

3.0 INSTALLATION

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

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

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

DANGER

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

DANGER

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

WARNING

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

WARNING

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

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

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

3.1 AutoMax Remote I/O Coaxial Cable System Components

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

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

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

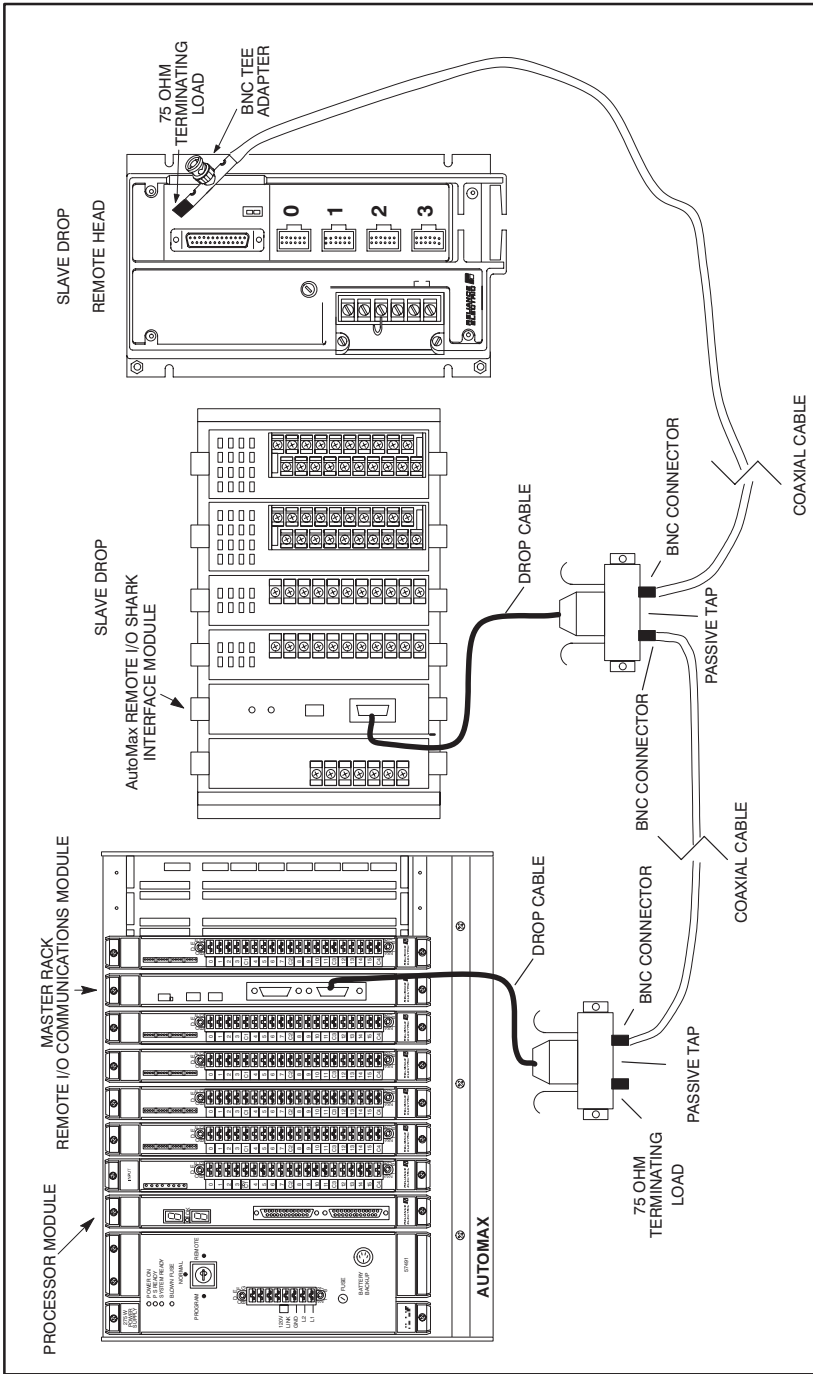


Figure 3.1 - Remote I/O Network Coaxial Cable System

3.1.1 Drop Cable and Communications Passive Tap

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

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

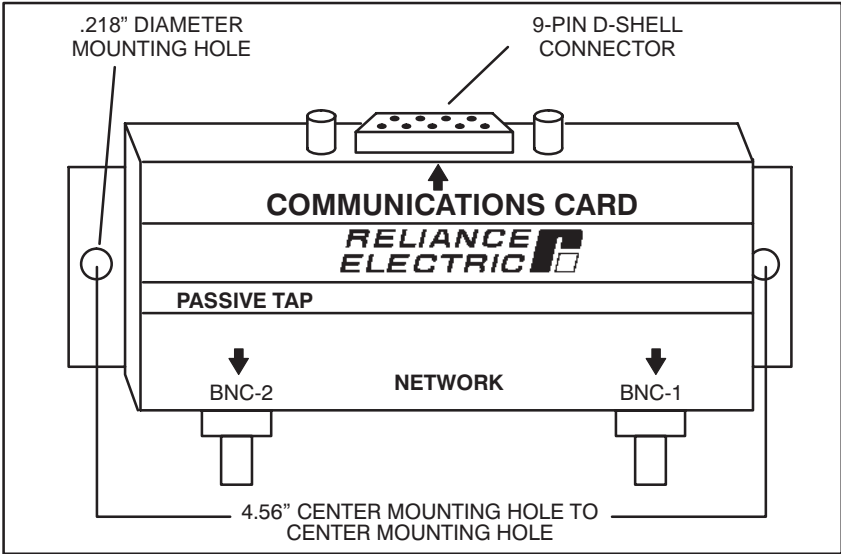


Figure 3.2 - Communications Passive Tap

3.1.2 Coaxial Cable

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

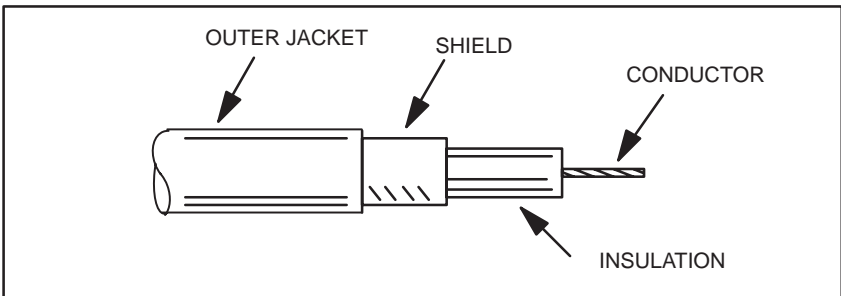


Figure 3.3 - Coaxial Cable

3.1.3 BNC Plug Connector

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

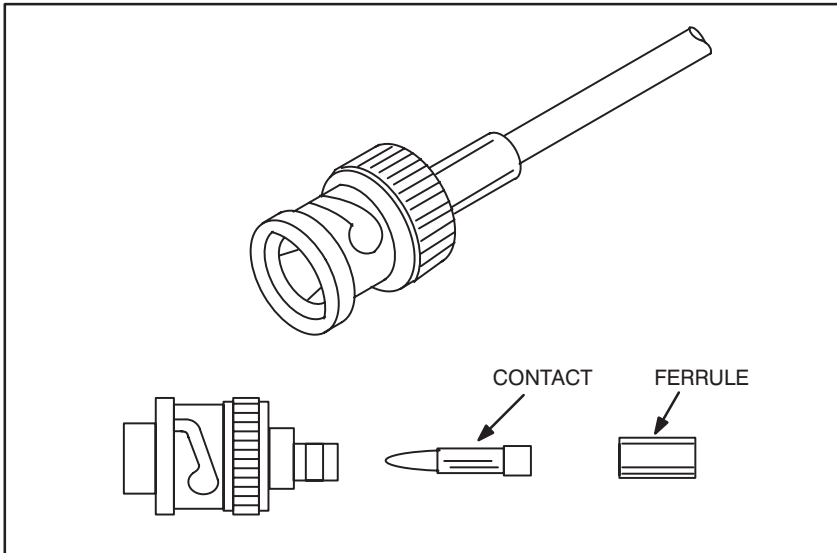


Figure 3.4 - Dual Crimp BNC Plug Connector

3.1.4 BNC Tee Adapter

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

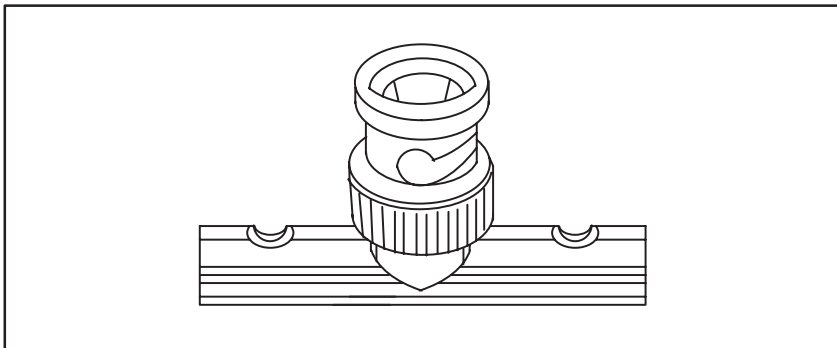


Figure 3.5 - BNC Tee Adapter

3.1.5 75 Ohm Terminating Load

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

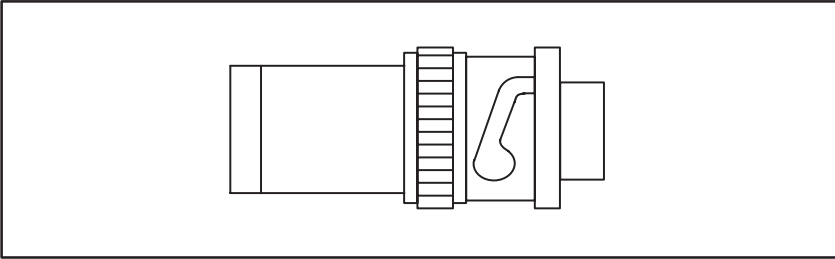


Figure 3.6 - 75 Ohm Terminating Load

3.1.6 BNC Jack-to-Jack Adapter

The BNC jack-to-jack in-line splicing adapter is recommended for making cable splices when the length of a cable must be extended (i.e, when adding a new drop). See figure 3.7. See Appendix G for the recommended part.

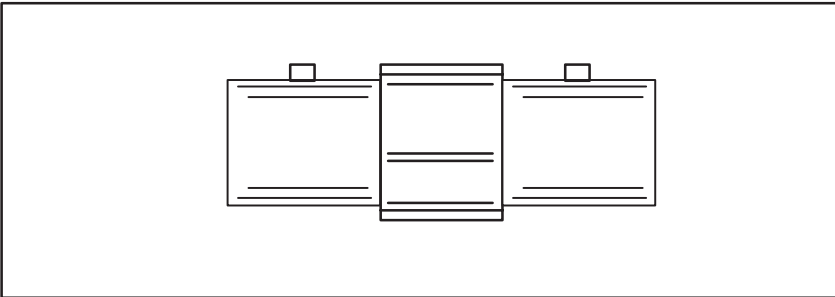


