Errata Sheet

This Errata Sheet contains corrections or changes made after the publication of this manual.

Product Family:	***Direct***LOGIC	**Date**:	January, 2018
Manual Number	DA-DNET-M		
Revision and Date	Rev. A, June 1998		

Changes to Chaper 3. Network Design and Setup

Page 3-9. Consideration 4: Cable Specifications

The second sentence recommends Belden 9855 or equivalent cable. While this cable will work in some applications (especially RS422 applications with few devices and short distances), it is not the ideal cable to use.

Replace this sub-section with:

"Although many types of cables may work for your application, we recommend you use a cable that is constructed to offer a high degree of noise immunity.

RS232 / RS422: AutomationDirect L19772 (Belden 8102) or equivalent

(Equivalent: 2 pairs, shielded, twisted pair, 24 AWG or larger, 100 Ohm Impedance, 22 pF/ft capacitance)

RS485: AutomationDirect L19827 (Belden 9841) or equivalent

(Equivalent: Single pair, shielded, twisted pair, 24 AWG or larger, 120 Ohm Impedance, 23 pF/ft capacitance)"

3

Network Design and Setup

In This Chapter. . . .

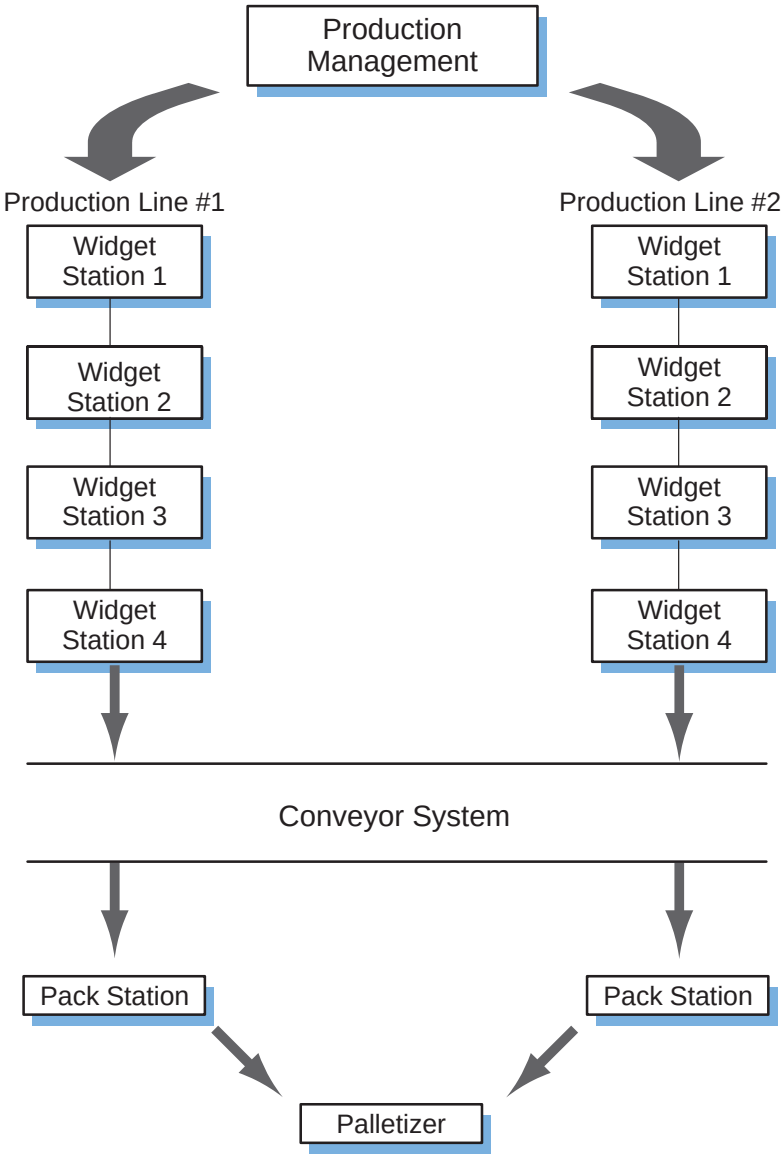
— Choosing the Configuration
— Cable Selection and Installation Guidelines
— DL430 and DL440 Port Pinouts
— DL405 DCM Port Pinouts
— DL340 CPU Port Pinouts
— DL305 DCU Port Pinouts
— DL240 CPU Port Pinouts
— Point-to-point Cables
— Multi-Drop Cables
— Network Design Checklist

Choosing the Configuration

Analyze your Application

There are almost as many ways to build your network as there are grains of sand at the beach. The first step in determining the configuration is to analyze your application. As with most things, there's probably a logical grouping that will point you in the right direction. If you have several systems you'll need to decide which station(s) will be the master(s) and which one(s) will be slaves.

