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Network Communications Module

M/N 57C404

Instruction Manual J2-3001-4

Rockwell Automation

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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.

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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Please note: References in this manual to 57C404 may be followed by a letter indicating a revision. All references to 57C404B in this manual apply to 57C404C. 57C404C reflects a firmware revision of the 57C404B.

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1.0 INTRODUCTION

The products described in this instruction manual are manufactured by Rockwell Automation Company.

The Network Communications module (M/N 57C404B) provides the necessary hardware required to transmit control and status data between two or more AutoMax®/DCS 5000 racks to create a distributed control system. The racks that make up the AutoMax DCS-NET network are called "drops". Each drop connected to the network must contain a Power Supply module, a Processor module, and a Network Communications module.

The network uses a master/slave software protocol. The master initiates and controls all transmissions on the network. All transmissions are broadcast, i.e., all modules receive the data packets simultaneously. An address is encoded in each data packet to identify which slave is to respond to a particular transmission. The slave's response is also broadcast with all drops receiving the response data packet.

Each module contains a 4K word dual-port memory for storing the data that is transmitted over the network. The dual-port memory of each Network module on the network contains an image of the latest version of all the network data. This allows each section of a multi-section control system to access data quickly from all other sections of the system. The dual-port memory can be accessed by the on-board CPU as well as over the backplane bus by any Processors in the rack through application programs.

Any slave Network module can be software-configured to function as more than one drop. The number of slave drops that a Network module represents is defined as the "drop depth" of that Network module. The number of virtual (software-configured) drops is limited to 55.

The physical drops (racks containing a Network module) are connected using coaxial cable or, when high noise immunity and total electrical isolation is required, fiber-optic cable. The coaxial cable network is organized 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. Up to 51 physical drops can be connected to the coaxial cable network depending upon the type of cable used and network length.

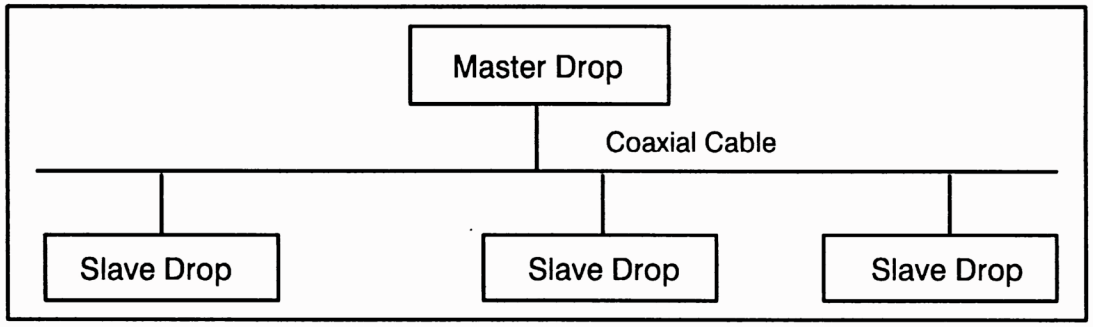


Figure 1.1 - A Typical DCS-NET Coaxial Cable Network Layout

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. Up to 55 physical drops can be connected to the fiber-optic network.

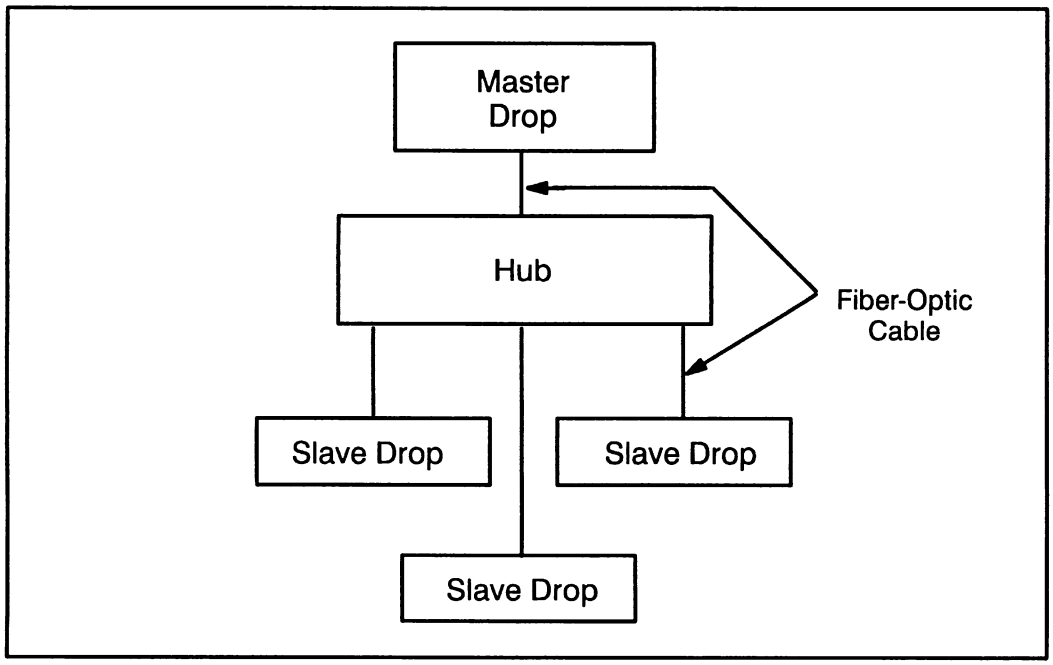


Figure 1.2 - A Typical DCS-NET Fiber-Optic Cable Network Layout

The type of cable used (whether coaxial or fiber-optic) does not effect the operation of the DCS-NET network protocols, application software, or the operation of the Network module.

Each rack on the network can contain multiple Network modules that are part of different networks to create a more complex system. Refer to figure 1.3.

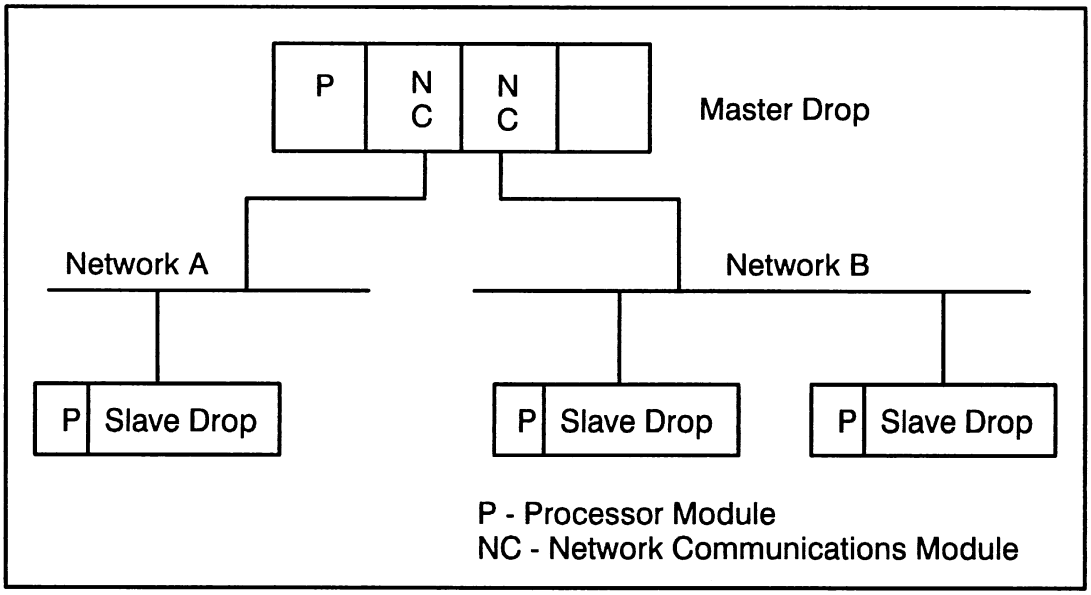


Figure 1.3 - Multiple Network Connections (Coax)

An IBM™-compatible personal computer connected through any AutoMax™ Processor can program/monitor any Processor on any network that has a drop in that rack. For example, in figure 1.4, an IBM-compatible personal computer connected to an AutoMax Processor in Slave drop 1 can be used to load the AutoMax Programming Executive to a Processor located in Slave drop 3.

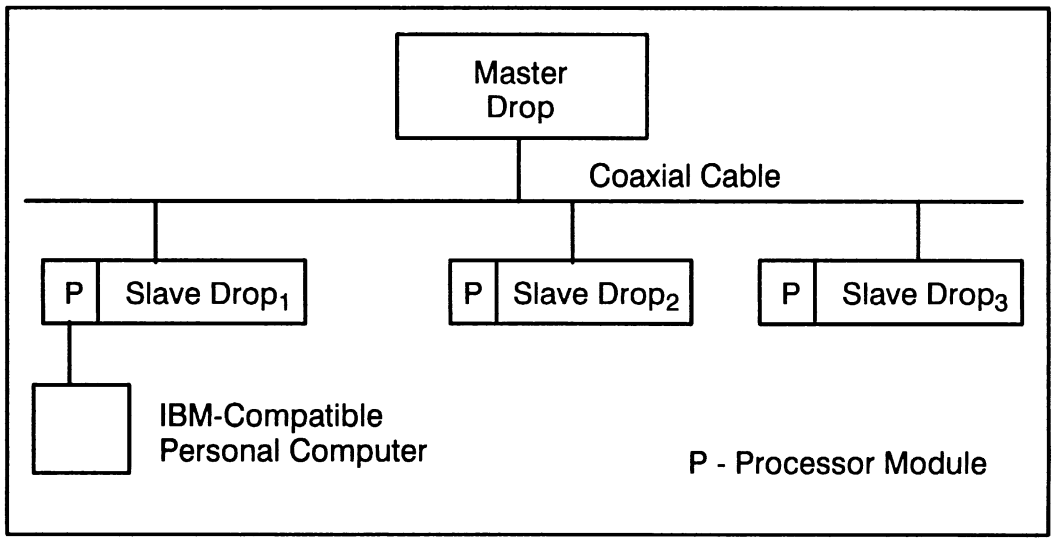


Figure 1.4 - Programming Terminal Communication Example (Coax)

Also, an IBM-compatible personal computer connected directly to the network (using an AutoMax PC Link Interface module, M/N 57C445) can access any drop on that network. See figure 1.5.

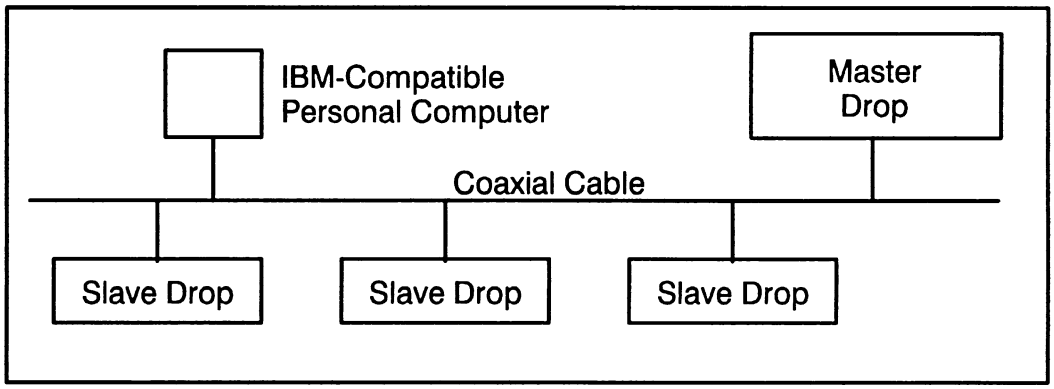


Figure 1.5 - A Personal Computer Connected Directly to the AutoMax Network (Coax)

The remainder of this manual describes the functions and specifications of the Network Communications module. It also includes a detailed overview of installation and servicing procedures, as well as examples of programming methods.

1.1 Additional Information

You must be familiar with all the instruction manuals that describe your system configuration. This may include, but is not limited to, the following:

- J-3616 KERMIT Reference Manual
- J-3618 NORTON Editor Reference Manual

- J-3650 AutoMax Processor Instruction Manual
- J-3675 AutoMax Enhanced Basic Language Instruction Manual
- J-3676 AutoMax Control Block Language Instruction Manual
- J-3677 AutoMax Ladder Logic Instruction Manual
- Your personal computer and DOS instruction manuals
- IEEE 518 Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers
- Your ReSource AutoMax Programming Executive Instruction Manual

1.2 Related Hardware and Software

M/N 57C404B contains the Network Communications module. It is used with the following hardware and software (purchased separately):

1. AutoMax Programming Executive software Version 3 or later. The Programming Executive software includes the tools required for programming in Enhanced BASIC, Control Block, and Ladder Logic/PC languages. Earlier versions of the Programming Executive are also supported. Refer to Appendix E.
2. M/N 57C430A, 57C431, or 57C435 AutoMax Processor.
3. M/N 57C407 DCS 5000 Processor (standard network support only; does not support network programming).
4. M/N 57C380 Communications Passive Tap. This is required at each network drop for connection to coaxial cabling.
5. M/N 57C381 Cable. This cable is used between the Network module and the passive tap in a coaxial cable network.
6. M/N 45C71 Coax BNC 75 Ohm Terminating Load. All coax systems require a terminating load at both ends of the cable.
7. M/N 57C366 – Cable. This cable is used between the Network module and a transceiver in a fiber-optic network.
8. M/N 57C365 – Stand-Alone Transceiver. This is required at each slave network drop for connection to fiber-optic cabling.
9. M/N 57C368 - Fiber-Optic Rack with Power Supply. This is used to mount the individual Rack-Mounted Transceivers to create a hub in a fiber-optic network.
10. M/N 57C367 – Rack-Mounted Transceiver. This is required in the Fiber-Optic Rack for each network drop for communication between drops.
11. M/N 57C445 – AutoMax PC Link Interface Module. This module allows an IBM-compatible personal computer to function as a drop on the AutoMax network.

2.0 MECHANICAL/ELECTRICAL DESCRIPTION

This section describes the mechanical and electrical characteristics of the Network Communications module.

2.1 Mechanical Description

The Network Communications module is a printed circuit assembly that plugs into the backplane of the AutoMax/DCS 5000 rack. The module consists of the 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 the module faceplate.

The 25-pin D-shell connector on the faceplate labeled "MONITOR" is used for the RS-232-compatible asynchronous link. An RS-232 compatible terminal which uses ASCII characters can be connected to the module for local monitoring. The 9-pin D-shell connector on the faceplate labeled "NETWORK" is used for the synchronous serial rack-to-rack communication line.

The two thumbwheel switches on the faceplate are used to set the network drop number. The upper thumbwheel switch represents the most significant digit, the lower switch represents the least significant digit. 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 which displays error codes. The error codes are defined in Appendix D. A green status light on the faceplate indicates when the module is operational (ON) or should be replaced (OFF).

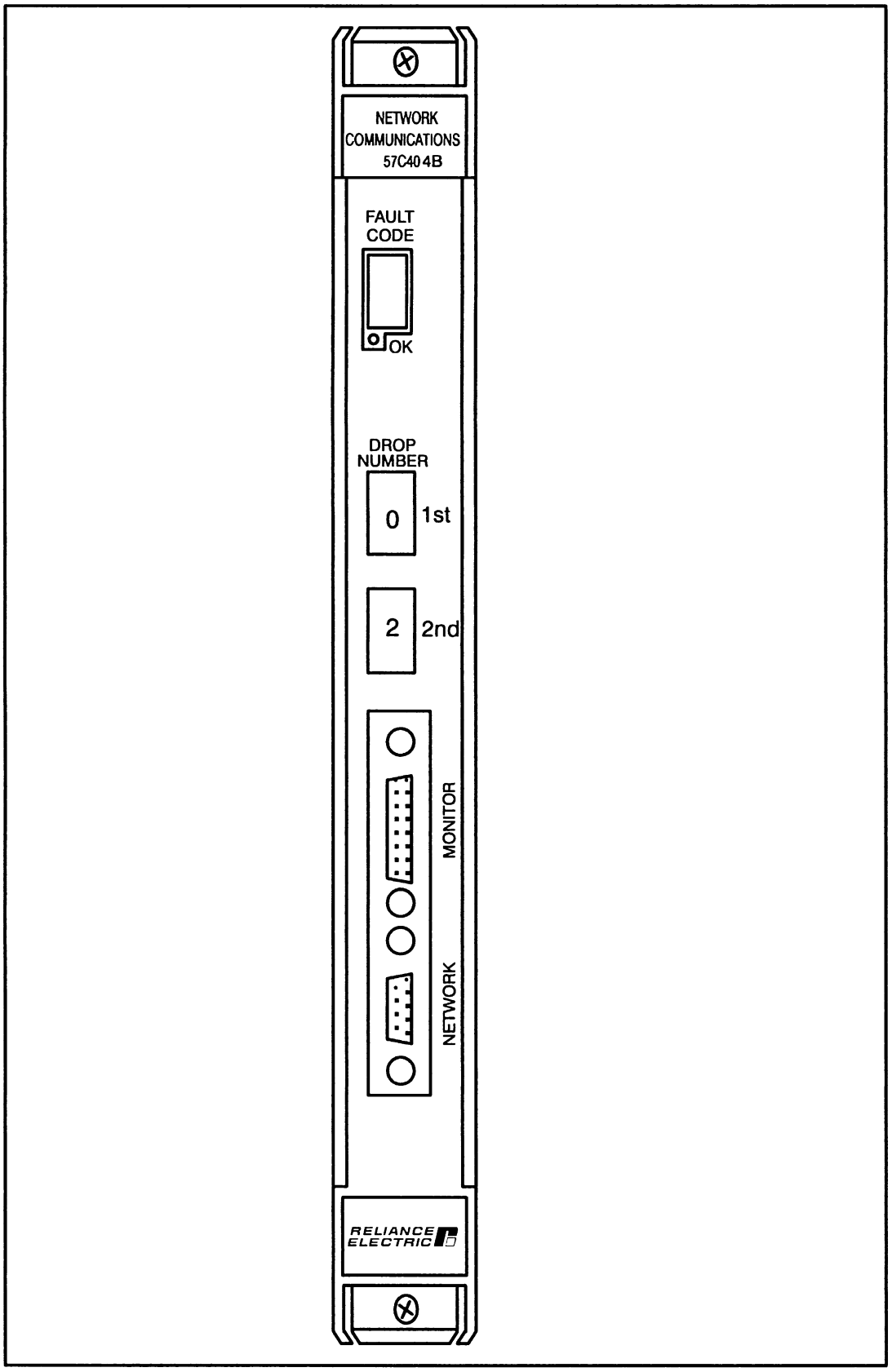


Figure 2.1 - Network Communications Module Faceplate

2.2 Electrical Description

Network operation is controlled by a 4 MHz CPU/direct memory access (DMA)/serial I/O (SIO) architecture. 4K words of dual port memory is provided to store the network variables. All program application data is sent and received by the Network module's CPU; no additional load is put on the main Processor modules for communication.

A slave module can be software-configured to function as more than one Network module. This feature provides for increased register capacity within one Network slave module. The dual-port memory in each module is divided into 56 areas called drop areas. Each drop area contains 64 16-bit registers. The master transmits 32 registers to each slave drop area and receives 32 registers from each slave drop area. By configuring a slave module to perform the function of "n" slave drops, n x 32 registers are transmitted to and received from the slave module. This is the functional equivalent of plugging "n" Network modules into the rack.

The number of slave drops that a Network module represents is defined as the "drop depth" of that Network module. The slave module will represent consecutive drop numbers beginning with the drop setting (the value of the thumbwheel switches on the faceplate). For example, if the thumbwheel switches have been set to "05" and the drop depth is equal to 4, that slave module will perform the function of drops 5, 6, 7, and 8.

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

At power up, the on-board processor will run diagnostics on the CPU, 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 diagnostic, the on-board CPU halts, the watchdog times out, and the seven-segment display shows the code of the failed diagnostic.

2.2.1 Data Transmission Cycle

The following example is used to illustrate how data is transmitted over the network. Assume a network is composed of three racks in the following arrangement:

In the master control rack, there is one Network module that has been defined as the master by setting the thumbwheel switches to "00". The master has no drop depth and this cannot be modified. In the second rack, there is a slave module that has been defined as drop 1 by setting the thumbwheel switches to "01" and has been given a drop depth of 1 (it will represent drop 1 only). In the third rack, there is a slave module that has been defined as drop 2 by setting the thumbwheel switches to "02" and has been given a drop depth of 2 (it will represent drops 2 and 3). The assignment of drop numbers between 1 and 55 is arbitrary, and the physical order of drop connections has no effect on the system. See figure 2.2.

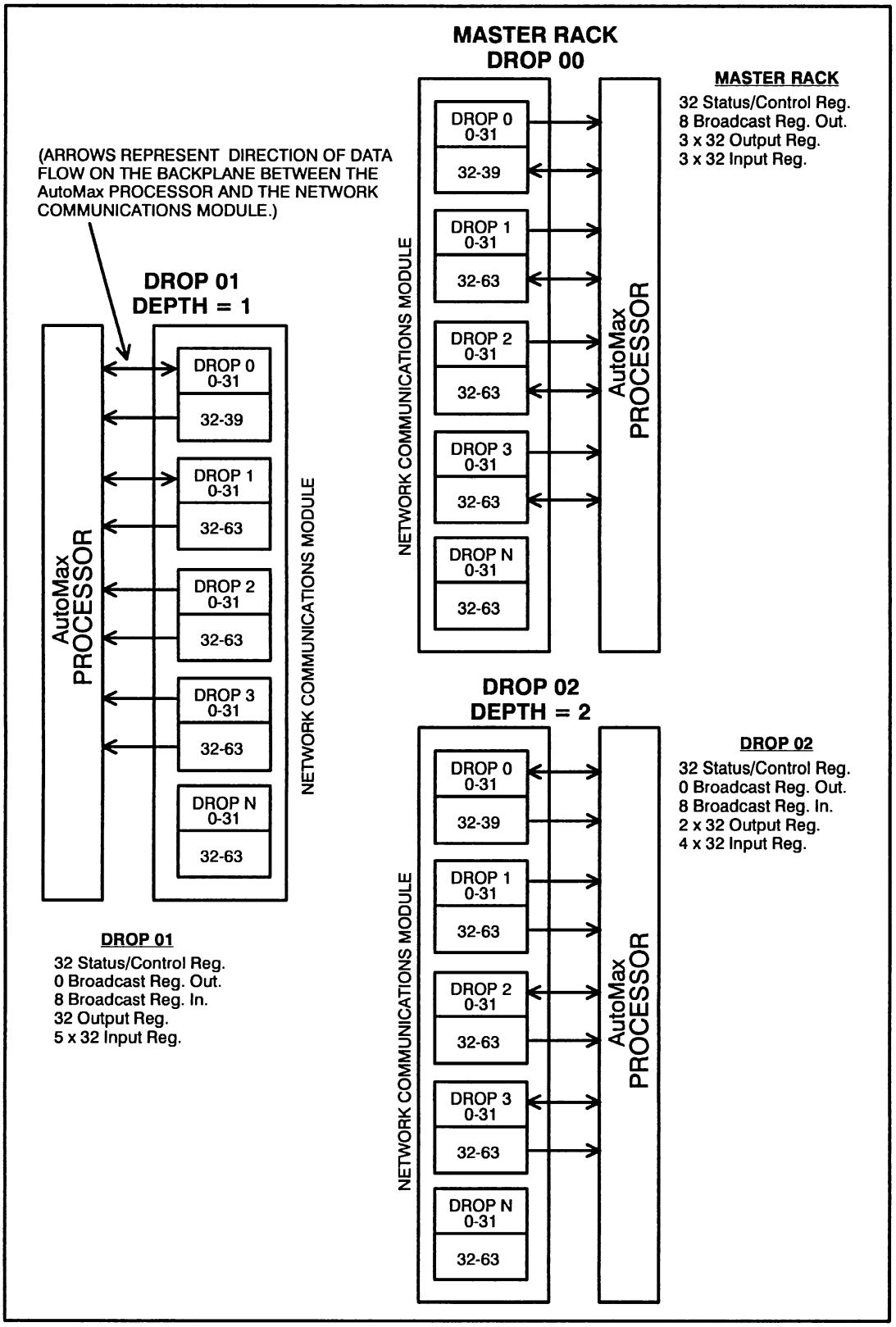


Figure 2.2 - Sample Network

At power up, the master polls all the slave drops to determine which drops are active on the network and sets the appropriate bits in its status registers (refer to section 4.1.1.1). The master initiates all transmissions on the network. During a communications cycle, the master will begin transmitting data to each active drop on the network in sequence. In this case, the master will transmit its broadcast registers (refer to section 4.1.1.11) and registers 32 to 63 of its drop 1 area. This packet of data is sent simultaneously to all active drops on the network. In other words, the broadcast registers in the drop 0 area and the second 32 registers in the drop 1 area on both slave Network modules will be updated with this transmission. See figure 2.3.

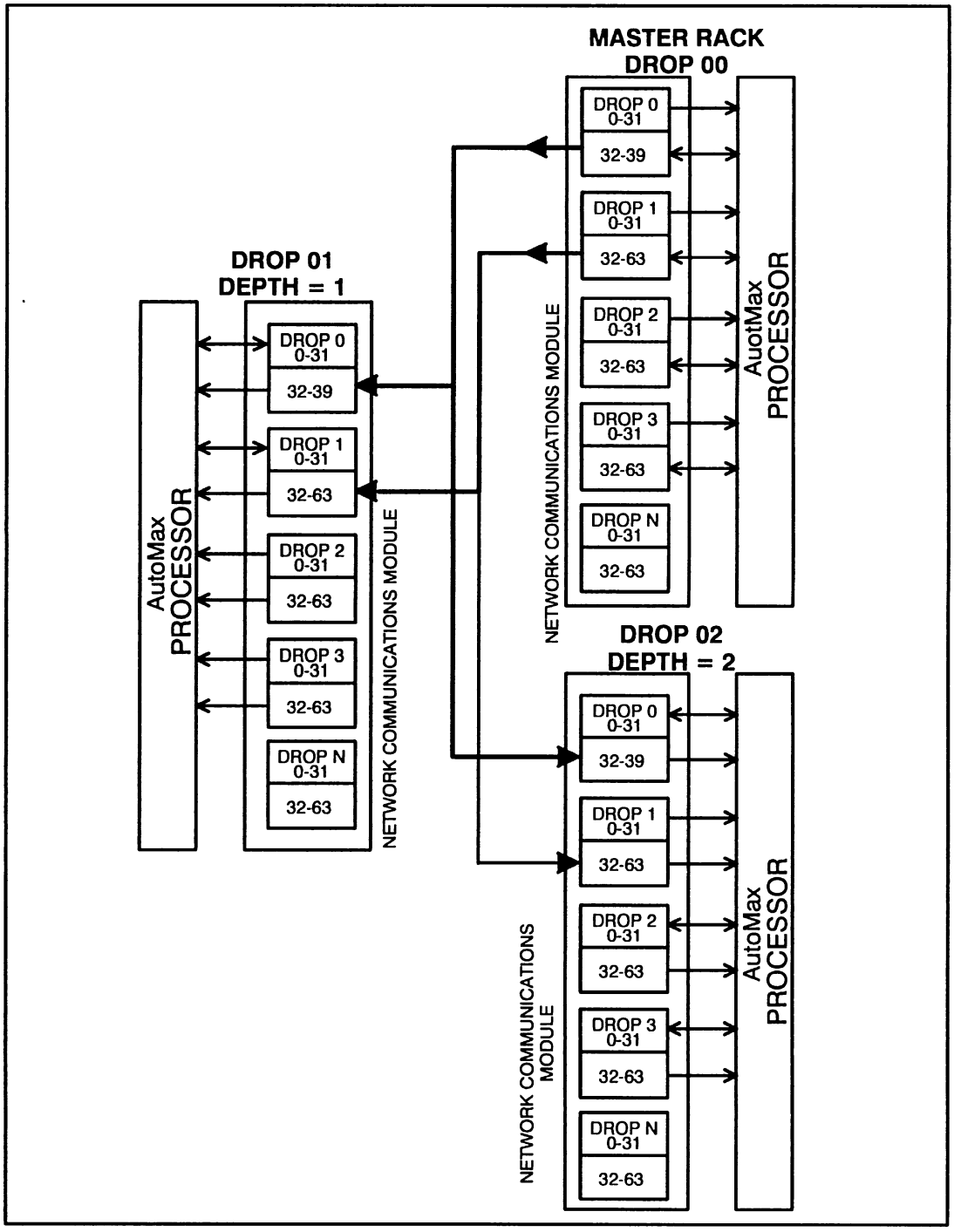


Figure 2.3 - Master Initiates Transmission

Encoded in this packet of data is the address of the drop area which is to respond to the transmission. In this case, drop 1 has been addressed and must transmit the first 32 registers of its drop 1 area to the master. The first 32 registers of the drop 1 area on the second slave module are also simultaneously updated. See figure 2.4.

