9154 Line Controller

System Manual

A CrossBar Network Product

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Information and specifications in this manual are subject to change without notice.

INTERMEC Part No. 048517 Version C

INTERMEC®

Solutions for Data Collection

Federal Communications Commission Radio Frequency Interference Statement

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Note: In order to meet Class A emission limits, the I/O cables that interconnect between the device and any peripheral (such as a printer, external modem, etc.) must be shielded.

WARRANTY INFORMATION

INTERMEC Corporation offers its customers a choice of warranty options. To receive a copy of the standard warranty provision for this product, contact your local INTERMEC sales organization and request the information. Refer to the Authorized Service Locations list which was shipped with this manual for the address and telephone number.

Upon request, customers who are residents of the USA and Puerto Rico will receive the INTERMEC Corporation Supplemental Statement of Warranty (Form 603876); customers residing outside the USA will receive a Statement of Warranty prepared and supported by their local INTERMEC distributor.

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SECTION 1

HOW TO USE THIS MANUAL

INTRODUCTION TO THE 9154 MULTI-DROP LINE CONTROLLER SYSTEM MANUAL

MANUAL AUDIENCE

USING THIS MANUAL EFFECTIVELY

RELATED INTERMEC MANUALS

WARRANTY INFORMATION

SAFETY SUMMARY
- General Safety Guidelines
- Warnings and Cautions

DOCUMENTATION CONVENTIONS
- Terminology
- Keystroke Definitions

INTRODUCTION TO THE 9154 MULTI-DROP LINE CONTROLLER SYSTEM MANUAL

The 9154 Multi-Drop Line Controller System Manual covers setup, operation, and troubleshooting for the 9154 Multi-Drop Line Controller. System design information and cabling requirements for a CrossBar™ system based on the 9154 controller are provided. For information about readers, printers, and host computer operation, see the Operator's manual for the specific component. A list of manuals for INTERMEC® devices compatible with the controller is contained in this section.

The scope of this manual is limited to hardware features, general operation, hardware installation, configuration, system programming and data communication, troubleshooting, and general maintenance. Information about the internal operation of the controller or instruction on how to repair the unit is not covered.

Throughout this manual, the 9154 Multi-Drop Line Controller will be called the controller and INTERMEC products which support Multi-Drop protocol will be called devices. For a complete list of documentation conventions, see "Terminology" in this section.

MANUAL AUDIENCE

The 9154 Multi-Drop Line Controller System Manual is written for systems programmers and operators who are knowledgeable in data communication methods and protocol. If you need a review of data communication you can find additional information in the INTERMEC Data Communications Manual, Part No. 044737.

Systems programmers and operators using this manual should be familiar with considerations and procedures for installing computer and data communications equipment with RS-232, RS- 422/485, and 4-wire RS-485 communication hardware.

Operators of the readers and printers attached to the controller will not need to be familiar with the operation of the 9154 Controller. To the device operator, the controller is an invisible part of the interface between their printer/reader and the host.

USING THIS MANUAL EFFECTIVELY

Information in the 9154 System Manual is organized in a series of functional units. To effectively use this manual, you should become familiar with how the manual is organized. Table 1-1 shows the organization of the functional units.

Table 1-1
How To Use This Manual Effectively

Section:	Title:	Information:
1	How to Use this Manual	Understand how the manual is organized.
2	Introduction to the 9154	Familiarize yourself with the
3	Designing a 9154 System	9154 Multi-Drop Line Controller and design the system layout.
4	Installing Hardware	Install the 9154 system and
5	Configuring the Controller	make sure it is running
6	Configuring Polled Devices	properly.
7	Host to 9154 Communication	Refer to specific
8	CRT Control of 9154 Communication	communication information as needed.
9	Power Failure and Recovery	Refer to information
10	Troubleshooting	periodically as problems arise
11	Maintenance	and as maintenance is required.

Start by reading Sections 1, "How to Use this Manual," and 2, "Introducing the 9154." Section 1 explains what this manual covers, how it is organized, and provides important warnings about the operation of the 9154 system. Section 2 gives an overview of what the controller does and introduces its specific hardware controls and interfaces.

For information on installing the system, see Section 3, "Designing a 9154 System," Section 4, "Installing Hardware," Section 5, "Configuring the Controller," and Section 6, "Configuring Polled Devices." Section 3 provides background information about how to design a controller-based system. Section 4 provides step-by-step procedures for physically installing the controller and cabling. Section 5 explains how to configure the controller.

Section 6, "Configuring Polled Devices," lists the requirements for configuring the polled devices to operate with the controller and Multi-Drop Protocol. Specific reader manuals will explain the details of how to implement those requirements. After completing Sections 3 through 6, the controller system should be installed and operational.

Section 7, "Host to 9154 Communication," and Section 8, "CRT Control of 9154 Communication," provide reference information on host communication and Supervisory CRT operation. Section 7 covers host to controller data communication in detail. Specific questions about types of data communication, such as unsolicited transmit and solicited receive, are answered here. Section 8 covers all the functions that can be performed by the Supervisory CRT, such as configuring interface parameters for host communication.

For information about problems that may develop during operation, see Section 9, "Power Failure and Recovery," Section 10, "Troubleshooting," and Section 11, "Maintenance." Section 9 describes what happens when the controller experiences a power interrupt. Section 10 explains how to isolate problems in the controller system and it includes instructions for using the Supervisory CRT to find data communication problems. Section 11 provides maintenance instructions to keep the controller operating trouble-free.

The Appendices contain equipment specifications, the factory default configuration parameter values for the controller, and the list of ASCII command characters. The Glossary defines terminology used in this manual and the index provides a quick reference to topics and concepts covered in this manual.

RELATED INTERMEC MANUALS

The following manuals offer additional information about equipment that may be used in a 9154 controller-based system.

Manual:	INTERMEC Part No.:
Systems Manuals	
9510 Online Reader System Manual	046854
9511 Online Reader System Manual *	047247
9512 Online Reader System Manual *	046156
9540 Bar Code Terminal System Manual *	048538
9550 Transaction Manager System Manual *	048539
8630-Series Operator's Guide, Installation Guide, and Programmer's Manual	046065
8640-Series Thermal TransferPrinter System Manual	048834
Quick Reference Cards	
9510 Online Reader Quick Reference Card	046853
9511/9512 Online Reader Quick Reference Card	047463
1700 Digital Keyboard Quick Reference Card	047234
9191 Satellite Wand Station Quick Reference Card	047249
9540/9550 Online Reader Quick Reference Card	048540
Other Manuals	
Data Communications Manual	044737
IRL 2.1 Programming Reference Manual	048609

* includes: 1700 Digital Keyboard Guide and 9191 Digital Satellite Wand Station Guide

WARRANTY INFORMATION

INTERMEC Corporation offers its customers a choice of warranty options. To receive a copy of the standard warranty provision for this product, contact your local INTERMEC sales organization and request the information. Refer to the Authorized Service Locations list which was shipped with this manual for the address and telephone number.

Upon request, customers who are residents of the USA and Puerto Rico will receive the INTERMEC Corporation Supplemental Statement of Warranty (Form 603876); customers residing outside the USA will receive a Statement of Warranty prepared and supported by their local INTERMEC distributor.

Please complete and return the Reader Reply Card which is located at the front of this manual. No postage is necessary if it is mailed within the United States.

SAFETY SUMMARY

General Safety Guidelines

WARNING

Only trained and authorized technicians or operators should work on energized electrical equipment. Improper repair methods could result in injury or death.

The safety of persons handling or operating INTERMEC equipment is extremely important. Warning and cautions necessary for safe handling and operation are included within the various sections of this manual. You should read all warnings and cautions in this manual before handling or operating INTERMEC equipment.

Do Not Repair Or Adjust Alone: Do not under any circumstance repair or adjust energized equipment alone. The immediate presence of someone capable of rendering aid is essential for operator safety.

First Aid: An injury, no matter how slight, should never be neglected. Always obtain first aid or medical attention immediately after incurring an injury.

Resuscitation: Persons working on or near high voltage should be familiar with approved industrial first aid methods. If someone is injured and stops breathing, initiate resuscitation immediately. A delay could result in the victim's death.

Energized Equipment: Energized electrical equipment is dangerous. Electrical shock from energized equipment can cause death. Never work on energized equipment unless authorized to do so by a responsible authority. If emergency work on energized equipment is authorized, be sure that it is accomplished in strict compliance with approved safety regulations.

Warning and Cautions

The specific warnings and cautions printed on the following pages appear within the text elsewhere in this manual. They are reprinted here for emphasis. Each warning and caution is referenced to the section in which it appears.

A WARNING is an operating procedure, practice, condition, or statement which, if not strictly observed, could result in injury or death to persons handling the equipment.

A CAUTION is an operating procedure, practice, condition, or statement which, if not strictly observed, could result in damage to or destruction of equipment, or subsequent loss of equipment effectiveness.

Section 1

WARNING

Only trained and authorized technicians or operators should work on energized electrical equipment. Improper repair methods could result in injury or death.

Section 2

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power-up.

Section 3

CAUTION

Interconnecting cables that run too close to other electrical equipment or cables of extreme length can cause internal physical damage or hinder performance of your equipment. The lay out of the installed cable should be engineered to ensure that the noise and ground potential values are kept within specification.

WARNING

The grounding conductor should not be attached to steam or hot water pipes, lightning-rod conductors, or pipe or rod service electrodes that are not part of a multiground neutral power circuit.

Section 4

CAUTION

The system must be grounded and the controller grounding stud must be connected to an earth ground. Failure to connect the unit to an earth ground could result in loss of system data integrity and the possible physical deterioration of the controller due to ESD or lightning.

WARNING

Before connecting the power supply, ensure that the controller Power pushbutton is in the off position. Failure to do so could cause injury due to electrical shock.

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power-up.

CAUTION

The signal levels between the controller and both the host computer and Supervisory CRT must be as specified within supported EIA standard. If other signal levels are used, the controller, Supervisory CRT, and host computer could be damaged.

Section 5

CAUTION

In most cases, two communication parameters can not be defined as the same value or communication will be impossible. For example, if the SOM and EOM characters are BOTH defined as ETX (03H), the host and the controller will be unable to communicate. The controller will not know whether or not ETX indicates the beginning or the end of a message.

Section 6

CAUTION

All devices must be set to the same baud rate as the controller. If all the devices are not operating at the same baud rate, data communication problems will result.

Section 8

CAUTION

In most cases, two communication parameters can not be defined as the same value or communication will be impossible. For example, if the SOM and EOM characters are BOTH defined as ETX (03H), the host and the controller will be unable to communicate.

Section 9

CAUTION

Do not interrupt power to the controller for more than two weeks, if the controller contains valuable data. A power interrupt exceeding two weeks may result in the loss of data as the NiCad battery runs down and becomes unable to protect data.

CAUTION

After the controller's battery is depleted to the extent it is unable to back up RAM, charge the battery before interrupting AC power. If the battery is not allowed to recharge, data stored in RAM could be lost during an extended power interrupt.

Section 11

WARNING

Only trained and authorized technicians or operators should work on energized electrical equipment. Improper repair methods could result in injury or death.

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power-up.

WARNING

Do not incinerate, crush, or puncture batteries. The electrolyte contained in NiCad batteries is composed of caustic materials that are harmful to eyes and skin.

WARNING

Do not short-circuit the battery. Burns may result. Short circuits can occur if a battery is placed on a metal shelf, if metal tools are used, or if the battery is placed in a pocket containing coins or keys.

DOCUMENTATION CONVENTIONS

Terminology

Throughout this manual, the 9154 Multi-Drop Line Controller is referred to as the controller or the 9154.

The word device, when used alone, refers to a data collection device (reader or printer), not an input device (wand, satellite wand station, or laser scanner) that scans bar code information into the data collection device.

The words device and polled device are used interchangeably. All devices mentioned in this manual support INTERMEC Multi-Drop protocol, so they may also be called Multi-Drop Devices.

The word plug refers to the male part of a connector, and the work socket refers to the female part of a connector.

All the plugs and sockets referred to in this manual, both 9-Pin and 25-Pin, are "D"-Style, sub-miniature connectors. Thus, 9-Pin socket, and 9-Pin, "D"-Style, sub-miniature socket are used interchangeably.

Keystroke Definitions

Letters enclosed in square brackets [ ] refer to a single key on the terminal keyboard. When two or more sets of square brackets are used, it means to press those keys simultaneously. For example, [CNTL] [P] means to press the control key and the letter "P" key at the same time. If there is a comma between the keys, press the keys individually in serial fashion. For example, [1], [0] means to press the number key "1", and then press the number key "0." Keyboard entries that require more than one keystroke may be enclose in quotation marks. For example, "4800" means to press the [4], [8], [0], [0] keys in sequence.

Depending on the type of keyboard, the name of certain keys may differ. This manual refers to the following keys:

Key:	What It Means:
[CR]	RETURN. This key may be labeled RETURN, RET, ENTER, or an ALT 191.
[ESC]	ESCAPE. This key may be labeled ESC, Esc, or Escape.
[CNTL]	CONTROL. This key may be labeled CTRL, ctrl, or Control.
[BKSP]	Backspace. This key may be labeled Backspace, BACKSPACE, or an ALT 191.
[DEL]	Delete. This key may be labeled, Rub, Del, or del.

SECTION 2

INTRODUCTION TO THE 9154

INTRODUCTION

LOCATING CONTROLLER COMPONENTS
- Front Panel
- Rear Panel
- Status and Power Lights

CONTROLLER FEATURES
- Controller Internal Features
- Controller External Features
- Controller Supervisory CRT Interface Features
- Controller Host Interface Features
- Controller Polled Device Interface Features

A SAMPLE 9154 SYSTEM

INTRODUCTION

The 9154 Multi-Drop Line Controller manages the flow of information between a host computer and up to 32 INTERMEC Bar Code Readers and Printers. The controller's buffering capability allows the host computer to perform other tasks in addition to serving the data collection network. Figure 2-1 shows the controller unit as it comes from INTERMEC, with its packaging removed.

Using a Supervisory CRT, you can configure the controller to operate with a wide variety of host computer requirements for communication protocol, including unsolicited or solicited data transmission. You can change data communication protocol parameter values from the default values as needed to satisfy user requirements.

The controller supports RS-232 and RS-422/RS-485 Communication standards as hardware interfaces to the host. 20 mA Current Loop standard can be supported with an external adapter.

Up to thirty-two readers or printers may be connected to the controller using a single 4-wire RS-485 Multi-Drop main trunk cable connected to the controller's Multi-Drop port. Over eight different models of INTERMEC readers and printers are supported.

Although the controller is built to withstand constant use in an industrial environment and requires little maintenance, it can be damaged by improper use. To avoid problems, read this manual carefully.

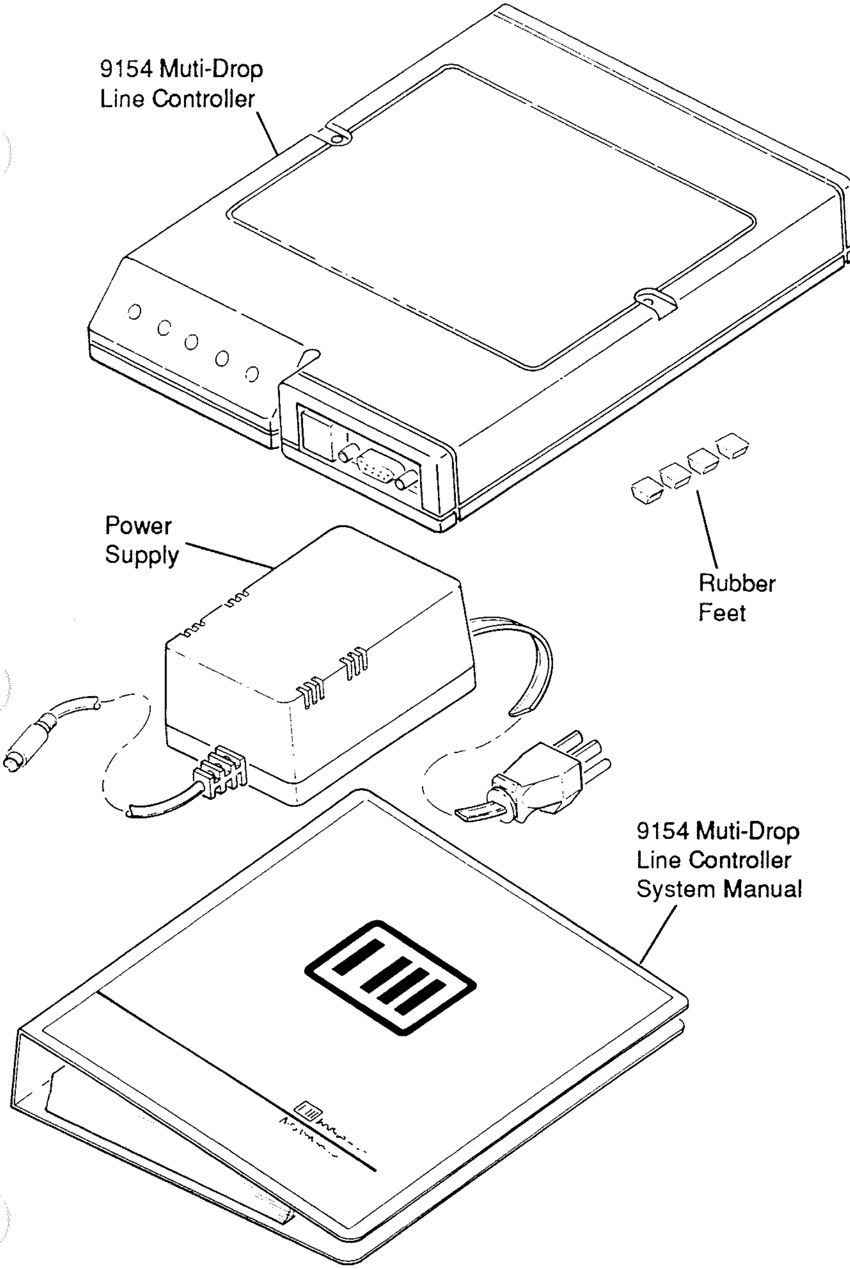


Figure 2-1
9154 Multi-Drop Line Controller

LOCATING CONTROLLER COMPONENTS

Both the front and rear panel of the controller contain connectors for connecting other system components. The front panel also contains one power and four status indicator lights. For the location of individual controls, see Figure 2-2 for the front panel and 2-3 for the rear panel. Information on using the controls and connectors to perform specific tasks appears as required throughout this manual.

Front Panel

In order from left to right, the front panel contains the five lights, the Power pushbutton, and the CRT connector. The front panel is illustrated in Figure 2-2. Mounting holes are located on the sides of the controller.

Status and Power Lights: The lights show the condition of various system functions and also highlight system problems by blinking. An explanation of how to use each of the status lights appears in the next sub-section, "Status Lights."

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power-up.

Power Pushbutton: Pushing the Power pushbutton in and out turns the controller on and off by controlling the power received from the power supply. When the Power Pushbutton is out, the controller will not operate. Once in operation, never remove the controller power supply before its power has been turned off. The internal battery only provides backup power for memory and the real time clock operation.

CRT Connector (9-Pin, "D" Style, sub-miniature socket): The CRT connection connects the controller to the Supervisory CRT with an RS-232 interface. You will need adapter cable which makes the 9-Pin to 25-Pin connection, such as INTERMEC Part No. 041789S. Section 4, "Installing Hardware," explains how to connect a Supervisory CRT to the controller.

Mounting Holes: Using the mounting holes, the controller can be mounted to a wall or other flat surface, either horizontal, vertical, or somewhere in between. The mounting holes are on either side of the controller and extend completely through the controller body. The two mounting holes do not have to be used. Section 4, "Installing Hardware," demonstrates how to mount the controller.

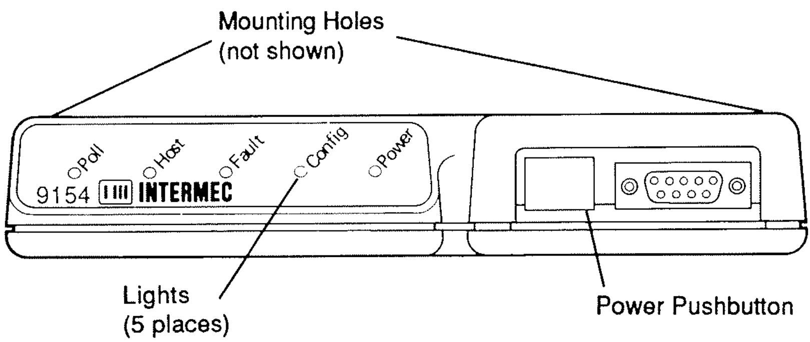


Figure 2-2
Front Panel

Rear Panel

In order from left to right, the rear panel contains connectors to the power supply, host, and polled devices, as well as the grounding stud. The rear panel is illustrated in Figure 2-3.

Power Supply Connector: The power supply connector connects the INTERMEC-supplied power supply to the controller. The controller does not directly connect to an AC power source. Section 4, "Installing Hardware," explains how to connect the power supply to the controller and a usable AC power source.

Host Connector (25-Pin, "D" Style, sub-miniature socket): The host connector connects the host computer to the controller with an RS-232 or RS-422/RS-485 interface. Current Loop is supported using an external adapter and the RS-232 interface. INTERMEC Technical Centers (ITCs) can provide a list of suggested manufacturers and ordering instructions for Current Loop adapters. Section 3, "Designing a 9154 System," explains how to choose an appropriate hardware interface for your work environment, and Section 4, "Installing Hardware," gives guidelines for installing the interfaces.

Polled Device Connector (9-Pin, "D" Style, sub-miniature socket): The device connector connects the 4-wire RS-485 Multi-Drop cabling from the polled devices to the controller. One main trunk cable is supported by the controller, but up to 32 devices can be connected to the main trunk cable. Section 3, "Designing a 9154 System," explains how to design a Multi-Drop cabling system, and Section 4, "Installing Hardware," explains how to install one.

Grounding Stud: The grounding stud is used to connect the controller to a building or earth ground. The controller must be connected to a ground for proper operation. Section 3, "Designing a 9154 System," explains how to select the best ground, and Section 4, "Installing Hardware," explains how to connect a ground cable to the controller.

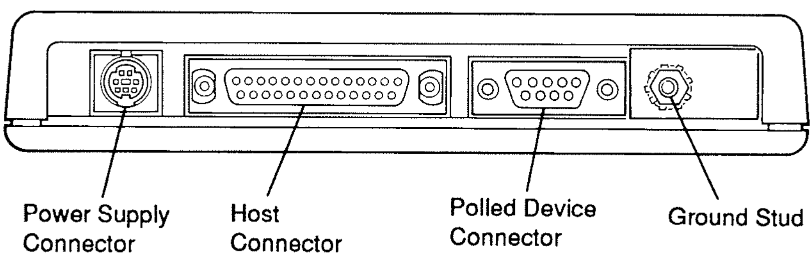


Figure 2-3
Rear Panel

Status and Power Lights

The five lights on the front panel indicate various system conditions. There are four status lights and one power light. Section 10, "Troubleshooting," explains how the status lights, when blinking, can also be used for diagnosing controller problems. Figure 2-4 shows the front panel location of each light. A description of each light follows.

In order from left to right:

Lights:	Turns on when:
1 Poll (Status)	A polled device and the controller are communicating.
2 Host (Status)	The host and the controller are communicating.
3 Fault (Status)	A communication error is detected in the host or polled device protocol. The Fault light will blink if the power up RAM test fails.
4 Config (Status)	The user has entered a Supervisory CRT screen that allows configuration parameters to be modified. The Config light will blink if a EEPROM hardware failure occurs.
5 Power	Controller power is on.

All four status lights (Poll, Host, Fault, and Config) blink if the ROM test fails.

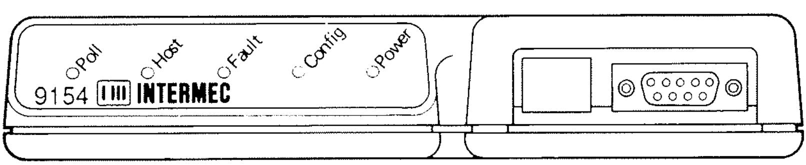


Figure 2-4
Status and Power Lights

CONTROLLER FEATURES

An overview of the 9154 Controller features follows. In later sections of the manual, as the information is required for using the controller effectively, each feature is explained in greater detail.

Controller Internal Features

The controller has the following internal features which help it function smoothly and self-sufficiently.

- An internal battery protects data in the controller's memory for up to two weeks in case of power failure. If a protected firmware routine is executing when power is interrupted, that routine will be completed when power is restored.

- Buffering capability allows polled device data to be stored while the host computer is performing other processing.

- Transient Voltage Suppression on the Supervisory CRT, Multi-Drop, and host hardware interfaces protect against electrostatic discharge (ESD).

- A configurable real time clock can append the time to data coming into the controller from the polled devices or broadcast the time to the readers.

Controller External Features

The controller has several external features that help make it easy to operate.

- Status lights indicate system conditions and assist in troubleshooting system problems.

- A grounding stud allows connection of the controller to an earth ground to provide convenient system grounding and lightning protection.

Controller Supervisory CRT Interface Features

The use of a Supervisory CRT simplifies configuration of the controller.

- A 9-Pin connector on the front of the controller allows attachment of a Supervisory CRT terminal. Once the controller system is set up, the Supervisory CRT can be used to view the system's operation, or it can be removed and used elsewhere.

- Automatic baud rate detection sequence for the Supervisory CRT port simplifies interfacing various CRT types to the controller. The following standard CRT types are supported:

  IBM 3101
  DEC VT100
  ADM 3/5
  Televideo
  ADM 31/32/42
  Hazeltine

The controller's CRT interface parameters can be easily configured to support other CRTs.

- The Supervisory CRT interface facilitates troubleshooting system problems. Supervisory CRT screens can display error messages as well as data in the polled device buffer, and can also be used to send messages to polled devices.

Controller Host Interface Features

The controller's host interface has the following features that make the controller adaptable to a wide range of host communication protocols. The controller's host interface can be customized to meet specific host requirements.

- Host-to-controller communication protocol can be modified from the default parameter values. Both solicited or Unsolicited protocol are selectable.
- High speed data transmission can occur at up to 19200 baud between the host computer and the controller.
- True XON/XOFF handshake capability for both receiving and transmitting data to the host allow unsolicited communication protocols to be used effectively.
- The controller can be connected with the host computer using an RS-232, RS-422/485, or an optional 20 mA Current Loop adapter connected to the RS-232 interface.
- A transparency check can be enabled on the controller-to- host communication data link so that communication protocol parameters may be sent as data.
- Device specific polling by the host is supported to simplify requesting the status of INTERMEC printers.

Controller Polled Device Interface Features

The controller's polled device interface, with its Multi-Drop port, has the following features that support a wide range of user device layouts.

- The Multi-Drop channel is capable of supporting up to 32 readers and printers. You can connect up to ten satellite wand stations to each reader in a daisy chain stretching up to 150 feet in length. Using a drop line configuration, the ten satellite wand stations can extend over a distance of up to 500 feet.

- The controller is upwardly compatible with the INTERMEC 9161 02 Multi-Drop Concentrator. The controller can work with over eight different models of INTERMEC readers and printers in a CrossBar network, including the following:

Devices:	Comments:
Readers:	
INTERMEC 9440	(Requires 9440 Communication dock)
INTERMEC 9510	
INTERMEC 9511	
INTERMEC 9512	
INTERMEC 9540	
INTERMEC 9550	
Printers:	
INTERMEC 863X-Series	
INTERMEC 864X-Series	

- High speed data transmission between the controller and the polled devices can occur at up to 19200 baud.

A SAMPLE 9154 SYSTEM

The 9154 Controller is a controller for the CrossBar system a group of INTERMEC components designed to work within existing data processing environments. CrossBar components can be used together to satisfy a wide variety of data collection and data processing needs. CrossBar networks are composed of three types of components:

1. A Controller or Port Concentrator
2. Various Bar Code Printers and Bar Code Readers
3. Input Devices

The controller or concentrator controls the data traffic between polled devices (readers and printers) and the host computer. Bar code printers print bar code labels. Bar code readers decode data from bar code labels and transmit it to the controller or port concentrator. Input devices scan the bar code labels and pass that information to the reader to be interpreted. Input devices include laser scanners, keyboards, satellite wand stations, and wands.

Figure 2-5 illustrates an example of a 9154 Controller-based CrossBar network used as a manufacturing control system. Moving outward from the controller along the Multi-Drop cable, and then clockwise around the system, the components are as follows.

- A printer is used in the Receiving Department to mark incoming parts with bar code labels. A reader with a wand is used to track incoming parts inventory.
- In stores, a reader equipped with a laser scanner and keyboard is used to track inventory of both parts and finished products.
- On the shop floor, assembly line workers use satellite wand stations to record what job was done, who performed the job, and when it was performed. Six satellite stations are connected to the reader.
- A reader with a slot scanner for reading badges is used by employees to record their starting and ending times.
- The host computer in the office is connected directly to the 9154 Controller using an appropriate hardware interface. The controller provides real time data from the devices to the host.
- The INTERMEC-supplied power supply transforms AC power to DC power levels required by the controller.
- A Supervisory CRT, used to configure the original system, is reconnected to troubleshoot problems or change operating parameters as needed.
- The 9154 Controller monitors all the communication between the host and the five devices. The entire system of polled devices is connected by Multi-Drop cabling. Using the controller as an interface, the host can work with the four readers and the printer using only one of its communication ports.

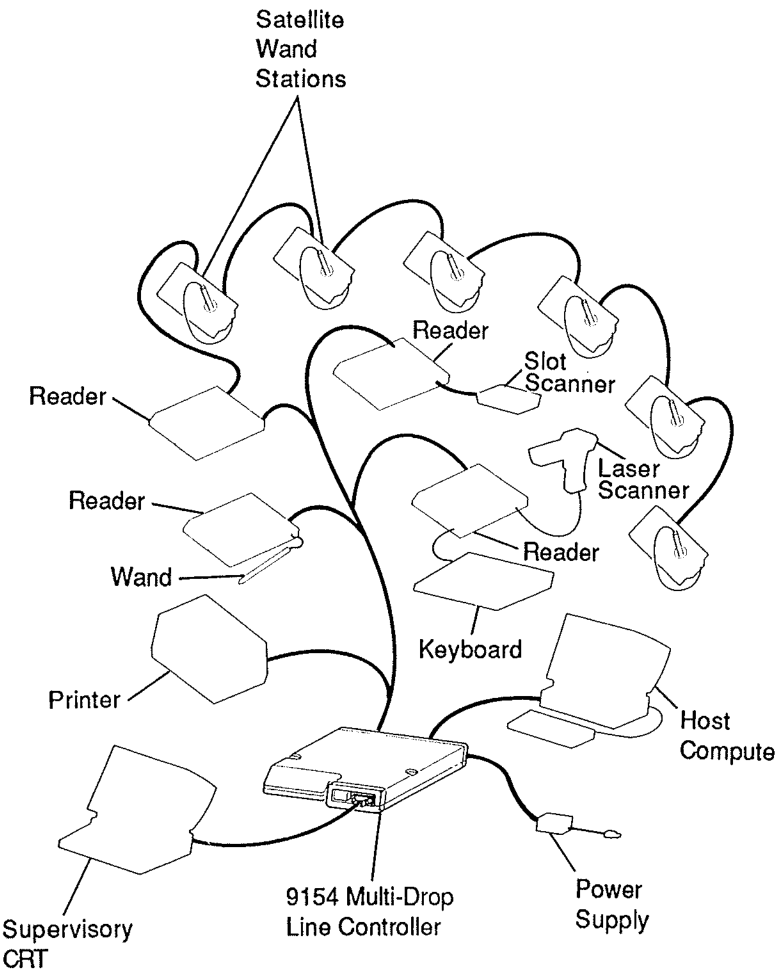


Figure 2-5
A Typical 9154 Controller Configuration

SECTION 3

DESIGNING A 9154 SYSTEM

DESIGN CONSIDERATIONS

PLANNING THE PHYSICAL LAYOUT
- Installation Plan
- Installation Guidelines
- Laying Multi-Drop Cabling
- Test System

SELECTING A COMMUNICATION INTERFACE BETWEEN THE HOST AND 9154
- Available Interfaces
- Comparing RS-232 and RS-422/485
- Data Line Considerations

GROUNDING CONSIDERATIONS
- Communication Interfaces and Grounding
- Grounding Conductor
- Making a Good Ground Connection
- Grounding Long Data Lines

LIGHTNING PROTECTION

THROUGHPUT AND RESPONSE TIME ANALYSIS
- Introduction
- Calculating the Response Time
- Deriving Cycle Times

CONFIGURATION PREPARATION
- Data Communication Considerations
- Configuration Parameters

DESIGN CONSIDERATIONS

This section contains general instructions for planning the installation of a CrossBar system based on the 9154 Controller. It addresses the physical installation and some aspects of the configuration of the controller firmware. Good initial planning prevents future operational problems. A system not meeting the guidelines and requirements outlined in this section is not guaranteed to work properly.

PLANNING THE PHYSICAL LAYOUT

Installation Plan

To plan your system installation, determine which locations will be serviced, how many stations are required, and what other equipment will be interfaced with the 9154 Controller. It is a good idea to review your requirements with a staff member of your company's facility maintenance department.

As part of the planning process, include a scale floor plan layout such as the one shown in Figure 3-1. List the required equipment in the layout and show the locations where equipment is to be installed. After making a scale layout, check the layout against the physical installation requirements listed in the next section, "Installation Guidelines," to ensure the system will work correctly.

Figure 3-1 illustrates the scale layout for the sample controller-based system shown in Figure 2-5. Note the distances marked on the layout. They can be used to check the total length of the Multi-Drop line, and to estimate the location of the Multi-Drop devices to ensure that the drop segments are kept to a maximum of 30 feet in length.

Many trade-offs in cable length and interfaces occur in designing a system. For example, to minimize the length of the main trunk cable, the controller may be located closer to the devices. A shorter main trunk line, however, may result in a longer cable connection between the controller and the host computer. A greater length of cable is susceptible to interference introduced by electrical machinery. To reduce interference, an RS-422/485 interface may be required rather than the RS-232 interface.

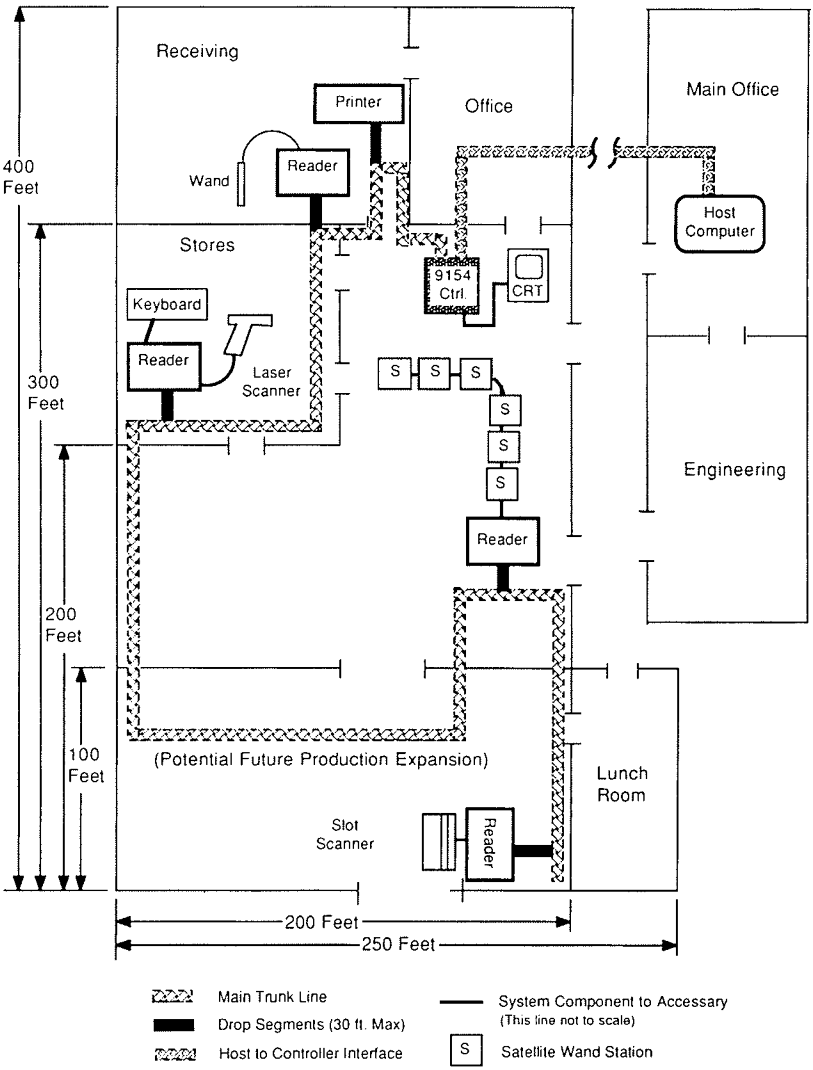


Figure 3-1
Installation Floor Plan

Installation Guidelines

Plan the layout of the system with the following guidelines in mind.

The Multi-Drop line connecting the devices must meet the following requirements. Figure 3-2 illustrates these requirements.

- The maximum length of the main trunk cable should not exceed 2000 feet.
- The maximum drop length from the main trunk cable to a device should not exceed 30 feet.
- The drop sites must be at least two feet apart.
- The polled devices connected to any one controller should all be located in the same building.

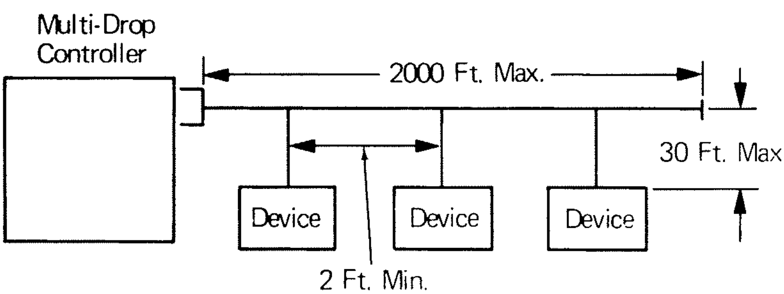


Figure 3-2
Minimum and Maximum Cable Lengths

The distance between the host and the controller is one of the factors effecting the choice of communication interface to use. The distance can be up to 4000 feet with an RS-422/485 interface and even longer lengths may be used with a RS-232 interface operating into a modem.

CAUTION

Interconnecting cables that run too close to other electrical equipment or using cables of extreme length can cause internal physical damage or hinder the performance of your equipment. The layout of the installed cable should be engineered to ensure that the noise and ground potential values are kept within specification.

To minimize electrical interference, avoid areas where cables and equipment will be located near other large electrical power equipment (for example, large motors, welders, motor controllers, and switching gear).

The building in which the system is to be installed must be provide a good earth ground to which the controller can be connected.

If the quality of the AC power source is questionable, surge protection is advised.

A maximum of 32 polled devices may be hooked up to the Multi-Drop line. However, since ten satellite wand stations can be connected to one reader, and each reader counts as one device, you can connect a much larger array of bar code equipment to the controller. In general, a device is something that can be reading all the time. For example, 10 satellite wand stations can be connected in a daisy chain to a reader, but at any given moment only one wand station may be scanning bar code.

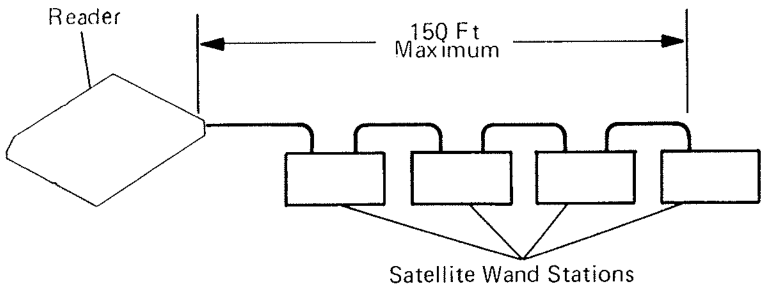
Satellite Wand Stations: The satellite wand stations themselves can be arranged in two configurations according to your needs. Figure 3-3 illustrates both the daisy chain and drop line layouts. For more detailed information about connecting satellite wand stations to your reader, see the appropriate INTERMEC reader manual.

