to-multipoint) communication
    - DH-485 (Use a 1761-NET-AIC with a 1747-CP3 cable to connect to the DH-485 network.)
    - ASCII I/O for connection to other ASCII devices, such as bar code readers, serial printers, and weigh scales
- remote I/O passthru
- built-in real-time clock/calendar
- 1 ms Selectable Timed Interrupt (STI)
- 0.50 ms Discrete Input Interrupt (DII)
- advanced math features – trigonometric, PID, exponential, floating point, and the compute instruction
- indirect addressing
- logical ASCII addressing
- flash PROM provides firmware upgrades without physically changing EPROMS
- optional flash EPROM memory module available
- keyswitch – RUN, REMote, PROGram (clear faults)
- battery-backed RAM
- additional instructions such as swap and scale with parameters
- multi-point list
- UL listed, CSA approved, CE compliant

The figure below shows some of the hardware components of the SLC 5/05 processors (1747-L551, 1747-L552, and 1747-L553).

Battery (provides back-up power for the CMOS RAM)

Memory Module

Hardware Address

XX:XX:XX

Operating System Memory Module Download Protection Jumper

Left Side View

IP ADDRESS

Keyswitch

Write-on Area for IP Address

Location of Serial and Catalog Numbers

SLC 5/05 CPU

RUN ☐ ☐ FORCE
FLT ☐ ☐ ENET
BATT ☐ ☐ RS232

RUN   REM PROG

Channel 1 Ethernet (10Base-T)

Channel 0 RS232 (DH485, DF1, or ASCII)

Front View
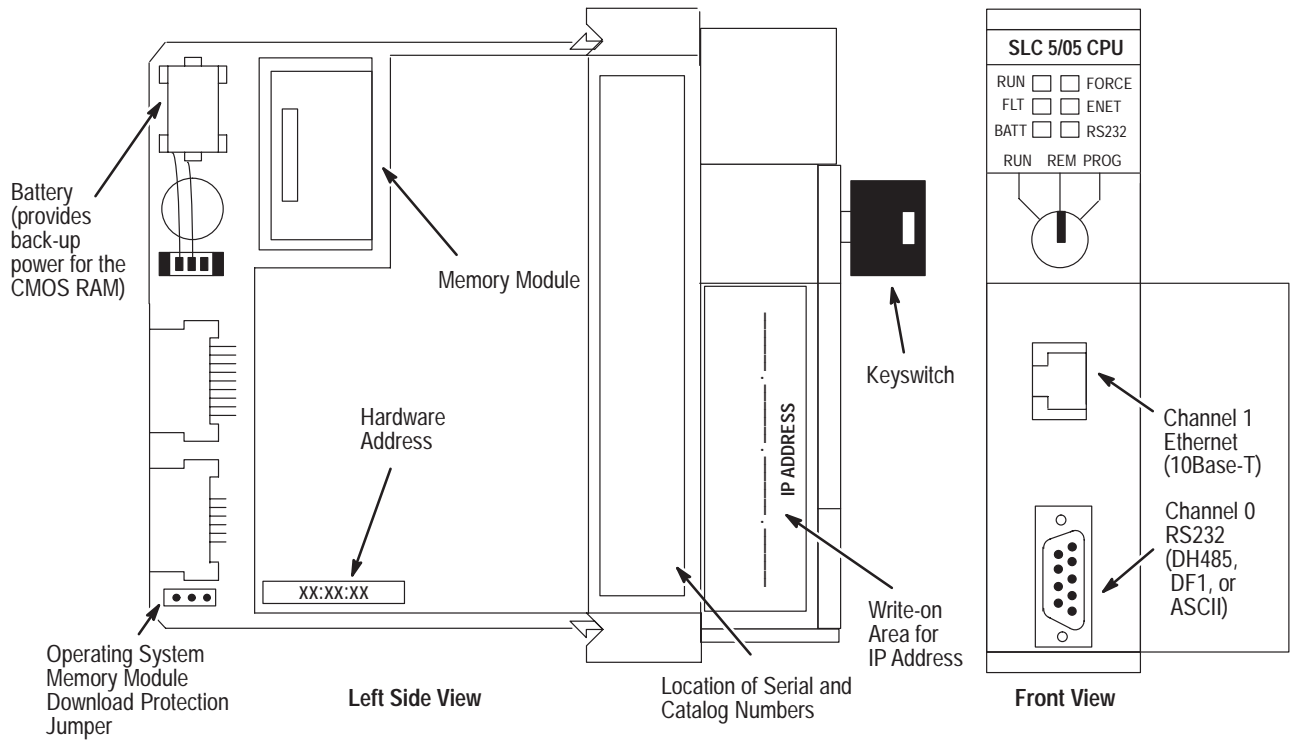
The table below provides a general explanation of the processor status LEDs.

Processor LED	When It Is	Indicates that
RUN (Color: green)	On (steadily)	The processor is in the Run mode.
	Flashing (during operation)	The processor is transferring a program from RAM to the memory module.
	Off	The processor is in a mode other than Run.
FLT (Color: red)	Flashing (at power up)	The processor has not been configured.
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory.
	On (steadily)	A fatal error is present (no communications).
	Off	There are no errors.
BATT (Color: red)	On (steadily)	The battery voltage has fallen below a threshold level, or the battery or the battery jumper is missing or not connected.
	Off	The battery is functional, or the battery jumper is present.
FORCE (Color: amber)	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled.
	On (steadily)	The forces have been enabled.
	Off	No forces are present or enabled.
ENET Channel 1 (Color: green or red)	Solid Green	The Ethernet port is functioning properly and is connected to an active Ethernet network.
	Flashing Green	The Ethernet port is functioning properly, connected to an active Ethernet network, and is transmitting packets.
	Flashing Red	A hardware or software fault has occurred and is being reported via a code. Contact Allen-Bradley Global Technical Services for assistance.
	Off	No Ethernet connection or processor halted.
RS232 Channel 0 (Color: green)	On (steadily) *DF1 Mode*	The SLC 5/05 processor is transmitting on the network.
	Off *DF1 Mode*	The SLC 5/05 processor is *not* transmitting on the network.
	On (steadily) *ASCII Mode*	The SLC 5/05 processor is transmitting on the network.
	Off *ASCII Mode*	The SLC 5/05 processor is *not* transmitting on the network.
	On (steadily) *DH485 Mode*	The Channel 0 Communications Active Bit (S:33/4) is set in the System Status file and the processor is actively communicating on the network.
	Flashing *DH485 Mode*	The processor is trying to establish communications, but there are no other active nodes on the network.
	Off *DH485 Mode*	A fatal error is present (no communications).

**Keyswitch for the
SLC 5/03, SLC 5/04, and
SLC 5/05 Processors**

The SLC 5/03, SLC 5/04, and SLC 5/05 processors include a
3-position keyswitch on the front panel that lets you select one of
three modes of operation: Run, Program, and Remote. You can
remove the key in each of the three positions.

> ⚠ **ATTENTION:** Depending on the size of your user
> program, the processor can take up to 2.5 seconds to
> change modes when you change the position of the
> keyswitch from RUN to PROG or to REM. Do not use
> the keyswitch in place of a hardwired master control
> relay or an emergency-stop switch.

Important: The SLC 5/01 and SLC 5/02 processors do not have a
keyswitch. Therefore, all modes must be changed via
the communication channels.

RUN Position

This position places the processor in the Run mode. The processor
scans/executes the ladder program, monitors input devices, energizes
output devices, and acts on enabled I/O forces. You can only change
the processor mode by changing the keyswitch position. You cannot
perform online program editing.

To change the processor mode to Run, toggle the keyswitch from
PROG or REM to RUN. When the keyswitch is left in the RUN
position, you cannot use a programmer/operator interface device to
change the processor mode.

PROG Position

This position places the processor in the Program mode. The
processor does *not* scan/execute the ladder program, and the
controller outputs are de-energized. You can perform online
program editing. You can only change the processor mode by
changing the keyswitch position.

To change the processor mode to Program, toggle the keyswitch
from REM or RUN to PROG. When the keyswitch is left in the
PROG position, you cannot use a programmer/operator interface
device to change the processor mode.

REM Position

This position places the processor in the Remote mode: either the REMote Run, REMote Program, or REMote Test mode. You can change the processor mode by changing the keyswitch position or by changing the mode from a programmer/operator interface device. You can perform online program editing in this position.

To change the processor mode to REM, toggle the keyswitch from RUN or PROG to REM. *When the keyswitch is in the REM position, you can use a programmer/operator interface device to change the processor mode.*

Installing Your Hardware Components

This chapter shows you how to install the following hardware components:

- your processor
- modules
- your memory module
- your power supply
- your chassis interconnect cable

Installing Your Processor

The processor always occupies the first slot of the first chassis. You can only install one processor per system.

> ⚠ **ATTENTION:** Never install, remove, or wire any module while power is applied. Also, do not expose processor modules to surfaces or other areas that may typically hold an electrostatic charge. Electrostatic charges can alter or destroy memory.

Important: If your processor has a battery — the battery is an option for the SLC 5/01 (1747-L511) processor — make sure it is connected before installing your processor into the chassis. This provides memory backup for your processor should the controller power supply fail.

Installing Modules

The following explains how to install your modules.

1. Align circuit board of the module with card guide in the chassis.

Retainer Clip

Circuit Board

Side View
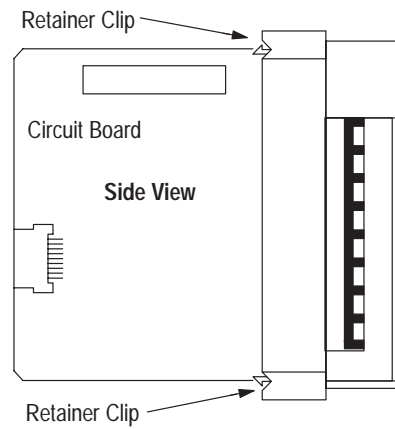
Retainer Clip

2. Gently slide the module in until both top and bottom retainer clips are secured.

19527
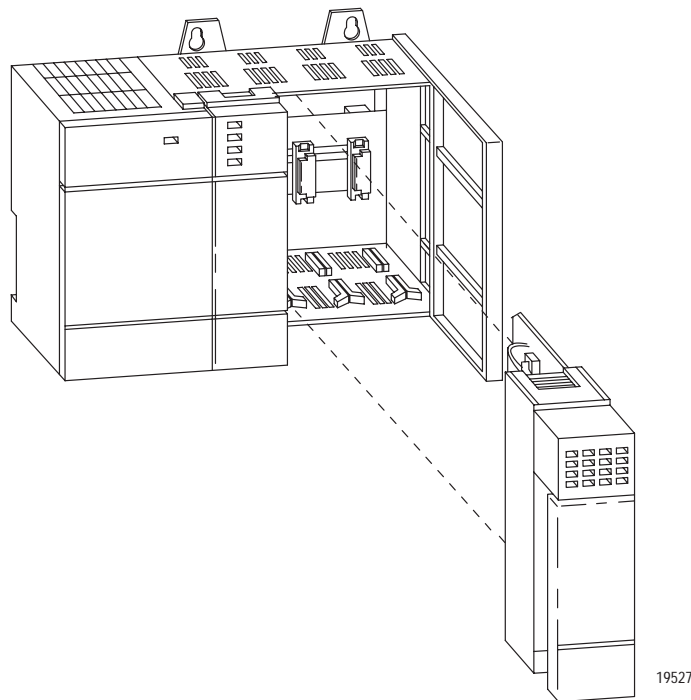
3. Install a wire tie to secure your wiring and keep it neat. (If you feed the tie into one hole, it will be routed back out through the other.)

4. Cover any unused slots with card slot fillers (Catalog Number 1746-N2) to keep the chassis free from debris and dust.

5. To remove the module, press the retaining clips at the top and bottom of the module and slide the module out.

Installing Your Memory Module

Always turn off power to the controller before removing the processor or inserting or removing the memory module. This guards against possible damage to the module and also undesired processor faults. Memory modules are mounted in carriers or have connectors that are "keyed" to guard against improper installation.

> ⚠️ **ATTENTION:** To avoid potential damage to the memory modules, handle them by the ends of the carrier or edges of the plastic housing. Skin oil and dirt can corrode metallic surfaces, inhibiting electrical contact. Also, do not expose memory modules to surfaces or areas that may typically hold an electrostatic charge. Electrostatic charges can alter or destroy memory.

1. If the processor module is installed in the chassis, remove the module by pressing the retainer clips at both the top and bottom of the module and sliding it out.

2. Locate the socket (or connector if you have an SLC 5/03, SLC 5/04, or SLC 5/05) on the processor board. Then place the memory module into the socket or onto the connector and press firmly in place.

Side View of SLC Processor
1747-L511, -L514, and -L524 Series B

Memory Module Socket

☐ Jumper J1
(Note: Jumper J1 not on 1747-L511)

Side View of SLC Processor
1747-L524 Series C

Memory Module Socket

Jumper J1 ☐

Side View of SLC Processor
1747-L531, -L532, -L541, -L542, -L543, -L551, -L552, and -L553

Memory Module Connector
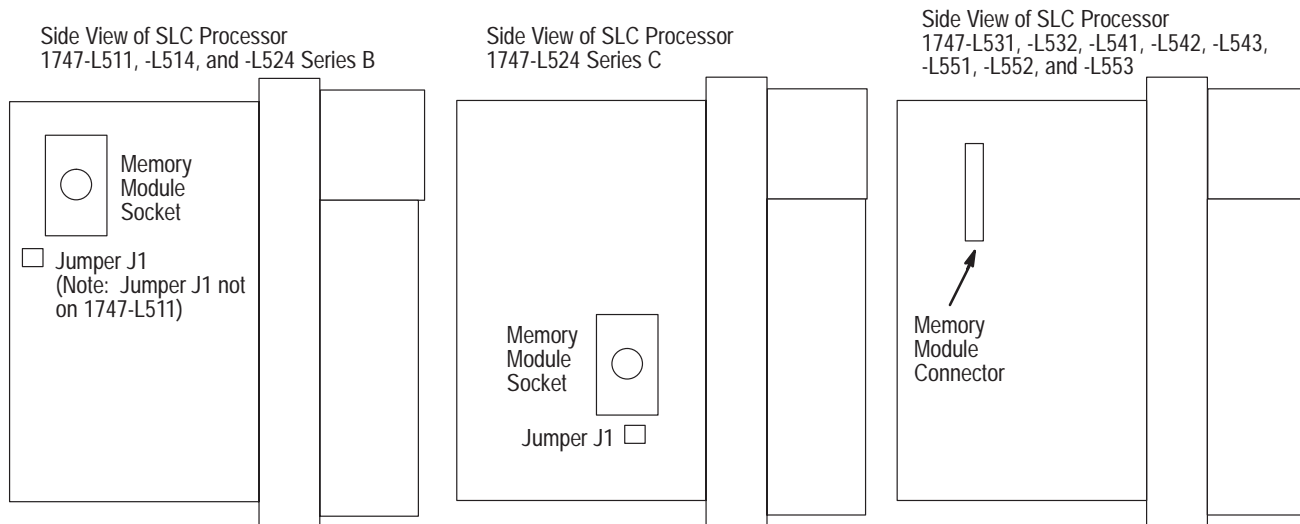
3. Place jumper J1 as shown below.

Processor Type	1747-M1, -M2, -M3	1747-M4	Invalid Settings
1747-L514, -L524 Series B and Series C			
1747-L511, -L531, -L532, -L541, -L542, -L543, -L551, -L552, and -L553	No Jumper J1	No Jumper J1	No Jumper J1

4. Install the processor module into the chassis.

5. Restore power to the controller.

Removing the Memory Module

To remove a memory module use the following procedure:

1. Remove power and pull out the processor.

2. Grasp the carrier tabs (or connector for the SLC 5/03, SLC 5/04, and SLC 5/05) with your thumb and index fingers, then gently but firmly lift upwards on either end of the memory module carrier.

3. When the end is partially raised, begin lifting the other end in the same manner. Repeat this until the memory module has been completely removed from the socket.

SLC 5/03, SLC 5/04, and SLC 5/05 Operating System Memory Module

The SLC 5/03, SLC 5/04, and SLC 5/05 processors use an operating system memory module to download new firmware. Take anti-static precautions when upgrading the operating system.

> ⚠️ **ATTENTION:** PROMs are electrostatic sensitive devices. Do not handle without proper grounding precautions. Do not install PROM with power applied to the processor.

Note: If an SLC 5/03 processor is running the new OS302 operating system, that SLC 5/03 processor has 321 instruction words less memory available for the user program than a processor running the OS300 or OS301 operating systems. Therefore, if you have a program for an OS300 or OS301 operating system that is near maximum capacity, saving the program as an OS302 program may result in an error. Save the program as an OS300 or OS301 program instead.

Note: If you upgrade an SLC 5/04 OS 400 processor to an SLC 5/04 OS401 processor, you will now have 28K of user instructions and 4K of data words. OS400 programs are not affected but are limited to the program size offered by the SLC 5/04 OS400 processor. Therefore, to make use of the additional 8K of user instructions, you need to resave your program offline after selecting OS401 operating system.

Communicating via DF1 Full-Duplex to an SLC 5/04 Processor with DF1 to DH+ Passthru Enabled

DF1 to DH+ passthru allows a device connected to channel 0 of an SLC 5/04 processor communicating with DF1 full-duplex protocol, to communicate with nodes on the DH+ network that the SLC 5/04 processor is connected to. Care must be taken when using this feature. You could inadvertently access devices on the DH+ network instead of channel 0 on the SLC 5/04 processor. Refer to the *Instruction Set Reference Manual* for more details.

Downloading firmware to the SLC 5/03, SLC 5/04, and SLC 5/05 Processors

Follow these steps to download new firmware to the SLC 5/03, SLC 5/04, and SLC 5/05 processors. Refer to page 6–7 for component placement information.

1. Save the current SLC 5/03, SLC 5/04, or SLC 5/05 processor program to your hard drive using your programming software.

Important: The user program is cleared as part of the operating system upgrade process. You must restore your program after successfully loading the operating system upgrade. Also, all communication ports are returned to default parameters.

2. Remove the communication cable between the SLC 5/03, SLC 5/04, or SLC 5/05 processor and your programming terminal.

3. Remove power from the chassis containing the SLC 5/03, SLC 5/04, or SLC 5/05 processor.

> ⚠ **ATTENTION:** Do not remove the processor from the SLC 500 chassis until all power is removed from the SLC 500 power supply.

4. Remove the SLC 5/03, SLC 5/04, or SLC 5/05 processor from the chassis.

5. Plug the operating system upgrade pack into the memory module socket.

6. Move the operating system write-protect jumper (J4) to the unprotected, or program, position.

7. Firmly seat the SLC 5/03, SLC 5/04, or SLC 5/05 processor back into the chassis.

8. Apply power to the chassis containing the processor while watching the LED display. All the LEDs should flash on and then turn off. The download process of the operating system by the SLC 5/03, SLC 5/04, and SLC 5/05 processors takes approximately 45 seconds. While the download is in progress, the RUN and FLT LEDs remain off. The other four LEDs — RS232, DH485 (DH+ on the SLC 5/04, and ENET on the SLC 5/05), FORCE, and BATT — turn on and off in a walking bit sequence. If the download is successful, these four LEDs remain on together. If the FLT LED turns on and a combination of LEDs flash on and off indicating an error condition, refer to the troubleshooting information in this document.

9. Following the successful completion of the download, remove power from the chassis containing the SLC 5/03, SLC 5/04, or SLC 5/05 processor.

10. Remove the SLC 5/03, SLC 5/04, or SLC 5/05 processor from the chassis.

> ⚠ **ATTENTION:** Do not remove the processor from the SLC 500 chassis until all power is removed from the SLC 500 power supply.

11. *Carefully* remove the operating system upgrade pack and place it in the anti-static packaging it was shipped in.

12. Move the operating system write-protect jumper (J4) back to the protected position.

13. Apply the enclosed operating system upgrade label to the SLC 5/03, SLC 5/04, or SLC 5/05 processor nameplate.

14. Firmly seat the SLC 5/03, SLC 5/04, or SLC 5/05 processor back into the chassis.

15. Attach the communication cable between the SLC 5/03, SLC 5/04, or SLC 5/05 processor and your programming terminal.

16. Apply power from the chassis containing the SLC 5/03, SLC 5/04, or SLC 5/05.

17. Apply power to the chassis containing the SLC 5/03, SLC 5/04, or SLC 5/05 processor while watching the LED display. All the LEDs should flash on and then turn off except for the FLT LED which should remaining flashing. If the FLT LED turns on and a combination of LEDs flash on and off indicating an error condition, refer to the troubleshooting information in this document.

18. Restore your program after successfully loading the operating system upgrade.

Component Placement

⚠ **ATTENTION:** Jumper J4, located on the bottom corner of the motherboard, provides write protection from any download of a new operating system. The "out of the box" position of this jumper is "PROTECT," or write protect. Without the jumper, the processors are write protected.

Catalog and Serial Number Label

Place the operating system upgrade label here.

The SLC 5/03, SLC 5/04, or SLC 5/05 processors are *protected* from the operating system download when jumper J4 is in this position:

⬛ **OR** ⬜

The SLC 5/03, SLC 5/04, or SLC 5/05 processors accept the operating system download when jumper J4 is in this position:

Operating System Upgrade/Memory Module Socket

Daughter Board

Mother Board

Jumper J4

SLC 500 PROCESSOR UNIT
CAT   SER   FAC
SERIAL NO.   PROC. REV.
PLACE OS UPGRADE LABEL HERE
OPERATING SYSTEM INFO
OS #   SER   FRN
ALLEN-BRADLEY
WHITE +
RED –
BATTERY
PROTECT
1
3
PROGRAM
J4
U L
CURRENT REQUIREMENTS: 1A @ 5 VDC
200mA @ 24 VDC
LISTED IND. CONT. EQ.
FOR HAZ. LOC. A196
CLASS 1, GROUPS A, B, C AND D, DIV. 2
OPERATING TEMPERATURE CODE T3C
MADE IN USA
SA ® CE
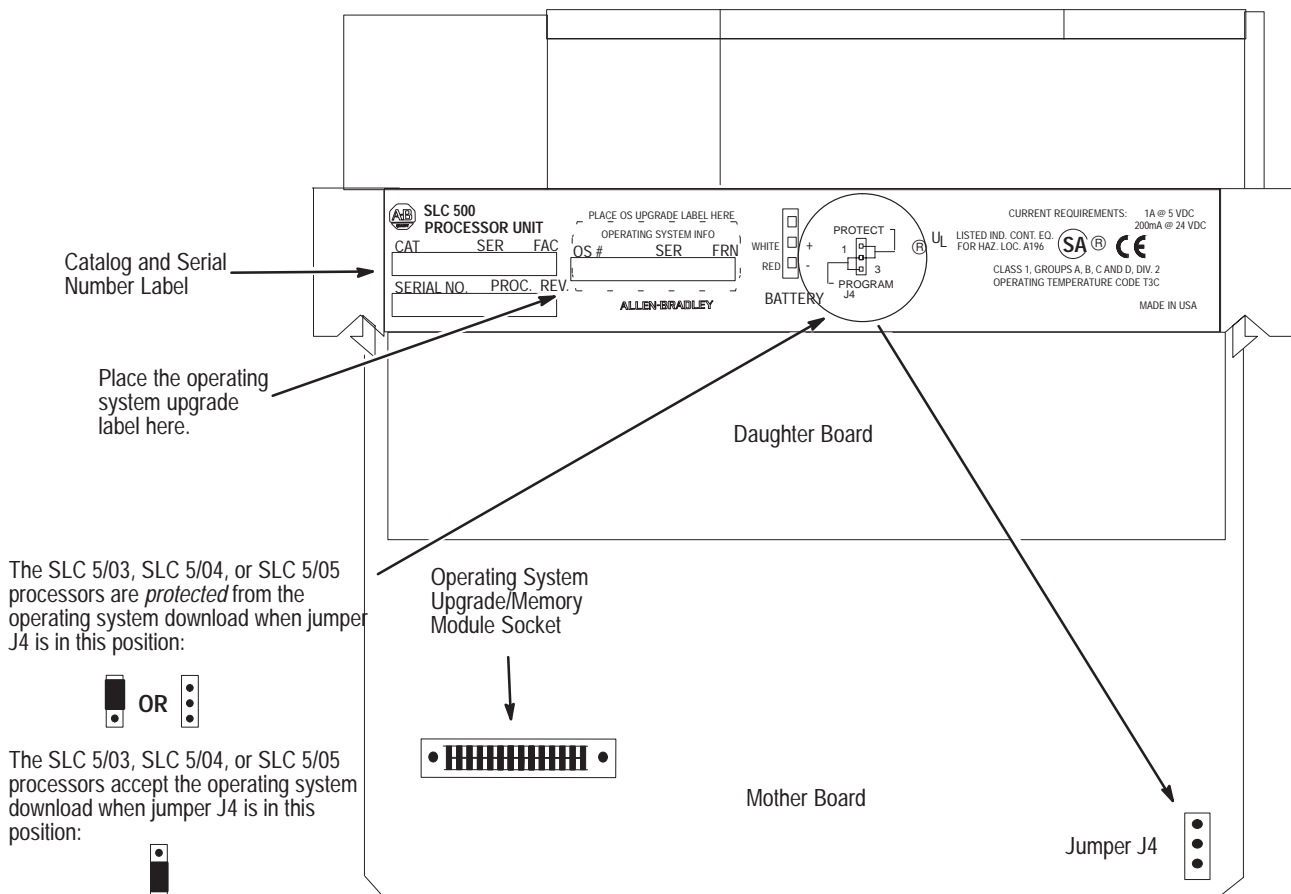
Installing Your Power Supply

If you have multiple chassis configurations, install the chassis interconnect cable before installing the power supply. (See page 6–10.) Also, the power supply terminals accept two #14 AWG wires and are marked as shown in the figure on page 6–8. To install the power supply, do the following:

1. Align the circuit board with the card guide on the left side of the chassis. Slide the power supply in until flush with the chassis.

19524
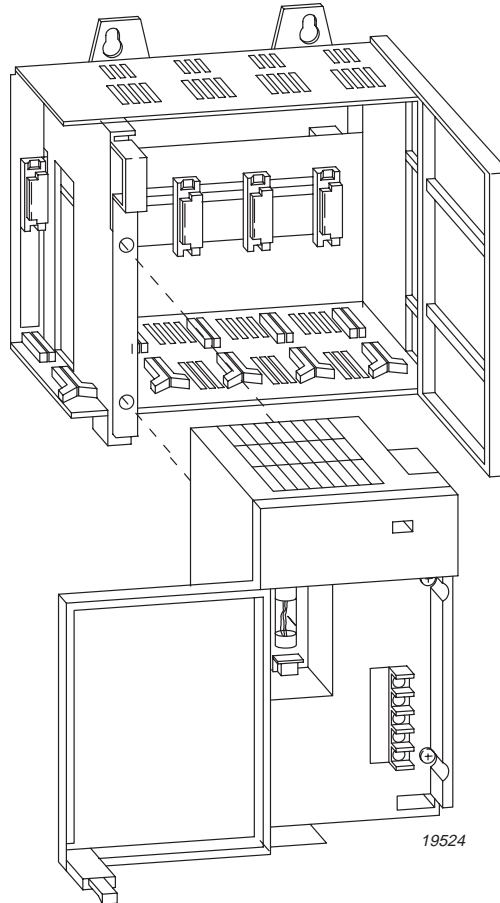
2. Fasten the power supply to the chassis with the two Phillips head screws.

3. Place the jumper to match the input voltage. (This does not apply to 1746-P3 or 1746-P5, which do not have a jumper.)

> ⚠ **ATTENTION:** Make jumper selection before applying power. Hazardous voltage is present on exposed pins when power is applied.
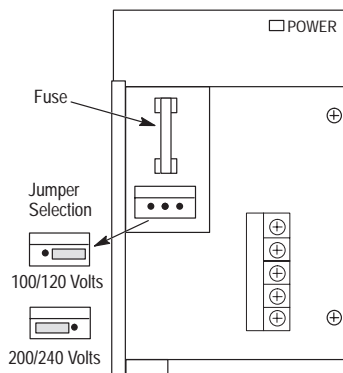
1746-P1 and -P2
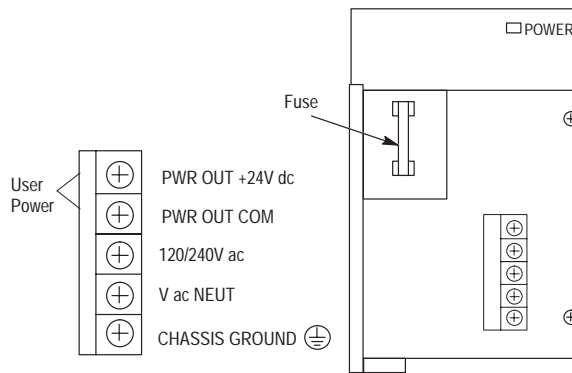
1746-P3
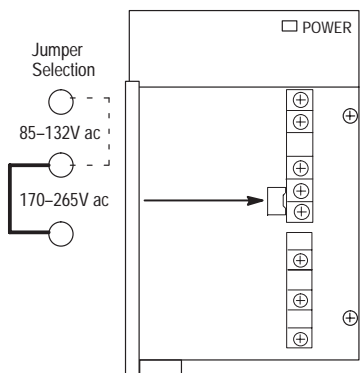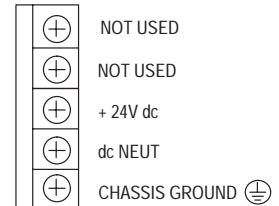
1746-P4
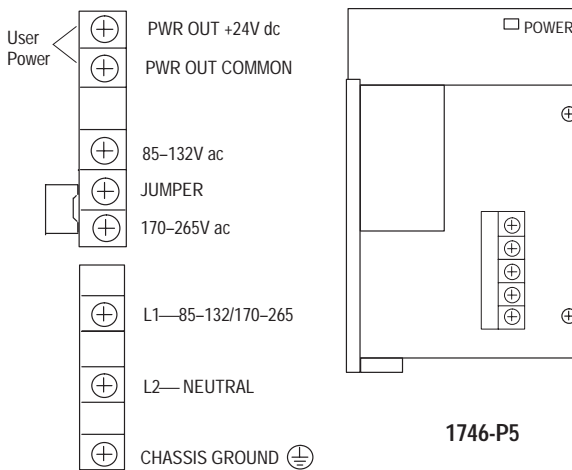
1746-P5
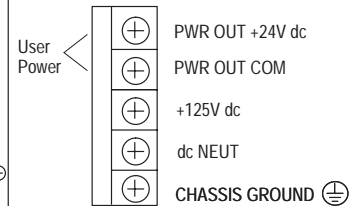
4. Remove the warning label from the top of the power supply.

5. Connect line power to the power supply.

⚠ **ATTENTION:** If you have a 1746-P3, see page 3–5 for special grounding considerations.

On the 1746-P1 and -P2 power supply, use the PWR OUT + 24 VDC and PWR OUT COM terminals to power sensors. The terminals provide an isolated, nonfused, 200 mA, 24V dc power supply.

Installing Your Chassis Interconnect Cable

Two cables are available to link modular hardware chassis. Catalog Number 1746-C7 cable is 152.4 mm (6 in.) in length and used when connecting chassis side-by-side. Catalog Number 1746-C9 is 914.4 mm (36 in.) in length and used to link one chassis below the other.

> ⚠ **ATTENTION:** Do not use any other cables than those provided. Longer cables could affect the integrity of data communications between the chassis, possibly causing unsafe operation. Also, make sure the cable is properly secured to protect against the effects of shock and vibration.

Install the chassis interconnect cable before installing the power supply in multiple chassis configurations.

The cables are "keyed" for proper installation. The end of the cable that plugs into the right socket in the chassis has the "key" on the top of the connector. The opposite end of the cable has the "key" on the inside of the connector for insertion into the expansion chassis.

To remove the cable, move the tabs on the socket outward and the connector pops out.

> ⚠ **ATTENTION:** The expansion cable must always exit the right end of the chassis with the processor. Refer to the following figures.
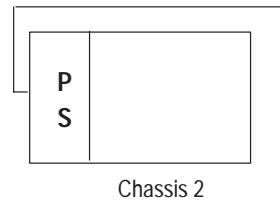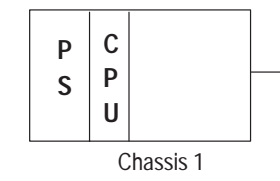
Chassis 1 / Chassis 2 — CORRECT INSTALLATION

Chassis 1 / Chassis 2 — INCORRECT INSTALLATION

Chassis 1 / Chassis 2 — INCORRECT INSTALLATION
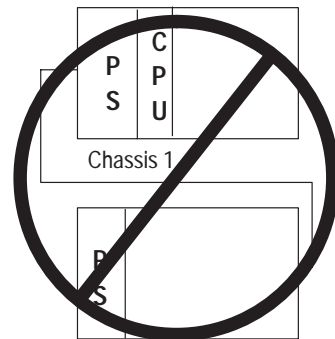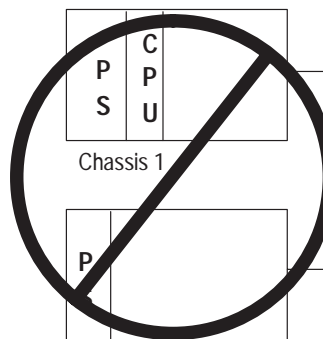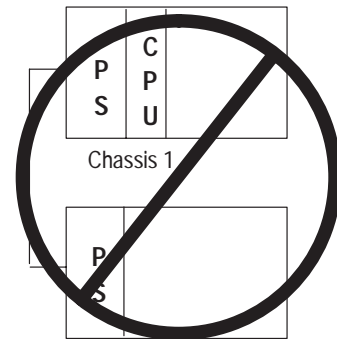
Chassis 1 / Chassis 2 — INCORRECT INSTALLATION

Wiring Your I/O Modules

This chapter describes how to wire your I/O modules. It covers the following:

- defining sinking and sourcing
- preparing your wiring layout
- features of an I/O module
- recommendations for wiring I/O devices
- wiring your I/O modules
- octal label kit installation
- using removable terminal blocks

Defining Sinking and Sourcing

Sinking and sourcing are terms used to describe a current signal flow relationship between field input and output devices in a control system and their power supply.

- Field devices connected to the positive side (+V) of the field power supply are sourcing field devices.
- Field devices connected to the negative side (DC Common) of the field power supply are called sinking field devices.

To maintain electrical compatibility between field devices and the programmable controller system, this definition is extended to the input/output circuits on the discrete I/O modules.

- Sourcing I/O circuits supply (source) current to sinking field devices.
- Sinking I/O circuits receive (sink) current from sourcing field devices.

Europe: DC sinking input and sourcing output module circuits are the commonly used options.

Contact Output Circuits — AC or DC

Relays can be used for either AC or DC output circuits and accommodate either sinking or sourcing field devices. These capabilities are a result of the output switch being a mechanical contact closure, not sensitive to current flow direction and capable of accommodating a broad range of voltages.

This high degree of application flexibility makes contact output modules very popular and useful in control environments with a broad mix of electrical I/O circuit requirements.

Solid-State DC I/O Circuits

The design of DC field devices typically requires that they be used in a specific sinking or sourcing circuit depending on the internal circuitry of the device. DC input and output field circuits are commonly used with field devices that have some form of internal solid state circuitry that need a DC signal voltage to function.

Sourcing Device with Sinking Input Module Circuit

The field device is on the positive side of the power supply between the supply and the input terminal. When the field device is activated, it sources current to the input circuit.
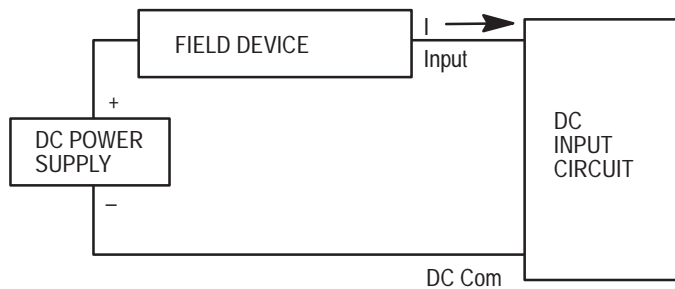
Sinking Device with Sourcing Input Module Circuit

The field device is on the negative side of the power supply between the supply and the input terminal. When the field device is activated, it sinks current from the input circuit.
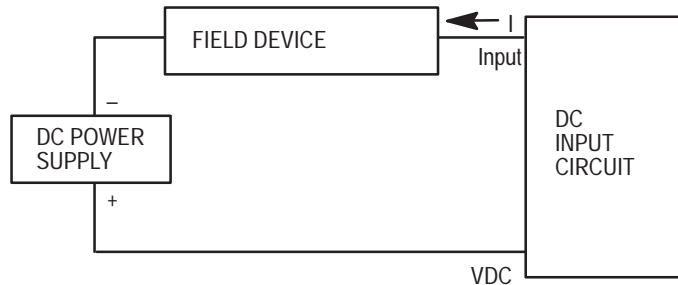
Sinking Device with Sourcing Output Module Circuit

The field device is on the negative side of the power supply between the supply and the output terminal. When the output is activated, it sources current to the field device.
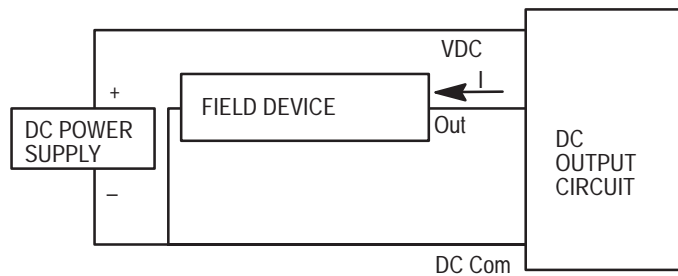
Sourcing Device with Sinking Output Module Circuit

The field device is on the positive side of the power supply between the supply and the output terminal. When the output is activated, it sinks current from the field device.
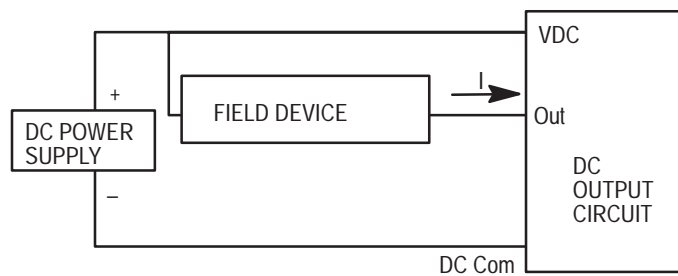
Preparing Your Wiring Layout

Careful wire routing within the enclosure helps to cut down electrical noise between I/O lines. Follow these rules for routing your wires:

- Route incoming power to the controller by a separate path from wiring to I/O devices. Where paths must cross, their intersection should be perpendicular.