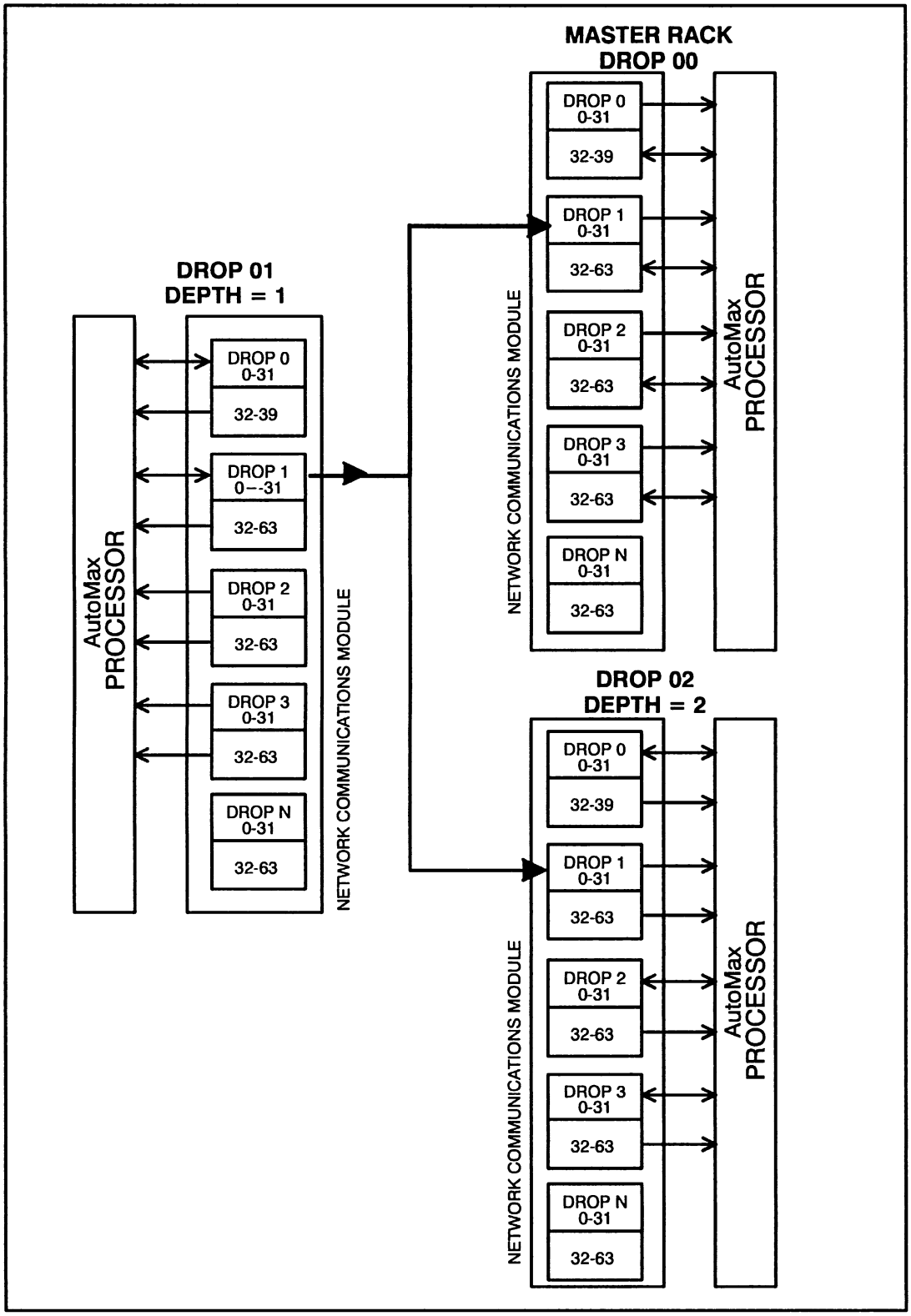


Figure 2.4 - Drop 1 Responds

The master then addresses the next sequential active drop on the network. In this case, this is drop 2. The master transmits its broadcast registers and the second 32 registers of its drop 2 area to all active drops on the network with drop 2 responding. See figures 2.5 and 2.6.

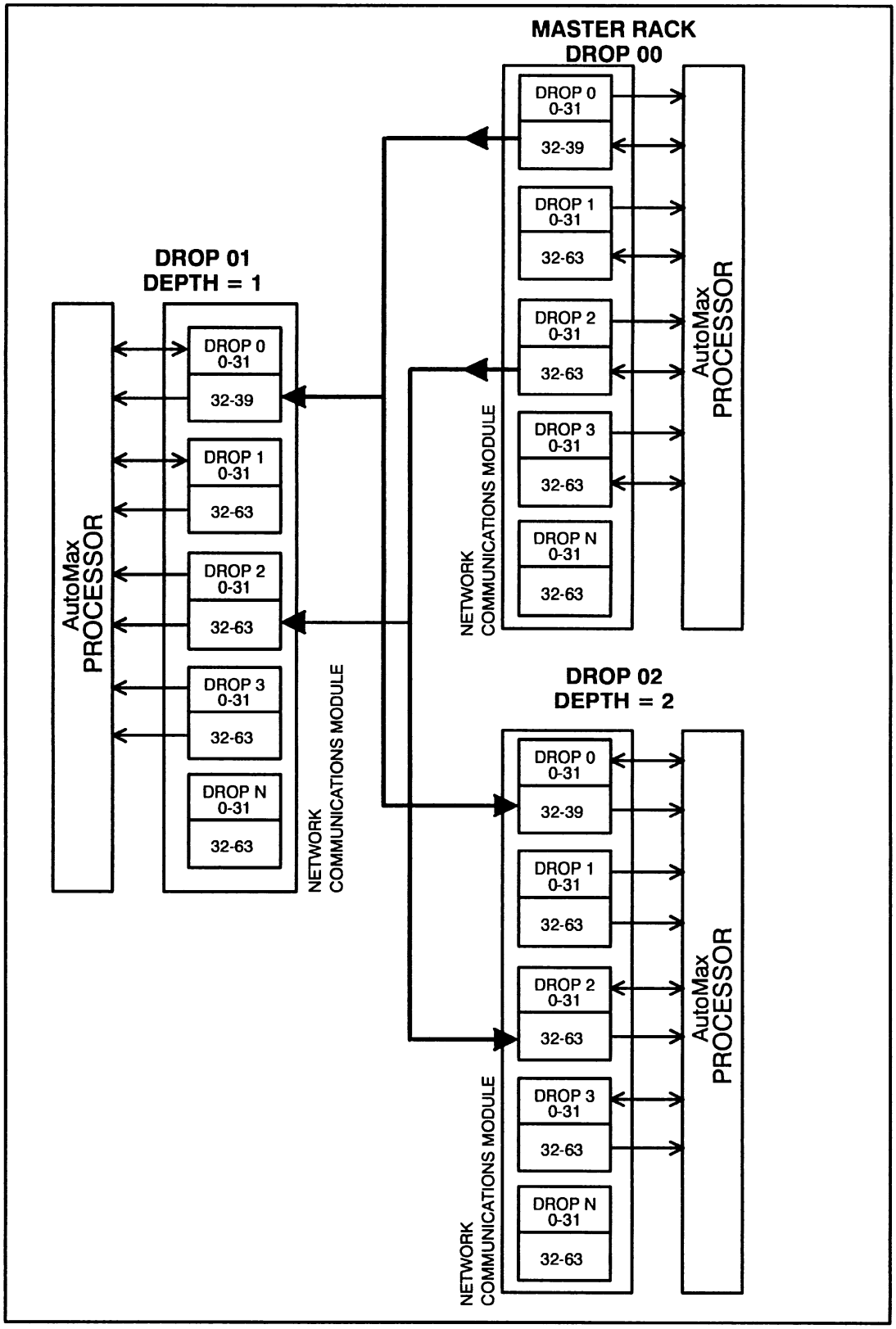


Figure 2.5 - Master's Second Transmission

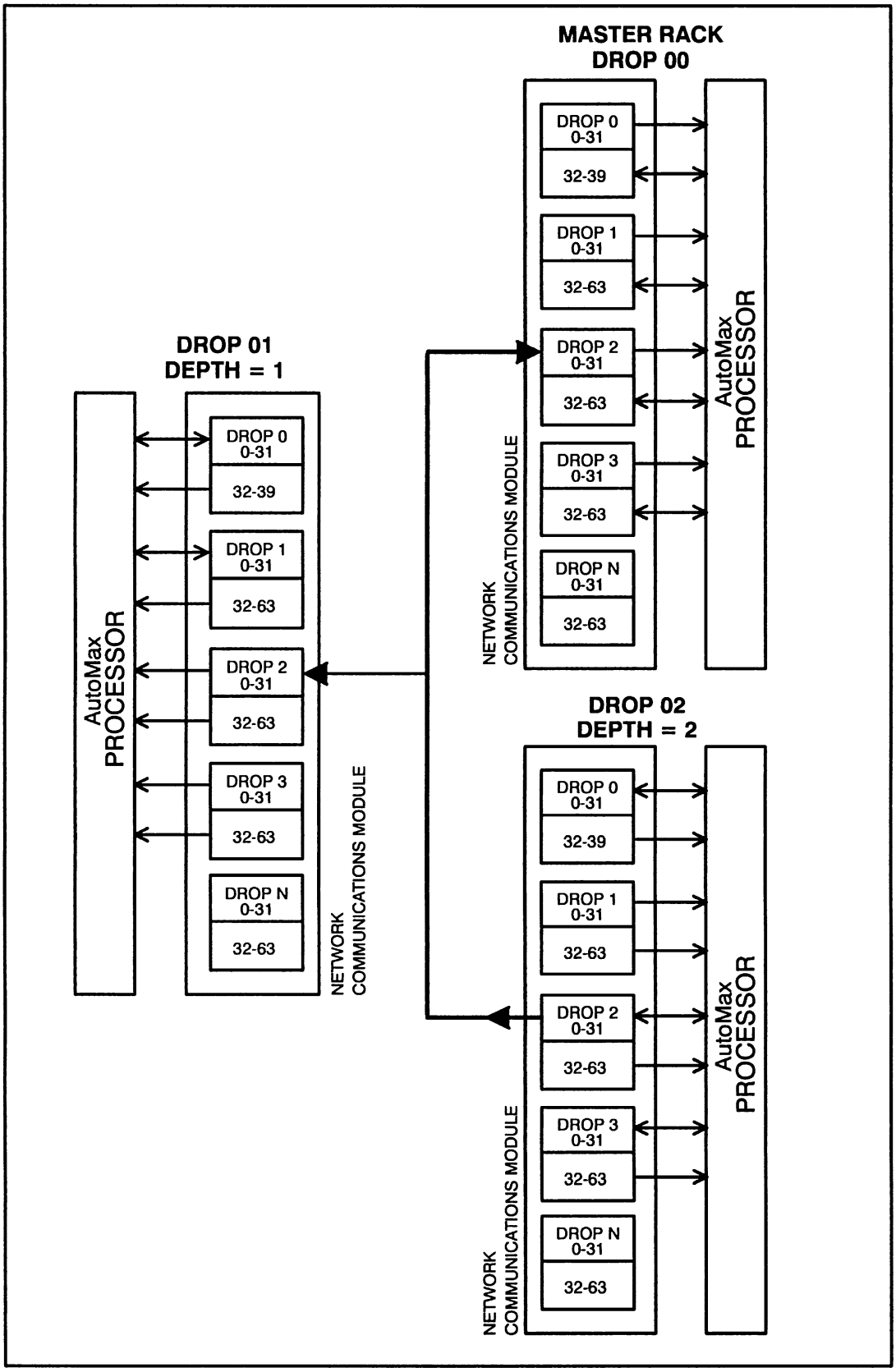


Figure 2.6 - Drop 2 Responds

The process continues until all active drops have exchanged data with the master. At this time, a programming terminal message can take place. Programming terminal messages can be transmitted from one drop to another drop. The master then polls one inactive drop to see if it has been added to the network. If a response is received, the appropriate bit is set in the master's drop status registers. The cycle then begins again with drop 1. The master will poll only one inactive drop after it has completed communicating with all of the active drops on the network.

To continue the above example, assume drops 4 and 5 have been added to the network. After the master has completed communicating with drop 3, it would poll drop 4. Drop 4 would respond and would be considered by the master to be active on the network. Drop 5 would not be polled and would not be active on the network until the master had completed another communication cycle with drops 1 through 4.

All messages are checked for correctness by the receiving drop. A message will be re-transmitted up to three times if a response is not received from the targeted drop. Any drop unable to correctly transmit or receive data will go off line.

If a slave drop fails, the master, upon recognizing that a slave drop has failed, will clear that drop's status bit. The bit will remain OFF for a minimum of 120 milliseconds in order for an application task to be able to detect it. The value of the slave's output registers in the master are fixed at their last value prior to communication loss. The values of master output registers to the slave are also fixed. The register values will resume updating between the master and slave when communication is restored. If a master drop fails, the entire image in the master's dual port memory will be cleared. All network slave drops will detect the master drop has failed and will clear all drop status bits and wait for the master to re-establish communication.

3.0 INSTALLATION

This section describes how to plan, construct, and install the AutoMax network coaxial cable system and how to install the Network Communications module. This section is limited to network coaxial cable installations in a metal conduit inside a manufacturing building. Guidelines for fiber-optic cable installation are provided in Appendix L. For information regarding other types of installations, contact Reliance Electric. Refer to section 3.6 for Network module installation 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

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: Powering down a cluster of drops may result in loss of communication on a coaxial cable network. Disconnect the drop cable from the passive tap before powering down a drop.

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 Network Coaxial Cable System Components

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

- Drop Cable
- Communications Passive Tap
- Coaxial Cable
- BNC Plug Connector

- BNC 75 Ohm Terminating Load
- BNC Jack-to-Jack In-Line Splicing Adapter

An example of the AutoMax network cable system is shown in figure 3.1. Appendix J lists the components recommended by Reliance Electric. The following sections describe each of these components.

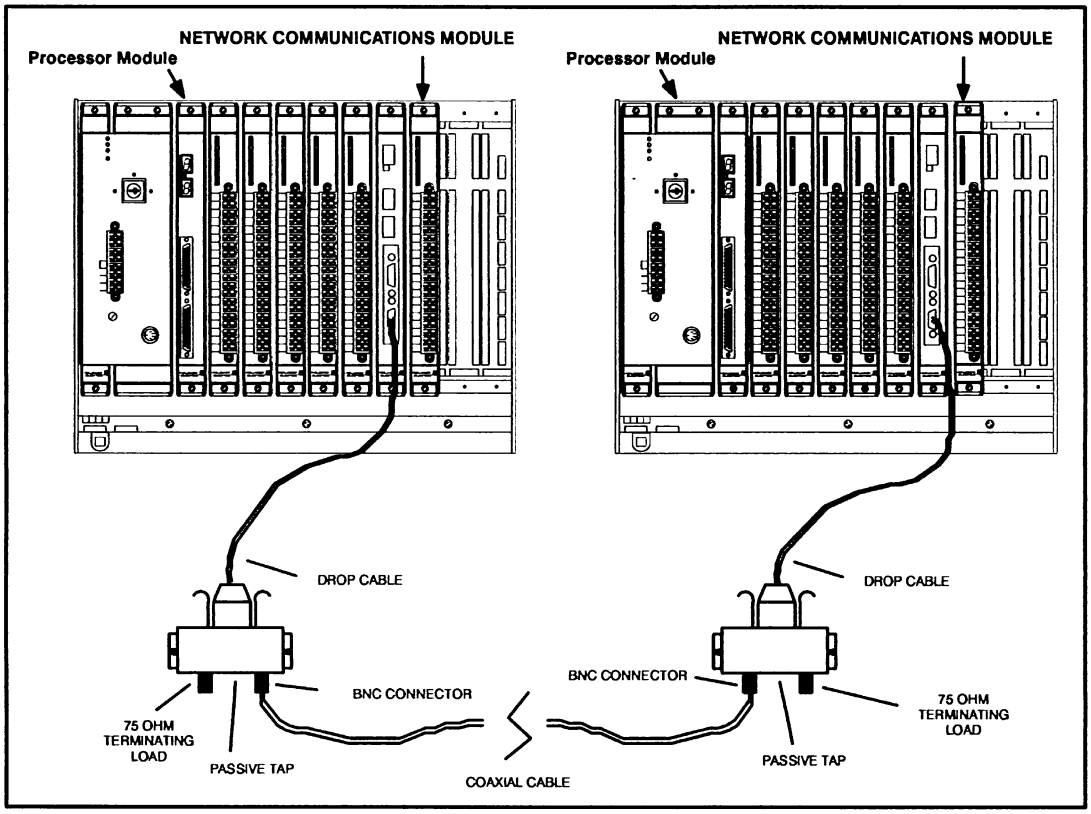


Figure 3.1 - AutoMax/DCS Network Coaxial Cable System

3.1.1 Drop Cable and Communications Passive Tap

The drop cable and the Communications Passive Tap (tap) are used to connect the Network module to the coaxial cable. The drop cable (M/N 57C381) is a three-foot long multiconductor cable with two 9-pin D-shell connectors at either end. It connects the Network module to the tap.

The tap (M/N 57C380), shown in figure 3.2, provides two BNC jack connectors for connection to the coaxial cables and terminating loads. A 9-pin D-shell connector is provided for connection to the drop cable. The tap has two fault isolation resistors in series with the transmission line to prevent a malfunctioning Network module from affecting other drops on the network. A schematic of the tap is shown in Appendix G.

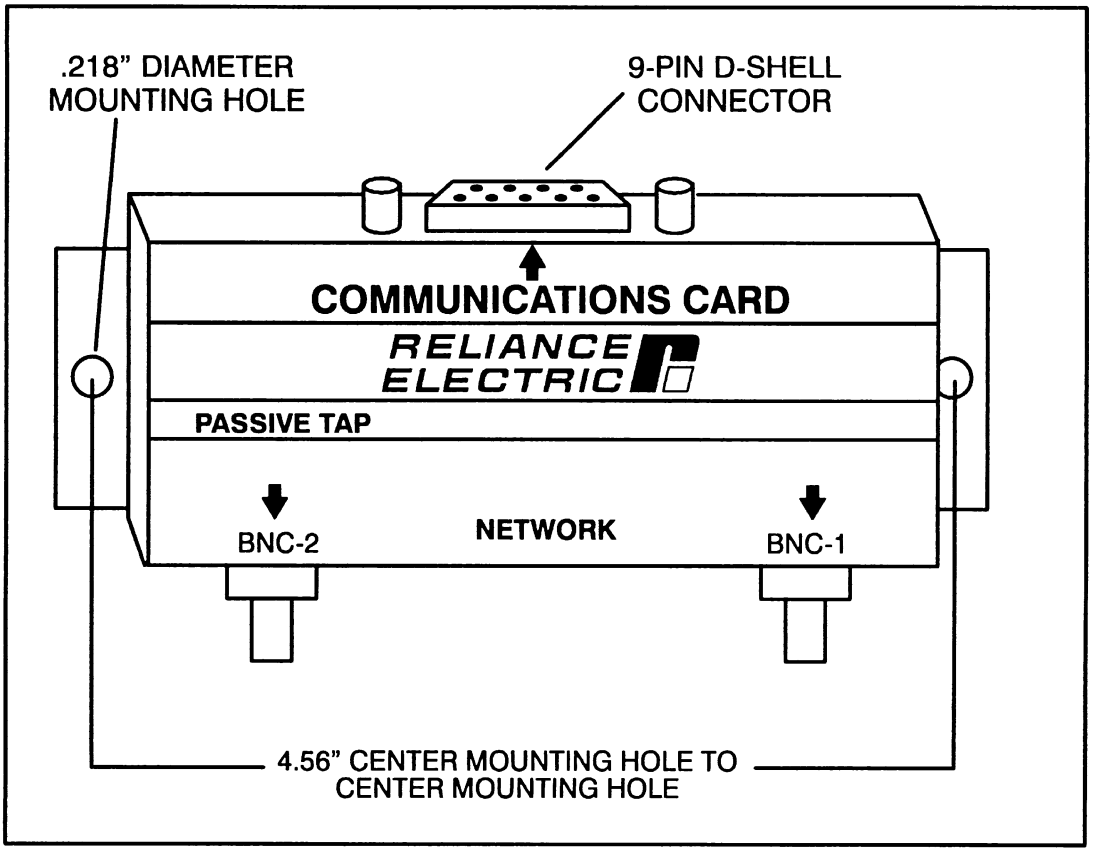


Figure 3.2 - Communications Passive Tap

3.1.2 Coaxial Cable

The DCS-NET network utilizes two types of coaxial cable, RG-59/U or RG-11/U. Cable specifications are provided in Appendix I. Refer to section 3.4 for recommendations regarding cable type selection. Figure 3.3 shows the composition of coaxial cable.

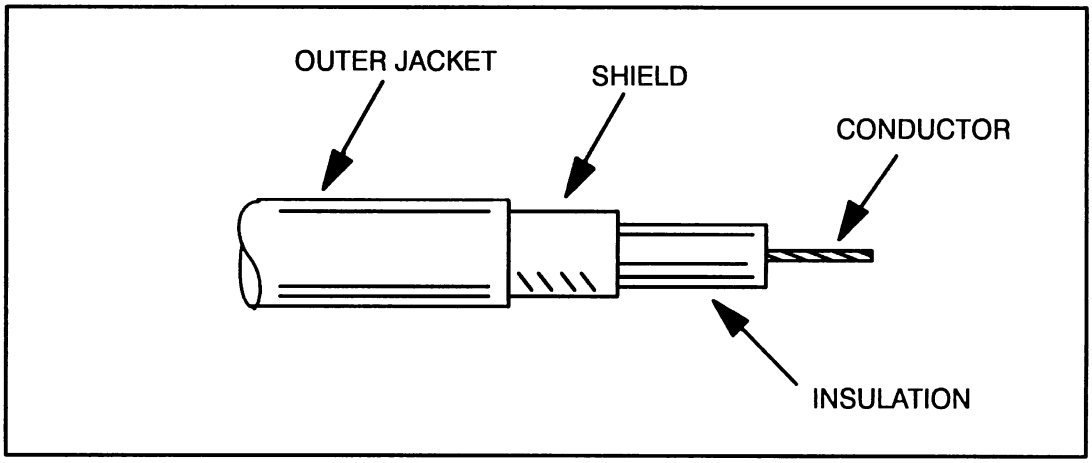


Figure 3.3 - Coaxial Cable

3.1.3 BNC Plug Connector

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

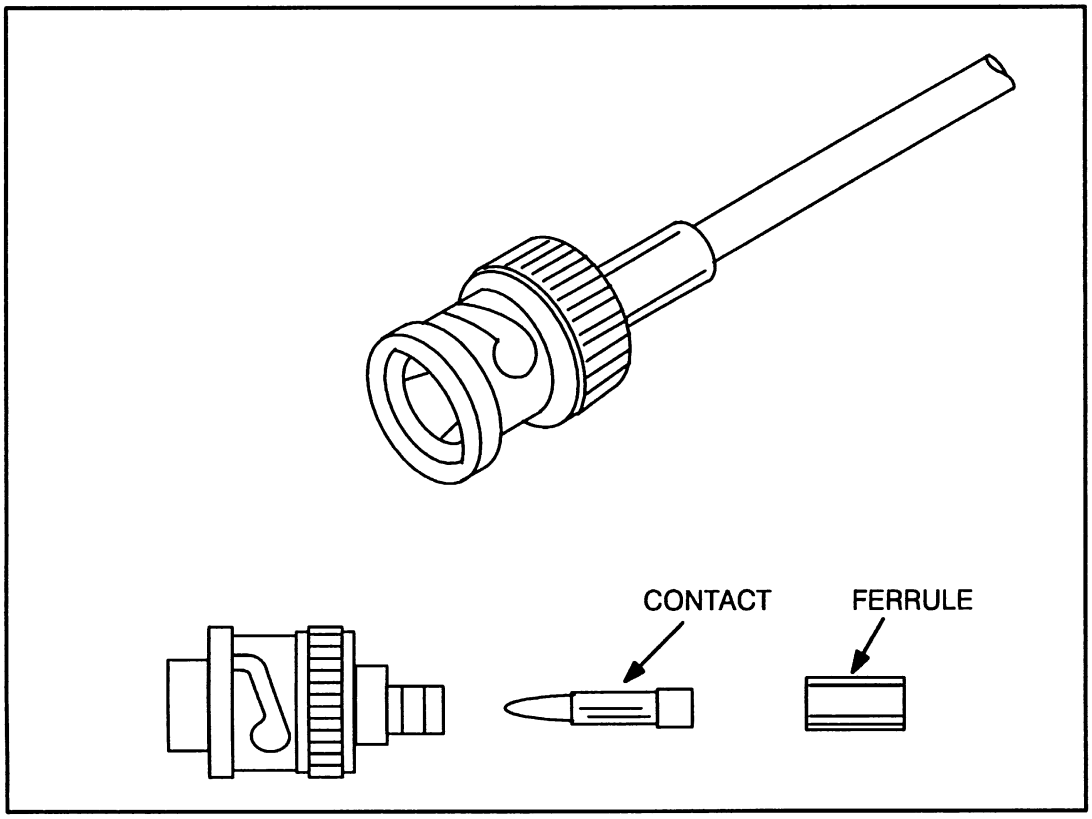


Figure 3.4 - Dual Crimp BNC Plug Connector

3.1.4 75 Ohm Terminating Load

The DCS-NET network coaxial cable system must be terminated with 75 ohm terminating loads attached to the taps located at both ends of the cable system. This minimizes the signal reflections which could interfere with other signals transmitted on the cable. The terminating load consists of a BNC plug connector and an internal 75 ohm resistor.

