AutoMax PC3000

M/N 57C560
M/N 57C565
M/N 57C570

Instruction Manual J2-3096-1

The information in this user manual is subject to change without notice.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL WHO ARE FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL AND OTHER APPLICABLE MANUALS IN THEIR ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVER-CURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

INSERTING OR REMOVING A MODULE MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

CAUTION: This module contains static-sensitive components. Careless handling can cause severe damage. Do not touch the connectors or the back of the module. When not in use, the module should be stored in an anti-static bag. The plastic cover should not be removed. Failure to observe these precautions could result in damage to or destruction of the equipment.

PREFACE

This section describes the purpose, intended audience, and scope of this manual. Some terminology used in this manual is also discussed.

Purpose of This Manual

This manual is intended to help you:

- install, configure, and maintain the AutoMax PC3000, including the AutoMax PC3000 Packaged Version
- plan, design, install, and maintain the AutoMax DCS-NET network and the Allen-Bradley Remote I/O link
- understand how to structure your application programs
- write application programs for initializing the AutoMax PC3000 remote I/O scanner interface and block transferring data to Allen-Bradley remote block-transfer modules

Intended Audience

This manual assumes an understanding of the:

- AutoMax DCS processors
- AutoMax Programming Executive software
- Allen-Bradley Remote I/O
- control system application and theory

Terminology Used in This Manual

This term:	Refers to the:
PC3000	AutoMax PC3000 Processor card or the AutoMax PC3000 Packaged Version
AutoMax PC3000 Processor card	M/N 57C560
AutoMax PC3000 Serial card	M/N 57C565
AutoMax PC3000 Packaged Version	M/N 57C570 AutoMax PC3000 Processor card and Serial card installed in an industrialized chassis.

For definitions of more terms, refer to the Glossary located in the back of this manual.

Overview of This Manual

This manual is divided into seven sections, identified by a numbered tab. The sections group related chapters according to the type of information being conveyed and follow the sequence of the life-cycle for a control system.

Tab Number:	Section:	Chapters It Contains:	Description:
1	Introduction	chapter 1, About the AutoMax PC3000	Provides an overview of the AutoMax PC3000 and its capabilities.
		chapter 2, Getting Started	Provides a flowchart of the tasks you need to accomplish to get the AutoMax PC3000 installed and running programs.
2	Design	chapter 3, Designing an AutoMax DCS-NET network	Provides information about choosing the appropriate network media and planning the network design accordingly.
		chapter 4, Designing Control Systems That Use the Allen-Bradley Remote I/O Link	Provides an overview of the Allen-Bradley remote I/O addressing and recommendations for link design.

Tab Number:	Section:	Chapters It Contains:	Description:
3	Installation	chapter 5, Installing the AutoMax PC3000 Processor and Serial Cards	Provides the procedures for installing the Processor and Serial cards into a PC chassis.
		chapter 6, Installing the AutoMax PC3000 Packaged Version	Provides the procedures for mounting the chassis and connecting incoming power and ground lines.
		chapter 7, Installing the AutoMax Coaxial DCS-NET Network	Provides information to help you install and test the DCS-NET network using coaxial cable.
		chapter 8, Installing an AutoMax Fiber-Optic DCS-NET Network	Provides information to help you install and test the DCS-NET network using fiber-optic cable.
		chapter 9, Connecting an Allen-Bradley Remote I/O Link	Provides the procedures for connecting the Allen-Bradley remote I/O link to the PC3000 Processor card.
		chapter 10, Connecting a Programming Device to the AutoMax PC3000	Provides information about how to connect a programming device that is running the AutoMax Programming Executive software to the PC3000.
		chapter 11, Connecting Devices to Port A of the Serial Card	Provides information about how to connect modems, PCs, and other DCE devices to Port A on the AutoMax PC3000.
4	Configuration	chapter 12, Configuring the AutoMax PC3000	Provides the procedures for setting up and configuring the PC3000, including setting the DCS-NET drop number and depth and the Processor tick rate.
		chapter 13, Configuring the AutoMax Allen-Bradley PC3000 Scanner	Provides the procedures for configuring variables for the remote rack inputs and outputs and the remote I/O scanner.
		chapter 14, Configuring and Programming the Block Data Transfers to Allen-Bradley I/O Modules	Explains the theory of block-data transfers to remote I/O and provides information about setting up and programming them.

Tab Number:	Section:	Chapters It Contains:	Description:
5	Programming and Operation	chapter 15, AutoMax Programming Basics	Provides introductory information about the available programming languages and the foundation structures needed to create programs.
		chapter 16, Initializing the AutoMax PC3000 A-B Remote I/O Scanner	Provides information about writing a program to initialize the remote I/O scanner. The scanner must be initialized before it can control remote I/O racks.
		chapter 17, Communicating with the AutoMax PC3000 Over the ISA Bus	Provides information about the PC3000 Application Interface.
		chapter 18, Monitoring the AutoMax PC3000	Provides information about the variables you need to monitor periodically via your application programs.
6	Troubleshooting and Maintenance	chapter 19, Troubleshooting the AutoMax PC3000	Provides tips and information to help you determine and fix operational issues.
		chapter 20, Maintaining the AutoMax PC3000	Provides procedures for replacing the lithium battery and the PC3000 Processor and Serial cards.
		chapter 21, Maintaining the DCS-NET Network	Provides recommendations to help you maintain the coaxial and fiber-optic cable systems.

Tab Number:	Section:	Chapters It Contains:	Description:
7	Reference	Appendix A, Specifications	Lists the technical data for the PC3000 Processor and Serial cards and the PC3000 Packaged Version.
		Appendix B, Recommendations for building CE-Compliant Systems	Lists guidelines to help you build PC3000 systems that comply with the European Union Directives 89/336/EEC, Electromagnetic Compatibility (EMC), and 73/23/EEC Low Voltage requirements.
		Appendix C, Cable Reference	Provides part lists for the DCS-NET coaxial and fiber optic cable systems and serial cable pin assignments.
		Appendix D, Register Assignment Map	Lists the PC3000 registers and their use.
		Appendix E, Replacement Parts List	Lists the part numbers and vendors of the replaceable parts for the PC3000.
		Appendix F, Using the Sample AutoMax Configurations and Programs	Explains how to use the sample configurations and tasks for the AutoMax PC3000, which are included on the AutoMax Programming Executive V4.1A application disk. You can copy and customize these samples for your AutoMax PC3000 application. They are intended to provide you with only a starting point as you create logic customized for your application.
		Appendix G, Examples of Remote I/O Programs	Provides examples of Remote I/O scanner initialization and block-transfer programs.
		Appendix H, Glossary	Lists terms used in this manual that may be unfamiliar to you.
		Index	Points you to the location of the information you are looking for.

For More Information

Refer to these manuals as needed for more information:

- AutoMax Programming Executive Software manual for version 4.1A or later
- AutoMax programming language reference manuals
- AutoMax Network Interface instruction manual

Table of Contents

Appendices

List of Figures

List of Tables

1.0 ABOUT THE AutoMax PC3000

The AutoMax PC3000 offers the power and flexibility of the AutoMax Distributed Control System in a low-cost, personal computer-based hardware platform. The AutoMax PC3000 product line includes:

- AutoMax PC3000 Processor card (M/N 57C560)
- AutoMax PC3000 Serial card (M/N 57C565)
- AutoMax PC3000 Packaged Version (M/N 57C570), which provides the Processor and Serial cards pre-installed in an industrialized chassis

For information about:	See this section:
How the AutoMax PC3000 Fits into Your Application	1.1
About the AutoMax PC3000 Processor Card	1.2
About the AutoMax PC3000 Serial Card	1.3
About the AutoMax PC3000 Packaged Version	1.4
Related Hardware and Software	1.5
What to Do Next	1.6

1.1 How the AutoMax PC3000 Fits into Your Application

Because the AutoMax PC3000 is based on the IBM PC open architecture, it fits cost-effectively into small-to-medium sized motor and drive control applications. The AutoMax PC3000 combines the power, speed, and functionality of the AutoMax Processor and the DCS-NET network with the connectivity to Allen-Bradley Remote I/O. The AutoMax PC3000 supports many AutoMax Multibus system features, including:

- Multi-tasking
- Three-programming languages
- Network programming
- A Runbase that can be downloaded for easy future upgrades
- AutoMax version 4.1A Programming Executive (required for programming)

Figure 1.1 illustrates how the AutoMax PC3000 can fit into your current application or help you create a new system.

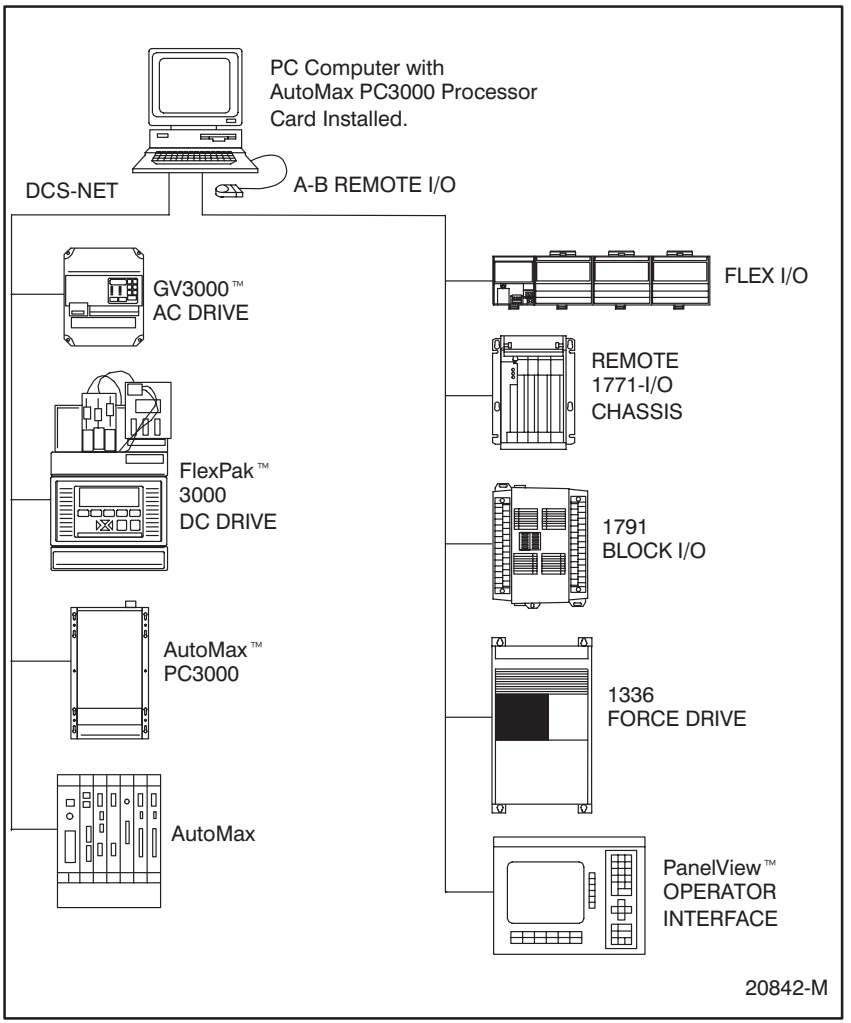


Figure 1.1 - The AutoMax PC3000 Networked into Your Application

Use the AutoMax PC3000 as a supervisor for:

- Reliance Standard Drives using the Network Option Board, such as:
  - FlexPak 3000™ DC drive
  - GV3000™ AC drive
- other AutoMax PC3000's
- AutoMax racks

The AutoMax PC3000 A-B Remote I/O Scanner connection enables the AutoMax PC3000 to control any piece of hardware that can communicate over the A-B Remote I/O Network, including:

- bulletin 1771, 1791, and 1794 I/O
- PanelView™ Operator Interface terminals
- RediPANEL™ stations
- 1336 Plus and Force drives

The A-B Remote I/O network connection, when used in concert with the AutoMax DCS-NET network, lets you create low-cost, high-performance drive systems with many features found in AutoMax systems. You can control one or multiple drives, depending on the physical length of the network and the level of performance required.

The AutoMax PC3000 **does not support** the following standard AutoMax Multibus features:

- Multi-processing
- Distributed Power System
- Communication Processors, other than the AutoMax DCS-NET network

1.2 About the AutoMax PC3000 Processor Card

The AutoMax PC3000 Processor card combines most features from the following AutoMax products into a single, ISA bus compatible printed circuit board:

- AutoMax 7010 Processor
- AutoMax DCS-NET network
- AutoMax A-B Remote I/O Scanner

The on-board lithium battery and a super capacitor protect the PC3000 Processor card from memory loss during power failures. LEDs on the card help you troubleshoot the networks.

Figure 1.2 illustrates the features of the AutoMax PC3000 Processor card.

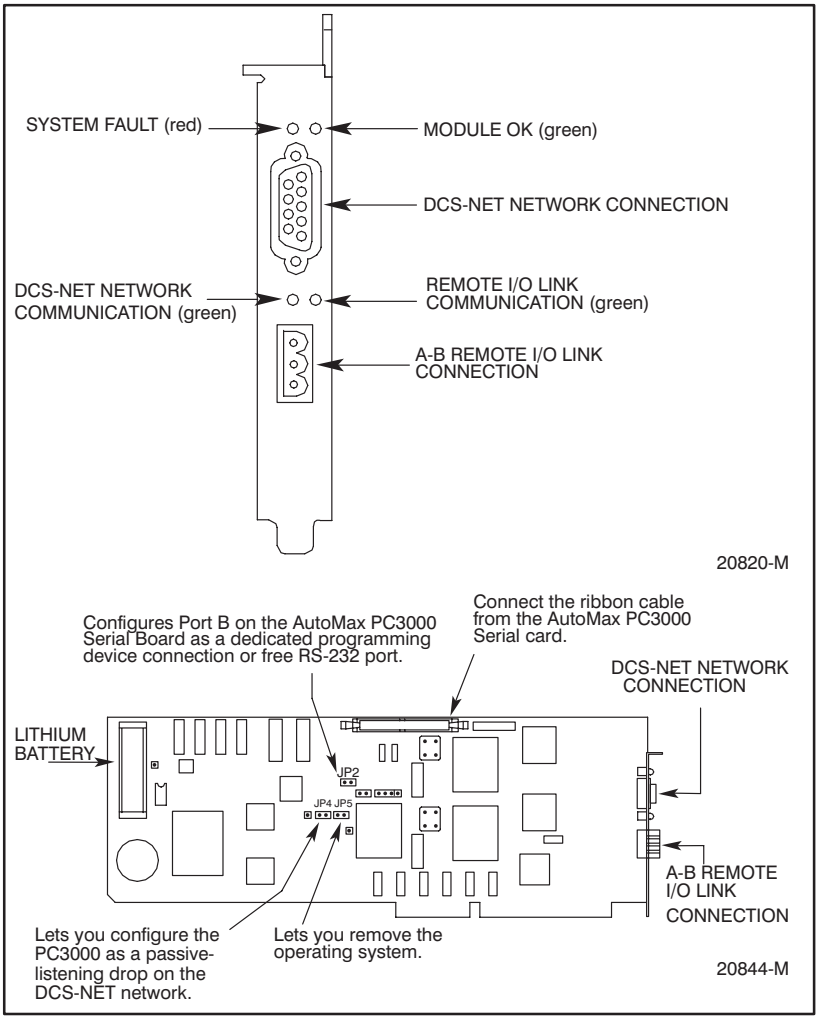


Figure 1.2 - AutoMax PC3000 Processor Card

By adding the AutoMax PC3000 Processor card to an existing personal computer chassis, you can create a lower-cost drive controller that has the flexibility to talk directly with human-machine interfaces and operator interfaces over the computer chassis' ISA bus. The PC's processor remains free to run human-machine interfaces, operator interfaces, or other software without adversely affecting system performance.

The PC3000 Processor card occupies two full ISA slots of a personal computer, which it uses for power and ISA bus communication. It also ships as a component of the PC3000 Packaged Version.

1.2.1 About the PC3000 Processor Functionality

The PC3000 Processor has 370K of RAM available for application programs. It can run programs created using AutoMax Enhanced BASIC, Enhanced Ladder Language, or Control Block languages. The Processor supports the AutoMax multi-tasking environment.

1.2.2 About the A-B Remote I/O Functionality

Use the Allen-Bradley Remote I/O Scanner interface to link the PC3000 to Allen-Bradley I/O devices that communicate via the remote I/O link. The scanner interface can control such devices as Allen-Bradley's 1771 I/O, Flex I/O, Block I/O, SLC 500 Remote I/O Adapter Module and companion I/O modules, and operator interfaces. The scanner interface can scan both discrete and analog I/O as well as force inputs and outputs.

The scanner interface supports 1-, 2-, and 1/2-slot addressing of a maximum of 32 remote racks. These racks can be either 1/4, 1/2, 3/4, or full racks. The PC3000 supports remote I/O communication rates of 57.6, 115.2, and 230.4 Kbps and can send a maximum of 48 block-transfer read or write requests of up to (and including) 64 words each.

About How the Scanner Module Transfers Discrete Data

A shared memory interface allows the scanner interface to communicate to the remote I/O adapter devices. It exchanges discrete data with remote I/O adapters. Figure 1.3 illustrates how discrete data is transferred.

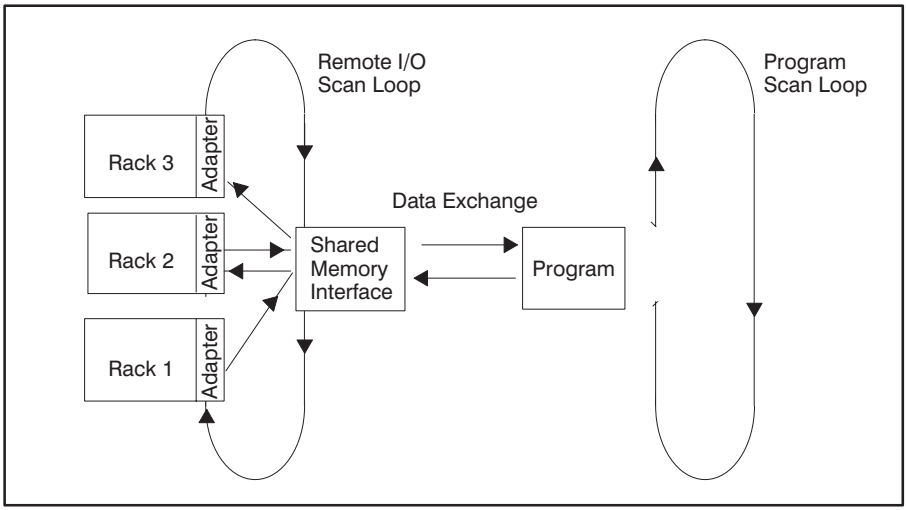


Figure 1.3 - Discrete Data Transfer

About How the Scanner Module Transfers Block Data

In addition to discrete data, the scanner module can also exchange block data with remote I/O devices, such as analog I/O modules. A block-transfer request instructs the scanner module to interrupt normal I/O scanning and transfer as many as 64 words of data to or from a selected I/O module. Only one block-transfer request per I/O rack can be processed during a remote I/O scan.

For more information about block-transfers, see chapter 14, "Configuring and Programming Block Data Transfers to A-B I/O Modules."

1.2.3 About the AutoMax DCS-NET Network Functionality

The AutoMax DCS-NET network is a serial, master/slave network that connects together multiple AutoMax racks. GV3000 and FlexPak 3000 drives, AutoMax PC3000s, and personal computers (with the AutoMax PC3000 Processor or PC-Link card installed) for a very predictable network response rate. Communication is performed at 875 Kbps over coaxial or fiber-optic cable. The number of devices you can have is dependent upon the type of cable you use and its length.

Each device on the network is called a drop. The master drop initiates and controls all transmissions on the network. All transmissions are broadcasted simultaneously. An address encoded on each data packet identifies which slave drop is to respond to that transmission. The slave's response is also broadcasted, with all drops on the network receiving the response data packets.

For more information about the DCS-NET network, see chapter 3.

1.3 About the AutoMax PC3000 Serial Card

The AutoMax PC3000 Serial card contains two optically-isolated serial ports:

- Port A is a 9-pin female D-shell connector. You can configure Port A to support either the RS-232 or RS-422 EIA interface via two jumpers.
- Port B is a 25-pin female D-shell connector. You can use this port as an external connection for a programming terminal running the AutoMax Programming Executive software, or you can configure it to support DCE devices via a jumper.

Figure 1.4 illustrates the features of the AutoMax PC3000 Serial card.

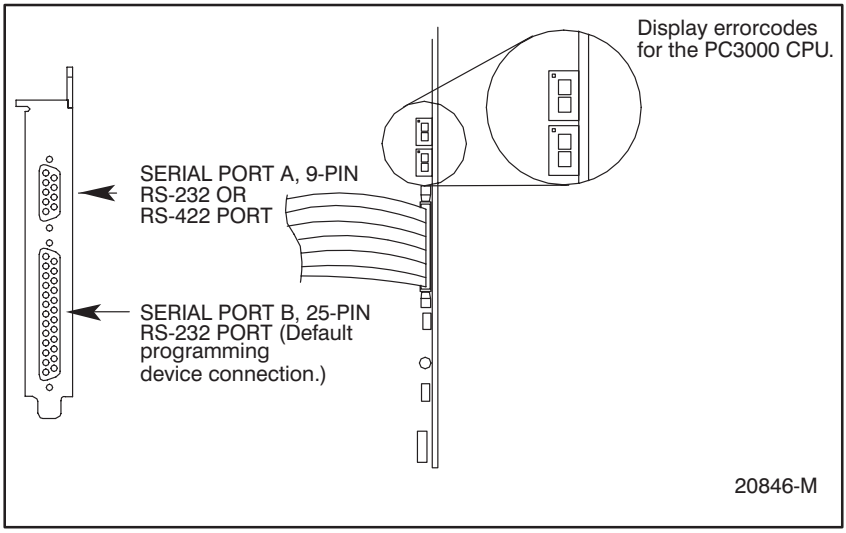


Figure 1.4 - The AutoMax PC3000 Serial Card

The Serial card ships as part of the AutoMax PC3000 Packaged Version, but the card is optional when installing it in a PC chassis. Installing the Serial card in the same PC as the PC3000 Processor card provides you with additional serial connectivity for programming devices, modems, and data display devices, etc.

The AutoMax PC3000 Serial card occupies one full ISA slot, and interfaces with the AutoMax Processor card via a ribbon cable. The ISA bus only provides power to the Serial card.

1.4 About the AutoMax PC3000 Packaged Version

The AutoMax PC3000 Packaged Version is well-suited for a plant-floor environment. It includes a panel-mount, industrial-grade enclosure housing a pre-installed AutoMax PC3000 Processor card and Serial card. The enclosure is equipped with its own fan, fan filter, and power supply. Incoming power connection terminals are mounted onto the enclosure. You connect a programming device for the Packaged Version via Port B on the PC3000 Serial card.

Figure 1.5 illustrates the AutoMax PC3000 Packaged Version.

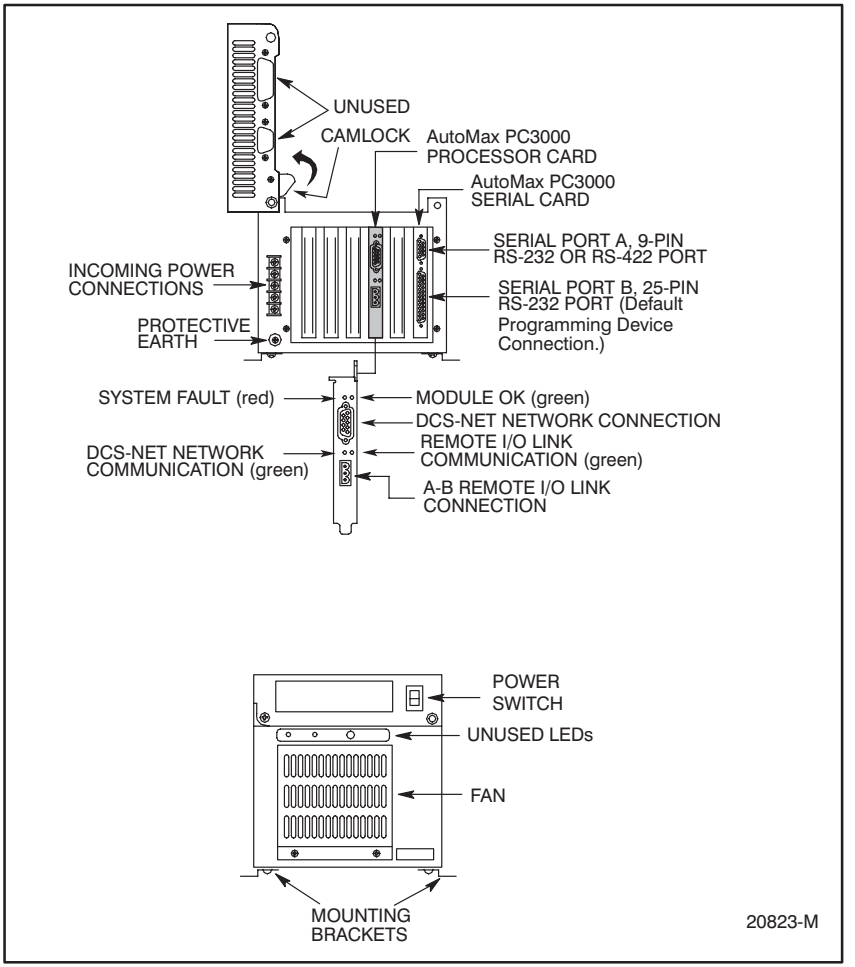


Figure 1.5 - AutoMax PC3000 Packaged Version

1.5 Related Hardware and Software

To configure and program the AutoMax PC3000, you need:

- an IBM-compatible personal computer running the Windows 95 operating system
- RS-232C Interface Cable, M/N 61C127, or another means of connecting to the DCS-NET network
- AutoMax PC3000 driver disk
- Version 4.1A or later AutoMax Programming Executive software

1.6 What to Do Next

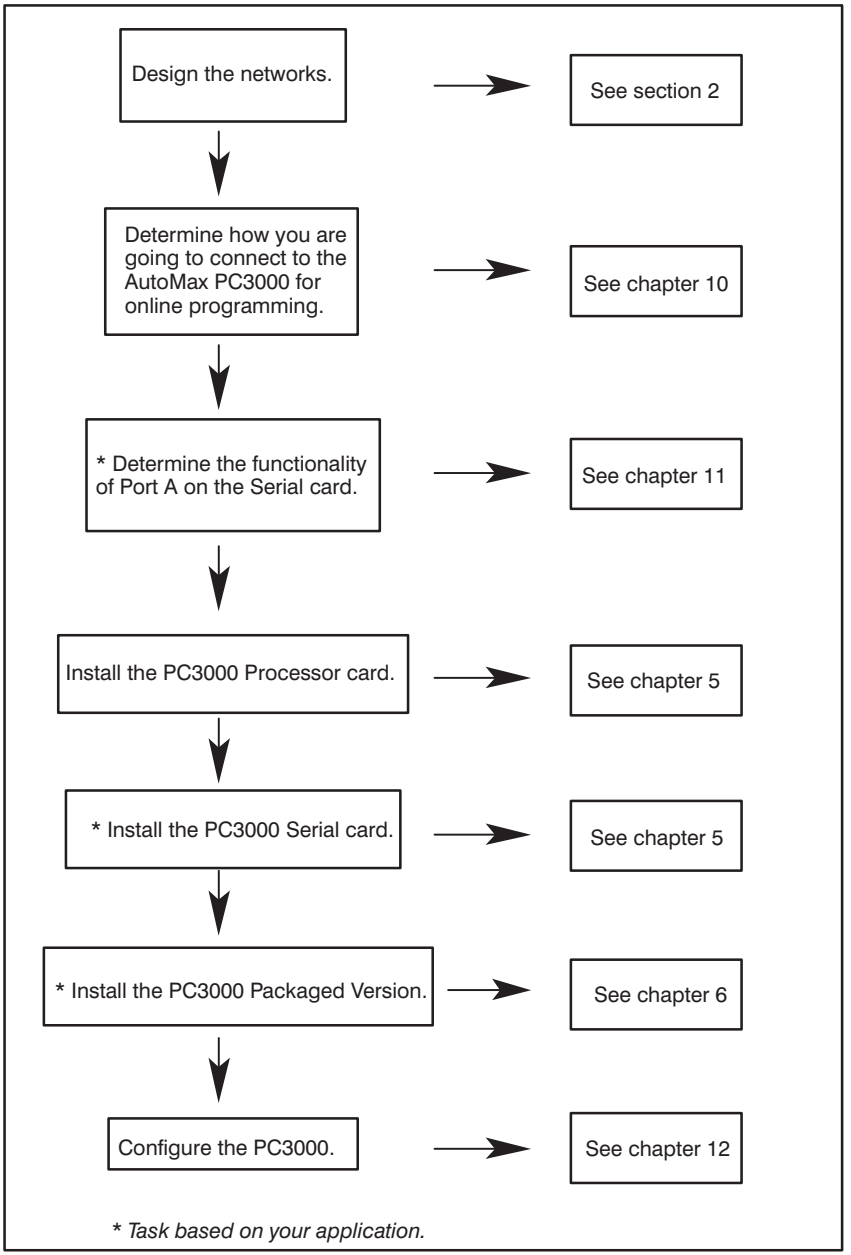
Go to chapter 2 for information about the tasks involved in designing and implementing a PC3000 system.

2.0 GETTING STARTED

Use this section as a guidepost to help you accomplish installing, configuring, and programming the AutoMax PC3000.

For information about:	See this section:
Overview of the Tasks Required to Install and Configure the AutoMax PC3000	2.1
Overview of the Tasks Required to Program the AutoMax PC3000	2.2
Finding the Information You Need When You Are New to AutoMax	2.3
Finding the Information You Need When You Are New to Allen-Bradley Remote I/O	2.4
Overview of the Tasks Required to Configure and Run the Remote I/O Scanner Interface	2.5
What to Do Next	2.6

2.1 Overview of the Tasks Required to Install and Configure the AutoMax PC3000

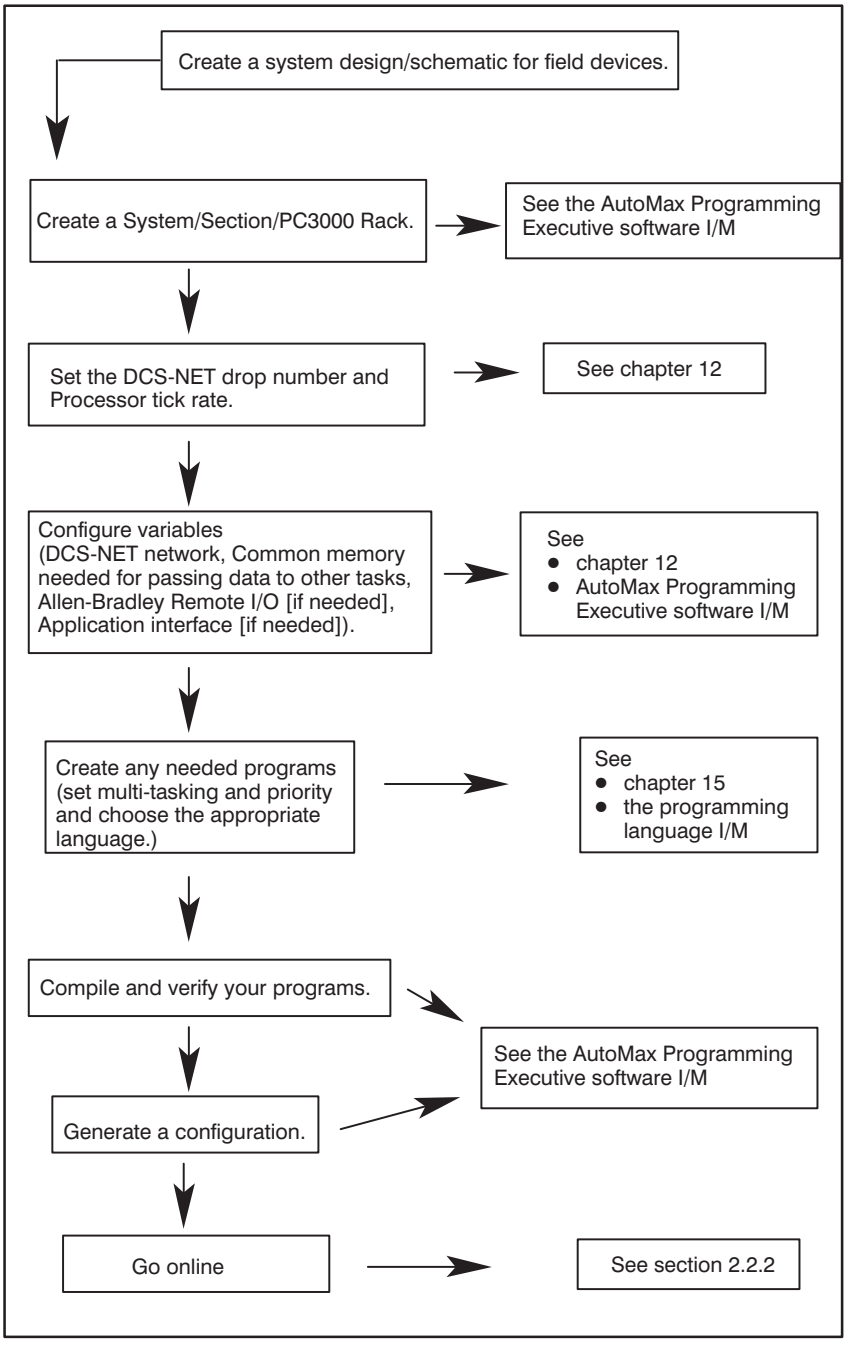


2.2 Overview of the Tasks Required to Program the AutoMax PC3000

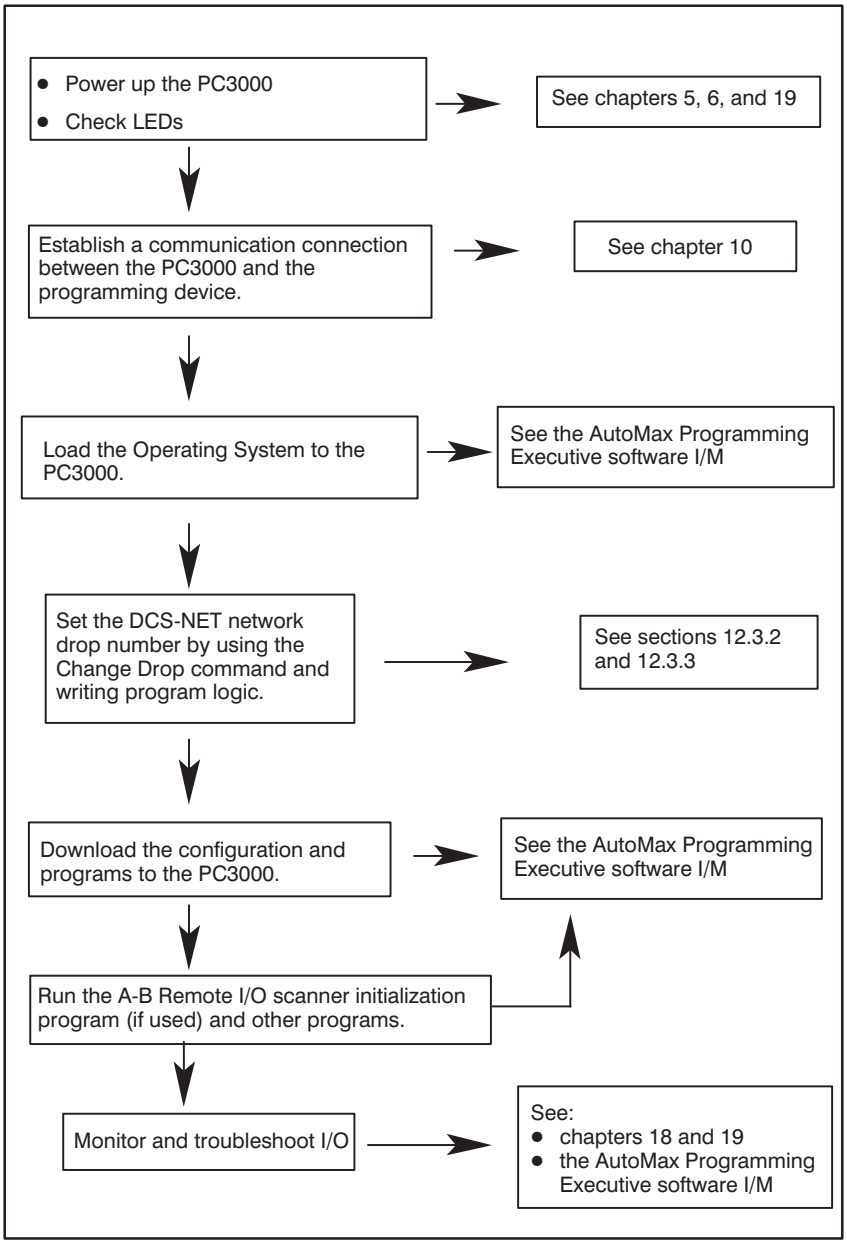
This section lists the tasks you must complete to create and run programs on the AutoMax PC3000 using the AutoMax Programming Executive software. This section assumes the following:

- The AutoMax PC3000 is properly installed.
- A PC using the Windows 95 operating system and running the AutoMax Programming Executive software Version 4.1A is being used as the programming device.

2.2.1 Using the AutoMax Programming Executive Software *Offline*



2.2.2 Using the AutoMax Programming Executive Software *Online*



2.3 Finding the Information You Need When You Are New to AutoMax

If you are a new user of the AutoMax product family, make sure to see these chapters in addition to the AutoMax PC3000 specific chapters:

• chapter 3	Designing an AutoMax DCS-NET Network
• chapter 7	Installing the AutoMax Coaxial DCS-NET Network
• chapter 8	Installing an AutoMax Fiber-Optic DCS-NET Network
• chapter 15	AutoMax Programming Basics
• chapter 21	Maintaining the DCS-NET Network
• Appendix C	Cable Reference
• Appendix D	Register Assignment Map
• Appendix F	Using the Sample AutoMax Configurations and Programs

2.4 Finding the Information You Need When You Are New to Allen-Bradley Remote I/O

If you are a new user of A-B Remote I/O, make sure to see these chapters in addition to the AutoMax PC3000 specific chapters:

• chapter 4	Designing Control Systems That Use the Allen-Bradley Remote I/O Link
• chapter 9	Connecting an Allen-Bradley Remote I/O Link
• chapter 13	Configuring the AutoMax Allen-Bradley PC3000 Scanner
• chapter 14	Configuring and Programming Block Data Transfers to A-B I/O Modules
• chapter 16	Initializing the AutoMax PC3000 A-B Remote I/O Scanner
• Appendix C	Cable Reference
• Appendix D	Register Assignment Map
• Appendix G	Examples of Remote I/O Programs

2.5 Overview of the Tasks Required to Configure and Run the Remote I/O Scanner Interface

Developing a good system design is important to any control system. See chapter 4, “Designing Control Systems That Use the Allen-Bradley Remote I/O Link” for information to consider while designing a control system using Allen-Bradley remote I/O. Included is some basic information about how Allen-Bradley I/O is segmented into logical units, such as I/O racks and I/O groups. An I/O rack is different than an I/O chassis. An I/O chassis is the physical housing of the I/O modules; whereas, an I/O rack is an addressing unit that equals 128 input bits and 128 output bits.

After installing the AutoMax Allen-Bradley Remote I/O Scanner Module, you must prepare it for operation. To do this:

- configure the discrete input and output image table for each rack in your system by assigning variable names to each used input and output
- configure the remote I/O racks in your system by assigning variable names to the remote rack status and control table for each remote I/O rack in your system
- configure the I/O scanner by assigning variable names to the scanner setup and status table
- write an initialization program that accomplishes the following:
    - sets the remote I/O data communication rate for the scanner module
    - enables the remote I/O racks that the scanner module will be scanning
    - places the scanner in RUN mode and initiates scanning of the remote I/O adapters

If you are using block-transfer requests to communicate with I/O, you must do the following:

- configure a block-transfer request by assigning variable names to the block-transfer status and request table

  You will use the block-transfer status and request table to define the destination and length of a block-transfer and how often it is to execute as well as to initiate and monitor the request.
- configure the data table used to exchange data between the scanner module and the target block-transfer module by assigning variable names to each word used for the block-transfer

  You will use the block-transfer data table to store word or bit data you have received from or will be sending to the block-transfer module via a block-transfer request.
- write an application program that sets up and executes a block-transfer operation

See chapter 14, “Configuring and Programming Block Data Transfers to A-B I/O Modules” for information about how to program a block-transfer.

2.6 What to Do Next

Begin the system design process.

3.0 DESIGNING AN AutoMax DCS-NET NETWORK

You can use either coaxial or fiber-optic cable for the DCS-NET network. This chapter provides information to help you design a DCS-NET network.

For information about:	See this section:
The AutoMax DCS-NET Network	3.1
Choosing the DCS-NET Network Media	3.2
Designing a Coaxial Network	3.3
Designing a Fiber-Optic Network	3.4
Calculating the Data Update Rate	3.5
What to Do Next	3.6

3.1 About the AutoMax DCS-NET Network

The AutoMax DCS-NET network is a proprietary network that connects multiple AutoMax Processors to form a distributed control system. In addition to connecting AutoMax Processors, you can connect GV3000 and FlexPak 3000 drives, AutoMax PC3000s, and PCs that have the PC3000 Processor or PC-Link cards installed. All network data is transmitted and received over a single serial-communication coaxial or fiber-optic cable at 875 Kbps.

The network is structured as a master/slave bus. The devices on the network are called “drops.” The master drop (drop 0) initiates and controls all transmissions on the network. All transmissions are broadcast, i.e., all Network interfaces receive the data packets simultaneously. An address encoded in each data packet identifies which slave drop is to respond to that transmission. The slave’s response is also broadcast, with all drops on the network receiving the response data packet. All messages are checked for correctness.

At power-up, the master polls all the slave drops to determine which drops are active on the network and sets the appropriate bits in its status registers. The master initiates all transmissions on the network. During a communication cycle, the master transmits data to each active drop on the network in sequence.

Each Network interface contains enough dual-port memory for storing all data that is transmitted over the network; therefore, each drop contains a memory image of the latest version of all network data at all times. This allows each section of the distributed control system to quickly and easily access data from other sections of the system. The dual-port memory image can be accessed by the CPU on the network interface as well as by any AutoMax Processor.

The dual-port memory of each Network interface is divided into 56 areas called drop areas. Each drop area contains 64, 16-bit registers. The master drop transmits 32 registers to each slave drop area and receives 32 registers from each slave drop area. See Figure 3.1.

You can perform all programming device operations from a single location and can connect to any drop on the network. An IBM-compatible PC running the AutoMax Programming Executive software can program or monitor any Processor on the same network by:

- connecting through any Processor or PC3000 on that network
- using the AutoMax PC-Link module

See chapter 10 for more information about programming over the DCS-NET network.

Programming device messaging occurs after the master drop finishes communicating with all the slave drops.

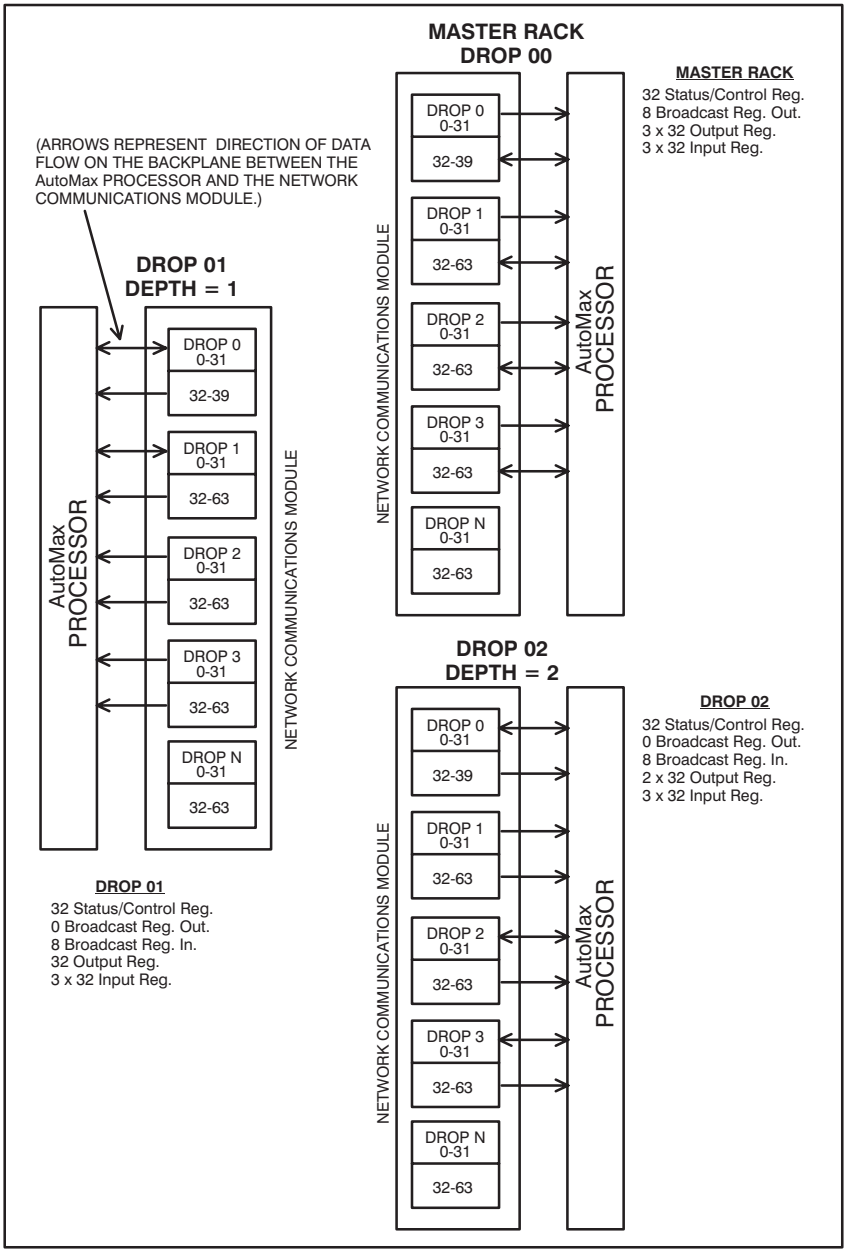


Figure 3.1 - Sample Network

At power-up, the master polls all the slave drops to determine which drops are active on the network and sets the appropriate bits in its status registers. The master initiates all transmissions on the network. During a communication cycle, the master will begin transmitting data to each active drop on the network in sequence. In figure 3.2, the master will transmit its broadcast registers and registers 32 to 63 of its drop 1 area. This packet of data is sent simultaneously to all active drops on the network. In other words, the broadcast registers in the drop 0 area and the second 32 registers in the drop 1 area on both slave Network modules will be updated with this transmission. See figure 3.2.

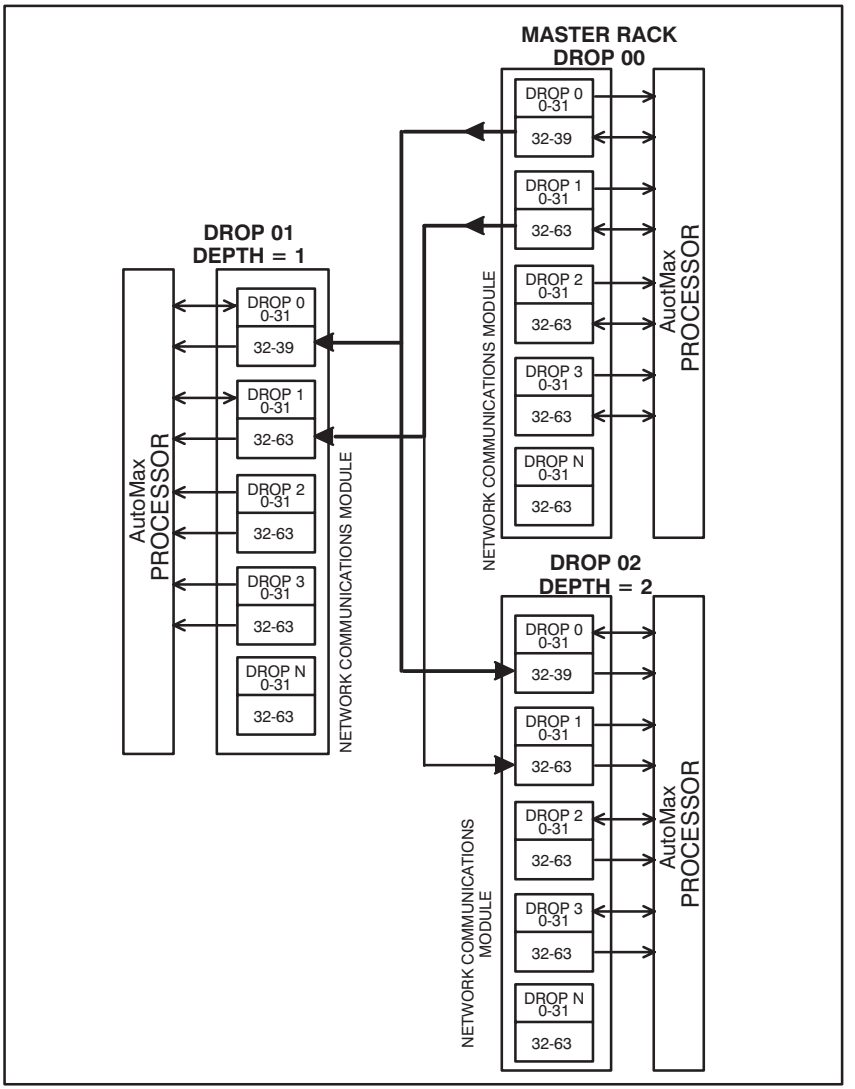


Figure 3.2 - Master Initiates Transmission

3.2 Choosing the DCS-NET Network Media

A DCS-NET network can be built using coaxial cable or fiber-optic cable. Fiber-optic cable is recommended when the following factors are required by the application:

- High noise immunity - Fiber-optic cable is not affected by electromagnetic interference and can be installed with other signal or power wiring.
- Isolation - Ground loops and spurious signals are prevented since there is no electrical connection between the two ends of the fiber-optic transmission system.
- Safety - Fiber-optic cable can be used in chemical plants, as well as in oil and gas refineries, since glass is unaffected by most chemicals or solvents. Breaking a fiber will not create a spark leading to a potential explosion. In addition, since there is no electrical current flowing, exposure to water will not cause a short circuit in the fiber-optic cable.
- Distance - Fiber normally has much lower attenuation than copper. Therefore, longer links can be constructed with fiber-optic cable than with copper (coaxial) cable.

Unlike the DCS-NET coaxial cable network, which allows multiple drops to be connected to a main trunkline, a fiber-optic link provides point-to-point communication only. Therefore, a different network configuration and different hardware components are required to enable communication between drops. A “star topology” network configuration is used for the DCS-NET fiber-optic network, as shown in figure 3.3; whereas, the DCS-NET coaxial network uses a trunkline/dropline configuration, as shown in figure 3.4.

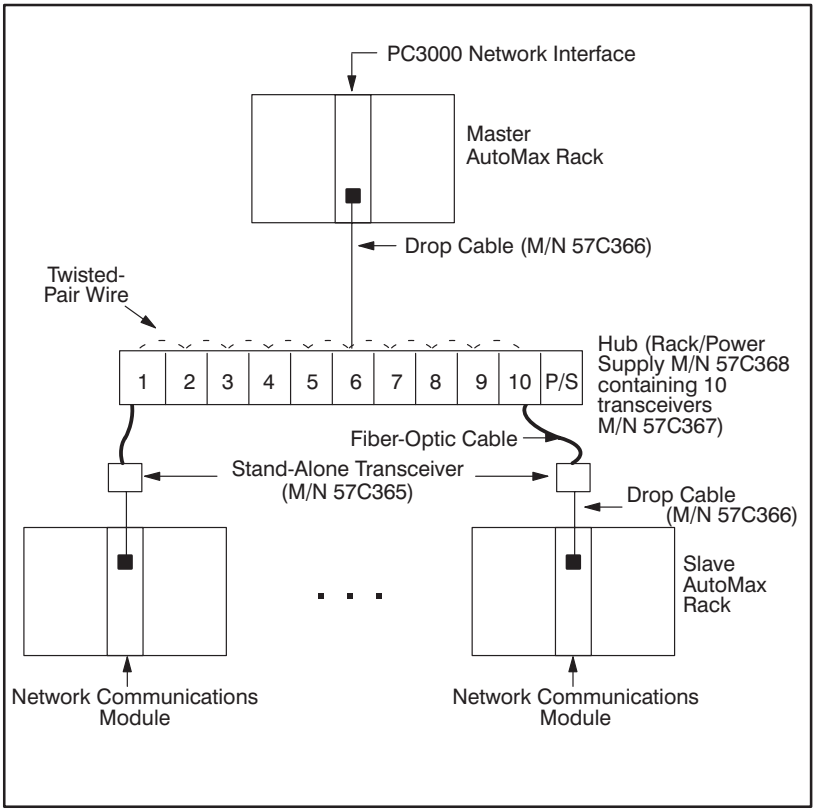


Figure 3.3 - DCS-NET Fiber-Optic Network

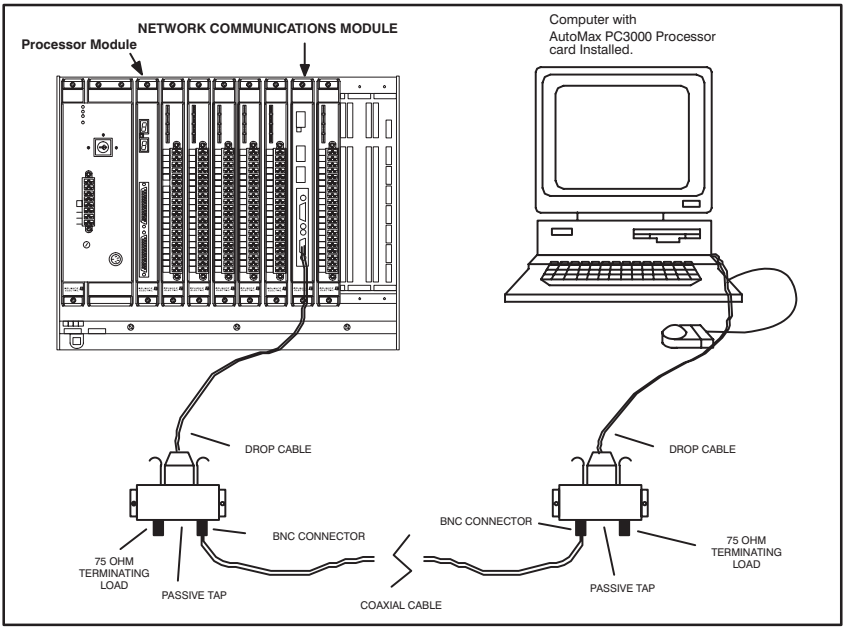


Figure 3.4 - AutoMax DCS-NET Network Coaxial Cable System

3.3 Designing a Coaxial Network

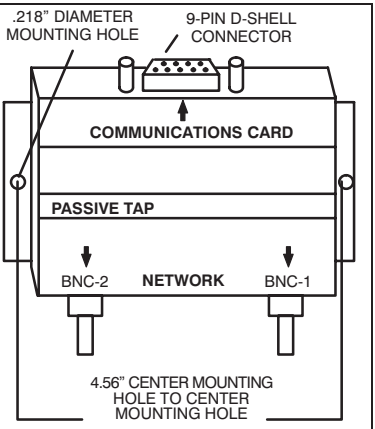
In a coaxial cable network, the drops are connected via a trunkline/dropline cable configuration. Each drop is connected to a tap, which is connected to the main line or trunk of the network. The type of cable you use determines the number of drops you can have.

