RS-232 Communication Interface

This appendix provides an overview of the RS-232 communication interface and explains how the SLC 5/03, SLC 5/04, and SLC 5/05 processors support it. This appendix also provides information on:

- RS-232 and SCADA applications.
- RS-232 communication interface overview.
- SLC 5/03, SLC 5/04, and SLC 5/05 processors and RS-232 communication.
- SLC 500 devices that support RS-232 communication.
- DF1 protocol and the SLC 5/03, SLC 5/04, and SLC 5/05 processors.
- Modbus RTU Master communication.
- ASCII communication.
- DF1 communication protocol modems overview.
- wiring connectors for RS-232 communication.
- applications for the RS-232 communication interface.

For online configuration procedures of the SLC 5/03, SLC 5/04, and SLC 5/05 processors for DF1 protocol, see your programming software user manual.

RS-232 and SCADA Applications

RS-232 is a communication interface included under SCADA (Supervisory Control and Data Acquisition) applications. SCADA is a term that refers to control applications that require communication over long distances. For more information about the use of Allen-Bradley equipment in SCADA applications, refer to the SCADA System Applications Guide*,* publication AG-UM008.

RS-232 Communication Interface Overview

RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical, mechanical, and functional characteristics for serial binary communication.

One of the benefits of RS-232 communication is that it lets you integrate telephone and radio modems into your control system. The distance over which you are able to communicate with certain system devices is virtually limitless.

The RS-232 channel on the SLC 5/03, SLC 5/04, and SLC 5/05 processors supports various protocols:

- Full-duplex DF1 (default)
- Half-duplex DF1 (SCADA)
- DH-485
- ASCII communication
- DF1 radio modem
- Modbus RTU Master

The SLC and PLC products detailed in this appendix that communicate over the RS-232 communication interface also use the DF1 serial communication protocol. DF1 protocol delimits messages, controls message flow, detects and signals errors, and retries after errors are detected.

SLC 5/03, SLC 5/04, and SLC 5/05 processors and RS-232 Communication

The SLC 5/03, SLC 5/04, and SLC 5/05 processors can communicate by means of the RS-232 communication port, channel 0. Channel 0 supports DF1 full-duplex protocol, DF1 half-duplex master and slave protocol, DH485 protocol, Modbus RTU Master communication, ASCII communication, and DF1 radio modem protocol. Refer to your programming software user manual for information on configuring the RS-232 communication port, channel 0.

The details of the DF1 protocols can be found in the DF1 Protocol and Command Set Reference Manual, Publication Number 1770-6.5.16.

Channel 0 provides a minimum of 500V dc isolation between the I/O signals and the logic ground of the SLC 5/03, SLC 5/04, and SLC 5/05 processors. The channel is a 9-pin D-shell. The table below provides a description of each of the pins.

Pin	Pin Name
1	DCD (Data Carrier Detect)
2	RXD (Receive Data)
3	TXD (Transmit Data)
4	DTR (Data Terminal Ready)
5	COM (Common Return [Signal Ground])
6	DSR (Data Set Ready)
7	RTS (Request to Send)
8	CTS (Clear to Send)
9	NC (No Connection)

The D-shell is the bottom port on the SLC 5/03, SLC 5/04, and SLC 5/05 processors.

SLC 500 Devices that Support RS-232 Communication

The SLC 500 product line has two other modules, aside from the SLC 5/03, SLC 5/04, and SLC 5/05 processors, that support the RS-232 communication interface. They are the 1746-BAS BASIC module and the 1747-KE DH-485/RS-232C interface. Both of these modules can be used with either the SLC 5/01 or SLC 5/02 processor.

1747-KE Module

The 1747-KE module is a communication interface module that acts as a bridge between DH-485 networks and devices requiring DF1 protocol. You can configure the DF1 port on the 1747-KE module for RS-232/423, RS-422, or RS-485 devices. Residing in an SLC 500 chassis, the 1747-KE module is ideally used as an interface module, linking remote DH-485 networks via a modem to a central host.

For more information on the 1747-KE module, see the DH-485/RS-232 Interface Module User Manual, publication 1747-IN006.

1746-BAS and 1746-BAS-T Modules

The 1746-BAS and 1746-BAS-T modules, which are programmed using the BASIC language, have two configurable serial ports for interfacing to computers, modems, serial printers, and other RS-232 compatible devices. You can also use them for off-loading complex math routines from an SLC 500 processor, thereby conserving ladder logic memory.

For more information on the 1746-BAS module, see the SLC 500 BASIC and BASIC-T Module User Manual, publication 1746-UM004.

DF1 Protocol and the SLC 5/03, SLC 5/04, and SLC 5/05 Processors

DF1 protocol combines data transparency (ANSI - American National Standards Institute - specification subcategory D1) and 2-way simultaneous transmission with embedded responses (F1). It is also a peer-to-peer, link-layer protocol. This means that system devices have equal access to messages being sent over the RS-232 communication interface.

DF1 protocol provides two modes of communication: full-duplex and half-duplex.

DF1 Full-duplex Protocol

DF1 full-duplex protocol (also referred to as DF1 point-to-point protocol) lets you use RS-232 point-to-point communication in applications that require it. This type of protocol supports simultaneous transmissions between two devices in both directions. You can use channel 0 as a programming port, or as a peer-to-peer port using the MSG instruction.

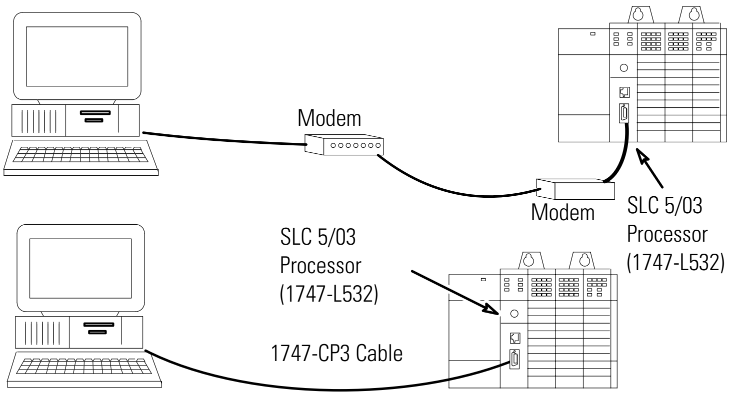
In full-duplex mode, the SLC 5/03, SLC 5/04, and SLC 5/05 processors can send and receive messages. When the SLC 5/03, SLC 5/04, and SLC 5/05 processors receive messages, they act as an end device, or final destination for the data packets[1]. The processor ignores the destination and source addresses received in the data packets. However, the processor swaps these addresses in the reply that it transmits in response to any command data packet that it has received.

By setting a parameter with your programming software, you can also make the processor verify that the host computer can receive embedded responses. To do this, the processor waits to receive an embedded response from the host computer, before sending one of its own. A host computer that can send embedded responses should also be able to receive them.

If you use modems with DF1 full-duplex protocol, make sure that they are capable of simultaneous bidirectional communication. Typically, dial-up modems designed to be connected to standard telephone lines can support full-duplex.