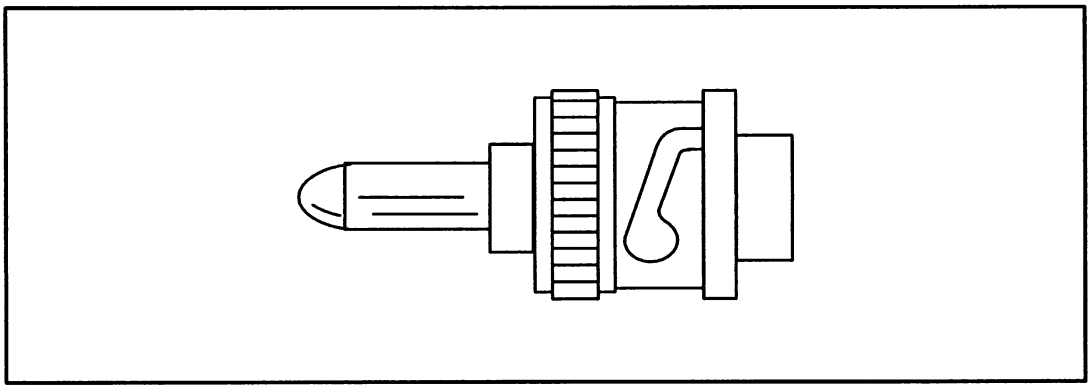


Figure 3.5 - 75 Ohm Terminating Load

3.1.5 BNC Jack-to-Jack Adapter

The BNC jack-to-jack in-line splicing adapter is recommended for making cable splices when the length of a cable must be extended (for example, when a new drop is added).

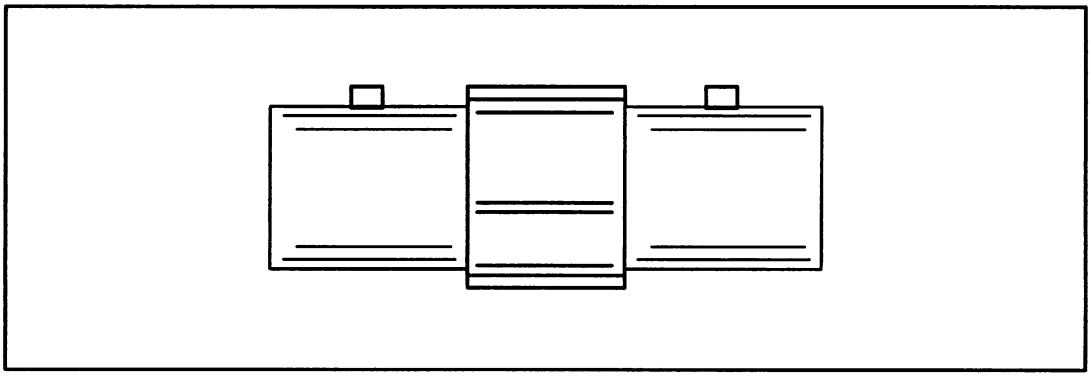


Figure 3.6 - BNC Jack-to-Jack Adapter

3.2 Installation Planning

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

The following procedure is recommended 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/DCS 5000 racks using an equipment floor plan.

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

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

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

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

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

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

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

Step 9. Calculate the number of required cable system components and select their types. Refer to Appendix J for a list of components recommended by Reliance Electric.

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

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

3.3 Cable System Protection and Isolation Recommendations

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

3.3.1 Coaxial Cable Protection

The coaxial cable must be properly handled prior to and during installation. Improper handling may result in cable damage and require cable replacement. Use the following guidelines when handling the coaxial cable:

- Keep the cable ends tightly sealed (e.g., with cable caps) during storage, transportation, and installation of the cable. Keeping the cable ends sealed will prevent exposure to moisture or other foreign matter.
- Do not exceed the minimum bend radius of the cable during storage or installation. Refer to Appendix I for cable specifications. Bending the coaxial cable sharper than the recommended minimum bend radius may decrease the reliability of the network.
- Prevent the cable from contacting abrasive surfaces such as concrete.
- Follow the cable pulling recommendations specified in section 3.5.2.

3.3.2 Electrical Isolation

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

- The exposed metal parts of the AutoMax network cable system components (BNC connectors, adapters, terminating loads) must not come in direct contact with electrical conductors (including electrical enclosures, AutoMax/DCS 5000 racks, tap shells, conduits, etc.). If necessary, these components should be shielded using insulating jackets, heat shrink tubing, or electrical seal tape.
- The network coaxial cable must be installed in a separate metal conduit. This conduit must be properly grounded along the entire length.
- The length of exposed cable inside a cabinet must not exceed 10 meters (33 feet).
- The network 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 of the network coaxial cable with other cables and wires cannot be avoided, you must comply with the recommendations provided in the ANSI/IEEE Standard 518-1982.
- Grounding, lightning, and surge protection of the network cable system and attached equipment must comply with the requirements of applicable codes.

3.3.3 Chemical and Thermal Isolation

The network coaxial cable system must be protected from damage caused by the following factors:

- Oil, grease, acids, caustics, and other harsh and/or hazardous chemicals that might damage the cable outer jacket and connectors, adapters, and terminating loads.
- Water, steam, and other liquids that could corrode connectors, adapters, and terminating loads.
- Open flame, steam lines, and any equipment with the temperature higher than the cable operating temperature.

3.3.4 Physical Isolation

Use the following guidelines to prevent physical damage and wear of the coaxial cable:

- Protect the cable from abrasion, vibration, moving parts, and personnel traffic.
- Avoid intersecting a cable route with the regular routes of cranes, forklifts, and similar equipment.
- Prevent the cable from contacting abrasive surfaces such as concrete.

3.4 Cable Type Selection

The number of drops that can be connected to the network varies depending upon the cable type and length. Figure 3.7 shows some representative distances and the maximum number of racks containing Network modules allowed.

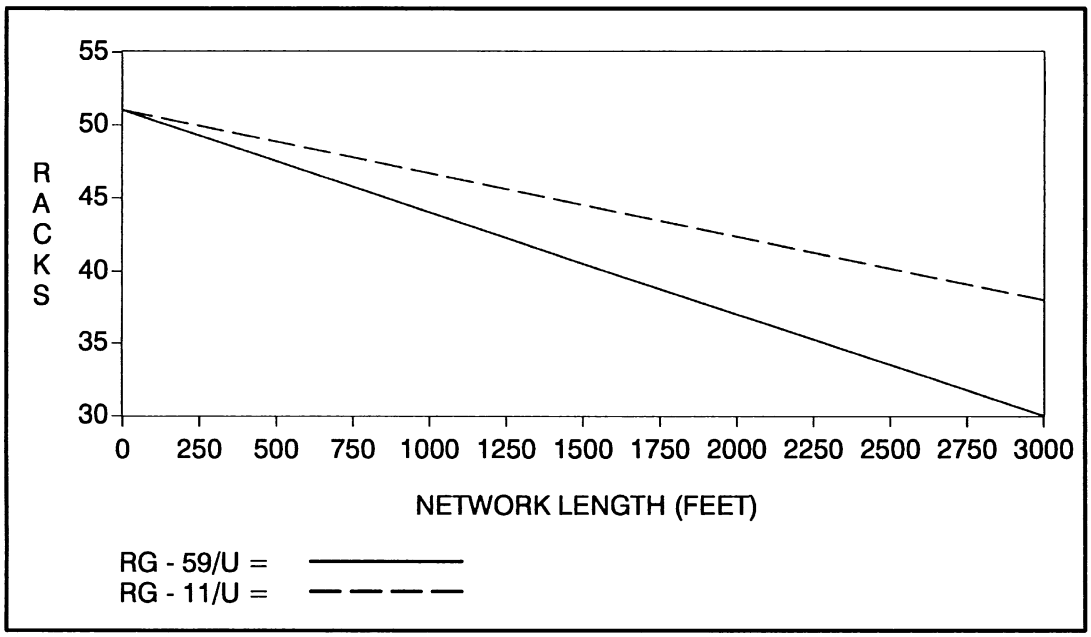


Figure 3.7 - Representative Racks vs. Network Length

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

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

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

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

3.5 Cable System Construction

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

Step 1. Inspect and test all cable before installation.

Step 2. Pull the first cable segment.

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

Step 4. Test this cable segment.

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

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

3.5.1 Cable Inspection and Testing

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

3.5.2 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 with physical inspection; it may require special cable testing equipment to locate the damage. Refer to the cable manufacturer's guidelines on cable pulling for more information.

3.5.3 Cable Termination

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

3.5.3.1 RG-59/U Termination

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

Step 1. After the cables have been installed in the conduit or cable trays, slide the ferrule onto the coax cable as shown in figure 3.8.

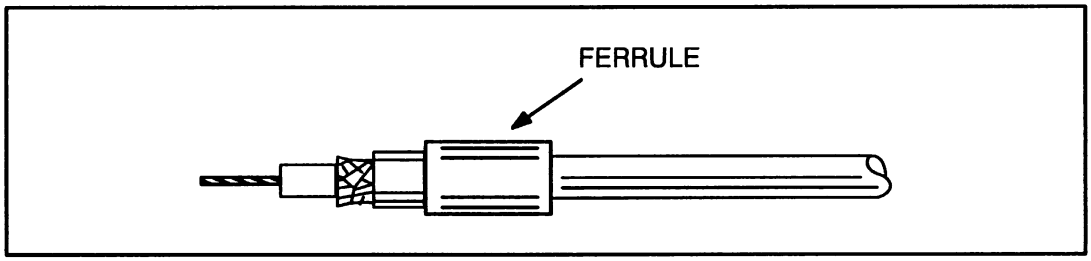


Figure 3.8 - Slide Ferrule onto RG-59/U Cable

Step 2. Strip the coax 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.

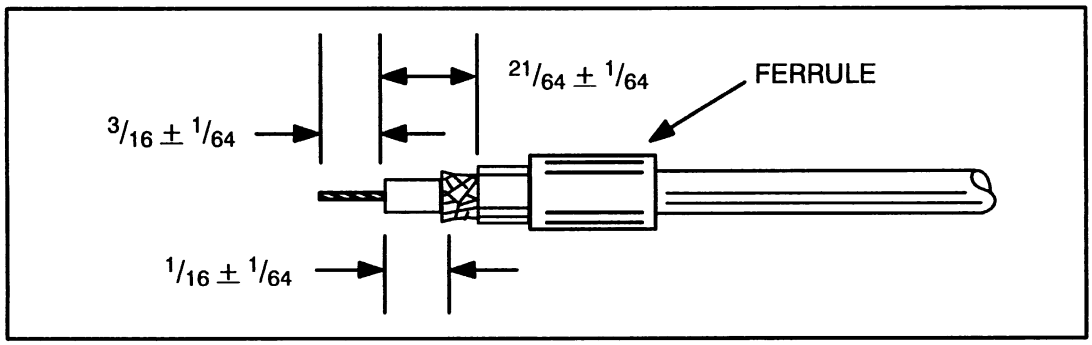


Figure 3.9 - RG-59/U (Belden 9259) Cable Stripping Dimensions

Step 3. Place the center contact, 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.

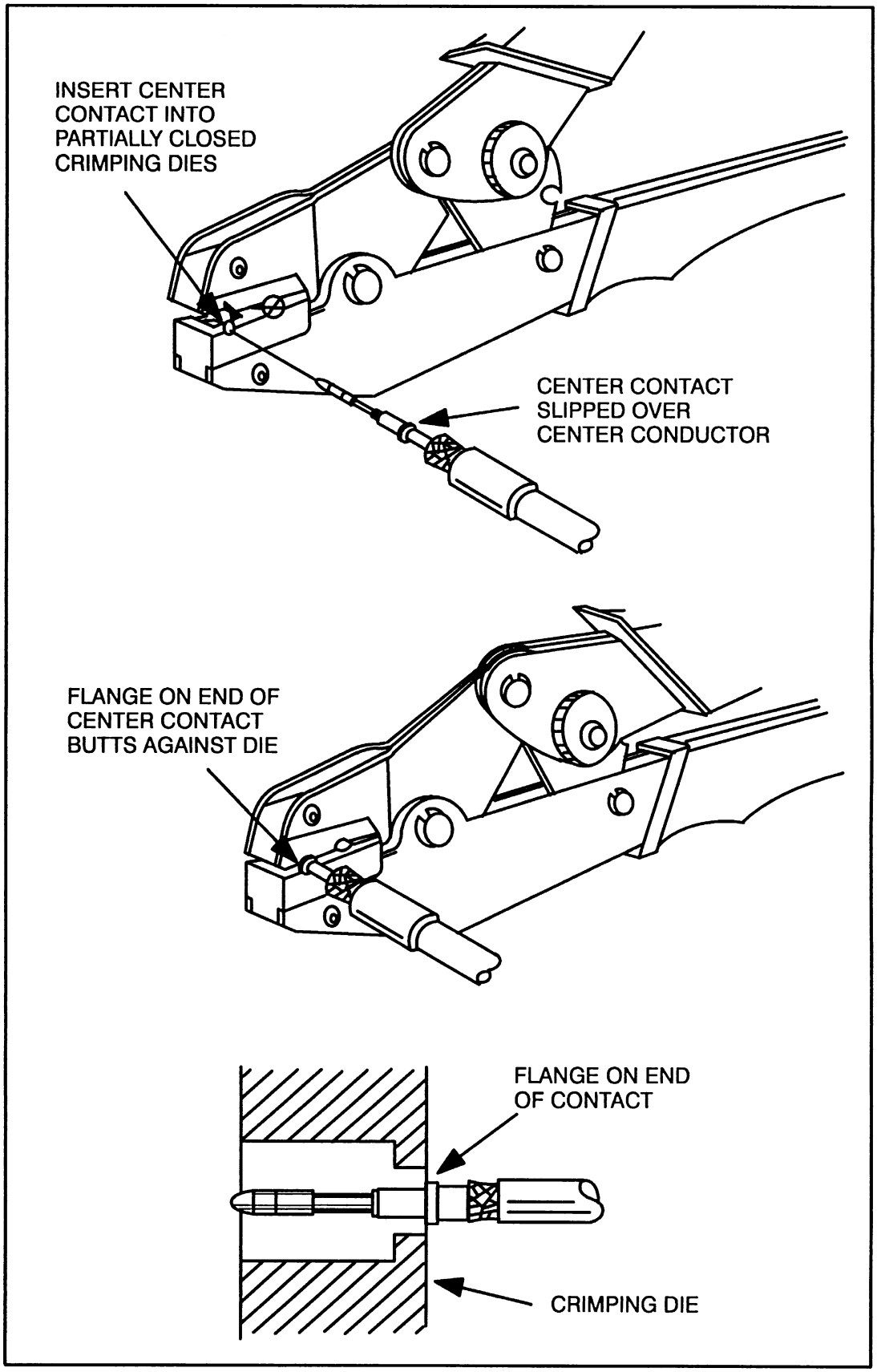


Figure 3.10 - Connector Installation Step 3 for RG-59/U Cable

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.

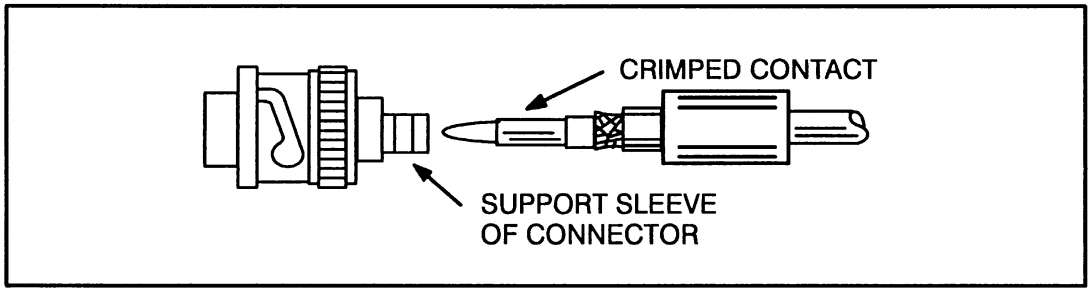


Figure 3.11 - Connector Installation Step 6 for RG-59/U Cable

Step 7. Insert the crimped center contact into the connector body until the cable dielectric butts against the dielectric inside the connector body. The flared braid will then fit around the support sleeve of the connector body, as shown in figure 3.12.

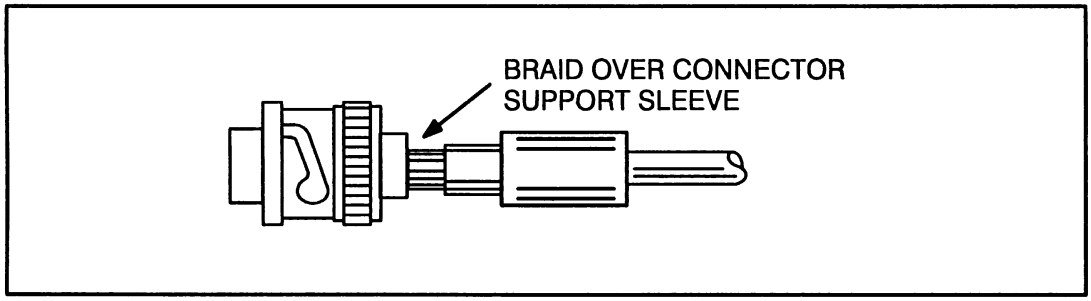


Figure 3.12 - Connector Installation Step 7 for RG-59/U Cable

Step 8. Slide the ferrule forward over the shield braid wire and the support sleeve until the ferrule butts against the shoulder on the connector body, as shown in figure 3.13.

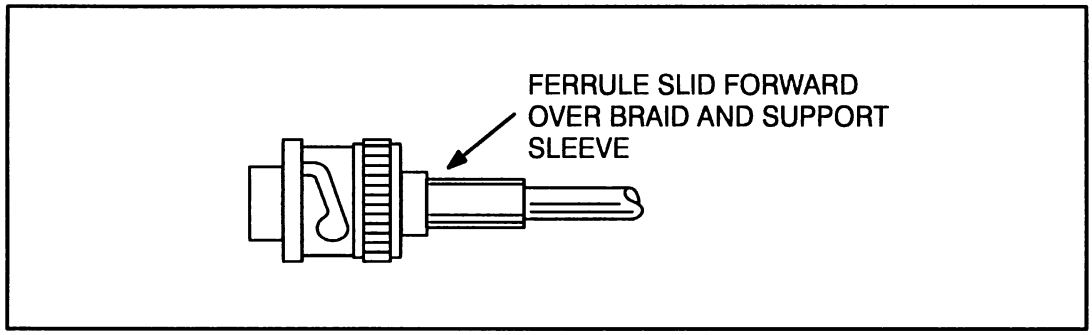


Figure 3.13 - Connector Installation Step 8 for RG-59/U Cable

Step 9. Place the ferrule on the anvil of the die assembly so that the shoulder on the connector body butts against the die, as shown in figure 3.14.

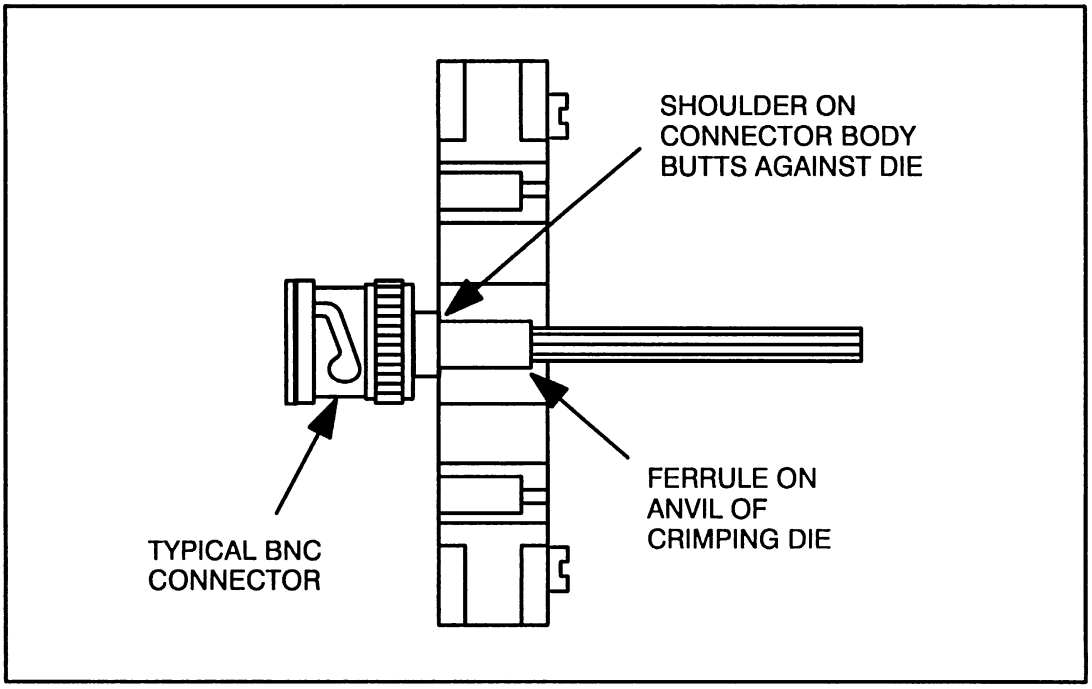


Figure 3.14 - Connector Installation Step 9 for RG-59/U Cable

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 coax cable, as shown in figure 3.15.

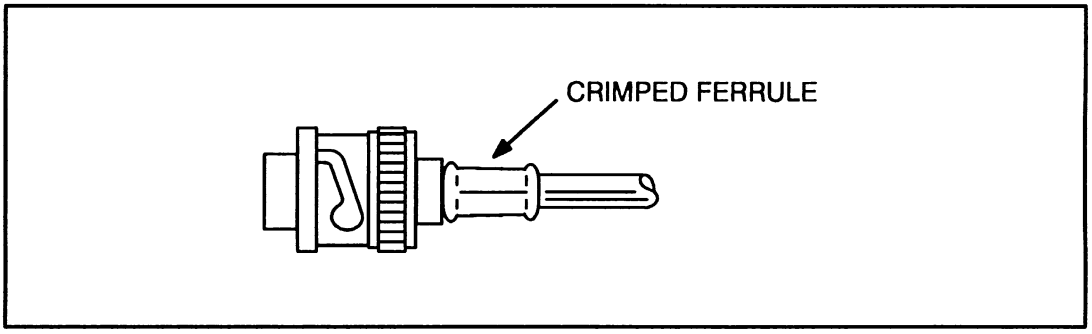


Figure 3.15 - Connector Attached to RG-59/U Cable

3.5.3.2 RG-11/U Termination

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

Step 1. After the cables have been installed in the conduit or cable trays, slide the ferrule onto the coax cable as shown in figure 3.16.

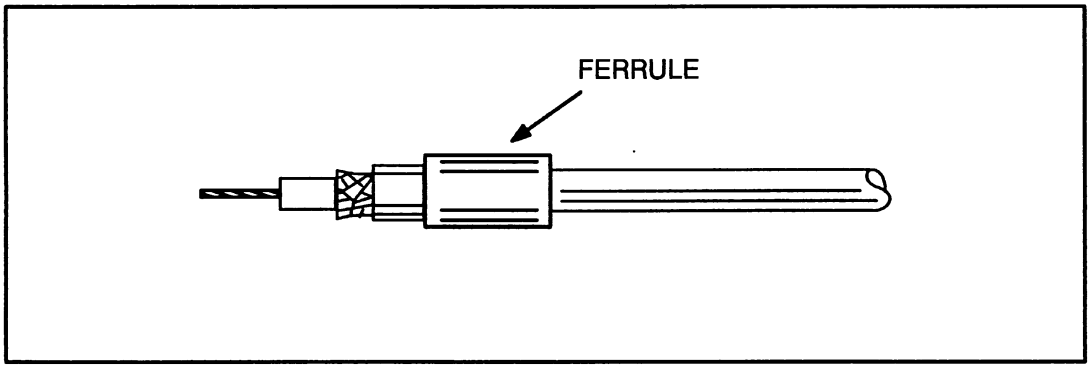


Figure 3.16 - Slide Ferrule onto RG-11/U Cable

Step 2. Strip the coax using the dimensions shown in figure 3.17. Be sure the shield braid wire is cut to the correct length and cannot touch the center conductor.

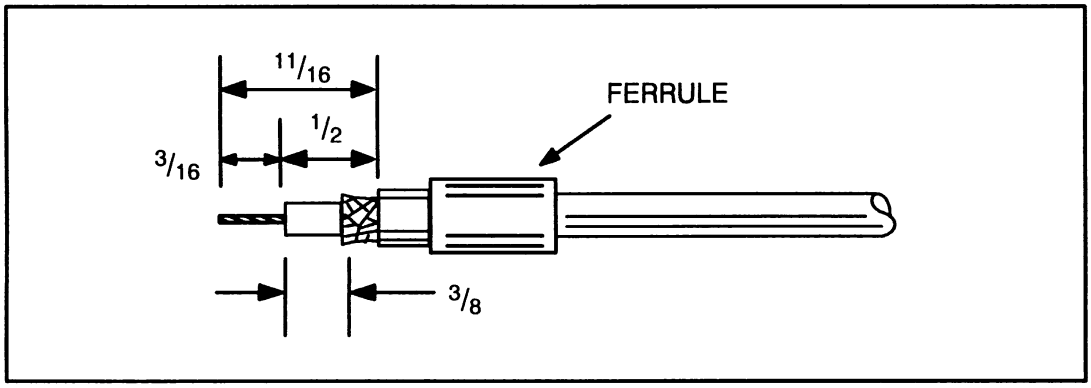


Figure 3.17 - RG-11/U (Belden 8213) Cable Stripping Dimensions

Step 3. On the crimping tool shown in figure 3.18, rotate locator/stop by turning the adjustment cap to the OPEN position.

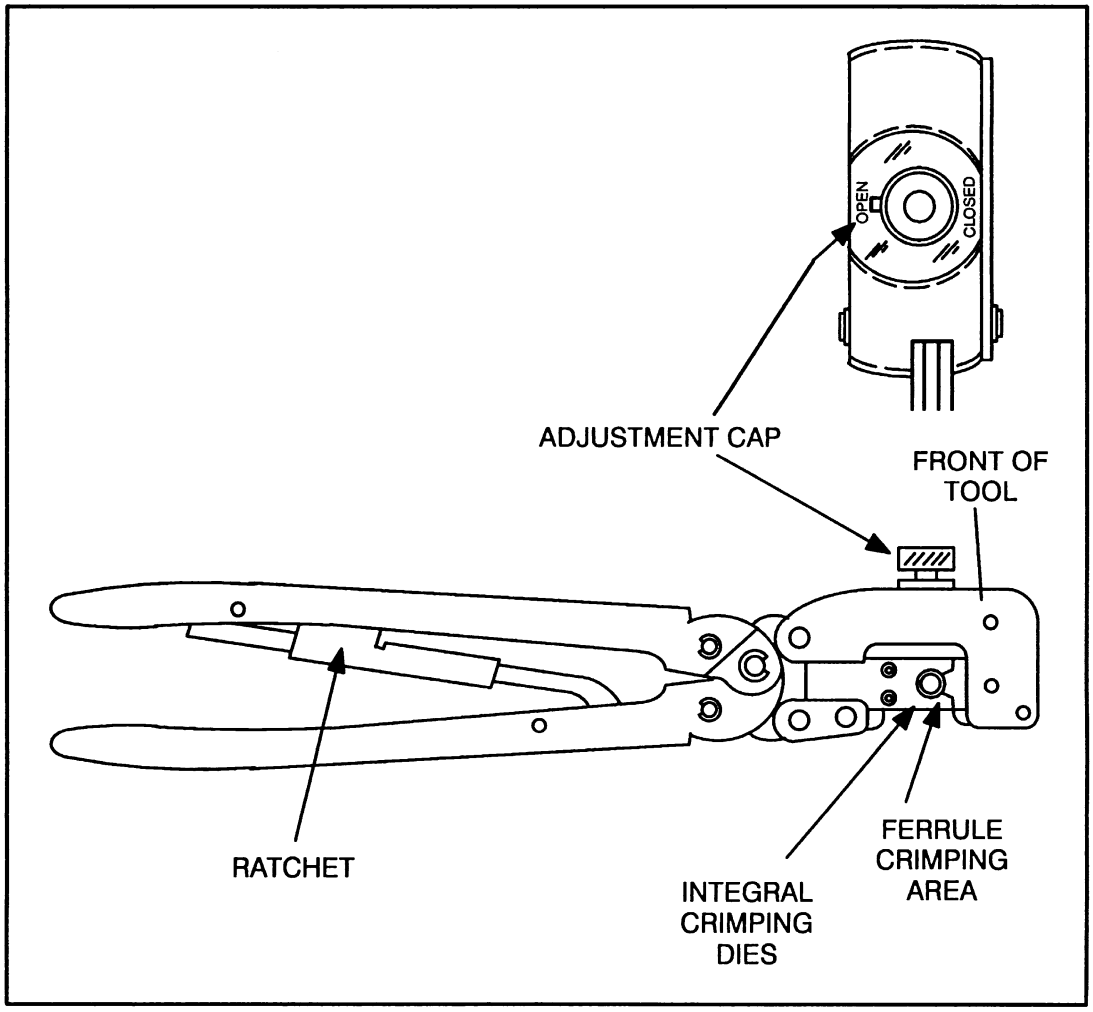


Figure 3.18 - Turn Adjustment Cap to OPEN Position

Step 4. Insert the conductor into the contact wire barrel until the contact butts against the cable dielectric, and place the contact in the tool head as shown in figure 3.19.

