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AutoMate®

Remote Head

M/N 45C37
45C37A
45C38
45C38A
45C38B

Industrial CONTROLS

Instruction Manual J-3037-1

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DANGER

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DANGER

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WARNING

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

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1.0 Introduction and Overview of Remote I/O System

1.1 Scope of Manual 1
1.2 Overview of Remote I/O System 1
1.2.1 Network Topology (Architecture) 1
1.2.2 Transmission Medium 1
1.2.3 Software Protocol 2
1.2.4 Remote I/O Processor Overview 2
1.2.5 Remote Head Overview 2

2.0 Remote Head Hardware

2.1 Status Indicators 3
2.1.1 Description of LED'S 3
2.1.2 LED Operation During Power Up 4
2.1.3 LED Operation After Power Up 4

2.2 Selector Switches 5
2.2.1 Mode Selector Switch 5
2.2.2 Drop Selector Switch 5

2.3 Remote Head Connections 6
2.3.1 Terminal Strip 6
2.3.1.1 Input Power 6
2.3.1.2 Ready Relay terminals 6
2.3.2 I/O Port Connectors 7
2.3.3 BNC Connector 7

2.4 I/O Reset Mode Selection 8
2.4.1 Introduction 8
2.4.2 Operation 8
2.4.3 Jumper Selection 9

2.5 Installation of Remote Head 11
2.5.1 Wire Layout 11
2.5.2 Hardware Layout Configuration 12
2.5.3 Grounding the Remote Head 13
2.5.3.1 Example of grounding the Remote Head 13
2.5.4 Installation Procedures 15
2.5.5 Connecting I/O Interconnect Cable 16
2.5.6 Connecting Input Power 17

2.6 Hardware Specifications 18
2.6.1 Electrical 18
2.6.2 Mechanical 19

3.0 Configuration

3.1 Remote Digital I/O Configuration 20
3.1.1 Example of Remote Head Configuration 21
3.2 I/O Port Address for Remote Head 22
3.2.1 TWS Example Program Using Instruction Blocks to Read Data 22

4.0 Installation of Remote I/O Network

4.1 Introduction 23
4.2 Cable Installation 23
4.2.1 Configuration Limitations 23
4.2.1.A Example of Remote I/O System with Three Drops 24
4.2.1.B Example of Coax Tee Connectors 25
4.2.2 Cable and Connector Specifications 26
4.2.3 Connector Installation 28
4.2.3.1 Connector Installation for Belden # 9259 29
4.2.3.2 Testing Connections 31
4.2.4 Grounding Considerations 31
4.2.5 Cable Routing Considerations 32
4.2.5.1 Electrical Isolation 32
4.2.5.1.1 General Information 32
4.2.5.1.2 Cable Grouping & Separation 33
4.2.5.2 Chemical Isolation 34
4.2.5.3 Physical Isolation 34

5.0 Diagnostics

5.1 Introduction 35

6.0 Theory of Operation 36

6.1 Initialization 37
6.2 I/O Configuration 38
6.3 Device Faults 38
6.4 LED Status Codes 39

REMOTE HEAD

M/N
45C37/45C37A
45C38/45C38A
45C38B

1.0 Introduction and General Description

1.1 Scope

The products described in this instruction manual are manufactured or distributed by Reliance Electric Industrial Company. This manual covers the application of the Auto-Mate Remote I/O Network. The major categories covered include physical specifications, application programming, installation, monitoring and troubleshooting.

1.2 Overview of Remote I/O System

The AutoMate 30/40 system includes the capability of remotely mounted digital or numerical I/O. This allows the I/O to be mounted wherever needed, for example on a machine or in a process. The two types of devices that can be connected to the remote I/O network are called a Remote Head (RH) and a Remote I/O Processor (RIOP).

1.2.1 Network Topology (Architecture)

Topology refers to the interconnecting geometry of the drops on the Network. Remote I/O uses the multidrop configuration in which each drop is connected to the network through the use of a Tee tap. Multidrop allows for very easy installation of the network wiring, as there is no central point to which all drops must be wired. Also, the order in which devices physically connect to the network is not important.

Up to 32 remote subsystem drops can be connected to a remote network configuration. All the drops can be Remote Heads address 0–37 (octal), but there can only be a maximum of 12 remote racks, address 0–13 (octal).

1.2.2 Transmission Medium

The transmission medium that is used for Remote I/O is coaxial cable in the baseband mode. A baseband system is one in which the digital data is placed directly on the media without modulation. The data communication rate is 800K baud (800,000 bits per second). There are two types of cables that can be used for the Remote I/O communication network. The overall distance requirement will determine which cable is used. The following are the cable types and the maximum distance capabilities:

Coax Cable Type	Max. Distance
Belden #9259	3,600 ft.
Belden #8213	6,000 ft.

See Section 4 installation of coax.

1.2.3 Software Protocol

The protocol used for Remote I/O Network is Master Slave. The Master sends data to all units on the network and then reads data from all drops on the network. The time required for the Master to transmit to each drop on line and receive the data is fixed. Therefore, response time can be predicted for varying communications loads and the maximum time for data update can be calculated.

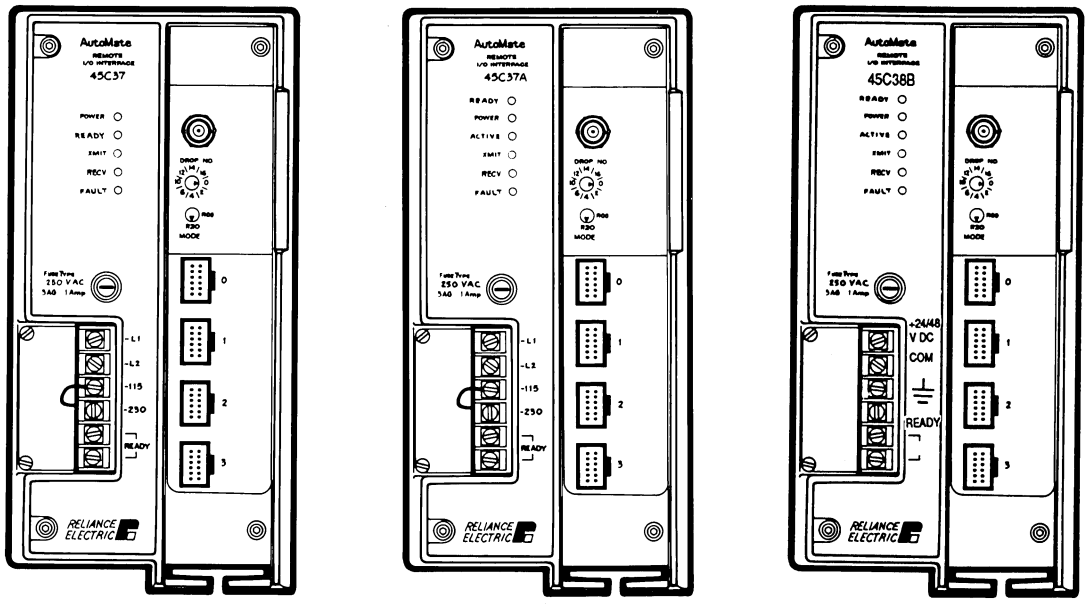
1.2.4 Remote I/O Processor

In the Remote I/O network, one RIOP MUST be designated as network Master. This is done by the mode selector switch on the RIOP card. When selected as the master the RIOP receives data from devices on Multibus, transmits it to the proper remote subsystems, receives the response data, and makes that data available to devices on Multibus. All communications protocol and error checking are handled by the Remote I/O Processor, so that the AutoMate 30/40 processor is not burdened with the remote I/O update.

This manual specifically applies to the REMOTE Head, but does discuss the Remote I/O Processor when referencing the Remote I/O system. For more details concerning the Remote I/O processor and system, refer to manual J3034.

1.2.5 Remote Head

The Remote Head is one of the devices that can be connected to the RIOP network. The remote head is used to interface with rails and local heads. In all configurations the Remote Head is always a slave device to the Master RIOP. The remote head has 4 I/O ports where 4 rails, local heads, interface modules or any combination can be connected.



45C37/45C38 45C37A/45C38A 45C38B

Front View of Remote Head

2.0 **Remote I/O Processor Hardware**

Each Remote Head is made up of 2 circuit boards in a metal housing; a Remote Processor card and the Power Supply.

The Remote Head Processor card includes an Intel 8031 microprocessor, high-speed UART, a female BNC coax connector for connecting to the network, and an I/O Interface chip for communicating with the four I/O ports.

The Remote Heads, model numbers 45C37/45C37A, 45C38/45C38A, and 45C38B are the same except for the type of power supply contained within the Head. The power supply for model number 45C37/45C37A has an input voltage of 120V/240 VAC. The power supply for model number 45C38/45C38A has an input voltage of 24 VDC. The power supply for model number 45C38B has an input voltage of 24–48 VDC. The power supply board is made up of and includes a switching power supply, voltage check, power failure circuitry, a ready relay whose contacts are available at the terminal strip, and six status indicators.

2.1 Status Indicators

2.1.1 Description of LED'S

There are 6 LED indicators, which tell the user the status of the Remote Head. These indicators are also used to indicate diagnostics, some of which are for the Remote network and some are for that Head, which aids in troubleshooting the Remote Head. On the 45C37 and 45C38 the first status LED is hidden. The descriptions below for the 45C37A also apply for the 45C38A and 45C38B.

Hidden (45C37)
READY(45C37A) — Remote I/O Processor CPU is working properly within the limits of internal diagnostics.

POWER — Indicates that the +5 volts within specified range. THIS DOES NOT INDICATE INPUT VOLTAGE TO THE POWER SUPPLY BUT ONLY OUTPUT POWER FROM THE SUPPLY.

READY (45C37)
ACTIVE (45C37A) — The CPU is communicating and updating I/O.

XMIT — Data is being transmitted, turned on for 100 msec every time the Remote Head transmits.

RECV — Data is being received, turned on for 100 msec every time the Remote Head receives a good message.

Rail Fault — Communication between the I/O ports and the I/O devices has failed, and I/O reset has been applied (shutting off outputs). When this indicator is on, the XMIT and RECV indicates which I/O port has failed. This is represented in a binary pattern. Refer to table below.

XMIT	RECV	PORT #
0	0	0
0	1	1
1	0	2
1	1	3

2.1.2 LED Operation During Power Up

On power up of the remote head, all the LED's are turned on except the ACTIVE (45C37A) or READY (45C37) as a lamp test.

The Remote Head then performs a self-test. During the self-test the ACTIVE (45C37A) or READY (45C37) LED remains off. The XMIT, RECV and the RAIL FAULT indicators are used to report a failure. The type of failure is determined by what LED's are on/off. (Refer to Table one)

If the diagnostics pass, the ACTIVE (45C37A) READY (45C37), XMIT, RECV, RAIL FAULT indicators are turned off, waiting for communication to be sensed on the Remote I/O network. When communication is sensed, the RECV indicator is then turned on, indicating the Remote Head is receiving messages.

2.1.3 LED Operation After Power Up

If a failure is detected, the ACTIVE (45C37A) or READY (45C37) LED will remain off and the error fault listed below will be displayed on the LED's. These fault conditions are terminal. The Remote Head requires that the power be cycled down and backup to recover.

TABLE 1 - LED STATUS CODES THAT ARE TERMINAL:

ACTIVE /READY	XMIT	RECV	RAIL FAULT	DESCRIPTION
OFF	OFF	OFF	OFF	communication failure or never established or executive checksum error
OFF	OFF	ON**	OFF	communication test 1 failure
OFF	ON	OFF	OFF	communication test 2 failure
OFF	OFF	OFF	ON	I/O interface failure
OFF	ON	ON	OFF	watchdog test failure
OFF	OFF	ON	ON	internal RAM failure (8031)
OFF	ON	OFF	ON	external RAM failure
OFF	ON	ON	ON	watchdog timeout

The LED's are also used to show non-fatal fault conditions.

TABLE 2 - LED STATUS CODES THAT ARE NON-FATAL:

READY	XMIT	RECV	FAULT	DESCRIPTION
ON	ON	ON	OFF	normal operation
ON	ON	ON	ON	port 3 device fault
ON	OFF	ON	ON	port 2 device fault
ON	ON	OFF	ON	port 1 device fault
ON	OFF	OFF	ON	port 0 device fault
ON	OFF	ON	OFF	undefined
ON	OFF	ON	OFF	undefined
ON	OFF	ON	OFF	undefined

**Note: before communication to this drop is established, the receive LED will blink as Who-Are-You (WRU) messages to other nodes are received.