    Important: Do not run signal or communications wiring and power wiring in the same conduit.

- If wiring ducts are used, allow for at least two inches between I/O wiring ducts and the controller. If the terminal strips are used for I/O wiring, allow for at least two inches between the terminal strips and the controller.

- Limit the cable length for the TTL input module to 15.24 m (50 ft) per point and 3.05 m (10 ft) per point for the TTL output module. Use low power DC I/O wiring even though it is less tolerant to electrical noise.

> ⚠ **ATTENTION:** Handle the TTL module by its ends, not metallic surfaces. Electrostatic discharges can damage the module. Do not expose the TTL module to electrostatic charges.

- Segregate I/O wiring by signal type. Bundle wiring with similar electrical characteristics together.

Wires with different signal characteristics should be routed into the enclosure by separate paths. Refer to *Allen-Bradley Programmable Controller Grounding and Wiring Guidelines*, Publication Number 1770-4.1.

> ⚠ **ATTENTION:** If the controller is being installed within a potentially hazardous environment (that is, Class I, Division 2), all wiring must comply with the requirements stated in the National Electrical Code 501-4 (b).

Recommendations for Wiring I/O Devices

The following are general recommendations for wiring I/O devices.

> ⚠ **ATTENTION:** Before you install and wire I/O devices, disconnect power from the controller and any other source to the I/O devices.

Use acceptable wire gauge — The I/O wiring terminals are designed to accept two wires per terminal (maximum) of the following size wire:

- *Europe:* 2mm^2 cross section or smaller
- *United States:* 14 AWG or smaller stranded wires

See diagram on page 7–6 for maximum torque values for wiring terminal screws and terminal block screws.

Label wires — Label wiring to I/O devices, power sources, and ground. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for DC I/O wiring and red for AC I/O wiring.

Secure wires — Route the wires down and away from the module, securing them with the cable tie.

Bundle wires — Bundle wiring for each similar I/O device together. If you use ducts, allow at least 5 cm (2 in.) between the ducts and the controller so there is sufficient room to wire the devices.

Identify terminals — Terminal cover plates have a write-on area for each terminal. Use this area to identify your I/O devices. Label the removable terminal block if you have not already.

> ⚠ **ATTENTION:** Calculate the maximum possible current in each power and common wire. Observe all local electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.
>
> Capacitors on input modules have a stored charge that can cause a non-lethal shock. Avoid mounting the controller in a position where installation or service personnel would be in danger from startle reaction.

Features of an I/O Module

Below is an example of a combination I/O module.

OUTPUT	INPUT

I/O Status Indicators

Color Band

Terminal Block Screw
max. torque = 0.6 Nm (5.3 in-lbs)

Input and Output Terminals
Connected to Terminal Block

Hinged Wiring Terminal Door
with Label

VAC–VDC

OUT 0

OUT 1

OUT 2

OUT 3

OUT 4

OUT 5

Terminal Block (May Be
color-coded and removable on
some modules.)

NOT
USED

Terminal Wiring
max. #14 AWG (2mm^2)
max. 2 wires per terminal
max torque = 0.9 Nm (8 in-lbs)

NOT
USED

IN 0

IN 1

IN 2

IN 3

IN 4

IN 5

Terminal Block Screw
max. torque = 0.6 Nm
(5.3 in-lbs)

NOT
USED

NOT
USED

AC COM

Tie Wire

Wires Leading to Output
and Input Devices

Wiring Your I/O Modules

Terminals on the modules have self-lifting pressure plates that accept 2 #14 AWG wires. Series B 12-point and 16-point and analog modules are equipped with removable terminal blocks for ease of wiring. The plug for the removable terminals is also color coded: red (AC), blue (DC), orange (relay), or green (specialty).

LED indicators on the front of each module display the status of each I/O point. The LED indicators illuminate when the proper signal to an input terminal is applied or when the processor commands an output to be energized.

To locate the I/O module wiring diagrams, contact your Allen-Bradley sales office for the latest product data entitled *Discrete Input and Output Modules,* Publication Number 1746-2.35. Or, locate the installation instruction sheet that was sent with your I/O module; it also includes I/O wiring diagrams.

1. Install a tie wire to secure your wiring and keep it neat. (If you feed the tie into one hole, it will be routed back out through the other.)

Tie Wire

Wires Leading to Output and Input Devices
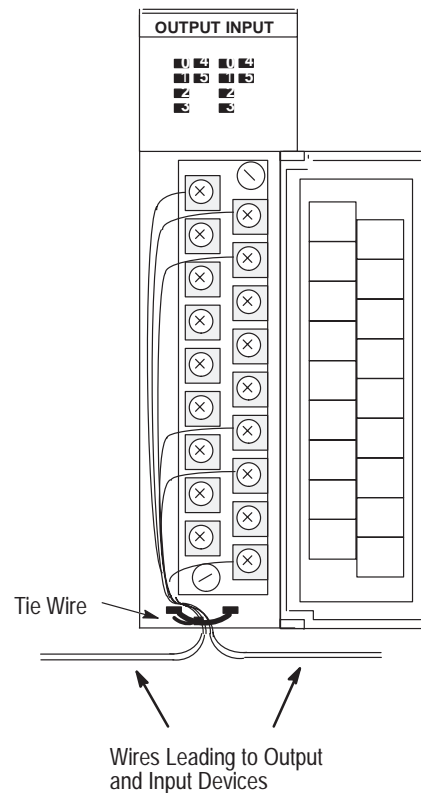
2. Cover any unused slots with card slot fillers (Catalog Number 1746-N2) to keep the chassis free from debris and dust.

Octal Label Kit Installation

The octal label kit consists of an octal filter label and a door label. Use these octal labels to replace the decimal labels that are attached to the I/O modules. An octal label kit is included with the I/O modules listed in the table on the following page. The kits can also be obtained through your Allen-Bradley distributor. (The octal label kit is applicable when using 1746 I/O with Allen-Bradley processors via a 1747-ASB Remote I/O Adapter.)

Applying the Octal Filter Label

1. Remove the octal filter label from its paper carrier.

2. Align the octal filter label numbers horizontally to the module color bar and over the decimal filter numbers, as shown in the illustration below.

3. Apply the octal label to the filter.

4. Press firmly to ensure proper adhesion of the label.

Applying the Octal Door Label

1. Remove the octal door label from its paper carrier.

2. Align it over the decimal door label on the inside of the door.

3. Press firmly to ensure proper adhesion of the label.

Module Color Bar   Decimal Filter Label   Octal Filter Label

INPUT

OCTAL

Octal Door Label

1746-XXXX   1746-XXXX (OCTAL)

Decimal Door Label
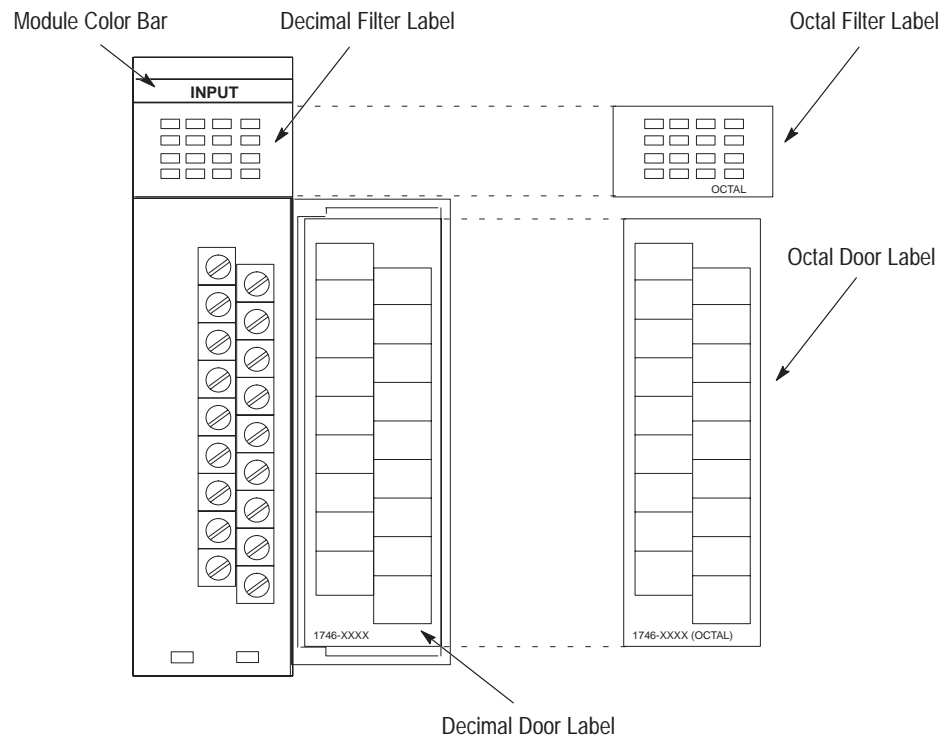
Octal Kit and I/O Module Information

Octal Kit Catalog Number (1746-)	Applies to I/O Module 1746-[1]
RL40	IA16
RL41	IB16
RL42	IG16
RL43	IM16
RL44	IN16
RL45	IV16
RL46	ITB16
RL47	ITV16
RL50	OA16
RL51	OB16
RL52	OG16
RL53	OV16
RL54	OW16
RL55	OBP16
RL56	OVP16
RL57	OAP12
RL58	IC16
RL59	IH16
RL60	IB32
RL61	IV32
RL70	OB32
RL71	OV32

[1] Kit available with series C I/O modules.

Using the Removable Terminal Block (RTB)

The Removable Terminal Block (RTB) is provided on all 12-point and 16-point discrete I/O modules and analog modules. They allow for faster and more convenient wiring of the I/O modules. The modules and the RTB are color-coded as follows:

Color	Type of I/O Removable Terminal Block
Red	AC inputs/outputs
Blue	DC inputs/outputs
Orange	relay outputs
Green	specialty modules

Replacement terminal blocks are available if they are lost or damaged. See the replacement part list in chapter 11.

Removing the RTB

Below are guidelines for removing the I/O Removable Terminal Block.

> ⚠ **ATTENTION:** Never install or remove I/O modules or terminal blocks while the SLC is powered.

1. If the I/O module is already installed in the chassis, remove power to the SLC.

2. Unscrew the upper right and lower left terminal block release screws.

3. Grasp the RTB with your thumb and forefinger and pull straight out.

4. Label the RTB with appropriate slot, rack (chassis) and module identification.

Terminal Block Release Screw

Terminal Block Release Screw

Dot indicates terminal number 0 (or top of I/O wiring).

SLOT_____RACK_____
–
● MODULE_____
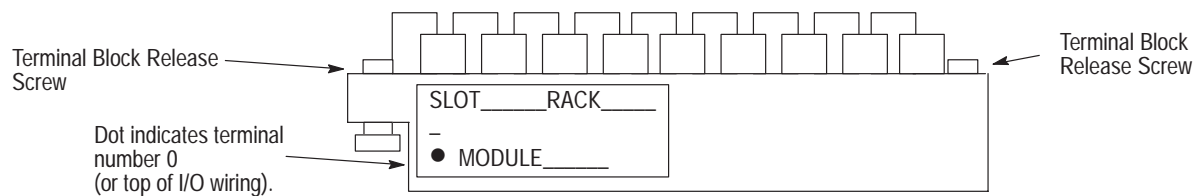
Installing the RTB

Below are guidelines for installing the RTB.

1. Be sure the color of the RTB matches the color band on the module.

> ⚠ **ATTENTION:** Inserting a wired RTB on an incorrect module can damage the module circuitry when power is applied.

2. Write the appropriate slot, chassis, and module type on the RTB label.

> ⚠ **ATTENTION:** Disconnect power before attempting to install or remove I/O modules or their terminal blocks.

3. Disconnect power.

4. Align the terminal block release screws with the mating connector in the module.

5. Press the RTB firmly onto the connector contacts.

6. Tighten the terminal block release screws. To avoid cracking the terminal block, alternate the tightening of the screws.

Terminal Block Release Screws
Maximum Torque=0.7–0.9 Nm
(6–8 in./lbs.)
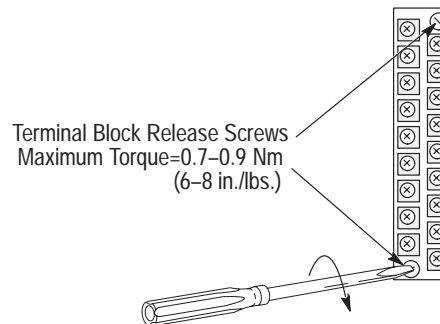
Starting Up Your Control System

This chapter describes how to start up your control system. To accomplish this, you must go through eight procedures.

Procedures for Starting Up the Control System

Start-up involves the following procedures to be carried out in sequence:

1. Inspect your installation.

2. Disconnect motion-causing devices.

3. Initialize and test your processor.

4. Test your inputs.

5. Test your outputs.

6. Enter and test your program.

7. Observe control motion.

8. Conduct a dry run of your application.

These procedures isolate problems such as wiring mistakes, equipment malfunction, and programming errors in a systematic, controlled manner.

We urge you to go through these procedures very carefully. This will help you avoid possible personal injury and equipment damage.

Important: Do not attempt system start-up until you are thoroughly familiar with the controller components and programming/editing techniques. You must also be thoroughly familiar with the particular application.

For general recommendation concerning installation safety requirements and safety requirements and safety related work practices, refer to the requirements specific to your region.

- *Europe:* Reference the standards found in EN 60204 and your national regulations.
- *United States:* refer to NFPA 70E, *Electrical Safety Requirements for Employee Workplaces.*

1. Inspect Your Installation

You can often prevent serious problems in later test procedures by first making a thorough physical inspection. We recommend that you do the following:

1. Make sure that the controller and all other devices in the system are securely mounted.

2. Check all wiring including:

- connections from the main disconnect to the controller input
- the master control relay/emergency-stop circuit
- input device circuits
- output device circuits

Make certain that all wiring connections are correct and that there are no missing wires. Check the tightness of all terminals to make certain wires are secure.

3. Measure the incoming line voltage. Be certain that it corresponds to controller requirements and that it falls within the specified voltage range. See specifications for input voltage ranges on page 2–11.

2. Disconnect Motion-causing Devices

In the following test procedures, the controller is energized. As a safety precaution, you must make certain that machine motion does not occur. The preferred way is to disconnect the motor wires at the motor starter or the motor itself. In this way, you can test the operation of the starter coil, verifying that your output circuit is wired correctly and functioning. Similarly, the preferred way to disconnect a solenoid is to disengage the valve, leaving the coil connected.

In some instances, you may not be able to disconnect a device the preferred way. In this case, it is necessary to open the output circuit at some convenient point.

For circuit testing purposes, it is best to open the circuit at a point as close as possible to the motion-causing device. For example, your output might be a relay coil that in turn energizes a motor starter; if it is impractical to disconnect the motor wires, the next best thing to do is to open the circuit at a point between the motor starter and the relay contact.

> ⚠️ **ATTENTION:** Machine motion during system checkout can be hazardous to personnel. During the checkout procedures 3, 4, 5, and 6, you must disconnect all devices that, when energized, might cause machine motion.

3. Initialize and Test Your Processor

When you are certain that machine motion cannot occur with the controller energized, you may begin by initializing the processor using the following steps.

1. Energize the chassis power supply. If power is supplied to the controller and the installation is correct, the initial factory conditions for all processors will be:

- Processor Name = "DEFAULT"
- Mode = Program Mode or Fault Mode
  (S:1/0 - S:1/4 = 0 0001) or (S:1/0 - S:1/4 = 0.0001 and S:1/13 = 1)
- Watchdog values = 100 ms
  (S:3H = 0000 1010)
- I/O Slot enables = ALL ENABLED
  (S:11/1 through S:12/14 set to 1)
- Node address = 1 (channel 1 = DH485)
  (S:15L = 0000 0001)
- Baud Rate = 19.2K baud (channel 1 = DH485)
  (S:15H = 0000 0100)
- *SLC 5/03, SLC 5/04, and SLC 5/05 only:*
  channel 0 configuration:
  > DF1 Full Duplex
  > No Handshaking
  > 1200 Baud (SLC 5/05 – 19.2K Baud)
  > CRC Error Check
  > Duplicate Detect On
  > No Parity
- *SLC 5/04 only:* channel 1 configuration:
  > DH+
  > 57.6K Baud
  > default node address = 1
- *SLC 5/05 only:* channel 1 configuration:
  > Ethernet[1]
  > 10 Mbps

[1] Configuring with BOOTP enabled so that a BOOTP server on the network can automatically provide the SLC 5/05 with the configuration necessary to start communicating over Ethernet. See Appendix G for more information.

> **⚠ ATTENTION:** These steps are covered more extensively in your programming software and Hand-Held Terminal user manuals. Reference these manuals if you have a problem completing one of the steps.

2. Power up the programming device.

3. Configure the controller.

4. Name the program. (Becomes the processor name when downloaded.)

5. Program a sample test rung not affecting machine operation.

6. Save the program and controller configuration.

7. Transfer the controller configuration and sample test program to the processor. After the new program is transferred to the processor, the CPU FAULT LED should clear. The CPU FAULT (or "FLT" on the SLC 5/03, SLC 5/04, and SLC 5/05) LED stops if it was flashing.

8. Enter the Run mode.

   The processor RUN status LED should turn on indicating the controller is in the Run mode with no CPU faults. If any other CPU status exists, refer to chapter 9 for recommended action.

9. Monitor and exercise simple test rung.

   If a simple test rung operates successfully without CPU faults, you may assume basic processor functions are properly functioning. If any other processor status exists, refer to chapter 10 for recommended action.

4. Test Your Inputs

After successful processor initialization and test, you may begin testing inputs following these steps:

1. Assuming you are still online with the programming device, put the controller into the Continuous Scan Test mode. This allows the processor to scan the I/O and program, but not turn on any physical outputs.

2. Monitor the data in data File 1, the input data file. All configured Inputs should be displayed.

3. Make sure the first input slot, whatever slot number that may be, is shown on the monitor.

4. Select the first input device connected to the first input terminal on the input module in the I/O chassis.

5. Manually close and open the addressed input device.

> **ATTENTION:** Never reach into a machine to actuate a device, unexpected machine operation could occur.

6. Observe the associated bit status using the programming device monitor function. Also, observe input status LED.

   A. When the input device is closed and the signal power is at the input terminal, the associated status bit is set to a one, and the input status LED should turn on.

   B. When the input device is opened and signal power does not exist at the input terminal, the associated status bit is set to a 0, and the input status LED should go off.

7. If associated bit status and input status LED match input device status, select the next input device and repeat steps 5 and 6 until all inputs in the SLC 500 chassis have been tested.

   If associated bit status and input status LED does not match the input device status, follow the recommended troubleshooting steps listed in chapter 10.

Input Troubleshooting Steps

1. Make sure the processor is in the Continuous Scan Test mode.

2. If associated bit status and LED status do not match the input device status, check status file S:11 and S:12 I/O slot enables. Bits S:11/0 through S:11/15 and S:12/0 through S:12/14 should all be one, enabling all I/O slots for the modular system.

3. Verify proper control power to the input device.

4. Remove the input device power and make sure circuit terminations are properly wired and tightened.

5. Re-energize the input device power and check for proper control voltage between the input terminal and signal common terminal.

6. If proper input control voltage does not exist, first check minimum signal common by verifying voltage between input device power source and the input common terminal.

7. If proper input voltage does exist, first check the minimum input current specification on the input module and then measure the current in the input circuit. Replace the input module if necessary.

8. If the input modules check out "OK" and proper voltage is measured between input device source and input module common terminal, test the input device and replace if necessary.

For more information on input troubleshooting see page 10–26.

5. Test Your Outputs

After you test all inputs, and have determined that they are functioning properly, test the outputs following these steps:

1. Refer to page 8–2 to insure no motion will occur when any controller output is energized.

2. Place the controller in the Program mode.

3. Create an output test rung as shown below for each output module configured.

```
                                        ┌─ MOV ──────────────┐
 ──┤ │────────────────────────────────  │  SOURCE B3: "XX"   │ ──────────
    │ │                                  │                    │
    │ │                                  │  DEST O0: "XX". "Y" │
                                        └────────────────────┘
```
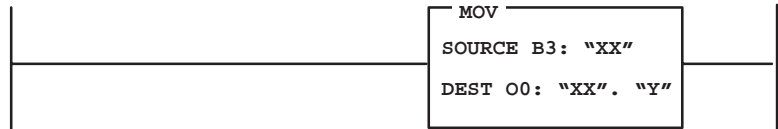
Let "XX" represent slot number of the output currently selected. "Y" represents output word identifier. This rung moves a word of data from the bit file to the output file.

4. Save the output test program and current controller configuration.

5. Transfer the output test program to the processor.

6. Put the controller in the Run mode.

7. Monitor the data in data file B3 on the programming device display.

8. Enter B3: "XX" at address prompt to select the output to be tested. "XX" represents the output slot number.

9. Enter 1 at data prompt for the address that corresponds to the bit in the output word.

10. Observe the output status LED and the output device.

    The output status LED should turn on. The output device should be energized (unless you disconnected it to prevent machine motion).

11. Reset the data value back to zero for selected address and both the output status LED and output device should de-energize.

12. If the status LED and the output device correspond to data settings in steps 10 and 11, repeat steps 8 through 11 for each output.

    If the status LEDs and output device states do not correspond to the data settings in steps 9 and 11, follow the recommended output troubleshooting steps in the next section.

Output Troubleshooting Steps

1. Make sure the processor is in the Run mode.

2. Verify proper addressing of the output test rung from the previous page.

3. By using a programming device, locate the output data file and bit data file. See if the status of the associated bits between these files match.

4. If the status of the bits match in step 3, and if the status of the output LED match the status of the bits, *but* the status of the output device is different, continue to step 5.

If the output status LED does not match associated bit status, check status file S:11 and S:12 I/O slot enables. Bits S:11/0 through S:11/15 and S:12/0 through S:12/14 should all be 1 enabling all I/O slots for the modular system.

If the output slot enable was verified, then try exchanging the output module under test with identical hardware and retest. If the new hardware works properly, replace the original.

5. Verify proper output voltage at the output terminal and then at the output device.

6. De-energize output circuit and check all output circuit terminations and wire routes.

7. If proper output voltage does not exist at output device and power source is adequate to drive output device, test the output device and replace if necessary.

For more information on output troubleshooting, see page 10–28.

6. Enter and Test Your Program

After you test all inputs and outputs and they are functioning properly, we recommend the following steps to safely and successfully enter and test your specific application program. (For extra assistance, see the *Hand-Held Terminal User Manual* or your programming software user manual.)

1. Verify the offline program.

   After the program has been entered in the offline edit file mode, program verification may begin.

   Remaining in the offline edit file mode you may use the cursor keys and/or search function of your programming device to inspect every instruction and rung for errors.

2. Check your written program, rung for rung, against the program entered into the offline memory. The most common errors found in program entry are:
   - incorrect addressing of instructions
   - omission of an instruction
   - more than one output instruction programmed using the same address

3. Transfer the program into the processor:

   A. Place your programming device online.

   B. Place the processor into Program mode.

   C. Select the download function when using the Hand-Held Terminal or the restore function when using your programming software.

4. Verify the online program transfer:

   A. Select monitor file function.

   B. Cursor through the program to verify that you selected the right program.

5. Conduct a single-scan program test:

   A. Select the monitor file function and place cursor on first rung.

   B. Select the Test mode.

   C. Select Single-Scan (SSN) test. In this test mode, the processor executes a single operating cycle, which includes reading the inputs, executing the ladder program, and updating all data without energizing the output circuits. However, the monitor file function will identify output status as if they were enabled.

   Timers are also incremented a minimum of 10 milliseconds each single scan.

D. Simulate the input conditions necessary to execute the current monitored rung of the program. If it is not practical to manually activate the input device, use the force function to simulate the proper condition.

> ⚠ **ATTENTION:** Never reach into a machine to actuate a device, unexpected machine operation could occur.

E. Activate a single operating scan as outlined in the programming device user manual.

F. Verify the intended effects on the output instructions for that rung and overall program logic effects.

G. Select the next program rung and repeat test procedures as listed above until the entire program has been tested.

6. Conduct a continuous scan program test.

Once the individual single scan rung tests have been completed and proper program operation verified, a continuous scan test is appropriate before motion checkout.

The mode simulates the controller Run mode without energizing the external outputs.

Use the following steps to further verify proper program and system function operation.

A. Remain or return to an online condition with the processor.

B. Monitor the file.

C. Select Test mode.

D. Select the Continuous Scan test.

E. Simulate the input conditions necessary to execute system functions.

F. Verify the intended operation of each system function and the effects of other system functions.

> ⚠ **ATTENTION:** Never reach into a machine to actuate a device, unexpected machine operation could occur.

7. Observe Control Motion

Now that program execution has been verified, checkout of control motion can begin. All persons involved with the programming, installation, layout design, machine or process design and maintenance should be involved in making decisions for determining the best and safest way to test the total system.

The following procedures are general in nature. Individual conditions may warrant their modification. The basic approach is to initiate testing with the least amount of machine motion. Only some outputs are allowed to generate machine motion. Then additional machine motion can be gradually added, thereby allowing any problems to be detected more easily under controlled conditions. The following procedure provides the steps for testing machine motion using one output at a time.

> ⚠️ **ATTENTION:** During all phases of checkout, station a person ready to operate an emergency-stop switch if necessary. The emergency-stop switch will de-energize the master control relay and remove power from the machine. This circuit must be hardwired only, it *must not* be programmed.

Use the following procedures:

1. Identify the first output device to be tested and reconnect its wiring.

> ⚠️ **ATTENTION:** Contact with AC line potential may cause injury to personnel. When reconnecting wiring, make sure that the AC power disconnect switch is opened.

2. Place the controller in the Run mode and observe the behavior of the output device. To do this, simulate the input conditions necessary to energize the output in the program. If it is not practical to manually activate an input device, use the force function to simulate the proper input condition.

> ⚠️ **ATTENTION:** Never reach into a machine to actuate a device, unexpected machine operation could occur.

3. Repeat steps 1 and 2, testing each output device, one at a time.

8. Conduct a Dry Run

⚠️ **ATTENTION:** During all phases of checkout, station a person ready to operate an emergency-stop switch if necessary. The emergency-stop switch will de-energize the master control relay and remove power from the machine. This circuit must be hardwired only, it *must not* be programmed.

After thoroughly checking out the controller system and program, proceed with a dry run of the application with all of the output devices enabled. This dry run will vary with the application. A machine tool dry run would test the program with all outputs enabled but without tooling an actual part.

After you check out the entire system, and your dry run has been completed satisfactorily, we recommend that you load your program into an EEPROM memory module for back-up program storage. Refer to the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software's user manual for directions on loading the EEPROM from RAM.

This step completes start-up procedures. Your SLC programmable controller is now ready for operation.

Maintaining Your Control System

This chapter covers the following maintenance issues:

- handling and storing battery, Catalog Number 1747-BA
- installing and replacing the battery of the SLC 5/01 or SLC 5/02 processor
- replacing your SLC 5/03, SLC 5/04, and SLC 5/05 battery
- replacing retainer clips on an I/O module
- replacing a fuse on the power supply

See page 3–12 for important information on testing the Master Control Relay Circuit and Preventive Maintenance.

Handling and Storing Battery, Catalog Number 1747-BA

Follow the procedure below to ensure proper battery operation and reduce personnel hazards.

Handling

- Use only for the intended operation.
- Do not ship or dispose of cells except according to recommended procedures.
- Do not ship on passenger aircraft.

> ⚠ **ATTENTION:** Do not charge the batteries. An explosion could result or the cells could overheat causing burns.
>
> Do not open, puncture, crush, or otherwise mutilate the batteries. A possibility of an explosion exists and/or toxic, corrosive, and flammable liquids would be exposed.
>
> Do not incinerate or expose the batteries to high temperatures. Do not attempt to solder batteries. An explosion could result.
>
> Do not short positive and negative terminals together. Excessive heat can build up and cause severe burns.

Storing

Store the lithium batteries in a cool, dry environment, typically +20° C to +25° C (+68° F to +77° F) and 40% to 60% relative humidity. Store the batteries and a copy of the battery instruction sheet in the original container, away from flammable materials.

Transporting

One or Two Batteries — Each battery contains 0.23 grams of lithium. Therefore, up to two batteries can be shipped together within the United States without restriction. Regulations governing shipment to or within other countries may differ.

Three or More Batteries — Procedures for the transportation of three or more batteries shipped together within the United States are specified by the Department of Transportation (DOT) in the Code of Federal Regulations, CFR49, "Transportation." An exemption to these regulations, DOT - E7052, covers the transport of certain hazardous materials classified as flammable solids. This exemption authorizes transport of lithium batteries by motor vehicle, rail freight, cargo vessel, and cargo-only aircraft, providing certain conditions are met. Transport by passenger aircraft is not permitted.

A special provision of DOT-E7052 (11th Rev., October 21, 1982, par. 8-a) provides that:

> "Persons that receive cell and batteries covered by this exemption may reship them pursuant to the provisions of 49 CFR 173.22a in any of these packages authorized in this exemption including those in which they were received."

The Code of Federal Regulations, 49 CFR 173.22a, relates to the use of packaging authorized under exemptions. In part, it requires that you must maintain a copy of the exemption at each facility where the packaging is being used in connection with shipment under the exemption.

Shipment of depleted batteries for disposal may be subject to specific regulation of the countries involved or to regulations endorsed by those countries, such as the IATA Restricted Articles Regulations of the International Air Transport Association, Geneva, Switzerland.

Important: Regulations for transportation of lithium batteries are periodically revised.

⚠ **ATTENTION:** Do not incinerate or dispose of lithium batteries in general trash collection. Explosion or violent rupture is possible. Batteries should be collected for disposal in a manner to prevent against short circuiting, compacting, or destruction of case integrity and hermetic seal.

For disposal, batteries must be packaged and shipped in accordance with transportation regulations, to a proper disposal site. The U.S. Department of Transportation authorizes shipment of "Lithium batteries for disposal" by motor vehicle only in regulation 173.1015 of CFR 49 (effective January 5, 1983). For additional information contact:

> U.S. Department of Transportation
> Research and Special Programs Administration
> 400 Seventh Street, S.W.
> Washington, D.C. 20590

Although the Environmental Protection Agency at this time has no regulations specific to lithium batteries, the material contained may be considered toxic, reactive, or corrosive. The person disposing of the material is responsible for any hazard created in doing so. State and local regulations may exist regarding the disposal of these materials.

For a lithium battery product safety data sheet, contact the manufacturer:

> Sanyo Energy Corporation
> 600 Supreme Drive
> Bensenville, Il 60106

Installing and Replacing the Battery of the SLC 5/01 or SLC 5/02 Processor

Back-up power for RAM is provided by a replaceable battery. The lithium battery provides back-up for approximately five years for the 1747-L511 and two years for the 1747-L514 and 1747-L524. A red BATTERY LOW LED alerts you when the battery voltage has fallen below a threshold level.

Once the BATTERY LOW LED goes on, do *not* remove processor power or   your program may be lost. Replace the battery as soon as possible. You can replace the battery while the processor is powered.

For battery installation or replacement do the following:

1. Open the door of the processor.

2. If you are:

    installing a battery in a new processor (battery never installed before), remove the jumper from the battery connector socket. Store the jumper in safe place for possible future use without the battery.

    replacing an old battery, unplug the existing battery connector and remove from the retainer clips. The figure below shows where to install the battery in a SLC 5/01 or SLC 5/02 processor.

3. Insert a new or replacement battery in the holder making sure it is held in by the retainer clips.

4. Plug the battery connector into the socket. See the figure below.
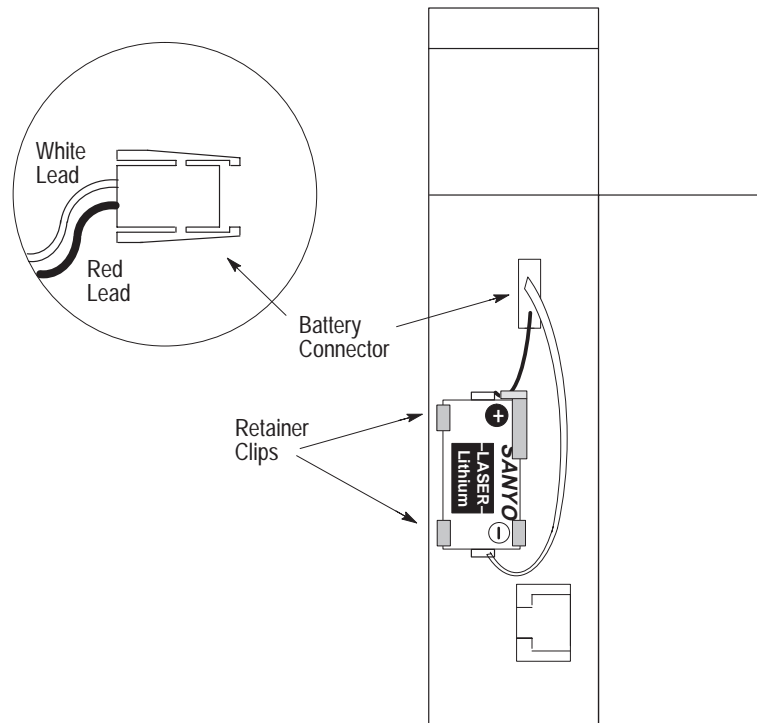
5. Close the processor door.

Replacing Your SLC 5/03, SLC 5/04, or SLC 5/05 Battery

Your SLC 5/03, SLC 5/04, or SLC 5/05 processor provides back-up power for RAM through a replaceable lithium battery. This battery provides back-up for approximately 2 years. A BATT LED on the front of the processor alerts you when the battery voltage has fallen below a threshold level.

To replace the lithium battery follow these steps:

> ⚠ **ATTENTION:** Do not remove the processor from the SLC 500 chassis until all power is removed from the SLC 500 power supply.

1. Remove power from the SLC 500 power supply.

2. Remove the processor from the chassis by pressing the retainer clips at both the top and bottom of the module and slide it out.

> ⚠ **ATTENTION:** Do not expose the processor to surfaces or other areas that may typically hold an electrostatic charge. Electrostatic charges can alter or destroy memory.

3. Unplug the battery connector. Refer to the figure below for battery connector location.

Battery

Red   White

Battery Connector

Left Side View
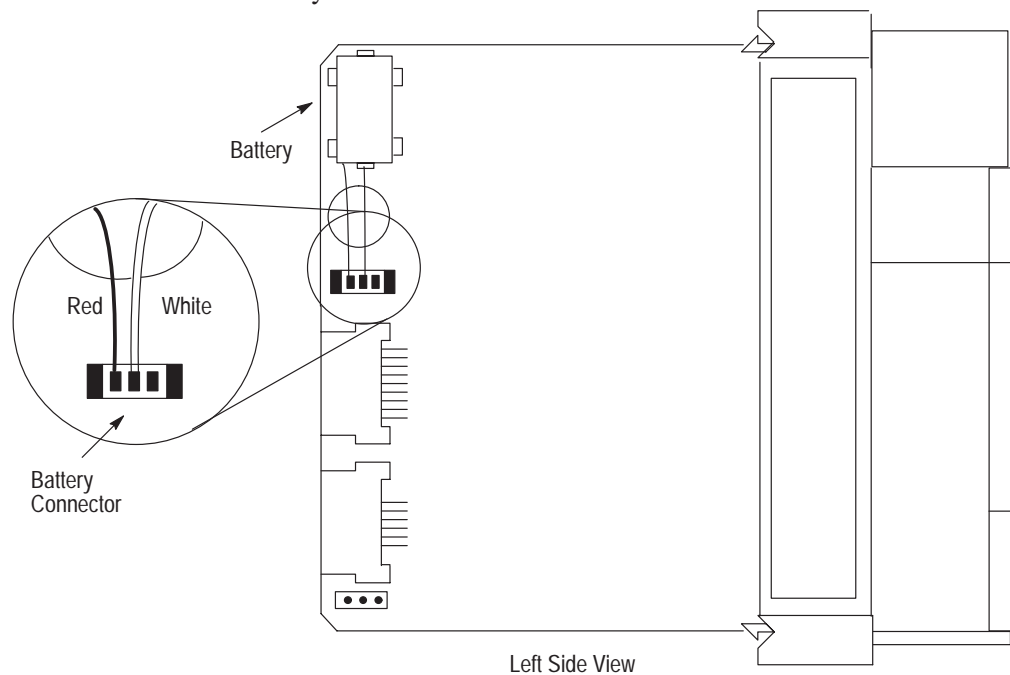
Important: The SLC 5/03, SLC 5/04, and SLC 5/05 processors have a capacitor that provides at least 30 minutes of battery back-up while the battery is disconnected. Data in RAM is not lost if the battery is replaced within 30 minutes.