3.3.1 AutoMax Network Coaxial Cable System Components

The AutoMax network coaxial cable system consists of the following components:

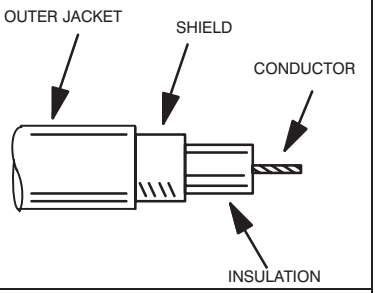
Drop Cable and Communications Passive Tap

The drop cable and the Communications Passive Tap (tap) are used to connect the AutoMax PC3000 to the coaxial cable. The drop cable (M/N 57C381) is a three-foot long multiconductor cable with two 9-pin D-shell connectors at either end. It connects the PC3000 to the tap. The tap (M/N 57C380) provides two BNC-jack connectors for connection to the coaxial cables and terminating loads. A 9-pin D-shell connector is provided for connection to the drop cable. The tap has two fault isolation resistors in series with the transmission line to prevent a malfunctioning PC3000 from affecting other drops on the network.



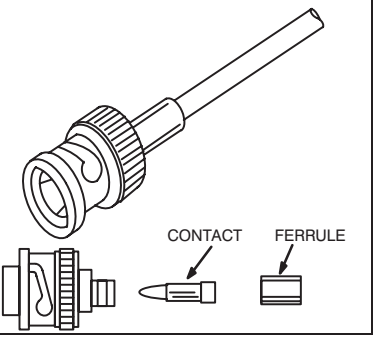
Coaxial Cable

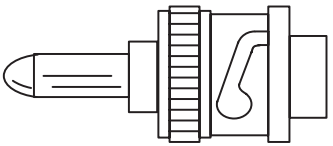
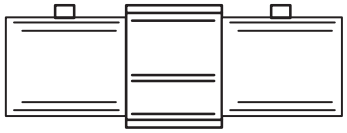
The DCS-NET network uses two types of coaxial cable, RG-59/U or RG-11/U. Cable specifications are provided in Appendix C. Refer to section 3.3.2 for information about selecting the appropriate cable.



BNC Plug Connector

Cable segments are terminated with BNC plug connectors for attachment to the taps. Reliance Electric recommends the dual-crimp, BNC plug connectors manufactured by AMP, Inc., or an equivalent.



75-Ohm Terminating Load The DCS-NET network coaxial cable system must be terminated with 75-ohm terminating loads attached to the taps located at both ends of the cable system. This minimizes the signal reflections that could interfere with other signals transmitted on the cable. The terminating load consists of a BNC plug connector and an internal 75-ohm resistor.	
BNC Jack-to-Jack Adapter The BNC jack-to-jack in-line splicing adapter is recommended for making cable splices when the length of a cable must be extended (for example, when a new drop is added).	

3.3.2 Selecting the Cable Type

The number of drops that can be connected to the network varies depending upon the cable type and length. Figure 3.5 shows some representative distances and the maximum number of physical drops allowed.

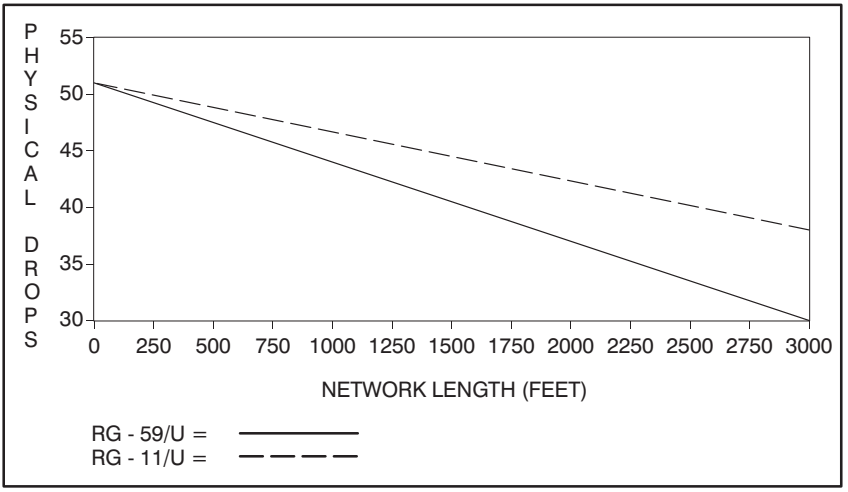


Figure 3.5 - Representative Racks vs. Network Length

To calculate the maximum number of drops, use the following formulas:

For Belden® 9259 (RG-59/U): $N = 52 - 0.725*X$
For Belden 8213 (RG-11/U): $N = 52 - 0.425*X$
where: N = maximum number of drops
X = cable length in hundreds of feet

The RG-59/U and RG-11/U cables can be mixed in a network application. For example, RG-59/U cabling may be used inside a

control cabinet with RG-11/U connecting the various cabinets together. If RG-59/U and RG-11/U cables are mixed, each foot of RG-59/U should be treated as a six foot length of RG-11/U for overall network length calculations. For example, to calculate the overall network length where 1000 feet of RG-11/U and 100 feet of RG-59/U are required, the 100 feet of RG-59/U would be treated as 600 feet of RG-11/U. Therefore, overall network length would be considered as 1600 feet of RG-11/U.

For specific applications (e.g., high temperatures), use cables equivalent to Belden 9259 or Belden 8213 regarding electrical characteristics, etc., as specified in Appendix C.

3.3.3 Planning for Installation

The DCS-NET network is designed to be user-constructed and installed. This enables the network system to be tailored to suit specific needs. Therefore, plan the cable installation carefully before attempting the actual installation (i.e., pulling and cutting cable, terminating with connectors, etc.). The time and effort spent on cable installation will be insignificant compared to the time and effort required to locate and repair damaged or improperly installed cables, connectors, or other cable system components.

The following procedure is recommended to design a cable system that will achieve maximum signal isolation and cable protection in a specific environment with minimum cable usage.

Step 1. Identify the actual location of the AutoMax racks using an equipment floor plan.

Step 2. Identify the preliminary cable route. Route cables to allow easy access in the future. Cable should be readily accessible when new drops are added, existing drops are moved to new locations, or maintenance is performed.

Step 3. Identify the environmental conditions (electrical noise levels, temperature, humidity, exposure to hazardous chemicals, etc.) along this route.

Step 4. Determine how to bypass physical and environmental obstacles (walkways, induction heat sources, furnaces, caustic chemical operations, steam and condensation lines, etc.) along this route.

Step 5. Determine the best type of cable installation (conduit, raceway, or equivalent) for all cable segments along the path.

Step 6. Calculate the total cable length. Note that the cable path distances should be considered in three dimensions.

Step 7. Select the proper cable type (RG-59/U or RG-11/U).

Step 8. Document the cable layout. This document should describe the network cable system design and installation and should be maintained throughout the life of the network. The document should include charts showing routes of all cable segments, locations of cable splices, as well as drop locations and their addresses. This information should be detailed enough to trace a signal path between any two points in the cable system in the event of a network failure or suspected problem.

Step 9. Calculate the number of required cable system components and select their types.

Step 10. Select the tools and instruments necessary to perform the cable system installation.

Step 11. Select the proper personnel to perform the cable installation. The RG-59/U and RG-11/U cables specified in this manual are flexible-type cables, which can be installed by a trained plant electrician.

3.3.4 Cable System Protection and Isolation Recommendations

The cable installation should conform to all applicable codes. To reduce the possibility of noise interfering with the control system, exercise care when installing cable from the system to the external devices. The following sections provide detailed recommendations.

Coaxial Cable Protection	The coaxial cable must be properly handled prior to and during installation. Improper handling may result in cable damage and require cable replacement. Use the following guidelines when handling the coaxial cable: • Keep the cable ends tightly sealed (e.g., with cable caps) during storage, transportation, and installation of the cable. Keeping the cable ends sealed helps prevent exposure to moisture or other foreign matter. • Do not exceed the minimum bend radius of the cable during storage or installation. Refer to Appendix C for cable specifications. Bending the coaxial cable sharper than the recommended minimum bend radius may decrease the reliability of the network. • Prevent the cable from contacting abrasive surfaces such as concrete. • Follow the cable pulling recommendations specified in section 7.3.
Electrical Isolation	Use the following guidelines when installing the coaxial cable to ensure electrical isolation: • The exposed metal parts of the AutoMax network cable system components (BNC connectors, adapters, terminating loads) must not come in direct contact with electrical conductors (including electrical enclosures, AutoMax racks, tap shells, conduits, etc.). If necessary, shield these components using insulating jackets, heat shrink tubing, or electrical seal tape. • The network coaxial cable must be installed in a separate metal conduit. This conduit must be properly grounded along the entire length. • The network coaxial cable must not be installed closer than **1 m** (three feet) away from electrical motors, generators, transformers, arc welders, rectifiers, high voltage lines, induction heat sources, and sources of microwave radiation. • If grouping the network coaxial cable with other cables and you cannot avoid wires, you must comply with the recommendations provided in the ANSI/IEEE Standard 518-1982. • Grounding, lightning, and surge protection of the network cable system and attached equipment must comply with the requirements of applicable codes.

Chemical and Thermal Isolation	The network coaxial cable system must be protected from damage caused by the following factors: • Oil, grease, acids, caustics, and other harsh and/or hazardous chemicals that might damage the cable outer jacket and connectors, adapters, and terminating loads. • Water, steam, and other liquids that could corrode connectors, adapters, and terminating loads. • Open flame, steam lines, and any equipment with the temperature higher than the cable operating temperature.
Physical Isolation	Use the following guidelines to prevent physical damage and wear of the coaxial cable: • Protect the cable from abrasion, vibration, moving parts, and personnel traffic. • Avoid intersecting a cable route with the regular routes of cranes, forklifts, and similar equipment. • Prevent the cable from contacting abrasive surfaces such as concrete.

3.4 Designing a Fiber-Optic Cable Network

In a fiber-optic network, a Stand-Alone Transceiver is required at each slave drop on the network. A Stand-Alone Transceiver is required at the master rack only when this rack and the hub cannot be located together in the same cabinet. The transceiver performs the optical conversion of electrical data signals from the Network module to the network and the electrical conversion of optical data signals from the network to the Network module.

Each drop is connected by a fiber-optic link to another transceiver mounted in a rack. Up to 10 transceivers can be mounted in the transceiver rack, also called a “hub.” All communication between drops takes place in the transceiver rack. The optical signals received by any transceiver in the rack are converted into electrical signals and propagated to all other transceivers in the rack via twisted-pair wire connections. Each transceiver then converts the electrical signals to optical signals and retransmits them to its corresponding drop.

Figure 3.6 shows how a larger network is created by linking hubs together.

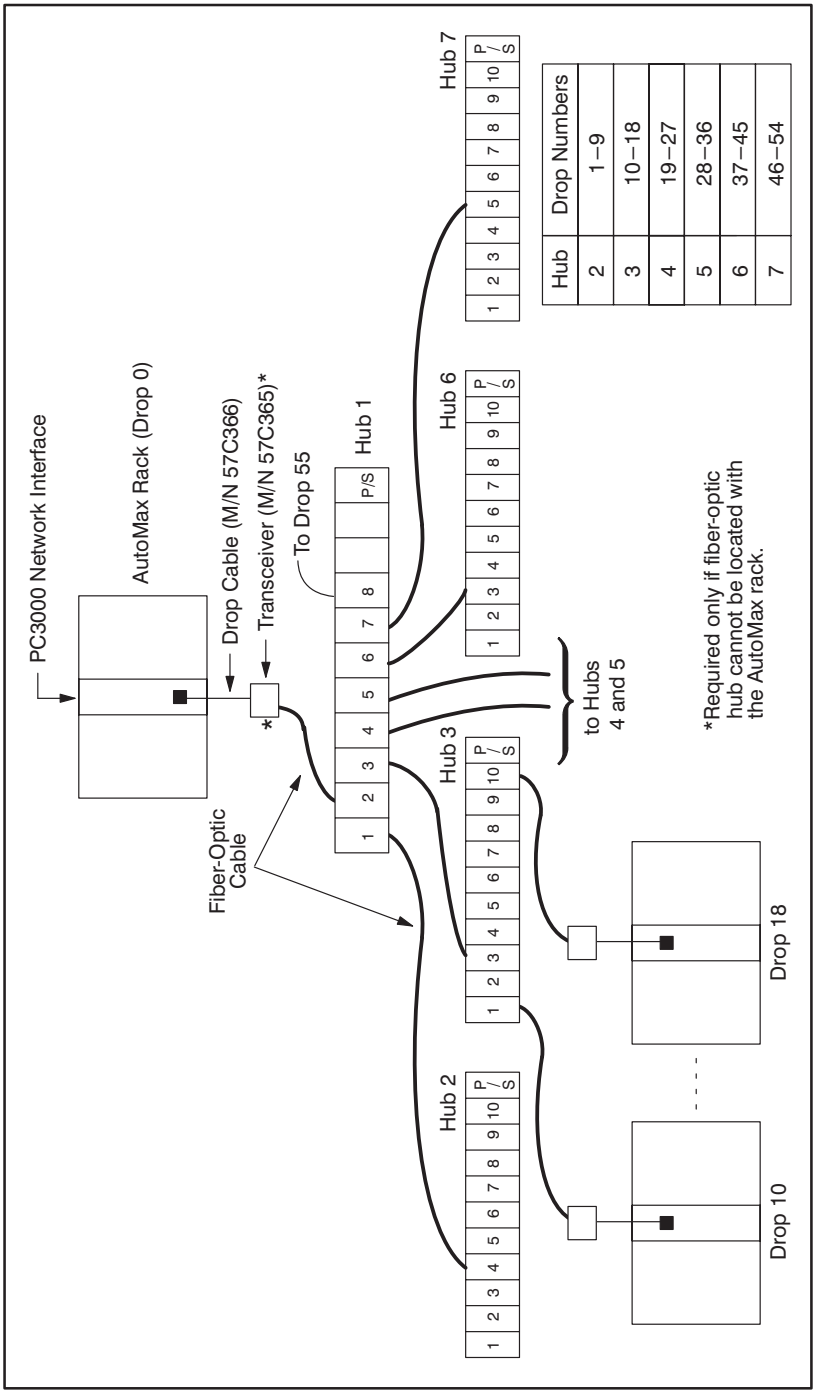


Figure 3.6 - Linking Hubs to Create a Larger Network

Figure 3.7 shows an IBM-compatible personal computer containing an AutoMax PC Link Interface module (M/N 57C445) connected to a Stand-Alone Transceiver. A twisted-pair-to-coax balun (AMP 555053-1 is recommended) is used to convert the cable between the PC Link module and the transceiver. The balun is connected to the PC Link module via the BNC Tee Adapter (M/N 45C70). Note that a 75 ohm terminating load (M/N 45C71) is required. The balun is connected to the transceiver using twisted-pair wire.

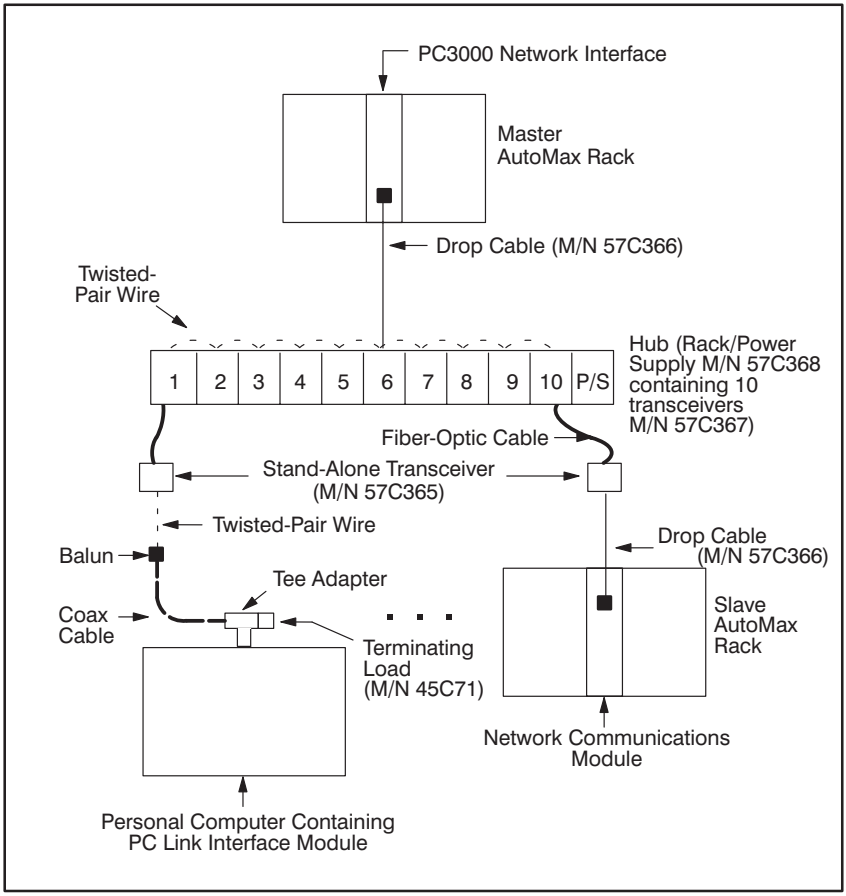
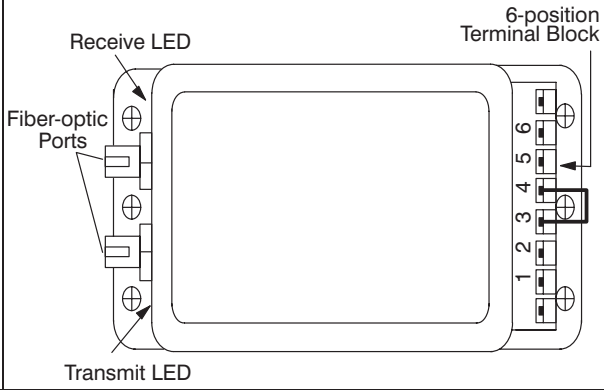
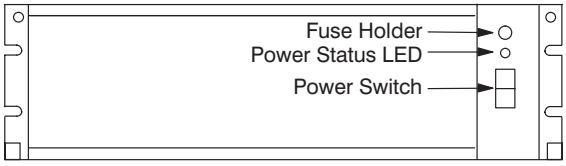


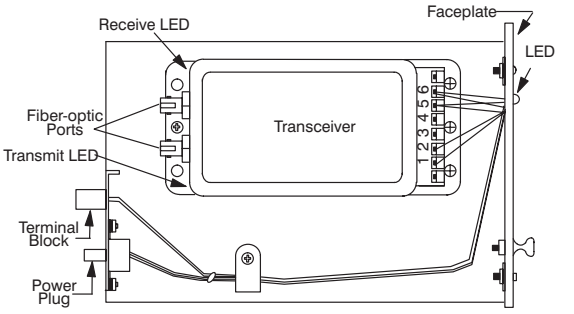
Figure 3.7 - Connecting a Personal Computer to a Stand-Alone Transceiver

3.4.1 DCS-NET Fiber-Optic Network System Components

The DCS-NET fiber-optic network system consists of the following components:

Drop Cable	The drop cable (M/N 57C366) is used to connect the Network module to the transceiver. A 9-pin D-shell connector is provided at one end of the 3-foot (1-meter) cable for connection to the PC3000. Terminations are provided on the other end of the cable for connection to the terminal strip on the transceiver.
Stand-Alone Fiber-Optic Transceiver	The Stand-Alone Fiber-Optic Transceiver (M/N 57C365) is required at each slave network drop for connection to the fiber-optic network. (A Stand-Alone Transceiver is required at the master rack only if the rack and the fiber-optic hub cannot be located together.) It performs the bi-directional conversion between electrical and optical signals. Transceiver technical specifications are listed in Appendix C. The transceiver is designed to be panel-mounted (vertically or horizontally). Mounting holes are provided on flanges that extend from both ends of the enclosure. Receive and transmit ports labeled “R” and “T”, respectively, are provided on one end of the transceiver for connection to the fiber-optic link with the transceiver hub. The transceiver is shipped with dust caps covering the fiber-optic ports. The dust caps should not be removed until the fiber-optic cables are installed, and should be replaced if the cables are disconnected, to prevent dust accumulation and the resulting loss of signal integrity. **WARNING** **TURN OFF AND LOCKOUT OR TAG POWER TO BOTH THE RACK CONTAINING THE NETWORK COMMUNICATIONS MODULE AND THE TRANSCEIVER (RACK-MOUNTED OR STAND-ALONE) BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION, REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.**

Stand-Alone Fiber-Optic Transceiver (continued)	The green LEDs on either side of each connector indicate the status of the receiver and transmitter and will flicker as data is received and transmitted by the transceiver. The opposite end of the transceiver contains a six-screw terminal block for operating power and signal connections. The 24 V DC required for transceiver operation must be provided externally. Note that terminal 6 (-24V) is internally connected to the transceiver enclosure. A jumper between terminals 3 and 4 is used to connect a built-in 120 ohm terminating load between terminals 1 and 2. This jumper must be used on all Stand-Alone Transceivers. 
Fiber-Optic Rack with Power Supply	The Fiber-Optic Rack and Power Supply (M/N 57C368) provide the mechanical means of mounting and providing power for up to 10 fiber-optic transceivers (M/N 57C367). Technical specifications are listed in Appendix C. The rack is a 19-inch, clear, anodized, aluminum enclosure with a transparent plastic front panel. The rack contains a 115/230 V AC power supply and 10 slots for transceivers. Each transceiver receives operating power through plug connections at the bottom of each slot in the rack. Transceiver-to-transceiver wiring and connection to the fiber-optic link is done through openings in the back of the rack. The Power Supply consists of a 115/230 to 14 V AC transformer connected to a standard IEC-style line cord. On the back of the rack, there is a switch wired to the transformer to allow switching the primary from 115 to 230 V AC. The faceplate of the Power Supply contains an ON/OFF rocker switch and a 1.25 amp fuse. A built-in indicator in the ON/OFF switch will illuminate to indicate the presence of power. 

Rack-Mounted Transceiver	The Rack-Mounted Transceiver (M/N 57C367) is simply the Stand-Alone Transceiver (M/N 57C365) attached to an adapter plate, which allows it to be mounted in the Transceiver Rack (M/N 57C368). The adapter faceplate contains one green LED which, when lit, indicates the transceiver is receiving power. Two captive screws on the faceplate secure the transceiver to the rack. A four-screw terminal block is provided on the back of the adapter for transceiver-to-transceiver data transmission via twisted-pair wire. A 2-pin plug on the back of the adapter provides connection to the rack backplane for input power. The Rack-Mounted Transceiver is shipped with the connections made between the four-screw terminal block and plug on the back of the adapter and the six-screw terminal block on the transceiver. A jumper between terminals 3 and 4 on the six-screw terminal block is used to connect a built-in 120-ohm terminating load between terminals 1 and 2. This jumper must be connected on transceivers at the extreme ends of the rack. Receive and transmit ports labeled “R” and “T”, respectively, are provided on the back of the transceiver for connection to the fiber-optic link with the Stand-Alone Transceiver. The transceiver is shipped with dust caps covering the fiber-optic ports. The dust caps should not be removed until the fiber-optic cables are installed and should be replaced if the cables are disconnected, to prevent dust accumulation and the resulting loss of the signal integrity. The green LEDs on either side of each connector indicate the status of the receiver and transmitter and will flicker as data is received and transmitted by the transceiver. **WARNING** **TURN OFF AND LOCKOUT OR TAG POWER TO BOTH THE RACK CONTAINING THE NETWORK COMMUNICATIONS MODULE AND THE TRANSCEIVER (RACK-MOUNTED OR STAND-ALONE) BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION, REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.** 

Fiber-Optic Cable	The DCS-NET network requires a 62.5 micron duplex fiber-optic cable. The recommended cable is Belden cable #225362 or equivalent. This cable has a PVC outer jacket and an internal Kevlar strength member. This cable is a breakout type of cable that contains two individually-insulated, tightly-buffered fiber-optic wires (fibers). This cable may be used in areas where the ambient temperature will not exceed 80°C (176°F). Additional cable specifications are provided in Appendix C. The fiber-optic connectors must be ST®-Compatible Multimode Connectors with ceramic ferrules. Refer to Appendix C for more information.

3.4.2 Planning for Installation

Use the following procedure to design a fiber-optic network that will achieve maximum signal isolation and cable protection in a specific environment with minimal fiber-optic cable usage.

You will need to select the tools and personnel that are required for fiber-optic cable assembly and installation. Unless you have in-house expertise with fiber-optic cable assemblies and installation, we recommend that you contact an experienced contractor for making up and installing fiber-optic cables.

Step 1. Identify the actual location of the AutoMax racks, Stand-Alone Transceivers, and the Transceiver Rack(s) using an equipment floor plan.

Step 2. Identify the tentative fiber-optic cable routes. Route the cables to allow easy access in the future.

Step 3. Identify the environmental conditions (temperature, humidity, hazardous chemicals) along the route that may damage the cable jacket.

Step 4. Determine how to bypass physical obstructions (walkways, heat sources, furnaces, caustic chemicals) along the route that may damage the cable jacket.

Step 5. Determine the best type of fiber-optic cable installation for each point-to-point link (conduit, raceway, wiring tray).

Step 6. Calculate the total length of the fiber-optic cable for each link.

Note that the maximum link length is 2000 meters without splicing.

Step 7. Document the fiber-optic cable system layout. This document should be maintained for the life of the installation.

Step 8. Determine the number of fiber-optic cable components that are needed. Refer to Appendix C for more information on recommended components.

3.5 Calculating the Data Update Rate

The update rate can be calculated using the following formula:

UPDATE_TIME = (DROP_TIME X N) + NEW_DROP_TEST_TIME + MSG_XFER_TIME

where DROP_TIME = amount of time needed for the master to request an update and a slave to respond to the request (2.99 ms).

N = number of slave drops (physical and virtual).

NEW_DROP_TEST_TIME = amount of time needed for the master to poll an inactive drop and wait for its response (2.48 ms assuming no response).

MSG_XFER_TIME = amount of time to transfer programming terminal messages. If the master is sending a message, the MSG_XFER_TIME is 2.09 milliseconds. If a slave is sending a message, this time is 3.395 milliseconds.

For example, a network composed of 10 drops which is not messaging will update each drop with a period of:

[(2.99 x 10) + 2.48] ms = 32.38 ms

The same network with slaves using messaging will update each drop with a period of:

[(2.99 x 10) + 2.48 + 3.395] ms = 35.775 ms

The update time is not affected by how many registers are used in an application task because all 32 input and 32 output registers are transmitted for each active drop.

3.6 What to Do Next

Finish designing your system. For more information about the DCS-NET network, see chapters 7, 8, and 21, and Appendix C.

4.0 DESIGNING CONTROL SYSTEMS THAT USE THE ALLEN-BRADLEY REMOTE I/O LINK

You can use the AutoMax PC3000 to scan remote racks on the Allen-Bradley Remote I/O Network.

For information about:	See this section:
Components of an Allen-Bradley Remote I/O System	4.1
Dividing I/O into Racks	4.2
Designing a Remote I/O Link	4.3
Determining Remote I/O Scan Times	4.4
Optimizing System Performance	4.5
A-B Equipment Installation Considerations	4.6
What to Do Next	4.7

For further information, see these Allen-Bradley publications:

- Rockwell Automation Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1
- Rockwell Automation Safety Guidelines for the Application, Installation, and Maintenance of Solid State Controls, publication SGI-1.1

Also refer to IEEE standard 518-1982.

4.1 Components of an Allen-Bradley Remote I/O System

Figure 4.1 shows some Allen-Bradley remote I/O devices that can be controlled by the AutoMax PC3000.

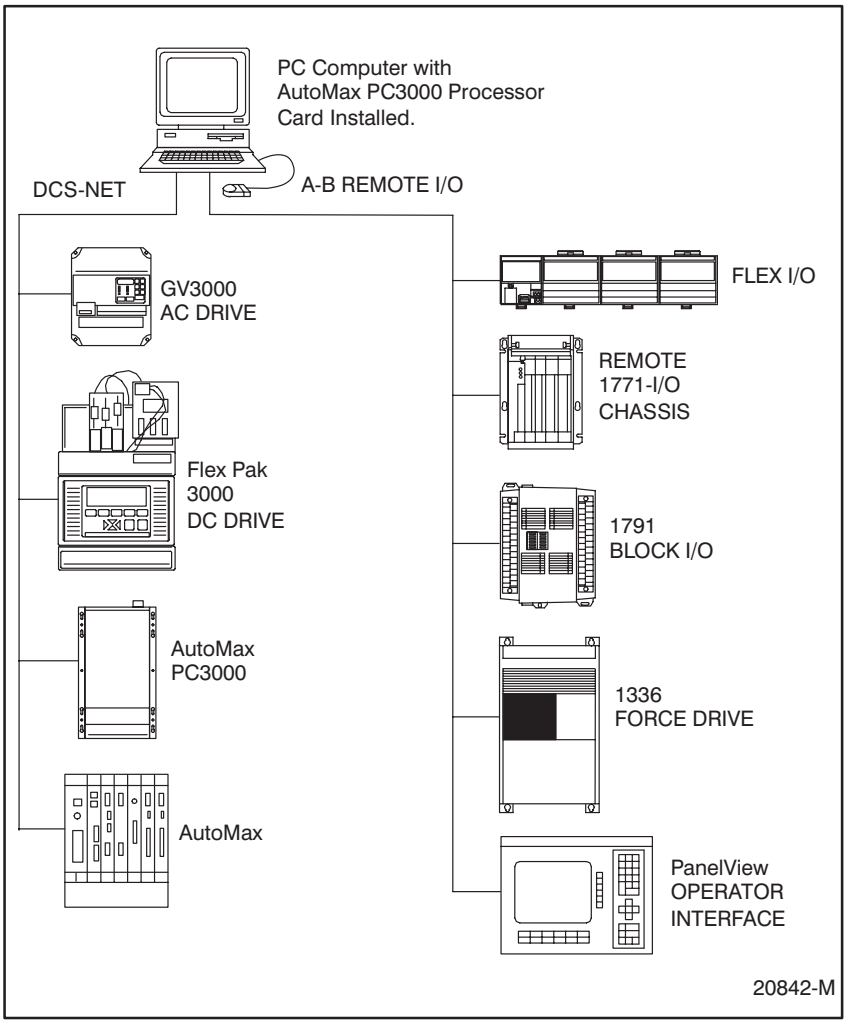


Figure 4.1 - A Typical Remote I/O System

4.2 Dividing I/O into Racks

I/O modules are installed in a chassis, but you must group the I/O points logically into an I/O rack, which is the principal I/O addressing unit. An I/O rack is composed of 128 inputs and 128 outputs or 8 input words and 8 output words.

Use this section to help you divide your I/O points into racks. This section describes:

- Allen-Bradley's I/O addressing concept
- how to address block-transfer modules
- how to determine your remote I/O racks

4.2.1 Allen-Bradley's I/O Addressing Concept

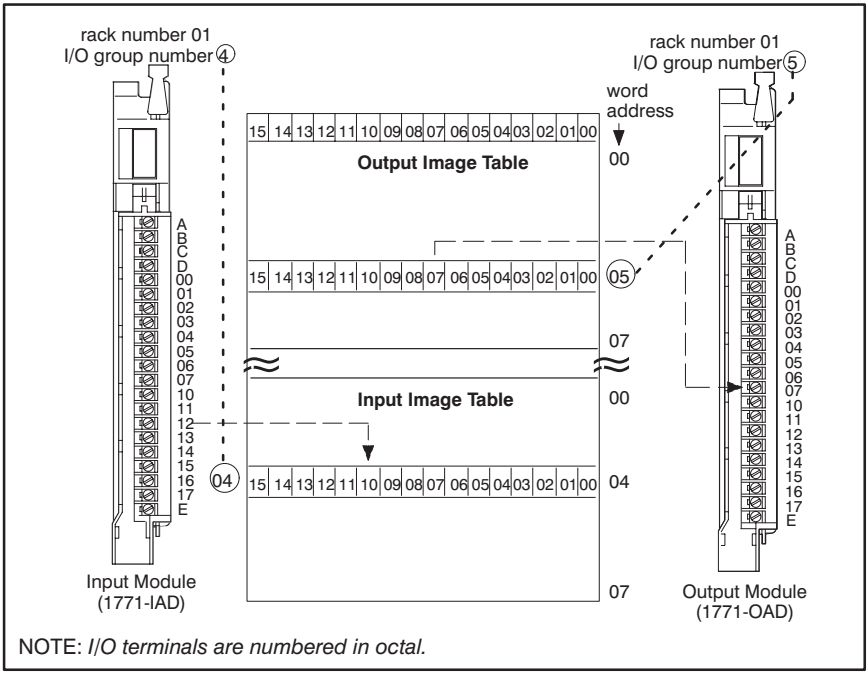
Since the purpose of the PC3000 Remote I/O scanner is to read inputs and control outputs of field devices such as switches, valves, and thermocouples, these inputs and outputs must occupy a location in the scanner module's memory so that they can be addressed in your control program. Each terminal on an input or output module that can be wired to a field device occupies a bit within the PC3000's memory. The part of memory that houses I/O addresses is the **input image table** and the **output image table**.

I/O addressing maps the physical location of an I/O module terminal to a bit location in the PC3000's memory. I/O addressing is a method of segmenting the PC3000's memory. See Table 4.1 for information about how memory is mapped into an I/O address.

Table 4.1 - How Memory is Mapped into an I/O Address

Memory unit:	**Definition:**	**Relation to scanner module's I/O image area:**
terminal or point	A specific terminal on an I/O module that occupies a space in the PC3000's memory.	The density of an I/O module, i.e., 8-point, 16-point, 32-point, directly relates to the amount of memory (bits) the module occupies in the scanner module's input or output image table. For example, a 16-point input module occupies 16 bits in the scanner module's input image table.
I/O group	I/O terminals that when combined occupy 1 word in the PC3000's input image table **and** 1 word in the PC3000's output image table.	16 input bits = 1 **word** in scanner module's input image table **and** 16 output bits = 1 **word** in the scanner module's output image table
I/O rack	The principal logical addressing construct that groups 8 input words and 8 output words into a unit. An I/O rack should not be confused with an I/O chassis, which is the physical housing of I/O modules. I/O racks are numbered in octal.	128 input bits and 128 output bits **or** 8 input words and 8 output words **or** 8 I/O groups

Figure 4.2 shows the relationship between an I/O terminal and its location in the PC3000's memory.



NOTE: *I/O terminals are numbered in octal.*

Figure 4.2 - Sample I/O Terminal Memory Mapping

The next section explains the available addressing methods, which let you define the relationship between an I/O chassis slot and an I/O group (16 input bits and 16 output bits).

4.2.2 Choosing an Addressing Method

For each I/O chassis in your system, you must define how many I/O chassis slots make up an I/O group (1 word each in the input image table and output image table). This choice is the chassis' addressing method. You must define the addressing method for each remote I/O chassis in your system by setting a switch, which is located on the I/O chassis or on the adapter module. For specific information, see the equipment's user manual. See section 4.6.3 in this manual for information about recommended switch settings.

Choose from among these available addressing methods:

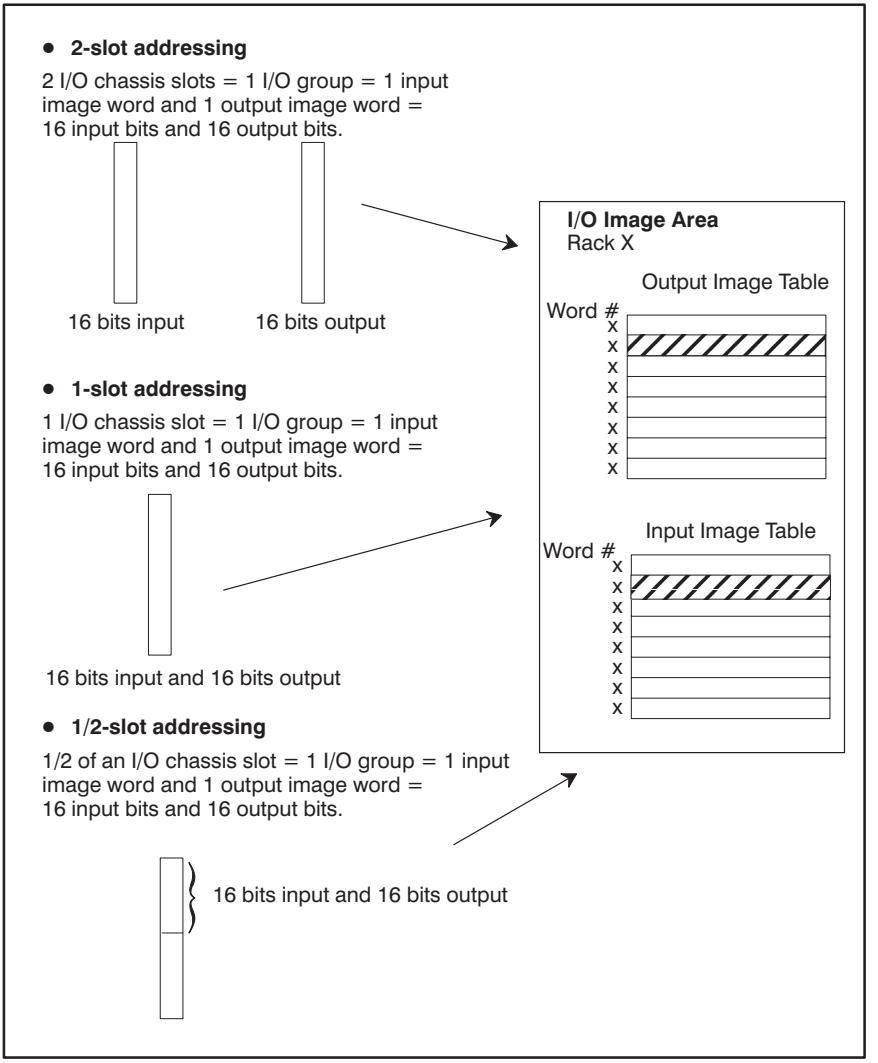


Figure 4.3 - Available I/O Rack Addressing Methods

When you place your I/O modules in the I/O chassis slots, the module's density determines how quickly I/O groups form. For example, figures 4.4 and 4.5 show how 8-, 16-, and 32-point modules utilize the scanner module's I/O image table when using the 1-slot addressing method.

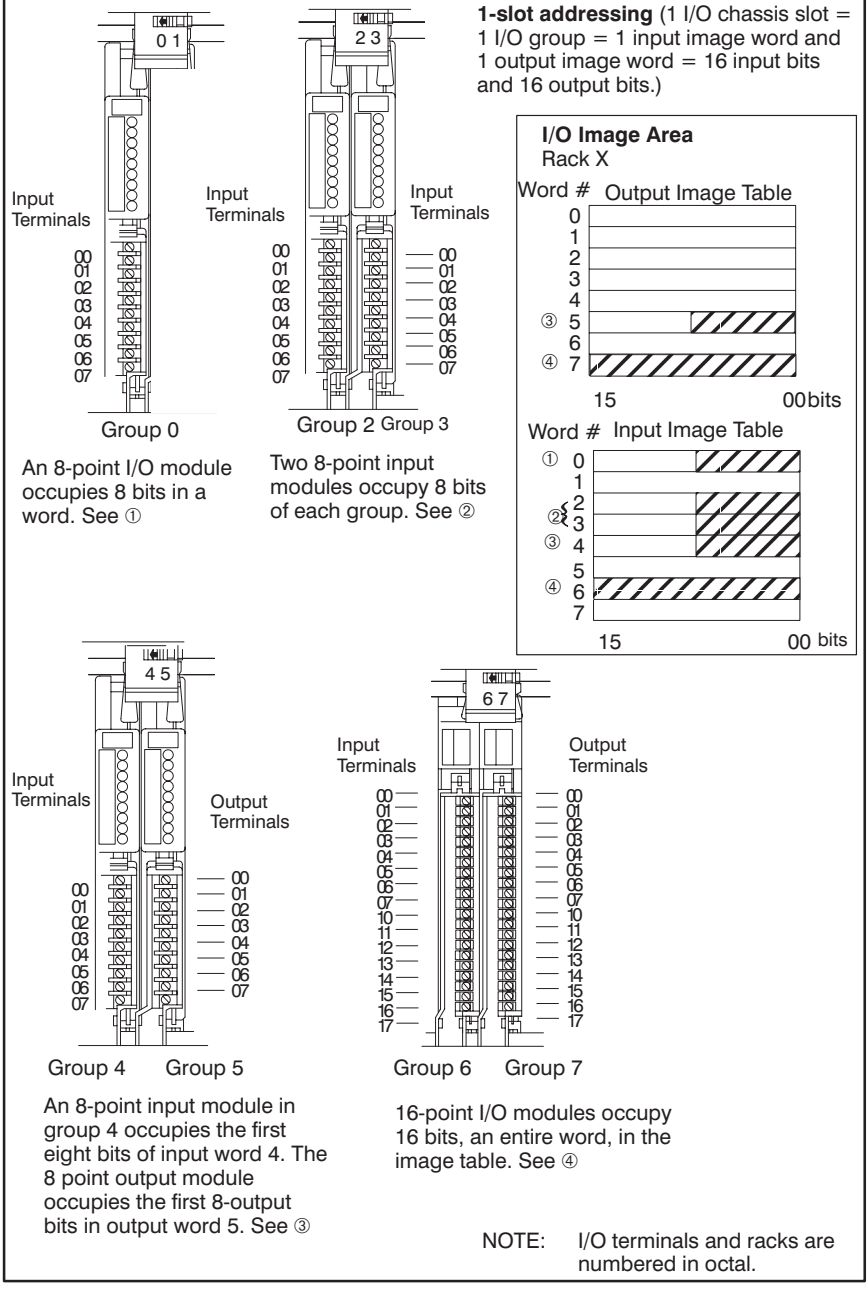


Figure 4.4 - Addressing Example Using 8- and 16-point I/O Modules

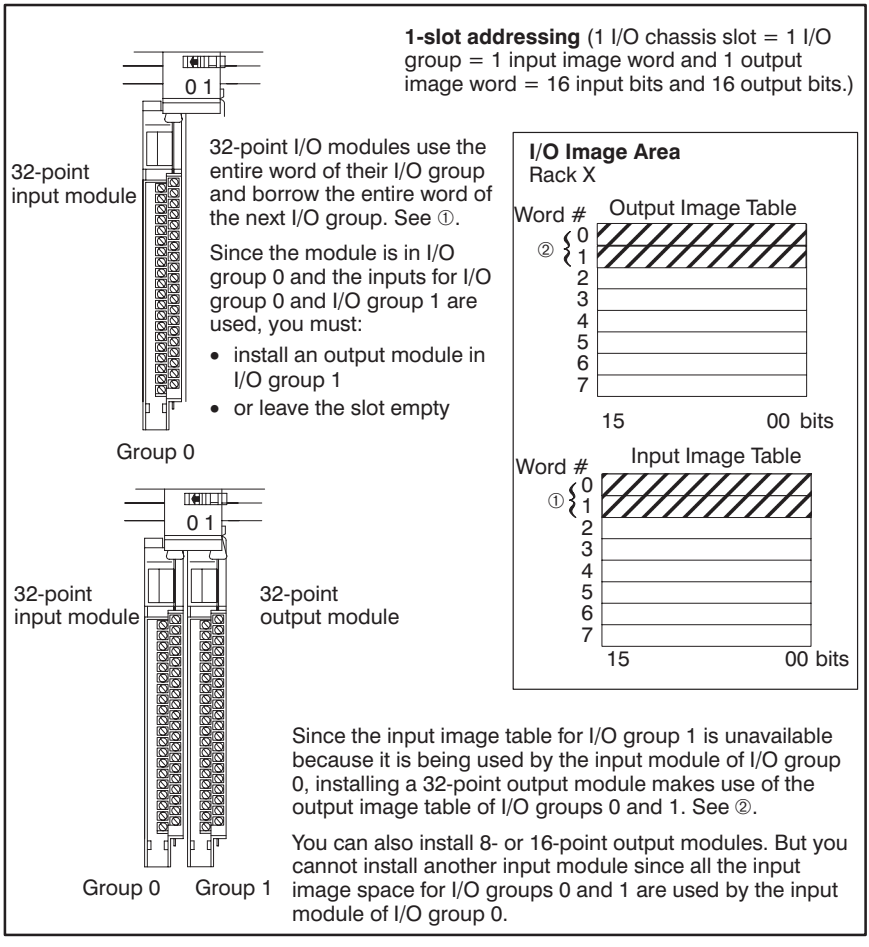
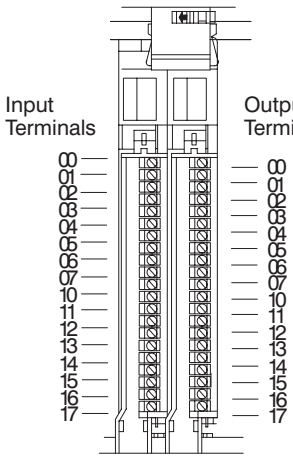


Figure 4.5 - Addressing Example Using 32-point I/O Modules

When planning your system design, consider the densities of the I/O modules you are using and choose an addressing method that most efficiently uses the I/O image area. See Figure 4.6.

2-slot addressing (2 I/O chassis slot = 1 I/O group = 1 input image word and 1 output image word = 16 input bits and 16 output bits.)



16-point I/O modules occupy 16 bits, an entire word, in the image table.

Installing as a pair a 16-point input module and a 16-point output module efficiently uses the image table.

NOTE: *I/O terminals and racks are numbered in octal.*

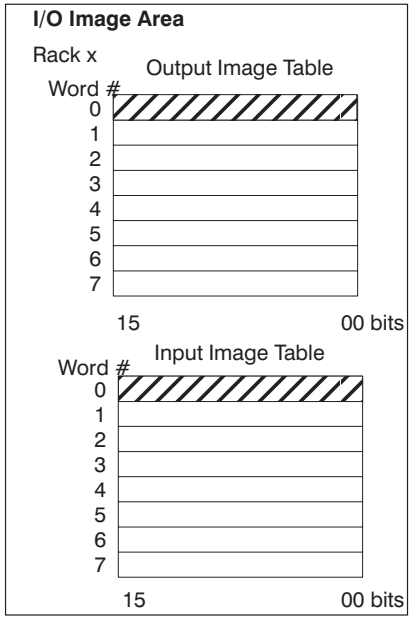


Figure 4.6 - An Example of Efficient I/O Image Table Use

4.2.3 Addressing Block-Transfer Modules

Block-transfer modules occupy 8 bits in the PC3000's I/O image table. Since all block-transfer modules are bidirectional, they cannot be used to complement either input or output modules.

To address a module occupying:	**Use the:**
one I/O chassis slot	assigned I/O rack and I/O group number of the slot in which the module resides and 0 for the I/O group slot number When using 1/2-slot addressing, use the assigned rack number, the **lowest** group number, and 0 for the I/O group slot number.
two I/O chassis slots	assigned rack number, the **lowest** I/O group number, and 0 for the I/O group slot number

4.2.4 Determining Your Remote I/O Racks

Depending on the addressing method you choose for a chassis, more than one rack can be housed in a chassis. These racks are then controlled by the same remote I/O adapter.

Racks are assigned octal numbers. The AutoMax PC3000 can scan a maximum of 32 full racks, which are assigned octal rack numbers 0-37. However, you must start each rack with I/O group 0, because you cannot split a rack between two remote I/O adapter devices. For example, you cannot have remote I/O adapter A occupying the first half of rack 5 and remote I/O adapter B occupying the last half of rack 5; adapter A must control all of rack 5. Consequently, the PC3000 can scan a maximum of 32 adapters, which equates to a maximum of 32 chassis.

NOTE: *The scanner module does not support chassis-to-chassis complementary I/O addressing. This means that you cannot place the input modules of a rack in one chassis and that rack's corresponding output modules in another chassis.*

4.2.5 Addressing Summary

Addressing Method	Guidelines
2-slot	• Two I/O module slots = 1 group. • Each physical 2-slot I/O group corresponds to one word (16 bits) in the input image table and one word (16 bits) in the output image table. • When you use 16-point I/O modules, you must install as a pair an input module and an output module in an I/O group; if you use an input module in slot 0, you must use an output module in slot 1 (or it must be empty). This configuration gives you the maximum use of a rack's I/O image table. • You cannot use a block-transfer module and a 16-point module in the same I/O group because block-transfer modules use 8 bits in both the input and output table. Therefore, 8 bits of the 16-point module would conflict with the block-transfer module. • You cannot use 32-point I/O modules. • Assign one I/O rack number to eight I/O groups.

Addressing Method	Guidelines
1-slot	• One I/O module slot = 1 group • Each physical slot in the chassis corresponds to one word (16 bits) in the input image table and one word (16 bits) in the output image table. • When you use 32-point I/O modules, you must install as a pair an input module and an output module in an even/odd pair of adjacent I/O groups; if you use an input module in slot 0, you must use an output module in slot 1 (or it must be empty). This configuration gives you the maximum use of a rack's I/O image table. • Use any mix of 8- and 16-point I/O modules, block-transfer, or intelligent modules in a single I/O chassis. Using 8-point modules results in fewer total I/O. • Assign one I/O rack number to eight I/O groups.
1/2-slot	• One half of an I/O module slot = 1 group • Each physical slot in the chassis corresponds to two words (32 bits) in the input image table and two words (32 bits) in the output image table. • Use any mix of 8-, 16-, and 32-point I/O or block-transfer and intelligent modules. Using 8-point and 16-point I/O modules results in fewer total I/O. • Assign one I/O rack number to eight I/O groups.

4.3 Designing a Remote I/O Link

Use Belden 9463 (Allen-Bradley cable 1770-CD) cable for the remote I/O network.

To design a remote I/O link you must:

- choose a data communication rate
- determine the cable lengths and terminating resistors you need

4.3.1 Deciding on a Data Communication Rate

Choosing a data communication rate for a remote I/O link not only specifies the rate at which data is transmitted between the scanner and adapters but also affects how far apart you can space the control system components.

When choosing a data communication rate, make sure of the following:

- all devices on the remote I/O link are capable of communicating at that rate
- the communication rate meets your application requirements for speed
- the maximum length of the remote I/O link, as determined by the communication rate, is sufficient for connecting your I/O

The PC3000 can communicate at 57.6, 115.2, or 230.4 Kbps.

4.3.2 Determining the Required Cable Lengths and Terminating Resistors

A remote I/O network must be configured as a daisychain configuration.

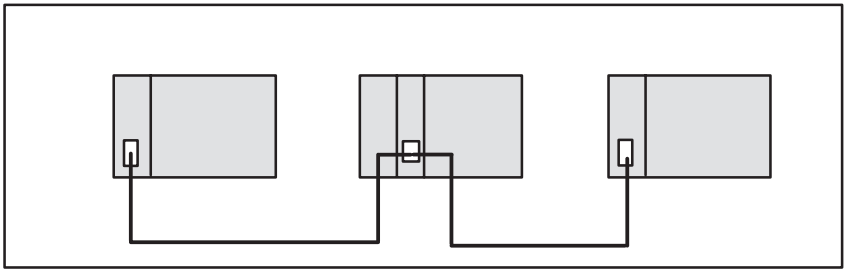


Figure 4.7 - Daisychain Configuration

The length of the remote I/O link is interdependent with the data communication rate. Refer to Table 4.2 for the required remote I/O link cable lengths.

Table 4.2 - Remote I/O Link Distances Per Data Communication Rate

A remote I/O link using this data communication rate (Kbps):	**Cannot exceed this cable length:**
57.6	3,048 m (10,000 ft)
115.2	1,524 m (5,000 ft)
230.4	762 m (2,500 ft)

For proper operation, you must terminate both ends of the remote I/O link by using external resistors. Use an 82Ω resistor to terminate each end of the remote I/O link, unless you are using any of the early devices listed in Table 4.3. If you are using any device listed in this table, you must install a 150Ω resistor at each end of the remote I/O link.

NOTE: *You only can have 16 physical devices on a remote I/O link that is terminated with 150Ω resistors.*

Table 4.3 - Early Remote I/O Link Devices That Require 150Ω Termination Resistors

Device Type	Catalog Number	Series
Adapters	1771-AS	All
	1771-ASB	A only
	1771-DCM	
Miscellaneous	1771-AF	All

4.4 Determining Remote I/O Scan Times

The remote I/O scan time is the time it takes for the scanner to communicate with each device in the remote I/O system. These factors affect the remote I/O scan time:

- link data communication rate
- number of enabled racks
- number of block-transfer requests

You can determine the total remote I/O scan time in a remote I/O system by this formula:

Total Remote I/O Scan Time = # of enabled racks $\times$ **time per rack**
(see Table 4.4)

The formula does not take into account the time required to complete block-transfer requests. This time can be calculated separately. See section 4.4.2 for more information.

4.4.1 Determining the Effect on the Remote I/O Scan Time by the Data Communication Rate

The communication rate determines the time it takes for the PC3000 module to communicate with each enabled rack. Table 4.4 lists the amount of time required to communicate to an enabled device at each communication rate.

Table 4.4 - Communication Times at Different Communication Rates

Data Communication Rate (kbps)	Time (ms)
57.6	10
115.2	7
230.4	3

NOTE: *These are full rack times. Smaller racks will somewhat decrease this time.*

If four full-racks are enabled, the I/O scan at 57.6 kbps is $4 \times 10 = 40$ ms. If you change the communication rate to 230.4 kbps, the I/O scan decreases to $4 \times 3 = 12$ ms.

4.4.2 Determining the Effect on the Remote I/O Scan Time by Block-Transfer Requests

A block-transfer is an interruption of the normal remote I/O scan to transfer a block of data to a specific I/O module. Most of the time that the PC3000 spends in performing the block-transfer is for the handshaking that occurs between it and the block-transfer module. This handshaking is embedded in the discrete I/O transfer and has no effect on the remote I/O scan. The remote I/O scan is affected when the actual data transfer occurs.

The amount of time that the block-transfer interrupts the remote I/O scan depends on the number of words being transferred, the data communication rate, and associated overhead.

Use this formula and the table below to calculate the block-transfer time:

block-transfer time = (number of words being transferred $\times$ ms/word based on the communication rate) + overhead for the communication rate

Communication Rate (kbps)	ms/Word	Overhead (ms)
57.6	.28	3
115.2	.14	2.5
230.4	.07	2

For example, if the communication rate is 115.2 kbps and you want to block-transfer 10 words, the interruption of the remote I/O scan is:

$(10 \times .14) + 2.5 = 1.4 + 2.5 = 3.9$ ms

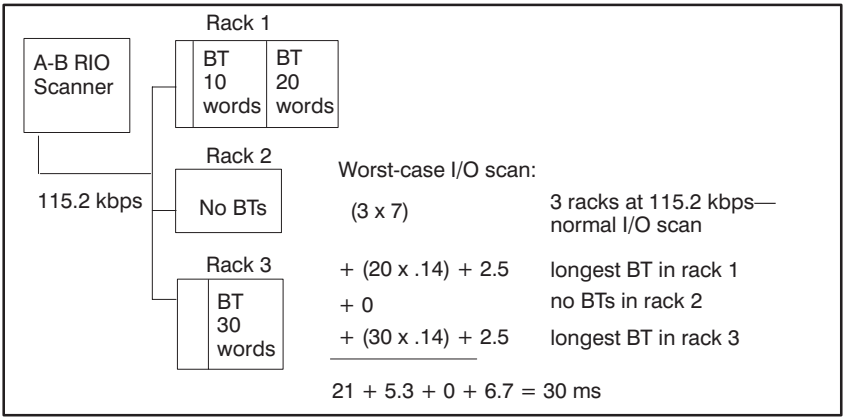
For the particular remote I/O scan in which the block-transfer takes place, 3.9 ms will be added to the remote I/O scan time.