Figure 3.7 - BNC Jack-to-Jack Adapter

3.2 Installation Planning

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

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

3.2.1 Installation Planning Procedure

Use the following procedure to plan your installation:

- Step 1. Identify the actual location of the AutoMax racks, Shark racks, and Remote Heads using the equipment floor plan.
- Step 2. Identify the preliminary cable route. Route cables to allow easy access in the future. Cable should be readily accessible when new drops are added, existing drops are moved to new locations, or maintenance is performed.
- Step 3. Identify the environmental conditions (electrical noise levels, temperature, humidity, exposure to hazardous chemicals, etc.) along the route.
- Step 4. Determine how to bypass physical and environmental obstacles (walkways, induction heat sources, furnaces, caustic chemicals, steam and condensation lines) along the route.
- Step 5. Calculate the total cable length. Note that the cable path distances must be considered in three dimensions.
- Step 6. Document the cable layout. This document should describe the Remote I/O cable system design and installation. It should be maintained throughout the life of the Remote I/O system. The document should include charts showing the routes of all cable segments, locations of cable splices, as well as drop locations and their addresses. This information should be detailed enough to trace a signal path between any two points in the cable system in the event of a Remote I/O system failure.
- Step 7. Calculate the number of required cable system components. Refer to Appendix G for a list of components recommended by Reliance Electric.
- Step 8. Select the tools and instruments necessary to perform the cable system installation.
- Step 9. Select the proper personnel to perform the cable installation. The RG-59/U cable specified in this manual is a flexible-type cable which can be installed by a trained plant technician.

