GE Fanuc Automation

Programmable Control Products

Series 90™ -70 Programmable Controller

Installation Manual

GFK-0262G *November 1999*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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RFI Standards

The Series 90-70 PLC and its associated modules have been tested and found to meet or exceed the requirements of FCC Rule, Part 15, Subpart J. The following note is required to be published by the FCC.

NOTE

This equipment generates, uses, and can radiate radio frequency energy and if not installed in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits of a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

The following note is required to be published by the Canadian Department of Communications.

NOTE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

The following statements are required to appear for Class I Div 2 Hazardous Locations.

1. EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C, and D, DIV. 2 HAZARDOUS LOCATIONS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.
2. **WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.**
3. **WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.**
4. ALL UNUSED SLOTS IN ALL BASEPLATES SHOULD BE POPULATED WITH A BLANK SLOT INTERRUPT JUMPER, IC697ACC722, OR EQUIVALENT WHEN THERE ARE MODULES INSTALLED TO ITS RIGHT WHICH MAY INTERRUPT THE CPU.

This manual provides a description of the hardware components and hardware installation procedures for the Series 90™ -70 Programmable Logic Controller (PLC). The Series 90-70 PLC is a product offering in the Series 90™ family of Programmable Logic Controllers from GE Fanuc Automation.

Revisions to This Manual

Appropriate changes have been made to this manual to reflect the hardware features of Release 7, and later Releases of the Series 90-70 PLC. Additionally, corrections and enhancements have been made where necessary. Following is a list of the revisions made to this manual since the release of the previous version (GFK-0262F):

- Information added for new features and products, including:
  - New Series 90-70 CPU models (CPX 772, CPX 782, CPX 928, CPX 935, CGR 772, CGR 935) (information added/revised throughout the manual)
  - References to Control programming software added throughout the manual
  - TCP/IP Ethernet communications (information added throughout the manual)
  - Enhanced redundancy features (chapter 1)
  - Additional serial ports on new CPU models (chapter 2)
  - User flash memory for CPX models of Series 90-70 CPUs (chapter 2)
  - Bulk Memory Access (BMA) feature for CPX model CPUs (chapter 2)
  - Break-free SNP support with Serial Ports 1 and 2 (chapter 2)
  - Additional PLC technical support phone numbers (chapter 3)
  - Installation instructions for power supplies for floating neutral systems (chapter 3)
  - 24 VDC Rack Fan Assembly (chapter 3)
  - Section added on factors determining battery replacement/memory protection strategy (chapter 3)
- Appendices were revised or new ones added, and are now as follows:
  - Appendix A is a Glossary of terms for the Series 90-70
  - Appendix B is a list of Acronyms and Abbreviations
  - Appendix C is a revised version of Serial Port and Cables
  - Appendix D describes the IC690ACC900 Converter (obsolete product, but included for reference for those already using this converter)
  - Appendix E describes the IC655CCM590 Isolated Repeater/Converter (obsolete product, but included for reference for those already using this converter)
  - Appendix F describes the IC690ACC901 Miniconverter Kit
  - Appendix G describes the IC690ACC903 Port Isolator
  - Appendix H, Heat Dissipation, describes how to calculate heat dissipation for a Series 90-70 PLC
  - Appendix I provides useful tables and formulas
  - Appendix J describes how to configure and use an SNP Multidrop system
- Minor editorial and format changes were made throughout the manual.

Some of the described features may not be available at the time this manual is published. For current availability of features and products, consult your local GE Fanuc PLC distributor or GE Fanuc sales representative.

Content of this Manual

This manual contains three chapters and three appendices. The content of each chapter and appendix is described below.

Chapter 1. Introduction to the Series 90-70 PLC: This chapter is an introduction to the Series 90-70 PLC and provides you with an overview of its features, functions, hardware structure, and programming.

Chapter 2. Product Description: This chapter provides you with descriptions of the various hardware components that are a part of a Series 90-70 PLC system. An emphasis is placed on the features and functions of each component that you will need to be familiar with in order to specify components and understand how they relate to the overall control system.

Chapter 3. Installation Procedures: The purpose of this chapter is to guide you through the steps required for installation of a Series 90-70 PLC control system. An emphasis is placed on the importance of following recommended system grounding procedures: for proper system operation, safety of system equipment, and for safety of personnel operating and using the system.

Important Note

The installation instructions described in this chapter apply to PLC installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see GFK-1179, *Installation Requirements for Conformance to Standards,* which is shipped with the programming software.

Appendix A. Glossary of Terms for the Series 90-70 PLC: Contains terms relevant to the Series 90-70 PLC and to Programmable Logic Controllers in general.

Appendix B Acronyms and Abbreviations

Appendix C. Serial Ports and Cables: This appendix describes the serial ports, converter, and cables used to connect Series 90 PLCs for Series 90 Protocol (SNP). This information is included for reference and for those users who may have applications that require cable lengths different than the factory-supplied cables.

Appendix D IC690ACC900 Converter (Obsolete Product): Contains detailed information about this obsolete product.

Appendix E IC655CCM590 Isolated Repeater/Converter (Obsolete Product): Contains detailed information about this obsolete product.

Appendix F IC690ACC901 Miniconverter Kit This appendix contains detailed information about the RS-422 to RS-232 Miniconverter (IC690ACC901).

Appendix G IC690ACC903 Port Isolator: Contains detailed product description and specifications.

Appendix H Series 90-70 Heat Dissipation: Describes how to calculate heat dissipation for the purpose of sizing enclosures.

Appendix I Tables and Formulas: Contains useful information such as Fahrenheit to Celsius temperature conversion, AWG wire sizes to Metric conversion, ASCII codes, Metric to English units conversion, etc.

Appendix J SNP Multidrop: Explains how to connect a programming unit to multiple PLCs and/or Option modules.

Related Publications:

- *GFK-0255 - Series 90™ Programmable Coprocessor Module and Support Software User's Manual*
- *GFK-0256 - MegaBasic™ Programming Language Reference Manual*
- *GFK-0263 - Logicmaster 90™ -70 Programming Software User's Manual*
- *GFK-0265 - Series 90™ -70 Programmable Logic Controller Reference Manual*
- *GFK-0398 - Series 90™ -70 Genius™ Bus Controller User's Manual*
- *GFK-0413 - GEnet™ System Manager Software User's Manual*
- *GFK-0448 - User's Guide to Integration of 3rd Party VME Modules*
- *GFK-0487 - Series 90™ PCM Development Software (PCOP) User's Manual*
- *GFK-0499 - CIMPLICITY® 90-ADS Alphanumeric Display System User's Manual*
- *GFK-0529 - Series 90™ SNP Communications User's Manual*
- *GFK-0579 - Series 90™ -70 Remote I/O Scanner User's Manual*
- *GFK-0582 - Series 90™ PLC Serial Communications User's Manual*
- *GFK-0585 - Series 90™ PLC SNP Communications Driver User's Manual*
- *GFK-0600 - Series 90™ -70 Data Sheet Manual*
- *GFK-0641 - CIMPLICITY™ 90-ADS Alphanumeric Display System Reference Manual*
- *GFK-0644 - Series 90™ -70 I/O Link Interface Module User's Manual*
- *GFK-0685 - Series 90™ Programmable Controllers Flow Computer User's Manual*
- *GFK-0712 - Series 90™ Digital Event Recorder User's Manual*
- *GFK-0727 - Series 90™ -70 PLC State Logic Processor User's Guide*
- *GFK-0730 - Series 90™ -70 PLC OnTOP User's Guide*
- *GFK-0731 - Series 90™ -70 PLC ECLiPS User's Manual*
- *GFK-0787 - Genius® Modular Redundancy User's Manual*
- *GFK-0827 - Series 90™ -70 Hot Standby CPU Redundancy User's Guide*
- *GFK-0854 - Series 90™ Sequential Function Chart Programming Language User's Manual*
- *GFK-1004 - TCP/IP Ethernet Communications for the Series 90™ -70 PLC User's Manual*
- *GFK-1062 - Series 90™ -70 High Speed Counter User's Manual*
- *GFK-1179 - Installation Requirements for Conformance to Standards*
- *GFK-1192 - Series 90™ -70 System Manual*
- *GFK-1246 - TCP/IP Ethernet Communications (Type 2) for the Series 90™ -70 PLC User's Manual*
- *GFK-1295 - Control User's Manual*
- *GFK-1527 - Series 90-70 Enhanced Hot Standby CPU Redundancy User's Guide*

At GE Fanuc Automation, we strive to produce quality technical documentation. After you have used this manual, please take a few moments to complete and return the Reader's Comment Card located on the next page.

Henry Konat
Technical Writer

Chapter 1

Introduction to the Series 90-70 PLC

Overview

The Series 90™ -70 Programmable Logic Controller (PLC) is a member of the Series 90 family of PLCs designed by GE Fanuc Automation North America, Inc. This PLC provides you with a full-function controller that is easy to install and configure, offers advanced programming features, and is designed for compatibility with other PLCs in the Series 90 family of PLCs. Through the use of the latest design and manufacturing technology, open architecture VME bus, and the ability to connect to Genius I/O and a series of CPU modules, the Series 90-70 PLC provides a powerful, cost-effective platform for small applications through the very largest.

Series 90-70 PLC Hardware

Series 90-70 PLC system components include several CPU modules, racks, power supplies, a rack-type I/O system, the Genius I/O system, Field Control I/O, and a variety of optional modules, including a Programmable Coprocessor Module (PCM), Genius I/O Bus Controller, Remote I/O Scanner, I/O Link Interface, Alphanumeric Display Coprocessor, communications modules, and many other modules. Application programs are developed using a Personal Computer as the programmer coupled with powerful programming and documentation software. The Series 90-70 PLC system is designed to support industry standard VME boards.

State-of-the-art manufacturing technology is employed to deliver a low cost, high density function. Surface mount CMOS, fine line, multi-layer and VLSI technology is effectively employed in the Series 90-70 PLC. Use of this technology results in higher component density, lower heat generation, higher system reliability, and improved product quality.

The CPU's architecture is based on the Intel 80X86 or 80X86DX microprocessor (depending on CPU model) with a VLSI Boolean Coprocessor (BCP). This combination delivers the flexibility of a general purpose microprocessor with the high speed of the BCP executing boolean ladder diagram elements in 0.4 microseconds.

Series 90-70 PLC Programming Software

The software architecture provides a structured platform upon which to build control programs. Programs may be built from many program blocks, each of which is related to a control function. Structured programs permit parallel development of a complete

program as a collection of program blocks developed independently by many different individuals or OEMs. Structured programs are easier to understand and debug. A control program may be built of many smaller program blocks, with each block relating to a specific machine function. This approach makes it easier to isolate and associate control logic with machine functions.

Faults are handled by a software alarm processor function that time-stamps and logs I/O and system faults in two tables which can be displayed by the programmer or uploaded to a host computer or other coprocessor. This alarm processor is a standard feature of all Series 90-70 CPUs.

This chapter introduces you to the Series 90-70 PLC and provides an overview of its features, functions, hardware structure, and programming features.

Series 90-70 PLC Features

The Series 90-70 PLC combines the desired features of the traditional PLC, with many improvements and product enhancements. Features traditionally found in most PLCs include:

- An industrial computer that has been hardened to operate in the harsh environment commonly encountered in the factory;
- Familiar relay ladder diagram (RLD) programming;
- I/O control through user logic programming;
- Instruction set designed specifically for the industrial control and process environment;
- Communications with cell controllers, operator interface terminals, dumb terminals, personal computers, and similar devices.

To these features, the Series 90-70 PLC adds an impressive array of new features, including:

- A high density single slot CPU;
- Structured relay ladder programming;
- Logicmaster 90 programming software;
- Control programming software;
- An industry standard VME bus interface between component boards;
- A general purpose micro-processor;
- Standard interconnection of intelligent boards with the PLC's CPU;
- High density (32 points) I/O on a single board;
- Easy module keying, which prevents plugging-in a wrong I/O module type;
- Two-rack operation from a single power supply;
- Discrete and analog interrupts for fast system response with standard hardware;
- Extensive system and module diagnostics for ease of troubleshooting;
- Built-in battery-backed calendar/clock;
- Software configurable analog modules;

- Configuration Software packages which provide for easy system configuration;
- An alarm processor fault diagnostic function;
- No jumpers or DIP switches to set on boards;
- Genius I/O subsystem with optional dual-bus redundancy;
- C language programming capability;
- Sequential Function Chart (SFC) Language capability;
- State Logic intuitive natural programming language;
- Synchronized Hot Standby CPU Redundancy for critical applications;
- Clock speeds between 12MHz and 96MHz;
- Database sizes from 32 K Bytes to 6 M Bytes;
- Retentive user program memory;
- Parameterized subroutines and background diagnostics;
- The innovative Field Control I/O system;
- Many other features.

Product Description of the Series 90-70 PLC

The Series 90-70 PLC has many other desirable features in addition to the above items, including built-in serial ports, a fast boolean coprocessor (.4µs per instruction), a fixed scan time option, and up to 64 hardware interrupts. The Lithium backup battery for CMOS Random Access Memory (RAM) can be replaced with power on, and your application programs can be password protected for selective security.

Two types of racks are available; standard Series 90-70 racks and VME Integrator racks. The standard Series 90-70 rack is available as a single 19-inch rack for panel or rack mounting, and a 13-inch rack for panel mounting. All standard Series 90-70 racks are physically identical, whether used as a CPU rack, or as an expansion rack. The 19-inch rack can contain 9 modules plus a power supply, or power supply connection; the 13-inch rack can contain 5 modules plus a power supply, or power supply connection.

VME Integrator racks can be used for 3rd Party VME modules and all Series 90-70 CPU and I/O configurations, except redundancy applications. These racks are available in front and rear mount models with backplane connectors spaced on 0.8 inch centers to accommodate 3rd Party VME modules (Series 90-70 modules use two of these slots).

Note

Integration of 3rd Party VME modules must be in accordance with guidelines described in the *User's Guide to Integration of 3rd Party VME Modules*, GFK-0448B, or later version.

Redundancy for the Series 90-70 PLC

CPU redundancy provides a method of allowing a critical application or process to continue operating if a failure occurs in any single component. There are several redundancy alternatives for the Series 90-70 PLC. These redundancy alternatives consist of implementation of the redundancy feature through a user logic program or through a redundancy alternative which consists of both hardware and software.

CPU model 780 (IC697CPU780) is required for Series 90-70 Hot Standby CPU Redundancy applications. Two of the model 780 CPUs are required in a Hot Standby CPU Redundancy system; one in the *Primary PLC* and one in the *Secondary PLC*. For detailed information refer to GFK-0827, the *Series 90-70 Hot Standby CPU Redundancy User's Guide.*

New developments should use the CGR 935 (IC697CGR935) or possibly the CGR 772 (IC697CGR772) as the controller in a CPU redundancy system. Two redundancy control methods can be configured using the CGR935. The Genius Hot Standby (GHS) method (IC660/661 Hot Standby) uses multiple single bus IC660/661 I/O networks with one redundant controller in each synchronized PLC. The Genius Dual Bus (GDB) method uses multiple I/O networks with either single or dual busses in each synchronized PLC with the capability of either unit being activated with a bumpless switch. For detailed information refer to GFK-1527, *Series 90-70 Enhanced Hot Standby CPU Redundancy User's Guide.*

CPU models 788 and 789 and CPM 790 (IC697CPU788, IC697CPU789, IC697CPM790) are required for Genius Triple Modular redundancy systems. These CPUs must be used in conjunction with a series of special programming blocks which provide Triple Modular redundancy operating and autotest routines. For detailed information refer to GFK-0787, the *Genius Modular Redundancy User's Manual.*

Other Series 90-70 redundancy alternatives are: hot standby application logic, hot standby product *plus* application logic, ESD (Emergency Shutdown System) duplex application logic, and ESD duplex and triplex GMR (Genius Modular Redundancy).

Models of Series 90-70 PLC CPU

Series 90-70 PLC CPUs are available in several models. For example, models 73*X* and most of the 77*X* models are 16-bit CPUs; models 78*X*, 91*X*, 92*X* and 93*X* are 32-bit CPUs; model CPX772 is a non-cached 32-bit CPU. Other differences in the CPUs are speed, I/O capacity, user memory size, floating point math functionality and special applications. CPUs are also available that support State Logic programming. The specifications and options for each Series 90-70 CPU model are listed in the following table. Those models that are were new with release 7, and later releases of the Series 90-70 PLC are shown in italics.

Table 1-1. Series 90-70 CPU Models

CPU Model	Speed (MHz)	Processor	Input Points*	Output Points*	On-Board User Memory	Expansion Memory (KBytes)	Floating Pt. Math
CPU 731	12	80C186	512	512	32K(Bytes)	notapplicable	No
CPU 771	12	80C186	2048	2048	notavailable	64/128/256/512	No
CPU 772	12	80C186	2048	2048	notavailable	64/128/256/512	Yes
CPU 780 (1)	16	80386DX	12288	12288	notavailable	128/256FM**/ 256/512	Yes
CPU 781	16	80386DX	12288	12288	notavailable	128/256FM**/ 256/512	No
CPU 782	16	80386DX	12288	12288	notavailable	128/256FM**/ 256/512	Yes
CPU 788 (2)	16	80386DX	352 *	352 *	notavailable	256/512	No
CPU 789 (2)	16	80386DX	12288	12288	notavailable	256/512	No
CPM 790 (2)	64	80486DX2	12288	12288	1M (Bytes)	notapplicable	Yes
CPM 915 (replaces CPM 914)	32	80486DX	12288	12288	1M(Bytes)	notapplicable	Yes
CPM 925 (replaces CPM 924)	64	80486DX2	12288	12288	1M(Bytes)	notapplicable	Yes
CSE 784 (3)	16	80386DX	12288	12288	notavailable	128/256FM**/ 256/512	Yes
CSE 924 (3)	64	80486DX2	12288	12288	512K(Bytes)	notapplicable	Yes
CSE 925 (3)	64	80486DX2	12288	12288	1M(Bytes)	notapplicable	Yes
CPX 772 (4)	96	80486DX4	2048	2048	512K(Bytes)	notapplicable	Yes
CPX 782 (4)	96	80486DX4	12288	12288	1M(Bytes)	notapplicable	Yes
CPX 928	96	80486DX4	12288	12288	6M(Bytes)	notapplicable	Yes
CPX 935	96	80486DX4	12288	12288	1M(Bytes)	notapplicable	Yes
CGR 772 (1, 4)	96	80486DX4	2048	2048	512K(Bytes)	notapplicable	Yes
CGR 935 (1)	96	80486DX4	12288	12288	1M(Bytes)	notapplicable	Yes

*Prior to Release 6.0 of Logicmaster, the programming software restricted the total of %I and %Q to the limit shown individually for each. For example, when using previous programming packages with a model CPU 782, there was a maximum of 12288 points of %I and %Q combined. This restriction no longer exists with the newer versions of Logicmaster, except for CPU 788, whose total number of Input and Output points cannot exceed 352.
** FM = 256 KBytes with 256 KBytes of non-volatile flash memory.

1. **For use with CPU redundancy applications:** CPU model 780 (IC697CPU780) is required for Series 90-70 Hot Standby CPU Redundancy applications. Two of the model 780 CPUs are required in a Hot Standby CPU Redundancy system; one in the *Primary PLC* and one in the *Secondary PLC*. For details, refer to GFK-0827, the *Series 90-70 Hot Standby CPU Redundancy User's Guide.* New developments should use the CGR 935 (IC697CGR935) or possibly the CGR772 (IC697CGR772). For details, refer to GFK-1527, *Series 90-70 Enhanced Hot Standby CPU Redundancy User's Guide.*
2. **CPU models 788 and 789 and CPM 790** (IC697CPU788, IC697CPU789, IC697CPM790) are required for Genius Triple Modular redundancy systems. These CPUs must be used in conjunction with a series of special programming blocks which provide Triple Modular redundancy operating and autotest routines. They will not operate unless these blocks are included in the loaded application program. For detailed information refer to GFK-0787, the *Genius Modular Redundancy User's Manual*.
3. **CSE 784, CSE 924, and CSE 925** are State Logic CPUs.
4. **CPX 772, CPX 782 and CGR 772** are 96MHz 80486DX4 units, but they run slower than the similarly configured CPX 928 and CPX 935 units.

Note

For current availability of CPU models, see your authorized GE Fanuc PLC distributor or sales representative.

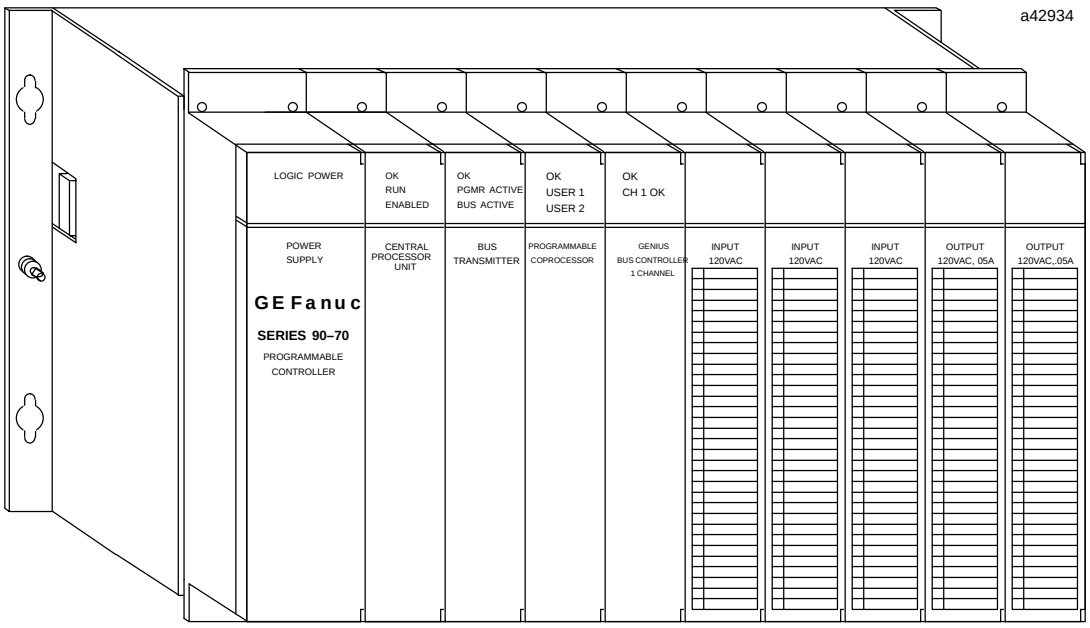


Figure 1-1. Series 90-70 Programmable Logic Controller (Typical)

Series 90-70 PLC Racks

The rack in which the CPU resides requires a power supply (or two-rack power cable), a CPU module installed in slot 1, and for a parallel communications link, an optional Bus Transmitter Module (BTM) installed in another slot (for example, slot 2). The BTM module is used to provide a high-speed parallel communications link with the Logicmaster 90 programmer and to additional racks. (This parallel communications link is not supported by the Control software.) The other 3 slots (in a 13-inch rack) or 7 slots (in a 19-inch rack) can contain combinations of I/O or intelligent modules to suit the needs of your application. There must be no empty slots to the left of option modules or I/O modules using interrupts. If the rest of the modules in a CPU rack are high-density 32-point I/O modules, a 5-slot rack can accommodate up to 128 total I/O points, while a 9-slot rack can accommodate up to 256 total I/O points.

If more I/O is required in the local Series 90-70 PLC control system than can be contained in a single rack, additional racks can be added to the system, up to a maximum of eight racks (including the CPU rack). Each rack in a system is identified by a unique number between 0 and 7, which is assigned by configuring a rack number jumper located on the backplane near the power supply slot. Rack number 0 (assigned to the CPU rack) must always be present in a system. Rack numbers assigned to other racks in a system do not need to be consecutively numbered. Rack numbers must not be duplicated in a multiple-rack system.

The following illustration shows a typical Series 90-70 PLC local system configuration. This configuration shows distributed Genius I/O blocks connected through Genius Bus Controllers. This is but one of many possible configurations. Examples of additional configurations are shown throughout this manual. Also, refer to the applicable manuals for Genius I/O and Field Control I/O products for more system examples.

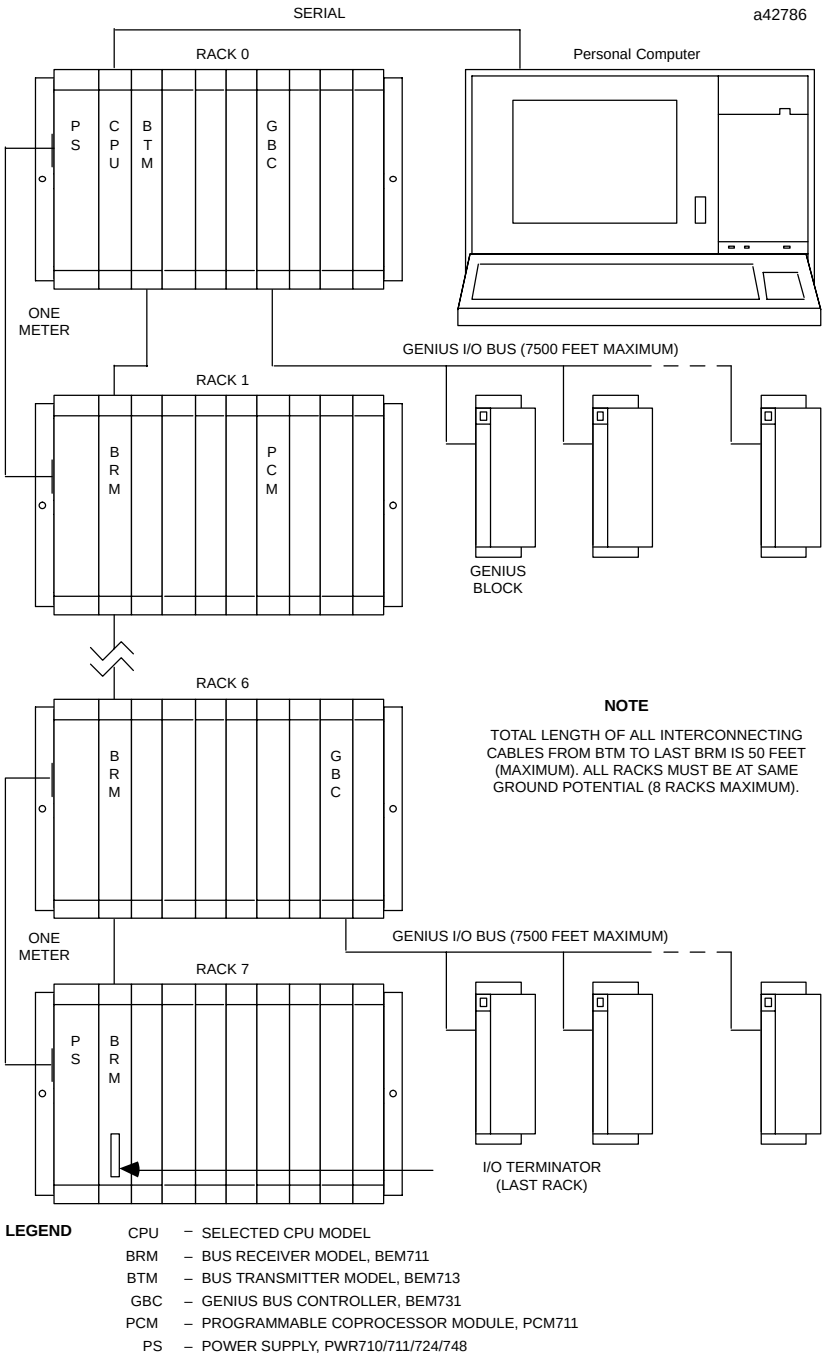


Figure 1-2. Local System Configuration (Typical)

Expansion Racks

Expansion racks are connected to the CPU through an 18 twisted-pair parallel I/O cable with one end connected to the lower connector on the BTM installed in the CPU rack, and the other end connected to the top connector on a Bus Receiver Module (BRM) installed in slot 1 in an expansion rack. Each additional rack is then connected in a daisy chain through I/O cables connected to the top and bottom connectors on the BRMs.

The total cable length from the CPU rack to the last expansion rack can be a maximum of 50 feet (15 meters). I/O cables are available in various lengths from 5 to 50 feet (1.5 to 15 meters). Additionally, a single power supply can power two racks (within current limits) when connected by an available cable three feet (1 meter) in length.

The I/O bus in an expanded system must be terminated by installing an I/O Bus Terminator Plug on the bottom connector of the last BRM. This terminator plug contains a resistor pack configured for proper I/O bus termination. If there are more than two racks in an expansion system, the intermediate expansion racks must not have the terminator plug installed.

Expansion racks can also be located at distances greater than 50 feet from the CPU when used with a Remote I/O Scanner interfacing to a Genius bus. This is done by installing a Remote I/O Scanner module in one or more racks and connecting them to the CPU through the serial Genius bus. This allows up to 1024 discrete inputs and 1024 discrete outputs, or 64 analog inputs and 64 analog outputs to be included on a remote drop. A remote drop is made up of the Remote I/O Scanner and the modules it serves on the Genius bus. Remote racks can be located up to 7500 feet (2285 meters) from the Genius Bus Controller to which they are connected.

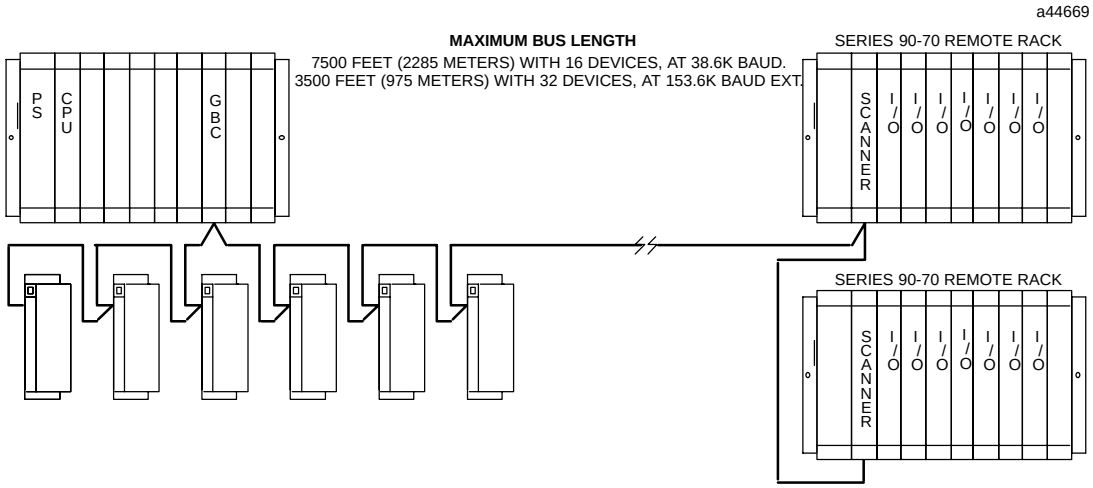


Figure 1-3. Remote I/O Scanner Location in System

General Specifications

General specifications for the Series 90-70 PLC are listed in the following table.

Typical Execution Rate	Boolean Contacts, .4 ms per K elements
Maximum Number of Discrete I/O Points*	CPU Model 788 only - 352, any mix, total number of physical input and output points together cannot exceed 352. This corresponds to approximately 100 redundant points. All other models - no restrictions.*
Operating Temperature**	0° to 60°C (32° to 140°F) for most models, inlet air at bottom of rack. Some require forced air cooling - see individual CPU model data sheet for details. **
Storage Temperature	-40° to 85°C (-40° to 185°F)
Humidity	5% to 95% (non-condensing)
Complies with Standards	
VME	System designed to support the VME standard C.1
NOTE **For a complete list of standards that the Series 90-70 PLCs conform to, refer to GFK-1179** *(Installation Requirements for Conformance to Standards)*.	
AC Power Source	
Voltage	120/240 VAC
Frequency	47 to 63 Hz
Output Power (maximum)	55 watts or 100 watts (two models)
DC Power Source	
Voltage	24 VDC, 48 VDC, or 125 VDC (depending on model)
Output Power (maximum)	90 watts (24 VDC PS), 90 watts (48 VDC PS)
Rack Weight (approximate, filled)	
9 slot	15 pounds (6.8 kg)
5 slot	9 pounds (4 kg)
Rack Dimensions	
9 slot (standard Series 90-70 rack and 17 slot VME Integrator rack)	Height 11.5″ (283mm) Width 19.0″ (483mm) Depth 7.25″ (184mm); (8.25" (209mm) with spacers if VME option kit installed)
5 slot	Height 11.5″ (267mm) Width 12.6″ (320mm) Depth 7.25″ (184mm) Note that all Series 90-70 I/O modules extend 1.7″ (43mm) beyond the front of the rack.
Back-up Battery Type	Lithium, long-life
Typical Battery Life, Loaded	6 months @ 40°C ambient (104°F) (all CPUs/PCM/ADC)
Battery Shelf Life, No Load	8 years @ 25°C (77°F) or 10 years @ 20°C (68°F)

*Prior to Release 6.0 of Logicmaster, the programming software restricted the total of %I and %Q to the limit shown individually for each. For example, when using previous programming packages with a model CPU 782, there was a maximum of 12288 points of %I and %Q combined. This restriction no longer exists with the newer versions of Logicmaster.

**70 CFM forced air required for models CSE 924, CSE 925, CPM 925, CPM 790, CPX 928, CPX 935, and CGR 935; without forced air, operating temperature is 0° to 40°C (32° to 104°F) or 0° to 50°C (32° to 122°F) - see data sheet for individual CPU model for exact requirements.

Configuration and Programming

In addition to the minimal configuration requirements of hardware items during installation of your Series 90-70 PLC, a software package provides for configuration of most system parameters. This system configuration and programming is accomplished with Logicmaster 90 (MS-DOS®) or Control (Windows®) software executing on a programming computer. Both configuration and programming can be done with the programming computer on-line or off-line from the PLC. Although programming can be done before configuration, it is recommended that configuration be done first so that the programming software can verify that certain memory constraints have not been exceeded during programming. Use of the programming and configuration software is described in the *Logicmaster™ 90-70 Programming Software User's Manual* (GFK-0263), *Control User's Manual*(GFK-1295), and the *Series 90™ -70 Programmable Controller Reference Manual* (GFK-0265).

Data Flow Concept

Series 90-70 PLC Data Flow is an important concept. Data Flow extends the concept of discrete power flow to include analog data flow. The benefit to the user is fewer keystrokes because intermediate storage references do not need to be keyed in. Performance is improved because data does not have to be moved to and from intermediate user storage locations between function block executions. Comprehension is better because more logic can be displayed on a single screen. The Data Flow concept is supported by the IEC standard.

Logicmaster 90 Programming Software

Logicmaster 90 programming software is compatible with personal computers. It has all of the functions of Logicmaster 6 plus an improved operator interface. Two levels of function keys provide operator *look-ahead* to avoid menu tree-climbing. It delivers a zooming concept which works in conjunction with the program structure of the CPU. Programs can be displayed at a high level and details are revealed with the use of the zoom key. Note that all CPU features are not supported by Logicmaster 90 software, such as Bulk Memory Area (BMA), which requires the Windows-based Control sofware.

The PLC system is configured with a powerful software configurator tool. Jumpers and DIP switches are virtually eliminated from the Series 90-70 PLC and the configuration is self-documenting.

System Configuration Software Package

The system Configuration Software package can do the following:

- Assign I/O addresses to each Series 90-70 I/O and Genius I/O module.
- Specify the rack and slot location of each module in the system.
- Specify any unique characteristics for each module in the system.
- Assign memory in the PLC for analog I/O, status tables, and user program space.
- Set passwords.
- Specify a name for the system.
- Configure the Series 90-70 PLC system off-line for later loading into the CPU.
- Select the action taken by the CPU for various fault conditions.
- Transfer configurations between the PLC and the programmer.

PLC Programming Software Package

The Programming Software package is used to create ladder logic programs. It offers a full range of programming functions, including:

- Basic contacts, coils, timers, counters.
- Unsigned binary, signed single-precision, double precision, and floating point numbers.
- Programming functions include Data Move, Table Move, Relational, Sort, List Operations, Matrix, Bit Operations, PID, Conversion, Control, and math functions including Trigonometric and Logarithmic functions.
- Support Series 90-70 I/O modules, the Genius I/O system, and qualified 3rd Party VME modules.
- Develop ladder diagram programs off-line.
- Monitor and change reference values on-line.
- Change a program on-line.
- Transfer programs and configuration data between the PLC and programmer.
- Store programs automatically on disk.
- Annotate programs.
- Print programs with annotation and/or cross references.
- Print display screens and tables.
- Print programs and configurations on a variety of printers.
- Display Help information.
- Use an IEC-compliant program structure for programming the PLC.
- Use symbolic references.
- User-defined parameterized subroutine blocks.
- Support of various redundancy alternatives.

Programmer Requirements

In order to run the Logicmaster 90-70 software on a programming computer, you will need the following:

- An 80386 or higher personal computer.
- Approximately 4 M Bytes of disk space.
- MS-DOS version 5.0 or later.
- There are two versions of Logicmaster 90-70; WSI and Standard Serial COM Port. For either version, a minimum 1024 kilobytes of Lotus/Intel/Microsoft Expanded Memory (LIM EMS 3.2 or higher) is required for optimum performance.
- The WSI version of Logicmaster 90-70 software requires a *minimum* of 545 K (558,080) bytes of available MS-DOS application memory in order to run.

- The Standard Serial COM Port version requires either a *minimum* of 590 K (604,160) Bytes of available MS-DOS application memory, *or* 545 K (558,080) Bytes of MS-DOS application memory plus an additional 49 K Bytes of High Memory Area (HMA), Upper Memory Blocks (UMB), or Expanded Memory (EMS) for the communications driver. This version uses a communications driver to perform the functions of the WSI board. For more information, refer to Chapter 7, Section 4, "Standard Serial COM Port," in the *Logicmaster 90-70 Programming Software User's Manual*, GFK-0263.

  A computer with a serial COM port serviced by the National Semiconductor 16550 UART chip is recommended for this version.

The programmer can communicate with the Series 90-70 PLC through a Work Station Interface (WSI) board, or by using the standard serial COM port version of Logicmaster 90-70 which does not require the WSI board. The Work Station Interface board must be installed in the computer to be used for programming. This communications link can be a high-speed parallel link to a BTM in the CPU rack (Logicmaster only), a serial communications link to an RS-422/RS-485 compatible serial port built into the CPU, or an Ethernet link. An I/O interface cable connects the WSI board to the PLC. The parallel connection to the PLC is to the top connector of a BTM, which is usually installed in slot 2, next to the CPU in the CPU rack. The serial connection is to the serial port connector on the CPU module.

There is a new version of Logicmaster (IC641SWP716) that was specifically designed as a DOS application that installs and works under Windows NT® and Windows 95®. This new version provides SNP or TCP/IP Ethernet communications to Series 90-70 PLCs and uses standard TCP/IP Windows drivers to provide maximum compatibility in a network environment. As a program designed for Windows NT and Windows 95, it consumes less of the system resources, easily handling the multitasking attributes of the Windows NT or Windows 95 operating system. For more information about this new product, call 1-800-GEFanuc.

System Programming with Control Software

Control programming software provides PLC programming and configuration in a Windows 95 or Windows NT 3.51 or 4.0 environment; it requires 100 MB of disk space. Basic information on using Control software can be found in GFK-1295, however your primary source of information is the Control software online help.

With Control sofware, you will be able to:

- Create an Equipment Folder.
- Configure Series 90-30 and Series 90-70 PLC hardware, as well as Genius and FIP devices.
- Create and edit variables.
- Create, edit, and monitor the execution of LD, C or SFC programs.

Online Help for Control Programming Software

Online Help is designed to give you quick, easy-to-access information about Control software topics. Use Help to get general information about a product feature, to learn how to perform a specific procedure, or to find the definition of an unfamiliar term. The three ways to find information in Help are by viewing the Help contents, performing a Help search, or using context-sensitive help.

Programmer Connection via Ethernet TCP/IP

Connecting your programmer via an Ethernet TCP/IP network requires installation of an Ethernet Interface module in the PLC. This can be either the Ethernet Controller, IC697CMM741, or Ethernet Interface (Type 2), IC697CMM742. Before connecting your programmer and PLC to the Ethernet TCP/IP network you must set the IP address in the Ethernet Interface, then connect the PLC and the programmer running Windows to the Ethernet Interface. For detailed information, see the *TCP/IP Ethernet Communications (Type 2) User's Manual* (GFK-1295) and the Windows programming manual.

Programming Overview

A program for the Series 90-70 PLC consists of one or more units referred to as program blocks. Each of these program blocks can be up to 16K bytes in size (32K bytes with Control software). The program always has a *Main Program Block* that contains the logic used when the program is started. This Main Program Block is executed repeatedly by the PLC. A Main Program Block can call other Program Blocks as it executes. These Program Blocks can also call other Program Blocks. As with the Main Program Block, each Program Block can contain up to 16K bytes (32K bytes with Control software). Dividing a program into a series of smaller program blocks can simplify programming and reduce the overall amount of logic needed for the program. Logicmaster 90 software allows up to eight levels of calls to Program Blocks. Up to 256 program blocks may be programmed in a single CPU.

Programming Language Options

Programming options for the Series 90-70 offer a choice of programming languages to suit the complexity of your application. The available options are relay ladder logic (RLL), C, State Logic, and Sequential Function Chart (SFC) language.

Relay Ladder Logic (RLL)

Relay Ladder Logic (RLL) diagrams are used by the Series 90-70 programmable controllers to construct continuous logic programs. RLL diagrams are designed to resemble the electrical diagram for an equivalent electrical relay logic circuit.

The RLL diagram contains two vertical power rails. The left power rail is assumed to be an electrical current source and is energized whenever the RLL program is running. The power rail on the right is assumed to be an electrical current sink. The two power rails are connected by horizontal lines called rungs (like the rungs of a ladder) on which the logical instructions are placed.

The basic RLL program instructions, contact and coils, represent actual hardware components (limit switches, solenoid coils, lights, etc.) and single-bit internal memory locations.

RLL diagrams use input contacts to represent boolean input symbols (variables). These contacts act as normally open (active high), or normally closed (active low) relay contacts. RLL diagrams use output coils to represent boolean output variables. If the logic to the left of an output coil is energized (set true), the boolean symbol represented by the output coil receives a boolean 1 (high); otherwise, it receives a boolean 1 (low).

RLL logic elements that reside on the same horizontal rung are assumed to be logically ANDed together. Function blocks are provided to facilitate complex operations that use more than one boolean symbol.

After the system writes to the physical outputs, it reads physical inputs and then solves the RLL logic. Power flow and solving of the program logic is always from left to right and from top to bottom.

C Programming Language

The Series 90-70 C Programmer's Toolkit (IC641SWP709) contains the libraries, utilities, and documentation that you will need to develop C program blocks or standalone programs using the C programming language. C program blocks are constructed using standard tools on a personal computer and are imported into a Series 90-70 PLC application program through the use of Logicmaster 90-70 or Control Librarian functions.

C program blocks can be called from ladder logic or invoked by an I/O or timed interrupt. The ability to write program blocks in C provides you with unmatched flexibility and increased execution speeds. Standalone C programs do not require a ladder diagram and are configured using the Logicmaster 90-70 Program Declaration Screen. Programming in C is ideal for complex applications, such as material handling and routing, that are too intricate for relay ladder language.

For information on C program blocks and C standalone programs using the C programming language, see the *C Programmer's Toolkit for Series 90-70 PLCs User's Manual*, GFK-0646.

State Logic

State logic programming is available through the addition of a State Logic Processor (SLP) module to a Series 90-70 PLC system (CPU models CSE 784/924/925). The SLP module provides real time multi-tasking control for machine and process applications. The SLP module is programmed using the English Control Language Programming System (ECLiPS). The SLP provides total state logic control, including diagnostic and simulation capabilities, for those applications requiring reduced development and startup times. For detailed information, refer to GFK-0727, the *Series 90-70 PLC State Logic Processor User's Guide,* GFK-0731, the *Series 90-70 PLC ECLiPS User's Manual,* and GFK-0730, the *Series 90-70 PLC OnTOP User's Guide.*

Sequential Function Chart Language

Sequential Function Chart language allows you to break control logic into pieces or segments called *steps*. Each step may contain related actions which are executed each time the step is active. On any given scan, not all steps may be active; the actions of inactive steps are not executed. The interrelationships among all the steps and the sequencing of the steps are displayed in the sequential function chart. As a result, the sequential function chart provides a way to organize and structure control programs for different applications. The sequential function chart is particularly well suited to applications requiring sequential control.

A sequential function chart consists of steps and *transitions* interconnected by directed *links*. Each step has zero or more associated actions. A step with no associated actions waits for the next transition condition to be ON. For detailed information on using Sequential Function Chart language, see the *Series 90 Sequential Function Chart Programming Language User's Manual*, GFK-0854.

User Memory for the Series 90-70 PLC

The type of user memory for the Series 90-70 PLC is CMOS RAM. CMOS RAM is an acronym commonly used for Complimentary Metal-Oxide Semiconductor, Random Access Memory. CMOS RAM is a fast, low power memory that can easily be examined (read) and changed (written to). However, CMOS RAM memory is volatile, which means that it can lose its content if power is removed. To retain its content under no-power conditions, a back-up battery is provided on-board in the form of a long-life lithium battery. Because of the low power drain of CMOS RAM memory devices, a lithium battery can maintain the contents of memory without application of power for approximately 6 months. The storage, or shelf life, of a new lithium battery is typically 8 to 10 years.

The on-board CMOS RAM memory available for application program and register data storage with models CPU 731/732 is 32 Kbytes; models CSE 924, CGR772 and CPX 772 have 512 KBytes; models CPM 790/915/925, CSE 925, CPX 782/935, and CGR 935 have 1 Mbyte; and model CPX 928 has 6 Mbytes of on-board memory.

The CPX772, 782, 928 and 935 CPUs have 256K of built-in, non-volatile flash memory for user data (program, configuration, register data) storage.

Models CPU 771/772/780/781/782/788/789 and CSE 784 require memory expansion boards for application program and register data storage. The user memory expansion boards for models CPU 771 and CPU 772 are available in four 16-bit versions: 64 K, 128 K 256 K, and 512 Kbytes. User memory expansion boards for models CPU 780, 781, 782, 788, and 789 are available as four 32-bit versions: 128 K, 256 K with 256 K of non-volatile flash memory (this memory expansion board allows application programs to be protected without battery backup), 256 K, and 512 Kbytes (refer to the data sheet for each CPU for exact memory requirements). See Table 1-5 for details.

The memory expansion board mounts on a single connector on the CPU. The memory expansion boards used for models CPU 771 and CPU 772 can also be used with the Programmable Coprocessor Module. Expansion memory boards for the model CPU 78*X* CPUs are arranged in a 32-bit wide configuration and are only compatible with those models.

User References

Data in the Series 90-70 PLC programs is referenced by its type and location in the system. A reference indicates the way that data is stored in the PLC. A reference specifies both a memory type and a precise address within that memory type. For example:

%I00001 specifies address 1 in input memory.
%R00256 specifies address 256 in register memory.

The % symbol is used to distinguish machine references from nicknames.

User Reference Types

The prefix of a user reference indicates the type of data it references in the PLC. User references in the Series 90-70 PLC are either register references or discrete references.

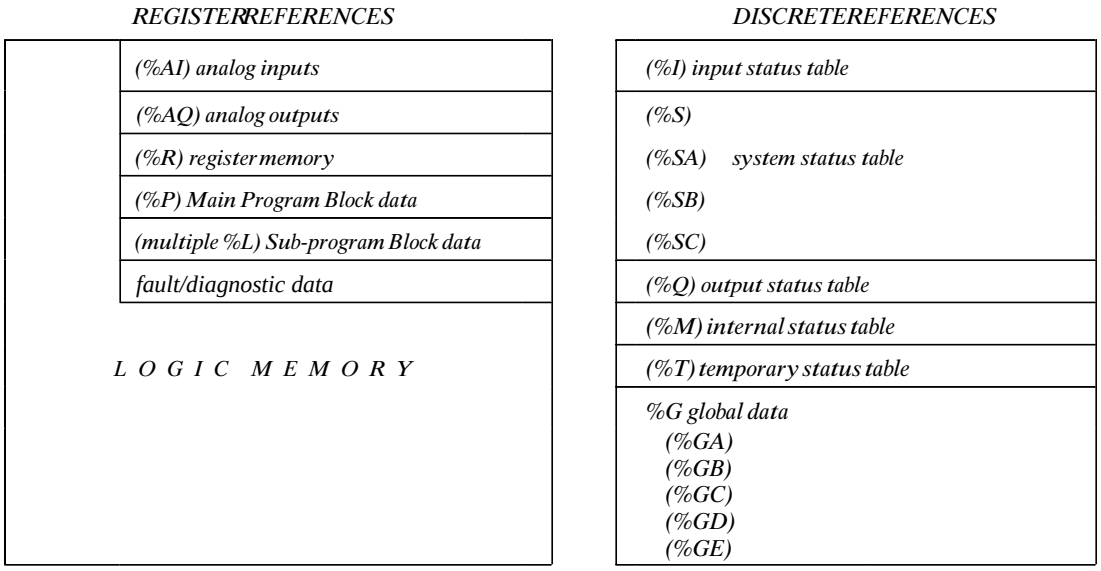


Figure 1-4. Series 90-70 PLC Register and Discrete Reference Data Structure

User Register References

Registers are referenced as 16-bit words. Descriptions of user register references are as follows:

- %AI - This prefix references analog (word) inputs. This prefix is followed by the actual address of the reference, for example: %AI0016. The reference occupies one word (16 bits) in %AI memory, at the specified address.
- %AQ - This prefix references analog (word) outputs. This prefix is followed by the actual address of the reference, for example: %AQ0056. The reference occupies one word (16 bits) in %AQ memory, at the specified address.
- %R - This prefix is used to assign register references that will store word-oriented program data, such as the results of calculations. Register memory can be configured up to 16K words in 1K increments. These references are retentive.
- %P - This prefix is used to reference program registers that are associated with the main program block.
- %L - This prefix references local registers that are unique to a local program block.
- Logic memory is used to store application programs. It is not directly addressable by the application programs.

User Discrete References

Discrete references represent individual bits of data. The following types of references are discrete references.

- %I - The prefix %I references discrete machine inputs. This prefix is followed by the reference's address in the status input table. For example: %I0012. The %I references are located in the input status table, which stores the states of inputs received from the hardware during the last input scan.
- %Q - The prefix %Q references discrete machine outputs. This prefix is followed by the reference's address in the output status table. For example: %Q0012. The %Q references are located in the output status table, which stores the states of outputs as last set by the application program. The states of these references are retained through loss of power unless used with a "normal non-retentive" coil, -( )-.
- %M - This prefix is used to reference internal coils. They are used in boolean logic when the result will be used again in the program. The %M references are retained through loss of power unless used with a "normal non-retentive" coil, -( )-. Since they do not represent actual machine outputs, any available location in %M memory can be assigned, for example: %M00064. Internal coils referenced as %SM (SET coil) and %RM (RESET coil) are retentive.
- %T - The %T prefix is used to reference temporary internal coils which will not be retained through loss of power. Temporary coils function like the %M references, described above. However, they can be used as often as needed as coils to control logic within the user program.
- %G - The %G prefix references global data (%GA - %GE). This data can be shared between devices on a Genius I/O bus.
- %S - The %S prefix references system memory. %S references are non-retentive. These discrete references are used by the PLC to store contact references that have special meaning (see Chapter 2 of the *Logicmaster 90 Programming Software Reference Manual*, GFK-0265 or Appendix C of the *Control User's Manual*, GFK-1295, for a complete list) such as:

%SA0002	OV_SWP	Exceeded constant sweep time
%SA0009	CFG_MM	System configuration mismatch
%SB0011	BAD_PWD	Password Failure

User Reference Size and Default

Maximum user references and default reference sizes for each model of CPU are listed in the tables below.

Table 1-2. User References

	CPU Model					
Item	**935/928 925/915**	**784/790**	**788 (1)**	**780/781 782/789**	**771/772**	**731**
Maximum %I reference(2)	12288 points	12288 points	352 points	12288 points	2048 points	512 points
Maximum %Q reference(2)	12288 points	12288 points	352 points	12288 points	2048 points	512 points
Maximum %M reference	12288 points	12288 points	12288 points	12288 points	4096 points	2048 points
Maximum %T reference	256 points	256 points	256 points	256 points	256 points	256 points
%S total (S,SA,SB, SC)	512 points	512 points	512 points	512 points	512 points	512 points
%G (GA, GB, GC, GD, GE)	7680 points	7680 points	7680 points	7680 points	7680 points	7680 points
User RAM	1024Kbytes (6MB for CPX 928) (3)	CPU 784: 512Kbytes (1MB for CPM 790) (4)	512Kbytes	512Kbytes (CPX 782 has 1024K bytes)	CPU 771/772: 64, 128, 256, 512 Kbytes depending on expansion memory board. (3) CPX 772 has 512 Kbytes.	32Kbytes
%AI (words, maximum)	8K	8K	8K	8K	8K	8K
%AQ (words, maximum)	8K	8K	8K	8K	8K	8K
%R, 1K word increments(maximum)	16K	16K	16K	16K	16K	16K
%L (words per program block; maximum)	8K	8K	8K	8K	8K	8K
%P (words, maximum)	8K	8K	8K	8K	8K	8K

[1] Total number of physical input and output points together cannot exceed 352 points for CPU model 788. This corresponds to approximately 100 redundant points. Refer to Chapter 1 of GFK-1277 for more information.

[2] Prior to Release 6.0 of Logicmaster, the programming software restricted the total of %I and %Q to the limit shown individually for each. For example, when using previous programming packages with a model CPU 782, there was a maximum of 12288 points of %I and %Q combined. This restriction no longer exists with the newer versions of Logicmaster, except for CPU 788, whose total number of Input and Output points cannot exceed 352.

[3] Up to 544 Kbytes available to Relay Ladder Logic; remainder can be used for C programs, %R, %AI, %AQ, tables, and other uses.

[4] Program size greater than 512 Kbytes (544 Kbytes) available in CPU release 7.10, and higher (non-redundant systems only).

Table 1-3. Default Memory Sizes

Memory Type	All Series 90-70 CPU Models
%AI	64 words
%AQ	64 words
%R	1024 words
%P *	0 words
%L *	0 words

* %P and %L are user-allocatable via program reference, based on user needs.

Other System References

In addition to the references discussed above, many other types of references are available for the Series 90-70 PLC including indirect references, unbound references, system references and fault references. For more detailed information on references for the Series 90-70 PLC, refer to the *Series 90-70 Programmable Controller Reference Manual*, GFK-0265.

Series 90-70 PLC I/O System

The Series 90-70 PLC I/O system provides the interface between the Series 90-70 PLC and user supplied input and output devices. The I/O system supports Series 90-70 rack-type I/O, intelligent option modules (PCM, ADS, etc.), the Genius I/O system, the Field Control I/O system, and many 3rd Party VME modules.

A Genius Bus Controller (GBC) module is available, as an option, to provide the interface between the Series 90-70 PLC CPU and one Genius I/O bus. The Series 90-70 PLC I/O system can support multiple GBCs with up to 30 blocks and a Hand-Held Monitor (HHM) connected to each Genius I/O bus. Additionally, a Remote I/O Scanner on the Genius bus allows Series 90-70 I/O to be located at a distance up to 7500 feet from the CPU rack.

Field Control is a family of highly modular distributed I/O and control products. These products are suitable for use in a wide range of host architectures.

The heart of the Field Control system is the Bus Interface Unit which interfaces Field Control I/O modules to a host PLC or computer via a Genius bus. It is ideally suited for use with a Series 90 PLC. However, any type of PLC or computer capable of controlling a Genius bus can be used as the host. It can exchange up to 128 bytes of input data and 128 bytes of output data with the host, each Genius bus scan. It can also handle Genius datagram communications.

The FIP Bus Controller (FBC) is a two-channel bus controller that occupies a single slot in a Series 90-70 standard or VME Integrator rack. I/O devices on the FIP bus are scanned asynchronously by the FIP Bus Controller and I/O data is transferred to the CPU once per scan. Up to 31 Bus Controllers, of any kind, can be included in a Series 90-70 PLC system. Of the 31 Bus Controllers, a maximum of four can be FIP Bus Controllers. The FIP Bus Controller supports Series 90-30 I/O in remote drops interfaced to the FIP bus through Remote I/O Scanner modules, Field Control Stations, and generic devices interfaced to the bus via a 3rd Party FIP module.

In addition, the I/O system can support Genius buses wired in a dual-bus redundant configuration with up to 30 blocks connected to each pair of buses through Bus Switching Modules (BSM). The Genius Bus Interface Unit can be used on a bus controlled by redundant CPUs or Bus Controllers. It can also be used on a dual bus.

Series 90-70 Rack-Type I/O Subsystem

The rack-type I/O subsystem for the Series 90-70 PLC is the Series 90-70 PLC I/O (also referred to as the Model 70 I/O). Series 90-70 I/O modules plug directly into the Series 90-70 PLC rack backplane. These I/O modules can be installed in any available I/O slot in the CPU rack, or any I/O slot in any expansion rack (certain limitations may apply, refer to individual data sheets and Chapter 3, *Installation Procedures* in this manual for details).

The Series 90-70 PLC I/O system does not require a dedicated I/O Controller, as with Genius I/O. A maximum configured Series 90-70 PLC I/O system supports up to 63 I/O modules in a local system (more I/O modules if remote racks are included). I/O modules are retained in their slots by molded latches that automatically snap onto the upper and lower rails of the rack when the module is fully inserted into its slot.

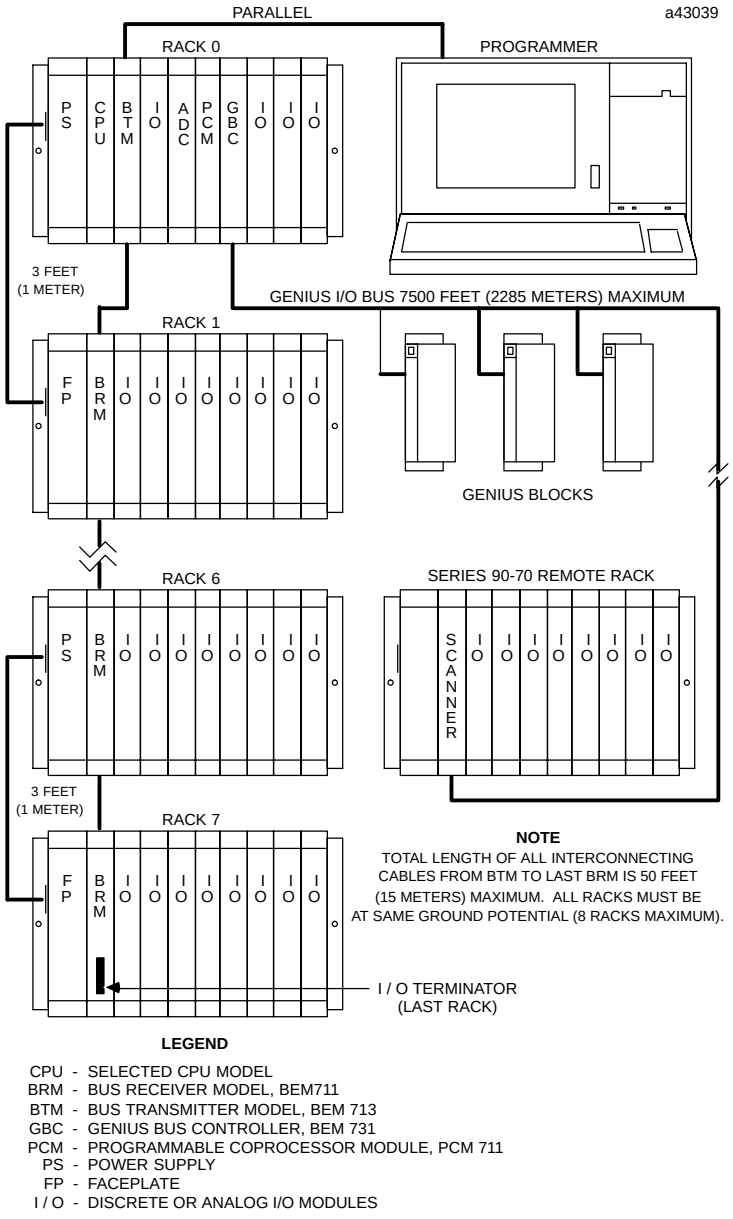


Figure 1-5. Example of Series 90-70 I/O System

Series 90-70 I/O Module Types

Series 90-70 I/O modules are available as five types: discrete input, discrete output, analog input, analog output, and option. Most discrete modules have either 16 or 32 points, depending on the type of module. Analog inputs can be cost-effectively multiplexed up to 120 circuits per rack by using a base converter module and up to seven expander modules. Interrupts may be configured from input 1 of any DC input module, or Analog input or output module. Input filters may be selected to be 1 ms or 10 ms time constants on any DC input module. Intelligent option modules are available for many applications. Refer to the following table for a list of available Series 90-70 I/O modules.

Table 1-4. Series 90-70 I/O Modules

Catalog Number †	Points	Description	Data Sheet or Manual
		Discrete Input Modules	
IC697MDL240	16	Input 120 VAC Isolated	GFK-0375
IC697MDL241	16	Input 240 VAC Isolated	GFK-0376
IC697MDL250	32	Input 120 VAC	GFK-0084
IC697MDL251	16	Input 120 VAC (non-isolated)	GFK-0718
IC697MDL252	32	Input 12 VAC	GFK-0756
IC697MDL253	32	Input 24 VAC	GFK-0757
IC697MDL254	32	Input 48 VAC	GFK-0784
IC697MDL640	32	Input 125 VDC, Positive/Negative Logic	GFK-0719
IC697MDL651	32	Input TTL	GFK-0377
IC697MDL652	32	Input 12 VDC Positive/Negative Logic	GFK-0378
IC697MDL653	32	Input 24 VDC Positive/Negative Logic	GFK-0379
IC697MDL654	32	Input 48 VDC Positive/Negative Logic	GFK-0380
IC697MDL671	16	Interrupt Input (14 Interrupt Points, 2 Configurable Points)	GFK-0880
		Discrete Output Modules	
IC697MDL340	16	Output 120 VAC 2A	GFK-0082
IC697MDL341	12	Output 120/240 VAC 2A Isol	GFK-0382
IC697MDL350	32	Output 120 VAC 0.5A	GFK-0081
IC697MDL740	16	Output 24/48 VDC 2A	GFK-0086
IC697MDL750	32	Output 24/48 VDC 0.5A	GFK-0085
IC697MDL752	32	Output 12 VDC 0.5A	GFK-0381
IC697MDL753	32	Output 5/48 VDC 0.5A Negative Logic	GFK-0383
IC697MDL940	16	Output Relay	GFK-0384
		Analog Modules	
IC697ALG230	8	Analog Input, High Level	GFK-0385
IC697ALG440	16	Analog Expander, Current	GFK-0385
IC697ALG441	16	Analog Expander, Voltage	GFK-0385
IC697ALG320	4	Analog Output, Voltage/Current	GFK-0388

† For current availability of the modules, data sheets or manuals listed above, consult your authorized GE Fanuc PLC distributor, or local GE Fanuc sales representative.

Circuit status of each I/O point on discrete I/O modules is indicated by a green LED mounted at the top of the module which is viewed through the clear plastic lens cover. Each module has an insert that goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information for that module type, and the outside surface has space to record circuit identification information. The outside edge of the insert is color coded so you can quickly identify the module as a high voltage (*red*) or low voltage (*blue*) type. Individual data sheets, with module descriptions and wiring information, are included with each I/O module.

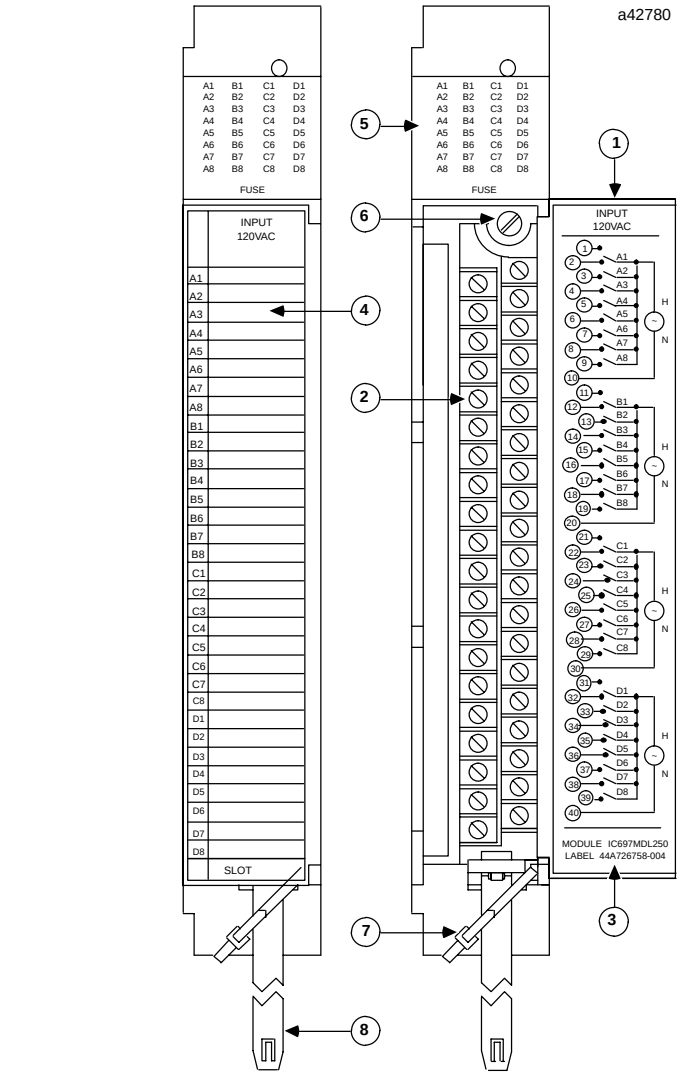


Figure 1-6. Series 90-70 I/O Module Features

Universal Terminal Boards

All Series 90-70 I/O modules have as a standard feature detachable field wiring terminal boards. This convenient feature makes it easy to prewire field wiring to the user supplied input and output devices, and to replace modules in the field without disturbing existing field wiring. The I/O connector terminals will accept up to one AWG #14 (2.1 mm^2) wire or two AWG #16 (1.3 mm^2) wires. Wires are routed out of the bottom of the terminal board cavity. A terminal board strap attached to the bottom front of each I/O terminal board is used to securely fasten the terminal board to the rack.

Mechanical Keying

All Series 90-70 I/O modules are mechanically interlocked by means of a key to prevent the accidental interchange of one module type for another. For example, a DC Output module cannot be inserted into a slot where the terminal board has been wired for an AC Input module. A unique key is provided with each module. When a module is initially installed in a rack, the key automatically latches onto the center rail on the backplane, where it remains when a module is removed. Only the correct module type can be inserted into that slot.

I/O Module Addressing

Module addressing is determined by the position (slot number) in the rack in which it is installed. There are no jumpers or DIP switch settings required for addressing of modules. Actual reference addresses for each module are assigned by the user with the configuration portion of the Logicmaster 90 or Control Programming Software package. The configurator function of Logicmaster 90 or Control allows the user to assign reference addresses to the I/O modules on a slot-by-slot basis.

Optional Modules for the Series 90-70 PLC

In addition to the bus expansion modules (Bus Transmitter Module, Bus Receiver Module) and I/O modules, optional modules currently available for use with the Series 90-70 PLC include:

- Genius Bus Controller (GBC)
- Remote I/O Scanner
- FIP Bus Controller (FBC)
- Programmable Coprocessor Module (PCM)
- Alphanumeric Display Coprocessor Module (ADC)
- Carrierband MAP Interface Module
- MMS and TCP/IP Ethernet LAN Controller Module
- Ethernet Interface (Type 2) Module
- Communications Coprocessor Module (CMM)
- I/O Link Interface Module
- High Speed Counter Module

- State Logic Processor (SLP) Module
- State Logic CPUs
- Serial Communication Module for State Logic
- Work Station Interface
- Redundancy Communications Module (RCM)

The function of each of the Option modules is described briefly in this chapter. For a more detailed description of each module, see Chapter 2 in this manual.

Table 1-5. Series 90-70 Option Modules

Catalog Number †	Description	Data Sheet	Manual
	Option Modules		
IC697ADC701	Alphanumeric Display Coprocessor	GFK-0521	GFK-0499 GFK-0641
IC697BEM721	I/O Link Interface	GFK-0645	GFK-0644
IC697BEM731	Genius Bus Controller	GFK-0165	GFK-0398
IC697BEM733	Remote I/O Scanner	GFK-0539	GFK-0579
IC697BEM741	FIP Bus Controller	GFK-1002	GFK-1038
IC697BEM763‡	DLAN/DLAN+ Interface Module	GFK-0728	GFK-0729
IC693BEM764‡	VMEDLAN/DLAN+ Interface Module	GFK-0728	GFK-1044
IC697CMM711	Communications Coprocessor	GFK-0370	GFK-0529
IC697CMM712	Serial Communications Module for State Logic	GFK-1039	GFK-1006
IC697CMM721	Carrierband MAP Interface	GFK-0368	GFK-0869
IC697CMM741	Ethernet LAN Controller MMS Communications TCP/IP Communications	GFK-0532	- GFK-0868 GFK-1004
IC697CMM742	Ethernet Interface (Type 2) High-performance TCP/IP Communications	GFK-1215	GFK-0868 GFK-1004
IC697HSC700	High Speed Counter	GFK-1057	GFK-1062
IC697PCM711	Programmable Coprocessor Module	GFK-0164	GFK-0255
IC697RCM711	Redundancy Communications Module	GFK-0834	GFK-0827
AD697SLP711	State Logic Processor Module	GFK-0734	GFK-0727
IC640WMI920/320 or IC640WMI910/310	Work Station Interface Board	GFK-0281 or GFK-0166	GFK-0867

† For current availability of the modules, data sheets or manuals listed above, consult your authorized GE Fanuc PLC distributor, or local GE Fanuc sales representative.

‡ The DLAN/DLAN+ and VME DLAN/DLAN+ Interface modules provide an interface between GE Fanuc Series 90-70 PLC systems and GE Drive Systems motor drives. For details and availability, consult your local GE Fanuc sales representative.

Genius Bus Controller

The Genius Bus Controller (GBC), IC697BEM731, for the Series 90-70 PLC provides the interface between the Series 90-70 PLC and a Genius I/O communications system. This

system can be interfaced to I/O control using Genius I/O blocks, a Genius Local Area Network, or Series 90-70 I/O in a remote rack. Configuration of the GBC is simplified by use of the configurator functions of the Logicmaster or Control software. The Genius Bus Controller is also an integral component of various redundancy configurations.

Each Genius I/O bus can have up to 30 Genius I/O blocks connected to it. Any type of Genius I/O block, as long as it is a phase B block, may be connected to these buses. Detailed information on the Genius Bus Controller can be found in the *Series 90-70 Bus Controller User's Manual*, GFK-0398. Information on Genius I/O blocks available for use on a Genius I/O network, can be found in the *Genius I/O System User's Manual*, GEK-90486.

Remote I/O Scanner

The Remote I/O Scanner, catalog number IC697BEM733, is an intelligent module that mounts in a remote rack, and interfaces Series 90-70 I/O modules to a Genius bus. The Remote I/O Scanner can be located up to 7500 feet from the CPU rack. It supports standard Series 90-70 discrete and analog I/O modules, as well as PCM, GDS, ADS, and analog expander modules.

Up to 128 bytes of inputs and 128 bytes of outputs can be handled by the Remote I/O Scanner in a remote rack (remote drop). Each remote drop can include up to eight racks (with a Remote I/O Scanner located in rack 0). Up to 30 remote drops can be located on the same Genius bus. The Remote I/O Scanner supports both CPU and Genius bus redundancy.

For detailed information on the Remote I/O Scanner, refer to the *Series 90-70 Remote I/O Scanner User's Manual*, GFK-0579.

FIP Bus Controller

The *FIP Bus Controller* (FBC), catalog number IC697BEM741, is a two-channel bus controller that interfaces an FIP I/O serial bus to a Series 90-70 PLC, or to a Series 90-30 FIP I/O nest. I/O devices on the FIP bus are scanned asynchronously by the FIP Bus Controller and I/O data is transferred to the CPU once per scan. Up to 31 Bus Controllers, of any kind, can be included in a Series 90-70 PLC system. Of the 31 Bus Controllers, a maximum of four can be FIP Bus Controllers. The FIP Bus Controller supports Series 90-30 I/O in remote drops (FIP I/O nest) interfaced to the FIP bus through Series 90-30 Remote I/O Scanner modules, Field Control I/O Stations, and generic devices interfaced to the bus via a 3rd Party FIP module.

For detailed information on the FIP Bus Controller, refer to the *Series 90-70 FIP Bus Controller User's Manual*, GFK-1038.

Programmable Coprocessor Module

The Programmable Coprocessor Module (PCM), catalog number IC697PCM711, enhances the overall operation of the Series 90-70 PLC CPU by providing a high performance coprocessor having 128 Kbytes of on-board CMOS battery-backed user memory. The user memory can be increased to as much as 640 Kbytes of CMOS battery-backed memory by the addition of the same memory expansion board option that is available for models CPU 771 and CPU 772. PCMs allow the user to assign up to 63 separate 80186-based coprocessors to computing, filing and communications tasks.

Each PCM is closely coupled to the CPU via the backplane and communicates to the CPU on demand or during a window each scan through the Service Request Processor. The PCM can be configured to behave as:

- One CCM Port;
- Two independent CCM ports;
- One CCM port and one MegaBasic application having one port;
- One MegaBasic application using one or both serial ports.

Applications may be programmed with a powerful BASIC language called MegaBasic to perform data acquisition, data storage and retrieval, real-time computing, and operator interface functions using an IBM-compatible development system.

The PCM also supports communications tasks. The architecture (with two independent ports) supports multi-tasking available initially as one BASIC task and one communication task. The PCM may be applied as a file server in a data intensive application. This approach frees the CPU for more critical real time tasks. Each PCM can have a file of 512K bytes to divide the tasks of file lookup. The PCM provides the capability of dual tasking by using each of the two serial ports for different tasks. The two serial ports could be used for other functions like bar code reader interface at the same time the PCMs are performing a file server function.

The PCM may be used to provide the GE Fanuc CCM communications protocol, has two serial ports, supports the MegaBasic programming language, and is programmed using a personal computer.

For detailed information on the Programmable Coprocessor Module, refer to the *Series 90 Programmable Coprocessor Module and Support Software User's Manual*, GFK-0255, and the *Series 90 PCM Development Software (PCOP) User's Manual*, GFK-0487.

Alphanumeric Display Coprocessor Module

The Alphanumeric Display Coprocessor Module, catalog number IC697ADC701, is a coprocessor to the Series 90-70 PLC CPU. It is programmed to perform display, report, and alarm functions through an Operator Interface Terminal, which can be a GE Fanuc OIT or Mini OIT, a Mini Touch OIT, a VT100 compatible terminal, a Nematron color or monochrome OptiTOUCH terminal, or a personal computer running TERMF. It communicates with the Series 90-70 CPU over the system backplane.

Many Alphanumeric Display Coprocessor modules can be supported in a single Series 90-70 PLC system and can be located in either the main rack or expansion racks.

Operation of the module may be initialized by depressing a pushbutton on the module or by an attached ADS (PCOP) development system. The status of the ADC is indicated by three green LEDs on the front of the module.

For detailed information on using the Alphanumeric Display Coprocessor Module in the an ADS System, refer to the *CIMPLICITY 90-ADS System User's Manual*, GFK-0499, and the *CIMPLICITY 90-ADS System Reference Manua*l, GFK-0641.

Carrierband MAP Interface Module

The Carrierband MAP Interface module, catalog number IC697CMM721, is a member of the family of GEnet Factory LAN hardware and software products. The Carrierband LAN Interface module provides direct connection for a Series 90-70 Programmable Logic Controller (PLC) to an IEEE 802.4 carrierband network.

The GEnet Factory LAN architecture is based on standards set forth in the Manufacturing Automation Protocol (MAP) specification. MAP is the single networking

scheme that allows all the vendors involved in automating a factory to work on a common communications architecture.

The Series 90-70 LAN Interface module supports the MAP specification version 3.0. The MAP protocol software is loaded into Random Access Memory (RAM) on the LAN Interface module. This allows upgrade to a new revision of software without modification to the hardware.

For detailed information on the Carrierband MAP Interface module, refer to GFK-0869, the *MAP 3.0 Communications for the Series 90-70 PLC User's Manual*.

Ethernet Controller Module

The Ethernet Controller module, catalog number IC697CMM741, plugs into a single slot in a Series 90-70 PLC rack providing an 802.3-standard 15-pin D-connector for attachment of a user-supplied AUI (or transceiver) cable. The AUI cable connects to a user-supplied transceiver that is directly connected to the Ethernet trunk cable.

Transceivers are available to operate on a variety of media including thickwire coaxial cable (10Base5) and ThinWire ™ coaxial cable (10Base2).