4.4.3 Calculating the Worst-Case Remote I/O Scan Time

Since it is impossible to predict within which remote I/O scan a block-transfer will occur, you only can calculate the worst-case remote I/O scan time. To calculate the worst case time:

- Determine the normal I/O time (without block-transfers)
- Add the time of the longest block-transfer to each entry in the scan list. (The PC3000 can only perform one block-transfer per entry in the scan list per I/O scan.)

For example:



4.5 Optimizing System Performance

You can also optimize block-transfer performance. You can block-transfer to only one block-transfer module per entry in the scan list per I/O scan. If you have three block-transfer modules in one I/O rack, it takes a minimum of three I/O scans to complete the block-transfers to all of the modules:

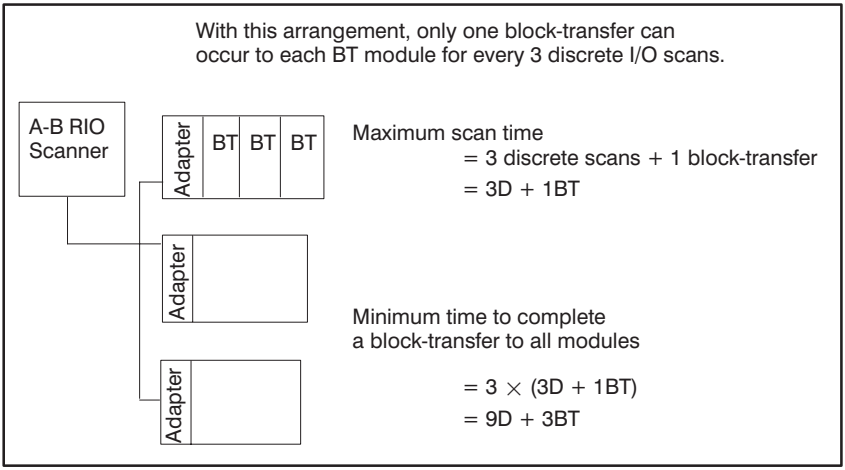


Figure 4.8 - System Optimized for Discrete-Data Transfer

If you place the three block-transfer modules in different racks, however, you can block-transfer to all three modules in one I/O scan. To optimize your system layout for block-data transfers, use an arrangement similar to the following:

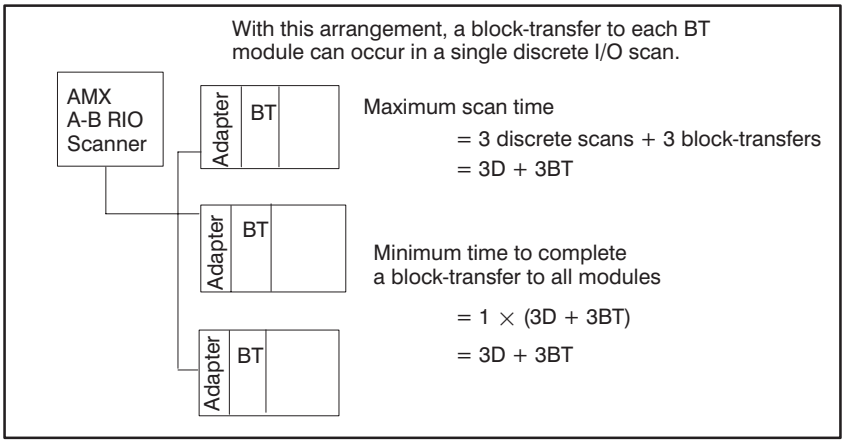


Figure 4.9 - System Optimized for Block-Data Transfer

Here are some guidelines regarding program scan times:

If you are:	**Your program's scan time should be:**
using block-transfers	greater than the minimum time to complete a block-transfer to all block transfer modules
not using block transfers	greater than the remote I/O scan time

4.6 Allen-Bradley Remote I/O Installation Considerations

Allen-Bradley remote I/O equipment requires mounting, wiring and grounding practices that may be different from AutoMax mounting, wiring and grounding practices. Although this section highlights some key points, refer to these standards and publications for complete details:

- IEEE standard 518-1982
- Rockwell Automation Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1
- Rockwell Automation Safety Guidelines for the Application, Installation, and Maintenance of Solid State Controls, publication SGI-1.1

Also, we provide recommendations for configuring adapter devices. Refer to section 4.6.3 for specific switch setting information.

4.6.1 About Remote I/O System Wiring

The raceway layout of a system reflects where the different types of I/O modules are placed in the I/O chassis. Therefore, you should determine the I/O-module placement prior to any layout and routing of wires. When planning your I/O-module placement, however, segregate the modules based on the conductor categories published for each I/O module. The guidelines in this section coincide with the guidelines for the installation of electrical equipment to minimize electrical noise inputs to controllers from external sources in IEEE standard 518-1982.

To plan a raceway layout, do the following:

- categorize conductor cables
- route conductor cables

4.6.1.1 Categorizing Conductors

Segregate all wires and cables into categories as described in the Rockwell Automation Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1. See the installation data for each I/O module that you are using for information about its classification.

4.6.1.2 Routing Conductors

To guard against coupling noise from one conductor to another, follow the general guidelines for routing cables described in the Rockwell Automation Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

You should also follow the safe grounding and wiring practices called out in the National Electrical Code (NEC, published by the National Fire Protection Association, in Quincy, Massachusetts) and local electrical codes.

4.6.2 About Remote I/O System Grounding

Figure 4.10 illustrates the recommended grounding configuration for a remote I/O system. For more information about properly grounding a remote I/O system, refer to the Rockwell Automation Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

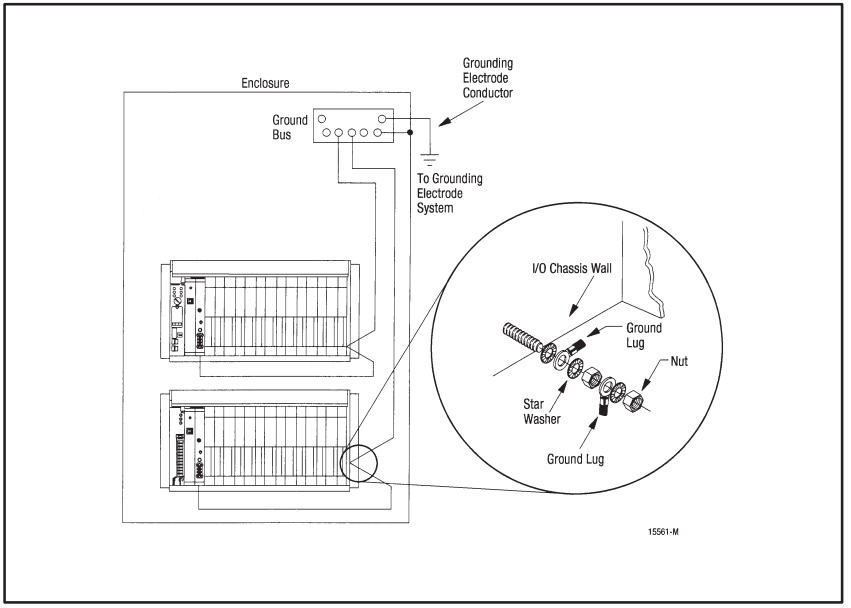


Figure 4.10 - Recommended Grounding Configuration for Remote I/O Systems

4.6.3 Recommended Switch Settings

Switches are used on remote I/O chassis and adapter devices for defining:

- the I/O rack addressing method for the chassis, which defines how much of a slot makes up a word in the I/O image table
- the state of the outputs in the chassis after a communication fault
- how the chassis can be reset
- the remote I/O link communication rate
- the I/O rack number and starting I/O group of the adapter device

Each chassis housing an adapter device has its own addressing method (1-slot, 2-slot, 1/2-slot). The addressing method specified for a chassis is independent from that chosen for other chassis in the remote I/O system.

For each adapter device, set the applicable switch according to these recommendations:

- outputs are turned off when a communication fault is detected by the I/O adapter

WARNING
FAILURE TO SPECIFY THAT OUTPUTS SHOULD TURN OFF WHEN A COMMUNICATION FAULT IS DETECTED BY THE I/O ADAPTER MAY RESULT IN UNEXPECTED AND UNPREDICTABLE MACHINE OPERATION AND BODILY INJURY.

- the I/O chassis can be restarted by the scanner module after a communication fault
- the I/O rack starts at I/O group 0

4.7 What to Do Next

Finish designing your system. For more information about the Allen-Bradley remote I/O link and the remote I/O scanner interface, see chapters 9, 13, 14, and 16 and appendices C, D, and H.

5.0 INSTALLING THE AutoMax PC3000 PROCESSOR AND SERIAL CARDS

To install the AutoMax PC3000 Processor card into a PC chassis, you need an IBM-compatible PC using the Windows 95 operating system that has two adjacent, full-size expansion slots free. Once the Processor card is installed in the PC, you must install the PC3000 driver. If you are going to use the AutoMax Programming Executive software with the PC3000, you need to configure the PC3000.

You can also install the optional AutoMax PC3000 Serial card into the same PC.

5.1 Handling the Cards

CAUTION: The printed circuit boards are static-sensitive. You should wear an anti-static wrist band (user supplied) while installing the AutoMax PC3000 Processor or Serial card. Avoid touching the card's components, connectors, or leads. Failure to observe this precaution could result in damage to or destruction of the equipment.

When handling the AutoMax PC3000 Processor or Serial card, hold the card only by its edges.

5.2 Installing the AutoMax PC3000 Processor Card

An AutoMax PC3000 Processor card requires two adjacent, full-size expansion slots in a PC chassis.

To install the card into a PC chassis, you must:

- prepare the computer
- install the card in a full-size expansion slot

5.2.1 Preparing the Computer

Before you can install the card, you must prepare the computer. You need a screwdriver for this procedure. Follow these steps, but refer to the computer's user manual for detailed instructions about installing optional cards.

Step 1. Make sure the computer is off. Disconnect the power cord.

Step 2. Remove the computer's cover.

Step 3. Find two, free, full-size expansion slots that are adjacent to each other. If you do not know which slots to use, see the computer's user manual.

Step 4. Remove the slot cover's screw by using a screwdriver, and remove the slot cover.

5.2.2 Installing the AutoMax PC3000 Processor Card

To install the card, follow these steps:

Step 1. Remove the card from its shipping container and from its anti-static bag. Be careful not to touch the components or the surface. Refer to section 5.1 for more information.

Step 2. Temporarily record the serial number of the Processor card you are installing. Knowing the serial number of each AutoMax PC3000 Processor card is important when you are installing more than one in a PC. The serial number is printed on a white tag locatedon the upper-right portion of the card.

Step 3. Set Jumper JP2 according to Figure 5.1.

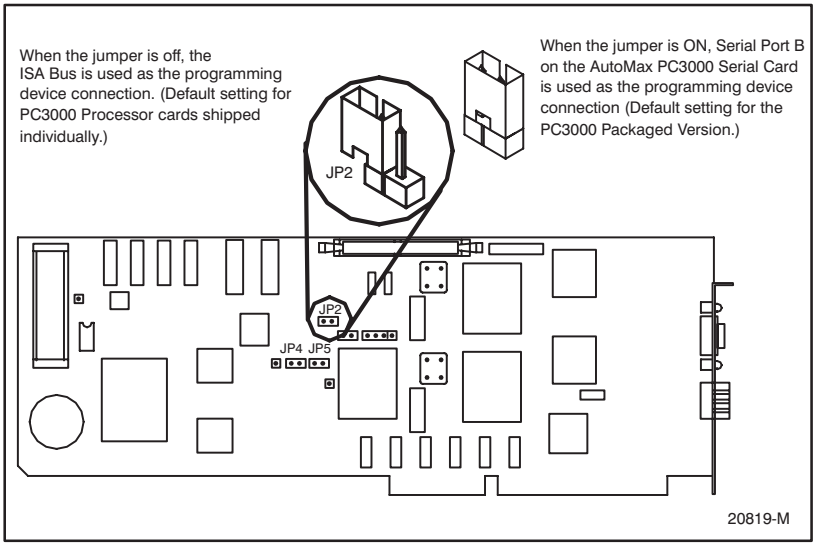


Figure 5.1-Jumper JP2 Settings

For more information about Port B on the Serial card, see chapter 10.

Step 4. Remove the paper strip that covers one end of the on-board battery. For information about handling lithium batteries, see chapter 20.

Step 5. Insert the card into the expansion slot. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the expansion socket. Make sure the card's gold-striped bottom edge sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.

Step 6. Secure the card with the slot cover screw.

Step 7. Use this table to help you determine your next step.

If you:	**Do the following:**
are not installing an AutoMax PC3000 Serial card	a) Replace the computer's cover. b) Install the AutoMax PC3000 driver. (See section 5.3)
are installing an AutoMax PC3000 Serial card	a) Install the Serial card. (See section 5.5) b) Install the AutoMax PC3000 driver. (See section 5.3)
have installed a second Processor card in the PC	Go to section 5.7.

5.3 Installing the AutoMax PC3000 Driver

When you power-up a computer that uses Windows 95 after installing the AutoMax PC3000 Processor card, the computer determines whether new cards have been installed. After you install the first AutoMax PC3000 Processor card in a computer, you must install the AutoMax PC3000 driver so that the PC3000 works with the Windows 95 operating system.

The driver for the PC3000 Processor ships with the PC3000 Processor card and as part of the disk set for the AutoMax Programming Executive software, V4.1A and later. You can order this disk separately as M/N 57C563.

To install the PC3000 driver, follow these steps:

Step 1. Power up the PC and boot into Windows 95.

Windows 95 determines whether a new card has been installed.

Step 2. When you see the prompt requesting you to insert the PC3000 driver, insert the disk containing the driver into the PC's disk drive.

Step 3. Specify the drive containing the disk for the PC3000 driver.

Step 4. Click OK and wait for the computer to reboot.

The AutoMax PC3000 Processor card and driver are now installed. Go to section 5.4.

5.4 Configuring the AutoMax PC3000 for Use with the AutoMax Programming Executive Software

If you want to use the AutoMax Programming Executive software with the PC3000 you must:

- add the card to the PC's Device Manager list and adjust the card's settings
- add the card's address to the SYSTEM.INI file

You may also need to add the card's memory address to the CONFIG.SYS file.

5.4.1 Adding the AutoMax PC3000 Processor to the Device Manager

This section describes how to access the Device Manager list and add the PC3000 Processor card to it.

Accessing the Device Manager List

To access the Device Manager list, follow these steps:

Step 1. After the Windows 95 startup has completed, select the Start menu from the Windows 95 task bar.

Step 2. From the Start menu, select Settings and choose Control Panel.

Step 3. Double-click the System icon.

Step 4. Once the System Properties dialog box is open, choose the Device Manager tab.

Adding the Processor Card

To add the Processor card, follow these steps:

Step 1. In the Device Manager, double-click the PC3000 device listing. You see the Reliance Electric AutoMax PC3000 listed. If a device conflict is present, you see this icon:

Should a device conflict exist, go to section 5.7 to manually configure the Processor card.

Step 2. Select the Reliance Electric AutoMax PC3000, and choose the Properties button. You see the properties for your PC3000 Processor card.

Step 3. Choose the Resources tab.

Step 4. Temporarily write down the starting and ending addresses for the card. For example: *C8000-C9FFF*.

Step 5. Deselect the **Use automatic settings** option.

Step 6. Select the **Input/Output Range.**

Step 7. Choose the Change Setting button. The Edit Input/Output Range dialog box appears.

Step 8. In the Edit Input/Output Range dialog box, change the range to the next available Input/Output range by using the Value list box. Make sure there are no device conflicts.

Step 9. Save your changes by clicking OK; exit the PC3000 Properties dialog box by clicking OK.

Step 10. When prompted by the Creating a Forced Configuration dialog box, click Yes.

Step 11. Close the System Properties and Control Panel.

5.4.2 Adding the PC3000 Processor Card's Address to the SYSTEM.INI File

You must edit the SYSTEM.INI file to add a reference to the PC3000 Processor card. To edit the SYSTEM.INI file, follow these steps:

Step 1. Using a text editor, open the SYSTEM.INI file that is located in the directory where Windows 95 is installed.

Step 2. Locate the section [386Enh].

Step 3. Add the following line to the [386Enh] section:
`EMMExclude=MEM1-MEM2`.

Where: MEM1 = the starting address of the PC3000 Processor card

MEM2 = the ending address of the PC3000 Processor card

Example: `EMMExclude = C800-C9FF`

NOTE: *Although Windows 95 displays the address range in five digits, you must enter the address as four digits. Do not enter the fifth digit in the SYSTEM.INI file.*

Step 4. Add a comment to this address that documents the serial number of the Processor card. For example:
`EMMExclude = C800-C9FF //(serial number)`

Step 5. Save and close the SYSTEM.INI file.

5.4.3 Adding the PC3000 Processor Card's Address to the CONFIG.SYS File

You may need to edit the CONFIG.SYS file to add the PC3000 Processor card's memory address.

To edit the CONFIG.SYS file, follow these steps:

Step 1. Using a text editor, open the CONFIG.SYS file located in the root of the boot drive.

Step 2. Search for the line containing: EMM386.SYS.

Step 3. Use this table to determine your next steps:

If you:	Do the following:
find the line containing: EMM386.SYS	a) Append the following to the EMM386.SYS statement: X=MEM1-MEM2 Where: MEM1 = the starting address of the PC3000 Processor card MEM2= the ending address of the PC3000 Processor card Example: `EMM386.SYS X=C800-C9FF` NOTE: *Although Windows 95 displays the address range in five digits, you must enter the address as four digits. Do not enter the fifth digit in the CONFIG.SYS file.* b) Add a comment on a separate line to this address that documents the serial number of the Processor card. For example: `REM X = C800-C9FF //(serial number)` c) Save and close the CONFIG.SYS file. d) Reboot the computer into Windows 95.
do not find the line	a) Close the CONFIG.SYS file. b) Reboot the computer into Windows 95.

If you are installing another PC3000 Processor card into the PC chassis, go to section 5.7.

5.5 Installing the Optional AutoMax PC3000 Serial Card

You can install the AutoMax PC3000 Serial card in any free, full-size slot. At least one empty slot must remain between the PC3000 Processor card and the PC3000 Serial card, and the two cards must be close enough to each other so that the serial card's ribbon cable can connect easily between them. To install the card into a PC chassis, you must:

- prepare the computer
- set any necessary jumpers
- install the card in a free, full-size expansion slot

5.5.1 Preparing the Computer

Before you can install the AutoMax PC3000 Serial card you must prepare the computer. You need a screwdriver for this procedure. Follow these steps, but refer to the computer's user manual for detailed instructions about installing option cards.

Step 1. Make sure the computer is off. Disconnect the power cord.

Step 2. Remove the computer's cover.

Step 3. Find a free, full-size expansion slot in the computer. If you do not know which slot to use, see the computer's user manual.

Step 4. Remove the slot cover's screw by using a screwdriver, and remove the slot cover.

5.5.2 Configuring Port A for RS-232 or RS-422 Communication

You can configure Port A to communicate using the EIA RS-232 or RS-422 interface by setting jumpers E1 and E2. See 11.1.1 for more information.

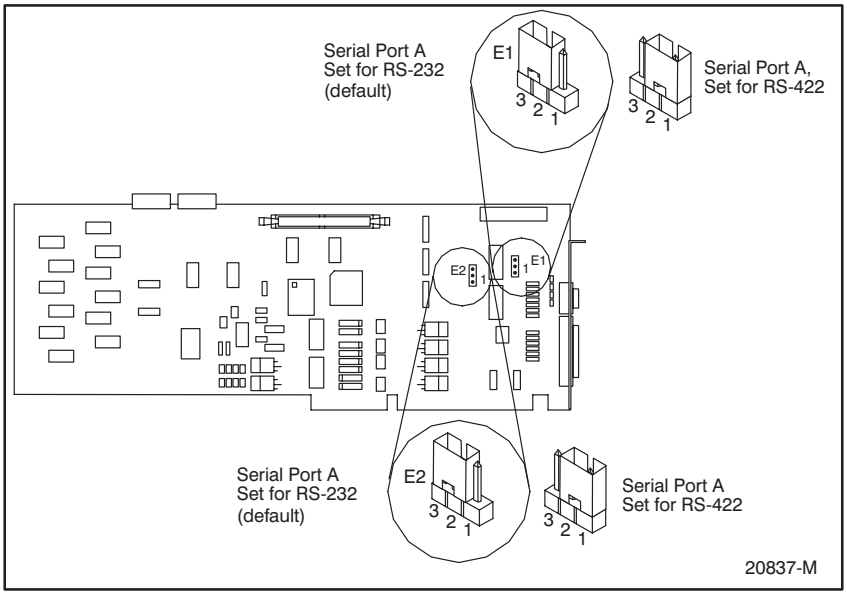


Figure 5.2 - Configuring Port A for RS-232 or RS-422

5.5.3 Configuring the AutoMax PC3000 Serial Card for Use in a PC Chassis

When installing the PC3000 Serial card in a PC chassis, you must **disable** jumpers E3 and E4 on the AutoMax PC3000 Serial card. See Figure 5.3.

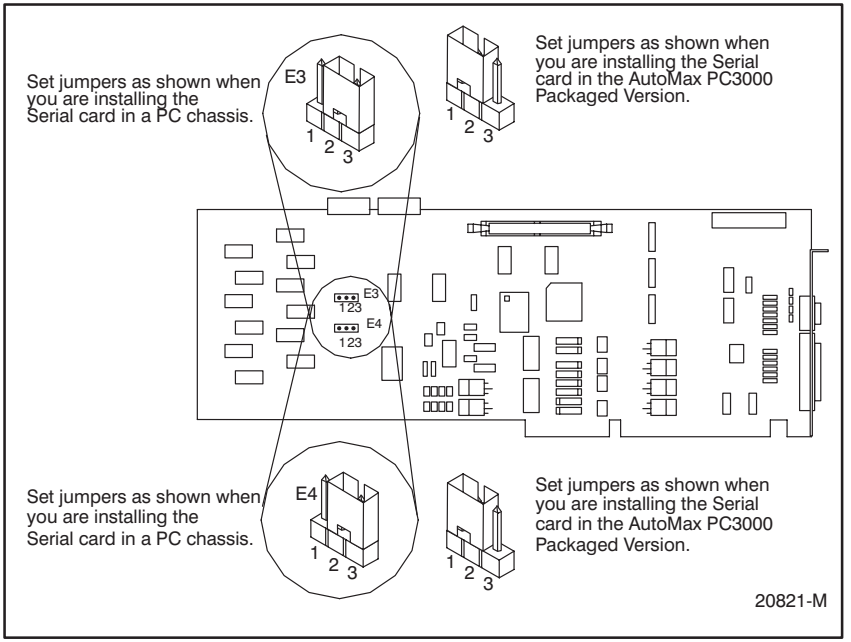


Figure 5.3 - Setting Jumpers E3 and E4

5.5.4 Installing and Connecting the Card

To install the AutoMax PC3000 Serial card, follow these steps:

Step 1. Remove the card from its shipping container and from its anti-static bag. Be careful not to touch the components or the surface.

Step 2. Make sure the jumpers are set according to your needs. See sections 5.5.2 and 5.5.3 for more information.

Step 3. Insert the card into the computer. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card the expansion socket. Make sure the card's gold-striped, bottom edge sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.

Step 4. Connect the ribbon cable to the AutoMax PC3000 Processor card's ribbon-cable connector. Make sure the cable is seated firmly in the connector. See figure 5.4.

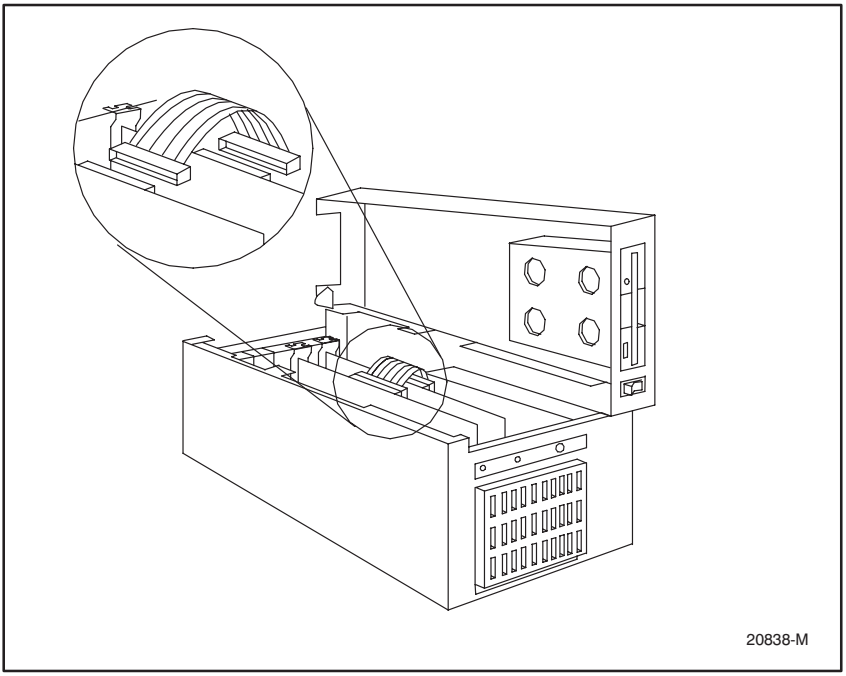


Figure 5.4 - Connecting the Ribbon Cable

Step 5. Secure the card with the slot cover's screw.

Step 6. Replace the computer's cover.

5.6 Wiring Considerations

DANGER

USERS ARE RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL OTHER APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVER-CURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS BODILY INJURY OR LOSS OF LIFE.

To reduce the possibility of electrical noise interfering with the proper operation of the control system, exercise care when installing the wiring from the system to the external devices. For detailed recommendations, refer to IEEE 518.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Refer to Chapter 4 for wiring and grounding recommendations when connecting to Allen-Bradley remote I/O devices.

See Appendix B for information about installing a PC3000 to meet CE compliance requirements.

5.7 Manually Configuring the Processor Card When Device Conflicts Are Present

You can encounter device conflicts when you install a PC3000 Processor card. Devices conflicts are indicated in the Device Manager list when you select PC3000. This icon appears beside the Reliance AutoMax PC3000 item: 

The possible device conflicts you can encounter are:

- I/O address
- memory address
- interrupts

If your PC has a BIOS that precedes the release of Windows 95, Reliance Electric recommends that you replace the computer's BIOS to avoid encountering device conflicts. Consult your computer's manufacturer about receiving an updated BIOS.

However, if you do encounter a device conflict, you must manually configure your card. To do this, follow these steps:

Step 1. In the Device Manager, select the Reliance Electric AutoMax PC3000, and click the Properties button.

Step 2. Select the Resources tab. You see a list of conflicting devices (figure 5.5)

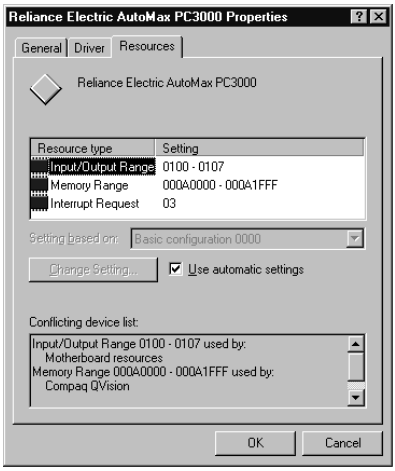


Figure 5.5 - List of Device Conflicts

Step 3. Deselect the **Use automatic settings** option.

Step 4. Based on the list of conflicting devices, select the appropriate Resource Type from the list.

Step 5. Click the **Change Setting** button, and choose another value in the **Value** list. Make sure that the new value does not conflict with other devices. This information is displayed in the **Conflict Information** box.

Step 6. Click OK to return to the **Resources** tab.

Step 7. Use this table to determine your next step.

If:	**Then:**
other conflicting devices are present	repeat steps 5–7 for each remaining conflicting device
no other conflicting devices exist	a) At the Resource tab, click OK. b) When prompted to confirm that you have manually changed the card's settings, click Yes. c) When prompted, shutdown the Windows 95 operating system and restart the computer.

Step 8. Finish installing the Processor card by editing the SYSTEM.INI and CONFIG.SYS files. Go to section 5.4.2 and 5.4.3.

5.8 Installing Multiple PC3000 Processor Cards in a PC

You can install more than one AutoMax PC3000 Processor and Serial cards in a PC. When installing multiple PC3000 Processor cards in a PC, pay careful attention to space and slot constraints. The cards must be installed one-at-a-time.

To install the second AutoMax PC3000 Processor card in a PC chassis, follow the steps in section 5.2. After you install the card in the PC chassis, you must adjust the card's settings in the PC's Device Manager. Follow the steps in the next sections.

5.8.1 Accessing the Device Manager List

To access the Device Manager list, follow these steps:

Step 1. Power up the PC, and boot into Windows 95.

Step 2. After Windows 95 startup has completed, select the Start menu from the Windows 95 task bar.

Step 3. From the Start menu, select Settings and choose Control Panel.

Step 4. Double-click the System icon.

Step 5. Once the System Properties dialog box is open, choose the Device Manager tab.

5.8.2 Adding the Processor Card

To add the Processor card, follow these steps:

Step 1. In the Device Manager, double-click the PC3000 device listing. You see the Reliance Electric AutoMax PC3000 listed. If a device conflict is present, you see this icon:

Step 2. Select the Reliance Electric AutoMax PC3000, and choose the Properties button. You see the properties for your PC3000 Processor card.

Step 3. Choose the Resources tab.

Step 4. Make sure that the option **Use automatic settings** is selected.

NOTE: *If this option is not selected, the PC3000 Processor card you selected in step 1 is not the card you just installed. Do the following:*

a) Leave the Properties tab for this card by clicking Cancel.

b) Choose the other Processor card listed.

c) Repeat steps 2-4.

Step 5. Temporarily write down the starting and ending addresses for the card. For example: *CA000-CBFFF*.

Step 6. Deselect the **Use automatic settings** option.

Step 7. Select the **Input**/**Output Range**.

Step 8. Click the **Change Setting** button. The Edit Input/Output Range dialog box appears.

Step 9. In the Edit Input/Output Range dialog box, change the range to the next available Input/Output range by using the Value list box. Make sure there are no device conflicts.

Step 10. Save your changes by clicking OK; exit the PC3000 Properties dialog box by clicking OK.

Step 11. When prompted by the Creating a Forced Configuration dialog box, click Yes.

Step 12. Close the System Properties and Control Panel.

5.8.3 Adding the PC3000 Processor Card's Address to the SYSTEM.INI File

You must edit the SYSTEM.INI file, located in the directory where Windows 95 is installed, to add a reference to the PC3000 Processor card.

Step 1. Using a text editor, open the SYSTEM.INI file that is located in the directory where Windows 95 is installed.

Step 2. Locate the section [386Enh].

Step 3. Add this additional line to the [386Enh] section: `EMMExclude=MEM1-MEM2`.

Where: MEM1 = the beginning address of the next PC3000 Processor card

MEM2 = the ending address of the next PC3000 Processor card

Example: `EMMExclude=CA00-CBFF`

NOTE: *Although Windows 95 displays the address range in five digits, you must enter the address as four digits. Do not enter the fifth digit in the SYSTEM.INI file.*

Step 4. Add a comment to this address that documents the serial number of the Processor card. For example:
`EMMExclude = CA00-CBFF //(serial number)`

Step 5. Save and close the SYSTEM.INI file.

5.8.4 Adding the PC3000 Processor Card's Address to the CONFIG.SYS File

You may need to edit the CONFIG.SYS file to add the PC3000 Processor card's memory address. To edit the CONFIG.SYS file, follow these steps:

Step 1. Using a text editor, open the CONFIG.SYS file located in the root of the boot drive.

Step 2. Search for the line containing: EMM386.SYS

Step 3. Use this table to determine your next step:

If you:	Do the following:

find the line containing: EMM386.SYS	a) Append the following to the EMM386.SYS statement: X=MEM1-MEM2
	Where: MEM1 = the starting address of the next PC3000 Processor card
	MEM2 = the ending address of the next PC3000 Processor card
	Example:
	`EMM386.SYS X=C800-C9FF X=CA00-CBFF`
	NOTE: *Although Windows 95 displays the address range in five digits, you must enter the address as four digits. Do not enter the fifth digit in the CONFIG.SYS file.*
	b) Add a comment on a separate line to this address that documents the serial number of the Processor card.
	For example:
	`REM X = CA00-CBFF //(serial number)`
	c) Save and close the CONFIG.SYS file.
	d) Reboot the computer into Windows 95.

do not find the line	a) Close the CONFIG.SYS file. b) Reboot the computer into Windows 95.

5.9 What to Do Next

Finish installing your other system components. For more information about monitoring the PC3000, see chapter 20.

6.0 INSTALLING THE AutoMax PC3000 PACKAGED VERSION

The AutoMax PC3000 Packaged Version requires an input voltage source and can be mounted on a panel in an enclosure.

For information about:	See this section:
Planning for Installation	6.1
Wiring Considerations	6.2
Mounting the AutoMax PC3000 Packaged Version	6.3
Grounding the AutoMax PC3000 Packaged Version	6.4
Connecting Power	6.5
Turning on the AutoMax PC3000 Packaged Version	6.6
Installation Considerations When Installing a Microprocessor Card in the PC3000 Industrialized Chassis	6.7
What to Do Next	6.8

6.1 Planning for Installation

The AutoMax PC3000 Packaged Version requires the following input power:

- 120 V AC @ 50 or 60 Hz

  or

- 220 V AC @ 50 or 60 Hz

You should provide an EMI/RFI line filter and surge suppression.

Component	Brand	Reliance Electric P/N
EMI/RFI line feeder (120 and 220 V AC)	Corcom 10VVI Filter	612421-1
Surge Protector 120 V AC	Okaya Electric Industries Co., Ltd. RAV-401BWZ-2A Surge Protector	600686-44A
Surge Protector 220 V AC	Okaya Electric Industries Co., Ltd. RAV-781BWZ-2A Surge Protector	600686-44B

See Appendix B for information about installing a PC3000 to meet CE compliance requirements.

6.2 Wiring Considerations

DANGER

USERS ARE RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL OTHER APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVER-CURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS BODILY INJURY OR LOSS OF LIFE.

To reduce the possibility of electrical noise interfering with the proper operation of the control system, exercise care when installing the wiring from the system to the external devices. For detailed recommendations, refer to IEEE 518.

Refer to chapter 4 for wiring and grounding recommendations when connecting to Allen-Bradley remote I/O devices.

See Appendix B for information about installing a PC3000 to meet CE compliance requirements.

6.3 Mounting the AutoMax PC3000 Packaged Version

You can mount the AutoMax PC3000 Packaged Version on a panel in an enclosure. Figure 6.1 shows the dimensions of the AutoMax PC3000 Packaged Version.

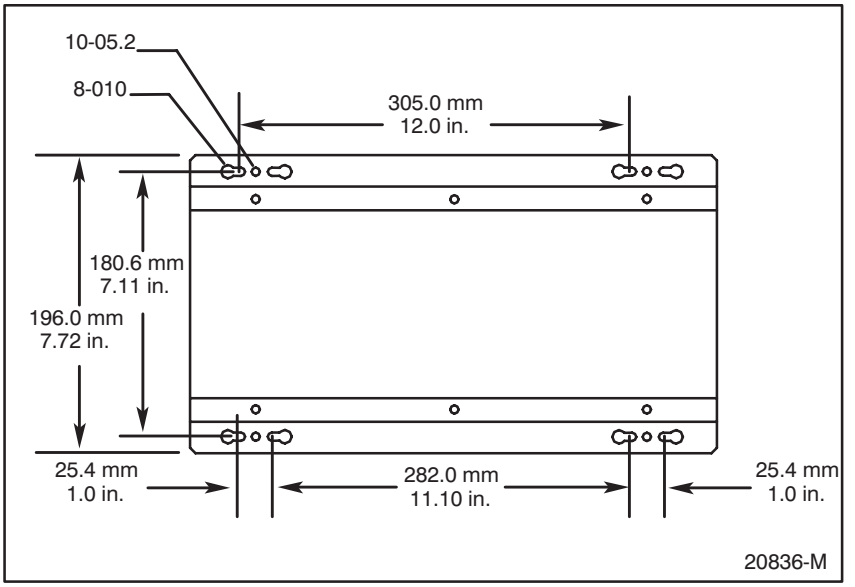


Figure 6.1 - Mounting Dimensions for the AutoMax PC3000 Packaged Version

To mount the AutoMax PC3000, follow these steps:

Step 1. Mark the locations of the bracket holes on the panel. Make sure to leave the following space:

- 22.9 cm (9 in.) next to the connector-side of the chassis to provide space for attaching the cable connectors
- 22.9 cm (9 in.) below the chassis fan to provide space for changing the filter and for air circulation

Use Figure 6.1 as a guide.

Step 2. Secure the PC3000 to the panel with four #10-32 screws.

6.4 Grounding the AutoMax PC3000 Packaged Version

When grounding the AutoMax PC3000, comply with the electrical code of the country where the equipment is or will be installed as well as the appropriate international, national, and local standards, codes, and ordinances.

Connect a ground wire to the “GND” terminal on the input power terminal block or to the ground terminal below the terminal block.

6.5 Connecting Power

Connect incoming power to the terminal strip on the PC3000 industrialized chassis. See figure 6.2 for details.

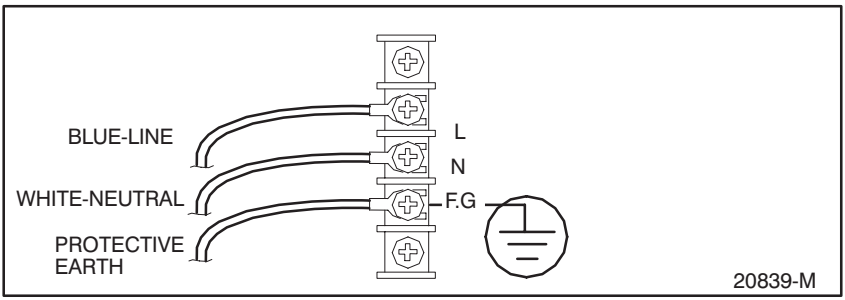


Figure 6.2 - Connecting Incoming Power

Open the chassis door and remove the paper strip covering one end of the battery, which is installed on the PC3000 Processor card.

6.6 Turning on the AutoMax PC3000

Once you have connected power to the AutoMax PC3000 Packaged Version, turn it on by using the power switch on the chassis.

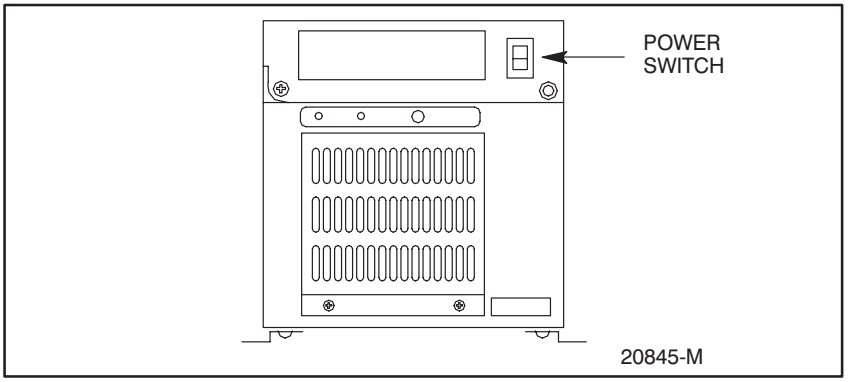


Figure 6.3 - Locating the AutoMax PC3000 Power Switch

6.7 Installation Considerations When Installing a Microprocessor Card in the PC3000 Industrialized Chassis

You can install a user-supplied, ISA-compatible microprocessor card into the AutoMax PC3000 industrialized chassis, making it an industrialized personal computer. To install a microprocessor card into the PC3000 chassis, follow these steps:

Step 1. Make sure that power to the chassis is off; disconnect the power leads for extra safety.

Step 2. Follow the installation instructions provided by the card's manufacturer.

Step 3. Set jumpers E3 and E4 according to figure 6.4.

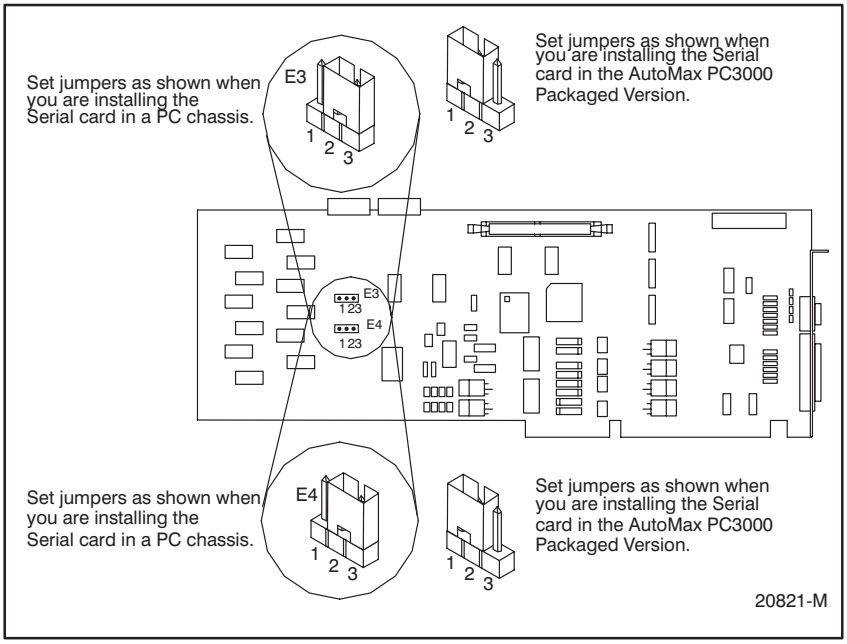


Figure 6.4 - Setting Jumpers E3 and E4

NOTE: *Should you ever remove the microprocessor card from the PC3000's chassis and continue to use the PC3000, you must position the jumpers of E3 and E4 over pins 1 and 2 to enable the load resistors.*

If you want to run the AutoMax Programming Executive software on the microprocessor, you must install the PC3000 driver and add the Processor card to the PC's Device Manager list. Follow the procedures in section 5.3 to do this.

6.8 What to Do Next

Finish installing your other system components. For information about maintaining the PC3000, see chapter 20.

7.0 INSTALLING AN AutoMax COAXIAL DCS-NET NETWORK

Installing the Coaxial DCS-NET network requires special tools and procedures.

For information about:	See this section:
Constructing a Coaxial Cable System	7.1
Inspecting and Testing the Cable	7.2
Pulling the Cable	7.3
Terminating the Cable	7.4
Testing Cable Segments	7.5
Constructing Long Cable Segments	7.6
What to Do Next	7.7

7.1 Constructing a Coaxial Cable System

Construction of the network coaxial cable system consists of the following steps. Each step is described in detail in the sections that follow.

Step 1. Inspect and test all cable before installation.

Step 2. Pull the first cable segment.

Step 3. Terminate each end of this cable segment with a BNC plug connector.

Step 4. Test this cable segment.

Step 5. Pull the next cable segment and repeat steps 3 and 4. Continue until all segments are installed.

Step 6. Assemble the complete cable system. Connect cables to the appropriate taps. Connect the terminating loads to the taps at both ends of the cable system. Connect the drop cables to the taps.

7.2 Inspecting and Testing the Cable

Inspect and test the cable before the installation. This helps ensure that the attenuation does not exceed the expected values at frequencies of interest (as specified in Appendix C) and that internal discontinuities causing reflections do not exist. Many cable suppliers (including Belden) pretest and certify the cable before shipment. However, the cable can be damaged when shipped or stored improperly. Because of this, it is very important to test the cable before the installation. To test for damage, shorts, and discontinuity, use a time domain reflectometer (TDR) or a return loss meter.

7.3 Pulling the Cable

The cable should be pulled manually allowing sufficient slack in the cable so that there is no tension on the cable or connectors when installed. Do not “snap” or apply sudden tension to the cable. Never use a powered cable puller without consulting the cable manufacturer and monitoring the pulling tension. High pulling tensions, tight-fitting conduits, and cable twisting can damage cable shielding and insulation. This type of damage may not be found with physical inspection; it may require special cable testing equipment to locate the damage. Refer to the cable manufacturer’s guidelines on cable pulling for more information.

7.4 Terminating the Cable

Cable stripping and crimping tools for the RG-59/U and RG-11/U cables are supplied by all major connector manufacturers and are available from your local electrical/electronic products distributors.

7.4.1 Terminating RG-59/U Cable

Use the following procedure to install the dual crimp plug connector onto the coaxial cable:

Step 1. After the cables have been installed in the conduit or cable trays, slide the ferrule onto the coax cable as shown in figure 7.1.

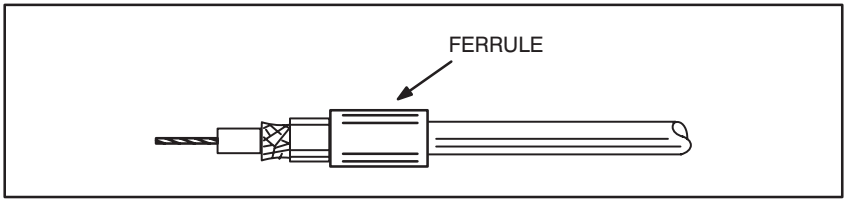


Figure 7.1 - Slide Ferrule onto RG-59/U Cable

Step 2. Strip the coax using the dimensions shown in figure 7.2. Be sure the shield braid wire is cut to the correct length and cannot touch the center conductor.

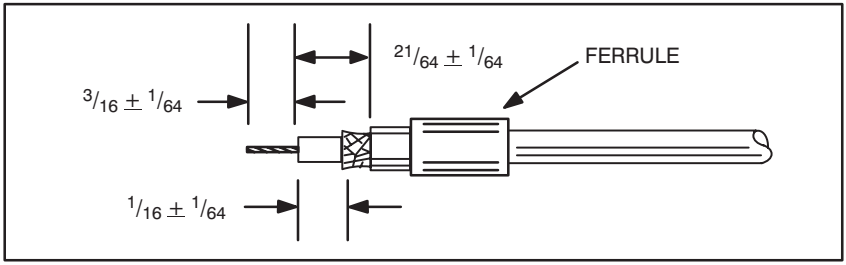


Figure 7.2 - RG-59/U (Belden 9259) Cable Stripping Dimensions

Step 3. Place the center contact, assembled on the stripped conductor, in the partially closed crimping dies as shown in figure 7.3. Be sure the flange on the end of the center contact butts against the crimping die.

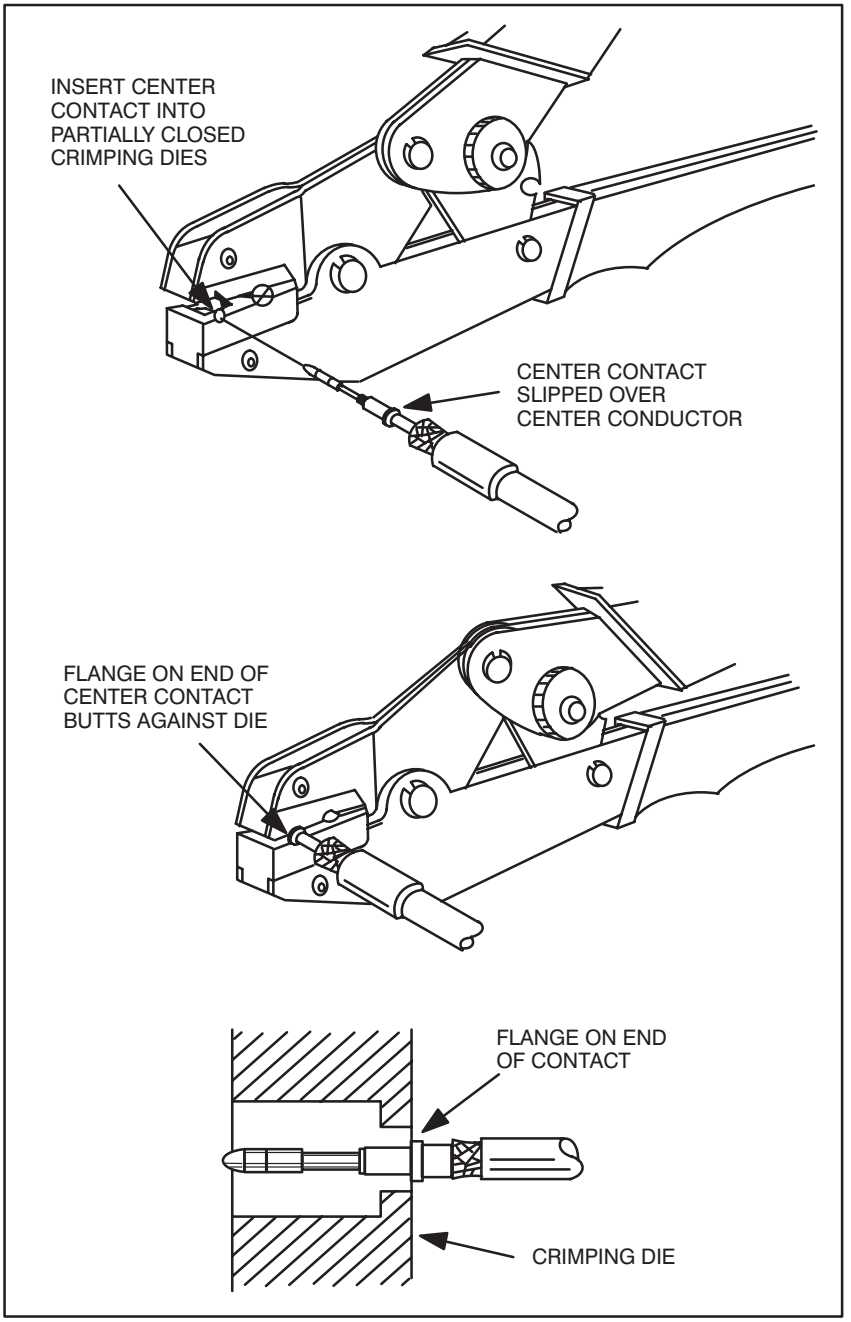


Figure 7.3 - Connector Installation Step 3 for RG-59/U Cable

Step 4. Crimp the center contact by holding the cable in place and closing the tool handles until the ratchet releases.

Step 5. Remove the crimped contact from the dies.

Step 6. Verify that the shield braid wire does not touch the center contact. Refer to figure 7.4.

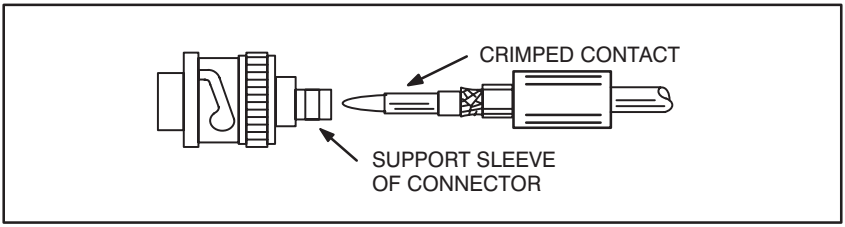


Figure 7.4 - Connector Installation Step 6 for RG-59/U Cable

Step 7. Insert the crimped center contact into the connector body until the cable dielectric butts against the dielectric inside the connector body. The flared braid will then fit around the support sleeve of the connector body, as shown in figure 7.5.

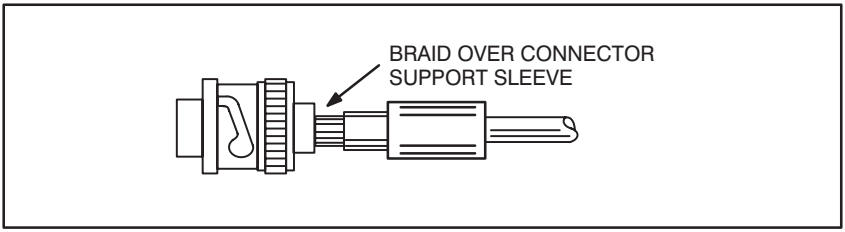


Figure 7.5 - Connector Installation Step 7 for RG-59/U Cable

Step 8. Slide the ferrule forward over the shield braid wire and the support sleeve until the ferrule butts against the shoulder on the connector body, as shown in figure 7.6.

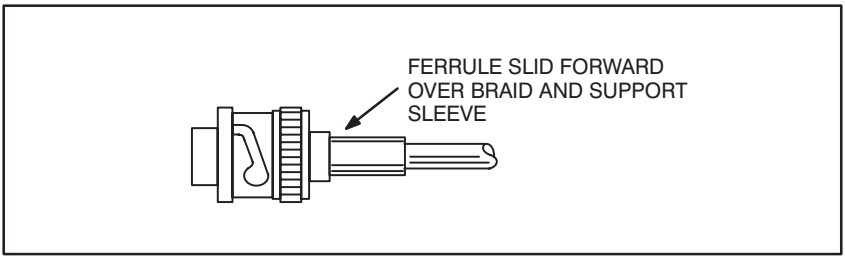


Figure 7.6 - Connector Installation Step 8 for RG-59/U Cable

Step 9. Place the ferrule on the anvil of the die assembly so that the shoulder on the connector body butts against the die, as shown in figure 7.7.

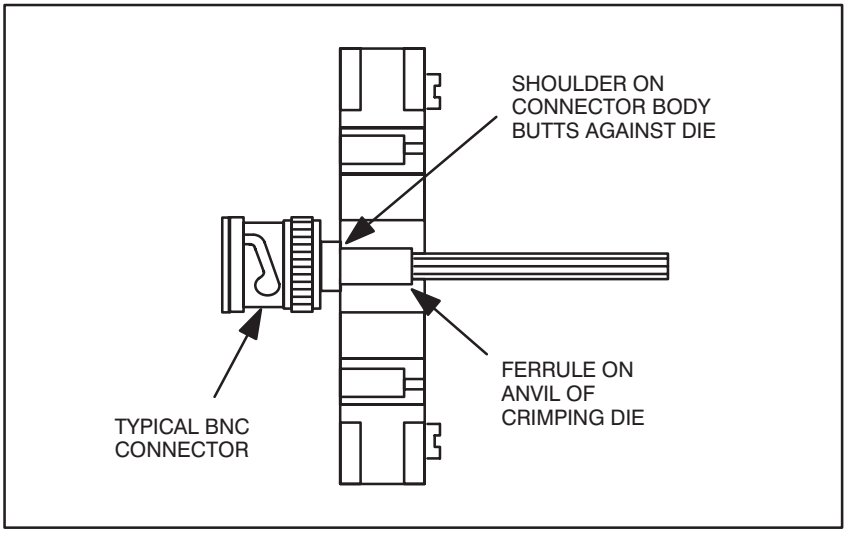


Figure 7.7 - Connector Installation Step 9 for RG-59/U Cable

Step 10. Hold the assembly in place, and close the crimp tool handles until the ratchet releases.