3.3 Cable System Protection and Isolation Recommendations

Installation of the cable should conform to all applicable codes. To reduce the possibility of noise interfering with the control system, exercise care when installing cable from the system to external devices.

3.3.1 Coaxial Cable Protection

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

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

3.3.2 Electrical Isolation

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

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

3.3.3 Chemical and Thermal Isolation

The Remote I/O coaxial cable system must be protected from damage caused by the following factors:

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

3.3.4 Physical Isolation

Use the following guidelines to prevent physical damage to the coaxial cable:

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

3.4 Cable System Construction

Construction of the Remote I/O coaxial cable system consists of the following steps. Each step is described in detail in the sections that follow:

- Step 1. Inspect and test all cable before installation.
- Step 2. Pull the first cable segment.
- Step 3. Terminate each end of this cable segment with a BNC plug connector.
- Step 4. Test this cable segment.
- Step 5. Pull the next cable segment and repeat steps 3 and 4. Continue until all segments have been installed.
- Step 6. Assemble the complete cable system. Connect cables to the appropriate taps and tee adapters. Connect the terminating loads to the taps or tee adapters at both ends of the cable system. Connect the drop cables to the taps.

3.4.1 Cable Inspection and Testing

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

3.4.2 Cable Pulling

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

3.4.3 Cable Termination

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

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

- Step 1. After the cables have been installed in the conduit or cable trays, slide the ferrule from the plug connector onto the coaxial cable as shown in figure 3.8.

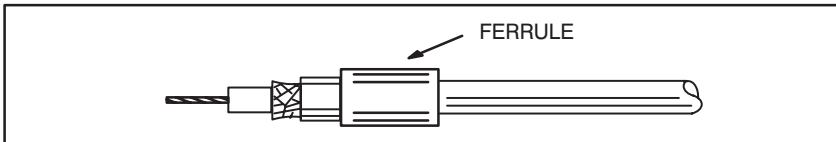


Figure 3.8 - Ferrule on the RG-59/U Cable

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

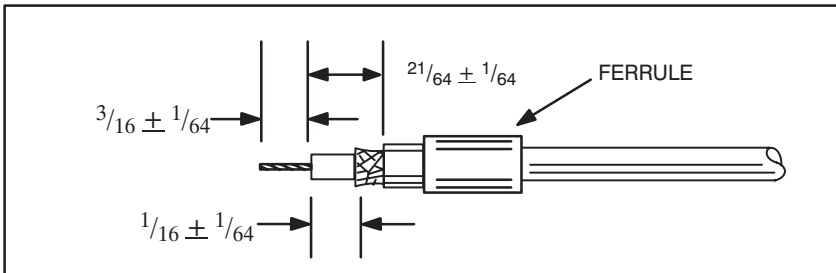


Figure 3.9 - RG-59/U (Belden 9259) Cable Stripping Dimensions

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

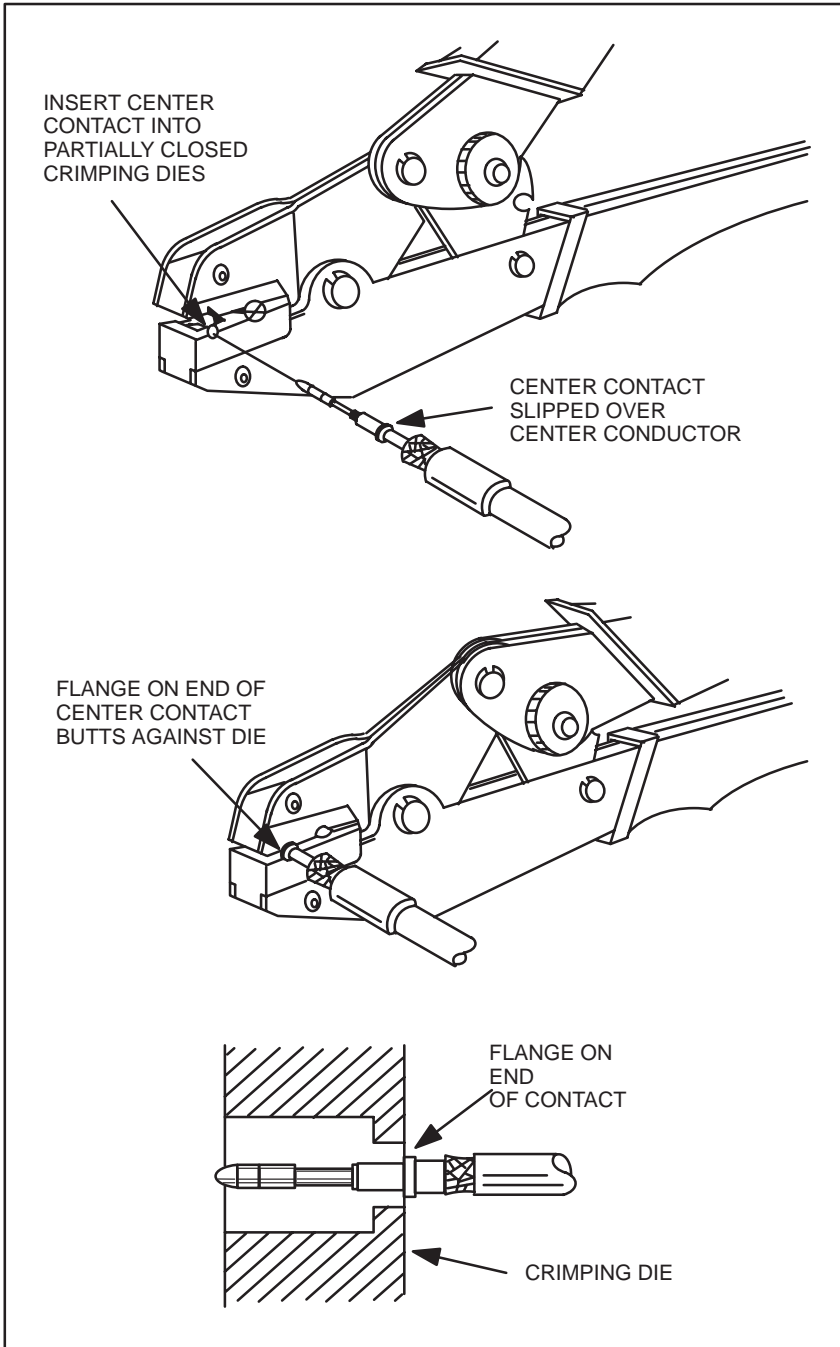


Figure 3.10 - Connector Installation Step 3 for RG-59/U Cable

- Step 4. Crimp the center contact by holding the cable in place and closing the tool handles until the ratchet releases.
- Step 5. Remove the crimped contact from the dies.
- Step 6. Verify that the shield braid wire does not touch the center contact. Refer to figure 3.11.

