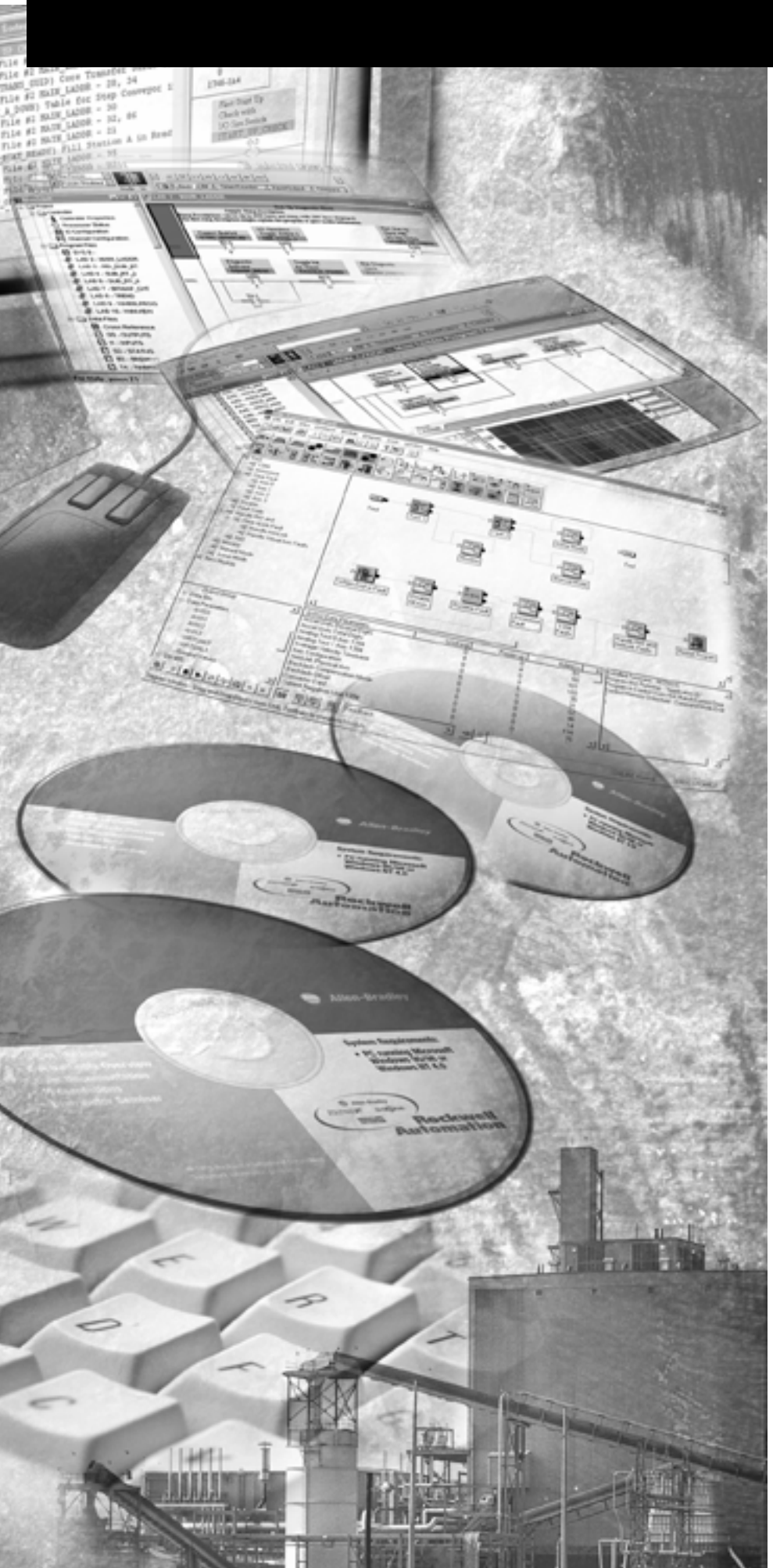

Allen-Bradley

SCADA System

Application Guide

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.ab.com/manuals/gi) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual we use notes to make you aware of safety considerations.

WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

SHOCK HAZARD

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.

The information below summarizes the changes to this manual since the last printing.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

For information on	See
Removing Configuring Classic PLC-5 Processors with 1785-KE Modules chapter	NA
Add in additional publications	Preface
Designing communication for DF1 Radio Modem	1-17 through 1-19
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Data Logging	3-58 through 3-69
Conditions that will erase the data retrieval file	3-69
DF1 Radio Modem	4-7 through 4-8
Configuring a Radio Modem station	4-27 through 4-32
Rockwell Automation modems	8-3 through 8-4
Configuring modems for PLC-5, SLC, and Logix processors	10-3
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Communicating over the telephone line	10-4 through 10-8
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Glossary

Index

What SCADA Information Is Available?

Two principle SCADA documents are available:

- SCADA System Application Guide Publication AG-UM008 (this manual)
  - Describes how to configure Allen-Bradley® products and third-party modems
  - Describes how to send messages
  - Provides application samples
- SCADA System Selection Guide (Publication AG-SG001)
  - Presents Allen-Bradley capabilities for SCADA applications
  - Guides you through choosing SCADA system components

Audience

We designed this document for individuals who are configuring a SCADA system or are answering configuration questions. This document assumes you know how to:

- handle, install, and operate the products referenced in this document
- install, navigate through, and use the software products referenced in this document
- prepare cables, if necessary

Contents of this Manual

Refer to the following listing for the contents of this user manual.

Chapter	Title	Contents
1	Designing Communication	Design and configuration choices for getting information to and from slave stations.
2	Configuring Enhanced PLC-5® Processors	Set up an enhanced PLC-5 processor as a master station, slave station, or a station on a point-to-point link.
3	Configuring MicroLogix™ 1100/1200/1500 Controllers	Set up a MicroLogix 1100/1200/1500 controller as a master station, slave station, or a station on a point-to-point link.
4	Configuring SLC™ 5/03, 5/04, and 5/05 Processors	Set up an SLC 5/03, 5/04, and 5/05 processor as a master station, slave station, or a station on a point-to-point link.
5	Configuring SLC™ 500 Processors with 1747-KE Interface Modules	Set up an SLC 500 fixed or modular processor (SLC 5/01 or 5/02) with a 1747-KE as a remote station, or a station on a point-to-point link.
6	Configuring MicroLogix 1000 Controllers	Set up a MicroLogix controller as a slave station, or a station on a point-to-point link.
7	Configuring Logix Controllers	Set up Logix controllers as a master station, slave station, or a station on a point-to-point link.
8	Configuring Modems	Provides information on connecting modems to Allen-Bradley devices.
9	Configuring RSLinx® Classic Software for DF1 Half-Duplex Communications	Provides reference information needed while configuring RSLinx Classic communication server software as a DF1 half-duplex polling master station or as a DF1 half-duplex slave station.
10	Using Dial-up Telephone Communication	Provides information on how to set up and initiate dial-up communication.
11	Remotely Programming Allen-Bradley Processors Over a Telemetry Network	Provides information on how to set up and configure RSLogix programming terminals on Ethernet to program remote processors.
A	Modem Cable Reference	Provides cable information.
B	Basic DF1 Protocol Troubleshooting	Provides information on how to troubleshoot communication errors.
C	Third-Party Supplier Contact Information	Provides 3rd party vendor contact information.
D	Worksheets	Provides worksheets to document your serial channel configurations.
E	Sample Ladder Logic	Provides information for developing your messaging logic.
Glossary		

Terms

We use these terms frequently in this book:

Term	Definition
Logix processor	A collective name used to refer to ControlLogix™, FlexLogix™, and CompactLogix™ processors.
Enhanced PLC-5 processor	A collective name used to refer to PLC-5/11, -5/20, -5/30, -5/40, -5/60, and PLC-5/80 processors.
Ethernet PLC-5 processor	A collective name used to refer to PLC-5/20E, -5/40E, and -5/80E processors.
master station	A device (programmable controller with I/O modules or a workstation) that sends data to and collects data from devices connected on a point-to-multipoint, half-duplex network.
slave station	A device (programmable controller with I/O modules) that is located in a remote site away from the master station and that controls I/O points at the remote site. A slave station accepts commands from and can send data (if capable) to a master station via a telemetry network.

See the Glossary for other definitions.

Address Conventions

Addresses

These values	Are represented as
octal	X_8
decimal	X_{10}

Related Publications

The following documents contain additional information concerning Allen-Bradley programmable controller products. To obtain a copy, contact your local Allen-Bradley office or distributor:

Title	Publication Number
Enhanced and Ethernet PLC-5 Programmable Controllers User Manual	1785-UM012
PLC-5 Instruction Set Reference Manual	1785-RM001
SLC 500 Instruction Set Reference Manual	1747-RM001
SLC 500 Modular Hardware Style Manual	1747-UM0011
DH-485/RS232C Interface Module User Manual	1747-UM005
MicroLogix 1000 Programmable Controllers Users Manual	1761-UM003
ControlLogix System User Manual	1756-UM001
Logix5000™ Controllers Common Procedures Programming Manual	1756-PM001
Logix Controllers General Instruction Set Reference Manual	1756-RM003
MicroLogix 1200 and 1500 Instruction Set Reference Manual	1762-RM001
MicroLogix 1200 User Manual	1762-UM001
MicroLogix 1500 User Manual	1764-UM001
CompactLogix System User Manual	1769-UM011
FlexLogix System User Manual	1794-UM001
DF1 Protocol and Command Set Reference Manual	1770-RM516
2004-2005 Americas Edition/Encompass Program Product Directory	6873-SG003

If you would like a manual, you can:

- download a free electronic version from the internet at **www.rockwellautomation.com/literature**.
- purchase a printed manual by contacting your local Allen-Bradley distributor or Rockwell Automation sales office.

Designing Communication

Chapter Objectives

Use this chapter along with the configuration chapters of the devices in your SCADA system to help you make design and configuration choices for getting information to and from slave stations.

While designing your communication scheme, consider these application requirements:

- responsiveness
- determinism
- cost
- efficiency

The factors that affect communication are a result of the protocol you are use, either half-duplex or full-duplex.

For information about	See page
choosing a polling mode for the DF1 Half-Duplex protocol	1-2
designing a communication scheme using standard-communication mode	1-8
designing a communication scheme using message-based communication mode	1-15
designing communication for DF1 Full-Duplex protocol	1-16
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Choosing a Polling Mode for DF1 Half-Duplex Master

A master station can be configured to communicate with slave stations in either Message-based polling mode or Standard polling mode. The pros and cons of each polling mode are described below.

Message-Based Polling Mode

Message-based polling mode is best used in networks when communication with the slave stations is not time critical and where the user needs to be able to limit when and how often the master station communicates with each slave station. It is **NOT** recommended for systems that require time continuous communication between the master and all the slave stations have MSG instructions in their programs.

With Message-Based polling mode, the only time a master station communicates with a slave station is when a message (MSG) instruction in ladder logic is triggered to that particular slave station's address. This polling mode gives the user complete control (through ladder logic) over when and how often to communicate with each slave station.

If multiple MSG instructions are triggered simultaneously, they will be executed in order, one at a time, to completion (i.e., the first MSG queued up will be transmitted and completed to done or error before the next queued up MSG is transmitted. Refer to appendix E for sample application programs). Any time a message is triggered to a slave station that can't respond (for instance, if its modem fails), the message will go through retries and timeouts that will slow down the execution of all the other queued up messages. The minimum time to message to every responding slave station increases linearly with the number of slave stations that can't respond.

If the Message-based selection is 'don't allow slaves to initiate messages,' then even if a slave station triggers and queues up a MSG instruction in its ladder logic, the master station will not process it. This mode is similar to how a master/slave network based on Modbus protocol would work, since Modbus slave stations cannot ever initiate a message.

If the Message-based selection is 'allow slaves to initiate messages,' when a slave station initiates a message to the master station (polled report by exception messaging) or to another slave station (slave-to-slave messaging), the MSG command packet will remain in that slave station's transmit queue until the master station triggers its own MSG command packet to it (which could be seconds, minutes or hours later, depending on the master's ladder logic).

Standard Polling Mode

Standard polling mode is strongly recommended for larger systems that require time critical communication between the master and all the slave stations, or for any system where slave station-initiated messages are going to be used (this includes slave programming over the network, since this uses the same mechanism that slave-to-slave messaging uses). The Active Node Table automatically keeps track of which slaves are (and are not) communicating. Standard polling mode should **NOT** be used in cases where the user needs to be able to limit when and how often the master station communicates with each slave station.

Standard polling mode causes the master station to continuously send one or more 4-byte poll packets to each slave station address configured by the user in the poll list(s) in round robin fashion. As soon as the end of the polling list is reached, the master station immediately goes back and starts polling slave stations from the top of the polling list over again. This is independent and asynchronous to any MSG instructions that might be triggered in the master station ladder logic. In fact, this polling continues even while the master station is in program mode. Refer to chapter 3 of the DF1 Protocol and Command Set Reference Manual, publication 1770-RM516, for additional information.

When a MSG instruction is triggered while the master station is in run mode, the master station will transmit the message packet just after it finishes polling the current slave station in the poll list and before it starts polling the next slave station in the poll list (no matter where in the poll list it is currently at). If multiple MSG instructions have been triggered simultaneously, at least four message packets may be sent out between two slave station polls. Each of these messages will have an opportunity to complete when the master polls the slave station that was addressed in the message packet as it comes to it in the poll list.

If each of the transmitted message packets is addressed to a different slave station, the order of completion will be based upon which slave station address comes up next in the poll list, not the order that the MSG instructions were executed and transmitted in.

When a slave station receives a poll packet from the master station, if it has one or more message packets queued up to transmit (either replies to a command received earlier or MSG commands triggered locally in ladder logic), the slave station will transmit the first message packet in the transmit queue.

If the standard mode selection is ‘single message per poll scan,’ then the master station will then go to the next station in the poll list. If the standard mode selection is ‘multiple messages per poll scan,’ the

master station will continue to poll this slave station until its transmit queue is empty.

The master station knows the slave station has no message packets queued up to transmit when the slave station responds to the master poll packet with a 2-byte poll response.

Every time a slave station responds or doesn't respond to its poll packet, the master station automatically updates its active node list (again, even if it's in program mode). In this list, one bit is assigned to each possible slave station address (0 to 254). If a slave station doesn't respond when it is polled, its active node list bit is cleared. If it does respond when it is polled, its active node bit is set. Besides being an excellent online troubleshooting tool, two common uses of the active node list are to report good/bad communication status for all slave stations to an operator interface connected to the master station for monitoring, alarming and logging purposes, and to precondition MSG instructions to each particular slave.

This second use is based on the supposition that if a slave station didn't respond the last time it was polled (which was just a few seconds ago, if that long), then chances are it won't be able to receive and respond to a MSG instruction now, and so it would most likely just end up going through the maximum number of retries and timeouts before completing in error (which slows down both the poll scan and any other messaging going on). Using this technique, the minimum time to message to every responding slave station actually decreases as the number of slave stations that can't respond increases.

IMPORTANT In order to remotely monitor and program the slave stations over the half-duplex network while the master station is configured for Standard polling mode, the programming computer DF1 slave driver (Rockwell Software RSLinx) station address must be included in the master station poll list.

About Polled Report-by-Exception

Polled report-by-exception lets a slave station initiate data transfer to its master station, freeing the master station from having to constantly read blocks of data from each slave station to determine if any slave input or data changes have occurred. Instead, through user programming, the slave station monitors its own inputs for a change of state or data, which triggers a block of data to be written to the master station when the master station polls the slave.

If your SCADA application is time-critical and any two or more of the following apply, then you can benefit from polled report-by-exception messaging:

- communication channel is slow (2400 bps or less)
- average number of words of data to monitor in each slave station is greater than five
- number of slave stations is greater than ten

About Slave-to-Slave Messaging

Most SCADA half-duplex protocols do not allow one slave station to talk to another slave station, except through special application-specific code, which requires processing overhead in the master station. However, Allen-Bradley's DF1 half-duplex protocol implements slave-to-slave communications as a feature of the protocol within the master station, without any additional application code or extra processing overhead. Refer to chapter 3 of the DF1 Protocol and Command Set Reference Manual, publication 1770-RM516, for additional information.

If one slave station has a message to send to another, it simply includes the destination slave station's address in the message instruction's destination field in place of the master station's address when responding to a poll. The master station checks the destination station address in every packet header it receives from any slave station. If the address does not match its own station address, the entire message is forwarded back onto the telemetry network to the appropriate slave station, without any further processing.

IMPORTANT Slave stations using 1747-KE interfaces can respond to slave-to-slave messages but cannot initiate slave-to-slave messages.

Addressing Tips

Each station on the network including the master station must have a unique address. The address range is 0 to 254_{10} (376_8), so you can have a maximum of 254 stations on a single telemetry network. Station address 255_{10} (377_8) is the broadcast address, which you cannot select as a station's individual address.

A remote programming terminal station address should be reserved, even if remote programming is not considered a requirement initially. This address will need to be periodically polled, even though it will remain on the inactive poll list unless a remote programming terminal is online.

SLC 500 and MicroLogix 1000 Processor Addressing Considerations

When an SLC 5/02 or MicroLogix 1000 slave station issues a PLC®-2-type message to a PLC-5 master station, the message's destination in the PLC-5 processor's data table is an integer file with the file number equal to the SLC 500 or MicroLogix 1000 processor station address.

An address lower than 9 may interfere with a PLC-5 processor master station since files 0-8 are usually left in their default configuration; file 9 is often used by programmers for the I/O list. Station address 255_{10} is the broadcast address. So, assign addresses between 10_{10}-254_{10}.

TIP For all other master station types, the SLC 5/02 or MicroLogix 1000 slave station can initiate a 500 CPU-type message.

When using an SLC 5/03, 5/04, or 5/05 processor, or a MicroLogix 1100, 1200 or 1500 controller, as a master station, the poll list configuration consists of a contiguous block of addresses. Therefore, assign slave station addresses in a contiguous block in order to avoid polling for nonexistent slave stations.

SLC 500 Processors with a 1747-KE Module Addressing Considerations

Since you can have up to 254 devices on a half-duplex network and 32 devices on a DH-485 network, to allow 255 DH-485 nodes requires using a group number. This parameter defines the address group of the SLC 500 half-duplex address. Each address group can consist of 32 addresses.

The slave address of the SLC 500 processor is determined with the following formula: (32*G)+ A, where G is the group number (0 to 7) and A is the DH-485 node address of the SLC 500 processor.

One station address within each group of size 32 must be reserved for any 1747-KE modules configured with that group number. A second address within each group should also be reserved for local DH-485 programming terminals. These 16 addresses (two per group) should never have to be polled by the master station.

ATTENTION

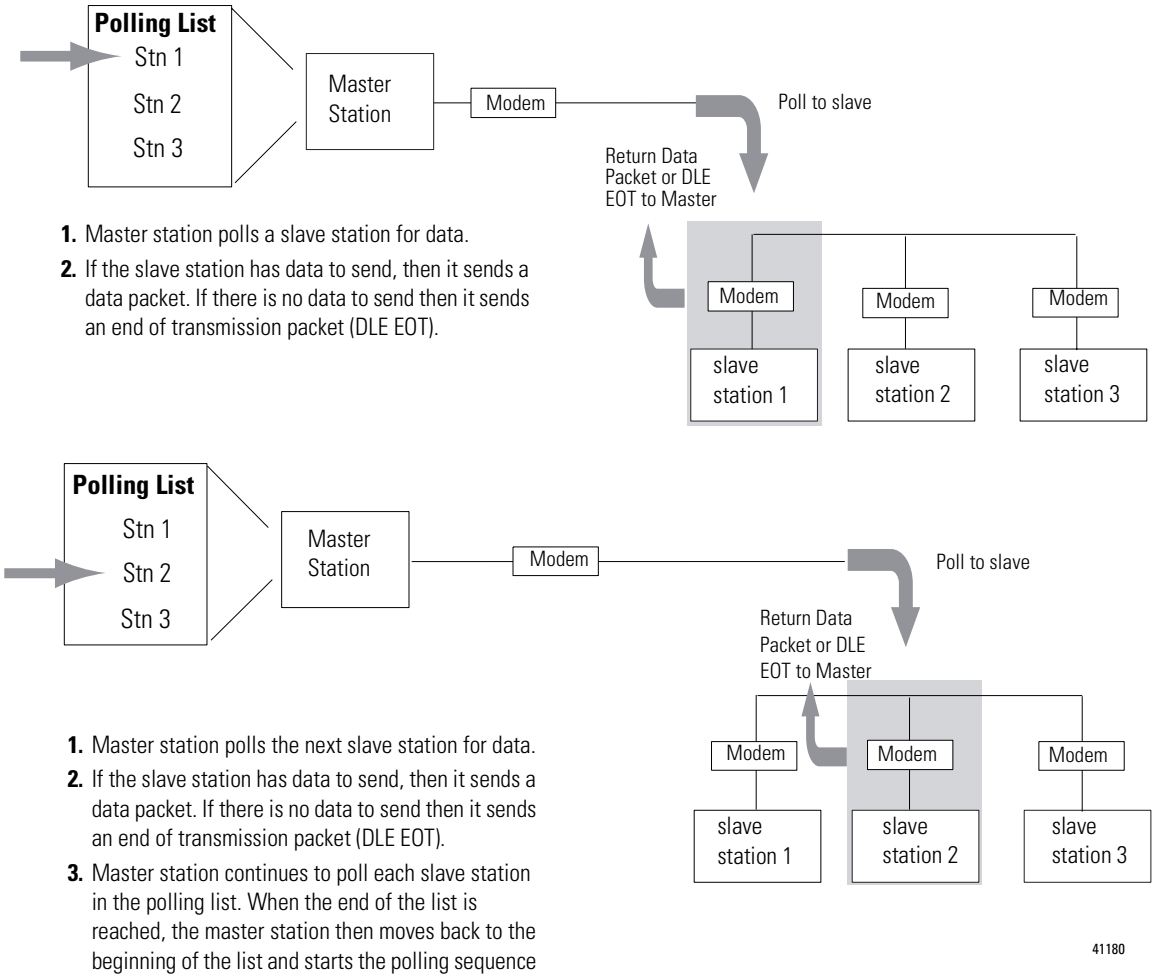
Do not use slave addresses contained within a KE group. When nodes are added to respective DH-485 networks, there is a possibility of duplicate nodes.

Communication Scheme Design Using Standard-Mode

Standard-communication mode for an Allen-Bradley master station uses centralized polling to gather data from slave stations. A master station using this communication technique asks (polls) individual slave stations if they have any information to send. All stations on the link 'hear' the master station's requests, but only the slave station to which a request is addressed replies. PLC-5, Logix and RSLinx master stations poll slave stations based on an ordered list (polling list) configured by the system designer. SLC 500 and MicroLogix master stations poll slave stations sequentially in a range of addresses configured by the system designer. Figure 1.1 shows how a slave station gets polled and how it responds.

A master station polls the slave stations in the order the slave stations appear on the list. Slave stations send either a data packet or a packet indicating that the station has no data to send.

Figure 1.1 Slave Station Polling and Response



1. Master station polls a slave station for data.
2. If the slave station has data to send, then it sends a data packet. If there is no data to send then it sends an end of transmission packet (DLE EOT).

1. Master station polls the next slave station for data.
2. If the slave station has data to send, then it sends a data packet. If there is no data to send then it sends an end of transmission packet (DLE EOT).
3. Master station continues to poll each slave station in the polling list. When the end of the list is reached, the master station then moves back to the beginning of the list and starts the polling sequence over again.

When the master station is configured for standard-communication mode, you do not need to program any master-station message instructions to communicate with slave stations. Communication with slave stations occurs by the master station sending polling packets to slave stations. You only need message instructions when you want the master station to write data to or read data from a location within a slave station's data table.

To help you understand	See
standard-communication mode	Figure 1.2
how a master station requests data	Figure 1.3

Figure 1.2 Standard Communication Mode

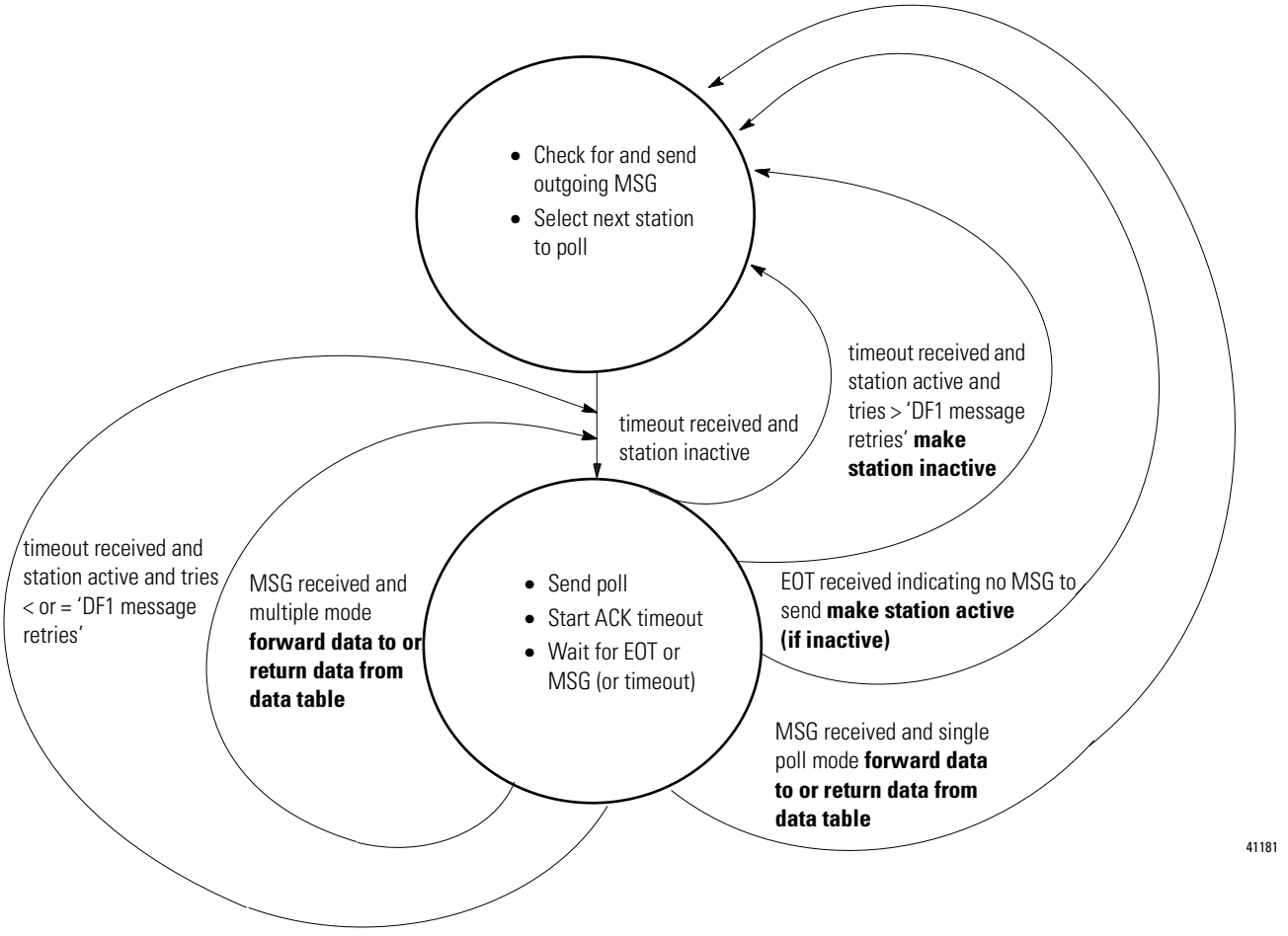
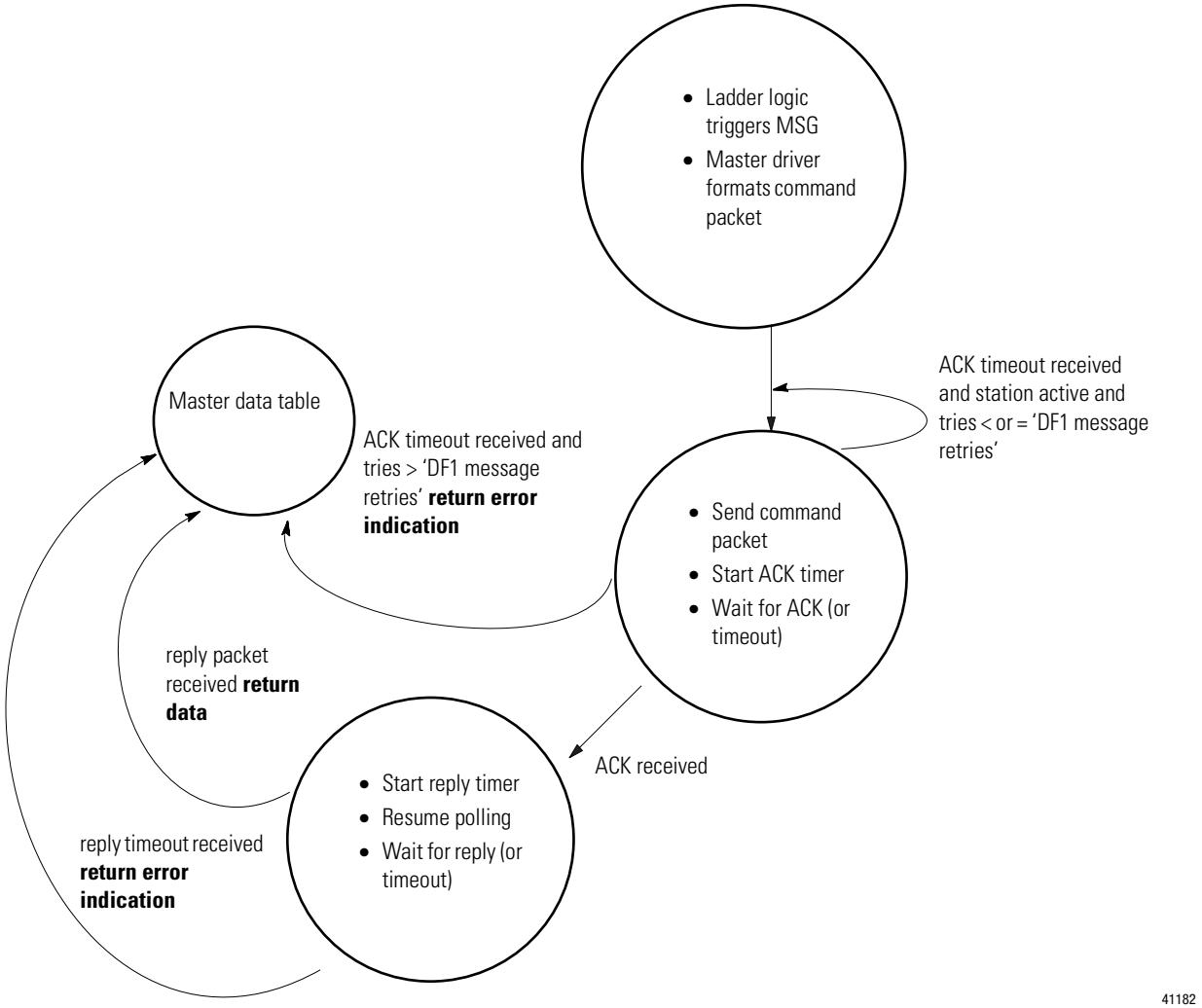


Figure 1.3 How a Master Station Requests Data



To design a communication scheme using standard-communication mode, you must do the following:

- design a polling scheme
- plan for timing issues

Designing a Polling Scheme

Each master station in a SCADA application must have a polling scheme configured. To design a polling scheme, do the following:

- choose the type of scheme best suited for your application
- optimize your polling scheme to obtain the best efficiency

The master station you are using determines the type of polling choices you have; however, Allen-Bradley master stations offer similar choices, such as:

- normal and priority polling lists
- ability to poll a slave station:
  - once per occurrence in the poll list (single)
  - until it has no more messages to send (multiple)

Choosing Normal or Priority Polling Lists

Slave stations listed in a priority poll list are polled more frequently than those listed in the normal poll list. Place the slave stations that you need information from more frequently in a priority poll list.

Within each poll list, slave stations are assigned a status, which is either active or inactive. A slave station becomes inactive when it does not respond to a master station's poll packet after the configured number of retries.

If your master station is a Logix controller or PLC-5, you can use application logic to reorder the polling lists and priority while the application logic is executing.

Figure 1.4 and Figure 1.5 show how normal and priority lists relate to one another.

Figure 1.4 The master station scans slave stations in a set sequence.

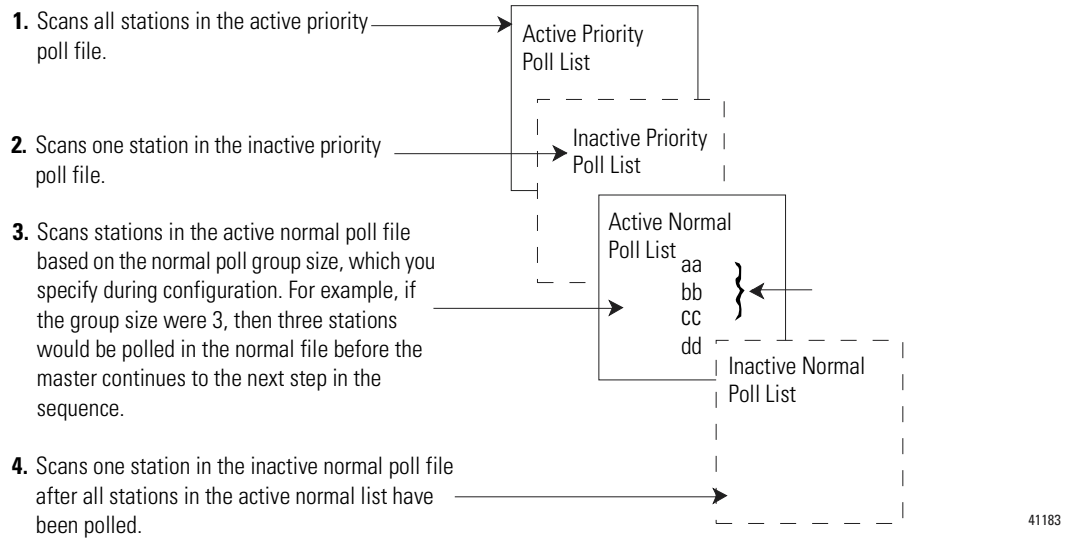
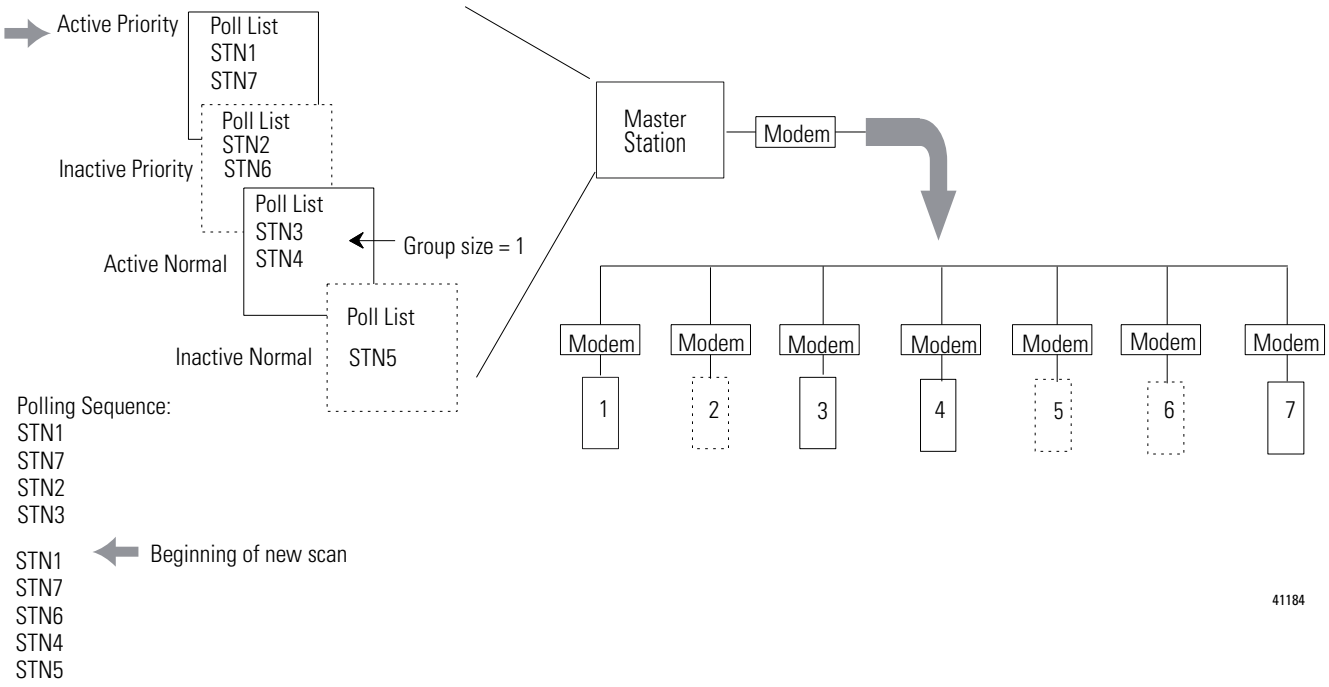


Figure 1.5 Here is how the polling sequence applies to an application.



Choosing Single or Multiple Message Transfer

Depending on your application's requirement, you can choose the number of messages you want to receive from a slave station during its turn.

If you want to receive	Choose
only one message from a slave station per poll per a station's turn. Choose this method only if it is critical to keep the poll list scan time to a minimum.	single transfer
as many messages from the slave station as it has in its queue.	multiple transfer

Planning for Timing Issues

Two types of timing categories exist.

- Protocol timers, which specify how long a master station will wait to 'hear' from a slave station.
- Request to send (RTS) timers, which you can use to make sure the modem is ready to accept data or has passed on the data (does not apply when control line is configured for No Handshaking).

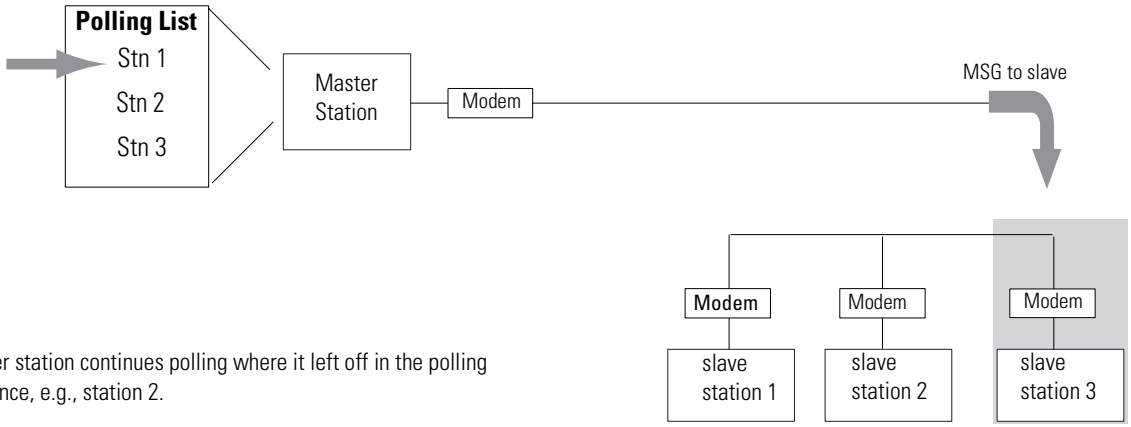
Set and adjust these timing values as necessary for your application. Set your RTS times based on the communication media and modem you are using.

Design Considerations

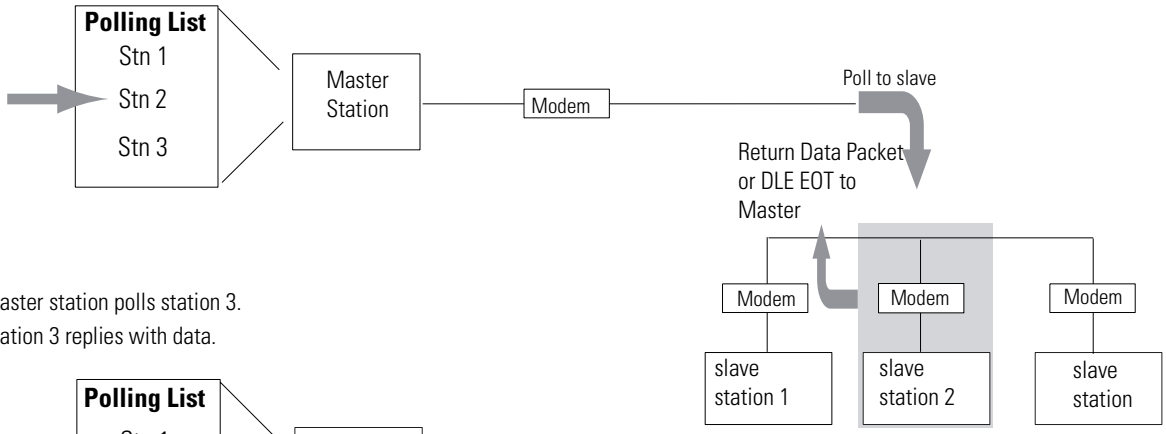
- Define a polling list type to use (normal or priority).
- Define a station list.
- Use Figure 1.6 to help understand how the MSGs are handled using standard communication.

Figure 1.6 Effect of MSGs on Logix, PLC-5, SLC 500, and MicroLogix Polling

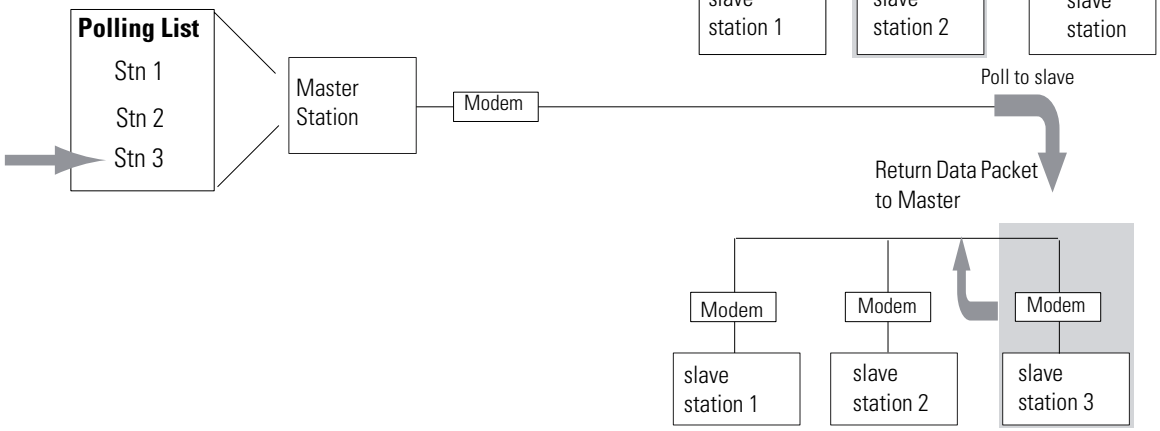
1. Polled station 1; ready to poll station 2.
2. MSG sent to station 3 (MSG was waiting in queue).



3. Master station continues polling where it left off in the polling sequence, e.g., station 2.



4. Master station polls station 3.
5. Station 3 replies with data.

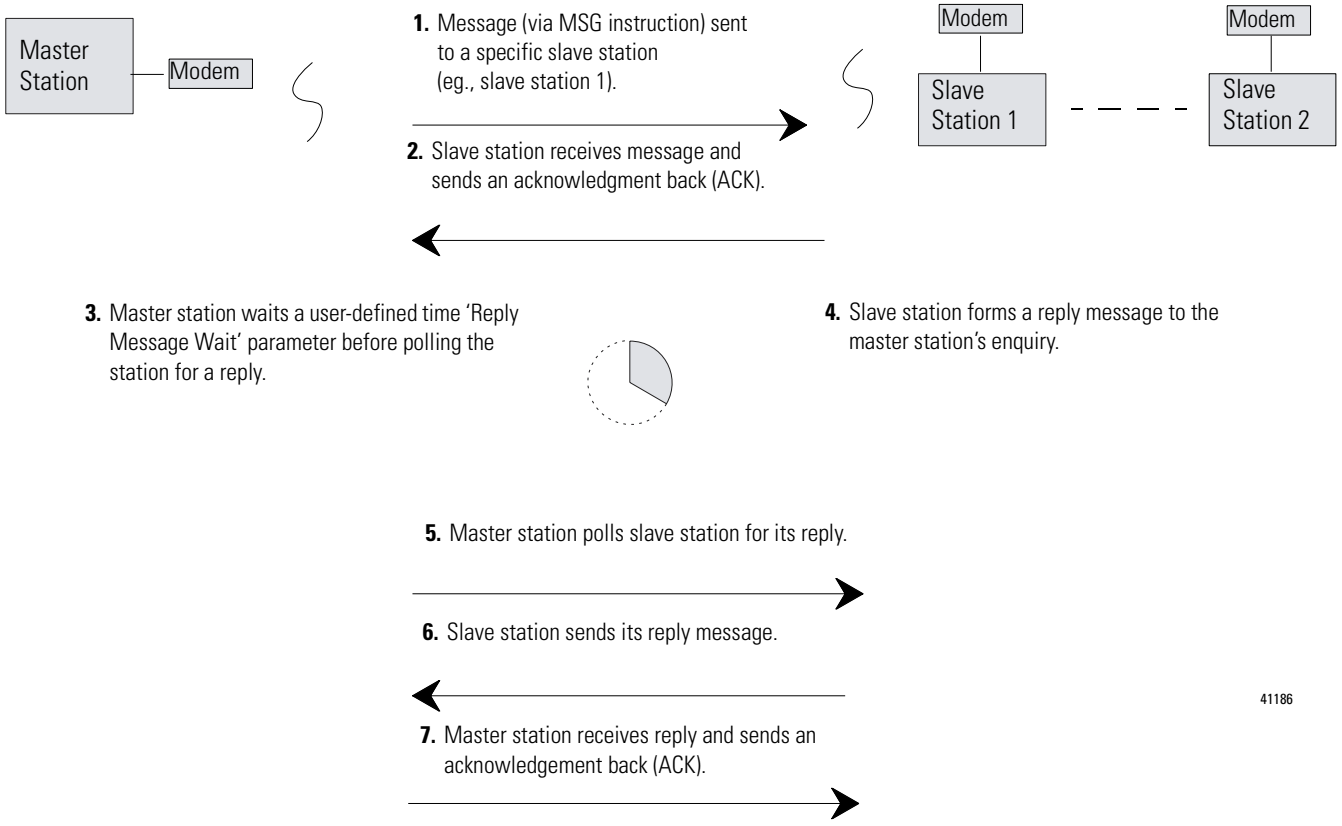


6. Master station returns to beginning of the poll list.

Communication Scheme Design Using Message-Based Mode

In message-based communication mode, the master station sends solicited messages (messages programmed via ladder logic) to a specific slave station when the master requires information. In this mode, the communication link is inactive until the master station has a message to send to a slave station. Figure 1.7 explains the communication sequence that occurs.

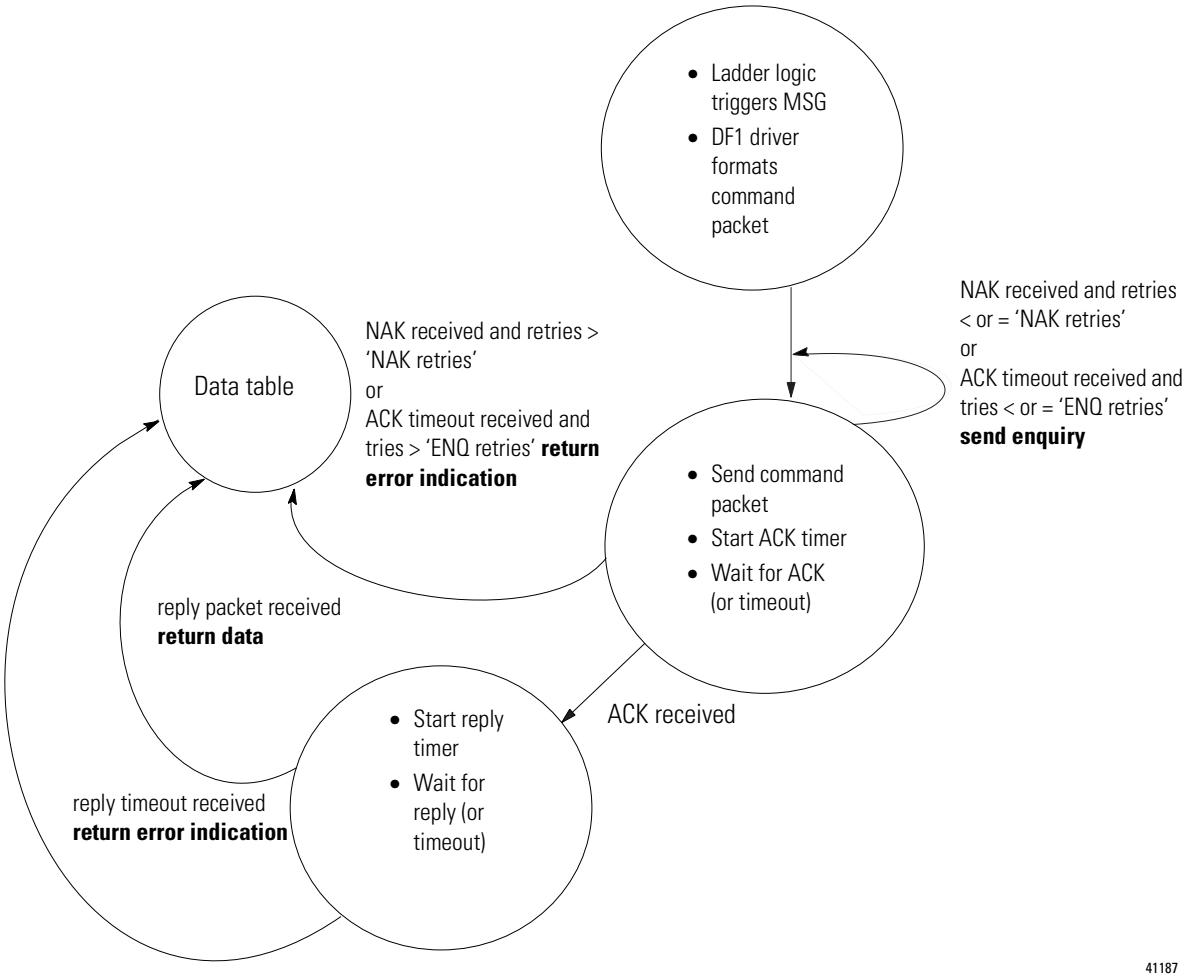
Figure 1.7
Message-Based Communication



Designing Communication for DF1 Full-Duplex Protocol

When designing communication using DF1 full-duplex protocol, you must configure timeout values and retry counts that control the communication between a transmitting station and a receiving station. Consider the type of link media you are using to help you determine the best values for the timer and counters. For example, you can expect a message being sent over a satellite link to take longer than one being sent over a telephone leased-line link. Figure 1.8 shows the communication sequence for DF1 full-duplex protocol.

Figure 1.8 Read or Write Requests via DF1 Full-Duplex



Designing Communication for DF1 Radio Modem Protocol

When designing communication using DF1 Radio Modem protocol, you must consider the capabilities of both the controllers and radio modems. The DF1 Radio Modem protocol can only be used with contollers that support and are configured for this protocol.

Determining When to Use DF1 Radio Modem Protocol

If your radio modem can handle full-duplex data port buffering and radio transmission collision avoidance, you can use peer-to-peer message initiation capability in every node (i.e., the ladder logic in any node can trigger a MSG instruction to any other node at any time). For messaging between nodes that are outside of radio transmission/reception range of each other, you may use either the Store and Forward capability of the protocol or the repeater capability of the radios.

If your radio modem cannot handle full-duplex data port buffering and radio transmission collision avoidance, you can still use DF1 Radio Modem protocol in a Master/Slave configuration, with message initiation limited to a single master node. If you still require slave node message initiation, then you must use the DF1 Half-Duplex protocol.

The primary advantage of using DF1 Radio Modem protocol for radio modem networks is in the transmission efficiency. Each read/write transaction (command and reply) requires only one transmission by the initiator (to send the command) and one transmission by the responder (to return the reply) as illustrated in Figure 1.9. The number of transmissions is minimized, radio power is minimized, and throughput is maximized. In contrast, DF1 Half-Duplex protocol requires five transmissions for the DF1 Master to complete a read/write transaction with a DF1 Slave as illustrated in Figure 1.7. Figure 1.10 illustrates the DF1 Radio Modem protocol.

An efficiency trade-off exists in that the DF1 Radio Modem protocol does not provide immediate feedback (ACK) to the initiator to indicate that the responder successfully received the communications packet without error.

The Store and Forward capability of the DF1 Radio Modem protocol allows messages between nodes that are outside of radio transmission/reception range of each other to be routed through intermediary nodes that are within range. Each of the intermediary nodes needs a Store and Forward table. The configuration needs to indicate, based on the source and destination addresses in the message packet, which packets to receive (store) and then re-broadcast (forward). Figure 1.11 illustrates the Store and Forward capability.

Figure 1.9
DF1 Radio Communication

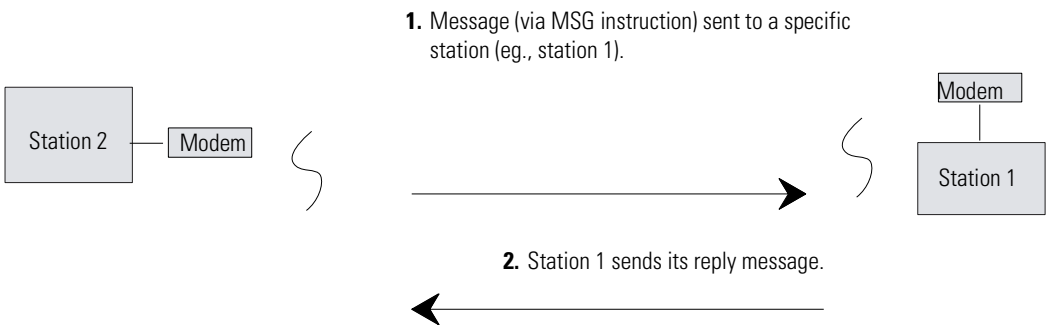


Figure 1.10
Read or Write Requests via DF1 Radio Modem

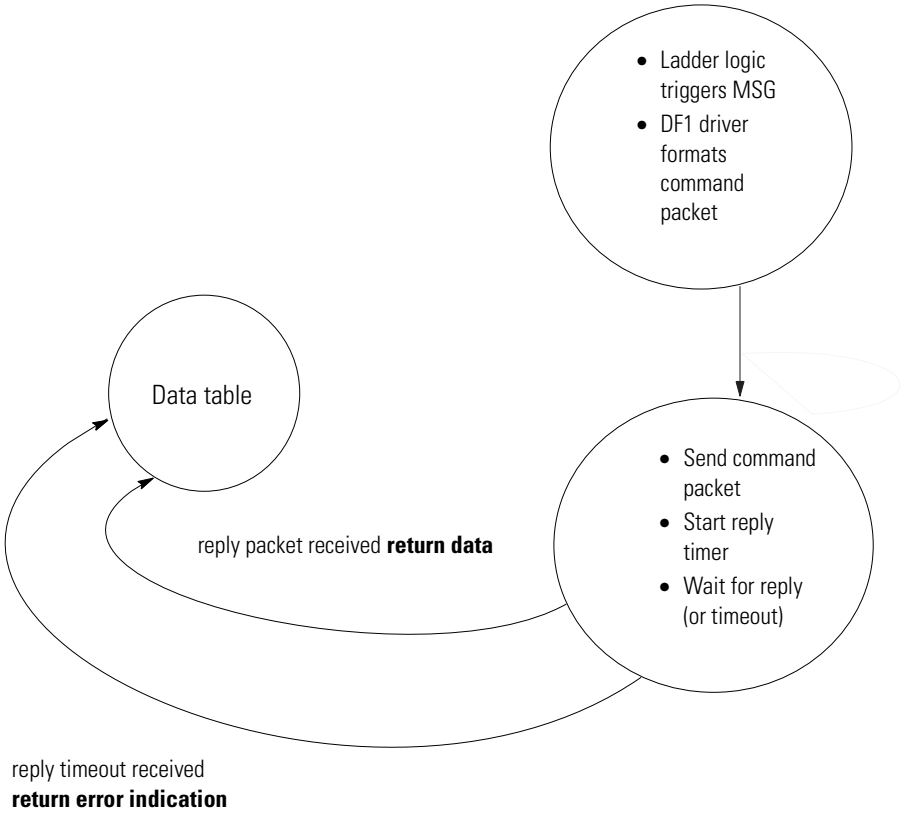
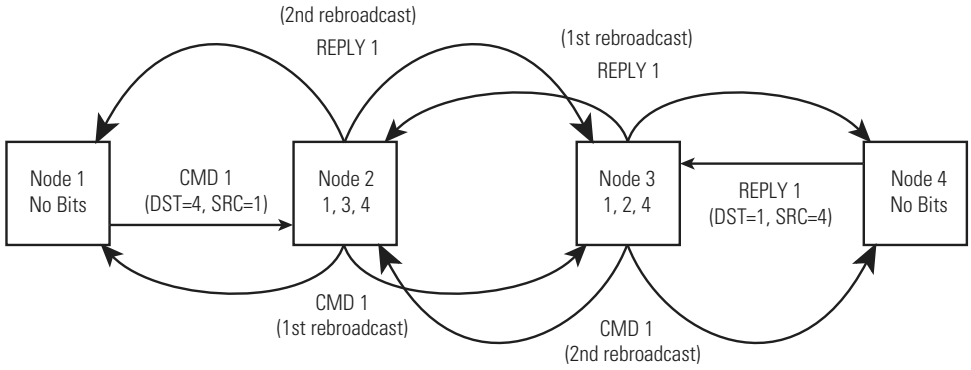


Figure 1.11
Applying Store and Forward in DF1 Radio Modem Protocol



What to Do Next?

Make sure you:

- choose the communication method best suited for your application.
- make initial configuration choices for the communication method you have chosen.
- use this chapter as a reference as you configure the devices in your SCADA system.

Configuring Enhanced PLC-5 Processors

Chapter Objectives

This chapter helps you set up an Enhanced PLC-5 processor as a master station, as a slave station, or as a station on a point-to-point link.

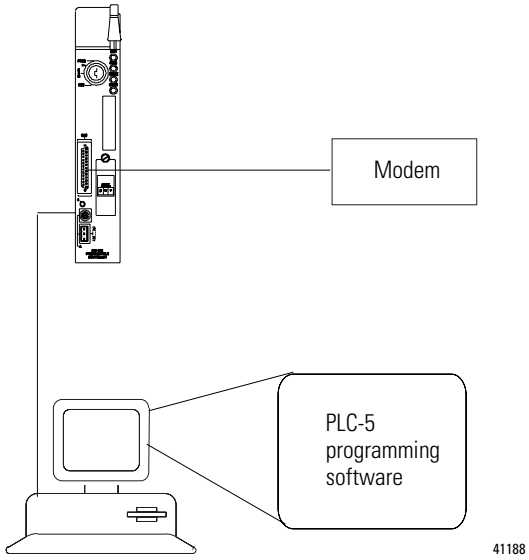
For information about	See page
an overview of the tasks required to configure a PLC-5 processor	2-1
installing the processor	2-2
configuring the processor as a DF1 half-duplex master station using standard-communication mode	2-3
configuring the processor as a DF1 half-duplex master station using message-based communication mode	2-11
configuring the processor as a slave station	2-15
configuring the processor as a station on a point-to-point link	2-20
the types of messages you can send from a PLC-5 processor to another processor, how to configure the MSG instruction, and some configuration characteristics	2-23

Overview

To configure an Enhanced PLC-5 processor, perform these tasks:

1. Install the processor; connect the serial cable to channel 0.
2. Define the processor's communication characteristics using your PLC-5 programming software.
3. Install and configure the modem for communication with the processor. Connect the modem to the processor's serial channel.

Figure 2.1 Configuring and Enhanced PLC-5



Installing the Processor

Before installing the processor, set the processor switch assemblies.

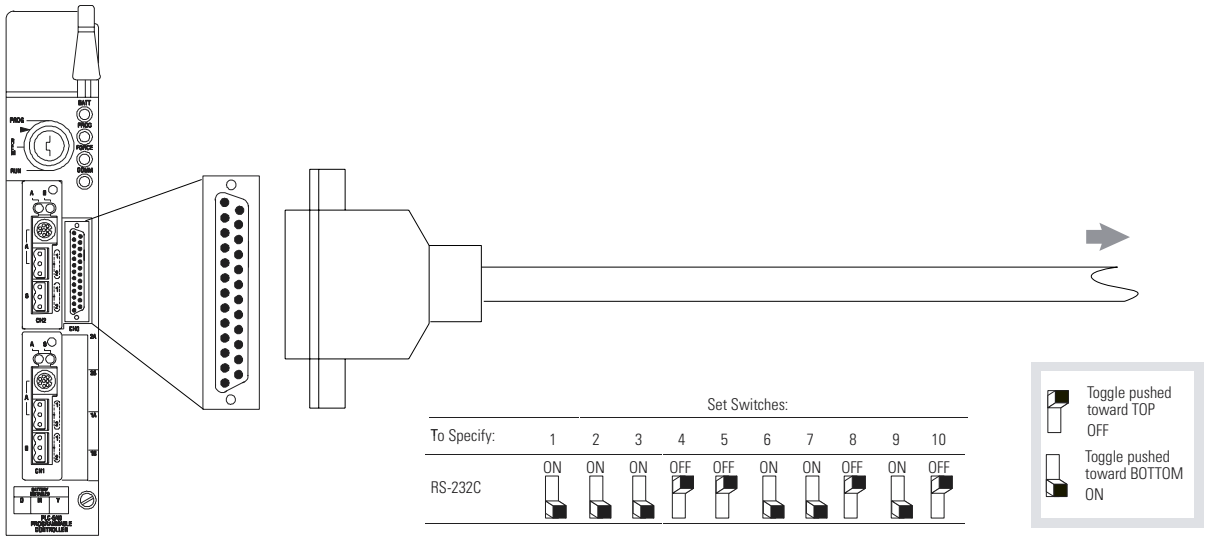
Define	By setting switch assembly
DH+ and DF1 point-to-point station address	S1
RS-232 as the electrical interface for the serial port	S2

For details about installing the processor, see the Enhanced PLC-5 Programmable Controllers Quick Start, publication 1785-QS012.

For cable pinouts, see Figure 2.2 or Appendix A-2.

Figure 2.2 Enhanced PLC-5 Serial Port Pin Assignments and S2 Settings.

25-pin male	25-pin		9-pin
C. GND	1	1	NC
TXD.OUT	2	2	3
RXD.IN	3	3	2
RTS.OUT	4	4	7
CTS.IN	5	5	8
DSR.IN	6	6	6
SIG.GND	7	7	5
DCD.IN	8	8	1
DTR.OUT	20	20	4



The DF1 Point-to-Point Station Address of the processor is the same as the DH+ address defined by S1.

Configuring a DF1 Half-Duplex Standard Mode Master Station

Choose standard-communication mode if you want to query slave stations for information based upon user-configured polling lists. This mode is used most often in point-to-multipoint configurations because it allows polled report-by-exception (page 1-4), slave-to-slave messaging (page 1-5) and slave programming over the telemetry network to be implemented. In addition, in this mode the master station maintains an active node table which allows an HMI or programming terminal to immediately identify which slave nodes can currently communicate and which nodes cannot.

ATTENTION

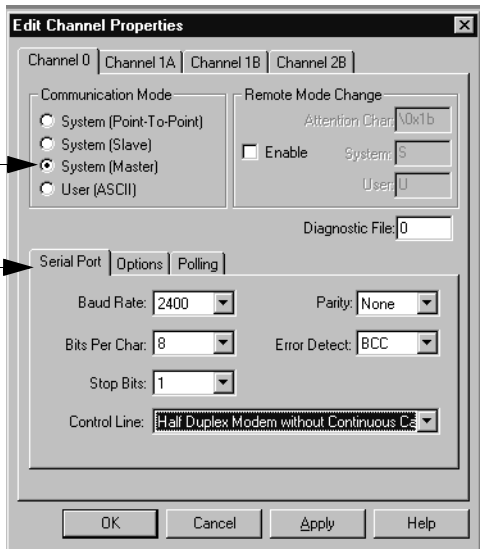
Connect only the pins shown in figure 2.2. Do not use a ribbon cable or one that connects to every 25-pin.

To configure the processor for a master station using standard communication, place the processor into program mode and follow the steps below using your RSLogix™ 5 software:

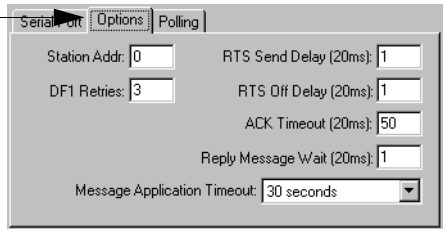
1. Double-click on the Channel Configuration file to bring up the Edit Channel Properties interface.

2. On the Channel 0 tab, choose System (Master) for your Communication Mode.

3. Configure the Serial Port, Options, and Polling parameters according to Table 2.1.



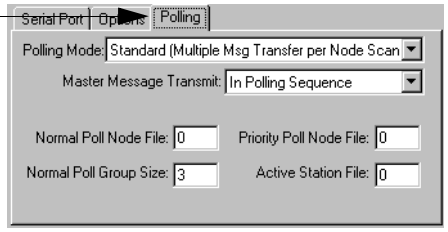
4. Configure Options parameters according to Table 2.1.



5. Configure the Polling parameters according to Table 2.1.

6. When all parameters are set, click OK.

7. Create station lists (page 2-8).



Define the Communication Driver Characteristics

Use Table 2.1 to help you understand the communication parameters you need to specify on the Channel Configuration screen for standard-communication mode.

Use Worksheet 2.1 (page D-5) for an example configuration and to record your station's configuration.

Table 2.1 Communication Parameters for a PLC-5 Master Station Using Standard-Communication Mode

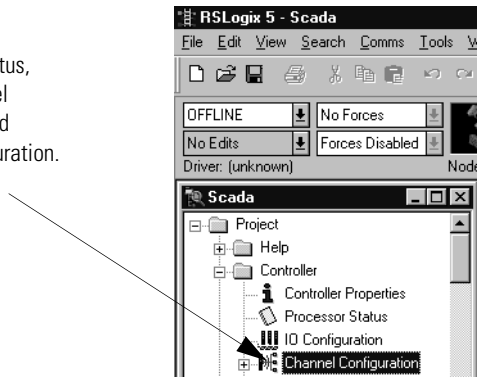
RSLogix 5 Tab	Parameter	Selections
Channel 0	Diagnostic File	Select an unused integer file to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See See Table 2.2 on page 2-8 for a description of what is in this file.
	Remote Mode Change	Check enable remote mode change if you want to switch the configuration of the channel during runtime. Leave the parameter set at the default (unchecked) if you are not using this feature.
	Mode Attention Character	Select a character that will signal a remote mode change. Leave the parameter set at the default if you are not using remote mode change.
	System Mode Character	Select a character that will signal the channel to switch into system mode. Leave the parameter set at the default if you are not using remote mode change.
	User Mode Character	Select a character that will signal the channel to switch into user mode. Leave the parameter set at the default if you are not using remote mode change.
Serial Port	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Bits Per Character	Match the number of bits per character to the devices with which you are communicating.
	Stop Bits	Match the number of stop bits to the devices with which you are communicating.
	Control Line	This parameter defines the mode in which the master driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex and the slave modem is full-duplex, choose FULL-DUPLEX MODEM. • If all the modems in the system are half-duplex, choose HALF-DUPLEX MODEM WITHOUT CONTINUOUS CARRIER.
Serial Port	Error Detect	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your system support. When possible, choose CRC.

RSLogix 5 Tab	Parameter	Selections
Options	Station Address	Define the octal address of the processor on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0 and 376_8. Station address 377_8 is the broadcast address, which you cannot select as a station's individual address.
	DF1 Retries	Defines the number of times a master station retries either a message before the master station declares the message undeliverable, or poll packet to an active station before the master station declares that station to now be inactive.
	RTS Send Delay	RTS send delay is the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear to Send (CTS) signal must be high for transmission to occur.
	RTS Off Delay	RTS off delay is the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero.
	ACK Timeout	Define the amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment from a slave station to its transmitted message before the processor retries the message or the message errors out.
	Reply Message Wait	Define the amount of time, in 20 millisecond increments, that the master station will wait after receiving an ACK (to a master-initiated message) before polling the slave station for a reply. Choose a time that is, at minimum, equal to the longest time that a slave station needs to format a reply packet. This is typically the maximum scan time of the slave station. **Note:** This field is only valid if the polling mode field is configured to be MESSAGE BASED.
	MSG Application Timeout	Define the number of 30 second increments within which the reply message must be received before the error bit is set on the message. The timer starts when the ACK is received.
Polling	Polling Mode	If you want to receive: • only one message from a slave station per its turn, choose STANDARD (SINGLE MESSAGE TRANSFER PER NODE SCAN). Choose this method only if it is critical to keep the poll list scan time to a minimum. • as many messages from a slave station as it has, choose STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN).
	Master Message Transmit	If you want the master station to: • send all of the master station-initiated MSG instructions to the slave stations before polling the next slave station in the poll list, choose Between Station Polls. This method makes certain that master station-initiated messages are sent in a timely and regular manner (after every slave station poll). • only send master station-initiated MSG instructions when the master's station number appears in the polling sequence, choose In Poll Sequence. With this method, sending master station-initiated messages are dependent upon where and how often the master station appears in the poll list. To achieve the same goal as the Between Station Polls method, the master-station's address would have to appear after every slave-station's address.

RSLogix 5 Tab	Parameter	Selections
Polling	Normal Poll Node File	Enter an unused integer file that will store the addresses of the slave stations you want in the normal poll list.
	Normal Poll Group Size	Enter the quantity of active stations located in the normal poll list that you want polled during a scan through the normal poll list before returning to the priority poll list.
	Priority Poll Node File	Enter an unused integer file that will store the addresses of the slave stations you want in the priority poll list.
	Active Station File	Enter an unused binary file that will store the status of all the stations in your network configuration. The file stores one station address per bit. 0 = inactive; 1 = active.

Displaying System (Master) Channel Status

1. To display Channel Status, double-click on Channel Status, which is located within Channel Configuration.



2. To access the various channels from the Channel Status screen, click on the tabs. Descriptions of the status screen fields can be found in Table 2.2.

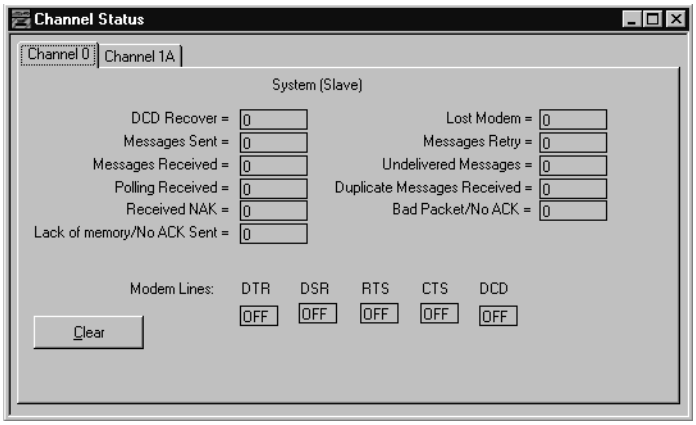


Table 2.2 Descriptions of System Mode DF1 Master Channel Status Fields

Status Field	Location	Description
Clear		Clear counters for all channels by clicking on Clear button.
DCD Recover	word 11	Displays the number of times the processor detects the DCD handshaking line has gone low to high.
Lost Modem	word 12	Displays the number of times that the modem lost bit (S:17/5) has gone low to high.
Messages Sent	word 1	Displays the number of messages sent by the processor (including message retry).
Messages Received	word 2	Displays the number of messages the processor received with no error.
Undeliverable Messages	word 3	Displays the number of messages that were sent by the processor but not received by the destination device.
Messages Retry	word 4	Displays the number of messages resent.
Duplicate Messages Received	word 9	Displays the number of times the processor received a message packet identical to the previous message packet.
EOT Received on First Poll	word 8	Displays the number of times the Master received an EOT in response to the first poll of a station.
Bad Packet / No ACK	word 7	Displays the number of incorrect data packets that the processor has received.
Last Normal Poll List Scan (100 ms)	word 5	The time it took to complete the previous scan of the normal station poll list.
Max Normal Poll List Scan (100 ms)	word 6	The maximum time taken to complete a scan of the normal station poll list.
Last Priority Poll List Scan (100 ms)	word 10	The time it took to complete the previous scan of the priority station poll list.
Max Priority Poll List Scan (100 ms)	word 13	The maximum time taken to complete a scan of the priority station poll list.
DTR (Data Terminal Read)	word 0; bit 4	Displays the status of the DTR handshaking line (asserted by the processor).
DCD (Data Carrier Detect)	word 0; bit 3	Displays the status of the DCD handshaking line (received by the processor).
DSR (Data Set Ready)	word 0; bit 2	Displays the status of the DSR handshaking line (received by the processor).
RTS (Request to Send)	word 0; bit 1	Displays the status of the RTS handshaking line (asserted by the processor).
CTS (Clear to Send)	word 0; bit 0	Displays the status of the CTS handshaking line (received by the processor).

Create Station Lists

After defining your polling files and group size, create station lists by entering the station address of each slave station into either the normal poll file or priority poll file of the PLC-5 data table. Place each station address in an individual word in a poll file (normal and priority) starting at word 2.

The normal and priority poll file layout is as follows:

This word in a poll file	Contains this information
word 0	total number of stations to be polled (for a list)
word 1	the address location (poll offset) of the station currently being polled (as long as all configured stations are active) For example: a value of 1 means the station address stored in word 2 is being polled, 2 means the address stored in word 3 is being polled, etc. This word is automatically updated by the master station as a new slave station is polled.
word 2 through word *xx*	the slave station address in the order that the stations should be polled Store one station address in each word.

To place a station address in a poll file:

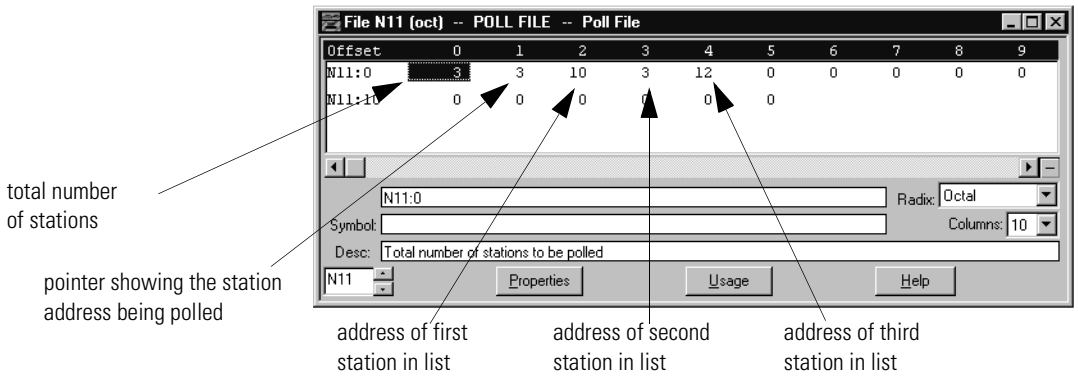
1. Access the PLC-5 data table.
2. Specify the address of the integer file that is either the normal poll file or priority poll file (e.g., If the normal poll file is N11, then you specify N11:0).
3. Enter the station addresses of the slave stations you want in the poll list starting at word 2. Put them in the order you want them polled.

IMPORTANT PLC-5 station addresses are octal addresses. The poll files are integer files that default to a decimal radix. To properly enter PLC-5 station addresses in a poll file, you must either:

- change the radix of the file to octal
- convert the PLC-5 octal station addresses to decimal

Figure 2.3 is an example of a station list containing three stations: octal addresses 10, 3, and 12. Station 12 is being polled.

Figure 2.3 Example Station List



Monitor Active Stations

To see what stations are active, view the active station file. Each bit in the file represents a station on the link. The stations are numbered in order as a continuous bit-stream file starting with the first bit in the first word (Figure 2.4).

Figure 2.4 Example Active Station File

Address	15 Data 0	
B11:0	1111 1111 1111 1111	← Remote station 0
B11:1	1111 1111 1111 1111	← Remote station 16_{10}
B11:2	1111 1111 1111 1111	

For PLC-5 processors:

Starting with these PLC-5 firmware revisions	This is what you will see
Series E/Revision B Series D/Revision C Series C/Revision L Series B/Revision M Series A/Revision M	At power-up or after reconfiguration, the master station assumes that all slave stations are **inactive** (bit=0).
For all prior firmware revisions	At power-up or after reconfiguration, the master station assumes that all slave stations are **active** (bit=1) and the station displays inactive only after it fails to respond to a poll packet.

Configuring a DF1 Half-Duplex Message-based Mode Master Station

Choose message-based communication mode if you want to use MSG instructions in user programming to communicate with one station at a time. If your application uses satellite transmission or public switched telephone network transmission, consider choosing message-based. Communication to a slave station can be initiated on an as-needed basis.

Also choose message-based mode when a redundant PLC-5 system is being used as a master station. Connect both PLC-5 processor serial ports to the master station modem through an RS-232 modem splitter and precondition all MSG instructions with the Primary Processor status bit.

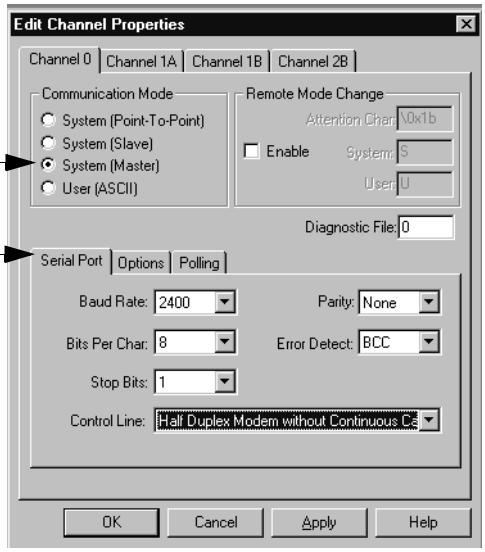
With message-based mode, you do not have an active station file that you can use to monitor station status. Also, you cannot implement slave-to-slave messaging or slave programming over the telemetry network.

To configure the processor for a master station using message-based communication, place the processor in program mode and follow the steps below using RSLogix 5:

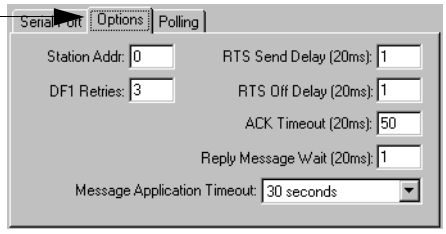
1. Double-click on the Channel Configuration file to bring up the Edit Channel Properties interface.

2. On the Channel 0 tab, choose System (Master) for your Communication Mode.

3. Configure the Serial Port, Options, and Polling parameters according to Table 2.3.

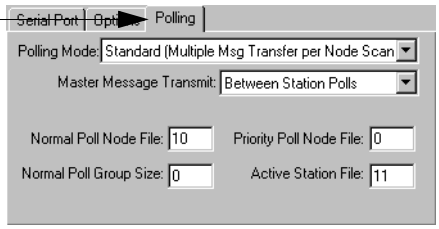


4. Configure Options parameters according to Table 2.3.



5. Configure the Polling parameters according to Table 2.3.

6. When all parameters are set, click OK.



Use Table 2.3 to help you understand the communication parameters you need to specify on the Edit Channel Properties screen.

Use Worksheet 2.2 (page D-6) for an example configuration and to record your station's configuration.

Table 2.3 Communication Parameters for a PLC-5 Master Station Using Message-Based Communication Mode

RSLogix 5 Tab	Parameter	Selections
Channel 0	Diagnostic File	Select an unused integer file to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 2.2 on page 2-8 for description of what's in this file.
	Remote Mode Change	Check enable remote mode change if you want to switch the configuration of the channel during runtime. Leave the parameter set at the default (unchecked) if you are not using this feature.
	Mode Attention Character	Select a character that will signal a remote mode change. Leave the parameter set at the default if you are not using remote mode change.
	System Mode Character	Select a character that will signal the channel to switch into system mode. Leave the parameter set at the default if you are not using remote mode change.
	User Mode Character	Select a character that will signal the channel to switch into user mode. Leave the parameter set at the default if you are not using remote mode change.
Serial Port	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Bits Per Character	Match the numbers of bits per character to the devices with which you are communicating.
	Stop Bits	Match the number of stop bits to the devices with which you are communicating.

RSLogix 5 Tab	Parameter	Selections
Serial Port	Control Line	This parameter defines the mode in which the master driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex and the slave modem is full-duplex, choose FULL-DUPLEX MODEM. • If all the modems in the system are half-duplex, choose HALF-DUPLEX MODEM WITHOUT CONTINUOUS CARRIER.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Error Detect	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your system support. When possible, choose CRC.
Options	Station Address	Define the octal address of the processor on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0 and 376_8. Station address 377_8 is the broadcast address, which you cannot select as a station's individual address.
	DF1 Retries	Define the number of times a master station retries either a message before the master station declares the message undeliverable, or a poll packet to an active station before the master station declares the station to be inactive.
	RTS Send Delay	RTS send delay is the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear to Send (CTS) signal must be high for transmission to occur.
	RTS Off Delay	RTS off delay is the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to ensure that the modem has transmitted the message but should normally be left at zero.
	ACK Timeout	Define the amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment from a slave station to its transmitted message before retrying. This timeout value is also used for the poll response timeout.
	Reply Message Wait	Define the amount of time, in 20 millisecond increments, that the master station will wait after receiving an ACK (to a master-initiated message) before polling the slave station for a reply. Choose a time that is, at minimum, equal to the longest time that a slave station needs to format a reply packet. This is typically the maximum scan time of the slave station.
	MSG Application Timeout	The application timeout of the message is the number of 30 second increments within which the reply message must be received before the error bit is set on the message. The timer starts when the ACK is received.

RSLogix 5 Tab	Parameter	Selections
Polling	Polling Mode	If you want to: • accept unsolicited messages from slave stations, choose MESSAGE BASED (ALLOW SLAVE TO INITIATE MESSAGES). Slave station-initiated messages are acknowledged and processed after all master station-initiated (solicited) messages. **Note:** Slave stations can only send messages when they are polled. If the message-based master station never sends a slave station a message, the master station will never send the slave station a poll. Therefore, to regularly obtain a slave station-initiated message from a slave station, you should choose to use standard communications mode instead. • ignore unsolicited messages from slave stations, choose MESSAGE BASED (DO NOT ALLOW SLAVES TO INITIATE MESSAGES). Slave station-initiated messages are acknowledged and discarded. The master station acknowledges the slave station-initiated message so that the slave station removes the message from its transmit queue, which allows the next packet slated for transmission into the transmit queue.
	Master Message Transmit	If you want the master station to: • send all of the master station initiated MSG instructions to the remote stations before polling the next remote station in the poll list, choose Between Station Polls. This method makes certain that master station initiated messages are sent in a timely and regular manner (after every remote station poll). • send only master station initiated MSG instructions when the master's station number appears in the polling sequence, choose In Poll Sequence. With this method, sending master station initiated messages are dependent on where and how often the master station appears in the poll list. To achieve the same goal as Between Station Polls method, the master station's address would need to appear after every remote station's address.
	Normal Poll Node File	Enter an unused integer file that will store addresses of the remote stations you want in the normal poll list.
	Active Station File	Enter an unused binary file that will store the status of all the stations in your network configuration. The file stores one address per bit. 0=inactive, 1=active.
	Priority Poll Node File	Enter an unused integer file that will store the addresses of the remote stations you want in the priority poll list.
	Normal Poll Group Size	Enter the quantity of active stations located in the normal poll list that you want polled during a scan through the normal poll list before returning to the priority poll list.

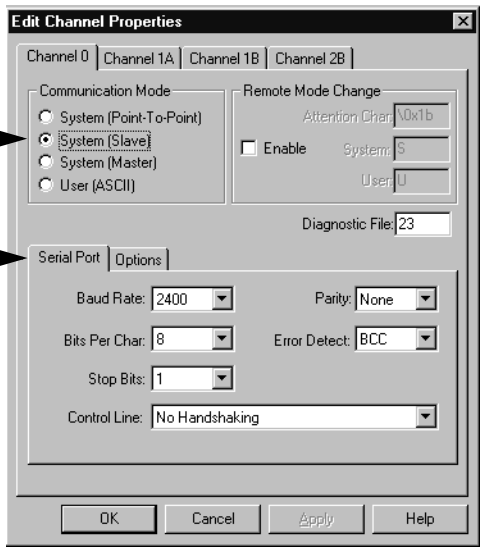
Configuring the Processor as a Slave Station

To configure the processor as a slave station, place the processor in program mode and follow the steps below using your programming software:

1. Double-click on the Channel Configuration file to bring up the Edit Channel Properties interface.

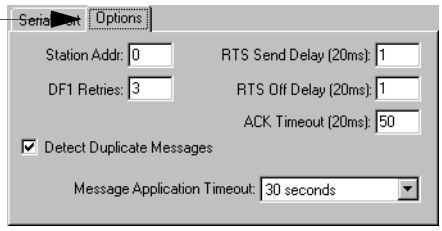
2. On the Channel 0 tab, choose System (Slave) for your Communication Mode.

3. Configure the Serial Port parameters according to Table 2.4.



4. Configure the Options parameters according to Table 2.4.

5. When all parameters are set, click OK.



Use Table 2.4. to help you understand the communication parameters you need to specify on the Channel Configuration screen.

Use Worksheet 2.3 (page D-7) for an example configuration and to record your station's configuration.

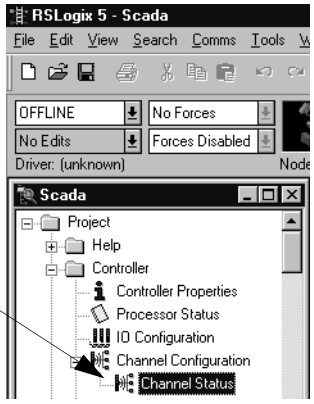
Table 2.4 Communication Parameters for a PLC-5 Slave Station.

RSLogix 5 Tab	Parameter	Selections
Channel 0	Diagnostic File	Select an unused integer file to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 2.5 on page 2-18 for a description of what this file contains.
	Remote Mode Change Enable	Check enable remote mode change if you want to switch the configuration of the channel during runtime. Leave the parameter set at the default (unchecked) if you are not using this feature.
	Mode Attention Character	Select a character that will signal a remote mode change. Leave the parameter set at the default if you are not using remote mode change.
	System Mode Character	Select a character that will signal the channel to switch into system mode. Leave the parameter set at the default (unchecked) if you are not using remote mode change.
	User Mode Character	Select a character that will signal the channel to switch into user mode. Leave the parameter set at the default if you are not using remote mode change.
Serial Port	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Bits Per Character	Match the number of bits per character to the devices with which you are communicating.
	Stop Bits	Match the number of stop bits to the devices with which you are communicating.
	Control Line	This parameter defines the mode in which the slave station driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex and transmits a constant carrier and the slave modem is half-duplex, choose HALF-DUPLEX MODEM WITH CONTINUOUS CARRIER. • If all the modems in the system are half-duplex, choose HALF-DUPLEX MODEM WITHOUT CONTINUOUS CARRIER.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Serial Port	Error Detect	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your system support. When possible, choose CRC.

RSLogix 5 Tab	Parameter	Selections
Options	Station Address	Define the octal address of the processor on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0 and 376_8. Station address 377_8 is the broadcast address, which you cannot select as a station's individual address.
	DF1 Retries	The number of times a slave station retries a message before the slave station declares the message undeliverable.
	RTS Send Delay	RTS send delay is the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The CTS (Clear-to-Send) signal must be high for transmission to occur.
	RTS Off Delay	RTS off delay is the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero.
	ACK Timeout	Define the amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment from the master station to its transmitted message.
	Detect Duplicate Messages	Duplicate packet detection lets the PLC-5 processor detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose detect duplicate messages, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
	MSG Application Timeout	Define the number of 30 second increments within which the reply message must be received before the error bit is set on the message. The timer starts when the ACK is received.

Displaying Slave System Channel Status

1. To display Channel Status, double click on Channel Status, which is located within Channel Configuration.



2. To access the various channels from the Channel Status Screen, click on the tabs. Descriptions of the status screen fields can be found in Table 2.5.

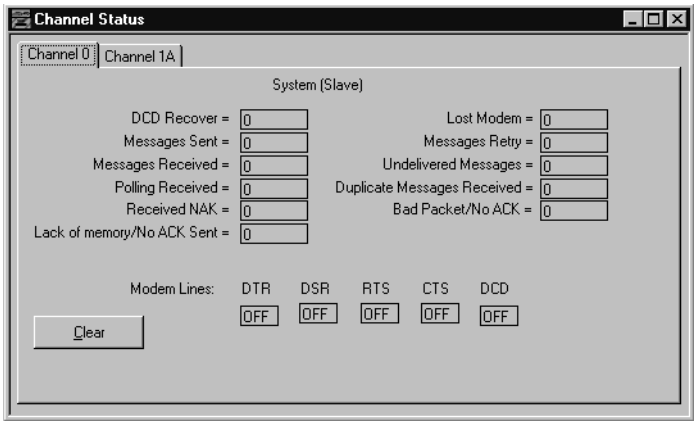


Table 2.5 Descriptions of System Mode DF1 Slave Channel Status Fields

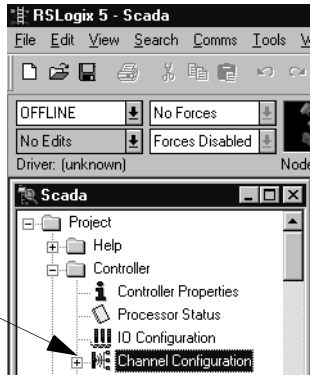
Status Field	Diagnostic File Location	Definition
DCD Recover	word 11	The number of times the processor detects the DCD handshaking line has gone low to high
Messages Sent	word 1	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	word 2	The number of messages received with no errors
Polling Received	word 6	The number of master poll packets received by the processor
Received NAK	word 5	The number of NAKs received by the processor
Lack of Memory/No ACK Sent	word 8	The number of times the processor could not receive a message because it did not have available memory
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Messages Retry	word 4	The number of message retries sent by the processor

Status Field	Diagnostic File Location	Definition
Undelivered Messages	word 3	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet
Bad Packet/No ACK	word 7	The number of incorrect data packets received by the processor for which a no ACK was returned
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

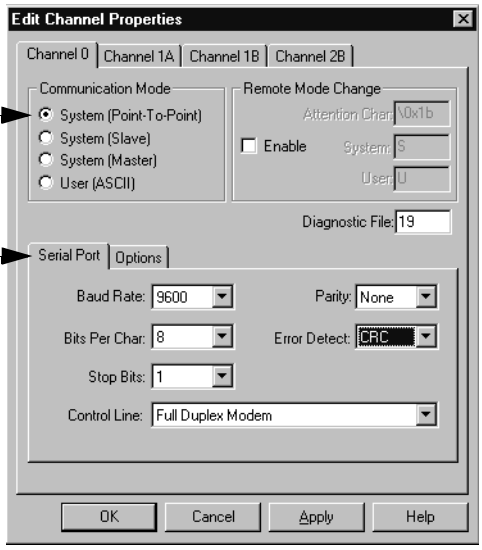
Configuring the Processor as a Station on a Point-to-Point Link

To configure the processor as a station on a point-to-point link, place the processor in program mode and follow the steps below using your programming software:

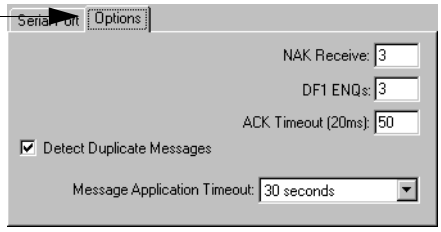
1. Double-click on the Channel Configuration file to bring up the Edit Channel Properties interface.