Step 11. Remove the crimped assembly from the crimping dies. The connector is now attached to the coax cable, as shown in figure 7.8.

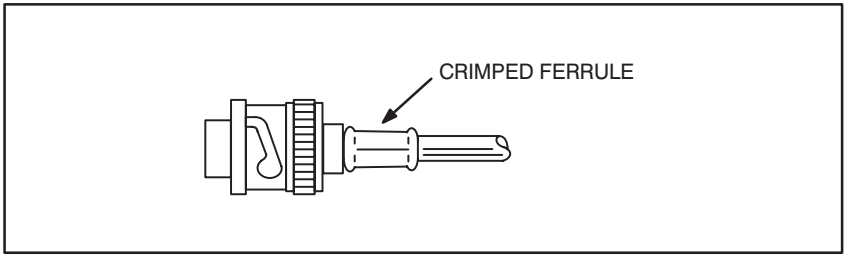


Figure 7.8 - Connector Attached to RG-59/U Cable

7.4.2 Terminating RG-11/U Cable

Use the following procedure to install the dual crimp plug connector onto the coaxial cable:

Step 1. After the cables have been installed in the conduit or cable trays, slide the ferrule onto the coax cable as shown in figure 7.9.

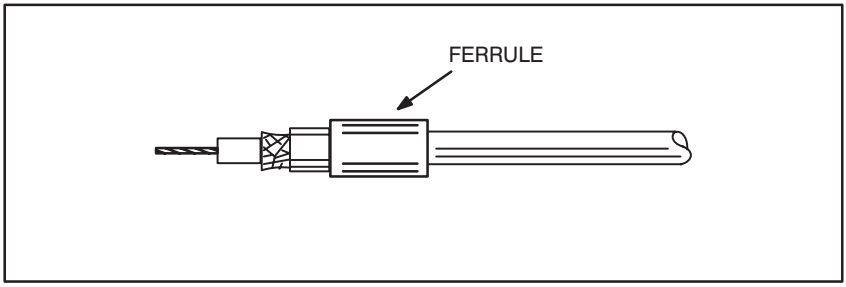


Figure 7.9 - Slide Ferrule onto RG-11/U Cable

Step 2. Strip the coax using the dimensions shown in figure 7.10. Be sure the shield braid wire is cut to the correct length and cannot touch the center conductor.

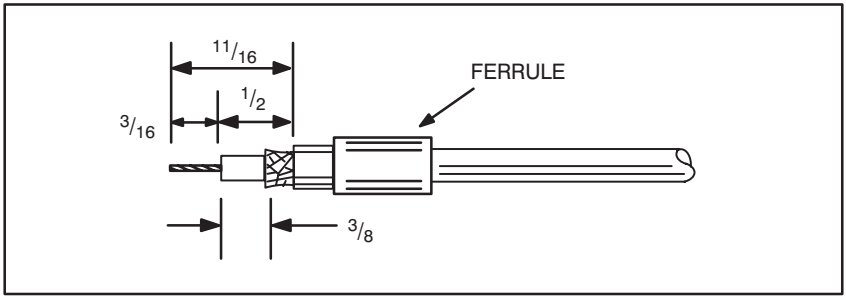


Figure 7.10 - RG-11/U (Belden 8213) Cable Stripping Dimensions

Step 3. On the crimping tool shown in figure 7.11, rotate locator/stop by turning the adjustment cap to the OPEN position.

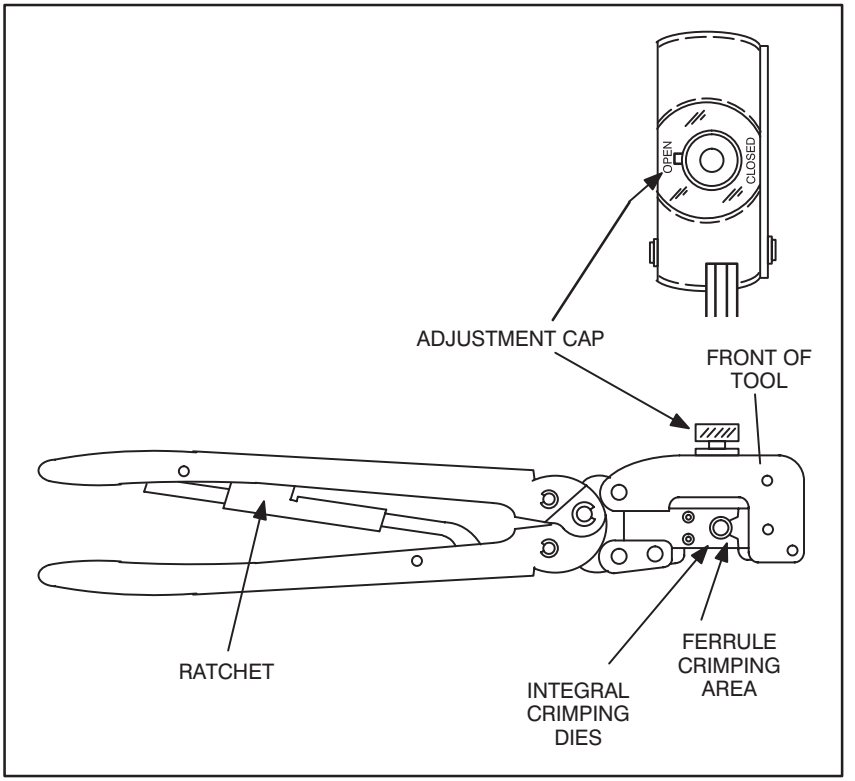


Figure 7.11 - Turn Adjustment Cap to OPEN Position

Step 4. Insert the conductor into the contact wire barrel until the contact butts against the cable dielectric, and place the contact in the tool head as shown in figure 7.12.

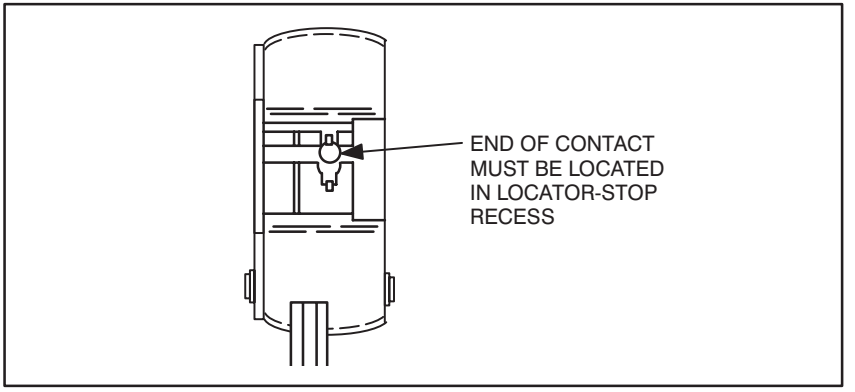


Figure 7.12 - Place Contact in Tool Head

Step 5. Push the cable in to hold the center contact against and perpendicular to locator/stop as shown in figure 7.13.

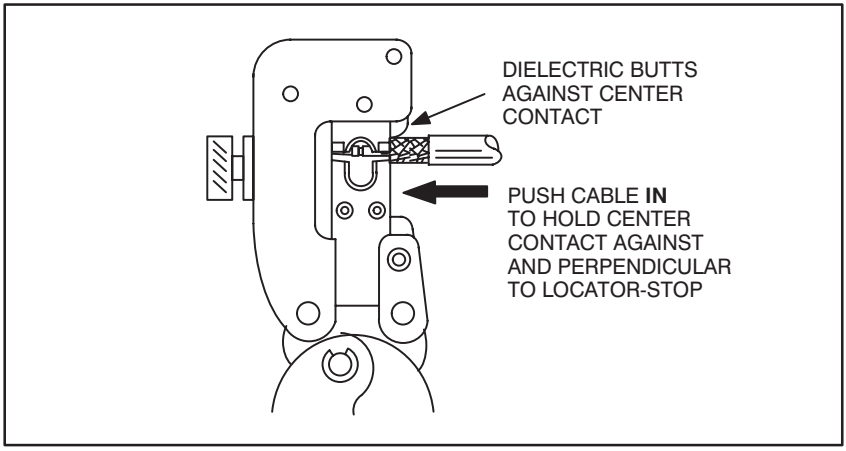


Figure 7.13 - Connector Installation Step 5 for RG-11/U Cable

Step 6. Make sure that the raised area on the contact wire barrel is located on the crimping die for proper termination as shown in figure 7.14.

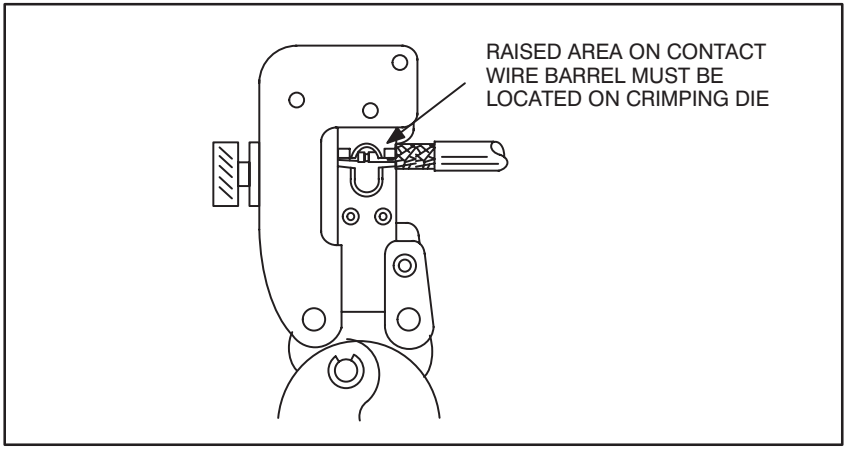


Figure 7.14 - Connector Installation Step 6 for RG-11/U Cable

Step 7. Close the tool handles fully until the ratchet releases to complete the crimp. Note that once the ratchet is engaged, the handles cannot be opened until they have been fully closed.

Step 8. Remove the crimped contact.

Step 9. Verify that the shield braid wire does not touch the center contact. Refer to figure 7.15.

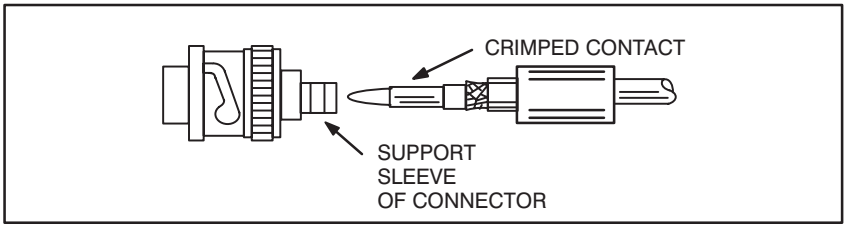


Figure 7.15 - Connector Installation Step 9 for RG-11/U Cable

Step 10. Insert the crimped center contact into the connector body until the cable dielectric butts against the dielectric inside the connector body. The flared braid will then fit around the support sleeve of the connector body, as shown in figure 7.16.

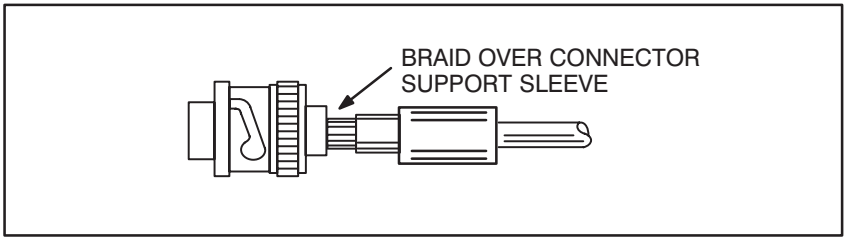


Figure 7.16 - Connector Installation Step 10 for RG-11/U Cable

Step 11. Slide the ferrule forward over the shield braid wire and the support sleeve until the ferrule butts against the shoulder on the connector body, as shown in figure 7.17.

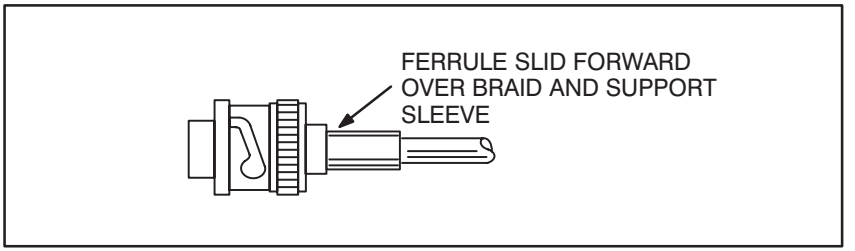


Figure 7.17 - Connector Installation Step 11 for RG-11/U Cable

Step 12. Place the connector assembly in tool as shown in figure 7.18. Make sure that the ferrule assembled on the cable is on the upper crimping die and that the shoulder on the connector rests against the die, as shown.

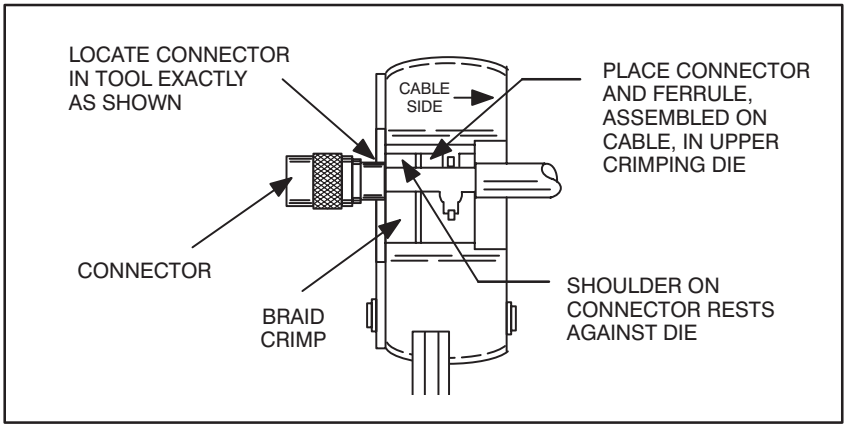


Figure 7.18 - Place Connector Assembly in Tool

Step 13. Close the handles until the ratchet releases to complete the crimp.

Step 14. Remove the crimped assembly from the crimping dies. The connector is now attached to the coax cable, as shown in figure 7.19.

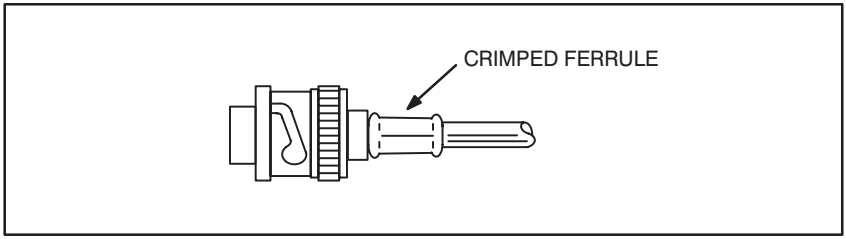


Figure 7.19 - Connector Attached to RG-11/U Cable

7.5 Testing Cable Segments

Once a cable segment has been terminated with a connector on each end, visually inspect the connector for loose connections, nicked insulation, or loose strands from the braid that might cause a poor connection or short. The center contact should be straight and centered inside the connector dielectric. Be sure that the center contact is inserted deep enough into the connector body. The tip of the center contact should be about even with the end of the connector dielectric. Be sure the ferrule is crimped tightly against the body of the connector and that the shield braid wire does not protrude from the ferrule. Check the cable's mechanical connections by grasping the outer conductor connector in one hand and the coax jacket in the other. Pull firmly. The connectors should hold.

7.6 Constructing Long Cable Segments

To construct a cable segment longer than the standard maximum cable spool length (over 1,000 feet or 300 m for Belden 9259 and over 2,000 feet or 600 m for Belden 8213), use a BNC jack-to-jack in-line splicing adapter. Use the following procedure to construct a long cable segment:

Step 1. Terminate both parts of a cable segment.

Step 2. Splice both parts using the jack-to-jack adapter. (Refer to figure 7.20.) Ensure that the splicing connection can be accessed easily.

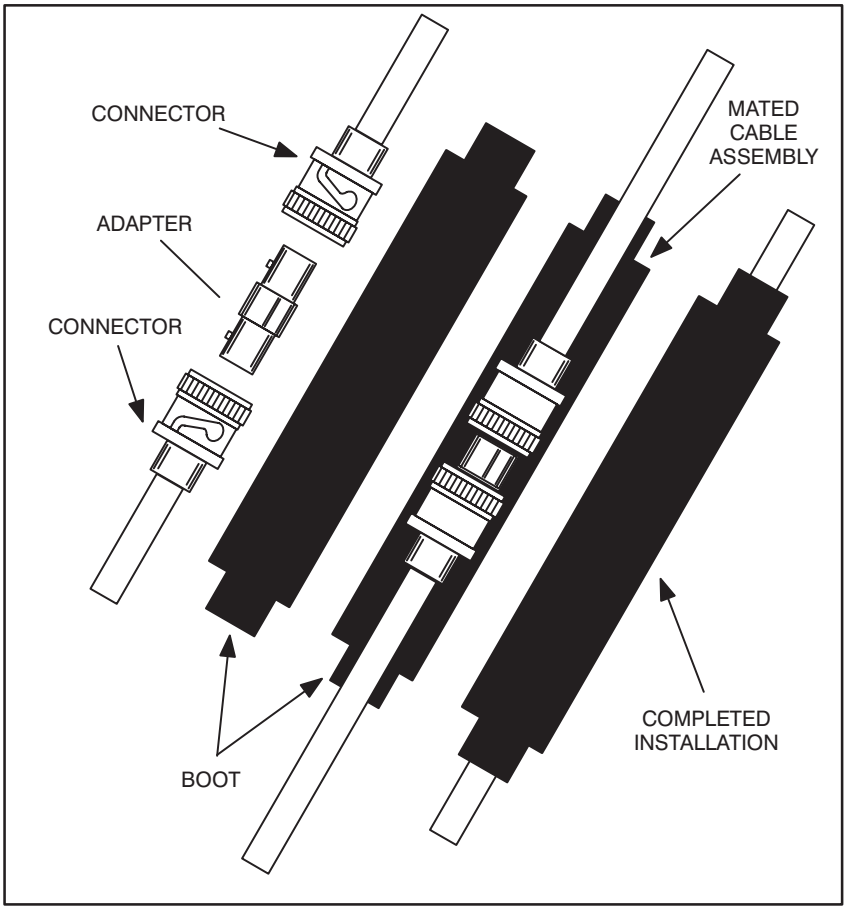


Figure 7.20 - Cable Splicing

Step 3. Isolate the splicing connection with an insulating jacket, a boot, heat shrink tubing, or electrical sealant tape.

Step 4. Document this connection on the cable system layout.

7.7 What to Do Next

Finish installing your other system components.

For information about:	See chapter:
maintaining the DCS-NET network	21
configuring network variables and setting the drop number	12

8.0 INSTALLING AN AutoMax FIBER-OPTIC DCS-NET NETWORK

Installing a fiber-optic DCS-NET network requires special procedures and handling.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

TURN OFF AND LOCKOUT OR TAG POWER TO BOTH THE RACK CONTAINING THE NETWORK COMMUNICATIONS MODULE AND THE TRANSCEIVER (RACK-MOUNTED OR STAND-ALONE) BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION, REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

8.1 Installing the Stand-Alone Transceiver

The Stand-Alone Transceiver may be mounted vertically or horizontally. Horizontal mounting is recommended, however, to provide better access to transceiver LEDs, connectors, and adjustments.

Use the following procedure to install the Stand-Alone Transceiver:

Step 1. Prepare the mounting surface using the mounting dimensions shown in figure 8.1 for the correct placement of the holes.

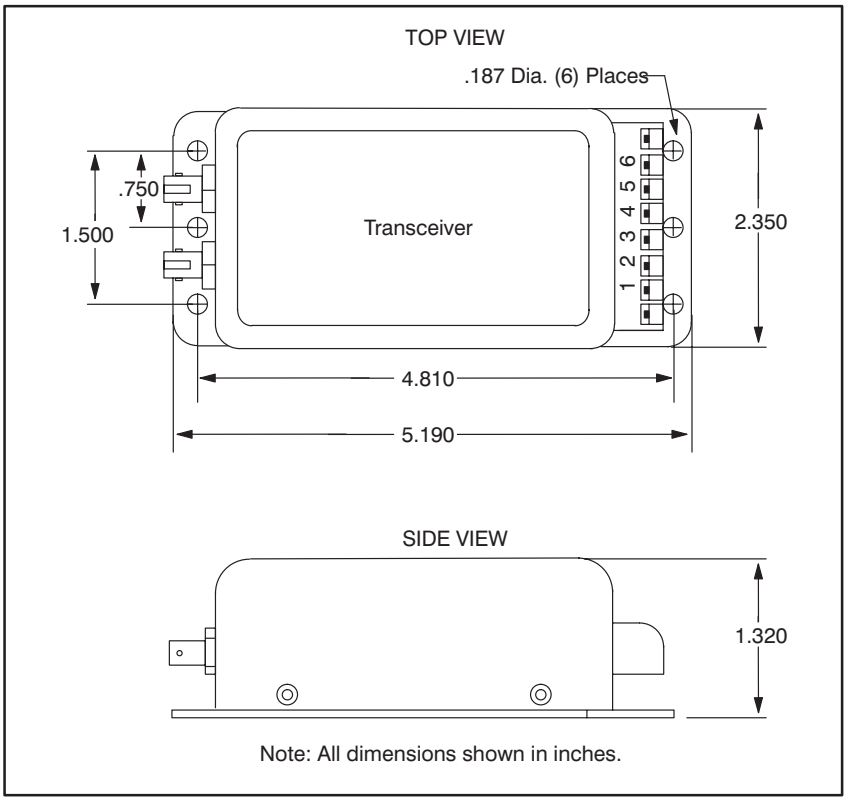


Figure 8.1 - Stand-Alone Transceiver Mounting Dimensions

Step 2. Secure the transceiver to the mounting surface using #8 screws.

Step 3. Verify that the external power supply is turned off. Make the drop cable and input power connections to the transceiver terminal block as shown in figure 8.2.

TRANSCEIVER TERMINAL	CONNECTION
1	DATA - DROP CABLE BROWN WIRE
2	DATA - DROP CABLE BROWN/WHITE WIRE
3	120-OHM LOAD JUMPER*
4	120-OHM LOAD JUMPER*
5	+24 V DC
6	GROUND (Connected to transceiver enclosure)

*A jumper between terminals 3 and 4 connects an internal 120-ohm termination resistor between terminals 1 and 2. This jumper must be used on all Stand-Alone Transceivers.

Figure 8.2 - Stand-Alone Transceiver Terminal Block Connections

Step 4. Connect the transceiver to the fiber-optic network using the guidelines provided in section 8.5.

Step 5. Turn power on to the transceiver.

8.2 Installing the Rack/Power Supply and Rack-Mounted Transceivers

You must make sure the rack is installed in an electrical cabinet. Ensure that all cables are long enough to provide accessibility to the Rack-Mounted Transceivers from the back of the rack to aid in replacement or troubleshooting. Use the following procedure to install the Rack/Power Supply and Rack-Mounted Transceivers.

Step 1. Set the selector switch on the back of the rack to 115 or 230 V AC as required.

Step 2. Install the rack using #8 screws. Allow at least 2.5-5 cm (1-2 in.) clearance around the rack for adequate ventilation. Rack mounting dimensions are shown in figure 8.3.

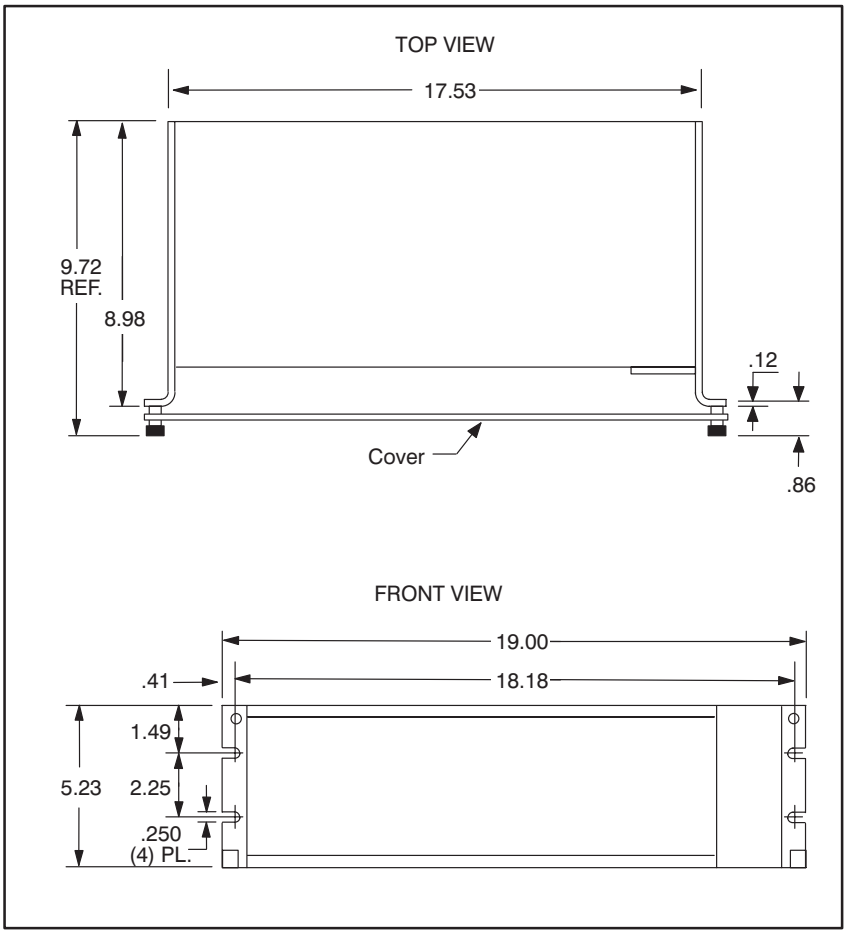


Figure 8.3 - Fiber-Optic Rack Mounting Dimensions

Step 3. Plug each transceiver into any empty slots in the rack. Verify that on the transceivers at the extreme ends of the rack, a jumper has been connected between terminals 3 and 4 on the six-screw terminal block.

Step 4. Use twisted-pair wire (as specified in Appendix C) to make all signal connections between transceivers as shown in figure 8.4. To improve network serviceability, make the signal connections between transceivers on a separate terminal strip as shown in figure 8.5. Use a standard terminal strip for these connections.

ADAPTER TERMINAL	CONNECTION
1	DATA - VIOLET WIRE
2	DATA - BLACK WIRE
3	NO CONNECTION
4	NO CONNECTION

Figure 8.4 - Rack-Mounted Transceiver Terminal Block Connections

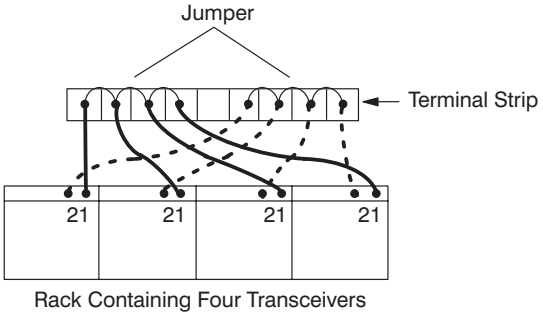


Figure 8.5 - Connecting Rack-Mounted Transceivers to a Terminal Strip

Step 5. Connect each transceiver to the fiber-optic network using the guidelines provided in section 8.5.

Step 6. Verify that the external power supply is turned off. Connect the power cord to a 115 or 230 V AC external power supply. Note that the rack frame is grounded directly through the ground pin of the line cord.

Step 7. Use the rocker switch on the front of the Power Supply to turn power ON to the rack. A built-in indicator in the switch will illuminate signifying the presence of power.

Step 8. Secure each transceiver with the captive screws on the faceplate of the module. Attach the transparent plastic front panel.

8.3 Installing the Fiber-Optic Cable

The fiber-optic cable must be handled by experienced personnel prior to and during installation. Improper handling may result in damage to the cable. Unless you have in-house expertise with fiber-optic cable assemblies and installation, you should contact an experienced contractor for making up and installing fiber-optic cables. Use the following general guidelines to protect the cable:

- Visually inspect the cable before the installation.
- Route the fiber-optic cable to protect it from abrasion, vibration, moving parts, and personnel traffic. Be sure the cable does not touch abrasive surfaces such as concrete, which could wear through and damage the cable's outer jacket.
- Locate the fiber-optic cable away from temperatures greater than 80 °C (176 °F).
- Protect the fiber-optic cable from oil, grease, acids, caustics, and other hazardous chemicals that may damage the cables outer jacket.
- Pull the cable in accordance with vendor instructions. Protect the fiber-optic connectors if they are attached.
- Do not exceed the minimum bend radius (75 mm or 3 in.) of the cable.
- Do not exceed the cable's maximum recommended pulling tension.
- Use a cable lubricant to reduce friction when pulling the cable.
- Attach the fiber-optic connectors if the cable was pulled without them. Test the cable using a power meter or optical time domain reflectometer.
- Label the fiber-optic cable, Stand-Alone Transceiver, and its corresponding Rack-Mounted Transceiver with the network ID, the network drop and network interface slot.

8.4 Attaching the Fiber-Optic Connectors

Typically, short fiber-optic cables are shipped with their connectors attached. You may need to attach connectors if replacement cables are needed, if the fiber-optic link is being altered, or if the cable is very long. Use only ceramic ferrule ST-type connectors. Refer to Appendix C for cable and connector specifications and the name of the recommended fiber-optic connector kit. This kit contains detailed instructions that describe how to attach the connectors to the fiber-optic cable.

8.5 Connecting a Fiber-Optic Cable Between a Stand-Alone Transceiver and a Rack-Mounted Transceiver

WARNING

TURN OFF AND LOCKOUT OR TAG POWER TO BOTH THE RACK CONTAINING THE NETWORK COMMUNICATIONS MODULE AND THE TRANSCEIVER (RACK-MOUNTED OR STAND-ALONE) BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION, REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

CAUTION: Do not damage the ends of the fiber-optic cable connectors by touching them or dropping them. Do not use factory-compressed air to clean the fiber-optic ports or connectors because the air may contain impurities that could scratch them. Failure to observe this precaution could result in damage to or destruction of the equipment.

Use the following procedure to connect a fiber-optic cable between a Stand-Alone Transceiver and a Rack-Mounted Transceiver:

Step 1. Remove the dust caps from the fiber-optic ports on the Stand-Alone and the Rack-Mounted Transceivers. Clean the ports with a lint-free cloth moistened with isopropyl alcohol or a can of compressed air. Save the dust caps. All fiber-optic connectors and ports, when not in use, should be covered with dust caps.

Step 2. Remove the dust caps from the fiber-optic cable's connectors. Use a lint-free cloth moistened with isopropyl alcohol or a can of compressed air to clean the cable's connectors.

Step 3. Attach the cable's connectors to the ports as follows:

- Panel-Mounted Transceiver "T" port: blue fiber-optic wire
- Panel-Mounted Transceiver "R" port: orange fiber-optic wire
- Rack-Mounted Transceiver "T" port: orange fiber-optic wire
- Rack-Mounted Transceiver "R" port: blue fiber-optic wire

Note that the fiber-optic wires are color-coded. Typically, the wires are orange and blue. The wires used in your installation may be of a different color, but they should be installed in the same manner as described here. Verify that the transmit connector of one unit is connected to the receive connector of the other unit. Note that both of the fiber-optic wires are the same.

Align the connector's pin with the slot in the transceiver's port. See figure 8-9. Push the connector onto the port. Turn the connector clockwise until it locks onto the port's two pins. Do not bend or kink the wire when you attach it to the port. Bending the wire sharply could break the fiber inside.

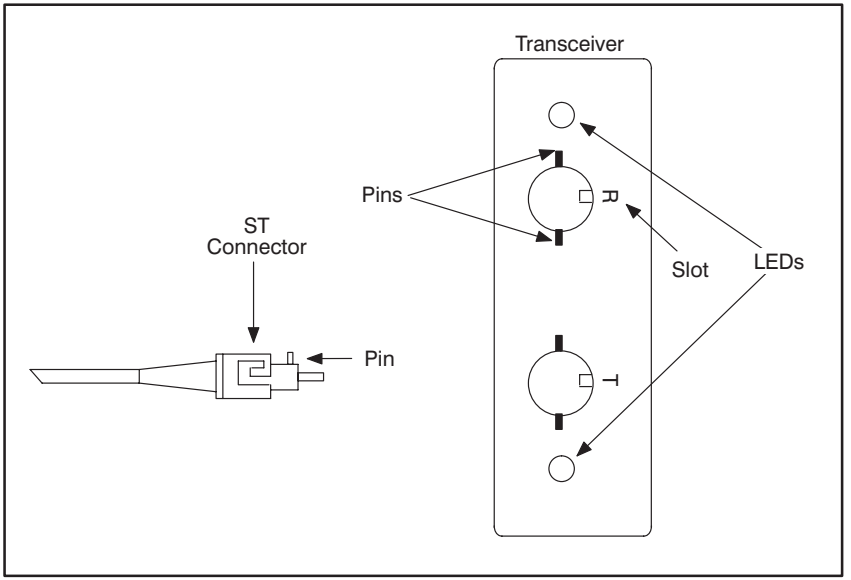


Figure 8.9 - Fiber-Optic Ports and Connectors

8.6 What to Do Next

Finish installing your other system components.

For information about:	See chapter:
installing a coaxial cable network	7
maintaining the DCS-NET network	21
configuring network variables and setting the drop number	12

9.0 CONNECTING AN ALLEN-BRADLEY REMOTE I/O LINK

If you are using the AutoMax PC3000 Processor card to control Allen-Bradley remote I/O, you must connect the remote I/O link.

For informtion about:	See this section:
Connecting the Remote I/O Link to the Processor Card	9.1
What to Do Next	9.2

9.1 Connecting the Remote I/O Link to the PC3000 Processor Card

Once the PC3000 Processor card is properly seated and secured in the chassis, connect the remote I/O link.

If the Processor card is an end device on the remote I/O link, you must install an appropriately-sized terminating resistor while wiring the remote I/O cable to the Phoenix connector. The resistor prevents the signal from being reflected from the ends of the cable. A resistor must be installed at each end of the link. You should have determined the resistor size for the remote I/O link in section 4.3.2. Both resistors used to terminate the link must be sized the same. Also, make sure that the leads are short. Leads that are too long can cause noise reflection on the link.

To connect the remote I/O link, follow these steps:

Step 1. Locate a proper length of Belden 9463 cable.

Step 2. Strip off enough of the cable jacket and insulation to expose the wire inside each of the three segments.

Step 3. Locate a Phoenix connector. This connector is shipped installed on the Remote I/O port on the Processor card.

Step 4. Connect the signal conductors and shield drain wire of the twinaxial cable onto the connector's terminals as shown in figure 9.1.

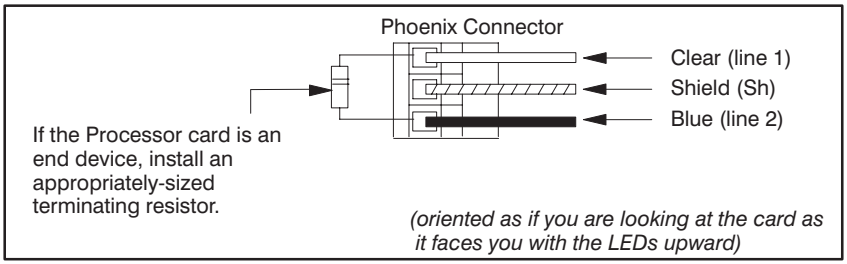


Figure 9.1 -Connecting the Twinaxial Cable Segments onto the Phoenix Connector

Step 5. Insert the Phoenix connector into the Processor card's remote I/O port.

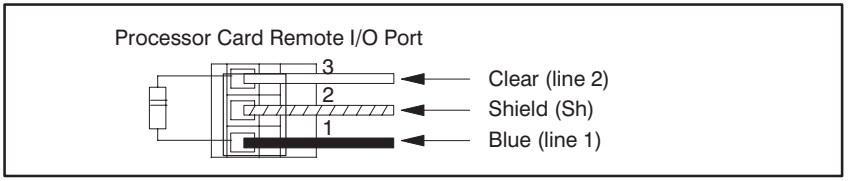


Figure 9.2 - Inserting the Phoenix Connector into the Remote I/O Port

Step 6. Connect the free cable-end to a remote I/O adapter device as shown in figure 9.3.

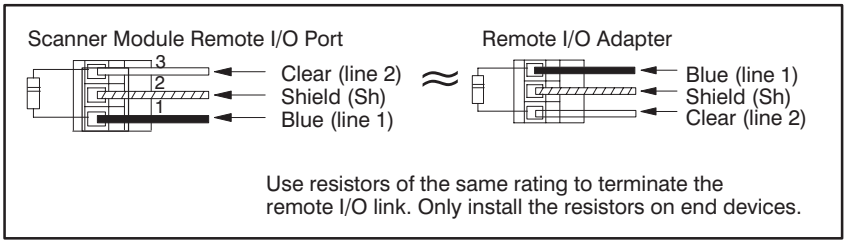


Figure 9.3 - Connecting the Free End to a Remote I/O Adapter Device

Step 7. Tie wrap the remote I/O link cable to the chassis to relieve strain on the cable, if possible.

9.2 What to Do Next

Finish installing your system components. For more information about configuring and programming the remote I/O scanner, see chapters 13, 14, and 16.

10.0 CONNECTING A PROGRAMMING DEVICE TO THE AutoMax PC3000

You need to connect a programming device running the AutoMax Programming Executive software to the AutoMax PC3000 to perform tasks such as downloading the operating system and application programs and monitoring programs.

For information about:	See this section:
Overview of the Connection Methods	10.1
Connecting to the AutoMax PC3000 Via the ISA Bus	10.2
Connecting to the AutoMax PC3000 Via Port B of the Serial Card	10.3
Connecting a Modem to the AutoMax PC3000 Via Port B of the Serial Card	10.4
Connecting to an AutoMax PC3000 Processor Via the DCS-NET Network	10.5
What to Do Next	10.6

10.1 Overview of the Connection Methods

You can connect to the AutoMax PC3000 several ways:

If the AutoMax PC3000 is installed in a:	You can connect a programming device:
PC chassis **without** the PC3000 Serial card	• directly to the AutoMax PC3000 via the ISA bus or • remotely to the AutoMax PC3000 via the DCS-NET network
PC chassis **with** the PC3000 Serial card	• directly to Port B of the AutoMax PC3000 Serial card or remotely via modems or • directly to the AutoMax PC3000 via the ISA bus or • remotely to the AutoMax PC3000 via the DCS-NET network
PC3000 Packaged Version	• directly to Port B of the AutoMax PC3000 Serial card or remotely via modems or • remotely to the AutoMax PC3000 via the DCS-NET network

10.2 Connecting to the AutoMax PC3000 Via the ISA Bus

If you are running the AutoMax Programming Executive using the same PC that houses the AutoMax PC3000, you can connect to the AutoMax PC3000 via the ISA bus. No cables are required, but you must properly set up communications to the PC3000.

Important: If you are connecting the PC3000 via the ISA bus and you have a PC3000 Serial card installed in the PC chassis, do the following:

Step 1. Remove power to the AutoMax PC3000.

Step 2. Remove jumper JP2 on the PC3000 Processor card. See figure 10.1.

Step 3. Apply power.

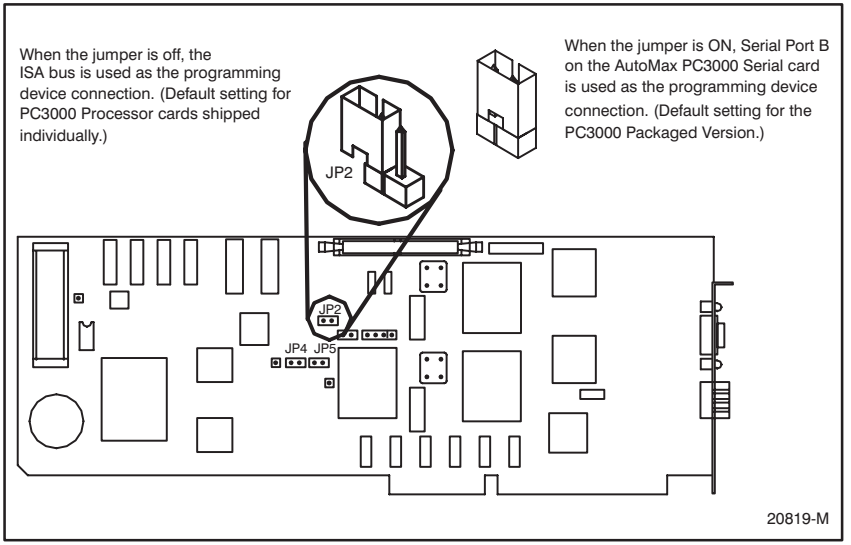


Figure 10.1 - Removing Jumper JP2

To setup communications over the ISA bus, do the following:

Step 1. Run the AutoMax Programming Executive software.

Step 2. From the Setup menu in the System Configurator, choose Communications.

Step 3. In the Communications Setup dialog box, choose Internal PC3000. This option is available only when you have an AutoMax PC3000 installed in the personal computer you are using.

Step 4. If you have more than one PC3000 installed in your computer, use the Card ID list box to pick the PC3000 with which you want to communicate.

Step 5. To accept your selection, choose OK.

10.3 Connecting to the AutoMax PC3000 Via Port B of the Serial Card

You can use Port B of the AutoMax PC3000 Serial card to connect a programming device to an AutoMax PC3000. You can use this connection method for an AutoMax PC3000 Packaged Version or a serial card housed in a PC chassis.

You need to provide the appropriate serial cable and properly set up the communication parameters.

Important: Make sure that jumper JP2 is installed on the AutoMax PC3000 Processor card. Having this jumper installed enables Port B to function as a programming device port. See figure 10.1.

10.3.1 Using the Correct Cable

Port B of the AutoMax PC3000 Serial card is an optically-isolated RS-232 port with a 25-pin female D-shell connector.

You can order cable M/N 61C127, or you can make your own cable. Use the following table to help you decide which pin assignment diagram to reference.

If your programming device has a:	**See figure:**
25-pin male D-shell	10.2
9-pin male D-shell	10.3

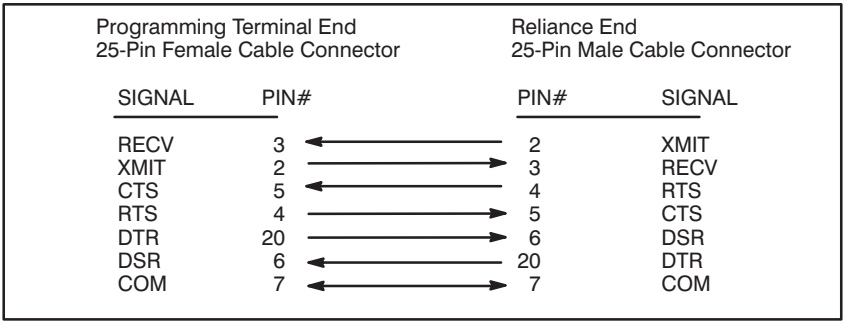


Figure 10.2 - 25-pin to 25-pin Programming Cable

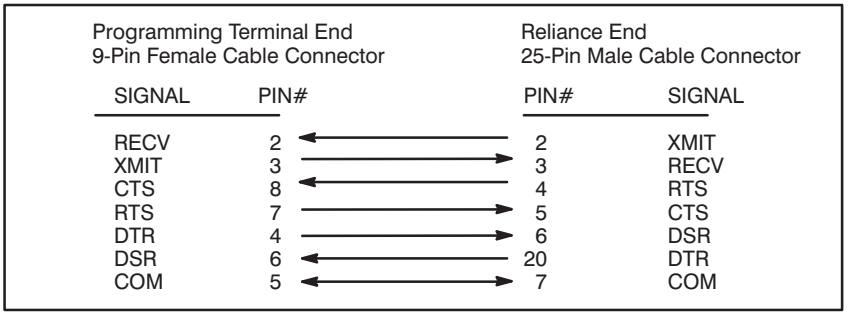


Figure 10.3 - 9-pin to 25-pin Programming Cable

When making your own programming cable, follow these recommendations:

- make sure that the cable is a 22-gauge multi-conductor cable
- make sure the cable does not exceed 3 m (10 ft.)
- check for shorts and continuity with an ohmmeter

10.3.2 Setting the Communication Parameters

Before the programming device can communicate with the AutoMax PC3000, you must make sure communications between the two devices are set up correctly. To do this, follow these steps:

Step 1. Run the AutoMax Programming Executive software.

Step 2. From the Setup menu in the System Configurator, choose Communication.

Step 3. Choose Serial Port as the Communication Type.

Step 4. In the Serial Port group box, choose:

- the serial port (Com 1 or Com 2) you have connected to the AutoMax PC3000
- the baud rate that you want to use to communicate with the AutoMax PC3000

Step 5. To accept your changes, click OK.

10.4 Connecting a Modem to the AutoMax PC3000 Via Port B of the Serial Card

You can connect to a remote AutoMax PC3000 by using modems. Connect a modem to Programming Port B of the PC3000 Serial card and then dial the modem from your site using a programming device equipped with a modem.

The following sections assume you are using Hayes or Hayes-compatible modems and terminal emulation software such as ProComm Plus™.

10.4.1 Setting Up the Modem That Is Connected to the AutoMax PC3000

This procedure assumes that the AutoMax PC3000 has its operating system loaded.

To set up a modem connected to an AutoMax PC3000, follow these steps:

Step 1. Run the AutoMax Programming Executive.

Step 2. From the Online menu, select Online Task Manager.

Step 3. Select the Connect menu.

Step 4. Select Baud Rate.

Step 5. Select the baud rate to match that of the modem you are connecting to the PC3000.

Step 6. Exit the Online Task Manager.

Step 7. Disconnect the cable between the PC3000 and the PC.

Step 8. Set the modem to use the auto-answer mode.

Step 9. Connect the modem to the telephone line and to Port B. The cable that connects the modem to the PC3000 uses straight wiring for pins 2, 3, and 7. For more information about cables, see Appendix C.

10.4.2 Setting Up the Programming Device's Modem

This section assumes you are using terminal emulation software. Refer to the software's user manual for specific instructions, and make sure the modem is set up as follows:

- The modem's baud rate matches that of the modem connected to the remote PC3000.
- Use these control strings:
    - AT & K0 (use no local flow control)
    - AT & D0 (ignore status of DTR signal)

After you have set up the modem, do the following:

Step 1. Use the terminal emulation software to dial the remote PC3000, and establish a connection.

Step 2. Run the AutoMax Programming Executive software, and select Online Task Manager from the Online menu to connect to the remote AutoMax PC3000.

10.5 Connecting to an AutoMax PC3000 Processor Via the DCS-NET Network

To connect to an AutoMax PC3000 over the DCS-NET network, you must be directly connected to a Processor or PC3000 that has access to the DCS-NET network, or you must use a PC-Link Interface module connected to the DCS-NET network.

The Processor you are directly connected to can be an AutoMax rack with a Network card or another PC3000. You can directly connect to an AutoMax Processor with a serial cable. You can directly connect to a PC3000 with a serial cable (when using the

PC3000 Serial card) or via the ISA bus if the PC3000 Processor card resides in a PC chassis.

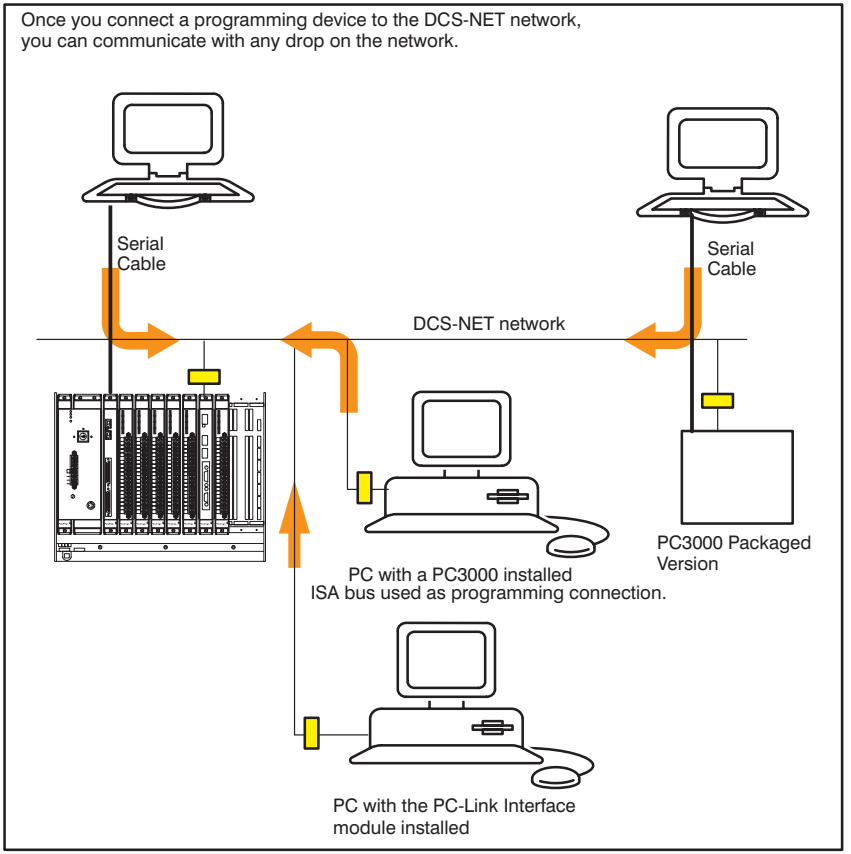


Figure 10.4 - Connecting to PC3000 Via the DCS-NET Network

For more information about:	See:
communicating over the DCS-NET network	AutoMax Programming Executive instruction manual
using the PC Link Interface Module	PC Link Interface Module instruction manual

10.6 What to Do Next

Once online communication is configured, you can load the PC3000 operating system. See chapter 11 for information about using Ports A and B for RS-232 and RS-422 communication.

11.0 CONNECTING DEVICES TO THE AutoMax PC3000 SERIAL CARD PORTS

You can connect devices, such as modems or data display equipment, to ports A and B on the AutoMax PC3000 Serial card.

Port A supports either the EIA RS-232 or RS-422 standard, which lets you connect a variety of Data Communications Equipment (DCE). When Port B is not configured as a programming-device connection, you can connect other RS-232 devices, such as modems.

For information about:	See this section:
Connecting Devices to Port A	11.1
Connecting Devices to Port B	11.2
Accessing the Serial Card Ports	11.3
What to Do Next	11.4

11.1 Connecting Devices to Port A

You can connect modems or other DCE devices to Port A of the AutoMax PC3000 Serial card. You can configure Port A to use either the RS-232 or RS-422 standard. The port supports asynchronous, full-duplex communication and has an optically-isolated, 9-pin female D-shell connector.

When connecting a DCE device to Port A, make sure that you:

- configure the port to accept an RS-232 or RS-422 DCE device
- use the correct cable to connect the device to the Port A

11.1.1 Selecting RS-232 or RS-422 Interface

You can use either the RS-232 or RS-422 protocol for communicating out Port A. By default, the port is configured for RS-232 communication. The settings of jumpers E1 and E2 determine which standard that Port A uses. Use Figure 11.1 to help you set jumpers E1 and E2.

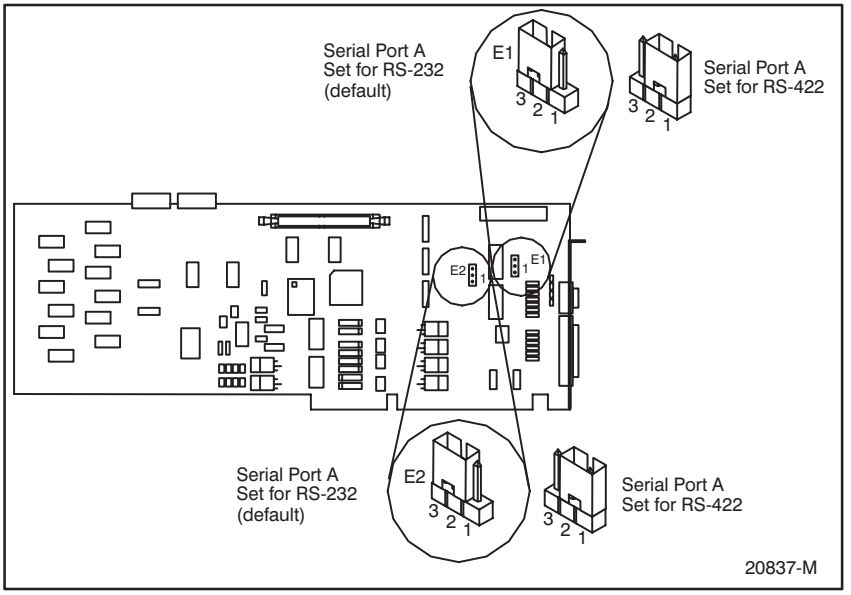


Figure 11.1 - Configuring Port A

Note: Pin 1 of jumpers E1 and E2 has a square pad mounted on the back of the board.

11.1.2 Using the Correct Cable

Table 11.1 lists the pin assignments for Port A. The cable you connect to Port A should have a 9-pin male connector that is properly wired.

When you are using the RS-422 protocol, do not use hardware handshaking because the CTS, DTR, and DSR signals are not available. When you are using hardware handshaking with the RS-232 protocol, you must supply an external power supply (5-12 V @2mA) connected to pin 6.

Table 11.1 - Pin Assignments for the AutoMax PC3000 Serial Card's Port A

	Protocol	
	RS-232	RS-422
Pin	**Assignment:**	**Assignment:**
1	Not used	TXD (−).Out
2	RXD.In	RXD (+).In
3	TXD.Out	TXD (+).Out
4	DTR.Out	Not Used
5	SIGNAL.Gnd	SIGNAL.Gnd
6	DSR.In	Not Used
7	RTS.Out	Not Used
8	CTS.In	Not Used
9	Not Used	RXD (−).In

Note: *If you do not enable bit 15 (hardware handshaking) in the SETUP parameter of the OPEN statement, only pins 2, 3, and 5 of the port you OPEN are functional.*

Pin Number	I/O	RS-232 Function
2	I	Received data
3	O	Transmitted data
4	O	Receiver status The signal is true whenever the receiver can accept characters, i.e., when the receiver buffer is not full. When the receiver buffer fills to within 53 characters, the signal is turned off. The signal can be used to disable another transmitter. It applies when hardware handshaking is enabled.
5	ground	Signal ground
6	I	Receiver enabled This signal must be true for the receiver to accept characters. If the signal becomes false while a message is being received, characters being received are deleted and an error is reported to the application software. This signal applies when hardware handshaking is enabled.
7	O	Transmitter status The signal is true whenever the transmitter is sending characters. It is used to “bracket” a character transmission. It can be used to enable/disable any type of external equipment, such as a tri-state transmit modem, which requires an enable signal to output characters. Refer to the OPEN statement in the BASIC Language instruction manual for details about the operation of the Modem Enable signal (RTS).
8	I	Transmitter enable The signal must be true for the transmitter to send a character. This signal is typically used for hardware flow control when hardware handshaking has been enabled.