Consider the following example. (It's the dreaded widget factory.)



Identify Your System Requirements

Determine how you plan to use the information that is transferred. This may help you design your network. For example, are you trying to share data between several machines, or are you trying to obtain data to be used in production reports or spreadsheets? Once you've taken a look at your application, you should be able to identify the configuration needs. For example, our simple widget factory needs to accomplish the following things.

Production Management: The production management system needs to issue build orders and obtain data that can be used in production reports. The management system also needs to monitor the production lines to determine which line should receive the build orders. For example, one line may be behind schedule while the other is completely free.

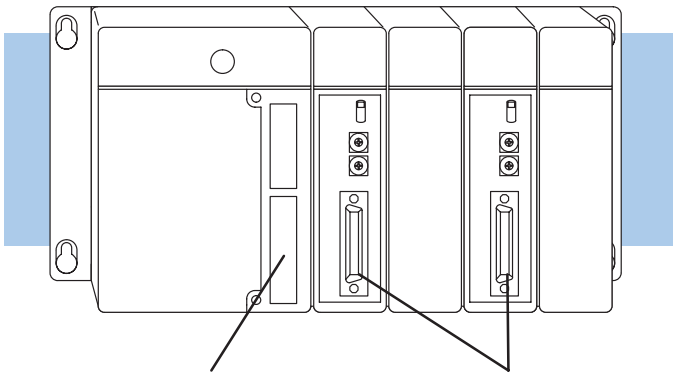
Production Lines 1 & 2: Each production line has a series of operations that must be followed to build a finished product. Once they are completed they can be sent to either pack station for packaging. In the real world, we all know that equipment sometimes doesn't work quite right, so each station should be monitored for operational status.

Pack Stations: The finished products are sent to the pack stations, which in turn send the cases to a palletizer for final shipping. Since there's only one palletizer and two stations packing different product models, the pack stations should coordinate their deliveries.

Palletizer: The palletizer stacks the widgets into (hopefully) nice, neat packages of widgets that can be sold by the millions.

Examine Data Sharing Requirements

Even though the three basic network configurations can be combined in an application, each network remains independent. The master station from one network cannot request data directly from slave stations on another network. This does not mean you cannot obtain data from these networks, you can. It just requires more than one interface for that slave station. For example, a DL440 PLC station with two DCM (Data Communication Module) interfaces actually can connect to three different networks. Check the manual for your particular slave station interface to determine the maximum number allowed in a single base.



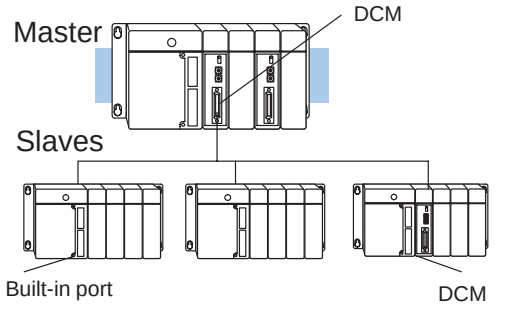
Sketch the Network Diagram

Since all applications must use one (or more) of the three basic network configurations (PLC as Master, Host as Master and Peer as Master), we can easily draw the complete diagram for our example factory. To refresh your memory, here are the possible configurations.

Possible Configurations

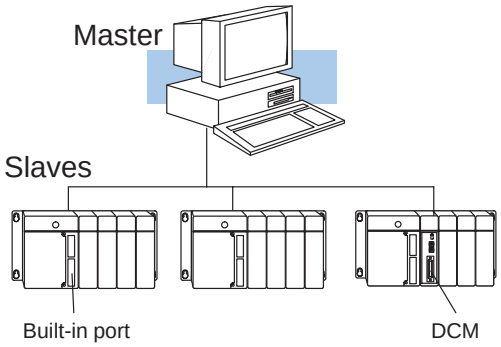
1 – PLC as Master Network

- Master can initiate read or write with any slave station
- PLC with DCM as master
- Full range of slave stations available



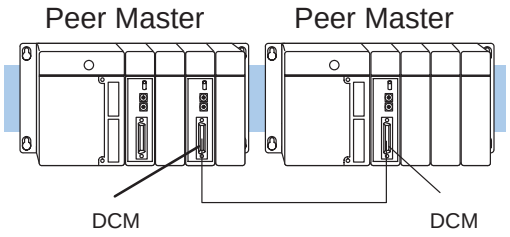
2 – Host as Master Network

- Host computer (or other intelligent device) as master
- Requires ***Direct***NET program in the host
- Full range of slave stations available

