Genius Bus Controller

GFK-0398

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Genius Bus Controller

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Programmable Control Products

Series 90™ –70
Genius™ Bus Controller

User's Manual

GFK–0398C *June 1992*

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.

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Preface

This manual describes the features and operation of the Series 90™–70 Bus Controller. It also provides the configuration and programming information needed to complete the interface between a Series 90–70 PLC and a Genius™ I/O bus.

If you need information about types of systems, system planning, installation, and system components, refer to the *Genius I/O System User's Manual* (GEK–90486). It is the primary source of information about Genius I/O products.

Content of this Manual

Chapter 1. Introduction: Chapter 1 describes the Series 90–70 Bus Controller and explains how it operates.

Chapter 2. Installation: Chapter 2 explains how to install or remove a Bus Controller, and how to connect it to a Genius serial bus.

Chapter 3. Bus Controller Configuration: Chapter 3 explains how to complete the Logicmaster configuration steps for a Bus Controller and its bus.

Chapter 4. Diagnostics: Chapter 4 describes diagnostics capabilities of interest in Series 90–70 PLC systems that use Genius I/O and communications.

Chapter 5. Communication Request: Chapter 5 describes the use of the COMREQ program instruction with a Bus Controller.

Chapter 6. Data Monitoring, Distributed Control, and Redundancy: Chapter 6 describes some advanced systems supported by the Series 90–70 Bus Controller.

Appendix A. ASCII Code List: Lists ASCII characters and their decimal and hexadecimal equivalents.

Changes for this Revision of the Manual

This manual describes the new features available with release 4.0 of the Bus Controller, including greater support for redundancy and reference address checking. New and revised information in this manual includes:

- Revised information on page 13 about completing Shield In and Shield Out connections to a Bus Controller.
- Instructions for configuring reference address checking, bus redundancy and Bus Controller redundancy, in chapter 3.
- Some new and revised diagnostics messages in chapter 4.
- Information about using passwords with COMREQs in chapter 5.
- An expanded description of redundancy features in chapter 6.
- Instructions for determining how many Bus Controllers can be used in a system that includes the use of dual (redundant) busses.

Related Publications

For more information, refer to these publications:

Genius I/O System User's Manual (GEK–90486–1). Reference manual for system designers, programmers, and others involved in integrating Genius I/O products in a PLC or host computer environment. This book provides a system overview, and describes the types of systems that can be created using Genius products. Datagrams, Global Data, and data formats are defined.

Genius Discrete and Analog Blocks User's Manual (GEK–90486–2). Reference manual for system designers, operators, maintenance personnel, and others using Genius discrete and analog I/O blocks. This book contains a detailed description, specifications, installation instructions, and configuration instructions for all currently–available discrete and analog blocks.

Series 90–70 PLC Installation and Operation Manual (GFK–0262). This book describes the modules of a Series 90–70 PLC system, and explains system setup and operation.

Logicmaster 90–70 User's Manual (GFK–0263). Reference manual for system operators and others using the Logicmaster 90–70 software to program, configure, monitor, or control a Series 90–70 PLC and/or a remote drop.

Logicmaster 90 Software Reference Manual (GFK–0265). Reference manual which describes program structure and defines program instructions for the Series 90–70 PLC.

Series 90–70 Remote I/O Scanner User's Manual (GFK–0579). Reference manual for the Remote I/O Scanner, which interfaces a drop containing Series 90–70 modules to a Genius bus. Any CPU capable of controlling the bus can be used as the host. This book describes the Remote I/O Scanner features, configuration, and operation.

Series Six™ ***Bus Controller User's Manual*** (GFK–0171). Reference manual for the Bus Controller, which interfaces a Genius bus to a Series Six PLC. This book describes the installation and operation of the Bus Controller. It also contains the programming information needed to interface Genius I/O devices to a Series Six PLC.

Series Five™ ***Bus Controller User's Manual*** (GFK–0248). Reference manual for the Bus Controller, which interfaces a Genius bus to a Series Five PLC. This book describes the installation and operation of the Bus Controller. It also contains the programming information needed to interface Genius I/O devices to a Series Five PLC.

Genius I/O PCIM User's Manual (GFK–0074). Reference manual for the PCIM, which interfaces a Genius bus to a suitable host computer. This book describes the installation and operation of the PCIM. It also contains the programming information needed to interface Genius I/O devices to a host computer.

We Welcome Your Comments and Suggestions

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.

Jeanne L. Grimsby
Senior Technical Writer

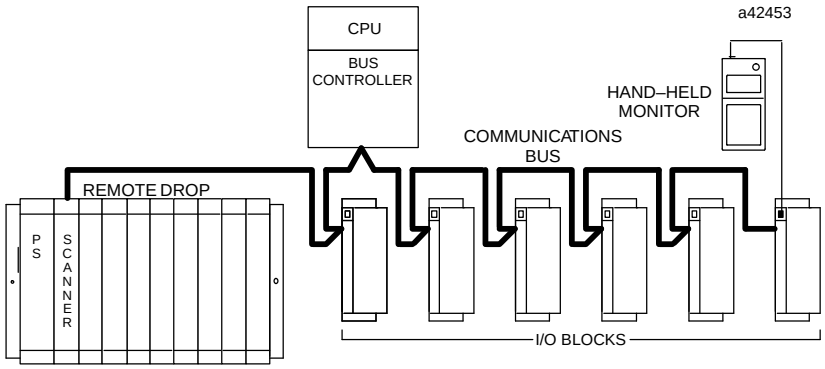
Contents

Chapter 1 Introduction

This chapter describes the Series 90–70 PLC Bus Controller and its operation.

System Overview

The Series 90™–70 PLC Bus Controller (catalog number IC697BEM731) is used to interface a Genius™ I/O serial bus to a Series 90–70 PLC.



A Genius bus may serve:

- **Genius blocks**, which provide interface to a broad range of discrete, analog, and special–purpose field devices. Genius blocks are self–contained modules with advanced diagnostics capabilities and many software–configurable features.
- **Remote Drops**, Series 90–70 I/O racks that are interfaced to the bus via Remote I/O Scanner Modules. Each remote drop can include any mix of discrete and analog I/O modules, providing up to 128 bytes of input data and 128 bytes of output data.
- **The Hand–held Monitor**, which can be used as a portable device or permanently–mounted. An HHM provides a convenient operator interface for block setup, data monitoring, and diagnostics.
- **Multiple hosts**, for communications using datagrams and Global Data.

A bus may feature I/O control enhanced by communications commands in the program. Or a bus may be used entirely for I/O control, with many I/O devices and no additional communications. Or a bus may be dedicated to CPU communications, with multiple CPUs and no I/O devices. More complex systems can also be developed, with dual CPUs and one or more additional CPUs for data monitoring.

Number of Bus Controllers

Up to 31 Bus Controllers can be included in a Series 90–70 PLC system with a release 3.0 or later CPU. For earlier CPU versions, the maximum number of Bus Controllers that can be accommodated is 16. In some redundant system configurations, fewer Bus Controllers can be used. See chapter 6 for details.

I/O Devices on the Bus

The I/O devices on a bus may be Genius I/O blocks, or standard Series 90–70 I/O modules in one or more remote drops. The total number of I/O circuits that can be served by one Genius bus depends on the types of I/O devices that are used and the memory available in the CPU.

Memory Required for Genius Blocks

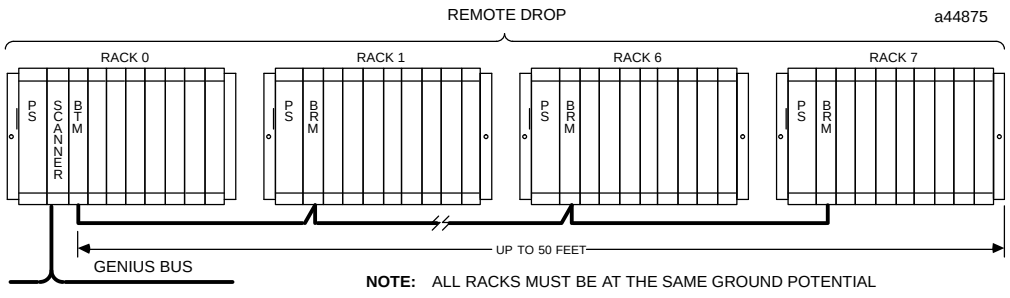
Memory requirements for Genius I/O blocks are shown below. For %I and %Q memory, the sizes shown are in bits. For %AI and %AQ memory, the sizes shown are in words.

Block Type	Maximum Memory Requirements			
	%I(bits)	%Q(bits)	%AI(words)	%AQ(words)
115 VAC Grouped I/O blocks	8	8		
115 VAC Isolated I/O blocks	8	8		
16 Ckt AC Input Block	16			
16 Ckt DC Sink/source blocks	16	16		
32 Ckt DC Sink/source blocks	32	32		
Relay Output blocks		16		
4 Input/2 Output Analog Blocks			4	2
Current–source Analog I/O Blocks			4	2
Current–source Analog Output Blocks				6
RTD Input blocks			6	
Thermocouple blocks			6	
High–speed Counter	16	16	15	
PowerTRAC Module	16	16	18	

Many Genius I/O blocks have both inputs and outputs on the same block. Blocks configured in the Logicmaster 90 software as having both inputs and outputs will occupy identical references in both %I and %Q memory, regardless of the block's software configuration. Unused references cannot be assigned to other inputs or outputs, *and should not be used in the application program*.

Memory Required for a Remote Drop

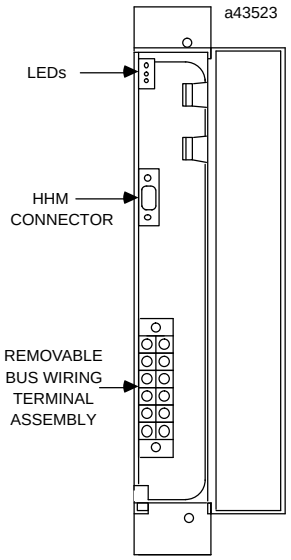
Together, one 90–70 Remote I/O Scanner (IC697BEM733) and the modules it serves make up a remote drop on the Genius bus.



The remote drop can include any mix of Series 90–70 discrete and analog input and output modules, up to a total of 128 bytes of inputs and 128 bytes of outputs (8 discrete points represent one byte and 1 analog channel uses 2 bytes).

Bus Controller Description

The Bus Controller is a standard, rack–mounted Series 90–70 PLC module.



Status LEDs

The LEDs on the front of the Bus Controller indicate its operating status. The top two LEDs should be on during normal operation. The bottom LED is not used.

Module OK Shows the status of the Bus Controller. This LED blinks during power-up diagnostics.

Channel OK Shows the status of the bus. This LED is on steadily when the bus is operating properly. It blinks for intermittent bus errors and is off for a failed bus. It is also off when no configuration has been received from the PLC CPU.

Hand–held Monitor Connector

The Hand–held Monitor connector on the Bus Controller faceplate provides attachment for a Hand–held Monitor. For Bus Controller IC697BEM931, the lower HHM connector, if present, is not used. All Hand–held Monitor functions except I/O block Device Number assignment can be performed with the HHM connected to the Bus Controller. Bus and block operation can be monitored, circuits forced or unforced, outputs Pulse Tested, diagnostic messages displayed, and faults cleared, from this convenient central location. Hand–held Monitor version IC660HHM501C (or later), permitting selection of a "host CPU" is recommended for proper operation with the Series 90–70 PLC.

Terminal Assembly

Serial bus and shield wiring connections are made to the removable terminal strip on the front of the Bus Controller. For Bus Controller IC697BEM931, only the upper three terminals are used. To remove the Terminal Assembly without disturbing the continuity of the bus, jumpers are used. See chapter 2.

The Genius Bus

The Genius bus is a shielded twisted–pair wire, daisy–chained between devices, and terminated at both ends. Proper cable selection is critical to successful operation of the system. Suitable cable types are listed in the *Genius I/O System User's Manual*.

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.

Bus Type	Daisy–chained bus cable; single twisted pair plus shield or Twinax. Fiber optics cable and modems can also be used.
Bus Termination	75, 100, 120, or 150 ohm resistor at both ends of electrical bus cable.
Baud Rate	Configurable. 153.6 Kbaud standard, 153.6 Kbaud extended, 76.8 Kbaud, or 38.4 Kbaud.
Maximum Bus Length	7500 feet at 38.4 Kbaud, 4500 feet at 76.8 Kbaud, 3500 feet at 153.6 Kbaud extended, 2000 feet at 153.6 Kbaud, standard. Maximum length at each baud rate also depends on cable type. Chapter 2 provides a complete list of cable types, showing corresponding bus lengths and baud rates. Greater bus lengths are possible using sections of fiber optics cable with modems.
Maximum Number of Devices	32 devices at 153.6 Kbaud standard, 153.6 Kbaud extended, or 76.8 Kbaud. 16 devices at 38.4 Kbaud. Includes bus controller and typically a Hand–held Monitor.
Data Encoding	Each bit is encoded into three dipulses, majority voted at the receiver to correct any single dipulse errors. A dipulse is an AC code consisting of a positive then negative excursion of voltage. Dipulses are individually sampled to reject low and high frequency interference.
Modulation Technique	Frequency Shift Keying (FSK) 0 to 460.8 KHz max. (153.6 Kilobaud)
Isolation	2000 volts Hi–Pot, 1500 volts transient common mode rejection.
Signal/noise Ratio	60 db

Bus Controller Operation

The Bus Controller handles all data transfer between the PLC and the devices on its bus. In order to do this, the Bus Controller must interface two completely separate and asynchronous activities:

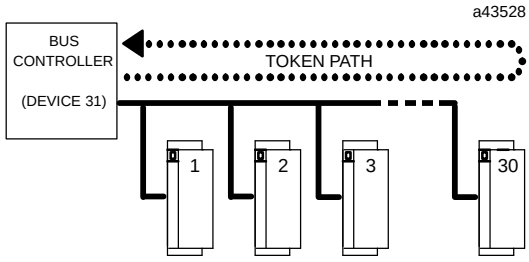
A. The Genius bus scan, a cycle of communications between the devices on a bus (including the Bus Controller itself). The cycle follows the order of Bus Addresses (0–31).

B. The CPU sweep, the cycle of actions that includes communications between the CPU and the Bus Controller.

The Bus Controller manages data transfer between the bus and the CPU by maintaining two separate on–board RAM memories. One interfaces with the bus and the other interfaces with the CPU. The Bus Controller automatically transfers data between these two memories, making data available to the bus or to the CPU when it is needed.

The Genius Bus Scan

A bus scan consists of one complete rotation of a “token” among the devices on the bus.



As mentioned earlier, these devices may include other Bus Controllers, or Remote I/O Scanners, in addition to (or instead of) the Genius blocks illustrated above.

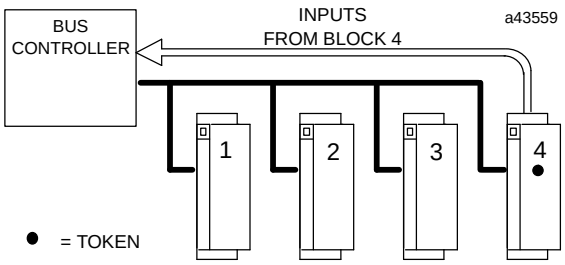
During a bus scan, the Bus Controller automatically:

- Receives all input data that has been sent by devices on the bus.
- Broadcasts Global Data.
- Updates outputs, as permitted, to the devices on the bus. Transmission of outputs from the Bus Controller can be disabled for one or more devices on the bus.
- Receives any fault messages issued by devices on the bus and sets diagnostic status references for use by the CPU.
- Sends a single command received from the CPU (for example, Clear Circuit Faults) to the appropriate devices.

The amount of time it takes for the communications token to pass to all devices depends on the baud rate, the number and types of devices on the bus, and the use of Global Data and datagram communications.

Input Data from Devices on the Bus

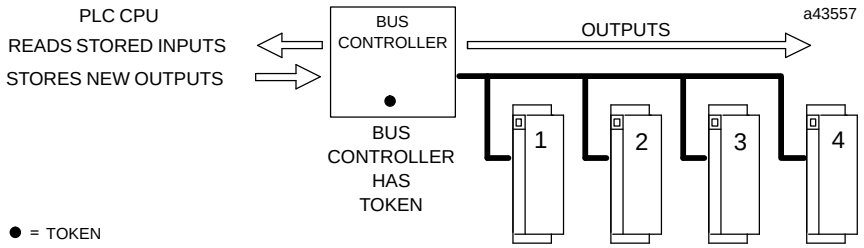
The Bus Controller receives input data from each input block, I/O block, and remote drop each time the block or Remote I/O Scanner has the communications token. (Because this data is broadcast, it may be received by any other bus interface module operating on the bus).



The Bus Controller stores all the input data it receives. Once per CPU sweep, the CPU reads all discrete and analog inputs from the Bus Controller. (Analog data is not multiplexed).

Output Data from the CPU

As the application program executes, the CPU sends outputs and any commands to the Bus Controller. The Bus Controller stores this data, transmitting it on the bus each time it has the communications token. Unlike inputs, which are broadcast, outputs are directed to the specific device that should receive them.



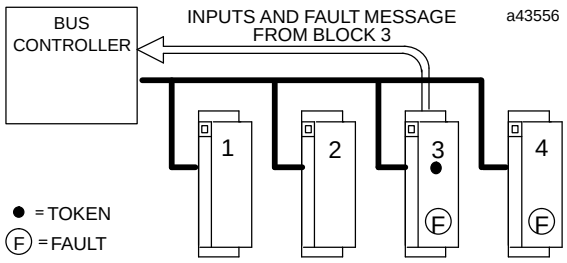
Outputs for 4 Input/2 Output Analog Blocks

Four words of %AQ memory are assigned to a 4 Input/2 Output block by the configuration software. The CPU stores the output data as shown below. Locations "n+2" and "n+3" are not used by the block.

n+3	n+2	n+1	n	**%AQ**
not used	not used	channel 2	channel 1	

Diagnostics

Genius blocks and other devices on the bus will automatically report faults, alarms and certain other predefined conditions to the PLC.



Only one diagnostic message can be sent during any bus scan. If a fault message has already been sent (by another device) during that scan, a device saves its own diagnostic message until the next available bus scan. For example, if the communications token is currently at device 2, and faults occur at devices 3 and 4 at the same time, device 3 can send its diagnostic message if another message has not already been sent. Device 4 must wait at least one more bus scan to send its diagnostic message.

The Bus Controller stores any diagnostic messages it receives. They are read automatically by the Series 90–70 CPU. Faults may then be displayed in the fault table using the Logicmaster 90–70 software and cleared from the programmer. Details are in chapter 4.

A Genius Hand–held Monitor can also be used for diagnostics and fault clearing.

In addition the built–in diagnostics capabilities of Genius devices, the Logicmaster 90–70 application program can make use of additional diagnostics mechanisms provided by the Series 90–70 PLC:

- System Status References that have been defined for Genius use.
- Fault and No Fault contacts that can be used to detect fault and lack of fault conditions.
- Alarm contacts that can be used to indicate when an analog value has reached an assigned alarm limit.

Datagrams

The Series 90–70 Bus Controller supports all Genius datagrams:

Datagram Type Type	Description
Read ID	Requests identifying information from a device on the bus.
Read ID Reply	The automatic response to a Read ID datagram.
Read Configuration	Requests configuration data from a device on the bus.
Read Configuration Reply	The automatic response to a Read Configuration datagram.
Write Configuration	Sends configuration data to a device on the bus.
Assign Monitor	Commands a device on the bus to direct an extra copy of each Fault Report to another device on the bus.
Read Diagnostics	Requests diagnostics data from a device on the bus.
Read Diagnostics Reply	The automatic response to a Read Diagnostics datagram.
Write Point	Sends up to 1 word of bit data to a Series Six or Series Five PLC, or to a host computer.
Read Block I / O	Requests I / O data from some types of Genius blocks.
Read Block I / O Reply	The automatic response to a Read Block I / O datagram.
Report Fault	An automatic diagnostic message received from a device on the bus.
Pulse Test	Commands a discrete block to pulse its outputs.
Pulse Test Complete	Automatic indication that outputs have been pulsed.
Clear Circuit Fault	Clears one specific circuit fault.
Clear All Circuit Faults	Clears all circuit faults on bus devices.
Switch BSM	Causes a Bus Switching Module to switch to alternate bus, if operational.
Read Device	Reads up to 128 bytes of CPU data via another Bus Controller.
Read Device Reply	The response to a Read Device datagram.
Write Device	Sends up to 128 bytes of data to a CPU, via its Bus Controller.
Read Data	Requests temporary data from a High–speed Counter block.
Read Data Reply	The automatic reply to a Read Data datagram.
Write Data	Sends temporary data to a High–speed Counter block.
Read Map	Requests the I / O map configuration of a Remote I / O Scanner.
Read Map Reply	Automatic response to a Read Map datagram.
Write Map	Sends I / O map configuration to a Remote I / O Scanner.

Additional datagrams, not listed above, are sent as system messages; they do not involve any application programming. The *Genius I/O System User's Manual* explains datagrams in detail. It also shows the formats of the data that is transferred by datagrams.

In the application program, COMREQ instructions are used to send datagrams and to read any unsolicited datagrams that have been received. See chapter 5 for instructions.

Global Data

Global Data is data which is automatically and repeatedly broadcast by a Bus Controller. The Series 90–70 Bus Controller can send up to 128 bytes of Global Data each bus scan. It can receive up to 128 bytes of Global Data each bus scan from each Bus Controller on its bus.

Sending Global Data

Once set up by configuration (see chapter 3), Global Data is broadcast automatically. Other Bus Controllers receiving the Global Data sent by a Series 90–70 PLC will place it in these memory locations:

Series 90–70 Sends Global Data To:	Other CPU Places Global Data in this Memory Location:
Series 90–70 PLC	%I, %Q, %G, %R, %AI, %AQ memory if manually–configured, or %G memory if automatically–configured. Memory type and beginning address are chosen during configuration of the *receiving* bus controller.
Series 90–30 PLC	%G memory location corresponding to Device Number (16–23) of the Series 90–70 Bus Controller that sent the data.
Series Six PLC	Register memory. Beginning address selected during configuration of the Series 90–70 Bus Controller that sent the data.
Series Five PLC	Register memory. Beginning address selected during configuration of the Series 90–70 Bus Controller that sent the data.
Computer	PCIM or QBIM Input Table Segment corresponding to Device Number of the Series 90–70 bus controller that sent the data.

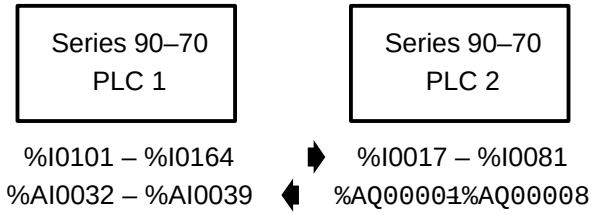
Receiving Global Data

The Bus Controller can be configured to receive or ignore Global Data from any other Bus Controller. The memory type and length for incoming Global Data are also selected during configuration, as described in chapter 3.

The Series 90–70 CPU can place incoming Global Data in %I, %Q, %G, %R, %AI, or %AQ memory.

Example

In the following example, a Series 90–70 PLC (PLC 1) sends 64 bits of Global Data beginning at %I0101 to another Series 90–70 PLC (PLC 2). PLC 2 places this data into its own memory beginning at %I0017. PLC 2 sends 8 words of %AQ data beginning at %AQ0001 to PLC 1. PLC 1 places this data into its own memory beginning at %AI0032.



Chapter 2 Installation

This chapter explains:

- How to install and remove a Bus Controller.
- How to connect a Genius serial bus.
- How to terminate a bus if a Bus Controller is physically at either end.

For Additional Information, Also See:

Chapter 1 for a description and illustration of the Bus Controller, explanation of its LEDs, and specifications for the Genius bus.

Chapter 3 for configuration instructions.

Chapter 6 for information about dual bus and dual controller systems.

Installing the Bus Controller

1. **Be sure the rack is powered down.**
2. **Position the Bus Controller at its intended location.**
3. **Push the Bus Controller into the card guide until it is aligned with the connector on the rack backplane.**
4. **Pressing the upper and lower flanges on the left of the module, push it into the connector until it clicks onto the rack rails.**

   Look to see that the board has seated properly in the connector.
5. **Complete the bus connections to the front of the board as described on the next page.**

Removing the Bus Controller

1. **Power down the rack in which the Bus Controller is located.** Before removing power, it is important to consider the impact on the controlled process.
2. **If the PLC is not part of a redundant system,** the bus wiring can be removed from the Bus Controller.

   If the PLC is part of a redundant system and another CPU on the bus is now functioning as the controller, the Bus Controller can be removed without powering down the bus, provided the Bus Controller's Serial 1 terminals and Serial 2 terminals have been jumpered as described in this chapter. If this has been done, do not disconnect the bus cable or any terminating resistor. Remove the terminal assembly from the Bus Controller carefully. Avoid contact with exposed cable wiring. Place the terminal assembly with the bus wiring still attached, in a protected location.

Caution

If exposed wiring comes in contact with conductive material, data on the bus may be corrupted, possibly causing the system to shut down.

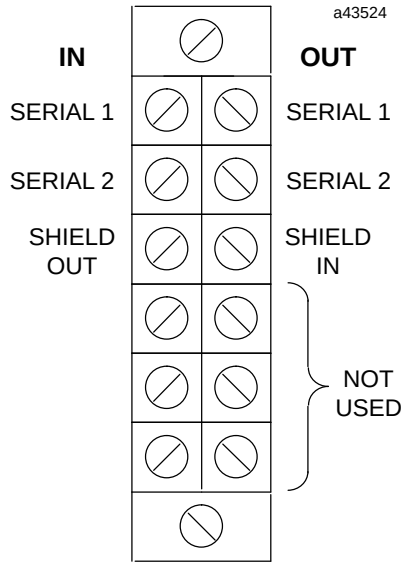
3. **Squeeze the retaining clips at the top and bottom of the cover to disengage them from the rack rails.**
4. **Pull the board firmly to remove it from the backplane connector.**
5. **Slide the board out of the card guide to remove it from the rack.**

Connecting the Serial Bus

For information about bus selection and installation, you should refer to the *Genius I/O System User's Manual*.

Connect the bus cable to the terminal assembly on the front of the Bus Controller. The tie-down screws can be removed to accommodate ring-type connectors. Terminal designations, illustrated below, are also shown on the module faceplate.

The maximum exposed length of bare wires should be two inches. For added protection, each shield drain wire should be insulated with spaghetti tubing to prevent the Shield In and Shield Out wires from touching each other or the signal wires.



Replacing an Older Bus Controller

If this hardware (GIOC1) is being used to replace older hardware (GIOA1 or GIOB1: see markscreen on the edge of the board), the GENIUS bus connections to the Bus Controller must be rewired. Refer to the wiring label inside the module cover for detals concerning the proper wiring of the connector. Note that GIOC1 hardware was also used with Genius Bus Controller versions IC697BEM731B and C.

Shield In and Shield Out Connections in an Existing Installation

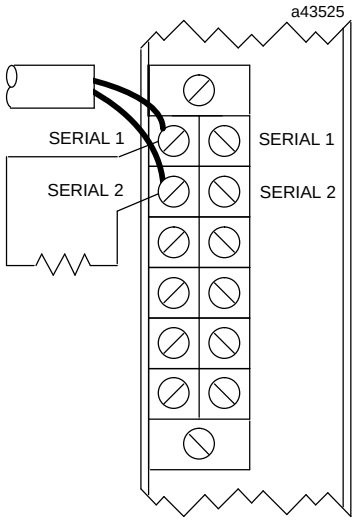
The actual positions of the Bus Controller's Shield In and Shield Out terminals are correctly shown above. On the faceplates of older Bus Controllers and in earlier revisions of the documentation, these terminals are shown reversed. *Regardless of the markings on the faceplate, all Series 90–70 Bus Controllers have their Shield In and Shield Out terminals in the positions shown above.*

Because of this inconsistency, Bus Controllers in an existing installation may have their Shield In and Shield Out terminals incorrectly connected (that is, not as illustrated above). For most applications, this should not be a problem, and rewiring is not necessary. If noise immunity is a particular concern, however, rewiring of the Shield In and Shield Out terminals on these older Bus Controllers is recommended.

Terminating the Bus

Each Genius communications bus must be terminated at both ends by its characteristic impedance, as explained in the *Genius I/O System User's Manual*.

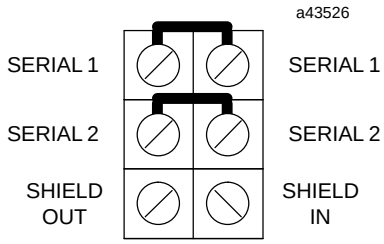
If the Bus Controller is located at the end of a bus, install the appropriate resistor across its Serial 1 and Serial 2 terminals.



Wiring for Bus Continuity

For a redundancy system, where another CPU on the bus will be capable of acting as a controller, jumpers should be installed on the Bus Controller's terminal assembly as shown at right. This will allow possible removal of the terminal assembly in the future without breaking the continuity of the bus.

For bus continuity, jumper the Serial 1 terminals together and jumper the Serial 2 terminals together (even if the Bus Controller is at the end of the bus). Alternatively, use only one terminal of each pair, and wire both cable ends to the selected terminals.



Chapter 3 Bus Controller Configuration

This chapter explains the Logicmaster 90–70 configuration steps for a Bus Controller and its bus devices. If the configuration software being used is earlier than release 4.01, some of the features described here will not be available.

Configuration Overview

A Bus Controller and the devices on its bus must be configured in two basic, different procedures.

1. The Bus Controller and the devices on its bus must be configured as part of the Series 90–70 PLC system using the Logicmaster 90–70 software.
2. The devices on the bus must also be configured separately. This includes:
   A. Configuring I/O blocks with a Hand–held Monitor and/or Write Configuration COMREQs.
   B. Configuring Remote Drops using Logicmaster 90–70.
   C. Configuring redundant Bus Controllers using Logicmaster 90–70.

This book only covers Logicmaster configuration of Bus Controllers.

For Additional Information, Also See:

Chapter 5, which describes Read Configuration and Write Configuration COMREQs.

Chapter 6, which describes data monitoring, distributed control, and redundant control systems.

The *Genius Analog and Discrete Blocks Manual*, which includes instructions for configuring most I/O blocks.

The *Genius I/O System and Communications Manual*, which details the data that can be transferred using Read Configuration and Write Configuration COMREQs.

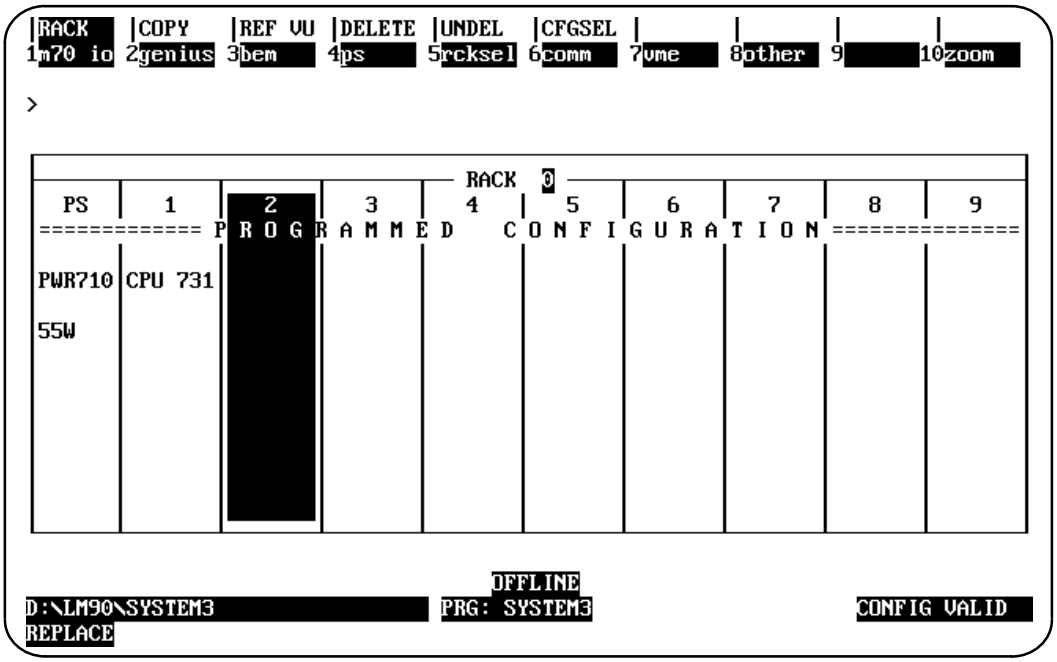
The *Logicmaster 90–70 Software User's Manual*, which covers configuration of the entire PLC.