2.2 **Selector Switches**

2.2.1 Mode Selector Switch

The Mode Selector Switch sets up the operation of the Remote Head, either as drop 0–17 or drop 20–37 as a slave in the Remote Network.

R00 – This position selects the Remote Head to operate as a Remote Drop in the range of 0–17 (octal).

R20 – This position selects the Remote Head to operate as a Remote Drop in the range of 20–37 (octal).

2.2.2 Drop No. Selector Switch

Drop No. Selector Switch – Selects the drop address of the Remote Head. Select 1 of 32 possible drops, 0–37 octal.

When the Mode selector switch is in R00, the selector switch sets the Remote Head drop number. The drop number would be 0–17 octal.

When the Mode selector switch is in R20, the selector switch sets the Remote Head drop number. The drop number would be 20–37 octal.

NOTE: The selector switch settings are read only on power up.

2.3 Remote Head Connections

2.3.1 Terminal Strip

The terminal is located on the front of the remote head and is protected by a guard cover. Input power for the power supply and the Ready contacts are accessible at this terminal strip.

DANGER

HIGH VOLTAGE APPEARS ON THE INPUT TERMINALS. REINSTALL THE GUARD COVERING THE TERMINAL STRIP AFTER THE WIRE CONNECTIONS ARE MADE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

2.3.1.1 Input Power

The input power for the Remote Head is connected at this point. The input power is either A-C or D-C depending on the model number of the Remote Head. M/N 45C37/45C37A is A-C input power either 120 V or 240 V. M/N 45C38/45C38A is the 24 VDC input power. M/N45C38B uses 24–48 VDC input power.

For A-C units the voltage select is done by moving a jumper which is brought out to the terminal strip from inside the power supply and must be installed to the corresponding input power terminal, either 120 volts or 240 volts.

Refer to section 2.4.6 figure 2.4.6.1 for an illustration of connecting the input power.

2.3.1.2 Ready Relay Terminals

A set of normally open contacts from the ready relay are available. These contacts should be used by the User to indicate loss of communication or in the Emergency stop circuit to remove power from the I/O devices, Figure 2.3.1.2.1 shows an example of the typical field wiring using the ready contacts in the emergency stop sequence. Figure 2.3.1.2.2 shows the schematic of the Ready Contact Circuit.

The operation of the ready relay is described in the theory of operation in section 6.

WARNING

YOU MUST PROVIDE A HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE PROGRAMMABLE CONTROLLER CIRCUITRY THAT INCLUDES THE READY RELAY CONTACTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2.3.1.2 Ready Relay Terminals (Cont.)

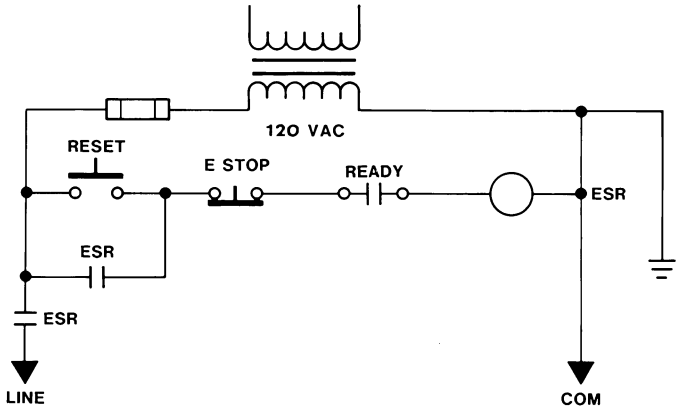


Figure 2.3.1.2.1
Typical Field Wiring Using Ready Contacts

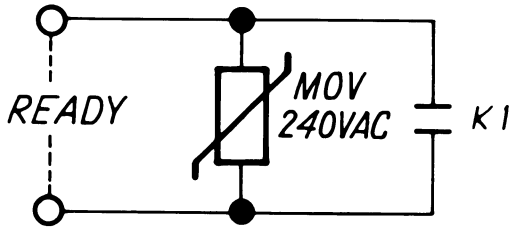


Figure 2.3.1.2.2
Schematic of the Ready Contact Circuit

2.3.2 I/O Port Connectors

There are four ports on the face of the Remote Head. Any combination of I/O Rails, Local Heads or Interface modules can be connected via an I/O interconnect cable. The length of the interconnect cable is 46 inches for a rail and Interface Module, and 10 feet or 46 inches for the local head. (The 10 foot cable is shipped with the Local Head). Cable management is provided on the front of the Remote Head. Refer to section 2.5.5 figure 2.5.5.1 and 2.5.5.2 which shows the connectors and cable area.

2.3.3 BNC Connector

This BNC connector is used to attach the remote head to the remote I/O network. The remote I/O network cabling is described in detail in section 4.0.

2.4 I/O RESET MODE SELECTION

2.4.1 INTRODUCTION

For most industrial applications, it is customary that all Digital outputs are reset if the power is lost, if the processor is stopped, or if a problem is detected within the system. This mode provides the safest operation.

In some applications, however, it may not be desirable to reset the digital outputs of the processor if loss of communication to that drop or if a fault is detected. This is most common in continuous applications where it is necessary for the process to continue.

2.4.2 OPERATION

The Remote Head 45C37/38 provides the user the option of selecting whether or not the outputs will be reset. With the jumper in place - as shipped from the factory - all digital outputs connected directly to the Remote head or via Local Heads will be reset if the power is lost, if the processor is stopped, or if communication to the Remote Head is interrupted.

With the jumper removed, all digital output connected directly to the Remote Head or via a Local Head will retain their last state if the processor is stopped or if communication to the Remote Head is interrupted. If power is lost, the outputs will of course be reset.

WARNING

WHEN THE I/O RESET IS DISABLED, THE USER MUST TAKE APPROPRIATE SAFETY PRECAUTIONS IF THE DIGITAL I/O WERE TO HOLD THEIR STATE INDEFINITELY. THIS CONDITION MUST BE ALARMED, AND THIS ALARMING CAN BE ACCOMPLISHED BY USE OF THE READY RELAY AND/OR THE APPLICATION PROGRAM AND APPROPRIATE DIAGNOSTIC BITS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Note, the operation of the Ready Relay is not affected by the jumper position. The Ready Relay will always open if communications to the Remote Head are interrupted. This relay should be used to take adequate safety measures in the event of communication loss. Refer to Section 6 for a more detailed discussion of Ready Relay operation.

2.4.3 Jumper Selection

The I/O reset function can be disabled two different ways depending on which Remote Head circuit board is installed in the Head.

In older units, a jumper is removed to disable I/O reset. In later (newer) units, I/O reset is disabled by cutting out a 0 ohm resistor. Figure 2.4.3 shows these two cases.

When the Remote Head has circuit board 59018-SR or earlier (example: 59018-SP), jumper J9 is removed.

When the Remote Head circuit board is 59018-SS or later, a 0 ohm resistor (R20) is cut out.

CAUTION

DO NOT REMOVE ANY OTHER JUMPERS THAT ARE ON THE BOARD. IN LATER UNITS (CIRCUIT BOARD 59018-SS OR LATER), J9 IS USED FOR ANOTHER FUNCTION AND THE REMOTE HEAD WILL NOT WORK PROPERLY.

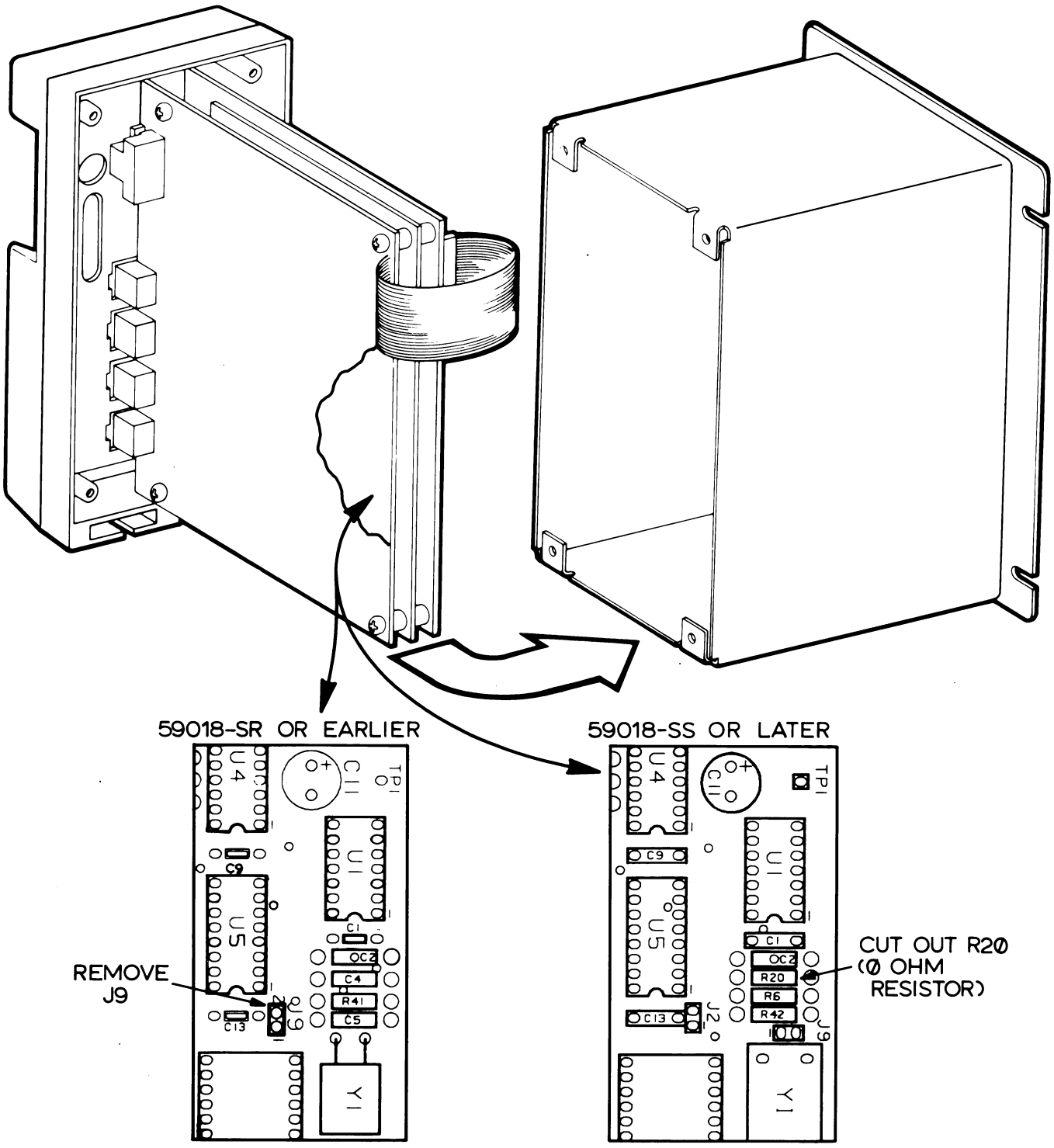

59018-SR OR EARLIER
59018-SS OR LATER
REMOVE
J9
CUT OUT R20
(Ø OHM
RESISTOR)
U4
U1
U5
C11
C9
C1
C2
C4
C5
R41
C13
J9
TP1
Y1
R20
R6
R42
J2

Figure 2.4.3

2.5 INSTALLATION OF EQUIPMENT

This section contains the procedures necessary for installation of the Remote Head Local Head and Rails as they apply to connecting to the Remote Head.

Safety is a prime consideration for the plant, and personnel, when installing and operating the equipment. This installation section should be reviewed thoroughly before starting. Recommendations that are made are only intended to supplement local and national codes and regulations. The personnel installing the AutoMate product line should be familiar with these codes as well as the procedures described in this section.

Once the installation planning is completed, the mounting and connection of field wiring can be accomplished. The following describes the procedures for mounting and wiring the Remote Head.

2.5.1 WIRE LAYOUT

The wiring within each enclosure must be carefully routed to minimize electrical noise and cross talk between input and output wiring. The following recommendations for panel wiring and field wiring should be observed.

Panel Wiring Recommendations.

- Ensure proper chassis grounding
- Separate low-level control signals
- Group and bundle wire types by similar electrical signals
- Separate AC and DC wiring when at all possible
- Avoid placing high voltage wiring with control wiring
- Terminate shielded wire only at one end, when shield is not used as conductor
- Avoid routing wiring over vibrating surfaces.