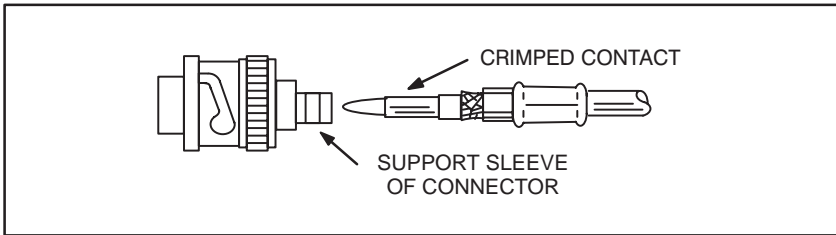


Figure 3.11 - Connector Installation Step 6 for RG-59/U Cable

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

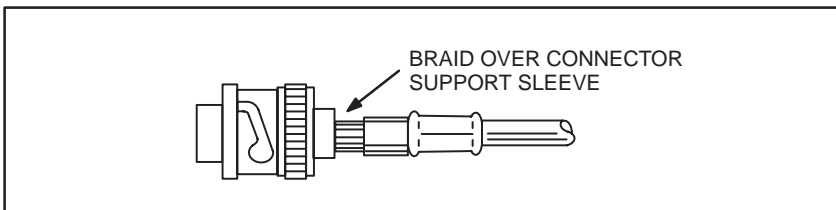


Figure 3.12 - Connector Installation Step 7 for RG-59/U

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

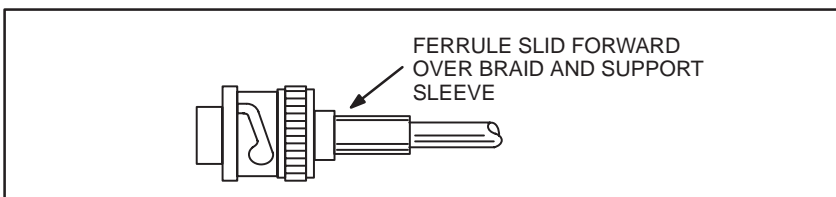


Figure 3.13 - Connector Installation Step 8 for RG-59/U Cable

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

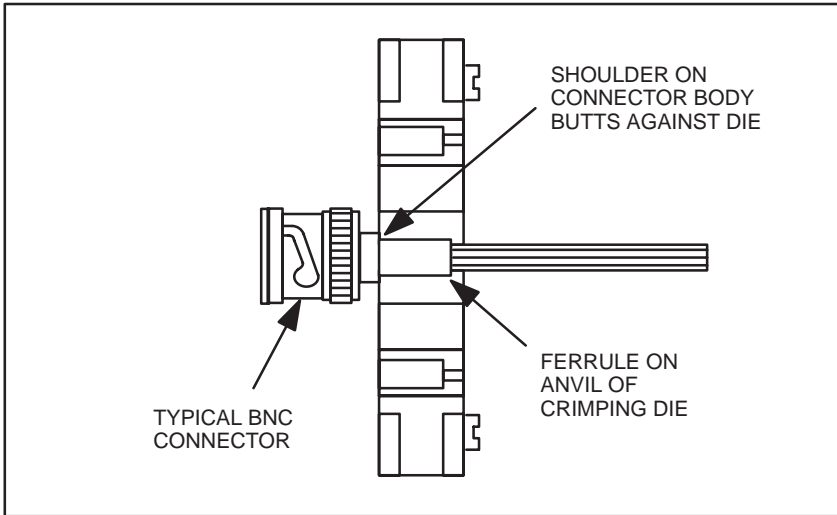


Figure 3.14 - Connector Installation Step 9 for RG-59/U Cable

- Step 10. Hold the assembly in place and close the crimp tool handles until the ratchet releases.
- Step 11. Remove the crimped assembly from the crimping dies. The connector is now attached to the coaxial cable. See figure 3.15.

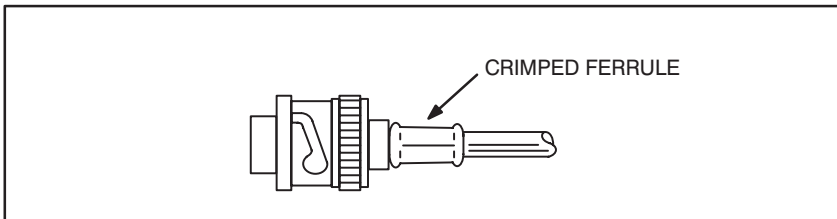


Figure 3.15 - Connector Attached to RG-59/U Cable

3.4.4 Cable Segment Testing

Once a cable segment has been terminated with a connector on each end, visually inspect the connector for loose connections, nicked insulation, or loose strands from the braid that might cause a poor connection or short. The center contact should be straight and centered inside the connector dielectric. Be sure that the center conductor is inserted deep enough into the connector body. The tip of the center contact should be approximately even with the end of the connector dielectric. Be sure the ferrule is crimped tightly against the body of the connector and that the shield braid wire does not protrude from the ferrule.

Check the cable's mechanical connections by grasping the outer conductor connector in one hand and the coaxial jacket in the other. Pull firmly. The connectors should hold. Use a time domain reflectometer to test for cable damage, shorts, and discontinuities.

