

AutoMax Remote I/O Communications

M/N 57C328

M/N 57C329

M/N 57C330

M/N 57C416

M/N 57C554

Instruction Manual J-3606-4

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ELECTRIC** 

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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.

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. Do not touch the connectors on 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 this precaution could result in damage to, or destruction of, the equipment.

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1.0 INTRODUCTION

The products described in this manual are manufactured or distributed by Reliance Electric Industrial Company.

The AutoMax[®] Remote I/O network interconnects an AutoMax or DCS 5000 Processor with remote AutoMax racks, Remote I/O Heads, or remote Shark[™] racks. The AutoMax Remote I/O Communications module (M/N 57C416) is the interface between the AutoMax or DCS 5000 Processor and the remote I/O on the network.

The AutoMax Remote I/O network is designed for master/slave operation. The network is composed of two main parts: a number of nodes (drops) and a transmission medium (coaxial or fiber-optic cable).

There are two types of drops: master and slave. The master drop is a Multibus[™] rack that contains at least one AutoMax or DCS 5000 Processor module and a Remote I/O Communications module.

Slave drops can be:

- Remote I/O Heads (M/N 57C328 and M/N 57C330)
- Remote Drive Interface Heads (M/N 57C329)
- Shark racks containing I/O modules and an AutoMax Remote I/O Shark Interface module (M/N 57C554)
- AutoMax racks containing AutoMax I/O modules and a Remote I/O Communications module
- IBM-compatible personal computers containing the AutoMax PC Link Interface module (M/N 57C445). Refer to the AutoMax PC Link instruction manual (J2-3011) for more information.

An AutoMax Remote I/O network can have a maximum of seven slave drops. All five types can be mixed on the same network.

The drops are connected using coaxial cable or, when noise immunity and total electrical isolation is required, fiber-optic cable. The coaxial cable network is structured in a bus configuration. This type of topology is characterized by a main trunkline in which individual nodes are connected in a multidrop fashion as shown in figure 1.1.

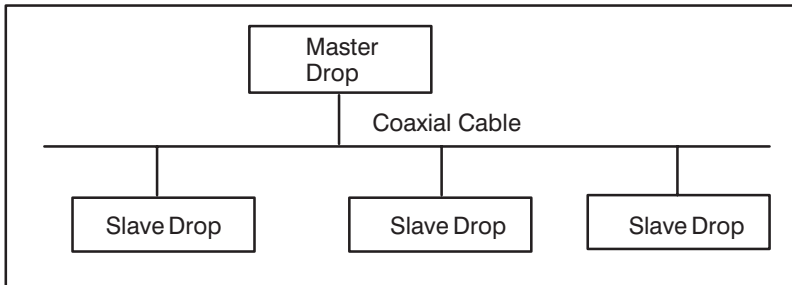


Figure 1.1 - A Typical Coaxial Cable Remote I/O Network

The black bar shown on the right-hand margin of this page will be used throughout this instruction manual to signify new or revised text or figures.

The fiber-optic cable network is organized in an active star configuration. With this type of topology, each node is connected to a multi-port central point, also referred to as a "hub," containing active re-transmitting devices as shown in figure 1.2.

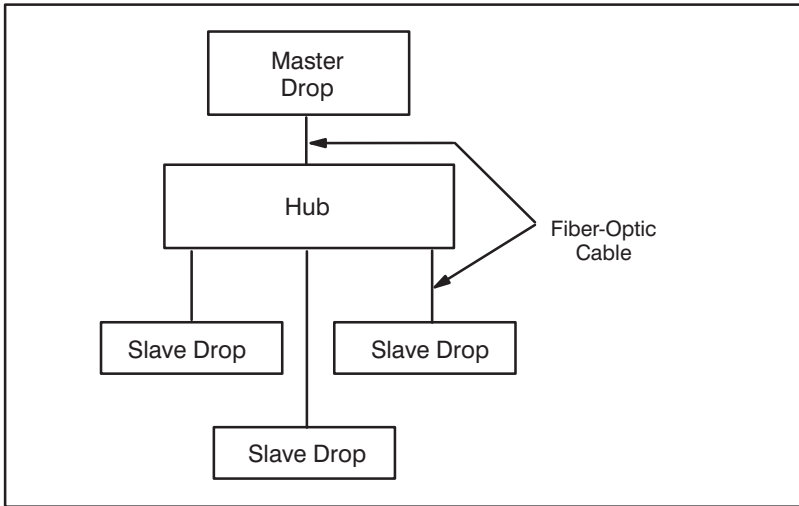


Figure 1.2 - A Typical Fiber-Optic Cable Remote I/O Network

The type of cable used (whether coaxial or fiber-optic) does not affect the operation of the Remote I/O network protocols, application software, or the operation of the Remote I/O Communications module, Shark Interface module, Remote I/O Head, or Remote Drive Interface Head.

The Remote I/O Communications module in the master drop (drop 0) rack functions as the network's Remote I/O master. Master or slave Remote I/O Communications modules may be installed in any slot in the rack. Any number of Remote I/O Communications modules can be installed in a master rack, each controlling a separate Remote I/O network. See figure 1.3.

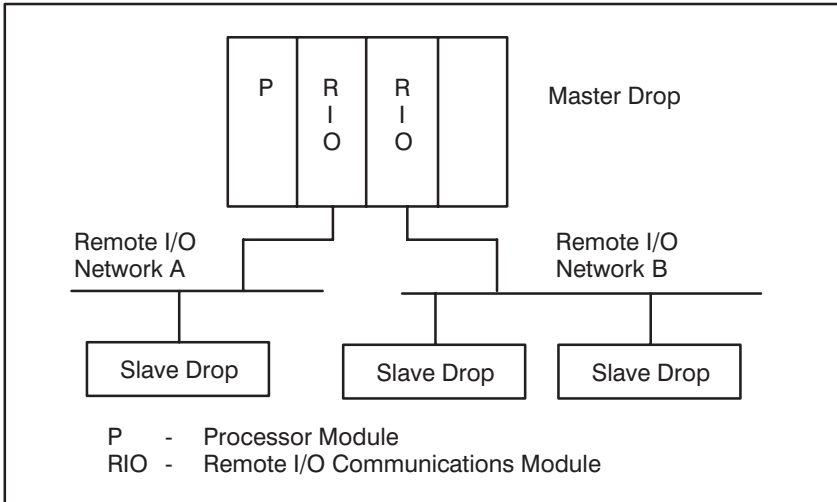


Figure 1.3 - Multiple Remote I/O Network Connections (Coax)

The master initiates and controls all data transmissions on the network by polling every slave drop in a round-robin sequence. A slave drop's Remote I/O Communication module, Remote I/O Head, or AutoMax Remote I/O Shark Interface module functions as an I/O scanner: it reads data in from the input modules and writes data out to the output modules. The data sent from the master drop to the slave updates the status of the slave's outputs. The slave drop sends the current status of its inputs back to the master.

Each Remote I/O Communications module contains a 4K word dual-port memory for storing the data that is transmitted over the network. Dual-port memory is accessible to both the module and the AutoMax Processor in the rack. In the master module, the dual-port memory contains an image of the status of all the inputs and outputs of the I/O modules in the slave drops. The application task that controls the I/O associated with these I/O modules actually examines the inputs and controls the outputs in the image area.

The Remote I/O Communications module provides an RS-232 compatible serial port and the associated software needed to monitor the status of the drops. An ASCII terminal or a personal computer running terminal-emulation software are also required. For more information, refer to section 5.0.

The remainder of this manual describes the functions and specifications of the Remote I/O Communications module, Remote I/O Head, Remote Drive Interface Head, and the AutoMax Remote I/O Shark Interface module. It also includes installation and troubleshooting procedures, as well as configuration and programming information.

1.1 Related Publications

Related publications that may be of interest:

- J-3012 AutoMate/AutoMax Digital I/O Rail and Modules Manual
- J-3650 AutoMax Processor Module Instruction Manual
- J-3675 AutoMax Enhanced Basic Language Instruction Manual
- J-3676 AutoMax Control Block Language Instruction Manual
- J2-3094 AutoMax Enhanced Ladder Language Instruction Manual
- J-3809 Shark XL II Programmable Controller Instruction Manual
- J2-3018 Shark XL I/O System Instruction Manual
- D2-3170 Rail Interface Card Instruction Manual
- Various AutoMax Programming Executive instruction manuals
- IEEE 518 Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers From External Sources
- Your personal computer and DOS operating system manual(s).
- Other instruction manuals applicable to your hardware configuration.

1.2 Related Hardware and Software

Model number (M/N) 57C416 contains one Remote I/O Communications module.

M/N 57C554 contains one AutoMax Remote I/O Shark Interface module.

M/N 57C328 and M/N 57C330 each contain one AutoMax Remote I/O Head.

M/N 57C329 contains one AutoMax Remote Drive Interface Head.

The Remote I/O Communications module, the AutoMax Remote I/O Head, the AutoMax Remote Drive Interface Head, and the AutoMax Remote I/O Shark Interface module can be used with all versions of the AutoMax and DCS 5000 Processor.

Remote I/O communications is supported by all versions of the AutoMax Programming Executive software.

1.3 Terms and Conventions Used in This Manual

Throughout this instruction manual, certain terms will be used for brevity and clarity.

A Remote I/O Communications module (M/N 57C416) will be referred to as a **Remote I/O module**.

A remotely-located AutoMax/DCS 5000 rack containing I/O modules and a Remote I/O Communications module will be referred to as a **Multibus drop**.

An AutoMax Remote I/O Head (M/N 57C328 or M/N 57C330 with AutoMate digital and analog I/O Rails and Local I/O Heads connected will be referred to as a **Remote I/O Head drop**.

An AutoMax Remote Drive Interface Head (M/N 57C329) with a drive connected will be referred to as a **Remote Drive Interface Head drop**.

A Shark rack containing I/O modules and an AutoMax Remote I/O Shark Interface module (M/N 57C554) will be referred to as a **Shark drop**.

An AutoMax Remote I/O Shark Interface module will be referred to as a **Shark Interface module**.

Unless otherwise stated, the material presented in this instruction manual applies to the Remote I/O module, Remote I/O Head, Remote Drive Interface Head, and the Shark Interface module. Any differences between these products will be pointed out explicitly

2.0 MECHANICAL/ELECTRICAL DESCRIPTION

This section describes the mechanical and electrical characteristics of the Remote I/O module, Remote I/O Head, Remote Drive Interface Head, and the Shark Interface module.

2.1 Mechanical Description

This section describes the faceplates, connectors, indicators, and switches of the Remote I/O module, Remote I/O Head, Remote Drive Interface Head, and the Shark Interface module.

2.1.1 Remote I/O Module (M/N 57C416)

The Remote I/O module is a printed circuit assembly that plugs into the backplane of the DCS 5000/AutoMax Rack. The module consists of a printed circuit board, faceplate, and protective enclosure. The faceplate contains ejector tabs at the top and bottom to simplify removing the module from the rack. See figure 2.1 for an illustration of the module faceplate.

The 25-pin D-shell connector on the faceplate supports the RS-232 compatible serial port described in section 5.0. The 9-pin D-shell connector on the faceplate is used to connect the module to the network.

The two thumbwheel switches on the faceplate are used to set the remote I/O network drop number. The upper thumbwheel switch represents the most significant digit; the lower thumbwheel switch represents the least significant digit. The thumbwheel switches are read only on power-up. If it is necessary to change the drop number, you must change the setting and then cycle power. On the back of the module are two edge connectors that attach to the system backplane.

For diagnostic purposes, the faceplate contains a seven-segment LED that displays error codes. The error codes are defined in Appendix D. A green status LED on the faceplate indicates when the module is operational (ON) or should be replaced (OFF).

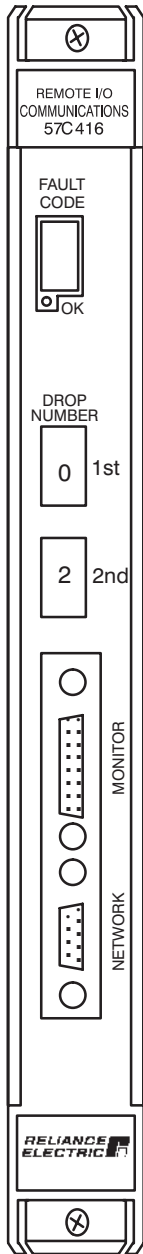


Figure 2.1 - Remote I/O Module Faceplate

2.1.2 Shark Interface Module (M/N 57C554)

The Shark Interface module is a printed circuit board assembly that plugs into the backplane of a Shark rack in the first slot to the right of the power supply.

It consists of a printed circuit board and a faceplate. The faceplate contains tabs at the top and bottom to simplify removing the module from the rack. On the back of the module are two connectors that attach to the system backplane. Module dimensions are given in Appendix A.

The faceplate of the module contains one 9-pin female D-shell connector labeled "NETWORK." See figure 2.2. This connector allows the module to connect to the Remote I/O network.

The module faceplate contains two green status LEDs. When lit, the top LED, labeled "CPU OK," indicates that the module has passed its power-up diagnostics and is operating properly. When lit, the bottom LED, labeled "COM OK," indicates that the module is communicating on the Remote I/O network. When the LED is flashing, it indicates that an invalid drop number has been selected on the rotary switch, which is described below .

The 16-position rotary switch is used to select the Shark rack's Remote I/O drop number (1 to 7 or 9 to F). This switch is read only on power-up. If it is necessary to change the rack's drop number, you must change the setting of the rotary switch and then cycle power.

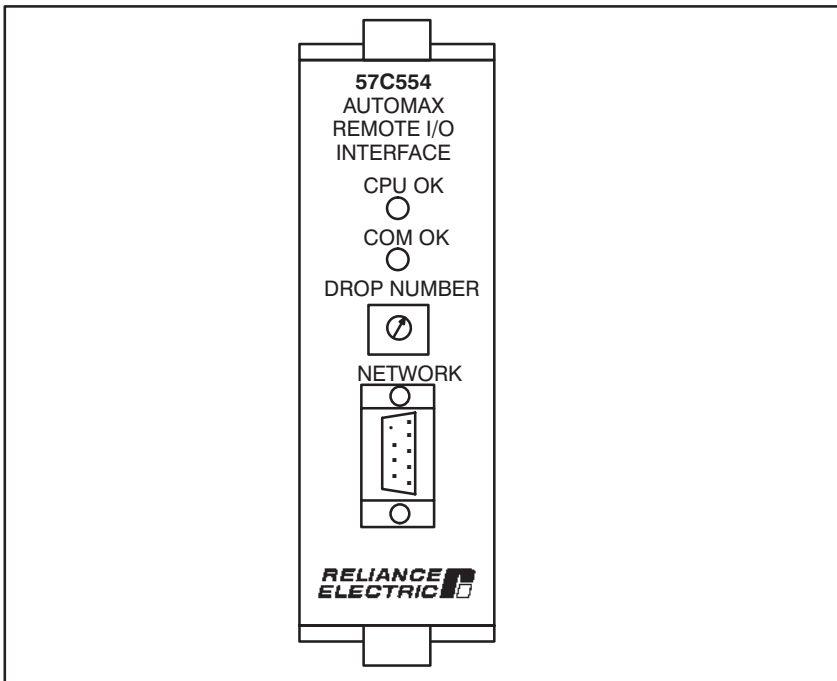


Figure 2.2 - AutoMax Remote I/O Shark Interface Module Faceplate

2.1.3 Remote I/O Head (M/N 57C328)

The Remote I/O Head can be used as an interface between the AutoMax Remote I/O network and the AutoMate rail I/O system, which consists of Local Heads, digital or analog rails, LED modules, or Thumbwheel Switch Modules. Note that although the Remote I/O Head can be used as an interface to drives with rail-type interface ports (such as the Reliance GP-2000/VTAC V controller), it is recommended that **only** the Remote Drive Interface Head (M/N 57C329) be used for interfacing with drives over an AutoMax Remote I/O network. See section 2.1.5 for more information.

The M/N 57C328 Remote I/O Head is identical to the M/N 57C330 Remote I/O Head, except that you can mix input and outputs in the same rail. Each port on the Remote I/O head contains separate address spaces for inputs and outputs. Like the M/N 57C330 Remote I/O Head, it can control up to 4 digital rails, analog I/O rails, or Local Heads. Each Local Head can in turn control up to 4 AutoMate digital rails. Therefore, a Remote I/O Head with 4 Local Heads connected to it can control a maximum 16 digital rails.

The AutoMax Remote I/O Head consists of a power supply, two printed circuit boards (a processor board and a remote I/O communications board), a faceplate, and a protective metal enclosure. See figure 2.3 for an illustration of the both Remote I/O Heads.

The 25-pin D-shell connector on the faceplate supports the RS-232-compatible serial port described in section 5.0. The BNC connector on the faceplate is used to connect the Remote I/O Head to the Remote I/O network. The four I/O connectors are used for Rail and/or Local Head communications.

The thumbwheel switch on the faceplate is used to set the Remote I/O network drop number. Drop numbers 1 through 7 inclusive indicate valid Remote I/O drop numbers.

The terminal strip on the faceplate provides connections for incoming power as well as a set of normally open contacts from the Ready Relay. The contacts are closed when the Remote I/O Head is operating properly and open if a problem is detected in the on-board microprocessor. These contacts can be used to take remedial action in the event of a problem with the on-board microprocessor.

For diagnostic purposes, the faceplate contains a seven-segment LED that displays error codes (see Appendix D). The faceplate also contains six status LEDs, which are labeled as follows:

RUN (amber): Normally on; if off, indicates that the CPU watchdog has timed out.

POWER (green): When on, indicates power is being supplied to the CPU and internal voltages are within range.

CPU READY (amber): Will turn on after the power-up diagnostics have been completed successfully and the CPU watchdog has not timed out. Also indicates the state of the Ready Relay contacts. When on, the Ready Relay contacts are closed.

FAULT MSB/FAULT LSB (amber): Normally off. When on, these LEDs indicate the particular rail that has experienced a fault. These LEDs are valid while the Rail Fault LED is lit. See section 6.8 for more information.

RAIL FAULT (red): When on, indicates that a rail fault has occurred.

Note that during power-up diagnostics, the bottom four LEDs (CPU, READY, FAULT MSB, FAULT LSB, and RAIL FAULT) will stay on long enough to allow verification that they will light.

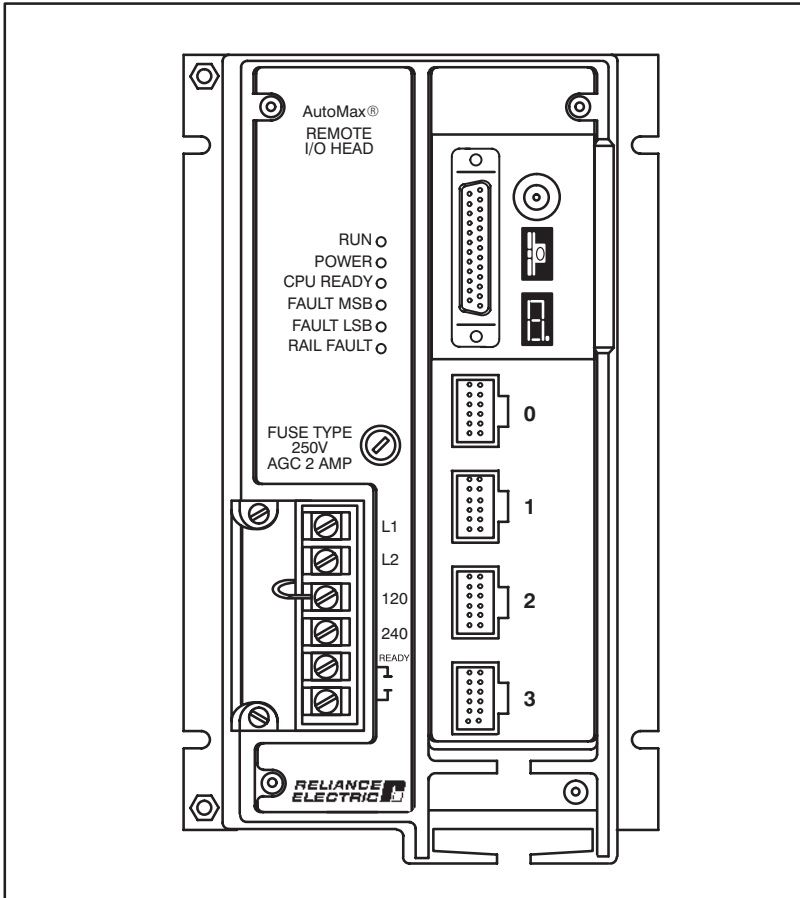


Figure 2.3 - AutoMax Remote I/O Head Faceplate (M/N 57C328 and M/N 57330)

2.1.4 Remote I/O Head (M/N 57C330)

The Remote I/O Head can be used as an interface between the AutoMax Remote I/O network and the AutoMate rail I/O system, which consists of Local Heads, digital or analog rails, LED modules, or Thumbwheel Switch modules. Note that although the Remote I/O Head can be used as an interface to drives with rail-type interface ports (such as the Reliance® GP-2000/VTAC V controller), it is recommended that only the Remote Drive Interface Head (M/N 57C329) be used for interfacing with drives over an AutoMax Remote I/O network. See section 2.1.5 for more information.

The Remote I/O Head can control up to 4 digital rails, analog I/O rails, or Local Heads. Each Local Head can in turn control up to 4 AutoMate digital rails. Therefore, a Remote I/O Head with 4 Local Heads connected to it can control a maximum of 16 digital rails. The digital rails must be all inputs or all outputs.

The AutoMax Remote I/O Head consists of a power supply, two printed circuit boards (a processor board and a remote I/O communications board), a faceplate, and a protective metal enclosure. See figure 2.3 for an illustration of the Remote I/O Head.

The 25-pin D-shell connector on the faceplate supports the RS-232-compatible serial port described in section 5.0. The BNC connector on the faceplate is used to connect the Remote Head to the Remote I/O network. The four I/O connectors are used for Rail and/or Local Head communications.

The thumbwheel switch on the faceplate is used to set the Remote I/O network drop number. Drop numbers 1 through 7 inclusive indicate valid Remote I/O drop numbers.

The terminal strip on the faceplate provides connections for incoming power as well as a set of normally open contacts from the Ready Relay. The contacts are closed when the Remote I/O Head is operating properly and open if a problem is detected in the on-board microprocessor. These contacts can be used to take remedial action in the event of a problem with the on-board microprocessor.

For diagnostic purposes, the faceplate contains a seven-segment LED that displays error codes (see Appendix D). The faceplate also contains six status LEDs, which are labeled as follows:

RUN (amber): Normally on; if off, indicates that the CPU watchdog has timed out.

POWER (green): When on, indicates power is being supplied to the CPU and internal voltages are within range.

CPU READY (amber): Will turn on after the power-up diagnostics have been completed successfully and the CPU watchdog has not timed out. Also indicates the state of the Ready Relay contacts. When on, the Ready Relay contacts are closed.

FAULT MSB / FAULT LSB (amber): Normally off. When on, these LEDs indicate the particular rail that has experienced a fault. These LEDs are valid while the Rail Fault LED is lit. See section 6.8 for more information.

RAIL FAULT (red): When on, indicates that a rail fault has occurred.

Note that during power-up diagnostics, the bottom four LEDs (CPU READY, FAULT MSB, FAULT LSB, and RAIL FAULT) will stay on long enough to allow verification that they will light.

2.1.5 Remote Drive Interface Head (M/N 57C329)

The Remote Drive Interface Head can be used only as an interface between the AutoMax Remote I/O network and drives with rail-type interface ports (such as the Reliance V★S GP-2000/VTAC V controller). **This Head must not be connected to Local Heads (M/N 61C22), Digital Rails (M/N 45C1), Analog Rails (various model numbers), LED modules (M/N 45C631), or Thumbwheel Switch modules (M/N 45C630).**

The Remote Drive Interface Head consists of a power supply, two printed circuit boards (a processor board and a remote I/O communications board), a faceplate, and a protective metal enclosure. See figure 2.4 for an illustration of the Remote Drive Interface Head.

The 25-pin D-shell connector on the faceplate supports the RS-232-compatible serial port described in section 5.0. The BNC connector on the faceplate is used to connect the Remote Drive Interface Head to the Remote I/O network. The four I/O connectors are used only to connect to drives with rail-type interface ports (e.g., the Reliance V★S GP-2000/VTAC V controller with a Rail Interface module (1SC4000)) via the interface cable (M/N 45C8) supplied with the Rail Interface module.

The thumbwheel switch on the faceplate is used to set the Remote I/O network drop number. Drop numbers 1 through 7 inclusive indicate valid Remote I/O drop numbers.

The terminal strip on the faceplate provides connections for incoming power as well as a set of normally open contacts from the Ready Relay. The contacts are closed when the Remote Drive Interface Head is operating properly and open if a problem is detected in the on-board microprocessor. These contacts can be used to take remedial action in the event of a problem with the on-board microprocessor.

For diagnostic purposes, the faceplate contains a seven-segment LED that displays error codes (see Appendix D). The faceplate also contains three status LEDs, which are labeled as follows:

RUN (amber): Normally on; if off, indicates that the CPU watchdog has timed out.

POWER (green): When on, indicates power is being supplied to the CPU and internal voltages are within range.

CPU READY (amber): Will turn on after the power-up diagnostics have been completed successfully and the CPU watchdog has not timed out. Also indicates the state of the Ready Relay contacts. When on, the Ready Relay contacts are closed.

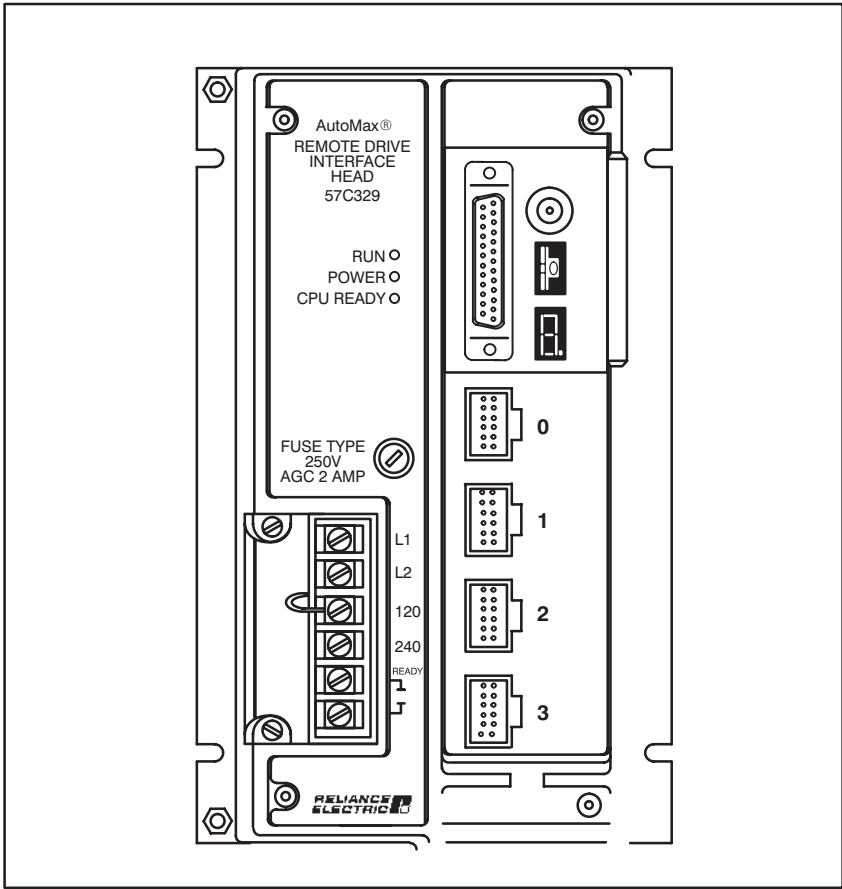


Figure 2.4 - AutoMax Remote Drive Interface Head Faceplate

2.2 Electrical Description

This section describes the electrical characteristics of the Remote I/O module, the Shark Interface module, the AutoMax Remote I/O Head, and the AutoMax Remote Drive Interface Head.