Field Wiring Recommendations

- Always run low-level signals separate from other field wiring
- DC I/O field wiring is kept separated from AC field wiring
- Avoid routing control wiring near high energy wiring
- Always adhere to national and local electrical codes when running wiring in conduit or in wire trays.

2.5.2 HARDWARE LAYOUT CONFIGURATION

Figure 2.5.2.1 illustrates four (4) I/O devices, 2 Local Heads and 2 Rails. This is only one of many different configurations.

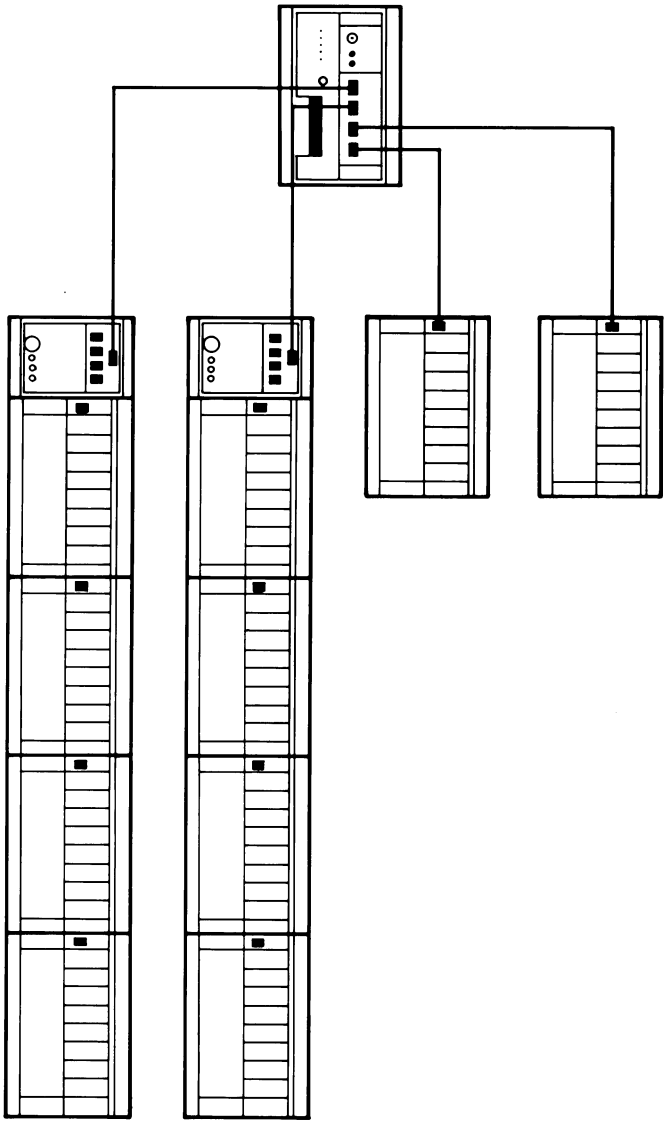


Figure 2.5.2.1

The interconnecting cable shipped with each rail and local head connects the remote head ports to the I/O device. The length of the interconnect cable is 46 inches for a rail and Interface Module, and 10 feet or 46 inches for the local head. (The 10 foot cable is shipped with the Local Head). The user must insure that in the layout that the cable can reach from the I/O port to the I/O device.

NOTE: The Remote Head itself must be mounted vertically, either in an enclosure or on a mounting surface to ensure proper air flow for cooling.

2.5.3 Grounding the Remote Head

Grounding the Remote Head is extremely important in electrical installations. Grounding not only minimizes personnel hazard, it also helps reduce noise. The ground path (when using a 1KVA transformer) should have less than 10 milli ohms resistance.

NOTE: The Remote Head, and its associated Rails and Local Heads, must be properly grounded to ensure proper operation.

On each Remote Head and I/O Rail two No. 10 studs are provided for grounding purposes. (Refer to Figure 2.5.3.1.1 for Stud Location.)

2.5.3.1 Example of One Method of Grounding the Remote Head.

Connect a green ground wire to the top stud on the Remote Head housing or Rails or Local Heads to earth ground.

NOTE: The grounding wire must be a minimum wire size of #14AWG. Also the insulation should be green in color, for U.S.A. applications.

NOTE: For proper termination a lug should be used. Also starwasher (toothed lock washer) should be under the lug to ensure effective grounding to the remote head.

If the remote head is to be mounted on a sub panel, and the subpanel is properly grounded, and the above grounding is not desired, the following should be observed.

Remove all paint, coating, and corrosion where the remote head, local head or Rail is to be mounted. (The paint on the mounting surface will prevent good electrical contact). Ensure a star washer is between the sub panel and the Rail, local head or remote head, this will ensure good electrical connection.

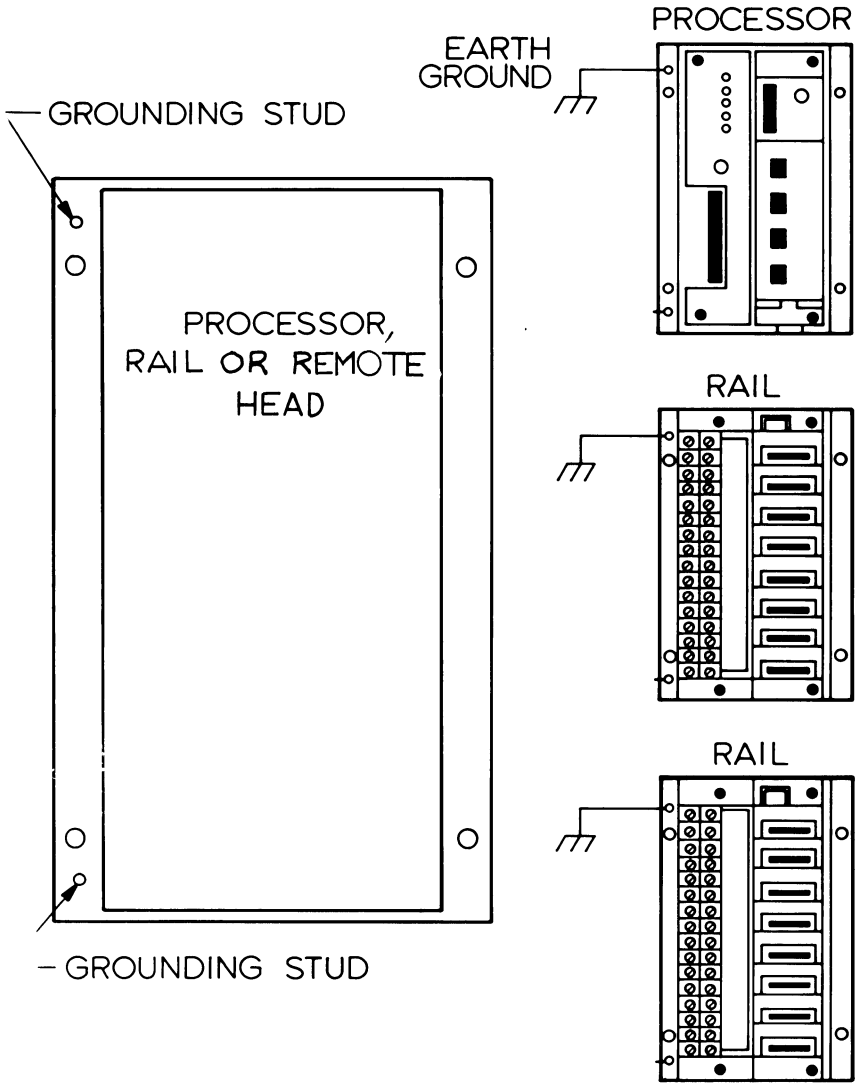


Figure 2.5.3.1.1

2.5.4 Installation Procedures

The following describes how to implement the mounting, connection of power, and wiring the Remote Head.

Mounting the Remote Head

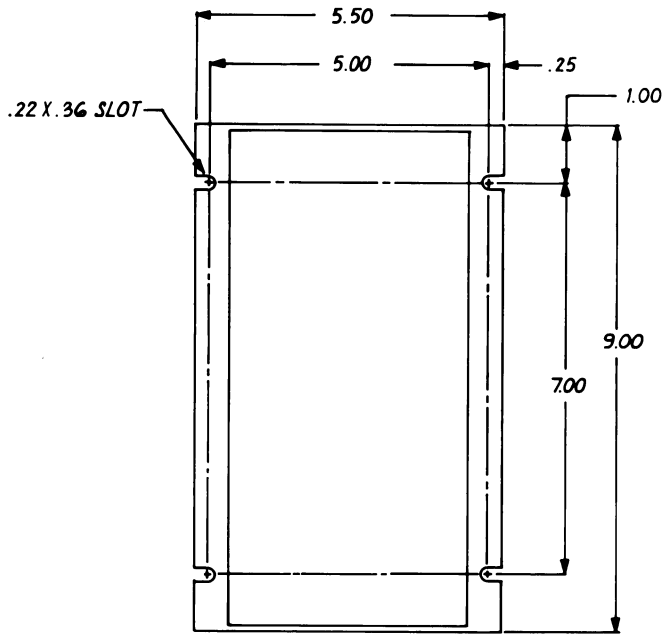


Figure 2.5.4.1

The remote head is designed to be vertically mounted using #10 bolts or studs, as mounting hardware. Refer to template Figure 2.5.4.1 for hole placement. The template is used for both the Remote Head and rails.

NOTE: If grounding is to be accomplished through the mounting surface, ensure that paint or other non-conductive finishes are removed from the mounting surface as previously discussed.

Examples of attaching the remote head to the mounting surface are shown in Figure 2.5.4.2.

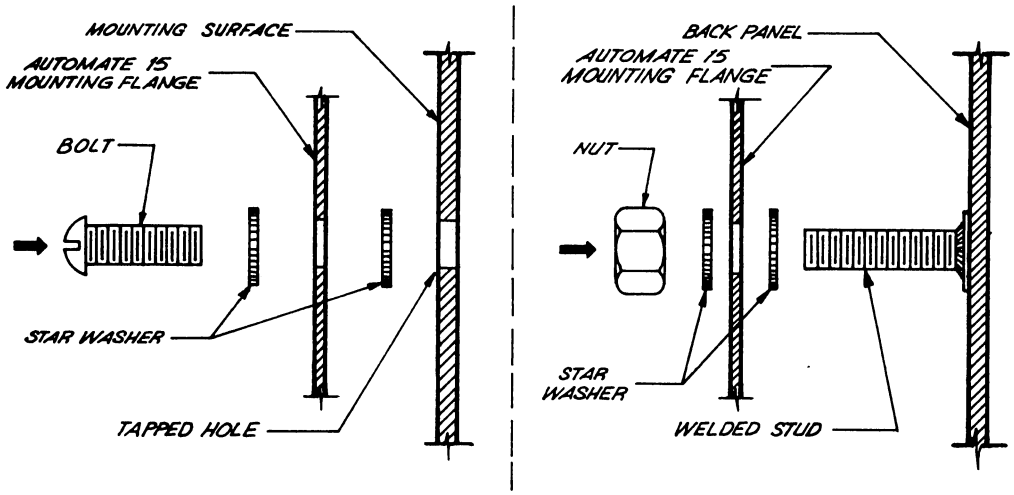


Figure 2.5.4.2

2.5.5 Connecting I/O Interconnect Cable to the Remote Head

After the Processor and the Rails have been mounted the interconnecting cable must be installed. The cable must be run within the Rail cable raceway for noise isolation.