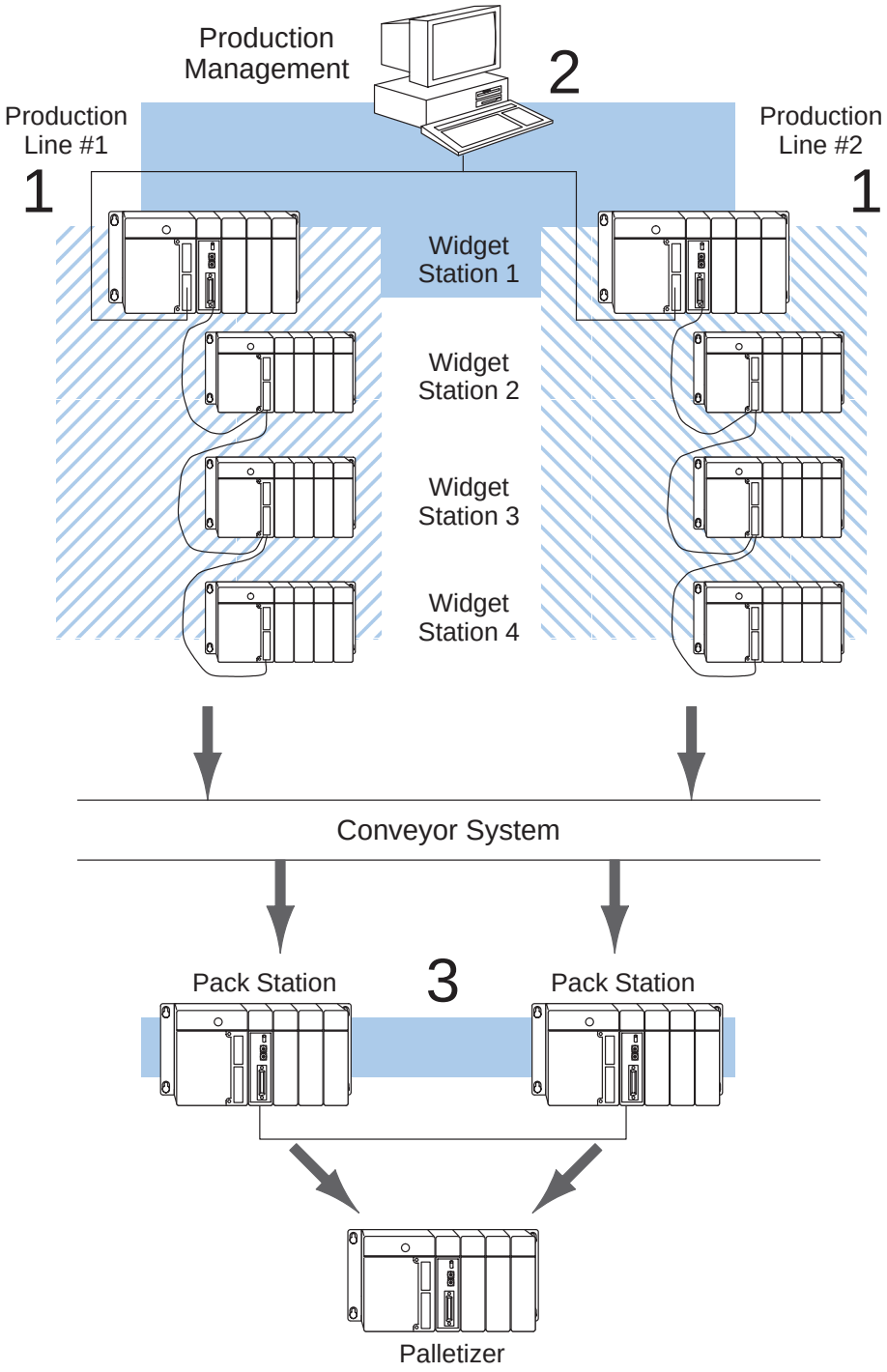


3 – Peer as Master Network

- Two stations only
- Only DL405 DCMs
- Either station can initiate a request



There are many different ways to configure the example. Notice, in the example on the next page, the areas where the different configurations were used. This example uses four small networks to solve the problem. The advantages of this approach are that you can optimize each portion without affecting other parts of the factory.



Now you're ready to build the network cables.

Once you've drawn your network configuration, you can build the network cables.

Cable Selection and Installation Guidelines

Things to Consider There are several considerations that help determine the type of cable needed for your application.

1. Will the DCM be physically connected in a point-to-point configuration or multi-drop configuration?
2. What electrical specification is best for your application? RS232C or RS422?
3. What is the cable schematic?
4. What are the relevant cable specifications?
5. What installation guidelines are necessary?
6. Do you just need a quick test cable?