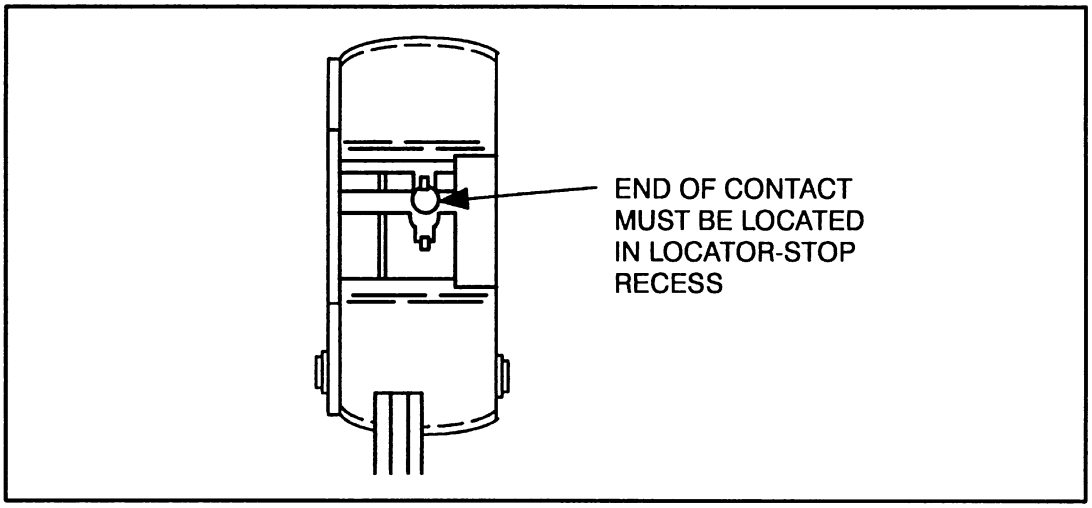


Figure 3.19 - Place Contact in Tool Head

Step 5. Push the cable in to hold the center contact against and perpendicular to locator/stop as shown in figure 3.20.

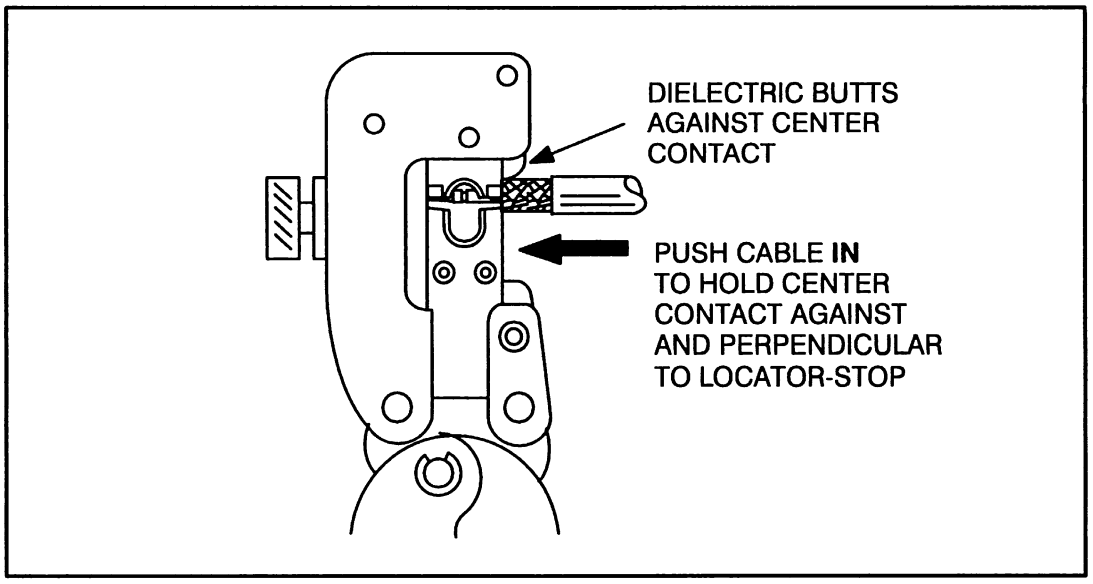


Figure 3.20 - Connector Installation Step 5 for RG-11/U Cable

Step 6. Make sure that the raised area on the contact wire barrel is located on the crimping die for proper termination as shown in figure 3.21.

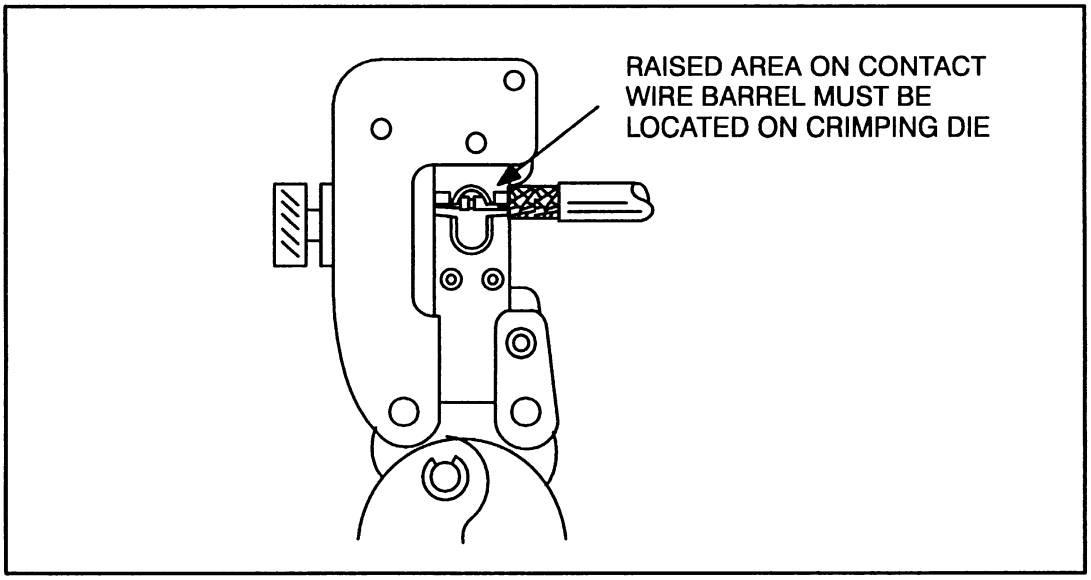


Figure 3.21 - Connector Installation Step 6 for RG-11/U Cable

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

Step 8. Remove the crimped contact.

Step 9. Verify that the shield braid wire does not touch the center contact. Refer to figure 3.22.

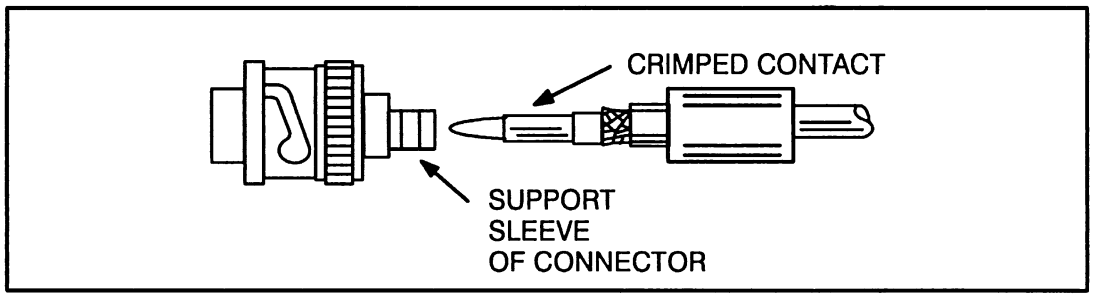


Figure 3.22 - Connector Installation Step 9 for RG-11/U Cable

Step 10. Insert the crimped center contact into the connector body until the cable dielectric butts against the dielectric inside the connector body. The flared braid will then fit around the support sleeve of the connector body, as shown in figure 3.23.

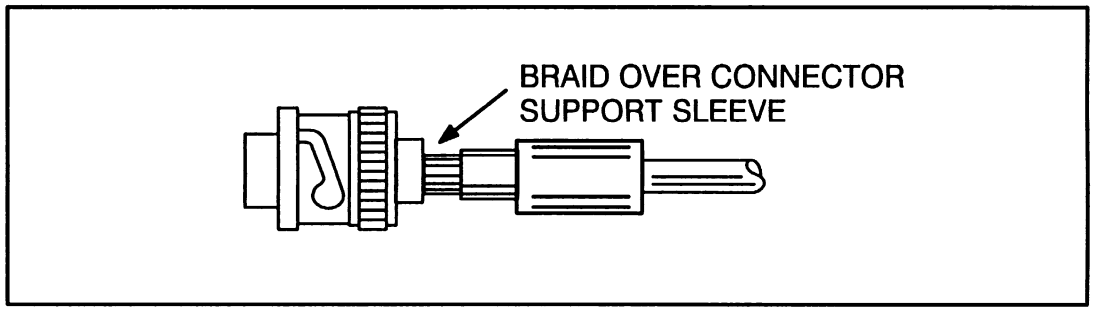


Figure 3.23 - Connector Installation Step 10 for RG-11/U Cable

Step 11. Slide the ferrule forward over the shield braid wire and the support sleeve until the ferrule butts against the shoulder on the connector body, as shown in figure 3.24.

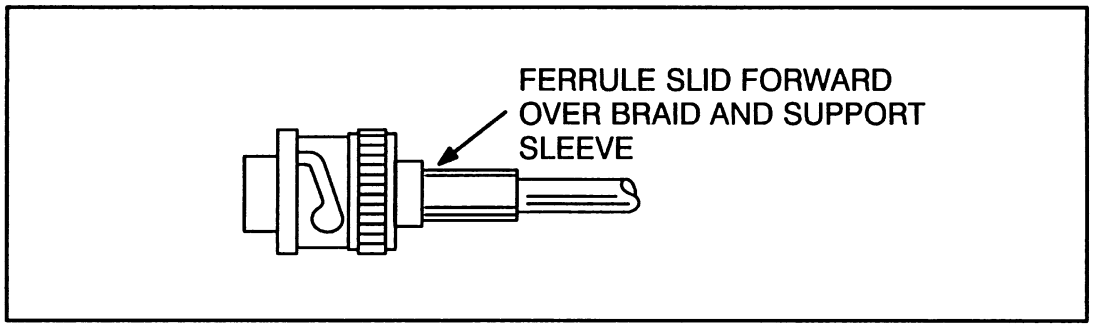


Figure 3.24 - Connector Installation Step 11 for RG-11/U Cable

Step 12. Place connector assembly in tool as shown in figure 3.25. Make sure that the ferrule assembled on the cable is on the upper crimping die and that the shoulder on the connector rests against the die, as shown.

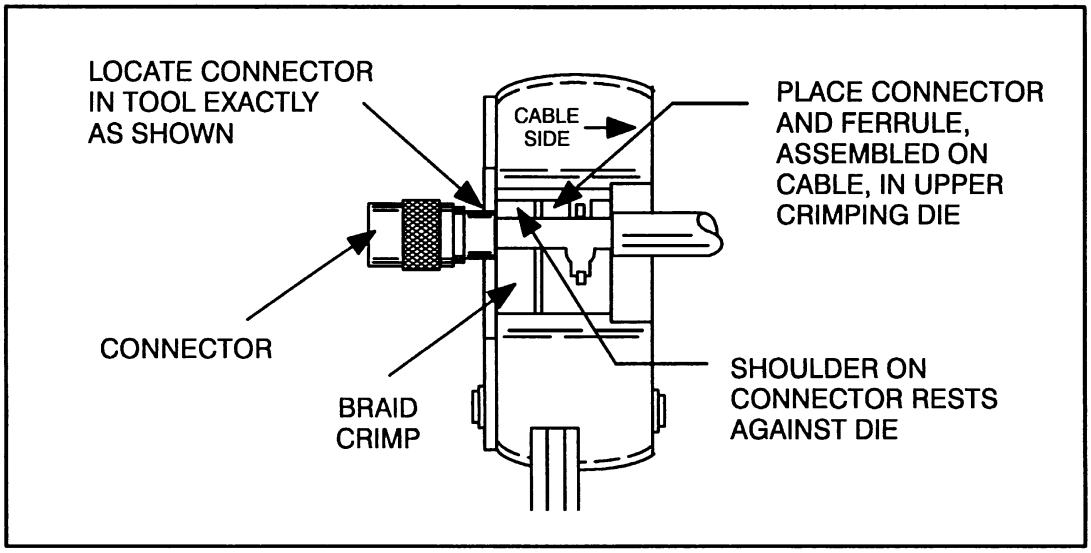


Figure 3.25 - Place Connector Assembly in Tool

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

Step 14. Remove the crimped assembly from the crimping dies. The connector is now attached to the coax cable, as shown in figure 3.26.

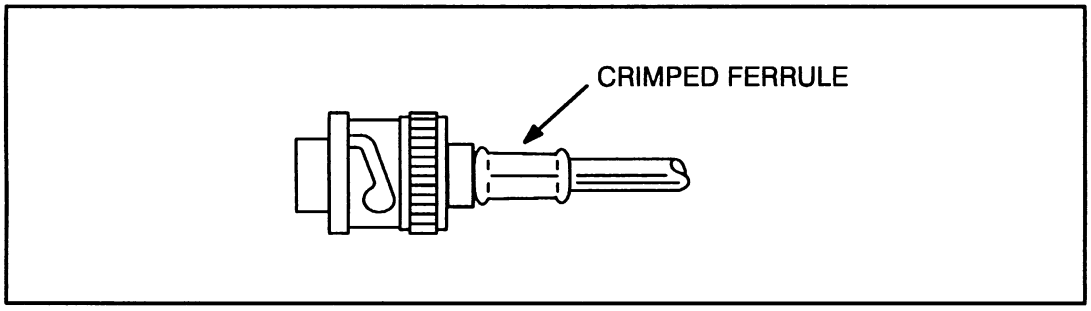


Figure 3.26 - Connector Attached to RG-11/U Cable

3.5.4 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 contact is inserted deep enough into the connector body. The tip of the center contact should be about even with the end of the connector dielectric. Be sure the ferrule is crimped tightly against the body of the connector and that the shield braid wire does not protrude from the ferrule.Check the cable's mechanical connections by grasping the outer conductor connector in one hand and the coax jacket in the other. Pull firmly. The connectors should hold.

3.5.5 Constructing Long Cable Segments

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

Step 1. Terminate both parts of a cable segment.

Step 2. Splice both parts using the jack-to-jack adapter. (Refer to figure 3.27.) Ensure the splicing connection can be accessed easily.

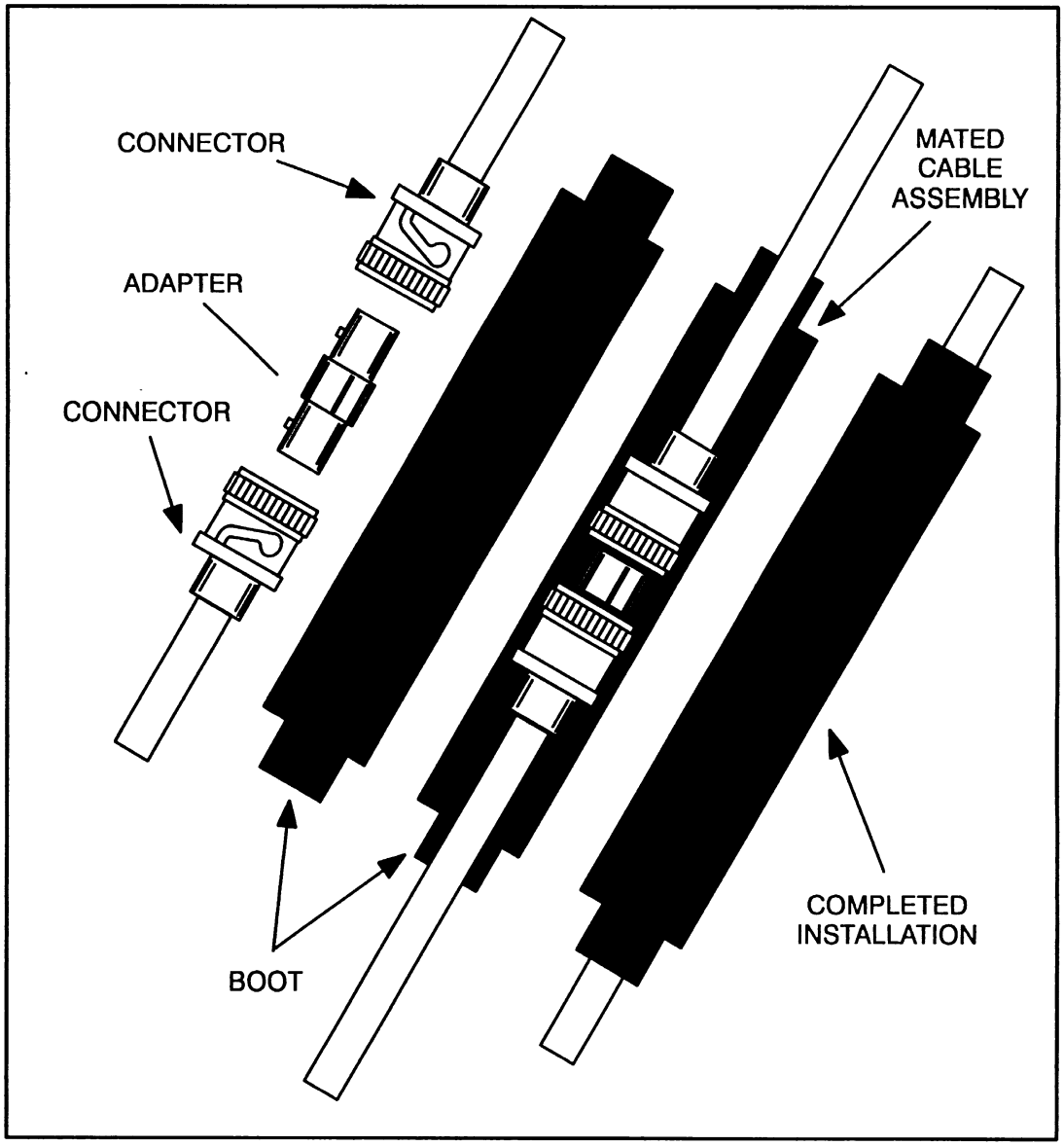


Figure 3.27 - Cable Splicing

Step 3. Isolate the splicing connection with an insulating jacket, a boot, heat shrink tubing, or electrical sealant tape as shown in figure 3.27.

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

3.6 Installing the Network Communications Module

Use the following procedure to install the 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 system. All power to the rack as well as all power to the wiring leading to the rack should be off.

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 Network 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 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 (physical or virtual), transmission collisions will occur on the line.

Drop number "00" indicates the network line master drop. Drop numbers 01 through 55, inclusive, indicate the slave drops on the line. All other switch settings are invalid.

It is recommended that you space the numbering of physical drops (i.e., the first physical drop set to 01, the second physical drop set to 05) even if you originally only require a drop depth of one. This will allow you to easily add virtual drops as they are needed in the future.

Deciding which Network module will be the master is based on the application. The master control rack will usually contain the master Network module. The master control rack will usually broadcast the stop bits, line references, etc. The master/slave configuration refers to master of communication or slave of communication and has no bearing on processor power or capability.

Step 6. If you are connecting the module to a fiber-optic network, go to step 8. If you are connecting the module to a coaxial cable network, continue to step 7.

Step 7. Use the following procedure to connect the module to a coaxial cable network.

a.) Connect the drop cable (M/N 57C381) to the 9-pin connector labeled "NETWORK" on the module faceplate. Note that the end of the cable which connects to the faceplate is labeled "COMM".

b.) 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".

c.) Connect the coaxial cable to the front of the passive tap. If this is a physically extreme drop on the network, a 75 ohm terminator (M/N 45C71) must be installed on the remaining BNC connector.

Figure 3.1 in section 3.1 shows the Network module connected to the network. Continue to step 9.

Step 8. Use the following procedure to connect the module to the fiber-optic network. Fiber-optic network installation guidelines are provided in Appendix L.

a.) Connect the drop cable (M/N 57C366) to the 9-pin connector labeled "NETWORK" on the module faceplate.

b.) Refer to figure L2.2 in Appendix L and connect the drop cable to the transceiver. Continue to step 9.

Step 9. 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 a diagnostic fault code 0 through 9 or b is displayed, the Network 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 section 6.2.

Step 10. Monitor status registers 15 - 18 of the drop 0 area in each module using either method described in section 5.0. If the values in these registers increase consistently over a short period of time, there is a communication problem. Refer to section 6.3 for instructions for troubleshooting a communication problem.

3.7 Replacing the Network Communications Module

Use the following procedure to replace the Network module.

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

DANGER

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

Step 2. Disconnect the drop cable from the passive tap or transceiver.

Step 3. Turn off power to the rack.

Step 4. Disconnect the drop cable from the Network module faceplate.

Step 5. Use a screwdriver to loosen the screws that hold the Network module in the rack. Take the module out of the slot in the rack.

Step 6. Take the new 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 7. Insert the module into the rack, making sure it is well-seated in the rack.

Step 8. 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 9. Attach the drop cable to the module faceplate.

Step 10. Attach the drop cable to the passive tap or transceiver.

Step 11. Turn on power to the rack.

Step 12. Monitor status registers 15 - 18 in the drop 0 area in each module using either method described in section 5.0. If the values in these registers increase consistently over a short period of time, there is a communication problem. Refer to section 6.3 for instructions for troubleshooting a communication problem.

3.8 Adding a Network Drop

Use the following procedure to add a drop to the coaxial cable network:

Step 1. Identify the route for a new cable segment (or segments). Refer to the recommendations provided in section 3.3. If a new drop is to be added at the end of the network cable system, only one new cable segment will be necessary. Otherwise, two new cable segments will be necessary.

Step 2. Calculate the new cable segment length. Ensure the new total cable length does not exceed the maximum cable length defined in the AutoMax network specification (see

Appendix H). If it exceeds the maximum specified cable length, consult with Reliance Electric before taking any further steps.

Step 3. Cut, install, terminate, and test the new cable segment following the instructions provided in section 3.5.

Step 4. Stop all communications over the AutoMax network.

Step 5. Refer to figure 3.28 and use the following procedures if a new drop if to be added to one of the ends of the network. Skip to step 6 if a drop is to be added along the cable route.

a.) Disconnect the terminating load from the tap of the existing drop and replace it with one end of the new cable segment.

b.) Connect the terminating load to a new tap. Connect the other end of the new cable segment to this tap.

c.) Attach the tap to the Network module using a drop cable.

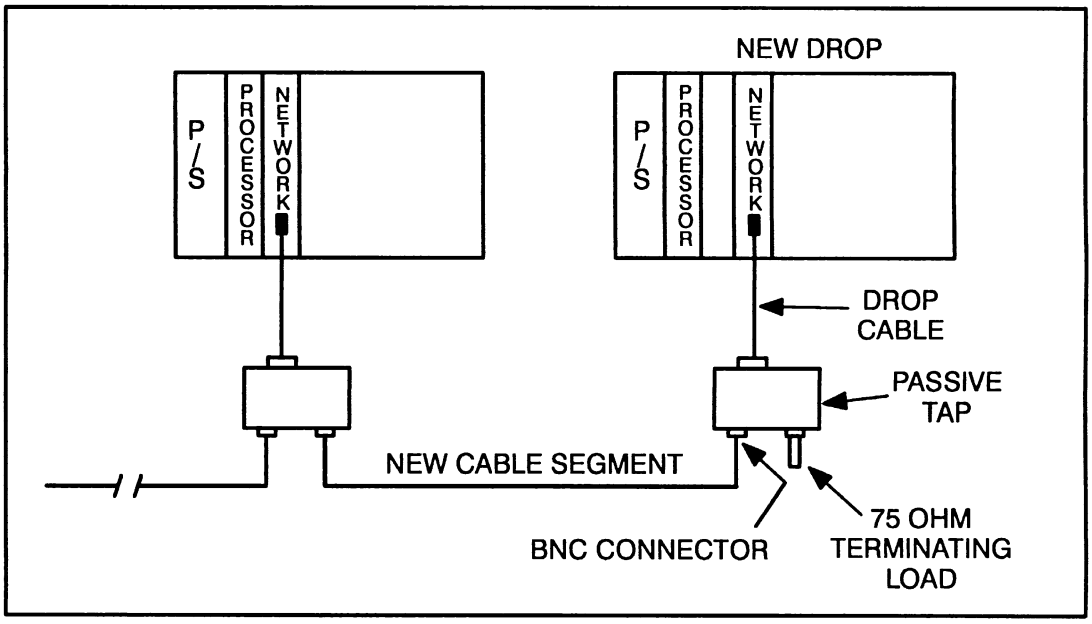


Figure 3.28 - Adding a New Drop at the End of the Network Cable System

Step 6. If a new drop is to be added along the cable route use the following procedure:

a.) Cut the AutoMax network cable at the point where the new drop is to be added.

b.) Terminate the cable ends with BNC plugs, and splice them with the new cable segments.

c.) Connect the other ends of the new cable segments with a tap attached to the new drop as shown figure 3.29.