2. On the Channel 0 tab, choose System (Point-to-Point) for your Communication Mode.
3. Configure the Serial Port parameters according to Table 2.6.



4. Configure the Options parameters according to Table 2.6.
5. When all parameters are set, click OK.



Use Table 2.6. to help you understand the screen parameters you need to specify on the Channel Configuration screen.

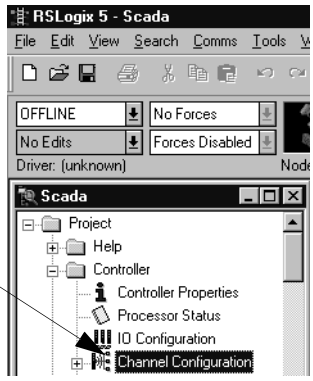
Use Worksheet 2.4 (page D-8) for an example configuration and to record your station's configuration.

Table 2.6 Configuring the PLC-5 Processor as a Device on a Point-to-Point Link

RSLogix 5 Tab	Parameter	Selections
Channel 0	Diagnostic File	Select an unused integer file that you want to use to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 2.7 on page 2-22 for a description of what this file contains.
	Remote Mode Change	Enable remote mode change if you want to switch the configuration of the channel during runtime. Leave the parameter set at the default if you are not using remote mode change.
	Mode Attention Character	Select a character that will signal a remote mode change. Leave the parameter set at the default if you are not using remote mode change.
	System Mode Character	Select a character that will signal the channel to switch into system mode. Leave the parameter set at the default if you are not using remote mode change.
	User Mode Character	Select a character that will signal the channel to switch into user mode. Leave the parameter set at the default if you are not using remote mode change.
Serial Port	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Bits Per Character	Match the number of bits per character to the device with which you are communicating.
	Stop Bits	Match the number of stop bits to the device with which you are communicating.
	Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If you are using a full-duplex modem, choose FULL-DUPLEX.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Options	NAK Receive	Define the number of NAKs the processor can receive in response to a transmitted message before the station declares the message undeliverable.
	DF1 ENQs	Define the number of enquiries (ENQs) that you want the processor to send after an ACK timeout occurs before the station declares the message undeliverable.
	ACK Timeout	Define the amount of time, in 20 millisecond increments, you want the processor to wait for an acknowledgment from a station to its transmitted message.
Options	Detect Duplicate Messages	Duplicate Packet Detection lets the PLC-5 processor detect if it has received a message that is a duplicate of its most recent message from another station. If you choose detect duplicate messages, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets, and execute them, leave this parameter unchecked.
	MSG Application Timeout	Define the number of 30 second increments within which the reply message must be received before the error bit is set on the message. The timer starts when the ladder program first initiates the message and is restarted if/when the ACK is received.
	Error Detect	With this selection you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your system support. When possible, choose CRC.
Important: The station address in the point-to-point driver is determined by the DH+ address defined by switch assembly S1.		

Displaying Point-to-Point System Channel Status

1. To display Channel Status, double-click on Channel Status, which is located within Channel Configuration.



2. To access the various channels from the Channel Status screen, click on the tabs. Descriptions of the status screen fields can be found in Table 2.7.

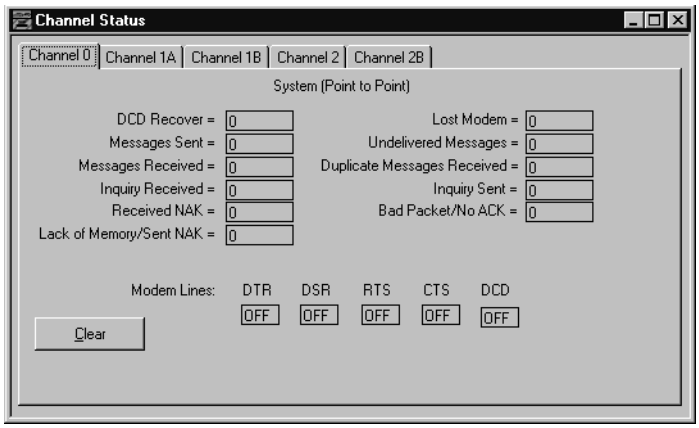
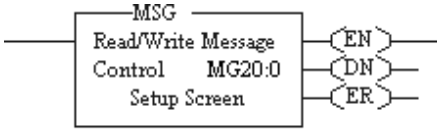


Table 2.7 Descriptions of System (Point-to-Point) Channel Status Fields

Status Field	Diagnostic File Location	Definition
DCD Recover	word 11	The number of times the processor detects the DCD handshaking line has gone low to high
Messages Sent	word 1	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	word 2	The number of messages received with no errors
Inquiry Received	word 6	The number of master poll packets received by the processor
Received NAK	word 5	The number of NAKs received by the processor
Lack of Memory/Sent NAK	word 8	The number of times the processor could not receive a message because it did not have available memory
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Undelivered Messages	word 3	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet

Status Field	Diagnostic File Location	Definition
Inquiry Sent	word 4	The number of ENQs sent by the processor
Bad Packet/No ACK	word 7	The number of incorrect data packets received by the processor for which a NAK was returned
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

Messaging



Messaging can occur between:

- a master station and a slave station
- a slave station and its master station (See Polled Report-by-Exception)
- slave stations or between two processors connected via a point-to-point link

Master Station to Slave Station

A PLC-5 master station communicates with the slave stations that are connected to it via modems in a point-to-multipoint configuration. A master station sends a slave station messages to receive status or issue commands. For sample messaging ladder logic, see page E-8.

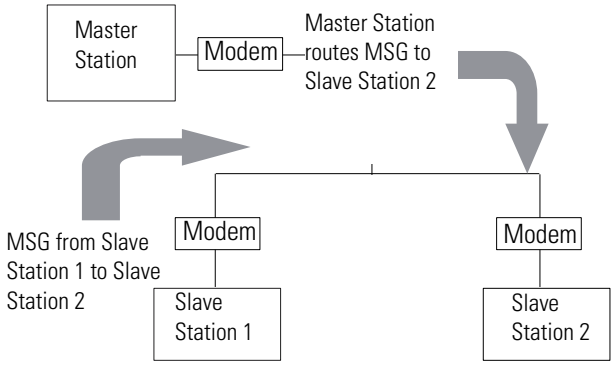
Polled Report-by-Exception

Slave stations can gather information from the I/O points they are responsible for and can send any anomalous readings to the master station. To do this, write ladder logic in the slave station to monitor certain conditions and send the data in a MSG instruction to the master station. Figure 2.6 is an example MSG instruction and control block that a PLC-5 processor in a slave station can send to a PLC-5 master station. For sample messaging ladder logic when using a PLC-5 as a slave, see page E-12.

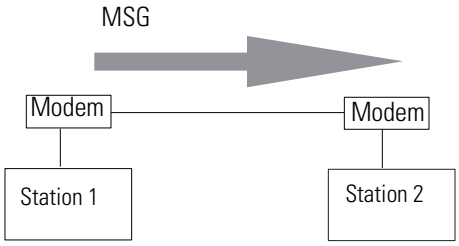
Processor-to-Processor

A processor-to-processor message can be two types:

- In a point-to-multipoint configuration, the messaging would be between slave stations; the master station automatically routes the message.



- In a point-to-point configuration, the messaging would be between the two connected peer devices.



The configuration of the network (point-to-multipoint vs. point-to-point) and the configuration of the station (master, slave, or peer) does not affect how you configure a MSG instruction. That is, a MSG instruction being sent between two PLC-5 slave stations is configured the same as a MSG instruction between two PLC-5 processors connected point-to-point, which is configured the same as a MSG instruction between a PLC-5 master station and a PLC-5 slave station. See Figure 2.5 through Figure 2.8 for example MSG control blocks.

Considerations When Configuring MSG Control Blocks

Keep these considerations in mind when configuring messages between a PLC-5 and SLC 500 or MicroLogix processor.

The following table lists which PLC-5 processors (series and revision) you can use with the MSG instruction to transfer data from/to a PLC-5 processor to/from any SLC 500 processor or MicroLogix 1000 in SLC native mode.

Processor Series/Revision	Processors
Series A / revision M	PLC-5/40, -5/40L, -5,60, -5/60L
Series A / revision J	PLC-5/30
Series A / revision H	PLC-5/11, -5/20
Series B / revision J	PLC-5/40, -5/40L, -5/60, -5/60L
Series C / revision G	PLC-5/11, -5/20, -5/20E, -5/30, -5/40, -5/40L, -5/V40, -5/V40L, -5/40E, -5/60, -5/60L, -5/80, -5/80E, -5/V80, -5/20C, -5/40C, -5/80C
Series D / all	PLC-5/11, -5/20, -5/20E, -5/30, -5/40, -5/40L, -5/V40, -5/V40L, -5/40E, -5/60, -5/60L, -5/80, -5/80E, -5/V80, -5/20C, -5/40C, -5/80C
Series E / all	PLC-5/11, -5/20, -5/20E, -5/30, -5/40, -5/40L, -5/V40, -5/V40L, -5/40E, -5/60, -5/60L, -5/80, -5/80E, -5/V80, -5/20C, -5/40C, -5/80C

- Since all SLC 5/05, 5/04 and 5/03 processors with Operating System 301 or higher can respond to (and initiate) PLC-5 native mode message commands, all PLC-5 processors can transfer data between their data tables and the data table of these particular SLC processors (except for the I/O image table) as if they were messaging with another PLC-5 processor.
- In a single instruction, the maximum amount of words you can read from or write to through channel 0 is as follows:
  - SLC 500, 5/01, 5/02, and MicroLogix 1000 processor, 41 words
  - SLC 5/03, 5/04, 5/05, MicroLogix 1100/1200/1500 processor, 103 words

When configuring messages between a PLC-5 and Logix processor, use the PLC-5 typed read and write commands and enclose the name of the Logix tag in double quotes. This is called logical ASCII addressing.

Example MSG Control Blocks

Application	See	Page
PLC-5 read message to another PLC-5 processor	Figure 2.5	2-26
PLC-5 write message to another PLC-5 processor	Figure 2.6	2-27
PLC-5 read message to an SLC 500 or MicroLogix 1000 processor	Figure 2.7	2-28
PLC-5 write message to an SLC 500 or MicroLogix 1000 processor	Figure 2.8	2-29

Figure 2.5 Example of a PLC-5 read MSG to Another PLC-5 (or SLC 5/03, 5/04, 5/05, MicroLogix 1100/1200/1500, or Logix) processor

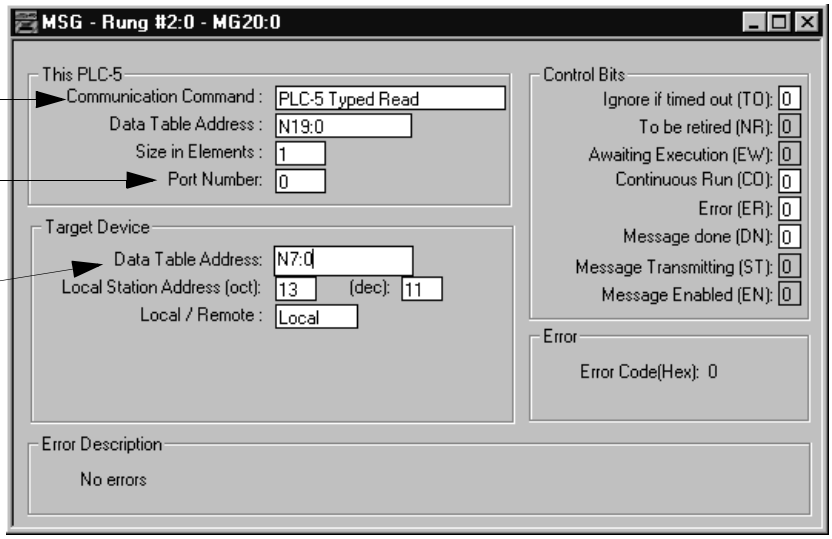
Ladder Rung

Control Block

MSG being sent to another PLC-5 processor.

MSG being sent out channel 0 (must use MG file type).

If the destination were a Logix processor, then the address could also be entered as 'tagname'.



This MSG example tells this (master) PLC-5 to read the information from PLC-5 (slave) station 13_8's, location N7:0 and place the information in file N19:0 (master).

Figure 2.6 Example of a PLC-5 Write MSG to Another PLC-5 (or SLC 5/03, 5/04, 5/05, MicroLogix 1100/1200/1500, or Logix) Processor

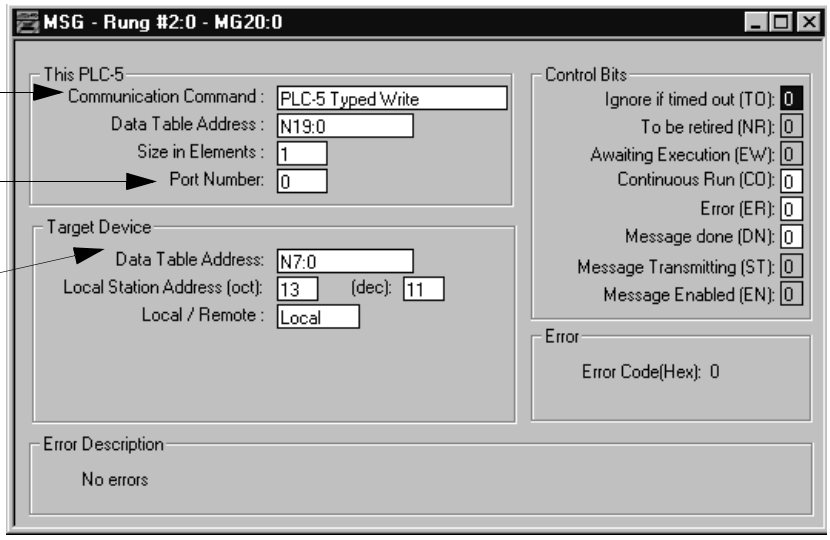
Ladder Rung

Control Block

MSG being sent to another PLC-5 processor.

MSG being sent out channel 0 (must use MG file type).

If the destination were a Logix processor, then the address could also be entered as "tagname".



This MSG example tells this (master) PLC-5 to write the information from its file N19:0 through its serial port (channel 0) to the PLC-5 (slave) station 13_8. The data's destination is N7:0 of the PLC-5 (slave) station.

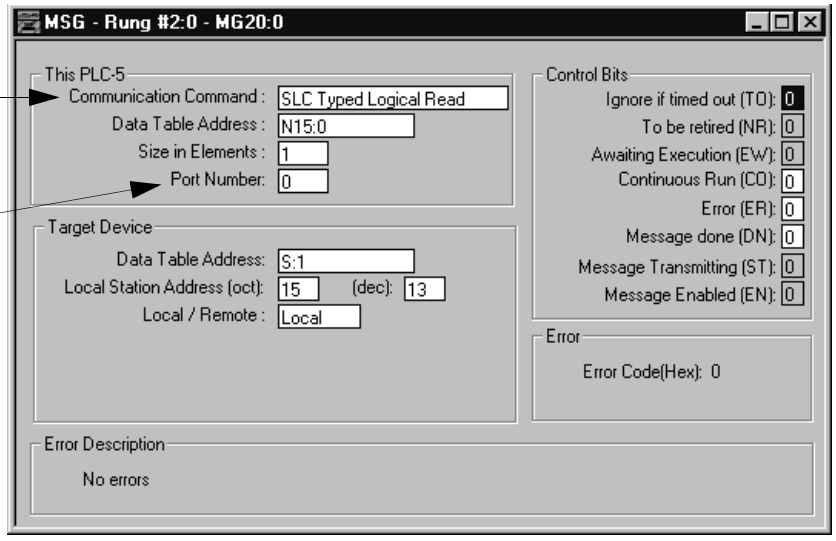
Figure 2.7 Example of a PLC-5 Read MSG to an SLC 500 or MicroLogix Processor

Ladder Rung

Control Block

MSG being sent to an SLC 500 or MicroLogix processor.

MSG being sent out channel 0 (must use MG file type).



This MSG example tells this PLC-5 (master) to read the information from SLC 500 (slave) 13_{10} (15_8) S:1 and place the information in its N15:0 file.

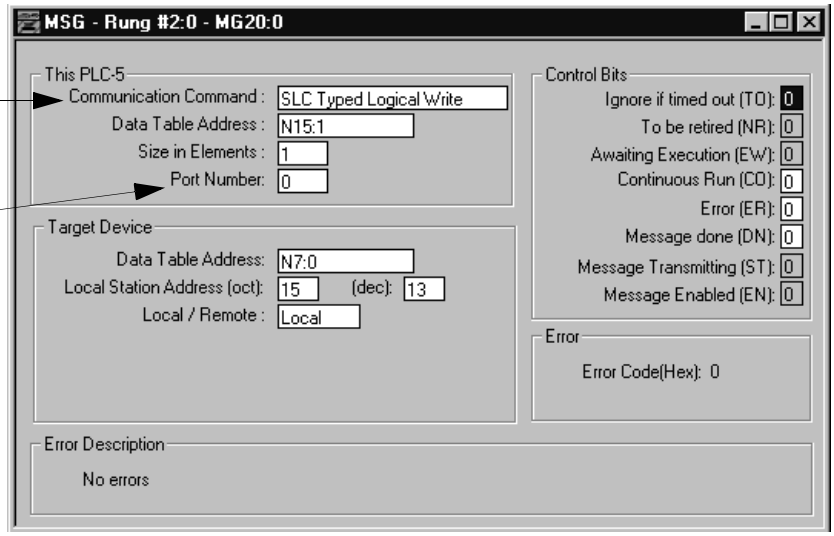
Figure 2.8 Example of a PLC-5 Write MSG to an SLC 500 or MicroLogix Processor

Ladder Rung

Control Block

MSG being sent to an SLC 500 or MicroLogix processor.

MSG being sent out channel 0 (must use MG file type).



This MSG example tells the PLC-5 master station to write the information from its N15:1 through its serial port (channel 0) to the SLC 500 slave station 13_{10} (15_8). The data's destination is N7:0 of the SLC 500 slave station.

Configuring MicroLogix 1100/1200/1500 Controllers

Chapter Objectives

This chapter helps you set up a MicroLogix 1100, 1200, or 1500 controller as a master station, as a slave station, as a radio modem station, or as a station on a point-to-point link.

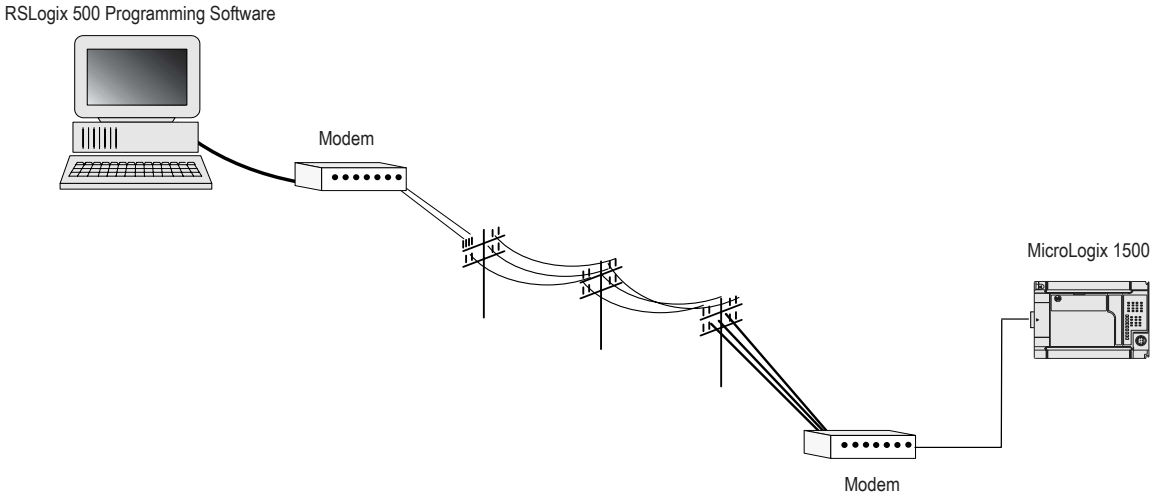
For information about	See page
an overview of the tasks required to configure a MicroLogix 1100/1200/1500 controller	3-2
installing the controller	3-2
using modems that support DF1 communication protocol	3-6
modem control line operation	3-8
configuring DF1 half-duplex channel 0 parameters	3-11
configuring the controller as a DF1 half-duplex master station using standard communication	3-12
configuring the controller as a DF1 half-duplex master station using message-based communication	3-19
configuring the controller as a DF1 half-duplex slave station	3-22
configuring channel 0 poll timeout	3-25
configuring the controller as a DF1 radio modem station	3-27
configuring the controller for DF1 point-to-point communication	3-33
the types of DF1 messages you can send from a MicroLogix 1100/1200/1500 controller to another processor; how to configure the MSG instruction and some configuration characteristics	3-36
example MSG control blocks	3-42
configuring the controller a a Modbus RTU master station	3-46
configuring the controller as a Modbus RTU slave station	3-47
data logging	3-58
conditions that will erase the data retrieval file	3-69

Overview

To configure a MicroLogix 1100/1200/1500 controller:

1. Install the controller; connect the serial cable to one of the communication channels.
2. Define the processor's communication characteristics using RSLogix™ 500 programming software.
3. Install and configure the modem for communication with the controller; connect the modem to one of the controller's serial channels.

Figure 3.1 Configuring a MicroLogix 1100/1200/1500 Controller



Installing the Controller

For details about installing the controller, see the MicroLogix 1100 Installation Instructions, publication 1763-IN001, MicroLogix 1200 Installation Instructions, publication 1762-IN006 or the MicroLogix 1500 Installation Instructions, publication 1764-IN001. Cable pinouts are shown in each example configuration as well as in Appendix A.

IMPORTANT The MicroLogix 1200/1500 channel 0 port is not optically isolated. For all modem applications, an external optical isolator is recommended. You may either supply your own or use a 1761-NET-AIC. The MicroLogix 1500 Channel 1 port and MicroLogix Channel 0 port are optically isolated.

MicroLogix 1200/1500 Channel 0 Cable Pinouts - User Supplied Optical Isolator

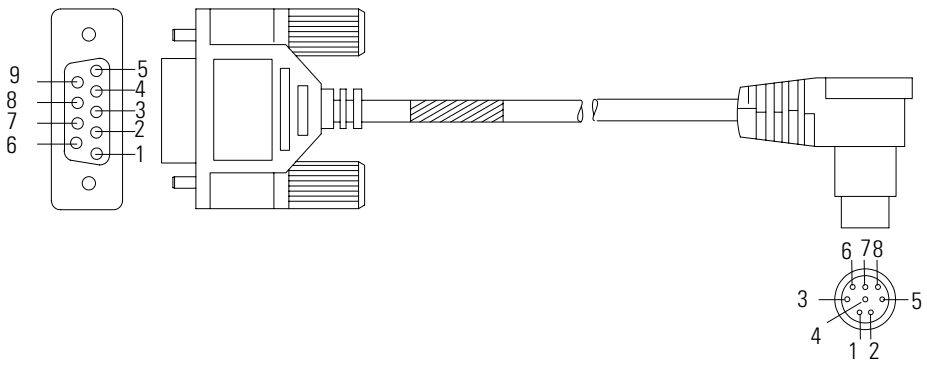
Standard Allen-Bradley cables include:

- 1761-CBL-PM02 Series B or higher (6.5 ft, 1.98 m)
- 1761-CBL-AP00 (17.7 in., 449.58 mm)

MicroLogix		Optical Isolator	Modem		
8-pin MiniDIN	**1761-CBL-PM02 1761-CBL-AP00**	**9-pin female**	**9-pin male**	**9-pin**	**25-pin**
DCD[1] 5		DCD 1	1	1	8
RXD 4		RXD 2	2	2	3
TXD 7		TXD 3	3	3	2
GND 2		GND 5	5	5	7
		DTR 4	4	4	20
		DSR 6	6	6	6
RTS 3		RTS 7	7	7	4
CTS 6		CTS 8	8	8	5

(1) This pin is not active.

Figure 3.2 8-pin MiniDIN to 9-pin Cable Pinouts - User Supplied Optical Isolator



MicroLogix 1200/1500 Channel 0 Cable Pinouts - Allen-Bradley Supplied Optical Isolator

Standard Allen-Bradley cables include:

- 1761-CBL-HM02 Series B or higher (6.5 ft, 1.98 m)
- 1761-CBL-AM00 (17.7 in., 449.58 mm)

MicroLogix		1761-NET-AIC	Modem					
8-pin MiniDIN	1761-CBL-HM02 1761-CBL-AM00	8-pin MiniDIN	9-pin female			9-pin		25-pin
DCD[1] 5	——	DCD 5	DCD.IN	1	——	1	——	8
RXD 4	××	RXD 4	RXD.IN	2	——	2	——	3
TXD 7	××	TXD 7	TXD.OUT	3	——	3	——	2
GND 2	——	GND 2	DTR.OUT	4	——	4	——	20
RTS 3	××	RTS 3	SIG.GND	5	——	5	——	7
CTS 6	××	CTS 6	DSR.IN	6	——	6	——	6
			RTS.OUT	7	——	7	——	4
			CTS.IN	8	——	8	——	5

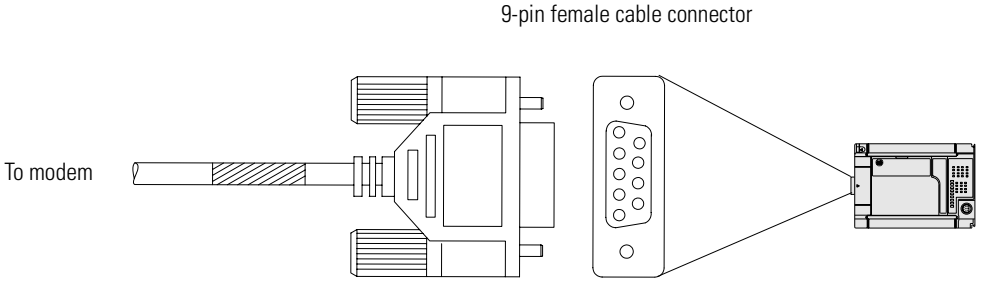
(1) This pin is not active.

MicroLogix 1500 LRP Channel 1 Cable Pinouts

MicroLogix			Modem		
9-pin female			**25-pin**		**9-pin**
DCD.IN	1		8		1
RXD.IN	2		3		2
TXD.OUT	3		2		3
DTR.OUT(1)	4		20		4
SIG.GND	5		7		5
DSR.IN (1)	6		6		6
RTS.OUT	7		4		7
CTS.IN	8		5		8

(1) These pins are not active.

Figure 3.3 MicroLogix 1500 LRP Channel 1 Cable Pinouts



MicroLogix 1100 Channel 0 Cable Pinouts

	MicroLogix			Modem		
8-pin MiniDIN	**1761-CBL-PM02 1761-CBL-AP00**	**9-pin female**		**9-pin**	**25-pin**
DCD(1) 5		DCD 1		1	8
RXD 4		RXD 2		2	3
TXD 7		TXD 3		3	2
GND 2		GND 5		5	7
		DTR 4		4	20
		DSR 6		6	6
RTS 3		RTS 7		7	4
CTS 6		CTS 8		8	5

(1) This pin is not active.

Using Modems that Support DF1 Communication Protocols

The types of modems that you can use with MicroLogix 1100/1200/1500 controllers include dial-up phone modems, leased-line modems, radio modems and line drivers. For point-to-point full-duplex modem connections, use DF1 full-duplex protocol. For general point-to-multipoint modem connections, use DF1 half-duplex master and slave protocols. In this case, one (and only one) of the other devices must be configured for DF1 half-duplex master protocol. For most radio modem connections, use DF1 radio modem protocol.

IMPORTANT Do not attempt to use DH-485 protocol through modems under any circumstance.

Dial-up Phone Modems

Dial-up phone line modems support point-to-point full-duplex communications. Normally, a MicroLogix 1100/1200/1500 controller on the initiating or receiving end of the dial-up connection, will be configured for DF1 full-duplex protocol with the control line parameter set for no handshaking.

When a MicroLogix 1100/1200/1500 controller is the initiator of the dial-up connection, use one of the ASCII write instructions to send out the AT dial-up string (for example ATDT 555-1212). For the MicroLogix 1500 LRP channel 1 only, bit (CS1:9/3) provides the feedback that the connection has been successfully made. To hang up the connection, return the modem to Command Mode and use an ASCII Write instruction to send out the ATH hang-up string.

See Chapter 11 for further details on using MicroLogix 1100/1200/1500 controllers in dial-up modem applications.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be point-to-point topology supporting full-duplex communications between two modems or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology, configure the MicroLogix 1100/1200/1500 controllers for DF1 full-duplex protocol with the control line parameter set to Full-Duplex Modem. In the point-to-multipoint topology, configure the MicroLogix 1100/1200/1500 controllers for DF1 half-duplex master or slave protocol with the control parameter set to Half-Duplex Modem (RTS/CTS Handshaking).

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either half-duplex or full-duplex communications, or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology using full-duplex radio modems, configure the MicroLogix 1100/1200/1500 for DF1 radio modem protocol. In the point-to-multipoint topology using half-duplex radio modems, configure the MicroLogix 1100/1200/1500 for DF1 radio modem protocol. If these radio modems require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem (RTS/CTS Handshaking).

Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Allen-Bradley's AIC+ Advanced Interface Converter is a line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet. In a point-to-point line driver topology, configure the MicroLogix 1100/1200/1500 controllers for DF1 radio modem protocol. In a point-to-multipoint line driver topology, configure the MicroLogix 1100/1200/1500 for DF1 half-duplex master or slave protocol. If these line drivers require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem (RTS/CTS Handshaking).

Modem Control Line Operation

The following explains the operation of the MicroLogix 1100/1200/1500 controllers when you configure the RS-232 channel for the following applications.

DF1 Full-Duplex

When configured for DF1 full-duplex, the following control line operation takes effect:

No Handshaking Selected

RTS is always inactive (low). Receptions and transmissions take place regardless of the state of CTS input. Only make this selection when the MicroLogix 1100/1200/1500 controllers are directly connected to another device that does not require handshaking signals.

Full-Duplex Modem (RTS On) Selected

RTS is always active (high).

Transmissions require CTS to be active.

DF1 Half-Duplex Slave

When configured for DF1 half-duplex slave, the following control line operation takes effect:

No Handshaking Selected

RTS is always inactive. Receptions and transmissions take place regardless of the state of CTS input. Only make this selection when the controller is directly connected to another device that does not require handshaking signals.

Half-Duplex Modem (RTS/CTS Handshaking) Selected

RTS is only activated during transmissions (and any programmed delays before or after transmissions). Transmissions require CTS to be active.

DF1 Half Duplex Master

When configuring for DF1 half-duplex master, the following control line operation takes effect:

No Handshaking Selected

RTS is always inactive. Receptions and transmissions take place regardless of the state of CTS input. Only make this selection when the controller is directly connected to another device that does not require handshaking signals.

Full-Duplex Modem (RTS On) Selected

RTS is always active (high).

Transmissions require CTS to be active.

Half-Duplex Modem (RTS/CTS Handshaking) Selected

RTS is only active during transmissions (and any programmed delays before and after transmissions).

Transmissions require CTS to be active

DF1 Radio Modem

When you configure the MicroLogix 1100/1200/1500 controllers for DF1 Radio Modem, the following control line operation takes effect:

No Handshaking Selected

RTS is always inactive. Receptions and transmissions take place regardless of the state of CTS input. This selection should only be made when the processor is directly connected to another device that does not require handshaking signals.

Half-Duplex Modem (RTS/CTS Handshaking) Selected

RTS is activated during transmission and during any programmed delays before or after transmissions. Programmed delays include RTS Send Delay and RTS Off Delay.

Transmissions require CTS to be active. If CTS is inactive at the onset of transmission, one second will be provided to wait for CTS to become active before the message packet is discarded.

Half-Duplex Modem with DCD Handshaking (MicroLogix 1500 LRP Channel 1 Only) Selected

RTS is activated during transmissions and during any programmed delays before and after transmissions. Programmed delays include RTS Send Delay and RTS Off Delay. The DCD input signal is monitored to determine if transmissions are acceptable. If DCD is active, receptions are possible.

Transmissions require CTS to be active and DCD to be inactive. If DCD is active at the onset of transmission, a configured delay (DCD Wait Delay) will wait for DCD to become inactive before discarding the packet. If CTS is inactive at the onset of transmission, one second will be provided to wait for CTS to become active before the message packet is discarded.

Configuring DF1 Half-Duplex Channel 0 Parameters

RTS Send Delay and RTS Off Delay

Through your programming software, the parameters RTS Send Delay and RTS Off Delay let you set how long RTS is on prior to transmission, as well as how long to keep it on after transmission is complete. These parameters only apply when you select half-duplex modem. For maximum communication throughput, leave these parameters at zero.

For use with half-duplex modems that require extra time to turnaround or key-up their transmitter even after they have activated CTS, the RTS Send Delay specifies (in 20 millisecond increments) the amount of delay time after activating RTS to wait before checking to see if CTS has been activated by the modem. If CTS is not yet active, RTS remains active, and as long as CTS is activated within one second, the transmission occurs. After one second, if CTS is still not activated, then RTS is set inactive and the transmission is aborted.

For modems that do not supply a CTS signal but still require RTS to be raised prior to transmission, jumper RTS to CTS and use the shortest delay possible without losing reliable operation.

IMPORTANT If an RTS Send Delay of 0 is selected, then transmission starts as soon as CTS is activated. If CTS does not go active within one second after RTS is raised, RTS is set inactive and the transmission is aborted.

Certain modems will drop their carrier link when RTS is set inactive even though the transmission has not quite been finished. The RTS Off Delay parameter specifies in 20 millisecond increments the delay between when the last serial character is sent to the modem and when RTS is deactivated. This gives the modem extra time to transmit the last character of a packet.

ATTENTION

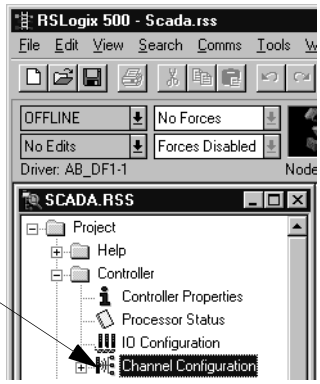
For almost all modem applications, the RTS Off Delay should be left at 0. Never select an RTS Off Delay that is greater than the RTS Send Delay in the other devices on the network, or you may incur two devices trying to transmit simultaneously.

Configuring a Standard-Mode DF1 Half-Duplex Master Station

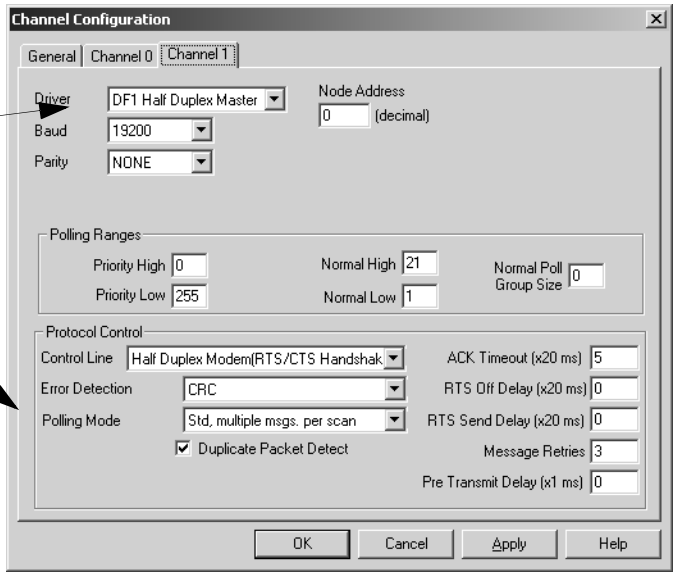
Choose standard mode if you want to query slave stations for information based upon user-configured polling ranges. This mode is used most often in general point-to-multipoint configurations.

To configure the processor for a master station using standard communication, place the processor into program mode and follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



2. On the Channel tab, choose DF1 Half-Duplex Master for your Driver.
3. Choose a Standard Polling Mode.
4. Configure the rest of the communication driver characteristics according to the table starting on page 3-13.



Use Worksheet 3.1 MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Standard Communication (page D-9) for an example configuration and to record your station's configuration.

The table starting on page 3-13 shows the parameters for configuring a MicroLogix 1100/1200/1500 controller as a master station using standard-communication mode to talk to slave stations.

Table 3.1 MicroLogix 1100/1200/1500 Master Using Standard-Communication Mode

Parameter	Selections
Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Node Address	A node address identifies the controller on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, and cannot be selected as a station's individual address.
Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex, choose FULL-DUPLEX MODEM (RTS ON). • If all the modems in the system are half-duplex, choose HALF-DUPLEX MODEM (RTS/CTS Handshaking). See page 3-8 for a description of the control line operation settings.
Error Detection	With this selection, you choose how the controller checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
Polling Mode	If you want to receive: • only one message from a slave station per its turn, choose STANDARD (SINGLE MESSAGE TRANSFER PER NODE SCAN). Choose this method only if it is critical to keep the poll list scan time to a minimum. • as many messages from a slave station as it has, choose STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN).
Duplicate Packet Detect	Duplicate Detect lets the controller detect if it has received a message that is a duplicate of its most recent message from another station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
ACK Timeout	The amount of time, in 20 millisecond increments, that you want the controller to wait for an acknowledgment to the message it has sent before the processor retries the message or the message errors out. This timeout value is also used for the poll response timeout. See page 3-14 for recommendations to minimize this value.
RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero. See page 3-11 for further guidelines for setting this parameter.

Table 3.1 MicroLogix 1100/1200/1500 Master Using Standard-Communication Mode

Parameter	Selections
RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 3-11 for further guidelines for setting this parameter.
Pre-Transmit Delay	Defines the amount of time in 1 millisecond increments that elapses between when the processor has a message to send and when it asserts the RTS signal.
Message Retries	Defines the number of times a master station retries either: • a message before it declares the message undeliverable • or a poll packet to an active station before the master station declares that station to be inactive.
Priority Polling Range – High	Select the last slave station address to priority poll.
Priority Polling Range – Low	Select the first slave station address to priority poll. Entering 255 disables priority polling.
Normal Polling Range – High	Select the last slave station address to normal poll.
Normal Polling Range – Low	Select the first slave station address to normal poll. Entering 255 disables normal polling.
Normal Poll Group Size	Enter the quantity of active stations located in the normal poll range that you want polled during a scan through the normal poll range before returning to the priority poll range. If no stations are configured in the Priority Polling Range, leave this parameter at 0.

Minimum DF1 Half-Duplex Master Channel 0 ACK Timeout

The governing timeout parameter to configure for a DF1 Half-Duplex Master is the channel 0 ACK Timeout. The ACK Timeout is the amount of time you want the processor to wait for an acknowledgment of its message transmissions. Set in 20 millisecond intervals, the value is the amount of time the master will wait for:

- an ACK to be returned by a slave when the master has just sent it a message, or
- a poll response or message to be returned by a slave when the master has just sent it a poll packet.

The timeout must be long enough that after the master has transmitted the last character of the poll packet, there is enough time for a slave to transmit (and the master receive) a maximum-sized packet before the time expires.

To calculate the minimum ACK timeout, you must know:

- the modem baud rate
- maximum-sized data packet (the maximum number of data words that a slave write command or read reply packet might contain)
- the RTS/CTS or turnaround delay of the slave modem
- the configured RTS Send Delay in the slave
- the program scan time of the slave

Determining Minimum Master ACK Timeout

To determine the minimum ACK Timeout, you must first calculate the transmission time by multiplying the maximum-sized data packet for your processor by the modem rate in ms/byte. For an example we will assume a MicroLogix controller (103 data words or 224 bytes total packet size including overhead) and a 9600 bps modem, which transmits at approximately 1 ms/byte. Therefore, the message transmission time is 224 ms. For approximate modem transmission rates, see the following table.

Table 3.2 Approximate Modern Transmission Rates

modem bps	approx. ms/byte
4800	2 ms/byte
9600	1 ms/byte
19200	0.5 ms/byte

Next, you need to determine the average slave program scan time. In RSLogix 500, double click on the Processor Status icon and then locate Average on the Scan Times tab. For this example, assume an average slave program scan time of 20 ms. The program scan time will vary by application.

Finally, you must determine the larger of two values, either the configured slave RTS Send Delay or the turnaround time of the slave modem. The RTS Send Delay time can be found by double-clicking on the slave's Channel Configuration icon and looking at the particular channel tab of the Channel Configuration screen. Note that the RTS Send Delay time is in intervals of 20 ms, so with a value of 3 in the box, the RTS Send Delay time would be 20 ms multiplied by 3. Using this value (60 ms) for our example, and assuming that the turnaround time of the modem is 50 ms (which will vary by modem), you would choose to use the RTS Send Delay time of 60 ms for your calculation.

Having determined the maximum message transmission time (224 ms), the average slave program scan time (20 ms) and the largest of either RTS Send Delay (60 ms) or the modem turnaround time, the minimum ACK timeout is simply the sum of these values.

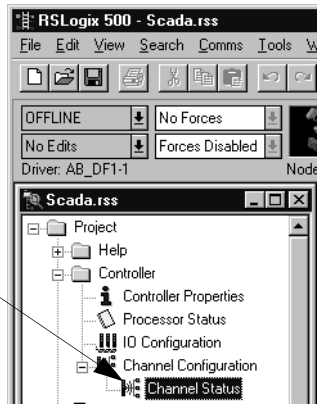
Use only the largest of these two values.

Parameter	Example Values (in ms)
Max message transmission time	224
Average program scan time	20
RTS Send Delay	60
modem turnaround time	50
calculated ACK Timeout	304
round up to nearest 20 ms	320

DF1 Half-Duplex Master Channel Status

Channel Status data is stored in the Communication Status Function File. Table 3.3 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status icon located beneath the Configuration icon to bring up the Channel Status interface.



2. See Table 3.3 for details concerning the DF1 Half-Duplex Master Channel Status interface.

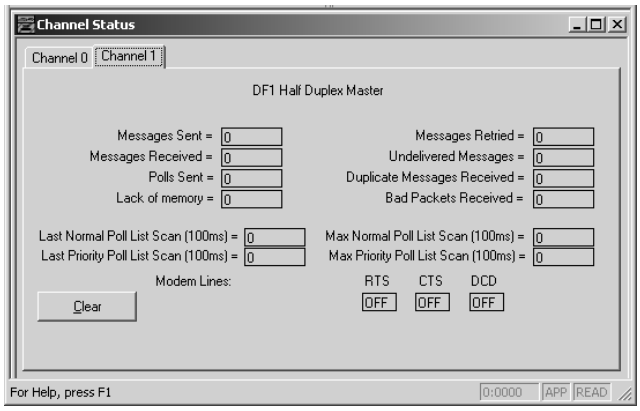


Table 3.3 Understanding the DF1 Half-Duplex Master Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Messages Sent	CSx:10	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	CSx:11	The number of messages received with no errors
Poll Sent	CSx:15	The total number of poll packets sent by the controller
Lack of Memory	CSx:17	The number of packets dropped due to lack of memory
Last Normal Poll List Scan	CSx:19	Time in 100 ms increments of last scan through Normal Poll List
Last Priority Poll List Scan	CSx:21	Time in 100 ms increments of last scan through Priority Poll List
Message Retried	CSx:13	The number of message retries sent by the processor

Table 3.3 Understanding the DF1 Half-Duplex Master Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Undelivered Messages	CSx:12	The number of messages that were sent by the controller but not acknowledged by the destination device
Duplicate Messages Received	CSx:18	The number of times the controller received a message packet identical to the previous message packet
Bad Packet Received	CSx:16	The number of incorrect data packets received by the controller for which no ACK was returned
Max Normal Poll List Scan	CSx:20	Maximum time in 100 ms increments to scan the Normal Poll List
Max Priority Poll List Scan	CSx:22	Maximum time in 100 ms increments to scan the Priority Poll List
RTS (Request to Send)	CSx:9/1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	CSx:9/0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)[1]	CSx:9/3	The status of the DCD handshaking line (received by the processor)

(1) Only present on the MicroLogix 1500 LRP channel 1.

(2) The channel number equals x.

Monitor Active Stations

To see what slave stations are active when the channel is configured for Standard Polling Mode (either single or multiple message per scan), view the DF1 Half-Duplex Master Active Node Table. The table is stored in the Communications Status Function File, words CSx:27 to CSx:42, where x is the channel number (x=0 for MicroLogix 1100, 1200 and MicroLogix 1500 1764-LSP; x=1 for MicroLogix 1500 1764-LRP). Each bit in the table represents a station on the link, from 0 to 254, starting with CSx:27/0 for address 0 and CSx:42/14 for address 254. The bit for address 255 (CSx:42/15) is never set, since it is the broadcast address which never gets polled.

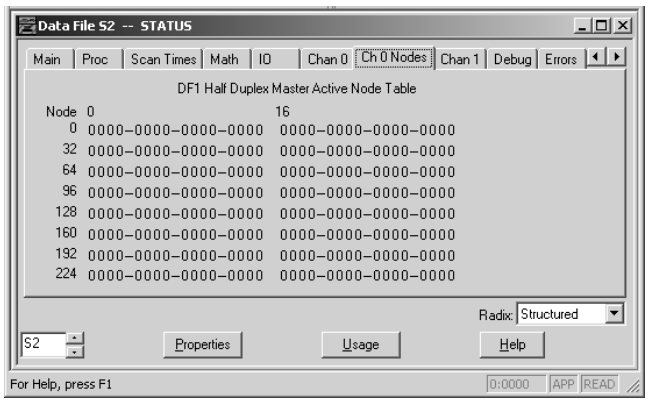
When valid Normal and/or Priority Poll Ranges are defined:

- if a slave responded the last time it was polled by the master, the bit corresponding to its address is set (1=active).
- if a slave did not respond the last time it was polled by the master, the bit corresponding to its address is cleared (0=inactive).

TIP The bit corresponding to the address configured for the DF1 Master is always cleared because the master address never gets polled.

If you are using RSLogix 500 version 6.10.10 or higher, you can view the active node table by clicking on Processor Status and then selecting the tab for the DF1 Master channel.

Figure 3.4 Example Active Node Table



At powerup or after reconfiguration, the master station assumes that all slave stations are inactive. A station is shown active only after it responds to a poll packet.

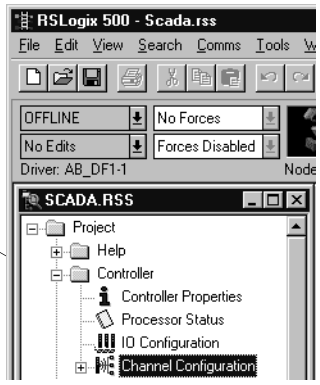
Configuring a Message-based Mode DF1 Half-Duplex Master Station

Choose message-based communication mode if you want to use MSG instructions in user programming to communicate with one station at a time. If your application uses satellite transmission or public switched telephone network transmission, consider choosing message-based. Communication to a slave station can be initiated on an as-needed basis.

With message-based mode, you do not have an active node file that you can use to monitor station status. Also, you cannot implement slave station-to-slave station messaging or slave programming.

To configure the processor for a master station using message-based communication, place the processor in program mode and follow the steps below using your programming software:

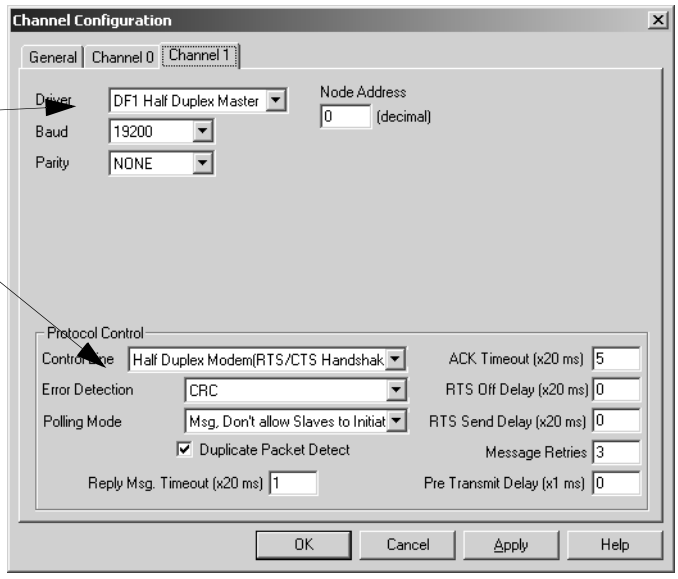
1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



2. On the Channel 1 tab, choose DF1 Half-Duplex Master for your Driver.

3. Choose a Message-based Polling Mode.

4. Configure the communication driver characteristics according to Table 3.4.



Use Worksheet 3.2 MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Message-based Communication (page D-10) for an example configuration and to record your station's configuration.

Define the parameters shown in Table 3.4 when configuring a MicroLogix 1100/1200/1500 controller as a master station using message-based communication mode to talk to slave stations.

Table 3.4 Configuring a MicroLogix 1100/1200/1500 as a Master Using Message-based Communication Mode

Parameter	Selections
Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Node Address	A node address identifies the controller on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, and cannot be selected as a station's individual address.
Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex, choose FULL-DUPLEX MODEM (RTS On). • If all the modems in the system are half-duplex, choose HALF-DUPLEX MODEM (RTS/CTS Handshaking). See page 3-8 for descriptions of control line operation settings.
Error Detection	With this selection, you choose the how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
Polling Mode	If you want to: • accept unsolicited messages from slave stations, choose MESSAGE BASED (ALLOW SLAVES TO INITIATE MESSAGES) Slave station-initiated messages are acknowledged and processed after all master station-initiated (solicited) messages. **Note:** Slave stations can only send messages when they are polled. If the message-based master station never sends a slave station a message, the master station will never send the slave station a poll. Therefore, to regularly obtain a slave station-initiated message from a slave station, you should choose to use standard communication mode instead. • ignore unsolicited messages from slave stations, choose MESSAGE BASED (DO NOT ALLOW SLAVES TO INITIATE MESSAGES) Slave station-initiated messages are acknowledged and discarded. The master station acknowledges the slave station-initiated message so that the slave station removes the message from its transmit queue, which allows the next packet slated for transmission into the transmit queue.
Duplicate Packet Detect	Duplicate Detect lets the controller detect if it has received a message that is a duplicate of its most recent message from another station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.

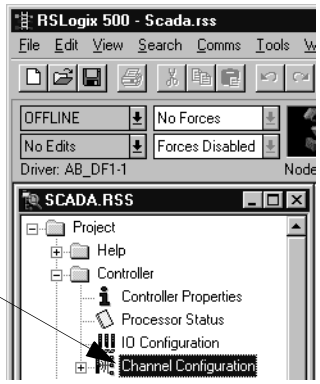
Table 3.4 Configuring a MicroLogix 1100/1200/1500 as a Master Using Message-based Communication Mode

Parameter	Selections
Reply Message Wait Timeout	Defines the amount of time, in 20 millisecond increments, that the master station will wait after receiving an ACK (to a master-initiated message) before polling the slave station for a reply. Choose a time that is, at minimum, equal to the longest time that a slave station needs to format a reply packet. This would typically be the maximum scan time of the slave station.
ACK Timeout	The amount of time, in 20 millisecond increments, that you want the controller to wait for an acknowledgment to the message it has sent before the processor retries the message or the message errors out. This timeout value is also used for the poll response timeout. See page 3-14 for recommendations to minimize this value.
RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero. See page 3-11 for further guidelines for setting this parameter.
RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 3-11 for further guidelines for setting this parameter.
Pre-Transmit Delay	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal.
Message Retries	Defines the number of times a master station retries a message before it declares the message undeliverable.

Configuring a Slave Station

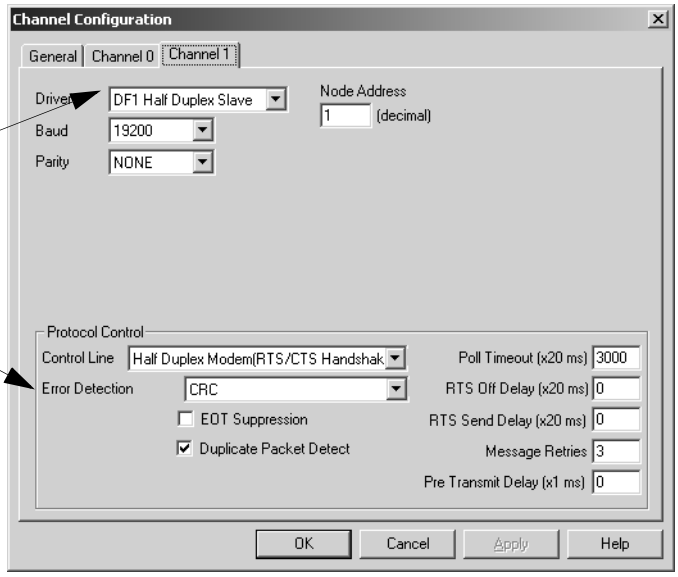
To choose the processor as a slave station, follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



2. On the Channel tab, choose DF1 Half-Duplex Slave for your Driver.

3. Configure the communication driver characteristics according to Table 3.5.



Use Worksheet 3.3 MicroLogix 1100/1200/1500 DF1 Half-Duplex Slave Station Configuration (pageD-11) for an example configuration and to record your station's configuration.

Define these parameters when configuring a MicroLogix 1100/1200/1500 controller as a slave station.

Table 3.5 Configuring a MicroLogix 1100/1200/1500 controller as a Slave Station

Parameter	Selections
Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Node Address	A node address identifies the controller on the DF1 half-duplex link. Each station on a link must have a unique node address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, which you cannot select as a station's individual address.
Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex and the slave modem is half-duplex, choose HALF-DUPLEX MODEM (RTS/CTS Handshaking). See page 3-8 for descriptions of the control line operation settings.
Error Detection	With this selection, you choose how the controller checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.

Table 3.5 Configuring a MicroLogix 1100/1200/1500 controller as a Slave Station

Parameter	Selections
Duplicate Packet Detect	Duplicate Detect lets the controller detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
Poll Timeout	The timer keeps track of how often the station is polled. If the station has a message to send, it starts a timer. If the poll timeout expires before the message timeout, which you specify in the MSG control block, the MSG error bit is set and the message is removed from the transmit queue. If the message timeout, which you specify in the MSG control block, expires before the poll timeout expires, the MSG error bit and MSG timeout bit are set. The poll timeout can be disabled by entering a zero. See page 3-25 for recommendations to minimize this value.
RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message, but should normally be left at zero. See page 3-11 for further guidelines for setting this parameter.
RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur.See page 3-11 for further guidelines for setting this parameter.
Message Retries	Defines the number of times a slave station resends its message to the master station before the slave station declares the message undeliverable.
Pre-Transmit Delay	Defines the amount of time in 1 millisecond increments that elapses between when the processor has a message to send and when it asserts the RTS signal.
EOT Suppression	If you want to minimize traffic on the network, you can choose to have the slave station not send EOT packets to the master station. When EOT packets are suppressed, the master station automatically assumes a slave station has no data to give if the slave station does not send a message packet as a response to a poll. A disadvantage of suppressing EOTs is that the master station cannot distinguish between an active station that has no data to transmit and an inactive station. A possible application for suppressing EOTs is the following: conserving power with a radio modem because the radio transmitter does not have to power-up to transmit a DLE EOT packet ("no data to give" packet). To suppress EOTs, check this parameter. To have the processor send EOTs, leave this parameter unchecked.

Configuring Poll Timeout

The Poll Timeout is only used when the DF1 half-duplex slave is initiating MSG instructions in ladder logic. This implies that the Master is most likely configured for Standard Polling Mode. The minimum Poll Timeout value is dependent on the maximum Master poll scan rate. Since the Master's polling and the Slave's triggering of a MSG instruction are asynchronous events, it is possible that in the instant just after the slave was polled, the MSG instruction gets triggered. This means the MSG instruction will remain queued-up for transmission until the Master has polled every other slave first. Therefore, the minimum Slave channel 0 Poll Timeout value is equal to the maximum Master poll scan rate rounded up to the next 20 ms increment.

Minimum Channel 0 Poll Timeout = Maximum Master Scann Poll Rate

DF1 Half-Duplex Slave Channel Status

Channel Status data is stored in the Communication Status Function file. Table 3.6 on page 3-25 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status Icon Located beneath the Configuration icon to bring up the Channel Status screen.

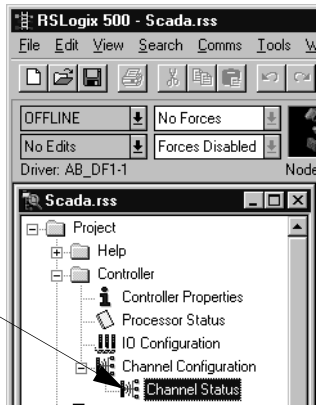


Table 3.6 Understanding the DF1 Half-Duplex Slave Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Messages Sent	CSx:10	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	CSx:11	The number of messages received with no errors
Polls Received	CSx:15	The number of master poll packets received by the processor
Received NAK	CSx:14	The number of NAKs received by the processor
Lack of Memory	CSx:17	The number of times the processor could not receive a message because it did not have available memory

Table 3.6 Understanding the DF1 Half-Duplex Slave Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Messages Retried	CSx:13	The number of message retries sent by the processor
Undelivered Messages	CSx:12	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	CSx:18	The number of times the processor received a message packet identical to the previous message packet
Bad Packet Received	CSx:16	The number of incorrect data packets received by the processor for which no ACK was returned
RTS (Request to Send)	CSx:9/1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	CSx:9/0	The status of the CTS handshaking line (received by the processor)
DCD (Carrier Detect)[1]	CSx:9/3	The status of the DCD handshaking line (received by the processor)

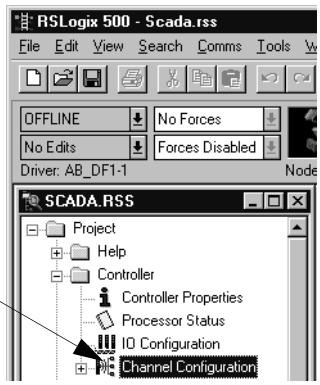
(1) Only present on the MicroLogix 1500 LRP channel 1.

(2) The channel number equals x.

Configuring a Radio Modem Station

To configure a MicroLogix 1100/1200/1500 controller channel 1 for DF1 Radio Modem, do the following using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



2. On the Channel tab, choose DF1 Radio Modem for your Driver.

3. Configure the communication driver characteristics according to Table 3.7.

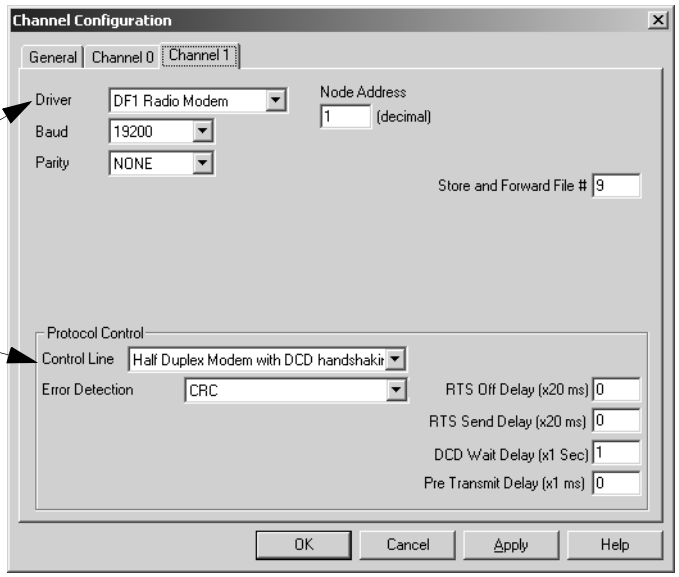


Table 3.7 Define these communication parameters when configuring a MicroLogix 1100/1200/1500 controller for DF1 Radio Modem communication.

Parameter	Default	Selections
Baud Rate	19,200	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
Parity	None	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Node Address	1	A node address identifies the processor on the DF1 half-duplex link. Each station on a link must have a unique node address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, which you cannot select as a station's individual address.
Store and Forward File Number	0	Select an unused file (9 to 255) to be the 256-bit Store and Forward table. Zero disables Store and Forward. Refer to Configuring the Store and Forward table for more information.
Control Line	No Handshaking	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • Half-Duplex Modem (RTS/CTS Handshaking)(1) • Half-Duplex Modem with DCD Handshaking See page 3-8 for descriptions of the control line operation settings
Error Detection	CRC	With this selection, you choose the how the processor checks the accuracy of each DF1 packet transmission. BCC: This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet CRC: This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
RTS Off Delay	0	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message, but should normally be left at zero. See page 3-11 for further guidelines for setting this parameter.

Table 3.7 Define these communication parameters when configuring a MicroLogix 1100/1200/1500 controller for DF1 Radio Modem communication.

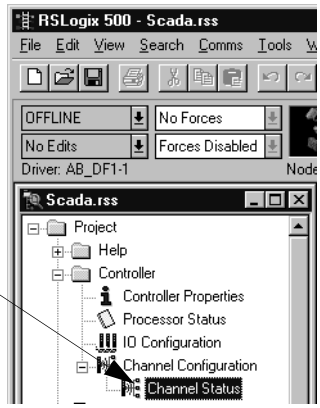
Parameter	Default	Selections
RTS On Delay	0	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 3-11 for further guidelines for setting this parameter.
DCD Wait Delay(1)	1	Only used with Half-Duplex Modem with DCD Handshaking Control Line setting. Defines how long, in seconds, the processor will wait for DCD to go low so that it can transmit, before giving up and erroring out MSG.
Pre-Transmit Delay	0	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal (if handshaking is selected) or begins transmitting (if no handshaking is selected).

(1) MicroLogix 1500 LRP Channel 1 only.

DF1 Radio Modem Channel Status

Channel status data is stored in the Communication Status Function file. See Table 3.8 for information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status Icon Located beneath the Configuration icon to bring up the Channel Status screen.



2. See Table 3.8 for details concerning the DF1 Radio Modem Channel Status Screen.

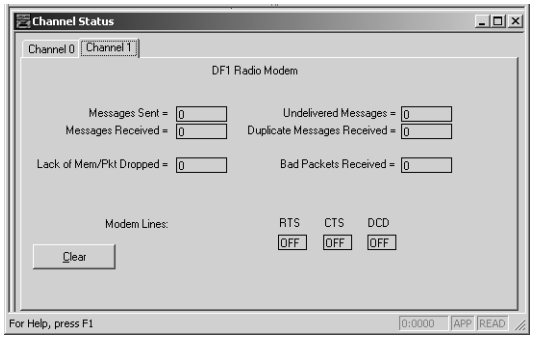


Table 3.8 Understanding the DF1 Radio Modem Channel Status

Status Field	Communication Status Function File Location[2]	Definition
Messages Sent	CSx:10	The total number of DF1 messages sent by the controller
Messages Received	CSx:11	The number of messages received with no errors
Lack of Memory/Packet Dropped	CSx:17	The number of times the controller could not receive a message because it did not have available memory
Undelivered Messages	CSx:12	The number of messages that could not be sent by the controller because of incorrect modem handshaking conditions.

Table 3.8 Understanding the DF1 Radio Modem Channel Status

Status Field	Communication Status Function File Location[2]	Definition
Duplicate Messages Received	CSx:18	The number of times the processor received a message packet identical to the previous message packet
Bad Packets Received	CSx:16	The number of data packets received with transmission errors by the processor
RTS (Request to Send)	CSx:9/1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	CSx:9/0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)[1]	CSx:9/3	The status of the DCD handshaking line (received by the processor)

(1) Only present on the MicroLogix 1500 LRP channel 1.

(2) The channel number equals x.

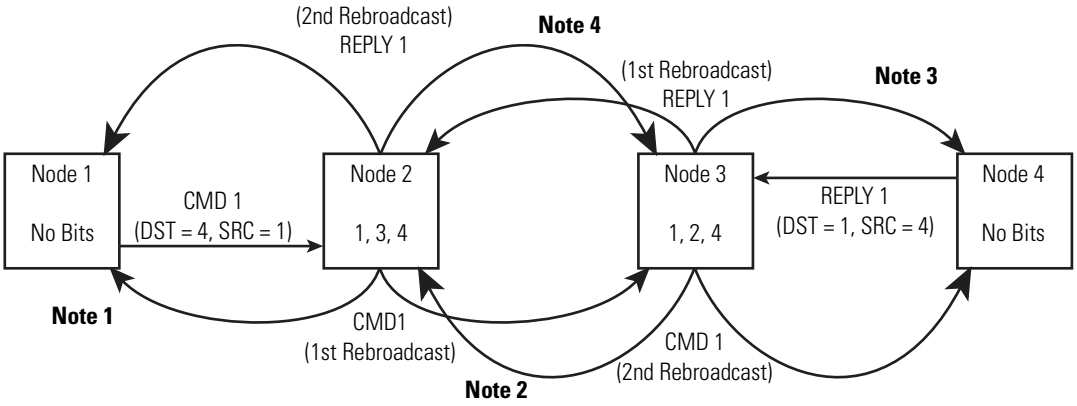
For the MicroLogix 1500 LRP, clicking the Clear button while monitoring Channel Status of either channel 1 or channel 0 online, will reset all of the channel status diagnostic counters for both channels to zero.

Configuring the Store & Forward Table

The Store & Forward Table occupies a 16-word binary data table file. Each bit in this file corresponds to a DF1 Radio Modem node address. In order to configure a MicroLogix to Store & Forward message packets between two other nodes, the bits corresponding to the addresses of those two other nodes must be set. For instance, if node 2 is used to Store & Forward message packets between nodes 1 and 3, then both bits Bx/1 and Bx/3 would have to be set in the Store & Forward Table (see Figure 3.6). You can set bit 255 to enable Store & Forward of broadcast packets, as well.

IMPORTANT Once Store & Forward is enabled, duplicate packet detection is also automatically enabled. Whenever Store & Forward is used within a radio modem network, every node should have Store & Forward enabled, even if all of the bits in the file are cleared, so that duplicate packets will be ignored.

Figure 3.5 Applying Store and Forward with DF1 Radio Modem Protocol



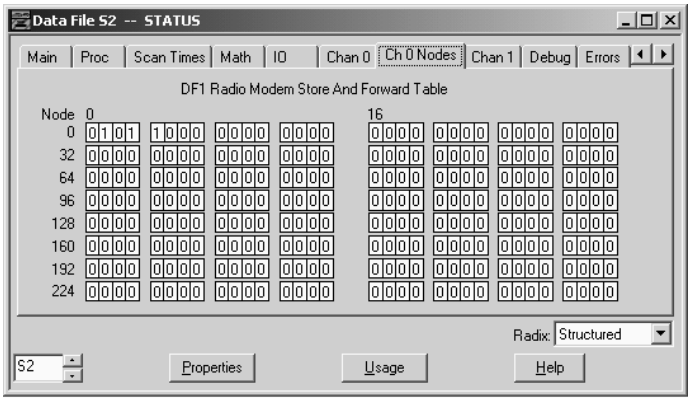
Note 1 – The link layer of Node 1 blocks the re-transmission of a packet that is received with the SRC byte equal to the receiving node's station address. Packets received that originate from the receiving node should never be re-transmitted.

Note 2 – To prevent Node 2 from re-transmitting a duplicate packet, the link layer of Node 2 updates the duplicate packet table with the last 20 packets received.

Note 3 – The link layer of Node 4 blocks the re-transmission of a packet that is received with the SRC byte equal to the receiving node's station address. Packets received that originate from the receiving node should never be re-transmitted.

Note 4 – To prevent Node 3 from re-transmitting a duplicate packet, the link layer of Node 3 updates the duplicate packet table with the last 20 packets received.

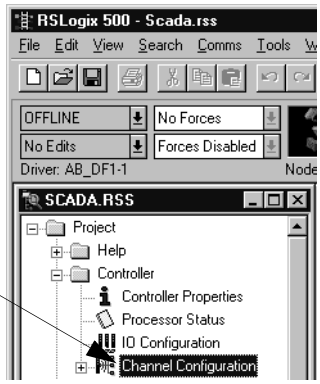
Figure 3.6 Store & Forward Table for Node 2



Configuring a Station on a Point-to-Point Link

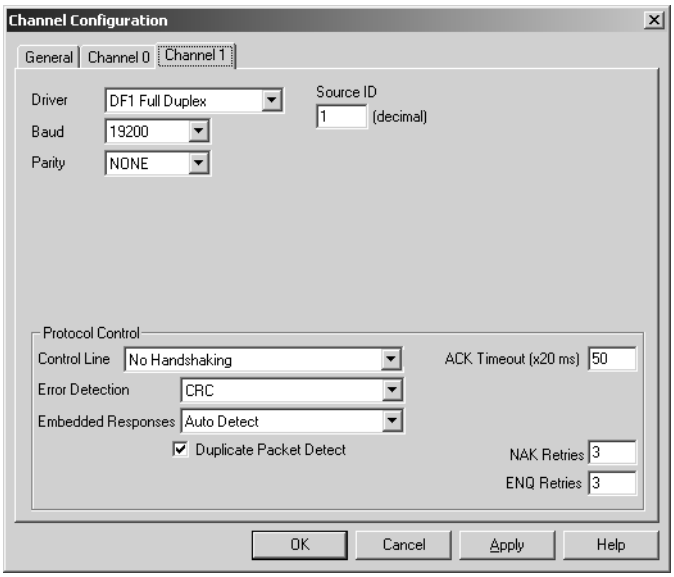
To configure the processor for point-to-point communication, follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



2. On the Channel tab, choose DF1 Full-Duplex for your Driver.

3. Configure the communication driver characteristics according to Table 3.9.



Use Worksheet 3.4 MicroLogix 1100/1200/1500 DF1 Full-Duplex Point-to-Point Configuration (page D-12) for an example configuration and to record your station's configuration.

Define the communication parameters shown in Table 3.9 when configuring a MicroLogix 1100/1200/1500 controller for DF1 full-duplex communication.

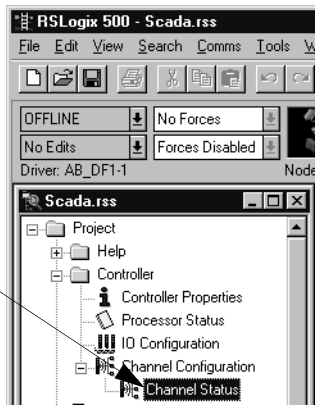
Table 3.9 Configuring a MicroLogix 1100/1200/1500 controller for DF1 Full-Duplex Communication

Parameter	Selections
Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
Source ID	This is the address, in decimal, that is used as the source address in any message initiated by this controller.
Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If you are using full-duplex modems, choose FULL-DUPLEX MODEM (RTS ON). See page 3-8 for descriptions of the control line operation settings.
Error Detection	With this selection, you choose how the controller checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
Embedded Responses	To use embedded responses, choose Enabled. If you want the controller to use embedded responses only when it detects embedded responses from another device, choose Auto-detect. If you are communicating with another Allen-Bradley device, choose Enabled. Embedded responses increase network traffic efficiency.
Duplicate Packet Detect	Duplicate Detect lets the controller detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
ACK Timeout	The amount of time, in 20 millisecond increments, that you want the controller to wait for an acknowledgment to the message it has sent before sending an enquiry (ENQ) for the reply.
NAK Retries	The number of times the controller will resend a message packet because the processor received a NAK response to the previous message packet transmission.
ENQ Retries	The number of enquiries (ENQs) that you want the controller to send after an ACK timeout occurs.

DF1 Full-Duplex Channel Status

Channel Status data is stored in the Channel Status Function file. Table 3.10 on page 3-35 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status Icon Located beneath the Configuration icon to bring up the Channel Status screen.



2. See Table 3.10 for details concerning the DF1 Full-Duplex Channel Status Screen.

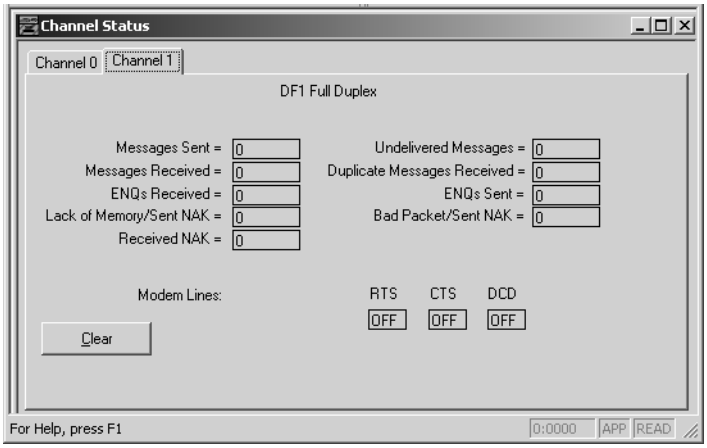


Table 3.10 Understanding The DF1 Full-Duplex Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Messages Sent	CSx:10	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	CSx:11	The number of messages received with no errors
ENQs Received	CSx:15	The number of ENQs received by the processor
Lack of Memory/Sent NAK	CSx:14	The number of times the processor could not receive a message because it did not have available memory
Received NAK	CSx:17	The number of NAKs received by the processor
Undelivered Messages	CSx:12	The number of messages that were sent by the processor but not acknowledged by the destination device

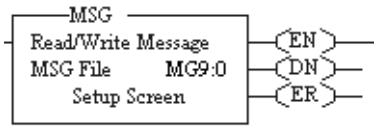
Table 3.10 Understanding The DF1 Full-Duplex Status Screen Fields

Status Field	Communication Status Function File Location[2]	Definition
Duplicate Messages Received	CSx:18	The number of times the processor received a message packet identical to the previous message packet
ENQs Sent	CSx:13	The number of ENQs sent by the processor
Bad Packet/Sent NAK	CSx:16	The number of incorrect data packets received by the processor for which a NAK was returned
RTS (Request to Send)	CSx:9/1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	CSx:9/0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)[1]	CSx:9/3	The status of the DCD handshaking line (received by the processor)

(1) Only present on the MicroLogix 1500 LRP channel 1.

(2) The channel number equals x.

DF1 Messaging



Messaging can occur between:

- a master station and a slave station
- a slave station and its master station (See Polled Report-by-Exception)
- slave stations or between two processors connected via a radio modem point-to-multipoint or full-duplex point-to-point link

Master Station to Slave Station

A MicroLogix 1100/1200/1500 master station communicates with the slave stations that are connected to it via modems in a point-to-multipoint configuration. A master station sends a slave station message to receive status or issue commands. For sample messaging ladder logic to use as a guide when using Standard or Message-based Polling Modes, see page E-2.

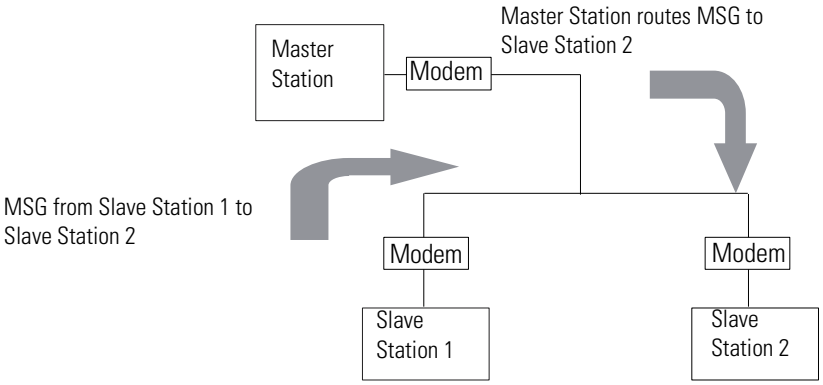
Polled Report-by-Exception

Slave stations can gather information from the I/O points they are responsible for and can send any anomalous readings to the master station. To do this, write ladder logic in the slave station to monitor certain conditions and send the data in an MSG instruction to the master station. For sample messaging ladder logic to use as a guide when using a MicroLogix 1100/1200/1500 as a Slave, see page E-6.

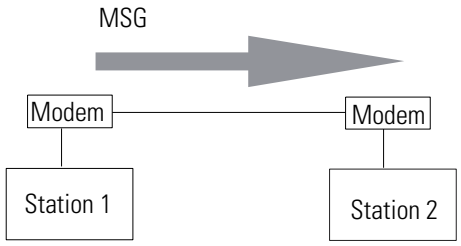
Processor-to-Processor

A processor-to-processor message can be the following types:

- In a general **point-to-multipoint** configuration, the messaging would be between slave stations; the master station automatically routes the message.



- In a **radio modem point-to-multipoint** or a **point-to-point** configuration, the messaging would be between the two connected peer devices.



The configuration of the network (point-to-multipoint vs. point-to-point) and the configuration of the station (master, slave, or peer) does not affect how you configure an MSG instruction. That is, an MSG instruction being sent between two MicroLogix slave stations is configured the same as an MSG instruction between two MicroLogix processors connected point-to-point, which is configured the same as an MSG instruction between a MicroLogix master station and a MicroLogix slave station. See Example MSG Control Blocks starting on page 3-42.

Considerations When Configuring MSG Control Blocks

Keep the following considerations in mind when configuring messages between a MicroLogix 1100/1200/1500 controller and other processors.

For both Point-to-Multipoint and Point-to-Point Link Configurations

- All MicroLogix 1100/1200/1500 controllers have the capability to initiate and reply to PLC-5-type read and write messages by choosing PLC-5 as the Target Device. Use this for both PLC-5 and Logix processors.
- The maximum read or write message for a MicroLogix 1100/1200/1500 controller is 103 words.
- The maximum read or write message to a MicroLogix 1000 is 41 words.

Minimum Master MSG Block Message Timeout

Once the master ACK timeout is determined (see page 3-14), then a minimum MSG block Message Timeout value can be determined. This value is calculated differently depending on the master polling mode.

Message-based Polling Mode

Message based polling mode messages are executed serially - each message in the queue must complete as done, or in error, before the next message in the queue is executed. For this mode, the minimum MSG Timeout should be:

Maximum number of simultaneously triggered MSG instructions * [The sum of ACK Timeouts due to the maximum number of Message Retries for each queued-up message + Reply Message Wait timeout] = The minimum MSG Timeout

Realize that if the Message Retries is set for the default (3), then the number of ACK Timeout periods is (3)*2+1=7 (message, poll, retry_1, poll, retry_2, poll, retry_3), because a poll packet is sent between every Message Retry.

However, the slave may still respond to retry 3 with an ACK just before the ACK Timeout period expires, and the master would poll after the Reply Message timeout period for the reply...which could take approximately another ACK Timeout period to receive.

Therefore, for message-based polling mode, set the MSG Timeout value to at least:

# of MSG instructions * [2*(Message_Retries+1) * ACK Timeout + Reply Message Timeout] = The minimum MSG Timeout

To continue the example, if Message Retries is configured for 3, ACK Timeout is configured for 16 * 20 ms = 320, and Reply Message Timeout is configured for 1* 20 ms, the MSG Timeout value would be:

$$1 * \left[2\,(3+1) \qquad .320 \text{ seconds} + .02 \right] \qquad 2.58 \text{ seconds}$$

Round up the MSG Timeout value to the nearest second (3)

If five MSG instructions were triggered at the same time, each MSG would need a timeout value of 5*2.58 = 12.9, which would be rounded up to 13 seconds.

TIP Leave the Message Retries at default (3) unless you have an extremely error free or error prone network.

Standard Polling Mode

For standard polling mode, the transmission of messages by the master can occur anywhere in the poll scan. This means that the master might transmit a message to station A just after it has completed polling station A as part of the poll scan. In this worst case scenario, it will take almost an entire poll scan before station A will be polled again and can reply to the master message so that the message can complete done or in error. In standard polling mode, the MSG Timeout should be at least as long as this maximum poll scan.

The maximum poll scan = The minimum MSG timeout

Standard Polling Mode With Single Message Transfer

For standard polling mode with single message transfer per poll scan, the maximum poll scan would be achieved when every slave had a maximum-sized message packet to transmit when polled. Recall that the ACK Timeout is calculated as being just long enough for the master to receive a maximum sized message packet, so the maximum poll scan time would be approximately:

$$\text{The number of slave stations} * \text{ACK Timeout} = \text{The maximum single message transfer poll scan time} = \text{The minimum MSG Timeout}$$

Therefore, if there are 10 slave stations and the ACK Timeout is 320 ms, then the maximum single message transfer poll scan time would be:

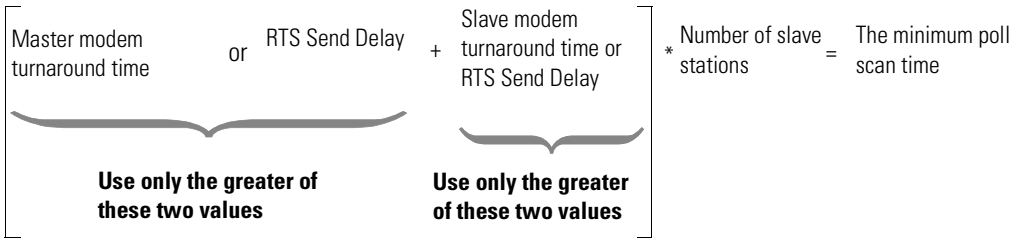
$$10 \text{ (slave stations)} * .320 \text{ seconds} = 3.20 \text{ seconds}$$

Round up the MSG Timeout value to the nearest second (4)

Standard Polling Mode With Multiple Message Transfer

For standard polling mode with multiple message transfer per poll scan, the maximum poll scan would be achieved when every slave had multiple maximum-sized message packets to transmit when polled. If the worst case scenario is 2 maximum-sized message packet to transmit, then the maximum poll scan time is approximately 2 times the maximum single message transfer poll scan time plus the minimum poll scan time.

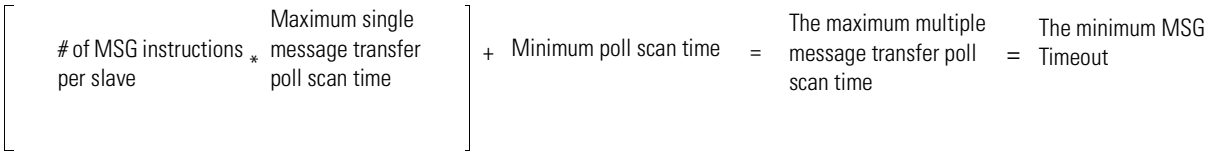
The minimum poll scan time occurs when the master sends out a 4 byte poll packet to each slave and in return receives a 2 byte response from each slave. This time is approximately the master modem turnaround time or RTS Send Delay (whichever is greater) plus the slave modem turnaround time or RTS Send Delay (whichever is greater), multiplied by the number of slave stations in the poll range.



For example, if the master modem turnaround time and RTS Send Delay are both 0 ms, and the slave modem turnaround time is 50 ms and RTS Send Delay is 60 ms, the minimum poll scan time would be:

0 + 60 ms * 10 (slave stations) = 600 ms

To finish the example:



2 = (3.20 seconds) + .600 seconds = 7 seconds

For this example, the MSG Timeout value should be at least 7 seconds.

Minimum Slave MSG Block Message Timeout

The minimum slave MSG Block Message Timeout should allow for the Master to go through Message Retries plus one number of maximum poll scans before timing out. Therefore, the minimum MSG Block

Message Timeout value should be at least (Slave Channel Poll Timeout) * (Slave channel Message Retries + 1), rounded up to the next whole second.

TIP Leave the Message Retries at default (3) unless you have an extremely error free or extremely error prone network.

Minimum Slave MSG Block Message Timeout = (Slave channel Poll Timeout)*(Slave Channel Message Retries + 1)

Minimum Radio Modem MSG Block Message Timeout

The minimum radio modem MSG Block Message Timeout should allow for the end-to-end transmission of the command going out and the reply coming back over the radio modem network, including time through repeaters and/or store and forward nodes.

TIP The default MSG Block Message Timeout is 5 seconds but for most radio modem configurations, this can be reduced to 2 seconds.

Minimum Point-to-Point MSG Block Message Timeout

The minimum point-to-point MSG Block Message Timeout should allow for the processor to go through Message Retries plus one ACK time out. Therefore, the minimum MSG Block Message Timeout value should be at least (ACK Timeout) * (Channel Message Retries + 1), rounded up to the next whole second.

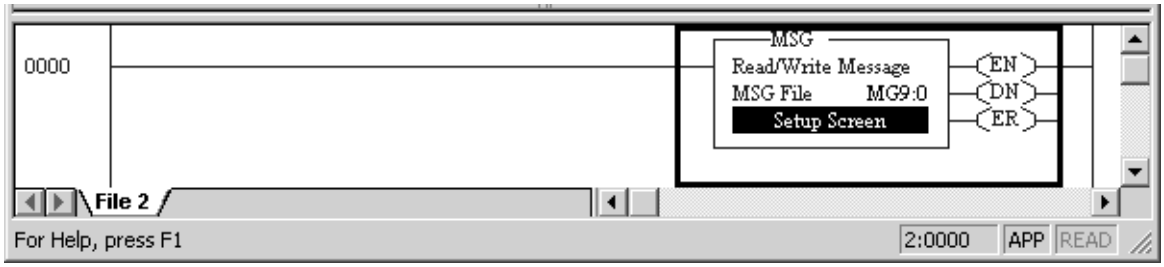
Minimum Point-to-Point MSG Block Message Timeout = (ACK Timeout)*(Channel Message Retries + 1)

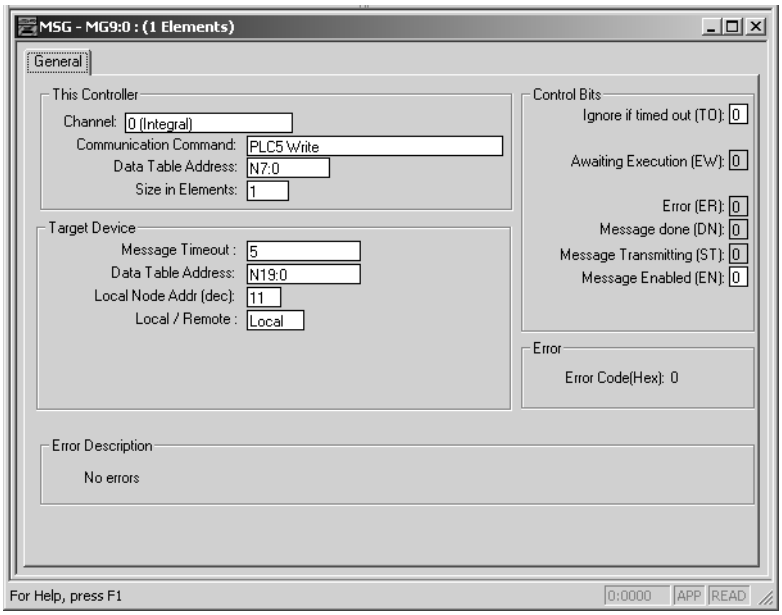
TIP Leave the channel Message Retries at default (3) unless you have an extremely error free or extremely error prone network.

Example MSG Control Blocks

Application	See page
MicroLogix 1100/1200/1500 write message to a PLC-5 or Logix controller	3-42
MicroLogix 1100/1200/1500 read message to a PLC-5 or Logix controller	3-43
MicroLogix 1100/1200/1500 write message to another SLC 500 or MicroLogix controller	3-44
MicroLogix 1100/1200/1500 read message to another SLC 500 or MicroLogix controller	3-45

Figure 3.7 Write MSG from an MicroLogix 1100/1200/1500 controller to a PLC-5 Processor or Logix Controller

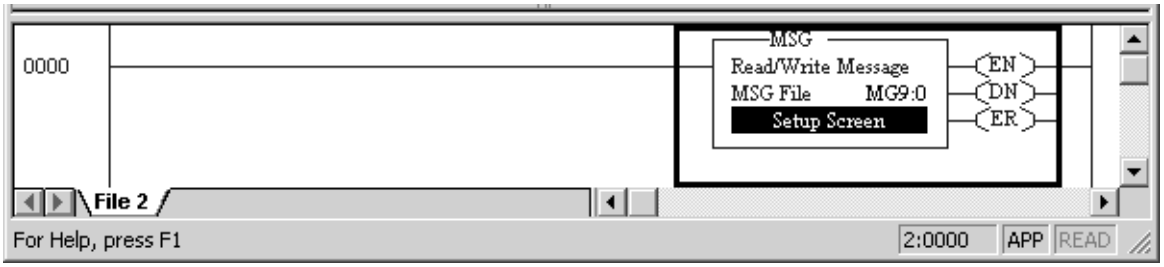


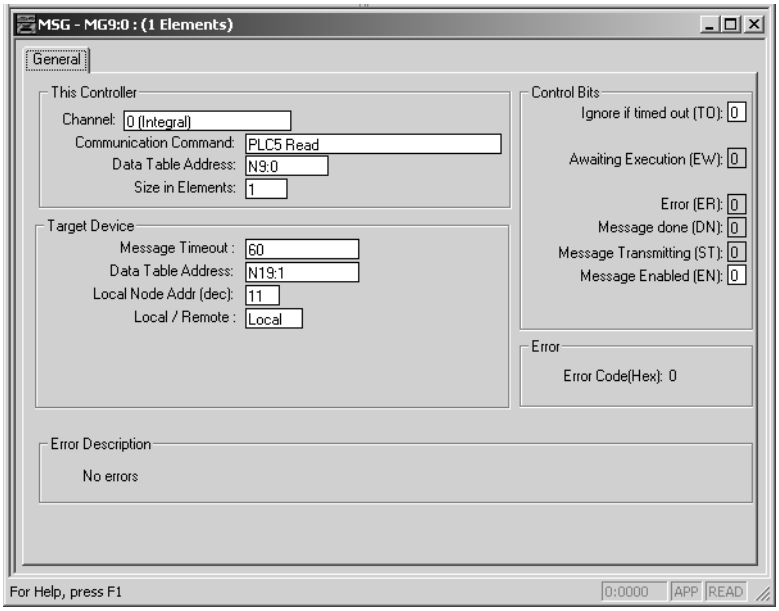


This MSG example tells the MicroLogix 1100/1200/1500 master station to write the information from its N7:0 through its serial port to the PLC-5 slave station 11_{10}. The data's destination is N19:0 of the PLC-5

slave station. For a Logix slave station, a tag name would have to already have been mapped to N19.

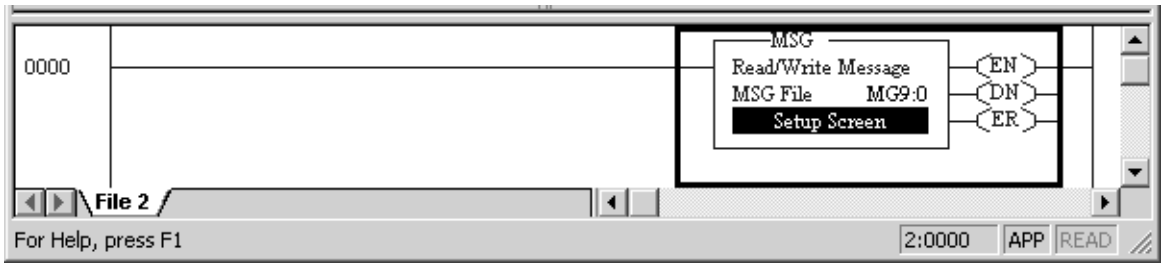
Figure 3.8 Read MSG from a MicroLogix 1100/1200/1500 controller to a PLC-5 Processor or Logix Controller.