The Ethernet Controller is designed so the communications protocols which operate above the Ethernet data link layer are implemented in software. This allows you to choose among three alternative communication protocols by downloading the Ethernet Interface with the applicable Communications Software. These three communications protocols are:

- **TCP/IP-Ethernet Communications Software** - Communicate with host computers and/or programmer using proprietary SRTP over a 4-layer TCP/IP (Internet) protocol stack; requires either a Local or Network Factory LAN System Manager (GSM) for configuration and downloading of Ethernet Controller software. For information on TCP/IP Ethernet communications, refer to GFK-1004, *TCP/IP Ethernet Communications for the Series 90-70 PLC User's Manual.*
- **MMS-Ethernet Communications Software** - Communicate with host computers and/or programmer using MMS (Manufacturing Message Specification - ISO 9506) on a 7-layer OSI protocol stack; requires GSM for configuration and downloading of Ethernet Controller software. For information on MMS-Ethernet communications, refer to GFK-0868, the *MMS-Ethernet Communications for the Series 90-70 PLC User's Manual.*
- **SRTP Communications Software** - Communicate (only) with programmer using SRTP over a 4-layer OSI protocol stack; this Ethernet Controller software does not require configuration and can be downloaded directly from the programmer.

The Ethernet executable software is loaded into RAM on the Ethernet Interface module. This software can be loaded either serially from the Local GEnet System Manager (GSM) or across the Ethernet network from the Network GSM. This allows upgrade to a new revision of software without modification to the hardware.

™ ThinWire is a trademark of Digital Equipment Corporation.

Ethernet Interface (Type 2) Module

The Ethernet Interface (Type 2) Module, catalog number IC697CMM742, provides high performance TCP/IP communications for the Series 90-70 PLC.

The Ethernet Interface (Type 2) plugs into a single slot in a Series 90-70 PLC rack and is configured with the Logicmaster 90 programming software (IC641SWC713/716 or IC641SWM713/716), or Control programming software (IC641CTL97x). Up to four Ethernet Interface (Type 2) modules can be installed in a Series 90-70 PLC CPU rack.

The Ethernet Interface (Type 2) contains three network ports: 10BaseT (RJ-45 connector), 10Base2 (BNC connector), and AUI (15-pin D-connector). The Ethernet Interface (Type 2) automatically selects the network port in use. One network port may be used at a time.

Communications Coprocessor Module

The Communications Coprocessor Module (CMM), catalog number IC697CMM711, provides Series 90 protocol (SNP), communications control protocol (CCM), and RTU Modbus protocol (RTU) functionality on a single board. SNP, CCM and RTU are available on either or both serial ports in any of nine possible combinations: CCM/CCM, CCM/RTU, RTU/CCM, RTU/RTU, SNP/CCM, SNP/RTU, CCM/SNP, RTU/SNP, and SNP/SNP.

The Communications Coprocessor module provides both the RS-232 and RS-485 interfaces and communicates with the PLC over the backplane. Many CMMs can be placed in a single Series 90-70 PLC system. For detailed information on the Communications Coprocessor Module, refer to GFK-0582, the *Series 90 PLC Serial Communications Manual*.

I/O Link Interface Module

The I/O Link Interface module, catalog number IC697BEM721, is used to interface a Series 90-70 PLC to GE Fanuc and Fanuc products on the proprietary Fanuc I/O link. The Fanuc I/O Link is a serial interface that provides high-speed exchange of I/O data between a master device and up to 16 slaves.

The I/O Link Interface module occupies a single slot in a PLC rack. Up to four I/O Link Interface modules can be installed in a Series 90-70 PLC. Each I/O Link Interface module can operate as an I/O Link master or slave.

When used as a master, an I/O Link Interface module can exchange up to 1024 discrete inputs and 1024 discrete outputs with slave devices (potential slaves include the Series 90-30 PLC, Series 0 CNC, and Power Mate CNC). When used as a slave, it can exchange up to 64 discrete inputs and 64 discrete outputs with the master.

For detailed information on the I/O Link Interface module, refer to the *Series 90-70 I/O Link Interface Module User's Manual,* GFK-0644.

High Speed Counter Module

The IC697 High Speed Counter (HSC70) module, catalog number IC697HSC700, directly processes rapid pulse signals up to 200 KHz (800 KHz for Type E in A Quad B mode). The module is able to sense inputs, process input count data, and control its outputs without communicating with the PLC CPU. The HSC70 has a simple and user-friendly PLC interface that makes it extremely useful in industrial applications such as:

- Velocity measurement
- Process control
- Material handling

The High Speed Counter can accept up to four independent counters depending on the type of counter that is configured (5 types available): A, B, C, D, or E. All counters have 12 inputs, four independent preset outputs, and optional PLC ladder interrupt capability.

For detailed information about the High Speed Counter, refer to the *Series 90-70 High Speed Counter User's Manual,* GFK-1062.

State Logic Processor Module

The State Logic Processor Module (SLP), catalog number AD697SLP711, provides real time multi-tasking control for machine and process applications. It can also be programmed to perform computations, data acquisition, data communications and operator interface functions. The SLP is programmed using the English Control Language Programming System (ECLiPS) software package. It communicates with the PLC CPU over the backplane and can access user and system data. Many SLPs can be supported in a single Series 90-70 PLC system and each SLP can support up to 1024 inputs and 1024 outputs.

The PLC CPU and SLP modules together in the Series 90-70 PLC provide a dual processor architecture that can be used in a wide variety of applications. The SLP provides total state logic control, including diagnostic and simulation capabilities, for those applications requiring reduced development and startup times. For those applications where both ladder logic and state logic programming is desired, the dual processor architecture allows a user to create both ladder logic and state logic application programs in any combination for efficient parallel processing solutions.

For detailed information on the State Logic Processor module, refer to the *Series 90-70 State Logic Processor User's Guide*, GFK-0727.

Serial Communications Module for State Logic

The Serial Communications Module (SCM) for State Logic, catalog number IC697CMM712, provides I/O ports for serial communications to the State Logic Control System. The State Logic CPU control system program uses the SCM to receive input from a serial device and to transmit information to a serial device. The SCM uses the CCM2 protocol (slave only).

Each module provides two ports that can each be configured to be RS-232 or RS-422/RS-485 ports. The State Logic Control System supports up to four SCMs providing a capacity of a total of eight serial ports. The SCMs must be installed in slots 2 through 5 of rack 0 (CPU rack).

For detailed information on the SCM for State Logic CPU, refer to the *Series 90-70 State Logic Control System User's Manual*, GFK-1006.

Work Station Interface

A Work Station Interface board (IC640WMI910/310 or IC640WMI920/320) is an option that will allow the Series 90-70 PLC to communicate with the programming device in which the Logicmaster 90 software is installed. The Work Station Interface board must be installed in the programmer hardware, which is typically a personal computer.

Programmer communications through the Work Station Interface may be via a parallel interface to the programming port on the BTM or a serial interface to the RS-422/485 serial port on the CPU. This option works only with the Logicmaster 90 software, not with the Control software.

Redundancy Communications Module

The Redundancy Communications Module (RCM), catalog number IC697RCM711, provides a communications path for sharing data between the two CPUs in a synchronized Hot Standby CPU Redundancy system. In a synchronized system, I/O data is controlled by one unit (the active unit) but is shared between both units (active and backup units). The RCM provides the communications path between the two units. An RCM must be configured in both the Primary PLC and the Secondary PLC. The RCM must reside in rack 0 and there can be no empty slot between the RCM and the CPU (there can be other modules).

The RCM has two connectors mounted on the front of the board. *The top connector is the only one used.* It is connected via an I/O cable with built-in termination to the last rack of the *other* PLC system. If no expansion rack is used, it is connected to the lower connector on the BTM of the other system. An I/O cable with built-in termination must connect to the RCM and is available in two lengths: IC697CBL811, 10 feet (3 meters) and IC697CBL826, 25 feet (7.5 meters).

Software Options

In addition to the items described above, many optional software packages are available for the Series 90 PLCs. Three of those packages are described below: the Network GEnet System Manager, Series 90 Flow Computer, and the Digital Event Recorder. For information about other software packages, see your GE Fanuc authorized PLC distributor or GE Fanuc sales representative.

Network GEnet System Manager

The Network GEnet System Manager (GSM), catalog number IC651MMZ300, is used to perform management and configuration functions for GE Fanuc LAN Interfaces. It is a menu-driven software package that runs on a personal computer operating under the DOS environment.

The GSM allows setup, configuration, and maintenance of GE Fanuc LAN devices over the Local Area Network. It provides centralized network control; there is no need to go to individual devices on the network for changes or maintenance. GSM software operates over an 802.4/MAP LAN or 802.3/Ethernet LAN and is available in two versions: Local and Network.

The Local version is included with each GEnet LAN Interface product to perform essential configuration and management functions. It communicates with the LAN Interface over the RS-232 serial communications link.

The Network version performs all the local GSM functions, and additionally has special functions to interact with the GE Fanuc Interfaces across the LAN from a central location. The network GSM may be connected to either an 802.4 carrierband, or 802.3 network with an appropriate PC LAN Interface installed in the PC. To use the Network GSM, you must purchase a 3rd Party PC LAN Interface. A list of PC LAN Interfaces supported by the Network can be found in GFK-0673, which is the data sheet for the

GSM. Additional information can also be found in GFK-0413, the *GEnet System Manager Software User's Manual*.

Flow Computer

The Series 90 Flow Computer, catalog number IC641SWP064, is a Programmable Coprocessor Module-based MegaBasic program which calculates the gas flow and volume for orifice meter applications in accordance with the AGA3 standard using either the NX-19 or Standing Katz supercompressibility methods. The Flow Computer can be used with one of two operator interfaces:

- Local operator interface only. The local operator interface can configure the Flow Computer, and view the calculated results using seven built-in screens. PLC registers are not used and ladder logic is unnecessary when the local operator interface is used.
- CIMPLICITY 90-ADS operator interface only - there is no local operator interface. The CIMPLICITY 90-ADS operator interface communicates to the Flow Computer through PLC registers. A set of CIMPLICITY 90-ADS screens is provided on the Flow Computer diskette.

A personal computer is used to install the Flow Computer diskette files to the PCM, download PLC configuration and ladder logic, and download ADS screens and configuration to the Alphanumeric Display Coprocessor module. For more information, refer to the *Series 90 Programmable Controllers Flow Computer User's Manual*, GFK-0685.

Digital Event Recorder

The Digital Event Recorder, catalog number IC641SWP066, is a maintenance tool for process troubleshooting with Logicmaster 90 software that can be used with any Series 90 PLC. Typical applications for the Digital Event Recorder include machine failure analysis, program debugging, process debugging, and data acquisition.

The Digital Event Recorder can use a Series 90 SNP (Series Ninety Protocol) or Work Station Interface driver. The Digital Event Recorder allows you to sample and record the value of specified locations in the PLC at high speed. Sampling can be triggered by a logic expression of up to 120 characters. Up to 32 locations, with each location having up to 1024 samples, can be gathered with a configurable sample time interval (40ms minimum) in intervals of 10ms.

The Digital Event Recorder will run in either Logicmaster mode or ADS mode. You can access the Digital Event Recorder by selecting a Logicmaster 90 softkey and an Operator Interface menu. Once started, sampling will continue until the required number of samples has been collected or you stop it by pressing the applicable function key.

A series of screens and pop-up menus allows for ease of setup and operation. A strip menu located at the top of the main screen shows the available options. Each option is selected by pressing the appropriate function key (F1 through F10).

For detailed information on the Digital Event Recorder, refer to the *Series 90 Digital Event Recorder User's Manual*, GFK-0712.

PLC Communications Options

The Series 90-70 supports various communications systems and protocols. The Series 90-70 PLC supports the core GE Fanuc communications systems, which are CCM,

Genius, Ethernet, and MAP. It also supports the Series 90 Protocol (SNP) communications. The availability of these systems simplifies connecting a Series 90-70 PLC to existing GE Fanuc products.

CCM Communications

CCM communications is an integral part of the PCM and is run as a task on one serial port, or both serial ports of the PCM. CCM communications is also available with the Communications Coprocessor Module.

Genius Communications

The Genius Bus Controller supports the Genius LAN (Local Area Network) functionality. Global data and datagrams are also supported. Default settings make it a simple procedure to configure a standard network capable of running global data.

A Remote I/O Scanner provides a method for Series 90-70 I/O to be used in conjunction with the Genius LAN. This feature provides Series 90-70 I/O with the distribution ability of the Genius I/O system.

MAP Communications

GE Fanuc provides a Carrierband embedded Manufacturing Automation Protocol (MAP) interface for the Series 90-70 PLC (IC697CMM721). The Carrierband Interface resides on a single-slot board which can be located in any I/O slot on the parallel I/O bus.

The MAP Interface runs MAP 3.0 and 3.0 Mini MAP. The MAP Interface board requires 12 VDC, which means that the power supply used in the rack in which it resides must supply ± 12 VDC (IC697PWR724/748 or IC697PWR711/713). Multiple MAP Interfaces can be used in a single Series 90-70 PLC system.

Ethernet Communications

The Ethernet Interface is designed so the communications which operate above the Ethernet data link layer are implemented in software and can be either MMS-Ethernet Communications, TCP/IP Communications, or SRTP communications. Also available is Ethernet Global Data (EGD). EGD requires IC697CMM742 the Ethernet Interface Type 2, version 2.60 and higher. Refer to the Ethernet Interface (Type 2) description in Chapater 3 for more information. You can choose one of the communications protocols by downloading the Ethernet Interface with the applicable Communications Software.

- The MMS (Manufacturing Message Specification - ISO 9506) communications protocol communicates with host computers over a 7-layer ISO protocol stack. For information on MMS-Ethernet communications, refer to GFK-0868, the *Ethernet Communications for the Series 90-70 PLC User's Manual.*
- The TCP/IP Ethernet communicates with host computers using proprietary SRTP over a 4-layer TCP/IP (Internet) protocol stack, and requires either a Local or Network Factory LAN System Manager (GSM) for configuration and downloading of Ethernet Controller software. For detailed information on TCP/IP Ethernet communications, refer to GFK-1004, *TCP/IP Ethernet Communications for the Series 90-70 PLC User's Manual.*
- The SRTP (Service Request Transfer Protocol) communications protocol is supported over a 4-layer ISO protocol stack.

- Ethernet Global Data allows 0ne device (the producer) to share a portion of its internal memory (the exchange) with one or more devices (the consumers) at a regularly scheduled periodic rate on an Ethernet network. For more information, refer to the Ether Interface (Type 2) data sheet, GFK-1309 and the TCP/IP Ethernet Communications for the Series 90 PLC User's Manual, GFK-1541.

The Ethernet Interface provides a direct PLC attachment to IEEE 802.3 CSMA/CD LAN. The Ethernet executable software, which is loaded into RAM memory on the Ethernet Interface module, can be loaded either locally from the Local GEnet System Manager (GSM) or across the Ethernet network from the Network GSM.

The Ethernet Interface plugs into a single slot in a Series 90-70 PLC rack and provides an 802.3-standard 15-pin D-connector for attachment of a user-supplied Attachment Unit Interface (AUI) or transceiver cable. The AUI cable connects to a user-supplied transceiver that is directly connected to the Ethernet trunk cable. The transceiver must be 802.3-compatible and must have the SQE option enabled.

Transceivers are commercially available to operate on a variety of media including thickwire coaxial cable (10Base5), ThinWire™ coaxial cable (10Base2), and twisted pair (10BaseT), fiber optic cable (10BaseF), and broadband cable (10Broad36).

Series 90 Protocols (SNP and SNP-X)

SNP (Series 90 Protocol) is a serial protocol used in the Series 90 PLC family to communicate between a host device and the PLC CPU through the CPU's serial port. A protocol is a set of rules that define an orderly transmission of data. In the case of SNP, it is a set of rules that establishes and maintains a serial communications link between a Master (host device running the master implementation of the SNP protocol) and a Slave (Series 90 PLC CPU). SNP is a master-slave protocol where the master initiates all communications and the slave responds to the master's requests. There is no peer-to-peer capability with the SNP protocol.

SNP is a half-duplex protocol that uses the RS-485 (enhanced version of RS-422) electricalinterface. Several system configurations are possible. There may be just one PLC on the serial link (direct, point-to-point port connection), or there may be many Series 90 PLCs on a serial link (multidrop port connection). Only one SNP master may be on a multi-drop link. SNP also supports communication over modems. CPX model boards have an RS-232 port for SNP. However, multidrop configurations are not possible with RS-232

The SNP-X protocol is a highly optimized addition to SNP. It offers fewer functions than SNP; however, SNP-X is simpler to use and provides a significant performance improvement over SNP. SNP-X is a half-duplex master-slave protocol and is avaiable on the Series 90-70 Communications Coprocessor module (IC697CMM711).

For detailed information and example multidrop connections, refer to Appendix C.

Where isolation is required, the RS-422 Isolated Repeater/RS-232 Converter (catalog number IC655CCM590) can be used in place of the RS-232/RS-422 Converter (catalog number IC690ACC900) or Miniconverter (catalog number IC697ACC901). In addition to converting from RS-232 to RS-422 communications, the Isolated Repeater/Converter provides ground isolation where a common ground cannot otherwise be established between components.

For more detailed information on the Series 90 Protocols, refer to GFK-0529, the *Series 90 SNP Communications User's Manual*, GFK-0585, the *Series 90 SNP Master Driver User's Manual*, and GFK-0582, the *Series 90 PLC Serial Communications User's Manual.*

Genius Triple Modular Redundancy

The *Genius™ Modular Redundancy* (GMR) system is realized through specific product enhancements to Series 90-70 PLCs and Genius I/O products, together with a set of GMR system software.

GMR is a high-reliability, high-availability redundancy system based upon the Series 90-70 PLC and Genius I/O. Enhancements for GMR have been made to the PLC CPU, bus controller, and Genius I/O blocks. These enhanced products, together with GMR system software, provide input voting by the PLCs, output voting by the blocks themselves, support for both discrete and analog I/O, automatic testing of discrete inputs and outputs, and extensive fault-monitoring capabilities for the application program. The CPUs which are installed in a GMR system must be either catalog number IC697CPU788, IC697CPU789, or IC697CPM790.

A basic GMR system consists of groups of Genius blocks gathering data from multiple or single sensors, multiple PLCs running the same application program, and groups of Genius blocks controlling shared output loads. Communications between the blocks and PLCs and among the PLCs is provided by the Genius bus, which is a serial link with configurable baud rate up to 153.6 K or lengths of up to 7500 feet.

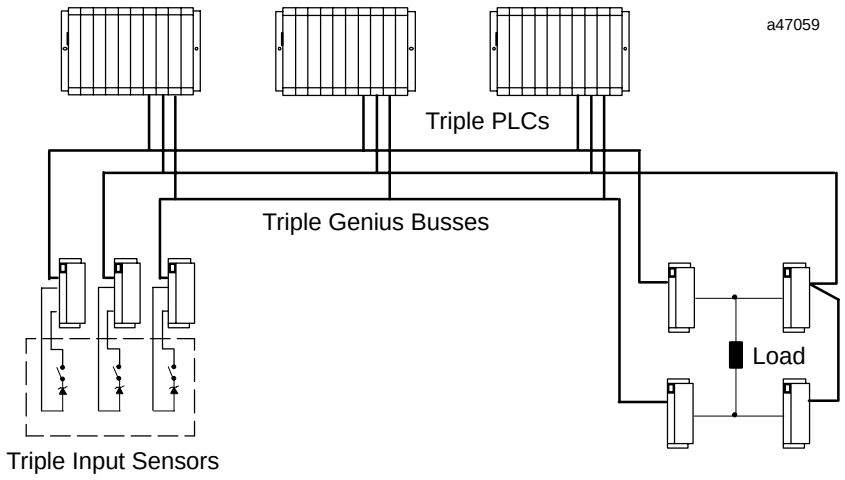


Figure 1-7. Example GMR Configuration

GMR provides great configuration flexibility. A system can include 1, 2, or 3 GMR PLCs. There can be just one I/O subsystem, as represented above, or more than one. Each I/O subsystem can include 1, 2, or 3 busses. A bus can serve up to a total of 32 devices (I/O blocks, PLCs, and a Hand-held Monitor). Each Genius I/O block can support its full complement of input or output devices (for example, 32 discrete I/O points). The system can include both non-redundant I/O blocks and individual non-redundant points on redundant blocks.

For detailed information on GMR, see GFK-0787, the *Genius Modular Redundancy User's Manual.*

Hot Standby CPU Redundancy

CPU Redundancy for the Series 90-70 Programmable Logic Controller provides two methods of allowing a critical application or process to continue operating if a failure occurs in any single component: Genius Hot Standby (GHS), and Genius Dual Bus (GDB). These two control strategies are summarized below.

GHS Control Strategy:

- Multiple single bus Genius I/O networks with one redundant controller in each synchronized PLC
- Multiple local single bus Genius I/O Networks
- Redundant Genius I/O driven exclusively by the Active Unit
- Primary Unit is always the Active Unit in synchronized system unless explicitly overridden by user or application; switch over from secondary active to primary active may not be bumpless in certain failure conditions
- Only critical control data must be transferred from Active to Backup CPU
- Compatible with the Release 4 based High Availability Redundancy Product GDB Control Strategy:
- Multiple dual bus Genius I/O networks with two redundant controllers in each synchronized PLC
- Multiple single bus Genius I/O networks with one redundant controller in each synchronized PLC
- Multiple local Genius I/O networks with single or dual buses/controllers
- Active Unit does not automatically switch to Primary on resynchronization
- Bumpless switch over with either PLC active
- Critical control data plus all redundant outputs must be transferred from Active to Backup CPU

A Hot Standby CPU Redundancy system consists of two CPUs connected to one or more Genius I/O buses. Each PLC is configured as either *Primary* or *Secondary*. The Primary PLC is the preferred PLC and contains all redundant Genius Bus Controllers at Serial Bus Address 31; the Secondary PLC contains all redundant Genius Bus Controllers at Serial Bus Address 30. The CPU that currently controls the system is called the *active* unit, the other CPU is the *standby* unit. Local I/O can be configured in the overall PLC system; however *it is not* part of the Hot Standby CPU Redundancy system.

If certain system failures are detected in the active unit, control is switched to the standby unit. Control can also be switched by depressing a pushbutton on the RCM, or through the user's logic program using a Service Request (SVCREQ #26). When a switch of control occurs, the units switch roles; the active unit becomes the standby unit and the standby unit becomes the active unit.

Each PLC *must have a Redundancy CPU module* (catalog number IC697CPU780, IC697CGR935, or IC697CGR772) and a *Redundancy CommunicationsModule* (IC697RCM711) which provides the synchronization link between the two units (and a Bus Transmitter Module (IC697BEM713)). The scanning process of both CPUs is synchronized to keep active and standby units in lockstep to minimize *bumps* or upsets to the process when switching from the active to the standby unit. The effect of this action is referred to as a *bumpless* switch.

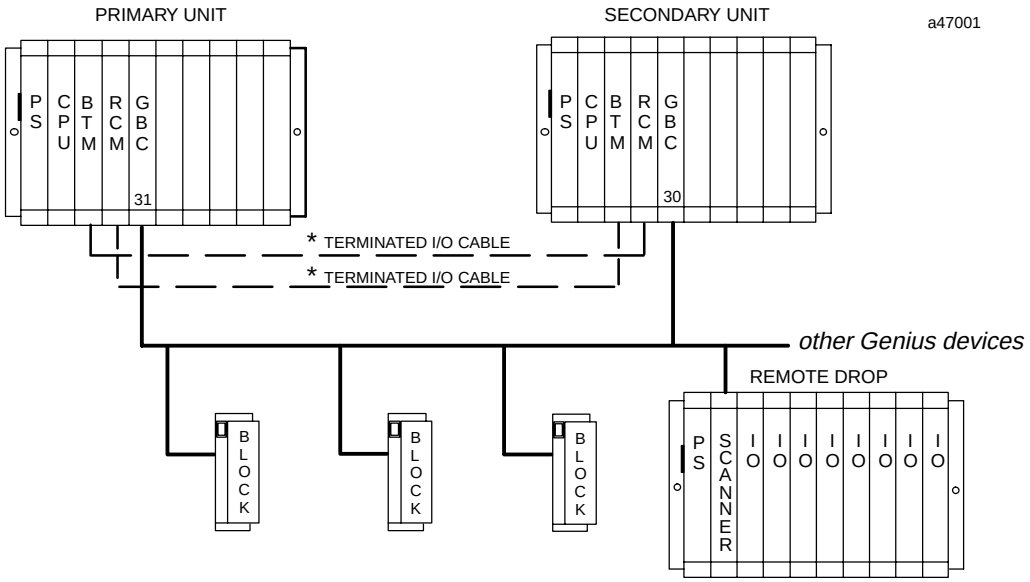
The Series 90-70 CPU redundancy system runs synchronously with a transfer of all control data that defines machine status and any internal data needed to keep the two CPUs operating in sync, and is capable of executing the same program and obtaining the same results (programs do not have to be the same). The transfer of data from the active unit to the standby unit occurs once per sweep. These CPU to CPU transfers are checked for data integrity.

A Hot Standby CPU or Enhanced Hot Standby CPU Redundancy system allows you to perform on-line repair of failed components without disrupting the process under control. Control status of both the Primary and the Secondary units can be monitored by the LEDS on the RCMs in each system. When a component of the active unit fails, control is switched to the backup unit. The failed component can then be replaced by removing power from the rack in which it is installed.

After replacing the failed component and returning power to the rack, the backup unit will resynchronize with the currently active unit.

For detailed information on Hot Standby CPU Redundancy, refer to the following publications:

- GFK-0827: *Series 90-70 Hot Standby CPU Redundancy User's Guide;*
- GFK-0834: data sheet for the *Redundancy Communications Module,* IC697RCM711;
- GFK-0837: data sheet for the *Redundancy Central Processing Unit Module*, IC697CPU780;
- GFK-1439: data sheet for CPU model IC697CGR935;
- GFK-1437: data sheet for CPU model IC697CGR772;
- GFK-1527: *Series 90-70 Enhanced Hot Standby CPU Redundancy User's Guide.*



Legend

PS	*Power Supply*	*IC697PWRXXX*
CPU	*Central Processor Unit*	*IC697CGR935/772, or CPU780*
BTM	*Bus Transmitter Module*	*IC697BEM713*
RCM	*Redundancy Communications Module*	*IC697RCM711*
GBC	*Genius Bus Controller*	*IC697BEM731*
BLOCK	*Genius I/O Block*	*IC660XXXYYY*
SCANNER	*Remote I/O Scanner*	*IC697BEM733*
*	*Terminated I/O Cable*	*IC697CBL811/826*

Figure 1-8. Synchronized Hot Standby CPU Redundancy System Configuration

Chapter 2 Product Description

This chapter describes the hardware components for the Series 90-70 PLC. Included are a brief summary of the function of the item in the system, and a physical description of that item. The items discussed in this chapter are as follows:

Table 2-1. Series 90-70 PLC Hardware Components

Catalog Number	Product Description
IC697CHS750	Standard Series 90-70 Rack, 5-slot, Rear (Panel) Mount
IC697CHS790	Standard Series 90-70 Rack, 9-slot, Rear (Panel) Mount
IC697CHS791	Standard Series 90-70 Rack, 9-slot, Front (Rack) Mount
IC697CHS782	VME Integrator Rack, 17-slot, Rear (Panel) Mount
IC697CHS783	VME Integrator Rack, 17-slot, Front (Rack) Mount
IC697PWR710	Power Supply, 120/240 VAC or 125 VDC, 55W
IC697PWR711	Power Supply, 120/240 VAC or 125 VDC, 100W
IC697PWR724	Power Supply, 24 VDC, 90W
IC697PWR748	Power Supply, 48 VDC, 90W
IC697CBL700	Two Rack Power Cable
IC697ACC715	VME Option Kit (J2 Backplane)
IC697ACC721	Fan Assembly, 120 VAC
IC697ACC724	Rack Fan Assembly, 240 VAC
IC697ACC744	Rack Fan Assembly, 24 VDC
IC697ACC722	Blank Slot Interrupt Jumper
IC697CPU731	Central Processing Unit, 12 Mhz, 32 KBytes On-Board User Memory
IC697CPU771	Central Processing Unit, 12 Mhz, Expandable
IC697CPU772	Central Processing Unit, 12 Mhz, Expandable, Floating Point
IC697CPU780	Central Processing Unit, 16 Mhz, 32-Bit, Expandable, Floating Point (for Hot Standby CPU Applications)
IC697CPU781	Central Processing Unit, 16 Mhz, 32-Bit, Expandable
IC697CPU782	Central Processing Unit, 16 Mhz, 32-Bit, Expandable, Floating Point
IC697CPU788	Central Processing Unit, 16 Mhz, 32-Bit, Expandable (for Genius Triple Modular Redundancy Systems), 352 Inputs and Outputs (any mix)
IC697CPU789	Central Processing Unit, 16 Mhz, 32-Bit, Expandable (for Genius Triple Modular Redundancy Systems), 12K Inputs and Outputs (any mix)

Table 2-1. Series 90-70 PLC Hardware Components (continued)

Catalog Number	Product Description
IC697CPM790	Central Processing Unit, 64 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory, (requires 70 CFM forced air cooling)
IC697CPM924 (replaces IC697CPM914)	Central Processing Unit, 32 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory
IC697CPM925 (replaces IC697CPM915)	Central Processing Unit, 64 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory (requires 70 CFM forced air cooling)
IC697CSE784	Central Processing Unit, 16 Mhz, 32-Bit, Expandable, Floating Point, 512 KBytes On-Board User Memory, State Logic
IC697CSE924	Central Processing Unit, 64 Mhz, 32-Bit, Floating Point, 512 KBytes On-Board User Memory, State Logic (requires 70 CFM forced air cooling)
IC697CSE925	Central Processing Unit, 64 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory, State Logic (requires 70 CFM forced air cooling)
IC697CPX772	Central Processing Unit, 96 Mhz, 32-Bit, Floating Point, 512 Kbytes On-Board User Memory; 256K of built-in flash memory
IC697CPX782	Central Processing Unit, 96 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory; 256K of built-in flash memory
IC697CPX928	Central Processing Unit, 96 Mhz, 32-Bit, Floating Point, 6 Mbytes On-Board User Memory (requires 70 CFM forced air cooling); 256K of built-in flash memory
IC697CPX935	Central Processing Unit, 96 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory (requires 70 CFM forced air cooling); 256K of built-in flash memory
IC697CGR772	Central Processing Unit for CPU Redundancy Applications, 96 Mhz, 32-Bit, Floating Point, 512 Kbytes On-Board User Memory
IC697CGR935	Central Processing Unit for CPU Redundancy Applications, 96 Mhz, 32-Bit, Floating Point, 1 Mbyte On-Board User Memory (requires 70 CFM forced air cooling)
IC697MEM713	CMOS Expansion Memory, 64K bytes (for models CPU 771/CPU 772 and PCM)
IC697MEM715	CMOS Expansion Memory, 128K bytes (for models CPU 771/CPU 772 and PCM)
IC697MEM717	CMOS Expansion Memory, 256K bytes (for models CPU 771/CPU 772 and PCM)
IC697MEM719	CMOS Expansion Memory, 512K bytes (for models CPU 771/CPU 772 and PCM)
IC697MEM731	CMOS Expansion Memory, 32-Bit, 128K bytes (for model 780/781/782/ CPUs)
IC697MEM732	CMOS Expansion Memory, 32-Bit, 256K bytes w/256K byte Non-Volatile Flash Memory (for model 780/781/782 CPUs)
IC697MEM733	CMOS Expansion Memory, 32-Bit, 256K bytes (for model 780/781/782/788/789 CPUs)
IC697MEM735	CMOS Expansion Memory, 32-Bit, 512K bytes (for model 780/781/782/788/789 CPUs)
IC697BEM711	Bus Receiver Module
IC697BEM713	Bus Transmitter Module
IC697BEM721	I/O LINK Interface
IC697BEM731	Genius Bus Controller
IC697BEM733	Remote I/O Scanner
IC697BEM741	FIP Bus Controller
IC697BEM763/764‡	DLAN/DLAN+ and VME DLAN/DLAN+ Interface Modules
IC697RCM711	Redundancy Communications Module

Table 2-1. Series 90-70 PLC Hardware Components (continued)

Catalog Number	Product Description
IC697ACC702	I/O Bus Terminator Plug
IC690ACC901	Miniconverter Kit, RS-232 to RS-422 converter
IC690ACC903	RS-485 Port Isolator (replaces IC655CMM590 Isolated repeater/Converter)
IC600WDxxx	Parallel I/O Bus Cable (5/10/25/50 feet)
IC697WMI920	Work Station Interface, Workmaster, PC-XT/AT
IC697WMI910	Work Station Interface, Workmaster II, PS/2
IC697CBL701	PCM to Workmaster or PC-XT Cable
IC697CBL702	PCM to IBM-AT Cable
IC697CBL703	Bus Transmitter Module to Workmaster II Programmer Parallel Cable
IC697CBL704	Workmaster II to Series 90 PLC Serial Cable
IC697CBL705	PCM to Workmaster II or PS/2
IC697PCM711/712	Programmable Coprocessor Module (PCM711) /Stand Alone PCM (PCM712)
IC697CMM711	Communications Coprocessor
IC697CMM712	Serial Communications Module for State Logic
IC697CMM721	Carrierband MAP Interface Module
IC697CMM741	Ethernet Controller
IC697CMM742	Ethernet Interface (Type 2) Module
IC697HSC700	High Speed Counter
IC697ADC701	Alphanumeric Display Coprocessor Module
AD697SLP711	State Logic Processor Module

‡ The DLAN/DLAN+ and VME DLAN/DLAN+ Interface modules provide an interface between GE Fanuc Series 90-70 PLC systems and GE Drive Systems motor drives. For details and availability, consult your local GE Fanuc salesrepresentative.

A general description of Series 90-70 I/O modules can be found in this chapter. For more detailed information on I/O modules, refer to the applicable data sheet for each module. A data sheet is included with each module or may be ordered through your GE Fanuc PLC distributor or local GE Fanuc sales representative. Data sheets are also available in a single manual, GFK-0600, the *Series 90-70 Programmable Controller Data Sheet Manual*.

Racks for Series 90-70

The Series 90-70 PLC product line has two types of racks: standard Series 90-70 racks, and VME Integrator racks. Each of these types of racks is described below.

Standard Series 90-70 Racks

Standard Series 90-70 racks for Series 90-70 PLC modules are available as either 5-slot (IC697CHS750 panel mount) or 9 slot (IC697CHS790 panel mount or IC697CHS791 rack mount) racks. A slot is also provided for a power supply. The racks are identical as far as the height and depth of modules they will accept. The 5-slot rack is 12.6 inches wide (320 mm, usually referred to as a 13-inch rack), and the 9-slot rack is 19 inches (483 mm) wide. The rack slots are identified, from left to right, as PS - then slots 1 through 5, for the 13-inch rack; and as PS - then slots 1 through 9 for the 19-inch rack. The first slot at the left in each rack always contains the power supply or the power supply connection for that rack. The slot adjacent to the power supply in the main rack (also called rack 0) must always contain the CPU module. Rack sizes may be mixed in a system installation to suit the requirements of your application. Racks may be panel mounted or rack mounted (refer to catalog numbers for proper ordering).

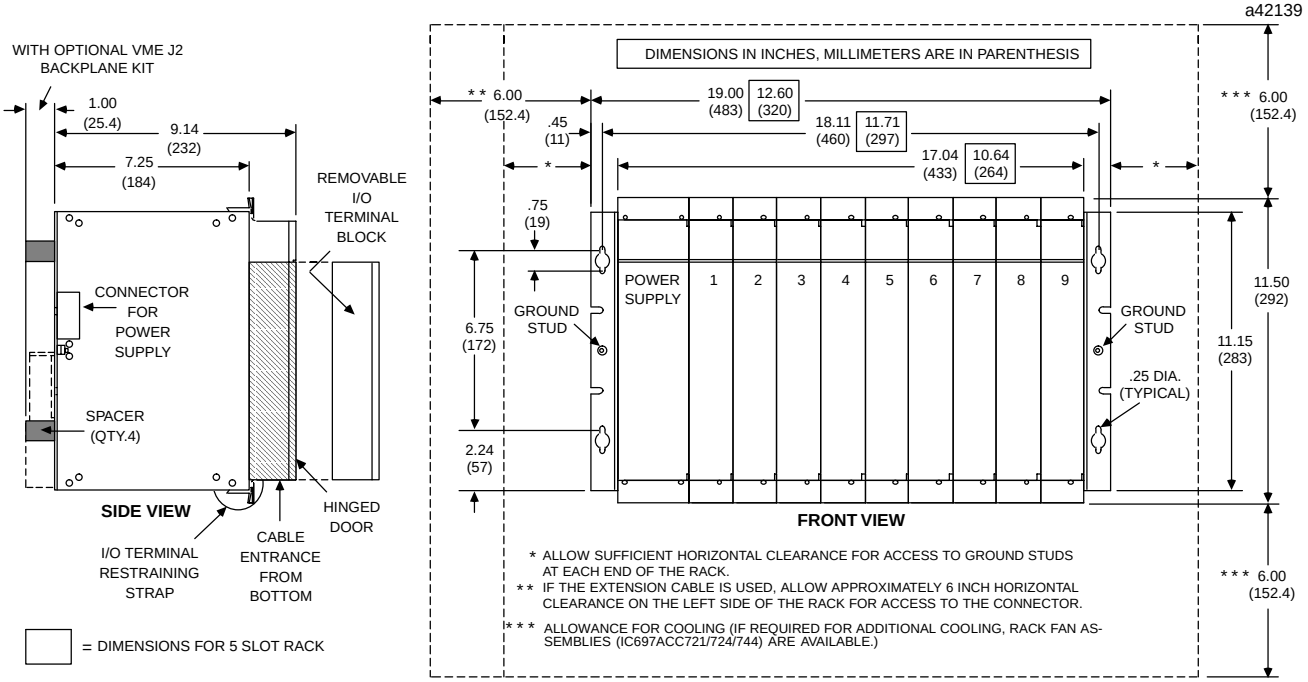


Figure 2-1. Standard Series 90-70 PLC Rear (Panel) Mount Rack

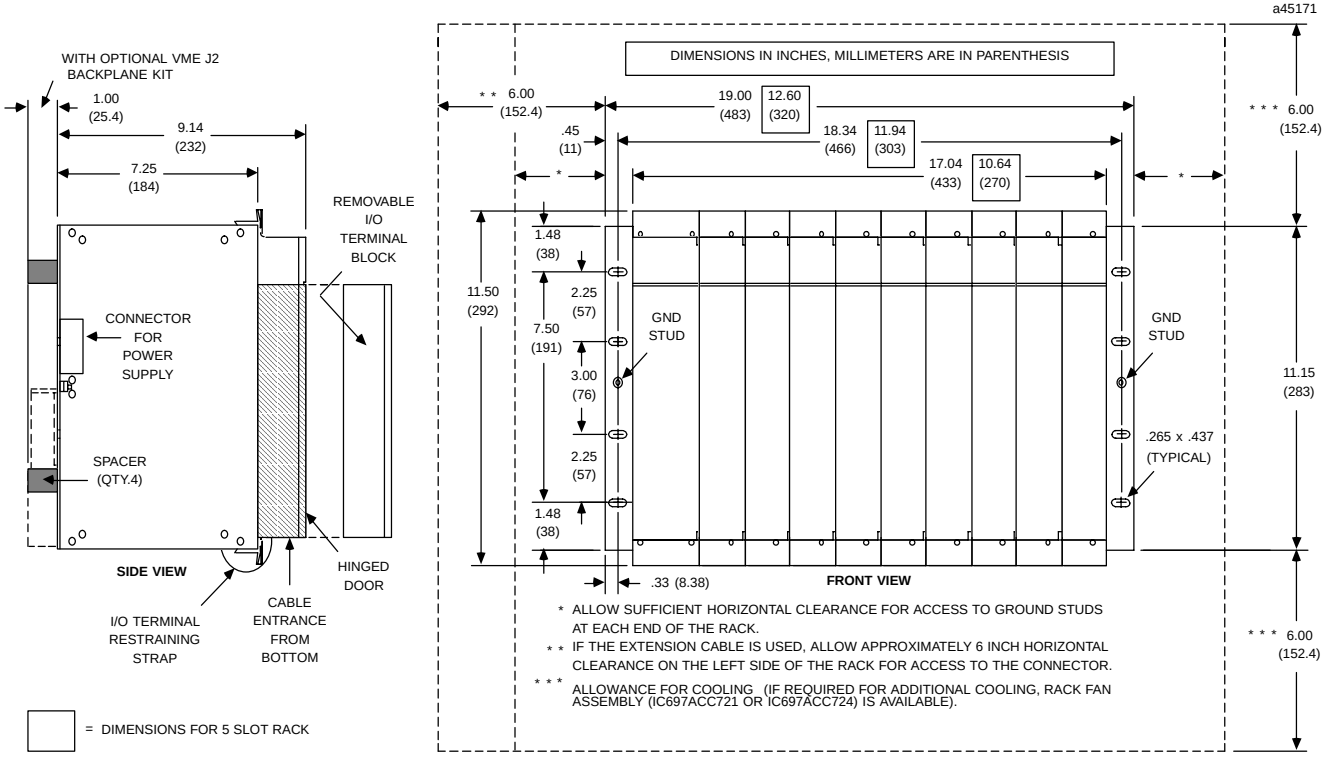


Figure 2-2. Standard Series 90-70 PLC Front (Rack) Mount Rack

Rack Mounting

A rack must be mounted in the orientation shown in the above figures. These racks do not require a fan for cooling as long as sufficient space is left around the rack when it is mounted. The installation instructions in this manual provide a guide to recommended distances that should be allowed to maintain proper air flow through the modules.

Some CPU models require forced air cooling in ambient temperatures greater than 40C (104F) or 50C (122F). For installations using these CPUs, fan assemblies (IC697ACC721, IC697ACC724, and IC697ACC744 are available for direct mounting on the rack. Refer to data sheets for individual CPUs for information on cooling requirements.

Rack Number

Each rack in a Series 90-70 PLC system is identified with a unique number (called the rack number) between 0 and 7. Rack number 0 must always be present and is assigned to the main rack that contains the CPU. Other racks in a multiple-rack system do not need to be contiguously numbered. Rack numbers are assigned by configuring four rack jumpers located on the backplane directly behind the power supply slot.

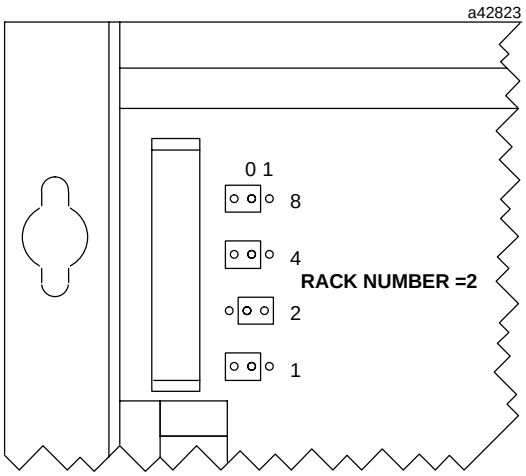


Figure 2-3. Rack Number Jumpers

Note

Rack numbers must not be duplicated in a system having multiple racks.

Module Location in Main Rack

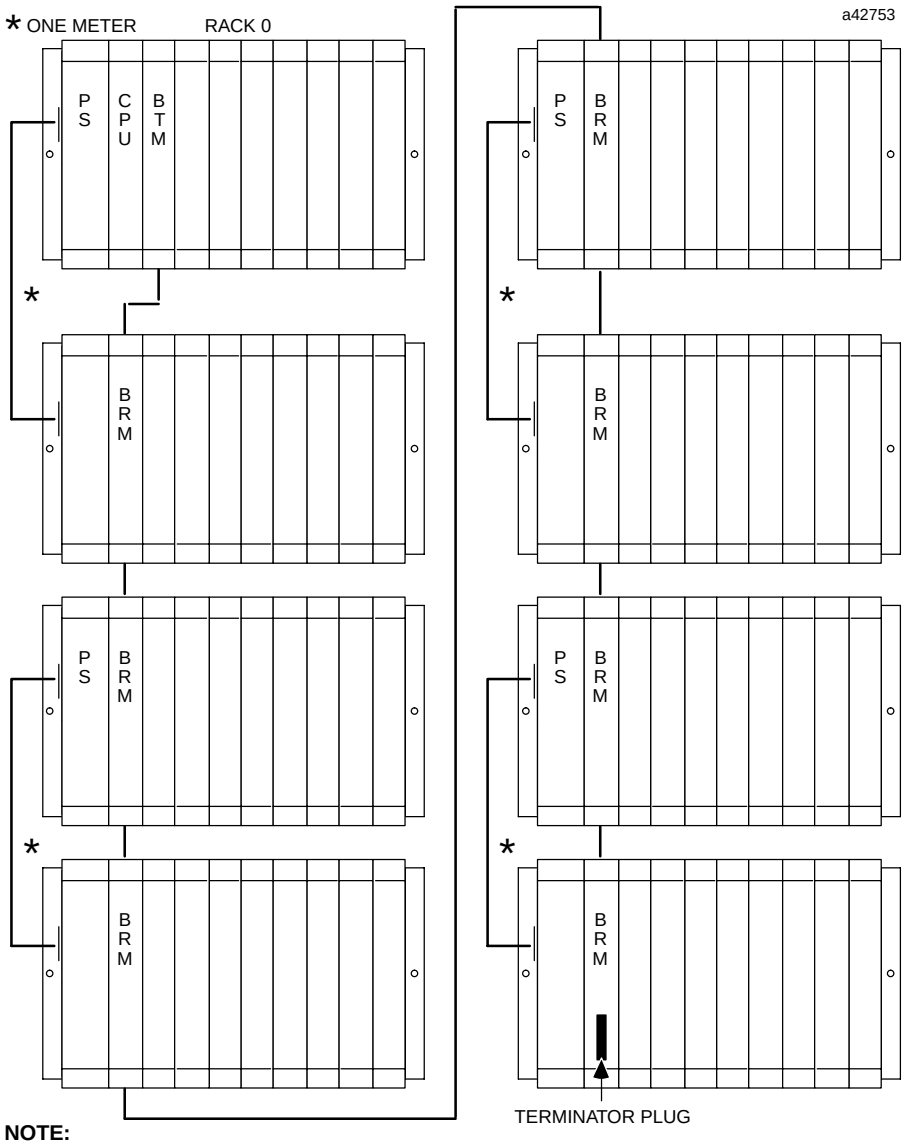
The first slot to the left is for the power supply or power supply connection to that rack. The next slot in the main rack (rack 0), labeled SLOT 1 on the backplane, must always contain the CPU module. If rack 0 is the only rack in a system, the remaining slots may contain either option modules (special function) or I/O modules. The BTM is optional in a single-rack system and can be used for parallel communications with the programmer. It can be installed in any slot; however, no empty slot can be between the BTM and CPU and it is recommended that the BTM be installed in slot 2, next to the CPU.

Module Location in an Expansion System

When a Series 90-70 PLC system is to include expansion racks, one slot in rack 0 must contain a BTM. It is recommended that the BTM be installed in slot 2, adjacent to the CPU. The bottom connector of the BTM is wired to the first physical expansion rack by connecting it to the top connector of a BRM through an I/O cable. This BRM is then connected to the top connector of the next expansion rack. This process is continued until all of the racks are connected in a chain. A typical system configuration with expansion racks is shown in the following figure.

The BTM and the BRMs transmit information relative to system status, input/output data and other messages between the CPU and all attached devices. The bus expansion racks do not have all of the VME signals available in the CPU rack. The BRM controls the bus in an expansion rack. In the main rack, the CPU provides the system clock and acts as the bus arbitrator. A BRM, when present, must reside in slot 1 of an expansion rack. All other modules in the rack must be contiguous with other modules in the rack.

The BTM provides a parallel communications link between the CPU and the programmer. Only the programmer may be attached to the upper connector on the BTM. A serial communications link from the CPU to the programmer is made from the serial port on the CPU to the programmer.



NOTE:
TOTAL LENGTH OF ALL INTERCONNECTING CABLES FROM BTM TO LAST BRM IS 50 FEET (MAXIMUM).
ALL RACKS MUST BE AT SAME GROUND POTENTIAL (8 RACKS MAXIMUM).

Figure 2-4. System Configuration with Expansion Racks

Distance Between Racks

The maximum distance from the main (CPU) rack to the last expansion rack is 50 feet (15 meters). When expansion racks are mounted in the same or nearby cabinets, there may be no more than a total of 50 feet of cable connecting all racks. Since none of the daisy-chained signals (all at the same ground potential) are broken at a rack, any rack can be independently powered-down without affecting the operation of the rest of the system (if the Loss of Rack is configured as a non-fatal fault). However, powering off a rack does generate a Loss of Rack fault in the PLC fault table. Until the rack is powered back on and all modules recovered, I/O points residing in that rack are faulted.

The available cables for connecting expansion racks are listed in the table below.

Table 2-2. I/O Cable Lengths

Catalog Number	Cable Length
IC600WD005	5 feet (1.5 meters)
IC600WD010	10 feet (3.0 meters)
IC600WD025	25 feet (7.5 meters)
IC600WD050	50 feet (15.0 meters)

Module Location in Remote Rack

Each remote rack must contain a Remote I/O Scanner installed in slot 1, next to the power supply (or next to the empty power supply slot in the second rack if two racks are powered by one power supply). The racks in the remote drop can contain any mix of discrete inputs and outputs or analog inputs and outputs up to a total of 1024 discrete inputs and 1024 discrete outputs, or 64 analog inputs and 64 analog outputs.

The Remote I/O Scanners connect to the Genius bus through a serial link connected to the Genius bus terminals on the removable terminal strip mounted on the bottom of the module. The maximum length of the Genius bus is 7500 feet at 38.4 Kbaud, 4500 feet at 76.8 Kbaud, 3500 feet at 153.6 Kbaud extended, and 2000 feet at 153.6 Kbaud standard.

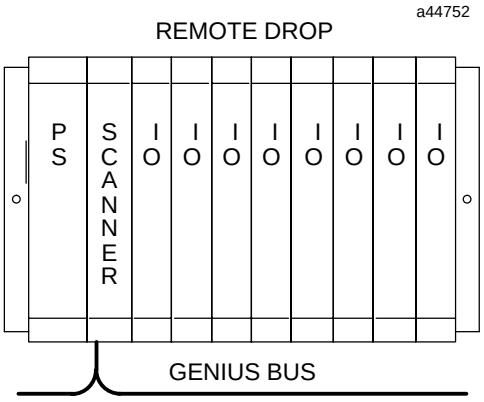


Figure 2-5. Remote I/O Scanner Location in Remote Rack

VME Integrator Racks

The VME Integrator Rack for the Series 90-70 PLC can be used for 3rd Party VME modules and all Series 90-70 CPU and I/O configurations, except redundancy applications. This rack has a 17-slot backplane and is designed to provide easy integration of 3rd Party VME modules into a Series 90-70 PLC system.

Note

Integration of 3rd Party VME modules must be in accordance with guidelines described in the *User's Guide to Integration of 3rd Party VME Modules*, GFK-0448B, or later.

Backplane connectors are spaced on 0.8 inch centers to accommodate 3rd Party VME modules. Series 90-70 modules each use two of these slots. Standard Series 90-70 racks have slots spaced on 1.6 inch centers for Series 90-70 modules. VME modules that require 0.8 inch spacing for installation may not fit in standard Series 90-70 racks (IC697CHS750/790/791).

Each rack configuration will accept one power supply in the leftmost module position, and either: (1) seventeen 3rd Party VME modules; (2) nine Series 90-70 modules; or, (3) a combination of Series 90-70 and 3rd Party VME modules. Note that the power supply capacity may limit the maximum number of modules in a rack.

Note

No more than three 3rd Party VME modules can be used in a rack with Series 90-70 modules. This restriction limiting the number of 3rd Party VME modules derives from the low power signal drivers used on most Series 90-70 modules. VME specifications allow for high signal loading which is associated with older logic technologies used on many VME modules. In order to guarantee operation, the total backplane loading must be limited to assure proper signal levels when driven by Series 90-70 modules. Note that there are no limits, beyond the number of supported slots, for systems comprised solely of Series 90-70 modules, or systems comprised solely of non-Series 90-70 VME modules.

The flexibility of these racks to allow both 3rd Party VME and Series 90-70 modules is accomplished through the use of jumpers on the backplane to configure slots. The VME Integrator Rack is factory configured to accept standard Series 90-70 modules. Integration of 3rd Party VME modules is done by moving these jumpers to different positions. The exact jumper configuration depends on the requirements of each 3rd Party VME module.

Two racks can be interconnected to share a single power supply (120/240 VAC versions and 24 VDC version; the 125 VDC power supply cannot be used to power two racks) for applications having extended I/O requirements. A Power Supply Extension Cable kit (IC697CBL700) is available for such applications. There are also four "power cube" screw connections (+5V, +12V, -12V, 0V) on the backplane for use with the Power Supply Adapter module or a Series 90-70 power supply when used to supply power to an optional P2 backplane. *These connections are not intended for direct connection to a 3rd Party power supply.*

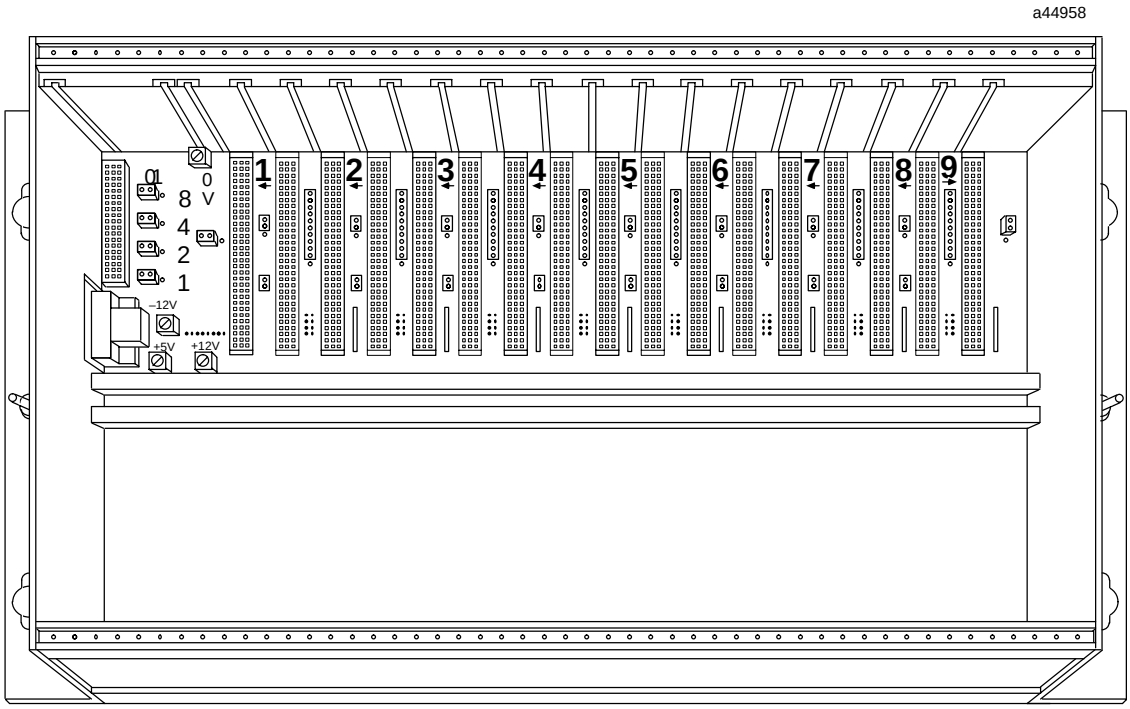


Figure 2-6. VME Integrator Rack

Each rack provides slot sensing for rack-type I/O modules. No jumpers or DIP switches on the I/O modules are required for module addressing of these modules. Slots are 0.8″ wide except for the power supply slot, which is 2.4″ wide.

Mounting Racks

The VME rack must be mounted in the orientation shown in the following figures. These figures also provide rack dimensions. Sufficient space must be left around the rack as shown to allow air flow for module cooling. A Rack Fan Assembly is available for installations requiring forced air cooling. The mounting requirements (either front or rear mount) must be determined according to the application and the proper rack ordered. Mounting flanges are an integral part of rack side panels and are installed at the factory. If the optional VME J2 backplane kit is installed on a panel mount rack and the spacers are used, one inch is added to the total rack depth.

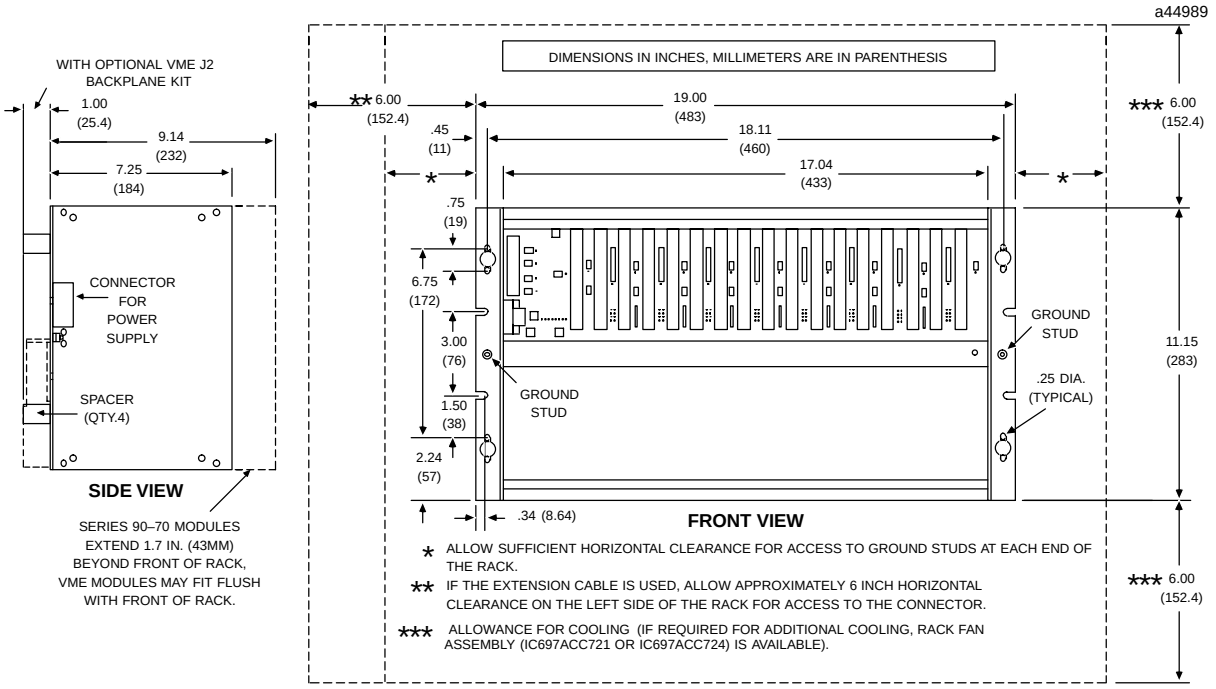


Figure 2-7. VME Integrator Rack Dimensions for Rack (Rear) Mount

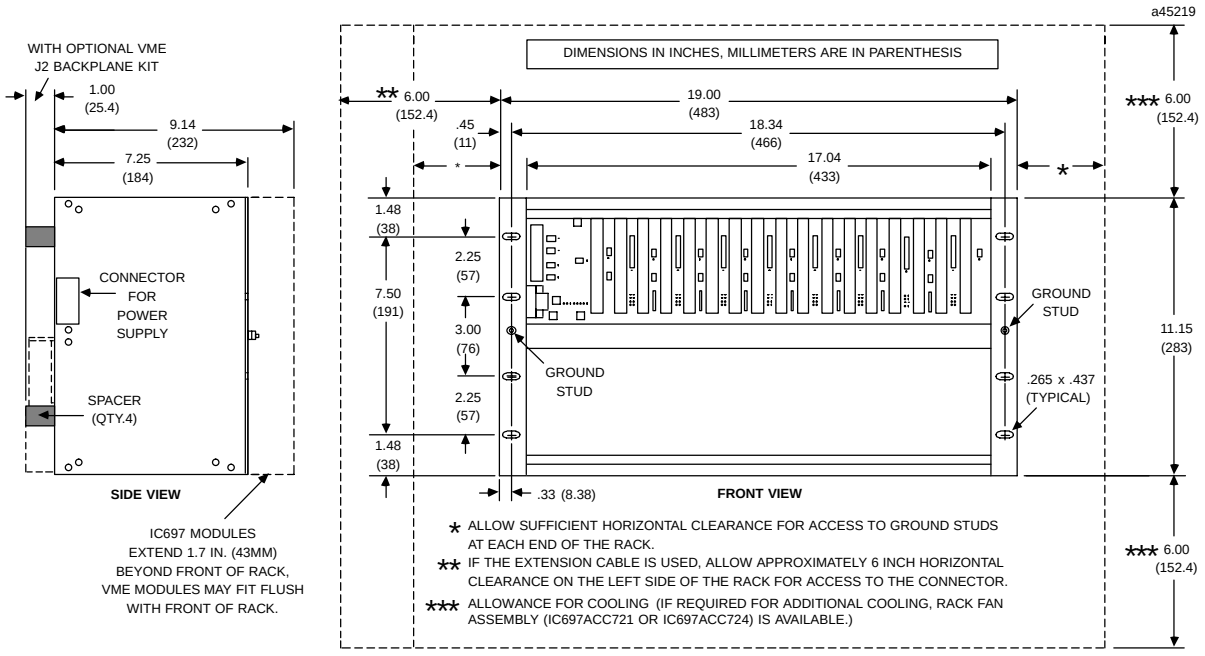


Figure 2-8. VME Integrator Rack Dimensions for Panel (Front) Mount

I/O Connections

These racks accommodate two module types: rack-type Series 90-70 high-density I/O modules, which use a detachable field wiring terminal board; and, VME modules that can be connected to field devices using various methods.

Configuring the VME Integrator Rack

A series of jumper positions is located on the backplane near each slot. These jumpers provide for flexibility in the types of modules to be installed, either VME modules in single slots (0.8 inch spacing between centers) or Series 90-70 modules, which require two slots (1.6 inch spacing between centers). GE Fanuc module slots are indicated by a number and an arrow; each slot is marked 1A through 9A.

Several functions and signals are configurable by these jumpers; information on configuration of these jumpers can be found in Chapter 3, Installation.

Slot Addressing

The Series 90-70 PLC system allows user configuration of I/O point references for modules in a VME Integrator Rack without the need for board address DIP switches or jumpers. Configuration is done with the configurator function of the Logicmaster 90 or Control Programming Software package. For more information on configuration, see GFK-0263, the *Logicmaster 90 Programming Software User's Manual* or GFK-1295, the *Control User's Manual*.

Note

In order to configure slots 12PL to 19PL, you must have Logicmaster 90 Programming Software Release 4.0 (or later).

Rack Number

VME Integrator Racks, like the standard Series 90-70 racks, are identified with a unique number between 0 and 7. Rack number 0 must always be present and is assigned to the main rack that contains the CPU. Other racks in a multiple-rack system do not need to be contiguously numbered. Rack numbers are assigned by configuring four rack jumpers located on the backplane directly behind the power supply slot.

Note

Rack numbers must not be duplicated in a system having multiple racks.

Module Retention

Series 90-70 I/O modules have molded latches that automatically snap onto the upper and lower rails of the rack when the module is fully inserted. 3rd Party VME modules do not have these latches**.** Optionally, M2.5x8 screws may be used to secure the modules to the rack for high-vibration applications.

Rack Fan Assembly

When a number of high-powered VME, or some CPU modules are installed in a rack, heat build-up can be a problem and forced air cooling may be required. An optional Rack Fan Assembly is available in three versions (IC697ACC721 for 120 VAC power source, IC697ACC724 for 240 VAC power source, and IC697ACC744 for 24 VDC power source) for installation on the bottom of the rack to provide this additional cooling. The fans have a low noise level and are assembled using ball bearings for extended life.

Note

Forced air cooling with a fan is required if CPU models CPM790, CPM925, CPX772, CPX782, CPX928, CPX935, CGR772, CGR935, or State Logic CPU models CSE924 or CSE925 are installed in a rack and ambient temperature is greater than 40C (104F) or 50C (122F), depending on model of CPU.

The rack fan assembly comes as a kit which includes a fan assembly, eight screws, and two optional mounting brackets. The two optional mounting brackets are required when mounting the fan assembly on earlier versions of racks. New rack assemblies can be identified by *metal grilles* on the top and bottom of the rack. ***Earlier versions of IC697CHSXXX racks do not have metal grilles.***

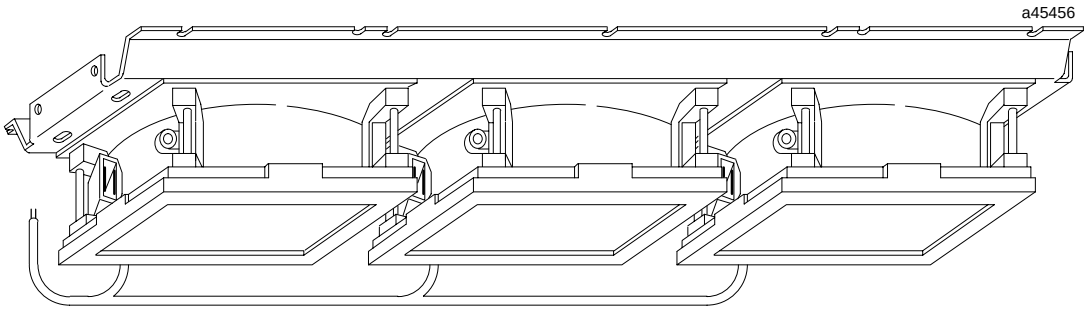


Figure 2-9. Rack Fan Assembly

Rack and Fan Assembly Compatibility

The current version of the Rack Fan Assemblies (IC697ACC721B, 724B, and 744) are compatible with IC697 racks having the following catalog numbers:

- *IC697CHS782A* and *IC697CHS783A* (or later) versions
- *IC697CHS790D* and *IC697CHS791D* (or later) versions

The previous version of the fan assembly (IC697ACC721A and 724A) is compatible with the following IC697 racks:

- IC697CHS782A, B only
- IC697CHS783A, B only
- IC697CHS790D only
- IC697CHS791D only

Fan Wiring Information

It is recommended that the fans be wired to the same source of power as the Series 90-70 PLC so that the fans are energized regardless of whether or not the PLC is energized. This will ensure that the fans are running when the PLC is active.

On the AC fan assemblies (ACC721 and ACC724), the three fans are wired in parallel. The fan on the left (looking at the rack front) has a three-foot cable to be wired to the applicable 120 or 240 VAC power source. The other two fans are connected through a cable/connector assembly to this fan as shown in the previous figure.

On the 24 VDC fan assembly (ACC744), each fan has a pair of 12" (310 mm), 24 AWG leads. These leads should be connected in parallel, with all of the Red leads connected to +24 Volts, and all of the Black leades conected to 24 Volt Common.

The following illustration shows the position of the fan assembly when it is mounted on a rack. Note that it is mounted on the bottom of the rack with air flowing from the bottom towards the top of the rack.

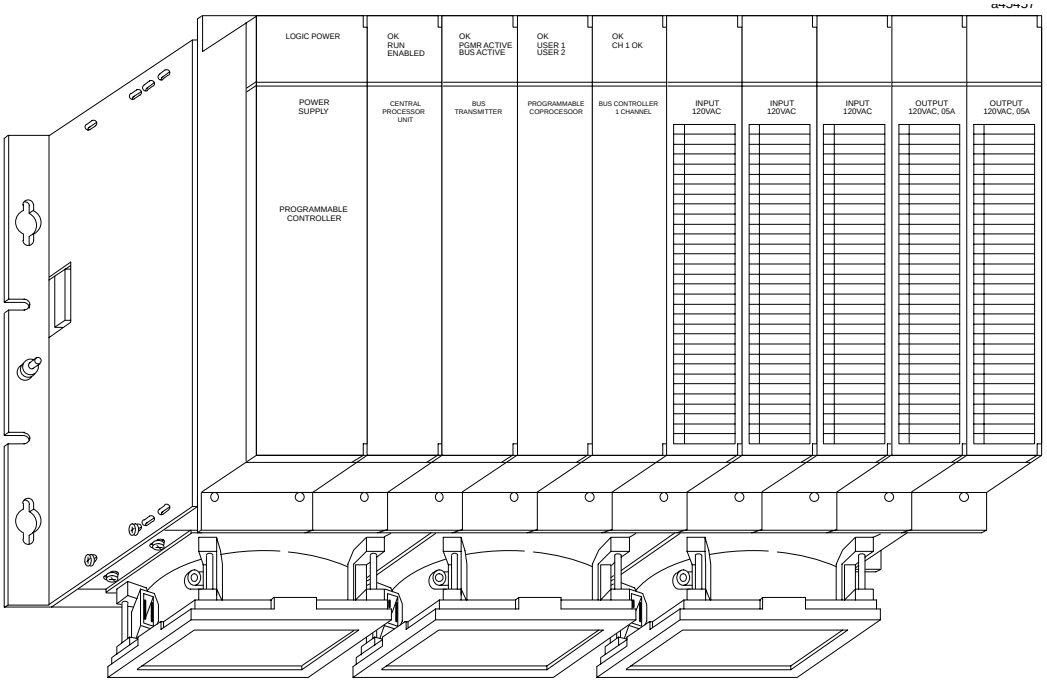


Figure 2-10. Fan Assembly Mounted on Rack

Table 2-3. Specifications for Rack Fan Assembly

Operating Voltage:	120 VAC, 50/60 Hz (IC697ACC721) 240 VAC, 50/60 Hz (IC697ACC724) 24 VDC (IC697ACC744)
Input Power (each fan):	15 to 17 watts at 120 VAC 16 to 17 watts at 240 VAC 6.7 watts at 24 VDC
Line Amps (each fan):	.18 to .20 amps at 120 VAC .09 to .10 amps at 240 VAC .028 amps at 24 VDC
Locked Rotor Amps (each fan):	.24 to .26 amps at 120 VAC .12 to .14 amps at 240 VAC .70 amps at 24 VDC

Table 2-3. Specifications for Rack Fan Assembly (Continued)

Operating Temperature:	−28° to +70°C (−18.4° to +158°F)
Nominal Air Flow (without filter):	@120 or 240 VAC, 60 Hz: 108 CFM (each fan)
Nominal Air Flow (with filter):	@120 or 240 VAC, 60 Hz: 71 CFM (each fan)
Weight of Fan Assembly:	5.94 pounds (2.69 kg)
MTBF for each Fan:	@ 40°C (104°F) >80,000 Hours (manufacturer's specification) @ 60°C (140°F) >50,000 Hours (manufacturer's specification)
Filter Assembly	
Retainer and Guard:	UL94V-0 Plastic
Filter Type:	Polyurethane Foam, 30 PPI (Pores Per Inch)

Blank Slot Interrupt Jumper

The Blank Slot Interrupt Jumper (IC697ACC722) for the Series 90-70 PLC is an accessory which allows you to reserve a slot in the Series 90-70 rack for future expansion. This jumper, when installed in a blank slot, allows for continuation of the interrupt signal through the backplane. Use of this board is required when there are modules installed to its right which may interrupt the CPU.

The Blank Slot Interrupt Jumper can be installed in a Series 90-70 CPU rack or expansion rack in slots 2 through 8 of a nine-slot rack, or slots 2 through 4 of a five-slot rack. It is not necessary to reserve the last slot (slot 9 in a nine-slot rack or slot 5 in a five-slot rack) in a rack. Also, a rack will not operate properly if this jumper is installed in slot 1. The Blank Slot Interrupt can also be installed in slots 2PL(2A) through 8PL(8A) of a VME Integrator Rack.

Note

The Blank Slot Interrupt Jumper, when installed, must be added to the system configuration using Logicmaster 90 or Control Programming Software. Refer to the *Logicmaster 90-70 Programming Software User's Manual*, GFK-0263 or *Control User's Manual*, GFK-1295 for details.

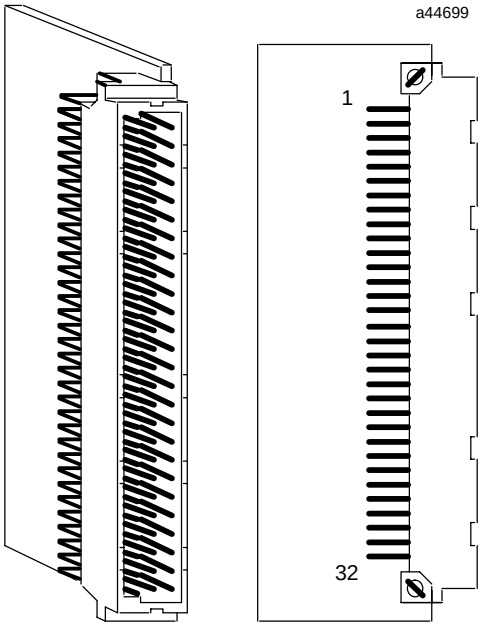


Figure 2-11. Blank Slot Interrupt Jumper

VME Option Kit

The VME Option Kit (IC697ACC715) allows you to add a J2 VME backplane to a standard Series 90-70 rack or a VME Integrator Rack. This kit consists of the hardware required for a J2 backplane; however, you must provide the J2 backplane.

J2 backplanes are available in many different lengths (typically 2 to 21 slots) and with different types of power pick-up connectors. For more detailed information on the J2 backplane, see the *User's Guide to Integration of 3rd Party VME Modules*, GFK-0448B, or later. For details on installation, see Chapter 3 in this manual and the data sheet provided with the kit, GFK-0552.

Power Supply

The power supply for the Series 90-70 PLC is available in the following versions:

- IC697PWR710, 120/240 VAC or 125 VDC input, +5 VDC output, 55 watts.
  for details see *Data Sheet GFK-1388 (older, non-VDC versions, GFK-0083)*
- IC697PWR711, 120/240 VAC or 125VDC input, +5 VDC/±12 VDC output, 100 watts.
  for details see *Data Sheet GFK-1448 (older, non-VDC versions, GFK-0392)*
- IC697PWR724, 24 VDC input, +5 VDC/±12 VDC output, 90 watts.
  for details see Da*ta Sheet GFK-1047*
- IC697PWR748, 48 VDC input, +5 VDC/±12 VDC output, 90 watts.
  for details see *Data Sheet GFK-1061*

For detailed information and specifications for each of the Series 90-70 power supplies, refer to the specific data sheet for each supply. Data sheets are shipped/packaged with each module. For information on FCC Noise Requirements, see GFK-0556.

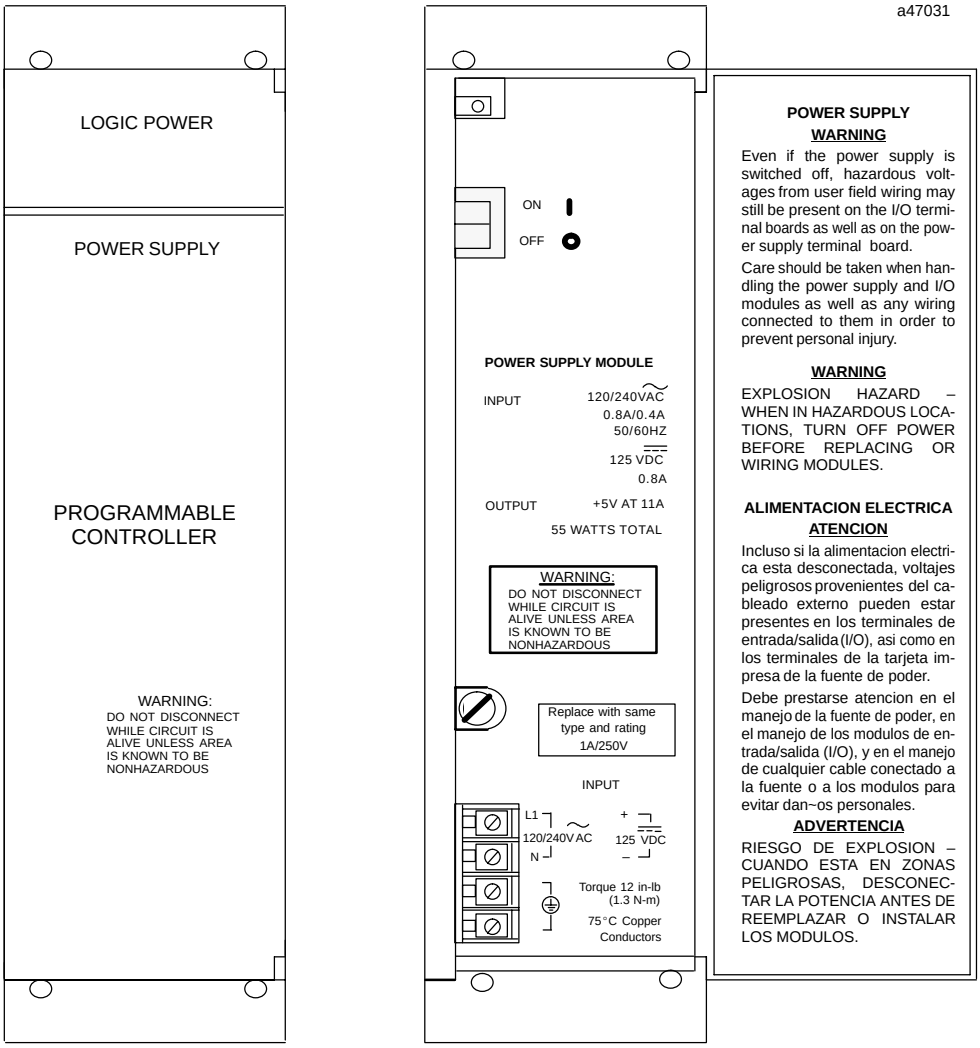


Figure 2-12. IC697PWR710, AC/DC Power Supply, 55W

AC and AC/DC Input Power Supplies

The power supply is installed in the leftmost slot (labeled #PS) of the rack, attaching directly to the backplane through a connector. The input source of AC or DC power connects to the Series 90-70 PLC system through a group of protected connections on the faceplate of the power supply. The IC697PWR710 AC/DC supply is a wide range supply with the two top terminals accepting either an AC or DC power source input.