3.4.5 Constructing Long Cable Segments

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

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

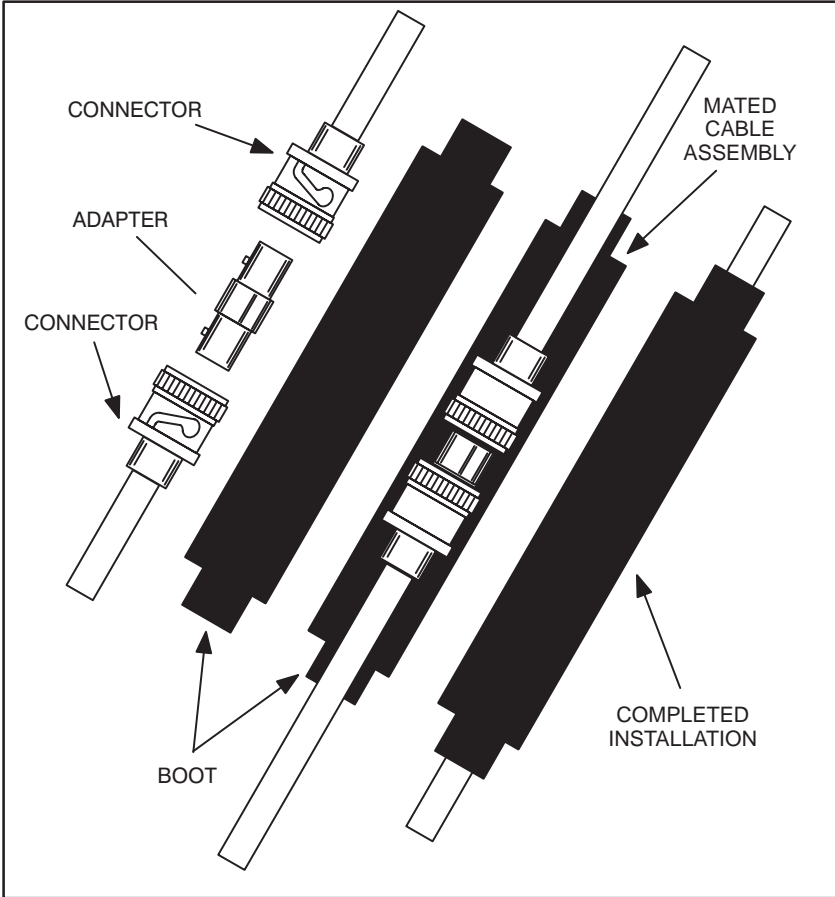


Figure 3.16 - Cable Splicing

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

3.5 Module Installation

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

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

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

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

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

DANGER

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

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

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

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

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

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

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

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

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

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

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

Stop all programs that may be running.

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

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

3.5.2 Installing the Shark Interface Module

Use the following procedure to install the Shark Interface module:

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

DANGER

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

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

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

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

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

Stop all programs that are running.