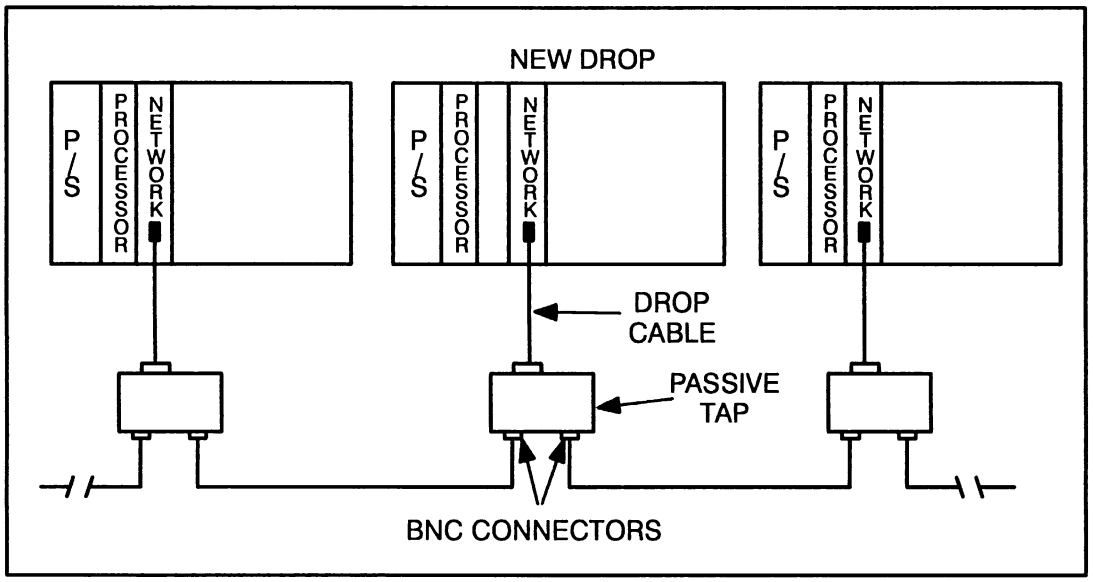


Figure 3.29 - Adding an Intermediate Drop to the Network Cable System

Step 7. Resume AutoMax network operation.

3.9 Disconnecting a Network Drop

CAUTION: Powering down a cluster of drops may result in loss of communication on a coaxial cable network. Disconnect the drop cable from the passive tap before powering down a drop.

To temporarily disconnect an AutoMax coaxial cable network drop, disconnect the drop cable from the tap before powering down the drop. To disconnect a coaxial cable network drop permanently or for an extended period of time, use the following procedure:

Step 1. Stop network operation.

Step 2. To disconnect a drop from an end of the network, refer to figure 3.30 and use the procedure below. Skip to step 3 for the procedure to disconnect a drop from along the cable route.

a.) Disconnect the drop by detaching the cable segment between this and the neighboring drop from the neighboring drop tap.

b.) Terminate this tap with a 75 ohm terminating load.

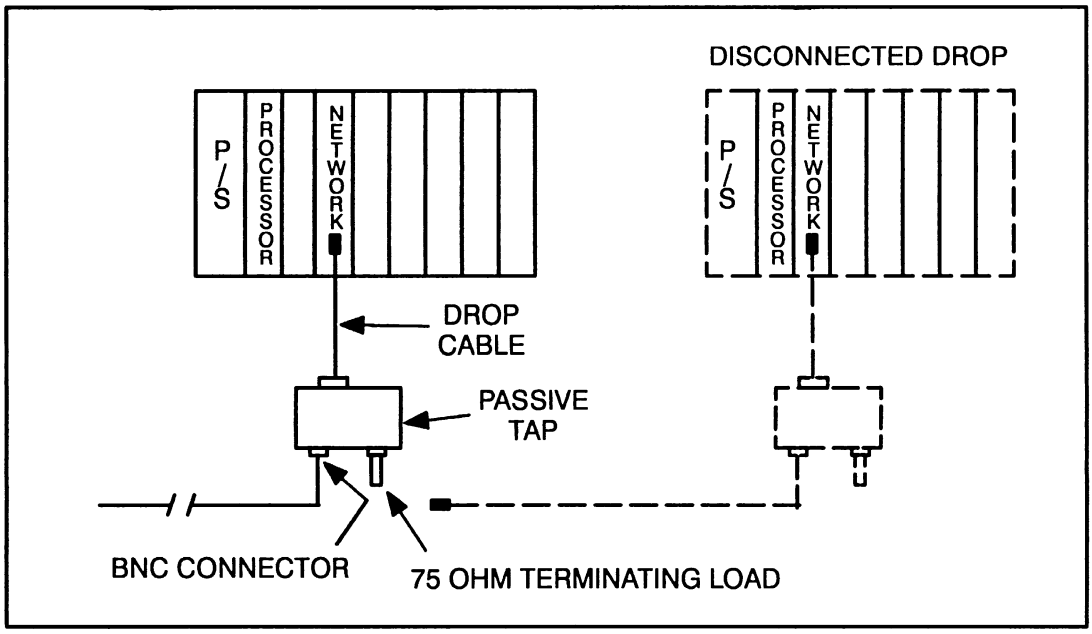


Figure 3.30 - Disconnecting a Drop from the End of the Network Cable System

Step 3. To disconnect a drop along the cable route, refer to figure 3.31 and use the following procedure:

a.) Disconnect both AutoMax network cable segments from the tap.

b.) Splice the cable segments using a jack-to-jack in-line splicing adapter.

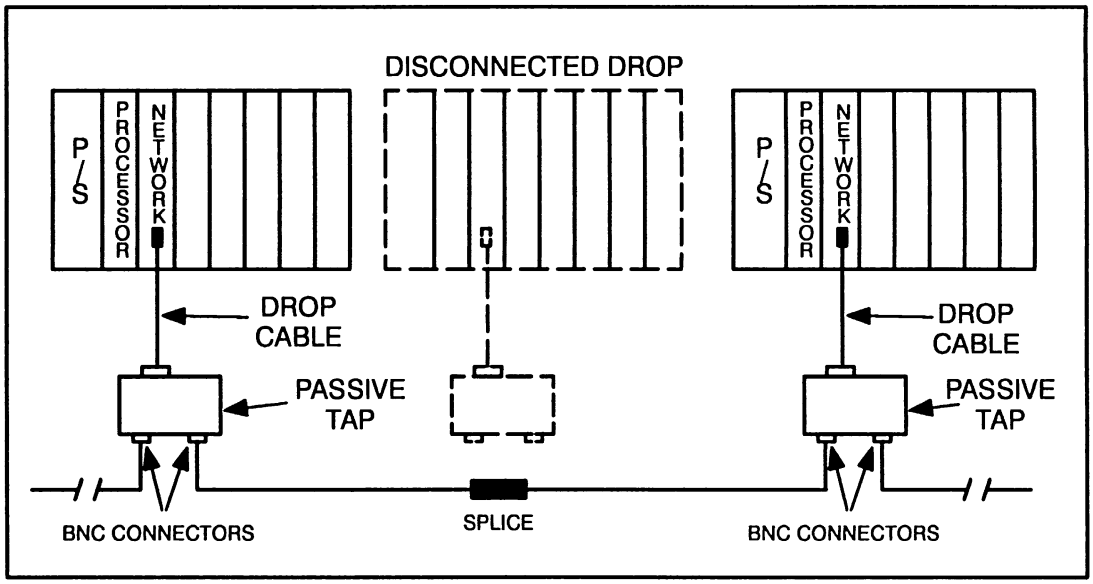


Figure 3.31 - Disconnecting an Intermediate Drop from the Network Cable System

Step 4. Resume network operation.

3.10 Coaxial Cable System Maintenance

Even if the installation is done properly, the AutoMax network may still experience some unexpected downtime. This may be due to gradual degradation of the cable system components or changes in the environmental conditions along the cable path. Because of this, some limited preventive maintenance is required.The following sections describe recommended maintenance procedures.

3.10.1 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.

3.10.2 Cable System Design Maintenance

When old equipment is relocated or new equipment is installed, new sources of heat, electrical noise, hazardous chemicals, and other changes in the network cable system environment may occur. Evaluate the effect these changes have on the performance of the network. If necessary, take corrective action such as rerouting certain AutoMax network cable segments and adding shielding to the cable system components.

3.10.3 Cable System Inspection

Inspect the AutoMax network cable system periodically for damage, shorts, and discontinuity. To perform these tests, use the appropriate time domain reflectometer (TDR) for the cable length. TDRs can be also used to perform cable testing during the installation or to locate a possible cable fault during troubleshooting. All tests should be properly documented.

4.0 PROGRAMMING

This section describes how the data is organized in the 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 Register Organization

The dual port memory in each Network module is divided into 56 areas, or drops, each containing 64 16-bit registers (a total of 3584 registers). Refer to figure 4.1 for register assignment.

DROP AREA	REGISTER	TYPE	MASTER	SLAVE
0	0-31 32-39	Status Broadcast	NOT TRANSMITTED Transmits	Receives
1	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
2	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
. . .	. . .	. . .	. . .	. . .
53	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
54	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
55	0-31 32-63	Data Exchange Data Exchange	Receives Transmits	* *
*Slaves transmit registers 0-31 from only the drop areas they represent. All other registers receive data only.				

Figure 4.1 - Register Assignment

Memory areas are written to by either the module's on-board CPU or by an application task running on a Processor module in the rack. Memory areas that are written to by the on-board CPU cannot be written to by an application task and vice versa. All memory areas, however, can be read by both the on-board CPU and application tasks.

4.1.1 Register Assignment in the Drop 0 Area

Registers 0-31 on each module contain network status and control information. This information is unique to each module and is not transmitted over the network. Except for the drop depth register (register 20) in the slave modules, registers 0-31 in the drop 0 area are written to by the on-board CPU. Therefore the application task has Read Only access to these registers.

Registers 32-39 in the drop 0 area are broadcast registers. These registers are controlled by an application task running in a Processor module in the master rack. These registers are

Read/Write in the master and Read Only everywhere else on the network.

The registers in the drop 0 area are defined as follows:

Register	Description
0	Reserved For System Use
1	Reserved For System Use
2	Reserved For System Use
3	Reserved For System Use
4	Drop 0-15 Status in Bits 0-15
5	Drop 16-31 Status in Bits 0-15
6	Drop 32-47 Status in Bits 0-15
7	Drop 48-55 Status in Bits 0-15
8	Reserved For System Use
9	Reserved For System Use
10	Reserved For System Use
11	Reserved For System Use
12	Drop Number
13	Keyswitch (1=Memory Protect, 2=Setup, 3=Program)
14	Messages Received
15	Receive Timeouts
16	Crc Errors
17	Overrun Errors
18	Abort Errors
19	Messages Transmitted
20	Drop Depth
21	Reserved For System Use
..	..
31	Reserved For System Use
32	Broadcast Data
33	Broadcast Data
34	Broadcast Data
35	Broadcast Data
36	Broadcast Data
37	Broadcast Data
38	Broadcast Data
39	Broadcast Data
40	Reserved For System Use
..	..
63	Reserved For System Use

Figure 4.2 - Register Assignment for Drop 0 Area

Note that some of the registers reserved for system use are not protected against being written to by an application task. It is the programmer's responsibility to ensure that drop 0 areas are not written to (with the exception of register 20 in the slave modules).

See sections 4.1.1.1 - 4.1.1.11 for a description of the registers in the drop 0 area.

4.1.1.1 Registers 4 - 7 (Drop Status Bits)

WARNING

THE DROP 0 STATUS BIT (REGISTER 4, BIT 0) MUST BE USED IN AN APPLICATION PROGRAM TO INDICATE NETWORK COMMUNICATION FAILURE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

WARNING

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

In the master, the drop status bits indicate which slave drops are active on the network. The drop status bit will be equal to 1 whenever the corresponding slave drop is actively communicating with the master.

In the slave, the drop status bits indicate which drops represented by that slave module are active on the network. The drop status bits will be equal to 1 when the corresponding drop is actively communicating with the master. If any of these bits are equal to 0, it indicates that the drop is either not represented by that slave module or is not communicating with the master.

In a slave module, the drop 0 status bit (register 4, bit 0) functions as the logical AND of the status bits of all the drops that slave module represents. The drop 0 status bit will be equal to 1 when ALL drops represented by that slave module are actively communicating with the master module. If any of the drops represented by the slave are not communicating with the master, the drop 0 status bit will be equal to 0. Therefore, the drop 0 status bit is used to indicate whether the slave module is communicating properly. If a drop fails, the status bit will be off a minimum of 120 milliseconds to allow detection by an application task.

For example, in a slave module with a drop setting of 02 and a drop depth of 3, the drop 0 status bit will be equal to 1 if the drop status bits for drops 2, 3, and 4 are also equal to 1 (i.e., communicating with the master). Refer to figure 4.3. If any or all of the three drops are not communicating with the master, the drop 0 status bit will be equal to 0.

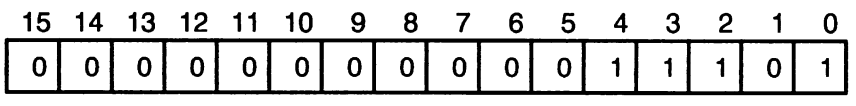


Figure 4.3 - Register 4 in Drop 02 Slave Module Indicating Drops 2, 3, and 4 Actively Communicating With Master

At power up, the Processor sets the drop depth of the slaves to "1" to permit remote access to the Processor. The drop 0 status bit in the slaves and the drop status bits in the master will not be set.

After a user application task has defined drop depth, the status bits in the slaves will be set to indicate the drops it represents. The drop 0 status bit will also be set. In the master, the drop status bits will be set to indicate all active drops on the network.

4.1.1.2 Register 12 - Drop Number

The on-board CPU reads the thumbwheel switch settings on the faceplate once at power up or after a self test and stores the data in this register.

4.1.1.3 Register 13 - Keyswitch Mode

This register corresponds with the keyswitch setting of the Power Supply module in the rack. 1=Memory Protect 2=Setup 3=Program

4.1.1.4 Register 14 - Messages Received

This register reflects the total number of messages received by that module. While the line is inactive, this value will remain unchanged. While the line is active, it will constantly increase to 65535 and then roll over to zero.

4.1.1.5 Register 15 - Receive Timeouts

When an active drop on the network is set up to receive, a timer is set for 6 msec in which a message should be received. If a message is not received, a receive timeout occurs and is logged in this register. The system allows for four consecutive timeouts before it writes fault code "C" to the seven-segment display, indicating a communication fault.

4.1.1.6 Register 16 - CRC Errors

The SIO performs an error-checking routine called a Cyclic Redundancy Check (CRC) as a result of the SDLC protocol. Any message received that is flagged with a CRC error is ignored and no reply is transmitted. This results in a re-transmission of the message. The value in this register will increment if a CRC error occurs. This value should ideally remain zero.

4.1.1.7 Register 17 - Overrun Errors

The value in this register will increment if the buffer in the SIO is filled and no read of the data has occurred. This value should ideally remain zero.

4.1.1.8 Register 18 - Abort Errors

The abort sequence feature of the SDLC protocol is not used in the transmission routine. Therefore, if an abort is detected in a receiver, there has been error. The value in this register will increment with each abort error detected. This value should ideally remain zero.

4.1.1.9 Register 19 - Messages Transmitted

This register reflects the total number of messages transmitted by the module. While the line is inactive, this value will remain unchanged in the slave. In the master, this value will rapidly increase as initialization request messages are constantly being sent. While the line is active, this value will constantly increase to 65535 and then roll over to zero.

4.1.1.10 Register 20 (Drop Depth)

In the master, this register is not used. In the slave, this register is used to define the number of drops that particular slave module represents. The drop depth register must never be set to a value less than 1 or greater than 56 minus the drop setting. In other words, if the drop setting is 54, the drop depth cannot be set greater than 2. Likewise, if the drop setting is 10, the drop depth cannot be set greater than 46.

The drop depth should be set to the minimum value required to satisfy the application to minimize the update period for that module. The drop depth value can be modified at any time without removing an active drop from the network. Note that the assignment of physical or virtual drops must not overlap or transmission collisions will occur.

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.

Bit 14 of this register is the error bit. It is set by the Network module if the existing drop depth value is invalid. When bit 14 is set, the last valid drop depth value is used. An invalid drop depth value written by an application task should be discovered and corrected during initial system testing.

Bit 15 is the processing complete bit. It is set when the Network module has completed processing of the drop depth register. If the drop depth value is changed by an application task, the task must monitor bit 15 to verify that the drop depth value processing has been completed by the Network module.

The Network module, used within a rack containing a 57C430A or later Processor module will automatically have a drop depth of one set by the Processor upon power-up. (If the Network module is used in an AutoMax Version 1.0 rack or a DCS rack, the drop depth will not be assigned until an application task sets it.) The processing complete bit (bit 15) will be equal to 1. At this time, it is possible for data from that drop (for example, the drop 5 area in physical drop 05) to be transmitted over the network. However, none of the virtual drop memory areas for that drop will be accessible until drop depth has been defined by the application task.

To assign drop depth, an application task writes the desired integer value to this register. The processing complete bit (bit 15) and the error bit (bit 14) should then be monitored to verify that the drop depth value has been accepted and processed. The application task must ensure that the processing complete bit is equal to 1 and the error bit is equal to 0 before proceeding.

4.1.1.11 Registers 32 - 39 (Broadcast Data)

The master transmits the data in its broadcast registers to the broadcast registers in each slave Network module simultaneously each time it updates a drop area. This is done every 2.99 milliseconds (the time it takes to update one drop area). The data in the broadcast registers is not targeted for any particular drop. Controlled by the application task running in a Processor module in the master rack, broadcast data is usually data of higher priority that needs to be transmitted to all drops as soon as possible, such as emergency stops, line speed references, and network status. These registers are Read/Write in the master and Read Only in the slaves.

4.1.2 Data Exchange Registers

Drop areas 1-55 of the dual port memory are divided into 64 16-bit data registers. Registers 0-31 in drop areas 1-55 contain the data that an application task in the slave rack has written to them. These registers will then be transmitted to the master and all other slaves on the network. The number of registers that an application task in that rack can write to is determined by the drop depth assigned to the Network module in that rack. Each slave has 32 registers times its drop depth that can be written to and then transmitted. In other words, a rack that has been defined as drop 01 with a drop depth of 2 has Read/Write access to registers 0-31 in memory drop areas 1 and 2 for a total of 64 registers. This area is Read Only everywhere else on the network.

Registers 32-63 contain the data that an application task in the master rack has written to the master Network module for a particular drop. This data is consequently transmitted from the master to the addressed drop with all other drops receiving the data simultaneously. The master has 32 registers times the number of drops on the network to write to and then transmit. This area is Read/Write in the master and Read Only everywhere else on the network.

The dual port image of registers 32-39 in the drop 0 area and drop areas 1-55 will be the same in each module that is active on the network. Therefore, the data in all drops which are active on the network is available to any other drop that is active on the network.

There will be a time lag between output data written from one drop and its appearance in the dual port image of all other drops. This time lag will be less than or equal to the update period as described in section 4.2.

4.2 Data Update Rate

The update rate can be calculated using the following formula:

UPDATE_TIME = (DROP_TIME X N) + NEW_DROP_TEST_TIME + MSG_XFER_TIME

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

N = number of slave drops (physical and virtual)

NEW_DROP_TEST_TIME = amount of time need for the master to poll an inactive drip and wait for its response (2.48 msec assuming no response).

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

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

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

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

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

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

4.3 Configuration

Before running any application tasks, the system must be configured. 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 variables defined during configuration are termed common variables. These are made available to BASIC and Control block application tasks using the COMMON statement. For Ladder Logic/PC tasks, you use the PC task editor to designate them COMMON.

When configuring each Network module, variable names are assigned to memory locations in the Network module, i.e., the registers in the drop areas. Because the memory image in each Network module on the network is identical, the variable will appear in the same memory location on each module. Each rack's configuration, therefore, should define the same variable in the same memory location in order for the Processor module in the rack to access it.

For example, assume one rack has defined register 10 in drop 1 of the Network module to be the tension feedback variable TENFDBK%. In order for another rack to access this variable, it must also define register 10 of drop 1 as this variable during configuration. The same variable name is usually used in each rack, but it is not required. Only the location of the variable must be defined the same.

WARNING

IF YOU USE REALS OR DOUBLE INTEGER VARIABLES IN THIS INSTANCE, YOU MUST IMPLEMENT A SOFTWARE HANDSHAKE BETWEEN THE TRANSMITTER AND RECEIVER TO ENSURE THAT BOTH THE LEAST SIGNIFICANT AND MOST SIGNIFICANT 16 BITS HAVE BEEN TRANSMITTED BEFORE THEY ARE READ BY THE RECEIVING APPLICATION PROGRAM. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY OR DAMAGE TO EQUIPMENT.

To configure the Network module refer to the ReSource AutoMax Programming Executive instruction manual.

In AutoMax Versions 1.0 and 2.0 and in all versions of DCS 5000, a configuration task must be created and loaded onto the Processor(s) in the rack before any application task can be executed. Refer to the Configuration Task Instruction Manual (J-3649) if your system is AutoMax Version 1.0 or 2.0.

4.4 Sample Application Program

As described above, network variables must be defined before they can be accessed by an application task. Below is an example of a configuration task required for defining network variables in AutoMax Version 1.0 and 2.0 systems. Note that AutoMax Version 3 and later systems do not require you to write a configuration task; all variables are defined using the Software Configurator in the Programming Executive software.

The configuration task defines the location of the variables in the module's memory. Defined in this task is the drop depth register, the drop depth register error bit, the drop depth processing complete bit, and the drop 0 status bit. These variables will not be transferred across the network; therefore, an IODEF statement is used. The network variable REF% defined in line 160 will be transmitted, therefore a NETDEF statement is used.

Drop 05 (Drop Depth = 2)
Network Module is in slot 5
Configuration Task:

```
100    IODEF DROP_DEPTH%[ SLOT=5, REGISTER=20]
110    IODEF NETDDER@[ SLOT=5, REGISTER=20, BIT=14]
120    IODEF NETDDOK@[ SLOT=5, REGISTER=20, BIT=15]
130    IODEF NETWOK@[ SLOT=5, REGISTER=4, BIT=0]
160    NETDEF REF%[ SLOT=5, DROP=6, REGISTER=2]
```

BASIC or Control Block Task:

The first three lines of the following task should be included at the beginning of the task initialization section of the highest priority BASIC or Control Block task. The first line declares the common network variables. Line 500 defines the drop depth. In the following task, SPEED_POT% is assumed to refer to an input from an A/D input module.

```
100    COMMON DROP_DEPTH%, REF%, SPEED_POT%
499    ! Start of task initialization
500    DROP_DEPTH%=2
1000   START EVERY 2 TICKS
2000   REF%=SPEED_POT% * 2
32767  END
```

If drop 08 wishes to use the value of REF% generated in drop 05, the following application task could be used. Note in line 160 of the configuration task that the name of the variable REF% has been changed to DROP5_REF%. This has no effect on the variable itself, but may be helpful to the programmer for reference purposes. Note also the only difference in defining the location of this variable is the slot number. The Network module is located in slot 7 of this rack. Because the dual port image will be identical in each module, this variable value will be located in register 2 of the drop 6 area in each module.

Drop 08 (Drop Depth = 1)
Network Module is in slot 7
Configuration Task:

```
100     IODEF DROP_DEPTH%[ SLOT=7, REGISTER=20]
110     IODEF NETDDER@[ SLOT=7, REGISTER=20, BIT=14]
120     IODEF NETDDOK@[ SLOT=7, REGISTER=20, BIT=15]
130     IODEF NETWOK@[ SLOT=7, REGISTER=4, BIT=0]
160     NETDEF DROP5_REF%[ SLOT=7, DROP=6, REGISTER=2]
```

Control Block Task:

```
100     COMMON DROP_DEPTH%, DROP5_REF%
500     DROP_DEPTH%=1
1000    CALL SCAN LOOP (TICKS = 4)
1500    CALL SELECT (INPUT 1 = DROP5_REF%          &
                     SELECT 1 = RUN@               &
                     OUTPUT = SEC_REF%)
          ..              ..
          ..              ..
32767   END
```

4.5 Ensuring Network Integrity

WARNING

THE AutoMax NETWORK IS DESIGNED TO CONTINUE OPERATING IF ONE OR MORE DROPS ON THE NETWORK FAILS OR IS TAKEN OFF LINE. IF CERTAIN DATA MUST BE TRANSFERRED RELIABLY TO ENSURE SAFE OPERATION, THE USER MUST ADD SOFTWARE HANDSHAKING IN THE APPLICATION PROGRAM THAT WILL DETECT LOSS OF COMMUNICATION. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

WARNING

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

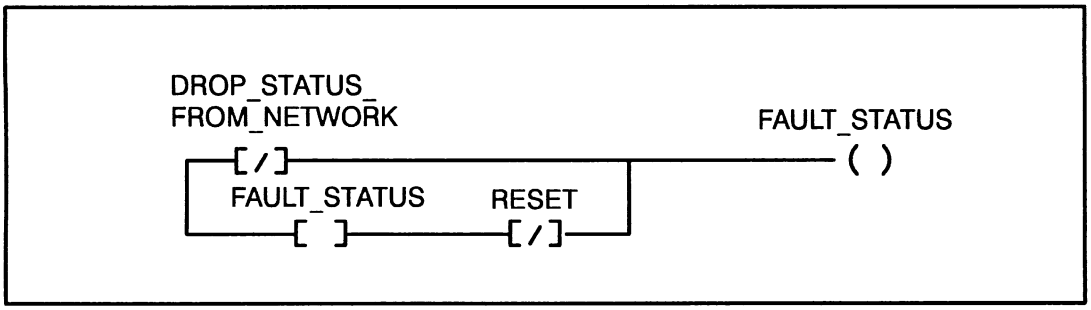
In the event of a network failure, i.e., a drop becomes unable to communicate with the master for any reason, controls must be in place to ensure the system reacts in a predictable, controlled manner. Each network module contains bits that indicate communication status. These bits must be used in the application task to generate faults indicating communication failure. Application tasks in the other racks determine how the system will react to a particular drop going off line. The application task must ensure that

properly functioning units on the network can continue to run with the states of I/O and process variables controlled in a predictable and safe manner.

If the network is installed correctly, the drops will communicate with essentially no errors at all. It is a normal occurrence in a system like this to periodically have an error, but the frequency should be very low. You may notice the error registers, over the period of a day or two, will log one or two errors. The system is designed to work around these occasional errors.

Each time the master transmits a message, it expects a response from the targeted drop. If there is no response, the master will retransmit the message up to three more times. In these instances, retransmitting the message will fix the momentary problem. However, if the master has failed to receive a response after transmitting a message four times, the drop will go off line for a minimum of 120 ms. This indicates something is seriously wrong. The cause of the communication failure should be investigated and corrected before the system is allowed to continue operating.

Using the following circuit in your PC task will record the fault status and enable the operator to determine that the network has been established, the application software is running, and the data is safe to use before restarting the system.



DROP_STATUS can be either the drop 0 status bit in the slave drop or the particular drop's status bit in the master (refer to section 4.1.1.1). RESET indicates a manual reset under operator control. When the drop goes off line for the 120 ms period, the FAULT_STATUS coil will go high and stay high until it is manually reset by the operator.

4.5.1 Detecting Partial Network Failure

Recall that all data is broadcast, i.e., transmitted simultaneously to all drops. If a response is not received from a targeted drop, the master will retry three times to communicate with that drop. However, if a drop that was not targeted for that transmission did not receive the message correctly, the master will not retransmit the message unless the targeted drop also did not receive it. It is possible, therefore, that this drop will not contain the most current copy of the data.

This problem can be detected by monitoring status registers 15-18 in the drop 0 area of the module. If these values increase rapidly over a short period of time, there is a problem with network integrity.

If this is a concern in your application, you should direct data from slave to master to slave. For example, assume data from one rack (drop 1) is critical to the operation of another rack (drop 2). After this data is transmitted to the master, the master can transfer it to its drop 2 area and then transmit it directly to drop 2.

4.6 Use of Hardware Interrupts in Racks Containing Network Modules

This section is applicable only to racks that contain a CML application task(s) or tasks that contain hardware EVENT statements in Control Block or BASIC application tasks. These two kinds of tasks require Processors to allocate hardware interrupt lines on the rack backplane because some portion of task execution depends upon receiving a user-defined hardware interrupt from another module in the rack, e.g., a Resolver Input module. The remainder of this section will first describe the basic method by which interrupt lines are allocated and then how Network Communications and Ethernet Network Interface modules affect the allocation process. See the Enhanced BASIC Language instruction manual (J-3675) for more information on hardware EVENT statements and the Control Block Language instruction manual (J-3676) for more information on CML tasks.