(1) The exceptions to this are SLC 5/04 and SLC 5/05 processors that have the DH+ to DF1 or Ethernet to DF1 full-duplex passthru bit enabled. In the case of the SLC 5/04, the processor checks the destination address in the packet and if it does not match the configured DH+ address of the processor, the packet is forwarded onto the DH+ network to the destination address DH+ node. In the case of the SLC 5/05, the processor checks the destination address in the packet. If the routing table exists and an IP address is in the routing table for that DF1 address, the packet is forwarded out to the Ethernet network to that IP address.

Full-duplex (Point-to-Point)



DF1 Half-duplex Protocol

DF1 half-duplex protocol provides a multi-drop single master/multiple slave network. In contrast to the DF1 full-duplex protocol, communication takes place in one direction at a time. You can use channel 0 as a programming port, or as a peer-to-peer port using the MSG instruction.

In half-duplex mode, the SLC 5/03, SLC 5/04, and SLC 5/05 processors can be either master or slave devices. As a master device, the processor polls each slave on the network on a regular and sequential basis. The master also supports routing of data packets from one slave to another, or slave-to-slave communication. As a slave device, the processor can send data packets when polled by the master device, which initiates all communication with slave devices.

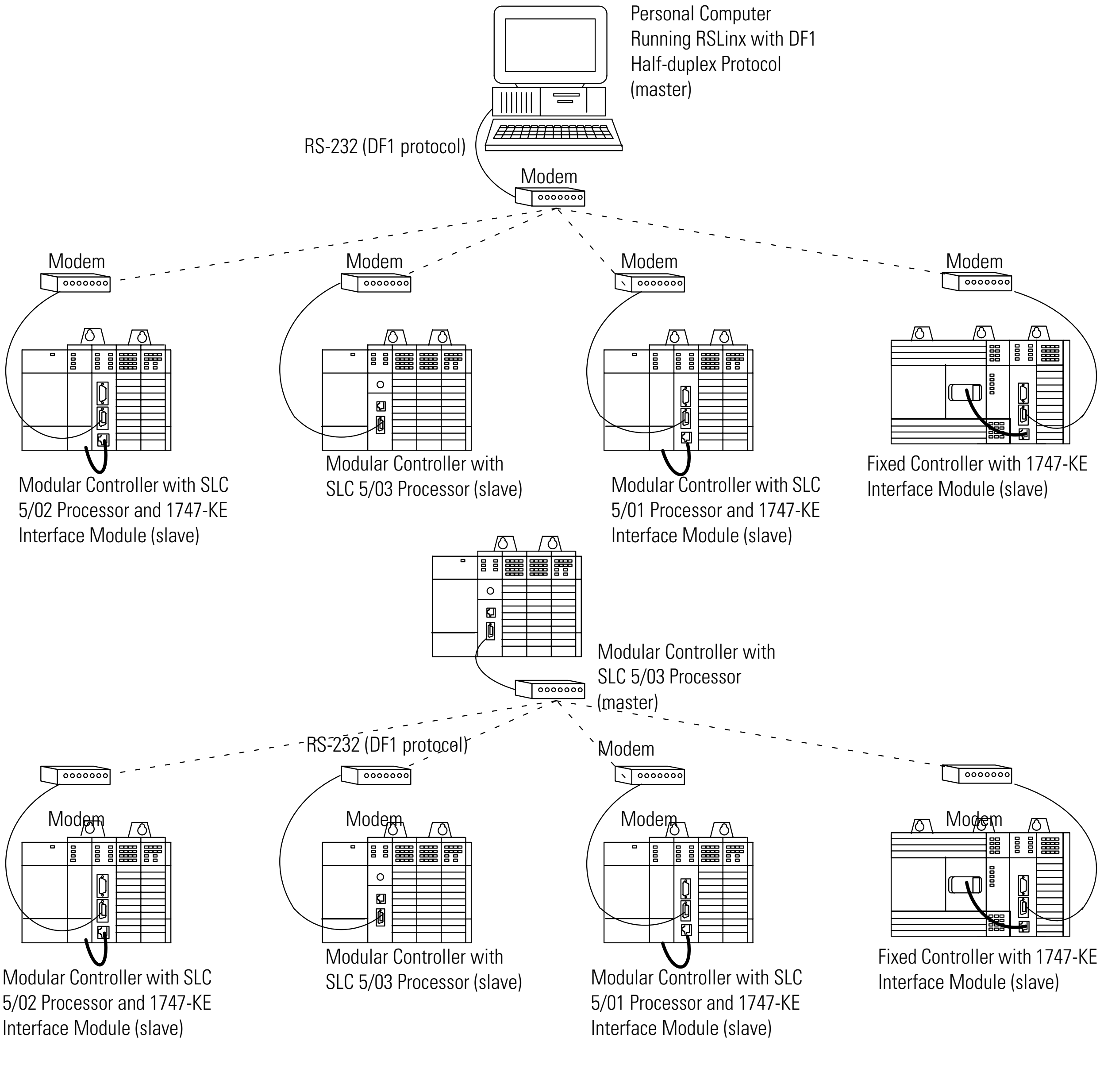
If the master device has no data to send, it can still receive data from the slave device. To do this, the master sends out a poll packet addressed to the slave. If the slave has data to send, it does so in response to the poll packet. Otherwise, the slave sends a simple two-byte response, so that the master knows that it is active.

Several Allen-Bradley products support half-duplex master protocol. They include the Enhanced PLC-5 processors, and SLC 5/03, SLC 5/04, and SLC 5/05 processors. RSLinx (2.0 or later) software also supports half-duplex master protocol.

DF1 Half-duplex supports up to 255 slave devices (addresses 0...254) with address 255 reserved for master broadcasts. The SLC 5/03, SLC 5/04, and SLC 5/05 processor support broadcast reception. SLC 5/03, SLC 5/04, and SLC 5/05 processors with operating system FRN C/6 can also initiate broadcast write commands via the MSG instruction for all channel 0 system mode drivers and for channel 1 (DH-485) on the SLC 5/03 processor.

TIP Broadcast is not supported for read commands or any remote messages. Broadcast is also not supported by the SLC 5/04 channel 1 DH+ network or the SLC 5/05 channel 1 Ethernet network.

Either half-duplex or full-duplex modem types can be used for the master, but half-duplex modems must be used for the slaves (assuming there is more than one on a multi-drop network).



DF1 Radio Modem Channel 0 Driver

Series C FRN 6 (FRN C/6) and later versions of operating systems OS302 (SLC 5/03 processor), OS401 (SLC 5/04 processor) and OS501 (SLC 5/05 processor) include a channel 0 system mode driver called DF1 radio modem. This driver implements a protocol, optimized for use with radio modem networks, that is a hybrid between DF1 full-duplex protocol and DF1 half-duplex protocol, and therefore is not compatible with either of these protocols.

IMPORTANT	The DF1 radio modem driver should only be used among devices that support and are configured for the DF1 radio modem protocol. Only SLC 5/03, SLC 5/04 and SLC 5/05 processors with operating systems FRN C/6 support DF1 radio modem protocol.

IMPORTANT	There are some radio modem network configurations that will not work with the DF1 radio modem driver. (See DF1 Radio Modem System Limitations on page 209.) In these configurations, continue to use DF1 half-duplex protocol.