A cable slot is provided on the face of the remote head. Press the interconnect cable through the slots, and connect the cable to the proper connector. (Refer to Figure 2.5.5.1 and 2.5.5.2)

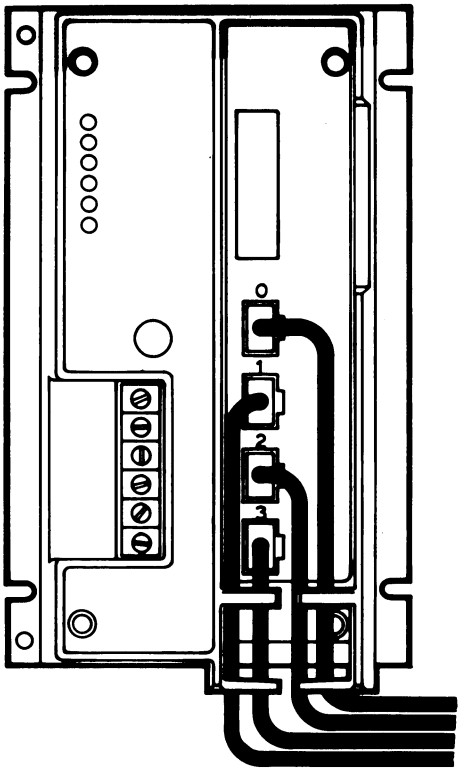


Figure 2.5.5.1

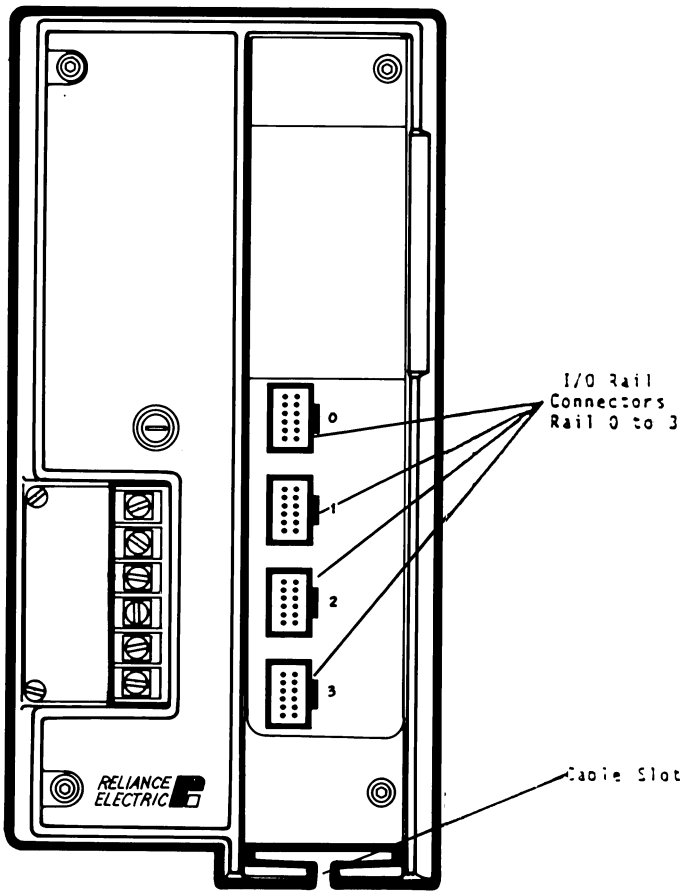


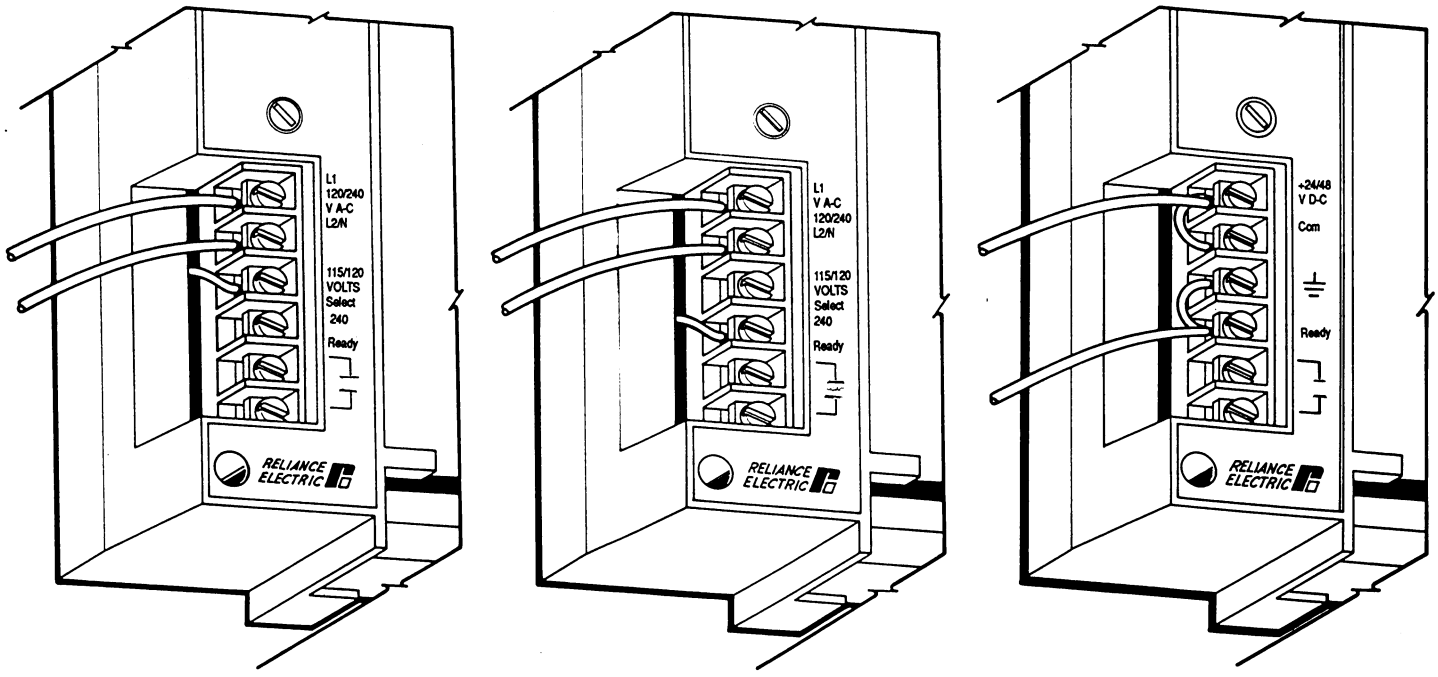
Figure 2.5.5.2

WARNING

UNEXPECTED MACHINE MOTION OR A PROCESS CHANGE MAY RESULT FROM REMOVING/INSERTING A MODULE OR CONNECTING/DISCONNECTING A CABLE. DISCONNECT POWER DURING MODULE REPLACEMENT OR CABLE ALTERATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2.5.6 Connecting Input Power

Figure 2.5.6.1 illustrates the connection to the AutoMate Remote Head for 120 V A-C or 24 V D-C input power. Refer to Section 2.6 for the Remote Head Power Specifications.



120V POWER INPUT | 240V POWER INPUT | 24VDC POWER INPUT

Figure 2.5.6.1

DANGER

HIGH VOLTAGE APPEARS ON THE INPUT TERMINALS. REINSTALL THE GUARD COVERING THE TERMINAL STRIP AFTER THE WIRE CONNECTIONS ARE MADE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

2.6 **Specifications**

2.6.1 Electrical

Ambient Temp.	:	0 to 60° C (Operational) –20 to 85° C (Storage)
Model Number	:	45C37, 45C37A
Input Power	:	120 V RMS + 15% (120–132 V RMS) 240 V RMS + 15% (168–264 V RMS)
Cycle Loss	:	3 Cycles
Line Frequency	:	47.5 – 63 Hz
Line Spike	:	1500 V Max.
Transient Voltages	:	120 RMS + 15%/–30% (84–138 V RMS)
@ 60 Hz	:	240 RMS + 15%/–30% (168–276 RMS)
Max Load	:	@ 120 V $^1/_2$ AMP
	:	@ 240 V $^1/_4$ AMP
Power Factor	:	0.8
Dissipation (Watts)	:	50 Watts logic power with 64 I/O installed
Fuse Size	:	2 AMP AGC
± 15 V Supply	:	50 ma
Ready Relay Contact (resistive load)		
Max Switching power	:	2000 VA (A-C), 192 W (D-C)
Max Switching voltage	:	250 C A-C, 30 VDC
Max Switching current	:	8 A
UL/CSA rating	:	5 A, $^1/_{10}$ HP 125, 250 VAC 5 A 30 VDC
Model Number	:	45C38, 45C38A, 45C38B
Input Power	:	24 VDC + 10% (M/N 45C38/45C38A) 24–48 VDC, 20–55 VDC acceptable range (M/N 45C38B)
Transient Voltages	:	100% overvoltage for 1 Sec.
A-C Ripple	:	4 V PEAK to PEAK
Max Load	:	2A @ 24 VDC
Dissipation	:	50 Watts
Fuse Size	:	5 AMP MTH
Ready Relay Contact (resistive load)		
Max Switching power	:	2000 VA (A-C), 192 W (D-C)
Max Switching voltage	:	250 C A-C, 30 VDC
Max Switching current	:	8 A
UL/CSA rating	:	5 A, $^1/_{10}$ HP 125, 250 VAC 5 A 30 VDC

2.6.2 Mechanical

9.38" High x 9.00" Deep x 5.50" Wide Without Peripheral Cable
9.38" High x 11.00" Deep x 5.50" Wide With All Cables Attached

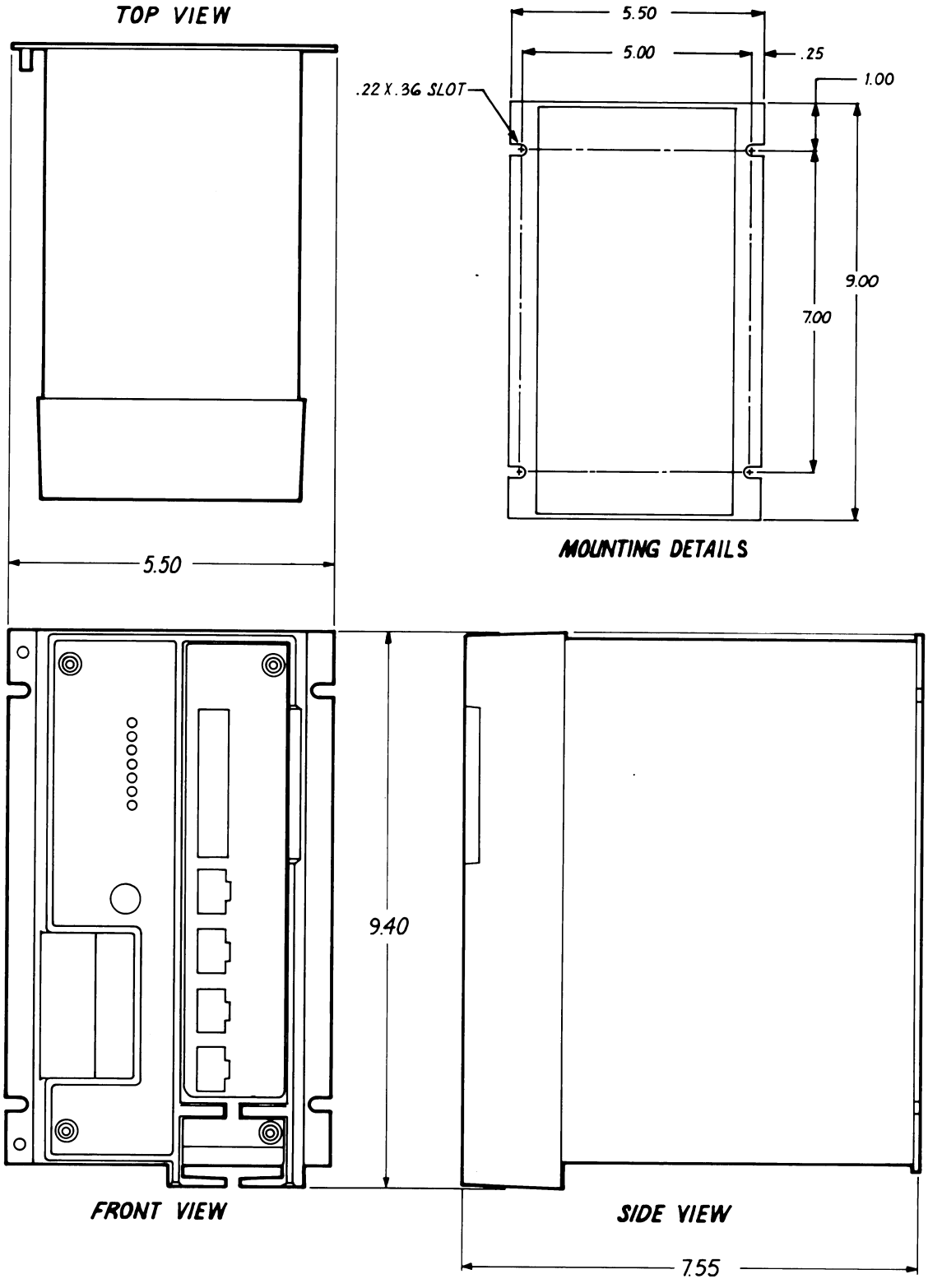


Figure 2.6.2.1
Mechanical Layout

3.0 **Configuration**

3.1 Remote Digital I/O Configuration

Remote digital I/O configuration is the process whereby the user assigns I/O registers to the Digital Rails that are connected to a Remote Head. Also when the I/O is configured, diagnostics for digital I/O are also activated. These Diagnostics are done by the AutoMate Processor automatically when configured. If the I/O was not configured, and communication was being done using Remote IN/OUT instructions the diagnostics would have to be accomplished in the application program.