4. Remove the battery from the retaining clips.

5. Insert a new battery into the battery retaining clips.

6. Plug the battery connector into the socket as shown in the figure on page 9–5.

7. Re-insert the module into the SLC 500 chassis.

8. Restore power to the SLC 500 power supply.

Replacing Retainer Clips on an I/O Module

If it becomes necessary to replace the retainer clip (also called self-locking tab), order Catalog Number 1746-R15 (4 per package)
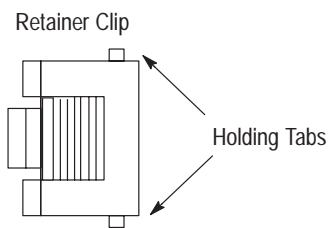
Removing Damaged Retainer Clips

If necessary, pry off the broken retainer clip from the bottom with a screwdriver. Do not twist it off. You can damage the module.
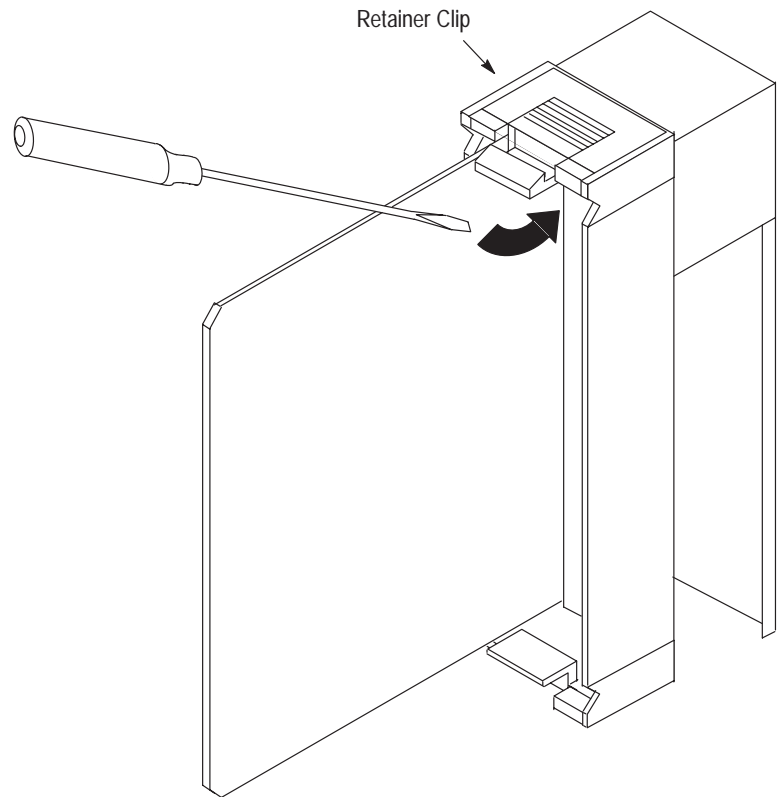
Retainer Clip

Installing New Retainer Clips

Insert one of the pins of the retainer clip into the hole in the I/O module and then snap the other end in place.

Replacing a Fuse on the Power Supply

To replace a fuse on the power supply (except for the 1746-P4 which does not have a replaceable fuse), do the following:

1. Remove power from the SLC 500 power supply.

2. Open the door on the power supply and use a fuse puller to remove the fuse.

> ⚠️ **ATTENTION:** Use only replacement fuses of the type and rating specified for the unit. Improper fuse selection can result in equipment damage.

3. Install a replacement fuse. See page 2–11 for replacements. See the figure below for fuse placement.
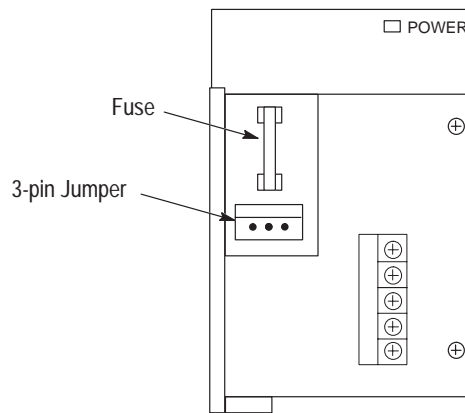
> ⚠️ **ATTENTION:** The exposed pin on the 3-pin jumper is electrically live. Contact with the pin may cause injury to personnel.

Troubleshooting

In this chapter, you will learn about:

- calling Allen-Bradley for assistance
- tips for troubleshooting your control system
- troubleshooting the SLC 5/01 and SLC 5/02 processors
- troubleshooting the SLC 5/03, SLC 5/04, and SLC 5/05 processors
- troubleshooting your input modules
- troubleshooting your output modules

Calling Allen-Bradley for Assistance

If you need to contact Allen-Bradley or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- processor type, series letter, operating system (OS) number (obtained from the status file), firmware (FRN) number (see label on side of processor module)
- processor LED status
- processor error codes (found in S:6 of status file)
- hardware types in system (I/O modules, chassis)
- revision of programming device (on the main menu of the Hand-Held Terminal or programming software)

Tips for Troubleshooting Your Control System

When troubleshooting, pay careful attention to these general warnings:

> ⚠ **ATTENTION:** Have all personnel remain clear of the controller and equipment when power is applied. The problem may be intermittent and sudden unexpected machine motion could result in injury. Have someone ready to operate an emergency-stop switch in case it becomes necessary to shut off power to the controller equipment. Also, see NFPA 70E Part II for additional guidelines for safety related work practices.
>
> Never reach into a machine to actuate a switch since unexpected machine motion can occur and cause injury.
>
> Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/outputs causing machine motion.

If installation and start-up procedures detailed in chapters 6, 7, and 8 were followed closely, your SLC controller will give you reliable service. If a problem should occur, the first step in the troubleshooting procedure is to identify the problem and its source.

The SLC 500 controller has been designed to simplify troubleshooting procedures. By observing the diagnostic indicators on the front of the power supply, processor unit and I/O modules, the majority of faults can be located and corrected. These indicators, along with error codes identified in the programming device user manual and programmer's monitor, help trace the source of the fault to the user's input/output devices, wiring, or the controller.

Removing Power

Before working on a SLC 500 modular system, always remove the power supply input power at the main power disconnect switch.

The power LED on the power supply indicates that DC power is being supplied to the chassis. The LED could be off when incoming power is present.

Replacing Fuses

When replacing a fuse, be sure to remove all power from the system.

Program Alteration

There are several causes of alteration to the user program, including extreme environmental conditions, Electromagnetic Interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect the memory has been altered, check the program against a previously saved program on an EEPROM, UVPROM or Flash EPROM module.

Troubleshooting the SLC 5/01 and SLC 5/02 Processors

To receive the maximum benefit of this troubleshooting section, we recommend you follow these steps:

1. Identify the status of your processor LEDs. See chapter 5 for a description of LEDs and their different states.

2. Using the tables on the following pages, match your processor and power supply LEDs with the status LEDs located in the first column.

3. Once the status LEDs are matched to the appropriate table, simply move across the table identifying error description and probable causes.

4. Follow the recommended action steps for each probable cause until the error is corrected.

5. If recommended actions do not correct the error, contact your local Allen-Bradley sales office or distributor.

Identifying SLC 5/01 and SLC 5/02 Processor Errors

The following LEDs and tables provide you with information regarding error messages, possible cause(s) for the error, and recommended action to take to resolve the error.

If the LEDs indicate:[1]

```
┌─────────────────────────────────┐
│ ┌─┐          ┌─┐    ┌ ┐         │
│ └─┘ POWER    └─┘ RUN └ ┘ COMM   │
│              ┌─┐ CPU FAULT      │
│              └─┘                │
│              ┌─┐ FORCED I/O     │
│              └─┘                │
│              ┌─┐ BATTERY LOW    │
│              └─┘                │
│                                 │
```

The Following Error Exists	Probable Cause	Recommended Action
Inadequate System Power	No Line Power	**1.** Verify proper line voltage and connections on the power terminals. **2.** Verify proper 120/240V power supply jumper selection. See page 6–8.
	Power Supply Fuse Blown	**1.** Check the incoming power fuse, check for proper incoming power connections. Replace fuse. **2.** If fuse blows again, replace the power supply. See page 9–8 on fuse replacement.
	Power Supply Overloaded	**1.** Remove line power to power supply. Remove several output modules from the chassis. Wait five minutes. Reapply power. **2.** If condition reoccurs, re-calculate module configuration power required and verify proper power supply selection. See page 2–11. This problem can occur intermittently if power supply is slightly overloaded when output loading and temperature varies.
	Defective Power Supply	**1.** Recheck other probable causes. **2.** Monitor the line power to chassis power supply for possible transient or shorting. **3.** Replace the power supply.

If the LEDs indicate:[1]

```
┌─────────────────────────────────┐
│ ┌─┐          ┌─┐    ┌ ┐         │
│ └─┘ POWER    └─┘ RUN └ ┘ COMM   │
│              ■ CPU FAULT        │
│              ┌─┐ FORCED I/O     │
│              └─┘                │
│              ┌─┐ BATTERY LOW    │
│              └─┘                │
│                                 │
```

The Following Error Exists	Probable Cause	Recommended Action
Inadequate System Power	Improper Line Power Voltage Selection	Verify proper 120/240V power supply jumper selection. See page 6–8.

Refer to the following key to determine the status of the LED indicators:

☐	Indicates the LED is OFF.
■	Indicates the LED is ON.
▨	Indicates the LED is FLASHING.
⋯	Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

If the LEDs indicate: [1]

POWER	☐ RUN	⸨ ⸩ COMM
	☐ CPU FAULT	
	☐ FORCED I/O	
	☐ BATTERY LOW	

The Following Error Exists	Probable Cause	Recommended Action
Processor Not in Run Mode	Either Improper Mode Selected or User Program Logic Error	**1.** Verify selected processor mode. **2.** If in program/test modes attempt Run mode entry. **3.** If in suspend mode, check user program logic for suspend instructions. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual.
	Line Power Out of Operating Range	**1.** Check proper 120/240V power supply jumper selection and incoming power connections. **2.** Monitor for proper line voltage at the incoming power connections. See page 6–8 for power supply installation.
	Improper Seating of Power Supply, and/or Processor in the Chassis	**1.** Remove power and inspect the power supply chassis connections and the processor chassis connections. **2.** Re-install the devices and re-apply power. **Important:** The processor only operates in slot 0 of chassis #1.
	Defective Processor, Power Supply or Chassis	**1.** Attempt Run mode selection of Processor in existing chassis. **2.** Place processor in another chassis not in the existing system. Apply power, reconfigure and attempt Run mode selection. If unsuccessful, replace processor. **3.** Try existing power supply in test chassis. If unsuccessful, replace power supply. If entry into the Run mode is allowed, replace the existing chassis.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▨   Indicates the LED is FLASHING.

⸨ ⸩   Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.
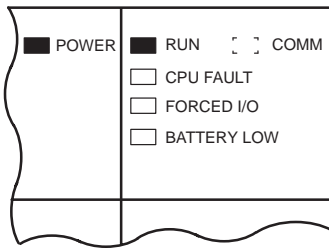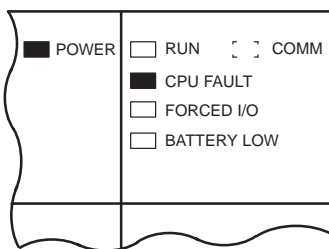
If the LEDs indicate:[1]

POWER	■ RUN	⌄ ⌄ COMM
	☐ CPU FAULT	
	☐ FORCED I/O	
	☐ BATTERY LOW	

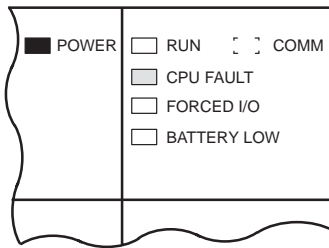| The Following Error Exists	Probable Cause	Recommended Action
System Inoperable, No Major CPU Faults Detected	User Program Logic Error	1. Monitor logic in Run mode and verify desired I/O status. 2. Check for minor CPU faults. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual
	Defective I/O Devices or I/O Wiring	Test inputs and outputs according to I/O troubleshooting procedures starting on page 10–26.

If the LEDs indicate:[1]

POWER	☐ RUN	⌄ ⌄ COMM
	■ CPU FAULT	
	☐ FORCED I/O	
	☐ BATTERY LOW	

The Following Error Exists	Probable Cause	Recommended Action
CPU Fault	CPU Memory Error	Cycle power.
	Faulty Memory Module	1. Remove power and then remove the memory module from the processor. 2. Re-install the processor and re-apply power to the power supply If steady CPU FAULT LED changes to flashing, replace the existing memory module with a replacement module. Refer to chapter 6 for removing and installing memory modules.
	Faulty CPU/Power Supply	1. Place the processor in another chassis not in the existing system and cycle power. If steady CPU FAULT LED reappears, replace the processor. 2. If CPU FAULT LED clears, monitor the line power going to the power supply in existing system. 3. Replace existing system power supply if line power checks OK.
	Processor Firmware Installed Incorrectly	If upgrading the processor to a different firmware level, verify firmware chip orientation matches the upgrade kit directions.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▨   Indicates the LED is FLASHING.
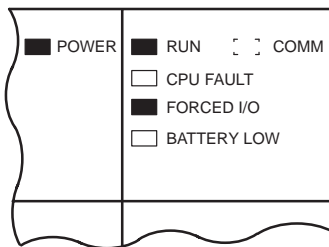
⌄ ⌄   Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

If the LEDs indicate:[1]

■ POWER	□ RUN	⸽ ⸽ COMM
	▨ CPU FAULT	
	□ FORCED I/O	
	□ BATTERY LOW	

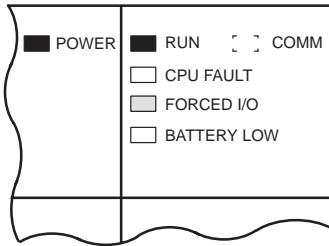| The Following Error Exists	Probable Cause	Recommended Action
CPU Major Fault	Initial CPU Factory Power-up Condition	1. Refer to chapter 8 and follow the start-up procedures. 2. Clear processor memory to get rid of the flashing CPU FAULT LED.
	Hardware/Software Major Fault Detected Erratic repetitive power cycling can cause a processor major hardware fault.	1. Monitor Status File Word S:6 for major error code. 2. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or the *Instruction Set Reference Manual* for error codes and additional troubleshooting information. 3. Remove hardware/software condition causing fault. 4. Clear Status File S:1/13 major error bits, if set. 5. Clear Status File S:5 minor error bits, if set. 6. Clear Status File S:6 major error code (optional). 7. Attempt a processor Run mode entry. If unsuccessful, repeat recommended action steps above.

If the LEDs indicate:[1]

■ POWER	■ RUN	⸽ ⸽ COMM
	□ CPU FAULT	
	■ FORCED I/O	
	□ BATTERY LOW	

The Following Error Exists	Probable Cause	Recommended Action
System does not operate per ladder logic.	User Forced I/O Disabling Operation	1. Monitor program file online and identify forced I/O. 2. Disable appropriate forces and test system conditions again. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual.

Refer to the following key to determine the status of the LED indicators:

☐ Indicates the LED is OFF.

■ Indicates the LED is ON.

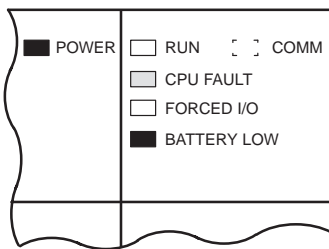▨ Indicates the LED is FLASHING.

⸽ ⸽ Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

If the LEDs indicate:[1]

■ POWER	■ RUN ⋮ COMM
	☐ CPU FAULT
	▨ FORCED I/O
	☐ BATTERY LOW

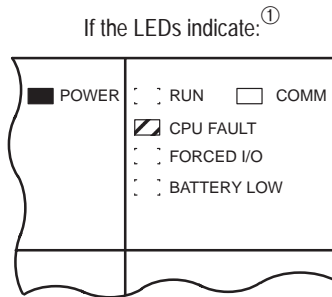| The Following Error Exists	Probable Cause	Recommended Action
System does not operate per programmed forces.	User Programmed Forces are Not Enabled	**1.** Monitor program file online and identify programmed forces. **2.** Enable appropriate forces and test system conditions again. Once forces are enabled, the FORCED I/O LED goes on steady. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual.

If the LEDs indicate:[1]

■ POWER	☐ RUN ⋮ COMM
	▨ CPU FAULT
	☐ FORCED I/O
	■ BATTERY LOW

The Following Error Exists	Probable Cause	Recommended Action
CPU Major Error with Low or No Battery Back-up	Loss of RAM during Power Down Period	**1.** Verify battery is connected. See pages 6–1 and 9–4. **2.** Replace the battery if you want RAM battery backup. See page 9–4. If you want to back up RAM with the capacitor in a SLC 5/01 (1747-L511), add or replace the BATTERY LOW LED jumper. **3.** Refer to processor major fault recommended action steps. Refer to either the *Hand-Held Terminal User Manual* (Catalog Number 1747-NP002) or your programming software user manual.

Refer to the following key to determine the status of the LED indicators:

☐ Indicates the LED is OFF.

■ Indicates the LED is ON.

▨ Indicates the LED is FLASHING.

⋮ Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

Identifying SLC 5/02 Processor Communication Errors

If the LEDs indicate:[1]

■ POWER	⦂ RUN ☐ COMM
	▨ CPU FAULT
	⦂ FORCED I/O
	⦂ BATTERY LOW

The Following Error Exists	Probable Cause	Recommended Action
The SLC 5/02 processor is not receiving data. No communication to the programmer.	DH-485 communication parameters are improperly set up.	**1.** Check communication parameters of programmer. Programmer and processor baud rate must match. Programmer and processor node addresses must be different. **2.** Try different combinations of: a. baud rate (Processor default is 19200.) b. node address (Processor default is 1.) **3.** Try to increase the maximum node address. (Default is 31.)
	Bad Connection of Communication Device	**1.** Check cable continuity. **2.** Check cable connections between programmer and processor. **3.** Check communication device (for example, the 1747-PIC). Replace if necessary.
	Low or No Power to Communication Device	**1.** Verify proper power supply selection and backplane loading. (1747-PIC and 1747-AIC draw power off the backplane.) **2.** Verify proper 120/240V power supply jumper selection. See page 6–8.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▩   Indicates the LED is FLASHING.

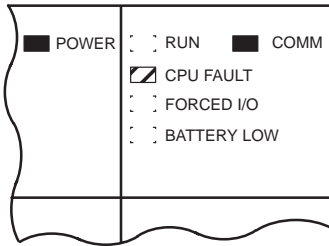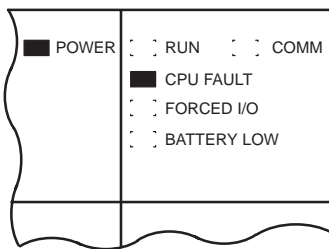▨   Indicates the LED is FLASHING or OFF.

⦂   Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

If the LEDs indicate:[1]

POWER	RUN	COMM
CPU FAULT		
FORCED I/O		
BATTERY LOW		

The Following Error Exists	Probable Cause	Recommended Action
The SLC 5/02 processor is receiving data, but is not communicating with the programmer.	DH-485 communication parameters are improperly set up.	**1.** Check communication parameters of programmer. Programmer and processor baud rate must match. Programmer and processor node addresses must be different. **2.** Try different combinations of: a. baud rate (Processor default is 19200.) b. node address (Processor default is 1.) **3.** Try to increase the maximum node address. (Default is 31.)

If the LEDs indicate:[1]

POWER	RUN	COMM
CPU FAULT		
FORCED I/O		
BATTERY LOW		

The Following Error Exists	Probable Cause	Recommended Action
A fatal error has occurred.	Excessive noise or a faulty SLC 5/02 processor.	**1.** Cycle power to obtain flashing CPU FAULT LED and default program. **2.** Examine the error code following the power cycle. Take appropriate action. **3.** Reload your program. **4.** Contact your local Allen-Bradley representative if the error persists.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▨   Indicates the LED is FLASHING.

▧   Indicates the LED is FLASHING or OFF.

⌐ ¬   Status of LED does not matter.

[1] The RUN LED on the SLC 5/01 processor is actually labeled "PC RUN." Also, the SLC 5/01 processor does not have a COMM LED.

Troubleshooting the SLC 5/03, SLC 5/04, and SLC 5/05 Processors

Between the time you apply power to an SLC 5/03, SLC 5/04, or SLC 5/05 processor and the communications are established via a connected programming device, the only form of communication between you and the processor is through the LED display.

When power is applied, all of the LEDs flash on and then off while the processor conducts hardware tests. This is part of the normal powerup sequence. Following the selftest by the processor, all the LEDs again flash on momentarily. If a user program is in a running state, the RUN LED will be on. If a fault exists within the processor, the FLT LED is on.

To receive the maximum benefit of this troubleshooting section, we recommend you follow these steps:

1. Identify the status of your processor LEDs. See chapter 5 for description of LEDs and their different states.

2. Using the tables on the following pages, match your processor and power supply LEDs with the status LEDs located in the first column.

3. Once the status LEDs are matched to the appropriate table, simply move across the table identifying error description and probable causes.

4. Then follow the recommended action steps for each probable cause until the cause is identified.

5. If recommended actions do not identify the trouble cause, contact your local Allen-Bradley sales office or distributor.

Clearing SLC 5/03, SLC 5/04, and SLC 5/05 Processor Faults Using the Keyswitch

Toggle the keyswitch from RUN to PROG and then back to RUN; this clears the fault. If the keyswitch is left in the RUN position, the processor mode cannot be changed from a programmer/operator interface device. If you return the keyswitch to the REM position, you can then use a programmer/operator interface device to change the processor mode.
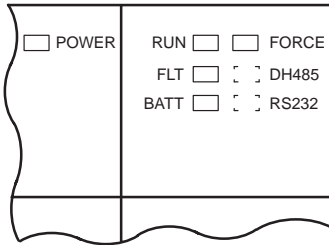
> ⚠ **ATTENTION:** If you clear a processor fault using the keyswitch, the processor immediately enters the Run mode.

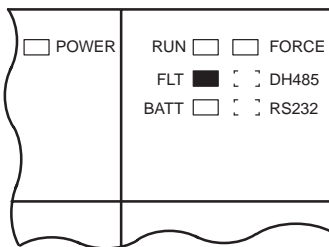### Identifying SLC 5/03, SLC 5/04, and SLC 5/05 Processor Errors

The following LEDs and tables provide you with information regarding error messages, possible cause(s) for the error, and recommended action to take to resolve the error.

If the LEDs indicate:[1]

```
┌─────────┬──────────────────────┐
│ ☐ POWER │  RUN ☐  ☐ FORCE      │
│         │  FLT ☐  ⋮ ⋮ DH485    │
│         │  BATT ☐ ⋮ ⋮ RS232    │
│         │                      │
│         │                      │
└─────────┴──────────────────────┘
```

The Following Error Exists	Probable Cause	Recommended Action
Inadequate System Power	No Line Power	**1.** Verify proper line voltage and connections on the power terminals. **2.** Verify proper 120/240V power supply jumper selection. See page 6–8.
	Power Supply Fuse Blown	**1.** Check the incoming power fuse, check for proper incoming power connections. Replace fuse. **2.** If fuse blows again, replace the power supply. See page 9–8 on fuse replacement.
	Power Supply Overloaded	**1.** Remove line power to power supply. Remove several output modules from the chassis. Wait five minutes. Reapply power. **2.** If condition reoccurs, re-calculate module configuration power required and verify proper power supply selection. See page 2–11. This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
	Defective Power Supply	**1.** **Recheck other probable causes.** **2.** Monitor the line power to chassis power supply for possible transient or shorting. **3.** Replace the power supply.

If the LEDs indicate:[1]

```
┌─────────┬──────────────────────┐
│ ☐ POWER │  RUN ☐  ☐ FORCE      │
│         │  FLT ■  ⋮ ⋮ DH485    │
│         │  BATT ☐ ⋮ ⋮ RS232    │
│         │                      │
│         │                      │
└─────────┴──────────────────────┘
```

The Following Error Exists	Probable Cause	Recommended Action
Inadequate System Power	Improper Line Power Voltage Selection	Verify proper 120/240V power supply jumper selection. See page 6–8.

Refer to the following key to determine the status of the LED indicators:

☐ Indicates the LED is OFF.

■ Indicates the LED is ON.

▨ Indicates the LED is FLASHING.

⋮ ⋮ Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the LEDs indicate:[1]

POWER	RUN ☐	☐ FORCE
	FLT ☐	⌞ ⌝ DH485
	BATT ☐	⌞ ⌝ RS232

The Following Error Exists	Probable Cause	Recommended Action
Processor Not in Run Mode	Either Improper Mode Selected or User Program Logic	1. Verify selected processor mode. 2. If the processor is in the Program/Test modes, attempt Run mode entry: • *If keyswitch is in the REM position and there is no key,* use the programmer. • *If keyswitch is in REM or PROG position,* and you have the key, toggle to the RUN position. 3. If in the suspend mode, check user program logic for suspend instructions. Refer to your programming software user manual.
	Line Power Out of Operating Range	1. Check proper 120/240V power supply jumper selection and incoming power connections. 2. Monitor for proper line voltage at the incoming power connections. See page 6–8 for power supply installation.
	Improper Seating of Power Supply, and/or Processor in the Chassis	1. Remove power and inspect the power supply chassis connections and the processor chassis connections. 2. Re-install the devices and re-apply power. **Important:** The processor only operates in slot 0 of chassis #1.
	Defective Processor, Power Supply, or Chassis	1. Attempt Run mode selection of Processor in existing chassis: • *If keyswitch is in the REM position and there is no key,* use the programmer. • *If keyswitch is in REM or PROG position,* and you have the key, toggle to the RUN position. 2. Place processor in another chassis not in the existing system. Apply power, reconfigure and attempt Run mode selection. If unsuccessful, replace processor. 3. Try existing power supply in test chassis. If unsuccessful, replace power supply. If entry into the Run mode is allowed, replace the existing chassis.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▧   Indicates the LED is FLASHING.

⌞ ⌝   Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.
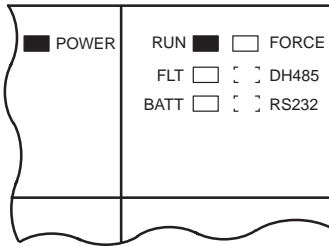
If the LEDs indicate:[1]

```
┌──────────────────────────────────┐
│ ■ POWER    RUN ■  □ FORCE        │
│            FLT □  ⸬ DH485        │
│            BATT □ ⸬ RS232        │
│                                  │
```

The Following Error Exists	Probable Cause	Recommended Action
System Inoperable, No Major CPU Faults Detected	User Program Logic Error	**1.** Monitor logic in Run mode and verify desired I/O status. **2.** Check for minor CPU faults. Refer to your programming software user manual.
	Defective I/O Devices or I/O Wiring	Test inputs and outputs according to I/O troubleshooting procedures starting on page 10–26.

If the LEDs indicate:[1]

```
┌──────────────────────────────────┐
│ ■ POWER    RUN □  □ FORCE        │
│            FLT ■  ⸬ DH485        │
│            BATT □ ⸬ RS232        │
│                                  │
```

The Following Error Exists	Probable Cause	Recommended Action
CPU Fault	CPU Memory Error	Cycle power.
	Faulty Memory Module	**1.** Remove power and then remove the memory module from the processor. **2.** Re-install the processor and re-apply power to the power supply. If steady FLT LED changes to flashing, replace the existing memory module with a replacement module. Refer to chapter 6 for removing and installing memory modules.
	Faulty CPU/Power Supply	**1.** Place the processor in another chassis not in the existing system and cycle power. If steady FLT LED reappears, replace the processor. **2.** If FLT LED clears, monitor the line power going to the power supply in existing system. **3.** Replace existing system power supply if line power checks OK.
	Processor Firmware Installed Incorrectly	If upgrading the processor to a different firmware level, verify firmware chip orientation matches the upgrade kit directions.

Refer to the following key to determine the status of the LED indicators:

□   Indicates the LED is OFF.

■   Indicates the LED is ON.

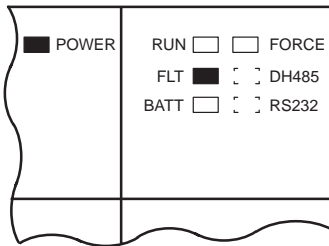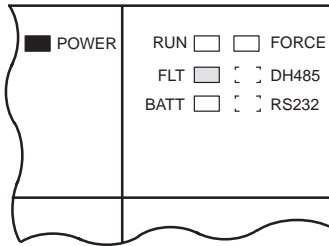▨   Indicates the LED is FLASHING.

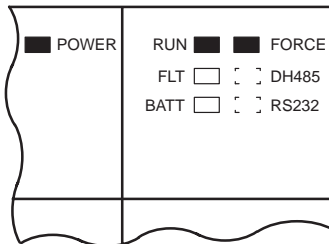⸬   Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the LEDs indicate:[1]

POWER		RUN ☐	☐ FORCE
		FLT ▨	⦙ DH485
		BATT ☐	⦙ RS232

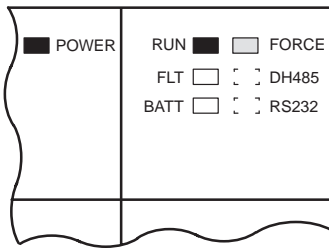| The Following Error Exists	Probable Cause	Recommended Action
CPU Major Fault	Initial CPU Factory Power-up Condition in Effect	1. Refer to chapter 8 and follow the start-up procedures. 2. Clear processor memory to get rid of the flashing FLT LED.
	Hardware/ Software Major Fault Detected Erratic repetitive power cycling can cause a CPU major hardware fault.	1. Use programmer to monitor and clear the fault (or if keyswitch in REM): a. Monitor Status File Word S:6 for major error code. b. Refer to your programming software user manual for error codes and additional troubleshooting information. c. Remove hardware/software condition causing fault. d. Clear Status File S:1/13 major error bits, if set. e. Clear Status File S:5 minor error bits, if set. f. Clear Status File S:6 major error code (optional). g. Attempt a processor Run mode entry. If unsuccessful, repeat recommended action steps above. 2. Use the keyswitch to clear the fault. Toggle the keyswitch to PROG and back to RUN. (See page 10–11.) If FAULT occurs again, use programmer to get error code and determine the source of problem.

If the LEDs indicate:[1]

POWER		RUN ■	■ FORCE
		FLT ☐	⦙ DH485
		BATT ☐	⦙ RS232

The Following Error Exists	Probable Cause	Recommended Action
System does not operate per ladder logic.	User Forced I/O Disabling Operation	1. Monitor program file online and identify forced I/O. 2. Disable appropriate forces and test system conditions again. Refer to your programming software user manual.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

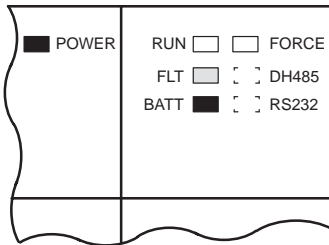▨   Indicates the LED is FLASHING.

⦙ ⦙   Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the LEDs indicate: [1]

POWER	RUN ■ □ FORCE
	FLT □ ⁝ DH485
	BATT □ ⁝ RS232

The Following Error Exists	Probable Cause	Recommended Action
System does not operate per programmed forces.	User programmed forces are not enabled.	**1.** Monitor program file online and identify programmed forces. **2.** Enable appropriate forces and test system conditions again. Once forces are enabled, the FORCE LED goes on steady. Refer to your programming software user manual.

If the LEDs indicate: [1]

POWER	RUN □ □ FORCE
	FLT □ ⁝ DH485
	BATT ■ ⁝ RS232

The Following Error Exists	Probable Cause	Recommended Action
CPU Major Error with Low or No Battery Back-up	Loss of RAM during Power Down Period	**1.** Verify battery is connected. See pages 6–1 and 9–5. **2.** Replace the battery if you want RAM battery backup. See page 9–5. **3.** Refer to processor major fault recommended action steps. Refer to your programming software user manual.

Refer to the following key to determine the status of the LED indicators:

□   Indicates the LED is OFF.

■   Indicates the LED is ON.

▨   Indicates the LED is FLASHING.

⁝   Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

Identifying SLC 5/03, SLC 5/04, and SLC 5/05 Processor Communication Errors

If the LEDs indicate:[1]

POWER	
■ POWER	RUN ⌐ ⌐ ⌐ FORCE
	FLT ▨ ☐ DH485
	BATT ⌐ ⌐ ⌐ RS232

The Following Error Exists	Probable Cause	Recommended Action
Fatal Error and No Communication	Inadequate System Power	1. Check line power. 2. Check 120/240V power supply jumper selection. See page 6–8. Also, see the recommended actions for inadequate system power on page 10–12.
	Communication channel is "shut down."	Check communication channel configuration with your programming software. Also, see "Returning the SLC 5/03, SLC 5/04, and SLC 5/05 Processors to 'Initial Factory Conditions'" on page 10–25.
	Communication channel is damaged.	Replace processor.

Refer to the following key to determine the status of the LED indicators:

☐ Indicates the LED is OFF.

■ Indicates the LED is ON.

▢ Indicates the LED is FLASHING.

▨ Indicates the LED is FLASHING or OFF.

⌐⌐⌐ Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the LEDs indicate:[1]

POWER	RUN [ ] [ ] FORCE
	FLT ▨ ▢ DH485
	BATT [ ] [ ] RS232

The Following Error Exists	Probable Cause	Recommended Action
The SLC 5/03 and SLC 5/04 processors are trying to establish communication, but cannot find other active nodes. (The LED is flashing green on the SLC 5/03 and SLC 5/04.)	DH-485 or DH+ communication parameters are improperly set up.	**1.** Check communication parameters of programmer. Programmer and processor baud rate must match. Programmer and processor node addresses must be different. **2.** Try different combinations of: a. baud rate (Processor default is 19.2K for DH-485 on the SLC 5/03, and 57.6K for DH+ on the SLC 5/04.) b. node address (Processor default is 1.) **3.** Try to increase the maximum node address. (Default is 31 for the SLC 5/03 processor only.) See your programming software user manual for channel configuration information.
	Bad Connection of Communication Device	**1.** Check cable continuity. **2.** Check cable connections between programmer and processor. **3.** Check communication device (for example, the 1747-PIC). Replace if necessary.
	Low or No Power to Communication Device	**1.** Verify proper power supply selection and backplane loading. (The 1747-PIC and 1747-AIC draw power off the backplane.) **2.** Verify proper 120/240V power supply jumper selection. See page 6–8.
Duplicate drop is detected. (The LED is flashing red on the SLC 5/04.)	Another DH+ device is already on the DH+ network at the node address of this same device.	**1.** Remove this device from the DH+ network. **2.** Cycle power. **3.** Reset the node address to an unused node before reconnecting device to the DH+ network. (Can perform reset if on-line via channel 0 RS-232 port without disconnecting from DH+.)
An ENET fault is being reported via a code. (The LED is flashing red on the SLC 5/05.)	A hardware or software fault has occured.	Contact Allen-Bradley Global Technical Services for assistance.

Refer to the following key to determine the status of the LED indicators:

▢   Indicates the LED is OFF.

▮   Indicates the LED is ON.

▢   Indicates the LED is FLASHING.

▨   Indicates the LED is FLASHING or OFF.

[ ]   Status of LED does not matter.

[1]   The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the RS232 Channel is in DH485 Mode and the LEDs indicate:[1]

POWER ■   RUN ⦂ ⦂ ⦂ FORCE
           FLT ▨ ⦂ ⦂ DH485
           BATT ⦂ ⦂ ☐ RS232

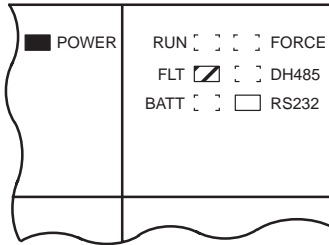| The Following Error Exists	Probable Cause	Recommended Action
Fatal Error and No Communication	Inadequate System Power	1. Check line power. 2. Check 120/240V power supply jumper selection. See page 6–8. Also, see the recommended action for Inadequate System Power on page 10–12.
	Communication channel is "shut down."	Check communication channel configuration with your programming software. Also, see "Returning the SLC 5/03, SLC 5/04, and SLC 5/05 Processors to 'Initial Factory Conditions'" on page 10–25.
	Communication channel is damaged.	Replace processor.
	Channel configured for DF1.	See your programming software user manual for channel configuration information.