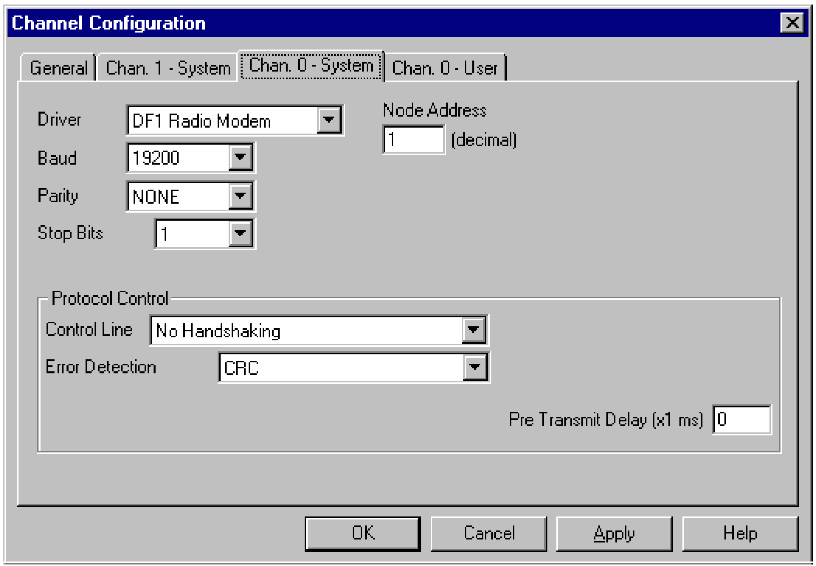
Like DF1 full-duplex protocol, DF1 radio modem allows any node to initiate to any other node at any time (if the radio modem network supports full-duplex data port buffering and radio transmission collision avoidance). Like DF1 half-duplex protocol, a node ignores any packets received that have a destination address other than its own, with the exception of broadcast packets and passthru packets.

Unlike either DF1 full-duplex or DF1 half-duplex protocols, DF1 radio modem protocol does not include ACKs, NAKs, ENQs, or poll packets. Data integrity is ensured by the CRC checksum.

Using the DF1 Radio Modem

The DF1 radio modem driver can be configured as the system mode driver for channel 0 using RSLogix 500 version 5.50 or later software.

Channel 0 Configuration



The Baud, Parity, Stop Bits and Error Detection selections are identical to the other DF1 drivers. Valid Node Addresses are 0...254, just like the DF1 half-duplex drivers.

The primary advantage of using DF1 radio modem protocol for radio modem networks is in 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). This minimizes the number of times the radios need to key-up to transmit, which maximizes radio life and minimizes radio power consumption. In contrast, DF1 half-duplex protocol requires five transmissions for the DF1 master to complete a read/write transaction with a DF1 slave - three by the master and two by the slave.

The DF1 radio modem driver can be used in a pseudo master/slave mode with any radio modems, as long as the designated master node is the only node initiating MSG instructions, and as long as only one MSG instruction is triggered at a time.

For modern serial radio modems that support full-duplex data port buffering and radio transmission collision avoidance, the DF1 radio modem driver can be used to set up a masterless peer-to-peer radio network, where any node can initiate communication to any other node at any time, as long as all of the nodes are within radio range so that they receive each other's transmissions.

DF1 Radio Modem System Limitations

The following questions need to be answered in order to determine if you can implement the new DF1 radio modem driver in your radio modem network.

- Are all of the devices SLC 5/03, 5/04 or 5/05 processors?

  If so, then they must all be at operating system FRN C/6 or later in order to be configured with the DF1 radio modem driver using RSLogix 500 version 5.50 or later software. If not, then make sure that all of the nodes can support the DF1 radio modem protocol. Once channel 0 is configured for DF1 radio modem, you will need to use channel 1 to locally monitor and program your SLC processor using RSLogix 500 software.

- Does each node receive the radio transmissions of every other node, being both within radio transmission/reception range and on a common receiving frequency (either via a Simplex radio mode or via a single, common, full-duplex repeater)?

  If so, then go to the next question to see if you can use the DF1 radio modem driver to set up a peer-to-peer radio network. If not, then you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to the node connected to the master radio modem whose transmissions can be received by every other radio modem in the network.

- Do the radio modems handle full-duplex data port buffering and radio transmission collision avoidance?

  If so, and the answer to the previous question is yes as well, then you can take full advantage of the peer-to-peer message initiation capability in every node (for example, the ladder logic in any node can trigger a MSG instruction to any other node at any time). If not, then you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to a single master node whose transmission can be received by every other node.

- Can I take advantage of the SLC 5/03, SLC 5/04, and 5/05 channel-to-channel passthru to remotely program the other SLC nodes using RSLinx and RSLogix 500 running on a personal computer connected to a local SLC processor via DH-485, DH+, or Ethernet?

  Yes, with certain limitations imposed based on the radio modem network.

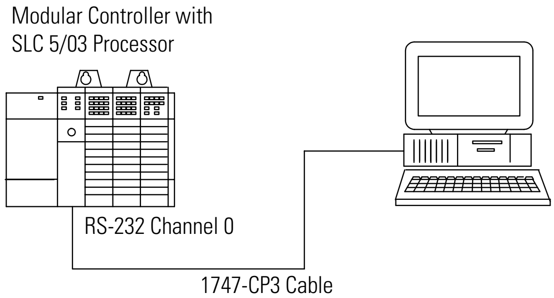
Modbus RTU Master Communication

Modbus RTU communication lets you connect the SLC 5/03, SLC 5/04, and SLC 5/05 processors to Modbus RTU slave devices for exchange of data values.

For an overview of the Modbus RTU Master protocol modem, refer to the SLC 500 Instruction Set Reference Manual (1747-RM001).

ASCII Communication

ASCII p otocol lets you connect the SLC 5/03, SLC 5/04, and SLC 5/05 processors to serial printers, personal computers, and other third-party devices. ASCII protocol lets your ladder program manage ASCII data.



DF1/Modbus RTU Communication Protocol Modems Overview

You can connect the SLC 5/03, SLC 5/04, and SLC 5/05 processors to several types of modems. In all cases, the processors act as Data Terminal Equipment (DTE). DTE send and/or receive data on a network. Modem or line drivers act as Data Communication Equipment (DCE), which provide the signal conversion and coding required for communication between DTE and data circuits. Other DCE include phone-line modems and specialized modems, such as radio and satellite-link modems.

In addition to Common Return (COM), Receive Data (RXD), and Transmit Data (TXD), the following active modem-control lines are provided on the SLC 5/03, SLC 5/04, and SLC 5/05 processors.

RTS (Request to Send) - this output signal indicates to the modem or other DCE that the DTE wants to transmit.

CTS (Clear to Send) - this input signal from the modem indicates the modem is ready to receive the transmission by the DTE for forwarding over a link.

DSR (Data Set Ready) - this input signal indicates the DCE device is ready for operation. Loss of this signal causes a modem-lost condition in the processor.

DTR (Data Terminal Ready) - this output signal from the DTE indicates that it is ready for operation. You can also use this signal with the processor to initiate DTR dialing in dial-up modems that support such a feature.