Daisy Chain: If the satellite wand stations are strung together in a daisy chain, the cable length from the reader to the last satellite station can be a maximum distance of 150 feet. You can place up to ten satellite wand stations can be placed anywhere within the 150 feet of length. Figure 3-3 a) illustrates the daisy chain configuration.

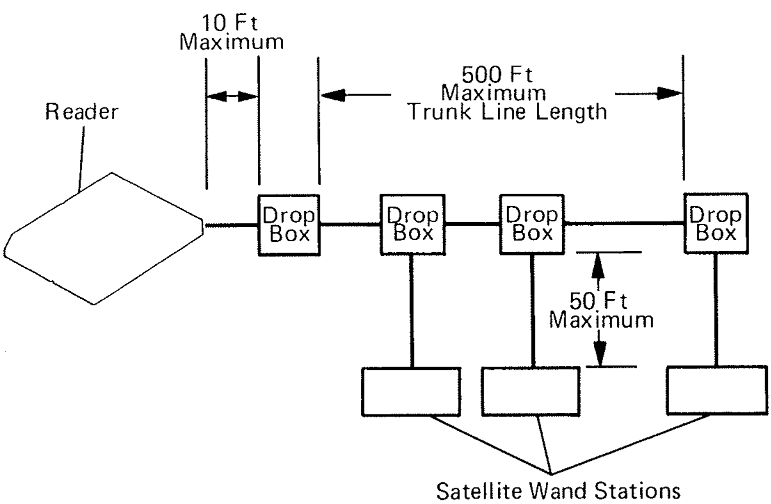
Drop Line: If a drop line is used, connect the 10 satellite wand stations to drop boxes which are placed in the drop line. Figure 3-3 b) illustrates the drop line configuration. You must meet the following layout for a drop line:

- The cable distance from the reader to the first drop box can be a maximum of 10 feet. A satellite wand station may not be connected to the first drop box.
- The entire length of the drop line, from the first drop box to the last drop box, may not exceed 500 feet.
- The maximum cable length from a drop box to a satellite wand station is 50 feet.
- Do not daisy chain together satellite wand stations off a drop box.

Available INTERMEC cables for making satellite wand station interconnections are listed in the Satellite Wand Station section of your reader manual.



a) Daisy Chain Configuration



b) Drop Line Configuration

Figure 3-3
Satellite Wand Station

Laying Multi-Drop Cabling

The two methods of installing the Multi-Drop cabling are:

1. Install the main trunk cable section-by-section. Lay a section of main trunk cable to the first device location. Add a drop cable, then add another piece of trunk cable to reach the next drop site, and so on.

2. Install the entire length of main trunk cable. Splice in drop cables at the appropriate locations, as required.

The choice of installation method is a matter of personal preference, but the second method, laying the entire length of main trunk cable, can be the quickest and easiest for new construction.

The Multi-Drop wiring is very flexible. You can add new sections of main trunk cable to the middle of an existing main trunk cable or to the end, provided the entire length does not exceed 2000 feet. The same flexibility applies to drop cables. You can cut the trunk cable anywhere and insert a new drop cable, provided that it is at least two feet to the nearest drop site.

Test System

If you are unfamiliar with Multi-Drop cabling, or CrossBar systems in general, consider setting up a test system before building an entire layout. The test system would familiarize you with the data communication interfaces and the wiring requirements of the Multi-Drop line. INTERMEC cables are available to aid in building a Multi-Drop test system.

To build a test system, you will need the following:

- One reader a with bar code scanner compatible with the controller
- Supervisory CRT
- 9154 Controller
- Host Computer or a second CRT

Note: Using a CRT instead of a host computer allows you to test the host communication interface without having a host computer application program.

The following cabling is required:

- A short null modem cable to connect the controller to the host computer or CRT, INTERMEC Part No. 043206 (Male/Female) or 043207 (Male/Male)

- Main Trunk Test Cable, INTERMEC Part No. 047661

- Drop Cable, INTERMEC Part No. 047653

- Supervisory CRT cable, INTERMEC Part No. 041789

Construct the test system following the instructions in Section 4. If the small test system operates correctly with one reader, then set up a much larger system using the same data communication and hardware interface.

SELECTING A COMMUNICATION INTERFACE BETWEEN THE HOST AND 9154

One of the important decisions you make in designing a controller-based CrossBar system is the choice of hardware communication interface between the host computer and the controller. This section provides guidelines for selecting an appropriate interface.

Available Interfaces

A variety of communication interfaces can be connected to the host computer connector on the rear of the controller. The communication interfaces are:

- RS-232
- RS-422/485
- Current Loop
- Modem

The major factors effecting the choice of communication interfaces are:

- Distance between the controller and the host computer
- Amount of electrical interference in the work environment
- Whether the cable is shielded
- Communication baud rate

Section 4 explains how to install the various host to controller interfaces and gives recommendations for choosing an appropriate interface based on the distance between the controller and the host computer. Descriptions of each interface follow.

RS-232: RS-232 is designed for short distances and is generally not used for long data lines. Because RS-232 connects the two signal grounds of the units together, any ground noise is coupled directly to the units. When using long RS-232 cables, noise problems can result, causing data transmission problems. However, RS-232 can be used successfully over longer distances if there is a "clean" electrical environment in the building.

RS-232 cable length is baud rate dependent. Table 3-1 shows the relationship between cable length and different baud rates.

Table 3-1
Allowable RS-232 Distances for Baud Rates

Baud Rate:	Distances (feet):
19200	250
9600	500
4800	1000
2400	2000

Shorter distance than those in Table 3-1 will be required with high capacitance cables. Use modems for RS-232 operation at distances greater than those listed in Table 3-1.

RS-422/485: RS-422/485 standard cable length is 4000 feet with a maximum allowable signal loss of 6 dB. The line speed can be up to 19200 baud at the distance of 4000 feet.

Current Loop: An optically isolated 20 mA Current Loop interface to the host computer will work at distances of 100 to 500 feet at 9600 baud. The standard for current loop is 500 feet. When connecting equipment, give consideration to the interconnecting cable characteristics, cable termination resistance, and grounding requirements. Current loop requires that an external adapter be attached to the RS-232 interface.

Modems: Installed at the cable ends for long-distance transmission, modems isolate the equipment grounds from the cable. The modem standard is RS-232. The cable should be terminated according to the modem manufacturer's instructions. The modem should have transformer coupling or optical isolation.

Communication between modems depends on the equipment chosen, but it is typically based on tones which are transformer isolated. Telephone company modems and leased lines can provide reliable communication over hundreds of miles.

Comparing RS-232 and RS-422/485

RS-232 and RS-422/485 are two standard methods of data transmission which use totally different methods to signal mark and space states. A discussion and comparison of the two standards follows.

RS-232: RS-232 relies on measuring voltage relative to ground. Various voltage levels, representing mark and space states with respect to ground, are used to communicate data. For example, -5 Volts could be mark and +5 Volts space.

With RS-232, or any other signal which uses voltage-relative-to-ground communication, differences in ground potential between the transmitting and receiving stations becomes important. For example, if the transmitting station applies +5 volts to a line relative to a "ground" that is 10 volts "higher" than the ground at the transmitting station, the voltage on that line will appear to be -5 volts. The receiving station will interpret that as a mark.

The most common cause of ground potential differences is imbalances in the power distribution systems supplying the transmitting and receiving stations. The best way to avoid ground potential problems caused by power distribution imbalances is to power both the transmitting and receiving equipment from the same power distribution system. The following table lists the different power sources and their relative ability to minimize ground imbalances between transmitting and receiving stations.

Quality:	Using the Same:
Ideal	Outlet box
Almost Ideal	Circuit breaker panel
Quite Good	Step-down transformer/voltage distribution panel
Fair	Building distribution system
Risky	Any other arrangement

While imbalances in the power distribution system is the most common cause of ground potential differences, the use of voltage interfaces between different buildings creates special problems during lightning storms; entire buildings will assume varying potentials, even if no direct lightning strikes occur to those buildings.

The problem of ground imbalances can also be partially alleviated by running a Signal Ground lead between the transmitting and receiving stations to provide a common ground reference. However, a common ground is not entirely adequate because if current flows through the Signal Ground wire, the resistance of the wire will permit a voltage difference between the two ends of the wire. Thus, one end of the signal ground will be at a higher voltage than the other end, just as if there was a problem with the power distribution system.

Current can be induced to flow through the Signal Ground wire by interference. Heavy machinery, welders, and switching equipment all can induce a current flow through the Signal Ground wire.

The need to eliminate interference to the ground signal is one of the reasons that shielding of RS-232 cabling is strongly recommended.

RS-422/485: A method of data transmission that is more satisfactory than the RS-232 voltage-relative-to-ground method is differential transmission used in an RS-422/485 interface. In this type of transmission, two conductors are used for each data path, and the information to be conveyed is expressed as the difference in voltage between the two conductors.

The ground potential difference is not important as long as it is not so high that it caused electric breakdown in the receiver circuitry. The receiver only needs to determine whether the relative voltage between conductor A and conductor B is positive or negative, which indicates whether the signal was in spacing or marking state.

Interfering signals are generally voltages relative to ground and will affect both conductors equally. Assume that noise voltage Vn is applied to two conductors, one carrying a +V and the other carrying a voltage -V. The resulting voltage will be +V +Vn and -V +Vn. However, the receiver will measure the difference between the two voltages, which is 2V, just as it was before the addition of noise. Noise of this kind is called "common mode" noise, and the differential capability of the receiver produce what is called "common mode rejection." EIA Standard RS-422/485 is an excellent example of a differential transmission system.

Data Line Considerations

A data line is defined as a cable that connects units in order to transfer binary data. A long data cable has one or more of the following characteristics:

- Longer than 50 feet
- Interconnects equipment in two separate buildings
- Runs near large electrical equipment, such as large motors, welders, motor controllers, switch gear, etc.

To increase communication effectiveness and immunity to noise, you may use the following cabling procedures.

Cables that are run longer than 50 feet must be shielded. The use of shielded cables is also recommended in noisy environments, even if you use RS-422/485 or 20 mA Current Loop.

Shielded cable has a higher capacitance per foot than unshielded cable; therefore, when it is used with 20 mA current loop, you may have to lower the baud rate.

Using twisted pair cable can improve noise immunity and reduce crosstalk in a data cable.

GROUNDING CONSIDERATIONS

Proper grounding is required for safety, equipment protection, and low noise. The building(s) containing the controller system must be grounded directly to a nearby ground grid which includes the building steelwork and all circuits and junction boxes. Adequate building grounding will limit the voltage generated by fault currents, such as those caused by lightning or equipment failure. All equipment racks must be connected to the building ground.

The power and communication grounds are connected at the controller. It is important that the controller, through its grounding stud, has a good ground since this is the central ground for the controller system.

Communication Interfaces and Grounding

The methods used to provide signal ground, and the negative effect of poor grounding, vary from one type of communication interface to the another. Specific grounding requirements for each type of interface follow.

RS-232: RS-232 is designed for short distances and is generally not used for long data lines. However, RS-232 can be used successfully over hundreds of feet if there is a "clean" electrical environment in the building and good grounding. Because RS-232 connects the two signal grounds of the units together, any ground noise is coupled directly into the units. If RS-232 is used, determine that there is a good earth ground, and that the controller system is properly connected to it.

RS-422/485: RS-422/485 uses a balanced transmission that is received with a differential receiver and a receiver signal ground that is not common with the cable. RS-422/485 is resistant to ground noise. RS-422/485 does not have voltage isolation like optically isolated current loop; however, RS-422/485 can be used at higher baud rates and over longer distances than current loop because of the inherent limitations of current based signals.

Current Loop: A 20 mA Current Loop with optical isolation at each end will isolate the grounds of each unit from the cable. If the equipment is set up in a star configuration, the central unit should be active for both transmit and receive loops.

Modems: Modems, which go at the end of the cable for long-distance transmission, isolate the equipment grounds from the cable. The cable should be terminated according to the modem manufacturer's instructions. The modem should have good isolation, such as transformer coupling or optical isolation.

Grounding Conductor

The protector ground conductor should have 30-mil rubber insulation, be covered by a fibrous material, and be no smaller than 14 AWG (gauge) copper or equivalent. The ground cables must be low impedance and bonded (see National Electrical Code and local building codes).

Making a Good Ground Connection

Run the grounding conductor in as straight a line as possible to the grounding electrode. Isolating the grounds between equipment reduces noise and can prevent damage from voltage transients.

Choosing a Grounding Electrode: The grounding conductor should be connected to the best available grounding electrode as follows (in order from best to worst):

WARNING

The grounding conductor should not be attached to steam or hot water pipes, lightning-rod conductors, or pipe or rod service electrodes that are not part of a multiground neutral power circuit.

- To the nearest accessible location on the building or structure grounding electrode system
- To power-service conduit, service-equipment enclosure, or grounding electrode conductor, where the grounded conductor of the power service is connected to the grounding electrode system
- To the grounding electrode, grounding electrode conductor, service conduit, or service equipment enclosure of the power service, if these are part of a multiground neutral power system
- To an effectively grounded metal structure
- To a continuous and extensive underground gas piping system
- To a ground rod pipe placed in permanently damp earth

Connection to a Pipe Electrode: The grounding electrode should be attached to a pipe electrode with a bolted clamp. Where a gas pipe electrode is used, make the connection between the gas meter and the street main. In either case, make the connection to the grounding electrode as close to the earth as possible.

Grounding Long Data Lines

Shield all long data lines. You must connect the shield to the building ground as the cable enters the building and to the equipment rack.

When aerial cables entering a building are exposed to electrical light or power cables, the metal sheath of those should be grounded or interrupted close to where the cable enters the building by an insulating joint or equivalent device.

LIGHTNING PROTECTION

In addition to grounding, long data lines need to be protected from excessive induced voltage caused by lightning, which can destroy the terminal circuitry.

Each signal line and communication ground, if used, should be terminated to a chassis ground using a varistor or similar device. The ground for the varistors must be directly connected to the terminal equipment and to the building ground.

THROUGHPUT AND RESPONSE TIME ANALYSIS

Introduction

Response time is how often a reader can scan a new bar code. You specify the maximum time interval by the way you design your system.

Two major system response time questions should be considered when designing a system: How much bar code can be read in a specific time period, and how often can bar code be read by a specific reader? This section explains how to calculate the response time. The response time value can be used to answer both of the preceding questions.

Long waiting times can frustrate and discourage reader operators. When planning a system, particularly a large one, it is recommended that you run a response time calculation on the system to ensure that readers respond to the operator fairly quickly.

The second part of this section, "Calculating the Response Time," gives equations for calculating how often a reader can read bar code in both interactive and batch operation.

The final part of this section, "Deriving Cycle Times," describes how to derive the cycle times used in the equations in the "Calculating the Response Time" section. Tables 3-2 and 3-3 show the communication exchanges used in deriving cycle times.

Reducing Response Time: If the operator has to wait too long before scanning the next bar code, use the following guidelines to reduce response time:

- Shorten message lengths (for example, disable headers or have the controller add time to the data stream rather than the devices).
- Switch from interactive to batch mode.
- On INTERMEC readers which run IRL ® (Interactive Reader Language), run programs which require little if any interactive communication.
- Reduce the number of devices that can operate at one time.
- Increase the speed at which the host processes data.

Design the controller system to minimize response time, but remember that one of the primary factors effecting system response time is the host processing time.

Calculating the Response Time

Response time can be defined as the amount of time that a device has to wait after starting one transaction before entering the next transaction.

There are two equations for calculating response time depending on whether the devices are operating in interactive or batch mode.

- In interactive mode (also referred to as Computer Response Required Mode), the reader(s) will wait for a prompt from the host accepting data entry from an operator. This mode allows the host computer to control reader operation, and allows host prompts to be sent to the reader operator.
- In batch mode, the reader(s) do not require interaction with the host computer before accepting a second data entry from the operator. This mode allows high speed operation.

The equations used for the two different modes of operation follow:

Batch Mode Response Time Equation: When the controller is operating in batch mode, data is collected from the Multi-Drop devices and transferred to the host at the end of the operation. The batch mode response time consists mainly of the time the controller takes to poll and receive a single record from each device; it can be accurately estimated by using the following equation for the poll cycle time, Tpol:

Tbatch= Tpol = N x (((MLR+9) x 10 / BR) + 0.03) seconds

Tbatch	=	The time between scans for a reader in batch mode
Tpol	=	The time it takes to poll and receive a message from all the readers
N	=	Number of Readers
MLR	=	Message Length from Reader
BR	=	Baud Rate of the Reader

This is a worst case equation because it assumes that all the devices included in the system are sending messages simultaneously.

A sample batch operation calculation with all readers scanning simultaneously follows:

Tbatch = 32(((15 + 9) x 10/19200) + 0.03) seconds

Number of Readers	=	32
Message Length from Reader	=	15 characters
Baud Rate	=	19200 baud

The response time is 1.36 seconds. For a reader scanning bar code, the maximum amount of time between scans is 1.36 seconds. This calculation ignores the scanning time.

Interactive Mode Response Time Equation: In interactive mode where the user enters data in response to a prompt and then waits for the next prompt before entering data again, the response time calculation is based on the time it takes to transfer the data to the host computer and for the host computer to respond with a prompt. The response time can be estimated by adding the Tpol time (the time for extracting data from the devices), the Tsel time (the time for sending data, in this case a prompt, to the devices), and the host processing time, as shown in the following equation.

Tinter = Tpol + Tsel + Thost = N(10((MLR + MLH + 20)/BR + (MLR + MLH + 21)/BH) + .053) + N(TH)

Tinter	=	The time between scans for a reader in interactive mode
Tpol	=	The time it takes to poll and receive a message from all the readers
Tsel	=	The time it takes to send a message to and receive an acknowledgement back from all the readers
Thost	=	The time for the host to process a message from each of the readers
N	=	Number of Readers
MLR	=	Message Length from Reader
MLH	=	Message Length from Host
BR	=	Baud Rate of the Reader
BH	=	Baud Rate of the Host
TH	=	Host Processing Time Required

This is a worst case equation because it assumes that all the devices included in the system are sending messages simultaneously.

A sample interactive operation calculation with all connected readers scanning simultaneously follows:

Tinter = 32(10((20+20+20)/19200 + (20+20+21)/9600) + .053) + 32(TH)
Tinter = 4.73 seconds + 32(Host processing time required)

Number of Readers	=	32
Message Length from Reader	=	20 characters
Baud Rate of the Reader	=	19200 baud
Message Length from Host	=	20 characters
Baud Rate of the Host	=	9600 baud

The response time is 4.73 seconds plus 32 times the host time for processing a single message from the reader. For a reader, the maximum time between scans is 4.73 seconds. This calculation ignores scanning time.

Deriving Cycle Times

The two response time equations are based on three different equations. The derivation of these three equations is shown below.

Poll Cycle Time: The poll cycle time is defined as the time required to poll and receive a single data record from all the connected devices. It consists of the data transmission time, the turnaround time of the polled device, and the turnaround time of the controller. In a situation where all the devices are up and running and have data ready to transmit, the cycle time for polling data from all the devices can be estimated from the following equation:

Tpolcycle = N x (((MLR + 9) x 10 / BR) + 2 x (TD + TC))

N	=	Total Number of Devices Connected
MLR	=	Message Length from Device
TD	=	Turnaround Time of each Polled Device
TC	=	Turnaround Time of the Controller
BR	=	Baud Rate of the Device

The TD time consists mainly of the time it takes a polled device to process the data received from the controller and prepare to send the response back.

The TC time is the time it takes the controller to process the data received from the polled device and prepare to respond again.

The (ML+9) is the message length plus the nine characters which are used for the protocol control that is depicted in Table 3-2.

The average turnaround time of the controller is approximately 10 msec and the average turnaround time of the Multi-Drop devices is assumed to be 5 msec.

By entering values for TD and TC into the Tpolcycle equation, the polling cycle time can be estimated from the following equation:

Tpol = N x (((MLR + 9) x 10 / BR) + 0.03) seconds

N	=	Number of Multi-Drop Devices
MLR	=	Message Length from Device
BR	=	Baud Rate in Bits per Second

Select Cycle Time: The select cycle time for sending a message to the Multi-Drop devices can be estimated by using the Select Sequence of the Multi-Drop Protocol (shown in Table 3-2) and is shown in the following equation:

Tsel = N x (((MLR + 11) x 10 / BR) + 0.04) seconds

N	=	Number of Multi-Drop Devices
MLR	=	Message Length from Device
BR	=	Baud Rate in Bits per Second

Host Cycle Time: The host cycle time is defined as the time required for each connected device to send one message to the host and to receive a reply message back. Host cycle time consists of the data transmission time, the turnaround time of the host, and the turn around time of the controller. Using the controller's asynchronous host protocol, as depicted in Table 3- 3, the cycle time is given by the following equation:

Thost = N x (((MLH + 8) x 10 / BH) + 3 x (TH + TC))

N	=	Total Number of Devices Connected
MLH	=	Message Length from Host
BH	=	Baud Rate of the Host
TH	=	Turnaround Time of the Host
TC	=	Turnaround Time of the Controller

The TH time is the time it takes the host to process the data received from the controller and prepare to send the response back.

The TC time is the time it takes for the controller to process the data received from the host and prepare to respond again.

The (MLH + 8) represents the message length plus the protocol control characters shown in Table 3-3.

Table 3-2
9154 Controller to Multi-Drop Device Data Exchange

9154 Controller:	Direction of Communication:	Multi-Drop Device:	Comment:
<EOT><POL><ENQ>	—>		9154 polls device for data.
	TD		
	<—	<Pol><STX>data<ETX><LRC>	Device sends data.
	.		
	TC		
	.		
<ACK>	—>		9154 acknowledges date received.
	.		
	.		
	TD		
	.		
	.		
	<—	<EOT>	Device sends end of transmission indicator.
	.		
<EOT><SEL><ENQ>	—>		9154 selects device to receive data.
	.		
	TD		
	.		
	<—	<Select><ACK>	Device acknowledges.
	.		
	TC		
	.		
<STX>data<ETX><LRC>	—>		9154 sends data.
	.		
	TD		
	.		
	<—	<Select><ACK>	Device acknowledges.
	.		
	TC		
	.		
<EOT>	—>		9154 send end of transmission indicator.

TC Turnaround time for the controller
TD Turnaround time for the device

Table 3-3
9154 Controller to Host Data Exchange

Host:	Direction of Communication:	9154 Controller:	Comment:
<POL>	—>		Host polls 9154 for data.
	TC		
	.		
	<—	<SOM>data<EOM>	9154 sends data.
	.		
	TH		
	.		
<SEL>	—>		Host acknowledges data received and selects 9154 to receive message.
	.		
	TC		
	.		
	<—	<AFF>	9154 acknowledges.
	.		
	TH		
	.		
<SOM> data <EOM>	—>		Host sends message.
	.		
	TC		
	.		
	<—	<AFF>	9154 acknowledges message received.

TC Turnaround time for the controller.
TH Turnaround time for the host

CONFIGURATION PREPARATION

The controller can be easily configured to support a wide variety of host communication protocols and user requirements. In most systems, the controller will be configured to communicate with the same data communication protocol as the host. To make the configuration process easier, become familiar with the data communication protocol that is used on your host computer.

See Section 7, "Host to 9154 Communication", for detailed information about host to controller communication.

Data Communication Considerations

Before configuring the controller, review the following checklist of data communication items

1. Which of the following types of data communication protocol will you use?
   - Solicited Receive and Transmit
   - Solicited Receive and Unsolicited Transmit
   - Unsolicited Receive and Solicited Transmit
   - Unsolicited Receive and Transmit
2. If you are using unsolicited receive or transmit, will the XON/XOFF handshake be used?
3. Will communication protocol parameters be transmitted as data, requiring use of the transparency character (DLE) and the transparency check?
4. Can you use Data Wait mode to cut down on host polling?
5. Are any of the host computer's data communication protocol commands different than the controller default values?
6. Will error messages need an SOM and/or an EOM, which are distinct from the SOM and EOM used for regular data communication?
7. Will time be appended to the data records from the polled devices by the devices or by the controller?

8. Should time be added to every polled device record received by the controller, or should time be appended to the data records only at some pre-determined time interval?

9. Will time be broadcast to the polled devices?

10. Will your host application program be using device specific polling, for example to determine printer status?

Configuration Parameters

The controller is configured with default settings for data communication parameters at the factory. Table 3-4 lists the communication parameters that can be customized on the controller and their factory default values.

See Appendix B for a list of allowable values and Section 5, "Configuring the Controller," for an explanation of how to enter configuration parameters.

Parameters that are not disabled by entering an "N" for No are disabled by leaving the parameter field blank on the Supervisory CRT. In Table 3-4, "--" indicates a blank field.

Table 3-4
Default and Configured Communication Parameters

Default Value:	Configured Parameter Value:
Supervisory CRT	
Clear Screen	
Sequence	SUB
Cursor Position	
Sequence	ESC=<SP><SP>
Row Offset	2
Column Offset	3
Host Line Parameters	
Line Speed	9600
Parity	Even
Data Bits	7
Stop Bits	1
Multi-Drop Line Parameters	
Line Speed 9600	
Address (of	
Multi-Drop port) p	
To Host Transmission Parameters	
Number of Records	
per Block	1
Record Separator	CR
Header	--
SOM	STX
EOM	ETX
RES	STX Z CR
AFF	STX Y CR
NEG	STX Z CR
Error Message SOM	STX
Error Message EOM	ETX
Transparency Check	
(Yes or No)	No
Data Wait Mode	
(Yes or No)	No

Table 3-4 (cont.)
Default and Configured Communication Parameters

Default Value:	Configured Parameter Value:
From Host Transmission Parameters	
POL	ENQ
SEL	BEL
AFF	ACK
NEG	NAK
DLE	DLE
SOM	STX
EOM	ETX
Record Separator	CR
Delay	(0-99) x 10 ms 0 ms
Timeout	(0-60) x 1 sec 60 sec
XON/XOFF (Yes or No)	No
LRC Enabled (Yes or No)	No
Real Time Clock Parameters	
Date	87/01/01
Time	00:00
Time Append	
Enable Time Append (Yes or No)	No
Interval (0-99) x minute	1 minute
Record Day Rollover (Yes or No)	No

Table 3-4 (cont.)
Default and Configured Communication Parameters

Default Value:	Configured Parameter Value:
Time Broadcast	
Enable Time Broadcast (Yes or No)	No
Interval (0-99) x minute	1 minute
Preamble	HT
Postamble	--
Display Format	24
Include YY/MM/DD (Yes or No)	No

SECTION 4

INSTALLING HARDWARE

INSTALLATION OVERVIEW

INSTALLING THE 9154 CONTROLLER
- Unpacking
- Standard Items
- Required Tools
- Mounting
- Connecting the Controller to Ground
- Power Sources

CONNECTING THE SUPERVISORY CRT TO THE 9154
- Configuration
- Controller to CRT Interface
- Connecting the Controller to the CRT

CONNECTING THE HOST COMPUTER TO THE 9154
- Choosing an Appropriate Interface
- RS-232
- RS-422/485
- Modem
- Current Loop

CONNECTING THE 9154 TO POLLED DEVICES
- Compatible Readers and Printers
- Designing a Multi-Drop Cable Layout
- Multi-Drop Cables
- Installing the Multi-Drop Cabling System
- Segment-By-Segment Main Trunk Cable Installation
- Laying the Main Trunk First
- Connection to Specific Readers

VERIFYING SYSTEM INSTALLATION

INSTALLATION OVERVIEW

This section describes how to physically set up the 9154 Controller and connect it to polled devices, Supervisory CRT and the host. The installation of the controller should be approached in a step-by-step fashion. For information about planning the layout of a system installation, see Section 3, "Designing a 9154 System."

The major tasks required for installing a controller system are:

1. Mount the Controller.
2. Connect a Ground Cable.
3. Connect a Power Supply.
4. Connect a Supervisory CRT.
5. Choose a Controller to Host Interface Type.
6. Install the Host Interface.
7. Connect Multi-Drop Cabling from the Controller to the Devices.

Although there are several ways to accomplish some of the tasks, they are all necessary for installing a controller system. The remainder of Section 4 tells you how to complete the seven tasks listed above.

INSTALLING THE 9154 CONTROLLER

Unpacking

The controller is thoroughly tested and inspected before shipment. When you receive the unit, remove it from its shipping container and verify the contents against the checklist in the next section, "Standard Items." Inspect for shipping damage. If the shipping container shows external damage and the unit does not operate properly, file a claim with the shipping firm immediately. The customer is responsible for all claims against the carrier. (See INTERMEC Terms of Sale.)

Keep the packing material and container should later repacking and shipment be necessary. Damage caused by improper repacking is not covered by the warranty. Figure 4-1 shows how the controller is packed, and how should be replaced in its container if it is returned or stored.

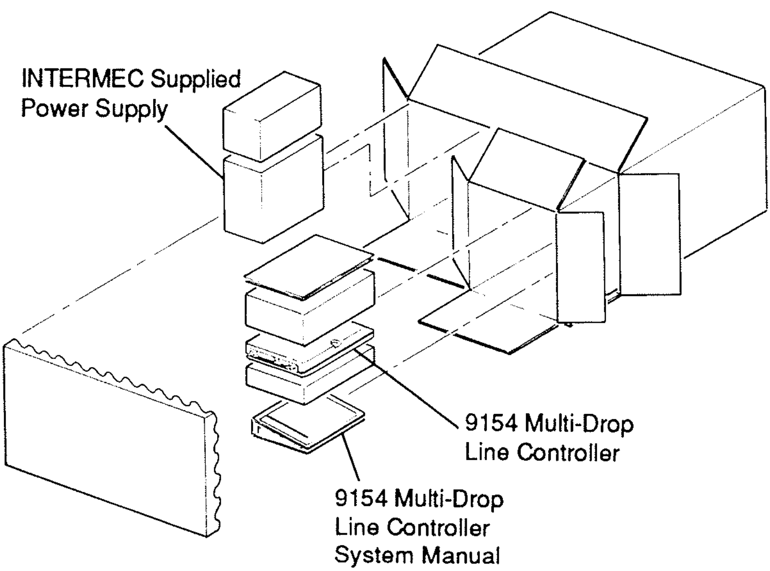


Figure 4-1
Unpacking the Controller

Standard Items

The following items are shipped with the controller:

- 9154 Multi-Drop Line Controller with four rubber feet
- List of Authorized Service Representatives
- 9154 Multi-Drop Line Controller System Manual, INTERMEC Part No. 048517
- Power supply

Required Tools

The following tools will be needed to install the controller and connecting cabling to the host and polled devices:

- Screwdriver (if the controller is mounted with screws)
- CRT (to configure the controller)
- Wrench (7/16 inch, to tighten the grounding nut)
- Small slot screwdriver (to fasten the cabling connectors)

The following additional tools will be required to make cables:

- Wire strippers
- Wire cutters
- Soldering iron
- Solder and flux
- Vise for holding connectors during assembly
- Heat gun and heat shrink sleeving
- Cable ties
- 1/4 inch diameter ring lug (18-20 AWG)
- Crimp tool for ring lug

Note: This manual does not describe how to make Multi-Drop cabling, although wiring diagrams for the necessary connections are provided.

Mounting

Depending on the environment in which the controller will be used and the specific needs of the operator, the controller may be mounted in one of two ways, either resting on a surface, or fastened to it. Both mounting methods are satisfactory for long-term controller operation. Instructions for each method follow.

Placing Controller on a Flat Surface: Follow these steps to mount the controller on a flat surface:

1. Select a flat horizontal surface like a table top. Ensure there is easy access to connectors and that the status lights are visible.

2. Remove the adhesive backing from the four rubber feet. Press a foot into the recess located in each of the four corners on the bottom of the controller.

3. Position the controller on the mounting surface. Ensure that the controller is not located too close to a surface edge where it could be pulled or knocked off.

4. Proceed to "Connecting the Controller to Ground."

Mounting the Controller with Screws: Figure 4-2 illustrates mounting using screws.

Note: 3/16 of an inch is the maximum screw thread diameter that will fit through the mounting holes on the controller.

1. Locate a flat surface on which to mount the controller. The surface may be vertical, horizontal, or any incline in between. Ensure there is easy access to connectors and that the status lights are visible.

2. Remove the adhesive backing from the four rubber feet. Press a foot into the recess located in each of the four corners on the bottom of the controller.

3. Use the mounting template (shown in Figure 4-3) to locate and drill screw holes. Do not drill through the controller mounting holes.

4. Place the controller over the drilled holes on the mounting surface.

5. Install a screw through each of the two mounting holes on the top of the controller into the holes on the surface.

6. Proceed to "Connecting the Controller to Ground."

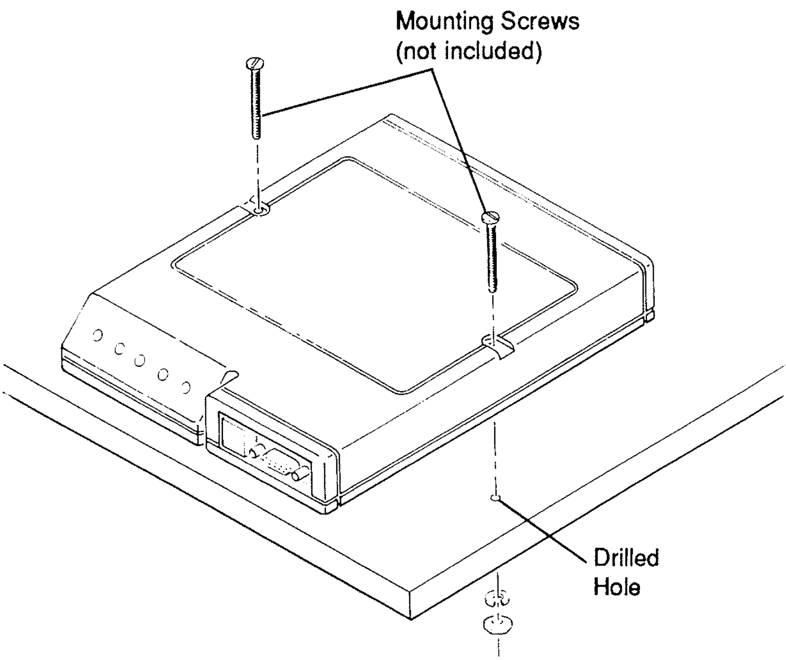


Figure 4-2
Mounting the Controller with Screws

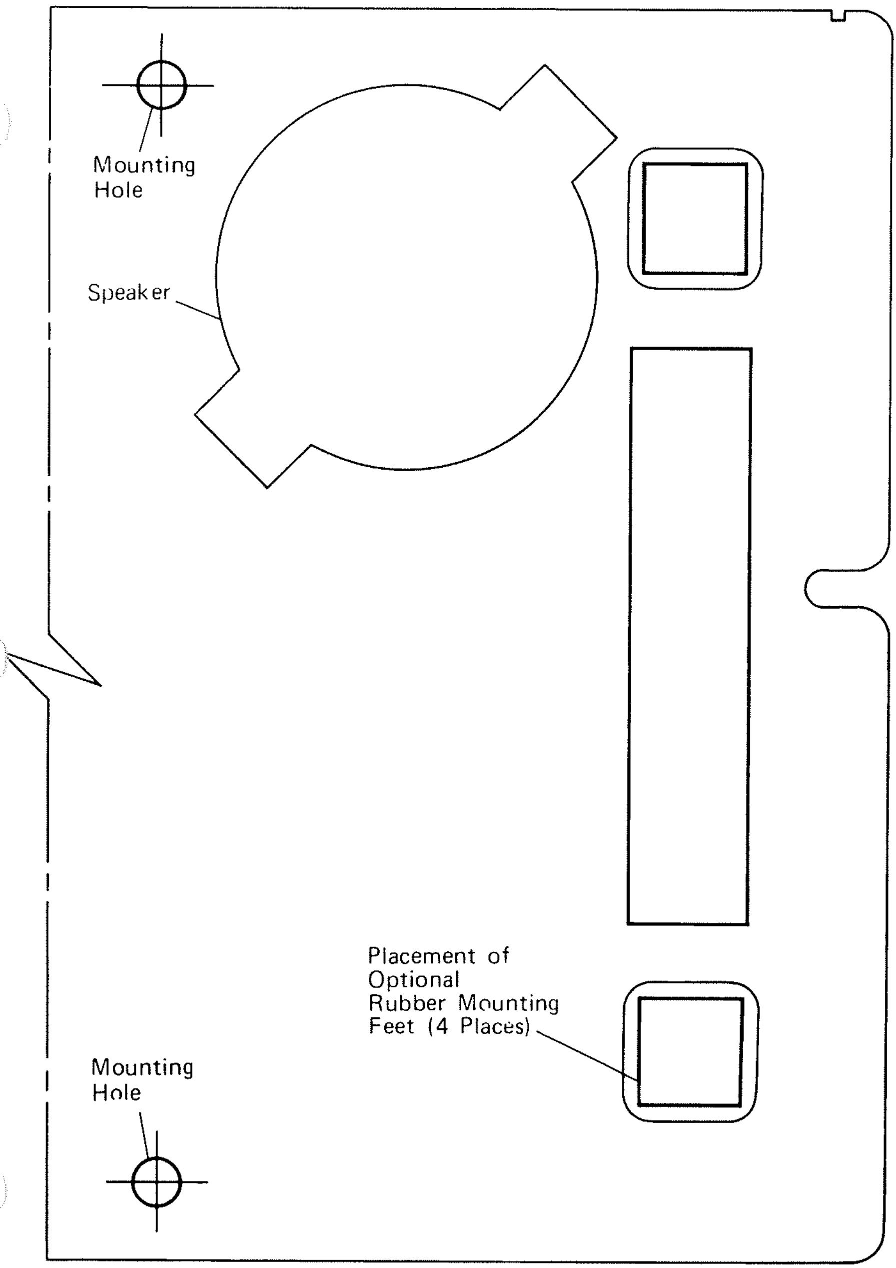


Figure 4-3
Mounting Template

Connecting the Controller to Ground

CAUTION

The system must be grounded and the controller grounding stud must be connected to an earth ground. Failure to connect the unit to an earth ground could result in loss of system data integrity and the possible physical deterioration of the controller due to ESD or lightning.

The controller grounding stud must be connected to an earth ground using an 14 gauge wire. Good earth grounds include building grounding electrode systems, metallic power service conduit, or a grounded metal structure. See Section 3, "Designing a 9154 System," for more information on selecting a good earth ground. Figure 4-4 illustrates how to connect the ground conductor to the controller's grounding stud.

To attach the ground cable to the controller grounding stud follow these steps:

1. Remove the self-locking nut from the back of the controller. Check that a star washer is on the grounding stud.

Note: The self-locking nut requires a 7/16 inch wrench. The stud has 1/4-20 threads.

2. Attach a ring lug with a 1/4 inch diameter hole to the 14 gauge ground wire.

3. Place the ring lug over the grounding stud.

4. Screw the self-locking nut back onto the grounding stud and tighten securely.

When attached, the ring lug on the ground cable should be located between the star washer on the grounding stud and the star washer attached to the self-locking nut. A tight connection with the ring lug between two star washers helps ensure a good ground connection.

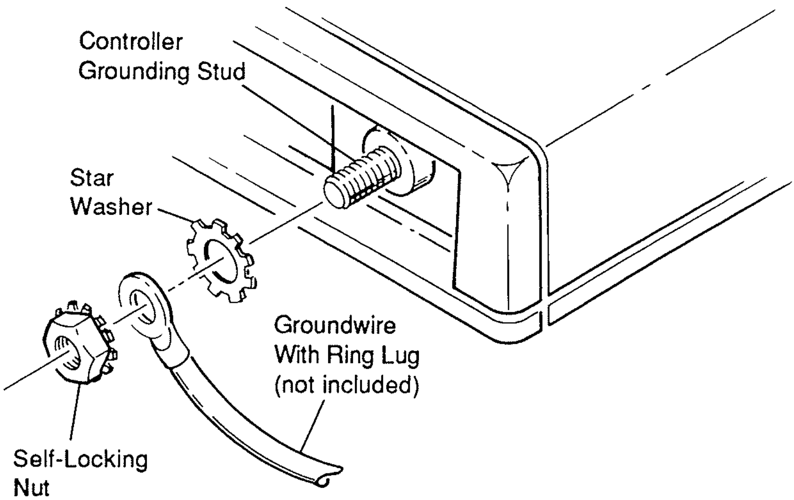


Figure 4-4
Connecting to an Earth Ground

Power Sources

The same basic controller unit is adaptable to different line voltages and frequencies by changing the power supply. The controller does not directly plug into an AC power outlet, but operates on DC power received from an external INTERMEC- supplied power supply.