If the RS232 Channel is in DH485 Mode and the LEDs indicate:[1]

POWER ■   RUN ⦂ ⦂ ⦂ FORCE
           FLT ▨ ⦂ ⦂ DH485
           BATT ⦂ ⦂ ▦ RS232

The Following Error Exists	Probable Cause	Recommended Action
The SLC 5/03, SLC 5/04, or SLC 5/05 processor is trying to establish communication, but cannot find other active nodes.	DH-485 communication parameters are improperly set up.	1. Check communication parameters of programmer. Programmer and processor baud rate must match. Programmer and processor node addresses must be different. 2. Try different combinations of: a. baud rate (Processor default is 19200.) b. node address (Processor default is 1.) 3. Try to increase the maximum node address. (Default is 31.) See your programming software user manual for channel configuration information.
	Bad Connection	1. Check cable continuity. 2. Check cable connections between programmer and processor.
	Low or No Power to Communication Device	1. Verify proper power supply selection and backplane loading. (The 1747-PIC and 1747-AIC draw power off the backplane.) 2. Verify proper 120/240V power supply jumper selection. See page 6–8.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▦   Indicates the LED is FLASHING.

▨   Indicates the LED is FLASHING or OFF.
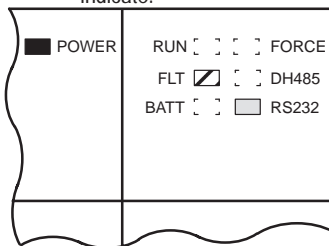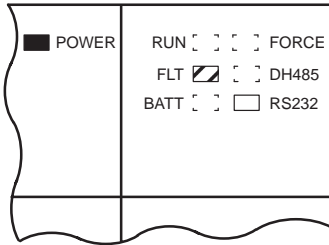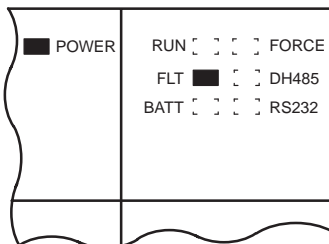
⦂ ⦂   Status of LED does not matter.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the RS232 Channel
is in DH485 Mode
and the LEDs
indicate:[1]

POWER | RUN [ ] [ ] [ ] FORCE
FLT ▨ [ ] DH485
BATT [ ] [ ] RS232

The Following Error Exists	Probable Cause	Recommended Action
The SLC 5/03, SLC 5/04, or SLC 5/05 processor is not transmitting.	Channel is configured for DH485 mode.	Check communication parameters of channel configuration. Also, see your programming software user manual.
	RS232/DF1 parameters improperly set up.	Check communication parameters of programmer and channel configuration: a. baud rate b. DF1 node addresses (Processor default is 1 for DF1 half-duplex, and 9 for DF1 full-duplex.) c. error checking d. number of data bits Programmer and processor baud rate must match. Programmer and processor addresses must be different. See your programming software user manual.
	Hardware Problem	**1.** Check cable connections. **2.** Check cable pinouts. Also, see appendix B for RS-232 pinouts.

If the LEDs indicate:[1]

POWER | RUN [ ] [ ] [ ] FORCE
FLT ■ [ ] DH485
BATT [ ] [ ] RS232

The Following Error Exists	Probable Cause	Recommended Action
A fatal error has occurred.	Excessive noise or a faulty SLC 5/03, SLC 5/04, or SLC 5/05 processor.	**1.** Cycle power to obtain flashing FLT LED and default program. **2.** Examine the error code following the power cycle. Take appropriate action. **3.** Reload your program. **4.** Contact your local Allen-Bradley representative if the error persists.

Refer to the following key to determine the status of
the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

▦   Indicates the LED is FLASHING.

▨   Indicates the LED is FLASHING or OFF.

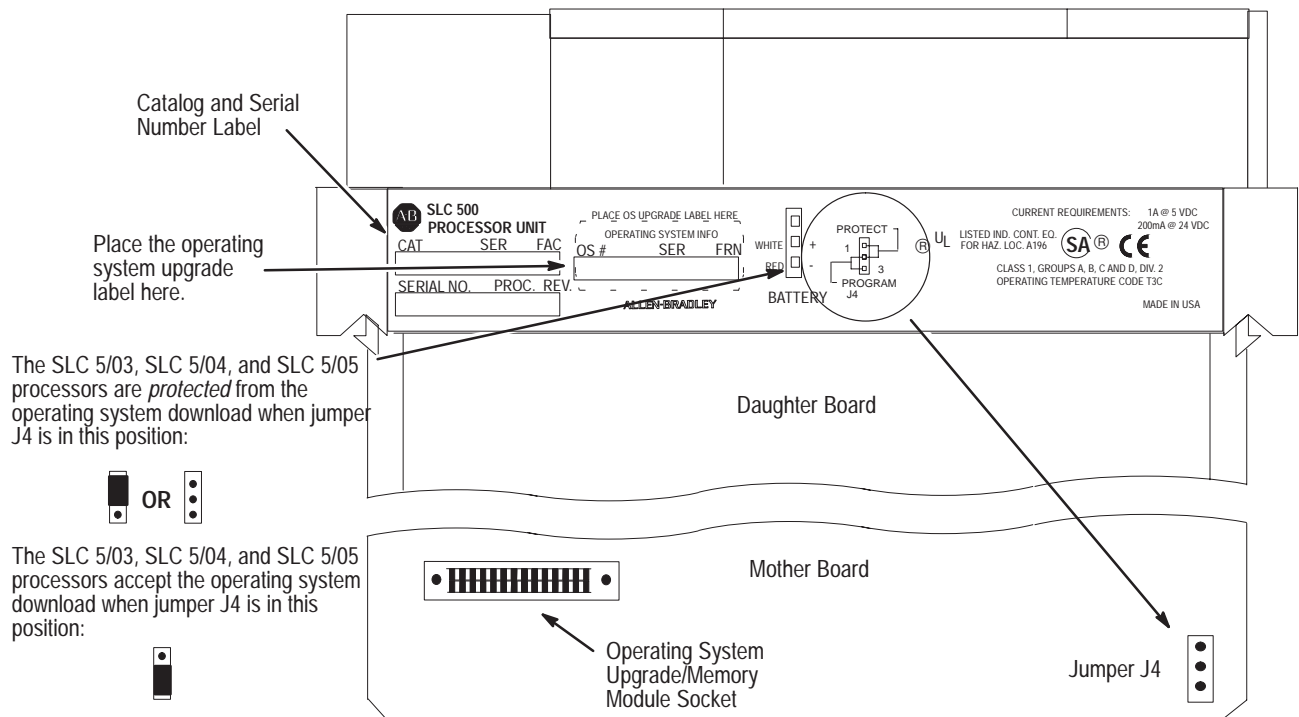⌐ ⌐   Status of LED does not matter.

[1]   The DH485 LED on the SLC 5/03 processor is labeled DH+ on
the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

Identifying Processor Errors while Downloading an Operating System

The download process of the operating system by the SLC 5/03, SLC 5/04, and SLC 5/05 processors takes approximately 45 seconds. While the download is in progress, the RUN and FLT LEDs remain off. The other four LEDs — RS232, DH485 (DH+ on the SLC 5/04 and ENET on the SLC 5/05), FORCE, and BATT — turn on and off in a walking bit sequence. If the download is successful, these four LEDs remain on together.

> ⚠ **ATTENTION:** Jumper J4, located on the bottom corner of the motherboard, provides write protection from any download of a new operating system. The "out of the box" position of this jumper is "PROTECT," or write protect. Without the jumper, the processors are write protected.

Catalog and Serial Number Label

Place the operating system upgrade label here.

The SLC 5/03, SLC 5/04, and SLC 5/05 processors are *protected* from the operating system download when jumper J4 is in this position:

The SLC 5/03, SLC 5/04, and SLC 5/05 processors accept the operating system download when jumper J4 is in this position:

Daughter Board

Mother Board

Operating System Upgrade/Memory Module Socket

Jumper J4

If the download is *not* successful, the FLT LED turns on and a combination of LEDs flash on and off indicating an error condition. The following LED diagrams and tables provide you with information regarding error messages, possible cause(s) for the error, and recommended action to take to resolve the error.

If the LEDs indicate:[1]

POWER ■ | RUN ☐ ☐ FORCE
         | FLT ■ ☐ DH485
         | BATT ■ ☐ RS232
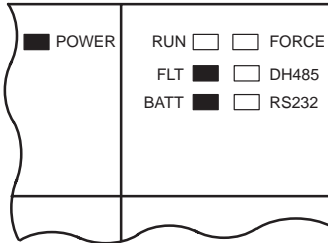
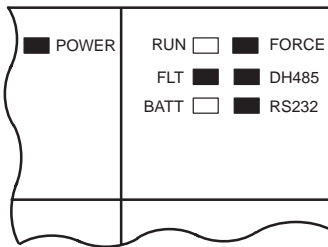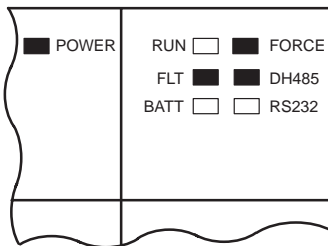| The Following Error Exists	Probable Cause	Recommended Action
NVRAM error	Major hardware failure due to noise, improper grounding, or poor power source.	Cycle power and see if the error repeats itself. If the error clears, you should be able to download the operating system. If the error persists, contact your Allen-Bradley representative.

If the LEDs indicate:[1]

POWER ■ | RUN ☐ ■ FORCE
         | FLT ■ ■ DH485
         | BATT ☐ ■ RS232

The Following Error Exists	Probable Cause	Recommended Action
Hardware Watchdog Timeout	Major hardware failure due to noise, improper grounding, or poor power source.	Cycle power and see if the error repeats itself. If the error clears, you should be able to download the operating system. If the error persists, contact your Allen-Bradley representative.

If the LEDs indicate:[1]

POWER ■ | RUN ☐ ■ FORCE
         | FLT ■ ■ DH485
         | BATT ☐ ☐ RS232

The Following Error Exists	Probable Cause	Recommended Action
Fatal Hardware Error	Major hardware failure due to noise, improper grounding, or poor power source.	Cycle power and see if the error repeats itself. If the error clears, you should be able to download the operating system. If the error persists, contact your Allen-Bradley representative.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

■   Indicates the LED is ON.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

If the LEDs indicate:[1]

```
■ POWER      RUN □    □ FORCE
             FLT ■    □ DH485
             BATT ■   ■ RS232
```

The Following Error Exists	Probable Cause	Recommended Action
Corrupted Operating System Memory Module	The operating system on the Flash EPROM is corrupt.	Cycle power and see if the error repeats itself. If the error persists, either contact your Allen-Bradley representative for a new operating system memory module, or download the old operating system.

If the LEDs indicate:[1]

```
■ POWER      RUN □    ■ FORCE
             FLT ■    □ DH485
             BATT ■   □ RS232
```

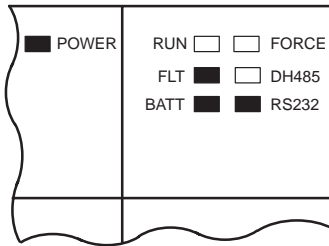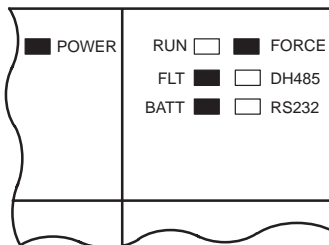| The Following Error Exists	Probable Cause	Recommended Action
Flash EPROM Failure	The processor flash is corrupt.	Cycle power and see if the error repeats itself. If the error clears, you should be able to download the operating system. If the error persists, contact your Allen-Bradley representative.

If the LEDs indicate:[1]

```
■ POWER      RUN □    ■ FORCE
             FLT ■    ■ DH485
             BATT ■   □ RS232
```
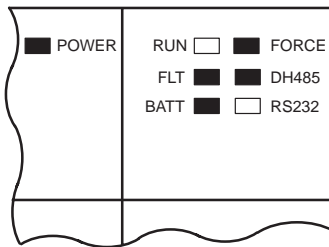
The Following Error Exists	Probable Cause	Recommended Action
Corrupt or Missing Operating System	The operating system is missing or has been corrupted.	Cycle power. If error clears, you should be able to download the operating system. If the error persists, contact your Allen-Bradley representative for a new operating system.

If the LEDs indicate:[1]

```
■ POWER      RUN □    ■ FORCE
             FLT ■    □ DH485
             BATT ■   ■ RS232
```
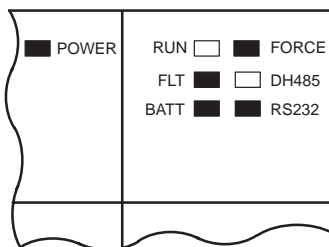
The Following Error Exists	Probable Cause	Recommended Action
Downloadable Operating System Failure	Failure during transmission of downloadable operating system.	Download the operating system.

Refer to the following key to determine the status of the LED indicators:

□   Indicates the LED is OFF.

■   Indicates the LED is ON.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.
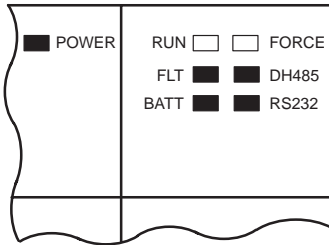
If the LEDs indicate:[1]

```
 ┌──┬───────────────────────┐
 │▮ │ RUN ☐   ☐ FORCE        │
 │PO│                        │
 │WER│ FLT ▮   ▮ DH485       │
 │  │ BATT ▮  ☐ RS232        │
 │  │                        │
 └──┴───────────────────────┘
```
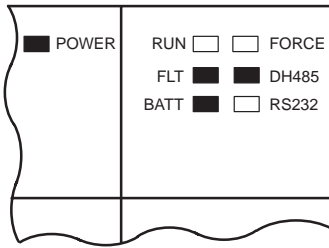
The Following Error Exists	Probable Cause	Recommended Action
Incompatible Platform	The upgrade of the operating system is incompatible with the processor hardware.	Use an operating system that is compatible with your processor hardware.

If the LEDs indicate:[1]

```
 ┌──┬───────────────────────┐
 │▮ │ RUN ☐   ☐ FORCE        │
 │PO│                        │
 │WER│ FLT ▮   ▮ DH485       │
 │  │ BATT ▮  ▮ RS232        │
 │  │                        │
 └──┴───────────────────────┘
```

The Following Error Exists	Probable Cause	Recommended Action
Memory Write Protected	An attempt was made to download the operating system onto write–protected memory.	Change the jumper on the processors to the program position.

Refer to the following key to determine the status of the LED indicators:

☐   Indicates the LED is OFF.

▮   Indicates the LED is ON.

[1] The DH485 LED on the SLC 5/03 processor is labeled DH+ on the SLC 5/04 processor, and ENET on the SLC 5/05 processor.

Returning the SLC 5/03, SLC 5/04, and SLC 5/05 Processors to "Initial Factory Conditions"

We *only* recommend this procedure if the communication channels have been shut down due to the configuration parameters, or if you absolutely cannot establish communications with the processor.

> ⚠ **ATTENTION:** If you return the processor to the initial factory conditions, the user program and communication configurations are returned to their default settings.

To do this:

1. Remove power from the SLC 500 power supply.

2. Remove the processor from the chassis.

3. *Disconnect the battery* by removing the battery connector from its socket.

4. Locate the VBB and GND connections on the right side of the motherboard.

5. Place a small bladed screwdriver across the VBB and GND connections and hold for 60 seconds. This returns the processor to the initial factory conditions.

SLC 5/03 (1747-L531 and 1747-L532)

Keyswitch

Mother Board

Right Side View

GND

Mother Board

VBB
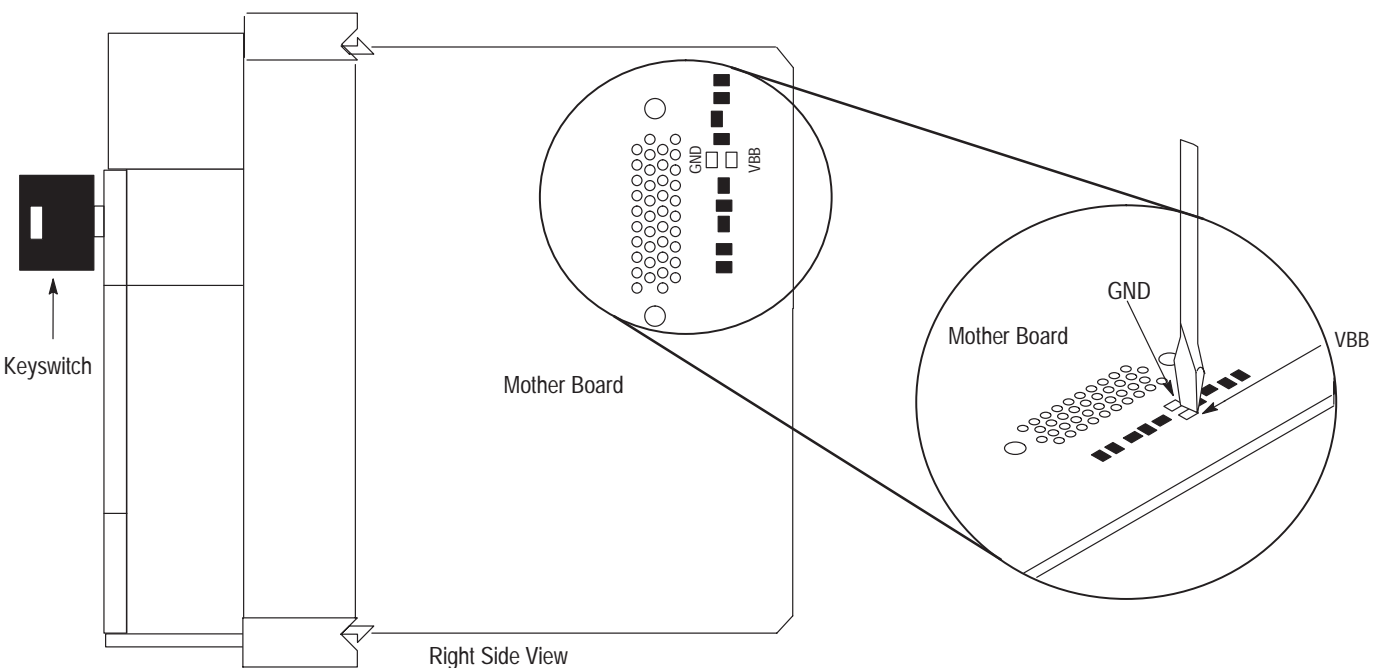
SLC 5/04 (1747-L541, 1747-L542, and 1747-L543)
SLC 5/05 (1747-L551, 1747-L552, and 1747-L553)
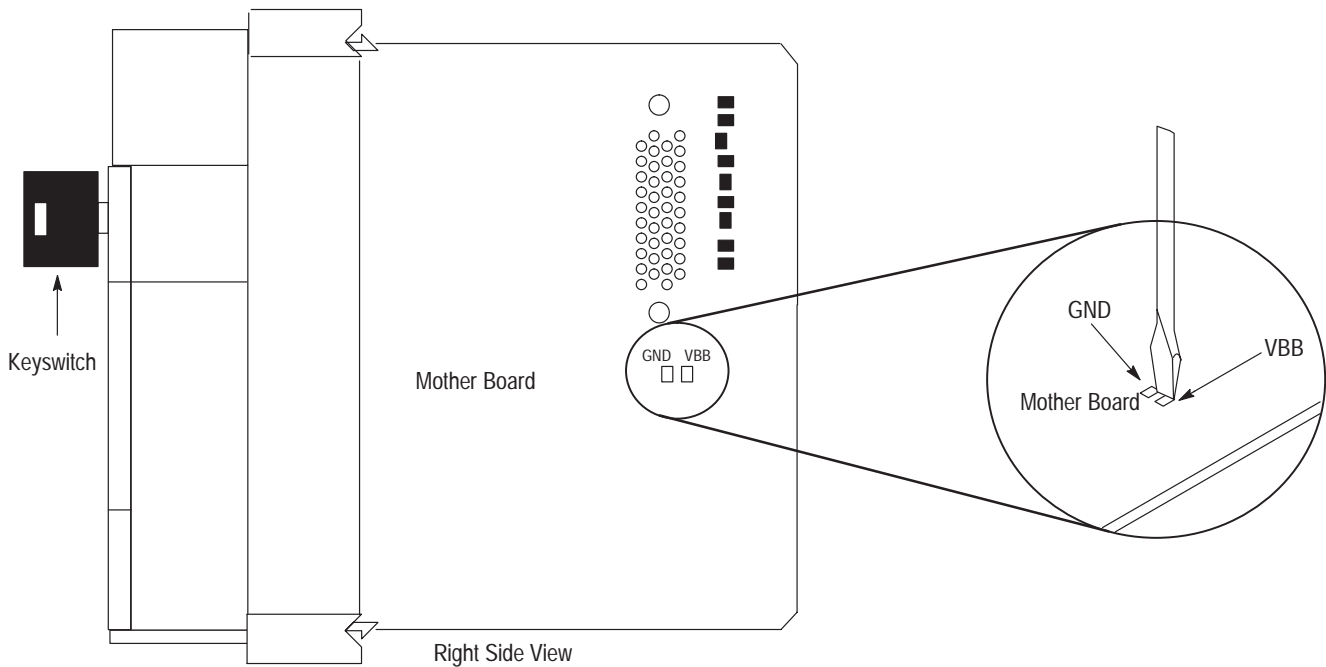
Troubleshooting Your Input Modules

The following will assist you in troubleshooting your input modules.

Input Circuit Operation

An input circuit responds to an input signal in the following manner:

1. An input filter removes false signals due to contact bounce or electrical interference.

2. Opto-electrical isolation protects the input circuit and backplane circuits by isolating logic circuits from input signals.

3. Logic circuits process the signal.

4. An input LED turns on or off indicating the status of the corresponding input device.

Troubleshooting Your Input Modules

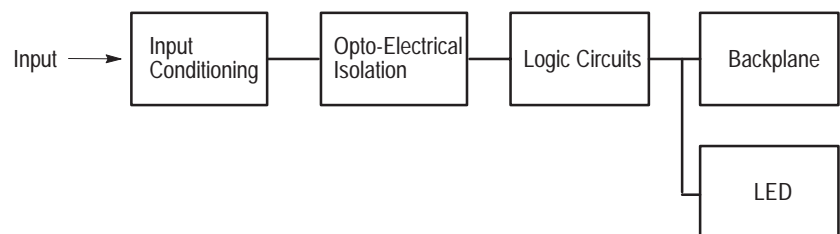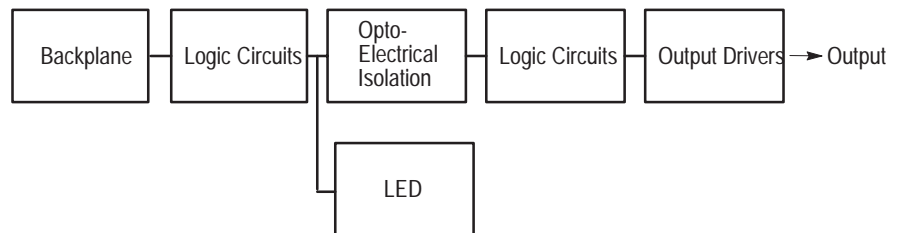| If your Input Circuit LED is	And Your Input Device is	And	Probable Cause	Recommended Action
On	On/Closed/Activated	Your input device will not turn off.	Device is shorted or damaged.	Verify device operation. Replace device.
		Your program operates as though it is off.	Input circuit is damaged.	Verify proper wiring. Try other input circuit. Replace module.
			Input is forced off in program.	Check the FORCED I/O or FORCE LED on processor and remove forces.
	Off/Open/Deactivated	Your program operates as though it is on and/or the input circuit will not turn off.	Input device Off-state leakage current exceeds input circuit specification.	Check device and input circuit specifications. Use load resistor to bleed-off current.
			Input device is shorted or damaged.	Verify device operation. Replace device.
			Input circuit is damaged.	Verify proper wiring. Try other input circuit. Replace module.
Off	On/Closed/Activated	Your program operates as though it is off and/or the input circuit will not turn on.	Input circuit is incompatible.	Check specification and sink/source compatibility (if DC input).
			Low voltage across the input.	Check the voltage across input circuit and check source voltage.
			Incorrect wiring or an open circuit.	Check wiring and COMmon connections.
			Input signal turn on time too fast for input circuit.	Check timing specifications.
			Input circuit is damaged.	Verify proper wiring. Try other input circuit. Replace module.
	Off/Open/Deactivated	Your input device will not turn on.	Input device is shorted or damaged.	Verify operation. Replace device.
		Your program operates as though it is on.	Input is forced on in program.	Check processor FORCED I/O or FORCE LED and remove forces. Verify proper wiring. Try other input circuit. Replace module.
			Input circuit is damaged.	Verify proper wiring. Try other input circuit. Replace module.

Troubleshooting Your Output Modules

The following will assist you in troubleshooting your output modules.

Output Circuit Operation

An output circuit controls the output signal in the following manner:

1. Logic circuits determine the output status.

2. An output LED indicates the status of the output signal.

3. Opto-electrical isolation separates output circuit logic and backplane circuits from field signals.

4. The output driver turns the corresponding output on or off.

```
┌────────────┐   ┌────────────────┐   ┌────────────────┐   ┌────────────────┐   ┌────────────────┐
│ Backplane  │───│ Logic Circuits │───│ Opto-          │───│ Logic Circuits │───│ Output Drivers │──► Output
│            │   │                │   │ Electrical     │   │                │   │                │
│            │   │                │   │ Isolation      │   │                │   │                │
└────────────┘   └────────────────┘   └───────┬────────┘   └────────────────┘   └────────────────┘
                                              │
                                      ┌───────┴────────┐
                                      │      LED       │
                                      └────────────────┘
```

Troubleshooting Your Output Modules

If your Output Circuit LED is	And Your Output Device is	And	Probable Cause	Recommended Action
On	On/Energized	Your program indicates that the output circuit is off or the output circuit will not turn off.	Programming problem.	Check for duplicate outputs and addresses using the search function. If using subroutines, outputs are left in their last state when not executing subroutines. Use the force function to force output off. If this does not force the output off, output circuit is damaged. If the output does force off, then check again for logic/programming problem.
			Output is forced on in program.	Check processor FORCED I/O or FORCE LED and remove forces.
			Output circuit is damaged.	Use the force function to force the output off. If this forces the output off, then there is a logic/programming problem. If this does not force the output off, the output circuit is damaged. Try other output circuit. Replace module.
	Off/De-energized	Your output device will not turn on and the program indicates that it is on.	Low or no voltage across the load.	Measure the source voltage and check specifications.
			Incorrect wiring or open circuit.	Check wiring and COMmon connections.
			Output device is incompatible.	Check specifications and sink/source compatibility (if DC output).
			Output circuit is damaged.	Check wiring. Try other output circuit. Replace module.
Off	On/Energized	Your output device will not turn off and the program indicates that it is off.	Output device is incompatible.	Check specifications.
			Output circuit Off-state leakage current may exceed output device specification.	Check specifications. Use load resistor to bleed off leakage current. See output specifications.
			Incorrect wiring.	Check wiring. Disconnect from SLC and verify device operation.
			Output device is shorted or damaged.	Verify device operation. Replace device.
			Output circuit is damaged.	Check wiring. Try other output circuit. Replace module.
	Off/De-energized	Your program indicates that the output circuit is on or the output circuit will not turn on.	Programming problem.	Check for duplicate outputs and addresses using search function. If using subroutines, outputs are left in their last state when not executing subroutines. Use the force function to force output on. If this does not force the output on, output circuit is damaged. If the output does force on, then check again for logic/programming problem.
			Output is forced off in program.	Check processor FORCED I/O or FORCE LED and remove forces.
			Output circuit is damaged.	Use the force function to force the output on. If this forces the output on, then there is a logic/programming problem. If this does not force the output on, the output circuit is damaged. Try other output circuit. Replace module.

Replacement Parts

This chapter provides a list of replacement parts and a list of replacement terminal blocks for your SLC 500 controller.

Replacement Parts

This table provides a list of replacement parts and their catalog numbers.

Description	Catalog Number
Chassis Interconnect Cable – The 1746-C7 is a 152.4 mm (6 in.) ribbon cable used when linking modular hardware style chassis up to 152.4 mm (6 in.) apart in an enclosure.	1746-C7
Chassis Interconnect Cable – The 1746-C9 is a 914.4 mm (36 in.) cable used when linking modular hardware style chassis from 152.4 mm (6 in.) up to 914.4 mm (36 in.) apart in an enclosure. This is the longest chassis interconnect cable recommended by Allen-Bradley.	1746-C9
Replacement Fuses — Five fuses per package. Orders must be for five fuses or multiples of five.	–
Catalog Number for **1746-P1** power supply.	1746-F1
Catalog Number for **1746-P2** power supply.	1746-F2
Catalog Number for **1746-P3** power supply.	1746-F3
Fixed I/O AC units, MDL 1.25 Ampere.	1746-F4
Fixed I/O DC units, MDL 1.6 Ampere.	1746-F5
Catalog Numbers for **1746-OBP16** and **1746-OVP16** output modules.	1746-F8
Catalog Number for **1746-OAP12**.	1746-F9
Modular Card Slot Fillers — Two fillers per package. Orders must be for two fillers or multiples of two.	1746-N2
32-Point Mating Connector – This connector is used for terminating a user-made cable. It is compatible with the Catalog Number 1492-IFM40x, DIN RAIL mountable terminal block interface module (used with 32 point I/O modules).	1746-N3
Kit consisting of 4 replacement terminal covers and labels for 4, 8, 16 I/O modules.	1746-R9
Replacement Covers and Labels — Two covers per package. Orders must be for two covers or multiples of two.	–
Catalog Number for **1746-P1**.	1746-R10
Catalog Numbers for **1746-P2** and **-P3** power supplies.	1746-R11
SLC 5/01 and SLC 5/02 Processors.	1746-R12
Specialty I/O.	1746-R13
SLC 5/03, SLC 5/04, and SLC 5/05 Processors.	1746-R14
Catalog Number for **1747-ASB**.	1746-R16
Replacement Fuse Holder for Catalog Number **1746-OAP12** — Two fuse holders per package. Orders must be for two fuse holders or multiples of two.	1746-R17
Replacement Retainer Clips — Four clips per package. Orders must be for four clips or multiples of four	1746-R15
Replacement Remote I/O Address Labels: Includes five labels for remote PLC system and five labels for remote SLC system.	1746-RL35
Replacement Octal Label Kit — Kit includes one octal LED label and one door label.	–
Catalog Number for **1746-IA16**.	1746-RL40
Catalog Number for **1746-IB16**.	1746-RL41
Catalog Number for **1746-IG16**.	1746-RL42
Catalog Number for **1746-IM16**.	1746-RL43
Catalog Number for **1746-IN16**.	1746-RL44
Catalog Number for **1746-IV16**.	1746-RL45
Catalog Number for **1746-ITB16**.	1746-RL46

Description	Catalog Number
Catalog Number for **1746-ITV16**.	1746-RL47
Catalog Number for **1746-OA16**.	1746-RL50
Catalog Number for **1746-OB16**.	1746-RL51
Catalog Number for **1746-OG16**.	1746-RL52
Catalog Number for **1746-OV16**.	1746-RL53
Catalog Number for **1746-OW16**.	1746-RL54
Catalog Number for **1746-OBP16**.	1746-RL55
Catalog Number for **1746-OVP16**.	1746-RL56
Catalog Number for **1746-OAP12**.	1746-RL57
Catalog Number for **1746-IC16**.	1746-RL58
Catalog Number for **1746-IH16**.	1746-RL59
Catalog Number for **1746-IB32**.	1746-RL60
Catalog Number for **1746-IV32**.	1746-RL61
Catalog Number for **1746-OB32**.	1746-RL70
Catalog Number for **1746-OV32**.	1746-RL71
Lithium Battery Assembly. This is an optional part used for the SLC 500 Fixed and Modular Hardware Style processors and the Hand-Held Terminal. Refer to product documentation for proper storage and handling instructions. For disposal information, consult your nearest Allen-Bradley Sales Office.	1747-BA
Replacement Processor to Peripheral Programming/Communication Cable – This 1.8 m (6 ft) cable is used to connect the interface converter to the SLC 500 controller when using personal computer interface software. This cable is also used to connect the Hand-Held Terminal to the SLC 500 controller and to connect the Data Table Access Module to the SLC 500 controller.	1747-C10
Replacement Processor to Isolated Link Coupler Cable – This 304.8 mm (12 in.) cable is used to connect the SLC 500 controller to the isolated link coupler.	1747-C11
Communication Module to Isolated Link Coupler Cable – This 914.4 mm (36 in.) cable is used to connect communication modules (i.e., 1746-BAS and 1747-KE) to the isolated link coupler. The isolated link coupler must be powered by an external power supply or connected to a device with a Catalog Number **1747-C10** or **1747-C11** cable.	1747-C13
Replacement Processor to Peripheral Programming/Communication Cable – This 6.096 m (20 ft) cable is used to connect the Interface Converter to the SLC 500 controller when using personal computer interface software. This cable is also used to connect the Hand-Held Terminal to the SLC 500 controller and to connect the Data Table Access Module to the SLC 500 controller.	1747-C20
SLC 5/03, SLC 5/04, and SLC 5/05 RS-232 Programmer Cable – This 3.96 m (12 ft) cable is used to connect the RS-232 channel (channel 0) to a personal computer serial port (9-pin DTE).	1747-CP3
Replacement Keys for the **SLC 5/03, SLC 5/04, and SLC 5/05** processors	1747-KY1
SLC 5/01 and SLC 5/02 EEPROM with 1K User Memory Backup	1747-M1
SLC 5/01 and SLC 5/02 EEPROM with 4K User Memory Backup	1747-M2
SLC 5/01 and SLC 5/02 UVPROM with 1K User Memory Backup	1747-M3
SLC 5/01 and SLC 5/02 UVPROM with 4K User Memory Backup	1747-M4
SLC 5/01 and SLC 5/02 Adapter Sockets — Orders must be for five sockets or multiples of five.	1747-M5
SLC 5/03, SLC 5/04, and SLC 5/05 Flash EPROM with up to 32K User Memory Backup	1747-M11
SLC 5/03, SLC 5/04, and SLC 5/05 Flash EPROM with up to 64K User Memory Backup	1747-M12
SLC 5/03, SLC 5/04, and SLC 5/05 adapter socket	1747-M15
Replacement Parts Kit for 20 I/O Fixed Hardware Style Processor, consists of: two Output Terminal Covers, two Input Terminal Covers, two Prom/Battery Covers, and one HHT/Comm Connector Cover.	1747-R5
Replacement Parts Kit for 30 & 40 I/O Fixed Hardware Style Processors, consists of: two Output Terminal Covers, two Input Terminal Covers, two Prom/Battery Covers, and one HHT/Comm Connector Cover.	1747-R7
HHT Keypad Replacement Overlay	–
English Memory Pak Firmware Releases 1.02, 1.07 and 1.10	1747-R20
French Memory Pak Firmware Releases 1.10	1747-R20F
German Memory Pak Firmware Releases 1.10	1747-R20G

Description	Catalog Number
Italian Memory Pak Firmware Releases 1.10	1747-R20I
English Memory Pak Firmware Releases 2.00 and Later	1747-R21
French Memory Pak Firmware Releases 2.00 and Later	1747-R21F

Replacement Terminal Blocks

This table provides a list of replacement terminal blocks and their catalog numbers.

Description	Catalog Number
Replacement Terminal Block (Red) — Used with AC I/O modules, Catalog Numbers **1746-IA16**, **-OA16**, **-IM16**, **-OAP12**	1746-RT25R
Replacement Terminal Block (Blue) — Used with DC I/O modules, Catalog Numbers **1746-IB16**, **-IC16**, **-IH16**, **-IV16**, **-OBP8**, **-OB16**, **-OBP16**, **-OVP16** **-OV16**, **-IN16**, **-IG16**, **-OG16**	1746-RT25B
Replacement Terminal Block (Orange) — Used with relay output modules, Catalog Numbers **1746-OW16**, **-OX8**	1746-RT25C
Replacement Terminal Block (Green) — Used with Specialty I/O modules, Catalog Numbers **1746-HSCE**, **-IO12**, **-NR4**, **-NI8**	1746-RT25G
Replacement Terminal Block — 2 position terminal block used with analog outputs, Catalog Numbers **1746-NO4I**, **-NO4V**	1746-RT26
Replacement Terminal Block — 8 position terminal block used with analog outputs, Catalog Numbers **1746-NO4I**, **-NO4V**	1746-RT27
Replacement Terminal Block — Used with analog input modules, Catalog Numbers **1746-NI4**, **-NIO4I**, **-NIO4V**, **-FIO4I**, **-FIO4V**	1746-RT28
Replacement Terminal Block — Used with RIO Communication Modules, Catalog Numbers **1747-SN**, **-DSN**, **-DCM**	1746-RT29
Replacement Terminal Block — Used with DH-485 Link Coupler, Catalog Number **1747-AIC**	1746-RT30
Replacement Terminal Block — Used with SLC 500 Remote I/O Adapter Module, Catalog Number **1747-ASB**	1746-RT31
Replacement Terminal Block — Used with Thermocouple/mV Module, Catalog Number **1746-NT4**	1746-RT32
Replacement Terminal Block — 3-position DH+ connector; used with SLC 5/04 Processors, Catalog Numbers **1746-L541**, **1746-L542**, **1747-L542P**, **1747-L543**	1746-RT33

Setting Up the DH-485 Network

The information in this appendix will help you plan, install, and operate the SLC 500 in a DH-485 network. This chapter also contains information that describes the DH-485 network functions, network architecture, and performance characteristics. It also covers:

- DH-485 network description
- DH-485 network protocol
- DH-485 token rotation
- DH-485 network initialization
- devices that use the DH-485 network
- 1747-AIC isolated link coupler for DH-485
- example system configuration (includes 1761-NET-AIC advanced interface converter)
- important planning considerations
- installing the DH-485 network

DH-485 Network Description

We have designed the DH-485 network to pass information between devices on the plant floor. The network monitors process parameters, device parameters, device status, process status and application programs to support data acquisition, data monitoring, program upload/download and supervisory control.