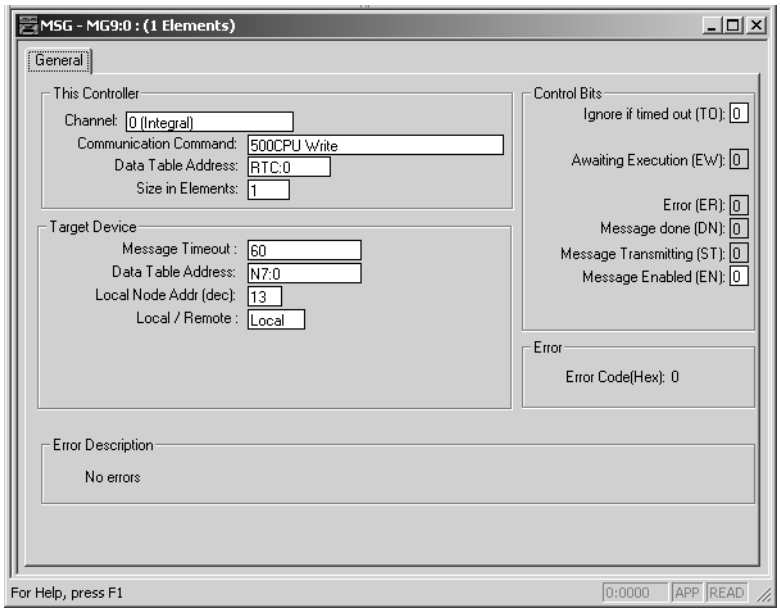




This MSG example tells the MicroLogix 1100/1200/1500 master station to read the information from PLC-5 slave station 11_{10}'s N19:1 and place the information in master station file N9:0. For a Logix slave station, a tag name would have to already have been mapped to N19.

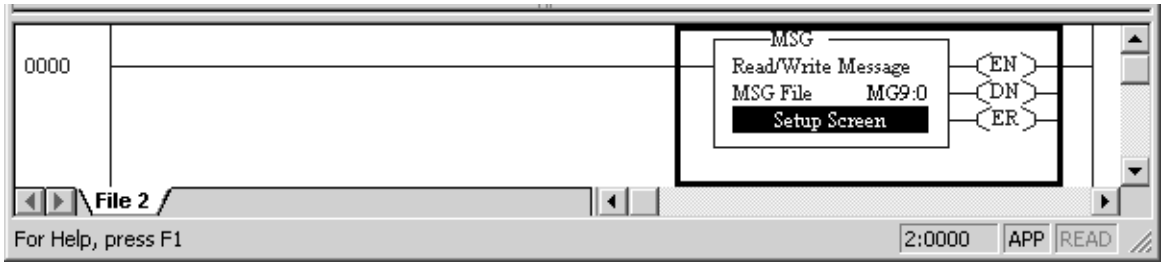
Figure 3.9 Write MSG from a MicroLogix 1100/1200/1500 controller to an SLC 500 or MicroLogix Controller

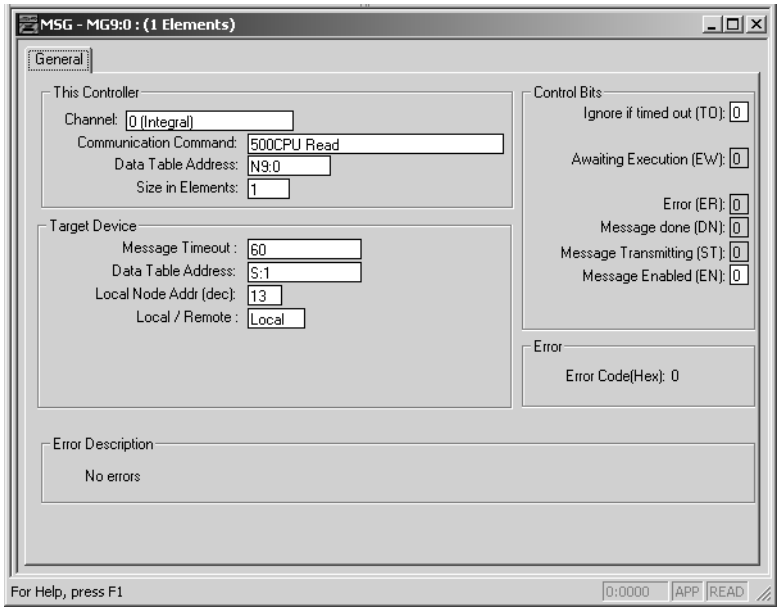




In this example, the MicroLogix master station is issuing a write request through its serial port to SLC station 13_{10}. The master station wants to write the information from RTC:0 into station 13_{10}'s file N7:0.

Figure 3.10 Read MSG from a MicroLogix 1100/1200/1500 controller to an SLC 500 or MicroLogix Controller





In this example, the MicroLogix master station is issuing a read request through its serial port to SLC station 13_{10}. The master station reads the information from station 13_{10}'s file S:1 and puts that information into its own N9:0 file.

Modbus RTU Protocol

This section provides the configuration parameters for Modbus RTU (Remote Terminal Unit transmission mode) protocol. For more information about the Modbus RTU protocol, see the Modbus Protocol Specification (available from http://www.modbus.org).

The driver can be configured as Modbus RTU Master or Modbus RTU Slave. The Modbus RTU Slave driver maps the four Modbus data types; coils, contacts, input registers, and holding registers, into four binary and/or integer data table files created by the user.

Modbus RTU Master

TIP Modbus RTU Master driver can be used with the following controllers:

- All MicroLogix 1100
- MicroLogix 1200, FRN 8 and higher
- MicroLogix 1500, FRN 9 and higher

Message instructions are used to transfer information between the data files in the Modbus RTU Master and the Modbus RTU Slaves.

Modbus addressing is limited to 16 bits per memory group, each with a range of 1 to 65,536. There are four memory groups, one for each function:

- coils (generally addressed as 0xxxx)
- contacts (1xxxx)
- input registers (3xxxx)
- holding registers (4xxxx)

Coils and contacts are addressed at the bit level. Coils are like outputs and can be read and written to. Contacts are like inputs and are read-only. Input registers and holding registers are addressed at the word level. Input registers are generally used for internally storing input values. They are read-only. Holding registers are general purpose and can be both read and written to.

The most significant digit of the address is considered a prefix, and does not get entered into the Modbus Data Address field when configuring the message instruction.

When the message is sent, the address is decremented by 1 and converted into a 4-character hex number to be transmitted via the network (with a range of 0-FFFFh); the slave increments the address

by 1, and selects the appropriate memory group based on the Modbus function.

TIP

Modbus protocol may not be consistently implemented in the field. The Modbus specification calls for the addressing range to start at 1; however, some devices start addressing at 0.

The Modbus Data Address in the Message Setup Screen may need to be incremented by one to properly access a Modbus slave's memory, depending on that slave's implementation of memory addressing.

Modbus RTU Slave

TIP

Modbus RTU Slave driver can be used with the following controllers:

- All MicroLogix 1100 controllers
- All MicroLogix 1200 controllers
- MicroLogix 1500 1764-LSP Series B and higher
- All MicroLogix 1500 1764-LRP

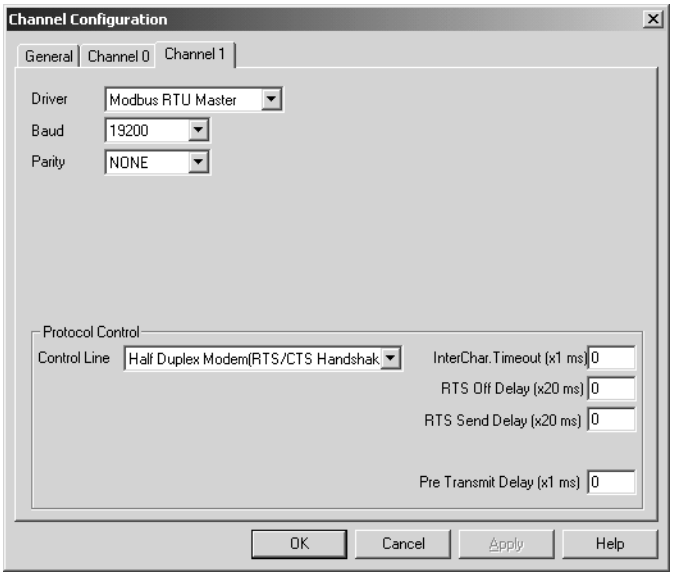
The coil and contact files can contain up to 4096 coils or contacts in each register when the data table file is configured for a maximum size of 256 words. Each input register and holding register file can contain up to 256 registers when the data table file is configured for a maximum size of 256 words. With the Expanded box checked, the controllers can be specifically configured to up to six 256-word data table files for a total of 1536 Modbus Holding registers.

TIP

A request to access a group of holding registers that span across two files is permitted. Note that the maximum number of registers in a command does not allow for more than two files to be accessed during a single Modbus command.

Modbus RTU Master Configuration

Select the Modbus RTU Master from the Channel Configuration menu as shown below.



The Baud defaults to 19200.

The Control Line can be configured as:

- No Handshaking
- Full-Duplex Modem (RTS on)
- Half-Duplex Modem (RTS/CTS handshaking)

The Protocol Control defaults are:

- No Handshaking
- InterChar. Timeout = 0
- Pre Transmit Delay = 0

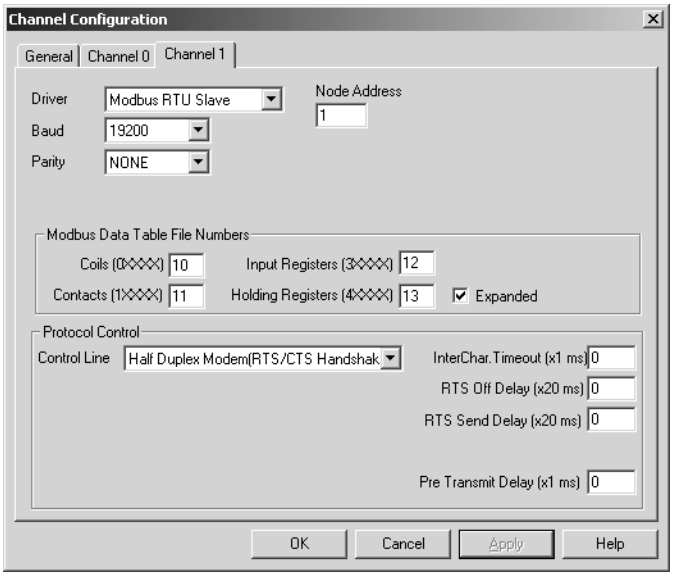
When the system driver is Modbus RTU Master, the following communication port parameters can be changed.

Modbus RTU Master Configuration

Parameter	Options	Programming Software Default
Channel	MicroLogix 1200 FRN 8 and higher: Channel 0 MicroLogix 1100 MicroLogix 1500 FRN 9 and higher: Channel 0 or 1	0 0 0 (LSP) or 1 (LRP)
Driver	Modbus RTU Master	
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even, odd	none
Control Line	No Handshaking, Full-Duplex Modem (RTS on), Half-Duplex Modem (RTS/CTS handshaking)	No Handshaking
Inter-character Timeout (x1 ms)	0 to 65535 (can be set in 1 ms increments); 0 = 3.5 character times Specifies the minimum delay between characters that indicates the end of a message packet.	0
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.	0
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.	0
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) When the Control Line is set to No Handshaking, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs 2 ms of delay time to change from receive to transmit mode. When the Control Line is set to Half-Duplex Modem or Full-Duplex Modem, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.	0

Modbus RTU Slave Configuration

The Modbus RTU Slave configuration screen and configuration procedure are shown below:



1. To set up Channel 0 and data files for Modbus communication, select the Channel 0 Configuration tab. For the 1764-LRP only, you can select either Channel 0 or Channel 1.

2. Choose 'Modbus RTU Slave' driver and assign driver characteristics.

3. Enter Modbus Data Table File Numbers. Select the Expansion check box to utilize multiple holding register data files. (All MicroLogix 1100, MicroLogix 1200 Series C FRN6 and higher, and MicroLogix 1500 Series C FRN7 and higher only. Requires RSLogix 500 version 5.50 or higher to program.)

TIP

The controller default is one data file of 256 registers. The Expansion check box enables an additional five files and 1280 holding registers.

The five additional tables do not need to be individually defined, but sequentially follow the first integer or bit file. For example, if the first file is N10 (or B10), then the additional five files will be N11 (or B11), N12 (or B12), N13 (or B13), N14 (or B14), and N15 (or B15).

4. Enter the data table size and type for each required file. The data table file(s) (not including the five additional tables if Expanded is checked) will be created automatically.

When the system driver is Modbus RTU Slave, you can change the following communication port parameters as listed below.

Modbus Slave Memory Map

Parameter	Options	Programming Software Default
Channel	MicroLogix 1200: Channel 0 MicroLogix 1100: Channel 0 MicroLogix 1500 1764-LSP Series B and higher: Channel 0 and 1 MicroLogix 1500 1764-LRP: Channel 0	0 (1200, 1100 & LSP) 1 (LRP)
Driver	Modbus RTU Slave	
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even, odd	none
Node Address	1 to 247 decimal	1
Control Line	No Handshaking, Half-Duplex Modem (RTS/CTS Handshaking)	No Handshaking
Inter-character Timeout (x1 ms)	0 to 65535 (can be set in 1 ms increments); 0 = 3.5 character times Specifies the minimum delay between characters that indicates the end of a message packet.	0
Modbus Data Table File Number Assignment (Must be Binary or Integer file type)	Coils (Discrete outputs, Modbus addresses 0001 to 4096) range = 3 to 255, 0 = no file	0
	Contacts (Discrete inputs, Modbus addresses 10001 to 14096) range = 3 to 255, 0 = no file	0
	Input Registers (Read Only, Modbus addresses 30001 to 30256) range = 3 to 255, 0 = no file	0
	Holding Registers (Read/Write, Modbus addresses 40001 to 40256) range = 3 to 255, 0 = no file	0
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.	0
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.	0
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) When the Control Line is set to No Handshaking, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs 2 ms of delay time to change from receive to transmit mode. When the Control Line is set to Half-Duplex Modem, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.	0

The Modbus memory map is summarized in the table above and detailed in the table on the next page.

Modbus Addressing	Description	Valid MicroLogix Addressing		
		File Type	Data File Number	Address
0001 to 4096	Read/Write Modbus Coil Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
10001 to 14096	Read-Only Modbus Contact Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
30001 to 30256	Read-Only Modbus Input Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
30501 to 30532	Modbus Communication Parameters	Communication Status File	-	-
31501 to 31566	Read-Only System Status File space	Status (S)	2	words 0 to 65
40001 to 40256	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
40257 to 41280(1)	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255 of four Holding Register files
41501 to 41566	Read/Write System Status File space	Status (S)	2	words 0 to 65
41793 to 42048(1)	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255 of the last Holding Register file

(1) These addresses only become active when specially configured for expanded holding registers.

Modbus Addressing	Modbus Address Reference	Modbus Function Code (decimal)
0001 to 4096	Read/Write Modbus Coil Data space	1, 5, 15
10001 to 14096	Read Only Modbus Contact Data space	2
30001 to 30256	Read Modbus Input Register space	4
30501	Modbus Data Table Coil File Number	4
30502	Modbus Data Table Contact File Number	4
30503	Modbus Data Table Input Register File Number	4
30504	Modbus Data Table Holding Register File Number	4
30506	Pre-Send Delay	4
30507	Modbus Slave Address	4
30508	Inter-character Timeout	4
30509	RTS Send Delay	4
30510	RTS Off Delay	4
30511	Parity	4
30512	Presentation Layer Error Code	4
30512	Presentation Layer Error Code	4
30513	Presentation Layer Error Count	4
30514	Executed Function Code Error	4
30515	Last Transmitted Exception Code	4
30516	File Number of Error Request	4

Modbus Addressing	Modbus Address Reference	Modbus Function Code (decimal)
30517	Element Number of Error Request	4
30518	Function Code 1 Message Counter - Read Single Output Coil	4
30519	Function Code 2 Message Counter - Read Discrete Input Image	4
30520	Function Code 3 Message Counter - Read Single Holding Register	4
30521	Function Code 4 Message Counter - Read Single Input Register	4
30522	Function Code 5 Message Counter - Set/Clear Single Output Coil	4
30523	Function Code 6 Message Counter - Read/Write Single Holding Register	4
30524	Function Code 8 Message Counter - Run Diagnostics	4
30525	Function Code 15 Message Counter - Set/Clear for Block of Output Coils	4
30526	Function Code 16 Message Counter - Read/Write for Block of Holding Registers	4
30527	Modem Status	4
30528	Total messages responded to by this slave	4
30529	Total messages to this Slave	4
30530	Total Messages Seen	4
30531	Link Layer Error Count	4
30532	Link Layer Error	4
31501 to 31566	Read Only System Status File	4
40001 to 40256	Read/Write Modbus Holding Register space (1st Holding Register file).	3, 6, 16
40257 to 40512	Read/Write Modbus Holding Register space (2nd Holding Register file).	3, 6, 16
40513 to 40768	Read/Write Modbus Holding Register space (3rd Holding Register file).	3, 6, 16
40769 to 41024	Read/Write Modbus Holding Register space (4th Holding Register file).	3, 6, 16
41025 to 41280	Read/Write Modbus Holding Register space (5th Holding Register file).	3, 6, 16
41501 to 41566	Read/Write System Status File	3, 6, 16
41793 to 42048	Read/Write Modbus Holding Register space (6th Holding Register file).	3, 6, 16

Modbus Commands

The controller configured for Modbus RTU Slave responds to the Modbus command function codes listed in the table starting below.

Command	Function Code (decimal)	Subfunction Code (decimal)
Read Coil Status	1	-
Read Input Status	2	-
Read Holding Registers	3	-
Read Input Registers	4	-

Command	Function Code (decimal)	Subfunction Code (decimal)
Write Single Coil(1)	5	-
Write Single Holding Register(1)	6	-
Echo Command Data	8	0
Clear Diagnostic Counters	8	10
Write Multiple Coils(1)	15	-
Write Multiple Holding Registers(1)	16	-

(1) Broadcast is supported for this command.

The controller configured for Modbus RTU Master can initiate messages using the Modbus command function codes listed in the following table.

Command	Function Code (decimal)	Subfunction Code (decimal)
Read Coil Status	1	-
Read Input Status	2	-
Read Holding Registers	3	-
Read Input Registers	4	-
Write Single Coil(1)	5	-
Write Single Holding Register(1)	6	-
Write Multiple Coils(1)	15	-
Write Multiple Holding Registers(1)	16	-

(1) Broadcast is supported for this command.

Modbus Error Codes

Upon receiving a Modbus command that is not supported or improperly formatted, the controller configured for Modbus RTU Slave will respond with one of the exception codes listed in the first table starting on the next page.

Upon receiving a Modbus reply with an exception code, the controller configured for the Modbus RTU Master posts a MSG error code listed in the second table on the following page.

:

Error Code	Error	Description	Transmitted Exception Code(1)
0	No error.		none
1	Function Code cannot Broadcast.	The function does not support Broadcast.	nothing transmitted
2	Function Code not supported.	The controller does not support this Modbus function or subfunction.	1
3	Bad Command Length.	The Modbus Command is the wrong size.	3
4	Bad Length.	The function attempted to read/write past the end of a data file.	3
5	Bad parameter	The function cannot be executed with these parameters.	1
6	Bad File Type	The file number being referenced is not the proper file type.	2
7	Bad File Number	The file number does not exist	2
8	Bad Modbus Address	The function attempted to access an invalid Modbus address.(2)	3
9	Table Write protected	The function attempted to write to a read-only file.	3
10	File Access Denied	Access to this file is not granted.	2
11	File Already Owned	Data file is already owned by another process.	2

(1) If Modbus Command is sent with a valid Broadcast address, then no exception reply will be sent for Error Codes 2 through 11.

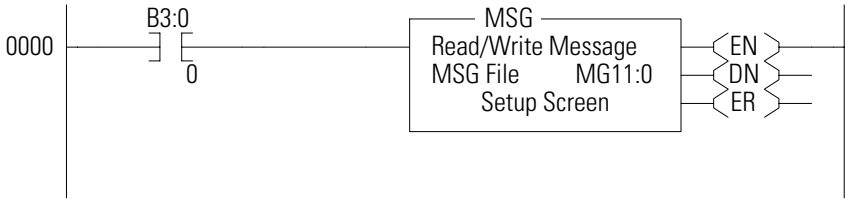
(2) Refer to page 3-51 for valid Modbus memory mapping.

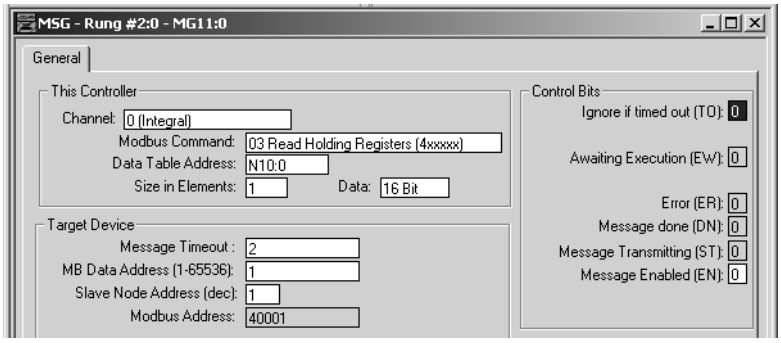
Error Code	Error	Description	Received Exception Code
81	Illegal Function	The function code sent by the Master is not supported by the slave or has an incorrect parameter.	1
82	Illegal Data Address	The data address referenced in the Master command does not exist in the slave, or access to that address is not allowed.	2
83	Illegal Data Value	The data value being written is not allowed, either because it is out of range, or it is being written to a read-only address.	3
84	Slave Device Failure	An unrecoverable error occurred while the slave was attempting to perform the requested action.	4
85	Acknowledge	The slave has accepted the request, but a long duration of time will be required to process the request.	5
86	Slave Device Busy	The slave is currently processing a long-duration command.	6
87	Negative Acknowledge	The slave cannot perform the program function received in the command.	7
88	Memory Parity Error	The slave attempted to read extended memory, but detected a parity error in the memory.	8
89	Non-standard Error Code	An error code greater than 8 was returned by the slave.	>8

Configuring a Modbus Message

This section describes how to configure a local message using the Modbus communication commands. Since configuration options are dependent on which channel is selected, the programming software has been designed to only show the options available for the selected channel.

Before configuring the MSG instruction, open the Channel Configuration screen as shown below and set the Driver to Modbus RTU Master. For more information on Channel Configuration, see Modbus RTU Master Configuration in appendix E.





Rung 0 shows a standard RSLogix 500 message (MSG) instruction preceded by conditional logic.

1. Access the message setup screen by double-clicking Setup Screen.
2. The RSLogix 500 Message Setup Screen appears. Use this screen to setup or monitor message parameters for 'This Controller', 'Target Device', and 'Control Bits'. Descriptions of each of these sections follow.

This Controller Parameters

If a Channel configured for Modbus Master is selected in the Channel field of the Message Setup Screen, the following Modbus Command options will become available:

- 01 Read Coil Status (0xxxx)
- 02 Read Input Status (1xxxx)
- 03 Read Holding Registers (4xxxx)
- 04 Read Input Registers (3xxxx)
- 05 Write Single Coil (0xxxx)
- 06 Write Single Register (4xxxx)
- 15 Write Multiple Coils (0xxxx)
- 16 Write Multiple Registers (4xxxx)

Local file types must be Binary (B) or Integer (N) for Modbus commands. In addition, 32-bit holding register commands (3 and 16) allow Floating Point (F) and Long (L) local file types.Starting data table address for coil/input bit commands (1, 2, 5 and 15) require a bit address. Starting data table addresses for register commands (3, 4, 6 and 16) require a word address.

Size in elements defaults to 1. For coil/input commands (1, 2, 5 and 15), elements are in bits. For 16-bit register commands (3, 4, 6 and 16), elements are in words. For 32-bit holding register commands (3 and 16), elements are 32 bits long.

Target Device

Message timeout is specified in seconds. If the target does not respond within this time period, the message instruction will generate a specific error. The amount of time that is acceptable should be based on application requirements and network capacity/loading. A 2-second message timeout is generally sufficient, as long as only one message is triggered at a time.

The default Modbus Data Address is 1. The Range is 1 to 65,536.

The default Slave Node Address is 1. The Range is 0 to 247. Zero is the Modbus broadcast address and is only valid for Modbus write commands (5, 6, 15 and 16).

Data Logging

Data Logging is supported by the MicroLogix 1100 and MicroLogix 1500 LRP. It allows you to capture (store) application data as a record for retrieval at a later time. Each record is stored in a user-configured queue in battery backed memory. Records are retrieved from the processor via communications. This section explains how Data Logging is configured and used.

This section contains the following topics:

- Queues and Records
- Configuring Data Log Queues
- DLG - Data Log Instruction
- Data Log Status File
- Retrieving (Reading) Records

Queues and Records

The MicroLogix 1100 controller has 128K bytes (128 x 1024) and the MicroLogix 1500 LRP has 48K bytes (48 x 1024) of additional memory for data logging purposes. Within this memory, you can define up to 256 (0 to 255) data logging queues. Each queue is configurable by size (maximum number of records stored) and by length (each record is 1 to 80 characters). The length and the maximum number of records determine how much memory is used by the queue. You can choose to have one large queue or multiple small queues.

The memory used for data logging is independent of the rest of the processor memory and cannot be accessed by the User Program. Each record is stored as the instruction is executed and is non-volatile (battery-backed) to prevent loss during power-down.

Example Queue 0

This queue is used to show how to calculate the string length of each record and maximum number of records.

Table 3.11 Queue 0 (Date = ✔, Time = ✔, Delimeter =)

	Date		Time		N7:11		L14:0		T4:5.ACC		I1:3.0		B3:2
Record 0	01/10/2000	,	20:00:00	,	2315	,	103457	,	200	,	8190	,	4465
Record 1	01/10/2000	,	20:30:00	,	2400	,	103456	,	250	,	8210	,	4375
Record 2	01/10/2000	,	21:00:00	,	2275	,	103455	,	225	,	8150	,	4335
Record 3	01/10/2000	,	21:30:00	,	2380	,	103455	,	223	,	8195	,	4360
Record 4	01/10/2000	,	22:00:00	,	2293	,	103456	,	218	,	8390	,	4375
Record 5	01/10/2000	,	22:30:00	,	2301	,	103455	,	231	,	8400	,	4405
Record 6	01/10/2000	,	23:00:00	,	2308	,	103456	,	215	,	8100	,	4395
Record 7	01/10/2000	,	23:30:00	,	2350	,	103457	,	208	,	8120	,	4415
Record 8	01/11/2000	,	00:00:00	,	2295	,	103457	,	209	,	8145	,	4505
Record 9	01/11/2000	,	00:30:00	,	2395	,	103456	,	211	,	8190	,	4305
Record 10	01/11/2000	,	01:00:00	,	2310	,	103455	,	224	,	8195	,	4455
Record 11	01/11/2000	,	01:30:00	,	2295	,	103456	,	233	,	8190	,	4495

String Length of Record

The size of a record is limited so that the length of the maximum formatted string does not exceed 80 characters. The following table can be used to determine the formatted string length.

Data	Memory Consumed	Formatted String Size
delimiter	0 bytes	1 character
word	2 bytes	6 characters
long word	4 bytes	11 characters
date	2 bytes	10 characters
time	2 bytes	8 characters

For queue 0, the formatted string length is 59 characters, as shown below:

Data	Date		Time		N7:11		L14:0		T4:5.ACC		I1:3.0		I1:2.1
Characters	10	1	8	1	6	1	11	1	6	1	6	1	6

= 10 + 1 + 8 + 1 + 6 + 1 + 11 + 1 + 6 + 1 + 6 + 1 + 6
= 59 characters

Number of Records

Using Queue 0 as an example, each record consumes:

Record Field	Memory Consumption
Date	2 bytes
Time	2 bytes
N7:11	2 bytes
L14:0	4 bytes
T4:5.ACC	2 bytes
I1:3.0	2 bytes
B3:2	2 bytes
Integrity Check	2 bytes
Total	**18 bytes**

In this example, each record consumes 18 bytes. So if one queue was configured, the maximum number of records that could be stored would be 2730. The maximum number of records is calculated by:

Maximum Number of Records = Data Log File Size/Record Size
= 48K bytes/18 bytes
= (48)(1024)/18
= 2730 records

Example Queue 5

Table 3.12 Queue 5 (Time = ✔, Delimiter = TAB)

	Time		N7:11		I1:3.0		I1:2.1
Record 0	20:00:00	TAB	2315	TAB	8190	TAB	4465
Record 1	20:30:00	TAB	2400	TAB	8210	TAB	4375
Record 2	21:00:00	TAB	2275	TAB	8150	TAB	4335
Record 3	21:30:00	TAB	2380	TAB	8195	TAB	4360
Record 4	22:00:00	TAB	2293	TAB	8390	TAB	4375
Record 5	22:30:00	TAB	2301	TAB	8400	TAB	4405
Record 6	23:00:00	TAB	2308	TAB	8100	TAB	4395

String Length of Record

The size of a record is limited so that the length of the maximum formatted string does not exceed 80 characters. The following table can be used to determine the formatted string length.

Data	Memory Consumed	Formatted String Size
delimiter	0 bytes	1 character
word	2 bytes	6 characters
long word	4 bytes	11 characters
date	2 bytes	10 characters
time	2 bytes	8 characters

For queue 5, the formatted string length is 29 characters, as shown below:

Data	Time		N7:11		I1:3.0		I1:2.1
Characters	8	1	6	1	6	1	6

= 8 + 1 + 6 + 1 + 6 + 1 + 6 = 29 characters

Number of Records

Using Queue 5 as an example, each record consumes:

Record Field	Memory Consumption
Time	2 bytes
N7:11	2 bytes
I1:3.0	2 bytes
I1:2.1	2 bytes
Integrity Check	2 bytes
Total	**10 bytes**

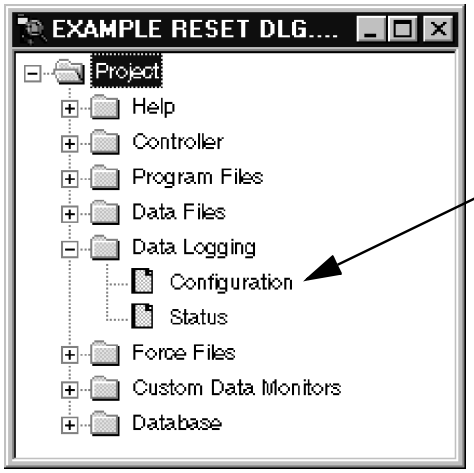
Each record consumes 10 bytes. So if only one queue was configured, the maximum number of records that could be stored would be 4915. The maximum number of records is calculated by:

Maximum Number of Records = Data Log File Size/Record Size
= 48K bytes/10 bytes
= (48)(1024)/10
= 4915 records

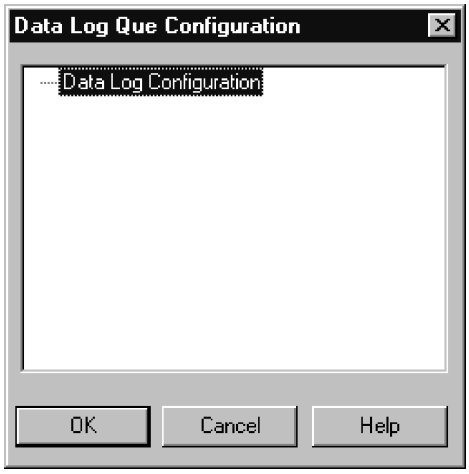
Configuring Data Log Queues

Data Logging is configured using RSLogix 500 programming software version V4.00.00 or later.

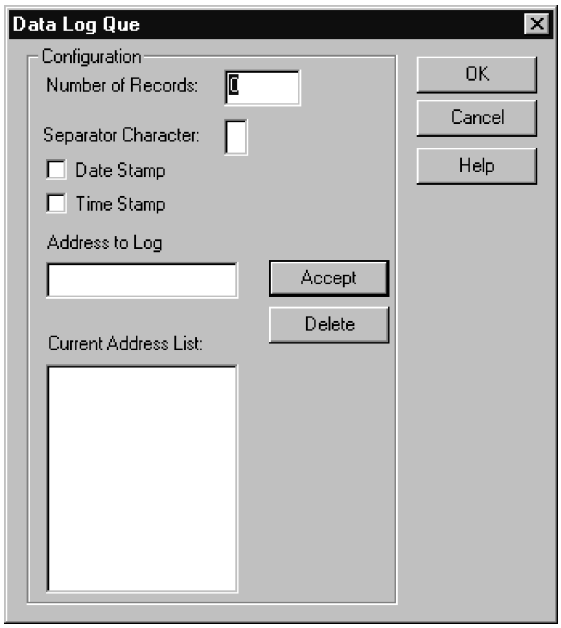
1. Open a MicroLogix 1100 or MicroLogix 1500 LRP application. The first step in using Data Logging is to configure the data log queue(s). Access to this function is provided via the RSLogix 500 Project tree:



2. The Data Log Que window appears. Double-click on Data Log Configuration.



3. The Data Log Que dialog box appears as shown below. Use this dialog box to enter the queue information.



Enter the following information:

Data Log Queue Configuration Parameter	Description
Number of Records	Defines the number of records (data sets) in the queue.
Separator Character	Choose the character to act as the separator for the data in this queue (tab, comma, or space). The separator character may be the same or different for each queue configured.
Date Stamp (optional)	if selected, the date is recorded in mm/dd/yyyy format(1).
Time Stamp (optional)	if selected, the time is recorded in hh:mm:ss format(1).
Address to Log	Enter the address of an item to be recorded and click on *Accept* to add the address to the *Current Address List*. The address can be any 16 or 32-bit piece of data.
Current Address List	This is the list of items to be recorded. Record size can be up to 80 bytes. You can use the *Delete* button to remove items from this list. See page 3-59 for information on record size.
A record consists of configured Date Stamp, Time Stamp, Current Address List, and Separator Characters.	

(1) If the real-time clock is not present on the controller and Date Stamp and Time Stamp are selected (enabled), the date is recorded as 00/00/0000 and the time as 00:00:00.

4. After entering all the information for the data log queue, click on OK. The queue is added to the Data Log Que window with a corresponding queue number. This is the queue number to use in the DLG instruction.

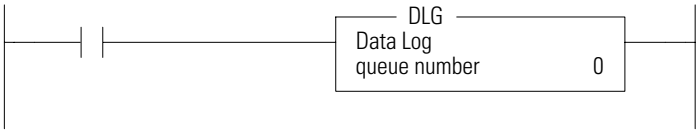
DLG - Data Log Instruction

IMPORTANT You must configure a data log queue before programming a DLG instruction into your ladder program.

The DLG instruction triggers the saving of a record. The DLG instruction has one operand:

Queue Number - Specifies which data log queue captures a record.

The DLG instruction only captures data on a false-to-true rung transition. The DLG rung must be reset (scanned false) before it will capture data again. Never place the DLG instruction alone on a rung. It should always have preceding logic, as shown below:



Data Log Status File

There is a Data Log Status (DLS) file element for each Data Log Queue. The DLS file does not exist until a data log queue has been configured.

The Data Log Status file has 3-word elements. Word 0 is addressable by bit only through ladder logic. Words 1 and 2 are addressable by word and/or bit through ladder logic.

The number of DLS file elements depends upon the number of queues specified in the application. The status bits and words are described below.

Table 3.13 Data Log Status (DLS) File Elements

	Control Element															
Word	**15**	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	EN(1)	0	DN(2)	OV(3)	0	0	0	0	0	0	0	0	0	0	0	0
1	FSZ = File Size (number of records allocated)															
2	RST = Records Stored (number of records recorded)															

(1) EN = Enable Bit

(2) DN = Done Bit

(3) OV = Overflow Bit

Data Logging Enable (EN)

When the DLG instruction rung is true, the Data Logging Enable (EN) is set (1) and the DLG instruction records the defined data set. To address this bit in ladder logic, use the format: DLS0:Q/EN, where Q is the queue number.

Data Logging Done (DN)

The Data Logging Done (DN) bit is used to indicate when the associated queue is full. This bit is set (1) by the DLG instruction when the queue becomes full. This bit is cleared when a record is retrieved from the queue. To address this bit in ladder logic, use the format: DLS0:Q/DN, were Q is the queue number.

Data Logging Overflow (OV)

The Data Logging Overflow (OV) bit is used to indicate when a record gets overwritten in the associated queue. This bit is set (1) by the DLG instruction when a record is overwritten. Once set, the OV bit remains set until you clear (0) it. To address this bit in ladder logic, use the format: DLS0:Q/OV, where Q is the queue number.

File Size (FSZ)

File Size (FSZ) shows the number of records that are allocated for this queue. The number of records is set when the data log queue is configured. FSZ can be used with RST to determine how full the queue is. To address this word in ladder logic, use the format: DLS0:Q.FSZ, where Q is the queue number.

Records Stored (RST)

Records Stored (RST) specifies how many data sets are in the queue. RST is decremented when a record is read from a communications device. To address this word in ladder logic, use the format: DLS0:Q.RST, where Q is the queue number.

TIP If a queue is full and another record is saved, the oldest record is over-written. Queue behavior is the same as a FIFO stack—first in, first out. If a queue is full and an additional record is saved, the 'first' record is deleted.

DLS information can be used in the following types of instructions:

Instruction Type	Operand
Relay (Bit)	Destination Output Bit
Compare	Source A
	Source B
	Low Limit (LIM instruction)
	Test (LIM instruction)
	High Limit (LIM instruction)
	Source (MEQ instruction)
	Mask (MEQ instruction)
	Compare (MEQ instruction)
Math	Source A
	Source B
	Input (SCP instruction)
Logical	Source A
	Source B
Move	Source

Retrieving (Reading) Records

Data is retrieved from a data logging queue by sending a logical read command that addresses the Data Log retrieval file. The oldest record is retrieved first and then, deleted. The record is deleted as soon as it is queued for transmission. If there is a power failure before the transmission is complete, the record is lost.

The data is retrieved as an ASCII string with the following format:

<date><UDS><time><UDS><1st Data><UDS><2nd Data><UDS>…<UDS><Last Data><NUL>

- where:
  <date> = mm/dd/yyyy - ASCII characters (date is optional)
  <time> = hh:mm:ss - ASCII characters (time is optional)
  <UDS> = User Defined Separator (TAB, COMMA, or SPACE)
  <X Data> = ASCII decimal representation of the value of the data
  <NUL> = record string is null terminated
- If the Real Time Clock module is not present in the controller, <date> is formatted as 00/00/0000, and <time> is formatted as 00:00:00.
- The Communications Device determines the number of sets of data that have been recorded but not retrieved.
- The controller performs a the data integrity check for each record. If the data integrity check is invalid, a failure response is sent to the Communications Device. The data set is deleted as soon as the failure response is queued for transmission.

TIP For easy use with Microsoft Excel, use the TAB character as the separator character.

Accessing the Retrieval File

You can use a dedicated retrieval tool or create your own application.

Retrieval Tools

There are a number of retrieval tools designed for use with Palm OS, Windows® CE, Windows 9x, and Windows NT®. You can download these free tools from our web site. Visit http://www.ab.com/micrologix.

Information for Creating Your Own Application

Controller Receives Communications Packet

Table 3.14 Command Structure

DST	SRC	CMD 0f	STS	TNS	FNC A2	Byte Size	File No.	File Tpe	Ele. No.	S/Ele. No.

Field	Function	Description
DST	Destination Node	
SRC	Source Node	
CMD	Command Code	
STS	Status Code	Set to zero (0)
TNS	Transaction Number	Always 2 bytes
FNC	Function Code	
Byte Size	Number of bytes to be read	Formatted string length (see equation below)
File Number		Always set to zero (0)
File Type		Must be A5 (hex)
Element Number	Queue number	Determines the queue to be read (0 to 255)
Sub/Element Number		Always set to zero (0)

Table 3.15 Equation

Record Field 1	+ Record Field 2	+ Record Field 3	. . .	+ Record Field 7	=	Formatted String Length

Table 3.16 Record Field Sizes

Data Type	Maximum Size
Word	7 bytes (characters)
Long Word	12 bytes (characters)
Date Field	11 bytes (characters)
Time Field	9 bytes (characters)

TIP The formatted string length cannot exceed 80 bytes in length.

TIP The last byte will be a zero value representing the terminator character.

Controller Responds with Reply

Table 3.17 Reply Structure

SRC	DST	CMD 4f	STS	TNS	DATA	EXT STS

Field	Function	Description
SRC	Source Node	
DST	Destination Node	
CMD	Command Code	
STS	Status Code	
TNS	Transaction Number	Always 2 bytes
DATA		Formatted string

If the data integrity check fails, the record is deleted and an error is sent with STS of 0xF0 and ext STS of 0x0E.

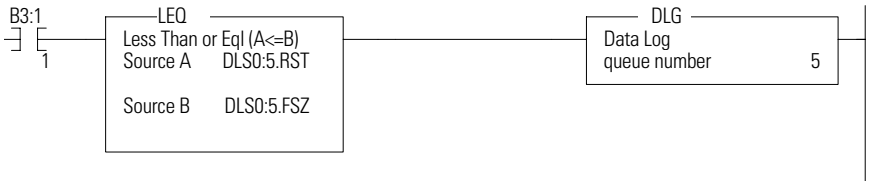
For more information on writing a DF1 protocol, refer to Allen-Bradley publication 1770-RM516, *DF1 Protocol and Command Set Reference Manual* (available from www.theautomationbookstore.com).

Conditions that Will Erase the Data Retrieval File

IMPORTANT The data in the retrieval file can only be read once. Then it is erased from the processor.

The following conditions will cause previously logged data to be lost:

- Program download from RSLogix 500 to controller.
- Memory Module transfer to controller except for Memory Module autoload of the same program.
- Full Queue - when a queue is full, new records are recorded over the existing records, starting at the beginning of the file. You can put the following rung in your ladder program to prevent this from happening:



Configuring SLC 5/03, 5/04, and 5/05 Processors

Chapter Objectives

This chapter helps you set up an SLC 5/03, 5/04, or 5/05 processor as a master station, as a slave station, as a radio modem station, or as a station on a point-to-point link.

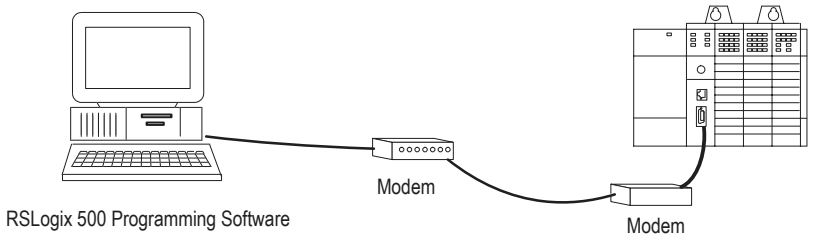
For information about	See page
an overview of the tasks required to configure an SLC 5/03, 5/04, or 5/05 processor	4-2
installing the processor	4-2
using modems that support DF1 communication protocols	4-3
modem control line operation	4-5
configuring DF1 half-duplex channel 0 parameters	4-8
configuring the processor as a DF1 half-duplex master station using standard communication	4-10
configuring the processor as a DF1 half-duplex master station using message-based communication	4-18
configuring the processor as a slave station	4-22
configuring channel 0 poll timeout	4-25
configuring the processor as a radio modem station	4-27
configuring the processor for point-to-point communication	4-33
the types of messages you can send from an SLC 5/03, 5/04, or 5/05 processor to another processor; how to configure the MSG instruction and some configuration characteristics	4-37
example MSG control blocks	4-43

Overview

To configure an SLC 5/03, 5/04, or 5/05 processor:

1. Install the processor; connect the serial cable to channel 0.
2. Define the processor's communication characteristics using RSLogix 500 programming software.
3. Install and configure the modem for communication with the processor; connect the modem to the processor's serial channel.

Figure 4.1 Configuring an SLC 5/03, 5/04 or 5/05 Processor

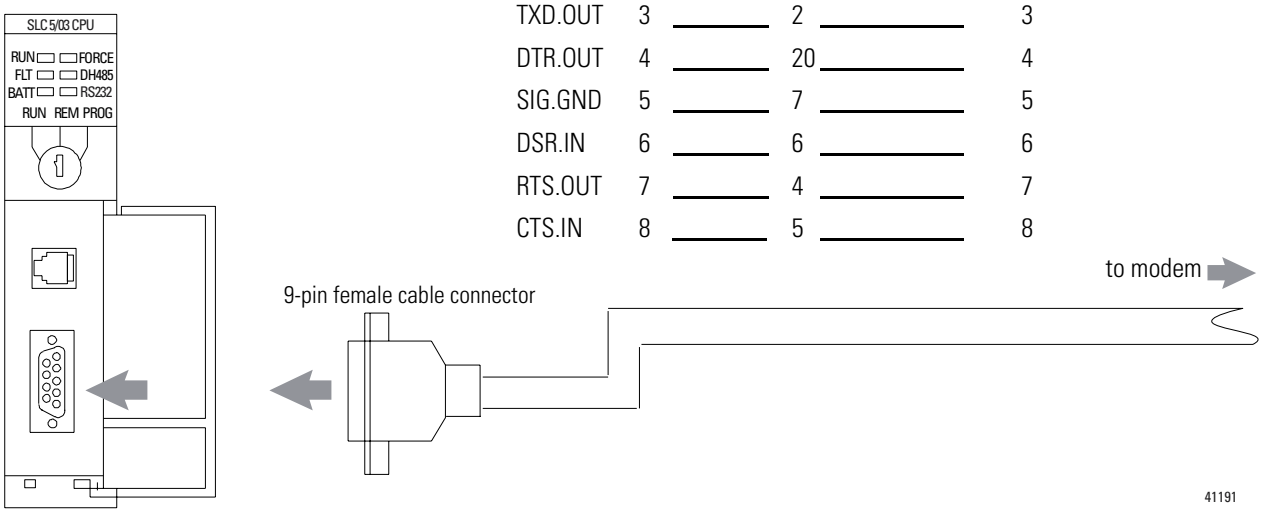


Installing the Processor

For details about installing the processor into an I/O chassis, see the SLC 500 Modular Hardware Style User Manual, publication 1747-UM011. Cable pinouts are shown in each example configuration as well as in Appendix A.

Figure 4.2 SLC 5/03, 5/04, 5/05 Serial Port Pin Assignments

9-pin female			25-pin		9-pin
DCD.IN	1		8		1
RXD.IN	2		3		2
TXD.OUT	3		2		3
DTR.OUT	4		20		4
SIG.GND	5		7		5
DSR.IN	6		6		6
RTS.OUT	7		4		7
CTS.IN	8		5		8



Using Modems that Support DF1 Communication Protocols

The types of modems that you can use with SLC processors include dial-up phone modems, leased-line modems, radio modems and line drivers. For point-to-point full-duplex modem connections, use DF1 full-duplex protocol. For general point-to-multipoint modem connections, use DF1 half-duplex master and slave protocols. In this case, one (and only one) of the other devices must be configured for DF1 half-duplex master protocol. For most radio modem connections, use DF1 radio modem protocol.

IMPORTANT Do not attempt to use DH-485 protocol through modems under any circumstance.

Dial-up Phone Modems

Dial-up phone line modems support point-to-point full-duplex communications. Normally, an SLC processor on the initiating or receiving end of the dial-up connection, will be configured for DF1 full-duplex protocol with the control line parameter set for Full-Duplex Modem. See page 4-5 for details on the operation of the RS-232 modem control signals when Full-Duplex Modem is selected. See Chapter 11 for further details on using SLC processors in dial-up modem applications.

When an SLC processor is the initiator of the dial-up connection, use one of the ASCII write instructions to send out the AT dial-up string (for example ATDT 555-1212). The status file modem lost bit (S:5/14) provides the feedback that the connection has been successfully made. To hang up the connection, use the ASCII AHL instruction to temporarily lower the DTR signal.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be point-to-point topology supporting full-duplex communications between two modems or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology, configure the SLC processor for DF1 full-duplex protocol with the control line parameter set to Full-Duplex Modem. In the point-to-multipoint topology, configure the SLC processors for DF1 half-duplex master or slave protocol with the control parameter set to Half-Duplex Modem without Continuous Carrier. See page 4-6 for details on the operation

of the RS-232 modem control signals when Half-Duplex Modem without Continuous Carrier is selected.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either half-duplex or full-duplex communications, or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology using full-duplex radio modems, configure the SLC processors for DF1 radio modem protocol. In the point-to-multipoint topology using half-duplex radio modems, configure the SLC processors for DF1 radio modem protocol. If these radio modems require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem without Continuous Carrier.

Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Allen-Bradley's AIC+ Advanced Interface Converter is a line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet. In a point-to-point line driver topology, configure the SLC processor for DF1 radio modem protocol. In a point-to-multipoint line driver topology, configure the SLC processors for DF1 half-duplex master or slave protocol. If these line drivers require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem without Continuous Carrier.

Modem Control Line Operation

The following explains the operation of the SLC 5/03, 5/04 and 5/05 processors when you configure the RS-232 channel for the following applications.

DF1 Full-Duplex

When configured for DF1 full-duplex, the following control line operation takes effect:

No Handshaking Selected

DTR is always active (high) and RTS is always inactive (low). Receptions and transmissions take place regardless of the states of DSR, CTS, or DCD inputs. Only make this selection when the SLC 5/03, 5/04 and 5/05 processors are directly connected to another device that does not require handshaking signals.

Full-Duplex Modem Selected

DTR and RTS are always active except:

- If DSR goes inactive, both DTR and RTS are dropped for 1 to 2 seconds, then reactivated. The modem lost bit (S:5/14) is turned on immediately. While DSR is inactive, the state of DCD is ignored. Neither receptions nor transmissions are performed.
- If DCD goes inactive while DSR is active, then receptions are not allowed. If DCD remains inactive for 9 to 10 seconds, DTR is set inactive. At this point, the modem lost bit is also set. If DSR remains active, DTR is raised again in 5 to 6 seconds.

Reception requires DSR and DCD to be active. Transmission requires all three inputs (CTS, DCD, and DSR) to be active. Whenever DSR and DCD are both active, the modem lost bit is reset.

DF1 Half-Duplex Slave

When configured for DF1 half-duplex slave, the following control line operation takes effect:

No Handshaking Selected

DTR is always active and RTS is always inactive. Receptions and transmissions take place regardless of the states of DSR, CTS, or DCD inputs. Only make this selection when the processor is directly connected to another device that does not require handshaking signals.

Half-Duplex Modem with Continuous Carrier Selected

DTR is always active and RTS is only activated during transmissions (and any programmed delays before or after transmissions). The handling of DCD and DSR are exactly the same as with Full-Duplex Modem. Reception requires DSR and DCD to be active. Transmissions require CTS, DCD and DSR to be active. Whenever DSR and DCD are both active, the modem lost bit is reset.

Half-Duplex Modem without Continuous Carrier Selected

This is exactly the same as Half-Duplex Modem with Continuous Carrier except monitoring of DCD is not performed. DCD is still required for receptions, but is not required for transmissions. Transmissions still require CTS and DSR. Whenever DSR is active, the modem lost bit is reset.

DF1 Half Duplex Master

When configuring for DF1 half-duplex master, the following control line operation takes effect:

No Handshaking Selected

DTR is always active and RTS is always inactive. Receptions and transmissions take place regardless of the states of DSR, CTS, or DCD inputs. Only make this selection when the processor is directly connected to another device that does not require handshaking signals.

Full-Duplex Modem Selected

DTR and RTS are always active, except at the following times:

- If DSR goes inactive, both DTR and RTS are dropped for 1 to 2 seconds then reactivated. The modem lost bit (S:5/14) is turned on immediately. While DSR is inactive, the state of DCD is ignored. Neither receptions nor transmissions are performed.
- If DCD goes inactive while DSR is active, then receptions are not allowed. If DCD remains inactive for 9 to 10 seconds, then DTR is set inactive. At this point, the modem lost bit is also set. If DSR remains active, then DTR is raised again in 5 to 6 seconds.

Reception requires DSR and DCD to be active. Transmission requires all three inputs (CTS, DCD, and DSR) to be active. Whenever DSR and DCD are both active, the modem lost bit is reset.

Half-Duplex Modem without Continuous Carrier Selected

DTR is always active and RTS is only active during transmissions (and any programmed delays before and after transmissions). The processor does not monitor DCD.

If DSR goes inactive, RTS is dropped. The modem lost bit (S:5/14) is turned on immediately. While DSR is inactive, neither receptions nor transmissions are performed.

Reception requires DSR to be active. Transmission requires two inputs, CTS and DSR, to be active. Whenever DSR is active, the modem lost bit is reset.

DF1 Radio Modem

When you configure the SLC 5/03, SLC 5/04, and SLC 5/05 processors for DF1 Radio Modem, the following control line operation takes effect:

No Handshaking Selected

DTR is always active and RTS is always inactive. Receptions and transmissions take place regardless of the states of DSR, CTS, or DCD inputs. This selection should only be made when the processor is directly connected to another device that does not require handshaking signals.

Half-Duplex with Continuous Carrier Selected

DTR is always active. RTS is activated during transmission and during any programmed delays before or after transmissions. Programmed delays include RTS Send Delay and RTS Off Delay. The DSR input signal must remain active for transmissions or receptions to occur. The modem lost bit is set whenever DSR is inactive. The DCD input signal is ignored.

Transmission requires CTS and DSR to be active. If CTS is inactive at the onset of transmission, one second will be provided to wait for CTS to become active before the message packet is discarded.

Half-Duplex without Continuous Carrier Selected

DTR is always active. RTS is activated during transmissions and during any programmed delays before and after transmissions. Programmed delays include RTS Send Delay and RTS Off Delay. The DSR input signal must remain active for transmissions or receptions to occur. The modem lost bit is set whenever DSR is inactive. The DCD input signal is monitored to determine if transmissions are acceptable. If DCD is active, receptions are possible.

Transmission requires CTS and DSR to be active and DCD to be inactive. IF DCD is active at the onset of transmission, a configurable delay (DCD Wait Delay) will wait for DCD to become inactive before discarding the packet. If CTS is inactive at the onset of transmission, one second will be provided to wait for CTS to become active before the message packet is discarded.

Configuring DF1 Half-Duplex Channel 0 Parameters

RTS Send Delay and RTS Off Delay

Through your programming software, the parameters RTS Send Delay and RTS Off Delay give you the ability to set how long RTS is on prior to transmission, as well as how long to keep it on after transmission is complete. These parameters only apply when you select half-duplex modem with or without continuous carrier. For maximum communication throughput, leave these parameters at zero.

For use with half-duplex modems that require extra time to turnaround or key-up their transmitter even after they have activated CTS, the RTS Send Delay specifies (in 20 millisecond increments) the amount of delay time after activating RTS to wait before checking to see if CTS has been activated by the modem. If CTS is not yet active, RTS remains active, and as long as CTS is activated within one second, the transmission occurs. After one second, if CTS is still not activated, then RTS is set inactive and the transmission is aborted.

For modems that do not supply a CTS signal but still require RTS to be raised prior to transmission, jumper RTS to CTS and use the shortest delay possible without losing reliable operation.

If an RTS Send Delay of 0 is selected, then transmission starts as soon as CTS is activated. If CTS does not go active within one second after RTS is raised, RTS is set inactive and the transmission is aborted.

Certain modems will drop their carrier link when RTS is set inactive even though the transmission has not quite been finished. The RTS Off Delay parameter specifies in 20 millisecond increments the delay between when the last serial character is sent to the modem and when RTS is deactivated. This gives the modem extra time to transmit the last character of a packet.

ATTENTION

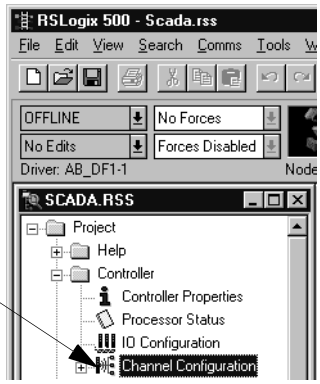
For almost all modem applications, the RTS Off Delay should be left at 0. Never Select an RTS Off Delay that is greater than the RTS Send Delay in the other devices on the network, or you may incur two devices trying to transmit simultaneously.

Configuring a Standard-Mode DF1 Half-Duplex Master Station

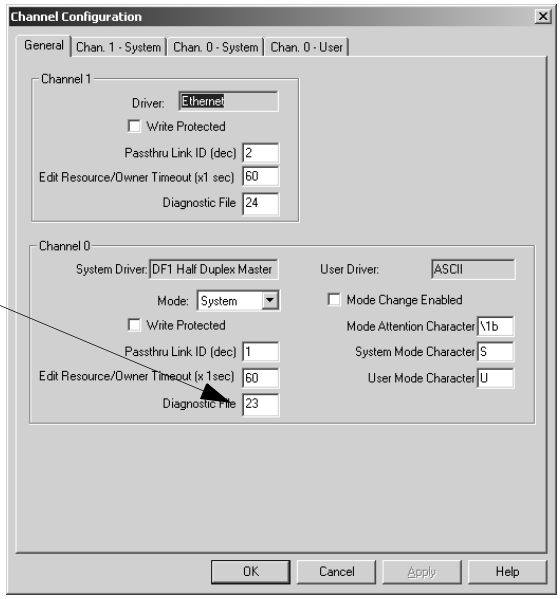
Choose standard mode if you want to query slave stations for information based upon user-configured polling ranges. This mode is used most often in general point-to-multipoint configurations.

To configure the processor for a master station using standard communication, place the processor into program mode and follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



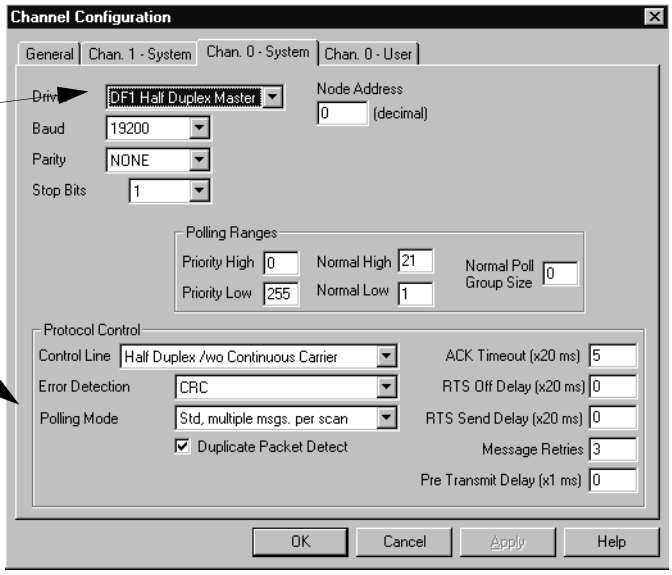
2. Define the location of the diagnostic file used for Channel Status here. For Channel Status details, see page 4-16.



3. On the Channel 0 tab, choose DF1 Half-Duplex Master for your Driver.

4. Choose a Standard Polling Mode.

5. Configure the rest of the communication driver characteristics according to See Table 4.1 on page 4-11.



Use Worksheet 4.1 (page D-14) for an example configuration and to record your station's configuration.

Table 4.1 shows the parameters for configuring an SLC 5/03, 5/04, or 5/05 processor as a master station using standard-communication mode to talk to slave stations.

Table 4.1 SLC 5/03, 5/04, or 5/05 Master Using Standard-Communication Mode

Tab	Parameter	Selections
General	Diagnostic File	SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 only. Select an unused file (9 to 255) to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 4.3 on page 4-16 for a file description.

Table 4.1 SLC 5/03, 5/04, or 5/05 Master Using Standard-Communication Mode

Tab	Parameter	Selections
Channel 0 System	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Stop Bits	Match the number of stop bits to the device with which you are communicating.
	Node Address	A node address identifies the processor on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0_{10} and 254_{10}. Node address255_{10} is the broadcast address, and cannot be selected as a station's individual address.
	Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex, choose FULL-DUPLEX MODEM. • If all the modems in the system are half-duplex, choose HALF-DUPLEX WITHOUT CONTINUOUS CARRIER. See page 4-5 for a description of the control line operation settings.
	Error Detection	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
	Polling Mode	If you want to receive: • only one message from a slave station per its turn, choose STANDARD (SINGLE MESSAGE TRANSFER PER NODE SCAN). Choose this method only if it is critical to keep the poll list scan time to a minimum. • as many messages from a slave station as it has, choose STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN).
	Duplicate Packet Detect	Duplicate Detect lets the SLC detect if it has received a message that is a duplicate of its most recent message from another station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.

Table 4.1 SLC 5/03, 5/04, or 5/05 Master Using Standard-Communication Mode

Tab	Parameter	Selections
Channel 0 System	ACK Timeout	The amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment to the message it has sent before the processor retries the message or the message errors out. This timeout value is also used for the poll response timeout. See page 4-13 for recommendations to minimize this value.
	RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero. See page 4-8 for further guidelines for setting this parameter.
	RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 4-8 for further guidelines for setting this parameter.
	Pre-Transmit Delay	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal.
	Message Retries	Defines the number of times a master station retries either: • a message before it declares the message undeliverable • or a poll packet to an active station before the master station declares that station to be inactive.
	Priority Polling Range – High	Select the last slave station address to priority poll.
	Priority Polling Range – Low	Select the first slave station address to priority poll. Entering 255 disables priority polling.
	Normal Polling Range – High	Select the last slave station address to normal poll.
	Normal Polling Range – Low	Select the first slave station address to normal poll. Entering 255 disables normal polling.
	Normal Poll Group Size	Enter the quantity of active stations located in the normal poll range that you want polled during a scan through the normal poll range before returning to the priority poll range. If no stations are configured in the Priority Polling Range, leave this parameter at 0.

Minimum DF1 Half-Duplex Master Channel 0 ACK Timeout

The governing timeout parameter to configure for a DF1 Half-Duplex Master is the channel 0 ACK Timeout. The ACK Timeout is the amount of time you want the processor to wait for an acknowledgment of its message transmissions. Set in 20 millisecond intervals, the value is the amount of time the master will wait for:

- an ACK to be returned by a slave when the master has just sent it a message, or
- a poll response or message to be returned by a slave when the master has just sent it a poll packet.

The timeout must be long enough that after the master has transmitted the last character of the poll packet, there is enough time for a slave to transmit (and the master receive) a maximum-sized packet before the time expires.

To calculate the minimum ACK timeout, you must know:

- the modem baud rate
- maximum-sized data packet (the maximum number of data words that a slave write command or read reply packet might contain)
- the RTS/CTS or turnaround delay of the slave modem
- the configured RTS Send Delay in the slave
- the program scan time of the slave

Determining Minimum Master ACK Timeout

To determine the minimum ACK Timeout, you must first calculate the transmission time by multiplying the maximum-sized data packet for your processor by the modem rate in ms/byte. For an example we will assume an SLC 5/03 processor (103 data words or 224 bytes total packet size including overhead) and a 9600 bps modem, which transmits at approximately 1 ms/byte. Therefore, the message transmission time is 224 ms. For approximate modem transmission rates, see the following table.

Table 4.2 Approximate Modern Transmission Rates

modem bps	approx. ms/byte
4800	2 ms/byte
9600	1 ms/byte
19200	0.5 ms/byte

Next, you need to determine the average slave program scan time. In RSLogix 500, double click on the Processor Status icon and then locate Average on the Scan Times tab. For this example, assume an average slave program scan time of 20 ms. Remember, program scan time will vary by application.

Finally, you must determine the larger of two values, either the configured slave RTS Send Delay or the turnaround time of the slave modem. The RTS Send Delay time can be found by double-clicking on the slave's Channel Configuration icon and looking at the Chan. 0 System tab of the Channel Configuration screen. Note that the RTS Send Delay time is in intervals of 20 ms, so with a value of 3 in the box, the RTS Send Delay time would be 20 ms multiplied by 3. Using this value (60 ms) for our example, and assuming that the turnaround time of the modem is 50 ms (which will vary by modem), you would choose to use the RTS Send Delay time of 60 ms for your calculation.

Having determined the maximum message transmission time (224 ms), the average slave program scan time (20 ms) and the largest of either RTS Send Delay (60 ms) or the modem turnaround time, the minimum ACK timeout is simply the sum of these values.

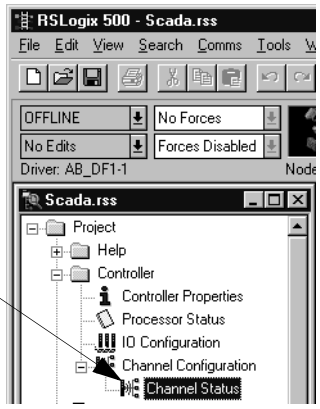
Parameter	Example Values (in ms)
Max message transmission time	224
Average program scan time	20
RTS Send Delay	60
modem turnaround time	50
calculated ACK Timeout	304
round up to nearest 20 ms	320

Use only the largest of these two values.

DF1 Half-Duplex Master Channel Status

Channel Status data is stored in the diagnostic file defined on the Channel 0 Configuration screen. Table 4.3 on page 4-16 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status Icon located beneath the Configuration icon to bring up the Channel Status interface.



2. See Table 4.3 for details concerning the DF1 Half-Duplex Master Channel Status interface.

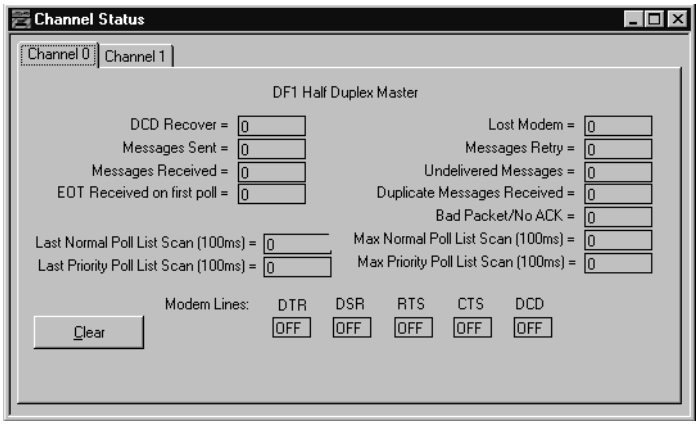


Table 4.3 Understanding the DF1 Half-Duplex Master Status Screen Fields

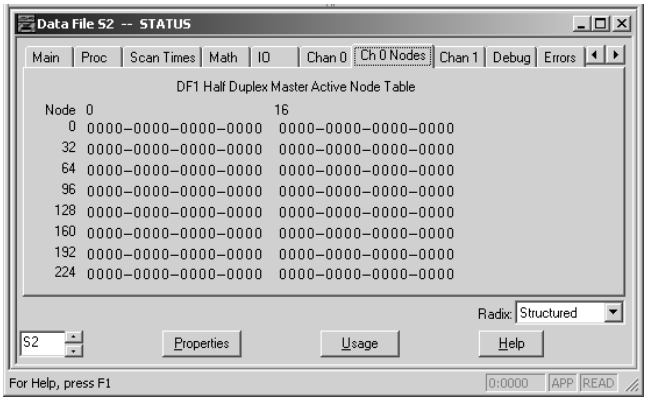
Status Field	Diagnostic File Location	Definition
DCD Recover	word 11	The number of times the processor detects the DCD handshaking line has gone low to high
Messages Sent	word 1	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	word 2	The number of messages received with no errors
EOT Received on First Poll	word 8	Not implemented
Last Normal Poll List Scan	word 5	Time in 100 ms increments of last scan through Normal Poll List
Last Priority Poll List Scan	word 10	Time in 100 ms increments of last scan through Priority Poll List
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Message Retry	word 4	The number of message retries sent by the processor

Status Field	Diagnostic File Location	Definition
Undelivered Messages	word 3	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet
Bad Packet/No ACK	word 7	The number of incorrect data packets received by the processor for which no ACK was returned
Max Normal Poll List Scan	word 6	Maximum time in 100 ms increments to scan the Normal Poll List
Max Priority Poll List Scan	word 13	Maximum time in 100 ms increments to scan the Priority Poll List
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

Monitor Active Stations

To see what stations are active, view the channel 0 active node table in the SLC 5/03, 5/04, or 5/05 processor status file (S:67/0-S:82/15). Each bit in the file represents a station on the link. The stations are numbered in order as a continuous bitstream file starting with the first bit in word S:67 (see the figure below).

Figure 4.3 Example Active Node Table



At powerup or after reconfiguration, the master station assumes that all slave stations are inactive. A station is shown active only after it responds to a poll packet.

Configuring a Message-based Mode DF1 Half-Duplex Master Station

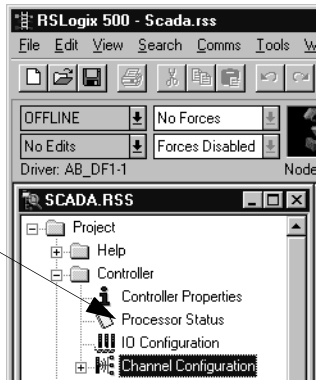
Choose message-based communication mode if you want to use MSG instructions in user programming to communicate with one station at a time. If your application uses satellite transmission or public switched telephone network transmission, consider choosing message-based. Communication to a slave station can be initiated on an as-needed basis.

Message-based communication should also be used in redundant SLC master station systems implemented with the 1746-BSN backup communication module.

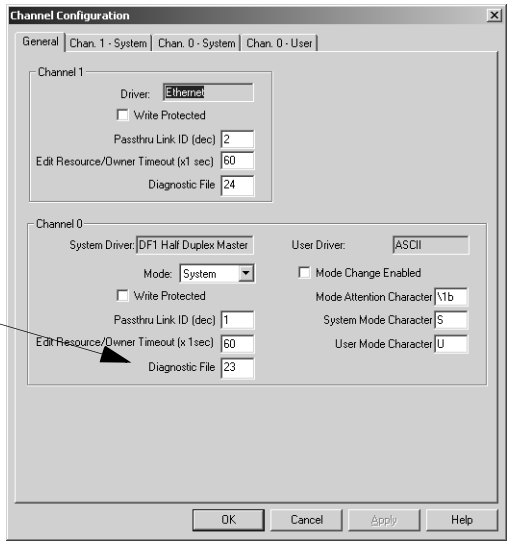
With message-based mode, you do not have an active node file that you can use to monitor station status. Also, you cannot implement slave station-to-slave station messaging or slave programming.

To configure the processor for a master station using message-based communication, place the processor in program mode and follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.



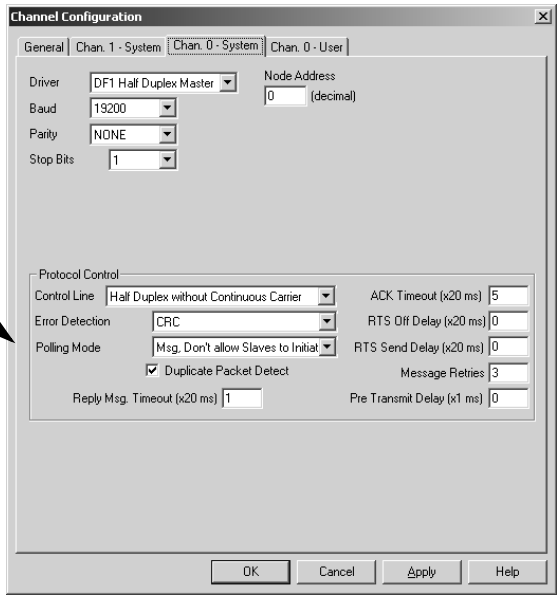
2. Define the location of the diagnostic file used for Channel Status here. For Channel Status details, see page 4-16.



3. On the Channel 0 tab, choose DF1 Half-Duplex Master for your Driver.

4. Choose a Message-based Polling Mode.

5. Configure the communication driver characteristics according to Table 4.4.



Use Worksheet 4.2 (page D-15) for an example configuration and to record your station's configuration.

Define the parameters shown in Table 4.4 when configuring an SLC 5/03, 5/04, or 5/05 processor as a master station using message-based communication mode to talk to slave stations.

Table 4.4 Configuring an SLC 5/03, 5/04, or 5/05 as a master and using message-based communication mode

Tab	Parameter	Selections
General	Diagnostic File	SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 only. Select an unused file (9 to 255) to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See See Table 4.3 on page 4-16 for a file description.
Channel 0 System	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Stop Bits	Match the number of stop bits to the devices with which you are communicating.
	Node Address	A node address identifies the processor on the DF1 half-duplex link. Each station on a link must have a unique address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, and cannot be selected as a station's individual address.
	Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex, choose FULL-DUPLEX. • If all the modems in the system are half-duplex, choose HALF-DUPLEX WITHOUT CONTINUOUS CARRIER. See page 4-5 for descriptions of control line operation settings.

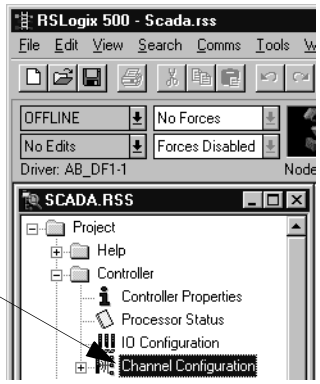
Table 4.4 Configuring an SLC 5/03, 5/04, or 5/05 as a master and using message-based communication mode

Tab	Parameter	Selections
Channel 0 System	Error Detection	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
	Polling Mode	If you want to: • accept unsolicited messages from slave stations, choose MESSAGE BASED (ALLOW SLAVES TO INITIATE MESSAGES) Slave station-initiated messages are acknowledged and processed after all master station-initiated (solicited) messages. **Note:** Slave stations can only send messages when they are polled. If the message-based master station never sends a slave station a message, the master station will never send the slave station a poll. Therefore, to regularly obtain a slave station-initiated message from a slave station, you should choose to use standard communication mode instead. • ignore unsolicited messages from slave stations, choose MESSAGE BASED (DO NOT ALLOW SLAVES TO INITIATE MESSAGES) Slave station-initiated messages are acknowledged and discarded. The master station acknowledges the slave station-initiated message so that the slave station removes the message from its transmit queue, which allows the next packet slated for transmission into the transmit queue.
	Duplicate Packet Detect	Duplicate Packet Detect lets the SLC detect if it has received a message that is a duplicate of its most recent message from another station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
	Reply Message Wait Timeout	Define the amount of time, in 20 millisecond increments, that the master station will wait after receiving an ACK (to a master-initiated message) before polling the slave station for a reply. Choose a time that is, at minimum, equal to the longest time that a slave station needs to format a reply packet. This would typically be the maximum scan time of the slave station.
	ACK Timeout	The amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment to the message it has sent before the processor retries the message or the message errors out. This timeout value is also used for the poll response timeout. See page 4-13 for recommendations to minimize this value.
	RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message but should normally be left at zero. See page 4-8 for further guidelines for setting this parameter.
	RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 4-8 for further guidelines for setting this parameter.
	Pre-Transmit Delay	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal.
	Message Retries	Defines the number of times a master station retries a message before it declares the message undeliverable.

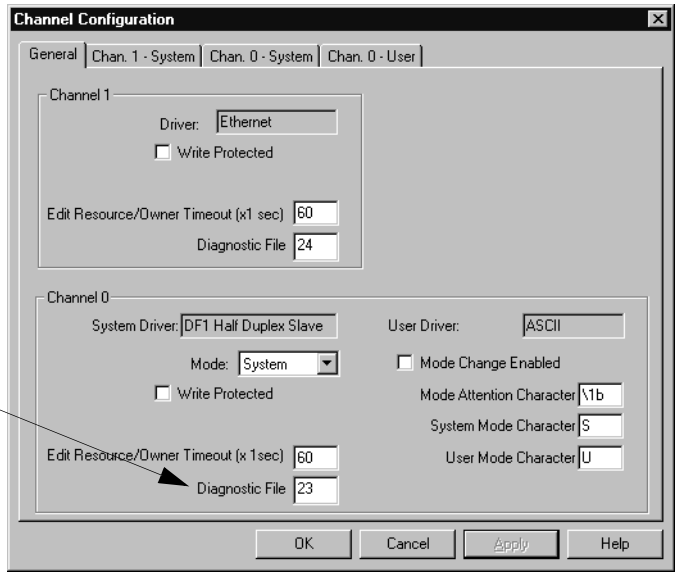
Configuring a Slave Station

To choose the processor as a slave station, follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.

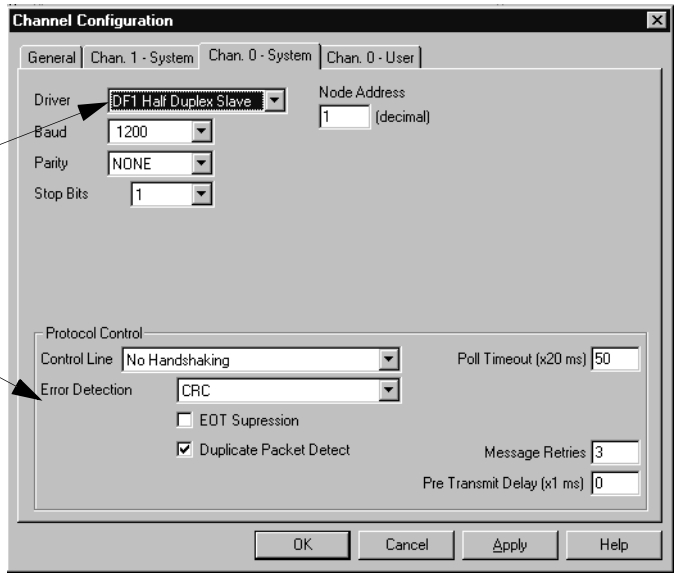


2. Define the location of the diagnostic file used for Channel Status here. For Channel Status details, see page 4-25.



3. On the Channel 0 tab, choose DF1 Half-Duplex Slave for your Driver.

4. Configure the communication driver characteristics according to Table 4.5.



Use Worksheet 4.3 (page D-16) for an example configuration and to record your station's configuration.

Define these parameters when configuring an SLC 5/03, 5/04, or 5/05 processor as a slave station.

Table 4.5 Configuring an SLC 5/03, 5/04, or 5/05 Processor as a Slave Station

Tab	Parameter	Selections
General	Diagnostic File	SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 only. Select an unused file to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 4.6 on page 4-25 for a file description.
Chan. 0 System	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Stop Bits	Match the number of stop bits to the device with which you are communicating.
	Node Address	A node address identifies the processor on the DF1 half-duplex link. Each station on a link must have a unique node address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, which you cannot select as a station's individual address.
	Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If the master modem is full duplex and the slave modem is half-duplex, choose HALF-DUPLEX WITH CONTINUOUS CARRIER. • If all the modems in the system are half-duplex, choose HALF-DUPLEX WITHOUT CONTINUOUS CARRIER. See page 4-5 for descriptions of the control line operation settings.
	Error Detection	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
	Duplicate Packet Detect	Duplicate Packet Detect lets the SLC detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.

Table 4.5 Configuring an SLC 5/03, 5/04, or 5/05 Processor as a Slave Station

Tab	Parameter	Selections
Chan. 0 System	Poll Timeout	The timer keeps track of how often the station is polled. If the station has a message to send, it starts a timer. If the poll timeout expires before the message timeout, which you specify in the MSG control block, the MSG error bit is set and the message is removed from the transmit queue. If the message timeout, which you specify in the MSG control block, expires before the poll timeout expires, the MSG error bit and MSG timeout bit are set. The poll timeout can be disabled by entering a zero. See page 4-25 for recommendations to minimize this value.
	RTS Off Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message, but should normally be left at zero. See page 4-8 for further guidelines for setting this parameter.
	RTS Send Delay	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 4-8 for further guidelines for setting this parameter.
	Message Retries	Defines the number of times a slave station resends its message to the master station before the slave station declares the message undeliverable.
	Pre-Transmit Delay	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal.
	EOT Suppression	If you want to minimize traffic on the network, you can choose to have the slave station not send EOT packets to the master station. When EOT packets are suppressed, the master station automatically assumes a slave station has no data to give if the slave station does not send a message packet as a response to a poll. A disadvantage of suppressing EOTs is that the master station cannot distinguish between an active station that has no data to transmit and an inactive station. A possible application for suppressing EOTs is the following: conserving power with a radio modem because the radio transmitter does not have to power-up to transmit a DLE EOT packet (”no data to give” packet). To suppress EOTs, check this parameter. To have the processor send EOTs, leave this parameter unchecked.

Configuring Channel 0 Poll Timeout

The Channel 0 Poll Timeout is only used when the DF1 half-duplex slave is initiating MSG instructions in ladder logic. This implies that the master is most likely configured for Standard Polling Mode. The minimum Poll Timeout value is dependent on the maximum master poll scan rate. Since the master's polling and the slave's triggering of a MSG instruction are asynchronous events, it is possible that in the instant just after the slave was polled, the MSG instruction gets triggered. This means the MSG instruction will remain queued-up for transmission until the master has polled every other slave first. Therefore, the minimum slave channel 0 Poll Timeout value is equal to the maximum master poll scan rate rounded up to the next 20 ms increment.

DF1 Half-Duplex Slave Channel Status

Channel Status data is stored in the diagnostic file defined on the Channel 0 Configuration screen. Table 4.6 on page 4-25 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status icon Located beneath the Configuration icon to bring up the Channel Status screen.

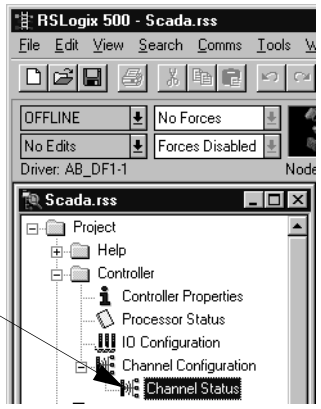


Table 4.6 Understanding the DF1 Half-Duplex Slave Status Screen Fields

Status Field	Diagnostic File Location	Definition
DCD Recover	word 11	The number of times the processor detects the DCD handshaking line has gone low to high
Messages Sent	word 1	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	word 2	The number of messages received with no errors
Polling Received	word 6	The number of master poll packets received by the processor
Received NAK	word 5	The number of NAKs received by the processor

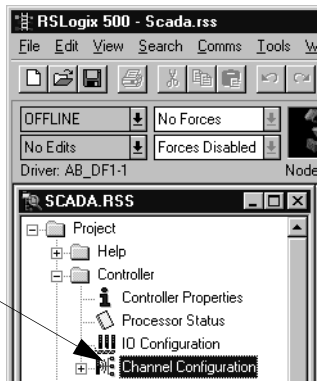
Table 4.6 Understanding the DF1 Half-Duplex Slave Status Screen Fields

Status Field	Diagnostic File Location	Definition
Lack of Memory/No ACK Sent	word 8	The number of times the processor could not receive a message because it did not have available memory
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Messages Retry	word 4	The number of message retries sent by the processor
Undelivered Messages	word 3	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet
Bad Packet/No ACK	word 7	The number of incorrect data packets received by the processor for which no ACK was returned
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

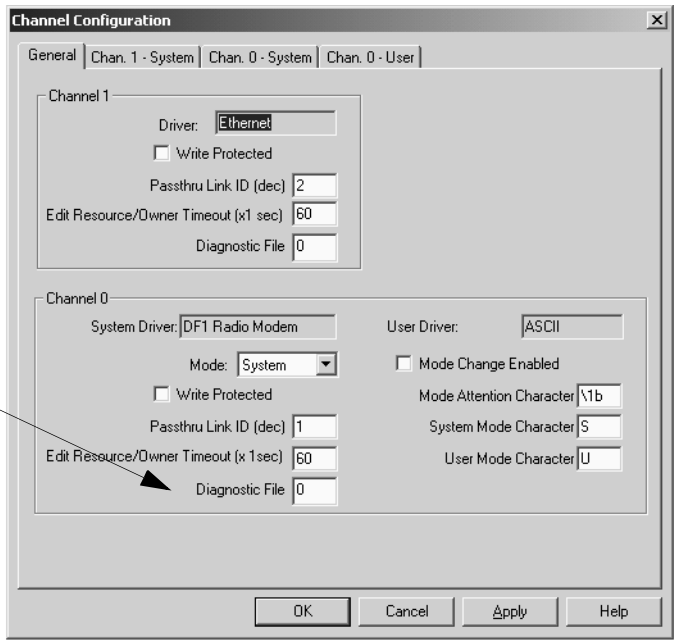
Configuring a Radio Modem Station

To configure an SLC 5/03, SLC 5/04 or SLC 5/05 processor channel 0 for DF1 Radio Modem, follow the steps below using your programming software:

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.

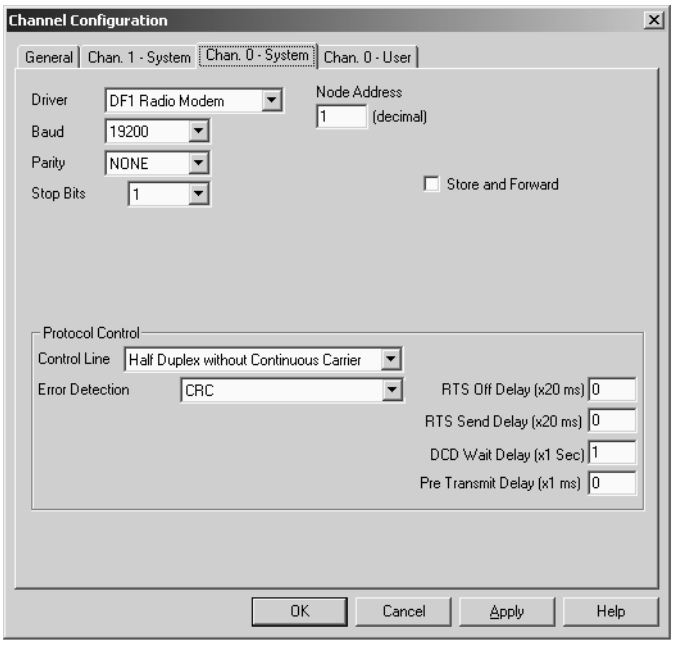


2. Define the location of the diagnostic file used for Channel Status here. See Table 4.8 on page 4-30 for diagnostic file details.



3. On the Channel 0 tab, choose DF1 Radio Modem for your Driver.

4. Configure the communication driver characteristics according to Table 4.7.



Use Worksheet 4.5 SLC 5/03, 5/04, and 5/05 DF1 Radio Modem Station Configuration (page D-18) for an example configuration and to record your station's configuration.

Table 4.7 Define these communication parameters when configuring an SLC 5/03, 5/04, or 5/05 processor for DF1 Radio Modem communication.

Tab	Parameter	Default	Selections
General	Diagnostic File	0	Select an unused file (9 to 255) to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See Table 4.8 on page 4-30 for a file description.
Chan. 0 System	Baud Rate	19,200	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Parity	None	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Stop Bits	1	Match the number of stop bits to the devices with which you are communicating.
	Node Address	1	A node address identifies the processor on the DF1 half-duplex link. Each station on a link must have a unique node address. Choose an address between 0_{10} and 254_{10}. Node address 255_{10} is the broadcast address, which you cannot select as a station's individual address.
	Store and Forward(1)	Unchecked	When checked, enables Store and Forward capability and duplicate packet definition. Refer to Applying DF1 Radio Modem Protocol on page 4-32 for more information.

Table 4.7 Define these communication parameters when configuring an SLC 5/03, 5/04, or 5/05 processor for DF1 Radio Modem communication.

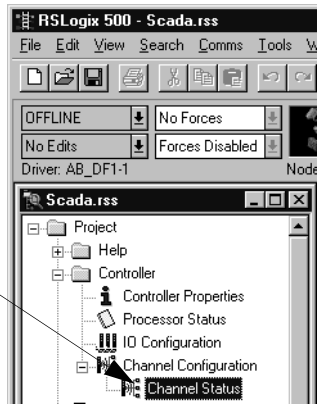
Tab	Parameter	Default	Selections
Chan. 0 System	Control Line	No Handshaking	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • Half-Duplex with Continuous Carrier(1) • Half-Duplex without Continuous Carrier(1) See page 4-5 for descriptions of the control line operation settings.
	Error Detection	CRC	With this selection, you choose the how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
	RTS Off Delay(1)	0	Defines the amount of time, in 20 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message, but should normally be left at zero. See page 4-8 for further guidelines for setting this parameter.
	RTS Send Delay(1)	0	Defines the amount of time, in 20 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message. The Clear-to-Send (CTS) signal must be high for transmission to occur. See page 4-8 for further guidelines for setting this parameter.
	DCD Wait Delay(1)	1	Only used with Half-Duplex without Continuous Carrier Control Line setting. Defines how long, in seconds, the processor will wait for DCD to go low so that it can transmit, before giving up and erroring out MSG.
	Pre-Transmit Delay	0	Defines the amount of time, in 1 millisecond increments, that elapses between when the processor has a message to send and when it asserts the RTS signal (if handshaking is selected) or begins transmitting (if no handshaking is selected).

(1) OS Series C, FRN 7and higher.

DF1 Radio Modem Channel Status

Channel Status data is stored in the diagnostic file defined on the Channel 0 Configuration screen. See Table 4.8 for information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status icon Located beneath the Configuration icon to bring up the Channel Status screen.



2. See Table 4.8 for details concerning the DF1 Radio Modem Channel Status Screen.

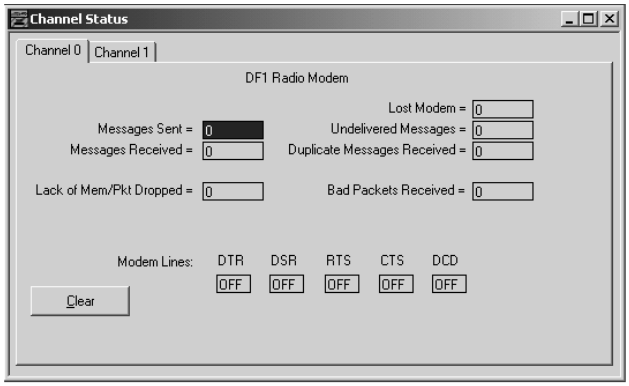


Table 4.8 SLC 5/03 and Higher Channel 0 DF1 Radio Modem Channel Status

Status Field	Diagnostic File Location	Definition
Messages Sent	word 1	The total number of DF1 messages sent by the processor
Messages Received	word 2	The number of messages received with no errors
Lack of Memory/Packet Dropped	word 8	The number of times the processor could not receive a message because it did not have available memory
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Undelivered Messages	word 3	The number of messages that could not be sent by the processor because of incorrect modem handshaking conditions

Table 4.8 SLC 5/03 and Higher Channel 0 DF1 Radio Modem Channel Status

Status Field	Diagnostic File Location	Definition
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet
Bad Packets Received	word 7	The number of data packets received with transmission errors by the processor
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

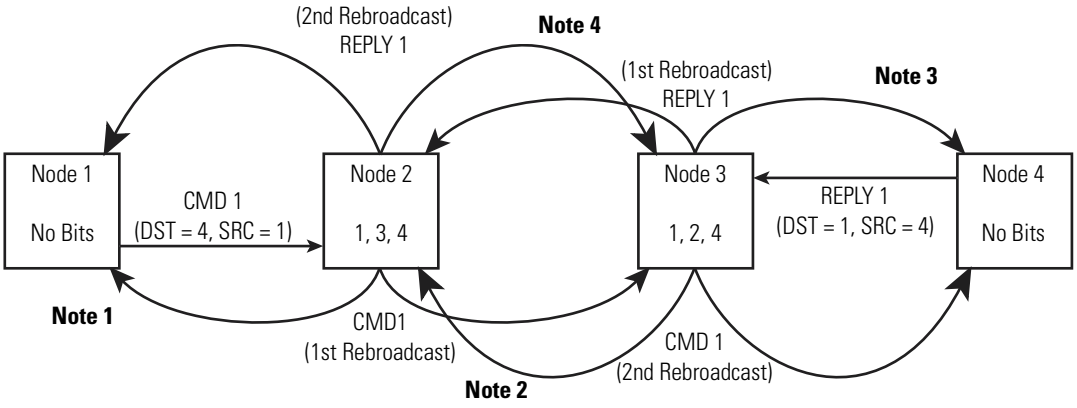
Clicking the Clear button while monitoring Channel Status of either channel 1 or channel 0 online, resets all of the channel status diagnostic counters for both channels to zero.