Because the number of interrupt lines is limited to four, it is necessary to take into account the rules by which they are allocated in order to prevent errors when application tasks are put into run. Each of the four interrupt lines can "service" one of the following:

a) up to four BASIC language hardware EVENT statements found in BASIC or Control Block tasks on one Processor module

b) one CML task (used in racks containing drive modules only)

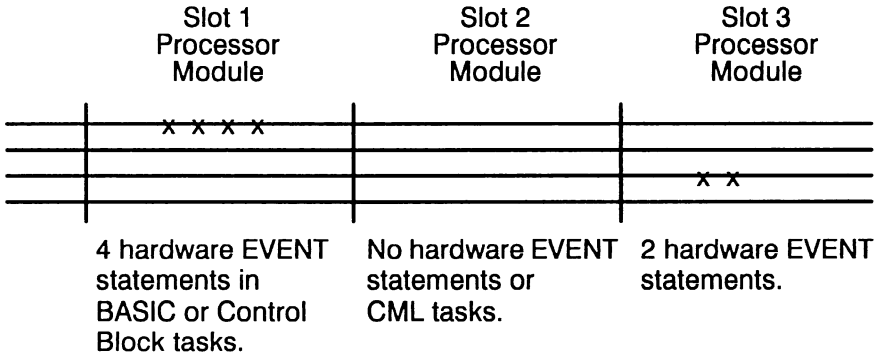
Any one Processor module can allocate one of the four interrupt lines for up to four EVENT statements and one line for a CML task. (CML tasks are limited to two per rack because of drive module configuration restrictions). Note that a minimum of one hardware interrupt line will be allocated for a Processor module regardless of whether there is one or four hardware EVENT statements used in application tasks loaded on that Processor.

The following examples of interrupt line allocation assume that there are three Processor modules in the rack. Note that these examples do not take into account the efficiency of distributing application tasks between Processor modules in this manner (in terms of system performance) and do not include Network Communications modules (M/N 57C404A or later) or Ethernet Network Interface modules (M/N 57C440). These two modules will be added in later examples.

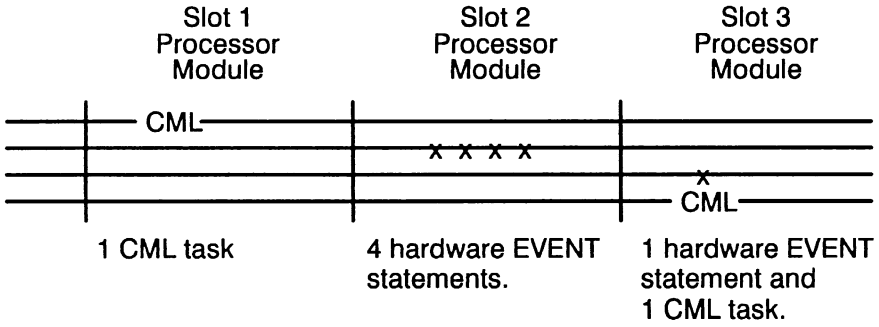
4.6.1 Examples of Interrupt Line Allocation

The following are examples of interrupt line allocation.

Example #1



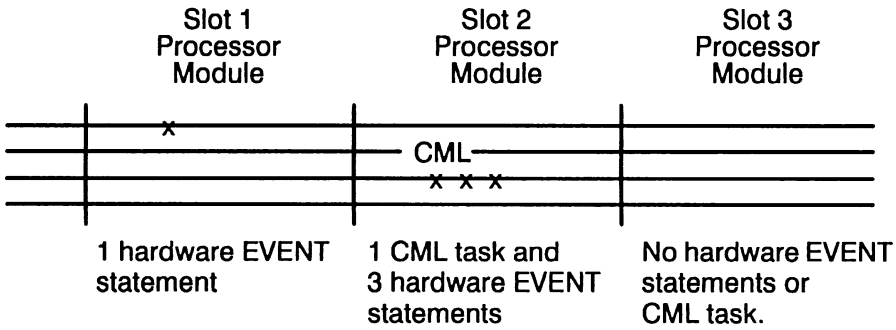
Example #2



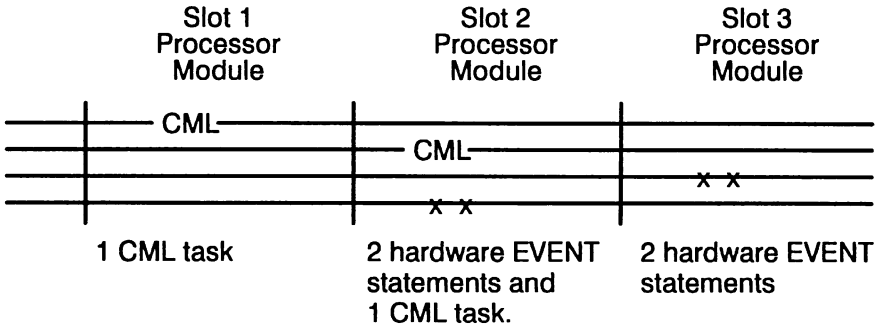
— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task

N = Network Modules
E = Ethernet Modules

Example #3



Example #4



— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task
N = Network Modules
E = Ethernet Modules

4.6.2 Examples of Interrupt Line Allocation with Network or Ethernet Modules in the Rack

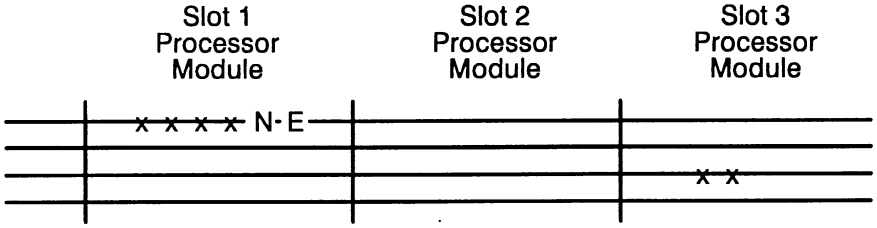
With the addition of Network modules (M/N 57C404A and later only) or Ethernet Network Interface modules to the rack, however, examples #2 and #4 in section 4.6.1 would cause an error (code 44 on Processor LEDs) when tasks were put into run and would not allow them to go into run. The following section explains the allocation of interrupts when Network and Ethernet modules are added to the examples in 4.6.1.

Network and Ethernet modules require the allocation of an interrupt line by the leftmost Processor module in the rack. The presence of either or both of these two modules in any quantity will require a single interrupt line. The interrupt line requested by these modules, however, can be shared with four hardware EVENT statements but cannot be shared with the interrupt line required by a CML task.

If two Network modules and one Ethernet module were added to the rack in the above examples, the following would occur. Note that when either of these modules are added to the rack, the leftmost Processor module will show an increase in CPU utilization (processing capacity used). The CPU utilization statistic is available through the Programming Executive software.

Example #1

The Network and Ethernet modules would share the interrupt line with the four hardware EVENT statements in the leftmost Processor module.



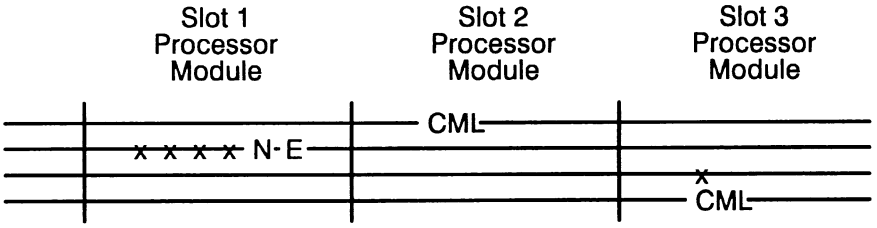
— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task

N = Network Modules
E = Ethernet Modules

Example #2

In example #2, the addition of Network and Ethernet modules would cause an error when application tasks were put into run. The CML task in the leftmost Processor module cannot share its interrupt line, and the remaining three lines are already allocated (one on the Processor in slot 2, two on the Processor in slot 3).

One solution to this problem would be to move the CML task from the Processor in slot 1 to the Processor in slot 2 and the task(s) containing the four hardware EVENT statements from the Processor in slot 2 to the Processor in slot 1. The Network and Ethernet modules could share the interrupt line required for the EVENT statements in the leftmost Processor.

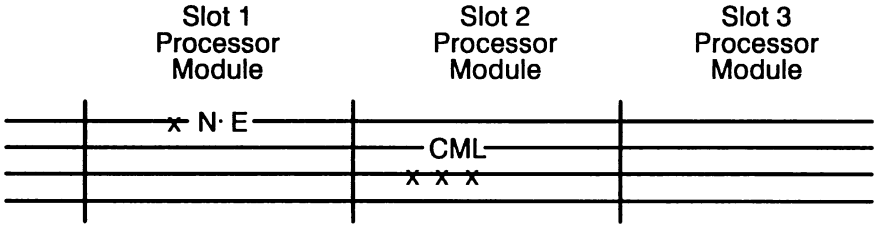


— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task

N = Network Modules
E = Ethernet Modules

Example #3

The Network and Ethernet modules would share the line required for the hardware EVENT statement in the leftmost Processor. Note that this line can be shared whether it is used for 1, 2, 3, or 4 EVENT statements.

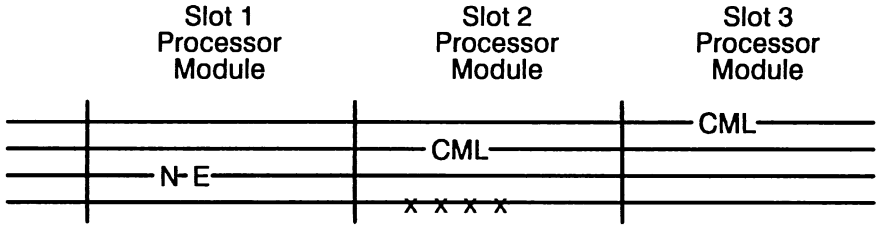


— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task
N = Network Modules
E = Ethernet Modules

Example #4

This example would cause an error when application tasks were put into run. Four interrupt lines have already been allocated. The leftmost Processor module has allocated one for its CML application task. The Processor module in slot 2 has allocated one for two hardware EVENT statements and one for its CML task. The Processor in slot 3 has allocated one for two hardware EVENT statements. There are no other interrupt lines for the leftmost Processor to allocate for the Network and Ethernet modules, and the interrupt line required for the CML task cannot be shared.

One solution is to move the CML task from the processor in slot 1 to the Processor in slot 3 and to move the task or tasks containing two hardware EVENT statements from the Processor in slot 3 to the Processor in slot 2. In this case, the Processor in slot 2 still requires two interrupt lines. The Processor module requires one interrupt line. The leftmost Processor will allocate an interrupt line for the Network and Ethernet modules. Note that this line could be shared with up to four EVENT statements.



— = Interrupt Line
x = Hardware EVENT Statement
CML = CML Task
N = Network Modules
E = Ethernet Modules

5.0 PROGRAMMING TERMINAL COMMUNICATIONS

This section describes the function of the programming terminal at the local and network levels. For more information regarding the features of the AutoMax Programming Executive, refer to the AutoMax Programming Executive instruction manual.

5.1 Connecting to the Network Module for Local Monitoring

Local monitoring of the Network module is performed with a terminal or a personal computer running emulation software connected to the RS-232 port on the faceplate of the Network Module. The terminal must be locked in capital letters. The RS-232 port is factory-configured for a data rate of 1200 baud, 8 data bits per character in transmission and receive, 1 stop bit, and no parity. The AutoMax Programming Executive includes the Kermit™ communications software which allows your personal computer to emulate a terminal. Refer to J-3616, the Kermit communications software instruction manual, for instructions on using Kermit.

There are two commands from the terminal that are recognized by the Network module: S and T. These are described below.

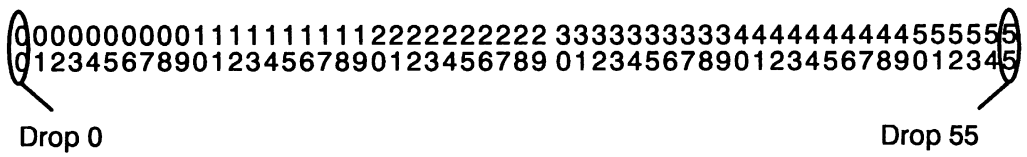
5.1.1 S (Status) Command

When an "S" (uppercase only) is typed at the terminal, all the parameters associated with the module will be displayed at the programming terminal. All drops will display the following status information:

SOFTWARE PART NUMBER 419450-nnnx
(nnn is the part version and x is the part revision letter)

CHASSIS IS	ACTIVE OR INACTIVE
LINE IS	ACTIVE OR INACTIVE
MODE IS	PROGRAM, MEMORY PROTECT, OR SETUP
DROP NUMBER	0 THROUGH 55
MESSAGES RECEIVED:	N
RECEIVE TIMEOUTS	N
CRC ERRORS	N
OVERRUN ERRORS	N
ABORT ERRORS	N
MESSAGES SENT:	N

DROP STATUS (X = ACTIVE)



The master logs the error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, and ABORT) for the entire network. All network statistical parameters will increase to 65535 and then roll over to zero.

MESSAGES RECEIVED: This is the value of register 14 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.4.

RECEIVE TIMEOUTS: This is the value of register 15 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.5.

CRC ERRORS: This is the value of register 16 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.6.

OVERRUN ERRORS: This is the value of register 17 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.7.

ABORT ERRORS: This is the value of register 18 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.8.

MESSAGES TRANSMITTED: This is the value of register 19 in the drop 0 area of the module's dual port memory. Refer to section 4.1.1.9.

DROP STATUS: This is essentially the same drop status information contained in dual port registers 4 through 7. If the module is a master, this indicates all drops that are active on the network. If the module is a slave, this indicates which drops that it represents are active on the network. For example, if the slave drop setting on the thumbwheel switches is equal to 1 and the Drop Depth specification is equal to 5, the DROP STATUS display will indicate whether or not drops 1, 2, 3, 4, and 5 are active by placing an "X" under the appropriate drop numbers.

This status report is not continually updated on the screen. You must press "S" each time you want updated information.

5.1.2 T (Self Test) Command

The "T" command is valid only if the Power Supply keyswitch is in the PROGRAM position and the Network module is not connected to the network. Typing "T" (uppercase only) initiates the power-up sequence and the self-diagnostic test of the Network module.

While this is executing, access to the dual port memory from the Multibus® is inhibited, causing any attempted accesses to the module to cause a bus error. Therefore, if application tasks running on a Processor module are accessing variables on this Network module, stop the application tasks to avoid shutting down the system with a user bus error before using this command.

This command can be used to reset the Network module after you have used the thumbwheel switches to change the drop number instead of cycling power to the entire rack. However, drop depth will be "0" after the module completes the test and error code "C" (communication failure) will appear on the Network module's LED display. This error can be cleared by writing a valid drop depth to register 20 of that module using the Monitor I/O feature of the AutoMax Programming Executive or running an application task that defines drop depth.

5.2 Connecting to an AutoMax Processor

Connecting an IBM-compatible computer running the AutoMax Executive to the leftmost Processor module in the rack allows you to communicate directly with the local rack or with any rack on the network. The default status is direct communication with the rack that is physically connected to the personal computer. See below for more information on direct and network communication.

Note that you do not need to establish a network connection through the ON-LINE menu to load an operating system over a network. However, the rack to which you are directly connected must have the operating system loaded before any operating systems can be loaded to other racks over the network. Refer to the AutoMax Programming Executive instruction manual for more information.

5.2.1 Direct Communication with the Local Rack

Selecting direct communication from the ON-LINE menu will cause the Executive software to send all communication to the rack to which the personal computer is directly connected. Direct connection is the default status. Refer to the AutoMax Programming Executive instruction manual for the procedure required for direct communication.

5.2.2 Network Communication

Any function of the AutoMax Programming Executive can be performed over the network. Refer to the AutoMax Programming Executive instruction manual for the procedure required to communicate over the network.

Data transmission scheduling by the master is "round robin", i.e., no drop may transmit a second time before all drops have transmitted the first time. Also, the master and slaves operate at equal priority when waiting to send data.

5.2.3 Terminal Connections Limitation

The number of terminals that may be communicating over the network is limited only by the number of programming ports available. However, no more than three network and one local connections may be made to one given rack at one time. Write access is controlled by password and is granted to only one connection per rack.

6.0 DIAGNOSTICS AND TROUBLESHOOTING

This section describes how to troubleshoot the Network Communications module. If the problem cannot be corrected using the procedures below, the unit is not user-serviceable. See Appendix L 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, 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.

6.1 The "OK" Light is OFF

Problem: The green "OK" status light on the face of the Network module is off. This light should be on when the module has passed its internal diagnostics after power-up. If the green "OK" status light is off, and no seven-segment error code is displayed, a local watchdog failure has occurred. Cycle power to the rack. If the "OK" status light remains off, replace the module.

6.2 Invalid Drop Number

Problem: Error code A appears on a Network module's LED 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 55.

Use the following procedure to clear the error code:

Step 1. Enter the correct drop number on the thumbwheel switches.

Step 2. Cycle power to the rack or issue a self test command ("T") through the programming terminal (refer to section 5.0).

6.3 Network Failure

Problem: Error code C appears on the Network module's LED display. This error code indicates a network failure. If the module is a master drop, no other drops are functional on the network. If the module is a slave drop, it is not receiving any messages from the master drop and the data contained in its dual port memory will remain at the last value written to it. The data targeted for that drop will remain frozen in the dual port memory of the other slaves on the network. This fault code is reset whenever the line goes active. The

causes of a network failure are incorrect drop depth specifications or lack of cable system integrity.

The master logs the error parameters (RECEIVE TIMEOUTS, CRC, OVERRUN, and ABORT) for the entire network. Monitoring these registers will indicate cable system integrity or lack of it. A few errors may accumulate over a period of time, such as a few days; but, when these parameter values increase consistently over a short period of time, there is a problem with the integrity. If this occurs, monitor the error parameters of each Network module to isolate the problem.

Use the following procedure to isolate the cause of a communication failure:

Step 1. Verify that the drop number of the slave modules is unique and the thumbwheel switches are set correctly. Verify that the thumbwheel settings on the module correspond to the drop number value in register 12 in the drop 0 area. The Network module reads the thumbwheel switches 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 this register.

Step 2. Verify that drop depth has been specified. If you have performed the self test function, the module will power up with a drop depth of "0". If the Network module is used in an AutoMax Version 1.0 system or a DCS 5000 system, it will also power up with a drop depth of "0". Writing a valid drop depth to register 20 or running an application task that defines drop depth will clear this error.

Step 3. Verify that the drop depth specifications for each slave module are such that the slave modules do not overlap in drop numbers. Only one slave module can be configured to respond to any given drop number.

NOTE: *Use steps 4 through 8 below if you have a coaxial cable network. If you have a fiber-optic network, see section L3.1.*

Step 4. Verify that the network connections to each module are secure. Check the drop cable connection at the module faceplate and at the passive tap. Verify that the coax cable connections are secure.

Step 5. Verify that the network cabling is terminated correctly. There must be a line terminator at each end of the network.

Step 6. Verify that the cabling between Network modules is installed in its own separate conduit held free from major noise sources, such as power or other signal wires.

Step 7. Inspect and test the cable system following the instructions in sections 3.5.1 and 3.5.4.

Step 8. Verify that the network cabling does not exceed the maximum allowable length given the number of physical drops and its electrical characteristics.

6.4 Bus Error

Problem: Error code 31 or 56-58 appears on a Processor module's LED display. These errors indicate the system has a problem accessing the module through the backplane bus. Possible causes of a bus error are a missing module, a module in the wrong slot, or a malfunctioning module. It is also possible that the user is attempting to write to Read Only registers on the module.

Use the following procedure to isolate a bus error:

Step 1. Verify that the module is in the correct slot.

Verify that the slot number being referenced in the application tasks agrees with the slot number defined during configuration.

Step 2. Verify the drop number is correct.

The thumbwheel switches may be changed while the module is on line without having any effect on the system. On the next power up, if the thumbwheel switches define a drop that is valid and unique on the network, the processor will accept it as a valid drop. However, the new drop setting will re-define the Read/Write areas in the module's memory. When the application task is run, it will no longer be able to write to the same areas as before, resulting in a bus error.

Step 3. Verify that the application software is correct.

Verify that the application software is not attempting to write to Read Only registers on the module. Refer to section 4.1.1.11 for access definition of the broadcast registers. Refer to section 4.1.2 for access definition of the data exchange registers.

Step 4. Verify that the hardware is working correctly.

One at a time, swap out the Network module, the Processor module(s), and the backplane. After each swap, determine if the problem has been corrected before swapping out the next item.

6.5 Interrupt Allocation Errors

Problem: Error code 44 appears on a Processor module's LED display or error code 2010 appears in the error log of a CML task. Both of these error codes indicate a problem in allocating hardware interrupt lines. Refer to section 4.6 for an explanation of how interrupt lines are allocated among Processor modules.

Appendix A

Hardware Technical Specifications

Network Communications Module M/N 57C404B

Ambient Conditions

- Storage temperature: 0°C - 60°C
- Operating temperature: −40°C - 85°C
- Humidity: 5 - 95%, non-condensing
- Altitude: 3300 feet (1000 meters) without derating

Dimensions

- Height: 11.75 in (29.845 cm)
- Width: 1.25 in (3.175 cm)
- Depth: 7.375 in (18.7325 cm)
- Weight: 2 lb (.9 kg)

Maximum Power Dissipation

- 20 watts

System Power Requirements

- 5 volts: 2.5 A
- +12 volts: 53 mA
- −12 volts: 7.5 mA

Communications Passive Tap M/N 57C380

Dimensions

- Height: 1.7 in (4.3 cm)
  9-pin connector extends .25 in (.635 cm) above tap
  BNC connectors extend .75 in (1.9 cm) below tap
- Width: 5.150 in (13.08 cm)
- Depth: 2.625 in (6.667 cm)
- Weight: .5 lb (.225 kg)

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 Tranceiver 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)

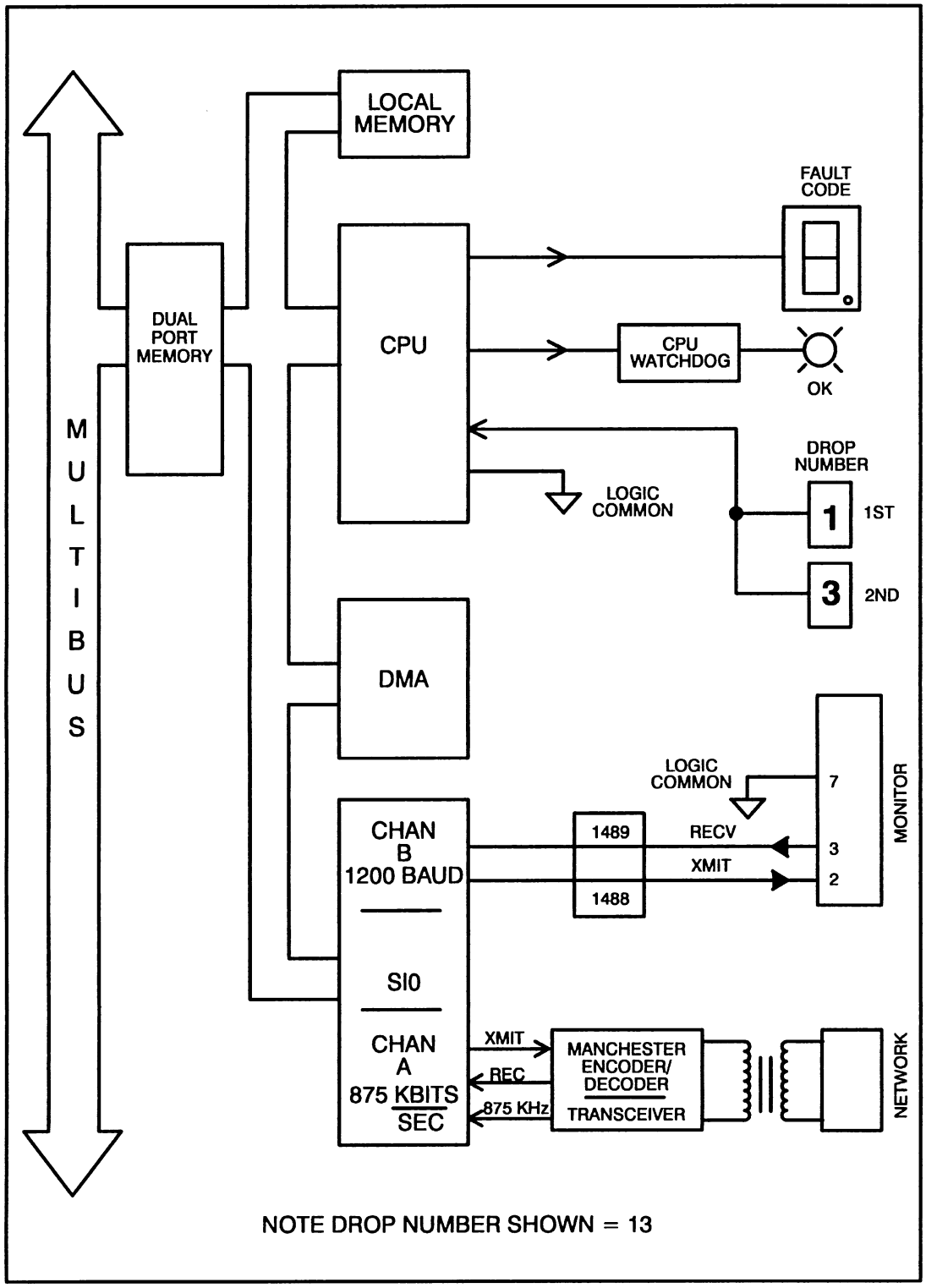
Input Power

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

All other specifications are identical to Stand-Alone Transceiver

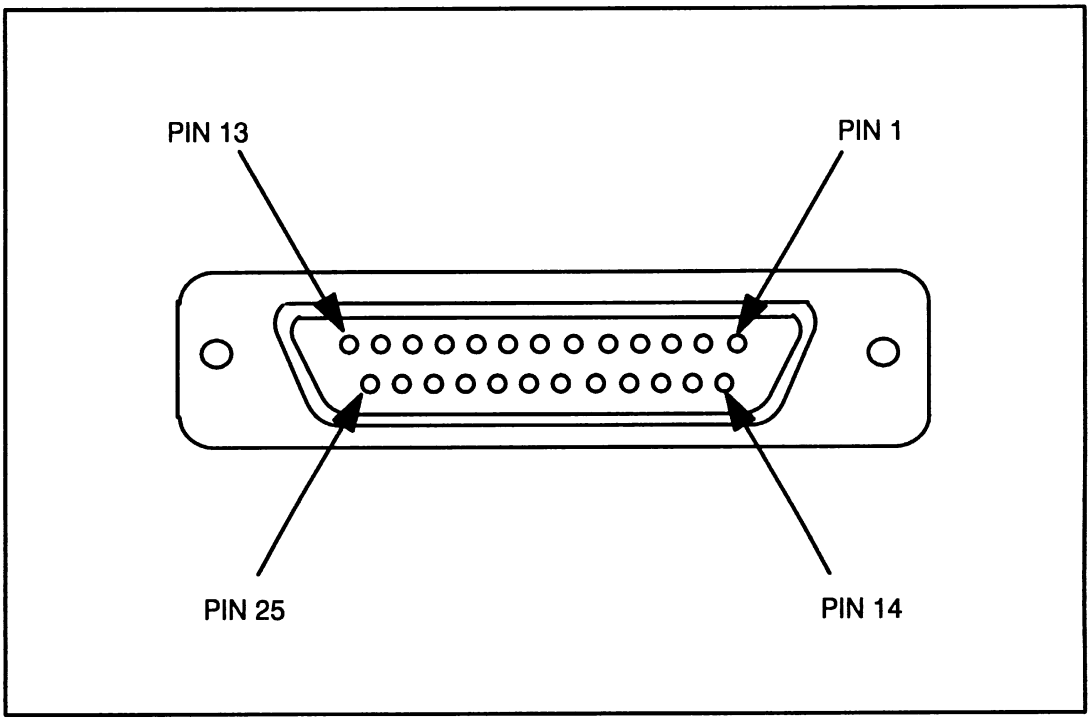
Appendix B

Network Communications Module Block Diagram



Appendix C

RS-232 Port Pinout



PIN #	SIGNAL
2	XMIT
3	RECV
7	COM

Appendix D

Error Codes

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 - Dual port memory failed power-up diagnostic

7 - Memory management unit failed power-up diagnostic

.8 or 8- Microprocessor on module did not attempt to go into run

- Bad, missing, or wrong runbase EPROMs
- Bad power supply
- Interference from another module
- Bad backplane

Try re-seating the module

9 - PIO port failed power-up diagnostic

A - Invalid drop number. This only occurs if the drop number on the thumbwheel switches is greater than 55.