The DH-485 network offers:

- interconnection of 32 devices
- multi-master capability
- token passing access control
- the ability to add or remove nodes without disrupting the network
- maximum network length of 1219 m (4000 ft)

DH-485 Network Protocol

The following section describes the protocol used to control message transfers on the DH-485 network. The protocol supports two classes of devices: initiators and responders. All initiators on the network get a chance to initiate message transfers. To determine which initiator has the right to transmit, a token passing algorithm is used.

DH-485 Token Rotation

A node holding the token can send any valid packet onto the network. Each node is allowed only one transmission (plus two retries) each time it receives the token. After a node sends one message packet, it attempts to give the token to its successor by sending a "token pass" packet to its successor.

If no network activity occurs, the initiator sends the token pass packet again. After two retries (a total of three tries) the initiator will attempt to find a new successor.

Important: The maximum address that the initiator will search for before wrapping to zero is the value in the configurable parameter "maximum node address." The default value for this parameter is 31 for all initiators and responders.

The allowable range of the node address of an initiator is 0 to 31. The allowable address range for all responders is 1 to 31. There must be at least one initiator on the network.

DH-485 Network Initialization

Network initialization begins when a period of inactivity exceeding the time of a link dead timeout is detected by an initiator on the network. When the time for a link dead timeout is exceeded, usually the initiator with the lowest address claims the token. When an initiator has the token it will begin to build the network. The network requires at least one initiator to initialize it.

Building a network begins when the initiator that claimed the token tries to pass the token to the successor node. If the attempt to pass the token fails, or if the initiator has no established successor (for example, when it powers up), it begins a linear search for a successor starting with the node above it in the addressing.

When the initiator finds another active initiator, it passes the token to that node, which repeats the process until the token is passed all the way around the network to the first node. At this point, the network is in a state of normal operation.

Devices that use the DH-485 Network

Presently, the following SLC 500 devices support the DH-485 network:

- SLC 500 Fixed I/O Controller (responder)
- SLC 5/01 Modular I/O Controller (responder)
- SLC 5/02 Modular I/O Controller (initiator/responder)
- SLC 5/03 Modular I/O Controller (initiator/responder)
- SLC 5/04 Modular I/O Controller (initiator/responder)
- SLC 5/05 Modular I/O Controller (initiator/responder)
- Personal computer running your programming software (initiator)
- Hand-Held Terminal (initiator)
- DTAM (initiator/responder)

Other devices that use the DH-485 network include those in the table below.

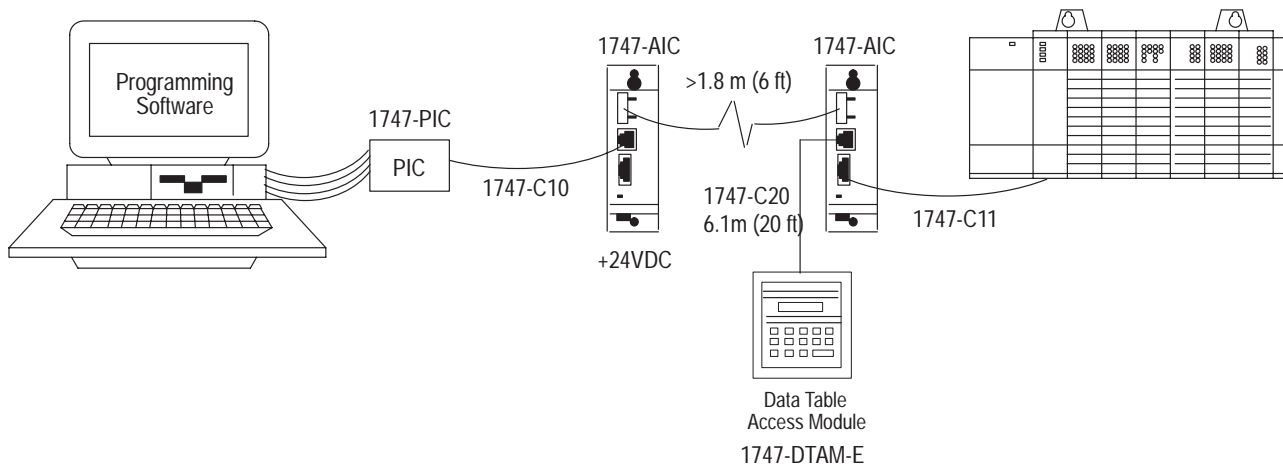| Catalog Number	Description	Installation Requirement	Function	Publication
1746-BAS	BASIC Module	SLC Chassis	Provides an interface for SLC 500 devices to foreign devices. Program in BASIC to interface the 3 channels (2 RS232 and 1 DH485) to printers, modems, or the DH-485 network for data collection.	1746-6.1 1746-6.2 1746-6.3
1747-KE	DH-485/DF1 Interface Module	SLC Chassis	Provides a non-isolated DH-485 interface for SLC 500 devices to host computers over RS-232 using full- or DF1 half-duplex protocol. Enables remote programming using your programming software to an SLC 500 processor or the DH-485 network through modems. Ideal for low cost RTU/SCADA applications.	1747-6.12
1770-KF3	DH-485/DF1 Interface Module	Standalone ("desktop")	Provides an isolated DH-485 interface for SLC 500 devices to host computers over RS-232 using full- or DF1 half-duplex protocol. Enables remote programming using your programming software to an SLC 500 processor or the DH-485 network through modems.	1770-6.5.18
1784-KR	PC DH-485 Interface Module	IBM XT/AT Computer Bus	Provides an isolated DH-485 port on the back of the computer. When used with your programming software, it improves communication speed and eliminates use of the Personal Interface Converter (1747-PIC). The Standard Driver allows you to write "C" programs for data acquisition applications.	1784-2.23 6001-6.5.5
1785-KA5	DH+™/DH485 Gateway	(1771) PLC Chassis	Provides communication between stations on the PLC-5® (DH+) and SLC 500 (DH-485) networks. Enables communication and data transfer from PLC® to SLC 500 on DH-485 network. Also enables programming software programming or data acquisition across DH+ to DH-485.	1785-6.5.5 1785-1.21
2760-RB	Flexible Interface Module	(1771) PLC Chassis	Provides an interface for SLC 500 (using protocol cartridge 2760-SFC3) to other A-B PLCs and devices. Three configurable channels are available to interface with Bar Code, Vision, RF, Dataliner™, and PLC systems.	2760-ND001
1784-KTX, -KTXD	PC DH485 IM	IBM XT/AT Computer Bus	Provides DH485 or DH+ connection	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH485 or DH+ connection	1784-6.5.19
2707-L8P1, -L8P2, -L40P1, -L40P2, -V40P1, -V40P2, -V40P2N, -M232P3, and -M485P3	DTAM Plus and DTAM Micro Operator Interfaces	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2707-800, 2707-803
2711-K5A2, -B5A2, -K5A5, -B5A5, -K5A1, -B5A1, -K9A2, -T9A2, -K9A5, -T9A5, -K9A1, and -T9A1	PanelView 550 and PanelView 900 Operator Terminals	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2711-802, 2711-816

1747-AIC Isolated Link Coupler for DH-485

The isolated link coupler (1747-AIC) is used to connect SLC 500 family devices to the DH-485 network (as shown on page A–5). The coupler provides a 6-position removable terminal block for connection to the DH-485 communication cable.

Network connections for SLC 500 processors are provided by the Catalog Number 1747-C11, 304.8 mm (12 in.) cable supplied with the link coupler. Network connections for peripheral devices, such as the Personal Interface Converter (1747-PIC), Data Table Access Module (1747-DTAM-E), or Hand-Held Terminal (1747-PT1) are provided by the standard Catalog Number 1747-C10 1.8 m (6 ft) cable supplied with each of those devices. If you need to connect a peripheral device that is between 1.8 m (6 ft) and 6.1 m (20 ft) away, use the 1747-C20 cable.

To protect connected devices, the coupler provides 1500V dc isolation between the communications cable and the attached SLC 500 controller and peripheral devices (PIC, DTAM, or HHT).

The isolated link coupler can also be used to provide connectivity between a peripheral device (programming software and PIC, HHT, or DTAM) for distances greater than 1.8 m (6 ft) up to a maximum of 1219 m (4000 ft). Below is an example of a "remote" connection between a computer running your programming software and an SLC 500 processor.

Example System Configuration

Below is an example of a DH-485 network.

The diagram shows a DH-485 network with the following components labeled:

- IBM–PC, XT, or compatible with 1784–KR, DH–485 PC Interface
- 1747–AIC
- SLC 500 Fixed I/O Controller
- SLC 500 20 point Fixed I/O Controller with 2-slot expansion chassis
- 1747–AIC
- SLC 500 Hand–Held Terminal
- 1747–AIC
- SLC 500 5/01 Modular I/O Controller
- Data Table Access Module
- 1747–AIC
- SLC 500 20 point Fixed I/O Controller
- SLC 5/03, 5/04, or 5/05 Modular I/O Controller
- 1761-NET-AIC Advanced Interface Converter
- Allen–Bradley 1784–T45, T47 or compatible laptop
- 1747–PIC Interface Converter
- 1747–AIC Isolated Link Coupler
- SLC 500 5/02 Modular I/O Controller

DH–485 Network max. length 1219 m (4,000 ft)

Configuring the SLC 5/03, SLC 5/04, and SLC 5/05 Channel 0 for DH485

The RS-232 port (channel 0) of the SLC 5/03, SLC 5/04, and SLC 5/05 processor can be configured for DH485 protocol. Refer to your programming software user manual for software configuration information.

You can connect channel 0 of the SLC 5/03, SLC 5/04, and SLC 5/05 processors to a DH485 network using the 1747-CP3 cable and a 1761-NET-AIC Advanced Interface Converter (AIC+). In this case, the AIC+ must be powered with 24V dc. The 1746-P1, -P2, and -P4 power supplies provide 24V dc user power which may be used to power the AIC+.
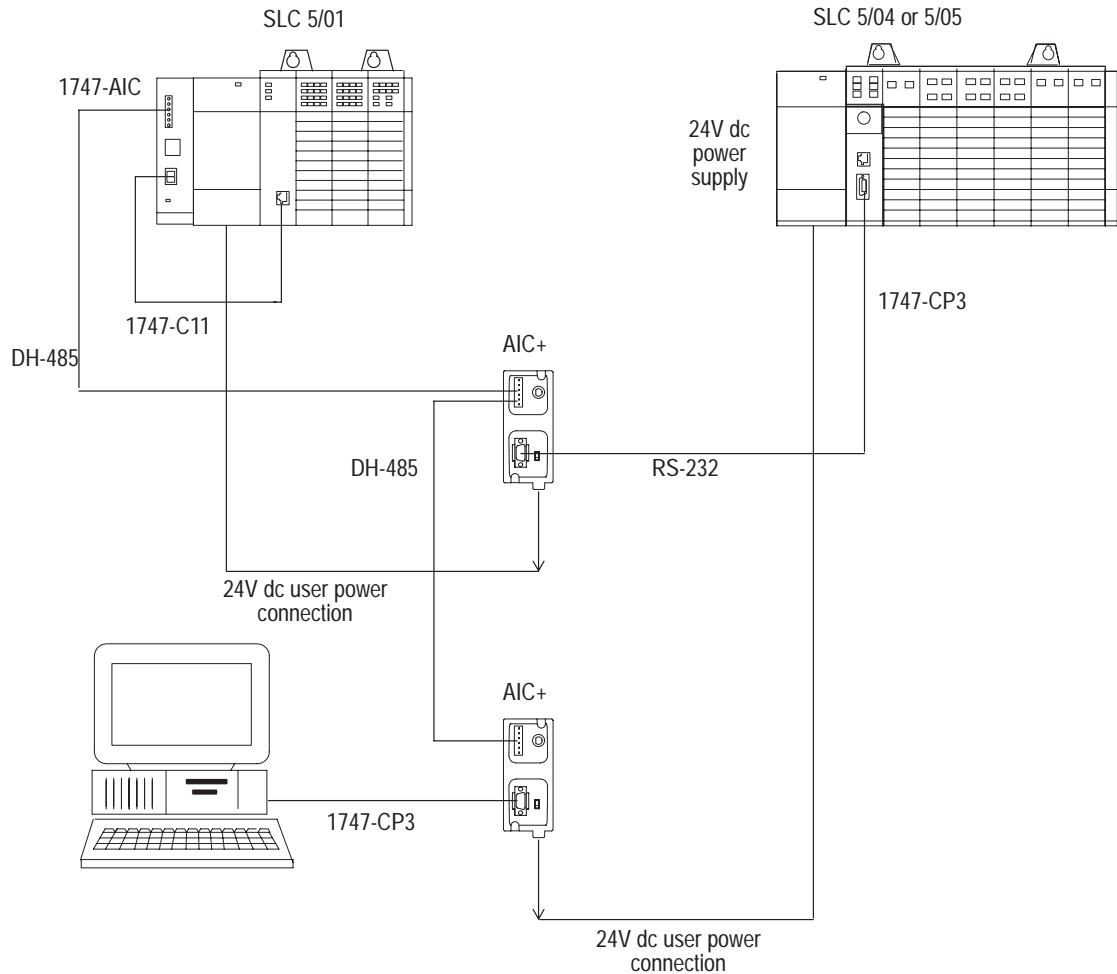
Important Planning Considerations

Carefully plan your network configuration before installing any hardware. Listed below are some of the factors that can affect system performance:

- amount of electrical noise, temperature, and humidity in the network environment
- number of devices on the network
- connection and grounding quality in installation
- amount of communication traffic on the network
- type of process being controlled
- network configuration

The major hardware and software issues you need to resolve before installing a network are discussed in the following sections.

Hardware Considerations

You need to decide the length of the communication cable, where you route it, and how to protect it from the environment where it will be installed.

When the communication cable is installed, you need to know how many devices are to be connected during installation and how many devices will be added in the future. The following sections will help you understand and plan the network.

Number of Devices and Length of Communication Cable

You must install a link coupler (1747-AIC) for each node on the network. If you plan to add nodes later, provide additional link couplers during the initial installation to avoid recabling after the network is in operation.

The maximum length of the communication cable is 1219 m (4000 ft). This is the total cable distance from the first node to the last node on the network.

Planning Cable Routes

Follow these guidelines to help protect the communication cable from electrical interference:

- Keep the communication cable at least 1.52 m (5 ft) from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.

- If you do not run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.15 m (6 in.) from ac power lines of less than 20A, 0.30 m (1 ft) from lines greater than 20A, but only up to 100k VA, and 0.60 m (2 ft) from lines of 100k VA or more.

- If you run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.08 m (3 in.) from ac power lines of less than 20A, 0.15 m (6 in.) from lines greater than 20A, but only up to 100k VA, and 0.30 m (1 ft) from lines of 100k VA or more.

Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

  – Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminum conduit in non-critical areas.

  – Use plastic connectors to couple between aluminum and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.

  – Ground the entire length of conduit by attaching it to the building earth ground.

  – Do not let the conduit touch the plug on the cable.

  – Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.

  – Install the conduit so that it meets all applicable codes and environmental specifications.

For more information on planning cable routes, see *Industrial Automation Wiring and Grounding Guidelines*, Publication Number 1770-4.1.

Software Considerations

Software considerations include the configuration of the network and the parameters that can be set to the specific requirements of the network. The following are major configuration factors that have a significant effect on network performance:

- number of nodes on the network

- addresses of those nodes

- baud rate

- maximum node address selection

- *SLC 5/03, SLC 5/04, and SLC 5/05 only*: token hold factor

- maximum number of communicating devices

The following sections explain network considerations and describe ways to select parameters for optimum network performance (speed).

Number of Nodes

The number of nodes on the network directly affects the data transfer time between nodes. Unnecessary nodes (such as a second programming terminal that is not being used) slow the data transfer rate. The maximum number of nodes on the network is 32.

Setting Node Addresses

The best network performance occurs when node addresses start at 0 and are assigned in sequential order. SLC 500 processors default to node address 1. The node address is stored in the processor status file (S:15L). Processors cannot be node 0. Also, initiators such as personal computers should be assigned the lowest numbered addresses to minimize the time required to initialize the network.

Setting Processor Baud Rate

The best network performance occurs at the highest baud rate. All devices must be at the same baud rate. The baud rate is stored in the processor status file (S:15H).

Maximum Node Address Setting

The maximum node address parameter should be set as low as possible. This minimizes the amount of time used in soliciting successors when initializing the network. If all nodes are addressed in sequence from 0, and the maximum node address is equal to the address of the highest addressed node, the token rotation will improve by the amount of time required to transmit a solicit successor packet plus the slot timeout value.

Note that this does not allow any node to be added to the network without affecting the response time. On the other hand, since the time required to hold an open station address is greater than the time required to pass a token, it can be useful to leave a temporary device (such as a personal computer) connected if there is only one such device. (A solicit successor packet requires the same transmission time as the token pass, but there is an added slot timeout period.)

See your programming software user manual or the *Hand-Held Terminal User Manual*, Catalog Number 1747-NP002, for the procedures to set node addresses, processor baud rate, and maximum node addresses.

Important: The SLC 500 Series A (only) processors set the maximum node address to 31 when power is cycled increasing initialization and response time of the network.

Maximum Number of Communicating Devices

SLC 500 fixed and SLC 5/01 processors can be selected by two initiators maximum at the same time. Using more than two initiators to select the same SLC 500 fixed and SLC 5/01 processors at the same time can cause communication timeouts.

Installing the DH-485 Network

To install a DH-485 network, you will need tools to strip the shielded cable and to attach the cable and terminators to the Isolated Link Coupler.

Install the DH-485 network using the following tools (or equivalent):

Description	Part Number	Manufacturer
Shielded Twisted Pair Cable	Belden #3106A or #9842	Belden
Stripping Tool	45-164	Ideal Industries
1/8 ″ Slotted Screwdriver	Not Applicable	Not Applicable

DH-485 Communication Cable and Isolated Link Coupler

The link coupler provides a connection for each node. The isolated link coupler electrically isolates the DH-485 communication interface from the processor and peripheral connections. Electrical-optical isolation is provided to 1500V.

The suggested DH-485 communication cable is Belden #3106A or #9842 cable. The cable is jacketed and shielded with two twisted wire pairs and a drain wire.

One pair provides a balanced signal line, and one wire of the other pair is used for a common reference line between all nodes on the network. The shield reduces the effect of electrostatic noise from the industrial environment on the network communication.

Installing the DH-485 Communication Cable

The communication cable consists of a number of cable segments daisy-chained together. The total length of the cable segments cannot exceed 1219 m (4000 ft).

When cutting cable segments, make them long enough to route them from one link coupler to the next with sufficient slack to prevent strain on the connector. Allow enough extra cable to prevent chafing and kinking in the cable.
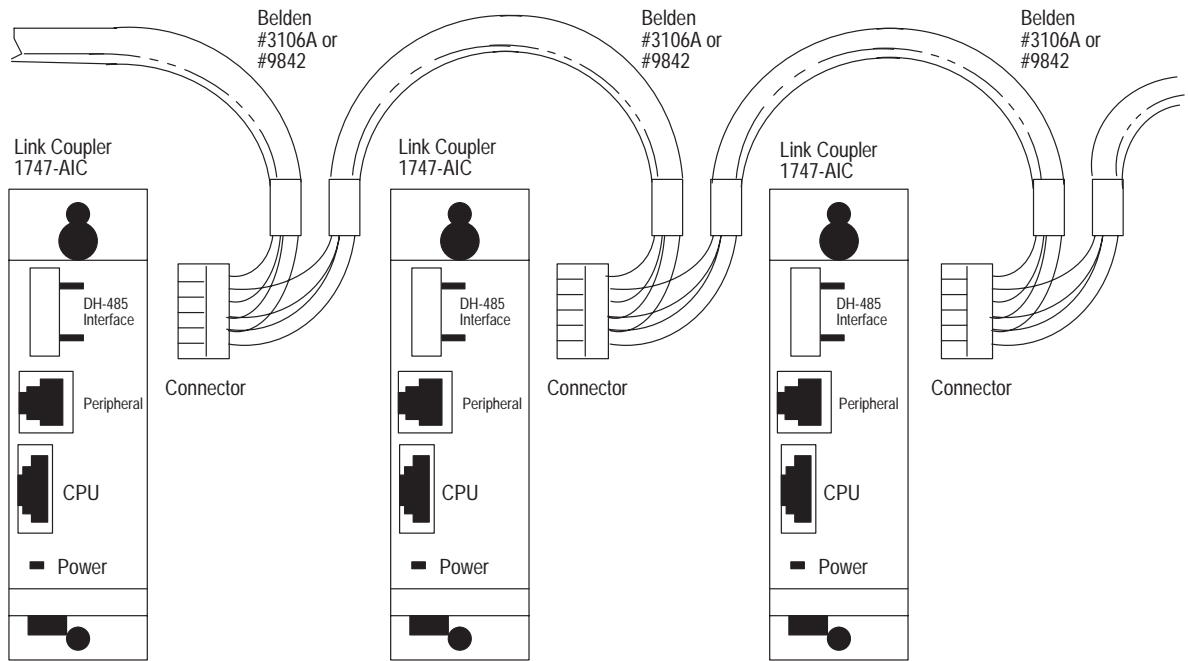
Important: A daisy-chained network is recommended as shown above. We do *not* recommend the following:
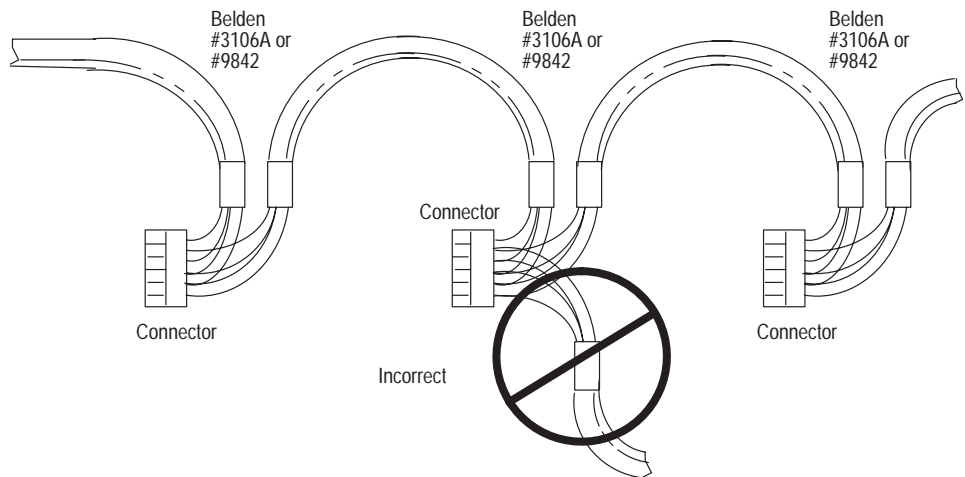
Connecting the Communication Cable to the Isolated Link Coupler

Attach the terminal block of the link coupler to the Belden #3106A or #9842 cable as shown below. Additional terminal blocks are available for replacement, see chapter 11.

Single Cable Connection
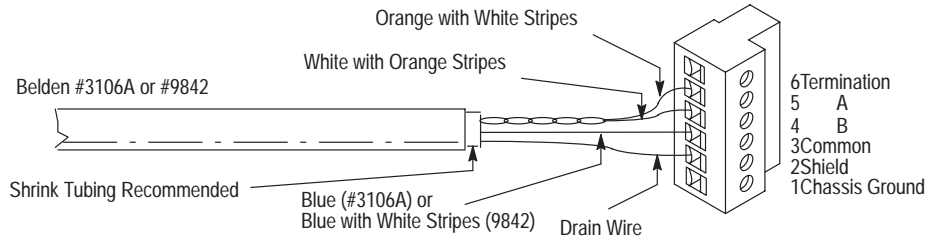
Multiple Cable Connection
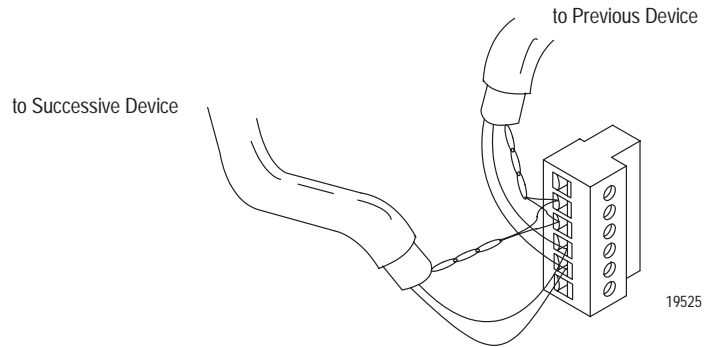
The table below shows wire/terminal connections for DH-485 connectors for Belden #3106A.

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 – Shield
Blue	Blue	Terminal 3 – (Common)
White/Orange	White with Orange Stripe	Terminal 4 – (Data B)
	Orange with White Stripe	Terminal 5 – (Data A)

The table below shows wire/terminal connections for DH-485 connectors for Belden #9842.

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 – Shield
Blue/White	White with Blue Stripe	Cut back – no connection [1]
	Blue with White Stripe	Terminal 3 – (Common)
White/Orange	White with Orange Stripe	Terminal 4 – (Data B)
	Orange with White Stripe	Terminal 5 – (Data A)

[1] To prevent confusion when installing the communication cable, cut back the white with blue stripe wire immediately after the the insulation jacket is removed. This wire is not used by DH-485.

Important: In Series A 1747-AIC, terminal 5 was called DATA B and terminal 4 was called DATA A. In this case, use terminal numbers only and ignore signal names DATA B and DATA A. The internal circuitry of the Series A is the same as Series B.

Grounding and Terminating the DH-485 Network

Only one of the link couplers at the end of the link must have Terminals 1 and 2 of the network connector jumpered together. This provides an earth ground connection for the shield of the communication cable.

Link couplers at both ends of the network must have Terminals 5 and 6 of the link connectors jumpered together. This connects the termination impedance (of 120Ω) that is built into each link coupler as required by the DH-485 specification. See the figure below for the proper jumpering.

End-of-Line Termination
Jumper
Jumper
Belden #9842 Cable
1219 m (4000 ft) Maximum
6 5 4 3 2 1
Jumper
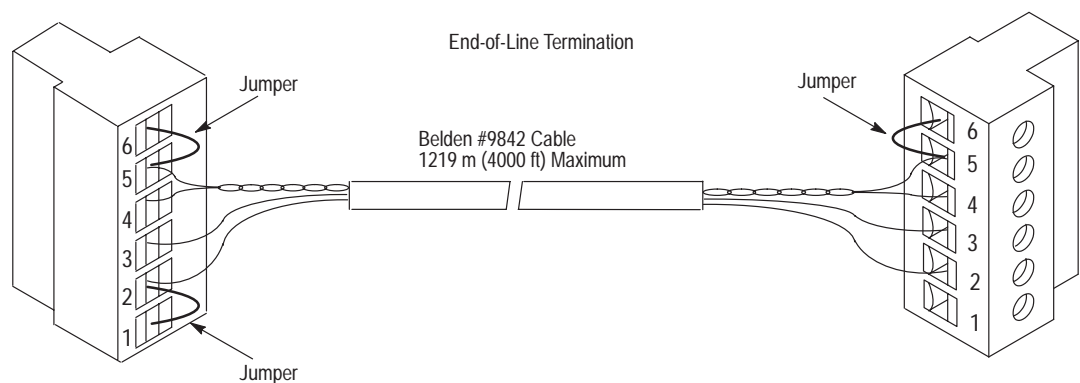
Powering the Link Coupler

In normal operation with the programmable controller connected to the link coupler, the processor powers both the link coupler and peripheral device (DTAM, PIC, HHT) — if connected — through the C11 cable.

If you do not connect the processor to the link coupler, then use a 24V dc power supply to power the link coupler and peripheral device. The 1747-AIC requires 85 mA at 24V dc. With a peripheral device connected, the total current required is 190 mA at 24V dc.

If both the processor and external power are connected to the link coupler, only the external source is used.

Important: Always connect the CHS GND (chassis ground) terminal to the nearest earth ground. This connection must be made whether or not an external 24V dc supply is used.

Below are three options for externally powering the 1747-AIC:

* If the link coupler is to be installed in an office environment, you can use the wall mount power supply (1747-NP1) or global desktop power supply (1747-NP2). The link coupler would be powered through either the 1747-C10 cable or by hardwiring from the supply to the screw terminals on the link coupler.

* If you use the AC chassis power supplies (1746-P1, 1746-P2, or 1746-P4), you can use the 24V dc user power supply (200 mA maximum) built into the power supply. The link coupler would be powered through a hard-wired connection from the screw terminals on the power supply to the screw terminals on bottom of the link coupler.

* You can use an external DC power supply with the following specifications:
    – operating voltage: 24V dc $\pm$ 25%
    – output current: 190 mA
    – rated NEC

    The link coupler would be powered through a hard-wired connection from the external supply to the screw terminals on the bottom of the link coupler.

> ⚠ **ATTENTION:** If you use an external power supply, it must be 24V dc. Permanent damage will result if miswired with wrong power source.

The figure below shows the external wiring connections and specifications of the link coupler.

Left Side

SLC 500
DH–485 LINK COUPLER

A·B QUALITY

CAT   SER

UL LISTED IND. CONT. EQ. FOR HAZ. LOC. A196

CSA ®   OPERATING TEMPERATURE CODE T3C   CE

CLASS 1, GROUPS A, B, C AND D, DIV. 2

6 TERMINATION
5 A
4 B
3 COMMON
2 SHIELD
1 CHASSIS GROUND

EXTERNAL POWER REQUIREMENTS

24 VDC +/– 25% AT 190 mA
N.E.C. CLASS 2

CAUTION –EXTERNAL POWER, IF USED, MUST BE 24VDC
PERMANENT DAMAGE TO CIRCUITRY WILL RESULT
IF MISWIRED WITH THE WRONG POWER SOURCE.

CHS GND   DC NEUT   24VDC

FAC 1P   MADE IN U.S.A.

CHS GND   DC NEUT   24 VDC

Bottom

You can connect an unpowered link coupler to the DH-485 network without disrupting network activity. In addition, if an SLC 500 controller powers a link coupler that is connected to the DH-485 network, network activity will not be disrupted should the SLC 500 controller be removed from the link coupler.

Installing and Attaching the Link Couplers

1. Take care when installing the link coupler in an enclosure so that the cable connecting the SLC 500 controller to the link coupler does not hit the enclosure door.

2. Carefully plug the terminal block into the DH-485 port on the link coupler you are putting on the network. Allow enough cable slack to prevent stress on the plug.

3. Provide strain relief for the Belden #9842 cable after it is wired to the terminal block. This guards against breakage of the Belden cable wires.

RS-232 Communication Interface

This appendix provides an overview of the RS-232 communication interface and explains how the SLC 5/03, SLC 5/04, and SLC 5/05 processors support it. This appendix also provides information on the following:

- RS-232 and SCADA applications
- RS-232 communication interface overview
- SLC 5/03, SLC 5/04, and SLC 5/05 processors and RS-232 communication
- SLC 500 devices that support RS-232 communication
- DF1 protocol and the SLC 5/03, SLC 5/04, and SLC 5/05 processors
- ASCII communication
- DF1 communication protocol modems overview
- wiring connectors for RS-232 communication
- applications for the RS-232 communication interface

For online configuration procedures of the SLC 5/03, SLC 5/04, and SLC 5/05 processors for DF1 protocol, see your programming software user manual.

RS-232 and SCADA Applications

RS-232 is a communication interface included under SCADA (Supervisory Control and Data Acquisition) applications. SCADA is a term that refers to control applications that require communication over long distances. For more information about the use of Allen-Bradley equipment in SCADA applications, refer to the *SCADA System Applications Guide,* Publication Number AG-6.5.8.

RS-232 Communication Interface Overview

RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical, mechanical, and functional characteristics for serial binary communication.

One of the benefits of RS-232 communication is that it lets you integrate telephone and radio modems into your control system. The distance over which you are able to communicate with certain system devices is virtually limitless.

The RS-232 channel on the SLC 5/03, SLC 5/04, and SLC 5/05 processors supports four protocols:

- Full-Duplex DF1 (default)
- Half-Duplex DF1 (SCADA)
- DH-485
- ASCII Communications

The SLC and PLC products detailed in this appendix that communicate over the RS-232 communication interface also use the DF1 serial communication protocol. DF1 protocol delimits messages, controls message flow, detects and signals errors, and retries after errors are detected.

SLC 5/03, SLC 5/04, and SLC 5/05 Processors and RS-232 Communication

The SLC 5/03, SLC 5/04, and SLC 5/05 processors can communicate by means of the RS-232 communication port, channel 0. Channel 0 supports DF1 full-duplex protocol and DF1 half-duplex master and slave protocol, DH485 protocol , as well as ASCII communications. Refer to your programming software user manual for information on configuring the RS-232 communication port, channel 0.

The details of the DF1 protocols can be found in the *DF1 Protocol and Command Set Reference Manual*, Publication Number 1770-6.5.16.

Channel 0 provides a minimum of 500V dc isolation between the I/O signals and the logic ground of the SLC 5/03, SLC 5/04, and SLC 5/05 processors. The channel is a 9-pin D-shell. The table below provides a description of each of the pins.

Pin	Pin Name	
1	DCD	(Data Carrier Detect)
2	RXD	(Receive Data)
3	TXD	(Transmit Data)
4	DTR	(Data Terminal Ready)
5	COM	(Common Return [Signal Ground])
6	DSR	(Data Set Ready)
7	RTS	(Request to Send)
8	CTS	(Clear to Send)
9	NC	(No Connection)

The D-shell is the bottom port on the SLC 5/03, SLC 5/04, and SLC 5/05 processors.

SLC 500 Devices that Support RS-232 Communication

The SLC 500 product line has three other modules, aside from the SLC 5/03, SLC 5/04, and SLC 5/05 processors, that support the RS-232 communication interface. They are the DH-485 Communication Interface (1770-KF3), the BASIC module (1746-BAS), and the DH-485/RS-232C Interface (1747-KE). All three of these modules can be used with either the SLC 5/01 or SLC 5/02 processor.

1770-KF3 Module

The 1770-KF3 module links host computers with the Allen-Bradley DH-485 Data Highway. The host computer communicates with the 1770-KF3 over an RS232 link using DF1 protocol. Through the 1770-KF3, the host computer can communicate with the nodes on the DH-485 network.

For more information on the 1770-KF3 module, see the *DH-485 Communication Interface User Manual*, Catalog Number 1770-6.5.18.

1747-KE Module

The 1747-KE is a communication interface module that acts as a bridge between DH-485 networks and devices requiring DF1 protocol. You can configure the DF1 port on the 1747-KE for RS-232/423, RS-422, or RS-485 devices. Residing in an SLC 500 chassis, the 1747-KE is ideally used as an interface module, linking remote DH-485 networks via a modem to a central host.

For more information on the 1747-KE module, see the *DH-485/RS-232 Interface Module User Manual*, Catalog Number 1747-6.12.

1746-BAS Module

The 1746-BAS module, which is programmed using the BASIC language, has two configurable serial ports for interfacing to computers, modems, serial printers, and other RS-232 compatible devices. You can also use it for off-loading complex math routines from an SLC 500 processor; this conserves ladder logic memory.

For more information on the 1746-BAS module, see the *SLC 500 BASIC Module Design and Integration Manual*, Catalog Number 1747-6.1.

DF1 Protocol and the SLC 5/03, SLC 5/04, and SLC 5/05 Processors

DF1 protocol combines data transparency (ANSI — American National Standards Institute — specification subcategory D1) and 2-way simultaneous transmission with embedded responses (F1). It is also a peer-to-peer, link-layer protocol. This means that system devices have equal access to messages being sent over the RS-232 communication interface.

DF1 protocol provides two modes of communication: full- and half-duplex.

DF1 Full-Duplex Protocol

DF1 full-duplex protocol (also referred to as DF1 point-to-point protocol) lets you use RS-232 point-to-point communication in applications that require it. This type of protocol supports simultaneous transmissions between two devices in both directions. You can use channel 0 as a programming port, or as a peer-to-peer port using the MSG instruction.

In full-duplex mode, the SLC 5/03, SLC 5/04, and SLC 5/05 processors can send and receive messages. When the SLC 5/03, SLC 5/04, and SLC 5/05 processors receive messages, they act as an end device, or final destination for the data packets.[1] The processor ignores the destination and source addresses received in the data packets. However, the processor swaps these addresses in the reply that it transmits in response to any command data packet that it has received.