Use the following table to help you make the cable you need.

For an example of this cable configuration:	See:
modem transmit enable with no flow control	Figure 11.2
cable break detect	Figure 11.3
one-directional flow control	Figure 11.4
bi-directional flow control	Figure 11.5
RS-422 cable	Figure 11.6

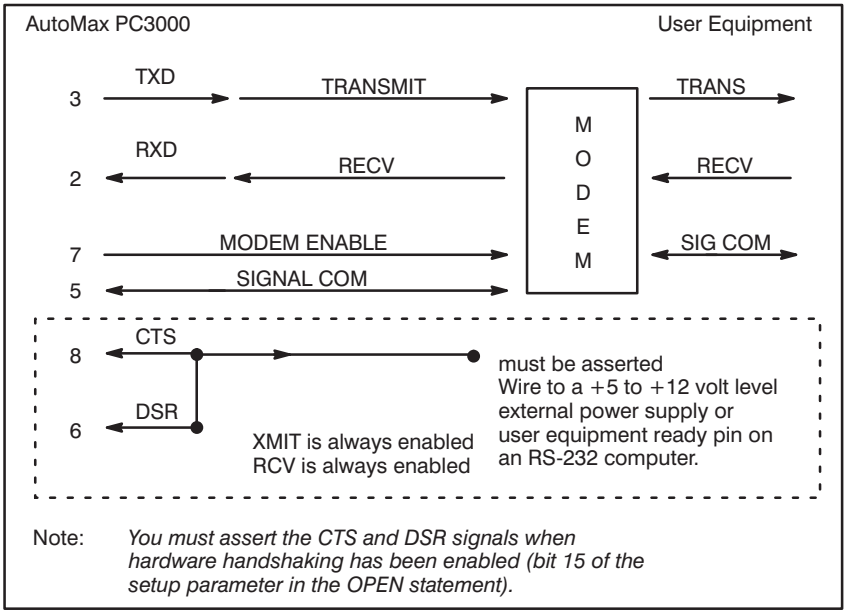


Figure 11.2 - Modem Transmit Enable With No Flow Control

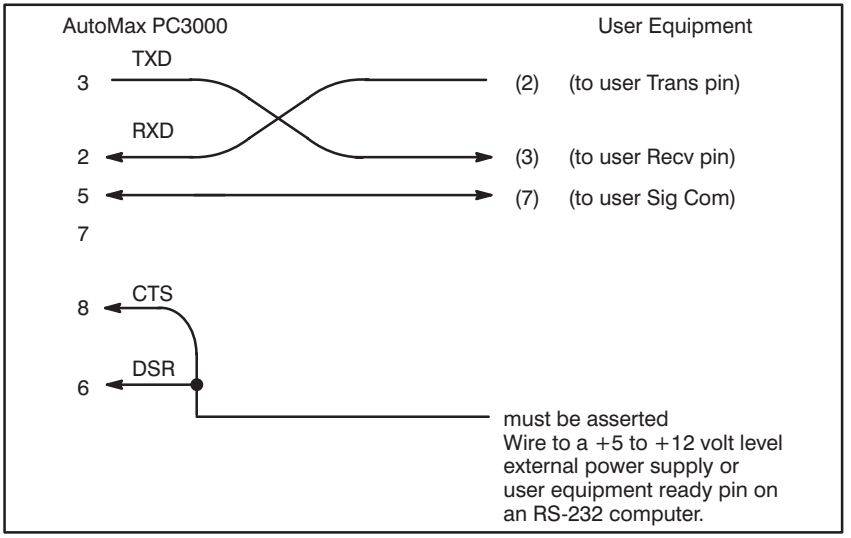


Figure 11.3 - Cable Break Detect

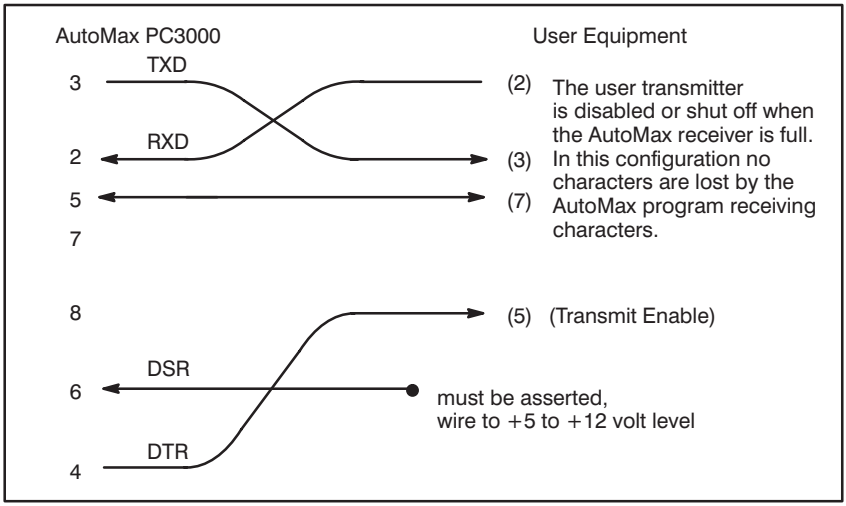


Figure 11.4 - One-directional Flow Control

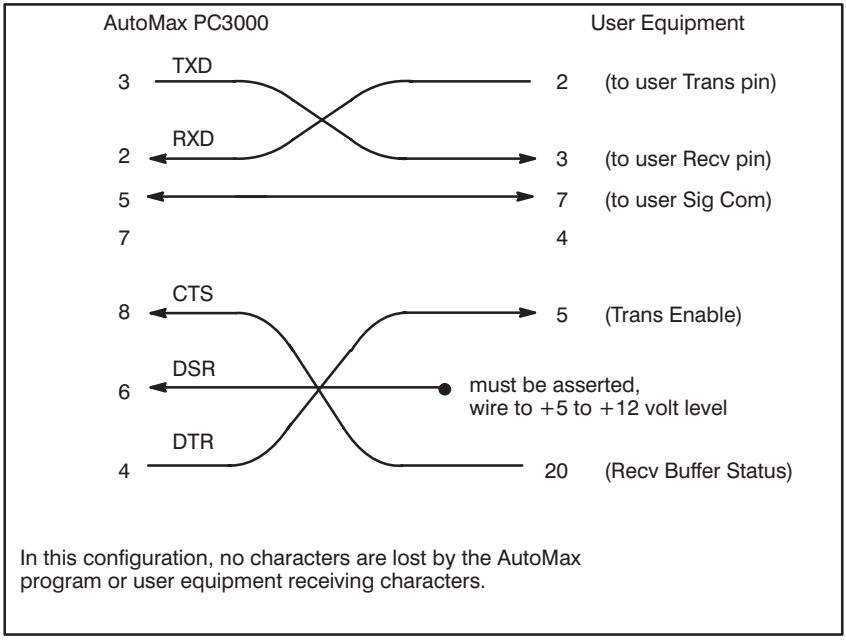


Figure 11.5 - Bi-directional Flow Control

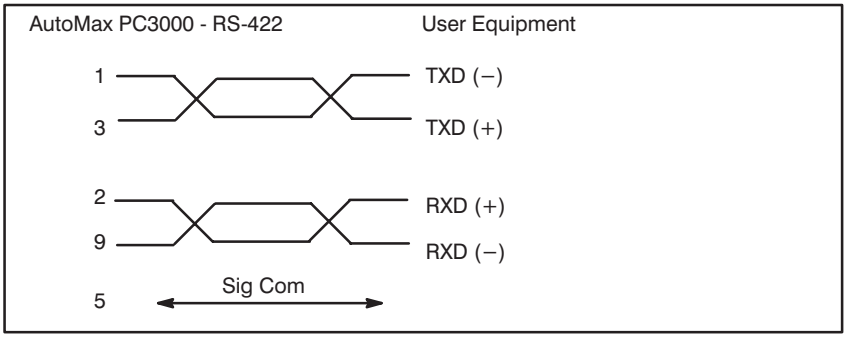


Figure 11.6 - RS-422 Cable

When you are using the RS-422 protocol, do not use hardware handshaking because the CTS, DTR, and DSR signals are not available.

11.2 Connecting Devices to Port B

You can connect modems or other DCE devices to Port B of the AutoMax PC3000 Serial card when the port is not configured as a programming-device connection. Port B is an optically-isolated port with a 25-pin female D-shell connector.

When connecting a DCE device to Port B, make sure that you:

- make port B available to accept a DCE device
- use the correct cable to connect the device to Port B

11.2.1 Making Port B Available

When you use Port B for communication to other RS-232 devices, you must set up an alternate programming-device connection. See chapter 10 for an explanation of these other methods. To enable Port B to accept devices other than a programming terminal:

Step 1. Remove power to the AutoMax PC3000.

Step 2. Remove the jumper JP2 on the PC3000 Processor card. See figure 11.7.

Step 3. Apply power.

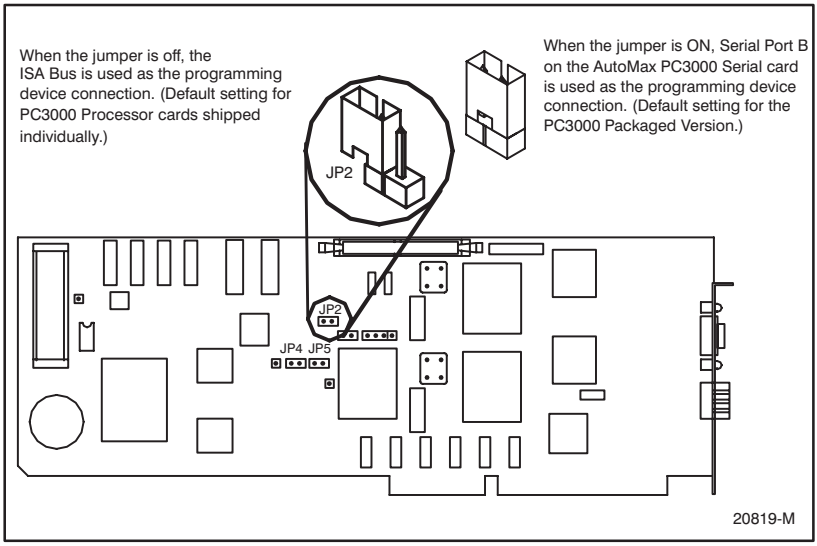


Figure 11.7 - Removing Jumper JP2 on the AutoMax PC3000 Processor Board

11.2.2 Using the Correct Cable

This section provides information about the pin assignments for Port B as well as examples of some typical cable wiring.

Table 11.2 lists the pin assignments for Port B. The cable you connect to Port B should have a 25-pin male connector that is properly wired.

Table 11.2 - Pin Assignments for the AutoMax PC3000 Serial Card's Port B

Pin:	Assignment:
2	TXD.Out
3	RXD.In
4	RTS.Out
5	CTS.In
6	DSR.In
7	SIG.GND
10	+12 V.Out
20	DTR.Out

Note: *If you do not enable bit 15 (hardware handshaking) in the SETUP parameter of the OPEN statement, only pins 2, 3, and 7 of the port you OPEN are functional.*

Pin Number	I/O	RS-232 Function
2	O	Transmitted data
3	I	Received data
4	O	Transmitter status The signal is true whenever the transmitter is sending characters. It is used to "bracket" a character transmission. It can be used to enable/disable any type of external equipment, such as a tri-state transmit modem, which requires an enable signal to output characters. Refer to the OPEN statement in the BASIC Language instruction manual for details about the operation of the Modem Enable signal (RTS).
5	I	Transmitter enable The signal must be true for the transmitter to send a character. This signal is typically used for hardware flow control when hardware handshaking has been enabled.
6	I	Receiver enabled This signal must be true for the receiver to accept characters. If the signal becomes false while a message is being received, characters being received are deleted and an error is reported to the application software. This signal applies when hardware handshaking is enabled.
7	ground	Signal ground

Pin Number	I/O	RS-232 Function
10	O	Isolated +12 V You can use this pin as an enable or equipment ready indicator. The signal is always on whenever power is applied to the PC3000.
20	O	Receiver status The signal is true whenever the receiver can accept characters, i.e., when the receiver buffer is not full. When the receiver buffer fills to within 53 characters, the signal is turned off. The signal can be used to disable another transmitter. It applies when hardware handshaking is enabled.

For an example of this cable configuration:	See:
modem transmit enable with no flow control	Figure 11.8
cable break detect	Figure 11.9
one-directional flow control	Figure 11.10
bi-directional flow control	Figure 11.11

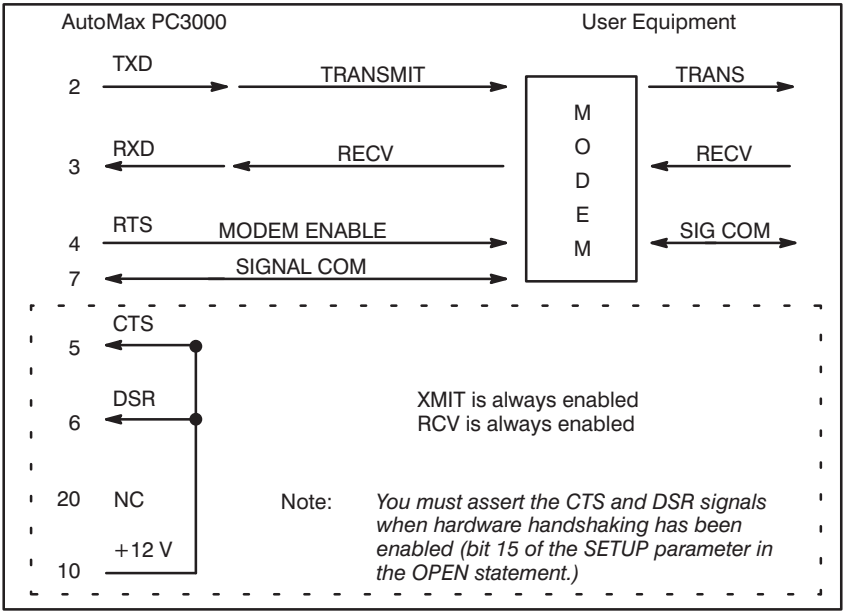


Figure 11.8 - Modem Transmit Enable With No Flow Control

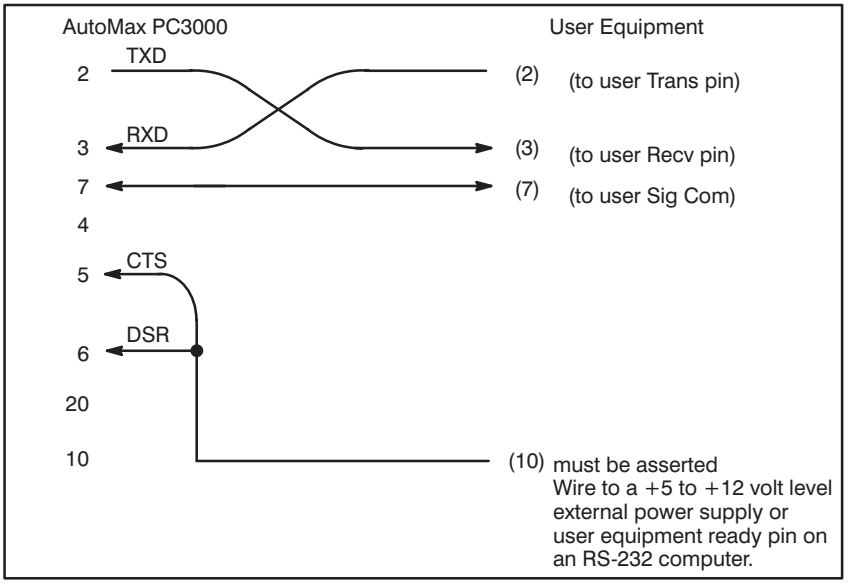


Figure 11.9 - Cable Break Detect

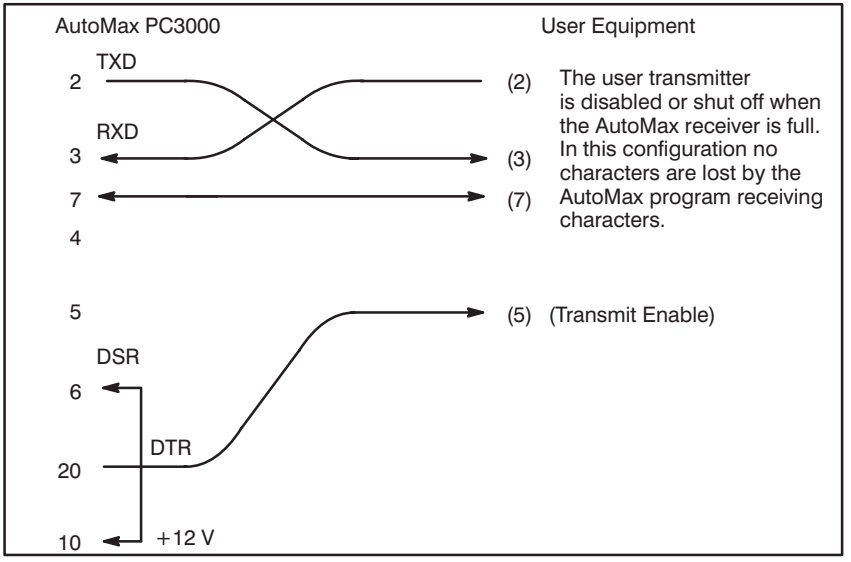


Figure 11.10 - One-directional Flow Control

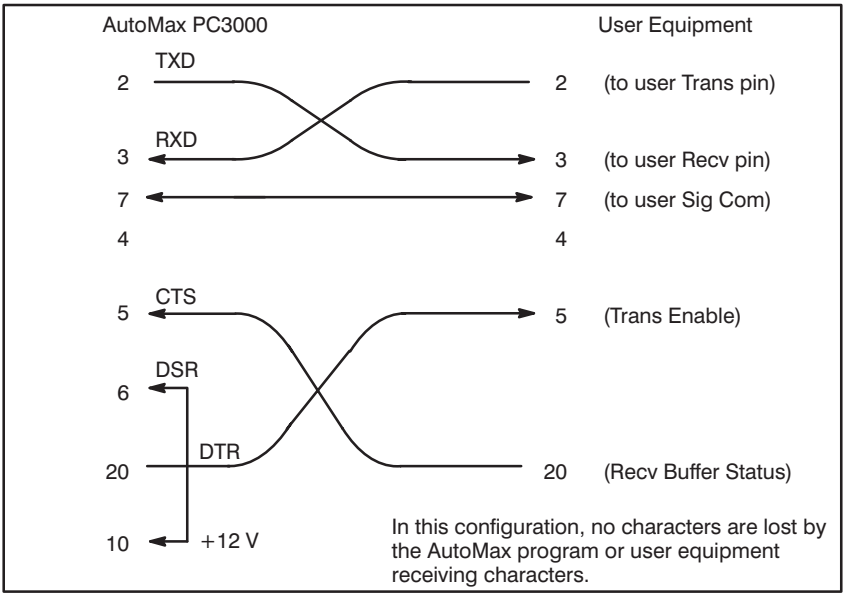


Figure 11.11 - Bi-directional Flow Control

11.3 Accessing the Serial Card Ports

To enable the Ports A and B on the AutoMax PC3000 Serial card, you must use the BASIC statement OPEN. The device names you use are PORTA or PORTB.

See the AutoMax Enhanced BASIC Language instruction manual, J-3675, for more information.

11.4 What to Do Next

Write any programs required for communicating with the serial devices. For information about connecting a programming device to the PC3000, see chapter 10.

12.0 CONFIGURING THE AutoMax PC3000

You configure an AutoMax PC3000 installed in a PC chassis or in the AutoMax PC3000 Packaged Version the same way.

This chapter presents basic steps and guidelines for configuring a PC3000. It assumes you have version 4.1A or later of the AutoMax Programming Executive software properly installed and running on a programming device.

For information about:	See this section:
Adding an AutoMax PC3000	12.1
Converting an Existing Rack into an AutoMax PC3000	12.2
Specifying the DCS-NET Drop Number and Drop Depth	12.3
Specifying the AutoMax PC3000 CPU Tick Rate	12.4
Assigning a Name to the AutoMax PC3000 Installed in a PC Chassis	12.5
Using the AutoMax PC3000 CPU Common Memory Variables	12.6
Using the DCS-NET Network Register Variables	12.7
Configuring the AutoMax PC3000 as a Passive-Listening DCS-NET Network Drop	12.8
What to Do Next	12.9

For an overview about the AutoMax programming environment, see chapter 15. Or, for information about the AutoMax Programming Executive, see its user manual.

12.1 Adding an AutoMax PC3000

Before you can configure the hardware for an AutoMax PC3000, you must first add it by using the System Configurator. Follow these steps to add a PC3000:

Step 1. Run the AutoMax Programming Executive software.

Step 2. In the System Configurator, select the system and section to which you want to add a PC3000.

Step 3. From the Rack menu, choose Add. The Add Rack dialog box is displayed.

Step 4. In the Slots group box, select PC3000.

Step 5. Fill in the rest of the information requested, such as the PC3000's name, location, description, etc.

Step 6. To create the rack, click OK.

One way to view the graphical display of the PC3000 is to select the rack and double-click it. The Rack Configurator application displays the PC3000, which looks like this:

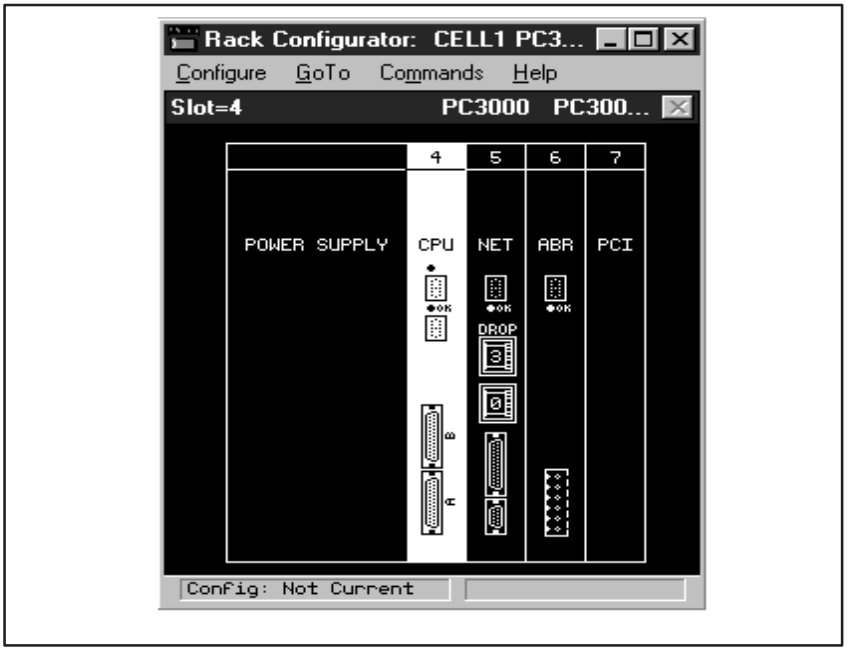


Figure 12.1 - AutoMax PC3000

Notice that the PC3000 is composed of four “modules” positioned in slots 4 through 7, in addition to the power supply. The following table describes each module.

Module:	**Label:**	**Function:**
AutoMax PC3000 CPU	CPU	Exchanges information between programs using the common memory variables and runs your application programs
PC3000 Network Interface	NET	Stores and manipulates status and data registers for the PC3000 DCS-NET network drop
PC3000 Allen-Bradley Remote I/O Interface	ABR	Controls Allen-Bradley remote I/O by configuring and programming this remote I/O scanner
PC3000 Application Interface	PCI	Can be used to exchange data between an AutoMax PC3000 and the microprocessor in the PC chassis via the ISA backplane

12.2 Converting an Existing Rack into an AutoMax PC3000

You can convert an existing rack to an AutoMax PC3000. To do this, follow these steps:

Step 1. Move existing modules or add modules to create this configuration:

In this slot number:	You must have:	Model Number:
4	any AutoMax Processor	M/N 57C435, M/N 57C431, M/N 57C430
5	a Network module	M/N 57C404
6	an Allen-Bradley Remote I/O module	M/N 57C443
7	a Generic module	GEN32K

Remove all other modules, or the conversion will not occur.

Step 2. From the System Configurator, choose Modify Info from the Rack menu.

Step 3. Choose PC3000 in the Slots group box.

Step 4. Make sure that the tasks are defined to run in slot 4. To do this, use the Modify Info command from the Task Manager's Task Menu.

Step 5. Generate a configuration.

12.3 Specifying the DCS-NET Drop Number and Drop Depth

For the AutoMax PC3000 to communicate on the DCS-NET network, you must set its network drop number. The drop number of all AutoMax PC3000 network interfaces are set at the factory as 55. Each AutoMax drop must have a unique drop number. When setting drop numbers, space their numbering to leave gaps for additional drops.

By setting the drop depth of an AutoMax PC3000 to a value other than 1, you can configure the AutoMax PC3000 to function as multiple virtual drops. Setting a drop depth of more than one provides increased register capacity for the AutoMax PC3000, allowing it to transmit/receive more information. Leaving gaps between drop numbers lets you easily add virtual drops. For example, setting the drop number of an AutoMax PC3000 to 05 and its drop depth to 3 configures it to function as drops 05, 06, and 07.

Set the drop depth to a value of 1-55, but do not exceed a value that is 56 minus the drop setting. For example, if the drop number is 54, you cannot set the drop depth greater than 2. Likewise, if the drop number is 10, you cannot set a drop depth greater than 46. You should set the drop depth to the minimum value required to satisfy the application and to minimize the update period for that module. To avoid transmission collisions, make sure that the drop numbers and drop depth settings of DCS-NET interfaces on your network do not overlap.

To set the DCS-NET network drop number and depth, you must:

- set the drop number and drop depth **offline** using the Rack Configurator
- set the drop number using the Change Drop command while connected **online** to the rack
- add program logic to write the drop depth value into the Drop Depth register (register 20) of the PC3000 DCS-NET network interface

The following sections briefly explain the steps you need to follow to set the DCS-NET network drop number and depth. For more information about the AutoMax DCS-NET network, see I/M J2-3001.

For information about configuring the PC3000 as a passive-listening drop on the DCS-NET network, see section 12.8

12.3.1 Setting the DCS-NET Network Drop Number and Depth While Offline

To set the DCS-NET network drop number and drop depth, follow these steps:

Step 1. While offline, access the Rack Configurator for the AutoMax PC3000 whose DCS-NET network drop number you want to change.

Step 2. Select the PC3000 Network Interface, located in slot 5.

Step 3. From the Configure menu, choose Modify.

Step 4. Type in values for these fields:

- Network
- Drop Number
- Drop Depth

Step 5. Click OK to accept your changes

Step 6. Generate a configuration.

NOTE: *This procedure changes only the Configuration File. You must use the Change Drop command while online to make the new values take effect.*

12.3.2 Setting the Physical Drop Number Using the Change Drop Command While Online

Other AutoMax DCS-NET network modules use thumbwheels to set the physical drop number. However, for the AutoMax PC3000, you set the physical drop number while connected online to the AutoMax PC3000. This drop number and the value entered offline using the Rack Configurator must match.

Since you must set the drop number online, you must choose and implement an online connection method. See chapter 10 for more information.

To set the physical drop number, follow these steps:

Step 1. From the Online menu, choose the Online Task Manager command.

Step 2. Connect to an AutoMax PC3000, either directly or over the network.

If you are connecting to a newly installed PC3000 over the DCS-NET network, specify a drop number of 55.

Important: When setting the drop number of multiple AutoMax PC3000s on the same DCS-NET network, you must bring each one online individually and set the drop number. Since each newly installed AutoMax PC3000 has a drop number of 55, you cannot connect them to the network at the same time, because each node must be set as a unique drop number.

Step 3. Access the Online:Connect screen by typing “C.”

Step 4. From the Online:Connect screen, access the Change Drop command by typing “C.”

Step 5. Type in the new drop number at the prompt.

Step 6. To accept the change, press ENTER, or cancel the change by pressing ESC.

The AutoMax PC3000 begins communicating using the new drop number.

NOTE: *If you are resetting the drop number of a PC3000 that was a passive-listening drop (drop 56), you must make sure that jumper JP4 is installed. See section 12.8 for more information.*

12.3.3 Setting the Drop Depth by Using Program Logic

In addition to setting the drop depth for a drop offline using the Rack Configurator, you must also define the drop depth for the DCS-NET network interface by:

- assigning a variable to the Drop Depth register (register 20)
- writing the drop depth value to the variable assigned to the Drop Depth register

This drop depth and the value entered offline using the Rack Configurator must match.

Include this program logic at the beginning of the highest priority program in its initialization section. The drop depth value must be written before any programs write to the virtual drop registers, or a bus error (31) occurs.

12.4 Specifying the AutoMax PC3000 CPU Tick Rate

AutoMax programs can be executed at a fixed scan rate. The scan rate is specified in terms of “ticks.”

The AutoMax PC3000 has a programmable tick rate, meaning you can change the definition of a tick. By changing the tick, you change the time base for program execution and, therefore, the program’s scan rate. The default setting for a tick is 5.5 ms. You can set the tick rate in increments of 0.5 ms.

You define the tick rate for a Processor offline. It is not set until you load the configuration to the Processor.

To set the tick rate for an AutoMax PC3000 Processor, do the following:

Step 1. Access the Rack Configurator for the PC3000 whose CPU tick rate you want to change.

Step 2. Select the PC3000 CPU, located in slot 4.

Step 3. From the Configure menu, choose Modify.

Step 4. Type in a new tick rate in milliseconds (0.5-10 ms), and click OK.

Step 5. Generate a configuration.

Step 6. Load the configuration to the PC3000.

12.5 Assigning a Name to the AutoMax PC3000 Installed in a PC Chassis

To help you identify the AutoMax PC3000 you have installed in your personal computer, you can assign a name to each AutoMax PC3000.

To assign a name to a PC3000 installed in a PC chassis, follow these steps:

Step 1. In the System Configurator, choose Communication from the Setup menu.

Step 2. In the Communication Type group box, choose Internal PC3000.

Step 3. Using the Card ID list box, choose the AutoMax PC3000 that you want to name. This box lists all of the AutoMax PC3000s installed in your personal computer.

Step 4. Click on Assign Name.

Step 5. In the Name field, type a name that is 10 characters or less.

Step 6. Click OK to accept the name.

The name you assigned appears after the card’s serial number in the Card ID list box in the Communication Setup dialog box.

12.6 Using the AutoMax PC3000 CPU Common Memory Variables

The AutoMax PC3000 CPU has registers available for assigning common memory variables—variables that you want to share between programs. The registers are volatile by default. Their values are not retained when the PC3000 loses power or you perform a Stop All. However, you can specify a variable to be non-volatile, so that its value is retained through power cycles and Stop All conditions.

Each PC3000 also has pre-defined common memory variables, but you must enter them on the Variable Configurator form if you want to use them in an application program. These pre-defined variables are:

- AUTORUNSTATUS@ — True when AUTO RUN is enabled for the rack; false if AUTO RUN is not enabled.
- FORCINGSTATUS@ — True when a variable is forced in the rack; false when no variables are forced in the rack.
- BATTERYSTATUS4@ — True when the AutoMax PC3000's battery is good.

Make sure you assign BATTERYSTATUS4@ to a common memory variable and write application code to periodically monitor this variable. Monitoring this variable is the only way to obtain status on the AutoMax PC3000 battery.

For more information about:	See:
symbolic programming	chapter 15 and the instruction manual of your chosen programming language
configuring common memory variables	AutoMax Programming Executive software instruction manual

12.7 Using the DCS-NET Network Register Variables

In the Variable Configurator for the PC3000 DCS-NET network interface, you can access these types of registers:

- setup registers
- drop status registers
- broadcast registers
- data exchange registers for drops 1-55

The AutoMax PC3000 DCS-NET network interface contains 56 areas, or drops, each containing 64 16-bit registers. These registers are used for data exchange between the master network module and the slave network modules in a system. Drop 0 is reserved for status and broadcast messages. The remaining 55 drops are reserved for data exchange among the modules.

In drops 1-55, registers 0-31 contain data that an application program in a corresponding drop has written to them. These registers are then transmitted to the master and all other slaves on the network. The number of registers that an application program can write to is determined by the drop depth assigned to the DCS-NET network interface (32 * the drop depth).

For each drop, registers 32-63 contain the data that an application program in the master rack has written to the master DCS-NET network module for the particular drop. Consequently, this data is transmitted from the master to the addressed drop, with the other drops receiving the data simultaneously. The number of registers that a master DCS-NET network module can write data to and then transmit is 32 registers times the number of drops on the network.

For more information about:	See:
DCS-NET network registers	chapter 19
configuring the network variables	the AutoMax Programming Executive software instruction manual

12.8 Configuring the AutoMax PC3000 as a Passive-Listening DCS-NET Network Drop

You can configure the PC3000 as a passive-listening drop on the DCS-NET network. This lets you use the AutoMax PC3000 to monitor:

- DCS-NET networks that have 55 drops
- network data without changing any network timing relationships

However, the AutoMax PC3000 cannot transmit data on the DCS-NET network when it is configured as a passive-listening drop.

Jumper JP4 on the Processor card controls whether the AutoMax PC3000 is operating as a passive-listening drop. Follow electrostatic discharge (ESD) precautions when handling the card. (See section 5.1.)

To configure the AutoMax PC3000 as a passive-listening drop, follow these steps:

Step 1. Remove power to the Processor card.

Step 2. Remove jumper JP4. See figure 12.2. If you need to remove the card to access the jumper, follow the procedures in sections 20.2.1 and 20.2.3.

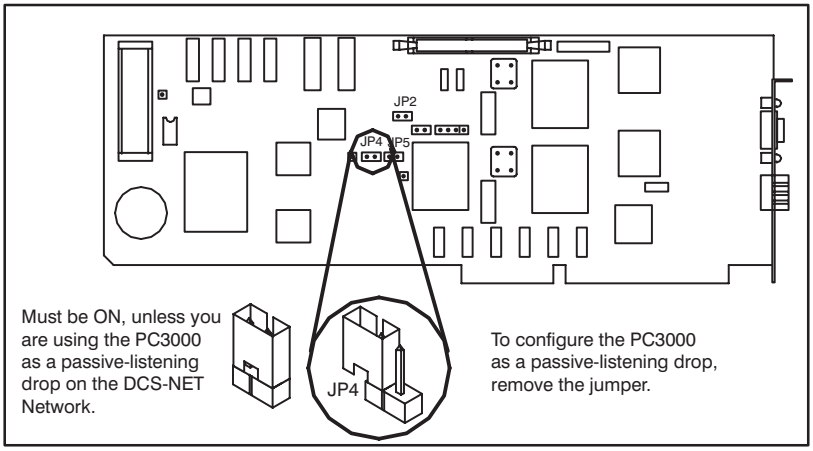


Figure 12.2 - Removing Jumper JP4

Step 3. Power up the PC3000.

After the AutoMax PC3000 powers up, its DCS-NET network drop number is 56. The PC3000 now acts as a passive listener on the DCS-NET network.

To re-configure the AutoMax PC3000 as a regular drop on the DCS-NET network, follow these steps:

Step 1. Remove power to the Processor card.

Step 2. Replace jumper JP4. See figure 12.2. If you need to remove the card to access the jumper, follow the procedures in sections 20.2.1 and 20.2.3.

Step 3. Power up the PC3000.

After the PC3000 powers up, the DCS-NET network drop number is set to the factory-setting of 55.

Step 4. If necessary, change PC3000's network drop number by following the procedures in section 12.3.

12.9 What to Do Next

You must configure the A-B remote I/O scanner interface if you will be controlling A-B remote I/O. See chapter 13. Otherwise, begin writing and implementing your application programs.

13.0 CONFIGURING THE AutoMax PC3000 A-B REMOTE I/O SCANNER

For information about:	See this section:
About Configuring the AutoMax PC3000 Scanner Interface	13.1
Configuring the Remote I/O Racks	13.2
Configuring the I/O Scanner by Assigning Variable Names to the Scanner Setup and Status Table	13.3
AutoMax PC3000 Scanner Configuration Example	13.4
What to Do Next	13.5

13.1 About Configuring the AutoMax PC3000 Scanner Interface

The PC3000 scanner is most easily configured using its Variable Configurator form, which is available in the AutoMax Programming Executive V4.1A and later. “Zooming into” the module gives you access to the module’s registers and bits. From there you use these “views” to configure the module:

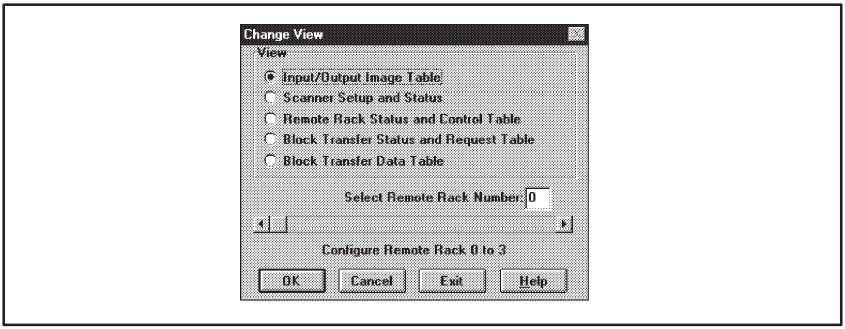


Figure 13.1 - Available Views for the PC3000 Scanner Variable Configurator Form

Use chapters 13 and 14 to determine the registers and bits to use. Also, use the Microsoft Excel® spreadsheet ABWKSH.XLS provided with the Programming Executive as a worksheet to record assigned variable names.

NOTE: *Data you enter in the spreadsheet cannot be imported into the AutoMax Programming Executive software.*

13.2 Configuring the Remote I/O Racks

Once you have your I/O modules laid out in chassis with adapters and have developed your I/O system addressing, you must enter this I/O rack information into the PC3000 remote I/O scanner interface. Assign variable names to the applicable module registers and/or bits using the Variable Configurator form and load data into these locations.

Each I/O rack has an input image table and an output image table. You use these tables to store input data and to extract output data for the rack. You must assign variable names to each input and output word and/or bit you use in a rack. You will then be able to use these names in your control programs.

Also, each I/O rack has status information associated with it. The status information can be a whole register or a bit within a register that you can monitor to detect rack communication and errors, among other information. You must assign a variable name to each status item so you can incorporate the variable into your control program.

13.2.1 Assigning Variable Names to the Inputs and Outputs in the Remote Racks

Each I/O group in an I/O rack has two corresponding registers in the scanner PC3000, one register for inputs and one for outputs. These registers are 16-bit words.

Before the scanner can communicate with an I/O rack you must assign a variable name to the input and output image register for each I/O group used in the I/O rack.

See Appendix D, “Register Assignment Map” for a complete listing of the registers and bits associated with the I/O image table.

To assign variable names to the input and output image table registers, use the Scanner’s Variable Configurator form. When you choose the Input/Output Image Table view, you see a form similar to the one shown in figure 13.2.

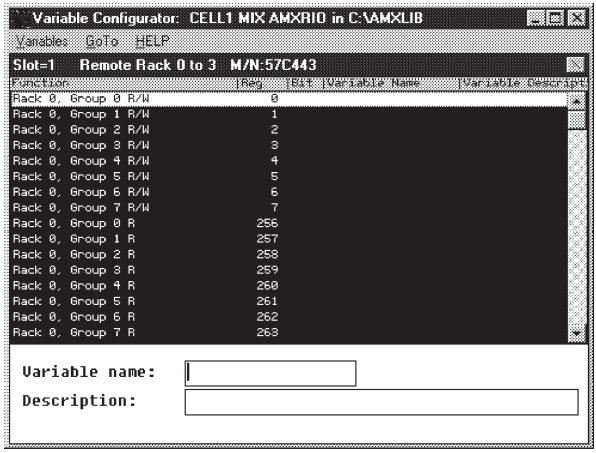


Figure 13.2 - Input/Output Image Table View

Within the Input/Output Image Table view, the output image table registers are presented first, followed by the input image table registers. Keep in mind that the registers corresponding to the output image table are read and write accessible, while those for the input image table are read only. You can assign a name to the entire register and/or to the individual bits.

WARNING

INPUT REGISTERS ARE READ ONLY. DO NOT ATTEMPT TO WRITE TO THEM. DOING SO COULD RESULT IN UNPREDICTABLE MACHINE OPERATION.

13.2.2 Assigning Variable Names to Remote I/O Rack Status and Control Registers

In addition to assigning variable names to a rack's input and output image table registers, you must assign names to the remote rack status and control registers, which are 16-bit words. These registers assist you in controlling whether a remote rack is scanned and monitoring any rack errors. Each remote rack has this status information:

- Rack Enable
- Remote Rack Status
- Ending Module Group
- Rack Timeouts
- Rack CRC Errors
- Rack Failures
- Rack Protocol Errors
- Block-transfer Errors

For this information:	See:
listing of the registers associated with the remote rack status and control	appendix D, “Register Assignment Map”
how to clear and correct rack errors	chapter 16, “Initializing the AutoMax PC3000 A-B Remote I/O Scanner”

To assign variable names to the remote rack status and control registers, use the scanner’s Variable Configurator form. When you choose the Remote Rack Status and Control Table view, you see a form similar to the one shown in Figure 13.3.

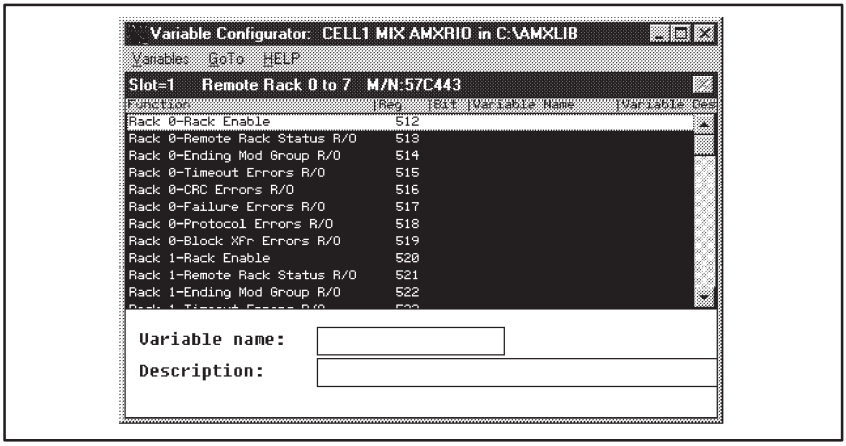


Figure 13.3 - Remote Rack Status and Control Table View

All remote rack status and control registers are read only, except the rack enable register.

For information about enabling a remote rack and monitoring its status, see chapter 16, “Initializing the AutoMax PC3000 A-B Remote I/O Scanner.”

13.3 Configuring the I/O Scanner by Assigning Variable Names to the Scanner Setup and Status Registers

Registers within the scanner, which are 16-bit words, have been assigned to these functions:

- controlling scanning and the scan mode
- defining the remote I/O communication rate
- monitoring the remote I/O link status
- storing the module ID

See Appendix D, “Register Assignment Map” for a complete listing of the registers associated with the scanner setup and status.

You must assign names to these registers so you can reference them in the control programs. To assign variable names to the remote rack status and control registers, use the scanner's Variable Configurator Form. When you choose the Scanner Setup and Status view, you see a form similar to the one shown in Figure 13.4.

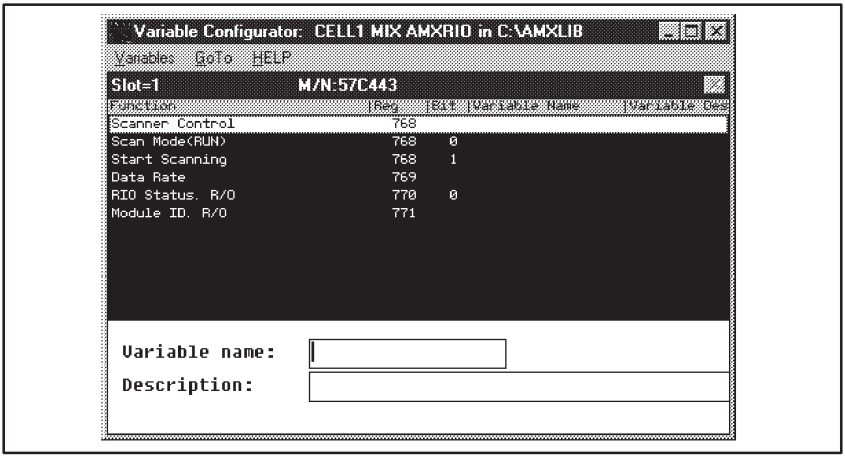


Figure 13.4 - Scanner Setup and Status View

All the scanner setup registers are read and write accessible. The RIO Status and Module ID registers are read only. You set the scan mode and data rate and enable scanning during the execution of the scanner initialization program, which you must create. For more information, see chapter 16, "Initializing the AutoMax PC3000 A-B Remote I/O Scanner."

13.4 AutoMax PC3000 Scanner Configuration Example

A typical scanner configuration is shown by the following figure.

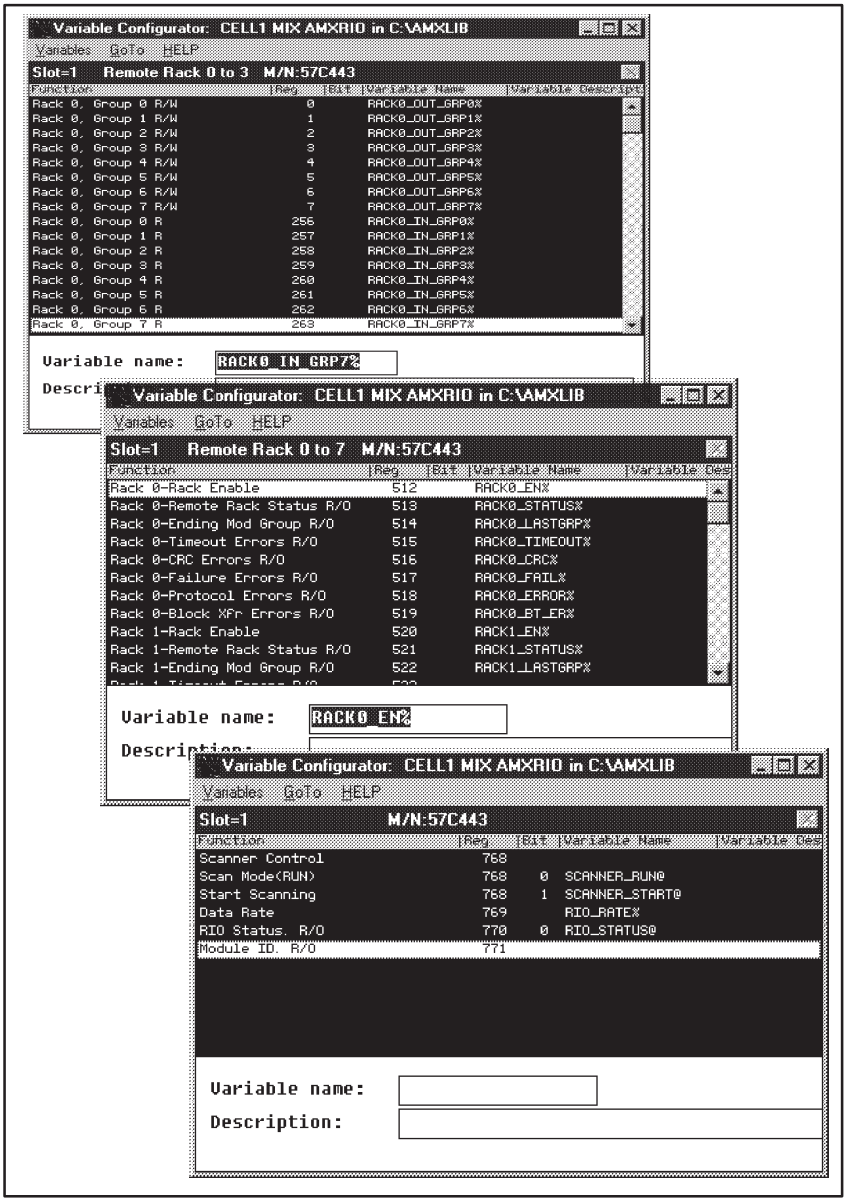


Figure 13.5 - An Example of a Typical Scanner Configuration

13.5 What to Do Next

If you are using block-transfers, you must configure and program them, see chapter 14. Otherwise, create your remote I/O scanner initialization program. See chapter 16.

14.0 CONFIGURING AND PROGRAMMING BLOCK DATA TRANSFERS TO A-B I/O MODULES

For information about:	See this section:
About Block-Transfers	14.1
Configuring Block-Transfers	14.2
Programming Block-Transfers	14.3
Monitoring Block-Transfer Status	14.4
What to Do Next	14.5

14.1 About Block-Transfers

Many I/O modules and remote I/O adapters, such as analog modules and operator interfaces, communicate to scanners solely by block-transfer. A block-transfer operation allows the transfer of a block of data to or from an I/O module during one remote I/O scan. A maximum of 64 words can be transferred during one request, and you can program a maximum of 48 block-transfer requests. One request can be processed per rack per remote I/O scan, but multiple requests to a rack can be initiated.

When programming a block-transfer, you specify whether it is a continuous or non-continuous read or write request.

14.1.1 About Block-Transfer Read and Write Requests

The AutoMax PC3000 can perform bi-directional block-transfers, meaning it can issue block-transfer read and block-transfer write requests. You must specify block-transfer read operations when you want to gather input and status data from the module and block-transfer write operations when you want to send output or configuration data to the module.

During a block-transfer read request, the number of words specified in the request's Length of the Block-Transfer register is read from the block-transfer module and placed in the corresponding words in the data table register.

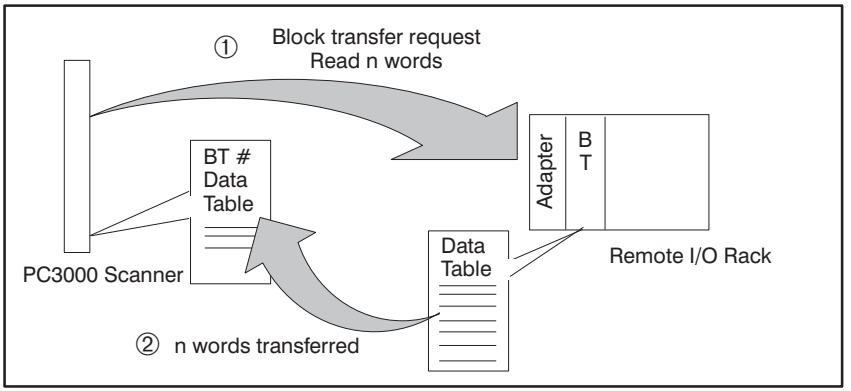


Figure 14.1 - Block-Transfer Read Operation

During a block-transfer write, the number of words specified in the request's Length of the Block Transfer register is copied from the appropriate data table registers and written to the block-transfer module.

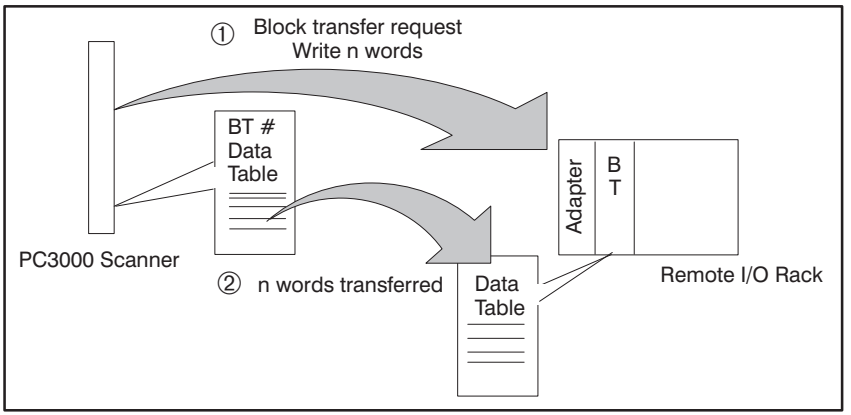


Figure 14.2 - Block-Transfer Write Operation

14.1.2 About Continuous and Non-Continuous Block-Transfer Requests

Block-transfer requests operate in one of two ways:

- continuous
- non-continuous

Use a continuous block-transfer when you want the block-transfer request to execute at regular intervals. This allows the block-transfer modules like analog I/O to act like discrete I/O, meaning you get predictable data transfer. When you set up the block-transfer, you can specify how often you want the block-transfer to execute in milliseconds. Once initiated, the continuous block-transfer request performs its operation by executing every *n* ms, which you defined as the update time, until an error occurs. When an error occurs, the block-transfer request is disabled.

When choosing an update time for a continuous block-transfer, keep in mind that only one block-transfer request can be executed per rack per remote I/O scan. When defining an update time, consider these factors:

- remote I/O scan time

  For information about estimating this time and designing your system to optimize block-transfers, see chapter 4, “Designing Control Systems That Use the Allen-Bradley Remote I/O Link.”

- block-transfer processing restrictions for target block-transfer modules

  The time you define is the minimum time in which the block-transfer will execute.

Define an update time that is:

- longer than the minimum time required to complete all the block-transfers in the program

  If you choose a time that is less than the minimum time required to complete all the block-transfers, the block-transfer data is read or written as fast as the remote I/O scan allows.

- not too fast for the processing capabilities of the target block-transfer module

Use non-continuous block-transfers when:

- you only need intermittent block data exchange, such as writing a message to an operator interface or gathering non-critical status information
- your application requires orderly handshaking with I/O modules

For every non-continuous block-transfer you want, you must write a separate command. However, with continuous block-transfers, you write one command for each target module.

14.2 Configuring Block-Transfers

For each block-transfer request you will be sending, you must assign variable names to the following before you can send a block-transfer request:

- status and control registers in which you specify the destination and behavior of the request
- data table registers, which are used to exchange data between the scanner module and the block-transfer module

14.2.1 Assigning Variable Names to a Block-Transfer Status and Request Table

Each block-transfer request has 4 words reserved for status and control. The words are organized as follows:

This word:	Is used to:
Status and Control (first word)	initiate the request and monitor its status This is the block-transfer status and control register.
Rack/Slot/Grp/Req (second word)	• define the block-transfer module's location • define the request as either a read or a write
Length of Block Xfer (third word)	define the number of words read or written during the transfer
Update Time (fourth word)	specify how often you want the request to be initiated

See Appendix D, "Register Assignment Map" for a listing of the registers associated with the block-transfer status and request table.

To assign variable names to the block-transfer status and request table registers, use the scanner module's Variable Configurator form. When you choose the Block Transfer Status and Request Table view, you see a form similar to the one shown in figure 14.3.

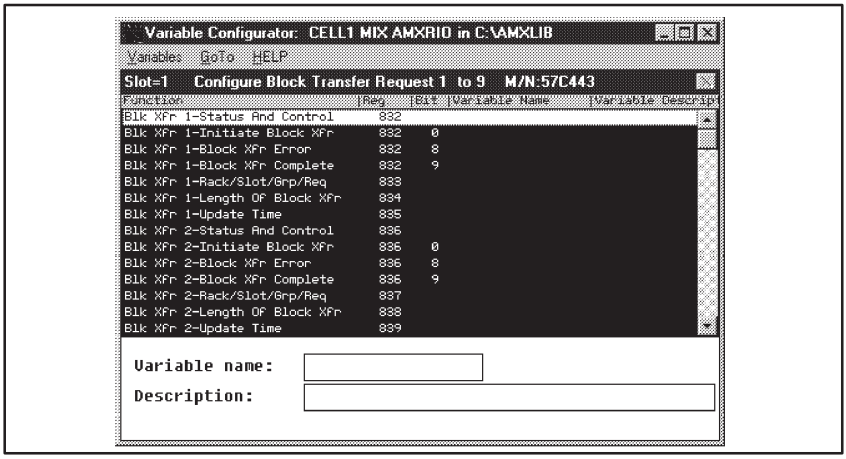


Figure 14.3 - Block Transfer Status and Request Table View

Each register is read and write accessible.