2.2.1 Remote I/O Module (M/N 57C416)

The Remote I/O module contains a microprocessor that connects to one port of the dual port memory while the other port interfaces with the Multibus backplane. A block diagram is shown in Appendix B.

The module contains a watchdog timer, which is enabled when power is turned on to the module. The on-board microprocessor must reset the watchdog timer within a specified time or the microprocessor will shut down and the OK LED on the faceplate will turn off.

At power up, the on-board processor will run diagnostics on the microprocessor, EPROM, RAM, serial I/O, memory management unit, and dual port memory, as well as perform system-level diagnostics. As each test is run, a number is written out to the seven-segment display. If there is a fault during the diagnostics, the microprocessor will halt, the watchdog will time out, and the seven-segment display will show the code of the failed diagnostic.

2.2.2 Shark Interface Module (M/N 57C554)

The Shark Interface module contains a microprocessor that interfaces to the Shark rack's backplane through timing and buffer circuitry.

Power for the module's logic circuitry is supplied by the rack's +5 VDC power supply. Power for the module's remote I/O network driver is supplied by the rack's +24 VDC power supply and is regulated at +12 VDC.

2.2.3 Remote I/O Head (M/N 57C328)

The remote I/O Head has an on-board power supply that provides all voltages necessary to power the Remote I/O Head and the I/O system. The power supply has an input voltage of 120/240 VAC.

The Remote I/O Head contains a microprocessor that connects to the four I/O ports via the I/O interface circuitry. At power up, the Head polls the rail sub-system to determine how many rails are connected to it. Each port on the Remote I/O Head is treated like a Multibus slot and can contain from 0-4 rails. Each rail is mapped to one input register and one output register in the dual port memory of the M/N 57C416, which allows you to mix digital inputs and outputs in the same rail. The location of the rail's registers is fixed in the dual port memory of M/N 57C416. See Appendix I for more information about the Remote I/O Head's memory map.

The Remote I/O Head connects to the Remote I/O network through one channel of a serial I/O device. The second channel of the serial I/O device provided a monitor port for the user. A block diagram is shown in Appendix B.

The Remote I/O Head contains a watchdog timer that is enabled when power is turned on to the Head. The microprocessor must reset the watchdog timer within a specified time or the microprocessor will shut down and the RUN and CPU READY LEDs on the faceplate will turn off.

A set of normally open contacts from the Ready Relay are provided on the terminal strip. The contacts open whenever a problem is detected in the on-board microprocessor. These contacts should be used in an E-stop (emergency stop) circuit to remove power from the outputs in case of emergency. See section 3.5.5 for more information.

At power up, the on-board microprocessor will run diagnostics on the microprocessor, EPROM, RAM, serial I/O, and the I/O interface, as well as perform system-level diagnostics. As each test is run, a number is written out to the seven-segment display. If there is a fault during the diagnostics, the microprocessor will halt, the watchdog will time out, and the seven-segment display will show the code of the failed diagnostics.

2.2.4 Remote I/O Head (M/N 57C330)

The Remote I/O Head has an on-board power supply that provides all voltages necessary to power the Remote I/O Head and the I/O system. The power supply has an input voltage of 120/240 VAC.

The Remote I/O Head contains a microprocessor that connects to the four I/O ports via the I/O interface circuitry. It connects to the Remote I/O network through one channel of a serial I/O device. The second channel of the serial I/O device provides a monitor port for the user. A block diagram is shown in Appendix B.

The Remote I/O Head contains a watchdog timer that is enabled when power is turned on to the Head. The microprocessor must reset the watchdog timer within a specified time or the microprocessor will shut down and the RUN and CPU READY LEDs on the faceplate will turn off.

A set of normally open contacts from the Ready Relay are provided on the terminal strip. The contacts open whenever a problem is detected in the on-board microprocessor. These contacts should be used in an E-stop (emergency stop) circuit to remove power from the outputs in case of emergency. See section 3.5.5 for more information.

At power up, the on-board microprocessor will run diagnostics on the microprocessor, EPROM, RAM, serial I/O, and the I/O interface, as well as perform system-level diagnostics. As each test is run, a number is written out to the seven-segment display. If there is a fault during the diagnostics, the microprocessor will halt, the watchdog will time out, and the seven-segment display will show the code of the failed diagnostic.

2.2.5 Remote Drive Interface Head (M/N 57C329)

The Remote Drive Interface Head has an on-board power supply that provides all voltages necessary to power the Remote Drive Interface Head and to communicate with up to four drives. The power supply has an input voltage of 120/240 VAC.

The Remote Drive Interface Head contains a microprocessor that connects to the four I/O ports via the I/O interface circuitry. It connects to the Remote I/O network through one channel of a serial I/O device. The second channel of the serial I/O device provides a monitor port for the user. A block diagram is shown in Appendix B.

The Remote Drive Interface Head contains a watchdog timer that is enabled when power is turned on to the Head. The microprocessor must reset the watchdog timer within a specified time or the microprocessor will shut down and the RUN and CPU READY LEDs on the faceplate will turn off.

A set of normally open contacts from the Ready Relay are provided on the terminal strip. The contacts open whenever a problem is detected in the on-board microprocessor. These contacts should be used in an E-stop (emergency stop) circuit to remove power from the outputs in case of emergency. See section 3.5.5 for more information.

At power up, the on-board microprocessor will run diagnostics on the microprocessor, EPROM, RAM, serial I/O, and the I/O Interface, as well as perform system-level diagnostics. As each test is run, a number is written out to the seven-segment display. If there is a fault during the diagnostics, the microprocessor will halt, the watchdog will time out, and the seven-segment display will show the code of the failed diagnostic.

2.3 Drop Numbers

Drop numbers are used to uniquely identify every rack on the Remote I/O network; therefore, a drop and a rack are the same entity on a Remote I/O network. There are a maximum of seven slave drops on a Remote I/O network, each identified by the rotary switch (Shark) or thumbwheel switches (Remote I/O module, Remote Drive Interface Head, and Remote I/O Heads) on the faceplate. For Remote I/O modules drop numbers 0 through 7 are valid, with drop 0 always being reserved for the master Remote I/O module. For all Remote Heads, only drop numbers 1 through 7 are valid.

For Shark racks, which can only be slave drops, the drop number setting should be selected based upon the I/O module complement in the rack. A rack containing digital modules only should be set to drop numbers 9 through F. This allows faster network throughput. Note that drop numbers 1 through 7 will also work for racks containing only digital modules; however, the total network throughput will be slower with this setting. See section 4.5 for information on network throughput.

A Shark rack containing mixed digital and analog (numeric) or all analog modules must be set to drop numbers 1 through 7. No other drop numbers are valid. In addition, you must also write a configuration word in the AutoMax application program as described in section 4.6.1. See figure 2.5 for valid drop number settings.

Drop #	Multibus Drop	Remote Head Drop	Shark Drop (all digital)	Shark Drop (mixed digital and analog or all analog)
0	OK (master)	X	X	X
1	OK	OK	OK*	OK
2	OK	OK	OK*	OK
3	OK	OK	OK*	OK
4	OK	OK	OK*	OK
5	OK	OK	OK*	OK
6	OK	OK	OK*	OK
7	OK	OK	OK*	OK
9	N/A	N/A	OK	X
A	N/A	N/A	OK	X
B	N/A	N/A	OK	X
C	N/A	N/A	OK	X
D	N/A	N/A	OK	X
E	N/A	N/A	OK	X
F	N/A	N/A	OK	X

OK = valid setting
 OK* = valid setting, but will result in lower throughput
 X = not a valid setting
 N/A = not applicable, i.e., the setting is unavailable

Note: If you are using settings 9 through F on any drop on the remote I/O network, see figure 2.6 for more information

Figure 2.5 - Remote I/O Network Drop Numbers

Note that drop numbers 1 through 7 and 9 through F are interpreted as being equivalent. In other words, you can assign a drop number of 1 or 9 on a network, but not both; you can assign a drop number of 2 or A, but not both, etc. See figure 2.6 for mutually exclusive drop number settings.

Mutually Exclusive Drop Numbers	
0	(none)
1	9
2	A
3	B
4	C
5	D
6	E
7	F

Figure 2.6 - Mutually Exclusive Drop Numbers

2.4 Remote I/O Drop Hardware

This manual provides information on the Remote I/O module, the Shark Interface module, the Remote I/O Heads, and the Remote Drive Interface Head.

For additional information regarding Shark I/O modules and racks, please refer to the Shark XL I/O System instruction manual, J2-3018.

For additional information on AutoMate Digital I/O and Rails, please refer to instruction manual J-3012.

For additional information on AutoMate Local I/O Heads, please refer to instruction manual J-3671.

For additional information about the Rail Interface module and the V★S GP2000/VTAC V controller, refer to instruction manual D2-3170.

3.0 INSTALLATION

This section describes how to plan, construct, and install the Remote I/O network coaxial cable system. This section also provides instructions on how to install the Remote I/O module, the Shark Interface module, the Remote I/O Heads, and the Remote Drive Interface Head. Instructions are also provided on how to connect them to the Remote I/O network.

The following information is limited to Remote I/O network coaxial cable installations that are in metal conduit inside of a building. Guidelines for fiber-optic cable installation are provided in Appendix K. For information regarding other types of installations, contact Reliance Electric.

Refer to section 3.5.1 for Remote I/O module installation procedures. Refer to section 3.5.2 for Shark Interface module installation procedures. Refer to section 3.5.3 for Remote I/O Head installation procedures. Refer to section 3.5.4 for Remote Drive Interface Head installation procedures.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, 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 OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

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

CAUTION: Powering down a drop may result in loss of communication on a coaxial cable network. Disconnect the drop cable from the passive tap before powering down a drop. Failure to observe these precautions could result in a network failure.

CAUTION: This module contains static-sensitive components. Do not touch the connectors on 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 this precaution could result in damage to, or destruction of, the equipment.

3.1 AutoMax Remote I/O Coaxial Cable System Components

The Remote I/O coaxial cable system consists of the following components, all of which are purchased separately:

- Communications Passive Tap (M/N 57C380) (one per drop)
- Drop Cable (M/N 57C381) (one per drop)
- BNC Tee Adapter (M/N 45C70) (application dependent)
- BNC 75 Ohm Terminating Load (M/N 45C71) (two per network)
- BNC Plug Connector (application dependent)
- BNC Jack-to-Jack Adapter (application dependent)
- RG-59/U Coaxial Cable

An example of the Remote I/O cable system is shown in figure 3.1. Appendix G lists the components recommended by Reliance Electric. Appendix H lists the network specifications. The following sections describe each of the components in more detail.

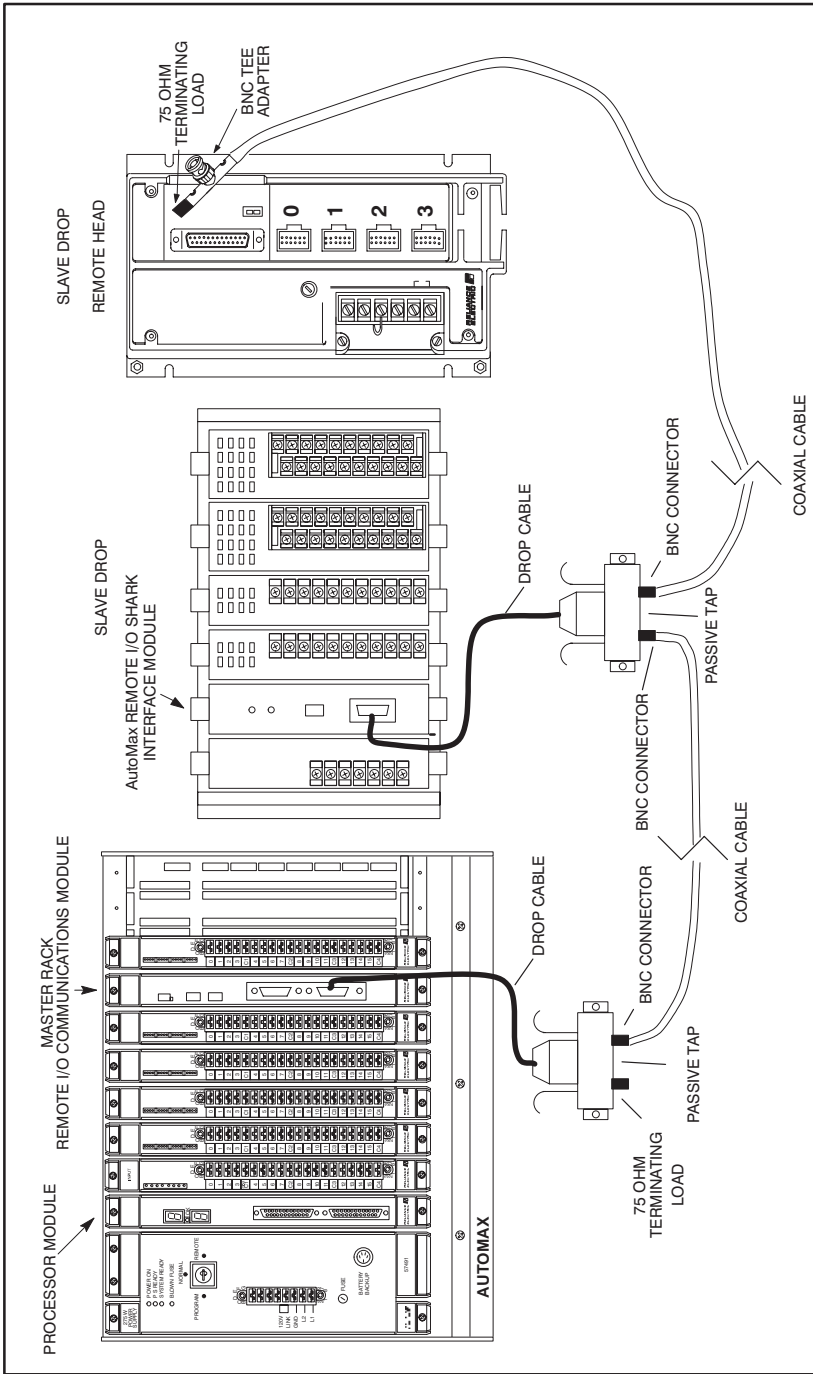


Figure 3.1 - Remote I/O Network Coaxial Cable System

3.1.1 Drop Cable and Communications Passive Tap

The Drop Cable (M/N 57C381) and the Communications Passive Tap (M/N 57C380) are used to connect the Remote I/O module and the Shark Interface module to the network coaxial cabling. The drop cable is a three-foot long multiconductor cable with a 9-pin D-shell connector at each end.

The tap provides two BNC jack connectors for connection to the coaxial cables and terminating loads. See figure 3.2. A 9-pin D-shell connector is provided for connection to the drop cable. A schematic of the tap can be found in Appendix E.

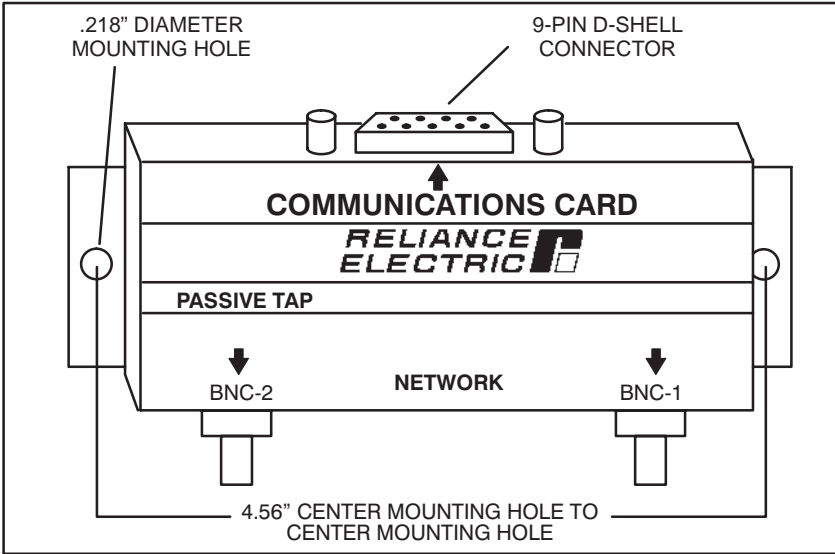


Figure 3.2 - Communications Passive Tap

3.1.2 Coaxial Cable

The Remote I/O system uses RG-59/U coaxial cable. Cable specifications are in Appendix F. Figure 3.3 shows typical coaxial cable composition.

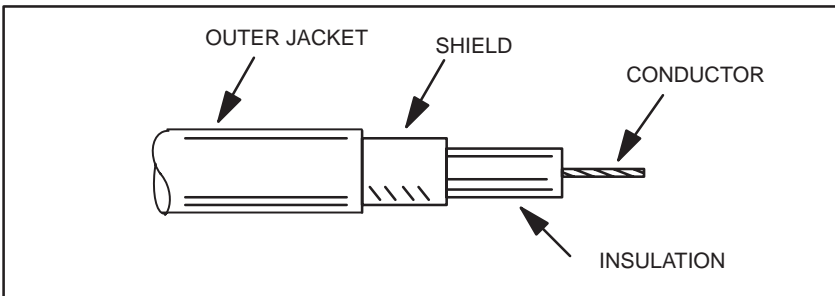


Figure 3.3 - Coaxial Cable

3.1.3 BNC Plug Connector

Coaxial cable segments are terminated with BNC plug connectors for attachment to the taps. See figure 3.4. See Appendix G for the recommended part.

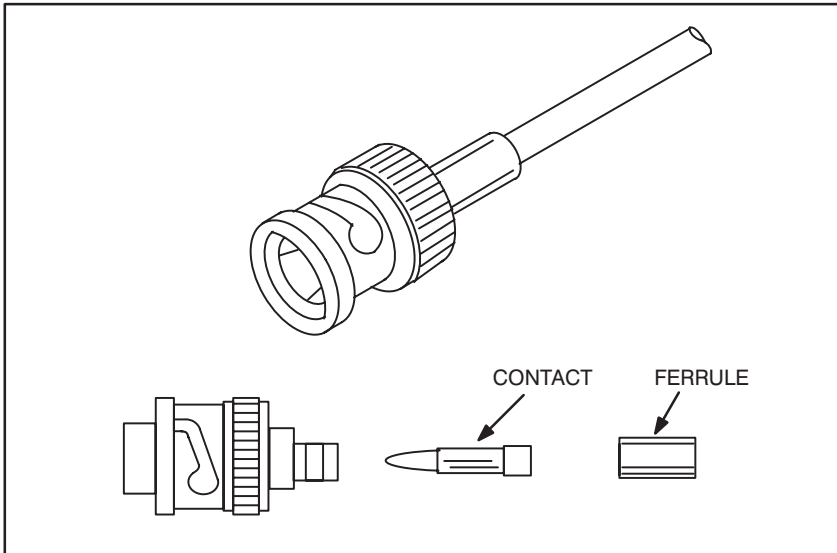


Figure 3.4 - Dual Crimp BNC Plug Connector

3.1.4 BNC Tee Adapter

The BNC Tee Adapter (M/N 45C70) is used to attach the Remote I/O Head (M/N 57C328 and M/N 57C330) and the Remote Drive Interface Head (M/N 57C329) to the Remote I/O network. See figure 3.5. The adapter must be attached directly to the BNC jack connector on the front panel of the Remote I/O Head or Remote Drive Interface Head.

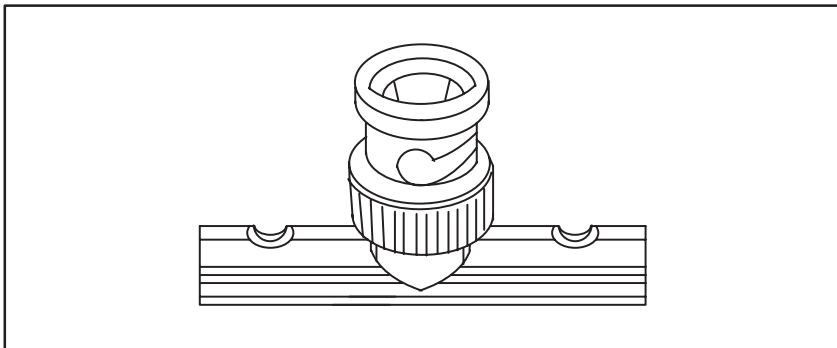


Figure 3.5 - BNC Tee Adapter

3.1.5 75 Ohm Terminating Load

The Remote I/O system must be terminated with 75 ohm terminating loads (M/N 45C71) attached to the taps or adapters located at both ends of the coaxial cable network. This minimizes the signal reflections which could interfere with other signals being transmitted on the network. The terminating load consists of a BNC plug connector and an internal 75 ohm resistor. See figure 3.6.

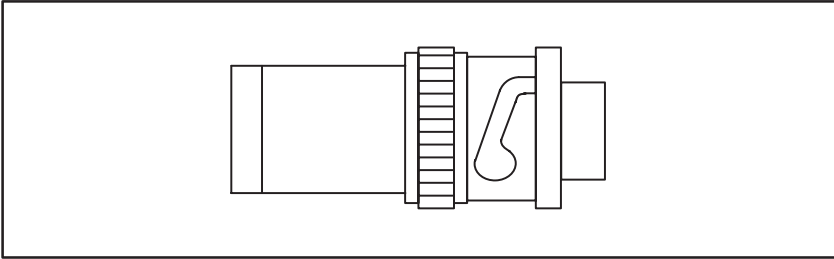


Figure 3.6 - 75 Ohm Terminating Load

3.1.6 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 (i.e, when adding a new drop). See figure 3.7. See Appendix G for the recommended part.

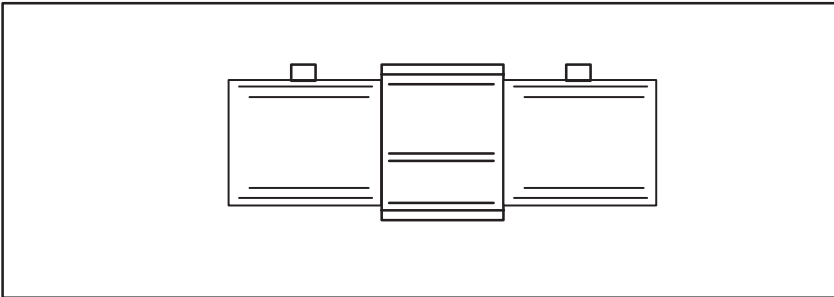


Figure 3.7 - BNC Jack-to-Jack Adapter

3.2 Installation Planning

The Remote I/O system is designed to be user-constructed and installed. This enables the system to be tailored to suit specific needs. Therefore, plan the cable installation carefully before attempting the actual installation.

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

3.2.1 Installation Planning Procedure

Use the following procedure to plan your installation:

- Step 1. Identify the actual location of the AutoMax racks, Shark racks, and Remote Heads using the 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 the route.
- Step 4. Determine how to bypass physical and environmental obstacles (walkways, induction heat sources, furnaces, caustic chemicals, steam and condensation lines) along the route.
- Step 5. Calculate the total cable length. Note that the cable path distances must be considered in three dimensions.
- Step 6. Document the cable layout. This document should describe the Remote I/O cable system design and installation. It should be maintained throughout the life of the Remote I/O system. The document should include charts showing the 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 Remote I/O system failure.
- Step 7. Calculate the number of required cable system components. Refer to Appendix G for a list of components recommended by Reliance Electric.
- Step 8. Select the tools and instruments necessary to perform the cable system installation.
- Step 9. Select the proper personnel to perform the cable installation. The RG-59/U cable specified in this manual is a flexible-type cable which can be installed by a trained plant technician.

3.3 Cable System Protection and Isolation Recommendations

Installation of the cable 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 external devices.

3.3.1 Coaxial Cable Protection

Coaxial cable must be handled properly 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 cable storage, transportation, and installation. Keeping the cable ends sealed will prevent exposure to moisture and other foreign matter.
- Do not exceed the minimum bend radius of the cable during storage or installation. Refer to Appendix F for cable specifications. Bending the coaxial cable more sharply than the recommended minimum bend radius may decrease the reliability of the Remote I/O system.
- Prevent the cable from contacting abrasive surfaces such as concrete.
- Follow the cable pulling recommendations given in section 3.4.2.

3.3.2 Electrical Isolation

Use the following guidelines when installing the coaxial cable to ensure electrical isolation:

- The exposed metal parts of the Remote I/O cable system components (BNC connectors, adapters, terminating loads) must not come in direct contact with electrical conductors (including electrical enclosures, AutoMax and Shark racks, Remote Head chassis, tap shells, conduits, etc.). If necessary, these components should be shielded using insulating jackets, heat shrink tubing, or electrical tape.
- The Remote I/O coaxial cable must be installed in a separate metal conduit. This conduit must be properly grounded along the entire length.
- The Remote I/O coaxial cable must not be installed closer than 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 Remote I/O coaxial cable with other cables cannot be avoided, you must follow the recommendations provided in ANSI/IEEE Standard 518.
- Grounding, lightning, and surge protection of the Remote I/O cable system and attached equipment must comply with the requirements of the National Electrical Code and applicable local codes.

3.3.3 Chemical and Thermal Isolation

The Remote I/O 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's outer jacket, adapters, connectors, and terminating loads.
- Water, steam, and other liquids that could corrode connectors, adapters, and terminating loads.
- Open flame, steam lines, and any equipment with a temperature higher than the cable operating temperature.

3.3.4 Physical Isolation

Use the following guidelines to prevent physical damage to 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 Cable System Construction

Construction of the Remote I/O 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 have been installed.
- Step 6. Assemble the complete cable system. Connect cables to the appropriate taps and tee adapters. Connect the terminating loads to the taps or tee adapters at both ends of the cable system. Connect the drop cables to the taps.

3.4.1 Cable Inspection and Testing

Inspect and test the cable before the installation. This will ensure that signal attenuation does not exceed the expected values at frequencies of interest (as specified in Appendix F), and that internal discontinuity that can cause reflections does 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 installation. To test for damage, shorts, or discontinuity, use a time domain reflectometer (TDR) or a return loss meter.

3.4.2 Cable Pulling

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 through a 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.

3.4.3 Cable Termination

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

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 from the plug connector onto the coaxial cable as shown in figure 3.8.