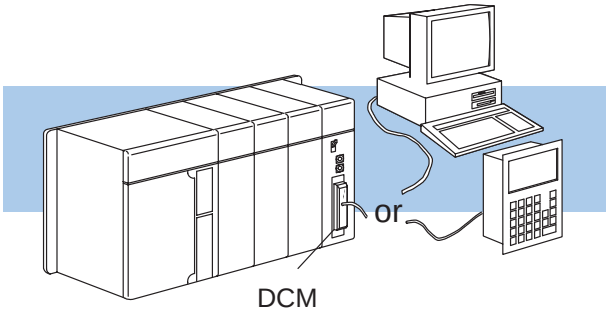
The next few pages discuss these considerations in detail. If you already know the type of cable needed, the cable schematics are included on pages 3–17 through 3–29.

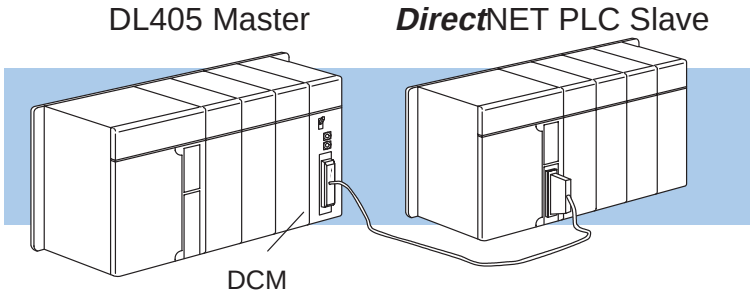
Consideration 1: Physical Configuration

DirectNET can be used in either a point-to-point or multi-drop configuration. A point-to-point connection only has two stations, a master and a slave. You should use this configuration when you want to connect a ***Direct***NET master station to a single ***Direct***NET slave station. For example, use the point-to-point configuration to connect a personal computer, an operator interface, or an intelligent device to a single station.

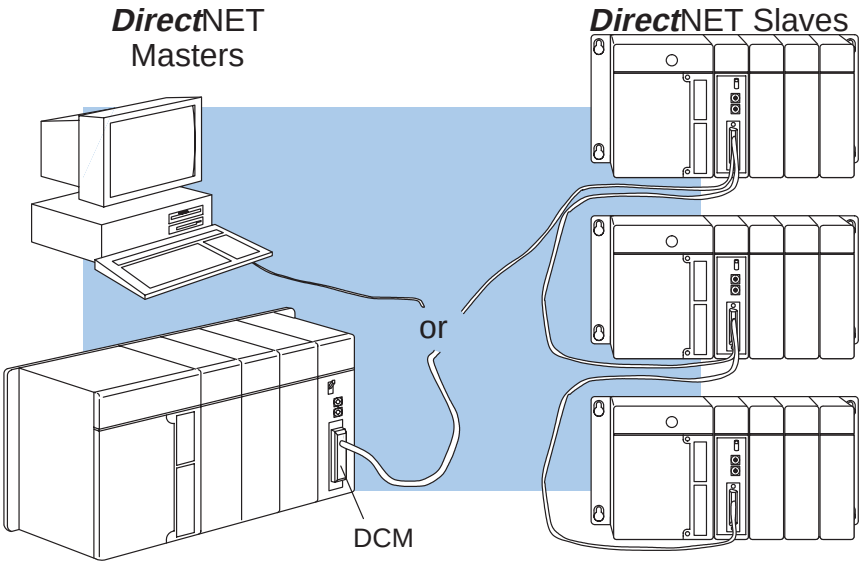
Use the multi-drop configuration to connect one master to two or more slaves.

Point to Point





Multi-drop



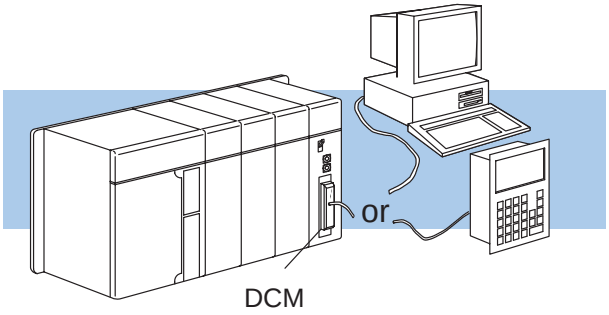
Consideration 2: Electrical Specification RS232C or RS422

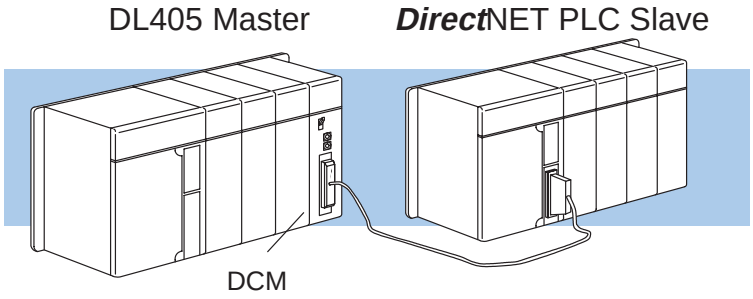
DirectNET supports both RS232C or RS422 communication. Your application and configuration choice will help determine which electrical specification is best for you. If you are using multi-drop, you must use RS422. If you are using point-to-point, you may have a choice between RS232C and RS422.