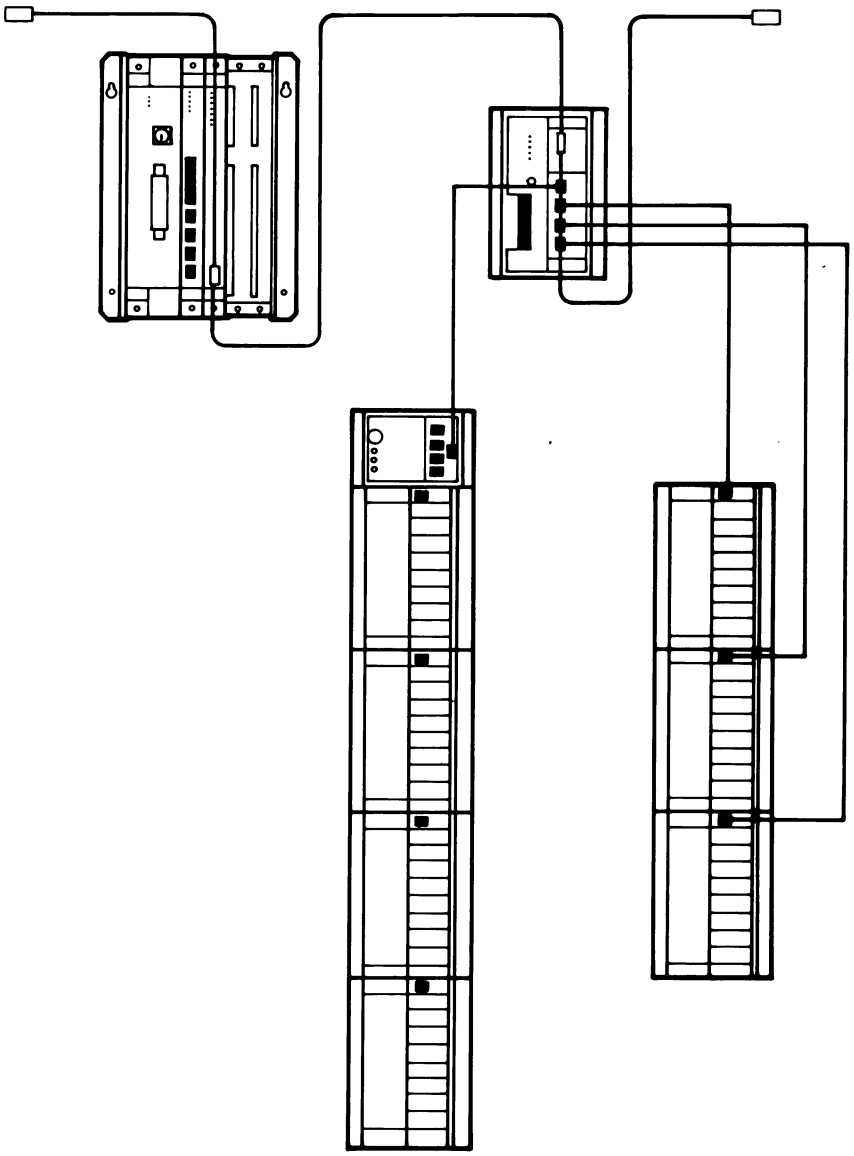
NUMERICAL I/O IS NOT CONFIGURED IN THE DIGITAL I/O CONFIGURATION TABLE. They are defined by instruction blocks in the application program.

Example of a Remote Digital I/O Configuration

The following figures illustrate a possible configuration of a remote I/O system. By no means are these the only possible combinations or arrangements.

Figure 3.1.1 shows a Remote Head with 1 Local Head and 3 rails connected directly for a total of 112 Digital I/O at this drop. To ensure proper operation, the Local Head and Rails must be plugged into the Remote Head before the Remote Head is powered up. The configuration table for this Remote Configuration is shown below the diagram.

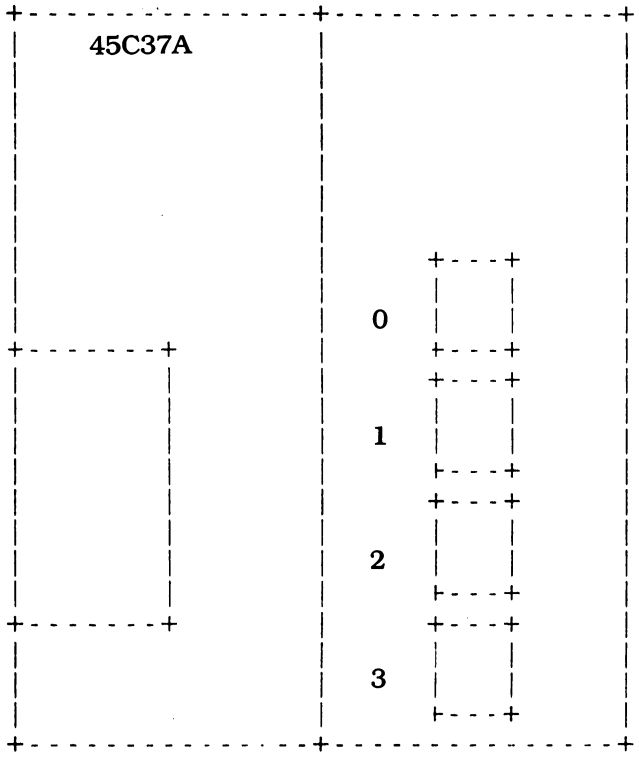
Figure 3.1.1



MSLT	DROP#	TYPE	RSLT	CARD	CHAN	I/O	REGISTER
2	14	RHD	NA	NA	0	LHD	00-03
					1	RAIL	04
					2	RAIL	05
					3	RAIL	06

3.2 I/O Port Channel Address for Remote Head

When an Interface Module (TWS or LED) is connected to an I/O port on a remote head it can be treated as a numerical I/O. The REMIN/REMOUT instructions can be used to get data from the modules instead of configuring them as digital I/O. When instruction blocks are used, digital I/O registers are not used, only data registers. To use the instruction blocks the user must know the port address, which is illustrated below.

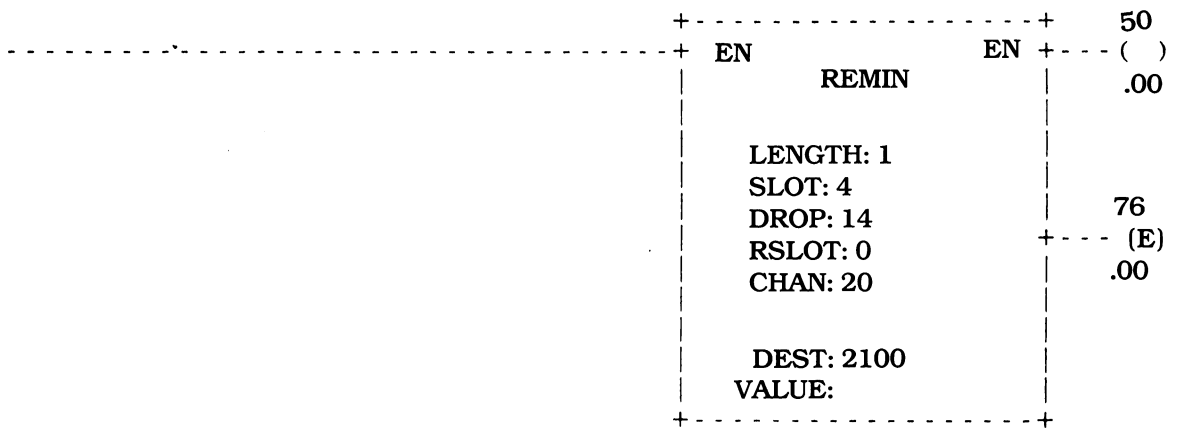


	LOCAL HEAD CHAN ADDRESS	RAIL ADDRESS
-----	CHAN 0-3	0
-----	CHAN 10-13	10
-----	CHAN 20-23	20
-----	CHAN 30-33	30

Figure 3.2.1
Remote Head Port/Channel Addresses

3.2.1 TWS Example Program Using Instruction Blocks to Read Data

For this example assume that an interface module is connected to port 2 of the remote head and the drop number of the remote head is 14 and the Master RIOP is in Slot 4.



4.0 Installation of Remote I/O Network

4.1 Introduction

The proper installation of the Remote I/O Network cable and proper configuration of the Drop parameters are critical to the ease of startup and proper long term operation of the Remote I/O Network. Allowing the user to install the network gives him the flexibility to configure a network particularly suited to his needs. However, this also places the responsibility for proper installation on the user. This section provides detailed information and a step-by-step procedure for installing the coax and configuring the Drops. It is important that the steps be followed carefully and checked along the way. If an error is made, it can be very difficult to find once the entire network is complete. A single loose connection somewhere in a 32 drop system can take many frustrating hours to find. Pay attention to the details!!

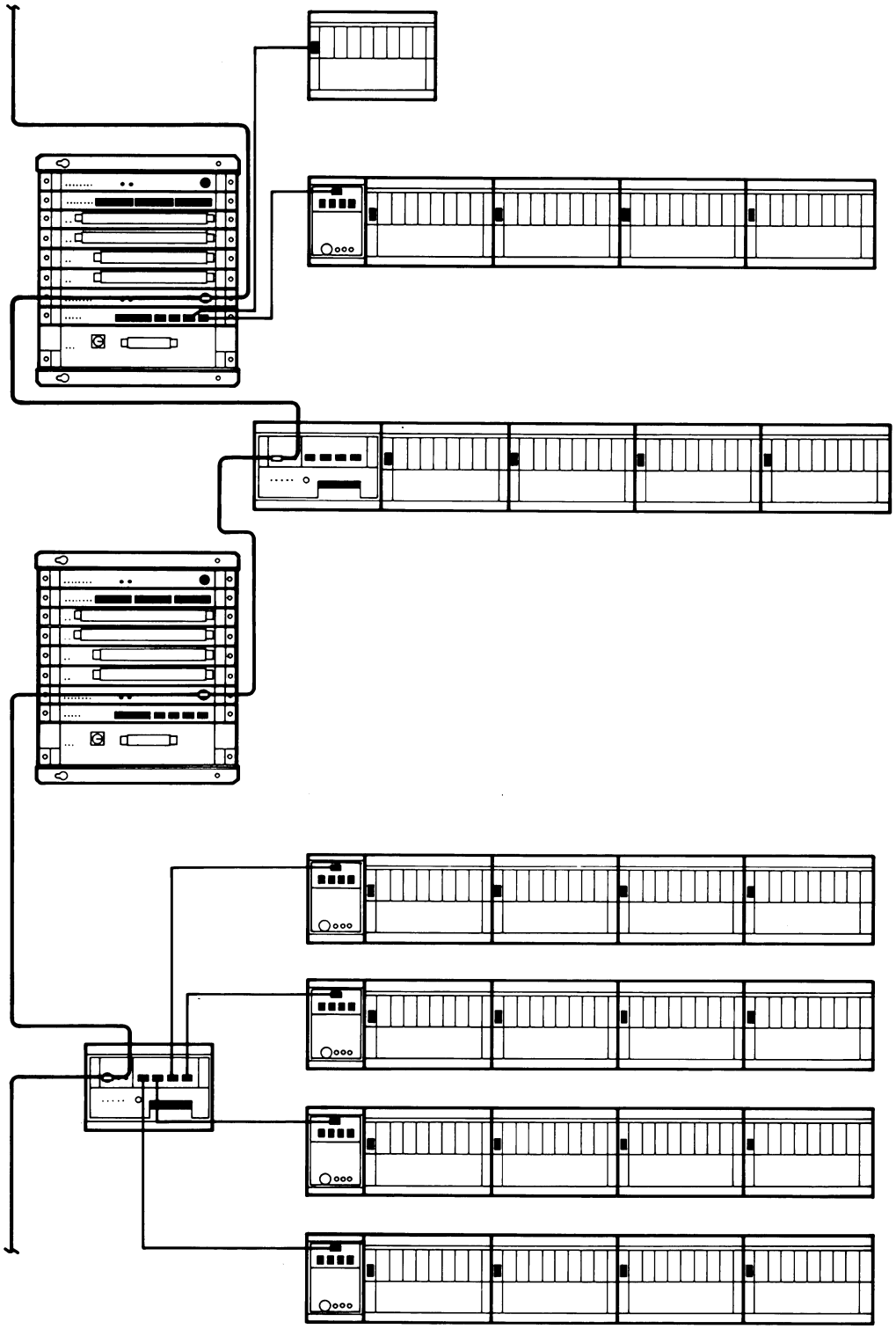
4.2 Cable Installation

4.2.1 Configuration Limitations

The following conditions apply to all installations of Remote I/O. Refer to Figure 4.2.1.A.