The IC697PWR711 version G and earlier AC input supply has a terminal jumper that must be configured on the two bottom terminals for either 120 VAC or 240 VAC to match the power source.

IC697PWR711 version H and later supplies include 125VDC input power source capability.

The 55 watt supply should be sufficient to handle the load requirements for most racks; however, if the total load requirements are to be greater than 55 watts, or a module requires ±12 VDC (that is, an Ethernet Interface or some 3rd Party modules), the 100 watt supply must be used. The IC697PWR711 input power supplies are shown in the following figures.

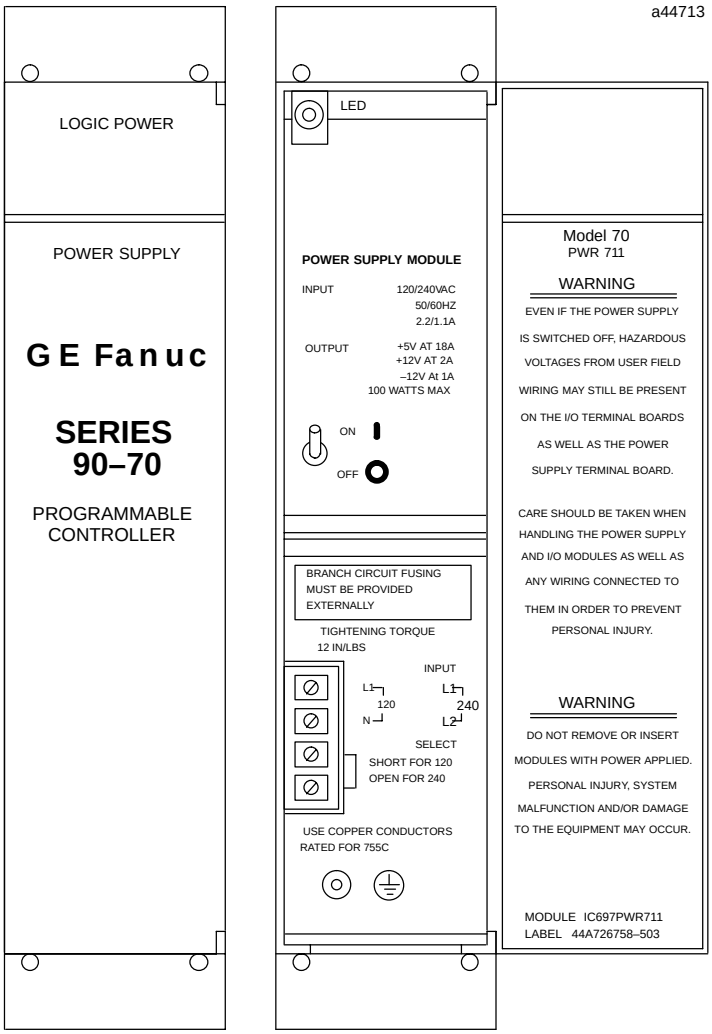


Figure 2-13. IC697PWR711 (versions C and Earlier), AC Power Supply, 100W

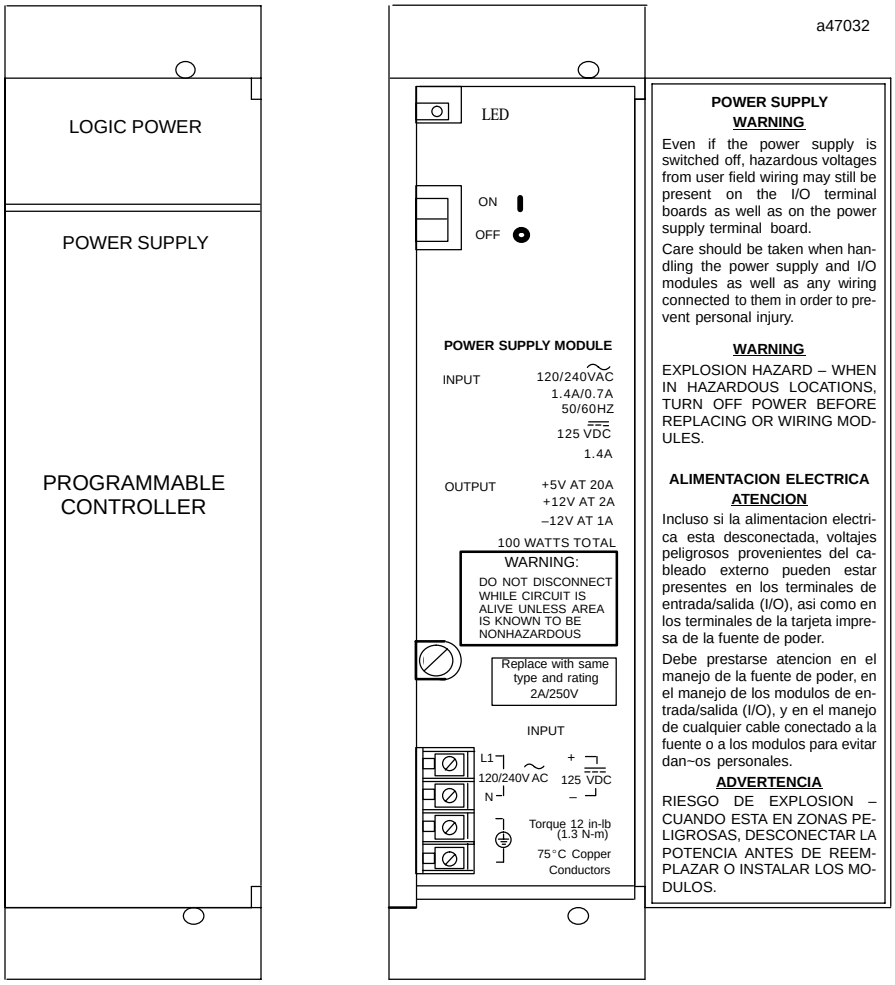


Figure 2-14. IC697PWR711 (version H), AC Power Supply, 100W

Electronic Overvoltage Protection

The AC/DC and AC input power supplies have electronic overvoltage protection which will turn the supply off if the 5V bus exceeds 6.2V (+0.5V). If this occurs, the supply must be turned off to be reset. Electronic overcurrent protection is provided for each of the three outputs. If the maximum current rating is exceeded, the voltage will collapse to a low value. The 100 watt supply also has a 5V Standby output (5VSTBY).

Power Supply Status Indicator

An LED on the faceplate provides an indication of the operating status of the power supply. The operating states of the LED are: *ON* when the power supply is operating properly, and *OFF* if a power supply fault should occur. These faults could include:

- Current requirements for the installed modules are greater than the power supply can provide (overload).
- Voltages required are not supplied to the power supply (failed power supply or no source power).

- Different power supply characteristics (input voltage, hold up time, etc.) are required than are provided by the supply (inadequate source power).

Power Supply Switch

A power supply has a single two-position switch mounted on the board below the LED. With the switch in the up position, labeled **ON 1**, the power supply is on and power flows to the rack. When the switch is in the down position, labeled **OFF 0**, power is discontinued to the rack.

Note

An FM certified version of the 120/240 VAC input, 100 watt (IC697PWR711-FM) power supply is available. The FM certified power supply *does not* have the ON/OFF power switch on the module.

AC and AC/DC Power Supply Specifications

Specifications for the 55W AC/DC input (IC697PWR710) and the 100W AC/DC (IC697PWR711C) power supplies are provided in the following tables. Note that all hardware standards information (UL, FCC, etc.) can be found in GFK-1179, *Installation Guidelines for Conformance to Standards*.

Table 2-4. Specifications for IC697PWR710 (Versions D and Later)

Nominal Rated Voltage:	120/240 VAC or 125 VDC
Input Voltage Range: **AC** **DC**	 90 to 264 VAC, 47 to 63 Hz 100 to 150 VDC,
Input Power:	90 watts maximum at full load
Input Half Cycle Peak Inrush:	3 amp (typical)
Power Factor	> .95
Output Power:	56 watts maximum
Output Voltage:	+5 VDC: 4.90 to 5.25 volts (5.1 volts nominal)
Protective Limits - **Overvoltage Limit:** **Overcurrent Limit:**	 6.2 volts (typical), *electronic overvoltage protection* 12 amps (typical), *electronic current limit*
Ride Through Time:	21 ms minimum (from loss of AC input)

Table 2-5. Specifications for IC697PWR711 (Versions H and Later)

Nominal Rated Voltage:	120/240 VAC or 125 VDC
Input Voltage Range:	
AC Input	90-132 VAC or 180-264 VAC, 50 - 60 Hz
DC Input	100 to 150 VDC
Input Power:	160 watts maximum at full load
Input Half Cycle Peak Inrush	55 amp (typical), 77 amp (maximum)
Output Power:	100 watts maximum (total for all 3 outputs)
Output Voltage:	+5 VDC: 4.90 to 5.25 volts (5.07 volts nominal)
	+12 VDC: 11.75 to 12.6 volts
	-12 VDC: -12.6 to -11.75 volts
Protective Limits -	
Overvoltage Limit:	+5 VDC output: 5.7 to 6.7 volts
Overcurrent Limit:	+5 VDC output: 26 amp, maximum
	+12 VDC output: 4 amp, maximum
	-12 VDC output: 2 amp, maximum
Holdup Time:	21 ms minimum (from loss of AC input)

24 VDC and 48 VDC Power Supplies

The 24 VDC (IC697PWR724) and 48 VDC (IC697PWR748) Power Supply modules are rack-mounted modules that plug directly into the Series 90-70 rack backplane. They provide three regulated DC power outputs: +5 volt, +12 and -12 volt (90 watts total power), and logic sequencing signals to the backplane. Electronic short circuit protection is provided on the 5V bus.

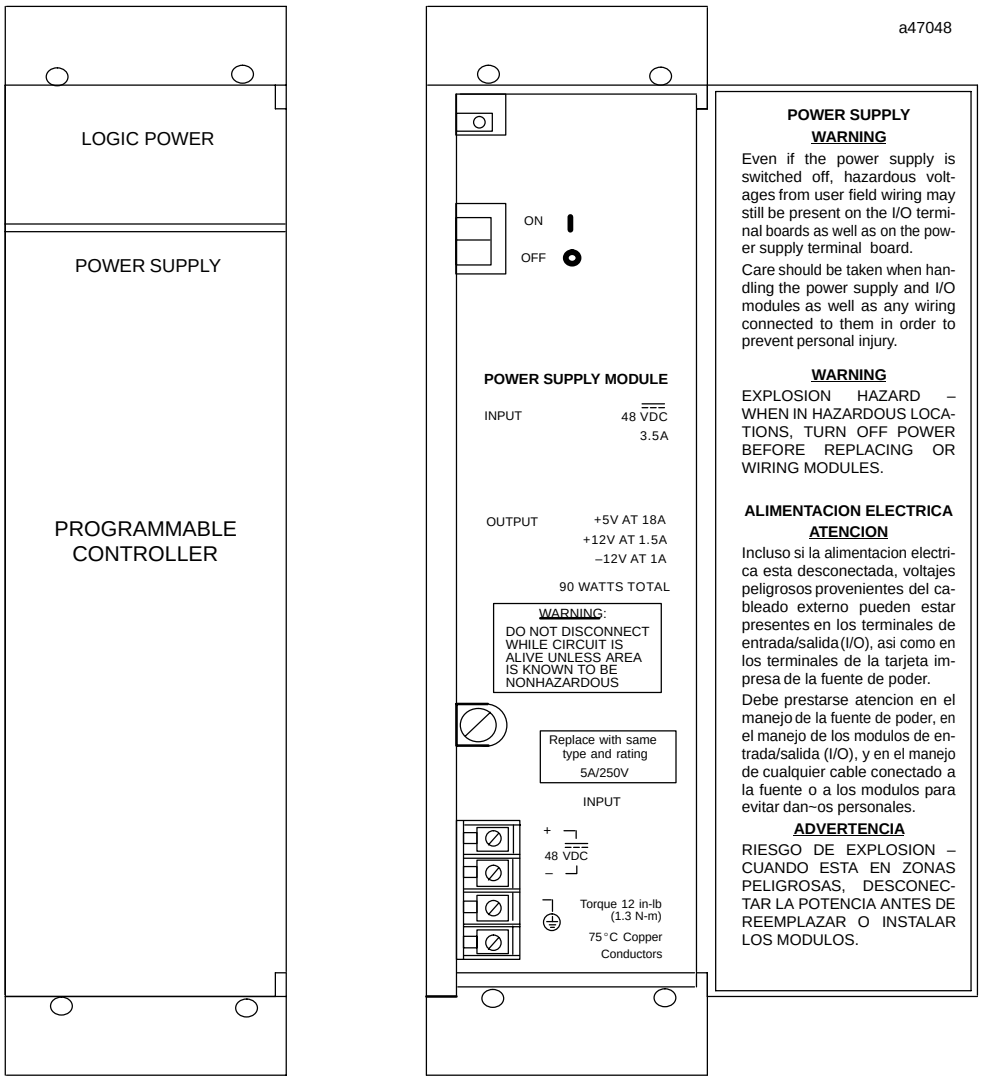


Figure 2-15. IC697PWR724/748, DC Power Supply (48 VDC Supply Shown)

These DC supplies can be used one of two ways: in a single rack application, or to provide power to a second rack if the total load is within the supply rating. Interconnection to the second rack is made through the two-rack power supply extension cable described later in this chapter.

Specifications for 24 VDC and 48 VDC Power Supplies

Specifications for the 24 VDC (IC697PWR724) and 48 VDC (IC697PWR748) power supplies are provided in the following tables. Note that all hardware standards information (UL, FCC, etc.) can be found in GFK-1179, *Installation Requirements for Conformance to Standards*.

Table 2-6. Specifications for 24 VDC Power Supply

Nominal Rated Voltage:	24 VDC
Input Voltage Range:	18 to 32 VDC
Input Power:	160 watts maximum @ full load
Input Inrush Energy:	22 joules maximum
Output Power:	90 watts maximum (total for all 3 outputs)
Output Voltage:	+5 VDC: 4.90 to 5.25 volts (5.07 volts nominal)
	+12 VDC: 11.75 to 12.6 volts
	-12 VDC: -12.6 to -11.75 volts
Protective Limits -	
Overvoltage Limit:	+5 VDC output: 5.7 to 6.7 volts
Overcurrent Limit:	+5 VDC output: 26 amp, maximum
	+12 VDC output: 4 amp, maximum
	-12 VDC output: 2 amp, maximum
Ride Through Time:	10 ms minimum @20 VDC

Table 2-7. Specifications for 48 VDC Power Supply

Nominal Rated Voltage:	48 VDC
Input Voltage Range:	35 to 60 VDC
Input Power:	160 watts maximum @ full load
Input Inrush Energy:	28 joules maximum at 60 VDC Input
Output Power:	90 watts maximum (total for all 3 outputs)
Output Voltage:	+5 VDC: 4.90 to 5.25 volts (5.07 volts nominal)
	+12 VDC: 11.75 to 12.6 volts
	–12 VDC: -12.6 to -11.75 volts
Minimum Load:	1.0 A on +5 VDC
Protective Limits -	
Overvoltage Limit:	+5 VDC output: 5.7 to 6.7 volts
Overcurrent Limit:	+5 VDC output: 26 amps, maximum
	+12 VDC output: 4 amps, maximum
	–12 VDC output: 2 amps, maximum
Ride Through Time:	10 ms minimum

Dual Rack Operation

A single power supply can provide power for two racks under the following conditions:

- Only 5V power is required in the second rack, and the total power required by both racks is within the capability of the supply.
- The current drawn by the second rack is less than 5.2 amperes.
- The two racks must be mounted in close proximity as limited by the available 3-foot connecting cable.

The connecting cable used for dual rack operation is described below. Note that the cable carries power and power sequencing signals only. Inter-rack communication and bus interface modules must be provided separately.

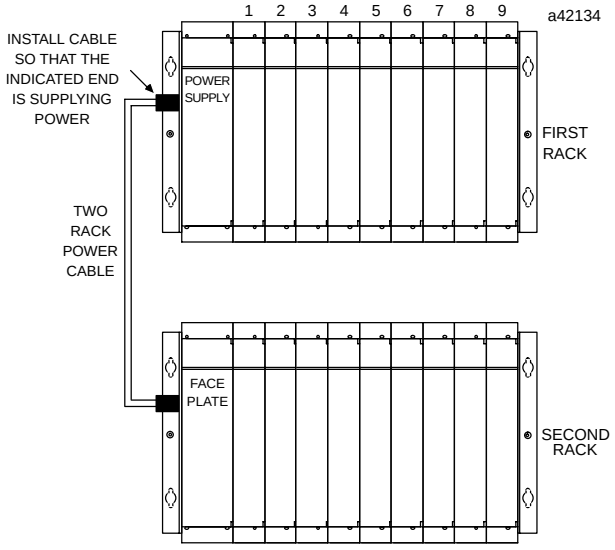


Figure 2-16. Dual Rack Configuration

Power Supply Extension Cable

A 3-foot (1 meter) Power Supply Extension cable, catalog number IC697CBL700, provides the necessary interconnection for dual rack operation. It carries the +5 volt power bus as well as the power sequencing signals.

The Power Supply Extension cable attaches to a 9-pin D type connector located on the backplane. Access to the connector is via a hole in the left side of the rack as shown in the drawing above. Adequate clearance (approximately 6 inches) must be provided on the left side of the rack for access to the connector.

This connector can also be used to provide power to a user installed 3rd Party J2 backplane. An option kit (IC697ACC715) is available for installing a J2 backplane. Maximum power that can be supplied to the J2 backplane is 5 VDC at 5.2 amps.

The Power Supply Extension cable must be secured before power is applied. It must not be disconnected during system operation.

Central Processing Unit (CPU)

The CPU for the Series 90-70 PLC is available in the following versions: models CPU 731, 771, 772, 780, 781, 782, 788, 789; CPM 790, 915, and 925; CSE 784, 924 and 925; CPX 772, 782, 928, and 935; and CGR 772 and 935. This variety of CPUs provides you with a choice of different speeds, I/O capacity, user memory size, and floating point math functionality (refer to Table 1-1 for details).

Note

Specific CPUs are required for special applications and should only be used for those applications. These CPUs are the model CPU 780, CGR 772, and CGR 935, which are required for Hot Standby CPU Redundancy applications; and, models CPU 788, CPU 789 and CPM 790, which are required for Genius Triple Modular Redundancy applications. For detailed information refer to the applicable manual for the desired application (see "Related Publications" in front of this manual).

CPU Architecture

The Series 90-70 PLC CPU contains either an 80C186 (models CPU 731 and CPU 771/772), 80386DX (models CPU 780/781/782/788/789), 80486DX (model CPM 915), 80486DX2 (models CPM 790/925), or 80486D4 (models CPX 772/782/928/935 and CGR 772/935) microprocessor as the main processing element, on-board memory, a dedicated VLSI processor for performing boolean operations and interfaces to a serial port and the system bus. The microprocessor provides all fundamental sweep and operation control, plus execution of non-boolean functions. Boolean functions are handled by a dedicated, VLSI, Boolean Coprocessor (BCP) designed by GE Fanuc.

User Memory for Models with Expansion Memory or Minimal On-Board Memory

Memory on several CPU models consists of on-board EPROM, and either on-board battery protected RAM (model CPU 731 has 32 Kbytes) or battery protected RAM on an expansion memory board. Models CPU 771 and CPU 772 have either 64K, 128K, 256K, or 512K of RAM memory on an expansion memory board for user program and register data storage (see Table 2-3). Models CPU 780/781/782/788 and 789 require a 32-bit memory expansion board (see Table 2-4) selected to suit your application.

Note

Model CPU 731 has a fixed memory configuration and does not require a memory expansion board to be installed.

Note

The memory expansion boards for models CPU 771 and CPU 772 are not compatible with the memory expansion boards for models CPU 78*X*.

When the CPU board is in storage, disconnect the lithium battery if there is no application program stored in memory. If a program is stored in memory, do not disconnect the battery; otherwise, the data will be lost.

Caution

If a *Low Battery Warning* occurs, replace the battery *before* removing power from the rack. Otherwise there is the possibility that data will be corrupted or the program will be cleared from memory.

User Memory for Models with 512K or More On-Board Memory

Program and data memory for the remaining Series 90-70 CPUs is provided by a memory board with battery-backed CMOS RAM which is an integral part of the module and does not need to be ordered separately. Models CSE 924 and CPX 772 have 512 Kbytes of memory. Models CPM 790, CPM 915/925 (these modules replace CPM 914/924), CPX 782/935, and CGR 772/935 have 1 Mbyte of memory. Model CPX 928 has 6 Mbytes of memory.

Flash Memory

Many of the 90-70 CPU models have 256K of non-volatile flash memory for storage of the operating system firmware. This allows updates of the firmware without disassembling the module or replacing EPROMs. The operating system firmware is updated by connecting a PC compatible computer to the serial port of the module and running the Loader software included with the firmware floppy disk. CPU Models that use flash memory are: CPX 772, CPX 782, CPX 928, CPX 935, CPM 915, and CPM 925.

Note

The CPX models (CPX 772, CPX 782, CPX 928, CPX 935) support storage of the user data (program, configuration, and register data) in the flash memory; the CPM 915 and CPM 925 do not.

Bulk Memory Access (BMA)

Bulk Memory Access (BMA) provides a large block of memory that can be accessed from your application program. Possible uses of the BMA include recipe files, bulk storage, memory allocation, temporary memory blocks, and so forth. Use of this feature requires Control programming software version 2.2, or later version. On-line Help for the BMA feature is available in Control programming software version 2.3 (BMA is not available with Logicmaster 90 programming software.)

The BMA is a contiguous block of memory (up to 4 MBytes) that can be used by logic programs and external devices. BMA is available in the CPX CPUs, IC697CPX772, IC697CPX782, IC697CPX928, and IC697CPX935 (CPU release 7.80 and later). Before BMA can be used, its size must be set to a value greater than zero in the Settings tab for the CPX CPU configuration.

A service request (SVCREQ #36) is used to read from the BMA to a local buffer area in the PLC, write from the local buffer area to the PLC, and retrieve the address of the BMA in the PLC.

VME Master

All of the Series 90-70 CPUs can operate as a VME master. For detailed information on this feature, refer to the *User's Guide to Integration of 3rd Party VME Modules*, GFK-0448.

Watchdog Timer

The CPU provides a watchdog timer to catch certain failure conditions. The value of this timer is controlled by the user from the programmer. The valid range of the watchdog timer is 10 milliseconds to 2550 milliseconds. The default value for the watchdog timer is 200 milliseconds; the timer resets at the beginning of each sweep.

CPU Features

The CPU must reside in slot 1 in the main (CPU) rack. An example of a Series 90-70 CPU is shown in the following figure, followed by a description of CPU features.

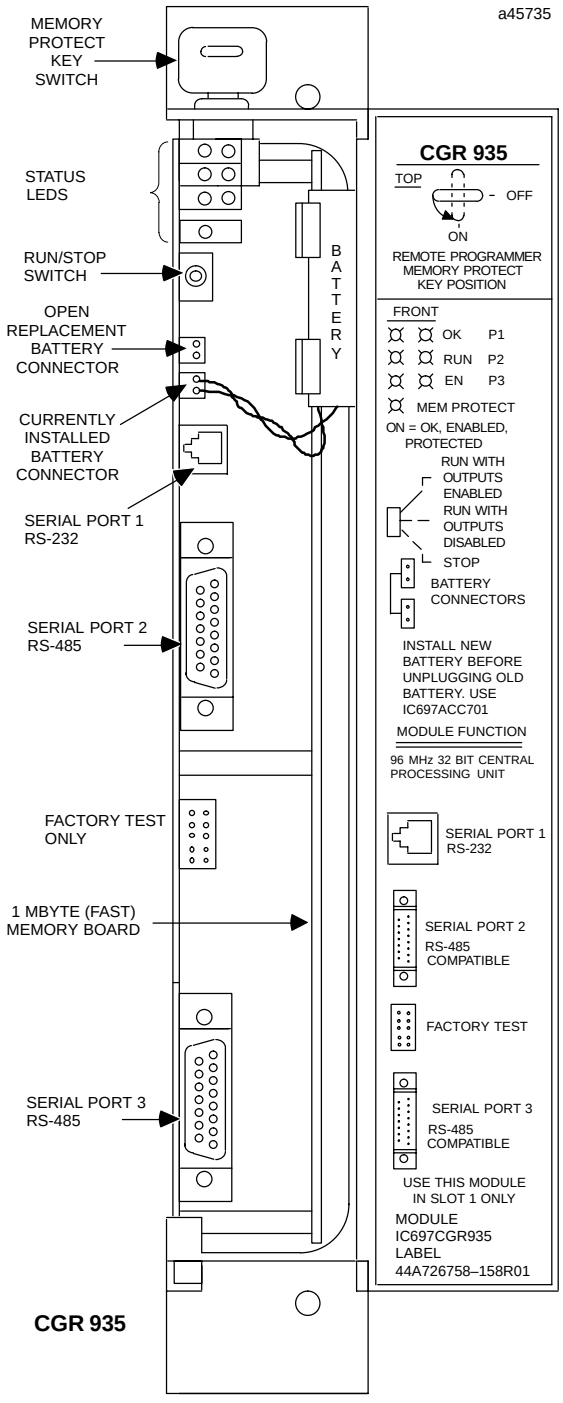


Figure 2-17. Series 90-70 PLC CPUs — CGR/CPX Design Shown

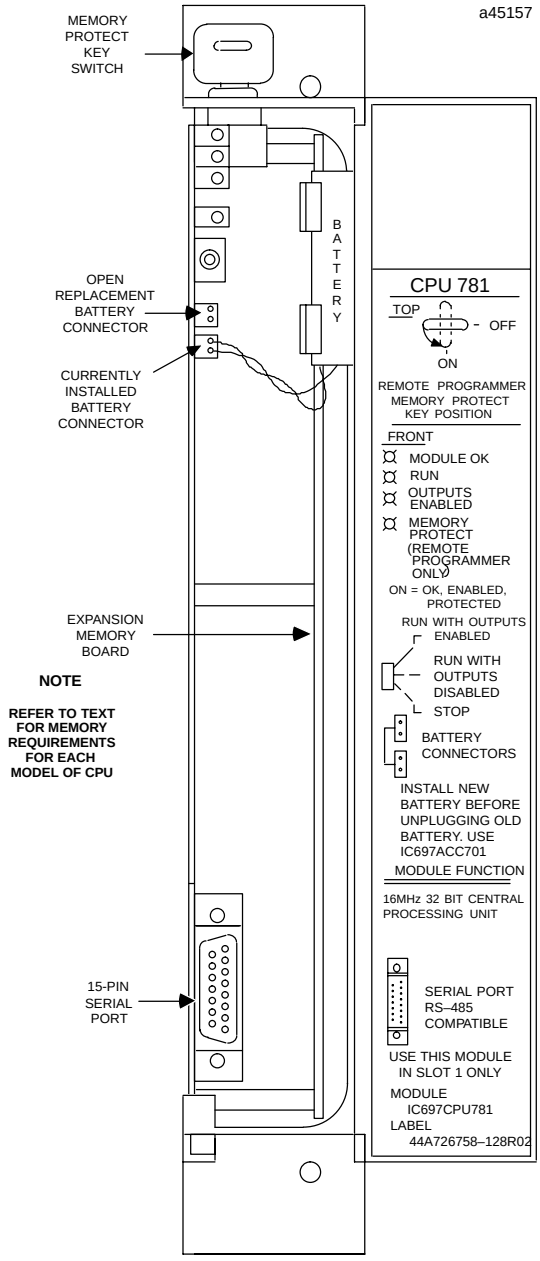


Figure 2-18. Series 90-70 PLC CPUs – CPU78x Design Shown

Memory Protect Keyswitch

For the added security of memory protection, the following CPU models have a remote programmer memory protect keyswitch on the module: CPU 780, 781, 782, 788, 789, 915 and 925; CGR 772 and 935; CPX 772, 782, 928, and 935. This keyswitch allows you to manually lock program and configuration data. When the keyswitch is in the *Memory Protect* position, program and configuration data can only be changed by a programmer connected parallel (via the BTM).

CPU Mode Switch

A three-position toggle switch is mounted at the top of the CPU board. This switch selects one of three operating modes for the CPU: *RUN/ENABLED, RUN/DISABLED*, or *STOP*. Although the mode of operation for the CPU can be controlled from both the switch and the programmer, the switch position restricts the ability of the programmer to put the CPU into certain modes. The following table shows the modes that can be selected by the programmer based upon the position of the CPU mode switch.

Table 2-8. Operating Mode Selection

CPU Mode Switch Position	Allowable Programmer Mode Command
RUN/ENABLED	STOP STOP/IOSCAN RUN/DISABLED RUN/ENABLED
RUN/DISABLED	STOP STOP/IOSCAN RUN/DISABLED
STOP	STOP STOP/IOSCAN

Run/Outputs Enabled

The top position of the switch is *Run with Outputs Enabled*. With the switch in this position, the CPU executes all portions of the sweep normally.

Run/Outputs Disabled

The middle position of the switch is *Run with Outputs Disabled*. With the switch in this position, the CPU executes all portions of the sweep normally, but outputs are held in their default state, and therefore remain unchanged.

STOP, STOP/IOSCAN

The bottom position of the switch is labeled *STOP*. Unless configured for STOP/IOSCAN, with the switch in this position, the CPU only communicates with the programmer and devices connected to the serial port, and recovers faulted modules. If configured for STOP/IOSCAN, the CPU will operate as in the STOP mode, with the exception that the I/O scan will continue to run. The logic solution will not be executed,

therefore, the output values will not change and will represent the values present in the output table when the transition to STOP/IOSCAN occurred. The input scan continues to run, updating the input tables with current input information.

Any of the values in the I/O tables can be changed using the programming computer. In STOP/IOSCAN mode, the physical outputs in the system will continue to follow the values in the output table.

Note

The STOP/IOSCAN mode ***is not a valid mode*** in a synchronized Hot Standby CPU Redundancy system. Refer to Chapter 4 in GFK-0827, the *Series 90-70 Hot Standby CPU Redundancy User's Guide,* for detailed information.

CPU Status LEDs

There are up to seven LEDs (depending on CPU model) mounted at the top of the CPU board; these LEDs indicate the current state of the CPU. All models but the CPX models have a single column of LEDs (three or four, depending on model) at the top left of the unit. The normal state of these LEDs when the CPU is running is *ON*. They are *OFF* or *flashing* to indicate special or failure conditions.

CPX model CPUs (CPX 772, 782, 928, 935) have a second column of three LEDs to the right of the others. These LEDs indicate status of the three on-board serial ports without having a terminal connected. They are *ON* only when the applicable serial port is active/enabled.

OK (All CPU Models)

The top LED, labeled *OK,* is an indicator of the health of the CPU. It is *ON* when the CPU is functioning properly. The LED blinks when the CPU executes the power-up diagnostics and when the system has failed. When in this state, the CPU can still communicate with the programmer. The LED is *OFF* when the system has failed and the CPU cannot communicate with the programmer.

RUN (All CPU Models)

The middle LED, labeled *RUN,* is an indicator of the RUN/STOP status of the CPU. It is *ON* when the CPU is in the RUN/ENABLE or RUN/DISABLE mode. When the CPU is in the STOP or STOP/IOSCAN mode, the LED is *OFF.*

ENABLED (All CPU Models)

The bottom (or third) LED, labeled *EN* (ENABLED) indicates the state of the outputs. This LED is *ON* when the outputs are enabled, and *OFF* when the outputs are disabled.

MEM PROTECT (Certain CPU Models)

The bottom LED is only available on CPU models that have a remote programmer Memory Protect keyswitch on the module. The MEM PROTECT LED indicates whether or not the memory protect feature is on or off. The LED is *ON* when the keyswitch is in the ON position.

PORT 1 ACTIVE (CPX and CGR Models Only)

The top right LED, labeled *P1*, is only available on CPX and CGR model CPUs. This LED indicates the status of on-board serial port 1 (RS-232 compatible). It is *ON* when serial port 1 is active/enabled, and *OFF* when the port is inactive.

PORT 2 ACTIVE (CPX and CGR Models Only)

The middle right LED, labeled *P2*, is only available on CPX and CGR model CPUs. This LED indicates the status of on-board serial port 2 (RS-485 compatible). It is *ON* when serial port 2 is active/enabled, and *OFF* when the port is inactive.

PORT 3 ACTIVE (CPX and CGR Models Only)

The bottom right LED, labeled *P3*, is only available on CPX and CGR model CPUs. This LED indicates the status of on-board serial port 2 (RS-485 compatible). It is *ON* when serial port 3 is active/enabled, and *OFF* when the port is inactive. Note that this port is the programming port.

Battery Connectors

Directly below the CPU mode switch are two identical battery connectors. The connector wired to the lithium backup battery cable plugs into one of these to connect the battery to the CMOS memory devices. Two connectors are provided for use when the battery requires replacement. This allows the battery currently installed to remain connected until the new battery is connected, thus minimizing the possibility of losing data.

Serial Port Connector for CPM, and CSE Model CPUs

The 15-pin D-connector at the bottom of the module provides the connection to an RS-422/RS-485 serial port. Its port provides a serial connection to the Work Station Interface (WSI) board installed in the programming computer. For applications requiring RS-232 communications, an RS-232 to RS-422 converter (IC690ACC900) or RS-232 to RS-422 miniconverter (IC690ACC901) is available. See the appropriate appendix for information on these converters.

Note

An RS-422 Isolated Converter (IC690ACC903) is available for applications requiring ground isolation where a common ground cannot be established between components. For details, see Appendix A.

A standard serial COM port version of Logicmaster 90-70 programming software, or Control programming software (note that the Control programming software does not support the CSE model CPUs) provides logic programming and configuration for the Series 90-70 PLC using the COM1 or COM2 serial port of the programming device (a WSI board is not needed). Connections for this configuration are made from the programmer's COM1 or COM2 serial port to the converter to the serial port on the Series 90-70 CPU.

Serial Port Connections for CPX and CGR Model CPUs

The CGR and CPX model CPUs have three on-board serial ports which can be configured to behave as three independent communications ports. These three ports are accessed by connections on the front of the module for serial interface to the programming computer, or other serial devices. Ports 1 and 2 support the SNP Slave protocol. Ports 1 and 2 support the following baud rates: 1200, 2400, 9600, 19200, 38400, and 57600.

- Port 1, the top port, is RS-232 compatible. Access to Port 1 is through a 6-pin RJ-11 connector. This connector has female contacts and is similar to modular jacks commonly used for telephones and modems. (IC690CBL316 can be used for a 9-pin AT PC connection.)
- Port 2, the center port, is RS-485 compatible and is optocoupler isolated. Access to Port 2 is through a 15-pin D connector that has female contacts.
- Port 3, the bottom port, is also RS-485 compatible, but is not isolated. Access to Port 3 is through a 15-pin D connector that has female contacts. This port is the programming port.

The serial connection can also be made from a serial port on the CPU to the serial port on the programming computer, or other serial device, or through the RS-232 to RS-422 Miniconverter (IC690ACC901). This connection can be made with available cables or you may build cables to fit the needs of your particular application.

A second column of three LEDs, located to the right of the LEDs at the top left of the unit, provides indication of serial port activity. The ports are labeled P1, P2, and P3 respectively, and are *ON* when the applicable port is active.

Enhanced Functionality of Serial Ports 1 and 2

Serial Ports 1 and 2 support break-free SNP (requires CPU release 8.00, or later). Break-free SNP improves serial communications using modems. The break-free implementation of the SNP protocol does not rely on receiving serial breaks. Consequently, modem pairs that alter the timing or characteristics of breaks from SNP masters may be used successfully. Note that break-free is now the default mode of operation for the SNP protocol on these two ports. Break-free operation is completely transparent. When normal breaks are received, SNP communication is identical to previous operation. However, Attach messages are also recognized without a preceding break. Modified breaks (for example, breaks transformed to a single ASCII NUL character with or without a framing error) are ignored.

Serial Ports 1 and 2 with SNP Slave protocol fully support programming using either Logicmaster 90 or Control programming software, including the program upload, download, and data monitoring features.

Note

Serial Ports 1 and 2 do not support connection of the C debugger or printf functionality using C programming.

Expansion Memory Board for Models CPU 771 and CPU 772

Storage of application programs and register data on the CPU models 771 and 772 requires an expansion memory board which mounts on the main CPU board. The expansion memory board uses battery-backed CMOS RAM memory devices for program and data storage. These same expansion memory boards can also be used with the PCM to increase the total available application memory. Four versions of the memory expansion board are available:

Table 2-9. Expansion Memory Boards, CPU Models 771/772 and PCM

Catalog Number	Memory Size
IC697MEM713	64K Bytes
IC697MEM715	128KBytes
IC697MEM717	256KBytes
IC697MEM719	512KBytes

The expansion memory boards are installed on the CPU or PCM module by mounting them on a connector provided for that purpose. The CMOS RAM memory on the expansion memory boards is backed-up by the lithium battery mounted on the CPU or PCM module on which the boards are installed.

Expansion Memory Board for Models CPU780/781/782/788/789 and CSE784

CPU models 780/781/782/788/789 and CSE 784 also require an expansion memory board. The expansion memory board for these CPUs uses battery-backed CMOS RAM memory devices for program and data storage. These expansion memory boards are arranged in a 32-bit memory configuration and can only be used on the model 78x CPUs. They are not compatible with the model 771 and 772 CPUs or the PCM. Four versions of the 32-bit memory expansion board are available.

These expansion memory boards are installed on the model 78x CPUs by mounting them on a connector provided for that purpose. Memory on the boards is backed-up by the battery mounted on the CPU module. The CMOS RAM memory on the expansion memory boards is backed-up by the lithium battery mounted on the CPU or PCM module on which the boards are installed.

Table 2-10. 32-Bit Expansion Memory Boards For 78x CPUs

Catalog Number	Memory Size
IC697MEM731	128KBytes
IC697MEM732	256KBytes and 256KBytes non-volatile flash memory
IC697MEM733	256KBytes
IC697MEM735	512KBytes

On-Board User Memory Board for All Other CPU Models

A memory board (sizes from 512K to 6 Mbyte) is a standard factory installed feature on many of the newer CPU models. The following table outlines the memory board sizes that are installed on these CPU models.

Table 2-11. CPUs with User Memory Boards Installed

CPU Model	Memory Board Installed (Size)
CSE 924	512KBytes
CSE 925	1 Mbyte
CPM 790	1 Mbyte
CPM 915	1 Mbyte
CPM 925	1 Mbyte
CGR 772	512KBytes
CGR 935	1 Mbyte
CPX 772	512KBytes
CPX 782	1 Mbyte
CPX 935	1 Mbyte
CPX 928	6 Mbytes

Bus Transmitter Module

When a BTM, IC697BEM713, is included in a system, it can be installed in any slot (except slot 1) in the CPU rack as long as it is not to the right of an empty slot. The BTM is an optional module in a single-rack system; a BTM is required if more than one rack is to be included in a Series 90-70 PLC control system. The BTM provides a high-speed parallel connection to the expansion racks, to a Bus Receiver Module (BRM) located in the first I/O expansion rack. The BTM also provides the programmer connection to the Work Station Interface board installed in the programmer.

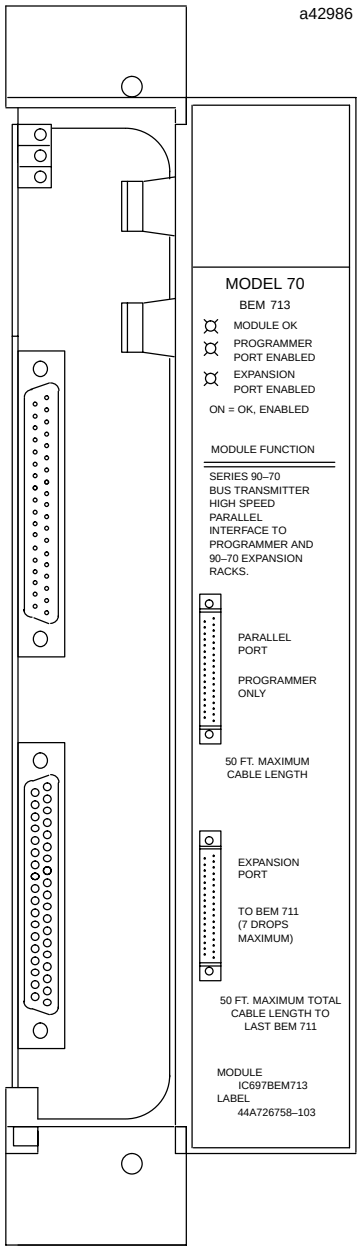


Figure 2-19. Bus Transmitter Module

Status Indicators

There are three LEDs located at the top of the BTM. The LEDs are labeled: MODULE OK, PROGRAMMER PORT ENABLED and EXPANSION PORT ENABLED. They are visible through the clear plastic lens at the top of the module's cover. The function of each LED is described below.

Module OK LED

The top LED is the MODULE OK LED. It is *ON* when the CPU software completes its power-up configuration of the BTM, and has polled (or attempted to poll) each expansion rack in the system. It is *OFF* when any of these conditions is not met.

Programmer Port Enabled LED

The middle LED is the Programmer Port Enabled LED. This LED is either *blinking* or *ON* when the programmer and the PLC are communicating. It is *OFF* when they are not communicating.

Expansion Port Enabled LED

The bottom LED provides the status of the expansion bus. It is either *blinking* or *ON* when the BTM is communicating with the BRMs connected to it through the parallel I/O bus link. It is *OFF* when they are not communicating.

BTM Connectors

There are two connectors on the front of the BTM board. The top one provides a parallel connection to a Work Station Interface (WSI) board installed in the programmer for the Series 90-70 PLC. This connection is made through a programmer cable (IC647CBL703) that is 10 feet (3 meters) in length (parallel connection is through a parallel I/O cable, IC600WD005A). Standard parallel I/O cables (see Table 2-1) are used to connect the BTM's lower connector to a BRM in the first expansion rack. Both of these connectors are 37-pin connectors; the top one is a male connector, while the lower one is female.

Bus Receiver Module

The Bus Receiver Module (BRM), IC697BEM711, which must be installed in slot 1 of each expansion rack in a system, is the expansion rack interface to the I/O bus. It provides the link to the I/O bus for I/O modules installed in its rack. The BRM in the first expansion rack connects to the BTM in the CPU rack through a parallel I/O bus cable. This cable is connected to the bottom connector on the BTM, and to the top connector on the BRM. The next rack to be included in the I/O bus is connected to the lower connector on the BRM in the first expansion rack and the top connector of the BRM in the next rack. Connection of expansion racks on the I/O bus is continued in this manner until a maximum of seven expansion racks is connected.

Note

The total cable length of all connecting cables between racks on the I/O bus cannot exceed 50 feet (15 meters).

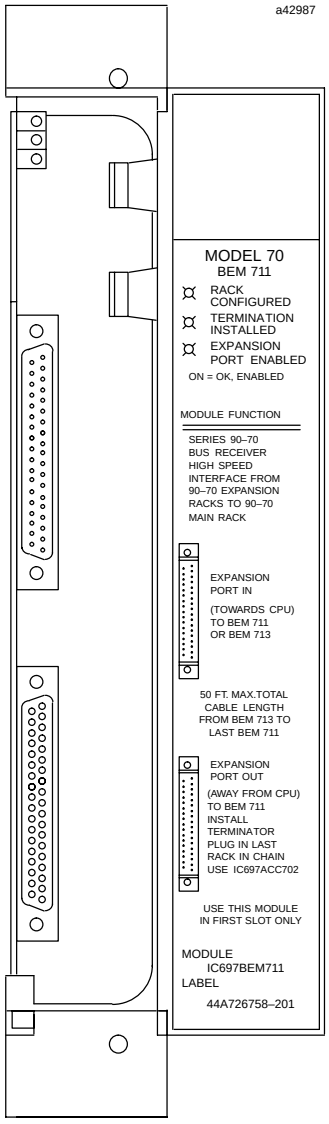


Figure 2-20. Bus Receiver Module

I/O Bus Signal Termination

The I/O bus signals must be terminated at the end of the bus. This is done by installing a resistor pack, which is inside a terminator plug (IC697ACC702) on the bottom connector of the BRM module that is installed in the last I/O expansion rack in the system. All BRMs are shipped from the factory with a terminator plug installed. These terminator plugs must be removed from any expansion rack located between the CPU rack and the last expansion rack.

Status Indicators

There are three LEDs located at the top of the BRM. The LEDs are labeled: OK, LAST RACK, and BUS ACTIVE. They are visible through the clear plastic lens at the top of the module's cover. The function of each LED is described below.

Board OK LED

The top LED, the Board OK LED, is *ON* when the CPU software completes its power-up configuration of the expansion rack and at least one module in that rack responds to the CPU requests for information. It is *OFF* when any of these conditions is not met.

Last Rack LED

The middle LED is the Last Rack LED. This LED is *ON* when the I/O bus terminator plug is installed in the bottom connector of this BRM, and is *OFF* when it is not installed. The terminator plug is to be installed only on the BRM that is at the end of the expansion rack I/O bus.

Expansion Bus Active LED

The bottom LED provides the status of the expansion bus. This LED is *ON* when the BRM has detected that there has been activity on the expansion bus in the last 500 ms, otherwise it is off. When this LED is *OFF*, the BRM is holding the Series 90-70 I/O modules in its rack in their default state.

BRM Connectors

The BRM has two connectors mounted on the front of the board. The top connector is for the I/O cable connection to either the lower connector on a BTM in the CPU rack or the lower connector on another BRM. The lower connector is for an I/O cable connection to the upper connector of a BRM in the next expansion rack on the I/O bus or a terminator plug if this is the last rack in a multiple-rack installation. The I/O cable is an 18 twisted-pair cable with a ground shield. The total maximum cable length from the CPU rack to the most distant expansion rack (at the same ground potential) is 50 feet. Standard parallel I/O bus cables that meet this specification are available in lengths of 5, 10, 25, and 50 feet.

Genius Bus Controller

The Genius Bus Controller (GBC), IC697BEM731 is the interface for the Series 90-70 PLC to a Genius I/O communications system. This system can be simply I/O control using Genius I/O blocks, or it can be a Genius Local Area Network. Configuration of the GBC is simple through use of Logicmaster 90 or Control software. Genius I/O blocks are scanned asynchronously by the GBC and I/O data is transferred to the CPU once per scan over the backplane of the Series 90-70 PLC rack. Up to 31 GBCs can be installed in a Series 90-70 system.

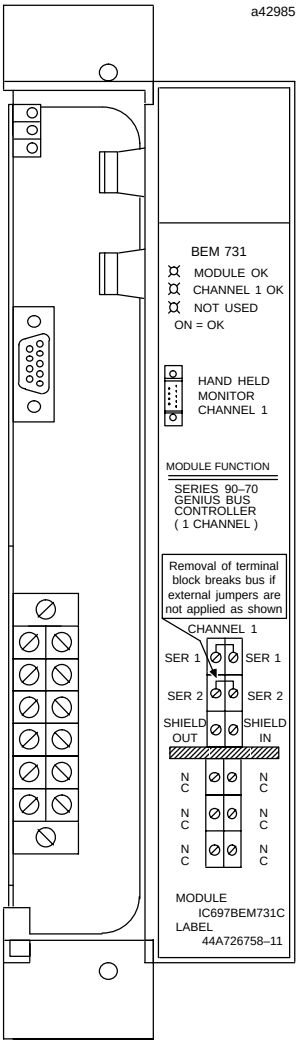


Figure 2-21. Series 90-70 Genius Bus Controller

Each bus can have up to 30 Genius I/O blocks connected to it (any type). *Genius dual-bus redundancy is also supported.* This scheme protects against GBC and Genius bus failures by connecting up to 30 blocks to a pair of GBCs and a pair of Genius buses with Bus Switching Modules.

The GBC supports directed communications initiated by a Communication Service Request (COMREQ) from the CPU. Faults that are reported by the GBCs are managed by the PLC Alarm Processor, which time stamps and queues faults in a Fault Table.

Genius Bus Controller Operation

The GBC contains an 80186 microprocessor as its main processing element, a 6303 microcontroller for communicating with the Genius I/O bus, an on-board memory, a custom VLSI chip for interfacing to the Genius I/O bus, and an interface to the system bus.

As a safety feature, a watchdog timer protects each Genius I/O link. This timer is periodically reset by the GBC software. Should it ever expire, the microcontroller on the board ceases functioning and the Channel OK LED turns off. If this happens, the Genius I/O blocks connected on the link will default their outputs to the appropriate predetermined state. The cause of the link failure must be determined to re-establish communications.

Genius Bus Controller User Features

A Genius Bus Controller can be installed in any slot in the main rack except for slot 1, which is reserved for the CPU module. It can be installed in any slot in an expansion rack except slot 1, which must contain a Bus Receiver Module.

Genius Bus Controller Status Indicators

The GBC has three LEDs located at the top of the board: one as an indicator of the state of the board, one to indicate the state of the Genius I/O link, and a third that is not used currently. When the board is functioning properly, the top two LEDs are *ON* (third LED currently not used). They are either *blinking* or *OFF* to indicate special or failure conditions. If, after the power-up diagnostics routine has been completed, all LEDs are *OFF*, this is an indication that a board failure has been detected and the board must be replaced.

Module OK LED

The top LED, labeled OK, indicates the health of the GBC. It is *ON* when the board has successfully completed the power-up diagnostics. If the power-up diagnostics detects a failure, or if the board fails during operation, the LED will be *OFF*. The LED *blinks* during the power-up diagnostics and when the GBC is installed in a slot different from the slot specified by the configuration information downloaded from the programmer.

CHANNEL 1 OK LED

The CHANNEL 1 OK LED is the middle LED. It operates identically to the Module OK LED in that it is *ON* after the board has successfully completed the power-up diagnostics and *OFF* if a failure has been detected during the power-up diagnostics, or if its bus or bus controller fails while the CPU is running (even in the STOP mode). If the failure is a bus controller failure, the LED will remain permanently off. If it is a bus failure, such as a broken wire or excessive bus errors, the LED remains off until the failure condition is corrected.

GBC Connectors

A GBC has two connectors. Directly below the LED is a dedicated nine-pin connector for connection to the Hand-Held Monitor. The actual bus connections are made through a 12-point removable terminal board. Six of these terminals are used for connection to the Genius I/O channel. The GBC may be located on either end or in the middle of the bus.

Remote I/O Scanner

The Remote I/O Scanner, IC697BEM733, allows Series 90-70 I/O to be distributed on the Genius I/O link at a location remote from the Series 90-70 CPU. This module resides in a standard 5 or 9-slot Series 90 rack along with Series 90-70 discrete and/or analog I/O modules. This subsystem is referred to as a remote rack. It operates similarly to a Series 90-70 CPU in that it controls all I/O functions within the remote rack it resides in; however, it does not perform any logic solution. All I/O data for that rack is communicated to and from the Series 90-70 CPU over the Genius I/O link.

Each remote rack may contain up to 1024 inputs and 1024 outputs, or up to 64 analog input channels and 64 analog output channels, or any combination that does not exceed a 128 byte input and 128 byte output limit.

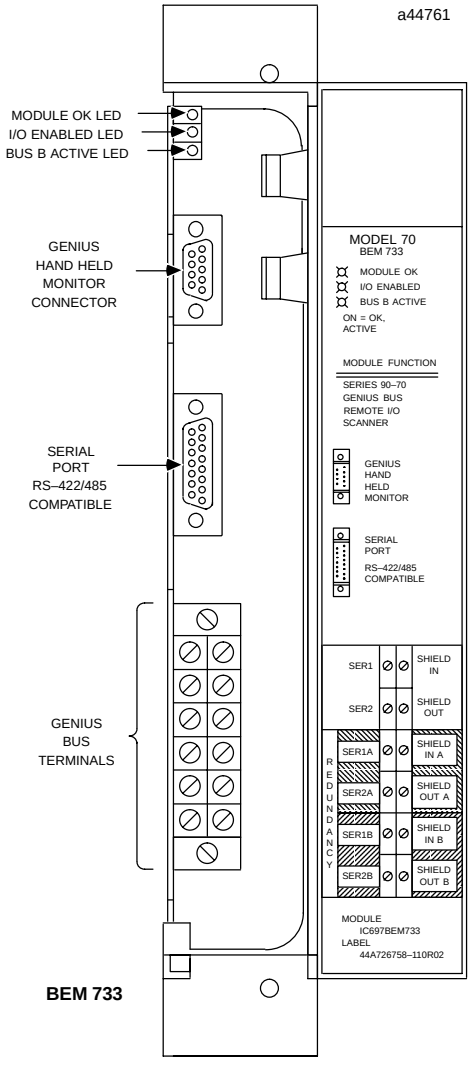


Figure 2-22. Remote I/O Scanner Module

Remote I/O Scanner Operation

The Remote I/O Scanner contains two separate, but closely linked, microprocessor systems. An 80186 microprocessor controls all activity within the remote rack, which includes configuration, programmer communication, and I/O scanning. A 64180 microprocessor along with a custom VLSI device handles all Genius communications. These two microprocessor systems are coupled together through shared memory. All I/O data, as well as diagnostic and system specific data, is passed through this memory.

A 15-pin connector provides an RS-422/RS-485 compatible serial port for connection to a Work Station Interface board installed in the programming computer (or connection to the programmer through an RS-422/485 to RS-232 converter without a Work Station Interface). A 9-pin connector, located directly below the LEDs, is a dedicated port for attaching a Genius Hand-Held Monitor. The Genius bus is attached through a removable terminal board identical to the board on the Genius Bus Controller module.

LED Status Indicators

The Remote I/O Scanner module has three LEDs which are labeled, from top to bottom, MODULE OK, I/O ENABLED, and BUS B ACTIVE. The Module OK LED turns on to indicate that the module has passed its diagnostic tests following power-up. It may also flash to indicate one of the conditions listed in the table below.

The I/O ENABLED LED turns on when I/O points in the remote rack are being serviced with data received from the controller. It will turn off if any of the following conditions occurs:

- The Genius bus linking the Remote I/O Scanner to the Genius Bus Controller is cut or otherwise seriously disrupted.
- The Series 90-70 PLC is Stopped (in STOP mode), or is configured in a manner that prevents the Genius Bus Controller from servicing the remote rack.
- The Remote I/O Scanner has been placed in STOP mode and has not been returned to RUN mode.

The I/O ENABLED LED may also flash, as indicated below.

Table 2-12. Summary of LED Indications

LED Name and Status		Description
MODULE OK	**I/O ENABLED**	
ON	ON	Normaloperation
Blinking	Blinking	Faultdetected
ON	AlternateBlinking	I/Odataforced
AlternateBlinking	SynchronousBlinking	Fault detected and I/O data forced
SynchronousBlinking	OFF	Genius Serial Bus Addressconflictdetected
ON	OFF	I/O not being serviced
OFF		No power or fatal power-up error

The BUS B ACTIVE LED turns on whenever Genius Bus B is active in redundant bus configurations where the Remote I/O Scanner has been configured as the Bus Switching Module Controller. The BUS B ACTIVE LED is off under all other conditions.

For detailed information on the Remote I/O Scanner, refer to GFK-0579, the *Series 90-70 Remote I/O Scanner User's Manual*.

FIP Bus Controller

A Series 90-70 FIP Bus Controller (FBC) is a two-channel bus controller that occupies a single slot in a standard or VME Integrator rack. The FBC is configured with the Logicmaster 90-70 or Control programming software configurator function. I/O devices on the FIP bus are scanned asynchronously by the bus controller and I/O data is transferred to the CPU once per scan. Up to 31 bus controllers, of any kind, can be included in a Series 90-70 system. Of the 31 bus controllers, a maximum of four can be FIP bus controllers.

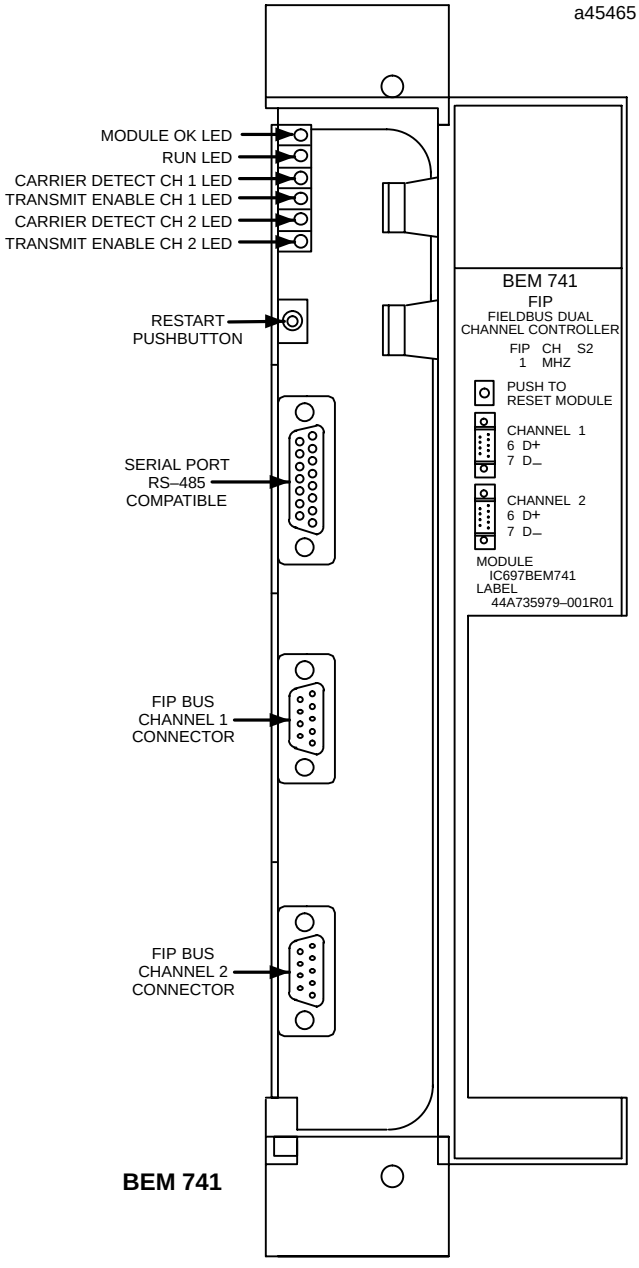


Figure 2-23. FIP Bus Controller

A FIP bus may serve:

- **Remote Drops**, IC693 I/O racks that are interfaced to the bus through Remote I/O Scanner Modules. Each remote drop can include any mix of discrete and analog I/O modules.
- **Field Control Stations**, Field Control I/O modules that are interfaced to the bus via a FIP Bus Interface Unit (BIU).
- **Generic Devices**, such as general-purpose computers that are interfaced to the bus via a 3rd Party FIP Module.

A FIP bus is used primarily for I/O control. It is also used to store configuration data to remote devices and to report faults.

Location in a System

A FIP Bus Controller module can be installed in any I/O slot in the CPU rack (rack 0) in a Series 90-70 PLC system. The following figure shows a typical installation with a FIP Bus Controller connected to a Series 90-70 Remote I/O Scanner which allows Series 90-30 I/O modules to be on the FIP Bus. The Series 90-30 Remote I/O Scanner and the modules it serves are referred to as a *FIP I/O Nest*. For detailed information on the Series 90-30 Remote I/O Scanner, refer to the *Remote I/O Scanner User's Manual,* GFK-1037.

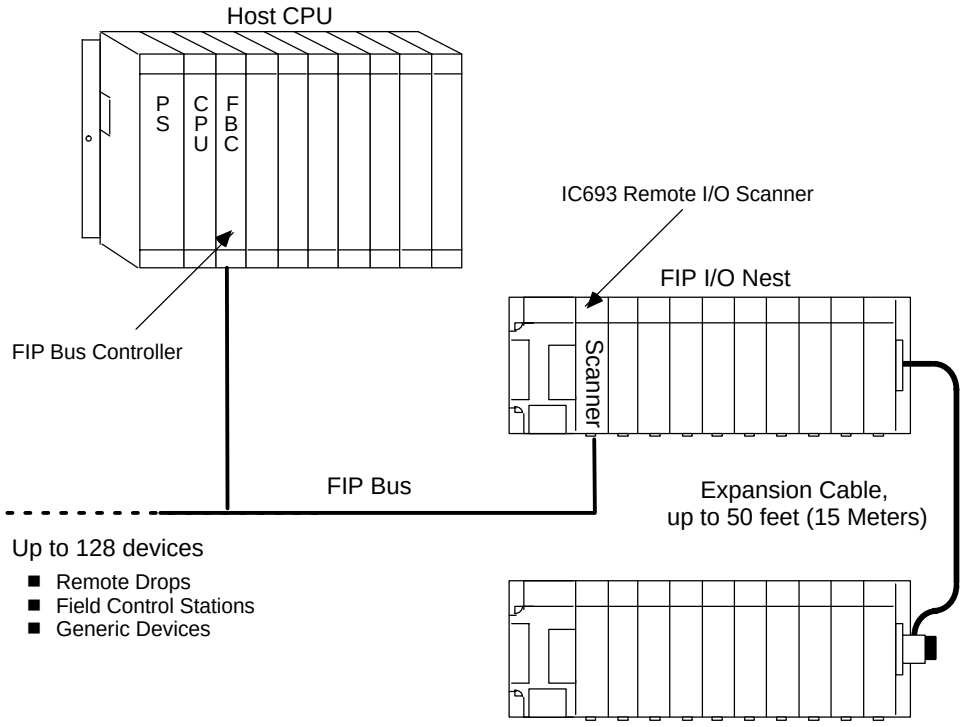


Figure 2-24. Example of FIP Bus Controller in a System

FIP Bus Controller User Features

Following is a basic description of the FIP Bus Controller module features:

Status LEDs

The six LEDs located on the front of the FIP Bus Controller display module status and communications activity.

The top two LEDs indicate module health. The bottom four LEDs indicate communications activity on the FIP bus. Two LEDs are dedicated to each of the two FIP channels.

MODULE OK

Shows the status of the FIP Bus Controller. This LED blinks during power-up diagnostics and should remain on as long as power is applied to the Bus Controller.

RUN

Shows the operational status of the FIP Bus Controller. This LED turns *ON* when the module is actively scanning I/O.

CARRIER DETECT CH 1

This LED is *ON* when detecting a carrier signal on the FIP bus attached to channel 1.

TRANSMIT ENABLE CH 1

This red LED is *ON* when the FIP Bus Controller transmits data on the FIP bus attached to channel 1.

CARRIER DETECT CH 2

This LED is *ON* when detecting a carrier signal on the FIP bus attached to channel 2.

TRANSMIT ENABLE CH 2

This red LED is *ON* when the FIP Bus Controller transmits data on the FIP bus attached to channel 2.

Pushbutton

A pushbutton located directly below the LEDs is provided as a means to enable the Bus Controller to accept an upgrade of its operating firmware. It is also used to locally reset the Bus Controller in the event of a watchdog timeout.

Serial Connector

The 15-pin Serial Connector on the FIP Bus Controller provides for attachment of a PC computer to perform an upgrade of the operating firmware of the Bus Controller. The port supports the RS-485 electrical standard.

Table 2-13. RS-485 Serial Port Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	Shield Ground	9	Termination Resistor*
2	no connection	10	RXD–
3	no connection	11	RXD+
4	ATTACH	12	TD–
5	+5V (5 Volts DC)	13	TD+
6	RTS–	14	RTS+
7	0V (DC Ground)	15	CTS+
8	CTS+	Shell	Board Frame Ground

* A 120 ohm resistor is capacitively coupled to the board frame ground.

FIP Bus Connectors (Channel 1 and 2)

Two 9-pin connectors on the FBC provide for attachment of one or two FIP busses. The top 9-pin connector is for FIP bus *Channel 1* and the bottom 9-pin connector is for FIP bus *Channel 2*. Since signals on both busses are identical, the two busses provide a redundant bus capability.

Table 2-14. FIP Bus Connector Pin Assignments

Pin Number	Signal Name	Pin Number	Signal name
1	noconnection	6	D+
2	noconnection	7	D–
3	noconnection	8	noconnection
4	noconnection	9	noconnection
5	noconnection	Shell	Signal Ground*

* The connector shell is capacitively coupled to the board frame ground.

FIP Bus

The FIP bus is a shielded twisted-pair wire. Proper cable selection is critical to successful operation of the system. Suitable cable types are listed in the *FIP Bus Controller User's Manual,* GFK-1038.

Conservative wiring practices, as well as national and local codes, require physical separation between control circuits and power distribution or motor power. Refer to sections 430 and 725 of the National Electric Code.

Table 2-15. FIP Bus Characteristics

Bus Type	Single twisted pair plus shield. Fiberoptics cable and modems can also be used.
Baud Rate	1.0 Mbaud
Maximum Bus Length	2000 feet (610 meters). Maximum length also depends on cable type. Cable types are described in detail in Chapter 2 of the *FIP Bus Controller User's Manual*. Greater bus lengths are possible using sections of fiberoptics cable with modems.
Maximum Number of Devices	256 devices
Data Encoding	Manchester II Encoding

I/O Link Interface

The I/O Link Interface Module, IC697BEM721, is used to interface a Series 90-70 PLC to GE Fanuc and Fanuc products which may also be placed on the proprietary Fanuc I/O Link. The Fanuc I/O Link is a serial interface that provides high-speed exchange of I/O data between a master device and up to 16 slaves.

The maximum distance between individual devices on an I/O Link is 33 feet (10 meters). If greater distances are required between modules, optional fiberoptics cable and Optical Adapters can be used to increase the maximum distance between individual devices to 330 feet (100 meters).

Up to four I/O Link Interface Modules can be installed in a Series 90-70 PLC. Each I/O Link Interface Module can be used in either master or slave mode. Usually, when there are multiple I/O Link Interface Modules in the same PLC, they are on separate I/O Links. However, it is possible to have more than one I/O Link Interface Module in the Series 90-70 PLC connected to the same link, if that suits the needs of the application.

When Used as a Master

An I/O Link Interface Module can exchange up to 1024 discrete inputs and 1024 discrete outputs with slave devices. Potential slaves include the Series 90-30 PLC, Series 0 CNC, and Power Mate CNC.

When Used as a Slave

The Series 90-70 I/O Link Interface Module can exchange up to 64 discrete inputs and 64 discrete outputs with the master. The master may be another Series 90-70 PLC, a Series 15, Series 16, or Series 18 CNC, a Series 0 Model C CNC, or an F-D Mate CNC. The Series 90-70 PLC and Series 0 CNC can be used as either master or slave.

The I/O Link Module is configured using Logicmaster 90-70 or Control software. Application software, supplied on diskettes with the I/O Link Interface Module, can be used to set up and control the I/O Link. This application software can also be used to assign the location of the input and output data to and from the I/O Link, and to provide diagnostics capabilities for the I/O Link. The Logicmaster 90-70 or Control programmer is used to integrate this application software with the rest of an application program.

Module Description

The I/O Link Interface Module occupies one slot in the Series 90-70 PLC rack. It can be installed in any rack, in any slot except slot 1, which is reserved for the CPU module.

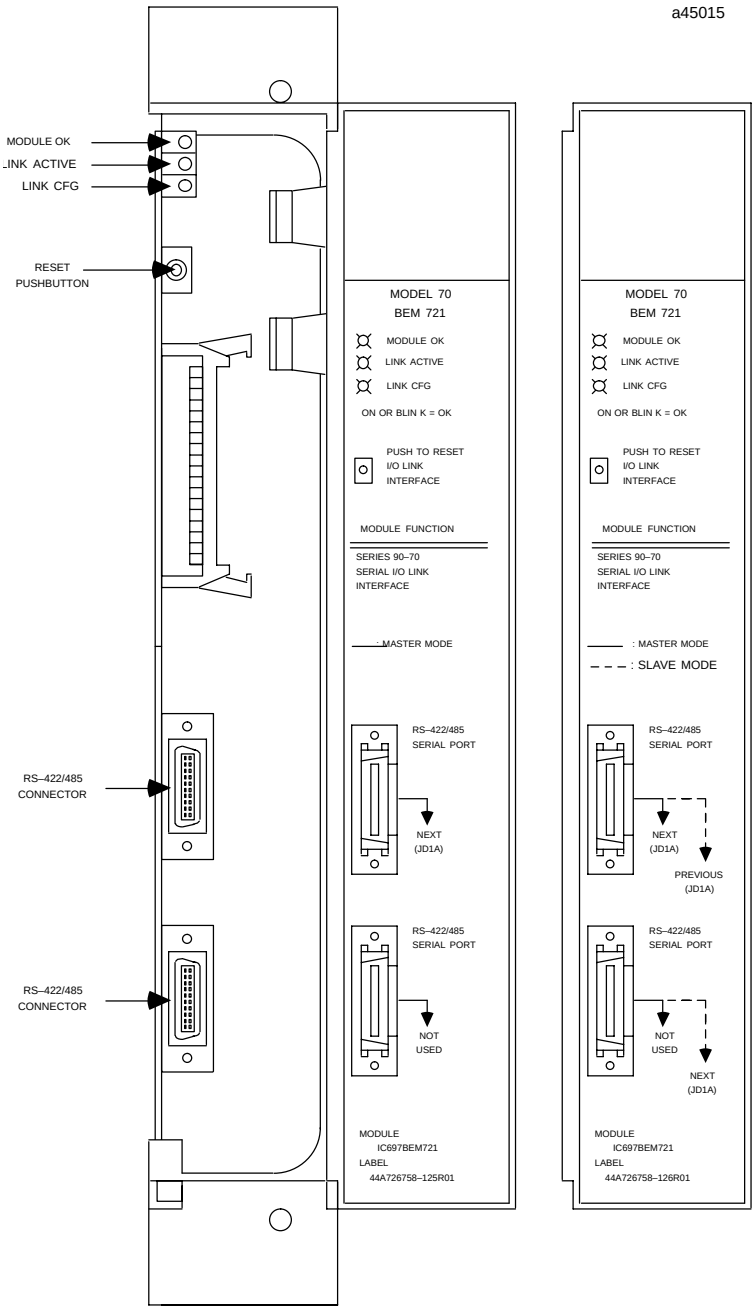


Figure 2-25. I/O Link Interface Module

Status Indicator LEDs

The module has three LEDS which indicate the operating, configuration, and communications status of the module.

LED Name	Function
MODULE OK	Indicates the module's operating status.
LINK ACTIVE	Indicates the module's communications status.
LINK CFG	Indicates whether I/O Link configuration has occurred.

Reset Pushbutton

The Reset pushbutton provides a convenient means to reset if a failure occurs. If the module is being used as a master, pushing the Reset button resets both the module and operation of the link. The application program must be used to re-initialize the link. If the module is being used as a slave, pushing the Reset button resets the module, if a fault has caused the module to stop operating while the rest of the link continues to function.

Serial Ports

The front of the I/O Link Interface Module has two 20-pin, D connector, RS-422/485 serial ports. These ports are used for connection to the GE Fanuc I/O Link.

For detailed information on the I/O Link Interface module, refer to GFK-0644, the *Series 90-70 I/O Link Interface Module User's Manual.*

Note

When powering-up the PLC CPU without a battery and I/O Link Interface modules are present, an incorrect *Loss of or Missing Option Module* fault will be logged for each I/O Link Interface module; however, the CPU will not consider these modules as lost, and the modules will continue to operate properly.

When using flash memory, the *Loss of or Missing Option Module* fault should be configured as *diagnostic* if I/O Link Interface modules are present.

Redundancy Communications Module

The Redundancy Communications Module (RCM), IC697RCM711, provides a communications path for sharing data between the two CPUs in a synchronized Hot Standby CPU Redundancy system. In a synchronized system, I/O data is controlled by one unit (the active unit) but is shared between both units (active and backup units). The RCM provides the communications path between the two units. An RCM must be configured in both the Primary PLC and the Secondary PLC. The RCM must reside in rack 0 and there can be no empty slot between the RCM and the CPU (there can be other modules).

RCM Features

The following figure shows the features of the RCM module.

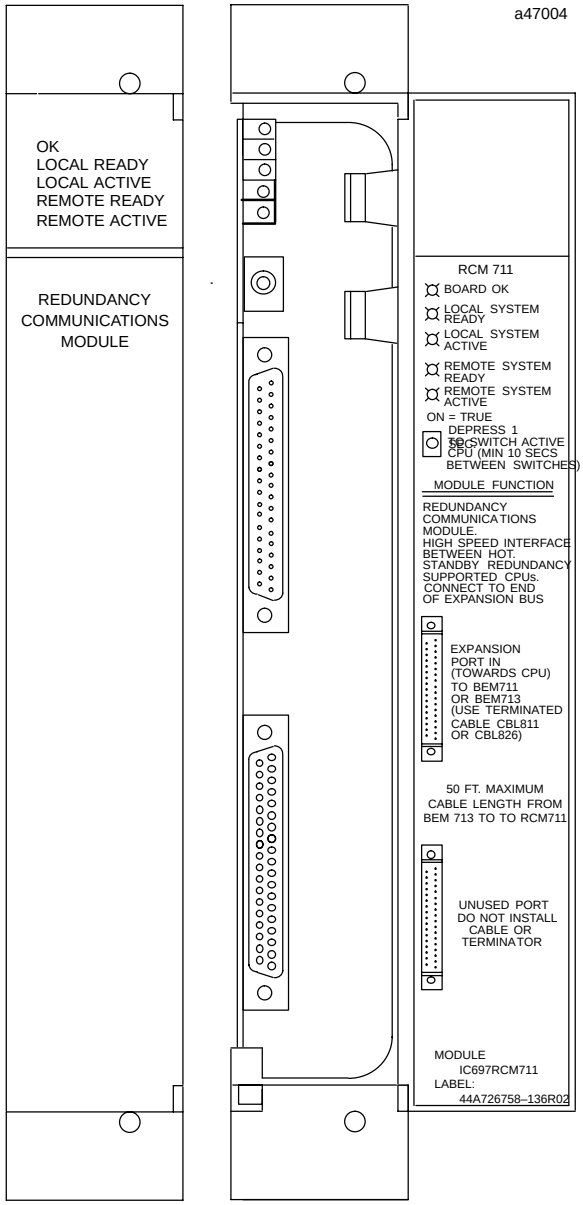


Figure 2-26. Redundancy Communications Module

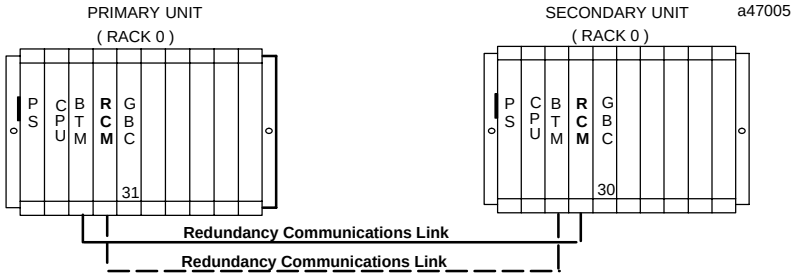


Figure 2-27. Example of RCM Location in a Hot Standby CPU Redundancy System

RCM System Status LEDS

A Hot Standby CPU Redundancy system has two RCM modules, each with five LEDs and a momentary pushbutton switch for manually switching between the active and the backup units. The LEDs will always be updated by the appropriate system. The RCM has two internal timers that will automatically turn off four of the LEDs (not the board OK LED) if the LEDs have not been updated within a specified time period. The two remote LEDs and the two local LEDs have separate timers since they are controlled from different systems.

The RCM has the following five LEDS:

- BOARD OK
- LOCAL SYSTEM READY
- LOCAL SYSTEM ACTIVE
- REMOTE SYSTEM READY
- REMOTE SYSTEM ACTIVE.

These LEDs report the status of the health of the RCM and the control status of the Hot Standby CPU Redundancy system. The status provided by these LEDs is also provided in an area of %S memory (%S33 - %S39) which is accessible from the user logic program but cannot be altered or overridden.

Note

The term *Local Unit,* when associated with a particular RCM, refers to that unit in which the RCM resides. *Remote Unit* refers to that unit in which the RCM is configured by the system for addressing as being in rack 7, slot 1. Each RCM will have an associated local and remote unit.

BOARD OK

The BOARD OK LED comes *ON* when the diagnostics are complete and the RCM has been determined to be operating normally. It will remain on unless the RCM fails.

LOCAL SYSTEM READY

The LOCAL SYSTEM READY LED indicates whether the local unit is ready to become the active unit in a redundant PLC configuration. If the LED is *ON*, the local unit has been configured for redundancy, is in RUN mode, and has performed sufficient

initialization, diagnostics, and hand-shaking to take control of the redundant system if it is selected as the active unit. It is the responsibility of the local unit to set the state of this LED at least once during each sweep; if the local unit is unable to set (or fails to set) the state of the LED, the hardware will force the LED to *OFF* after the timer has timed out.

LOCAL SYSTEM ACTIVE

The LOCAL SYSTEM ACTIVE LED indicates whether the local unit is the controlling (or active) unit in a redundancy system. It is the responsibility of the local unit to set the state of this LED at least once during each sweep; if the local unit is unable to set (or fails to set) the state of the LED, the hardware will force the LED to *OFF* after the timer has timed out.