AC Power Requirements: Power for the controller power supply comes from a standard AC power outlet.

The controller power supply comes with the appropriate cord for the standard AC power outlet used with the voltage and frequency the power supply is designed for. For standard USA AC power outlets it comes shipped with a three-wire plug. To operate the controller from a two-conductor outlet, use a UL- or VDE-approved, three-conductor adapter and ground the pigtail for safety.

Ensure AC power to the controller's power supply is noise-free, consistent, and at the voltage and frequency specified on the power supply case.

INTERMEC will not accept responsibility for the results of poor quality AC power sources, such as those containing power spikes. Power spikes can interrupt controller operation. If the potential for power spikes, or inconsistent power exists, INTERMEC recommends that industry approved surge protectors be placed between the power supply and the AC power source.

Power Supply: The required input voltage and frequency of the power supply is one of the options specified by the customer when the unit is ordered. Before plugging in the power supply, check to ensure that it is the proper power supply for your environment. The voltage and frequency are marked on the power supply case.

Voltage VAC:	Cycles Hz:	INTERMEC Part No.:
120	50-60	046791
100	50-60	046972
220	50-60	046973
240	50-60	046974

Connecting the Power Supply: To connect the power supply, follow these four steps. Figure 4-5 illustrates how to connect the power supply.

WARNING

Before connecting the power supply, ensure that the controller Power pushbutton is in the off position. Failure to do so could cause injury due to electrical shock.

1. Connect the power supply 7-Pin output plug connector to the power connector on the controller's rear panel.

2. If necessary, insert an approved three-conductor adapter and/or a surge protector into the AC power outlet socket the power supply will be connected to.

3. Insert the plug on the power supply input cable into the AC power source socket.

4. Do not turn on the controller yet. You will be instructed to turn the controller on after you have installed the system hardware.

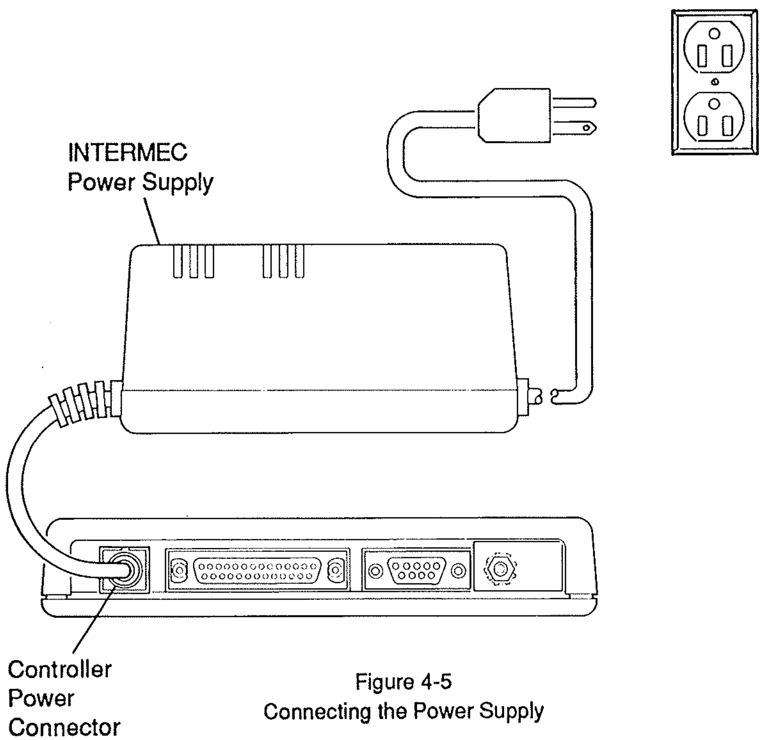


Figure 4-5
Connecting the Power Supply

Disconnecting the Power Supply: To disconnect the power supply from the controller, perform the following steps.

1. Disconnect, disable with the Supervisory CRT, or turn off any attached polled devices.

2. Turn off the controller.

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power up.

3. Disconnect the power supply from the rear of the controller.

CONNECTING THE SUPERVISORY CRT TO THE 9154

Configuration

The controller can be configured to communicate with most CRTs. To do this, however, you may need to make minor adjustments to the communication parameters controlling the controller CRT interface. Section 5, "Configuring the Controller," explains how to configure the controller CRT interface using Automatic Baud Rate Detection. All CRTs must be set for full duplex operation. If the CRT has an auto scroll mode, it should be enabled. Instructions for connecting a CRT to the controller follow.

Controller to CRT Interface

The electrical interface between the controller and the Supervisory CRT is an RS-232 standard. The controller connector is a standard 9-Pin, "D" Style, sub-miniature socket located on the front of the unit.

A 9-Pin to 25-Pin interface cable, such as INTERMEC Part No. 041789S is required to connect the CRT. The wiring diagram for this connection is shown in Figure 4-6.

The controller's Supervisory CRT connector is configured as a DCE (Data Communications Equipment) interface. The pin assignments are:

Pin No.:	Signal:	Direction (from controller):
2	Transmitted Data	Incoming
3	Received Data	Outgoing
5	Clear to Send (biased true)	Outgoing
7	Signal Ground	(required)

 281-483-8292

Connecting the Controller to the CRT

Figure 4-7 displays a typical controller to Supervisory CRT connection. To make the connection follow these steps:

1. Locate the CRT terminal close to the controller. Set the CRT to full duplex operation.

2. Obtain either INTERMEC Part No. #041789S or build an equivalent cable wired as shown in Figure 4-6.

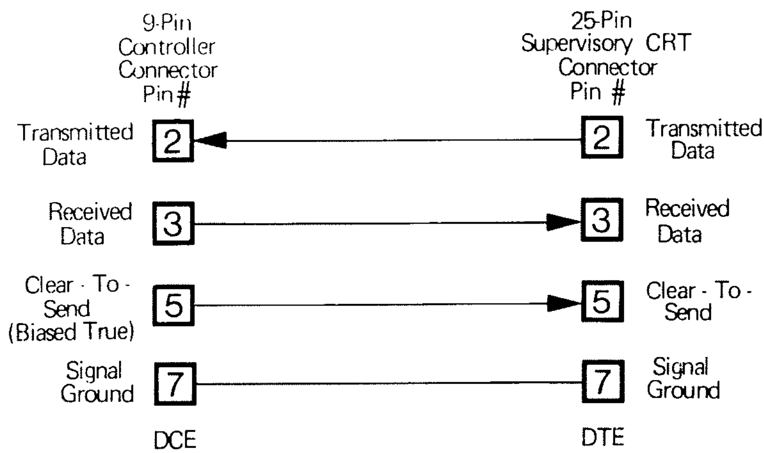


Figure 4-6
Controller to RS-232 CRT Wiring Diagram

3. Connect the 9-Pin plug end of the connection cable to the 9- Pin socket on the front of the controller.

4. Connect the 25-Pin plug end of the connection cable to the the 25-Pin socket on the Supervisory CRT.

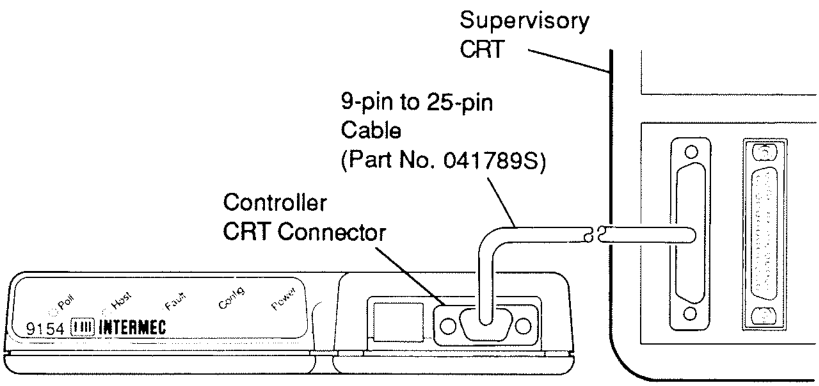


Figure 4-7
Connecting the Supervisory CRT to the Controller

CONNECTING THE HOST COMPUTER TO THE 9154

The host to controller communication link is an important part of the controller system. If the link is unsatisfactory, the data transmitted to and from the host may be in error. To connect the host to the controller, select an interface type, and install the interface using the guidelines contained in this section.

Choosing an Appropriate Interface

A variety of transmission methods can be used to connect the controller with the host. Several factors effect the choice of interface:

- Baud rate
- Distance to the host
- Quantity of electrical noise in the surrounding environment
- Whether the cable is shielded

For most work environments, the interfaces listed in Table 4-1 are recommended. See Section 3, "Designing a 9154 System," for detailed information about selecting a communications interface, particularly if the interface you select does not match the recommendations in Table 4-1.

Table 4-1
Preferred Host to Controller Interfaces

Distance	Preferred Interface:
250 feet maximum	RS-232 (up to19200 baud)
4000 feet maximum	RS-422/485
Longer than 4000 feet	RS-232 with Modem

After selecting a host to controller interface appropriate to the work environment, install the interface using the instructions contained in the following sections.

RS-232

The controller can be connected to the host using a standard RS- 232 communications interface. Observe the following pin assignment requirements and other relevant wiring guidelines.

I/O Signal Levels:

CAUTION

The signal levels between the controller and both the host computer and Supervisory CRT must be as specified with supported EIA standard. If other signal levels are used, the controller, Supervisory CRT, and host computer could be damaged.

To avoid damaging any equipment, the signal levels of your Supervisory CRT and host should conform to EIA RS-232. RS-232 specifies the following I/O signal levels for serial transmission:

	RS-232 I/O Signal Levels	
Outbound Lines:	+12V	-12V
Control Lines	True (1)	
Data Lines	Space (0)	Mark (1)
Inbound Lines:	+3V Min. +25V Max.	-3V Min. -25V Max.
Control Lines	True (1)	False (0)
Data Lines	Space (0)	Mark (1)

Connecting the Controller to an RS-232 Host: The controller is wired as a DTE (Data Terminal Equipment) and must have the following minimum connections to operate properly with RS-232:

Pin No.:	Function:	Direction:
2	Transmit Data	Outgoing
3	Receive Data	Incoming
7	Signal Ground	(required)

If the controller is to be connected directly to a host computer port, use a modem bypass (null modem) cable with appropriate crossovers. If you are building a custom cable, one end must have a connector compatible with the host computer and the other end must have a 25-Pin, "D" Style, sub-miniature plug connector to connect with the controller. Figure 4-8 shows the crossover connections for this configuration.

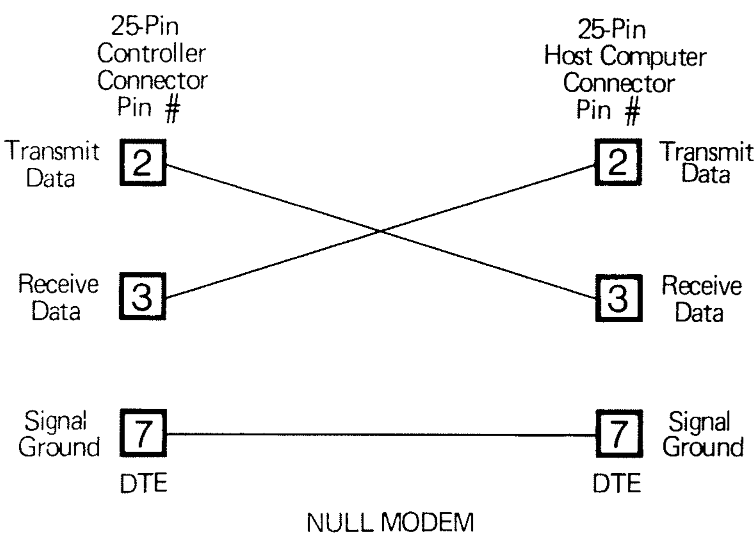


Figure 4-8
Controller to RS-232 Host Wiring Diagram

Figure 4-9 displays a typical connection of the controller to a host computer. To connect the controller and host computer, follow this procedure:

1. Obtain a cable with an RS-232 crossover, a 25-Pin, "D" Style, sub-miniature plug on one end, and whatever connector is required for the host computer on the other end.

2. Plug the 25-Pin plug into the 25-Pin host socket on the rear of the controller.

3. Plug the other end of the cable into the host computer.

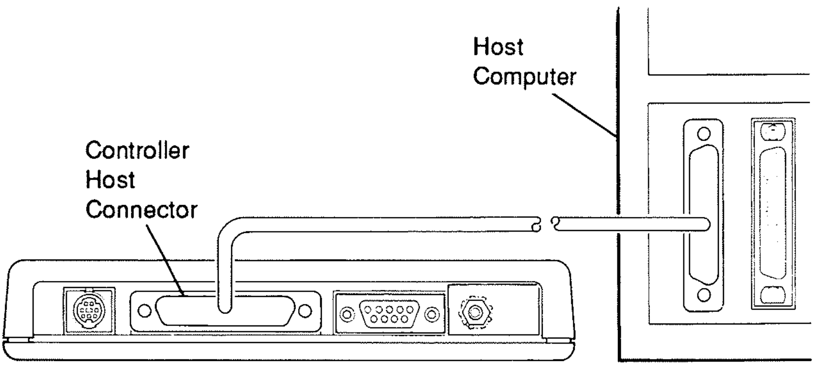


Figure 4-9
Connecting the Controller to a Host Computer

If the host computer requires more than these three connections, see the following descriptions of additional RS-232 signals the controller supports.

The controller host port is wired as a DTE (Data Terminal Equipment) device. For an RS-232 interface, the pin assignments are:

Pin No.:	EIA Circuit Symbol:	Signal:	Direction (from controller):
1	AA	Chassis Ground	(optional)
2	BA	Transmitted	Data Outgoing
3	BB	Received Data	Incoming
4	CA	Request-to-Send	Outgoing
5	CB	Clear-to-Send	Incoming
6	CC	Data Set Ready	Incoming
7	AB	Signal Ground	(required)
8	CF	Receive Line Signal Detector	Incoming
20	CD	Data Terminal Ready	Outgoing

Request-to-Send (Pin No. 4): When the controller has data to transmit, this line is made true and the controller tests the CTS and DSR lines. When both control lines are true, it transmits the data and changes the Request-to-Send to a false condition.

Clear-to-Send (Pin No. 5): This line is made true by the modem when it is ready to receive data. The controller will not transmit data until this line is made true. The default condition of this line (no connection) is a constant true.

Data Set Ready (Pin No. 6): This line is made true when the modem is ready to receive data. The default condition of this line (no connection) is constant true.

Receive Line Signal Detector (Pin No. 8): This line is made true by the modem when a carrier is detected. The default condition (no connection) of this line is constant true.

Data Terminal Ready (Pin No. 20): This line is constant true when the controller's power is on. DTR must be true before the controller will transmit data.

RS-422/485

The host RS-422/485 communication interface is generally intended for use at high baud rates; however, RS-422/485 may also be required under any of the following three conditions:

1. The interconnecting cable is too long for effective unbalanced operation (RS-232).
2. The interconnecting cable is exposed to noise sources that could induce unwanted voltage, in excess of plus or minus one volt, into an unbalanced line.
3. It is necessary to minimize interference with other signals.

See your host computer manual to determine if your host computer supports RS-422 and for information on how to connect RS-422 to your computer.

For RS-422/485 communication, there are two wires for receive data and two wires for transmit data. The two wires for each circuit are labeled A and B. For a mark (binary 1, or OFF), the A wire is negative with respect to the B wire. For a space (binary 0, or ON), wire A is positive with respect to wire B.

The transmitter must generate greater than 2 volts with 100 ohms between wire A and wire B. The receiver must detect signals greater than 200 mV. Cable lengths up to 4000 feet are allowed by the standard.

Connecting the Controller to an RS-422/485 Host: The cable connected to the controller must have the following pin assignments to operate properly under RS-422/485:

Pin No.	Signal:	Direction:
1	Chassis Ground	(optional)
13	Received Data B	Incoming
14	Transmitted Data A	Outgoing
16	Received Data A	Incoming
19	Transmitted Data B	Outgoing

The receive driver is enabled by the controller at all times. However, the transmit driver can be enabled or disabled by the firmware. It is enabled in the default state.

Figure 4-9 illustrates the connection of the host computer to the controller. To connect the controller to the host computer with an RS-422/485 interface follow these steps:

1. Make an interface cable with a 25-Pin, "D" style, sub-miniature plug on one end and whatever connector is needed for the host computer on the other end.

2. Plug the 25-Pin plug into the 25-Pin host connector on the rear of the controller.

3. Plug the other end of the cable into the host computer.

Modem

Modems allow communication across longer distances than direct connection with a given interface. If the host computer is located farther than several thousand feet from the controller, modems should be used for communication.

To connect the controller to a host with a modem, follow this procedure:

1. Connect the controller host port socket to a modem using a 25-Pin to 25-Pin, modem cable assembly such as INTERMEC Part No. 043237S which supports an RS-232 interface.

2. Connect the two modems together using an appropriate interface, such as an acoustic coupler or direct connection to telephone communication lines.

3. Connect a second modem to the host computer using the appropriate cable assembly for the host and modem.

Current Loop

A 20 mA Current Loop interface offers clearer transmission and noise immunity in environments prone to electrical interference or where data transmission over long distances is required. Current Loop can only be used with asynchronous communication, which is the data communication method supported by the controller.

Current Loop is available as a controller option. Consult your local INTERMEC representative for Current Loop adapters that will work with the controller. To use Current Loop, the controller must use an RS-232 interface with a Current Loop adapter connected.

CONNECTING THE 9154 TO POLLED DEVICES

The controller has one polling port with a 9-Pin,"D" Style, sub-miniature socket. Multi-Drop cabling connected to this port can support up to 32 devices. This section explains how to connect the controller to the polled devices with a Multi-Drop cabling system. Figure 4-10 illustrates the connection of a Multi-Drop cable to the controller.

The tasks required to install a Multi-Drop cabling system are:

1. Design the layout of the Multi-Drop cabling system.

2. Select Multi-Drop cables for installation.

3. Choose the method for installing the Multi-Drop cabling.

4. Install the Multi-Drop cabling.

5. Connect the devices to the cabling.

Each of these steps are described in this section, "Connecting the 9154 to Polled Devices."

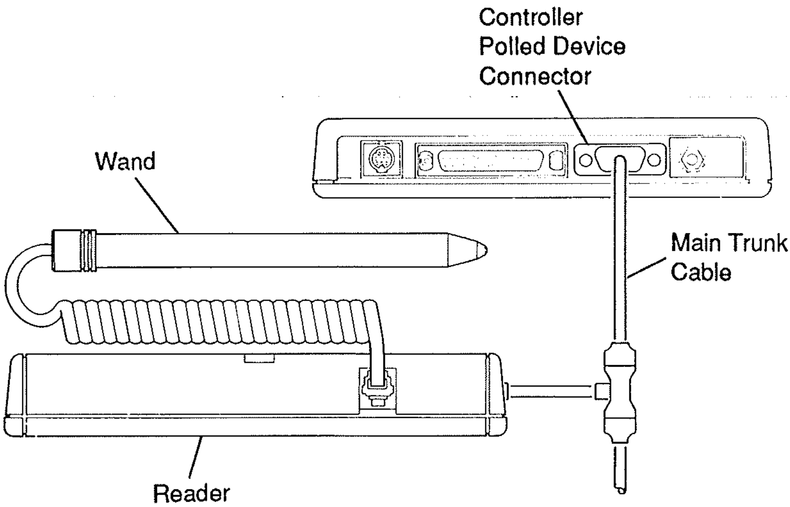


Figure 4-10
Connecting a Multi-Drop Cable to the Controller

Compatible Readers and Printers

INTERMEC Multi-Drop Protocol is the only polling protocol supported by the 9154 Controller. The following INTERMEC devices can be configured to operate with Multi-Drop protocol and thus can be used with the controller on its Multi-Drop line.

Table 4-2
Readers and Printers Compatible with the 9154

Model Number:	Comments:
Readers	
INTERMEC 9440	(Requires 9440 Communication Dock)
INTERMEC 9510	All units
INTERMEC 9511	All units
INTERMEC 9512	All units
INTERMEC 9540	All units
INTERMEC 9550	All units
Printers	
INTERMEC 863X-Series	All units
INTERMEC 864X-Series	All units

Designing a Multi-Drop Cable Layout

The following terminology is helpful when discussing Multi-Drop cabling.

Term:	What it is:
Main trunk cable	The Multi-Drop cable extending from the 9-Pin polled device connector on the rear of the controller.
Main trunk segment	A section of main trunk cable, usually from one drop site to the next drop site.
Drop site	The location on the main trunk cable where a drop cable is connected.
Drop cable	The cable that extends from the main trunk cable to the polled device. This cable makes the 9-Pin to 25-Pin connection.

The allowed Multi-Drop layout consists of one main trunk cable with a maximum of 32 drop sites where drop cables are attached. Follow these guidelines for creating a cable layout:

- The one main trunk cable may be a maximum length of 2000 feet.
- On the main trunk cable the minimum distance allowed between drop sites is two feet of main trunk cable. This means the minimum length of a main trunk cable is two feet.
- The drop cable, from the main trunk cable to the device port, may be a maximum of 30 feet long.

No other layout is guaranteed to work properly. See Section 3, "Designing a 9154 System," for specific instructions on system design.

Multi-Drop Cables

Devices connected to the controller interchange data using 4-wire RS-485. INTERMEC cables for each part of the Multi-Drop system are described in this section. If you are making your own cables, they must satisfy the specific requirements which follow.

Cabling Requirements: The basis of the Multi-Drop system is a shielded, four-wire (two twisted pairs) cable. The cable used should be made up of two individually or fully shielded pairs. Cable specifications are listed below:

Cable Requirement:	Specification:
Wire Size	24 gauge or larger
Nominal Impedance	100 ohms or less
Nominal Capacitance	12.5 pf/ft or less
Attenuation	6 dbv in 2100 ft or less
Heat Resistance	Pass the VW-1 vertical flame test.

You may create custom Multi-Drop cabling for connecting polled devices. Table 4-3 provides a list of Belden cables that meet the above requirements for Multi-Drop cabling.

Table 4-3
Belden Cable Meeting 9154 Controller Requirements

Belden Part No	VW-1 Test	Gauge	Nom Imped	Nom Cap	6 dbv
9729	Yes	24	100	12.5	2100
8102	No	24	100	12.5	2100
8162	No	24	100	12.5	2100
89729	UL	24	100	12.5	2100

Belden cable #89729 has the additional feature of being UL listed for use in an air plenum without being in conduit (NEC Article725, UL classified, Class 2 Circuits).

Available INTERMEC Cables: To save the time and expense of locating a source for custom cabling components, cables and components designed specifically for use in Multi-Drop systems may be obtained from INTERMEC. See Table 4-4 for a list of cables and components. See Figure 4-11 for an example of how INTERMEC cables would be used in an installation.

Table 4-4
INTERMEC Cabling for Multi-Drop Systems

Purpose:	INTERMEC Part No.:
Main Trunk Cable	583262
Trunk Cable Test Segment	047661
Trunk Cable Connector Kit	047662
Drop Cable	047653

Note: It is recommended, even if no other INTERMEC cables or connectors are purchased, that an INTERMEC Drop Cable, Part No. 047653, be purchased for each device to eliminate the time and expense of making the 9-Pin to 25-Pin connection at every drop site.

Note: By using INTERMEC Part No. 047653, a 30 foot drop may be made from the trunk cable. When wiring a cable yourself, INTERMEC recommends a 20 foot maximum drop.

A description of each INTERMEC cable follows:

Main Trunk Cable, INTERMEC Part No. 583262: This cable is ordered by the foot. During installation, lengths of cable are cut off the cable roll and used with Trunk Cable Connector Kit, INTERMEC Part No. 047662, to make trunk cable segments.

Trunk Cable Test Segment, INTERMEC Part No. 047661: This cable is used in test situations. It is pre-wired to connect with a Drop Cable, INTERMEC Part No. 047653, and is six feet long. See Section 3, "Designing a 9154 System," for information about test systems.

Trunk Cable Connector Kit, INTERMEC Part No. 047662: This kit is used to connect the main trunk cable to drop cables. The kit contains:

- 9-Pin Plug
- 9-Pin Socket
- Wiring Accessories
- Wiring Diagram

Drop Cable, INTERMEC Part No. 047653: The drop cable is used to connect a device to the main trunk line. It comes equipped with a pre-wired, molded T-connector that connects to the trunk line, and a 25-Pin, "D" Style, sub-miniature plug that connects to the Multi-Drop device.

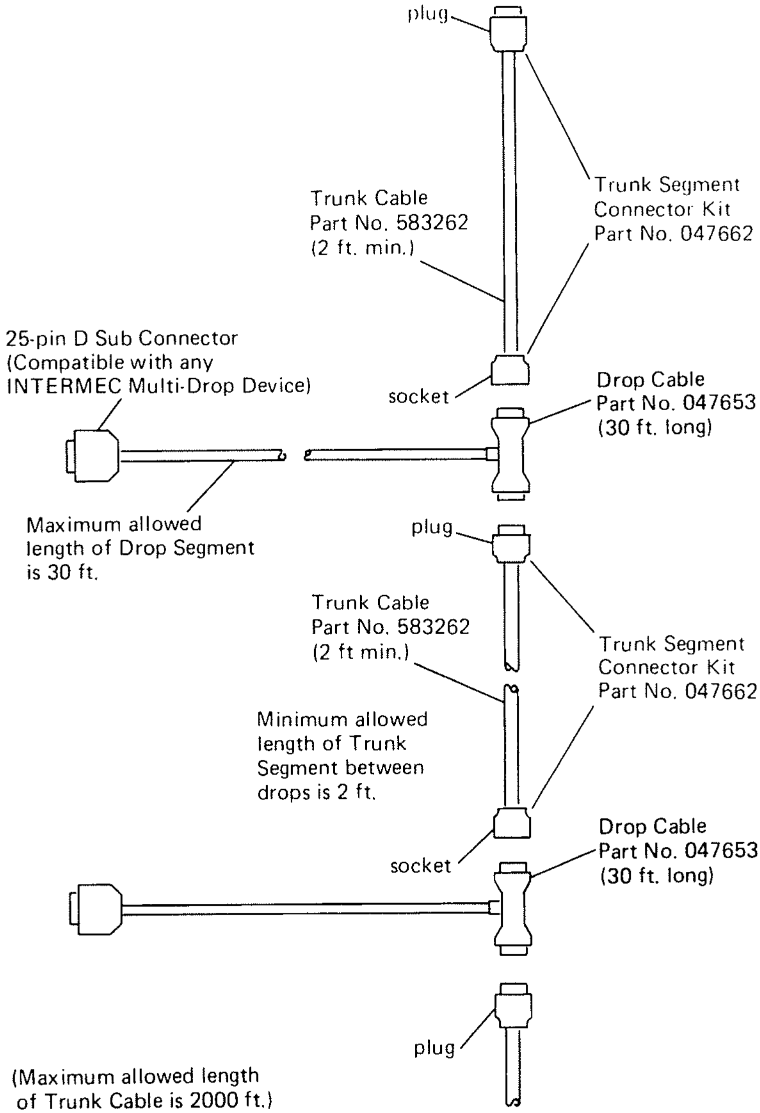


Figure 4-11
Multi-Drop Cable Installation

Installing the Multi-Drop Cabling System

There are two ways to install a Multi-Drop Cabling system:

- Build the main trunk cable segment-by-segment as the drop cables are installed.
- Lay the entire main trunk cable, then go back and insert drop cables.

Choose the method you are going to use and see the appropriate guidelines in the sections that follow. Regardless of which method is used, observe the following two guidelines.

Ending the Main Trunk Cable: The main trunk cable may be ended either at a drop site where the T-connector is the termination, or by leaving a section of unterminated main trunk line.

No special termination should be installed because it will reduce the signal amplitude in the rest of the line.

Splices: Splices between cable sections can be made open (with heat shrink or other applied protection), but keep the unshielded section shorter than two inches. The splice can also be made in a shielded box, but this is not required. The shields are connected to each other at all cable section ends and to the controller through pin 1.

Segment-By-Segment Main Trunk Cable Installation

The main trunk cable may be built as the bar code readers and printers are installed. Instructions for building a system this way follow:

1. Measure and cut a length of Multi-Drop cable (INTERMEC Part No. 583262) a little longer than the distance from the controller to the first device drop site. The distance must be at least two feet as shown in see Figure 4-11.

2. Wire a 9-Pin, "D" style, sub-miniature plug to the controller end of the cable length and wire a 9-Pin, "D" Style, sub-miniature socket to the drop cable end of the cable. The cable ends must be wired as illustrated in Figure 4-12.

   INTERMEC Part No. 047662 supplies the required connectors. Figure 4-10 illustrates the completed connection of the main trunk cable between the controller and the polled device.

3. Attach a drop cable from the main trunk cable to the device location using one of the two following methods:

   - Use INTERMEC Part No. 047653; plug the T-connector into the main trunk cable and plug the 25-Pin,"D" style, sub-miniature connector into the device.

   - Construct the connection using wiring information from Figure 4-12. Check that the length of the drop cable is sufficient to reach from the main trunk cable to the device, but not longer than 20 ft. Any excess cable length between the main trunk and the device should be bundled and tied.

4. Repeat steps 1 through 3 as many times as necessary until the last drop cable have been added.

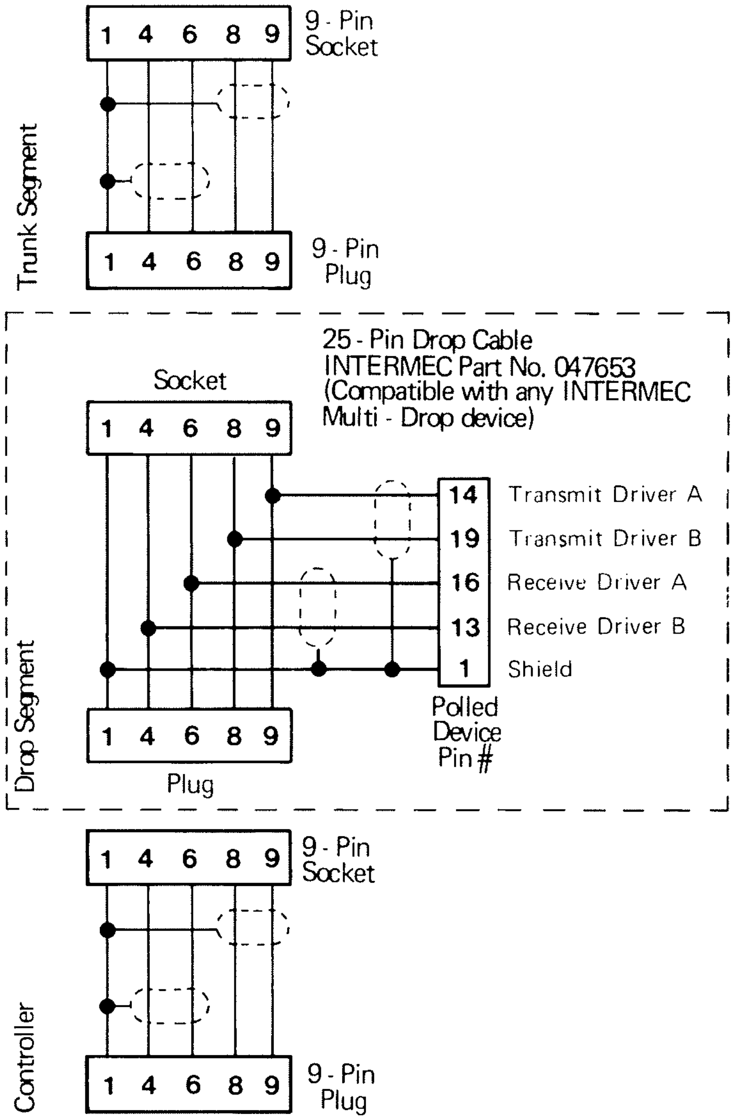


Figure 4-12
Multi-Drop Wiring Diagram

Laying the Main Trunk First

An alternative to creating Multi-Drop cabling segment-by-segment is to lay the main trunk cable out along its entire path. Then add drop cables after the main trunk cable has been installed.

1. Install the main trunk line along its entire path ensuring that there is slack in the cable so that connections can easily be inserted and corrected during installation.

2. Attach a 9-Pin, "D" style, sub-miniature plug to the end of the main trunk cable nearest the controller. Insert the plug into the host connector on the rear of the controller.

3. Cut the main trunk line near the drop site. Ensure that the cut is at least two feet from any other drop sites or the controller.

4. Attach a 9-Pin, "D" Style, sub-miniature socket to the end of the main trunk cable nearest the controller. Attach a 9-Pin, "D" style, sub-miniature plug to the end of the main trunk cable away from the controller.

5. Attach a drop cable from the main trunk cable to the device location using one of the two following methods:

   - Use INTERMEC Part No. 047653 plug the T-connector into the main trunk cable and the 25-Pin, "D" style, sub-miniature connector into the device.

   - Construct the connection using wiring information from Figure 4-12. Check that the length of the drop cable is sufficient to reach from the main trunk cable to the device, but not longer than 20 ft. See Figure 4-11 for maximum and minimums lengths. Any excess cable length between the main trunk and the device should be bundled and tied.

6. Repeat steps 3 through 5 at each drop site.

Note: The method explained in steps 3 through 5 may be used to insert new drop sites in an already existing main trunk cable.

Connection to Specific Readers

All the devices supporting Multi-Drop protocol connect to the Multi-Drop cable using a 25-Pin, "D" Style, sub-miniature socket. The maximum length allowed between the device and the main trunk cable is 30 feet. The transmit and receive drivers are at all times. Figure 4-12 illustrates the pins used by this interface.

The 9-Pin to 25-Pin connection necessary to connect the devices to the Multi-Drop main trunk cable is described in "Segment-By-Segment Cable Installation" earlier in this section. If you used INTERMEC Part No. 047653, no cable connection is required when connecting the polled device to the trunk cable.

See your reader manual for information about connecting input devices like slot scanners, wands, satellite wand stations, and laser scanners to the reader.

VERIFYING SYSTEM INSTALLATION

At this point the controller system should be fully installed. Except for removing the Supervisory CRT after the controller has been configured in Section 5, "Configuring the Controller," no more hardware handling should be necessary.

Before applying power to the controller or any connected equipment, review the following checklist to verify the system installation:

1. Check the controller location and mounting:

Type of Mounting:	Check:
Flat surface	Controller is positioned away from edges.
Screws	Firmly attached.

2. Ensure that the AC power source is noise-free and at the proper voltage and frequency.

3. Check that the controller power supply rating is the proper one for the AC power source.

4. Check that a grounding wire is connected both to the grounding stud on the rear of the controller and a good earth ground.

5. Check that the Supervisory CRT is plugged into the 9-Pin socket on the front of the controller, located next to the Power pushbutton.

6. Check that the host computer line is plugged into the 25-Pin socket on the rear of the controller.

7. Ensure that the controller to host computer interface is a reasonable choice for the work environment. In particular, check the interface if the distance is longer than 250 feet for RS-232 or longer than 4000 feet for RS-422/485. Section 3, "Designing a 9154 System," discusses the choice of interface.

8. Check that the Multi-Drop main trunk cable is plugged into the 9-Pin socket on the rear of the controller.

9. Check the layout of the Multi-Drop cabling to ensure that:

   - The single main trunk cable is no longer than 2000 feet.
   - The main trunk cable has no cable termination.
   - The distance between drop sites on the main trunk line is at least two feet.
   - No customer-manufactured drop cable is longer than 20 feet. No drop using INTERMEC Part No. 047653 is longer than 30 feet.

10. Check that all cable plugs are firmly inserted into the sockets, and the connections are secured where applicable.

11. Inspect that the following pin assignments are properly made:

    - The controller to Supervisory CRT(9-Pin to 25- Pin)
    - Drop cables (9-Pin to 25-Pin)
    - Main trunk cable connection (9-Pin to 9-Pin)
    - Serial interface to the host (RS-232, RS-422/485, 20 mA Current Loop, and modem)

Section 5, "Configuring the Controller," and Section 6, "Configuring Polled Devices," explain how to configure the controller and the polled devices. The host computer must also be configured, but that information is outside the scope of this manual. See your host system reference manual for host configuration information.

SECTION 5

CONFIGURING THE CONTROLLER

CONFIGURATION OVERVIEW

APPLYING POWER TO THE 9154

CONFIGURING THE 9154 TO COMMUNICATE WITH THE SUPERVISORY CRT

MASTER MENU

INITIALIZING THE CONTROLLER

SELECT OPERATING PARAMETERS

SELECT TRANSMISSION PARAMETERS

SELECT CLOCK PARAMETERS

SELECT POLLED DEVICES

VERIFYING CONTROLLER CONFIGURATION

SETTING DEVICE ADDRESSES

CONFIGURATION OVERVIEW

This section explains how to customize the controller firmware to communicate with the host computer and the polled devices. All the controller system hardware should be connected before performing the step-by-step procedures outlined in this section. See Section 4, "Installing Hardware" for step-by-step instructions on installing system hardware.

After the Supervisory CRT is configured to communicate with the controller, as explained in the next section, "Configuring the 9154 to Communicate with the Supervisory CRT," you will use the Supervisory CRT to configure the controller. The Supervisory CRT has four screens for configuring controller parameters, all of which are accessed from the Master Menu. Those four screens are:

- Select Operating Parameters
- Select Transmission Parameters
- Select Clock Parameters
- Select Polled Devices

Some of the procedures in this section may be skipped if the factory default values for those parameters are satisfactory. If all the default values are satisfactory for establishing data communication, no configuration is necessary.

Once the values which come from the unit from the factory have been changed, the new settings must be saved before they can be used by the controller. They may be saved to RAM, or to both RAM and EEPROM. The RAM copy of the configuration parameters will be lost if a prolonged power interrupt (over two weeks) occurs. If the configuration parameters are saved to EEPROM, they are permanent until changed by the Supervisory CRT or host, and will not be lost during a prolonged power interrupt.

APPLYING POWER TO THE 9154

Turn on the controller by pushing in the Power pushbutton on the front of the controller.

When the controller is powered up, it will perform a series of self tests. Once the tests are complete, the controller will immediately begin polling the Multi-Drop port and initializing communication with the host computer using the factory settings for the operating, transmission, real time clock, and polled device parameters stored in RAM. For a listing of factory default settings for all parameters, see Appendix B.

The controller will continue using the default values until it receives other instructions from the host or Supervisory CRT.

CONFIGURING THE 9154 TO COMMUNICATE WITH THE SUPERVISORY CRT

Before the Supervisory CRT can be used to configure the controller for communication with the host computer or the polled devices, the controller must be able to communicate with the Supervisory CRT.

When the power is turned on, the controller sends the Master Menu screen out the CRT port to the Supervisory CRT screen. If the Master Menu that appears is formatted incorrectly or displays garbled characters, you must configure the Supervisory CRT line parameters using the Automatic Baud Rate Detection sequence. If no screen appears, check the hardware connection between the controller and the CRT. If no screen appears, and the hardware connection is satisfactory, there may be a large difference between the controller and CRT baud rate, and the Automatic Baud Rate Detection sequence must be used.

Automatic Baud Rate Detection Sequence

To start the Automatic Baud Rate Detection sequence, follow these steps. Ensure that the controller power is turned on before starting.

1. Press the [Break] key on the Supervisory CRT keyboard.

Note: Once the [Break] key is pressed, the rest of the sequence must be entered within 10 seconds or the Automatic Baud Rate Detection sequence must be started again by repeating step 1. If the 10 second timeout occurs, the operating system will attempt to display the same screen shown when the [Break] key was pressed.

2. Enter [Shift] [U] (capital letter "U") until U or any other character is displayed on the screen OR until you have pressed [Shift] [U] eight times.