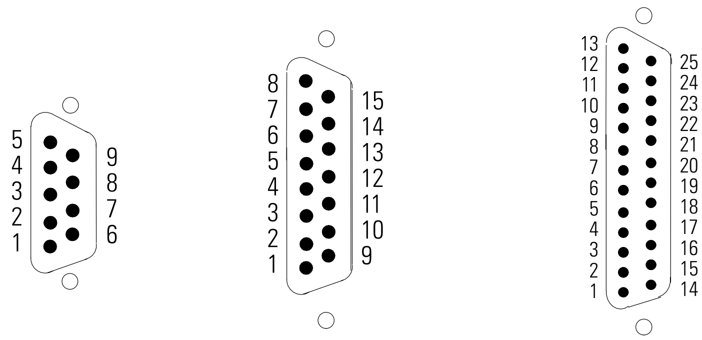
DCD (Data Carrier Detect) - this is an input signal from the DCE that indicates a carrier signal is being received and that presumably data is to be received for forwarding to the DTE connected.

Wiring Connectors for RS-232 Communication

To connect Allen-Bradley devices with other devices over RS-232, you must wire the cable connectors so that communication can occur through the cabling, which provide the interface between devices.

Types of RS-232 Connectors

The figures below show male connectors, and their pinout locations, for Allen-Bradley devices.



9-Pin Connector (male) 15-Pin Connector (male) 25-Pin Connector (male)

DTE Pinout

Channel 0 is configured as DTE for all SLC 5/03, SLC 5/04, and SLC 5/05 processors. The pinouts are the same as the 9-pin personal computer port.

DTE 9 Pinout		Signal is	Equivalent DTE 15 Pinout	Equivalent DTE 25 Pinout
Pin	Description			
1	DCD Data Carrier Detect	Input	8	8
2	RXD Received Data	Input	3	3
3	TXD Transmitted Data	Output	2	2
4	DTR Data Terminal Ready	Output	11	20
5	COM Common Return (Signal Ground)	Shared	7	7
6	DSR Data Set Ready	Input	6	6

DTE 9 Pinout		Signal is	Equivalent DTE 15 Pinout	Equivalent DTE 25 Pinout
Pin	Description			
7	RTS Request to Send	Output	4	4
8	CTS Clear to Send	Input	5	5
9	NC No Connection	Input		22 (RI Ring Indicator)

DCE Pinout

Devices such as a modem are DCE. The pinouts on these terminals are wired to interface with DTE.

DCE 9 Pinout		Signal is	Equivalent DCE 25 Pinout
Pin	Description		
1	DCD Data Carrier Detect	Input	8
2	RXD Received Data	Input	3
3	TXD Transmitted Data	Output	2
4	DTR Data Terminal Ready	Output	20
5	COM Common Return (Signal Ground)	Shared	7
6	DSR Data Set Ready	Input	6
7	RTS Request to Send	Output	4
8	CTS Clear to Send	Input	5
9	RI Ring Indicator	Input	22

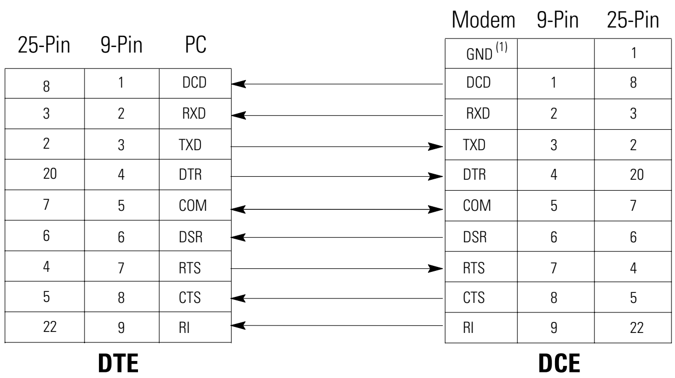
IMPORTANT DCE signal names are viewed from a DTE perspective. For example, TXD is a DTE output and also a DCE input.

Pin Assignments for Wiring Connectors

Use the following pin assignments to wire the connectors of Allen-Bradley control devices with modems and peripheral devices that support RS-232 communication. See the table below to find the wiring diagram that you need.

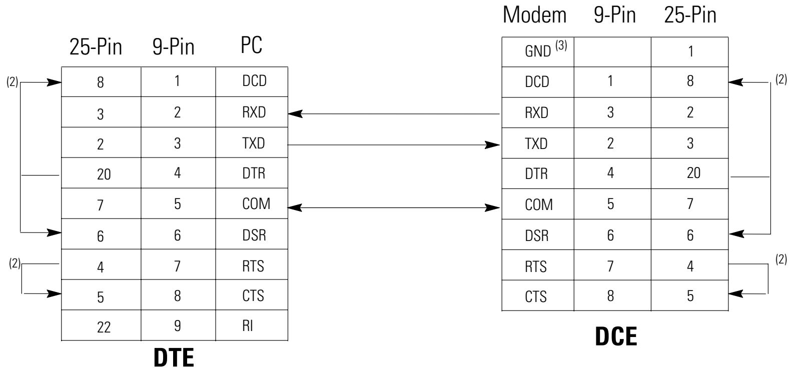
To connect this device	To this Device	Remarks	See this page
Personal computer	Modem	Hardware handshaking enabled	213
	Peripheral DTE	Hardware handshaking disabled	214
SLC 5/03, SLC 5/04, and SLC 5/05 processors	Modem	Hardware handshaking enabled	214
	Peripheral DTE	Hardware handshaking disabled	215
	Personal Computer	Using a 1747-CP3 cable	215
1747-KE module	Modem	Hardware handshaking enabled	216
	Peripheral DTE	Hardware handshaking disabled	216
1746-BAS module	Modem	Hardware handshaking enabled	217
	Peripheral DTE	Hardware handshaking disabled	217
2760-RB module	Modem	Hardware handshaking enabled	218
	Peripheral DTE	Hardware handshaking disabled	218
PLC-5 (channel 0)	Modem	Hardware handshaking enabled	219
	Peripheral DTE	Hardware handshaking disabled	219

Personal Computer to a Modem (Hardware Handshaking Enabled)



(1) Connect to the shield of the cable.

Personal Computer to SLC 5/03, SLC 5/04, or SLC 5/05 Processor, 1770-KF3 Module, or PLC-5 Processor (Hardware Handshaking Disabled) [(1)]

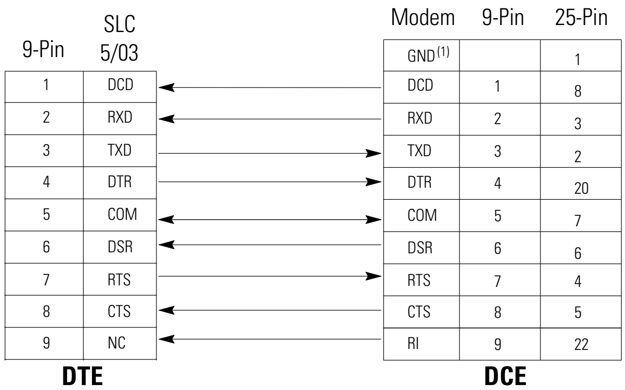


(1) You can also use the 1747-CP3 cable.

(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.