14.2.2 Assigning Variable Names to the Block-Transfer Data Table Registers

The block-transfer data table is the location where data is exchanged between the scanner module and a block-transfer module. Each block-transfer request has 64 sequential registers (words) reserved. Within the data table, you either place data destined for the block-transfer module or copy data received from the block-transfer module. The amount of data read or written is based on the length of the block-transfer that you specified in the third word of the block-transfer request's status and control table.

See Appendix D, "Register Assignment Map" for a complete listing of the data registers associated with the block-transfer status and request table.

To assign variable names to the block-transfer data table registers and the bits within the registers, use the scanner's Variable Configurator form. When you choose the Block Transfer Data Table view, you see a form similar to figure 14.4.

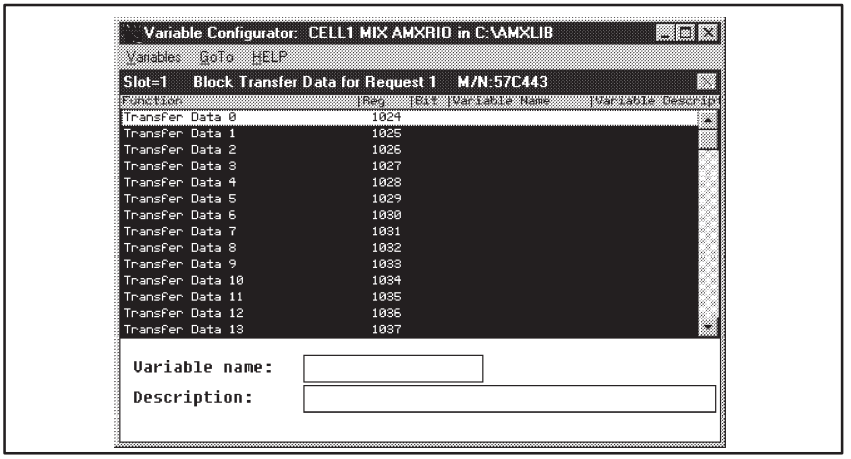


Figure 14.4 - Block Transfer Data Table View

Assign a variable name to each data table register you need. Start at word 0 of the data table. The data table is read and write accessible.

14.3 Programming Block-Transfers

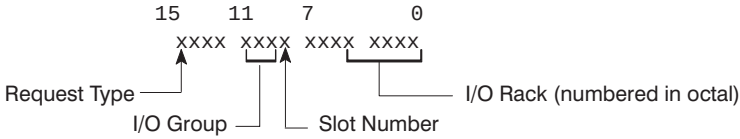
Once you have configured the block-transfer requests, you must create logic that sets up and initiates the block-transfers. Your application program must:

- specify the location of the module receiving the block-transfer request (the target I/O module)
- specify a read or write operation
- specify the length of a block-transfer
- specify the update interval of the block-transfer, either continuous or non-continuous
- initiate the block-transfer request to the target I/O module
- write data to or read data from the block-transfer data registers according to the application's need
- monitor the status bits

See the following sections for detailed information and Appendix D, "Register Assignment Map" for the complete block-transfer status, control, and data table listing.

14.3.1 Specifying the Location of the Target Block-Transfer Module

Each block-transfer request must have an I/O module location associated with it. The location of the target I/O module specifies its I/O rack, group, and the slot number within the I/O group. You set these parameters by setting bits of the variable associated with the second word within the request's status and control table, which is labeled Rack/Slot/Group/Req. The bits and their meaning are:



For more information about determining the location of a block-transfer module, see section 4.2.3.

To specify the target block-transfer module's location, do the following:

Step 1. Specify the I/O rack within which the module resides ($0\text{-}37_8$) by loading the remote rack number into bits 0-4 of the variable associated with the request's Rack/Slot/Group/Req register.

For example, if the target module for request 1 was located in rack 7, bits 0-4 of register 833 should contain the value of 7.

```
833:      xxxx xxxx xxx0 0111
```

Step 2. Specify the slot number of the block-transfer module by setting bit 8 of the variable associated with the Rack/Slot/Group/Req register. The slot number is either 0 or 1, and specifies the position of the module in the I/O group.

If the I/O chassis containing the block-transfer module is using:	Set bit 8 of the variable associated with the request's Rack/Slot/Group/Req register to:
1- or 1/2-slot addressing	0
2-slot addressing	0, if the module is in the low slot of the I/O group 1, if the module is in the high slot of the I/O group

For example, if the target module for request 1 was located in slot 0 of its I/O group, then bit 8 of register 833 should contain the value of 0.

```
833:      xxxx xxx0 xxx0 0111
```

Step 3. Specify the I/O group to which the target module belongs by loading a value of 0-7 in bits 9-11 of the variable associated with the Rack/Slot/Group/Req register.

For example, if the target module for request 1 was located in I/O group 3, bits 9-11 of register 833 should contain the value of 3.

```
833:      xxxx 011 0 xxx0 0111
```

14.3.2 Specifying a Read or Write Operation

You must define a block-transfer request to be either a read or a write request. To do this, set bit 15 of the variable associated with the second word within the request's status and control table, which is labeled Rack/Slot/Group/Req.

To specify this type of request:	Set bit 15 of the variable associated with the request's Rack/Slot/Group/Req register to:
read	1
write	0

For example, to specify block-transfer 1 to be a read request, bit 15 of register 833 would contain a value of 1.

```
833:       1xxx 0110 xxx0 0111
```

14.3.3 Specifying the Length of a Block-Transfer

The length of the block-transfer specifies how many words of data will be read from or written to the target block-transfer module per block-transfer request. Specify the length of the block-transfer request by loading a value of 1-64 into the variable associated with the Length of Block Xfer register within the block-transfer status and control table. This parameter corresponds to the third word within this table.

For example, if you wanted to transfer 10 words of data during block-transfer request 1, you would load a value of 10 into register 834.

14.3.4 Specifying the Update Time of the Block-Transfer

Setting an update time determines if a block-transfer is continuous or non-continuous. You specify an update time for a block-transfer request within the variable associated with the register labeled Update Time (the fourth word of the request's block-transfer status and request table). The time you enter is in intervals of 10 ms.

To specify this type of block-transfer:	Enter this within the request's Update Time register:
continuous	a value in units of 10 ms Update time (ms) = n $\times$ 10, where n is the number you load into the register.
non-continuous	a value of 0

For example, if you wanted block-transfer request 1 to execute every 30 ms, you would place a value of 3 into register 835.

For more information about continuous and non-continuous block-transfers, see section 14.1.2.

14.3.5 Initiating Block-Transfer Requests to I/O Modules

A block-transfer request must be initiated before it can execute. To initiate a block-transfer request, set bit 0 of the variable associated with the request's Initiate Block Xfer register to 1 (on). For example, to initiate block-transfer request 1, set bit 0 of register 832 to 1 (on).

For this type of block-transfer:	The Initiate Block Xfer bit:
continuous	remains set until an error occurs
non-continuous	remains set until the request has been completed or an error occurs

You can stop a request by resetting the Block Xfer bit to 0 (off).

You can determine when the block-transfer request is completed by monitoring the Block Xfer Complete bit (bit 9 in the Status and Control word). For more information, see section 14.4.

Before initiating a block-transfer write request, make sure to place the data you want to write to the target module within the request's data table. Place the data starting at word 0. Place as much data as you specified in the length of the block-transfer.

14.3.6 Using the Block-Transfer Data Table

The block-transfer data table is the storage location for data being written to and read from the target block-transfer modules. You must create logic that places data in the appropriate data table words for transfer to the module and for extracting the data received from the module. The amount of data in the data table should correspond to the number of words being transferred (length of the block-transfer).

14.4 Monitoring Block-Transfer Status

WARNING

YOU MUST INCLUDE LOGIC IN YOUR APPLICATION PROGRAM TO MONITOR THE STATUS OF EACH BLOCK-TRANSFER REQUEST. WHEN AN ERROR OCCURS, AN ERROR BIT IS SET, BUT YOUR APPLICATION PROGRAM MUST READ THIS BIT SO THAT YOU WILL BE NOTIFIED OF ANY ERRORS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN UNPREDICTABLE MACHINE OPERATION AND BODILY INJURY.

Each block-transfer request has these status bits, which are located in the first word of the block-transfer's status and request table:

- Block Transfer Error (bit 8)
- Block Transfer Complete (bit 9)

14.4.1 Monitoring the Block Transfer Error Bit (Status and Control Word Bit 8)

A request's Block Transfer Error bit is set whenever an error occurs during the block-transfer. While the error bit is set, the request is disabled. You must clear the bit and re-initiate the block-transfer request before the block-transfer request can execute again. Make sure to frequently monitor the error bits of your block-transfer requests.

NOTE: *If a continuous block-transfer request results in frequent errors, try lengthening the update time. The target module may not be able to accept a request as fast as it is being sent.*

14.4.2 Monitoring the Block Transfer Complete Bit (Status and Control Word Bit 9)

A request's Block Transfer Complete bit is set whenever a block-transfer has been completed.

If the block-transfer is:	Then:
continuous	the complete bit is set (1) when the first transfer has been completed It then remains on until you clear it via your application program. Once you clear the bit, it is set after the next request is complete. If your application needs to know each time the block transfer is updated, you should clear this bit each time, so the program can determine when the bit gets set again.
non-continuous	the complete bit is set (1) when the request is finished You must re-initialize the block transfer request for it to be able to execute when the logic conditions next dictate it. If your application needs to know each time the block transfer is updated, you should clear this bit each time, so the program can determine when the bit gets set again.

14.4.3 Block-Transfer Status Bit Summary

Block-Transfer Request Type	Condition	Status and Control		
		Initiate (bit 1)	Error (bit 8)	Complete (bit 9)
continuous	initiating	1	0	0
	completed first request	1	0	1 *
	error	0	1	1
non-continuous	initiating	1	0	0
	completed	0	0	1
	error	0	1	1
* See section 14.4.2 for more information about the Complete bit.				

14.5 What to Do Next

Make sure you have configured the remote I/O scanner. See chapter 15. Then, create your scanner initialization program. See chapter 16.

15.0 PROGRAMMING BASICS

Use this chapter to gain basic information about how to create programs for the AutoMax PC3000. For detailed information, see the AutoMax Programming Executive documentation.

For information about:	See this section:
Programming Overview	15.1
Organizing Your Application Project	15.2
About the Organization of the AutoMax Programming Executive Software	15.3
Configuring I/O	15.4
Configuring Variables	15.5
What to Do Next	15.6

15.1 Programming Overview

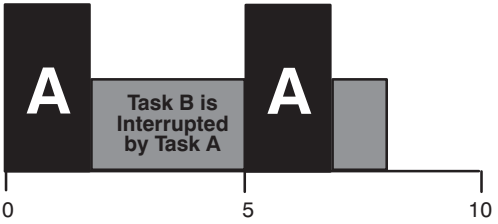
The AutoMax system lets you share data among other AutoMax systems and coordinate programs. Other features include:

- multi-tasking operating system
- user-scheduling of programs
- symbolic programming (no addresses)
- three integrated programming languages (Ladder Logic, BASIC, and Control Block)

15.1.1 About the Multi-Tasking Operating System

The AutoMax multi-tasking operating system lets you:

- break your application into logical parts
- write separate programs for each part
- schedule how often each program will run
- assign priorities to help ensure that the most critical program runs on time



Task A - Every 5 milliseconds, 2-millisecond duration, priority = 5
Task B - Every 10 milliseconds, 4-millisecond duration, priority = 6

NOTE: *In AutoMax DCS, lower numeric value = higher-priority assignment, i.e., 5 is higher priority than 6.*

Figure 15.1 - AutoMax Multi-Tasking

Any process that is to be controlled can be broken down into small application programs. Each program may control an individual function in software, but is linked to other programs to control the overall process. For example, in a batching operation, control is needed to measure and weigh the different elements of a specific mixture. This can be handled in one software module or task. In addition, a need for some type of machine-sequencing control usually exists. This would make up a second software block.

Operator interface and data collection are two more functions that could be a part of the system. As the main system is broken down into its smaller components, approaching the control of each of these individual components becomes easier than trying to solve the entire application in one effort.

These programs, although separate, share control information across their boundaries. They reference the appropriate variables by name, and the CPU can access the I/O and memory associated with the names.

Multi-tasking helps you simplify the writing, debugging, and maintaining of your application program by letting you separate your overall control scheme into individual programs. Multi-tasking also reduces the overall execution time of the control scheme and provides a faster response to critical programs. You can also stop a program while others are running, facilitating troubleshooting and testing.

15.1.2 About User-Scheduled Programs

After dividing your application into logical parts and writing programs to control each part, you can schedule these programs to run according to the needs of the application. With priority scheduling in a multi-tasking environment, you can make sure that more critical programs are not suspended by the execution of lower priority programs.

You can assign a program a priority level of 4-11, where 4 is the highest priority level and 11 the lowest. As different programs are executed, higher priority programs can “interrupt” lower priority

programs, suspending their execution until the higher priority program has finished. Once the higher priority program has finished executing, the lower priority program resumes its execution. You can assign the same priority to multiple programs. In such a case, the programs execute in alphabetical order. Figure 15.2 illustrates priority scheduling.

You can also assign other characteristics to a program.

If you want the program to:	Define it as:
always stay in run while the other programs are running To stop a critical program, you must stop all the programs in a rack.	Critical
be able to be uploaded from the AutoMax rack If a program is not defined as reconstructible, it cannot be saved back to disk, and you must make sure that you keep backup copies of the original programs. NOTE: *Ladder Logic tasks are always reconstructible.*	Reconstructible
test or troubleshoot a function Utility programs must be individually loaded to a rack.	Utility

15.1.3 About Symbolic Programming

You write AutoMax application programs using symbol names rather than register and I/O addresses. For example, a variable may be symbolically named “START_LINE@” in an AutoMax system, rather than identifying a register location. Using symbolic programming lets you create application software independent of the hardware, letting you re-use application software without re-writing it. You can also move programs to other CPUs in the system to balance memory loading or improve system response.

Variables in the system can be shared between programs in the same rack, between the racks in a system, or they may be used only in a single program.

The AutoMax Programming Executive resolves symbol names and I/O addresses for you by using a database that associates the hardware in the system with the symbolic names.

15.1.4 About the Available Programming Languages

You can choose among these languages when programming a control application:

- Ladder Logic
- BASIC
- Control Block

Selecting which language to use for a given program depends on the function being programmed.

For:	Use this language:
sequential control and machine interlocking Typical inputs would be: • operator pushbuttons • photo-eyes • machine limit switches Typical outputs would be: • machine solenoids • pilot lights • motor starters	Ladder Logic
data manipulation, communications, and complex math You can use BASIC to write programs that talk to operator interfaces or to peripheral devices, such as thickness gauges, scales, etc.	BASIC
• closed-loop regulation, such as controlling position, speed, tension, flow pressure, and temperature • continuous process control applications, such as material handling The Control Block language is a family of subroutines that can be linked together to facilitate a “data flow” approach to programming.	Control Block

15.2 Organizing Your Application Project

The AutoMax Programming Executive software helps you organize the design for any project into a hierarchy:

- Library — can contain multiple systems or projects

  You can find libraries under a drive root directory.

- System — represents an entire project or machine that may have multiple racks and networks tying it together

  The system is a subdirectory under the Library.

- Section — groups together racks performing related functions

  You can have multiple sections per system; however, no separate subdirectory is created under the System level. Section information is stored as database files under the System subdirectory.

- Rack — groups together the programs and database files that hold the rack hardware and variable configuration information.

  A subdirectory is created under the System for each rack.

15.3 About the Organization of the AutoMax Programming Executive Software

The AutoMax Programming Executive software provides a graphic environment to help you create, organize, document, and troubleshoot application programs.

The following table lists the offline functions.

This application:	**Helps you:**
System Configurator	organize the project software, or system, into sections or racks. Each system is a functional group of sections, and each section is a functional group of racks.
Rack Configurator	configure the hardware in a rack, such as AutoMax Multibus modules. The AutoMax PC3000 hardware that can be *configured* is the: • AutoMax CPU • DCS-NET module • A-B Remote I/O module • PC3000 Application Interface

This application:	Helps you:
Variable Configurator	map variable names to I/O points or memory locations
Task Manager	add, edit, compile, print, and verify programs You also use the Task Manager to specify the language (BASIC, Control Block or Ladder Logic) and to define a task's priority and whether it is a Critical, Reconstructible, or a Utility program.

15.4 Configuring I/O

After you establish a system, section, and rack structure, you can begin adding hardware to a rack.

For information about adding an AutoMax PC3000, see chapter 12.

15.5 Configuring Variables

Once the hardware for a rack has been defined, you can configure the variables in each rack. Configure variables by attaching symbolic names to the physical I/O and memory locations that must be accessible to one or more application programs in a rack.

The types of variables you can use in an AutoMax system are:

- single integer variables (16-bit word)
- double integer variables (32-bit word)
- Boolean variables
- real variables
- string variables

For more information about:	See:
variable types	the instruction manual for your chosen programming language(s) or the AutoMax Programming Executive user manual.
specific variables to configure for the AutoMax PC3000	chapter 12

15.6 What to Do Next

Refer to the language manuals and the AutoMax Programming Executive software instruction manual for more information.

You need to create programs that monitor the PC3000. See chapter 18 for more information.

16.0 INITIALIZING THE AutoMax PC3000 A-B REMOTE I/O SCANNER

Before the AutoMax PC3000 can begin scanning remote I/O, you must prepare it for scanning by writing and running an initialization program. Within this program, you must do the following in this recommended order:

- specify the data communication rate
- enable the remote I/O racks that you want the scanner to scan
- initiate scanning
- place the scanner module in run mode
- make sure all enabled racks are communicating

The following sections describe the data registers you must include in the initialization program. For a sample program in BASIC and Enhanced Ladder Logic languages, see Appendix G, “Examples of Remote I/O Programs.”

For information about:	See this section:
Specifying the Data Communication Rate	16.1
Specifying the Remote Racks That Will Be Scanned	16.2
Initiating Scanning	16.3
Placing the Scanner in RUN Mode	16.4
What to Do Next	16.5

16.1 Specifying the Data Communication Rate

You should have determined the data communication rate in chapter 4, “Designing Control Systems That Use the AutoMax Allen-Bradley Remote I/O Link.” All devices on a remote I/O link must be:

- able to communicate at the rate you have chosen
- configured to communicate at that rate

You can configure the communication rate of Allen-Bradley remote I/O adapters by setting a switch located on the device or on the chassis in which the adapter resides.

To specify the PC3000’s remote I/O data communication rate, you must write a value to register 769 (Data Rate) that corresponds to the data communication rate you want. See Table 16.1.

Table 16.1 - Setting the Remote I/O Data Communication Rate

To use this communication rate:	Write this value into the variable associated with the Data Rate (register 769):
57.6 Kbps	0
115.2 Kbps	1
230.4 Kbps	2

Important: The data communication rate must be set before you enable the scanner module to start scanning the remote I/O racks.

Should you ever need to change the data communication rate, follow the procedure in section 16.4.

16.2 Specifying the Remote Racks That Will Be Scanned

Within the initialization program, you must specify the remote I/O racks that you want the PC3000 scanner to scan by setting each rack's Rack Enable bit, because on power-up all racks are disabled. Set the Rack Enable bit for all configured remote I/O racks used in your system.

To enable a rack, set bit 0 of the variable corresponding to the Rack Enable register to on (1).

Table 16.2 - Listing of the Remote Rack Enable Registers

To enable this rack:	Set bit 0 of this register to on (1):	To enable this rack:	Set bit 0 of this register to on (1):
Rack 0	512	Rack 20	640
Rack 1	520	Rack 21	648
Rack 2	528	Rack 22	656
Rack 3	536	Rack 23	664
Rack 4	544	Rack 24	672
Rack 5	552	Rack 25	680
Rack 6	560	Rack 26	688
Rack 7	568	Rack 27	696
Rack 10	576	Rack 30	704
Rack 11	584	Rack 31	712
Rack 12	592	Rack 32	720
Rack 13	600	Rack 33	728
Rack 14	608	Rack 34	736
Rack 15	616	Rack 35	744
Rack 16	624	Rack 36	752
Rack 17	632	Rack 37	760

If you want to prevent a rack from being scanned, make sure that bit 0 of the rack's Rack Enable Register is off (0).

16.3 Initiating Scanning

Your initialization program should only initiate scanning after the data rate has been set.

To start the PC3000 scanning the enabled racks, set bit 1 of register 768 to on (1). This bit is labeled Start Scanning in the scanner's Variable Configurator form.

Once you initiate scanning and the scanner is in RUN mode, the PC3000 sets the data rate as defined by the value in register 769 and starts updating I/O from the remote racks. Once scanning has begun, the module clears the Start Scanning bit (register 768, bit 1).

If all the enabled racks are communicating, the PC3000's remote I/O LED (green) should be on. If the serial card is present, the 7-segment LEDs should be off.

16.4 Placing the Scanner in RUN Mode

When the scanner has been initiated and it is in RUN mode, the following occurs:

- inputs are updated
- outputs are enabled
- I/O can be forced

Inputs are updated as long as the Start Scanning bit is enabled. However, your initialization program must place the scanner module in RUN mode so that outputs in the remote racks being scanned are updated.

To place the scanner in RUN mode, set bit 0 of the variable associated with register 768 to on (1). This bit is labeled Scan Mode in the scanner's Variable Configurator form.

The Scan Mode bit is reset to off (0) whenever a STOP ALL error occurs. For a list of STOP ALL error codes, see chapter 19.

16.5 What to Do Next

Begin creating and implementing your control programs.

17.0 EXCHANGING DATA WITH AN AutoMax PC3000 OVER THE ISA BUS

You can use the ISA bus to exchange data between an internal PC3000 and the PC's microprocessor. This section provides a brief explanation of these registers.

For this information:	See section:
About the Register Organization of the AutoMax PC3000 Application Interface	17.1
Using the Volatile Variables	17.2
Using the Non-Volatile Variables	17.3
Using the System Information Variables	17.4
What to Do Next	17.5

17.1 About the Register Organization of the AutoMax PC3000 Application Interface

The PC3000 Application Interface contains registers you can use to exchange information over the ISA backplane between applications running on the PC3000 and applications running on the PC's microprocessor. The Application Interface contains both volatile and non-volatile registers. You can attach a variable to a whole register or to individual bits within a register.

When creating programs that use variables in these registers, keep in mind the addressing differences that exist between the AutoMax PC3000 and the Intel™ microprocessor in a PC. Real variables in the AutoMax PC3000 are in the Motorola® format. You can use the BASIC function CONVERT% to convert them into the Intel or IEEE format. See the AutoMax Enhanced BASIC Language instruction manual, J-3675, for more information.

17.2 Using the Volatile Variables

Use registers 0-999 of the PC3000 Application Interface to store volatile data. Variables do not retain their value through power cycles and Stop All conditions.

17.3 Using the Non-Volatile Variables

Use registers 1000-1999 of the PC3000 Application Interface to store non-volatile data. Variables retain their value through Stop All conditions and power cycles.

17.4 Using the System Information Variables

The system information variables store the error codes for the CPU, DCS-NET network, and the A-B Remote I/O network. Their locations are:

This error code:	Is stored in register:
CPU	2000
DCS-NET network	2001
A-B Remote I/O network	2002

These error codes also appear on the Processor Information screen. See chapter 19 for information about interpreting these error codes.

Registers 2003-2047 are reserved for system use. Do not write data to these registers.

17.5 What to Do Next

Contact Reliance Electric for more information about creating custom drivers and other programs for the PC3000 Application Interface.

18.0 MONITORING THE AutoMax PC3000

You must monitor the status of the AutoMax PC3000, the DCS-NET network and the remote I/O scanner interface.

For information about:	See this section:
Monitoring the Status of the Battery	18.1
Monitoring Status	18.2
Overview of the DCS-NET Interface	18.3

See chapter 19 for information about troubleshooting the AutoMax PC3000.

18.1 Monitoring the Status of the Battery

To detect whether the battery on the Processor card is weak, monitor the Variable BATTERYSTATUS4@. See section 12.6 for information about this variable. The battery status is also available on the online Processor Info. screen. For more information about the on-board battery, see chapter 20.

18.2 Monitoring Status

WARNING

YOU MUST INCLUDE LOGIC IN YOUR APPLICATION PROGRAM TO MONITOR SCANNER, COMMUNICATION, AND REMOTE I/O RACK STATUS. WHEN AN ERROR OCCURS, THE APPLICABLE ERROR BIT GOES ON, BUT YOUR APPLICATION PROGRAM MUST READ THESE BITS SO THAT YOU WILL BE NOTIFIED OF ANY ERRORS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN UNPREDICTABLE MACHINE OPERATION AND BODILY INJURY.

18.2.1 Monitoring Scanner Status

To determine if the scanner is in RUN mode, monitor the variable associated with Scan Mode (register 768, bit 0). Once this bit is set (1), it remains set unless a STOP ALL error occurs, which resets the bit to 0.

18.2.2 Monitoring Remote I/O Link Status

To determine if all the enabled racks on the remote I/O link are communicating properly, monitor the variable associated with the RIO Status register (register 770, bit 0). This bit is set to 1 when all the enabled racks are communicating. When this bit is 0, one or more remote racks have an error.

If all the racks in your control system are enabled as part of your application, monitoring RIO Status would give you the information you need to determine if communication is occurring.

If some racks are disabled as part of your application program or you want to monitor each rack's status individually, then use the rack status and error counter variables. See section 18.2.3.

18.2.3 Monitoring Rack Status and Error Counters

To monitor each rack thoroughly, monitor the status register and error counters for each rack. Each rack has one register that contains rack status information and five registers for rack error counters.

The rack status register is the second word within the eight word Remote Rack Status and Control Table. Monitor the variable associated with a rack's Remote Rack Status register.

Table 18.3 - Interpreting Rack Status and Error Counters

When this value is contained within a rack's Remote Rack Status register:	It means that the rack:
0	is not being updated
1	is functioning normally while the scanner is in RUN mode
2	is functioning normally while the scanner is **not** in RUN mode
3	has a rack error

If a rack is offline (not being updated), the scanner's input image table remains at its last state and the rack's data is frozen. The rack error counters increment when the rack is not being updated or a rack error occurs.

The error counter registers are the fourth through the eighth words within the eight word Remote Rack Status and Control Table. Each error counter can count up to 255. Once a value of 255 is reached, the counter resets to 0. To obtain a record of a rack's error counts, monitor the variables associated with these registers:

- Rack X—Timeout Errors
- Rack X—CRC Errors
- Rack X—Failure Errors
- Rack X—Protocol Errors
- Rack X—Block Xfer Errors

For tips about how to prevent these errors, see chapter 19.

If you are unsure of the size of any rack, you can monitor the variable associated with the third word within the eight word Remote Rack Status and Control Table, which is labeled Ending Mod Group.

Table 18.4 - Discovering the Ending Module Group for a Rack

When this value is contained within a rack's Ending Mod(ule) Group register:	It means the last I/O group is:	And the rack size is:
0	1	1/4 rack (2 words)
1	3	1/2 rack (4 words)
2	5	3/4 rack (6 words)
3	7	full rack (8 words)

For a list of the status register and error counter registers associated with each rack, see Appendix D, "Register Assignment Map."

18.3 Overview of the DCS-NET Interface Register Organization

The DCS-NET network interface is divided into 56 areas, or drops, each containing 64 16-bit registers (a total of 3584 registers). Refer to table 18.5 for register assignment.

Table 18.5 - DCS-NET Network Register Assignment

DROP AREA	REGISTER	TYPE	MASTER	SLAVE
0	0-31 32-39	Status Broadcast	NOT TRANSMITTED Transmits	 Receives
1	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
2	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
. . .	. . .	. . .	. . .	. . .
53	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
54	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
55	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
*Slaves transmit registers 0-31 from only the drop areas they represent. All other registers receive data only.				

Memory areas are written to by either the card's on-board CPU or by an application task running on a Processor module in the rack. Memory areas that are written to by the on-board CPU cannot be written to by an application task and vice versa. All memory areas, however, can be read by both the on-board CPU and application tasks.

18.3.1 Using the Registers in the Drop 0 Area

Registers 0-31 contain network status and control information. This information is unique and is not transmitted over the network.

Except for the drop depth register (register 20) in the slave modules, registers 0-31 in the drop 0 area are written to by the on-board CPU. Therefore the application task has Read Only access to these registers.

Registers 32-39 in the drop 0 area are broadcast registers. These registers are controlled by an application task running in a Processor module in the master rack. These registers are Read/Write in the master and Read Only everywhere else on the network.

The registers in the drop 0 area are defined as follows:

Register	Description
0	Reserved For System Use
1	Reserved For System Use
2	Reserved For System Use
3	Reserved For System Use
4	Drop 0-15 Status in Bits 0-15
5	Drop 16-31 Status in Bits 0-15
6	Drop 32-47 Status in Bits 0-15
7	Drop 48-55 Status in Bits 0-15
8	Reserved For System Use
9	Reserved For System Use
10	Reserved For System Use
11	Reserved For System Use
12	Drop Number
13	(Reserved For System Use
14	Messages Received
15	Receive Timeouts
16	CRC Errors
17	Overrun Errors
18	Abort Errors
19	Messages Transmitted
20	Drop Depth
21	Reserved For System Use
..	..
31	Reserved For System Use
32	Broadcast Data
33	Broadcast Data
34	Broadcast Data
35	Broadcast Data
36	Broadcast Data
37	Broadcast Data
38	Broadcast Data
39	Broadcast Data
40	Reserved For System Use
..	..
63	Reserved For System Use

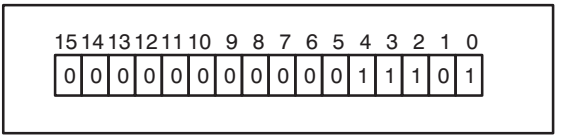
Figure 18.1 - Register Assignment for Drop 0 Area

Note that some of the registers reserved for system use are not protected against being written to by an application task. You must ensure that drop 0 areas are not written to (with the exception of register 20 in the slave modules).

See the following table for a description of the registers in the drop 0 area.

Table 18.6 -Description of Registers in Drop 0 Area

Registers	Description
Registers 4 - 7 (Drop Status Bits)	**WARNING** **THE DROP 0 STATUS BITS MUST BE USED IN AN APPLICATION PROGRAM TO INDICATE NETWORK COMMUNICATION FAILURE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.** **WARNING** **THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.** In the master, the drop status bits indicate which slave drops are active on the network. The drop status bit will be equal to 1 whenever the corresponding slave drop is actively communicating with the master. In the slave, the drop status bits indicate which drops represented by that slave module are active on the network. The drop status bits will be equal to 1 when the corresponding drop is actively communicating with the master. If any of these bits are equal to 0, it indicates that the drop is either not represented by that slave module or is not communicating with the master. In a slave module, the drop 0 status bit (register 4, bit 0) functions as the logical AND of the status bits of all the drops that slave module represents. The drop 0 status bit will be equal to 1 when ALL drops represented by that slave module are actively communicating with the master module. If any of the drops represented by the slave are not communicating with the master, the drop 0 status bit will be equal to 0. Therefore, the drop 0 status bit is used to indicate whether the slave module is communicating properly. If a drop fails, the status bit will be off a minimum of 120 milliseconds to allow detection by an application task. For example, in a slave module with a drop setting of 02 and a drop depth of 3, the drop 0 status bit will be equal to 1 if the drop status bits for drops 2, 3, and 4 are also equal to 1 (i.e., communicating with the master). Refer to figure 18.2. If any or all of the three drops are not communicating with the master, the drop 0 status bit will be equal to 0.

Registers	Description
Registers 4 - 7 (Drop Status Bits) (Continued)	 Figure 18.2 - Register 4 in Drop 02 Slave Module Indicating Drops 2, 3, and 4 Actively Communicating With Master At power-up, the Processor sets the drop depth of the slaves to “1” to permit remote access to the Processor. The drop 0 status bit in the slaves and the drop status bits in the master will not be set. After a user application task has defined drop depth, the status bits in the slaves will be set to indicate the drops it represents. The drop 0 status bit will also be set. In the master, the drop status bits will be set to indicate all active drops on the network.
Register 12 - Drop Number	This register stores the drop number you set with the Change Drop command. See section 12.3.2 for more information about changing the drop. Bit 15 is set when a valid drop number is assigned.
Register 14 - Messages Received	This register reflects the total number of messages received by that module. While the line is inactive, this value will remain unchanged. While the line is active, it will constantly increase to 65535 and then roll over to zero.
Register 15 - Receive Timeouts	When an active drop on the network is set up to receive, a timer is set. If a message is not received before the timer expires, a receive timeout occurs and is logged in this register. The system allows for four consecutive timeouts before it writes fault code “C” to error code register 2001 in the Application Interface or on the Processor Info. screen.
Register 16 - CRC Errors	The SCC performs an error-checking routine called a Cyclic Redundancy Check (CRC) as a result of the SDLC protocol. Any message received that is flagged with a CRC error is ignored and no reply is transmitted. This results in a re-transmission of the message. The value in this register will increment if a CRC error occurs. This value should ideally remain zero.
Register 17 - Overrun Errors	The value in this register will increment if the buffer in the SCC is filled and no read of the data has occurred. This value should ideally remain zero.
Register 18 - Abort Errors	The abort sequence feature of the SDLC protocol is not used in the transmission routine. Therefore, if an abort is detected in a receiver, there has been error. The value in this register will increment with each abort error detected. This value should ideally remain zero.

Registers	Description
Register 19 - Messages Transmitted	This register reflects the total number of messages transmitted by the module. While the line is inactive, this value will remain unchanged in the slave. In the master, this value will rapidly increase as initialization request messages are constantly being sent. While the line is active, this value will constantly increase to 65535 and then roll over to zero.
Register 20 (Drop Depth)	In the master, this register is not used. In the slave, this register is used to define the number of drops that particular slave module represents. The drop depth register must never be set to a value less than 1 or greater than 56 minus the drop setting. In other words, if the drop setting is 54, the drop depth cannot be set greater than 2. Likewise, if the drop setting is 10, the drop depth cannot be set greater than 46. The drop depth should be set to the minimum value required to satisfy the application to minimize the update period for that module. The drop depth value can be modified at any time without removing an active drop from the network. Note that the assignment of physical or virtual drops must not overlap or transmission collisions will occur. Bit 14 of this register is the error bit. It is set by the Network module if the existing drop depth value is invalid. When bit 14 is set, the last valid drop depth value is used. An invalid drop depth value written by an application task should be discovered and corrected during initial system testing. Bit 15 is the processing complete bit. It is set when the Network module has completed processing of the drop depth register. If the drop depth value is changed by an application task, the task must monitor bit 15 to verify that the drop depth value processing has been completed by the Network module. To assign drop depth, an application task writes the desired integer value to this register. The processing complete bit (bit 15) and the error bit (bit 14) should then be monitored to verify that the drop depth value has been accepted and processed. The application task must ensure that the processing complete bit is equal to 1 and the error bit is equal to 0 before proceeding.

Registers	Description
Registers 32 - 39 (Broadcast Data)	The master transmits the data in its broadcast registers to the broadcast registers in each slave Network module simultaneously each time it updates a drop area. This is done every 2.99 milliseconds (the time it takes to update one drop area). The data in the broadcast registers is not targeted for any particular drop. Controlled by the application task running in a Processor module in the master rack, broadcast data is usually data of higher priority that needs to be transmitted to all drops as soon as possible, such as emergency stops, line speed references, and network status. These registers are Read/Write in the master and Read Only in the slaves.

18.3.2 Assigning Variables to the Data Exchange Registers

Drop areas 1-55 are divided into 64 16-bit data registers. Registers 0-31 in drop areas 1-55 contain the data that an application task in the slave rack has written to them. These registers will then be transmitted to the master and all other slaves on the network. The number of registers that an application task in that rack can write to is determined by the drop depth assigned to the PC3000. Each slave has 32 registers times its drop depth that can be written to and then transmitted. In other words, a PC3000 that has been defined as drop 01 with a drop depth of 2 has Read/Write access to registers 0-31 in memory drop areas 1 and 2 for a total of 64 registers. This area is Read Only everywhere else on the network.

Registers 32-63 contain the data that an application task in the master rack has written to the master DCS-NET network interface for a particular drop. This data is consequently transmitted from the master to the addressed drop with all other drops receiving the data simultaneously. The master has 32 registers times the number of drops on the network to write to and then transmit. This area is Read/Write in the master and Read Only everywhere else on the network.

The dual port image of registers 32-39 in the drop 0 area and drop areas 1-55 will be the same in each module that is active on the network. Therefore, the data in all drops which are active on the network are available to any other drop that is active on the network.

A time lag will exist between output data written from one drop and its appearance in the dual port image of all other drops. This time lag will be less than or equal to the update period as described in chapter 3.

18.4 Ensuring Network Integrity

WARNING

THE AutoMax NETWORK IS DESIGNED TO CONTINUE OPERATING IF ONE OR MORE DROPS ON THE NETWORK FAILS OR IS TAKEN OFFLINE. IF CERTAIN DATA MUST BE TRANSFERRED RELIABLY TO ENSURE SAFE OPERATION, THE USER MUST ADD SOFTWARE HANDSHAKING IN THE APPLICATION PROGRAM THAT WILL DETECT LOSS OF COMMUNICATION. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

In the event of a network failure, i.e., a drop becomes unable to communicate with the master for any reason, controls must be in place to ensure the system reacts in a predictable, controlled manner. Each Network interface contains bits that indicate communication status. These bits must be used in the application program to generate faults indicating communication failure. Application programs in the other racks determine how the system will react to a particular drop going offline. The application program must ensure that properly functioning units on the network can continue to run with the states of I/O and process variables controlled in a predictable and safe manner.

If the network is installed correctly, the drops will communicate with essentially no errors at all. It is a normal occurrence in a system like this to periodically have an error, but the frequency should be very low. You may notice the error registers, over the period of a day or two, will log one or two errors. The system is designed to work around these occasional errors.

Each time the master transmits a message, it expects a response from the targeted drop. If there is no response, the master will retransmit the message up to three more times. In these instances, retransmitting the message will fix the momentary problem. However, if the master has failed to receive a response after transmitting a message four times, the drop will go offline for a minimum of 120 ms. This indicates something is seriously wrong. The cause of the communication failure should be investigated and corrected before the system is allowed to continue operating.

Using the circuit shown in figure 18.3 in your ladder program will record the fault status and enable the operator to determine that the network has been established, the application software is running, and the data is safe to use before restarting the system.

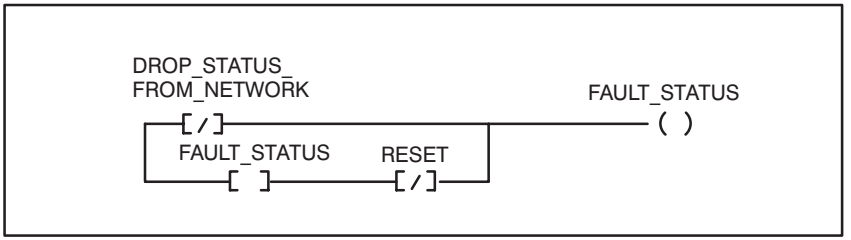


Figure 18.3 - Examining Network Status

DROP_STATUS can be either the drop 0 status bit in the slave drop or the particular drop's status bit in the master. RESET indicates a manual reset under operator control. When the drop goes offline for the 120 ms period, the FAULT_STATUS coil will go high and stay high until it is manually reset by the operator.

18.5 Detecting Partial Network Failure

Recall that all data is broadcast, i.e., transmitted simultaneously to all drops. If a response is not received from a targeted drop, the master will retry three times to communicate with that drop. However, if a drop that was not targeted for that transmission did not receive the message correctly, the master will not retransmit the message unless the targeted drop also did not receive it. It is possible, therefore, that this drop will not contain the most current copy of the data.

This problem can be detected by monitoring status registers 15-18 in the drop 0 area of the module. If these values increase rapidly over a short period of time, there is a problem with network integrity.

If this is a concern in your application, you should direct data from slave to master to slave. For example, assume data from one rack (drop 1) is critical to the operation of another rack (drop 2). After this data is transmitted to the master, the master can transfer it to its drop 2 area and then transmit it directly to drop 2.

18.6 What to Do Next

Refer to chapter 19 to help you troubleshoot the PC3000.

19.0 TROUBLESHOOTING THE AutoMax PC3000

LED indicators and error codes help you troubleshoot the AutoMax PC3000. You can monitor the error codes using the AutoMax Programming Executive Processor Info. screen while online. This screen displays the error codes for the CPU, DCS-NET network interface, and A-B Remote I/O interface. You can also access the error codes by monitoring the system status registers of the PC3000 Application interface.

For information about:	See section:
Interpreting LED Indicators on the AutoMax PC3000 Processor Card	19.1
Interpreting Error Codes	19.2
Handling Remote I/O Rack Errors	19.3
Handling Bus Errors	19.4
Troubleshooting the Serial Ports	19.5
Receiving Incorrect Data	19.6
Resetting the AutoMax PC3000	19.7
Removing the PC3000's Operating System	19.8
Changing the Remote I/O Data Communication Rate	19.9
What to Do Next	19.10

19.1 Interpreting LED Indicators on the AutoMax PC3000 Processor Card

Use the LEDs on the Processor card to determine if the module is functioning properly. Figure 19.1 shows the card's LEDs.

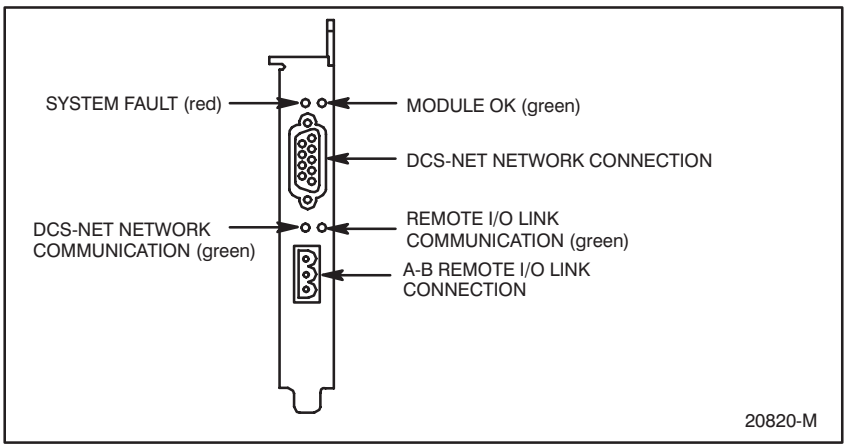


Figure 19.1 - Processor LEDs

Follow these guidelines and Table 19.1 to help you troubleshoot the PC3000:

- check the System Fault LED
- check the Module OK LED

If the System Fault LED is off and the Module OK LED is on, you have a communication problem with the DCS-NET or Remote I/O network.

Table 19.1 - Interpreting the PC3000 Processor Card LEDs

LED indicator:	**State:**	**Description:**	**Probable Cause:**	**Recommended Action:**
System Fault	on	indicates that a system fault has occurred	A hardware problem has occurred.	Cycle power. If the LED is still on, replace the PC3000 Processor card.
	off	indicates that no system faults are present	normal operation	No action is required.
Module OK	on	indicates that the card is working properly	normal operation	
	off	indicates that the PC3000 is not working properly	a software or communication problem is present	Cycle power. If the LED is still off, reload the operating system. If the LED remains off, replace the Processor card.
DCS-NET Network Communicating	on	indicates that the DCS-NET network is working properly	normal operation	No action is required.
	off	indicates that no communication is occurring	• The network is not being used. • A cable is detached or broken. • The network is not configured properly.	• Make sure the cables are attached and unbroken. • Check the Master drop. • Make sure no duplicate drop numbers are present.

LED indicator:	State:	Description:	Probable Cause:	Recommended Action:
Remote I/O Link communicating	on	indicates that the Remote I/O link is working properly	normal operation	No action is required.
	off	indicates that the Remote I/O link is not working	• The Remote I/O link is not being used. • An error is present in one or more racks.	• Check the status of the remote racks, and correct any problems. • Make sure the baud rate is defined and matches that of the remote I/O adapters. • Make sure the addressing is correct.
	two flashes	indicates a module checksum failure	A software or hardware problem occurred during power-up.	• Reload the operating system. • If the problem persists, replace the Processor card.
	three flashes	indicates a local RAM error		
	four flashes	indicates a dual port RAM error	A software or hardware problem is present.	
	five flashes	indicates a spurious reset		
	six flashes	indicates a bad opcode		

19.2 Interpreting Error Codes

The CPU, DCS-NET network interface, and the A-B Remote I/O interface each have their own error codes, which help you diagnose and troubleshoot a problem. You can view these error codes on the AutoMax Programming Executive Processor Info. screen while online. You can also monitor specific system status registers in the PC3000 Application Interface. These numeric codes are displayed in the hexadecimal format.

The following sections describe the error codes for the:

- CPU
- DCS-NET network interface
- A-B Remote I/O interface

19.2.1 Interpreting CPU Error Codes

You can view the CPU error codes by using any of the following:

- 7-segment LED indicators on the Serial card
  See figure 19.2.
- Processor Info. screen
- monitoring register 2000, the CPU Error Code, of the PC3000 Application Interface

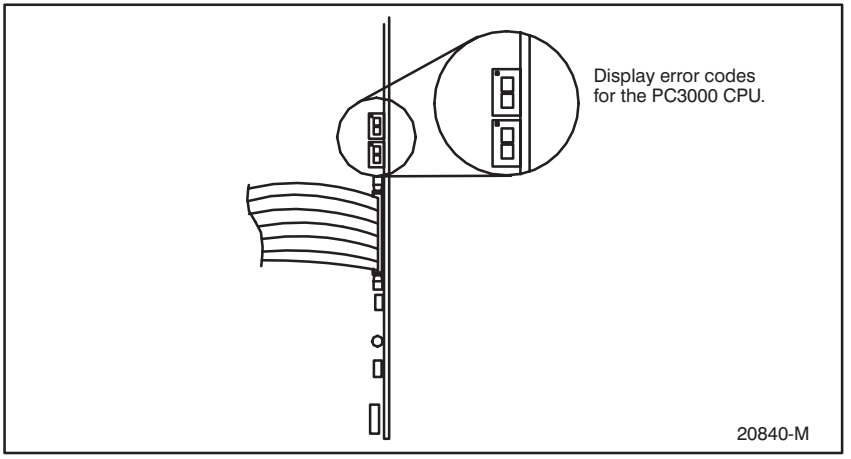


Figure 19.2 - PC3000 Serial Card LEDs

Use the following table to help you interpret the CPU error codes:

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:	Corrective Action:
00	0000	CPU Overload	Programs are using all of the CPU time.	• Move one or more programs to another Processor. • Add delays to tight loops in programs.
02	0002	Invalid task or configuration checksum	Hardware or software problem	• Cycle power. • If the problem persists, remove the operating system (see section 19.8) and reload it. • If the problem still persists, replace the AutoMax PC3000 Processor card.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:	Corrective Action:
Power-Up Diagnostics				
0.0.	8000	EPROM failed	Hardware problem	• Cycle power. • If the problem persists, replace the AutoMax PC3000 Processor card.
0.1.-0.3.	8001-8003	Bad CPU		
0.4.	8004	Internal bus error test failure		
0.5.	8005	Network load failure		
0.6.	8006	A-B remote I/O load failure		
0.7.	8007	Bad run of network		
0.8.	8008	Bad run of A-B remote I/O		
1.0.	8010	RAM failure		
1.1.	8011	RAM failure		
1.4.	8014	RAM failure		
2.0.	8020	I/O protection failure		
2.1.	8021	PIO failure		
2.2.	8022	PC accelerator failure		
2.3.	8023	timer/counter failure		

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:	Corrective Action:
2.4.	8024	SCC failure	Hardware problem	• Cycle power. • If the problem persists, replace the AutoMax PC3000 Processor card.
2.6.	8026	SCC interrupt failure		
2.7.	8027	RTC interrupt failure		
Runbase booting				
6.0.	8060	Unexpected interrupt on Port B of the Serial card	Hardware problem	• Cycle power. • If the problem persists, replace the AutoMax PC3000 Processor card.
6.1.	8061	Parity error	You may be attempting online functions before the operating system is loaded.	
6.2.	8062	Port B receiver overrun		
6.3.	8063	Framing error		Exit the Online menu and load the operating system.
6.4.	8064	Serial port fatal error	Hardware problem	• Cycle power and try to load the operating system. • If the problem persists, replace the AutoMax PC3000 Processor card.
6.5.	8065	Illegal interrupt on Port A of the Serial card	A device is plugged into Port A.	Disconnect the device, and cycle power. Try to load the operating system.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:	Corrective Action:
6.6.	8066	Transmit interrupt error	Hardware problem	• Cycle power. • Replace the processor card if the problem persists.
6.7.	8067	Runbase integrity loss	OS is being downloaded	Reload the AutoMax Programming Executive software.
6.8.	8068	Bad runbase checksum		
7.1.	8071	Message timeout during download	Cable disconnected or download terminated	Cycle power and try to load the operating system.
7.2.	8072	Spurious interrupt received	Hardware problem	• Cycle power • If the problem persists, replace the PC3000 Processor card.
Loading the Runbase Over the Network				
8.0.	8080	Bad message length specified for network message	CPU has failed.	• Cycle power. • If the problem persists, replace the AutoMax PC3000 Processor card.
8.1.	8081	Bad destination drop	CPU has failed or a cable is disconnected.	Check co-axial cable and try replacing the Processor card.
8.2.	8082	Transmitting drop inactive		

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:	Corrective Action:
8.3.	8083	Destination drop unallocated	A problem exists with the destination network interface.	Check the destination DCS-NET network interface.
8.4.	8084	Destination port busy		
8.5.	8085	Did not receive expected response		
8.6.	8086	Spurious network interrupt received	Hardware problem	• Cycle power • If the problem persists, replace the PC3000 Processor card.
8.7.	8087	Network message is being transmitted		
8.9.	8089	ISA message is being transmitted		
Informational Messages				
LO	FF00	Load the operating system	No operating system is loaded.	• Make sure jumper JP5 is installed on the PC3000 Processor card. • Load the operating system to the PC3000.
b0	80B0	The configuration is being validated.	Configuration is being loaded.	No action.
d0	00D0	Application program installation on progress	Application program is being loaded.	No action.
Blank	FFFF			

STOP ALL Errors

When these errors occur, all programs running in the PC3000 are stopped.

To correct a STOP ALL error,

Step 1. Correct the problem in the application program.

Step 2. Cycle power to the PC3000, and reload the configuration and application programs.

If the problem persists, replace the PC3000.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
10	0010	Event count underflow	Too many WAITs (max. 32768). Not enough SETs (BASIC tasks).
11	0011	Event count overflow	Too many SETs (BASIC tasks). Not enough WAITs (max. 32767).
13	0013	Runbase boot error	A check on the runbase failed.
14	0014	Processor overlap limit exceeded	Ran out of processing capacity (time).
17	0017	Address error detected	A read/write to an invalid address occurred.
18	0018	Spurious interrupt or hardware failure	Hardware failure
19	0019	5V power failure detected	A problem exists with the incoming power or the power supply is bad.
1C	001C	Illegal instruction detected	• Runbase software fault • Bad PC3000
1d	001D	Privilege violation detected	• Runbase software fault • Bad PC3000
1E	001E	Un-implemented instruction detected	
1F	001F	Illegal interrupt detected	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
31	0031	Bus error	Attempts to access an invalid address, the DCS-NET network, or remote I/O link have failed. See section 19.4 for more information.
32	0032	Define channel error	A problem exists in the application software.
33	0033	Define scan error	A hardware fault is present.
34	0034	Memory integrity lost	A hardware fault is present.
3D	003D	12V power failure detected	A problem exists with the AutoMax PC3000 power supply.

BASIC STOP ALL Error Codes

When any of these errors are encountered, a problem has occurred in a BASIC program. All programs running on the PC3000 stop. To correct the error, fix the problem in the application program.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
40	0040	Too many RETURNs from GOSUBs (or RETURN without GOSUB)	BASIC program logic
41	0041	Illegal jump into a FOR loop	
42	0042	NEXT statement does not match current FOR	
43	0043	Invalid START EVERY statement	
44	0044	Invalid EVENT statement	
45	0045	STOP statement executed in application software (all I/O is cleared)	
46	0046	SET or WAIT attempted with no event definition	
47	0047	Task stack overflow	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
48	0048	GOSUBs not balanced at END statement	BASIC program logic
49	0049	Insufficient space for channel buffer	
4A	004A	Attempted to execute undefined opcode	
4B	004B	Attempted to execute non-executable opcode	
4C	004C	Attempted to execute illegal opcode	
4E	004E	Attempted to take the square root of a negative number	
4F	004F	Attempted RESUME without being in an ON ERROR handler	

Multibus and PC3000 STOP ALL Error Codes

To correct these errors, cycle power to the PC3000 and reload the configuration and application programs. If the Module OK light is still off, replace the Processor card.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
51	0051	Flash write access violation error	See section 19.4 for more information.
53	0053	I/O access violation error	
54	0054	On-board access violation error	
58	0058	Multibus access violation error	• Check for an incorrect IOWRITE statement. • Correct any incorrect accesses in the application programs. • See section 19.4 for more information.
62	0062	Network transmit queue underflow	Run base software failure

Configuration Error Codes

These errors usually indicate a discrepancy between the actual hardware and the I/O definitions in the configuration for the PC3000.

To correct these errors:

- Verify that the configuration correctly described the physical configuration of the system and the programs installed in the PC3000.
- Cycle power to the PC3000 and reload the configuration and application programs.

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
E0	00E0	• TASK specified in configuration is un-installed, at wrong priority, or of the wrong type. • Wrong spelling of TASK	
E1	00E1	• Invalid configuration. • Configuration not successfully downloaded.	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
E2	00E2	I/O referenced in configuration is missing.	
E3	00E3	• I/O referenced in configuration is missing. • Invalid configuration. • Configuration not successfully loaded.	
E4	00E4	Error building task, insufficient memory in the Processor, invalid configuration, or configuration not successfully downloaded.	
E5	00E5	Error building task, insufficient memory in the Processor, invalid configuration, or configuration not successfully downloaded.	
E6	00E6	• I/O referenced in configuration is missing. • Error building task. • Insufficient memory in the Processor.	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
E7	00E7	Invalid configuration, configuration not successfully downloaded, I/O referenced in configuration is missing, invalid configuration, or configuration not successfully downloaded.	
E8	00E8	Error installing application program, common symbol could not be resolved, or insufficient memory in the CPU.	
E9	00E9	Error installing application program, common symbol could not be resolved, insufficient memory in the CPU, invalid configuration, or configuration not successfully downloaded.	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
EA	00EA	Error installing the application program, common symbol could not be resolved, insufficient memory in the CPU, or I/O referenced in configuration is missing.	
Eb	00EB	Error installing application program, common symbol could not be resolved, insufficient memory in the CPU, I/O referenced in configuration is missing, invalid configuration, or configuration not successfully downloaded.	
EC	00EC	• Error building task. • Error installing application program. • Common symbol could not be resolved. • Insufficient memory in CPU.	