3. Once a character appears, enter a single [Shift] [I] (capital letter "I").

END key is the break sequence for the VT100

Selecting Supervisory CRT Terminal Type

After entering "I", you will be prompted to select a terminal type.

```
Terminal Types:        1  IBM 3101     4  TELEVIDEO, ADM 31/32/42
                       2  DEC VT100    5  HAZELTINE
                       3  ADM 3/5      6  OTHER

Enter Terminal Type: -
```

The six terminal choices are: five standard types of terminals and "OTHER." "OTHER" allows the controller to be configured for the specific clear screen and cursor position commands used by the terminal.

If the Supervisory CRT being used is one of the five types listed or has been configured to emulate one of these types, enter the number corresponding to that terminal type and press [CR].

Terminal Type Number:	Terminal:
1	IBM 3101
2	DEC VT100
3	ADM 3/5
4	Televideo, ADM 31/32/42
5	Hazeltine

For example, to configure the controller to communicate with a generic terminal or PC terminal emulator that is configured as a DEC VT100, enter [2] and press [CR]. The new default terminal will be stored in RAM. If you want to store the terminal type number in EEPROM, you must invoke the store EEPROM command (ESC) from the Master Menu or from one of the other Configuration screens.

If the CRT being used is not one of the five standard types, continue to the next section, "Configuring for a Non-Standard CRT." Otherwise, skip to the section called "Master Menu."

Configuring for a Non-Standard CRT

If the Supervisory CRT being used is not one of the five types listed, use "OTHER" to set the specific clear screen and cursor address command for the "home" position. You must have a reference manual or specific knowledge of the CRT being used for configuration. The Supervisory CRT will prompt you to enter the following three parameters:

- Clear Screen Sequence
- Cursor Row & Column Position
- Cursor Address Command Sequence for the Home Position

Follow these steps to configure the controller for a Non-Standard CRT:

1. Enter [6] then press [CR] to start the "OTHER" sequence, the following clear screen prompt will appear:

   Enter Clear Screen Sequence:

2. Enter the Clear Screen sequence and press [CR].

   The Clear Screen sequence can be up to six ASCII characters. If more than six are entered, only the first six characters will be displayed and the CRT will beep. Press [CR] to accept.

   If you want to enter [CR] or any other active CRT command as part of the Clear Screen Sequence, it must be preceded by [CNTL] [P]. CRT commands that must be preceded by [CNTL] [P] include: [CNTL] [T], [Backspace], [DEL/Rubout], [CNTL] [X], [CNTL] [R] and [CNTL] [K]. To enter DLE, [CNTL] [P] must be entered twice.

   See Table 5-1 for directions on entering ASCII control characters with the use of the [CNTL] key.

   After you enter the Clear Screen sequence, the following cursor row and column prompt will appear:

   Enter Cursor Row & Column Positions:

3. Enter the Cursor Row and Column positions and press [C].

   You must enter two numeric digits ("0" to "7") so that the controller will know where to look for the cursor home coordinates. The first digit specifies the offset for the row. The second digit specifies the offset for the column position.
   When entering offsets, 0 defines an offset of one character and 7 defines an offset of eight characters. The offsets are measured from the first character of the command sequence. In the example that follows, <ESC> is the first character of the cursor home command sequence. Counting to the right, the cursor row position is the third character of the sequence and the cursor column position is the fourth. The offsets from the start of the cursor home command sequence is 2 and 3 respectively. The correct entry would be "23."

1	**234**	Command Sequence character position
0	**123**	Offsets

   <ESC>=RC

   R is the cursor row position (actual value of 1) which is offset 2 from the start of the cursor home command sequence.

   C is the cursor column position (actual value of 5) which is offset 3 from the start of the cursor home command sequence.

   After entering the offsets, the final prompts will appear as follows:

   Enter Cursor Address Command Sequence for the Home Position:

4. Enter the cursor address command sequence and press [CR]. The cursor home position must be defined when entering this sequence.

   The Cursor Address sequence can be up to eight ASCII characters long. If more than eight are entered, only the first eight characters will be displayed and the CRT will beep. Press [CR] to accept.

   If you want to enter [CR] or any other active CRT command as part of the Clear Screen Sequence, it must be preceded by [CNTL] [P]. CRT commands that must be preceded by [CNTL] [P] include: [CNTL] [T], [Backspace], [DEL/Rubout], [CNTL] [X], [CNTL] [R] and [CNTL] [K]. To enter DLE, [CNTL] [P] must be entered twice.

   See Table 5-1 for directions on entering other ASCII control characters.

   When the final CRT parameter, the Cursor Address command, has been entered, all the CRT parameters are initialized and automatically stored in RAM as the new default values for the controller's CRT interface. The Master Menu will be displayed, as shown in the section, "Master Menu." If you want to store the CRT parameters to EEPROM, you must invoke the store to EEPROM command ([ESC]) from the Master Menu or from one of the Configuration screens.

If you remove the Supervisory CRT after configuring the controller, it will be easy to re-connect a CRT which is compatible with the original Supervisory CRT if CRT parameters are stored in EEPROM.

MASTER MENU

After the controller has been configured to communicate with the Supervisory CRT, the Master Menu screen should appear. However, several conditions can effect the Master Menu display.

If the controller detects a fault in its internal memory when the power is turned on, the Master Menu will not appear and a status condition indicating the fault will appear on the status lights.

If all power-up tests pass, the Master Menu will appear and will display "Running" next to the "System" heading. If the HALT ([CNTL] [K]) command is given, "Idle" will appear instead. If the polled device data storage capacity is full, "Buffer Full" will be displayed.

Enter [CTNL] [K], the Stop Polling command, to stop the polling of devices which starts automatically when the controller is turned on. It will be easier to configure the controller if you stop it from polling devices. After the controller has been configured, enter [CNTL] [R] to start polling.

INITIALIZING THE CONTROLLER

All screens are accessed from the Master Menu by entering the appropriate screen number and pressing [CR]. The four screens used to configure data communication between the host and controller and the host and polled devices follows:

Screen Number:	Screen Name:
1	Select Operating Parameters
2	Select Transmission Parameters
3	Select Clock Parameters
6	Select Polled Devices

Note: The Config LED comes on when screen 1, 2, 3, or 6 are displayed.

The initialization process is the same for each of the four screens. It requires these three steps.

1. Display the appropriate screen from the Master Menu screen by entering the screen number followed by [CR].

2. Change/Select/Insert the appropriate values for the parameters displayed on that screen.

3. Save the new values in RAM, or both RAM and EEPROM, re-initialize the controller, and return to the Master Menu screen.

As mentioned in Section 3, "Designing a System," the initialization process can be streamlined by first making a list of the configuration parameters, particularly for the host to controller data link. Refer to "Configuration Preparation" in Section 3 for a list of configurable parameters.

Using the Supervisory CRT Screens to Configure

Each screen contains a series of fields where parameters can be entered or selected. Each field is preceded by the name of the parameter. Not all fields will accept input; some are used only for displaying information. The commands that can be executed from that screen are listed at the bottom of the screen. Use of each screen is similar and involves the following tasks and commands.

Cursor Movement: Press [CR] to move the cursor from one field to the next. Pressing [CR] after the parameter is entered moves the cursor to the next field. When the cursor is in the last field, pressing [CR] moves the cursor to the first field at the top of the screen.

Entering and Changing Parameters: To enter or change a parameter, position the cursor in the appropriate input field and type in the desired value and then press [CR]. Backspace to correct errors with [backspace] or [DEL/Rubout], or use [CNTL] [X] to clear the whole field. Disable a parameter by clearing the field and pressing [CR]. To enter a Supervisory CRT command as data, it must be preceded by [CNTL] [P]. When [CR] is pressed after a value is entered:

- If the parameter value is valid, the cursor moves to the next input field.
- If the parameter value is invalid, the Supervisory CRT beeps, and the cursor moves to the beginning of the input field. An acceptable value for the parameter must be entered before the cursor will move to the next field. Acceptable values are listed to the right of the input field for some parameters.

Note: A valid value does not mean that the value is appropriate for your particular data communication interface, only that it is an acceptable value for that specific parameter.

Saving Parameters

Before saving the parameters, review the new values displayed on the screen. If any parameters need changing, follow these steps:

1. Move the cursor to the appropriate field by repeatedly pressing [CR].
2. Change the parameter, or enter [CNTL] [X] to erase the field and then enter a new parameter value.

Once all the parameters on a screen have been configured accurately, they must be saved to RAM or to EEPROM and RAM. The controller will operate with the old values of the configuration parameters until the new values are saved.

1. Enter [CNTL] [T] to save the configuration parameters on the screen on which it was invoked to RAM. This will not update the EEPROM. If the controller power is interrupted so long that battery-backed RAM fails to save the RAM configuration parameters, the EEPROM values will replace the RAM values.

2. Enter [ESC] to save the configuration parameters on all the screens to EEPROM. This also updates the RAM copy of the configuration parameters.

Regardless of which command is used, the Master Menu is displayed on the Supervisory CRT screen and the controller is re-initialized to operate with the new configuration parameter values.

Writing EEPROM Configuration Parameters to RAM: If you want to exit a screen without saving any changes, use the following procedure to restore the original values. This procedure will change all the configuration parameters on screens 1, 2, 3, and 6 to the EEPROM values.

Note: This procedure will also erase all data in the polled device buffer and host mailboxes.

1. Change at least one configuration parameter value and press [CR] to confirm, but do not enter [CNTL] [T] to save it.

2. Turn the controller off by switching the Power pushbutton to the off position.

3. Turn the controller on by pushing the Power pushbutton to the on position.

The configuration parameters displayed on screens 1,2,3, and 6 will have the EEPROM values.

Screen Commands

The commands listed below can be given from the initialization screens and are used in the initialization process. For a complete description of all Supervisory CRT commands, see the "Supervisory CRT Command Summary" in Section 8.

[CNTL] [X]

Cancels line. Erases the value in the input field where the cursor is positioned and repositions the cursor at the beginning of the field. Can be used to disable a parameter.

[CNTL] [T]

Returns to Master Menu. Removes the current screen from the CRT and returns to the Master Menu. Screen parameter values are saved to the RAM copy of the configuration parameters. The controller is re-initialized to operate with the new RAM copy of the configuration parameters.

The controller always calculates a checksum of the RAM copy of the configuration parameters when [CNTL] [T] is invoked.

When the controller is turned on, the controller always checks for a correct checksum. If the RAM checksum is correct, the controller is initialized to operate with the RAM copy of the configuration parameters.

If the RAM checksum is incorrect, the controller is initialized to operate with the EEPROM copy of the configuration parameters, and the polled device data queue and the host mailbox are cleared of all existing data. The RAM checksum will fail after a prolonged power interrupt or if a power interrupt occurs before changed parameter values are saved.

[ESC]	Updates EEPROM. Writes all the parameter values currently displayed on the screens to RAM and EEPROM and then returns to the Master Menu. The controller is re-initialized to operate with the new EEPROM copy of the configuration parameters.
[CTRL] [V]	Write Factory Default. This command is available from the Master Menu screen only. It asks if you want to "Write Default Configuration Parameters To EEPROM? (Y/N)..". If you enter "Y", the factory default parameters will be written to EEPROM and then RAM. The controller will be re-initialized with the factory default values, including the screens displayed on the Supervisory CRT. "N" or any other entry will cause the Master Menu screen to be redisplayed.
[CNTL] [Y]	Update Clock. This command is used on the Select Clock Parameters screen to update the controller's real time clock to the time and date parameters displayed on that screen.
[CNTL] [R]	Starts Polling. This command instructs the controller to start polling the devices on the Multi-Drop line using the current configuration parameters.
[CNTL] [K]	Stop Polling. This command stops the controller from polling the devices on the Multi-Drop line.
[CNTL] [P]	Next Entry Data Only. After using this command, the next keyed input is received by the controller as data. This allows the ASCII control codes associated with the above Supervisory CRT commands to be entered as data. Enter [CNTL] [P] twice to enter DLE as data.

SELECT OPERATING PARAMETERS

The operating parameters are set using the Select Operating Parameters screen. To display this screen, enter [1] and then [CR] from the Master Menu. The cursor will be positioned in the first input field, Line Speed, under the Host Line Parameters heading.

```
                    Select Operating Parameters
                                                              HH:MM

Host Line Parameters:

   Line Speed ......     9600   (19200,9600,4800,2400,1200,600,300,110)
   Parity ..........     E      (E = even, O = odd, N = none)
   Data Bits .......     7      (7 or 8)
   Stop Bits .......     1      (1 or 2)

Multi-Drop Parameters:

   Line Speed ......     9600   (19200,9600,4800,2400)
   Address .........     p      (m, n, o, p)

CRT Line Parameters:

   Line Speed ......     9600   (19200,9600,4800,2400,1200,600,300,110)
   Parity ..........     E      (E = even, O = odd, N = none)
   Data Bits .......     7      (7 or 8)
   Stop Bits .......     2      (defaulted)
   Clear Screen ....     {SUB}                    (ADM 3/5)
   Row/Column Offsets    2/3
   Cursor Address ..     {ESC}=<SP><SP>

Press CNTL-T Return to Task Options
Press CNTL-X to Cancel Entry
Press ESC to Update EEPROM
```

Two types of operating parameters can be modified with this screen:

1. Host line parameters set the line parameters between the controller and the host.

2. Multi-Drop parameters set the configurable parameters between the polled devices and the controller.

The CRT line parameters display the current values of the line parameters between the Supervisory CRT and the controller. These parameters are displayed but can not be changed from this screen; CRT Line Parameters are configured by the Automatic Baud Rate Detection sequence.

Line Parameters for Host Port

Four parameters can be configured for the Host Port Line: Line Speed, Parity, Data Bits, and Stop Bits. Check the default settings against the values required by the host, because these values must match.

Line Speed: Data is interchanged between the host and the controller at one of eight selectable baud rates. The eight available settings are listed below:

19200
9600
4800
2400
1200
600
300
110

The default setting is 9600. If the default setting is satisfactory, press [CR]. The cursor will move to the next field, Parity. If you need change the value, type the new value, and then press [CR]. If the entered value is acceptable for that parameter, the cursor will move to the next field, Parity.

If the typed value is not one of the eight values listed to the right of the field, the Supervisory CRT will beep, and the cursor will move to the beginning of the Line Speed field. Either retype an appropriate value over the old line speed, or press [CNTL] [X] to cancel the entry and then type in a new value. Before pressing [CR], you can use the backspace or DEL/Rubout keys to change entries.

Parity: The following three options are available for Host line parity.

Even
Odd
None

To implement mark or space parity use the following values:

Data format:	Data bits:	Parity:	Stop bits:
7 bits, mark	7	None	2
7 bits, space	8	None	2
8 bits, mark	8	None	2
8 bits, space	NA	NA	NA

NA Not applicable

The table assumes that stop bits are set to one.

The default setting is even. If even is a satisfactory value for Parity, press [CR]. The cursor will move to the next parameter field, Data Bits.

To change the parity to Odd or None, enter the first letter of the parity type followed by [CR]. The cursor will move to the next field, Data Bits.

Data Bits: Host Line Data Bits is the number of bits in a transmitted or received character. Two options are available:

7
8

The default number of data bits in a character is seven. If this is satisfactory, press [CR]. The cursor will move to the next parameter field, Stop Bits.

If the host computer operates at eight, enter [8], then press [CR]. The cursor will move to the next parameter field, Stop Bits.

Stop Bits: The Host Line has two options for the number of stop bits per byte:

1
2

The default number of stop bits is one. If one is satisfactory, press [CR]. The cursor will move to the next parameter field, Multi-Drop Line Speed.

If the host computer operates with two stop bits, enter [2], then press [CR]. The cursor will move to the next parameter field, Multi-Drop Line Speed.

Multi-Drop Parameters

The two Multi-Drop parameters, Line Speed and Address, are related to communication between the polled devices and the controller, and the controller's subsequent transmission of the data to the host computer.

Line Speed: Multi-Drop Line Speed is the baud rate at which communication occurs between the controller and the polled devices. All the polled devices must be set at the same line speed as the controller. Four options are available for line speed:

19200
9600
4800
2400

The default value for Multi-Drop Line Speed is 9600. If this is satisfactory, press [CR]. The cursor will move to the next parameter field, Address.

To change the line speed to one of the other four values, enter the new value and the press [CR]. The cursor will move to the next parameter field, Address.

Address: The 9154 Controller has only one Multi-Drop port. To maintain compatibility with the INTERMEC 9161 02 Multi-Drop Concentrator, the controller's Multi-Drop port must be assigned one of four addresses. The specific address selected is arbitrary, but will be used when processing data records on the host computer. Four choices for the controller's Multi-Drop port address correspond to the four Multi-Drop port addresses on the 9161 02 Multi-Drop Concentrator:

m
n
o
p

The default Multi-Drop port address is p. If this is satisfactory, press [CR]. The cursor will move back to the top of the screen, to the beginning of the Host Line Speed field.

To chose another port, enter the new port address in lower case or upper case and press [CR]. The cursor will move back to the top of the screen, to the beginning of the Host Line Speed field.

Saving Operating Parameters

Review the operating parameters displayed on the screen and change if necessary.

Then save the parameter values, re-initialize the controller, and return to the Master Menu by using one of the two following commands:

[CNTL] [T]	Save the operating parameters to RAM.
[ESC]	Save the operating parameters to RAM and EEPROM.

See "Saving Parameters" earlier in this section for detailed information about saving parameters.

SELECT TRANSMISSION PARAMETERS

The transmission protocol parameters are set using the Select Transmission Parameters screen. To display the screen, enter [2] and then [CR] from the Master Menu. The cursor will be positioned in the first input field, No. of Records Per Block.

For information about the different types of data communication protocols that can be used on the controller, see Section 7, "Host to Controller Communication."

```
                 Select Transmission Parameters           HH:MM

     To Host:                         From Host:

     No. Of Records Per Block:   1    POL:     <ENQ>
     Record Separator:    <CR>        SEL:     <BEL>
     Header:                          AFF:     <ACK>
     SOM:        <STX>                NEG:     <NAK>
     EOM:        <ETX>                DLE:     <DLE>
     RES:        <STX> Z <CR>         SOM:     <STX>
     AFF:        <STX> Y <CR>         EOM:     <ETX>
     NEG:        <STX> Z <CR>         Record Separator:  <CR>
     Error Message SOM:   <STX>       Delay (x 10 ms):    .0
     Error Message EOM:   <ETX>       Timeout (x 1 sec):  60
     Transparency Check N (Y or N)    Xon / Xoff Enable:  N     (Y or N)
     Data Wait Mode:    N (Y or N)    LRC Enable:         N     (Y or N)



Press    CNTL-P to Enter Command as Data
Press    CNTL-X to Cancel Line
Press    CNTL-T Return to Task Options
Press    ESC to Update EEPROM
```

The Select Transmission Parameters screen lets you modify a full range of data communication parameters to fit any host requirements.

Transmission parameters can be classified into two groups:

1. To Host Transmission Parameters
2. From Host Transmission Parameters

How to Select Transmission Parameters

Accepting Displayed Parameter Value: The controller comes from the factory with default values for the parameters. Pressing [CR] when the cursor is on a parameter field moves the cursor to the next parameter and leaves the displayed value unchanged.

Changing the Displayed Parameter Value: Enter the new value and press [CR]. If the value is acceptable for the parameter, the cursor will move down to the next parameter value. If the value is unacceptable, the Supervisory CRT will beep and the cursor will remain in that parameter field. An acceptable value must be entered before the cursor will move to the next field.

Disabling Parameters: A blank field indicates that the parameter is disabled. For example, Header, the third parameter down in the left-hand column, is blank. This indicates that if the default values were used, no header would be sent with each message to the host. Depending on the choice of data communication protocol, as explained in Section 7, "Host to 9154 Communication," various communication parameters may be disabled.

Entering ASCII Control Codes: The ASCII control codes will be displayed as their abbreviated English equivalents with brackets (<>) surrounding them. For example, DC1 will be shown as three separate characters on the Supervisory CRT screen: <DC1>. A NAK will appear as <NAK> on the Supervisory CRT screen.

However, when ASCII control characters are entered from the CRT keyboard, they are entered using the [CNTL] key, and not by their three character representation. For example, to enter NAK, enter [CNTL] [U], [CR], and not [N], [A], [K], [CR]. Table 5-1 lists the keys to press to enter all the ASCII control codes.

Entering Supervisory CRT Commands as Data: If any transmission parameter is going to be configured using a command utilized by the Supervisory CRT, such as BS, EM, CR, DC2, DC4, or CAN, it must be preceded by a [CNTL] [P] to inform the controller that this character is not to be intepreted as a command. For example, to assign the End of Record CR, enter [CNTL] [P], [CR]. Then press [CR] again to validate the parameter and move the cursor to the next parameter field. Enter [CTNL] [P] twice to enter DLE as data. Table 5-1 shows the relationship between ASCII control codes and Supervisory CRT commands.

CAUTION

In most cases, two communication parameters can not be defined as the same value or communication will be impossible. For example, if the SOM and EOM characters are BOTH defined as ETX (03H), the host and the controller will be unable to communicate. The controller will not know whether or not ETX indicates the beginning or the end of a message.

Table 5-1
Keystrokes for Entering ASCII Control Characters

Character	Definition	By [CNTL] [P]	Keystroke
NUL	Null	[CNTL]	[@]
SOH	Start of Heading	[CNTL]	[A]
STX	Start of Text	[CNTL]	[B]
ETX	End of Text	[CNTL]	[C]
EOT	End of Transmission	[CNTL]	[D]
ENQ	Enquiry	[CNTL]	[E]
ACK	Affirmative Acknowledge	[CNTL]	[F]
BEL	Bell	[CNTL]	[G]
BS	Backspace	[CNTL]	[H]
HT	Horizontal Tab	[CNTL]	[I]
LF	Line Feed	[CNTL]	[J]
+ HALT	Stop Polling	[CNTL]	[K]
VT	Vertical Tab	[CNTL] [P]	[CNTL] [K]
FF	Form Feed	[CNTL]	[L]
CR	Validate Entry		RETURN
CR	Carriage Return	[CNTL] [P]	RETURN
SO	Shift Out	[CNTL]	[M]
SI	Shift In	[CNTL]	[O]
+ DLE	Next Entry Data Only	[CNTL]	[P]
DLE	Data Link Escape	[CNTL] [P]	[CNTL] [P]
DC1	Device Control (XON)	[CNTL]	[Q]
+ RUN	Start Polling	[CNTL]	[R]
DC2	Device Control	[CNTL] [P]	[CNTL] [R]
DC3	Device Control (XOFF)	[CNTL]	[S]
MENU	Return to the Master Menu	[CNTL]	[T]
DC4	Device Control	[CNTL]	[T]
NAK	Negative Acknowledgement	[CNTL]	[U]
+ DEFAULT	Write Factory Default	[CNTL]	[V]
SYN	Synchronous Idle	[CNTL] [P]	[CNTL] [V]
ETB	End Transmission Block	[CNTL]	[W]
+ ERASE	Erase Line	[CNTL]	[X]
CAN	Cancel	[CNTL] [P]	[CNTL] [X]
+ SEND	Update Clock/Send Message	[CNTL]	[Y]
EM	End of Medium	[CNTL] [P]	[CNTL] [Y]
SUB	Substitute	[CNTL]	[Z]
+ EEPROM	Update EEPROM	[CNTL]	[[]
ESC	Escape	[CNTL] [P]	[CNTL] [[]
FS	File Separator	[CNTL]	[\]
GS	Group Separator	[CNTL]	[]]
RS	Record Separator	[CNTL]	[^]
US	Unit Separator	[CNTL]	[_]
+ DEL	Delete Data Entry		[DEL]
DEL	Delete Data Entry	[CNTL] [P]	[DEL]
SPACE	Space		[SPACE]

\+ Indicates this command can be invoked from a screen.

To Host Transmission Parameters

Twelve parameters on the Transmission Parameters screen configure the way the controller transmits messages to the host computer. Descriptions of each parameter follow.

No. of Records Per Block: Indicates the maximum number of individual polled device records that will be sent by the controller to the host in a given message block. The default is one. If one is satisfactory for No. Records Per Block, press [CR].

To change the No. of Records Per Block, enter a new value between 0 and 99 and press [CR].

For the most effective communication, it is recommended that you do not change this value. However, you can change the default value may be changed to any number between 0 and 99. If 0 is entered, no data will ever be transmitted.

If the AFF/NEG handshake is enabled later on this screen, the controller must re-transmit the whole transmission block if a NEG is received. Therefore, it is recommended you send a small amount of records within a transmission block.

Record Separator: The controller sends the Record Separator after every individual data record transmitted to the host. The default for the To Host Record Separator is CR (0DH). If this is acceptable, press [CR]. To change To Host Record Separator, enter up to two ASCII characters and press [CR]. If the No. of Records Per Block was defined as greater than one, the record separator should be defined.

Header: A header can be placed on the messages sent to the host by the controller. A common use of the header might be to designate which peripheral the message came from. The header can be up to five ASCII characters in length.

The default is header disabled, as shown by the blank field. If no header is needed, press [CR]. To add a header, enter the value and press [CR]. For example, to signify a controller number you could type "Cont1," and press [CR].

SOM: The Start of Message (SOM) is sent after the header, if used, and can be up to five ASCII characters.

The default SOM code is STX (02H). If this is acceptable, press [CR]. To change the SOM, enter the new value and press [CR].

To disable the SOM, enter [CNTL] [X], [CR]. The SOM field will be left blank, and the cursor will move to the next field, EOM.

EOM: The End Of Message (EOM) is sent after the data part of the message, and can be up to five ASCII characters.

The default EOM is the single ASCII character ETX (03H). If this is an acceptable EOM, press [CR]. Like the SOM, the EOM can be disabled for some protocols by entering [CNTL] [X] to clear the field and then pressing [CR].

RES: When the host asks the controller for data by sending a POL, and the controller has no data, the controller will send the host an RES.

The default setting for RES is the three ASCII characters STX Z CR. RES can be up to five ASCII characters.

AFF: If the host wants to transmit data to the controller, it will first send a SEL. The controller will respond to the host with either AFF or NEG. If the controller responds with AFF, it indicates that it is acceptable for the host to send data.

The default setting for AFF is the three ASCII characters STX Y CR. AFF can be up to five ASCII characters.

NEG: If the host sends a SEL to the controller asking if it is acceptable to send data, the controller will send a NEG if it can not accept data.

The default setting for NEG is STX Z CR. NEG can be up to five ASCII characters.

Error Message SOM: If the host transmits a message to a device address that is not connected, that has another message waiting to be transmitted to it, or that is disabled, the controller will send the following message to the host:

(Error Message SOM) XZ BEL (EOR)(Error Message EOM)

X is the port address and **Z** is the device address. **BEL (ASCII 7H)** denotes the error.

This message is sent when the host is waiting for an AFF/NEG response. If both the Error Message SOM and the Error Message EOM are disabled, the port and device address, followed by ASCII BEL will be sent to the host. If the AFF/NEG response is disabled, no response will be sent.

Error messages for more than one address can be sent in a single message block. For example, the host might send messages to three devices (A, B, and C), but two address buffers (A and C) are full. The controller would accept the message for B and send error messages for A and C back to the host in the following format:

(Error Message SOM) XA BEL XB BEL (EOR)(Error Message EOM)

The controller will not place the End of Record between the two records XA BEL and XB BEL.

The Error Message Start Of Message indicates the start of an error message. It can be up to five ASCII characters and can be set to a different value than the SOM. The Error Message SOM might be set to a different value than the SOM if the host application program identifies which polled device addresses were unable to receive a message, and uses that information in sending future messages.

The default value for the Error Message SOM is the single ASCII character STX, just like the SOM. The Error Message SOM and the SOM are two of the few transmission parameters that can be set to the same values.

Error Message EOM: The Error Message End Of Message indicates the end of an error message. The Error Message EOM and the EOM are two of the few transmission parameters that can be set as same values. However, the Error Message EOM can be set to a different value than the EOM.

The default value for the Error Message EOM is the single ASCII character ETX, just like the EOM. It can be up to five ASCII characters.

Transparency Check: The Transparency Check parameter allows the controller to send a control character used in the data communication protocol as part of the data stream. If the Transparency Check is enabled, an ASCII DLE (10H) character is placed directly in front of ASCII control characters contained in the data stream before any data is transmitted.

Even though the controller is shipped with it disabled, it is recommended that the Transparency Check be enabled since polled devices may send data that matches protocol settings in the host to controller interface. (The 9161 02 Multi-Drop Concentrator does not implement a transparency check.)

The default value for the Transparency Check is "N" for disabled. If this is satisfactory, press [CR].

To enable the Transparency Check, enter [Y], [CR].

Data Wait Mode: When Data Wait Mode is disabled, the controller will wait until it is polled by the host before sending data. When the Data Wait Mode is enabled, if the host has polled the controller, the controller will transmit data to the host as soon as data becomes available. Once data is transmitted to the host, the controller will wait for another POL from the host before transmitting more data.

For example, if the host polled the controller at 00:00:00 (hours, minutes, seconds), and data was available at 00:00:05, the controller would wait until it was polled at 00:01:00 to send data. With Data Wait Mode enabled, the controller will transmit the data at 00:00:05. If more data is received at 10:00:50, that data will not be transmitted until the controller is polled again at 10:01:00.

If device specific polling is used by the host application program, the controller will only send information for requested addresses. If the host wants to poll other addresses, it must send the poll for that address or a general poll.

The default setting for Data Wait Mode is "N" for disabled, if that is satisfactory, press [CR].

To enable Data Wait Mode, enter [Y], then press [CR].

From Host Transmission Parameters

The twelve From Host Transmission parameters specify what control character the controller expects the host computer to transmit.

The first two parameters, POL and SEL, are especially important because they determine whether the communication between the controller and the host is solicited or unsolicited for controller transmit and receive respectively. Section 7, "Host to 9154 Communication," explains the different applications of solicited and unsolicited protocols.

POL: The POL is used by the the host to ask if the controller has data. POL can be up to two ASCII characters.

The default value for POL is ASCII ENQ.

POL can be left blank, in which case the controller sends data as soon as it has it, without waiting for a host POL. To disable POL, enter [CNTL] [X], [CR]. The POL field will be cleared, and the cursor will move to the next parameter field, SEL.

The controller will respond to device specific polling where the host asks for data from a specific device only if POL is enabled. A device specific poll is arranged as follows:

XZ POL

X is the single character port address (m,n,o,p).

Z is the single character device address (A-Z, or 0-5).

The address XZ may also be "SS" to poll controller status.

Responses to device specific polls are the same as for general polls. See Section 7, "Host to 9154 Communication," for more information about device specific polling.

SEL: The SEL is used by the host to ask if the controller wants to send a message. SEL can be up to two ASCII characters.

The default value for SEL is ASCII BEL. If this value is satisfactory, press [CR].

SEL can be left blank, in which case the host can send data whenever it has data, without waiting for an AFF from the controller to confirm that it is ready to receive the data. To disable SEL enter [CNTL] [X] and press [CR].

AFF: AFF is the host response to a controller message indicating that the data is good.

The default value of AFF is ASCII ACK. AFF may be two ASCII characters.

NEG: NEG is the host response to a controller message and indicates that the data is bad and should be re-transmitted.

The default value of NEG is ASCII NAK. NEG can be up to two ASCII characters.

DLE: DLE is the character that precedes the control codes in host-to-controller communication to tell the controller that the character immediately after DLE is to be interpreted as data and not as a command.

The default for the host DLE is DLE (10H). The host DLE can be any single ASCII character.

SOM: The Host to Controller Start of Message is sent at the beginning of data messages to the controller. With certain protocols, this parameter can be disabled.

However, to maintain a secure data environment, it is recommended that this parameter not be disabled.

The default for the host SOM is STX (02H). The host SOM can be up to two ASCII characters.

EOM: The Host to Controller End of Message is sent at the end of data messages to the controller. This parameter must not be disabled or the controller will be unable to determine when or where received data ends.

The default for the From Host EOM is ETX (03H). The From Host EOM can be up to two ASCII characters.

Record Separator: The Host Record Separator is sent after every individual data record that the host sends to the controller.

The default for the Host Record Separator is CR (0DH). It may be up to two ASCII characters.

Delay Timer: If the host sends a POL to the controller asking if it has data, the controller will respond to that POL in the time specified by the Delay timer. The numeric value that is entered in the Delay data field is multiplied by 10 msec to give the amount of time that the controller will respond in. For example, if the Delay value is 2, the controller will respond in 20 msec.

The default for the Delay timer is 0 msec. Any two digit number between 0 and 99 may be entered in the Delay Timer field.

Timeout: The Timeout parameter selects the amount of time the controller will wait, after sending a message to the host computer, before it expects a response. The Timeout is also used when receiving data from the host. The next character must be received within the Timeout specificied. The numeric value for this parameter is multiplied by one second to obtain the length of the timeout period. For example, if the timeout is "5", and the controller has transmitted data in response to a host POL, the controller will expect an AFF or NEG before five seconds have elapsed. If the timeout period is exceeded, the controller will register a timeout error, and be ready to re-transmit the data record at the next host POL.

The default for the Timeout is 60 seconds. The Timeout can be any one or two digit number, 0 to 60.

XON/XOFF Enable: The XON/XOFF Handshake allows the controller and host to limit data transmissions if their receive buffers are full. The XON/XOFF handshake is especially useful if you are using an unsolicited communication protocol.

When the receiving unit's receive buffer is full, it will send XOFF (ASCII DC3) to the transmitter, telling it not to send any more data. After the receiving unit's receive buffer has room for more data, the receiving unit will send XON (ASCII DC1) to tell the transmitting unit that it is ready to accept data again.

The default for XON/XOFF is "N" for disabled. If this is satisfactory, press [CR].

To enable XON/XOFF, enter "Y" for Yes and press [CR].

LRC: The LRC is a message error check sent after the EOM character. The LRC is calculated as the exclusive OR of all the applicable characters in the following message block:

<Header> <SOM> Data <EOR> <EOM>

If the header is enabled, all characters except the first character of the header are used.

If the header is disabled, all character except the first character of the SOM are used.

If neither the header or the SOM are used all of the characters in the message are used.

The default for the LRC is "N", for disabled. If this value is satisfactory, press [CR].

To enable LRC, enter [Y] for Yes and then press [CR].

Saving Transmission Parameters

Review the transmission parametes displayed on the screen and change if necessary.

Then save the parameter values, re-initialize the controller, and return to the Master Menu by using one of the two following commands:

[CNTL] [T]	Save the transmission parameters to RAM.
[ESC]	Save the transmission parameters to RAM and EEPROM.

See "Saving Parameters" earlier in this section for detailed information about saving parameters.

SELECT CLOCK PARAMETERS

The real time clock parameters are set using the Select Clock Parameters screen. To display the Select Clock Parameters screen enter [3], the press [CR]. The cursor will be positioned in the first parameter field, Date.

```
                    Select Clock Parameters
                                                              HH:MM

     Set Real Time Clock:
       Date ................. YY.MM.DD      (YY.MM.DD)
       Time ................. HH.MM         (HH.MM)

   Press CNTL-Y to Set Clock

     Time Append:
       Enable Time Append ... N      (Y or N)
       Interval ............. 1      (0-99 minutes)
       Record Day Rollover .. N      (Y or N)

     Time Broadcast:
       Enable Broadcast ..... N      (Y or N)
       Interval ............. 1      (0-99 minutes)
       Preamble .............<HT>
       Postamble ............
       Display Format ....... 24     (12 or 24)
       Include YY/MM/DD····· N      (Y or N)


   Press CNTL-X to Cancel Line
   Press CNTL-T Return to Task Options
   Press ESC to Update EEPROM
```

Three types of real time clock parameters are available on this screen:

1. Set Time and Date
2. Time Append
3. Time Broadcast

Set Time and Date is used to update the controller real time clock.

Time Append specifies if and how to add time to the data records received from polled devices.

Time Broadcast specifies if and how time should be broadcast to the polled devices.

Both Time Append and Time Broadcast can be disabled. If they are disabled you will not need to change the other field associated with them.

The host computer can configure all of the controller's time parameters with host commands. For more information about computer configuration of the controller, see Section 7, "Host to 9154 Communication."

Note: If the host happens to update a clock parameter while this screen is displayed on the Supervisory CRT, the screen will be redisplayed so that you can see the change.

Set Real Time Clock

The two Set Real Time Clock parameters are used to change the time on the controller's internal real time clock. The current time is displayed in the upper right corner of the Supervisory CRT screen, and will be used for any Time Append or Time Broadcast parameters that are enabled.

Date: To update the controller's real time clock enter a new date in the following format:

YY.MM.DD

The following field restrictions apply:

Field:	Field Name:	Valid Entry:
MM	Month	1-12
DD	Day	1-31
YY	Year	00-99

Numbers are the only acceptable entries. If a invalid entry is made in the field, the CRT will beep and the cursor will stay in the field. The field delimiter (.) between YY and MM, and MM and DD must be entered in its proper locations or the Supervisory CRT will not accept the entry.

Time: The current real time clock time is displayed in the upper right corner of the screen in the following format:

HH.MM (HH = hour, MM = minutes).

To update the time on the controller's real time clock, enter a new time in the hours and minutes format. The following field restrictions apply:

Field:	Field Name:	Valid Entry:
HH	Hours	0-23 (24-hour)
MM	Minutes	0-59

Numbers are the only allowable entries in either the Hours or Minutes field. If a invalid entry is made in either part of the field, the CRT will beep and the cursor will be re-positioned at ìthe start of the field. The field delimiter between Hours and Minutes (.) must be entered, or the Supervisory CRT will beep and not accept the input.

Updating the Real Time Clock: After setting the time, you can update the controller real time clock by entering [CNTL] [Y]. Once the real time clock has been updated, all time functions will use the new time.

Time Append Parameters

The three Time Append parameters allow time to be appended to the records received from the polled devices at a specified time interval.

Do not enable time append on both the controller and the polled devices. If time is enabled on both, problems will occur at the host application when a record is received with two time stamps.

To add time to every record, enable Time Append and leave the Time Append Interval as zero. The controller will append time to every record in the following format:

data>DD:HH:MM <EOR>

To add time at regular intervals, enable Time Append and change the Time Append Interval to a non-zero value. A time record will be added to data waiting to be sent to the host at the specified time interval. The format is:

>DD:HH:MM <EOR>

Enable Time Append: Time append adds the time to records received from the devices at the time interval specified by the time interval parameter. Two options are available, "Y" for Yes, to enable time append, and "N" for No, to disable time append. The default is "N" for disabled.

If you will need time append enabled, press [CR].

To enable time append, enter [Y] and press [CR].

Interval: The interval is the minimum length of the time between adding time records to the information in the polled device data buffer. The time interval can be up to two digits (0-99) and represents minutes.

For example, if the time interval is one minute, and an hour passes before the next data record is received from the polled devices, the polled device data buffer is not given a time statement every minute. Instead, the time is added only when a data record is added for transmission, regardless of how many time intervals have passed.

In situations where the controller system is sparingly used for periods of time (for example, during the lunch hour), the communication between the controller and the host computer would consist primarily of time messages. Instead, when a record is finally received, a time message with the time of the last minute will be added.

The example that follows shows the data as it would appear in the Review Data Buffer screen explained in Section 8, "CRT Control of 9154 Communication."

A5PCB2223-45
>02:04:14
A3PCB2224-44
>02:04:15

If a time interval of 0 is satisfactory, press [CR]. This means that a time message will be appended to every data record.

To set a new time interval, enter a number between 0 and 99 to represent minutes and press [CR].

Record Day Rollover: The Record Day Rollover puts a time stamp into the polled device buffer at 12:00 midnight. This guarantees that the host computer program will have data to extract from the controller when its program starts in the morning.

The default value for Record Day Rollover is N for No. If having the Record Day Rollover disabled is satisfactory, press [CR].

To enable Record Day Rollover, enter [Y] and press [CR].

Time Broadcast

The five time broadcast parameters allow the current time to be broadcast to the polled devices, as displayed in the upper right corner of the Supervisory CRT screen. The format of the time broadcast depends on how the time broadcast parameters are configured. The format of the time is hour, minute in either military or standard 12-hour time format. Any combination of the Preamble, YY/MM/DD, and Postamble can be disabled.