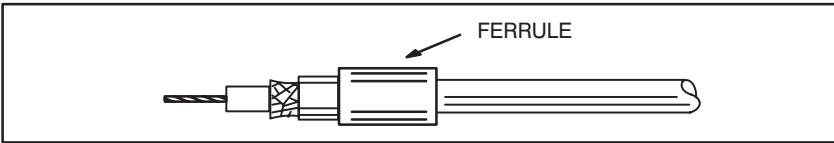


Figure 3.8 - Ferrule on the RG-59/U Cable

- Step 2. Strip the coaxial cable using the dimensions shown in figure 3.9. Be sure the shield braid wire is cut to the correct length and cannot touch the center conductor.

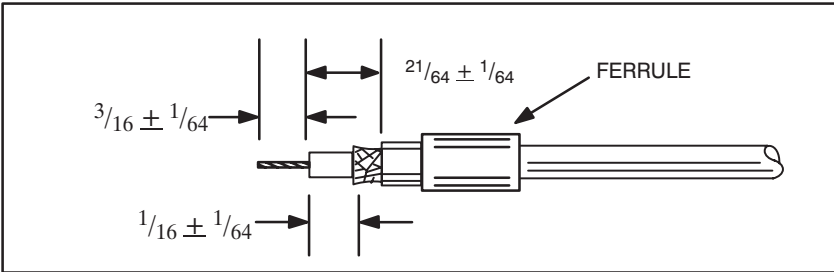


Figure 3.9 - RG-59/U (Belden 9259) Cable Stripping Dimensions

- Step 3. Place the center contact from the BNC plug connector, assembled on the stripped conductor, in the partially closed crimping dies as shown in figure 3.10. Be sure the flange on the end of the center contact butts against the crimping die.

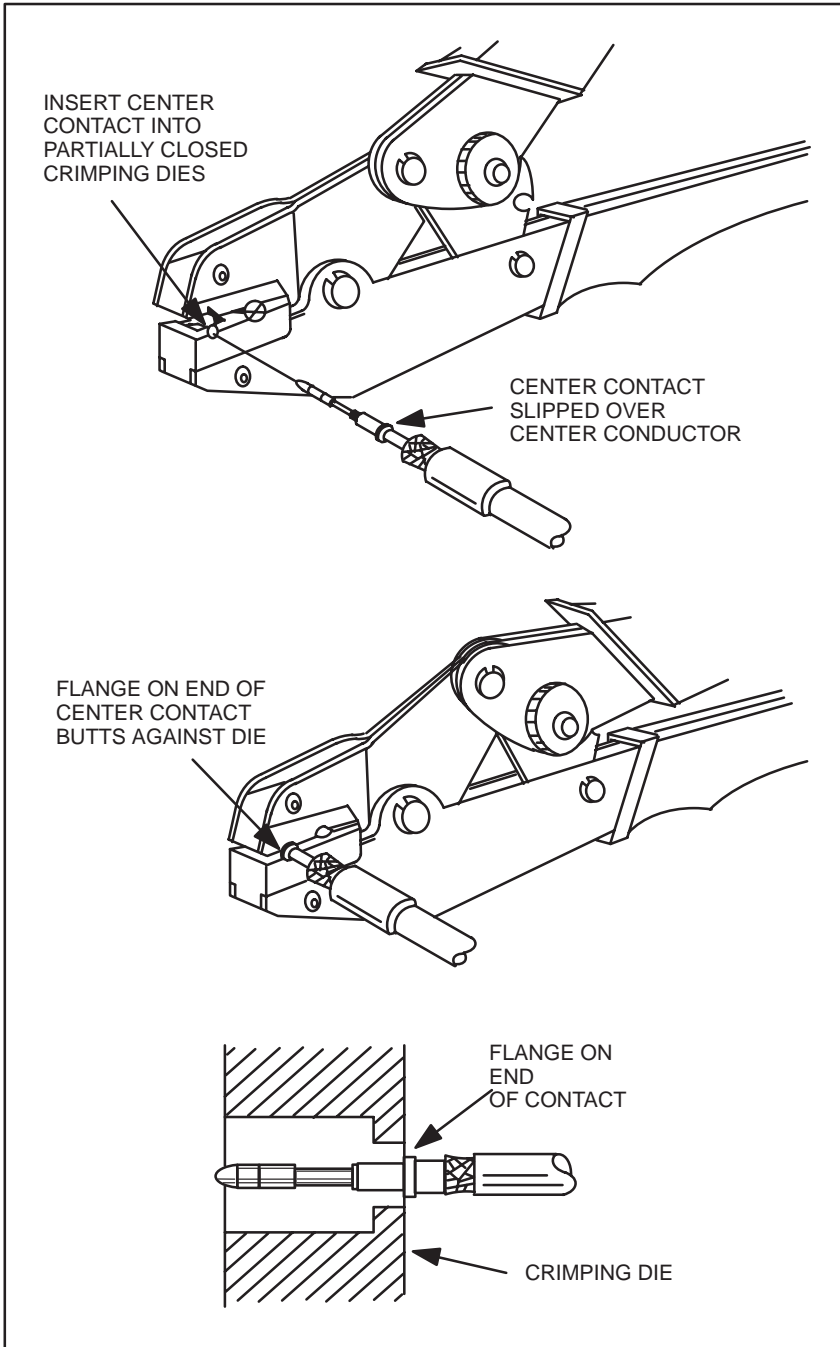


Figure 3.10 - Connector Installation Step 3 for RG-59/U Cable

- 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 3.11.

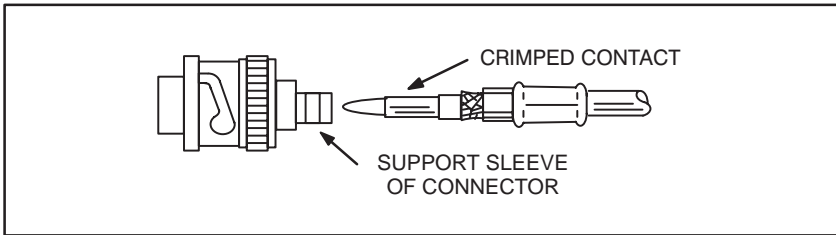


Figure 3.11 - Connector Installation Step 6 for RG-59/U Cable

- Step 7. Insert the crimped center contact into the BNC 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. See figure 3.12.

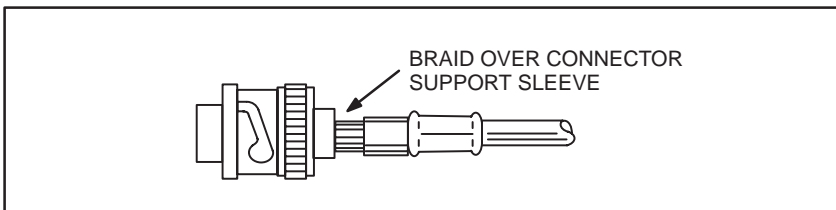


Figure 3.12 - Connector Installation Step 7 for RG-59/U

- Step 8. Slide the ferrule forward over the shield braid wire and support sleeve until the ferrule butts against the shoulder on the connector body. See figure 3.13.

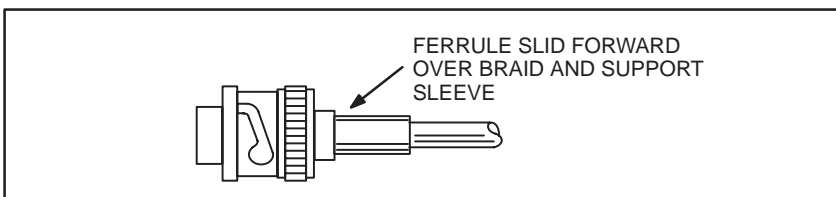


Figure 3.13 - Connector Installation Step 8 for RG-59/U Cable

- Step 9. Place the ferrule on the anvil of the die assembly so that the shoulder on the connector body butts against the die. See figure 3.14.

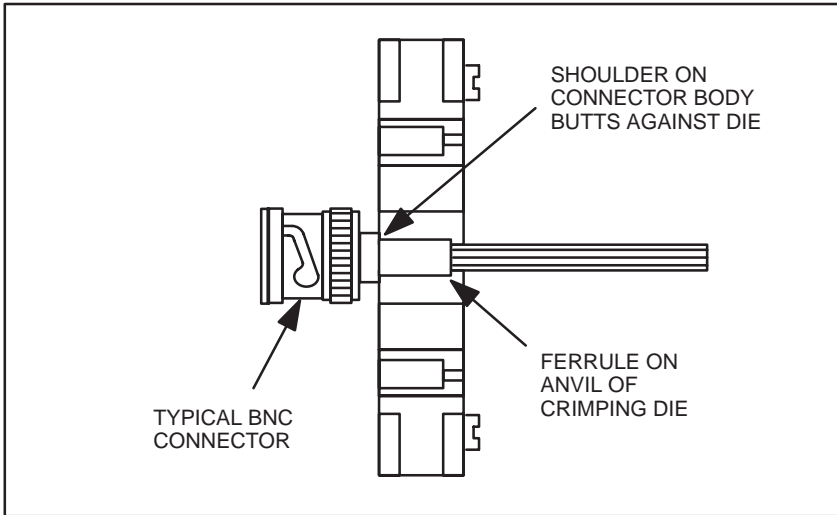


Figure 3.14 - Connector Installation Step 9 for RG-59/U Cable

- 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 coaxial cable. See figure 3.15.

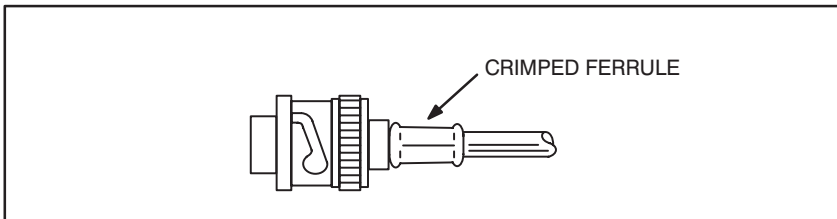


Figure 3.15 - Connector Attached to RG-59/U Cable

3.4.4 Cable Segment Testing

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 conductor is inserted deep enough into the connector body. The tip of the center contact should be approximately 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 coaxial jacket in the other. Pull firmly. The connectors should hold. Use a time domain reflectometer to test for cable damage, shorts, and discontinuities.

3.4.5 Constructing Long Cable Segments

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

- Step 1. Terminate both ends of the cable segment.
- Step 2. Splice both parts using the jack-to-jack adapter. See figure 3.16. Ensure the splicing connection can be accessed easily.

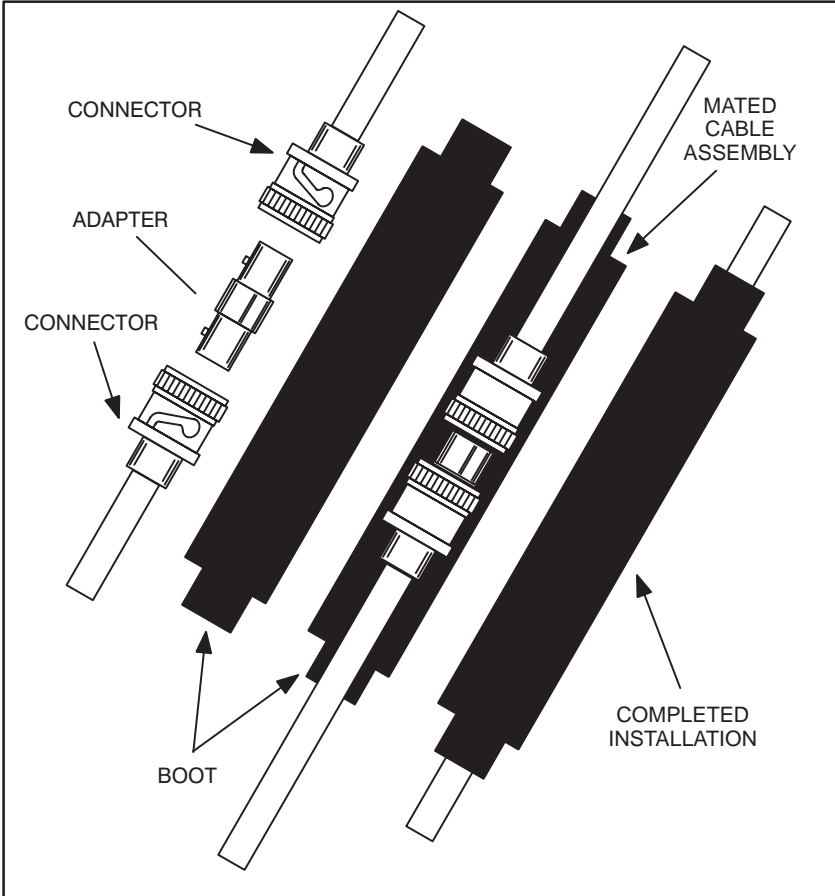


Figure 3.16 - Cable Splicing

- Step 3. Isolate the splicing connection with an insulating jacket, a boot, heat shrink tubing, or electrical sealant tape as shown in figure 3.16.
- Step 4. Document this connection on the cable system layout.

3.5 Module Installation

The following sections describe how to install the Remote I/O module, the Shark Interface module, Remote I/O Head, and Remote Drive Interface Head.

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 more detailed recommendations, refer to IEEE 518.

3.5.1 Installing the Remote I/O Module (M/N 57C416)

Use the following procedure to install the Remote I/O module:

Step 1. Stop any application tasks that may be running.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 2. Turn off power to the rack. All power to the rack as well as all power to the wiring leading to the rack should be off. For rack mounting and power supply wiring information, refer to the AutoMax Power Supply and Racks manual, J2-3008.
- Step 3. Take the module out of its shipping container. Take it out of the anti-static bag, being careful not to touch the connectors on the back of the module.
- Step 4. Insert the module into the desired slot in the rack, making sure it is well-seated in the rack. The module may reside in any slot in the rack. Use a screwdriver to secure the module into the rack.
- Step 5. Set the drop number of the Remote I/O module using the two thumbwheel switches on the module faceplate. The upper switch is the most significant digit and the lower switch is the least significant digit.
- The drop number settings are recognized only at power up. Therefore, make sure each drop on the network has a unique drop number before power is applied. If more than one drop is given the same drop number, transmission collisions will occur on the line.
- Drop number "00" indicates the module is a network's master drop. Drop numbers 01 through 07, inclusive, indicate the module is a slave drop. All other switch settings are invalid.
- Step 6. Connect the drop cable (M/N 57C381 if you have a coaxial cable network, M/N 57C366 if you have a fiber-optic network) to the 9-pin connector on the module faceplate. Note that the end of the cable which connects to the faceplate is labeled "COMM."
- Step 7. Turn on power to the rack. An internal diagnostic routine is automatically executed by the module. If an error is

encountered, an error code will be displayed on the seven-segment LED.

If the green status light is off and no seven-segment error code is displayed, a local watchdog failure has occurred. If diagnostic fault codes 0 through 9 or b are displayed, the Remote I/O module must be replaced. Refer to Appendix D for a description of the error codes.

If the thumbwheel switches are set to an invalid drop number, the "A" fault code will be displayed on the seven-segment LED on the module faceplate after power-up. To clear the invalid drop number fault code, refer to chapter 6.

Step 8. If you are connecting the module to a fiber-optic network, go to step 10. If you are connecting the module to a coaxial cable network, continue to step 9.

Step 9. To connect the module to a coaxial cable network, connect the drop cable to the Communications Passive Tap (M/N 57C380). Note that the end of the cable which connects to the passive tap is labeled "TAP"

Figure 3.1 shows the Remote I/O module connected to the network. Continue to step 11.

Step 10. To connect the module to a fiber-optic network, refer to figure K2.2 in Appendix K, and connect the drop cable to the transceiver. Continue to step 11.

Step 11. Monitor status registers 15 to 18 of the drop 0 area in each module using the Status command described in chapter 5. If the values in these registers increase consistently over a short period of time, there is a communication problem. Refer to chapter 6 for instructions on troubleshooting a communication problem.

Step 12. Verify the installation by connecting the programming terminal to the system and running the AutoMax Programming Executive software.

Stop all programs that may be running.

Use the I/O MONITOR function. If the module is in the local (master) rack, enter the Remote I/O module slot number. Enter 4 (status register) for the register to be monitored. The value displayed should be 1 in every bit that represents a drop that is communicating with the master (1-7).

If the module you want to monitor is in a remote (slave) rack, enter the slot number of the master Remote I/O module, the Remote I/O drop number (1-7), and the slot number of the Remote I/O module in the remote rack. (also called the remote slot). Enter the data register to be monitored. The value displayed should reflect the status of the register. Toggle an input or output and verify that its status is reflected correctly in the register.

3.5.2 Installing the Shark Interface Module

Use the following procedure to install the Shark Interface module:

Step 1. Stop any application tasks that may be running.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 2. Turn off power to the Shark rack including any power to the wiring leading to the rack. For rack mounting and power supply wiring information, refer to the Shark XL I/O System instruction manual, J2-3018.
- Step 3. Take the module out of its shipping container. Be careful not to touch the connectors on the back of the module.
- Step 4. Place the Shark Interface module in the first slot to the right of the Power Supply module. Be sure the module is well-seated in the rack.
- Step 5. Set the drop number of the Shark Interface module using the 16-position rotary switch on the module faceplate. Valid drop numbers for racks containing both analog and digital modules are 1 through 7. Valid drop numbers for racks containing only digital modules are 9 through F. Refer to section 2.3.

Note that the drop number is read only upon power up. If the drop number is to be changed, power must be cycled for the new number to be recognized.

- Step 6. Connect the drop cable (M/N 57C381 if you have a coaxial cable network, M/N 57C366 if you have a fiber-optic network) to the 9-pin connector on the module faceplate. The end of the cable that connects to the module is labeled "COMM."
- Step 7. Turn on power to the rack. The Shark Interface module automatically executes its power-up diagnostics. If no errors are detected, the green CPU OK LED will be on. If the LED is off, refer to chapter 6 for troubleshooting information.
- If the power-up diagnostics detect an invalid drop number, the green COM OK LED will flash. Change the setting of the 16-position rotary switch and cycle power to clear the invalid drop number.
- Step 8. If you are connecting the module to a fiber-optic network, go to step 10. If you are connecting to a coaxial cable network, continue to step 9.
- Step 9. To connect the module to a coaxial cable network, connect the drop cable to the Communications Passive Tap (M/N 57C380). The end of the cable that connects to the passive tap is labeled "TAP." Figure 3.1 shows the Shark Interface module connected to the Remote I/O network. Continue to step 11.

- Step 10. To connect the module to a fiber-optic network, refer to figure K2.2 in Appendix K and connect the drop cable to the transceiver. Continue to step 11.
- Step 11. Check the status of the master Remote I/O module's green OK LED. The LED should be on. If the LED is off, refer to chapter 6 for help in troubleshooting a communication problem. The seven-segment display should be blank.
- Step 12. Verify the installation by connecting the programming terminal to the system and running the AutoMax Programming Executive software.

Stop all programs that are running.

Use the I/O Monitor function. Enter the slot number of the master Remote I/O module. Enter 4 (status register) for the register to be monitored. The value displayed should contain a "1" for each drop (1 to 7) that is currently communicating with the master.

3.5.3 Installing the Remote I/O Head (M/N 57C328 and M/N 57C330)

Use the following procedure to install the Remote I/O Head:

- Step 1. Refer to the mounting dimensions in figure 3.17. The Remote I/O Head is designed to be mounted vertically (either in an enclosure or on a mounting surface to ensure proper air flow for cooling). Additional units, Local Heads, or rails may be mounted as close as the mounting feet will allow.

When designing your layout, keep in mind that the Local I/O Interface cable (M/N 45C8) is 10 feet long and the I/O Rail cable (M/N 45C5) is 4 feet long. You must ensure that the cables can reach from the Remote I/O Head to each Local Head or rail.

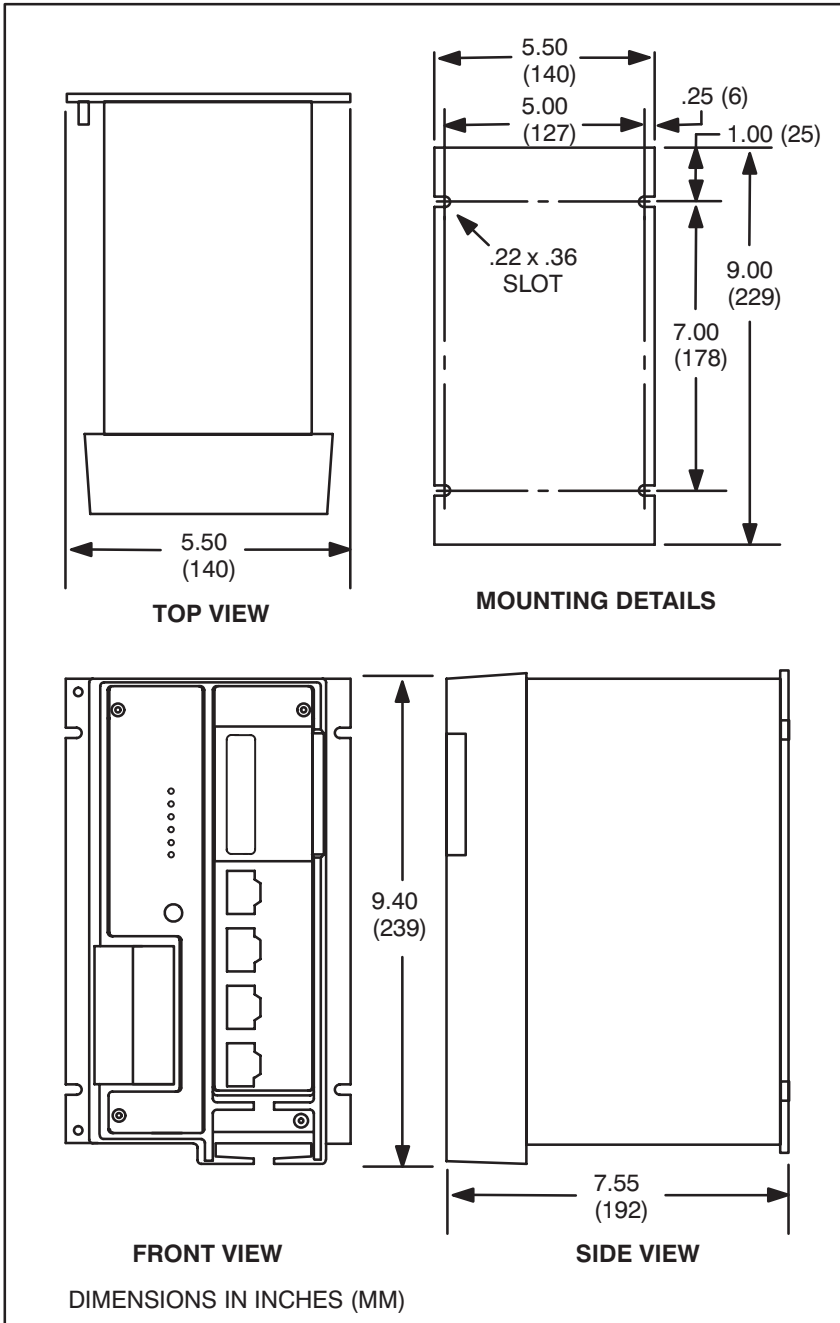


Figure 3.17 - Mounting Dimensions

- Step 2. Mount the Remote I/O Head on the panel and attach it securely with #10 (M5) bolts or studs. Examples of attaching the Remote I/O Head to the mounting surface are shown in figure 3.18.

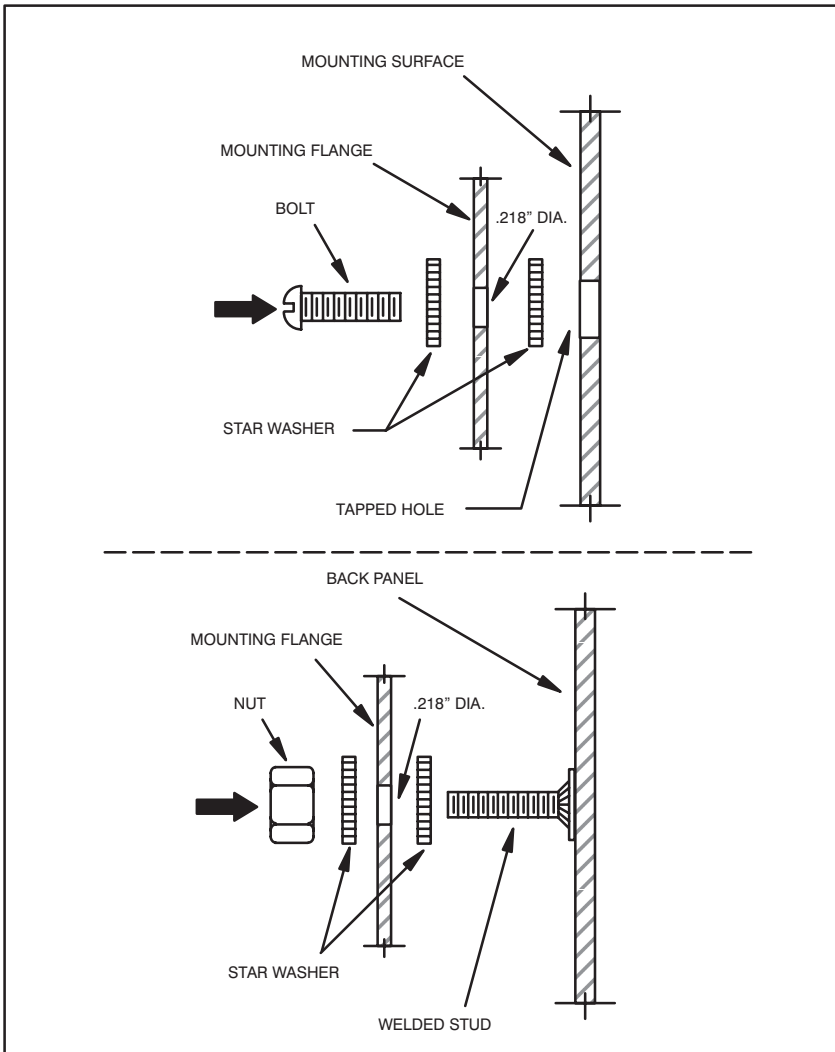


Figure 3.18 - Mounting Examples

- Step 3. Using figure 3.19, locate the two No. 10 studs provided on the Remote I/O Head for grounding purposes. The Remote I/O Head must be properly grounded to minimize personnel hazard and to ensure proper operation. The ground path, when using a 1KVA transformer, should have less than 10 milliohms resistance. The grounding wire must be a minimum size of 14 AWG. The insulation should be green for U.S.A. applications.