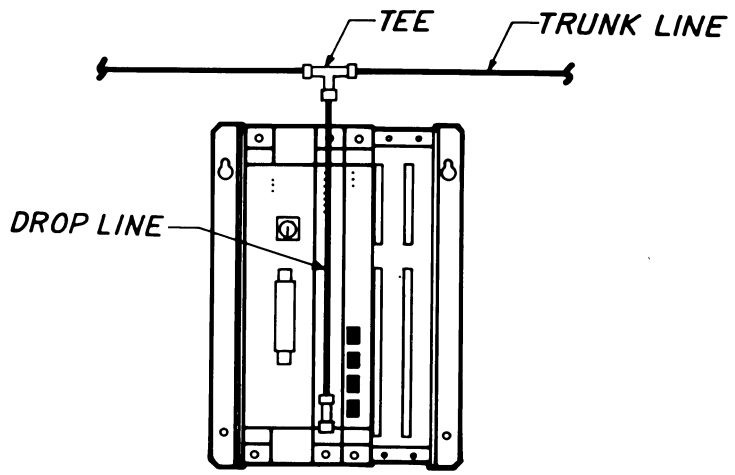
- The maximum total cable length must be 3,600 feet or less when using Belden #9259 cable.
- The maximum total cable length must be 6,000 feet or less when using Belden #8213 cable.
- The minimum cable length between adjacent Drops must be 50 feet.
- A 75 ohm terminating load must be placed at the extreme ends of the network. Two and only two loads must be present.
- The Tee connectors for each Drop must be connected directly to the REMOTE device. In other words, there can be no drop cables from the main trunk line. In some installations where the Remote I/O cable is run over head (or under ground), this requires that the cable be looped down (or up) to the Remote Head or Remote Processor. Refer to Figure 4.2.1.B.
- A maximum of 32 slave devices can be connected to the network.
- All devices must be set to unique Drop numbers, BEFORE POWER UP.
- Drop numbers do not have to be assigned consecutively, NOTING that the First Twelve Drops can only be Remote Rack or Remote Head. All other drops thereafter can only be Remote Heads.

Figure 4.2.1.A

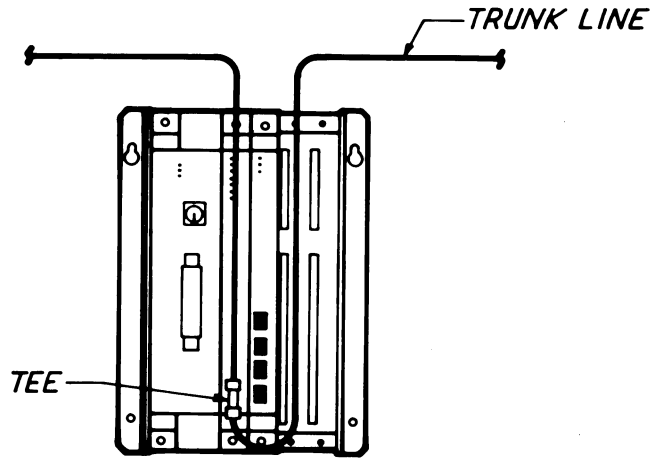


Example of Remote I/O With 3 Drops

FIGURE 4.2.1.B



NOT ALLOWED



ALLOWED

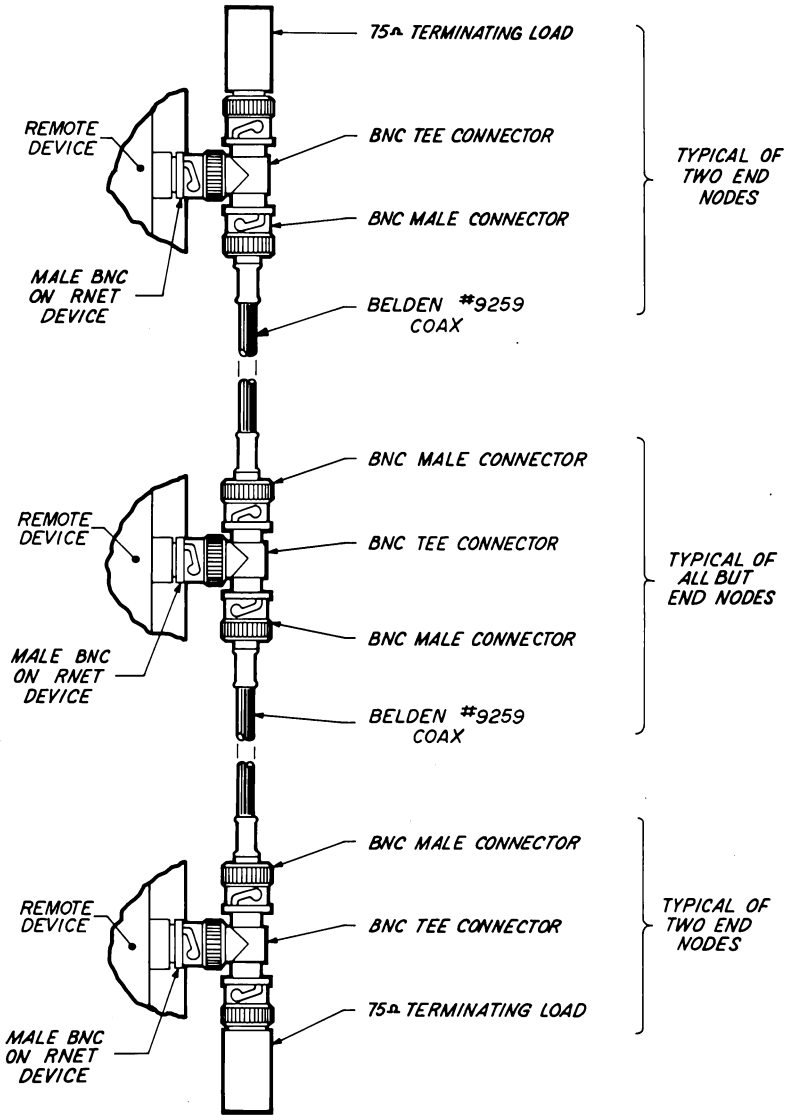
Example of Coax Tee Connectors

4.2.2 Cable and Connector Specifications

It is most important that the recommendations for cable, connectors, terminations and crimp tools be followed. Not all RE-59/U cables have the same characteristics. There are differences in ohm's/ft., center conductor construction (solid or stranded), center conductor diameters, insulation characteristics, and shield diameter. All of these will create the possibility of incompatibility with connectors (which also vary) and differing electrical characteristics. The result of mismatches is poor performance and poor reliability due to marginal connections. Reliance Electric does not support the use of any cables/ connectors other than those listed below.

Item	Reliance Model No.	Manufacturer Part Number
RG-59/U Coax Cable	--	Belden #9259
Coax BNC Tee Connector	45C70	Amp 329518
Coax BNC 75 Ohm Terminating Load	45C71	Amphenol 46650-75
RG-59/U Coax BNC Male Connector	45C72	Amp 227079-7
RG-59/U Coax Connector Crimp Tool Kit	45C73	Amp 220190-1 (Tool) Amp 220189-2 (Die)
RG-11/U Coax Cable		Belden #8213

FIGURE 4.2.2.2.A



Typical BNC Connection System

4.2.3 Connector Installation

4.2.3.1 Connector Installation for Belden #9259

Reference:

Amp, Inc IS-2798
Commercial Series BNC Plugs
(Use cable strip dimension)

Amp, Inc IS-2901
Crimping Tool - Maintenance Sheet
Amp, Inc IS-2786
Crimping Tool - Instruction Sheet

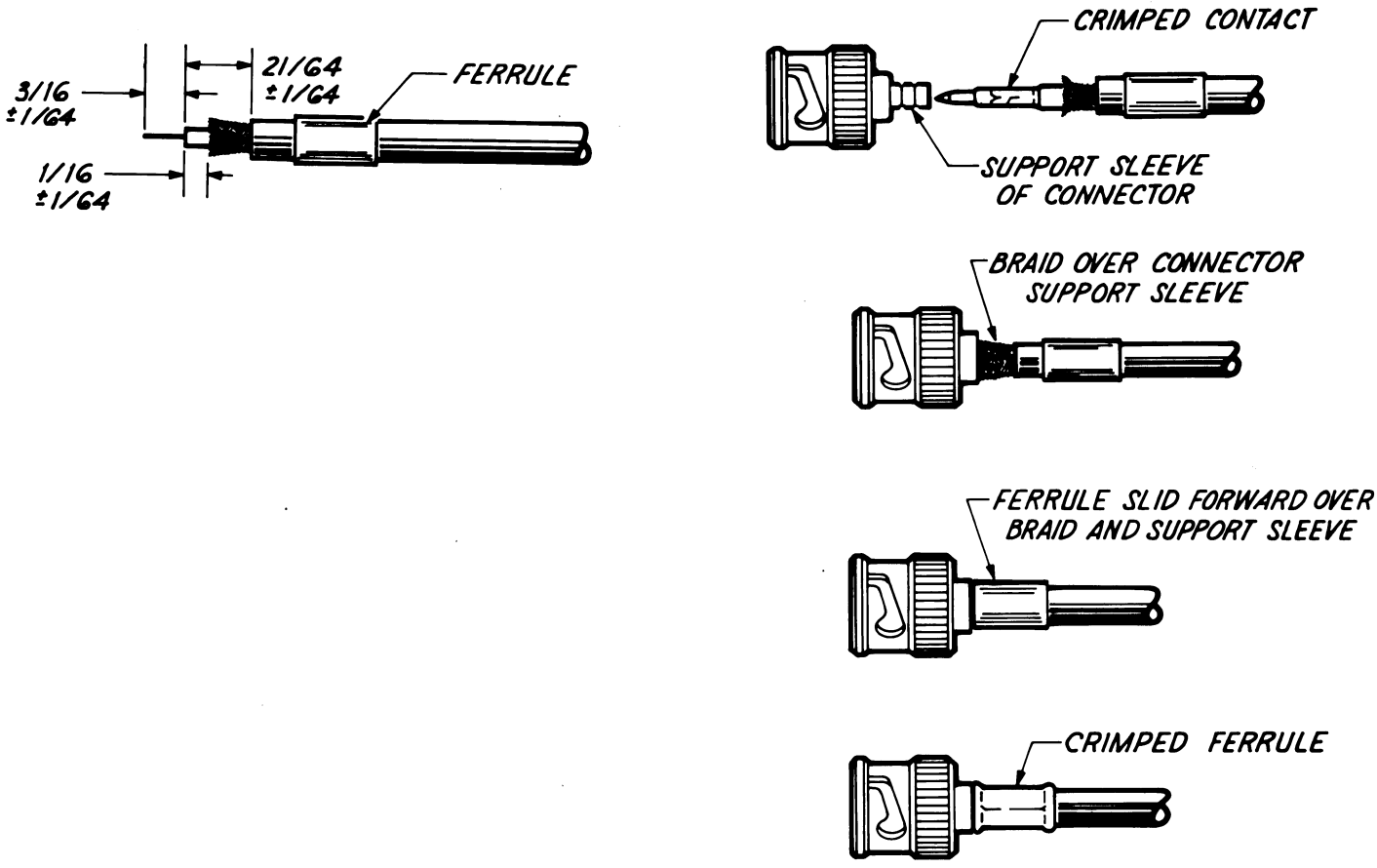


Figure 4.2.3.1.1 Coax Termination Details

1. Slide ferrule onto coax cable.
   (See figure 4.2.3.1.1.A)
2. Strip coax to dimensions shown (See Figure 4.2.3.1.1.A). Check that shield braid wire is cut to the correct length and can not touch the center conductor.
3. Crimp the center contact using Reliance 45C73 crimp tool.
   (See figure 4.2.3.1.2)

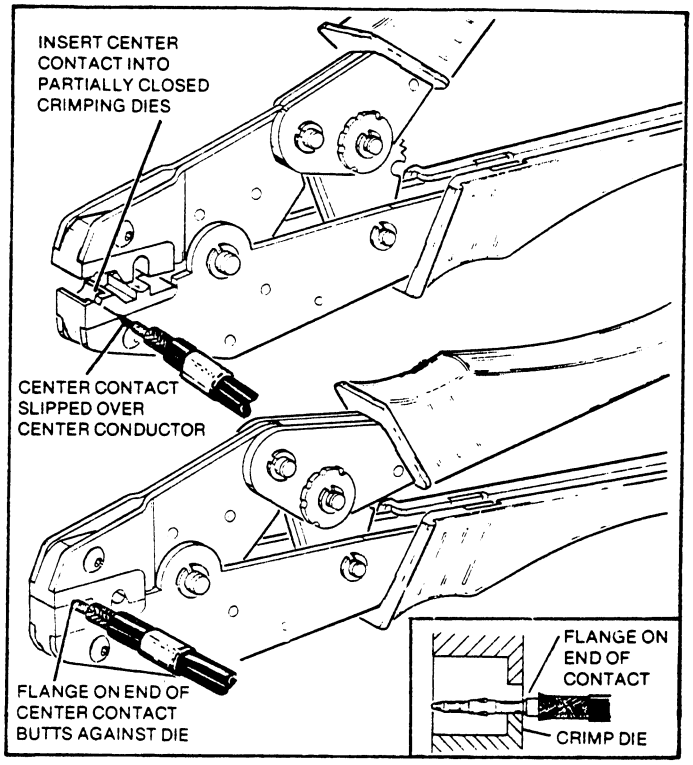


Figure 4.2.3.1.2 Crimping Center Contact

A. Place the center contact, assembled on the stripped conductor, in the partially closed crimping dies as shown in Figure 4.2.3.1.2.