If Time Broadcast is enabled, time will be sent to the polled devices in the following format:

<preamble>HH:MM<postamble>

If Include YY/MM/DD is specified, time will be sent in the following format:

<preamble>YY/MM/DD:HH:MM<postamble>

If time is going to be displayed on the polled devices, time broadcast must be enabled. If no time broadcast is desired, and the value for Enable Time Broadcast is "N", then skip the whole Time Broadcast section of the screen.

Enable Time Broadcast: This parameter allows time, in the format determined by the other time broadcast parameters, to be transmitted to the polled devices.

The default setting is "N" for Time Broadcast disabled. If this is satisfactory, press [CR].

To enable the broadcast of time, enter [Y] then [CR].

Interval: The time broadcast interval parameter specifies how often the time display on the polled devices will be updated. The range of acceptable inputs is any two digits from 0 to 99. The parameter value specifies minutes.

The default parameter is "1," indicating that the time will be updated every minute. If "1" is satisfactory, press [CR].

To change the time interval, enter a new number for the minutes desired, and then press [CR]. If set to "0", the time will not be broadcast.

Preamble: The preamble parameter allows a short message to be placed before the time broadcast. It can be one to five ASCII characters long or be left blank to signify that it is disabled. If a message longer than five characters is entered, the Supervisory CRT will beep, and the message will be truncated to five characters.

The default message for Preamble is the single ASCII character HT. If this is satisfactory, press [CR].

To disable the Preamble, enter [CNTL] [X], [CR]. The [CNTL] [X] command clears the parameter field, and the [CR] enters the blank field, disabling the parameter.

To enter a new message, type over the existing message, and then press [CR]. For example, to display "Time" before the time broadcast, type "Time" and press [CR]. The preamble must be the single character HT for INTERMEC readers with a display to right-justify the time data on the display.

Postamble: The Postamble parameter allows a short message to be placed after the time broadcast. Like the Preamble, this parameter can contain one to five ASCII characters or be left blank to signify that it is disabled. If a message longer than five characters is entered, the Supervisory CRT will beep, and the message will be truncated to the first five characters.

The default value for Postamble is disabled. If this is satisfactory, press [CR].

To display a postamble after the message, enter the message and [CR]. For example, type "Time" and press [CR] to enter Time as a postamble.

Display Format: The Display Format parameter selects which of the two hour formats to use. The two formats are: military (or 24 hour) and standard 12-hour time.

The default value is 24-hour time. If this time format is acceptable, press [CR].

To change the Display Format to 12-hour time, type "12" and then press [CR].

Include YY/MM/DD: When Include YY/MM/DD is enabled, the year, month, and day are transmitted as part of the time message.

The default for Include YY/MM/DD is disabled. If this is satisfactory, press [CR].

To enable Include YY/MM/DD and broadcast year, month, and day as part of the Time Broadcast, enter [Y], then press [CR].

Saving Clock Parameters

Review the Select Clock Parameters displayed on the screen and change if necessary.

Then save the parameter values, re-initialize the controller, and return to the Master Menu by using one of the two following commands:

[CNTL] [T]	Save the Select Clock Parameters to RAM.
[ESC]	Save the Select Clock Parameters to RAM and EEPROM.

See "Saving Parameters" earlier in this section for detailed information about saving parameters.

SELECT POLLED DEVICES

The device addresses polled by the controller are selected using the Select Polled Devices screen. To display the Select Polled Devices screen, enter [3], then press [CR] from the Master Menu. The cursor will be positioned by the status for the first address, A.

```
                        Select Polled Devices
                                                                     HH:MM

Device  Status  (E=Enabled,D=Disabled)  Device  Status  (E=Enabled,D=Disabled)

   A       E                               Q       E
   B       E                               R       E
   C       E                               S       E
   D       E                               T       E
   E       E                               U       E
   F       E                               V       E
   G       E                               W       E
   H       E                               X       E
   I       E                               Y       E
   J       E                               Z       E
   K       E                               0       E
   L       E                               1       E
   M       E                               2       E
   N       E                               3       E
   O       E                               4       E
   P       E                               5       E




 Press CNTL-T For Listing of Task Options
 Press ESC to Update EEPROM
```

The controller comes from the factory with all device addresses enabled for polling. To increase the efficiency of the device polling, addresses where a device will not be connected should be disabled. You only need to enable those addresses where polled devices are connected to the controller's Multi-Drop port.

Note: The Select Polled Devices screen will be updated and redisplay if the host modifies the addresses that are enabled/disabled using a host command.

Enabling Device Addresses

Use the following procedure to enable only as many addresses as needed by your devices.

1. Count the number of devices (readers and printers) that are physically installed on the main trunk cable extending from the polled device connector on the rear of the controller.

2. Move the cursor to the first address to be disabled. For example, if you have six devices connected to the main trunk cable, move the cursor down to the seventh address, G.

   For ease of tracking, it is recommended that addresses be enabled starting with A and progressing to 5. However, you can arbitrarily and at random chose which addresses will be enabled. Ensure that there is an enabled address for each device, and you keep track of which addresses are enabled.

Note: To facilitate configuring the polled devices, keep a list of the Multi-Drop addresses that are enabled on the controller.

3. Disable each of the rest of the addresses by entering [D] for disable, followed by [CR] to confirm. After each [CR] the cursor will move to the next address. To skip an address, press [CR] without entering D.

Note: Some unused addresses may be left enabled to facilitate adding devices to the main trunk cable.

4. Review the status of the addresses displayed on the screen and change as necessary.

5. Save the status of the addresses, re-initialize the controller, and return to the Master Menu by using one of the two following commands:

[CNTL] [T]	Save the status of the addresses to RAM.
[ESC]	Save the status of the addresses to RAM and EEPROM.

See "Saving Parameters" earlier in this section for detailed information about saving the status of the addresses.

6. If the polling of devices was stopped at the start of the configuration session, start polling again by entering [CNTL] [R].

VERIFYING CONTROLLER CONFIGURATION

At this point, the controller should be fully configured to communicate with the host and the polled devices. Review the following guidelines to verify a secure protocol environment.

1. The From Host EOM should never be disabled. If the From Host EOM is disabled the reception of data is impossible.

2. It is recommended that the To Host EOM be enabled. If it is not, the host must recognize the end of a message block some other way.

3. It is recommended that both the To Host and From Host SOM be enabled. This gives the data link protocol the ability to always know where a message starts.

4. It is advisable to start all protocol fields with ASCII control characters.

5. It is recommended that the Transparency Check be enabled so that data from polled devices will always be sent by the controller to the host as data only (if data is an ASCII control value, a DLE will precede the data).

6. The From Host DLE should not be disabled. Enabling the From Host DLE allows the host to send any ASCII characters to a polled device as data.

7. If using Unsolicited Receive and Unsolicited Transmit protocol, it is advisable to enable XON/XOFF flow control to ensure secure data communication.

8. Enabling the LRC provides added security to all transmitted and received data messages. Disabling LRC makes the protocol less secure. However, it is advisable to disable the LRC when using XON/XOFF flow control because the calculated LRC could match the XON or XOFF characters.

9. The AFF/NEG responses (To Host and From Host) allow for verification of successful/unsuccessful communication events. If the event is unsuccessful, this handshake allows the device in error to re-transmit the data. When this handshake is used, no data can be lost since another transmission event can not take place until the affirmative response is received from the previous transmission event. If the AFF/NEG handshake is disabled, data can be lost if the receiving device (controller or host computer) does not successfully get the data the first time.

10. If the controller is configured to transmit more than one record per message block, the EOR should be enabled so that the host application program can discern the individual records. If multiple records are sent with the EOR disabled, the host application program must discern the end of records some other way. If the AFF/NEG handshake is enabled, the whole message block must be re-transmitted if a NEG response is received from the host.

11. If Data Wait mode is enabled, the communication burden on both the host and the controller is reduced. However, enabling Data Wait mode only makes sense if the From Host POL is enabled.

12. If the From Host SEL is enabled, the controller will send a NEG to the host and not let it send any data until additional buffer space is available.

    If the From Host SEL is disabled, the controller will try to buffer whatever data is received. The host can overflow the receive buffer, but if the AFF/NEG handshake is enabled, the host will be asked to re-transmit the data. If the XON/XOFF handshake is enabled, the host will receive the XOFF before overflow occurs.

    If the From Host SEL is disabled, and the AFF/NEG and XON/XOFF handshakes are disabled, the host can overflow the controller's receive buffer, and the data will be lost.

SETTING DEVICE ADDRESSES

Once the operating, transmission, clock parameters, and polled device addresses have been configured, the controller is ready for operation. The only task remaining is to configure the polled devices so that they will communicate with the controller.

The devices must be configured to operate at the addresses enabled on the Select Polled Devices screen or they will not be polled. Section 6, "Configuring Polled Devices," provides guidelines for configuring the polled devices, with particular emphasis placed on selecting device addresses.

See the appropriate operator's manuals for specific directions on configuring the different models of reader and printers.

SECTION 6

CONFIGURING POLLED DEVICES

INTRODUCTION

MULTI-DROP POLLING ON THE 9154

MULTI-DROP PROTOCOL
- Selecting Multi-Drop Protocol
- Setting Baud Rate
- Setting the Device Address

USER-DEFINED MULTI-DROP PROTOCOL
- Configuring a Device's Communication Parameters
- Setting Baud Rate
- Setting the Device Address

TRACKING ADDRESS USAGE

DETERMINING AVAILABLE DEVICE ADDRESSES

INTRODUCTION

This section explains how readers and printers connected to the controller must be configured to communicate with a 9154 Controller system. The controller will only work with devices that support Multi-Drop protocol. A list of readers and printers that are compatible with the controller is provided in Section 4.

There are two methods for configuring a device to communicate with the 9154 Controller using Multi-Drop protocol. The procedure you use depends on the model and how the device is used. The two methods are:

1. Multi-Drop Protocol
2. User-Defined Multi-Drop Protocol

Normally, you use method 1. However, if you have a device like the 9512 Reader that supports IRL (Interactive Reader Language) and you need to define your own IRL download parameters, use method 2, User-Defined Multi-Drop protocol.

Regardless of which method you use, there are three steps to configuring a device to communicate with the controller.

1. Selecting or configuring Multi-Drop protocol
2. Setting baud rate
3. Setting the device address

This section describes only the requirements for configuring devices used with the controller. For specific information about how to select baud rate, select Multi-Drop protocol, configure communication parameters, and set addresses, see the appropriate reader or printer manual. Depending on the available input devices, the parameters may be entered with a wand, by a keyboard, or using a Supervisory CRT.

After the polled devices have been configured, the controller system should be operational. See Section 10, "Troubleshooting," for methods of testing system operation.

The controller supports device specific polling, a feature which allows the host to request information from a specific Multi-Drop address. For information about this capability see Section 7, "Host to 9154 Communication."

MULTI-DROP POLLING ON THE 9154

Multi-Drop polling is accomplished using one main trunk line to carry messages to a series of up to 32 devices. Each of the 32 devices is assigned its own one-character address, A-Z or 0-5. For each address there are distinct POL and SEL characters. Each device can identify information directed to it by the specific POL and SEL character accompanying the message. The POL characters are used to request information from the devices and the SEL characters are used to request permission to transmit to the devices.

The controller starts polling the devices by sending the POL signal for the first enabled address to all the connected devices on the main trunk cable. If there is no response before the time out limit is reached, the controller polls the next enabled address.

To increase the speed at which connected devices are polled, the controller only polls the addresses that are enabled on the Supervisory CRT screen 6, Select Polled Devices. See Section 5, "Configuring the Controller," for instructions on enabling addresses.

Because the controller is compatible with INTERMEC 9161 02 Multi-Drop Concentrator, the controller's Multi-Drop port is assigned an address (m,n,o, or p) like each of the four Multi-Drop ports on the INTERMEC 9161 02 Multi-Drop Concentrator. The port address becomes part of the device address as illustrated in Figure 6-1. While used when the host computer communicates with the controller, the port address is not used by the controller when polling the devices. The choice of port address is configured on the Supervisory CRT Select Operating Parameters screen. See Section 5, "Configuring the Controller," for instructions on configuring the controller's Multi-Drop port.

Since the device address is a parameter configured on the device, the address is independent of physical location. In Figure 6-1, for example, the addresses are all assigned in order from "A" for the first device to "5" for the device farthest away from the controller on the Multi-Drop line. However, the addresses could just as easily be assigned in reverse order, starting with "5" and ending with "A", or in no particular order at all. No matter where a device is located along the main trunk line, the device will respond to its own POL and SEL and no others.

For Multi-Drop polling to work, all the devices must operate at the same baud rate as the controller. Baud rate can be configured for both the controller and the devices.

More information about Multi-Drop protocol can be obtained from INTERMEC Data Communication Manual, Part No. 044737.

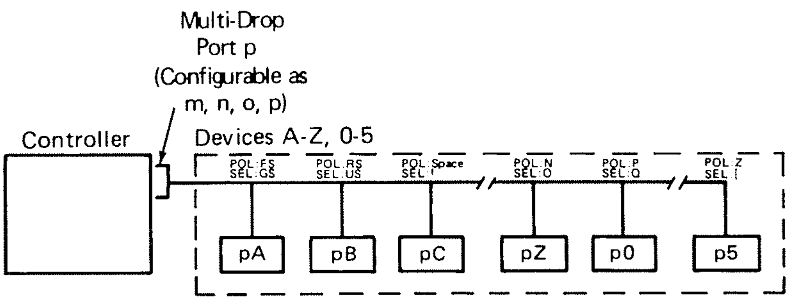


Figure 6-1
Multi-Drop Device Addressing Scheme

MULTI-DROP PROTOCOL

The following readers and printers allow direct selection of Multi-Drop protocol:

9440 Readers (9440 Communication Dock required)
9510 Readers
9511 Readers
9512 Readers
9540 Readers
9550 Readers
863X-Series Printers
864X-Series Printers

If you are using Interactive Reader Language (IRL) with Multi-Drop protocol, your host application program must use the default values for the IRL parameters listed in Table 6-1. If you use IRL download parameter values other than those listed in Table 6-1, you must use User-Defined Multi-Drop protocol. See the next sub-section "User-Defined Multi-Drop Protocol."

Selecting Multi-Drop Protocol

Select Multi-Drop protocol from the list of protocols displayed on the screen used for protocol selection. For example, 9510, 9511, 9512 Online Readers have their protocol selected in Configuration mode, while 863X-Series Printers have their protocol selected in Options Mode. For specific instructions, see the manual for your device.

Table 6-1
IRL (Interactive Reader Language) Parameters

Parameter:	Default Value:	What it does:
EOF	SOH	The End of File character indicates the end of a file.
EOR	NUL	The End of Record character indicates the end of a record. A value of NUL means the EOR is disabled.
Records	1	Number of program records transmitted per block at one time. If more than one, the EOR should be defined.
SOP	SI	The Start of Program character notifies the reader that data encountered after the SOP is a block of IRL program statements.
EOP	SYN	End of IRL Program Block/Continue character is sent after a block of IRL program statements and notifies the reader that another block of IRL statements is being sent.
RUN	DC2	The Compile and Run IRL Program character indicates the end of a program. If the program is error-free, the reader will run the program.
END	SO	The End of IRL Program Block/Compile character notifies the reader that the program download is complete.
PSS	CR	The Program Statement Separator separates individual IRL program statements within a block.
PAK	RS	The PAK character is a Good Program Compile character which the reader sends in response to a downloaded IRL program that compiles error free.
BAK	BEL	The BAK character is a Compile Error character which the reader sends in response to a downloaded IRL program the contains compile errors.

Note: Use either the RUN or END character at the end of a message, but not both.

Setting Baud Rate

CAUTION

All devices must be set to the same baud rate as the controller. If all the devices are not operating at the same baud rate, data communication problems will result.

All the polled devices must be set to the same baud rate of transmission as the controller's Multi-Drop port. The other operating parameters, such as the parameter value for parity and the timeout, are all automatically set when Multi-Drop protocol is selected. For specific information about setting the baud rate, see the device manual.

Setting the Device Address

Setting the address involves entering a one character value for the address, A-Z or 0-5. How a device address is selected varies with the model of device. For example, 9510, 9511, 9512 Online Readers have their device address entered in Configuration mode, while 863X-Series Printers have their device address selected in Options Mode. See the manual for your model of device.

The address should be one of the addresses enabled on the Supervisory CRT Select Polled Devices screen. Record the device address in the form provided later in this section under "Tracking Device Addresses."

USER-DEFINED MULTI-DROP PROTOCOL

If your host application program uses IRL download parameters values different than the default values listed in Table 6-1, standard Multi-Drop protocol can not be used because it will not allow you to change the values of IRL parameters. Instead, you must use User-Defined Multi-Drop Protocol which allows the entering of custom IRL download parameters. When User-Defined Multi-Drop protocol is used, the other device communication parameters must be individually configured to Multi-Drop protocol values or the controller will not be able to communicate with the devices.

Configuring a Device's Communication Parameters

With IRL readers like the 9512, User-Defined Multi-Drop protocol is used to configure communication parameters. The parameters must correspond to the Multi-Drop protocol values listed in Table 6-2. See the device manual for specific instruction on entering parameters.

Table 6-2
User-Defined Multi-Drop Parameter Requirements

Parameter:	Required Value:
AFF	ACK
NEG	NAK
REQ	ENQ
RES	EOT
EOM1	ETX
EOM2	NUL (Disabled)
SOM	STX
LRC	Must be enabled
Timeout	100 msec
Interchar	0 msec
Turnaround	5 msec
Terminal Mode	Buffered or Transparent
Stop Bits	1
Data Bits	7
Parity	Even
(For the 951X family)	
XON = NUL (Disabled)	
XOFF = NUL (Disabled)	

When you use User-Defined Multi-Drop protocol, you can redefine the IRL download parameters listed in Table 6-1. For more information about IRL refer to IRL 2.1 Programming Reference Manual, INTERMEC Part No. 048609. For specific information about configuring IRL characters see your reader manual.

Setting Baud Rate

CAUTION

All devices must be set to the same baud rate as the controller. If all the devices are not operating at the same baud rate, data communication problems will result.

Baud rate may be 2400, 4800, 9600 or 19200 baud. The baud rates for each device must be the same as the controller baud rate setting and all other devices. See the manual for your device for instructions on setting baud rate.

Setting the Device Address

In User-Defined Multi-Drop protocol, a device address is assigned by entering the POL and SEL character corresponding to the desired Multi-Drop address. Table 6-3 lists the POL and SEL characters for each of the 32 device addresses. This table should be used to set addresses for devices that require selection of POL and SEL characters. To use the table, locate the device address, and then read across to find the POL and SEL characters that must be entered.

Table 6-3
Device Address and POL/SEL Characters for Multi-Drop Protocol

Device Address:	Pol Character:		Sel Character:	
	ASCII	HEX	ASCII	HEX
A	FS	1C	GS	1D
B	RS	1E	US	1F
C	Space	20	!	21
D	"	22	#	23
E	$	24	%	25
F	&	26	'	27
G	(	28	)	29
H	*	2A	+	2B
I	,	2C	-	2D
J	.	2E	/	2F
K	0	30	1	31
L	2	32	3	33
M	4	34	5	35
N	6	36	7	37
O	8	38	9	39
P	:	3A	;	3B
Q	<	3C	=	3D
R	>	3E	?	3F
S	@	40	A	41
T	B	42	C	43
U	D	44	E	45
V	F	46	G	47
W	H	48	I	49
X	J	4A	K	4B
Y	L	4C	M	4D
Z	N	4E	O	4F
0	P	50	Q	51
1	R	52	S	53
2	T	54	U	55
3	V	56	W	57
4	X	58	Y	59
5	Z	5A	[	5B

TRACKING ADDRESS USAGE

Because there are two ways to set the device address, it is possible to give two devices the same address. For example, one device may be directly assigned address N, and another with User-Defined Multi-Drop protocol assigned 6 for POL and 7 for SEL (which corresponds to address N). If two devices have the same address, then both devices will try to drive the line at the same time, and communication problems will result.

To avoid assigning two devices the same address, it is advisable to keep a list of addresses already in use. Table 6-4 provides a sample form for recording addresses.

Each address should be marked off as it is assigned a device. It is helpful to know the identification number of each device so that if a device is removed later from the middle of the address range, another device can be placed at that address. If there are no device identification numbers, put a check in the Device Identification column or write down a description such as: 9510, Receiving; 9512, Shipping; 9512, Stores; etc.

Note: The controller will only poll and select addresses enabled on the Supervisory CRT Select Polled Devices screen.

Table 6-4
Device Address Form

Address:	Enabled/ Disabled:	ID Number:	Date:
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			
N			
O			
P			
Q			
R			
S			
T			
U			
V			
W			
X			
Y			
Z			
1			
2			
3			
4			
5			

DETERMINING AVAILABLE DEVICE ADDRESSES

To determine which device addresses are enabled, turn all the polled devices on and call up the Select Polled Devices screen on the Supervisory CRT.

Device addresses that are enabled and have devices connected to them will have E in the status column and just to the right of "Connected."

If there is an E in the status column, but "Connected" does not appear, that address is enabled, but no device is connected, so a device could be configured with that address.

If there is a D in the status column, that address would have to be enabled before a device could be configured with that address. The procedure for checking addresses is explained in detail in Section 10, "Troubleshooting."

If you have followed the procedures from Sections 3, 4, 5, and 6, in order, your Multi-Drop data collection system should be ready to operate. If your system does not operate properly, Section 10, "Troubleshooting," provides remedies for problems that may keep your system from operating.

SECTION 7

HOST TO 9154 COMMUNICATION

INTRODUCTION

DATA COMMUNICATION BETWEEN THE HOST AND 9154
- Data Format
- 9154 to Host Communication Protocol
- Host to 9154 Communication Protocol
- XON/XOFF Handshake
- Transparency Character
- Longitudinal Redundancy Check

FOUR TYPES OF 9154 TO HOST COMMUNICATION
- Solicited Receive and Solicited Transmit (SSM)
- Solicited Receive and Unsolicited Transmit (SUM)
- Unsolicited Receive and Solicited Transmit (USM)
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HOST COMPUTER CONTROL OF THE 9154
- Start or Stop Polling
- Enable/Disable Time Broadcast
- Enable/Disable Time Append
- Device Status Command
- Tailoring the Controller for a Supervisory CRT Screen
- Updating the Controller EEPROM
- 9161 02 Multi-Drop Concentrator Host Commands Not Implemented on the 9154 Controller

INTRODUCTION

The controller provides an efficient means for the host computer to communicate with the polled devices. It adds and removes data communication protocol to the data stream so that communication can occur with the least amount of host involvement.

This section describes data communication between the host and the controller in detail. Using the Supervisory CRT, the controller can be configured to communicate using a wide range of protocols. All the data communication parameters discussed in this section are configured using the Supervisory CRT. To take full advantage of the controller's capabilities, review this section carefully.

Two types of settings can be configured for host communications:

- The data communication protocol characters can be changed from their standard ASCII default values to suit the requirements of the host computer.

- The controller can be configured to communicate with the host using solicited or unsolicited protocols, as well asXON/XOFF Handshake and Data Wait Mode.

Section 5, "Configuring the Controller," explains how to implement the data communication options discussed in this section.

DATA COMMUNICATION BETWEEN THE HOST AND 9154

Most of the communication protocol characters used to communicate with the controller can be changed to suit the requirements of the host computer. For example, the host to controller AFF (Affirmative Acknowledgement) signal could be changed from the default of STX Z CR to STX STX Z, STX, ETX X CR, or any other string of up to five ASCII characters. In the descriptions throughout this section, the protocol characters, such as POL, AFF, NEG, and SOM, can either be the factory default values with which the controller was shipped, for example AFF (ACK (06H)), NEG (NAK (15H)), and SOM (STX (02H)), or can be changed to other selected ASCII characters. See Section 5, "Configuring the Controller," for specific instructions about selecting different values for protocol characters.

In examples of protocol, brackets <> will be placed around parameters which may be disabled. For example, in the protocol example which follows, SOM may be disabled.

<SOM> Data EOM

Data Format

Data transmission exchanges sent to and from the controller are asynchronous, ASCII, serial by bit. A selection of baud rate settings for the host port is stored in the controller's EEPROM, allowing 110, 300, 600, 1200, 2400, 4800, 9600, and 19200 baud data communication.

The sequence of each byte in any data transmission is:

Start bit Data bits (LSB first) Parity Stop bit(s)

Either seven or eight data bits are allowed in each transmission. Parity can be even, odd, or disabled. One or two stop bits are allowed, but the second stop bit should be used only to implement mark and space data formats.

Mark and Space Parity: To implement mark or space data format, the host line parameters must be configured as follows.

Data format:	Data bits:	Parity:	Stop bits:
7 bits, mark	7	disabled	2
7 bits, space	8	disabled	2
8 bits, mark	8	disabled	2
8 bits, space	NA	NA	NA

NA Not applicable

Note: The host is expected to be configured with one stop bit. If two stop bits are used, the controller must implement an intercharacter delay.

All the operating parameters for the data format can be configured using the Supervisory CRT's Select Operating Parameters screen and are stored in the controller's EEPROM.

9154 to Host Communication Protocol

The host solicits data from the controller by transmitting the host POL character(s). If POL is disabled on the controller, the controller sends data out the host port whenever data is available for transmission. If POL is enabled and received, the controller will transmit a message block, if available, or transmit a host RES character(s) if no data is available.

The controller can be configured with the Supervisory CRT to enable or disable a Data Wait Mode option. If the option is enabled the host need not repeatedly poll the controller for data. If the POL is received by the controller and no data is available to send to the host, the controller will wait for input from any of the polled devices and transmit this data to the host computer as soon as it is available. This option frees the host from repeatedly querying the controller for data transmission. If the Data Wait Mode option is disabled, the host must send the POL character(s) to the controller when data is present before data will be transmitted to the host.

9154 to Host Message Blocks: The format for message blocks transmitted to the host is:

<Header> <SOM> Message Block <EOM><LRC>

Header is a short message up to five ASCII characters long.

SOM is the Start of Message indicating the beginning of the data block.

Message Block contains one or more individual data records. Each pair of records is separated by a record separator. A data transmission block may contain from 1 to 99 records.

EOM is the End of Message and indicates the end of the message block. It is recommended that the EOM never be disabled.

LRC is the Longitudinal Redundancy Check. See "Longitudinal Redundancy Check" later in this section for an explanation of how it is calculated.

9154 to Host Data Records: The transmission format of each individual data record from the controller to the host is:

XZ Data <EOR>

X is the Multi-Drop port address which can be one of four values, "m", "n", "o," or "p." X must match the port address defined in the RAM copy of the controller's configuration parameters.

Z is the Multi-Drop device address on port X. Depending upon which device the host is communicating with, Z may be "A-Z" or "0-5."

Data is a single data record containing up to 254 characters, excluding the End of a Record character.

EOR is the record terminator. It indicates the end of an individual data record. The specific ASCII value for EOR can be configured using the Supervisory CRT and is stored in the controller's RAM copy of the configuration parameters.

Before any data characters are transmitted, a transparency check is made if the Transparency Check option is enabled. In a transparency check, the defined DLE character will precede any character in a data field which is an ASCII control character. If this option is disabled, control characters transmitted as data will give no indication that they are data characters rather than control characters.

It is recommended that all data communication protocol fields start with an ASCII control character. For example, if AFF is changed from the default STX Y CR, and STX is removed, the new value should have another ASCII control character, like ETX, as its first character.

Host to 9154 Communication Protocol

If the host SEL is enabled and received by the controller while waiting for polled device data, the controller will transmit an AFF response to the host, signaling that it is ready to receive host data. The controller sends a NEG response if it is not ready for data. The AFF/NEG responses are also used (if enabled) to inform the host that data was received correctly or incorrectly.

The NEG response will occur on a message block sent from the host to the controller whenever one of the following conditions occur:

- Bad parity of any character in the message
- Bad LRC character received when LRC is enabled
- Number of characters in one record is greater than 254

If the controller sends a NEG in response to a message block, the entire message block must be re-transmitted by the host.

The controller can be configured to re-transmit its previous message to the host whenever a timeout of ten seconds or more has occurred (no exchange of data between controller and host for the timeout period). When the re-transmission occurs, the controller will display an error message of "HOST: Timeout" on the error screen of the Supervisory CRT.

Host to 9154 Message Blocks: The format of message blocks transmitted to the controller is:

<SOM> Data <EOM> <LRC>

SOM is the Start of Message.

Data is a transmission block that may contain multiple records but the total byte count of the data portion must not exceed 512 bytes, including record terminators.

EOM is the End of Message. It is recommended that this parameter not be disabled.

LRC is computed by the exclusive OR of all data received, excluding the SOM (or first character of the SOM if the SOM is a string of characters). The LRC provides data security for the protocol.

Host to 9154 Data Records: The transmission format for data records from the host to the controller is:

XZ Data <EOR>

X is the Multi-Drop port address which can be one of four values, "m", "n", "o" or "p." X must match the port address defined in the RAM copy of the controller's configuration parameters.

Z is the Multi-Drop device address on port X. Depending upon which device the host is communicating with, Z may be "A-Z" or "0-5."

Data may contain up to a maximum of 254 data characters.

EOR is the record terminator indicating the end of a single record going to a specific address.

Because some of the controller's control characters are used by the data link protocol between the controller and host, a transparent character flag (ASCII DLE) can be used by the host to prevent characters in the data stream from being interpreted as control characters for data link protocol. If the DLE is received, the next character will be processed by the controller as regular data and stored in the buffer. The transparent character is never stored in the buffer, but is included in the calculation of an LRC. The DLE character can be defined to be any ASCII character and is stored in controller's copy of the configuration parameters.

The data records for each polled device are not queued. For each polled device the controller has buffer for receiving one record (maximum of 254 characters) of data from the host. This buffer is available for receiving another record of data only when the controller transmits the previous message to the corresponding polled device.

If the host sends a message to a controller buffer for a particular polled device, and that address already has a message waiting to be sent to that device, the controller will respond with an error message to the host, instead of accepting the message intended for that device.

The format of host-to-polled device buffer error is:

<Error Message SOM> XZ BEL <EOR> <Error Message EOM> <LRC>

X is the port address and Z is the device address. This message indicates that the host computer will need to re-transmit the message later.

Device Specific Polling: Device specific polling allows the host to request information from a specific device similar to the way the host sends a message to a specific device.

The controller responds to device specific polls identically to the way it responds to general polls. However, with device specific polling, the message transmitted by the controller will be only one record, even if records per block is more than one.

Device specific polling only works with solicited transmit protocols (From Host POL sequence enabled) where the host polls the controller for information. The format is as follows:

Xz POL

X is the controller's Multi-Drop port address (m,n,o,p).

z is the Multi-Drop address of the device (A-Z or 0-5).

POL is the host to controller POL sequence.

The address, Xz, can also be "SS" which allows the host to specifically request a status response from the controller.

Only one poll is active at a time. If you are using device specific polling, the controller only transmits a record for the device that is currently being polled. If a device specific poll is sent for address B, it replaces the previous poll for address A. No data for address A will be transmitted until a device specific poll for address A is transmitted, or the general poll.

When Data Wait mode is enabled, if a specific device have been polled, but no data is available, the controller will not transmit data until it receives a record from that specific device, or it receives a POL sequence from the host for a device that has data available. The SEL sequence can occur while the controller is waiting to send data.

XON/XOFF Handshake

When the controller transmits and receives data from the host, buffers in the controller and host store and process data simultaneously as it arrives. If either the host or controller is processing data more slowly than the data is being transmitted, its buffer will become full and data may be lost or need to be re-transmitted.

With POL/SEL protocol, the controller can inform the host when it is unable to receive data for a particular device by transmitting a NEG. When the host computer is unable to receive data, it simply stops polling. When POL or SEL are disabled, as in unsolicited protocols, some other means of data communication control is necessary.

To avoid potential data loss, XON and XOFF characters can be used by the receiving unit to control the transmission of data by the transmitting unit. By sending XOFF, the receiving unit informs the transmitting unit to stop sending data until it can process the data in its buffer, and is again able to receive more data. Once the receiving unit has caught up, it can send XON to inform the transmitting unit that it is ready to accept data.

The controller can use an XON/XOFF Handshake on both receive and transmit operations. Although it can be used with solicited protocol, XON/XOFF is especially valuable with unsolicited protocol where the controller is unable to control the flow of data with AFF/NEG protocol.

When the XON/XOFF feature is enabled, the controller will suspend its data transmission whenever an XOFF (ASCII DC3) character is received from the host. The controller will remain in this state until an XON (ASCII DC1) character is received, causing data transmission to the controller to resume. The controller can recognize the XON and XOFF characters when it is receiving messages and also when it is transmitting messages.

The controller will also transmit the XOFF character whenever less than 10 characters of buffer space are available for receiving additional data. For example, if the host sends data for a device address whose buffer is already full, XOFF will be transmitted by the controller. When buffer space becomes available, that is the previous record has been successfully sent to the polled device, the XON response will be transmitted to the host.

An example of an XON/XOFF handshake occurring while the host is requesting a record from the controller is shown below:

Host:	Controller:	Comments:
POL		Host requests a record.
	SOM A MES	
XOFF		Host buffering space is full. The controller receives the XOFF and suspends transmission.
		The host computer is busy processing information.
XON		Host is ready to receive data.
	SAGE EOM	Controller sends rest of message.
AFF		Host acknowledges it has received the message.

Since the controller must wait for the XON after an XOFF is received, the controller might become temporarily suspended if it missed the host's XON because of a transmission failure. In this case, both the host and the controller might be waiting for data and a timeout probably will occur. The host program should send another XON response to the controller in an attempt to recover from this error condition.

An example of a data exchange where the controller misses the XON character transmission from the host is shown below:

Host:	Controller:	Comments:
POL		Host requests a record.
	SOM A MES	
XOFF		Host buffering space is full. The controller receives the XOFF and suspends transmission.
		The host computer is busy processing information.
XON		Host is ready to receive data.
		Controller misses the host's XON because of a transmission error.
		A host timeout occurs because no communication has occurred.
NEG		To overcome the temporary delay, the host requests re-transmission of last record.
	SOM A MESSAGE EOM	Controller re-transmits last record
AFF		Host acknowledges it has received the message.

Be sure to disable the LRC if XON/XOFF data flow control if enabled. It is always possible that the calculated LRC may match the XON (ASCII DC1) or XOFF (ASCII DC3) characters. The controller data link knows when the LRC is expected and will not check for the XON/XOFF characters if the LRC is enabled and expected. It is still possible to transmit the XON or XOFF characters as data if the operator has enabled the Transparency Check option. A transparency check is never made before transmitting the LRC.

Transparency Character

Because some ASCII control characters are used by the data link protocol between the controller and the host, a transparent character flag (ASCII DLE) can be used by the host to prevent characters in the data stream from being interpreted as control characters used for data link protocol.

The DLE indicates that the next character is not a control character, but a part of the data stream. When DLE is received immediately before a control character, the control character will be processed by the controller as a data character and stored in the buffer. The transparency character DLE is not stored in the buffer, but is included in the LRC calculation.

For example, the following host message block will allow CR to be received by the controller and then transmitted as a piece of data to an attached reader or printer. The device, on port N at address A, will receive CR as a data character rather than as the control character End of Record. In this example the data communication protocol values are all the factory default values.

STX pA 123 DLE CR 456 CR ETX

STX is the Start of Message.

p is the address for the controller's one Multi-Drop channel.

A is the device address to which the message is being sent.

123 is the first three characters of the data record.

DLE is the transparency character.

CR is the fourth character of data, although it also can be the default end of record control character.

456 is the final three characters of the data record.

CR is the End of Record.

ETX is the End of Message.

In this transmission, the controller strips out DLE, and sends the following message which is received by the polled device at address A as one record:

123 CR 456

If the DLE character had not been placed before the first CR, the host message would have been interpreted as two records going to two separate devices. Stripping out the SOM, EOM, and LRC, the message would be:

pA 123 CR 456 CR

The first six characters, nA 123 CR, would have been accepted as the message "123" going to device A on channel n. The final four characters, 456 CR, would be interpreted as the message "6" going to device 5 (which may exist) on channel 4, which is not an address option for the controller's Multi-Drop port. The last four characters would generate an error and device A would not receive the additional data.

Longitudinal Redundancy Check

The Longitudinal Redundancy Check (LRC) is an error check character transmitted with each message sent to the host computer. It is also an option for messages transmitted from the host. The LRC is computed as the exclusive OR of the applicable characters in the data stream. The applicable characters are determined under three different conditions, as follows:

1. If a header is used, the LRC calculation starts at the second character of the header, and includes the rest of the message block. The host must transmit messages to the controller without headers.

Header	SOM	Data message	EOM
D1	**STX**	**pA 123 CR pB 456 CR**	**ETX**

(Characters used in LRC calculation)

1	**STX**	**pA 123 CR pB 456 CR**	**ETX**

2. If no header is used, the LRC calculation starts at the second character of the SOM, and includes the rest of the message block. If the SOM is only one character, the LRC calculation starts at the first character of the message block.

SOM	Data message	EOM
STX	**pA 123 CR pB 456 CR**	**ETX**

(Characters used in LRC calculation)

	pA	**123 CR pB 456 CR ETX**

The STX shown above is a three-character representation of the single ASCII character (Hex 42) and, thus, as the first and only character in the SOM, is removed from the LRC calculation.

3. If there is no header and no SOM, or the SOM is only one character in length, the LRC calculation starts at the first character of the data block, and includes the rest of the message block.

Data message	EOM
pA 123 CR pB 456 CR	**ETX**

(Characters used in LRC calculation)

pA 123 CR pB 456 CR	**ETX**

FOUR TYPES OF 9154 TO HOST COMMUNICATION

The controller communicates with the host using a POL/AFF type of protocol where POL is sent to ask for data, and acknowledgements (AFF/NEG) are sent when information is received.

The host application program can transmit POL or SEL instead of AFF to the controller when it is waiting for a response to the last transmitted message block. If the controller receives a POL or SEL at this time, the previous message block is assumed to have been successfully received by the host. If a POL is received, the controller will transmit the next message block in the data queue. If a SEL is received, the controller will respond with AFF/NEG. This feature allows the host to POL for records with a minimum of protocol interaction and delays.

You can change the values of the protocol characters to other than standard ASCII values, as well as delete or alter the characters that make up the protocol, to suit the communication requirements of your host computer.

Four major types of communication protocol are available depending on whether or not data transmission is solicited or unsolicited by the host computer. The controller can be configured to communicate in all four types.

The data communication protocol used is determined during configuration by whether or not the From Host POL and SEL fields are left blank. Section 5, "Configuring the Controller," explains how to configure the controller with the Supervisory CRT. Figure 7-1 shows the two parameter fields (POL and SEL) which are configured to choose solicited or unsolicited protocol.

```
                    Select Transmission Parameters
                                                              HH:MM

 To Host:                                From Host:

   No. Of Records Per Block:   1           POL:   <ENQ>
   Record Separator:  <CR>                 SEL:   <BEL>
   Header:                                 AFF:   <ACK>
   SOM:   <STX>                            NEG:   <NAK>
   EOM:   <ETX>                            DLE:   <DLE>
   RES:   <STX> Z <CR>                     SOM:   <STX>
   AFF:   <STX> Y <CR>                     EOM:   <ETX>
   NEG:   <STX> Z <CR>                     Record Separator: <CR>
   Error Message SOM: <STX>                Delay (x 10 ms):    0
   Error Message EOM: <ETX>                Timeout (x 1 sec):  60
   Transparency Check N    (Y or N)        Xon / Xoff Enable:  N   (Y or N)
   Data Wait Mode:    N    (Y or N)        LRC Enable:         N   (Y or N)


Press CNTL-P to Enter Command as Data
Press CNTL-X to Cancel Line
Press CNTL-T Return to Task Options
Press ESC to Update EEPROM
```

Figure 7-1
Selecting Solicited or Unsolicited Protocol

For each type of protocol, POL and SEL are as follows:

Type of Protocol:	POL:	SEL:
Solicited Receive and Solicited Transmit	VALUE	VALUE
Solicited Receive and Unsolicited Transmit	( )	VALUE
Unsolicited Receive and Solicited Transmit	VALUE	( )
Unsolicited Receive and Unsolicited Transmit	( )	( )

( ) indicates that the field has no value in it.