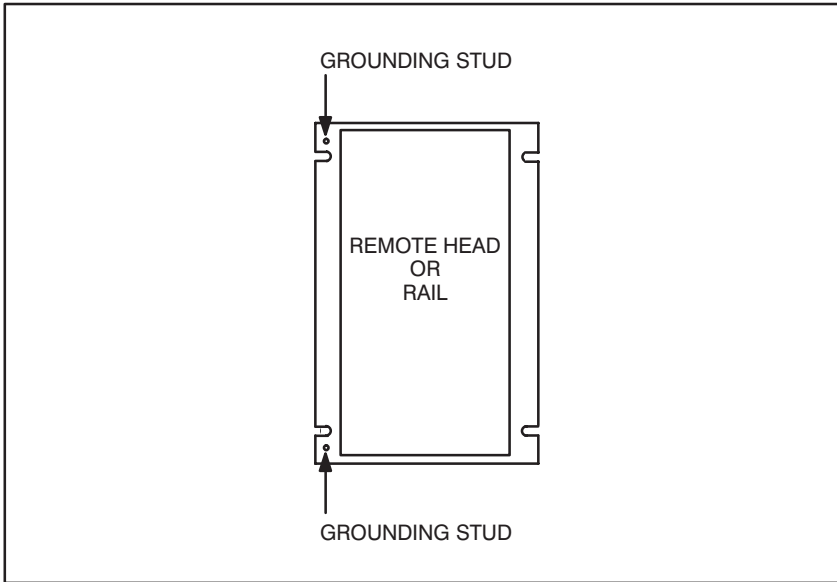


Figure 3.19 - Grounding Stud Location

- Step 4. Connect a green wire from earth ground to either stud on the Remote I/O Head housing. For proper termination, a lug should be used. A star washer (toothed lock washer) should be used under the lug to ensure effective grounding to the Remote I/O Head.

If the Remote I/O Head is to be mounted on a properly grounded sub-panel, remove all paint, coating, and corrosion where the Remote I/O Head is to be mounted. (Paint on the mounting surface will prevent good electrical contact.) Use a star washer between the sub-panel and the Remote I/O Head for a good electrical connection.

As I/O Rails are installed, grounding should be run from each rail to this common ground (see figure 3.20).

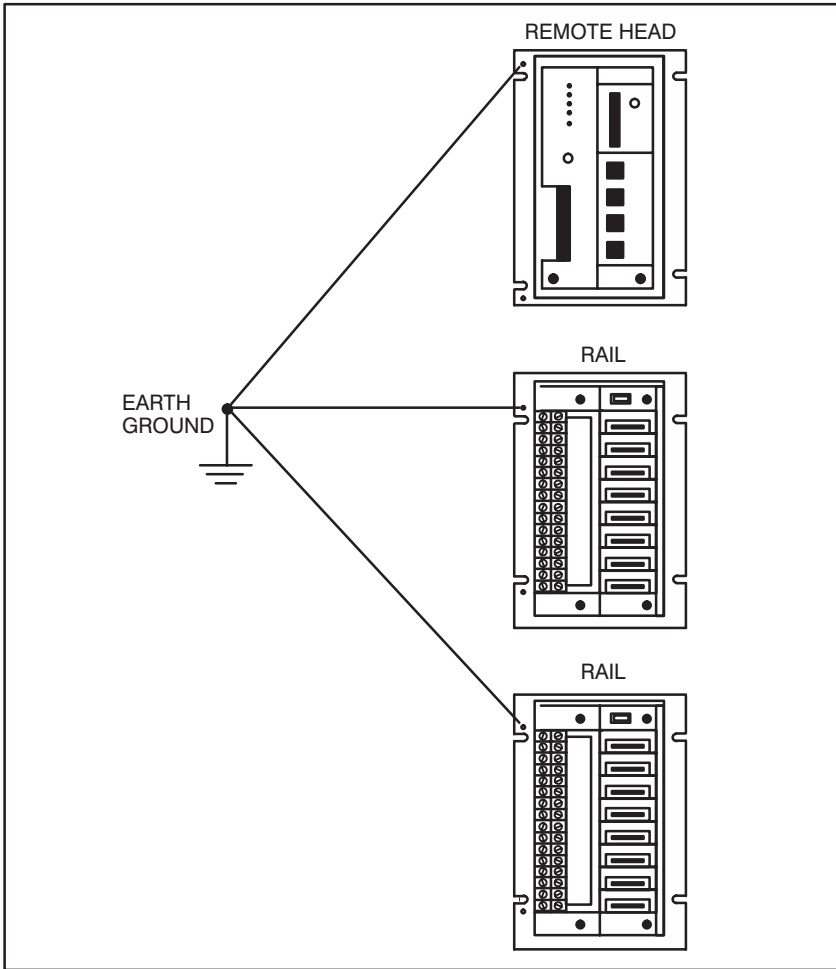


Figure 3.20 - Grounding the Remote Head

DANGER

THE OPEN FACEPLATE TERMINALS CAN POSE A SHOCK HAZARD IF TOUCHED WHEN POWER IS APPLIED. THE GUARD COVERING THE TERMINAL STRIP MUST BE REINSTALLED AFTER TERMINATIONS ARE MADE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 5. Refer to figure 3.21 and use the following procedure to connect input power to the Remote I/O Head:

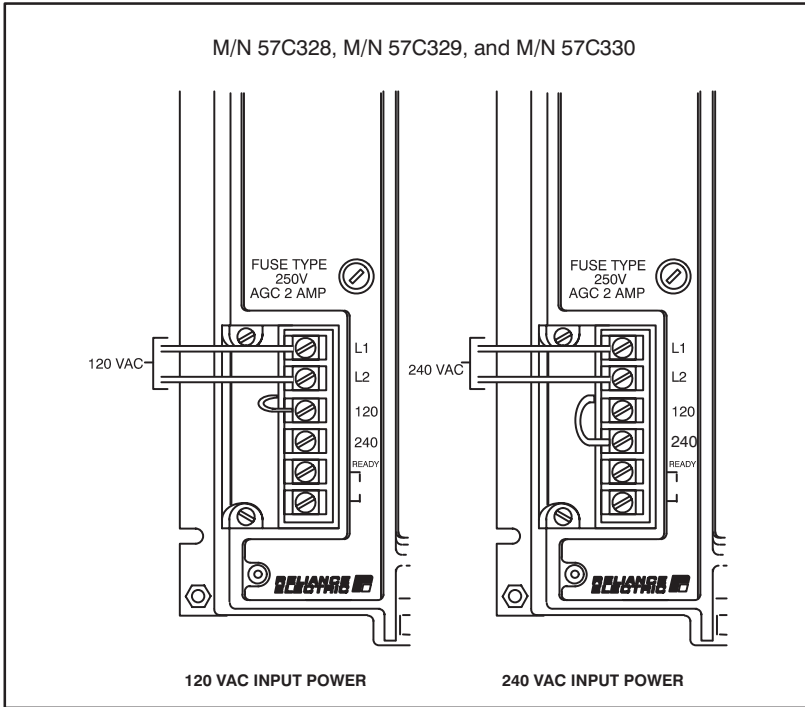


Figure 3.21 - 120 VAC or 240 VAC Input Power Connections

- a.) Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
 - b.) Turn off and lock out or tag all sources of incoming power. Make certain that no voltage is present on the wires that will be used to provide 120 VAC or 240 VAC input power.
 - c.) Using 14 AWG wire, connect the input power wires to terminals L1 and L2.
 - d.) Connect the jumper wire to the corresponding terminal, either 120 or 240 volts.
 - e.) Slide the guard back to cover the terminal strip and replace the screw.
- Step 6. Set the drop number (1-7) of the Remote I/O Head using the thumbwheel switch on the faceplate.

The drop number setting is recognized only at power up. Therefore, make sure each drop on the network has a unique drop number before power is applied. If more than one drop is given the same drop number, transmission collisions will occur on the line.

The Remote I/O Head can be used only as a slave drop (drop numbers 1-7, inclusive). Switch settings 0, 8 and 9 are invalid. If the thumbwheel switch is set to an invalid drop number, error code "A" will be displayed on the seven-segment LED on the Remote I/O Head's faceplate after power up. To clear the invalid drop number fault code, refer to chapter 6.

- Step 7. If you are connecting the module to fiber-optic network, go to step 9. If you are connecting the module to a coaxial cable network, continue to step 8.
- Step 8. To connect the module to the coaxial cable network, connect the BNC Tee Adapter from the Remote I/O network to the BNC connector on the Remote I/O Head faceplate. Continue to step 10.
- Step 9. To connect the module to a fiber-optic network, a twisted-pair-to-coax balun (AMP 555053-1 is recommended) is used to convert the cable between the module and the transceiver as shown in figure 3.22. The balun is connected to the module via the BNC Tee Adapter. Note that a 75 ohm terminating load (M/N 45C71) is required. Refer to figure K2.2 in Appendix K and connect the twisted pair wire to the transceiver. Continue to step 10.

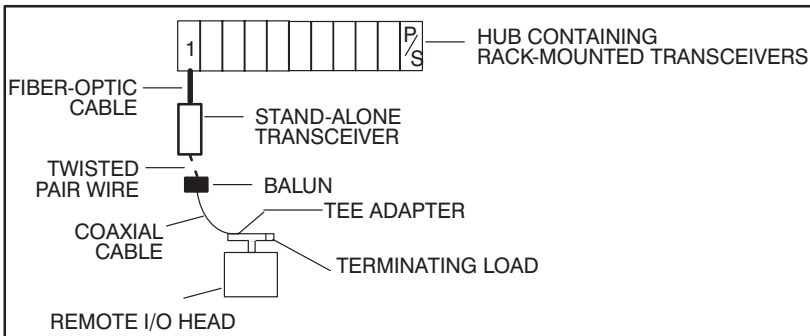


Figure 3.22 - Connecting the Remote I/O Head to the Fiber-Optic Network

- Step 10. Connect the rail ports using a Rail I/O Interconnect Cable (M/N 45C5), which is provided with the analog and digital rails. If you are using the Ready Relay, see section 3.5.5 for connection information.
- Step 11. Turn on power to the Remote I/O Head.
- Step 12. Verify the installation by connecting the programming terminal to the system and running the AutoMax Programming software.

Stop all application programs that may be running.

Use the I/O MONITOR function. Enter the slot number of the master Remote I/O module, the remote I/O drop number (1-7), and the port number (0-3) of the Local Head or rail. Enter the data register (0-3 for a Local Head, 0 for a rail) to be monitored. The value displayed should reflect the status of the register. Toggle an input or output and verify that its status is reflected correctly in the register.

3.5.4 Installing the Remote Drive Interface Head (M/N 57C329)

Use the following procedure to install the Remote Drive Interface Head:

- Step 1. Refer to the mounting dimensions in figure 3.17. The Remote Drive Interface Head is designed to be mounted vertically (either in an enclosure or on a mounting surface to ensure proper air flow for cooling). Additional Remote Drive Interface Heads may be mounted as close as the mounting feet will allow. When designing your layout, keep in mind that the Local I/O Interface cable (M/N 45C8) is 10 feet long. You must ensure that the cables can reach from the Remote Drive Interface Head to each drive.
- Step 2. Mount the Remote Drive Interface Head on the panel and attach it securely with #10 (M5) bolts or studs. Examples of attaching the Remote Drive Interface Head to the mounting surface are shown in figure 3.18.
- Step 3. Using figure 3.19, locate the two No. 10 studs provided on the Remote Drive Interface Head for grounding purposes. The Remote Drive Interface Head must be properly grounded to minimize personnel hazard and to ensure proper operation. The ground path, when using a 1KVA transformer, should have less than 10 milliohms resistance. The grounding wire must be a minimum size of 14 AWG. The insulation should be green for U.S.A. applications.
- Step 4. Connect a green wire from earth ground to either stud on the Remote Drive Interface Head housing. For proper termination, a lug should be used. A star washer (toothed lock washer) should be used under the lug to ensure effective grounding to the Remote Drive Interface Head.

If the Remote Drive Interface Head is to be mounted on a properly grounded sub-panel, remove all paint, coating, and corrosion where the Remote Drive Interface Head is to be mounted. (Paint on the mounting surface will prevent good electrical contact.) Use a star washer between the sub-panel and the Remote Drive Interface Head for a good electrical connection.

DANGER

THE OPEN FACEPLATE TERMINALS CAN POSE A SHOCK HAZARD IF TOUCHED WHEN POWER IS APPLIED. THE GUARD COVERING THE TERMINAL STRIP MUST BE REINSTALLED AFTER TERMINATIONS ARE MADE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 5. Refer to figure 3.21 and use the following procedure to connect input power to the Remote Drive Interface Head:
 - a.) Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
 - b.) Turn off and lock out or tag all sources of incoming power. Make certain that no voltage is present on the

wires that will be used to provide 120 VAC or 240 VAC input power.

- c.) Using 14 AWG wire, connect the input power wires to terminals L1 and L2.
- d.) Connect the jumper wire to the corresponding terminal, either 120 or 240 volts.
- e.) Slide the guard back to cover the terminal strip and replace the screw.

Step 6. Set the drop number (1-7) of the Remote Drive Interface Head using the thumbwheel switch on the faceplate.

The drop number setting is recognized only at power up or after a self test function. Therefore, make sure each drop on the network has a unique drop number before power is applied. If more than one drop is given the same drop number, transmission collisions will occur on the line.

The Remote Drive Interface Head can be used only as a slave drop (drop numbers 1-7, inclusive). Switch settings 0, 8 and 9 are invalid. If the thumbwheel switch is set to an invalid drop number, error code "A" will be displayed on the seven-segment LED on the Remote Drive Interface Head's faceplate after power up. To clear the invalid drop number fault code, refer to chapter 6.

Step 7. To connect the module to a fiber-optic network, go to step 9. If you are connecting the module to a coaxial cable network, continue to step 8.

Step 8. Connect the BNC Tee Adapter from the Remote I/O network to the BNC connector on the Remote Drive Interface Head faceplate. Continue to step 10.

Step 9. To connect the module to a fiber-optic network, a twisted-pair-to-coax balun (AMP 555053-1 is recommended) is used to convert the cable between the module and the transceiver as shown in figure 3.23. The balun is connected to the module via the BNC Tee Adapter. Note that a 75 ohm terminating load (M/N 45C71) is required. Refer to figure K2.2 in Appendix K and connect the twisted pair wire to the transceiver. Continue to step 10.

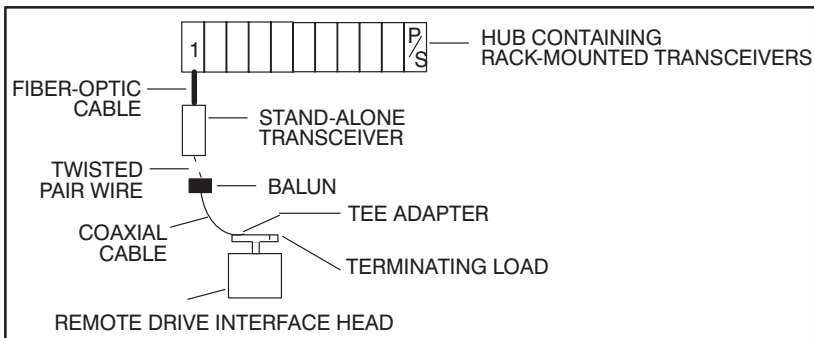


Figure 3.23 - Connecting the Remote Drive Interface Head to the Fiber-Optic Network

- Step 10. Connect the rail ports using a Rail I/O Interconnect Cable (M/N 45C5), which is provided with the Rail Interface module (1SC4000). If you are using the Ready Relay, see section 3.5.5 for connection information.
- Step 11. Turn on power to the Remote Drive Interface Head.
- Step 12. Verify the installation by connecting the programming terminal to the system and running the AutoMax Programming Executive software.
- Stop all application programs that may be running.
- Use the I/O MONITOR function. Enter the slot number of the master Remote I/O module, the Remote I/O drop number (1-7), the port number (0-3) of the drive, and the drive control register number (0 for the GP-2000). The value displayed should reflect the status of the drive.

3.5.5 Remote I/O Network Emergency-Stop Considerations

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.

The Remote I/O network is designed so that network cable loss or a slave Remote I/O or Shark Interface module failure results in outputs on the affected racks being turned off. In the case of a master Remote I/O module failure, all outputs on all Remote I/O network drops will be turned off.

A hard-wired E-Stop (Emergency Stop) circuit must be used either on the incoming A-C power lines to the master rack or on the master rack and each individual slave rack which may need to be shut down independently of the entire network.

A set of normally open contacts from the Ready Relay are provided on the terminal strip of both the Remote I/O Head and the Remote Drive Interface Head. The contacts open whenever a problem is detected in the on-board microprocessor. Figure 3.24 shows the composition of the relay. These contacts should be used in an E-stop (emergency stop) circuit to remove power from the outputs in case of emergency. Figure 3.25 shows a typical field wiring circuit using the contacts in an E-stop sequence. Connections to the Ready terminals should be made using 14 AWG wire.

- Step 2. Turn off power to the rack.
- Step 3. Disconnect the drop cable from the module faceplate.
- Step 4. Use a screwdriver to loosen the screws that hold the module in the rack. Take the module out of the slot in the rack.
- Step 5. Take the replacement module out of its shipping container. Take it out of the anti-static bag, being careful not to touch the connectors on the back of the module.
- Step 6. Insert the replacement module into the rack, making sure it is well-seated in the rack.
- Step 7. Set the drop number of the module by using the two thumbwheel switches on the module faceplate. The upper switch is the most significant digit; the lower switch is the least significant digit.
- Step 8. Attach the drop cable to the module faceplate.
- Step 9. Turn on power to the rack.
- Step 10. Monitor status registers 15-18 in the drop 0 area in each module using the Status command described in chapter 5. If the values in these registers increase consistently over a short period of time, there is a communication problem. Refer to chapter 6 for instructions on troubleshooting a communication problem.

3.6.2 Replacing the Shark Interface Module (M/N 57C554)

Use the following procedure to replace a module:

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 1. Turn off power to the rack and all external devices.
- Step 2. Turn off power to the Shark rack including any power to the wiring leading to the rack.
- Step 3. Disconnect the drop cable from the Shark Interface module's faceplate.
- Step 4. Remove the module from the rack.
- Step 5. Take the replacement module out of its shipping container. Be careful not to touch the connectors on the back of the module.
- Step 6. Insert the replacement module into the rack. Be sure the module is well-seated in the rack.
- Step 7. Set the drop number of the module using the 16-position rotary switch on the module faceplate.
- Step 8. Connect the drop cable to the 9-pin connector on the module faceplate.

- Step 9. Turn on power to the rack. The module automatically executes its power-up diagnostics. If no errors are detected, the green CPU OK LED will turn on. If the LED is off, refer to chapter 6 for troubleshooting information.
- Step 10. Check the status of the master Remote I/O module's green NETWORK ACTIVE LED. The LED should be on. If the LED is off, refer to chapter 6 for help in troubleshooting a communication problem.

3.6.3 Replacing the Remote I/O Head (M/N 57C328 and M/N 57C330)

Use the following procedure to replace the Remote I/O Head:

- Step 1. Stop any application tasks that may be running.
- Step 2. Disconnect the BNC Tee Adapter that connects the Remote I/O Head to the Remote I/O network.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 3. Turn off power to the Remote I/O Head including any power to the wiring leading to the Remote I/O Head.
- Step 4. Disconnect the I/O cables from the I/O port connectors.
- Step 5. Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
- Step 6. Disconnect the input power wires.
- Step 7. Disconnect the green grounding wire.
- Step 8. Remove the #10 bolts and remove the Remote I/O Head from the mounting surface.
- Step 9. Attach the replacement Remote I/O Head to the mounting surface using #10 (M5) bolts or studs.
- Step 10. Connect the green grounding wire.
- Step 11. Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
- Step 12. Connect the input power wires. (Refer to section 3.5.3 and figure 3.21 for input power connection.)
- Step 13. Slide the guard back to cover the terminal strip and replace the screw.
- Step 14. Set the drop number (1-7) of the Remote I/O Head using the thumbwheel switch on the faceplate.
- Step 15. Re-connect the I/O cables to the I/O port connectors.
- Step 16. Turn on power to the Remote I/O Head.
- Step 17. Re-connect the BNC Tee Adapter from the Remote I/O network to the BNC connector on the Remote I/O Head faceplate.

3.6.4 Replacing the Remote Drive Interface Head (M/N 57C329)

Use the following procedure to replace the Remote Drive Interface Head:

- Step 1. Stop any application tasks that may be running.
- Step 2. Disconnect the BNC Tee Adapter that connects the Remote Drive Interface Head to the Remote I/O network.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 3. Turn off power to the Remote Drive Interface Head including any power to the wiring leading to the Remote Drive Interface Head.
- Step 4. Disconnect the I/O cables from the I/O port connectors.
- Step 5. Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
- Step 6. Disconnect the input power wires.
- Step 7. Disconnect the green grounding wire.
- Step 8. Remove the #10 bolts and remove the Remote Drive Interface Head from the mounting surface.
- Step 9. Attach the replacement Remote Drive Interface Head to the mounting surface using #10 (M5) bolts or studs.
- Step 10. Connect the green grounding wire.
- Step 11. Using a screwdriver, remove one of the screws from the plastic guard covering the terminal strip and slide the guard to the left to expose the terminals.
- Step 12. Connect the input power wires. (Refer to section 3.5.3 and figure 3.21 for input power connection.)
- Step 13. Slide the guard back to cover the terminal strip and replace the screw.
- Step 14. Set the drop number (1-7) of the Remote Drive Interface Head using the thumbwheel switch on the faceplate.
- Step 15. Re-connect the I/O cables to the I/O port connectors.
- Step 16. Turn on power to the Remote Drive Interface Head.
- Step 17. Re-connect the BNC Tee Adapter from the Remote I/O network to the BNC connector on the Remote Drive Interface Head faceplate.

3.7 Adding a Slave Drop to the Remote I/O Network

Use the following procedure to add a Multibus rack, a Shark rack, a Remote I/O Head, or a Remote Drive Interface Head as a slave drop on the coaxial cable network:

- Step 1. Identify the route for the new cable segment(s). Refer to the recommendations provided in section 3.3. If the new drop is to be added at the end of the network, only one new cable segment will be necessary. Otherwise, two new cable segments may be needed.
- Step 2. Calculate the new cable segment length. Ensure the new total cable length does not exceed the maximum cable length of 3,000 feet as defined in the network cable specifications in Appendix F. If it exceeds 3,000 feet, consult with Reliance Electric before going on to the next step.
- Step 3. Cut, install, terminate, and test the new cable segment following the instructions provided in sections 3.4.
- Step 4. Stop all application tasks.
- Step 5. Refer to figure 3.26 and use the following procedures if a new rack drop is to be added to one of the ends of the network. Go to step 6 if a rack 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.) If you are adding a slave rack drop, connect the terminating load to a new tap. If you are adding a Head drop, connect the terminating load to a new BNC Tee Adapter. Connect the other end of the new cable segment to this tap (or BNC connector).
 - c.) Using a drop cable, attach the Remote I/O module or the Shark Interface module to the new tap. For Head drops, connect the BNC Tee Adapter directly to the Remote I/O Head or Remote Drive Interface Head.
 - d.) Go to step 7.

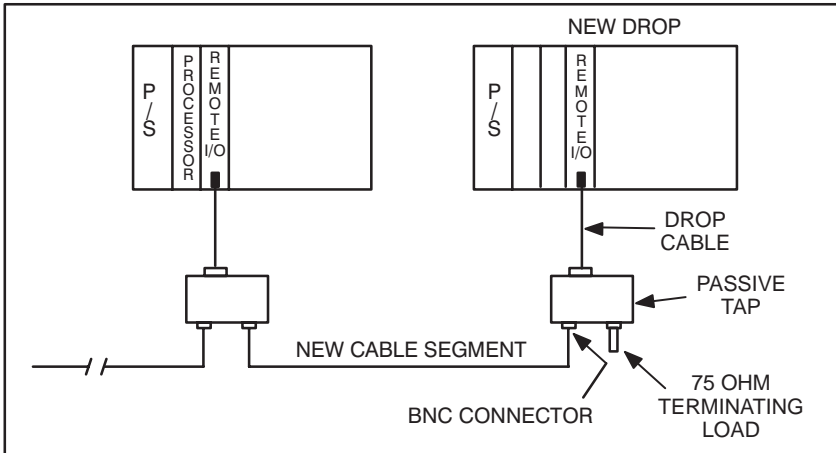


Figure 3.26 - Adding a New Rack Drop to the End of the Remote I/O Network (Coax)

- Step 6. If a new drop is to be added along the cable route, use the following procedure:
- a.) Cut the remote I/O cable at the point where the new drop is to be added.
 - b.) Terminate the cable ends with BNC connectors and, if necessary, splice them with the new cable segments. Test the spliced cable segments following the instructions provided in section 3.4.
 - c.) For rack drops, connect the other ends of the new cable segments with a tap attached to the new drop as shown in figure 3.27. For Head drops, connect the ends of the new cable segments to a BNC Tee Adapter. Connect the Tee Adapter directly to the Remote I/O Head or Remote Drive Interface Head.
- Step 7. Make sure the drop number of the newly-added Remote I/O module, Shark Interface module, Remote I/O Head, or Remote Drive Interface Head is properly selected before you cycle power and resume Remote I/O network operation.

Monitor drop 0 for the status of all remote drops to verify that no drops have been adversely affected by the installation.

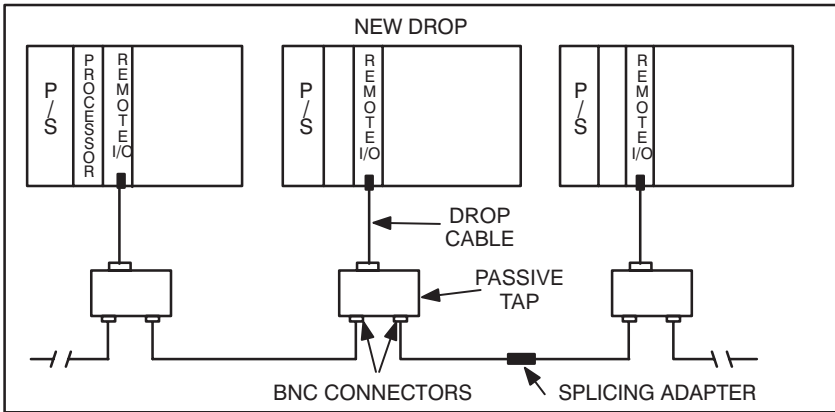


Figure 3.27 - Adding an Intermediate Rack Drop to the Remote I/O Network (Coax)

3.8 Disconnecting a Slave Drop from the Remote I/O Network

CAUTION: Powering down a drop may result in a loss of communication on a coaxial cable network. Disconnect the drop cable from the passive tap before powering down a drop. Failure to observe these precautions could result in a network failure.

To temporarily disconnect a slave drop from the coaxial cable Remote I/O network, disconnect the drop cable from the tap before powering down the drop.

Use the following procedure to permanently disconnect a Multibus rack, a Shark rack, or either Remote Head from the network:

- Step 1. Stop all application tasks.
- Step 2. To disconnect a drop from the end of a network, refer to figure 3.28 and use the procedure below:
 - a.) Disconnect the drop by detaching the cable segment between this and the neighboring drop at the neighboring drop tap.
 - b.) Terminate this tap with a 75 ohm terminating load.