The *Series 90–70 Remote I/O Scanner User's Manual*, which covers configuration of Remote Drops.

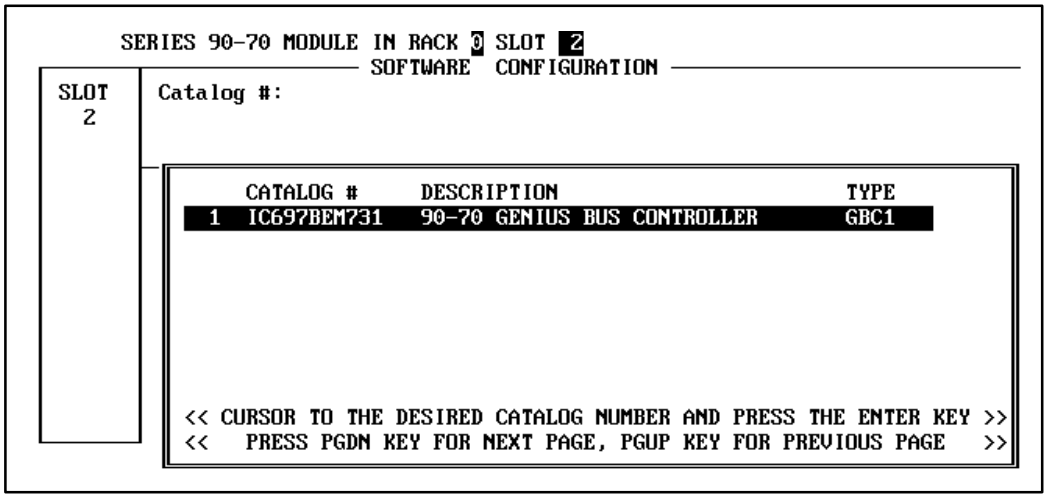
Configuring a Bus Controller

A Bus Controller is configured in the same manner as other rack–mounted Series 90–70 PLC modules.

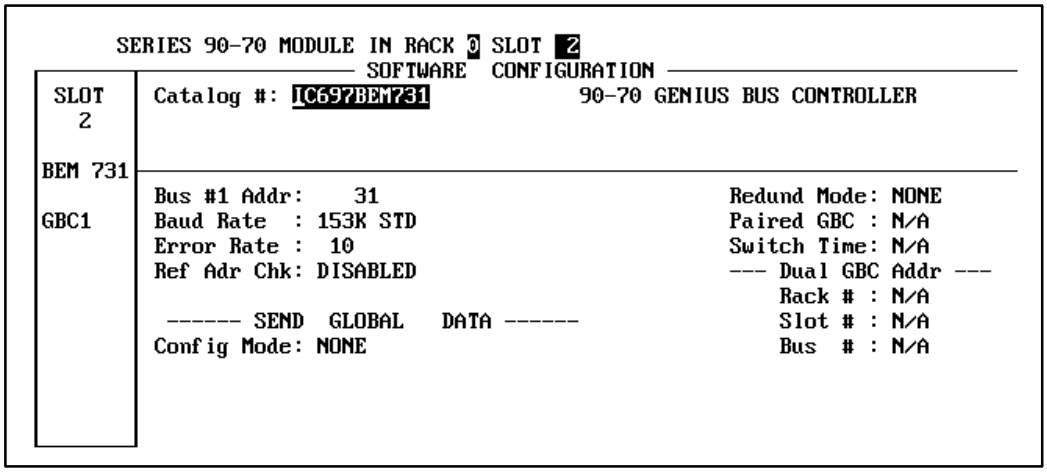
Place the cursor at the slot representation corresponding to the Bus Controller's installed location in the PLC rack.



Select F2 (Genius), then F1 (gbc). Press the Enter key to select the Bus Controller.



After selecting the Bus Controller, complete its configuration entries:



The default entries can be used as is, or changed. *Until a valid configuration is stored to the PLC CPU, the Bus Controller will not operate on the Bus, and its Channel OK LED will not light*.

Bus Addr. Ordinarily, the Device Number (Bus Address) assigned to a Bus Controller is 31. Any number from 0 to 31 can be used; each must be unique on that Genius bus. For redundancy applications, only 30 and 31 should be used.

Baud Rate All devices on a bus *must* use the same baud rate: 153.6 Kbaud standard, 153.6 Kbaud extended, 76.8 Kbaud, or 38.4 Kbaud. Selection of a baud rate depends on the application, as explained in the *Genius I/O System User's Manual*. Usually, the bus length determines the baud rate. The entry made here establishes the baud rate for the Bus Controller *only*. If the default baud rate (153.6 Kbaud standard) will not be used, the baud rate of other devices on the bus must also be changed. Typically, this is done using a Hand–held Monitor.

Error Rate This entry determines how the Bus Controller will respond to errors on the bus. If the Bus Controller should drop off the bus when a specified number of errors occur within a 10–second period, enter that number of errors here. If the Bus Controller should remain on the bus when errors occur and try to maintain communications, enter 0 here.

Caution

If the bus includes a Bus Switching Module or another device that controls bus switching, the Error Rate MUST be set to 0. Otherwise, the Bus Controller may drop off the bus when the BSM is switching a block to the bus.

Ref Adr Chk This entry can be used to verify that references already configured for devices on the Genius bus match the status references assigned to the same devices in Logicmaster 90. If ENABLED, references are checked for all configured devices except PowerTRAC blocks or "GENA"–based bus devices. This feature will *not detect or configure* an unconfigured device, *or correct references that do not match.*

Configuring Global Data

Config Mode: This entry determines how Global Data will be set up for the Bus Controller. If the Bus Controller will not send or receive Global Data, select NONE.

If the Bus Controller will transmit Global Data, select MANUAL if you want to specify a reference address and data length. Or select AUTO to let the Logicmaster 90 software automatically configure the data length and Global Data address. See "Automatic Global Data Setup" on page 19.

If you select MANUAL, the following entries appear:

```
------ SEND  GLOBAL   DATA ------
Config Mode: MANUAL
From Addr  :  %R00001
Data length:     1
To (Opt.)  :     0
```

From Addr: Specify the beginning PLC address from which data will be transmitted on the bus. It can be from %I, %Q, %G, %R, %AI, or %AQ memory.

Data Length: Also for MANUAL configuration mode, this entry specifies the amount of Global Data to be sent each bus scan.

If bit–oriented memory (%I, %Q, or %G) is selected above, this may be 0 to 1024 bits. It must be a multiple of 8. If you enter a number that is not a multiple of 8, the software will automatically adjust it upward.

If word–oriented memory (%AI, %AQ, or %R) is selected above, this may be 0 to 64 words. If more than 64 words are selected, the Logicmaster 90 software automatically adjusts the length to 64 words.

The total amount of memory specified must not exceed the configured memory size for that memory type. For example, for the 731 CPU, the maximum value for %I memory that can be configured is 512.

To (Opt): *This information is not used by another Series 90–70 Bus Controller.* If the Global Data sent by this Bus Controller will be received by a Series Six™ PLC or a Series Five™ PLC, use this entry to configure the destination register address in the other PLC. Only one such destination address can be specified for Global Data sent by each Bus Controller; if there is more than one Series Six and / or Series Five PLC on the bus, they must all use the same register address for Global Data received from this Bus Controller. For information about selecting and entering a register address for one of these PLCs, refer to the *Genius I/O System User's Manual*.

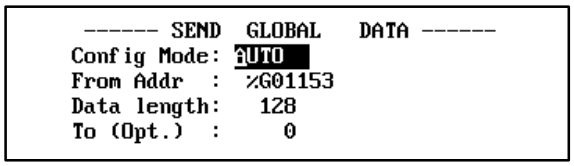
Note

The Bus Controller's Global Data address will not be displayed on the Hand–held Monitor's Block / Bus Status screen unless you enter a register address here that corresponds to the actual Global Data address.

If the Global Data destination is another Series 90–70 PLC, the destination memory address is specified as part of that PLC's configuration.

Automatic Global Data Setup

Selecting AUTO configuration mode automatically assigns a Global Data address and length to the Bus Controller. As many as 6 Bus Controllers in the same rack can easily be configured for Global Data in this way (additional Bus Controllers can be configured by selecting MANUAL, as described previously). If you select AUTO configuration mode, these entries appear for Global Data:



Length for Automatic Global Data

When AUTO is selected, the Logicmaster 90 software assigns a Global Data length based upon the Bus Controller's Device Number. The length may be either 4 bytes or 16 bytes.

Bytes of Global Data	Device Numbers
4	16 through 23
16	24 through 31

A Bus Controller's Device Number is its bus address. The bus address chosen for a Bus Controller may not conflict with that of any other device on its bus. Two or more Bus Controllers in a PLC system may use the same Device Number, providing they are on *different busses*.

Address for Automatic Global Data

When AUTO is selected, the Logicmaster 90 software assigns %G references to Global Data. Like the length, the starting address is based on the Bus Controller's Device Number. For the first Bus Controller configured in AUTO config. mode, the software selects one of these %G references:

Bytes of Global Data	Device Number	Starting Address	Ending Address
4	16	%G0001	%G0032
4	17	%G0033	%G0064
4	18	%G0065	%G0096
4	19	%G0097	%G0128
4	20	%G0129	%G0160
4	21	%G0161	%G0192
4	22	%G0193	%G0224
4	23	%G0225	%G0256
16	24	%G0257	%G0384
16	25	%G0385	%G0512
16	26	%G0513	%G0640
16	27	%G0641	%G0768
16	28	%G0769	%G0896
16	29	%G0897	%G1024
16	30	%G1025	%G1152
16	31	%G1153	%G1280

For example, if the Device Number of the first Bus Controller configured in AUTO mode is 21, the Logicmaster 90 software automatically assigns references %G0161 through %G0192, and the Global Data length is 4 bytes.

Configuring Additional Bus Controllers in AUTO Mode

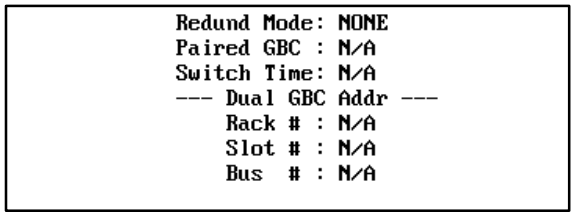
To accommodate additional Bus Controllers in the same rack, %G memory has five more areas, identified as %GA, %GB, %GC, %GD, and %GE. The second Bus Controller configured in AUTO mode is automatically assigned to %GA, the third to %GB, and so on. Within those memory areas, reference assignments and Global Data lengths are the same for %G.

	1st Bus Controller	2nd Bus Controller	3rd Bus Controller	4th Bus Controller	5th Bus Controller	6th Bus Controller
Device Number	**%G Addresses**	**%G Addresses**	**%GB Addresses**	**%GC Addresses**	**%GD Addresses**	**%GE Addresses**
16	1–32	1–32	1–32	1–32	1–32	1–32
17	33–64	33–64	33–64	33–64	33–64	33–64
18	65–96	65–96	65–96	65–96	65–96	65–96
19	97–128	97–128	97–128	97–128	97–128	97–128
20	129–160	129–160	129–160	129–160	129–160	129–160
21	161–192	161–192	161–192	161–192	161–192	161–192
22	193–224	193–224	193–224	193–224	193–224	193–224
23	225–256	225–256	225–256	225–256	225–256	225–256
24	257–385	257–385	257–385	257–385	257–385	257–385
25	386–512	386–512	386–512	386–512	386–512	386–512
26	513–640	513–640	513–640	513–640	513–640	513–640
27	641–768	641–768	641–768	641–768	641–768	641–768
28	769–896	769–896	769–896	769–896	769–896	769–896
29	897–1024	897–1024	897–1024	897–1024	897–1024	897–1024
30	1025–1152	1025–1152	1025–1152	1025–1152	1025–1152	1025–1152
31	1153–1280	1153–1280	1153–1280	1153–1280	1153–1280	1153–1280

Assigning a Bus Controller to a %G channel in AUTO mode reserves that channel; no part of it can be assigned to another Bus Controller in the rack. If an "external" device on the bus sends Global Data to the Bus Controller, that data will be placed in the same channel, at the starting address that corresponds to the other controller's Device Number. The starting location cannot be changed but the length can, if necessary, by switching to MANUAL mode. *If the length is changed, it is important to be sure that the new length does not overlap a memory area being used for another device's Global Data.*

Configuring Redundancy

The rest of the entries on the Bus Controller configuration screen are for redundancy.



Use of these features requires the following hardware and software:

- Series 90–70 PLC CPU, version 4.0 or later.
- Series 90–70 PLC Bus Controller, version 4.0 or later.
- Logicmaster 90 Software, release 4.01 or later.

To get back the redundant configuration, zoom into the Bus Controller configuration screen, and re–select the **Redundancy Mode.**

Redund Mode: The type of redundancy, if any. See chapter 6 for more detailed descriptions of redundancy modes. Configuration examples for redundancy are also shown on the following pages.

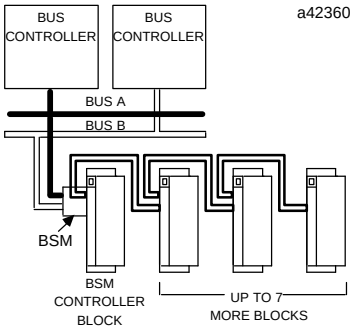
Note: if you set up a Bus Controller for redundancy, then either COPY or UNDELETE the Bus Controller's configuration, the ***Redundancy Mode*** *of the copy or restored version will be reset to NONE and the* ***Redundancy*** *of blocks on the bus will be reset to NO.*

None: This is the default. **None** means the Bus Controller communicates with a single bus, it is the only controller on the bus sending outputs, and no I/O devices on the bus are set up for any type of redundancy.

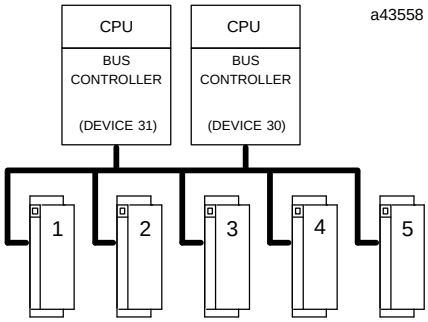
If, during subsequent configuration of devices on the bus. any is set up for redundancy, this item will automatically be changed to ***Dual Bus.***

Similarly, if ***Redund Mode*** *is set to anything except NONE, any devices on the bus that have already been configured will automatically have their* ***Redundancy*** *parameter set to YES.*

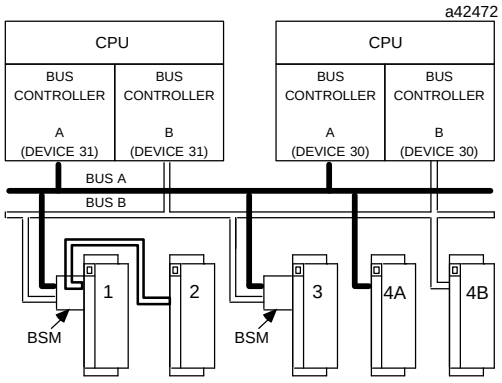
Dual Bus: In a dual bus configuration, there are two busses, each of which has its own Bus Controller. The Bus Controllers can be either in the same PLC or separate PLCs. Switching devices, usually Genius Bus Switching Modules (BSMs), each link up to seven additional devices to the dual busses.



Red Ctrl: Select this for redundant Bus Controllers, either in the same PLC or separate PLCs:



DB/RC: Select this for a system that combines redundant Bus Controllers with a dual bus. It requires two PLCs and four Bus Controllers:



Paired GBC: Both dual bus and dual controller redundancy use pairs of Bus Controllers. This selection specifies the location of the other Bus Controller of the pair. The three choices are:

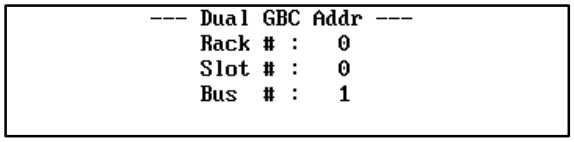
Internal:	If the **Redundancy Mode** is either dual bus or redundant control and both Bus Controllers are located in the same PLC (not necessarily in the same rack), select **Internal**. You must also enter a **Dual GBC Addr** (see below).
External:	If the **Redundancy Mode** is either dual bus or redundant control and the other Bus Controller is in another PLC, select **External**.
Int/Ext:	Select this if **Redund Mode** is set to **DB/RC**. You must also enter a **Dual GBC Addr** (see below).

*If, during subsequent configuration of devices on the bus, any is set up for redundancy, this item will automatically be changed to **External.***

Switch Time: This is the amount of time that will be allowed for switching on a dual bus. The choices are 2.5 seconds and 10 seconds. If the **Redundancy Mode** is either **Dual Bus** or **DB/RC** and the total bus scan time on either bus is expected to exceed 100mS, change the **Switch Time** selection to 10 seconds. If the Bus Controller stops receiving input data from a device or devices on the bus, it will wait this specified time period before defaulting inputs or generating fault reports.

Be sure to select the same time period when configuring the devices on the bus with a Hand–held Monitor or Write Configuration COMREQs. This determines the length of time I/O devices on the bus allow for bus switching, before defaulting their outputs.

Dual GBC Addr If you selected **Internal** for **Paired GBC**, enter the location of the other Bus Controller:



For **rack #** and **slot #**, enter the rack and slot number where the other Bus Controller is located in the Series 90–70 PLC. The **bus #** entry should be left as 1.

Note

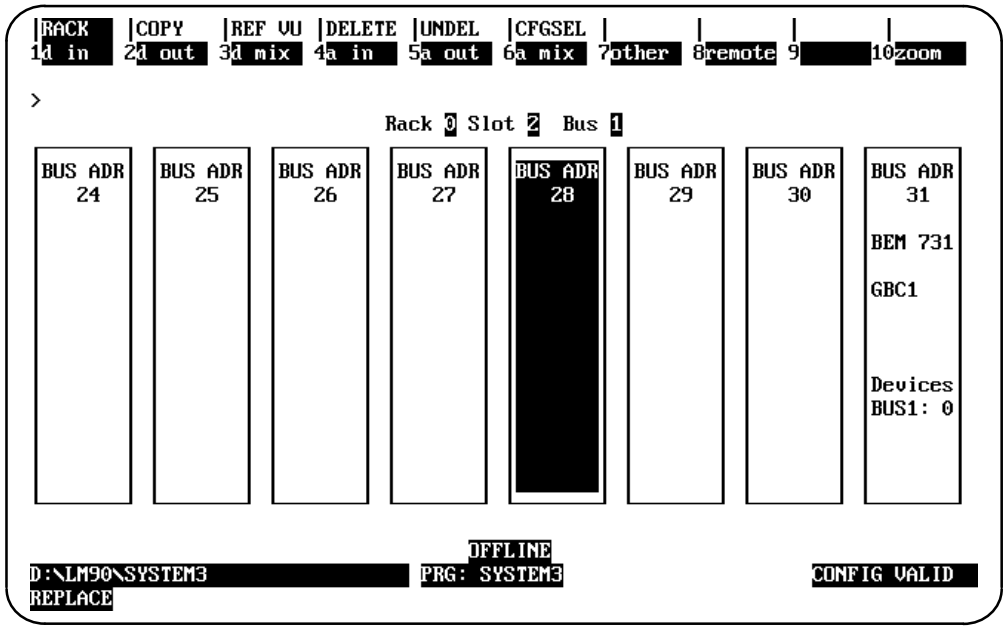
When configuring a redundant system, remember to change the **Loss of IOC** fault from fatal to diagnostic. Otherwise, loss of a Bus Controller will cause the PLC to shut down. (This change can be made on the Fault Categories screen, during CPU configuration.)

Configuring Devices on the Bus

After configuring the Bus Controller, configure the devices on its bus by pressing F10 (Zoom) with the cursor at the Bus Controller slot. The bus configuration screen (see below) appears.

Selecting a Device

Each location on the bus is represented by a Device Number from 0 to 31. To select a Device Number. position the cursor at its numbered box on the bus display. For example, positioning the cursor as shown below would assign Device Number 28.



With the cursor positioned at the correct Device Number, configure the device type:

d in (F1) Select F1 for a discrete input block or combination block with inputs only.

d out (F2) Select F2 for a discrete output block, or a combination block with outputs only.

d mix (F3) Select F3 for a discrete I/O block with both inputs and outputs. This includes blocks configured for “outputs with feedback”.

a in (F4) Select F4 for an analog block that has inputs only.

a out (F5) Select F5 for an analog block that has outputs only.

a mix (F6) Select F6 for an analog block with both inputs and outputs.

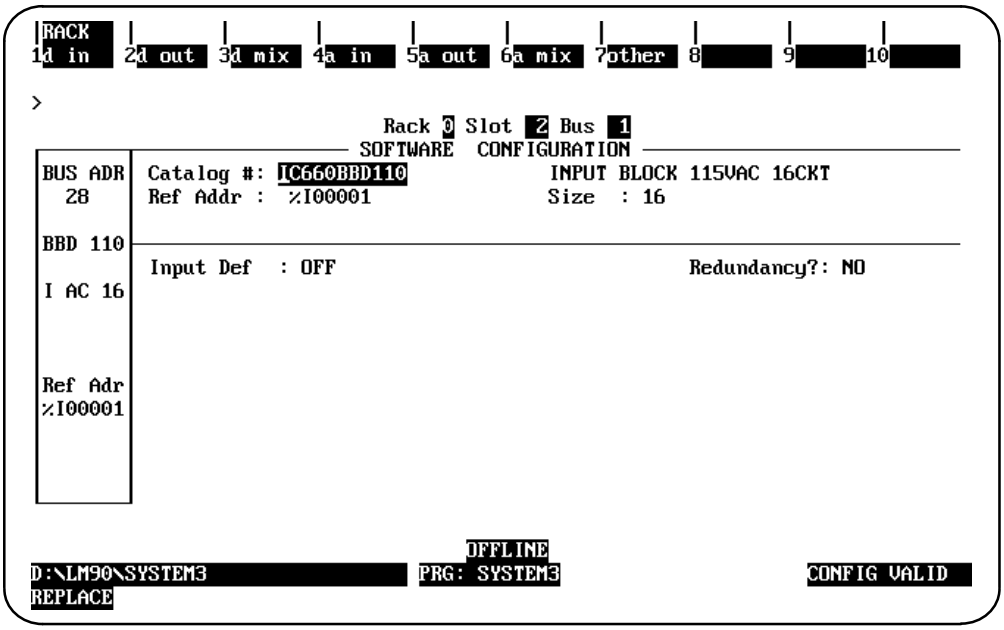
other (F7) Select F7 to configure another Bus Controller, a High–speed Counter, a PowerTRAC Block, a PCIM, GENI, GENA, or “generic” I/O device.

remote (F8) Select F8 to add a remote drop the bus.

Configuring I/O Blocks

Genius I/O blocks with selectable I/O configuration appear in more than one list. If a discrete combination block will have inputs only, select it from the "D IN" (F1) list. If it will have outputs only, select it from the "D OUT" (F2) list. If it will have both inputs and outputs, select it from the "D MIX" (F3) list. If a block is selected from the wrong list, or *if its I/O type configuration is changed at a later time*, a "Genius I/O Type Mismatch" error will be placed in the PLC Fault Table.

When a block type has been selected from the correct list, press the Enter key. A configuration screen for that block will appear. For example, this is a configuration screen for a 115 VAC 8 Circuit Grouped I/O block.



You must enter a configuration screen for each device on the bus, although you may wish to use the default references and configuration selections.

This does NOT configure the characteristics of the Genius I/O blocks themselves. That separate configuration is normally done using a Hand–held Monitor, but may also be done using Communication Request instructions in the application program. For information about Communication Request instructions, see chapter 5.

Block Reference Address

A block's Reference Address is the beginning reference for its inputs and outputs. As each block is configured, the software selects the correct memory types for that block.

For example, for a discrete block with both inputs and outputs, this address is shown in the configuration screen as:

```
Ref Addr :  %QInnnnn
```

For an analog block with both inputs and outputs, this address is shown in the configuration screen as:

```
Ref Addr :  %AQInnnnn
```

Memory Type

The memory type shown on the configuration screen cannot be changed. If a discrete combination block will NOT use the reference types shown (for example, if %QI is shown, but the block will be configured with a Hand–held Monitor for inputs–only operation), the block has been selected from the wrong list. The memory type displayed on this screen must match the memory type selected with the Hand–held Monitor. If it doesn't, delete the current entry then re–select the block from the correct list.

Address

The Logicmaster programmer automatically assigns the next available reference address within a memory type. If the address displayed is not appropriate, a different address can be entered from the keyboard. Discrete references must begin on a byte boundary (a byte boundary is a number which is one greater than a multiple of 8, for example: 9, 17, or 25). If you assign a reference address out of sequence, the software will then continue to increment that number for additional modules. For example, if you assigned the reference %I0401 to the first input module and it had 16 circuits, the software would next assign %I0417 or %QI0417 to an input or combination block. You could change this to a different address. A message appears when the highest available address has been assigned, although you may have skipped lower addresses.

References for Blocks having both Discrete and Word Inputs: For certain types of Genius I/O blocks (an example is the High–speed Counter block), the input data that is routinely broadcast by the block consists of BOTH discrete and word–type data.

For such a block, the configured Reference Address represents three memory locations (in %I, %Q, and %AI memories) instead of the two (%I and %Q) assigned to other types of blocks.

For example, a High–speed Counter block has 16 bits of input data, 16 bits of output data, and 15 words of calculated data. If a High–speed Counter block were configured to use Reference Address 0049, the following memory locations would be used by the block:

%I0049 to %I0064	for the block's inputs
%Q0049 to %Q0064	for the block's outputs
%**AI0049 to %AI0063**	for the block's calculated data

References for Inputs–only or Outputs–only Blocks: An Inputs–only block uses one reference in %I or %AI memory for each circuit on the block. Similarly, a block with outputs only requires one reference in %Q or %AQ memory only.

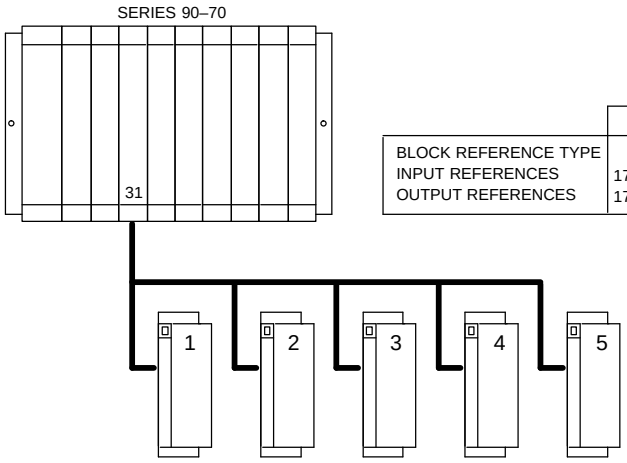
References for Blocks with both Inputs and Outputs: A block which has both inputs and outputs uses the same number of input and output references, regardless of the block's actual I/O mix.

An analog block with 4 inputs and 2 outputs requires four words of analog input memory and four words of analog output memory. The block only uses the first two output words; however, the second two output words cannot be used for outputs because they cannot be assigned by the configuration software. However, they can be used for internal registers in the application program.

References for Redundancy: The Series 90–70 PLC handles I/O data the same way for redundant and non–redundant systems. For any redundant Bus Controller pair in the PLC, each CPU sweep the CPU receives a one set of bus inputs and sends one set of bus outputs. The Series 90–70 PLC does *not* maintain two sets of references for devices that are set up for redundancy.

Reference Address Configuration Example

As the following examples show, it is not necessary to configure blocks in Device Number sequence. Device Numbers are unrelated to the assignment of Reference Addresses.



	1	2	3	4	5
BLOCK REFERENCE TYPE	QI	AQI	Q	AI	I
INPUT REFERENCES	17–24	1–4	–	5–10	1–16
OUTPUT REFERENCES	17–24	1–4	1–16	–	–

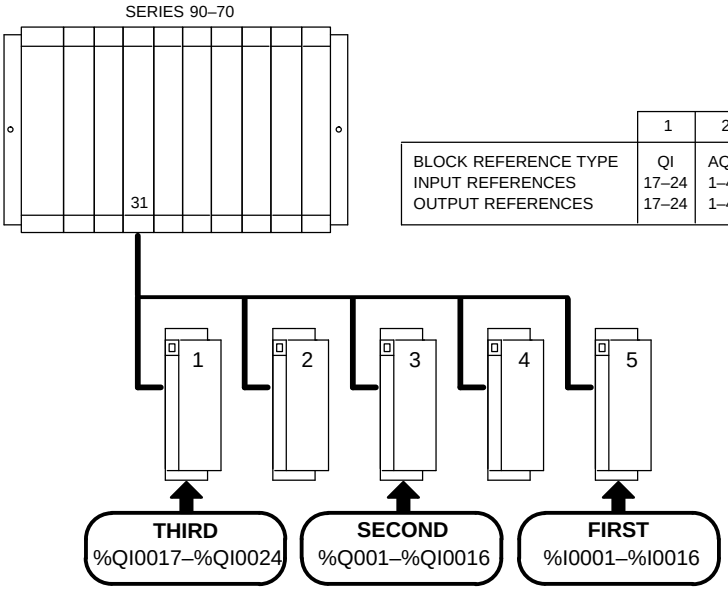
The bus has five blocks:

Device Number 1:	8–circuit Isolated I/O block
Device Number 2:	4 Input/2 Output analog block
Device Number 3:	16–circuit discrete Relay Output block
Device Number 4:	RTD analog block (6 inputs, no outputs)
Device Number 5:	16–circuit discrete Inputs–only block

The order in which the blocks are configured determines their reference assignments.

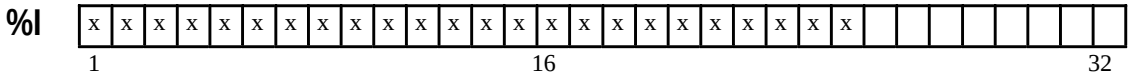
Reference Address Example Configuration 1:

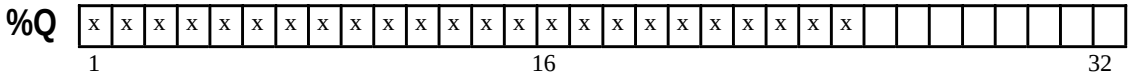
Here, the first block to be configured is Device Number 5, the 16–circuit Inputs–only block. The configuration software assigns to it %I0001. The second block configured is Device Number 3, the Relay Output block. The software assigns to it %Q0001. If Device Number 1, the 8–circuit Isolated I/O block, were configured next, the software would automatically assign it %QI0017.