Value indicates that the field contains either the factory fault value, or some other value.

A description of each of the four major variations of protocol and tables illustrating usage follow.

Solicited Receive and Solicited Transmit (SSM)

This is the standard protocol where both the POL sequence and SEL sequence are enabled (non-blank). With SSM, the host must send the POL sequence to solicit data from the controller, and the SEL sequence to solicit the attention of the controller to receive data. This protocol allows device specific polling to be implemented by the host. Table 7-1 shows an example of SSM data exchange. The following events occur in Table 7-1:

Event:	What is Occurring:
1 to 3	Host asks for and receives data from the controller.
4 to 7	Host asks to send, sends data, and the controller receives data.
8 to 9	Host asks for data, but the controller has none.
10 to 16	Host asks for data, controller sends data, but an error occurs. Controller re-transmits and eventually data is received successfully.
17 to 22	Host asks to send data, then sends data, but an error occurs. Host re-transmits until the controller receives the data.
23 to 26	Host asks to send data, sends data, but the buffer for that polled device is full. Controller sends error message.

Table 7-1
Example Data Exchange Between 9154 and Host Computer (USM)
Solicited Recieve Solicited Transmit Mode

HOST COMPUTER		
EVENT	CONDITION	COMMAND
1	9154 have data?	POL
2		
3	Data received OK	AFF
4	9154 ready to receive data?	SEL
5		
6	Send data	<SOM>pD DATA<EOR>EOM<LRC>
7		
8	9154 have data?	POL
9		
10	9154 have data?	POL
11		
12	Data parity/LRC error	NEG
13		
14	Data parity/LRC error	NEG
15		
16	Data OK	AFF
17	9154 ready to receive data?	SEL
18		
19	Send data	<SOM>pD DATA<EOR>EOM<LRC>
20		
21	Send data	<SOM>pD DATA<EOR>EOM<LRC>
22		
23	9154 ready to receive data?	SEL
24		
25	Send data	<SOM>pD DATA<EOR>EOM<LRC>
26		

NOTE: pD p = Multi-Drop Port Address (m, n, o, p)
D = Device Address (A-Z, 0-5)
<> protocol parameter can be disabled

Table 7-1 (cont.)
Example Data Exchange Between 9154 and Host Computer (USM)
Solicited Recieve Solicited Transmit Mode

9154 CONTROLLER	
CONDITION	RESPONSE
Yes	<SOM>pD DATA<EOR>EOM<LRC>
Yes Data received OK	AFF AFF
No	<RES>
Yes Re-Send Re-Send	<SOM>pD DATA<EOR>EOM<LRC> <SOM>pD DATA<EOR>EOM<LRC> <SOM>pD DATA<EOR>EOM<LRC>
Yes Data Error Data OK	AFF NEG AFF
Yes	AFF
Previous Message for this address still in buffer, device at this address not connected or is disabled	<ERR_SOM>pD BEL<EOR><ERR_EOM><LRC>

Table 7-2 shows the effect of other protocol sequences on SSM, and is useful in determining when other data communication protocol parameters can be disabled.

Table 7-2
Other Variations of SSM (Solicited Receive and Solicited Transmit Mode)

	CAN BE DELETED	COMMENT
TO HOST:		
Header	Yes	If present, header will be sent before SOM of message sent by 9154.
SOM	Yes	If present, SOM will be sent as start of message.
EOM	Yes	Can be deleted if host can recognize end of message by other means.
EOR	Yes	If no record separator is desired in message sent by 9154.
AFF	No	Host must wait for AFF before sending data to 9154 and clear the buffer only after AFF has been received in response to the message.
NEG	No	Host must not send message if NEG is received in response to select, and must retransmit message if message was sent last.
RES	Yes	If deleted, 9154 w ll not send RES when poll is received and there is no data to send.
ERR_SOM	Yes	If present, SOM will be sent as start of error message.
ERR_EOM	Yes	If present, EOM will be sent as end of error message.

Table 7-2 (cont.)
Other Variations of SSM (Solicited Receive and Solicited Transmit Mode)

	CAN BE DELETED	COMMENT
FROM HOST:		
SOM	Yes	If deleted, 9154 will start accepting data after it has sent an AFF in response to host select. It will continue to accept data until an EOM is received.
EOM	No	Must be present to inform 9154 that this is end of message sent by host.
EOR	Yes	Can be deleted if only one record is sent per message by the host.
AFF	Yes	Can be deleted if host does not send AFF in response to message sent by 9154. The next poll from host can act as AFF.
NEG	Yes	Can be deleted if host does not wish to ask 9154 for retransmissions of message sent by 9154.
DLE	Yes	Can be deleted if host message does not contain any of the protocol control character as data.
POL	No	Must be present while in SSM
SEL	No	Must be present while in SSM

The RES is never sent if the Data Wait Mode option is enabled.

Solicited Receive and Unsolicited Transmit (SUM)

With SUM, the POL sequence is disabled (blank) and the SEL sequence is enabled (non-blank). When the POL sequence is disabled, the controller will send data to the host whenever data is available. This protocol allows device specific polling to be implemented by the host. If the host wishes to send data to the controller, it must send the SEL, and then start to send the data only after receiving the AFF sequence from the controller. Table 7-3 shows an example of SUM data exchange. The following events occur in Table 7-3:

Event:	What is Occurring:
1 to 3	Controller sends data to the host.
4 to 7	Host asks to send, then sends, and the controller receives data.
8 to 14	Controller sends data, but an error occurs. Controller re-transmits and eventually data is received successfully.
15 to 20	Host asks to send data, then sends data, but an error occurs. Host re-transmits until the controller receives the data.
21 to 24	Host asks to send data, sends data, but the buffer for that polled device is full. Controller sends error message.

Table 7-3
Example Data Exchange Between 9154 and Host Computer (SUM)
Solicited Receive Unsolicited Transmit

HOST COMPUTER		
EVENT	CONDITION	COMMAND
1		
2		
3	Data received OK	AFF
4	9154 ready to receive data?	SEL
5		
6	Send data	<SOM>pD DATA<EOR>EOM<LRC>
7		
8		
9		
10	Data parity/LRC error	NEG
11		
12	Data parity/LRC error	NEG
13		
14	Data OK	AFF
15	9154 ready to receive data?	SEL
16		
17	Send data	<SOM>pD DATA<EOR>EOM<LRC>
18		
19	Send data	<SOM>pD DATA<EOR>EOM<LRC>
20		
21	9154 ready to receive data?	SEL
22		
23	Send data	<SOM>pD DATA<EOR>EOM<LRC>
24		

NOTE: pD p = Multi-Drop Port Address (m, n, o, p)
D = Device Address (A-Z, 0-5)
<> protocol parameter may be disabled

Table 7-3 (cont.)
Example Data Exchange Between 9154 and Host Computer (SUM)
Solicited Receive Unsolicited Transmit

9154 CONTROLLER	
CONDITION	RESPONSE
9154 has data	
	<SOM>pD DATA<EOR>EOM<LRC>
Yes	AFF
Data received OK	AFF
9154 has data	
	<SOM>pD DATA<EOR>EOM<LRC>
Re-Send	<SOM>pD DATA<EOR>EOM<LRC>
Re-Send	<SOM>pD DATA<EOR>EOM<LRC>
Yes	AFF
Data Error	NEG
Data OK	AFF
Yes	AFF
Previous Message for this address still in buffer, device at this address not connected or is disabled	<ERR_SOM>pD BEL<EOR><ERR_EOM><LRC>

Table 7-4 shows the effect of other protocol sequences on SUM, and is useful in determining when other data communication protocol parameters can be disabled.

Table 7-4
Other Variations of SUM (Solicited Receive and Unsolicited Transmit Mode)

	CAN BE DELETED	COMMENT
TO HOST:		
Header	Yes	If present, header will be sent before SOM of message sent by 9154.
SOM	Yes	If present, SOM will be sent as start of message.
EOM	Yes	If deleted, host must be able to recognize end of message by examining message sent by 9154.
EOR	Yes	Can be deleted if no record separator is needed in message sent by 9154.
AFF	No	Must be nonblank. 9154 sends AFF in response to host select, and host message if message is error free.
NEG	No	Must be nonblank. 9154 sends NEG in response to host select if it is not ready to receive, or message received contains error, and must be retransmitted.
RES	NA	RES is not used in SUM protocol. Data messages will be sent whenever they are available; no RES will be sent.
ERR_SOM	Yes	If present, ERR_SOM will be sent as start of error message.
ERR_EOM	Yes	If present, ERR_EOM will be sent as end of error message to host.

Table 7-4 (cont.)
Other Variations of SUM (Solicited Receive and Unsolicited Transmit Mode)

	CAN BE DELETED	COMMENT
FROM HOST:		
SOM	Yes	If deleted, 9154 will start accepting data after it has sent an AFF in response to host select. It will continue to accept data until an EOM is received.
EOM	No	Must be nonblank. This is sent to inform 9154 that this is end of message from the host.
EOR	Yes	Can be deleted if only one record is sent per message by the host.
AFF	No	Must be nonblank. After a message has been sent to the host, the 9154 will wait for AFF from the host before it will send the next message unsolicited.
NEG	Yes	Can be deleted if the host does not wish to ask 9154 to retransmit last message sent.
DLE	Yes	Can be deleted if the host message does not contain any of the protocol control characters as data.
SEL	No	Must be present to receive messages while in SUM.
POL	Yes	Must be deleted to select SUM.

Unsolicited Receive and Solicited Transmit (USM)

With USM, the POL sequence is enabled and the SEL sequence is disabled. The host can transmit data to the controller without sending a SEL sequence. Once a message is sent to the controller, the host must wait for the AFF/NEG acknowledgement before transmitting the next message. The controller will send data to the host when the POL sequence is received. Table 7-5 shows an example of data exchange using USM protocol. The following events occur in Table 7-5:

Event:	What is Occurring:
1 to 3	Host asks for and receives data from the controller.
4 to 6	Host sends data, controller receives the data.
7 to 8	Host asks for data, but the controller has none.
9 to 15	Host asks for data, controller sends data, but an error occurs. Controller re-transmits and eventually data is received successfully.
16 to 20	Controller sends data, but an error occurs. Controller re-transmits and eventually data is received successfully.
21 to 23	Host sends data, but the buffer for that polled device is full. Controller sends error message.

Table 7-5
Example Data Exchange Between 9154 and Host Computer (SSM)
Unsolicited Receive Solicited Transmit Mode

HOST COMPUTER		
EVENT	CONDITION	COMMAND
1	9154 have data?	POL
2		
3	Data received OK	AFF
4	Host has data for 9154	
5	Send data	<SOM>pD DATA<EOR>EOM<LRC>
6		
7	9154 have data?	POL
8		
9	9154 have data?	POL
10		
11	Data parity/LRC error	NEG
12		
13	Data parity/LRC error	NEG
14		
15	Data OK	AFF
16	Host has data for 9154	
17	Send data	<SOM>pD DATA<EOR>EOM<LRC>
18		
19	Send data	<SOM>pD DATA<EOR>EOM<LRC>
20		
21	Host has data for 9154	
22	Send data	<SOM>pD DATA<EOR>EOM<LRC>
23		

NOTE: pD p = Multi-Drop Port Address (m, n, o, p)
D = Device Address (A-Z, 0-5)
<> protocol parameter may be disabled

Table 7-5 (cont.)
Example Data Exchange Between 9154 and Host Computer (SSM)
Unsolicited Receive Solicited Transmit Mode

9154 CONTROLLER	
CONDITION	RESPONSE
Yes	<SOM>pD DATA<EOR>EOM<LRC>
Data received OK	AFF
No	<RES>
Yes Re-Send Re-Send	<SOM>pD DATA<EOR>EOM<LRC> <SOM>pD DATA<EOR>EOM<LRC> <SOM>pD DATA<EOR>EOM<LRC>
Data Error Data OK	NEG AFF
Previous Message for this address still in buffer, device at this address not connected or is disabled	<ERR_SOM>pD BEL<EOR><ERR_EOM><LRC>

Table 7-6 shows the effect of other protocol sequences on USM, and is useful in determining when other data communication protocol parameters can be disabled.

Table 7-6
Other Variations of USM (Unsolicited Receive and Solicited Transmit Mode)

	CAN BE DELETED	COMMENT
TO HOST:		
Header	Yes	If present, header will be sent before SOM of message sent by 9154.
SOM	Yes	If present, SOM will be sent as start of message.
EOM	Yes	Can be deleted if host can recognize end of messages by some other means.
EOR	Yes	Can be deleted if no record separation is needed in message sent by 9154.
AFF	No	Must be nonblank. 9154 sends AFF after an error-free message is received from the host. The host can then send the next message.
NEG	No	Must be nonblank. 9154 sends NEG if message received from host contains error. Host must retransmit last message.
RES	Yes	If deleted, 9154 will not send RES when poll is received and there is no data to send.
ERR_SOM	Yes	If present, ERR_SOM will be sent as start of error message.
ERR_EOM	Yes	If present, ERR_EOM will be sent as end of error message.

Table 7-6 (cont.)
Other Variations of USM (Unsolicited Receive and Solicited Transmit Mode)

	CAN BE DELETED	COMMENT
FROM HOST:		
SOM	Yes	If deleted, 9154 will start accepting data without checking for SOM and will continue to accept data until an EOM is detected.
EOM	No	Must be nonblank. The EOM must be sent to inform 9154 that the end of message has been reached.
EOR	Yes	Can be deleted if only one record is sent per message by the host.
AFF	Yes	If deleted, 9154 will accept message without waiting for response from the host.
NEG	Yes	Can be deleted if the host does not wish to ask 9154 to retransmit last message.
DLE	Yes	Can be deleted if the message from host does not contain any of the protocol control characters as data.
SEL	Yes	Must be deleted to select USM.
POL	No	Must be present while in USM.

The RES will not be sent if the Data Wait Mode option is enabled.

Unsolicited Receive and Unsolicited Transmit (UUM)

With UUM, both the POL and SEL sequences are disabled. This allows the controller to both transmit and receive data at any time. UUM requires that both the host and controller must be able to simultaneously receive and transmit data. It also requires that some means of data flow control be used to prevent loss of data when receive buffers become full (XON/XOFF flow control or a hardware handshake, CTS-RTS). Table 7-7 shows some examples of data exchange using UUM. The following events occur in Table 7-7:

Event:	What is Occurring:
1 to 2	Controller sends data to the host.
3 to 4	Host sends data.
5 to 6	Host sends data.
7 to 8	Host sends data. Error messages are never sent with UUM protocol.

Table 7-7
Example Data Exchange Between 9154 and Host Computer (UUM)
Unsolicited Receive Unsolicited Transmit Mode (TTY Protocol)

HOST COMPUTER			9154 CONTROLLER	
EVENT	CONDITION	COMMAND	CONDITION	RESPONSE
1			9154 has data	<SOM>pD DATA<EOR>EOM<LRC>
2				
3	Host has data for 9154			
4	Send data	<SOM>pD DATA <EOR>EOM<LRC>		
5	Host has data for 9154			
6	Send data	<SOM>pD DATA <EOR>EOM<LRC>		
7	Host has data for 9154			
8	Send data	<SOM>pD DATA <EOR>EOM<LRC>		

NOTE: pD p = Multi-Drop Port Address (m, n, o, p)
D = Device Address (A-Z, 0-5)
<> protocol parameter may be disabled

Note that UUM uses no handshake to verify that a message was received correctly. This protocol implies that both receive and transmit operations can occur simultaneously. Enabling the XON/XOFF feature or using a CTS/RTS hardware handshake will provide a means for controlling the flow of data in such a protocol environment.

Table 7-8 shows the effects of other protocol sequences on UUM, and is useful in determining when other data communication protocol parameters can be disabled. The following protocol sequences are not used by UUM even if they are enabled: To Host (AFF, NEG, RES, Error Message SOM, Error Message EOM), and From Host (AFF, NEG).

Table 7-8
Other Variations of UUM (Unsolicited Receive and Unsolicited Transmit)

	CAN BE DELETED	COMMENT
TO HOST:		
Header	Yes	If present, header will be sent before SOM of message sent by 9154.
SOM	Yes	If present, SOM will be sent as start of message.
EOM	Yes	Can be deleted if host can recognize end of messages by some other means.
EOR	Yes	Can be deleted if no record separation is desired.
AFF	NA	Not used in UUM.
NEG	NA	Not used in UUM.
RES	NA	Not used in UUM.
ERR_SOM	NA	Not used in UUM.
ERR_EOM	NA	Not used in UUM.

Table 7-8 (cont.)
Other Variations of UUM (Unsolicited Receive and Unsolicited Transmit)

	CAN BE DELETED	COMMENT
FROM HOST:		
SOM	Yes	If deleted, 9154 will not check for SOM in messages sent by host.
EOM	No	Must be nonblank. The EOM must be sent to delimit a message sent to 9154.
EOR	Yes	Can be deleted if the host does not use record separators in the message sent to 9154.
AFF	NA	Not used in UUM.
NEG	NA	Not used in UUM.
DLE	Yes	Can be deleted if the host message does not contain SOM, EOM, or EOR as data.
POL	Yes	Must be deleted to select UUM protocol.
SEL	Yes	Must be deleted to select UUM protocol.

HOST COMPUTER CONTROL OF THE 9154

While some of the controller parameters can be set only from the Supervisory CRT, a number of controller configuration parameters can be configured by the host computer.

The host commands discussed in this section are used in a host application program to allow control and configuration of the controller.

When the host computer modifies controller parameters, only the RAM copy of the configuration parameters is changed. The EEPROM copy of the configuration parameters is left unchanged, unless the specific host EEPROM update command is invoked. This prevents over-writing the EEPROM so many times that its write limit is exceeded. It is assumed that the host computer may be adjusting controller configuration parameters on a daily basis.

The 9154 Multi-Drop Line Controller is designed to be compatible with the INTERMEC 9161 02 Multi-Drop Concentrator. Some of the commands implemented on the 9161 02 Multi-Drop Concentrator are not implemented on the 9154 Controller because the 9154 Controller has only one Multi-Drop port and the 9161 02 has four Multi-Drop ports.

The host computer should be configured so that it automatically inserts the necessary communication protocol required to send commands from the host. See the preceding parts of this section for specific descriptions of the data communication protocol.

Command Summary: The following commands can be sent from the host computer to the controller.

Command:	Action:
SD	Suspend Polling a Specific Device
SE	Start Polling a Specific Device
RG	Start Polling
RS	Suspend Polling
XMz	Start Polling on a Port
XNz	Suspend Polling on a Port
TT	Display Time on Polled Devices
TN	Stop Displaying Time on Polled Devices
TE	Record Time Messages as Part of Data Stream
TD	Stop Recording Time Messages
TS	Set the Real Time Clock
TR	Set the Real Time Clock (a 9161 02 command)
TH	Define Time Preamble
TP	Define Time Postamble
SS	Transmit Device Status
Z	Supervisory CRT Cursor Position
V	Supervisory CRT Clear Screen
UE	Update Controller EEPROM Parameters

For more information about specific implementation of these commands, see the individual descriptions that follow.

Start or Stop Polling

SD z

SD is the disable polling on a specific device command.

z is the address(es) of the device to be disabled.

This command also clears all previous errors or any pending message(s) intended for the specific device from the host.

If the z parameter is not specified, the controller will disable polling of all devices.

SE z

SE is the enable polling on a specific device command.

z is the address(es) of the device to be disabled.

If the z parameter is not specified, the controller will enable polling of all devices.

RG

This message enables device polling. It is the start or resume polling command.

RS

This message suspends polling of all devices. It is the stop/suspend polling command. After this command is transmitted by the host, readers will be unable to scan bar code.

XMz

XM is the start polling port command.

z specifies the ports to be enabled.

This message enables the polling of devices on a specific port and clears all previous errors or pending messages from host to polled devices:

On the controller, z can specify port m, n, o, or p. If a port is specified, that port must be the same port address that the controller is using for its Multi-Drop port. If no port address is specified, the controller will enable its single Multi-Drop port and the port address will remain the same value defined using the Supervisory CRT. XMz is a 9161 02 Multi-Drop lConcentrator command implemented on the controller.

XNz

XN is the stop polling command.

z specifies the ports to be disabled.

This message disables the polling of devices on a specific port. After this command is transmitted by the host, readers will be unable to scan bar code.

If the z parameter is not specified, the controller will disable its single Multi-Drop port. If the port to disable is specified, the controller requires that the specified port match the port address assigned to its single Multi-Drop port (m,n,o,p). XNz is a 9161 02 Multi-Drop Concentrator command implemented on the controller.

Enable/Disable Time Broadcast

TT

This message instructs the controller to enable Time Broadcast so that a time message which will be displayed. It is the time message broadcast command. When the preamble is the factory default value (HT), the message will be right-justified on the device status display.

The time message is composed of either hour and minutes, or year, month, day, hour, and minutes, depending on how the controller is configured.

The broadcast interval is a configurable parameter. The date format and time interval of broadcast are determined by parameters whose values are set on the Supervisory CRT screens. The default values are every one minute for time interval, and a 24-hour clock for time format. The time messages may have a preamble and/or postamble, and the default is "HT" for preamble and no postamble. The preamble and postamble are entered from the Supervisory CRT screens or using the TH and TP commands.

TN

This message instructs the controller to disable time broadcast messages to the devices for display on their status display. It is the stop time message broadcast command.

Enable/Disable Time Append

TE

This message instructs the controller to record time messages along with the data, using time messages generated by the controller real time clock. It is the enable time append command.

The default time value is 87:01:01:00:00, that is, January 1, 1987, 00 hours, 00 minutes. The default time interval for changing the time is one minute. Every minute a new time message will be recorded. To set the real time clock to a new time, use either the Supervisory CRT or the set real time clock command below.

TD

This message instructs the controller to stop recording time messages along with the data. It is the Disable Time Append.

Set Real Time Clock: To set the real time clock parameters to something other than the default values, send one of the following messages. This is a command that might be used every day to set the controller real time clock.

TS DDhhmmaabb

TS is the time set command.

DD is the day field (1-31).

hh is the hour field (00-23).

mm is the minute field (00-59).

aa is the time message recording interval in minutes (00-99).

bb is the time broadcast interval in minutes (00-99).

The default hours format is military time (0-23 hours). Parameters aa and bb may be left out if desired. If the time format is in error, the time will not be updated, but if parameters aa or bb are entered, they will be processed.

TS is a 9161 02 Multi-Drop Concentrator command implemented on the controller. The date fields not included in this command, year and month, will remain unchanged. These unchanged date fields must be configured using the Supervisory CRT Select Clock Parameters screen or the TR command.

TR YYMMDDhhmmaabbccde

TR is the time set command (not compatible with the 9161 02).

YY is the year field (0-99).

MM is the month field (1-12).

DD is the day field (1-31).

hh is the hour field (00-23).

mm is the minute field (00-59).

aa is the time append interval in minutes (00-99).

bb is the time broadcast interval in minutes (00-99).

cc is the time broadcast mode (12 or 24 hour clock).

d is enable/disable Day Rollover (Y = yes, N = no).

e is enable/disable Include YY/MM/DD (Y = yes, N = no).

The default hours format is military time (0-23 hours). Parameters aa and e may be left out if desired. If the time format is in error, the time will not be updated, but if parameters aa or e are entered, they will be processed.

Other time features can also be modified with the commands that follow.

TH xxxxx

TH is the define time broadcast preamble command.

xxxxx is the preamble. Only the first five characters are accepted. If the field is left blank, the preamble will be disabled.

TH is not implemented on the 9161 02 Multi-Drop Concentrator.

TP xxxxx

TP is the define time broadcast postamble command.

xxxxx is the postamble. Only the first five characters are accepted. If the field is left blank, the postamble is disabled.

TP is not implemented on the 9161 02 Multi-Drop Concentrator.

Device Status Command

SS Xz

SS is the device status command.

X is the port address (m,n,o,p).

z is the Multi-Drop address (A-Z, 0-5).

Together, X and z specify which device is to be polled. X must match the value assigned the controller port.

The status of several devices may be requested in the same message. Each address should be separated from the preceding address by the End of Record character.

The controller will respond with the following when polled, or as status becomes available if unsolicited transmit is used.

SS Xz Status

SS indicates that this is a status message

X is the port address (m, n, o, p).

z is the Multi-Drop address (A-Z, 0-5).

Status is the device status, where:

D	is for disabled.
E	is for enabled.
C	is for connected, and enabled.

This command is not implemented by the 9161 02 Multi-Drop Concentrator. An application program which uses this command to request status should use a solicited transmit protocol, which enables the host to use a specific POL to get the device status. If an unsolicited transmit is used, there is no guarantee that the next message transmitted by the controller will be the status requested by the host.

Tailoring the Controller for a Supervisory CRT Screen

If the controller is not using one of the five pre-configured CRT types, you can define the clear screen and cursor positioning commands.

Z xxxxxx

Z is the command.to modify the clear screen command.

xxxxxx is any user-defined value up to six ASCII characters.

This command sets the clear screen command sequence for the Supervisory CRT. It is the clear screen command.

V trcxxxxxxxx

This message modifies the Supervisory CRT cursor positioning command sequence. It is the cursor positioning command, where:

V is the command to modify its cursor positioning command.

t is the CRT type, where:

1	IBM 3101
2	DEC VT100
3	ADM 3/5
4	Televideo, ADM 31/32/42
5	Hazeltine
6	Other

If 1 through 5 are entered, the remaining data will be ignored, and the known values for that terminal type for r, c, and xxxxxxxx will be configured.

r is the offset to the character that represents the row in the "home" cursor positioning sequence (0-7). The cursor row offset is 0 for the first character of offset, and 7 for eight characters of offset.

c is the offset to the character that represents the column in the "home" cursor positioning sequence (0-7). The cursor column offset is 0 for the first character of offset, and 7 for eight characters of offset.

xxxxxxxx must be the "home" cursor command of the Supervisory CRT, up to eight ASCII characters.

Updating the Controller EEPROM

UE

After the host has modified operating parameters, the controller can be commanded to copy the changes into EEPROM. This protects the changes made to RAM from being lost if the battery fails to back up RAM. The command requires the host to delay sending any more messages for approximately three seconds since no data transmission can occur while the EEPROM is being updated.

9161 02 Multi-Drop Concentrator Host Commands Not Implemented on the 9154 Controller

As previously mentioned, the controller implements some, but not all, of the host commands implemented on the 9161 02 Multi-Drop Concentrator. Some of the 9161 02 Multi-Drop Concentrator commands are unnecessary or redundant because the 9161 02 Multi- Drop Concentrator has four Multi-Drop ports while the controller has only one Multi-Drop port.

If the controller receives a 9161 02 Multi-Drop Concentrator host command that it does not understand, it will ignore it. If AFF/NEG protocol is enabled, an AFF will be sent to the host if no data link errors occur. However, the unimplemented commands will be ignored by the controller's command processor and an error, "Illegal Host Data" will be logged in the error message queue. Illegal data can be either illegal format for Host command or illegal address for polled device specified.

SECTION 8

CRT CONTROL OF 9154 COMMUNICATION

INTRODUCTION

SUPERVISORY CRT COMMAND SUMMARY

FLUSHING THE DATA QUEUES

CONFIGURATION PARAMETERS

MASTER MENU SCREEN

SELECT OPERATING PARAMETERS SCREEN

SELECT TRANSMISSION PARAMETERS SCREEN

SELECT CLOCK PARAMETERS SCREEN

DISPLAY ERROR MESSAGES SCREEN

DISPLAY BUFFER REVIEW SCREEN

SELECT POLLED DEVICES SCREEN

SEND MESSAGES TO POLLED DEVICES SCREEN

INTRODUCTION

This section describes all the screens that can be displayed on the Supervisory CRT. Some of these screens allow you to configure controller operation to your specific communication needs by either accepting default values or entering new values. The rest of the screens allow you to monitor system operation.

Section 5, "Configuring the Controller," explains how to configure the system parameters using the Supervisory CRT screens, and Section 10, "Troubleshooting," explains how the screens may be used to troubleshoot system problems.

To use this section, the Supervisory CRT must be connected to the controller. For instructions about connecting the Supervisory CRT to the controller, see Section 4, "Installing Hardware." For instructions about configuring the controller to work with the Supervisory CRT, see Section 5, "Configuring the Controller."

The Supervisory CRT can be used to perform the following functions:

1. Initialize the operating parameters of the system.
2. Change the operating parameters of the system once it is up and running.
3. Monitor system operation.
4. Debug the system if problems are encountered.

Screen Organization: The screens are organized into two levels. On the top level is the Master Menu which is used to access the second level screens. The second level is comprised of the seven screens which are used to perform specific tasks. The numbers assigned to each screen must be entered from the Master Menu to display that particular screen. The only way to get from one screen on the second level to another screen on the second level is to go back to the Master Menu first. See Figure 8-1 for an illustration of the screen organization of the controller screens.

For detailed information on how to move the cursor and make parameter entries using the Supervisory CRT screens, see "Initializing the System with the Supervisory CRT," in Section 5, "Configuring the Controller."

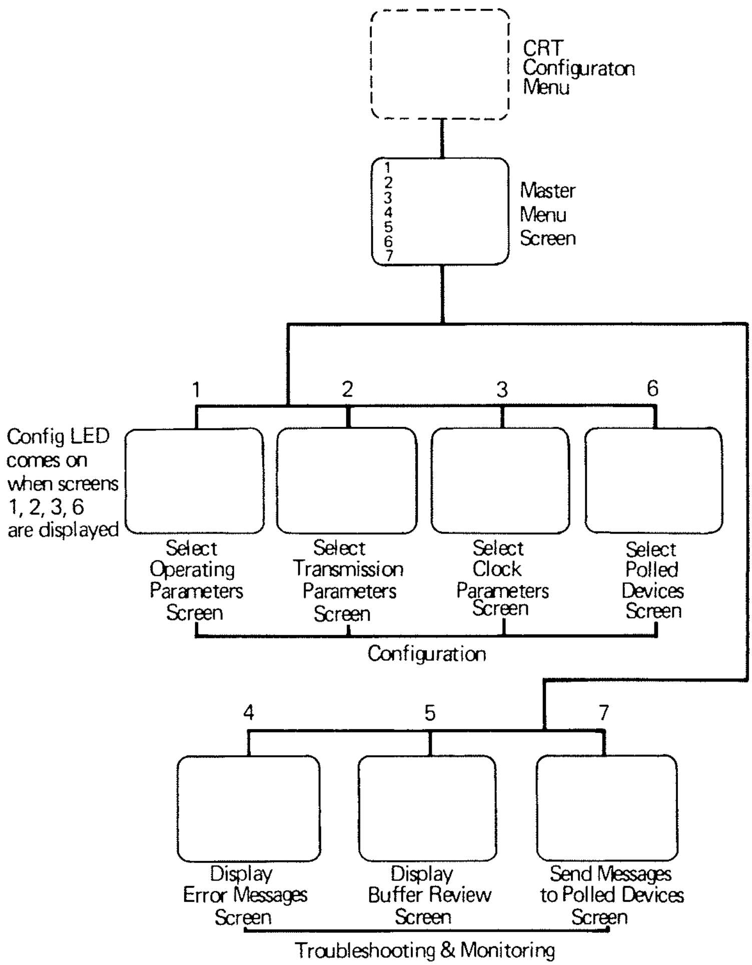

Figure 8-1
CRT Screen Organization

SUPERVISORY CRT COMMAND SUMMARY

This section describes the control characters entered from the CRT terminal and their specific functions. Not all commands work on all screens, and several commands perform different functions on different screens. A description of the specific functions performed by each command on each screen follows.

[CNTL] [T]	Calls up the Master Menu screen which lists the task options. If entered from screens 1, 2, 3, or 6, the controller will be re-initialized, since the RAM copy of the configuration parameters may have been changed. Note that the EEPROM itself does not change. See "Flushing the Data Queues" in this section for an explanation of how the EEPROM copy of the configuration parameters can be written into RAM.
[CNTL] [R]	Starts Polling. This command is valid from all screens, including the Master Menu. It instructs the controller to start polling the devices on the Multi-Drop line using the current configuration parameters.
[CNTL] [K]	Stops Polling. This command is valid from all screens, including the Master Menu. It commands the controller to stop polling the devices on the Multi-Drop line. Readers will be unable to read bar code once this command is entered, unless they can buffer their own data.
[CNTL] [X]	Cancels entry of data. When entering a parameter or data in a screen field, this command cancels that entry, and positions the cursor at the beginning of the field. In Screen 2, when protocol parameters are being modified, this command can be used to disable a parameter.

[CNTL] [Q]	Starts review of data/error buffer. On Screen 4 or 5, this command scrolls information in the buffer onto the screen, one line at a time.
[CNTL] [S]	Stops review of data/error buffer. On Screen 4 or 5, this command stops the scrolling of information in the buffer onto the screen.
[CNTL] [Y]	This command is valid from Screen 3 and 7 only. Its function depends on the screen from which it is given. On Screen 3, this command updates the time on the controller's real time clock. On Screen 7, this command sends the message in the message field to the polled devices specified in the address field.
[DEL] or [RUBOUT] or [Backspace]	Backspaces the cursor one position and erases the last character. This command is used to correct parameter or data entries, without using the [CNTL] [X] command which erases the whole field.
[ESC]	Updates the EEPROM copy of configuration parameters using the values currently on the all the screens. This command is valid only from Screens 1, 2, 3, or 6. Both RAM and the EEPROM copy of the configuration parameters are updated. When [ESC] is invoked, the following prompt will appear: UPDATE CONFIGURATION PARAMETERS TO EEPROM? (Y/N). If you enter Y, the EEPROM and RAM will be updated; any other entry will simply re-display the Master Menu. The Master Menu screen will always be re-displayed and the controller re- initialized when Y is entered.

[CNTL] [V]

This command writes the factory default configuration values to EEPROM and RAM. The controller is re-initialized to display the factory default values on the Supervisory CRT screens and to operate with the factory default values. This command is valid only from the Master Menu screen.

Use this command to return to the factory settings for the configuration parameters if you want to start configuration all over again.

[CNTL] [P]

When [CNTL] [P] is entered when the cursor is in a field, the next keyboard entry will be interpreted as data and not a command. This allows you to enter the ASCII characters represented by the Supervisory CRT commands as data. For example, to specify SYN (Hex 056) as data, enter:

[CNTL] [P], [CNTL] [V]

The [CNTL] [P] before [CNTL] [V] means that it will be interpreted as the single ASCII character SYN, and not as the command to write the default configuration values to EEPROM and RAM. Enter [CNTL] [P] twice to enter DLE as data.

Other Commands: The Supervisory CRT will ignore all other commands except those listed above. The Supervisory CRT will beep if an unauthorized command is received.

FLUSHING THE DATA QUEUES

The following procedure is used to flush the controller data queues and write the EEPROM copy of the configuration parameters to RAM. This procedure should be used if the RAM copy of the configuration parameters becomes so inaccurate during configuration that it would be easier to start again with the EEPROM copy of the configuration parameters.

1. Change at least one of the configuration parameters displayed on the following Supervisory CRT screens.

    Select Operating Parameters
    Select Transmission Parameters
    Select Clock Parameters
    Select Polled Devices

2. Enter [CR] to confirm the value, but do not enter [CNTL] [T] or [ESC] to re-initialize the controller.

3. Turn the controller power off by switching the Power pushbutton to the off position.

4. Turn the controller power on by pushing the Power pushbutton to the on position.

When you return to screens 1, 2, 3, and 6 the configuration values that will be displayed will be those that were in the EEPROM before the controller power was turned off in step 3.

CONFIGURATION PARAMETERS

When the controller is on, three distinct copies of the configuration parameters exist at any given time. These three copies work together to provide the security of backup copies as well as configuration flexibility. During actual operation, the controller does not use any of the configuration copies themselves, but uses values for specific parameters stored in the firmware itself. Those values are obtained from the RAM copy of the configuration parameters during the controller initialization and re-initialization process.

An explanation of what each copy of the configuration parameters does and how it is obtained, follows. Figure 8-2 illustrates the relationship between the three copies of the configuration parameters and the controller program.

RAM

The configuration parameters are read from the RAM when the controller power is turned on or when you invoke [CNTL] [T]. Following re-initialization, the controller communicates with both the Multi-Drop connected devices and the host using the parameters values stored in RAM. When parameters are configured and saved with [CNTL] [T] they are not saved to EEPROM; changes are stored only in the RAM copy. Data in RAM is saved by a battery backup when the controller power is off. The battery backup circuit will hold RAM data for at least two weeks.

On power up, the controller creates a RAM copy from the EEPROM copy of the configuration parameters if a prolonged power interruption results in a loss of data in the battery backed up RAM.

When the host configures the controller, the changes in configuration parameters are written only in RAM, unless you invoke the specific write EEPROM command. Host configured parameters are not written to EEPROM to avoid exceeding the recommended number of writes to the EEPROM. For example, the host might configure the controller real time clock every day.

To flush data queues, and write the EEPROM values into the RAM copy of the configuration parameters refer to the preceding section, "Flushing the Data Queues."

EEPROM

The EEPROM copy of the configuration parameters is a permanent copy. Interruption of the controller power will not cause a loss of data in EEPROM. After configuring the controller to communicate with its host, you will usually save the new configuration parameters to EEPROM. If user changes are not stored in EEPROM, the factory default settings will remain in EEPROM. The only way the EEPROM copy of the configuration parameters can be altered is by using the Supervisory CRT or the specific host command.

If a prolonged power interruption destroys the RAM copy, the EEPROM configuration parameters will be used to configure the controller when power is restored. After configuring the controller's communication parameters, you should write the values to EEPROM to avoid losing them in the event of a prolonged power interruption.

Factory Default Settings

No matter how the other two copies of the configuration parameters are altered using the host computer or the Supervisory CRT, the factory default settings always remain the same. For a list of the factory default settings stored in EEPROM, see Appendix B. When you initially receive the controller, the EEPROM and RAM copies of the configuration parameters contain the factory default values for these parameters.

If you ever need to restore the factory default settings to the EEPROM copy of the configuration parameters, enter [CNTL] [V] from the Master Menu on the Supervisory CRT. The [CNTL] [V] command also causes a destructive RAM test to be performed, which also updates the RAM copy of configuration parameters to the factory default settings. Thus, when [CNTL] [V] is invoked, all the copies of the configuration parameters will be returned to the factory default settings.