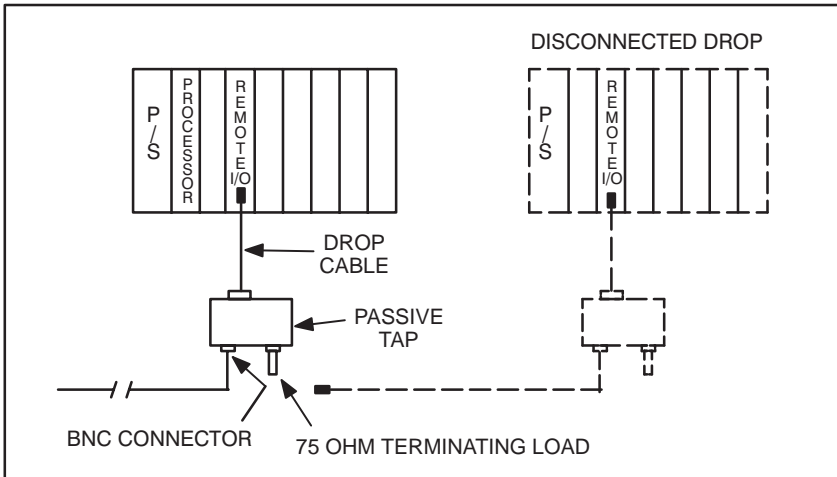


Figure 3.28 - Disconnecting an End Rack Drop from the Remote I/O Network (Coax)

- Step 3. To disconnect a drop along the cable route, refer to figure 3.29 and use the following procedure:
- a.) Disconnect both Remote I/O network cable segments from the tap or BNC Tee Adapter.
 - b.) Splice the cable segments using a jack-to-jack in-line splicing adapter.
- Step 4. Resume Remote I/O network operation

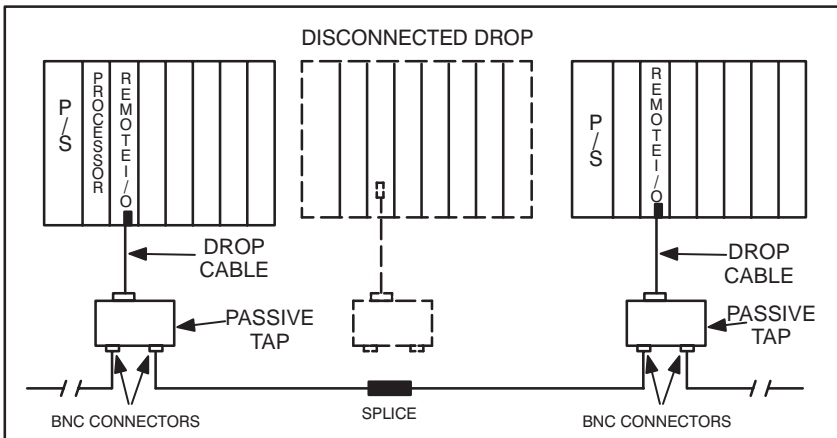


Figure 3.29 - Disconnecting an Intermediate Rack Drop from the Remote I/O Network (Coax)

3.9 Remote I/O Network Coaxial Cable Maintenance

Over time, Remote I/O network operating efficiency may suffer from gradual degradation of the network cabling components or changes in the environmental conditions along the cable paths. In order to prevent this from occurring, some preventive maintenance should be performed on the network. See sections 3.9.1 through 3.9.3 for more information.

3.9.1 Remote I/O Cable Documentation Maintenance

It is important to keep the network cable documentation up-to-date with all of the changes that are made to the network.

3.9.2 Remote I/O Cable Design Maintenance

When old equipment is removed or new equipment is installed, new sources of heat, electrical noise, or hazardous chemicals may appear in the Remote I/O network's environment. Evaluate the effect these changes will have on the performance of the network. If necessary, take corrective actions such as re-routing certain cable segments or installing additional cable shielding.

3.9.3 Remote I/O Cable Inspection

Inspect the Remote I/O cabling periodically for damage, shorts, or discontinuity. To perform these tests, use the appropriate time domain reflectometer (TDR). Time domain reflectometers can also be used to perform cable testing during installation or when trying to locate a cable fault during troubleshooting. Be sure to document all tests properly.

4.0 PROGRAMMING

This section describes how the data is organized in the Remote I/O module, Remote I/O Head, Remote Drive Interface Head, and Shark Interface module, and provides examples of how the module is accessed by the application software. For more detailed information on programming, refer to the AutoMax Programming Reference Binder.

4.1 Master Remote I/O Module Dual Port Memory

The dual-port memory in the master module contains an image of the status of all the inputs and outputs on the digital and analog I/O modules in the slave drops. Application tasks running on AutoMax Processors in the master rack reference the I/O on the network in the dual port. The master Remote I/O module manages the data in the image area and communicates this data to the slave drops on the Remote I/O network.

4.2 Register Organization

The dual port memory of the master module is divided into 8 image areas, one for each drop and the master. Refer to Appendix I for more detailed information on memory mapping. Drop 0 registers are used for status and control in the master.

In the master all drop 0 registers are READ ONLY. Refer to figure 4.1 for drop 0 (Status) register assignments.

The master drop maintains status for all slave drops on the network. The drop status bits (register 4) are TRUE or ON when the corresponding drop is active. A FALSE or OFF state indicates that the drop is either not present or has failed to communicate.

You can view this status information for the master Remote I/O module using the I/O Monitor or "S" (Status) command (see section 5) from the serial port. You can view status information for slave Remote I/O modules or Heads using the "S" (Status) command. You cannot view status information for Shark drops.

Register	Description
0-3	Not used
4	Status of drop 1-7 in bits 1-7
5-11	Not used
12	Drop number
13	Program mode (keyswitch position 1 = memory protect, 2 = setup, 3 = program)
14	Messages received
15	Receive timeouts
16	CRC/parity errors
17	Overrun errors
18	Abort errors
19	Messages transmitted
20-511	Not used

Figure 4.1 - Drop 0 Status Register Assignments

4.3 Data Access

Multibus, Shark, and Remote Head input registers are Read Only. Multibus, Shark, and Remote Head output registers are Read/Write. Registers in dual port memory will acknowledge Multibus accesses just like the module does in the slave drop. A register on a particular module in a slave drop that is Read Only will be Read Only in the master drop dual port memory. A bus error will occur if a register in the master dual port memory is referenced and that register does not exist in the slave Multibus, Shark, or Remote Head drop.

Registers 0 through 7 on a Shark I/O module are always reserved for input data. Registers 8 through 15 are always reserved for output data. Registers 16 through 32 are not accessible. Note that in the case of a digital module in a mixed (both digital and analog modules) Shark rack, a bus error will NOT be reported if an invalid register is referenced. An invalid register may be a register that is not valid for the particular module in the slot, or that is not valid for Shark modules at all, i.e., 16 through 32. See Appendix I for a listing of the individual Shark module memory maps.

Registers 0-3 on an M/N 57C328 Remote I/O Head are always reserved for input data, and registers 4-7 are always reserved for output data. These registers are divided into four input/output pairs. Each pair is reserved for a Rail; therefore, you can mix input and output modules in a Rail. Registers 8-31 on an M/N 57C328 Remote I/O Head are not accessible. Refer to Appendix I for more information.

Registers 0 and 1 on a Remote Drive Interface Head are always AutoMax outputs (information to the drive) and registers 2 and 3 are always AutoMax inputs (information from the drive). See appendix I for a memory map of the Remote Drive Interface Head.

Non-Reliance Multibus I/O modules (modules not manufactured by Reliance Electric) that are Write Only will be Read/Write in the master drop dual port memory. Non-Reliance modules used in slave drops are subject to the following limitations:

- The module base address must begin on a 64K boundary.

- The module must be memory-mapped, not I/O mapped.
- The module must support 16-bit data transfers.
- Interrupts will be ignored.
- Input and output registers must be located at separate addresses. Modules that do not have separate addresses will be considered output modules.

4.4 Data Transmission

At power up, the master will poll all of the slave drops to determine which drops are connected to the network and the total number of Multibus modules in each drop. You can assign Multibus slave drop numbers (1 through 7) or (9 through F for Shark digital racks) arbitrarily, but each drop must have a unique number. The physical order of drop connections has no effect on the system.

Through the Multibus backplane, the slave Remote I/O module collects and stores input and output data associated with up to 15 general purpose I/O modules in its remote rack. The Shark Interface module collects I/O data from up to 10 modules in its remote rack(s). The Remote I/O Head collects I/O data from up to 128 2-bit modules in its attached rails. The Remote Drive Interface Head collects I/O data from up to four drives. This data is sent to the master Remote I/O module when it polls the slave drop.

The master module collects and stores the data in its dual port memory, which is accessible to the Processor module in the master rack. After polling all active slave drops, the master then polls one inactive drop to determine whether or not another drop has been added to the network. If a response is received, the new drop will be added to the list of active drops. The cycle then repeats.

All messages are checked for correctness by the receiving drop. Messages received in error are re-transmitted up to three times. Drops unable to correctly transmit and receive data will go off-line. Status information about the slave drops is maintained in the master and can be accessed by applications tasks or the Monitor function in the AutoMax Programming Executive software.

4.5 Data Update Rate

The time required for the master Remote I/O module to update all of the registers in one slave drop is dependent on the number of registers being transferred to/from each slave on the Remote I/O network, i.e., the total number of I/O in the rack.

The update time for each I/O register on the Remote I/O network is equal to the time needed to service each slave drop plus the amount of time required by system overhead.

The time required to service each slave drop (DROP_TIME) can be calculated as follows:

For a Multibus rack slave drop,

$$\text{DROP_TIME} = [1.5 + (N \times 0.018)] \text{ milliseconds}$$

where: N = Total number of registers being transferred to/from the slave drop

For an M/N 57C330 Remote I/O Head slave drop,

$$\text{DROP_TIME} = [1.9 + (X \times 0.08) + (Y \times 0.036)] \text{ milliseconds}$$

where: X = Total number of output registers being transferred to the slave drop

Y = Total number of input registers being transferred from the slave drop

For an M/N 57C328 Remote I/O Head drop,

$$\text{DROP_TIME} = [1.7 + R \times 0.036] \text{ milliseconds}$$

where: R = number of connected rails

For a Remote Drive Interface Head slave drop,

$$\text{DROP_TIME} = 2.1 \text{ milliseconds}$$

For a Shark slave drop (all digital I/O) with a drop number of 9 to F,

$$\text{DROP_TIME} = 1.8 \text{ milliseconds}$$

For a Shark slave drop (analog and digital I/O) with a drop number of 1 to 7,

$$\text{DROP_TIME} = 4.0 \text{ milliseconds}$$

The update period of each I/O register on the Remote I/O network is equal to the sum of the drop time for each drop on the network plus 2.7 milliseconds to poll any inactive drops.

For example, a Remote I/O network with four drops has the following update rate:

Drop 1, Multibus Rack: 5 inputs, 8 outputs

Drop 2, Multibus Rack: 5 inputs, 6 outputs

Drop 3, Remote I/O Head: 6 inputs, 5 outputs

Drop 4, Digital Shark Rack

$$\text{Drop 1 Time} = [1.5 + (13 \times .018)] = 1.734 \text{ msec}$$

$$\text{Drop 2 Time} = [1.5 + (11 \times .018)] = 1.698 \text{ msec}$$

$$\text{Drop 3 Time} = [1.7 + (5 \times .013) + (6 \times .028)] = 1.933 \text{ msec}$$

$$\text{Drop 4 Time} = = 1.900 \text{ msec}$$

$$\text{Time to poll inactive drops} = \underline{2.700 \text{ msec}}$$

$$\text{Update period for each Remote I/O register} = 9.965 \text{ msec}$$

Each register on the Remote I/O network in this example will be updated by the master Remote I/O module every 9.965 milliseconds.

4.6 Configuration

Before running any application tasks, the system must be configured using the AutoMax Programming Executive software. The major function of configuration is to assign meaningful symbolic names to physical points in the system. This feature allows you to construct application tasks using variable names instead of actual physical locations.

The products mentioned in this manual are supported by the current version of the AutoMax Programming Executive software. To configure any of the modules using an older version of the

Programming Executive software, use a Generic I/O card in the Rack Configurator. If a feature of the module is not supported in your version of the Programming Executive software or you need more information, contact Reliance Electric.

4.6.1 Shark Configuration

In addition to configuring the Shark Interface module in the rack configuration, the programmer must also write a special configuration word to slot 0, register 0 in an application task if the Shark rack does not contain all digital modules and the rotary drop number switch has been set to a number between 1 and 7. This configuration word specifies the type of module that is found in each slot of the Shark drop as shown in figure 4.2. Set bit 15 of the configuration word equal to one once bits 1 through 10 have been properly set.

Bit 1	= 0: Remote slot 1 contains an analog module = 1: Remote slot 1 contains a digital module
Bit 2	= 0: Remote slot 2 contains an analog module = 1: Remote slot 2 contains a digital module
.	.
.	.
Bit 9	= 0: Remote slot 9 contains an analog module = 1: Remote slot 9 contains a digital module
Bit 10	= 0: Remote slot 10 contains an analog module = 1: Remote slot 10 contains a digital module
Bit 15	= 1: Configuration word is complete

Figure 4.2 - Shark I/O Module Configuration Word

A Shark rack can be configured once after it is powered up or after it is reconnected to the network. If you want to change the configuration, you must either issue a Stop-All command from the AutoMax/DCS 5000 Processor or disconnect the drop cable, change the configuration word, and then re-connect the drop cable.

4.6.2 Rail I/O Configuration (M/N 57C328)

The Remote I/O network transmits rail data from the master drop to the slave drop and from the slave drop to the master drop depending on whether the rail contains output or input modules, respectively. You can mix input and output modules in a rail. Each rail maps to one input register and one output register in the Remote I/O master.

When a slave drop is initially polled by the Remote I/O master, it will transmit the rail configuration to the master. The master will use this information to control access to that drop's registers in the master's dual port memory via the Multibus. It will allow Read/Write access for registers defined as OUTPUT and Read Only access to registers defined as INPUT. All other registers (those without rails connected) will have no access allowed.

Whenever you change the rail configuration (i.e., you add or remove rails), the drop will disconnect from the network, re-run the power-up

diagnostics, and then communicate the new rail configuration to the Remote I/O master.

WARNING

REMOVING OR INSERTING A MODULE OR I/O INTERCONNECT CABLE WITH POWER APPLIED MAY RESULT IN UNEXPECTED MACHINE MOTION OR LOSS OF PROCESS CONTROL. STOP THE MACHINE OR PROCESS IN AN ORDERLY FASHION AND DISCONNECT THE POWER TO THE SYSTEM BEFORE YOU REMOVE OR INSERT A MODULE OR I/O INTERCONNECT CABLE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

4.6.3 Rail I/O Configuration (M/N 57C330)

The Remote I/O network transmits rail data from the master drop to the slave drop or from the slave drop to the master drop depending on whether the rail contains output or input modules, respectively. Therefore, input and output modules cannot be mixed within a rail. Each rail can contain up to eight input or output modules.

The rail configuration is determined approximately every 20 milliseconds while the Remote I/O network is active. The Remote I/O Head can determine if there is a rail connected at any port but cannot directly determine whether the rail contains input or output modules. The system determines whether a particular rail contains input modules or output modules based on the data going to or from the rail.

When a rail is first determined to exist at a particular port, that rail is marked as “undefined.” If an “undefined” rail passes back data that has non-zero values, it is then defined as an input register whose data will be transmitted to, but not from, the master drop. Conversely, if non-zero data is written to an “undefined” rail, it is then defined as an output register to which data will be transmitted from, but not to, the master drop. Once a particular register is defined as input or output, it will remain defined as such regardless of future data values until one of the following occurs:

WARNING

REMOVING OR INSERTING A MODULE OR I/O INTERCONNECT CABLE WITH POWER APPLIED MAY RESULT IN UNEXPECTED MACHINE MOTION OR LOSS OF PROCESS CONTROL. STOP THE MACHINE OR PROCESS IN AN ORDERLY FASHION AND DISCONNECT THE POWER TO THE SYSTEM BEFORE YOU REMOVE OR INSERT A MODULE OR I/O INTERCONNECT CABLE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

- a.) power is cycled to the remote drop;
- b.) the line goes from an ACTIVE state to INACTIVE;
- c.) the rail is removed (disconnected) from the Remote I/O system.

When a slave drop is initially polled by the Remote I/O master, it will transmit the rail configuration to the master. The master will use this information to control access to that drop’s registers in the master’s dual port memory via the Multibus. It will allow Read/Write access for registers defined as OUTPUT or not yet defined, and Read Only

access to registers defined as INPUT. All other registers (those without rails connected) will have no access allowed.

Whenever the rail configuration is to be physically changed (i.e., rails added or removed), the drop should first be disconnected from the network (disconnect the BNC Tee Adapter from the Remote I/O Head). The drop should then be powered down before the rail configuration is modified.

WARNING

INPUTS SHOULD NOT BE FORCED. DURING A POWER CYCLE, THE FORCED INPUTS ARE INTERPRETED AS OUTPUTS AND, THEREFORE, WILL NOT FUNCTION PROPERLY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

4.6.4 Remote Drive Interface Head Configuration

The Remote Drive Interface Head can control up to four drives that use a rail-type interface (e.g., the Reliance V★S GP-2000/VTAC V controller). **The AutoMax Remote Drive Interface Head must not be connected to Local Heads, digital rails, or Analog Rails, LED modules, or Thumbwheel Switch modules.**

The Remote Drive Interface Head uses a fixed configuration of two inputs and two outputs per I/O port. The Head assumes that the first two registers (0 and 1) are AutoMax outputs (information to the drive) and the second two registers (2 and 3) are AutoMax inputs (information from the drive). This configuration cannot be changed.

The Remote Drive Interface Head will communicate with a device connected to a port only if that device responds as a Local Head. The Head will not reset when communication re-tries to a port are exhausted. The Ready Relay will not drop out. The Head will clear input registers and continuously attempt to re-establish communication with the device connected to the port.

AutoMax application tasks must be used to determine whether a drive is communicating with the Head using a register or bit generated by the drive. Refer to the documentation for the Rail Interface module (D2-3170) and the GP-2000/VTAC V Main Controller Installation, Operation and Maintenance instruction manual for more information.

WARNING

REMOVING OR INSERTING A MODULE OR I/O INTERCONNECT CABLE WITH POWER APPLIED MAY RESULT IN UNEXPECTED MACHINE MOTION OR LOSS OF PROCESS CONTROL. STOP THE MACHINE OR PROCESS IN AN ORDERLY FASHION AND DISCONNECT THE POWER TO THE SYSTEM BEFORE YOU REMOVE OR INSERT A MODULE OR I/O INTERCONNECT CABLE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Whenever the configuration is to be physically changed (i.e., drives added or removed), the drop should first be disconnected from the network (disconnect the BNC Tee Adapter from the Remote Drive Interface Head). The drop should then be powered down before the configuration is modified.

4.7 Application Programming

The variable names assigned to registers and bits during configuration are referred to as common variables. These are made available to BASIC and Control Block application tasks through the COMMON statement. Ladder Logic/PC tasks can access these variables simply by referencing them in their sequences. The remainder of this section provides application task examples.

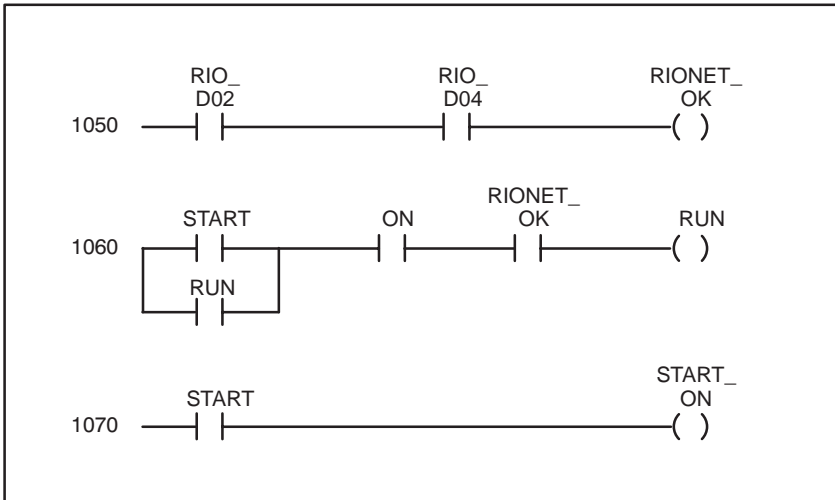
4.7.1.1 Configuration Task Example

The following is an example of a configuration task for the master Remote rack in figure 4.3. Note that a configuration task is required only if you are using AutoMax Version 2.1 or earlier. If you are using AutoMax Version 3.0 or later, you use the AutoMax Programming Executive Software to assign symbolic names to the same physical I/O points.

```
1000 !
1100 ! remote I/O network protection
1200 !
1300 IODEF RIO_D02@[SLOT=8,REGISTER=4,BIT=2]
1400 IODEF RIO_D04@[SLOT=8,REGISTER=4,BIT=4]
1500 !
1600 ! remote digital I/O
1700 !
1800 RIODEF START@[MASTER_SLOT=8,DROP=2,SLOT=11,REGISTER=0,      &
      BIT=5]
1900 RIODEF ON@[MASTER_SLOT=8,DROP=4,SLOT=3,REGISTER=0,BIT=2]
2000 RIODEF RUN@[MASTER_SLOT=8,DROP=4,SLOT=1,REGISTER=0,BIT=1]
2010 ! For an M/N 57C328 Remote I/O Head, the statement would be:
      RIODEF RUN@[MASTER_SLOT=8,DROP=4,SLOT=1,REGISTER=4,BIT=1)
2100 RIODEF START_ON@[MASTER_SLOT=8,DROP=4,SLOT=1,REGISTER=1,    &
      BIT=1]
2110 ! For an M/N 57C328 Remote I/O Head, the statement would be:
      RIODEF START_ON@[MASTER_SLOT=8,DROP=4,SLOT=1,REGISTER=5,BIT=1
2200 !
2300 ! remote analog I/O
2400 !
2500 RIODEF SPD_REF@[MASTER_SLOT=8,DROP=04,SLOT=0,REGISTER=0] 2600
      RIODEF SPD_IND@[MASTER_SLOT=8,DROP=02,SLOT=0,REGISTER=3] 2700
      MEMDEF RIONET_OK@
```

4.7.1.2 Ladder Logic Task Example

The following is an example of a Ladder Logic task for the Remote I/O network in figure 4.3. This task verifies that both slave drops are on-line before application tasks use the speed reference value.



`RIONET_OK` should be included in the READY sequence. Note that the trailing "at" symbol (@) is not used for Boolean variables in ladder logic tasks.

4.7.1.3 BASIC Task Example

The following is an example of a BASIC task for the Remote I/O network in figure 4.3. This task reads a speed reference value and writes it to a speed indicator.

```
1000 COMMON SPD_REF%
1010 COMMON SPD_IND%
1020 COMMON RUN@
1030 START EVERY 10 TICKS
1040 IF NOT RUN@ THEN SPD_IND% = 0 \GOTO 10000
1050 SPD_IND% = SPD_REF%
10000 END
```

The symbolic names defined as “COMMON” reference the I/O points defined in the configuration for the Remote I/O network.

4.7.2 Shark Programming Examples

The sample programs that follow reference the physical points illustrated in figure 4.4.

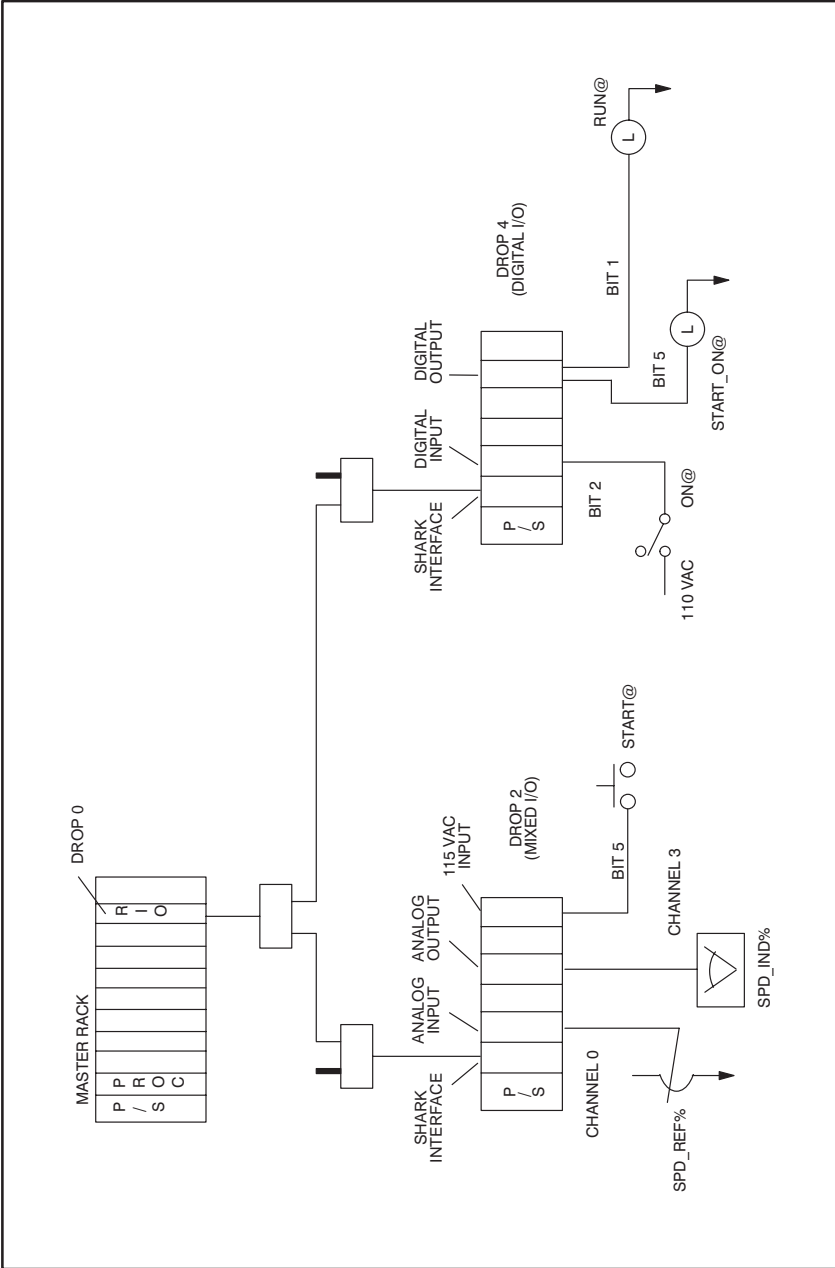


Figure 4.4 - Sample Coaxial Cable Remote I/O Network With Shark Rack Drops

4.7.2.1 Configuration Task Example

The following is an example of a configuration task for the Remote I/O network in figure 4.4. The two variables, DO_CFG% and DO2_CFG_RDY@, are used to configure drop 2. It is not necessary to configure drop 4 since it is an all digital rack as specified by the setting of the Shark Interface module's rotary switch to the "C" position.

Note that a configuration task is required only if you are using AutoMax Version 2.1 or earlier. If you are using Version 3.1 you must upgrade to at least AutoMax Version 3.2 if you are using Shark drops. If you are using AutoMax Version 3.2 or later, you use the AutoMax Programming Executive Software to assign symbolic names to the same physical I/O points.