	1	2	3	4	5
BLOCK REFERENCE TYPE	QI	AQI	Q	AI	I
INPUT REFERENCES	17–24	1–4	–	5–10	1–16
OUTPUT REFERENCES	17–24	1–4	1–16	_	_

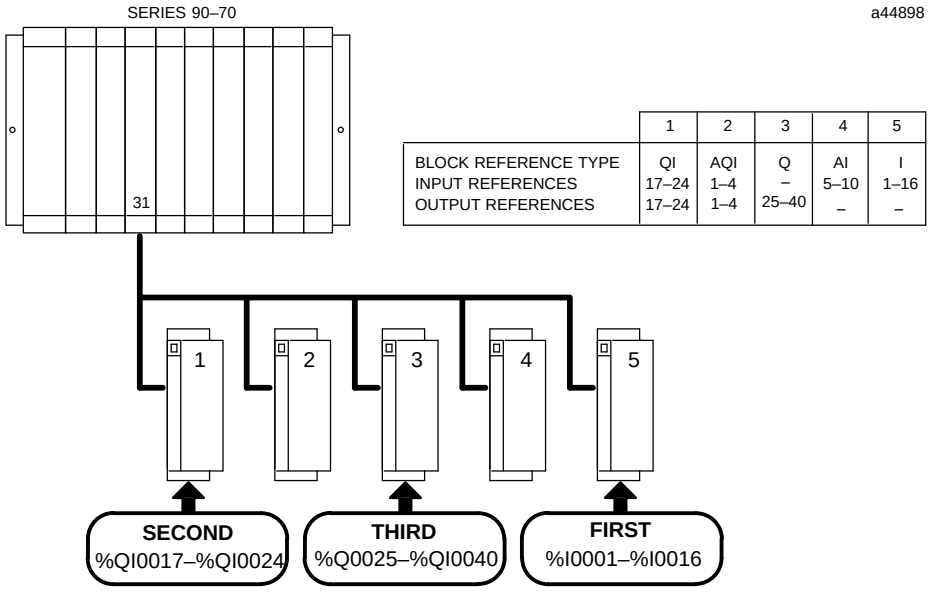
The assignment of %I and %Q memory would then be:





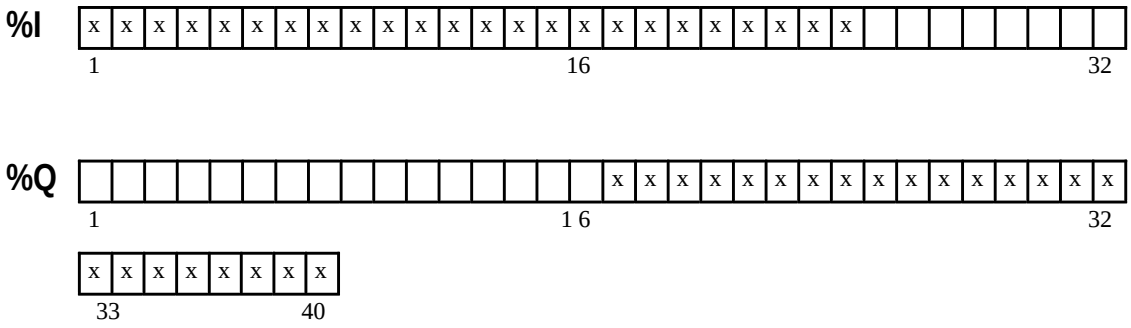
Reference Address Example Configuration 2:

If the 16–circuit Input block were configured first, the 8–circuit Isolated block second, and the 16–circuit Relay block third, the software would not go back and assign reference address %Q0001 to the Relay block.



	1	2	3	4	5
BLOCK REFERENCE TYPE	QI	AQI	Q	AI	I
INPUT REFERENCES	17–24	1–4	–	5–10	1–16
OUTPUT REFERENCES	17–24	1–4	25–40	–	–

The automatic memory assignments in %I and %Q would be like this instead:



In this case, the Reference Address %Q0001 could be typed in from the keyboard, resulting in the memory usage shown first.

It is not necessary to configure the analog blocks as a separate group. The software assigns their Reference Addresses independently of the discrete Reference Addresses.

Disabling Outputs

If outputs are disabled, the Bus Controller will not send output data from the CPU to the designated device(s). *Output Disable is not selectable for inputs–only devices. Inputs–only blocks are ALWAYS sent a dummy message to turn on their I/O Enabled LEDs.*

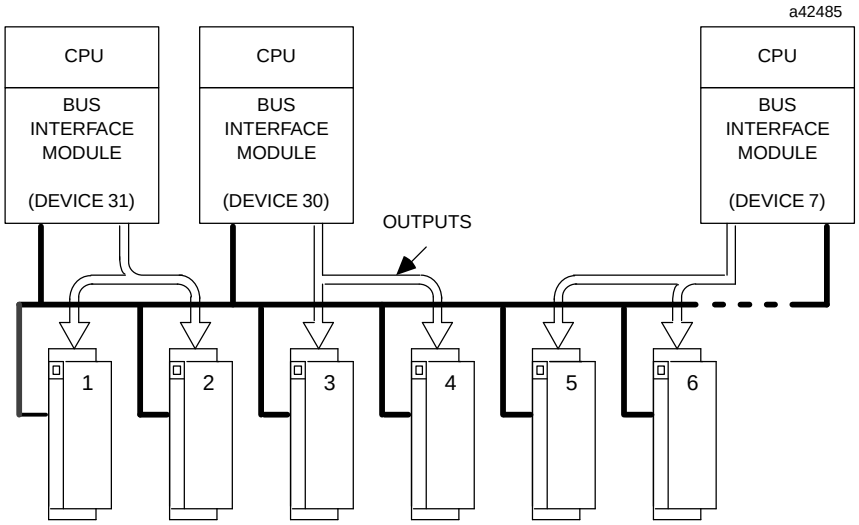
It is possible for outputs to be disabled or re–enabled using Communication Request instructions in the application program. If this capability will be needed, then outputs should be *enabled* during I/O configuration.

Ordinarily, the configuration software would be used to disable outputs that were to remain disabled. To re–enable such inputs, it would be necessary to change the configuration and re–store the new configuration to the PLC.

Outputs might be disabled in a system where multiple CPUs are used for distributed control, or a system using the Series 90 PLC as an assigned monitoring device. Examples are shown below.

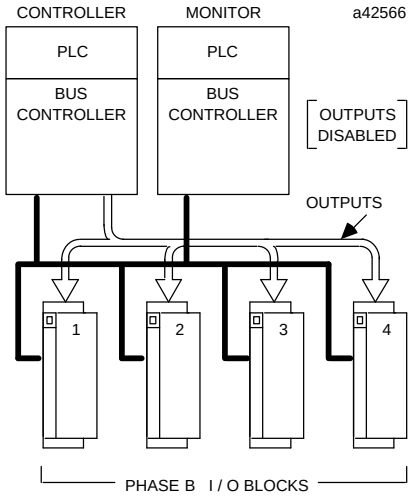
Example

Selectively Disabling Outputs for Distributed Control of I/O Blocks: Some systems use two or more CPUs on the same bus for distributed control of I/O blocks. In a distributed control system, each CPU sends outputs to (and receives fault reports from) certain blocks on the bus and not others. This is accomplished by selectively enabling or disabling outputs to the blocks.

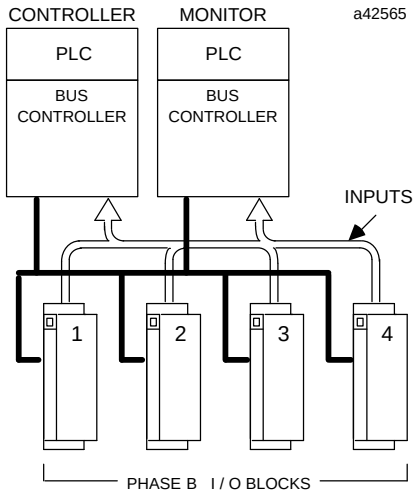


Example

Disabling Outputs for an Assigned Monitor: If the Series 90 PLC will be used to monitor inputs from certain blocks on the bus, outputs to those blocks should be disabled. When being used as a monitor, the PLC will also receive fault reports and configuration change messages if the blocks have been sent Assign Monitor datagrams.



Output data for these blocks will be supplied by one or more other CPUs on the *same* bus.



If a CPU is used as a monitor, it may NOT have two of its Bus Controllers located on the same bus. Otherwise, the CPU would receive input data from both Bus Controllers for the same references, and internal system errors will result.

Block Redundancy Configuration

If a block will be used in dual bus or dual controller mode, or both, set the entry for **Redundancy** to YES.

If **Redundancy** is set ot YES for any block on a bus, the Bus Controller must also be configured for a form of redundancy: dual bus, redundant control, or dual bus / redundant control.

The configuration software will automatically attempt to supply a correct configuration when you set device **Redundancy** to YES:

- If the Bus Controller is configured for a **Redundancy Mode** of NONE, and you set the **Redundancy** of any device on the bus to YES, the Bus Controller's configuration is automatically changed to **Redundancy**: DUAL BUS and **Paired GBC**: EXTERNAL.
- If the Bus Controller is configured for a **Redundancy Mode** of either DUAL BUS or Redundant Control (Red Ctrl), and **Paired GBC** is INTERNAL, each device on the bus is automatically configured at the same bus address (Device Number) on the redundant bus, and given the same reference addresses.

  If **Paired GBC** is set to EXTERNAL, the block is not automatically configured on the other bus of the pair.
- If the Bus Controller is configured for a **Redundancy Mode** of DB / RC (dual bus / redundant control) each device on the bus is automatically configured at the same bus address (Device Number) on the redundant bus, and given the same reference address.

Redundancy

The redundancy mode of I / O blocks is automatically matched to the **Redundancy Mode** configuration of the Bus Controller;

Bus Controller	I/O Block
none	none
redundant control	Hot Standby
dual bus	BSM Present = YES
DB / RC	BSM Present = YES

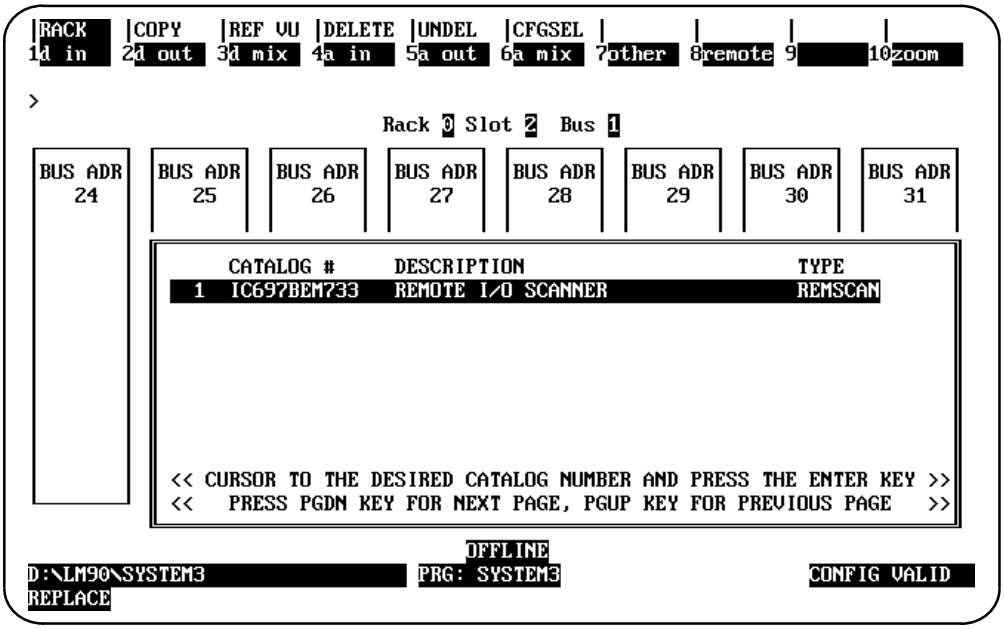
Configuring a Remote Drop

To add a remote drop to the bus, select a Device Number for the Remote I/O Scanner by moving the cursor to the desired number and pressing F8 (Remote).

Note

If a Remote I/O Scanner has a Device Number conflict on an operating bus, it will not scan the modules in the remote drop until the fault is cleared.

In the example below, a Remote I/O Scanner has been selected at Device Number 29.



Press the Enter key to accept the Remote I/O Scanner (IC697BEM733) at the desired Device Number. A configuration screen next appears for the Remote I/O Scanner.

Please refer to the *Series 90–70 Remote I/O Scanner User's Manual* for additional configuration instructions.

Redundancy

The redundancy mode of the Remote I/O Scanner is automatically matched to the **Redundancy Mode** configuration of the Bus Controller;

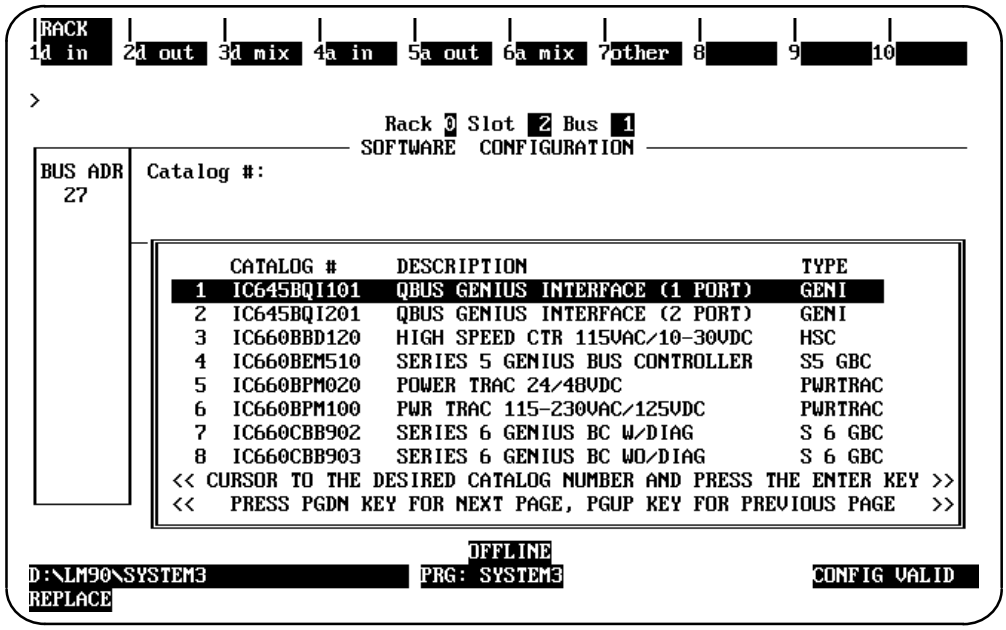
Bus Controller	**Remote I/O Scanner**
none	none
redundant control	Hot Standby
dual bus	BSM Present = YES
DB/RC	BSM Present = YES

Configuring Other Devices on the Bus

Select F7 (other) from the bus configuration screen to configure:

- Another Bus Controller on the same bus.
- A PCIM or QBIM interface module.
- A High–speed Counter Block.
- A PowerTRAC Block.
- A GENI, GENA, or generic I / O device.

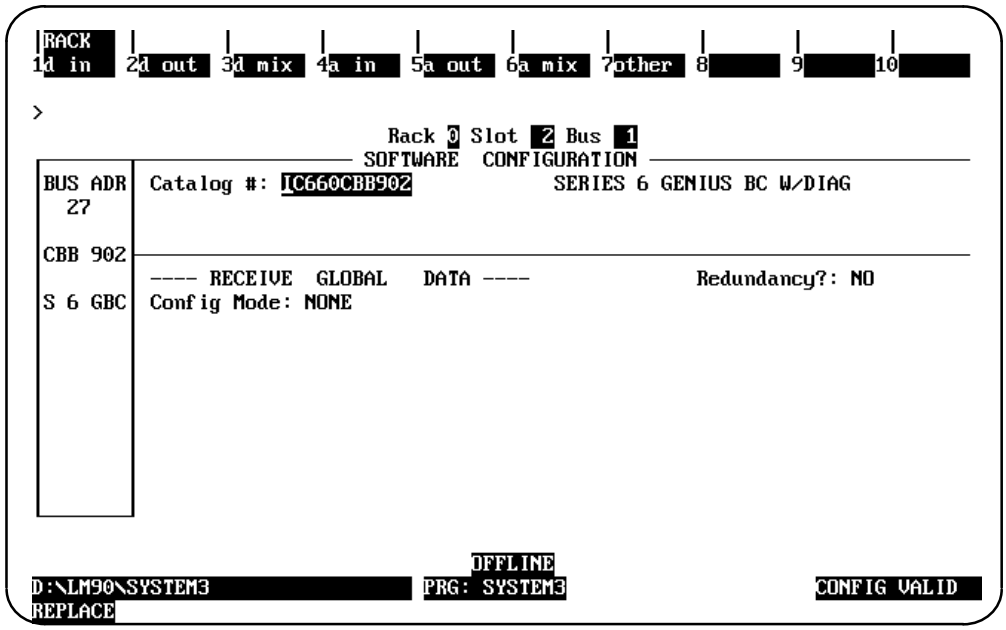
After you select "other ", a screen like this appears:



To display the names of additional devices, use PGUP or PGDN. Configuration for the devices listed on this menu is summarized on the following pages.

Configuring an Attached Bus Controller, Genius Communications Module, PCIM, QBIM, or GENI–based Device

Select the module from the menu of "other" modules. Press the Enter key. The configuration screen that appears will look like this example:



Receiving Global Data

If the Bus Controller you are now configuring (at the rack level) will not accept Global Data from this Bus Controller, the entry for **Config Mode** should be NONE. If it will accept the Global Data, select the CPU reference address for the data to be placed after it is received.

A. For automatic configuration of a %G reference based on the module's Device Number, select AUTO. See page 19 for more information.

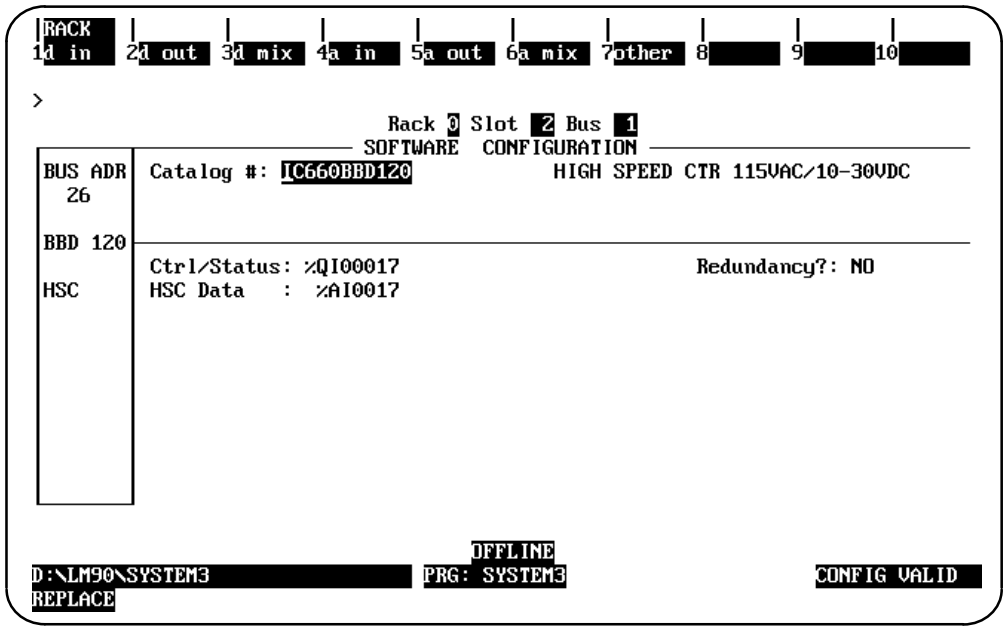
B. To choose a specific reference in %I, %Q, %G, %AI, %AQ, or %R memory for the data, select MANUAL. You can then enter the beginning reference, and the length of memory to be reserved.

To:	The beginning address in %I, %Q, %G, %AI, %AQ, or %R memory.
Input Length:	The amount of Global Data expected to be received. For bit–oriented data, this is the number of bits. For word–oriented data, it is the number of words. If the expected data length (defined by configuration) and the actual data length (defined by the content of the Read ID Reply message from the module) don't agree, a System Configuration Mismatch fault is placed in the PLC Fault Table.

If **Redundancy** is set ot YES, the Bus Controller must also be configured for a form of redundancy. The configuration software will automatically attempt to supply a correct configuration when you set device **Redundancy** to YES, as explained on page 32.

Configuring a High–speed Counter Block

Select the High–speed Counter from the menu of "other" modules. Press the Enter key. A configuration screen like this will appear:



The High–speed Counter Block has both bit–type data and word–type data. On this screen, select the beginning references for both. When you make a %QI entry for "Ctrl/Status", it automatically assigns the corresponding starting reference in %AI memory for the block's word data ("HSC Data").

Ctrl/Status The %QI reference location for the block's discrete I/O data. The length is fixed at 16 bits.

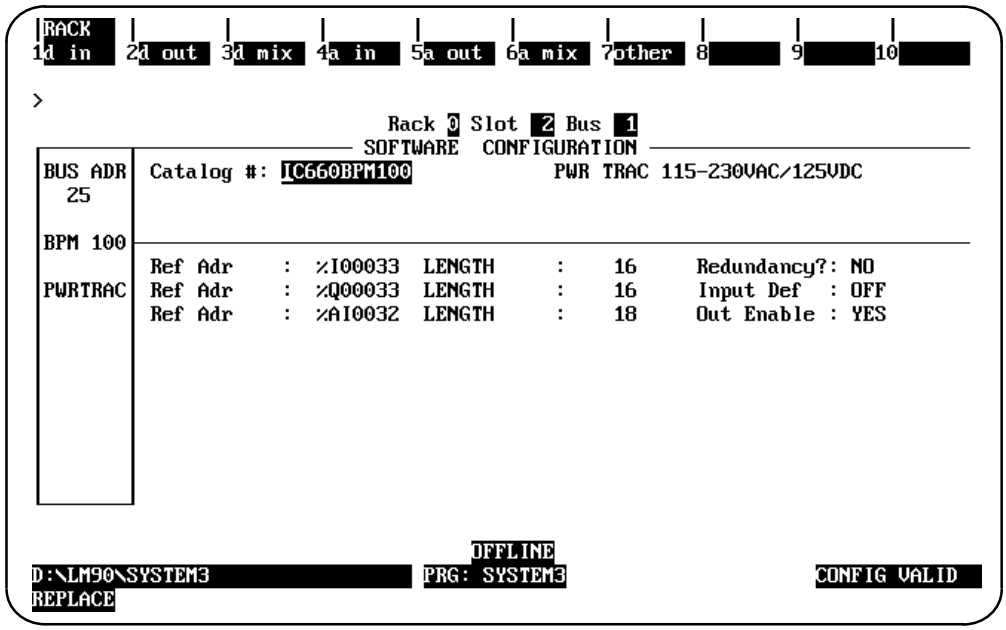
HSC Data The %AI reference for the block's word data. The length is fixed at 15 words.

If you would like more information about the content and format of this data, please see the *High–speed Counter User's Manual*.

If **Redundancy** is set ot YES, the Bus Controller must also be configured for a form of redundancy. The configuration software will automatically attempt to supply a correct configuration when you set device **Redundancy** to YES, as explained on page 32.

Configuring a PowerTRAC Block

Select the PowerTRAC Block from the menu of "other" modules. Press the Enter key. A configuration screen like the one shown below will appear.



The PowerTRAC Block has both bit–type data and word–type data. On this screen, select the beginning references for both. The required lengths are shown. You can also select the default state for the block's input data, and enable or disable CPU outputs to the block.

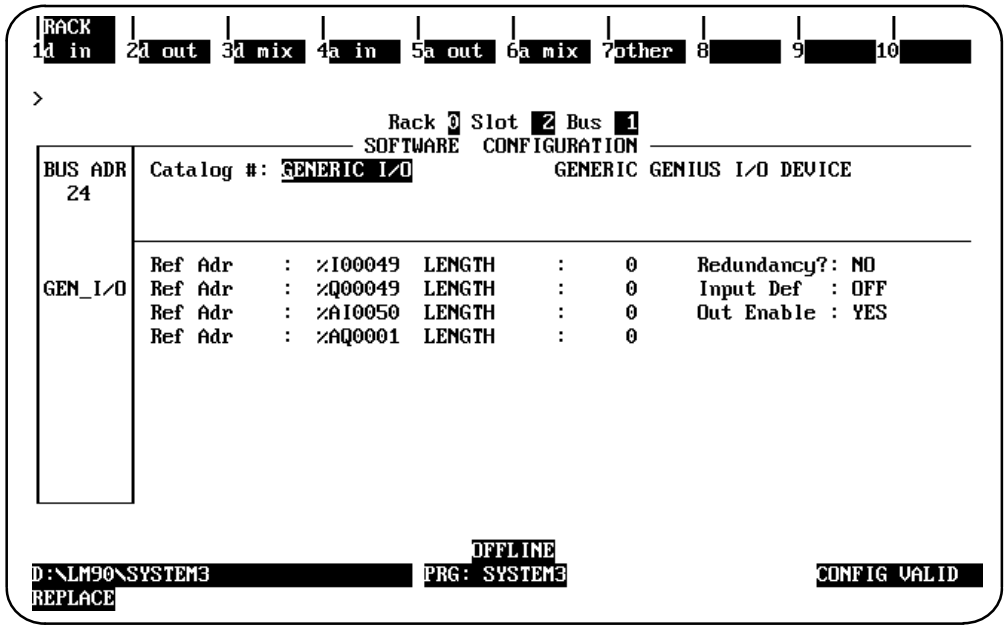
If **Redundancy** is set ot YES, the Bus Controller must also be configured for a form of redundancy. The configuration software will automatically attempt to supply a correct configuration when you set device **Redundancy** to YES, as explained on page 32.

If you would like more information about the content and format of PowerTRAC block data, please see the *PowerTRAC Block User's Manual*.

Configuring a Generic I/O Device

A device on the bus can be configured as a "generic" I/O device. This might be done to provide selections for "input defaults" and "outputs enabled" that are not otherwise available for a given Genius product, or to configure a device that is not included in the other menus.

To configure a generic device, select GENERIC I/O from the menu of "other" modules. Press the Enter key. A configuration screen like this will appear:



Select the beginning references and lengths for the module's bit and word data. The combined lengths of bit and word inputs (%I and %AI) must exactly match the amount of data that will be sent by the device. The combined lengths of bit and word outputs (%Q and %AQ) must exactly match the amount of data that will be sent by the Bus Controller to the device. *If the device being configured is a Bus Controller, assign it INPUTS ONLY.*

You can also select the default state for the device's input data, and enable or disable CPU outputs to the device.

If **Redundancy** is set ot YES, the Bus Controller must also be configured for a form of redundancy. The configuration software will automatically attempt to supply a correct configuration when you set device **Redundancy** to YES, as explained on page 32.

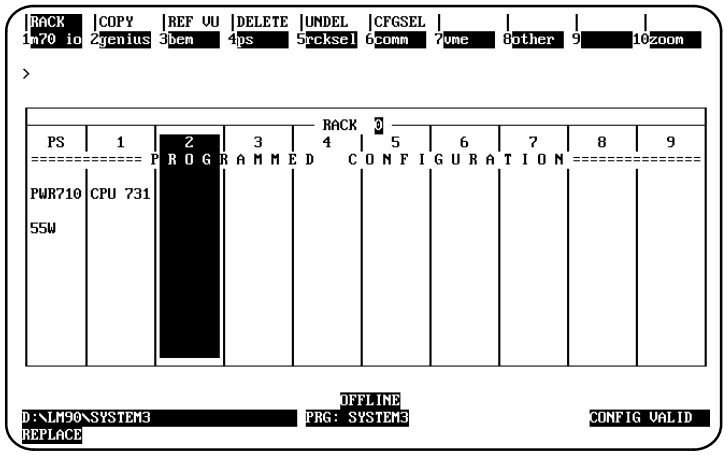
Bus Controller Configuration Steps

The examples on the following pages show Logicmaster configuration steps for non–redundant and redundant Bus Controllers:

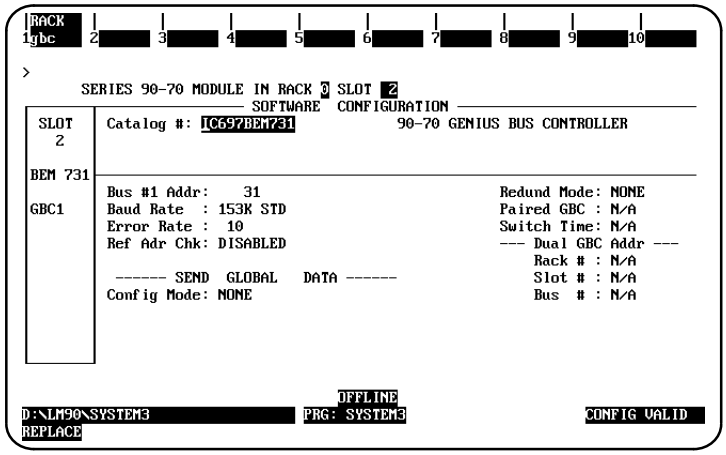
- ***Example 1:*** A non–redundant Bus Controller.
- ***Example 2:*** A Bus Controller that will use bus redundancy (dual bus), with the other Bus Controller in another PLC (typical application).
- ***Example 3:*** A Bus Controller that will use bus redundancy (dual bus), with the other Bus Controller in the same PLC (not necessarily in the same rack, however).
- ***Example 4:*** A Bus Controller that will use controller redundancy, with the other Bus Controller in another PLC (typical application).
- ***Example 5:*** A Bus Controller that will use controller redundancy, with the other Bus Controller in the same PLC (not necessarily in the same rack).
- ***Example 6:*** A Bus Controller that will use both dual bus and controller redundancy (typical application).

Bus Controller Configuration Example 1: No Redundancy

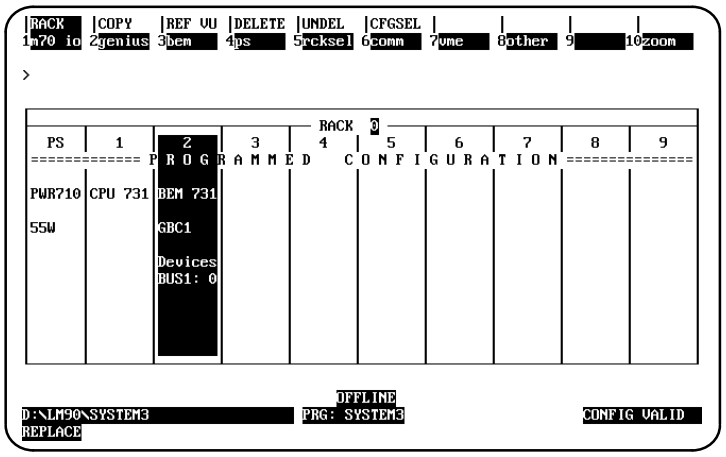
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



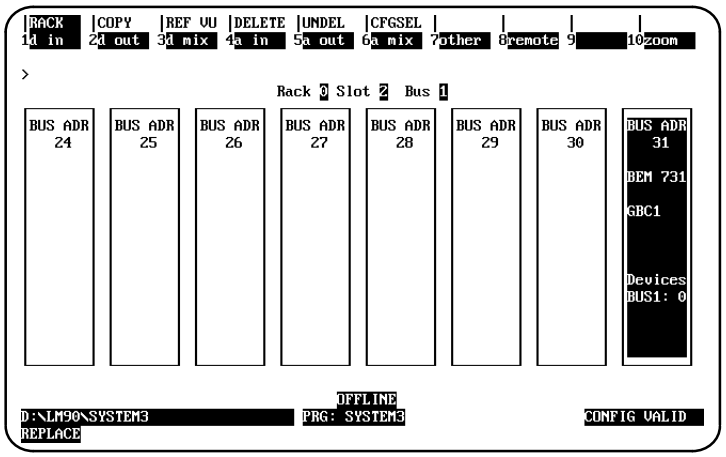
5. Complete the entries on the left side of the screen.
6. On the right side of the screen, leave **Redund mode** set to NONE. The entries below it cannot then be edited.
7. Press the ESC key to return to the rack configuration screen.



8. The rack configuration screen now includes the Bus Controller.
9. Press F10 (zoom) to go to the bus configuration screen.

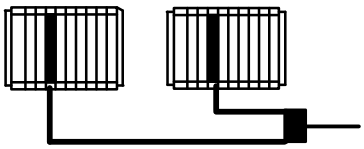


10. On the bus configuration screen, the Bus Controller appears at its configured Bus Address, 31 in this example.
11. From here, you can configure the devices on the bus.