B. Make certain that the flanged end of the center contact is butting against the crimping die.

C. Hold the cable in place and close the crimping tool handles until the ratchet releases to complete the crimp.

D. Remove the crimped contact from the dies.

E. Check that the shield braid wire does not touch the center contact. (See figure 4.2.3.1.1.B)

4. Insert the center contact into the connector body until the cable butts against the dielectric inside of the connector body. The flared braid must fit over the support sleeve. (See figure 4.2.3.1.1.C)
5. Slide ferrule forward over the shield braid wire and the support sleeve until the ferrule butts against the connector body. (See figure 4.2.3.1.1.D)
6. Crimp the ferrule using 45C73 crimp tool.(See figure 4.2.3.1.3)

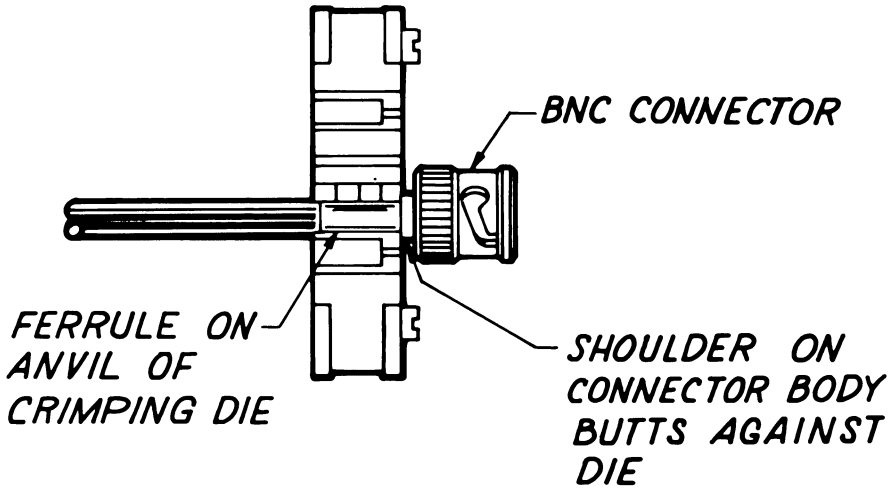


Figure 4.2.3.1.3 Crimping Ferrule

A. Place the ferrule on the anvil of the die so that the shoulder on the connector body butts against the die.
B. Hold the assembly in place and close the crimp tool handles until the ratchet releases.
C. Remove the crimped assembly from the crimping dies.

4.2.3.2 Testing Connections

After each individual cable is complete (one male connector on each end), the cable should be tested electrically and mechanically.

First, visually inspect the connector for loose connections, nicked insulation, loose strands from the braid, or any other condition that might cause poor connections or shorts. The center contact should be straight (not bent) and centered inside of the connector dielectric. Check 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. Check that the ferrule was crimped tightly against the body of the connector and that no shield braid wire protrudes from the ferrule.

Second, the mechanical connection should be checked. Grasp the outer conductor connector in one hand and the coax jacket in the other. Pull firmly (about 10 lbs.). The connector should hold.

Finally, a simple Ohm meter can be used to check the cable electrically. Check for continuity (< 1 ohm) from the center conductor on one to the center conductor on the other end. Check for continuity (< 2 ohm) from the outer conductor on one end to the outer conductor on the other end. Check for an open circuit between the center conductor and the outer conductor at either end.

4.2.4 Grounding Considerations

The exposed metal parts of the "BNC" connectors are signal conductors and must not come in contact with any surfaces that are electrical conductors. While these surfaces present no shock hazard, the Remote I/O system will not function properly if they contact any conductive surface, even the AutoMate Chassis or Heads, as noise may be introduced into the system. Therefore, care should be taken to insure the isolation of these surfaces. In-line Connections should be taped or have heat shrink tubing applied. No connections should be made within conduits or junction boxes. The chains on some terminating loads should be removed.

4.2.5 Cable Routing Considerations

The coax cable routing for the Remote I/O Network must be designed and installed to be isolated from environmental factors such as electrical interference and physical damage. Some of the major factors are as follows:

4.2.5.1 Electrical Isolation

The following are recommendations for isolating the Remote I/O cable from electrical interference:

4.2.5.1.1 General Information

- If the coax cable is installed in metal conduit, the conduit must be properly grounded along its entire length.
- Do not install the coax closer than three feet from electrical motors, generators, transformers, SCR drives (rectifiers), welders, high voltage lines, induction heat sources or sources of microwave radiation.

4.2.5.1.2 Cable Grouping and Separation

WARNING

ROUTING CABLES FROM DIFFERENT WIRING GROUPS TOGETHER MAY INDUCE VOLTAGES THAT COULD CAUSE UNEXPECTED MACHINE MOTION. ONLY ALLOW CABLES OF THE SAME WIRING GROUP TO BE IN CLOSE PROXIMITY TO EACH OTHER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

The reason for separation of various voltages and power levels is to reduce the possibility of electrical noise. Cables of like voltages and power levels can be grouped together in trays and conduits. Unlike levels must be routed in separate trays and conduit. Intermixing of levels is not allowed. The following table can be used to determine which voltage and power levels can be grouped together.

Grouping Definition

Level	Description
1. Low	Coax cables for Reliance Remote I/O systems; Analog <50-volt D-C; signal commons; very low voltage signals from devices like strain gages, thermocouples and RTD's; operational amplifier signals; power amplifier signals; digital tachometer and encoder signals; phone circuits;
2. Medium	Analog signals > 50-volt D-C with <28-volt A-C ripple: switching circuits >24-volts D-C and <28-volts D-C; relays >24-volts; analog tachometer and pilot signals;
3. High	D-C switching signals >28-voltS; analog signals >50-volts with >28-volt A-C ripple; regulating signals <20 amps (such as motor generator loops); fused 250-volt D-C control bus: A-C feeder >20 amps; A-C control >20 amps (such as pushbuttons, indicator lights, and limit switches); convenience outlets; panel lighting;
4. Power	A-C and D-C wiring <20 amps

Table 4.2.5.1.A Cable Grouping Definition

The following table can be used to determine the required separation between the Remote I/O coax cable and any other cable group as defined by the previous table.

Level	Separation in Inches Tray to Tray	Conduit to Tray	Conduit Conduit
1. Low	0	0	0
2. Medium	1	1	1
3. High	6	4	3
4. Power	26	18	12

Table 4.2.5.1.B Cable Separation for Remote I/O Coax

4.2.5.2 Chemical Isolation

The coax cable should be protected from the following factors:

- Oil, grease, acids, caustics, and other harsh or hazardous chemicals that could damage the coax outer jacket or corrode metal connectors.
- Contact with temperatures greater than 60 degrees C.

4.2.5.3 Physical Isolation

The cable routing must be designed and installed to prevent physical damage to the coax.

- The cable must to routed to protect it from abrasion, from vibration, moving parts, and personnel traffic. Also, the cable should not contact surfaces such as concrete to prevent wear.
- Caution must be exercised while installing coax. High pulling tensions, tight fitting conduits, and "kinked" or pinched cables can damage the cable shielding and insulation. These types of damage may not be found with physical inspection; it requires special cable test equipment to locate the damage. Cable should be manually pulled, allowing sufficient slack and using cable pulling lubrication to minimize tensions. Cable should never have sudden tension applied or "snapped" NEVER - Never use a powered cable puller without consulting the cable manufacturer and monitoring the pulling tension.

5.0 **Diagnostics**

5.1 Introduction

The diagnostics in the AutoMate 30/40 processor use system registers to monitor and control specific system functions.

The diagnostics provided by the Remote I/O Processor are:

Status of Each Remote drop
Type of Card in Remote Slot in Remote Racks
Status of Card in Remote Slot
Type of I/O Device Connected to I/O port either
  Remote Heads or LIOP
Status of I/O device connected to I/O port
Communication Retries to each drop
CRC errors from each drop

Diagnostic information for the Remote I/O Network is collected by the Master RIOP. These diagnostics are read by the AutoMate processor(s). Each AutoMate processor, in turn updates its system and status diagnostics registers. Not all of the diagnostics appear as data bits in these registers. Some are compared by the processor against the digital I/O configuration tables. The AutoMate processor then sets a status bit. For example the type of I/O device connected to the I/O port does not appear in the status or diagnostic registers but is compared to the digital I/O configuration table by the AutoMate processor. If the device is the wrong type (rail/local head) the processor would not be allowed to go into run and the I/O configuration error bit would be set (3774.01 A30 or 17574.01A40).

It should be noted that the AutoMate processor will update the remote drop diagnostic registers associated with that RIOP, whenone or more remote drops from that master remote I/O processor are configured as digital I/O. When all the remote drops are numerical, the user has to read the diagnostic data from the remote I/O buffers. If the type and status of a remote card, remote head or a device connected to a remote card head is desired the user also has to read the diagnostic data from the remote I/O buffers.

For more information concerning the diagnostics refer to J3034 (Remote I/O Processor and System Reference Manual) and the processor software manual.

6.0 Theory of Operation

This writeup covers remote I/O logic card 59018-SR (or later) and software version 2.2 (or later).

The remote I/O head communicates with the Remote I/O Processor via coaxial cable using the master-slave protocol.

It is capable of driving four I/O devices, each of which may be a rail, a local head, or interface modules (or nothing). In the present software release, the Remote I/O Head is capable of responding to five commands from the master processor:

WRU — who are you. The remote head responds with the node identification (F101H) for a remote head and the current device type for each of the four ports. (0 = not used, 1 = rail, 4 = local head) If the length of the WRU message is seven bytes, the Remote Head recognizes that the master is using the new remote protocol. In the protocol, several flags are sent to the remote head to enable or disable diagnostics as selected by the application program in the Automate processor.

WRD — write data to slave. If it has determined that the master is using the old remote protocol, the remote head responds with an acknowledgment; otherwise, no acknowledgment is sent. It then proceeds to update the I/O devices. If the byte count is incorrect for the current configuration, or if the count does not match the number of data bytes actually received, the data is discarded and the update is not performed. If the update cannot be performed, an error bit is set in the response frame. The I/O update is not performed except in response to this command. Refer to the section on I/O configuration.

RDD — read data from slave. The remote head responds with the I/O data obtained from the previous update. If the configuration has changed, a flag is set in the error byte sent to the master processor. Also, rail faults are reported in the error byte. Note that the remote head will not respond to this command until after it has received a WRD command and performed an I/O update.

RST — reset I/O devices. This command causes the remote head to reset all connected rails or local heads. It also re-initializes the I/O configuration table within the remote head. It does not drop out the head ready relay.

WCF — write configuration. The remote head responds with an acknowledgment and proceeds to verify its I/O configuration. If there is a configuration error, the error bit will be set in the response to a RDD command. Refer to the section on I/O configuration.