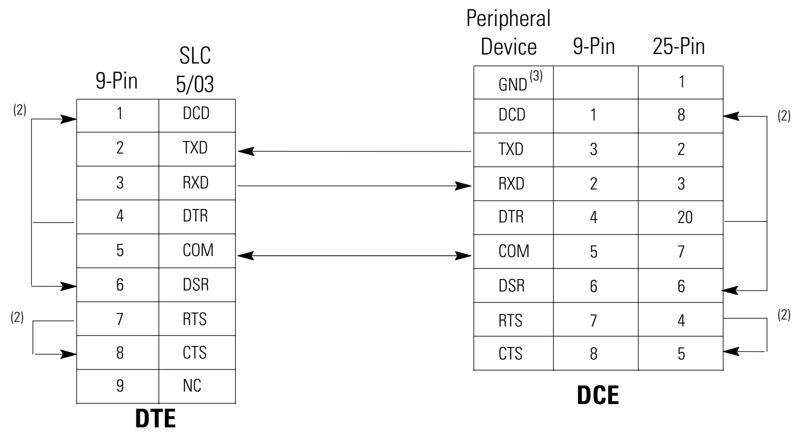
(3) Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor Connected to a Modem (Hardware Handshaking Enabled)



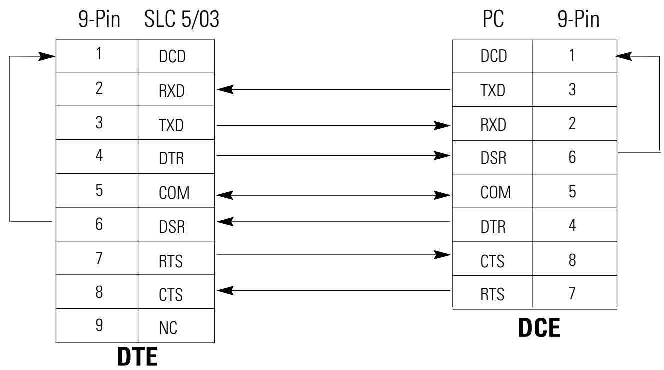
(1) Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor to another SLC 5/03, SLC 5/04, or SLC 5/05 Processor, Personal Computer, 1770-KF3 Module, or PLC-5 Processor (Hardware Handshaking Disabled) [(1)]

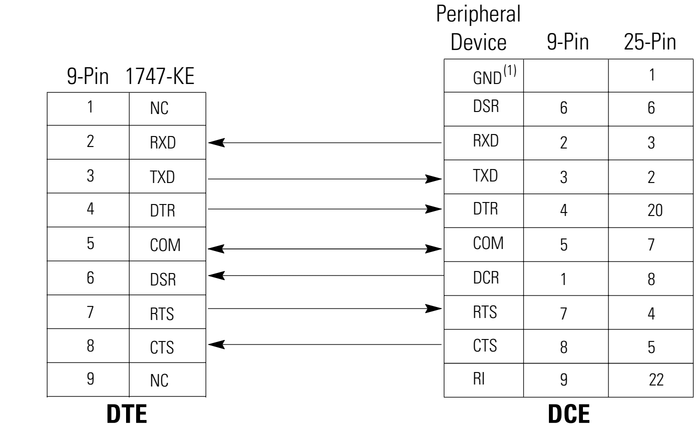


(1) You can also use the 1747-CP3 cable.
(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.
(3) Connect to the shield of the cable.

SLC 5/03, SLC 5/04, or SLC 5/05 Processor Connected to a Personal Computer with a 1747-CP3 Cable

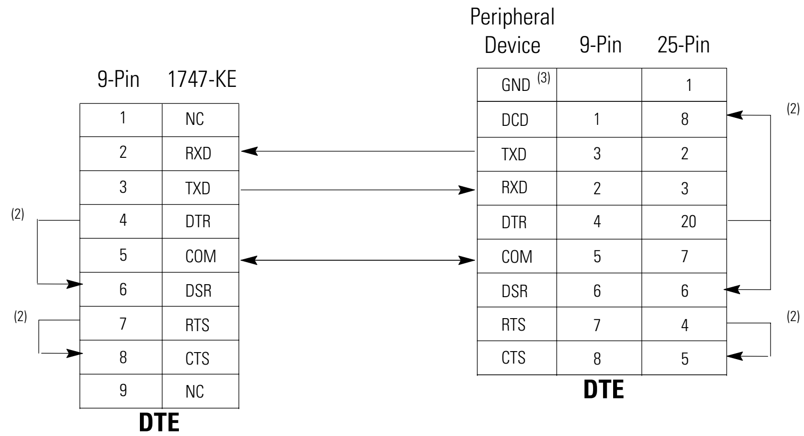


1747-KE Module to a Modem (Hardware Handshaking Enabled)



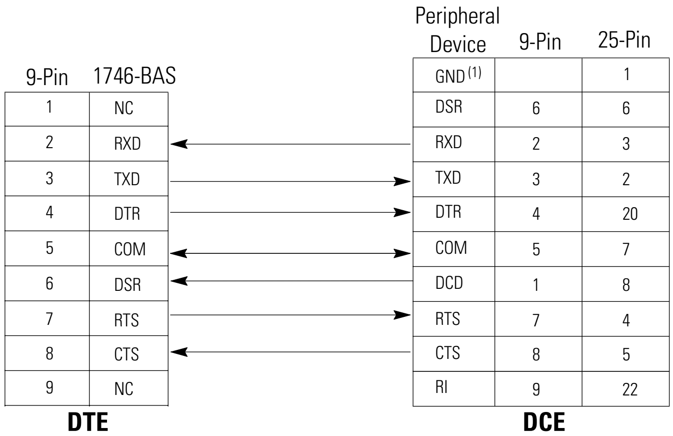
(1) Connect to the shield of the cable.

1747-KE Module to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, Personal Computer, 1770-KF3 Module, or PLC-5 Processor (Hardware Handshaking Disabled) (1)



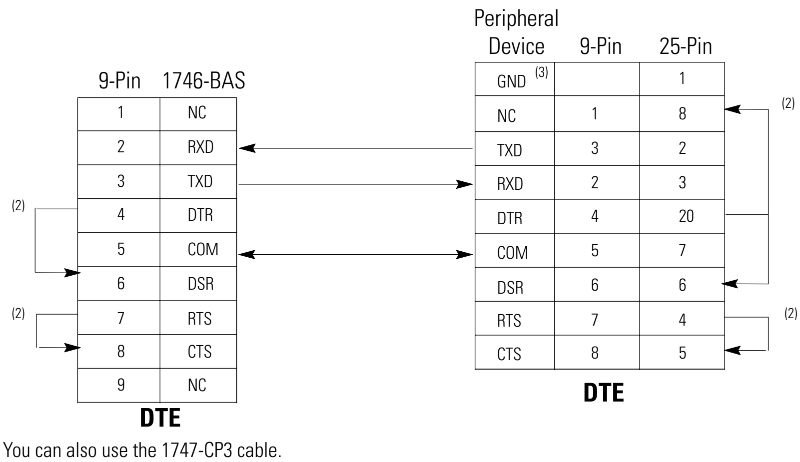
(1) You can also use the 1747-CP3 cable.
(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.
(3) Connect to the shield of the cable.

1746-BAS Module to a Modem (Hardware Handshaking Enabled)



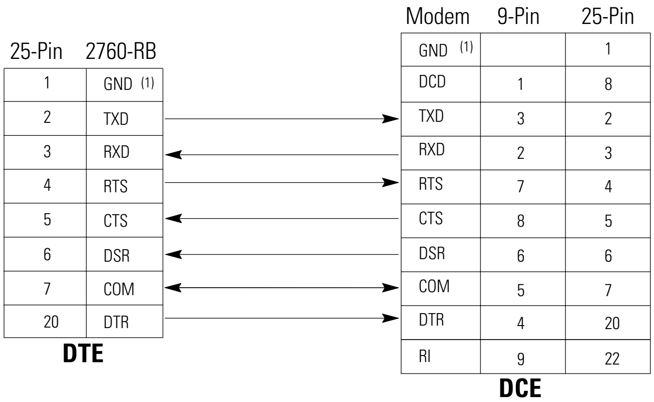
(1) Connect to the shield of the cable.