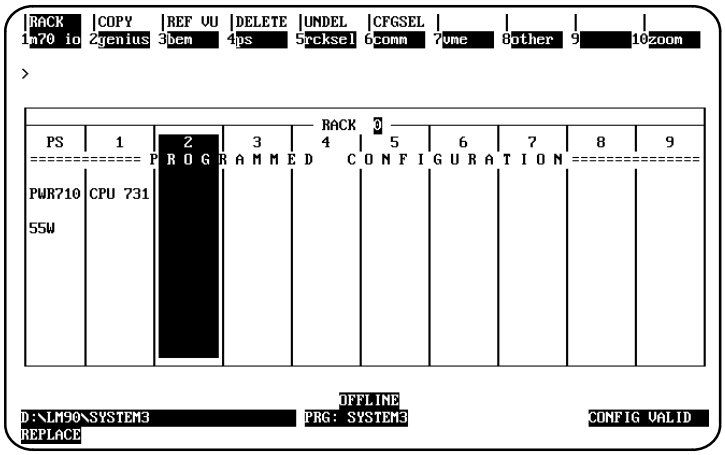


end of Example 1

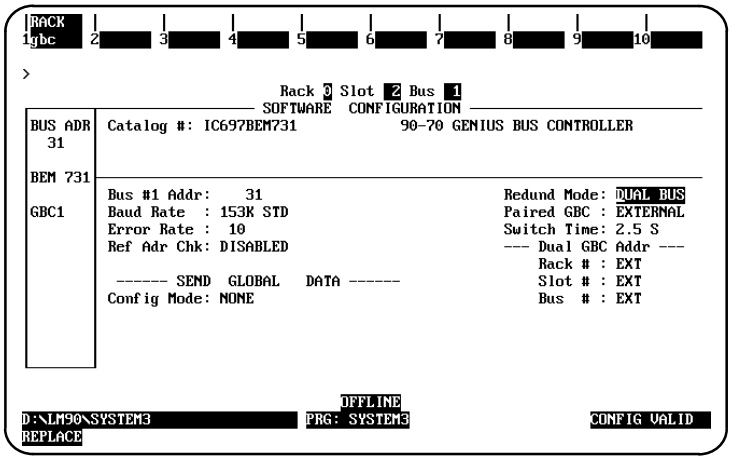
Bus Controller Configuration Example 2: Bus Redundancy Only, Bus Controllers in Separate PLCs



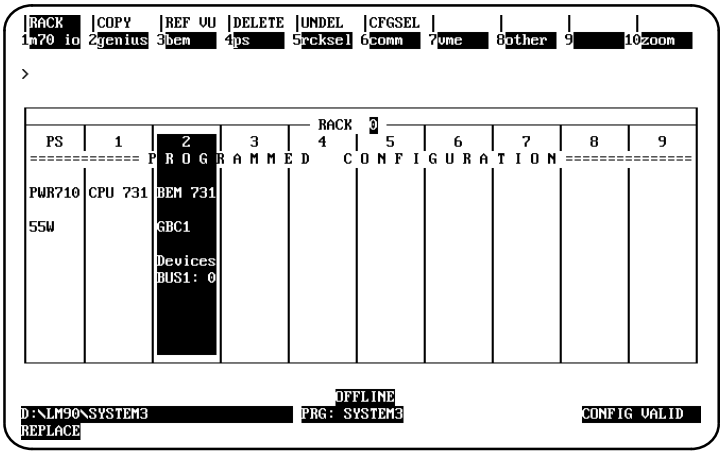
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



5. Complete the entries on the left side of the screen.
6. On the right side of the screen, change **Redund Mode** set to DUAL BUS.
7. Set **Paired GBC** to EXTERNAL.
8. If the bus scan time will exceed 100mS, set **Switch Time** to 10S.
9. When you are finished with the entries on this screen, press the ESC key to return to the rack configuration screen

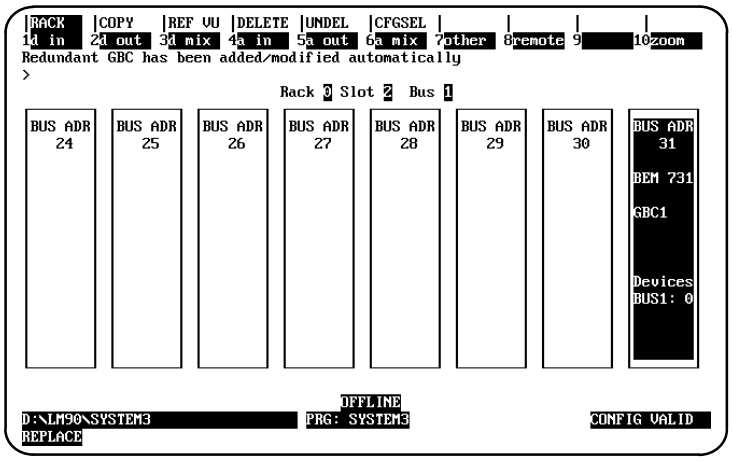


10. The Bus Controller appears on the rack configuration screen.
11. From this screen, you can zoom into the bus configuration screen.



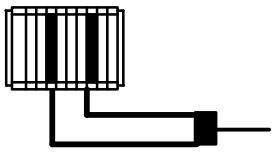
12. The Bus Controller appears at its configured Bus Address, 31 in this example.
13. To configure the bus, include all devices that are connected to the dual bus (via bus switching devices), as well as any devices that are connected only to the portion of the bus controlled by this Bus Controller.

Repeat these steps for the other Bus Controller when configuring its PLC.

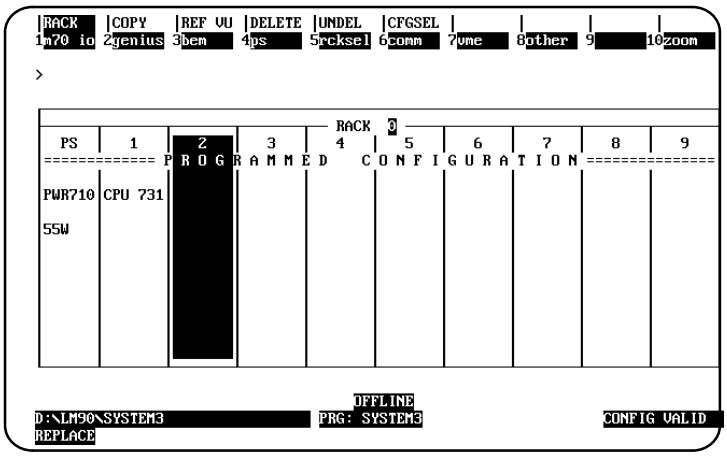


end of Example 2

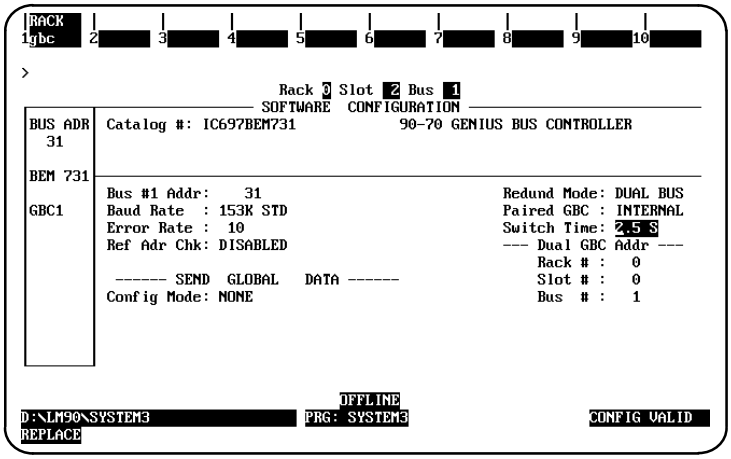
Bus Controller Configuration Example 3: Bus Redundancy Only, Bus Controllers in the Same PLC



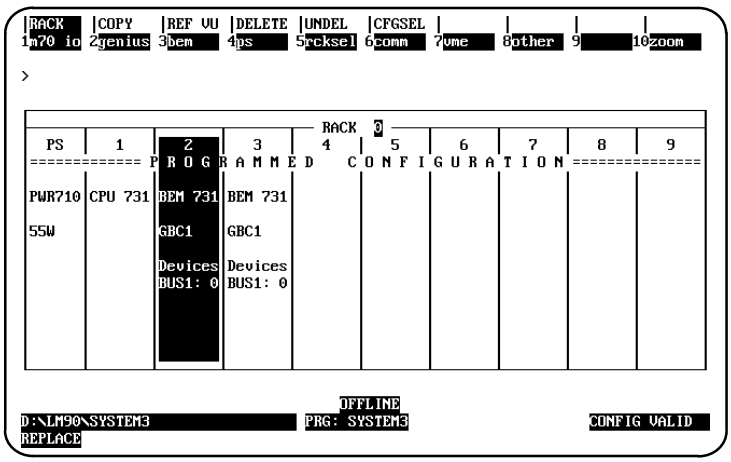
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



5. Complete the entries on the left side of the screen.
6. On the right side of the screen, change **Redund Mode** set to DUAL BUS.
7. Change the entry for **Paired GBC** to INTERNAL. Press the Enter key.
8. If the bus scan time will exceed 100mS, set **Switch Time** to 10S.
9. For **Dual GBC Addr**, enter the rack and slot number of the *other* Bus Controller of the pair.
10. When you are finished with the entries on this screen, press the ESC key to return to the rack configuration screen.

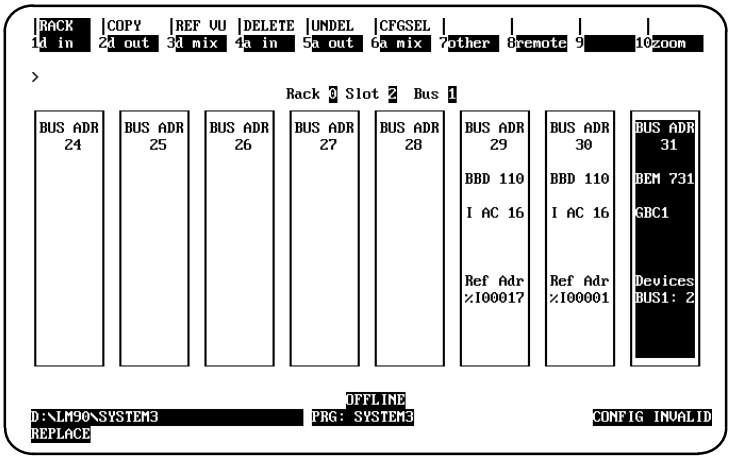


11. The rack configuration screen now includes *both* of the Bus Controllers, as illustrated at right (in this example, the other bus controller is in the same rack, but that is not necessary).
12. Zoom into the bus configuration screen for the first Bus Controller.



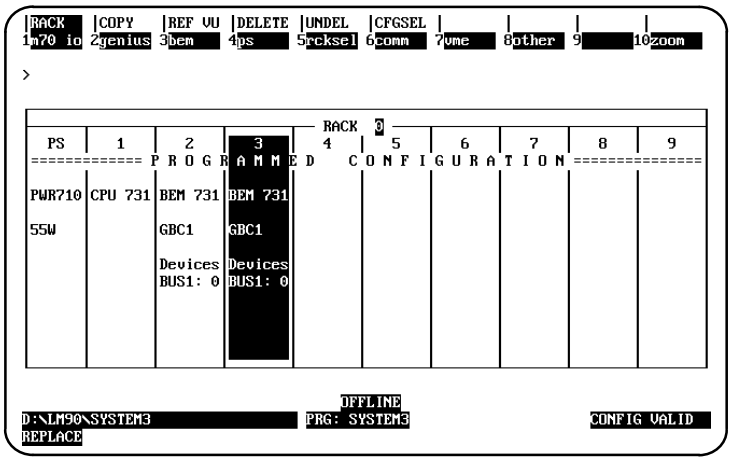
13. The Bus Controller appears at its configured Bus Address, 31 in this example.

14. Complete the Logicmaster configuration for the other Bus Addresses. Include all devices that are connected to both busses of the pair via bus switching devices. Set their **Redundancy** to YES. Also include any devices that are directly connected just to the portion of the bus that is controlled by this Bus Controller. Set their **Redundancy** to NO. In this example, there are two discrete I/O blocks. The one at Bus Address 30 is set for NO redundancy, while the one at Bus Address 31 is set for YES.



15. Press the ESC key to return to the rack display.

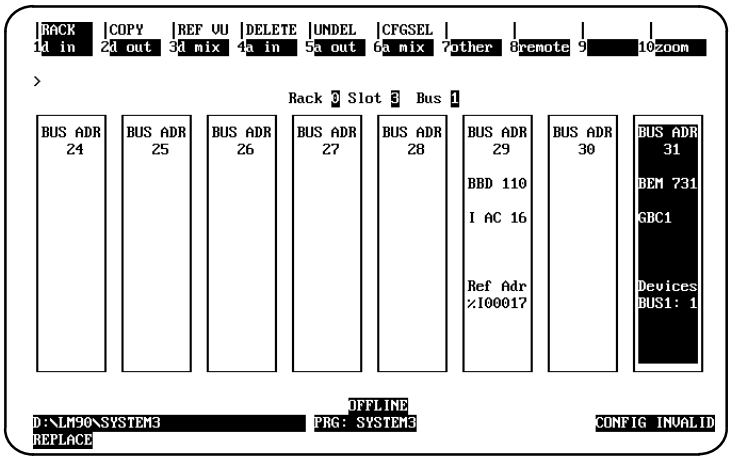
16. Zoom into the bus configuration screen for the second Bus Controller.



17. Notice that, by default, the second Bus Controller has the same Bus Address as the first. This could be changed on the second Bus Controller's configuration screen. However, it is usually preferable for the pair of Bus Controllers to have the same Bus Address.

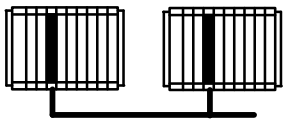
18. Notice also that the block configured for redundancy YES has automatically been added to the dual bus. The block configured for redundancy NO has not. Configure any non–redundant devices on this portion of the bus.

19. Press the ESC key to return to the rack display.

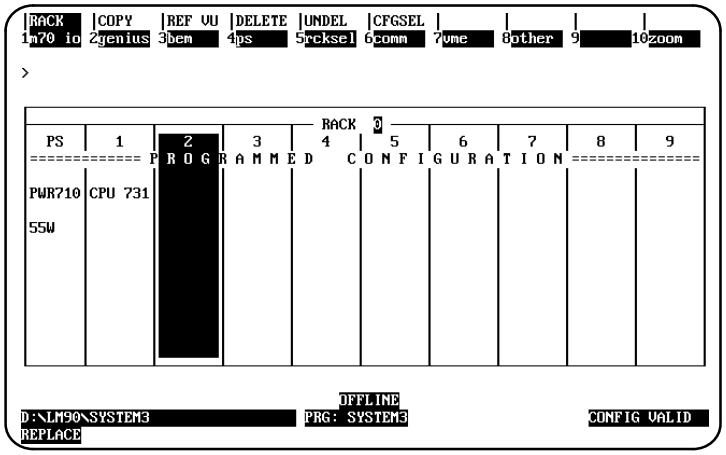


end of Example 3

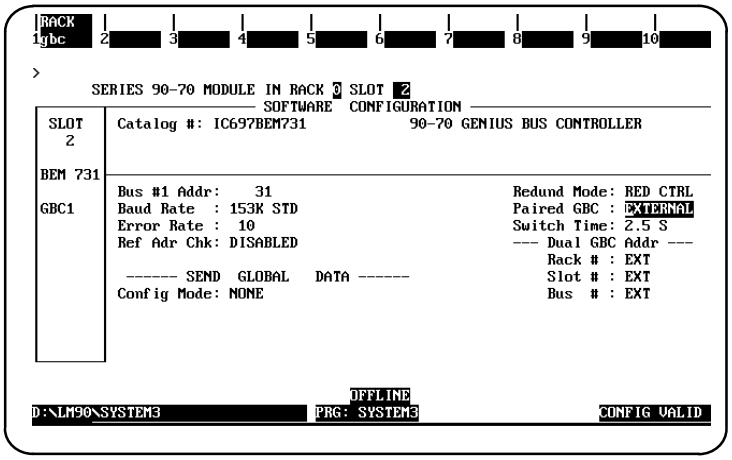
Bus Controller Configuration Example 4: Controller Redundancy Only, Bus Controllers in Two PLCs



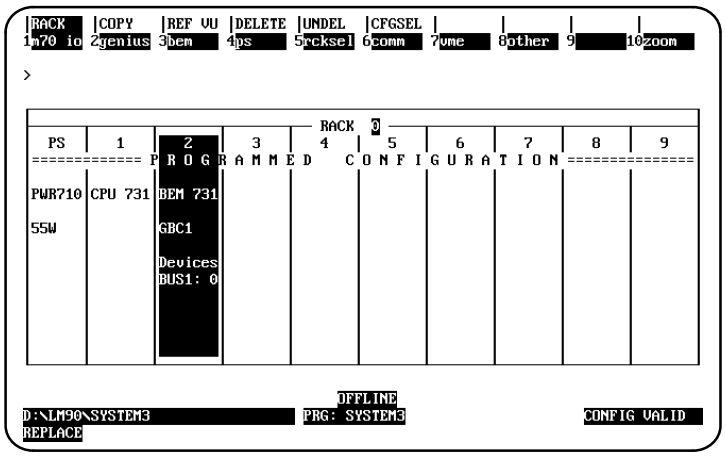
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



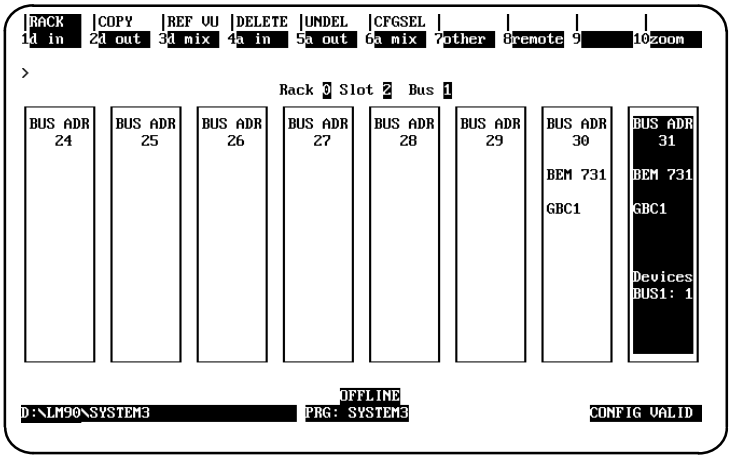
5. Complete the entries on the left side of the screen. The Bus Address (**Bus #1 Addr**) of the Bus Controller must be either 31 (as shown here) or 30.
6. On the right side of the screen, change **Redund Mode** set to RED CTRL (redundant controllers).
7. Set **Paired GBC** to EXTERNAL.
8. When you are finished with the entries on this screen, press the ESC key to return to the rack configuration screen.



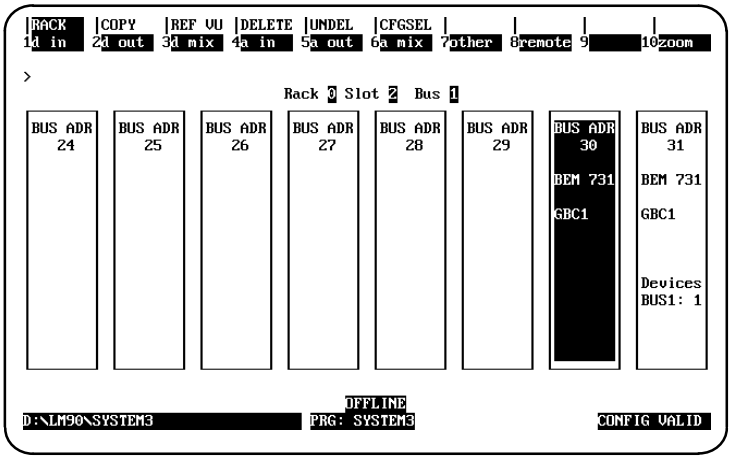
9. The Bus Controller appears on the rack configuration screen.
10. From this screen, you can zoom into the bus configuration screen.



11. The Bus Controller appears at its configured Bus Address, 31 in this example. The other Bus Controller automatically appears next to it.



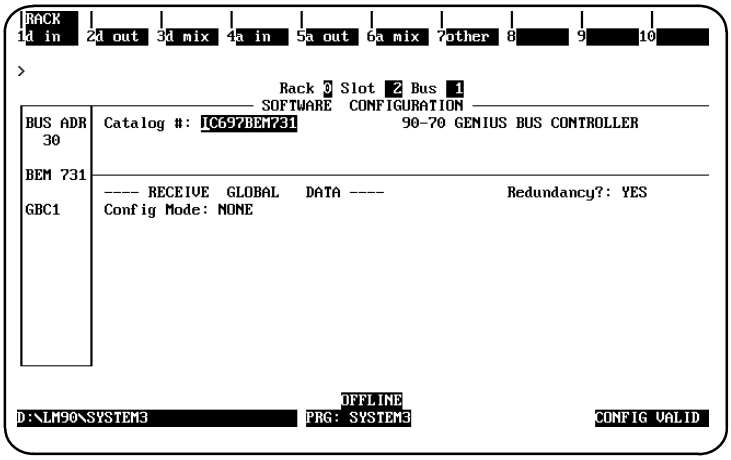
12. If the two Bus Controllers will exchange Global Data, select the other Bus Controller and press F10 (zoom) A configuration screen appears.



13. Enter the Global Data parameters.

14. Press ESC to return to the bus configuration screen.

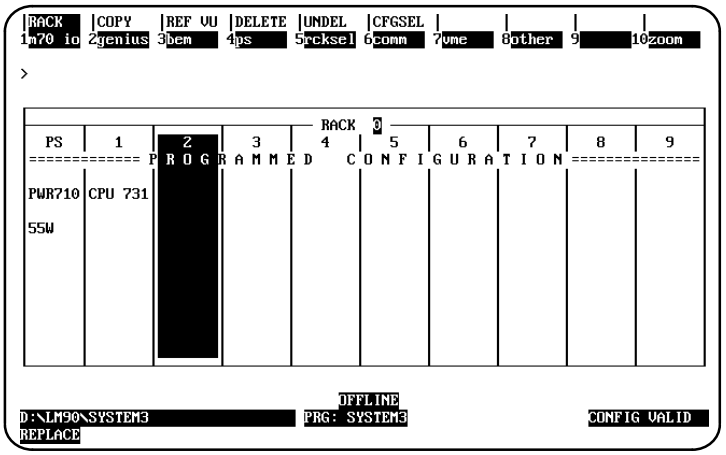
Repeat these steps for the other Bus Controller, when configuring its PLC.



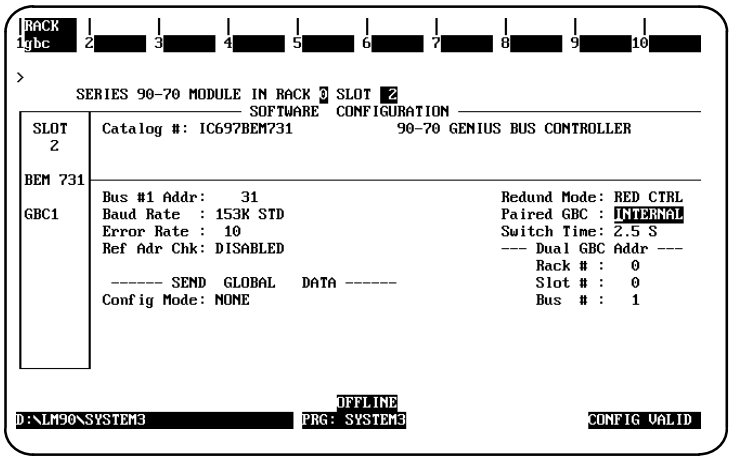
end of Example 4

Bus Controller Configuration Example 5: Controller Redundancy Only, Bus Controllers in the Same PLC

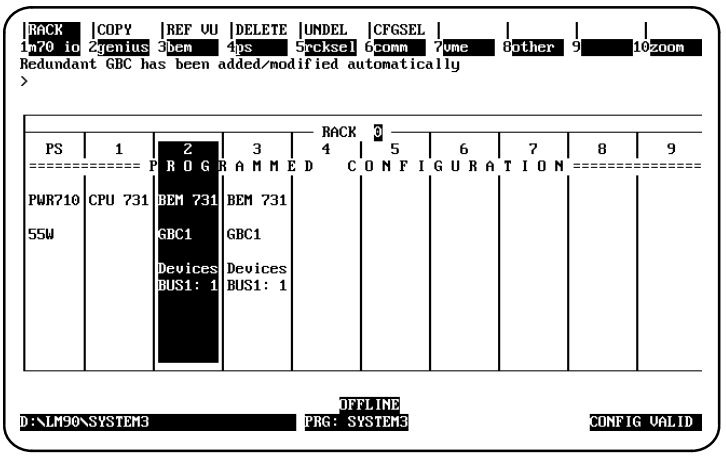
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



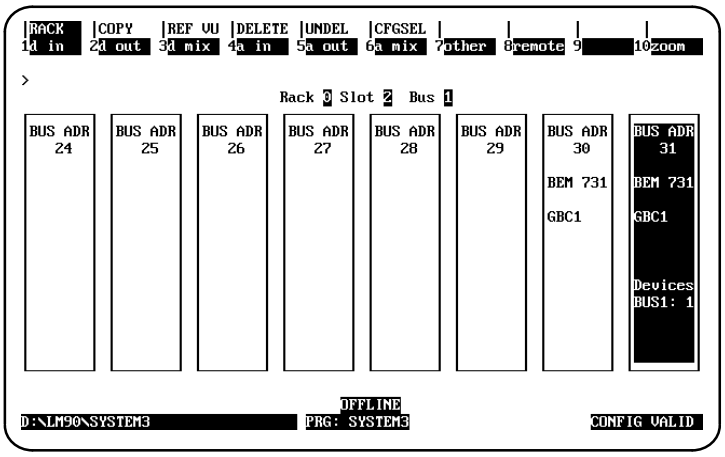
5. Complete the entries on the left side of the screen. The Bus Address of the Bus Controller must be either 31 (as shown here) or 30.
6. On the right side of the screen, change **Redund mode** set to RED CTRL (redundant controllers).
7. Set **Paired GBC** to INTERNAL.
8. For **Dual GBC Addr**, enter the rack and slot number of the *other* Bus Controller of the pair.
9. When you are finished with the entries on this screen, press the ESC key to return to the rack configuration screen.



10. *Both* of the Bus Controllers now appear on the rack configuration screen. In this example, they are in the same rack, as shown as right, but that is not necessary. Each now appears as a configured device on the bus of the other (**BUS1 : 1**).
11. Zoom into the bus configuration screen for the first Bus Controller.

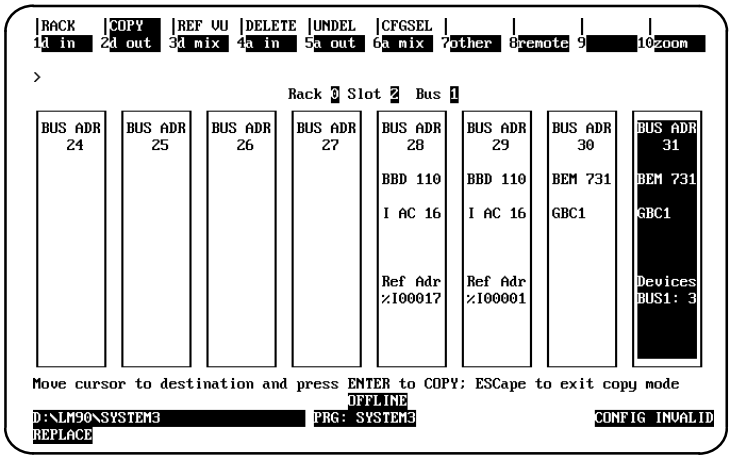


12. The bus configuration screen also includes both of the Bus Controllers, as shown as right. From this screen, you can configure the devices on the bus for the Bus Controller located in rack 0, slot 2, which is at Bus Address 31.

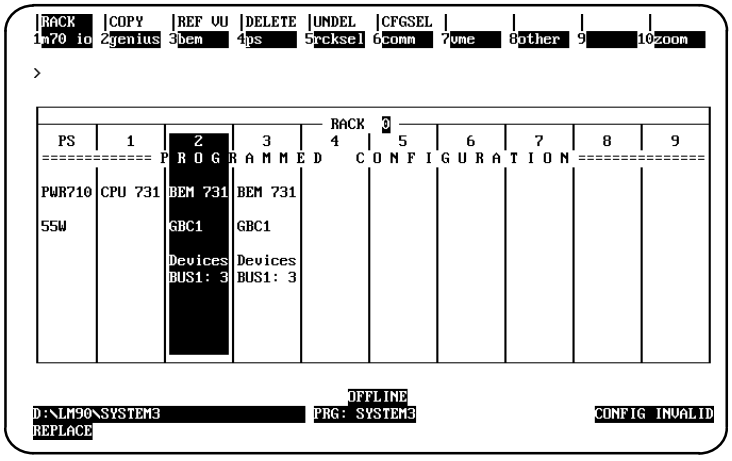


13. If the two Bus Controllers will exchange Global Data, select the other Bus Controller and press F10 (zoom) A configuration screen appears. Enter the Global Data parameters on the configuration screen. Press ESC to return to this bus configuration screen.

14. Configure the rest of the bus. In this example, discrete blocks are placed at Bus Addresses 29 and 28. They are configured for **redundancy** YES.

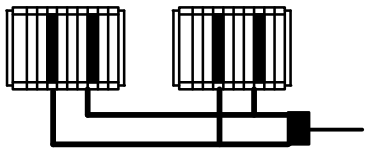


15. Press ESC to return to the rack display. Notice that each device configured for the first Bus Controller was copied to the bus of the second (**BUS1: 3**).

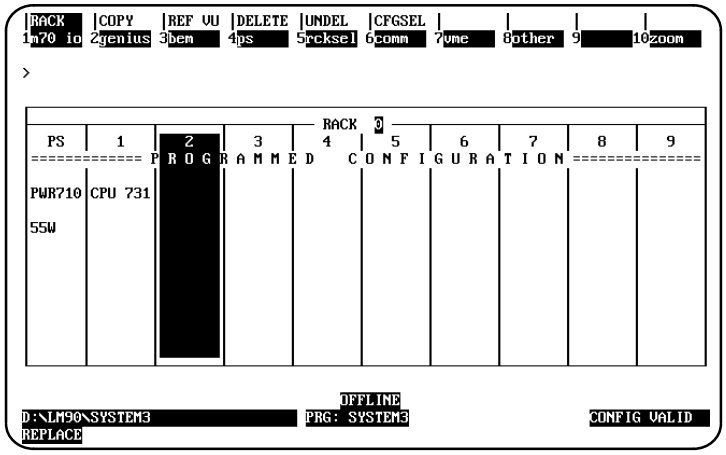


end of Example 5

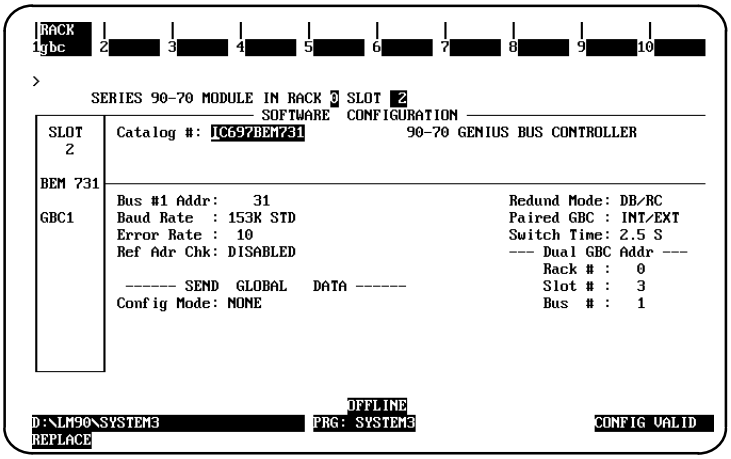
Bus Controller Configuration Example 6: Bus AND Controller Redundancy, Bus Controllers in Two PLCs



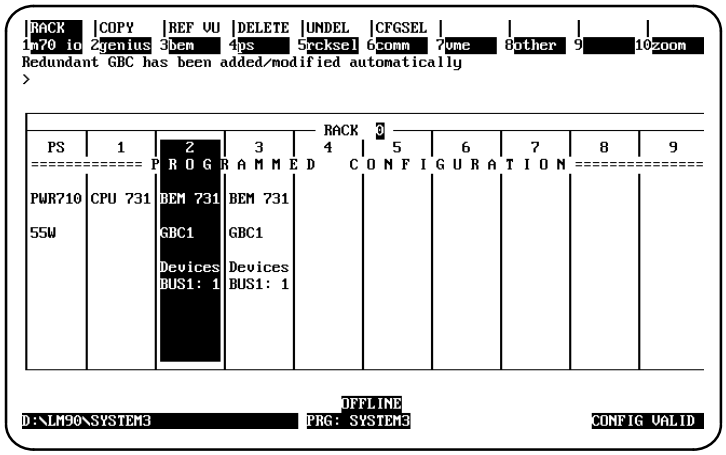
1. Select the rack and slot location for the Bus Controller.
2. Press F2 (genius).
3. From the Catalog # screen, press F1 (gbc).
4. From the Description screen, press Enter.