6.1 Initialization:

The following tests are performed on power-up:

executive checksum, internal RAM (8031), watchdog timer, external RAM, comm test 1 - with analog switch closed, comm test 2 - with analog switch open, I/O update - clears all I/O devices.

Failure codes for these tests are displayed on the LED's and are shown in table 1. After successfully completing these tests, the watchdog timer is started, and the communication relay is closed, allowing the remote ready to receive messages over the network. The internal configuration table is initialized at this time. The receive LED indicates that the remote head is receiving messages over the network.

After receiving a valid message addressed to this node, the head relay is closed and the ready LED is lit. All I/O data is returned as zeros, and all outputs are held off for a period of 40 ms after this first message, to allow time for the head relay to close. Also, after receiving this first message, several communication timers are started. These timers will time out after communication stops as follows:

100 ms after losing all communication, the outputs are reset, the ready LED is turned off, and the ready relay is opened.

1500 ms after losing all communication, the communication relay is opened, and the two communication tests are repeated. After these tests are completed successfully, the communication relay is re-energized and the remote head waits for further commands.

1500 ms after losing communication addressed to this node, the outputs are reset, the ready LED is turned off, the ready relay is opened, and the communication tests are repeated, as described above.

After the ready relay is opened, communication addressed to this node must be received in order to close it again, as described above.

6.2 I/O Configuration:

During power-up, the internal I/O configuration is initialized to what is actually plugged in at that time. The configuration is checked when a change is sensed in the plug status of any port. An error is reported to the master if the configuration has changed.

The WCF command informs the remote head of what I/O devices are configured in the Automate application program. After receiving this command, if any of these devices are missing or unplugged, the missing devices will be reported as I/O fault bits, but not shown on the LED's.

It is possible for a device to be present at power-up, but not configured in the application program. In this case, if this device is unplugged, an error will not be reported. Also, if the WCF command was not received, missing devices will not be reported as I/O faults.

If an I/O device is disconnected and then reconnected, normal updating will resume within a range of 0.5 to 2 seconds, provided that the device is reconnected to the same port that it was connected to on power-up. Note that a device cannot be added after power-up. Connecting a different device type to a port will prevent it from being updated, and will send a configuration change error to the master unit. This feature is intended to prevent updating of devices whose cables have been inadvertently swapped.

NOTE: THE REMOTE HEAD WILL NOT RECOGNIZE DEVICES CONNECTED AFTER POWER-UP. TO ADD A DEVICE, TURN POWER OFF TO THE REMOTE HEAD, CONNECT THE DEVICE TO THE REMOTE HEAD, AND REAPPLY POWER TO THE REMOTE HEAD.

WARNING

UNEXPECTED MACHINE MOTION OR A PROCESS CHANGE MAY RESULT FROM REMOVING/INSERTING A MODULE OR CONNECTING/DISCONNECTING A CABLE. DISCONNECT POWER DURING MODULE REPLACEMENT OR CABLE ALTERATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

6.3 Device Faults

The Local head parity test will be performed on all local heads unless diagnostics have been disabled in the Automate application program.

If the full local head test has been enabled in the application program, it is assumed that all local heads contain the full complement of four rails. Any missing rails on a local head will cause a fault to be reported for that local head.

If a rail or local head fault occurs, the device is reset and the port number of the faulty device is displayed on the LED's as shown in table 1. An error bit is set in the response frame to the master unit, and all inputs for that device are cleared.

6.4 LED Status Codes

TABLE 1

READY	XMIT	RECV	FAULT	DESCRIPTION
ON	ON	ON	OFF	normal operation
ON	ON	ON	ON	port 3 device fault
ON	OFF	ON	ON	port 2 device fault
ON	ON	OFF	ON	port 1 device fault
ON	OFF	OFF	ON	port 0 device fault
ON	OFF	ON	OFF	undefined
ON	ON	OFF	OFF	undefined
ON	OFF	OFF	OFF	undefined
OFF	OFF	OFF	OFF	communication failure or executive checksum error
OFF	OFF	ON*	OFF	communication test 1 failure
OFF	ON	OFF	OFF	communication test 2 failure
OFF	OFF	OFF	ON	I/O interface failure
OFF	ON	ON	OFF	watchdog test failure
OFF	OFF	ON	ON	internal RAM failure (8031)
OFF	ON	OFF	ON	external RAM failure
OFF	ON	ON	ON	watchdog timeout

* Note: before communication to this node is established, the receive LED will blink as WRU messages to other nodes are received.

Operation of Ready Relay

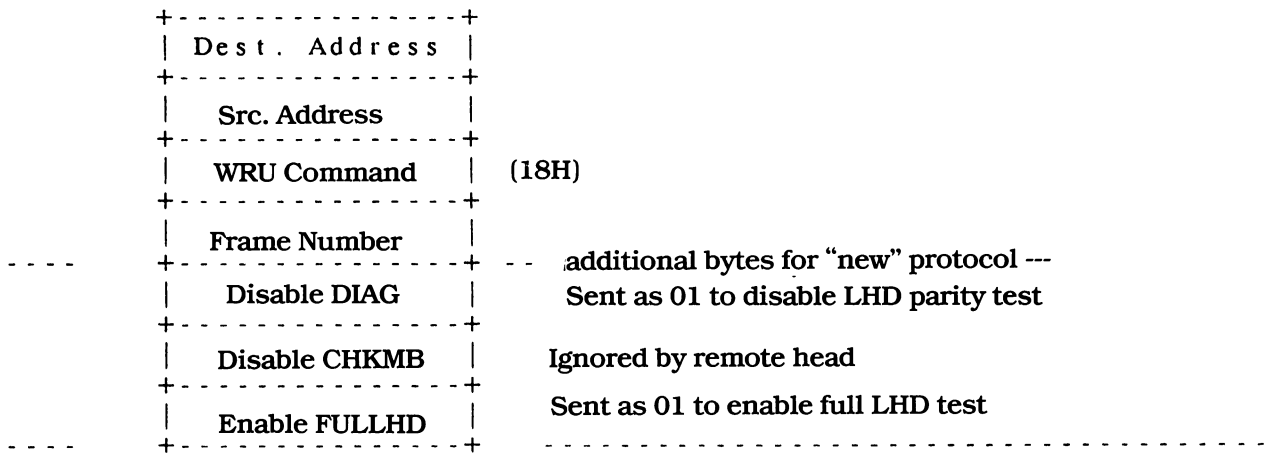
After a successful power up, completing all diagnostics tests, the watchdog timer is started, and the communication relay is closed, allowing the remote head to receive messages over the network. After receiving a valid message addressed to this drop, the ready relay is energized closing the normally open contact. After receiving this first message, several communication timers are started. These timers will time out after communication stops as follows:

100 ms after losing all communication, the ready relay is opened.

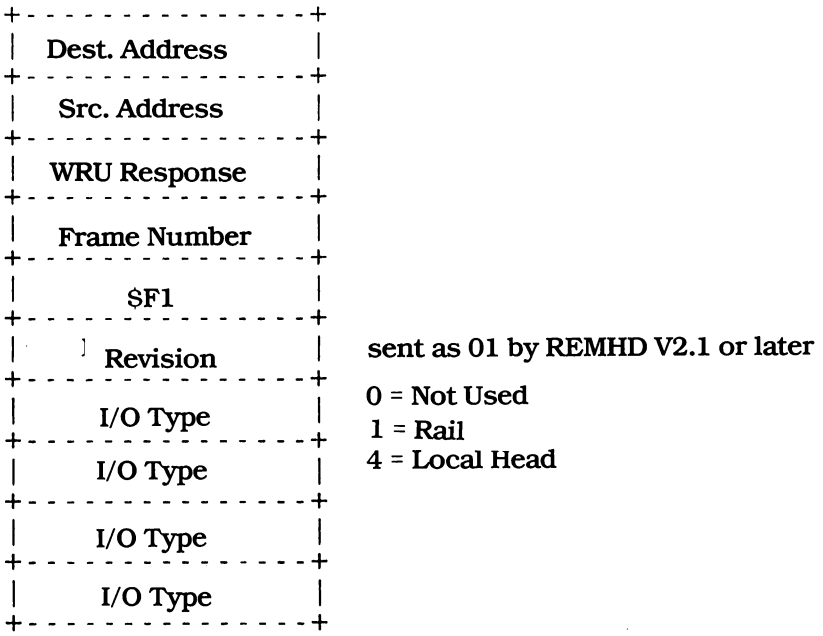
1500 ms after losing communication addressed to this drop, the ready relay is opened, and the communication tests are repeated. After the ready relay is opened, communication addressed to this drop must be received in order to close the relay again.

WHO ARE YOU MESSAGE FORMAT

Command From Master

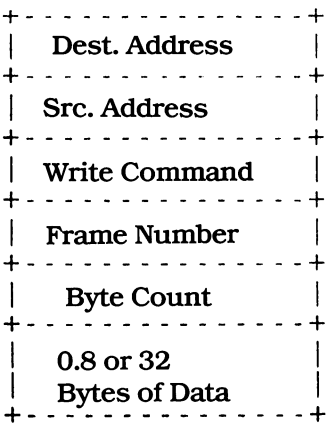


Response From Slave

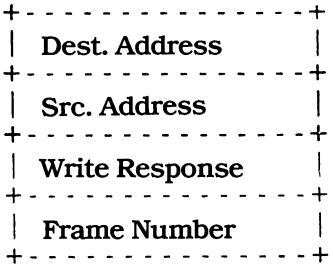


WRITE DATA MESSAGE FORMAT

Command From Master



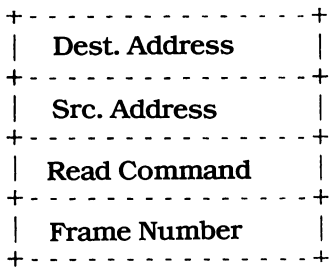
Response From Slave



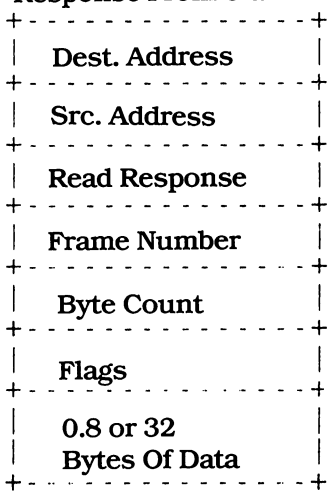
Slave will not send response to write command if using new protocol.

READ DATA MESSAGE FORMAT

Command From Master



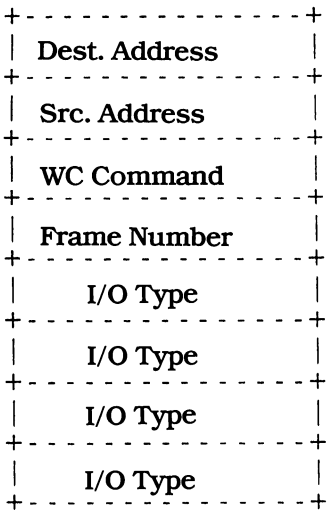
Response From Slave



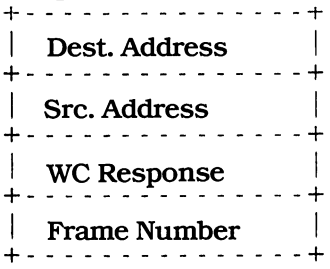
Bit 6: Config changed
Bit 3-0: Error Bits

WRITE CONFIGURATION COMMAND MESSAGE FORMAT

Command From Master

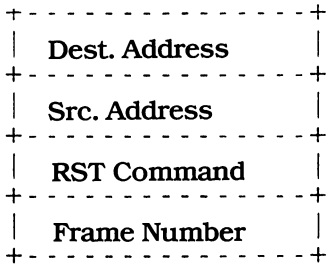


Response From Slave



RESET I/O COMMAND MESSAGE FORMAT

Command From Master



Response From Slave - none

RELIANCE CONTROLS
DOCUMENTATION IMPROVEMENT FORM

Document Number: _____

Page Number(s): _____

Comments: *(Please give chapters, page numbers or specific paragraphs that the change will affect. Include markeups from the document or attach additional pages if necessary.)*

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

What will this improvement suggestion provide? _____

_____

_____

Originator: _____ City: _____ State: _____ ZIP: _____

Company: _____ Phone: (____) _____

Address: _____ Date: _____

Technical Writing Internal Use:	**Follow-Up Action:**
Writer: _____	Date: _____

Thank you for your comments . . .

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RELIANCE ELECTRIC

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