REMOTE SYSTEM READY

The REMOTE SYSTEM READY LED indicates whether the remote unit is ready to become the active unit in a redundant PLC configuration. If the LED is *ON*, the remote unit has been configured for redundancy, is in RUN mode, and has performed sufficient initialization, diagnostics, and hand-shaking to take control of the redundant system if it is selected as the active unit. It is the responsibility of the remote unit to set the state of this LED at least once during each sweep; if the remote unit is unable to set (or fails to set) the state of the LED, the hardware will force the LED to *OFF* after the timer has timed out.

REMOTE SYSTEM ACTIVE

The REMOTE SYSTEM ACTIVE LED indicates whether the remote unit is the controlling (or active) unit in a redundancy scheme. It is the responsibility of the remote unit to set the state of this LED at least once during each sweep; if the remote unit is unable to set (or fails to set) the state of the LED, the hardware will force the LED to *OFF* after the timer has timed out.

Unit Selection Pushbutton

The module has a momentary pushbutton switch which, when depressed for 1 second and released, allows you to manually switch control from the *active* unit to the *backup* unit if the backup unit is *READY.* The status of each pushbutton is checked by the PLC CPU software. The switch between units can also be controlled through user logic implementation of a SVC_REQ function that is activated by user logic. After a switch has been requested, you must wait 10 seconds before requesting another switch.

RCM Connectors

The RCM has two connectors mounted on the front of the board. *The top connector is the only one used.* It is connected via an I/O cable with built-in termination to the last rack of the *other* PLC system. If no expansion rack is used, it is connected to the lower connector on the BTM of the other system. The I/O cable with built-in termination is available in two lengths:

- IC697CBL811, 10 feet (3 meters)
- IC697CBL826, 25 feet (7.5 meters)

Work Station Interface (WSI)

Note

The Work Station Interface (WSI) is not supported by the Control software.

The programmer can communicate with the Series 90-70 PLC through the Work Station Interface (WSI) board. Two versions of the WSI are available: IC640WMI910 is for use with a Workmaster computer, or an IBM compatible personal computer; IC647WMI920 is for use in a Workmaster II or an IBM PS/2 Personal Computer. Both of these WSI boards provide a combination serial/parallel interface to the Series 90 PLCs. The WSI board is available bundled with Logicmaster 90 Programming Software.

The WSI resides in a full-length slot of the computer that executes the programming software.

Note

Most personal computers use serial communications to interface with the Series 90-70 PLC CPU.

WSI Architecture

An 80188 microprocessor provides all operation control for the WSI. The hardware interface to the computer's bus is discrete logic and contains an 8K shared RAM. The parallel interface permits the WSI board to communicate with the CPU in the same manner as other intelligent Series 90-70 PLC option modules. The serial interface allows communications to the CPU through the serial port on the CPU. The WSI board has a ROM containing power-up diagnostics and software to load the operating software from the programmer.

The daughter board contains non-renewable fuses and terminations for the parallel cable bus.

WSI Status Indicator

The WSI board has one LED that can be seen only when the computer's cover is partially removed. This LED *blinks* during the power-up diagnostics. If a board failure is detected by the power-up diagnostics, the LED will turn *OFF* and remain off. Otherwise, it is *ON*. If this happens, the board should be replaced. A second LED, located on the daughter board, is *ON* during a communications session and for 500 ms after receiving a message from the CPU; otherwise it is *OFF*.

WSI Connectors

The WSI has one 37-pin connector which is used for both parallel and serial communications. The connection to the PLC is made from this connector, through a parallel I/O cable to the top connector on the BTM, or through a serial cable to the serial port connector on the CPU. An available parallel I/O cable (IC697CBL703) is 10 feet (3 meters) in length, and an available serial cable (IC697CBL704) is also 10 feet (3 meters) in length.

The following illustrations are examples of the connection from programmer to BTM for a parallel interface and programmer to CPU for a serial interface.

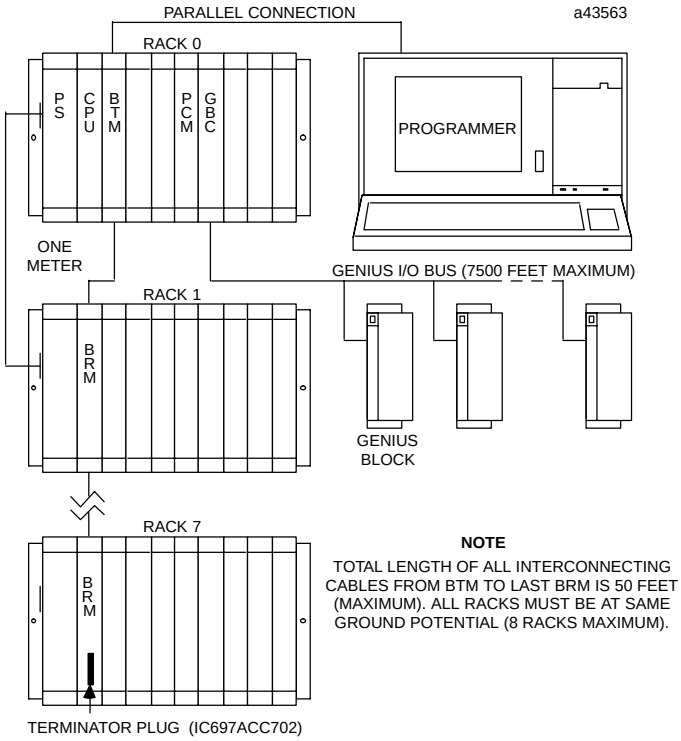


Figure 2-28. System Configuration - Parallel Interface to Programmer

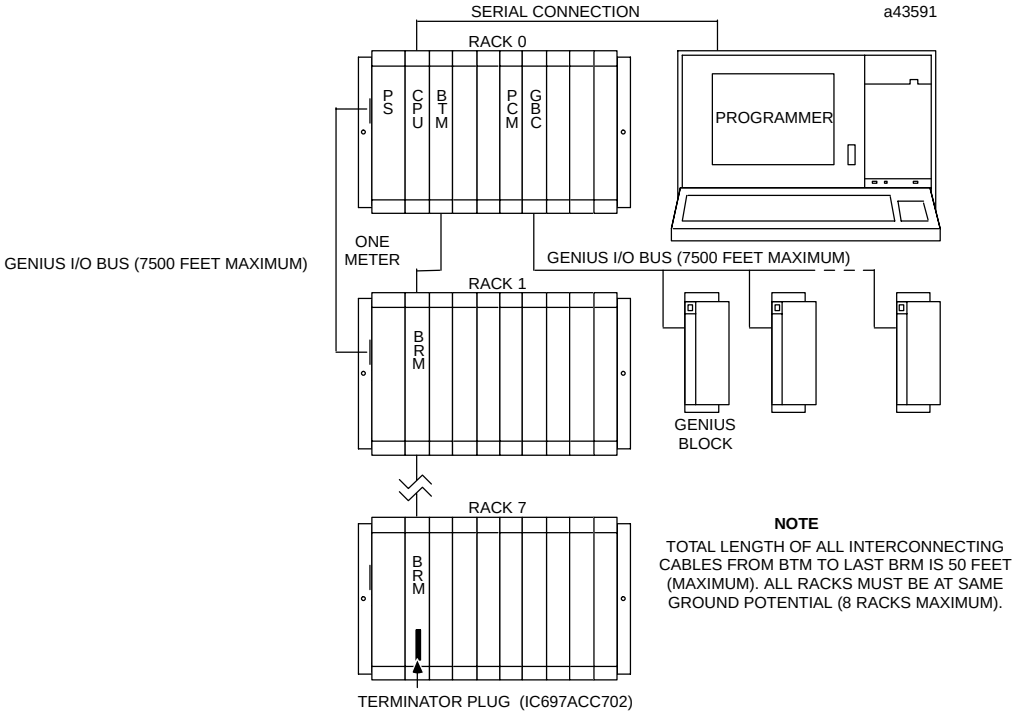


Figure 2-29. System Configuration - Serial Interface to Programmer

Programmable Coprocessor Module

The Programmable Coprocessor Module (PCM) is available in two versions, IC697PCM711 and IC697PCM712. The PCM is a general purpose microcomputer on a single board which enhances the functionality of the Series 90-70 PLC. IC697PCM712 is a standalone module. The primary application of PCM712 modules is in Series 90-70 expansion racks connected to standard VME Bus CPUs. For more information, see GFK-0819, the *Series 90-70 Standalone PCM Application Developer's Guide.*

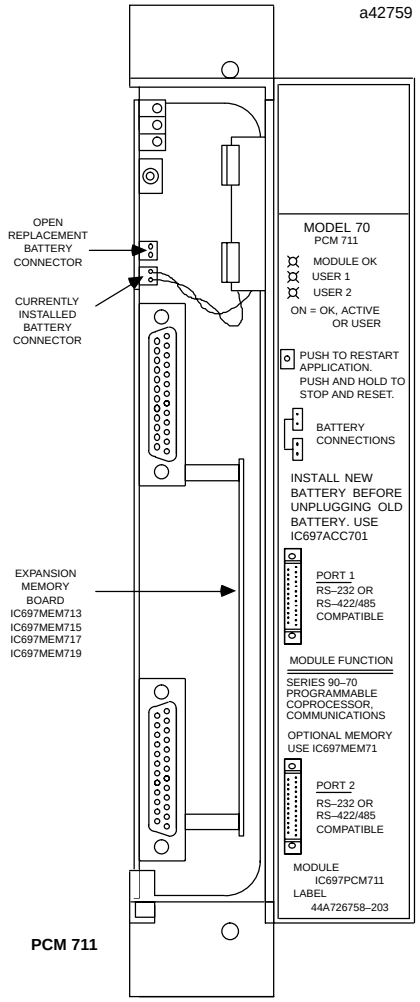


Figure 2-30. Programmable Coprocessor Module

The PCM has two serial ports, each with its own port connector, for interfacing to serial RS-232/485 devices. It supports the GE Fanuc CCM communications protocol, the MegaBasic programming language, and is programmed using a personal computer.

The PCM has 128K bytes of on-board CMOS battery-backed user memory which may be expanded up to 640K bytes by installing an available memory expansion board on the PCM. These are the same memory expansion boards available for use with the model 771/772 CPUs. Even with fully expanded memory, the PCM still requires only one slot in a rack. The mode of operation is selected via a combination of PCM software configuration and user wiring.

PCM Architecture

The PCM board contains an 80186 microprocessor as its main processing element, on-board memory, an interface to the system bus and the serial ports, and a watchdog timer. The 80186 microprocessor handles all processing and operation control on the board. The 72001 Advance Multi-Purpose Serial Controller controls the interface to the serial ports. The PCM has 128K bytes battery backed RAM Memory, and up to 512K bytes battery backed expansion RAM.

An application program is not required in the PLC CPU to use the PCM. The PCM can be installed in any I/O slot in any rack in the system.

Memory on the PCM consists of PROM, local RAM, and shared RAM. PROM memory contains the PCM operating system and CCM task code. Local RAM is divided into two data areas; one for use by the PCM, and the other for user data and programs. Shared RAM is used for communications between the PCM and the PLC.

Multi Tasking Capability

Since up to 63 PCMs can be supported by a single Series 90-70 PLC system, up to 63 separate 80186-based coprocessors can be assigned by the user to computing, filing, and communications tasks. This architecture frees the CPU for more critical real-time tasks. For example, as a file server, several PCMs (each with a file of up to 512K bytes) may divide the task of file lookup. In addition, the two serial ports on each of the PCMs could be used for other functions, such as a bar code reader interface, at the same time the PCM is performing a file server function. For example, the PCM can run two simultaneous CCM tasks, a MegaBasic task, and multiple C tasks.

PCM Status Indicators

Three LEDs, labeled MODULE OK, USER1, and USER2, are visible through the clear plastic lens at the top of the module. The top LED, MODULE OK, indicates the current status of the module. This LED is *ON* when the module has successfully completed its power-up diagnostics, configuration data for the module is good, and the module is functioning normally.

The LED is *OFF* when a module malfunction has been detected during the power-up diagnostics, or the module has failed during operation. A *blinking* LED indicates that the configuration data downloaded from the programmer to the PLC does not match current configuration data stored in the PCM module.

The function of the middle and bottom LEDs can be assigned by the user through programming. Typically, they are used to indicate activity on the serial ports, and can be defined to display any combination of the following serial port status indicators:

- Transmit on serial port 1
- Receive on serial port 1
- Transmit on serial port 2
- Receive on serial port 2
- Transmit on backplane
- Receive on backplane
- Application task defined

Restart/Reset Pushbutton

A Restart/Reset pushbutton is located below the USER2 LED. This pushbutton is used in conjunction with the PCM OK LED to reinitialize the PCM module, by initiating a hard or soft reset.

A *hard reset* is initiated if the pushbutton is depressed continuously for 5 seconds or more. The PCM will perform a reset operation and reinitialize to the factory default configuration. All user tasks and CCM tasks will be stopped.

A *soft reset* is initiated if the pushbutton is depressed for less than 5 seconds. The PCM will be reinitialized from the user's configuration data, any active I/O and timer requests will be cancelled, and a power cycle will attempt to restart the software in the user configuration mode.

PCM Serial Port Connectors

Two serial port connectors provide connections to the PCM's serial interfaces. Access to these connectors is provided by opening the hinged door on the module. These ports are identified as PORT 1 and PORT 2; both ports support RS-232 and RS-422/485 modes, which are configurable through user programming. Although either port can be used for most purposes, certain operations require that a specific port be used.

Port 1 can be used in higher performance applications since it supports Direct Memory Access (DMA) transfers. Port 1 is used for connecting the programming device with PCM Programming and Configuration software.

Three prewired cables are available to connect the PCM to the programming device: IC690CBL701 (PCM to Workmaster or PC-XT); IC690CBL702 (PCM to PC-AT); and, IC690CBL705 (PCM to Workmaster II or PS/2).

PCM Backup Battery Connectors

Two identical battery connectors are provided on the board for connection to the lithium backup battery for on-board and expansion board CMOS RAM memory. Two connectors are provided in case the battery requires replacement. The battery currently installed can remain connected until the new battery is connected to the unused connector. The connector wired to the lithium backup battery cable plugs into one of the connectors. The battery can be replaced with the rack powered-on.

PCM Option Connector

An option connector, located at the bottom of the PCM board, allows installation of additional user expansion memory. A memory expansion board may be added to the PCM board. These memory expansion boards are the same boards that can be installed on the Model 771 and 772 CPUs to increase the total on-board memory capacity. Four of these memory expansion boards are available: 64K, 128K, 256K, or 512K Bytes. The memory expansion board mounts on a single connector on the PCM.

For more information on the IC697PCM711 Programmable Coprocessor Model, see GFK-0255, the *Series 90 Programmable Coprocessor Module and Support Software User's Manual.*

Alphanumeric Display Coprocessor Module

The Alphanumeric Display Coprocessor (ADC) Module, IC697ADC701, is a coprocessor to the Series 90-70 PLC CPU and is used in a CIMPLICITY 90-ADS system. It is programmed to perform CIMPLICITY 90 display, report, and alarm functions through an Operator Interface Terminal, which can be a GE Fanuc OIT or Mini OIT, a Mini Touch OIT, a VT100 compatible terminal, a Nematron color or monochrome OptiTOUCH terminal, or a Workmaster II, or IBM-compatible personal computer running TERMF (a terminal emulation software package). The ADC communicates with the Series 90-70 CPU over the system backplane. Multiple ADC modules can be supported in a single Series 90-70 PLC system. They can be located in either the main rack or expansion racks, but cannot be used in a remote drop.

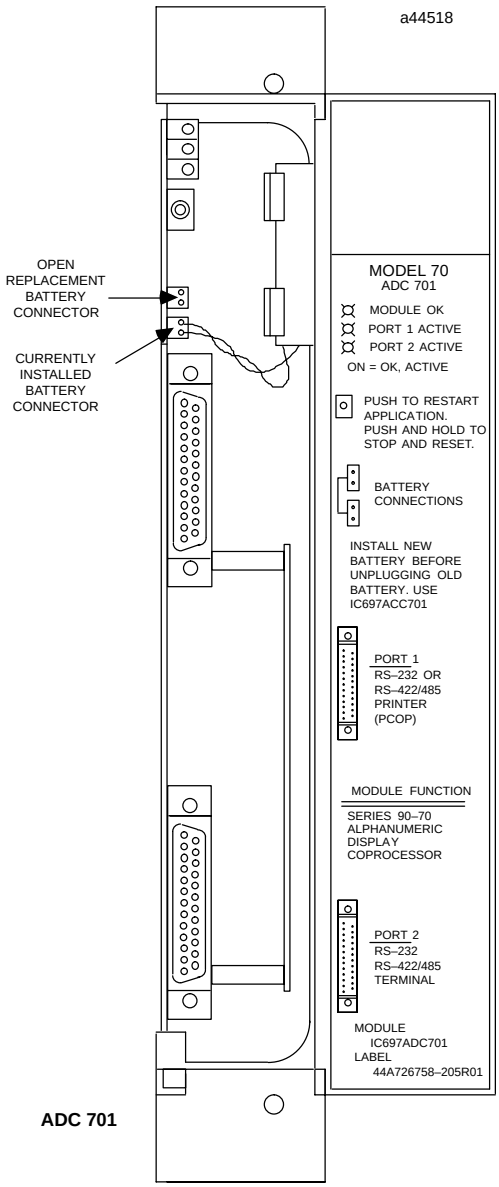


Figure 2-31. Alphanumeric Display Coprocessor Module

Programming and Configuration

A personal computer with PCM Development Software (PCOP) installed connects to the top port as shown below. The default setting is 19,200 bps. The PCM Development Software is used to configure the serial port parameters and to install the CIMPLICITY 90 software onto the ADC. Refer to the the *CIMPLICITY 90-ADS User's Manual*, GFK-0499, and *CIMPLICITY 90-ADS Reference Manual,* GFK-0641, for details of operation.

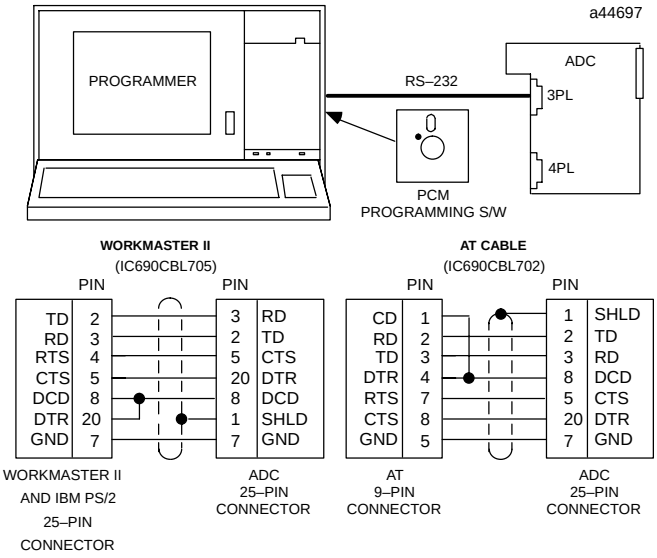


Figure 2-32. Example of PCM Development System Connection to ADC

Serial Ports

There are two serial ports available on the ADC module. Both ports are RS-232 and RS-422/RS-485 compatible and the use of each port is dedicated for ADC operation. Port 1 (labeled 3PL in the illustration) is normally connected to an RS-232 serial COM port of a host computer for communications to PCOP at 19.2 Kilobaud. Alternately, port 1 may be connected to a serial RS-232 printer (see the *CIMPLICITY 90-ADS User's Manual* to learn how to reconfigure Port 1).

Module Configuration

There are no user DIP switches or jumpers on this board for configuration. However, the CIMPLICITY 90 software must be loaded using PCM Development Software (refer to the *CIMPLICITY 90-ADS User's Manual* for details). The ADC must be configured with Logicmaster 90 or Control Configuration Software prior to use.

Status Indicators

Three Status LEDs are available on the module's faceplate. The top LED (MODULE OK) indicates the condition of the ADC module; the bottom two LEDs (PORT 1 ACTIVE and PORT 2 ACTIVE) indicate serial port activity.

Controls

One pushbutton is provided, which is accessed by opening the hinged door. Push and hold the pushbutton for less than 5 seconds to restart the CIMPLICITY 90 software. Push and hold the pushbutton for more than 5 seconds and the module factory default configuration will be installed. This action will not clear memory, but will permit communication with the programmer using factory default settings.

Memory Backup Battery

A lithium battery (IC697ACC701) is provided to maintain the contents of user memory when power is removed. If the battery must be replaced, the new battery must be installed in the unused battery connector before you remove and discard the old battery. If a low battery fault is detected during power-up diagnostics, the MODULE OK LED (top) will not stay on.

Carrierband MAP Interface Module

The Carrierband MAP Interface module, IC697CMM721, is a member of the GEnet Family of products, which provide high performance solutions for interconnecting automation controllers and for integrating them into multi-vendor networks. The Series 90-70 MAP Interface module provides direct connection for a Series 90-70 PLC to an IEEE 802.4 carrierband network.

The GEnet Factory LAN architecture is based on standards set forth in the Manufacturing Automation Protocol (MAP) specification. MAP is the single networking scheme that allows all the vendors involved in automating a factory to work on a common communications architecture. The LAN Interface module supports the MAP specification version 3.0. The MAP protocol software is loaded into RAM on the LAN Interface module. This allows easy upgrade to a new revision of software without modification to the hardware.

Module Features

The features of the GEnet Factory MAP Interface module are described briefly here. For a more complete description, see the appropriate section in GFK-0869, the *MAP 3.0 Communications for the Series 90-70 PLC User's Manual*.

The Carrierband MAP Interface is a single-slot module composed of a factory assembled digital controller and modem. The entire LAN Interface occupies only a single slot in the Series 90-70 PLC rack. The following figure illustrates the LAN Interface module as part of the network.

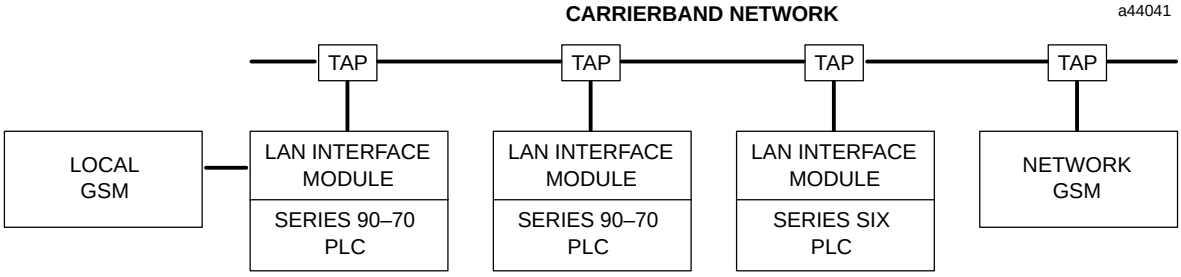
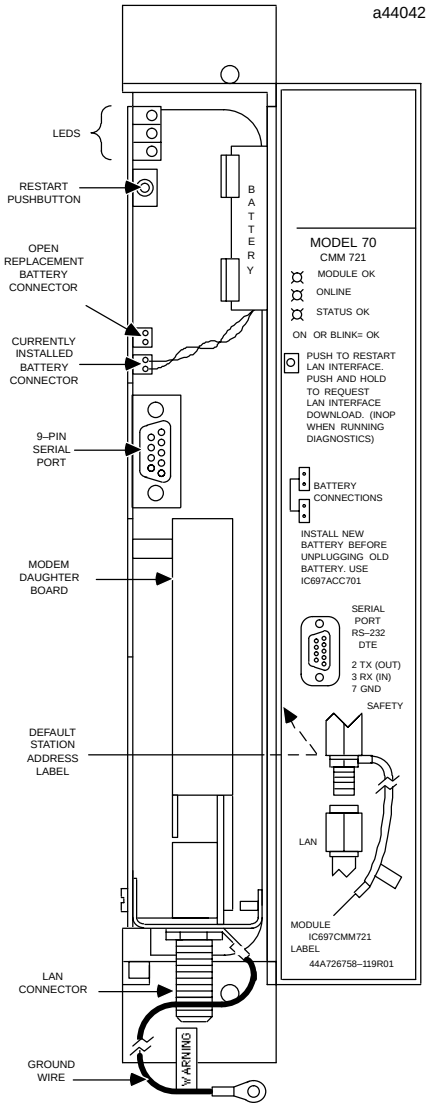


Figure 2-33. LAN Interface Module Connects the Series 90-70 PLC to a Carrierband Network

The LAN Interface connects the PLC directly to the carrierband network through the 5 Mbps modem daughter board on the module. Intermediate devices such as bridges or gateways are not required. The direct connection provides the high performance required for real-time control applications.

Communications software is downloaded to the LAN interface and stored in RAM. This makes it easy to upgrade the communications software simply by downloading it again rather than by physical replacement of ROM-chips. An on-board battery provides memory retention that prevents loss of the communication software due to power loss for at least six months.


a44042
LEDS
RESTART PUSHBUTTON
OPEN REPLACEMENT BATTERY CONNECTOR
CURRENTLY INSTALLED BATTERY CONNECTOR
9–PIN SERIAL PORT
MODEM DAUGHTER BOARD
DEFAULT STATION ADDRESS LABEL
LAN CONNECTOR
GROUND WIRE
BATTERY
WARNING
MODEL 70
CMM 721
MODULE OK
ONLINE
STATUS OK
ON OR BLINK= OK
PUSH TO RESTART LAN INTERFACE. PUSH AND HOLD TO REQUEST LAN INTERFACE DOWNLOAD. (INOP WHEN RUNNING DIAGNOSTICS)
BATTERY CONNECTIONS
INSTALL NEW BATTERY BEFORE UNPLUGGING OLD BATTERY. USE IC697ACC701
SERIAL PORT RS–232 DTE
2 TX (OUT)
3 RX (IN)
7 GND
SAFETY
LAN
MODULE IC697CMM721 LABEL
44A726758–119R01

communication software that is downloaded to the board using the GEnet System Manager (GSM). A GSM is a separate computer running GSM software that is available from GE Fanuc Automation.

Module Status Indicators

The LAN Interface Module indicators consist of three LEDs, which are described in the following table:

Table 2-16. LAN Interface Module LED Indicators

Indicator	Status	Description
MODULE OK	ON	This LED is ON if the LAN Interface hardware has passed diagnostics and is operating properly.
	OFF	It is OFF if the module fails a diagnostics test or if a failure is detected while the board is running.
	BLINKING	This LED is blinking if the module is running diagnostics or in Soft Switch Entry state.
ONLINE	ON	This LED is ON when the LAN Interface is periodically receiving the right to transmit on the network.
	OFF	This LED is OFF when: - no other stations are connected and communicating on the network, - the network is not communicating due to a disruption of the cable, - the local station has malfunctioned, or, - the LAN Interface has been instructed not to enter the network.
	BLINKING	It is BLINKING when the module is transferring data on the network or loading over the network.
STATUS OK	ON	This LED is ON if the module is running without exception conditions.
	OFF	This LED is OFF if the module is running and detects an event that calls for supervisory attention. In this case, the user should connect the GSM and follow instructions in GFK-0869, to obtain further information.
	BLINKING	This LED is BLINKING if the module is loading or looking for a load source for the LAN Interface software.

Restart Button

The Restart Button serves two functions: Restart, and Reload and Restart. The Restart button is inaccessible when the hinged door to the LAN Interface module is closed.

Restart: Pressing the Restart button forces a restart of the LAN Interface module. When the button is pressed, all LEDs go out. When the button is released, power-up diagnostics are run and the software on the module is restarted.

Restart and Reload: Pressing and holding the Restart button until the STATUS OK LED comes ON forces a restart and reload of the LAN Interface module. When the button is pressed, all LEDs go OUT. After 3-4 seconds, the STATUS OK LED will turn ON, acknowledging the load request. When the button is released, power-up diagnostics run and the LAN Interface requests a download from the GSM.

Note

In either case, any data being transferred by the LAN Interface at the time of the Restart will be lost.

The Restart/Load pushbutton is not operable during the LAN Interface diagnostic phase. The LAN Interface is in diagnostic phase when the BOARD OK LED is BLINKING and the ONLINE and STATUS OK LEDs are OFF.

Battery

The battery/battery holder is located to the right of the LEDs. The battery connectors are located on the controller board between the Restart button and the 9-pin connector to the serial port.

Serial Port

A 9-pin serial port (RS-232C interface) on the LAN Interface module is used to connect the LAN Interface with the local GSM. The communication software may be loaded to the module through this port. The LAN Interface module is a Data Terminal Equipment (DTE) device.

A cable is needed to connect the GSM to the LAN Interface. The following figure shows how to construct this cable.

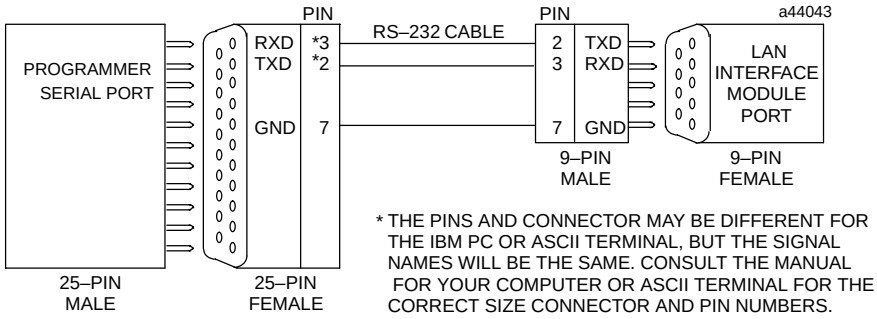
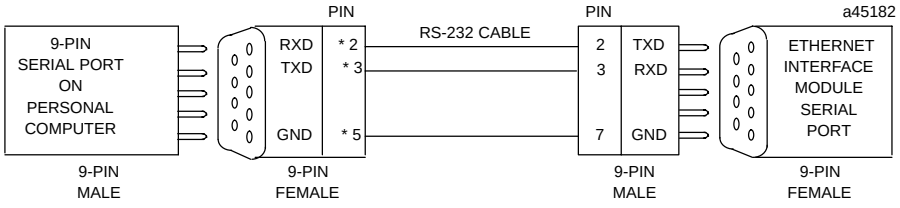


Figure 2-35. Serial Cable to Connect the GSM (25-Pin Connector) to the LAN Interface



* THE PINS AND CONNECTOR MAY BE DIFFERENT FOR SOME COMPUTERS OR TERMINALS, BUT THE SIGNAL NAMES WILL BE THE SAME. CONSULT THE MANUAL FOR YOUR COMPUTER OR ASCII TERMINAL FOR THE CORRECT SIZE AND PIN NUMBERS.

Figure 2-36. Serial Cable to Connect GSM (9–Pin Connector) to Ethernet Interface

Station Address Label

The default station (MAC) address label lists the station address to be used by this module, unless a locally assigned address is set by the user.

LAN Connector

The LAN Interface module is connected to the network through the coaxial LAN connector. The LAN connector, for attaching the drop cable of the LAN cable plant, is mounted and positioned downward on the lower front edge of the LAN Interface module.

Caution

The LAN connector and LAN Interface module may be damaged if components other than the recommended cable plant components are used. Such damage is not covered by the LAN Interface module equipment warranty. Refer to GFK-0014 (*GEnet Factory LAN Carrier Band Cable Plant Design and Installation Manual*) or contact your local GE Fanuc Automation sales office for further information.

Safety Ground Wire

The safety ground wire grounds the modem and coaxial cable shield to the chassis of the Series 90-70 PLC rack.

Warning

The ground wire must be securely fastened to the chassis of the Series 90-70 PLC rack and the rack must be properly grounded. Failure to do so may cause personal injury or improper operation of the equipment.

Ethernet Controller

The Series 90-70 Ethernet Controller, IC697CMM741, is a member of the GEnet family of products. The Ethernet Controller plugs into a single slot in a Series 90-70 PLC rack, providing an 802.3-standard 15-pin D-connector for attachment of a user-supplied AUI (or transceiver) cable. The AUI cable connects to a user-supplied transceiver that is directly connected to the Ethernet trunk cable. The transceiver must be 802.3 compatible and must have the SQE option enabled. Transceivers are available to operate on a variety of media including thickwire coaxial cable (10Base5) and ThinWire™ coaxial cable (10Base2).

The Ethernet Controller is designed so the communications protocols which operate above the Ethernet data link layer are implemented in software. This allows you to choose one of two alternative communication protocols by downloading the Ethernet LAN Interface with the applicable communications software. The communications protocols are:

- **TCP/IP-Ethernet Communications Software** - Communicate with host computers and/or Programmer using proprietary SRTP over a 4-layer TCP/IP (Internet) protocol stack; requires either a Local or Network Factory LAN System Manager (GSM) for configuration and downloading of Ethernet Controller software. For detailed information on TCP/IP Ethernet communications, refer to GFK-1004, *TCP/IP Ethernet Communications for the Series 90-70 PLC User's Manual*

- **MMS-Ethernet Communications Software** - Communicate with host computers and/or Programmer using MMS (Manufacturing Message Specification - ISO 9506) on a 7-layer OSI protocol stack; requires GSM for configuration and downloading of Ethernet Controller software. For detailed information on MMS-Ethernet communications, refer to GFK-0868, the *MMS-Ethernet Communications for the Series 90-70 PLC User's Manual.*

Note

A third option, SRTP Communications Software, supports only communications with Programmer using SRTP over a 4-layer OSI protocol stack; this Ethernet Controller software does not require configuration and can be downloaded directly from the programmer.

The Ethernet Controller provides basic functions in firmware or ROM. This firmware includes self-test diagnostics and special software that allows you to configure and test your interface in the PLC and on the Ethernet LAN. It also allows you to load the communications software into RAM either from the GSM (serially or over the network), or from an IC641 OSI-Ethernet Programmerstation.

The communications software is stored in RAM so you can upgrade communications software without replacing ROM chips. The battery maintains the contents of RAM in case of power outages. The following figure shows the relationship between the MMS-Ethernet Controller and the Local and Remote GSMs.

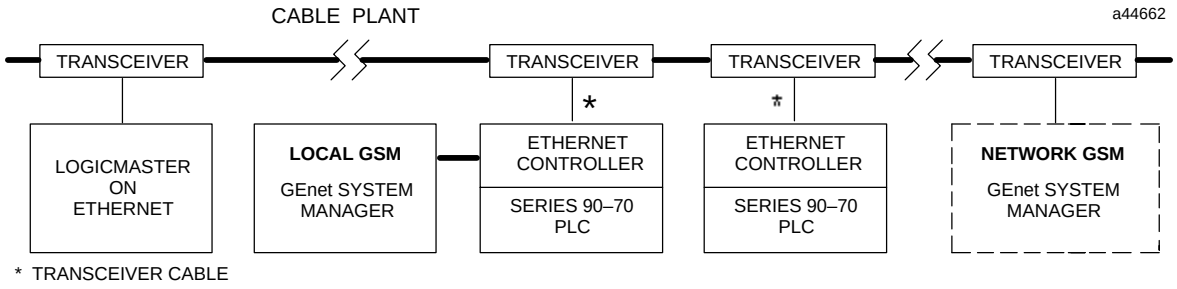


Figure 2-37. Ethernet Controller Connects the Series 90-70 PLC to an 802.3 LAN

Features of the Ethernet Controller

The MMS-Ethernet Controller can be plugged directly into the Series 90-70 CPU rack. It is a single-slot module that is connected via a user-provided transceiver cable to an external transceiver. The transceiver is attached directly to the IEEE 802.3 network cable. The Ethernet Controller operates at 10 Mbps on the Ethernet LAN.

The selected communications software is downloaded to the Ethernet Controller and stored in RAM. This makes it easy to upgrade the communications software by downloading it again rather than by replacing the ROM-chips. An on-board battery provides memory retention that protects against loss of the communication software due to power loss for a minimum of six months.

The Ethernet Controller provides a host of built-in maintenance and diagnostic features. The three diagnostic LEDs indicate operating conditions which may require maintenance action, such as: module, the network, and module states. A Default Station Address permits you to request and accept a download of software from a centralized management station elsewhere on the LAN. *Soft Switches* are used to adapt the Ethernet Controller to your needs without jumpers or switches on the board; this simplifies module replacement.

Note

For a more complete description, see the appropriate section in GFK-0868, the *MMS-Ethernet Communications for the Series 90-70 PLC User's Manual* or GFK-1004, *TCP/IP Ethernet Communications for the Series 90-70 PLC User's Manual.*

IEEE 802.3 Media

The Ethernet Controller can be used on any of the following media by an appropriate (user-supplied) transceiver cable and transceiver. IEEE 802.3 specifies the definitive requirements of each of these media.

10Base5 Coax: The thickwire Ethernet (10Base5) uses a 0.4 inch diameter 50-ohm coaxial cable. The maximum length of a cable segment (single span of cable) is 500 meters. The distance between any two stations must be a multiple of 2.5 meters. A maximum of 100 stations is allowed on a thickwire Ethernet segment. A segment can be connected to longer network lengths using repeaters. A terminator has to be attached to each end of a trunk cable segment.

10Base2 Coax: The ThinWire Ethernet (10Base2) uses a less expensive 0.2 inch diameter 50-ohm coaxial cable. The maximum length of a thinwire cable segment is 185 meters. A maximum of 30 stations is allowed on a thinwire Ethernet segment.

10BaseT: 10Base-T Ethernet uses two twisted pairs of up to 100 meters in length between each node and a hub or repeater. Typical hubs or repeaters support 6 to 12 nodes connected in a star wiring topology.

10BaseF: 10BaseF has two variations that both use the same type of fiberoptic cable: 10BaseFP can support up to 33 nodes at distances of up to 500 meters from a passive star; 10BaseFL supports up to 2000 meters between a node and a repeater (a multi-port repeater would thus constitute a star). Additionally, 10BaseFB provides a means of interconnecting (only) repeaters by up to 2000 meters of (the same) fiberoptic cable.

Note

Various Ethernet baseband media can be interconnected by appropriate repeaters. Capabilities and limitations are defined in IEEE 802.3 Chapter 13, *System Considerations for Multi-Segment Networks*.

10Broad36: 10Broad36 uses 75-ohm coaxial cable and CATV-like media components (taps, amplifiers, headend translators, etc.) to support hundreds of nodes at distances of up to 2800 meters. Broadband cannot be connected to baseband via repeaters. Broadband cable plant design and installation must be in accordance with IEEE 802.7 and requires special expertise. GE Fanuc recommends that you contract professional specialists for these services. Consult your local authorized GE Fanuc distributor, GE Fanuc sales representative or field service office for help in identifying local specialists.

Module Physical Description

The Ethernet Controller is a single-slot module. The module plugs directly into the Series 90-70 PLC CPU rack (if plugged into an expansion rack, the unit will run much slower), and is connected using transceiver cable to an external transceiver. The external transceiver is directly connected to the network cable. The Ethernet Controller is a special-purposemicrocontroller. It contains RAM storage for LAN communication software that is downloaded to the board using the GEnet System Manager (GSM). A GSM is optional software residing on a separate computer; this software is available from GE Fanuc Automation.

The following figure shows the physical layout of the Ethernet Controller followed by a description of user features.

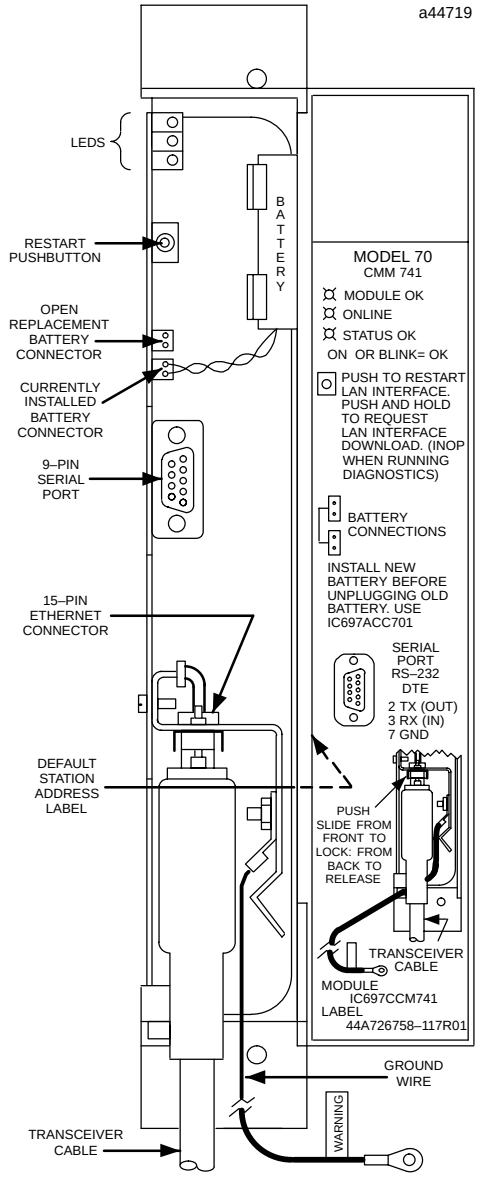


Figure 2-38. Ethernet LAN Interface Module CMM 741

User Items

The Ethernet Controller has the following user-accessibleelements:

- Three LEDs: located at the top of the board and are visible through a window in the front door.
- Default Station (MAC) Address Label: affixed on the outside of the plastic housing. This address is used for network communications, unless overridden by the user.
- Restart Pushbutton: located immediately below the LEDs.

- Battery and Battery Holder: located to the right of LEDs (between Restart button and serial port).
- Local Serial Port: 9-pin female connector for RS-232 Interface.
- Transceiver/AUI port: 15-pin connector with side-lock located beneath the local serial port.

Module Status Indicators

Table 2-17. Ethernet Controller Module Indicators

Indicator	Status	Description
MODULE OK	ON	This LED is ON if the Ethernet Controller hardware has passed diagnostics and is operating properly.
	OFF	It is OFF if the module fails a diagnostics test or if a failure is detected while the board is running.
	BLINKING	This LED is blinking if the module is running diagnostics or in Soft Switch Entry state.
ONLINE	ON	The ONLINE LED is ON when the Ethernet Controller is periodically receiving the right to transmit on the network.
	OFF	This LED is OFF when: - no other stations are connected and communicating on the network - the network is not communicating due to a disruption of the cable - the local station has malfunctioned or - the Controller has been instructed not to enter the network.
	BLINKING	It is BLINKING when the module is transferring data on the network or loading over the network.
STATUS OK	ON	This LED is ON if the module is running without exception conditions.
	OFF	This LED is OFF if the module is running and detects an event that calls for supervisory attention. In this case, the user should connect the GSM and follow instructions in GFK-0868, to obtain further information.
	BLINKING	This LED is BLINKING if the module is loading or looking for a load source for the LAN Interface software.

Restart Button

The Restart button serves two functions: Restart, and Restart and Reload. The Restart button is inaccessible when the door to the MMS-Ethernet Controller is closed.

Restart: Pressing the Restart button (for less than 5 seconds) forces a restart of the Ethernet Controller. The power-up diagnostics run and the software on the module is restarted.

Restart and Reload: Pressing and holding the Restart button for 5 seconds or more requests a restart and reload of the Ethernet Controller. When the Restart button is pressed, all LEDs go out. After 5 seconds have elapsed, the STATUS OK LED will come ON to indicate that the Ethernet Controller will request a reload. Upon release, the power-up diagnostics run and the Ethernet Controller requests a reload.

Note

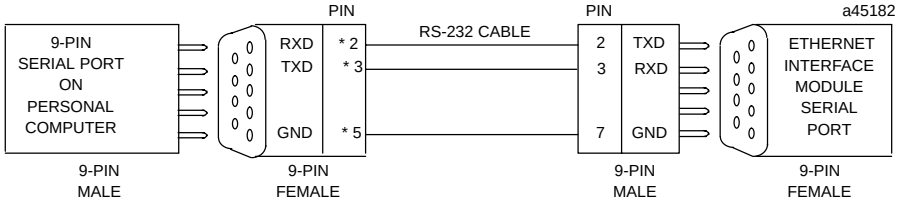
Any data being transferred by the Ethernet Controller at the time of the Restart or Restart and Reload will be lost. The Restart Pushbutton is not operable during the board's diagnostic phase. The Ethernet Controller is in diagnostic phase when the BOARD OK LED is BLINKING and the ONLINE and STATUS OK LEDs are OFF.

Battery

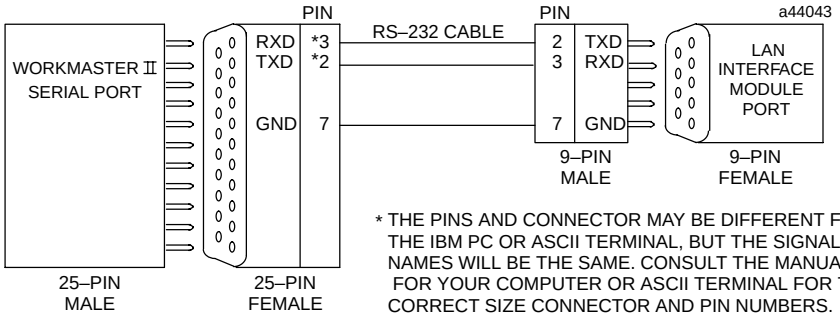
The battery and battery holder are located to the right of the LEDs. The battery connectors are located on the board between the Restart button and the 9-pin connector to the serial port. When connected, the battery maintains the contents of RAM if there is no power to the board. The battery will maintain RAM contents for a minimum of six months.

Local Serial Port

The 9-pin serial port (RS-232 interface) is used to connect to the local version of the GEnet System Manager (GSM). The communication software may be loaded through this port. The Ethernet Controller module is a Data Terminal Equipment (DTE) device. A cable, as shown below, is needed to connect the GSM to the MMS-Ethernet Controller.



* THE PINS AND CONNECTOR MAY BE DIFFERENT FOR SOME COMPUTERS OR TERMINALS, BUT THE SIGNAL NAMES WILL BE THE SAME. CONSULT THE MANUAL FOR YOUR COMPUTER OR ASCII TERMINAL FOR THE CORRECT SIZE AND PIN NUMBERS.



* THE PINS AND CONNECTOR MAY BE DIFFERENT FOR THE IBM PC OR ASCII TERMINAL, BUT THE SIGNAL NAMES WILL BE THE SAME. CONSULT THE MANUAL FOR YOUR COMPUTER OR ASCII TERMINAL FOR THE CORRECT SIZE CONNECTOR AND PIN NUMBERS.

Figure 2-39. Cables to Connect the GSM to the Ethernet Interface (Top=9 Pin to 9 Pin; Bottom=9 Pin to 25 Pin)

Transceiver Port

The 15-pin transceiver port is located on the front bottom edge of the board. This port connects the Ethernet Controller to the Ethernet network.

Caution

PLC power must be OFF when connecting or disconnecting the transceiver.

Station Address Label

The Default Station (MAC) Address label lists the station address to be used by this module, unless a locally assigned address is set by the user with *Soft Switches*. This label is found on the right-hand side, outside of the module's plastic housing.

Ethernet Interface (Type 2) Module

The IC697CMM742 Ethernet Interface (Type 2) provides high performance TCP/IP communications for the Series 90-70 PLC.

The Ethernet Interface (Type 2) plugs into a single slot in a Series 90-70 PLC rack and is configured with the IC641 PLC programming software. Up to four Ethernet Interface (Type 2) modules can be installed in a Series 90-70 PLC CPU rack.

The Ethernet Interface (Type 2) contains three network ports: 10BaseT (RJ-45 connector), 10Base2 (BNC connector), and AUI (15-pin D-connector). The Ethernet Interface automatically selects the network port in use. One network port may be used at a time.

- The 10BaseT network port permits direct connection to a 10BaseT (twisted pair) network hub or repeater without an external transceiver.
- The 10Base2 network port permits direct connection to a 10Base2 (ThinWire™) network without an external transceiver.
- The AUI network port permits attachment of a user-supplied AUI (Attachment Unit Interface, or transceiver) cable.

The AUI cable connects the Ethernet Interface to a user-supplied transceiver that is directly connected to the 10Mbps Ethernet network. The transceiver must be 802.3 compatible and must have the SQE option enabled.

Transceivers are commercially available to operate on a variety of 10Mbps media including 0.4 inch diameter coaxial cable (10Base5), ThinWire coaxial cable (10Base2), twisted pair (10BaseT), fiberoptic (10BaseF), and broadband cable (10Broad36).

The Ethernet Interface (Type 2) provides TCP/IP communications with other Series 90-70 and Series 90-30 PLCs, host computers running the Host Communications Toolkit or CIMPLICITY software, and computers running the TCP/IP version of the MS-DOS or Windows-based programming software. These communications use the proprietary SRTP and Ethernet Global Data protocols over a 4-layer TCP/IP (Internet) stack.

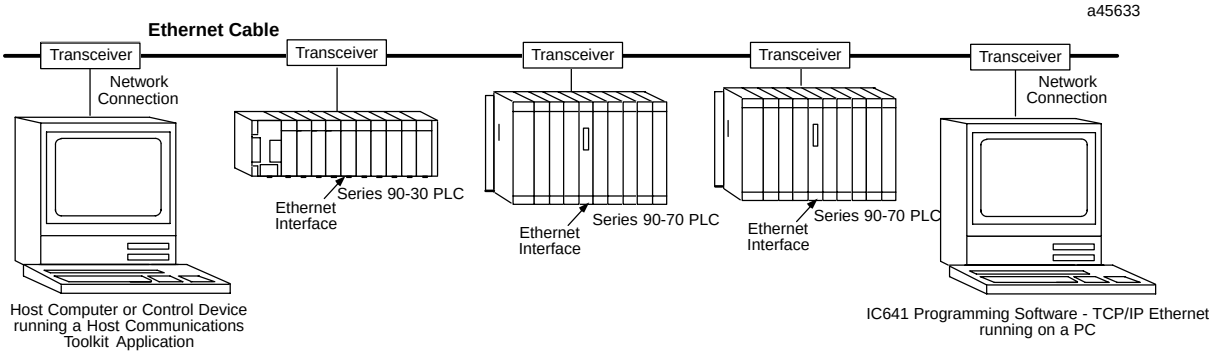


Figure 2-40. Ethernet Interface Connects the Series 90-70 PLC to an 802.3 LAN

™ ThinWire is a trademark of Digital Equipment Corporation.

Features of the Ethernet Interface (Type 2)

The Ethernet Interface (Type 2) provides the following features:

- Connects Series 90-70 PLC to an IEEE 802.3 CSMA/CD 10Mbps Ethernet LAN via one of three network ports: 10BaseT, 10Base2, or AUI.
- 10BaseT and 10Base2 network ports provide direct connection to 10BaseT or 10Base2 network without an external transceiver.
- Standard 15-pin AUI network port allows choice of 10Base5, 10Base2, 10BaseT, 10BaseF, or 10Broad36 medium with user-supplied 802.3-compatible transceiver.
- Firmware is pre-loaded for easy installation and is maintained indefinitely; firmware is easily upgraded in-system from the PC attached to the RS-485 serial port.
- The Ethernet Interface provides:
  - □ Data exchange using Ethernet Global Data (EGD)
  - □ TCP/IP communication services using SRTP
  - □ Full PLC programming and configuration services
  - □ Comprehensive station management and diagnostic tools

Note

For a more complete description, see the appropriate section in GFK-0868, the *MMS-Ethernet Communications for the Series 90-70 PLC User's Manual* or GFK-1541, *TCP/IP Ethernet Communications for the Series 90 PLC User's Manual.*

IEEE 802.3 Media

The Ethernet Interface (Type 2) can operate directly on 10BaseT or 10Base 2 media via its 10BaseT and 10Base2 Network ports. These media are described below. Additionally, the Ethernet Interface (Type 2) can operate on any of the following media with the appropriate (user-supplied) transceiver cable and transceiver via its AUI network port.

10Base5 Coax: The thickwire Ethernet (10Base5) uses a 0.4 inch diameter 50-ohm coaxial cable. The maximum length of a cable segment (single span of cable) is 500 meters. The distance between any two stations must be a multiple of 2.5 meters. A maximum of 100 stations is allowed on a thickwire Ethernet segment. A segment can be connected to longer network lengths using repeaters. A terminator has to be attached to each end of a trunk cable segment.

10Base2 Coax: The ThinWire Ethernet (10Base2) uses a less expensive 0.2 inch diameter 50-ohm coaxial cable. The maximum length of a thinwire cable segment is 185 meters. A maximum of 30 stations is allowed on a thinwire Ethernet segment.

10BaseT: 10Base-T Ethernet uses a twisted pair cable of up to 100 meters in length between each node and a hub or repeater. Typical hubs or repeaters support 6 to 12 nodes connected in a star wiring topology.

10BaseF: 10BaseF has two variations that both use the same type of fiberoptic cable: 10BaseFP can support up to 33 nodes at distances of up to 500 meters from a passive star; 10BaseFL supports up to 2000 meters between a node and a repeater (a multi-port

repeater would thus constitute a star). Additionally, 10BaseFB provides a means of interconnecting (only) repeaters by up to 2000 meters of (the same) fiberoptic cable.

Note

Various Ethernet baseband media can be interconnected by appropriate repeaters. Capabilities and limitations are defined in IEEE 802.3 Chapter 13, *System Considerations for Multi-Segment Networks*.

10Broad36: 10Broad36 uses 75-ohm coaxial cable and CATV-like media components (taps, amplifiers, headend translators, etc.) to support hundreds of nodes at distances of up to 2800 meters. Broadband cannot be connected to baseband via repeaters. Broadband cable plant design and installation must be in accordance with IEEE 802.7 and requires special expertise. GE Fanuc recommends that you contract professional specialists for these services. Consult your local authorized GE Fanuc distributor, GE Fanuc sales representative or field service office for help in identifying local specialists.

Module Physical Description

The Ethernet Interface (Type 2) is a single-slot module that plugs directly into the Series 90-70 PLC CPU rack.

The Ethernet Interface (Type 2) has the following user-accessibleelements:

- Four LEDs: located at the top of the board and visible through a window in the front door.
- Default Station (MAC) Address Label: affixed on the inside edge of the module faceplate. This address is used for network communications, unless overridden by the user.
- Restart Button: located immediately below the LEDs.
- Station Mgr Serial Port: RS-232 Interface.
- Software Load Serial Port: RS-485 Interface.
- Service Option Connector.
- 10BaseT Network Port.
- 10Base2 Network Port.
- AUI Network Port.
- Replaceable +12 VDC Fuse (FU#).
- Onboard 10Base2 Transceiver Power Disable Jumper (JP7 - normally not disabled).

The following figure shows the Ethernet Interface (Type 2) and its user features.

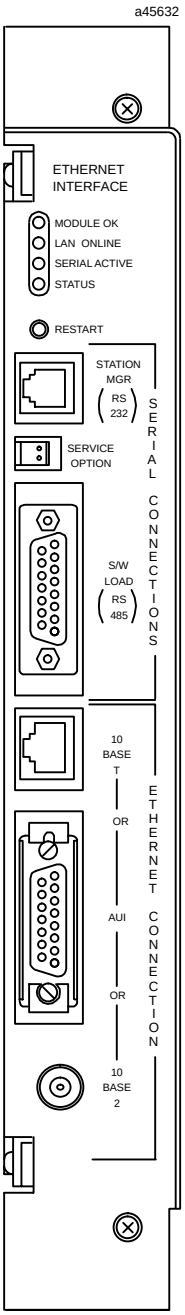


Figure 2-41. Ethernet Interface (Type 2) Module CMM 742

Module Status Indicators

Table 2-18. Ethernet Interface (Type 2) Module Indicators

Indicator	Status	Description
MODULE OK	ON	This LED is ON if the LAN Interface hardware has passed diagnostics and is operating properly.
	OFF	This LED is OFF if the module fails a diagnostics test or if a failure is detected while the board is running during board operation.
	BLINKING	This LED is blinking if the module is running diagnostics or to indicate special operating conditions.*
LANONLINE	ON	This LED is ON when the LAN Interface is connected to the network and is ready to communicate.
	OFF	This LED is OFF when: - the Ethernet Interface is not communicating in the network due to disconnection or a a disruption of the cable. - the Ethernet Interface has malfunctioned. - the Ethernet Interface has been instructed not to enter the network.
	BLINKING	This LED is BLINKING when the module is transferring data on the network or to indicate special operating conditions.*
SERIAL ACTIVE	OFF	This LED is OFF during inactivity at the RS-485 serial port.
	BLINKING	This LED is BLINKING during data transfer at the RS-485 serial port, or to indicate special operating conditions.*
STATUS OK	ON	This LED is ON if the module is running without exception conditions.
	OFF	This LED is OFF if the module is running and detects an event that calls for supervisory attention. In this case, the user should refer to the PLC Fault Table for further information, as described in the "Trouble-shooting" chapter of the User's manual.
	BLINKING	This LED is BLINKING during special operating conditions.*

* Special operating conditions are indicated by multiple LEDs blinking in unison:

- During the *Software Load* state, all LEDs blink in unison.
- During the *Waiting for IP Address* state, the MODULE OK and STATUS LEDs blink in unison.
- During the *Maintenance* state, the MODULE OK and SERIAL ACTIVE LEDs blink in unison.

Restart Button

The Restart button serves four functions: *LED Test*, *Restart*, *Restart and Reload*, and *Restart and Enter Maintenance State*. The Restart button is recessed behind the module faceplate to prevent accidental activation. To activate the Restart button, it must be depressed with a pointed instrument.

LED Test: Whenever the Restart is released, all LEDs flash ON and then OFF to permit visual verification that the LEDs are functional. The Ethernet Interface then restarts into the appropriate state, depending on the duration that the Restart was pressed.

Restart and Reload: Pressing and holding the Restart button for between 5 and 10 seconds restarts the Ethernet Interface into the Software Load state. All LEDs go out when the Restart button is pressed. After 5 seconds have elapsed, the STATUS LED will turn ON to indicate that the Interface will request a reload. When the Restart button is released, the Interface enters the Software Load state and waits to be loaded.

Restart and Enter Maintenance State: Pressing and holding the Restart button for 10 seconds restarts the Ethernet Interface into the Maintenance state. All LEDs go out when the Restart button is pressed. After 5 seconds have elapsed, the STATUS LED will turn ON, then after 10 seconds have elapsed, the SERIAL ACTIVE and STATUS LEDs will both turn ON to indicate that the Interface will enter the Maintenance state.

Note

Any data being transferred by the Ethernet Interface at the time of the Restart will be lost.

The Restart Button is not operable during the diagnostic phase of power-up. The Ethernet Interface is in the diagnostic phase when the MODULE OK LED is BLINKING and the other LEDs are OFF.

Service Option Connector

If a problem occurs with the Ethernet Interface that requires removal from the PLC rack, the onboard exception log will be preserved for 2 to 3 days. The Service Option connector allows you to attach a 3 volt lithium battery (IC697ACC701) to save the log event for longer periods.

Station Mgr (RS-232) Serial Port

The 6-pin RJ-11 phone jack RS-232 serial port is used to connect a terminal or terminal emulator to access the Station Manager software on the Ethernet Interface.

Software Load (RS-485) Serial Port

The 15-pin D-type RS-485 port is used to connect a PC running the PC Software Loader software to the Ethernet Interface in order to update the firmware in the Ethernet Interface. Miniconverter Kit IC690ACC901 contains an RS-232/RS-485 converter to use with this port, see Appendix F for more information.

10BaseT Network Port

The 8-pin RJ-45 phone jack 10BaseT network port is used to connect a twisted-pair cable from a 10BaseT hub or repeater directly to the Ethernet Interface without an external transceiver.

AUI Port

The 15-pin AUI network port connects the transceiver cable to the Ethernet Interface. The external 802.3 transceiver connects to the Ethernet network.

Caution

PLC power must be OFF when connecting or disconnecting the transceiver.

Note

Transceivers must be 802.3-compatible and must have the SQE option Enabled.

Replaceable +12 VDC Fuse

A replaceable fuse is available on the +12 VDC power that is supplied by this module to the AUI port to power external transceivers.

Communications Coprocessor Module

The Communications Coprocessor Module (CMM), IC697CMM711, is a member of the Series 90 PLC family of communication modules, and provides communications using the Series 90 (SNP), Communications Control (CCM) and Remote Terminal (RTU) protocols. SNP, CCM and RTU are available on either or both serial ports in any of nine possible configurations: CCM/CCM, CCM/RTU, RTU/CCM, RTU/RTU, SNP/CCM, SNP/RTU, CCM/SNP, RTU/SNP and SNP/SNP.

The CMM module provides both the RS-232 and RS-485 electrical Interfaces and communicates with the PLC CPU over the VME backplane. Many CMMs can be placed in a single Series 90-70 PLC system as shown in the following figure.

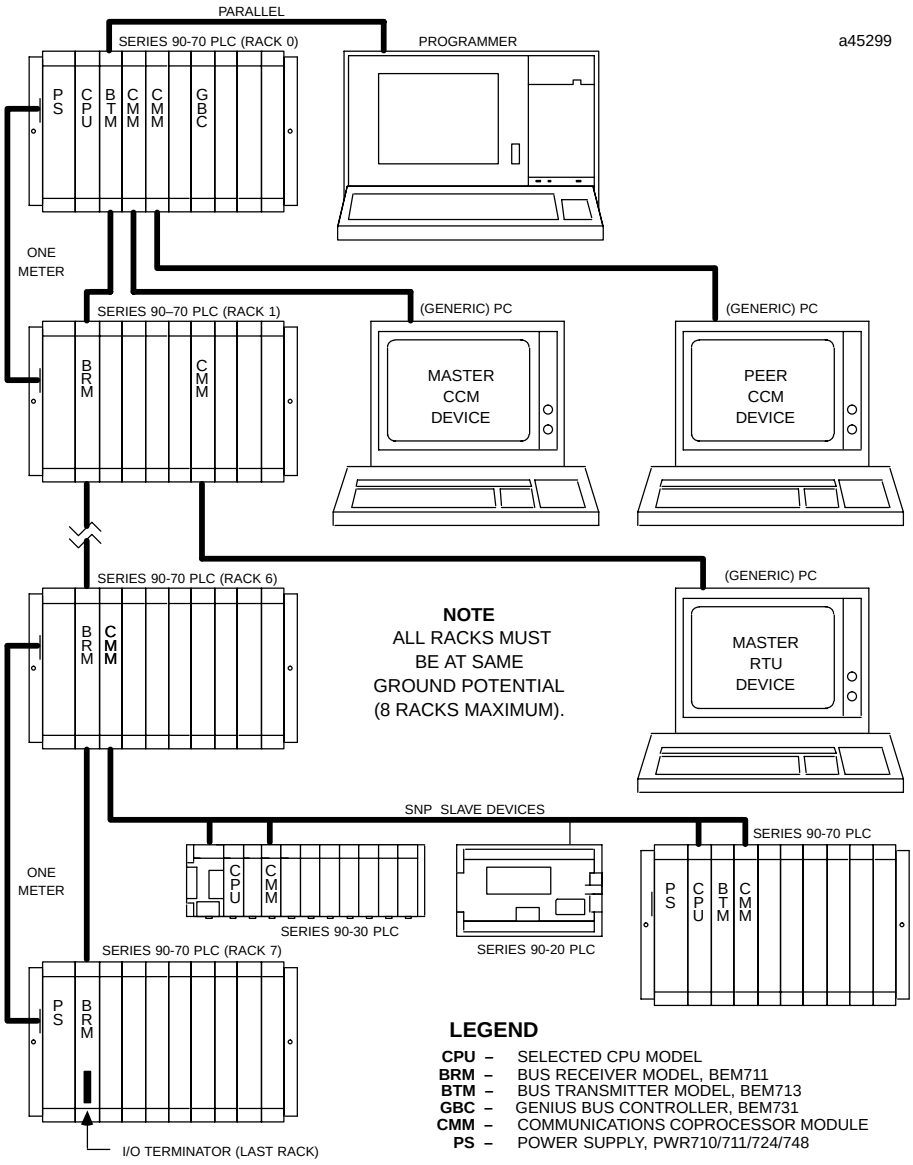


Figure 2-42. CCM Interface in a Series 90-70 System Configuration

Series 90 PLC functions provided by the CMM module configured for the SNP protocol are: read/write of most Series 90 reference tables including %R, I, Q, M, T, AI, AQ, G, P, and L; access to PLC and I/O fault tables; read/set of PLC time and date; full datagram capability; and an autodial feature to support telephone modem use.

In the master SNP configuration, the CCM module initiates communications with remote Series 90 PLCs through application ladder program communication requests (COMREQs). This configuration allows a Series 90 PLC to perform data acquisition and limited supervisory control functions over a multidrop network of Series 90 PLCs. In the slave SNP configuration, the additional serial ports can support connection to various operator interface units.

Series 90 PLC functions provided by the CMM module configured for the CCM protocol are: read/write of register, input, and output tables; bit set/clear of inputs and outputs; read of scratch pad; Q-sequence (slave response only); and the ability to modify the CCM diagnostic status words.

In the master and peer CCM configurations, the CMM module initiates communications with remote devices through application ladder program communication requests (COMREQs).

The RTU mode of operation is a query/response protocol used for communications between the CMM and a host computer. The host computer is the master device and transmits the query to the RTU slave which responds to the master. In RTU mode, only slave configuration is available.

In the RTU slave protocol, the following functions are provided:

- Read input and output tables
- Read analog input
- Read register table
- Read scratchpad
- Read exception status
- Force a single or multiple output(s)
- Preset a single or multiple register(s)
- Report the device type
- Perform loopback maintenance

Features of the Communications Coprocessor Module

The CMM module is a single slot module that can be installed in the CPU or any expansion rack. Features of the CMM module are shown in the following figure.

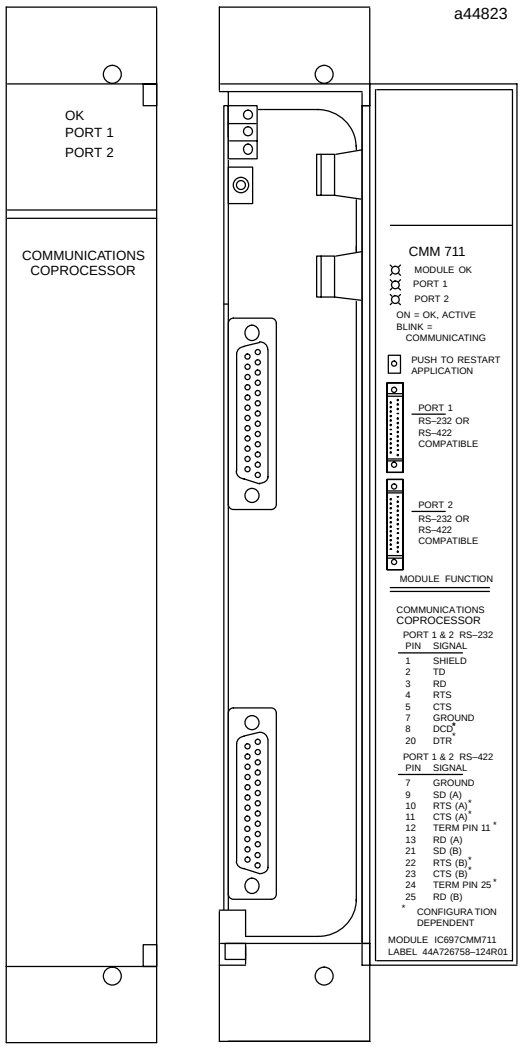


Figure 2-43. Communications Coprocessor Module

There are no jumpers or switches on the module for configuration; all configuration is done through the Logicmaster 90 or Control configuration software. User maintenance items on the CMM are: three LEDs for system status indication, a restart pushbutton, and two serial ports (RS-232 and RS-422/RS-485).

Status Indicators

There are three status LEDs on the module as shown above. The top LED (MODULE OK) indicates the condition of the module. The bottom two LEDs, PORT 1 and PORT 2, indicate activity on the corresponding serial port.

When the module powers-up, the top LED will blink. When the diagnostics have completed successfully, the top LED stays on.

Pushbutton Control

One pushbutton (PUSH TO RESTART) is provided. You push this button to reinitialize communications.

Serial Ports

Both ports are RS-232 and RS-422/RS-485 compatible. Both ports acting simultaneously can each provide up to 19.2 Kbps of full duplex data communications.

Connectors 3PL (PORT 1) and 4PL (PORT 2) contain signals for both RS-232C and RS-422/RS-485 types of communication circuits. The pin assignments for the RS-232C signals are per the RS-232C specification with an exception that pins not normally used for RS-232C are used for RS-422/RS-485 signals. Refer to GFK-0370, which is the data sheet for this module, for more information on these ports.

For additional information on serial communications, refer to GFK-0582, the *Series 90 PLC Serial Communications User's Manual*.

High Speed Counter

The High Speed Counter (HSC) module, IC697HSC700, provides direct processing of rapid pulse signals up to 200 kHz (800 kHz for Type E in A Quad B mode) for industrial control applications such as:

- Turbine flowmeter
- Meter proving
- Velocity measurement
- Material handling
- Motion control
- Process control
- Printing processes

Direct processing means that the module is able to sense inputs, process the input count information, and control the outputs without needing to communicate with a CPU.

The High Speed Counter uses 18 words of input memory. This consists of 32 bits of discrete input memory (%I) and 16 words of analog input memory (%AI). These inputs are updated once per CPU sweep. The High Speed Counter also uses 32 bits of discrete output memory (%Q) and 6 words of analog output memory (%AQ) which are transferred once per sweep. DOIO functions can be used to update any type of the HSC reference data more frequently.

The High Speed Counter is configured using the Logicmaster 90 or Control Programming Software Configurator function. Many features can be configured from the user's application program as well. Each feature is set to a factory default configuration which is suitable for many applications. There are no jumpers or DIP switches to set on the module. The green LEDs at the top of the module indicate the operating status of the module and the current status of each of the preset outputs.

Configurable Counter Types

The HSC module can be configured to operate as one of five types of counters. These counter types are:

- Type A - selects four identical, independent simple 16-bit counters
- Type B - selects two identical, independent 32-bit bidirectional counters
- Type C - selects one complex counter
- Type D - selects four identical, independent simple 32-bit counters
- Type E - selects two identical, fast response 16-bit counters

Type A Configuration

When used in this basic configuration, Type A, the module has four identical programmable up or down 16-bit counters. Each counter can be programmed to count either up or down. Each has three inputs: a Preload input, a Count Pulse input, and a Strobe input.

Type B Configuration

In its Type B configuration, the module has two identical bidirectional 32-bit counters. The count inputs may be configured to accept Up/Down, Pulse/Direction, or A Quad B

signals. For a Type B counter configuration, each counter has two completely independent sets of Strobe inputs and Strobe registers. A Disable input is available to suspend counting. A Linked Strobe mode allows counter 2 counts to generate a strobe on both counters. This allows timing of a pulse by comparison to a known pulse rate.

Type C Configuration

In the Type C configuration, the module has one 32-bit counter with three strobe registers with strobe inputs, and two Preload values with Preload inputs. In addition, the module has a Home Position register for preloading the Accumulator to the Home Position value. Two sets of bi-directional counter inputs can be connected to operate in a differential fashion. Each set of inputs can be configured for A Quad B, Up/Down, or Pulse/Direction operation. The Type C configuration is suitable for applications requiring motion control, differential counting, or homing capability.

Type D Configuration

The Type D counter contains four identical 32-bit bidirectional counters which can interpret A Quad B, Up/Down, or Pulse/Direction inputs. A Home Position register allows a marker input to preload the Accumulator to the Home Position during a Home cycle. In A Quad B mode, the counter detects quadrature errors.

Type E Configuration

The Type E counter contains two identical 16-bit counters with Strobe and Preload inputs capable of counting Up/Down or A Quad B signals. Each has a Count Disable and a Strobe Disable input. The Type E counter is designed primarily as a Down counter, but can handle Up counts to account for A Quad B *jitter*. When a counter counts down to zero, it turns on a dedicated preset output with a 15µs response time.

Module Features

The High Speed Counter module features include:

- 12 differential or single-ended (source) inputs with input voltage range selection of either 5 VDC (TTL) or 10 to 30 VDC (NON-TTL)
- 4 positive logic (source) outputs independently assignable to any available counter (Types A - D)
- External oscillator
- Built-in +5 VDC output
- TTL, Non-TTL, and Magnetic Pickup input thresholds
- Counts per timebase register for each counter (Types A - D)
- Software configuration
- Internal module diagnostics
- Individual LEDs that provide a visual indication of Module OK and Output States
- A removable terminal board for connection of field wiring

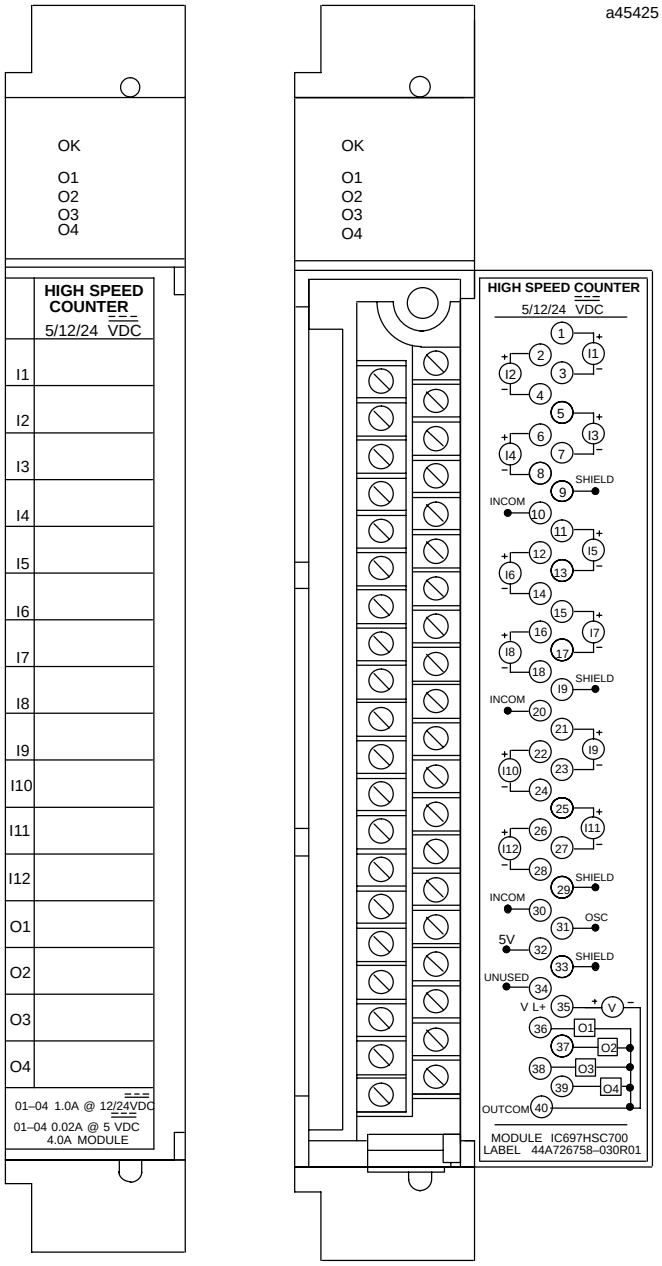


Figure 2-44. Series 90-70 High Speed Counter Module

Inputs can be used as count signals, direction, disable, edge-sensitive strobe, and preload inputs depending on the counter type selected by the user. Outputs can be used to drive indicating lights, solenoids, relays, and other devices.

For each counter, a Counts per Timebase register indicates the number of counts in a given time interval. The Counts per Timebase data is a 16-bit signed number. The sign indicates up counts (+) or down counts (−). The Timebase value is specified in milliseconds and ranges from 1 to 65535 milliseconds.

All configuration parameters for the module are downloaded from the PLC to the High Speed Counter after it passes its internal diagnostics and the MODULE OK indicator has turned on. An initial (default) set of configuration parameters is loaded during diagnostics.

These default parameters can be used or modified through a download from the PLC, or the parameters may be changed by the user with the Hand-Held Programmer.

Operation of the High Speed Counter module is monitored by a watchdog timer circuit which, if it detects a module failure, will force all outputs off and turn off the MODULE OK LED.

Status Indication

Five status LEDs are viewable on the module as shown in the previous figure. The function of each LED is as follows:

MODULE OK LED

The MODULE OK LED indicates current status of the High Speed Counter module as described in Table 1.

Table 2-19. HSC MODULE OK LED Status

State	Description
OFF	When the MODULE OK LED is off, the High Speed Counter module is *not* functioning. This is the result of a hardware malfunction; for example, the diagnostic checks detected a failure, or the PLC CPU is *not* present. Corrective action is required in order to get the module functioning again.
ON	When the LED is on steadily, the High Speed Counter module is functioning properly. Normally, this LED should *always* be on, indicating that the diagnostic tests were successfully completed and the programming software configuration data for the module is correct.
Blinking	The LED flashes at a 1 Hz rate when power-up diagnostics have completed successfully and the module is waiting for configuration. It also flashes at a 4 Hz rate when an error occurs. When the error is cleared, the LED will return to being on steadily.

Output LEDs (01 - 04)

These four LEDs indicate the ON/OFF state of the corresponding module output circuit. The output circuits can be used to drive indicating lights, solenoids, relays, and other such similar devices. The LEDs are either ON or OFF (output activated or not activated).