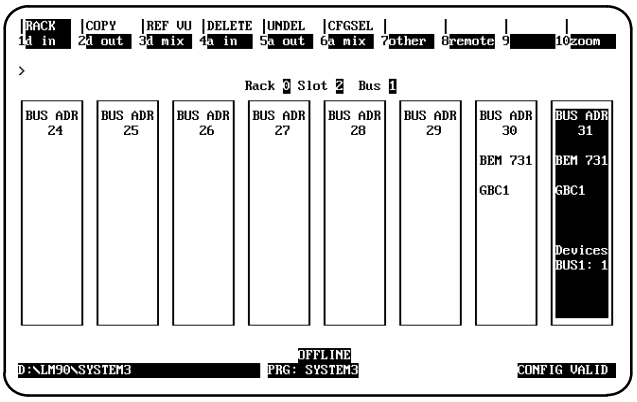
5. Complete the entries on the left side of the screen. The Device Number (**Bus #1 Addr**) of the Bus Controller must be either 31 (as shown here) or 30.
6. On the right side of the screen, change **Redund Mode** to DB/RC (dual bus, redundant controllers).
7. Set **Paired GBC** to INT/EXT (internal/external).
8. If the bus scan time will exceed 100mS, set **Switch Time** to 10S.
9. For **Dual GBC Addr**, enter the rack and slot number of the other Bus Controller of the internal pair.



10. When you are finished with the entries on the Bus Controller configuration screen, press the ESC key to return to the rack configuration screen, which now includes both internal Bus Controllers. *The two external Bus Controllers are part of the second PLC's configuration.*
11. Zoom into the bus configuration screen for the first Bus Controller.

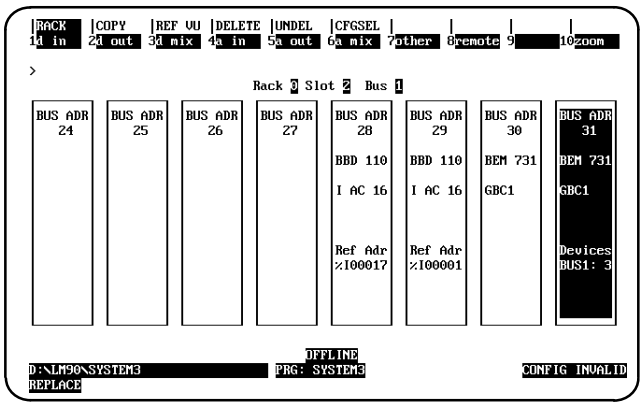


12. The bus configuration screen, as shown as right, includes two Bus Controllers. One, in this example the one at Bus Address 31, is the internal Bus Controller that was just configured. The second, here the one at Bus Address 30, is the Bus Controller in the other PLC.



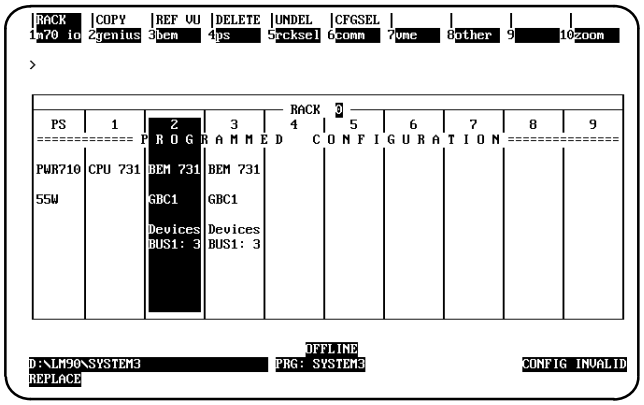
13. If the two Bus Controllers will exchange Global Data, select the other Bus Controller and press F10 (zoom) A configuration screen appears. Enter the Global Data parameters on the configuration screen. Press ESC to return to this bus configuration screen.

14. Configure the other Bus Addresses. Here, discrete blocks have been located at Bus Addresses 28 and 29.



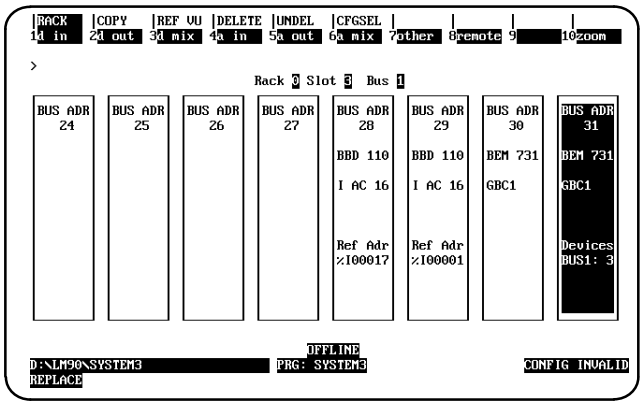
15. Press ESC again to return to the rack display.

16. From the rack configuration screen, select the other Bus Controller. Press F10 (zoom) to display its bus configuration screen.



17. Notice that this Bus Controller has the same Bus Address (31 in this example) as the other internal Bus Controller. The second Bus Controller shown here is the external Bus Controller.

18. Notice also that the redundant devices have been copied to this bus. If the Bus Controllers will exchange Global Data, zoom into the Bus Address of the external Bus Controller and enter its parameters.



end of Example 6

Chapter 4 Diagnostics

This chapter describes the following diagnostics capabilities of interest in Series 90–70 PLC systems that use Genius I/O and communications:

- Relevant system status references.
- Fault and No Fault Contacts, which can be used with program references or with the built–in fault–locating references.
- High Alarm and Low Alarm Contacts, which will indicate when an analog reference has reached one of its alarm limits.
- Display and clearing of Genius faults from the programmer I/O Fault Table. I/O Table faults related to the Bus Controller and Genius devices are listed at the end of the chapter.

For Additional Information, Also See:

Chapter 1 for an overview of Genius fault reporting.

Chapter 5, which describes the use of Read Diagnostics, Clear Circuit Faults, and Clear All Circuit Faults COMREQs (Communication Requests).

Chapter 6 to learn how the Bus Controller's redundancy capabilities can optionally be utilized to check its I/O and diagnostics data memory when it is not used with a dual bus or as a dual controller.

System Status References

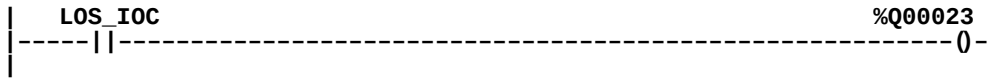
System status references are pre–defined locations and nicknames. They can be included in an application program to check for fault–related conditions. The following system status references are of special interest for a system with a Bus Controller:

Reference	Nickname	Conditions Indicated When Set
%SA0009	CFG_MM	System Configuration Mismatch
%SA0012	LOS_RCK	Loss of Rack
%SA0013	LOS_IOC	Loss of Bus Controller
%SA0014	LOS_IOM	Loss of I/O module
%SA0017	ADD_RCK	Addition of Rack
%SA0018	ADD_IOC	Addition of Bus Controller
%SA0019	ADD_IOM	Addition of I/O module
%SA0022	IOC_FLT	Bus fault or Bus Controller fault
%SA0023	IOM_FLT	I/O module fault
%SA0029	SFT_IOC	Bus Controller software failure
%SB0016	MAX_IOC	Too many Bus Controllers (maximum is 31)
%SC0011	IO_FLT	I/O fault occurred
%SC0013	IO_PRES	Fault logged into I/O Fault Table
%S00010	IO_FULL	I/O Fault Table is full

These references and their Nicknames can be used like any other type of reference. For more information, see the *Logicmaster 90 Software Reference Manual*.

Example:

A PLC system includes one Bus Controller. During CPU configuration, the system status fault **LOS_IOC** has been designated a diagnostic (rather than fatal) fault. **LOS_IOC** represents loss of the Bus Controller; if this occurs, the Loss of IOC fault will be placed in the I/O Fault Table. In this example, the application program also monitors the **LOS_IOC** reference. If this reference is set, the contact passes power flow to an output coil, which energizes a warning light on an operator panel.



Fault and No Fault Contacts

Fault and No Fault contacts can be used to detect fault or lack of fault conditions on a discrete (%I or %Q) or analog (%AI or %AQ) reference, or they can be programmed with the Series 90-70's built-in fault-locating references (see below). Unless they are used ONLY with fault-locating references, fault memory for their use must be set up using the CPU Configuration functions of the Logicmaster 90-70 software.

A Fault contact will detect a fault in a discrete or analog input or output, or a hardware component of the system. The contact passes power flow if the reference has a fault.

Example:

```
|   %AI0034                                                %M00053
|---[FAULT]-------------------------------------------------( )-
|
```

When used with a %I, %Q, %AI, or %AQ reference, a fault associated with the **–[F AULT]–** contact must be cleared to remove it from the fault table and stop the contact passing power flow. *Clearing such a fault with a Hand–held Monitor does not remove it from the fault table or stop the contact passing power flow.*

No Fault Contacts will also detect faults in discrete or analog inputs and outputs. A No Fault Contact passes power flow if its associated reference does not have a circuit fault.

Example:

```
|   %I00167                                                %Q00168
|---[NOFLT]-------------------------------------------------()-
|
```

Fault Locating References

Both Fault and No Fault contacts can be programmed with fault–locating references to identify faults associated with system hardware. These fault references are for informational purposes only. The PLC does not halt execution if one of these reference faults occurs. For a Genius device, the format of the fault–locating reference is **M_rsbmm**, where **r** is the rack number 0 to 7, and **s** is the slot number of the Bus Controller; **b** is the bus number, and **mm** is the Device Number (serial bus address) of the affected Genius device (00 to 31). For example, **M_46128** represents rack 4, slot 6, bus 1, module 28. For more information about fault–locating references, please refer to the *Logicmaster 90–70 Software User's Manual.*

High Alarm and Low Alarm Contacts

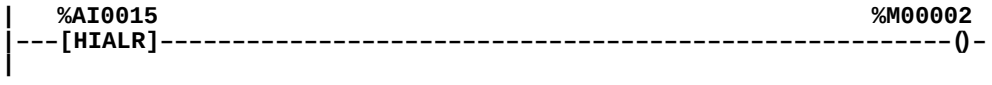
High Alarm and Low Alarm Contacts will indicate that an analog reference has reached one of its alarm limits. These alarm limits are established when a device is configured. If an alarm limit is reached, a block or Remote I/O Scanner sends the high alarm or low alarm message to the Bus Controller. Analog alarms are not considered fault conditions. This information is ignored by the Fault and No Fault contacts, as explained on the previous page.

Example

The analog input assigned to reference %AI00015 has been configured to have the following Alarm Limits:

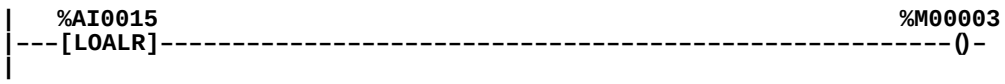
150ft/sec	High Alarm
25 ft/sec	Low Alarm

If the input exceeds a rate of 150 feet per second, a High Alarm contact energizes internal coil %M00002.



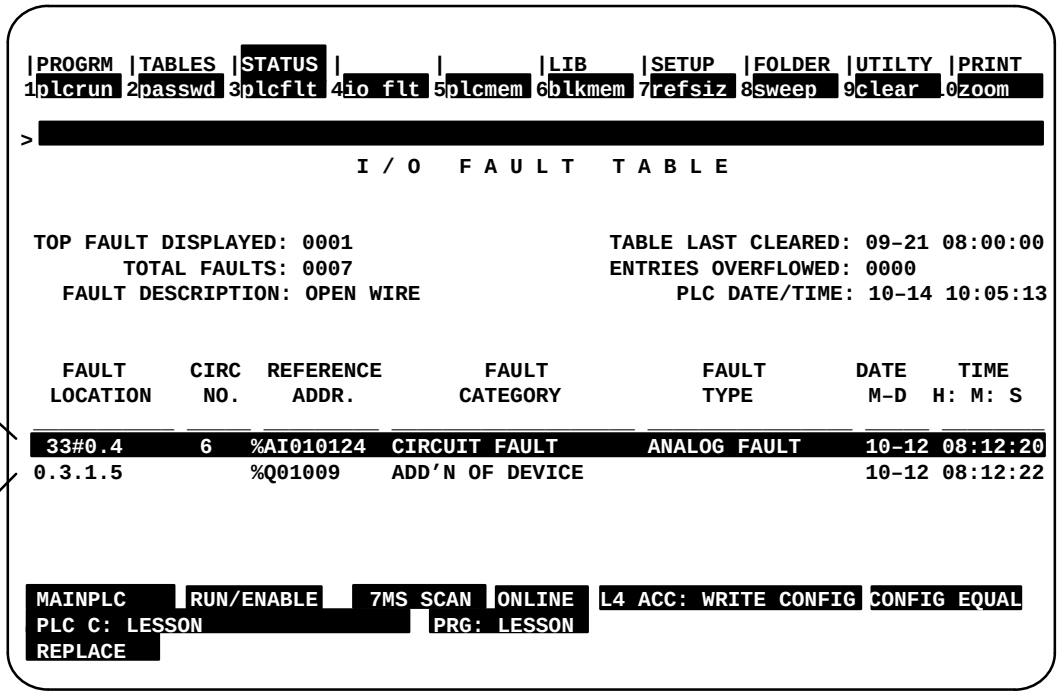
Example

If the same analog input slows to a rate of 22 feet per second, its Low Alarm contact energizes internal coil %M00003.



Fault Table

Faults and alarms from I/O devices, Bus Controller faults, and bus faults are automatically logged into the Series 90–70 PLC's I/O Fault Table. Faults can be displayed with the programmer in either On–Line or Monitor mode. The programmer must be in On–Line mode to clear faults (this feature may be password protected).



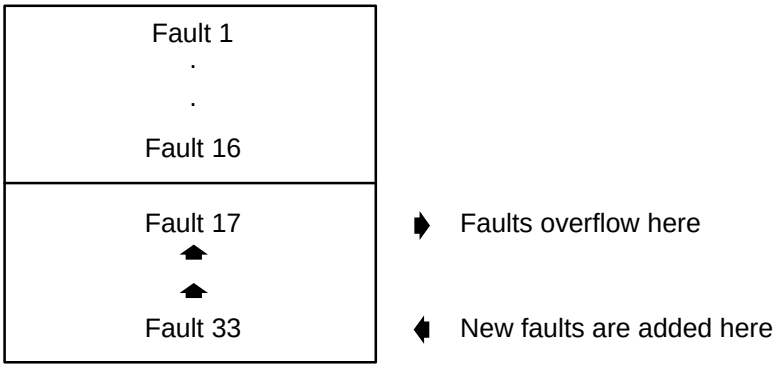
For a Genius bus fault, the display shows the date and time the fault occurred, and the following information:

Fault Location:	For a Genius bus fault, the format is: rack / slot / bus / bus address. For a Remote Drop fault, the format is: Drop ID# / rack / slot. See above.
Circ No:	The relative position of a point within its module.
Reference Addr:	The I/O reference address where the fault was detected. It consists of the memory type (%I, %Q, %IQ, %AI, %AQ) and a five–digit offset.
Fault Category:	The general type of fault that has occurred. For diagnostic faults, the CPU sets fault references. For fatal faults, the CPU sets fault references and places itself in STOP mode.
Fault Type:	Further explains fault categories: Circuit Fault, Module Fault, I/O Bus Fault, Loss of Block, and GBC Software Exception. See the table on pages 58–61.
Fault Description:	Provides additional information if the highlighted fault is one of the Circuit Faults or a Module Fault. See the table on pages 58–61.

Number of Faults in the I/O Fault Table

The I/O Fault Table can contain up to 32 faults. Additional faults cause the table to overflow, and faults are lost. The system reference **IO_FULL** (%S00010) is set to indicate that the fault table is full.

As faults occur, the first 16 are logged into the table and remain there until the table is cleared again; none of these 16 faults will be dropped if the table overflows. For faults 17 through 32, the Fault Table operates as a First–In–First–Out stack. When fault 33 occurs, fault 17 is dropped from the table. Clearing the Fault Table removes all the fault listings.



Clearing Faults

You must clear the I/O Fault Table from Logicmaster 90 for the fault to be cleared in the PLC CPU and for the associated fault contact to be cleared. *Clearing faults with a Hand–held Monitor alone does not remove them from the Fault Table, or cause any associated* **–[FAULT]–** *contacts to stop passing power flow.*

Clearing the Fault Table causes the Bus Controller to send a Clear All Circuit Faults background message to all blocks on the bus. Faults can be cleared from the Fault Table either from the programmer screen or by the application program.

Clearing the fault table removes the faults it contains; it does not clear fault conditions in the system. If the condition that caused a fault still exists and is detected, the fault will be reported again.

Removing I/O Force Messages from the I/O Fault Table

When a point is forced on a Genius block with a Hand–held Monitor, a fault is registered in the Series 90 I/O Fault Table. Subsequent forces on the same block do not generate additional messages. Only when *all* forces are removed from the block does the Bus Controller log an Unforce message in the I/O Fault Table.

Loss of Device Faults Caused by High Bus Error Rate

If the bus is experiencing a high error rate (possibly due to electrical interference or damaged cable), Loss of Device faults may be logged into the Fault Table. Loss of Device faults that are logged in conjunction with I/O Bus Faults can be usually be attributed to the poor quality of the bus installation. The condition causing the bus errors should be corrected as soon as possible.

Fault Table Definitions

Fault Category	Diag. or Fatal	Indicates	Fault Type	Indicates	Fault Description	Indicates
CIRCUIT FAULT	D	Short circuit, open wire, etc.	DISCRETE FAULT	Circuit fault on discrete I/O point	LOSS POWER	Loss of user side power
					SHORT CIRCUIT	Short in user wiring
					OVERLOAD	Sustained overcurrent
					NO LOAD	Very low or no current flow
					OVER TEMP	Switch temperature too high
					SWITCH FAIL	Genius "smart switch" failure
					POINT FAULT	Integral individual point fault
					FUSE BLOWN	Integral output fuse blown.
			ANALOG FAULT	Fault on analog I/O channel	AI LOW ALARM	Input channel low alarm
					AI HI ALARM	Input channel high alarm
					AI UNDER RANGE	Input channel under range
					AI OVER RANGE	Input channel over range
					OPEN WIRE	Open wire detected on input channel
					AQ UNDER RANGE	Output channel under range
					AQ OVER RANGE	Output channel over range
					CS FEEDBACK ERR	Feedback error from Current–source Analog block
			GENA FAULT	Fault on a GENA	GENA CKT FLT	Fault on a GENA analog or discrete point
			LL ANALOG FAULT	Fault on a low–level analog channel	AI LOW ALARM	Input channel low alarm
					AI HI ALARM	Input channel high alarm
					AI UNDER RANGE	Input channel under range
					AI OVER RANGE	Input channel over range
					OPEN WIRE	Open wire detected on input channel
					WIRING ERROR	improper RTD connection or thermocouple reverse junction fault
					INTERNAL FAULT	Cold junction sensor fault on thermocouple block, or internal error in RTD block.
					INPUT SHORT	Input channel shorted
			REMOTE FAULT	Fault on a Remote I/O Scanner	n/a	Any fault detected by a Remote I/O Scanner and sent to the PLC.

Fault Table Definitions *(continued)*

Fault Category	Diag or Fatal	Indicates	Fault Type	Indicates	Fault Description	Indicates
LOSS OF DEVICE	D	Block no longer responding. See page 58.	NOT SPEC FAULT	No reason specified		
			AD COMM FAULT	Loss of A / D communications.		
ADDITION OF DEVICE	D	New block appeared				
GENIUS BUS SWITCH	D	Redundant bus switched				
I/O BUS FAULT	D	Genius bus fault	BUS FAULT	Genius bus fault		
			BUS OUT DISABLE	Bus Controller disabled all outputs on the bus because communications timed out between the PLC CPU and the Bus Controller.		
			SBA CONFLICT	Bus Controller's Device Number duplicated elsewhere on bus.		
I/O MODULE FAULT	D	EEPROM fault, watch dog timeout	HEADEND FAULT	Block Fault (EEPROM, Watchdog, etc..)	CONFIG MEM FAIL	Genius EEPROM or NVRAM failure
					CAL MEM FAIL	Genius calibration memory failure
					SHARE RAM FAIL	Genius Shared RAM fault
					INTRNAL CKT FLT	Genius internal circuit fault
					WD TIMEOUT	Watchdog Timeout (discrete I/O modules only)
					POINT FAULT	Point fault (also indicated for CIRCUIT FAULT category)
					FUSE BLOWN	Integral output fuse blown (also indicated for CIRCUIT FAULT category)
			A TO D COMM FAULT	Analog to digital communications fault or calibration error		
			USER SCALING ERROR	Scaling error cause out of range values		

Fault Table Definitions *(continued)*

Fault Category	Diag. or Fatal	Indicates	Fault Type	Indicates	Fault Description
ADDITION OF IOC	D	Addition of Bus Controller			
LOSS OF IOC	F*	Loss of or missing Bus Controller			
BUS CONTROL-LER SOFTWARE FAULT	F *	Bus Controller software fault			
FORCED CIRCUIT	D	Genius I/O point forced (eg: from Hand–held Monitor)			
UNFORCED CIRCUIT	D	Last forced circuit released (eg: from Hand–held Monitor)			
EXTRA DEVICE	D	Found extra device on Genius bus			
EXCESSIVE FAULTS	D	Bus Controller has stopped reporting faults because too many have oc-curred	HIGH ERROR RATE	Bus Controller has dropped off the bus for at least 1.5 seconds.	
GBC SOFTWARE EXCEPTION	D	Bus Controller software exception	DG QUEUE FULL	Incoming datagram queue is full	
			RW QUEUE FULL	The queue for Read / Write requests in the Bus Con-troller is full. The requests may be from the Genius bus or from COMREQs.	
			LP MAIL REJECTED	The low–priority mail queue from the Bus Con-troller to the PLC is full. The response to the PLC was lost.	

* May be configured as (D)iagnostic, *particularly in a redundant system.*

Additional Fault Information

If you need more information about a listing in the Fault Table, move the cursor to that fault and press the CTRL and F keys. A number string will appear above the command line. The *Series 90–70 PLC Installation and Operation Manual* (GFK–0262, version C or later) explains how to interpret this additional fault information.

Chapter 5 Communication Requests

This chapter explains how to use Communication Requests to:

- Pulse Test outputs on Genius blocks
- Read the configuration of a device on the bus, or the Bus Controller
- Write configuration data to a device on the bus or a Bus Controller
- Assign a device on the bus to monitor fault reports from Genius blocks
- Clear a circuit fault on the bus
- Clear all faults on the bus
- Switch a Bus Switching Module
- Read diagnostics (faults) from a device on the bus or the Bus Controller
- Read up to 64 words of data from a device on the bus
- Write up to 64 words of data from the CPU to a device on the bus
- Enable / disable all outputs from the Bus Controller to devices on the bus
- Enable / disable the Bus Controller's ability to receive or transmit Global Data
- Enable / disable I / O fault categories
- Send a datagram to a device on the bus.
- Send a datagram to a device which then sends a reply datagram.
- Transfer an unsolicited incoming datagram from the Bus Controller to the CPU.

For Additional Information, Also See:

The *Genius I/O System and Communications Manual* (GEK–90486–1), which describes Genius Datagrams in detail.

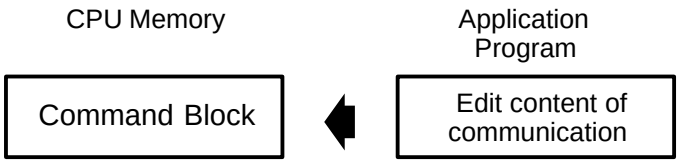
COMREQs and Passwords

Level 1 and 2 Logicmaster passwords, which prevent write access, cannot be used in applications that include COMREQs. COMREQs require write access to return their completion status.

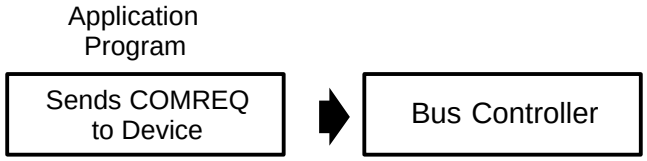
Programming for a Communication Request

In order to communicate with an intelligent module (such as a Bus Controller), the application program should perform the following three actions.

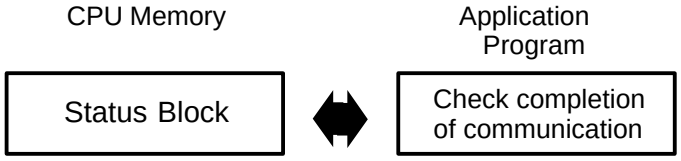
First, the program must supply the content of the communication. Block Moves or similar program instructions can be used to place the information into CPU memory. This content is called the Command Block.



Second, the program must use a COMREQ instruction to perform the intended function.



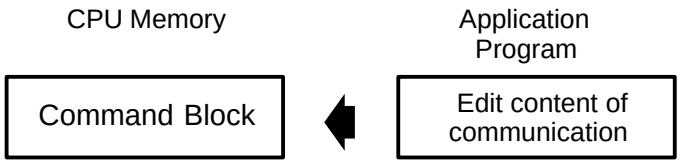
Third, the program should check the status of the requested task by looking at an area of CPU memory that is referred to as the Status Block.



COMREQs should be executed sequentially. The application program should check the status of the previous COMREQ to a Bus Controller before sending it another one. Failure to do this may result in improper operation of the Bus Controller.

COMREQ Command Block Format

The first step in programming communications requests is to set up the contents of the communication. This can be done using Block Moves or similar program instructions, as shown later in this chapter.



Data is placed together in adjacent locations in CPU memory to form a Command Block.

Location	Data
address	"Data Block" Length
address + 1	Wait / NoWait Flag
address + 2	Status Pointer Memory Type
address + 3	Status Pointer Offset
address + 4	Idle Timeout Value
address + 5	Max. Communication Time
address + 6 to address + 70	Data Block

The length of the Command Block depends on the type of COMREQ being sent. 70 words is the maximum, for a COMREQ that transfers a 128–byte datagram; most Command Blocks are much shorter. A table on page 67 gives an overview of the contents of each type of COMREQ that may be sent to a Series 90–70 Bus Controller.

Command Block Contents

Command Block contents are described below:

Length: The first word of the Command Block indicates the "data block" length. This is the amount of data from **[address + 6]** to the end of the Command Block Each type of COMREQ command has a unique Data Block, as shown in this chapter.

Wait/No Wait Flag: This must be set to 0 for No Wait.

Status Pointer Memory Type: The Status Pointer Memory Type and Offset (see below) identify the location of the function's associated Status Block. The Status Block is where the COMREQ will return its status. If one of the bit–oriented memories (%I or %Q) is used as the status location, its bits can be monitored (see page 71).

Location	Data
address + 1	Status Pointer Memory
address + 2	Status Pointer offset

The high byte of address + 2 of the pointer is not used; it must be zero.The low byte of address + 2 specifies the type of memory where the Status Pointer will be located.

For This Memory Type:		Enter This Number:
%I	discrete input table	70
%Q	discrete output table	72
%R	register memory	8
%AI	analog input table	10
%AQ	analog output table	12

Status Pointer Offset: Address + 3 of the Command Block contains the address within the memory type selected. The offset of the status location is 0–based. For example, if the Status Block were located at %R099, memory type would be specified as 08 (for %R memory) and the offset would be 98.

Idle Timeout Value: This field is not used for the No Wait mode of communication.

Maximum Communication Time: This field is not used for the No Wait mode of communication.

Data Block: The Data Block contains the parameters of the command. Complete descriptions of all commands appear later in this chapter. The Data Block begins with a Command Number in Address +6. The Command Number identifies the type of communications function to be performed. The following Command Numbers are used for the Genius Bus Controller:

Command	Function
1	Pulse Test Outputs
2	Read Configuration
3	Write Configuration
4	Read Diagnostics
5	Clear Circuit Fault
6	Clear All Circuit Faults
7	Assign Monitor
8	Outputsenable / disable
9	Global Data enable / disable
10	Switch BSM
11	Read Device
12	Write Device
13	Dequeue Datagram
14	Send Datagram
15	Request Datagram Reply
16	I / OFault Categoryenable / disable

Commands 14 and 15 are used to send Datagrams. Most of the other commands listed above can also be sent as datagrams. For more information, see page 74.

Command Block Quick Reference

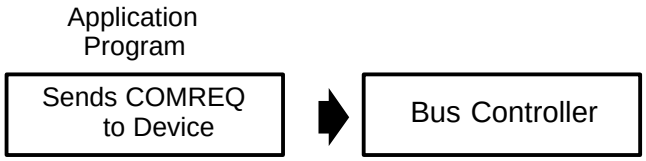
This table summarizes the content of the COMREQ commands for a Bus Controller.

COMREQ Description	Command Block Content									
	Add.	**Add. +1**	**Add.+ 2**	**Add.+ 3**	**Add.+ 4**	**Add.+ 5**	**Add.+ 6**	**Add.+ 7**	**Add.+ 8**	**to Add.+ n**
	Length	**Wait/ No Wait**	**Status Pointer Memory Type**	**Status Pointer Offset**	**Idle Timeout Value**	**Max. Comms. Time**	**COM-REQ #**	**Additional Content**		
Pulse Test	2	0	”	”	0	0	1	Device SBA*		
Read Configuration	5	”	”	”	”	”	2	Add.+7 to Add.+10: see page 76		
Write Configuration	data length +3	”	”	”	”	”	3	Add.+7 to Add.+n: see page 77		
Read Diagnostics	5	”	”	”	”	”	4	Add.+7 to Add.+n: see page 78		
Clear Circuit Fault	3	”	”	”	”	”	5	Device SBA*	circuit number	
Clear All Circuit Faults	2	”	”	”	”	”	6	”		
Assign Monitor	3	”	”	”	”	”	7	”	Monitor SBA* (0–13)	
Outputs Enable, Disable	0	”	”	”	”	”	8	”	1 (enable) or 0 (disable)	
Global Data Enable, Disable	3	”	”	”	”	”	9	”	”	
Switch BSM	3	”	”	”	”	”	10	”	0 (bus A) or 1 (bus B)	
Read Device	16	”	”	”	”	”	11	Add.+7 to Add.+21: see page 85		
Write Device	13 to 77 words	”	”	”	”	”	12	Add.+7 to Add.+n: see page 90		
Dequeue Datagram	7	”	”	”	”	”	13	Add.+7 to Add.+12: see page 91		
Send Datagram	6 to 70 words	”	”	”	”	”	14	Add.+7 to Add.+n: see page 94		
Request Datagram Reply	10 to 78 words	”	”	”	”	”	15	Add.+7 to Add.+n: see page 97		
I/O Faults Enable, Disable	3	”	”	”	”	”	16	Device SBA*		

* Serial Bus Address (Device Number)

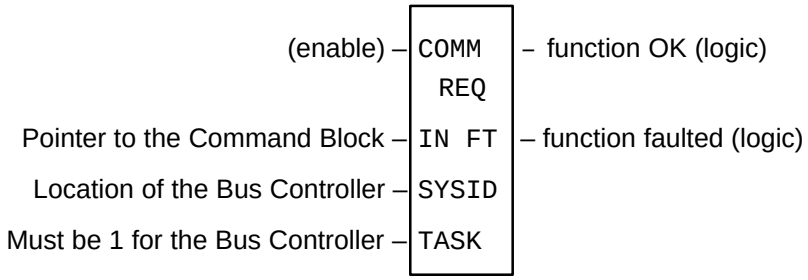
The COMREQ Instruction

After supplying the content of the communication in the Command Block, the application program uses a COMREQ instruction to request communications with the Bus Controller.