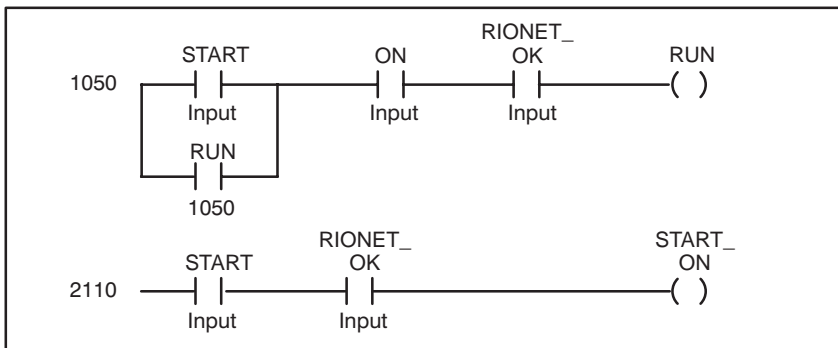
```

10    ! Shark RIO example
20    !
30    !
100   TASK EX[TYPE=BASIC, PRIORITY=7, SLOT=0, CRITICAL=FALSE]
110   TASK EXPC[TYPE=PC, PRIORITY=8, SLOT=0, CRITICAL=FALSE]
120   !
1100  ! remote I/O network protection
1200  !
1300  IODEF    RIO_D02@[SLOT=8,REGISTER=4,BIT=2]
1400  IODEF    RIO_D04@[SLOT=8,REGISTER=4,BIT=4]
1500  !
1600  ! Shark drop 2 (mixed rack)
1700  !
1800  RIODEF   D02_CFG%[MASTER_SLOT=8,DROP=2,SLOT=0,REGISTER=0]
1900  RIODEF   D02_CFG_RDY@[MASTER_SLOT=8,DROP=2,SLOT=0,      &
          REGISTER=0,BIT=15]
2000  RIODEF   SPD_REF%[MASTER_SLOT=8,DROP=2,SLOT=1,REGISTER=0]
2100  RIODEF   SPD_IND%[MASTER_SLOT=8,DROP=2,SLOT=3,REGISTER=11]
2200  RIODEF   START@[MASTER_SLOT=8,DROP=2,SLOT=5,REGISTER=0,  &
          BIT=5]
2300  !
2400  ! Shark drop 4 (all digital rack)
2500  !
2600  RIODEF   ON@[MASTER_SLOT=8,DROP=4,SLOT=1,REGISTER=0,BIT=2]
2700  RIODEF   RUN@[MASTER_SLOT=8,DROP=4,SLOT=4,REGISTER=8,BIT=1]
2800  RIODEF   START_ON@[MASTER_SLOT=8,DROP=4,SLOT=4,REGISTER=8, &
          BIT=5]
3200  MEMDEF   RIONET_OK@

```

4.7.2.2 Ladder Logic Task Example

The following is an example of a Ladder Logic task for the Remote I/O network in figure 4.4. This task verifies that both slave drops are on-line before application tasks use the speed reference value.



RIONET_OK should be included in the READY sequence. It is set by the BASIC task shown in 4.7.2.3. Note that the trailing “at” symbol (@) is not used for Boolean variables in ladder logic tasks.

4.7.2.3 BASIC Task Example

The following is an example of a BASIC task for the Remote I/O network in figure 4.4. The task is composed of three main sections. The first section, lines 1300 to 1500, checks to see if network drops 2 and 4 are recognized by the master. If they are not recognized, the program will continue to loop until they are. The second section, lines 2400 to 2500, configures drop 2. This is done by writing to variable D02_CFG%, the configuration register. Once the configuration word has been written, the configuration ready bit (10) is set. Note that drop 4 does not need to be configured in this way since it is an all digital rack. The last section of the task, lines 3300 to 3700, simply writes the analog input value SPD_REF% to indicator SPD_IND%. If either drop 2 or drop 4 malfunctions, the program will go to line 300 and wait for the affected drop to recover.

```

10      !
20      ! Shark RIO BASIC Example
30      !
100     COMMON RIO_D02@
200     COMMON RIO_D04@
300     COMMON SPD_REF%
400     COMMON SPD_IND%
500     COMMON RUN@
600     COMMON RIONET_OK@
700     COMMON D02_CFG@
800     COMMON D02_CFG_RDY@
1000    !
1100    ! Wait for slave drops to come on-line. The program will
1200    ! loop until drops two and four come on-line.
1300    RIONET_OK@ = FALSE    \ SPD_IND% = 0
1400    DELAY 1 TICKS
1500    IF NOT (RIO_D02@ AND RIO_D04@) THEN GOTO 1400
1600    !
1700    ! Configure Shark Remote I/O racks
1800    ! Drop 4 is an all digital rack and does not need to be
1900    ! configured
2000    ! Drop 2 is a mixed rack. By default slots are configured
2100    ! as analog. Configure slot 5 as digital and set
2200    ! the configuration ready bit (15).
2300    !
2400    D02_CFG% = 20H        \!Set the configuration word
2500    D02_CFG_RDY@ = TRUE   \!Set the configuration complete bit
2600    !
2700    ! Set RIO ready for pc task
2800    !
2900    RIONET_OK@ = TRUE
3000    !
3100    ! Task loop
3200    !
3300    IF NOT RUN@ THEN SPD_IND% = 0 \ GOTO 3500
3400    SPD_IND% = SPD_REF%
3500    IF NOT (RIO_D02@ AND RIO_D04@) THEN GOTO 1300
3600    DELAY 1 TICKS
3700    GOTO 3300
3800    END

```

The symbolic names defined as “COMMON” reference the I/O points defined in the configuration for the Remote I/O network.

5.0 PROGRAMMING TERMINAL COMMUNICATIONS

Local monitoring of a Remote I/O module, Remote I/O Head, or Remote Drive Interface Head is performed with an ASCII terminal or a personal computer running terminal-emulation software connected to the RS-232 port on the faceplate of the module. Note that the Shark Interface module does not support the programming terminal functions.

The RS-232 port is factory-configured for a data rate of 1200 baud, 8 data bits per character in transmit and receive, 1 stop bit, and no parity. The AutoMax Programming Executive includes the Kermit communications software, which allows your personal computer to emulate an ASCII terminal. Refer to the Kermit Reference manual (J-3616) for instructions on using the Kermit software. Figure 5.1 illustrates an example in which the user monitors slave drop 1 status from a terminal or personal computer connected to the Remote I/O module in this drop.

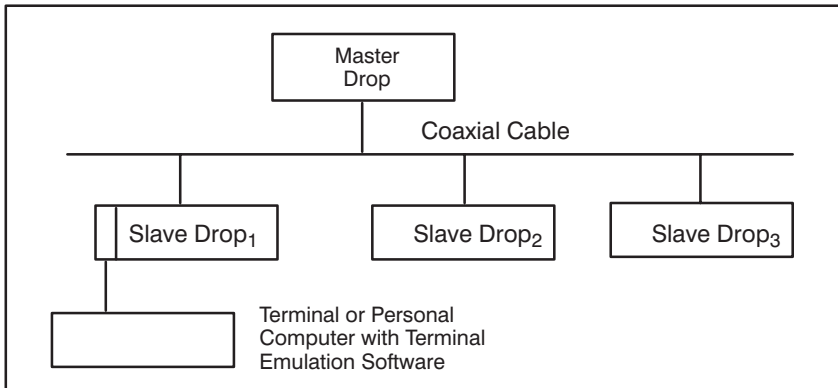


Figure 5.1 - Drop Status Monitoring

5.1 Remote I/O Module (M/N 57C416)

There are four commands from the terminal that are recognized by the Remote I/O module: T, S, R, and W. These commands are described below. All entries on the terminal must be made in capital letters.

5.1.1 Self Test (T)

This command is valid only if the Power Supply's keyswitch is in the Program position and the line is inactive, i.e., no communication is taking place on the Remote I/O network. Entering "T" initiates the power-up sequence and the self-diagnostic test of the Remote I/O module.

While the self test is executing, access to the dual port memory from the Multibus is inhibited. Any attempted accesses to the module will cause a bus error.

Therefore, if application tasks running on a Processor module in the master rack access variables on this Remote I/O module, you should stop the application tasks before doing the self-test to avoid shutting down the system with a bus error.

5.1.2 Status (S)

Entering "S" will display at the operator's console all the parameters associated with the module. All line statistic parameters will increase to 65535 and then roll over to zero. All drops will display the following status information:

```
SOFTWARE PART NUMBER 419451-0nnx
(nn is the part version number; x is the part revision number)
CHASSIS IS             ACTIVE or INACTIVE
LINE IS               ACTIVE or INACTIVE
MODE IS               PROGRAM, MEMORY PROTECT
                    (NORMAL), or SETUP
DROP NUMBER           0 through 7
MESSAGES RECEIVED:   n
  RECEIVE TIMEOUTS   n
  CRC ERRORS         n
  OVERRUN ERRORS    n
  ABORT ERRORS       n
MESSAGES SENT:       n
```

where:

MESSAGES RECEIVED is the total number of messages received by the module. While the line is inactive, this value will remain unchanged. While the line is active, it will constantly increase in value.

RECEIVE TIMEOUTS is the total number of timeouts that have occurred while the drop was waiting for a message to be received. While the line is inactive, the master module will indicate a value fluctuating between 0 and 3 and the slave module will indicate a value of 0.

CRC ERRORS is the total number of cyclic redundancy check errors that have occurred since the last reset of the module. This number should ideally remain equal to zero.

OVERRUN ERRORS is the total number of message overrun errors that have occurred since the last reset of the module. This number should ideally remain equal to zero.

ABORT ERRORS is the total number of message abort errors that have occurred since the last reset of the module. This number should ideally remain equal to zero.

MESSAGES SENT is the total number of messages transmitted by the module. While the line is inactive, this value for the master module will rapidly increase since "init request" messages are constantly being sent. For the slave modules, it will remain unchanged. While the line is active, this value will constantly increase.

The four error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, and ABORT) indicate coaxial line integrity (or lack of it). A few errors may accumulate over a period of time, such as hours or days, but when these parameter values increase consistently over a period of

seconds, there is a problem with integrity. Refer to chapter 6 for the troubleshooting procedure.

In addition to the above status information, the Status command will display the I/O configuration of the local rack for slave drops. The following column header will be displayed:

SLOT REGISTER I/O

where:

SLOT = 0-15

REGISTER = 0-31

I/O = INPUT - Register is READ ONLY
OUTPUT - Register is either READ ONLY or READ/WRITE

5.1.3 Read Slot (R)

This command is used to read the registers on an I/O module in the drop. When “R” is entered, you will be prompted for a slot number. When the slot number (followed by a carriage return) is entered, the data from that particular slot in the slave drop will be displayed. Data will be displayed in hexadecimal, decimal, and binary formats with the following headers:

REGISTER I/O HEX DEC BIN

5.1.4 Write Slot (W)

Entering “W” enables you to write or modify data in a register or an output module in a specified slot of the slave drop. The Power Supply keyswitch must be in the Program position and the line must be inactive, that is, no communication is taking place on the Remote I/O network. Data can be written in decimal (default format), in hexadecimal, or in binary.

WARNING

BEFORE PERFORMING THE WRITE SLOT COMMAND, THE USER MUST VERIFY THAT THE OUTPUTS ARE EITHER ELECTRICALLY DISCONNECTED OR WILL NOT CAUSE UNEXPECTED MACHINE MOTION IF ENERGIZED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

You will need to respond to the following prompts:

WRITE SLOT: Enter the slot number followed by a carriage return.

REGISTER: Enter the register number (0 to 31) followed by a carriage return.

NEW DATA: Enter the new data in one of the three formats followed by a carriage return.

HEX: (Hexadecimal) Enter a leading 0, then any hexadecimal characters 0 through F. The data is right justified if less than four hexadecimal characters are entered.

DEC: (Decimal) Enter data using any digits 0 through 9.

BIN: (Binary) Enter a leading B, then any valid combination of 1s and 0s. The data is right justified if less than 16 bits are entered.

The WRITE function will then display the current values of all registers located at the specified slot with the following headers:

REGISTER HEX DEC BIN

5.2 Remote Heads (M/N 57C328, M/N 57C329, and M/N 57C330)

There are five commands from the terminal that are recognized by the Remote Heads: T, S, C, R, and W. These commands are described below.

5.2.1 Self Test (T)

Entering "T" initiates the power-up sequence and the self-diagnostic test of the Remote Head. This command is valid only if the line is inactive, i.e., no communication is taking place on the Remote I/O network. Therefore, it can be used to recognize a new drop number (using the thumbwheel switch) without cycling power to the Head.

5.2.2 Status (S)

Entering "S" will display at the operator's console all the parameters associated with the module. All line statistic parameters (other than PORT RETRIES) will increase to 65535 and then roll over to zero. All drops will display the following status information:

```
SOFTWARE PART NUMBER 419451-1nnx
(nn is the part version number; x is the part revision number)
LINE IS                ACTIVE or INACTIVE
DROP NUMBER            1 through 7
MESSAGES RECEIVED:    n
RECEIVE TIMEOUTS      n
CRC ERRORS             n
OVERRUN ERRORS        n
ABORT ERRORS          n
MESSAGES SENT:        n
LAST RESET:           zz
PORT RETRIES (P0, P1, P2, P3): n, n, n, n
```

where:

MESSAGES RECEIVED is the total number of messages received by the drop. While the line is inactive, this value will remain unchanged. While the line is active, it will constantly increase in value.

RECEIVE TIMEOUTS is the total number of timeouts that have occurred while the drop was waiting for a message to be received. While the line is inactive, the slave drop will indicate a value of 0.

CRC ERRORS is the total number of cyclic redundancy check errors that have occurred since the last reset of the drop. This number should ideally remain equal to zero.

OVERRUN ERRORS is the total number of message overrun errors that have occurred since the last reset of the drop. This number should ideally remain equal to zero.

ABORT ERRORS is the total number of message abort errors that have occurred since the last reset of the drop. This number should ideally remain equal to zero.

MESSAGES SENT is the total number of messages transmitted by the drop. While the line is inactive, this value for the slave drops will remain unchanged. While the line is active, this value will constantly increase.

LAST RESET is a non-volatile register that contains the cause of the latest software reset. Upon initial power-up, the "zz" parameter should be equal to "NONE". If no software restarts occur during operation, the "zz" parameter will remain "NONE." The other possible values of "zz" are:

- LE reset due to excessive line errors of any kind (Receive Timeouts, CRC, Overrun, Abort).
- UI reset due to "Unexpected Init" request message.
- PF reset due to a "Power Fail" interrupt that occurred while the line was active. Input power has to remain valid (i.e., the power failure must be a spurious interrupt, line notch or line dip) for this code to be stored and displayed.
- Pn reset due to a port (rail) fault detected during the most recent port I/O update cycle. "n" equals the port number (0-3) that experienced the fault. (M/N 57C328 and M/N 57C330 only).

PORT RETRIES (P0, P1, P2, P3) is the number of port operations retried on each port. These values will increase to 255 and then roll over to 0. Ideally, these values should remain equal to zero.

The five error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, ABORT, and PORT RETRIES) indicate high speed line integrity (or lack of it). A few errors may accumulate over a period of time, such as hours or days; but when these parameter values increase consistently over a period of seconds, there is a problem with integrity. See section 6.5 for the troubleshooting procedure.

In addition to the above status information, the Status command will display the I/O configuration of the local drop. The following column header will be displayed:

PORT REGISTER I/O

where:

PORT	=	0-3	
REGISTER	=	0-3	
I/O	=	'	- No rail exists
		'unknown'	- Rail exists but it has not been determined whether it is INPUT or OUTPUT (M/N 57C330 only)
		'INPUT'	- Rail exists and contains INPUT modules
		'OUTPUT'	- Rail exists and contains OUTPUT modules
		'INPUT/ OUTPUT'	- Rail exists (M/N 57C328 only)

5.2.3 Clear (C)

The Clear command is used to clear the two-digit LAST RESET code and the PORT RETRIES counters. When "C" is entered, "CLEARED" will be displayed for the LAST RESET and PORT RETRIES fields.

5.2.4 Read Port (R)

The Read Port command is used to read the registers on a rail attached to the Head. When "R" is entered, you will be prompted for a port number. When the port number (0-3, followed by a carriage return) is entered, the data from that particular port will be displayed. Data will be displayed in hexadecimal, decimal, and binary format:

REGISTER I/O HEX DEC BIN

5.2.5 Write Port (W)

Entering "W" enables you to write data to an output rail or an output register on a drive. This command is valid only when the serial line is inactive. Data can be written in decimal (default format), in hexadecimal, or in binary.

WARNING

BEFORE PERFORMING THE WRITE SLOT COMMAND, THE USER MUST VERIFY THAT THE OUTPUTS ARE EITHER ELECTRICALLY DISCONNECTED OR WILL NOT CAUSE UNEXPECTED MACHINE MOTION IF ENERGIZED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

You must respond to the following prompts:

WRITE PORT: Enter the port number (0-3) followed by a carriage return.

REGISTER: Enter the register number (0 to 3) followed by a carriage return.

At this point, if the entered rail location cannot be written to because the register does not exist or the rail is an input rail, the appropriate error message will be displayed and the operation will be terminated.

If the entered rail location exists but has not yet been defined as INPUT or OUTPUT, the following prompt will be displayed (M/N 57C330 only):

This register has not been defined as INPUT or OUTPUT. If you continue and write data to this register, it will be defined as an output. Do you wish to continue and define this register as output? (Y/N)

If you enter anything other than "Y" (Yes), the operation will be terminated. If "Y" is entered, the register will be defined as OUTPUT and the operation will continue. You will be prompted:

NEW DATA: Enter the new data followed by a carriage return. The data can be entered in any one of the following formats:

HEX: (Hexadecimal) Enter a leading 0, then any hexadecimal characters 0 through F. The data is right-justified if less than four hexadecimal characters are entered.

DEC: (Decimal) Enter data using any digits 0 through 9.

BIN: (Binary) Enter a leading B, then any valid combination of 1s and 0s. The data is right-justified if less than 16 bits are entered.

The WRITE function will then display the current values of all registers located at the specified port using the following display format:

REGISTER HEX DEC BIN

6.0 DIAGNOSTICS AND TROUBLESHOOTING

This section describes how to troubleshoot the Remote I/O module, Remote I/O Head, Remote Drive Interface Head, the Shark Interface module, and the Remote I/O network. See Appendix D for a list of the error codes that can be displayed by the Remote I/O module or Remote Heads. If the problem cannot be corrected using the procedures below, the modules are not user-serviceable. See appendix K for information on troubleshooting the fiber-optic link and its components.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, 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.

6.1 The Remote I/O Module's OK LED is Off

Problem: The green OK status LED on the Remote I/O module's faceplate is off. This LED should be on when the module has passed its internal diagnostics after power up. If the LED is off, and no error code is displayed, a local watchdog failure has occurred. Try cycling power to the rack. If the LED remains off, replace the module.

6.2 Error Code A is on the Remote I/O Module's 7-Segment Display

Problem: Error code A appears on the Remote I/O module's seven-segment display at power up. This error code indicates an invalid drop number. This will only occur if the drop number on the thumbwheel switches is greater than 07. Use the following procedure to clear the error code:

- Step 1. Set the correct drop number on the thumbwheel switch.
- Step 2. Cycle power to the rack.

6.3 Remote I/O Network Failures

Problem: Error code C appears on any Remote I/O module's 7-segment display. This error code indicates a network failure. If the module is a master drop, no other drops will be able to function on the network. If the module is a slave drop, it is not receiving any messages from the master drop. This fault code is reset whenever the line becomes active. The causes of a Remote I/O network failure are: cable failure, master rack failure, or a slave rack failure.

If the Processor in the master rack fails or issues a BOARD RESET command (clears all outputs in the rack), the entire image in the master's dual port memory will be cleared. All Remote I/O slave drops will detect that the master has failed. Their response to this will be to clear all AutoMax module outputs in remote drops. The remote drops will then wait for the master to re-establish communication.

The failure of a slave drop to communicate with the master can result from a bus error or failure of the rack power supply or backplane. If a Multibus slave drop fails, the Remote I/O module in the slave rack will issue a BOARD RESET command. This command will clear all outputs in the slave rack.

WARNING

FOREIGN I/O MODULES (NON-RELIANCE MODULES) DO NOT RESPOND TO THE BOARD RESET COMMAND. THEREFORE, IF FOREIGN I/O MODULES ARE USED IN AN AUTOMAX SYSTEM AND IT IS REQUIRED THAT THEIR OUTPUTS BE SET TO A KNOWN STATE WHEN A FAILURE OCCURS, OTHER METHODS MUST BE EMPLOYED TO SATISFY THIS REQUIREMENT. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

If a Remote I/O Head slave drop fails, the Remote I/O Head will attempt to clear all outputs at that drop. In this situation, the outputs connected to the rails or Local Heads may not be cleared.

WARNING

IN APPLICATIONS WHERE IT IS IMPERATIVE THAT OUTPUT DEVICES BE DISABLED OR DE-ENERGIZED WHEN THE DROP FAILS, POWER TO THE OUTPUT DEVICES SHOULD BE ROUTED THROUGH THE READY RELAY ON THE REMOTE I/O HEAD OR REMOTE DRIVE INTERFACE HEAD POWER SUPPLY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

If a Shark slave drop fails, the Shark Interface module in the slave rack will issue a reset I/O command. This command will clear all outputs in the slave rack.

When the master recognizes that a slave drop (Multibus, Shark, Remote Drive Interface Head, or Remote I/O Head) has failed, it will clear all inputs in its dual port memory and the status bit indicating the slave drop's status will be turned off for a minimum of 120 milliseconds.

Monitoring registers 15-18 in the drop 0 area will indicate network integrity. The master logs the error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, and ABORT) for the entire network. 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 drop using the Status command (except for Shark racks) to isolate the problem.

Use the following general procedure to isolate the cause of a Remote I/O network failure:

- Step 1. Verify that the drop number of each slave module is unique and the thumbwheel switches are set correctly. The thumbwheel switches are read only once at power up. If any changes have been made to the thumbwheel

switches, you must cycle power to the rack (or reset the module using the self test function) in order for the new settings to be recorded in register 12.

Note: Use steps 2 through 8 if you have a coaxial cable network. If you have a fiber-optic network, see section K3.1.

- Step 2. 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 3. Verify that the coaxial cable is terminated correctly. There must be a line terminating load at each end of the network.
- Step 4. Verify that the coaxial cable system was installed correctly. Refer to section 3.3 for additional information.
- Step 5. Verify the integrity of the coaxial cable system. Refer to section 3.9 for additional information.

6.4 The Shark Interface Module's CPU OK LED is Off

Problem: The green CPU OK status LED on the Shark Interface module's faceplate is off. This LED should be on when the module has passed its power-up diagnostics. If the green status LED is off, a local watchdog failure has occurred. First, try cycling power to the rack. If the CPU OK status LED remains off, replace the module.

6.5 The Shark Interface Module's COM OK LED is Blinking

Problem: The green COM OK status LED on the Shark Interface module's faceplate is blinking. This LED should be on when the module is communicating over the Remote I/O network. The LED should be off when the module is not communicating over the network. If the green status LED is blinking, an invalid drop number has been selected on the 16-position rotary switch on the module's faceplate. Set the rotary switch to the proper position and cycle power to the rack. The rotary switch drop number settings are:

- 1 to 7 for racks containing both analog and digital modules
- 9 to F for racks containing all digital modules.

6.6 All LEDs on the Remote I/O Head or Remote Drive Interface Head are Off

Problem: All LEDs on the Remote I/O Head (or Remote Drive Interface Head) are off. This problem indicates that the Head is not receiving 120 VAC (or 240 VAC) power within the specified ranges, the fuse has blown, or that the Head is malfunctioning.

DANGER

THE FOLLOWING STEPS ARE PERFORMED WITH POWER ON. EXERCISE EXTREME CAUTION BECAUSE HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Step 1. Using a voltmeter, verify that the power source is 120 VAC or 240 VAC, whichever is appropriate, and that it is functioning correctly. Verify that the jumper on the terminal strip is set correctly.
- Step 2. Stop any application programs that may be running.
- Step 3. Turn off power to the Remote I/O Head (or Remote Drive Interface Head).
- Step 4. Inspect the Head fuse using the directions below. If the fuse is blown, replace it.

CAUTION: The fuse must be replaced only with another fuse of the exact same type, an AGC 2 amp fuse. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

- a.) Using a screwdriver, press down and turn counterclockwise to release the fuseholder located on the faceplate.
 - b.) Pull the fuseholder out of the Head.
 - c.) Remove the old fuse from the fuseholder and replace it with the new fuse.
 - d.) Re-insert the fuseholder into the Head.
 - e.) Press down and turn the screwdriver clockwise to reinstall the fuseholder. The fuseholder must be flush against the faceplate.
- Step 5. Turn on power to the Head. If the LEDs on the Head do not turn on, replace the Head.

6.7 Error Code A is on the Remote I/O Head or Remote Drive Interface Head 7-Segment Display

Problem: Error Code A appears on the seven-segment display of the Remote I/O Head (or Remote Drive Interface Head) at power-up. This error code indicates an invalid drop number. This will occur only if the drop number on the thumbwheel switch is 0, 8, or 9. Use the following procedure to clear the error code:

- Step 1. Set the correct drop number on the thumbwheel switch.
- Step 2. Cycle power to the Remote I/O Head or Remote Drive Interface Head.

WARNING

IN APPLICATIONS WHERE IT IS IMPERATIVE THAT OUTPUT DEVICES BE DISABLED OR DE-ENERGIZED WHEN THE DROP FAILS, IT IS RECOMMENDED THAT THE SUPPLY POWER TO THE OUTPUT DEVICES BE ROUTED THROUGH THE READY RELAY ON THE REMOTE I/O HEAD POWER SUPPLY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

6.8 The Remote I/O Head's Rail Fault LED is On

Problem: The RAIL FAULT LED on the Remote I/O Head faceplate is on. This indicates that there has been a loss of communication between the Remote I/O Head and one of the Local Heads or Rails connected to the I/O ports.

The FAULT MSB and FAULT LSB LEDs will display a binary code that indicates which of the ports has had an interruption in communication (rail fault). Refer to figure 6.1.

FAULT MSB LED	OFF	OFF	ON	ON
FAULT LSB LED	OFF	ON	OFF	ON
Rail Fault on port	0	1	2	3

Figure 6.1 - AutoMax Rail Fault LED Codes

Refer to the Digital I/O Rails and Modules instruction manual (J- 3012) for detailed troubleshooting procedures for I/O Rail failures.

6.9 Error Code 31 is on the Processor Module's LED Display

Problem: Error code "31" appears on a Processor module's LED display. This error indicates the system has a problem accessing the module through the backplane bus. A bus error may be caused by removal of an I/O module, an I/O module failure, a rack backplane failure, attempting to access an invalid address, or incorrect cabling (45C8, 45C5).

Use the following procedure to isolate a bus error:

- Step 1. Decode the error-specific information listed in the Processor Info Log. See J-3650 or J-3669 for the procedure for decoding bus errors.
- Step 2. Verify that the address being written to is a Read/Write location. Read Only registers and bits cannot be written to by application tasks.
- Step 3. Verify that the hardware is working correctly.
Systematically replace the Remote I/O module, the Processor module(s), and the rack/backplane assembly, one at a time, with a corresponding module or assembly known to be operating correctly. After replacing each module or assembly, if the problem is not corrected, replace the original before going on to the next item.