User Terminal Connector

The removable terminal strip has 40 screw terminals for connection to field devices to the High Speed Counter inputs and outputs. Pin assignments for field wiring connections are provided in the following table. For detailed information on how each signal applies to the different counter types, refer to GFK-1062, the *High Speed Counter User's Manual.*

State Logic Modules

Three modules are available for systems programmed in State Logic. These modules are the *State Logic Processor, State Logic CPU,* and *Serial Communications Module.*

State Logic Processor

The State Logic Processor Module (SLP), AD697SLP711, provides real time multi-tasking control for machine and process applications. It can also be programmed to perform computations, data acquisition, data communications and operator interface functions. The SLP is programmed using the English Control Language Programming System (ECLiPS) software package. It communicates with the PLC CPU over the backplane and can access user and system data. Many SLPs can be supported in a single Series 90-70 PLC system and each SLP can support up to 1024 inputs and 1024 outputs.

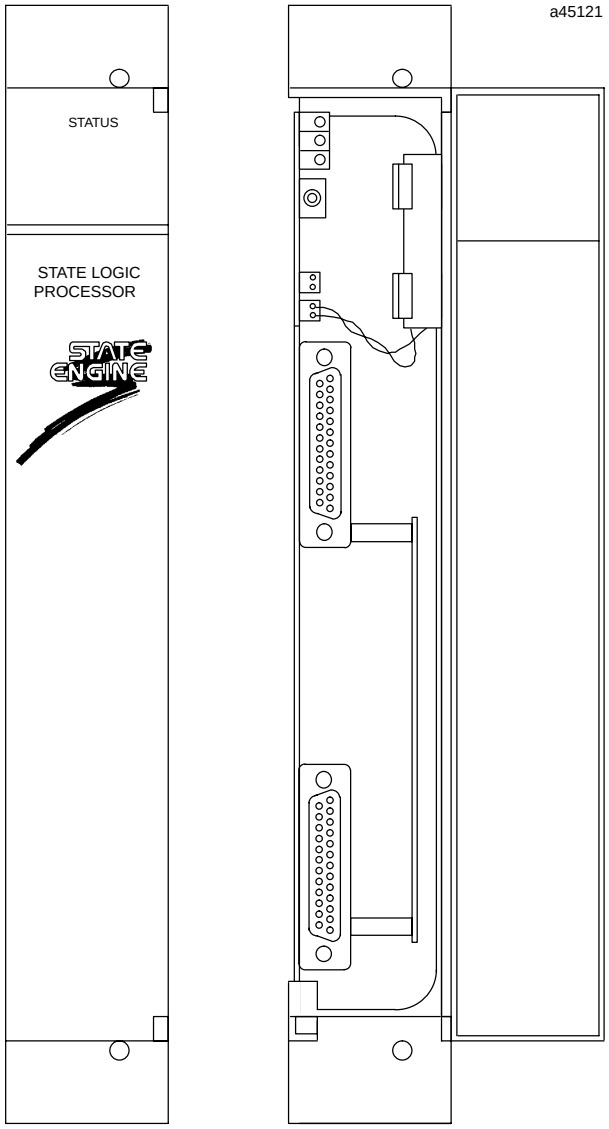


Figure 2-45. State Logic Processor Module

The PLC CPU and SLP modules together in the Series 90-70 PLC provide a dual processor architecture which can be used in a wide variety of applications. The SLP provides total state logic control, including diagnostic and simulation capabilities, for those applications requiring reduced development and startup times. For those applications where both ladder logic and state logic programming is desired, the dual processor architecture allows a user to create both ladder logic and state logic application programs in any combination for efficient parallel processing solutions.

In Series 90-70 PLC ladder logic control systems, the SLP module can be added to provide high-level machine and process-level diagnostics which can drastically reduce total system downtime. Also, the SLP module can provide machine or process simulation capabilities to Series 90-70 PLC ladder logic control systems to help reduce debug and startup times.

There are no user DIP switches or jumpers on this module for configuration. However, the module must be configured into the overall PLC system using Logicmaster 90-70 configuratorsoftware.

An IBM-compatible PC-XT or AT computer with the ECLiPS programming system software installed is connected to port 1, (top port) as shown in the following figure.

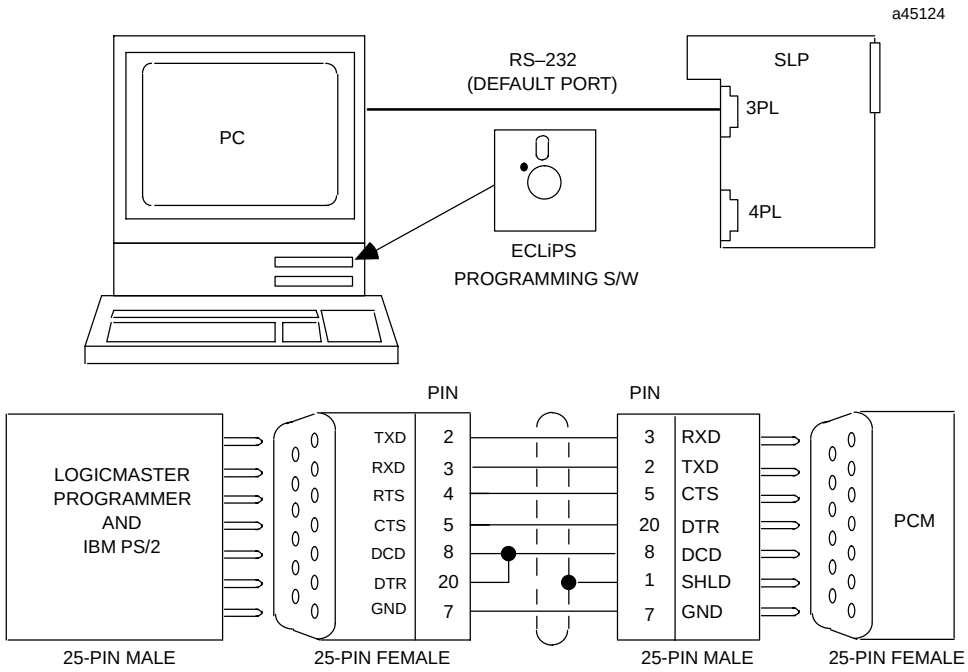


Figure 2-46. Development PC System Running ECLiPS and Its Connection to the State Logic Processor Module

The top port is the default programming port, but the SLP can also be configured to be programmed through port 2, the bottom port. The default setting is 19,200 bps. Both ports can be configured independently as RS-422/RS-485 or RS-232 serial ports for operation with a variety of serial devices such as operator interfaces, bar code readers, weigh scales, etc. One of the two ports can also be configured to communicate with the CCM2 protocol as a slave typically for use with operator interface terminals. Refer to the *State Logic Processor User's Guide* for details of operation.

Three Status LEDs are located on the SLP module. The top LED indicates the condition of the module and is ON during normal operation. The bottom two LEDs are not used and will always be off.

One pushbutton is provided. Push and hold the pushbutton for less than 5 seconds and you will simply restart the user application program if it was configured to *auto-run* at power up. Push and hold for more than 5 seconds and the module is reinitialized and the user application program must be reloaded.

State Logic CPUs

In addition to the Series 90-70 CPUs described previously, there are three State Logic CPUs available:

- IC697CSE784 is a 32-bit CPU which operates at 16 MHz and provides 512 Kbytes of battery-backed expansion memory as standard features.
- IC697CSE924 is a 32-bit CPU which operates at 64 MHz and provides 512 Kbytes of battery-backed expansion memory as standard features.
- IC697CSE925 is a 32-bit CPU which operates at 64 MHz and provides 1 Mbyte of battery-backed expansion memory as standard features.

The CSE 784, 924 and 925 are single slot CPUs that provide State Logic control programming and floating point calculations. These CPUs can be programmed in State Logic, Relay Ladder Logic, and C to perform real-time control of machines, processes, and material handling systems.

The Adatek ECLiPS software products are used to program the State Logic CPUs in State Logic; Logicmaster 90-70 programming software is used to program in Relay Ladder Logic and C. The Logicmaster 90-70 programming software is used to perform all configuration functions for the State Logic CPUs.

Features of the State Logic CPUs include:

- 12K inputs and outputs (any mix).
- Up to 8K analog I/O.
- 0.4 microseconds per boolean function.
- 16 or 64 MHz (depending on model), 80486DX2 or 80386DX (depending on model) microprocessor.
- Provides 512 K bytes or 1 Mbyte (depending on model) of battery-backed memory in the same slot.
- Remote programmer keyswitch memory protection.
- Four status LEDs.
- Software configuration (no DIP switches or jumpers to set).
- Reference information inside front door.
- In-system upgradable firmware.

The State Logic CPUs communicate with I/O and smart option modules over the rack-mounted backplane by way of the VME C.1 Standard format.

Supported option modules include LAN Interface modules, several Coprocessor modules, Bus Controller for Genius I/O products, Communications modules, I/O Link Interface, and all of the Series 90-70 family of discrete and analog I/O modules.

The CSE 925 State Logic CPU module is shown in the following figure.

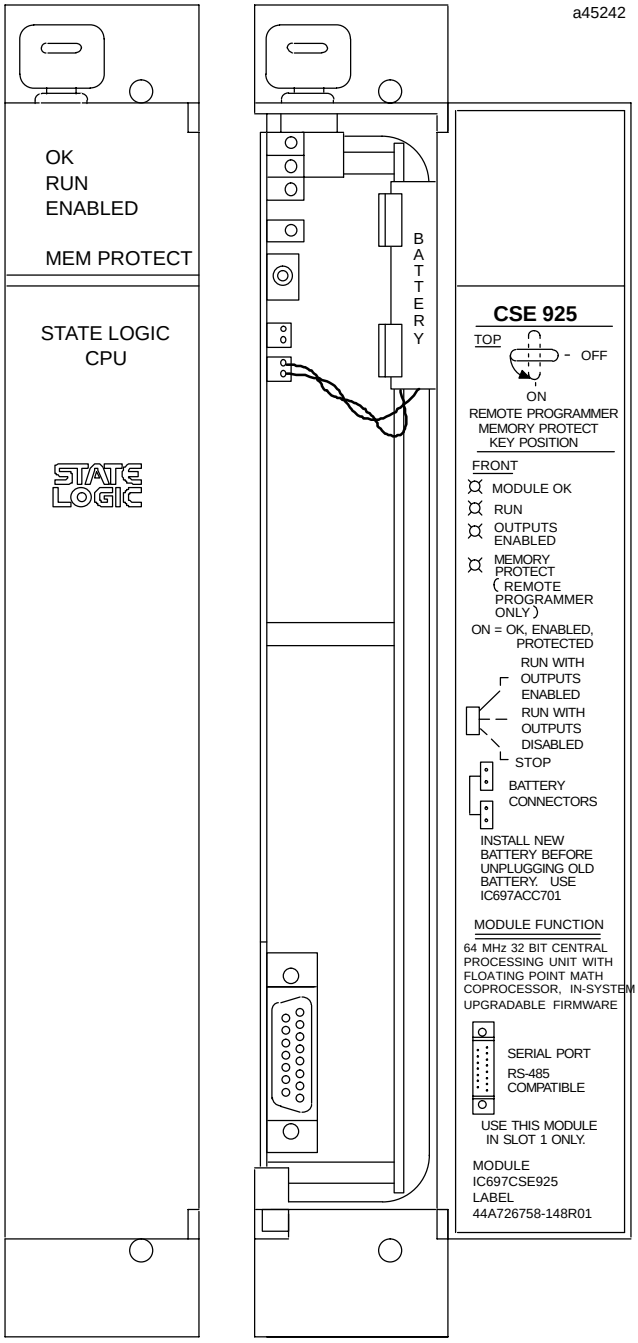


Figure 2-47. State Logic CPU – Model CSE 925 Shown

User Memory

Program and data memory for the CSE 784 is provided by a memory board with 512 Kbytes of battery-backed CMOS RAM. Program and data memory for the CSE 925 is provided by a memory board with 1 Mbyte of battery-backed CMOS RAM. These memory boards are an integral part of the State Logic CPU modules and do not need to be ordered separately.

Operation, Protection, and Module Status

Operation of these modules can be controlled by the three-position RUN/STOP switch or remotely by an attached programmer, and State Logic or Logicmaster 90-70 programming software. Program and configuration data can be locked through software passwords or manually by the memory protect keyswitch. When the key is in the protected position, program and configuration data cannot be changed. The status of a CPU is indicated by the four green LEDs on the front of the module.

The CSE 924 and CSE 925 CPUs require forced air cooling for proper operation in ambient temperatures greater than 50°C (122°F). A fan capable of 70 CFM (including filters) should be located beneath slot 1 of the rack containing the CPU. Fan assemblies (IC697ACC721 and IC697ACC724) can be ordered for direct mounting on the Series 90-70 PLC rack. Refer to Chapter 3 for detailed installation information about the fans.

Serial Communications Module for State Logic CPU

The Serial Communications Module (SCM), IC697CMM712, provides I/O ports for serial communications to the State Logic Control System. The State Logic CPU control system program uses the SCM to receive input from a serial device and to transmit information to a serial device.

Each module provides two ports that can each be configured to be RS-232 or RS-422/RS-485 ports. The State Logic Control System supports up to four Serial Communications Modules providing a total of eight serial ports. The Serial Communications Modules are inserted in slots 2 through 5 of rack 0.

One of the eight ports can be a CCM2 port. An expanded form of the CCM2 protocol is supported providing read/write capability for analog input and output values, %M internal flags, and current States of Tasks, in addition to the normal discrete inputs and outputs, and variable values. Additional functionality is provided for custom CCM communication programs.

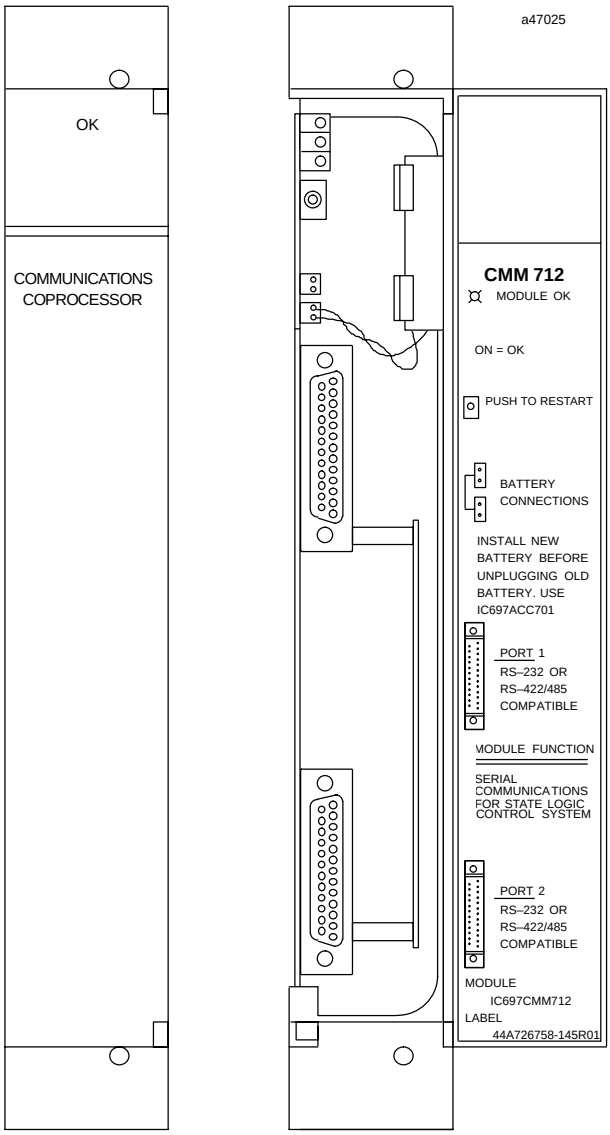


Figure 2-48. Serial Communications Module for State logic

The Serial Communications Module must be installed in rack 0 (CPU rack) in a Series 90-70 PLC system as shown below. Up to four Serial Communications modules can be included in a system.

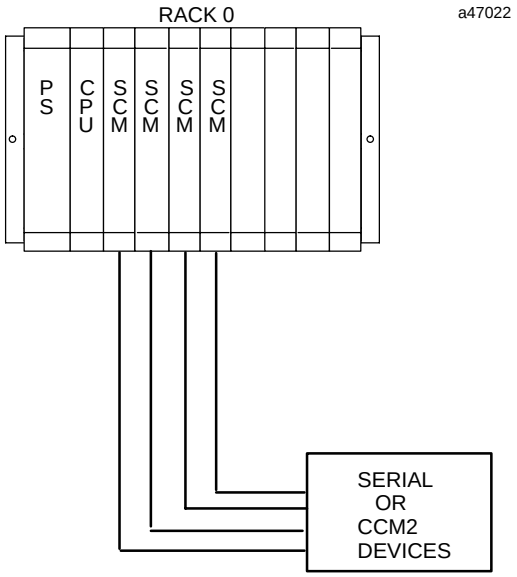


Figure 2-49. Typical PLC System Configuration with SCMs

Serial Ports

Both ports are RS-232 and RS-422/RS-485 compatible. Both ports acting simultaneously can each support up to 19.2 Kbaud full duplex data communications.

Port 1 (3PL) and Port 2 (4PL)

Connectors 3PL and 4PL contain signals for both RS-232 and RS-422/RS-485 types of communication circuits. The pin-outs for the RS-232 signals are per the RS-232 specification with an exception that pins not normally used for RS-232 are used for RS-422/RS-485 signals.

Configuration

There are no DIP switches or jumpers on this module for configuration. The Logicmaster 90-70 programming software configuration function is used to configure the State Logic CPU for this module.

The SCM is installed in slots 2 through 5 of rack 0. The following table explains the correlation between the slot number and the port number used in the State Logic program.

Table 2-20. Slot to Port Number Correlation

SLOT NUMBER	PORT NUMBER
2	1 and 2
3	3 and 4
4	5 and 6
5	7 and 8

Status Indication

One Status LED, labeled OK, indicates the condition of the module.

Controls

One pushbutton is provided which allows two conditions:

- Push and hold for less than 5 seconds to reset the module.
- Push and hold for more than 5 seconds and the module factory default configuration will be installed, which may require the State Logic program to be reloaded.

Series 90-70 I/O Modules

There are five types of Series 90-70 rack-type I/O modules.

- Discrete input
- Discrete output
- Analog input
- Analog output
- Intelligent option modules

The following paragraphs provide an overview of the Series 90-70 PLC I/O modules. The available I/O modules are listed in Chapter 1 of this manual. Operation of each of the Series 90-70 I/O modules is described in a data sheet available for each module. All data sheets are available bound into one manual, GFK-0600, the *Series 90-70 Programmable Controller Data Sheets Manual.*

All Series 90-70 I/O modules are retained in their slots by molded latches that automatically snap onto the upper and lower rails of the rack when the module is fully inserted into its slot. For applications where racks will be installed in high vibration areas, screws can be used to further secure the modules in the rack. A cable tie cleat is molded into the bottom front of each module, which provides a convenient place to secure a cable tie wrapped around the wire bundle.

Series 90-70 Discrete Input Modules

Discrete input modules convert AC and DC input power levels to the logic levels required by the Series 90-70 PLC. An optical coupler provides isolation between the incoming power and the logic. An on-board microcontroller gathers data regarding the state of each input point and provides it upon demand to the CPU. When input point 1 on DC input boards is configured as an interrupt, the microcontroller also interrupts the CPU when an input occurs on point 1.

Series 90-70 Discrete Output Modules

Discrete output modules convert and isolate logic levels into AC and DC power levels for driving real-world devices. A power semiconductor provides the drive for each output point. An on-board custom VLSI device receives data regarding the desired state of each output point from the CPU, and controls the outputs. It also controls the default state when ordered to do so by the CPU or when it detects a system failure. The default state may be configured by the user to be either ***Off*** or ***Hold Last State*** on a per module basis, i.e., each output module can be configured as desired by the user.

Discrete I/O Module LEDs

An LED block consisting of four columns of eight LEDs is mounted at the top of each discrete I/O board. A bezel overlays the block that has a letter/number identification for each LED, as shown in the following figure. Each LED indicates the state of the logic for the respective input or output point. The LED does not indicate the state of the power connection. Each discrete I/O board, regardless of the number of points and type (input or output), uses the same LED block.

For 32-point modules, all LEDs are used; for 16-point modules, only the first four LEDs (from the top) in each column are used: A1 through A4, B1 through B4, C1 through C4,

and D1 through D4. An LED located at the bottom of the LED block indicates the status of the on-board fuses for output modules. If one or more of the fuses should blow, this LED will turn on.

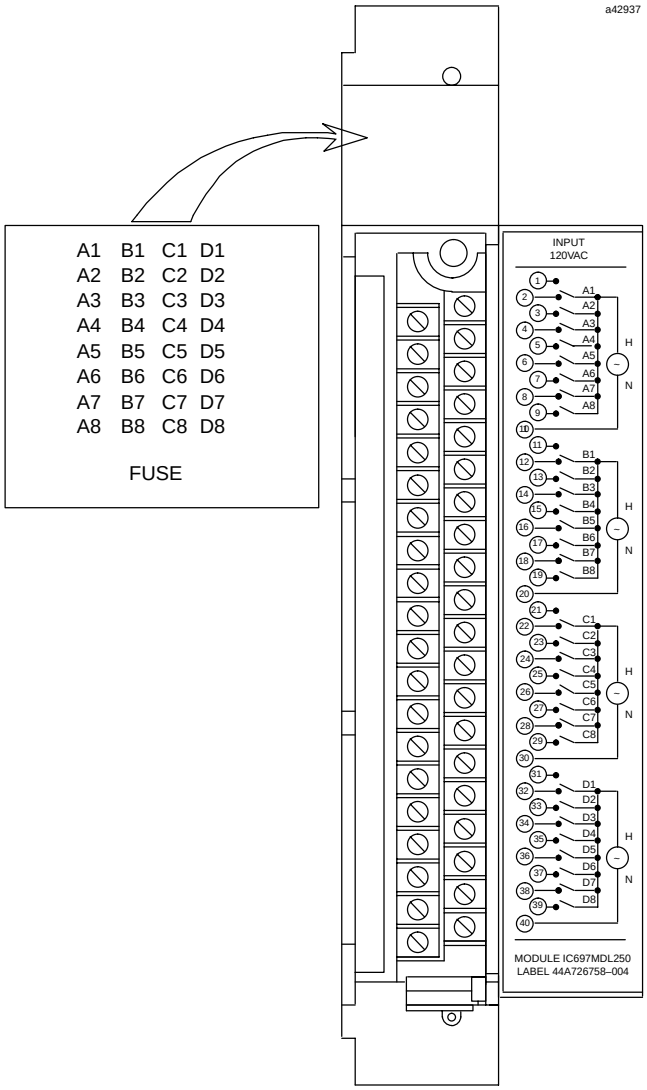


Figure 2-50. I/O Point Status Indicator LEDs for Discrete I/O Modules

I/O Module Wiring Connections

All Series 90-70 I/O modules have a detachable terminal board for field wiring connections. This detachable terminal board has terminals for connections to the external AC or DC power source, power return, and field devices supplied by the user. Each discrete I/O module, regardless of type (input or output), uses an identical 40-terminal connector. A wiring connection diagram for each discrete I/O module can be found on the inside of the insert installed in the module's hinged door and also in the data sheet for each module. The following figure shows this terminal board.

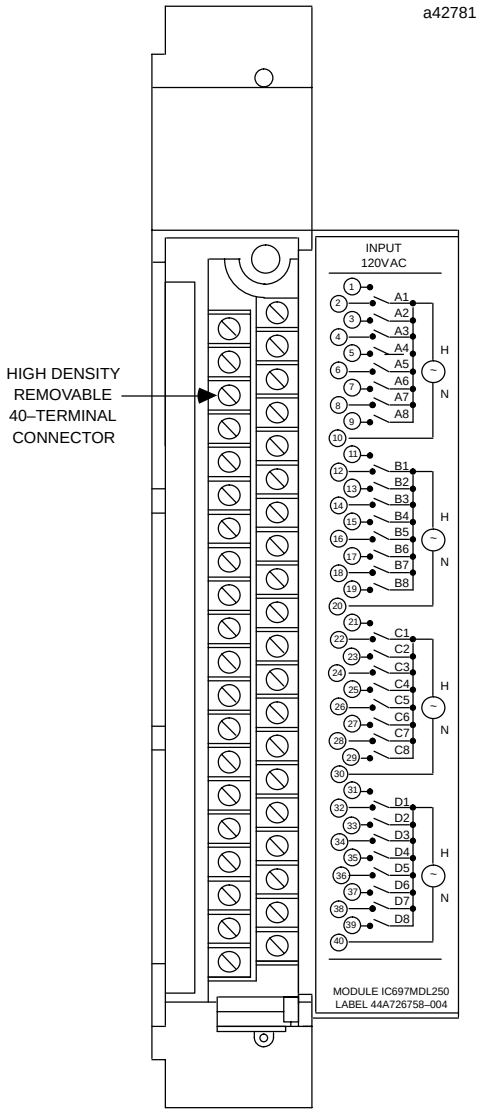


Figure 2-51. I/O Module Terminal Board

Series 90-70 Analog Input Modules

Series 90-70 Analog Input Modules include a high-level eight channel module (Base Converter, IC697ALG230), a 16-channel Current Expander module (IC697ALG440), and a 16-channel Voltage Expander module (IC697ALG441).

High-Level Analog Input Module

The high-level input (Base Converter) module contains eight high-speed analog inputs, a low-speed expansion input channel which can be shared by multiple expander modules, a 14-bit A/D (Analog to Digital) converter, 16-bit microprocessors, and the backplane interface to the system.

Analog inputs are referenced to the %AI register memory. A maximum of 8K registers is available with each input channel using one register. Each Base Converter module can be configured for limit and overrange interrupts.

Analog Input Expander Modules

The expander modules contain 16 current or 16 voltage input channels, an analog multiplexer and a serial interface to the expander bus. Analog data from the expander modules is transmitted to the analog input module on the expander bus. Up to seven expander modules can be interfaced to an analog input module to expand the number of inputs to 120.

The high-level analog input module and its associated expander modules must be installed in the same rack with the high-level analog input module in the lowest slot position of the group. It is recommended that the expander modules be installed to the right of the analog input module and in adjacent consecutive slots to assure contiguous addressing beginning with the address assigned to the analog input module.

Analog Input Characteristics

Each analog channel is capable of converting an analog input signal to a digital signal which can be used as required by the application. The input ranges of these analog inputs can be 5 to 10 volts full scale with either positive or negative polarity, or 4 to 20 milliamp current loop. Each channel of the high-level analog input module is individually soft configurable, with the configurator software, for either voltage or current ranges, user scaling, alarm limits and diagnostics. Built-in resistors are selectable at the terminal board for current inputs. The expander module is also soft configurable and is available in two versions: one with all current inputs and one with all voltage inputs. Resolution of the converted signal is 14 bits binary (1 part in 16384), including sign, resolving 1.25 millivolts on voltage range, or 50 microamps on current range. The input data format is 2's complement binary (sign plus 15 bits).

Wiring Connections to Analog Input Channels

Connection to the analog input modules from user devices is made to screw terminals on a removable 40-terminal connector. A circuit wiring diagram for high-level analog input modules and expander modules can be found in the data sheet included with each module and on the inside surface of the label in the module's hinged door.

The expansion channel bus connections consist of two differential wire pairs which must be connected between the expander modules and the analog input module. This connection must be made with shielded, twisted-pair cable to the 40-terminal connector.

Module Status Indicator

The high-level analog input modules have two LEDs located at the top front of the module. The top LED, labeled BOARD OK, indicates that the board has powered-up, passed its power-up diagnostic tests, and has received good configuration data. The second LED, labeled PORT OK, is an indication that the expander bus is connected and operating properly.

Alarm Comparator Function

The high-level analog input module input points have a High/Low Alarm function which indicates that an input is outside of a range of upper and lower limits set by the user with the configuration software. When a high or low alarm limit is exceeded, the appropriate fault contacts are set, either --[HIALR]-- or --[LOALR]--.

Series 90-70 Analog Output Modules

The Series 90-70 Analog Output Module is available as a combination Voltage and Current module (IC697ALG320) that allows each channel to be configured for either current or voltage. The analog output module has four channels.

High-Level Analog Output Modules

The High-Level Analog Output module contains four high-speed analog outputs, separate 14-bit D/A (Digital to Analog) converters, a 16-bit microprocessor and the backplane interface to the system. The high-level analog output system accepts digital data from the PLC CPU and converts this data to analog outputs for use as required by the application.

Analog Output Characteristics

Each analog channel is capable of converting a digital signal to an analog signal. Operating ranges for the output channels are -10 to +10 volts, 0 to +10 volts, -5 to +5 volts, and 0 to +5 volts (-10 to +10 volts default) for voltage outputs and 0 to 22.5 mA (4 to 20 mA default) for current outputs. Resolution of the converted signal is 14 bits binary (1 part in 16384) for a -10 to +10 VDC output, and 13 bits binary (1 part in 8192) for a 4 to 20 mA output. Calibration is set at the factory and stored in a non-volatile memory (EEPROM) which eliminates the need for manual calibration by the user. The proper calibration for each channel on the analog output module, which can be configured for either voltage or current, is set by the configurator software, as are scaling and diagnostic features.

Wiring Connections to Analog Output Channels

Connection to the analog output modules from user devices is made to screw terminals on a removable 40-terminal connector. A circuit wiring diagram for high-level analog output modules can be found in the data sheet included with each module and on the inside surface of the label inside the module's hinged door.

Module Status Indicator

The analog output modules have one LED located at the top front of the module. This status indicator, labeled BOARD OK, indicates that the board has powered-up, passed its power-up diagnostic tests, and has received good configuration data.

Option Modules

The optional modules currently available for the Series 90-70 PLC system were described previously in this chapter. For more information about availability of Series 90-70 I/O modules and Third Party modules that may be used in a Series 90-70 I/O system, please consult your GE Fanuc PLC Distributor, or your local GE Fanuc sales office.

Chapter 3 Installation Procedures

— Important Note —

The installation instructions described in this chapter apply to PLC installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see ***GFK-1179, Installation Requirements for Conformance to standards****. Also see* ***GFK-0867A (or later version), GE Fanuc Product Approvals, Standards, General Specifications.***

Overview

This chapter describes the procedures for installing the Series 90-70 PLC and preparing the system for use. Included are instructions for unpacking, inspecting, setting rack jumpers, installing the rack in a rack or panel, installing modules, and connecting cables.

Hardware Packaging

Any rack, whether used as a main (CPU) rack or as an expansion rack, functions identically to any other rack. Each standard Series 90-70 rack has five or nine slots for modules, plus provision for a power supply or power supply connection in the leftmost slot. Standard Series 90-70 racks are available in 19-inch wide rack or panel-mounted styles and a 13-inch wide panel-mounted style. VME Integrator racks are 19 inches wide and have 17 slots plus provision for a power supply or power supply connection in the leftmost slot. Each rack is shipped in its own carton, without a power supply.

The power supply and all of the Series 90-70 modules are shipped in individual containers. When multiple modules are included in one shipment, individual module boxes are packaged either two, five, or ten boxes to a carton.

The rack in which the CPU resides requires a power supply in Slot PS, and a CPU module in Slot 1. A Bus Transmitter Module (BTM), if it is to be in a system, is typically installed in Slot 2. The BTM is required for parallel communications with the programmer or if the system is to include multiple racks. The power supply, an optional power supply extension cable, the CPU, and the BTMs are each ordered separately.

The programmer, if purchased from GE Fanuc, is packed in a separate shipping container. GE Fanuc recommends that all shipping containers and all packing material be saved in case it should be necessary to transport or ship any part of the system.

Visual Inspection

Upon receiving your Series 90-70 PLC system, carefully inspect all shipping containers for damage during shipping. If any part of the system is damaged, notify the carrier immediately. The damaged shipping container should be saved as evidence for inspection by the carrier.

As the consignee, it is your responsibility to register a claim with the carrier for damage incurred during shipment. However, GE Fanuc will fully cooperate with you, should such action be necessary.

Preinstallation Check

After unpacking Series 90-70 PLC racks, cables, all modules, and the programming computer, **record all serial numbers**. Serial numbers are required if you should need to contact Product Service during the warranty period of the equipment. All software product registration cards should be completed and returned to GE Fanuc.

Verify that all components of the system have been received and that they agree with your order. If the system received does not agree with your order, call Programmable Control Customer Service, toll free, in Charlottesville, VA at 1-800-432-7521. A Customer Service representative will then give you further instructions.

If you need technical help, PLC Technical Support can be reached as listed below.

Technicalsupport for the PLC items described in this manual:	
PLCHotline	1-800-GE FANUC(1-800-433-2682,or Intemationaldirectdial804-978-6036
Intemetaddress	plchotline@cho.ge.com
Faxnumber	804-978-5099
Fax link	804-978-5824
GE Fanuc BBS	804-978-5458

Rack Installation

Racks can be either standard Series 90-70 racks or VME Integrator racks, depending on the requirements of your application. Installation of both types of racks is described below.

Standard Series 90-70 Racks

Standard Series 90-70 PLC racks may be rack or panel mounted, depending on the version ordered. Rack-mounted racks have flanges on the front of each rack for attaching to 19-inch standard instrument rack hardware. Panel-mounted racks have rear-attached flanges for mounting on an electrical panel. Rack dimensions for installation purposes are shown in the following figures.

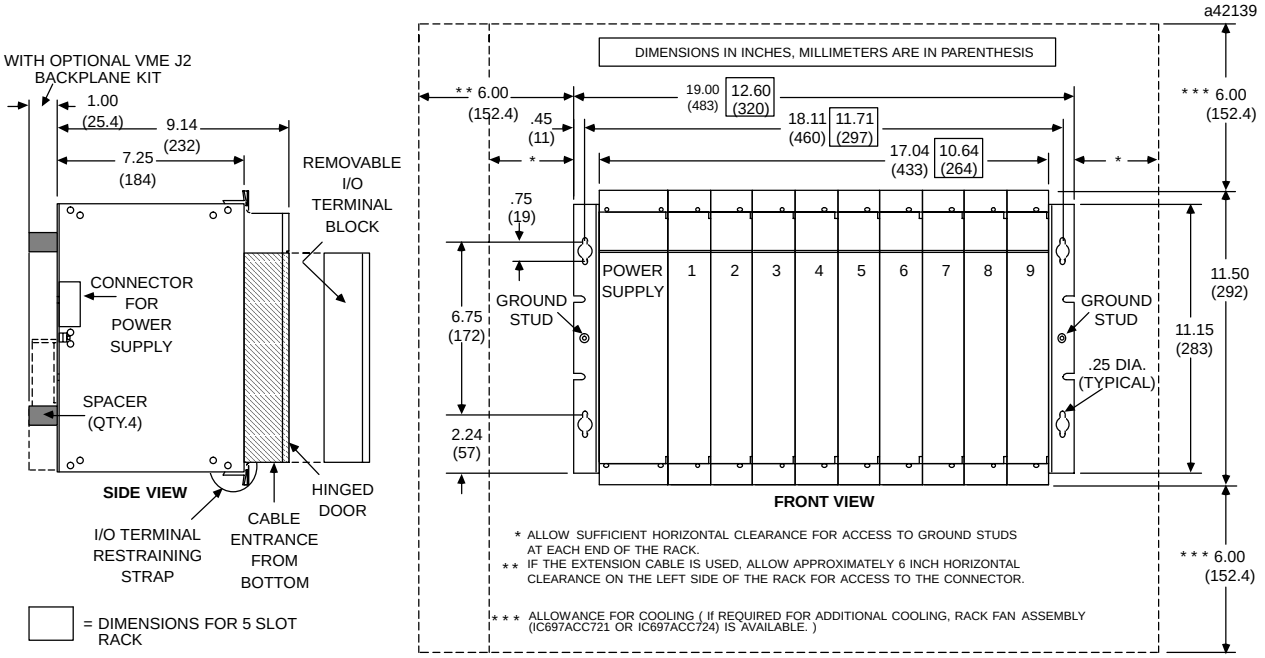


Figure 3-1. Standard Series 90-70 Rack Mounting Dimensions and Requirements for Standard Rear (Panel) Mount Rack

A rack must be mounted in the orientation shown above. These racks do not normally require a fan for cooling as long as sufficient space is left around the rack when it is mounted. The installation instructions in this manual provide a guide to recommended distances that should be allowed to maintain proper air flow around/through the modules.

Certain CPU modules require forced air cooling (70 CFM) as outlined in the following table.

Table 3-1. CPU Models Requiring Forced Air Cooling

Ambient Temperature	CPU Units Requiring Forced Air Cooling of 70 CFM
Greaterthan 40°C (104°F)	IC697CPM925 IC697CPM790 IC697CSE924 IC697CSE925
Greaterthan 50°C (122°F)	IC697CGR935 IC697CPX928 IC697CPX935

A fan capable of 70 CFM (including filters) must be installed on the rack in installations that include any one of the CPU models listed above.

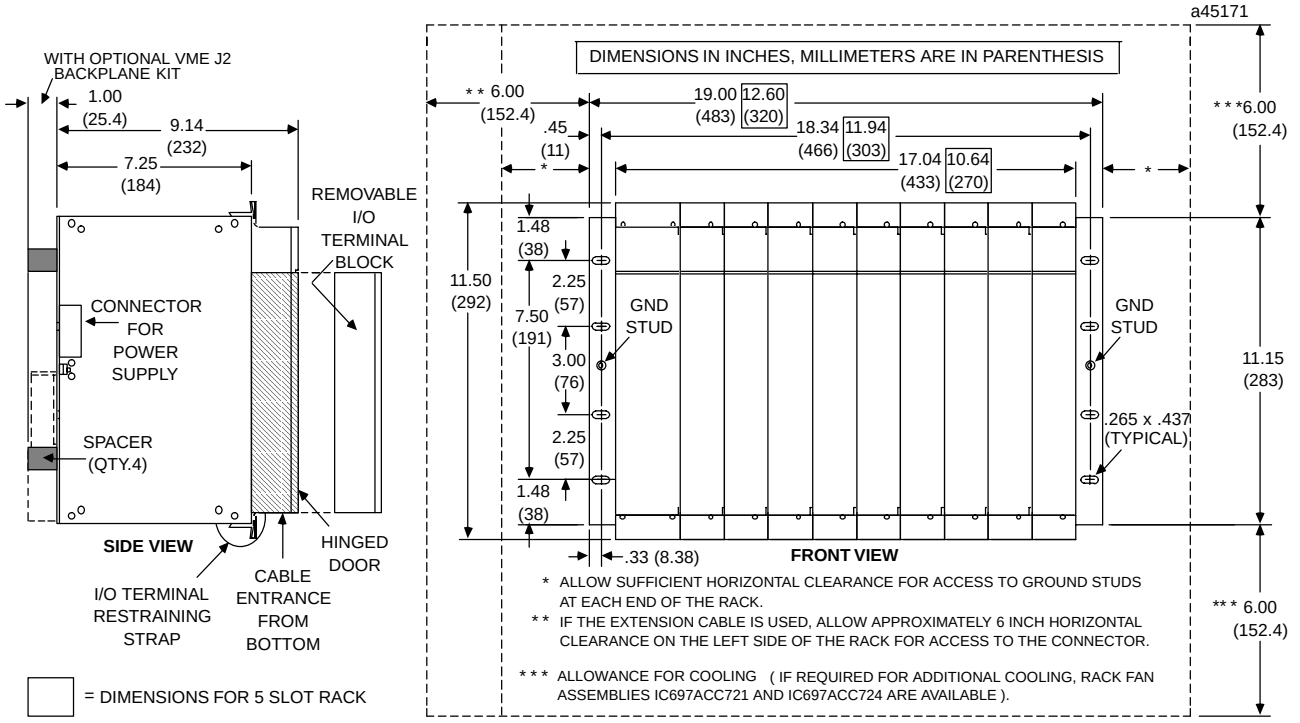


Figure 3-2. Standard Series 90-70 Rack Mounting Dimensions and Requirements for Standard Front (Rack) Mount Rack

Fan assemblies (IC697ACC721, IC697ACC724, and IC697ACC744) are available for direct mounting on the rack. Refer to *Rack Fan Assembly Installation* later in this chapter for additional information.

VME Integrator Racks

VME Integrator racks can be rack or panel mounted, depending on the version ordered. The rack-mounted version has flanges on the front for attaching the rack to a 19-inch standard instrument rack. The panel-mounted version has flanges attached to the rear of the rack for mounting on an electrical panel. VME Integrator mounting dimensions are shown in the following figures. The VME Integrator rack must be mounted in the orientation shown.

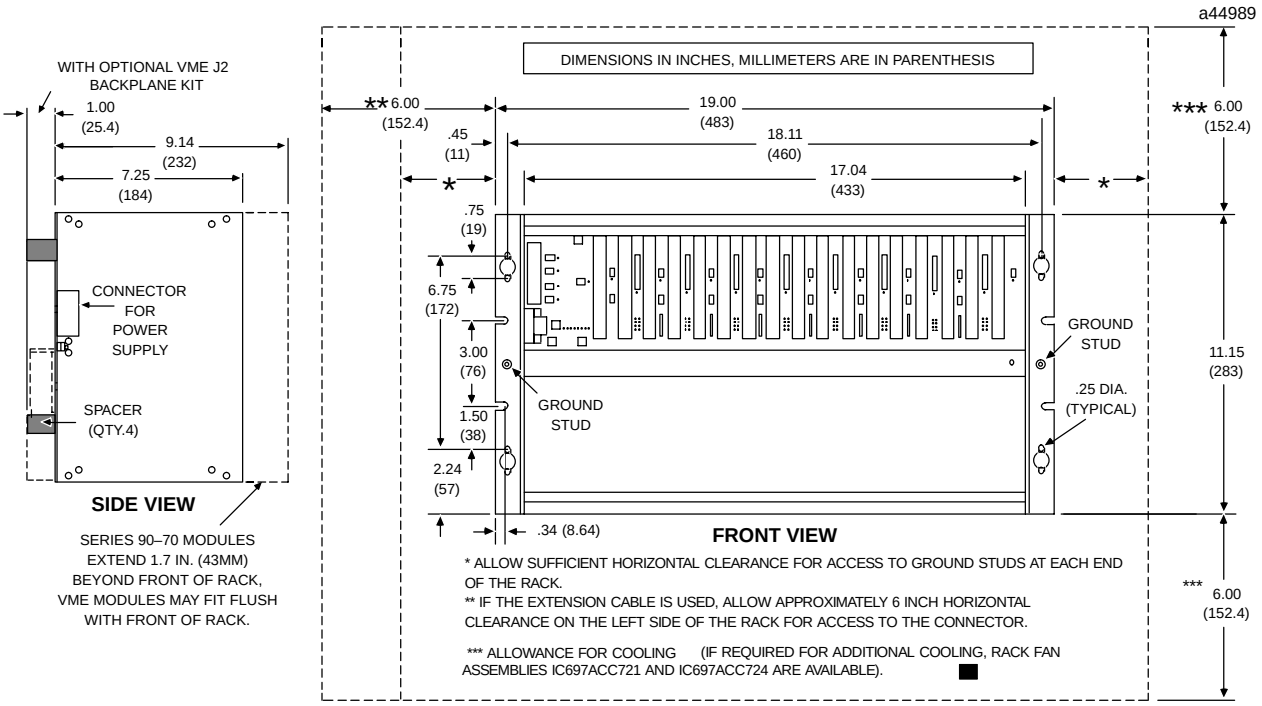


Figure 3-3. VME Integrator Rack Mounting Dimensions and Requirements for Rear (Panel) Mount Installation

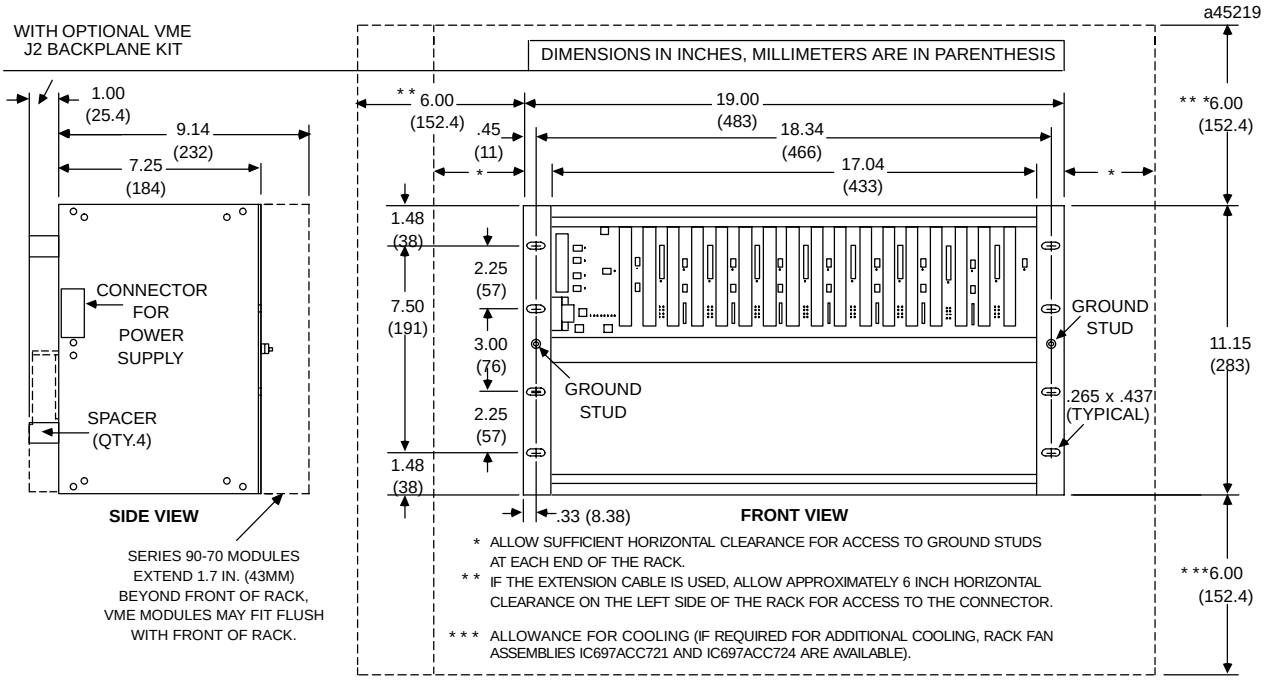


Figure 3-4. VME Integrator Rack Mounting Dimensions and Requirements for Front (Rack) Mount Installation

Sufficient space must be left around the rack as shown to allow air flow for module cooling. Rack Fan Assemblies are available for installations requiring forced air cooling.

The rack mounting requirements (either front or rear mount) must be determined according to the application and the proper rack ordered. Mounting flanges are an integral part of rack side panels and are installed at the factory.

Additionally, if 3rd Party wire wrap VME boards are installed, the standoffs included in the optional J2 backplane kit must be installed to allow sufficient rack clearance from the panel. The depth of the standoffs must be added to the overall depth of the rack.

Configuring the VME Integrator Rack

A series of jumper positions is located on the backplane near each slot. These jumpers provide for flexibility in the types of modules to be installed, either VME modules in single slots (0.8 inch spacing between centers) or Series 90-70 modules, which require two slots (1.6 inch spacing between centers).

The slots for GE Fanuc modules are indicated by a number and an arrow; the slots are also marked 1A through 9A. Table 3-2 shows the relationship of the slot numbers to the jumper positions.

The functions and signals which are configurable by these jumpers are:

- Select rack ID for multiple rack systems (Series 90-70 feature)
- Configure SYSFAIL signal to be enabled or disabled (per slot)
- Configure LWORD signal in slot 1 to be inactive
- Configure IRQ1/ - IRQ4/ signals for VME slots 12PL to 19PL
- Configure Bus Grant signals for VME slots 12PL to 19PL

The following figure provides an example of jumper locations on the backplane. The jumpers shown are referenced in the following text.

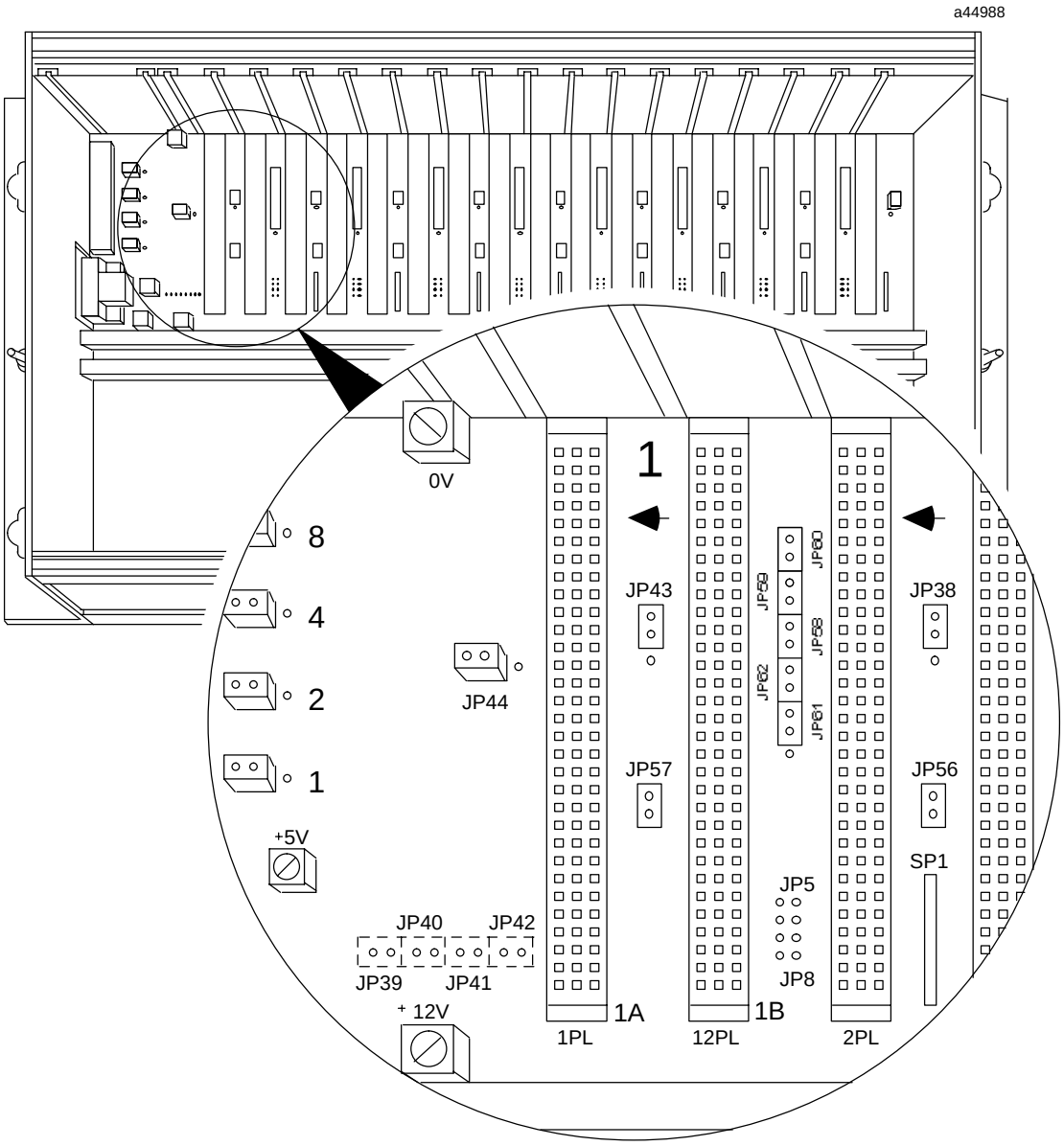


Figure 3-5. Example of Jumper Locations on Backplane

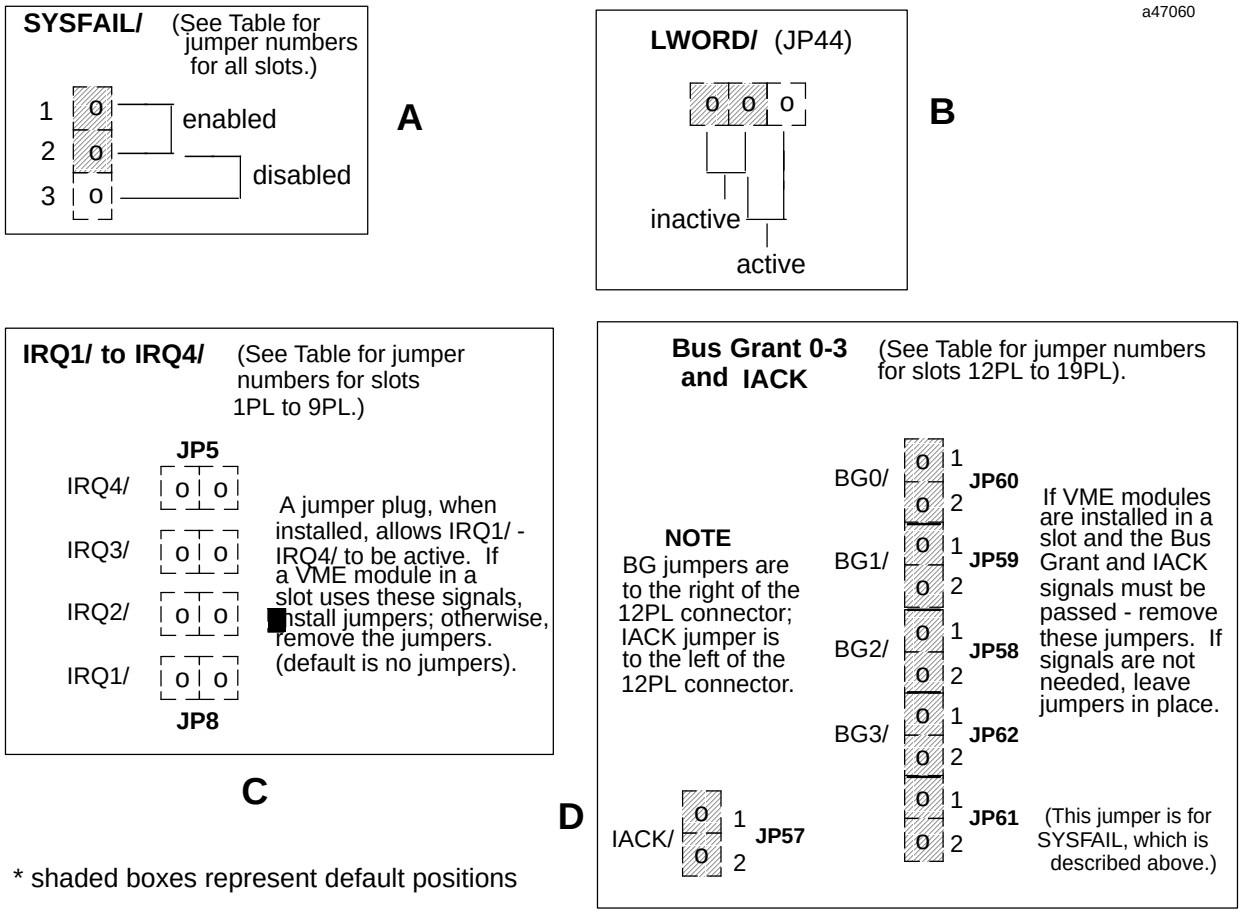
Default Jumper Configurations

The following table describes the jumper configuration for each of the configurable VME rack signals. The default configuration for each of these signals is shown below.

Signal Name or Function	See	Applicable Jumpers	Description
Rack ID Select	-	JP1 to JP4	Selects rack ID number 0 -7, see text for settings (*default rack ID = 0*).
SYSFAIL/	**A**	See Table for jumper numbers	Enabled or disabled for each slot (*default = enabled*).
LWORD/	**B**	JP44	Slot 1 only, set to active or inactive (*default=inactive*).
IRQ1/ to IRQ4/ (Interrupt lines)	**C**	See Table for jumper numbers	Select for IC697 module slots 1PL to 9PL. If VME module in slot uses these signals, install jumpers (*default = no jumpers*).
Bus Grant 0 - 3/ and IACK/	**D**	See Table for jumper numbers	If VME modules are installed that pass daisy chain signals, jumpers must be removed in VME slots 12PL to 19P (*default = jumpers*).

Factory default jumper positions are shown below with shaded areas representing a jumper that is present. ***The configuration example shown below is for slot 12PL. The physical arrangement for the other connectors is the same, only the jumper numbers (JPxx) are different.***

a47060



* shaded boxes represent default positions

The following table provides a list of the slots and jumpers associated with each slot. A configuration selection consists of a jumper plug that is placed over two adjacent pins. In some cases (such as LWORD jumper), this pin is placed over 2 of 3 in-line pins; other selections require the jumper plugs to be present or not be present. Multiple jumpers listed in a column under a signal are shown in the same numerical order as they appear on the backplane (that is, left to right or top to bottom).

Table 3-2. Jumper Location and Function

Slot Number	Bus Grant 0→3 Jumpers	IACK Jumper	Sysfail Jumper	IRQ1/ to IRQ4/ Jumper
1VME-12PL(1B)	JP60,59,58,62	JP57	JP61	-
2VME-13PL(2B)	JP53,54,55,51	JP56	JP52	-
3VME-14PL(3B)	JP66,65,64,68	JP63	JP67	-
4VME-15PL(4B)	JP72,71,70,74	JP69	JP73	-
5VME-16PL(5B)	JP78,77,76,80	JP75	JP79	-
6VME-17PL(6B)	JP84,83,82,86	JP81	JP85	-
7VME-18PL(7B)	JP90,89,88,92	JP87	JP91	-
8VME-19PL(8B)	JP96,95,94,98	JP93	JP97	-
1GEF-1PL(1A)	-	-	JP43	JP39,40,41,42
2GEF-2PL(2A)	-	-	JP38	JP5,6,7,8
3GEF-3PL(3A)	-	-	JP99	JP9,10,11,12
4GEF-4PL(4A)	-	-	JP45	JP13,14,15,16
5GEF-5PL(5A)	-	-	JP46	JP17,18,19,20
6GEF-6PL(6A)	-	-	JP47	JP21,22,23,24
7GEF-7PL(7A)	-	-	JP48	JP25,26,27,28
8GEF-8PL(8A)	-	-	JP49	JP29,30,31,32
9GEF-9PL(9A)	-	-	JP50	JP33,34,35,36

There are three basic configurations of modules that can be accommodated by the VME Integrator rack:

- Standard (Series 90-70 modules only);
- Series 90-70 controller and Series 90-70 modules and/or 3rd Party VME modules, or;
- 3rd Party VME modules only.

These configurations are explained in the sections that follow.

Standard Configuration

This configuration consists of a Series 90-70 CPU or Bus Receiver in slot 1PL and Series 90-70 modules in the remaining applicable slots (2PL to 9PL).

Note

Do not install Series 90-70 modules in VME slots 12PL to 19PL.

Standard Configuration Jumper Positions

- JP1 through JP4 (rack ID jumpers) jumpered to the proper position for Rack ID, where applicable.
- JP43 remains in its default position (as shipped from factory). This allows the SYSFAIL signal to be activated by the Series 90-70 CPU.
- JP44 remains in its default position. This jumpers the LWORD signal in slot 1 to be inactive allowing only 16-bit wide data transfers.
- All other jumpers remain in their factory set default positions.

Series 90-70/VME Configuration

This configuration consists of a Series 90-70 CPU or Bus Receiver module in slot 1PL *and* a combination of Series 90-70 modules and 3rd Party VME modules in the remaining slots. Series 90-70 modules can be placed in slots 2PL to 9PL only. 3rd Party VME modules can use VME slots 12PL to 19PL and slots 2PL to 9PL. Note that all slots have a jumper that allows you to disable the SYSFAIL/ signal to that slot by removing the appropriate jumper.

Note

Integration of 3rd Party modules must be in accordance with guidelines described in the *User's Guide to Integration of 3rd Party VME Modules*, GFK-0448B, or later.

Series 90-70/VME Jumper Positions

- JP1 through JP4 (rack ID jumpers) jumpered to the proper position for Rack ID.
- JP43 remains in its default position (as shipped from factory). This allows the SYSFAIL signal to be activated by the Series 90-70 CPU (SYSFAIL required by Series 90-70 I/O modules).
- JP44 remains in its default position. This jumpers the LWORD signal in slot 1 to inactive (for GE Fanuc modules) allowing only 16-bit wide data transfers.
- VME modules can be installed in either the Series 90-70 module slots (2PL to 9PL) or in the VME slots (12PL to 19PL).
  - If VME modules are installed in the Series 90-70 module slots (2PL to 9PL), and they use the IRQ1/ through IRQ4/ signals, then you must install the four jumpers in positions that are located to the immediate left of the Series 90-70 slots in use.
  - If the VME modules are installed in VME slots (12PL to 19PL), and the board must pass the Bus Grant and IACK signals, you must remove five jumpers for each slot being used. *Leave these jumpers in if the board does not need to pass the Bus Grant and IACK signals on a daisy chain.* These jumpers are the top four to the immediate right of the slot being used and the lower jumper (of two) to the immediate left of the slot being used.

VME Configuration

This configuration consists of a 3rd Party controller in slot 1PL and 3rd Party VME modules in the remaining slots (2PL to 9PL and 12PL to 19PL). Note that each slot has a jumper that allows the SYSFAIL/ signal to be disabled to that slot since all VME modules may not require access to that signal.

VME Jumper Positions

- To configure slot 1 for a 3rd Party Controller, five jumpers must be removed. The four jumpers behind the power supply (JP1 to JP4) must be moved to positions JP39 to JP42. Jumper JP44 must be moved from its default position to the right.
- If VME modules are installed in the Series 90-70 module slots (2PL to 9PL) and they use the IRQ1/ - IRQ4/ signals, then you must install four jumpers in the positions that are located to the immediate left of the Series 90-70 slots in use.
- If the VME modules are installed in VME slots (12PL to 19PL), and the board must pass the Bus Grant and IACK signals, you must remove five jumpers for each slot being used. *Leave these jumpers in if the board does not need to pass the Bus Grant and IACK signals on a daisy chain.* These jumpers are the top four to the immediate right of the slot being used and the lower jumper (of two) to the immediate left of the slot being used.

Slot Addressing

The Series 90-70 PLC system allows user configuration of I/O point references for modules in a rack without the need for board address DIP switches or jumpers. Configuration is done with the configurator function of the Logicmaster 90-70 or Control Programming Software package. For more information on configuration, see GFK-0263, the *Logicmaster 90-70 Programming Software User's Manual* or GFK-1295, the *Control User's Manual.*

Note

In order to configure slots 12PL to 19PL in a VME Integrator rack, you must have Release 4 (or higher) of Logicmaster 90-70 Programming Software, or Control ProgrammingSoftware.

Rack Number Selection

The Series 90-70 PLC determines the number (0 through 7) assigned to each rack in the system from four binary-encoded jumpers on the rack's backplane. These jumpers are located on the rack backplane directly adjacent to the power supply slot and must be configured before the power supply is installed. Rack number selection is the same for both standard Series 90-70 racks and VME Integrator racks.

To set the rack number, move jumpers 1, 2, and 4 to either the 0 or 1 position. The sum of the digits in the 1 position equals the desired rack number. Note that jumper 8 is always set to the "0" position (this jumper is not used by the Series 90-70 CPU).

For example, rack number 2 would have the 2 jumper in the 1 position and the 1, 4, and 8 jumpers in the 0 position. The following example shows the rack jumpers positioned to select rack number 2.

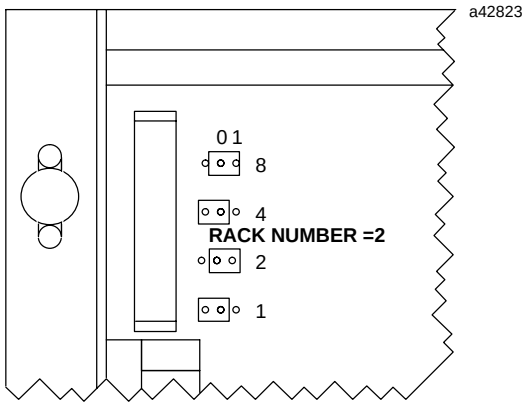


Figure 3-6. Rack Number Jumpers (Rack 2 Selected)

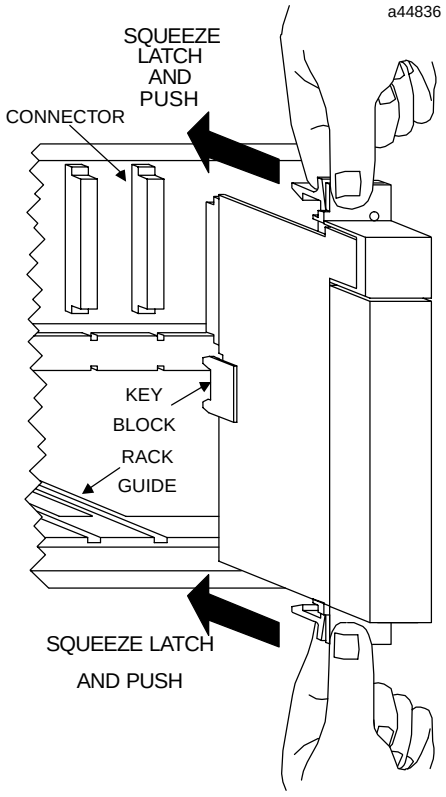
Inserting Modules

The following procedure is recommended when inserting a module into its slot in a rack:

1. **Ensure that the rack in which the module is to be inserted is powered-down**.
2. Grasp the module firmly with your hand and insert it into the card guide.
3. Align the module's printed circuit board with the connector on the rack backplane and slide it towards the connector until it has started to seat.
4. Place one thumb on the left side of the top plastic flange and the other thumb on the left side of the bottom plastic flange. Push the board into the connector until the top and bottom latches click onto the rack rails. Visually inspect the board to be sure it has seated properly.

Warning

Do not insert or remove a module when power is applied to the rack. This could cause the system to stop, damage the module, or cause personal injury to you. Use care when inserting or removing a module so that the printed circuit board and/or its components are not damaged.



Important - Place hands with thumbs on the **extreme left** side of module (to prevent board bowing and for insertion reference).

Figure 3-7. I/O Module Installation - First Time

I/O Module Installation Considerations

I/O modules have a key block for mechanical keying to prevent exchanging one module type for another. Guidelines for first-time installation were shown in the previous figure.

Removing a Module

The following instructions should be followed when removing a module from its slot in a rack:

1. Grasp the module firmly at the top and bottom of the board cover with your thumbs on the front of the cover and your fingers on the plastic clips on the back of the cover.
2. Squeeze the rack clips on the back of the cover with your fingers to disengage the clips from the rack rail and pull the board firmly to remove it from the backplane connector.
3. Slide the printed circuit board along the card guide and remove it from the rack.

I/O Module Replacement Considerations

The technique illustrated below is recommended when removing or replacing a module. If a key block has already been installed on the rack, insert the module **without** the key block.

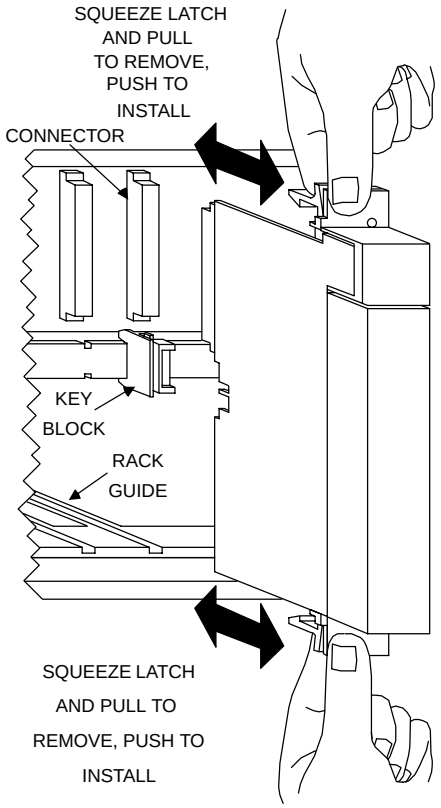


Figure 3-8. I/O Module Replacement

Rack Fan Assembly

The Rack Fan Assembly is an easily installed accessory for the Series 90-70 VME Integrator racks and standard Series 90-70 nine-slot racks. The Rack Fan Assembly is available in three versions, one for 120 VAC operation, one for 240 VAC, and one for 24 VDC operation.

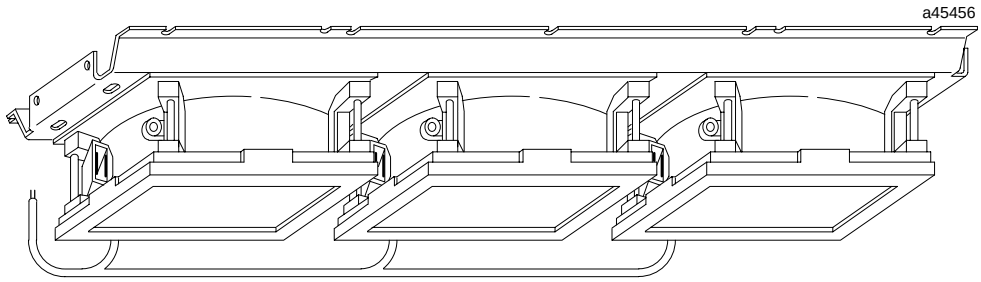


Figure 3-9. Rack Fan Assembly

It is recommended that the fans be wired to the same source of power as the Series 90-70 PLC so that the fans are energized regardless of whether or not the PLC is energized. This will ensure that the fans are running when the PLC is active.

AC Fan Assemblies

On the AC fan assemblies (ACC721 and ACC 724), the three fans are wired in parallel. The fan on the left (looking at front of rack) has a three-foot cable to be wired to the applicable 120 or 240 VAC power source. The other two fans are connected through a cable/connector assembly to this fan.

DC Fan Assembly

On the 24 VDC fan assembly (ACC724), each fan has a pair of 12" (310 mm), 24 AWG leads. These leads should be connected in parallel, with all of the Red leads connected to +24 Volts, and all of the Black leads connected to 24 Volt Common.

The following illustration shows the position of the fan assembly when it is mounted on a rack. Note that it is mounted on the bottom of the rack with air flowing from the bottom towards the top of the rack.

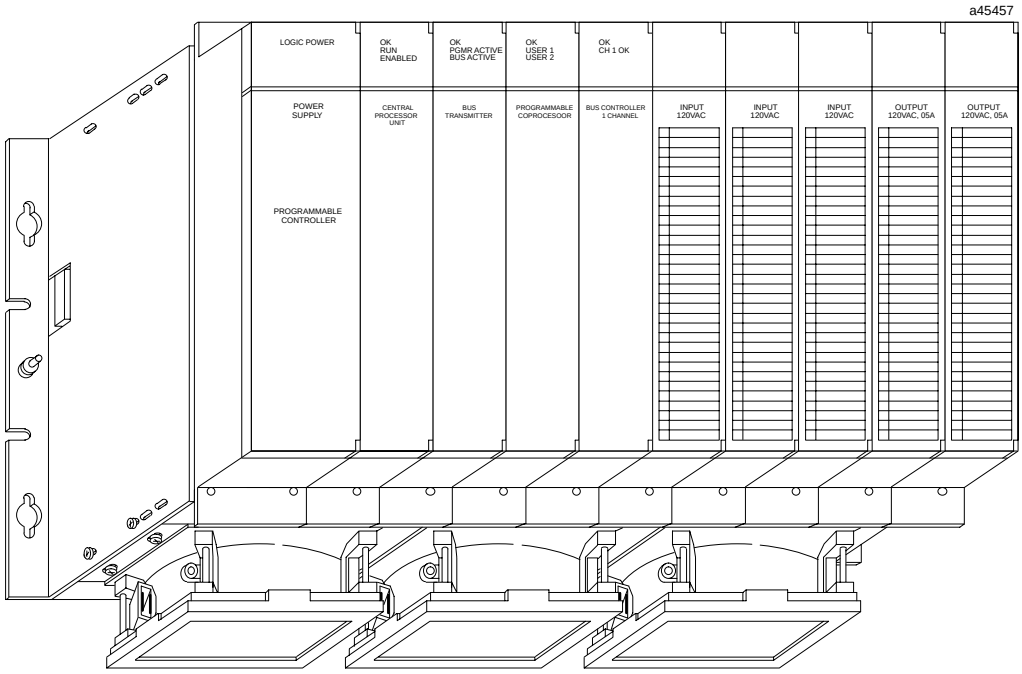


Figure 3-10. Fan Assembly Mounted on Rack

Installing the Fan Assembly

To install the fan assembly, follow the instructions outlined on the following page. Figure 3-12 shows the mounting details for the Fan Assembly and the optional mounting bracket. The optional brackets are required when mounting the Fan Assembly on earlier versions of racks (as described in Chapter 2).

Tools Required

Installation of the fan assembly is easy; the only tool you need is a #2 Phillips screwdriver.

Dimensions for Mounting

Dimensions of the Rack Fan Assembly for mounting are shown in the following figure.

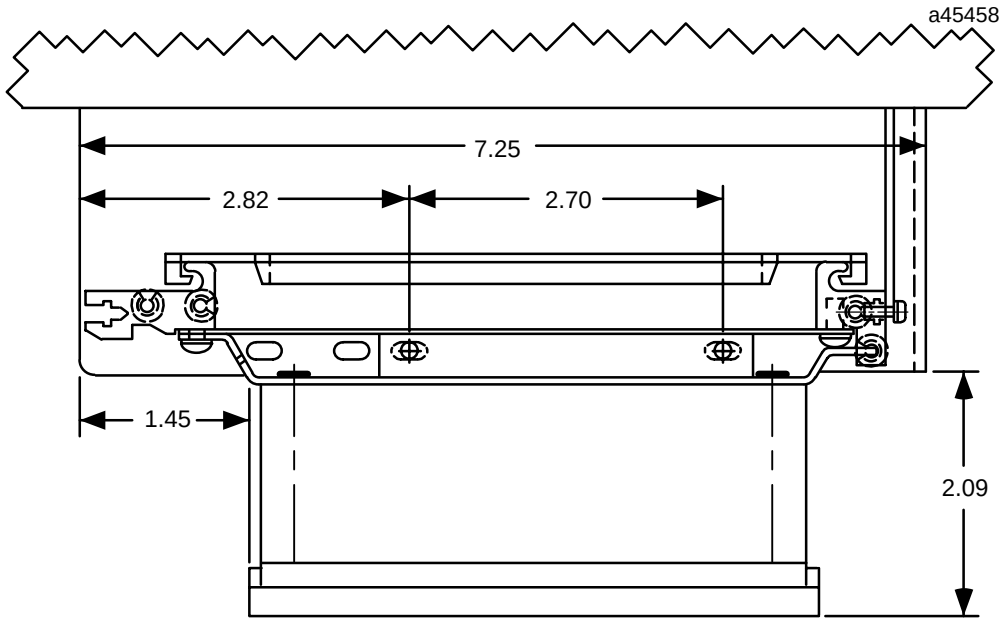


Figure 3-11. Rack Fan Assembly Dimensions for Mounting

Mounting Fan Assembly on Racks

1. Position the fan assembly on the bottom of the rack and slide the flange on the rear of the fan assembly (flange ***without*** slots) under the lip of the rear rail on the rack.
2. While doing this, align the two holes in each end of the fan assembly with the holes in the rack side plates.
3. Install two screws in each end and secure the fan assembly by tightening the screws to 10-12 in.-lbs.
4. There are two additional screws that must be installed in the front rail. Install these screws and tighten to 10-12 in.-lbs.

Mounting Fan Assembly on Earlier Versions of Racks (with Optional Bracket)

1. Slide the flange on the two optional brackets under the lip of the front and rear rails on the rack. The bracket tabs must face towards the rack side plates. Slide the brackets out towards the rack side plates.
2. Secure the brackets by aligning the two bracket holes with the two edge slots in each side plate.
3. Install two screws at each end and secure the bracket by tightening the screws to 10-12 in.-lbs.
4. Attach the fan assembly to the optional brackets with four screws, two at each end of the fan assembly. Secure by tightening the screws to 10-12 in.-lbs.