By setting a parameter with your programming software, you can also make the processor verify that the host computer can receive embedded responses. To do this, the processor waits to receive an embedded response from the host computer, before sending one of its own. A host computer that can send embedded responses should also be able to receive them.

If you use modems with DF1 full-duplex protocol, make sure that they are capable of simultaneous bi-directional communication. Typically, dial-up modems designed to be connected to standard telephone lines can support full-duplex.

[1] The exception to this is the SLC 5/04 OS401 or higher that has the DH+ to DF1 full-duplex passthru bit enabled. In this case, the processor checks the destination address in the packet and if it does not match the configured DH+ address of the processor, then the packet is forwarded onto the DH+ network to the destination address DH+ node.

Full-Duplex (Point-to-Point)
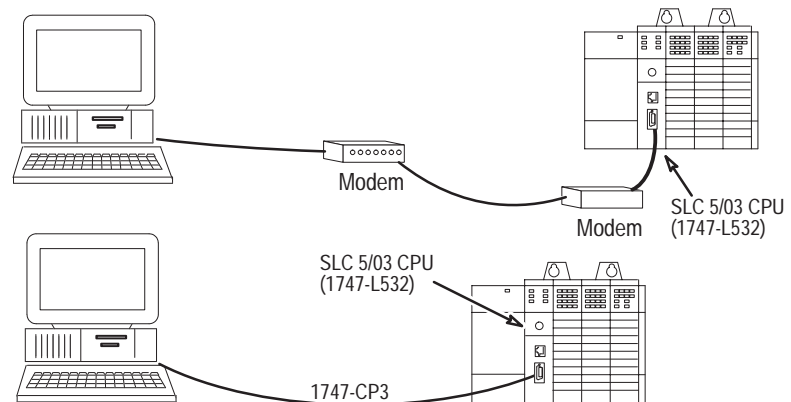
DF1 Half-Duplex Protocol

DF1 half-duplex protocol provides a multi-drop single master/multiple slave network. In contrast to the DF1 full-duplex protocol, communication takes place in one direction at a time. You can use channel 0 as a programming port, or as a peer-to-peer port using the MSG instruction.

In half-duplex mode, the SLC 5/03, SLC 5/04, and SLC 5/05 processors can be either master or slave devices. As a master device, the processor polls each slave on the network on a regular and sequential basis. The master also supports routing of data packets from one slave to another, or slave-to-slave communication. As a slave device, the processor can send data packets when polled by the master device, which initiates all communication with slave devices.

If the master device has no data to send, it can still receive data from the slave device. To do this, the master sends out a poll packet addressed to the slave. If the slave has data to send, it does so in response to the poll packet. Otherwise, the slave sends a simple two byte response, so that the master knows that it is active.

Several Allen-Bradley products support half-duplex master protocol. They include the Enhanced PLC-5 processors, and SLC 5/03, SLC 5/04, and SLC 5/05 processors. WINtelligent Linx and RSLinx (2.0 or higher) from Rockwell Software, Inc. also support half-duplex master protocol.

DF1 Half-duplex supports up to 255 slave devices (address 0 to 254) with address 255 reserved for master broadcasts. The SLC 5/03, SLC 5/04, and SLC 5/05 support broadcast reception, but cannot initiate a broadcast command.

Either half-duplex or full-duplex modem types can be used for the master, but half-duplex modems must be used for the slaves (assuming there is more than one on a multi-drop network).

WINtelligent Linx or RSLinx Running
DF1 Half-Duplex Protocol (MASTER)

RS-232 (DF1 Protocol)   Modem

Modem

Modem

Modem

Modem

SLC 5/02 Processor
Modular Controller with 1747-KE
Interface Module (SLAVE)

SLC 5/03 Processor
Modular Controller
(SLAVE)

SLC 5/01 Processor
Modular Controller with 1747-KE
Interface Module (SLAVE)

SLC 500 Fixed I/O
Controller with 1747-KE
Interface Module (SLAVE)

SLC 5/03 Processor
Modular Controller

(MASTER)

RS-232 (DF1 Protocol)   Modem

Modem

Modem

Modem

Modem

SLC 5/02 Processor
Modular Controller with 1747-KE
Interface Module (SLAVE)

SLC 5/03 Processor
Modular Controller (SLAVE)

SLC 5/01 Processor
Modular Controller with 1747-KE
Interface Module (SLAVE)

SLC 500 Fixed I/O
Controller with 1747-KE
Interface Module (SLAVE)

ASCII Communication

ASCII protocol allows you to connect the SLC 5/03, SLC 5/04, and SLC 5/05 processors to serial printers, PCs, and other third party devices. ASCII protocol allows your ladder program to manage ASCII data.

SLC 5/03 Processor
Modular Controller

1747-CP3   RS-232 Channel 0
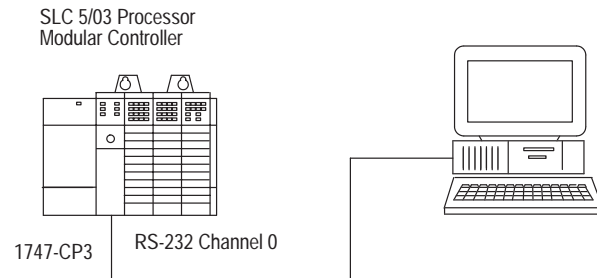
DF1 Communication Protocol Modems Overview

You can connect the SLC 5/03, SLC 5/04, and SLC 5/05 processors to several different types of modems. In all cases, the processors act as Data Terminal Equipment (DTE). DTE send and/or receive data on a network. Modem or line drivers act as Data Communication Equipment (DCE), which provide the signal conversion and coding required for communication between DTE and data circuits. Other DCE include phone-line modems and specialized modems, such as radio and satellite-link modems.

In addition to Common Return (COM), Receive Data (RXD), and Transmit Data (TXD), the following active modem-control lines are provided on the SLC 5/03, SLC 5/04, and SLC 5/05 processors:

RTS (Request to Send) — this output signal indicates to the modem or other DCE that the DTE wants to transmit.

CTS (Clear to Send) — this input signal from the modem indicates the modem is ready to receive the transmission by the DTE for forwarding over a link.

DSR (Data Set Ready) — this input signal indicates the DCE device is ready for operation. Loss of this signal causes a "modem-lost" condition in the processor.

DTR (Data Terminal Ready) — this output signal from the DTE indicates that it is ready for operation. You can also use this signal with the processor to initiate DTR dialing in dial-up modems that support such a feature.

DCD (Data Carrier Detect) — this is an input signal from the DCE that indicates a carrier signal is being received and that presumably data is to be received for forwarding to the DTE connected.

Wiring Connectors for RS-232 Communication

To connect Allen-Bradley devices with other devices over RS-232, you must wire the cable connectors so that communication can occur through the cabling, which provide the interface between devices.

Types of RS-232 Connectors

The figure below show male connectors, and their pinout locations, for Allen-Bradley devices.

9-point Connector (Male)   15-point Connector (Male)   25-point Connector (Male)
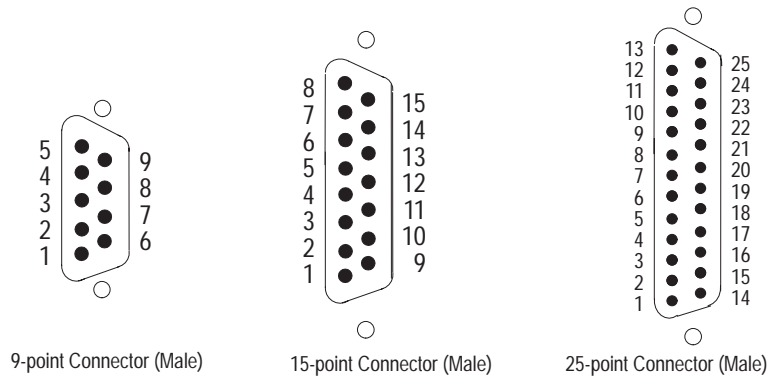
DTE Pinout

Channel 0 is configured as DTE for all SLC 5/03, SLC 5/04, and SLC 5/05 processors. The pinouts are the same as the 9-pin AT port.

DTE 9 pinout		Signal is	Equivalent DTE 15 pinout	Equivalent DTE 25 pinout
1 –DCD	Data Carrier Detect	Input	8	8
2 –RXD	Received Data	Input	3	3
3 –TXD	Transmitted Data	Output	2	2
4 –DTR	Data Terminal Ready	Output	11	20
5 –COM	Common Return (Signal Ground)	Shared	7	7
6 –DSR	Data Set Ready	Input	6	6
7 –RTS	Request to Send	Output	4	4
8 –CTS	Clear to Send	Input	5	5
9 –NC	No Connection	Input		22 RI Ring Indicator

DCE Pinout

Devices such as a modem are DCE. The pinouts on these terminals are wired to interface with DTE.

DCE 9 pinout		Signal is	Equivalent DCE 25 pinout
1 –DCD	Data Carrier Detect	Output	8
2 –RXD	Received Data	Output	3
3 –TXD	Transmitted Data	Input	2
4 –DTR	Data Terminal Ready	Input	20
5 –COM	Common Return (Signal Ground)	Shared	7
6 –DSR	Data Set Ready	Output	6
7 –RTS	Request to Send	Input	4
8 –CTS	Clear to Send	Output	5
9 –RI	Ring Indicator	Output	22

Important: DCE signal names are viewed from a DTE perspective. For example, TXD is a DTE output and also a DCE input.

Pin Assignments for Wiring Connectors

Use the following pin assignments to wire the connectors of
Allen-Bradley control devices with modems and peripheral devices
that support RS-232 communication. See the table below to find the
wiring diagram that you need.

To Connect this Device	To this Device	Remarks	See this Page
IBM AT	Modem	Hardware Handshaking Enabled	B–11
	Peripheral DTE	Hardware Handshaking Disabled	B–11
SLC 5/03, SLC 5/04, and SLC 5/05 Processors	Modem	Hardware Handshaking Enabled	B–11
	Peripheral DTE	Hardware Handshaking Disabled	B–12
	IBM AT	Using a 1747-CP3 Cable	B–12
1747-KE	Modem	Hardware Handshaking Enabled	B–12
	Peripheral DTE	Hardware Handshaking Disabled	B–13
1746-BAS	Modem	Hardware Handshaking Enabled	B–13
	Peripheral DTE	Hardware Handshaking Disabled	B–14
1770-KF3	Modem	Hardware Handshaking Enabled	B–14
2760-RB	Modem	Hardware Handshaking Enabled	B–14
	Peripheral DTE	Hardware Handshaking Disabled	B–15
1771-KGM (PLC-2)	Modem	Hardware Handshaking Enabled	B–15
	Peripheral DTE	Hardware Handshaking Disabled	B–16
1775-KA (PLC-3)	Modem	Hardware Handshaking Enabled	B–16
	Peripheral DTE	Hardware Handshaking Disabled	B–17
PLC-5 (channel 0)	Modem	Hardware Handshaking Enabled	B–17
	Peripheral DTE	Hardware Handshaking Disabled	B–18
5130-RM (PLC-5/250)	Modem	Hardware Handshaking Enabled	B–18
	Peripheral DTE	Hardware Handshaking Disabled	B–19

IBM AT to a Modem (Hardware Handshaking Enabled)

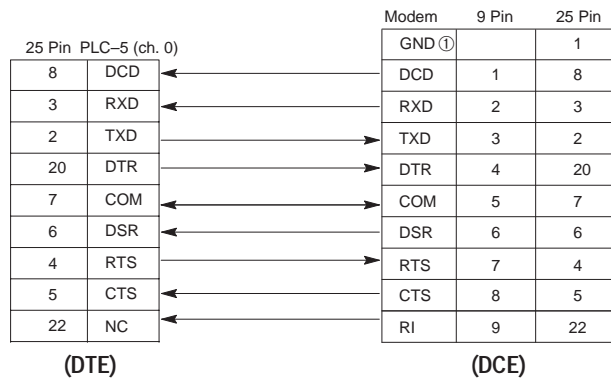| 25 Pin	9 Pin	IBM AT		Modem	9 Pin	25 Pin
				GND ①		1
8	1	DCD	←	DCD	1	8
3	2	RXD	←	RXD	2	3
2	3	TXD	→	TXD	3	2
20	4	DTR	→	DTR	4	20
7	5	COM	←	COM	5	7
6	6	DSR		DSR	6	6
4	7	RTS	→	RTS	7	4
5	8	CTS	←	CTS	8	5
22	9	RI	←	RI	9	22

(DTE)   (DCE)
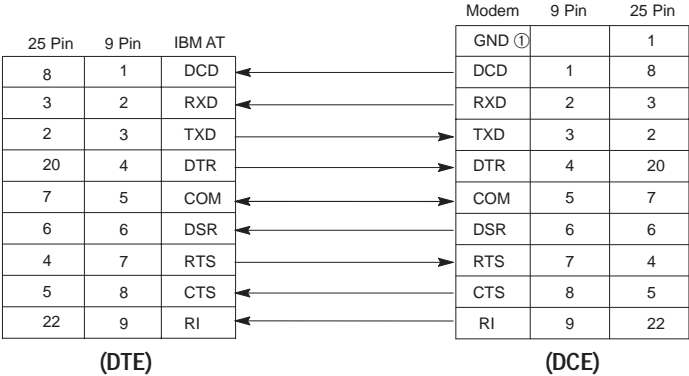
① Connect to the shield of the cable.

IBM AT to SLC 5/03, SLC 5/04, or SLC 5/05 Processor, 1770-KF3, 1775-KA, 1773-KA, 5130-RM or PLC-5 (Hardware Handshaking Disabled) ①
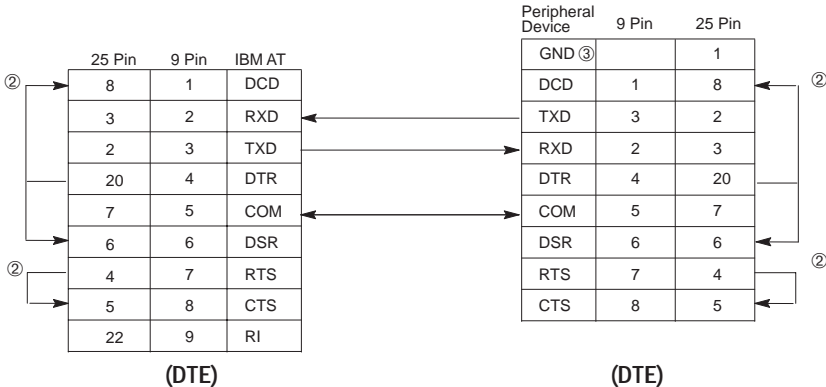
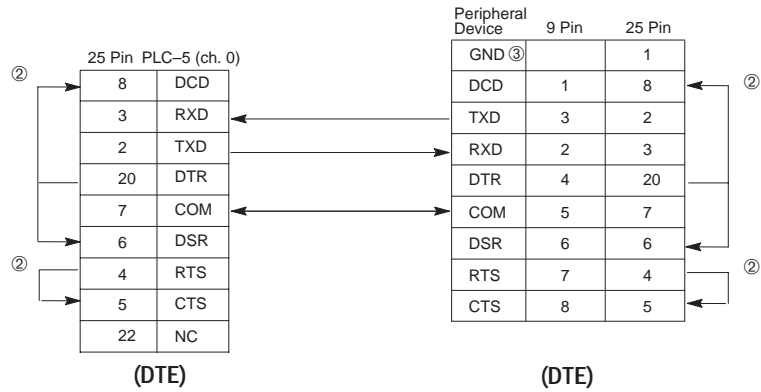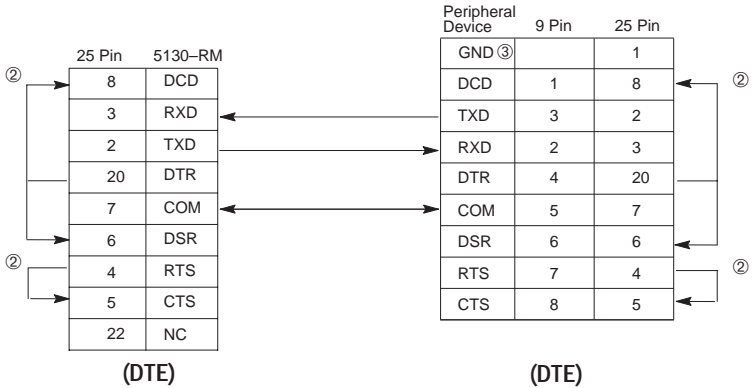|	25 Pin	9 Pin	IBM AT		Peripheral Device	9 Pin	25 Pin	
					GND ③		1	
② →	8	1	DCD		DCD	1	8	← ②
	3	2	RXD	←	TXD	3	2	
	2	3	TXD	→	RXD	2	3	
	20	4	DTR		DTR	4	20	
	7	5	COM	← →	COM	5	7	
→	6	6	DSR		DSR	6	6	← ②
② →	4	7	RTS		RTS	7	4	②
→	5	8	CTS		CTS	8	5	←
	22	9	RI					

(DTE)   (DTE)

① You can also use cable 1747-CP3.

② Jumpers are only needed if you cannot disable the hardware handshaking on the port.

③ Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor Connected to a Modem (Hardware Handshaking Enabled)

9 Pin	5/03		Modem	9 Pin	25 Pin
			GND ①		1
1	DCD	←	DCD	1	8
2	RXD	←	RXD	2	3
3	TXD	→	TXD	3	2
4	DTR	→	DTR	4	20
5	COM	←	COM	5	7
6	DSR	←	DSR	6	6
7	RTS	→	RTS	7	4
8	CTS	←	CTS	8	5
9	NC	←	RI	9	22

(DTE)   (DCE)
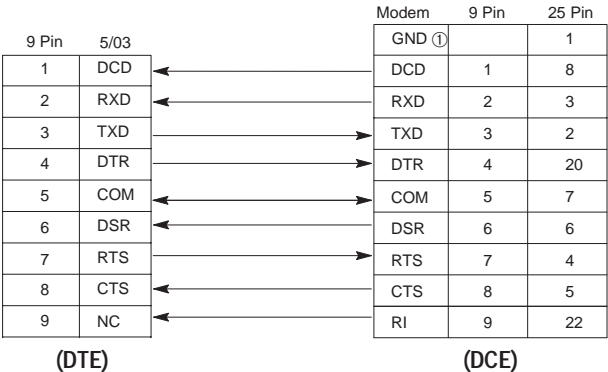
① Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor to another SLC 5/03, SLC 5/04, or SLC 5/05, IBM AT, 1770-KF3, 1775-KA, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]
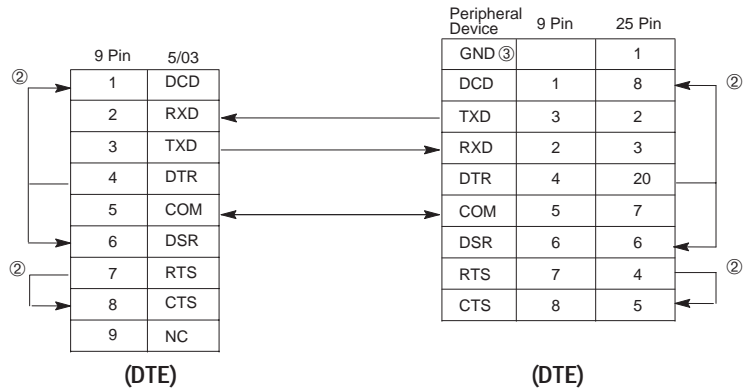
9 Pin	5/03
1	DCD
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
DCD	1	8
TXD	3	2
RXD	2	3
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5

(DTE)

[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor Connected to an IBM AT with a 1747-CP3 Cable

9 Pin	5/03
1	DCD
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

IBM AT	9 Pin
DCD	1
TXD	3
RXD	2
DSR	6
COM	5
DTR	4
CTS	8
RTS	7

(DTE)
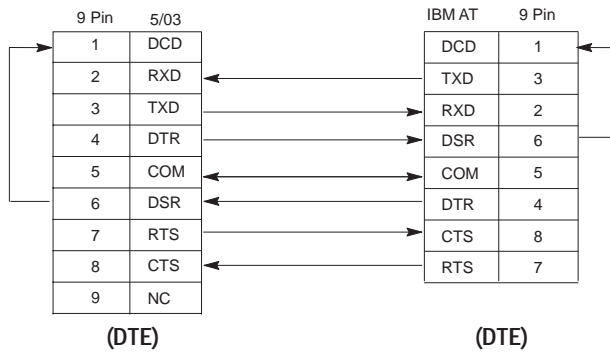
1747-KE to a Modem (Hardware Handshaking Enabled)

9 Pin	1747–KE
1	NC
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
DSR	6	6
RXD	2	3
TXD	3	2
DTR	4	20
COM	5	7
DCD	1	8
RTS	7	4
CTS	8	5
RI	9	22

(DCE)

[1] Connect to the shield of the cable.
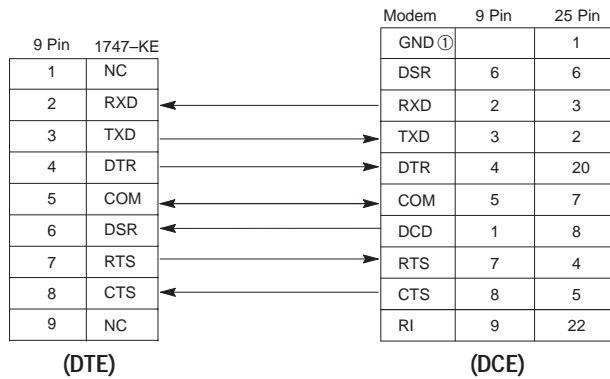
1747-KE to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1775-KA, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]

9 Pin	1747–KE
1	NC
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
DCD	1	8
TXD	3	2
RXD	2	3
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5

(DTE)
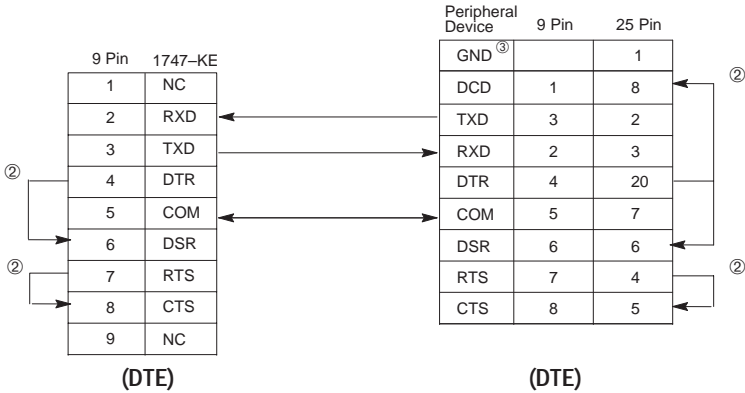
[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

1746-BAS to a Modem (Hardware Handshaking Enabled)

9 Pin	1746–BAS
1	NC
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
DSR	6	6
RXD	2	3
TXD	3	2
DTR	4	20
COM	5	7
DCD	1	8
RTS	7	4
CTS	8	5
RI	9	22

(DCE)
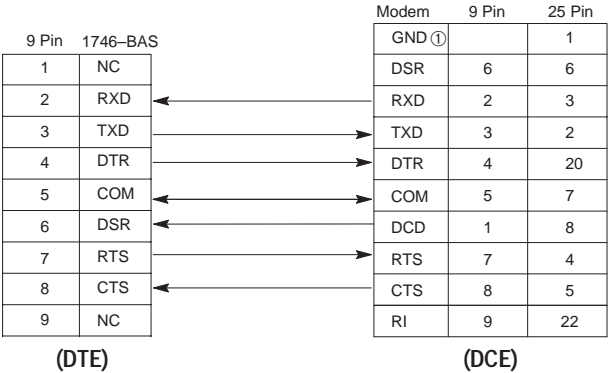
[1] Connect to the shield of the cable.

1746-BAS to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1775-KA, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]

9 Pin	1746–BAS
1	NC
2	RXD
3	TXD
4	DTR
5	COM
6	DSR
7	RTS
8	CTS
9	NC

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
NC	1	8
TXD	3	2
RXD	2	3
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5

(DTE)
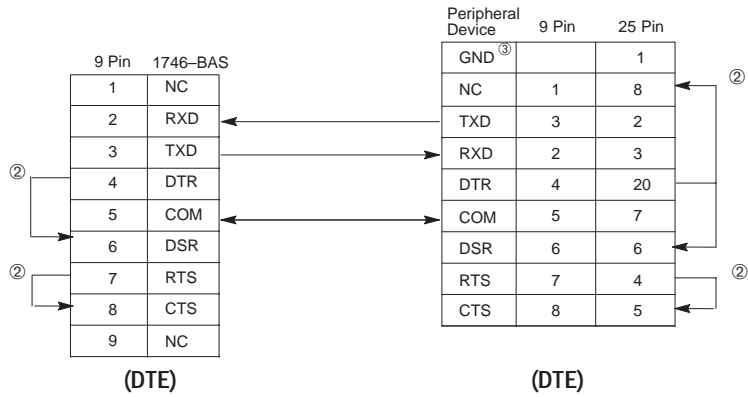
[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

1770-KF3 to a Modem (Hardware Handshaking Enabled)

25 Pin	1770–KF3
8	DCD
3	RXD
2	TXD
20	DTR
7	COM
6	DSR
4	RTS
5	CTS
22	NC

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
DCD	1	8
RXD	2	3
TXD	3	2
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5
RI	9	22

(DCE)
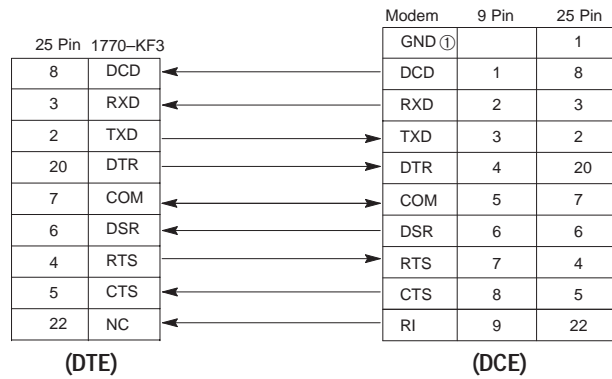
[1] Connect to the shield of the cable.

2760-RB to a Modem (Hardware Handshaking Enabled)

25 Pin	2760–RB
1	GND [1]
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	COM
20	DTR

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
DCD	1	8
TXD	3	2
RXD	2	3
RTS	7	4
CTS	8	5
DSR	6	6
COM	5	7
DTR	4	20
RI	9	22

(DCE)
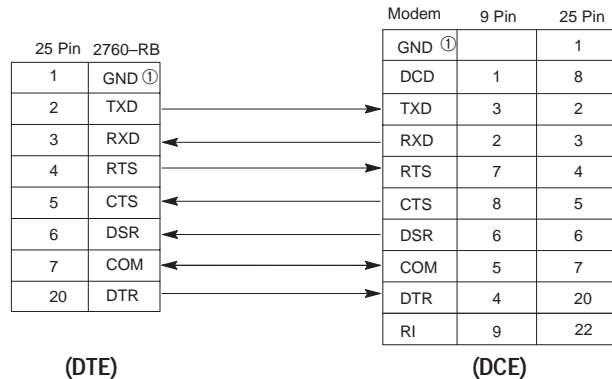
[1] Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

2760-RB to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1775-KA, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]

25 Pin	2760–RB
1	GND [3]
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	COM
20	DTR

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
DCD	1	8
RXD	3	2
TXD	2	3
DTR	7	4
COM	8	5
DSR	6	6
RTS	5	7
CTS	4	20

(DTE)
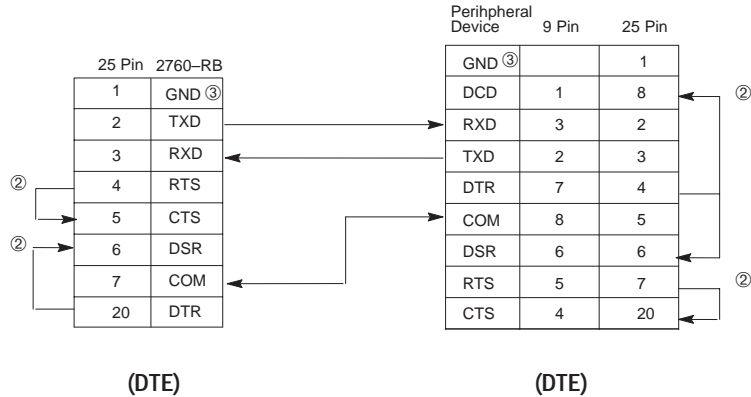
[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

1771-KGM to a Modem (Hardware Handshaking Enabled)
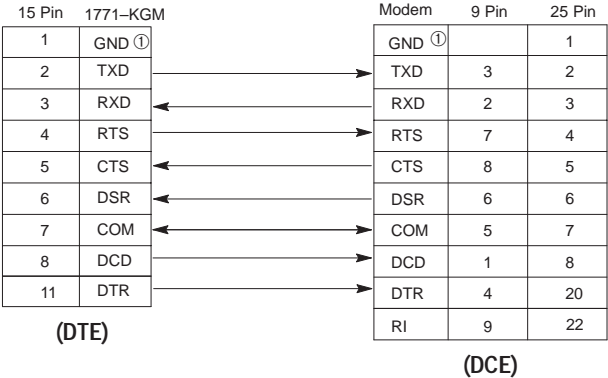
15 Pin	1771–KGM
1	GND [1]
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	COM
8	DCD
11	DTR

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
TXD	3	2
RXD	2	3
RTS	7	4
CTS	8	5
DSR	6	6
COM	5	7
DCD	1	8
DTR	4	20
RI	9	22

(DCE)

[1] Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

1771-KGM to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1775-KA, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]

15 Pin	1771–KGM
1	GND [3]
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	COM
8	DCD
11	DTR

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
DCD	1	8
RXD	2	3
TXD	3	2
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5

(DTE)
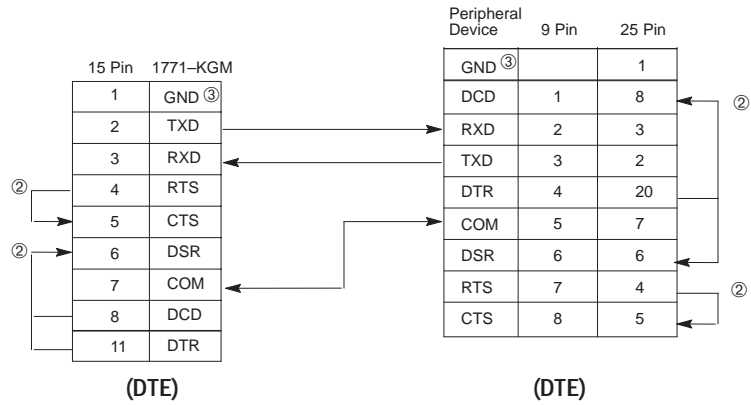
[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

1775-KA to a Modem (Hardware Handshaking Enabled)

25 Pin	1775–KA
8	DCD
3	RXD
2	TXD
20	DTR
7	COM
6	DSR
4	RTS
5	CTS
22	NC

(DTE)

Modem	9 Pin	25 Pin
GND [1]		1
DCD	1	8
RXD	2	3
TXD	3	2
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5
RI	9	22

(DCE)
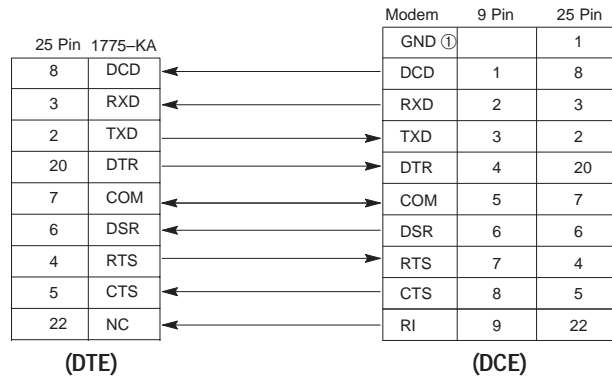
[1] Connect to the shield of the cable.

1775-KA to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1773-KA, 5130-RM, or PLC-5 (Hardware Handshaking Disabled) [1]
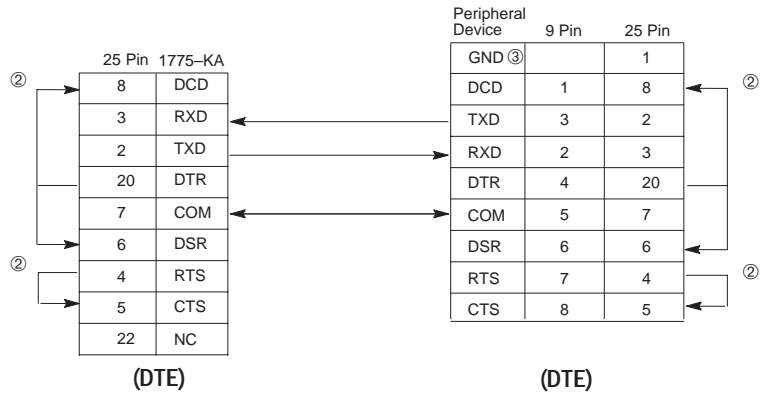
25 Pin	1775–KA		Peripheral Device	9 Pin	25 Pin
			GND [3]		1
8	DCD		DCD	1	8
3	RXD		TXD	3	2
2	TXD		RXD	2	3
20	DTR		DTR	4	20
7	COM		COM	5	7
6	DSR		DSR	6	6
4	RTS		RTS	7	4
5	CTS		CTS	8	5
22	NC				

(DTE)   (DTE)

[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

PLC-5 (Channel 0) to a Modem (Hardware Handshaking Enabled)

25 Pin	PLC–5 (ch. 0)		Modem	9 Pin	25 Pin
			GND [1]		1
8	DCD		DCD	1	8
3	RXD		RXD	2	3
2	TXD		TXD	3	2
20	DTR		DTR	4	20
7	COM		COM	5	7
6	DSR		DSR	6	6
4	RTS		RTS	7	4
5	CTS		CTS	8	5
22	NC		RI	9	22

(DTE)   (DCE)

[1] Connect to the shield of the cable.

PLC-5 (Channel 0) to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1773-KA, 5130-RM, PLC-5, 1747-KE, or 1746-BAS (Hardware Handshaking Disabled) [1]

25 Pin PLC–5 (ch. 0)		Peripheral Device	9 Pin	25 Pin
		GND [3]		1
8	DCD	DCD	1	8
3	RXD	TXD	3	2
2	TXD	RXD	2	3
20	DTR	DTR	4	20
7	COM	COM	5	7
6	DSR	DSR	6	6
4	RTS	RTS	7	4
5	CTS	CTS	8	5
22	NC			

(DTE)   **(DTE)**

[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

5130-RM to a Modem (Hardware Handshaking Enabled)

25 Pin 5130–RM		Modem	9 Pin	25 Pin
		GND [1]		1
8	DCD	DCD	1	8
3	RXD	RXD	2	3
2	TXD	TXD	3	2
20	DTR	DTR	4	20
7	COM	COM	5	7
6	DSR	DSR	6	6
4	RTS	RTS	7	4
5	CTS	CTS	8	5
22	NC	RI	9	22

(DTE)   **(DCE)**
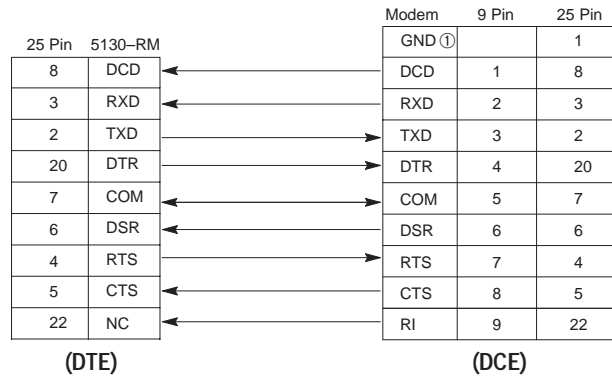
[1] Connect to the shield of the cable.

5130-RM to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, IBM AT, 1770-KF3, 1773-KA, 5130-RM, PLC-5, 1747-KE, or 1746-BAS (Hardware Handshaking Disabled) [1]

25 Pin	5130–RM
8	DCD
3	RXD
2	TXD
20	DTR
7	COM
6	DSR
4	RTS
5	CTS
22	NC

(DTE)

Peripheral Device	9 Pin	25 Pin
GND [3]		1
DCD	1	8
TXD	3	2
RXD	2	3
DTR	4	20
COM	5	7
DSR	6	6
RTS	7	4
CTS	8	5

(DTE)

[1] You can also use cable 1747-CP3.

[2] Jumpers are only needed if you cannot disable the hardware handshaking on the port.

[3] Connect to the shield of the cable.

Applications for the RS-232 Communication Interface

The figures below show you different applications for the RS-232 communication interface.