You can use RS232C if the cable length is less than 50 feet and if the cable will not be subjected to induced electrical noise that is commonly found near welders, large motors, or other devices that create large magnetic fields.

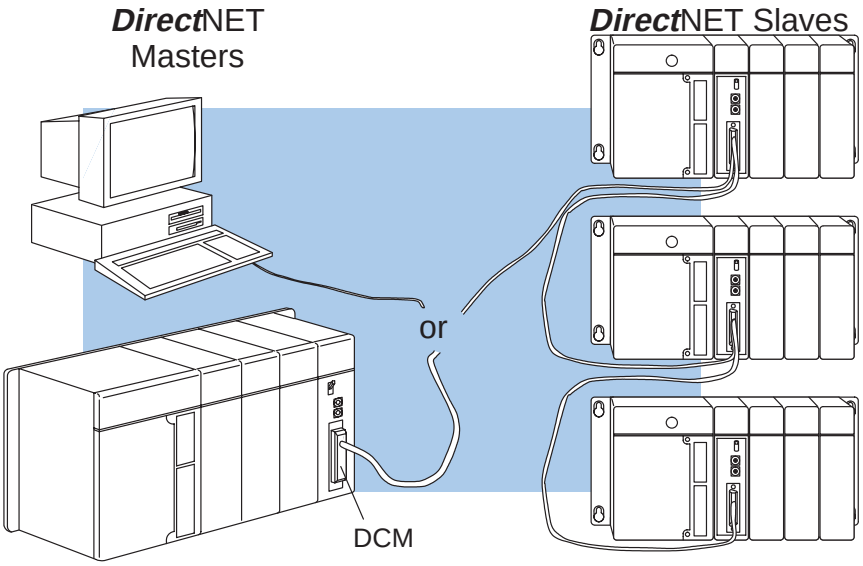
You should use RS422 for all other applications. RS422 allows longer cable distances (up to 3300 feet) and provides higher noise immunity.

RS232C or RS422 for Point-to-Point





RS422 for Multi-drop



Consideration 3: Cable Schematics

There are two sections in this chapter that provide various types of cable schematics that are appropriate for most applications. Point-to-Point cable diagrams can be found on pages 3–17 through 3–21. Multi-drop cable diagrams can be found on pages 3–22 through 3–29. You may have to combine some of these examples to design a cable that meets your exact application requirements.

Consideration 4: Cable Specifications

Although many types of cables may work for your application, we recommend you use a cable that is constructed to offer a high degree of noise immunity. ~~A cable constructed equivalent to Belden 9855 should be sufficient. The following specifications should be used as a guideline.~~

~~Structure . . . . . Shielded, twisted pair (RS232C only uses two wires and a ground)~~

~~Conductor size . . . . . 24 AWG or larger~~

~~Insulation . . . . . Polyethylene~~

~~Shield . . . . . Copper braid or aluminum foil~~

~~Impedance . . . . . 100Ω @ 1MHz~~

~~Capacitance . . . . . 60pf / meter or less~~

See Errata Sheet at the beginning of this file for updated cable recommendations.

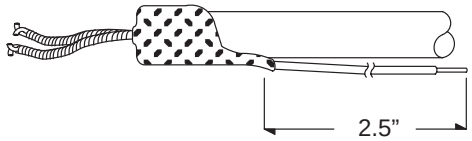
Consideration 5: Installation Guidelines

Your company may have guidelines for cable installation. If so, you should check those before you begin the installation. Here are some general things to consider.

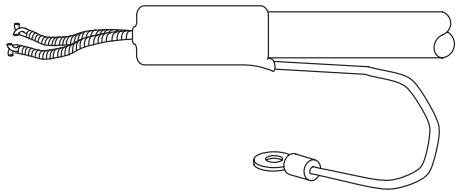
- Don't run cable next to larger motors, high current switches, or transformers. This may cause noise problems.
- Route the cable through an approved cable housing to minimize the risk of accidental cable damage. Check local and national codes to choose the correct method for your application.
- Consider redundant cabling if the application data is critical. This allows you to quickly reconnect all stations while the primary cable is being repaired.