1746-BAS Module to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, Personal Computer, 1770-KF3 Module, or PLC-5 Processor (Hardware Handshaking Disabled) (1)



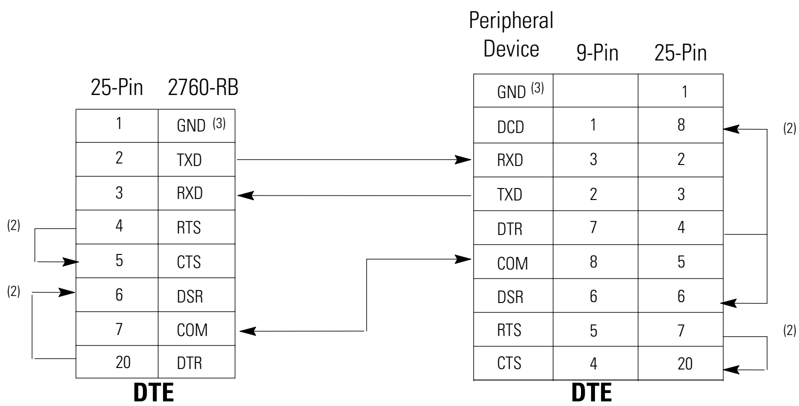
(1) You can also use the 1747-CP3 cable.
(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.
(3) Connect to the shield of the cable.

2760-RB Module to a Modem (Hardware Handshaking Enabled)



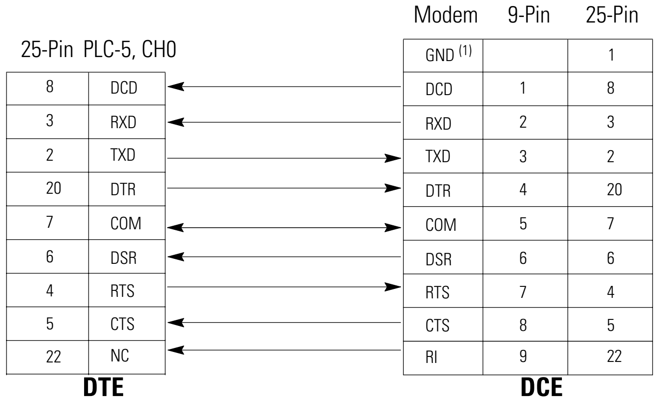
(1) Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

2760-RB Module to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, Personal Computer, 1770-KF3 Module, or PLC-5 Processor (Hardware Handshaking Disabled)



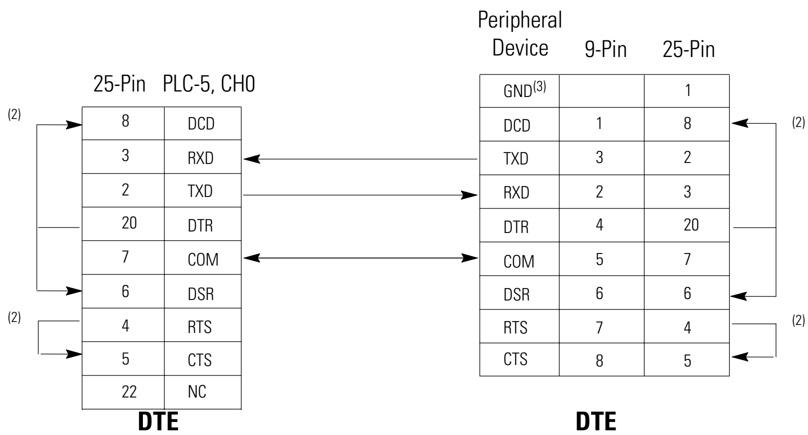
(1) You can also use the 1747-CP3 cable.
(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.
(3) Connect the shield of the cable to the GND pin on one end only. Leave the other end open.

PLC-5 Processor (Channel 0) to a Modem (Hardware Handshaking Enabled)



(1) Connect to the shield of the cable.

PLC-5 Processor (Channel 0) to a SLC 5/03, SLC 5/04, or SLC 5/05 Processor, Personal Computer, 1770-KF3 Module, PLC-5 Processor, 1747-KE Module, or 1746-BAS Module (Hardware Handshaking Disabled) [1]



(1) You can also use the 1747-CP3 cable.

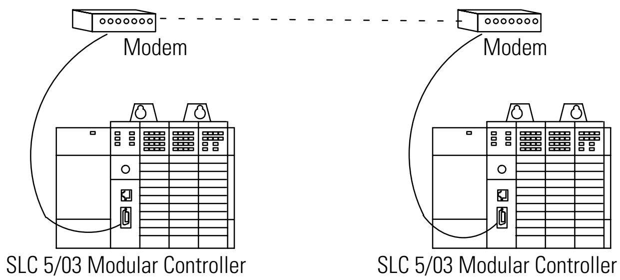
(2) Jumpers are only needed if you cannot disable the hardware handshaking on the port.

(3) Connect to the shield of the cable.

Applications for the RS-232 Communication Interface

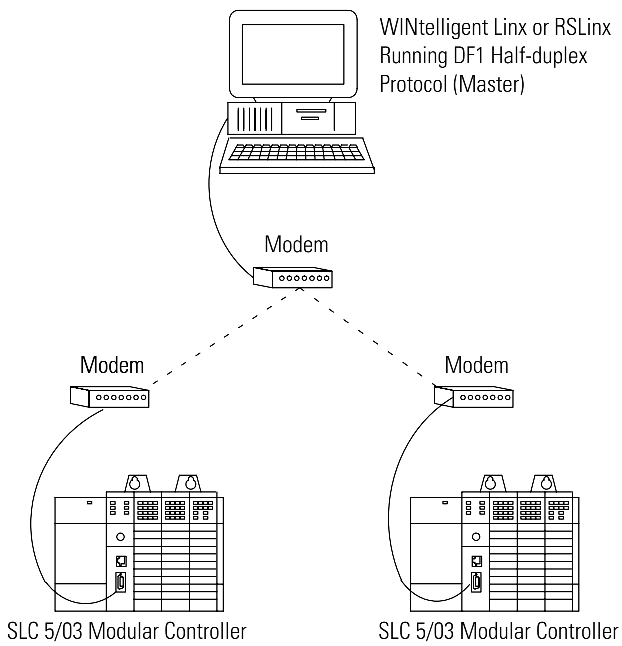
The figures below illustrate different applicationsfor the RS-232 communication interface.

DF1 Full-duplex Peer-to-peer



Half-duplex with Slave-to-slave Routing

IMPORTANT	The 1747-KE module does not support slave-to-slave transfers.



Setting Up the DH+ Network

This appendix provides an overview of the Data Highway Plus (DH+) communication protocol and explains how the SLC 5/04 processors support it. This appendix also provides:

- a DH+communication protocol overview.
- an SLC 5/04 processor and DH+communication.
- wiring connectors for DH+communication for SLC 5/04.
- a typical DH+network configuration.