DF1 Full-Duplex Peer-to-Peer

Modem   Modem

SLC 5/03   SLC 5/03
Processor Modular   Processor Modular
Controller   Controller
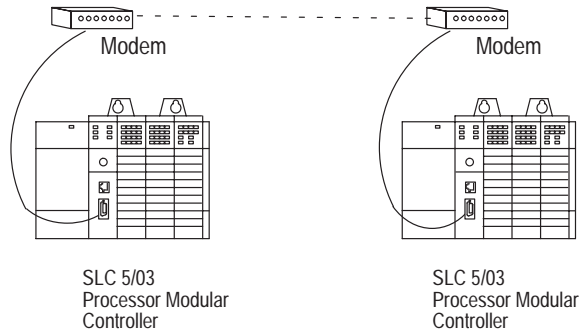
Half-Duplex with Slave-to-Slave Routing

Important: The 1747-KE module does not support slave-to-slave transfers.

WINtelligent Linx or RSLinx
Running DF1 Half-Duplex
Protocol (Master)

RS-232
(DF1 Protocol)

Modem

Leased Line

Modem   Modem

SLC 5/03   SLC 5/03
Processor Modular   Processor Modular
Controller   Controller
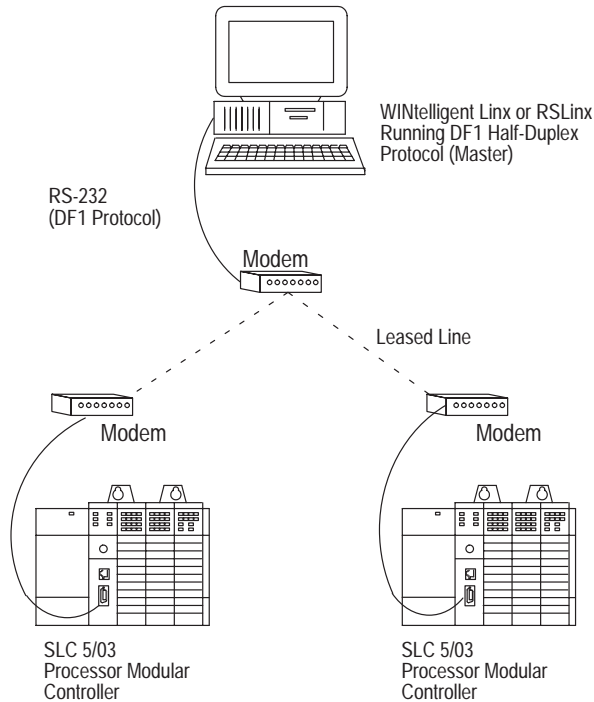
Setting Up the DH+ Network

This appendix provides an overview of the Data Highway Plus (DH+) communication protocol and explains how the SLC 5/04 processors support it. This appendix also provides information on the following:

- DH+ communication protocol overview
- SLC 5/04 processor and DH+ communication
- wiring connectors for DH+ communication for SLC 5/04
- typical DH+ network configuration

Data Highway Plus Communication Protocol Overview

Data Highway Plus implements peer-to-peer communication with a token-passing scheme to rotate link mastership among a maximum of 64 nodes. Since this method does not require polling, it helps provide time-efficient reliable data transport. The DH+ features:

- remote programming of PLC-2, PLC-3, PLC-5 and SLC 500 processors on your network
- direct connections to PLC-5 processors and industrial programming terminals
- easy re-configuration and expansion if you want to add more nodes later
- a communication rate of 57.6K baud, 115.2K baud, or 230.4K baud

Important: A programming device, such as an IBM compatible PC, using a 1784-KT Communication Interface module does not operate faster than 57.6K baud. The 1784-KTXD can operate at all three communication rates.

The following table summaries the type of termination resistor needed to stop communicating at the specified baud rate with the maximum cable length.

Termination Link Resistor Value Ω	Communication Rate (Kbaud)	Maximum Cable Length m (ft)
150	57.6	3,048 (10,000)
150	115	1,542 (5,000)
82	230.4	762 (2,500)

SLC 5/04 Processors and DH+ Communication

The SLC 5/04 processors let you operate DH+ communication protocol by means of the DH+ communication channel 1. The SLC 5/04 processors also support DF1 full-duplex protocol, DF1 half-duplex master and slave protocol, ASCII, or DH-485 via its RS-232 port, channel 0. The 3-pin connector, provided with the SLC 5/04 processors, is for actual DH+ communication and the 8-pin connector is for monitoring DH+ communication.

DH+ Channel 1 3-Pin

Pin	Pin Name
1	DH+ Data Line 1
2	Shield
3	DH+ Data Line 2

DH+ Channel 1 8-Pin

Pin	Pin Name
1	DH+ Data Line 2
2	No Connection
3	Shield
4	+24V
5	No Connection
6	DH+ Data Line 1
7	+24V Return
8	No Connection

The location of channel 1 is detailed in the drawing below.
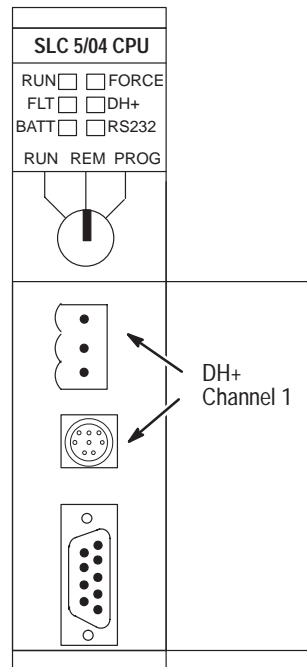
Front View

Wiring Connectors for DH+ Communication for SLC 5/04 Processors

To connect Allen-Bradley devices with other devices over DH+, you must wire the 3-pin cable connectors so that communication can occur through the cabling. Each device requires its own node address.

Belden #9463   Belden #9463
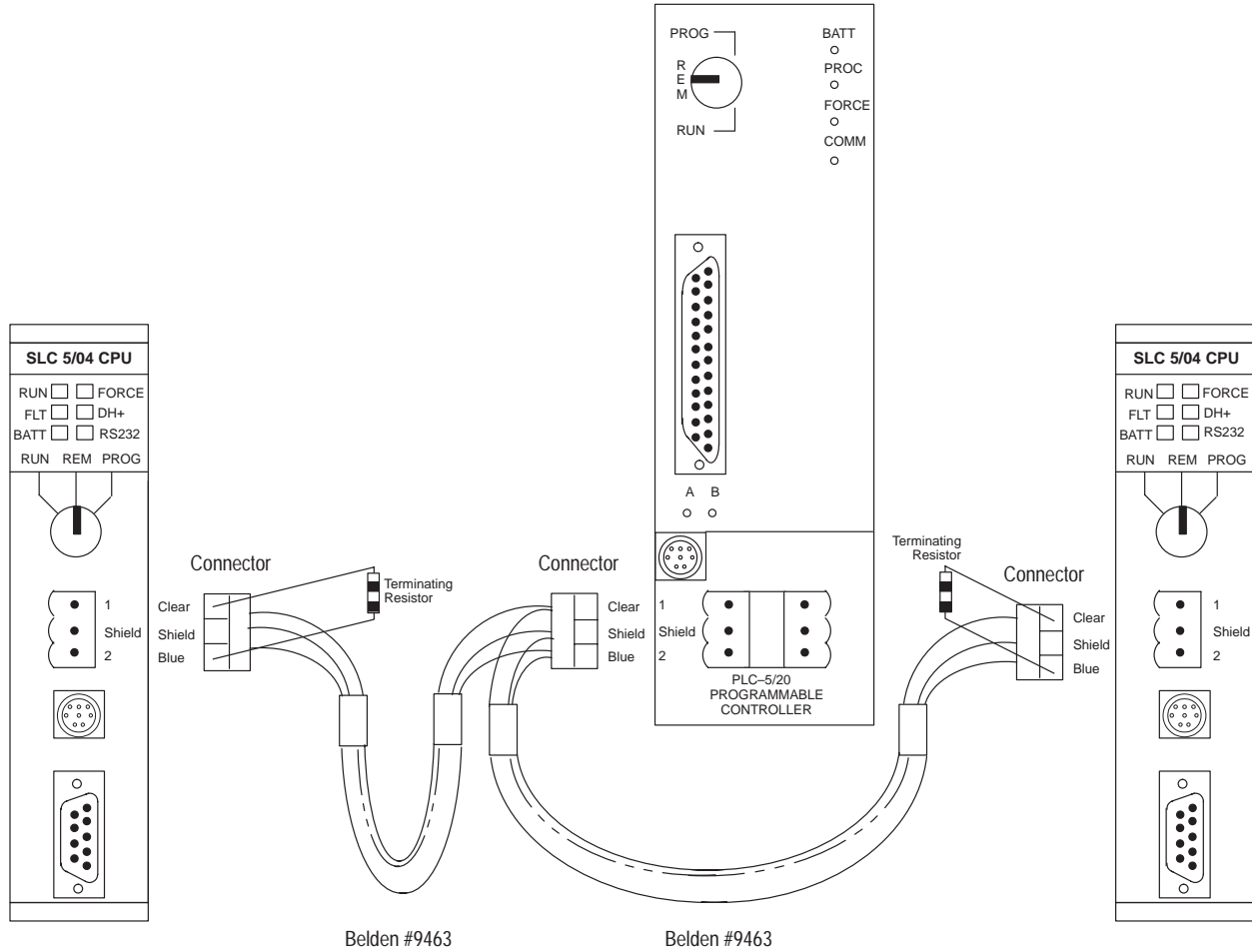
Terminate the DH+ link on both ends by connecting a 150Ω, 1/2W resistor between terminals 1 and 2 of the 3-pin connector when you are communicating at 57.6K baud with a PLC-5 processor or 115.2K baud with other SLC 5/04 processors. Use an 82Ω, 1/2W resistor if you are communicating at 230.4K baud with other SLC 5/04 processors or Series E enhanced PLC-5 processor.

Typical DH+ Network Configuration

The following figure illustrates a possible configuration for the SLC 5/04 processor on a DH+ network. You can also use an SLC 500, SLC 5/01, SLC 5/02, SLC 5/03, or SLC 5/05 processor in place of the SLC 5/04 on the DH+ network if the 1785-KA5 card is used with a PLC-5.

The DH+ protocol uses factory set timeouts to restart token-passing communication if the token is lost because of a defective node.

Other devices that use the DH+ network include those in the table below.

Catalog Number	Description	Installation Requirement	Function	Publication
1784-KTX, -KTXD	PC DH+ IM	IBM XT/AT Computer Bus	Provides DH+ or DH-485 connection	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH+ or DH-485 connection	1784-6.5.19
1784-KT/B	PC DH+ IM	IBM XT/AT Computer Bus	Provides DH+ connection	1784-2.31

Control Networks

This appendix provides a brief introduction about control networks. For information on control networks, see the *DCM User Manual*, Catalog Number 1747-NM007, *RIO Scanner User Manual,* Publication Number 1747-6.6 and the *DeviceNet Scanner Configuration Manual* Publication Number 1747-6.5.2.

Allen-Bradley Remote I/O Network

The Allen-Bradley Remote I/O Network is a master/slave control network that enables chassis of I/O, operator interface terminals, push-button panels, I/O blocks, message displays, drives and much more to be great distances from the host PLC processor. The SLC 500 fixed, SLC 5/01, SLC 5/02, SLC 5/03, SLC 5/04, or SLC 5/05 can interface to this network through the 1747-DCM module for distributed control. The DCM allows the SLC 500 to look like another device on the network.

Below is an example of the Allen-Bradley Remote I/O Network.

PLC-5™ or SLC 5/02, SLC 5/03, or SLC 5/04 proceesors with 1747-SN scanner

1747–DCM 1747–DCM 1747–DCM

Fixed SLC 5/01 SLC 5/03

1771–Remote I/O Network

PanelView Operator Terminal
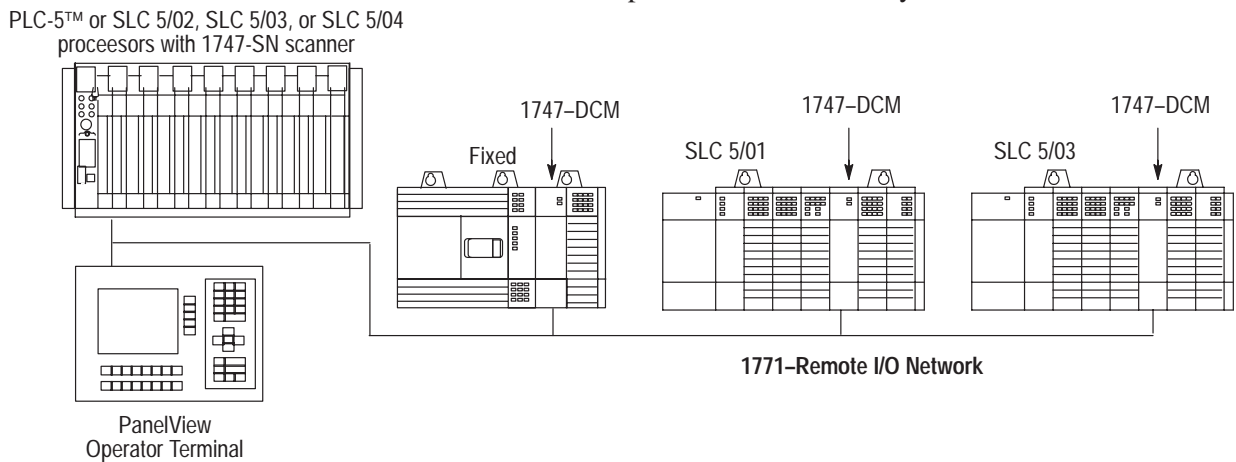
With the SLC 5/02, SLC 5/03, SLC 5/04, or SLC 5/05 processor, a 1747-SN Remote I/O Scanner can be used as the master of a remote I/O network. With a SLC 5/02, SLC 5/03, SLC 5/04, or SLC 5/05 and SN, a PLC is not required on the network.

1747–SN

1771–Remote I/O Network

Block I/O

1747–ASB 1747–ASB

PanelView Operator Terminal
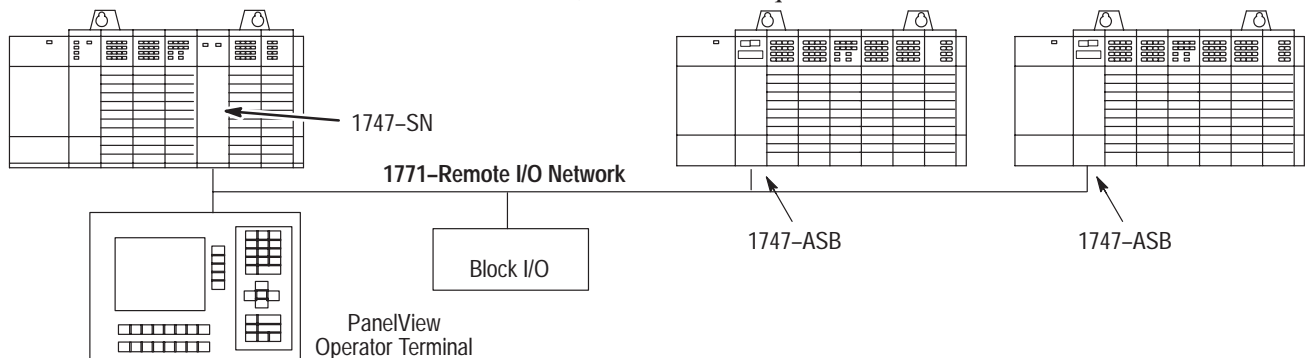
Each 1747-SN Scanner supports 4 logical racks of 256 I/O each per logical rack. If large amounts of data needs to be transferred to a device such as a PanelView Operator Interface, the 1747-SN Series B Scanner supports block transfer of up to 64 words of data. Up to 16 devices can be connected to a single remote I/O network. The SLC system supports multiple 1747-SN scanners if more devices are required to be controller by a single SLC processor.

Remote I/O Passthru

Remote I/O passthru allows you to communicate between a personal computer on the DH+ network to devices on the Remote I/O Network. For example, a personal computer running PanelBuilder Software and communicating on the DH+ network could upload and download applications from a PanelView Operator Terminal communicating on the Remote I/O network. This feature eliminates the need to physically connect the personal computer to the PanelView Operator Terminal when you need to change the application. This option is available on the SLC 5/04 processor, the 1747-SN Series B Scanner, and the PLC-5 processor.
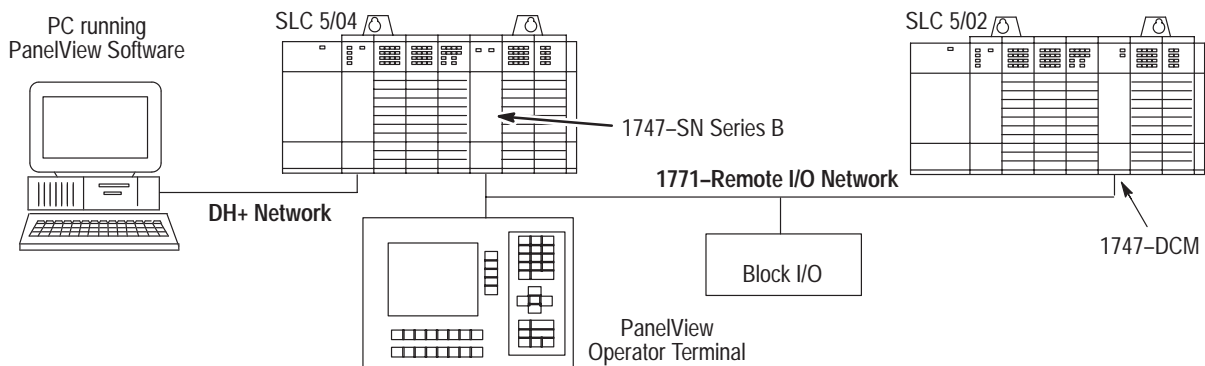
Note: The SLC 5/03 OS302 or later, SLC 5/04 OS401 or later, and SLC 5/05 also support remote I/O passthru via both their communication ports.

DeviceNet Network

A device network connects plant floor devices directly to the control system (e.g., SLC 500 controller) reducing the number of I/O interfaces and wiring associated with a typical hard-wired solution. The DeviceNet communication network is a completely open device network and has the support of industry's leading sensor, actuator, and control manufacturers.

In a typical configuration, the 1747-SDN DeviceNet Scanner acts as an interface between DeviceNet devices and the SLC 5/02, SLC 5/03, SLC 5/04, and SLC 5/05 processors. The scanner communicates with DeviceNet devices over the network to:

- read inputs from a device
- write outputs to a device
- download configuration data
- monitor a device's operational status

The scanner communicates with the SLC 500 processors to exchange I/O data. Information exchanged includes:

- device I/O data
- status information
- configuration data

A single scanner (master) can communicate with up to 63 nodes (slaves) on DeviceNet. The SLC system supports multiple scanners if more devices are required to be controlled by a single SLC 500 processor.

SLC 5/02, SLC 5/03, SLC 5/04, or SLC 5/05

1747-SDN Scanner

1770-KFD

computer with DeviceNet Manager Software

RS-232 Cable

DeviceNet

RediSTATION

1305 drive

Flex I/O
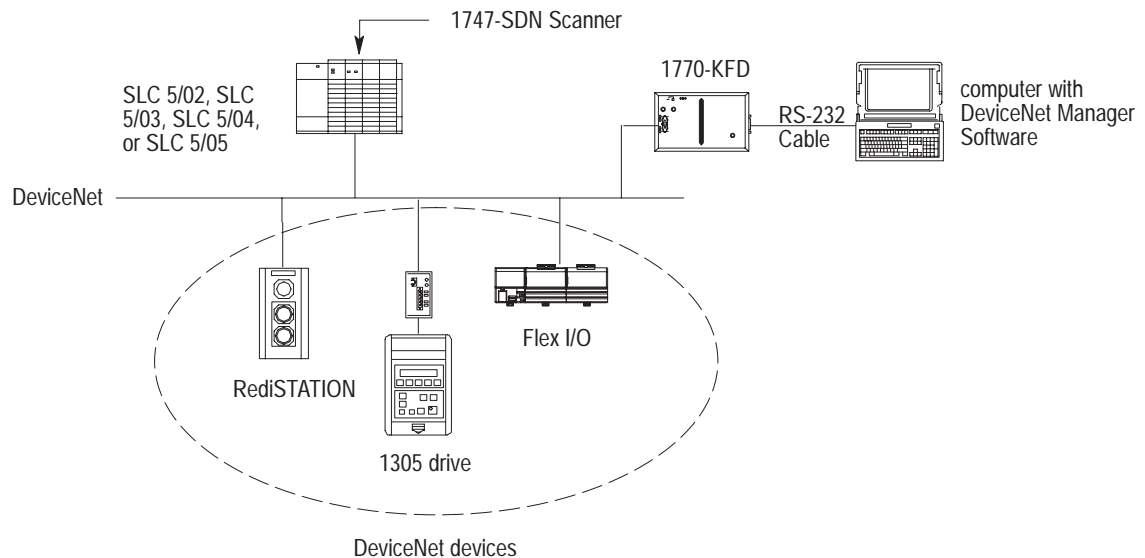
DeviceNet devices

DeviceNet Network Length

The DeviceNet network lengths are listed below.

Network Length	Baud Rate
100 m (328.08 ft)	500K baud
200 m (656.16 ft)	250K baud
500 m (1640.42 ft)	125K baud

Power Supply Worksheet

Use this Table to Calculate the Power Supply Loading

Use the table below to calculate the power supply needed for each chassis that you have (step 1 of the worksheet located on page E–4).

Hardware Component	Catalog Numbers	Maximum Current at 5V (Amps)	Maximum Current at 24V (Amps)
Processors	1747-L511	0.350	0.105
	1747-L514	0.350	0.105
	1747-L524	0.350	0.105
	1747-L531	0.500	0.175
	1747-L532	0.500	0.175
	1747-L541	1.0	0.200
	1747-L542	1.0	0.200
	1747-L543	1.0	0.200
	1747-L551	1.0	0.200
	1747-L552	1.0	0.200
	1747-L523	1.0	0.200
Discrete Input Modules	1746-IA4	0.035	0
	1746-IA8	0.050	0
	1746sc-IA8I [1]	0.110	0
	1746-IA16	0.085	0
	1746-IB8	0.050	0
	1746sc-IB8I [1]	0.110	0
	1746-IB16	0.085	0
	1746-IB32	0.106	0
	1746sc-IC8I [1]	0.110	0
	1746-IC16	0.085	0
	1746-IG16	0.140	0
	1746-IH16	0.085	0
	1746-IM4	0.035	0
	1746-IM8	0.050	0
	1746sc-IM8I [1]	0.110	0
	1746-IM16	0.085	0
	1746-IN16	0.085	0
	1746-ITB16	0.085	0
	1746-ITV16	0.085	0
	1746-IV8	0.050	0
	1746-IV16	0.085	0
	1746-IV32	0.106	0

Hardware Component	Catalog Numbers	Maximum Current at 5V (Amps)	Maximum Current at 24V (Amps)
Discrete Output Modules	1746-OA8	0.185	0
	1746-OA16	0.370	0
	1746sc-OAP8I [1]	0.170	0
	1746-OAP12	0.370	0
	1746-OB8	0.135	0
	1746-OB16	0.280	0
	1746-OB16E	0.135	0
	1746-OB32	0.452	0
	1746-OBP8	0.135	0
	1746-OBP16	0.250	0
	1746-OG16	0.180	0
	1746-OV8	0.135	0
	1746-OV16	0.270	0
	1746-OV32	0.452	0
	1746-OVP16	0.250	0
	1746-OW4	0.045	0.045
	1746-OW8	0.085	0.090
	1746-OW16	0.170	0.180
	1746-OX8	0.085	0.090
Discrete Input & Output Modules	1746-IO4	0.030	0.025
	1746-IO8	0.060	0.045
	1746-IO12	0.090	0.070
Analog Modules	1746-FIO4I	0.055	0.150
	1746-FIO4V	0.055	0.120
	1746sc-INI4I [1]	0.460	0
	1746sc-INI4VI [1]	0.570	0
	1746sc-INO4I [1]	0.120	0.250
	1746sc-INO4VI [1]	0.120	0.250
	1746-NI4	0.025	0.085
	1746-NI8	0.200	0.100
	1746-NIO4I	0.055	0.145
	1746-NIO4V	0.055	0.115
	1746-NO4I	0.055	0.195
	1746-NO4V	0.055	0.145

Hardware Component	Catalog Numbers	Maximum Current at 5V (Amps)	Maximum Current at 24V (Amps)
Specialty Modules	1746-BAS	0.150	0.040[2]
	1746-BTM	0.110	0.085
	1746-HSCE	0.320	0
	1746-NR4	0.050	0.050
	1746-NT4	0.060	0.040
	1746-INT4	0.110	0.085
	1746sc-NT8[1]	0.250	0.070
	1746-QS	1.0	0.200
	1746-QV	0.215	0
Remote I/O Modules	1747-SN	0.900	0
	1747-ASB	0.375	0
	1747-DSN	0.900	0
	1747-DCM	0.360	0
DeviceNet Module	1747-SDN	1.2	0
Communication Modules	1747-KE	0.150	0.040[3]
	1747-AIC	0	0.085
	1747-PIC	0	0.060[4]
Data Table Access Module	1747-DTAM	0	0.104[4]
Hand-Held Terminal	1747-PT1 Series A & B	0	0.105[4]

[1] Sold and supported by Spectrum Controls, Inc., Bellevue, WA. For additional information contact Spectrum at (206)746-9481.

[2] If the BASIC Module is connected to any device (HHT, DTAM, PIC) either directly or through a 1747-AIC Link Coupler, add the appropriate current loading for the device to the BASIC module's power supply loading value at 24V dc.

[3] If the KE Module DH-485 channel is connected to a Catalog Number 1747-AIC Link Coupler, add 0.190A to the KE module's power supply loading value at 24V dc. If the KE Module is connected to any device (HHT, DTAM, PIC) either directly or through a 1747-AIC Link Coupler, add the appropriate current loading for the device to the KE module's power supply loading value at 24V dc.

[4] The 24V dc loading values of the PIC are included in the 24V dc loading value of the processor.

Make copies of the worksheet on page E–4 as needed.

Procedure

1. **For each slot of the chassis that contains a module, list the slot number, the catalog number of the module, and its 5V and 24V maximum currents. Also include the power consumption of any peripheral devices that may be connected to the processor other than a DTAM, HHT, or PIC — the power consumption of these devices is accounted for in the power consumption of the processor.**

Chassis Number: __1__   Chassis Number: __2__

	Catalog Number	Maximum Currents 5V	24V

slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____
slot ___ _____ _____ | _____

Peripheral Device: _____   _____ | _____

2. **Add the power supply loading currents for all the system devices (at 5V and 24V).**

Total Current: _____ | _____

When using the 1746-P4 power supply, use the formula below to calculate total power consumption of all the system devices (at 5V and 24V). Note that the 1746-P4 Chassis total power supply loading currents cannot exceed 70 Watts. If you are not using a 1746-P4 power supply, proceed to step 3.

([Total current] x 5V) + ([Total current] x 24V) + ([User Current] x 24V) = [Total Power] W

([Total current] x 5V) + ([Total current] x 24V) + ([User Current] x 24V) = [Total Power] W

3. **Compare the Total Current required for the chassis with the Internal Current Capacity of the power supplies.**

To select the proper power supply for your chassis, make sure that the power supply loading current for the chassis is *less than* the internal current capacity for the power supply, for both 5V and 24V loads.

Internal Current Capacity

	5V	24V
Catalog Number 1746-P1	2.0A	0.46A
Catalog Number 1746-P2	5.0A	0.96A
Catalog Number 1746-P3	3.6A	0.87A
Catalog Number 1746-P4	10.0A	2.88A (70 Watts maximum)
Catalog Number 1746-P5	5.0A	0.96A

Required Power Supply for this Chassis: 1746- [ ]

Required Power Supply for this Chassis: 1746- [ ]

Note: Consider future system expansion when selecting a power supply.

Calculating Heat Dissipation for the SLC 500 Control System

This appendix will assist you in calculating the heat dissipation of your SLC 500 Controller. It consists of the following:

- definition of key terms
- table and graphs
- example heat dissipation calculation
- heat dissipation worksheet (page F–8)

Definition of Key Terms

The following terms are used throughout this appendix. Familiarize yourself with them before proceeding further into the appendix.

Watts per point — maximum heat dissipation that can occur in each field wiring point when energized.
Minimum watts — amount of heat dissipation that can occur when there is no field power present.
Total watts — the watts per point plus the minumum watts (with all points energized).

Module Heat Dissipation: Total Watts Vs. Calculated Watts

There are two ways to determine the module heat dissipation. You can use the Total Watts value from the table on page F–2 or you can calculate the value.

Total Watts — maximum amount of heat the module generates with field power present (with all points energized). Use this especially if you are not sure how many points will be energized at any time.

Calculated Watts — if you want to determine the amount of heat generated by the points energized on your module, use the formula below. Then use these values for calculating the *power supply loading* for each chassis — this is done using the worksheet.

> Module Heat Dissipation =
> (number of points energized x watts per point) + minimum watts

Once you have determined which way you will calculate the heat dissipation of your modules, see the Example Worksheet for Calculating Heat Dissipation on page F–7. This worksheet shows you how to calculate the heat dissipation for the example SLC control system on page F–6. Once you feel comfortable with the layout of the worksheet, go to the worksheet on page F–8 and fill it out for your control system.

Use this Table to Calculate Heat Dissipation

Use the table below to calculate the power supply loading for each chassis that you have (step 1 of the worksheet).

Hardware Component	Catalog Numbers	Watts per Point	Minimum Watts	Total Watts
Processors	1747-L511	not applicable	1.75	1.75
	1747-L514	not applicable	1.75	1.75
	1747-L524	not applicable	1.75	1.75
	1747-L531	not applicable	4.00	4.00
	1747-L532	not applicable	4.00	4.00
	1747-L541	not applicable	4.00	4.00
	1747-L542	not applicable	4.00	4.00
	1747-L543	not applicable	4.00	4.00
	1747-L551	not applicable	4.00	4.00
	1747-L552	not applicable	4.00	4.00
	1747-L523	not applicable	4.00	4.00
Discrete Input Modules	1746-IA4	0.27	0.175	1.30
	1746-IA8	0.27	0.250	2.40
	1746sc-IA8I [1]	0.43	0.550	4.00
	1746-IA16	0.27	0.425	4.80
	1746-IB8	0.20	0.250	1.90
	1746sc-IB8I [1]	0.31	0.550	3.00
	1746-IB16	0.20	0.425	3.60
	1746-IB32	0.20	0.530	6.90
	1746sc-IC8I [1]	0.49	0.550	4.50
	1746-IC16	0.22	0.425	3.95
	1746-IG16	0.02	0.700	1.00
	1746-IH16	0.32	0.217	5.17
	1746-IM4	0.35	0.175	1.60
	1746-IM8	0.35	0.250	3.10
	1746sc-IM8I [1]	0.76	0.550	6.60
	1746-IM16	0.35	0.425	6.00
	1746-IN16	0.35	0.425	6.00
	1746-ITB16	0.20	0.425	3.60
	1746-ITV16	0.20	0.425	3.60
	1746-IV8	0.20	0.250	1.90
	1746-IV16	0.20	0.425	3.60
	1746-IV32	0.20	0.530	6.90

[1] Sold and supported by Spectrum Controls, Inc., Bellevue, WA. For additional information, contact Spectrum at (206) 746-9481.

Hardware Component	Catalog Numbers	Watts per Point	Minimum Watts	Total Watts
Discrete Output Modules	1746-OA8	1.000	0.925	9.00
	1746-OA16	0.462	1.850	9.30
	1746sc-OAP8I [1]	1.125	0.850	9.85
	1746-OAP12	1.000	1.850	10.85
	1746-OB8	0.775	0.675	6.90
	1746-OB16	0.338	1.40	7.60
	1746-OB16E	0.150	0.675	3.07
	1746-OB32	0.078	2.26	4.80
	1746-OBP8	0.300	0.675	3.08
	1746-OBP16	0.310	1.250	6.26
	1746-OG16	0.033	0.900	1.50
	1746-OV8	0.775	0.675	6.90
	1746-OV16	0.388	1.400	7.60
	1746-OV32	0.078	2.26	4.80
	1746-OVP16	0.310	1.250	6.26
	1746-OW4	0.133	1.310	1.90
	1746-OW8	0.138	2.590	3.70
	1746-OW16	0.033	5.170	5.70
	1746-OX8	0.825	2.590	8.60
Discrete Input & Output Modules	1746-IO4	0.27 per input point 0.133 per output point	0.75	1.60
	1746-IO8	0.27 per input point 0.133 per output point	1.38	3.00
	1746-IO12	0.27 per input point 0.133 per output point	2.13	4.60
Analog Modules	1746-FIO4I	not applicable	3.76	3.8
	1746-FIO4V	not applicable	3.04	3.1
	1746sc-INI4I [1]	0.237	2.30	3.25
	1746sc-INI4VI [1]	0.100	2.85	3.25
	1746sc-INO4I [1]	0.525	4.50	6.60
	1746sc-INO4VI [1]	0.525	4.50	6.60
	1746-NI4	not applicable	2.17	2.2
	1746-NI8	not applicable	3.4	3.4
	1746-NIO4I	not applicable	3.76	3.8
	1746-NIO4V	not applicable	3.04	3.01
	1746-NO4I	not applicable	4.96	5.0
	1746-NO4V	not applicable	3.78	3.8

[1] Sold and supported by Spectrum Controls, Inc., Bellevue, WA. For additional information, contact Spectrum at (206) 746-9481.

Hardware Component	Catalog Numbers	Watts per Point	Minimum Watts	Total Watts
Specialty Modules	1746-BAS	not applicable	3.75	3.8
	1746-HSCE	not applicable	1.6	1.6
	1746-NR4	not applicable	1.5	1.5
	1746-NT4	not applicable	0.8	0.8
	1746sc-NT8 [1]	0.00	3.0	3.0
Remote I/O Modules	1747-SN	not applicable	4.5	4.5
	1747-ASB	not applicable	1.875	1.875
	1747-DSN	not applicable	4.5	4.5
	1747-DCM	not applicable	1.8	1.8
Communication Modules	1747-KE	not applicable	3.75	3.8
	1747-AIC	not applicable	2.0	2.0
	1747-PIC	not applicable	2.0	2.0
Data Table Access Module	1747-DTAM	not applicable	2.5	2.5
Hand-Held Terminal	1747-PT1 Series A & B	not applicable	2.5	2.5

[1] Sold and supported by Spectrum Controls, Inc., Bellevue, WA. For additional information, contact Spectrum at (206) 746-9481.

Use these Graphs to Determine the Power Supply Dissipation

Use the graphs below for determining the power supply dissipation in step 2 of the worksheet.

1746-P1 Power Supply Change in Power Dissipation due to Output Loading

Power Supply Dissipation (Watts) vs Power Supply Loading (Watts)

1746-P2 Power Supply Change in Power Dissipation due to Output Loading

Power Supply Dissipation (Watts) vs Power Supply Loading (Watts)

1746-P3 Power Supply Change in Power Dissipation due to Output Loading

Power Supply Dissipation (Watts) vs Power Supply Loading (Watts)

1746-P4 Power Supply Change in Power Dissipation due to Output Loading

Power Supply Dissipation (Watts) vs Power Supply Loading (Watts)

1746-P5 Power Supply Change in Power Dissipation due to Output Loading

Power Supply Dissipation (Watts) vs Power Supply Loading (Watts)

Example Heat Dissipation Calculation

If your controller consisted of the following hardware components, you would calculate heat dissipation as shown in the worksheet on page F–7.
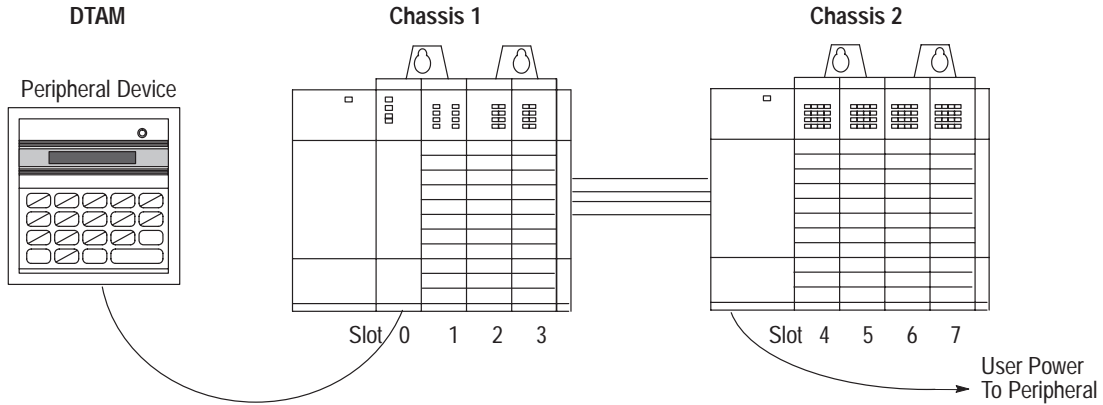
The following table details the total watts dissipated by the modules and peripheral devices in the above SLC 500 controller.