Configuring the Store & Forward Table

The Store & Forward Table occupies status file words S:67 to S:82. Each bit in this range corresponds to a DF1 Radio Modem node address. In order to configure an SLC to Store & Forward message packets between two other nodes, the bits corresponding to the addresses of those two other nodes must be set. For instance, if node 2 is used to Store & Forward message packets between nodes 1 and 3, then both bits S:67/1 and S:67/3 would have to be set in the Store & Forward Table (see Figure 4.5). You can set bit 255 (S:82/15) to enable Store & Forward of broadcast packets, as well.

IMPORTANT Once Store & Forward is enabled, duplicate packet detection is also automatically enabled. Whenever Store & Forward is used within a radio modem network, every node should have Store & Forward enabled even if all of the bits in the file are cleared, so that duplicate packets will be ignored.

Figure 4.4 Applying DF1 Radio Modem Protocol



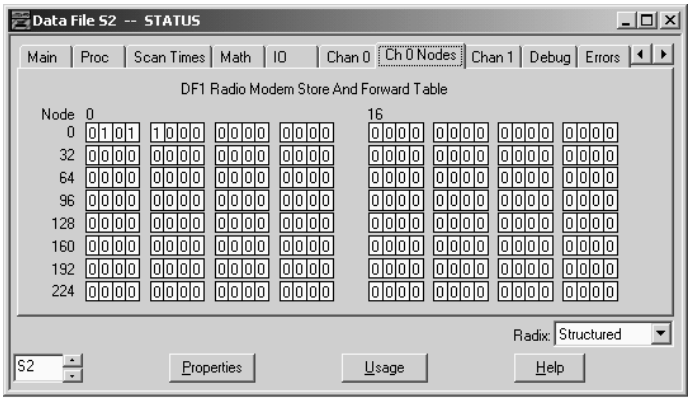
Note 1 – The link layer of Node 1 blocks the re-transmission of a packet that is received with the SRC byte equal to the receiving node's station address. Packets received that originate from the receiving node should never be re-transmitted.

Note 2 – To prevent Node 2 from re-transmitting a duplicate packet, the link layer of Node 2 updates the duplicate packet table with the last 20 packets received.

Note 3 – The link layer of Node 4 blocks the re-transmission of a packet that is received with the SRC byte equal to the receiving node's station address. Packets received that originate from the receiving node should never be re-transmitted.

Note 4 – To prevent Node 3 from re-transmitting a duplicate packet, the link layer of Node 3 updates the duplicate packet table with the last 20 packets received.

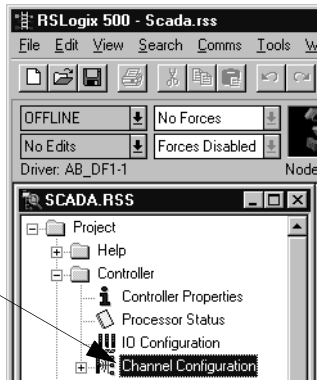
Figure 4.5 Store & Forward Table for Node 2



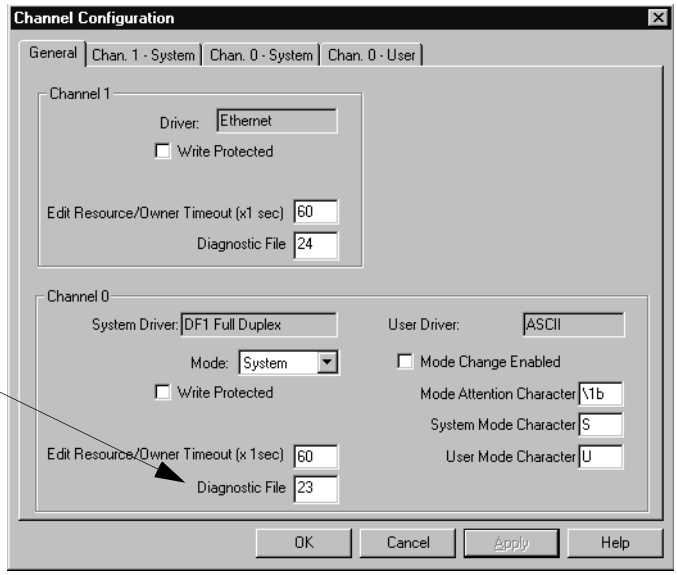
Configuring a Station on a Point-to-Point Link

To configure the processor for point-to-point communication, follow the steps below using your programming software.

1. To bring up the Channel Configuration interface, double-click on the Channel Configuration icon.

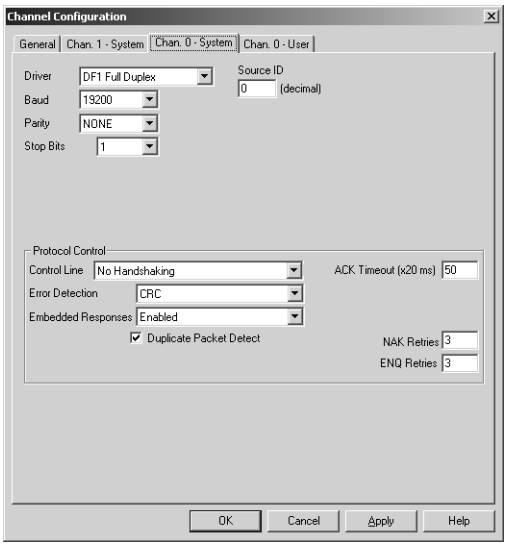


2. Define the location of the diagnostic file used for Channel Status here. See Table 4.10 on page 4-36 for diagnostic file details.



3. On the Channel 0 tab, choose DF1 Full-Duplex for your Driver.

4. Configure the communication driver characteristics according to Table 4.9.



Use Worksheet 4.4 (page D-17) for an example configuration and to record your station's configuration.

Define the communication parameters shown in Table 4.9 when configuring an SLC 5/03, 5/04, or 5/05 processor for DF1 full-duplex communication.

Table 4.9 Configure an SLC 5/03, 5/04, or 5/05 Processor for DF1 Full-Duplex Communication

Tab	Parameter	Selections
General	Diagnostic File	SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 only. Select an unused file (9 to 255) to store channel status information. You must define a diagnostic file in order to be able to view channel 0 status. See See Table 4.10 on page 4-36 for a file description.
Chan. 0 System	Baud Rate	Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate.
	Parity	Parity provides additional message packet error detection. To implement even parity checking, choose Even. To implement no parity checking, choose None.
	Stop Bits	Match the number of stop bits to the devices with which you are communicating.
	Source ID	This is the address, in decimal, that is used as the source address in any message initiated by this processor.
	Control Line	This parameter defines the mode in which the driver operates. Choose a method appropriate for your system's configuration: • If you are not using a modem, choose NO HANDSHAKING. • If you are using full-duplex modems, choose FULL-DUPLEX MODEM. See page 4-5 for descriptions of the control line operation settings.

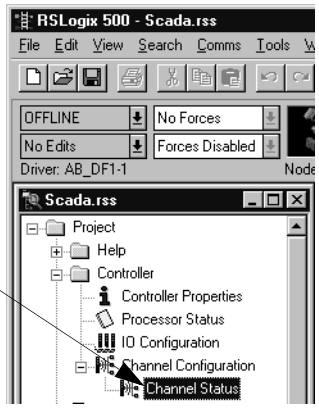
Table 4.9 Configure an SLC 5/03, 5/04, or 5/05 Processor for DF1 Full-Duplex Communication

Tab	Parameter	Selections
Chan. 0 System	Error Detection	With this selection, you choose how the processor checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select an error detection method that all devices in your configuration can use. When possible, choose CRC.
	Embedded Responses	To use embedded responses, choose Enabled. If you want the processor to use embedded responses only when it detects embedded responses from another device, choose Auto-detect. If you are communicating with another Allen-Bradley device, choose Enabled. Embedded responses increase network traffic efficiency.
	Duplicate Packet Detect	Duplicate Packet Detect lets the SLC detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate detect, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, check this parameter. If you want to accept duplicate packets and execute them, leave this parameter unchecked.
	ACK Timeout	The amount of time, in 20 millisecond increments, that you want the processor to wait for an acknowledgment to the message it has sent before sending an enquiry (ENQ) for the reply.
	NAK Retries	The number of times the processor will resend a message packet because the processor received a NAK response to the previous message packet transmission.
	ENQ Retries	The number of enquiries (ENQs) that you want the processor to send after an ACK timeout occurs.

DF1 Full-Duplex Channel Status

Channel Status data is stored in the diagnostic file defined on the Channel 0 Configuration screen. Table 4.10 on page 4-36 explains information regarding the diagnostic counter data displayed.

1. Double-click on the Channel Status Icon Located beneath the Configuration icon to bring up the Channel Status screen.



2. See Table 4.10 for details concerning the DF1 Full-Duplex Channel Status Screen.

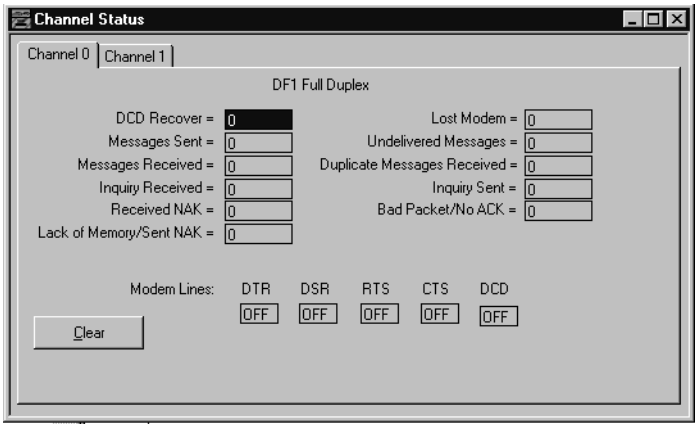
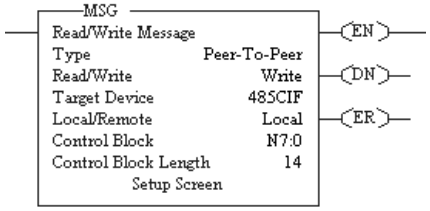


Table 4.10 Understand The DF1 Full-Duplex Status Screen Fields

Status Field	Diagnostic File Location	Definition
DCD Recover	word 11	The number of times the processor detects the DCD handshaking line has gone low to high
Messages Sent	word 1	The total number of DF1 messages sent by the processor (including message retries)
Messages Received	word 2	The number of messages received with no errors
Inquiry Received	word 6	The number of ENQs received by the processor
Received NAK	word 5	The number of NAKs received by the processor
Lack of Memory/Sent NAK	word 8	The number of times the processor could not receive a message because it did not have available memory
Lost Modem	word 12	The number of times the lost modem bit has gone low to high
Undelivered Messages	word 3	The number of messages that were sent by the processor but not acknowledged by the destination device
Duplicate Messages Received	word 9	The number of times the processor received a message packet identical to the previous message packet
Inquiry Sent	word 4	The number of ENQs sent by the processor
Bad Packet/No ACK	word 7	The number of incorrect data packets received by the processor for which a NAK was returned
DTR (Data Terminal Ready)	word 0;bit 4	The status of the DTR handshaking line (asserted by the processor)
DSR (Data Set Ready)	word 0;bit 2	The status of the DSR handshaking line (received by the processor)
RTS (Request to Send)	word 0;bit 1	The status of the RTS handshaking line (asserted by the processor)
CTS (Clear to Send)	word 0;bit 0	The status of the CTS handshaking line (received by the processor)
DCD (Data Carrier Detect)	word 0;bit 3	The status of the DCD handshaking line (received by the processor)

Messaging



Messaging can occur between:

- a master station and a slave station
- a slave station and its master station (See Polled Report-by-Exception)
- slave stations or between two processors connected via a radio modem point-multipoint or full-duplex point-to-point link

Master Station to Slave Station

An SLC 5/03, 5/04, or 5/05 master station communicates with the slave stations that are connected to it via modems in a point-to-multipoint configuration. A master station sends a slave station message to receive status or issue commands. For sample messaging ladder logic to use as a guide when using Standard or Message-based Polling Modes, see page E-2.

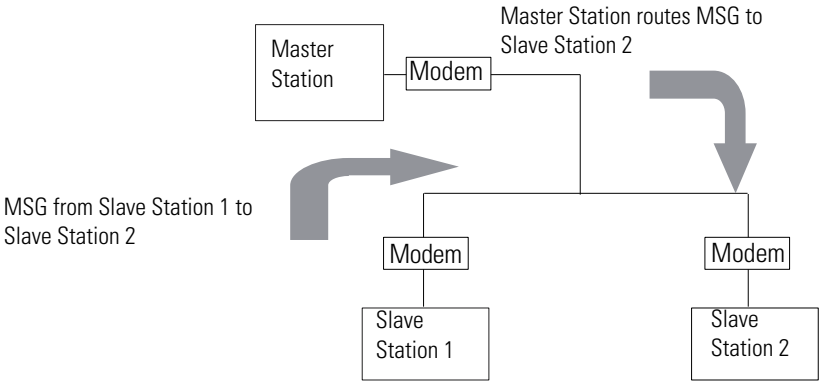
Polled Report-by-Exception

Slave stations can gather information from the I/O points they are responsible for and can send any anomalous readings to the master station. To do this, write ladder logic in the slave station to monitor certain conditions and send the data in an MSG instruction to the master station. For sample messaging ladder logic to use as a guide when using an SLC 500 as a slave, see page E-6.

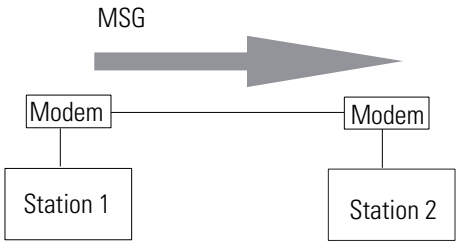
Processor-to-Processor

A processor-to-processor message can be the following types:

- In a general **point-to-multipoint** configuration, the messaging would be between slave stations; the master station automatically routes the message.



- In a **radio modem point-to-multipoint** or a **point-to-point** configuration, the messaging would be between the two connected peer devices.



The configuration of the network (point-to-multipoint vs. point-to-point) and the configuration of the station (master, slave, or peer) does not affect how you configure an MSG instruction. That is, an MSG instruction being sent between two SLC slave stations is configured the same as an MSG instruction between two SLC processors connected point-to-point, which is configured the same as an MSG instruction between an SLC master station and an SLC slave station. See Example MSG Control Blocks starting on page 4-43.

Considerations When Configuring MSG Control Blocks

Keep the following considerations in mind when configuring messages between an SLC 5/03, 5/04, or 5/05 processor and other processors.

For both Point-to-Multipoint and Point-to-Point Link Configurations

- All SLC 5/04 and 5/05 processors, and 5/03 processors with operating system 301 or greater have the capability to initiate and reply to PLC-5-type read and write messages by choosing PLC-5 as the Target Device. Use this for both PLC-5 and Logix processors.
- The maximum read or write message for an SLC 5/03, 5/04, or 5/05 processor through Channel 0 is 103 words.
- The maximum read or write message to a MicroLogix 1000 is 41 words.

Minimum Master MSG Block Message Timeout

Once the master ACK timeout is determined (see page 4-13) then a minimum MSG block Message Timeout value can be determined. This value is calculated differently depending on the master polling mode.

Message-based Polling Mode

Message based polling mode messages are executed serially - each message in the queue must complete as done, or in error, before the next message in the queue is executed. For this mode, the minimum MSG Timeout should be:

Maximum number of simultaneously triggered MSG instructions * [The sum of ACK Timeouts due to the maximum number of Message Retries for each queued-up message + Reply Message Wait timeout] = The minimum MSG Timeout

Realize that if the Message Retries is set for the default (3), then the number of ACK Timeout periods is (3)*2+1=7 (message, poll, retry_1, poll, retry_2, poll, retry_3), because a poll packet is sent between every Message Retry.

However, the slave may still respond to retry 3 with an ACK just before the ACK Timeout period expires, and the master would poll after the Reply Message timeout period for the reply...which could take approximately another ACK Timeout period to receive.

Therefore, for message-based polling mode, set the MSG Timeout value to at least:

# of MSG instructions * [2*(Message_Retries+1) * ACK Timeout + Reply Message Timeout] = The minimum MSG Timeout

To continue the example, if Message Retries is configured for 3, ACK Timeout is configured for 16 * 20 ms = 320, and Reply Message Timeout is configured for 1* 20 ms, the MSG Timeout value would be:

$$1 * \left[2^{(3+1)} \quad .320 \text{ seconds} + .02 \right] \quad 2.58 \text{ seconds.}$$

Round up the MSG Timeout value to the nearest second (3)

If 5 MSG instructions were triggered at the same time, each MSG would need a timeout value of 5*2.58 = 12.9, which would be rounded up to 13 seconds.

TIP Leave the channel 0 Message Retries at default (3) unless you have an extremely error free or error prone network.

Standard Polling Mode

For standard polling mode, the transmission of messages by the master can occur anywhere in the poll scan. This means that the master might transmit a message to station A just after it has completed polling station A as part of the poll scan. In this worst case scenario, it will take almost an entire poll scan before station A will be polled again and can reply to the master message so that the message can complete done or in error. In standard polling mode, the MSG Timeout should be at least as long as this maximum poll scan.

The maximum poll scan = The minimum MSG timeout

Standard Polling Mode With Single Message Transfer

For standard polling mode with single message transfer per poll scan, the maximum poll scan would be achieved when every slave had a maximum-sized message packet to transmit when polled. Recall that the ACK Timeout is calculated as being just long enough for the master to receive a maximum sized message packet, so the maximum poll scan time would be approximately:

$$\text{The number of slave stations} * \text{ACK Timeout} = \text{The maximum single message transfer poll scan time} = \text{The minimum MSG Timeout}$$

Therefore, if there are 10 slave stations and the ACK Timeout is 320 ms, then the maximum single message transfer poll scan time would be:

10 (slave stations) * .320 seconds = 3.20 seconds

Round up the MSG Timeout value to the nearest second (4).

Standard Polling Mode With Multiple Message Transfer

For standard polling mode with multiple message transfer per poll scan, the maximum poll scan would be achieved when every slave had multiple maximum sized message packets to transmit when polled. If the worst case scenario is 2 maximum sized message packet to transmit, then the maximum poll scan time is approximately 2 times the maximum single message transfer poll scan time plus the minimum poll scan time.

The minimum poll scan time occurs when the master sends out a 4 byte poll packet to each slave and in return receives a 2 byte response from each slave. This time is approximately the master modem turnaround time or RTS Send Delay (whichever is greater) plus the slave modem turnaround time or RTS Send Delay (whichever is greater), multiplied by the number of slave stations in the poll range.

[Master modem turnaround time or RTS Send Delay + Slave modem turnaround time or RTS Send Delay] * Number of slave stations = The minimum poll scan time

Use only the greater of these two values.

Use only the greater of these two values.

For example, if the master modem turnaround time and RTS Send Delay are both 0 ms, and the slave modem turnaround time is 50 ms and RTS Send Delay is 60 ms, the minimum poll scan time would be:

0 + 60 ms * 10 (slave stations) = 600 ms

To finish the example:

[# of MSG instructions per slave * Maximum single message transfer poll scan time] + Minimum poll scan time = The maximum multiple message transfer poll scan time = The minimum MSG Timeout

2 ** (3.20 seconds) + .600 seconds = 7 seconds

For this example, the MSG Timeout value should be at least 7 seconds.

Minimum Slave MSG Block Message Timeout

The minimum slave MSG Block Message Timeout should allow for the Master to go through Message Retries plus one number of maximum poll scans before timing out. Therefore, the minimum MSG Block Message Timeout value should be at least (Slave Channel 0 Poll Timeout) * (Slave channel 0 Message Retries + 1), rounded up to the next whole second.

TIP Leave the channel 0 Message Retries at default (3) unless you have an extremely error free or extremely error prone network.

Minimum Slave MSG Block Message Timeout = (Slave channel 0 Poll Timeout)*(Slave Channel 0 Message Retries + 1)

Minimum Radio Modem MSG Block Message Timeout

The minimum radio modem MSG Block Message Timeout should allow for the end-to-end transmission of the command going out and the reply coming back over the radio modem network, including time through repeaters and/or store and forward nodes.

TIP The default MSG Block Message Timeout is 5 seconds but for most radio modem configurations, this can be reduced to 2 seconds.

Minimum Point-to-Point MSG Block Message Timeout

The minimum point-to-point MSG Block Message Timeout should allow for the processor to go through Message Retries plus one ACK time out. Therefore, the minimum MSG Block Message Timeout value should be at least (ACK Timeout) * (Channel 0 Message Retries + 1), rounded up to the next whole second.

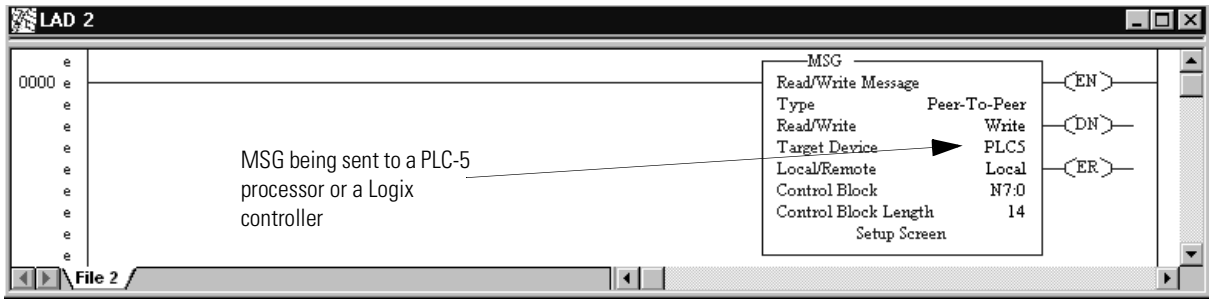
Minimum Point-to-Point MSG Block Message Timeout = (ACK Timeout)*(Channel 0 Message Retries + 1)

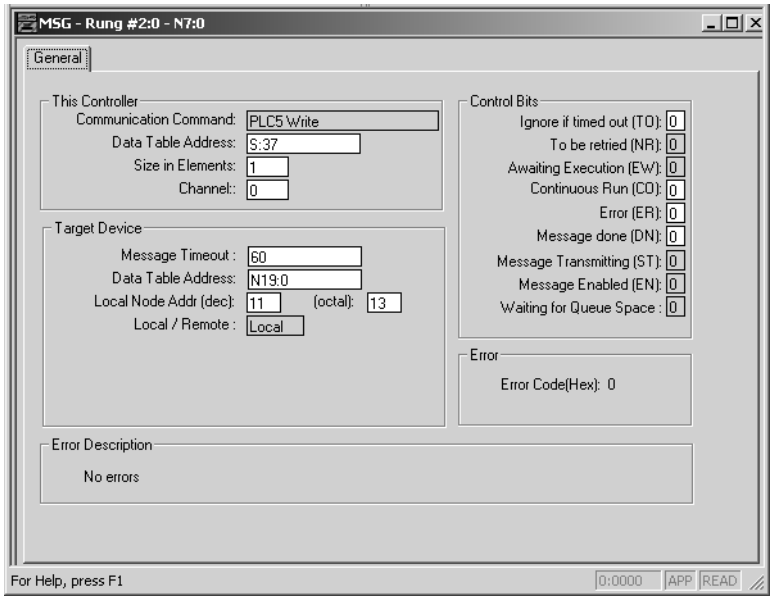
TIP Leave the channel 0 Message Retries at default (3) unless you have an extremely error free or extremely error prone network.

Example MSG Control Blocks

Application	See page:
SLC 5/03, 5/04, or 5/05 write message to a PLC-5 or Logix processor	4-43
SLC 5/03, 5/04, or 5/05 read message to a PLC-5 or Logix processor	4-44
SLC 5/03, 5/04, or 5/05 write message to another SLC 500 or MicroLogix processor	4-45
SLC 5/03, 5/04, or 5/05 read message to another SLC 500 or MicroLogix processor	4-46

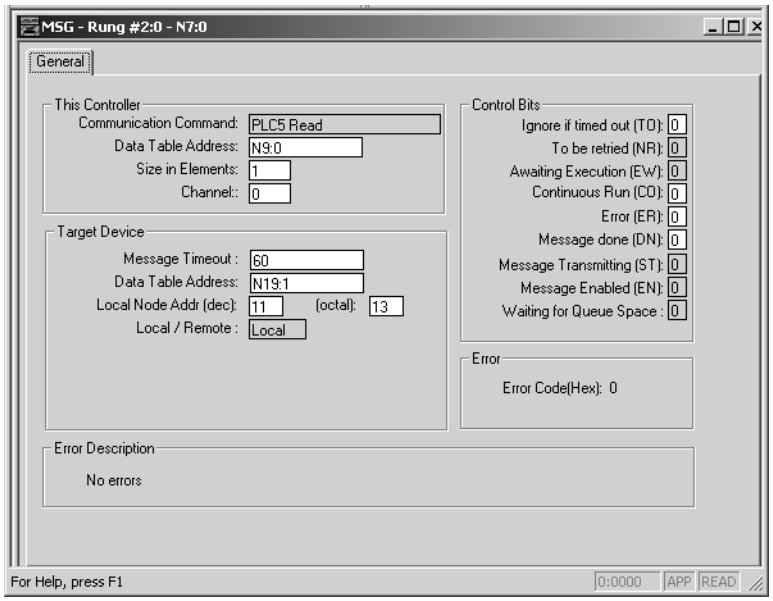
Figure 4.6 Write MSG from an SLC 5/03, 5/04, or 5/05 Processor to a PLC-5 Processor or Logix Controller





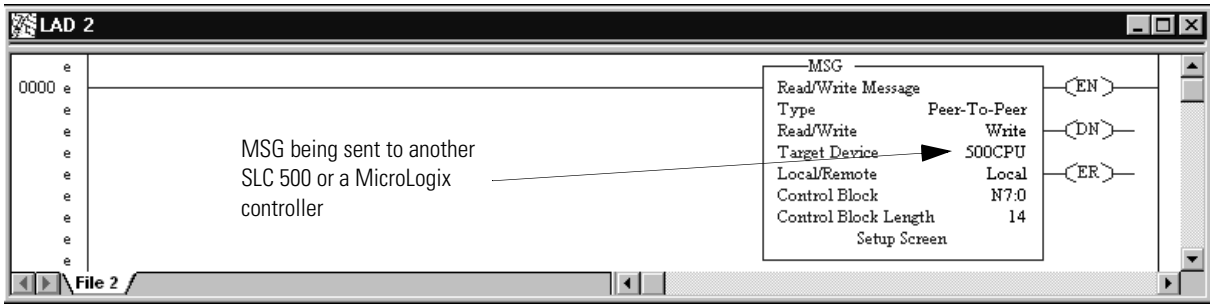
This MSG example tells the SLC 5/03, 5/04, or 5/05 master station to write the information from its S:37 through its serial port (channel 0) to the PLC-5 slave station 11_{10}. The data's destination is N19:0 of the PLC-5 slave station. For a Logix slave station, a tag name would have to already have been mapped to N19. Alternatively, SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 processors support logical ASCII addressing, which means any Logix controller tag can be written to by entering the tag name in double quotes in the Target's Data Table Address field.

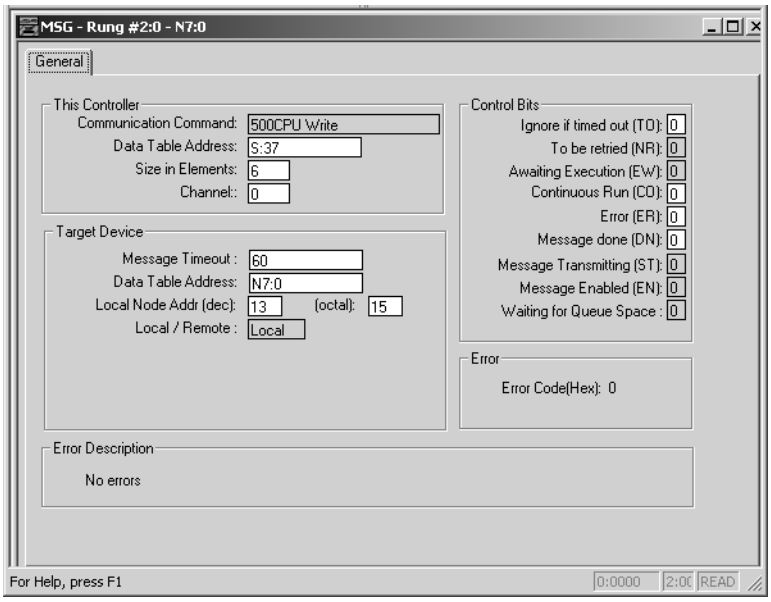
Figure 4.7 Read MSG from an SLC 5/03, 5/04, or 5/05 Processor to a PLC-5 Processor or Logix Controller.



This MSG example tells the SLC 5/03, 5/04, or 5/05 master station to read the information from PLC-5 slave station 11_{10}'s N19:1 and place the information in master station file N9:0. For a Logix slave station, a tag name would have to already have been mapped to N19. Alternatively, SLC 5/03 (OS 302 C or higher), 5/04 (OS 401 C or higher) and 5/05 processors support logical ASCII addressing, which means any Logix controller tag can be read by entering the tag name in double quotes in the Target's Data Table Address field.

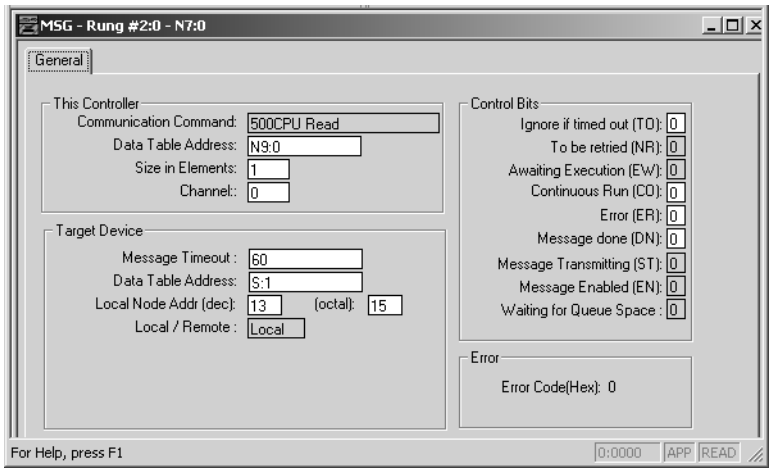
Figure 4.8 Write MSG from an SLC 5/03, 5/04, or 5/05 Processor to Another SLC 500 or a MicroLogix Controller





In this example, the SLC master station is issuing a write request through its serial port (channel 0) to SLC station 13_{10}. The master station wants to write the information from S:37 into station 13_{10}'s file N7:0.

Figure 4.9 Read MSG from an SLC 5/03, 5/04, or 5/05 Processor to Another SLC 500 or MicroLogix Controller



In this example, the SLC master station is issuing a read request through its serial port (channel 0) to SLC station 13_{10}. The master station reads the information from station 13_{10}'s file S:1 and puts that information into its own N9:0 file.

Configuring SLC 500 Processors with 1747-KE Interface Modules

Chapter Objectives

This chapter helps you set up an SLC 500 fixed or modular processor (SLC 5/01 or 5/02 processor) with a 1747-KE as a remote station or as a station on a point-to-point link.

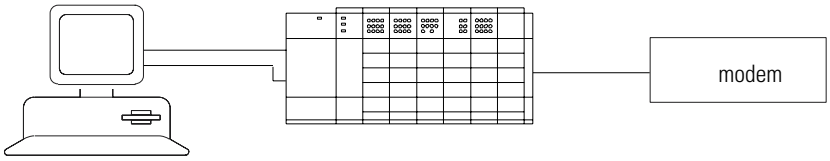
For information about:	See page:
an overview of the tasks required to configure an SLC 500 processor with a 1747-KE module as a remote station	5-1
installing the SLC 500 processor	5-2
installing the 1747-KE interface module	5-2
configuring the SLC 500 processor	5-3
configuring the 1747-KE interface module	5-4
configuring messages in the SLC 5/02 processor	5-11

Overview

To configure an SLC 500 processor with a 1747-KE interface module as a remote station:

1. Install the processor (modular processors only).
2. Install the 1747-KE module.
3. Configure the processor using your programming software.
4. Define the 1747-KE communication characteristics using an ASCII terminal or terminal emulation software like Hyperterminal in Windows 95. Connect a properly wired cable to the interface module's serial port (DF1 port).
5. Install and configure the modem for communication with the 1747-KE module; connect the modem to the 1747-KE module's serial channel. See Chapter 8.

Figure 5.1 Configuring SLC 500 Processor with 1747-KE Module



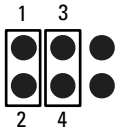
Installing the Processor

For details about installing the modular processor, see SLC 500 Modular Hardware Style User Manual, publication 1747-UM011.

Installing the 1747-KE Interface Module

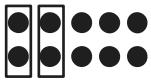
To install the interface module, do the following:

1. To allow an ASCII terminal to communicate with the module, place the module in series B functionality Configuration Mode by setting JW4 as follows:



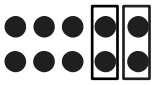
Configuration Mode Setting

2. Since the ASCII terminal communicates with the module via an RS-232 connection, verify that the CONFIG port is configured for RS-232 by verifying this setting for JW1:



CONFIG port is configured for RS-232

3. Since the DF1 port connects to a modem, verify that the port is configured for RS-232 by verifying this setting for JW2:

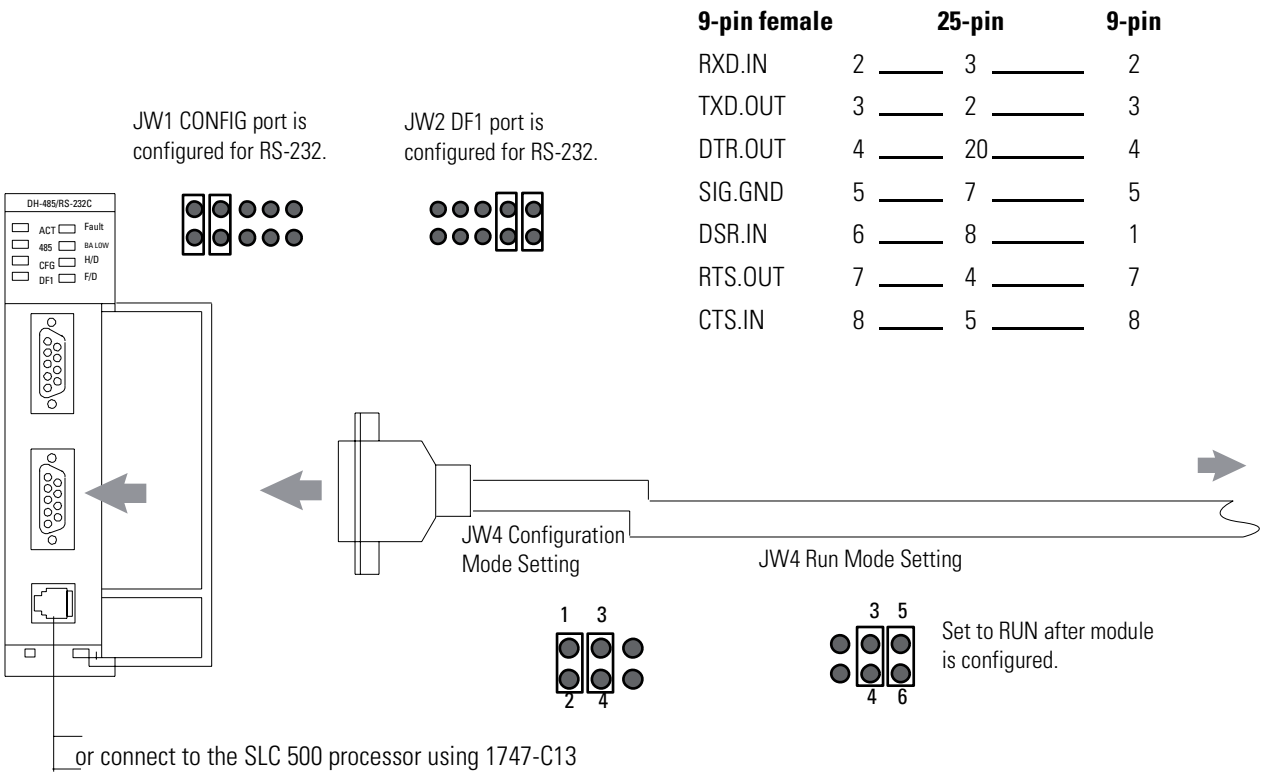


DF1 port is configured for RS-232

4. Install the module into a powered-down chassis.

For details about installing the interface module, see the DH-485/ RS-232C Interface Module User Manual, publication 1747-6.12.

Figure 5.2 1747-KE Serial Port Pin Assignments



Configuring the Processor

As you are specifying each module within the chassis scanned by the SLC 500 processor, remember to specify a slot for the 1747-KE module. Configure the DH-485 node address of the programming terminal as 0-31; the default is 0.

Also, define a node address for the SLC 500 processor. This address, when combined with the group number (configured on the interface module when in remote mode), comprises the remote station's address.

Series A interface modules may only be configured using an ASCII terminal, while series B interface modules may be either configured using an ASCII terminal or using ladder logic in the SLC 500 communicating across the backplane.

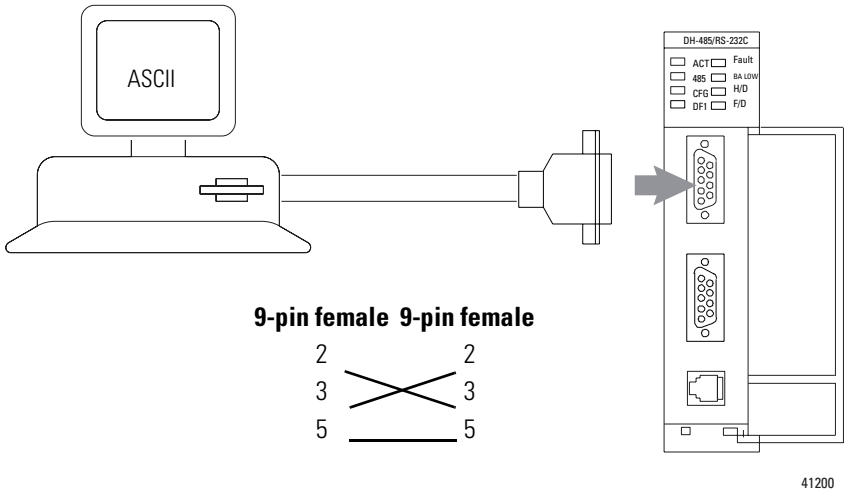
Configuring the 1747-KE Interface Module

To configure the interface module with an ASCII terminal:

- prepare to configure the driver
- configure the DF1 protocol driver, and
- save the configuration

Prepare to Configure the Driver

1. Connect an ASCII terminal or personal computer running terminal emulation software to the interface module's CONFIG port.



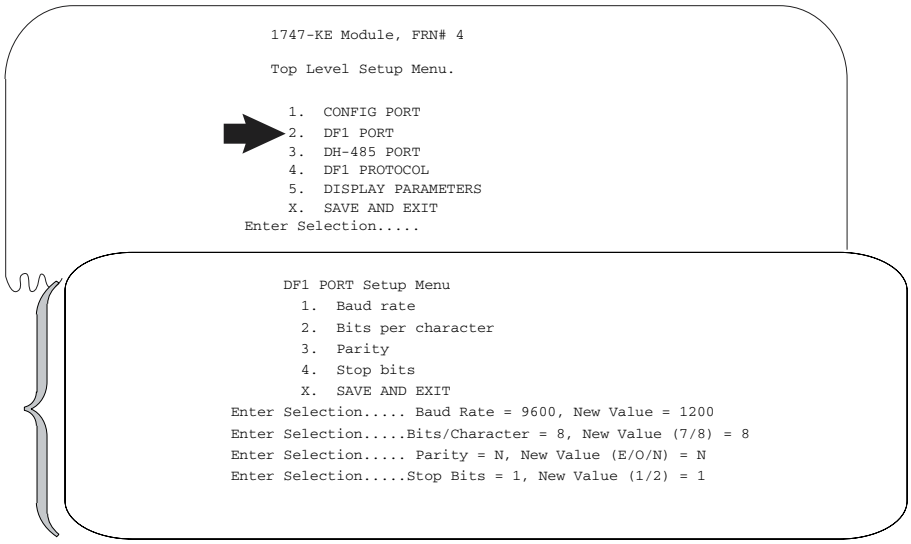
2. Turn on power to the chassis containing the interface module.

3. Run the ASCII terminal emulation software, and configure the software to match the default CONFIG port parameters, which are the following:

Parameter	Selections
Baud rate	1200
Bits per character	8
Parity	none
Stop bits	one

4. Configure the DF1 port as shown in Figure 5.3.

Figure 5.3 Configuring the DF1 Port

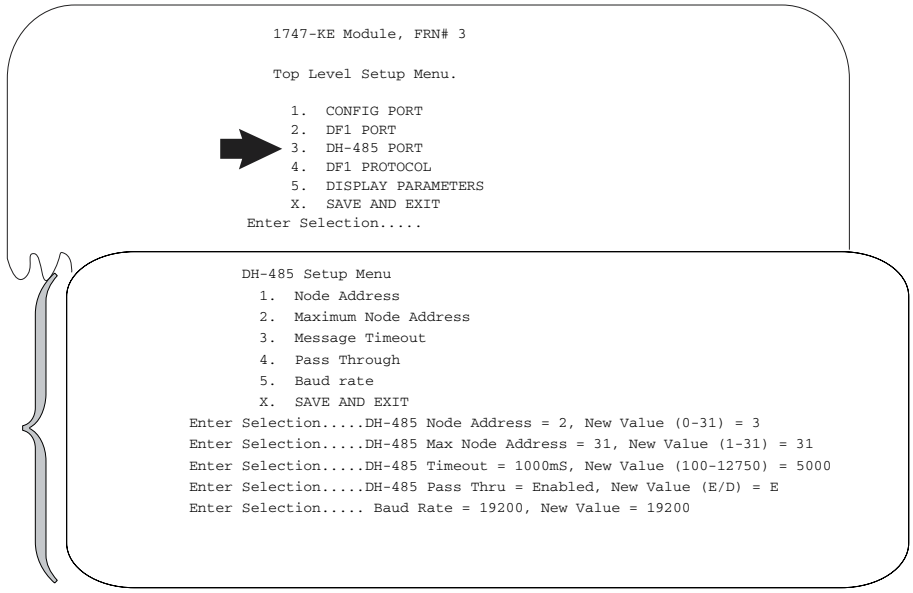


Configure the port as shown here.
(These settings must match those of the modem to which you are connecting.)

Parameter	Selections
Baud rate	rate at which the device communicates
Bits per character	the number of bits that make-up a character
Parity	provides additional message packet error detection
Stop bits	delineates data during transfer

5. Configure the DH-485 port as shown in Figure 5.4.

Figure 5.4 Configuring the DH-485 Port



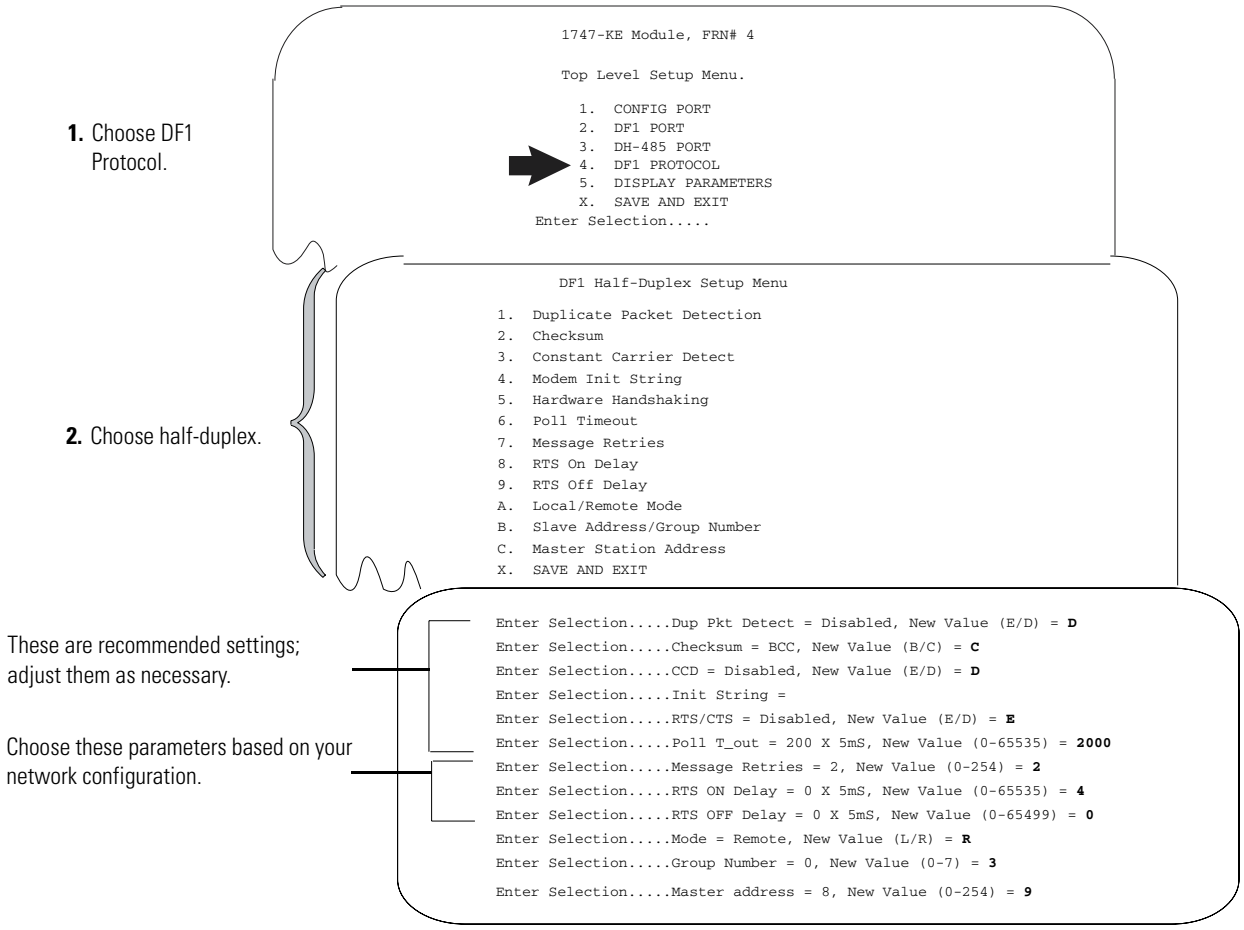
Configure port as shown here.

Parameter	Selections
Node address	Select a unique address of the module on the DH-485 network.
Maximum node address	Choose the highest address on the DH-485 link. The default is 31.
Message timeout	Choose an amount of time to wait for a response to a message sent on the DH-485 network before the node errors out the message.
Pass through	If you want diagnostic commands: • executed by the module, choose Disabled. • passed through to the destination node, choose Enabled.
Baud rate	Set all devices on the DH-485 network to the same baud rate.

Configure the DF1 Protocol Driver

If the processor and interface module are part of a	Then choose	Go to
point-to-multipoint configuration	Half-duplex	Figure 5.5
point-to-point configuration	Full-duplex	Figure 5.6

Figure 5.5 Configuring the DF1 Half-Duplex Driver

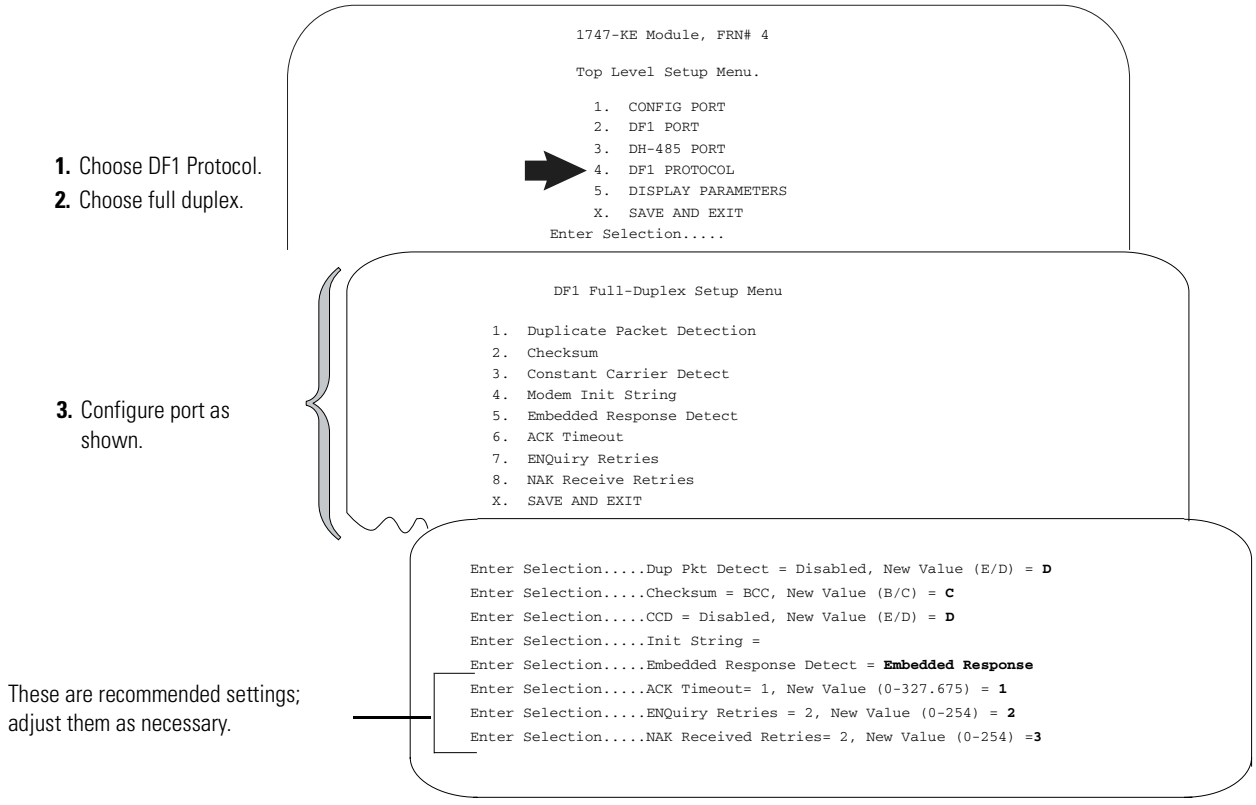


Use Worksheet 5.1 (page D-19) for an example configuration and to record your station's configuration.

Parameter	Selections
Duplicate Packet Detection	Duplicate packet detection lets the interface module detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate packet detection, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, choose Enable. If you want to accept duplicate packets, choose Disable.
Checksum	With this selection, you choose how the interface module checks the accuracy of each DF1 packet transmission. **BCC**: This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select a method that all your devices on the network can use. When possible, choose CRC.
Constant Carrier Detect	If you want the interface module to monitor the carrier from the modem (DCD signal), choose Enabled. The module will not begin communication until the carrier is detected. If the remote modem does not normally receive a constant carrier from the master modem, choose Disabled.
Modem Init String	Enter an ASCII string to configure your modem by using Hayes commands upon every power cycle of the interface module.
Hardware Handshaking	Choose enabled to use the RTS and CTS signals for controlling the modem.
Poll Timeout	The timer keeps track of how often the station is polled. If the station has a message to send, it starts a timer. If the timer expires before the message is sent, then the error bit is set on the MSG instruction.
Message Retries	The number of times the processor will resend its message to the master station if the processor does not receive an acknowledgment.
RTS On Delay	RTS on delay is the amount of time, in 5 millisecond increments, that elapses between the assertion of the RTS signal and the beginning of the message transmission. This time allows the modem to prepare to transmit the message.
RTS Off Delay	RTS off delay is the amount of time, in 5 millisecond increments, that elapses between the end of the message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure that the modem has transmitted the message, but should normally be left at zero.
Local/Remote Mode	Local mode requires a master station that is capable of specifying both a station address and a destination address. Because the interface module acts as a slave on a half-duplex network, the half-duplex master's access to the DH-485 node is indirect. The destination address and the station address are generally different. In Remote mode, the module appears transparent to the half-duplex master so that the remote SLC 500s can be polled directly as individual slaves on the half-duplex network. The interface module responds to the half-duplex master if the station address specified corresponds to the node address of any (token-passing) station on the DH-485 network connected to that interface module. Remote mode is preferred as it allows remote programming of all SLC 500 processors, as well as polled report-by-exception messages from SLC 5/02 processors on DH-485 to the master station.

Parameter	Selections
Slave Address/Group Number	When the module is configured for remote mode, enter a Group Number (octal). Since you can have up to 254 devices on a half-duplex network and 31 devices on a DH-485 network, to allow 255 DH-485 nodes requires using a group number. This parameter defines the address group of the SLC 500 half-duplex address. Each address group can consist of 32 addresses. The address of the SLC 500 processor is determined with the following formula: (32*G)+A, where G is the group number (0 to 7) and A is the DH-485 node address of the SLC 500 processor. One station address within each group of size 32 must be reserved for any KE module interfaces configured with that group number. A second address within each group should also be reserved for local DH-485 programming terminals. These 16 addresses should never have to be polled by the master station. Finally, a remote programming terminal station address should be reserved, even if remote programming is not considered a requirement initially. This address will need to be periodically polled, even though it will remain on the inactive list unless there is an online remote programming terminal. When the module is configured for local mode, enter a slave address. This parameter is the address of the module on the half-duplex link (0 to 254).
Master Station Address	The address of the master station, (0 to 254_{10}).

Figure 5.6 Configuring the Driver for DF1 Full-Duplex



Use Worksheet 5.2 (page D-20) for an example configuration and to record your station's configuration.

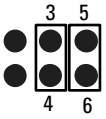
Parameter	Selections
Duplicate Packet Detection	Duplicate Packet Detection lets the interface module detect if it has received a message that is a duplicate of its most recent message from the master station. If you choose duplicate packet detection, the processor will acknowledge (ACK) the message but will not act on it since it has already performed the message's task when it received the command from the first message. If you want to detect duplicate packets and discard them, choose Enable. If you want to accept duplicate packets, choose Disable.
Checksum	With this selection, you choose the how the interface module checks the accuracy of each DF1 packet transmission. **BCC:** This algorithm provides a medium level of data security. It cannot detect: • transposition of bytes during transmission of a packet • the insertion or deletion of data values of zero within a packet **CRC:** This algorithm provides a higher level of data security. Select a method that all your devices on the network can use. When possible, choose CRC.
Constant Carrier Detect	If you want the interface module to monitor the carrier from the modem (DCD signal), choose Enabled. The module will not begin communication until the carrier is detected. If the local modem does not normally receive a constant carrier from the remote modem, choose Disabled.
Modem Init String	Enter an ASCII string to configure your modem by using Hayes commands upon every power cycle of the interface module.
Embedded Response Detect	To use embedded responses, choose Enabled. If you want the processor to use embedded responses only when it detects embedded responses from another device, choose Auto-detect. If you are communicating with another Allen-Bradley device, choose Enabled. Embedded responses increase network traffic efficiency.
ACK Timeout	The amount of time, in 5 millisecond increments, that you want the processor to wait for an acknowledgment to the message it has sent before sending an enquiry (ENQ) for the reply.
ENQuiry Retries	The number of enquiries (ENQs) that you want the processor to send after an ACK timeout occurs.
NAK Receive Retries	The number of times the processor will re-send a message packet because it received a NAK response to the previous message packet transmission.

Save the Configuration

To save the configuration, follow these steps:

1. To save the configurations and exit from the menus, type X.
2. Remove power from the SLC chassis; disconnect the ASCII terminal.

3. Remove interface module. Place the module in RUN mode by setting JW4 as follows:

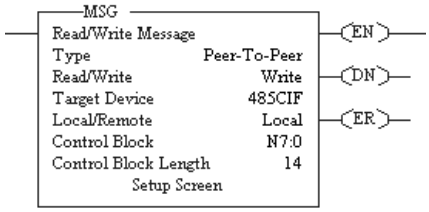


Run Mode Setting

4. Insert module. Power the chassis.

For details about alternatively configuring the series B interface module from the SLC through the backplane, see the DH-485/RS-232C Interface Module User Manual, publication 1747-6.12.

Messaging



SLC 5/01 processors and the fixed controllers can only respond to a master station. These processors cannot initiate messages on their own.

Messaging in an SLC 5/02 processor can occur between:

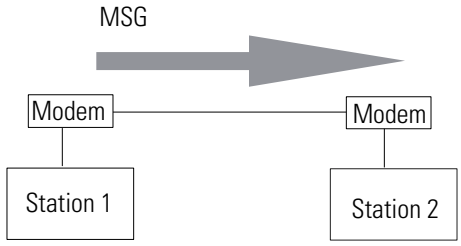
- a master station and a remote station. (For more information see the chapter pertaining to the master device you are using.)
- a remote station and its master station (see Polled Report-by-Exception).
- between two processors connected via a point-to-point link.

Polled Report-by-Exception

A remote station can gather information from the I/O points it is responsible for and can send any anomalous readings to the master station. To do this, write logic in the remote station's processor to monitor certain conditions and send the data in an MSG instruction to the master station. Figure 5.7 is an example MSG instruction and control block that an SLC 5/02 processor in a remote station can send to a PLC-5 master station.

Processor-to-Processor

An SLC 5/02 processor can send messages to another processor in a point-to-point configuration.



Considerations When Configuring MSG Control Blocks

Keep these considerations in mind when configuring messages between an SLC 5/02 processor and a PLC-5 processor.

Point-to-Multipoint and Point-to-Point Link Configurations

- In the SLC 5/02 MSG instruction, Target Node is the decimal DH-485 node address of the 1747-KE module and Target Offset is the decimal byte-offset, which is the element you want to write data into or read data from.
- The SLC 5/02 processor uses word addressing, while the PLC-5 processor uses byte addressing. In the Target Offset field of the SLC 500 MSG control block, enter a word value equivalent to the byte (element) of the PLC-5 file number you want to write data into or read data from. For example in Figure 5.7, the Target Offset is 20; this corresponds to element 10_{10} in a PLC-5 processor because one word = two bytes. Never enter an odd value for a Target Offset.
- If you are sending messages between an SLC 5/02 processor and a PLC-5 processor, then set S:2/8 in the SLC 5/02 status file to 1. This bit is the CIF (Common Interface File) Addressing Mode selection bit and lets the SLC 5/02 processor accept byte-offsets from a PLC-5 processor.
- The SLC 5/02 processor can only directly address words 0_{10}-127_{10} in a PLC-5 data table file. By specifying a byte-offset of 254 in the Target Offset field and specifying a Message Length of 41, you can indirectly address words 128_{10}-167_{10} in a PLC-5 data table file. The maximum read or write message length for an SLC 5/02 processor is 41 elements.

Point-to-Multipoint Link Configurations

In the PLC-5 processor, create integer files that correspond to the station addresses of the SLC 5/02 processors that will be sending messages to the PLC-5 processor. Because, when an SLC 5/02 sends a MSG instruction to a PLC-5 processor, the SLC 5/02 processor reads data from and writes data to a PLC-5 integer file that is equal to the SLC 5/02 processor's DF1 station address.

Point-to-Point Link Configurations

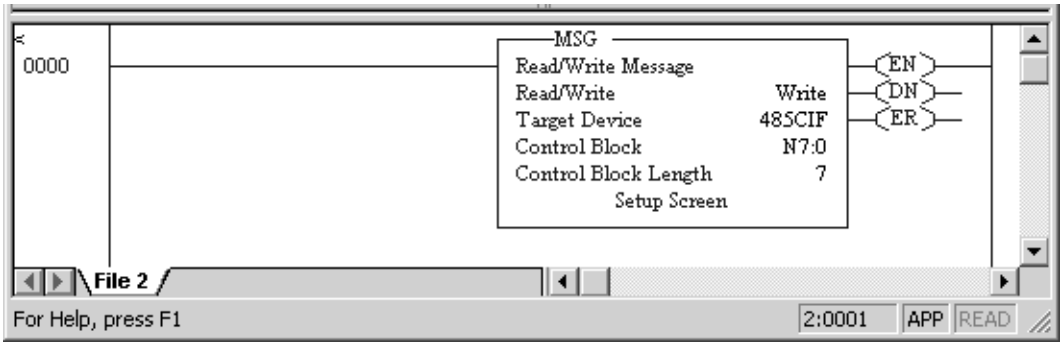
In the PLC-5 processor, create and make available the file that corresponds to the DH-485 node address of the SLC 500 processor for SLC 5/02 read and write messages.

Example MSG Control Blocks

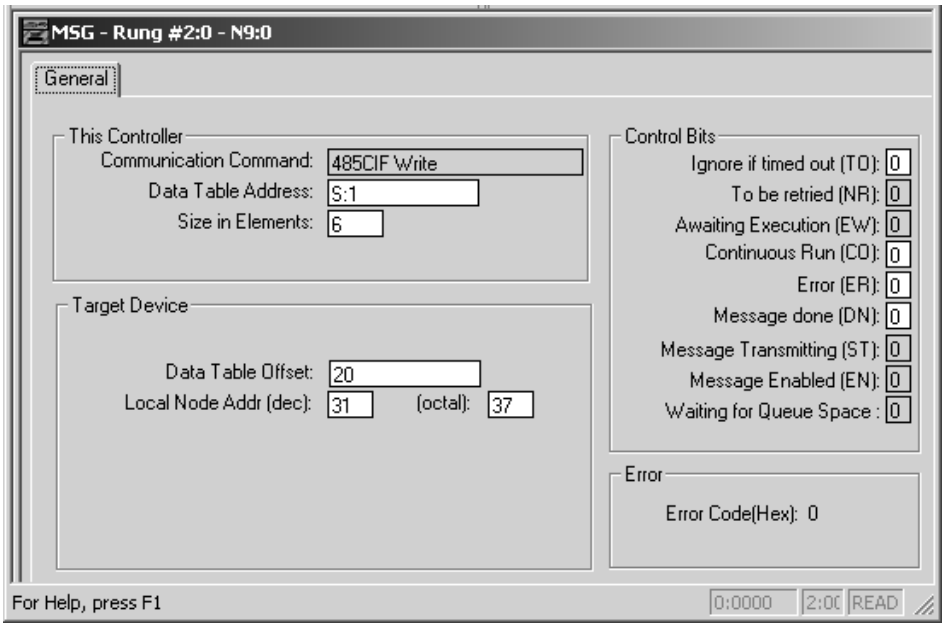
For application	See	On page
SLC 5/02 write message to a PLC-5 processor	Figure 5.7	5-14
SLC 5/02 read message to a PLC-5 processor	Figure 5.8	5-15
SLC 5/02 write MSG to an SLC 500 processor	Figure 5.9	5-16
SLC 5/02 read MSG to an SLC 500 processor	Figure 5.10	5-17

Figure 5.7 Write MSG instruction from an SLC 5/02 processor to a PLC-5 processor.

ladder rung



setup screen



This MSG example is telling the SLC 5/02 remote station (station 99_{10}) to write the information from its S:1 to S:6 to the PLC-5 master station 9_{10} through the KE module $31_{10.}$ The data's destination is N99:10 (for a target byte offset of 20_{10}) of the PLC-5 processor.

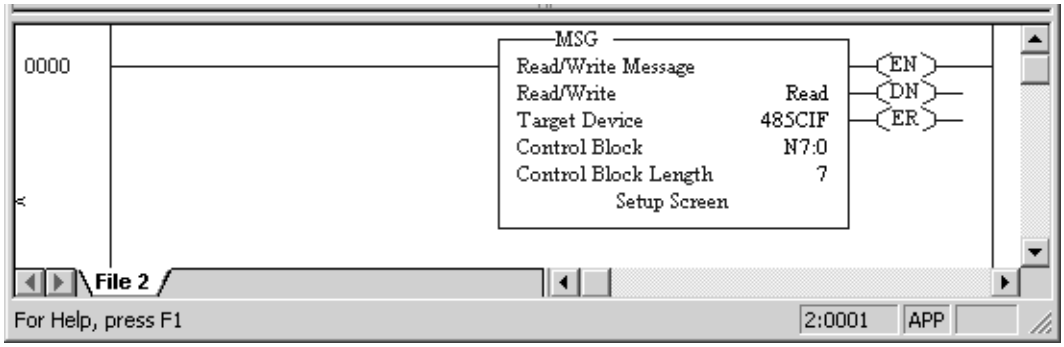
IMPORTANT The SLC 5/02 processor writes the information into an integer file in the PLC-5 processor's data table. The integer file number is equal to the SLC 5/02 processor's station address. (This event is called PLC-2 emulation.)

For example, if the SLC 5/02 processor in this example is station 99_{10}, then it writes the data from its S:1 to S:6 into N99 of the PLC-5 master station. File N99 must exist in the PLC-5 in order for it to receive data from the SLC 5/02 remote station.

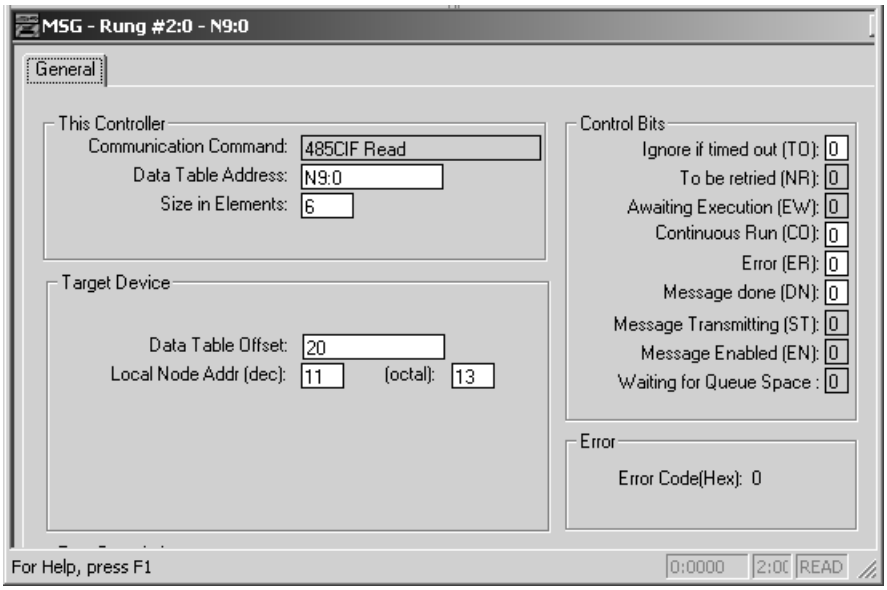
Note that the SLC 5/02 station address 99_{10} in this example is station address 143_8, which is derived by a DH-485 node address of 03 for the SLC 5/02 processor and a group number of 03 defined in the 1747-KE interface module.

Figure 5.8 Read MSG instruction from an SLC 5/02 processor to a PLC-5 processor.

ladder rung



setup screen



In this example, SLC 5/02 station 10_{10} is issuing a read command, through a 1747-KE module whose DH-485 node address is 11_{10}, to a PLC-5 station. The SLC 5/02 station (station 10_{10}) reads the information in N10:10 to N10:15 of the PLC-5 station and puts that information into its N9:0 to N9:5.

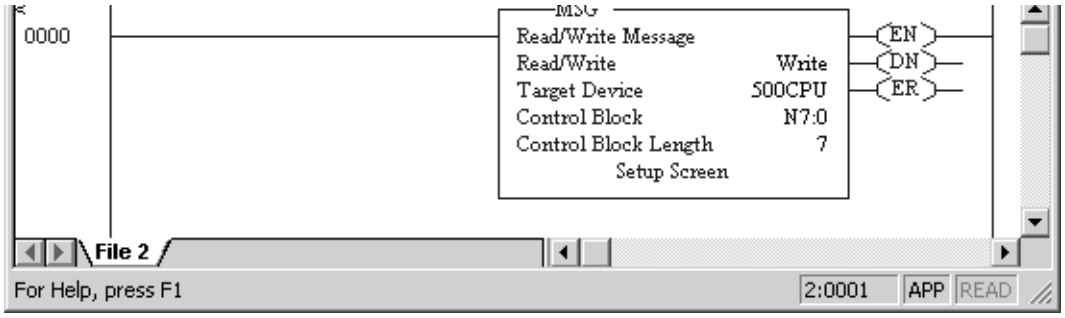
IMPORTANT The SLC 5/02 processor reads the information from an integer file in the PLC-5 processor's data table that corresponds to the SLC 5/02 processor's station address. (This event is called PLC-2 emulation.)

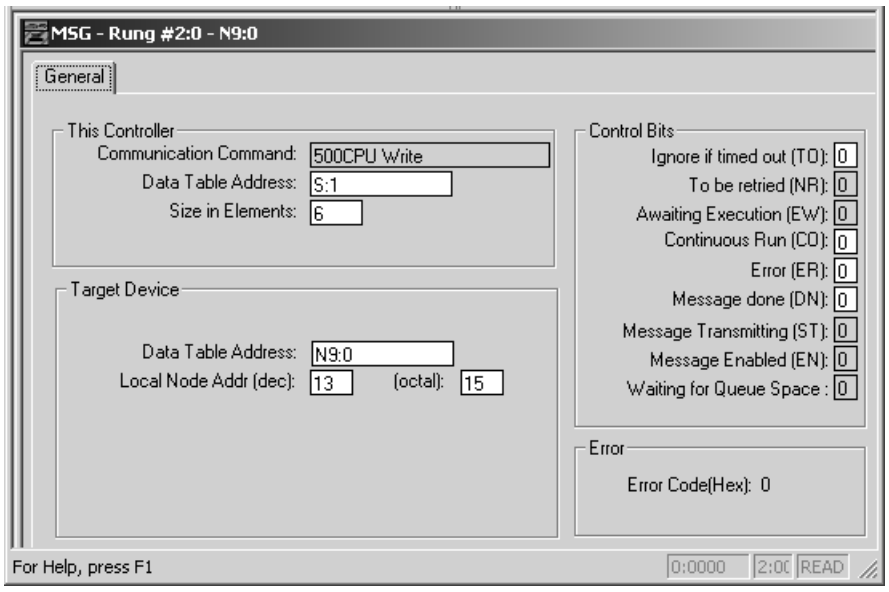
For example, if the SLC 5/02 processor in this example is station 10_{10}, then it reads the data from N10:10-N10:15 in the PLC-5 processor. File N10 must exist in the PLC-5 in order for the SLC 5/02 processor to read data from it.

For an example write MSG instruction from an SLC 5/02 processor to a PLC-5 processor, see Figure 5.7 on page 5-14. The MSG control block is configured the same regardless if the message is being sent from an SLC 5/02 remote station to a PLC-5 master station or an SLC 5/02 processor and a PLC-5 processor that are communicating in a point-to-point configuration.

Figure 5.9 Write MSG instruction from an SLC 5/02 processor to an SLC 500 processor.

ladder rung



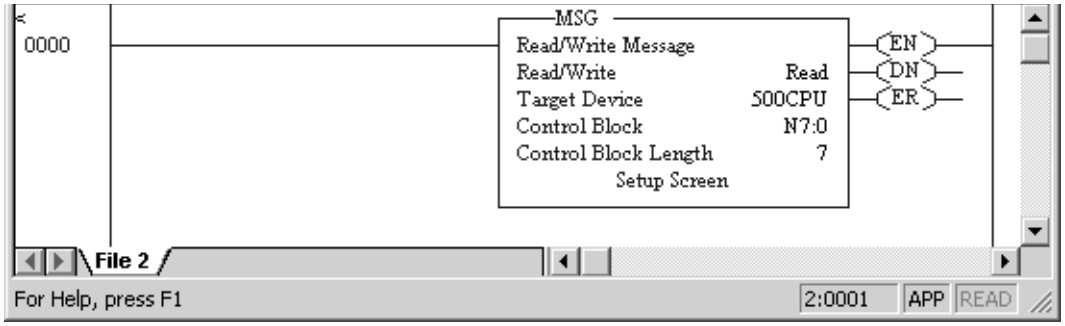


In this example, SLC 5/02 station 3 is issuing a write request, through a 1747-KE module whose DH-485 node address is 13_{10}, to an SLC 5/03 processor.

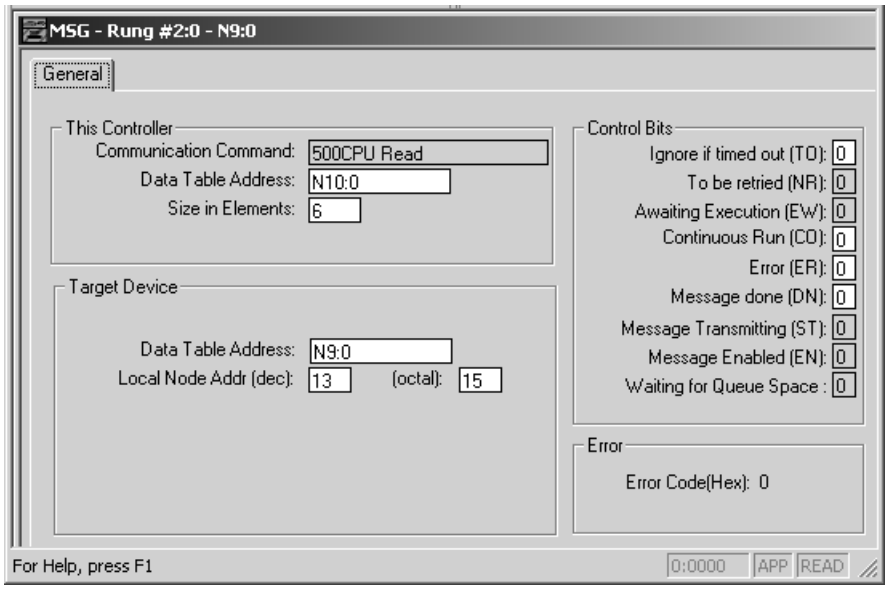
Station 3 wants to write the information from its S:1 to S:6 into the SLC 5/03 processor's data files N9:0 to N9:5.

Figure 5.10 Read MSG instruction from an SLC 5/02 processor to an SLC 500 processor.

ladder rung



setup screen



In this example, SLC 5/02 station 3 is issuing a read request, through a 1747-KE module whose DH-485 node address is 13_{10}, to an SLC 5/03 processor.

Station 3 reads the information from station 13_{10}'s data files N9:0 to N9:5 and puts that information into its own N10:0 to N10:5.

Configuring MicroLogix 1000 Controllers

Chapter Objectives

This chapter helps you set up a MicroLogix 1000 controller as a slave station, or as a station on a point-to-point link.

For information about	See page
an overview of the tasks required to configure a MicroLogix 1000 controller	6-2
installing the controller	6-3
automatic protocol switches	6-4
using modems that support DF1 communication protocols	6-5
modem control line operation	6-7
configuring the controller as a slave station	6-10
configuring RTS send delay and RTS off delay	6-11
configuring poll timeout	6-12
configuring the controller for point-to-point communication	6-13
the types of messages you can send from a MicroLogix 1000 controller to another processor; how to configure the MSG instruction and some configuration characteristics	6-14

Overview

To configure a MicroLogix 1000 controller:

1. Connect the serial cable to the PC.

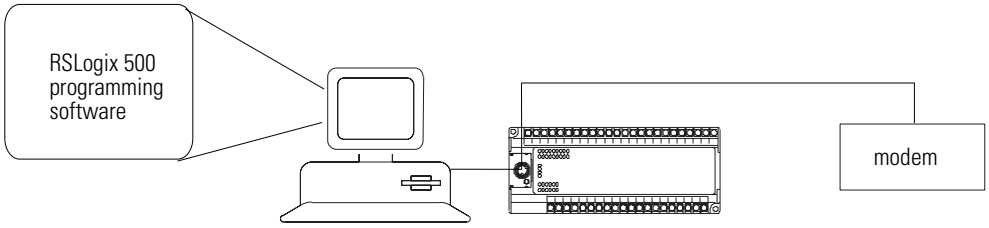
   The controller must be online to configure DF1 half-duplex slave parameters.

2. Define the controller's communication characteristics using RSLogix 500 programming software.

3. Disconnect the controller from the programming PC and install the controller at its working destination.

4. Connect the modem to the controller's serial channel.

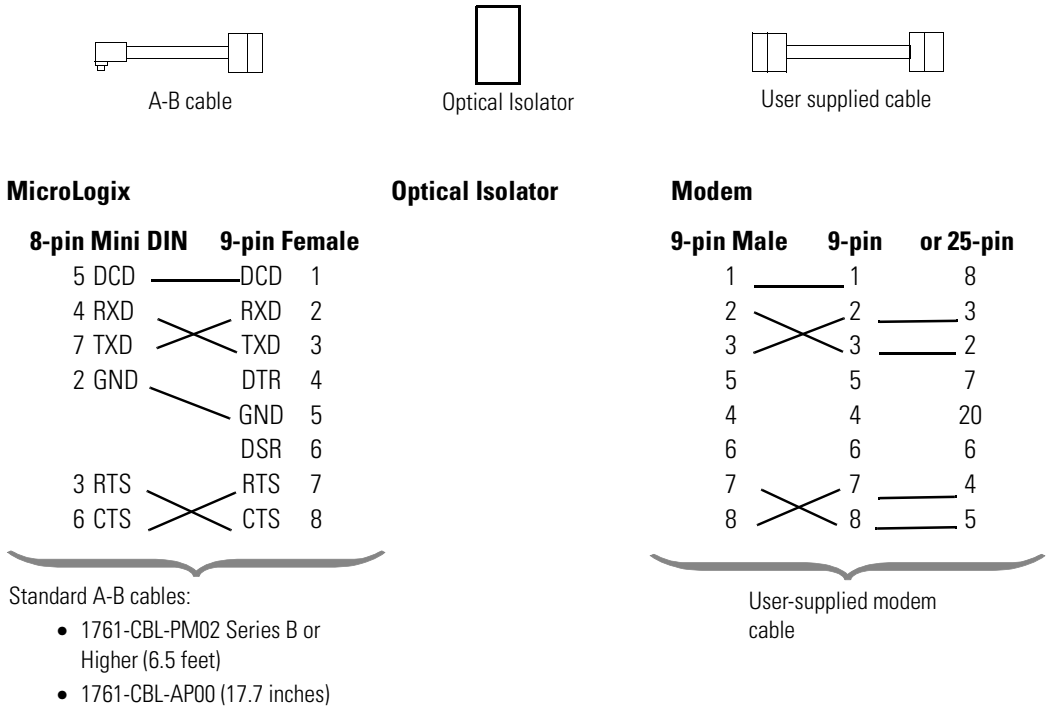
Figure 6.1 Basic Configuration



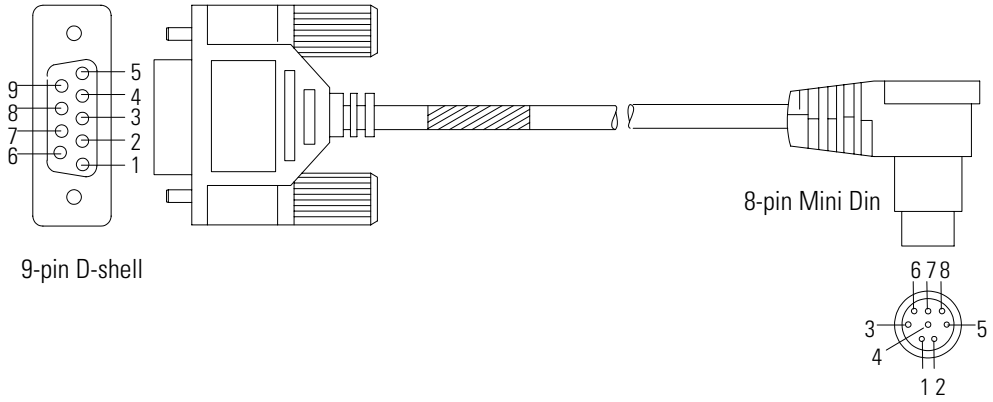
Installing the Controller

For details about installing the controller see the MicroLogix 1000 Programmable Controllers User Manual, publication number 1761-UM003. Cable designations are shown in each example configuration as well as in Appendix A.

Figure 6.2 MicroLogix Cable Pinouts



1761-CBL-PM02 Series B Cable

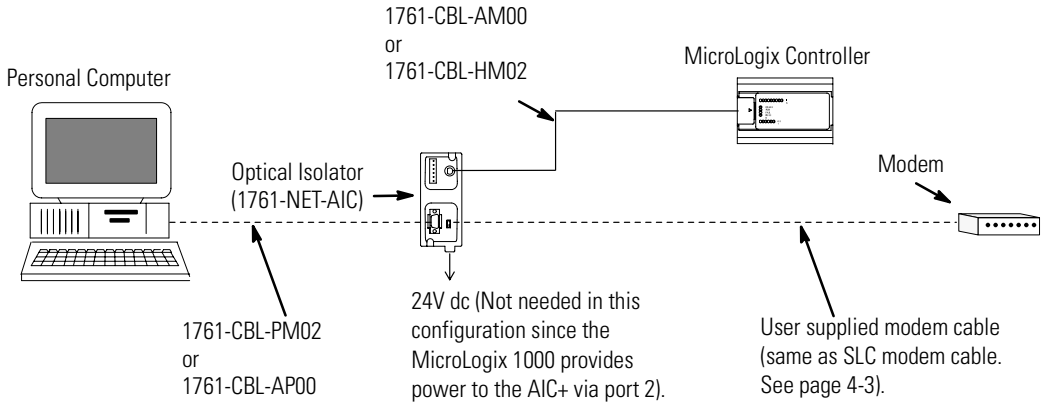


Isolated Connections

MicroLogix controllers should be installed using an Optical Isolator. The AIC+, catalog number 1761-NET-AIC is recommended. Example installations are shown below. Using the AIC+ also provides a communication active LED, which is not standard on the MicroLogix 1000 controller.

Figure 6.3 Isolated Connections Using AIC+

Note: In an actual application, only the personal computer or the modem would be connected to AIC+ port number 1 at any given time.



Automatic Protocol Switching

The MicroLogix 1000 Series D (and higher) discrete and MicroLogix 1000 analog controllers perform automatic protocol switching between DH-485 and the configured DF1 protocol. The controller cannot automatically switch between DF1 full-duplex and DF1 half-duplex slave. With DF1 configured as the primary protocol (S:0/10=0), this feature allows you to switch from active communication on a DF1 half-duplex network to the DH-485 protocol to make program changes.

Simply disconnect the MicroLogix controller from the half-duplex modem and connect it to your personal computer. The controller recognizes the computer is attempting to communicate using the DH-485 protocol and automatically switches to it. When your program changes are complete, you can disconnect your computer, reconnect the modem, and the controller will automatically switch back to DF1 half-duplex slave protocol.

The following baud rate limitations affect autoswitching:

- If the configured DH-485 baud rate is 19200, the configured DF1 baud rate must be 4800 or greater.
- If the configured DH-485 baud rate is 9600, the configured DF1 baud rate must be 2400 or greater.

If your DF1 half-duplex slave baud rate is 1200 or less, and if your process can tolerate a brief power cycle of the MicroLogix 1000 controller, you may set DH-485 as the primary protocol (S:0/10=1). Upon power cycle, if your programming computer is attempting to communicate using DH-485 protocol it will successfully go online. Otherwise, if the modem is connected, upon power cycle the MicroLogix 1000 controller will automatically switch from DH-485 to DF1 protocol.

Using Modems that Support DF1 Communication Protocols

The types of modems that you can use with MicroLogix controllers include dial-up phone modems, leased-line modems, radio modems and line drivers. For point-to-point full-duplex modem connections that do not require any modem handshaking signals to operate, use DF1 full-duplex protocol. For point-to-multipoint modem connections, or point-to-point modem connections that require RTS/CTS handshaking, use DF1 half-duplex slave protocol. In this case, one (and only one) of the other devices must be configured for DF1 half-duplex master protocol.

IMPORTANT Do not attempt to use DH-485 protocol through modems under any circumstance.

IMPORTANT Only Series D or later MicroLogix 1000 discrete controllers and all MicroLogix 1000 analog controllers support RTS/CTS modem handshaking, and only when configured for DF1 half-duplex slave protocol with the control line parameter set to Half-Duplex Modem. No other modem handshaking lines (i.e. Data Set Ready, Carrier Detect and Data Terminal Ready) are supported by any MicroLogix controllers.

Dial-up Phone Modems

Dial-up phone line modems support point-to-point full-duplex communications. Normally, a MicroLogix controller is on the receiving end of the dial-up connection, and is configured for DF1 full-duplex protocol. The modem connected to the MicroLogix controller must support auto-answer and must not require any modem handshaking signals from the MicroLogix (i.e. DTR or RTS) in order to operate. The MicroLogix has no means to cause its modem to initiate or disconnect a phone call, so this must be done from the site of the remote modem.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be point-to-point topology supporting full-duplex communications between two modems or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology, configure the MicroLogix for DF1 full-duplex protocol (as long as the modems used do not require DTR or RTS to be high in order to operate). In the point-to-multipoint topology, configure the MicroLogix controllers for DF1 half-duplex slave protocol with the control parameter set to Half-Duplex Modem.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either half-duplex or full-duplex communications, or in a point-to-multipoint topology supporting half-duplex communications between three or more modems. In the point-to-point topology using full-duplex radio modems, configure the MicroLogix controllers for DF1 full-duplex protocol (as long as the modems used do not require DTR or RTS to be high in order to operate). In the point-to-point topology using half-duplex radio modems, or point-to-multipoint topology using half-duplex radio modems, configure the MicroLogix controllers for DF1 half-duplex slave protocol. If these radio modems require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem.

Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Allen-Bradley's AIC+ Advanced Interface Converter is a line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet. In a point-to-point line driver topology, configure the MicroLogix controller for DF1 full-duplex protocol (as long as the modems used do not require DTR or RTS to be high in order to operate). In a point-to-multipoint line driver topology, configure the MicroLogix controllers for DF1 half-duplex slave protocol. If these line drivers require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem.

Modem Control Line Operation

DF1 Full-Duplex Operation

DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) is useful where RS-232 point-to-point communication is required. This type of protocol supports simultaneous transmissions between two devices in both directions. DF1 protocol controls message flow, detects and signals errors, and retries if errors are detected. Its implementation in the MicroLogix 1000 does not support any modem control lines.

DF1 Half-Duplex Slave Operation

DF1 half-duplex slave protocol provides a multi-drop single master/multiple slave network. In contrast to DF1 full duplex, communication takes place in one direction at a time. You can use the RS-232 port on the MicroLogix as both a half-duplex programming port, as well as a half-duplex peer-to-peer messaging port.

The master device initiates all communication by polling each slave device. The slave device may only transmit message packets when it is polled by the master. It is the master's responsibility to poll each slave on a regular and sequential basis to allow slaves to send message packets back to the master. During a polling sequence, the master polls a slave either repeatedly until the slave indicates that it has no more message packets to transmit or just one time per polling sequence, depending on how the master is configured.

An additional feature of the DF1 half-duplex protocol is that it is possible for a slave device to enable a MSG instruction in its ladder program to send or request data to/from another slave. When the initiating slave is polled, the MSG instruction command packet is sent to the master. The master recognizes that the command packet is not intended for it but for another slave, so the master immediately rebroadcasts the command packet to the intended slave. When the intended slave is polled, it sends a reply packet to the master with the data the first slave requested. The master immediately rebroadcasts the reply packet to that slave. This slave-to-slave transfer is a function of the master device and is also used by programming software to upload and download programs to controllers on the DF1 half-duplex link.

DF1 half-duplex supports up to 255 devices (address 0 to 254) with address 255 reserved for master broadcasts. The MicroLogix supports broadcast reception but cannot initiate a broadcast command. The MicroLogix supports half-duplex modems using RTS/CTS hardware handshaking.

DF1 Slave on a Multi-drop Link

When communication is between either your programming software and a MicroLogix controller or between two MicroLogix controllers via a slave-to-slave connection on a larger multi-drop link, the devices depend on a DF1 Master to give each of them polling permission to transmit in a timely manner. As the number of slaves increases on the link (up to 254), the time between when your programming software or the MicroLogix controller is polled also increases. This increase in time becomes larger is you are using low baud rates.

As these time periods grow, the following values may need to be changed to avoid loss of communication:

- programming software - increase poll timeout value and reply timeout values
- MicroLogix controller - increase poll timeout

Ownership Timeout

When a program download sequence is started by a software package to download a ladder logic program to a MicroLogix controller, the software takes file ownership of the controller. File ownership prevents other devices from reading from or writing to the controller while the download is in process. If the controller were to respond to a device's read commands during the download, the controller could respond with incorrect information. Similarly, if the controller were to accept information from other devices, the information could be lost because the program download sequence could immediately overwrite the information. Once the download is completed, the programming software returns the file ownership to the controller, so other devices can communicate with it again.

With the addition of DF1 half-duplex slave protocol, the controller clears the file ownership if no supported commands are received from the owner within the timeout period. If the file ownership were not cleared after a download sequence interruption, the controller would not accept commands from any other devices because it would assume another device still had file ownership.

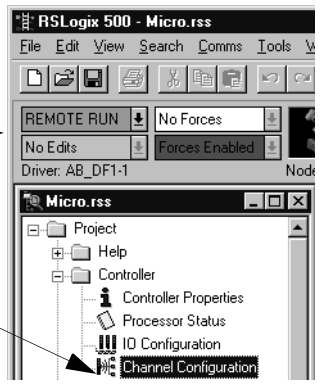
If a download sequence is interrupted, due to noise caused by electromagnetic interference, discontinue communications to the controller for the ownership timeout period and restart the program download. The ownership timeout period is set to 60 seconds as a default for all protocols. However, if you are using DF1 half-duplex and the poll timeout value is set higher than 60 seconds, the poll timeout value will be used instead of the ownership timeout. After the timeout, you can re-establish communications with the controller and try the program download again. The only other way to clear file ownership is to cycle power on the controller.

Configuring a Slave Station

IMPORTANT The MicroLogix 1000 controller must be online to be configured. When offline, the controller does not allow key parameters to be available to set.

To choose the controller as a slave station, follow the steps below your programming software:

1. Check that you are online with the controller to be configured. You should see Remote Run or Remote Program.
2. Double-click on the Channel Configuration icon to bring up the Channel Configuration interface.



3. Scroll down the list and choose the desired baud rate.
4. Click the radio button and choose Half-Duplex Slave.
5. Configure the communication driver characteristics according to Table 6.1.