COMREQ Inputs and Outputs

The COMREQ instruction has four inputs and two outputs:



COMREQ Inputs

(enable) Permissive logic that controls power flow to the COMREQ function block.

IN: The memory location of the Command Block, which contains the specific command information. The Command Block may be located in any word–oriented area of memory (%P, %L, %R, %AI, or %AQ).

SYSID: A hex value that gives the rack and slot location of the Bus Controller. Use this format:

Examples

Rack	Slot	Hex word value
0	4	0004h
7	2	0702h

TASK: For Bus Controller version IC697BEM731, the task is always “1”.

COMREQ Outputs

The function’s OK and FT outputs can provide power flow to optional logic which can verify successful completion of the COMREQ. The OK and FT outputs may have these states:

ENable	Error?	OK output	FT output
active	no	true	false
active	yes	false	true
not active	no execution	false	false

The OK and FT outputs are never both true at the same time; OK indicates correct execution while FT indicates a fault condition. The COMREQ passes power flow to OK unless:

- The specified Device Number (serial bus address) is not present.
- The specified task is not valid for the device. This is not checked if the specified device is a Genius Bus Controller.
- The data length is zero.

If any fault above occurs, the function passes power flow to FT instead.

If there are errors in the portion of the Command Block used specifically by the Bus Controller (for example, the Device Number entered is incorrect), these errors are reflected in the value returned in the status location, not in the FT output.

COMREQ Status Block

When the Bus Controller receives the communication from the CPU, it returns its current status to the CPU, at the memory location reserved for that purpose. This memory location is referred to as the "Status Block". Possible status values that may be returned are listed on the next page.

When a command is complete, the Bus Controller writes any resulting data into the area designated in the command, and sets the status to Complete (4).

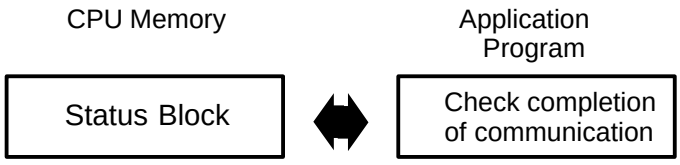
Note

Because COMREQs require write access to return their status, level 1 and 2 Logicmaster software passwords, which prevent write access, cannot be used with COMREQs.

If one of the bit–oriented memories (%I or %Q) is used as the status location, its bits can be monitored. These bits correspond to the binary values listed below. For example, if %I048 were selected as the beginning location, reference %I050 would be set to 1 each time the COMREQ completed successfully.

Clearing the Status Block

COMREQs to the Bus Controller should be executed sequentially. Before sending a COMREQ to the Bus Controller, the application program should check the status of any previous COMREQ to that Bus Controller.



When the previous COMREQ has completed, the program should set the Status Block to a value not in the list on the next page. Establishing this initial condition allows the program to differentiate between the result of an earlier command and the currently–executing command.

Contents of the Status Block

The Status Block is two words of memory to which the Bus Controller returns the status of the COMREQ.

The lower word is used for general information about the execution of the COMREQ:

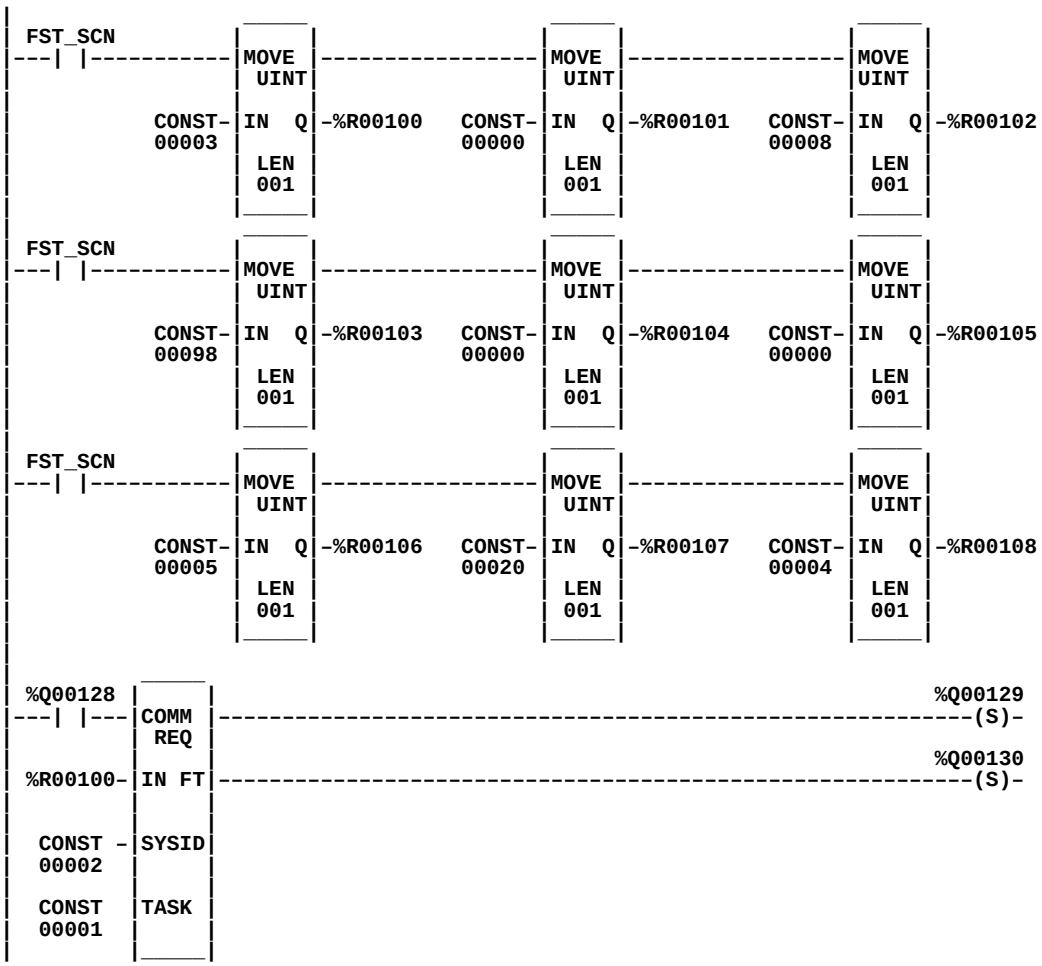
VALUE		DESCRIPTION
decimal (word)	binary (bit)	
	MSB	
0	000000000000	Bus Controller busy
1	000000000001	Command not accepted, Bus Controller busy with previous request
4	000000000010	Command completed successfully
8	000000001000	Command terminated due to syntax error
16	000000010000	Command terminated due to data error
32	000000100000	Command terminated due to suspended activity on bus
64	000001000000	No data to transfer
128	000010000000	Command not supported by target device
256	000100000000	Only No Wait commands may be sent to the target device
512	001000000000	Maximum Comms. Time must be greater than or equal to 5mS
1024	010000000000	Text buffer invalid in wait mode
2048	100000000000	Device did not accept the message, or timed out.

The upper word of the status location provides additional status information.

VALUE decimal (word)	DESCRIPTION
11	Non–discrete block specified for Pulse Test
21	Non–I / O device specified for Read Configuration
51	Invalid circuit number
71	Non–controller device specified for Assign Monitor
101	Switch BSM – device not BSM
102	Switch BSM – bus position greater than 1
121	P and L access not available
141	Function code greater than 111
142	Sub function code greater than 255
143	Priority greater than 1
144	Datagram length greater than 134
201	Invalid Device Number (greater than 31, but not 255)
202	Incorrect length for the command type
203	Device Number not configured or not active
204	Previous No Wait command in progress; current No Wait command not accepted
205	Invalid status pointer location specified
206	Command number is out of range
207	Subcommand code is out of range
208	Only partial data transferred
209	Device Number 255 not allowed for this command
210	Command specified is not valid for Genius Bus Controller
211	Command specified is only valid for controller devices
212	Command specified is not supported by the device to which it was sent
213	Invalid Alarm Enable / Disable mask

Programming Examples

The following example shows how a Communication Request can be used to clear a circuit fault on point 4 of a Genius I/O block whose Device Number is 20.

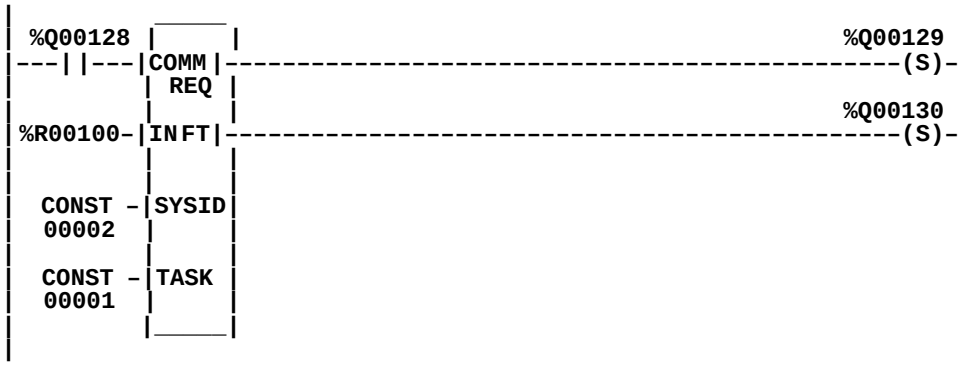


This example logic uses a series of Move instructions to assemble the data that will be used as inputs for the Communication Request instruction, and for its associated Command Block.

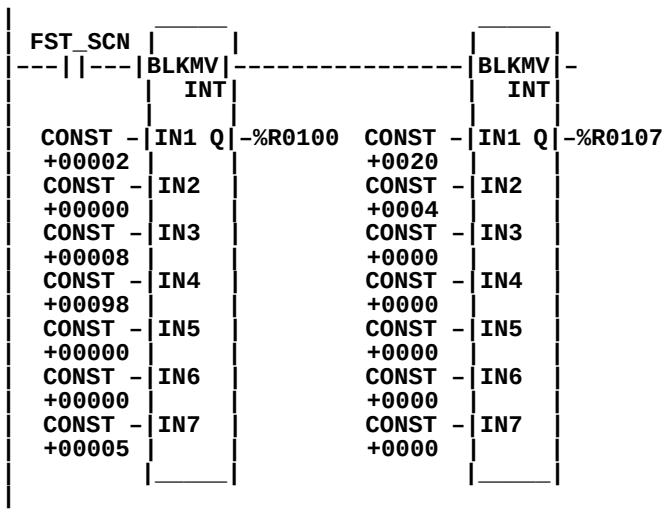
Address	Contents	Value	Description
%R100	Command length	3	No wait
%R101	Wait / NoWait Flag	0	Selects %R memory type
%R102	Status Pointer Memory	08	Address in %R memory (%R099)
%R103	Status Pointer Offset	98	Unused (No Wait selected)
%R104	Idle Timeout Value	0	Unused (No Wait selected)
%R105	Max.CommunicationTime	0	Clear Circuit Fault
%R106	Command Number	5	Device Number of the block
%R107	Device Number	20	Clear 4th point on block (For a COMREQ, points
%R108	Point to be cleared	4	are numbered starting at 1 (not 0). If this were a datagram message instead of a COMREQ command, points would begin at 0).

The Move instructions are executed during the first CPU sweep, when the special reference **FST_SCN** is true. This assures that the Communication Request will never be executed with incomplete or incorrect parameters.

The example uses the reference %Q128 as a permissive to the Communication Request. Output %Q129 is set if the Communication Request executes successfully. If it does not, output %Q130 is set instead. For the Communication Request, failure might occur if the Communication Request has been set up incorrectly, or for any of the other errors specified in the beginning of this chapter. A fault output is NOT caused by failure to receive a reply. This must be detected from the contents of the status location.



Another way to assemble the data for the example Command Block would be to use a Block Move instruction:



COMREQs and Datagrams

The table below lists datagrams with their Subfunction Codes, shows the best ways to send datagrams, and explains what happens to datagrams received from other devices.

Datagram (hex code)	Ways to Send It	How Incoming Datagram is Handled
Read ID (00)	COMREQ 15 (Request Datagram Reply) *	Bus Controller replies automatically to Read ID datagram received from bus device.
Read ID Reply (01)	(Sent automatically)	Handled automatically if COMREQ 15 was used to send Read ID datagram. *
Read Configuration (02)	COMREQ 2 (Read Configuration) COMREQ 15 (Request Datagram Reply) *	Bus Controller ignores it.
Read Configuration Reply (03)	(Sent automatically)	Handled automatically if COMREQ 2 or 15 was used to send Read Configuration datagram. *
Write Configuration (04)	COMREQ 3 (Write Configuration) COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Assign Monitor (05)	COMREQ 7 (Assign Monitor) COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Begin Packet Sequence(06)	COMREQ 14 (Send Datagram)	Bus Controller ignores it.
End Packet Sequence (07)	COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Read Diagnostics (08)	COMREQ 4 (Read Diagnostics) COMREQ 15 (Request Datagram Reply) *	Bus Controller replies automatically.
Read Diagnostics Reply (09)	(Sent automatically)	Handled automatically if COMREQ 4 or 15 was used to send Read Diagnostics datagram. *
Write Point (0B)	COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Read Block I / O (0C)	COMREQ 15 (Request Datagram Reply) *	Bus Controller ignores it.
Read Block I / O Reply (0D)	(Sent automatically)	Handled automatically if COMREQ 15 was used to send Read Block I / O datagram. *
Report Fault (0F)	(Sent automatically)	Received from bus devices; Bus Controller automatically places the fault in the Fault Table.
Pulse Test (10)	COMREQ 1 (Pulse Test) *	Bus Controller ignores it.
Pulse Test Complete (11)	(Sent automatically)	Handled automatically if COMREQ 1 was used to send Pulse Test datagram. *
Clear Circuit Faults (12)	COMREQ 5 (Clear Circuit Fault) COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Clear All Circuit Faults (13)	COMREQ 6 (Clear All Ckt Faults) COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Switch BSM (1C)	COMREQ 10 (Switch BSM) COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Read Device (1E)	COMREQ 11 (Read Device) COMREQ 15 (Request Datagram Reply)	Bus Controller automatically sends reply.
Read Device Reply (1F)	(Sent automatically)	Handled automatically if COMREQ 11 or 15 was used to send Read Device datagram. *
Write Device (20)	COMREQ 12 (Write Device) COMREQ 14 (Send Datagram)	Bus Controller processes automatically.
Read Data (27)	COMREQ 15 (Request Datagram Reply)	Bus Controller ignores it.
Read Data Reply (28)	(Sent automatically)	Handled automatically if COMREQ 15 was used to send Read Data datagram. *
Write Data (29)	COMREQ 14 (Send Datagram)	Bus Controller ignores it.
Read Map (2A)	COMREQ 15 (Request Datagram Reply)	Bus Controller ignores it.
Read Map Reply (2B)	(Sent automatically)	Handled automatically if COMREQ 15 was used to send Read Map datagram.
Write Map (2C)	COMREQ 14 (Send Datagram)	Bus Controller ignores it.

* All datagrams can be sent using COMREQ 14 (Send Datagram). If COMREQ 14 is used to send a datagram that has a reply, COMREQ 13 (Dequeue Datagram) must also be used, to obtain the reply from the Bus Controller's queue of unsolicited incoming datagrams

COMREQ #1: Pulse Test Command

The Pulse Test command causes the Bus Controller to send a normal–priority Pulse Test datagram.

Pulse testing is used to verify the operation of outputs on discrete Genius I/O blocks. It checks whether the outputs will change state, and whether output circuits (wires, power sources, loads) will start or stop current flow. Any circuit faults generated by pulse tests are reported through the normal Report Fault message. Pulse testing is recommended for blocks that seldom change state. It is typically done once per hour, or once per shift; it should not be done more often than once per minute. Pulse testing provides assurance that when needed, an output will operate correctly. Blocks that control outputs that change state frequently do not need to be pulse tested. Pulse testing does not provide enough energy to activate mechanical devices such as motor starters, relays, or solenoid valves, but may change the state of a very small load. If appropriate, blocks can be configured (with the Hand–held Monitor or via a Write Configuration command) to ignore a Pulse Test datagram. Pulse testing can also be done using a Hand–held Monitor.

Command Block Format for the Pulse Test Command

Address:	Command Length	2
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max.communications time	0
Address +6:	Command number	1
Address +7:	Device Number	0 – 31. Or enter 255 to Pulse Test all discrete blocks.

COMREQ #2: Read Configuration Command

The Read Configuration command is used to request configuration data from any block on the bus. It causes the Bus Controller to send a normal–priority Read Configuration datagram to the indicated block. After receiving the request, the block returns its configuration data to the Bus Controller in 16–byte increments. When the Bus Controller has received all the configuration data, it transfers the data to the memory location specified in the Command Block. Because configuration data consists of both bit–type and byte–type portions, it is best to place it in word memory, then move the bit–oriented data to bit memory (%M or %T is recommended). Contents of Read Configuration Reply messages for I/O blocks are shown in the *Genius I/O System User's Manual*.

Before a block can be sent this command, its Device Number (serial bus address) must be set up using the Logicmaster 90 configuration software. In addition, the block must have had its Device Number entered using a Hand–held Monitor.

Command Block for the Read Configuration Command

Address:	Command Length	5
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	2
Address +7:	Device Number	0 – 31.
Address +8:	Maximum data memory length. May represent either bits or words (depends on the memory type selected below).	18 words (288 bits): any discrete block 13 words (208 bits): 16 Circuit AC Input block 42 words (672 bits): Analog blocks (4 inputs / 2 outputs) 42 words (672 bits): RTD or Thermocouple blocks 42 words (672 bits): 6–input Analog blocks 35 words (560 bits): High–speed Counter 13 words (208 bits): PowerTRAC Block If the length of data returned by the device exceeds this length, the Bus Controller writes as much data as possible to the PLC CPU and returns a data error to the COMREQ status location. If the same COMREQ will be used to read configuration data from more than one type of block (for example, in a subroutine), be sure to allow enough length to accommodate the largest amount of data that might be returned.
Address +9:	Memory type of the location where the Bus Controller will place the data in the CPU.	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ).
Address +10:	Memory offset	Starting address within this memory type.

COMREQ #3: Write Configuration Command

The Write Configuration command is used to send configuration data from the CPU to a block on the bus. (The Bus Controller cannot write configuration data to another bus interface module or to a Hand–held Monitor). A Write Configuration command to the Bus Controller itself would be rejected with status 128 (command not supported by target device).

Before a block can be sent this command, its Device Number (serial bus address) must be set up using the Logicmaster 90 configuration software. In addition, the block must have had its Device Number entered using a Hand–held Monitor.

The PLC sends the intended configuration data from CPU memory to the Bus Controller. The Bus Controller schedules background Write Configuration messages to the block. Once message transmission begins, the Bus Controller sends the configuration data to the block, up to 16 bytes per bus scan. The block does not use any of the new configuration data until it all has been received. No new commands can be sent to the block until the operation has been completed. When all the data has been sent, the Bus Controller changes the status to 4 (Done).

The length of the data sent with this command must exactly match the length required by the device. If the lengths are not equal the Bus Controller returns a Syntax Error to the COMREQ status location.

Command Block for the Write Configuration Command

Address:	Command Length	This number equals the amount of configuration data to be sent, plus 3. For example, for an RTD block, which has 42 words of configuration data, you would enter 45 here. Configuration data formats for all Genius I/O blocks are shown in the *Genius I/O System User's Manual*.
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	3
Address +7:	Device Number	0 – 31. (SBA of the block to which configuration data will be written).
Address +8:	Length of configuration data in bytes.	Up to 248 bytes (128 words) of configuration data may be written to a device. See "COMREQ #2: Read Configuration" for data lengths.
Address +9 to Address +n:	Configuration Data	Configuration data formats are given in the *Genius I/O System User's Manual*.

COMREQ #4: Read Diagnostics Command

Use this command to request diagnostic information from a block or a bus interface module. Diagnostics can be requested from any block, even those configured not to issue Report Fault messages. The diagnostic data returned by a block will indicate faults that have occurred since powerup or since the last Clear Faults datagram. Current diagnostic state can be found by issuing a Clear Faults command to the circuit(s) or channel(s) to clear the fault history, then issuing a Read Diagnostics command.

This command causes the Bus Controller to send a Read Diagnostics datagram to the specified device. When the device receives this datagram, it returns a Read Diagnostics Reply datagram. I/O blocks return data in message segments of up to 16 bytes per bus scan. The content of the Read Diagnostics Reply message depends on the device being queried. The first word of the reply must contain the length of the data that follows. Data is packed two bytes per word. Message formats are shown in the *Genius I/O System User's Manual*. When all the data has been received, the Bus Controller transfers it to the CPU and sets the COMREQ status to 4 (Done).

Command Block for the Read Diagnostics Command

Address:	Command Length	5
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	3
Address +7:	Device Number	0 – 31 (of the device whose diagnostics are to be read).
Address +8:	Maximum data memory length, in bits or words (depends on the memory type selected below).	This entry tells the CPU how much memory will be needed to store the data returned by the block. The number of bits or words needed depends on the number of circuits on the block, and the block type: 10 words (160 bits): Discrete I/O blocks, 8–ckt 18 words (288 bits): Discrete I/O blocks, 16–ckt 34 words (544 bits): Discrete I/O blocks, 32–ckt 8 words (128 bits): Analog, 4 input/2 output blocks 8 words (128 bits): RTD Input Blocks 8 words (128 bits): Thermocouple Input Blocks 6 words (96 bits): High–speed Counter (For a PowerTRAC Block, status information is automatically provided as "input" data. See the *PowerTRAC Block User's Manual* for more information.) If the data returned by the designated device exceeds this length, the Bus Controller will write as much as possible to the PLC CPU and return a data error to the COMREQ status location.
Address +9:	Memory type of the location where the Bus Controller will place the data in the CPU.	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ). Since diagnostic data is both bit–type and byte–type, use of word memory is recommended. Bit–type data can then be moved to a bit memory such as %T or %M.
Address +10:	Memory offset	Starting address within this memory type.

COMREQ #5: Clear Circuit Faults Command

The Clear Circuit Faults command is used to clear any faults on a specified circuit of a Genius I/O block. The Clear Circuit Fault command causes the Bus Controller to issue a normal–priority Clear Circuit Fault datagram.

Command Block for Clear Circuit Faults

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	5
Address +7:	Device Number	0 – 31 (.of the Genius block on which the circuit to be cleared is located).
Address +8:	Circuit Number	This is the relative number of the circuit, not its reference number. The first circuit on the block is considered to be number 1. For example, to clear faults on circuit 5, you would enter 5 here. For a 4 Input / 2 Output analog block, circuit numbers 1 to 4 are for inputs, 5 and 6 are for outputs.

COMREQ #6: Clear All Circuit Faults Command

The Clear All Circuit Faults command is used to clear all faults on a Genius I/O block. It causes the Bus Controller to issue a normal–priority Clear All Circuit Faults datagram.

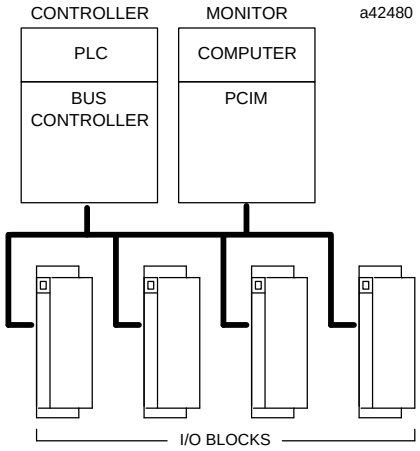
Command Block for Clear All Circuit Faults

Address:	Command Length	2
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	6
Address +7:	Device Number	0 – 31 (of the Genius block on which the circuit to be cleared is located). To send this datagram to all blocks on the bus, enter the number 255.

COMREQ #7: Assign Monitor Command

An Assigned Monitor is an additional bus interface module (usually in another CPU) that monitors Genius I/O devices on the bus. Remote I/O Scanners and I/O blocks broadcast their inputs to all devices on the bus. Therefore, any interface module on the bus will receive all inputs sent by the blocks. However, blocks direct fault reports and configuration change messages only to the bus interface module that sends them outputs. Blocks configured for CPU Redundancy will automatically transmit two copies of any fault report or configuration change message, directing them to Device Numbers 30 and 31.

The Assign Monitor command can be used to have Genius I/O devices send extra fault report and configuration change messages to a monitoring bus interface module. Blocks would send two copies of each fault report or configuration message in a non–redundant system. Blocks in a redundant system would send three (two to the redundant bus interface modules, and the third to the Assigned Monitor).



Multiple CPUs might be used to monitor different blocks on the same bus. However, only one device can be assigned to monitor any given block.

When the Series 90–70 Bus Controller receives the Assign Monitor COMREQ command from the CPU, it issues a normal–priority Assign Monitor Datagram to one block or to all blocks on the bus. If sent to bus interface modules, it has no effect.

Command Block for the Assign Monitor Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	7
Address +7:	Device Number of the block(s) that should send extra fault reports	0 – 31
Address +8:	Device Number of the bus interface module that will RECEIVE the extra fault reports.	0 – 31 to send this command to one block. To send this command to ALL blocks, enter the number 255. If only some blocks should report to the faults to the assigned monitor (for example, to minimize bus scan time), program separate Assign Monitor commands to each.

COMREQ #8: Enable/Disable Outputs Command

The Enable / Disable Outputs command can be sent to the Bus Controller to disable sending outputs *to any blocks whose outputs were enabled during I/O configuration with the Logicmaster 90 software.* Outputs that were configured as *disabled* are NOT affected by this COMREQ command. The effect of disabling outputs is the same as running the control in Run / Disable mode.

Command Block for the Enable/Disable Outputs Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	8
Address +7:	Device Number	Enter 0–31 to enable or disable outputs to one block. To enable or disable outputs to ALL devices on the bus, enter the number 255.
Address +8:	Enable / Disable command	To disable outputs to the device(s) specified in address +7, enter 0. To enable outputs, enter 1.

COMREQ #9: Enable/Disable Global Data

If Global Data has been enabled using the Logicmaster 90 software, this COMREQ command can be used after powerup to disable or re–enable the sending of Global Data from the Bus Controller, or receiving it from one or more devices on the bus.

If this COMREQ attempts to enable Global Data when it is already enabled, or to disable Global Data when it is already disabled, the Bus Controller ignores the request and returns status 4 (successful completion) to the Status Block.

Command Block for the Enable/Disable Global Data Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	9
Address +7:	Device Number	Enter 0–31 to specify the bus interface module to / from which Global Data is being enabled or disabled. This may be the Device Number of the Bus Controller itself, or of any other bus interface module on the bus. To enable or disable the Bus Controller *sending* Global Data, enter the Bus Controller's Device Number. To enable or disable the Bus Controller *receiving* Global Data from another bus interface module, enter the Device Number of that bus interface module. To enable or disable the Bus Controller *sending or receiving* ANY Global Data, enter the number 255. If 255 is entered, the command will complete successfully if there are any controller devices on the bus.
Address +8:	Enable / disable command	To disable Global Data to or from the device specified in address +7, enter 0. To enable Global Data, enter 1.

COMREQ #10: Switch BSM Command

In a dual bus system, the Switch BSM command can be used to cause a Bus Switching Module to select a bus. This command causes the Bus Controller to issue a normal–priority Switch BSM datagram.

The program must already know which bus is *currently* selected. The CPU may issue the Switch BSM command at intervals to ensure continued proper bus switching capability. If the command is successful, the CPU will report a Loss of Block diagnostic for the BSM Controller block and for any other block on the same bus stub. If the dual bus system includes a second Bus Controller controlling the other bus, that Bus Controller should report an Addition of Block diagnostic for each of those blocks. If the BSM position is currently forced by the Hand–held Monitor, the command will have no effect. A data error is returned to the status reference if the block does not control a BSM.

Command Block for the Switch BSM Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	10
Address +7:	Device Number of the Genius block to which the Bus Switching Module is attached	0–31
Address +8:	Desired bus position	Bus A (0) or Bus B (1). If not 0 or 1, syntax error is returned.

COMREQ #11: Read Device Command

To read up to 128 bytes of data from another CPU and place it in PLC CPU memory, use the Read Device command. This causes the Bus Controller to issue a normal–priority Read Device datagram. When the data is received, it will automatically be placed in the CPU memory location specified in the Command Block.

Command Block for the Read Device Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	11
Address +7:	Device Number	0 – 31, for the device which is the source of the data.
Address +8: Address +9:	Memory address, bytes 1, 2. "	Specify the location where data will be read FROM. See the instructions on the following pages. (It is not necessary to specify a memory address when sending a Read Device COMREQ to a computer).
Address +10: Address +11: Address +12: Address +13:	Program name, characters 1, 2 " characters 3, 4 " characters 5, 6 " characters 7, 8	Required to read %P or %L memory in another Series 90–70 PLC. See the instructions on the following pages. If the target of the command is NOT another Series 90–70 PLC, Address +10 through Address +17 are ignored; they may contain any value. Program names are limited to 7 characters. Character 8 and all other trailing characters MUST be entered as nulls.
Address +14: Address +15: Address +16: Address +17:	Block name, characters 1, 2 " characters 3, 4 " characters 5, 6 " characters 7, 8	Required to read %L memory in another Series 90–70 PLC. For %P, Address +14 through Address +17 are ignored. Block names are limited to 7 characters. Character 8 and all other trailing characters MUST be entered as nulls.
Address +18:	Data length, in words, bytes or bits. This is the amount of data to be read.	Reading a Series 90–70 PLC, data length is bits or words, depending on the memory type being read. For other types of devices, the length is given as expected by the device. The maximum length is equal to 128 bytes.
Address +19:	Maximum memory length needed for the returned data	Value in bits or words (depends on memory type selected below).
Address +20:	Memory type to receive the returned data	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ).
Address +21:	Memory offset	Starting address within this memory type.

Memory Specification for Read Device and Write Device

The following pages explain how to specify the target memory type when sending a Read Device or Write Device datagram to a Series 90–70 PLC, Series Six PLC, Series Five PLC, or host computer.

Memory Specification: Series 90–70 PLC

For a Series 90 PLC, in address + 8 enter the memory type, using one of the numbers listed in the table below.

Target Memory Type	Value (decimal)	Description	Bits per Reference
%L	0	Local register memory (each subroutine)	16
%P	4	Program register memory	16
%R	8	Register memory	16
%AI	10	Analog input memory	16
%AQ	12	Analog output memory	16
%I	16 70	Discrete input memory (byte mode) Discrete input memory (bit mode)	8 1
%Q	18 72	Discrete output memory (byte mode) Discrete output memory (bit mode)	8 1
%T	20 74	Discrete temporary memory (byte mode) Discrete temporary memory (bit mode)	8 1
%M	22 76	Discrete momentary internal memory (byte mode) Discrete momentary internal memory (bit mode)	8 1
%SA	24 78	Discrete system memory group A (byte mode) Discrete system memory group A (bit mode)	8 1
%SB	26 80	Discrete system memory group B (byte mode) Discrete system memory group B (bit mode)	8 1
%SC	28 82	Discrete system memory group C (byte mode) Discrete system memory group C (bit mode)	8 1
%S	30 84	Discrete system memory (byte mode) Discrete system memory (bit mode)	8 1
%G	56 86	Discrete Genius automatic global data table (byte mode) Discrete Genius automatic global data table (bit mode)	8 1

Memory Offset for Series 90–70 PLC

In address +9, enter a numerical offset within this memory type, for the beginning of the data. Memory offsets start at 0; thus %R1 and %I1 are both accessed using a Memory Offset of 0.

Example A: For 3 bits starting at %I0014, you would enter the offset 13, and a data length of 3 bits.

Example B: To write data to a Series 90–70 PLC beginning at %R100, you would enter the Memory Type 8 (decimal) and the Memory Offset 99 (decimal).

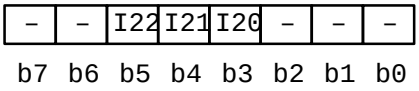
Bit Mode or Byte Mode for Series 90–70 PLC

Bit–oriented memories (%I and %Q) can be accessed either on byte boundaries (byte mode) or as a string of bits (bit mode). Bit mode is used to access a single point within a discrete memory, or a collection of points within a discrete memory which need not start or end on a byte boundary. Byte mode is used to access one or more groups of 8 contiguous points within a discrete memory, and must start on a byte boundary.