Chassis 1				Chassis 2			
Slot Number	Catalog Number	Min. Watts	Total Watts	Slot Number	Catalog Number	Min. Watts	Total Watts
0	1747-L511	1.75	1.75	4	1746-IA16	.425	4.8
1	1746-BAS	3.75	3.8	5	1746-IA16	.425	4.8
2	1746-IA8	.250	2.4	6	1746-OW16	5.17	5.5[1]
3	1746-OV8	.675	6.9	7	1746-OW16	5.17	5.7
Peripheral Device	1747-DTAM	2.5	2.5	NA	NA	NA	NA
User Power to Peripheral	NA	NA	NA	NA	NA	2.4[2]	NA

[1] This output card uses 5.5 watts because only 10 points are on at any one time. Using the calculated watts formula — (number of points energized x watts per point) + minimum watts = heat dissipation of module — the calculated watts for the 1746-OW16 module is 5.5W: (10 points X .033) + 5.17 = 5.5W.

[2] The user power on the 1746-P1 power supply for Chassis 2 is being used to power a peripheral (100 mA at 24 VDC).

NA (Not Applicable)

Example Worksheet for Calculating Heat Dissipation

Prodecure							Chassis 1	Chassis 2	Chassis 3
1. Calculate the *heat dissipation* for each chassis without the power supply.									
A. Write in the watts (calculated watts or total watts, see page F–2) dissipated by the processor, I/O and specialty modules, and any peripheral devices attached to the processor. Then, for each chassis, add these values together.									
		Chassis 1		Chassis 2		Chassis 3			
Slot		Catalog Number	Heat Dissipation	Catalog Number	Heat Dissipation	Catalog Number	Heat Dissipation		
0		1747-L511	1.75W	1746-IA16	4.80W				
1		1746-BAS	3.8W	1746-IA16	4.80W				
2		1746-IA8	2.4W	1746-OW16	5.50W				
3		1746-OV8	6.90W	1746-OW16	5.70W				
4									
5									
6									
7									
8									
9									
10									
11									
12									
peripheral		1747-DTAM	2.5W						
TOTAL			17.35W		20.80W				
B. Place the heat dissipation for each chassis into the appropriate columns.							17.35W	20.8W	––
2. Calculate the *heat dissipation* for each power supply.									
A. Calculate the power supply loading for each chassis: write in the minimum watts for each device (see page F–2) and then, for each chassis, add these values together.									
Important: If you have a device connected to user power, multiply 24V by the current used. Include user power in the total power supply loading.									
		Chassis 1		Chassis 2		Chassis 3			
Slot		Catalog Number	Min. Heat Dissipation	Catalog Number	Min. Heat Dissipation	Catalog Number	Min. Heat Dissipation		
0		1747-L511	1.75W	1746-IA16	0.425W				
1		1746-BAS	3.75W	1746-IA16	0.425W				
2		1746-IA8	0.250W	1746-OW16	5.170W				
3		1746-OV8	0.675W	1746-OW16	5.170W				
4									
5									
6									
7									
8									
9									
10									
11									
12									
user power					2.4W				
peripheral		1747-DTAM	2.5W						
TOTAL			8.925W		13.590W				
B. Use the power supply loading for each chassis and the graphs on page F–5 to determine the power supply dissipation. Place the power supply dissipations into the appropriate columns.							13.0W	15.0W	––
3. Add the chassis dissipation to the power supply dissipation.							30.35W	35.8W	––
4. Add across the columns for the total heat dissipation of your SLC 500 controller.								TOTAL (Watts)	66.15
5. Convert to BTUs/hr. **Multiply the total heat dissipation of your SLC 500 controller by 3.414.**								TOTAL (BtUs/hour)	225.84

Worksheet for Calculating Heat Dissipation

Prodecure	Chassis 1	Chassis 2	Chassis 3
1. Calculate the *heat dissipation* for each chassis without the power supply.			
A. Write in the watts (calculated watts or total watts, see page F–2) dissipated by the processor, I/O and specialty modules, and any peripheral devices attached to the processor. Then, for each chassis, add these values together.			

Slot	Chassis 1		Chassis 2		Chassis 3	
	Catalog Number	Heat Dissipation	Catalog Number	Heat Dissipation	Catalog Number	Heat Dissipation
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
peripheral						
TOTAL						

Prodecure	Chassis 1	Chassis 2	Chassis 3
B. Place the heat dissipation for each chassis into the appropriate columns.			
2. Calculate the *heat dissipation* for each power supply.			
A. Calculate the power supply loading for each chassis: write in the minimum watts for each device (see page F–2) and then, for each chassis, add these values together.			
Important: If you have a device connected to user power, multiply 24V by the current used. Include user power in the total power supply loading.			

Slot	Chassis 1		Chassis 2		Chassis 3	
	Catalog Number	Min. Heat Dissipation	Catalog Number	Min. Heat Dissipation	Catalog Number	Min. Heat Dissipation
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
user power						
peripheral						
TOTAL						

Prodecure	Chassis 1	Chassis 2	Chassis 3
B. Use the power supply loading for each chassis and the graphs on page F–5 to determine the power supply dissipation. Place the power supply dissipations into the appropriate columns.			
3. Add the chassis dissipation to the power supply dissipation.			
4. Add across the columns for the total heat dissipation of your SLC 500 controller.	TOTAL (Watts)		
5. Convert to BTUs/hr. **Multiply the total heat dissipation of your SLC 500 controller by 3.414.**	TOTAL (BtUs/hour)		

Communicating with Devices on an Ethernet Network

This appendix:

- describes SLC 5/05 processors and Ethernet communication
- describes SLC 5/05 performance considerations
- describes Ethernet network connections and media
- explains how the SLC 5/05 establishes node connections
- lists Ethernet configuration parameters and procedures
- describes configuration for subnet masks and gateways

SLC 5/05 Processors and Ethernet Communication

Ethernet is a local area network that provides communication between various devices at 10 Mbps. The physical communication media options for the SLC 5/05 are:

- built-in
  - twisted pair (10Base-T)
- with media converters or hubs
  - fiber optic
  - broadband
  - thick-wire coaxial cable (10Base-5)
  - thin-wire coaxial cable (10Base-2)

See page G–2 for more information on Ethernet physical media.

The SLC 5/05 supports Ethernet communication via the Ethernet communication channel 1 shown in the drawing below.
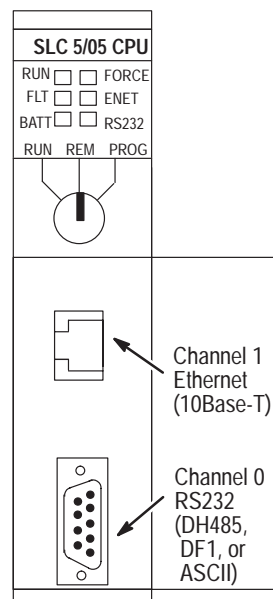
SLC 5/05 Performance Considerations

Actual performance of an SLC 5/05 processor varies according to:

- size of Ethernet messages
- frequency of Ethernet messages
- network loading
- the implementation of and performance of your processor application program

Optimal Performance: PC to SLC 5/05 Processor (2-node Ethernet network)

Operation	Words	MSG per second	ms per MSG	Words per second
Single Typed Read	1	140	281	140
Single Typed Reads	20	138	287	2760
Single Typed Reads	100	129	312	12,900

SLC 5/05 and PC Connections to the Ethernet Network

The SLC 5/05 Ethernet connector conforms to ISO/IEC 8802–3 STD 802.3 and utilizes 10Base-T media. Connections are made directly from the SLC 5/05 to an Ethernet hub. The network setup is simple and cost effective. Typical network topology is pictured below.

Ethernet Network Topology
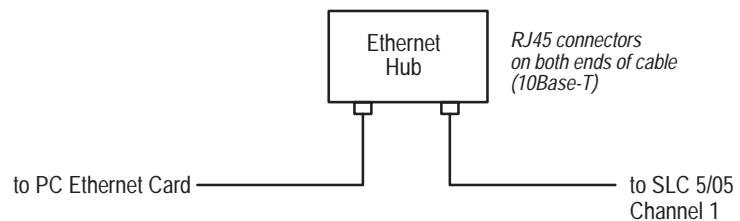
Important: The SLC 5/05 processor contains a 10Base-T, RJ45 Ethernet connector which connects to standard Ethernet hubs via 8-wire twisted pair straight-through cable. To access other Ethernet mediums, use 10Base-T media converters or Ethernet hubs that can be connected together via fiber, thin-wire, or thick-wire coaxial cables, or any other physical media commercially available with Ethernet hubs.

Ethernet Channel 1 8-Pin 10Base-T Connector

The Ethernet connector is an RJ45, 10Base-T connector. The pin-out for the connector is shown below:

Pin	Pin Name
1	TD+
2	TD–
3	RD+
4	not used by 10BASE-T
5	not used by 10BASE-T
6	RD–
7	not used by 10BASE-T
8	not used by 10BASE-T

When to use straight-through and cross-over pin-out:

- SLC 5/05 Ethernet port to 10Base-T Ethernet hub cables utilize a straight-through pin-out (1–1, 2–2, 3–3, 6–6).
- Direct point-to-point 10Base-T cables connecting the SLC 5/05 Ethernet port directly to another SLC 5/05 Ethernet port (or a computer 10Base-T port) require a cross-over pin-out (1–3, 2–6, 3–1, 6–2).

Cables

Shielded and non-shielded twisted-pair 10Base-T cables with RJ45 connectors are supported. The maximum cable length between an SLC 5/05 Ethernet port and a 10Base-T port on an Ethernet hub (without repeaters or fiber) is 100 meters (323 feet). However, in an industrial application, the cable length should be kept to a minimum.

Ethernet Connections

TCP/IP is the mechanism used to transport Ethernet messages. On top of TCP, the Client/Server Protocol is required to establish sessions and to send the MSG commands. Connections can be initiated by either a client program (INTERCHANGE or RSLinx application) or a processor.

The client program or processor must first establish a connection to the SLC 5/05 to enable the SLC 5/05 to *receive* solicited messages from a client program or another processor. The client program must also establish a connection to the SLC 5/05 to enable the SLC 5/05 to *send* unsolicited messages to a client program.

In order to send a peer message, the SLC 5/05 must first establish a connection with the destination node at a specified IP address on the Ethernet network. A connection is established when a MSG instruction executes and no previous connection exists.

When a MSG instruction executes, the SLC 5/05 checks to see whether a connection has been established with the destination node. If a connection has not been established, the SLC 5/05 attempts to establish a connection of the peer type.

The SLC 5/05 supports a maximum of 16 connections, allowing simultaneous communication with up to 16 other devices or applications. The connections are dedicated as follows:

Number of Connections[1]	Dedicated to:
4	peer messages
4	client messages
8	either peer or client messages

[1] Connections established by an INTERCHANGE client, RSLinx client, RSLogix 500, and peers are all included when counting the number of connections.

Important: For peer connections, no more that one connection per destination node is established. If multiple MSG instructions use the same destination node, they share the same connection.

Configuring the Ethernet Channel on the SLC 5/05

There are two ways to configure the SLC 5/05 Ethernet channel 1. The configuration can be done via a BOOTP request at processor powerup, or, by manually setting the configuration parameters using RSLogix 500 Programming Software. The configuration parameters are shown below and the configuration procedures follow.

Parameter	Description	Default	Status
Diagnostic File Number	The file number of the diagnostic counter for this channel. A Diagnostic File Number value of zero means that no diagnostics file has been configured for this channel. The Diagnostic File Number must be an integer within the limits of 7, 9–255.	0	read/write
MSG Connection Timeout	The amount of time (in ms) allowed for a MSG instruction to establish a connection with the destination node. The MSG Connection Timeout has 250 ms resolution and a range from 250 to 65,500.	15,000 ms	read/write
MSG Reply Timeout	The amount of time (in ms) that the SLC 5/05 will wait for a reply to a command that it has initiated via a MSG instruction. The MSG Reply Timeout has 250 ms resolution and a range from 250 to 65,500.	3,000 ms	read/write
Inactivity Timeout	The amount of time (in minutes) that a MSG connection may remain inactive before it is terminated. The Inactivity Timeout has a 1 minute resolution and a range from 1 to 65,500 minutes.	30 minutes	read/write
IP Address	The SLC 5/05 internet address (in network byte order). The internet address must be specified to connect to the TCP/IP network.	0 (undefined)	read/write
Subnet Mask	The SLC 5/05 subnet mask (in network byte order). The Subnet Mask is used to interpret IP addresses when the internet is divided into subnets. A Subnet Mask of all zeros indicates that no subnet mask has been configured.	0	read/write
Broadcast Address	NOT SUPPORTED AT THIS TIME. The SLC 5/05 broadcast address (in network byte order). The Broadcast Address is used in sending multicast messages. A Broadcast Address of all zeros indicates that no broadcast address had been configured. In this case, the network code will choose a valid broadcast address when needed for that current subnet.	0	
Gateway Address	The address of a gateway (in network byte order) that provides connection to another IP network. A Gateway Address of all zeros indicates that no gateway has been configured.	0	read/write
BOOTP Enable	The BOOTP enable switch. When BOOTP is enabled, the SLC 5/05 will attempt to learn its network related parameters at powerup via a BOOTP request. There must be a BOOTP server on the network capable of responding to this BOOTP request. When BOOTP is disabled, the SLC 5/05 will use the locally configured network related parameters (IP Address, Subnet Mask, Broadcast Address, etc.).	1 (enabled)	read/write
Hardware Address	The SLC 5/05 Ethernet hardware address.	Ethernet hardware address	read only

Configuration Using RSLogix500 Programming Software

Refer to the documentation provided with your programming software.

Configuration Via BOOTP

BOOTP is a standard protocol that TCP/IP nodes use to obtain start-up information. By default, the SLC 5/05 broadcasts BOOTP requests at powerup. The BOOTP Valid parameter remains clear until a BOOTP reply has been received. BOOTP lets you dynamically assign IP Addresses to processors on the EthernetLink.

To use BOOTP, a BOOTP Server must exist on the local Ethernet subnet. The server is a computer that has BOOTP Server software installed and reads a text file containing network information for individual nodes on the network.

The BOOTP request can be disabled by clearing the BOOTP Enable parameter in the channel Configuration File. When BOOTP Enable is cleared (disabled), the SLC 5/05 uses the existing channel configuration data.

Important: If BOOTP is disabled, or no BOOTP server exists on the network, you must use SLC 500 programming software to enter/change the IP address for each processor. See page G–5 for that configuration procedure.

The host system's BOOTP configuration file must be updated to service requests from SLC 5/05 processors. The following parameters must be configured:

Parameter	Description
IP Address	A unique IP Address for the SLC 5/05 processor.
Subnet Mask	Specifies the net and local subnet mask as per the standard on subnetting *RFC 950, Internet Standard Subnetting Procedure.*
Gateway	Specifies the IP address of a gateway on the same subnet as the SLC 5/05 that provides connections to another IP network.

Note: If you do not have BOOTP Server capabilities on your network, and you want to dynamically configure Channel 1, contact your local Allen-Bradley representative to obtain a free BOOTP Utility diskette.

> When BOOTP is enabled, the following events occur at power-up:
>
> - The processor broadcasts a BOOTP-request message containing its hardware address over the local network or subnet.
> - The BOOTP server compares the hardware address with the addresses in its look-up table in the BOOTPTAB file.
> - The BOOTP server sends a message back to the processor with the IP address and other network information that corresponds to the hardware address it received.
>
> With all hardware and IP addresses in one location, you can easily change IP addresses in the BOOTP configuration file if your network needs change.

Using DOS/Windows BOOTP

The optional BOOTP Server diskette contains DOS-based and Windows-based BOOTP server utilities. Both provide BOOTP services for SLC 5/05 processors. Regardless of the platform you are using, you must:

- install the boot-server utility
- edit the boot-server configuration file
- run the boot-server utility

Important: Do not use the BOOTP utility disk if you already have INTERCHANGE software installed. Instead, use the boot-server capabilities that came with your INTERCHANGE software.

Install the DOS/Windows BOOTP server

To install the DOS BOOTP server:

1. Put the utility disk that came with your processor in your disk drive.

2. Change directory to the disk drive.

3. Type **install**, and press **[Enter]**.

4. The software is installed in C:\ABIC\BIN. Put this directory in the path statement of your AUTOEXEC.BAT file.

Edit the DOS/Windows BOOTP Configuration File

The boot-server configuration file, BOOTPTAB, is located in the C:\ABIC\BIN directory. This file contains the information needed to boot SLC 5/05 processors.

You must edit the BOOTPTAB file, which is an ASCII text file, to include the name, IP address, and hardware address for each SLC 5/05 processor you want the server to boot. To edit this file:

1. Open the BOOTPTAB file using a text editor.

   The file contains lines that look like this:

   ```
   #Default string for each type of Ethernet client
   defaults5E: ht=1:vm=rfc1048
   ```

   These are the default parameters for SLC 5/05 processors and must always precede the client lines in the BOOTPTAB file.

   The file also contains a line that looks like this:

   ```
   plc5name: tc=defaults5E:ip=aa.bb.cc.dd:ha=0000BC1Cxxyy
   ```

   Important: Use this line as the configuration template for SLC 5/05 processors.

2. Make one copy of the SLC 5/05 processor template for every SLC 5/05 processor in your system.

3. Edit each copy of the template as follows:

    A. Replace `plc5name` with the name of the SLC 5/05 processor. Use only letters and numbers; do not use underscores.

    B. Replace `aa.bb.cc.dd` with the IP address to be assigned to the processor.

    C. Replace `xxyy` with the last four digits of the hardware address. Use only valid hexadecimal digits (0-9, A-F); do not use the hyphens that separate the numbers. (You will find the hardware address on a label affixed to the printed circuit board of the SLC 5/05 processor. **Note:** See page 5–13 for an illustration showing the location of the hardware address.)

4. Save, close, and make a backup copy of this file.

Example

In this example there are three SLC 5/05 processors and an HP 9000 programming terminal. The names and hardware addresses are device specific:

Device	Name	IP Address	Hardware Address
SLC 5/05	sigma1	12.34.56.1	00–00–BC–1D–12–34
SLC 5/05	sigma2	12.34.56.2	00–00–BC–1D–56–78
SLC 5/05	sigma3	12.34.56.3	00–00–BC–1D–90–12
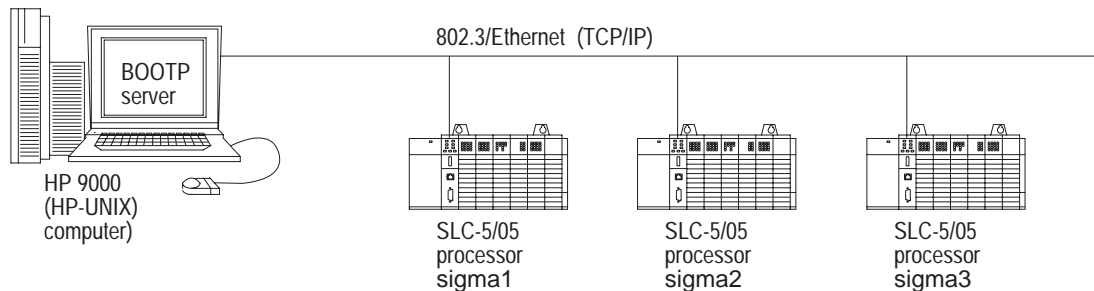
Based on this configuration, the BOOTPTAB file looks like:

```
#  Legend:  gw -- gateways
#           ha -- hardware address
#           ht -- hardware type①
#           ip -- host IP address
#           sm -- subnet mask
#           vm -- BOOTP vendor extensions format②
#           tc -- template host

#Default string for each type of Ethernet client
defaults5E: ht=1:vm=rfc1048

#Entries for SLC 5/05 processors:
sigma1: tc=defaults5E:ip=12.34.56.1:ha=0000BC1D1234
sigma2: tc=defaults5E:ip=12.34.56.2:ha=0000BC1D5678
sigma3: tc=defaults5E:ip=12.34.56.3:ha=0000BC1D9012
```

① 1 = 10MB Ethernet

② Use rfc1048

Run the Boot Server Utility

You can run either the DOS-based utility or the Windows-based BOOTP utility, but not both.

If you have BOOTP enabled and the message BOOTP response not received appears, check the cabling connections and the BOOTP server system.

If you're using this platform	then invoke this executable	from the	See page
DOS-based	DTLBOOTD.EXE	DOS command line (specify optional parameters if necessary)	G–10
Windows	DTLBOOTW.EXE	Windows Program Manager	G–10

Both utilities are located in the C:\ABIC\BIN directory and use the information contained in the BOOTPTAB file.

Be sure to place the BOOTPTAB file in the directory from which you are running the BOOTP utility. If this file is not found in that directory, the utility will try to find the file in the directory specified by the environment variable ABIC_CONFIG.

Running the DOS-Based Utility

To run the boot-server utility, DTLBOOTD.EXE, follow these steps:

1. At the DOS prompt, type:

DTLBOOTD [**–D**] [**–T** *<timeout>*] [**–B** *<numboots>*]
[**–F** *<numfiles>*] [*configfile*] [*logfile*]

Parameter	Description
-D	provide additional information for debug purposes.
–T <timeout>	exit after <timeout> seconds of inactivity.
–B <numboots>	exit after answering <numboots> number of boot requests.
–F <numfiles>	exit after answering <numfiles> number of file requests.
configfile	name of the boot server configuration file to use. The default configuration file is %ABIC_CONFIG%\BOOTPTAB.
logfile	name of the log file to use. The default log file is %ABIC_CONFIG%\DTLBOOTD.LOG.

Once you invoke the utility, it runs until the specified exit parameter is satisfied. Exit any time by pressing **[Esc]**.

2. Apply power to all chassis containing SLC 5/05 processors.

At power-up, each SLC 5/05 processor broadcasts a BOOTP request if BOOTP was enabled at the channel 1 configuration screen. The Ethernet boot server compares the hardware address with those listed in BOOTPTAB and responds by sending the corresponding IP address and other configuration data to the client via a BOOTP reply.

Running the Windows-Based Utility

To run the boot-server utility, DTLBOOTW.EXE, follow these steps:

1. Start Microsoft Windows®, if it is not already running.

2. Open the Program Manager window, if it is not already open.

3. Choose File on the menu bar and select Run from the menu.

4. In the dialog box, type C:\ABIC\BIN\DTLBOOTW; then, choose OK or press [Enter].

Once you invoke the utility, it will run until you terminate it by closing the DTLBOOTW.EXE window and exiting from Windows.

5. Apply power to all chassis containing and SLC 5/05 processors.

At power-up, each SLC 5/05 processor broadcasts a BOOTP request. The Ethernet boot server compares the hardware address with those listed in BOOTPTAB and responds by sending the corresponding IP address and other configuration data to the client via a BOOTP reply.

Using Subnet Masks and Gateways

Configure subnet masks and gateways using the Ethernet channel 1 configuration screen:

Important: If BOOTP is enabled, you can't change any of the advanced Ethernet communications characteristics.

If your network is divided into subnetworks that use gateways or routers, you must indicate the following information when configuring channel 1:

*   subnet mask
*   gateway address

A *subnet mask* is a filter that a node applies to IP addresses to determine if an address is on the local subnet or on another subnet. If an address is located on another subnetwork, messages are routed through a local gateway to be transferred to the destination subnetwork.

If your network is not divided into subnets, then leave the subnet mask field at the default.

If you are	Then	See page
manually configuring channel 1 and have a network with subnets	• be sure the BOOTP enable field is disabled • use your programming software to enter the subnet mask and gateway address.	G–12
using BOOTP to configure channel 1 and have a network with subnets	• be sure BOOTP is enabled • configure the BOOTPTAB file to include the subnet mask(s) and gateway address(es)	G–13

Manually Configuring Channel 1 for Processors on Subnets

If you are manually configuring channel 1 for a processor located on a subnet, deselect the "BOOTP Enable" option by clicking on the checked box.

See the table below to configure the subnet mask and gateway address fields for each processor via your programming software.

Ethernet Channel 1 Configuration Screen Advanced Functions

This field:	Specifies:	Configure by doing the following:
Subnet Mask	The processor's subnet mask.	Enter an address of the following form:
	The subnet mask is used to interpret IP addresses when the internet is divided into subnets.	a.b.c.d Where: a, b, c, d are between 0-255 (decimal)
		If your network is not divided into subnets, then leave the subnet mask field at the default.. If you change the default and need to reset it, type 0.0.0.0.
Gateway Address	The IP address of the gateway that provides a connection to another IP network.	Enter an address of the following form:
		a.b.c.d Where: a, b, c, d are between 0-255 (decimal)
	This field is required when you communicate with other devices not on a local subnet.	The default address is No Gateway.

Using BOOTP to Configure Channel 1 for Processors on Subnets

Configure the BOOTPTAB file according to the subnet mask and gateway address for each SLC 5/05 processor on the link. See the example below and the corresponding BOOTPTAB file on the next page.

Important: Because BOOTP requests are seen only on the local subnet, each subnet needs its own BOOTP server and BOOTPTAB file.

personal computer WINDOWS
or HP 9000 or VAX computer

BOOTP
server

SLC 5/05
processor

Subnet A

130.151.194.xxx

Ethernet TCP/IP network

Hostname:	Iota1
IP address:	130.151.194.19
Subnet Mask:	255.255.255.0
Gateway Address:	130.151.194.1

130.151.194.1

Ethernet gateway
or "router"

BOOTP
server

130.151.132.1   130.151.138.1

BOOTP
server

130.151.132.xxx   130.151.138.xxx

Subnet B

SLC 5/05
processor

SLC 5/05
processor

Subnet C

Hostname:	Iota2
IP address:	130.151.132.110
Subnet Mask:	255.255.255.0
Gateway Address:	130.151.132.1

Hostname:	Iota3
IP address:	130.151.138.123
Subnet Mask:	255.255.255.0
Gateway Address:	130.151.138.1

The BOOTPTAB files that correspond to this example looks like:

```
#   Legend:   gw -- gateways
#             ha -- hardware address
#             ht -- hardware type
#             ip -- host IP address
#             sm -- subnet mask
#             vm -- BOOTP vendor extensions format
#             tc -- template host

#Default string for each type of Ethernet client
defaults5E: ht=1:vm=rfc1048:sm=255.255.255.0

#Entries for SLC 5/05 processors:
iota1:\
        tc=defaults5E:\
        gw=130.151.194.1:\
        ha=0000BC1D1234:/
        ip=130.151.194.19
```

```
#   Legend:   gw -- gateways
#             ha -- hardware address
#             ht -- hardware type
#             ip -- host IP address
#             sm -- subnet mask
#             vm -- BOOTP vendor extensions format
#             tc -- template host

#Default string for each type of Ethernet client
defaults5E: ht=1:vm=rfc1048:sm=255.255.255.0

#Entries for SLC 5/05 processors:

iota2:\
        tc=defaults5E:\
        gw=130.151.132.1:\
        ha=0000BC1D5678:/
        ip=130.151.132.110
```

```
#   Legend:   gw -- gateways
#             ha -- hardware address
#             ht -- hardware type
#             ip -- host IP address
#             sm -- subnet mask
#             vm -- BOOTP vendor extensions format
#             tc -- template host

#Default string for each type of Ethernet client
defaults5E: ht=1:vm=rfc1048:sm=255.255.255.0

#Entries for SLC 5/05 processors:

iota3:\
        tc=defaults5E:\
        gw=130.151.138.1:\
        ha=0000BC1D9012:/
        ip=130.151.138.123
```

Glossary

You can find the following terms used throughout this manual.

Auto Answer — Type of modem that has self-contained timeouts and tests. They can answer and hang the phone up automatically.

Backplane Current Draw — The amount of current the module requires from the backplane. The sum of the backplane current draw for all modules in a chassis is used to select the appropriate chassis power supply.

Baud Rate — The speed of communication between devices on a network. All devices must communicate at the same baud rate. For example, the DH-485 network devices default to 19,200 baud.

Calculated Watts — The amount of heat generated by those points energized on an I/O module.

Channel — Communication port on a module.

Chassis — A hardware assembly that houses devices such as I/O modules, adapter modules, processor modules, and power supplies.

Continuous Current Per Module — The maximum current for each module. The sum of the output current for each point should not exceed this value.

Continuous Current Per Point — The maximum current each output is designed to continuously supply to a load.

CPU — Central Processing Unit or processor.

DF1 protocol — A peer-to-peer link-layer protocol that combines features of ANSI X3.28-1976 specification subcategories D1 (data transparency) and F1 (two-way simultaneous transmission with embedded responses).

Direct Connect — type of modem that is connected to a dedicated, leased phone line and is active at all times.

DH+ — Data Highway Plus implements peer-to-peer communication with a token-passing scheme to rotate link mastership among the nodes connected to that link. Data Highway Plus has the capability for online programming and is optimized for networks with fewer nodes (Data Highway Plus supports up to 64 nodes).

DH-485 Network — The DH-485 network is a collection of devices connected to the communication cable allowing information exchange. A communication network based on the EIA Standard for RS-485 using an Allen-Bradley proprietary protocol.

Discrete Input and Output (DIO) — The discrete input and output is the transfer of one to 32 words between a SLC-500 processor and a scanner. All 32 words of input data and all 32 words of output data are updated on each SLC program scan.

DTE Controlled Answer — Type of modem that is unattended and is attached directly to the phone lines. The interface module or the SLC 5/03 processor acts as the Data Terminal Equipment (DTE) which controls the modem via the DTR and RTS signals. The module incorporates timeouts and tests to properly operate these types of modems.

DTR Dialing (SLC 5/03 only) — Type of modem that lets you dial a number or end a call based on the status of the RS232 DTR (Data Terminal Ready) signal. To program the modem initialization string and phone number into the internal memory of the modem, use a dumb terminal (or PC running terminal emulation software like Procomm, Window's Terminal, or PBASE). Once you have programmed the modem, activate the DTR signal to dial the number, or deactivate the DTR signal to end the call.

Ethernet™ Network — A local area network with a baseband communication rate of 10M bits per second.

EEPROM — Electrically Erasable Programmable Read Only Memory module used to store, back-up, or transfer SLC 500 programs. The SLC 500 can read and write to an EEPROM.

Flash EPROM — Flash Erasable Programmable Read Only Memory module. It combines the programming versatility of EEPROMs with the security precautions of UVPROMs. This means that you have the option of leaving your EPROM programs write protected or unprotected.

Full-duplex — A high-performance protocol that allows simultaneous two-way data transmission. For point-to-point applications only.

Half-duplex — A high-performance protocol that can be used in point-to-point and multi-point applications.

Initiator — A node on the DH-485 network capable of acting as a master. When an initiator has the token it can send messages and request replies from any node on the DH-485 network. A personal computer running your programming software is an initiator on the data link. The SLC 5/02, SLC 5/03, and SLC 5/04 processors can also be initiators.

Input Device — A device, such as a push button or a switch, that supplies signals through input circuits to a programmable controller.

Inrush Current — The temporary surge current produced when a device or circuit is initially energized.

I/O — Inputs and Outputs

IP Address — A 32-bit address assigned to hosts that want to participate in a TCP/IP internet. IP addresses are the abstraction of physical hardware addresses, with a network and host partition which makes routing efficient.

Isolated Link Coupler — The link coupler provides an electrically isolated network connection for an SLC 500 controller (processor or programming station). The link couplers connect the daisy-chained DH-485 communication cable.

LED — Light Emitting Diode. Used as status indicator for processor functions and inputs and outputs.

Manual — Typically an acoustically coupled type of modem. The connection is established by a person on each end of the phone line. They then insert the handsets into an acoustic coupler to complete the connection.

Maximum Watts — The maximum amount of heat that the module generates with field power present.

Minimum Load Current — The lowest amount of current the output is designed to operate at. Operating at or below this value is not reliable.

Minimum Watts — The amount of heat dissipation that can occur when there is no field power present.

Multi-master network — A network in which more than one node has the ability to initiate communications and initialize the link.

M0/M1 File Transfer — A M1/M0 file transfer is a method of moving large amounts of data between a SLC 500 processor and its scanner. It transfers files containing a maximum of 256 words and may take more than one SLC program scan to complete.

Network — A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

Node — Also called a station. An address or software location on the network.

Nominal Input Current — The current at nominal input voltage.

Off-State Current — For input circuits, the maximum amount of leakage current allowed from an input device in its Off-state.

Off-State Leakage — For output circuits, the maximum amount of (leakage) current that may flow when the output circuit is in its Off-state.

Off-State Voltage (max) — The maximum input voltage level detected as an Off condition by the input module.

On-State Voltage Drop — The voltage developed across the output driver circuit during the On state at maximum load current.

Operating Voltage — For inputs, the voltage range needed for the input to be in the On state. For outputs, the allowable range of user-supplied voltage.

Output Device — A device, such as a pilot light or a motor starter coil, that is energized by the programmable controller.

Points per Common — The number of input or output points connected to a single return (common) or supply (vcc).

Poll Message — A poll message is a point-to-point transfer of data sent by the scanner that solicits a response from a single device. The device responds with its data bit and status bit.

Protocol — The "language" or packaging of information that is transmitted across a network.

(I/O) Rack — An I/O addressing unit that corresponds to 8 input image-table words and 8 output image-table words. A rack can contain a maximum of 8 I/O groups for up to 128 discrete I/O.

Remote I/O Network — A network where the communication between the processor and the I/O is across a serial link.

RS-232 — An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits. A single-ended serial communication interface.

RTB —Removable Terminal Block.

Signal Delay — For inputs, the response time required to transmit the circuit status from the field wiring to the digital logic. For outputs, the time required to transmit the circuit status from digital logic to the output wiring.

Sinking — A term used to describe current flow between an I/O device and SLC I/O circuit — typically, a sinking device or circuit provides a path to ground, low, or negative side of power supply.

Sinking/Sourcing — Describes a current signal flow relationship between field input and output devices in a control system and their power supply. Sourcing I/O modules supply (or source) current to sinking field devices. Sinking I/O modules receive (or sink) current from sourcing field devices.

Sourcing — A term used to describe current flow between an I/O device and SLC I/O circuit — typically, a sourcing device or circuit provides a path to the source, high, or positive side of power supply.

Strobe Message — A strobe message is a multicast transfer of data sent by the scanner that solicits a response from each slave device. The devices respond with their data.

Surge Current Per Point — The maximum amplitude and duration (pulse) of current allowed for a given period of time and temperature.

Surge Suppressor — A device used to absorb voltage transients created by energizing an inductive load to reduce electrical noise or to protect the output circuit. For example, an R-C network, MOV (metal oxide varistor) or diode.

Token — The logical right to initiate communications. In a multi-master network a single token is passed between initiators to make sure two nodes do not transmit at the same time.

UVPROM — An Ultra-Violet light erasable Programmable Read Only Memory module used to back-up, store, or transfer SLC 500 programs. The SLC 5/01 and SLC 5/02 can only read from a UVPROM. An external PROM programmer is used to program (write to) the device.

Voltage Category — The nominal voltage used to describe the module.

Watts Per Point — The maximum heat dissipation that can occur in each field wiring point when energized.

Index

keyswitch positions for the SLC 5/03 and SLC 5/04 processors
  PROG, 5-15
  REM, 5-16
  RUN, 5-15

L

line voltage variations, excessive, 2-23

line voltage, power supply specification, 2-11

link coupler
  mounting dimensions, 4-5
  powering, A-14

lithium batteries
  1747-BA, 2-10
  Code of Federal Regulations, 49 CFR 173.22a, 9-2
  disposal of, 9-3
  DOT-E7052 provision, 9-2
  installing on SLC 5/01 or SLC 5/02 processors, 9-4
  installing on SLC 5/03 and higher processors, 9-5
  shipping when depleted, 9-2
  storing and handling, 9-1
  transportation, 9-2

local I/O capacity, processor specification, 2-9

M

machine motion, preventing, 8-2

maintenance, preventive, 3-12

manuals, related, P-3

Master Control Relay, 3-7

master devices, DF1 half-duplex protocol, B-5

maximum inrush current, power supply specification, 2-11

memory back-up for the 1747-L511, 2-10

memory back-up options, processor specification, 2-9

memory module, for SLC 5/03 and higher processors, 2-20

memory modules
  for SLC 5/01 and 5/02 processors, 2-18
  for SLC 5/03 and higher processors, 2-20
  installation, 6-3

minimum watts, defined, F-1

modems, for RS-232, B-7

module release, 1-5

modules, installation, 6-2

motor starters (bulletin 509), surge suppressors, 2-25

motor starters (bulletin 709), surge suppressors, 2-25

mounting dimensions
  10-slot chassis, 4-3
  13-slot chassis, 4-4
  4-slot chassis, 4-1
  7-slot chassis, 4-2
  AIC+ Advanced Interface Converter, 4-6
  Data Table Access Module, 4-5
  DTAM Micro, 4-5
  DTAM Plus, 4-5
  link coupler, 4-5

Mounting Modular Hardware Style Units, 4-1

Mounting Your SLC 500 Control System, 4-1
  10-slot chassis, 4-1
  13-slot chassis, 4-1
  4-slot chassis, 4-1
  7-slot chassis, 4-1
  AIC+ Advanced Interface Converter, 4-1
  Data Terminal Access Module (DTAM), 4-1
  DTAM Micro Operator Interface, 4-1
  DTAM Plus Operator Interface, 4-1
  link coupler, 4-1

MSG instruction, B-4

N

National Fire Protection Association (NFPA), 3-1

noise generators, 2-23

noise immunity, processor specification, 2-9

noise, excessive, 2-23

O

operating cycle, SLC 500 controller, 2-3

operating system upgrade, 6-4

operator interface, selecting
  DTAM, 2-16
  DTAM Micro, 2-17
  DTAM Plus, 2-16
  HHT, 2-15
  IBM compatible computer, 2-15
  PanelView 550, 2-17

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