Data Highway Plus Communication Protocol Overview

Data Highway Plus implements peer-to-peer communication with a token-passing scheme to rotate link mastership among a maximum of 64 nodes. Since this method does not require polling, it helps provide time-efficient reliable data transport. The DH+features:

- remote programming of PLC-2, PLC-3, PLC-5 and SLC 500 processors on your network.
- direct connections to PLC-5 processors and industrial programming terminals.
- easy re-configuration and expansion if you want to add more nodes later.
- a communication rate of 57.6 Kbaud, 115.2 Kbaud, or 230.4 Kbaud.

The following table summarizes the type of termination resistor needed to communicate at the specified communication rate with the maximum cable length.

Termination Resistor and Communication Link

Termination Link Resistor Value Ω	Communication Rate (Kbaud)	Maximum Cable Length m (ft)
150	57.6	3048 (10,000)
150	115	1542 (5000)
82	230.4	762 (2500)

SLC 5/04 Processors and DH+ Communication

The SLC 5/04 processors let you operate DH+communication protocol by means of the DH+communication channel 1. The SLC 5/04 processors also support DF1 full-duplex protocol, DF1 half-duplex master and slave protocol, ASCII, or DH-485 via its RS-232 port, channel 0. The 3-pin connector, provided with the SLC 5/04 processors, is for actual DH+communication and the 8-pin connector is for monitoring DH+communication.

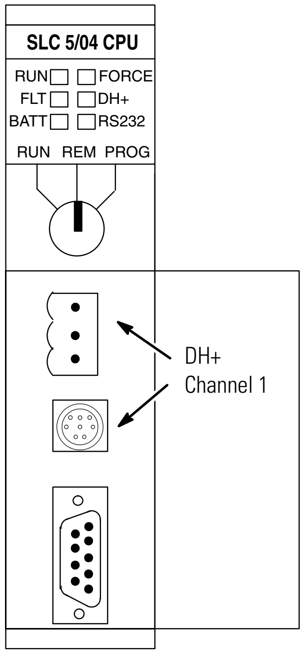
DH+ Channel 1, 3-Pin

Pin	Pin Name
1	DH+Data Line 1
2	Shield
3	DH+Data Line 2

DH+ Channel 1, 8-Pin

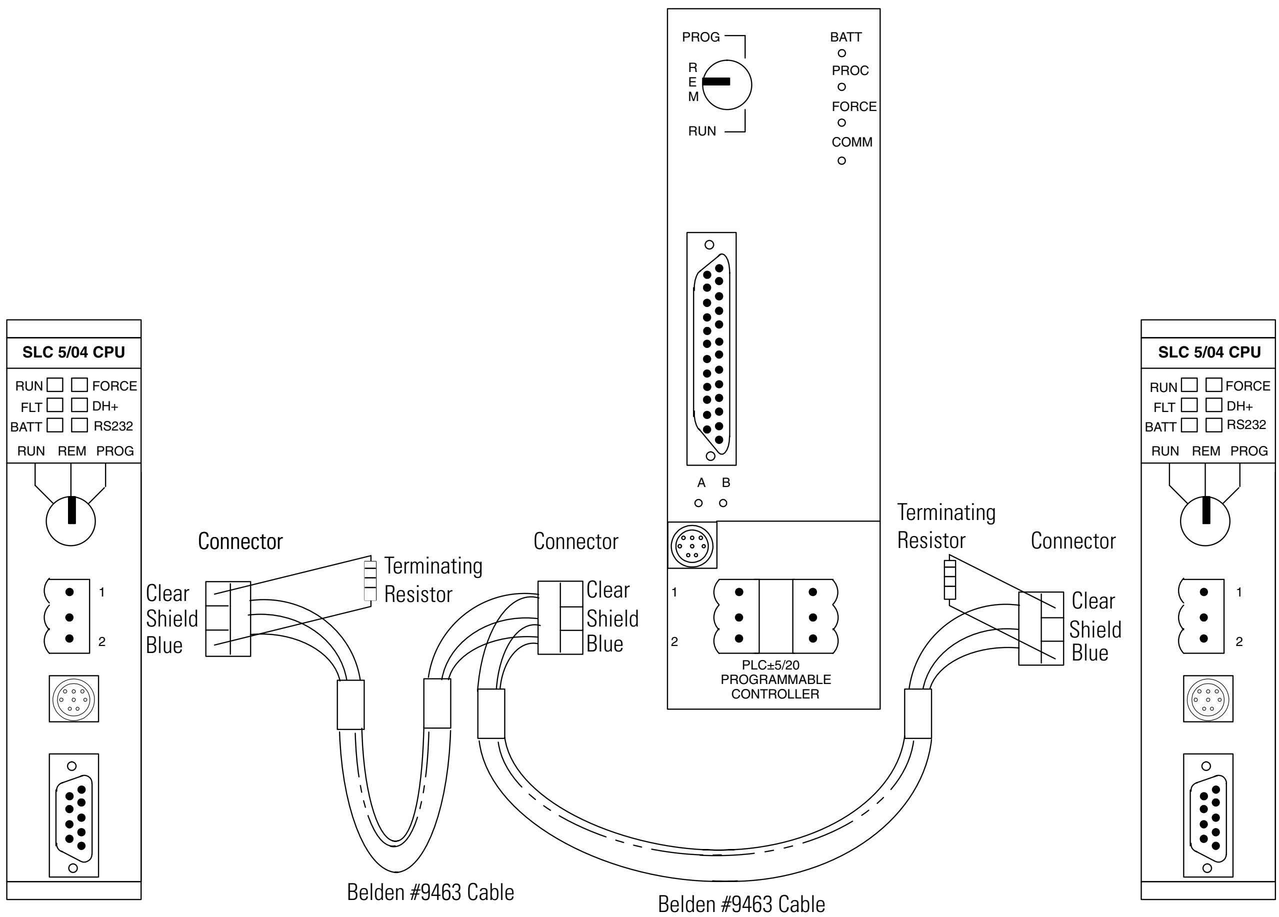
Pin	Pin Name
1	DH+Data Line 2
2	No Connection
3	Shield
4	No Connection
5	No Connection
6	DH+Data Line 1
7	No Connection
8	No Connection