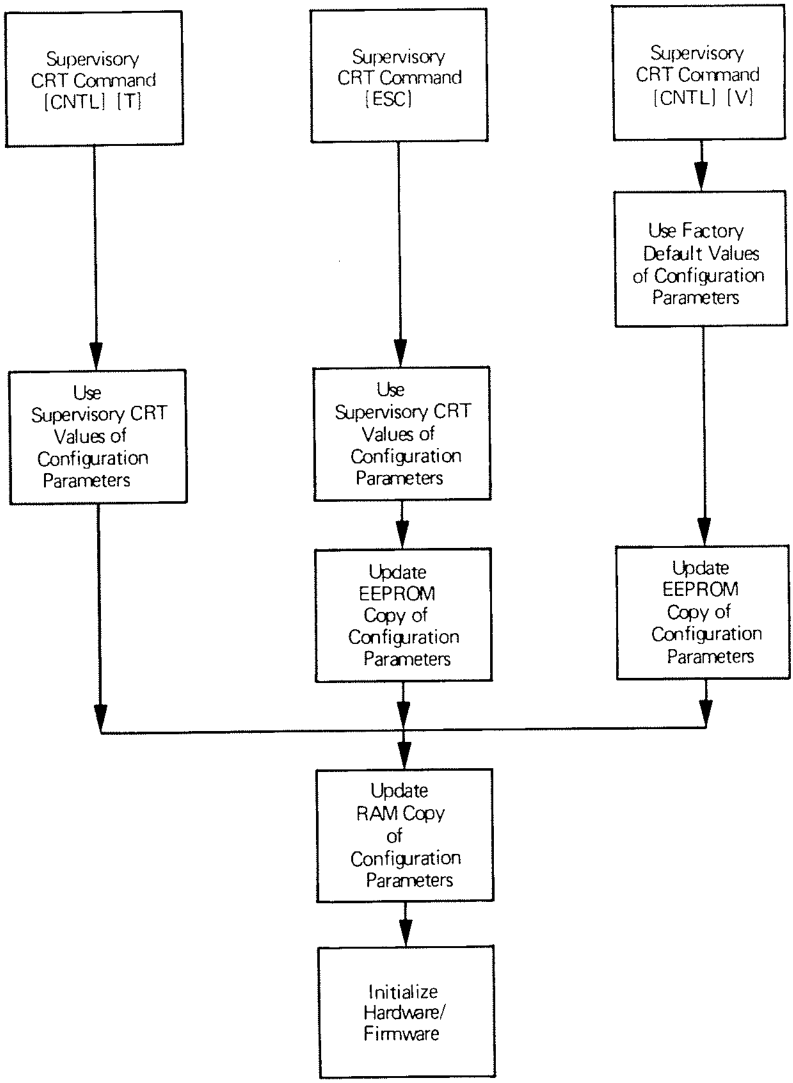

Figure 8-2
Three Copies of the Configuration Parameters

MASTER MENU SCREEN

The Master Menu is the first screen displayed. Its primary purpose is to control access to the other screens, and to allow the implementation of commands for writing the configuration parameters to EEPROM. Figure 8-3 shows the Master Menu screen.

```
                          Master Menu
                                                          HH:MM
                    9154 Multi-Drop Controller
                    Program 048418.-
                    Copyright 1987
                    INTERMEC Corporation


1 - Select Operating Parameters
2 - Select Transmission Parameters
3 - Select Clock Parameters
4 - Display Error Messages
5 - Display Data Review
6 - Select Polled Devices
7 - Send Messages to Polled Devices

Task No: -                Free bytes:  XXXXX (XXX%)

System: Idle / Running / Buffer Full



Press CNTL-R to Start Polling
Press CNTL-K to Stop Polling
Press CNTL-X to Cancel Line
Press ESC to Write to EEPROM
Press CNTL-V to Enter Default Parameters in EEPROM
```

Figure 8-3
Master Menu Screen

Master Menu Screen Layout

The top part of the screen lists the screen title and the program number. The revision number after the program number should be the most recent revision of the program. If not, you can obtain the most recent program revision from your local INTERMEC representative.

The time on the controller real time clock is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

Task Options: The Task Options section of the screen lists the seven screens that can be reached from the Master Menu, and describes the main function of each screen. In general, the first three and the sixth are used to configure the controller. The fourth, fifth, and seventh screens are used to troubleshoot and monitor system operation.

Configuration Screens:

Select Operating Parameters
Select Transmission Parameters
Select Clock Parameters
Select Polled Devices

Troubleshooting and Monitoring of Operation:

Display Error Message
Display Buffer Review
Send Messages to Polled Devices

The screens may be, and often are, used for other purposes than those they were primarily intended to perform. For example, if a system problem develops, you could review the configuration screens to ensure that the configuration parameters are set to acceptable values. When the system is first set up, the Display Buffer Review screen can be used to ensure time messages are being appended correctly.

Task No: The cursor will be located in the data field next to the heading "Task No". To display a screen, enter the screen number and then press [CR].

System: This field indicates the status of the controller.

If, "Running" is displayed, the controller passed all power-up tests, and the system is operating normally.

If "Idle" is displayed, the "HALT" command has been received, and there are problems with the controller operation.

If "Buffer Full" is displayed, the polled devices buffer is full, and no more data can be received from polled devices.

Polled Device Queue Status

To the right of the Task No. prompt, the number of free bytes in the polled device queue the screen displays. Free bytes is also shown as a percentage of total bytes. When the percentage is 0, the polled device data queue is full.

Master Menu Screen Operation

When the Master Menu screen is displayed, the cursor will be positioned in the Task No. field, and remain there during the entire time this screen is displayed. To display one of the seven listed screens, enter the screen number (1, 2, 3, 4, 5, 6, or 7) and then press [CR]. The screen corresponding to the number entered will be displayed. If a wrong number is entered, use either backspace or the [CNTL] [X] command to clear the field so that another screen number can be entered. For a complete description of screen commands, see the "Supervisory CRT Command Summary" in this section.

SELECT OPERATING PARAMETERS SCREEN

If "1" is entered for Task No. on the Master Menu, the Operating Parameters screen shown in Figure 8-4 will be displayed on the Supervisory CRT. This screen allows the user to configure the data-link layer of data communication with the host, and specify Multi-Drop parameters.

```
                Select Operating Parameters
                                                                 HH:MM

    Host Line Parameters:

      Line Speed ......      9600    (19200,9600,4800,2400,1200,600,300,110)
      Parity ..........      E       (E - even, O - odd, N - none)
      Data Bits .......      7       (7 or 8)
      Stop Bits .......      1       (1 or 2)

    Multi-Drop Parameters:

      Line Speed ......      9600    (19200,9600,4800,2400)
      Address .........      p       (m, n, o, p)

    CRT Line Parameters:

      Line Speed ......      9600    (19200,9600,4800,2400,1200,600,300,110)
      Parity ..........      E       (E - even, O - odd, N - none)
      Data Bits .......      7       (7 or 8)
      Stop Bits .......      2       (defaulted)
      Clear Screen ....      (SUB)                      (ADM 3/5)
      Row/Column Offsets     2/3
      Cursor Address ..      (ESC)-<SP><SP>

    Press CNTL-T Return to Task Options
    Press CNTL-X to Cancel Entry
    Press ESC to Update EEPROM
```

Figure 8-4
Select Operating Parameters Screen

Select Operating Parameters Screen Layout

The time on the controller real time clock time is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

The working part of the Select Operating Parameters screen is divided into three sections:

- Host Line Parameters
- Multi-Drop Port Parameters
- CRT Line Parameters

Each section is made up of three columns. The parameter name is given in the first column. The second column contains data fields for entering and displaying values for the parameter. The third column, if it exists, lists the possible values that can be entered for the parameter.

Commands that can be invoked from the Select Operating Parameters screen are listed at the bottom of the screen.

Host Line Operating Parameters

Four Host Line parameters must be configured on the controller so that it will communicate with the host. The host and controller values for these parameters must be the same.

Line Speed: The baud rate (bytes per second) at which the controller will communicate with, and expect communication from, the host. The possible values are restricted to:

19200
9600
4800
2400
1200
600
300
110

Parity: The value for the parity bit in host-to-controller communication. See Section 5, "Configuring the Controller," for information about implementing mark or space parity. The values are restricted to:

Even
Odd
None

Data Bits: The number of data bits in a byte of communication. The values are restricted to:

7
8

Stop Bits: The number of stop bits in a byte of communication between the controller and the host computer. The values are restricted to:

1
2

Multi-Drop Line Parameters

Two Multi-Drop line parameters must be configured on the controller to determine how the controller communicates with the polled devices.

Line Speed: The baud rate (bytes per second) at which the controller will communicate with, and expect communication from, the polled devices. The values of Line Speed for the controller and all the polled devices must be the same. The possible values are restricted to:

19200
9600
4800
2400

Address: Because the 9154 Controller is compatible with the INTERMEC 9161 02 Multi-Drop Concentrator, the single Multi-Drop port on the controller is given an address that corresponds to one of the addresses of the four Multi-Drop ports on the 9161 02 Multi-Drop Concentrator (n, m, o, or p). The Multi-Drop port address is not used in the polling of devices by the controller; only the device address is used. However, the Multi-Drop port address is used in communication between the host computer and the polled devices. The address configured on the controller must correspond to the Multi-Drop port address used by the host. The possible values for the port address are restricted to:

m
n
o
p

CRT Line Parameters

Seven CRT line parameters were configured on the controller so that it could communicate with the Supervisory CRT. These values are displayed for reference, even though it is not possible to change them from this screen. The CRT line parameters were configured using the Automatic Baud Rate sequence discussed in Section 5, "Configuring the Controller." If these parameters were not configured properly, the Supervisory CRT would not be able to communicate with the controller and display the Select Operating Parameters screen.

The CRT line parameters can have different values than the host line parameters.

Line Speed: The baud rate (bytes per second) at which the controller communicates with the Supervisory CRT. The possible values are restricted to:

19200
9600
4800
2400
1200
600
300
110

Parity: The value of the parity bit in controller to Supervisory CRT communication. The values are restricted to:

Even
Odd
None

Data Bits: The number of data bits in a byte of communication between the controller and the Supervisory CRT. The values are restricted to:

7
8

Stop Bits: The number of stop bits in a byte of communication between the controller and the Supervisory CRT. The default value is two.

Clear Screen: Up to six ASCII characters that define the Supervisory CRT's clear screen sequence. A single ASCII control character is displayed in a three-character representation.

Terminal Type: To the right of the Clear Screen parameter, the screen displays the terminal type, if it is one of the six standard terminals. The standard terminals are:

IBM 3101
DEC VT100
ADM 3/5
Televideo
ADM 31/32/42
Hazeltine

Row/Column Offsets: The first digit specifies the offset into the Cursor Address sequence which indicates the row. The second digit specifies the offset for the column. Values for each digit are restricted to 0-7. For entering offsets, 0 defines the first character, and 7 defines the eighth character.

Cursor Address: Up to eight ASCII characters that define the Cursor Address Command sequence for the "home" position. A single ASCII control character is displayed in a three-character representation.

SELECT TRANSMISSION PARAMETERS SCREEN

If "2" is entered for Task No. on the Master Menu, the Transmission Parameters screen shown in Figure 8-5 will be displayed on the Supervisory CRT. The Select Transmission Parameters screen allows the user to configure all the data communication parameters between the host and the controller.

```
                    Select Operating Parameters
                                                             HH:MM

Host Line Parameters:

  Line Speed ......    9600   (19200,9600,4800,2400,1200,600,300,110)
  Parity ..........    E      (E = even, O = odd, N = none)
  Data Bits .......    7      (7 or 8)
  Stop Bits .......    1      (1 or 2)

Multi-Drop Parameters:

  Line Speed ......    9600   (19200,9600,4800,2400)
  Address .........    p      (m, n, o, p)

CRT Line Parameters:

  Line Speed ......    9600   (19200,9600,4800,2400,1200,600,300,110)
  Parity ..........    E      (E = even, O = odd, N = none)
  Data Bits .......    7      (7 or 8)
  Stop Bits .......    2      (defaulted)
  Clear Screen ....    (SUB)                    (ADM 3/5)
  Row/Column Offsets   2/3
  Cursor Address ..    {ESC}=<SP><SP>


Press CNTL-T Return to Task Options
Press CNTL-X to Cancel Entry
Press ESC to Update EEPROM
```

Figure 8-5
Select Transmission Parameters Screen

Select Transmission Parameters Screen Layout

The time on the controller real time clock time is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

The working part of the Select Transmission Parameters screen is divided into two columns. The left-hand column lists the controller-to-host computer data transmission parameters that can be modified, and the right-hand column list the host computer to controller data transmission parameters that can be modified.

The Select Transmission Parameters Screen allows a full range of data communication parameters to be modified to fit any host requirements. See Section 4, "Host to 9154 Communication," for information on possible configurations of this screen.

The Transmission parameters can be classified into two groups:

1. To Host Transmission Parameters
2. From Host Transmission Parameters

Where applicable, ASCII control characters are shown in standard three-character representations. For example, the Start of Message character (SOM) is STX.

CAUTION

Two communication parameters can not be defined as the same value or communication will be impossible. For example, if the SOM and EOM characters are BOTH defined as ETX (03H), the host and the controller will be unable to communicate.

If the factory default values for the data communication parameters is satisfactory, you do not need to change this screen.

To Host Transmission Parameters

The left-hand column of parameters configures the way the controller communicates with the host. Configured values should match host computer data communication protocol.

No. of Records Per Block: Indicates the maximum number of individual polled device records that will be sent by the controller to the host in a given message block. The default is one. The default value may be changed to any number between 0 and 99.

Record Seperator: The To Host Record Separator is sent after every individual data record the controller transmits to the host. The default is the ASCII character CR (0DH).

Header: A header can be placed on the messages sent to the host by the computer. The header can be up to five ASCII characters in length. The default is header disabled, as shown by the blank field.

SOM: The Start of Message, SOM, is sent after the header, if used, and can be up to five ASCII characters long. The default SOM is the single ASCII character STX (02H).

EOM: The End Of Message, EOM, is sent after the data, and can be up to five ASCII characters. The default EOM is the single ASCII character ETX (03H).

RES: When the host asks the controller for data by sending a POL, the controller will send an RES, indicating that it has no data. RES, thus, has the same meaning as NEG (Negative Acknowledgement), except that it is used in a different situation. The default setting for RES is the three ASCII characters STX Z CR.

AFF: If the host wants to transmit data to the controller, it will first send a SEL. The controller will respond to the computer with either AFF or NEG. If the controller responds with AFF, it indicates that it is acceptable to send data. AFF can be up to five ASCII characters. The default setting for AFF is the three ASCII characters STX Y CR.

NEG: If the host sends a SEL to the controller asking if it can send data, and the controller can not accept data, the controller will send a NEG. NEG can be up to five ASCII characters. The default setting for NEG is STX Z CR.

Error Message SOM: If the host transmits a message to an unconnected device address, or a device that has another message waiting to be transmitted to it, the controller will send the following message to the host:

"Error Message SOM" Reader Address BEL CR "Error Message EOM"

The Error Message Start Of Message indicates the start of an error message. The Error Message SOM can be up to five ASCII characters and be changed to a different value than the SOM. The default value for the Error Message SOM is the single ASCII character STX, just like the SOM.

Error Message EOM: The Error Message End Of Message indicates the end of an error message. The Error Message EOM can be up to five ASCII characters and can be set to a different value than the EOM. The default value for the Error Message EOM is the single ASCII character ETX, just like the EOM.

Transparency Check: The Transparency Check parameter allows the controller to send a control code used in the data communication protocol as part of the data stream. If the Transparency Check is enabled the defined DLE is placed directly in front of ASCII control characters contained in the data stream before they are transmitted. The default value for the Transparency Check is "N" for disabled.

Data Wait Mode: When Data Wait Mode is disabled, the controller will wait until it is polled by the host before sending data. When Data Wait Mode is enabled, if the host has polled the controller, the controller will transmit data to the host as soon as it becomes available. Once data is transmitted, the controller will wait for another POL from the host before it will transmit more data.

From Host Transmission Parameters

Host transmission parameters, in the right-hand column on the screen, specify what the controller will look for when it expects control characters from the host.

Two parameters are of particular importance: POL and SEL. These parameters configure solicited or unsolicited protocol. Section 7, "Host to 9154 Communication," discusses both solicited and unsolicited protocol.

POL: The POL is used by the the host to ask if the controller has any data to transmit. POL can be up to two ASCII characters. The default value for POL is the single ASCII character ENQ.

SEL: The SEL is used by the the host to ask if the controller will accept a message. SEL can be up to two ASCII characters. The default value for SEL is the single ASCII character BEL.

AFF: AFF is the host response to a controller message and indicates that the data was good. AFF can be up to two ASCII characters long. The default value of AFF is the single ASCII character ACK.

NEG: NEG is the host response to a controller message and indicates that the data was bad and needs to be re- transmitted. NEG can be up to two ASCII characters. The default value of NEG is the single ASCII character NAK.

DLE: DLE is the character that precedes the control codes in host-to-controller communication to tell the controller that the character immediately after the defined DLE is to be interpreted as data and not as a command. The host DLE can be any single ASCII character. The default for the host DLE is DLE (10H).

SOM: The Host to Controller Start of Message is sent at the beginning of data messages to the controller. The host SOM can be any one or two ASCII characters. With certain protocols, it is ignored and may be left blank. The default for the host SOM is STX (02H).

EOM: The Host to Controller End of Message is sent at the end of data messages to the controller. The host EOM can be any one or two ASCII characters. With certain protocols, it is ignored and may be left blank. The default for the host EOM is ETX (03H).

Record Separator: The host Record Separator is sent after every individual data record that the host sends to the controller. The host record separator may be any one or two ASCII characters. The default for the host Record Separator is CR (0DH).

Delay Timer: If the host sends an ENQ request for data to the controller, the controller will respond to that ENQ in the time specified by the Delay Timer. The numeric value in the Delay data field is multiplied by 10 msec to give the amount of time in which the controller will respond. The Delay Timer can be any one to four digit number (0-99). For example, if the Delay value was two, the controller would respond in 20 msec. The default for the Delay Timer is 0 msec.

Timeout: The Timeout parameter selects the amount of time the controller will wait after sending a message to the host computer before it expects a response. The numeric value for this parameter is multiplied by one second to obtain the length of the timeout period. For example, if the timeout is "5" and the controller has transmitted an AFF in response to a host POL, the controller will transmit AFF again after waiting five seconds. The default for the Timeout is 60 seconds. It can be any value between 0-60.

The Timeout is also used when receiving data from the host. The next character must be received before the Timeout specified.

XON/XOFF Enable: The XON/XOFF Handshake allows the controller and host to limit data transmissions if their receive buffers are full. The XON/XOFF handshake is especially useful if an unsolicited communication protocol is being used.

When the receiving unit's receive buffer is full, it will send XOFF (ASCII DC3) to the transmitter, telling it not to send anymore data. After the receiving unit's receive buffer has room for more data, the receiving device will send XON (ASCII DC1) to tell the transmitting unit that it is acceptable to send data again. The default for the XON/XOFF is "N", for disabled.

LRC: The LRC is a message error check sent after the EOM character. The LRC is calculated as the exclusive OR of all the applicable characters in the message block. If a SOM is used, all characters are applicable to the LRC calculation except the first character of the SOM. If a SOM is not used, all the characters are applicable to the LRC calculation, starting at the first character of data. The default for the LRC is "N", for disabled. If the header is enabled, all characters are applicable to the LRC calculation except the first character of the header.

SELECT CLOCK PARAMETERS SCREEN

If "3" is entered for the Task No. on the Master Menu, the Select Clock Parameters screen shown in Figure 8-6 will be displayed on the Supervisory CRT. The Select Clock Parameters screen lets you control the way the controller's real time clock is used.

```
                    Select Clock Parameters
                                                          HH:MM

    Set Real Time Clock:
      Date ................. YY.MM.DD      (YY.MM.DD)
      Time ................. HH.MM         (HH.MM)

  Press CNTL-Y to Set Clock

    Time Append:
      Enable Time Append ... N      (Y or N)
      Interval ............. 1      (0-99 minutes)
      Record Day Rollover .. N      (Y or N)

    Time Broadcast:
      Enable Broadcast ..... N      (Y or N)
      Interval ............. 1      (0-99 minutes)
      Preamble .............<HT>
      Postamble ............
      Display Format ....... 24     (12 or 24)
      Include YY/MM/DD..... N       (Y or N)


  Press CNTL-X to Cancel Line
  Press CNTL-T Return to Task Options
  Press ESC to Update EEPROM
```

Figure 8-6
Select Clock Parameters Screen

Select Clock Parameters Screen Layout

The time on the controller real time clock time is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

The working part of the Select Clock Parameters screen is divided into three sections:

1. Set Real Time Clock
2. Time Append
3. Time Broadcast

The screen is made up of three columns. The first column gives the parameter name. The second column contains data fields for entering parameter values and lists the current setting for each parameter. The third column, if it exists, lists the possible values for the parameter.

Except for the Set Clock command, all commands that can be invoked from the Select Operating Parameters screen are listed at the bottom of the screen. The Set Clock command is listed just after the Set Real Time Clock parameters display.

When the Set Clock command is invoked, the time is updated on the the controller real time clock and displayed in the upper right corner of all the screens.

Set Real Time Clock

Set Real Time Clock is used to set the time and date on the controller's real time clock. The current default date and time are displayed just to the right of the prompts.

Date: The date is entered in the following format:

YY.MM.DD

YY	Year, two digits (00-99). Delimiter, must be entered.
MM	Month, two digits (01-12). Delimiter, must be entered.
DD	Day, two digits (01-31).

Time: The time must be entered in the following format:

HH.MM

HH	Hours, two digits, 00-23 (24 hour clock).Delimiter separating Hour and Minute, must be present.
MM	Minutes, two digits, 0-59.

The controller real time clock counts seconds; however, seconds is not a configurable parameter. If a new time value is entered, the delimiters must be present. When the time is updated using the Set Clock command, [CNTL] [Y], the time displayed in the upper right hand corner of all the screens will change.

Time Append Parameters

Three Time Append parameters configure the controller for appending time records to the data records received from the polled devices.

Enable Time Append: This parameter determines if time is appended to the data records, using the format specified in the next two parameters. Two values are allowed:

Y Yes, enable time append, add time records.

N No, disable time append, do not add time records.

Time Interval: The Time Interval parameter specifies the length of time in minutes between the addition of time records to the data received from the polled devices. The interval may be up to two digits (0-99).

Record Day Rollover: The Record Day Rollover parameter determines whether or not a data record will be added to the polled device buffer at 12:00 PM when the day changes. Two values are allowed:

Y Yes, enable Day Rollover, add a time record at midnight.

N No, disable Day Rollover, do not add a time record.

If Time Append is enabled, but the Time Append Interval is zero, the controller will append time to every record. The format of the record is:

Data>DD:HH:MM

Where Data is the data record, and DD:HH:MM is the time record in the Day, Hour, Minute format.

If Time Append is enabled, and the Time Append Interval is a non-zero value, a time record is added as a separate record to the data waiting to be sent to the host. The format is:

>DD:HH:MM

Time Broadcast Parameters

Six time broadcast parameters configure the controller to send time messages to the polled devices for display on their screen. The time message is displayed left-justified on the device screen.

Enable Time Broadcast: This parameter determines if time is broadcast to the polled devices, using the format in the next five parameters. Two values are allowed:

Y	Yes, enable time broadcast, send time messages.
N	No, disable time broadcast, do not send time messages.

Interval: The Interval parameter specifies the length of time between broadcasts in minutes. The interval may be up to two digits (0-99).

Preamble: The Preamble parameter allows a short message to be displayed before the time message on the polled devices. The message may be one to five ASCII characters long, or the field may be left blank.

Postamble: The Postamble parameter allows a short message to be displayed after the time message on the polled devices. The message may be one to five ASCII characters long, or the field may be left blank.

Display Format: The Display Format parameter determines whether the time is represented in a 12-hour or 24-hour format. The allowable values are:

12	For 12-hour format.
24	For military time, in the 24-hour format.

Include YY/MM/DD: The Include YY/MM/DD parameter allows the current year, month, and day on the real time clock to be added to the time message broadcast to the polled device. Two values are allowed:

Y Yes, include year, month, and day in the time messages.

N No, do not include year, month, and day in the time messages.

If Time Broadcast is enabled, time will be sent to the polled devices in the following format:

<preamble>HH:MM<postamble>

If there are no preamble or postamble, those fields will be missing, and the rest of the message will be left-justified.

If Include YY/MM/DD is enabled, the time is sent in the following format:

<preamble>YY/MM/DD:HH:MM<postamble>

DISPLAY ERROR MESSAGES SCREEN

If "4" is entered for Task No. on the Master Menu, the Display Error Messages screen shown in Figure 8-7 will be displayed on the Supervisory CRT. The last 20 "errors" recorded by the controller will appear on the screen.

```
                 Display Error Messages
                                                         HH:MM


01:00:03 Device A: Parity
01:00:05 Device D: Framing
01:00:09 Device K: Overrun
01:00:21 Host Transmit Error: Parity, Framing
01:00:34 Host Receive Error: LRC
01:01:01 Power Interrupt
.
.
.
.
.
.
.
01:03:46 Device 3: Xmit Problem



CNTL-Q to Start Review       CNTL-S to Stop Review
Press CNTL-T For Listing of Task Options
```

Figure 8-7
Display Error Messages Screen

The time on the controller real time clock time is displayed in the upper right hand corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

Display Error Messages Screen Operation

This screen displays the last twenty errors that occurred in system operation. You can scroll through the error buffer by entering [CNTL] [Q] to start the review of the errors, and the [CNTL] [S] to stop the review when desired. The errors will remain on the screen until they are replaced with new errors which scroll onto the bottom of the screen. Thus, the most recent error recorded appears at the bottom of the screen, and the oldest error is displayed at the top of screen. To facilitate scrolling, the Supervisory CRT should be in scroll mode.

If multiple errors occur for a single transmission event, they may be listed together separated by commas. For example, in Figure 8-7, one host transmission event had both a parity and a framing error.

The Display Error Messages screen only displays errors generated by the controller in response to data communications received from the host computer or the polled devices. Errors generated by the host from data received from the controller will not be displayed.

Error Format

Each error event occupies its own distinct screen line. Three basic error formats exist: device, host, and controller.

Device Errors: Errors that occur in the data communication between the controller and the devices have the following format:

01:00:03 Device A: Parity

01:00:03 indicates that a Time the error occurred.

Device identifies the error as a device error.

A is the Device address at which the error occurred.

Parity is the name of the error type.

Host Errors: Errors that occur in the data communication between the controller and the host have one of the two following formats:

01:00:21 Host Receive Error: Parity

01:00:21 indicates the time the error occurred.

Host Receive Error identifies the error as one that occurred in the host to controller data link when the host was sending data, the select procedure.

Parity is the name of the error type

01:00:21 Host Transmit Error: Parity

01:00:21 is the time the error occurred.

Host Receive Error identifies the error as one that occurred on the host to controller data link when the controller was sending data, the poll procedure.

Parity is the name of the error type.

Errors on the host to controller data link may occur anywhere in the transmission event. For example, if there is a parity error in the host's AFF response, after the host solicits data from the controller, it is a Host Transmit Error because the controller was transmitting a data message to the host (even though the error occurred in data link protocol received by the controller). Because of the error, the whole event was nullified and the controller will have to transmit the data again.

Controller Errors: Errors related to controller operation have the following format:

01:01:01 Power Interrupt

01:01:01	Time of error occurrence.
Power Interrupt	Name of error type.

Time: Indicates when the error occurred. The time is taken from the controller real time clock. This field precedes the error message. The time is represented in the following format:

DD:HH:MM

DD	Days, (1-31)
HH	Hours, (0-23), 12-hour or 24-hour clock depending upon real time clock format.
MM	Minutes, (0-59).

An example of the format taken from Figure 8-7 follows:

01:00:03 Device A: Parity

Error Types

Over 20 distinct types of errors can be displayed on the screen. All the error message displays will be preceded by the time the error occurred. Section 10, "Troubleshooting" explains what the regular occurrence of a particular type of error means. The error types below are listed alphabetically by error type, with Device errors first, Host errors second, and Controller errors last.

Device (Device Address): Buffer Overflow
The controller is receiving too much information from the devices. The devices are sending information too fast, or too much information at one time (more than 254 bytes).

Device (Device Address): Framing
Stop and start bits were not found where they should have been found.

Device (Device Address): Illegal data
The data link worked, but the format of the data was in error.

Device (Device Address): LRC
The controller is receiving the wrong LRC from the device for the transmitted message block.

Device (Device Address): Overrun
The controller receive buffer is full. The controller is receiving information from the devices at a faster rate than it can process it.

Device (Device Address): Parity
The parity bit was the wrong one for the message to match the even parity required by Multi-Drop Protocol.

Device (Device Address): SOM not received
No Start of Message character was received.

Device (Device Address): Timeout
The device did not send data or respond before the timeout limit was reached after the controller sent a message to the device. For example, if the controller timeout limit is 5 seconds, after the controller sends a message to a device, the device has 5 seconds to respond. If after 5 seconds the device has not responded, the controller logs this error.

Device (Device Address): Xmit problem
NEG received by controller, device did not receive transmission.

Host Receive Error: Buffer Overflow
The controller is receiving too much information from the host. The host is sending information too fast, or too much information (more than 512 bytes) at one time.

Host Receive Error: Framing or Host Transmit Error: Framing
A stop bit or start bit was not found where it should be.

Host Receive Error: Illegal data
Data link worked, but format of data is in error. Data was either not a valid command or the device address was invalid.

Host Receive Error: LRC
The LRC is not set correctly, or the controller is receiving the wrong LRC from the the host for the message block.

Host Transmit Error: NEG received
NEG was received by controller, indicating the host did not receive the transmission.
Host Receive Error: Overrun or Host Transmit Error: Overrun
The controller receive buffer has received too much information from the host. The controller is receiving information from the host faster than it can process the information. Host Transmit Error: Overrun is unlikely to happen, but is a potential problem.

Host Receive Error: Parity or Host Transmit Error: Parity
The parity bit was the wrong one for the message to match the choice of Even, Odd, or No parity shown on the Select Operating Parameters screen.

Host Receive Error: SOM not received
No Start of Message character was received; meaning depends upon whether protocol is solicited, or unsolicited.

Host Receive Error: Timeout or Host Transmit Error: Timeout
The host did not send data or respond before the timeout limit was reached after the controller sent a message to the host.

Polled Device Buffer Full
Controller polled device buffer has reached its limit for receiving information.

Power Interrupt
An interruption of power has caused the NMI circuit to be invoked to protect essential firmware routines and ensure the routine is completed on power up.

DISPLAY BUFFER REVIEW SCREEN

If "5" is entered for Task No. on the Master Menu, the Display Buffer Review screen shown in Figure 8-8 will be displayed on the Supervisory CRT. This screen lets you view any records stored in the Multi-Drop buffer that are ready to be transmitted to the host.

```
                         Display Buffer Review
                                                           HH:MM




41234567
SDATA1234567890
GDATAHELLO THERE!!!!!!
CDATATHIS IS A TEST OF STRING
LENGTH!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
>01:00:09
3DATA343533242234234-98
.
.
.
.
.
.
.
>01:00:10




CNTL-Q to Start Review       CNTL-S to Stop Review
Press CNTL-T For Listing of Task Options
```

Figure 8-8
Display Buffer Review Screen

Display Buffer Review Screen Operation

Data records are displayed first at the top of the screen. Each data record received from a device starts on its own line. If one line does not have enough room to hold the entire record, the end of the record is wrapped around to the next line if CRT auto wrap is enabled. The data displayed at the top of the screen will be the next data record to be transmitted by the controller to the host.

Unless a time message is being appended to every record, time messages are displayed in the buffer like data records.

You can move forward through the buffer beyond the records initially displayed by using the [CNTL] [Q] command to start the display of records, and the [CNTL] [S] command to stop scrolling. If the CRT has a scrolling or roll mode, the selection of this mode will facilitate the review of data records. When all the data in the buffer has been displayed, the controller will wait for more data to display. As new records are received, they will scroll onto the bottom of the screen as the old records scroll off the top.

To return to the top of the data queue, you must exit to the Master Menu, and then return to the Display Buffer Review screen.

Data Format

Data records displayed on the screen have the following format.

Time Message Format: Each time message is displayed in a format like the following example from Figure 8-8.

01:00:09

>	Indicates that a time message follows.
01	Days, two digits, (01-31)
:	Delimiter used between days and hours.
00	Hours, two digits (00-23), 12-hour or 24-hour format depends on configuration of real time clock.
:	Delimiter used between hours and minutes.
09	Minutes, two digits (00-59).

Data Message Format: Each data message is displayed in a format like the following example from Figure 8-8 above.

41234567

4	Device address, one character, A-Z or 0-5.
1234567	The data record.

Notice that the data record does not contain any of the Multi- Drop communication protocol; the SOM, EOM, and LRC have all been stripped out by the controller before inserting the data in the buffer. The data record also does not contain any of the data communication protocol necessary to communicate with the host. This protocol will be added when the message is transmitted from the controller.

The frequency with which time messages are appended to data records received from polled devices depends on the time interval specified with the Select Clock Parameters screen.

No two time messages will ever appear back-to-back. The controller will only append time to the data buffer when a data record has been received from a polled device. For example, if five minutes had passed between the transmission of data to the controller, the buffer would look like this:

>01:12:00
A19844234-12
>01:17:00
119844237-10

SELECT POLLED DEVICES SCREEN

If "6" is entered for Task No. on the Master Menu, the Select Polled Devices screen shown in Figure 8-9 will be displayed on the Supervisory CRT. The Select Polled Devices screen lets you specify which Multi-Drop addresses will be enabled or disabled and check which addresses are being used by devices. The controller will only poll or select enabled addresses.

```
                         Select Polled Devices
                                                              HH:MM

Device Status (E=Enabled,D=Disabled) Device Status (E=Enabled,D=Disabled)
------ ------ ---------------------- ------ ------ ----------------------
  A      E                              Q      E    Connected
  B      E                              R      E
  C      E                              S      E
  D      E                              T      E
  E      E                              U      E
  F      E                              V      E
  G      E                              W      E    Connected
  H      E                              X      E
  I      E                              Y      E
  J      E                              Z      E
  K      E                              0      E
  L      E                              1      E
  M      E                              2      E
  N      E                              3      E
  O      E                              4      E
  P      E                              5      E




Press CNTL-T For Listing of Task Options
Press ESC to Update EEPROM
```

Figure 8-9
Select Polled Devices Screen

Select Polled Devices Screen Layout

The time on the controller real time clock time is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

The main part of the screen is a two column list of device addresses: A-P in the first column, and Q-5 in the second column. To the right of the addresses, there are spaces for displaying address and device status. At the bottom of the screen are the two commands for saving changes.

Select Polled Devices Screen Operation

Enabling or Disabling Addresses: The controller will only poll or select those addresses which are enabled. To enable or disable device addresses, move the cursor to the appropriate addresses by pressing [CR] as many times as is necessary, and then enter [D] for disable polling to that address, or [E] for enable polling to that address. A [CR] after entering the status will confirm the value and move the cursor to the next address.

Connected Devices: To the right of the status column is a column which displays "Connected" if a device is actually operating at that address. The address must be enabled, even if a device is configured to operate at that address. If it is not enabled, "Connected" will not appear on this screen. In Figure 8-9, addresses Q and W are enabled and connected.

SEND MESSAGES TO POLLED DEVICES SCREEN

If "7" is entered for Task No. on the Master Menu, the Send Messages to Polled Devices screen shown in Figure 8-10 will be displayed on the Supervisory CRT. The Send Messages to Polled Devices screen lets you send a message to specified device addresses.

```
                 Send Messages to Polled Devices
                                                              HH:MM

    A                          Q
    B                          R
    C                          S
    D                          T
    E                          U
    F                          V
    G                          W
    H                          X
    I                          Y
    J                          Z
    K                          0
    L                          1
    M                          2
    N                          3
    O                          4
    P                          5
   ----------------------------------------------------------


   Addresses:

   Text(Press CNTL-Y to Send):

   Press CNTL-T For Listing of Task Options
```

Figure 8-10
Send Messages to Polled Devices Screen

Send Messages to Polled Devices Screen Layout

The time on the controller real time clock time is displayed in the upper right corner in the following format:

HH:MM

HH is hours in 24 hour format.
MM is minutes.

The main part of the screen is divided in half with each half displaying a list of device addresses, A-P on the left and Q-5 on the right. To the right of each address is space for displaying the first 35 characters of messages being sent to that address.

At the bottom of the screen are prompts for entering addresses and messages to be sent to the polled devices.

Send Messages to Polled Devices Screen Operation

Addresses: When the screen is first displayed, the cursor should be positioned in the "Addresses:" field. Enter the address for the devices to which you want to send messages in this field. A message may be sent to any or all of the addresses.

To Send To:	Do This:
One address	Enter that address, for example, "A."
Two or more addresses	Enter the addresses, without any delimiters and in any order, for example, "abcz125y."
All addresses	Leave the address field blank.

Once an address has been entered, press [CR] to acknowledge the address and move the cursor to the "Text" data field.

If invalid addresses are entered, the CRT will beep, ignore them and not display them on the screen. If there are no valid addresses, the CRT will treat the field as if it were empty, and send the message to all addresses.

Text: This field is used for entering a message to be sent to the devices specified in the "Addresses:" field. The message can be up to 79 ASCII characters in length. If the text entered is longer than 79 characters, the Supervisory CRT will beep, and the message will be truncated to the first 79 characters.

To enter a Supervisory CRT command as a character, first enter [CNTL] [P] and then the control character. For example, you may want to enter DC4 (HEX 14) which is [CNTL] [T], the return to Master Menu command. To avoid invoking the command, enter [CNTL] [P], then press [CNTL] [T].

Once the message text has been typed, enter [CNTL] [Y] to send the message. The first 35 characters of the message will be displayed, sometimes only for a brief moment, on the screen next to each address that has been specified. As soon as the device receives the message, it will be removed from the screen. If the Multi-Drop communication link between the controller and polled devices is working properly, the message should be received and cleared from the screen almost simultaneously.

If the message is displayed on the screen for an extended period of time, the device address next to the message has more than likely been disconnected.

It is not possible to send a second message to a device while the first message is still displayed on the screen. To remove the old message, enter the address in the address field, and enter l[CNTL] [X] in the text field to clear it. Then enter [CNTL] [Y] to send the blank text to the address, thereby clearing the message. Then enter a new message.

The messages displayed on the Send Messages to Polled Devices screen are not the messages sent to the polled devices by the host. Those messages can not be reviewed from the Supervisory CRT.

SECTION 9

POWER FAILURE AND RECOVERY

HANDLING POWER INTERRUPTION AND RECOVERY

POWER INTERRUPTION

WHILE POWER IS INTERRUPTED

POWER RESTORATION

HANDLING POWER INTERRUPTION AND RECOVERY

Power for controller operation is supplied by an INTERMEC power supply connected to an AC power source. Power interruption is defined as the temporary or permanent loss of power to the controller. There are four common ways power may be interrupted:

1. The controller is deliberately turned off to flush the data queues. See Section 5, "Configuring the Controller," or Section 8, "CRT Control of 9154 Communication."

2. The controller is turned off at night when the system is not operating.

3. The controller is accidentally turned off without stopping system operation first.

4. The AC power source is interrupted.

Regardless of the reason for the interruption, the 9154 Controller protects all data buffers in the controller. Data in transmission is re-transmitted after power is restored.

This section explains how the controller responds in each of the three phases of power interruption:

1. Power Interruption
2. While Power is Interrupted
3. Power Restoration

POWER INTERRUPTION

When a power interruption occurs, all 9154 Controller communication functions instantly halt. Data will not be transmitted to or accepted from the host computer. The controller is unable to communicate with the polled devices. Unless readers can buffer their own data, they will be unable to read bar code labels.

All RAM data is battery-backed up, including the RAM copy of the configuration parameters. All firmware routines essential to maintaining data integrity are protected. The controller's internal battery supplies power for the backup operation.

When using the Supervisory CRT to configure parameters:

- If a power interrupt occurs while the first new parameter value on that screen is being typed in, but before a [CR] has been entered to move to the next parameter, the new value will be lost because it has not yet been entered into RAM.

- If a power interrupt occurs after one or more new values have been confirmed by a [CR], but before [CNTL] [T] or [ESC] has been entered to save them, the RAM configuration parameters test will fail when power is restored.

WHILE POWER IS INTERRUPTED

CAUTION

Do not interrupt power to the controller for more than two weeks, if the controller contains valuable data. A power interrupt exceeding two weeks may result in the loss of data as the NiCad battery runs down and becomes unable to protect data stored in RAM.

The controller's RAM data and real time clock operation are backed up for a minimum of two weeks by the internal NiCad battery. After two weeks, loss of data integrity may occur as the battery is unable to continue protecting RAM. AC power must be restored for operation to resume.

POWER RESTORATION

When AC power is restored, a RAM status test is performed.

- If RAM is still protected by the battery, the controller will then perform tests on ROM and the RAM copy of the configuration parameters.
- If the RAM configuration parameters test passes, the RAM copy of the parameters is fine and is left unchanged.
- If the RAM configuration parameters test fails, the EEPROM copy of the configuration parameters will be written to RAM.

After the RAM configuration parameters test, the controller initializes data communication with the host and polled devices using the RAM copy of the configuration parameters. Any essential controller operation that was being performed prior to the power interrupt is completed.

With regard to data in transmission, if solicited protocol is being used, the controller reverts to waiting for a POL or SEL from the host computer. If the controller was transmitting a message when power was interrupted, the next POL from the host after power restoration causes re-transmission of the message. Conversely, if a power interrupt occurs while the controller is receiving a message from the host, the message must be re-transmitted by the host, starting with the SEL sequence.

Even if solicitation is disabled, the controller still knows if it was sending a message when a power interrupt occurred, so the message will be re-transmitted after power restoration.

- If RAM has lost its integrity, a destructive RAM test is performed that will destroy all RAM data, including the RAM copy of the configuration parameters. The controller will configure itself to operate with the parameter values stored in EEPROM, and resume normal operation.