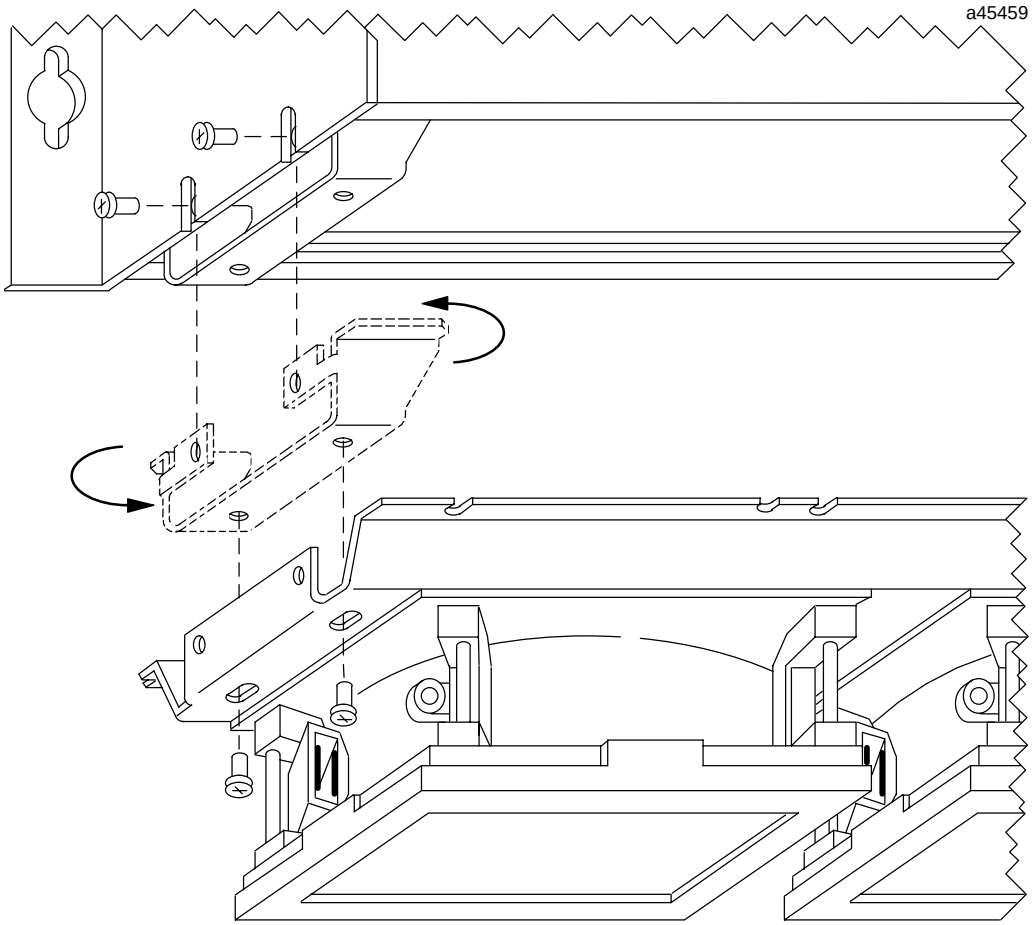


Figure 3-12. Mounting Details for Fan Assembly and Optional Mounting Bracket

Changing the Rack Fan Assembly Filter

Each fan has a polyurethane filter which can be removed and cleaned or replaced as needed. Removing a filter is easy; simply lift the tabs located on all four sides of the plasticretainer. Remove the filter and clean or replace it with a new filter. To replace a retainer, align the retainer with the filter assembly and snap the retainer back in place.

Details of the filter assembly are shown in the following figure.

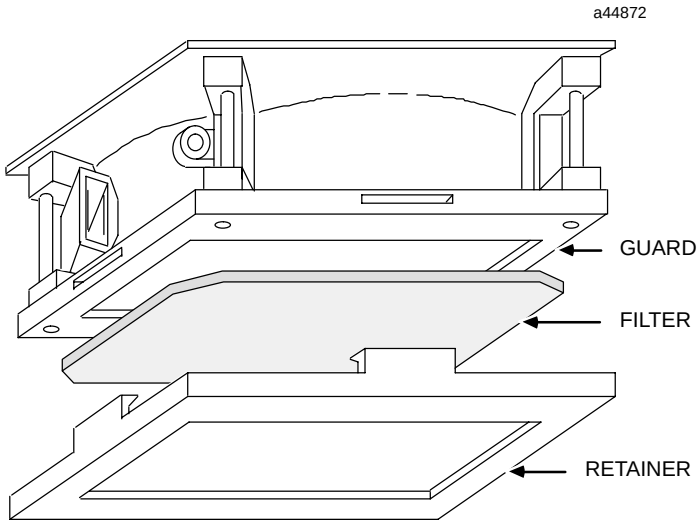


Figure 3-13. Filter Guard Assembly

Filter Elements

Replacement filter elements are available from Comair Rotron (manufacturer's catalog number 55416, 5 pack).

Blank Slot Interrupt Jumper Installation

The Blank Slot Interrupt Jumper for the Series 90-70 PLC, IC697ACC722, is an accessory that has been designed to allow you to reserve a slot in the Series 90-70 rack for future expansion. This jumper, when installed in a blank slot, allows for continuation of the interrupt signal through the backplane. Use of this board is required when there are modules installed to its right which may interrupt the CPU.

The Blank Slot Interrupt Jumper can be installed in a standard Series 90-70 CPU rack or expansion rack in slots 2 through 8 of a nine-slot rack or slots 2 through 4 of a five-slot rack. It is not necessary to reserve the last slot (slot 9 in a nine-slot rack or slot 5 in a five-slot rack). A rack will not operate properly if this jumper is installed in slot 1.

Note

The Blank Slot Interrupt Jumper, when installed, must be added to the system configuration using Logicmaster 90-70 or Control Programming software.

When installing the Blank Slot Interrupt Jumper, orient it as shown in the following figure.

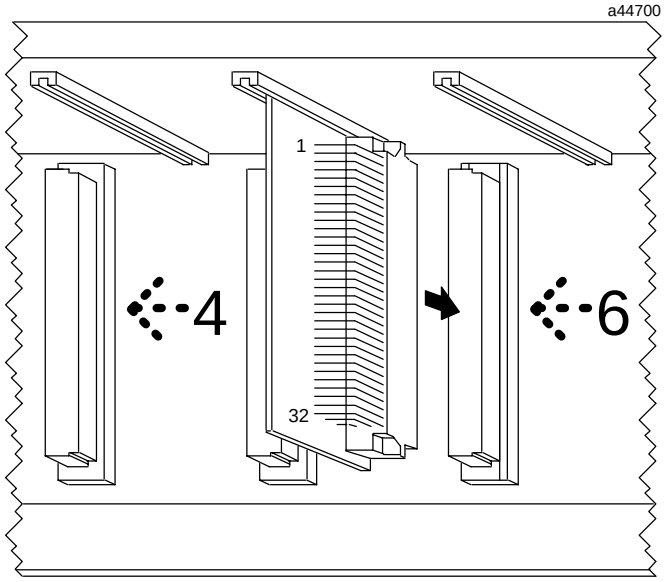


Figure 3-14. Installation of Blank Slot Interrupt Jumper

Configuration Considerations

If version 2.05 or earlier of Logicmaster 90-70 Programming software is being used, it is recommended that the Blank Slot Interrupt Jumper be configured as a Bus Transmitter Module (IC697BEM713), although any module may be used to reserve the slot. When the Blank Slot Interrupt Jumper is configured as a BTM (or any other module) and is stored to the PLC, the following message will appear on the programmer's screen:

WARNING: Configuration mismatch exists - see fault tables

In addition, a "Loss of ....." fault will be logged into the appropriate fault table. Logicmaster 90 and Control configuration software includes a selection for the Blank Slot Interrupt Jumper, IC697ACC722, on the screen accessed by the ***F8 - other*** function key. When the Blank Slot Interrupt Jumper is configured in versions later than 2.05, there will not be a mismatch when the configuration is stored to the PLC.

Backup Battery for RAM Memory

The CPU, PCM, ADC, Carrierband MAP Interface, Broadband MAP Interface, and Ethernet LAN Controller modules have battery-backed CMOS RAM memory. These modules are shipped from the factory with the battery disconnected from the board. Before powering on the CPU and before installing other modules, the long-life lithium battery (IC693ACC701) used to maintain the contents of the CMOS RAM memory in one of the modules listed above must be installed. The following figure shows the battery location.

The battery is accessed by opening the module faceplate door, and is mounted on two clips on the top front of the module as shown below. Connection is made by inserting the battery connector into one of two receptacles mounted on the module's printed circuit board.

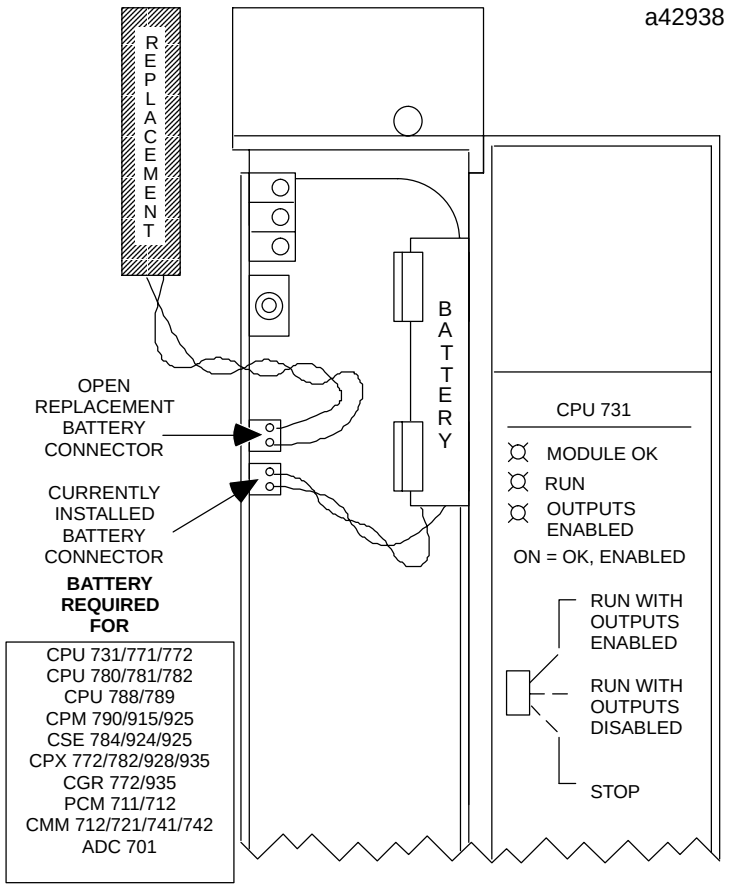


Figure 3-15. Location of Backup Battery for RAM Memory

Battery Installation

Warning

To avoid the chance of losing the contents of RAM memory, you can carefully perform the following steps with PLC power ON. This procedure should only be performed by qualified electrical personnel who are trained in applicable electrical safety rules and procedures. Failure to follow standard electrical safety practice can result in injury or death to personnel, damage to equipment, or both.

Initial Battery Installation

When connecting a battery, the following procedure is recommended.

1. Open the module faceplate door and observe the battery mounting clip on the right side of the faceplate housing, and the battery connector clips on the left side.
2. Firmly place the battery in its mounting clips with the cable end facing down.
3. Orient the battery connector with the mating receptacle on the board.
4. Using a pair of needlenose pliers to hold the connector, push the battery connector into the receptacle on the board.
5. Close the module faceplate door.

Replacing a Battery

If a battery is to be replaced, use the following procedure:

Note

The battery can be replaced with power applied to the rack and the CPU in RUN or STOP mode.

1. Open the module faceplate door and remove the battery from its clip without disconnecting the battery.
2. Firmly place the replacement battery in its mounting clips with the cable end facing down.
3. Orient the battery connector with the mating receptacle on the board.
4. Using a pair of needlenose pliers, push the new battery connector into the receptacle on the board. Remove the old battery cable from its receptacle and discard the battery.

   You can pull on the old battery cables to remove them from the receptacle as long as you do so carefully; however, it is recommended that you use a pair of needlenose pliers for grasping the battery connector. Be careful not to dislodge the new battery cables.
5. Close the module faceplate door.

Warning

Observe the following precautions when handling a lithium battery: do not discard the battery in fire; and, do not attempt to recharge the battery. The battery may burst, burn or release hazardous materials.

Be sure that the board covers provided with the CPU and PCM modules are in place before installing these modules.

Caution

Do not attempt to remove the back cover on any circuit board. Failure to observe this caution may result in an electrostatic build-up and discharge. This discharge may result in damage to CMOS circuits or may cause discharge of the non-rechargeable lithium battery and the loss of memory contents.

Clearing Memory Contents

If you do not wish to retain the contents of the battery-backed memory, do the following when installing a new or replacement module which has a battery already mounted. Prior to inserting the module into the rack, disconnect the battery cable from its receptacle and short the contacts on the board receptacle.

- You can remove the battery connector by carefully reaching into the battery cavity with your fingers (do not use a metal object to do this) and unplug the battery connector.

Shorting the contacts on the battery holder receptacle will discharge the battery circuit and permit all the memory contents to be lost, ensuring that when you power up, the memory will appear to the software as unused memory.

Note

After you have cleared the memory contents as described above, be sure to reconnect the battery before installing the CPU or any other module with a battery.

Battery Replacement/Memory Protection Factors

Since there are differences in each PLC application, each user will have to determine on an individual basis what strategy to use. There are several factors to consider when planning a battery replacement/memory protection strategy:

- How critical is the application? Will considerable loss be sustained if the PLC goes down? If so, frequent replacement of the battery would be a wise choice. For critical applications, the cost of a battery would be quite low in comparison to the cost of a PLC shut-down.
- How readily can a backup program be loaded? Are there technicians on-site who know how to load a backup program? Is the backup program accessible at all times to those responsible for maintaining the equipment? Is a personal computer or equivalent equipped with GE Fanuc programming software available at all times for use in loading the backup program?
- Do you have a preventive maintenance program? A formal program would help ensure that the battery is replaced on time. Some users replace the backup battery each year during their annual shut-down period.
- How accessible is the PLC? In some applications, the PLC may be mounted in a remote location that is not easily accessed.
- Safety codes. Some users may have safety rules that would not allow replacing the battery with power applied.
- How is the PLC used? Is power left on all the time, or is it shut down every day? See the heading "Factors Affecting Battery Life."

The Importance of Backing up your Program

Experience has shown that regardless of what strategy you use to maintain PLC memory, you should, additionally, always keep an up-to-date backup copy of your application program. The effort required to create and maintain a backup copy is very small compared to the work required to reprogram, or re-key from hardcopy, your entire application if, due to some misfortune, it was lost. Other suggestions to help minimize down time:

- Make sure the backup copy is readily accessible to those who may need to use it.
- Train more than one person to load the backup program in case that one person is not available when needed. Information on creating a backup can be found in GE Fanuc 's software user's manuals. This procedure is also covered in applicable GE Fanuc programming software training courses.
- Ensure that a suitable computer (usually a laptop type) is equipped with GE Fanuc PLC programming software and will be readily available to load the backup program to the PLC.
- Create a written backup procedure. Fortunately, restoring your program from the backup copy is probably not something you will do very often. As a result, however, some of the steps could easily be forgotten.

Factors Affecting Battery Life

Replacing your battery once per year is a good rule of thumb. However, no one can predict precisely how long a backup battery will last because this depends upon what

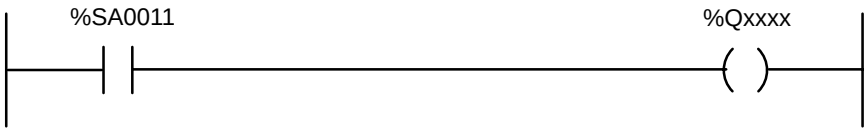
CPU is used, what temperature it is subjected to, and how it used. Considering the following list of factors that affect battery life will help you decide how frequently to replace the battery in your application:

- A battery that is not in use has an estimated life (called its "shelf life") of 5 years at "room temperature" (25 degrees C, or 77 degrees F).
- A battery that is used continuously (supplying current to memory circuits with PLC power off) has an average estimated life of 6 months, if used at room temperature.
- As long as a PLC is powered up, its battery is not being used; so how often you power down your PLC has a direct affect on battery life. Some users keep their PLC powered up all of the time while others turn theirs off every night.
- Temperature has a relatively large affect on battery life. Temperaturesconsiderably above room temperature (25 degrees C, or 77 degrees F), or below freezing (0 degrees C, or 32 degrees F) will appreciably shorten battery life.
- The type of CPU has a small affect on battery life. Some CPUs have more memory than others. Also, some CPUs have a clock and some do not. More memory requires more battery current to maintain its contents; and a clock requires battery current to maintain its operation.

Low Battery Warning Methods

There are three basic ways that the PLC warns of a low battery:

- The MODULE OK LED at the top of the module will not stay on during power—up diagnostics when the battery is low. The disadvantage of this method is that the PLC is often mounted in an enclosure, so this LED might not be easily seen.
- The PLC Fault Table is updated with a battery low message. Viewing the PLC Fault Table requires that a programmer be connected to the PLC.
- Certain System Reference bits are set to logic 1 when the battery is low. These are %S0014 (PLC_BATT), %SA0011 (LOW_BAT), %SC0009 (ANY_FLT), %S0010 (SY_FLT), and %SC0012 (SY_PRES). The most specific is %SA0011 (LOW_BAT). This bit could be used as a contact in your ladder logic program to turn on an output that controls a warning light on an operator panel (as in the example rung below), or to send a warning to an operator interface terminal.



In the rung shown above, the %SA0011 contact will close when a low battery is detected by the PLC. This will turn on the %Q output coil, which addresses an output module's output that will turn on a warning light. An alternate method would be to communicate the status of the coil (which, in that case, would probably be a %M coil) to a Human to Machine Interface (HMI) terminal such as a GE Fanuc CIMPLICITY HMI unit. The HMI could be programmed to display a warning message when that particular bit goes to a logic 1. For more information about System Reference bits and ladder logic programming, see the the *Series 90-70 PLC Reference Manual for Logicmaster Users*, GFK-0256 or the *Series 90-70 System Manual for Control Software Users*, GFK-1192.

Operating Without a Memory Backup Battery

Whether it would be to your advantage to use a battery-less scheme depends on your application. There are various advantages and disadvantages to consider in making your decision.

Possible Advantage

The obvious advantage of operating without a memory backup battery is that you are freed from the need to maintain the battery. To be able to run without a battery, you need to have a CPU that has non-volatile flash memory. Table 1-1 shows which CPUs have flash memory boards. These devices can store program logic, configuration, and register values without the need for a backup battery.

Possible Disadvantages

Information is not stored to your Flash PROM device automatically. To store information, you must use a programming device to tell the CPU to write the current PLC (RAM) memory contents to the PROM device. This requirement may make battery-less operation undesirable for many users. For example, in many applications, important data is gathered and stored in RAM register memory, data such as the current level of material in a tank that is being filled, or a running count of parts produced, etc. This constantly changing data is not being copied automatically to the PROM device. It only exists in RAM memory. Therefore, if power is lost and there is no RAM memory backup battery, this data will be lost.

However, one way to preserve data in a battery-less system is to send it over a network to a computer that can store the data on its hard drive. Also, static data (data that doesn't change) contained in RAM memory, such as mathematical constants or look-up table type information, can be stored initially in PROM and automatically written back to RAM each time the PLC powers up.

Another consideration is that if you change your program (or configuration), someone will have to remember to write the changed information to the flash memory device. If that step is forgotten, then the change only exists in RAM memory, and in a battery-less system, it will be lost the next time power is removed from the PLC.

Reading, Writing, Verifying Flash Memory

Here are the basic steps for using flash memory (operation with Control programming software is described). Refer to GFK-0263G, or later revision of the *Logicmaster 90-70 Programming Software User's Manua*l for details on using Logicmaster 90 software to do the flash operations.

1. Refer to the data sheet for individual CPUs for information on availability of flash memory for that CPU. Flash memory allows you to store Equipment Folder data to the flash memory device on the memory expansion board . The following flash memory features are available:

   Read: Allows you to read selected contents of flash memory into the PLC CPU.
   Write: Allows you to write selected contents of PLC memory into flash memory.
   Verify: Allows you to verify that the contents of flash memory match those of the CPU.

2. Confirm that you are connected to the PLC and are online. If the PLC connection is lost during the load operation, the Load from PLC dialog box will display the message "NOT Connected to PLC".
3. Select the Tools menu, choose Transfer Utilities, then choose Flash. The Read/Write/Verify Flash Memory dialog box will appear.
4. Three folder components will be available: Hardware Configuration, IEC Resource (Logic), and Global Vars (Ref Tables). Select the folder components you want for the flash operation. You can select individual components by clicking on them. To select all components, click the Select All button. To deselect all components listed, click the Deselect All button.
5. Select the flash operation by clicking the appropriate button on the left side of the dialog box (either Read, Write, or Verify). The top button on the right side of the dialog box indicates which flash operation is selected. (If you change the flash operation selection, it will change.)
6. To start the flash operation, click the top button on the right side of the dialog box.
7. When the clear operation is complete, a dialog box appears indicating success or error will appear.

Determining Battery Age Using Battery Date Code

Battery age can be determined from the date code stamped on the battery.

The battery, manufactured by Panasonic, will have a four-digit date code. It will be something like 5615 or 7Y34. Use the following information to determine the date of manufacture.

- First digit shows the year in a rotating 10-year cycle. For example, 0=1990, 1=1991, 2=1992 ... 9=1999, 0=2000, 1=2001, 2=2002, etc. This seeming duplication should not be a problem because the shelf life of these batteries is 5 years. Batteries in inventory that are older than 4 years old should be discarded according to the manufacturer's instructions (since they have less than one year of life remaining we would not recommend using them in a PLC). This will ensure that outdated batteries are not mistaken for newer batteries.
- Second digit shows the month. 1=January, 2=February, 3=March, 4=April, 5=May, 6=June, 7=July, 8=August, 9=September, O=October, Y=November, Z=December.
- Third digit shows the week of the month.
- Fourth digit shows the day of the week. 1=Monday, 2=Tuesday, 3=Wednesday, 4=Thursday, 5=Friday, 6=Saturday, 7=Sunday.

For example, the code 7612 is interpreted as:

Manufactured on June 3, 1997

RAM Memory Battery Backup Connection Path

CMOS RAM memory is a volatile type of memory, which means that it can lose its contents (ladder program, configuration, etc.) if power is removed. To retain RAM memory contents under no-power conditions, a long-life lithium battery is provided. This battery is normally mounted in the CPU, PCM, CCM, or ADC module. To avoid accidental disconnection of the

memory backup battery, it is beneficial to know the connection path between the battery and the memory circuits:

The battery connection path to RAM memory is simply through the modules battery connector to the RAM circuits inside the CPU module.

If the battery connection between the backup battery and the RAM memory circuits was broken, the contents of RAM memory would be lost. ***To avoid the possible problems associated with losing the contents of RAM memory, we recommend that you maintain an up-to-date backup copy of your program folder.*** Instructions for creating program folder backups can be found in the *Logicmaster 90-70 Programming Software User's Manual,* GFK-0466, *Control User's Guide*, GFK-1295

I/O Expansion Bus Termination

When two or more racks are cabled together to form a Series 90-70 PLC expansion system, the I/O expansion bus must be properly terminated. To accomplish this, each Bus Receiver Module (BRM) is shipped with a termination resistor pack (IC697ACC&02). This pack is built into a connector and is installed on the lower connector on the BRM. Since only the last BRM on the bus may have the packs installed, in a system with three or more racks, the packs in the intermediate BRMs must be removed. To remove a pack, simply disconnect it from the lower connector. Unused packs may be discarded.

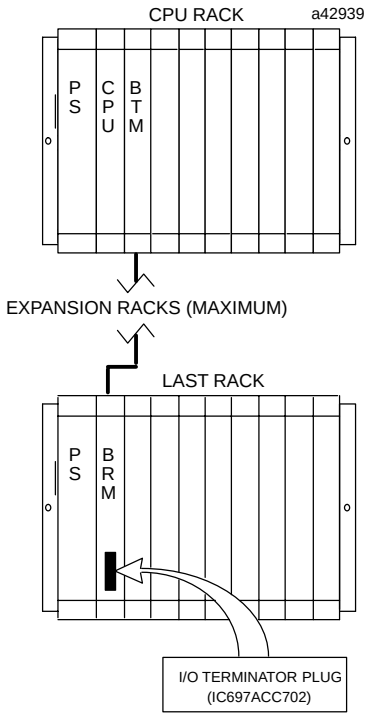


Figure 3-16. Terminator Plug Installation

The middle LED on the BRM is on when the termination resistor pack is installed. Only the last BRM on the bus, the one that has the terminator plug installed, should have its middle LED steady on. The middle LED on all other BRMs should be off.

I/O Bus Termination in a Redundant CPU System

In a Hot Standby CPU Redundancy system, the I/O bus must be terminated at the Redundancy Communications Module (RCM), which allows for easy replacement of a faulty RCM module. This is done by using a cable that has the termination resistors built into the connector that is installed on the RCM. These cables are available in two lengths, which are; IC697CBL811 (10 feet/3 meters) and IC697CBL826 (25 feet/7.5 meters). Refer to GFK-0827, *Hot Standby CPU Redundancy User's Guide*, or GFK-1527, *Series 90-70 Enhanced Hot Standby CPU Redundancy User's Guide* for information.

CMOS Expansion Memory Board Installation for Model 771/772 CPUs and PCM

CMOS expansion memory boards IC697MEM713/715/717/719 provide the required storage for application programs and program data on CPU model 771 and 772, and expansion memory for application program storage on the PCM. The same boards are used on both the CPU and PCM modules. The boards mount on a single connector on the CPU or PCM as shown in the figure below.

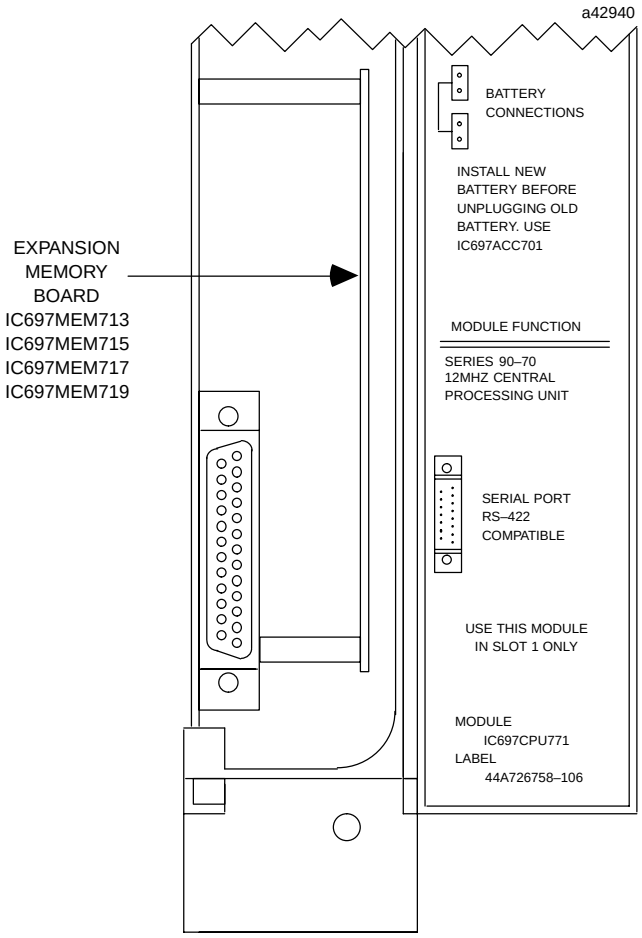


Figure 3-17. Expansion Memory Board Location on CPU Models 771/772 and PCM

Installation Instructions

1. Carefully align the pins on the bottom side of the board with the connector on the CPU or PCM.
2. Align the holes on the opposite end of the board with the expansion board standoffs.
3. Push the board onto the connector.
4. Ensure that the board is fully seated and that all stand-offs are snapped securely into both boards.

CMOS Expansion Memory Board Installation for 32-Bit CPUs

CMOS expansion memory boards IC697MEM731/732/733/735 are compatible with CPU models 780, 781, 782, 788 and 789. Additionally, the IC697MEM735 expansion memory board is installed on model CPM 915 and State Logic CPU model CSE 784 at the factory and is the standard on-board memory size for those CPUs. Memory on these expansion memory boards is arranged in a 32-bit wide configuration for compatibility with the 80386DX 32-bit microprocessor used in CPU models 780/781/782/ 788/789 and the CSE 784, and the 80486DX used in the CPM 915 (80486DX2 for CPM 925 and CSE 925).

Note

The remaining Series 90-70 CPU models have a minimum 512 KByte memory board installed at the factory.

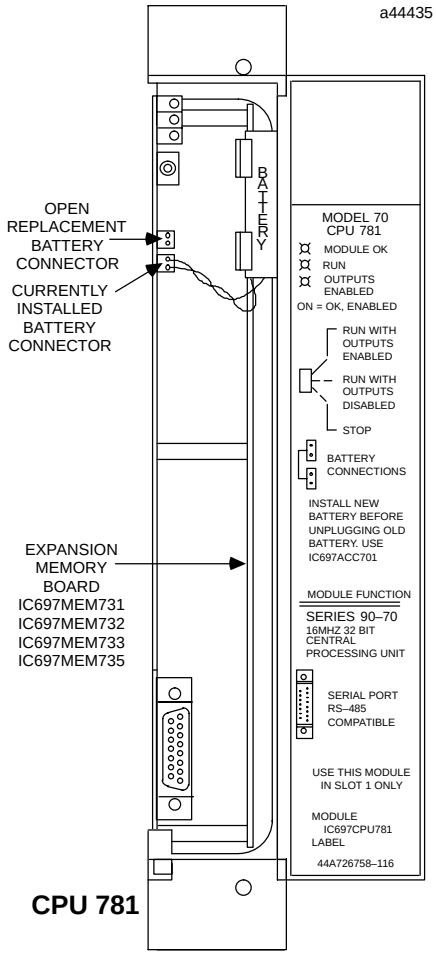


Figure 3-18. Expansion Memory Board Location on Models CPU 780/781/782/788/789 and CPM 915/925 (CPU 781 shown)

Installation Instructions

1. Align the expansion memory board and CPU connectors.
2. Carefully align the captive screws on the expansion memory board with the standoffs already installed on the CPU board.
3. Push the expansion memory board onto the CPU connector making sure that the mating screws remain aligned with their respective standoffs.
4. Fasten each expansion memory board screw into the standoff with a #1 Phillips screwdriver.

Module Installation Requirements

The modules for your system should now be installed in their proper slots in the CPU and I/O expansion racks. The Power Supply, CPU, and BRM modules must reside in specific slots as shown in the following illustration. It is recommended that the BTM, if required in a system, be installed in slot 2. For additional information on specific slot requirements, refer to the manual or data sheet for the applicable product.

Caution

Before installing modules in racks, ensure that the total load requirements of the modules for each rack do not exceed the total current supplied by the rack power supply. When using one power supply to power two racks, ensure that the load calculations include the modules to be installed in both racks. If this caution is not followed, erratic system operation may result.

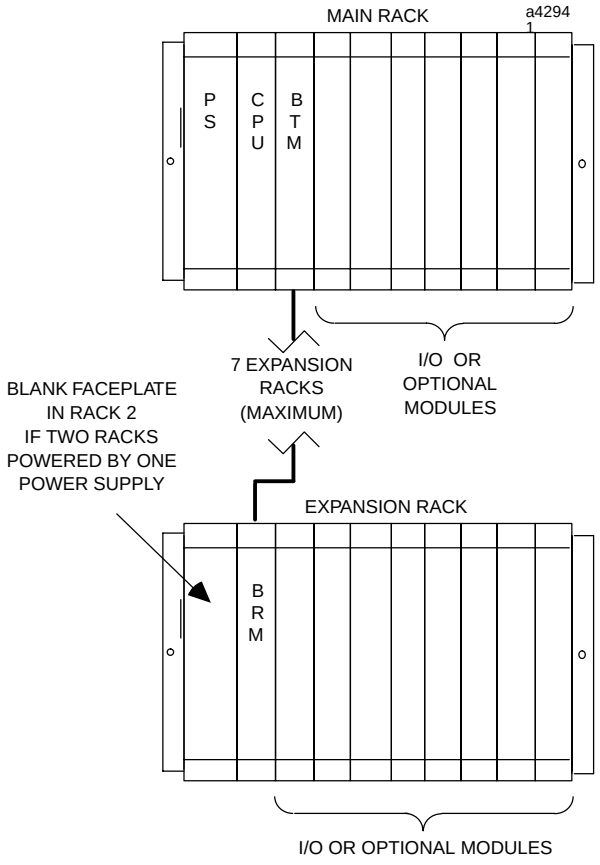


Figure 3-19. Location of Modules in Racks

The Programmable Coprocessor Module, Genius Bus Controller Module and Series 90-70 I/O Modules may be placed in any slot in any rack with the following precautions:

- The Configuration Files created by the Configuration Software Package must match the physical configuration of the modules. If they do not, the programmable controller may not operate, because one or more faults will be logged in the PLC Fault Table.

- When Programmable Coprocessor Modules and Genius Bus Controller modules are in a rack, all slots to the left of these modules must be occupied. If any of these slots is empty, these intelligent option modules will not be able to register interrupt requests with the CPU.
- Series 90-70 Input Modules which are not configured for Input point 1 to interrupt the CPU when an input transition occurs may be placed in any available slot. When Series 90-70 Input Modules are configured for Input point 1 to interrupt, there must be no empty slots to the left of the I/O Module.

When installing a module, position the component side of the board to your right, away from the power supply. As a check, a module is properly oriented for installation when the LEDs are positioned at the top of the module's front edge.

AC Power Supply Input Voltage and Grounding

Note

The following information is valid for the AC input only power supply, catalog number IC697PWR711, versions A and B. Version C (IC697PWR711C) of this power supply is an AC/DC power source input supply.

The power input terminal board on the AC supply provides two points for connecting 120 V or 240 V power and two additional points which must be shorted together if line voltage is 120 V and must be open if line voltage is 240 V. Power input connections should be made with copper AWG #16 (1.33 mm^2) wire rated for 75°C (167°F).

It is recommended that the GND terminal on the power supply be connected to the GND terminal on the rack and to earth using copper AWG #12 (3.31 mm^2) wire rated for 75°C (167°F) and a ring terminal to ensure adequate grounding. Use of a nut and star washer for each wire on the GND lug is recommended.

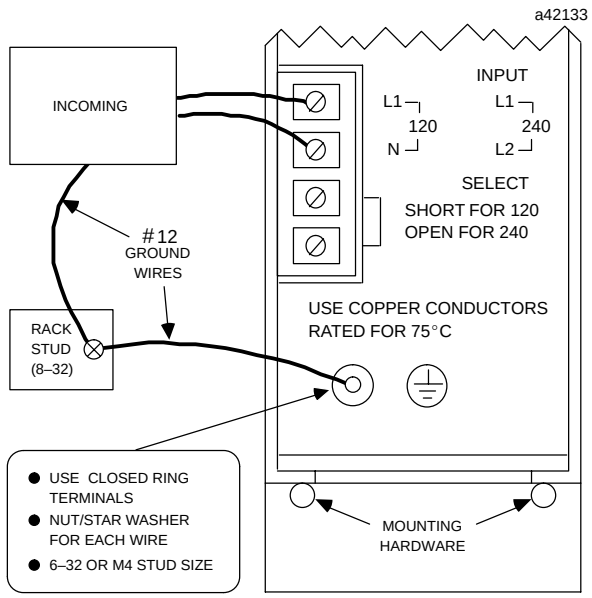


Figure 3-20. AC Power Supply Terminal Board and Connections

AC/DC Power Supply Installation

The power supply with catalog number IC697PWR710, version A, B, and C, accepted only 120 or 240 VAC input power source. Version D or higher (current version is H) of this power supply accepts 120/240 VAC or 125 VDC input power source. The following installation information also applies to IC697PWR711, version C or higher (current version is H), a 100W 120/240VAC/125VDC power supply. A power supply can be used in either a CPU rack or an expansion rack.

1. After unpacking the AC/DC power supply, install it in the leftmost slot in a rack. This slot is labeled PS on the backplane.
2. Secure the power supply in its slot by fastening the screws at the top and bottom of the supply. The power supply has a single terminal board for field wiring connections, which is located on the lower part of the faceplate.

Caution

Ensure that the top and bottom power supply screws are securely fastened. These screws provide a solid ground connection between the power supply and rack, as well as mechanical support. Failure to follow this procedure may result in erratic system operation.

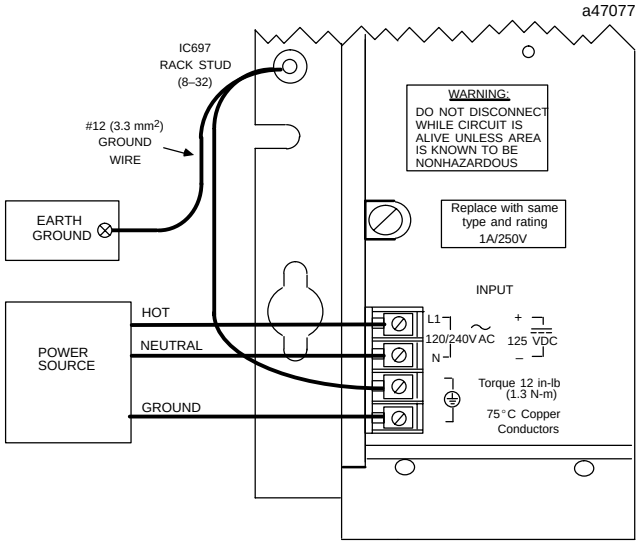


Figure 3-21. AC/DC Power Supply Terminal Board and Connections

Throughout the following sections, please refer to the illustration of the terminal board on the AC/DC power supply provided above.

AC Power Source Connections for AC/DC Power Supply

1. Provide the required AC power source for your system. This supply is a wide-range supply and will accept an AC input of 90 to 264 VAC.
2. Open the door protecting the board and make the following connections.
3. Connect the hot (L1, black wire) and neutral (N, white wire) wires of a three-wire AC power cord to the upper two terminals on the terminal board as shown in the illustration and the safety ground wire (green wire) to one of the two bottom ground terminals on to the terminal board. The power cord plug should have the proper pin configuration for either 120 VAC or 240 VAC.

Warning

If the same AC power source is used to provide AC power to other racks in a Series 90-70 PLC System, ensure that all AC input connections are identical at each rack. Do not cross Line 1 (L1) and Line 2 (L2). A resulting difference in potential could injure personnel or cause damage to equipment. The same ground must be used on all racks.

4. After these connections have been completed, carefully reinstall the protective cover plate.

Warning

Ensure that the protective cover is installed over all terminal boards. During normal operation, either 120 VAC or 240 VAC is present on the AC Power Supply. The cover protects against accidental shock hazard, which could cause severe or fatal injury to the operator or maintenance personnel.

DC Power Source Connection

1. Provide the required 125 VDC power source (100 to 150 VDC) for your system.
2. Open the door protecting the board and make the following connections.
3. Connect the positive (+) wire from the DC power source to the top terminal on the terminal board and the negative (−) wire to the second terminal from the top on the terminal board.

Ground Connection

It is recommended that one of the two bottom ground terminals on the power supply be connected to the GND terminal on the rack and to earth using copper AWG #12 (3.3 mm^2) wire rated for 75°C (167°F) to ensure adequate grounding.

DC Power Supply Installation

The 24 VDC (IC697PWR724) and 48 VDC (IC697PWR748) power supplies are rack-mounted modules that plug directly into a 48-pin backplane-mounted connector in the left-most slot in the rack. They provide +5 volt, +12 volt and -12 volt power, and logic level sequencing signals to the backplane. Both supplies are rated at 90 watts maximum total power for all three outputs.

The 24 VDC or 48 VDC power supply module can be used in either of two ways: in a single rack application; or, to provide power to a second rack if the total load is within the supply rating. Interconnection to the second rack is made through a prewired cable (IC697CBL700) available from GE Fanuc. Protection is provided for overcurrent and overvoltage fault conditions.

DC Power Source Connections

The power input terminal board provides two terminals (top terminal is for positive (+) connection, second terminal is for negative (–) connection) for connecting 24 VDC or 48 VDC power and an additional terminal (third terminal) for system and noise ground. Power input connections should be made with copper wire rated for 75°C (167°F).

It is recommended that the GND terminal on the power supply be connected to the GND terminal on the rack and to earth using copper AWG #12 (3.3 mm^2) wire rated for 75°C (167°F) and a ring terminal to ensure adequate grounding. Use of a nut and star washer for each wire on the GND lug is recommended.

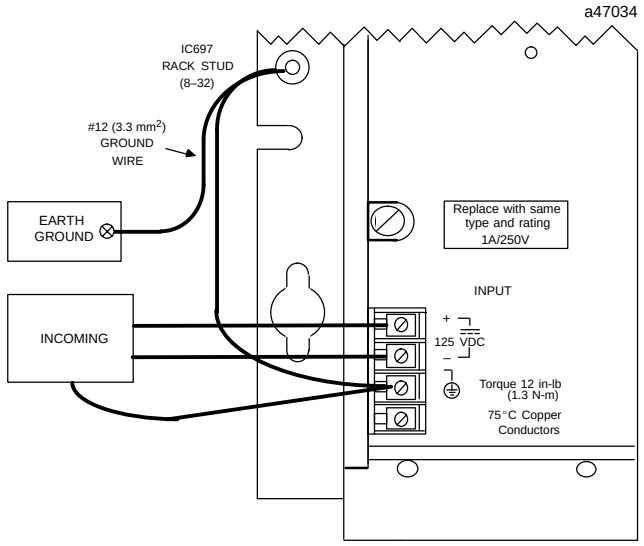


Figure 3-22. DC Power Supply Terminal Board and Connections

Warning

Because the power ON/OFF switch does not disconnect power from the internal storage elements, it is possible for the input terminals to discharge to user wiring when power is reapplied. To prevent this condition, turn the power supply switch on after the removal of user input power to discharge all stored energy through the supply.

Power Supply Installation for Floating Neutral (IT) Systems

When the power supply is installed in a system where the Neutral line is not referenced to Protective Earth Ground, the following special installation instructions must be followed to prevent damage to the power supply.

Definition of Floating Neutral Systems

A *Floating Neutral System* is a system of power distribution wiring where Neutral and Protective Earth Ground are not tied together by a negligible impedance. In Europe, this is referred to as an IT system (see IEC950). In a *Floating Neutral System*, voltages measured from input terminals to protective earth ground may exceed 264 Volts AC maximum input voltage as specified in the power supply specifications (see data sheet for Series 90-70 power supplies). The example system below would need to be installed using the special installation instructions that follow.

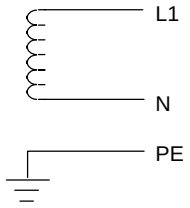


Figure 3-23. Example of Floating Neutral System

Systems in which one leg of the power distribution wiring is tied to Protective Earth or a tap between two legs of the power distribution wiring is tied to Protective Earth are not *Floating Neutral Systems*.

The example systems below do not require any special installation instructions.

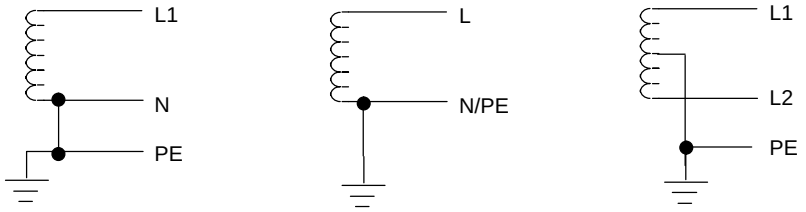


Figure 3-24. Examples of Non-Floating Neutral Systems

Special Installation Instructions for Floating Neutral Systems

1. The input power terminals should be wired according to the instructions in the applicable power supply data sheet.
2. The factory installed jumper between terminals 3 and 4 of the power supply module must be removed.
3. Voltage surge protection devices, such as MOVs, MUST be installed between the following terminals:

- □ From L1 to earth ground
- □ From L2 (Neutral) to earth ground

The voltage surge devices must be rated such that the system is protected from power line transients that exceed *Line voltage + 100V +*$(N-PE)_{MAX.}$

For example, in a 240 Volt AC system with neutral floating 50V above earth ground, the transient protection should be rated at:

$$240V + 100V + 50V = 390V$$

System Grounding Procedures

All components of a programmable logic control system and the devices it is controlling must be properly grounded. This is particularly important for the reasons listed below.

- A low-resistance path from all parts of a system to earth minimizes exposure to shock in the event of short circuits or equipment malfunction.
- The Series 90-70 PLC system requires proper grounding for correct operation.

The importance of a properly grounded system cannot be over emphasized.

Ground Conductors

- Ground conductors should be connected in a tree fashion with branches routed to a central earth ground point. This ensures that no ground conductor carries current from any other branch. This method is shown in the figure below.
- Ground conductors should be as short and as large in size as possible. Braided straps or ground cables (typically green insulation with a yellow tracer - AWG #12 (3.3 mm^2) or larger) can be used to minimize resistance. Conductors must always be large enough to carry the maximum short circuit current of the path being considered.

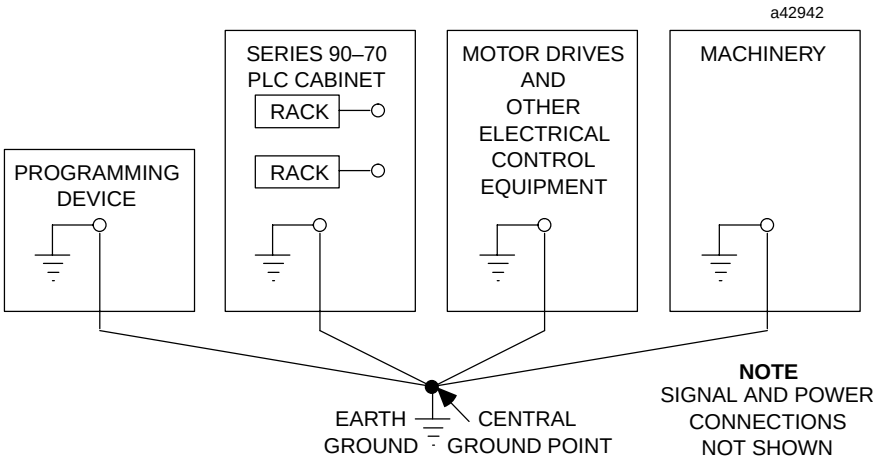


Figure 3-25. Recommended System Grounding

Series 90-70 PLC Equipment Grounding

Equipment grounding recommendations and procedures are listed below. These grounding procedures must be properly followed for safe operation of your Series 90-70 PLC system.

Safety and Reference Ground

- Safety and Reference ground connections should be made from the GND terminal on the rack to earth ground using minimum AWG #12 (3.3 mm^2) wire and a ring terminal. Use of a nut and star washer for each wire on the GND lug is recommended to ensure adequate grounding.

Warning

If the ground lug on the rack is not connected, the rack is not grounded. The rack must be grounded to minimize electrical shock hazard which may result in severe personal injury or fatality.

- Bottom mounting hardware for the power supply must be tightened to assure power supply-to-rack grounding.
- All racks that are grouped together in a Series 90-70 PLC system MUST have a common ground connection. This is especially important for racks which are not mounted in the same control cabinet.
- The best way to provide ground connections is to ensure that the Series 90-70 PLC rack metal frames are directly connected to the control panels or racks in which the racks are mounted. This should be accomplished by connecting a ground strap from one of the ground lugs on either side of the rack to the control panel or cabinet. Be sure to follow applicable electrical safety codes.

Shield Ground

- The bottom rail of the rack is used for module shield grounding. Some Series 90-70 PLC modules have a ground clip that contacts the conductive bottom rail when the module is fully inserted. Shield connections in the user connector are routed to this ground clip through conductors on the module.

Programming Device Grounding

- For proper operation, the programming device (personal computer) ***must have*** a ground connection in common with the CPU rack in which the BTM is located. Normally, this common ground connection is provided by ensuring that the programmer's power cord is connected to the same power source (with the same ground reference point) as the rack.

Power Supply Load Capacity

The load capacity of the power supply in a Series 90-70 PLC rack is the sum of the internal loads placed on it by each of the modules residing in the rack. The maximum capacity for each of the power supplies is listed in the following table.

Table 3-3. Power Supply Load Capacity

Catalog Number	Power Source Voltage	Output Voltage and Maximum Current
IC697PWR710/712	120/240VAC or 125 VDC	+5 VDC at 11 amps
IC697PWR711/713	120/240VAC or 125 VDC	+5 VDC at 20 amps +12 VDC at 2 amps −12 VDC at 1 amp
IC697PWR724	24 VDC	+5 VDC at 18 amps +12 VDC at 1.5 amps −12 VDC at 1 amp
IC697PWR748	48 VDC	+5 VDC at 18 amps +12 VDC at 1.5 amps −12 VDC at 1 amp

Note

Current ratings for the IC697PWR711, IC697PWR724, and IC697PWR748 power supplies as listed above are individual bus maximums. The total power of all three must not exceed the wattage rating of the supply.

Also note that option modules that require +12 and -12 VDC must be installed in a rack powered by either the IC697PWR711, IC697PWR724, or IC697PWR748 power supply.

Module Load Requirements

The following table shows the DC load required by each module (in amperes). Total load of all modules in a rack must not exceed the maximum load capacity of the power supply in the rack in which the modules are installed. Refer to the previous table for power supply load capacities.

Table 3-4. Module Load Requirements (Amps)

Catalog Number	Module	+5 VDC	+12 VDC	-12 VDC
IC697CPU731/732	CPU 731	1.0		
IC697CPU771/772	CPU 771/772, with Expansion Memory (all sizes)	1.1/1.2		
IC697CPU780	CPU 780, with Expansion Memory (all sizes)	1.6		
IC697CPU781/782	CPU 781/782, with Expansion Memory (all sizes)	1.6		
IC697CPU788/789	CPU 788/789, with Expansion Memory (all sizes)	1.6		
IC697CPM790	CPM 790, with 1 MByte Memory Board	3.3		
IC697CPM915	CPM 915, with 512 KByte Memory Board	2.8		
IC697CPM925	CPM 925, with 1 MByte Memory Board	3.3		
IC697CSE784	CSE 784, State Logic with Expansion Memory	1.6		
IC697CSE924	CSE 924, with 512 KByte Memory Board	3.3		
IC697CSE925	CSE 925, State Logic with 1 MByte Memory Board	3.3		
IC697CPX772	CPX 772, with 512 KByte Memory Board	3.1		
IC697CPX782	CPX 782, with 1 MByte Memory Board	3.1		
IC697CPX928	CPX 928, with 6 MByte Memory Board	3.1		
IC697CPX935	CPX 935, with 1 MByte Fast Memory Board	3.4		
IC697CGR772	CGR 772, with 512 MByte Memory Board	3.1		
IC697CGR935	CGR 935, with 1 MByte Memory Board	3.3		
IC697BEM713	Bus Transmitter	1.4		
IC697BEM711	Bus Receiver	0.8		
IC697RCM711	Redundancy Communications Module	1.2		
IC697PCM711/712	Programmable Coprocessor Module	1.0		
IC697CMM711	Communications Coprocessor Module	0.7		
IC697CMM712	Serial Communications Module for State Logic	0.7		
IC697CMM721†	Carrierband MAP Interface	1.0	.10	.15
IC697CMM741†	MMS-Ethernet LAN Controller	1.2	.50	
IC697CMM742†	Ethernet Interface (Type 2)	2.0	.50	
IC697ADC701	Alphanumeric Display Coprocessor	1.0		
IC697BEM721	I/O Link Interface Module	1.0		
	+ each Optical Adapter	0.2		
IC697BEM731/734	Genius Bus Controller	1.3		
IC697BEM733/735	Remote I/O Scanner	0.8		
IC697BEM741/742	FIP Bus Controller	1.4		
IC697BEM763	DLAN/DLAN+ Interface Module	1.0		
IC697BEM764	VME DLAN/DLAN+ Interface Module	1.0		
IC697HSC700	High Speed Counter	1A ‡		
IC697MDL240	120 VAC Isolated, Input, 16 points	0.25		
IC697MDL241	240 VAC Isolated, Input, 16 points	0.25		
IC697MDL250	120 VAC Input, 32 points	0.35		
IC697MDL251	120 VAC Input, 16 points	0.35		
IC697MDL252	12 VAC Input, 32 points	0.3		
IC697MDL253	24 VAC Input, 32 points	0.3		
IC697MDL254	48 VAC Input, 32 points	0.3		
IC697MDL340	120 VAC Output, 16 point	0.25		
IC697MDL341	120/240 VAC Isolated 2A Output, 16 points	0.25		
IC697MDL350	120 VAC Output, 32 point	0.5		
IC697MDL640	125 VDC Pos/Neg Logic Input, 16 points	0.3		
IC697MDL651	Negative Logic, TTL, Input, 32 points	0.53		
IC697MDL652	12 VDC Pos/Neg Logic Input, 32 points	0.3		
IC697MDL653	24 VDC Pos/Neg Logic Input, 32 points	0.3		
IC697MDL654	48 VDC Pos/Neg Logic Input, 32 points	0.3		
IC697MDL671	Interrupt Input Module, 16 points (14 Interrupt)	0.3		
IC697MDL740	24/48 VDC Output, 16 point	0.25		

Table 3-4. Module Load Requirements (Amps), continued

CatalogNumber	Module	+5 VDC	+12 VDC	-12 VDC
IC697MDL753	5/48 VDC 0.5A Neg Logic Output, 32 points	0.25		
IC697MDL750	24/48 VDC Output, 32 point	0.15		
IC697MDL752	12 VDC 0.5A Output, 32 points	0.25		
IC697MDL940	Relay Output 16 points	0.75		
IC697MEM713/15/17/19	CMOS Expansion Memory	n/a*		
IC697MEM731/32/33/35	CMOS 32 Bit Expansion Memory	2.25		
IC697ALG230	Analog Input Base Converter	0.8		
IC697ALG440	Analog Input Current Expander	0.4		
IC697ALG441	Analog Input Voltage Expander	0.4		
IC697ALG320	High Level Analog Output, Voltage/Current	1.66		
AD697SLP711	State Logic Processor Module	1.0		

† These modules require ± 12 V for operation; use the IC697PWR711, IC697PWR724, or IC697PWR748 power supply.

‡ Listed current + (10 mA x number of ON outputs) + (1.6 x encoder current).

* The power requirement of these modules is minor and is included in the power requirement of the base board.

Cable Connections

The cables that are most often used in a Series 90-70 PLC system are listed below (your application will require some combination of these cables):

- *Two Rack Power Cable,* IC697CBL700. Used to connect the second rack to the first rack when one power supply provides power for two racks.
- *Work Station Interface Cable (Parallel).* For the Workmaster II computer, this is a 10-foot cable that connects the programming device to the CPU through the top connector on the BTM over a parallel link. The catalog number of this cable is IC647CBL703. The parallel cable used with the Workmaster computer is IC600WD005 (5 feet), which is a standard parallel I/O cable.
- *Work Station Interface Cable (Serial).* For the Workmaster II computer, this is a 10-foot cable that connects the programming device to the CPU through the serial port connector on the CPU module over a serial link. The catalog number of this cable is IC647CBL704. The serial cable for use with the Workmaster computer is IC690CBL701.
- *I/O Expansion Rack Cable.* This cable is used to connect the BTM in the CPU rack to a BRM in the first expansion rack and from BRM to BRM in additional expansion racks to continue the parallel I/O bus. The catalog number for this cable is IC600WDxxx (xxx is the cable length with available lengths ranging from 5 to 50 feet, refer to Table 2-2).
- *PCM to Programmer Cables.* Three different serial cables are available for this purpose. Note that these cables can also be used with other modules, such as the Alphanumeric Display Coprocessor module.
  - Catalog number IC690CBL701 is used to connect a PCM to a Workmaster computer, or to a PC-XT or compatible computer.
  - Catalog number IC690CBL702 is used to connect a PCM to a PC-AT or compatible computer.
  - Catalog number IC690CBL705 is used to connect a PCM to a Workmaster II computer or IBM PS/2 personal computer.

- *I/O Cable with built-in termination.* Two of these cables are available for I/O bus termination in a Hot Standby CPU Redundancy system. These cables provide a means of allowing easy replacement of a faulty Redundancy Communications Module and are connected to the RCM at the end of the expansion bus.
  - □ Catalog number IC697CBL811 is 10 feet (3 meters) in length.
  - □ Catalog number IC697CBL826 is 25 feet (7.5 meters) in length.

Powering Two Racks from a Single Power Source

Two racks may be powered from a single power supply if the total current requirement for both racks does not exceed the load capacity of the power supply. Additionally, the rack that does not contain the power supply must not have a load greater than 5.2 amps and modules that require 12 volts cannot be installed. The rack containing the power supply is connected to the second rack through a power supply extension cable. This cable is plugged into a connector located next to the power supply on each rack.

The connectors on each end of the cable are identical. To install the cable, insert the 9-pin D-connectors into the mating 9-pin D-receptacles on the top left side of the rack next to the power supply slot.

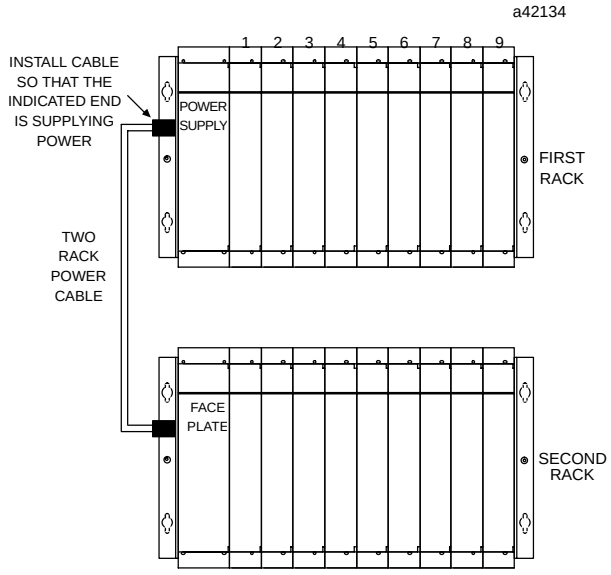


Figure 3-26. Two Racks Powered by One Power Source

Installing the Work Station Interface Board

A Work Station Interface board must be installed in the computer that is to communicate with the PLC. This communications link can be either parallel or serial. The Work Station Interface board can be installed in any full length slot in your computer. Installation of the board should be performed as described in the Work Station Interface data sheet or in the computer manufacturer's instructions for option boards.

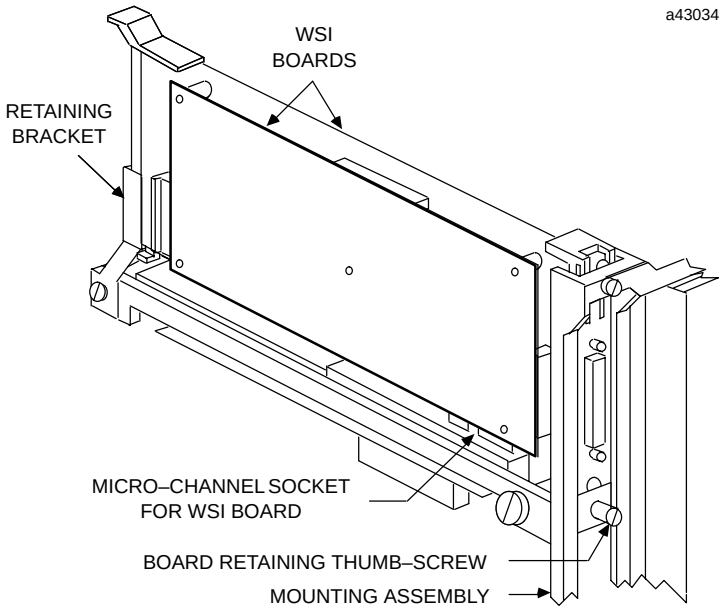


Figure 3-27. WSI Installed in a Workmaster II Computer

After the board has been installed, apply power to the computer and observe the board's LEDs for proper operation. The upper LED (on the mother board) flashes for approximately 20 seconds after power-up while the board executes its diagnostic tests. After diagnostics have completed successfully, the LED remains on, indicating proper operation. The other LED (on the daughter board) is normally off, but turns on for approximately 500 milliseconds when the board receives communications from the PLC. After confirming the LED operation, replace the computer's protective cover.

Be sure that the programmer has a ground connection in common with the CPU rack to which the programmer will connect. This is assured by connecting the computer to be used for programming to the same AC power source (with the same ground reference point) as the rack.

Warning

If the programmer is not connected as described above, damage to the CPU module, Bus Transmitter Module, or Work Station Interface board can occur. In addition, erratic control operation may result. If the programmer is online to an operating system, erratic operation may cause conditions which are hazardous to personnel and equipment.

Parallel WSI and I/O Expansion Rack Cable

The parallel Work Station Interface and I/O rack expansion cables have a shielded, twisted-pair cable, with a male connector on one end and a female connector on the other. Instructions for installing this cable are provided below.

Installing a Parallel Work Station Interface Cable

Install the cable (IC647CBL703) for a parallel connection between the Workmaster II programming computer and the PLC as follows (use IC600WD005 for the Workmaster computer):

1. Attach the 37-pin male connector to the Work Station Interface board.
2. Attach the 37-pin female connector to the top connector on the BTM (parallel connection).

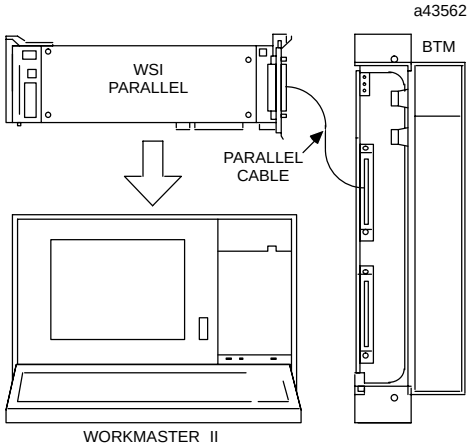


Figure 3-28. Work Station Interface Board Parallel Connection to PLC

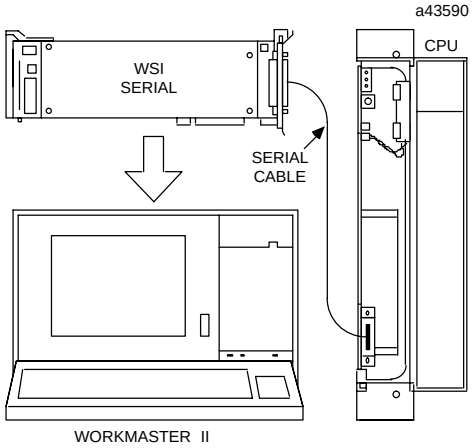


Figure 3-29. Work Station Interface Board Serial Connection to PLC

Installing a Serial Work Station Interface Cable

Install the cable (IC647CBL704) for a serial connection between the programming computer and the PLC as follows (use IC697CBL701 for the Workmaster computer):

1. Attach the 37-pin male connector to the applicable Work Station Interface board. Two versions of the Work Station Interface are available for use with a Series 90-70 PLC. Catalog numbers for these boards are:
   - □ IC647WMI920 for Workmaster II or IBM PS/2 computers;
   - □ IC640WMI910 for Workmaster or IBM PC-XT or AT computers.
2. Attach the 15-pin male connector to the serial port connector on the CPU.

The following illustration shows the wiring configuration for the serial cable (for Workmaster II) for those who may want to build a cable with a different length than the cable (catalog number IC647CBL704, 10 feet long) available from GE Fanuc.

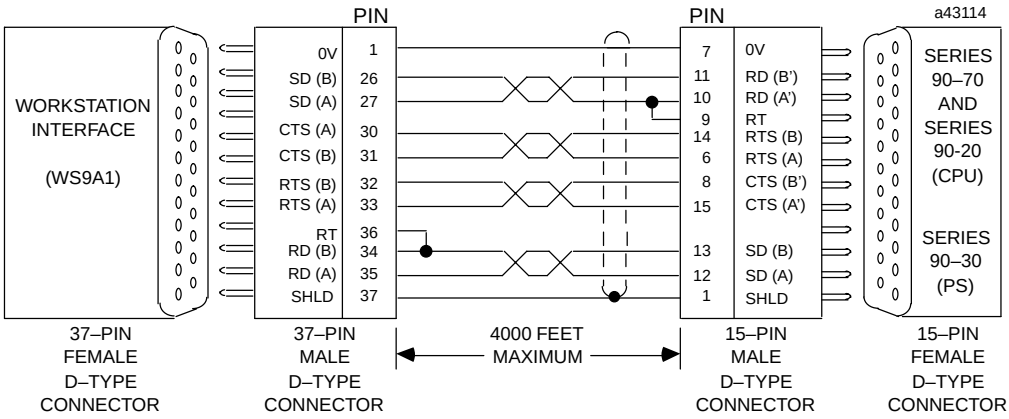


Figure 3-30. Series 90 PLC to Programmer Serial Cable

- Cable Type - 24 AWG, 30V computer grade. Extra flexible construction recommended for short lengths.
- Connectors - ***37-pin male*** D-type with 4-40 screws and AMP hood No.1-207908-0, or equivalent. ***15-pin male*** D-type with M3 screws (AMP hardware kit 207871-1) and AMP hood No. 207470-1, or equivalent. Note that an AMP connector is not supplied with the hardware kit.

Serial Port Isolation

The CPX models of the Series 90-70 CPU (IC697CPX772, IC697CPX782, IC697CPX928, and IC697CPX935) provide three on-board serial ports. Port 2, the port in the center, is optocoupler isolated and RS-485 compatible.

The remainder of the Series 90-70 CPUs and the Remote I/O Scanner have NO isolation circuitry at the SNP port. If isolation is required, use the GE Fanuc RS-485 port isolator (catalog number IC690ACC903), or equivalent product.

Caution

If a multidrop network cannot be guaranteed to be on the same electrical ground and served by the same phase on the mains, isolation must be provided separately for each CPU and Remote I/O Scanner.

Multidrop Configuration

Cable and connector requirements, and examples of wiring diagrams for connecting a programming computer to Series 90 PLCs in an 8-wire multidrop, serial data configuration are provided in the pages that follow (for more information on SNP multidrop, see Appendix J). The maximum number of PLCs that may be included in a multidrop configuration is dependent on the length of the link, as shown below:

Cable Length	Maximum Number of PLCs
4000 feet	8
2000 feet	16
1000 feet	32

The 15-pin serial port connector for the Series 90-70 PLC is located on the CPU. The 37-pin serial port connector is located on the Work Station Interface board installed in the computer. The cable type for these connections should be 24 AWG, 30V computer grade. Extra flexible construction is recommended for short lengths. In multidrop configurations, all PLCs must have common ground potentials (refer to Appendix D for more information). The Work Station Interface provides ground isolation, allowing the programmer ground to vary by up to 500V.

Multidrop Configuration Examples

Two examples of multidrop configurations are shown. Each includes a remote drop. The illustrations suggest how extra connectors can be installed to allow the use of a programmer at various points in the system without disturbing the serial link between the PLC and the remote drop. When extra connectors are used, it is important to be sure that the connections will be secure. For example, the connectors can be permanently mounted on panels.

The illustrations show connections for a Workmaster II programmer, although a different type of programmer could be used.

If the programmer does not have a Workstation Interface board, RS-232-to-RS-422 conversion must be provided at each location. A conversion box can be installed at each drop, or one conversion box can be moved from location to location with the programmer.

In locations where isolation is not a problem, the non-isolated RS-232-to-RS-422 Miniconverter (IC690ACC901) can be used.

In locations where ground potential differences may occur, it is important to provide adequate ground isolation. The Port Isolator (IC690ACC903) is available for this purpose (for more information, see Appendix G).

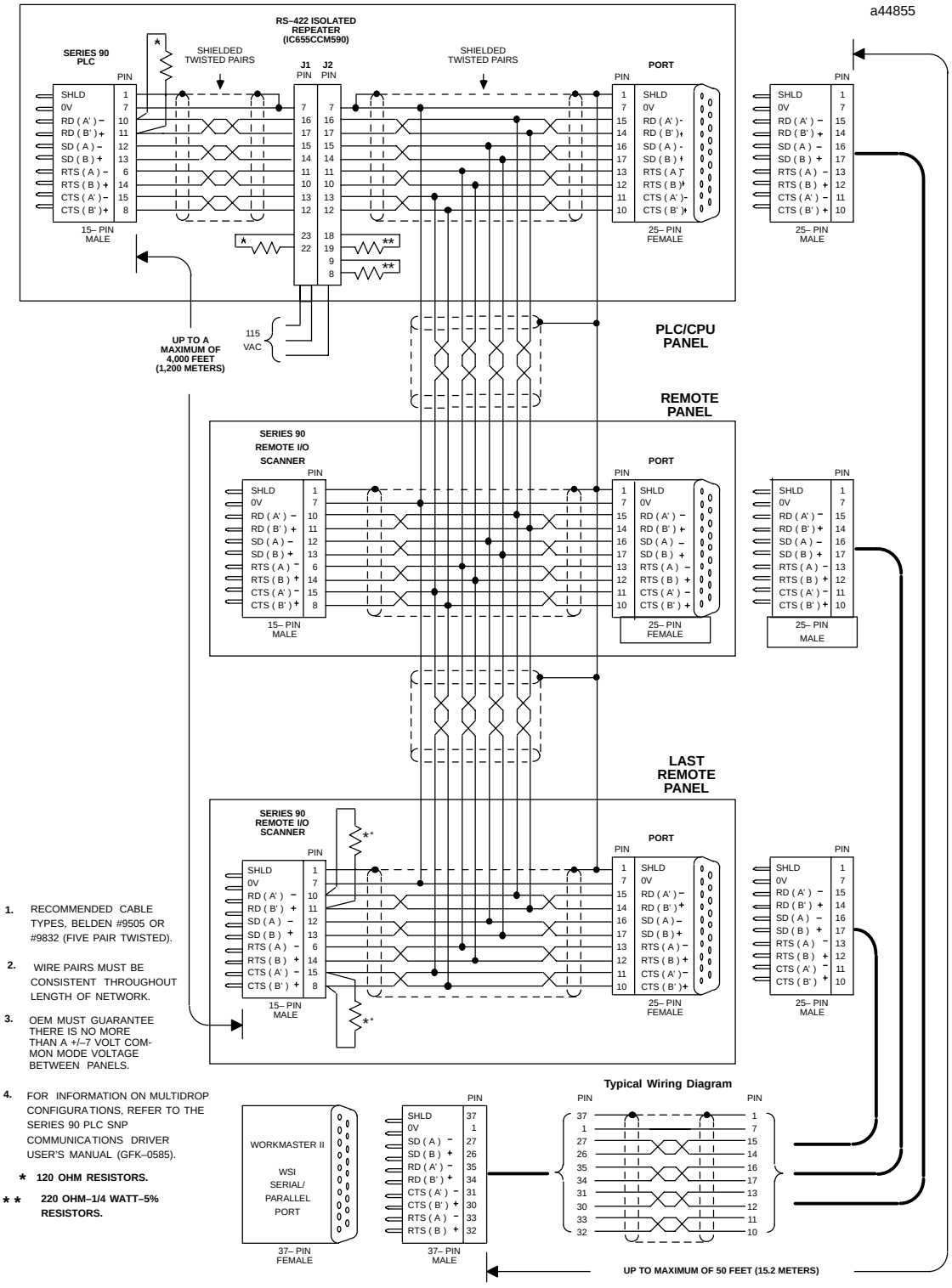


Figure 3-31. SNP Multidrop with WSI Board in Workmaster II

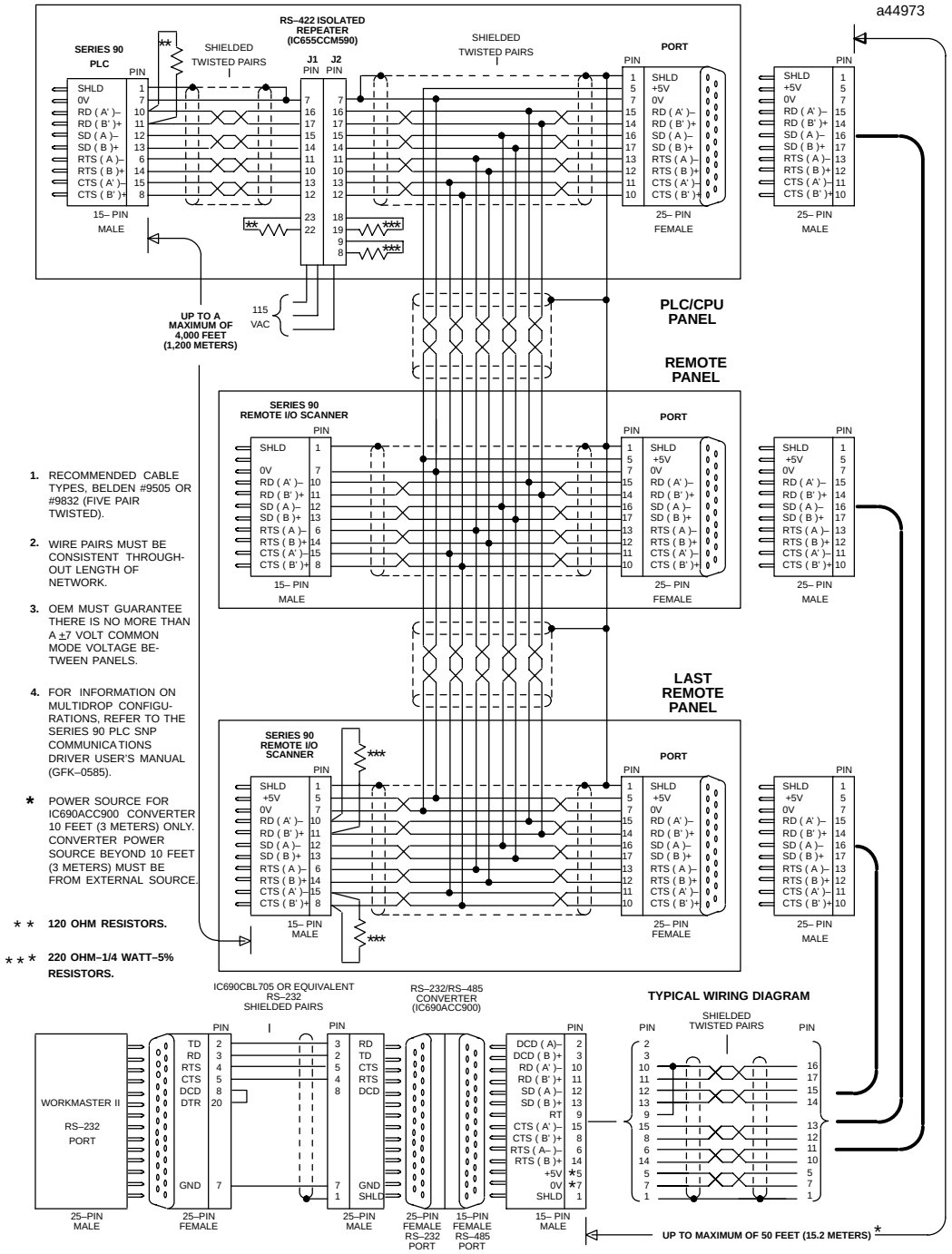


Figure 3-32. SNP Multidrop without WSI Board in Workmaster II

Installing an I/O Expansion Rack Cable

The I/O expansion rack cable is limited to a total cable length of 50 feet (15 meters) from the bottom connector on the BTM module to the top connector on the last BRM module. Use the following procedure when installing cables between I/O expansion racks.

1. Select the proper length cable or cables required for your expansion system configuration.
2. Connect the male cable connector to the bottom female connector on a BTM or BRM.
3. Connect the female cable connector to the top male connector on a BRM.
4. After all required cables are installed between racks, install a Termination Plug on the bottom female connector on the last BRM on the I/O bus.

Installation of the I/O expansion rack cable is shown in the following figure.

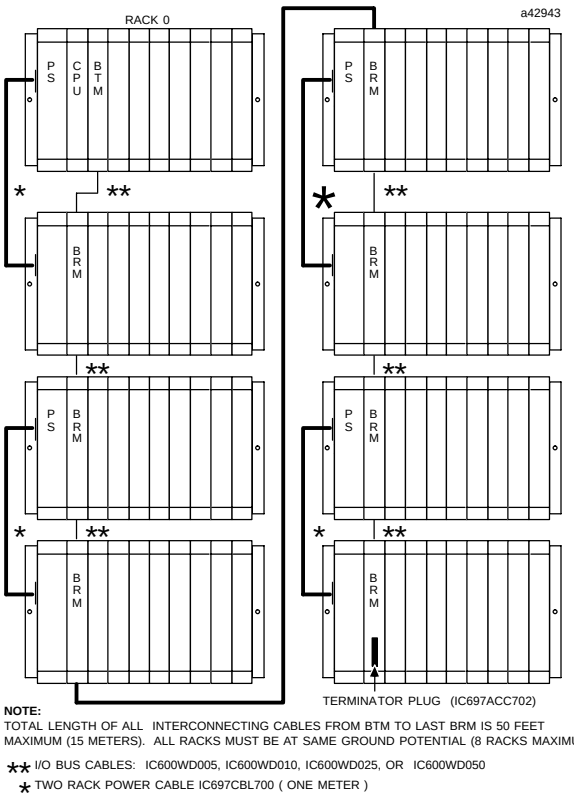


Figure 3-33. Cable Connection Between Racks in an I/O Expansion System

Installing PCM to Programmer Cables

When you are ready to install the PCM to programmer cable, ensure that the proper prewired cable is available for your programmer. These cables physically appear the

same, the difference being the internal pin connections. Each of these cables is 10 feet (3 meters) in length.

1. Connect the 25-pin male connector to the top serial port female connector on the front of the PCM.
2. Connect the 9-pin female connector to the male RS-232 connector (serial port) on the programming device.