Error Code:	Hex Value in Register 2000:	Description:	Probable Cause:
Ed	00ED	• Error building task. • Error installing application program. • Common symbol could not be resolved. • Insufficient memory in CPU. • Invalid configuration or configuration not successfully downloaded.	
EE	00EE	• Error building task. • Error installing application program. • Common symbol could not be resolved. • Insufficient memory in CPU. • I/O referenced in the configuration is missing.	

Fatal Error Codes F0-F9 and FA-FF

These errors usually indicate that the runbase is not functioning correctly. If any of these errors appear, the configuration task and all application programs are deleted from the PC3000. To correct these errors:

- Cycle power.
- Reload the configuration task and all application tasks.

If the error persists, replace the Processor card.

19.2.2 Interpreting DCS-NET Network Error Codes

You can view the DCS-NET network error codes by using any of the following:

- Processor Info. screen
- monitoring register 2001, the Network Error Code, of the PC3000 Application Interface

Use the following table to help you interpret the DCS-NET network error codes:

Error Code:	Hex Value in Register 2001:	Description:	Probable Cause:	Corrective Action:
0	0000	CPU failed		Replace the Processor card.
1	0001	EPROM failed power-up diagnostics		
2	0002	RAM failed power-up diagnostics		
3	0003	CTC failed power-up diagnostics		
4	0004	SCC failed power-up diagnostics		
5	0005	DMA runtime failure; message transmit timeout		
6	0006	Dual Port memory failed power-up diagnostic		
A	000A	Invalid drop number	This only occurs if the drop number you defined using the Change Drop command is greater than 55.	Check the defined drop number. See chapter 12.
C	000C		Board not communicating.	Replace the Processor card.

Error Code:	Hex Value in Register 2001:	Description:	Probable Cause:	Corrective Action:
d	000D		System (backplane) watchdog failure; PC3000 went down; module is operational but will not transmit or receive data until the watchdog is reset.	Replace the Processor card.
E	000E		Power failure	This code is normally present from the time that a low voltage is detected until power is completely lost.

Correcting an error code C:

This error code indicates a network failure. If the module is a master drop, no other drops are functional on the network. If the module is a slave drop, it is not receiving any messages from the master drop and the data contained in its dual port memory will remain at the last value written to it. The data targeted for that drop will remain frozen in the dual port memory of the other slaves on the network. This fault code is reset whenever the line goes active. The causes of a network failure are incorrect drop depth specifications or lack of cable system integrity.

The master logs the error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, and ABORT) for the entire network. Monitoring these registers will indicate cable system integrity or lack of it. A few errors may accumulate over a period of time, such as a few days; but, when these parameter values increase consistently over a short period of time, there is a problem with the integrity. If this occurs, monitor the error parameters of each Network module to isolate the problem.

Use the following procedure to isolate the cause of a communication failure:

Step 1. Verify that the drop number of the slave modules is unique and the drop number is set correctly via the Change Drop command.

Step 2. Verify that drop depth has been specified. If you have performed the self test function, the module will power up with a drop depth of “0”. If the Network module is used in an AutoMax Version 1.0 system or a DCS 5000 system, it will also power up with a drop depth of “0”. Writing a valid drop depth to register 20 or running an application task that defines drop depth will clear this error.

Step 3. Verify that the drop depth specifications for each slave module are such that the slave modules do not overlap in drop numbers. Only one slave module can be configured to respond to any given drop number.

NOTE: *Use steps 4 through 8 below if you have a coaxial cable network. If you have a fiber-optic network, see chapter 21.*

Step 4. Verify that the network connections to each module are secure. Check the drop cable connection at the module faceplate and at the passive tap. Verify that the coax cable connections are secure.

Step 5. Verify that the network cabling is terminated correctly. There must be a line terminator at each end of the network.

Step 6. Verify that the cabling between Network modules is installed in its own separate conduit held free from major noise sources, such as power or other signal wires.

Step 7. Inspect and test the cable system following the instructions in sections 3.5.1 and 3.5.4.

Step 8. Verify that the network cabling does not exceed the maximum allowable length given the number of physical drops and its electrical characteristics.

19.2.3 Interpreting A-B Remote I/O Error Codes

You can view the A-B Remote I/O error codes by using any of the following:

- Processor Info. screen
- monitoring register 2002, the Allen-Bradley Remote I/O Error Code, of the PC3000 Application Interface

Use the following table to help you interpret the A-B Remote I/O Interface error codes:

Error Code:	Hex Value in Register 2002:	Description:	Probable Cause:	Corrective Action:
7	0007	scanning status indicator (bit 1 of register 768 in the A-B Remote I/O Scanner Interface is off [0])	The scanner has not been enabled.	Set bit 1 of register 768 to on (1).
C	000C	remote I/O status indicator (bit 0 of register 770 in the A-B Remote I/O Scanner Interface is off [0])	The remote I/O racks are enabled and at least one is not communicating properly.	Check each rack for communication. Make sure each rack starts with I/O group 0 by checking the adapter device's switch setting. If you disable the rack that is not communicating, the "C" will disappear.
P	FE00	RUN mode indicator (bit 0 of register 768 in the A-B Remote I/O Scanner Interface is off [0])	The scanner is not in RUN mode.	Set bit 0 of register 768 to on (1)
.d	800D	system watchdog indicator	The backplane watchdog has failed. The scanner module is operational, but it will not transmit or receive data.	• Reset the watchdog • Stop all programs in the PC3000, and cycle power to it.

19.3 Handling Remote I/O Rack Errors

A rack error means that scanner and adapter communication has been interrupted. Make sure your application program provides for an orderly and safe handling of any rack errors, since this affects the devices controlled by the I/O modules.

If you receive repeated rack errors, begin checking the following:

- Does the rack start with I/O group 0?
- Are the remote I/O link cables properly connected and in good condition? Check for braid wires touching signal wires.
- Are the terminating resistor leads short?
- Is power applied to all the devices?
- Are all devices communicating at the same data rate?
- Is system grounding properly implemented?
- Are the I/O cables properly routed and shielded from noise?

19.4 Handling Bus Errors

Bus errors can occur when logic in the application program attempts to write to a wrong or invalid register. The following error codes signify that a bus error occurred:

- 31
- 51
- 53
- 54
- 58

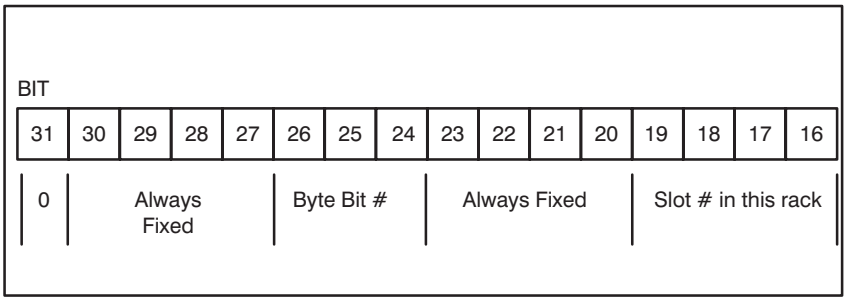
Use the following procedure to isolate a bus error:

Step 1. Determine where the bus error occurred.

Connect the PC to the PC3000 and run the AutoMax Programming Executive Online Task Manager. Display the Task Info. Log for the program that indicates the error. The error log displays the address that caused the bus error or a line number in a Ladder Logic, BASIC, or Control Block application program. The bottom of the Task Info. Log screen displays additional information about a 31 bus error code. The address is displayed in hexadecimal notation. To help interpret the error code, follow these steps:

a) Convert the hexadecimal value into a binary number. If the hexadecimal number consists of fewer than eight digits, pad the number with zeroes.

b) Examine the most significant 16 bits by using this pattern



c) Interpret the least significant bits of the binary number according to the type of module found in the slot.

See the AutoMax Programming Executive or the AutoMax Pocket Reference instruction manuals for more information about decoding bus errors.

Step 2. Verify that the I/O definitions in the configuration are correct. Verify that the register numbers defined in the configuration are valid for the module.

Step 3. Verify that your application programs are correct.

Make sure logic is not writing to an invalid register. The error log will contain the statement number in the program where the error occurred.

19.5 Troubleshooting the Serial Ports

The following table provides tips for helping you troubleshoot the AutoMax PC3000 serial ports.

If this serial port is not working properly:	**Check the following:**
Port A	• Make sure that Port A is configured for the communication interface you are using, either RS-232 or RS-422. The settings of jumpers E1 and E2 determine the port's configuration. See chapter 5 for more information. • Make sure you are using the OPEN statement correctly.
Port B	• Make sure that Port B is configured as a programming device connection or a free RS-232 port. See chapter 5 for more information. • If you are using the port as a programming device connection, make sure you have the communication settings properly defined. • If you are using the port as a serial port, make sure you are using the OPEN statement correctly.

19.6 Receiving Incorrect Data

If you encounter a problem where the data used by the application programs is either always off, always on, or different than expected, the possible causes are:

- a programming error
- malfunctioning module

To correct this problem, follow these steps:

Step 1. Verify that the module can be accessed.

a) Connect the PC to the PC3000 and run the AutoMax Programming Executive Online Task Manager.

b) Stop all programs that may be running.

c) Use the Monitor I/O function to display the individual registers of the PC3000.

Step 2. Verify that the configuration references the correct slot and register locations.

Step 3. Verify that the application programs running in the PC3000 are correct.

Make sure that the application programs that reference the symbolic names associated with hardware have been declared COMMON (Global).

19.7 Resetting the AutoMax PC3000

You may need to reset the PC3000 to correct an error condition. Reset the PC3000 by cycling power to it.

To cycle power to:	Do the following:
a PC3000 installed in a PC chassis	Cycle power on the PC.
a PC3000 Packaged Version	Cycle power to the chassis by using the power switch on the chassis.

19.8 Removing the PC3000's Operating System

If the PC3000 operating system locks up, you can remove the operating system from the PC3000 Processor card by doing the following:

Step 1. Remove power to the Processor card.

Step 2. Remove jumper JP5.

Step 3. Power up the PC3000.

Step 4. Remove power to the PC3000 and replace the jumper JP5. See figure 19.3.

Step 5. Power-up the PC3000 and reload the operating system.

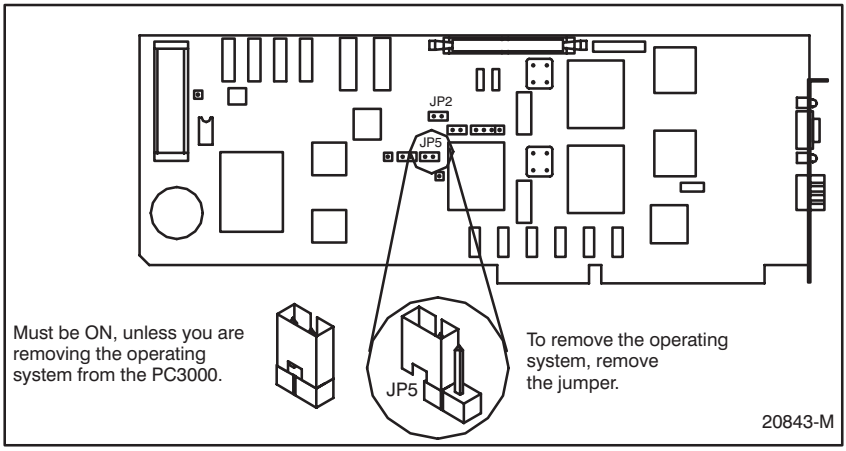


Figure 19.3 - Removing Jumper JP5

19.9 Changing the Remote I/O Data Communication Rate

Once you set the remote I/O data communication rate for the scanner module, you should avoid changing the rate. If you must use a rate different from the one you originally set, follow these steps:

Step 1. Stop all running programs in the AutoMax chassis.

Step 2. Make sure that all adapters on the remote I/O link are configured for the new data communication rate. All devices on a remote I/O link must be communicating at the same rate.

Step 3. Define a new data communication rate for the scanner module within the scanner initialization program. See section 16.1.1.

Step 4. Cycle power to the scanner module.

Step 5. Re-run the scanner module's initialization program.

The new data communication rate takes effect after the scanner module initialization program has finished.

19.10 What to Do Next

Schedule regular maintenance for the PC3000. Refer to chapter 20 as needed.

20.0 MAINTAINING THE AutoMax PC3000

Routine maintenance of the AutoMax PC3000 includes replacing:

- the battery on the AutoMax PC3000 Processor card
- the air filter for the Industrial AutoMax PC3000 chassis

For information about:	See this section:
Handling the Cards	20.1
Replacing the Battery on the AutoMax PC3000 Processor Card	20.2
Replacing the AutoMax PC3000 Processor Card	20.3
Removing the old AutoMax PC3000 Processor Card from the Device Manager	20.4
Replacing the AutoMax PC3000 Serial Card	20.5
Replacing the AutoMax PC3000 Packaged Version	20.6
Replacing the Filter for the AutoMax PC3000 Packaged Version	20.7
What to Do Next	20.8

20.1 Handling the Cards

CAUTION: The printed circuit boards are static-sensitive. You should wear an anti-static wrist band (user supplied) while installing the AutoMax PC3000 Processor or Serial cards. Avoid touching the cards components, connectors, or leads. Failure to observe this precaution could result in damage to or destruction of the equipment.

When handling the AutoMax PC3000 Processor or Serial card, hold the card only at its edges.

20.2 Replacing the Battery on the AutoMax PC3000 Processor Card

The battery retains the PC3000 memory for about 186 days in the event of a power failure. Replace the battery only with Reliance Electric M/N 57C385.

The super capacitor provides a minimum of ten minutes (a maximum of ten hours) of backup power after the BATTERYSTATUS4@ variable goes false and power is removed from the rack. You need to replace the battery before back-up power fails to avoid re-loading the operating system and application tasks.

When replacing the battery, you must:

- remove the AutoMax PC3000 Processor card
- replace the battery
- re-install the AutoMax PC3000 Processor card

20.2.1 Removing the AutoMax PC3000 Processor Card

Before replacing the battery, you must remove the PC3000 Processor card from the chassis. To do this, follow the steps for the AutoMax PC3000 model you are using:

Removing the card from the PC3000 Packaged Version:		**Removing the card from a PC chassis:**	
Step 1.	Turn off power to the AutoMax PC3000 chassis. Disconnect the incoming lines.	Step 1.	Shutdown the Windows 95 operating system, and turn off power to PC chassis. Disconnect the incoming power cord.
Step 2.	Disconnect the Allen-Bradley Remote I/O cables and the DCS-NET network cables, if present.	Step 2.	Disconnect the Allen-Bradley Remote I/O cables and the DCS-NET network cables, if present.
Step 3.	If the chassis is mounted, you may want to un-mount it to make replacing the card easier.	Step 3.	Place the chassis on flat surface.
Step 4.	Open the chassis.	Step 4.	Open the PC chassis.
Step 5.	Using a screwdriver, remove the hold down clamp and the slot cover screw that holds the AutoMax PC3000 Processor card in place.	Step 5.	Using a screwdriver, remove the slot cover screw that holds the AutoMax PC3000 Processor card in place.
Step 6.	Disconnect the ribbon cable from the AutoMax PC3000 Processor card.	Step 6.	If you have an AutoMax PC3000 serial card installed, disconnect the ribbon cable from the AutoMax PC3000 Processor card
Step 7.	Remove the card from the slot, making sure to hold the card by its edges.	Step 7.	Remove the card from the slot, making sure to hold the card by its edges.

20.2.2 Replacing the Battery

To replace the battery, follow these steps:

Step 1. Remove the old battery from its holder on the AutoMax PC3000 Processor card.

Step 2. Obtain the proper replacement battery, and remove the tape from it.

Step 3. Insert the new battery in the battery holder on the AutoMax PC3000 Processor card. Orient the battery so that the end marked “+” on the battery is facing the end marked “+” on the battery holder.

20.2.3 Re-installing the AutoMax PC3000 Processor Card

To re-install the AutoMax PC3000 Processor card, follow the steps for the AutoMax PC3000 model you are using:

Replacing the card in a PC3000 Packaged Version:		**Replacing the card in a PC chassis:**	
Step 1.	Insert the card into the chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the expansion socket. Make sure the gold-striped bottom edge of the board sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.	Step 1.	Insert the card into the computer chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the expansion socket. Make sure the gold-striped bottom edge of the board sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.
Step 2.	Using a screwdriver, secure the card with the slot cover screw.	Step 2.	Using a screwdriver, secure the card with the slot cover's screw.
Step 3.	Connect the ribbon cable of the serial card to the connector on the AutoMax PC3000 Processor card.	Step 3.	If you have an AutoMax PC3000 Serial card installed, connect the ribbon cable of the Serial card to the connector on the AutoMax PC3000 Processor card.
Step 4.	Using a screwdriver, replace the hold down clamp.	Step 4.	Replace the computer chassis' cover.
Step 5.	Close the chassis door, and remount the chassis if needed.	Step 5.	Reconnect the DCS-NET network and A-B Remote I/O cables.
Step 6.	Reconnect the DCS-NET network and A-B Remote I/O cables.	Step 6.	Plug in the power cord, and turn on the computer.
Step 7.	Reconnect the incoming power line, and turn on the AutoMax PC3000 Packaged Version.		

Once you apply power to the card, the following should occur:

- green OK light should be lit
- BATTERYSTATUS4@ variable should be true

If the Processor does not respond or the LEDs on the Serial card show the code "LO," you need to reload the operating system.

For more information, see the AutoMax Programming Executive instruction manual. After re-loading the operating system, you must:

- reset the network drop number
- re-load your application tasks

20.2.4 Disposing of the Battery

Do not dispose lithium batteries in a general trash collection when their combined weight is greater than or equal to 0.5 gram. Check your state and local regulations that deal with the disposal of lithium batteries.

WARNING

FOLLOW THESE PRECAUTIONS:

- **DO NOT INCINERATE OR EXPOSE THE BATTERY TO HIGH TEMPERATURES.**
- **DO NOT SOLDER THE BATTERY OR LEADS; THE BATTERY COULD EXPLODE.**
- **DO NOT OPEN, PUNCTURE, OR CRUSH THE BATTERY. THE BATTERY COULD EXPLODE, AND TOXIC, CORROSIVE, AND FLAMMABLE CHEMICALS COULD BE EXPOSED.**
- **DO NOT CHARGE THE BATTERY. AN EXPLOSION MIGHT RESULT OR THE CELL MIGHT OVERHEAT AND CAUSE BURNS.**
- **DO NOT SHORT POSITIVE OR NEGATIVE TERMINALS TOGETHER. THE BATTERY WILL HEAT UP.**

FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY OR DAMAGE TO OR DESTRUCTION OF EQUIPMENT.

20.3 Replacing the AutoMax PC3000 Processor Card

You may need to replace the AutoMax PC3000 Processor card. To do this, you must:

- remove the old card
- prepare and install the new card

If you are replacing a PC3000 Processor card in a PC chassis, you must first remove the card from the PC's Device Manager list. See section 20.4.

20.3.1 Removing the Old AutoMax PC3000 Processor Card

To remove the AutoMax PC3000 Processor card, follow the steps for the AutoMax PC3000 model you are using:

Removing the card from an PC3000 Packaged Version:		**Removing the card from a PC chassis:**	
Step 1.	Turn off power to the AutoMax PC3000 Packaged Version. Disconnect the incoming lines.	Step 1.	Complete the steps in section 20.4.
Step 2.	Disconnect the Allen-Bradley Remote I/O cables and the DCS-NET network cables, if present.	Step 2.	Shutdown the Windows 95 operating system, and turn off power to the PC chassis. Disconnect the incoming power cord.
Step 3.	If the chassis is mounted, you may want to un-mount it to make replacing the card easier.	Step 3.	Disconnect the Allen-Bradley Remote I/O cables and the DCS-NET network cables, if present.
Step 4.	Open the chassis.	Step 4.	Place the chassis on a flat surface.
Step 5.	Using a screwdriver, remove the hold down clamp and the slot cover's screw that holds the AutoMax PC3000 Processor card in place.	Step 5.	Open the PC chassis.
Step 6.	Disconnect the ribbon cable from the AutoMax PC3000 Processor card.	Step 6.	Using a screwdriver, remove the slot cover's screw that holds the AutoMax PC3000 Processor card in place.
Step 7.	Remove the card from the slot, making sure to hold the card by its edges.	Step 7.	If you have an AutoMax PC3000 Serial card installed, disconnect the ribbon cable from the AutoMax PC3000 Processor card.
		Step 8.	Remove the card from the slot, making sure to hold the card by its edges.

20.3.2 Preparing a New AutoMax PC3000 Processor Card for Installation

To prepare a new AutoMax PC3000 Processor card for installation, follow these steps:

Step 1. Remove the new card from its shipping container and from its anti-static bag. Be careful not to touch the components or the surface.

Step 2. Make sure jumper JP2 on the new AutoMax PC3000 Processor card is set the same as that on the old AutoMax PC3000 Processor card.

Step 3. Remove the paper strip that covers one end of the battery.

20.3.3 Installing a New AutoMax PC3000 Processor Card

To install a new AutoMax PC3000 Processor card, follow the steps for the AutoMax PC3000 model you are using:

Installing the card into an PC3000 Packaged Version:		**Installing the card into a PC chassis:**	
Step 1.	Insert the card into the chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the socket. Make sure the gold-striped bottom edge of the board sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.	Step 1.	Insert the card into the computer chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the socket. Make sure the gold-striped bottom edge of the board sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.
Step 2.	Using a screwdriver, secure the card with the slot cover's screw.	Step 2.	Using a screwdriver, secure the card with the slot cover's screw.
Step 3.	Connect the ribbon cable of the serial card to the connector on the AutoMax PC3000 Processor card.	Step 3.	If you have an AutoMax PC3000 Serial card installed, connect the ribbon cable of the serial card to the connector on the AutoMax PC3000 Processor card.
Step 4.	Using a screwdriver, replace the hold down clamp.	Step 4.	Replace the computer chassis' cover.
Step 5.	Close the chassis door, and remount the chassis if needed.	Step 5.	Reconnect the DCS-NET network and A-B Remote I/O cables.
Step 6.	Reconnect the DCS-NET network and A-B Remote I/O cables.	Step 6.	Plug in the power cord, and turn on the computer.

Installing the card into an PC3000 Packaged Version:		Installing the card into a PC chassis:	
Step 7.	Reconnect incoming power, and turn on the AutoMax PC3000 Packaged Version.	Step 7.	Boot into Windows 95, and adjust the card's setting in the Device Manager. If a single PC3000 Processor card is installed in a PC, follow the procedures in section 5.4. If multiple PC3000 Processor cards are installed in a PC, follow the procedures in section 5.8.
Step 8.	Configure the card by loading the operating system and setting the DCS-NET network drop number to that of the card you removed.	Step 8.	Configure the card by loading the AutoMax PC3000 operating system and setting the DCS-NET network drop number to that of the card you removed.

For more information about:	See:
downloading the operating system	the AutoMax Programming Executive software instruction manual
setting the DCS-NET network drop number	chapter 12

20.4 Removing the old AutoMax PC3000 Processor Card from the Device Manager

(Only for a PC3000 installed in a PC chassis)

Before you physically remove an AutoMax PC3000 Processor card from a PC chassis, remove the card from the Device Manager list and remove any references to it in the SYSTEM.INI and CONFIG.SYS files.

If you have more than one PC3000 Processor card installed in the PC chassis, you need to know the serial number and memory address of the card you want to remove. You can find this information through the Communication Setup dialog box in the Programming Executive software. The serial number, memory address, and the name you have assigned it are listed in the fields. Temporarily record this information.

20.4.1 Accessing the Device Manager List

To access the Device Manager list, follow these steps:

Step 1. From Windows 95, select the Start menu from the task bar.

Step 2. From the Start menu, select Settings, and choose Control Panel.

Step 3. Double-click the System icon.

Step 4. Once the System Properties dialog box is open, choose the Device Manager tab.

20.4.2 Removing the Processor Card from the Device Manager List

To remove the Processor card from the Device Manager list, follow these steps:

Step 1. In the Device Manager, double-click the PC3000 device listing. You see the Reliance Electric AutoMax PC3000 listed.

Step 2. Select the Reliance Electric AutoMax PC3000 card you want to remove, and choose the Properties button.

Step 3. Choose the Resources tab.

Step 4. Make sure the memory address displayed matches the recorded memory address.
NOTE: *If you have multiple PC3000 cards installed in the PC and the memory address displayed does not match the address you recorded, the PC3000 Processor card you selected in Step 1 is not the card you want to remove. Do the following:*

a) Leave the Properties tab for this card by clicking Cancel.

b) Choose the other Processor card listed.

c) Repeat steps 2 through 4.

Step 5. In the Device Manager, click the Remove button.

Step 6. Confirm that you removed the device by clicking OK.

Step 7. Close the System Properties and the Control Panel.

20.4.3 Removing the PC3000 Processor Card's Address from the SYSTEM.INI File

You must edit the SYSTEM.INI file to remove the reference to the PC3000 Processor card.

Step 1. Using a text editor, open the SYSTEM.INI file, which is located in the directory where Windows 95 is installed.

Step 2. Locate the section [386Enh].

Step 3. Remove the following line in the [386Enh] section:
`EMMExclude=MEM1-MEM2 //(serial number)`

Where: MEM1 = the starting address of the PC3000 Processor card

MEM2 = the ending address of the PC3000 Processor card

Example: `EMMExclude=C800-C9FF //(serial number)`

Step 4. Save and close the SYSTEM.INI file.

Step 5. Use this table to determine your next step:

If you:	Do the following:
Edited the CONFIG.SYS file when you installed the card	Follow the steps in section 20.4.4
Did not edit the CONFIG.SYS file when you installed the card	Remove the card by following the steps in section 20.3

20.4.4 Remove the PC3000 Processor Card's Address from the CONFIG.SYS File

If you edited the CONFIG.SYS file when you installed the card, you need to remove the PC3000 Processor card's memory address. To edit the CONFIG.SYS file, follow these steps:

Step 1. Using a text editor, open the CONFIG.SYS file located in the root of the boot drive.

Step 2. Search for the line containing: EMM386.SYS.

Step 3. Remove the "X statement" (X=MEM1-MEM2) for the card you are removing:

Where: MEM1 = the first address range of the PC3000 Processor card

MEM2 = the second address range of the PC3000 Processor card

Example: `EMM386.SYS X=C800-C9FF`

Step 4. Remove the remark statement if present.
`REM X = C800-C9FF`

Step 5. Remove the card from the PC by following the procedures in section 20.3.

20.5 Replacing the AutoMax PC3000 Serial Card

You may need to replace the AutoMax PC3000 Serial card. To do this, you must:

- remove the old card
- prepare the new card
- install a new card

20.5.1 Removing the Old AutoMax PC3000 Serial Card

To remove the AutoMax PC3000 Serial card, follow the steps for the AutoMax PC3000 model you are using:

Removing the card from a PC3000 Packaged Version:		**Removing the card from a PC chassis:**	
Step 1.	Turn off power to the AutoMax PC3000 Packaged Version. Disconnect the incoming lines. NOTE: *If the chassis is mounted, you may want to un-mount it to make replacing the card easier.*	Step 1.	Shutdown the Windows 95 operating system, and turn off power to the PC chassis. Disconnect the incoming power cord.
Step 2.	Open the chassis.	Step 2.	Place the chassis on a flat surface.
Step 3.	Using a screwdriver, remove the hold down clamp and the slot cover's screw that holds the AutoMax PC3000 serial card in place.	Step 3.	Open the PC chassis.
Step 4.	Disconnect the ribbon cable from the AutoMax PC3000 Processor card.	Step 4.	Using a screwdriver, remove the slot cover's screw that holds the AutoMax PC3000 Serial card in place.
Step 5.	Remove the card from the slot, making sure to hold the card by its edges.	Step 5.	Disconnect the ribbon cable from the AutoMax PC3000 Processor card.
		Step 6.	Remove the card from the slot, making sure to hold the card by its edges.

20.5.2 Preparing a New AutoMax PC3000 Serial Card for Installation

To prepare a new AutoMax PC3000 Serial card for installation, follow these steps:

Step 1. Remove the new card from its shipping container and from its anti-static bag. Be careful not to touch the components or the surface.

Step 2. Set the jumpers E1 and E2 to match the settings on the old serial card. These jumpers control whether Port A is an RS-232 or RS-422 interface. See chapter 5 for more information.

Step 3. Set jumpers E3 and E4 to match the settings on the old serial card. These jumpers control load resistors. See chapter 5 for more information.

20.5.3 Installing a New AutoMax PC3000 Serial Card

To install a new AutoMax PC3000 Serial card, follow the steps for the AutoMax PC3000 model you are using:

Installing the card into a PC3000 Packaged Version:		**Installing the card into a PC chassis:**	
Step 1.	Insert the card into the chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the expansion socket. Make sure the gold-striped bottom edge of the board sits firmly in the slot socket and that the bracket of the board is in the corresponding groove.	Step 1.	Insert the card into the computer chassis. While firmly pressing down on the card, use a front-to-back rocking motion to seat the card in the socket. Make sure the gold-striped bottom edge of the board sits firmly in the expansion slot socket and that the bracket of the board is in the corresponding groove.
Step 2.	Using a screwdriver, secure the card with the slot cover's screw.	Step 2.	Using a screwdriver, secure the card with the slot cover's screw.
Step 3.	Connect the ribbon cable of the Serial card to the connector on the AutoMax PC3000 Processor card.	Step 3.	Connect the ribbon cable of the Serial card to the connector on the AutoMax PC3000 Processor card.
Step 4.	Using a screwdriver, replace the hold down clamp.	Step 4.	Replace the computer chassis' cover.
Step 5.	Close the chassis door, and remount the chassis if needed.	Step 5.	Plug in the power cord, and turn on the computer.
Step 6.	Reconnect the incoming power line, and turn on the AutoMax PC3000 Packaged Version.		

20.6 Replacing the AutoMax PC3000 Packaged Version

You can replace individual cards within the chassis; see sections 20.3 and 20.5. To replace the entire chassis, follow these steps:

Step 1. Turn off the AutoMax PC3000, and disconnect its incoming power.

Step 2. Disconnect the Allen-Bradley Remote I/O cables and the DCS-NET network cables, if present.

Step 3. Un-mount the chassis.

Step 4. Mount the new chassis. See chapter 6 for more information.

20.7 Replacing the Filter for the AutoMax PC3000 Packaged Version

We recommend that you inspect the AutoMax PC3000 Packaged Version's filter every month. The type of environment in which it is used determines how frequently you must replace the filter.

An extra filter ships with each AutoMax PC3000 Package Version. For additional filters, contact Allen-Bradley — Reliance Global Technical Services at 1-800-669-6119.

To replace the filter, refer to figure 20.1 and follow these steps:

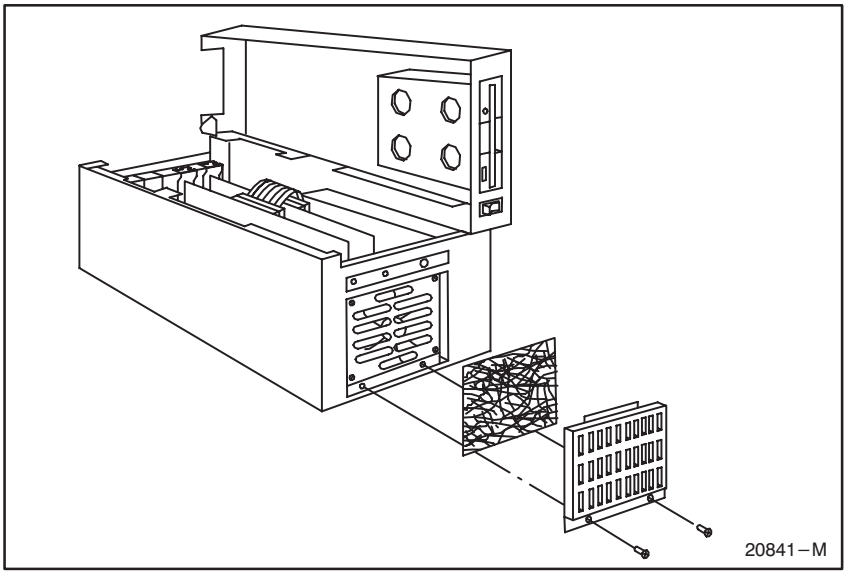


Figure 20.1 - Replacing the Chassis Filter

Step 1. Turn off the AutoMax PC3000, and disconnect its incoming power.

Step 2. Using a Phillips screwdriver, remove the screws at the bottom of the filter cover.

Step 3. Gently but firmly pull the cover free of the chassis.

Step 4. Remove the filter, and replace it with a new, clean one.

Step 5. Reinsert the filter and filter cover onto the chassis, and secure the filter cover with the two Phillips screws.

Step 6. Re-apply power to the rack.

20.8 What to Do Next

While scheduling maintenance for the PC3000, make sure to regularly inspect and maintain the DCS-NET network.

21.0 MAINTAINING THE DCS-NET NETWORK

21.1 Maintaining the Coaxial Cable DCS-NET Network

Refer to this section for information about adding or disconnecting a network drop, maintaining the cable system design and documenting and inspecting the cable system.

For information about:	See this section:
Maintaining the Coaxial Cable DCS-NET Network	21.1
Maintaining the Fiber-Optic DCS-NET Network	21.2
What to Do Next	21.3

21.1.1 Adding a Network Drop

Use the following procedure to add a drop to the coaxial cable network:

Step 1. Identify the route for a new cable segment (or segments). Refer to the recommendations provided in chapter 3. If a new drop is to be added at the end of the network cable system, only one new cable segment will be necessary. Otherwise, two new cable segments will be necessary.

Step 2. Calculate the new cable segment length. Ensure that the new total cable length does not exceed the maximum cable length defined in the AutoMax network specification (see Appendix C). If it exceeds the maximum specified cable length, consult with Reliance Electric before taking any further steps.

Step 3. Cut, install, terminate, and test the new cable segment following the instructions provided in chapter 7.

Step 4. Stop all communications over the AutoMax network.

Step 5. Refer to figure 21.1 and use the following procedures if a new drop is to be added to one of the ends of the network. Skip to step 6 if a drop is to be added along the cable route.

a) Disconnect the terminating load from the tap of the existing drop and replace it with one end of the new cable segment.

b) Connect the terminating load to a new tap. Connect the other end of the new cable segment to this tap.

c) Attach the tap to the Network module using a drop cable.

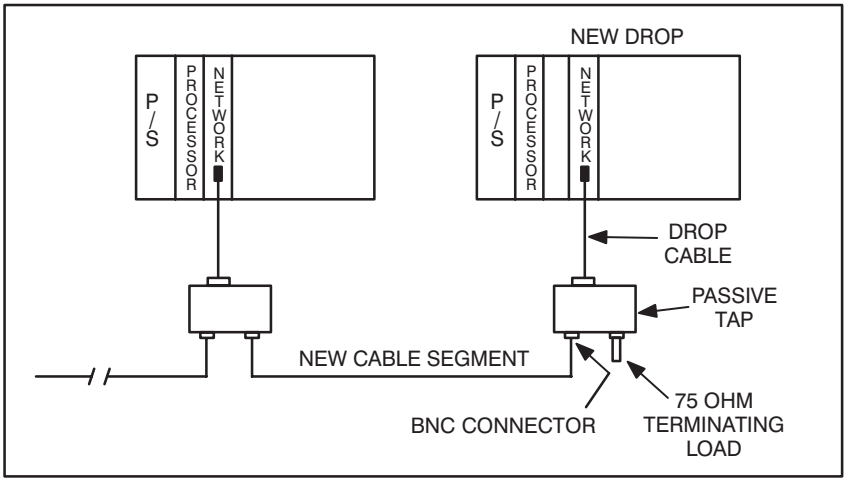


Figure 21.1 - Adding a New Drop at the End of the Network Cable System

Step 6. If a new drop is to be added along the cable route, use the following procedure:

a) Cut the AutoMax network cable at the point where the new drop is to be added.

b) Terminate the cable ends with BNC plugs, and splice them with the new cable segments.

c) Connect the other ends of the new cable segments with a tap attached to the new drop as shown figure 21.2.

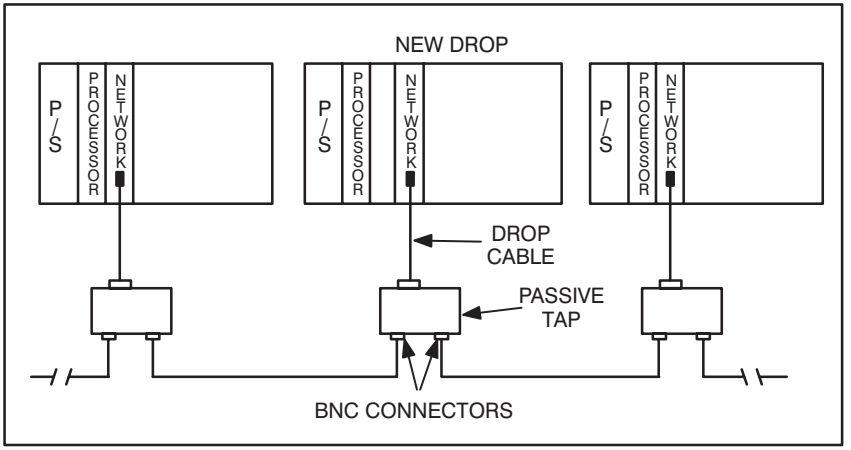


Figure 21.2 - Adding an Intermediate Drop to the Network Cable System

Step 7. Resume AutoMax network operation.

21.1.2 Disconnecting a Network Drop

CAUTION: Powering down a cluster of drops may result in loss of communication on a coaxial cable network. Disconnect the drop cable from the passive tap before powering down a drop.

To temporarily disconnect an AutoMax coaxial cable network drop, disconnect the drop cable from the tap before powering down the drop. To disconnect a coaxial cable network drop permanently or for an extended period of time, use the following procedure:

Step 1. Stop network operation.

Step 2. To disconnect a drop from an end of the network, refer to figure 21.3 and use the procedure below. Skip to step 3 for the procedure to disconnect a drop from along the cable route.

a) Disconnect the drop by detaching the cable segment between this and the neighboring drop from the neighboring drop tap.

b) Terminate this tap with a 75-ohm terminating load.

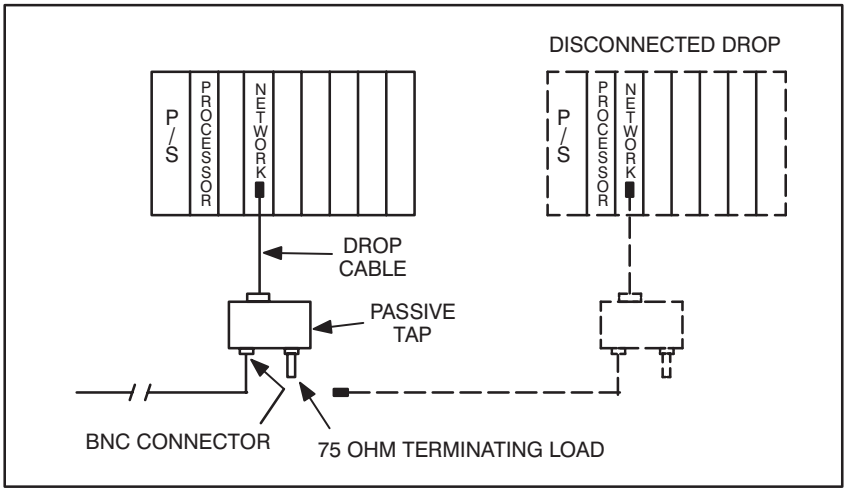


Figure 21.3 - Disconnecting a Drop from the End of the Network Cable System

Step 3. To disconnect a drop along the cable route, refer to figure 21.4 and use the following procedure:

a) Disconnect both AutoMax network cable segments from the tap.

b) Splice the cable segments using a jack-to-jack in-line splicing adapter.

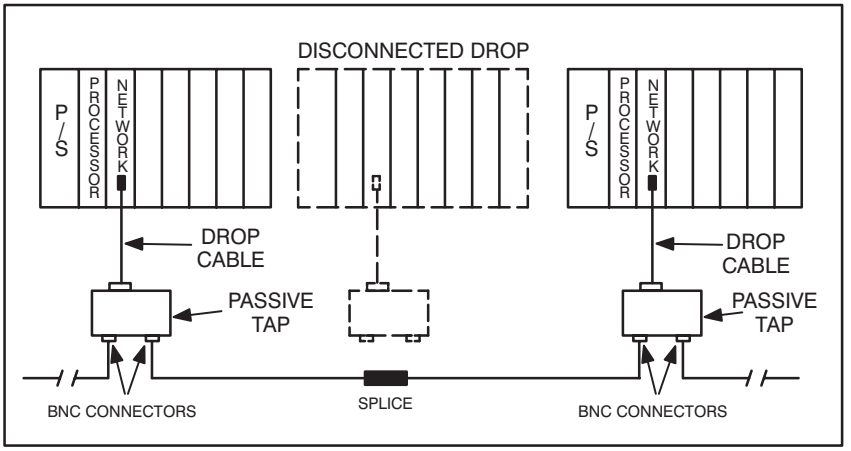


Figure 21.4 - Disconnecting an Intermediate Drop from the Network Cable System

Step 4. Resume network operation.

21.1.3 Maintaining the Coaxial Cable System

Even if the installation is done properly, the AutoMax network may still experience some unexpected downtime. This may be due to gradual degradation of the cable system components or changes in the environmental conditions along the cable path. Because of this, some limited preventive maintenance is required.

Keep the network cable system documentation up-to-date with all changes made to the network configuration during the life of the network.

When old equipment is relocated or new equipment is installed, new sources of heat, electrical noise, hazardous chemicals, and other changes in the network cable system environment may occur. Evaluate the effect these changes have on the performance of the network. If necessary, take corrective action such as rerouting certain AutoMax network cable segments and adding shielding to the cable system components.

21.1.4 Inspecting the Cable System

Inspect the AutoMax network cable system periodically for damage, shorts, and discontinuity. To perform these tests, use the appropriate time domain reflectometer (TDR) for the cable length. TDRs can be also used to perform cable testing during the installation or to locate a possible cable fault during troubleshooting. All tests should be properly documented.

21.2 Maintaining the Fiber-Optic DCS-NET Network

Refer to this section for information about maintaining the fiber-optic DCS-NET network.

21.2.1 Replacing the Stand-Alone Transceiver

Use the following procedure to replace a Stand-Alone Transceiver.

Step 1. Remove power from the external power supply that is supplying power to this transceiver.

Step 2. Disconnect the input power cable and the drop cable from the transceiver's six-screw terminal block.

Step 3. Disconnect the fiber-optic cable from the transceiver.

Step 4. Replace the transceiver.

Step 5. Re-connect the input power cable and the drop cable as shown in chapter 8. Connect the jumper between terminals 3 and 4.

Step 6. Re-connect the fiber-optic cable as shown in chapter 8.

Step 7. Turn power on to the external power supply.

21.2.2 Replacing the Rack-Mounted Transceiver

Use the following procedure to replace a Rack-Mounted Transceiver.

Step 1. Remove the plastic panel from the front of the fiber-optic rack.

Step 2. Turn the Fiber-Optic Rack's Power Supply off using the rocker switch on the Power Supply's faceplate.

Step 3. Disconnect the fiber-optic cable from the transceiver.

Step 4. Disconnect the twisted-pair cable from the transceiver's four-screw terminal block.

Step 5. Loosen the captive screws on the transceiver's faceplate and remove it from the rack.

Step 6. If the new transceiver is to be located at an extreme end of the rack, connect the jumper between terminals 3 and 4 on the transceiver's six-screw terminal block.

Step 7. Insert the transceiver into the rack and secure it with the captive screws.

Step 8. Connect the twisted-pair cable to the new transceiver as shown in chapter 8.

Step 9. Connect the fiber-optic cable as shown in chapter 8.

Step 10. Turn the Power Supply on. Verify that the LED on the faceplate of the transceiver is on. This indicates that it is receiving power.

Step 11. Re-attach the plastic panel to the front of the rack.

21.2.3 Replacing the Fiber-Optic Rack and Power Supply

Use the following procedure to replace the Fiber-Optic Rack and Power Supply. Before beginning this procedure, verify that the fiber-optic cable, the Rack-Mounted Transceiver, and its corresponding Stand-Alone Transceiver are labeled with the network ID number, the network drop number, and the Network module slot number.

Step 1. Remove the plastic panel from the front of the Fiber-Optic Rack.

Step 2. Turn the Fiber-Optic Rack's Power Supply off using the rocker switch on the Power Supply's faceplate.

Step 3. Remove power from the Power Supply's external 115 or 230 V AC source.

Step 4. Disconnect the Power Supply's power cord from the external 115 or 230 V AC source.

Step 5. Disconnect the twisted-pair cables and fiber-optic cables from each transceiver in the rack.

Step 6. Remove the rack from the mounting surface.

Step 7. Set the selector switch on the back of the new rack to 115 or 230 V AC as required.

Step 8. Attach the rack to the mounting surface.

Step 9. Insert each transceiver into the new rack and connect the twisted-pair cable and fiber-optic cable (refer to chapter 8).

Step 10. Connect the power cord to the 115 or 230 V AC source.

Step 11. Turn power on to the 115 or 230 V AC source.

Step 12. Turn the Fiber-Optic Rack's Power Supply on using the rocker switch on the Power Supply's faceplate. The built-in indicator in the switch will illuminate to indicate the presence of power. Verify that the LEDs on all of the Rack-Mounted Transceivers in the rack are on.

Step 13. Re-attach the plastic panel to the front of the Fiber-Optic Rack.

21.2.4 Adding a Network Drop

Use the following procedure to add a drop to the fiber-optic network:

Step 1. Identify the route for a new fiber-optic link. Refer to the recommendations provided in chapter 8.

Step 2. Calculate the new link length. Ensure the new total cable length does not exceed the maximum cable length defined in Appendix C. If it exceeds the maximum specified cable length, consult with Reliance Electric before taking any further steps.

Step 3. Install and test the new cable segment following the instructions provided in chapter 8.

Step 4. Install the new Stand-Alone Transceiver following the instructions provided in chapter 8.

Step 5. Stop all communications over the AutoMax network.

Step 6. Install the new Rack-Mounted Transceiver following the instructions provided in chapter 8. If the transceiver rack is full, install another rack following the instructions provided in chapter 8 and connect the transceivers as shown in figure 21.5.

Step 7. Resume network operation.

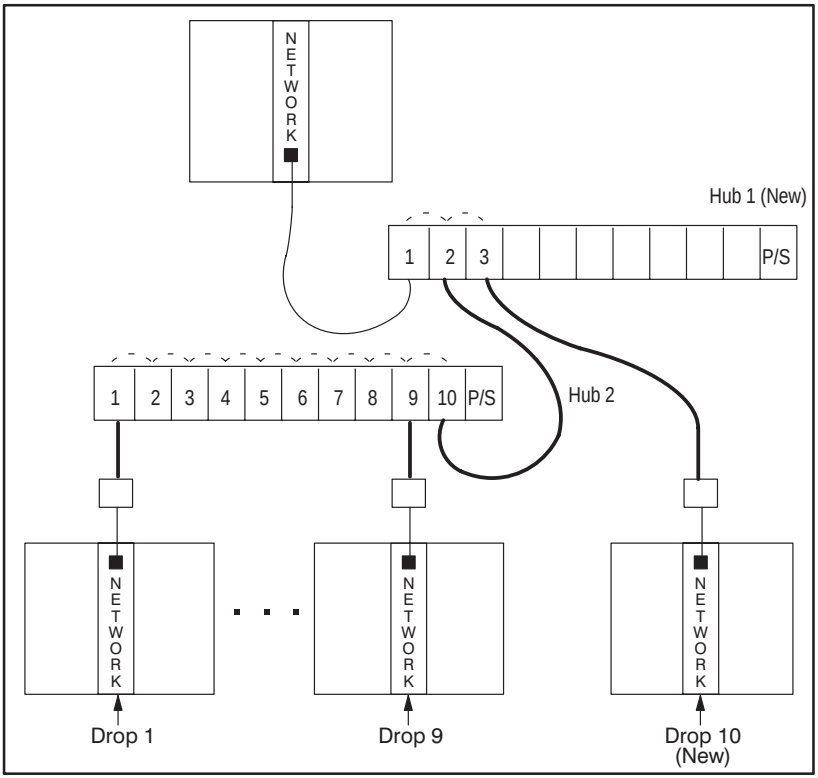


Figure 21.5 - Adding a Network Drop

21.2.5 Disconnecting a Network Drop

Use one of the following methods to disconnect a drop from the AutoMax network. Note that you do not need to stop network operation when you disconnect a drop from the network.

- Disconnect the drop cable from the Network module.
- Disconnect the fiber-optic cable from the Stand-Alone Transceiver.
- Disconnect the fiber-optic cable from the Rack-Mounted Transceiver.

21.2.6 Inspecting the Cable System

Periodically inspect the fiber-optic cable system. Use the optical time domain reflectometer (OTDR) or power meter for the cable inspection. You can also use OTDRs to perform cable testing during the installation or to locate a possible cable fault during troubleshooting. All tests should be properly documented.

21.3 What to Do Next

Refer to the troubleshooting and maintenance sections as needed. Use the appendices to help you determine replacement parts and locate the reference information.

Appendix A

Technical Specifications

AutoMax PC3000 Processor Card (M/N 57C560)

Operating Requirements

Temperature	+5 °C to +55 °C (+41 °F to +131 °F)
Relative Humidity	10% to 95%, non-condensing
Maximum Altitude	2,000 m (6562 ft.)
Shock and Vibration	Complies with requirements of the IEC 1131-2 standard.

Storage and Transport Requirements

Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity	5% to 95%, non-condensing

Dimensions

Length	33.9 cm (13.4 in.)
Height	12.2 cm (4.8 in.)

Requires two full-size ISA expansion slots

System Power Requirements

	Voltage	
	5 V	**12 v**
Current	2.4 A	0.08 A
Power Consumption	12 W	1 W

Battery Specifications

Type	lithium
Size	AA
Voltage	3.6 V
Amp Hours	2.0 h

WARNING

FOLLOW THESE PRECAUTIONS:

- **DO NOT INCINERATE OR EXPOSE THE BATTERY TO HIGH TEMPERATURES.**
- **DO NOT SHORT POSITIVE OR NEGATIVE TERMINALS TOGETHER. THE BATTERY WILL HEAT UP.**
- **DO NOT CHARGE THE BATTERY. AN EXPLOSION MIGHT RESULT OR THE CELL MIGHT OVERHEAT AND CAUSE BURNS.**
- **DO NOT SOLDER THE BATTERY OR LEADS; THE BATTERY COULD EXPLODE AND TOXIC, CORROSIVE, AND FLAMMABLE CHEMICALS COULD BE EXPOSED.**

FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Memory Retention

Minimum hold-up with battery	186 days
Typical hold-up with battery	8.2 years
Minimum hold-up without battery	10 minutes
Typical hold-up without battery	10 hours
Maximum charge-up time for the supercapacitor	15 minutes

Functional

Module will operate as an ISA slave and support the Microsoft *Plug and Play* standard.

AutoMax PC3000 Serial Card (M/N 57C565)

Operating Requirements

Temperature	+5 °C to +55 °C (+41 °F to +131 °F)
Relative Humidity	10% to 95%, non-condensing
Maximum Altitude	2,000 m (6562 ft.)
Shock and Vibration	Complies with requirements of the IEC 1131-2 standard.

Storage and Transport Requirements

Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity	5% to 95%, non-condensing

Dimensions

Length	33.9 cm (13.4 in.)
Height	12.2 cm (4.8 in.)

Type

Port A	RS-232/422
Port B	RS-232

System Power

	5 V		12 V	
E3/E4 jumpered 1-2	2.75 A	13.75 W	0.04 A	0.48 W
E3/E4 jumpered 2-3	0.25 A	1.25 W	0.04 A	0.48 W

AutoMax PC3000 Packaged Version (M/N 57C570)

Operating Requirements

Temperature	+5 °C to +55 °C (+41 °F to +131 °F)
Relative Humidity	10% to 95%, non-condensing
Maximum Altitude	2,000 m (6562 ft.)
Minimum Dielectric Strength	Complies with requirements of the EC 73/23 EEC Low Voltage Directive.
Shock and Vibration	Complies with requirements of the IEC 1131-2 standard.

Storage and Transport Requirements

Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity	5% to 95%, non-condensing

Dimensions and Weight

Height	39.4 cm (15.5 in.)
Width	16.5 cm (6.5 in.)
Depth	17.8 cm (7.0 in.)
Weight	5.6 kg (12.3 lb.)

Input Power Requirements

Voltage	90-132 V AC or 180-264 V AC, autoranging
Current	1.5/0.75 A maximum
Frequency	47-63 Hz

Battery Specifications

Type	lithium
Size	AA
Voltage	3.6 V
Amp Hours	2.0 h

WARNING

FOLLOW THESE PRECAUTIONS:

- **DO NOT INCINERATE OR EXPOSE THE BATTERY TO HIGH TEMPERATURES.**
- **DO NOT SHORT POSITIVE OR NEGATIVE TERMINALS TOGETHER. THE BATTERY WILL HEAT UP.**
- **DO NOT CHARGE THE BATTERY. AN EXPLOSION MIGHT RESULT OR THE CELL MIGHT OVERHEAT AND CAUSE BURNS.**
- **DO NOT SOLDER THE BATTERY OR LEADS; THE BATTERY COULD EXPLODE AND TOXIC, CORROSIVE, AND FLAMMABLE CHEMICALS COULD BE EXPOSED.**

FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Memory Retention

Minimum hold-up with battery	186 days
Typical hold-up with battery	8.2 years
Minimum hold-up without battery	10 minutes
Typical hold-up without battery	10 hours
Maximum charge-up time for the super capacitor	15 minutes

Appendix B

Recommendations for Building CE-Compliant Systems

This appendix provides instructions about how to build and install an AutoMax PC3000 system compliant with the European Union Directives 89/336/EEC, Electromagnetic Compatibility (EMC), and 73/23/EEC, Low Voltage requirements.

These instructions are only applicable to the industrial environment as it is defined in the standards accompanying these Directives.

AutoMax PC3000 Packaged Version (M/N 57C570)

The requirements for an AutoMax PC3000 Packaged Version installation compliant with the European Union EMC and Low Voltage Directives are:

1. Install the AutoMax PC3000 Packaged Version inside a grounded cabinet.
2. Provide incoming power to the AutoMax PC3000 Packaged Version via a control transformer. The recommended transformer rating is 0.5 KVA minimum.
3. Install an EMI/RFI filter between the AutoMax PC3000 Packaged Version and the control transformer. The Corcom 10VV1 filter (Reliance Electric P/N 612421-1) is recommended for both 120 V and 220 V AC. Install the filter as close to the PC3000 chassis as possible. Connect the filter input to the control transformer with a shielded cable or twisted-pair wires of the appropriate size. If a shielded cable is used, ground the shield at one end. Connect the filter output to the PC3000 chassis with a shielded cable or twisted-pair wires of the appropriate size. Make sure that the wires connecting the control transformer with the filter input are as far away as possible from the wires that connect the filter output with the PC3000. Ground the filter case.
4. Install a surge protection device between the EMI/RFI filter and the control transformer. The RAV-401BWZ-2A surge protector from Okaya Electric Industries Co., LTD (Reliance Electric part number 600686-44A) is recommended for a line voltage of 120 V AC. The RAV-781BWZ-2A surge protector from Okaya Electric Industries Co., LTD (Reliance Electric part number 600686-44B) is recommended for a line voltage of 220 V AC.