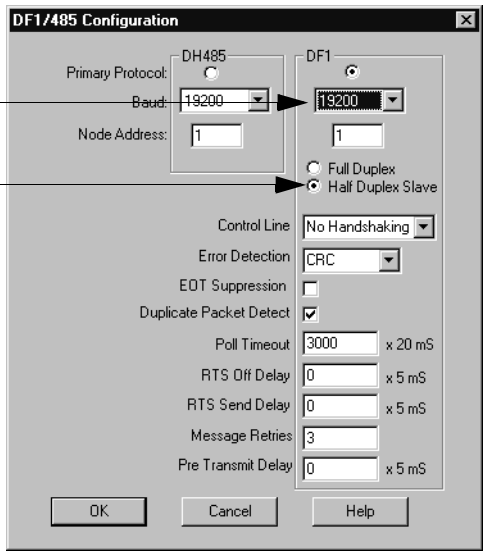


Table 6.1 DF1 Half-duplex Slave Configuration Parameters

Parameter	Description	Default
Baud Rate	Toggles between the communication rate of 300, 600, 1200, 2400, 4800, 9600, 19200, and 38.4K.	9600
Node Address	Valid range is 0 to 254 decimal.	1
Control Line	Toggles between No Handshaking and Half-duplex Modem.	No Handshaking
Duplicate Packet Detection	Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions when the sender's retries are not set to 0. Toggles between Enabled and Disabled.	Enabled
Error Detection	Toggles between CRC and BCC.	CRC
RTS Off Delay	Specifies the delay time between when the last serial character is sent to the modem and when RTS will be deactivated. Gives modem extra time to transmit the last character of a packet. The valid range is 0 to 255 and can be set in increments of 5 ms. Refer to page 6-11 for further details.	0
RTS Send Delay	Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS. The valid range is 0 to 255 and can be set in increments of 5 ms. Refer to page 6-11 for further details.	0
Poll Timeout	Poll Timeout only applies when a slave device initiates a MSG instruction. It is the amount of time that the slave device will wait for a poll from the master device. If the slave device does not receive a poll within the Poll Timeout, a MSG instruction error will be generated, and the ladder program will need to requeue the MSG instruction. The valid range is 0 to 65535 and can be set in increments of 20 ms. If you are using a MSG instruction, it is recommended that a Poll Timeout value of 0 not be used. Poll Timeout is disabled if set to 0. Refer to page 6-12 for further details.	3000 (60 seconds)
Pre-send Time Delay	Delay time before transmission. Required for 1761-NET-AIC physical half-duplex networks. The 1761-NET-AIC needs delay time to change from transmit to receive mode. The valid range is 0 to 255 and can be set in increments of 5 ms.	0
Message Retries	Specifies the number of times a slave device will attempt to resend a message packet when it does not receive an ACK from the master device. For use in noisy environments where message packets may become corrupted in transmission. The valid range is 0 to 255.	3
EOT Suppression	Slave does not respond when polled if no message is queued. Saves modem transmission power when there is no message to transmit. Toggles between Yes and No.	No

Configuring RTS Send Delay and RTS Off Delay

Through your programming software, the parameters RTS Send Delay and RTS Off Delay give you the ability to set how long RTS is on prior to transmission, as well as how long to keep it on after transmission is complete. These parameters only apply when you select half-duplex modem. For maximum communication throughput, leave these parameters at zero.

For use with half-duplex modems that require extra time to turnaround or key-up their transmitter even after they have activated CTS, the RTS Send Delay specifies (in 5 millisecond increments) the

amount of delay time after activating RTS to wait before checking to see if CTS has been activated by the modem. If CTS is not yet active, RTS remains active, and as long as CTS is activated within one second, the transmission occurs. After one second, if CTS is still not activated, then RTS is set inactive and the transmission is aborted.

For modems that do not supply a CTS signal but still require RTS to be raised prior to transmission, jumper RTS to CTS and use the shortest delay possible without losing reliable operation.

If an RTS Send Delay of 0 is selected, then transmission starts as soon as CTS is activated. If CTS does not go active within one second after RTS is raised, RTS is set inactive and the transmission is aborted.

Certain modems will drop their carrier link when RTS is set inactive even though the transmission has not quite been finished. The RTS Off Delay parameter specifies in 5 millisecond increments the delay between when the last serial character is sent to the modem and when RTS is deactivated. This gives the modem extra time to transmit the last character of a packet.

ATTENTION

For almost all modem applications, the RTS Off Delay should be left at 0. Never Select an RTS Off Delay that is greater than the RTS Send Delay in the other devices on the network, or you may incur two devices trying to transmit simultaneously.

Configuring Poll Timeout

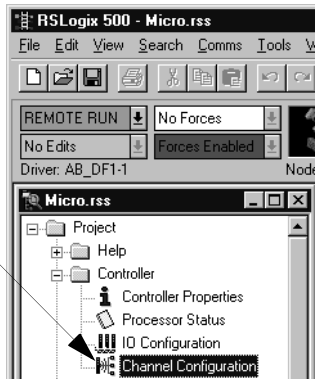
The Poll Timeout is only used when the DF1 half-duplex slave is initiating MSG instructions in ladder logic. This implies that the master is most likely configured for Standard Polling Mode. The minimum Poll Timeout value is dependent on the maximum master poll scan rate. Since the master's polling and the slave's triggering of a MSG instruction are asynchronous events, it is possible that in the instant just after the slave was polled, the MSG instruction gets triggered. This means the MSG instruction will remain queued-up for transmission until the master has polled every other slave first. Therefore, the minimum Slave Poll Timeout value is equal to the maximum master poll scan rate rounded up to the next 20 ms increment.

Minimum Poll Timeout = (maximum Master scan poll rate)

Configuring a Point-to-Point Station

To choose the controller as a point-to-point station, follow the steps below using your programming software:

1. Double-click on the Channel Configuration icon to bring up the Channel Configuration interface.



2. Scroll down the list and choose the desired baud rate.
3. Click the radio button and choose Full Duplex.
4. Communication characteristics are not adjustable in Full Duplex. See table 6.2 for default parameter settings.

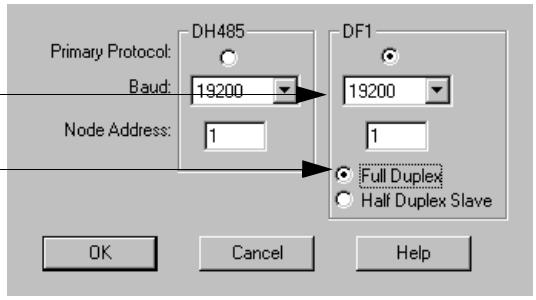


Table 6.2 DF1 Full-Duplex Configuration Parameters MicroLogix 1000

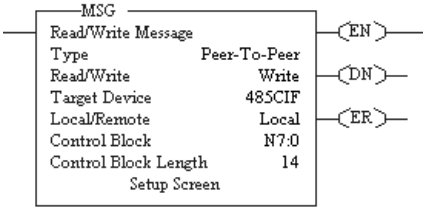
Parameter	Options	Default
Baud Rate	Toggles between the communication rates of 300, 600, 1200, 2400, 4800(1), 9600, 19200, and 38400(1).	9600(2)
Node Address	Valid range is 0 to 254 decimal for MicroLogix 1000 Series C and later discrete and all MicroLogix 1000 analog. Not configurable for MicroLogix 1000 Series A and B discrete.	1
Parity	None	No Parity
Stop Bits	None	1
Error Detection	None	CRC
DLE NAK Retries	None	N retries(3)
DLE ENQ Retries	None	N retries(3)
ACK Timeout	None	1 second
Duplicate Packet Detection	None	Enabled
Control Line	None	No Handshaking
Embedded Responses	None	Enabled

(1) Applicable only to MicroLogix 1000 Series D or later discrete and all MicroLogix 1000 analog controllers.

(2) If retentive communication data is lost, the default is 1200 for MicroLogix 1000 Series A, B, or C discrete only.
For MicroLogix 1000 Series D or later discrete and all MicroLogix 1000 analog, if retentive communication data is lost, baud rate defaults to 9600.

(3) N=255 for MicroLogix 1000 Series A and B discrete.
N=6 for MicroLogix 1000 Series C and later discrete and all MicroLogix 1000 analog.

Messaging



Messaging in a MicroLogix 1000 controller can occur between:

- a master station and a slave station. For more information see the chapter pertaining to the master device you are using.
- a slave station and its master station. See Polled Report-by-Exception.
- between two controllers connected via a point-to-point link.

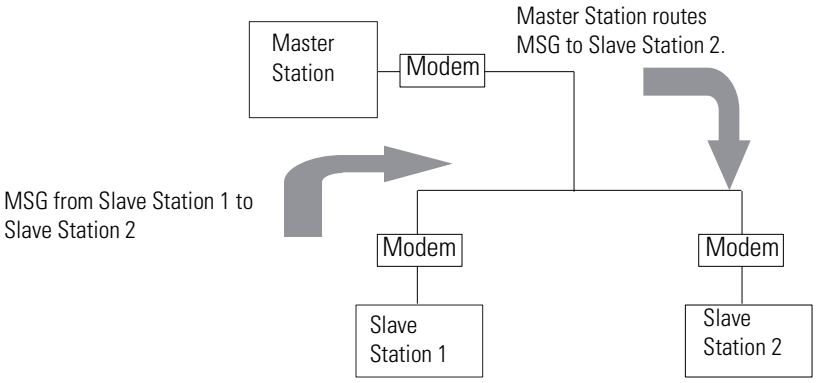
Polled Report-by-Exception

A slave station can gather information from the I/O points it is responsible for and can send any anomalous readings to the master station. To do this, write logic in the slave station's controller to monitor certain conditions and send the data in an MSG instruction to the master station. Figure 6.5 is an example MSG instruction and control block that a MicroLogix 1000 controller slave station can send to a PLC-5 master station. Figure 6.7 is an example MSG instruction and control block that a MicroLogix 1000 controller slave station can send to a MicroLogix 1200 and 1500, SLC 500 or Logix master station. For sample messaging ladder logic when using a MicroLogix 1000 as a slave, see page E-14.

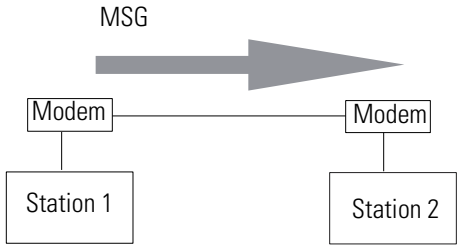
Processor-to-Processor

A processor-to-processor message can be the following types:

- In a point-to-multipoint configuration, the messaging would be between slave stations; the master station automatically routes the message.



- In a point-to-point configuration, the messaging would be between the two connected peer devices.



The configuration of the network (point-to-multipoint vs. point-to-point) and the configuration of the station (slave or peer) does not affect how you configure an MSG instruction. That is, an MSG instruction being sent between two MicroLogix slave stations is configured the same as an MSG instruction between two MicroLogix controllers connected point-to-point. See Figure 6.5 through Figure 6.8 for example MSG control blocks.

Considerations When Configuring MSG Control Blocks

The MicroLogix 1000 can only execute 1 MSG instruction at a time. Each MSG instruction should complete done or in error before the next one is triggered.

Use the active protocol bit (S:0/11) as a pre-condition in the MSG instruction rung to restrict message operation to a specific protocol. This is a read-only bit that indicates which communication protocol is currently enabled (0=DF1 and 1=DH-485).

Keep the following considerations in mind when configuring messages between a MicroLogix 1000 controller and a PLC-5 processor:

- In the MicroLogix 1000 485CIF type MSG instruction, Target Node is the decimal node address of the PLC-5 processor and Targets CIF Offset is the decimal byte-offset, which is the element you want to write data into or read data from.

- The MicroLogix 1000 controller uses word addressing, while the PLC-5 processor uses byte addressing. In the Targets CIF Offset field of the MicroLogix 1000 MSG control block, enter a word value equivalent to the byte (element) of the PLC-5 file number you want to write data into or read data from. For example in Figure 6.5, the Targets CIF Offset is 20; this corresponds to element 10_{10} in a PLC-5 processor because one word = two bytes. Never enter an odd value for a Targets CIF Offset.
- The MicroLogix 1000 controller can only directly address words 0_{10}-127_{10} in a PLC-5 data table file. By specifying a byte-offset of 254 in the Targets CIF Offset field and specifying a Message Length of 41, you can indirectly address words 128_{10}-167_{10} in a PLC-5 data table file. The maximum read or write message length for a MicroLogix 1000 controller is 41 elements.
- In the PLC-5 processor, create integer files that correspond to the station addresses of the MicroLogix 1000 controllers that will be sending messages to the PLC-5 processor. Because, when a MicroLogix 1000 sends a MSG instruction to a PLC-5 processor, the MicroLogix 1000 controller reads data from and writes data to a PLC-5 integer file that is equal to the MicroLogix 1000 controller's DF1 station address.

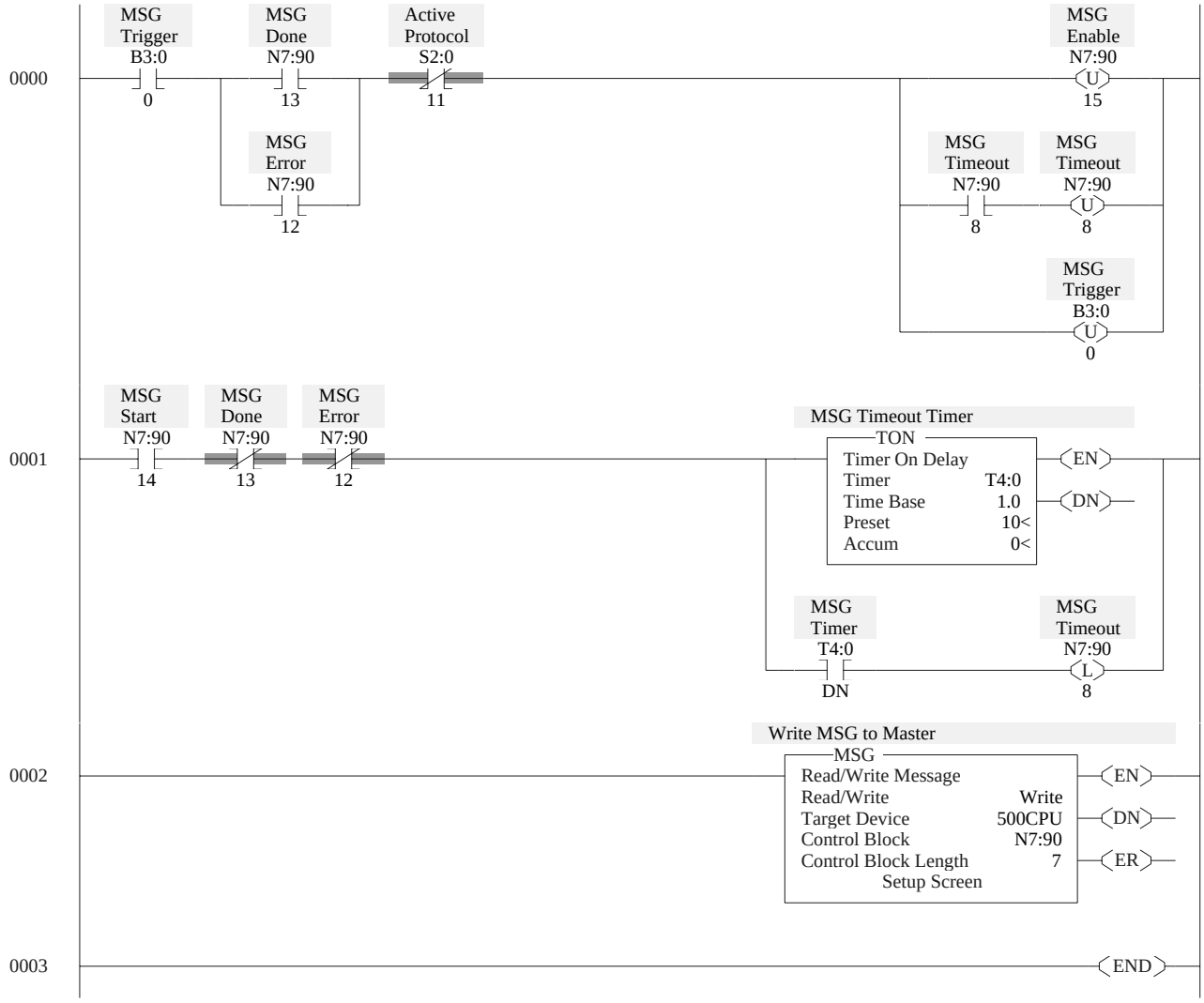
Keep the following considerations in mind when configuring messages between a MicroLogix 1000 controller and another MicroLogix, SLC 500 or Logix controller:

- Use the 500CPU type MSG instruction. The maximum read or write message length is 41 elements.
- In a Logix controller, a controller-scoped tagname must be mapped to a PLC 3, 5/SLC file number.

Configuring MSG Block Message Timeout

The MicroLogix 1000 does not have a message timeout built into the MSG instruction. So the user should assign a timer with the appropriate MSG timeout bit control for each MSG instruction. See Figure 6.4 for a sample of MSG Timeout ladder logic.

Figure 6.4 Message Timeout Ladder Logic



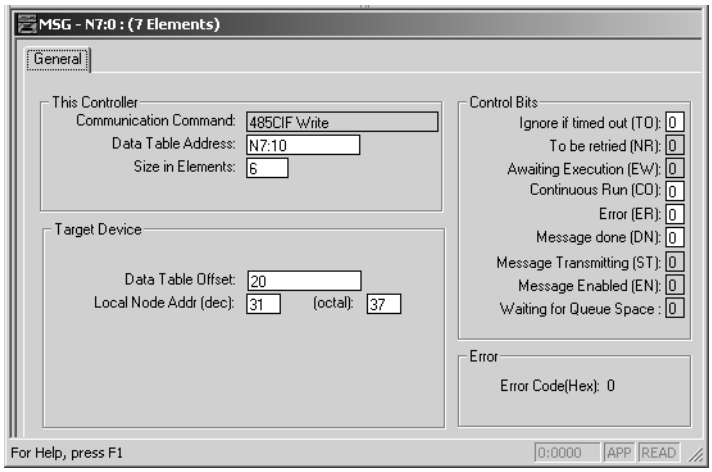
Example MSG Control Blocks

Application	See	Page
MicroLogix 1000 write message to a PLC-5 processor	Figure 6.5	6-19
MicroLogix 1000 read message to a PLC-5 processor	Figure 6.6	6-20
MicroLogix 1000 write MSG to either MicroLogix, SLC 500 or Logix controller	Figure 6.7	6-21
MicroLogix 1000 read MSG to either MicroLogix, SLC 500 or Logix controller	Figure 6.8	6-22

Figure 6.5 Write MSG Instruction from a MicroLogix 1000 Controller to a PLC-5 Processor

ladder rung

setup screen



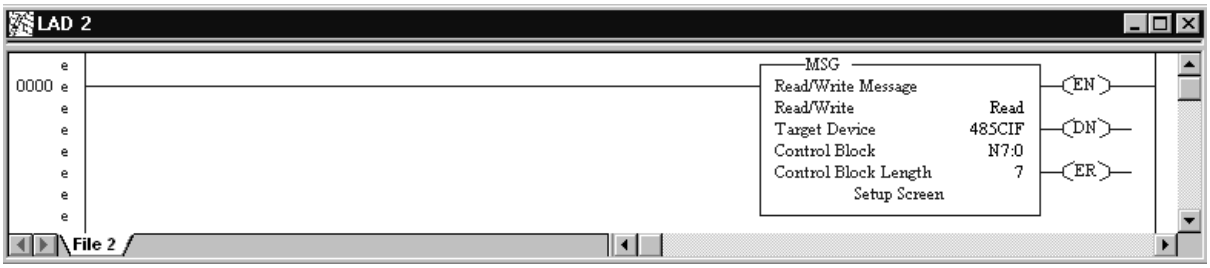
This MSG example is telling the MicroLogix 1000 station (station 99_{10}) to write the information from its N7:10-N7:15 to the PLC-5 station 31_{10}. The data's destination is N99:10 (for a target byte offset of 20_{10}) of the PLC-5 processor.

IMPORTANT The MicroLogix 1000 controller writes the information into an integer file in the PLC-5 processor's data table. The integer file number is equal to the MicroLogix 1000 controller's station address (this event is called PLC-2 emulation).

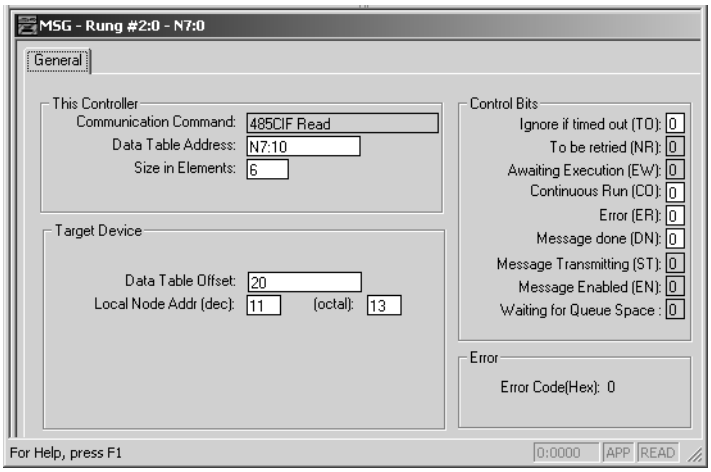
For example, if the MicroLogix 1000 controller in this example is station 99_{10}, then it writes the data from its N7:10 - N:15 into N99 of the PLC-5 station. File N99 must exist in the PLC-5 in order for it to receive data from the MicroLogix 1000 station.

Figure 6.6 Read MSG Instruction from a MicroLogix 1000 Controller to a PLC-5 Processor

ladder rung



setup screen



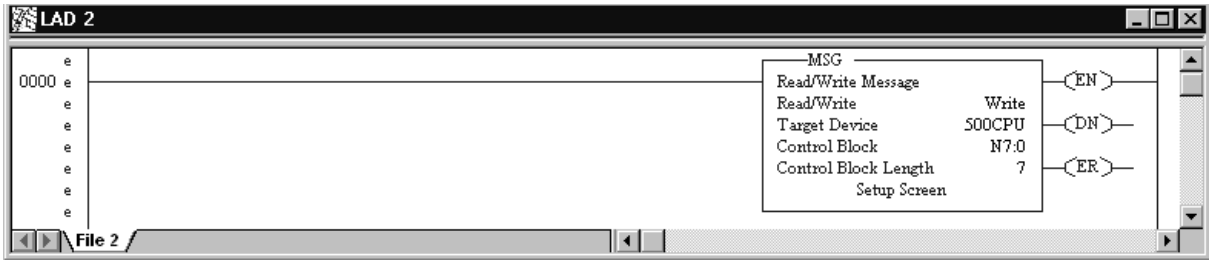
In this example, MicroLogix 1000 station 10_{10} is issuing a read command to a PLC-5 station. The MicroLogix 1000 station (station 10_{10}) reads the information in N10:10-N10:15 of the PLC-5 station and puts that information into its N7:10-N7:15.

IMPORTANT The MicroLogix 1000 controller reads the information from an integer file in the PLC-5 processor's data table that corresponds to the MicroLogix 1000 controller's station address (this event is called PLC-2 emulation).

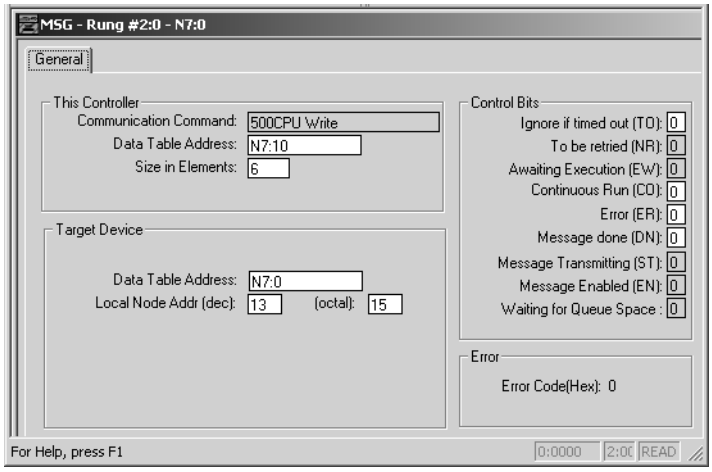
For example, if the MicroLogix 1000 controller in this example is station 10_{10}, then it reads the data from N10:10-N10:15 in the PLC-5 processor. File N10 must exist in the PLC-5 in order for the MicroLogix 1000 controller to read data from it.

Figure 6.7 Write MSG Instruction from a MicroLogix 1000 Controller to a Micrologix, SLC 500 or Logix Controller

ladder rung



setup screen



In this example, MicroLogix 1000 station 3 is issuing a write request to station 13_{10}.

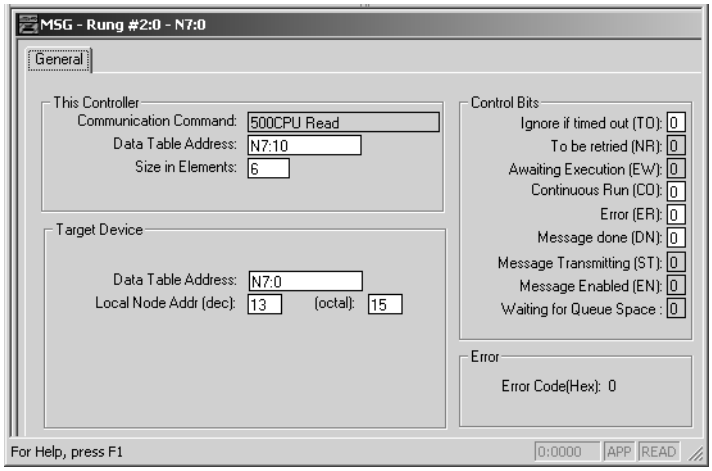
Station 3 wants to write the information from its N7:10-N7:15 into the station 13_{10} data files N7:0-N7:5.

For a Logix controller, a controller-scoped tagname must be mapped to N7.

Figure 6.8 Read MSG Instruction from a MicroLogix 1000 Controller to a MicroLogix, SLC 500 or Logix Controller

ladder rung

setup screen



In this example, MicroLogix 1000 station 3 is issuing a read request to station 13_{10}.

Station 3 reads the information from station 13_{10}'s data files N7:0-N7:5 and puts that information into its own N7:10-N7:15.

For a Logix controller, a controller-scoped tagname must be mapped to N7.

Configuring Logix Controllers

Chapter Objectives

This chapter helps you set up a Logix (ControLogix, FlexLogix, and CompactLogix) controller as a master station, as a slave station, or as a station on a point-to-point link.

For information about:	See page:
an overview of the tasks required to configure a Logix controller	7-2
installing the controller	7-3
using modems that support DF1 communication protocols	7-3
configuring the controller to use the serial port	7-5
modem control line operation	7-7
configuration considerations for RTS send and off delays	7-8
configuring a standard-mode DF1 half-duplex master station	7-8
configuring a master station for standard polling mode	7-9
DF1 half-duplex master diagnostic counter	7-13
configuring a message-based mode DF1 half-duplex master station	7-16
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configuring the controller as a slave station	7-19
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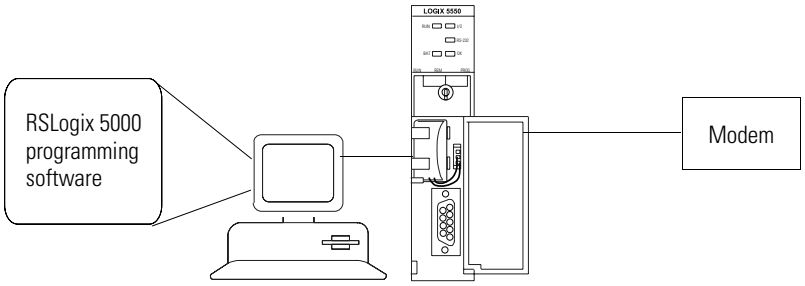
DF1 half-duplex slave diagnostic counters	7-20
configuring the controller as a station on a point-to-point link	7-22
DF1 point-to-point diagnostic counters	7-24
accessing DF1 diagnostic counters	7-25
messaging	7-28
example MSG control blocks	7-31
logix controller error codes for PLC and SLC messages	7-38

Overview

To configure a Logix controller:

1. Install the controller.
2. Install and configure the modem.
3. Define the controller's communication characteristics using RSLogix™ 5000 programming software.

Figure 7.1 Configuring a Logix Controller



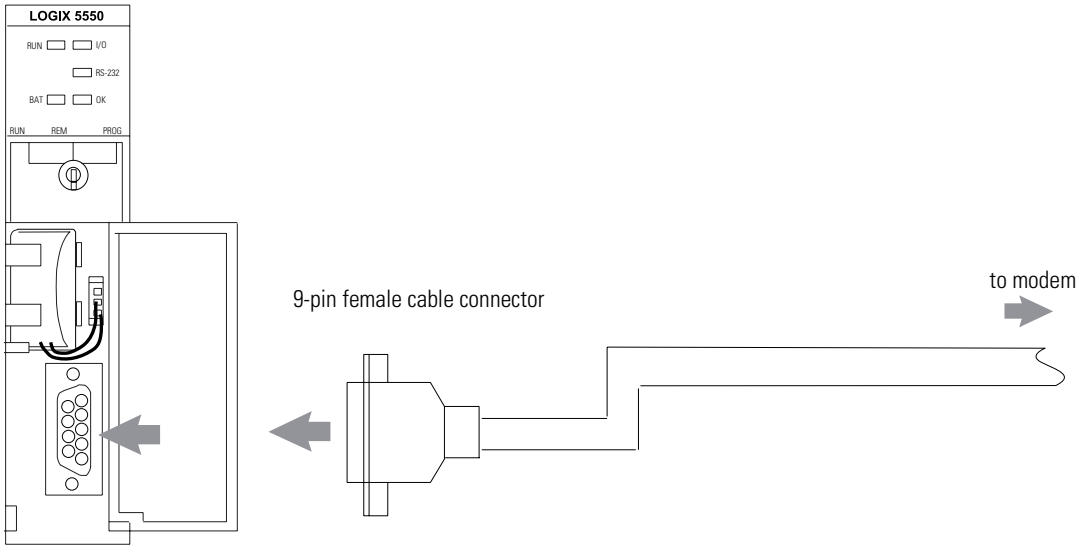
Installing the Controller

For details about installing the controller, see the Logix Controller Installation Instructions.

9-pin female	25-pin Modem		9-pin Modem
DCD.IN	1	8	1
RXD.IN	2	3	2
TXD.OUT	3	2	3
DTR.OUT	4	20	4
SIG.GND	5	7	5
DSR.IN	6	6	6
RTS.OUT	7	4	7
CTS.IN	8	5	8

For cable pin assignments, see below, or page A-5.

Figure 7.2 Logix Serial Port Pin Assignments



Using Modems that Support DF1 Communication Protocols

The types of modems that you can use with Logix controllers include dial-up phone modems, leased-line modems, radio modems and line drivers. For point-to-point full-duplex modem connections, use DF1 full-duplex protocol. For point-to-multipoint modem connections, use DF1 half-duplex master and slave protocols. In this case, one (and only one) of the other devices must be configured for DF1 half-duplex master protocol.

Dial-up Phone Modems

Dial-up phone line modems support point-to-point full-duplex communications. Normally, a Logix controller on the initiating or receiving end of the dial-up connection will be configured for DF1 full-duplex protocol with the control line parameter set for Full-Duplex Modem. See page 7-7 for details on the operation of the RS-232 modem control signals when Full-Duplex Modem is selected. Refer to chapter 11 for further details on using Logix controllers in dial-up modem applications.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be point-to-point topology supporting full-duplex communications between two modems or in a point-to-multipoint topology supporting half-duplex communications between two or more modems. In the point-to-point topology, configure the Logix controller for DF1 full-duplex protocol with the control line parameter set to Full-Duplex Modem. In the point-to-multipoint topology, configure the Logix controller for DF1 half-duplex master or slave protocol with the control parameter set to Half-Duplex Modem without Continuous Carrier. See page 7-7 for details on the operation of the RS-232 modem control signals when Half-Duplex Modem without Continuous Carrier is selected.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either half-duplex or full-duplex communications, or in a point-to-multipoint topology supporting half-duplex communications between two or more modems. In the point-to-point topology using full-duplex radio modems, configure the Logix controllers for DF1 full-duplex protocol. In the point-to-multipoint topology using half-duplex radio modems, configure the Logix controllers for DF1 half-duplex master or slave protocol. If these radio modems require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem without Continuous Carrier.

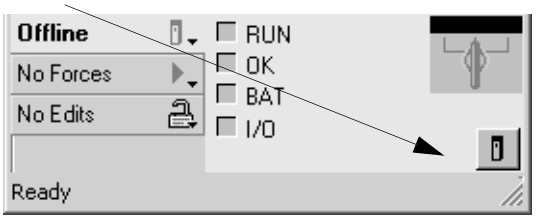
Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Allen-Bradley's AIC+ Advanced Interface Converter is a line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet. In a point-to-point line driver topology, configure the Logix controller for DF1 full-duplex protocol. In a point-to-multipoint line driver topology, configure the Logix controllers for DF1 half-duplex master or slave protocol. If these line drivers require RTS/CTS handshaking, configure the control line parameter to Half-Duplex Modem without Continuous Carrier.

Configuring the Controller to Use the Serial Port

To configure the serial port:

1. To bring up the Controller Properties interface, click on the controller icon just beneath the keyswitch icon.



2. Choose the appropriate Serial Port Channel tab and configure according to your specification. Serial Port parameters and defaults can be found in 7.1.

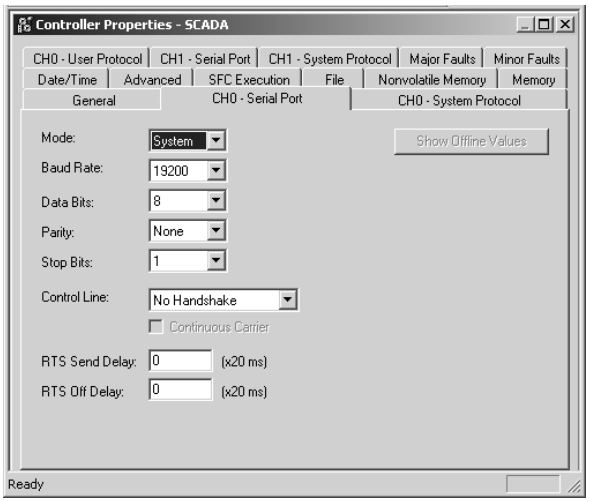


Table 7.1 Serial Port Parameters and Defaults

Parameter	Description	Default
Baud Rate	Specifies the communication rate for the serial port. Select a baud rate that all devices in your system support. Select 110, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400 bits/s.	19200
Parity	Specifies the parity setting for the serial port. Parity provides additional message-packet error detection. Select Even, Odd, or None.	None
Data Bits	Specifies the number of data bits per message character. Select 7 or 8.	8
Stop Bits	Specifies the number of stop bits per message character. Select 1 or 2.	1
Control Line	Specifies the mode in which the serial driver operates. Select No Handshake, Full-Duplex, Half-Duplex (with Continuous Carrier unchecked), or Half-Duplex (with Continuous Carrier checked). If you are not using a modem, select No Handshake If both modems in a point-to-point link are full-duplex, select Full-Duplex for both controllers. If the master modem is full duplex and the slave modem is half-duplex, select Full-Duplex for the master controller and select Half-Duplex (with Continuous Carrier checked) for the slave controller. If all the modems in the system are half-duplex, select Half-Duplex (without Continuous Carrier unchecked) for the controller. See page 7-7 for further details.	No Handshake
RTS Send Delay	Enter a count that represents the number of 20 ms periods of time that elapse between the assertion of the RTS signal and the beginning of a message transmission. This time delay lets the modem prepare to transmit a message. The CTS signal must be high for the transmission to occur. See page 7-7 for further details. The range is 0 to 32767 periods.	0
RTS Off Delay	Enter a count that represents the number of 20 ms periods of time that elapse between the end of a message transmission and the de-assertion of the RTS signal. This time delay is a buffer to make sure the modem successfully transmits the entire message. See page 7-7 for further details. The range is 0 to 32767 periods. Normally leave at zero.	0

Modem Control Line Operation

The following sections explain the operation of the Logix controller serial port control line selections.

No Handshake Selected

DTR is always active (high) and RTS is always inactive (low). Receptions and transmissions take place regardless of the states of DSR, CTS, or DCD inputs. Only make this selection when the Logix controller is directly connected to another device that does not require handshaking signals.

Full-Duplex Selected

DTR and RTS are always active except:

- If DSR goes inactive, both DTR and RTS are dropped for 1 to 2 seconds, then reactivated. The modem lost minor fault comes on immediately. While DSR is inactive, the state of DCD is ignored. Neither receptions nor transmissions are performed.
- If DCD goes inactive while DSR is active, then receptions are not allowed. If DCD remains inactive for 9 to 10 seconds, DTR is set inactive. At this point, the modem lost minor fault also comes on. If DSR remains active, DTR is raised again in 5 to 6 seconds.

Reception requires DSR and DCD to be active. Transmission requires all three inputs (CTS, DCD, and DSR) to be active. Whenever DSR and DCD are both active, the modem lost minor fault goes off.

Half-Duplex Selected with Continuous Checked

DTR is always active and RTS is only activated during transmissions (and any programmed delays before or after transmissions). The handling of DCD and DSR are exactly the same as with Full-Duplex Modem. Reception requires DSR and DCD to be active. Transmissions require CTS, DCD and DSR to be active. Whenever DSR and DCD are both active, the modem minor fault goes off.

Half-Duplex Selected with Continuous Carrier Unchecked

This is exactly the same as Half-Duplex Modem with Continuous Carrier checked, except monitoring of DCD is not performed. DCD is still required for receptions, but is not required for transmissions. Transmissions still require CTS and DSR. Whenever DSR is active, the modem lost minor fault goes off.

Configuration Considerations for RTS Send and Off Delays

Through your programming software, the parameters RTS Send Delay and RTS Off Delay give you the ability to set how long RTS is on prior to transmission, as well as how long to keep it on after transmission is complete. These parameters only apply when you select Half-Duplex with or without continuous carrier. For maximum communication throughput, leave these parameters at zero.

For use with half-duplex modems that require extra time to turnaround or key-up their transmitter even after they have activated CTS, the RTS Send Delay specifies (in 20 millisecond increments) the amount of delay time after activating RTS to wait before checking to see if CTS has been activated by the modem. If CTS is not yet active, RTS remains active, and as long as CTS is activated within one second, the transmission occurs. After one second, if CTS is still not activated, then RTS is set inactive and the transmission is aborted.

For modems that do not supply a CTS signal but still require RTS to be raised prior to transmission, jumper RTS to CTS and use the shortest delay possible without losing reliable operation.

If an RTS Send Delay of 0 is selected, then transmission starts as soon as CTS is activated. If CTS does not go active within one second after RTS is raised, RTS is set inactive and the transmission is aborted.

Certain modems will drop their carrier link when RTS is set inactive even though the transmission has not quite been finished. The RTS Off Delay parameter specifies, in 20 millisecond increments, the delay between when the last serial character is sent to the modem and when RTS is deactivated. This gives the modem extra time to transmit the last character of a packet.

ATTENTION

For almost all modem applications, the RTS Off Delay should be left at 0. Never Select an RTS Off Delay that is greater than the RTS Send Delay in the other devices on the network, or you may incur two devices trying to transmit simultaneously.

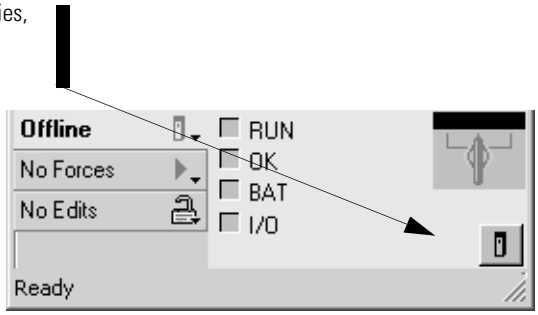
Configuring a Standard-Mode DF1 Half-Duplex Master Station

Choose standard-communication mode if you want to query slave stations for information based upon user-configured polling lists. This mode is used most often in point-to-multipoint configurations because it allows polled report-by-exception (page 1-4), slave station-to-station messaging (page 1-5) and slave programming over the telemetry network (Chapter 11) to be implemented. In addition, in this mode the master station maintains an active node table which allows an MMI or programming terminal to immediately identify which slave nodes can currently communicate and which nodes cannot.

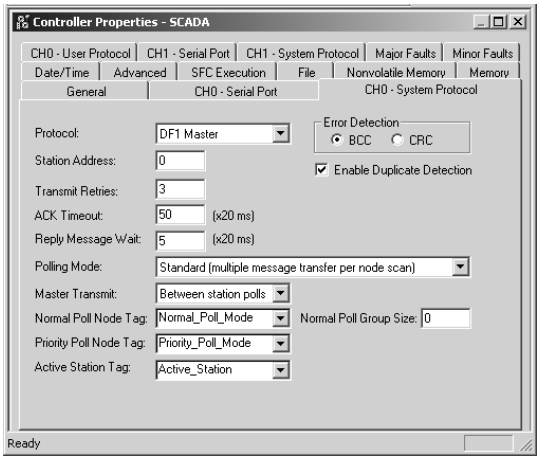
Configuring a Master Station for Standard Polling Mode

To configure the controller for a master station using standard communication, perform the following tasks using your RSLogix 5000 software:

1. To bring up the Controller Properties, click on the controller icon just beneath the keyswitch icon.



2. Choose the Serial Port Protocol tab and configure according to your specification. Serial Port Protocol parameters and defaults can be found in Table 7.2.



Use Table 7.2 to help you understand the communication parameters you need to specify on the Controller Properties screen for standard-communication mode.

Use Worksheet 7.1 Logix DF1 Half-Duplex Master Station Configuration Using Standard Communication (page D-22) for an example configuration and to record your station's configuration.

Table 7.2 Configuring a Logix controller as a master station using standard-communication mode

Parameter	Description	Default
Station Address	The station address for the serial port on the DF1 master. Enter a valid DF1 address (0 to 254).	0
Transmit Retries	Specifies the number of times a message is retried after the first attempt before being declared undeliverable. Enter a value 0 to 127.	3

Parameter	Description	Default
ACK Timeout	Specifies the amount of time you want the controller to wait for an acknowledgment to its message transmission. Enter a value 0 to 32767. Limits are defined in 20 ms intervals.	50 (1000 ms)
Polling Mode	If you want to receive: • only one message from a slave station per its turn, choose STANDARD (SINGLE MESSAGE TRANSFER PER NODE SCAN). Choose this method only if it is critical to keep the poll list scan time to a minimum. • as many messages from a slave station as it has, choose STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN)	
Master Transmit	If you want the master station to: • send all of the master station-initiated MSG instructions to the slave stations before polling the next slave station in the poll list, choose Between Station Polls. This method makes certain that master station-initiated messages are sent in a timely and regular manner (after every slave station poll). • only send master station-initiated MSG instructions when the master's station number appears in the polling sequence; choose In Poll Sequence. With this method, sending master station-initiated messages are dependent upon where and how often the master station appears in the poll list. To achieve the same goal as the Between Station Polls method, the master-station's address would have to appear after every slave-station's address.	Between Station Polls
Normal Poll Node Tag	An integer array (*list* in the format example) that contains the station addresses of the slave stations (in the order in which to poll the stations). Create a single-dimension array of data type INT that is large enough to hold all the normal station addresses. The minimum size is three elements. This tag must be controller-scoped. The format is: *list[0]* contains total number of stations to poll *list[1]* contains address of station currently being polled *list[2]* contains address of first slave station to poll *list[3]* contains address of second slave station to poll *list[n]* contains address of last slave station to poll	
Normal Poll Group Size	The number of normal stations the master station polls after polling all the stations in the priority poll array.	0
Priority Poll Node Tag	An integer array that contains the station addresses of the slave stations you need to poll more frequently (in the order in which to poll the stations). Create a single-dimension array of data type INT that is large enough to hold all the priority station addresses. The minimum size is three elements. This tag must be controller-scoped. The format is: *list[0]* contains total number of stations to be polled *list[1]* contains address of station currently being polled *list[2]* contains address of first slave station to poll *list[3]* contains address of second slave station to poll *list[n]* contains address of last slave station to poll	
Active Station Tag	An array that assigns a bit to every potential DF1 address (0 to 254). The bit is set if the station is active and cleared if the station is inactive. Both the normal poll array and the priority poll array can have active and inactive stations. A station becomes inactive when it does not respond to the master's poll. Create a single-dimension array of data type SINT that has 32 elements (256 bits). This tag must be controller-scoped.	
Error Detection	Select BCC or CRC error detection. Configure all stations to use the same type of error checking. **BCC:** the controller sends and accepts messages that end with a BCC byte for error checking. BCC is quicker and easier to implement, but does not detect as many errors as CRC. **CRC:** the controller sends and accepts messages with a 2-byte CRC for error checking. CRC is a more effective error detection algorithm.	BCC
Enable Duplicate Detection	Select whether or not the controller should detect and ignore duplicate messages.	Enabled

Minimum DF1 Half-Duplex Master ACK Timeout

The governing timeout parameter to configure for a DF1 Half-Duplex Master is the ACK Timeout. The ACK Timeout is the amount of time you want the controller to wait for an acknowledgment of its message transmissions. Set in 20 millisecond intervals, the value is the amount of time the master will wait for:

- an ACK to be returned by a slave when the master has just sent it a message, or
- a poll response or message to be returned by a slave when the master has just sent it a poll packet.

The timeout must be long enough that after the master has transmitted the last character of the poll packet, there is enough time for a slave to transmit (and the master receive) a maximum sized packet before the time expires.

To calculate the minimum ACK timeout, you must know:

- the modem baud rate
- maximum sized data packet (the maximum number of data words that a slave write command or read reply packet might contain)
- the RTS/CTS or turnaround delay of the slave modem
- the configured RTS Send Delay in the slave
- the program scan time of the slave

Determining Minimum Master Serial Port ACK Timeout

To determine the minimum ACK Timeout, you must first calculate the transmission time by multiplying the maximum sized data packet for your controller by the modem rate in ms/byte. For an example we will assume communications with SLC 5/03 slaves (103 data words or 224 bytes total packet size including overhead) and a 9600 bps modem, which transmits at approximately 1 ms/byte. Therefore, the message transmission time is 224 ms. For approximate modem transmission rates, see the following table.

Table 7.3 Approximate Modem Transmission Rates

modem bps	approx. ms/byte
4800	2
9600	1
19200	0.5

Next, you need to determine the average slave program scan time. For this example, lets assume an average slave program scan time of 20 ms. Remember, program scan time will vary by application.

Finally, you must determine the larger of two values, either the configured slave RTS Send Delay or the turnaround time of the slave modem. The RTS Send Delay time can be found by double-clicking on the slave's Channel Configuration icon and looking at the Chan. 0 System tab of the Channel Configuration screen. Note that the RTS Send Delay time is in intervals of 20 ms, so with a value of 3 in the box, the RTS Send Delay time would be 20 ms multiplied by 3. Using this value (60 ms) for our example, and assuming that the turnaround time of the modem is 50 ms (which will vary by modem) you would choose to use the RTS Send Delay time of 60 ms for your calculation.

Having determined the maximum message transmission time (224 ms), the average slave program scan time (20 ms) and the largest of either RTS Send Delay (60 ms) or the modem turnaround time, the minimum ACK timeout is simply the sum of these values.

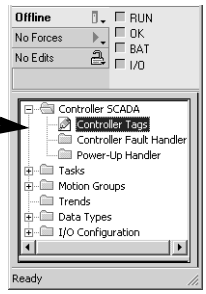
Parameter	Example Values (in ms)
Max message transmission time	224
Average program scan time	20
RTS Send Delay	60
modem turnaround time	50
calculated ACK Timeout	304
round up to nearest 20 ms	320

Use only the largest of these two values.

DF1 Half-Duplex Master Diagnostic Counter

DF1 Half-Duplex Master driver status data is stored in the Diagnostic Counter attribute of the DF1 communication object. You must define a controller tag to be the destination for this data and copy the system data to this tag using a GSV instruction. For the required ladder logic, see page 7-25.

To bring up the Controller Tag interface, click once on the Controller Tags icon.



For details of the Diagnostic Counter files, see Table 7.4.

Table 7.4 DF1 Half-Duplex Master Diagnostic Counters

Status Field	Diagnostic Tag Array Location	Definition
signature (68_{10})	word 0	DF1 Half-Duplex Master is the configured protocol
DTR (Data Terminal Ready)	word 1;bit 4	The status of the DTR handshaking line (asserted by the controller)
DCD (Data Carrier Detect)	word 1;bit 3	The status of the DCD handshaking line (received by the controller)
DSR (Data Set Ready)	word 1;bit 2	The status of the DSR handshaking line (received by the controller)
RTS (Request to Send)	word 1;bit 1	The status of the RTS handshaking line (asserted by the controller)
CTS (Clear to Send)	word 1;bit 0	The status of the CTS handshaking line (received by the controller)
packets sent	word 2	The total number of DF1 packets sent by the controller (including message retries)
packets received	word 3	The number of packets received with no errors
undelivered packets	word 4	The number of packets that were sent by the controller but not acknowledged by the destination device
messages retried	word 5	Defines the number of times a master station retries either: • a message before it declares the message undeliverable, or • a poll packet to an active station before the master station declares that station to be inactive
unused	word 6	unused
unused	word 7	unused
bad packets not ACKed	word 8	The number of incorrect data packets received by the controller for which an ACK was not returned
unused	word 9	unused
duplicate packets received	word 10	The number of times the controller received a message packet identical to the previous message packet
unused	word 11	unused
DCD recoveries count	word 12	The number of times the controller detects the DCD handshaking line has gone low to high
lost modem count	word 13	The number of times the lost modem minor fault has come on.
priority scan time maximum	word 14	Maximum time in 100 ms increments to scan the Priority Poll List
priority scan time last	word 15	The last recorded priority poll scan time (in 100 ms increments)
normal scan time maximum	word 16	Maximum time in 100 ms increments to scan the Normal Poll List
normal scan time last	word 17	The last recorded normal poll scan time (in 100 ms increments)
unused	word 18	

Create Polling List(s)

After defining your polling tag(s) and group size, create polling lists by entering the station address of each slave station into either the normal poll node tag or priority poll node tag. Place each station address in an individual word in a poll tag (normal or priority) starting at word 2.

The normal and priority poll file layout is as follows:

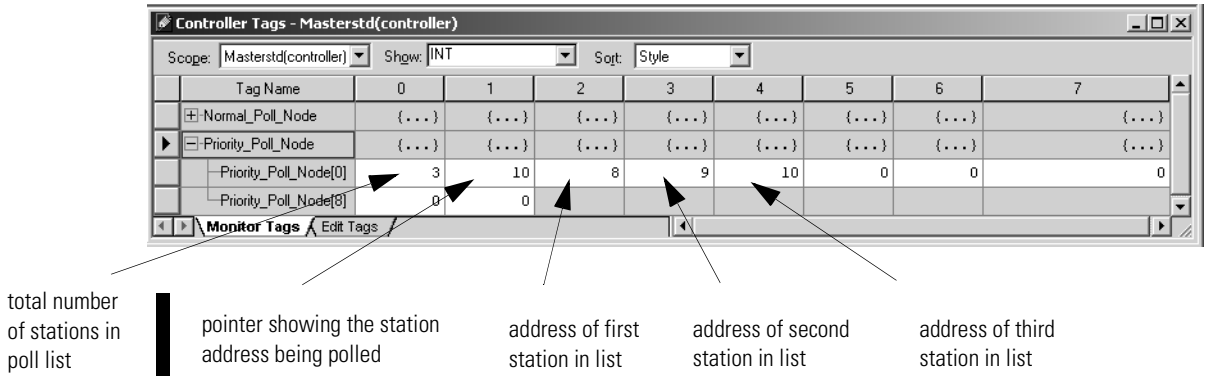
This word in a poll tag	Contains this information
word 0	total number of stations to be polled (for a list)
word 1	the address of the station currently being polled This word is automatically updated by the master station as a new slave station is polled.
word 2 through word *xx*	the slave station address in the order that the stations should be polled Store one station address in each word.

To place a station address in a poll file:

1. Access the Controller Tags.
2. Expand the normal or priority poll node tag.
3. Enter the station addresses of the slave stations you want in the poll list starting at word 2. Put them in the order you want them polled. Enter the total number of slave station addresses in this list into word 0.

Figure 7.3 is an example of a polling list containing three stations: addresses 8, 9, and 10. Station 10 is being polled.

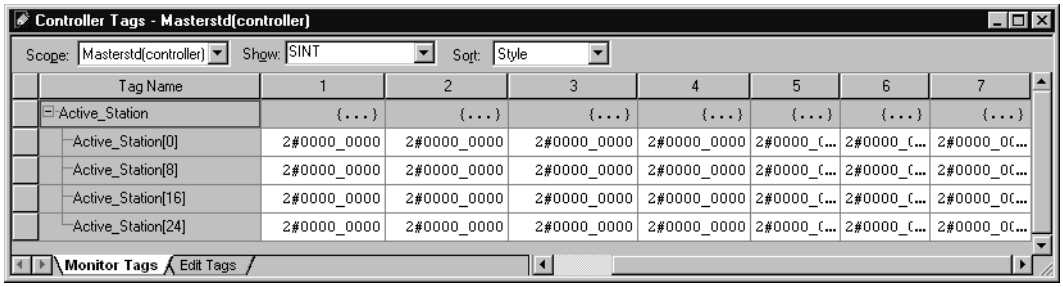
Figure 7.3 Example Station List



Monitor Active Stations

To see what stations are active, view the active station tag. Each bit in the tag represents a station on the link. The stations are numbered in order as a continuous bit-stream file starting with the first bit in the first word (Figure 7.4). If the bit is a one, the station is active; if the bit is a zero, the station is inactive.

Figure 7.4 Example Active Station File



Configuring a Message-Based Mode DF1 Half-Duplex Master Station

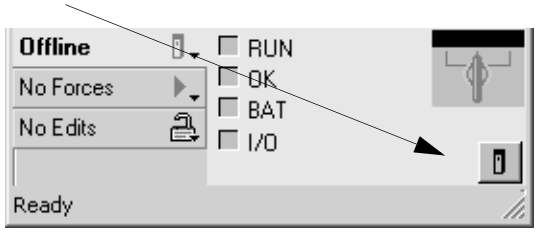
Choose message-based communication mode if you want to use MSG instructions in user programming to communicate with one station at a time. If your application uses satellite transmission or public switched telephone network transmission, consider choosing message-based. Communication to a slave station can be initiated on an as-needed basis.

With message-based mode, you do not have an active station file that you can use to monitor station status. Also, you cannot implement slave station-to-slave station messaging over the telemetry network.

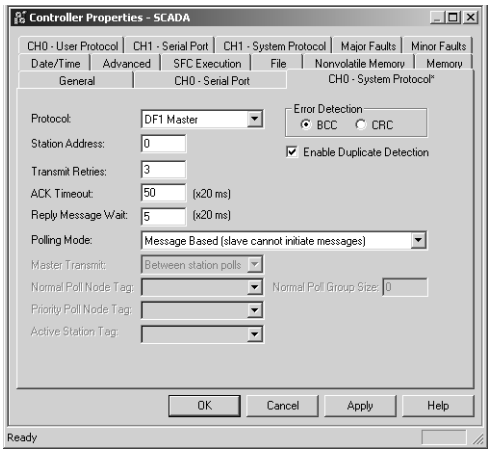
Configuring a Master Station for Message-based Polling Mode

To configure the controller for a master station using message-based communication, follow the steps below using RSLogix 5000:

1. To bring up the Controller Properties interface, click on the controller icon just beneath the keyswitch icon.



2. Choose the Serial Port Protocol tab and configure according to your specification. Serial Port Protocol parameters and defaults can be found in Table 7.5.



Use Table 7.5 to help you understand the communication parameters you need to specify on the Controller Properties screen.

Use Worksheet 7.2 Logix DF1 Half-Duplex Master Station Configuration Using Message-based Communication (page D-23) for an example configuration and to record your station's configuration.

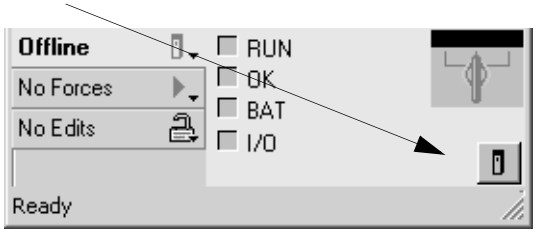
Table 7.5 Configuring a Logix controller as a master station using message-based communication mode

Parameter	Description	Default
Station Address	The station address for the serial port on the DF1 master. Enter a valid DF1 address (0 to 254).	0
Transmit Retries	Specifies the number of times a message is retried after the first attempt before being declared undeliverable. Enter a value 0 to 127.	3
ACK Timeout	Specifies the amount of time you want the controller to wait for an acknowledgment to its message transmission. Enter a value 0 to 32767. Limits are defined in 20 ms intervals.	50 (1000 ms)
Reply Message Wait	Specifies the amount of time the master station waits after receiving an ACK to a master-initiated message before polling the slave station for a reply. Enter a value 0 to 65535. Limits are defined in 20 ms intervals.	5 (100 ms)
Polling Mode	If you want to: • accept unsolicited messages from slave stations, choose MESSAGE BASED (slave can initiate messages) Slave station-initiated messages are acknowledged and processed after all master station-initiated (solicited) messages. **Note:** Slave stations can only send messages when they are polled. If the message-based master station never sends a slave station a message, the master station will never send the slave station a poll. Therefore, to regularly obtain a slave station-initiated message from a slave station, you should choose to use standard communications mode instead. • ignore unsolicited messages from slave stations, choose MESSAGE BASED (slave cannot initiate messages) Slave station-initiated messages are acknowledged and discarded. The master station acknowledges the slave station-initiated message so that the slave station removes the message from its transmit queue, which allows the next packet slated for transmission into the transmit queue.	Message Based (slave can initiate messages)
Error Detection	Select BCC or CRC error detection. Configure all stations to use the same type of error checking. **BCC:** the controller sends and accepts messages that end with a BCC byte for error checking. BCC is quicker and easier to implement, but does not detect as many errors as CRC. **CRC:** the controller sends and accepts messages with a 2-byte CRC for error checking. CRC is a more effective error detection algorithm.	BCC
Enable Duplicate Detection	Select whether or not the controller should detect and ignore duplicate messages.	Enabled

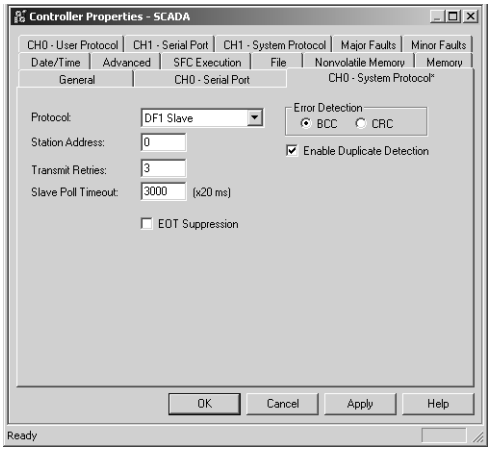
Configuring the Controller as a Slave Station

To configure the controller as a slave station, follow the steps below using your programming software:

1. To bring up the Controller Properties interface, click on the controller icon just beneath the keyswitch icon.



2. Choose the Serial Port Protocol tab and configure according to your specification. Serial Port Protocol parameters and defaults can be found in Table 7.6.



Use Table 7.6 to help you understand the communication parameters you need to specify on the Controller Properties screen.

Use Worksheet 7.3 (page D-24) for an example configuration and to record your station's configuration.

Table 7.6 Define these parameters when configuring a Logix controller as a slave station.

Parameter	Description	Default
Station Address	The station address for the serial port on the DF1 slave. Enter a valid DF1 address (0 to 254).	0
Transmit Retries	The number of times the slave station retries a message after the first attempt before the station declares the message undeliverable. Enter a value 0 to 127.	3
Slave Poll Timeout	Specifies the amount of time the slave station waits to be polled by a master before indicating a fault. Enter a value 0 to 32767. Limits are defined in 20 ms intervals. See"Configuring Slave Poll Timeout" for further details.	3000 (60,000 ms)
EOT Suppression	Select whether or not to suppress sending EOT packets in response to a poll. The default is not to suppress sending EOT packets.	Do not suppress
Error Detection	Select BCC or CRC error detection. Configure all stations to use the same type of error checking. **BCC:** the controller sends and accepts messages that end with a BCC byte for error checking. BCC is quicker and easier to implement, but does not detect as many errors as CRC. **CRC:** the controller sends and accepts messages with a 2-byte CRC for error checking. CRC is a more effective error detection algorithm.	BCC
Enable Duplicate Detection	Select whether or not the controller should detect and ignore duplicate messages.	Enabled

Configuring Slave Poll Timeout

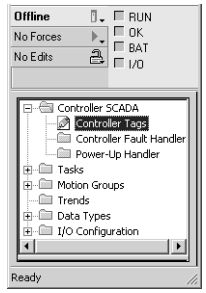
The Slave Poll Timeout is only used when the DF1 half-duplex slave is initiating MSG instructions in ladder logic. This implies that the Master is most likely configured for Standard Polling Mode. The minimum Slave Poll Timeout value is dependent on the maximum Master poll scan rate. Since the Master's polling and the Slave's triggering of a MSG instruction are asynchronous events, it is possible that in the instant just after the slave was polled, the MSG instruction gets triggered. This means the MSG instruction will remain queued-up for transmission until the Master has polled every other slave first. Therefore, the minimum Slave Poll Timeout value is equal to the maximum Master poll scan rate rounded up to the next 20 ms increment.

Minimum Slave Poll Timeout = (maximum Master scan poll rate)

DF1 Half-Duplex Slave Diagnostic Counters

DF1 Half-Duplex Slave driver status data is stored in the Diagnostic Counter attribute of the DF1 communication object. You must define a controller tag to be the destination for this data and copy the system data to this tag using a GSV instruction. For the required ladder logic, see page 7-25.

1. To bring up the Controller Tag interface, click once on the Controller Tag icon.



2. For details of the Diagnostic Counter files, see Table 7.7.

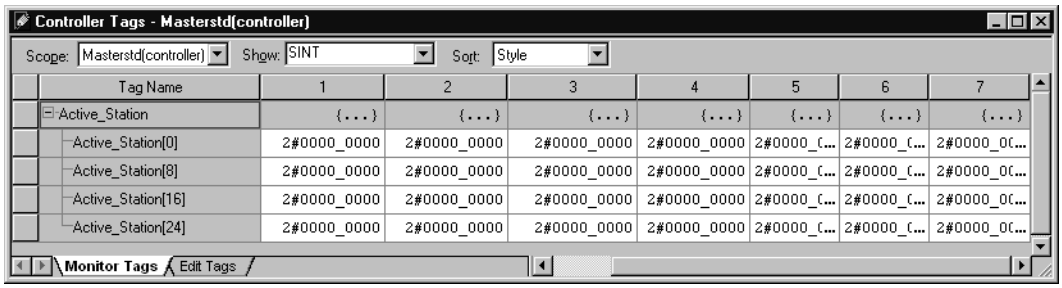


Table 7.7 DF1 Half-Duplex Slave Diagnostic Counters

Status Field	Diagnostic Tag Array Location	Definition
signature (66_{10})	word 0	DF1 Half-duplex Slave is the configured protocol.
DTR (Data Terminal Ready)	word 1;bit 4	The status of the DTR handshaking line (asserted by the controller)
DCD (Data Carrier Detect)	word 1;bit 3	The status of the DCD handshaking line (received by the controller)
DSR (Data Set Ready)	word 1;bit 2	The status of the DSR handshaking line (received by the controller)
RTS (Request to Send)	word 1;bit 1	The status of the RTS handshaking line (asserted by the controller)
CTS (Clear to Send)	word 1;bit 0	The status of the CTS handshaking line (received by the controller)
packets sent	word 2	The total number of DF1 packets sent by the controller (including message retries)
packets received	word 3	The number of packets received with no errors
undelivered packets	word 4	The number of packets that were sent by the controller but not acknowledged by the destination device
messages retried	word 5	Defines the number of times a slave station retries a message before it declares the message undeliverable.
NAKs received	word 6	The number of NAKs received by the controller
poll packets received	word 7	The number of poll packets received by the controller

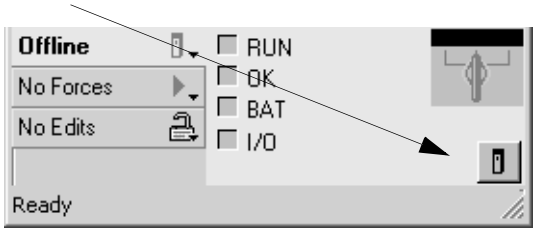
Table 7.7 DF1 Half-Duplex Slave Diagnostic Counters

Status Field	Diagnostic Tag Array Location	Definition
bad packets not ACKed	word 8	The number of incorrect data packets received by the controller for which an ACK was not returned
no memory not ACKed	word 9	The number of times the controller could not receive a message because it did not have available memory
duplicate packets received	word 10	The number of times the controller received a message packet identical to the previous message packet
unused	word 11	
DCD recoveries count	word 12	The number of times the controller detects the DCD handshaking line has gone low to high
lost modem count	word 13	The number of times the lost modem minor fault has come on.
unused	word 14-18	

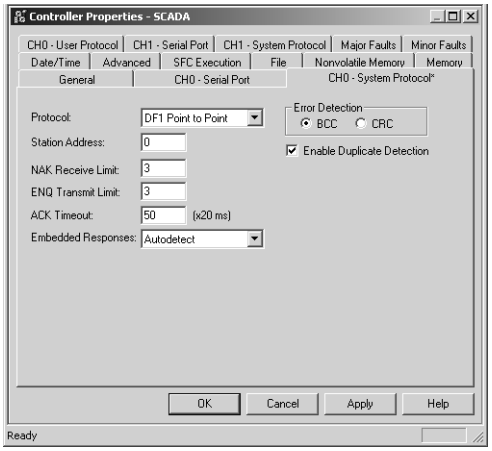
Configuring the Controller as a Station on a Point-to-Point Link

To configure the controller as a station on a point-to-point link, follow the steps below using your programming software:

1. To bring up the Controller Properties interface, click on the controller icon just beneath the keyswitch icon.



2. Choose the Serial Port Protocol tab and configure according to your specification. Serial Port Protocol parameters and defaults can be found in Table 7.8.



Use Table 7.8 to help you understand the screen parameters you need to specify on the Controller Properties screen.

Use Worksheet 7.4 (page D-25) for an example configuration and to record your station's configuration.

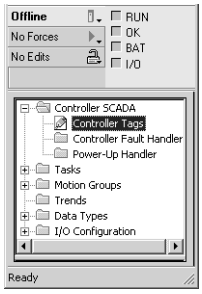
Table 7.8 Configuring a Logix controller for DF1 full-duplex communication

Parameter	Description	Default
Station Address	The station address for the serial port on the DF1 point-to-point network. Enter a valid DF1 address (0 to 254).	0
NAK Receive Limit	Specifies the number of NAKs the controller can receive in response to a message transmission. Enter a value 0 to 127.	3
ENQ Transmit Limit	Specifies the number of inquiries (ENQs) you want the controller to send after an ACK timeout. Enter a value 0 to 127.	3
ACK Timeout	Specifies the amount of time you want the controller to wait for an acknowledgment to its message transmission. Enter a value 0 to 32767. Limits are defined in 20 ms intervals.	50 (1000 ms)
Embedded Response	Specifies how to enable embedded responses. Select Autodetect (enabled only after receiving one embedded response) or Enabled.	Autodetect
Error Detection	Select BCC or CRC error detection. Configure all stations to use the same type of error checking. **BCC:** the controller sends and accepts messages that end with a BCC byte for error checking. BCC is quicker and easier to implement, but does not detect as many errors as CRC. **CRC:** the controller sends and accepts messages with a 2-byte CRC for error checking. CRC is a more effective error detection algorithm.	BCC
Enable Duplicate Detection	Select whether or not the controller should detect and ignore duplicate messages.	Enabled

DF1 Point-to-Point Diagnostic Counters

DF1 Point-to-Point driver status data is stored in the Diagnostic Counter attribute of the DF1 communication object. You must define a controller tag to be the destination for this data and copy the system data to this tag using a GSV instruction. For the required ladder logic, see page 7-25.

1. To bring up the Controller Tag interface, click on the Controller Tags icon.



2. For details of the DisgnosticCounter files, see Table 7.9.

Table 7.9 DF1 Full-Duplex (Point-to-Point) Diagnostic Counters

Status Field	Diagnostic Tag Array Location	Definition
signature (67_{10})	word 0	DF1 Point-to-Point is the configured protocol
DTR (Data Terminal Ready)	word 1;bit 4	The status of the DTR handshaking line (asserted by the controller)
DCD (Data Carrier Detect)	word 1;bit 3	The status of the DCD handshaking line (received by the controller)
DSR (Data Set Ready)	word 1;bit 2	The status of the DSR handshaking line (received by the controller)
RTS (Request to Send)	word 1;bit 1	The status of the RTS handshaking line (asserted by the controller)
CTS (Clear to Send)	word 1;bit 0	The status of the CTS handshaking line (received by the controller)
packets sent	word 2	The total number of DF1 packets sent by the controller (including message retries)
packets received	word 3	The number of packets received with no errors
undelivered packets	word 4	The number of packets that were sent by the controller but not acknowledged by the destination device
unused	word 5	

Table 7.9 DF1 Full-Duplex (Point-to-Point) Diagnostic Counters

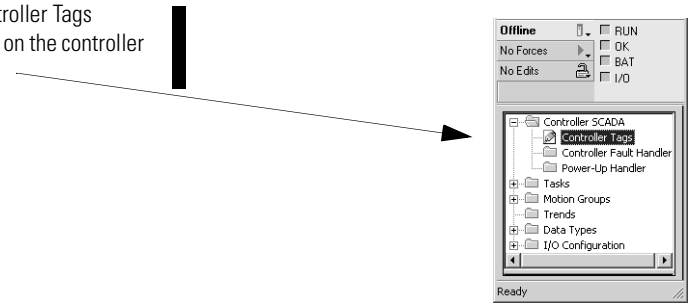
Status Field	Diagnostic Tag Array Location	Definition
NAKs received	word 6	The number of NAKs received by the controller
ENQs received	word 7	The number of ENQs received by the controller
bad packets NAKed	word 8	The number of incorrect data packets received by the controller for which a NAK was returned
no memory sent NAK	word 9	The number of times the controller could not receive a message because it did not have available memory
duplicate packets received	word 10	The number of times the controller received a message packet identical to the previous message packet
bad characters received	word 11	The number of bad characters received
DCD recoveries count	word 12	The number of times the controller detects the DCD handshaking line has gone low to high
lost modem count	word 13	The number of times the lost modem minor fault has come on
unused	word 14-17	
ENQs sent	word 18	The number of ENQs sent by the controller

Accessing DF1 Diagnostic Counters

To access the DF1 diagnostic counter array, it is necessary to include a specific rung of ladder logic in your program. The purpose of the ladder logic is to write the Diagnostic Counter values into a named tag, where the values can then be easily viewed.

The following instructions explain how to create the DF1 diagnostic counter storage tag, view local and remote DF1 diagnostic counters and reset local DF1 diagnostic counters.

1. To bring up the Controller Tags interface, click once on the controller Tags icon.



2. From the Edit Tag tab, create a controller tag of type INT [19].

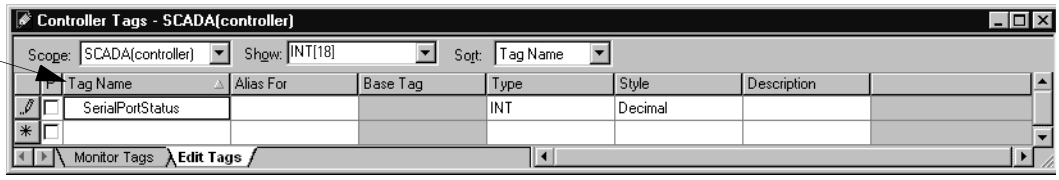


Figure 7.5 Viewing Local DF1 Diagnostic Counters

3. Create the necessary ladder logic to copy the Diagnostic Counter system values to the tag you just created (SerialPortStatus).

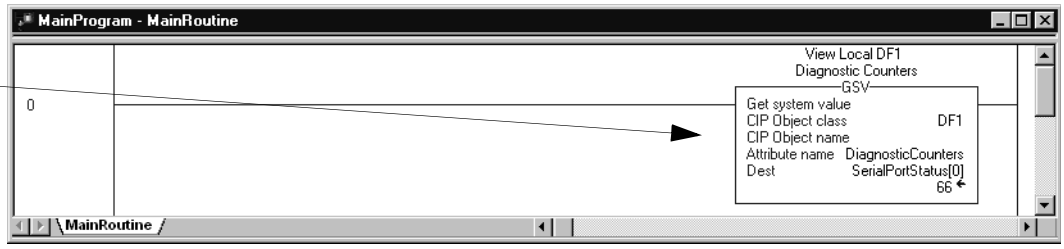
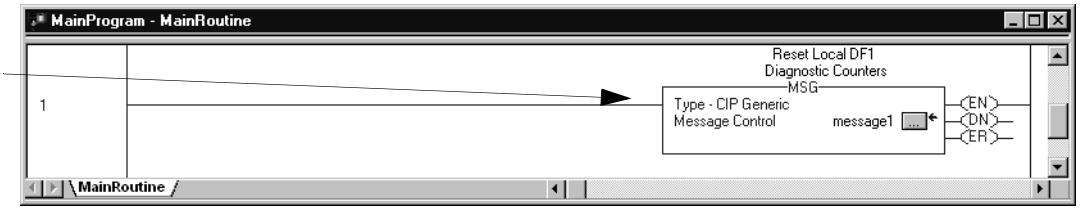
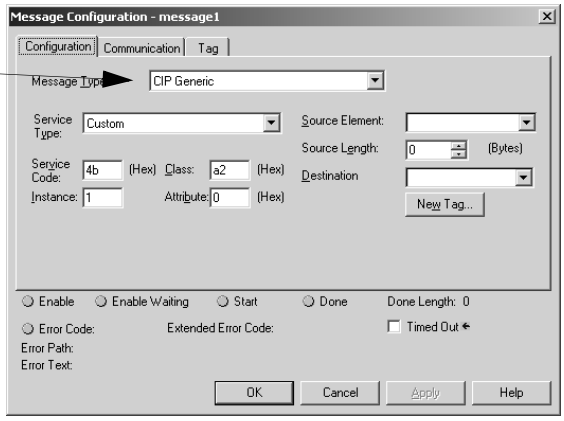


Figure 7.6 Resetting Local DF1 Diagnostic Counters

4. Create a message instruction to clear the Diagnostic Counter system values.



5. Enter in the field values exactly as shown.



6. Enter in 1, *s* for the Path, where *s* is the slot number of this controller (slot 0 in this example).

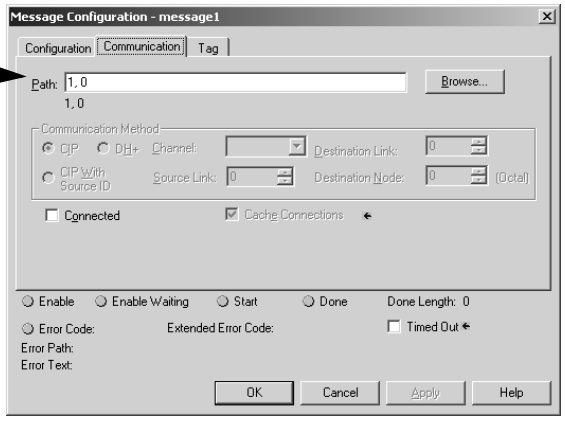
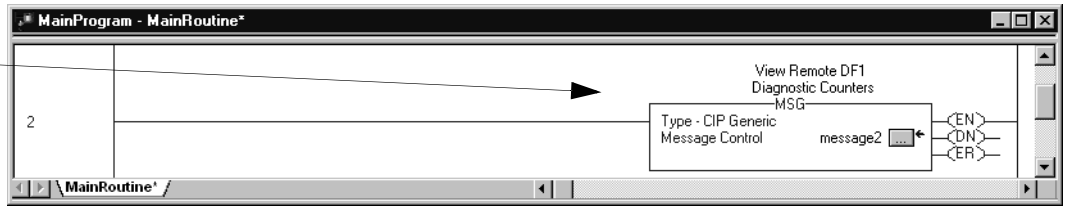
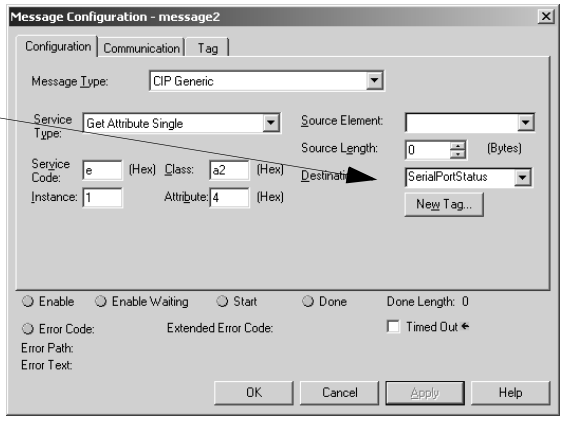


Figure 7.7 Viewing Remote DF1 Diagnostic Counters

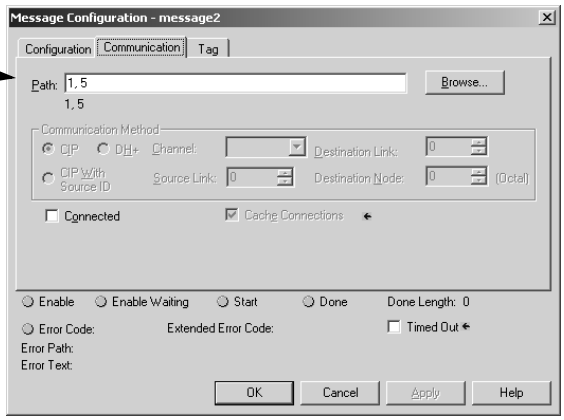
7. Create a message instruction to read remote Diagnostic Counter system values.



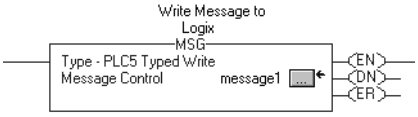
8. Enter in the field values exactly as shown, using the DF1 diagnostic counter storage tag created previously for the Destination field.



9. Enter in the path to the remote controller.



Messaging



Messaging can occur between:

- a master station and a slave station,
- a slave station and its master station (see Polled Report-by-Exception),
- slave stations or between two controllers connected via a point-to-point link.

Master Station to Slave Station

A Logix master station communicates with the slave stations that are connected to it via modems in a point-to-multipoint configuration. A master station sends a slave station message to receive status or issue commands. For sample messaging ladder logic to use as a guide when using Standard or Message-based Polling Modes, see page E-19.

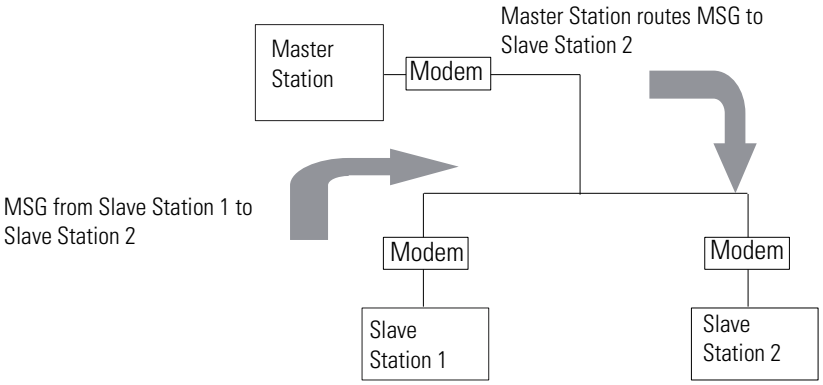
Polled Report-by-Exception

Slave stations can gather information from the I/O points they are responsible for and can send any anomalous readings to the master station. To do this, write ladder logic in the slave station to monitor certain conditions and send the data in an MSG instruction to the master station. For sample messaging ladder logic to use as a guide when using a Logix as a slave, see page E-21.

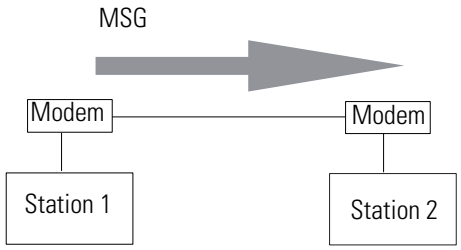
Controller-to-Controller

A controller-to-controller message can be the following types:

- In a point-to-multipoint configuration, the messaging would be between slave stations; the master station automatically routes the message.



- In a point-to-point configuration, the messaging would be between the two connected peer devices.



The configuration of the network (point-to-multipoint vs. point-to-point) and the configuration of the station (master, slave, or peer) does not affect how you configure an MSG instruction. That is, an MSG instruction being sent between two Logix slave stations is configured the same as an MSG instruction between two Logix controllers connected point-to-point, which is configured the same as an MSG instruction between a Logix master station and a Logix slave station. See Figure 7.8 through Figure 7.13 for example MSG control blocks.

Considerations When Configuring MSG Control Blocks

Keep these considerations in mind when configuring serial port messages between a Logix controller and other controllers.

- The connection path for serial port messages always begins with either a '2' or a '3' to indicate send out the first or second serial port (as opposed to a '1', which would indicate send to the backplane).
- Leave the Communication Method as CIP.
- Leave the message configuration Cache Connections unchecked, as message connections passing through the serial port cannot be cached, regardless of this setting.
- CIP Data Table Read and Write message types are sent as connected messages, which means every time a MSG of one of these types is triggered, there are three command packets that are transmitted: a make connection command, the read or write command, and a break connection command. This is very inefficient use of serial communication bandwidth.
- PLC5 and SLC Typed Read and Write message types are sent as unconnected messages, which means only one command packet is transmitted every time a MSG of one of these types is triggered. Therefore, even when initiating to another Logix controller, it is much more efficient to use a PLC5 Typed Read or Write message type.
- Logix uses either logical ASCII addressing or symbolic addressing for PLC5 Typed Read or Write message types. To address a Logix tag directly, use symbolic addressing by entering in *@tagname* for the Source or Destination Element field, where *tagname* is a defined controller scoped tag in the receiving Logix controller. To address a PLC-5 controller file, use logical ASCII addressing by entering in XY:Z for the Source or Destination Element field, where X is file type status (S), integer (N), bit (B), or float (F), Y is the file number and Z is the starting element number. This format may also be used to read or write a Logix controller tag, if that tag has been mapped in the receiving Logix to a 'PLC 3,5/SLC' file number. For PLC-5 file type float (F), the Source or Destination Tag in the initiating Logix must be of type REAL. For the other valid PLC-5 file types, the Source or Destination Tag in the initiating Logix should be of type INT.
- The SLC Typed Read and Write message types can only be used to read integer (N), binary (B), and long (L) data files in SLC 500 and MicroLogix controllers where available. The Source or Destination Tag in the initiating Logix should be of type INT.

- SLC 5/05, SLC 5/04, and SLC 5/03 controllers can respond to PLC5 Typed Read or Write message types that use logical ASCII addressing. Using this message type, the Logix can directly read or write the status (S) file and float (F) file(s) of these SLC controller versions (in addition to the N and B file types).
- The maximum number of integer file elements that can be transferred with any SLC 5/03, 5/04 or 5/05 controller using a single Logix MSG instruction is 118.
- The maximum number of integer file elements that can be transferred with any MicroLogix 1100/1200/1500 controller using a single Logix MSG instruction is 121.
- The maximum number of integer file elements that can be transferred with any MicroLogix 1000 controller using a single Logix MSG instruction is 41.

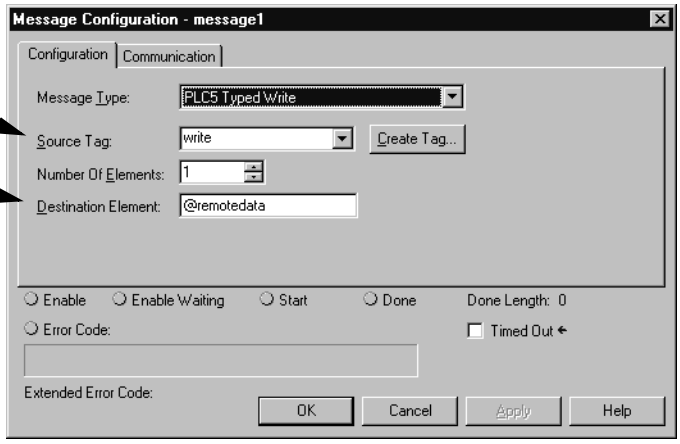
Example MSG Control Blocks

Application	See page
Logix write message to another Logix controller	7-32
Logix read message to another Logix controller	7-33
Logix write message to a PLC-5 or SLC 500 controller	7-34
Logix read message to a PLC-5 or SLC 500 controller	7-35
Logix write message to an SLC 500 or MicroLogix controller	7-36
Logix read message to an SLC 500 or MicroLogix controller	7-37

Figure 7.8 Example of a Write MSG from a Logix to a Logix Controller

Local controller scoped tag containing data to be written.

Remote controller scoped tag into which data will be written.



Path (out serial port) to station (254).

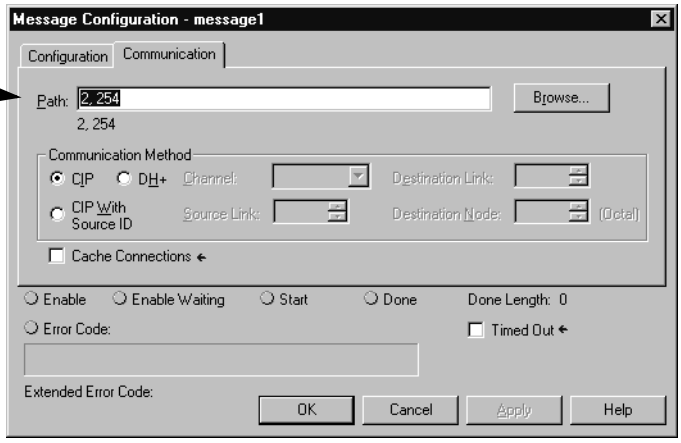
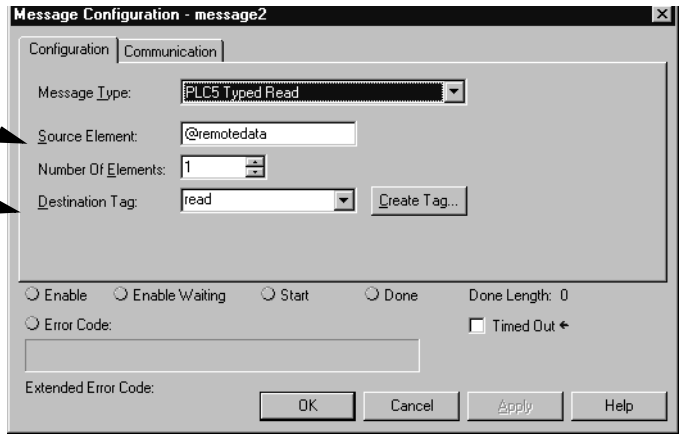


Figure 7.9 Example of a Read MSG from a Logix to a Logix Controller

Remote controller scoped tag where data will be read from.

Local controller scoped tag into which data will be copied.



Path (out serial port) to station (254).

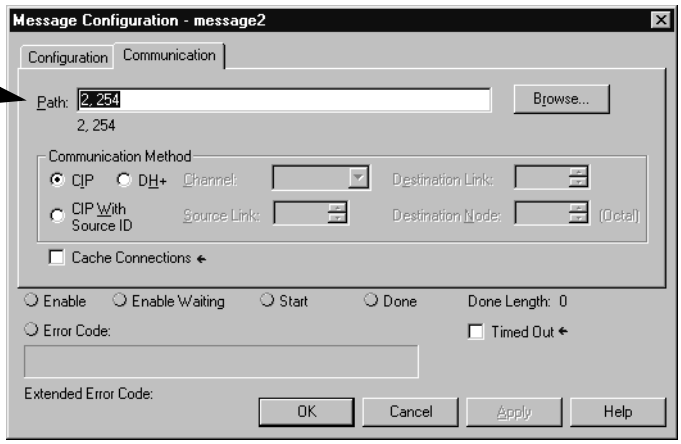
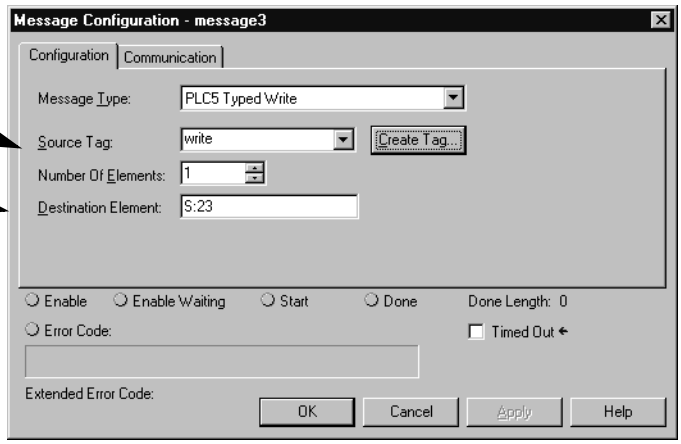


Figure 7.10 Example of a Write MSG From a Logix to a PLC-5 or SLC 500 Controller

Local controller scoped tag containing data to be written.

Remote PLC-5 data table address into which data will be written.



Path (out serial port) to station (199).

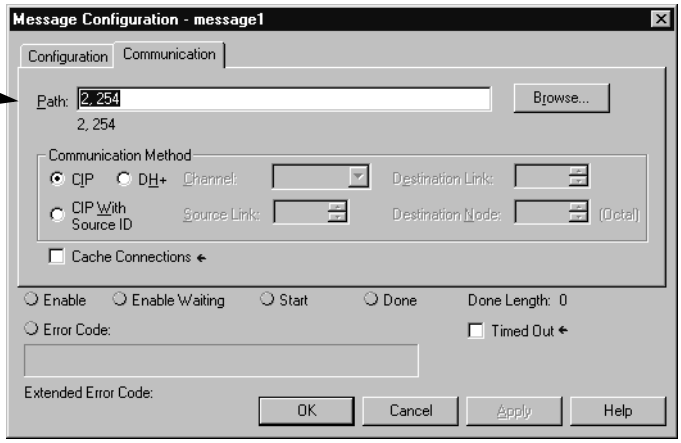
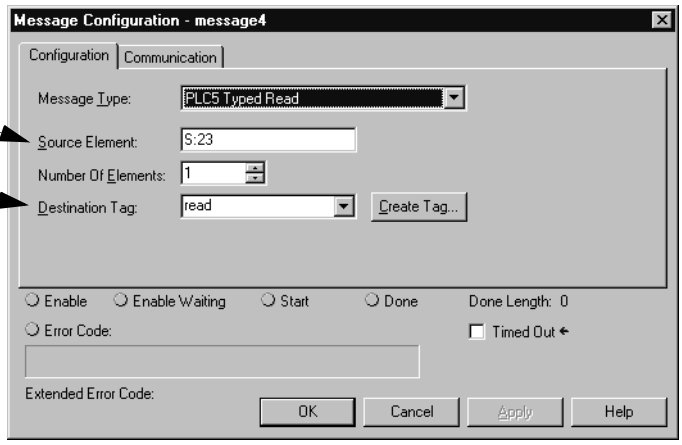


Figure 7.11 Example of a Read MSG from a Logix to a PLC-5 or SLC 500 Controller

Remote PLC-5 data table address where data will be read from.

Local controller scoped tag into which data will be copied.



Path (out serial port) to station (199).