Cable Shield Grounding — No matter what type of configuration is required, it is important to ground the cable shield to minimize the possibility of noise. The preferred method is to connect one end (preferably the receiver end) of the cable shield to the connector housing. If noise problems are still present and you have a good earth ground for the cabinet, you should connect one end of the shield to the cabinet earth ground. *Don't* ground both ends of the shield because this will create induced noise on the cable.

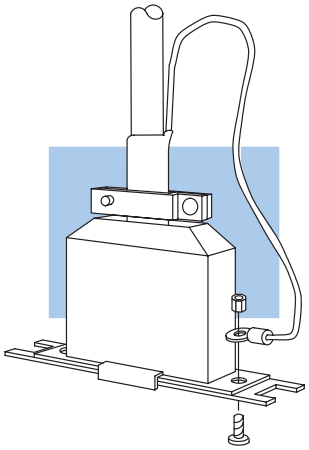
Step 1: Strip back about 2.5" of the shield.



Step 2: Crimp a ring connector onto the shield.



Step 3: Secure the shield to the connector shell.



Consideration 6: A Quick Test Cable

PLC***Direct***™ offers a Universal Cable Kit (part number FA–CABKIT). This cable kit allows you to connect various types of ***Direct***LOGIC™ products with an RS232C cable in a matter of minutes. The kit consists of a cable (phone cable with male plugs already attached) and several specially wired connectors and phone cables.

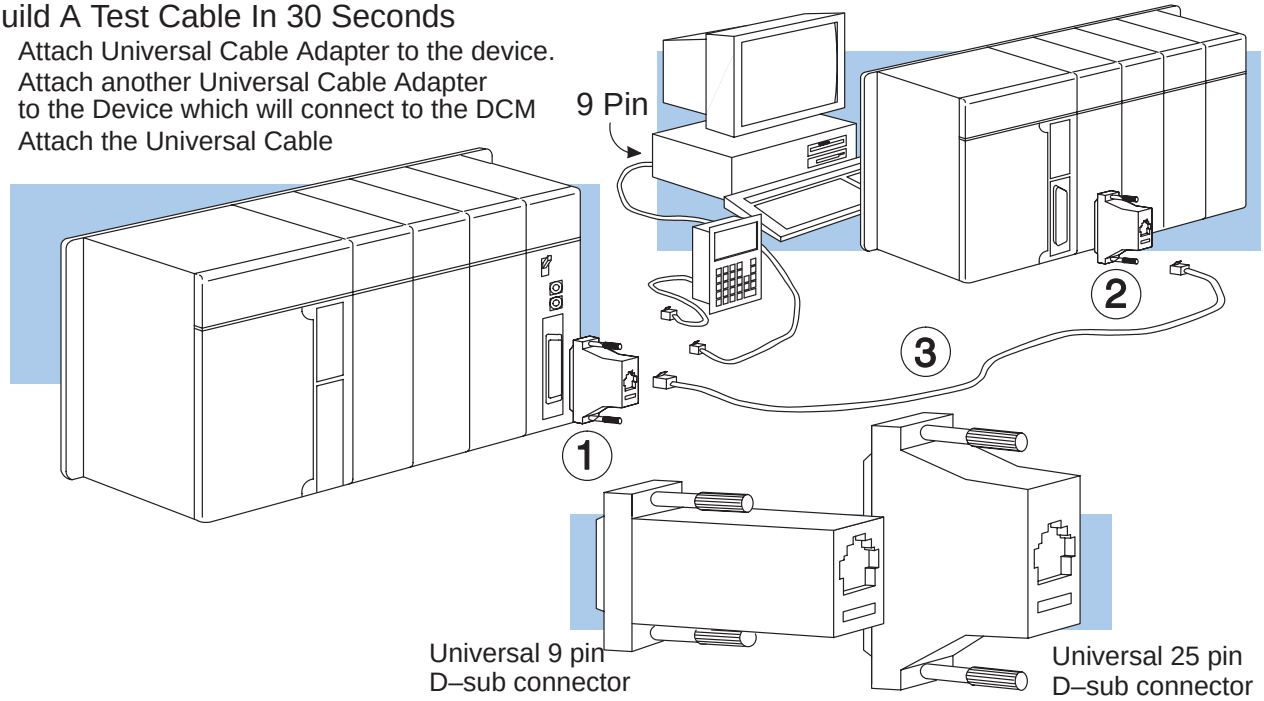
The special connectors are a D-sub style with built-in female phone jacks. The kit includes a wide variety of the special connectors so you can use one kit to easily connect products from the different ***Direct***LOGIC™ family of products. To use the kit just follow these steps.

1. Plug the appropriate D-sub connector onto the device (CPU, DCU, or DCM).
2. Plug the appropriate D-sub connector onto the other device you are connecting.
3. Connect the cable to the two D-sub connectors.