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. The module is operational but will not transmit or receive data until the watchdog is reset.

E - Power failure. The code is normally present from the time that a low voltage is detected until power is completely lost.

Error codes 0-9 and b will require replacement of the Network Communications module.

Appendix E

Network Compatibility Chart

CPU	FACEPLATE LABEL	
57C430A & 57C431 AutoMax V2.X & V3.X 57C435 AutoMax V3.1 or later Supports Network Programming	57C404B 57C404A 57C404 57404-1 57404	Full network programming Full network programming Full network programming Standard network supporting drop depth Standard network without drop depth
57C430 AutoMax V1.0 Standard Network Support Only	57C404B 57C404A 57C404 57404-1 57404	Standard network supporting drop depth Standard network supporting drop depth Standard network supporting drop depth Standard network supporting drop depth Standard network without drop depth
57C407 DCS 5000 Standard Network Support Only	57C404B 57C404A 57C404 57404-1 57404	Standard network supporting drop depth Standard network supporting drop depth Standard network supporting drop depth Standard network supporting drop depth Standard network without drop depth

NOTES:

1. Only Processor models 57C430A and later may be mixed in a rack.
2. Network programming is supported only if all nodes on the network are models 57C404B, 57C404A, or 57C404 (they may be intermixed).
3. Models 57C404B, 57C404A, 57C404, and 57C404-1 may be intermixed on the same network. However, the network will be limited to the capabilities of the earliest version module. (For example, network programming will not be possible if model 57C404-1 is intermixed with models 57C404, 57C404A, or 57C404B since model 57C404-1 does not support this feature.)
4. Model 57404 may not be mixed with any other version on the same network.
5. All versions of network modules may be intermixed in a rack.
6. Network modules labeled 57C404 are remanufactured by Reliance's Digital Product Repair facility and are the same as model 57C404A.
7. Enhancements to Network modules with network programming capability are described below:

   57C404 - Initial release of network programming feature.

   57C404A - The Drop 0 status bit in the slaves is set only after the user task has programmed drop depth. Compatible with 57404-1 and 57C404 Network modules.

57C404B - The Drop Status bits in the master are set only after the user task has programmed drop depth in the slaves. Compatible with previous Network module releases. When operating with previous versions, however, the Drop Status bits in the master are set to indicate drops active on the network whether drop depth has been programmed by the system or the user.

Appendix F

Response to a System Stop-All

The Network module (57C404B) responds to a system stop-all by clearing all registers in the dual port memory. (In versions 57C404 and 57C404A, the dual port memory was not cleared.) This enhancement affects the master and the slaves in the following ways:

Slaves:

When the Processor puts a slave drop back on line by writing a "1" to the drop depth register, outputs from the slave (registers 0-31) are zero and will overwrite the corresponding input registers in the master.

Outputs from the master (registers 32-63) will overwrite the input registers in the slave that had been cleared momentarily by the stop-all.

The above applies only to Drop N, where N is the drop number on the module's faceplate. For drop depths greater than 1, data for the virtual drops is not exchanged with the master until an application task programs a larger drop depth. This means that at the slave, master outputs to the virtual drops are fixed at zero. At the master and the other slaves, slave outputs from virtual drops remain fixed at their last value prior to the stop-all.

Master:

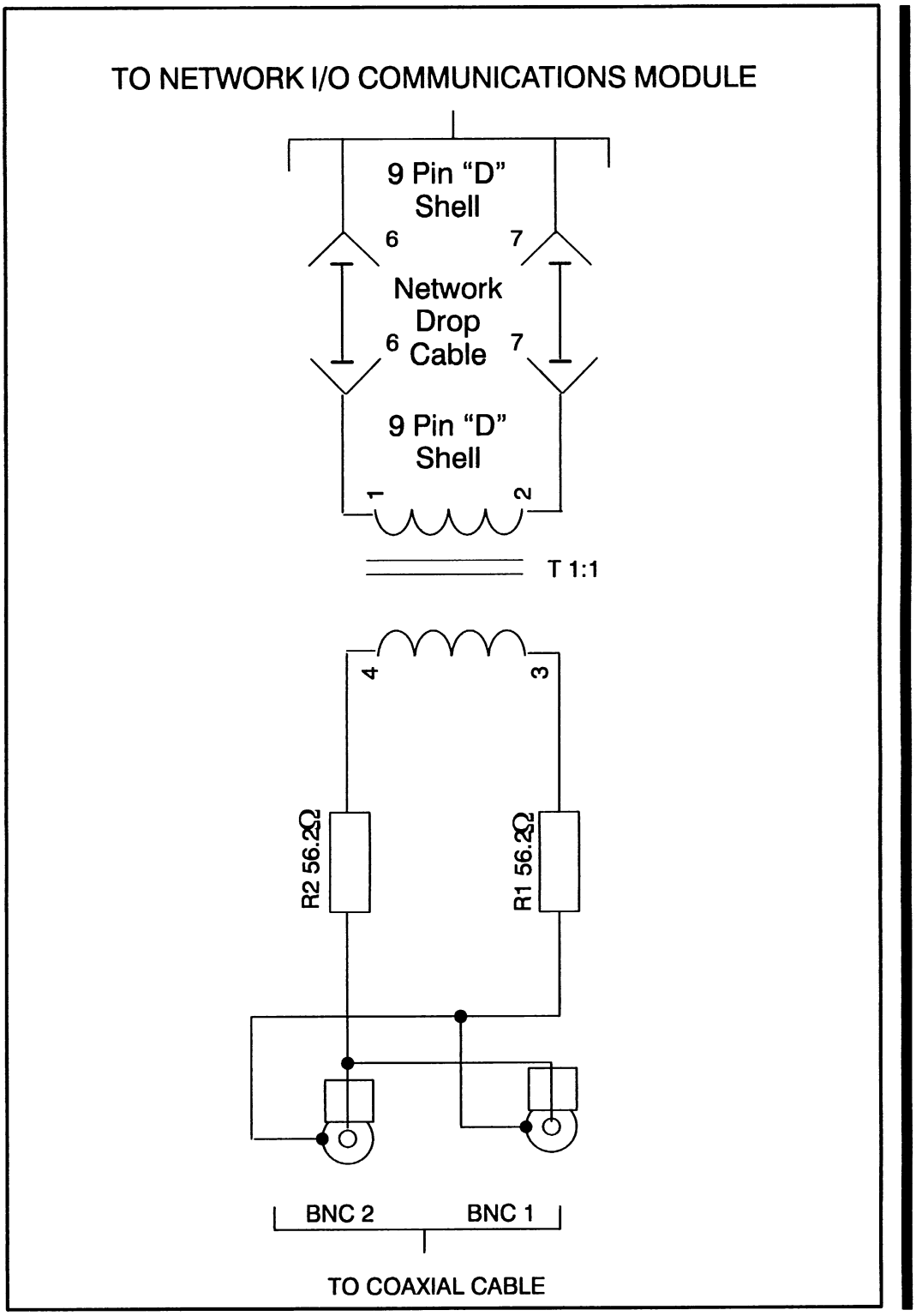
As the master re-establishes communication with the slave drops, its output registers (32-63) are zero. Consequently, slave inputs which had been frozen at their last value prior to the stop-all will be cleared to zero.

Master input registers (0-31) which had been cleared by the stop-all will be overwritten by the current slave output register values.

Appendix G

Schematics

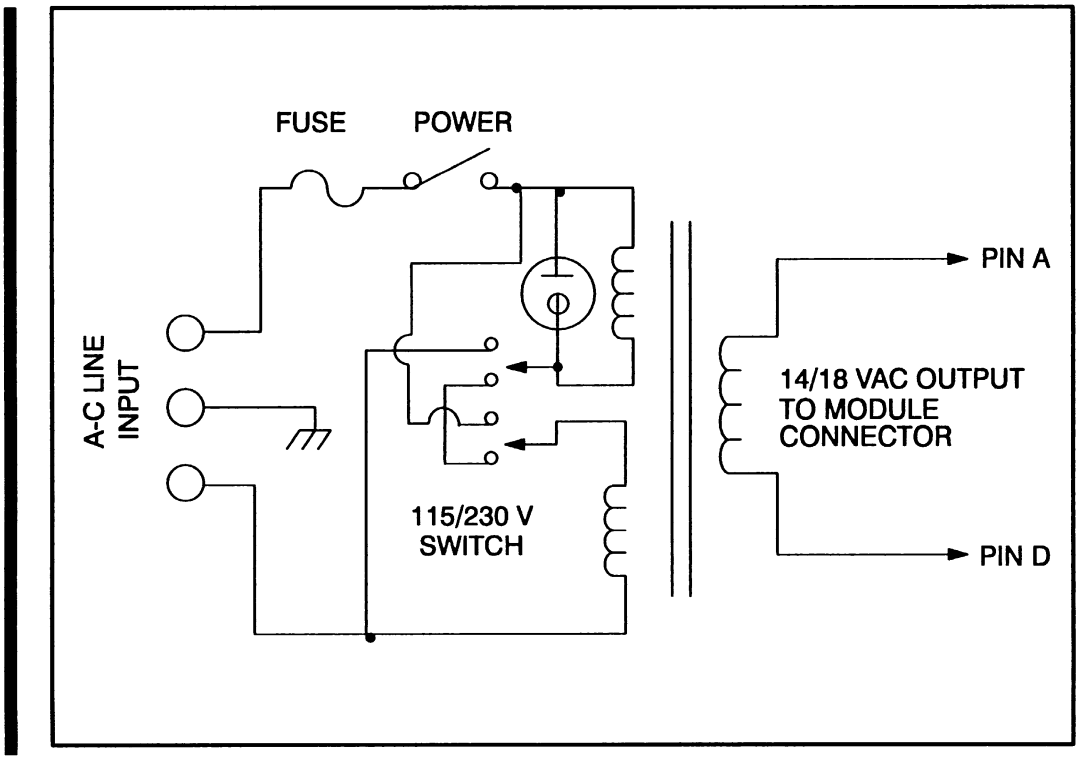
Communications Passive Tap M/N 57C380



Appendix G

(Continued)

Fiber-Optic Rack Power Supply
M/N 57C368



Appendix H

DCS-NET Network Specifications

Specification	Using Coaxial Cable	Using Fiber-Optic Cable
Topology	Bus	Active Star
Cable Options	RG-59U (Belden 9259) RG-11U (Belden 8213)	62.5 micron (Belden 225362)
Maximum Cable Length	RG-59U: 3000 ft (1000 m) RG-11U: 6000 ft (2000 m)	12,000 ft (4000 m)*
Organization	Master-Slave	
Max. No. of Physical Slave Drops	51	55
Max. No. of Logical Software-Configured Slave Drops	55	
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 I

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°C

Appendix I

(Continued)

Minimum Bending Radius

- 2.5 inches

Maximum Standard Length

- 1000 feet

Belden 8213 RG-11/U Type Coaxial Cable

Nominal Impedance

- 75 ohms

Nominal Velocity of Propagation

- 78%

Nominal Capacitance

- 17.3 picofarad/foot

Nominal Attenuation at 1 MHz

- 0.17 decibels/100 feet
- 100% sweep tested 5-450 MHz

Outer Jacket

- Black polyethylene

Nominal Outer Diameter

- 0.405 inches

Shield

- Coverage and material: 95% bare copper braid
- Nominal D-C resistance: 1.2 ohms/1000 feet

Insulation

- Cellular polyethylene

Center Conductor

- Material: solid bare copper
- Nominal D-C resistance: 2.6 ohms/1000 feet

Appendix I

(Continued)

Suggested Operating Temperature Range

- −55°C, +80°C

Minimum Bending Radius

- 5 inches

Maximum Standard Length

- 2000 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 I

(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 Attentuation

- −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 J

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)
RG-11/U Type	N/A	Belden 8213
Dual Crimp Plug Connector for Belden 8213 Coax	N/A	AMP™ 225886-6
Crimping Tool for AMP 225886-6 Connector	N/A	AMP™ 220015-1 (Die Included)
Jack-to-Jack In-Line Splicing Adapter (for RG-59 and RG-11 Cables)	N/A	AMP™ 221551-3

Appendix J

(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
BNC Tee Adapter	M/N 45C70	N/A

Appendix K

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 K

(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 L

DCS-NET Fiber-Optic Network Installation Guidelines

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L1.0 INTRODUCTION

This appendix provides an overview of fiber-optic networks, a description of the hardware components that comprise the DCS-NET fiber-optic network, and guidelines for installing the components and fiber-optic cable when used with the Network Communications module. Refer to sections 3.6 and 3.7 in this manual for Network Communications module installation and replacement procedures.

L1.1 DCS-NET Fiber-Optic Network Overview

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

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

Unlike the DCS-NET coaxial cable network, which allows multiple drops to be connected to a main trunkline, a fiber-optic link provides point-to-point communication only. Therefore, a different network configuration and different hardware components are required to enable communication between drops. A "star topology" network configuration is used for the DCS-NET fiber-optic network, as shown in figure L1.1.

The type of cable or the network configuration used has no effect on the operation of the DCS-NET network protocols, application software, or the operation of the Network Communications module.

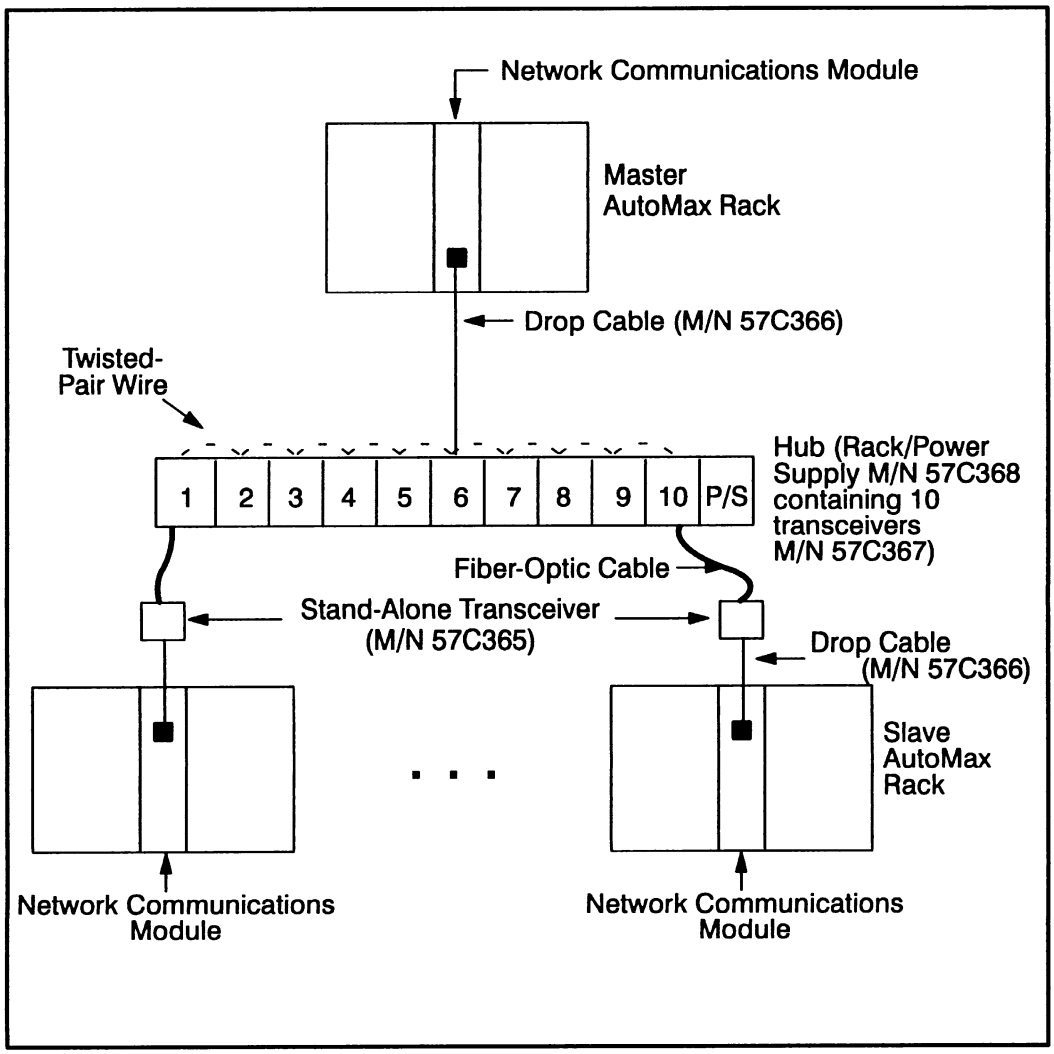


Figure L1.1 - DCS-NET Fiber-Optic Network

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.

Figure L1.2 shows how a larger network is created by linking hubs together.

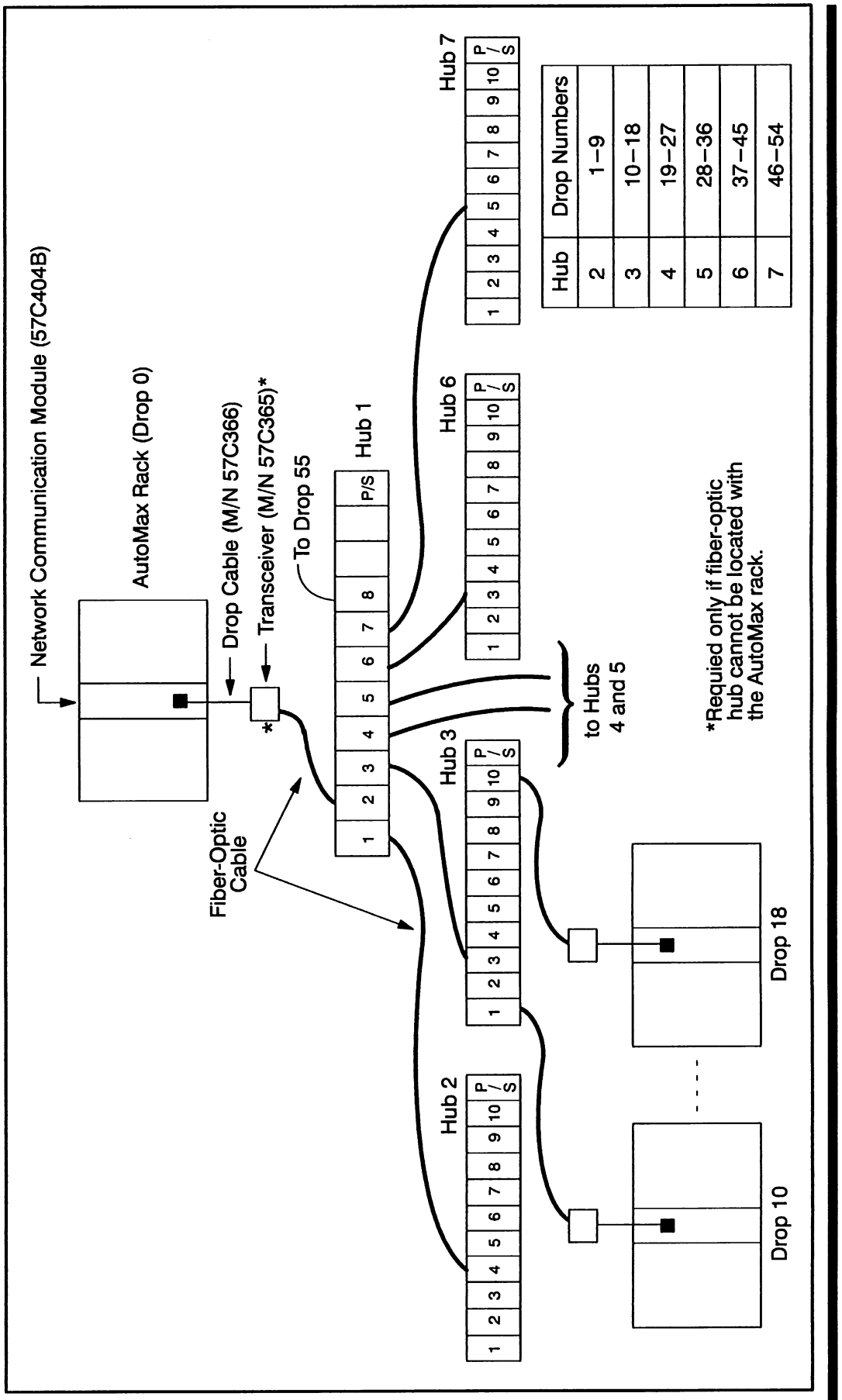


Figure L1.2 - Linking Hubs to Create a Larger Network

Figure L1.3 shows an IBM-compatible personal computer containing an AutoMax PC Link Interface module (M/N 57C445) connected to a Stand-Alone Transceiver. A twisted-pair-to-coax balun (AMP 555053-1 is recommended) is used to convert the cable between the PC Link module and the transceiver. The balun is connected the PC Link module via the BNC Tee Adapter (M/N 45C70). Note that a 75 ohm terminating load (M/N 45C71) is required. The balun is connected to the transceiver using twisted-pair wire.

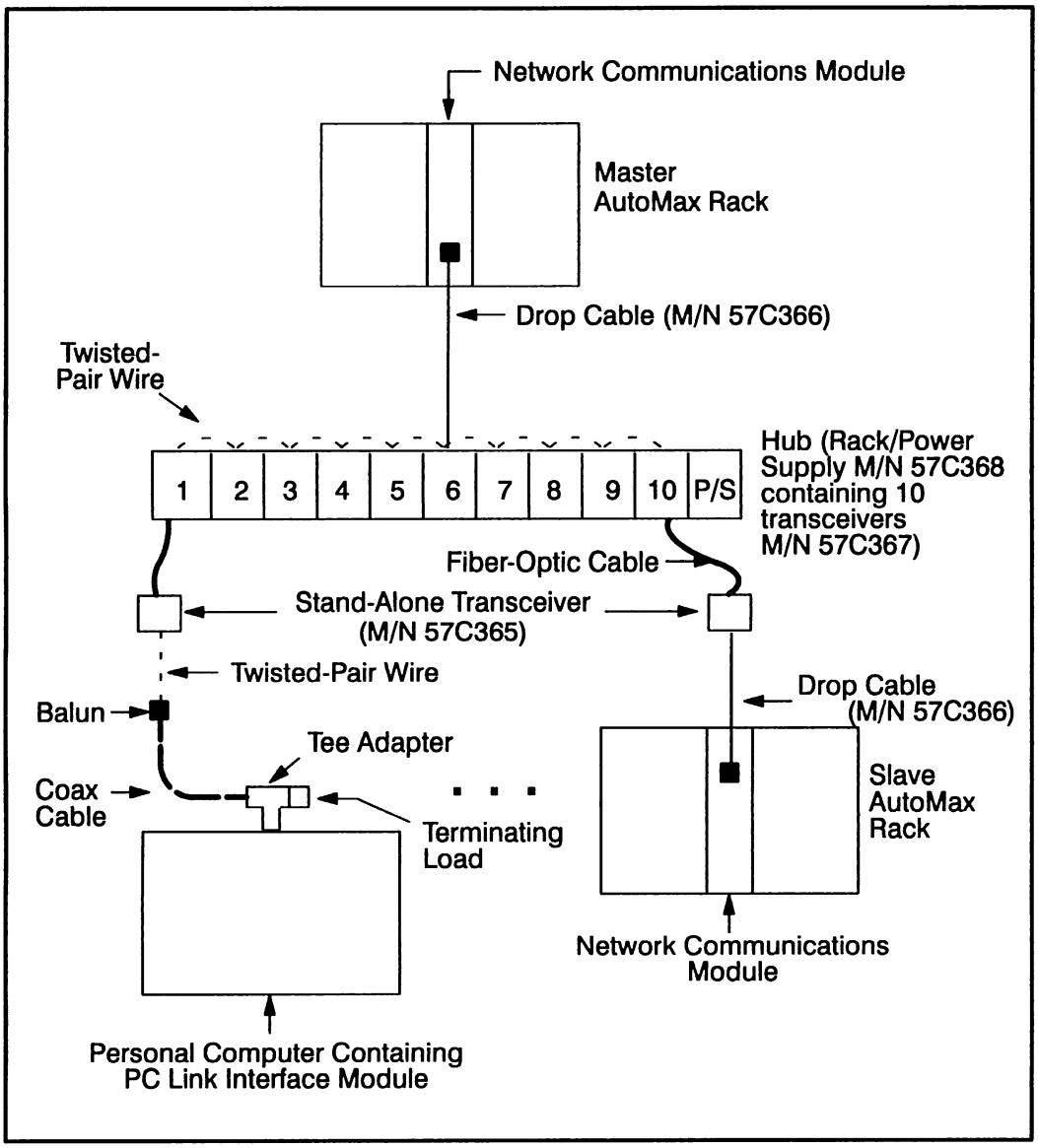


Figure L1.3 – Connecting a Personal Computer to a Stand-Alone Transceiver

L1.2 DCS-NET Fiber-Optic Network System Components

The DCS-NET fiber-optic network system, when used with the Network Communications module, consists of the following components:

- Drop Cable (M/N 57C366)
- 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 L1.1 and described in the sections that follow.

L1.2.1 Drop Cable

The drop cable (M/N 57C366) is used to connect the Network module to the transceiver.

A 9-pin D-shell connector is provided at one end of the 3-foot (1-meter) cable for connection to the Network module. Terminations are provided on the other end of the cable for connection to the terminal strip on the transceiver. Refer to figures L2.2 and L2.4 for these connections.

L1.2.2 Stand-Alone Fiber-Optic Transceiver

The Stand-Alone Fiber-Optic Transceiver (M/N 57C365) is required at each slave network drop for connection to the fiber-optic network. (A Stand-Alone Transceiver is required at the master rack only if the rack and the fiber-optic hub cannot be located together.) It performs the bi-directional conversion between electrical and optical signals. Transceiver technical specifications are listed in Appendix 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 L1.4.

Receive and transmit ports labeled "R" and "T", respectively, are provided on one end of the transceiver for connection to the fiber-optic link with the transceiver hub. The transceiver is shipped with dust caps covering the fiber-optic ports. The dust caps should not be removed until the fiber-optic cables are installed, and should be replaced if the cables are disconnected, to prevent dust accumulation and the resulting loss of signal integrity.