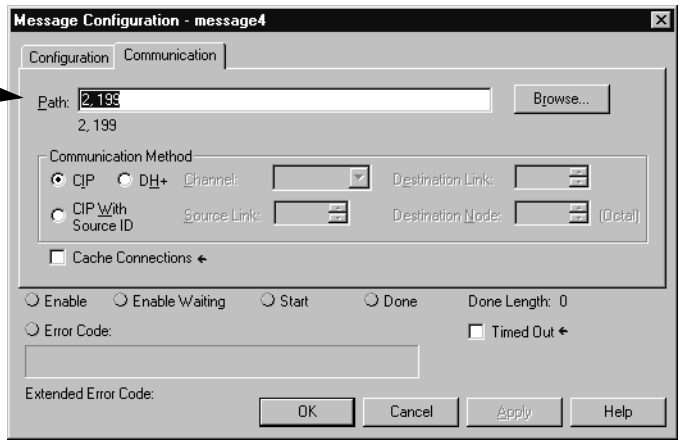
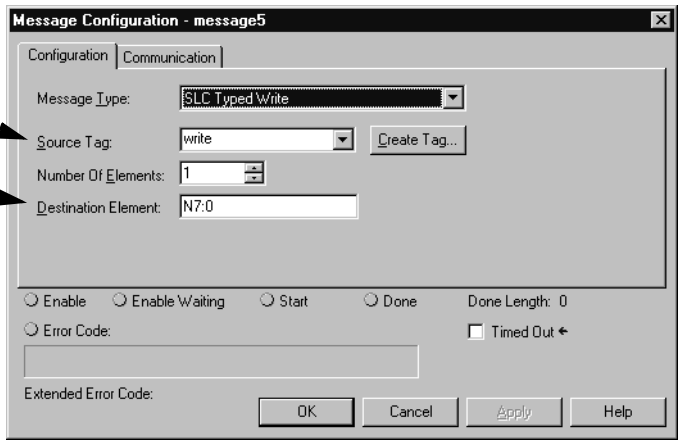


Figure 7.12 Write MSG Instruction From a Logix to an SLC or MicroLogix Controller

Local controller scoped tag containing data to be written.

Remote SLC data table address info which data will be written.



Path (out serial port) to station (222).

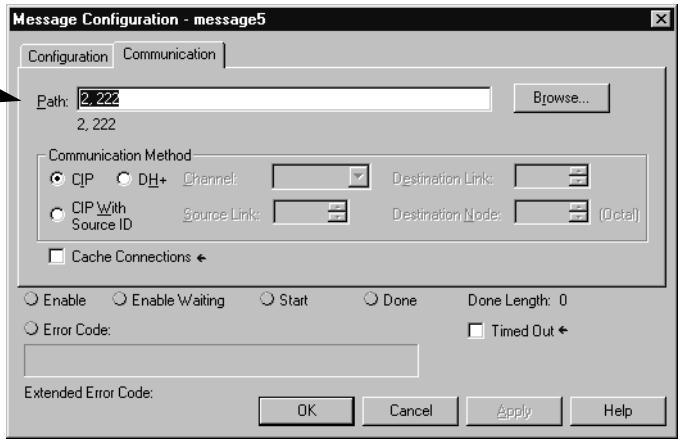
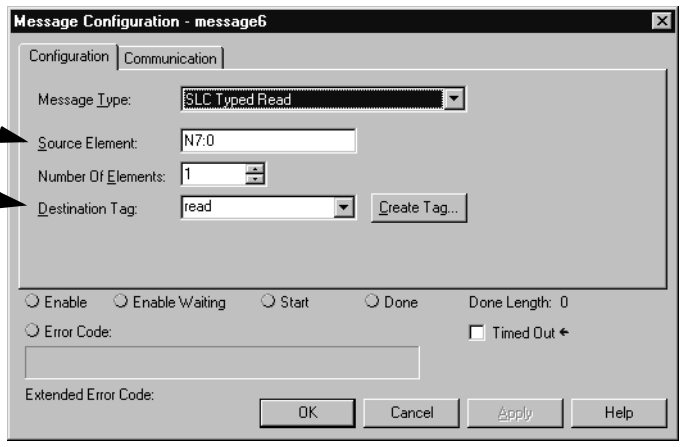


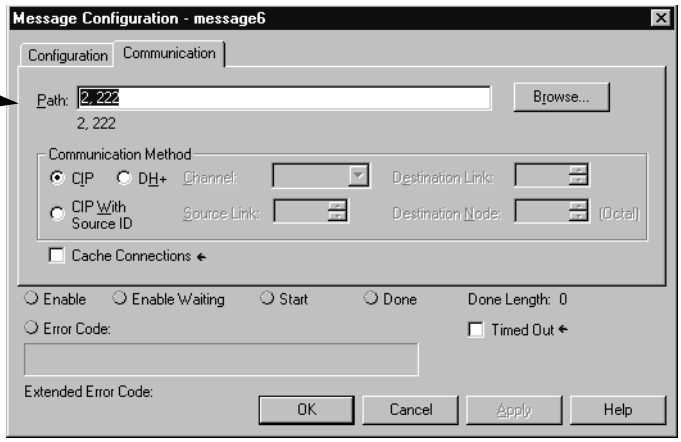
Figure 7.13 Read MSG Instruction from a Logix to an SLC or MicroLogix Controller

Remote SLC data table address from which data will be read.

Local controller scoped tag into which data will be copied.



Path (out serial port) to station (222).



Logix Controller Error Codes for PLC and SLC Messages

With the release Logix R10.x firmware, you will find new error code values for errors that are associated with PLC and SLC message types (PCCC messages).

- This change lets RSLogix 5000 software display a more meaningful description for many of the errors. Previously the software did not give a description for any of the errors associated with the 00F0 error code.
- The change also makes the error codes more consistent with errors returned by other controllers, such as PLC-5 controllers.

The following table shows the change in the error code values from R9.x and earlier to R10.x and later. As a result of the change, the .ERR member returns a unique value for each PCCC error. The .EXERR is no longer required for these errors.

R9.x and earlier		R10.x and later		Description
.ERR	.EXERR	.ERR	.EXERR	
0010		1000		Illegal command or format from local processor
0020		2000		Communication module not working
0030		3000		Remote node is missing, disconnected, or shut down
0040		4000		Processor connected but faulted (hardware)
0050		5000		Wrong station number
0060		6000		Requested function is not available
0070		7000		Processor is in Program mode
0080		8000		Processor's compatibility file does not exist
0090		9000		Remote node cannot buffer command
00B0		B000		Processor is downloading so it is not accessible
00F0	0001	F001		Processor incorrectly converted the address
00F0	0002	F002		Incomplete address
00F0	0003	F003		Incorrect address
00F0	0004	F004		Illegal address format - symbol not found
00F0	0005	F005		Illegal address format - symbol has 0 or greater than the maximum number of characters supported by the device
00F0	0006	F006		Address file does not exist in target processor
00F0	0007	F007		Destination file is too small for the number of words requested
00F0	0008	F008		Cannot complete request Situation changed during multipacket operation
00F0	0009	F009		Data or file is too large Memory unavailable
00F0	000A	F00A		Target processor cannot put requested information in packets
00F0	000B	F00B		Privilege error; access denied

R9.x and earlier		R10.x and later		Description
.ERR	.EXERR	.ERR	.EXERR	
00F0	000C	F00C		Requested function is not available
00F0	000D	F00D		Request is redundant
00F0	000E	F00E		Command cannot be executed
00F0	000F	F00F		Overflow; histogram overflow
00F0	0010	F010		No access
00F0	0011	F011		Data type requested does not match data available
00F0	0012	F012		Incorrect command parameters
00F0	0013	F013		Address reference exists to deleted area
00F0	0014	F014		Command execution failure for unknown reason PLC-3 histogram overflow
00F0	0015	F015		Data conversion error
00F0	0016	F016		The scanner is not available to communicate with a 1771 rack adapter
00F0	0017	F017		The adapter is no available to communicate with the module
00F0	0018	F018		The 1771 module response was not valid
00F0	0019	F019		Duplicate label
00F0	001A	F01A		File owner active - the file is being used
00F0	001B	F01B		Program owner active - someone is downloading or editing online
00F0	001C	F01C		Disk file is write protected or otherwise not accessible (offline only)
00F0	001D	F01D		Disk file is being used by another application Update not performed (offline only)

Configuring Modems

Chapter Objectives

This chapter provides reference information for help in connecting modems to Allen-Bradley devices.

Included here are cable pin assignments and switch settings for modems manufactured by Rockwell Automation and by companies that participate in Rockwell Automation's Encompass Program.

IMPORTANT Consult the user documentation provided by the individual vendor. The guidelines presented here are **NOT** intended to replace vendor documentation. Use the vendor documentation as your primary source and these examples as supplemental sources.

For information about	See page
Installing a modem	8-1
Configuration tips	8-2
Telephone modem configurations	8-2
Rockwell Automation	8-3
DATA-LINC Group	8-5
Miille Applied Research Company, Inc. (MARC)	8-11
Radio modem configurations	8-21
DATA-LINC Group	8-23
Electronic Systems Technology (ESTeem)	8-29
Microwave Data Systems (MDS)	8-35
Power line modem configurations	8-39
DATA-LINC Group	8-39

Installing a Modem

To install a modem:

1. Configure the modem to communicate with Data-Terminal Equipment (DTE) such as: PLC-5 or SLC processor, PC, etc.

2. Connect the modem to the transmission media (phone line, radio transmitter, etc.).

3. Connect the modem to the DTE.

For details about how to install, configure, and operate a modem, see the modem's user documentation.

Configuration Tips

When configuring modems for communication with Allen-Bradley devices, remember to:

- configure the modem for **asynchronous** communication.
- configure the modem's RS-232 communication rate to match that of the connected Allen-Bradley processor and the modem's transmission rate to match that of the receiving modem.
- set the modem to transmit 10-bit characters, if applicable.
- assign a unique address to the modem, if applicable.

For information about this modem type	By this vendor	See page
Telephone	Rockwell Automation	8-3
	DATA-LINC GROUP	8-5
	Miille Applied Research Company, Inc. (MARC)	8-11
Radio	DATA-LINC GROUP	8-23
	Electronic Systems Technology (ESTeem)	8-29
	Microwave Data Systems (MDS)	8-35
Power line	DATA-LINC GROUP	8-39

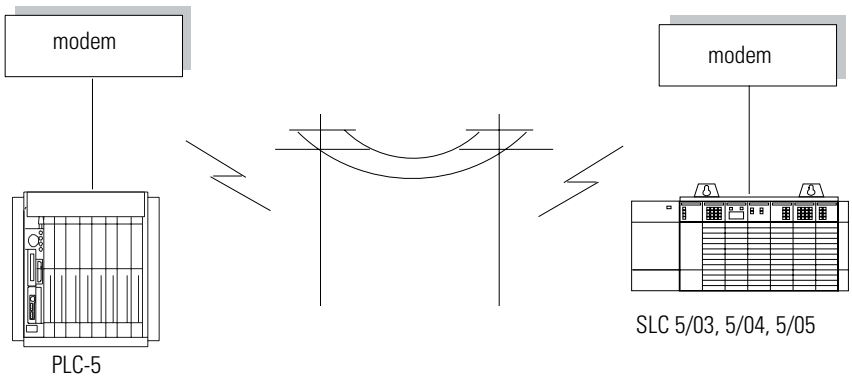
Telephone Modem Configurations

Telephone modems communicate over either dial-up or leased-line wires. When communicating with Allen-Bradley processors, configure these modems according to:

- the cable assignments listed here,
- the switch and strap settings listed here,
- your application.

For information about this vendor's products	See page
Rockwell Automation	8-3
DATA-LINC GROUP	8-5
Miille Applied Research Company, Inc. (MARC)	8-11

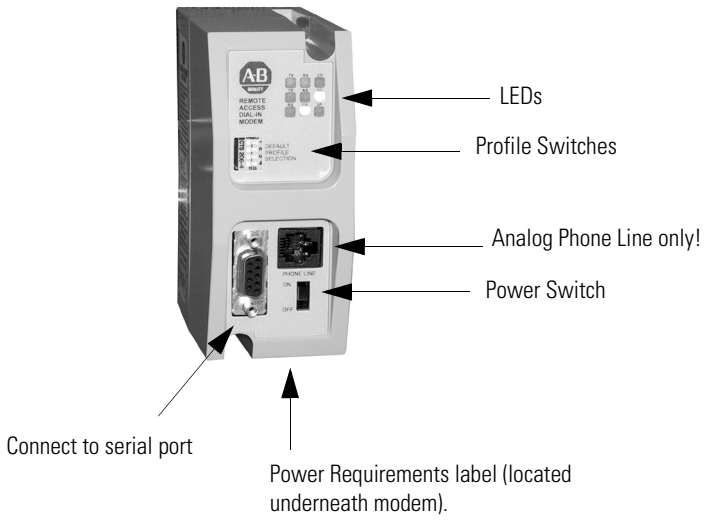
Figure 8.1
Typical Telephone Modem Configuration



Rockwell Automation

Rockwell Automation offers the 9300-RAKIT as a dial-up modem solution for connecting to Allen-Bradley processors. The 9300-RAKIT includes a DIN rail mount telephone modem, an AC power adapter, and cables and adapters needed to connect the modem to a PLC-5, SLC, MicroLogix, or Logix processor serial port.

Figure 8.2 9300-RAKIT Modem



All connections, switches, and LEDs are located on the front of the modem. The 8-48V dc power connection is made on the bottom of the modem. At 24V dc, the modem draws 100 mA so it can be powered from the processor 24V dc user power if available. You can also use the 110V ac adapter for supplying power.

The phone line connection is made through the RJ-45 jack (a phone cable is included). Four switches allow a selection of one of four different profiles to be loaded at power-up. The default profiles are listed in the following table.

Table 8.1 Profile Settings

Profile Number	Profile Operation
1	Sets the maximum line rate to 9600 bps and configures the serial port for hardware flow control and a fixed speed of 9600 bps.
2	Sets the maximum line rate to 9600 bps and configures the serial port for a fixed speed of 9600 bps and disables flow control.
3	Sets the maximum line rate to 19,200 bps and configures the serial port for hardware flow control and a fixed speed of 19,200 bps.
4(1)	Sets the maximum line rate to 19,200 bps and configures the serial port for a fixed speed of 19,200 bps and disables flow control.
Reset modem	Power off the modem, turn all four DIP switches on and restore power to the modem. After 10 seconds, power the modem off and reset the DIP switches.

(1) For dial-in applications, Profile 4 can be used as set. For dial-out applications, you need to make additional modifications to Profile 4 via AT commands prior to dialing out.

DATA-LINC Group

DATA-LINC GROUP supplies telephone modems compatible with Allen-Bradley processors. The modems provide long-distance communication over leased lines or standard dial-up lines.

Follow these guidelines for connecting an Allen-Bradley processor to these models of DATA-LINC telephone modems. Use the table below to choose the appropriate model for your application.

Table 8.2 DATA-LINC Modem Types

Link Type	Transmission Rate	Topology	Modem Model	See page
digital leased-line	57,600	point-to-point point-to-multipoint	DLM4300(1)	8-5
analog leased-line	1200 (4- wire)	point-to-multipoint	LLM1000-4(1)	8-6
	1200 (4-wire)	point-to-point		
analog leased-line	1200 (2-wire)	point-to-multipoint	LLM1000-2(1)	8-6
dial-up or analog leased-line	28,800 (2-wire)	point-to-point	DLM4000	8-9
dial-up	28,800	point-to-point	DLM4100-SLC	8-10
dial-up	28,800	point-to-point	DLM4100-PLC	8-10

(1) 1746 and 1771 rack mount available

TIP For additional modem specifications consult your DATA-LINC user manual or www.data-linc.com.

DATA-LINC modems are pre-configured at the factory for each application, and no modem field settings, programming or adapters are required.

DLM4300

The DATA-LINC DLM4300 Digital Leased Line Modem is a pollable, multi-drop, multi-point modem for connection to telco 56K digital leased lines, know as DDS. The DLM4300 connects to all Allen-Bradley PLCs and supports asynchronous serial data with selectable data rates from 1200 to 38.4K baud. Remote modem response is accomplished by either RTS line control or DATA-LINC's proprietary Data Sense Carrier Control. The DLM4300 employs high level error control and full digital leased line conditioning. Range on properly conditioned leased lines is unlimited. The DLM4300 is

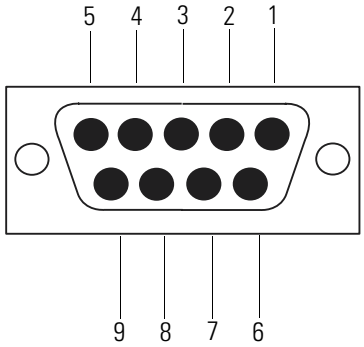
encased in a rugged steel enclosure with large mounting flanges for ease of installation.

The DLM4300 connects to the PC/PLC through a DB-9 female connector. All connections and LEDs are located at the front of the modem. Line connection is made through the RJ-45 jack, as are the LEDs for Data Out, Data In, Carrier Detected and Power, providing visible confirmation of modem operation and diagnosis.

Table 8.3 DLM4300 DB-9 Assignments

DLM4300 Pin #	PLC-5 25-Pin	AIC+, Logix5550, PC, or SLC 500 9-Pin	Assignment
1	8	1	Carrier Detect
2	3	2	Transmit Data
3	2	3	Receive Data
4	20	4	DTR
5	7	5	Signal Ground
6	6	6	DSR
7	4	7	RTS
8	5	8	CTS
9	NC	NC	Ground

Figure 8.3 DLM4300 Assignments



LLM1000-2 and LLM1000-4

The LLM1000 series modems are 2 and 4 wire Frequency-shift keyed, half-duplex/simplex, Bell 202/CCITT V.23 compatible, 0 to 1200 baud modem that interface with Allen-Bradley equipment. They are designed to be used on private, leased unswitched telephone lines or any dedicated two conductor wire (twisted or untwisted, shielded or

unshielded). The range is twenty miles on any ordinary pair wire, or unlimited on 'loaded' telephone company voice grade leased lines.

Table 8.4 LLM1000-2 Four Position Terminal Block Connections

Terminal Block	Assignment	
1	Carrier	FSK carrier transmission line(no polarity)
2		
3	Power +	Supply power +
4	Power -	Supply power -

Table 8.5 LLM1000-2 DB-9 Assignment

LLM100-2 DB-9 Pin	Assignment
1	Carrier Detect
2	Data Out
3	Data In
4	Not Connected
5	Signal Ground
6	DSR
7	RTS
8	CTS
9	Not Connected

Figure 8.4 LLM1000-2 Assignment

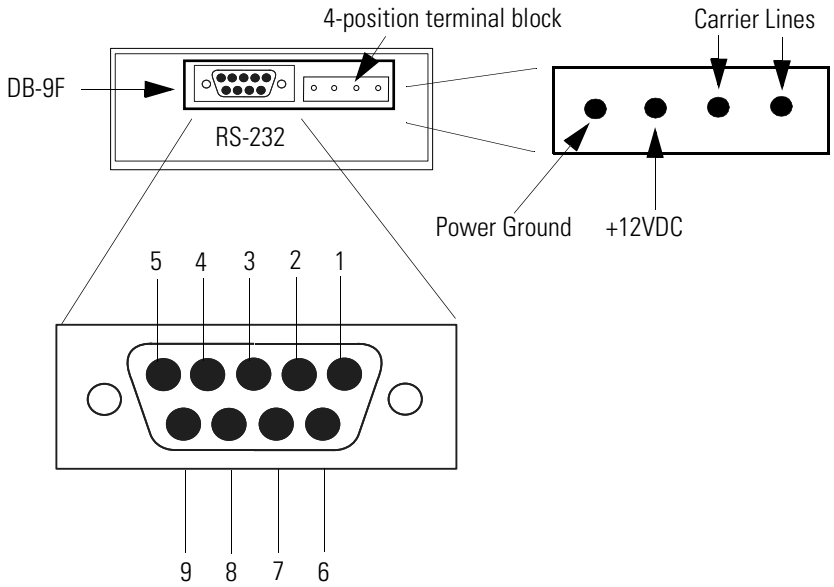


Table 8.6 LLM1000 Connecting Cable Assemblies

DATA-LINC Part Number	Description
C232/LLM10/PLC5/CH 0	LLM1000 to PLC-5
C232/LLM10/SLC5/CH 0	LLM1000 to SLC-5
C232/LLM10/1785-KE	LLM1000 to 1785-KE
C232/LLM10/1770-KE	LLM1000 to 1770-KE
C232/LLM10/MLGXCBL	LLM1000 to 1761-CBL-PM02 Series B Cable (A-B MicroLogix cable)
C232/LLM10/1747-KE	LLM1000 to 1747-KE
C232/LLM10/PC	LLM1000 to PC
C232/LLM10/1771-DB	LLM1000 to 1771-DB
C232/LLM10/1770-KF2	LLM1000 to 1770-KF2
C232/LLM10/1770-KF3	LLM1000 to 1770-KF3
C232/LLM10/1770-KFC	LLM1000 to 1770-KFC
C232/LLM10/1770-KFD	LLM1000 to 1770-KFD
C232/LLM10/DUALPLC5/CH 0	LLM1000 to Dual PLC-5
C232/LLM10/1394SERVO	LLM1000 to 1394 Servo
C232/LLM10/PM-II	LLM1000 to A-B Power Monitor II

DLM4000

The DLM4000 is a stand-alone industrial use modem that communicates with Allen-Bradley equipment as either a dial-up or leased line device. It is capable of communication at speeds up to 28.8K baud, and responds to standard AT commands. The DLM4000 has a rugged steel housing with large mounting flanges for ease of installation.

Table 8.7 DLM 4000 Pin Assignment

DLM4000 Pin #	Assignment	Assignment	PLC-5 25-Pin	AIC+, Logix5550, PC, or SLC 500 9-Pin
1	PROTECT.GND	SHIELD	1	CASE
2	RXD.IN	TXD.OUT	2	3
3	TXD.OUT	RXD.IN	3	2
4	RTS	RTS.OUT	4	7
5	CTS	CTS.IN	5	8
6	DSR	DSR.IN	6	6
7	SIGNAL GROUND	SIGNAL GROUND	7	5
8	CD	DCD.IN	8	1
20	DTR	DTR.OUT	20	4

Figure 8.5 DLM4000

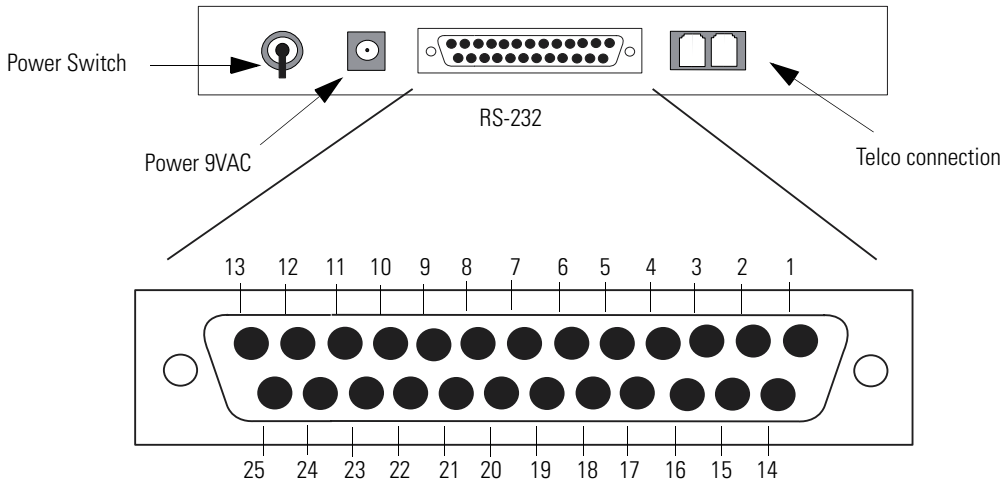


Table 8.8 DLM4000 Connecting Cable Assemblies

DATA-LINC Part Number	Description
C232/DLM40/PLC5/CH 0	DLM4000 to PLC-5
C232/DLM40/SLC5/CH 0	DLM4000 to SLC-5
C232/DLM40/1785-KE	DLM4000 to 1785-KE
C232/DLM40/1770-KE	DLM4000 to 1770-KE
C232/DLM40/MLGXCBL	DLM4000 to 1761-CBL-PM02 Series B Cable (A-B MicroLogix cable)
C232/DLM40/1747-KE	DLM4000 to 1747-KE
C232/DLM40/PC	DLM4000 to PC
C232/DLM40/1771-DB	DLM4000 to 1771-DB
C232/DLM40/1770-KF2	DLM4000 to 1770-KF2
C232/DLM40/1770-KF3	DLM4000 to 1770-KF3
C232/DLM40/1770-KFC	DLM4000 to 1770-KFC
C232/DLM40/1770-KFD	DLM4000 to 1770-KFD
C232/DLM40/DUALPLC5/CH 0	DLM4000 to Dual PLC-5
C232/DLM40/1394SERVO	DLM4000 to 1394 Servo
C232/DLM40/PM-II	DLM4000 to A-B Power Monitor II

DLM4100-SLC and DLM4100-PLC

The DLM4100-SLC is a 1746 form factor chassis mounted industrial use modem that communicates with the Allen-Bradley SLC 500 as a

dial-up device. The DLM4100-PLC is a 1746 form factor rack mounted industrial use modem that communicates with the Allen-Bradley PLC-5 as a dial-up device. Both models are externally powered, capable of communication at speeds up to 28.8K baud, and respond to standard AT commands.

To connect the DLM4100-SLC to a PLC-5 use the DATA-LINC communication cable C232/DLM41/SLC5/CH 0, CABLE ASSEMBLY DLM4100 TO A-B SLC-500. Refer to Table 8.23 on page 8-26 for cable pinout details.

To connect the DLM4100-PLC to a PLC-5 use the DATA-LINC communication cable C232/DLM41/SLC5/CH 0, CABLE ASSEMBLY DLM4100 TO A-B PLC-5. See Table 8.24 on page 8-27 for cable pinout details.

Miille Applied Research Company, Inc. (MARC)

MARC, Inc. supplies telephone modems compatible with Allen-Bradley PLC-5 processors and SLC processors. The modems provide long-distance communication over leased telephone lines or standard dial-up lines.

Follow these guidelines for connecting an Allen-Bradley PLC-5 or SLC processor to these models of MARC telephone modems. Use the table below to choose the appropriate model for your application.

Link Type	Transmission Rate	Topology	Modem Model	See page
leased-line	1200 (2- or 4- wire)	point-to-multipoint	166-101 (1746 rack mount)	8-12
	300 (2-wire), 1200 (4-wire)	point-to-point		
leased-line	1200 (2- or 4- wire)	point-to-multipoint	137-001 (1771 rack mount)	8-14
	300 (2-wire), 1200 (4-wire)	point-to-point		
leased-line	1200 (2- or 4-wire)	point-to-multipoint	148-001 (1771 rack mount)	8-16
	300 (2-wire), 1200 4-wire)	point-to-point		
dial-up	2400	point-to-point	166-100 (1746 rack mount)	8-18
dial-up	2400	point-to-point	166-010 (1771 rack mount)	8-20
	14,400		166-010-144 (1771 rack mount)	
	28,800		166-010-288 (1771 rack mount)	

TIP For additional modem specifications consult your MARC user documentation or www.miille.com.

Figure 8.6 Typical SCADA Configuration Using MARC Leased-Line Modems

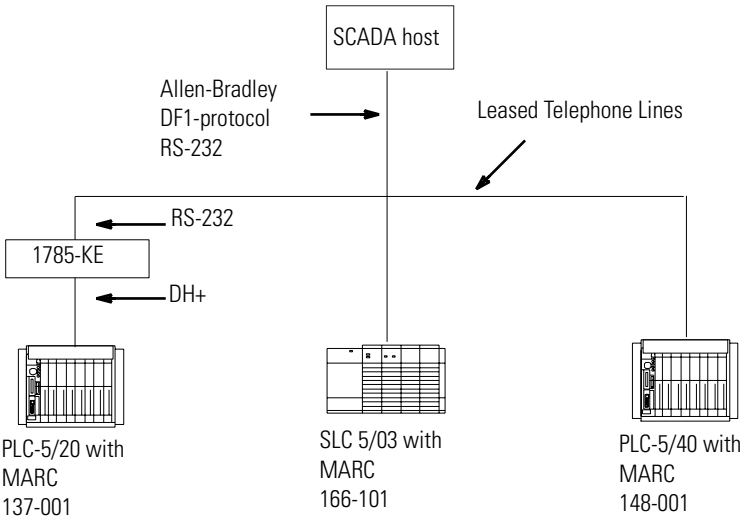
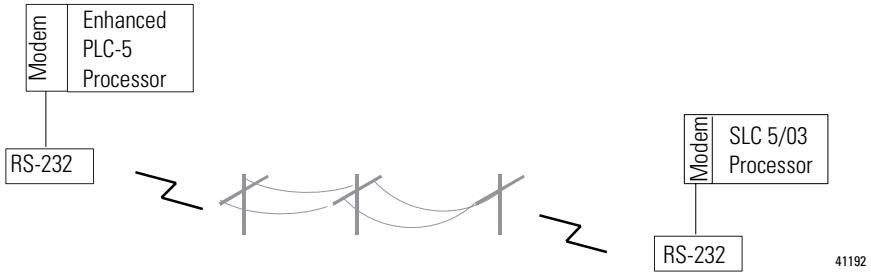


Figure 8.7 Typical SCADA Configuration Using MARC Dial-Up Modems



MARC Model 166-101

Model 166-101 is an asynchronous frequency-shift keyed (FSK) modem for use on leased lines or local twisted pairs. This modem, which fits into a single slot of the Allen-Bradley 1746 chassis, features switch-selected Bell and CCITT operating modes and adjustable transmit levels.

To connect an Allen-Bradley SLC processor to this module, follow these specifications for:

- cable pin assignments
- switch settings

Cable Pin Assignments

The Model 166-101 requires a RS-232 9-pin D-shell female connector with the pin assignments shown below or these MARC cable assemblies:

- 127-070 (1747-KE to MARC 166-101)
- 127-069 (SLC 5/03, 5/04 or 5/05 to MARC 166-101)

Figure 8.8 MARC, Inc. Model 166-101

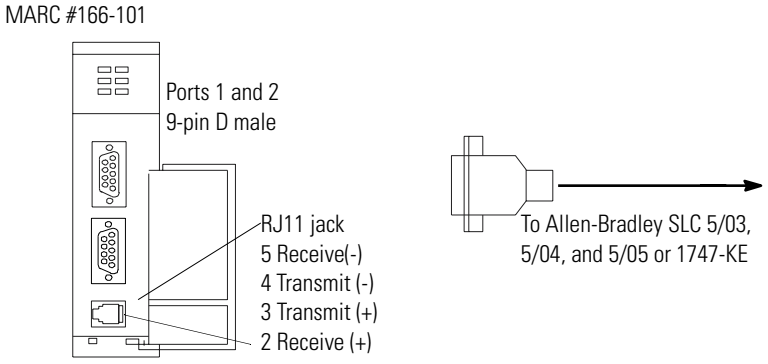


Table 8.9 MARC, Inc. Model 166-101 Pin Assignments

Modem 9-pin male	Pin Name		Pin Name	SLC 9-pin male	1747-KE 9-pin male
2	RXD.OUT	—	RXD.IN	2	2
3	TXD.IN	—	TXD.OUT	3	3
4	DTR.IN	—	DTR.OUT	4(1)	4
5	SIG.GND	—	SIG.GND	5	5
6	DCD.OUT	—	DCD/DSR.IN	1	6
7	RTS.IN	—	RTS.OUT	7	7
8	CTS.OUT	—	CTS.IN	8	8

(1) Pin 4 is jumpered (within the connector) to pin 6.

Switch Settings

For Bell 202 full-duplex operating mode, set the switches on Model 166-101 according to those in Table 8.10. For Bell 202 half-duplex operating mode (point-to-multipoint), set the switches on Model 166-101 according to those is Table 8.11.

ATTENTION

Switch settings shown here are for modems using RJ11 plugs on 4-wire lines. If you are using 2-wire lines, consult the MARC user manual.

Table 8.10 Model 166-101 Full-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode	xxx	xxx	off	on	on	off	on	xxx
2 Transmit Level	off	on	off	off	off	off	off	off

Table 8.11 Model 166-101 Half-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode	xxx	xxx	on	on	on	off	on	xxx
2 Transmit Level	off	on	off	off	off	off	off	off

MARC Model 137-001

The MARC 137-001 module is an asynchronous frequency-shift keyed (FSK) modem for use on leased lines or local twisted pairs. This modem, which fits into a single slot of the Allen-Bradley 1771 I/O chassis, features switch-selectable Bell and CCITT operating modes and adjustable transmit levels.

To connect an Allen-Bradley PLC-5 processor to MARC Model 137-001, follow these specifications for:

- cable pin assignments
- switch settings

Cable Pin Assignments

The Model 137-001 requires a 15-pin male connector with the pin assignments shown below or these MARC cable assemblies:

- 127-056 (1785-KE to MARC 137-001)
- 127-067 (1785 PLC-5/xx to MARC 137-001)

Figure 8.9 MARC, Inc. Model 137-001

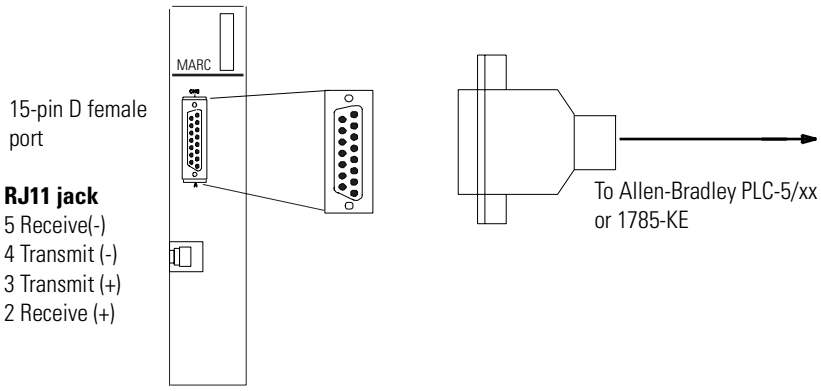


Table 8.12 MARC, Inc. Model 137-001 Pin Assignments

Modem 15-pin female	Pin Name		Pin Name	PLC-5 25-pin female	1785-KE 15-pin female
1	DCD.OUT	—	DCD.IN	8	8
2	TXD.IN	—	TXD.OUT	2	2
3	RXD.OUT	—	RXD.IN	3	3
4	DTR.IN	—	DTR.OUT	20(2)	11(3)
5(1)	SIG.GND	—	SIG.GND	7	7(4)
7	RTS.IN	—	RTS.OUT	4	4
8	CTS.OUT	—	CTS.IN	5	5

(1) Pin 5 is jumpered (within the connector) to pin 9.

(2) Pin 6 is jumpered (within the connector) to pin 20.

(3) Pin 6 is jumpered (within the connector) to pin 11.

(4) Pin 7 is jumpered (within the connector) to pin 13.

Switch Settings

For Bell 202 full-duplex operating mode, set the switches on Model 137-001 according to those in Table 8.13. For Bell 202 half-duplex mode (point-to-multipoint), set the switches on Model 166-101 according to those in Table 8.14.

ATTENTION

Switch settings shown here are for modems using RJ11 plugs on 4-wire lines. If you are using 2-wire lines, consult the MARC user manual.

Table 8.13 Model 137-001 Full-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode	off	on	on	off	on	xxx	xxx	xxx
2 Transmit Level	off	on	off	off	off	off	off	off

Table 8.14 Model 137-001 Half-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode	on	on	on	off	on	xxx	xxx	xxx
2 Transmit Level	off	on	off	off	off	off	off	off

MARC Model 148-001

The MARC 148-001 comprises two 137-001 modems in a single package. You can operate the modems independently or in a redundant mode. This model fits into a single slot of the Allen-Bradley 1771 I/O chassis and features switch-selectable Bell and CCITT operating modes and adjustable transmit levels.

To connect an Allen-Bradley PLC-5 processor to MARC Model 148-001, follow these specifications for:

- cable pin assignments
- switch settings

Cable Pin Assignments

The Model 148-001 requires an RS-232 15-pin male connector with the pin assignments shown in Figure 8.10 or these MARC cable assemblies:

- 127-058 (1785-KE to MARC 148-001)
- 127-064 (1785 PLC-5/xx to MARC 148-001)

Figure 8.10 MARC, Inc. Model 148-001

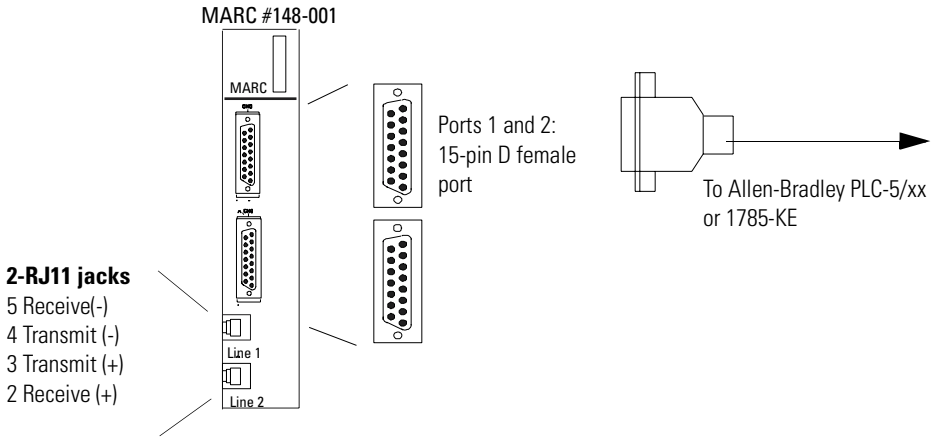


Table 8.15 MARC, Inc. Model 148-001 Pin Assignments

Modem 15-pin female	Pin Name		Pin Name	PLC-5 25-pin female	1785-KE 15-pin female
2	TXD.IN	—	TXD.OUT	2	2
3	RXD.OUT	—	RXD.IN	3	3
4	RTS.IN	—	RTS.OUT	4	4
5	CTS.OUT	—	CTS.IN	5	5
7	SIG.GND	—	SIG.GND	7	7(1)
8	DCD.OUT	—	DCD.IN	8	8
11	DTR.IN	—	DTR.OUT	20(2)	11(3)

(1) Pin 7 is jumpered (within the connector) to pin 13.

(2) Pin 20 is jumpered (within the connector) to pin 6.

(3) Pin 11 is jumpered (within the connector) to pin 6.

Switch Settings

For Bell 202 full-duplex operating mode, set the switches on Model 148-001 according to those in Table 8.16. For Bell 202 half-duplex operating mode (point-to-multipoint), set the switches on Model 148-001 to those in Table 8.17.

ATTENTION

Switch settings shown here are for modems using RJ11 plugs on 4-wire lines. If you are using 2-wire lines, consult the MARC user manual.

Table 8.16 Model 148-001 Full-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode, Port 1	off	on	on	off	on	xxx	xxx	xxx
2 Transmit Level, Port 1	off	on	off	off	off	off	off	off
3 Operating Mode, Port 2	off	on	on	off	on	xxx	xxx	xxx
4 Transmit Level, Port 2	off	on	off	off	off	off	off	off

Table 8.17 Model 148-001 Half-Duplex Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
1 Operating Mode, Port 1	on	on	on	off	on	xxx	xxx	xxx
2 Transmit Level, Port 1	off	on	off	off	off	off	off	off
3 Operating Mode, Port 2	on	on	on	off	on	xxx	xxx	xxx
4 Transmit Level, Port 2	off	on	off	off	off	off	off	off

MARC Model 166-100

Model 166-100 Bell and CCITT compatible is a dial-up telephone modem that fits into one slot of the Allen-Bradley 1746 chassis.

To connect an Allen-Bradley SLC processor to this module, follow these specifications for:

- cable pin assignments
- switch settings

Cable Pin Assignments

The Model 166-100 requires a RS-232 9-pin D-shell female connector with the pin assignments shown below or these MARC cable assemblies:

- 127-070 (1747-KE to MARC 166-100)
- 127-077 (SLC 5/03, 5/04 or 5/05 to MARC 166-100)

Figure 8.11 MARC, Inc. Model 166-100

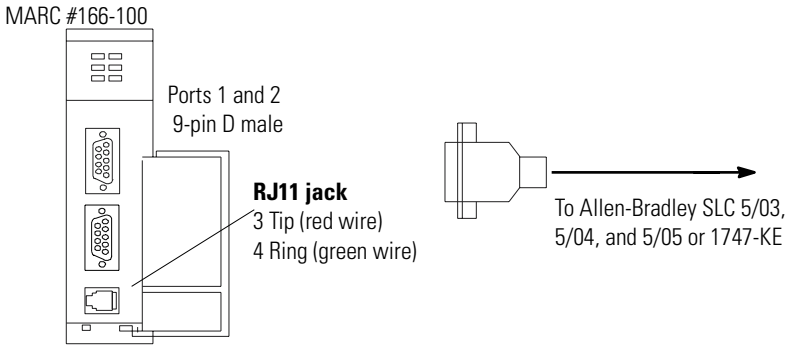


Table 8.18 MARC, Inc. Model 166-100 Pin Assignments

Modem 9-pin male	Pin Name		Pin Name	SLC 9-pin male	1747-KE 9-pin male
2	RXD.OUT	—	RXD.IN	2	2
3	TXD.IN	—	TXD.OUT	3	3
4	DTR.IN	—	DTR.OUT	4	4
5	SIG.GND	—	SIG.GND	5	5
6	DCD.OUT	—	DCD/DSR.IN	1[(1)]	6
7	RTS.IN	—	RTS.OUT	7	7
8	CTS.OUT	—	CTS.IN	8	8

(1) Pin 4 is jumpered (within the connector) to pin 6.

Switch Settings

Set the switches on Model 166-100 according to those in Table 8.19.

Table 8.19
Model 166-100 Switch Settings

Switch Assembly	1	2	3	4	5	6	7	8
Transmit Level	off	on	off	off	off	off	off	off

MARC Model 166-010

Model 166-010 is a Bell and CCITT compatible dial-up telephone model that fits into a single slot of the Allen-Bradley 1771 I/O chassis.

To connect an Allen-Bradley PLC-5 processor to MARC Model 166-010, follow these specifications for:

- cable pin assignments
- switch settings

Cable Pin Assignments

The Model 166-010 requires a 15-pin male connector with the pin assignments shown below or these MARC cable assemblies:

- 127-079 (1785-KE to MARC 166-010)
- 127-078 (1785 PLC-5/xx to MARC 166-010)

Figure 8.12 MARC, Inc. Model 166-010

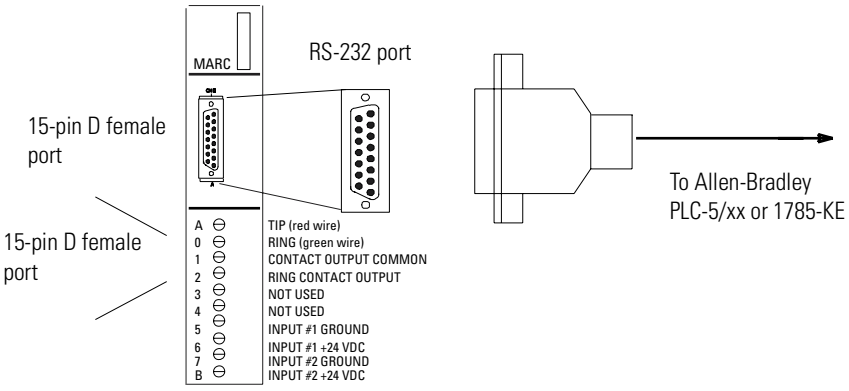


Table 8.20 MARC, Inc. Model 166-010 Pin Assignments

Modem 15-pin female	Pin Name		Pin Name	PLC-5 25-pin female	1785-KE 15-pin female
2	TXD.IN	—	TXD.OUT	2	2
3	RXD.OUT	—	RXD.IN	3	3
4	RTS.IN	—	RTS.OUT	4	4
5	CTS.OUT	—	CTS.IN	5	5
7	SIG.GND	—	SIG.GND	7	7
8	DCD.OUT	—	DCD.IN	8(1)	8(1)
11	DTR.IN	—	DTR.OUT	20	11

(1) Pin 8 is jumpered (within the connector) to pin 6.

Switch Settings

The Model 166-010 (-xxx) modems have a set of four 16-position rotary switches, S1 through S4, which are visible through an opening in the side of the module cases. S1 is used to select the number of rings to allow before answering a call. Setting S1 to zero will disable the auto answer mode entirely. S2 is used to select the dialing mode of the modem. Position 0 disables dial-out, position 1 enables dial-out through one of two 24 VDC inputs wired to the module swing arm, and position 2 enables ASCII string dialing using AT commands.

Switches S3 and S4 are only used on the Model 166-010-144 and -288 high speed modems. S3 sets the maximum modem connect baud rate, and S4 selects the baud rate used to communicate with the PLC. (Note that for the 2400 baud Model 166-010 modem, the maximum modem connect baud rate is fixed at 2400 and the baud rate to communicate with the PLC is fixed at 9600.) Setting both S3 and S4 to position 8 will allow the high speed modem to connect at the maximum baud rate it can negotiate with the remote modem, up to 14,400 or 28,800 baud, and communicate with the PLC at 19,200 baud.

Radio Modem Configurations

Radio modems communicate over a radio frequency band. The FCC requires that you obtain a license before you operate a radio modem at a particular location and frequency within certain radio frequency bands. Operating within a licensed radio frequency band minimizes the chance of transmission interference from other nearby radio modems. Unfortunately, in populated areas most, if not all, of the radio frequencies are already licensed and in use.

The FCC allows you to use relatively low transmit power spread-spectrum radio modems without a license. Spread-spectrum is a transmission-frequency varying technique that lets many spread-spectrum radios operate within the same radio frequency band

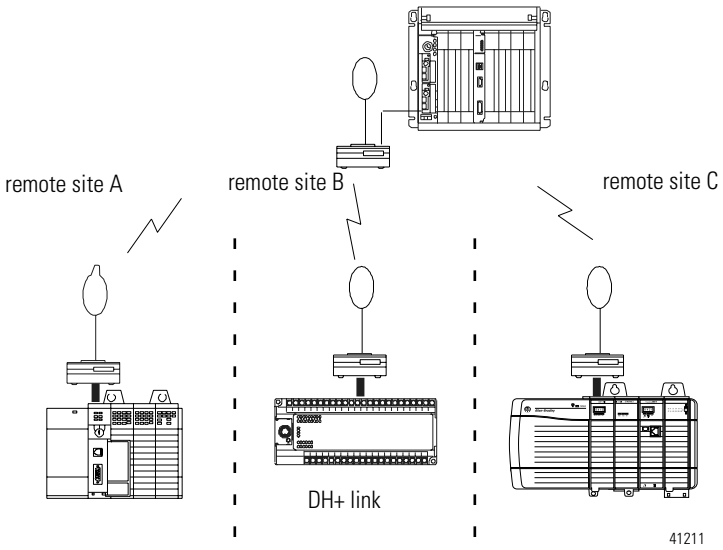
with some interference. The amount of interference is directly proportional to the number of users in the area.

You can use radio modems for either point-to-point or point-to-multipoint applications. When communicating with Allen-Bradley programmable controllers, configure radio modems according to:

- the cable assignments listed here
- the switch and settings listed here
- your application

For information about these vendor's products	See page
DATA-LINC GROUP	8-23
Electronic Systems Technology (ESTeem)	8-29
Microwave Data Systems (MDS)	8-35

Figure 8.13 Typical Configuration using Radio Modems and Allen-Bradley processors



DATA-LINC Group

Use the following table to determine which DATA-LINC radio modem you need. Refer to Table 8.25 for cabling information. Consult DATA-LINC for specific information regarding the installation of DATA-LINC products.

Table 8.21 DATA-LINC Radio Modem

Spread-spectrum Frequency	Topology	A-B Protocol	Maximum Distance Line-of-Sight	DATA-LINC Model #
902-928 MHz	Point-to-Point	DF1 Full-duplex	20 miles	SRM 6000
	Point-to-Multipoint	DF1 Half-duplex		SRM 6000-SLC(2)
				SRM 6000-PLC(3)
2400-2484 MHz	Point-to-Point	DF1 Full-duplex	7 miles	SRM 6100
	Point-to-Multipoint	DF1 Half-duplex		SRM 6100-SLC(2)
				SRM 6100-PLC(3)
902-928 MHz	Point-to-Point	Ethernet(1)	15 miles	SRM 6200E
	Point-to-Multipoint			SRM 6200E-SLC(2)
				SRM 6200E-PLC(3)

(1) 10BASE-T connector

(2) 1746 chassis mount

(3) 1771 rack mount

TIP For additional modem specifications consult your DATA-LINC user documentation or www.data-linc.com

SRM6000/6100/6200E

The DATA-LINC SRM6000, SRM6100 and SRM6200E are license-free spread spectrum frequency hopping wireless modems that can interface with Allen-Bradley PLCs. The modems can be configured as master, remote, or repeater (SRM6000/6100 only) and data communications are asynchronous. Baud rates can be set as high as 115.2K.

To connect the SRM6000 and SRM6100 to the PLC, use a communication cable for your specific application as indicated in the Cable Assemblies List. The modem connector pinout is as follows:

Table 8.22 SRM6000 and SRM6100 Pin Assignment

SRM6000/6100 Pin #	PLC-5 25-Pin	AIC+, Logix5550, PC, and SLC 500 9-Pin	Assignment
1	8	1	Carrier Detect
2	3	2	Transmit Data
3	2	3	Receive Data
4	20	4	DTR
5	7	5	Signal Ground
6	6	6	DSR
7	4	7	RTS
8	5	8	CTS
9	NC	NC	Ground

Figure 8.14 SRM6000/6100 Front Panel

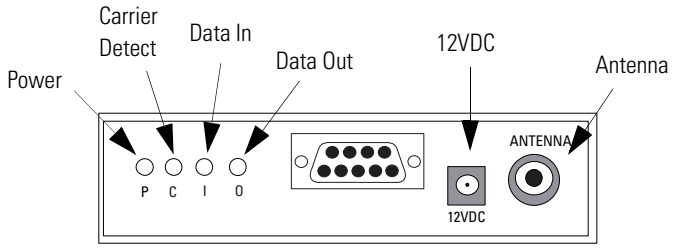
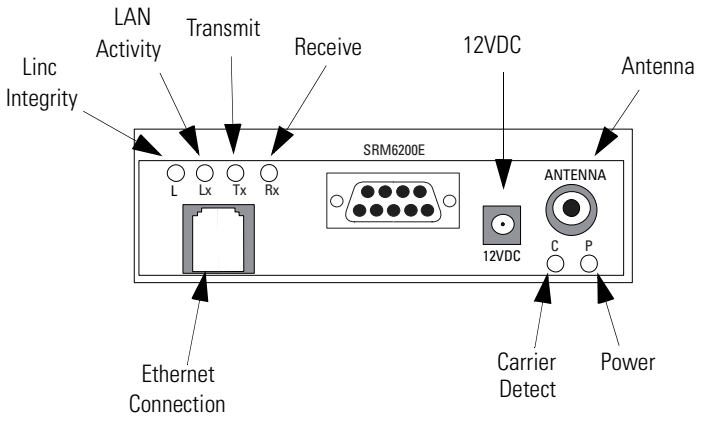


Figure 8.15 SRM6200E Front Panel



Data connection for the SRM6200E is via a RJ45 10BASE-T Ethernet port.

IMPORTANT SRM6000 Radio Modems can be installed in any SRM6200E system for use as repeaters (to extend system range or circumvent line-of-sight problems).

Switch Settings

There are no switches or jumpers to be set or adjusted. The SRM6000/6100/6200E comes pre configured from the factory. Use the SRM6000/6100/6200E Users' Guide (available from DATA-LINC) for changing configuration in the field.

SRM6000/6100/6200E-SLC

The DATA-LINC SRM6000/6100/6200-SLC are license-free, spread spectrum frequency-hopping wireless modem that fits directly into the Allen-Bradley SLC 500 chassis. These modems draw a maximum of 500 mA at 24V dc.

IMPORTANT For the SRM6000/6100/6200-SLC, the selected Allen-Bradley chassis power supply must be able to sustain the current requirements for all devices installed in the chassis, or communications could be interrupted.

The modems can be configured as master, remote, or repeater (SRM6000/6100-SLC only) and data communications are asynchronous. Baud rates can be set as high as 115.2k.

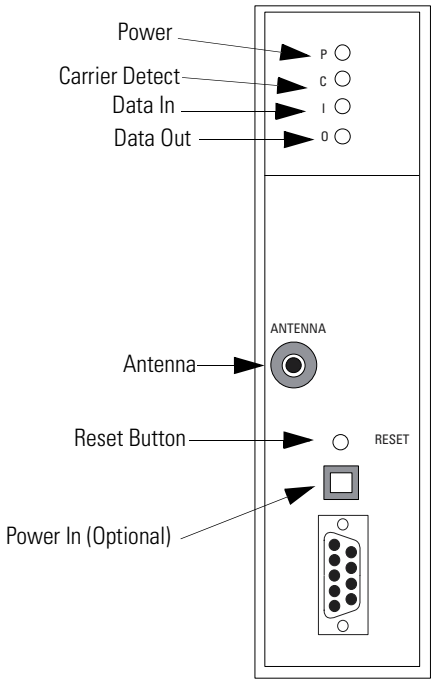
To connect the SRM6000-SLC or SRM6100-SLC to an SLC 500, use the DATA-LINC communication cable part number C232/SRM60/SLC5/CH 0, CABLE ASSEMBLY SRM6000 to Allen-Bradley SLC 500.

The modem connector pin assignment is as follows:

Table 8.23 SRM6000-SLC and SRM6100-SLC Pinout

SRM6000-SLC 6100-SLC Pin #	SLC 500	Assignment
1	1	Carrier Detect
2	2	Transmit Data
3	3	Receive Data
4	4	DTR
5	5	Signal Ground
6	6	DSR
7	7	RTS
8	8	CTS
9	NC	Ground

Figure 8.16 SRM6000-SLC and SRM 6100-SLC Front View



Data connection for the SRM6200E-SLC is via a RJ45 10BAST-T Ethernet port.

The SRM6000/6100/6200E-SLC are pre-configured. Use the SRM6000/6100/6200E-SLC User's Guide (available from DATA-LINC) to change configuration in the field.

SRM6000/6100/6200E-PLC

The DATA-LINC SRM6000/6100/6200E-PLC are license-free, spread spectrum frequency-hopping wireless modem that fits directly into the Allen-Bradley PLC-5 chassis. The modems can be configured as master, remote, or repeater (SRM6000/6100-PLC only), and data communications are asynchronous. Baud rates can be set as high as 115.2K.

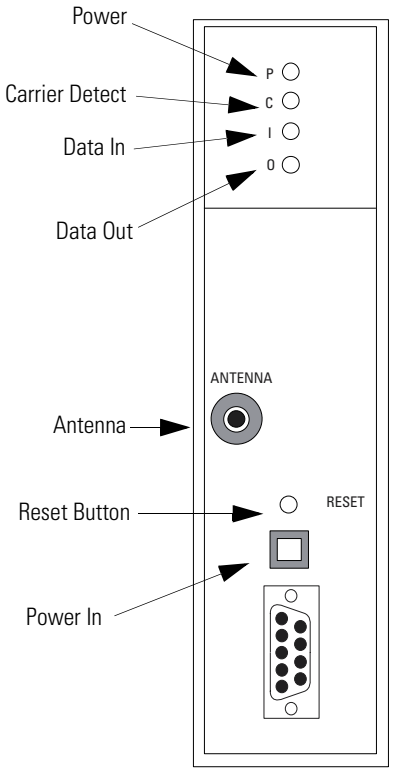
To connect the SRM6000-PLC or SRM6100-PLC to a PLC-5, use the DATA-LINC communication cable part number C232/SRM60/PLC5/CH 0, CABLE ASSEMBLY SRM6000 to Allen-Bradley PLC-5.

The modem pin assignment is as follows:

Table 8.24 SRM6000-PLC and SRM6100-PLC Pin Assignment

SRM6000 Pin #	PLC-5 25-Pin	Assignment
1	8	Carrier Detect
2	3	Transmit Data
3	2	Receive Data
4	20	DTR
5	7	Signal Ground
6	6	DSR
7	4	RTS
8	5	CTS
9	NC	Ground

Figure 8.17 SRM6000-PLC and SRM6100-PLC Front View



Data connection for the SRM6200E-PLC is via a RJ45 10BASE-T Ethernet port.

The SRM6000/6100/6200E-PLC are pre configured from the factory.Use the SRM6000/6100/6200E-PLC User's Guide (available from DATA-LINC) to change configuration in the field via the DB-9 connector on the modem.

Connecting Cable Assemblies

Table 8.25 DATA-LINC Connecting Cable Assemblies

DATA-LINC Part Number	Description
C232/SRM60/PLC5/CH 0	SRM6000 to PLC-5
C232/SRM60/SLC5/CH 0	SRM6000 to SLC-5
C232/SRM60/1785-KE	SRM6000 to 1785-KE
C232/SRM60/1770-KE	SRM6000 to 1770-KE
C232/SRM60/MLGXCBL	SRM6000 to 1761-CBL-PM02 Series B Cable (Allen-Bradley MicroLogix cable)
C232/SRM60/1747-KE	SRM6000 to 1747-KE
C232/SRM60/PC	SRM6000 to PC
C232/SRM60/1771-DB	SRM6000 to 1771-DB
C232/SRM60/1770-KF2	SRM6000 to 1770-KF2
C232/SRM60/1770-KF3	SRM6000 to 1770-KF3
C232/SRM60/1770-KFC	SRM6000 to 1770-KFC
C232/SRM60/1770-KFD	SRM6000 to 1770-KFD
C232/SRM60/DUALPLC5/CH 0	SRM6000 to Dual PLC-5
C232/SRM60/1394SERVO	SRM6000 to 1394 Servo
C232/SRM60/PM-II	SRM6000 to A-B Power Monitor II

Electronic Systems Technology (ESTeem)

ESTeem licensed frequency radio modems support the Allen-Bradley DF1 communication protocol and provide a radio area network (RAN) interface to Allen-Bradley products, which allows peer-to-peer communications without the use of a conventional hard-wired network.

Using an ESTeem radio modem, Allen-Bradley Logix5550, PLC-5, SLC 500, and MicroLogix 1000 processors can communicate over the RAN using standard MSG instructions. ESTeem modems allow networking of full-duplex-to-full-duplex Allen-Bradley products.

Choose an ESTeem modem based on:

- distance between sites
- operating environment
- frequency on which your application operates

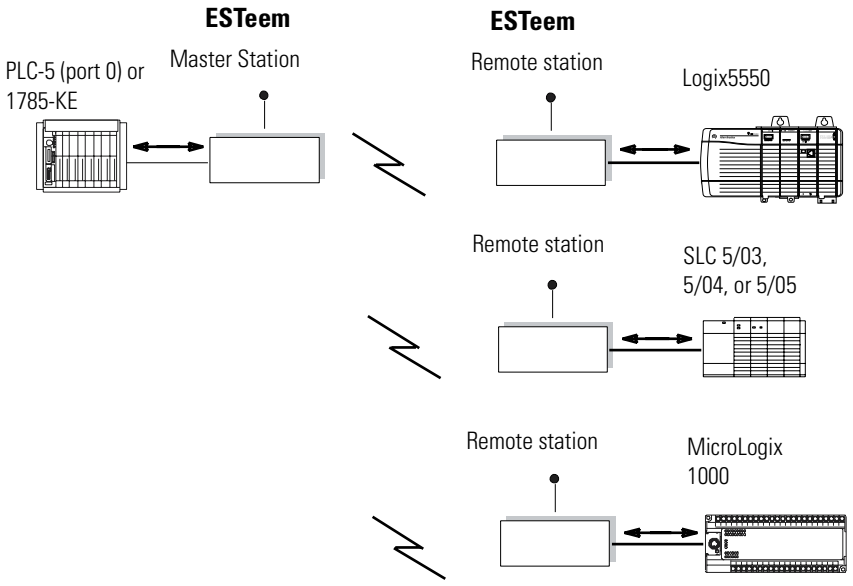
Use the table below to choose the ESTeem model that fits your needs:

Table 8.26 ESTeem Modems

For this frequency	And this distance	Use this ESTeem Modem
66-79 MHz	5 miles LOS	Model 192V
150-174 MHz	10 miles LOS - 2 watts 15 miles LOS - 4 watts	Model 192M
400-420 MHz	15 miles LOS	Model 192F
450-470 MHz	10 miles LOS - 2 watts 15 miles LOS - 4 watts	Model 192C

TIP For additional modem specifications consult your ESTeem user manual or www.esteem.com

Figure 8.18 Typical ESTeem Modem Configuration



All ESTeem model 192 wireless modems have the following features or available options:

- 19,200 bps RF data rate
- integral digi-repeater
- frequency of operation programmable software
- receiver squelch programmable software
- remote programmability of all features over the RF, infrared or dial-in phone interface
- radio diagnostic programs included
- radio self-test
- packet monitor
- received signal-to-noise ratio
- received signal strength output (optional)
- infrared communication port for local programming and diagnostics
- phone communication port for remote programming and diagnostics (optional)

To connect an Allen-Bradley processor to these modems, follow these specifications for:

- cable pin assignments
- switch settings

For software configuration information, refer to ESTeem Engineering Report #97-001.

Cable Pin Assignments and Dip Switch Settings

ESTeem radio modems require a RS-232, 25-pin male D-shell connector with the pin assignments shown in . on the following page. Refer to Table 8.20 and Table 8.28 for the RS-232 dip switch settings.

Figure 8.19 ESTeem Modem

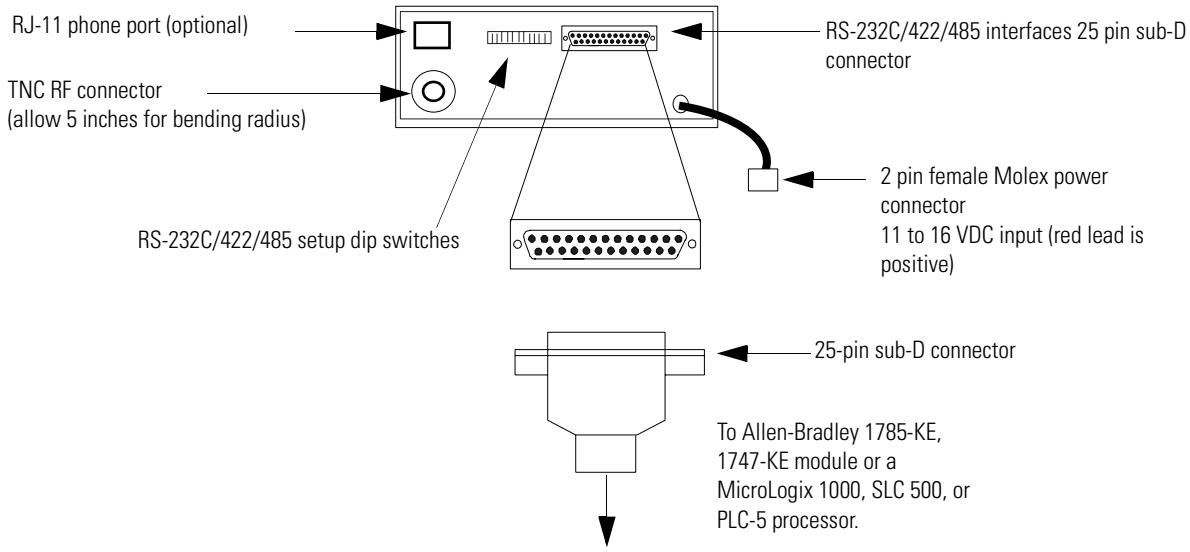


Table 8.27 Cable Pin Assignments for ESTeem Radio Modems

If you are connecting to an Allen-Bradley	Use these pin assignments for cable interface from the ESTeem modem to the A-B module

PLC-5/11, -5/20, -5/30, -5/40, -5/60, or -5/80

Modem 25-pin female(1)	Pin Name		Pin Name	PLC-5 25-pin female
2	TXD.IN	—	TXD.OUT	2
3	RXD.OUT	—	RXD.IN	3
4	RTS.IN	—	RTS.OUT	4
5	CTS.OUT	—	CTS.IN	5
6	DSR.OUT	—	DSR.IN	6
7	SIG.GND	—	SIG.GND	7
8	DCD.IN	—	DCD.OUT	8
1	Shield			

(1) ESTeem cable # AA06 (6')

If you are connecting to an Allen-Bradley — **Use these pin assignments for cable interface from the ESTeem modem to the A-B module**

1785-KE

Modem 25-pin female[1]	Pin Name		Pin Name	1785-KE 15-pin female
NC	Shield	—	Shield	1
2	TXD.IN	—	TXD.OUT	2
3	RXD.OUT	—	RXD.IN	3
4	RTS.IN	—	RTS.OUT	4
5	CTS.OUT	—	CTS.IN	5
6	DSR.OUT	—	DSR.IN	6
7	SIG.GND	—	Signal	7
11	SIG.GND	—	Ground	13
8	DCD.OUT	—	DCD.IN	8
20	DTR.IN	—	DTR.OUT	11
22	RING	—	RING	9

(1) A-B 1770-CP cable (16.5')

1747-KE
1746-BAS
KF2 or KF3 module
PC
SLC 5/03, 5/04, or 5/05
Logix5550
or AIC+ for
MicroLogix 1000

Modem 25-pin female[1]	Pin Name		Pin Name	KF2, KF3 module 25-pin male	PC, SLC, Logix5550 and AIC+ 9-pin male
2	TXD.IN	—	TXD.OUT	2	3
3	RXD.OUT	—	RXD.IN	3	2
4	RTS.IN	—	RTS.OUT	4	7
5	CTS.OUT	—	CTS.IN	5	8
6	DSR.OUT	—	DSR.IN	6	6
7	SIG.GND	—	SIG.GND	7	5
8	DCD.IN	—	DCD.OUT	8	1
1	Shield				

(1) ESTeem cable # AA07 (6') for KF2, KF3. ESTeem cable #AA061 (6') for all others.

Figure 8.20 ESTeem Switch Locations

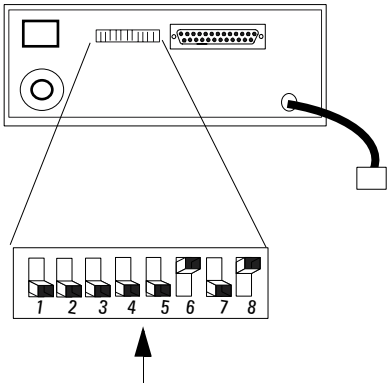


Table 8.28 ESTeem Modem RS-232 Switch Settings

		Baud Rate (19200)			**Data Format (8,N,1)**				**Auto Connect (Enabled)**
Switch Bit		1	2	3	4	5	6	7	8
Setting	for operation	off	off	off	off	off	on	off	on
	for programming(1)	off	off	off	off	off	on	off	off

(1) For information about programming this modem, see ESTeem Engineering Report #97-001.

Microwave Data Systems (MDS)

MDS supplies radio modems that communicate within point-to-point or multiple-address configurations.

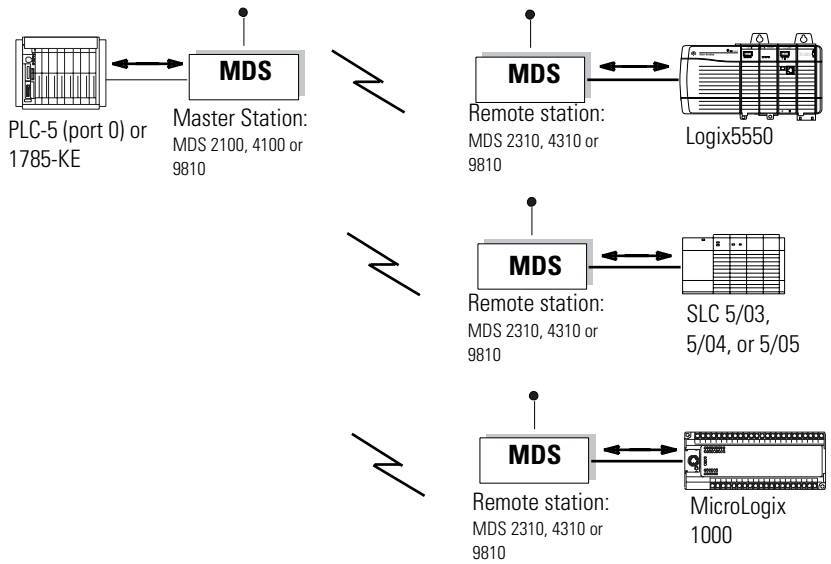
The frequency on which your application operates determines the type of modem MDS recommends you use. Use the table below to choose the model that fits your needs.

Table 8.29 MSD Modems

For this frequency	Use this MDS modem	See page
900-960 MHz	Model 2100 (master)	8-36
350-512 MHz	Model 4100 (master)	8-36
914-960 MHz	Model 2310 (remote)	8-37
350-512 MHz	Model 4310 (remote)	8-37
902-928 MHz (spread spectrum)	Model 9810	8-38

TIP For additional modem specifications consult your MDS user manual or www.microwavedata.com.

Figure 8.21 Typical SCADA configuration using MDS modems



MDS Model 2100 and 4100 Master Stations

Models 2100 and 4100 are full-duplex, multiple address, master radio stations.

Cable Pin Assignments

Each of these models requires a 25-pin male connector with the following pin assignments:

Figure 8.22 MDS Model 2100 and Model 4100 Master Stations

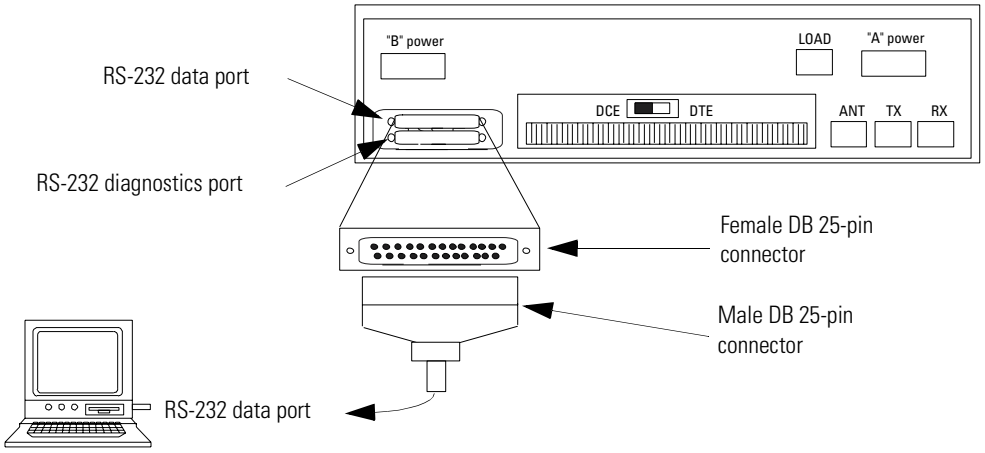


Table 8.30 MSD Model 2100 and 4100 Pin Assignments

Modem 25-pin female	Pin Name		Pin Name	PLC-5 25-pin female	SLC 9-pin male
1	Protective GND	—	Shield	1	CASE
2	TXD.IN	—	TXD.OUT	2	3
3	RXD.OUT	—	RXD.IN	3	2
4	RTS.IN	—	RTS.OUT	4	7
5	CTS.OUT	—	CTS.IN	5	8
6	DSR.OUT	—	DSR.IN	6	6
7	SIG.GND	—	SIG.GND	7	5
8	DCD.OUT	—	DCD.IN	8	1

MDS Model 2310 and 4310 Remote Stations

Models 2310 and 4310 are multiple address, remote data transceiver stations.

Cable Pin Assignments

Each of these models requires a 25-pin male connector with the following pin assignments:

Figure 8.23 MDS Model 2310 and Model 4310 Remote Data Transceivers

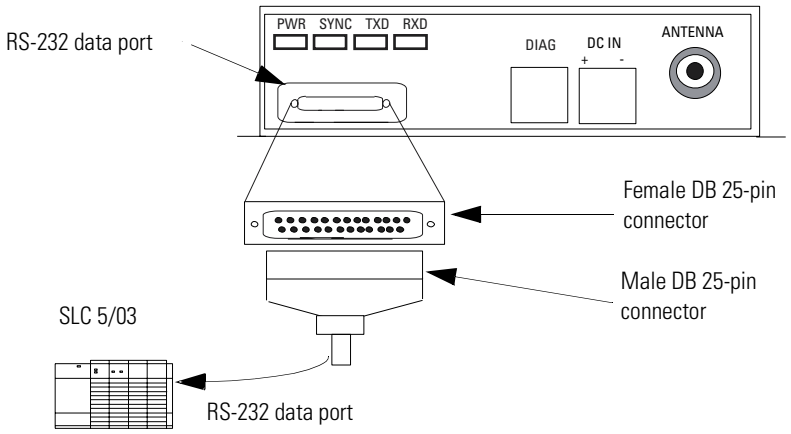


Table 8.31 MSD Model 2310 and 4310 Pin Assignments

Modem 25-pin female	Pin Name		Pin Name	PLC-5 25-pin female	SLC 9-pin male
1	Protective GND	—	Shield	1	CASE
2	TXD.IN	—	TXD.OUT	2	3
3	RXD.OUT	—	RXD.IN	3	2
4	RTS.IN	—	RTS.OUT	4	7
5	CTS.OUT	—	CTS.IN	5	8
6	DSR.OUT(1)	—	DSR.IN	6	6
7	SIG.GND	—	SIG.GND	7	5
8	DCD.OUT	—	DCD.IN	8	1

(1) DSR.OUT provides a +8V DC DSR signal through a 1K-ohm resistor.

MDS Model 9810 Spread Spectrum

Model 9810 is a spread-spectrum modem, which operates under FCC Part 15 rules to provide unlicensed operation for point-to-point and multipoint radios. Spread-spectrum is a frequency-varying technique that lets several spread-spectrum modems operate within the same radio frequency band.

Cable Pin Assignments

Model 9810 requires a 25-pin male connector with the following pin assignments:

Figure 8.24 MDS Model 9810 Spread Spectrum Data Transceiver

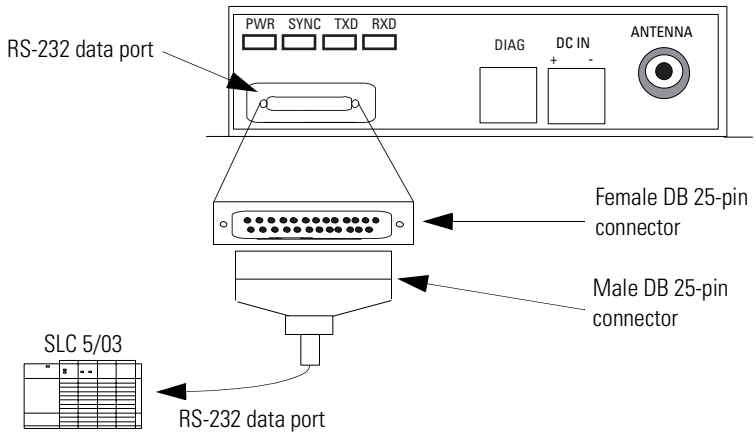


Table 8.32 MSD Model 9810 Pin Assignments

Modem 25-pin female	Pin Name		Pin Name	PLC-5 25-pin female	SLC 9-pin male
1	Protective GND	—	Shield	1	CASE
2	TXD.IN	—	TXD.OUT	2	3
3	RXD.OUT	—	RXD.IN	3	2
4	RTS.IN	—	RTS.OUT	4	7
5	CTS.OUT	—	CTS.IN	5	8
6	DSR.OUT(1)	—	DSR.IN	6	6
7	SIG.GND	—	SIG.GND	7	5
8	DCD.OUT	—	DCD.IN	8	1

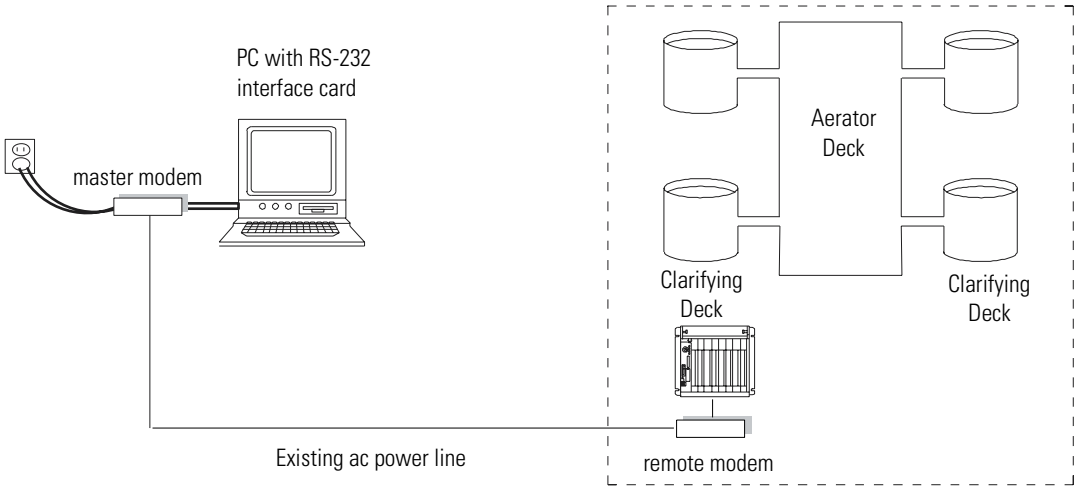
(1) DSR.OUT provides a +8V DC DSR signal through a 1K-ohm resistor.

Power Line Modem Configurations

Power line modems can also be used for SCADA applications. Instead of using dedicated lines to transmit data, power line modems are wired directly to existing ac cables in the plant or factory. You need only a power-delivery medium and an RS-232 interface.

When communicating with Allen-Bradley programmable controllers using power line modems, configure the modems according to the specifications in this section.

Figure 8.25 Typical power line modem configuration



DATA-LINC Group

LCM100 Line Carrier Modem

Interfacing with Allen-Bradley equipment using facility power lines, the LCM100 permits full duplex asynchronous data communication over 120VAC or 240 VAC power lines at data rates up to 9600 baud. A system consisting of a master and a remote at ranges up to 800 feet through wire. The LCM100 can be configured for RS-232 or RS-422/485 communications. Communication through sliding contacts and brushes is possible with the LCM100.

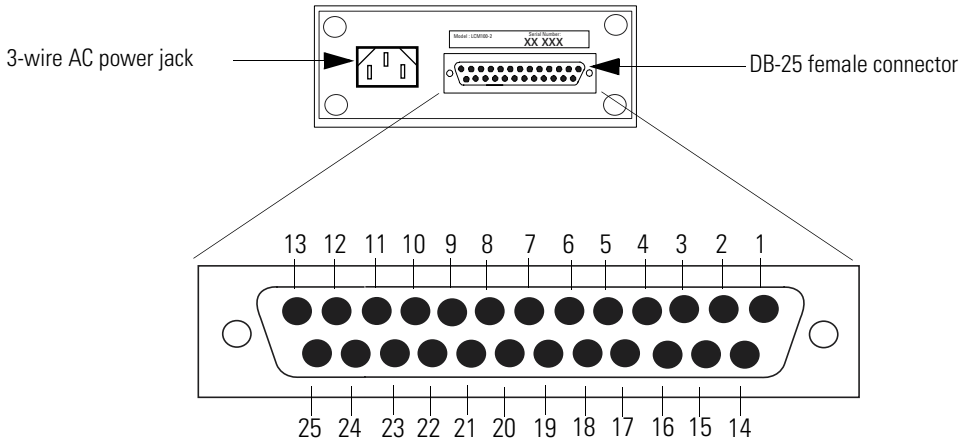
IMPORTANT The LCM100 installation must include a PLI500 Power Line Isolator.

Connection to the LCM100 is through the DB-25 female connector and the 3-wire AC powerjack located on the back of the unit.

Table 8.33 LCM100 RS-232 Pin Functions and Pin Assignment

LCM100 Pin #	Pin Name	Pin Name	PLC-5 25 Pin	SLC 500 9 Pin
1	PROTECT.GND	SHIELD	1	CASE
2	RXD.IN	TXD.OUT	2	3
3	TXD.OUT	RXD.IN	3	2
4	RTS	RTS.OUT	4	7
5	CTS	CTS.IN	5	8
6	DSR	DSR.IN	6	6
7	SIG.GND	SIG.GND	7	5
8	CD	DCD.IN	8	1
20	DTR	DTR.OUT	20	4

Figure 8.26 LCM100 Connections and Pin Assignment



TIP For additional modem specifications consult your DATA-LINC user manual or www.data-linc.com.

Configuring RSLinx Classic Software for DF1 Half-Duplex Communications

Chapter Objectives

This chapter provides a reference while configuring Rockwell Software RSLinx Classic communication server software as a DF1 half-duplex polling master station or a DF1 half-duplex slave station.

RSLinx Classic is the communications driver for other Windows-based Rockwell Software products, such as RSView32, which is an operator interface package, and RSLogix 500, which is an SLC programming package. Under Windows 98, Windows 2000, Windows XP, or Windows NT, these software packages can all be run on the same PC, which means one PC can function as SCADA master, operator interface, and programming terminal. The Gateway version of RSLinx Classic also adds the capability of allowing other PCs, also running RSLinx Classic and connected to the SCADA master PC via local area or wide area Ethernet, to have the same access to the telemetry network as the SCADA master PC.

Configuring RSLinx Classic Version 2.x as a Master Station

Figure 9.1 through Figure 9.8 show sample screens for configuring the RSLinx Classic DF1 half-duplex polling master communications driver. Some things to note in this example configuration are:

- RTS control (hardware handshaking) is only available under Windows NT. If the master modem requires RTS/CTS or hardware handshaking, RSLinx Classic must be run on a Windows NT personal computer.
- The Modem Configuration option should be left as 'No Modems' unless the telemetry network consists of dial-up telephone modems.

For more information about specific RSLinx Classic DF1 half-duplex polling master configuration parameters, see the RSLinx Classic online help.

Figure 9.1 General Driver Settings

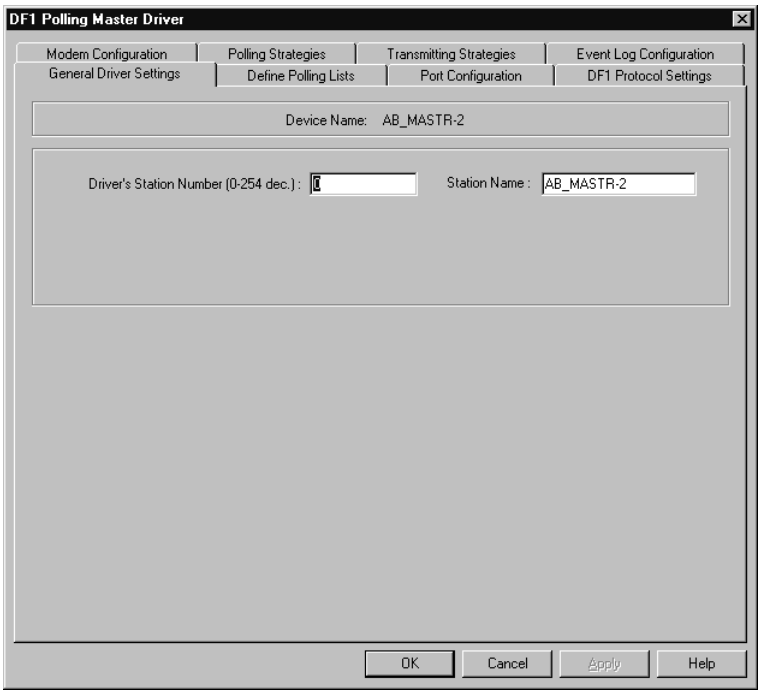


Table 9.1 General Driver Settings Parameter Descriptions

Control	Control Text
Driver's Station Number (0 to 254 decimal)	Enter the station number for this driver. All packets sent to this station address are forwarded to RSLinx Classic. The default is 0.
Station Name	RSLinx Classic automatically gives each communications device a driver name, which consists of a Driver Type and Driver Number. The actual communications device determines the Driver Type, while the Driver Number corresponds with the instance of a given Driver Type. For example, the first instance of this driver is named AB_MSTR-1. The next driver instance would be named AB_MSTR-2.

Figure 9.2 Define Polling Lists

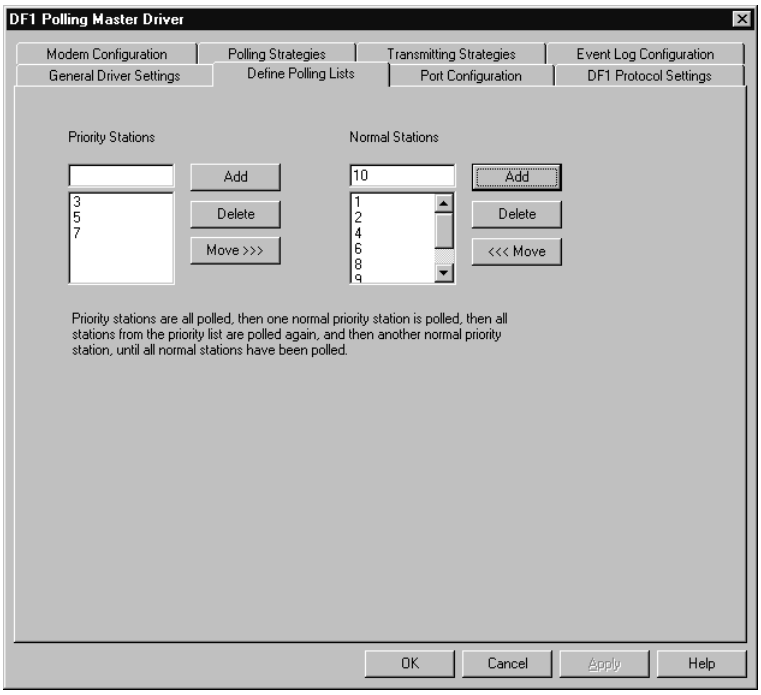


Table 9.2 Define Polling Lists Parameter Description

Control	Control Text
Priority Stations	Stations defined as Priority are polled during every polling cycle. All Priority Stations are polled, and then one Normal Station is polled. All Priority Stations are polled again, and then another Normal Station is polled. This cycle continues until all Normal Stations are polled.
Priority Stations	Displays the current list of Priority Stations.
Add	Click this button to add a station to the Priority Stations list.
Delete	Click this button to delete a station from the Priority Stations list.
Move	Click this button to move a station from the Priority Stations list to the Normal Stations list.
Normal Stations	Stations defined as Normal are polled one at a time after each Priority Stations polling cycle. All Priority Stations are polled, and then one Normal Station is polled. All Priority Stations are polled again, and then another Normal Station is polled. This cycle continues until all Normal Stations are polled.
Normal Stations	Displays the current list of Normal Stations.
Add	Click this button to add a station to the Normal Stations list.
Delete	Click this button to delete a station from the Normal Stations list.
Move	Click this button to move a station from the Normal Stations list to the Priority Stations list.

Figure 9.3 Port Configuration

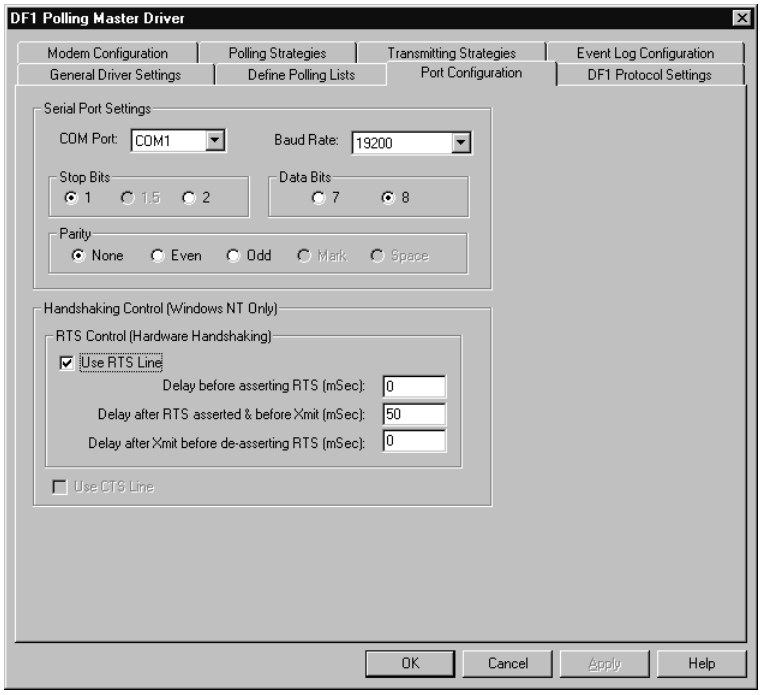


Table 9.3 Port Configuration Parameter Descriptions

Control	Control Text
COM Port	Select the serial port of the computer from which the polling master driver communicates. The default is COM 1.
Baud Rate	Select the baud rate of the device with which the polling master driver communicates. The default is 19200.
Stop Bits	Select the Stop Bits (1 or 2). The default is 1.
Data Bits	Select the Data Bits (7 or 8). The default is 8.
Parity	Select the parity of the device with which the polling master driver communicates. The default is none.
Use RTS Line	In Windows NT only, if enabled, RTS is turned on when the polling master driver is about to begin a transmission, and turned off when the transmission is complete. This behavior may change based on the Hardware Handshaking timer values. If cleared, RTS is asserted (turned on) when the port is opened, and remains asserted until the driver is terminated. The default is unchecked.
Delay before asserting RTS (ms)	This is useful when using half-duplex modems that require an off-delay timer to control the carrier wave. When the driver receives characters, it may assert the RTS line to begin its own transmissions before the sending slave has the opportunity to deassert the RTS line. This provides a minimum time delay between when the driver determines it needs to transmit something, and the time it actually asserts the RTS line. The default is 0.
Delay after RTS asserted & before Xmit (ms)	Some modems require a period of time after the RTS line is asserted for the carrier wave to stabilize. The character transmission is delayed for the period of time specified. These values may be expressed in milliseconds, but RSLinx Classic actually rounds the value down to the nearest 10 milliseconds. The default is 50 ms.
Delay after Xmit before de-asserting RTS (ms)	Some modems require an off-delay after the last character is transmitted out the serial port before the RTS line is deasserted. These values may be expressed in milliseconds, but RSLinx Classic actually rounds the value down to the nearest 10 milliseconds. The default is 0.
Use CTS Line	If enabled, characters are not transmitted out the serial port unless the CTS line is asserted. Not currently implemented.