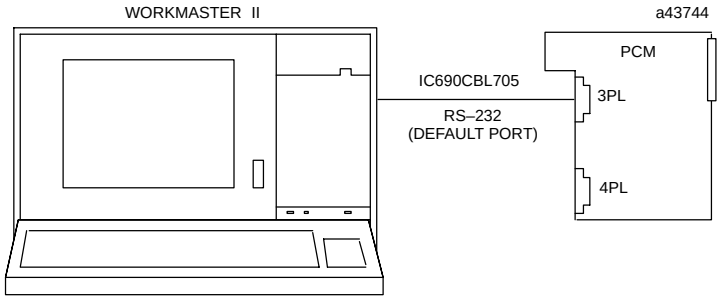


Figure 3-34. Connection of PCM and Workmaster II Computer (Cable: IC690CBL705)

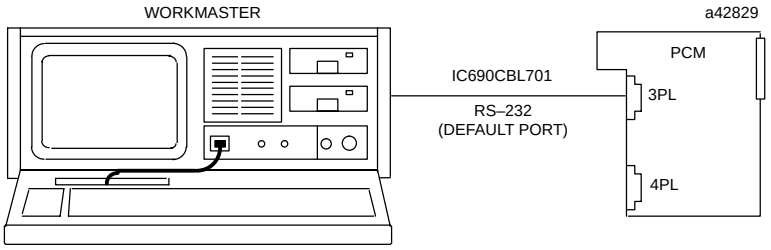


Figure 3-35. Connection of PCM and Workmaster Computer (Cable: IC690CBL701)

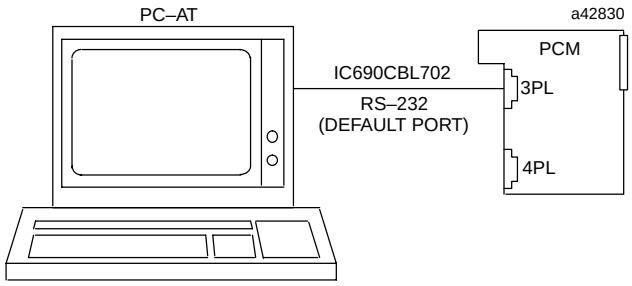


Figure 3-36. Connection of PCM and PC-AT Personal Computer (Cable: IC690CBL702)

Caution

The Series 90-70 PLC rack that contains the PCM, and the programmer ground connections must be at the same ground potential. Incorrect wiring will result in damage to the programmer or the PCM.

Installing the I/O Bus Cable with Built-in Termination

I/O bus cables must be used for connecting the Redundancy Communications Module (RCM) in a Hot Standby CPU Redundancy system. The use of these cables is especially helpful when troubleshooting a faulty system in that it allows the RCM module to be replaced with minimal disruption of the expansion bus. For detailed installation information, please refer to GFK-0827, the *Series 90-70 Hot Standby CPU Redundancy User's Guide*.

1. Select the desired cable:
   - □ IC697CBL811, 10 feet (3 meters)
   - □ IC697CBL826, 25 feet (7.5 meters)
2. The RCM has two connectors mounted on the front of the board. *The top connector is the only one used.* Connect the end of the cable that has the built-in termination to the top connector on the RCM in the last rack of the *other* PLC system (at end of I/O bus).
3. If no expansion rack is used, the other end of the cable is connected to the lower connector on the BTM of the other system as shown below (for information on connections if expansion racks are present, refer to GFK-0827).

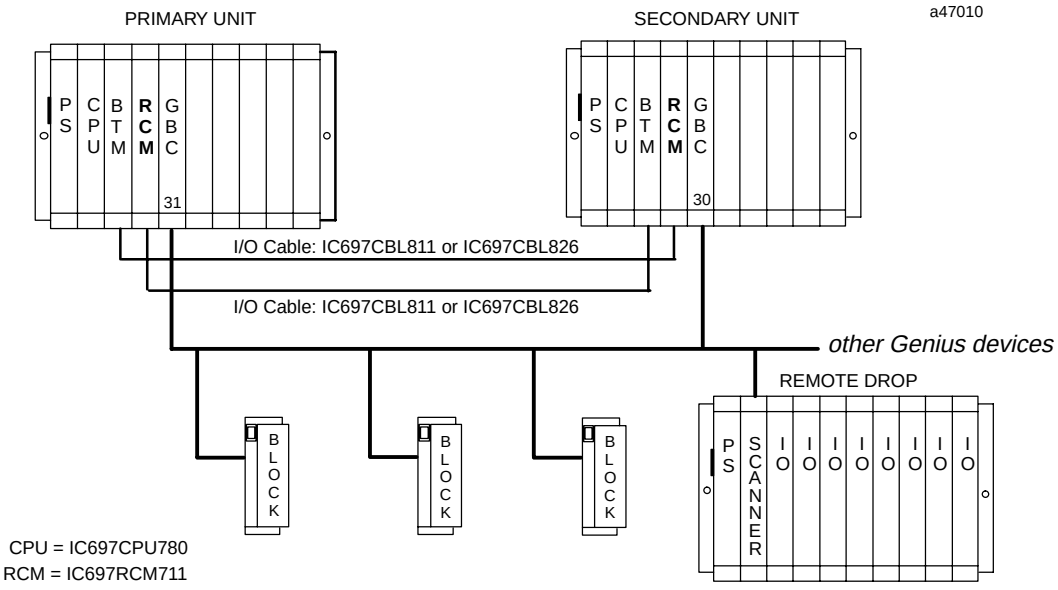


Figure 3-37. Example of Cable Connections in a Hot Standby CPU Redundancy System

Field Wiring to I/O Modules

The following procedures are recommended when connecting field wiring to the detachable terminal board on an I/O module. Features referenced in the following procedures that are common to all Model 70 I/O modules are illustrated in the following figure.

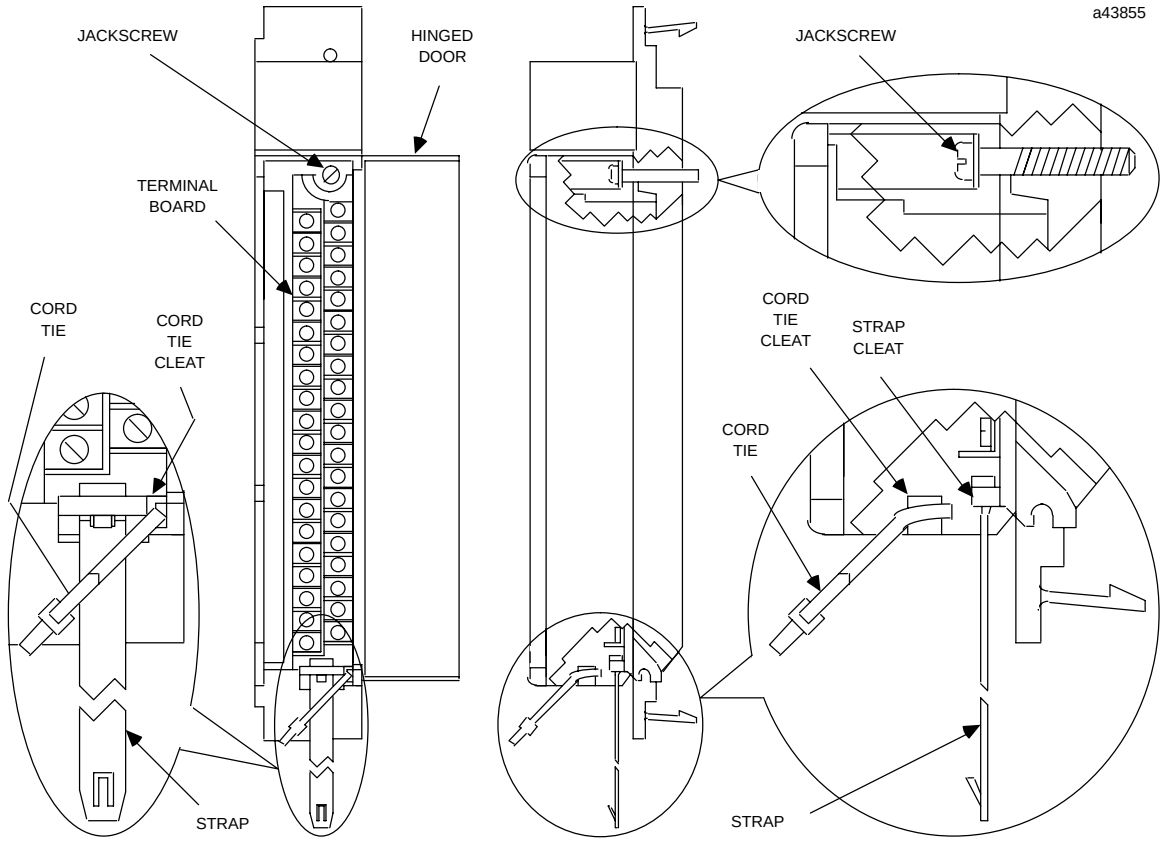


Figure 3-38. I/O Module Features

Removing the Terminal Board

1. *Turn off power before removing or installing terminal boards.*

2. Open the hinged door on the module to access the jackscrew which holds the terminal board securely in place. The detachable field wiring terminal board can now be removed from the module by turning the jackscrew counter-clockwise until it is fully disengaged.

3. To remove the terminal board, grasp the top of the terminal board and swing it outward.

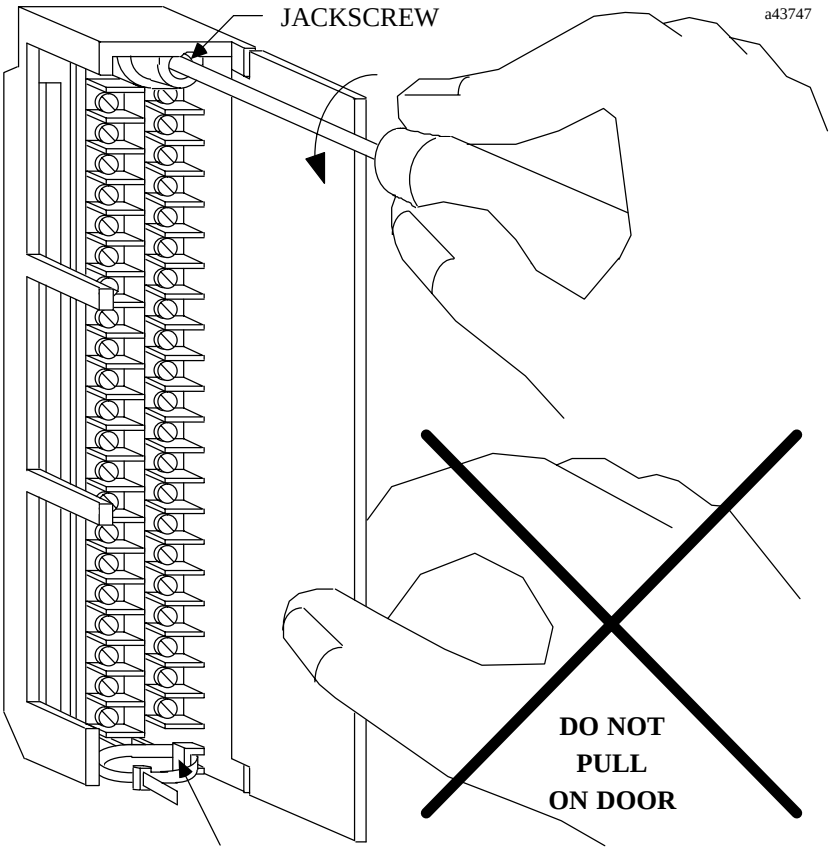


Figure 3-39. Removal of I/O Terminal Board

Caution

Do not use the hinged door to remove the terminal board. The hinged door could be damaged.

Making Connections to Field Wiring

4. The terminal board is designed to accept wire sizes from AWG #22 (0.35 mm^2) through AWG #14 (2.1 mm^2). It is important that, when using AWG #14 wire and wiring all points, a maximum insulation diameter of .135 inch not be exceeded. To ensure proper connection, two wires may be terminated on any one terminal only if both wires are the same size.

5. The terminal board is designed to accept a maximum of forty (40) AWG #14 wires. If AWG #14 wires are to be used, then wire markers should be placed at least 8 inches (203 mm) from termination end to provide sufficient space for the hinged door to close.

6. After completing connections to all modules in a rack, the wire bundle must be secured. To ensure that the wire bundle is secured properly, it is recommended that a cable tie be wrapped around the wire bundle and tightly secured through the

cable tie cleat located at the lower right corner of the terminal board. For extremely large wire bundles, additional cable ties should be used.

Installing Door Label Insert

7. A door label insert is included with each module to indicate circuit wiring information and provide space to record user circuit wiring identification. A slot is provided on the hinged door to allow for insertion of this label. If the label is difficult to insert, crease the scored edge before insertion. The outside label has a color coded stripe to allow quick identification of the module voltage type (blue, low voltage; red, high voltage).

Replacing and Securing the Terminal Board

8. After field wiring is completed, the terminal board should be securely fastened to the rack by inserting the terminal board strap (attached to each module) into the small rectangular slots in the bottom card guide grill on the rack. This strap not only secures the terminal board to the rack, it also provides a way of identifying the wired terminal board with its correct mating rack slot location.

9. To ensure that there is adequate module ventilation, it is recommended that at least a 6-inch clearance be allowed above and below the rack grill. Wire bundles should not obstruct the rack grill work.

Appendix A Glossary

Glossary of Terms for the Series 90-70 PLC

Address Consists of a letter followed by a number, which together refer to a specific memory location. For example, %I00005 refers to the fifth location in input (%I) memory.

Analog An electrical signal activated by physical variables representing force, pressure, temperature, flow, etc. It's a signal represented by a value rather than a simple on or off state.

Application Program A program written by the user to control a particular machine or process.

ASCII (American Standard Code for Information Interchange)
An 8-bit (7 bits plus 1 parity bit) code used for data.

Backplane A circuit board consisting of a group of connectors and associated circuitry. The connectors accept plug-in modules.

Battery Connector
A connector wired to a lithium battery which connects the battery to the CMOS RAM memory devices. The battery connector is plugged into a receptacle accessed by opening the module's faceplate door.

Baud A unit of data transmission. Baud rate is approximately equal to the number of bits per second transmitted.

Bit (Binary Digit)

The smallest unit of memory. It can be used to store only one piece of information that has two states (for example, One/Zero, On/Off, Good/Bad, Yes/No). Data that requires more than two states (e.g., numerical values 000to 999) requires multiple bits (see Word).

Blank Slot Interrupt Jumper

A jumper assembly, which when installed in a rack allows you to reserve a slot in a rack for future expansion. This jumper, when installed in a blank slot, allows for continuation of the interrupt signal through the backplane.

Bus An electrical path, usually shared by two or more devices, for transmitting and receiving data or power.

Byte A group of binary digits operated on as a single unit. In the Series 90-70 PLC, a byte consists of eight contiguous bits.

Circuit Wiring Diagram

Field wiring information that provides a guide to users for connecting field devices to input and output modules. Each I/O module has a circuit wiring diagram printed on the inside surface of an insert in the module's hinged door.

Configuration Software

That portion of a programming software package that provides the tools for configuring the hardware scheme as well as certain system parameters.

CPU (Central Processing Unit)

The central device or controller that interprets user instructions, makes decisions, and executes the functions based on a stored application program.

Data Memory User references within the CPU which are accessible by the application program for storage of discrete or register data.

Discrete Refers to devices that are either on or off.

Expansion Rack

A 5 or 9-slot rack added to a Series 90-70 PLC when the application calls for more modules than the main rack can contain. A Series 90-70 PLC system supports up to 7 expansion racks. The last expansion baseplate in the system can be no more than 50 feet from the CPU in the main rack.

Expansion Cable (I/O Bus)

A cable that propagates the parallel I/O bus signals between expansion baseplates. The total length of all expansion cables, from the main baseplate to the last expansion baseplate in the system, can be no more than 50 feet (15 meters).

Expansion Memory Board
A board containing various sizes of memory for installation on certain CPU modules or on the PCM module. These boards, depending on model, can contain CMOS RAM or CMOS RAM and flash memory devices.

Field Devices Input or output devices external to the PLC such as pushbutton or limit switches, relays, pilot lights, solenoids.

Firmware A series of operating system instructions contained in PROM (Programmable Read Only Memory) which are used for internal processing functions. These instructions provide the structure for application program operations.

Flash Memory A non-volatile EEPROM type memory device.

Genius I/O An intelligent I/O system consisting of I/O blocks, bus controllers, and other devices.

Grounding Terminal
A terminal on each power supply which must be connected to earth ground (through the AC power source) to ensure that the power supply is properly and safely grounded.

Hardware All of the physical (mechanical, electrical, and electronic) devices that comprise the Series 90-70 PLC and its applications.

Hinged Door A plastic door on the front of a module which, when open, allows access to certain module hardware features.

Input Module An I/O module that converts signals from user devices to logic levels that can be used by the CPU.

Input Scan Time The time required for the CPU to scan all input devices for new input values.

I/O (Input/Output)
That portion of the PLC to which field devices are connected and which isolates the CPU from electrical noise.

I/O Electrical Isolation
A method of separating field wiring from logic level circuitry. Typically, this is accomplished through the use of solid-state optical isolation devices.

I/O Fault Table A fault table listing I/O faults. These faults are identified by time, date, and location.

I/O Module A plug-in module containing a printed circuit assembly that interfaces between user devices and the Series 90-30 PLC.

K (Kilo) An abbreviation for kilo or exactly 1024 in the language of computers.

LED (Light Emitting Diode) Status Display
A display consisting of LEDs located at the top of Series 90-70 modules. The LEDs indicate such things as On or Off status of discrete points, OK status of Option modules, or the transfer of data over communication ports.

Main Rack A rack in a Series 90-70 PLC system that contains the CPU module.

Microsecond One millionth of a second. 1 x 10 (-6) or 0.000001 second. Microsecond may be abbreviated as micros.

Millisecond One thousandth of a second. 1 x 10 (-3) or 0.001 second. Millisecond may be abbreviated as ms.

Mnemonic An abbreviation given to an instruction. The mnemonic is often an acronym, formed by combining initial letters or parts of words.

Module A replaceable electronic subassembly usually plugged into connectors on a backplane and secured in place, but easily removed in case of a failure or system redesign. In the Series 90-70 PLC, a combination of a printed circuit board and its associated faceplate (and removable terminal connector on I/O modules) which, when combined, form a complete assembly.

Noise Undesirable electrical disturbances to normal signals, generally of high frequency content.

Non-Volatile Memory
A memory (for example, EPROM) capable of retaining its stored information under no-power conditions (power removed or turned off).

Off-Line Mode Off-Line mode is used for program development. The programmer does not communicate with the PLC in Off-Line mode; the physical communications link may be intact, but the programmer is specifically not performing communications with the PLC. Power flow display and reference values are not updated.

On-Line Mode On-Line mode provides full CPU communications, allowing data to be both read and written.

Output Data transferred from the CPU, through an Output interface module to an external device or process.

Output Devices Physical devices such as motor starters, solenoids, etc., that are switched by the PLC. *See Field Devices*.

Output Module An I/O module that converts logic level signals within the CPU to usable output signals for controlling a machine or process.

Parallel Communications
A method of data transfer, whereby data is transferred on several wires simultaneously.

Peripheral Equipment
External devices that can communicate with a PLC (for example, programmers and printers).

PLC (Programmable Logic Controller)
A solid-state industrial control device which receives signals from user-supplied control devices, such as switches and sensors, implements them in a precise pattern determined by ladder diagram based application programs stored in user memory, and provides outputs for control of processes or user-supplied devices such as relays or motor starters. It is usually programmed in relay ladder logic and is designed to operate in an industrial environment.

PLC Fault Table A fault table listing PLC faults. These faults are identified by time, date, and location.

Programmer Usually consists of a personal computer running the PLC programming software.

Programming Software
That portion of the programming software package that is used to create ladder logic programs.

PROM (Programmable Read Only Memory)
A retentive digital device programmed at the factory and not easily changed by the user. PROM usually contains operating system instructions for internal system use.

Rack A mechanical frame that contains the backplane and slots into which Series 90-70 modules are installed.

Rack Fan Assembly
An optional assembly, containing three fans, which can be mounted on a rack when additional rack cooling is required.

Rack Number A unique number, assigned to each rack for identification purposes. The numbers range from 0 to 7. The CPU (main) rack is always rack 0.

Rack Number Jumpers
Four groups of three pins, plus a jumper, located on the backplane directly behind the power supply, used to assign a rack number.

RAM (Random Access Memory)
A solid-state memory that allows data to be stored and accessed at random locations. This memory stores program files and related data while power is applied to the system. This type of memory, however, is volatile. Because data stored in RAM is lost under no-power conditions, a backup battery is usually used to retain the contents under those conditions. The backup battery used in the Series 90-70 PLC is a long-life lithium battery mounted on the CPU and PCM modules.

Redundancy A method of of allowing a critical component or process to continue running if a failure occurs in a single component. A Series 90-70 PLC system provides several redundancy alternatives, which include a user program or a combination of software and hardware.

Reference Type A specific group of memory types in the Series 90-70 PLC (for example, %I references discrete inputs and %Q references discrete outputs). The % symbol is used to distinguish machine references (memory addresses) from nicknames.

Register A group of 16 consecutive bits in register memory, referenced as a %R address. Each register is numbered, beginning at %R00001. Register memory is used for temporary storage of numerical values and for bit manipulation.

Remote Rack

A 5 or 9-slot baseplate added to a system when the application calls for the presence of a baseplate more than 50 feet from the Local system configuration.

Removable Terminal Block

The removable assembly which attaches to the front of an I/O module, and contains the screw terminals to which field wiring is connected.

Restart Pushbutton

A pushbutton on the front of certain module used to reinitialize the module, or to perform other specific functions (refer to module data sheets for additional information).

RUN Mode A condition or state of the Series 90-70 PLC, where the CPU executes the application program.

Scan Also called "Sweep." The routine that the CPU performs repeatedly in performing its sequence of tasks. The basic scan runs in this sequence: housekeeping tasks, input tasks, ladder logic solving, output tasks, programmer communications, and option module communications. Once the CPU reaches the end of a scan, it begins another one and continues this sequence until stopped by a fault or by human intervention. Each scan takes a measurable amount of time (milliseconds) , which may having an impact on time-critical tasks.

Serial Communications

A method of data transfer, whereby the bits are handled sequentially rather than simultaneously, as in parallel data transmission.

Serial Port An RS-485/422 port on the PLC, accessible through a 15-pin connector, to which the programmer must be connected in order to communicate with the PLC. The CPU can communicate with various serial devices through this port. A converter is needed when communicating with an RS-232 device through this port.

STOP Mode A condition or state of the Series 90-30 PLC, where the CPU no longer executes the application program.

Storage Used synonymously with memory.

Sweep See "Scan."

Termination Plug A resistor pack inside of a terminator plug used to properly terminate the I/O Expansion Bus signals. It is physically installed inside of a terminator plug (IC697ACC702), or termination resistors connected internally in the terminated I/O cable in a Hot Standby CPU Redundancy system (cables IC697CBL811 and IC697CBL826).

User Memory The portion of system memory in which the application program and data is stored. This memory can be battery-backed CMOS RAM of flash memory (depending on CPU model)

User Reference Type A reference assigned to data which indicates the memory in which it is stored in the PLC. References can be either bit-oriented(discrete) or word-oriented(register).

VME Integrator Rack A rack that can be can contain both standard Series 90-70 modules and Third Party VME modules. This rack has a 17-slot backplane.

VME Option Kit An optional accessory that allows you to add a J2 VME backplane to a standard Series 90-70 rack or to a VME Integrator rack.

Volatile Memory A type of memory that will lose the information stored in it if power is removed from the memory devices. It requires a backup battery for retention of contents of memory. In the Series 90-70 PLC, a lithium battery is used for this purpose.

Watchdog Timer A timer in the CPU used to ensure that certain hardware conditions are met within a predetermined time. If the CPU scan runs longer than the time setting of the Watchdog Timer, a fatal fault will occur which will stop PLC operation.

Word A measurement of memory length. In the Series 90-70 PLC, a word is 16-bits in length.

Appendix B Acronyms and Abbreviations

AAUI	Apple Attachment Unit Interface
ADS	Alphanumeric Display Coprocessor
AIA/NAS	Aerospace Industries of America
ANSI	American National Standards Institute
API	American Petroleum Institute
APM	Axis Positioning Module
AREA	American Railway Engineering Association
ASCII	American National Standard Code for Information Interchange
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BCD/BCDD	Binary Coded Decimal and Binary Coded Decimal Digit
BRM	Bus Receiver Module
BTM	Bus Transmitter Module
CCM	Communications Control (protocol). Originally developed as a communications protocol for the Communications Control Module in the Series Six PLC. This protocol is also used on the Series 90-70.
CMM	Abbreviation for the Series 90-70 Communications Coprocessor Module, based on the module's catalog number (IC697CMM711).
CMOS	Complementary Metal Oxide Semiconductor
CPU	Central Processing Unit
COM	Serial Communications Port
C-UL-US	Dual Canadian and US listing mark of Underwriter's Laboratories.
DER	Digital Event Recorder
DIN	Deutches Institute for Normung
DIP	Dual-In-Line Package (DIP switch)
EGD	Ethernet Global Data
EIA	Electronic Industries Association
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
EU	European Union
FIP	Factory Instrumentation Protocol
GBC	Genius Bus Controller
H (or Hex)	Hexadecimal
HSC	High Speed Counter
I/O	Input/Output
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers

ISO	International Organization for Standardization
IOC	Input/Output Controller
ISCP	Instruction Sequencer Coprocessor
JIS	Japanese Industrial Standards
K	1024 (Abbreviation for Kilobyte)
Kbyte	Kilobyte (1024 bytes)
LAN	Local Area Network
LED	Light Emitting Diode
LCD	Liquid Crystal Display
MAP	Manufacturing Automation Protocol
Mbyte	Megabyte (1,048,576 bytes)
NEC	National Electrical Code (by National Fire Protection Association)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association or National Fluid Power Association
NIST	National Institute of Standards and Technology
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PC	Personal Computer
PCM	Programmable Coprocessor Module
PCMCIA	Personal Computer Memory Card International Association
PE	Protective Earth (ground)
PLC	Programmable Logic Controller
PROM	Programmable Read Only Memory
PS	Power Supply
PTM	Power Transducer Module
PTMPM	Power Transducer Module — Processor Module
PTMIM	Power Transducer Module — Interface Module
RAM	Random Access Memory
RTD	Resistive Temperature Detector
RTU	Remote Terminal Unit
SER	Sequential Event Recorder
SL	Statement List Language (also refers to SL Series Servo products)
SLP	State Logic Processor
SNP	Series 90 Protocol
TCM	Temperature Control Module
TCP/IP	Transmission Control Protocol/Intemet Protocol
TOD	Time-Of-Day
TP	Twisted Pair
UDP	User Datagram Protocol
UL	Underwriter's Laboratories
UTP	Unshielded Twisted Pair
VME	Versa Module Eurocard, derived from European standards for printed circuit boards and racks
WSI	Work Station Interface

Appendix C Serial Port and Cables

This appendix describes the serial port, converter, and cables used to connect Series 90 PLCs for Series 90 Protocol (SNP). This information is included for reference and for those users who have applications that require cable lengths different than the factory-supplied cables.

What this Appendix Contains

Information in this section includes:

- Communications Interface
- Cable and Connector Specifications
- Serial Port Configuration
- RS-232/RS-485 Converter (Catalog No. IC690ACC901)
- Serial Cable Diagrams
  - Point-to-Point Connection
  - Multidrop Connection

RS-422 Interface

The Series 90 PLC family of products are compatible with EIA RS-422 specifications. RS-422 drivers and receivers are utilized to accomplish communications between several system components using multiple driver/receiver combinations on a single cable with five twisted pairs. The cable length between master and any slave cannot exceed 4,000 (1,219 meters) feet.

A multi-drop system of eight drivers and receivers can be configured. The maximum common mode voltage between each additional drop is the RS-422 standard of +7 Volts to −7 Volts. The driver output must be capable of ± 2 V minimum into 100 ohms. The driver output impedance must be at least 120 K ohms in the high impedance state. The receiver input resistance is 12 K ohms or greater. Receiver sensitivity is ± 200 millivolt.

Caution

Care must be taken that common mode voltage specifications are met. Common mode conditions that exceed those specified will result in errors in transmission and/or damage to Series 90 PLC components. When the common mode voltage specification is exceeded, a port isolator such as the GE Fanuc IC690ACC903 must be used. See Appendix E for details on this port isolator.

Cable and Connector Specifications

The cable assembly presents one of the most common causes of communication failure. For best performance construct the cable assemblies according to the recommended connector parts and specifications.

Table C-1. Connector/Cable Specifications

Item	Description
Mating Connectors:	**Series 90 PLC:** Serial (RS-422) port with metric hardware Connector: 15-pin male, D-Subminiature Type, Cannon DA15S (solder pot) Hood: AMP 207470-1 connector shell Hardware Kit: AMP 207871-1 Kit includes 2 metric screws and 2 screw clips
	Workmaster II: Serial (RS-232) port with standard RS-232 connector Connector: 25-pin female, D-Subminiature Type, Cannon DB25S (solder pot) with DB110963-3 hood or equivalent (standard RS-232 connector)
	Workmaster: Serial (RS-232) port with standard RS-232 connector Connector: 9-pin female, D-Subminiature Type, Cannon DE9S (solder pot) with DE110963-1 hood or equivalent (standard RS-232 connector)
	IBM-AT/XT: Serial (RS-232) port with standard RS-232 connector Connector: 9-pin female, D-Subminiature Type, Cannon DE9S (solder pot) with DE110963-31 hood or equivalent (standard RS-232 connector)
	RS-232/RS-485 Converter: one 15-pin male, and one 25-pin male connector 15-pin male connector requires metric hardware (same connector, hood, and hardware as for Series 90 PLC listed above) 25-pin male D-Subminiature Type, Cannon DA25S (solder pot) with DB110963-3 hood or equivalent (standard RS-232 connector)
Cable:	Computer grade, 24 AWG (.22 mm^2), minimum with overall shield Catalog Numbers: Belden 9505, Belden 9306, Belden 9832 These cables provide acceptable operation for data rates up to 19.2 Kbps as follows: RS-232: 50 feet (15 meters) maximum cable length RS-422/RS-422: 4000 feet (1200 meters) maximum length. Must not exceed the maximum RS-422 Common Mode specification of +7V to -7V. Isolation at the remote end may be used to reduce or eliminate Common Mode voltages. For distances under 50 feet (15 meters), almost any twisted pair or shielded twisted pair cable will work, as long as the wire pairs are connected correctly. When using RS-422/RS-422, the twisted pairs should be matched so that both transmit signals make up one twisted pair and both receive signals make up the other twisted pair. If this is ignored, cross-task resulting from the mismatching will affect the performance of the communications system. When routing communication cables outdoors, transient suppression devices can be used to reduce the possibility of damage due to lightning or static discharge. *Care should be exercised that all connected devices are grounded to a common point. Failure to do so could result in damage to the equipment.*

Series 90 PLC Serial Port

The Series 90 PLC serial port is compatible with RS-422. An RS-232 to RS-422 converter is required to interface to systems that provide RS-232 compatible interfaces. The Series 90 PLC, RS-422 serial port provides the physical connection for SNP communication. This port is a 15-pin D-type female connector located as follows:

- Series 90-70 PLC and Series 90-20 — CPU Module
- Series 90-30 PLC — Power Supply

Figure C-1 shows the serial port orientation and connector layout for the Series 90 PLC types (note that the orientation of the connector on the Series 90-20 CPU (not shown below) is rotated 90 degrees from the Series 90-30 connector with pin 1 to the upper right). Table C-2 shows the pin numbering and signal assignment applicable to both PLCs.

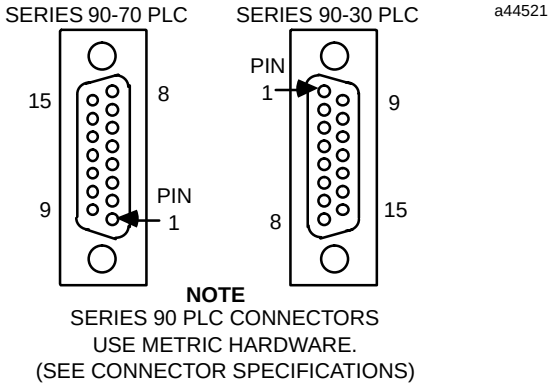


Figure C-1. Series 90 PLC, RS-422 Serial Port Connector Configuration

Table C-2. Series 90 PLC, RS-422 Serial Port Pin-out

Pin Number	Signal Name	Description
1	Shield	
2		No Connection
3		No Connection
4	ATCH *	Hand-Held Programmer attach signal
5	+5V *	+5V Power for: HHP and RS-232/485 Converter
6	RTS (A)	Request To Send
7	Signal Ground	Signal Ground, OV
8	CTS (B')	Clear To Send
9	RT *	Terminating Resistor for RD **
10	RD (A')	Receive Data
11	RD (B')	Receive Data
12	SD (A)	Send Data
13	SD (B)	Send Data
14	RTS (B)	Request To Send
15	CTS (A')	Clear To Send

* Signals available at the Connector but are not included in the RS-422 specification. SD (Send Data) and RD (Receive Data) are the same as TXD and RXD (used in the Series Six PLC). (A) and (B) are the same as - and + . A and B denote outputs, and A' and B' denote inputs.

** Termination resistance for the Receive Data (RD) signal needs to be connected only on units at the end of the lines. This termination is made on the Series 90 PLC products by connecting a jumper between pins 9 and 10 inside the 15-pin D-shell with the following exception. For Series 90-70 PLCs with Catalog Numbers IC697CPU731J, and IC697CPU771G and earlier the termination for RD at the PLC is implemented by a jumper between pins 9 and 11.

Workmaster Serial Port

The Workmaster II industrial computer, RS-232 serial port is a 25-pin D-type male connector, and the early model Workmaster is a 9-pin male connector.

Figure C-2 shows the serial port connector layout for both computers. Table C-3 shows the pin numbering and signal assignment for both connector types.

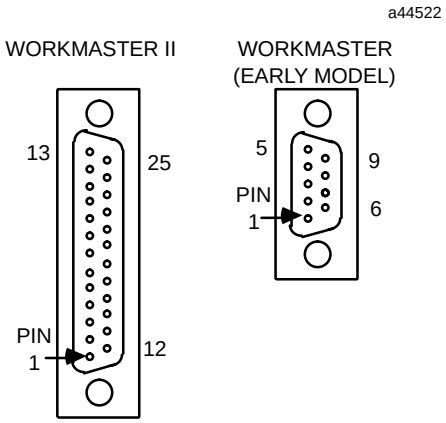


Figure C-2. Workmaster RS-232 Serial Port Connector Configuration

Table C-3. Workmaster RS-232 Serial Port Pins-out

Workmaster II (25-pin connector)		
Pin No.	**Signal**	**Description**
1		NC
2	TD	Transmit Data
3	RD	Receive Data
4	RTS	Request to Send
5	CTS	Clear to Send
6		NC
7	GND	Signal Ground
8	DCD	Data Carrier Detect
9,10		NC
11		Tied to line 20
12-19		NC
20	DTR	Data Terminal Ready
21		NC
22		Ring Indicate
23-25		NC

Workmaster (9-pin connector)		
Pin No.	**Signal**	**Description**
1		NC
2	TD	Transmit Data
3	RD	Receive Data
4	RTS	Request to Send
5	CTS	Clear to Send
6		NC
7	GND	Signal Ground, 0V
8	DCD	Data Carrier Detect
9	DTR	Data Terminal Ready

NC = Not Connected

For more information about the Workmaster industrial computer serial port refer to the following manuals:

GFK-0401 Workmaster II PLC Programming Unit Guide to Operation
GEK-25373 Workmaster Programmable Control Information Center Guide to Operation

IBM-AT/XT Serial Port

The IBM-AT, IBM-XT or compatible computer's RS-232 serial port is a 9-pin D-type male connector as shown in the figure below.

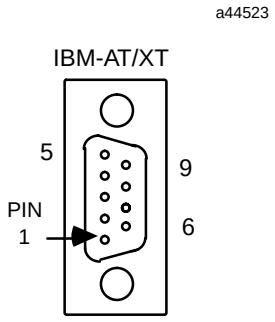


Figure C-3. IBM-AT/XT Serial Port

Table C-4. IBM-AT/XT Serial Port Pins-out

IBM-AT Pin No.	Signal	Description
1	DCD	Data Carrier Detect
2	RD	Receive Data
3	TD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6		NC
7	RTS	Request to Send
8	CTS	Clear to Send
9		NC

IBM-XT Pin No.	Signal	Description
1		NC
2	TD	Transmit Data
3	RD	Receive Data
4	RTS	Request to Send
5	CTS	Clear to Send
6		NC
7	GND	Signal Ground
8	DCD	Data Carrier Detect
9	DTR	Data Terminal Ready

NC = Not Connected

RS-232/RS-485 Converter

IC690ACC901 Miniconverter Kit

This kit consists of an RS-422 to RS-232 miniconverter, a 6 foot (2 meter) serial cable, and a 9-pin to 25-pin serial port converter plug. This miniconverter is documented in Appendix D. This miniconverter has replaced the older, larger, obsolete IC690ACC900 converter.

IC690ACC900 Obsolete Converter

The obsolete RS-232/RS-485 Converter (IC690ACC900) converts from RS-232 to RS-422/RS-485 communications. The converter has one 15-pin female D-type port, and one 25-pin female D-type port.

This converter is no longer available. Please substitute the IC690ACC901 miniconverter. Information about this converter is included in this manual for reference and troubleshooting purposes.

For detailed information on the converter, refer to Appendix D. Examples of serial cable diagrams, which include the converter, are provided in the remainder of this appendix..

Serial Cable Diagrams

This section describes only a few of the many and various Point-to-Point, and Multidrop serial port connections for Series 90 PLCs.

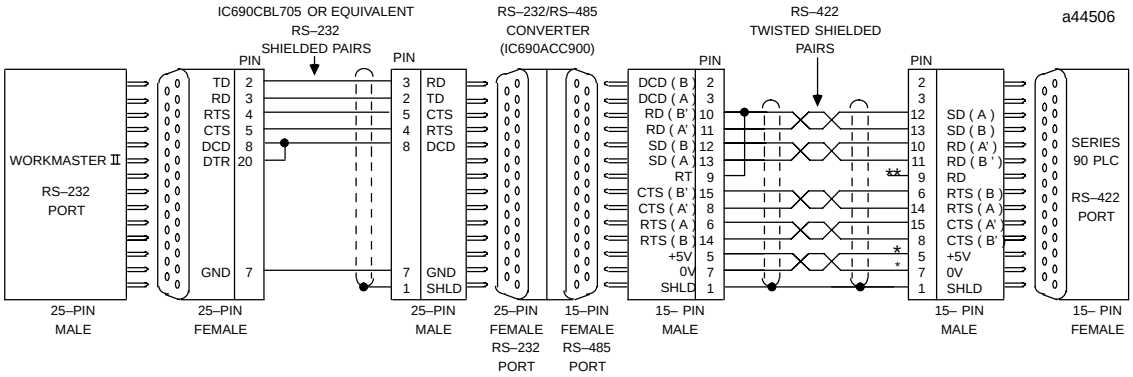
In the point-to-point configuration only two devices can be connected to the same communication line. The communication line can be directly connected using RS-232 (50 feet, 15 meters maximum) or RS-485 (4000 feet, 1200 meters maximum). Modems can be used for longer distances.

Note

The cable connector for the Series 90-70 and Series 90-30 PLCs serial port must be a right angle connector in order for the hinged door on the module to close properly. Refer to Table A-1 Connector/Cable Specification.

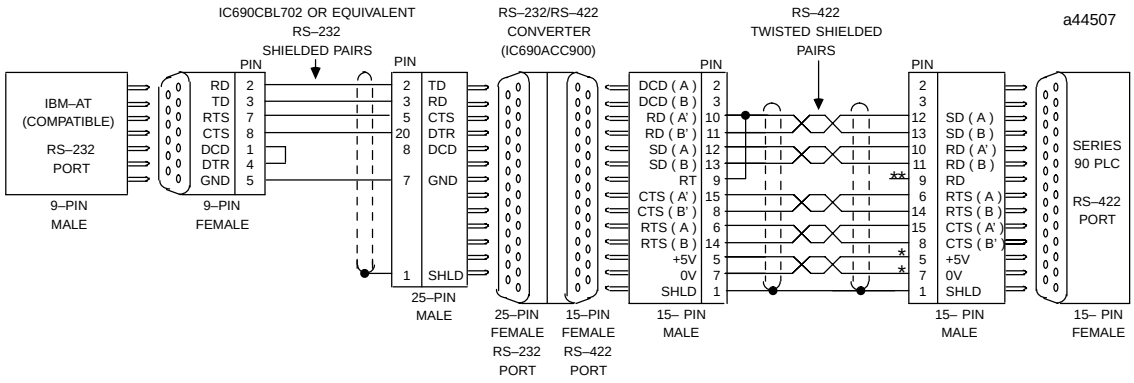
RS-232 Point-to-Point Connections

The next three figures illustrate typical RS-232 point-to-point connection to Series 90 PLCs.



* POWER SOURCE FOR POINT–TO–POINT CONNECTION 10 FEET (3 METERS) ONLY. CONVERTER POWER SOURCE BEYOND 10 FEET (3 METERS) AND FOR MULTIDROP CONNECTION MUST BE EXTERNAL SOURCE.

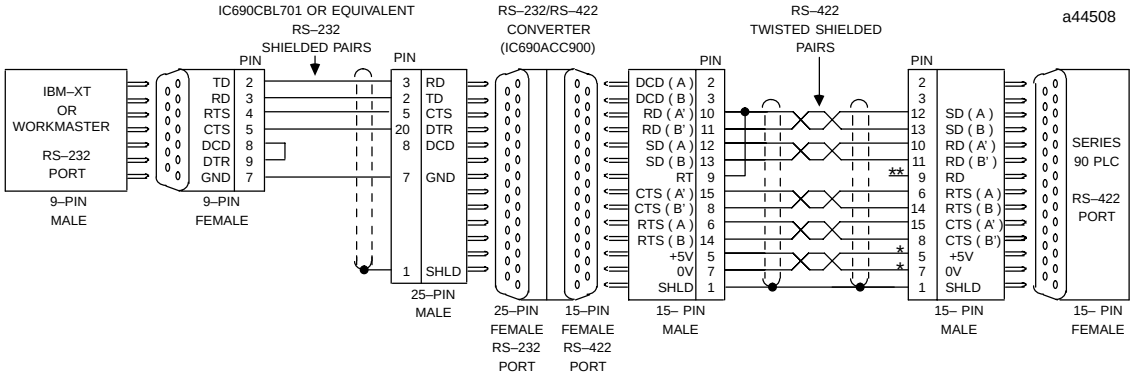
** TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.



* POWER SOURCE FOR POINT–TO–POINT CONNECTION 10 FEET (3 METERS) ONLY. CONVERTER POWER SOURCE BEYOND 10 FEET (3 METERS) AND FOR MULTIDROP CONNECTION MUST BE EXTERNAL SOURCE.

** TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

Figure C-4. IBM-AT (compatibles) Personal Computer to Series 90 PLCs



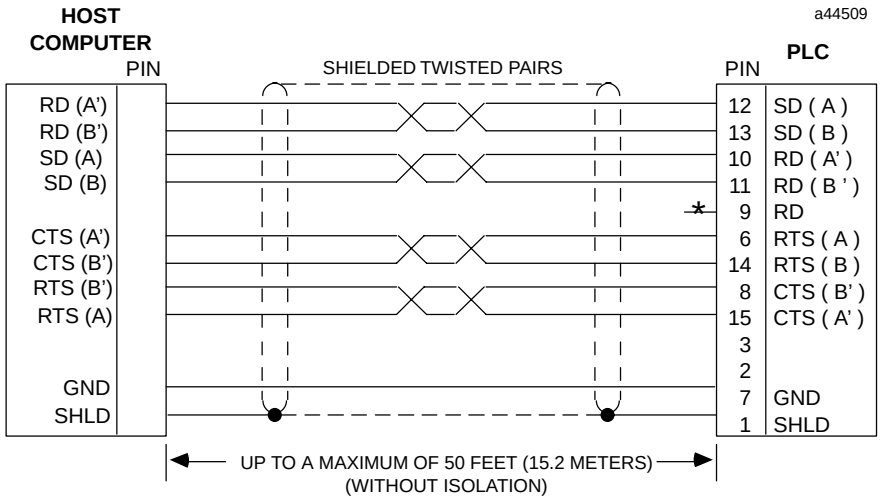
* POWER SOURCE FOR POINT–TO–POINT CONNECTION 10 FEET (3 METERS) ONLY. CONVERTER POWER SOURCE BEYOND 10 FEET (3 METERS) AND FOR MULTIDROP CONNECTION MUST BE EXTERNAL SOURCE.

** TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

Figure C-5. Workmaster or IBM-XT (compatibles) Personal Computer to Series 90 PLCs

RS-422 Point-to-Point Connection

If your host device is equipped with a RS-422 card you can connect directly to Series 90 PLCs as illustrated in Figure C-7.



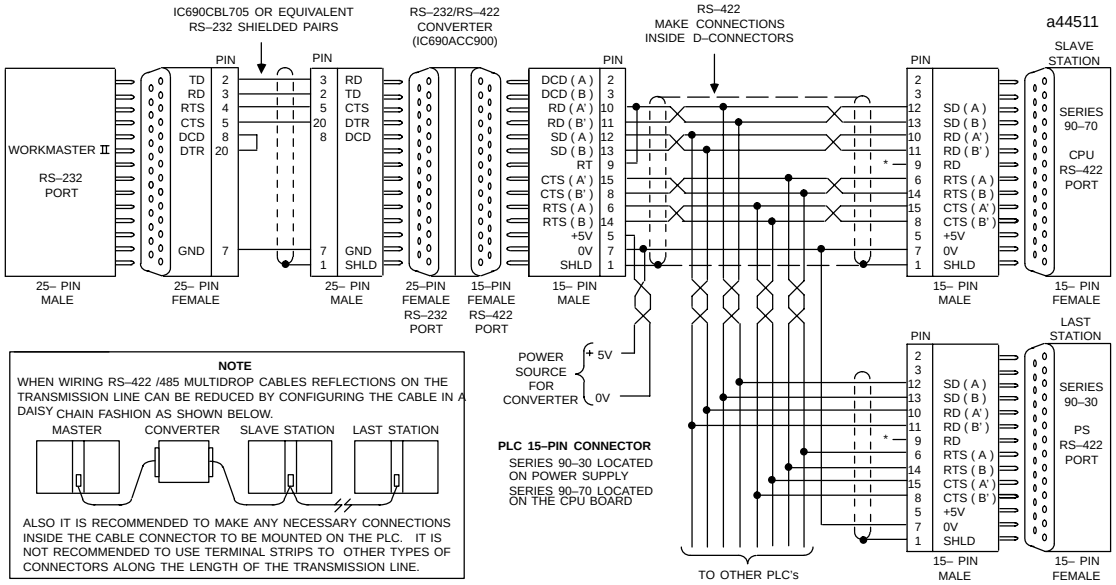
* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

Figure C-6. Typical RS-422, Host to PLC Connection, with Handshaking

Multidrop Connections

In the multidrop configuration, the host device is configured as the master and one or more PLCs are configured as slaves. This method can be used when the maximum distance between the master and any slave does not exceed 4000 feet (1200 meters). This figure assumes good quality cables and a *moderately* noisy environment. A maximum of 8 slaves can be connected using RS-422 in a *daisy chain* or multidrop configuration. The RS-422 line must include handshaking and use wire type as specified in the "Cable and Connector Specifications" section.

The following illustrations shows wiring diagrams and requirements for connecting a Workmaster II or IBM-PS/2, Workmaster, IBM-AT/XT or compatible computer to Series 90 PLCs in an 8-wire multidrop, serial data configuration.



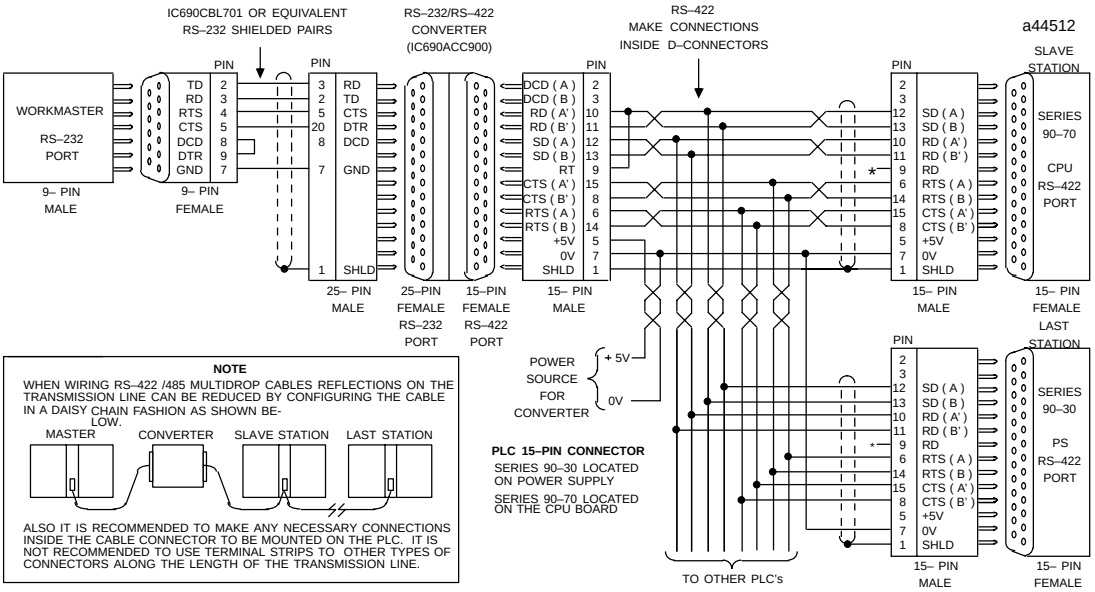
* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

GROUND POTENTIAL: MULTIPLE UNITS, NOT CONNECTED TO THE SAME POWER SOURCE, MUST HAVE COMMON GROUND POTENTIALS OR GROUND ISOLATION FOR PROPER OPERATION OF THIS SYSTEM.

Figure C-7. Workmaster II/Series 90 PLC Multidrop Connection

Note

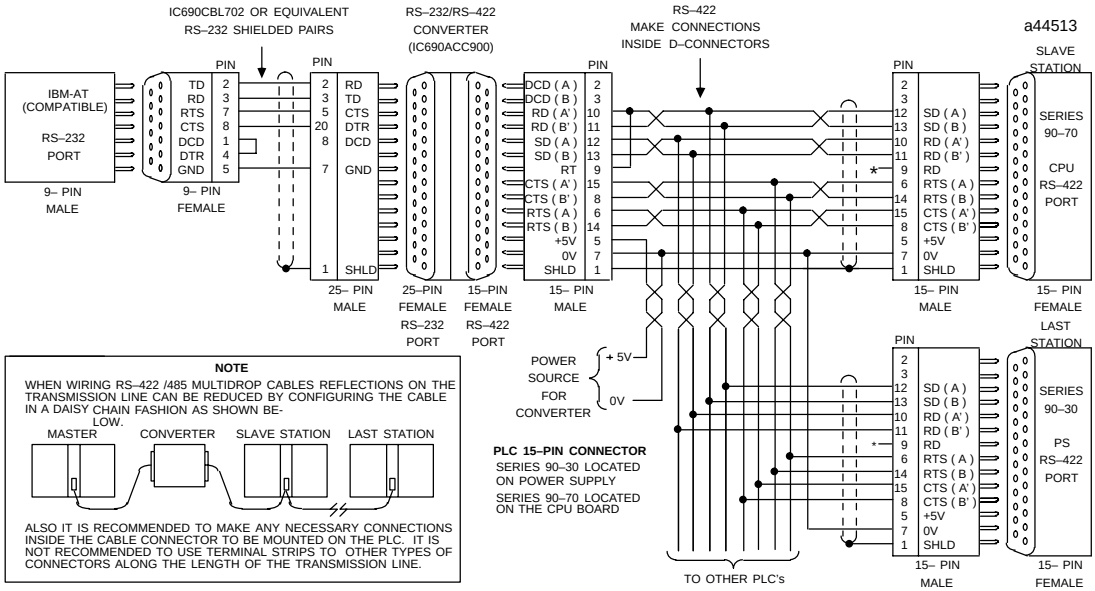
The cable connector for the Series 90-70 serial port must be a right angle connector in order for the hinged door on the module to close properly. Refer to Table C-1, "Connector/CableSpecification."



* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

GROUND POTENTIAL: MULTIPLE UNITS, NOT CONNECTED TO THE SAME POWER SOURCE, MUST HAVE COMMON GROUND POTENTIALS OR GROUND ISOLATION FOR PROPER OPERATION OF THIS SYSTEM.

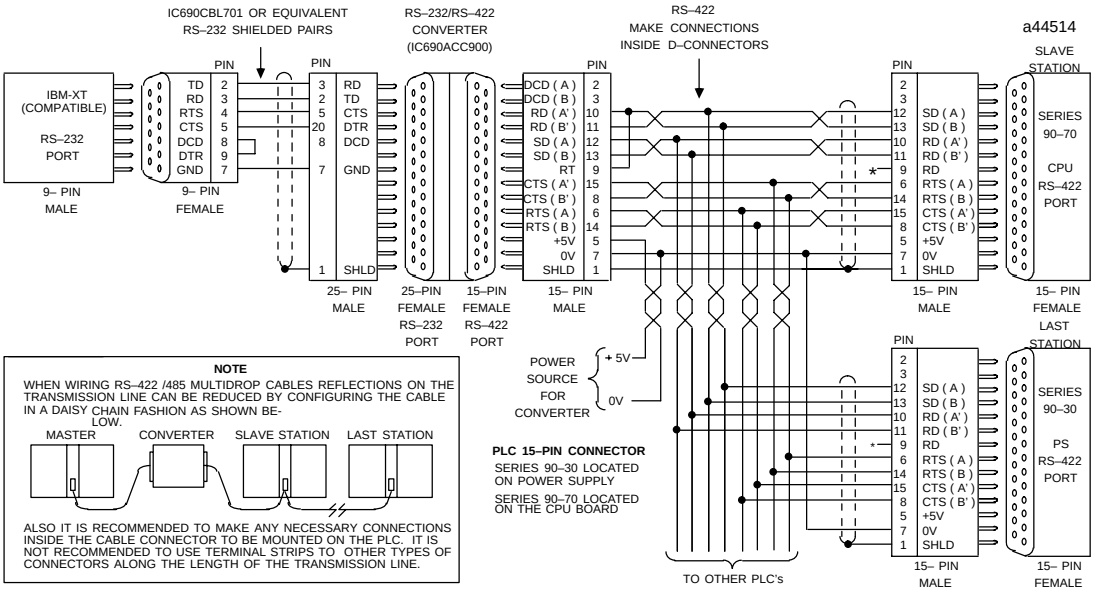
Figure C-8. Workmaster/Series 90 PLC Multidrop Connection



* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

GROUND POTENTIAL: MULTIPLE UNITS, NOT CONNECTED TO THE SAME POWER SOURCE, MUST HAVE COMMON GROUND POTENTIALS OR GROUND ISOLATION FOR PROPER OPERATION OF THIS SYSTEM.

Figure C-9. IBM-AT/Series 90 PLC Multidrop Connection



* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

GROUND POTENTIAL: MULTIPLE UNITS, NOT CONNECTED TO THE SAME POWER SOURCE, MUST HAVE COMMON GROUND POTENTIALS OR GROUND ISOLATION FOR PROPER OPERATION OF THIS SYSTEM.

Figure C-10. IBM-XT/Series 90 PLC Multidrop Connection

Appendix D

IC690ACC900 Converter

(Obsolete Product)

NOTE: This product is no longer available. This appendix is for reference for those already using this converter. We recommend the IC690ACC901 as a replacement for most applications (see Appendix F for details).

This appendix provides a detailed description of the RS-422/RS-485 to RS-232 Converter (IC690ACC900) for the Series 90 Programmable Logic Controllers.

Features

- Provides the Series 90 PLCs with an interface to devices that use the RS-232 interface.
- Allows connection to programming computer without a Work Station Interface board.
- Easy cable connection to either a Series 90-70 PLC or a Series 90-30 PLC.
- No external power needed; operates from +5 volt DC power on the Series 90 PLC backplane.
- Convenient, light weight self-contained unit.

Functions

The RS-422/RS-485 to RS-232 Converter provides an RS-232 serial interface for the Series 90-70 and Series 90-30 PLCs, which have a built-in RS-422/RS-485 interface. Specifically, it provides a serial connection between a Series 90-30 or Series 90-70 PLC serial port and the serial port on the programming computer without the need for a Work Station Interface to be installed in the computer. The programming computer can be a Workmaster II computer, or IBM PS/2 or compatible computer.

Location in System

The RS-422/RS-485 to RS-232 converter is a free-standing device which requires two cables as the connections between the PLC and the programmer. Its location is limited only by the length of the connecting cables as listed in the interface specifications (see

Table 5). The cable at the PLC end that connects to the RS-422/RS-485 connector on the converter can be up to 10 feet in length (without an external source of +5 VDC) and up to 1000 feet (300m) in length with an external source of +5 VDC. The cable from the RS-232 connector on the converter to the programming computer's serial port can be up to 50 feet (15m) in length.

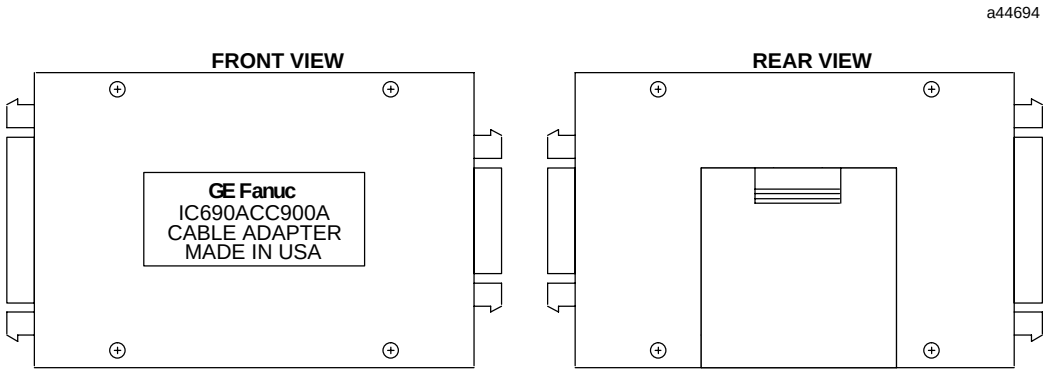


Figure D-1. Front and Rear View of Converter

Installation

Installation of the RS-422/RS-485 to RS-232 Converter consists of connecting two cables. Select the proper cables for your installation. Prewired cables (see below) are available from GE Fanuc, or if cables of different lengths are required by your application, you can build your own cables. Specifications for building these cables are provided later in this appendix..

You do not need to connect an external source of power to the converter for a cable length of 10 feet, or less, since the necessary power connections of +5 VDC and signal ground are derived from the PLCs backplane bus through the cable which connects to the Series 90-30 or 90-70 PLC.

1. Select one of the three RS-232 compatible cables (10 feet in length) that will connect the programmer's (or other serial device) RS-232 serial port to the RS-232 port on the converter. The catalog numbers of these cables are: IC690CBL701 (use with Workmaster industrial computer, or IBM PC-XT or compatible personal computer), IC690CBL702 (use with IBM PC-AT or compatible personal computer), and IC690CBL705 (use with Workmaster II industrial computer, or IBM PS/2 or compatible personal computer).
2. A standard 6-foot cable (HHP compatible) is available to connect the RS-422/RS-485 port on the converter to the RS-485 port on the Series 90-30 or Series 90-70 PLC. The catalog number of this cable is IC693CBL303.

Installation of these cables should be done with the PLC powered-down.

- Connect the 25-pin male connector on the 10 foot cable to the 25-pin female connector on the converter.

- Connect the female connector (9-pin or 25-pin) on the opposite end of this cable to the male RS-232 connector (serial port) on the selected programming (or other serial) device. If you build you own cable, use a connector that is compatible with your serial device.
- Notice that both ends of the 6-foot RS-422/RS-485 compatible cable are the same; a 15-pin male connector is attached at both ends. Connect one end of this cable to the 15-pin female connector on the RS-422/RS-485 connector on the converter.
- Connect the other end of this cable to the 15-pin female connector, which interfaces to the RS-485 compatible serial port on the Series 90-30 or Series 90-70 PLC. For the Series 90-30 PLC, this connector is accessed by opening the hinged door on the power supply. The serial port connector for the Series 90-70 PLC is on the CPU module, and is accessed by opening the hinged door on the module.

Cable Description

The serial connection to the Series 90-70 PLC (see Figure D-1) is to the RS-422/RS-485 compatible serial port connector, located at the bottom of the CPU module behind the hinged door, through an available 6 foot (2 meter) serial interface cable - IC693CBL303. Wiring information and recommended cable and connectors are provided for those who may want to build their own cable having a different length.

The serial connection to the Series 90-30 PLC is to the RS-485 compatible serial port connector located behind the hinged door on the right front of the power supply, through the same 6 foot serial interface cable, IC693CBL303, or equivalent, Figure D-2).

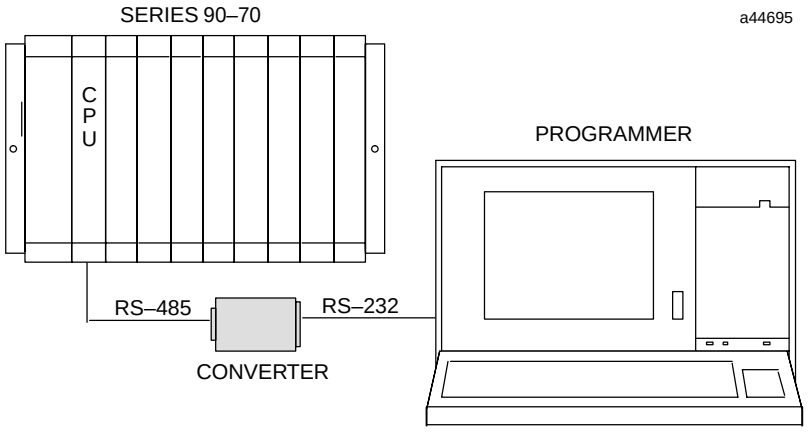


Figure D-2. Typical Configuration with Series 90-70 PLC

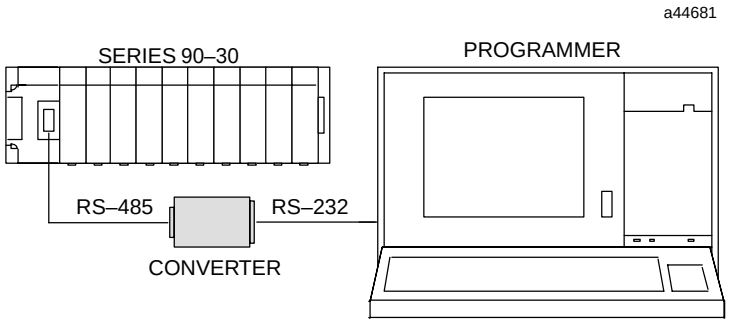


Figure D-3. Typical Configuration with Series 90-30 PLC

RS-232 Interface Pin Assignments

Pin assignments and signal definitions for the RS-232 interface are listed below.

Table D-1. RS-232 Interface for Converter

Pin	Signal Name	Function	I/O
1	Shield	Cable shield	-
2	SD	Transmitted Data	Out
3	RD	Received Data	In
4	RTS	Request To Send	Out
5	CTS	Clear To Send	In
6	-	No connection	-
7	SG	Signal Ground	-
8	DCD	Data Carrier Detect	In
9/19	-	No connection	-
20	DTR	Data Terminal Ready	Out
21 to 25	-	No connection	-

RS-422/RS-485 Interface Pin Assignments

Pin assignments and signal definitions for the RS-422/RS-485 interface are listed below.

Table D-2. RS-422/RS-485 Interface for Converter

Pin	Signal Name	Function	I/O
1	Cable Shield		
2	DCD(A)	Differential Data Carrier Detect	Out
3	DCD(B)	Differential Data Carrier Detect	Out
4	ATCH/	Attach (used with HHP)	n/a
5	+5 VDC	Logic Power	In
6	RTS(A)	Differential Request To Send	Out
7	SG	Signal Ground, 0V	In
8	CTS(B')	Differential Clear To Send	In
9	RT	Resistor Terminator	n/a
10	RD(A')	Differential Receive Data	In
11	RD(B')	Differential Receive Data	In
12	SD(A)	Differential Send Data	Out
13	SD(B)	Differential Send Data	Out
14	RTS(B)	Differential Request To Send	Out
15	CTS(A')	Differential Clear To Send	In

Logic Diagram

The following figure shows the logic diagram for the RS-422/RS-485 to RS-232 Converter.

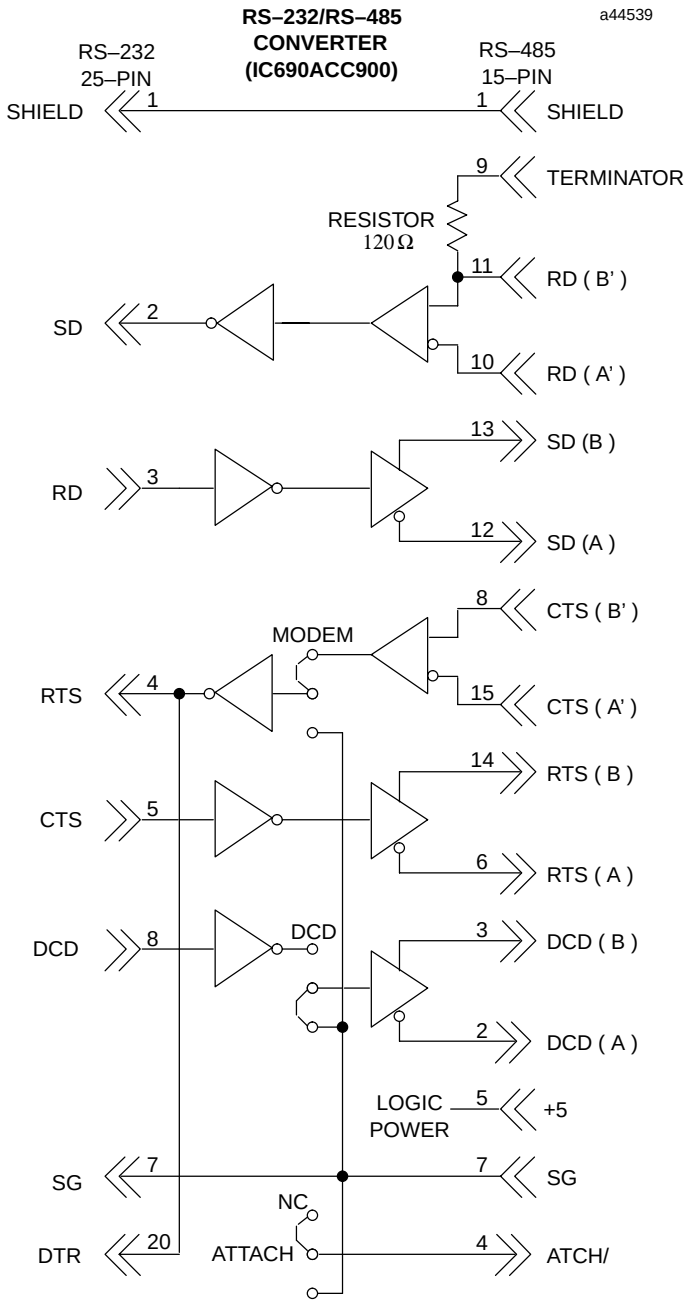


Figure D-4. RS-422/RS-485 to RS-232 Converter Logic Diagram

Jumper Configuration

There are three jumper locations on the converter board for selection of user options. Each jumper position has three pins, as shown in the following illustration. These jumper positions, labeled JP2, JP3, and JP4, are accessed by removing the square plastic cover on the top of the converter. Configuration can be changed as required by carefully removing one or more of the jumpers with a pair of needle nose pliers and placing it on the desired pair of pins.

Refer to the description of these selectable jumper positions in the following table and place the jumper on the selected pair of pins. The pin numbers are 1, 2, and 3. Default jumper locations are indicated by a rectangle around the pins to be jumpered for each position. The default pin numbers are 1 and 2.

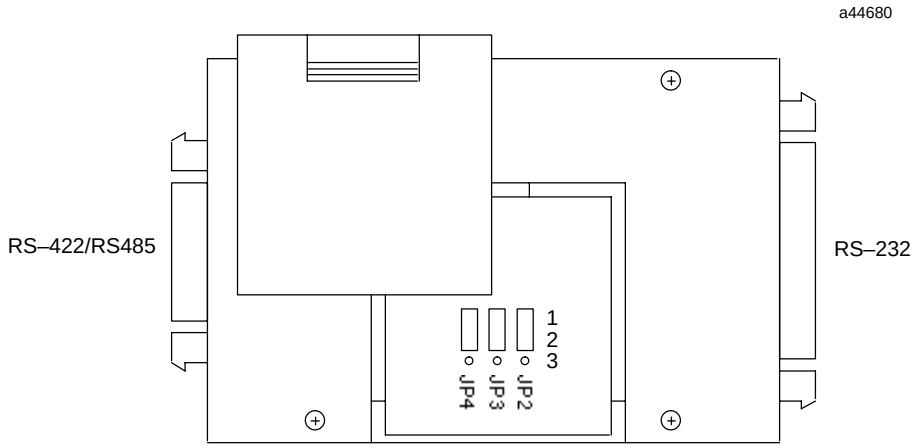


Figure D-5. Location of Jumpers for User Options

Table D-3. Jumper Configuration for RS-422/RS-485 to RS-232 Converter

Jumper Position	Label	Jumper Position	Description †
JP2	DCD	[1 2] 3	Default position 1 and 2 is used when the device communicating with the PLC does not supply the Carrier Detect signal. JP2 forces the DCD signal active on the RS-485 port.
		1 [2 3]	Use jumper positions 2 and 3 if the device does supply the Carrier Detect signal. This allows the programming device to control DCD.
JP3	MODEM	[1 2] 3	Default position 1 and 2 is used when an attached Modem does not require the Clear To Send (CTS) signal. This allows the programming device to control the RTS signal.
		1 [2 3]	Jumper positions 2 and 3 are used when the attached Modem does require the CTS signal (most modems require this signal). Forces RTS to be continually active.
JP4	ATTACH	[1 2] 3	Default position 1 and 2 is used for most applications communicating with the PLC via a serial programming device.
		1 [2 3]	Jumper positions 2 and 3 are used if the device communicating with the PLC is intended to emulate the HHP protocol.

† Refer to the documentation for your serial device for signal requirements.

Example of Cable Configurations

Examples of cable configurations required when using the converter can be found in Appendix C. Specifications for the converter are shown in the following table.

Table D-4. Specifications for IC690ACC900 Converter

Power Requirements:	
Voltage	5 volts DC, +5%
Current	170 mA, ±5%
RS-422/RS-485 Interface Cables:	
Maximum cable length	1000 feet(300m)
Cable Type: †	
6 feet (2m)	Cable type: Belden 9508, AWG #24 (0.22 mm^2)
30 feet (10m) ‡	Cable type: Belden 9309, AWG #22 (0.36 mm^2)
≥30 feet, up to 1000 feet (300m) ‡	Same cable as for 30 feet.
Connector Type	15-pin D-type Male Subminiature (both ends)
RS-232 Interface Cable:	
Maximum cable length Up to 50 feet (15m)	50 feet (15m)
Connector Type	25-pin D-type Female Subminiature (converter end) 9-pin, 15-pin, or 25-pin (depending on type of connector on your serial device) D-type Female Subminiature (programming device end)

† Catalog numbers are provided as suggestions only. Any cable having the same electrical characteristics is acceptable. It is strongly recommended that you use stranded wire. Since it is sometimes hard to find a cable with the desired number of twisted pairs (the Belden 9309 has an extra pair), you may end up with a cable with extra pairs.

‡ For distances over 10 feet, the +5 volt DC logic power source must be provided externally by connecting an external power supply to the +5V and SG (0V) connections at the converter end of the cable. ***The +5V pin at the PLC connector end of the cable must not be connected to the cable.*** The +5V and SG connections from the external power supply must be isolated from its own power line ground connection. Ensure that there is no connection between the external supply and the PLC except the SG cable connection.

Appendix E

IC655CCM590 Isolated Repeater/Converter

(Obsolete Product)

NOTE: This product is no longer available. This appendix is for reference by those already using this product. It has been replaced by catalog number IC690ACC903 (see Appendix F for details).

This appendix describes how to use the *Isolated Repeater/Converter* (IC655CCM590) with Series 90 PLCs. The following topics are covered in this appendix.

- Description of the Isolated Repeater/Converter
- System Configurations
- Cable Diagrams

Note

The catalog number for the Isolated Repeater/Converter was previously IC630CCM390.

Description of the Isolated Repeater/Converter

The Isolated Repeater/Converter (IC655CCM590) can be used for the following purposes.

- To provide ground isolation where a common ground cannot be established between components.
- To boost RS-422 signals for greater distance and more drops.
- To convert signals from RS-232 to RS-422 or RS-422 to RS-232.

The figure on the next page shows the appearance of the unit and the location of features that are of interest to the user.

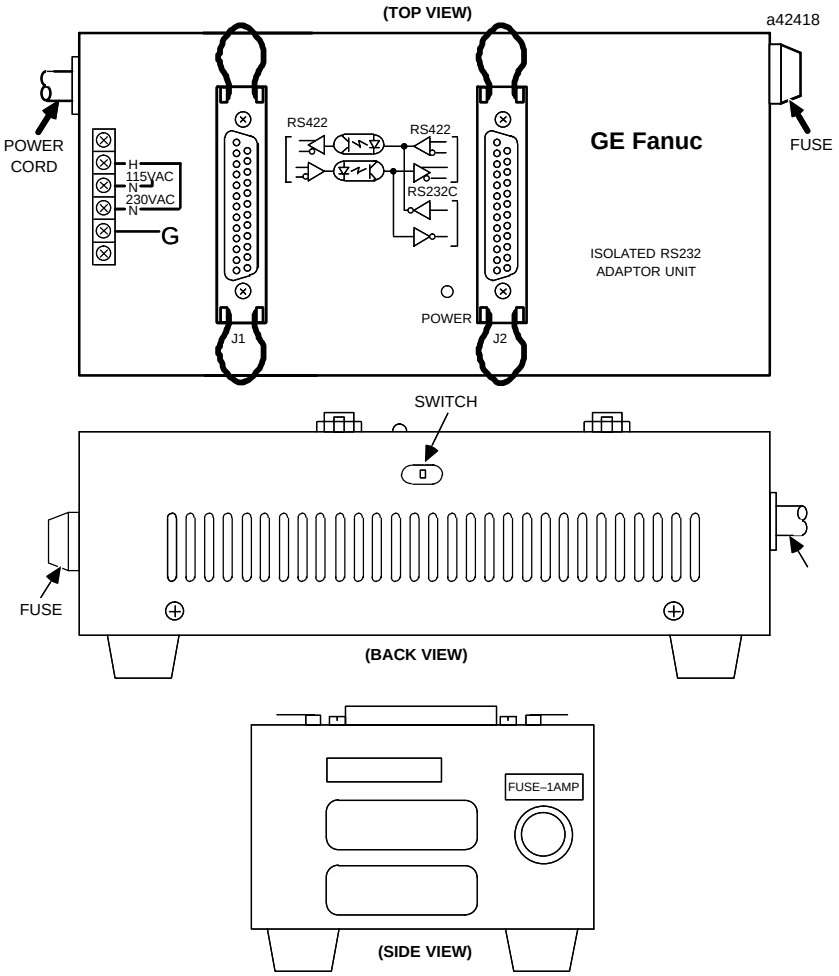


Figure E-1. Isolated/Repeater Converter

Items of interest to the user on the Isolated Repeater/Converter are described below.

- Two 25-pin female D-type connectors (Two 25-pin male, D-type connectors (solder pot), are included for user cabling.)
- 115/230 VAC power connection (internal) 4-position terminal block.
- Fused 1 Amp power protection.
- Power ON (green) indicator LED.
- Three-position toggle switch, recessed in the back of the unit, is set according to the system configurations shown later in this appendix.

Logic Diagram of the Isolated Repeater/Converter

The figure below provides a functional look at the unit. Note the 3-position switch for controlling the J1 port transmitters. This switch is discussed in *System Configurations* later in this appendix..