Appendix A

Hardware Technical Specifications

Remote I/O Communications Module

M/N 57C416

Ambient Conditions

- Storage Temperature: -40° to 185°F
 -40° to 85°C
- Operating Temperature (at the module): 32° to 140°F
 0° to 60°C
- Humidity: 5 to 95%, non-condensing
- Altitude: 1000 meters (3300 feet) without derating

Dimensions

- Height: 29.845 cm (11.75 inches)
- Width: 3.175 cm (1.25 inches)
- Depth: 18.733 cm (7.375 inches)
- Weight: 0.9 kg (2 pounds)

Maximum Power Dissipation

- 20 W

System Power Requirements

- +5 VDC 2.5 A
- +12 VDC 53 mA
- -12 VDC 7.5 mA

Communications Passive Tap M/N 57C380

Dimensions

- Height: 4.3 cm (1.7 inches)
9-pin connector extends .635 cm (0.25 inches) above tap
BNC connectors extend 1.9 cm (0.75 inches) below tap
- Width: 13.08 cm (5.15 inches)
- Depth: 6.667 cm (2.625 inches)
- Weight: 0.225 kg (0.5 pounds)

Appendix A (Continued)

AutoMax Remote I/O Shark Interface Module M/N 57C554

Ambient Conditions

- Storage Temperature: -4° to 158°F
 -20° to 70°C
- Operating Temperature (at the module): 32° to 131°F
 0° to 55°C
- Humidity: 30 to 90%, non-condensing
- Altitude: 1000 meters (3300 feet) without derating

Dimensions

- Height: 15.2 cm (6 inches)
- Width: 3.5 cm (1.4 inches)
- Depth: 10.1 cm (4 inches)
- Weight: 112 g (4 ounces)

Maximum Power Dissipation

- 2.68 W

System Power Requirements

- Channel 1: 345 mA
- Channel 2: 40 mA
- Channel 3: 0 mA

Appendix A (Continued)

AutoMax Remote I/O Head M/N 57C328 and M/N 57C330

Ambient Conditions

- Storage Temperature: -40°C to 85°C
 -40°F to 185°F
- Operating Temperature: 0°C to 60°C
 32°F to 140°F
- Humidity: 5 to 95%, non-condensing
- Altitude: 1000 meters (3300 feet) without derating

Dimensions

	Without Cables	With Cables Attached
● Height:	23.9 cm (9.40 inches)	23.9 cm (9.40 inches)
Width:	14.0 cm (5.50 inches)	14.0 cm (5.50 inches)
Depth:	19.2 cm (7.55 inches)	24.1 cm (9.50 inches)

Weight

- 2.9 kilograms (6.5 pounds)

Input Power

- 120 VAC (-15% to $+10\%$) (102-132 VAC)
- 240 VAC (-15% to $+10\%$) (204-264 VAC)

Holdup Time

- 3 Cycle

Line Frequency

- 47.5 to 63 Hz

Momentary Voltage Deviation (60 Millisecond Duration)

- 120 VAC ($\pm 30\%$) (80-150 VAC)
- 240 VAC ($\pm 30\%$) (160-300 VAC)

Maximum Load

- at 120 VAC: 0.5A
- at 240 VAC: 0.25A

Maximum Power Dissipation

- 50 W

Fuse Type

- Buss® 2 Amp, 250V, AGC, or equivalent

Ready Relay Contact Rating

- 8A, 250 VAC

Appendix A

AutoMax Remote Drive Interface Head M/N 57C329

Ambient Conditions

- Storage Temperature: –40°C to 85°C
–40°F to 185°F
- Operating Temperature: 0°C to 60°C
32°F to 140°F
- Humidity: 5 to 95%, non-condensing
- Altitude: 1000 meter (3300 feet) without derating

Dimensions

	Without Cables	With Cables Attached
● Height	23.9 cm (9.40 inches)	23.9 cm (9.40 inches)
Width	14.0 cm (5.50 inches)	14.0 cm (5.50 inches)
Depth	19.2 cm (7.55 inches)	24.1 cm (9.50 inches)

Weight

- 2.9 kilograms (6.5 pounds)

Input Power

- 120 VAC (–15% to +10%) (102-132 VAC)
- 240 VAC (–15% to +10%) (204-264 VAC)

Holdup Time

- 3 Cycle

Line Frequency

- 47.5 to 63 Hz

Momentary Voltage Deviation (60 Millisecond Duration)

- 120 VAC (+30%) (80–150 VAC) * 240 VAC ($\pm 30\%$) (160-300 VAC)

Maximum Load

- at 120 VAC: 0.5A
- at 240 VAC: 0.25A

Maximum Power Dissipation

- 50 W

Fuse Type

- Buss® 2 Amp, 250V, AGC, or equivalent

Ready Relay Contact Rating

- 8A, 250 VAC

Appendix A

(Continued)

Stand-Alone Fiber-Optic Transceiver M/N 57C365

Dimensions

- Height: 1.3 in (3.3 cm)
- Width: 5.19 in (13.18 cm)
- Depth: 2.35 in (5.96 cm)

Ambient Conditions

- Operating temperature: 0°C to +60°C
- Storage temperature: -40°C to +95°C
- Humidity: 5 to 95%, non-condensing
- Maximum altitude: 3300 feet (1000 meters), without derating

Fiber-Optic Interface

- Operating wavelength: 850 nm
- Allowable transmission loss: 0-13 dB (62.5 micron cable)
- Cable length: 3 to 6500 feet (1 to 2000 meters)
- Connector type: ST

Input Power

- 24 VDC, regulated (line and load regulation should not exceed 1%)

Appendix A

(Continued)

Fiber-Optic Rack with Power Supply M/N 57C368

Dimensions

- Height: 5.23 in (13.28 cm)
- Width: 19.00 in (48.26 cm)
- Depth: 9.72 in (24.68 cm)

Power Supply Input Power

- 115/230 VAC, -15% to +20%

Power Supply Fuse

- 1.25 amp

Ambient Conditions

- Operating temperature: 0°C to +60°C
- Storage temperature: -40°C to +95°C
- Humidity: 5 to 95%, non-condensing
- Maximum altitude: 3300 feet (1000 meters), without derating

Rack-Mounted Fiber-Optic Transceiver M/N 57C367

Dimensions

- Height: 5.25 in (13.34 cm)
- Width: 1.48 in (3.65 cm)
- Depth: 7.50 in (19.05 cm)

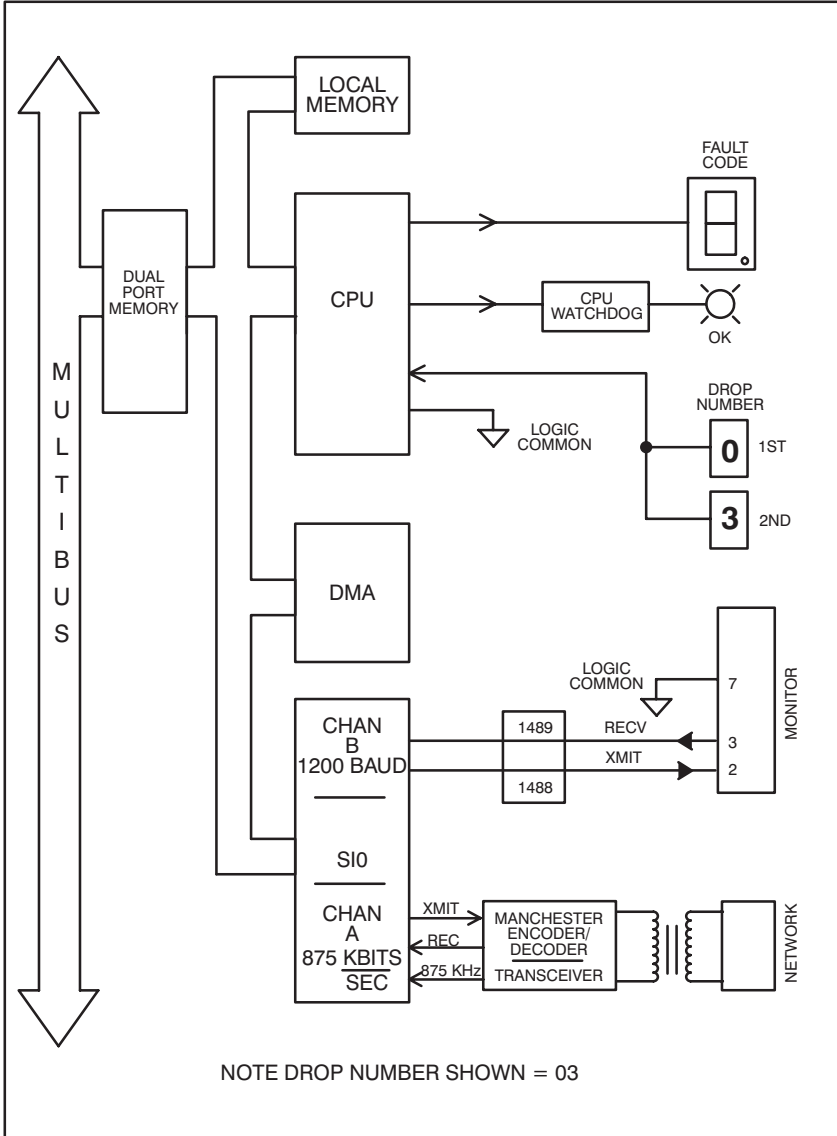
Input Power

- 14–18 VAC supplied by Fiber-Optic Rack Power Supply

All other specifications are identical to Stand-Alone Transceiver

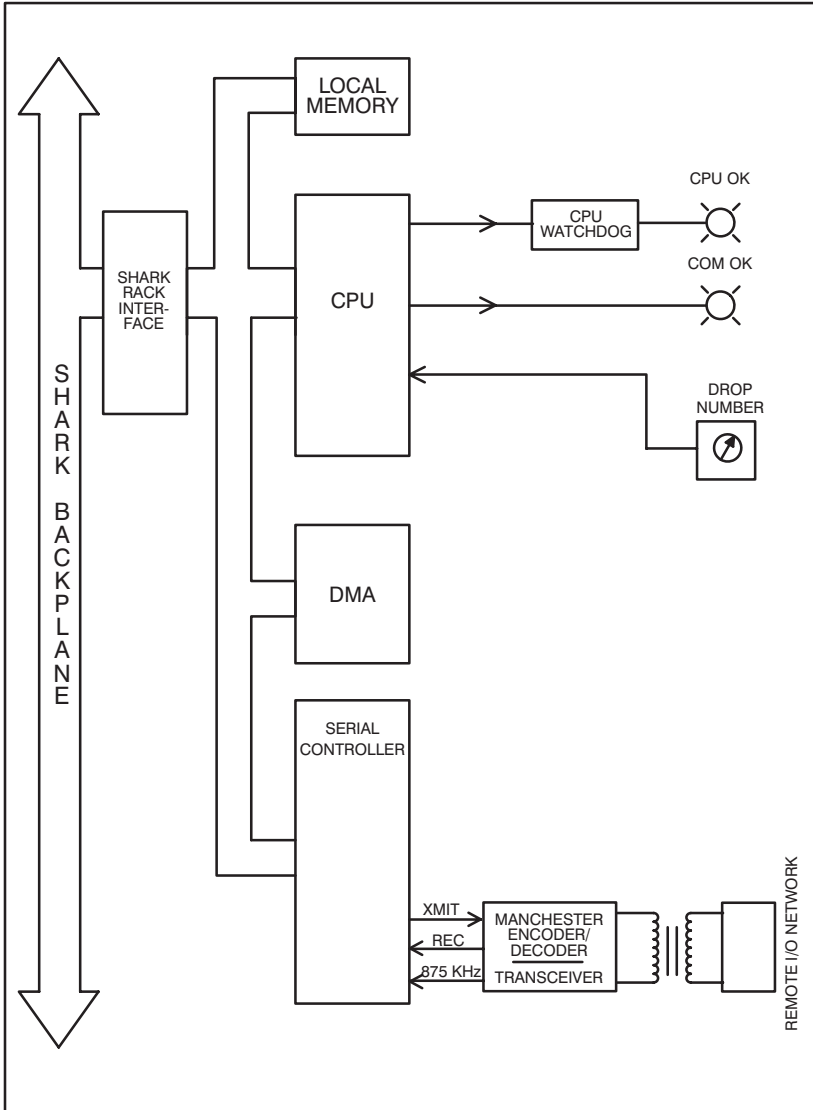
Appendix B

Block Diagrams Remote I/O Communications Module M/N 57C416



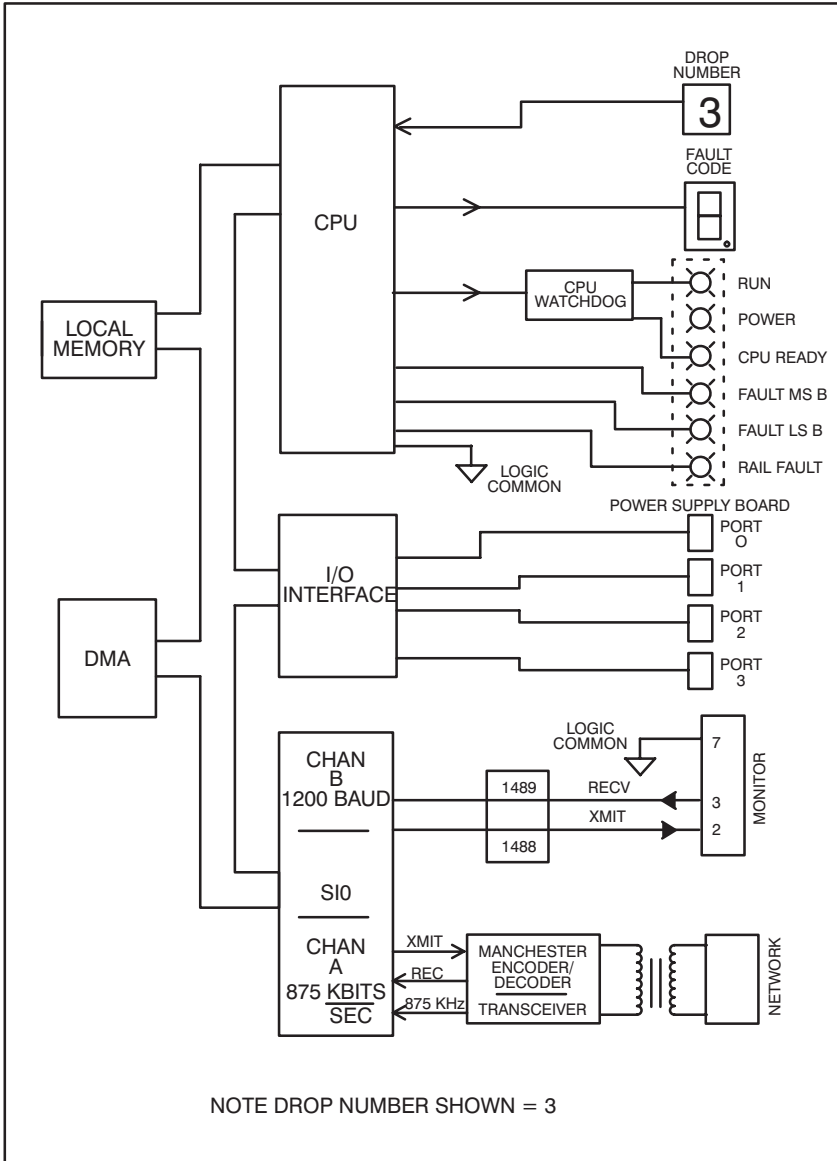
Appendix B (Continued)

AutoMax Remote I/O Shark Interface Module M/N 57C554



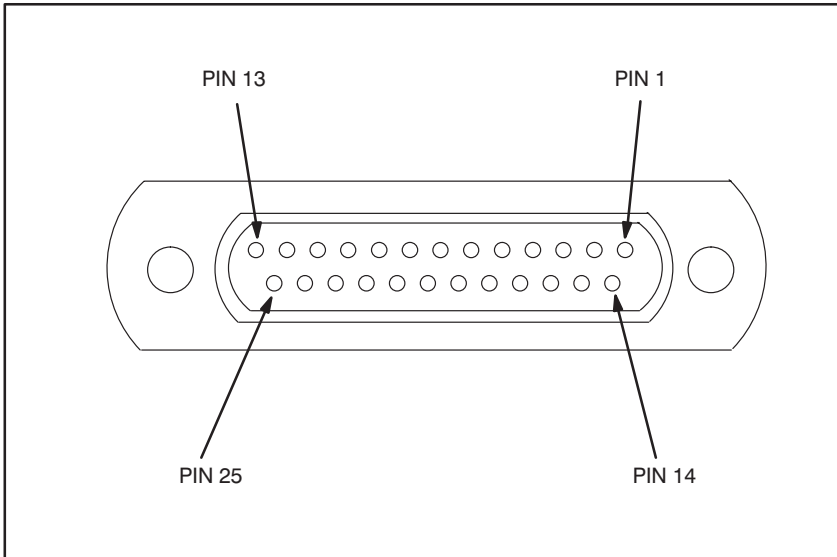
Appendix B

Remote I/O Head M/N 57C328 and M/N 57C330



Appendix C

RS-232 Port Pinout



PIN #	SIGNAL
2	XMIT
3	RECV
7	COM

The RS-232 port is used for programming terminal communications with the Remote I/O module, Remote I/O Head, or Remote Drive Interface Head. The programming terminal is connected to this port using an Interface cable (M/N 61C127).

Appendix D

Remote I/O Error Codes Remote I/O Module Remote I/O Head Remote Drive Interface Head

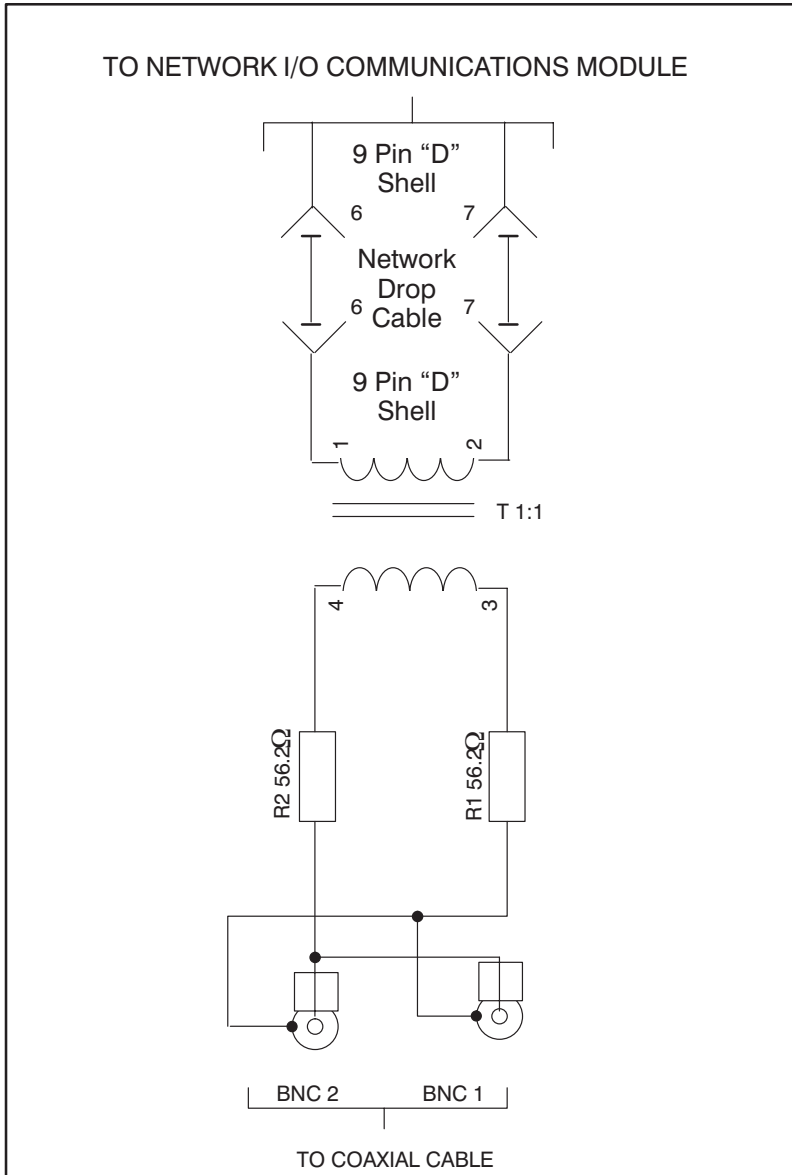
- 0 CPU failed power-up diagnostic
- 1 EPROM failed power-up diagnostic
- 2 RAM failed power-up diagnostic
- 3 CTC failed power-up diagnostic
- .3 CTC runtime failure
- 4 SIO port failed power-up diagnostic
- 5 DMA failed power-up diagnostic
- .5 DMA runtime failure; message transmit timeout occurred
- 6 I/O device interface failure (Remote I/O Head and Remote Drive Interface Head only)
- 6 Dual port memory failed power-up diagnostic (Remote I/O module only)
- .6 Runtime I/O interface failure (Remote I/O Head and Remote Drive Interface Head only)
- 7 Memory Management unit failed power-up diagnostic (Remote I/O module only)
- .8 or 8 Microprocessor on module did not attempt to go into run (Remote I/O module only)
 - Bad, missing, or wrong runbase EPROM,
 - Bad power supply
 - Interference from another module
 - Bad backplaneTry re-seating the module
- 9 PIO port failed power-up diagnostic
- A Invalid drop number. This occurs only if the drop number on the thumbwheel switch is greater than 07.
- b Watchdog timer failed power-up diagnostic
- C Communication line 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. This fault code is reset whenever the line goes active.
- d System (backplane) watchdog failed; a Processor module went down. Board is operational but will not transmit or receive any data until the watchdog is reset. (Remote I/O module only).
- E Power failure. This code is normally present from the time that a low voltage is detected until power is completely lost.

Appendix E

Schematics

Communications Passive Tap

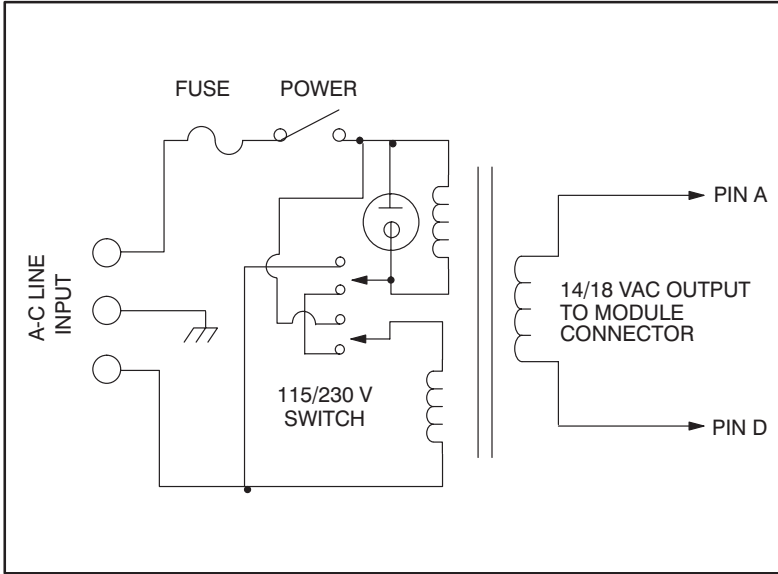
M/N 57C380



Appendix E

(Continued)

Fiber-Optic Rack Power Supply M/N 57C368



Appendix F

Network Cable Specifications

Belden 9259 RG-59/U Type Coaxial Cable

Nominal Impedance

- 75 ohms

Nominal Velocity of Propagation

- 78%

Nominal Capacitance

- 17.3 picofarad/foot

Nominal Attenuation at 1 MHz

- 0.3 decibels/100 feet

Outer Jacket

- PVC

Nominal Outer Diameter

- 0.242 inches

Shield

- Coverage and material: 95% bare copper
- Nominal D-C resistance: 2.6 ohms/1000 feet

Insulation

- Cellular polyethylene

Center Conductor

- Material: stranded bare copper
- Nominal D-C Resistance: 15 ohms/1000 feet

Suggested Operating Temperature Range

- -40°C , $+80^{\circ}\text{C}$

Appendix F

(Continued)

Minimum Bending Radius

- 2.5 inches

Maximum Standard Length

- 1000 feet

Belden 225362 62.5 Micron Fiber-Optic Cable

Cable Size

- 62.5 micron core, 125 micron cladding, 900 micron buffer

Recommended Manufacturer

- Belden

Belden Part Number

- 225362 - breakout cable

Number of Fibers per Cable

- 2

Outside Diameter

- 6 mm (.236")

Jacket Material

- PVC

Operating Temperature

- -20° to 80°C
-36° to 176°F

Maximum Pulling Tension

- 68 Kg (150 lbs)

Minimum Bend Radius

- 70 mm (3")

Appendix F

(Continued)

Maximum Attenuation

- 3.5 dB per km

Nominal Operating Frequency

- 820 nanometers

Fiber-Optic Connector

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

Appendix G

Cable System Component List

Coaxial Cable Network

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 Coax	M/N 45C72	AMP™ 227079-7
Crimping Tool Kit For AMP 227079-7	N/A	AMP™ 220190-1 (Tool) AMP™ 220189-2 (Die)
Jack-to-Jack In-Line Splicing Adapter	N/A	AMP™ 221551-3
BNC Tee Adapter	M/N 45C70	N/A

Appendix G

(Continued)

Fiber-Optic Network

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
Stand-Alone Transceiver	M/N 57C365	Math Associates EN-19418C
Rack with Power Supply	M/N 57C368	Math Associates MCR-1000A (Rack)
Rack-Mounted Transceiver	M/N 57C367	Math Associates EN-19418B
62.5 Micron Cable	N/A	Belden 225362
Twisted Pair Cable	417900-84CAH	Paige Electric 412402
Twisted-Pair-to-Coax Balun	N/A	Amp 555053-1

Appendix H

Remote I/O Network Specifications

Specification	Using Coaxial Cable	Using Fiber-Optic Cable
Topology	Bus	Active Star
Cable Options	RG-59U (Belden 9259)	62.5 micron (Belden 225362)
Maximum Cable Length	RG-59U: 3000 ft (1000 m)	6,000 ft (2000 m)*
Organization	Master-Slave	
Max. No. of Slave Drops	7	
Data Encoding Technique	Manchester II Biphase	
Data Link Frame Format	SDLC	
Max. Communication Time	2.99 msec per drop	
Baud Rate	1.75 M baud	
Bit Rate	875 Kbits/sec	

*Measured from Stand-Alone Transceiver to Stand-Alone Transceiver through the hub.

Appendix J

Glossary of Terms

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.

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.

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.

crimping tool: a mechanical device that is used to crimp a contact and a ferrule of a BNC Plug connector.

dielectric: a material that serves as an insulator.

discontinuity: a broken connection (open circuit), or loss of specified connection characteristic.

dust cap: a device attached to a connector to provide protection against dust and foreign debris.

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.

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.

Appendix J

(Continued)

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.

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.

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 the impedance of the circuit, cable or device to which it is connected.

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.

plug: a movable portion of a coaxial RF connector attached to a cable or removable assembly.

raceway: any channel designed expressly and used solely for holding wires and cables.

reflections: return of the radio frequency energy towards the source which is caused by an impedance mismatch along the transmission path.