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

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

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

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

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

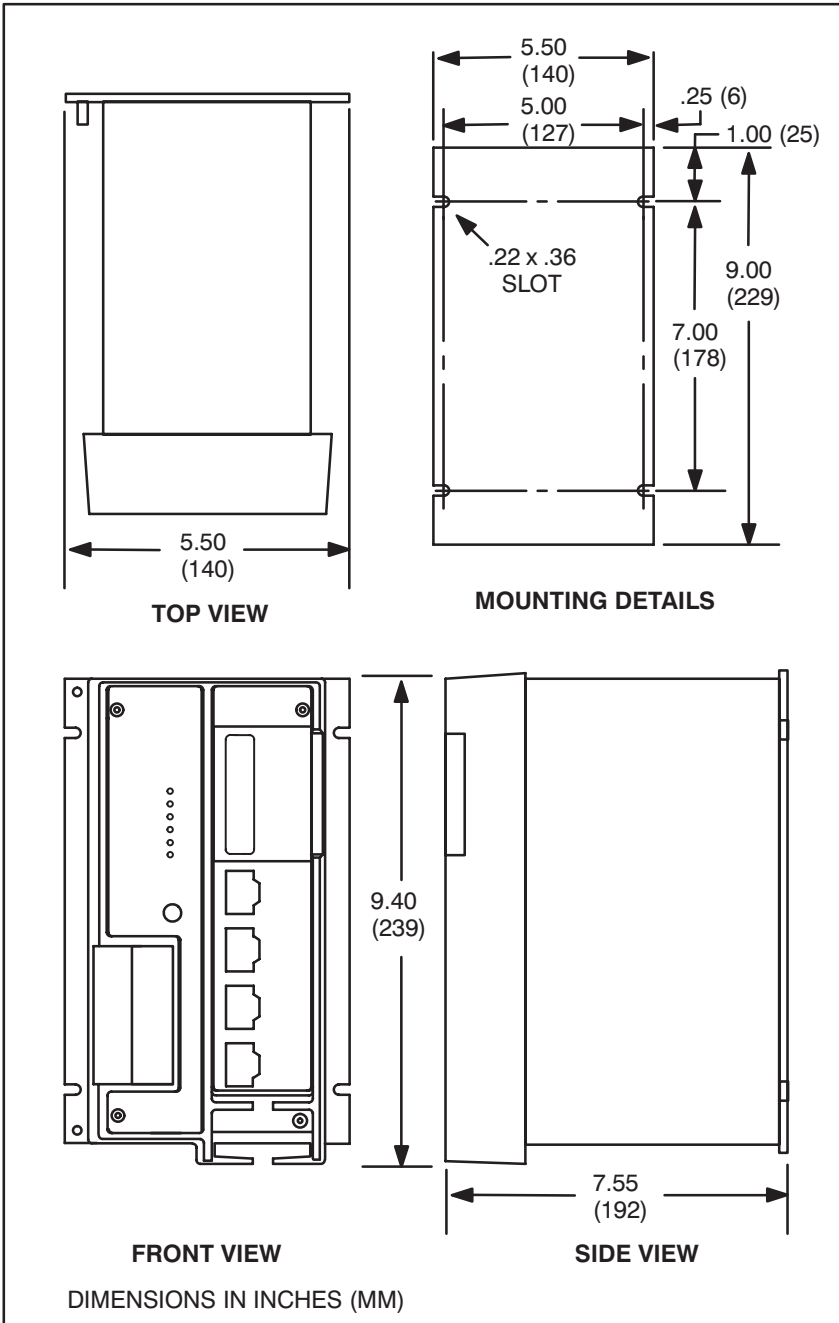


Figure 3.17 - Mounting Dimensions

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

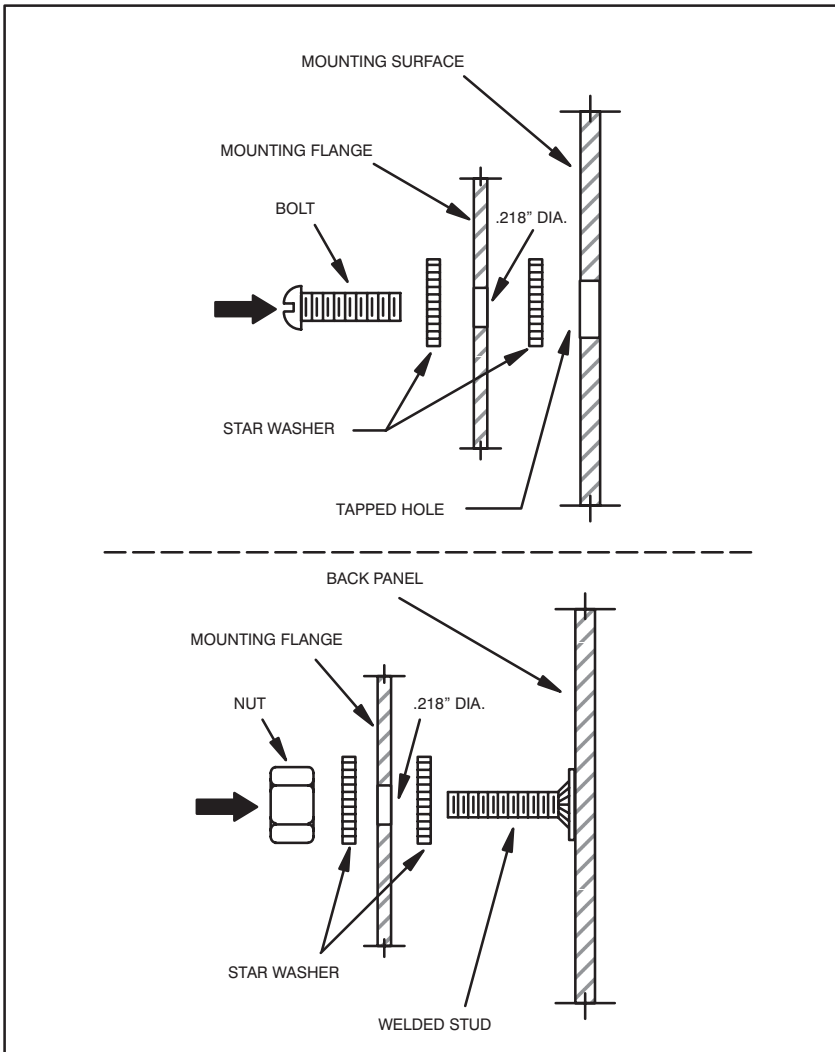


Figure 3.18 - Mounting Examples

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

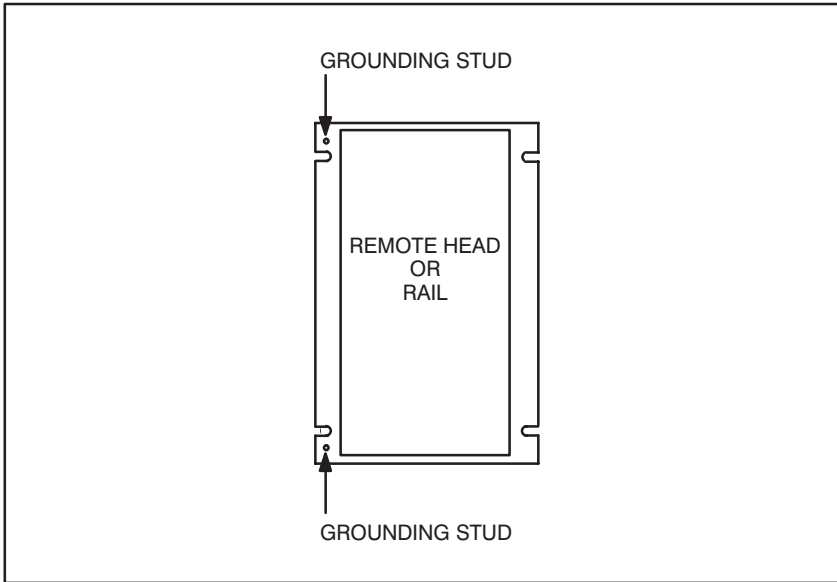


Figure 3.19 - Grounding Stud Location

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

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

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

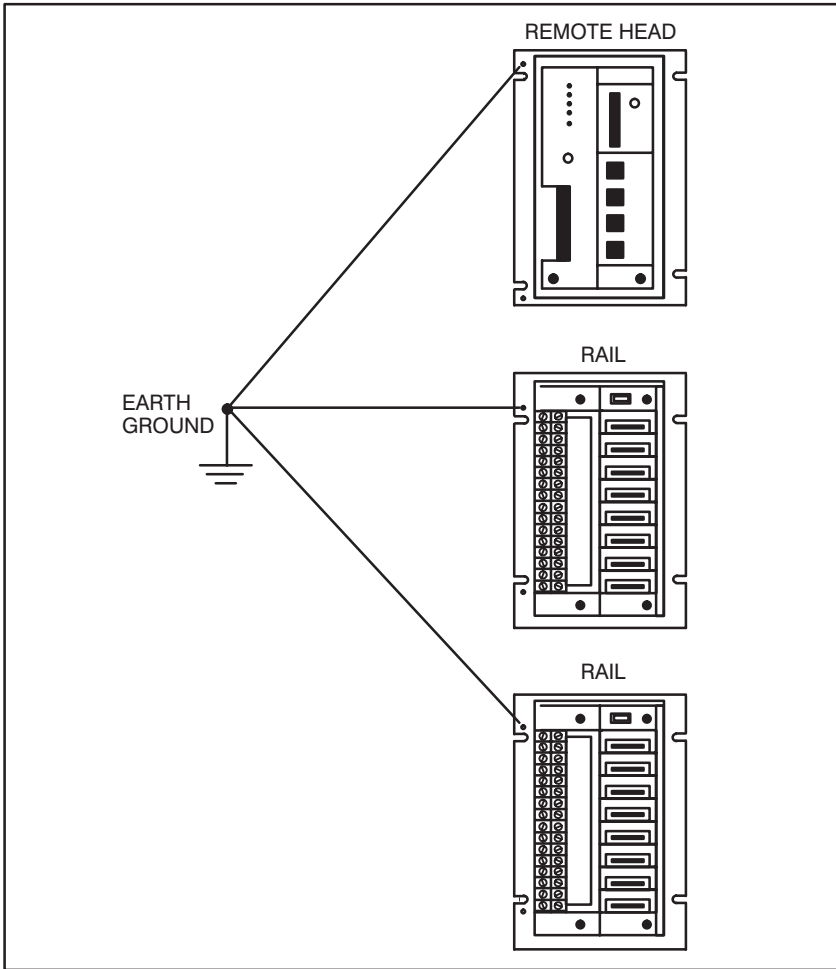


Figure 3.20 - Grounding the Remote Head

DANGER

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

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

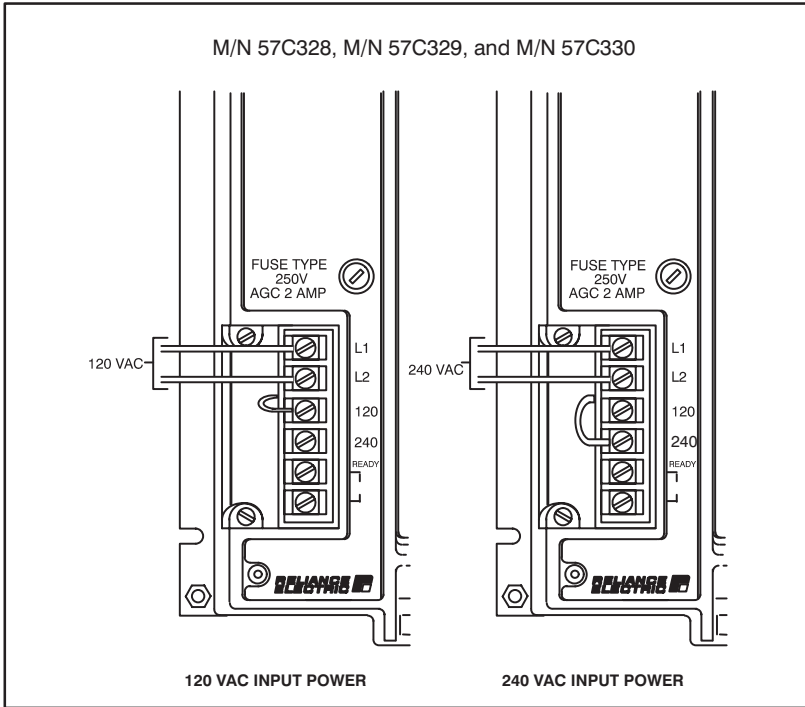


Figure 3.21 - 120 VAC or 240 VAC Input Power Connections

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

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

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

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

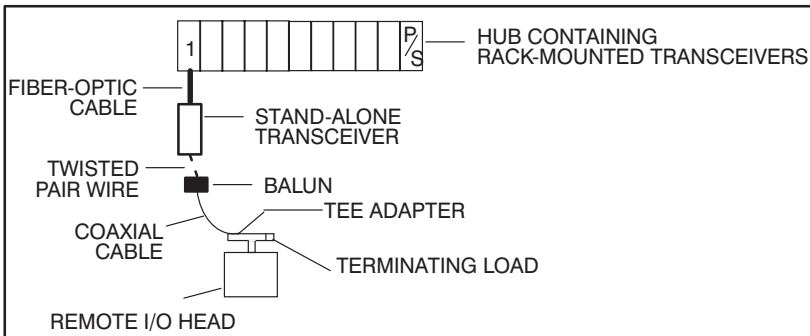


Figure 3.22 - Connecting the Remote I/O Head to the Fiber-Optic Network

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

Stop all application programs that may be running.

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