Figure 9.4 DF1 Protocol Settings

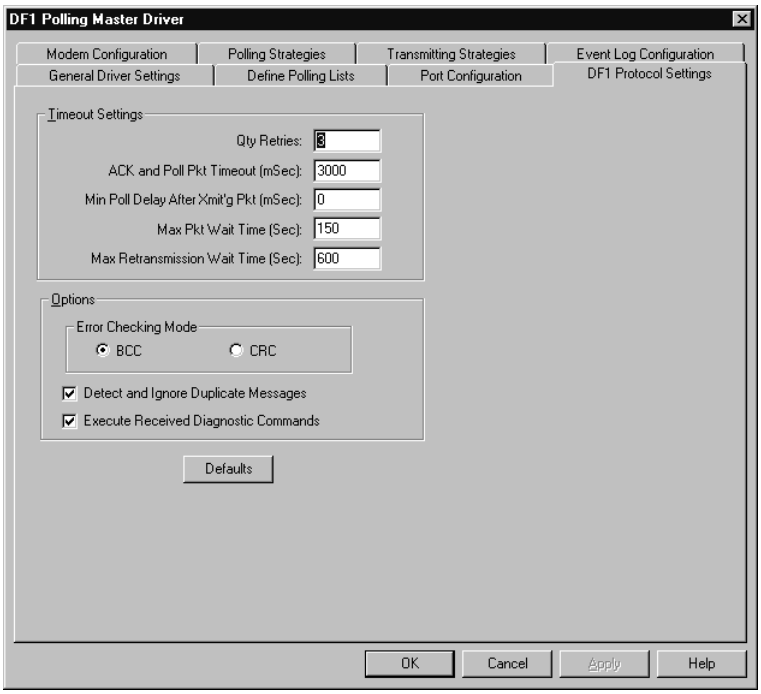


Table 9.4 DF1 Protocol Settings Parameter Descriptions

Control	Control Text
Qty Retries	When polling and transmitting, this controls how many attempts are made before giving up on that operation. Zero (0) is not a legal value. The default is 3 retries.
ACK and Poll Pkt Timeout (ms)	Timeout value before the driver assumes that the current operation has failed. After failure, if the retry count has not been exceeded, the driver attempts it again. The default is 3000 ms.
Min Poll Delay After Xmit'g Pkt (ms)	After the driver transmits a packet to a slave device, this is the minimum time it waits before polling the slave for responses. This is useful when there is a high overhead associated with connecting to the slave device (such as going through a dial-up modem), and you want a reply to a packet sent to the slave while still connected to it. Default is zero (0).
Max Pkt Wait Time (s)	Maximum period of time the driver keeps a packet buffered in memory while it is waiting for an opportunity to be transmitted to the slave. When this period is exceeded, the packet times out. The default is 150 seconds.
Max Retransmission Wait Time (s)	Similar to Max Pkt Wait Time, except that Max Retransmission Wait Time applies to packets sent from one slave device to another slave device (where the driver acts as a forwarder of messages). The default is 600 seconds.
Error Checking Mode	Select BCC or CRC. All devices on the network must be configured the same. The default is BCC.
Detect and Ignore Duplicate Messages	If selected, the driver keeps the header information of the last packet received from each slave device in memory. If a new packet is identical to the last packet, it is considered a duplicate, so the slave is ACKed and the packet is discarded. The default is checked.
Execute Received Diagnostic Commands	Diagnostic command packets addressed to the same station address as the master are executed and reply packets are sent to the sender. If the checkbox is cleared, an error message is returned to the sender. The default is checked.
Defaults	Resets the default values for each control on the dialog box.

Figure 9.5 Modem Configuration

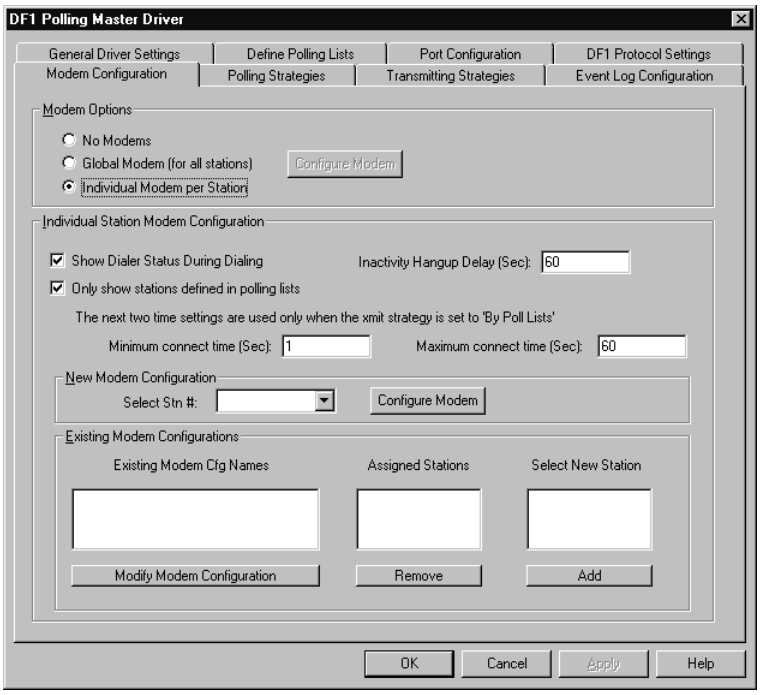


Table 9.5 Dial-up Modem Configuration Parameter Description

Control	Control Text
Modem Options	Select to not use dial-up modems, to use one dial-up modem for all drivers, or to specify an individual dial-up modem for each station.
Configure Modem	Click this button to configure the modem after selecting the Global Modem option. This button is disabled if No Modems or Individual Modem per Station option is selected.
Show Dialer Status During Dialing	Enable to display a report of dialer station while dialing.
Only show stations defined in polling lists	Enable to display in the Select Stn # list only stations defined in a polling list. If cleared, all station numbers are displayed.
Inactivity Hangup Delay (s)	This is useful when using temporary polling lists, but no stations are defined. In this case, the driver remains connected to the last station it was talking to at the moment the last station was removed from the temporary polling list. After the time indicated here, the modem hangs up. A value of 0 indicates that it never tries to hang up.
Minimum connect time (s)	Enter the minimum amount of time in seconds the modem must be connected.
Maximum connect time (s)	Enter the maximum amount of time in seconds the modem must be connected.
Select Stn #	Choose a station number to configure.
Configure Modem	Click this to configure the modem dialing parameters for the station chosen in Select Stn #.
Existing Modem Cfg Names	Displays the modem configurations defined in the New Modem Configuration group box.
Modify Modem Configuration	Select a modem configuration listed in the Existing Modem Cfg Names list and click this button to modify the configuration.
Assigned Stations	Contains a list of station numbers assigned to the selected modem configuration name. More than one station may be assigned to a modem configuration.
Remove	Click this to delete an assigned station from the list.
Select New Station	Contains the list of available station numbers or the available station numbers for those stations defined in a polling list. If no station numbers display, there are no available stations to be configured because they have all been configured or no stations have been defined in polling lists, or Only show stations defined in polling lists is enabled.
Add	Select a station number from the Select New Station list and click this button to add the new station.

Figure 9.6 Polling Strategies

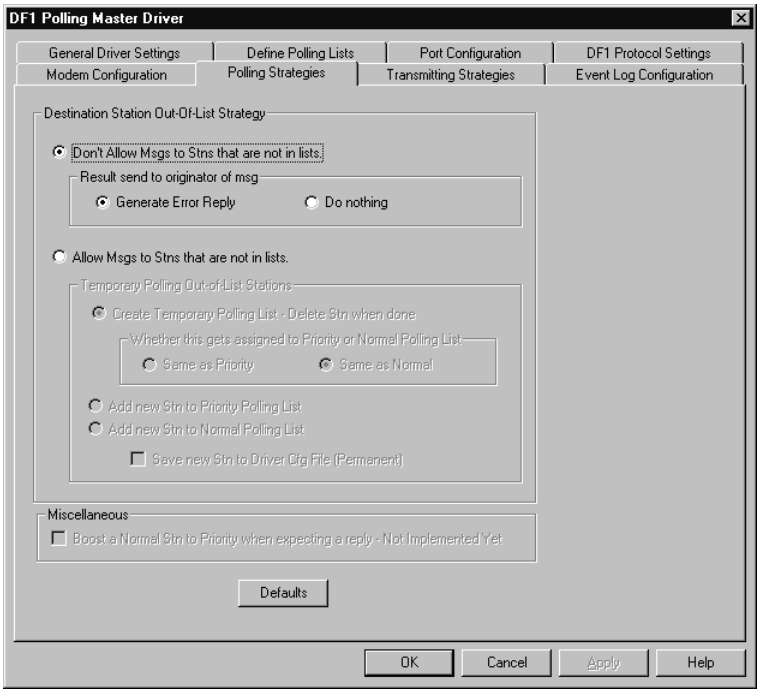


Table 9.6 Polling Strategies Parameter Descriptions

Control	Control Text
Don't Allow Msgs to Stns that are not in lists	Enable this to prevent transmissions to stations not already defined in one of the polling lists. Depending on the Result send to originator of msg settings, the sender of the packet may or may not be informed by the driver that the packet was rejected. This is the default setting.
Result send to originator of msg	Select Generate Error Reply to instruct the driver to inform the sender that the station is not on the link by generating a packet with a status code of 2 (station not on a link). Select Do nothing to instruct the driver not to send any indication to the sender. The default is generate error reply.
Allow Msgs to Stns that are not in lists	Enable this to allow transmissions to stations not defined in one of the polling lists. This provides the ability to communicate to slave devices on an event triggered basis.
Create Temporary Polling List - Delete Stn when done	When the expected replies reach zero, the driver requests additional packets. If the slave answers with no packets, and no packets intended for the slave are buffered in the driver, this station is deleted from the dynamic polling list, and all activity to the slave ceases until another packet is received. Also, if the driver sends a polling packet to the slave and the slave is assumed to be inactive, the count is set to zero, and if no other packets are intended for the slave, the slave is removed from the temporary polling list.
Whether this gets assigned to Priority or Normal Polling List	When using temporary polling, the driver must know whether to treat these temporary stations the same as normal or priority polling stations.
Add new Stn to Priority Polling List	When a packet is intended for a slave that is not in one of the polling lists, the station is permanently added to the priority polling list and is treated the same as any other priority slave.
Add new Stn to Normal Polling List	When a packet is intended for a slave that is not in one of the polling lists, the station is permanently added to the normal polling list and is treated the same as any other normal slave.
Save new Stn to Driver Cfg File (Permanent)	When the station is added to the priority or normal polling list, the addition is only in effect until the driver is shut down. If this option is enabled, those stations are permanently added to the polling lists, and will display the next time the driver is used.
Boost a Normal Stn to Priority when expecting a reply	This feature is not yet implemented.
Defaults	Resets the default values for each control on the dialog box.

Figure 9.7 Transmitting Strategies

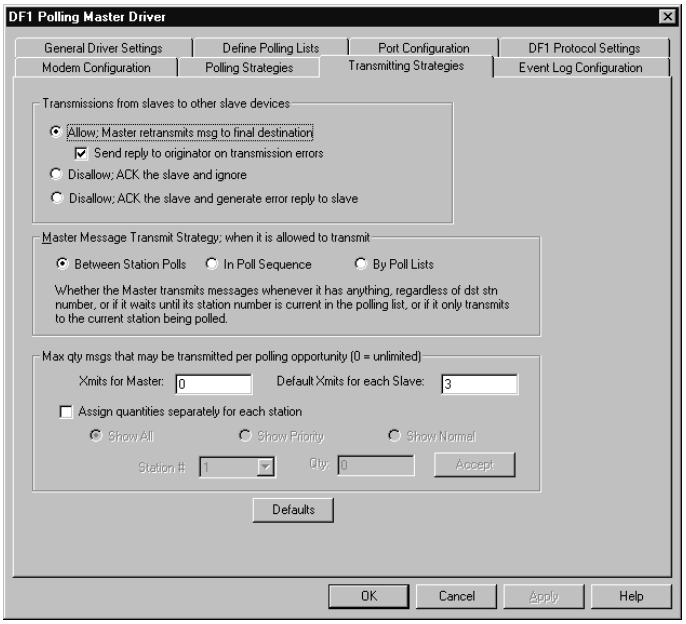


Table 9.7 Transmitting Strategies Parameter Descriptions

Control	Control Text
Allow; Master retransmits msg to final destination	Allows slave to slave communications. This is the default setting.
Send reply to originator on transmission errors	When enabled, if the driver fails to forward a command packet (a reply is expected) to another target device, RSLinx Classic generates a reply packet with a status code of 2 (station not on link). The default is checked.
Disallow; ACK the slave and ignore	The message from the slave is discarded with no indication given to the slave. This slave is responsible for timing out the packet and taking any required action.
Disallow; ACK the slave and generate error reply to slave	The message from the slave is discarded and a reply packet to the slave is generated with a status code of hex 10 (illegal command was received by the target station).
Between Station Polls	The master waits until any current polling cycles are complete before transmitting any packets that have buffered. This mode is not recommended when each station has its own dial-up modem configuration. This is default setting.
In Poll Sequence	The master can not transmit any messages buffered until its turn in the polling list is reached. The master station address must appear in either the normal or priority poll lists.
By Poll Lists	The master polls each slave in turn according to the polling lists, but only transmits to the slave which is the current station being polled.
Xmits for Master	When the master has something to transmit, if this is set to a non-zero value, the master ceases transmitting when that quantity of messages is reached and conducts another polling operation. If this is set to zero, the master transmits as many messages as it has buffered.
Default Xmits for each Slave	This limits the maximum number of times the master polls a slave before moving on to another slave to be polled.
Assign quantities separately for each station	The maximum number of polling packets the master sends to the slave may be regulated separately for each slave. Select to display all stations, or either Priority or Normal stations.
Station #	Select the station number to display.
Qty	Enter the number of packets to display.
Accept	Click this to accept the quantity entered for the station number.
Defaults	Resets the default values for each control on the dialog box.

Figure 9.8 Event Log Configuration

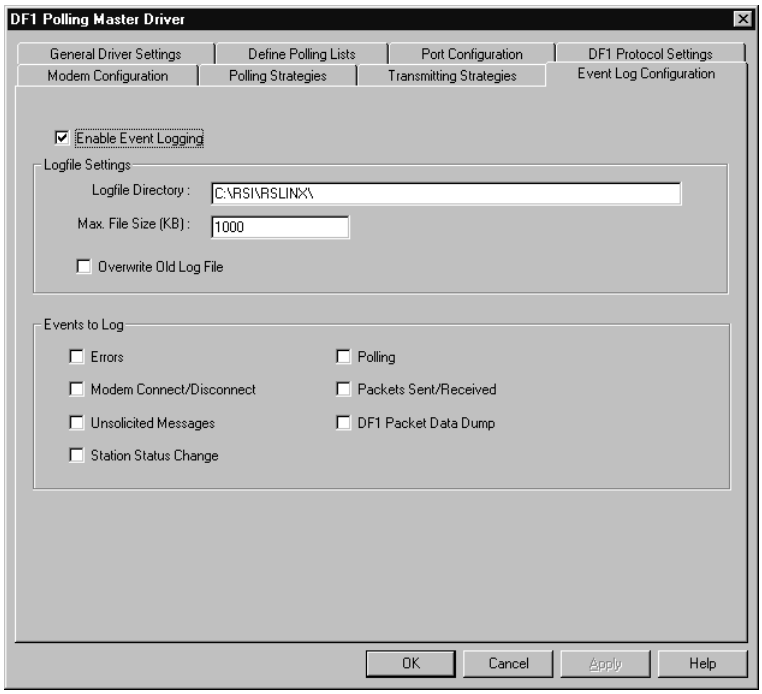


Table 9.8 Event Log Configuration Parameter Descriptions

Control	Control Text
Enable Event Logging	Enable this to set the event logging parameters. The default is unchecked.
Logfile Directory	Specify the directory where you want the log file to be generated.
Max. File Size (kB)	Enter the maximum amount (in kilobytes) that the size of the log file can be.
Overwrite Old Log File	Enable this to overwrite the existing log file in the specified directory.
Events to Log	Select the specific events to be included in the log file.

Configuring RSLinx Classic Version 2.x as a Slave Station

Figure 9.9 through Figure 9.13 show sample screens for configuring the RSLinx Classic DF1 half-duplex slave communications driver. Some things to note in this example configuration are:

- RTS control (hardware handshaking) is only available under Windows NT. If the slave modem requires RTS/CTS or hardware handshaking, RSLinx Classic must be run on a Windows NT personal computer.
- The Modem Configuration option should be left as 'No Modems' unless the telemetry network consists of dial-up telephone modems.

For more information about specific RSLinx Classic DF1 half-duplex slave configuration parameters, see the RSLinx Classic online help.

Figure 9.9 DF1 Slave Driver General Configuration

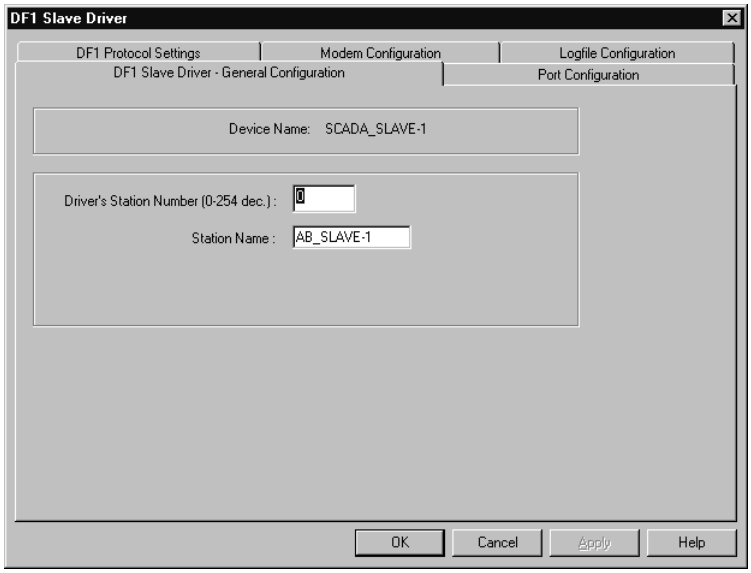


Table 9.9 General Driver Settings Parameter Descriptions

Control	Control Text
Driver's Station Number (0 to 254 decimal)	Enter the station number for this driver. All packets sent to this station address are forwarded to RSLinx Classic. The default is 0.
Station Name	RSLinx Classic automatically gives each communications device a driver name, which consists of a Driver Type and Driver Number. The actual communications device determines the Driver Type, while the Driver Number corresponds with the instance of a given Driver Type. For example, the first instance of this driver is named AB_SLAVE-1. The next driver instance would be named AB_SLAVE-2.

Figure 9.10 Slave Port Configuration

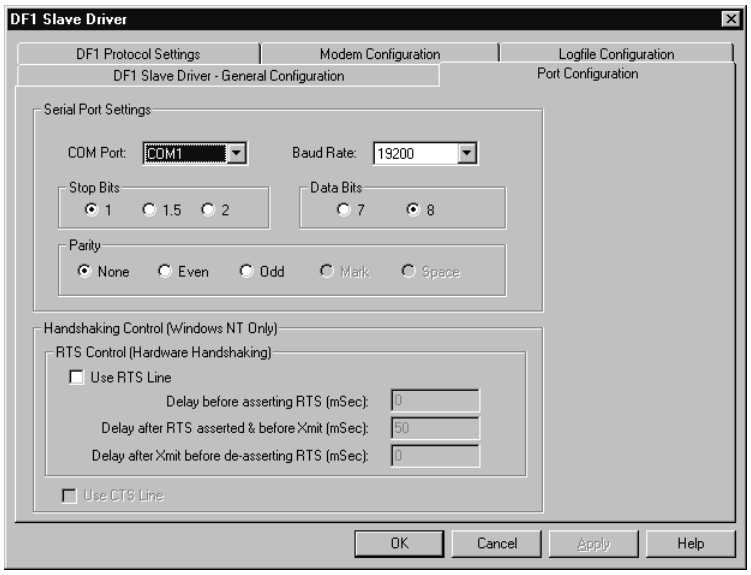


Table 9.10 Port Configuration Parameter Descriptions

Control	Control Text
COM Port	Select the serial port of the device with which the polling slave driver will communicate. The default is COM1.
Baud Rate	Select the baud rate of the device with which the polling slave driver will communicate. The default is 19200.
Stop Bits	Select the Stop Bits (1, 1.5 or 2). The default is 1.
Data Bits	Select the Data Bits (7 or 8). The default is 8.
Parity	Select the parity of the device with which the polling slave driver will communicate. The default is None.
Use RTS Line	In Windows NT only, if enabled, RTS is turned on when the polling slave driver is about to begin a transmission, and turned off when the transmission is complete. This behavior may change based on the Hardware Handshaking timer values. If cleared, RTS is asserted (turned on) when the port is opened, and remains asserted until the driver is terminated. The default is unchecked.
Delay before asserting RTS (ms)	This is useful when using half-duplex modems that require an off-delay timer to control the carrier wave. When the driver receives characters, it may assert the RTS line to begin its own transmissions before the sending slave has the opportunity to deassert the RTS line. This provides a minimum time delay between when the driver determines it needs to transmit something, and the time it actually asserts the RTS line. The default is 0.
Delay after RTS asserted & before Xmit (ms)	Some modems require a period of time after the RTS line is asserted for the carrier wave to stabilize. The character transmission is delayed for the period of time specified. These values may be expressed in milliseconds, but RSLinx Classic actually rounds the value down to the nearest 10 ms. The default is 50 ms.
Delay after Xmit before de-asserting RTS (ms)	Some modems require an off-delay after the last character is transmitted out the serial port before the RTS line is deasserted. These values may be expressed in milliseconds, but RSLinx Classic actually rounds the value down to the nearest 10 ms. The default is 0.
Use CTS Line	If enabled, characters will not be transmitted out the serial port unless the CTS line is asserted. Not currently implemented.

Figure 9.11 DF1 Slave Protocol Settings

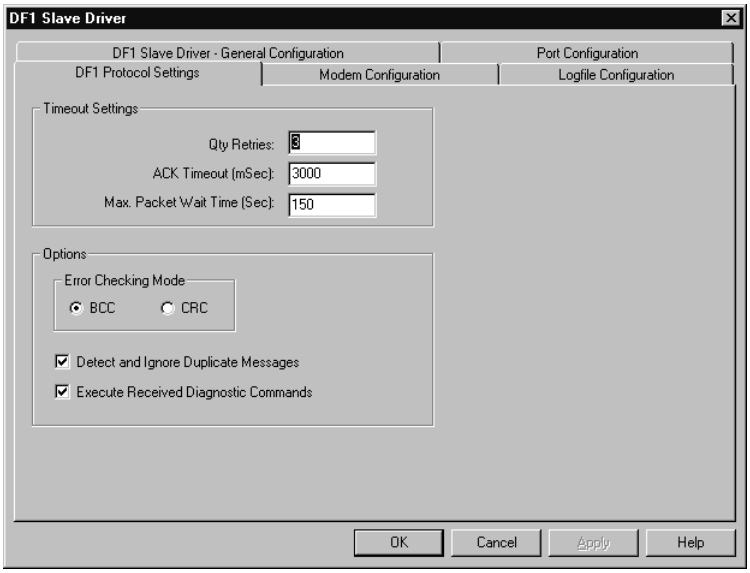


Table 9.11 DF1 Protocol Settings Parameter Descriptions

Control	Control Text
Qty Retries	When polling and transmitting, this controls how many attempts are made before giving up on that operation. Zero (0) is not a legal value. The default is 3 retries.
ACK Timeout (ms)	Timeout value before the driver assumes that the current operation has failed. After failure, if the retry count has not been exceeded, the driver attempts it again. The default is 3000 ms.
Max Pkt Wait Time (s)	Maximum period of time the driver keeps a packet buffered in memory while it is waiting for an opportunity to be transmitted to the slave. When this period is exceeded, the packet times out. The default is 150 seconds.
Error Checking Mode	Select BCC or CRC. All devices on the network must be configured the same. The default is BCC.
Detect and Ignore Duplicate Messages	If selected, the driver keeps the header information of the last packet received from the master in memory. If a new packet is identical to the last packet, it is considered a duplicate, so the slave is ACKed and the packet is discarded. The default is checked.
Execute Received Diagnostic Commands	Diagnostic command packets addressed to the same station address as the slave are executed and reply packets are sent to the sender. If the checkbox is cleared, an error message is returned to the sender. The default is checked.

Figure 9.12 Slave Modem Configuration

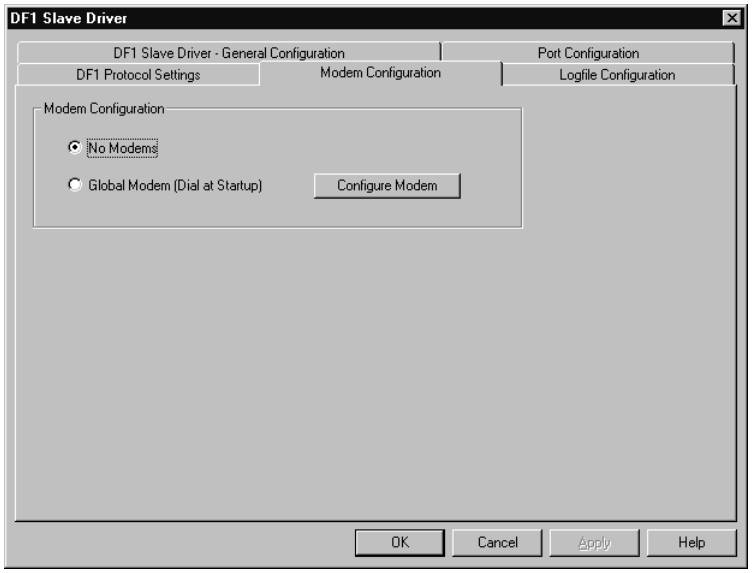


Table 9.12 Slave Dial-up Modem Configuration Parameter Description

Control	Control Text
Modem Options	Select to not use or not to use a dial-up modem.
Configure Modem	Click this button to configure the modem after selecting the Global Modem option. This button is disabled if No Modems option is selected.

Figure 9.13 Slave Logfile Configuration

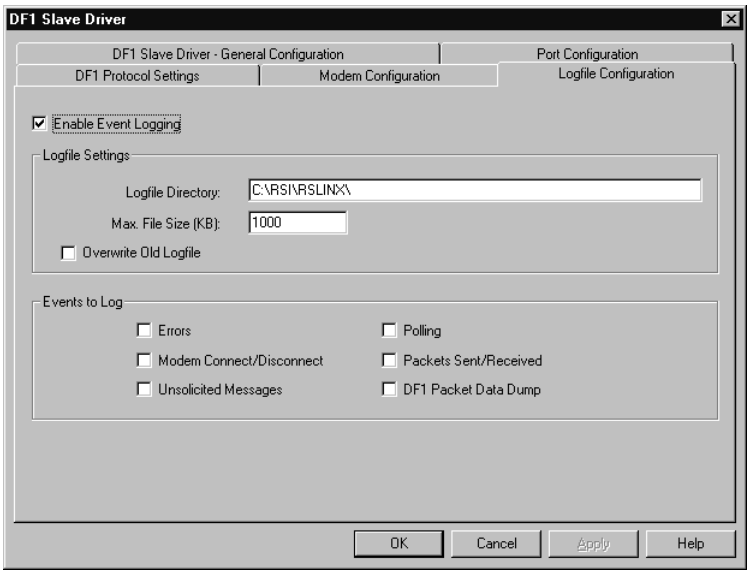


Table 9.13 Event Log Configuration Parameter Descriptions

Control	Control Text
Enable Event Logging	Enable this to set the event logging parameters. The default is unchecked.
Logfile Directory	Specify the directory where you want the log file to be generated.
Max. File Size (kB)	Enter the maximum amount (in kilobytes) that the size of the log file can be.
Overwrite Old Log File	Enable this to overwrite the existing log file in the specified directory.
Events to Log	Select the specific events to be included in the log file.

Using Dial-up Telephone Communication

Chapter Objectives

This chapter helps you set up and initiate dial-up communication. This chapter pertains to the enhanced PLC-5 processors, SLC 5/03, 5/04, and 5/05 processors, MicroLogix 1100, 1200, and 1500 controllers, and Logix processors.

TIP A Micrologix 1000 controller may be on the receiving end of a dial-up modem connection using an auto-answer phone modem, but it has no means to cause its modem to initiate or hang-up a phone modem connection.

For information about	See page
overview	10-2
setting up the system	10-3
communicating over the telephone line	10-4
peer-to-peer communication	10-8
report-by-exception and/or master station-initiated communication	10-9

If you are setting up a dial-up communication system for the first time, refer to this chapter as well as to chapters 2, 3, 4, 7, and 8.

Overview

You can implement dial-up communication in a telemetry system as shown in the following configurations (Figure 10.1 and Figure 10.2).

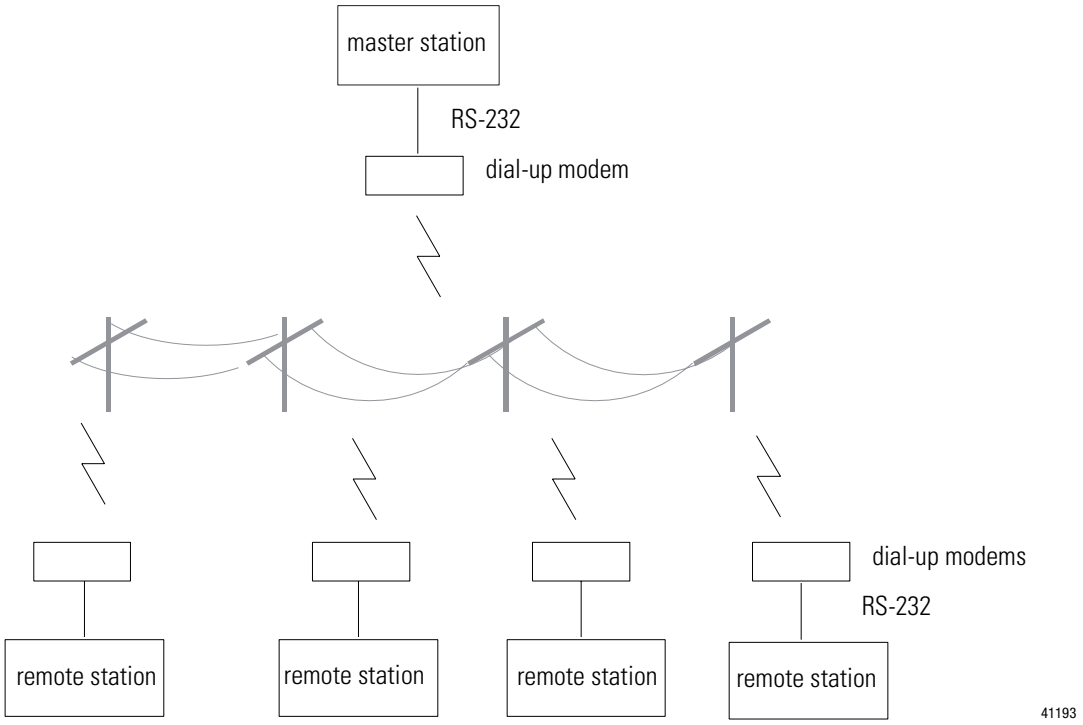
Use dial-up communication for peer-to-peer communication between processors, as shown below. This is most appropriate for applications that do not require extensive communication time.

Figure 10.1 Dial-up Communication

Use the public switched telephone network to communicate between a master station and multiple remote stations.

A master station can contact each remote station through the telephone lines on a scheduled basis and/or the remote stations can dial-up the master station on a report-by-exception basis.

Figure 10.2 Public Switch Telephone Network



Setting up the System

Before you can begin sending messages over the telephone line, you must:

- configure the processor
- configure the modems

Configure the Processor

Configure the processor's serial channel for full-duplex DF1 protocol and full-duplex modem handshaking (except MicroLogix) using RSLogix software.

For example configurations, see the chapter in this book that pertains to the processor you are configuring.

Configure the Modems for the PLC-5, SLC, and Logix Processors

Three RS-232 control signals are critical to the operation of dial-up modems with PLC-5, SLC and Logix processors (when channel zero is configured for full-duplex modem support): Data Set Ready (DSR), Carrier Detect (CD), and Data Terminal Ready (DTR). DSR and CD are signals that the modem produces and the attached processor or module senses, while DTR is a signal the processor or module produces to control its dial-up modem. DSR must be configured in the modem to be on (or high) whenever a modem connection exists and off (or low) otherwise. CD must be configured in the modem to be on (or high) whenever a modem carrier from a remote modem is being received and off (or low) otherwise. For DTR, the modem should be configured to disconnect an existing connection when the processor or module transitions DTR from on to off (or high to low).

This RS-232 control signal operation is configured into the dial-up modem in at least one of three ways, depending on the model: through switch settings, through pushbutton control panels, or by sending standard AT ASCII commands to the modem's RS-232 port. The ASCII string to send to the modem that supports AT commands to configure the RS-232 control signals to operate as described above is as follows: AT &S1 &C1 &D2 Q1 E0 &W.

The ASCII string should be sent to the modem followed by carriage return and line feed control characters. Note that the Q1 and E0 disable response codes and local character echo, and the &W saves the configuration to the modem's nonvolatile memory, if available.

Configure the Modems for MicroLogix 1100/1200/1500 Controllers

The MicroLogix channel 0 serial port does not support the DSR, CD or DTR modem handshake signals. (The MicroLogix 1500 channel 1 does support CD, but not DSR or DTR.) The only handshake signal from the modem supported by the MicroLogix is Clear to Send (CTS). Therefore, a different modem handshaking scheme is required when using MicroLogix 1100/1200/1500 controllers to initiate dial-out connections. Even when a MicroLogix 1100/1200/1500 channel 0 is configured for no handshaking, it still monitors CTS. Therefore, RTS and DTR must be ignored by the modem and CTS must be configured in the modem to be on (or high) whenever a modem carrier from a remote modem is being received and off (or low) otherwise. That way, CTS can be used to determine when the modem connection has been successfully established. The only way to hang up the connection is to return the modem to command mode (typically by sending the ASCII string '+++' to the modem), and then sending an ASCII ATH command.

The ASCII string to send to the modem that supports AT commands to configure the RS-232 control signals to operate as described above is as follows: AT &S0 &C1 &D0 &R2 Q1 E0 &W.

The ASCII string should be sent to the modem followed by carriage return and line feed control characters. Note that the Q1 and E0 disable response codes and local character echo, and the &W saves the configuration to the modem's nonvolatile memory, if available.

See chapter 8 for example cable configurations for specific dial-up modems.

Communicating Over the Telephone Line

To communicate over the telephone line:

1. Initiate modem dialing.
2. Verify connection to the remote modem.
3. Transfer data back and forth.
4. Hang up the telephone link.

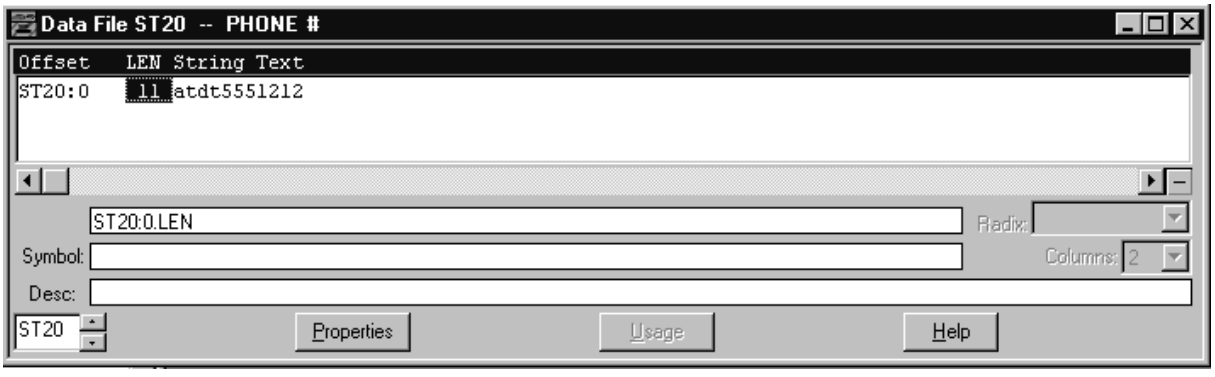
Initiate Modem Dialing

To initiate dialing from a PLC-5, SLC, Logix or MicroLogix processor, use the ASCII write with append instruction (AWA). This instruction lets you send an ASCII string out the serial port with no protocol framing added, despite the fact that the serial port has been configured for DF1 protocol. By sending the dialing command string to the modem, the modem then dials the telephone number given, which lets the two modems establish a connection. Figure 10.3 is a sample ladder logic rung used to trigger the AWA instruction to send the dialing string (stored in a data file) to a modem, as it appears in a PLC-5, SLC or MicroLogix processor.

Figure 10.3 AWA Instruction

Figure 10.4 shows the telephone number stored in file ST20. In a Logix processor, the telephone number would be stored in a string tag.

Figure 10.4 Store the Telephone Number



To dial a modem from the processor, use an AWA instruction and store the telephone number to be dialed in a string file element or string tag via the programming software. In this example, when the B3:0/0 bit is set, the processor sends the ASCII string atdt5551212 out the serial port. This causes the modem to attempt to dial the number (5551212) and establish the telephone link. To enter this type of rung into your ladder logic, go to the Instruction Toolbar of your RSLogix programming software and choose the AWA symbol under the ASCII Control or ASCII Serial Port tab. The length of the string being sent is 0, which specifies the whole string. When the instruction is executed, all characters in the string (ST20:0) will be sent. Use data monitor to store the telephone number within the source address of the AWA.

TIP The number being dialed in this example is a local number. If the number were long distance, the number in the string file would have to include a 1 and the area code, for example: 14145551212. The dialing string must be set to exactly what you would send if you were dialing from a dumb terminal.

Verify Connection to the Remote Modem

For PLC-5 and SLC processors, start a modem connection timer upon triggering the dialing string and monitor the channel 0 lost modem bit in the status file to determine when the connection is successful. (The lost modem bit goes from a one to a zero when the connection is established.) In a PLC-5 processor, the lost modem bit address is S:17/5, while in the SLC 5/03, 5/04, and 5/05 processors, the address is S:5/14.

For Logix processors, program an unconditional GSV instruction to continually read the channel 0 diagnostic counters into a tag array. Start a modem connection timer upon triggering the dialing string and monitor the channel 0 Carrier Detect (CD) bit (bit 3 in word 1 of the diagnostic counter tag array) until it becomes a 1 to determine when the connection is successful.

For MicroLogix controllers, start a modem connection timer upon triggering the dialing string and monitor the channel 0 CTS bit, CS0:9/0, until it becomes a one to determine when the connection is successful.

If the user-configured connection timer times out before the monitored bit changes, then most likely either the remote modem is not answering or the number is busy. In this case, the modem hang-up sequence should be initiated and the phone connection retried later.

Once a successful connection is established, you can begin message-based data transfer. Remember that this link is a peer link, which means that both processors can initiate read and write requests as required over the modem link.

Transfer Data

Using dial-up telephone modems is the same as described in Chapters 2, 3, 4, and 7 of this manual.

Disconnect the Telephone Link

For PLC-5, SLC, Logix processors, to disconnect the telephone link, use the ASCII handshake lines instruction (AHL) to toggle DTR from high to low and back to high again. To set DTR high, trigger the AHL with an AND mask of 0000 and an OR mask of 0001. To set DTR low, trigger the AHL with an AND mask of 0001 and an OR mask of 0000.

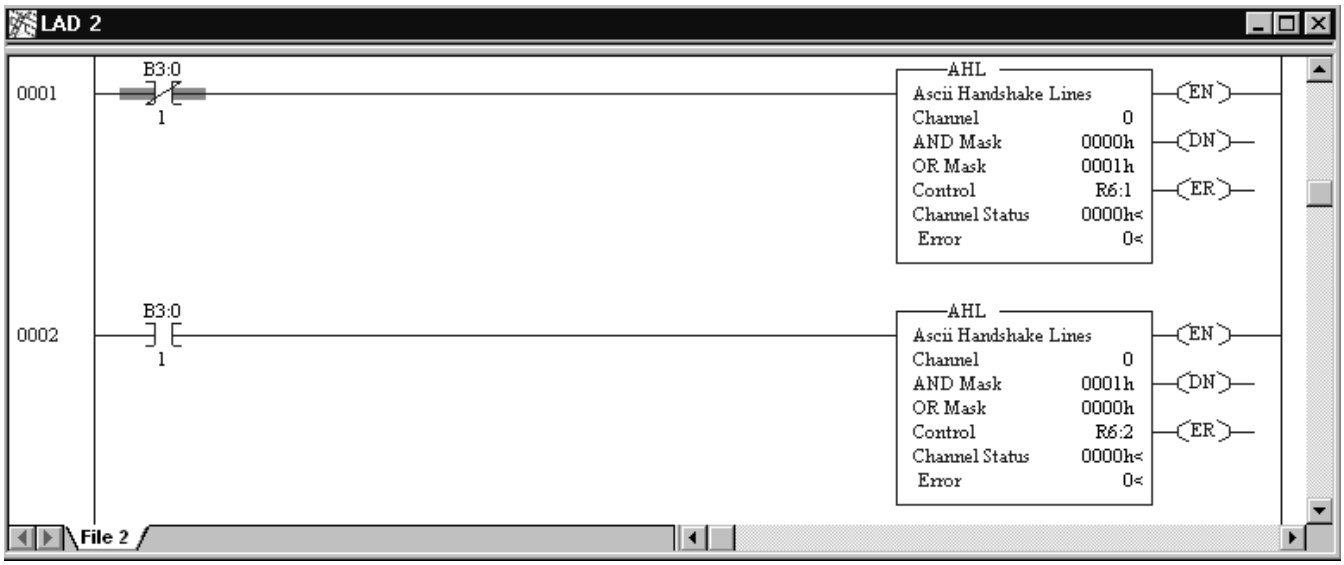
For MicroLogix 1100/1200/1500 controllers, use an ASCII write instruction (AWT) to transmit a '+++' to the modem to return it to command mode. Then use an ASCII write command with the append instruction (AWA) to transmit an ATH command for the modem to hang up.

Once the line is disconnected, you can:

- re-establish dial-up modem communications with the same processor, or
- establish a modem connection with another device by changing the dialing string sent to the modem in the AWA instruction source.

Figure 10.5 shows sample ladder logic rungs used to lower and raise DTR to disconnect a telephone connection.

Figure 10.5 AHL Instructions Lower and Raise DTR



Peer-to-Peer Communication

Peer-to-peer communication is the simplest method. Two units establish a telephone modem link point-to-point using DF1 full-duplex protocol. In this mode, neither unit has control over the other, but is simply a peer. One of the units sends the command string to a telephone modem to dial the other unit. Once the communication has been established, then each unit can send messages back and forth to exchange data. The unit that initiated the connection normally hangs up the connection as well.

This configuration is an extension of peer-to-peer communication in that it involves stations establishing point-to-point telephone modem links using DF1 full-duplex protocol.

Report-by-Exception and/or Master Station-Initiated Communication

Report-by-exception communication refers to the remote stations initiating a dial-up connection to the master station upon change of input status or process data in order to update the master station's data table.

Master station-initiated communication refers to the master station initiating the dial-up connections to each of the remote stations on a round robin or time-scheduled basis in order to update the master station's data table.

A combination of report-by-exception and master station-initiated communication is possible but requires two communication ports and modems (one for dial-in and one for dial-out) at the master station in order to be effective. This can be accomplished using a 1785-KE module with a PLC-5 processor, a 1747-KE module with an SLC 5/03, or a dual-port processor such as a MicroLogix 1500 LRP or a CompactLogix L31.

Remotely Program Allen-Bradley Processors Over a Telemetry Network

Chapter Objectives

This chapter helps you set up and configure RSLogix programming terminals on Ethernet to program remote PLC-5, SLC 500, MicroLogix, and Logix processors over a point-to-multipoint telemetry network.

Connecting RSLogix programming software to the remote stations over the telemetry network helps you do the following without having to go to the remote site:

- monitor the online data table
- upload, download, and edit the ladder logic program
- troubleshoot the system

You can remotely connect to your processors while normal telemetry system data acquisition and control functions occur concurrently.

For information about	See page
remote programming via RSLinx Classic Gateway	11-2
remote programming via SLC 5/05 Ethernet to DF1 Passthru	11-4
remote programming via Logix Ethernet/IP to DF1 Bridge	11-7

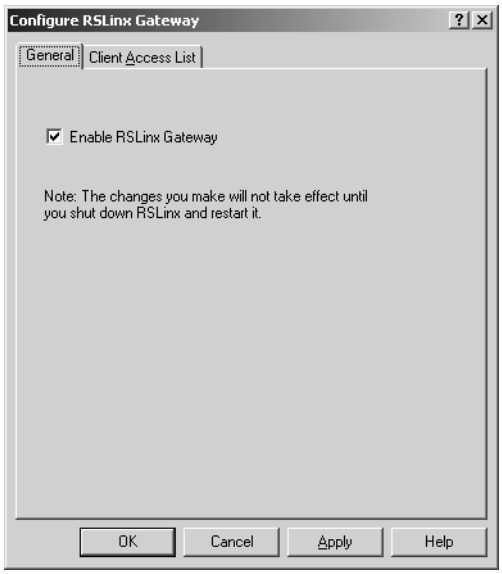
Remote Programming via RSLinx® Gateway™

When RSLinx Classic is running on a PC that is a node on a serial DF1 Half-Duplex network, then RSLogix 5, RSLogix 500, and RSLogix 5000 running on the same PC can upload, download and go online with any remote Allen-Bradley processor nodes on that same network. See chapter 9 for details on configuring RSLinx as a DF1 Half-Duplex Polling Master node or a DF1 Half-Duplex Slave node.

In addition, if the version of RSLinx Classic is Gateway, then other PCs connected on the same Ethernet network that are running RSLinx Classic and RSLogix 5, RSLogix 500, and RSLogix 5000 can also bridge through that PC and go online with any remote Allen-Bradley processor node.

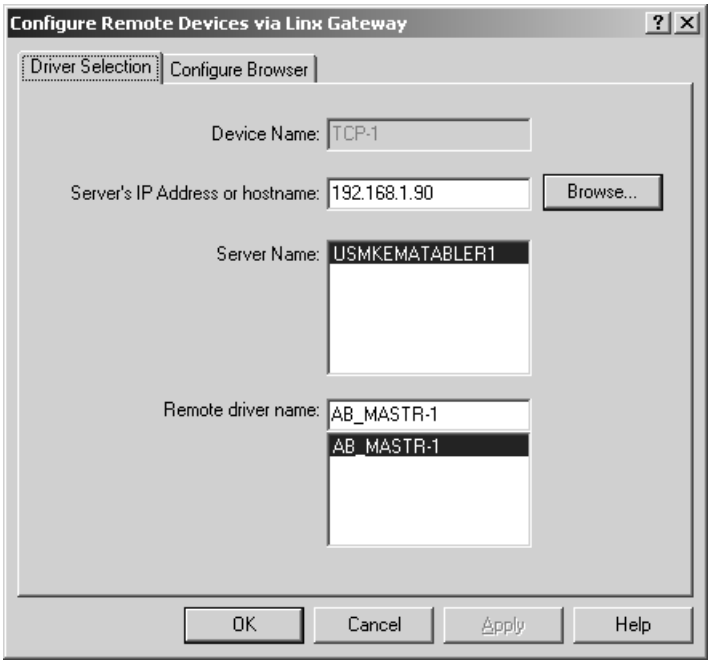
To implement the PC bridge, first verify that RSLinx® Gateway™ is enabled on the PC connected to the DF1 Half-Duplex network. Under Communications, > Configure Gateway, verify that Enable RSLinx Gateway is checked.

Figure 11.1 Configure RSLink Gateway



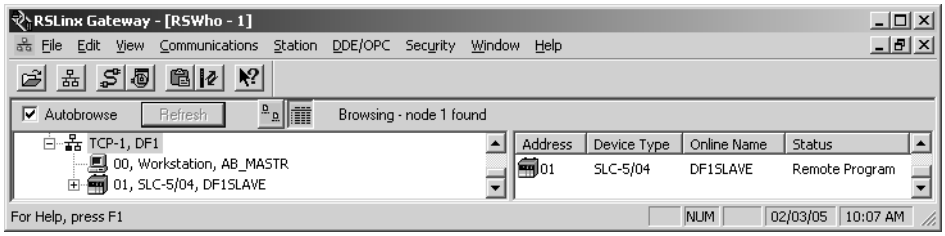
Then, on the remote PC that is running RSLinx Classic, create a new RSLinx Remote Devices via Linx Gateway driver. In the Driver Selection tab, click on Browse. RSLinx searches the Ethernet network for any PC's running RSLinx Gateway. By Server Name, click on the computer name of the PC running the DF1 Half-Duplex driver and by Remote Driver Name, click on the name of that DF1 Half-Duplex driver. Click OK to accept.

Figure 11.2 Configure Remote Device



Now you should be able to use RSWho to browse a remote node on the DF1 network through this RSLinx Gateway driver, as if this PC were directly connected to that network.

Figure 11.3 Remote RSWho Browse Through RSLinx Gateway



Once RSWho can browse the remote node, then you can use the appropriate RSLogix programming software to upload, download and go online with that remote node.

Remote Programming via SLC 5/05 Ethernet to DF1 Passthru

SLC 5/05 processors with OS 501, Series C, FRN 6 or higher firmware support channel 1 Ethernet to channel 0 DF1 passthru. This allows PCs running RSLinx Classic version 2.43, or higher, to browse through the SLC 5/05 processor to remote PLC-5, SLC or MicroLogix processors on the DF1 network to upload, download or go online using RSLogix programming software. This capability is supported when the SLC 5/05 channel 0 driver is DF1 Full-Duplex, DF1 Half-Duplex Master or DF1 Radio Modem

TIP Although SLC 5/05 passthru can be used to browse Logix processors, it cannot be used to upload, download or go online with Logix processors.

To configure passthru on the SLC 5/05, the DF1 Gateway Enable Bit, S:34/5, must be set and the Passthru Routing Table File number must be configured within the Channel 1 Channel Configuration.

Figure 11.4 DF1 Gateway Enable Bit

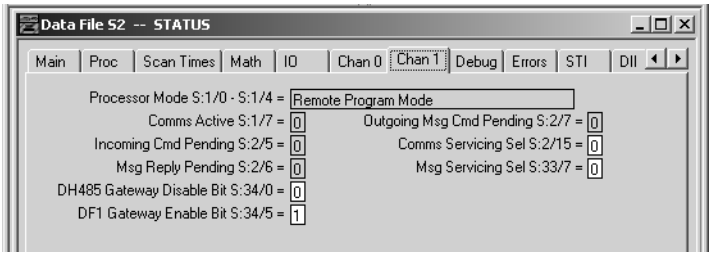
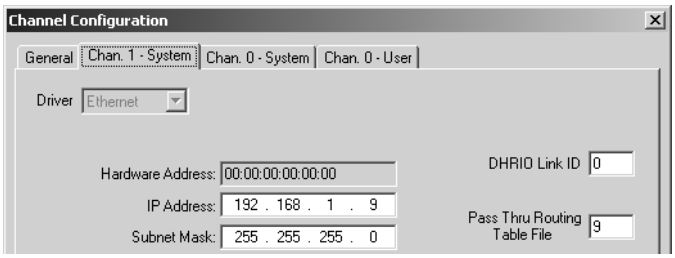
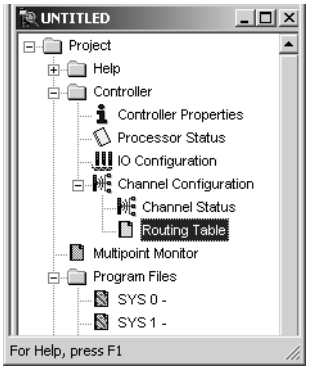


Figure 11.5 Passthru Routing Table File Number



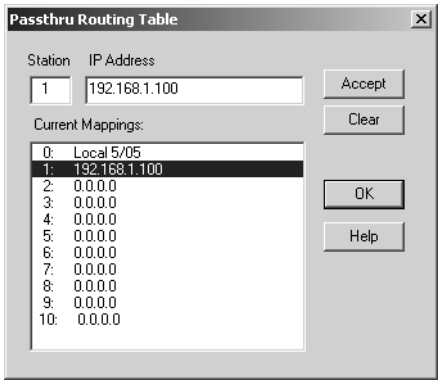
After configuring the Pass Thru Routing Table File number, access to the passthru routing table is located underneath the Channel Configuration selection in RSLogix 500. Click on the '+' sign in front of Channel Configuration to reveal the routing table selection.

Figure 11.6 Passthru Routing Table Icon



Double-click on Routing Table to view and modify the passthru routing table. The IP address of the PC running RSLinx Classic must be entered into the passthru routing table in order for RSWho to be able to browse through the SLC 5/05.

Figure 11.7 Passthru Routing Table Configuration

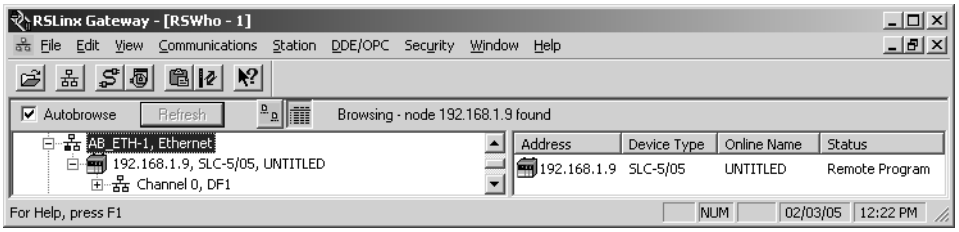


Configure the RSLinx AB_ETH Ethernet driver and run RSWho to browse the passthru SLC 5/05 on this network and click on the '+' sign in front of the SLC 5/05 to reveal a Channel 0, DF1 network underneath.

TIP

If the '+' sign doesn't show up in front of the SLC 5/05, then either bit S:34/5 is not set in the processor, the processor firmware is not OS501, Series C, FRN 6 or greater, the RSLinx version is not 2.43 or later, or channel 0 is not set to a valid passthru DF1 driver.

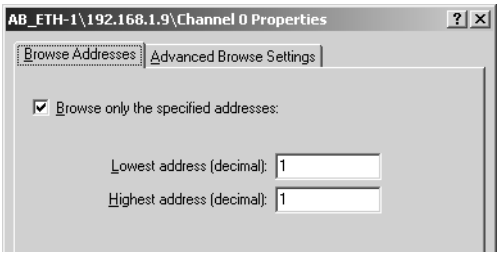
Figure 11.8 RSWho Browse to Channel 0, DF1



IMPORTANT SLC 5/05 passthru does not work with the RSLinx AB_ETHIP EtherNet/IP driver.

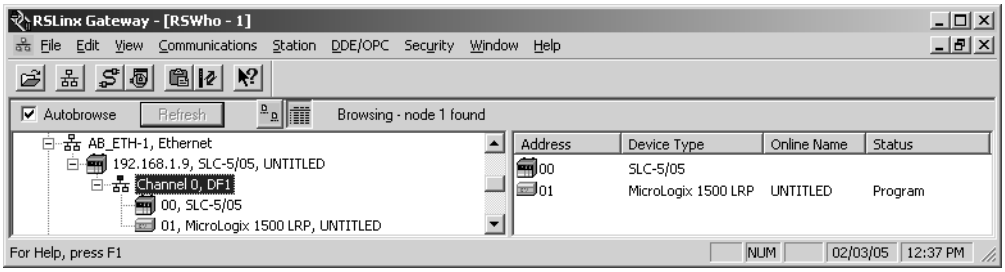
Right-click on this Channel 0, DF1 network and select Properties. Under Browse Addresses, enable the Browse only the specified addresses box and enter in the range of addresses to browse.

Figure 11.9 Setting Range of DF1 Addresses to Browse



Now, left-click on the Channel 0, DF1 network to begin browsing this range of DF1 addresses.

Figure 11.10 RSWho Browse Using SLC 5/05 Passthru



TIP If none of the expected processors show up under the Channel 0, DF1 network (other than 00, SLC-5/05) while browsing, verify that while in program mode, the SLC 5/05 RS-232 LED is flashing periodically. If not, then most likely the IP address of the PC is not properly entered into the SLC 5/05 Routing Table. You can verify the IP address of your Windows PC by typing IPCONFIG at the Windows command prompt.

Once RSWho can browse the remote node, then you can use either RSLogix 5 or RSLogix 500 programming software to upload, download and go online with that remote PLC-5, SLC or MicroLogix node.

TIP If online with a remote node, RSLogix kicks you offline due to a timeout error, then it may be necessary to increase the passthru SLC 5/05 Channel 1 MSG Reply Timeout. The default is 3 seconds, which may not be adequate for a larger telemetry network or slower modems. Try increasing the timeout to 10 seconds and see if the online stability improves.

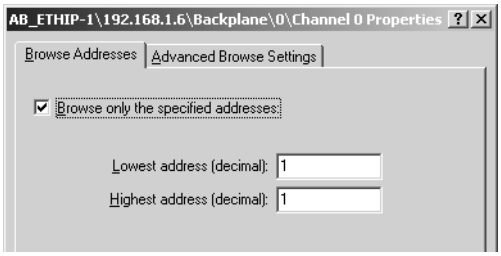
Remote Programming via Logix EtherNet/IP to DF1 Bridge

Logix processors support Common Industrial Protocol (CIP), which allows them to work as bridges between different networks that support CIP, such as EtherNet/IP and DF1. RSLinx Classic takes advantage of this capability in order to browse from Ethernet to the Logix EtherNet/IP interface, through to the Logix processor serial port and onto the DF1 network. This allows RSLogix 5, RSLogix 500, and RSLogix 5000 to upload, download and go online with PLC-5, SLC, MicroLogix and Logix processors on the DF1 network.

Using the RSLinx AB_ETHIP EtherNet/IP driver, browse to the Logix EtherNet/IP interface, click on the '+' sign in front of it, and browse down to the Logix processor. Click on the '+' sign in front of the Logix processor and a Channel 0, DF1 network should show up underneath of it.

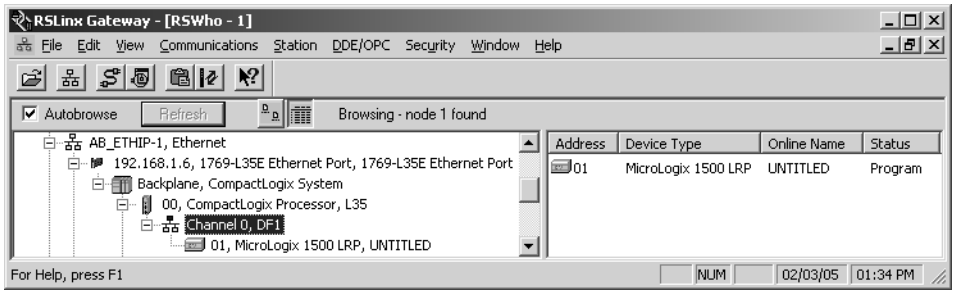
Right click on this Channel 0, DF1 network and select Properties. Under Browse Addresses, enable the Browse only the specified addresses box and enter in the range of addresses to browse.

Figure 11.11 Setting Range of DF1 Addresses to Browse



Now, left-click on the Channel 0, DF1 network to begin browsing this range of DF1 addresses.

Figure 11.12 RSWho Browse Using Logix Bridging



Once RSWho can browse the remote node, then you can use either RSLogix 5, RSLogix 500 or RSLogix 5000 programming software to upload, download and go online with that remote PLC-5, SLC, MicroLogix or Logix node.

Modem Cable Reference

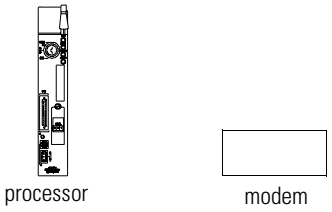
Appendix Objective

Use this appendix as a quick guide for finding the cables you need.

To find modem cabling information on	See page
Enhanced PLC-5	A-2
1747-KE Module	A-3
ASCII terminal to 1747-KE Module	A-4
SLC 5/03, 5/04, or 5/05, Logix, and MicroLogix 1500 Channel 1	A-5
1785-KE Module	A-6
MicroLogix	A-7

Enhanced PLC-5

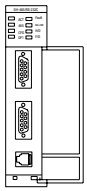
Figure A.1 Enhanced PLC-5 Processor to Modem Cable Pin Assignment



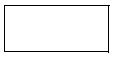
25-pin male			25-pin	9-pin
C.GND	1	———	1	NC
TXD.OUT	2	———	2	3
RXD.IN	3	———	3	2
RTS.OUT	4	———	4	7
CTS.IN	5	———	5	8
DSR.IN	6	———	6	6
SIG.GND	7	———	7	5
DCD.IN	8	———	8	1
DTR.OUT	20	———	20	4

1747-KE Interface Module

Figure A.2 1747-KE Interface to Modem Cable Pin Assignment



1747-KE module



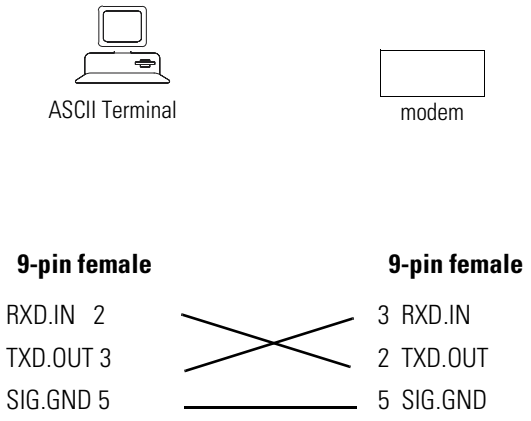
modem

9-pin female		25-pin	9-pin
RXD.IN	2	3	2
TXD.OUT	3	2	3
DTR.OUT	4	20	4
SIG.GND	5	7	5
DSR.IN	6	8	1
RTS.OUT	7	4	7
CTS.IN	8	5	8

ASCII Terminal to 1747-KE module

Use Allen-Bradley cable A-B 1747-CP3 to connect an ASCII terminal to a 1747-KE module.

Figure A.3 ASCII Terminal to 1747-KE Module Cable Pin Assignment

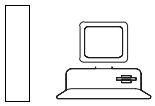


SLC 5/03, 5/04, or 5/05, Logix, and MicroLogix 1500 Channel 1

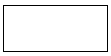
Table A.1 Connection Types for Cables

Connection Type	Allen-Bradley Cable
SLC 5/03, 5/04, or 5/05 processor to a modem	A-B 1784-CAS (25-pin male modem connector)
Workstation with a 9-pin serial port to a modem	
AIC+ Advanced Interface Converter for MicroLogix	
Logix controller to a modem	
MicroLogix 1500 channel 1 to a modem	

Figure A.4 SLC 5/03 - 5/05, Workstation, AIC+, Logix, and MicroLogix 1500 channel 1 Cable Pin Assignment



processor or PC



modem

9-pin female			25-pin		9-pin
DCD.IN	1		8		1
RXD.IN	2		3		2
TXD.OUT	3		2		3
DTR.OUT	4		20		4
SIG.GND	5		7		5
DSR.IN	6		6		6
RTS.OUT	7		4		7
CTS.IN	8		5		8

1785-KE Module

Use Allen-Bradley cable A-B 1770-CP to connect a 1785-KE module to a modem.

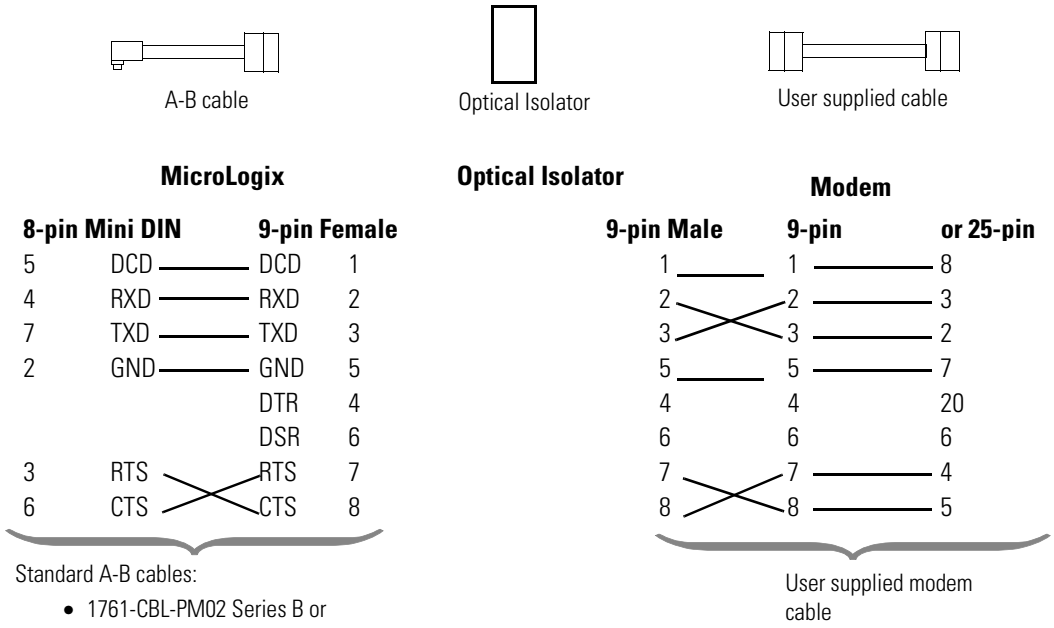
Figure A.5 1785-KE Module to Modem Cable Pin Assignment

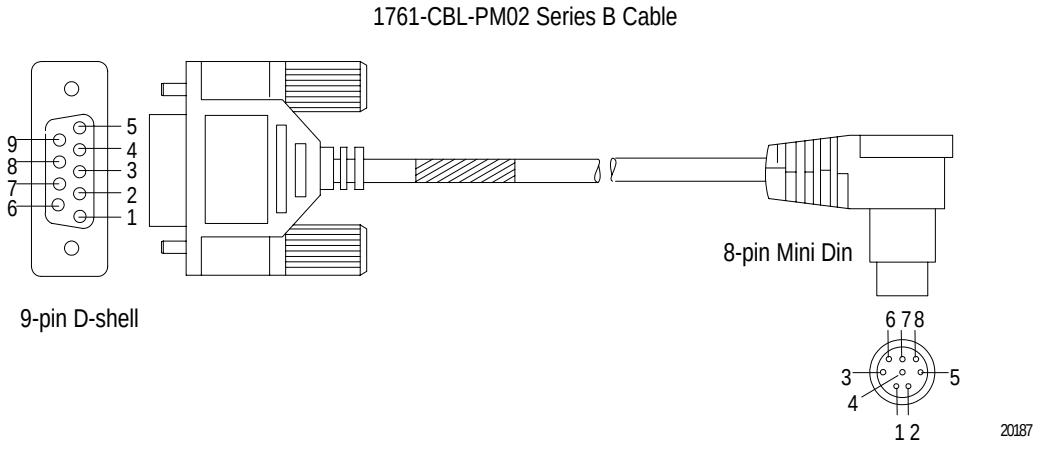
	15-pin male	25-pin	9-pin
C.GND	1	1	NC
TXD.OUT	2	2	3
RXD.IN	3	3	2
RTS.OUT	4	4	7
CTS.IN	5	5	8
DSR.IN	6	6	6
SIG.GND	7	7	5
DCD.IN	8	8	1
DTR.OUT	11	20	4
	20		

MicroLogix

Use A-B 1761-PM02 Series B (or higher) (MicroLogix Mini-DIN to 9-pin female connector) to connect a MicroLogix serial port to a modem through an optical isolator.

Figure A.6 MicroLogix Channel 0 Serial Port to Modem Cable Pin Assignment





Basic DF1 Protocol Troubleshooting

Appendix Objectives

This appendix helps you troubleshoot communication problems.

For information about	See page
general tips	B-1
communication troubleshooting	B-1
DF1 half-duplex protocol	B-4
DF1 full-duplex protocol	B-6
DF1 radio modem protocol	B-7

General Tips

When you encounter problems, check these items:

- cabling (cable length, connectors, pinouts, etc.)
- power connections
- communication rate settings for all devices must match
- control line configuration
- handshaking parameters
- error detection selection for all devices must match (BCC or CRC)

Communication Troubleshooting

For new installations, if possible, setup the communications in the lab before installing the processors in the field using a directly connected null-modem cable. Verify that the protocol settings and addressing are properly configured for all processors. For multi-drop configurations, you need only verify Master-to-Slave communications. Next, replace the null-modem cable with modem cables and introduce the modems as the link between the devices. Troubleshoot the modem link(s).

If the MSG instruction errs, follow this troubleshooting sequence:

1. Use the MSG instruction error code and error description for clues. The two most common error codes are:

Error Code	Description	Analysis and Corrective Action
07hex	No acknowledgment (ACK) was received when the MSG was sent and retried.	The communications link is failing somewhere. Follow the rest of the numbered steps to determine the problem.
037hex	MSG timeout, which indicates an ACK was received but an error free reply was not received before the MSG timed out.	Either the MSG timeout parameter is set too short or the reply, if received, has checksum errors, which indicates a marginal modem link. This MSG error may also be seen with radio modems that generate the ACK locally in the modem (ESTeem and Metricom), but don't successfully deliver either the message to its destination or the reply back to the initiator due to modem configuration or network problems. Further analysis with a serial line analyzer may be required.

2. Use the initiating processor's RS-232 LED (labeled COMM on PLC-5s) to verify that characters are being transmitted out of the serial port. If characters are not being transmitted, either:
   - the MSG is improperly configured to be sent out a different port, or
   - the required modem handshaking signals (based on the processor serial port Control Line configuration) are not present at the processor's RS-232 port due to improper modem cable or modem configuration.

3. Use the initiating modem's transmit data LED to verify data packets are being sent. If data packets are not being sent:
   - check the cable between the processor and its modem to ensure that the receive and transmit pins and modem handshaking pins (if used) are properly connected.
   - verify that both modem and processor either use or ignore handshaking.

4. Use the receiving modem's receive data LED to determine whether data packets are being received by the modem. If data packets are not being received, determine problem with the modem link.

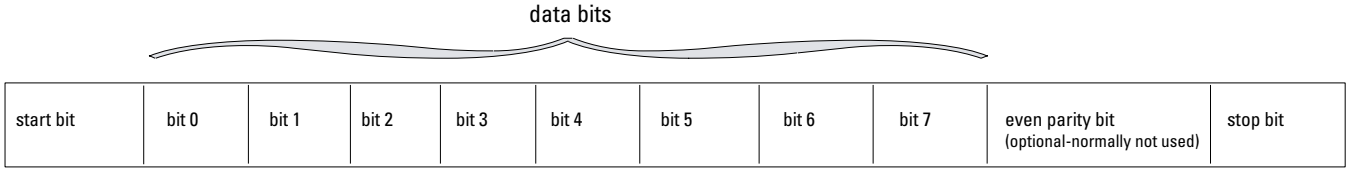
5. Use the receiving processor's RS-232 LED to verify that characters are being transmitted out of the serial port. If troubleshooting the MicroLogix 1000 controller with a modem connection through the AIC+, then the AIC+ TX LEDs provide this indication. If no characters are being transmitted, the receiving processor may not be replying to the message because it was not properly received. Check for:
   - incorrect cable between the modem and receiving processor.
   - improper modem cable or modem configuration. (Required modem handshaking signals based on the processor serial port Control Line configuration are not present at the processor's RS-232.)
   - baud rate mismatch between modems and processors.
   - error detection (BCC or CRC) mismatch between sending and receiving processors.
   - destination address mismatch between MSG and receiving processor (DF1 half-duplex protocol only).
6. Use the initiating modem's receive data LED to determine whether data packets are being received back by the modem. If not, determine problem with modem link.

If you are unable to determine the cause of the MSG error after going through this list, then further analysis with a serial line analyzer may be required. Use the following sections to understand the DF1 hex codes you should expect to capture with your serial line analyzer.

DF1 Protocol

Allen-Bradley products send data asynchronously and serially over the RS-232 interface, one 8-bit byte at a time. The transmission format conforms to ANSI X3.16, CCITT V.4, and ISO 1177, with the exception that the parity bit is retained while the data length is extended to 8 bits.

The following illustration summarizes the transmission format.



DF1 full- and half-duplex protocols are character-oriented and combine ASCII characters into two symbol types:

- control
- data

A symbol is a sequence of one or more bytes having a specific meaning to the link protocol. The component characters of a symbol must be sent one after another with no other characters inserted between them.

DF1 Half-Duplex Protocol

To help you diagnose communication problems, you can use a serial line analyzer to see the data packets being transmitted on the RS-232 link between the DTE and the DCE. For further details, see the DF1 Protocol and Command Set Reference Manual, Publication 1770-RM516.

For this information	See
different types of communication packet exchanges between a master station and a remote station	Table B.1
definitions of the packets	Table B.2

Table B.1 Summary of DF1 Half-Duplex Protocol Packet Exchanges

Message Type	Master Station's Packet	Remote Station's Packet
Master station sending a MSG instruction to a remote station	DLE SOH stn DLE STX message DLE ETX BCC/CRC	DLE ACK
Master station sending a poll; remote station replying to a poll indicating it has no data to transmit	DLE ENQ stn BCC	DLE EOT
Master station sending a poll; remote station sending a MSG instruction as a reply	DLE ENQ stn BCC DLE ACK (master station acknowledges receipt of the remote station's message)	DLE STX message DLE ETX BCC/CRC

Table B.2 Identify the DF1 Half-Duplex Packets

Symbol	Hexadecimal	Binary		Type	Meaning
DLE SOH	10 01	0001 0000	0000 0001	control symbol	Start of header Sender symbol that indicates the start of a master station's message
DLE STX	10 02	0001 0000	0000 0010	control symbol	Start of text Sender symbol that separates the multi-drop header from the data
DLE ETX BCC/CRC	10 03 xx(xx)	0001 0000	0000 0011	control symbol	End of text and checksum Sender symbol that terminates a message
DLE EOT	10 04	0001 0000	0000 0100	control symbol	End of transmission Response symbol used by remote stations as a response to a poll when they have no messages to send
DLE ENQ STN BCC	10 05 xx xx	0001 0000	0000 0101	control symbol	Enquiry poll packet Sender symbol, issued only by the master station, that starts a poll command
DLE ACK	10 06	0001 0000	0000 0110	control symbol	Acknowledgment Response symbol which signals that a message has been successfully received
DLE DLE	10 10	0001 0000	0001 0000	data symbol	Represents the data value or STN value of 10 (hex)
DLE NAK	10 15	0001 0000	0001 0101	control symbol	Global link reset command only issued by the master station during powerup or a serial port reconfiguration The command causes the remote station to cancel all messages that are ready to transmit to the master station. Typically, the remote station returns an error code to the affected MSG instructions.
STN	application specific			data symbol	Station number of the remote station on your half-duplex link (00-FE)
APP DATA	application specific			data symbol	Single characters having values 00-0F and 11-FF Includes data from application layer including user programs and common application routines

See ANSI X3.4, CCITT V.3, or ISO 646 for the standard definition of these characters.

DF1 Full-Duplex Protocol

To help you diagnose communication problems, you can use a serial line analyzer to see the data packets being transmitted on the RS-232 link between the DTE and the DCE. For further details, see the DF1 Protocol and Command Set Reference Manual, publication 1770-RM516.

For the	See
different types of communication packet exchanges between two full-duplex stations	Table B.3
definitions of the packets	Table B.4

Table B.3 Summary DF1 Full-Duplex Protocol Packet Exchanges

Message Type	Sender Station's Packet	Receiver Station's Packet
Sender station transmits a MSG instruction to a receiving station; receiver station acknowledges	DLE STX message DLE ETX BCC/CRC	DLE ACK
Sender station transmitting a MSG instruction to a receiver station; receiver station cannot receive the message or error in transmission	DLE STX message DLE ETX BCC/CRC	DLE NAK
Sender station receives a corrupted DLE ACK from the receiver station; sender station requests re-transmission of last control symbol; receiver station sends the DLE ACK again	DLE ENQ	DLE ACK

Table B.4 Identify the DF1 Full-Duplex Packets

Symbol	Hexadecimal	Binary		Type	Meaning
DLE STX	10 02	0001 0000	0000 0010	control symbol	Start of header Sender symbol that indicates the start of a message
DLE ETX BCC/CRC	10 03 xx(xx)	0001 0000	0000 0011	control symbol	Sender symbol that terminates a message
DLE ENQ	10 05	0001 0000	0000 0101	control symbol	Sender symbol that requests retransmission of a response symbol from the receiver
DLE ACK	10 06	0001 0000	0000 0110	control symbol	Response symbol that signals that a message has been successfully received
DLE DLE	10 10	0001 0000	0001 0000	data symbol	Represents the data value of 10 (hex)
DLE NAK	10 15	0001 0000	0001 0101	control symbol	Negative acknowledgment Response symbol that signals that a message was not received successfully
APP DATA	application specific			data symbol	Single characters having values 00-0F and 11-FF Includes data from the application layer including user programs and common application routines

See ANSI X3.4, CCITT V.3, or ISO 646 for the standard definition of these characters.

DF1 Radio Modem Protocol

To help you diagnose communication problems, you can use a serial line analyzer to see the data packets being transmitted on the RS-232 link between the DTE and the DCE. For further details, see the DF1 Protocol and Command Set Reference Manual, publication 1770-RM516.

For the	See
different types of communication packet exchanges between two radio modem stations	Table B.5
definitions of the packets	Table B.6

Table B.5 Summary DF1 Radio Modem Protocol Packet Exchanges

Message Type	Sender Station's Packet	Receiver Station's Packet
Sender station transmits a MSG instruction to a receiving station; receiver station replies	DLE STX message DLE ETX BCC/CRC	DLE STX reply DLE ETX BCC/CRC
Sender station transmitting a MSG instruction to a receiver station; receiver station cannot receive the message or error in transmission - packet dropped, no reply	DLE STX message DLE ETX BCC/CRC	none

Table B.6 Identify the DF1 Radio Modem Packets

Symbol	Hexadecimal	Binary		Type	Meaning
DLE STX	10 02	0001 0000	0000 0010	control symbol	Start of header Sender symbol that indicates the start of a message
DLE ETX BCC/CRC	10 03 xx(xx)	0001 0000	0000 0011	control symbol	Sender symbol that terminates a message
DLE DLE	10 10	0001 0000	0001 0000	data symbol	Represents the data value of 10 (hex)
APP DATA	application specific			data symbol	Single characters having values 00-0F and 11-FF Includes data from the application layer including user programs and common application routines

See ANSI X3.4, CCITT V.3, or ISO 646 for the standard definition of these characters.

Third-Party Supplier Contact Information

Appendix Objectives

Use this appendix to help locate the third-party products mentioned in this document. For more information about either the vendors or products:

- contact the vendor directly
- see the Encompass Product Directory, publication 6873-SG003
- contact your local Allen-Bradley office or distributor

Contact List

Use the table starting below as a reference. This list is not inclusive.

Company	Product types offered	Contact information
DATA-LINC Group	dial-up, leased-line, spread spectrum radio, and power line modems	DATA-LINC Group 3535 Factoria Blvd, SE Bellevue, WA 98006 Phone: (425) 882-2206 Fax: (425) 867-0865 www.data-linc.com
Electronic Systems Technology	ESTeem licensed and spread spectrum radio modems	Electronic Systems Technology 415 N. Quay Street Kennewick, WA 99336 Phone: (509) 735-9092 Fax: (509) 735-5475 www.esteem.com
Microwave Data Systems	licensed and spread spectrum radio modems	Sales Coordinator Microwave Data Systems 175 Science Parkway Rochester, NY 14620-4261 Sales and Engineering Phone: (585) 442-4000 General Phone: (585) 242-9600 Fax: (585) 242-9620 www.microwavedata.com
Miille Applied Research Co., Inc. (MARC)	protocol converters, 1771 and 1746 chassis mounted modems for dial-up and leased line	Miille Applied Research Co., Inc. 1730 S. Richey St. Pasadena, TX 77502 Phone:(713) 472-6272 Fax: (713) 472-0318 www.miille.com

Company	Product types offered	Contact information
ProSoft Technology, Inc.	protocol interfaces for SCADA, plant floor and foreign device interface applications. custom development and tools are also available the ProSoft RTU-5/03 Processor is targeted at SCADA/RTU applications in industries that use the Modbus protocol	ProSoft Technology, Inc. Corporate Office 1675 Chester Ave Bakersfield, CA 93301 Phone: (661) 716-5100 Fax: (661) 716-5101 www.prosoft-technology.com
Dataradio COR Ltd.	licensed and spread spectrum radio modems	Dataradio COR Ltd. 299 Johnson Ave Waseca, MN 56093 Phone: (507) 833-8819 Fax: (507) 833-6748 www.dataradio.com
Frontline Test Equipment, Inc.	NetDecoder serial analyzer software for decoding DF1 protocol	Frontline Test Equipment, Inc. 337 West Rio Road Charlottesville, VA 22901 Phone: (434) 984-4500 Fax: (434) 984-4505 www.fte.com

Worksheets

Appendix Objective

Use this appendix to document your serial channel configurations. Each worksheet corresponds to a processor's master or remote station configuration.

Make photocopies of the worksheets. Do not write on the originals.

For defining this configuration	Use	Found on page	And configuration screen on page	With definitions on page
SCADA system schematic	Worksheet 1.1	D-4	not applicable	not applicable
Enhanced PLC-5 DF1 Half-Duplex Master Station Configuration Using Standard Communication	Worksheet 2.1	D-5		
Enhanced PLC-5 DF1 Half-Duplex Master Station Configuration Using Message-based Communication	Worksheet 2.2	D-6		
Enhanced PLC-5 DF1 Half-Duplex Slave Station Configuration	Worksheet 2.3	D-7		
Enhanced PLC-5 DF1 Full-Duplex Point-to-Point Configuration	Worksheet 2.4	D-8		
MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Standard Communication	Worksheet 3.1	D-9		
MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Message-based Communication	Worksheet 3.2	D-10		
MicroLogix 1100/1200/1500 DF1 Half-Duplex Slave Station Configuration	Worksheet 3.3	D-11		
MicroLogix 1100/1200/1500 DF1 Full-Duplex Point-to-Point Configuration	Worksheet 3.4	D-12		
MicroLogix 1100/1200/1500 Radio Modem Slave Station Configuration	Worksheet 3.5	D-13		
SLC 5/03, 5/04 DF1 Half-Duplex Master Station Configuration Using Standard Communication	Worksheet 4.1	D-14		
SLC 5/03, 5/04, and 5/05 DF1 Half-Duplex Master Station Configuration Using Message-based Communication	Worksheet 4.2	D-15		
SLC 5/03, 5/04, and 5/05 DF1 Half-Duplex Slave Station Configuration	Worksheet 4.3	D-16		
SLC 5/03, 5/04, and 5/05 DF1 Full-Duplex Point-to-Point Configuration	Worksheet 4.4	D-17		
SLC 5/03, 5/04, and 5/05 DF1 Radio Modem Station Configuration	Worksheet 4.5	D-18		
SLC 500 Processor with 1747-KE Module DF1 Half-Duplex Slave Station Configuration	Worksheet 5.1	D-19		

For defining this configuration	Use	Found on page	And configuration screen on page	With definitions on page
SLC 500 Processor with 1747-KE Module Point-to-Point Configuration	Worksheet 5.2	D-20		
MicroLogix 1000 DF1 Half-Duplex Slave Station Configuration	Worksheet 6.1	D-21		
Logix DF1 Half-Duplex Master Station Configuration Using Standard Communication	Worksheet 7.1	D-22		
Logix DF1 Half-Duplex Master Station Configuration Using Message-based Communication	Worksheet 7.2	D-23		
Logix DF1 Half-Duplex Slave Station Configuration	Worksheet 7.3	D-24		
Logix DF1 Full-Duplex Point-to-Point Configuration	Worksheet 7.4	D-25		

When You're Finished

After you complete the worksheets, forward copies to your:

- programmers who need the information to write the PLC ladder-logic programs that control the equipment in your system,
- software integrators who need the information for the configuration screens, and
- hardware installers who need the information to install and connect the equipment.

Finally, keep a copy of the completed worksheets as part of the system documentation package. The information contained on the worksheets can be used as part of the system validation process required within certain industries by government agencies and industry associations.

How to Use the Worksheets

Each SCADA worksheet has different fields that you define, but the basic layout is the same. Make as many copies of the worksheets as you need. Do not write on the originals.

Each worksheet refers to the parameter tab location.

Each worksheet has an example.

Tab	Parameter	Example	Your Configuration
Serial Port	Diagnostic File	9	
	Remote Mode Change	DISABLED	
	Baud Rate	9600	
	Stop Bits	1	
	Control Line	HALF DUPLEX WITHOUT CONTINUOUS CARRIER	
	Parity	NONE	
Options	Station Address	1	
	Reply MSG Wait	5	
	ACK Timeout	15	
	DF1 Retries	3	
	MSG Application Timeout	1	
	Error Detect	CRC	

Worksheet 1.1 SCADA System Schematic

Use this worksheet to sketch your SCADA system, or include a drafting diagram. Include network addresses for each system component.

Worksheet 2.1 Enhanced PLC-5 DF1 Half-Duplex Master Station Configuration Using Standard Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 2-5.

Tab	Parameter	Example	Your Configuration
Serial Port	Remote Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Bits Per Character	8	
	Stop Bits	1	
	Control Line	HALF DUPLEX WITHOUT CONTINUOUS CARRIER	
	Parity	NONE	
	Error Detect	CRC	
Options	Station Address	1	
	DF1 Retries	3	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	ACK Timeout (x 20 ms)	15	
	MSG Application Timeout (x 20 ms)	1	
Polling	Polling Mode	STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN)	
	Master Message Transmit	BETWEEN STATION POLLS	
	Normal Poll Node File	N10	
	Normal Poll Group Size	3	
	Priority Poll Node File	N11	
	Active Station File	B9	

Worksheet 2.2 Enhanced PLC-5 DF1 Half-Duplex Master Station Configuration Using Message-based Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 2-11.

Tab	Parameter	Example	Your Configuration
Serial Port	Remote Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Bits Per Character	8	
	Stop Bits	1	
	Control Line	HALF DUPLEX WITHOUT CONTINUOUS CARRIER	
Options	Parity	NONE	
	Error Detect	CRC	
	Station Address	1	
	DF1 Retries	3	
	MSG Application Timeout (x 20 ms)	1	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	ACK Timeout (x 20 ms)	15	
	Reply MSG Wait (x 20 ms)	5	
Polling	Polling Mode	MESSAGE BASED (ALLOW SLAVES TO INITIATE MESSAGES)	

Worksheet 2.3 Enhanced PLC-5 DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. Do not write on the original. For descriptions of each line item, see page 2-12.

Tab	Parameter	Example	Your Configuration
Serial Port	Remote Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Bits Per Character	8	
	Stop Bits	1	
	Control Line	HALF DUPLEX WITHOUT CONTINUOUS CARRIER	
	Parity	NONE	
	Error Detect	CRC	
Options	Station Address	2	
	DF1 Retries	3	
	Detect Duplicate Messages	ENABLED	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	ACK Timeout (x 20 ms)	15	
	MSG Application Timeout (x 30 sec)	1	

Worksheet 2.4 Enhanced PLC-5 DF1 Full-Duplex Point-to-Point Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 2-18.

Tab	Parameter	Example	Your Configuration
Serial Port	Remote Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Bits Per Character	8	
	Stop Bits	1	
	Control Line	FULL DUPLEX MODEM	
	Parity	NONE	
	Error Detect	CRC	
	Detect Duplicate Messages	ENABLED	
Options	NAK Receive	3	
	DF1 ENQs	3	
	ACK Timeout (x 20 ms)	15	
	MSG Application Timeout (x 20 ms)	1	

Worksheet 3.1 MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Standard Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 3.1 on page 3-13.

Tab	Parameter	Example	Your Configuration
Chan. 0 (1100/1200/1500 LSP) Chan. 1 (1500 LRP)	Baud Rate	9600	
	Parity	NONE	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT MODEM	
	Error Detection	CRC	
	Polling Mode	STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN)	
	Duplicate Packet Detect	Enabled	
	ACK Timeout	50	
	RTS Off Delay (x 20 ms)	0	
	RTS Send Delay (x 20 ms)	0	
	Message Retries	3	
	Pre-Transmit Delay (x 1 ms)	0	
	Priority Polling Range - High	0	
	Priority Polling Range - Low	255	
	Normal Polling Range - High	3	
	Normal Polling Range - Low	1	
	Normal Poll Group Size	0	

Worksheet 3.2 MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Station Configuration Using Message-based Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 3.4 on page 3-21.

Tab	Parameter	Example	Your Configuration
Chan. 0 (1100/1200/1500 LSP) Chan. 1 (1500 LRP)	Baud Rate	9600	
	Parity	NONE	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT MODEM	
	Error Detection	CRC	
	Polling Mode	MESSAGE BASED (ALLOW SLAVE TO INITIATE MESSAGE)	
	Duplicate Packet Detect	Enabled	
	Reply Message Wait Timeout	1	
	ACK Timeout	50	
	RTS Off Delay (x 20 ms)	0	
	RTS Send Delay (x 20 ms)	0	
	Message Retries	3	
	Pre-Transmit Delay (x 1 ms)	0	

Worksheet 3.3 MicroLogix 1100/1200/1500 DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 3.5 on page 3-23.

Tab	Parameter	Example	Your Configuration
Chan. 0 (1100/1200/1500)	Baud Rate	9600	
Chan. 1 (1500 LRP)	Stop Bits	1	
	Parity	NONE	
	Node Address	99	
	Control Line	HALF-DUPLEX MODEM	
	Error Detect	CRC	
	EOT Suppression	DISABLED	
	Duplicate Detect	ENABLED	
	Poll Timeout	500	
	RTS Off Delay	0	
	RTS Send Delay	0	
	Message Retries	3	
	Pre-Transmit Delay	0	

Worksheet 3.4 MicroLogix 1100/1200/1500 DF1 Full-Duplex Point-to-Point Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 3.9 on page 3-34.

Tab	Parameter	Example	Your Configuration
Chan. 0 (1100/1200/1500) Chan. 1 (1500 LRP)	Baud Rate	1200	
	Parity	NONE	
	Source ID	0	
	Control Line	FULL-DUPLEX MODEM	
	Error Detection	CRC	
	Embedded Responses	ENABLED	
	Detect Duplicate Packet	ENABLED	
	ACK Timeout (x 20 ms)	500	
	NAK Retries	3	
	ENQ Retries	3	

Worksheet 3.5 MicroLogix 1100/1200/1500 Radio Modem Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 3.7 on page 3-28.

Tab	Parameter	Example	Your Configuration
Chan. 0 (1100, 1200, 1500 LSP) Chan. 1 (1500 LRP)	Baud Rate	9600	
	Stop Bits	1	
	Parity	NONE	
	Node Address	99	
	Control Line	HALF-DUPLEX MODEM WITH DCD HANDSHAKING	
	Error Detect	CRC	
	Store and Forward File Number	99	
	DCD Wait Delay	1	
	RTS Off Delay	0	
	RTS Send Delay	0	
	Pre-Transmit Delay	0	

Worksheet 4.1 SLC 5/03, 5/04, and 5/05 DF1 Half-Duplex Master Station Configuration Using Standard Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 4.1 on page 4-11.

Tab	Parameter	Example	Your Configuration
Chan. 0 System	Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Parity	NONE	
	Stop Bits	1	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	Error Detection	CRC	
	Polling Mode	STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN)	
	Duplicate Packet Detect	Enabled	
	ACK Timeout	50	
	RTS Off Delay (x 20 ms)	0	
	RTS Send Delay (x 20 ms)	0	
	Message Retries	3	
	Pre-Transmit Delay (x 1 ms)	0	
	Priority Polling Range - High	0	
	Priority Polling Range - Low	255	
	Normal Polling Range - High	3	
	Normal Polling Range - Low	1	
	Normal Poll Group Size	0	

Worksheet 4.2 SLC 5/03, 5/04, and 5/05 DF1 Half-Duplex Master Station Configuration Using Message-based Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 4.4 on page 4-20.

Tab	Parameter	Example	Your Configuration
Chan. 0 System	Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Parity	NONE	
	Stop Bits	1	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	Error Detection	CRC	
	Polling Mode	MESSAGE BASED (ALLOW SLAVE TO INITIATE MESSAGE)	
	Duplicate Packet Detect	Enabled	
	Reply Message Wait Timeout	1	
	ACK Timeout	50	
	RTS Off Delay (x 20 ms)	0	
	RTS Send Delay (x 20 ms)	0	
	Message Retries	3	
	Pre-Transmit Delay (x 1 ms)	0	

Worksheet 4.3 SLC 5/03, 5/04, and 5/05 DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 4.5 on page 4-23.

Tab	Parameter	Example	Your Configuration
Chan 0. System	Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Stop Bits	1	
	Parity	NONE	
	Stop Bits	1	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	Error Detect	CRC	
	EOT Suppression	DISABLED	
	Duplicate Detect	ENABLED	
	Poll Timeout	500	
	RTS Off Delay	0	
	RTS Send Delay	0	
	Message Retries	3	
	Pre-Transmit Delay	0	

Worksheet 4.4 SLC 5/03, 5/04, and 5/05 DF1 Full-Duplex Point-to-Point Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 4.9 on page 4-34.