Channel 1 Location



Wiring Connectors for DH+ Communication for SLC 5/04 Processors

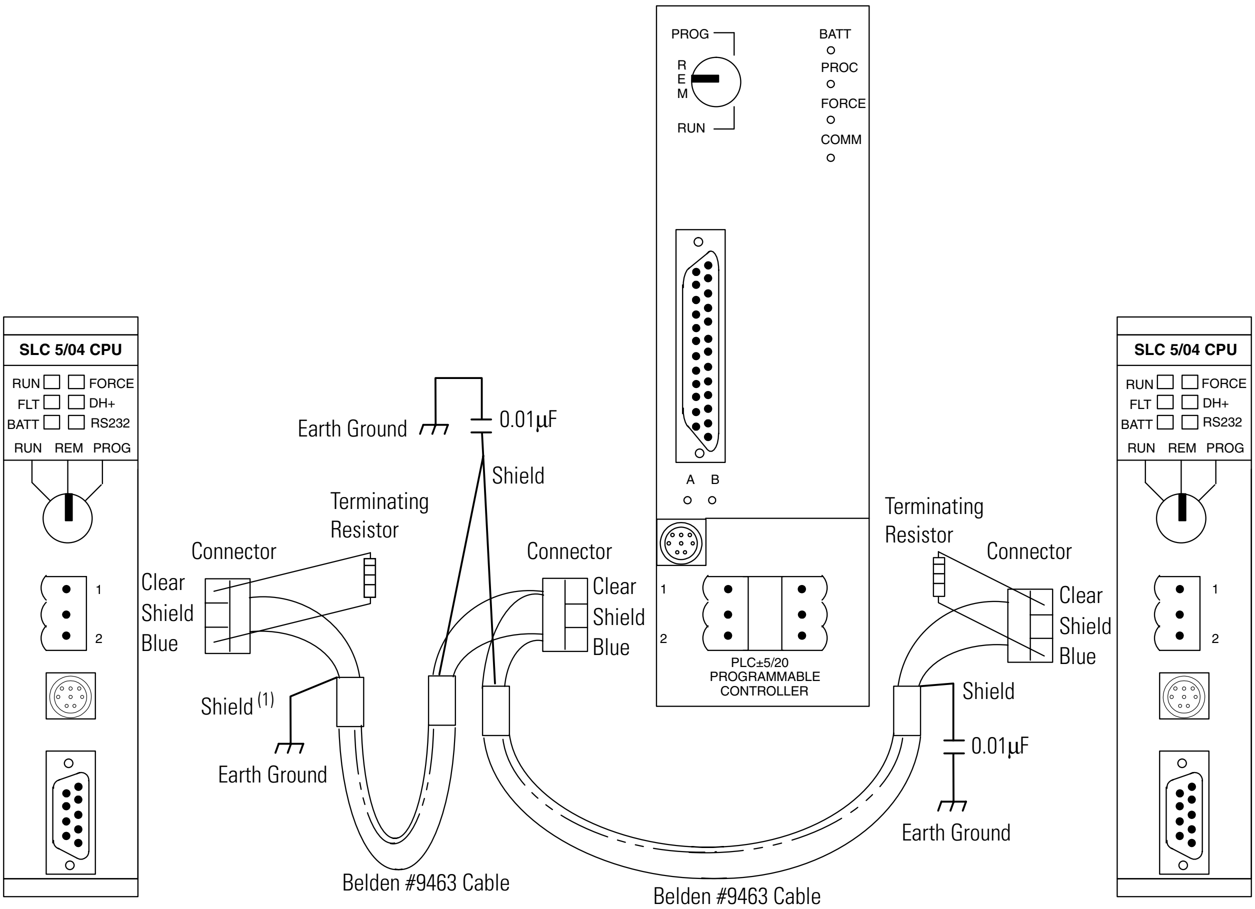
To connect Allen-Bradley devices with other devices over DH+, you must wire the 3-pin cable connectors so that communication can occur through the cabling. Each device requires its own node address.



Terminate the DH+ link on both ends by connecting a 150 Ω, 1/2 W resistor between terminals 1 and 2 of the 3-pin connector when you are communicating at 57.6 Kbaud with a PLC-5 processor or 115.2 Kbaud with other SLC 5/04 processors. Use an 82 Ω, 1/2 W resistor if you are communicating at 230.4 Kbaud with other SLC 5/04 processors or series E enhanced PLC-5 processor.

Minimizing Noise

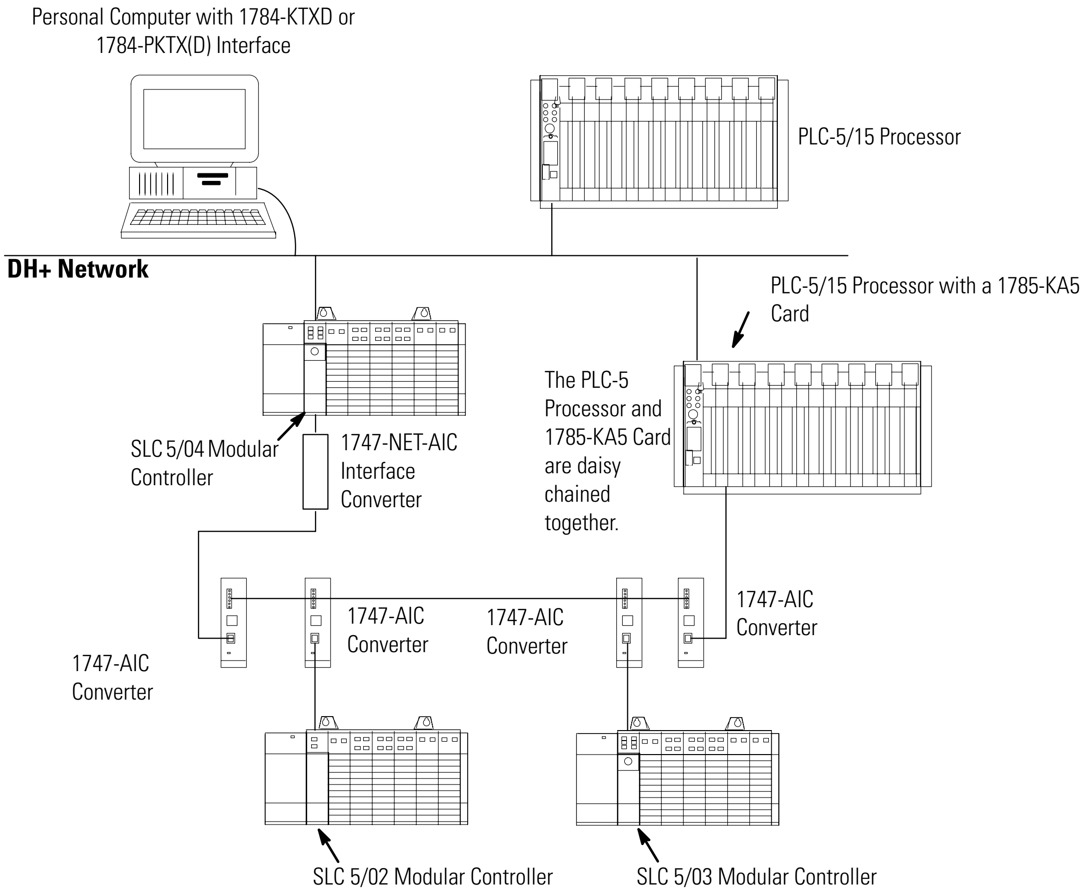
To minimize the affect of noise on the SLC 5/04 processor, ground the cable shields to earth via 0.01μF capacitors as shown in the DH+ wiring example below. Only directly ground the shield at one point on the network.



(1) To chassis ground directly at one point only in the network.

Typical DH+ Network Configuration

The following figure illustrates a possible configuration for the SLC 5/04 processor on a DH+network. You can also use an SLC 500, SLC 5/01, SLC 5/02, SLC 5/03, or SLC 5/05 processor in place of the SLC 5/04 processor on the DH+network if the 1785-KA5 card is used with a PLC-5 processor.



The DH+protocol uses factory set timeouts to restart token-passing communication if the token is lost because of a defective node.

Other devices that use the DH+ network include those in the table below.

Catalog Number	Description	Installation Requirement	Function	Publication Number
1784-PCMK	PCMCIA interface card	PCMCIA slot in computer	Provides DH+ or DH-485 connection	1784-UM519
1784-PKTX(D)	Personal computer DH+ interface card	PCI bus	Provides DH+ or DH-485 connection	1784-UM527