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

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

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

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

DANGER

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

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

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

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

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

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

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

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

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

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

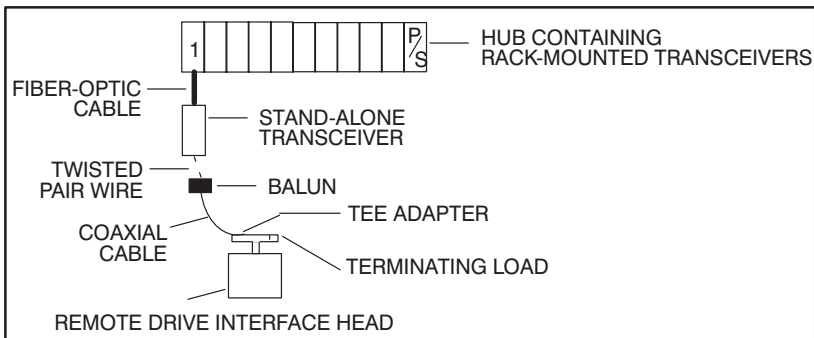


Figure 3.23 - Connecting the Remote Drive Interface Head to the Fiber-Optic Network

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

3.5.5 Remote I/O Network Emergency-Stop Considerations

WARNING

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

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

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

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

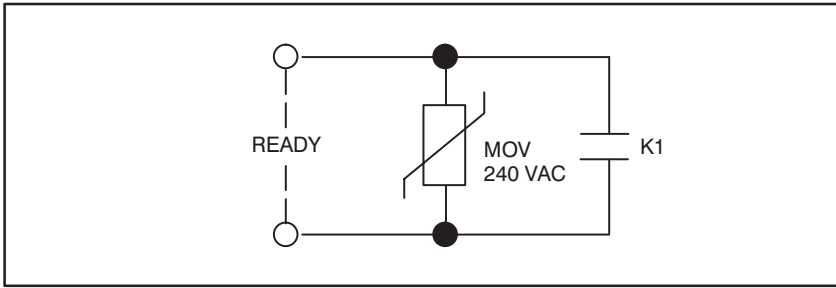


Figure 3.24 - Ready Relay

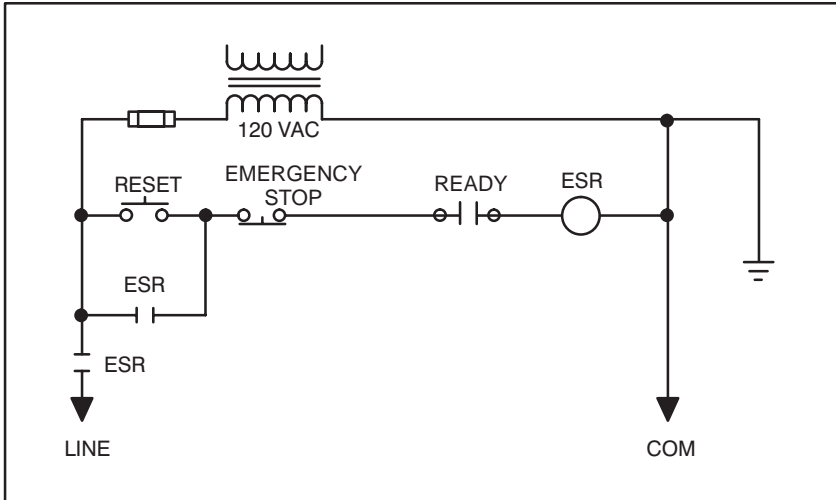


Figure 3.25 - Typical E-Stop Circuit Using Ready Contacts

3.6 Module Replacement

The following sections provide instructions on how to replace a Remote I/O module, a Shark Interface module, a Remote I/O Head, and a Remote Drive Interface Head.