Tab	Parameter	Example	Your Configuration
Chan. 0 System	Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	1200	
	Parity	NONE	
	Stop Bits	1	
	Source ID	0	
	Control Line	FULL-DUPLEX MODEM	
	Error Detection	CRC	
	Embedded Responses	ENABLED	
	Detect Duplicate Packet	ENABLED	
	ACK Timeout (x 20 ms)	500	
	NAK Retries	3	
	ENQ Retries	3	

Worksheet 4.5 SLC 5/03, 5/04, and 5/05 DF1 Radio Modem Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see Table 4.7 on page 4-28.

Tab	Parameter	Example	Your Configuration
Chan 0. System	Mode Change	DISABLED	
	Diagnostic File	N19	
	Baud Rate	9600	
	Stop Bits	1	
	Parity	NONE	
	Stop Bits	1	
	Node Address	99	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	Error Detect	CRC	
	Store and Forward	DISABLED	
	DCD Wait Delay	1	
	RTS Off Delay	0	
	RTS Send Delay	0	
	Pre-Transmit Delay	0	

Worksheet 5.1 SLC 500 Processor with 1747-KE Module DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 5-7.

Tab	Parameter	Example	Your Configuration
	Duplicate Packet Detection	ENABLED	
	Checksum	CRC	
	Constant Carrier Detect	DISABLED	
	Modem Init String		
	Message Timeout	10000	
	Hardware Handshaking	ENABLED	
	Poll Timeout (x 5 ms)	2000	
	Message Retries	2	
	RTS On Delay (x 5 ms)	0	
	RTS Off Delay (x 5 ms)	0	
	Local/Remote Mode	REMOTE	
	Slave Address/Group Number	0	
	Master Station Address	0	

Worksheet 5.2 SLC 500 Processor with 1747-KE Module Point-to-Point Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 5-7.

Tab	Parameter	Example	Your Configuration
	Duplicate Packet Detection	ENABLED	
	Checksum	CRC	
	Constant Carrier Detect	DISABLED	
	Modem Init String		
	Message Timeout	10000	
	Hardware Handshaking	ENABLED	
	Embedded Response Detect	EMBEDDED RESPONSE	
	ACK Timeout (x 5 ms)	200	
	ENQuiry Retries	2	
	NAK Received Retries	2	

Worksheet 6.1 MicroLogix 1000 DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 6-11

Tab	Parameter	Example	Your Configuration
	Baud Rate	9600	
	Node Address	99	
	Control Line	HALF-DUPLEX MODEM	
	Error Detection	CRC	
	EOT Suppression	DISABLED	
	Duplicate Packet Detect	ENABLED	
	Poll Timeout (x 20 ms)	3000	
	RTS Off Delay (x 5 ms)	0	
	RTS Send Delay (x 5 ms)	0	
	Message Retries	3	
	Pre-Transit Delay (x 5 ms)	0	

Worksheet 7.1 Logix DF1 Half-Duplex Master Station Configuration Using Standard Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 7-9.

Tab	Parameter	Example	Your Configuration
	Baud Rate	9600	
	Parity	NONE	
	Data Bits	8	
	Stop Bits	1	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	Station Address	99	
	Transmit Retries	3	
	ACK Timeout (x 20 ms)	50	
	Polling Mode	STANDARD (MULTIPLE MESSAGE TRANSFER PER NODE SCAN)	
	Normal Poll Group Size	0	
	Normal Poll Node Tag	Normal_Poll_Array	
	Priority Poll Node Tag	Priority_Poll_Array	
	Active Station Tag	Active_Station_Array	
	Master Transmit	BETWEEN STATION POLLS	
	Error Detection	CRC	
	Duplicate Detection	ENABLED	

Worksheet 7.2 Logix DF1 Half-Duplex Master Station Configuration Using Message-based Communication

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 7-18.

Tab	Parameter	Example	Your Configuration
	Baud Rate	9600	
	Parity	NONE	
	Data Bits	8	
	Stop Bits	1	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	Station Address	99	
	Transmit Retries	3	
	ACK Timeout (x 20 ms)	50	
	Reply Message Wait Time	1	
	Polling Mode	MESSAGE BASED (ALLOW SLAVE TO INITIATE MESSAGES)	
	Error Detection	CRC	
	Duplicate Detection	ENABLED	

Worksheet 7.3 Logix DF1 Half-Duplex Slave Station Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 7-23.

Tab	Parameter	Example	Your Configuration
	Baud Rate	9600	
	Parity	NONE	
	Data Bits	8	
	Stop Bits	1	
	Control Line	HALF-DUPLEX WITHOUT CONTINUOUS CARRIER	
	RTS Send Delay (x 20 ms)	0	
	RTS Off Delay (x 20 ms)	0	
	Station Address	99	
	Transmit Retries	3	
	Slave Poll Timeout (x 20 ms)	1500	
	EOT Suppression	DISABLED	
	Error Detection	CRC	
	Duplicate Detection	ENABLED	

Worksheet 7.4 Logix DF1 Full-Duplex Point-to-Point Configuration

Use this worksheet to record your station's configuration. For descriptions of each line item, see page 7-24.

Tab	Parameter	Example	Your Configuration
	Baud Rate	1200	
	Parity	NONE	
	Data Bits	8	
	Stop Bits	1	
	Control Line	FULL DUPLEX MODEM	
	RTS Send Delay (x 20 msec)	0	
	RTS Off Delay (x 20 msec)	0	
	Station Address	9	
	NAK Receive Limit	3	
	ENQ Transmit Limit	3	
	ACK Timeout (x 20 msec)	500	
	Embedded Responses	ENABLED	
	Error Detection	CRC	
	Duplicate Detection	ENABLED	

Sample Ladder Logic

Appendix Objective

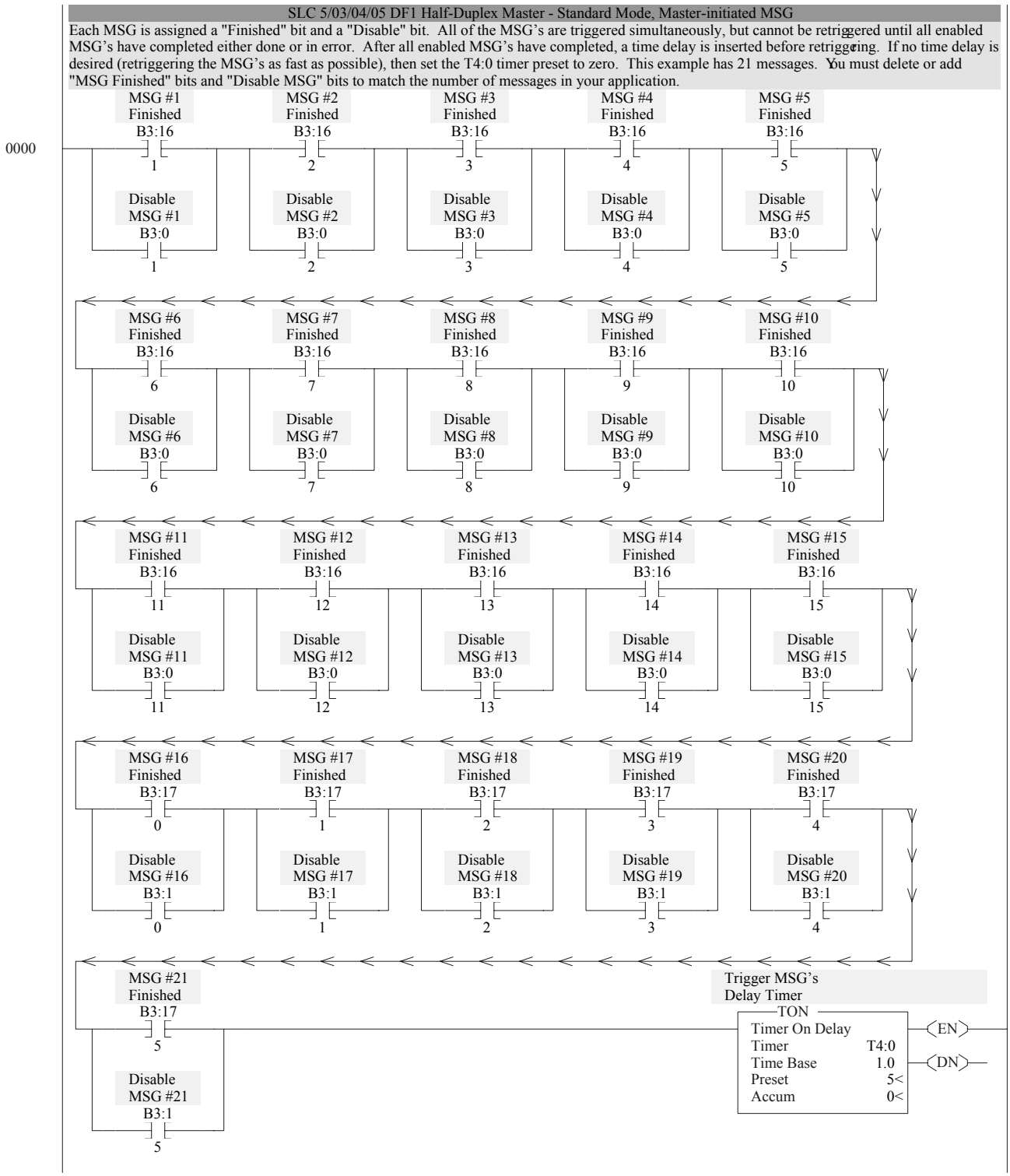
This appendix provides guidance for developing your messaging logic for MicroLogix, SLC 500, PLC-5, and Logix processors.

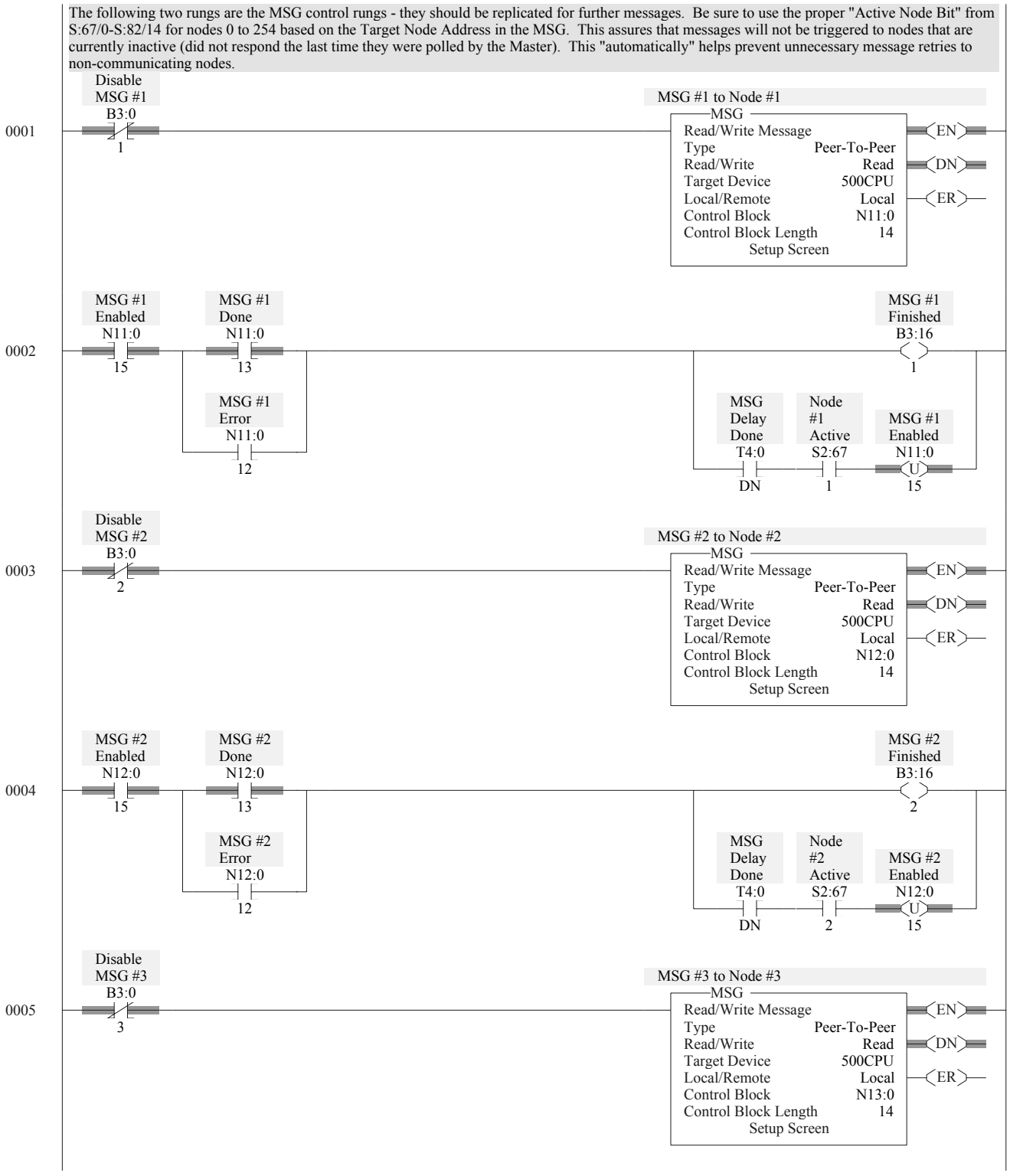
The user of and those responsible for applying the information contained in this appendix must satisfy themselves as to the acceptability of each application and use of the program. In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this information.

The examples shown in this appendix are intended solely to illustrate the principles of the controllers and some of the methods used to apply them. Rockwell Automation cannot assume responsibility or liability for actual use based upon the examples shown.

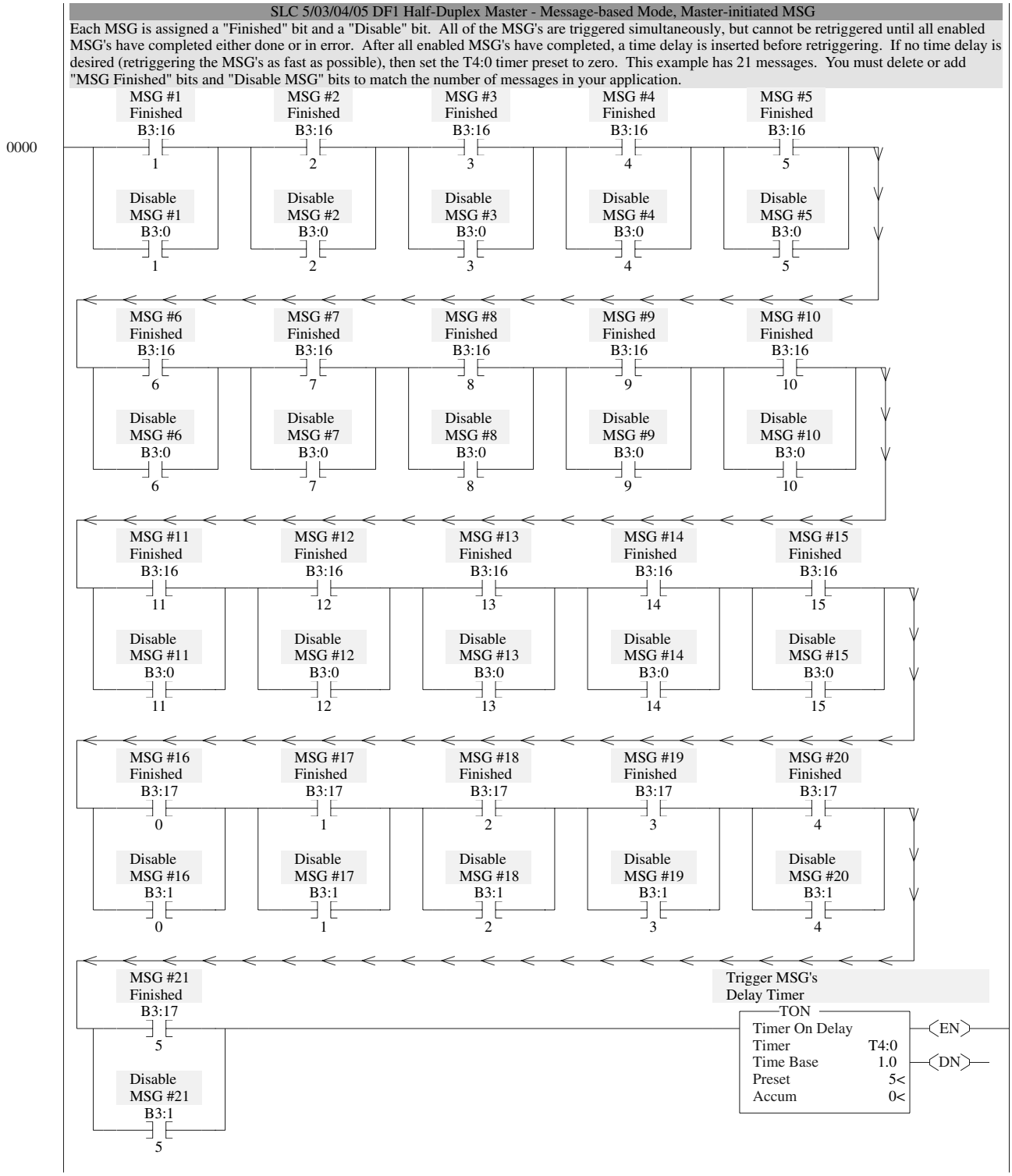
For sample ladder logic on	See page
SLC DF1 Half-Duplex Master Standard Mode, Master-initiated MSG	E-2
SLC DF1 Half-Duplex Master Message-based Mode and DF1 Radio Modem initiated MSG	E-4
SLC DF1 Half-Duplex Slave and DF1 Radio Modem Report-By-Exception MSG	E-6
PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Standard Mode, Master-initiated MSG	E-8
PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Message-based, Master-initiated MSG	E-10
PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Slave Report-By-Exception MSG	E-12
MicroLogix 1000 Analog DF1 Half-Duplex Slave Report-by-Exception MSG	E-14
Logix DF1 Half-Duplex Master Standard Mode, Master-initiated MSG	E-16
Logix DF1 Half-Duplex Master Message-based Mode, Master-initiated MSG	E-19
Logix DF1 Half-Duplex Slave Report-By-Exception MSG	E-21

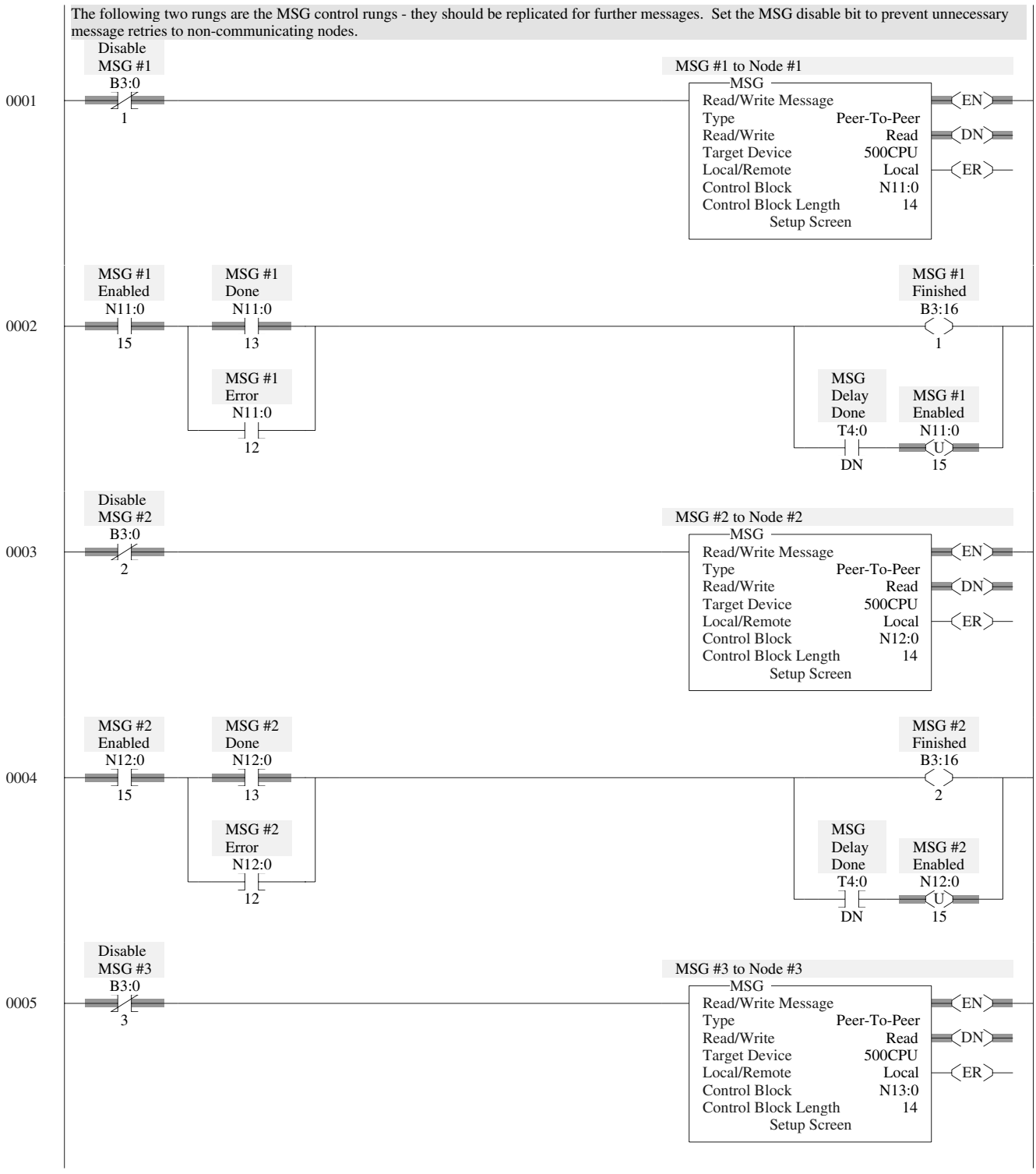
SLC DF1 Half-Duplex Master Standard Mode, Master-initiated MSG



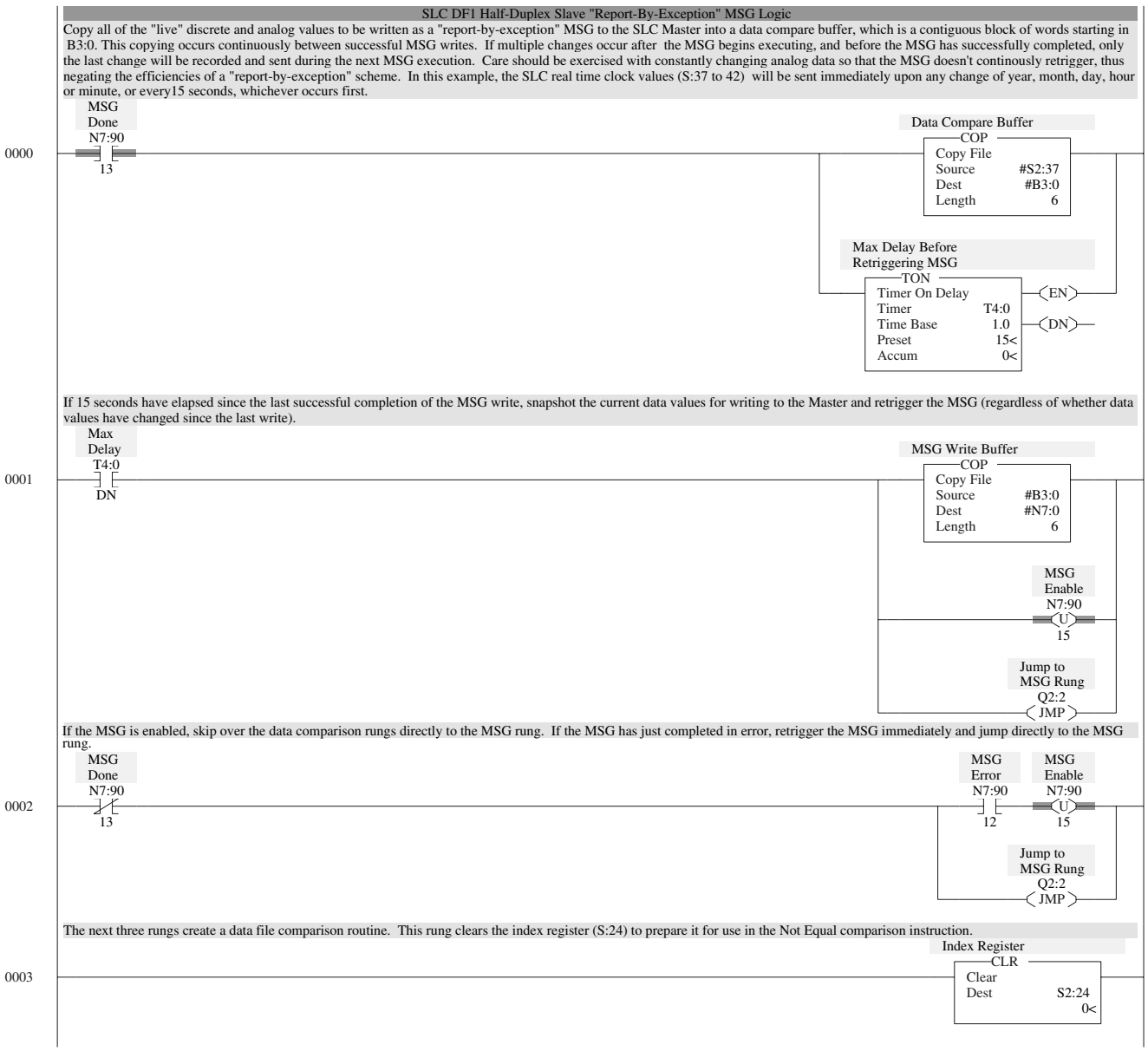

The following two rungs are the MSG control rungs - they should be replicated for further messages. Be sure to use the proper "Active Node Bit" from S:67/0-S:82/14 for nodes 0 to 254 based on the Target Node Address in the MSG. This assures that messages will not be triggered to nodes that are currently inactive (did not respond the last time they were polled by the Master). This "automatically" helps prevent unnecessary message retries to non-communicating nodes.
0001
Disable MSG #1
B3:0
1
MSG #1 to Node #1
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N11:0
Control Block Length 14
Setup Screen
EN
DN
ER
0002
MSG #1 Enabled
N11:0
15
MSG #1 Done
N11:0
13
MSG #1 Error
N11:0
12
MSG #1 Finished
B3:16
1
MSG Delay Done
T4:0
DN
Node #1 Active
S2:67
1
MSG #1 Enabled
N11:0
U
15
0003
Disable MSG #2
B3:0
2
MSG #2 to Node #2
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N12:0
Control Block Length 14
Setup Screen
EN
DN
ER
0004
MSG #2 Enabled
N12:0
15
MSG #2 Done
N12:0
13
MSG #2 Error
N12:0
12
MSG #2 Finished
B3:16
2
MSG Delay Done
T4:0
DN
Node #2 Active
S2:67
2
MSG #2 Enabled
N12:0
U
15
0005
Disable MSG #3
B3:0
3
MSG #3 to Node #3
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N13:0
Control Block Length 14
Setup Screen
EN
DN
ER

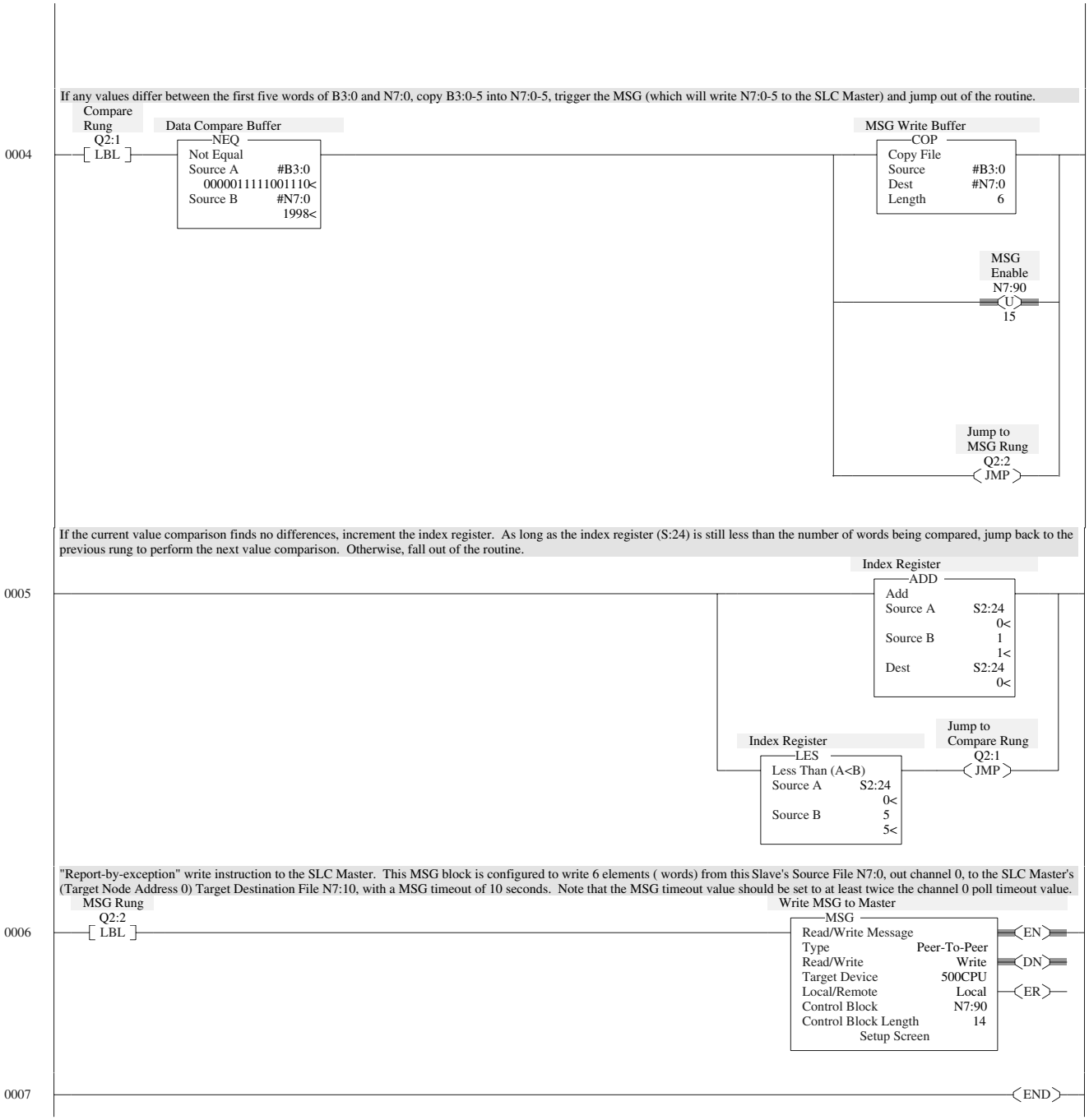
SLC DF1 Half-Duplex Master Message-based Mode and DF1 Radio Modem initiated MSG



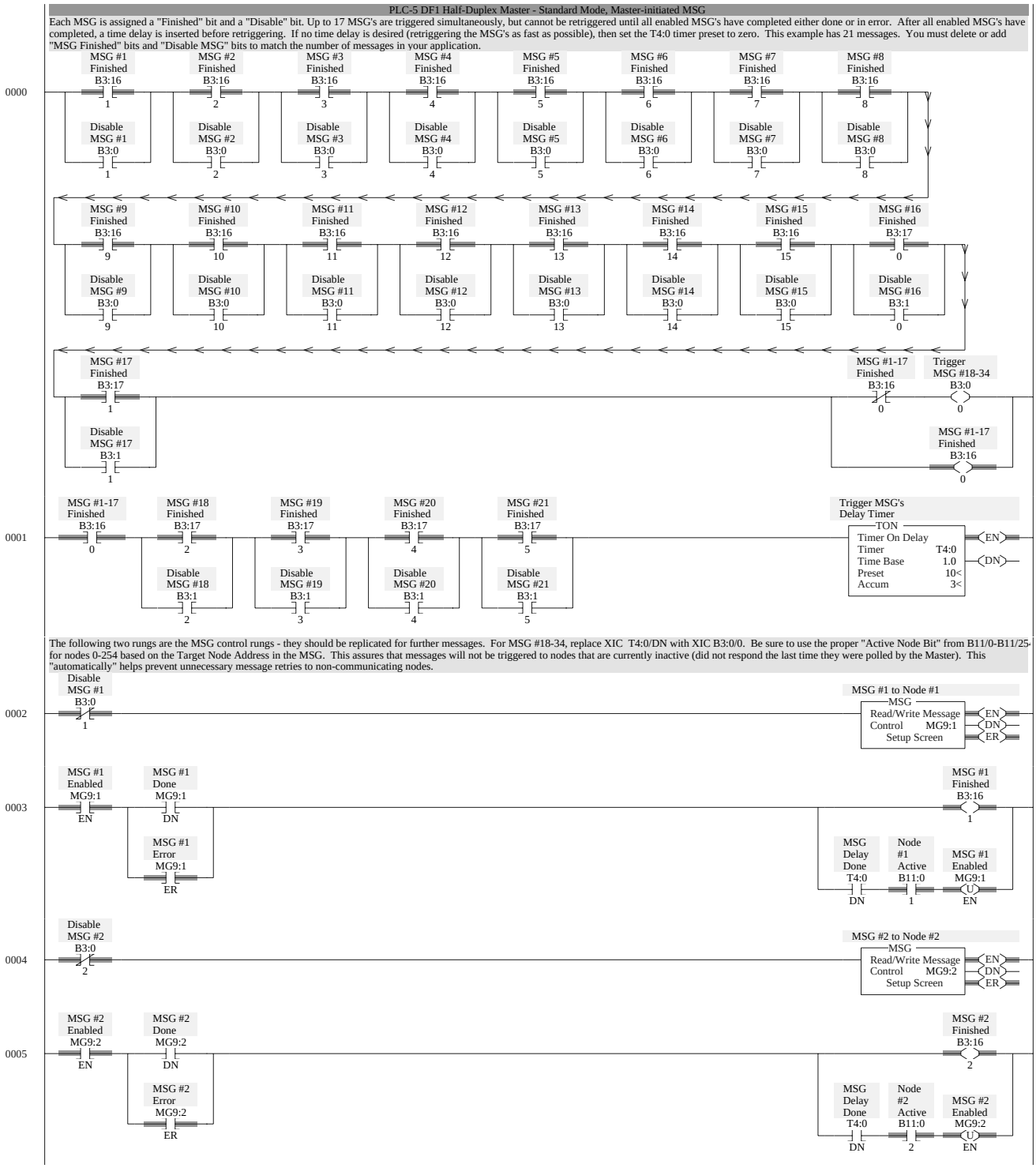

The following two rungs are the MSG control rungs - they should be replicated for further messages. Set the MSG disable bit to prevent unnecessary message retries to non-communicating nodes.
0001
Disable MSG #1
B3:0
1
MSG #1 to Node #1
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N11:0
Control Block Length 14
Setup Screen
EN
DN
ER
0002
MSG #1 Enabled
N11:0
15
MSG #1 Done
N11:0
13
MSG #1 Error
N11:0
12
MSG #1 Finished
B3:16
1
MSG Delay Done
T4:0
DN
MSG #1 Enabled
N11:0
U
15
0003
Disable MSG #2
B3:0
2
MSG #2 to Node #2
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N12:0
Control Block Length 14
Setup Screen
EN
DN
ER
0004
MSG #2 Enabled
N12:0
15
MSG #2 Done
N12:0
13
MSG #2 Error
N12:0
12
MSG #2 Finished
B3:16
2
MSG Delay Done
T4:0
DN
MSG #2 Enabled
N12:0
U
15
0005
Disable MSG #3
B3:0
3
MSG #3 to Node #3
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N13:0
Control Block Length 14
Setup Screen
EN
DN
ER

SLC DF1 Half-Duplex Slave and DF1 Radio Modem Report-by-Exception MSG



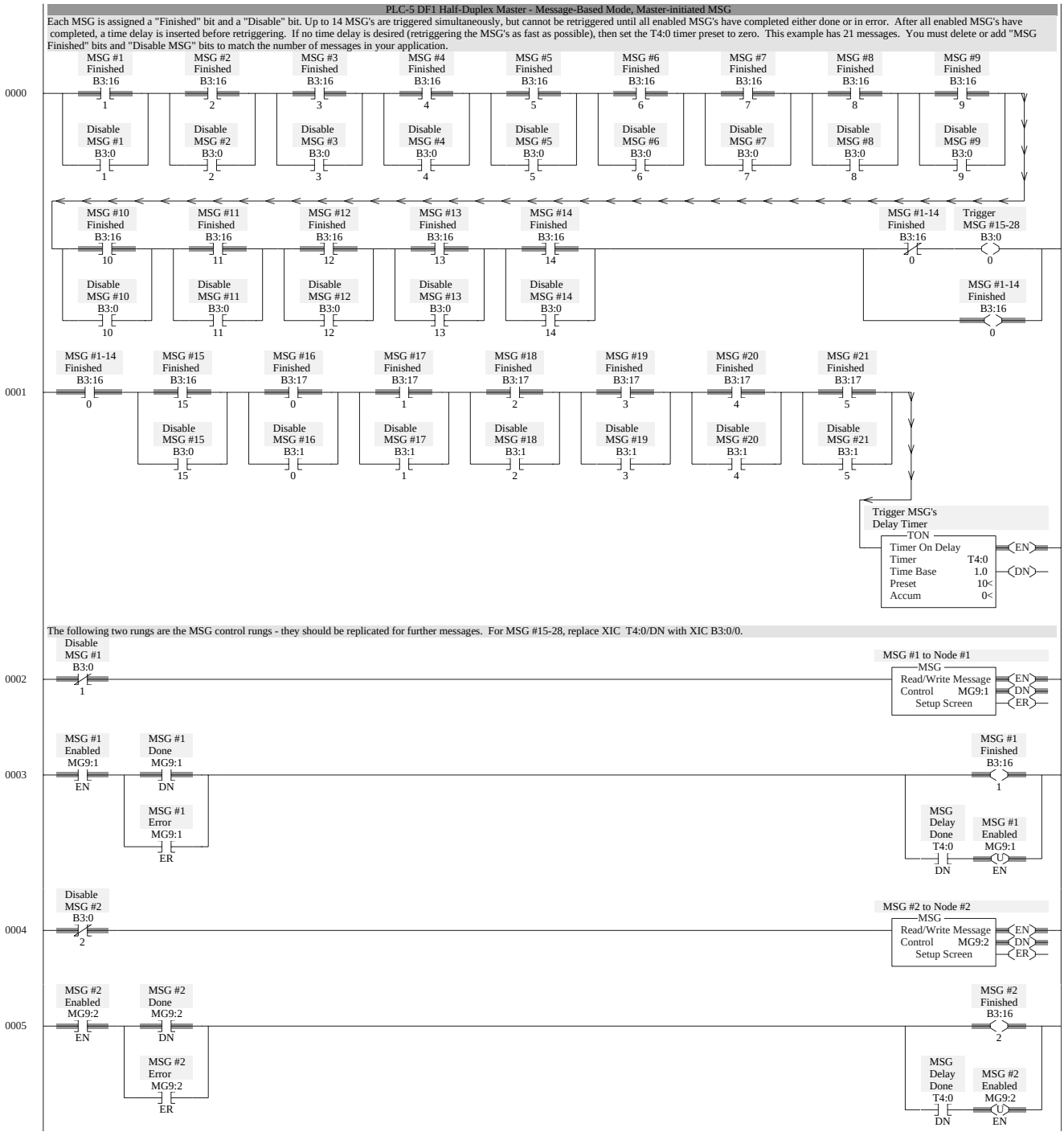

If any values differ between the first five words of B3:0 and N7:0, copy B3:0-5 into N7:0-5, trigger the MSG (which will write N7:0-5 to the SLC Master) and jump out of the routine.
Compare Rung
Q2:1
LBL
0004
Data Compare Buffer
NEQ
Not Equal
Source A #B3:0
0000011111001110<
Source B #N7:0
1998<
MSG Write Buffer
COP
Copy File
Source #B3:0
Dest #N7:0
Length 6
MSG Enable
N7:90
U
15
Jump to MSG Rung
Q2:2
JMP
If the current value comparison finds no differences, increment the index register. As long as the index register (S:24) is still less than the number of words being compared, jump back to the previous rung to perform the next value comparison. Otherwise, fall out of the routine.
0005
Index Register
ADD
Add
Source A S2:24
0<
Source B 1
1<
Dest S2:24
0<
Index Register
LES
Less Than (A<B)
Source A S2:24
0<
Source B 5
5<
Jump to Compare Rung
Q2:1
JMP
"Report-by-exception" write instruction to the SLC Master. This MSG block is configured to write 6 elements (words) from this Slave's Source File N7:0, out channel 0, to the SLC Master's (Target Node Address 0) Target Destination File N7:10, with a MSG timeout of 10 seconds. Note that the MSG timeout value should be set to at least twice the channel 0 poll timeout value.
MSG Rung
Q2:2
LBL
0006
Write MSG to Master
MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Write
Target Device 500CPU
Local/Remote Local
Control Block N7:90
Control Block Length 14
Setup Screen
EN
DN
ER
0007
END

PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Standard Mode, Master-initiated MSG



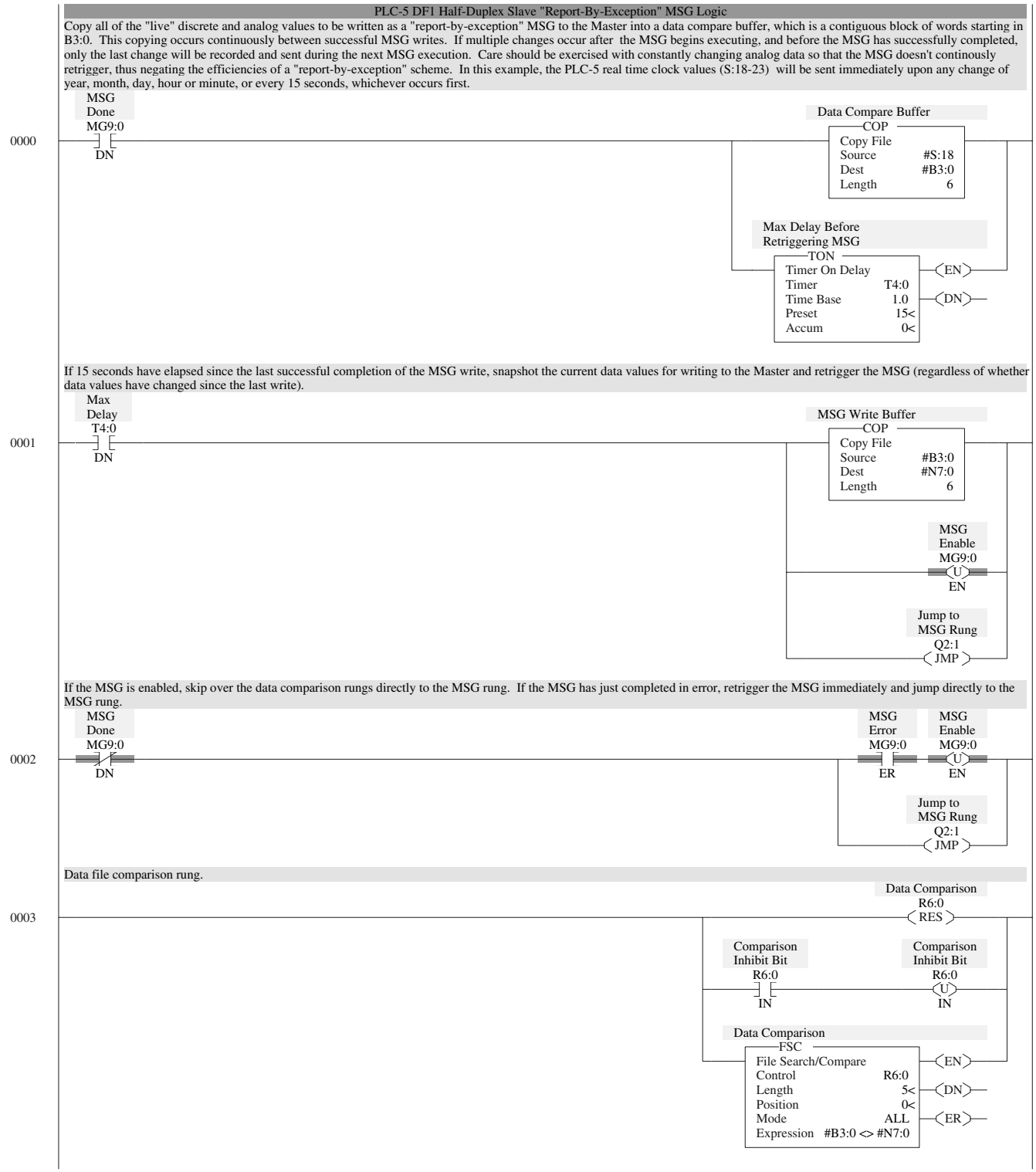
0006
Disable MSG #3
B3:0
3
MSG
Read/Write Message
Control MG9:3
Setup Screen
EN
DN
ER
0007
MG9:3
EN
MG9:3
DN
MG9:3
ER
MSG #3 Finished
B3:16
3
MSG Delay Done
T4:0
DN
B11:0
3
MG9:3
U
EN
0008
Disable MSG #4
B3:0
4
MSG
Read/Write Message
Control MG9:4
Setup Screen
EN
DN
ER
0009
MG9:4
EN
MG9:4
DN
MG9:4
ER
MSG #4 Finished
B3:16
4
MSG Delay Done
T4:0
DN
B11:0
4
MG9:4
U
EN

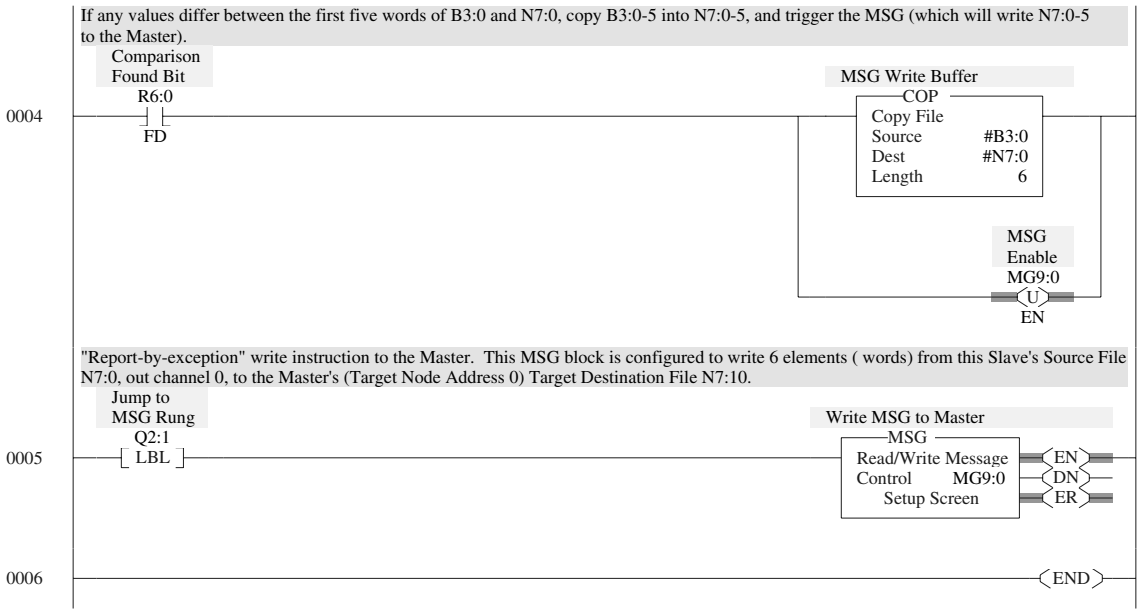
PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Master Message-based, Master-initiated MSG



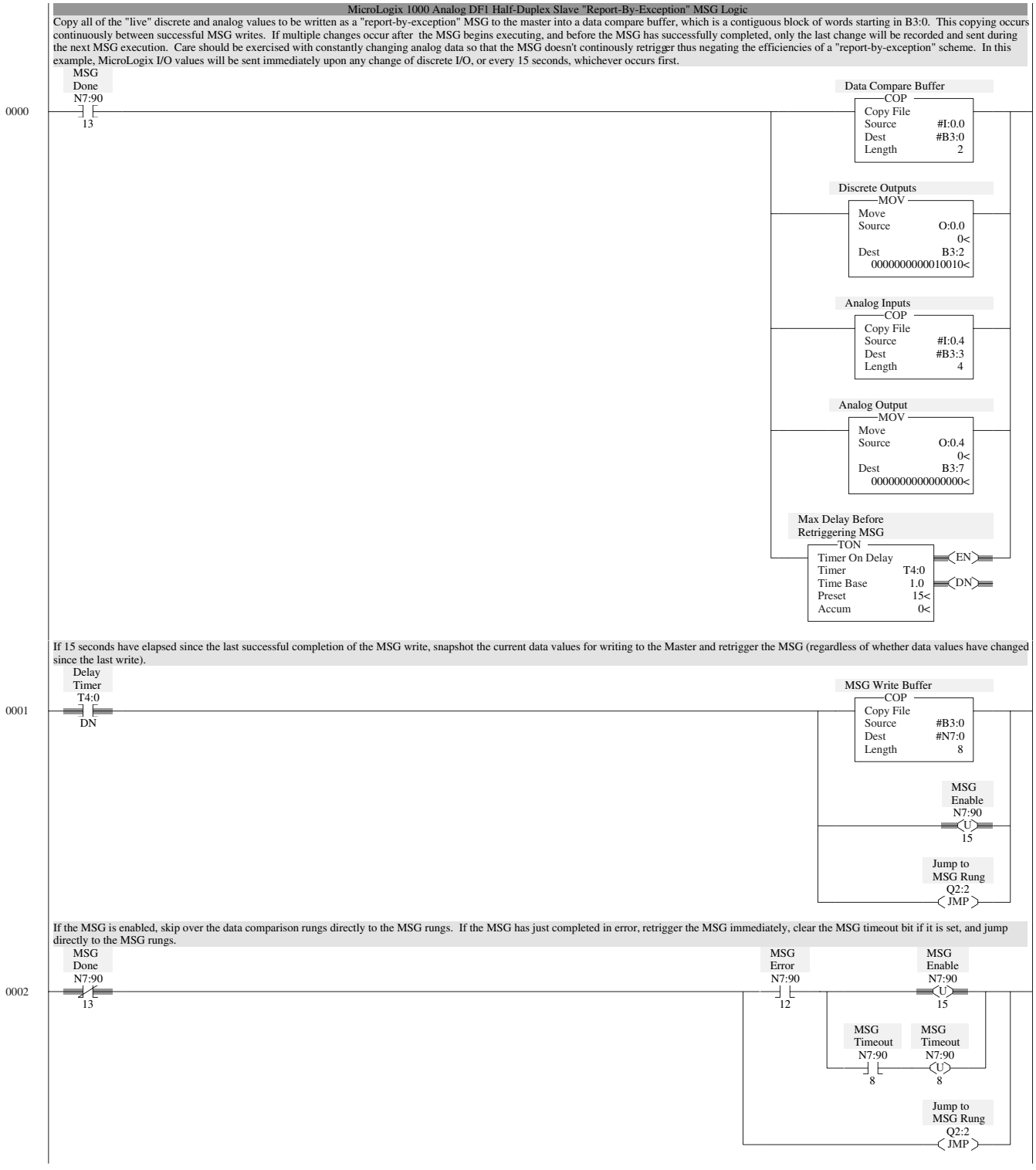
0006
Disable MSG #3
B3:0
3
MSG
Read/Write Message
Control MG9:3
Setup Screen
EN
DN
ER
0007
MG9:3
EN
MG9:3
DN
MG9:3
ER
MSG #3 Finished
B3:16
3
MSG Delay Done
T4:0
DN
MG9:3
(U)
EN
0008
Disable MSG #4
B3:0
4
MSG
Read/Write Message
Control MG9:4
Setup Screen
EN
DN
ER
0009
MG9:4
EN
MG9:4
DN
MG9:4
ER
MSG #4 Finished
B3:16
4
MSG Delay Done
T4:0
DN
MG9:4
(U)
EN
0010
Disable MSG #5
B3:0
5
MSG
Read/Write Message
Control MG9:5
Setup Screen
EN
DN
ER

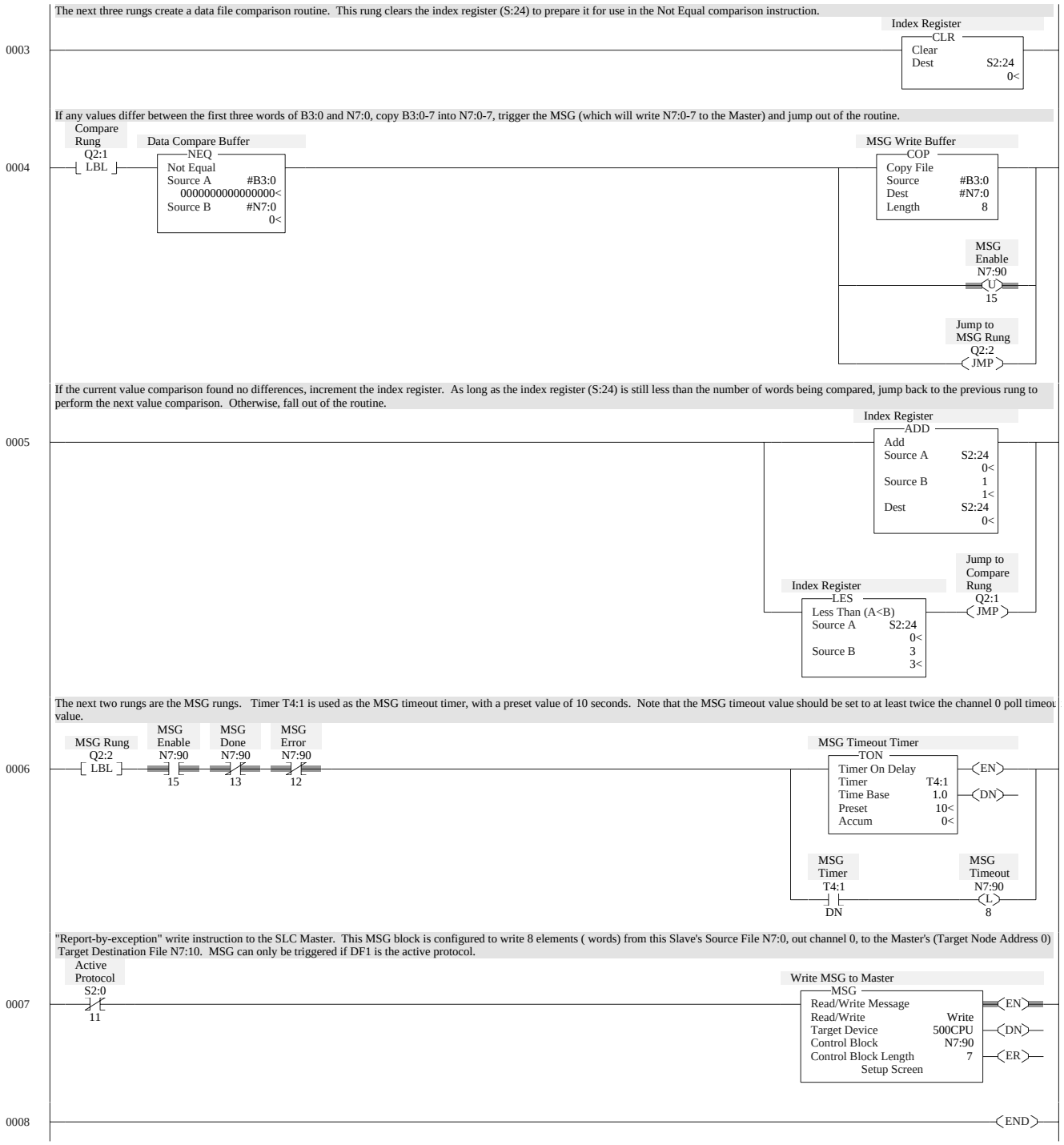
PLC-5 and MicroLogix 1100/1200/1500 DF1 Half-Duplex Slave Report-by-Exception MSG



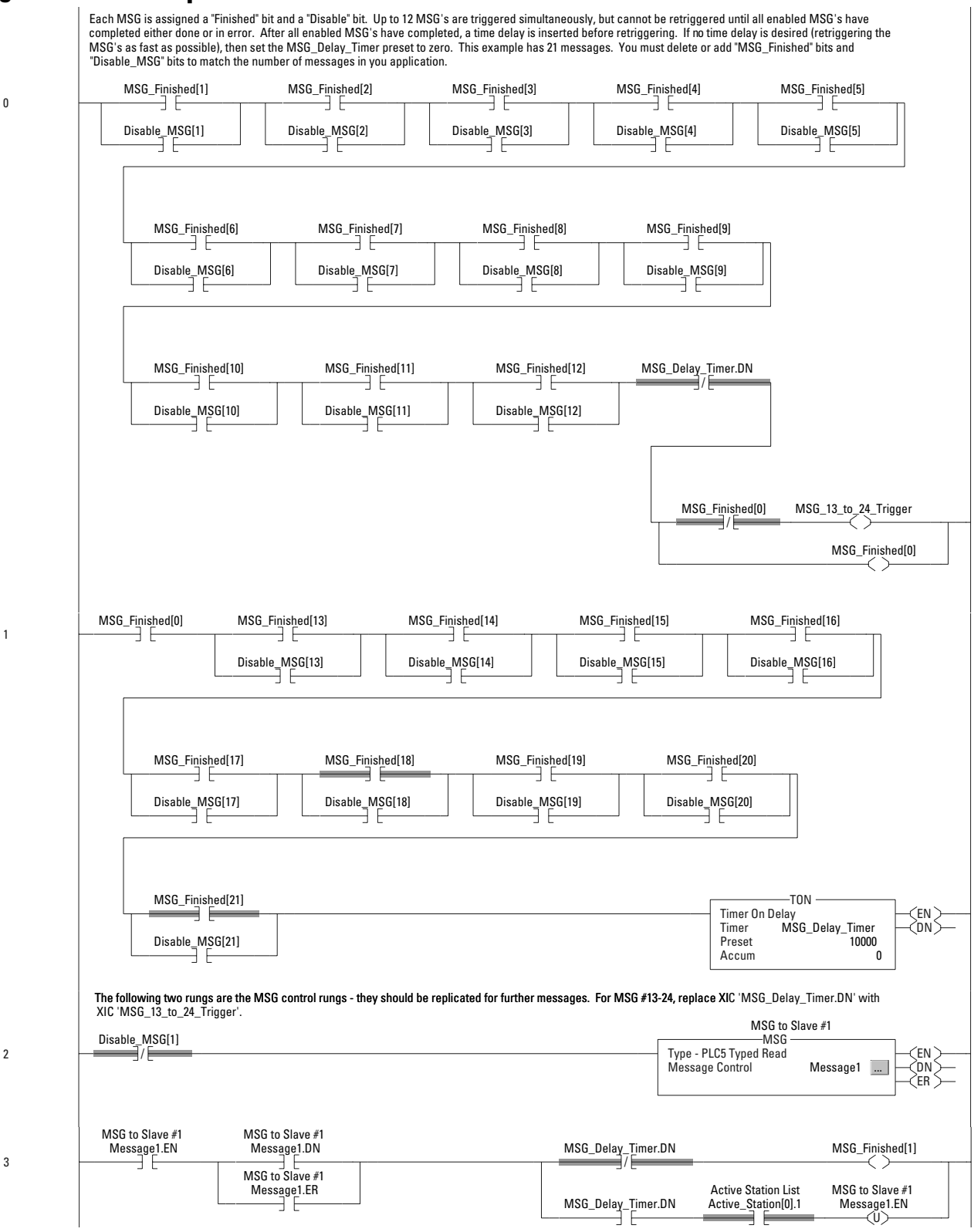

If any values differ between the first five words of B3:0 and N7:0, copy B3:0-5 into N7:0-5, and trigger the MSG (which will write N7:0-5 to the Master).
Comparison
Found Bit
R6:0
FD
0004
MSG Write Buffer
COP
Copy File
Source #B3:0
Dest #N7:0
Length 6
MSG
Enable
MG9:0
U
EN
"Report-by-exception" write instruction to the Master. This MSG block is configured to write 6 elements (words) from this Slave's Source File N7:0, out channel 0, to the Master's (Target Node Address 0) Target Destination File N7:10.
Jump to
MSG Rung
Q2:1
LBL
0005
Write MSG to Master
MSG
Read/Write Message
Control MG9:0
Setup Screen
EN
DN
ER
0006
END

MicroLogix 1000 Analog DF1 Half-Duplex Slave Report-by-Exception MSG

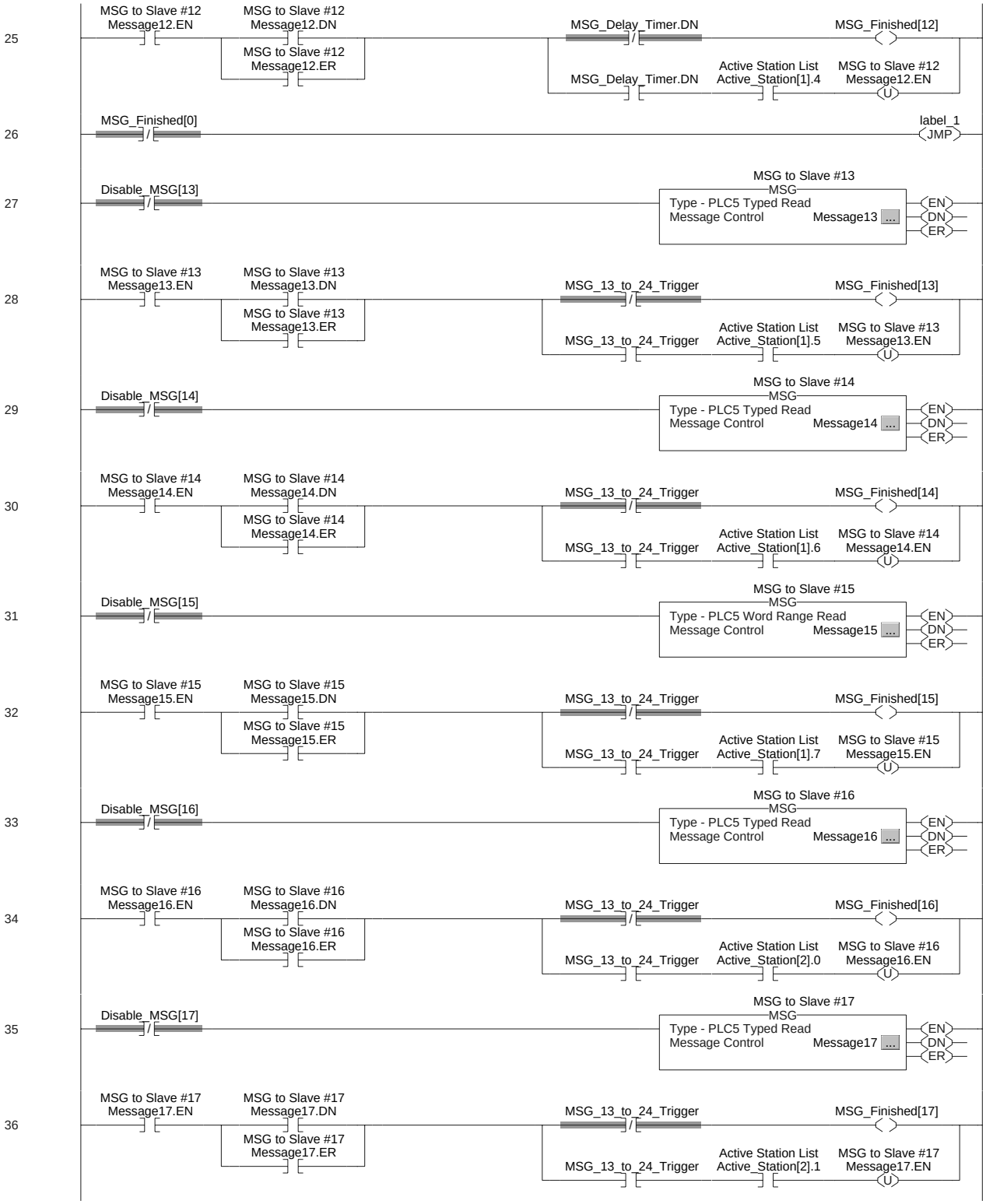


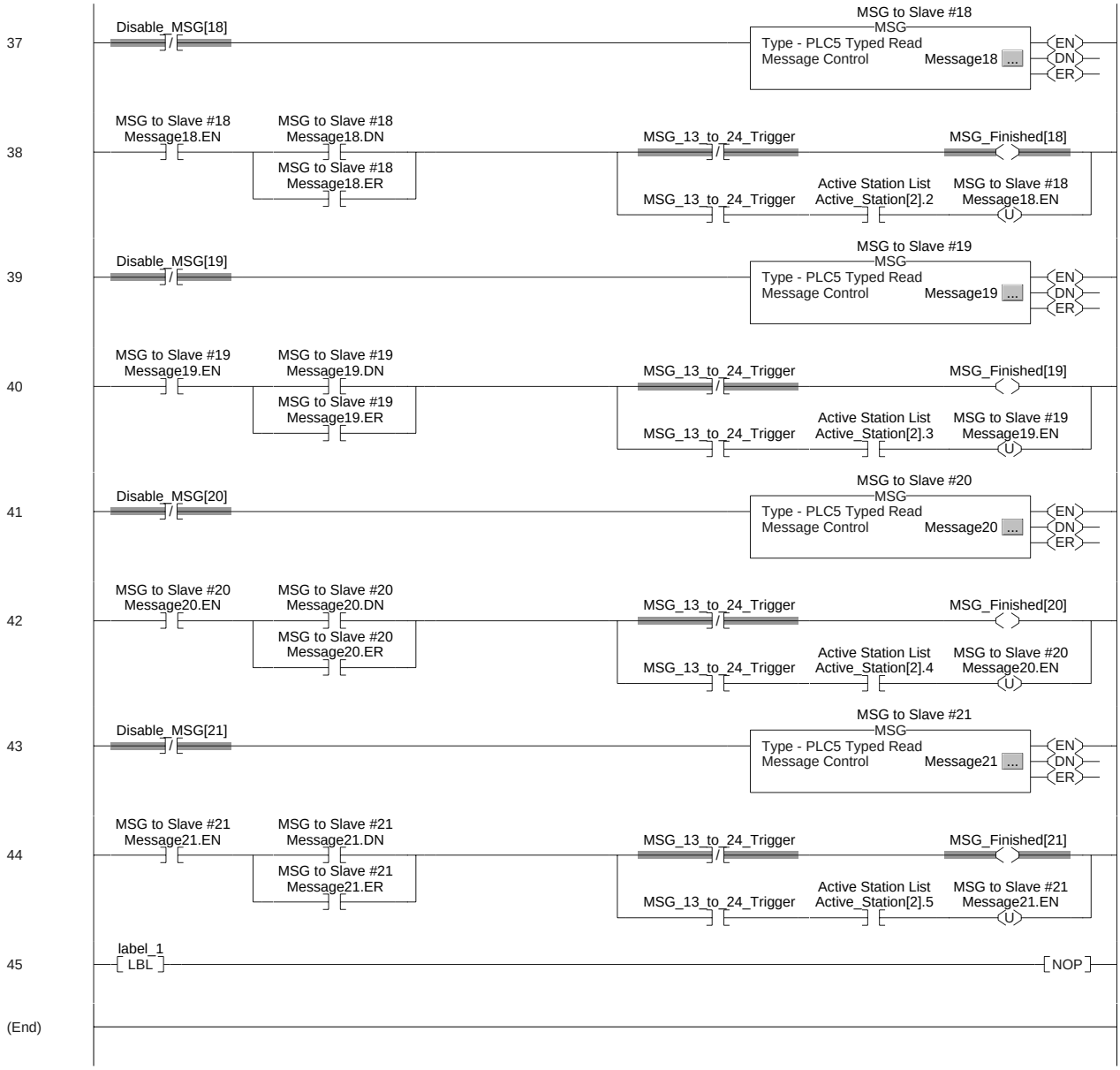

The next three rungs create a data file comparison routine. This rung clears the index register (S:24) to prepare it for use in the Not Equal comparison instruction.
Index Register
CLR
Clear
Dest S2:24 0<
0003
If any values differ between the first three words of B3:0 and N7:0, copy B3:0-7 into N7:0-7, trigger the MSG (which will write N7:0-7 to the Master) and jump out of the routine.
Compare Rung
Q2:1
LBL
Data Compare Buffer
NEQ
Not Equal
Source A #B3:0 0000000000000000<
Source B #N7:0 0<
MSG Write Buffer
COP
Copy File
Source #B3:0
Dest #N7:0
Length 8
MSG Enable
N7:90
U
15
Jump to MSG Rung
Q2:2
JMP
0004
If the current value comparison found no differences, increment the index register. As long as the index register (S:24) is still less than the number of words being compared, jump back to the previous rung to perform the next value comparison. Otherwise, fall out of the routine.
Index Register
ADD
Add
Source A S2:24 0<
Source B 1 1<
Dest S2:24 0<
Jump to Compare Rung
Q2:1
JMP
Index Register
LES
Less Than (A<B)
Source A S2:24 0<
Source B 3 3<
0005
The next two rungs are the MSG rungs. Timer T4:1 is used as the MSG timeout timer, with a preset value of 10 seconds. Note that the MSG timeout value should be set to at least twice the channel 0 poll timeou value.
MSG Rung
Q2:2
LBL
MSG Enable
N7:90
15
MSG Done
N7:90
13
MSG Error
N7:90
12
MSG Timeout Timer
TON
Timer On Delay
Timer T4:1
Time Base 1.0
Preset 10<
Accum 0<
EN
DN
MSG Timer
T4:1
DN
MSG Timeout
N7:90
L
8
0006
"Report-by-exception" write instruction to the SLC Master. This MSG block is configured to write 8 elements (words) from this Slave's Source File N7:0, out channel 0, to the Master's (Target Node Address 0) Target Destination File N7:10. MSG can only be triggered if DF1 is the active protocol.
Active Protocol
S2:0
11
Write MSG to Master
MSG
Read/Write Message
Read/Write Write
Target Device 500CPU
Control Block N7:90
Control Block Length 7
Setup Screen
EN
DN
ER
0007
END
0008

Logix DF1 Half-Duplex Master Standard Mode, Master-Initiated MSG

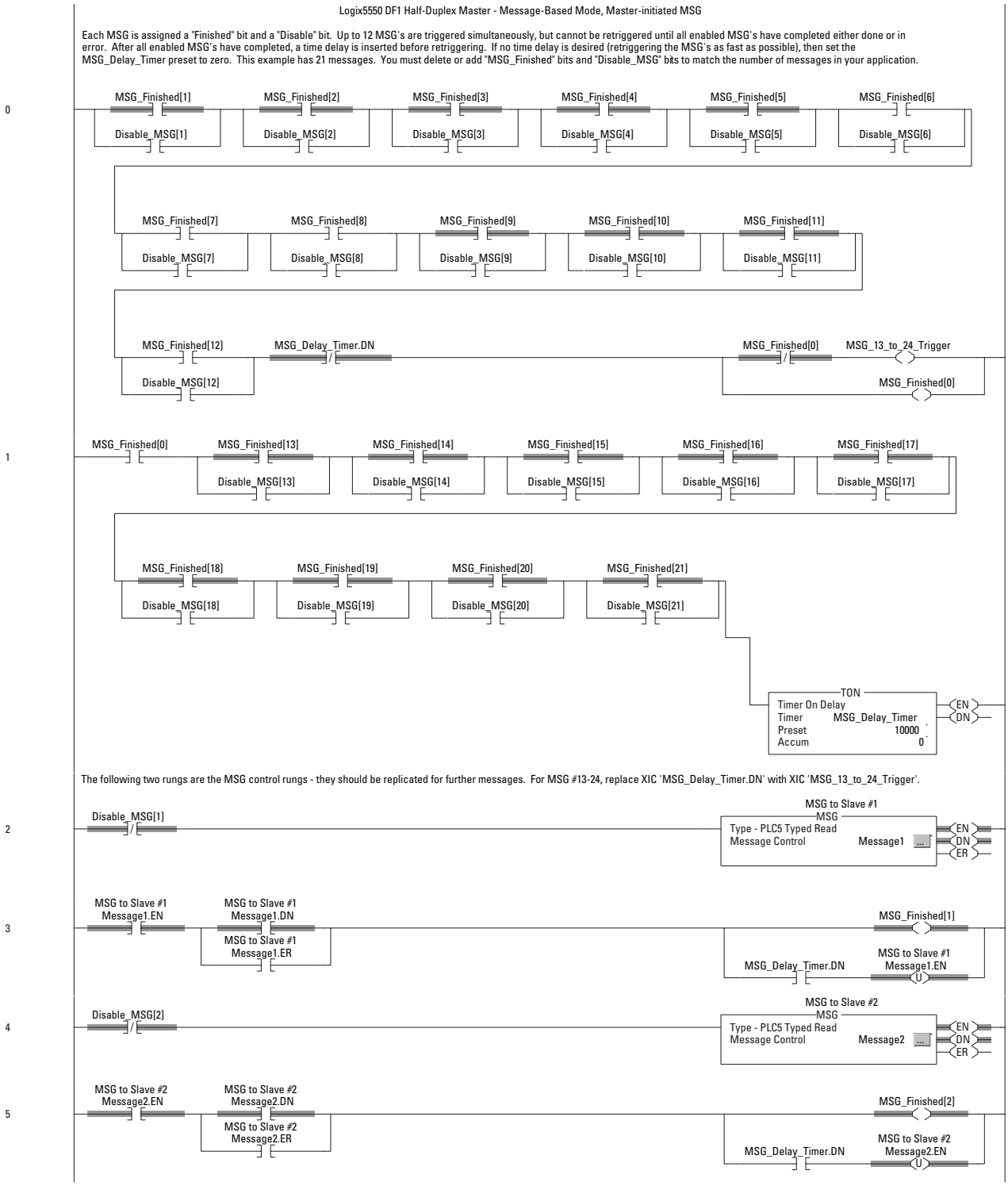


Rungs 4-23 have been omitted.

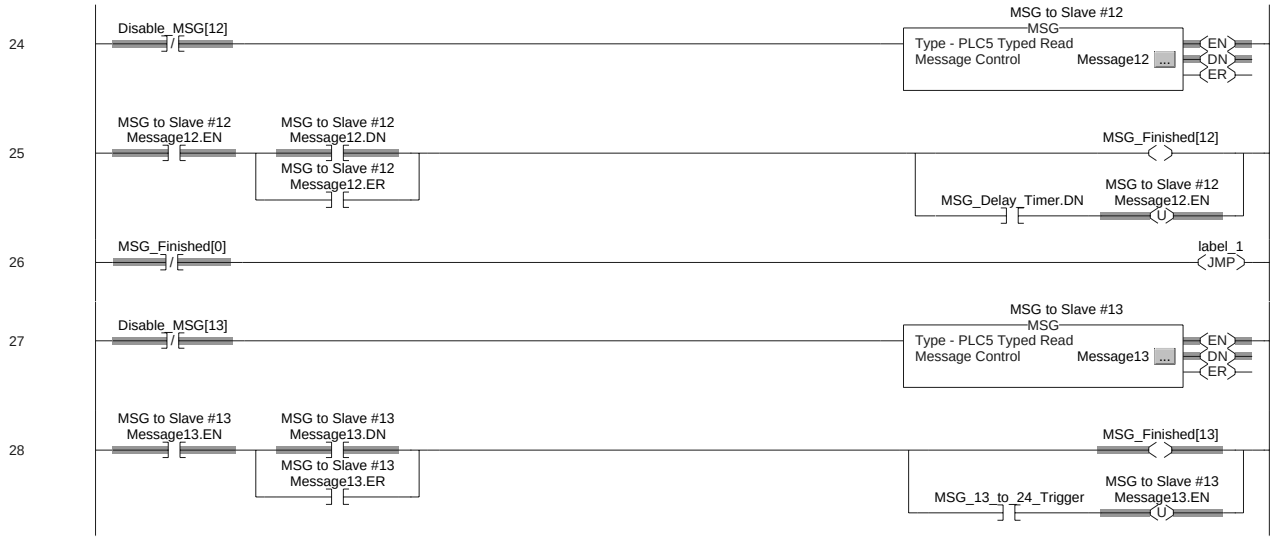



37
Disable_MSG[18]
MSG to Slave #18
MSG
Type - PLC5 Typed Read
Message Control
Message18
EN
DN
ER
38
MSG to Slave #18 Message18.EN
MSG to Slave #18 Message18.DN
MSG to Slave #18 Message18.ER
MSG_13_to_24_Trigger
MSG_Finished[18]
MSG_13_to_24_Trigger
Active Station List Active_Station[2].2
MSG to Slave #18 Message18.EN
U
39
Disable_MSG[19]
MSG to Slave #19
MSG
Type - PLC5 Typed Read
Message Control
Message19
EN
DN
ER
40
MSG to Slave #19 Message19.EN
MSG to Slave #19 Message19.DN
MSG to Slave #19 Message19.ER
MSG_13_to_24_Trigger
MSG_Finished[19]
MSG_13_to_24_Trigger
Active Station List Active_Station[2].3
MSG to Slave #19 Message19.EN
U
41
Disable_MSG[20]
MSG to Slave #20
MSG
Type - PLC5 Typed Read
Message Control
Message20
EN
DN
ER
42
MSG to Slave #20 Message20.EN
MSG to Slave #20 Message20.DN
MSG to Slave #20 Message20.ER
MSG_13_to_24_Trigger
MSG_Finished[20]
MSG_13_to_24_Trigger
Active Station List Active_Station[2].4
MSG to Slave #20 Message20.EN
U
43
Disable_MSG[21]
MSG to Slave #21
MSG
Type - PLC5 Typed Read
Message Control
Message21
EN
DN
ER
44
MSG to Slave #21 Message21.EN
MSG to Slave #21 Message21.DN
MSG to Slave #21 Message21.ER
MSG_13_to_24_Trigger
MSG_Finished[21]
MSG_13_to_24_Trigger
Active Station List Active_Station[2].5
MSG to Slave #21 Message21.EN
U
45
label_1
LBL
NOP
(End)

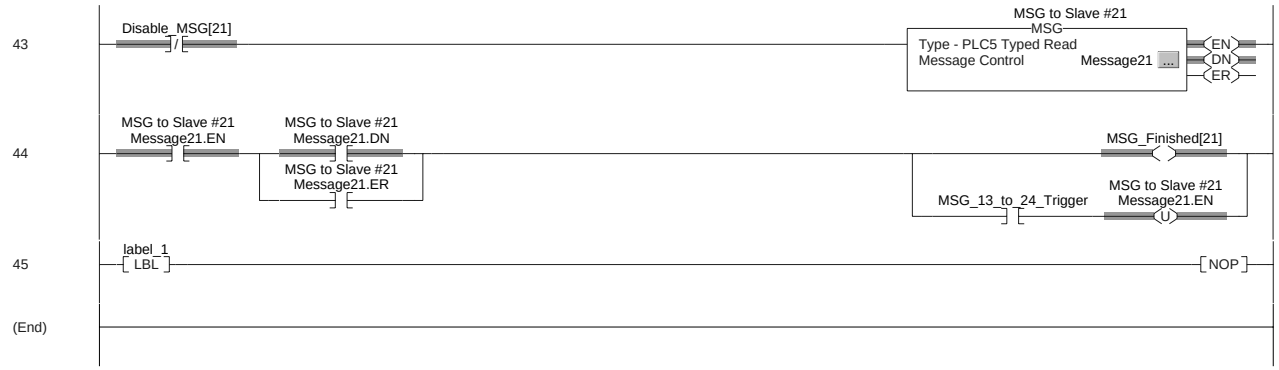
Logix DF1 Half-Duplex Master Message-based Mode, Master-Initiated MSG



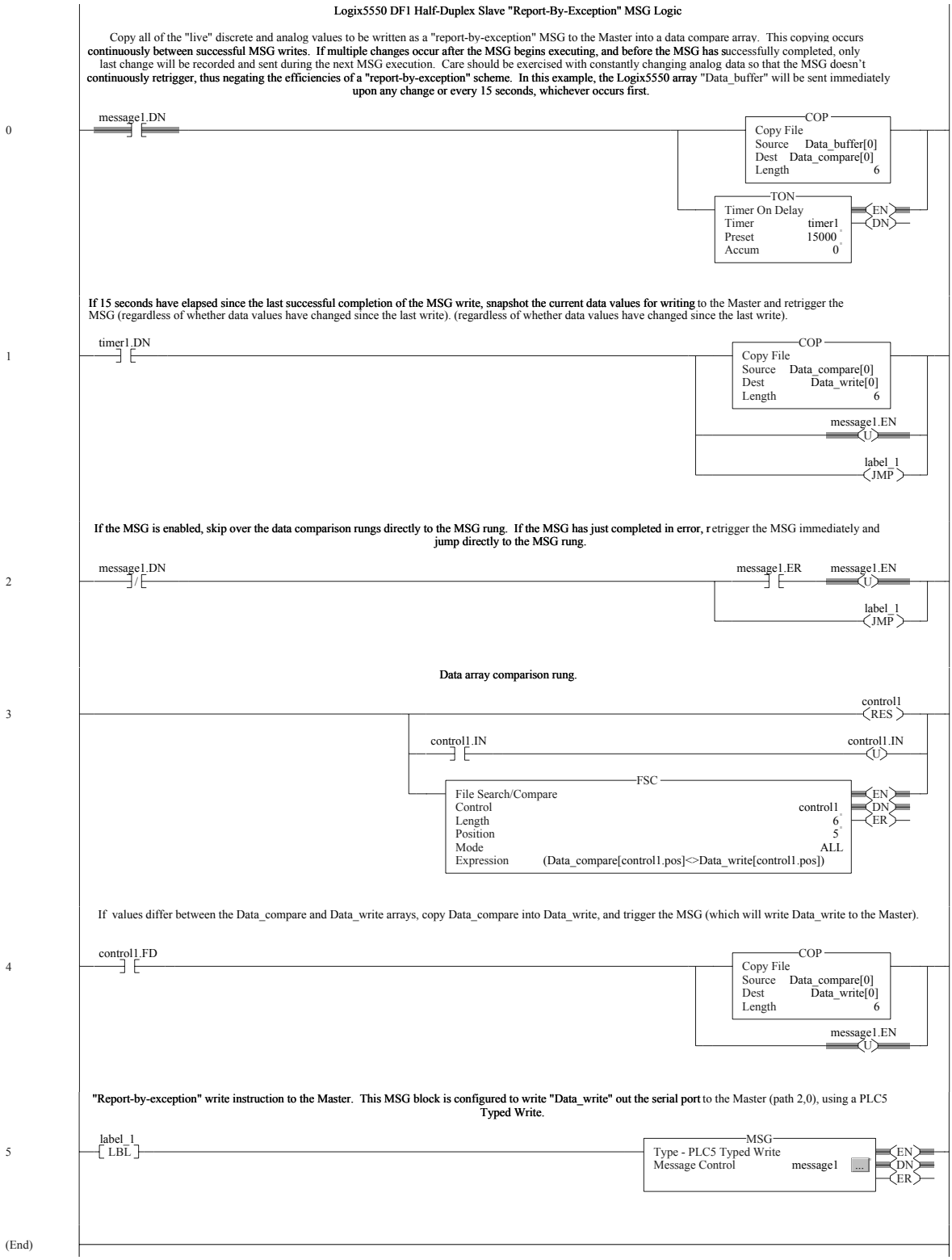
Rungs 6-23 have been omitted.



Rungs 28-42 have been omitted.



Logix DF1 Half-Duplex Slave Report-By-Exception MSG



ACK	See Acknowledgment.
Acknowledgment	An ASCII control character that indicates the transmission and acceptance of data.
Asynchronous transmission	A method of serial transmission where characters may be transmitted at unequal time intervals. Asynchronous transmission requires that each character contains start/stop elements so the receiver can detect the start and end of each character.
BCC	Block-Check Character. The 2's complement of the 8-bit sum (modulo-256 arithmetic sum) of all data bytes in a transmission block. It provides a means of checking the accuracy of each message transmission.
Bridge	An interface between links in a communication network that routes messages from one link to another when a station on one link addresses a message to a station on another link.
Classic PLC-5™ Processor	A collective name used to refer to PLC-5/10, -5/12, -5/15, and -5/25 processors.
CRC	Cyclic redundancy check. An error detection scheme where all of the characters in a message are treated as a string of bits representing a binary number. This number is divided by a predetermined binary number (a polynomial), and the remainder is appended to the message as a CRC character. A similar operation occurs at the receiving end to prove transmission integrity.
CTS	Clear-to-Send. A signal from the modem that tells the transmitting device to start transmitting data.
DCD	Data Carrier Detect. A signal from the modem indicating that the carrier is being received.
DCE	Data Communication Equipment. 1) Equipment that provides the functions required to establish, maintain, or terminate a connection. 2) The signal conversion and coding required for communication between data terminal equipment and data circuits. Examples include modems, line drivers, coaxial cable, satellite links, etc. DCE may or may not be an integral part of a computer.
DF1 HDx	The Allen-Bradley asynchronous half-duplex protocol.
Digital Data Service (DDS)	A special wide-bandwidth Private Leased Line (PLL) that uses digital techniques to transfer data at higher speeds and lower error rate than voice-band, analog PLLs. The line is available 24 hours a day.

DSR	Data-set Ready. A signal from the modem that indicates the modem is connected, powered up, and ready for data transmission.
DTE	Data Terminal Equipment. Equipment that is attached to a network to send or receive data, or both. Programmable controllers, workstations, and interface modules are examples of DTEs.
DTR	Data Terminal Ready. A signal that indicates the transmission device (terminal) is connected, powered up, and ready to transmit.
Enhanced PLC-5 Processors	A collective name used to refer to PLC-5/11, -5/20, -5/30, -5/40, -5/60, and PLC-5/80 processors.
EOT	End Of Transmission. An ASCII control character that indicates the end of a data transmission.
Ethernet PLC-5 Processors	A collective name used to refer to PLC-5/20E, -5/40E, and -5/80E processors.
Extended Local PLC-5E™ Processors	A collective name used to refer to PLC-5/40L and -5/60L processors.
FCC	Federal Communication Commission (United States).
Full-Duplex Circuit	A physical circuit that allows simultaneous, bidirectional transmission of data; also called a four-wire circuit.
Full-Duplex Modem	A modem that is capable of simultaneous, bidirectional transmissions.
Full-Duplex Protocol	1) A mode of operation for a point-to-point link with two physical circuits in which messages or transmission blocks can be sent in both directions at the same time. 2) Contrasted with two-way alternate.
General Switched Telephone Network	International version of a Public Switched Telephone Network.
Half-Duplex Circuit	A physical circuit that allows transmission of data in either direction but not at the same time.
Half-Duplex Modem	A modem that sends and receives messages on carriers of the same frequency. Therefore, simultaneous, bidirectional transmissions are not possible.

Half-Duplex Protocol	1) A mode of operation for a point-to-point or multipoint baseband link with two physical circuits in which messages or transmission blocks can be sent in one direction or the other but not both at the same time. 2) Contrasted with two-way simultaneous. The master station-to-remote station communication uses a half-duplex protocol.
Handshake	A series of signals between a computer (DTE) and a peripheral device (DCE; e.g., a modem) that establishes the parameters required for passing data.
Integrated Service Unit (ISU)	Data communication equipment for a digital data network, which serves as the data transmitting and receiving device. An ISU is a combination of a digital service unit (DSU) and a channel service unit (CSU).
I/O Rack	An I/O addressing unit that corresponds to 8 input image table words and 8 output image table words.
Link	A data channel established between two or more stations.
Master Station	A device (programmable controller with I/O modules or a workstation) that sends data to and collects data from devices connected on a point-to-multipoint, half-duplex network.
Modem	A device that modulates digital information from a programmable controller or computer to an analog signal that is transported over phone lines, radio waves, and satellite transmissions and demodulates the analog data back into digital data at the receiving site.
Modem Handshaking	A signaling protocol used for transferring information between devices in a synchronized manner at a rate acceptable to both devices. It may be accomplished by hardware or software.
Multi-drop Link	1) A link that has more than 2 stations. 2) Contrasted with point-to-point link.
NAK	Negative Acknowledgment. An ASCII control character transmitted by a receiver as a negative response to the sender.
Node	A station on a network.
Octal Numbering System	A numbering system that uses only the digits 0 through 7; also called base-8.
Packet	The transmission unit exchanged at the network layer.

Packet Radio Modem	An intelligent radio modem that packetizes the data it receives from the transmitting station. The modem places a header and a trailer around the data before it transmits the data to the destination device. The header can also contain routing information. Packet radio modems also perform their own data error checking and will re-transmit the data if an error is encountered.
PAD	Packet assembler/disassembler. Equipment used to assemble and disassemble data packets for transmission on a packet-switching network such as a satellite system.
Parallel port	An electrical connection on a computer capable of transmitting or receiving two or more bits of data at one time; the communications port to which such devices as parallel printers can be attached.
Point-to-multipoint	A network where connections exist between one master station and multiple remote stations.
Point-to-point	A network where a connection is made between two and only two terminal installations.
Poll	When the master station sends a message to a remote station that allows the remote station an opportunity to return a response to the master or another remote station. In this manual, when the master polls a remote station, it is not initiating a read request.
Polling cycle	The order and frequency in which network nodes in a poll list are polled.
Poll List	A list of nodes or stations on a network to be polled on a regular and repeated basis.
Protocol	A set of conventions governing the format and timing of data transmission between communication devices, including handshaking, error detection, and error recovery.
Private Leased Line Network (PLL)	A dedicated voice-band telephone line between two or more locations primarily used for data transmission.
Public Switched Telephone Network (PSTN)	The standard dial-up telephone network originally used for voice communication.
RS-232	An EIA electrical connection standard, most often used as a standard interface for serial binary communication between data terminal equipment and data communications equipment. Also known as EIA–232.
RTS	Request To Send. A request from the module to the modem to prepare to transmit. It typically turns on the data carrier.
RTU	Remote Terminal Unit. See remote station.

RXD	Received Data. A serialized data input to a receiving device.
Remote Station	A device (programmable controller with I/O modules) that is located in a remote site away from the master station and that controls I/O points at the remote site. A remote station accepts commands from and can send data (if capable) to a master station via a telemetry network.
SCADA	Supervisory Control and Data Acquisition
Slave	See remote station.
Slave Protocol	See Half-Duplex Protocol.
Serial Port	An electrical connection on a computer that handles data bits one after another; the communications port (COM1 or COM2) to which devices such as a modem, a mouse, or a serial printer can be attached.
Spurious Character	A false or unexpected character received when none is expected.
Standard Radio Modem	A standard radio modem is an assembly that contains both a radio and a modem, which transmits data without any special handling. Data error checking is the responsibility of the receiving station (DTE).
Station	Any programmable controller, computer, or data terminal connected to, and communicating by means of, a data channel; a device on a network.
Station Addressing	The syntax allowing packets to be routed correctly between master and remote stations.
Synchronous Transmission	A type of serial transmission that maintains a constant time interval between successive events.
Telemetry	Transmission and collection of data obtained by sensing real-time conditions.
Topology	The way a network is physically structured. Example: a ring, bus, or star configuration.
Transceiver	An electronic device that operates as both a radio transmitter and receiver.
TXD	Transmitted Data. An output from the module that carries serialized data.

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