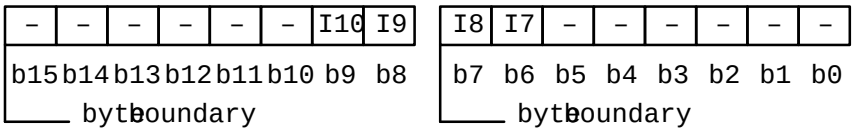
In byte mode, the Message Offset reflects the byte being read or written. Offset 0 corresponds to bits 1–8, offset 1 to bits 9–16, and so on.

In bit mode, the Message Offset reflects the bit being read or written, offset 0 corresponds to bit 1, offset 1 to bit 2, and so on.

In bit mode, one or more bytes of data are read or written, even though some of the bits within the bytes might be ignored. The bit or bits will be in the correct offset position within the byte. For example, if three bits starting a %I0020 are requested, they will appear in the middle of the returned data byte. The "–" indicates unused bits. On READ, they are guaranteed to be 0. On WRITE, they are ignored.

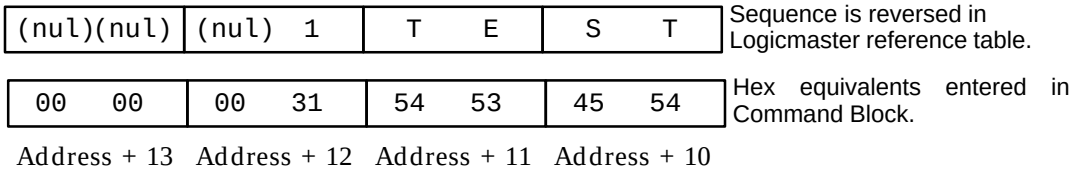


If four bits starting at %I00007 are requested, two bytes are transferred.



Entering a Program or Block Name

If the target of the command is another Series 90–70 PLC, and the memory type to be read is either %P or %L, a program name and, possibly a block name, must be entered. Names are limited to 7 characters. Character 8 and any other trailing characters must be nulls. Names are entered in ASCII hex format, as indicated by the following example:



Hex ASCII equivalents are listed in appendix A. Lowercase letters are not valid in names.

Memory Specification: Series Six PLC

For a Series Six PLC, Read Device and Write Device include an absolute memory location in either Register memory or I/O Status Table memory. Byte 4 of the address must be 80 hex.

Series Six Memory Type		Absolute Address	
		Decimal	Hexadecimal
I/O Status Table	Outputs Inputs	08192 – 08319 08320 – 08447	2000 – 207F 2080 – 20FF
Register Memory	R00001–R16384	16384 – 32767	4000 – 7FFF

Caution

When sending a Write Device COMREQ to a Series Six PLC, be sure the CPU address specified is for the register table (first hex digit is 4–7) or the I/O Status Table (first hex digit is 2). Writing CPU data to any other absolute memory location may cause potentially hazardous control conditions.

Memory Specification: Series Five PLC

For a Series Five PLC, **[Address+8]** of the Read Device or Write Device COMREQ contain a memory offset, which is the beginning location for the data:

Series Five Memory Type		Offset (hex)
Register Memory	R00001 to R16384	0000 – 7FFF
I/O Memory	I1+0001 to I1+1024 I2+0001 to I2+1024 O1+0001 to O1+1024 O2+0001 to O2+1024 I0001 to I1024 O0001 to O1024 O1–0001 to O1–1024 O2–0001 to O2–1024 I1–0001 to I1–0512	8000 – 807F 8080 – 80FF 8100 – 817F 8180 – 81FF 8200 – 827F 8280 – 82FF 8300 – 837F 8380 – 83FF 8500 – 853F

To find the exact offset in the register table, follow these steps:

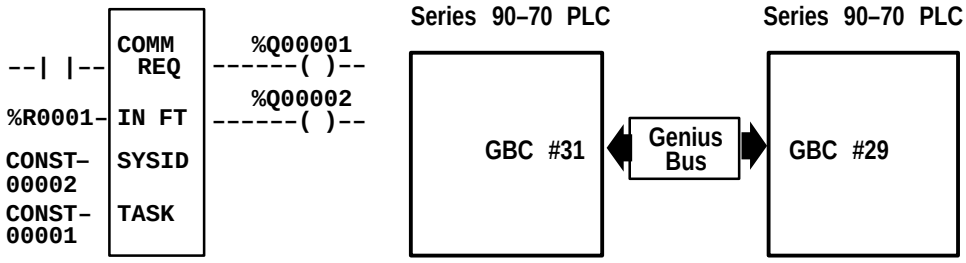
1. **Subtract 1 from the register number.**
2. **Multiply the result by 2 to find the decimal byte offset.**
3. **Continue as described below.**

For a decimal offset in the register or I/O tables:

1. **Convert the decimal number to hex.**
2. **Add the hex number to the beginning offset for that memory type.**

Example of Read Device

In the following example, a Series 90–70 PLC reads ten words of %P memory starting at location %P0050 from program “TEST1” in another Series 90–70 PLC.



Program Name	ABC	TEST1
Initiating Device	X	
Target Device		X
Command Block Location (COMREQ parameters)	%R001–%R022	
Status Block Location (COMREQ Status)	%R023–%R024	
COMREQ Output References	%Q001, %Q002	
Memory location to read data from		%P050–%P060
Memory location to place data	%AQ050–%AQ060	

When the data is received from the target PLC, the requesting PLC will store it beginning at %AQ0050 in its own memory.

Example Command Block

Command Block Register	Description	Value	Comment
Address +1	Wait / NoWait	0	No Wait
Address +2	Memory type for Status Pointer	8	%R memory
Address +3	Starting address for Status Pointer	22	%R023 (1 + 22 offset)
Address +4	Timeout value	0	Not used for No Wait
Address +5	Max Communication Time	0	Not used for No Wait
Address +6	Command Code	11	Read Device
Address +7	Device Number	29	Target Bus Controller
Address +8	Memory Address bytes 1 & 2	2	%P memory
Address +9	Memory Address bytes 3 & 4	49	%P0050 (1 + 49 offset)
Address +10	Program Name characters 1 & 2	’ET’	TEST1
Address +11	Program Name characters 3 & 4	’TS’	
Address +12	Program Name characters 5 & 6	’1’	character 6 is null *
Address +13	Program Name character 7 & 8	xx	Ignored (don’t care)
Address +14	Block Name characters 1 & 2		Ignored
Address +15	Block Name characters 3 & 4		Ignored
Address +16	Block Name characters 5 & 6		Ignored
Address +17	Block Name character 7 & 8		Ignored
Address +18	Data length (word) to read	10	10 words
Address +19	Destination length (words)	10	10 words
Address +20	Memory type for received data	12	%AQ memory
Address +21	Memory offset for data	49	%AQ0050 (1+49 offset)

* In hex, the two values in Address +12 are 31h (ASCII 1) and 00h (ASCII nul).

COMREQ #12: Write Device Command

To send up to 128 bytes of data to another CPU on the bus, use the Write Device command. Any type of data that can be addressed by its memory type and offset can be sent. This command causes the Bus Controller to issue a normal–priority Write Device datagram to the specified device. To send a Write Device datagram with high priority, see *COMREQ #14: Send Datagram*.

Using Write Device Messages Instead of Global Data

Write Device datagrams can be used together with Global Data, or can replace Global Data. Consider using Write Device datagrams instead of Global Data if Global Data takes up too much bus scan time for the application, data does not need to be sent every bus scan, or the CPU sweep time becomes too long for the application.

If this datagram will be broadcast, and there is another Series 90–70 Bus Controller on the bus that should NOT receive it, send the datagram using COMREQ #14 instead. See page 94.

Command Block for the Write Device Command

Address:	Command Length	13 – 77. Enter the number of words from Address +6 to the end of the data.
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	12
Address +7:	Device Number	0 – 31, for the device to be written to.
Address +8: Address +9:	Memory address, bytes 1, 2. "	Enter the location for data to be written to. See the instructions for "Read Device". (It is not necessary to specify a memory address when sending a Write Device COMREQ to a computer).
Address +10: Address +11: Address +12: Address +13:	Program name, characters 1, 2. " characters 3, 4. " characters 5, 6. " characters 7, 8.	Required to write %P or %L memory in another Series 90–70 PLC. See the instructions for "Read Device". If the target of the command is NOT another Series 90–70 PLC, Address +10 through Address +17 are ignored; they may contain any value.
Address +14: Address +15: Address +16: Address +17:	Block name, characters 1, 2. " characters 3, 4. " characters 5, 6. " characters 7, 8.	Required to write %L memory in another Series 90–70 PLC. For %P, Address +14 through Address +17 are ignored. Block names are limited to 7 characters. Character 8 and all other trailing characters MUST be entered as nulls.
Address +18:	Data length, in words, bytes or bits. This is the amount of data to be read.	Writing a Series 90–70 PLC, data length is bits or words, depending on the memory type being read. For other types of devices, the length is given as expected by the device. The maximum length is equal to 128 bytes.
Address +19 to Address +n:	Data to be written to the other device.	

COMREQ #13: Dequeue Datagram Command

The Bus Controller handles most incoming datagrams automatically, with no additional programming required. Under certain circumstances, however, the Dequeue Datagram command must be used to transfer incoming datagrams to the CPU. Program the Dequeue Datagram command for the following:

- Replies that are received after sending Reply–type datagrams with the Send Datagram command. (If Send Datagram with Reply is used instead, it automatically handles replies).
- Unsolicited datagrams that are not recognized by the Bus Controller (Function Code not 20).

Command Block for the Dequeue Datagram Command

Address:	Command Length	7
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	13
Address +7:	Maximum data memory length	Enter bit or word value (depends on the memory type selected below). This entry tells the CPU how much memory will be needed to store all the data. If the length of data returned by the device exceeds this length, the Bus Controller writes as much data as possible to the PLC CPU and returns a data error to the COMREQ status location.
Address +8:	Memory type	Enter the number that represents the location where the Bus Controller will place the data in the CPU: 70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +9	Starting address	Offset within this memory type.
Address +10	Function code of the datagram.	Enter a function code. or enter FF hex to match any function code.
Address +11:	Subfunction code of the datagram.	Enter a subfunction code, or FF hex to match any subfunction code.
Address +12:	Device Number (sender)	Enter 0 – 31, or FF hex to match any Device Number

Number of Dequeue Datagram Commands Needed

One Dequeue Datagram command is needed for each incoming datagram. If multiple incoming Datagrams are expected during one CPU sweep, it will be necessary to place multiple Dequeue Datagram commands in the program to assure their efficient transfer to the CPU.

The number of Dequeue Datagram commands needed depends on whether the Datagrams have been sent using Normal or High Priority, and the relative lengths of the CPU sweep time and the scan time of the bus, as explained below.

If the Bus Scan Time is Greater than the CPU Sweep Time

If all Datagrams on the bus are sent with Normal Priority, there is a limit of one incoming Datagram per CPU sweep. Therefore, only one Dequeue Datagram command per sweep will be needed to handle incoming Datagrams.

If all Datagrams on the bus are sent with High Priority, the Bus Controller can potentially receive one Datagram from each transmitting device during a scan. The program should include the same number of Dequeue Datagram commands as incoming Datagrams.

If the Bus Scan Time is Less than the CPU Sweep Time

If the bus scan time is significantly shorter than the CPU sweep time, you can estimate the number of Dequeue Datagram commands that must be sent to the Bus Controller to accommodate incoming Datagrams on that bus.

First, determine how many scans can occur in one CPU sweep. For example, if the bus scan were 20mS and the CPU sweep were 90mS, the ratio between them would be 4.5 to 1. This should be rounded upward to 5.

This is the maximum number of Normal Priority Datagrams that might be received in a single CPU sweep. Plan to have the same number of Dequeue Datagram commands to that Bus Controller in the program to handle the incoming Datagrams.

For High Priority Datagrams, multiply the number found above by the total number of devices on the bus that might send a High Priority Datagram to the Bus Controller in one bus scan. This is the total number of incoming Datagrams from that bus the program might have to handle in a single CPU sweep. Plan on this number of Dequeue Datagram commands to the Bus Controller.

Additional Logic for Incoming Datagrams

Up to 16 datagrams are enqueued by the Bus Controller in an internal queue. These include any unsolicited reply–type datagrams. This permits the program to, for example, send a Read ID Send Datagram and dequeue the Read ID Reply with the Dequeue Datagram COMREQ.

If the 16–item queue fills, an informational fault GBC_SOFTWR_EXCPTN is logged (Fault Type is DQ_QUEUE_FULL) in the I/O Fault Table. If the Dequeue Datagram is issued and there are no datagrams in the queue, the Status Pointer is set to NO DATA TO TRANSFER.

Program logic should be used to assure that no datagrams are lost by being accidentally written over. This might be done by copying each datagram to another memory location, or by changing the data memory location specified in the Command Block after each incoming datagram is received.

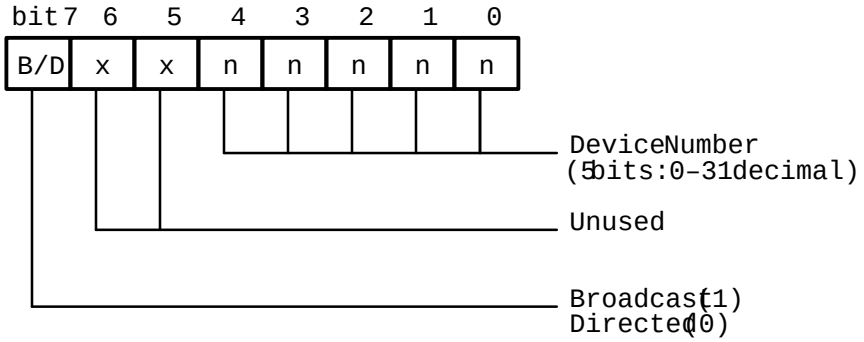
Format of Returned Data

The Dequeue Datagram returns data in the following format.

Location	High Byte	Low Byte
Memory Address	Data Length	Status byte
Memory address +1	Subfunction code	Function code
Memory address +2	Data byte 2	Data byte 1
⬇ ⬇ ⬇	⬇ ⬇ ⬇	⬇ ⬇ ⬇
Memory address +69	Data byte 134	Data byte 133

Items are explained below.

Status Byte: The status byte reports the Device Number of the device that sent the datagram. It also indicates whether the message was broadcast or directed by the other device.



Data Length: The number (0 to 134) of data bytes after the subfunction code.

Function Code: The function code of the received message: 0 to 111 decimal or 0 to 6F hex.

Subfunction Code: The subfunction code of the received message: 0 to 255 decimal or 0 to FF hex.

COMREQ #14: Send Datagram Command

Most datagrams are normally programmed using their assigned COMREQ command numbers. However, datagrams can also be sent using the Send Datagram command and the Request Datagram Reply command. The Send Datagram command might be used to send:

- Datagrams for which no COMREQ command number is defined, such as Begin Packet Sequence, End Packet Sequence, and Write Point.
- Read Device and Write Device datagrams that are broadcast, but which should be ignored by another Series 90–70 Bus Controller.
- Datagrams that must be guaranteed transmission during the next bus scan. This should be done with restraint, for the reasons explained on the following pages.
- Datagrams which do not cause another device to send back a reply, such as Pulse Test, or Write Configuration.

  Datagrams which DO cause another device to send back a reply, such as Read Diagnostics or Read Configuration, are usually programmed using their assigned COMREQ numbers or the Request Datagram Reply command (COMREQ #15). However, if Send Datagram is used to send datagrams that cause replies, the Dequeue Datagram command must be used to transfer the replies back to the CPU.

Before using Send Datagram, refer to the table on page 74 for more information about COMREQs and datagrams.

Command Block for the Send Datagram Command

Address:	Command Length	6 – 70. Enter the number of words from Address +6 to Address +n.
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	14
Address +7:	Device Number of the device to receive the message.	0 – 31, or 255 to broadcast the message.
Address +8:	Function code	For any datagram listed below, 32 decimal (20 hex).
Address +9	Subfunction code (hex)	See the list on page 74.
Address +10	Priority	Enter 0 for normal priority, or 1 for high priority.
Address +11:	Datagram length (in bytes)	Enter the actual length of the Datagram, beginning at [address +12].
Address +12: to Address+n:	Datagram content	Enter the entire datagram as part of the Command Block. The *Genius I/O System User's Manual* shows datagram structures. *If the Send Datagram command is used to broadcast a Write Device datagram, and that datagram should be IGNORED by another Series 90–70 Bus Controller, set the first byte of the datagram as shown in the System User's Manual (this byte is normally 0), to FE hex.*

Datagram Priority

A Bus Controller can send one datagram per bus scan. That datagram may be assigned either normal priority or high priority. Therefore, during one bus scan, there may be one normal priority datagram followed by up to 31 high priority datagrams, *or* up to 32 high priority datagrams sent by the devices on the bus.

In one bus scan (one complete rotation of the bus token among all devices on the bus), there can be just one normal priority datagram sent by any device. If a normal priority datagram or similar system message (such as a fault report) has already been sent by any device (including itself), a device must wait until its next turn on the bus before it can send a normal priority datagram.

Datagrams and I/O Blocks

If the bus will also be used for I/O block control, normal priority datagrams are recommended to allow other messages such as fault reports (which the system handles as normal priority datagrams) to get through. In addition, normal priority datagrams ensure that bus scan time is only modestly delayed for communications. Bus scan time affects the response time of any I/O data on the bus. If there are I/O blocks on the bus, use high priority only if the datagram transmission cannot be delayed. Normal priority will work satisfactorily except when there are many devices attempting to send datagrams simultaneously.

Number of Datagrams per CPU Sweep

The application program should include logic that verifies successful completion of earlier datagrams before requesting new ones. Because a Bus Controller can only send one datagram per bus scan, the number of datagrams that can be executed during the same CPU sweep of program logic depends on the relative lengths of the CPU sweep and the bus scan.

If the Bus Scan Time is Greater than the CPU Sweep Time: If the bus scan time is greater than the CPU sweep time, the Bus Controller will be able to send no more than one datagram during one execution of the application program. Successful transmission of a normal priority datagram will depend on the absence of datagram and system message traffic on the bus.

If the Bus Scan Time is Less than the CPU Sweep Time: If the bus scan time is significantly shorter than the CPU sweep time, the bus may be able to transmit multiple datagrams during one execution of the application program.

Effect of Datagrams on the Genius I/O Bus: Normal Priority Datagrams allow fault reports and Hand–held Monitor communications on a bus to continue undisturbed. Only one Normal Priority Datagram is allowed each bus scan, so the scan time stays relatively constant, and I/O update timing varies only by small increments.

If High Priority Datagrams are being transmitted constantly, the Hand–held Monitor will not function properly; fault reports from blocks will be prevented from being transmitted on the bus, and regular Communication Request commands (such as Write Configuration commands) to that Bus Controller will fail with a transmission error. For these reasons, use of High Priority Datagrams on a bus with I/O blocks should be avoided if possible.

If High Priority Datagrams are transmitted infrequently, they will cause some delay in the Hand–held Monitor communications and other normal system messages, but the delay should not be noticeable.

High Priority Datagrams will typically put more pressure on the Bus Controller to transfer multiple Datagrams per CPU sweep. However, this can also occur with Normal Priority Datagrams if the bus scan time is much shorter than the CPU sweep time.

Maximum CPU Sweep Time Increase for Datagrams: To estimate the impact of Datagrams on CPU sweep time, add together the times required for all Datagrams that might be sent between the Bus Controller and the CPU during one sweep if No Wait mode is selected. Repeat this for each Bus Controller in the PLC that sends or receives Datagrams.

	Total Datagram Bytes Sent (may be none)	x	.031mS	=	
+	LARGEST incoming Normal Priority Datagram Received, bytes	x	.031mS	=	
OR					
+	Total incoming High Priority Datagrams Bytes Received	x	.031mS	=	
+			1.200mS	=	_____mS

Additional Information about Timing

If you need more information about timing for datagrams, Global Data, I/O devices, and remote drops, please refer to the *Genius I/O System User's Manual*.

COMREQ #15: Request Datagram Reply Command

The Request Datagram Reply command can be used to send any datagram that causes the target device to return a reply, such as: Read Configuration or Read Diagnostics. With this command, the Bus Controller automatically transfers replies to the CPU; no separate Dequeue Datagram command is needed to handle them.

These datagrams are normally programmed using their assigned COMREQ command numbers. The primary reason for sending any of these datagrams using COMREQ #15 would be to assign it high priority, guaranteeing that it would be sent on the next bus scan. Before doing this, see *COMREQ #14: Send Datagram* for important information about datagram priority.

Command Block for the Request Datagram Reply Command

Address:	Command Length	10 – 78. Enter the number of words from Address +6 to Address +n.
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	15
Address +7:	Device Number of the device to receive the message.	0 – 31
Address +8:	Function code	For any datagram listed below, 32 decimal (20 hex).
Address +9	Subfunction code (hex) of the datagram to be sent.	00 Read ID 02 Read Configuration 08 Read Diagnostics 0C Read Block I / O 1E Read Device 27 Read Data
Address +10	Priority	Enter 0 for normal priority, or 1 for high priority.
Address +11:	Datagram length (in bytes)	Enter the actual length of the Datagram, beginning at [address +16].
Address +12:	Subfunction code (hex) of the reply	01 Read ID Reply 03 Read Configuration Reply 09 Read Diagnostics Reply 0D Read Block I / O Reply 1F Read Device Reply 28 Read Data Reply
Address +13:	Memory type for the reply	Enter a number: 8 (%R), 10 (%AI), or 12 (%AQ)
Address +14:	Memory offset	Starting address within this memory type.
Address +15:	Maximum data memory length needed If the length of the memory is smaller than the amount of reply data received, the extra portion of the data will be lost, and a data error (16) will be returned to the status location.	Enter a value in bits or words, depending on the memory type selected. This entry tells the CPU how much memory will be needed to store all the reply data. The length depends on the message and device type. – for Read Configuration Reply, see COMREQ #2. – for Read Diagnostics Reply, see COMREQ #4. – for Read Device Reply, message length depends on device type. May be up to 64 words. – for Read Data Reply, message length is 5 words. – for Read ID Reply, message length depends on device type. See the *Genius I/O System User's Manual*.
Address +16 to Address +n:	Datagram Content	Enter the entire datagram as shown in the *Genius I/O System User's Manual.*

Format of Returned Data

Returned data format is the same as for Dequeue Datagram. See page 93.

COMREQ #16: Enable/Disable I/O Fault Categories

The Enable / Disable I / O Fault Categories command can be sent to the Bus Controller to disable or re–enable the reporting of all I / O faults, or Addition / Loss of Block faults.

If all I / O faults are disabled, the Bus Controller will not forward to the CPU any fault reports it receives from devices on its bus. This includes all I / O faults, as well as Loss of Block and Addition of Block messages.

It is also possible to disable only reports of Addition or Loss of Block conditions, while still forwarding other faults from the devices on the bus. This can be useful in a system where blocks are intentionally switched on and off the bus, or in other applications where these messages are not wanted.

If the passing of some or all fault reports is disable, the corresponding point–specific fault contacts *will* operate. They are not affected by the use of this COMREQ. Some system–level and block–level fault contacts will be affected by the loss of the inhibited information.

Command Block for the Enable/Disable I/O Fault Categories Command

Address:	Command Length	3
Address +1:	No Wait	0
Address +2:	Status Block memory type	70 (%I), 72 (%Q), 8 (%R), 10 (%AI), or 12 (%AQ)
Address +3:	Status Block offset	Beginning address for the COMREQ status.
Address +4:	Idle timeout value	0
Address +5:	Max. communications time	0
Address +6:	Command number	16
Address +7:	I / O Fault Category to be enabled or disabled.	It may be: 0 0 0 0 all I / O fault categories enabled. F F F F all I / O fault categories disabled. 0 0 0 6 Addition / Loss of Block fault categories disabled.
Address +8:		Must be: 0 0 0 0 if Address +7 is 0000 or 0006. Must be: F F F F if Address +7 is FFFF.

The default is for all fault categories to be enabled.

Chapter 6

Data Monitoring, Distributed Control, and Redundancy

This chapter describes the following types of advanced I/O control systems:

- **Data Monitoring:** Where an additional CPU (either a PLC or a computer) monitors inputs and diagnostics from some or all of the blocks on a bus.
- **Distributed control**: Where two or more CPUs control different I/O blocks on the same bus.
- **Redundancy:** The use of dual busses, dual controllers, or both.

These types of systems are possible because of the unique operation and communications capabilities of Genius I/O devices on a bus. Each Genius I/O block broadcasts its input messages to all other devices on the bus. Therefore, more than one CPU can receive inputs from the same blocks.

The CPUs can communicate on the same bus, allowing formation of a common database. In addition, any CPU can send datagram messages to any other device on the bus.

For Additional Information, Also See:

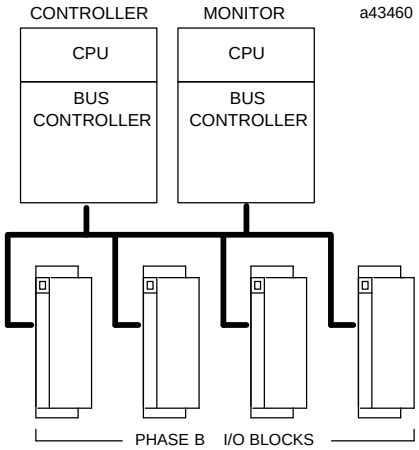
Chapter 1, which describes non–redundant types of systems.

Chapter 4 for configuration details.

Chapter 5 for descriptions of COMREQs that might be used in a monitoring or redundancy system.

Data Monitoring

In addition to the PLC or computer running the application program, other CPUs on the bus can monitor inputs, diagnostics, and Configuration Change messages sent by Genius I/Odevices.



Monitoring Inputs

Genius I/O devices broadcast their inputs once per bus scan. These inputs may be accessed by any PLC or computer on the bus.

If the Series 90–70 PLC is to be used to monitor inputs from I/O devices not being controlled by its application program, the devices will be configured in the same manner as other I/O devices on the bus. The PLC will use the Reference Number assigned to each I/O device to store its inputs. Even though the monitoring PLC would not ordinarily be expected to send outputs to devices being monitored, outputs to those devices should be disabled when the PLC's I/O configuration is done. This will prevent any unwanted outputs being sent to the I/O devices from the monitoring PLC.

If a computer is used to monitor I/O data on the bus, it is important to consider data type, message length, and message format when programming the computer. For example, a High–speed Counter block sends its word–type data first, followed by discrete data. Other devices have different data formats.

Monitoring Diagnostics and Configuration Change Messages

In addition to receiving the broadcast input data, one PLC or computer on the bus may also receive extra copies of any fault reports and configuration change messages that may be sent by the bus devices. This PLC or computer, referred to as the Assigned Monitor, may not send control outputs to an I/O device. If the monitor is capable of sending outputs to a I/O device it is monitoring, those outputs must be disabled.

The monitoring device can communicate with other devices on the bus through Global Data or datagram messages. For example, it would be possible for a monitoring device to send a Read Diagnostics datagram to an I/O device that was not configured to send it fault reports automatically.

This feature is compatible with both redundant and non–redundant Genius configurations.

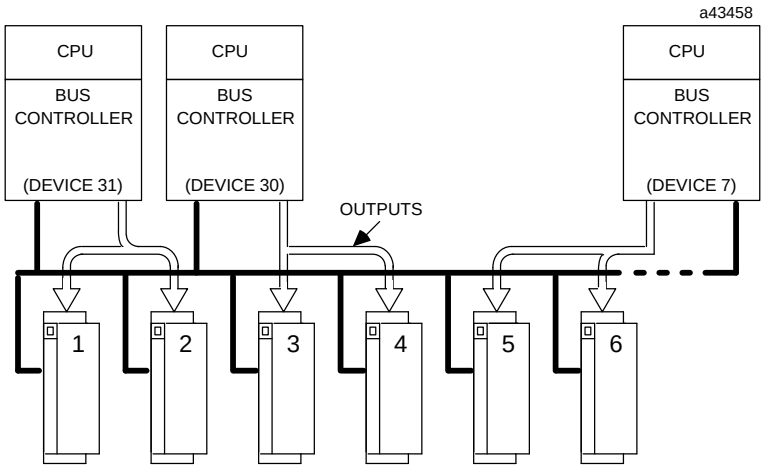
Distributed Control

Distributed control means that two or more Bus Controllers are sending control outputs to different I/O devices on the same bus. Ordinarily, these Bus Controllers would be in different PLCs, but with the Series 90–70, they may also be in the same PLC.

Diagnostics are only automatically sent from the block to the Bus Controller that is controlling its outputs. The Assign Monitor datagram can be used to command blocks on the bus to also direct fault reports to a second Bus Controller.

This is a form of split control, not a type of redundancy. Bus Controllers and devices on the bus are set up for CPU Redundancy Mode = None, since each I/O device is receiving outputs from only one Bus Controller. Remember that all I/O devices on the bus broadcast inputs to all bus interface modules automatically.

For example, a Bus Controller is configured at Bus Address 31, and the I/O devices it will control are configured at Bus Addresses 1 and 2. A Bus Controller in another PLC is located at Bus Address 30. The I/O blocks it will control are located ate Bus Addresses 3 and 4. A third Bus Controller is at Bus Address 7. Two I/O blocks on its bus are located at Bus Addresses 5 and 6. All devices are connected by the same bus.



When setting up a Series 90–70 PLC system for distributed control, there are two different ways to assign references to I/O devices:

A. Each Bus Controller can be assigned just those I/O devices whose outputs it controls. If this is done, devices that are not configured for a Bus Controller (but which are actually present on the bus) will generate Extra Device faults in that PLC at startup. Once these faults are cleared, they will not reappear unless power is cycled to the Bus Controller or I/O device.

B. Each Bus Controller can be assigned all of the I/O devices actually present on the bus. Outputs are disabled to I/O devices controlled by another Bus Controller. This means that each I/O device must be assigned a Reference Number in each CPU. References assigned to devices controlled by another CPU are unavailable for further use.

Redundancy

Redundancy provides extra protection for critical processes through duplication of system components. For the Series 90–70 PLC (CPU rev. 4.0 and Bus Controller rev. 4.0), the following can be configured using Logicmaster 90–70 rev. 4.0:

- Dual bus, one PLC
- Dual bus, two PLCs
- Redundant controllers, one PLC
- Redundant controllers, two PLCs
- Dual bus and redundant controllers, two PLCs

Systems that are appropriate for a rev. 4 Series 90–70 PLC are described on the following pages. If the Series 90–70 PLC is rev. 3, see page 115.

Important Considerations

Suitability of Series 90–70 PLC redundancy depends on the requirements of the application. Some important factors to be considered are described below.

1. CPU synchronization is not supported.
    1. Using a Genius LAN, transfer of data from the master CPU data to the backup CPU can take 10 to 20 CPU sweeps, depending on the quantity of data.
    2. The Series 90–70 PLC has transitional bits, but does not have a table that can be transferred from one CPU to another for synchronization. One–shots, counters, and transitional contacts cannot be guaranteed to be the same in both PLCs.
    3. The timebase is not transferrable, so timers (real time and running time) cannot be guaranteed to be the same. In addition, timers and counters used in program blocks which are not called every sweep may produce different results.
    4. For PID function blocks, elapsed time may be different in the two PLCs, because it represents the total time since PLC powerup.
2. Hot Standby redundancy should only be used for systems that do not require bumpless transfer of control from one CPU to the other.
3. A higher level of support for both bus redundancy and CPU redundancy is provided by Release 4 products (Series 90–70 PLC rel. 4, Logicmaster 90–70 rel. 4, and Series 90–70 Genius Bus Controller, version 4.0). These versions should therefore be used for redundant systems. The restrictions listed above still apply, however.

Dual Bus Redundancy

Dual busses can be used to provide backup protection against cable break or loss or removal of a Bus Controller. Each bus of the dual bus pair has its own Bus Controller. The two Bus Controllers can be located in the same PLC or in two PLCs.

If the Bus Controllers are in the same PLC, they can be placed in the same rack, or they can be placed in different racks to protect against rack failure.