RG: a symbol used to designate coaxial cables made to a government specification.

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.

surge: a temporary and relatively large increase in the voltage or current in an electric circuit or cable.

transceiver: a module composed of a transmitter and receiver.

Appendix K

Fiber-Optic Remote I/O Network Installation Guidelines

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K1.0 INTRODUCTION

This appendix provides an overview of fiber-optic networks, a description of the hardware components that comprise the AutoMax fiber-optic Remote I/O network, and guidelines for installing the components and fiber-optic cable. Refer to sections 3.5 and 3.6 in this manual for module installation and replacement procedures.

K1.1 Fiber-Optic Remote I/O Network Overview

An AutoMax Remote I/O 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 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 fiber-optic Remote I/O network, as shown in figure K1.1.

The type of cable or the network configuration used has no effect on the operation of the Remote I/O network protocols, application software, or the operation of the Remote I/O module, the Shark Interface module, the Remote I/O Head, or the Remote Drive Interface Head.

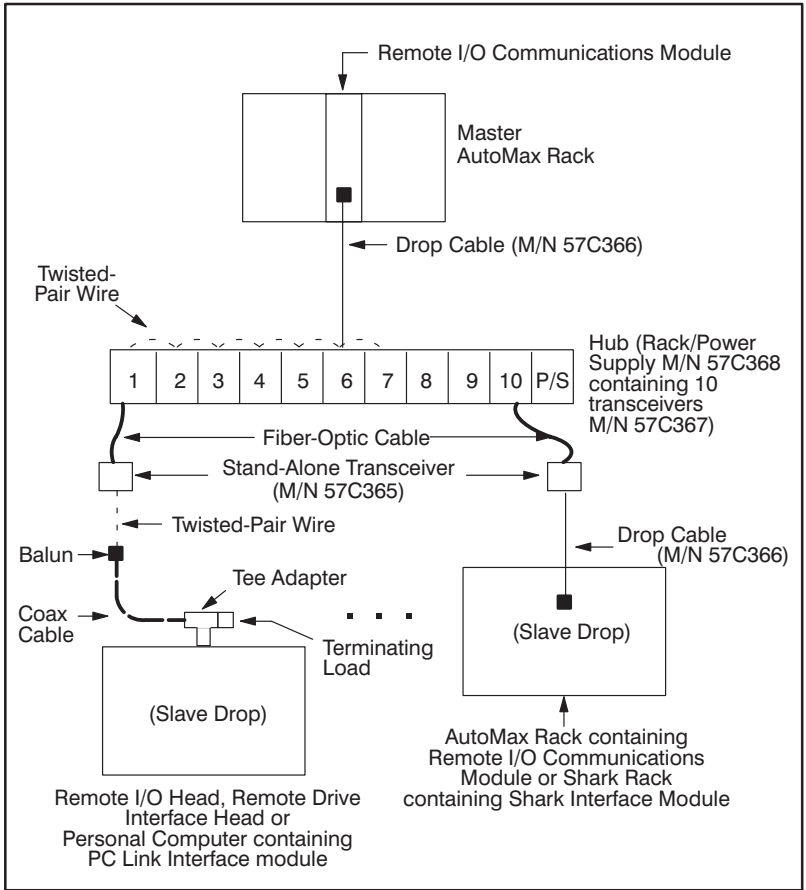


Figure K1.1 - Fiber-Optic Remote I/O Network

As shown in the above figure, 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.

K1.2 Fiber-Optic Remote I/O Network System Components

The AutoMax fiber-optic Remote I/O network system consists of the following components:

- Drop Cable (M/N 57C366) - used only with the Remote I/O Communications module or the Shark Interface module.
- BNC Tee Adapter (M/N 45C70), BNC Terminating Load (M/N 45C71), and Balun - used only with the Remote I/O Head, the Remote Drive Interface Head, or a personal computer containing a PC Link module.
- Stand-Alone Fiber-Optic Transceiver (M/N 57C365)
- Fiber-Optic Rack with Power Supply (M/N 57C368)
- Rack-Mounted Fiber-Optic Transceiver (M/N 57C367)
- Fiber-Optic Cable

Each of these components is shown in figure K1.1 and described in the sections that follow.

K1.2.1 Drop Cable

The drop cable (M/N 57C366) is used to connect the Remote I/O Communications module or the Remote I/O Interface 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 Network module. Terminations are provided on the other end of the cable for connection to the terminal strip on the transceiver. Refer to figures K2.2 and K2.4 for these connections.

K1.2.2 BNC Tee Adapter and Balun

For the Remote I/O Head, the Remote Drive Interface Head, and the PC Link module, a twisted-pair-to-coax balun is used to convert the cable between the module and the transceiver. The balun is connected to the 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. See section 3.1.4 for more information on the BNC Tee Adapter.

K1.2.3 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 cannot be located within 3 feet of the fiber-optic hub.) It performs the bi-directional conversion between electrical and optical signals. Transceiver technical specifications are listed in Appendix A.

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. See figure K1.2.

Receive and transmit ports labeled "R" and "T", respectively, are provided on one end of the transceiver for connection to the 1

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 MASTER OR SLAVE DROP AND THE CORRESPONDING RACK-MOUNTED OR STAND-ALONE TRANSCEIVER 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.

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. See section K2.2 for the terminal block designations. The 24VDC 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.

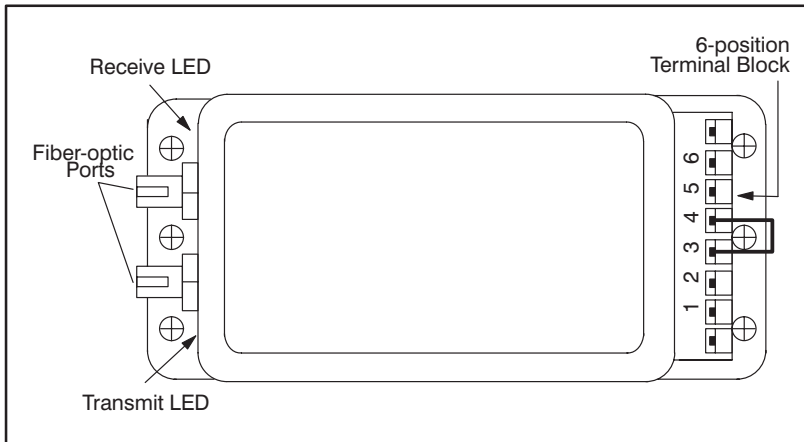


Figure K1.2 - Stand-Alone Transceiver

K1.2.4 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 A.

The rack is a 19-inch clear anodized aluminum enclosure with a transparent plastic front panel. The rack contains a 115/230VAC 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 14V 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 230V 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. See Appendix E for the Power Supply schematic.

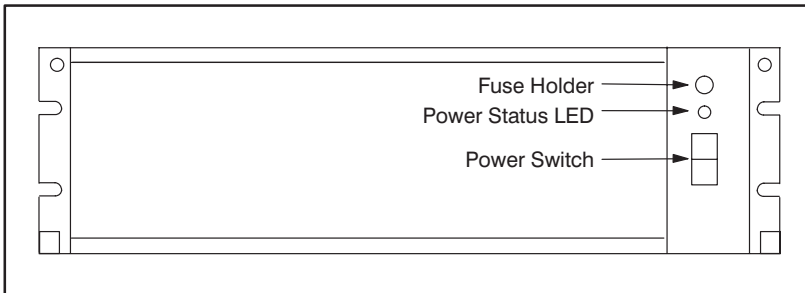


Figure K1.3 - Fiber-Optic Rack and Power Supply

K1.2.5 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). See figure K1.4.

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 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 MASTER OR SLAVE DROP AND THE CORRESPONDING RACK-MOUNTED OR STAND-ALONE TRANSCEIVER 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.

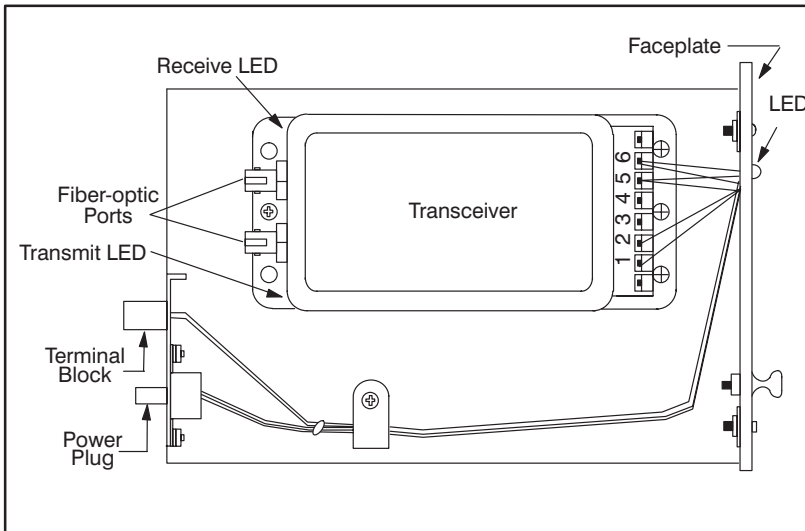


Figure K1.4 - Rack-Mounted Transceiver

K1.2.6 Fiber-Optic Cable

The Remote I/O 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 which 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 F.

The fiber-optic connectors must be ST®-Compatible Multimode Connectors with ceramic ferrules. Refer to Appendix F for more information.

K2.0 INSTALLATION

This section describes how to install and replace the individual components that make up a fiber-optic link. It also provides network installation and cable handling guidelines. Refer to section 3.6 in the manual for module installation and replacement procedures.

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 MASTER OR SLAVE DROP AND THE CORRESPONDING RACK-MOUNTED OR STAND-ALONE TRANSCEIVER 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.

K2.1 Installation Planning

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 drops, 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.

- Step 7. Note that the maximum link length is 2000 meters without splicing.
- Step 8. Document the fiber-optic cable system layout. This document should be maintained for the life of the installation.
- Step 9. Determine the number of fiber-optic cable components that are needed. Refer to Appendix G for more information on recommended components.

K2.2 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 K2.1 for the correct placement of the holes.

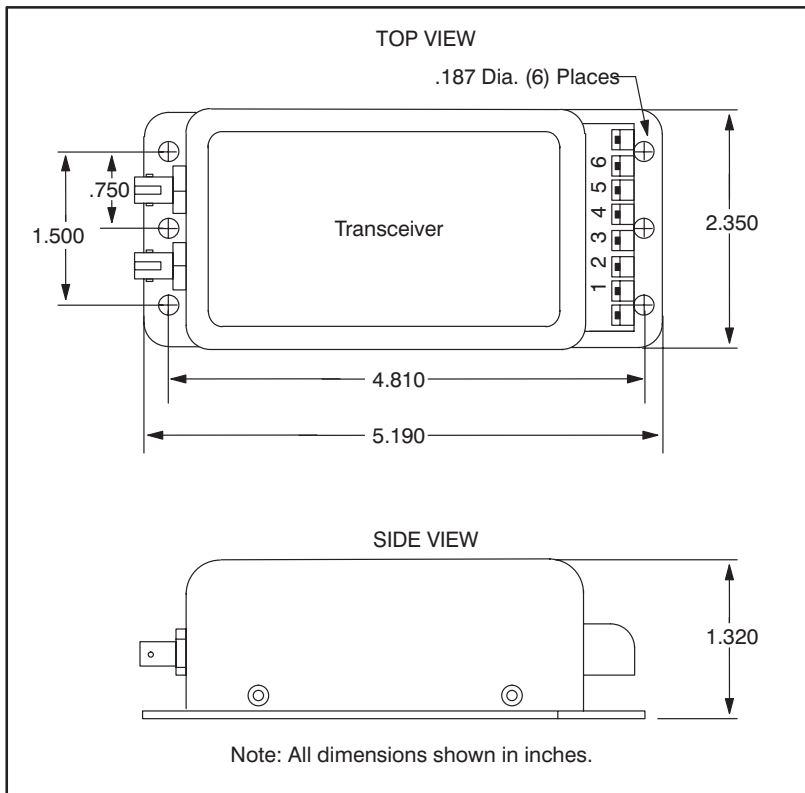


Figure K2.1 - Stand-Alone Transceiver Mounting Dimensions

- 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 K2.2.

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	+24VDC
6	GROUND (Connected to transceiver enclosure)

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

Figure K2.2 - Stand-Alone Transceiver Terminal Block Connections

- Step 4. Connect the transceiver to the fiber-optic network using the guidelines provided in section K2.5.
- Step 5. Turn power on to the transceiver.

K2.3 Installing the Rack/Power Supply and Rack-Mounted Transceivers

The user is responsible for providing the means for rack installation 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 VAC as required.
- Step 2. Install the rack using #8 screws. Allow at least 1" to 2" clearance around the rack for adequate ventilation. Rack mounting dimensions are shown in figure K2.3.

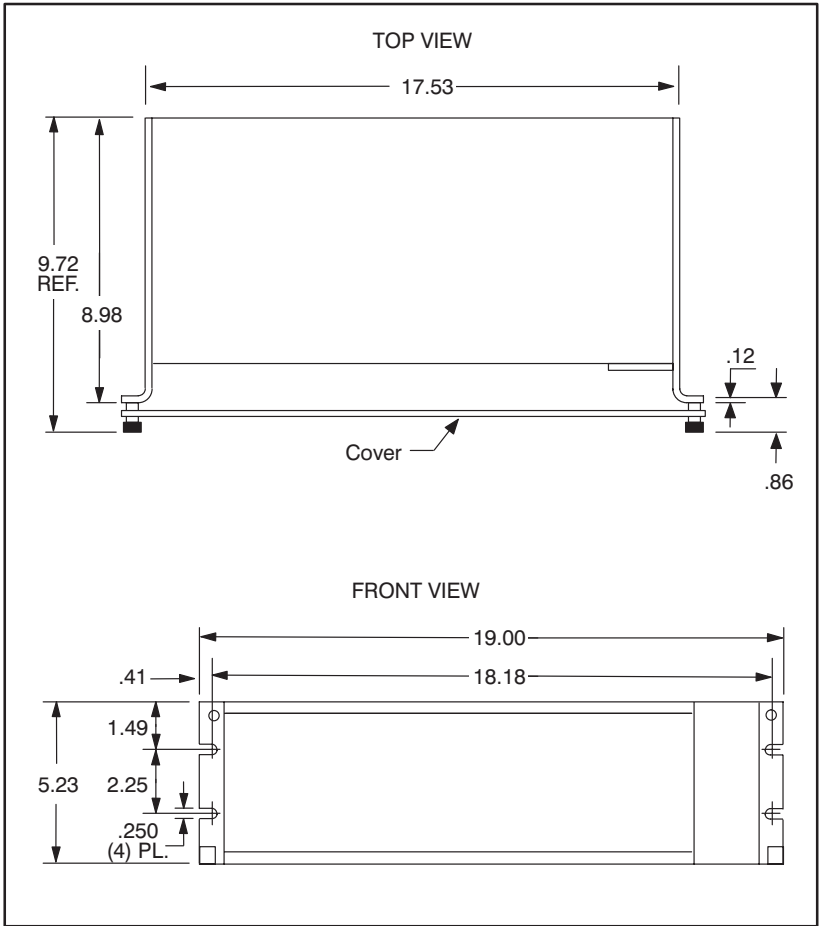


Figure K2.3 - Fiber-Optic Rack Mounting Dimensions

- 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 G) to make all signal connections between transceivers as shown in figure K2.4. To improve network serviceability, make the signal connections between transceivers on a separate terminal strip as shown in figure K2.5. 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 K2.4 - Rack-Mounted Transceiver Terminal Block Connections

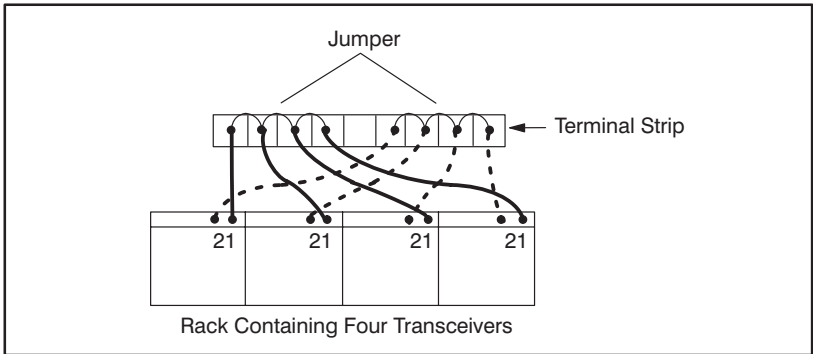


Figure K2.5 - Connecting Rack-Mounted Transceivers to a Terminal Strip

- Step 5. Connect each transceiver to the fiber-optic network using the guidelines provided in section K2.5.
- Step 6. Verify that the external power supply is turned off. Connect the power cord to a 115 or 230VAC 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.

K2.4 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, Reliance Electric recommends that you 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 (3" or 75mm) 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 Remote I/O module slot.

K2.4.1 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 Appendices F and G for cable and connector specifications. Appendix G also lists 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.

K2.5 Connecting a Fiber-Optic Cable Between a Stand-Alone Transceiver and a Rack-Mounted Transceiver

WARNING
<p>TURN OFF AND LOCKOUT OR TAG POWER TO BOTH THE MASTER OR SLAVE DROP AND THE CORRESPONDING RACK-MOUNTED OR STAND-ALONE TRANSCEIVER 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.</p>

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 K2.6. 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.

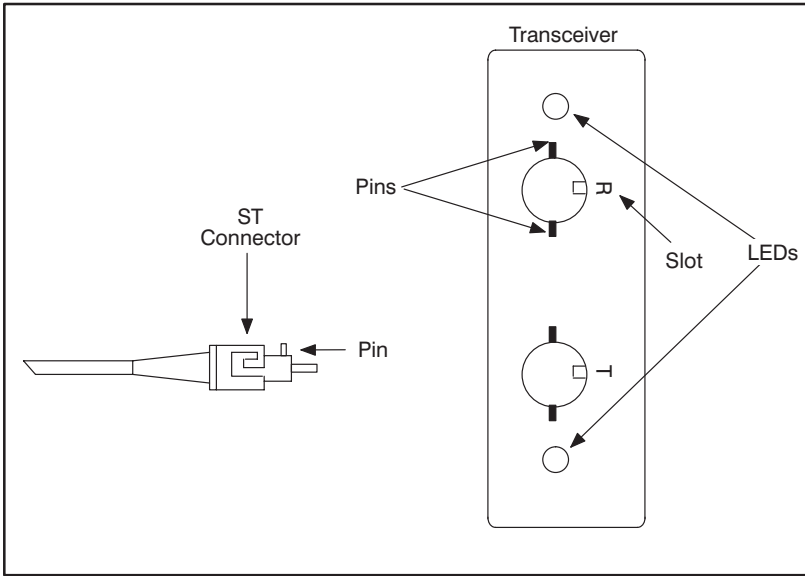


Figure K2.6 - Fiber-Optic Ports and Connectors

K2.6 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 section K2.2. Connect the jumper between terminals 3 and 4.
- Step 6. Re-connect the fiber-optic cable as shown in section K2.5.
- Step 7. Turn power on to the external power supply.

K2.7 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 section K2.3.
- Step 9. Connect the fiber-optic cable as shown in section K2.5.
- 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.

L2.8 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 Remote I/O 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 230VAC source.
- Step 4. Disconnect the Power Supply's power cord from the external 115 or 230VAC 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 VAC 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 (refer to section K2.3) and fiber-optic cable (refer to section K2.5).
- Step 10. Connect the power cord to the 115 or 230VAC source.
- Step 11. Turn power on to the 115 or 230VAC 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.

K2.9 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 section K2.4.
- Step 2. Calculate the new link length. Ensure the new total cable length does not exceed the maximum cable length defined in Appendix H. 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 section K2.4.
- Step 4. Install the new Stand-Alone Transceiver following the instructions provided in section K2.2.
- Step 5. Stop all communications over the AutoMax network.
- Step 6. Install the new Rack-Mounted Transceiver following the instructions provided in section K2.3.
- Step 7. Resume network operation.

K2.10 Disconnecting a Network Drop

Use one of the following methods to disconnect a drop from the Remote I/O network. Note that you do not need to stop network operation when you disconnect a drop from the network.

- Disconnect the drop cable or the Tee Adapter from the selected module.
- Disconnect the fiber-optic cable from the Stand-Alone Transceiver.
- Disconnect the fiber-optic cable from the Rack-Mounted Transceiver.

K2.11 Fiber-Optic Cable System Maintenance

The following sections describe recommended maintenance procedures.

K2.11.1 Cable System Documentation Maintenance

Keep the network cable system documentation up-to-date with all changes made to the network configuration during the life of the network.

K2.11.2 Cable System Design Maintenance

When old equipment is relocated or new equipment is installed, new sources of heat, 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 re-routing certain fiber-optic cables.

K2.11.3 Cable System Inspection

Inspect the fiber-optic cable system periodically. Use the optical time domain reflectometer (OTDR) or power meter for the cable inspection. OTDRs can also be used to perform cable testing during the installation or to locate a possible cable fault during troubleshooting. All tests should be properly documented.

K3.0 DIAGNOSTICS AND TROUBLESHOOTING

This section describes how to troubleshoot the fiber-optic Remote I/O network and its components. Refer to section 6.0 of this manual for troubleshooting procedures for the Remote I/O module, the Remote I/O Head, Remote Drive Interface Head, and the Shark Interface module.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL 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 IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

K3.1 Network Failure

Problem: Error code C appears on any Remote I/O module's LED display. This error code indicates a network failure. Read section 6.3 of this manual and follow step 1-4 before continuing with the procedure described below. The following procedure is used to isolate the cause of a network failure by systematically checking the hardware components that make up a point-to-point fiber-optic link. After each step, determine if the problem has been corrected before continuing to the next step.

- Step 1. Verify that the connections are secure between the drop faceplate and the Stand-Alone Transceiver. (Depending upon the application, this will require checking the drop cable or the Tee Adapter and balun connections.) Verify that its connections to the Stand-Alone Transceiver's terminal block are secure and correct as shown in figure K2.2.
- Step 2. Check the Stand-Alone Transceiver. Using a voltmeter, verify that the power supply voltage is within normal limits. Verify that the fiber-optic cable connections are secure. Note that the LEDs on the transceiver will flicker to indicate that the transceiver is sending/receiving messages. Verify that the jumper is securely connected between terminals 3 and 4. Replace the transceiver.
- Step 3. Check the fiber-optic cable. Verify that the cable has not been damaged due to improper handling (e.g., bending it beyond the minimum bend radius). Test the cable using a fiber-optic power meter or a fiber-optic time domain reflectometer (OTDR). The recommended cable assembly test set is listed in Appendix F. Replace the cable.
- Step 4. Remove the plastic panel from the front of the Fiber-Optic Rack, and check the corresponding Rack-Mounted Transceiver.

- a.) Using a voltmeter, verify that the power supply voltage is within normal limits. (This step assumes that the Power Supply in the the Fiber-Optic Rack is functional; refer to section K3.2). The power status indicator on the faceplate should be on. If it is off, unscrew the captive screws on the faceplate and remove the transceiver from the rack. Using a voltmeter, verify that the rack is supplying 14 to 18 VAC through the plug in the backplane. Re-insert the transceiver into the rack securely. Replace the transceiver.
- b.) Verify that the fiber-optic cables are connected securely to the transceiver. Note that the LEDs on the transceiver will flicker if it is sending/receiving messages.
- c.) Verify that the data signal wiring is connected securely to the four-screw terminal block as shown in figure K2.4.
- d.) If the transceiver is located at one of the extreme ends of the rack, verify that the jumper is securely connected between terminals 3 and 4 of the transceiver's six-screw terminal block.

K3.2 Power Supply Status Indicator is OFF

Problem: The green status light on the face of the Power Supply is off. This light should be on to indicate the presence of power. If this light is off, use the following procedure to isolate the cause.

- Step 1. Verify that the rocker switch on the front of the Power Supply is in the ON position.
- Step 2. Verify that the Power Supply is receiving correct input power.
- Step 3. Verify that the selector switch is in the appropriate position (115 or 230).
- Step 4. Turn off power to the Fiber-Optic Rack. Remove the fuse from the Power Supply and, using an ohmmeter, verify that the fuse is not blown. If the fuse is good, re-insert it and continue with step 5
If the fuse is blown, replace it with the fuse type specified in Appendix A.
- Step 5. Turn on power to the rack. If the problem is not corrected, replace the Fiber-Optic Rack and Power Supply.

K3.3 Fiber-Optic Link Adjustment

If a fiber-optic link between any two transceivers is longer than 1000 meters and the values in registers 15-18 increase consistently, you may have to adjust the duty cycle of the the received signal on each end of the link. Use the following procedure:

- Step 1. Disconnect all other links from the network.
- Step 2. Connect an oscilloscope between terminals 1 and 2 on the transceiver terminal block. The received signal amplitude is approximately 4 volts peak-to-peak.

- Step 3. The received signal duty cycle should be 50%. If it is not, then use the potentiometer on the transceiver to adjust it. The potentiometer is located between the two fiber-optic connectors as shown in figure K3.1. Remove the snap-in button to access and adjust the potentiometer.

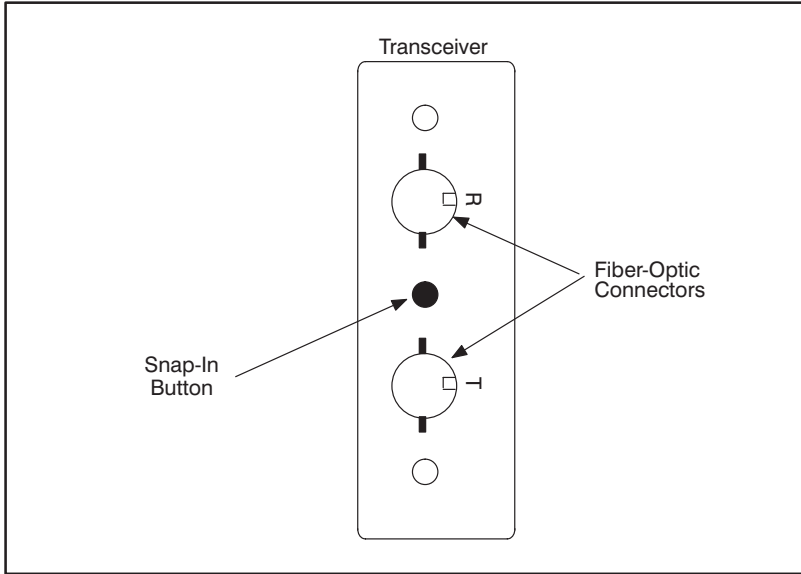


Figure K3.1 - Potentiometer Location

Numbers

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- M/N 57C329, remote drive interface head, 2-7, 2-10, A-4
- M/N 57C330, remote I/O head, 2-5, 2-10, A-3
- M/N 57C365, M/N 57C367, M/N 57C368, fiber-optic transceivers, A-5
- M/N 57C380, communications passive tap, 3-4
- M/N 57C381, drop cable, 3-4
- M/N 57C416, remote I/O module, 2-1, 2-8, 5-1, A-1
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