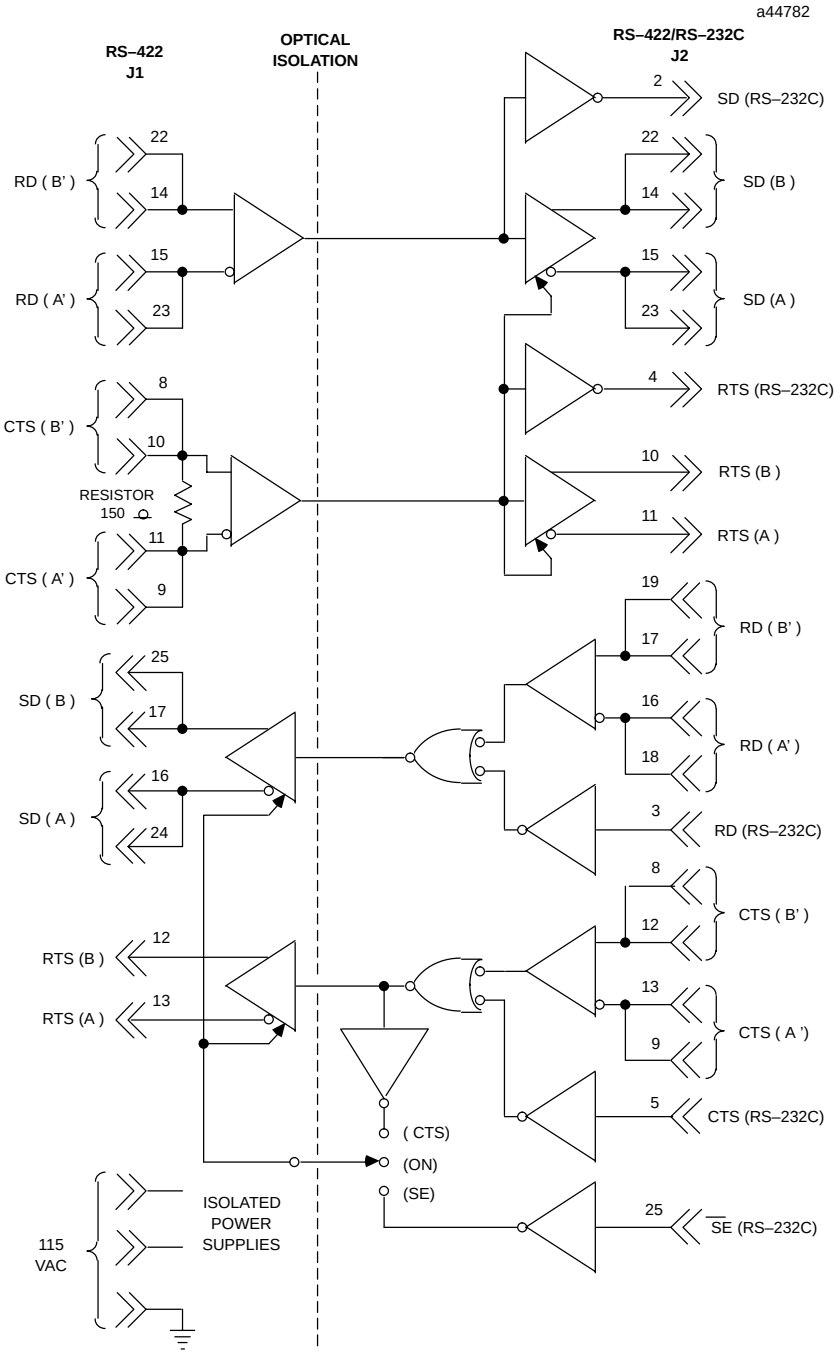


Figure E-2. RS-422 Isolated Repeater/RS-232 Converter Logic Diagram

Note

All inputs are biased to the inactive state. Inputs left unconnected will produce a binary 1 (OFF) state on the corresponding output.

Pin Assignments for the Isolated Repeater/Converter

Table E-1. Isolated Repeater/Converter Pin Assignments

J1 RS-422 Port (25-pin female connector)		
Pin	**Signal**	**Description**
1		NC
2		NC
3		NC
4		NC
5		NC
6		NC
7	0V	Ground Connection
8	CTS(B')	Clear to Send (Optional Termination)
9	CTS(A')	Clear to Send (Optional Termination)
10	CTS(B')	Clear to Send
11	CTS(A')	Clear to Send
12	RTS(B)	Request to Send
13	RTS(A)	Request to Send
14	RD(B')	ReceiveData
15	RD(A')	ReceiveData
16	SD(A)	Send Data
17	SD(B)	Send Data
18		NC
19		NC
20		NC
21		NC
22	RD(B')	ReceiveData
23	RD(A')	ReceiveData
24	SD(A)	Send Data

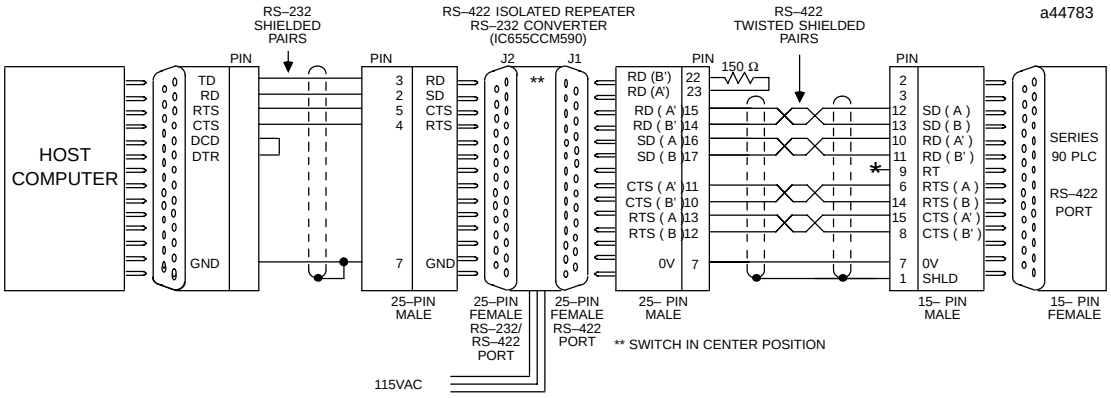
J2 RS-422/RS-232 Port (25-pin female connector)		
Pin	**Signal**	**Description**
1		NC
2	SD	Send Data (RS-232)
3	RD	Receive Data (RS-232)
4	RTS	Request to Send (RS-232)
5	CTS	Clear to Send (RS-232)
6		NC
7	0V	Ground Connection
8	CTS(B')	Clear to Send Optional Termination)
9	CTS(A')	Clear to Send (Optional Termination)
10	RTS(B)	Request to Send
11	RTS(A)	Request to Send
12	CTS(B')	Clear to Send
13	CTS(A')	Clear to Send
14	SD(B)	Send Data
15	SD(A)	Send Data
16	RD(A')	ReceiveData
17	RD(B')	ReceiveData
18	RD(A')	Receive Data (Optional Termination)
19	RD(B')	Receive Data (Optional Termination)
20		NC
21		NC
22	SD(B)	Send Data (Optional Termination)
23	SD(A)	Send Data (Optional Termination)
24		NC

NC=NoConnection
SD (Send Data) and RD (Receive Data) are the same as TXD and RXD (used in the Series Six PLC).
(A) and (B) are the same as - and + A and B denote outputs, and A' and B' denote inputs.

Caution

The signal ground connections (pin 7 on each connector) must be made between the Isolated Repeater/Converter and the PLC for J1, and the Isolated Repeater/Converter and the host computer for J2.

Pin 7 of the J1 port is connected to the metal shell of the J1 connector. Pin 7 of the J2 port is connected to the metal shell of the J2 connector. These two signal ground connections are isolated from each other and from the power system ground (green wire on the terminal block). To maintain proper isolation, these signal grounds cannot be tied together.



* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

Figure E-3. Example RS-422 Isolated Repeater/RS-232 Converter Connection

System Configurations

The figures below show various ways you can connect the Isolated Repeater/Converter to convert signals, expand the number of drops, and obtain greater distance. Any system configuration can be reduced to a minimum number of cables each covering a part of the overall system configuration. The following examples of system configurations refer to these cables as Cables A through E which are described in *Cable Diagrams* later in this section.

Downstream and Upstream Contention. In this section, simple multidrop configurations are those where a single Isolated Repeater/Converter is used. Complex multidrop configurations contain one or more multidrop sections where an Isolated Repeater/Converter is included as one of the drops. In both simple and complex multidrop configurations, the transmitters directed downstream from the master can be on at all times. There will be no contention for the communication line because only one device (the master) transmits downstream.

In simple multidrop configurations, there will be no contention when transmitting upstream as long as devices tri-state their drivers when idle and turn them on only when they have something to transmit. This is the case for the Series 90-70 and Series 90-30 CMMs.

In complex multidrop configurations, however, special steps must be taken to switch the upstream transmitters of the Isolated Repeater/Converter.

Switching Upstream Transmitters. For the RS-422 drivers to be active at the J2 port of the Isolated Repeater/Converter, the RTS input at J1 must be true. The state of the RS-422 drivers at the J1 port depends on the position of the switch on the unit. When the switch is in the center position, the J1 transmitters will always be turned on. When the switch is in the CTS position, (toward the power cable), then either the RS-232 or RS-422 CTS signal must be true to turn on the J1 drivers.

Note

Note the position of the switch on the Isolated/Repeater Converter in the system configurations below.

Simple Multidrop Configuration

This configuration shows how to connect a single Isolated Repeater/Converter for signal conversion or greater distance.

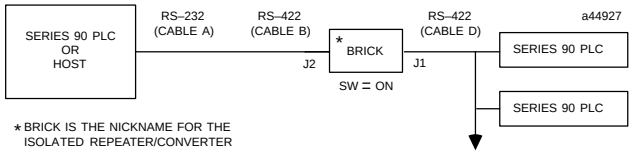


Figure E-4. Simple System Configuration Using the Isolated Repeater/Converter

Complex Multidrop Configuration

This configuration shows how to connect multiple Isolated Repeater/Converters for signal conversion, greater distance, and more drops.

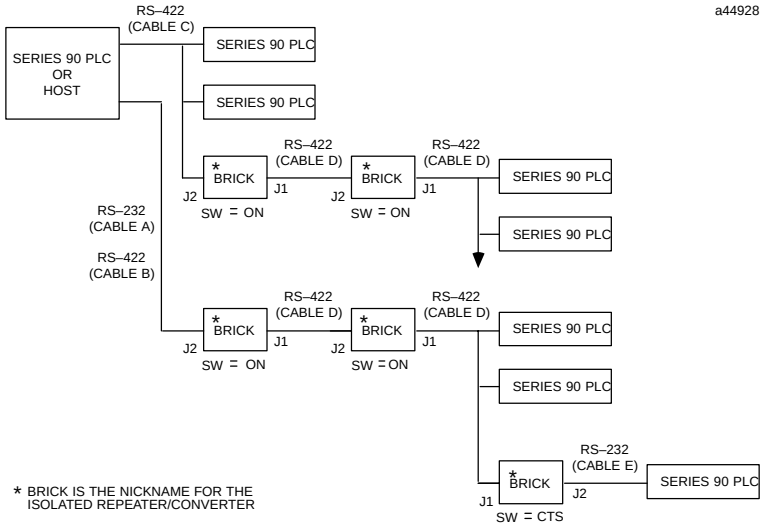


Figure E-5. Complex System Configuration Using the Isolated Repeater/Converter

Rules for Using Repeater/Converters in Complex Networks

When designing a complex multidrop network including PLCs and RS-422 repeater/converters (bricks), the following rules apply:

Rule 1: When using a brick as a repeater, port J2 should always be directed toward the host device, and Port J1 should always be directed away from the host device. The switch located on the side of the brick should always be in the center position (ON). The only case in which Port J1 is directed toward the host is when the brick is used as a converter (RS-232) at the slave. The switch is in the right position (CTS).

Rule 2: If a Series 90 CMM slave device is located downstream of a brick, set the configuration of the CMM serial port to NONE flow control with a 10 ms Modem Turnaround Delay (Applies to CCM, SNP, and SNP-X protocols only).

Rule 3: Do not place more than 3 bricks in a single communication path between the host and the slave devices.

Cable Diagrams

The cable diagrams below are referred to as Cables A-E from the system configurations in the previous figures. These diagrams show the principles for constructing your own cables and can be modified to fit your specific application.

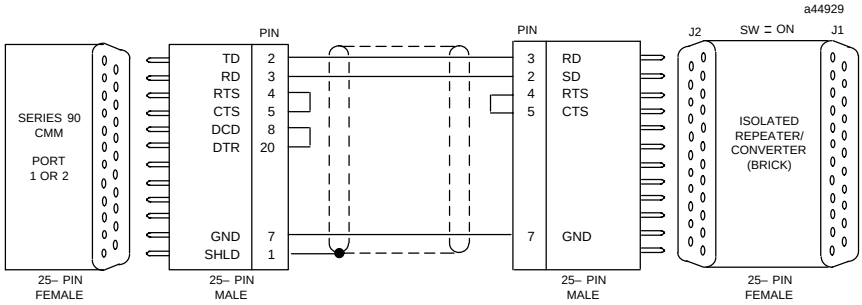


Figure E-6. Cable A; RS-232 CMM To Converter

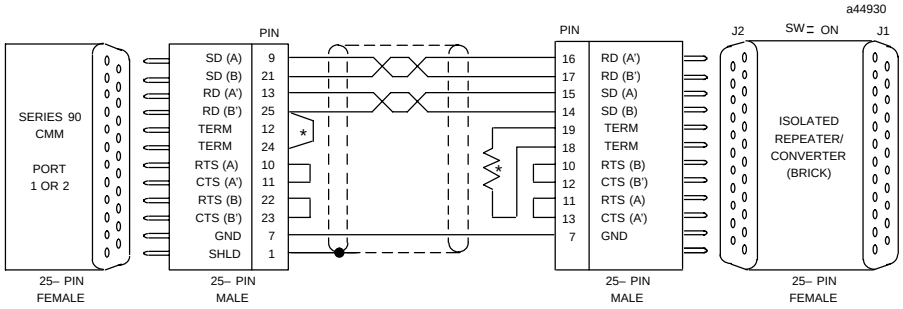


Figure E-7. Cable B; RS-422 CMM To Converter

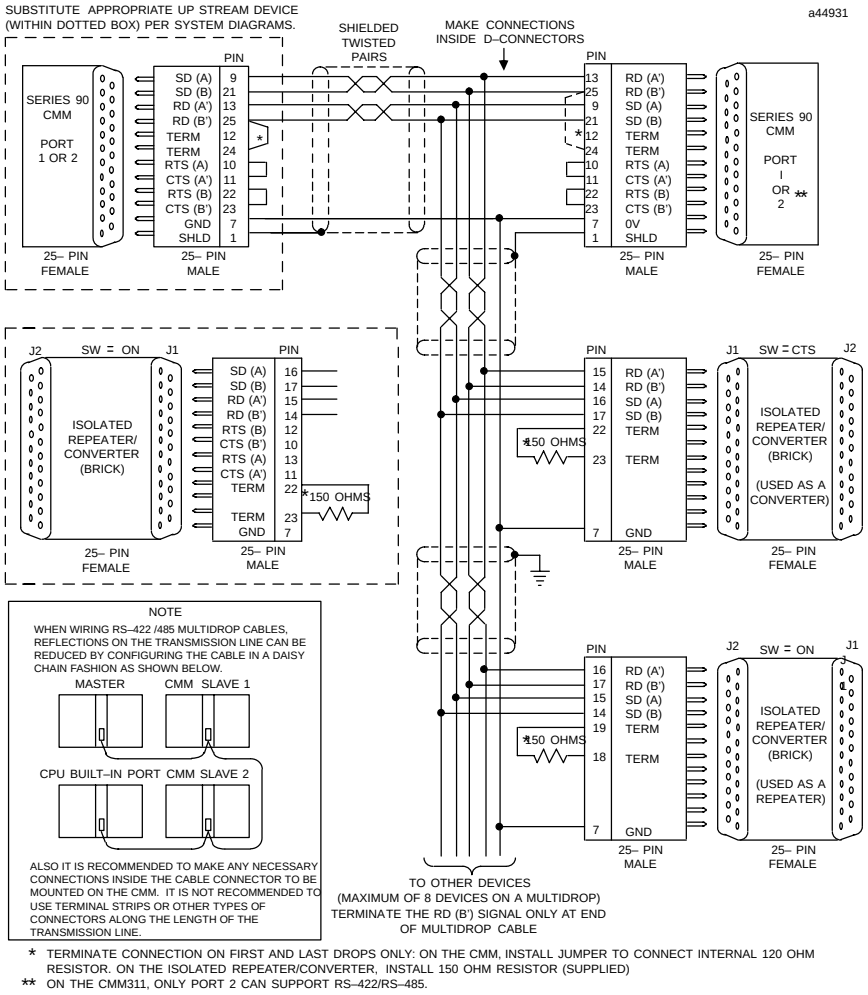
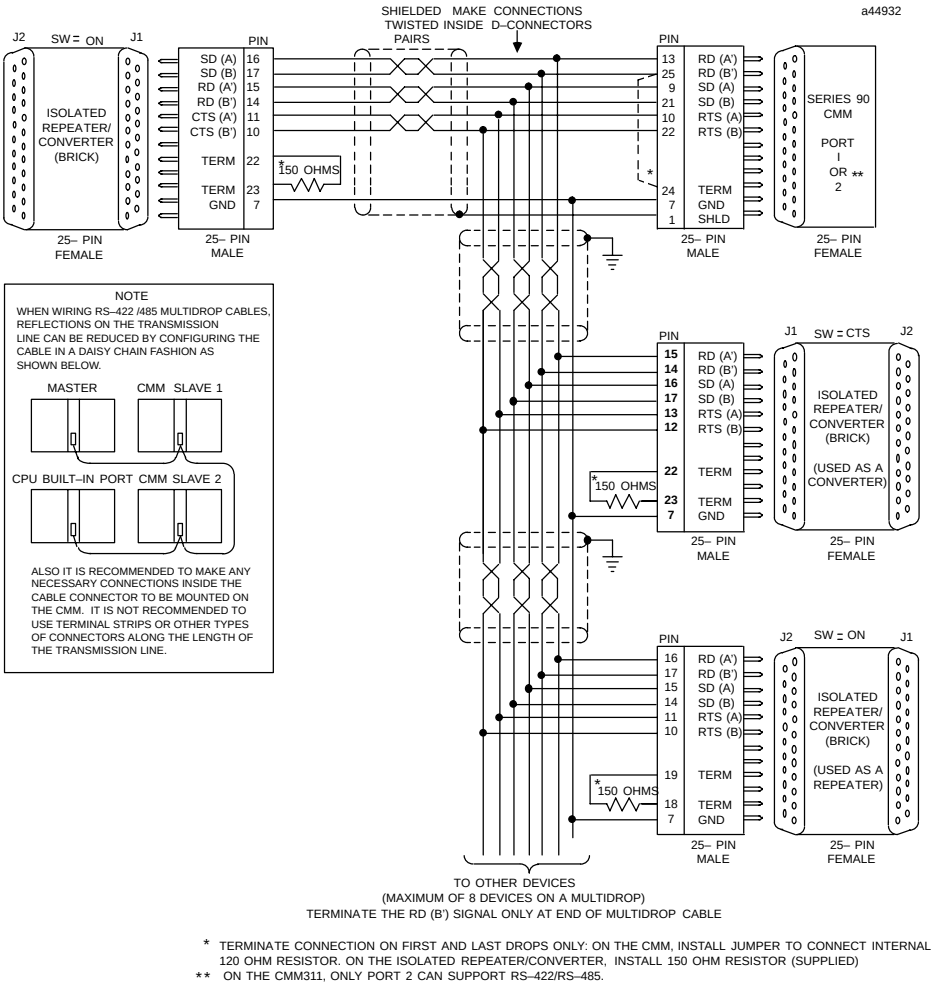


Figure E-8. Cable C; RS422 Twisted Pair



* TERMINATE CONNECTION ON FIRST AND LAST DROPS ONLY: ON THE CMM, INSTALL JUMPER TO CONNECT INTERNAL 120 OHM RESISTOR. ON THE ISOLATED REPEATER/CONVERTER, INSTALL 150 OHM RESISTOR (SUPPLIED)

** ON THE CMM311, ONLY PORT 2 CAN SUPPORT RS–422/RS–485.

Figure E-9. Cable D; RS-422 Twisted Pair

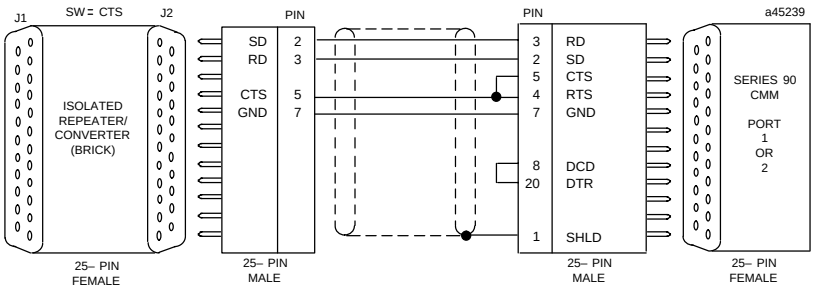


Figure E-10. Cable E; RS-232 Converter to CMM

Appendix F

IC690ACC901 Miniconverter Kit

Description of Miniconverter

The Miniconverter Kit (IC690ACC901) consists of an RS-422 (SNP) to RS-232 Miniconverter, a 6 foot (2 meter) serial extension cable, and a 9-pin to 25-pin Converter Plug assembly. The 15-pin SNP port connector on the Miniconverter plugs directly into the serial port connector on the Series 90-30 power supply, Series 90-70 CPU or Series 90-20 CPU. The 9-pin RS-232 port connector on the Miniconverter connects to an RS-232 compatible device.

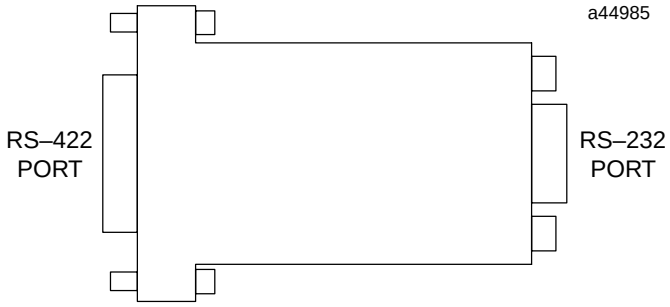


Figure F-1. Series 90 SNP to RS-232 Miniconverter

When used with an IBM PC-AT, or compatible computer, one end of the extension cable plugs into the Miniconverter's 9-pin serial port connector, the other end plugs into the 9-pin serial port of the computer. The Converter plug (supplied with kit) is required to convert the 9-pin serial port connector on the Miniconverter to the 25-pin serial port connector on the GE Fanuc Workmaster II computer, or an IBM PC-XT or PS/2 Personal Computer.

The GE Fanuc Workmaster computer requires an additional adapter (not supplied with kit - please contact your local GE Fanuc PLC distributor) for use with the Miniconverter.

Pin Assignments

The pinouts of the Miniconverter are shown in the following two tables. The first table shows the pinout for the RS-232 port, the second table shows the RS-422 port.

Pin Assignments, RS-232 Port

Table F-1 is for the RS-232 port. The direction of signal flow is with respect to the Miniconverter.

Table F-1. Miniconverter RS-232 Port

Pin	Signal Name	Direction
2	SD - Send Data	Output
3	RD - Receive Data	Input
5	GND - Ground	n/a
7	CTS - Clear To Send	Input
8	RTS - Request To Send	Output

The pinouts were chosen to allow direct connection (using a straight through, or 1 to 1 cable (as provided with kit)) to the IBM PC-AT. Most IBM compatible computers equipped with an RS-232 port will provide a pinout compatible with the one shown above.

Pin Assignments, RS-422 Port

Table F-2 is the pinout for the Miniconverter's RS-422 serial port. The direction of signal flow is also with respect to the Miniconverter.

Table F-2. Miniconverter RS-422 Port

Pin	Signal Name	Direction
1	SHLD - Shield	n/a
5	+5 VDC - Power	Input
6	CTS(A') - Clear To Send	Input
7	GND - Ground	n/a
8	RTS(B) - Request To Send	Output
9	RT - Receive Termination	Output
10	SD(A) - Send Data	Output
11	SD(B) - Send Data	Output
12	RD(A') - Receive Data	Input
13	RD(B') - Receive Data	Input
14	CTS(B') Clear To Send	Input
15	RTS(A) - Request To Send	Output

System Configurations

The Miniconverter can be used in a point-to-point configuration as described above, or in a multidrop configuration with the host device configured as the master and one or more PLCs configured as slaves.

The multidrop configuration requires a straight through (1 to 1) cable from the Miniconverter's RS-422 port to the first slave PLC's SNP port. Other slaves will require a daisy chain connection between slaves. A maximum of eight devices can be connected in an RS-422 multidrop configuration. All of the devices must have a common ground. If ground isolation is required, you can use the GE Fanuc Isolated Repeater/Converter (IC655CCM590) in place of the Miniconverter.

When using the Miniconverter with a modem connection, it may be necessary to jumper RTS to CTS (consult the user's manual for your modem).

Cable Diagrams (Point-To-Point)

When connecting the Miniconverter to IBM PC and compatible computers with hardware handshaking, the following cable connections should be used.

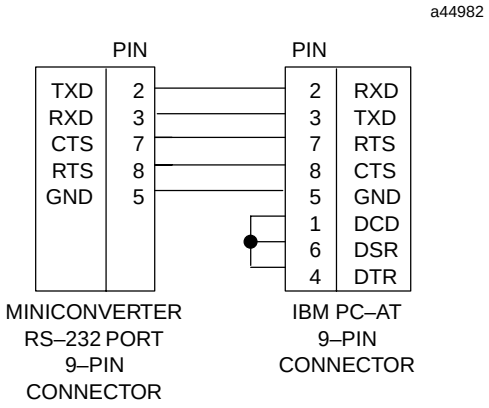


Figure F-2. Miniconverter to PC-AT

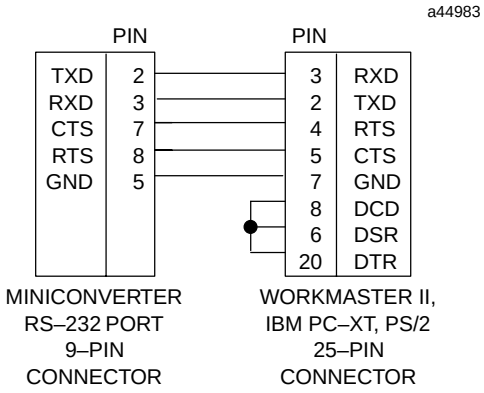


Figure F-3. Miniconverter to Workmaster II, PC-XT, PS/2

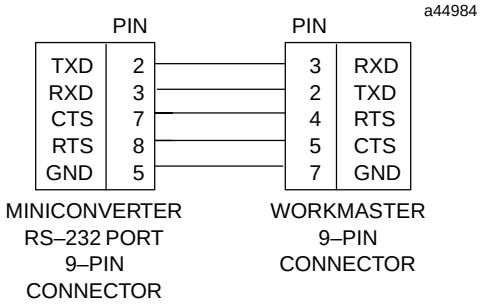


Figure F-4. Miniconverter to 9-Pin Workmaster or PC-XT Computer (Additional Adapter Required)

Table F-3. Miniconverter Specifications

Mechanical:	
RS-422	15-pin D shell male for direct mounting to Series 90 serial port.
RS-232	9-pin D shell male for connection to RS-232 serial port of a Workmaster II computer or Personal Computer.
Electrical and General:	
Voltage Supply	+5 VDC (supplied by PLC power supply)
Typical Current	Version A (IC690ACC901A) - 150 mA Version B (IC690ACC901B) - 100 mA
Operating Temperature	0 to 70° C (32 to 158° F)
Baud Rate	38.4K Baud maximum
Conformance	EIA-422 (Balanced Line) or EIA-423 (Unbalanced Line)
Ground Isolation	Not provided

Appendix G

IC690ACC903 Port Isolator

The IC690ACC903 RS-485 Port Isolator replaces the IC655CMM590 Isolated Repeater/Converter (also referred to as the "Brick"). The device features 500 volts of isolation in a compact package servicing all IC693, IC697, and IC200 PLC product lines. The product connects directly to an RS-485 serial port or though a short extender cable provided with the device. The extension cable is intended for use in applications where direct connection to the port is obstructed by surrounding equipment or when it is not acceptable for the device to protrude from a PLC module. The Port Isolator can operate in either single- or multi-drop mode, which is selected by a slide switch on the top of the module.

The Port Isolator provides the following features:

- Four opto-isolated signal channels: SD, RD, RTS, and CTS
- Electrical compatibility with RS-485
- Single- or multi-drop operation
- Input termination consistent with standard for serial channels
- A 5V DC/DC converter for power isolation
- Hot insertion is supported

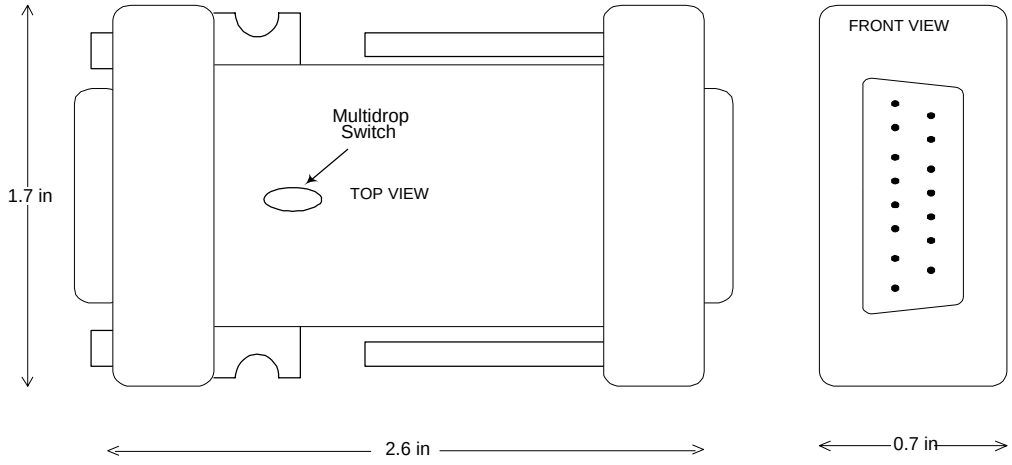


Figure G-1. RS485 Port Isolator

Connectors

The Isolator provides two connectors, one 15 pin male D-type (PL1) and one 15 pin female D-type (PL2). The pin assignments are identical, except that pin 4 on PL2 is connected to the module ID resistor.

Table G-1. RS-485 Connectors

Connector	Pin	Pin Name	Pin Type	Description
PL1	1	SHLD	–	Chassis Ground
	2	NC	–	
	3	NC	–	
	4	NC	–	
	5	5V	–	+5V power
	6	CTS (A')	In	Clear to send –
	7	0V	–	Signal Ground
	8	RTS (B)	Out	Request to send +
	9	NC	–	
	10	SD (A)	Out	Send data –
	11	SD (B)	Out	Send data +
	12	RD (A')	In	Read data –
	13	RD (B')	In	Read data +
	14	CTS (B')	In	Clear to send +
	15	RTS (A)	Out	Request to send –

Connector	Pin	Pin Name	Pin Type	Description
PL2	1	NC	–	
	2	NC	–	
	3	NC	–	
	4	NC	–	
	5	5V	–	+5V power
	6	RTS (A)	Out	Request to send –
	7	0V	–	Signal Ground
	8	CTS (B')	In	Clear to send +
	9	RT	–	Terminating Resistor*
	10	RD (A')	In	Read data –
	11	RD (B')	In	Read data +
	12	SD (A)	Out	Send data –
	13	SD (B)	Out	Send data +
	14	RTS (B)	Out	Request to send +
	15	CTS (A')	In	Clear to send –

* Use the terminating resistor if the Port Isolator is used in port-to-port mode or at the end of a multi-drop configuration. To terminate the RD balanced line, place a jumper wire from pin 9 to pin 10.

* A denotes – and B denotes +. A and B denote outputs and A' and B' denote inputs.

Logic Diagram

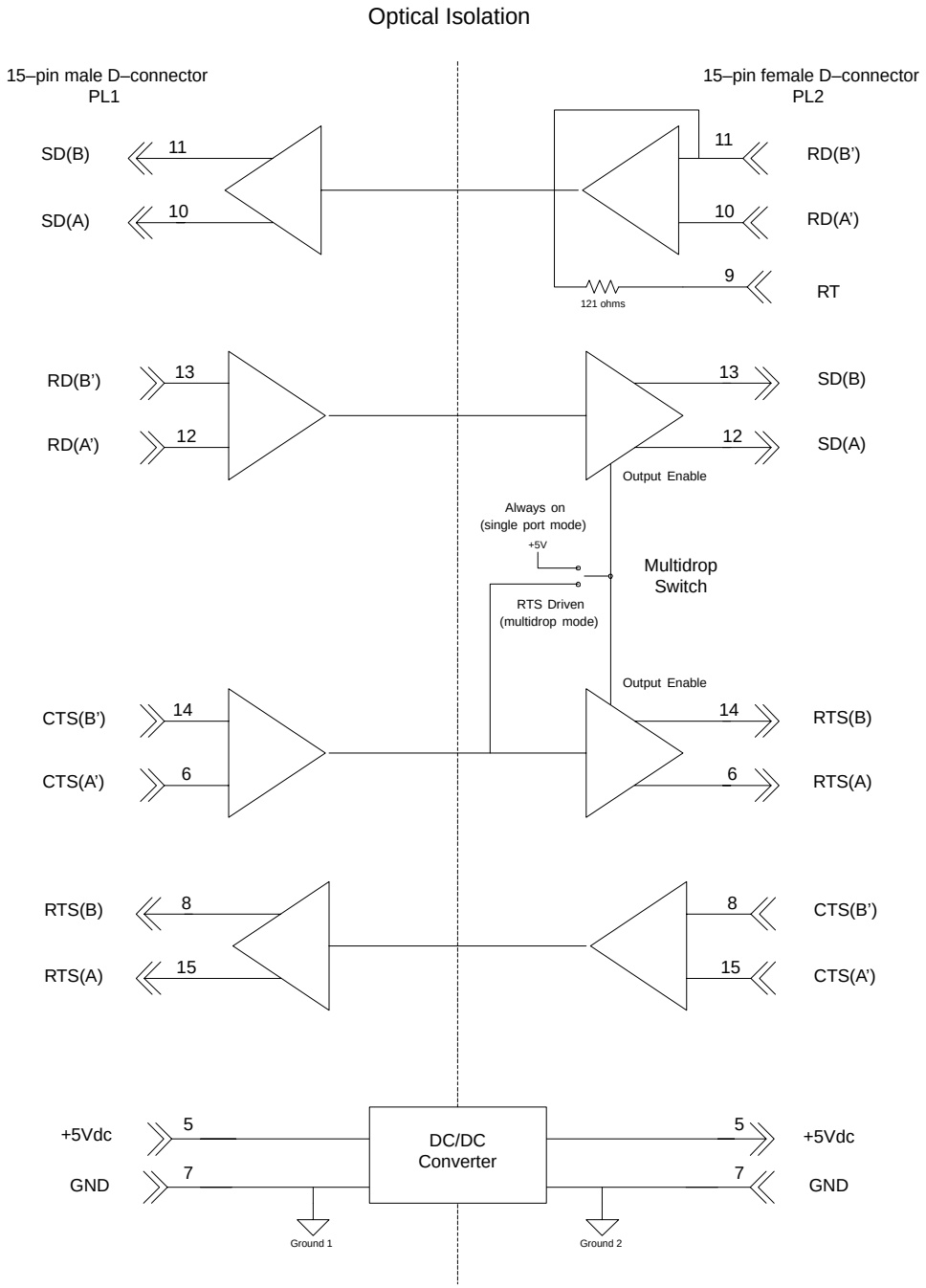


Figure G-2. IC690ACC903 Block Diagram

Installation

The Isolator is packaged in a contoured plastic enclosure designed for either direct attachment to a serial port or through a 12" extender cable for panel mounted applications. Two M3 thumbscrews secure the device to its mating connector. The device can be easily inserted into an existing communication channel with no additional hardware. In Figure G-3, the Isolator is shown connected directly to a CPU module. Alternatively, the Isolator can be mounted separately from the PLC system using the extender cable provided. For mounting separately to a panel, you will need to provide two #6–32 (4 mm)mounting screws (Figure G-4).

When installing the Isolator, tighten the connector screws and panel mounting screws (if used) to the following torque values:

Screws	Type	Torque
Connector Thumbscrews (supplied with Isolator)	M3	8 in./lbs. (0.9 Newton–meter)
Panel Mounting Screws (user–supplied)	#6/32 (4 mm)	12 in./lbs. (1.4 Newton–meters)

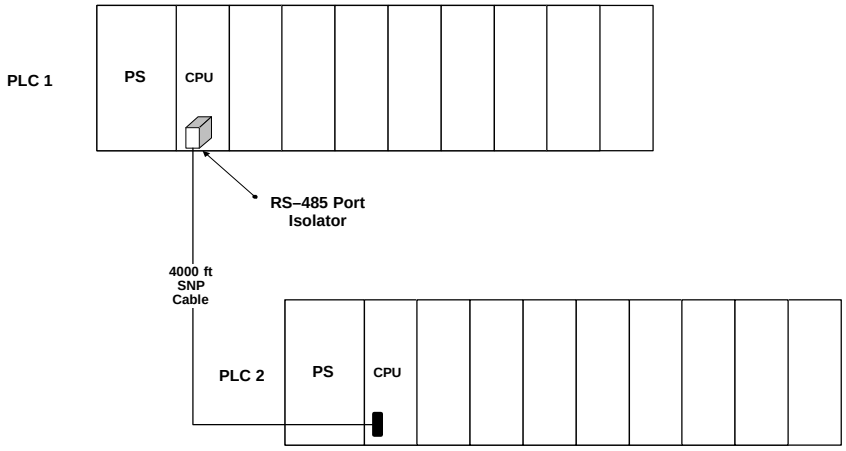


Figure G-3. RS-485 Port Isolator in PLC Network

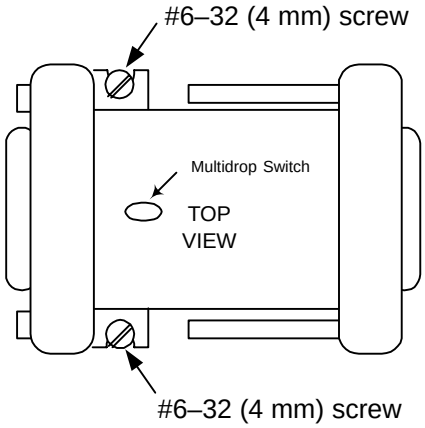


Figure G-4. Mounting Port Isolator to Panel

The RS485 Port Isolator supports both port-to-port and multi-drop configurations (Figure G-5). For installation information, refer to section 3 of the Serial Communications User's Manual (GFK-0582). One configuration not covered in the User's Manual is the case where the Isolator is powered by a source other than the host port. This configuration is used to prevent an interrupt in communications if the host system requires a power cycle. It also prevents power loss to equipment using the port for power. For this, you will need to build a custom cable as shown in Figure G-6.

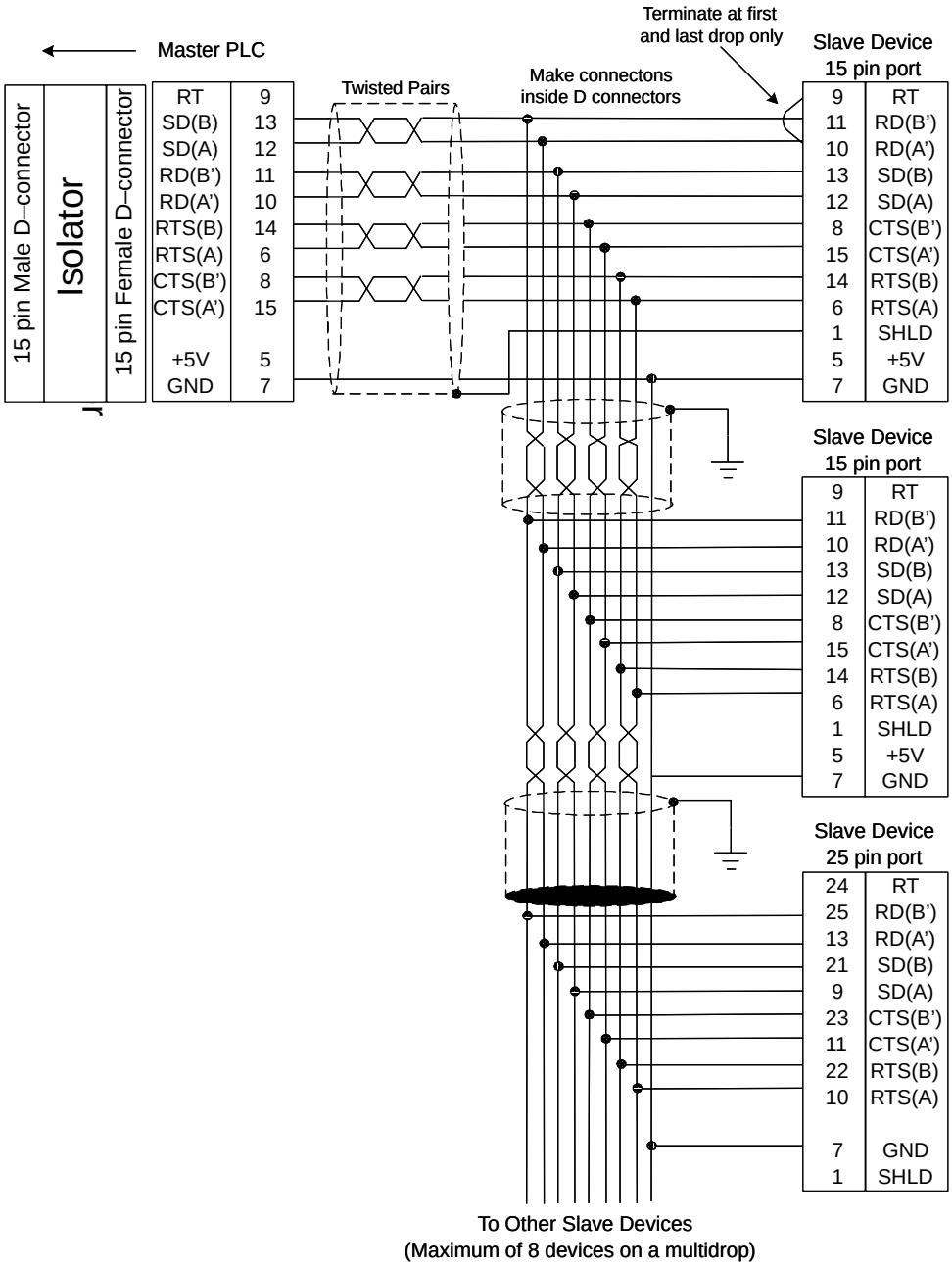


Figure G-5. Multidrop Configuration Connecting Devices with 15–Pin Ports and 25–Pin Ports

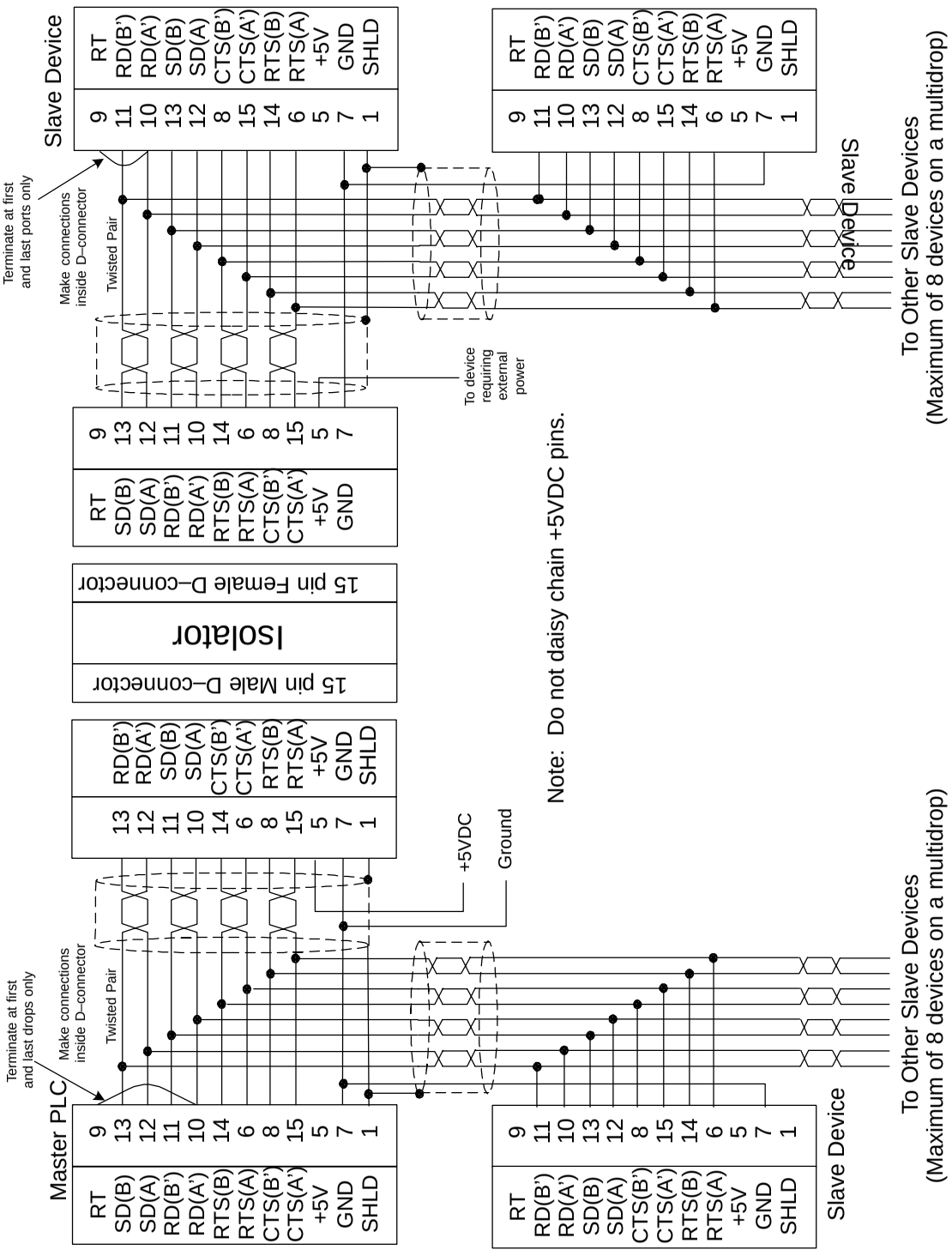


Figure G-6. Cable for Supplying External Power Through the Port Isolator

Specifications

Mechanical	
RS–485	15-pin D shell male for direct mounting to serial port on the programmable controller 15-pin D shell female for communication cable
Installation Hardware	Two M3 thread connector thumbscrews. Recommended torque: 8 in./lbs. (0.9 Newton–meter). These are supplied with Isolator. Two user supplied #6/32 (4mm) thread panel mounting screws. Recommended torque: 12 in./lbs. (1.4 Newton–meter)
Electrical	
Voltage Supply Typical Current	+5VDC (supplied by port) 25 mA 100 mA available for external equipment
Ground Isolation Conformance	500 Volts EIA-422/485 Balanced Line
Operating Temperature	0° – 60°C (32° – 140° F)
Baud Rate	Those supported by PLC

Note: This appendix is based on Data Sheet GFK-1663.

Appendix H

Series 90-70 Heat Dissipation

Overview

Most PLCs are mounted in an enclosure. The enclosure should be capable of properly dissipating the heat produced by all of the devices mounted inside it. This appendix describes how to calculate heat dissipation for a Series 90-70 PLC. The strategy is to calculate a heat dissipation value, in Watts, for each individual module in the PLC. Then these individual values will be added together to obtain a total heat dissipation figure for the PLC. When making your calculations, don't forget the following:

- To convert percent to a decimal, move the decimal two places to the left. For example, 40% would be expressed as 0.40, and 100% would be 1.00.
- To convert milliamps (mA) to Amperes (A or Amps), move the decimal three places to the left. For example, 10mA would convert to .010A, and 130mA would convert to 0.130A.

Information Required

- In addition to the information in this manual, you will need GFK-0600, *Series 90-70 Data Sheet Manual*, or individual module data sheets.
- You will need operating current values for the discrete output devices connected to the PLC's discrete output modules. These include control relays, motor starters, solenoids, pilot lights, etc. Each device manufacturer publishes these values. If an exact value is not available for a device, you can make a close estimate by obtaining the value for a similar device from a catalog. These values are also needed for selecting Output modules during the design process in order to ensure that the module's maximum ratings are not exceeded.

Step 1: Basic Method to Calculate Module Dissipation

Note that this step does not apply to Power Supply Modules, which are covered in Step 2. The values needed for this calculation are found in the Module Load Requirements table in Chapter 3. We will use the basic electrical power formula in these calculations:

Power (in Watts) = Voltage (in Volts) x Current (in Amps).

We will assume that all input power to these modules is eventually dissipated as heat. The procedure is:

- Look up the module in the Module Load Requirements table (Chapter 3) and obtain the current values for each of the three power supply voltages listed. The voltage is printed at the head of each column. All modules use the +5VDC supply, and a relatively few modules also use one or both of the two 12VDC supplies.
- For a given module, calculate the power dissipation for each column in the table that contains a current value by multiplying the current value (in Amps) times the voltage for that column. For modules using more than one voltage, add the calculated power values to arrive at the total for the module.

Example 1:

The Module Load Requirements table shows that the IC697CPU789 module draws:

- 1.6 Amps from the +5VDC supply.
- No current from either of the two 12VDC supplies

To calculate power dissipation, multiply 1.6 Amps times 5 Volts. The answer is:

8.0 Watts (of heat dissipated by this module)

Example 2:

The Module Load Requirements table shows that the IC697CMM742 module draws:

- 2 Amps from the +5VDC supply
- 0.5 Amps from the +12VDC supply
- To calculate power dissipation from the +5VDC supply:

  Multiply 2.0 Amps times 5 Volts to arrive at a value of 10.0 Watts.

To calculate power dissipation from the +12VDC supply:

Multiply 0.5 Amps times 12 Volts to arrive at a value of 6.0 Watts.

Adding the two together, we find the total heat dissipated by this module is 16 Watts.

STEP 2: CALCULATION FOR PLC POWER SUPPLIES

A basic rule for Series 90 power supplies is that they are 66% efficient. Another way of stating this is that the power supply dissipates 1 Watt of power in the form of heat for every 2 Watts of power it delivers to the PLC. Therefore, you can calculate the total power requirement for all of the modules in the rack served by a particular power supply using the method in Step 1 above, then divide that figure by 2 to arrive at the power supply dissipation value. You cannot simply use the rating of the power supply (such as 100 Watts) for this calculation because the application may not require the full capacity of the power supply. Since each Series 90-70 rack has its own power supply, each rack should be calculated on an individual basis.

Step 3: Output Calculations for Discrete Output Modules

Discrete solid state Output modules require two calculations, one for the module's signal-level circuits, which was already done in Step 1, and one for the output circuits.

(This output circuit calculation is not required for the Relay Output modules.) Since the solid state output switching devices in these modules will drop a measurable amount of voltage, their power dissipation can be calculated. Note that the power dissipated by the output circuits comes from a separate power source, so it is not included in the figure used to calculate PLC power supply dissipation in Step 2.

To calculate output circuit power dissipation:

- In the *Series 90-70 Data Sheet Manual*, GFK-0600 (or individual module data sheet), find the value for the Output Voltage Drop for your particular module as listed in the module Specifications table.
- Obtain the required current value for each device (such as a relay, pilot light, solenoid, etc.) connected to an output point on the module and estimate its percent of on-time. To obtain the current values, check the device manufacturer's documentation or an electronics catalog. The percent of on-time can be estimated by someone familiar with how the equipment operates or will operate.
- Multiply the Output Voltage Drop times the current value times the estimated percent of on-time to arrive at average power dissipation for that output.
- Repeat for all outputs on the module. To save time, you could determine if several outputs were similar in current draw and on-time so that you would only have to make their calculation once.
- Repeat these calculations for all Discrete Output modules in the rack.

Discrete Output Module Example:

The Data Sheet for the IC697MDL340 16-Point Discrete 120 VAC Output Module lists the following information:

Output Voltage Drop: 3 Volts maximum

Use that value for all of the calculations for this module.

In this example, two of the Output module's output points drive solenoids that control the advance and retract travel of a hydraulic cylinder. The solenoid manufacturer's data sheet shows that each solenoid draws 1.0 Amp. The cylinder advances and retracts once every 60 seconds that the machine is cycling. It takes 6 seconds to advance and 6 seconds to retract.

Since the cylinder takes equal time to advance and retract, both solenoids are on for equal lengths of time: 6 seconds out of every 60 seconds, which is 10% of the time. Therefore, since both solenoids have equal current draws and on-times, our single calculation can be applied to both outputs.

Use the formula *Average Power Dissipation = Voltage Drop x Current Draw (in Amps) x Percent (expressed as a decimal) of on-time*:

- 3.0 x 1.0 x 0.10 = 0.3 Watts per solenoid

Then multiply this result by 2 since we have two identical solenoids:

- 0.3 Watts x 2 Solenoids = 0.60 Watts total for the two solenoids

Also in this example, the other 14 output points on this 16-point module operate pilot lights on an operator's panel. Each pilot light requires .05 Amps of current. Seven of the pilot lights are on 100% of the time and seven are on an estimated 40%.

For the seven lights that are on 100% of the time:

- 3.0 x .05 x 1.00 = 0.15 Watts per light

Then multiply this value by 7:

- 0.15 Watts x 7 lights = 1.05 Watts total dissipation for the first seven lights

For the seven lights that are on 40% of the time:

- 3.0 x .05 x 0.40 = .06 Watts per light

Then multiply this value by 7:

- .06 Watts x 7 lights = 0.42 Watts total dissipation for the other 7 lights

Adding up the individual calculations, we get:

- 0.60 + 1.05 + 0.42 = 2.07 Watts for the module's total output calculation

Step 4: Input Calculations for Discrete Input Modules

A Discrete Input Module requires two calculations, one for the module's signal-level circuits, which was already done in Step 1, and one for the input circuits. Note that the power dissipated by the input circuits comes from a separate power source, so are not included in the figure used to calculate PLC power supply dissipation in Step 2. We will assume that all input circuit power delivered to these modules is eventually dissipated as heat. The procedure is:

- In the *Series 90-70 Data Sheet Manual*, GFK-0600 (or individual module data sheet), find the value for the Input Current for your particular module listed in the module Specificationstable.
- Multiply the input voltage times the current value times the estimated percent of on-time to arrive at average power dissipation for that input.
- Repeat for all inputs on the module. To save time, you could determine if several inputs were similar in current draw and on-time so that you would only have to make their calculation once.
- Repeat these calculations for all Discrete Input modules in the rack.

Discrete Input Module Example:

The Specifications table for the IC697MDL240 16-Point Discrete 120 VAC Input Module in the module's Data Sheet gives the following information:

- *Input Current: 10 mA (.010 Amps) (typical) at rated voltage*

Use this value for all of the input calculations for this module.

In this example, eight of the Input Module's points are used for switches that, for normal operation, stay on (closed) 100% of the time. These include the Emergency Stop, Over Temperature, Lube Pressure OK, and similar switches.

Use the formula *Average Power Dissipation = Input Voltage x Input Current (in Amps) x Percent (expressed as a decimal) of on-time:*

- 120 x .010 x 1.0 = 1.2 Watts per input

Then multiply this result by 8:

1.2 Watts x 8 inputs = 9.6 Watts total for the 8 inputs

Also in this example, two input points on this 16-point module are for the Control On and Pump Start pushbuttons. Under normal conditions, these pushbuttons are only pressed once per day for about one second – just long enough to start up the control and pump. Therefore, their effect on our power calculation is negligible and we will assume a power dissipation of zero for them:

0.0 Watts total for 2 inputs

For the remaining six inputs of our sixteen point module, it is estimated that they will be on for an average of 20% of the time. So the following calculation is made for these six inputs:

Using the formula of *Average Power Dissipation = Input Voltage x Input Current (in Amps) x Percent (expressed as a decimal) of on-time:*

120 x .010 x 0.20 = 0.24 Watts per input

Then multiply this result by 6:

0.24 Watts x 6 inputs = 1.44 Watts total for the 6 inputs

Finally, adding up the individual calculations, we get:

9.6 + 0.0 + 1.44 = 11.04 Watts for the module's total input calculation

Step 5: Final Calculation

Once the individual power dissipations have been calculated, add them all to obtain total PLC heat dissipation. Note that the PLC rack, analog input modules, and analog output modules have been ignored in this procedure because their power dissipation values are negligible when compared with the total. Also, since each Series 90-70 rack has its own power supply, each rack should be calculated on an individual basis. The following table summarizes the final calculation:

Series 90-70 Rack Heat Dissipation Calculation Summary

Step	Description	Value (Watts)
1	Calculate total of dissipation values for all modules in the rack	
2	Divide value obtained in Step 1 by 2 to obtain Power Supply value	
3	Calculate total of all Output modules' output dissipation values	
4	Calculate total of all Input modules' input dissipation values	
5	Add the above four values to obtain the total dissipation of the rack	

Other Information Related to Enclosure Sizing

The Rack Installation section in Chapter 3 of this manual contains rack dimensions and minimum ventilation clearance distances required around the racks. A description of a cooling fan required for specific CPUs is also in Chapter 3.

Appendix I

Tables and Formulas

Standard ASCII (American Standard Code for Information Interchange) Codes

Char.	Dec.	Hex.		Char.	Dec.	Hex.		Char.	Dec.	Hex.
NUL	0	00		+	43	2B		V	86	56
SOH	1	01		,	44	2C		W	87	57
STX	2	02		–	45	2D		X	88	58
ETX	3	03		.	46	2E		Y	89	59
EOT	4	04		/	47	2F		Z	90	5A
ENQ	5	05		0	48	30		[	91	5B
ACK	6	06		1	49	31		\	92	5C
BEL	7	07		2	50	32		]	93	5D
BS	8	08		3	51	33		^	94	5E
HT	9	09		4	52	34		–	95	5F
LF	10	0A		5	53	35		‘	96	60
VT	11	0B		6	54	36		a	97	61
FF	12	0C		7	55	37		b	98	62
CR	13	0D		8	56	38		c	99	63
SO	14	0E		9	57	39		d	100	64
SI	15	0F		:	58	3A		e	101	65
DLE	16	10		;	59	3B		f	012	66
DC1	17	11		<	60	3C		g	103	67
DC2	18	12		=	61	3D		h	104	68
DC3	19	13		>	62	3E		i	105	69
DC4	20	14		?	63	3F		j	106	6A
NAK	21	15		@	64	40		k	107	6B
SYN	22	16		A	65	41		l	108	6C
ETB	23	17		B	66	42		m	109	6D
CAN	24	18		C	67	43		n	110	6E
EM	25	19		D	68	44		o	111	6F
SUB	26	1A		E	69	45		p	112	70
ESC	27	1B		F	70	46		q	113	71
FS	28	1C		G	71	47		r	114	72
GS	29	1D		H	72	48		s	115	73
RS	30	1E		I	73	49		t	116	74
US	31	1F		J	74	4A		u	117	75
SP	32	20		K	75	4B		v	118	76
!	33	21		L	76	4C		w	119	77
”	34	22		M	77	4D		x	120	78
#	35	23		N	78	4E		y	121	79
$	36	24		O	79	4F		z	122	7A
%	37	25		P	80	50		{	123	7B
&	38	26		Q	81	51		|	124	7C
’	39	27		R	82	52		}	125	7D
(	40	28		S	83	53		~	126	7E
)	41	29		T	84	54		“	127	7F
*	42	2A		U	85	55				

AWG to Metric Wire Size Conversion

Since there is not an exact correspondence between American AWG wire sizes and metric sizes, the metric values in the following table are close approximations. If you need greater precision, contact your wire supplier.

AWG to Metric Wire Size Conversion	
AWG Size	**Metric Cross Section in square millimeters (mm^2)**
1	42.4
2	33.6
4	21.2
6	13.2
8	8.37
10	5.26
12	3.31
14	2.08
16	1.31
18	0.82
20	0.52
22	0.32
24	0.21
26	0.13
28	0.081
30	0.051

Temperature Conversion

Formulas

°C = 5/9(°F – 32)

°F = (9/5 x °C) + 32

Celsius to Fahrenheit Conversion (to nearest degree)					
Degrees Celsius	**Degrees Fahrenheit**	**Degrees Celsius**	**Degrees Fahrenheit**	**Degrees Celsius**	**Degrees Fahrenheit**
–50	–58	50	122	145	293
–45	–49	55	131	150	302
–40	–40	60	140	155	311
–30	–22	65	149	160	320
–25	–13	70	158	165	329
–20	–4	75	167	170	338
–15	5	80	176	175	347
–10	14	85	185	180	356
–5	23	90	194	185	365
0	32	95	203	190	374
5	41	100	212	195	383
10	50	105	221	200	392
15	59	110	230	205	401
20	68	115	239	210	410
25	77	120	248	215	419
30	86	125	257	220	428
35	95	130	266	225	437
40	104	135	275	230	446
45	113	140	284	235	455

Conversion Information

1 ounce (weight) =	28.35 grams
1 pound (weight) =	453.6 grams
1 pound (weight) =	16 ounces
1 pound (force) =	4.448 newtons
1 short ton (weight)=	907.2 kilograms
1 short ton (weight)=	2,000 pounds
1 horsepower (power)=	550 foot–pounds per second
1 horsepower (power) =	746 watts of electrical power
1 kilowatt (power) =	1.341 horsepower
1 kilowatt–hour (energy or work) =	3,412.142 Btu
1 kilowatt–hour (energy or work) =	1,000 watts/hr.
1 watt (power) =	3.412 Btu/hr.
1 watt (power) =	1 joule/sec.
1 joule/sec. (power) =	1 watt
1 joule (energy)=	1 newton–meter
1 Btu =	0.293 watt
1 Btu =	778.2 foot–pounds
1 Btu =	252 gram–calories
1 Btu (energy)=	1055 joules
1 newton–meter (torque or work) =	0.7376 pound–feet
1 newton–meter (torque or work) =	8.851 pound–inches
1 pound–foot (torque or work) =	1.3558 newton–meters
1 pound–inch (torque or work) =	0.113 newton–meters
1 ounce–inch (torque or work) =	72 gram–centimeters
1 degree (angular) =	0.0175 radians
1 minute (angular) =	0.01667 degrees
1 radian (angular) =	57.3 degrees
1 quadrant (angular) =	90 degrees

English and Metric Equivalents

This section is based upon information published on the World Wide Web by the U.S. government's National Institute of Standards and Technology (NIST). Forfurther information, visit their web site at www.nist.gov.

Units of Length

Units of Length (Underlined Figures are Exact)						
Units	**Inches**	**Feet**	**Yards**	**Millimeters**	**Centimeters**	**Meters**
1 inch =	1	0.083 333	0.027 777	25.4	2.54	0.025 4
1 foot =	12	1	0.333 333	304.8	30.48	0.304 8
1 yard =	36	3	1	914.4	91.44	0.914 4
1 mile =	63,360	5,280	1,760	1,609,344	160,934.4	1,609.344
1 mm =	0.0393 700	0.003 280 8	0.001 093 6	1	.1	.001
1 cm =	0.393 700 8	0.032 808	0.010 936	10	1	0.01
1 meter =	39.370 08	3.280 840	1.093 613	1000	100	1

Units of Area

Units of Area (Underlined Figures are Exact)					
Units	**Square Inches**	**Square Feet**	**Square Yards**	**Square Centimeters**	**Square Meters**
1 square inch =	1	0.006944	0.000 771 604 9	6.451 6	0.000 645 16
1 square foot =	144	1	0.111111	929.030 4	0.092 903 04
1 square yard =	1296	9	1	8,361.273 6	0.836 127 36
1 square mile =	4,014,489,600	27,878,400	3,097,600	25,899,881,103.36	2,589,988.110 336
1 square centimeter =	0.155 000 3	0.001 076 391	0.0001195990	1	0.0001
1 square meter =	1,550.003	10.763 91	1.195 990	10,000	1

Units of Volumne (Cubic Inches, Cubic Feet, Cubic Yards)

Units of Volume (Underlined Figures are Exact)			
Units	**Cubic Inches**	**Cubic Feet**	**Cubic Yards**
1 cubic inch =	1	0.000 578 703 7	0.000 021 433 47
1 cubic foot =	1,728	1	0.037 037 04
1 cubic yard =	46,656	27	1
1 cubic centimeter =	0.061 023 74	0.000 035 314 67	0.000 001 307 951
1 cubic decimeter =	61.023 74	0.035 314 67	0.001 307 951
1 cubic meter	61,023.74	35.314 67	1.307 951

Units of Volumne (Cubic Centimeters, Cubic Decimeters, Cubic Meters)

Units of Volume (Underlined Figures are Exact)			
Units	**Milliliters (Cubic Centimeters)**	**Liters (Cubic Decimeters)**	**Cubic Meters**
1 cubic Inch =	16.387 064	0.016 387 064	0.000 016 387 064
1 cubic foot =	28,316.846 592	28.316 846 592	0.028 316 846 592
1 cubic yard =	764,554.857 984	764.554 857 984	0.764 554 857 984
1 cubic centimeter =	1	0.001	0.000 001
1 cubic decimeter =	1,000	1	0.001
1 cubic meter =	1,000,000	1,000	1

Appendix J SNP Multidrop

SNP Multidrop Overview

As used in this appendix, the term "SNP Multidrop" refers to a system that allows a programmer (called the "master or host"), such as a personal computer running GE Fanuc programming software, to connect to two or more PLCs or intelligent Option modules (called "slaves") via a single connection. In this arrangement the programmer is able to program, configure, test, troubleshoot, etc., any one of the multidropped devices from one connection point.

Physically, a typical SNP multidrop system consists of a programmer and two or more PLCs interconnected by a "daisy-chain" type cabling arrangement, as shown in the figure below. It is necessary to assign each slave device (PLC or Option module) a unique SNP (Series Ninety Protocol) address, using programming software such as Logicmaster or Control. The SNP address is used by the programmer to designate which PLC it will communicate with. The SNP protocol uses the RS-422 communications standard. Note that the PLCs or Option modules do not communicate with each other over the multidrop system. They only communicate with the programmer. And only one device, the one designated by the programmer, can communicate with the programmer at a time.

Multidrop Cables

There are two sources of multidrop cables:

- **GE Fanuc cable, catalog number IC690CBL714A** – This pre-made cable can be purchased for applications where the PLCs are mounted in the same cabinet, such as in the case of redundant systems. The length of this cable is 40 inches (1 meter).
- **Custom built** – For PLCs that are more than 40 inches (1 meter) apart, it is necessary to build a custom length cable. The specifications are provide below.

Limitations

- The maximum cable length between a master (programmer) and slave device (PLC or Option module) in a multidrop system is 4,000 feet (1,219 meters).
- The maximum number of slave devices is limited to eight.

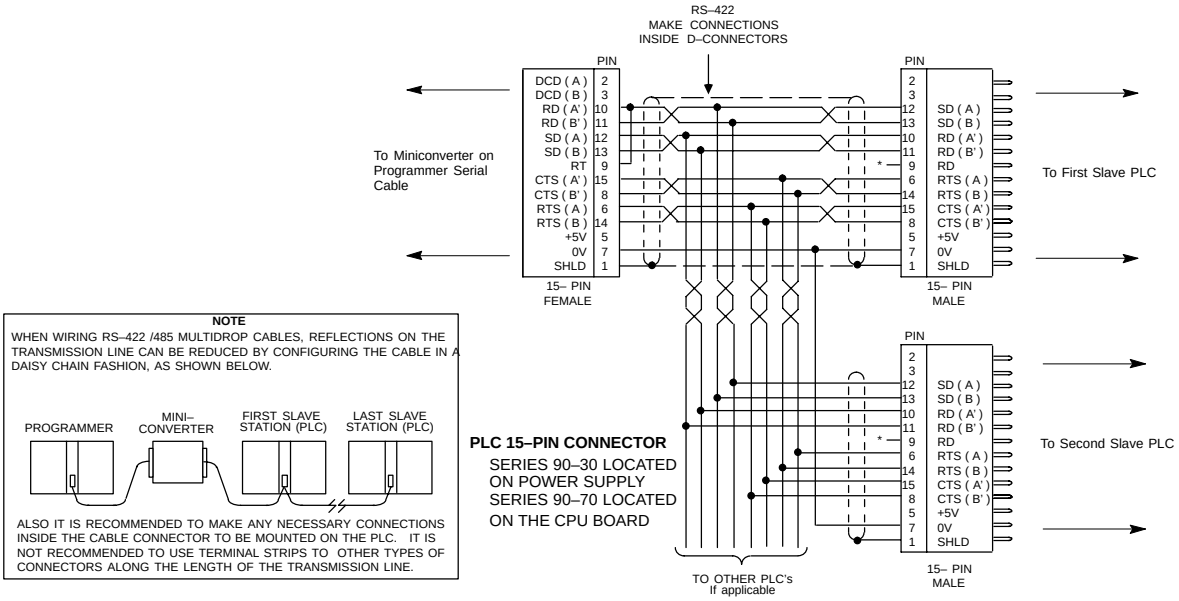
Cable and Connector Specifications

The cable assembly presents one of the most common causes of communication failure. For best performance, construct the cable assemblies using the recommended connector parts and specifications.

Table J-1. Connector and Cable Specifications

Item	Description
Connectors	**Series 90 PLC:** Serial (RS-422) port with metric hardware Connector: 15-pin male, D-Subminiature Type, Cannon DA15S (solder pot) Hood: AMP 207470-1 connector shell Hardware Kit: AMP 207871-1 Kit includes 2 metric screws and 2 screw clips
	Miniconverter: For connecting to IC690ACC901 miniconverter Connector: 15-pin female, DB15F, Hood: AMP #207470-1 or equivalent M3 Latchblocks: AMP #208101 or equivalent
Cable	Computer grade, 24 AWG (.22 mm^2), minimum with overall shield Catalog Numbers: Belden 9505, Belden 9306, Belden 9832 These cables provide acceptable operation for data rates up to 19.2 Kbps as follows: RS-422/RS-422: 4000 feet (1200 meters) maximum length. Must not exceed the maximum RS-422 Common Mode specification of +7V to -7V. Isolation at the remote end may be used to reduce or eliminate Common Mode voltages. When using RS-422/RS-422, the twisted pairs should be matched so that both transmit signals make up one twisted pair and both receive signals make up the other twisted pair. If this is ignored, cross-task resulting from the mismatching will affect the performance of the communications system. When routing communication cables outdoors, transient suppression devices can be used to reduce the possibility of damage due to lightning or static discharge. *Care should be exercised that all connected devices are grounded to a common point. Failure to do so could result in damage to the equipment.*

MultiDrop Cable Wiring Diagram



* TERMINATION RESISTANCE FOR THE RECEIVE DATA (RD) SIGNAL NEEDS TO BE CONNECTED ONLY ON UNITS AT THE END OF THE LINES. THIS TERMINATION IS MADE ON THE SERIES 90 PLC PRODUCTS BY CONNECTING A JUMPER BETWEEN PIN 9 AND PIN 10 INSIDE THE 15–PIN D–SHELL WITH THE FOLLOWING EXCEPTION. FOR SERIES 90–70 PLCs, CATALOG NUMBERS IC697CPU731 AND IC697CPU771, THE TERMINATION FOR RD AT THE PLC IS IMPLEMENTED BY A JUMPER BETWEEN PIN 9 AND PIN 11.

GROUND POTENTIAL: MULTIPLE UNITS, NOT CONNECTED TO THE SAME POWER SOURCE, MUST HAVE COMMON GROUND POTENTIALS OR GROUND ISOLATION FOR PROPER OPERATION OF THIS SYSTEM.

Figure J-1. Multidrop Cable Wiring Diagram

SNP Multidrop Example

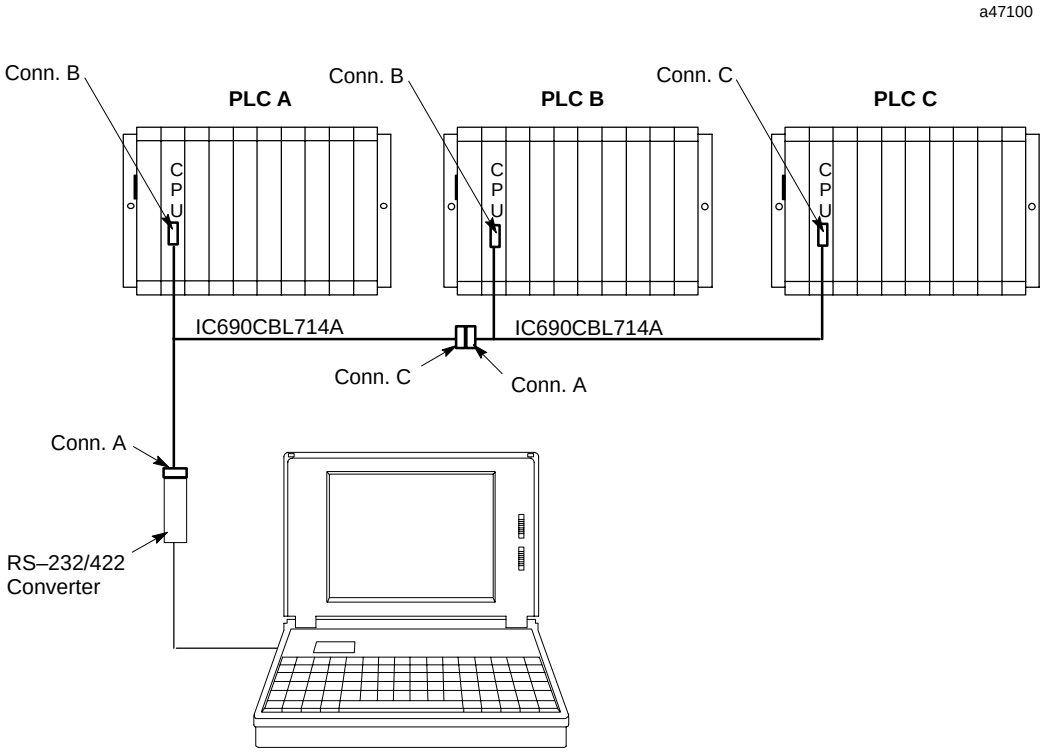


Figure J-2. Multidrop Arrangement for Series 90-70 TMR Redundant System

Configuring and Connecting a Programmer to a Multidrop Network

Each slave device on a multidrop system must have its own unique SNP ID (identification). The SNP ID assignment is made with a programmer running GE Fanuc programming software. Logicmaster or Control software packages all can be used for this purpose. The following example uses Logicmaster. Please see your software user's manual or on-line help screens for instructions. Regardless of what software you use, the basic steps are:

- Connect your programmer to each individual PLC or module on the multidrop system and assign each one a unique SNP ID.
- Connect your programmer to the multidrop system and select Multidrop for the programmer's connection method.
- In the programming software, select the SNP ID of the PLC or module you wish to connect to.

Assigning a PLC SNP ID to a PLC with Logicmaster

- Take your programmer to the first PLC to be assigned, and connect directly to its programmer port.
- From the Logicmaster Main Menu, select F2, "Logicmaster 90 Configuration Package."

- Select F2, "CPU Configuration."
- Put the software in the ONLINE mode.
- Select F3, "Assign PLC ID." On the ASSIGN PLC ID screen, the CURRENT PLC ID field will display an ID if the PLC has one. If the PLC does not currently have an SNP ID, this field will be blank. (In the OFFLINE mode it will display a series of asterisks.)
- Key in the new PLC ID. For newer CPUs, it may be from one to seven alpha-numeric characters long. For older CPUs, it is limited to a maximum of six characters. For example, it could be PLC1, APM001, A1, B00001, etc.
- Press the Enter key. The new SNP ID will be written to the PLC and the CURRENT PLC ID field on your screen will update to show this new SNP ID.
- Repeat the above steps for each PLC that is on the multidrop system. If assigning an SNP ID to a module, you must use the appropriate software. See the user's manual for the module for instructions.

Connecting your Logicmaster Programmer to a PLC on a Multidrop System

- Connect your programmer to the programmer connection for the multidrop system.
- From the Logicmaster Main Menu, select F2, "Logicmaster 90 Configuration Package."
- Select F7, "Programmer Mode and Setup."
- Select F3, "Select PLC Connections."
- In the SELECTED SNP ID field, enter the SNP ID of the PLC or device you wish to communicate with.
- In the PORT CONNECTION field, select MULTIDROP.
- Press F6, "setup," to connect to the selected PLC. You should connect to the selected PLC within a few seconds. If you cannot connect, see the next section.

SNP Multidrop Troubleshooting

If you are having trouble connecting to a PLC or module over the multidrop system, check the following:

- **Is there a problem with all PLCs or only one?** Try connecting to other PLCs over the multidrop system. If you cannot connect to any, check for a common problem such as a defective cable. If you can connect to all but one PLC, use the direct connection method described in the next paragraph. Also, if you only have a problem with the last PLC on the multidrop link, the last section of cable may have a problem. Or, perhaps you can connect to all PLCs up to a certain point, but none beyond that point. This would also strongly suggest that there is a problem in a section of cable.
- **SNP ID may be incorrect.** You may not be able to connect because you are specifying the wrong SNP ID. If you are not sure of a PLC's correct SNP ID and would like to check it, you can connect your programmer directly to the PLC's programmer port and read its SNP ID from the software's ASSIGN PLC ID screen, (as described in "Assigning an SNP ID to a PLC with Logicmaster," above). Make sure you change the programming software's connection method to Direct for this

test. When set for Direct connection, the software will communicate with a directly connected PLC without regard to its SNP ID.

- **Communications settings may not match**. If the PLC's serial port communication settings and the programming software's communication settings do not match, they will not be able to communicate. These settings include such things as BAUD Rate, Parity, Stop Bits, etc. If you suspect this to be the problem, try connecting directly to the PLC as described above in "SNP ID may be incorrect." If you cannot connect directly, there may be a communication settings mismatch. If so, try setting the programming software to its default communication settings.
- **Multidrop may not be selected as the connection method.** The default connection method in the programming software is Direct, which requires that you be connected directly to a PLC or module's programmer port. If this default setting is not changed to Multidrop, you will not be able to connect to a selected SNP ID over a multidrop system.
- **You may have a hardware problem.** Inspect the multidrop cable; it may be wired incorrectly, damaged, or disconnected. A wire may be loose on one of the connectors. Also check the status of the PLC you are trying to connect to. It may not be powered up; it may be stopped; or it may have some other problem. Eliminate the PLC itself as a possible problem by connecting your programmer directly to the PLC's programmer port. You should be able to communicate with a PLC using this direct connection even if the programming software is configured for Multidrop, as long as the SNP IDs match.

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