CAUTION

If the controller's battery is depleted to the extent it is unable to back up RAM, charge the battery before interrupting AC power. If you do not allow the battery to recharge, data stored in RAM could be lost during an extended power interrupt.

After a prolonged power interrupt, the battery should be recharged before interrupting power. A depleted battery charges whenever there is AC power and the controller Power pushbutton is in the on position. For example, the battery charges when the controller is transmitting data or any other time during normal operation.

For short power interrupts, like cycling the power on and off, the battery should be sufficiently charged after a few minutes. However, fully recharging the battery may take up to four hours. The battery will be unable to back up RAM for an extended period of time until it has fully recharged.

SECTION 10

TROUBLESHOOTING

CONTROLLER TROUBLESHOOTING

TROUBLESHOOTING WITH THE SUPERVISORY CRT
Isolate Data Communication and Protocol Errors
Determine if the Polled Devices Are Communicating with the Controller
Determine Which Device Addresses are Being Used

CONTROLLER TROUBLESHOOTING

Table 10-1 lists problems that might occur in controller operation and their possible cause. To use the table, first identify the symptom, then isolate the cause, and finally try the corrective measure listed.

Table 10-1
Troubleshooting System Problems

Symptom:	Possible Problem:	Try This:
Controller will not operate.	Not using proper power supply.	Check that the AC power source matches the configuration on the power supply label. Switch to appropriate power supply if necessary.
	Power supply defective.	Check power supply; replace if defective.
The power LED doesn't light.	The controller does not receive at least 5V of power.	See "Controller will not operate" above.
The Config LED blinks every 1/2 second while the controller is operating.	The EEPROM, where the configuration parameters are written, is defective.	Contact your local INTERMEC service representative.
The Fault LED blinks every 1/2 second while the controller is operating.	RAM, which provides workspace and stores the active copy of the configuration parameters, is defective.	Contact your local INTERMEC service representative.

Table 10-1 (cont.)
Troubleshooting System Problems

Symptom:	Possible Problem:	Try This:
All four status LEDs blink every 1/2 second when controller power is turned on.	ROM test failed. ROM, where program resides, is defective.	Contact your local INTERMEC service representative.
The Fault LED often blinks during operation of the controller.	Repeated communication errors are occurring in either the host or device data links.	Check the controller configuration using Supervisory CRT; change parameters if necessary. Section 5 provides information on the configuration of operating parameters. Review information in the next section, "Troubleshooting with a Supervisory CRT." Check the device addresses. Ensure that only one device is assigned to any given address. Section 6 explains how to select device addresses. Check the cable and cable connections for any source of electrical noise. See the information in the next section, "Troubleshooting with a Supervisory CRT."

Table 10-1 (cont.)
Troubleshooting System Problems

Symptom:	Possible Problem:	Try This:
The controller does not communicate with the host.	The controller is not configured properly; baud rate, parity, stop bits, or LRC are not set correctly.	Check the controller configuration using the Supervisory CRT; change parameters if necessary. Section 5 provides instructions for checking the configuration parameters.
	Transmission parameters are not set correctly.	Check the controller transmission parameters using the Supervisory CRT; change parameters if necessary. See Section 5 for instructions.
	Cabling is incorrectly installed.	Check that the cable was made properly. Look for opens, shorts, and miswires.
		Check that the cable meets system requirements. Refer to Section 4 for specifications.
		Check that the cable ends are securely fastened to components connections.

TROUBLESHOOTING WITH THE SUPERVISORY CRT

The Supervisory CRT is particularly useful in troubleshooting data communication and configuration errors.

To check the configuration parameters, call up the Task Option screens (1, 2, 3, or 6) from the Master Menu. See Section 5, "Configuring the Controller," for instruction on how to display these screens and modify the parameters settings.

Screens 4, 5, and 6, accessible from the Master Menu, are useful for finding errors. Section 8, "CRT Control of 9154 Communication," provides detailed information on the general use of screens 4, 5, and 6. This section provides suggestions for using these screens to find errors in the data communication protocol. It covers the following diagnostic operations:

- Isolate data communication and protocol errors and determine what caused the error.
- Determine if the polled devices are communicating effectively with the controller.
- Determine which device addresses are being used.

To use this section, call up the Master Menu. The Supervisory CRT must be physically connected and configured, as described in Section 4, "Installing Hardware," and Section 5, "Configuring the Controller."

Isolate Data Communication and Protocol Errors

To isolate errors call up the Display Error Messages screen by entering [4], [CR] at the Master Menu screen. The Display Error Messages screen displays the last 20 errors recorded by the controller. As new errors occur, they scroll onto the bottom of the screen, so the list of displayed errors is continuously updated. Figure 10-1 shows a sample Display Error Messages screen.

```
                    Display Error Messages
                                                          HH:MM


01:00:03 Device A: Parity
01:00:05 Device D: Framing
01:00:09 Device K: Overrun
01:00:21 Host Transmit Error: Parity, Framing
01:00:34 Host Receive Error: LRC
01:01:01 Power Interrupt
.
.
.
.
.
.
.
01:03:46 Device 3: Xmit Problem




CNTL-Q to Start Review       CNTL-S to Stop Review
Press CNTL-T For Listing of Task Options
```

Figure 10-1
Displaying Error Messages

Troubleshooting Hints: If occasional data communication errors occur, for example "Host Transmit Error: NEG Received," there may be nothing wrong; in normal data communication some errors may occur. The data communication protocol should take care of the problem by requiring messages to be repeated.

However, if the "common" errors occur too often, there is probably something wrong with the data communication protocol. For example, if Overrun errors occur regularly, it may be necessary to change the baud rate at which devices are polled. Changing the baud rate involves changing the controller baud rate setting for polling devices, and setting all the polled devices to the new baud rate.

Some errors are fatal, for example, Power Interrupt. Until power is returned, no communication will occur. Section 9, "Power Failure and Recovery," explains in detail how the controller handles power interruption.

Device Errors: For device errors, the Display Error Messages screen also shows the address where the error occurred. If a particular address has many errors, it probably indicates that the device, or devices, with that address has problems. For example, two devices could have been configured with the same address, and, thus, be trying to drive the line at the same time. (This could result in a series of parity and framing errors recorded for one particular address.)

Host Receive Errors: When the host has initiated the select sequence to send the controller a message, any error found by the controller during the transaction will be a "Host Receive Error." The controller will expect the data to be re-transmitted by the host.

Host Transmit Errors: If the host polls the controller or a specific device and an error is found by the controller during the transaction, it will be a "Host Transmit Error." For example, if the controller has sent a message, and a parity error is detected in the hosts response, it would be a "Host Transmit Error: Parity." The controller will retain the data for automatic re-transmission.

Time of Occurrence: Each error message is accompanied by the time at which it occurred. The time of occurrence precedes the error message, and is recorded from the controller's real time clock in the following format:

00:00:03
DD:HH:MM

DD	Day
HH	Hour
MM	Minute

Since the errors will remain even if the controller power is turned off, be careful to record and review which errors occur before and after changes were made to the configuration parameters or the physical set up. The errors that are displayed may be the result of past problems that have since been corrected.

Error Types: With the mix of data link and error types there are a variety of error messages that may be displayed on the screen. The error messages are listed alphabetically below by error type, along with suggested remedies to consider if the error is occurring regularly, or if the occurrence of the error is fatal. Device errors are listed first, then the combination of Host Transmit and Host Receive Errors, followed by controller errors.

Device (Device Address): Buffer Overflow
The controller is receiving too much information from the devices. The devices are sending information too fast, or sending too much information (more than 254 bytes) at one time. Check the baud rate for controller to polled devices communication. Fix polled device communication protocol so that it sends records that are shorter.

Device (Device Address): Framing
A stop or start bit was not found where it should be. If this error occurs regularly, check the device baud rate.

Device (Device Address): Illegal data
The data link worked but the format of the data was in error. Check the device configuration. Inspect for hardware failure of the device.

Device (Device Address): LRC
The controller is receiving the wrong LRC from the device for the transmitted message block. If this error occurs occasionally, Multi-Drop protocol will re-transmit the message automatically and nothing else needs to be done. If this error occurs regularly, the Multi-Drop line is probably receiving electro-magnetic interference.

Device (Device Address): Overrun
The controller receive buffer is full. The controller is receiving information from the devices at a faster rate than it can process it. This is a firmware check; consult your local INTERMEC service representative.

Device (Device Address): Parity
For the given message, the parity bit was the wrong one to match the even parity required by Multi-Drop protocol. This is a UART error; check that baud rate and parity are configured correctly.

Device (Device Address): SOM not received
No Start of Message character was received. Check configuration of polled devices where error occurs. Ensure devices are operating with Multi-Drop protocol.

Device (Device Address): Timeout
The device did not send data or respond before the timeout limit was reached after the controller sent a message to the device. Check configuration of controller and polled device, particularly the timeout setting.

Device (Device Address): Xmit problem
NEG received by controller, indicating that the device did not receive that transmission. Since the controller will re-send message there is no problem unless this error occurs continuously. If this error occurs continuously, check the configuration of any Multi-Drop device where this error occurs, and ensure that they are set to Multi-Drop protocol.

Host Receive Error: Buffer Overflow
The controller is receiving too much information from the host.

Host is sending information too fast, or too much information at one time (more than 512 bytes). Check host to controller configuration. Adjust host communication protocol so that it does not send so much information.

Host Receive Error: Framing or Host Transmit Error: Framing
A stop bit or start bit was not found where it should be.

If this error occurs regularly, check baud rate of controller. Check baud rate of host if adjustment of controller baud setting does not correct this problem.

Host Receive Error: Illegal data
Data link worked, but the format of data is in error. Data was either not a valid command, or the device address was invalid. Check the host application program. Check which device addresses are enabled on the Supervisory CRT Select Polled Devices screen.

Host Receive Error: LRC
LRC is not set correctly or controller is receiving wrong LRC from host. If this error occurs occasionally, there is no problem, if the host re-transmits the message automatically. If this error occurs regularly, the host-to-controller line is probably receiving electro-magnetic interference.

Host Transmit Error: NEG received
Host did not receive transmission. Since controller will re-send the message, there is no problem, unless this error occurs continuously. If the error occurs continuously, check the communication protocol of both the host and the controller.

Host Receive Error: Overrun or Host Transmit Error: Overrun
The controller receive buffer has received too much information from the host. The controller is receiving information from the host faster than it can process it. This is a firmware check, consult your local INTERMEC service representative.

Host Receive Error: Parity or Host Transmit Error: Parity
For the given message, the parity bit was the wrong one to match the configured protocol. This is a UART error; check that baud rate and parity are configured correctly.

Host Receive Error: SOM not received
No Start of Message character; the problem depends on the protocol used. Check that both the host and the controller are set up for the same type of solicited or unsolicited protocol. Check that the configuration of the SOM on the controller matches the host protocol.

Host Receive Error: Timeout or Host Transmit Error: Timeout
Host did not send data or respond before the timeout limit was reached, after the controller sent a message to the host. Check configuration of controller, especially timeout setting.

Polled Device Buffer Full
Controller polled device buffer has reached its limit for receiving information. Check for a device that is sending information continuously without operator usage. Check that all devices are set up for Multi-Drop protocol. If the host computer has not been processing information received from the controller, it should do so now.

Power Interrupt
An interruption of power caused the firmware protection circuit to be invoked; information in RAM is protected by the battery-backup circuitry. After power is returned, past data will be processed before the normal power up routine is performed. See Section 9, "Power Failure and Recovery," for a more detailed explanation of how the controller handles power interruptions.

Determine if the Polled Devices Are Communicating with the Controller

To determine if the polled devices are communicating with the controller, run the following test:

1. Call up the Display Buffer Review screen from the Master Menu by entering [5] and then pressing [CR] to select Task Option 5.

   The Display Buffer Review screen will be displayed on the Supervisory CRT. This screen calls up the polled device FIFO (First In, First Out) buffer and allows you to view any records stored. If the time append is enabled, the time that records enter the FIFO buffer is displayed. Figure 10-2 illustrates the Display Buffer Review screen with time appended every minute.


```
                     Display Buffer Review
                                                     HH:MM




41234567
SDATA1234567890
GDATAHELLO THERE!!!!!!
CDATATHIS IS A TEST OF STRING
LENGTH!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
>01:00:09
3DATA343533242234234-98
.
.
.
.
.
.
.
>01:00:10




CNTL-Q to Start Review      CNTL-S to Stop Review
Press CNTL-T For Listing of Task Options
```

Figure 10-2
Displaying Buffer Review

2. Step through the buffer until the most recent data records are displayed.

   Press [CNTL] [Q] to start the buffer review. The controller will continuously write data (oldest records first) to the Supervisory CRT screen a line at a time. The records will appear on the screen starting at the top; once the screen area is full, they scroll up from the bottom. If the CRT has a scrolling or roll mode, this mode should be selected. The review can be stopped by entering [CNTL] [S], and restarted by entering [CNTL] [Q]. After all the data in the buffer has been displayed, the controller will display more data as it is received.

3. Transmit a message from the polled device to the controller.

   a. With a reader, scan a bar code symbol, know to be "good," for which the human-readable representation is known, like the following bar code:

      TEST LABEL

   b. With a printer, use the communications diagnostic test or request the printer status. Use the Supervisory CRT Send Messages to Polled Devices screen to request printer status. See the printer manual for the specific commands and procedure.

4. Look for a new record displayed on the Display Buffer Review screen.

   The address of the polled device is indicated by the first character of the data entry.

   If the polled device can not accurately transmit/receive data from the controller, do the following:

   - Check the hardware interface and cable connections between the polled device and the input device and between the polled device and the controller.

   - Check the power supply connection to the polled device and to the outlet.

   - Check the configuration of the polled device.

   - Enter [CNTL] [R] from the Supervisory CRT to ensure the controller is polling the devices.

   - If the device is a reader, review proper scanning techniques in the wand or scanner operation guide.

5. Repeat steps 3 and 4 for as many of the polled devices as desired.

6. Enter [CNTL] [T] to return to the Master Menu screen.

Determine Which Device Addresses are Being Used

To determine which addresses are in use, check device address status on the Select Polled Devices screen on the Supervisory CRT. The Select Polled Devices screen allows the user to check which Multi-Drop addresses are enabled or disabled, and also which of the enabled addresses are being used. For more detailed information about the Select Polled Devices screen, see Section 8, "CRT Control of 9154 Communication."

The procedure outlined below is easier and quicker than compiling a list of all the individual device addresses. It would be necessary to go to each device, put it into the required mode, and determine its address. Even then you still would not know if the controller was configured to use those addresses.

1. Call up the Select Polled Devices screen from the Master Menu by entering [6], [CR]. The Select Polled Devices screen will be displayed as shown in Figure 10-3.

```
                         Select Polled Devices
                                                                     TIME
Device  Status(E=Enabled,D=Disabled)DeviceStatus(E=Enabled,D=Disabled)

   A       E                           Q       E     Connected
   B       E                           R       E
   C       E                           S       E
   D       E                           T       E
   E       E                           U       E
   F       E                           V       E
   G       E                           W       E     Connected
   H       E                           X       E
   I       E                           Y       E
   J       E                           Z       E
   K       E                           0       E
   L       E                           1       E
   M       E                           2       E
   N       E                           3       E
   O       E                           4       E
   P       E                           5       E

Press CNTL-T For Listing of Task Options
```

Figure 10-3
Select Polled Devices

2. Look in the status column, to the right of the device addresses, and see which addresses have an E for enabled.

3. Inspect the devices to ensure that they are all on.

4. Check the column to the right of the status column on the Select Polled Devices screen. Any device address with "Connected" in it is being used. For example, address W in Figure 10-3 is being polled by the controller, and is able to respond.

5. Check that the "Connected" devices equal the number of devices that are physically connected and turned on.

   If the number of devices is larger than the number of "Connected" addresses on the Select Polled Devices screen, either there is a problem with one or more devices not communicating with the controller, or two devices may have the same address.

6. If some addresses are enabled, but "Connected" is not displayed, these addresses may be used by new devices.

   If you need more enabled addresses, press [CR] until the cursor is across from the address, and then enter [E], followed by [CR] to enable an address. Repeat as necessary.

7. Exit the Select Polled Devices screen using one of the two following procedures:

   a. Enter [CNTL] [T] to write the device address settings to the RAM copy of the configuration parameters, re- initialize the controller and return to the Master Menu.

   b. Enter [ESC] to save the device address settings to the EEPROM copy of the configuration parameters, re- initialize the controller and return to the Master Menu.

SECTION 11

MAINTENANCE

MAINTENANCE SUMMARY

SAFETY PRECAUTIONS
- Energized Equipment
- Resuscitation
- Do Not Repair or Adjust Alone

INSPECTION

CLEANING

DISCONNECTING OR POWERING DOWN THE CONTROLLER

POWER SUPPLY

MAINTENANCE

INTERNAL BATTERY

MAINTENANCE SUMMARY

The 9154 Controller requires no maintenance during normal operation. For years of trouble-free use, follow the guidelines and procedures listed below:

SAFETY PRECAUTIONS

WARNING

Only trained and authorized technicians or operators should work on energized electrical equipment. Improper repair methods could result in injury or death.

Energized Equipment

Energized electrical equipment is dangerous. Electrical shock from energized equipment can cause death. Never work on energized equipment unless authorized to do so by a responsible authority. If emergency work on energized equipment is authorized, be sure that it is accomplished in strict compliance with approved safety regulations.

Resuscitation

Persons working on or near high voltage should be familiar with approved industrial first aid methods. If someone is injured and stops breathing, initiate resuscitation immediately. A delay could result in the victim's death.

Do Not Repair or Adjust Alone

Do not under any circumstances repair or adjust energized equipment alone. The immediate presence of someone capable of rendering aid is essential for operator safety.

INSPECTION

Occasionally, a visual inspection of the controller and the rest of the system should be performed to ensure that the system is intact and that hazardous changes in the work environment have not occurred.

1. Check that the controller is properly connected to an earth ground. The connection to the controller grounding stud should be tight and free of corrosion. The connection wire should be tightly connected to an earth ground, such as the building ground, power service conduit, or grounded metal structure.

2. Inspect the work environment for conditions that would interfere with the proper function of the controller. Large electric motors, welders, and switching equipment may alter the original conditions under which the data communication interface was chosen. See Section 3, "Designing a 9154 System," and Section 4, "Installing Hardware," for information on how to choose the correct data communication interface for your environment.

3. Check that the controller is properly mounted. Ensure that the mounting location is safe and free from the potential for water or other liquids coming in contact with the controller system.

4. Check all data communication connections. Ensure that they are properly connected and free of corrosion.

CLEANING

Wipe dust and dirt from the controller using a soft cloth and non-abrasive cleaner. The controller is spill-proof, but not water-proof. Do not allow cleaning fluid or any other liquid to get into the interior of the controller.

DISCONNECTING OR POWERING DOWN THE CONTROLLER

CAUTION

Before disconnecting the power supply from the controller, ensure the controller Power pushbutton is in the off position. If the power supply is disconnected before the controller is turned off, the controller's firmware may not function correctly on power-up.

To avoid damaging the equipment, observe the following procedure when disconnecting power to the controller:

1. Disconnect, disable with the Supervisory CRT, or turn off all polled devices.
2. Turn off the controller.
3. Disconnect the power supply from the rear of the controller.

POWER SUPPLY

The power supply is not a repairable unit. If the power supply is damaged, it must be removed and replaced with a new power supply. Contact your local INTERMEC service representative.

When replacing a power supply, check that the new power supply is the correct one for the controller and the available power source. See Section 4, "Installing Hardware," for instructions on determining the proper power supply.

If you are experiencing recurrent problems with the power supply, the best way to protect the power supply is to ensure that the power source is noise-free, free of voltage surges, and of the proper voltage and frequency. Electronic devices are available to remove voltage surges from power sources.

MAINTENANCE

During normal operation, you should never have to open the controller. If damage to the EEPROM or other internal components is suspected, contact your local INTERMEC service representative.The four status lights indicate that the following internal damage may exist.

- If the fault light blinks every half second, the RAM is defective.
- If the configuration light blinks every half second, the EEPROM is defective.
- If all four status lights blink every half second when the controller is powered up, the ROM is defective.

For additional information on determining if internal damage has occurred, see Section 10, "Troubleshooting."

INTERNAL BATTERY

WARNING

Do not incinerate, crush, or puncture batteries. The electrolyte contained in NiCad batteries is composed of caustic materials that are harmful to eyes and skin.

WARNING

Do not short-circuit the battery. Burns may result. Short circuits can occur if a battery is placed on a metal shelf, if metal tools are used, or if the battery is placed in a pocket containing coins or keys.

The controller contains a NiCad battery that backs up the RAM during power-down. As necessary, the controller charges the battery. The battery requires no maintenance and should last the life-time of the controller.

Affirmative Acknowledgement Character (AFF) -- Indicates an affirmative acknowledgement to a message.

Alphanumeric -- The character set which contains letters, numbers and usually other characters such as punctuation marks.

ASCII -- The character set and code described in American National Standard Code for Information Interchange, ANSI X3.4- 1977. Each ASCII character is encoded with 7-bits (8-bits including parity check). The ASCII character set is used for information interchange between data processing systems, communication systems and associated equipment. The ASCII set consists of both control and printing characters.

Bar Code Reader -- A device used to read a bar code symbol.

Bit -- An abbreviation for "binary digit". A single element (0 or 1) in a binary number.

Byte -- A combination of bits in a predetermined pattern, designed to represent a digit or alphanumeric character.

Character -- 1. A single group of bars and spaces which represent an individual number, letter, punctuation mark, or other symbol. 2. A graphic shape representing a letter, numeral, or symbol. 3. A letter, digit, or other symbol that is used as part of the organization, control, or representation of data.

CMOS -- A type of integrated circuit with a low power drain. Chemically, a combination of PMOS and NMOS.

Compile and Run IRL Program Character (RUN) -- Sent by the host to define the end of a downloaded program and tell the reader to run the program (if no errors found).

Computer Response Required Mode (CRRM) -- When enabled, the reader requires a response from the computer before the reader will accept more data. The message must be transmitted using the protocol currently in effect. The protocol characters only, with no data, are sufficient.

Configuration -- The selected parameters to determine the operation of the controller.

CrossBar -- An INTERMEC designation for a group of Bar Code equipment that works together to provide flexible networks that meet customer requirements. Devices that readily communicate with each other.

Digital -- Pertaining to data in the form of digits. In signals, digital refers to a signal which assumes one of a predetermined set of values, such as 0 or 1, as opposed to a signal which may assume any value over a continuing range of values, such as an analog signal.

Drop Cable -- The cable that extends from a Multi-Drop main trunk cable to the polled device. A length of 30 feet is allowed with INTERMEC Part No. 047653. Maximum length of 20 feet with a customer-supplied cable.

Drop Site -- The location on a Multi-Drop main trunk cable where a drop cable is connected.

EEPROM -- Electrically Erasable Programmable Read Only Memory.

In the 9154 Controller, the integrated circuit (IC) where configuration parameters are stored when they are permanently saved.

EIA -- Electrical Institute of America. Maintains industry standards for electrical and electronic equipment, for example RS-232. Specifications can be ordered from EIA Engineering Department, Standards Sales Office, 2001 Eye St. NW, Washington, DC, 20006.

Electromagnetic Noise -- Sometimes called Electromagnetic Interference (EMI), the undesirable electromagnetic phenomena (energy waves) from sources such as lightning discharge, rotating electrical machinery, welding equipment, electronic equipment, and radio or television transmission. Electromagnetic noise degrades signals generated by electronic equipment and impairs performance.

End of File Character (EOF) -- Sent at the end of a file when using IRL.

End of Message Character (EOM) -- Sent at the end of reader messages and must be sent at the end of host messages. The transmit and receive EOM characters can be defined separately.

End of Program Block/Continue Character (EOP) -- Sent by the host after a block of IRL program statements to tell the reader that another block of IRL statements is coming.

End of Record Character (EOR) -- Sent at the end of a message record.

FCC -- Federal Communications Commission. Maintains government regulations regarding communication and electronic equipment.

FIFO -- First In, First Out. The first record stored in a buffer is the first record to be processed.

Hardware -- Physical equipment, such as mechanical, magnetic, electrical, or electronic devices, as opposed to the computer program or method of use.

Interference -- See Electromagnetic Noise.

LED -- Light emitting diode. A semiconductor that produces light at a wavelength determined by its chemical composition. This light source is often used in bar code readers.

LRC -- Longitudinal Redundancy Check; a check that is the exclusive OR of all the rest of the bits in the message. In 9154 Controller operation it starts at the second bit of the header, if no header is used at the second character of the SOM, or at a minimum at the first character of the message.

Main Trunk Cable -- The Multi-Drop cable extending from the 9-Pin polled device connector on the rear of the controller.

Modem -- MOdulator/DEModulator; a device for conversion of one form of a signal to another that is suitable for transmission over communication circuits, typically from digital to analog and then from analog to digital.

Multi-Drop Protocol -- Used when connecting multiple readers to a INTERMEC 9154 Controller or a 9161A Option 02 Multi-Drop Concentrator. Multi-Drop protocol is similar to Polling Mode D; however, in Multi-Drop, each device on the line is assigned a unique POL and SEL character. Multi-Drop operates only at 2400 baud or higher, and its data communication protocol can't be modified.

Negative Acknowledge Character (NEG) -- Indicates a negative acknowledgement to a message.

Online -- An operation in which peripheral devices are connected directly to the processing unit.

Parity -- A system for encoding binary characters with an odd or even number of binary "1" bits. Parity is not related to whether the original characters are odd or even, but rather to how an individual character is made to have an odd or even number of "1" bits with the addition of one more bit (1 or 0). When Even parity is used, characters having an odd number of binary ones in their structure have a "1" bit added to make the number of "1" bits even. Characters whose binary representation already has an even number of "1" bits have a "0" bit added so that the number of "1" bits remains even. For the purpose of data processing and data communication, parity is used to provide a self-checking feature in bar codes and other transmission techniques.

Poll Character (POL) -- Sent by the host to request reader data. For Multi-Drop protocol, a unique character should be defined for each reader on a data line.

Preamble -- Predefined data that is automatically appended to the beginning of transmitted data. Commonly used to identify which peripheral the host is receiving information from.

Program Acknowledgement Character (PAK) -- Sent by the reader in response to a good program.

Program Statement Separator Character (PSS) -- Separates individual IRL program statements from one another in a block of IRL program statements. PSS must not be defined same as EOM.

RAM -- Random Access Memory; contents can be altered any time. Information can be written or read anywhere within the storage device in the same amount of time, regardless of where the information is stored.

Reader -- A device used for machine reading of bar codes; typically consists of a scanner, a decoder, and a data communications interface.

ROM -- Read Only Memory; normally contents of this type of electronic memory are read, but can't be altered. See EEPROM.

RS-232 -- An industry standard (EIA) for a 25-Pin hardware interface used between computers and various types of peripheral equipment to allow communication.

RS-422/485 -- An industry standard (EIA) for a 9-Pin hardware interface between electronic equipment which is used to allow the equipment to communicate.

Select Character (SEL) -- Sent by the host to request if the reader can accept data. For Multi-Drop protocol, a unique character should be defined for each reader on a data line.

Start of Message Character (SOM) -- The first character in messages sent to or received from the host.

Transient Voltage Suppressors -- An electronic circuit that protects a line from voltage surges. Used on the 9154 Controller host computer and Supervisory CRT interfaces.

UART -- Universal Asynchronous Receiver/Transmitter. Modem.

XON/XOFF Character -- Allows XON/XOFF flow control.

APPENDIXES

APPENDIX A: SPECIFICATIONS

APPENDIX B: DEFAULT EEPROM SETTINGS

APPENDIX C: ASCII CONTROL CHARACTERS

APPENDIX D: FULL ASCII CHART

APPENDIX A: SPECIFICATIONS

PHYSICAL CHARACTERISTICS

The controller package consists of an injection molded plastic top and bottom housing. The bottom housing supports the electronics. The package is spill resistant but not waterproof. The interior of the housing is sprayed with conductive paint for shielding.

DIMENSIONS

Height: 1.4 in (3.5 cm)
Width: 6.5 in (16.5 cm)
Length: 7.5 in (19.1 cm)

HARDWARE INTERFACES

Host Port

EIA RS-232
EIA RS-422/485

Multi-Drop Port

EIA 4-wire RS-485

Supervisory CRT Port

EIA RS-232

ENVIRONMENTAL

The controller will operate in ambient temperatures from 0° C to +50° C and can be stored from -10° C to +60° C. The controller will operate from 10% to 90% relative humidity (non-condensing).

OPERATOR FEEDBACK

The controller has four status lights and one power light which are visible through a window on the front panel. The power light turns on when the controller receives +5 volts.

SAFETY STANDARDS MET

- UL 478 5th Ed.
- CSA C22.2 #154-M1983
- VDE 0806/08.81
- VDE 0871/06.78
- FCC Docket 10780 Part 15, sub par. J

APPENDIX B: DEFAULT EEPROM SETTINGS

Parameter:	Default:	Possible Values:
Supervisory CRT		
Clear Screen Sequence	<SUB>	Up to 6 ASCII characters
Cursor Position Sequence	<ESC>=RC	Up to 8 ASCII characters
Host Line Parameters		
Line Speed	9600	19200,9600,4800,2400,1200, 600,300,110
Parity	E	E=Even, O=Odd, N=None
Data Bits	7	7 or 8
Stop Bits	1	1 or 2
Multi-Drop Line Parameters		
Line Speed	9600	19200,9600,4800,2400
Address	p	m, n, o, p
Supervisory CRT Line Parameters		
Line Speed	9600	19200,9600,4800,2400,1200, 600,300,110
Parity	E	E=Even, O=Odd, N=None
Data Bits	7	7 or 8
Stop Bits	2	defaulted
To Host Transmission Parameters		
# Records Per Blk	1	0 to 99
Record Separator	<CR>	Up to 5 ASCII characters
Header	——	Up to 5 ASCII characters
SOM	<STX>	Up to 5 ASCII characters
EOM	<ETX>	Up to 5 ASCII characters
RES	<STX> Z <CR>	Up to 5 ASCII characters
AFF	<STX> Y <CR>	Up to 5 ASCII characters
NEG	<STX> Z <CR>	Up to 5 ASCII characters
Error Message SOM	<STX>	Up to 5 ASCII characters
Error Message EOM	<ETX>	Up to 5 ASCII characters
Transparency Check	N	Y for Yes or N for No
Data Wait Mode	N	Y for Yes or N for No

Parameter:	Default:	Possible Values:
From Host Transmission Parameters		
POL	<ENQ>	Up to 2 ASCII characters
SEL	<BEL>	Up to 2 ASCII characters
AFF	<ACK>	Up to 2 ASCII characters
NEG	<NAK>	Up to 2 ASCII characters
DLE	<DLE>	Up to 2 ASCII characters
SOM	<STX>	Up to 2 ASCII characters
EOM	<ETX>	Up to 2 ASCII characters
Record Separator	<CR>	Up to 2 ASCII characters
Delay (x 10 ms)	1	0 to 99
Timeout (x 1 sec)	60	0 to 60
Xon / Xoff Enable	N	Y or N
LRC Enable	N	Y or N
Real Time Clock Parameters		
Date	87.01.01	Year.Month.Day
Time	00.00	Hour.Month
Time Append		
Enable Time Append	N	Y for Yes or N for No
Interval (x 1 minute)	1	0 to 99
Record Day Rollover	N	Y for Yes or N for No
Time Broadcast		
Enable Time Broadcast	N	Y for Yes or N for No
Interval (x 1 minute)	1	0 to 99
Preamble	<HT>	up to 5 ASCII characters
Postamble	——	up to 5 ASCII characters
Display Format	24	12 or 24
Include YY/MM/DD	N	Y for Yes or N for No

APPENDIX C: ASCII CONTROL CHARACTERS

NUL
Null character. This character is non-printing time delay or filler character.

SOH
Start of Heading. Used in bysync data streams to denote the start of message heading data block.

STX
Start of Text. Signals the end of heading data and the beginning of information data.

ETX
End of Text. Informs the receiver that all information data has been transmitted.

EOT
End of Transmission. Indicates the end of transmission of all data associated with a message.

ENQ
Enquiry. Request a response.

ACK
Acknowledgement. Used to verify proper communication between transmitter and receiver.

BEL
Bell. Signals a situation that requires human intervention.

BS
Backspace. Used to control the active print position of the cursor and printer.

HT
Horizontal Tab. Causes the cursor to move to the next predetermined position before printing.

LF
Line Feed. Causes the cursor to advance to the same column position in the next line of text.

VT
Vertical Tab. Causes the cursor position to advance to the same column a predetermined number of lines down from the present line.

FF
Form Feed. Used to advance a print head to the next logical top of form or to a predetermined line of the next form or page.

CR
Carriage Return. Used to advance the active print or display position to the first column of the same line. Unless the carriage return is followed by a line feed, the characters that follow the carriage return will overstrike characters already printed on the line.

SO
Shift Out. Extends the standard graphics character set.

SI
Shift In. Resets to the Standard ASCII character set.

DLE
Data Link Escape. Used to modify the meaning of a limited number of subsequent characters.

DC1
Device Control 1. An electronic toggle switch. This character is often designated as XON and is used to re-initiate the listing of a file that was temporarily halted by a DC3 character.

DC2
Device Control 2. An electronic toggle switch. Varies with vendor application.

DC3
Device Control 3. An electronic toggle switch. This character is often designated as XOFF and is used to temporarily halt the listing of a file.

DC4
Device Control 4. An electronic toggle switch. Varies with vendor applications.

NAK
Negative Acknowledgement. Used to indicate improper transmission between a transmitter and a receiver.

SYN
Synchronous Idle. Used in the bisync protocol to initiate or maintain communication synchronization when no data is being transmitted.

ETB
End of Transmission Block. Used to indicate the end of a particular block of transmitted data.

CAN
Cancel. Varies with vendor application, but is generally used to denote an error in data transfer.

EM
End of Medium. Used to indicate either the physical end of a data medium or the end of a portion of data medium containing desired data.

SUB
Substitute. Used for data communication accuracy control.

ESC
Escape. Used for communications with printers.

FS
File Separator. An information separator control character used to mark a logical boundary between files being transferred.

GS
Group Separator. An information separator character used to mark the logical boundaries between groups of transmitted data.

RS
Record Separator. An information separator character used to mark logical boundaries between records.

US
Unit Separator. The final information separator character.

DEL
Delete. Not actually a character but is used to erase or obliterate characters.

SP
Space.

APPENDIX D: FULL ASCII CHART

FULL ASCII

Binary[0]	Hex[1]	Dec[2]	C39[3]	Char[4]	Binary	Hex	Dec	C39	Char
00000000	00	00	%U	NUL	01000000	40	64	%V	@
00000001	01	01	$A	SOH	01000001	41	65	A	A
00000010	02	02	$B	STX	01000010	42	66	B	B
00000011	03	03	$C	ETX	01000011	43	67	C	C
00000100	04	04	$D	EOT	01000100	44	68	D	D
00000101	05	05	$E	ENQ	01000101	45	69	E	E
00000110	06	06	$F	ACK	01000110	46	70	F	F
00000111	07	07	$G	BEL	01000111	47	71	G	G
00001000	08	08	$H	BS	01001000	48	72	H	H
00001001	09	09	$I	HT	01001001	49	73	I	I
00001010	0A	10	$J	LF	01001010	4A	74	J	J
00001011	0B	11	$K	VT	01001011	4B	75	K	K
00001100	0C	12	$L	FF	01001100	4C	76	L	L
00001101	0D	13	$M	CR	01001101	4D	77	M	M
00001110	0E	14	$N	SO	01001110	4E	78	N	N
00001111	0F	15	$O	SI	01001111	4F	79	O	O
00010000	10	16	$P	DLE	01010000	50	80	P	P
00010001	11	17	$Q	DC1	01010001	51	81	Q	Q
00010010	12	18	$R	DC2	01010010	52	82	R	R
00010011	13	19	$S	DC3	01010011	53	83	S	S
00010100	14	20	$T	DC4	01010100	54	84	T	T
00010101	15	21	$U	NAK	01010101	55	85	U	U
00010110	16	22	$V	SYN	01010110	56	86	V	V
00010111	17	23	$W	ETB	01010111	57	87	W	W
00011000	18	24	$X	CAN	01011000	58	88	X	X
00011001	19	25	$Y	EM	01011001	59	89	Y	Y
00011010	1A	26	$Z	SUB	01011010	5A	90	Z	Z
00011011	1B	27	%A	ESC	01011011	5B	91	%K	[
00011100	1C	28	%B	FS	01011100	5C	92	%L	\
00011101	1D	29	%C	GS	01011101	5D	93	%M	]
00011110	1E	30	%D	RS	01011110	5E	94	%N	^
00011111	1F	31	%E	US	01011111	5F	95	%O	_
00100000	20	32	SP	SP[6]	01100000	60	96	%W	`
00100001	21	33	/A	!	01100001	61	97	+A	a
00100010	22	34	/B	"	01100010	62	98	+B	b
00100011	23	35	/C	#	01100011	63	99	+C	c
00100100	24	36	/D	$	01100100	64	100	+D	d
00100101	25	37	/E	%	01100101	65	101	+E	e
00100110	26	38	/F	&	01100110	66	102	+F	f
00100111	27	39	/G	'	01100111	67	103	+G	g
00101000	28	40	/H	(	01101000	68	104	+H	h
00101001	29	41	/I	)	01101001	69	105	+I	i
00101010	2A	42	/J	*	01101010	6A	106	+J	j
00101011	2B	43	/K	+	01101011	6B	107	+K	k
00101100	2C	44	/L	,	01101100	6C	108	+L	l
00101101	2D	45	/M	-	01101101	6D	109	+M	m
00101110	2E	46	/N	.	01101110	6E	110	+N	n
00101111	2F	47	/O	/	01101111	6F	111	+O	o
00110000	30	48	/P[7]	0	01110000	70	112	+P	p
00110001	31	49	/Q	1	01110001	71	113	+Q	q
00110010	32	50	/R	2	01110010	72	114	+R	r
00110011	33	51	/S	3	01110011	73	115	+S	s
00110100	34	52	/T	4	01110100	74	116	+T	t
00110101	35	53	/U	5	01110101	75	117	+U	u
00110110	36	54	/V	6	01110110	76	118	+V	v
00110111	37	55	/W	7	01110111	77	119	+W	w
00111000	38	56	/X	8	01111000	78	120	+X	x
00111001	39	57	/Y	9	01111001	79	121	+Y	y
00111010	3A	58	/Z	:	01111010	7A	122	+Z	z
00111011	3B	59	%F	;	01111011	7B	123	%P	{
00111100	3C	60	%G	<	01111100	7C	124	%Q	|
00111101	3D	61	%H	=	01111101	7D	125	%R	}
00111110	3E	62	%I	>	01111110	7E	126	%S	~
00111111	3F	63	%J	?	01111111	7F	127	%T[8]	■[9]

Control Character Definitions[5]

Control Character	Definition
NUL	Null, or all zeroes
SOH	Start of Heading
STX	Start of Text
ETX	End of Text
EOT	End of Transmission
ENQ	Enquiry
ACK	Acknowledgement
BEL	Bell
BS	Backspace
HT	Horizontal Tab
LF	Line Feed
VT	Vertical Tab
FF	Form Feed
CR	Carriage Return
SO	Shift Out
SI	Shift In
DLE	Data Link Escape
DC1	Device Control 1 (XON)
DC2	Device Control 2
DC3	Device Control 3 (XOFF)
DC4	Device Control 4
NAK	Negative Acknowledge
SYN	Synchronous Idle
ETB	End Transmission Block
CAN	Cancel
EM	End of Medium
SUB	Substitute
ESC	Escape
FS	File Separator
GS	Group Separator
RS	Record Separator
US	Unit Separator
SP	Space
DEL	Delete

Notes

0 Bit positions are 76543210
1 Hexadecimal value
2 Decimal value
3 Code 39 character(s)
4 ASCII character
5 Hold down Control key and press key to left of definition
6 SP is the SPACE character
7 The Code 39 characters /P through /Y may be interchanged with the numbers 0 through 9
8 May be interchanged with %X or %Y or %Z
9 ■ is the DELETE character

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