WARNING: This cable is suitable for quick testing situations and should not be used in actual applications. This cable is not shielded and is highly susceptible to electrical noise. Electrical noise can cause unpredictable operation that may result in a risk of personal injury or damage to equipment. Use the cable specifications described earlier in this manual to select a cable suitable for actual applications.

Build A Test Cable In 30 Seconds

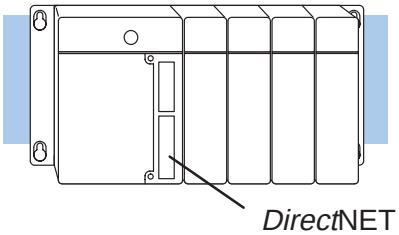
1. Attach Universal Cable Adapter to the device.
2. Attach another Universal Cable Adapter to the Device which will connect to the DCM
3. Attach the Universal Cable



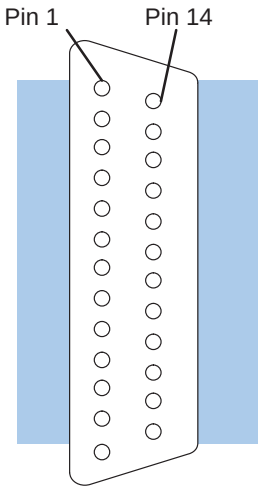
NOTE: The adapters take care of any pin swapping that may be required between the devices. You do not have to make *any* wiring adjustments.

DL430 and DL440 Port Pinouts

The DL430 and DL440 CPUs have built-in ***Direct***NET ports. This port is only a slave port. The following diagram shows the port pinout connections.



Port Pinouts

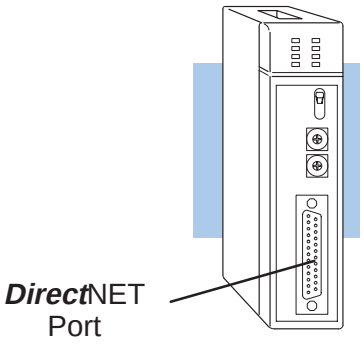


Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	RS422 data out +
2	RS232C data out	15	Not connected
3	RS232C data in	16	RS422 data out –
4	RS232C RTS	17	Not connected
5	RS232C CTS	18	RS422 RTS –
6	Not connected	19	RS422 RTS +
7	Signal ground	20	Not connected
8	Not connected	21	Not connected
9	RS422 data in +	22	Not connected
10	RS422 data in –	23	RS422 CTS –
11	RS422 CTS +	24	Not connected
12	Not connected	25	Not connected
13	Not connected		

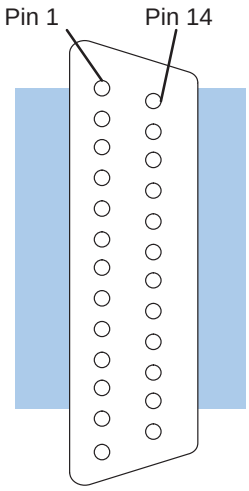
Pin labeling conforms to the IBM DTE and DCE standards.

DL405 DCM Port Pinouts

The DL405 DCM can be used as a master or slave station interface. The following diagram shows the port pinout connections.



Port Pinouts



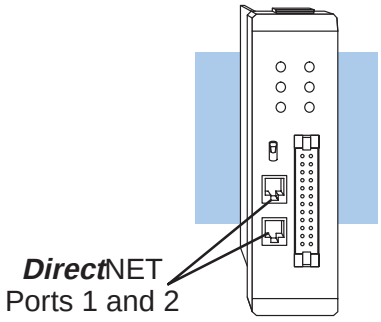
Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	RS422 data out +
2	RS232C data out	15	RS422 data out –
3	RS232C data in	16	RS422 data in –
4	RS232C RTS	17	RS422 data in +
5	RS232C CTS	18	Not connected
6	Internal Circuit 5V	19	Not connected
7	Internal Circuit 0V	20	Not connected
8	RS422 RTS +	21	Not connected
9	RS422 RTS –	22	RS422 data out +
10	RS422 RTS +	23	RS422 data out –
11	RS422 RTS –	24	RS422data in –
12	RS422 CTS +	25	RS422 data in +
13	RS422 CTS –		

Pin labeling conforms to the IBM DTE and DCE standards.

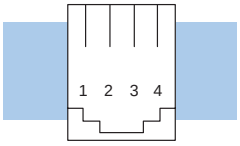
DL340 CPU Port Pinouts

The DL340 CPU has two built-in ***Direct***NET slave ports under the hinged cover.