3.6.1 Replacing the Remote I/O Module (M/N 57C416)

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

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

DANGER

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

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

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

Use the following procedure to replace a module:

DANGER

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

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

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

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

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

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

DANGER

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

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

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

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

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

DANGER

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

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

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

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

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

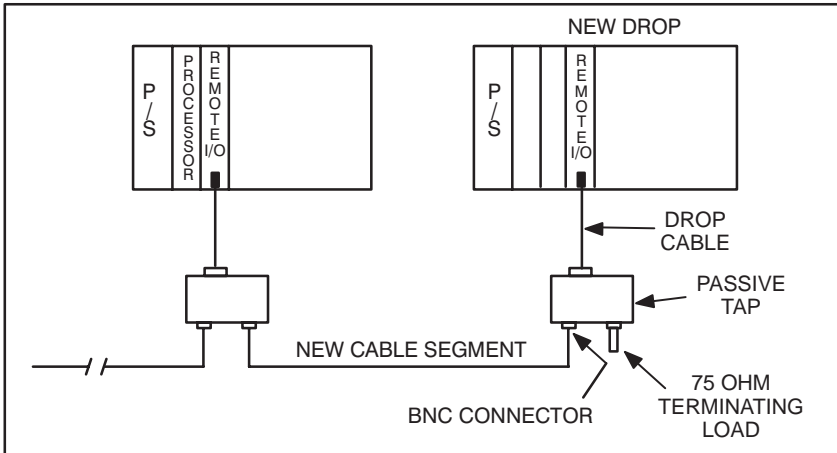


Figure 3.26 - Adding a New Rack Drop to the End of the Remote I/O Network (Coax)

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

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

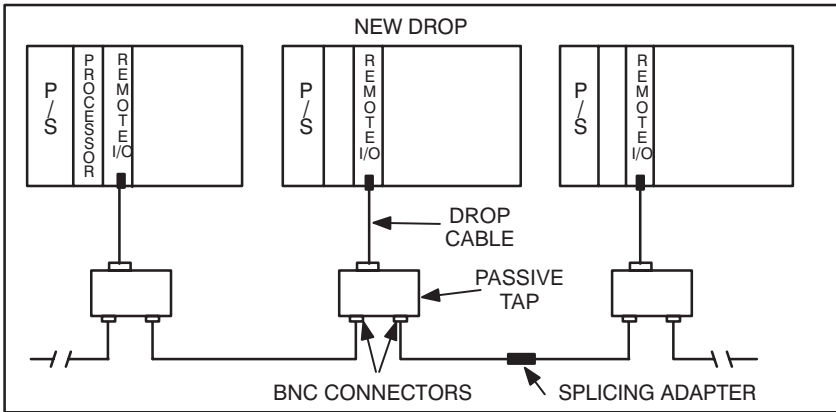


Figure 3.27 - Adding an Intermediate Rack Drop to the Remote I/O Network (Coax)

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

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

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

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

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

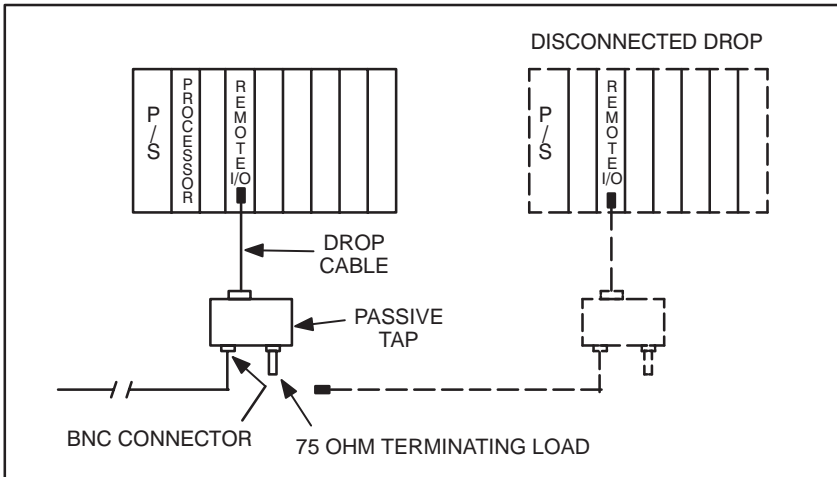


Figure 3.28 - Disconnecting an End Rack Drop from the Remote I/O Network (Coax)

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

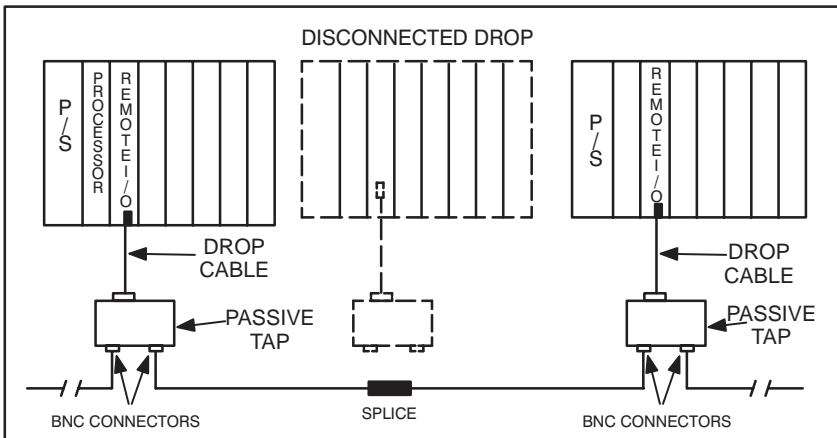


Figure 3.29 - Disconnecting an Intermediate Rack Drop from the Remote I/O Network (Coax)

3.9 Remote I/O Network Coaxial Cable Maintenance

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

3.9.1 Remote I/O Cable Documentation Maintenance

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

3.9.2 Remote I/O Cable Design Maintenance

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

3.9.3 Remote I/O Cable Inspection

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