   If the control transformer secondary is grounded, one surge protector is required. The surge protector has three wires, labeled terminal 1, ground, and terminal 2. Connect the surge protector wire labeled 1 or 2 to the filter input terminal, which is connected to the ungrounded end of the control transformer secondary. Connect the surge protector's ground wire to the filter input terminal, which is connected to the ungrounded end of the control transformer secondary. Make these wires as short as possible. See figure B.1.

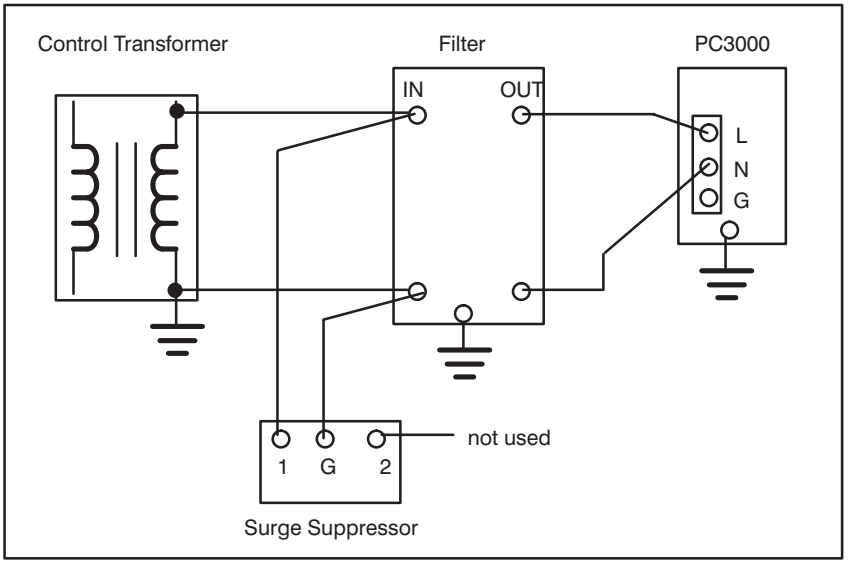


Figure B.1 - Connecting a Grounded Control Transformer Secondary

If the control transformer secondary is ungrounded, two surge protectors are required: one for the line-to-line and one for line-to-ground protections. Connect the first surge protector wire labeled terminal 1 or 2 to one of the filter input terminals. Connect the surge protector's ground wire to the other filter input terminal. Connect the second surge protector's wires labeled 1 and 2 to the filter input terminals. Connect the second surge protector's ground wire to the protective ground. Make these wires as short as possible. See figure B.2.

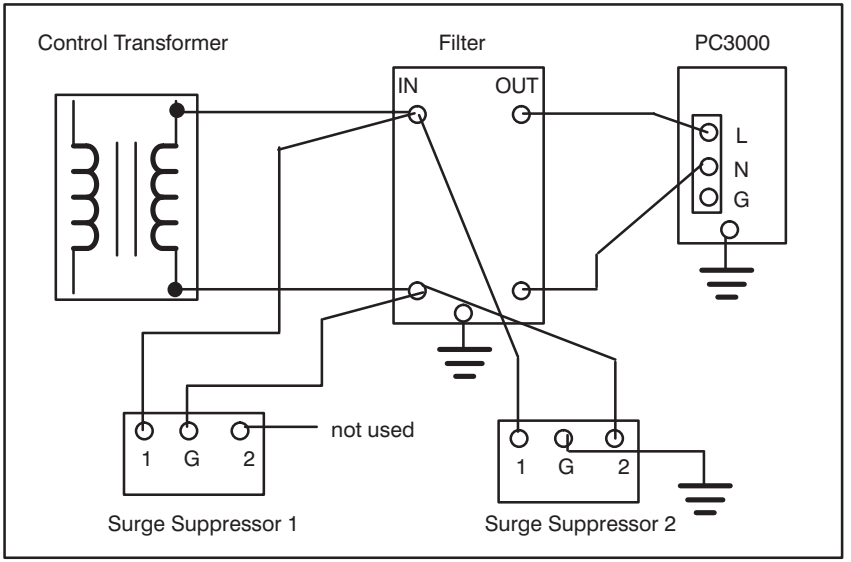


Figure B.2 - Connecting an Ungrounded Control Transformer Secondary

5. Connect the AutoMax PC3000 Packaged Version to a protective ground with an individual ground wire. A protective ground terminal is provided on the PC3000 chassis. It is located below the input terminal block and marked with an appropriate international symbol. The ground wire must be selected in accordance with appropriate international and national standards.
6. AutoMax DCS-NET and Allen-Bradley Remote I/O cable systems must be installed in accordance with the requirements described in their instruction manuals.
7. RS-232/RS-422 cables connecting user devices to ports A and B on the Serial card must be shielded. Cable connectors must have EMI/RFI shielded cable clamps attached to the cable shield. No other measures are needed since the cable shield is grounded at the PC3000. Cable lengths must not exceed 10 m (33 ft.). For longer distances, use CE marked modems or equivalent devices. Power them from the same control transformer as the PC3000 to which they are connected.

AutoMax PC3000 Installed in a PC Chassis

For an AutoMax PC3000 installed in a PC chassis to be compliant with the European Union EMC and Low Voltage Directives, use a CE-marked PC and follow the installation instructions published in the PC's manual as well as the instructions in points 6 and 7 above. If necessary, use a CE-marked uninterruptable power supply (UPS).

Appendix C

Cable Reference

This appendix lists specifications for the DCS-NET and Remote I/O networks.

DCS-NET Network Specifications

This section lists the specifications for the DCS-NET network and network components.

Network Specifications

Specification	Using Coaxial Cable	Using Fiber-Optic Cable
Topology	Bus	Active Star
Cable Options	RG-59/U (Belden 9259) RG-11/U (Belden 8213)	62.5 micron (Belden 225362)
Maximum Cable Length	RG-59/U: 1000 m (3000 ft) RG-11/U: 2000 m (6000 ft)	4000 m (12,000 ft.) *
Organization	Master/Slave	Master/Slave
Max. No. of Physical Slave Drops	51	55
Max. No. of Logical Software-Configured Slave Drops	55	55
Data Encoding Technique	Manchester II Biphase	
Data Link Frame Format	SDLC	
Max. Communication Time	2.99 ms/drop	
Baud Rate	1.75 Mbaud	
Bit Rate	875 Kbps	

* Measured from Stand-Alone Transceiver-to-Stand-Alone Transceiver through the hub.

Coaxial Cable System Components

Component	Reliance Part No.	Recommended Manufacturer Part No.
Drop Cable	M/N 57C381	N/A
Passive Tap	M/N 57C380	N/A
Terminating Load	M/N 45C71	Amphenol 46650-75
RG-59/U Coaxial Cable	N/A	Belden 9259
Dual Crimp Plug Connector For Belden 9259	M/N 45C72	AMP 227079-7

Component	Reliance Part No.	Recommended Manufacturer Part No.
Crimping Tool Kit for AMP 225886-6 Connector	N/A	AMP 220015-1 (Die Included)
Jack-to-Jack In-Line Splicing Adapter (for RG-59 and RG-11 Cables)	N/A	AMP 221551-3

Coaxial Cable Specifications

	Belden 9259 RG-59/U	Belden 8213 RG-11/U
Nominal Impedance	75 ohms	75 ohms
Nominal Velocity of Propagation	78%	78%
Nominal Capacitance	17.3 picofarad/foot	17.3 picofarad/foot
Nominal Attenuation at 1 MHz	0.3 decibels/100 feet	• 0.17 decibels/100 feet • 100% sweep tested 5-450 MHz
Outer Jacket	PVC	Black polyethylene
Nominal Outer Diameter	0.242 inches	0.405 inches
Shield	• Coverage and material: 95% bare copper • Nominal DC resistance: 2.6 ohms/1000 feet	• Coverage and material: 95% bare copper • Nominal DC resistance: 1.2 ohms/1000 feet
Insulation	Cellular polyethylene	Cellular polyethylene
Center Conductor	Material: stranded bare copper Nominal DC resistance: 15 ohms/1000 feet	Material: solid bare copper Nominal DC resistance: 2.6 ohms/1000 feet
Suggested Operating Temperature Range	−40 °C, + 80 °C	−55 °C, + 80 °C
Minimum Bending Radius	2.5 inches	5 inches
Maximum Standard Length	1000 feet	2000 feet

Fiber-Optic Cable System Components

Component	Reliance Part No.	Recommended Manufacturer Part No.
Fiber-Optic Connector	N/A	3M 6100
Connector Termination Kit	N/A	3M 6150A
Drop Cable	M/N 57C366	N/A

Component	Reliance Part No.	Recommended Manufacturer Part No.
Stand-Alone Transceiver	M/N 57C365	Math Associates EN-19418B
Rack with Power Supply	M/N 57C368	Math Associates MCR-1000A (Rack)
Rack-Mounted Transceiver	M/N 57C367	Math Associates EN-19418C
62.5 Micron Cable	N/A	Belden 225362
Twisted-Pair	417900-84CAH	Paige Electric 412402
Twisted-Pair-to-Coax Balun	N/A	AMP 555053-1
BNC Tee Adapter	M/N 45C70	N/A

Belden 225362 62.5 Micron Fiber-Optic Cable Specifications

Component	Specification
Cable Size	62.5 micron core, 125 micron cladding, 900 micron buffer
Recommended Maufacturer	Belden
Belden Part Number	225362 - breakout cable
Number of Fibers per Cable	2
Outside Diameter	6 mm (0.236 inches)
Jacket Material	PVC
Operating Temperature	−20° to 80 °C −36° to 176 °F
Maximum Pulling Tension	68 kg (150 lbs.)
Maximum Bend Radius	70 mm (3 inches)
Maximum Attenuation	3.5 dB per km
Nominal Operating Frequency	820 nanometers

Fiber-Optic Connector

Component	Specification
Recommended Fiber-Optic Connector	Hot Melt Connector, ST-compatible Manufacturer: 3M 3M Part Number: 6100
Ferrule	Ceramic
Maximum Attenuation	−0.6 dB per mated pair
Recommended Connector Termination Kit	Hot Melt Termination Kit, ST-compatible Manufacturer: 3M 3M Part Number: 6150A
Recommended Cable Assembly Test Set	Fiber-Optic Test Set, ST-compatible Manufacturer: 3M/Photodyne 3M/Photodyne Part Number: 118

Allen-Bradley Remote I/O Link

This section lists the specifications for the Allen-Bradley Remote I/O link.

Component	Specification
Required Cable	Belden 9463 Twinaxial Allen-Bradley Part number 1770-CD
Maximum Cable Length per Communication Rate	3,048 m (10,000 ft.) @ 57.6 kbps 1,524 m (5,000 ft.) @ 115.2 kbps 762 m (2,500 ft.) @ 230.4 kpbs
Maximum Number of Adapters That Can Be Scanned	32
Maximum Number of I/O Racks Supported	32, numbered 0-37 octal
Maximum Block-transfer Requests	48
Maximum Words Transferred During Each Block-Transfer Request	64

Pin Assignments for the AutoMax PC3000 Serial Card's Port B

Pin:	Assignment:
2	TXD.Out
3	RXD.In
4	RTS.Out
5	CTS.In
6	DSR.In
7	SIG.GND
10	+12 V.Out
20	DTR.Out

Pin Assignments for the AutoMax PC3000 Serial Card's Port A

	Protocol	
	RS-232	RS-422
Pin	Assignment:	Assignment:
1	Not used	TXD (−).Out
2	RXD.In	RXD (+).In
3	TXD.Out	TXD (+).Out
4	DTR.Out	Not Used
5	SIGNAL.Gnd	SIGNAL.Gnd
6	DSR.In	Not Used
7	RTS.Out	Not Used
8	CTS.In	Not Used
9	Not Used	RXD (−).In

Appendix D

Register Assignment Map

This appendix lists the PC3000's registers for the:

- CPU interface
- DCS-NET network interface
- Allen-Bradley Remote I/O scanner interface
- application interface

Common Memory Variables from AutoMax PC3000 CPU Interface—CPU

0-8191, Variables can be volatile and non-volatile

AutoMax PC3000 Network Interface—NET

Register Type	Register	Description
Setup Registers	12	Drop number
	14	Messages Received
	15	Receive Timeouts
	16	CRC Errors
	17	Overrun Errors
	18	Abort Errors
	19	Messages Transmitted
	20	Drop Depth
	20, bit 14	Invalid Drop Depth
	20, bit 15	Drop Depth Configured
Drop Status Registers	4	Drop 00-15 in bits 0-15
	5	Drop 16-31 in bits 0-15
	6	Drop 32-47 in bits 0-15
	7	Drop 40-55 in bits 0-7
Broadcast Data Registers		32-39 (read only)
Registers in Drop Areas 1-55, excluding PC3000 drops		0-63 for each drop area (read only)
Registers in PC3000 drop(s)		0-31 (read and write) 32-63 (read only)

Allen-Bradley Remote I/O Scanner Interface—ABR

Output Image Table				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 0	0		Rack 0, I/O group 0: Output image table	read/write
	1		Rack 0, I/O group 1: Output image table	read/write
	2		Rack 0, I/O group 2: Output image table	read/write
	3		Rack 0, I/O group 3: Output image table	read/write
	4		Rack 0, I/O group 4: Output image table	read/write
	5		Rack 0, I/O group 5: Output image table	read/write
	6		Rack 0, I/O group 6: Output image table	read/write
	7		Rack 0, I/O group 7: Output image table	read/write
Rack 1	8-15		Rack 1 Output image table	read/write
Rack 2	16-23		Rack 2 Output image table	read/write
Rack 3	24-31		Rack 3 Output image table	read/write
Rack 4	32-39		Rack 4 Output image table	read/write
Rack 5	40-47		Rack 5 Output image table	read/write
Rack 6	48-55		Rack 6 Output image table	read/write
Rack 7	56-63		Rack 7 Output image table	read/write
Rack 10	64-71		Rack 10 Output image table	read/write
Rack 11	72-79		Rack 11 Output image table	read/write
Rack 12	80-87		Rack 12 Output image table	read/write
Rack 13	88-95		Rack 13 Output image table	read/write
Rack 14	96-103		Rack 14 Output image table	read/write
Rack 15	104-111		Rack 15 Output image table	read/write
Rack 16	112-119		Rack 16 Output image table	read/write
Rack 17	120-127		Rack 17 Output image table	read/write
Rack 20	128-135		Rack 20 Output image table	read/write
Rack 21	136-143		Rack 21 Output image table	read/write
Rack 22	144-151		Rack 22 Output image table	read/write
Rack 23	152-159		Rack 23 Output image table	read/write
Rack 24	160-167		Rack 24 Output image table	read/write
Rack 25	168-175		Rack 25 Output image table	read/write
Rack 26	176-183		Rack 26 Output image table	read/write

Output Image Table				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 27	184-191		Rack 27 Output image table	read/write
Rack 30	192-199		Rack 30 Output image table	read/write
Rack 31	200-207		Rack 31 Output image table	read/write
Rack 32	208-215		Rack 32 Output image table	read/write
Rack 33	216-223		Rack 33 Output image table	read/write
Rack 34	224-231		Rack 34 Output image table	read/write
Rack 35	232-239		Rack 35 Output image table	read/write
Rack 36	240-247		Rack 36 Output image table	read/write
Rack 37	248-255		Rack 37 Output image table	read/write
Input Image Table				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 0	256		Rack 0, I/O group 0: Input image table	read
	257		Rack 0, I/O group 1: Input image table	read
	258		Rack 0, I/O group 2: Input image table	read
	259		Rack 0, I/O group 3: Input image table	read
	260		Rack 0, I/O group 4: Input image table	read
	261		Rack 0, I/O group 5: Input image table	read
	262		Rack 0, I/O group 6: Input image table	read
	263		Rack 0, I/O group 7: Input image table	read
Rack 1	264-271		Rack 1 Input image table	read
Rack 2	272-279		Rack 2 Input image table	read
Rack 3	280-287		Rack 3 Input image table	read
Rack 4	288-295		Rack 4 Input image table	read
Rack 5	296-303		Rack 5 Input image table	read
Rack 6	304-311		Rack 6 Input image table	read
Rack 7	312-319		Rack 7 Input image table	read
Rack 10	320-327		Rack 10 Input image table	read
Rack 11	328-335		Rack 11 Input image table	read
Rack 12	336-343		Rack 12 Input image table	read
Rack 13	344-351		Rack 13 Input image table	read
Rack 14	352-359		Rack 14 Input image table	read
Rack 15	360-367		Rack 15 Input image table	read
Rack 16	368-375		Rack 16 Input image table	read
Rack 17	376-383		Rack 17 Input image table	read

Input Image Table				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 20	384-391		Rack 20 Input image table	read
Rack 21	392-399		Rack 21 Input image table	read
Rack 22	400-407		Rack 22 Input image table	read
Rack 23	408-415		Rack 23 Input image table	read
Rack 24	416-423		Rack 24 Input image table	read
Rack 25	424-431		Rack 25 Input image table	read
Rack 26	432-439		Rack 26 Input image table	read
Rack 27	440-447		Rack 27 Input image table	read
Rack 30	448-455		Rack 30 Input image table	read
Rack 31	456-463		Rack 31 Input image table	read
Rack 32	464-471		Rack 32 Input image table	read
Rack 33	472-479		Rack 33 Input image table	read
Rack 34	480-487		Rack 34 Input image table	read
Rack 35	488-495		Rack 35 Input image table	read
Rack 36	496-503		Rack 36 Input image table	read
Rack 37	504-511		Rack 37 Input image table	read
Remote Rack Status (8 words per rack)				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 0	512	0	Rack 0 Enable. To enable the rack, set this bit to 1. To disable the rack, set this bit to 0.	read/write
	513		Rack 0 Rack Status A value of 0 means rack 0 is not being updated. A value of 1 means rack 0 is OK in RUN mode. A value of 2 means rack 0 is OK and not in RUN mode. A value of 3 means rack 0 has an error.	read
	514		Module group ending rack 0 A value of 0 means rack 0 ends at I/O group 1. A value of 1 means rack 0 ends at I/O group 3. A value of 2 means rack 0 ends at I/O group 5. A value of 3 means rack 0 ends at I/O group 7.	read
	515		Rack 0 timeouts. After 255 timeouts, the counter restarts at 0.	read

Remote Rack Status (8 words per rack)				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 0	516		Rack 0 CRC errors After 255 timeouts, the counter restarts at 0.	read
	517		Rack 0 failures After 255 timeouts, the counter restarts at 0.	read
	518		Rack 0 protocol errors After 255 timeouts, the counter restarts at 0.	read
	519		Rack 0 block transfer protocol errors After 255 timeouts, the counter restarts at 0.	read
Rack 1	520-527		Rack 1 Rack Status and Control	See layout for rack 0.
Rack 2	528-535		Rack 2 Rack Status and Control	See layout for rack 0.
Rack 3	536-543		Rack 3 Rack Status and Control	See layout for rack 0.
Rack 4	544-551		Rack 4 Rack Status and Control	See layout for rack 0.
Rack 5	552-559		Rack 5 Rack Status and Control	See layout for rack 0.
Rack 6	560-567		Rack 6 Rack Status and Control	See layout for rack 0.
Rack 7	568-575		Rack 7 Rack Status and Control	See layout for rack 0.
Rack 10	576-583		Rack 10 Rack Status and Control	See layout for rack 0.
Rack 11	584-591		Rack 11 Rack Status and Control	See layout for rack 0.
Rack 12	592-599		Rack 12 Rack Status and Control	See layout for rack 0.
Rack 13	600-607		Rack 13 Rack Status adn Control	See layout for rack 0.
Rack 14	608-615		Rack 14 Rack Status and Control	See layout for rack 0.

Remote Rack Status (8 words per rack)				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 15	616-623		Rack 15 Rack Status and Control	See layout for rack 0.
Rack 16	624-631		Rack 16 Rack Status and Control	See layout for rack 0.
Rack 17	632-639		Rack 17 Rack Status and Control	See layout for rack 0.
Rack 20	640-647		Rack 20 Rack Status and Control	See layout for rack 0.
Rack 21	648-655		Rack 21 Rack Status and Control	See layout for rack 0.
Rack 22	656-663		Rack 22 Rack Status and Control	See layout for rack 0.
Rack 23	664-671		Rack 23 Rack Status and Control	See layout for rack 0.
Rack 24	672-679		Rack 24 Rack Status and Control	See layout for rack 0.
Rack 25	680-687		Rack 25 Rack Status and Control	See layout for rack 0.
Rack 26	688-695		Rack 26 Rack Status and Control	See layout for rack 0.
Rack 27	696-703		Rack 27 Rack Status and Control	See layout for rack 0.
Rack 30	704-711		Rack 30 Rack Status and Control	See layout for rack 0.
Rack 31	712-719		Rack 31 Rack Status and Control	See layout for rack 0.
Rack 32	720-727		Rack 32 Rack Status and Control	See layout for rack 0.
Rack 33	728-735		Rack 33 Rack Status and Control	See layout for rack 0.
Rack 34	736-743		Rack 34 Rack Status and Control	See layout for rack 0.

Remote Rack Status (8 words per rack)				
	Register:	**Bit:**	**Function:**	**Access:**
Rack 35	744-751		Rack 35 Rack Status and Control	See layout for rack 0.
Rack 36	752-759		Rack 36 Rack Status and Control	See layout for rack 0.
Rack 37	760-767		Rack 37 Rack Status and Control	See layout for rack 0.
Scanner				
	Register:	**Bit:**	**Function:**	**Access:**
Scanner Control	768		Defines the scan mode and enables scanning	read/write
		0	Scanner mode To place the scanner in RUN mode, set this bit to 1. To remove the scanner from RUN mode, reset this bit to 0.	
		1	To start the scanner scanning remote I/O, set this bit to 1. To stop the scanner from scanning remote I/O, reset this bit to 0.	
Data Rate	769		Sets the communication rate for the scanner For a communication rate of 57.6 kbps, write a value of 0 into this register. For a communication rate of 115.2 kbps, write a value of 1 into this register. For a communication rate of 230.4 kbps, write a value of 2 into this register.	read/write
Remote I/O Link Status	770	0	When this bit is set to 1, the scanner is receiving communication from all enabled racks. When this bit is 0, one or more remote racks have an error.	read
Module Identification	771		Contains the module identification number, which is 43525 (0xaa04 hex) unsigned or −22012 signed. The signed value is displayed by the AutoMax Programming Executive software.	read
Not Used	772-775		Not used	

Scanner (*continued*)				
	Register:	**Bit:**	**Function:**	**Access:**
Firmware Revision	776		Contains the scanner's firmware revision information	read
Not Used	777-831		Not used	

Block Transfer Status, Request, and Control (4 words per block transfer request)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 1	832		Block Transfer 1—Status and Control Table	read/write
		0	Initiate block transfer 1 To initiate block transfer 1, set this bit to 1. This bit remains set until the block transfer is complete or an error occurs.	
		8	Block Transfer 1—error When this bit is set to 1, an error with block transfer 1 has occurred. If an error occurs with a continuous block transfer, this bit is set and the block transfer is disabled.	
		9	Block transfer 1 complete When a block transfer has completed, this bit is set to 1. Once you clear the bit, it sets when the next transfer is complete. For continuous block transfers, this bit is set to 1 when the first transfer is complete and remains set until you clear it via the application program.	
	833		Block transfer 1's module location and request type	read/write
		0-4	Remote rack number to which the module belongs. Enter a value from 0-37 octal	
		8	Module's slot number. Enter a value of 0 or 1.	
		9-11	The I/O group to which the module belongs. Enter a value from 0-7.	
		15	Block Transfer 1—Request Type Specify a read request by setting this bit to 1. Specify a write request by setting this bit to 0.	
	834		The number of words (length) of Block Transfer 1. Enter a value from 1-64 (words).	read/write

Block Transfer Status, Request, and Control (4 words per block transfer request)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 1	835		Update time for Block Transfer 1 To specify a non-continuous block transfer, enter a value of 0. To specify a continuous block transfer, enter the time interval. Time interval (ms) = x*10, where x is the value you enter in this register.	read/write
Block Transfer 2	836-839		Block transfer 2—Status and Control Table	read/write
Block Transfer 3	840-843		Block transfer 3—Status and Control Table	read/write
Block Transfer 4	844-847		Block transfer 4—Status and Control Table	read/write
Block Transfer 5	848-851		Block transfer 5—Status and Control Table	read/write
Block Transfer 6	852-855		Block transfer 6—Status and Control Table	read/write
Block Transfer 7	856-859		Block transfer 7—Status and Control Table	read/write
Block Transfer 8	860-863		Block transfer 8—Status and Control Table	read/write
Block Transfer 9	864-867		Block transfer 9—Status and Control Table	read/write
Block Transfer 10	868-871		Block transfer 10—Status and Control Table	read/write
Block Transfer 11	872-875		Block transfer 11—Status and Control Table	read/write
Block Transfer 12	876-879		Block transfer 12—Status and Control Table	read/write
Block Transfer 13	880-883		Block transfer 13—Status and Control Table	read/write
Block Transfer 14	884-887		Block transfer 14—Status and Control Table	read/write
Block Transfer 15	888-891		Block transfer 15—Status and Control Table	read/write
Block Transfer 16	892-895		Block transfer 16—Status and Control Table	read/write
Block Transfer 17	896-899		Block transfer 17—Status and Control Table	read/write
Block Transfer 18	900-903		Block transfer 18—Status and Control Table	read/write

Block Transfer Status, Request, and Control (4 words per block transfer request)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 19	904-907		Block transfer 19—Status and Control Table	read/write
Block Transfer 20	908-911		Block transfer 20—Status and Control Table	read/write
Block Transfer 21	912-915		Block transfer 21—Status and Control Table	read/write
Block Transfer 22	916-919		Block transfer 22—Status and Control Table	read/write
Block Transfer 23	920-923		Block transfer 23—Status and Control Table	read/write
Block Transfer 24	924-927		Block transfer 24—Status and Control Table	read/write
Block Transfer 25	928-931		Block transfer 25—Status and Control Table	read/write
Block Transfer 26	932-935		Block transfer 26—Status and Control Table	read/write
Block Transfer 27	936-939		Block transfer 27—Status and Control Table	read/write
Block Transfer 28	940-943		Block transfer 28—Status and Control Table	read/write
Block Transfer 29	944-947		Block transfer 29—Status and Control Table	read/write
Block Transfer 30	948-951		Block transfer 30—Status and Control Table	read/write
Block Transfer 31	952-955		Block transfer 31—Status and Control Table	read/write
Block Transfer 32	956-959		Block transfer 32—Status and Control Table	read/write
Block Transfer 33	960-963		Block transfer 33—Status and Control Table	read/write
Block Transfer 34	964-967		Block transfer 34—Status and Control Table	read/write
Block Transfer 35	968-971		Block transfer 35—Status and Control Table	read/write
Block Transfer 36	972-975		Block transfer 36—Status and Control Table	read/write
Block Transfer 37	976-979		Block transfer 37—Status and Control Table	read/write
Block Transfer 38	980-983		Block transfer 38—Status and Control Table	read/write
Block Transfer 39	984-987		Block transfer 39—Status and Control Table	read/write
Block Transfer 40	988-991		Block transfer 40—Status and Control Table	read/write

Block Transfer Status, Request, and Control (4 words per block transfer request)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 41	992-995		Block transfer 41—Status and Control Table	read/write
Block Transfer 42	996-999		Block transfer 42—Status and Control Table	read/write
Block Transfer 43	1000-1003		Block transfer 43—Status and Control Table	read/write
Block Transfer 44	1004-1007		Block transfer 44—Status and Control Table	read/write
Block Transfer 45	1008-1011		Block transfer 45—Status and Control Table	read/write
Block Transfer 46	1012-1015		Block transfer 46—Status and Control Table	read/write
Block Transfer 47	1016-1019		Block transfer 47—Status and Control Table	read/write
Block Transfer 48	1020-1023		Block transfer 48—Status and Control Table	read/write
Block Transfer Data Tables (64 words per block transfer)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 1	1024-1087		Block transfer 1 Data Table	read/write
Block Transfer 2	1088-1151		Block transfer 2 Data Table	read/write
Block Transfer 3	1152-1215		Block transfer 3 Data Table	read/write
Block Transfer 4	1216-1279		Block transfer 4 Data Table	read/write
Block Transfer 5	1280-1343		Block transfer 5 Data Table	read/write
Block Transfer 6	1344-1407		Block transfer 6 Data Table	read/write
Block Transfer 7	1408-1471		Block transfer 7 Data Table	read/write
Block Transfer 8	1472-1535		Block transfer 8 Data Table	read/write
Block Transfer 9	1536-1599		Block transfer 9 Data Table	read/write
Block Transfer 10	1600-1663		Block transfer 10 Data Table	read/write
Block Transfer 11	1664-1727		Block transfer 11 Data Table	read/write
Block Transfer 12	1728-1791		Block transfer 12 Data Table	read/write
Block Transfer 13	1792-1855		Block transfer 13 Data Table	read/write
Block Transfer 14	1856-1919		Block transfer 14 Data Table	read/write
Block Transfer 15	1920-1983		Block transfer 15 Data Table	read/write
Block Transfer 16	1984-2047		Block transfer 16 Data Table	read/write
Block Transfer 17	2048-2111		Block transfer 17 Data Table	read/write
Block Transfer 18	2112-2175		Block transfer 18 Data Table	read/write
Block Transfer 19	2176-2239		Block transfer 19 Data Table	read/write
Block Transfer 20	2240-2303		Block transfer 20 Data Table	read/write
Block Transfer 21	2304-2367		Block transfer 21 Data Table	read/write
Block Transfer 22	2368-2431		Block transfer 22 Data Table	read/write
Block Transfer 23	2432-2495		Block transfer 23 Data Table	read/write

Block Transfer Data Tables (64 words per block transfer)				
	Register:	**Bit:**	**Function:**	**Access:**
Block Transfer 24	2496-2559		Block transfer 24 Data Table	read/write
Block Transfer 25	2560-2623		Block transfer 25 Data Table	read/write
Block Transfer 26	2624-2687		Block transfer 26 Data Table	read/write
Block Transfer 27	2688-2751		Block transfer 27 Data Table	read/write
Block Transfer 28	2752-2815		Block transfer 28 Data Table	read/write
Block Transfer 29	2816-2879		Block transfer 29 Data Table	read/write
Block Transfer 30	2880-2943		Block transfer 30 Data Table	read/write
Block Transfer 31	2944-3007		Block transfer 31 Data Table	read/write
Block Transfer 32	3008-3071		Block transfer 32 Data Table	read/write
Block Transfer 33	3072-3135		Block transfer 33 Data Table	read/write
Block Transfer 34	3136-3199		Block transfer 34 Data Table	read/write
Block Transfer 35	3200-3263		Block transfer 35 Data Table	read/write
Block Transfer 36	3264-3327		Block transfer 36 Data Table	read/write
Block Transfer 37	3328-3391		Block transfer 37 Data Table	read/write
Block Transfer 38	3392-3455		Block transfer 38 Data Table	read/write
Block Transfer 39	3456-3519		Block transfer 39 Data Table	read/write
Block Transfer 40	3520-3583		Block transfer 40 Data Table	read/write
Block Transfer 41	3584-3647		Block transfer 41 Data Table	read/write
Block Transfer 42	3648-3711		Block transfer 42 Data Table	read/write
Block Transfer 43	3712-3775		Block transfer 43 Data Table	read/write
Block Transfer 44	3776-3839		Block transfer 44 Data Table	read/write
Block Transfer 45	3840-3903		Block transfer 45 Data Table	read/write
Block Transfer 46	3904-3967		Block transfer 46 Data Table	read/write
Block Transfer 47	3968-4031		Block transfer 47 Data Table	read/write
Block Transfer 48	4032-4095		Block transfer 48 Data Table	read/write

PC3000 Application Interface—PCI

Register	Location
Volatile Variables	0-999
Non-Volatile Variables	1000-1999
System Information Variables - Error Codes	
• CPU	2000
• DCS-NET network	2001
• A-B Remote I/O network	2002

Appendix E

Replacement Parts

Order these replacement parts as needed.

Component	Part Number
PC3000 Processor Card	M/N 57C560
PC3000 Serial Card	M/N 57C565
PC3000 Packaged Version	M/N 57C570
AA, Lithium Battery	M/N 57C385
Fan Filter for the Packaged Version	Order additional filters from: Allen-Bradley — Reliance Global Technical Services at: 1-800-669-6119.
DCS-NET Network Allen-Bradley Remote I/O Network	See Appendix C
2- and 3-position jumpers and 3-pin Phoenix connector	Order similar parts from any electronic component vendor For the Phoenix connector, order MSTB1.5/3ST-5.08 from Combi-con.

Appendix F

Using the Sample AutoMax Configurations and Programs

Included on the AutoMax Programming Executive V4.1 software application disk are sample configurations and programs that you can copy and customize for your AutoMax PC3000 application. These samples are intended to provide you with only a starting point as you create logic customized for your application. The samples are structured according to this model:

- An AutoMax PC3000 supervises the FlexPak 3000 DC and GV3000 AC drives. These drives are connected to the PC3000 via the DCS-NET network. The PC3000 acts as the network master.
- The same AutoMax PC3000 controls a 1794, Flex, I/O remote rack and a remote PanelView operator interface. These devices are connected via the Remote I/O network.
- The PanelView operator interface displays data from the FlexPak 3000 and GV3000 drives and the Flex I/O.
- Operator input from the PanelView is sent to the FlexPak 3000 and GV3000 drives and the Flex I/O remote rack.

The sample configurations include:

- a basic configuration for the FlexPak 3000 DC drive and GV3000 AC drive each using the DCS-NET network option board
- A-B remote I/O scanner configuration for:
  - 1794 (Flex) I/O
  - 1791 (Block) I/O
  - PanelView operator interface
- Block transfer configuration for transferring data from the PanelView operator interface to the drives and Flex I/O

The sample programs include:

- an initialization program for the A-B remote I/O scanner
- a program that flashes lights on the Flex I/O and PanelView operator interface
- programs that transfer configurations to the FlexPak 3000 and GV3000 drives
- programs that interlock I/O in the FlexPak 3000 and GV3000 drives

BASIC, Ladder Logic, and Control Block languages were used to create the programs.

Getting Started

You can find the sample configurations and programs for the AutoMax PC3000 on the application disk for the AutoMax Programming Executive software V4.1. To copy the templates into a system in the Executive software, do the following:

Step 1. Obtain the application disk, and determine if it is write-protected. If it is, move the tab on the disk to un-protected.

Step 2. Place the disk in the drive, and run the AutoMax Programming Executive software.

Step 3. In the System Configurator, choose Copy from the System menu.

Step 4. Select the drive containing the application disk, and select the system PC3000.

Using the Sample Configurations

Once you have the sample configurations copied into a system, you can begin to view and customize them for your application. The DCS-NET network interface and the A-B remote I/O scanner interface each store the sample configurations. You can view the assigned variables by using the Variable Configurator for the selected interface "module." Just double-click the selected "module" for the AutoMax PC3000 displayed in the Rack Configurator. Detailed variable descriptions document the purpose of the assigned variables.

Use this table to help you locate the configuration you want:

Sample configuration:	**Location:**	**Description:**
DCS-NET network master	DCS-NET network interface, Drop Area 1	Generic register assignments for drop 1 of the DCS-NET network.
FlexPak 3000 DC drive basic configuration	DCS-NET network interface, Drop Area 6	Variables that configure the FlexPak 3000 drive have been defined for the registers in drop 6. Some individual bits have also been assigned variable names. You can copy this configuration to other drops as necessary per your application.
GV3000 AC drive basic configuration	DCS-NET network interface, Drop Area 8	Variables that configure the GV3000 drive have been defined for the registers in drop 8. Some individual bits have also been assigned variable names. You can copy this configuration to other drops as necessary per your application.
1794 (Flex) I/O definitions	A-B Remote I/O scanner interface, Input/Output registers for Racks 1 and 2	Registers in these racks are allotted for 16-bit input and output 1794 I/O modules.
1791 (Block) I/O definitions	A-B Remote I/O scanner interface, Input/Output registers for Rack 3 and 4	Registers in these racks are allotted for 16-bit input and output 1791 I/O modules.

Sample configuration:	Location:	Description:
PanelView operator interface definitions for operating the drives	A-B Remote I/O scanner interface, Input/Output registers for Rack 5	Registers in rack 5 are allotted for storing buttons on the PanelView that will allow an operator to control the drives.
A-B Remote I/O scanner setup and initialization	A-B Remote I/O scanner interface, Scanner setup and status registers	You need to create logic using the variables you assign in these registers to initialize the scanner interface. This template has defined variables for you.
Remote rack status and control registers	A-B Remote I/O scanner interface, Remote rack status and control registers	You need to create logic using the variables you assign in these registers to enable and monitor the remote racks used in your application. This template has defined variables for you.
Block transfers to the PanelView operator interface	A-B Remote I/O scanner interface, Block transfer status and request registers	This template has assigned variables to the minimum amount of registers you need to perform block transfers to the PanelView operator interface.
	Block transfer data registers	Registers are allotted for block transferring data to the PanelView operator interface.

Using the Sample Programs

Sample programs have been developed to illustrate how to perform a variety of tasks. You can copy these programs and tailor them to your application. They have been written using the AutoMax BASIC, Control Block, and Ladder Logic languages. These programs reference the variable names defined in the Variable Configurator. You can view the list of tasks in the Task Manager after you have copied the templates. The following table explains the purpose of each sample program.

This program:	Is written using the:	And performs this function:
ABFLASH	BASIC language	Flashes LEDs on the Flex I/O modules
ABPCFLSH	Ladder Logic language	Flashes LEDs on the Flex I/O modules
ABINIT	BASIC language	Initializes the A-B remote I/O scanner interface.
FLEX	Ladder Logic language	Interlocks I/O for the FlexPak 3000 DC drive
S1FLEX	Control Block	Transfers the FlexPak 3000 configuration to the drive over the DCS-NET network
S1SPD	Control Block	Transfers the GV3000 configuration to the drive over the DCS-NET network
S1SQ	Ladder Logic language	Interlocks I/O for the GV3000 AC drive

Appendix G

Examples of Remote I/O Programs

Scanner Initialization Program Examples

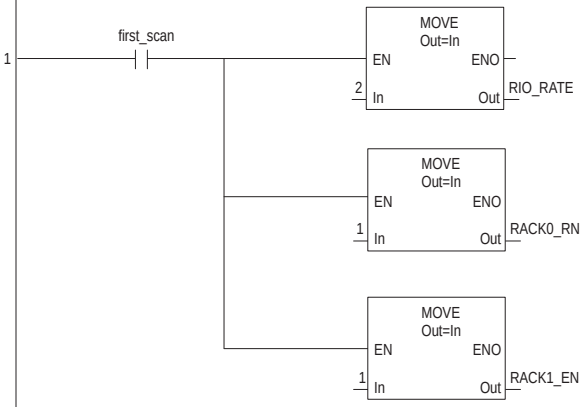
Refer to this section for BASIC and Ladder Language scanner initialization program examples.

BASIC Program Example

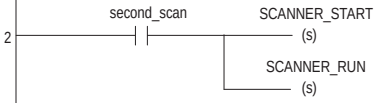
```
1010  COMMON   RACK0_EN%          \! AB-RIO REG 512
1020  COMMON   RACK1_EN%          \! AB-RIO REG 520
1030  COMMON   SCANNER_CONTROL%   \! AB-RIO REG 768
1040  COMMON   SCANNER_RUNG@      \! AB-RIO REG 768, BIT 0
1050  COMMON   SCANNER_START@     \! AB-RIO REG 768, BIT 1
1060  COMMON   RIO_RATE%          \! AB-RIO REG 769
1070  COMMON   RIO_STATUS         \! AB-RIO REG 770
8010  RIO_RATE% = 2               \! 230 KBaud
8020  RACK0_EN% = 1               \! Enable Rack 0
8030  RACK1_EN% = 1               \! Enable Rack 1
8040  SCANNER_CONTROL% = 3        \! Sets scanner into RUN
                                  mode and starts the
                                  scanner

32767 END
```

Ladder Language Program Example

During the first scan of the program, this rung sets the remote I/O data rate and enables racks 0 and 1.



During the second scan of the program, scanning is initiated and placed into RUN mode.



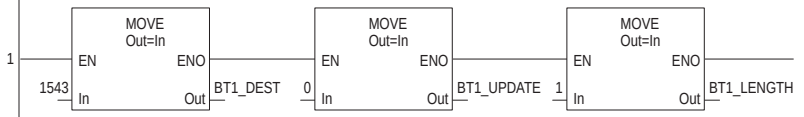
Block Transfer Program Examples

Refer to this section for BASIC and Ladder Language block-transfer program examples.

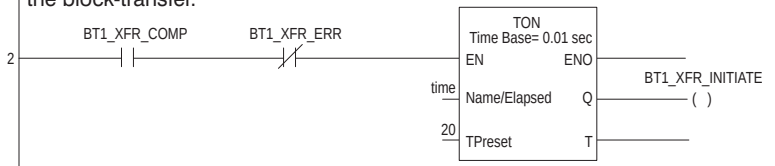
```
1070 COMMON      BT1_XFR_INITIATE@     \! AB-RIO REG 832, BIT 0
1080 COMMON      BT1_XFR_ERR@          \! AB-RIO REG 832, BIT 8
1090 COMMON      BT1_XFR_COMP@         \! AB-RIO REG 832, BIT 9
1100 COMMON      BT1_DEST%             \! AB-RIO REG 833
1110 COMMON      BT1_LENGTH%           \! AB-RIO REG 834
1120 COMMON      BT1_UPDATE%           \! AB-RIO REG 835
1130 COMMON      BT1_DATA_OUT%         \! AB-RIO REG 1024
8050 ! Set up block transfer 1, write to Rack 7, Slot 0, Grp 3    \&
      Reg 833                                                    \&
      Bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0                  \&
           0  x  x  x  0  1 1 0 x x x 0 0 1 1 1 = 607 Hex        \&
      for a block transfer read bit 15 is set to a 1 = 8607 Hex  \&
8060 BT1_DEST% = 1543
8070 BT1_UPDATE% = 0 \ ! Hand-shaked block transfer
8071 BT1_LENGTH = 1
10000  !
10010  BT1_DATA_OUT% = 0 \ ! Zero output
10020  BT1_XFR_INITIATE@ = 1
10030  IF BT1_XFR_ERR@ OR BT1_XFR_COMP@ THEN
              GOTO 10040
       ELSE
              DELAY 1 TICKS \ GOTO 10030
       END_IF
10040  ! IF BT1_XFR_ERR@ THEN (Handle Block Transfer Error)
32767  END
```

Ladder Language Program Example

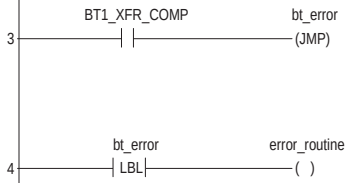
As in the BASIC program, this rung sets up a non-continuous block-transfer write request of one word to a block-transfer module in Rack 7, Group 3, and Slot 0. In the first MOVE instruction, the decimal value of 1543 equals the hexadecimal value of 607H. This instruction specifies the target module's location and a write request. The second MOVE instruction specifies a non-continuous block-transfer request. The third MOVE instruction specifies the length of the request.



This rung examines the block-transfer error bits and waits 0.2 s before initiating the block-transfer.



This rung examines the block-transfer error bit. If the bit is on, the JMP coil jumps to Rung 4 which would be an error routine.



How Physical I/O Translates into Logical Remote I/O Groups

This section illustrates how I/O is laid out to form logical I/O groups in the Allen-Bradley addressing schemes. The examples present 1-slot, 2-slot, and 1/2-slot addressing schemes using various I/O module densities. These examples also show how the I/O groups are mapped into the PC3000 scanner's I/O image table.

While these examples are based on the SLC 500 chassis, the concept applies to other remote I/O platforms, such as 1771, Flex I/O, and Block I/O.

2-slot Rack Addressing Configuration Example
(Rack 20)

SLC Chassis Physical Slot	Number of Inputs/Outputs Per Physical Slot	Logical I/O Group	Scanner Register Location	
			Input Register	Output Register
0	8 bits in or 8-bits out	0	384	128
1	8 bits in or 8-bits out		385	129
2	8 bits out or 8-bits in	1	386	130
3	8 bits out or 8-bits in		387	131
4	16 bits in or 16-bits out	2	388	132
5	16 bits out or 16-bits in			
6	4 bits in or 4 bits out	3		
7	4 bits in or 4 bits out			
8	4 bits out or 4 bits in	4		
9	4 bits out or 4 bits in			
10		5		
11				
12		6		
13				
14		7		
15				

1-slot Rack Addressing Configuration Example
(Racks 20 and 21)

	SLC Chassis Physical Slot	Number of Inputs/Outputs Per Physical Slot	Logical I/O Group	Scanner Register Location	
				Input Register	Output Register
Rack 20	0	8 bits in	0	384 (low byte)	
	1	8 bits out	1		129 (low byte)
	2	16 bits in	2	386	
	3	16-bits out	3		131
	4	16-bits out	4		132
	5	16-bits in	5	389	
	6	32-bits out*	6		134 & 135
	7	32-bits in*	7	390 & 391	
Rack 21	8		0		
	9		1		
	10		2		
	11		3		
	12		4		
	13		5		
	14		6		
	15		7		

*Even registers are the low word and odd registers the high word.

1/2-slot Rack Addressing Configuration Example
(Rack 20)

SLC Chassis Physical Slot	Number of Inputs/Outputs Per Physical Slot	Logical I/O Group	Scanner Register Location	
			Input Register	Output Register
0	8 bits in	0, 1	384 (low byte)	
1	8 bits out	2, 3		130 (low byte)
2	32 bits in*	4, 5	388 & 389	
3	32 bits out*	6, 7		134 & 135
4	16 bits in	0, 1	392	
5	16 bits out	2, 3		138
6	32 bits in*	4, 5	396 & 397	
7	32 bits out*	6, 7		142 & 143
*Even registers are the low word and odd registers the high word.				

Appendix H

Glossary of Terms

1/2-slot addressing: a mode of addressing in which each half I/O module of an I/O chassis is addressed as an I/O group. Each I/O module slot contains two I/O groups.

1-slot addressing: a mode of addressing in which each I/O module slot of an I/O chassis is addressed as an I/O group. Each I/O module slot contains a single I/O group.

2-slot addressing: a mode of addressing in which each even/odd pair of an I/O module slots of an I/O chassis is addressed as an I/O group. Each I/O module slot contains half of an I/O group.

ABR: Allen-Bradley Remote I/O Interface. Controls Allen-Bradley remote I/O by configuring and programming this remote I/O scanner.

A-B remote I/O: Allen-Bradley I/O being controlled by the PC3000's A-B Remote I/O scanner.

attenuation: signal reduction inherent in a transmission line or cable over a given distance. The amount of loss is usually stated in decibels per kilometer at a specific wavelength.

bend loss: increased attenuation caused by bending a fiber cable at a radius smaller than the recommended bend radius.

bend radius, minimum: radius to which a fiber cable can be bent without damaging the cable.

block data: a set of words or bytes handled as a unit, but not addressable as a unit as with a file. A block is typically defined by the number of words in length and starting word address within a file.

block-transfer: to transfer a block (64 words maximum) of data to or from an I/O module in one scan.

block-transfer read: to transfer a block of data **from** an I/O module.

block-transfer write: to transfer a block of data **to** an I/O module.

BNC series: a radio frequency (RF) quick connect/disconnect connector covered by Military Specification.

braid: a weave of metal fibers used as a shield covering for an insulated conductor or a group of insulated conductors.

breakout cable: a tightly-buffered multifiber fiber-optic cable.

buffer: the coating immediately surrounding an individual optical fiber. It is used for mechanical protection of the fiber.

cladding: the glass or plastic outer coating of an optical fiber that surrounds the core and keeps the light within the fiber. It is usually described by its diameter.

coaxial cable: a cylindrical transmission line comprised of a center conductor, a dielectric material, a shield (or an outer conductor), and usually covered by an insulating jacket.

conduit: a pipe, tube, or tile for routing and protecting electrical wires or cables.

connector: a coupling device designed to connect conductors from one circuit with those from another circuit.

Control Block language: a computer programming language used for closed-loop regulation and continuous process control of a typical industrial control application. Control Block language uses BASIC statements to comment and document programs and to control functions.

core: the central portion of an optical fiber that actually carries the light. It is usually described by its diameter in microns. For example, 50/125 means 50 micron diameter core, 125 micron diameter cladding.

CPU: exchanges information between programs using the Common memory variables and runs your application programs. See also *PC3000 Processor*.

crimping tool: a mechanical device that is used to crimp a contact and a ferrule of a BNC Plug connector.

DCE: Data Communication Equipment. 1) Equipment that provides the functions required to establish, maintain, or terminate a connection. 2) The signal conversion and coding required for communication between data terminal equipment and data circuits. Examples include modems, line drivers, coaxial cable, satellite links, etc. DCE may or may not be an integral part of a computer.

DCS-NET network: AutoMax Distributed Control System Network. The AutoMax PC3000's DCS-NET network interface communication processor for the AutoMax PC3000. Stores and manipulates status and data registers for the PC3000 DCS-NET network drop.

dielectric: a material that serves as an insulator.

discontinuity: a broken connection (open circuit), or loss of specified connection characteristic.

discrete input/output: an input/output that has an individual circuit connection at the I/O module that corresponds directly to a data table bit or word that stores the value of the signal at the I/O circuit (digital or analog). This allows the ladder logic to have discrete access to the I/O value.

drop: devices that are connected to the AutoMax DCS-NET network. See also *Node*.

drop depth: configures a specific device (drop) to function as multiple drops. For example, setting the drop number of an AutoMax PC3000 to 05 and its drop depth to 3 configures it to function as drops 05, 06, and 07.

drop number: a unique number assigned to a device (drop) or network enabling the AutoMax PC3000 to communicate on the DCS-NET network.

DTE: Data Terminal Equipment. Equipment that is attached to a network to send or receive data, or both. Programmable controllers, workstations, and interface modules are examples of DTEs.

dust cap: a device attached to a connector to provide protection against dust and foreign debris.

Enhanced BASIC Language: a computer programming language modeled after standard BASIC. It consists of simple statements, functions, and math notations to perform operations.

Enhanced Ladder Language: a computer language used for programming sequence control and machine interlocking operations in a typical industrial control application.

ferrule: a short tube used to make a solderless connection to shielded or coaxial cable.

fiber-optic link: a data transmission system consisting of a transmitter, receiver, and length of fiber-optic cable.

fiber optics: light pulse transmission through optical fibers.

ground: a connection between an electrical circuit and the earth, or some conducting body (e.g., chassis) serving in place of earth.

handshake: a series of signals between a computer (DTE) and a peripheral device (DCE; e.g., a modem) that establishes the parameters required for passing data.

heat-shrinkable: describes tubes, caps, sleeves, boots, or other forms of plastic which shrink when heated to encapsulate, protect or insulate connections, splices, terminations and other configurations.

impedance: the total opposition a circuit, cable or component offers to alternating current. It includes both resistance and reactance and is generally expressed in ohms.

input image table: See *I/O image table.*

I/O chassis: a chassis (housing) for the I/O modules and either a processor to control the I/O module or an adapter to interface a scanner to the I/O modules.

I/O group: a group of input and/or output circuits that corresponds to a word (16 bits) each in the input and output image tables.

I/O image table: an area in memory (scanner or adapter module) with addresses corresponding to each input and output module.

I/O rack: an I/O addressing unit that corresponds to 8 input image table words and 8 output image table words. A rack can contain a maximum of 8 I/O groups for a maximum of 128 I/O with unique addressing of I/O modules.

impedance match: a condition whereby an impedance of a particular circuit, cable or component is the same as the impedance of the circuit, cable or device to which it is connected.

ISA bus: the backplane in the personal computer (PC); it enables the cards in the PC to talk to the computer's microprocessor or to each other.

jack: a connecting device into which a plug can be inserted to make circuit connections.

jacket: the outer sheath which protects against the environment and may also provide additional insulation.

master: a device (programmable controller with I/O modules or a workstation) that sends data to and collects data from devices connected on a network.

maximum recommended pulling tension: the maximum load which can be applied along the axis of a cable without breaking the fibers.

microbend loss: attenuation caused by excessive cable bending or manufacturing flaws.

micron: one millionth of a meter or 0.000039 inch.

minimum bend radius: the smallest radius to which a cable can be bent without damaging the fiber.

mismatch: a condition whereby an impedance of a particular circuit, cable or component is not equal to the impedance of the circuit, cable or device to which it is connected.

modem: a device that modulates digital information from a programmable controller or computer to an analog signal that is transported over phone lines, radio waves, or satellite transmissions and demodulates the analog back into digital data at the receiving sites.

module slot: a location for installing a module. In typical modular construction, modules plug into a backplane; each module slides into a slot that lines it up with its backplane connector.

NET: PC3000 Network Interface. Stores and manipulates status and data registers for the PC3000 DCS-NET network drop. See also *DCS-NET network.*

node: devices that are connected to the AutoMax DCS-NET network. See also *Drop*.

non-volatile: variables that store data whose value is retained through power cycles of the PC3000 Application Interface (PCI) and Stop All conditions.

optical power: the power emitted from a light source into a fiber-optic cable; defined in watts but usually expressed in decibels.

optical power budget: the total amount of optical power available from the fiber-optic transmitter less the losses present in the fiber-optic link.

output image table: See *I/O image table*.

parallel port: an electrical connection on a computer capable of transmitting or receiving two or more bits of data at one time; the communications port to which devices such as parallel printers can be attached.

PC: Personal computer.

PC3000 Processor: exchanges information between programs using the Common memory variables and runs your application programs. See also *CPU.*

PCI: PC3000 Application Interface. Exchanges data between an AutoMax PC3000 and a PC's microprocessor via the ISA bus.

physical drop: the drop number assigned to a drop. See also *Drop Number*.

plug: a movable portion of a coaxial RF connector attached to a cable or removable assembly.

program: synonymous with and used in place of the term task.

raceway: any channel designed expressly and used solely for holding wires and cables.

rack: See *I/O Rack*.

reflections: return of the radio frequency energy towards the source which is caused by an impedance mismatch along the transmission path.

remote I/O: I/O connected to a processor across a serial link. With a serial link, remote I/O can be located long distances from the processor.

remote I/O link: a serial link for carrying I/O data between a processor (scanner) and remote I/O adapters.

remote I/O scanner: a separate module or component of a module that provides communication with remote I/O adapters across a remote I/O link.

RG: a symbol used to designate coaxial cables made to a government specification.

RS-232/422: EIA electrical connection standards for serial binary communication between data terminal equipment and data communications equipment.

serial port: an electrical connection on a computer that handles data bits one after another; the communications port (COM1 or COM2) to which devices such as a modem, a mouse, or a serial printer can be attached.

shield: a sheet, screen or braid of metal (usually copper, aluminum, or other conducting material) usually placed between a dielectric and a jacket of a coaxial cable.

slot: See *module slot.*

surge: a temporary and relatively large increase in the voltage or current in an electric circuit or cable.

task: See *program.*

transceiver: a module composed of a transmitter and receiver.

virtual drop: drop numbers created when a drop depth is specified enabling a device to function as more than one drop. See also *Drop Depth*.

volatile: variables that store data whose value is not retained through power cycles and Stop All conditions.

word: a group of 16 bits in sequence that is treated as a unit.

Index

Numbers

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

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