WARNING

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

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 L2.2 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.

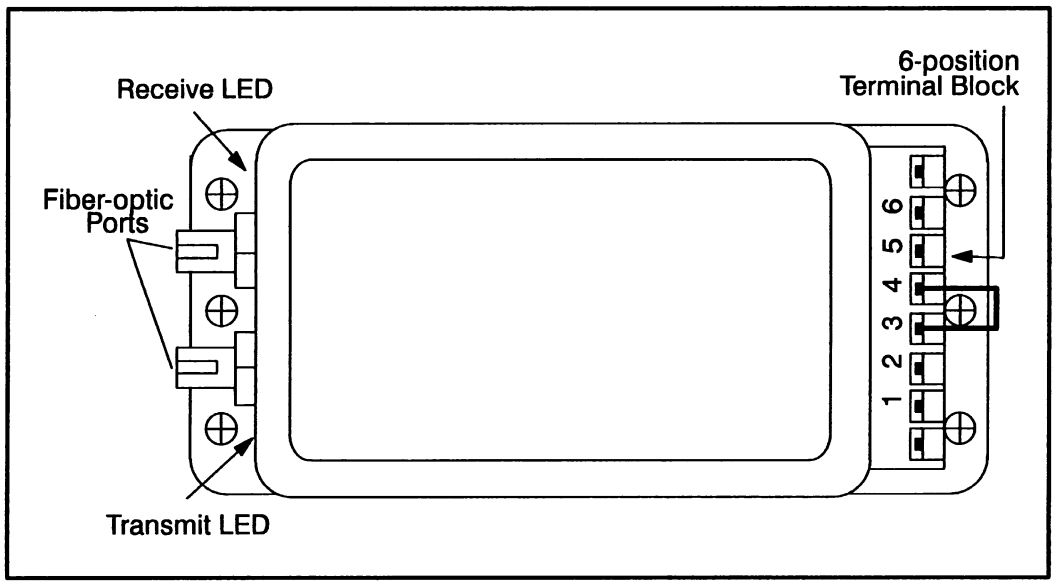


Figure L1.4 - Stand-Alone Transceiver

L1.2.3 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 G for the Power Supply schematic.

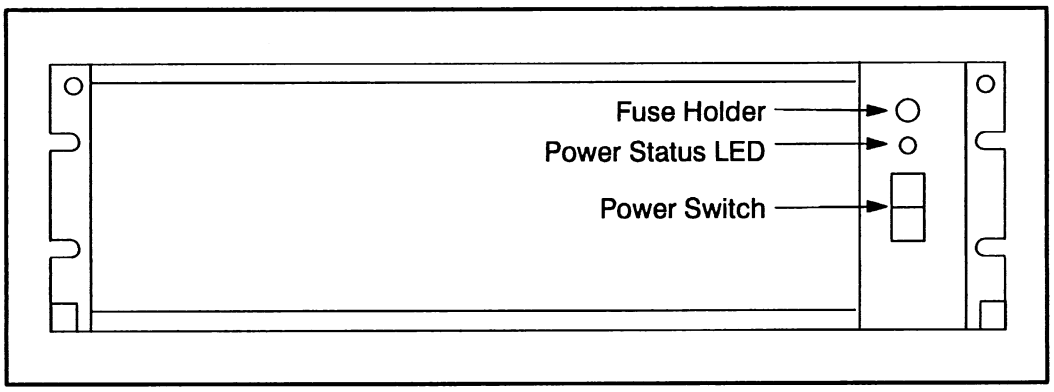


Figure L1.5 - Fiber-Optic Rack and Power Supply

L1.2.4 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 L1.6.

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

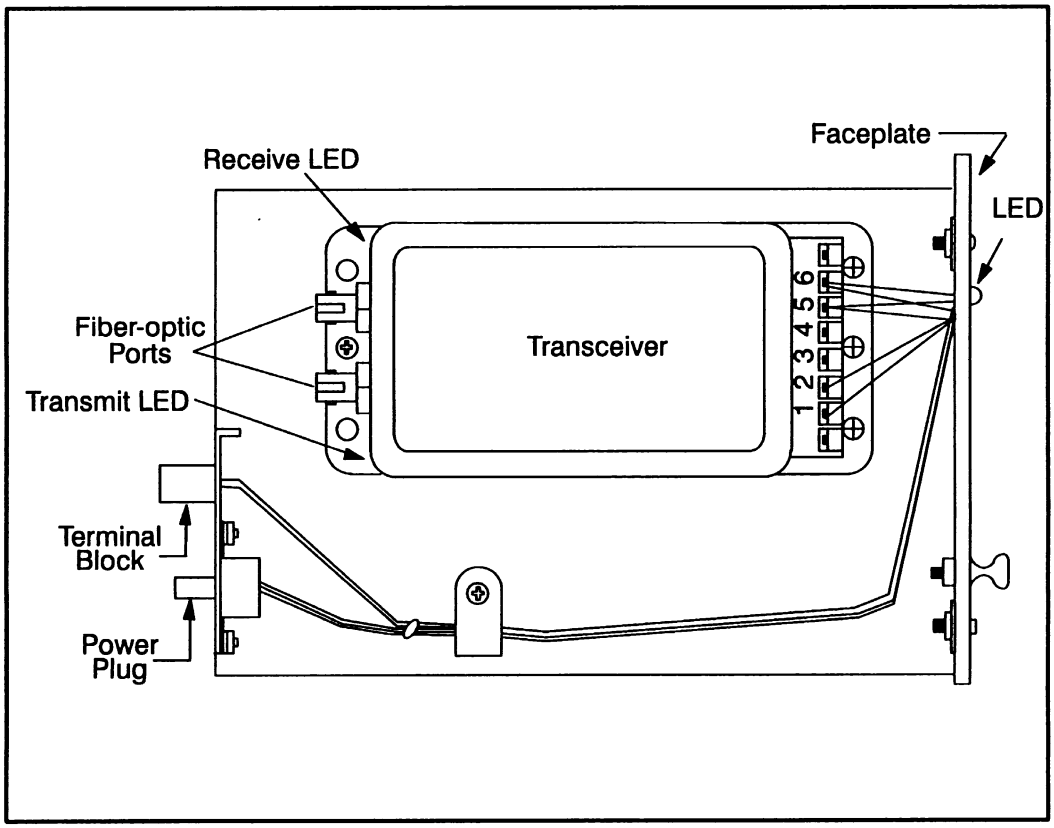


Figure L1.6 - Rack-Mounted Transceiver

L1.2.5 Fiber-Optic Cable

The DCS-NET network requires a 62.5 micron duplex fiber-optic cable. The recommended cable is Belden cable #225362 or equivalent. This cable has a PVC outer jacket and an internal Kevlar strength member. This cable is a breakout type of cable 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 I.

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

L2.0 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 the procedure to install and replace the Network Communications module.

DANGER

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

WARNING

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

L2.1 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 racks, Stand-Alone Transceivers, and the Transceiver Rack(s) using an equipment floor plan.

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

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

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

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

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

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 J for more information on recommended components.

L2.2 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 L2.1 for the correct placement of the holes.

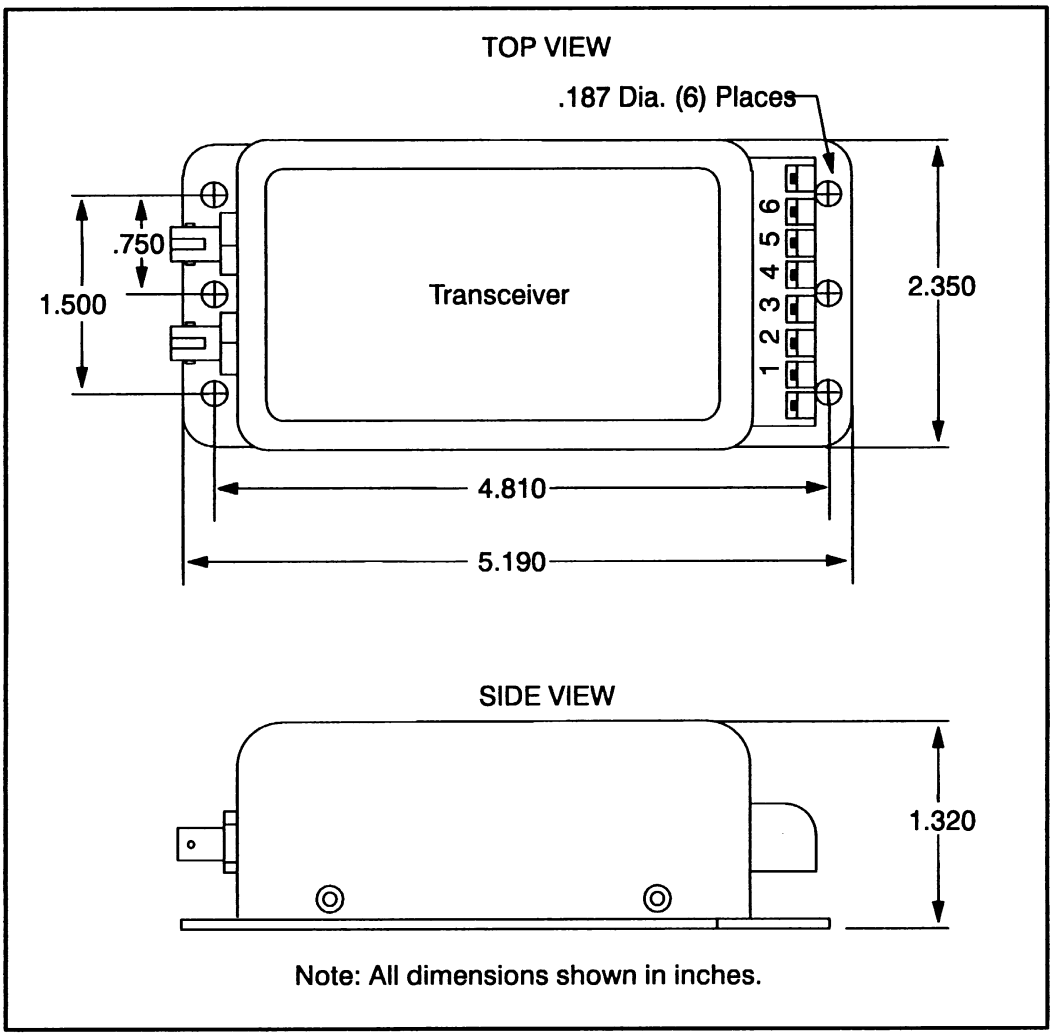


Figure L2.1 - Stand-Alone Transceiver Mounting Dimensions

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 L2.2.

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 L2.2 - Stand-Alone Transceiver Terminal Block Connections

Step 4. Connect the transceiver to the fiber-optic network using the guidelines provided in section L2.5.

Step 5. Turn power on to the transceiver.

L2.3 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 L2.3.

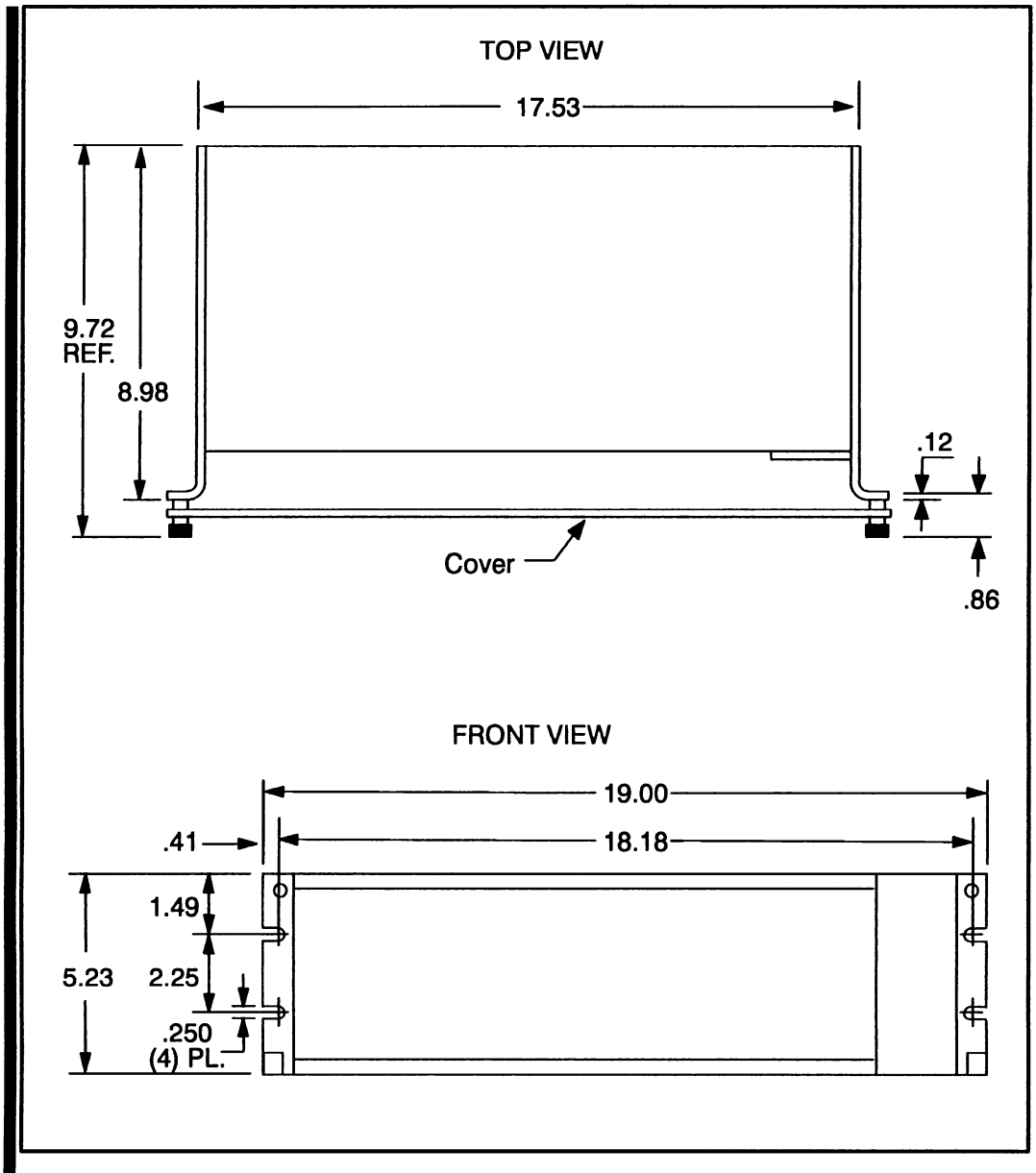


Figure L2.3 - Fiber-Optic Rack Mounting Dimensions

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 J) to make all signal connections between transceivers as shown in figure L2.4. To improve network serviceability, make the signal connections between transceivers on a separate terminal strip as shown in figure L2.5. 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 L2.4 - Rack-Mounted Transceiver Terminal Block Connections

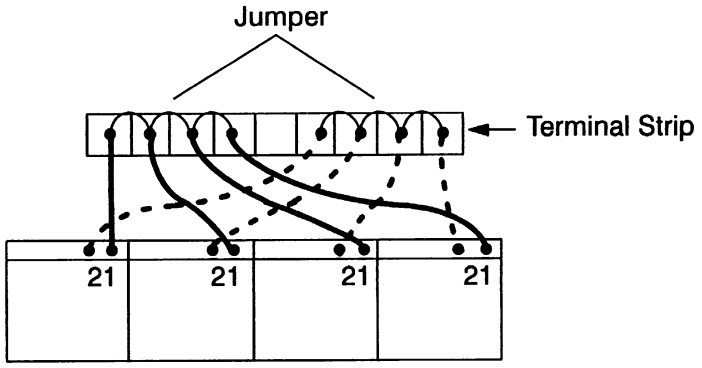


Figure L2.5 - Connecting Rack-Mounted Transceivers to a Terminal Strip

Step 5. Connect each transceiver to the fiber-optic network using the guidelines provided in section L2.5.

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.

L2.4 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 Network module slot.

L2.4.1 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 I and J for cable and connector specifications. Appendix J 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.

L2.5 Connecting a Fiber-Optic Cable Between a Stand-Alone Transceiver and a Rack-Mounted Transceiver

WARNING

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

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

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

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

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

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

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

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

Align the connector's pin with the slot in the transceiver's port. See figure L2.6. 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.

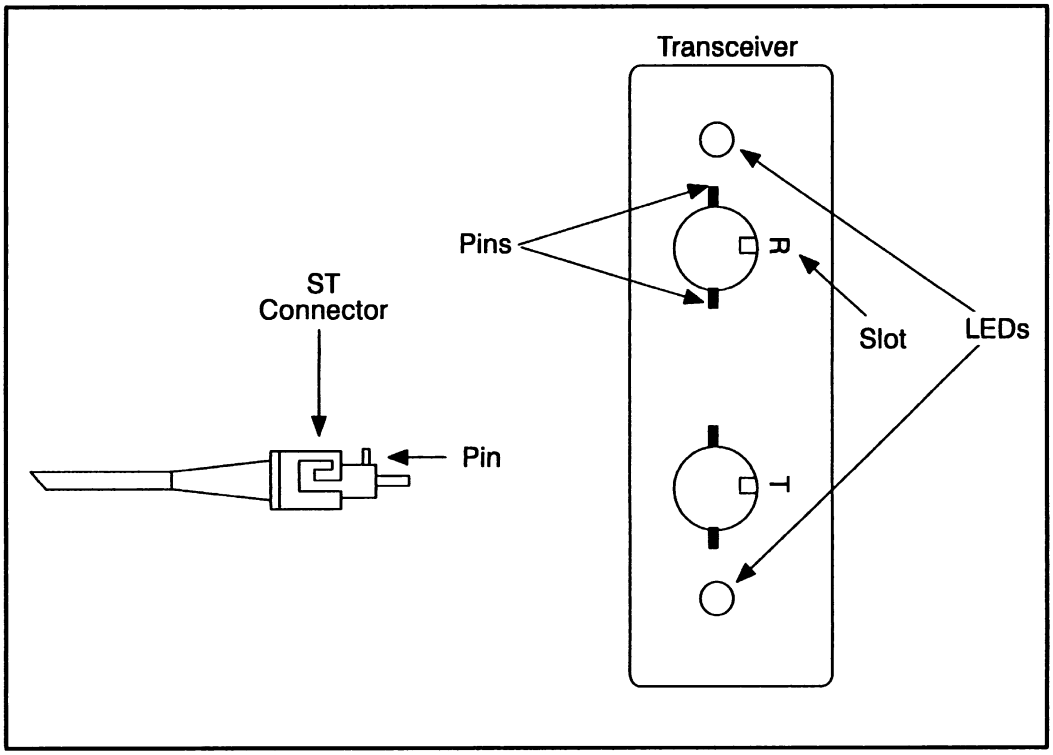


Figure L2.6 - Fiber-Optic Ports and Connectors

L2.6 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 L2.2. Connect the jumper between terminals 3 and 4.

Step 6. Re-connect the fiber-optic cable as shown in section L2.5.

Step 7. Turn power on to the external power supply.

L2.7 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 L2.3.

Step 9. Connect the fiber-optic cable as shown in section L2.5.

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 Network module slot number.

Step 1. Remove the plastic panel from the front of the Fiber-Optic Rack.

Step 2. Turn the Fiber-Optic Rack's Power Supply off using the rocker switch on the Power Supply's faceplate.

Step 3. Remove power from the Power Supply's external 115 or 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 L2.3) and fiber-optic cable (refer to section L2.5).

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.

L2.9 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 L2.4.

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 L2.4.

Step 4. Install the new Stand-Alone Transceiver following the instructions provided in section L2.2.

Step 5. Stop all communications over the AutoMax network.

Step 6. Install the new Rack-Mounted Transceiver following the instructions provided in section L2.3. If the transceiver rack is full, install another rack following the instructions provided in section L2.3 and connect the transceivers as shown in figure L2.7.

Step 7. Resume network operation.

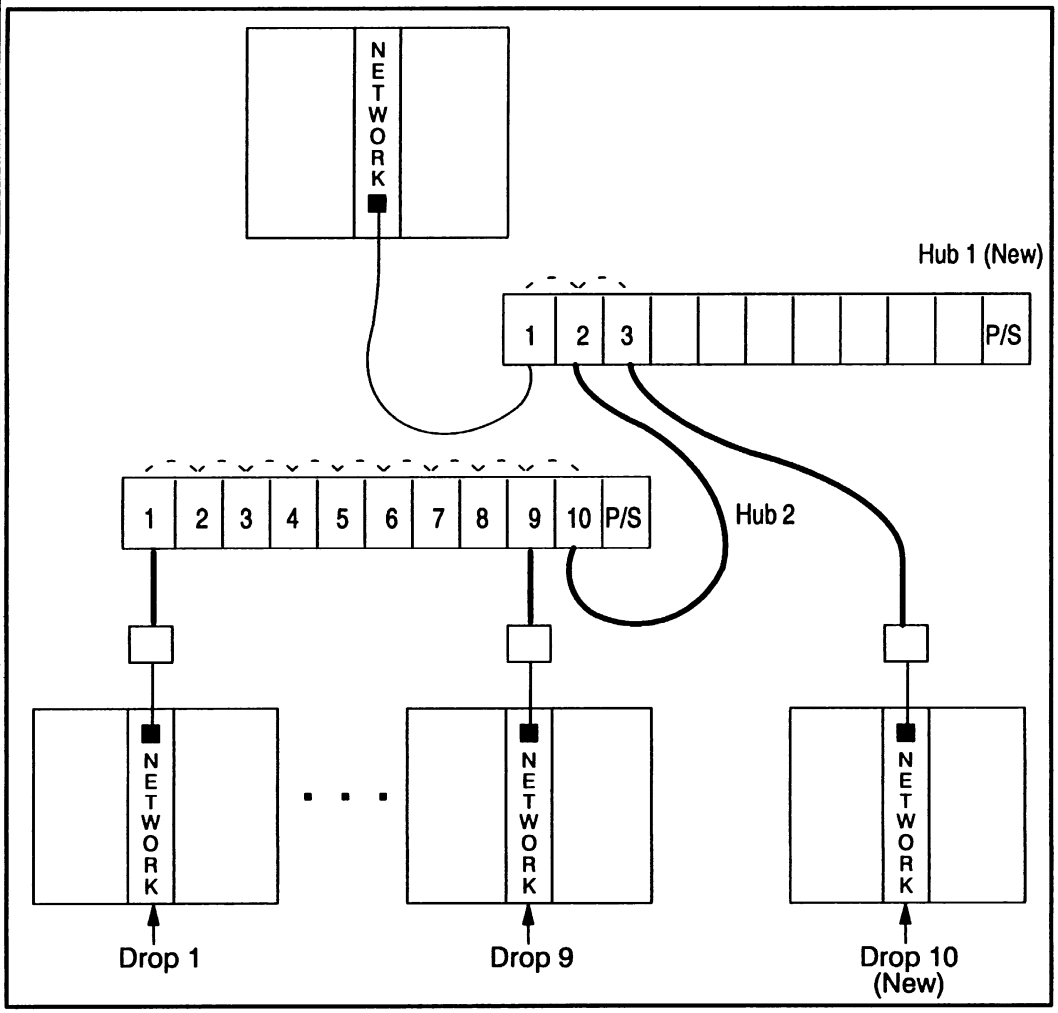


Figure L2.7 - Adding a Network Drop

L2.10 Disconnecting a Network Drop

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

- Disconnect the drop cable from the Network module.
- Disconnect the fiber-optic cable from the Stand-Alone Transceiver.
- Disconnect the fiber-optic cable from the Rack-Mounted Transceiver.

L2.11 Fiber-Optic Cable System Maintenance

The following sections describe recommended maintenance procedures.

L2.11.1 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.

L2.11.2 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.

L2.11.3 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.

L3.0 DIAGNOSTICS AND TROUBLESHOOTING

This section describes how to troubleshoot the fiber-optic network and its components. Refer to section 6.0 of this manual for troubleshooting procedures for the Network Communications 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.

L3.1 Network Failure

Problem: Error code C appears on the Network module's LED display. This error code indicates a network failure. Read section 6.3 of this manual and follow steps 1-3 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 (Network module, drop cable, Stand-Alone Transceiver, fiber-optic cable, and Rack-Mounted Transceiver). After each step, determine if the problem has been corrected before continuing to the next step.

Step 1. Check the drop cable. Verify that it is securely connected to the Network module's faceplate. Verify that its connections to the Stand-Alone Transceiver's terminal block are secure and correct as shown in figure L2.2. Replace the drop cable.

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 I. 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 L3.2). 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 L2.4.

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.

L3.2 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.

L3.3 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 L3.1. Remove the snap-in button to access and adjust the potentiometer.

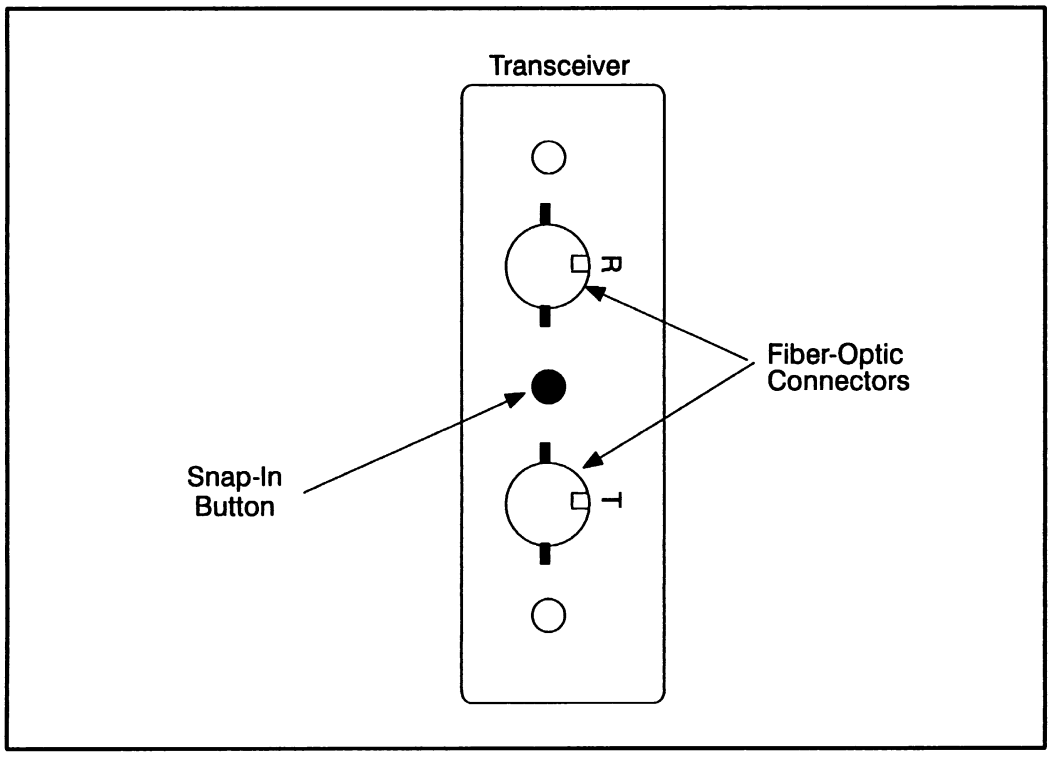


Figure L3.1 - Potentiometer Location

For additional information

1 Allen-Bradley Drive
Mayfield Heights, Ohio 44124 USA
Tel: +1 440 646 3434
www.rockwellautomation.com/support

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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