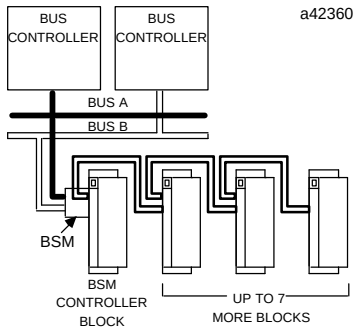
For applications that do not require bumpless transfer of control, the Bus Controllers can be located in different PLCs.

Note

If bumpless transfer is a requirement, bus redundancy with two PLCs is not recommended since the second PLC is essentially off–line before the switch.

Dual Bus Operation

In dual bus redundancy, bus selection is controlled by a switching device (either a Bus Switching Module, or a Remote I/O Scanner module with built–in bus switching capability).



Clusters of up to eight devices each can be connected to a dual bus by a switching device. The maximum number of devices that can be located on both busses is 30, which requires at least 4 bus switching devices.

If the bus switching device stops receiving outputs from the active bus, it automatically switches to the other bus. If the bus it switches to is operational, the regular I/O updates will resume with the Bus Controller on the new bus. An “Output Default Timeout” of 2.5 or 10 seconds must be selected for each bus device, so its outputs do not default during this switchover/login process. Bus switching and block login requires finite periods of time. This varies from system to system, depending on the Genius bus scan time, the CPU sweep time, and the number of devices switching. Generally, switchovers are completed before the 2.5 second timeout expires. The 10–second option is available for systems requiring a longer switchover period. During the timeout period, outputs hold their last valid output state.

If, after switching due to loss of communications on the original bus, no outputs are received on the new bus, the bus switching device does not switch back. It waits until

communications are restored on the newly–connected bus, or until power is cycled. This prevents unnecessary switching when no communications are available.

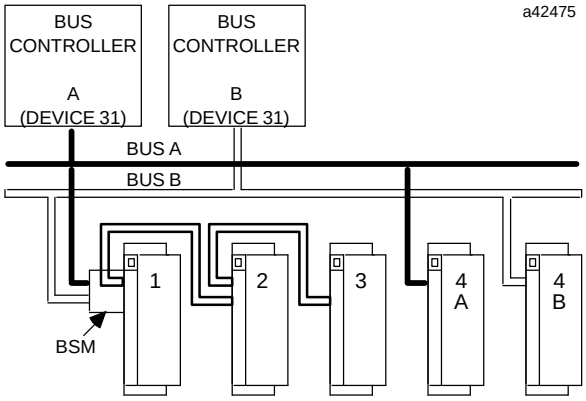
Data Transfer on a Dual Bus

In dual bus redundancy, both Bus Controllers are capable of sending outputs to the devices on the bus. However, the devices in a bus cluster will only receive outputs from the bus that is currently selected by their switching device.

Similarly, although the devices in a cluster continually broadcast input data and diagnostic messages, they are only received by the Bus Controller on the bus that is currently selected by their switching device. The Bus Controller on the inactive bus cannot receive inputs, fault reports or Configuration Change messages.

Non–redundant Devices on a Dual Bus

Although most devices in a dual bus system will probably be connected to both bus cables via a switching device, it is possible to have non–redundant devices connected directly to one bus of the pair. The following illustration represents a dual bus with some non–redundant I/O blocks.

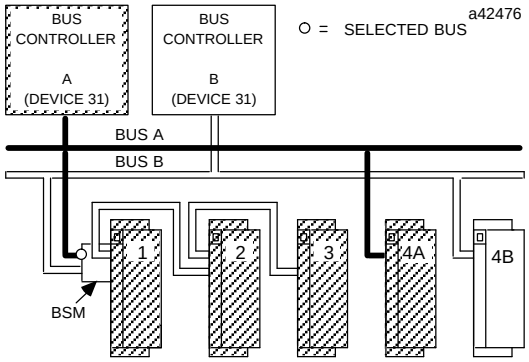


Both of the Bus Controllers are configured at Bus Address 31 on their respective busses. A Bus Switching Module interfaces three redundant I/O blocks to the dual bus. The redundant blocks are configured at Bus Addresses 1, 2, and 3 on both busses.

There are also two non–redundant I/O blocks. Each of them is configured at Bus Address 4 on its bus.

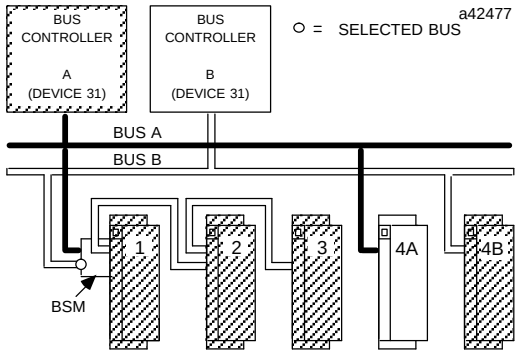
During normal operation, both bus A and bus B operate in the same way as a single bus:

- Blocks 1, 2, and 3 interface to either bus A or bus B, as selected by the BSM.
- Block 4A communicates with the Bus Controller on bus A only.
- Block 4B communicates with the Bus Controller on bus B only.



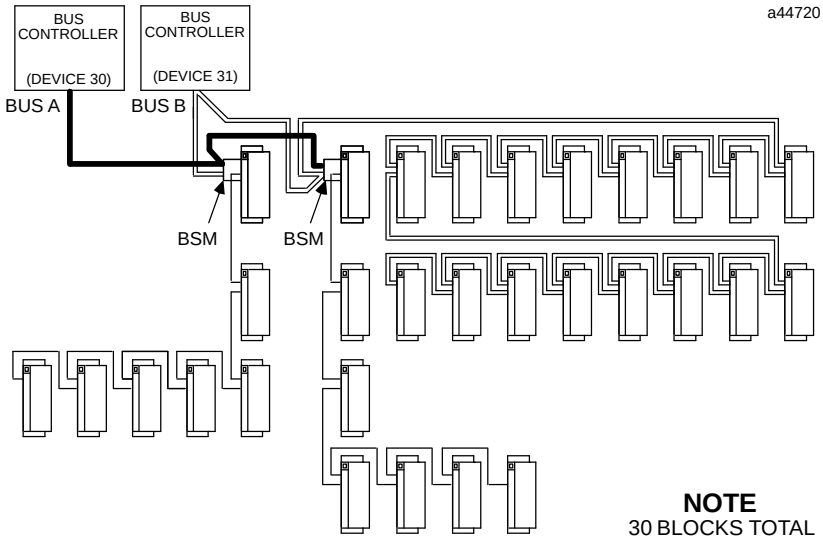
If Bus Controller A stops communicating with the redundant blocks (due to program action, a Bus Controller fault, a cable break, or loss of power), then:

- The BSM will switch the cluster of blocks 1, 2, and 3 to bus B.
- Block 4A, which is a non–redundant block, will no longer receive outputs from its Bus Controller, and will no longer be able to send inputs or diagnostics to the PLC. If there are outputs on block 4A, they will either hold their last state or default, depending on the block's configuration. Although communications have been interrupted, the block is still receiving power, so any outputs that were ON or that default to ON will continue to operate.



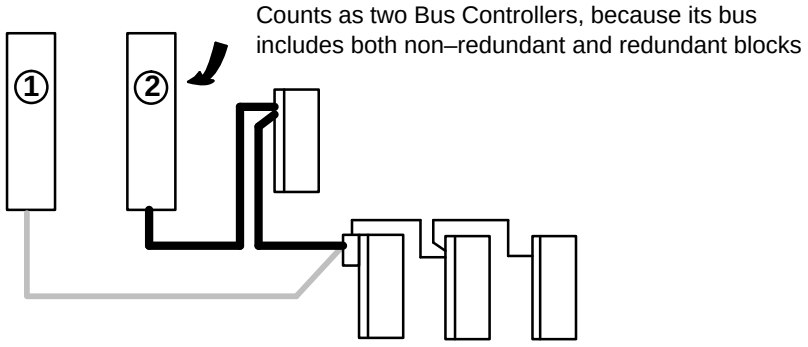
Number of Bus Devices on a Dual Bus

Up to 30 bus devices can be connected, either directly or as part of a cluster, to a dual bus. Redundant devices count toward both busses' totals. Non–redundant devices only count in the total of the bus to which they are directly connected. That means more devices can be used on a dual bus if some are not redundant.



Number of Bus Controllers in a PLC with Dual Busses

Although using non–redundant devices on a dual bus increases the total number of bus devices that can be used on a dual bus, *it decreases the number of Bus Controllers that can be used in the PLC.* That is because any Bus Controller that has both redundant devices and non–redundant devices on its bus *counts as 2 Bus Controllers* against the total of 31 permitted in a system.

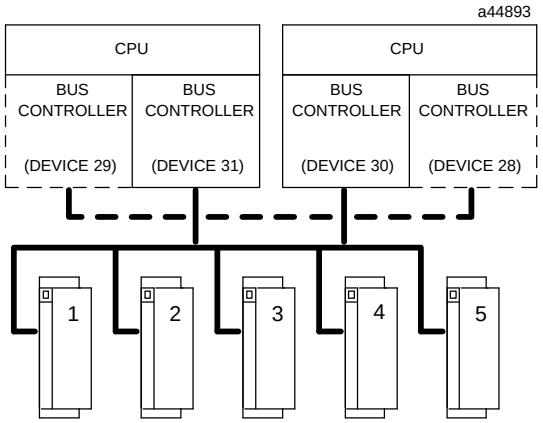


In a large system, grouping non–redundant devices on the same bus or busses will permit the greatest number of Bus Controllers to be used in the PLC. For example, a PLC could have 30 Bus Controllers with all redundant devices, and 1 Bus Controller with all non–redundant devices.

Dual Bus with the Bus Controllers in Two PLCs

In a dual bus system where the Bus Controllers are in the same PLC, the same application program automatically acts on inputs received from the devices and creates outputs for them, regardless of which bus is active at any given time.

But if the Bus Controllers are NOT in he same PLC, the application program must monitor the busses dynamically to determine the correct reference to use at any given time. Because the CPUs cannot communicate with each other on the dual bus, another Bus Controller is needed in each CPU, on each bus, to transmit synchronization data between the two CPUs. Global Data or datagrams can be used.



The illustration shows an optional Bus Controller in each CPU, connected via an additional Genius bus, for data sharing between the CPUs. In this example, the additional Bus Controllers are for communications only; they do not control I/O. In that case, it is not necessary to give them the same Bus Addresses.

Disabling Outputs from the Backup Bus Controller

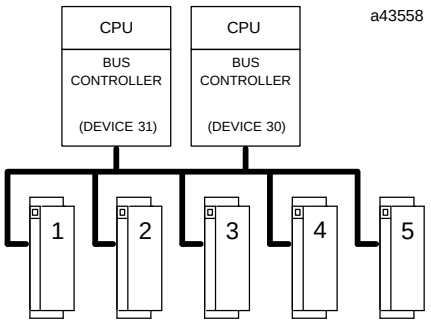
When using bus redundancy with two PLCs, it may be necessary to disable the outputs sent by the backup Bus Controller until the application program has logged in all the devices, then enable outputs under program control. If this is done, the additional time without outputs must not cause the total time without outputs to exceed the 2.5 or 10 second timeout selected for the block.

Redundant Controllers

Redundant controllers provide backup controller protection for devices on a bus. The redundant controllers can be in the same PLC (in the same rack or in different racks), or in two PLCs.

Bus Controller redundancy with one PLC provides protection against failure of the Bus Controller.

Bus Controller redundancy with two PLCs, represented below, provides protection against failure in the Bus Controller or elsewhere in the primary PLC.



Synchronizing Dual CPUs

Since bus devices broadcast their inputs to all CPUs on a bus, redundant Bus Controllers in separate PLCs need to maintain synchronization of their output data. Datagrams and Global Data can be used to synchronize the PLCs.

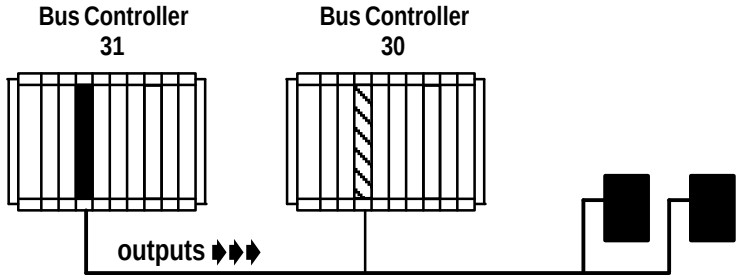
Either PLC can monitor the outputs of the other using the Outputs with Feedback feature of discrete Genius I/O blocks. Since I/O blocks can monitor the actual state of the load and feed this state back to the PLC as input data, both PLCs can monitor the actual state of all outputs.

Bus Device Configuration: Hot Standby or Duplex Mode

For a redundant controller system, devices on the bus can be individually configured (using a Hand–held Monitor or Write Configuration datagrams) for Hot Standby or Duplex CPU Redundancy mode, or none.

Hot Standby Mode

If the system does NOT require bumpless transfer of control from one PLC to the other, devices on the bus can be configured for Hot Standby CPU redundancy. Here, Hot Standby mode is shown using two PLCs. However, it can also be done with one PLC; with one rack or separate racks.

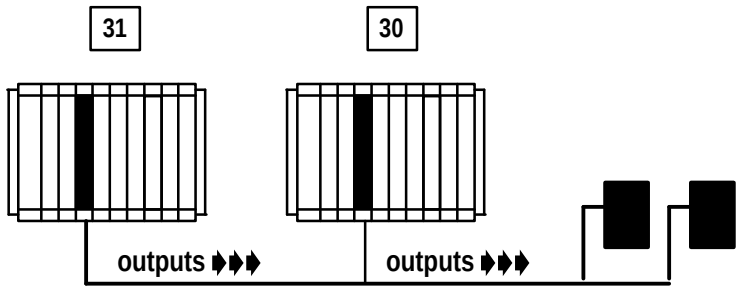


In Hot Standby mode, blocks receive outputs from both Bus Controllers, but they are normally controlled directly by the Bus Controller at Bus Address (Device Number) 31. If no output data is available from Bus Address 31 for a period of three bus scans, the outputs are immediately controlled by the Bus Controller at Bus Address 30. If output data is not available from either 30 or 31, outputs go to their configured default or hold their last state. The Bus Controller at Bus Address 31 always has priority, so that when 31 is on–line, it always has control of the outputs.

Analog blocks, when configured for CPU redundancy, must be operated in Hot Standby redundancy mode.

Duplex Redundancy Mode

If a bus device is configured for Duplex mode, it receives outputs from BOTH Bus Address 30 and 31 and compares them. Here, Duplex mode is shown using two PLCs. It can also be done with one rack or separate racks.



If both outputs are the same, the device sets the output to that state. If both outputs are not the same, the device sets the output to its preselected Duplex Default State. The following table shows how outputs operate in Duplex redundancy.

Commanded State, from Bus Address 31	Commanded State, from Bus Address 30	Configured Duplex Default State	Actual Output State
On	On	Don‘t Care	On
Off	On	Off	Off *
Off	Off	Don’t Care	Off
On	Off	On	On *

* Decided by “Duplex Default State” selection.

If either 30 or 31 stops sending outputs to a device, the outputs are directly controlled by the remaining device.

Only discrete blocks can be configured for Duplex redundancy mode. If there are analog blocks on the same bus, they can be configured in Hot Standby mode or no CPU redundancy.

Note

In both Hot Standby and Duplex modes, both CPUs get the inputs from the blocks automatically. In addition, the blocks automatically send fault reports to both Bus Controllers.

Dual Bus and Redundant Controllers

The two methods just described can be combined for dual bus and controller redundancy. A dual bus / dual controller system provides protection against failure in the bus trunk cable, the Bus Controller and the PLC. Through application programming, dual bus / dual controller redundancy can be implemented in two different ways:

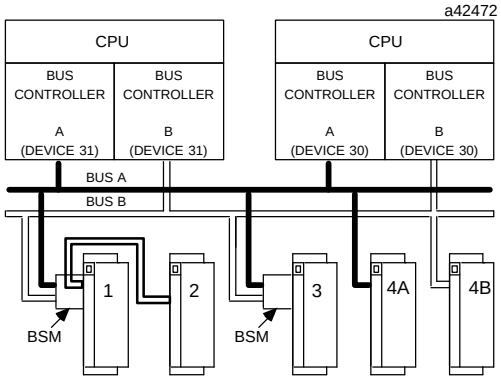
A. For operation with both Hot Standby and Duplex devices on the bus. This application does NOT provide bumpless transfer of control.

B. For bumpless transfer of control as long as both Bus Controllers in the primary PLC are available (transfer is not bumpless between PLCs, however). This application is not suitable for devices that must operate in Duplex CPU Redundancy mode.

Details of both types of application are given on the following pages.

Basic Operation of a Dual Bus/Dual Controller System

Both Bus Controllers in a given Series 90–70 PLC must use the same Bus Address (either 30 or 31).



In the example system represented above, both bus A and bus B operate in the same way as a single bus, dual CPU system. Blocks 1, 2, and 3 interface to both PLCs via Bus Controllers 31(A) and 30(A) whenever the active bus is bus A, or via Bus Controllers 31(B) and 30(B) whenever the active bus is bus B. Block 4(A) interfaces to both PLCs via Bus Controllers 31(A) and 30(A). Block 4(B) interfaces to both PLCs via Bus Controllers 31(B) and 30(B).

Outputs

All four Bus Controllers are capable of sending outputs, although only outputs from the Bus Controllers on the active bus are actually received. It may be necessary to disable the outputs sent by the backup Bus Controller until the application program has logged in all the devices, then enable outputs under program control. If this is done, the additional time without outputs must not cause the total time without outputs to exceed the 2.5 or 10 second timeout selected for the block.

Inputs and Diagnostics

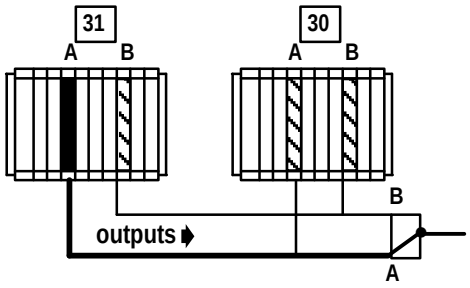
Both Bus Controllers on the selected bus automatically receive all inputs and fault reports from any device on the bus that has been configured as being in "CPU Redundancy" mode.

Bus and Controller Redundancy for Hot Standby Devices

When both PLCs provide outputs, and devices are configured for Hot Standby CPU Redundancy, the sequence of control in case of bus controller, bus, or PLC failure is:

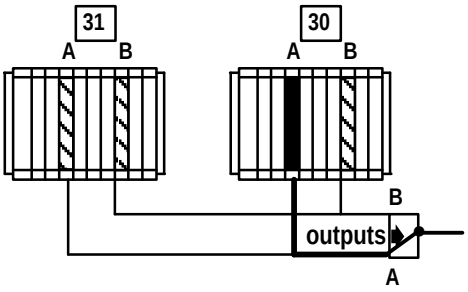
1. *primary PLC, bus A*
2. *backup PLC, bus A*
3. *primary PLC, bus B*
4. *backup PLC, bus B*

Because the PLCs are operating independently, each time the control switches from one PLC to the other there may be a "bump" in the process. This may be of no consequence in some applications, and of significant consequence in others.



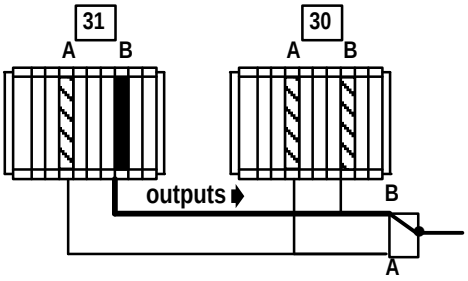
Normal Operation

In the default setup shown at left, during normal operation Bus Controller 31A in the primary PLC controls all devices set up for Hot Standby CPU redundancy.



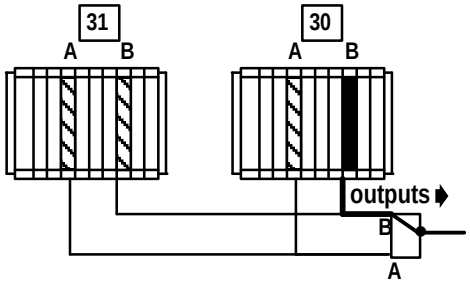
Control Passes to Backup PLC on Bus A

If the device fails to receive valid output data from Bus Controller 31 for three bus scans, it will permit Bus Controller 30A to control its outputs.



Control Passes to Bus B

If the device that controls bus switching stops receiving outputs from bus A for a period of three bus scans, it switches to bus B. Normal operation then resumes on bus B. Bus Controller 31B controls (in the primary PLC) controls all devices set up for Hot Standby CPU redundancy.



Control Passes to Backup PLC on Bus B

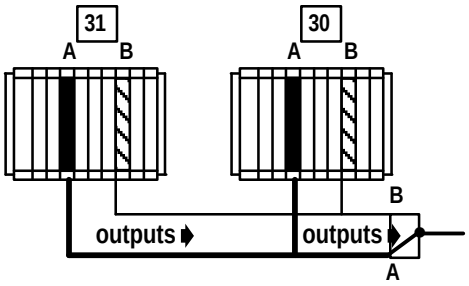
If the device fails to receive valid output data from Bus Controller 31 for three bus scans,it will permit Bus Controller 30B to control its outputs.

Bus and Controller Redundancy for Duplex Devices

If the application requires that bus devices operate in Duplex CPU Redundancy mode, outputs must be enabled to both the primary and the backup PLC. The sequence of control in case of Bus Controller, bus, or PLC failure is:

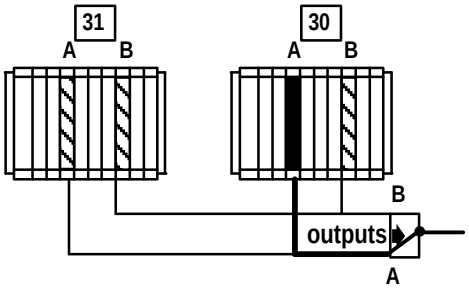
- *control shared by Bus Controllers 31 and 30 on bus A*
- *Bus Controller 30, bus A*
- *control shared by Bus Controllers 31 and 30 on bus B*
- *Bus Controller 30, bus B*

Because the PLCs are operating independently, each time the control switches from one PLC to the other there may be a "bump" in the process. This may be of no consequence in some applications, and of significant consequence in others.



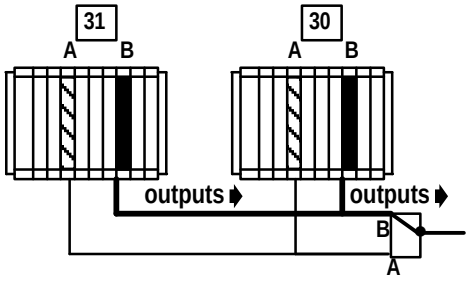
Normal Operation

In the default setup shown at left, during normal operation Bus Controllers 31A and 30A jointly control any devices set up for Duplex CPU redundancy.



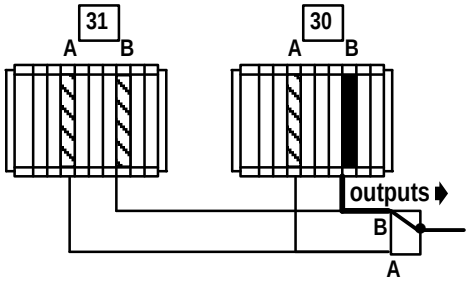
Devices Controlled by Bus Controller 30 on Bus A

If a duplex device fails to receive output data from Bus Controller 31A for three bus scans, it will permit Bus Controller 30A to control its outputs.



Control Passes to Bus B

If the device that controls bus switching stops receiving outputs from bus A for a period of three bus scans, it switches to bus B. Normal operation then resumes on bus B. Bus Controllers 31B and 30B jointly control any devices set up for Duplex CPU redundancy.



Control Passes to Backup PLC on Bus B

If a duplex device fails to receive output data from Bus Controller 31B for three bus scans, it will permit Bus Controller 30B to control its outputs.

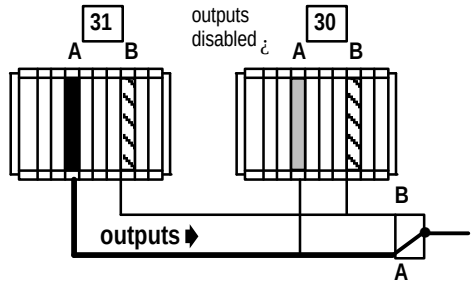
Operation Remains with Primary PLC, Dual Bus and Dual Controllers

The following application is for devices configured in Hot Standby CPU Redundancy mode. It is not suitable for devices that operate in Duplex CPU redundancy mode. The order of control is:

primary PLC, bus A

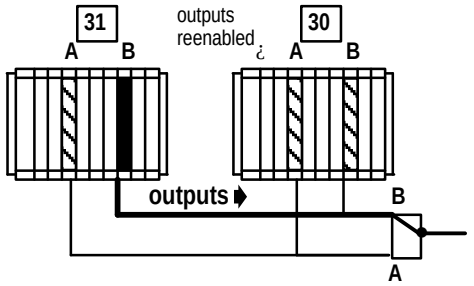
- *primary PLC, bus B*
- *backup PLC, bus B*
- *backup PLC, bus A*

This provides "bumpless" transfer of control within the primary PLC, and within the backup PLC, although there will still be a bump in the process when control is transferred from PLC to PLC.



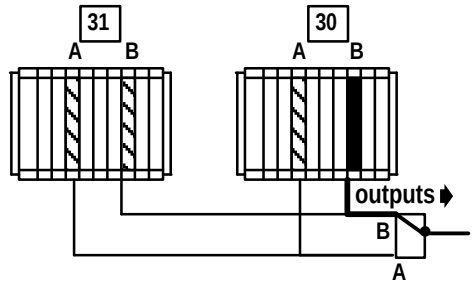
Normal Operation

During normal operation, Bus Controller 31A in the primary PLC controls all devices. At powerup, the application program in the backup PLC sends a Disable Outputs COMREQ to Bus Controller 30A. That prevents the backup PLC from assuming control following a bus switch from bus A to bus B (see below).



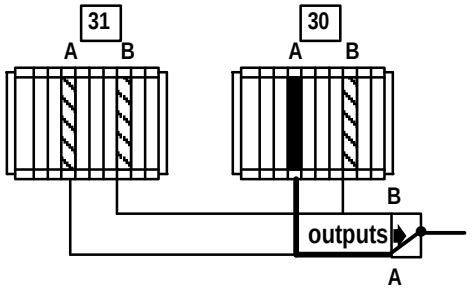
Control Passes to Bus B

Because Bus Controller 30A in the backup PLC is not sending outputs, if the bus switching device stops receiving outputs from Bus Controller 31A for a period of three bus scans, it switches to bus B. Normal operation then resumes on bus B. Bus Controller 31B in the primary PLC controls all devices set up for Hot Standby CPU redundancy. After the bus switch is completed, the application program in the backup PLC should re–enable outputs from Bus Controller 30A, so it will be ready to resume control if needed.



Control Passes to Backup PLC on Bus B

If Bus Controller 31B stops sending outputs, or if the primary PLC is not available when the bus switches, Bus Controller 30B in the backup PLC controls all devices.



Control Passes to Backup PLC on Bus A

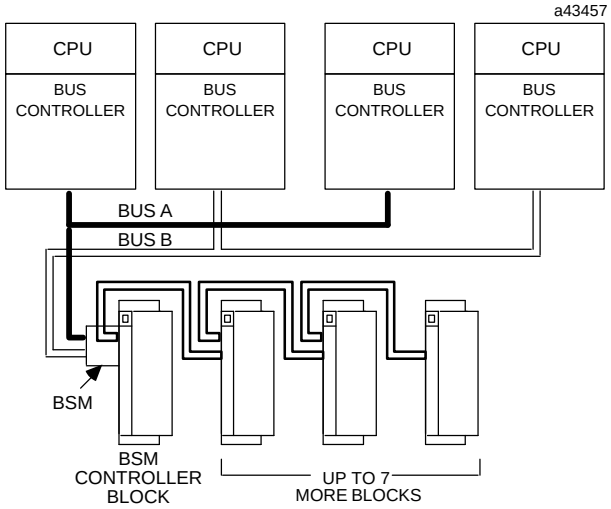
If a device stops receiving outputs from Bus Controller 30B for three bus scans, the bus switches to A again. If outputs from Bus Controller 31A have not been restored, Bus Controller 30A in the backup PLC assumes control. If outputs from Bus Controller 31A have been restored, normal operation resumes. The application program in the backup PLC should once again disable outputs from Bus Controller 30A to bring the system back to its original operating mode.

Genius Redundancy for Series 90–70 Rev. 3

Bus redundancy for a rev. 3 CPU and Bus Controller requires the written approval of GE Fanuc application engineering. Operation of bus redundancy is as described earlier in this chapter.

Dual Bus and Dual Controllers

To provide CPU redundancy, Bus Controller redundancy, and bus redundancy, a Series 90–70 PLC with version 3 CPU and Bus Controller must include two or four CPUs and four Bus Controllers. Clusters of up to eight devices each can be connected to both busses by bus switching devices.



A system like the one depicted above provides protection against single point failure in a CPU or Bus Controller or on a bus trunk cable. It does not protect against failure of a bus switching device, a BSM controller block, or a bus stub connecting blocks in a cluster.

The devices in each cluster communicate only with the bus that is currently selected. The other CPU does not receive inputs, Report Fault datagrams, or Configuration Change datagrams from the blocks. Therefore, if the switching device switches busses, the newly–selected CPUs will not have the most current inputs or diagnostics from the devices in the cluster.

In a version 3 system, bus devices MUST be configured with one set of references for operations on bus A, and a separate set of references for operations on bus B. The application program must decide which bus is operational, and use the appropriate set of references for the devices' I/O data.

Appendix A

ASCII Code List

In Read Device and Write Device datagrams, either uppercase or lowercase letters can be used for program and task names *if the Bus Controller is version 3.0 or later.* For earlier versions of the Series 90–70 Bus Controller, program and task names must be all uppercase.

Char.	Dec.	Hex.	Char.	Dec.	Hex.	Char.	Dec.	Hex.
NUL	0	00	0	48	30	[	91	5B
SOH	1	01	1	49	31	\	92	5C
STX	2	02	2	50	32	]	93	5D
ETX	3	03	3	51	33	^	94	5E
EOT	4	04	4	52	34	_	95	5F
ENQ	5	05	5	53	35	’	96	60
ACK	6	06	6	54	36	a	97	61
BEL	7	07	7	55	37	b	98	62
BS	8	08	8	56	38	c	99	63
HT	9	09	9	57	39	d	100	64
LF	10	0A	:	58	3A	e	101	65
VT	11	0B	;	59	3B	f	102	66
FF	12	0C	<	60	3C	g	103	67
CR	13	0D	=	61	3D	h	104	68
SO	14	0E	>	62	3E	i	105	69
SI	15	0F	?	63	3F	j	106	6A
DLE	16	10	@	64	40	k	107	6B
DC1	17	11	A	65	41	l	108	6C
DC2	18	12	B	66	42	m	109	6D
DC3	19	13	C	67	43	n	110	6E
DC4	20	14	D	68	44	o	111	6F
NAK	21	15	E	69	45	p	112	70
SYN	22	16	F	70	46	q	113	71
ETB	23	17	G	71	47	r	114	72
CAN	24	18	H	72	48	s	115	73
EM	25	19	I	73	49	t	116	74
SUB	26	1A	J	74	4A	u	117	75
ESC	27	1B	K	75	4B	v	118	76
FS	28	1C	L	76	4C	w	119	77
GS	29	1D	M	77	4D	x	120	78
RS	30	1E	N	78	4E	y	121	79
US	31	1F	O	79	4F	z	122	7A
SP	32	20	P	80	50	{	123	7B
!	33	21	Q	81	51	|	124	7C
”	34	22	R	82	52	}	125	7D
#	35	23	S	83	53	~	126	7E
$	36	24	T	84	54	“	127	7F
%	37	25	U	85	55			
&	38	26	V	86	56			
’	39	27	W	87	57			
(	40	28	X	88	58			
)	41	29	Y	89	59			
*	42	2A	Z	90	5A			
+	43	2B						
,	44	2C						
–	45	2D						
.	46	2E						
/	47	2F						

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

S

T

U

W