The ports are limited to RS232C communication, so you have to use an RS232C/RS422 converter for multi-drop connections. This port is an RJ11 (handset connector) phone jack. The ***Direct***LOGICE Universal Cable Kit (FA–CABKIT) can be used if you do not want to create a phone jack connection.



Port 2 is the Master port.



Phone Jack Connector

Ports 1 and 2 Pinouts

Pin	Signal Definition
1	RS232C data in
2	RS232C data out
3	Request to Send
4	Ground

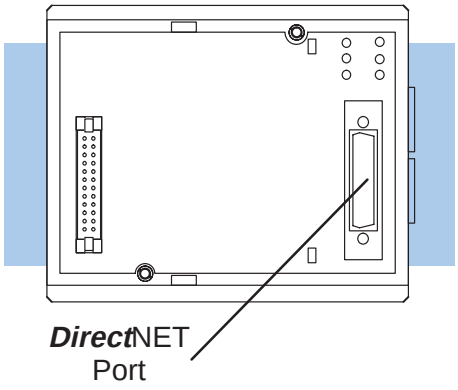
Pin labeling conforms to the IBM DTE and DCE standards.

DL305 DCU Port Pinouts

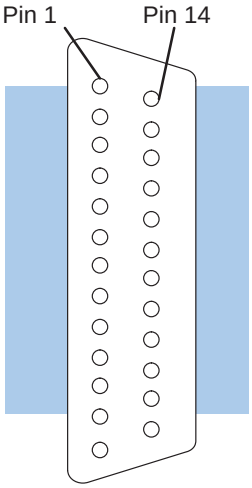
There are two versions of the DL305 DCU.

- D3–232–DCU (RS232C version)
- D3–422–DCU (RS422 version)

The DL305 DCU can only be used as a slave station interface. If you only have one master and one slave, you can use either version. If you have more than one slave you should probably use the the RS422 version. You can use the RS232C version, but you'll need an RS232C/ RS422 converter (FA–UNICON) for each station.



Port Pinouts



D3–422–DCU (RS422)

Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	RS422 data out +
2	Not connected	15	RS422 data out –
3	Not connected	16	RS422 data in –
4	Not connected	17	RS422 data in +
5	Not connected	18	Not connected
6	Not connected	19	Not connected
7	Logic ground 0V	20	Not connected
8	Not connected	21	Not connected
9	Not connected	22	RS422 data out +
10	RS422 RTS +	23	RS422 data out –
11	RS422 RTS –	24	RS422data in –
12	RS422 CTS +	25	RS422 data in +
13	RS422 CTS –		

D3–232–DCU (RS232C)

Pin	Signal Definition	Pin	Signal Definition
1	Not connected	14	Not connected
2	RS232C TXD	15	Not connected
3	RS232C RXD	16	Not connected
4	RS232C RTS	17	Not connected
5	RS232C CTS	18	Not connected
6	Not connected	19	Not connected
7	Logic ground 0V	20	Not connected
8	Not connected	21	Not connected
9	Not connected	22	Not connected
10	Not connected	23	Not connected
11	Not connected	24	Not connected
12	Not connected	25	Not connected
13	Not connected		

Pin labeling conforms to the IBM DTE and DCE standards.

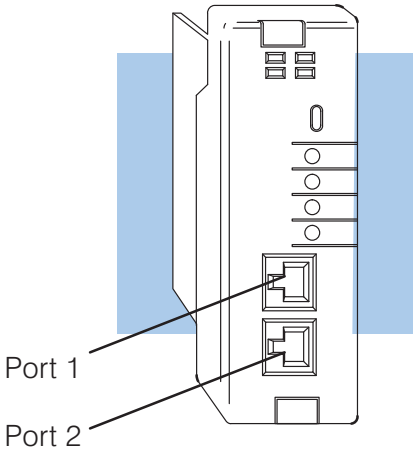
DL240 CPU Port Pinouts

The DL240 CPU has two built-in ***Direct***NET ports.

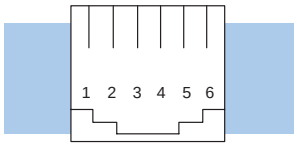
Port 1: can be used for point-to-point communications with either RS232C or RS422. However Port 1 cannot be used in a multi-drop configuration even with an RS232C / RS422 converter. This is because the RTS signal pin is used for 5V.

Port 2: can be used for either point-to-point or multi-drop connections. An RS232C/RS422 converter is required for multi-drop connections.

These ports are RJ11 phone jacks. The ***Direct***LOGIC™ Universal Cable Kit (FA–CABKIT) can be used if you do not want to create a phone jack connection.



DirectNET Ports



Phone Jack Connector

Port 1 Pinouts

Pin	Signal Definition
1	0 V
2	5 V
3	RS232C Data in
4	RS232C Data out
5	5 V
6	0 V

Port 2 Pinouts

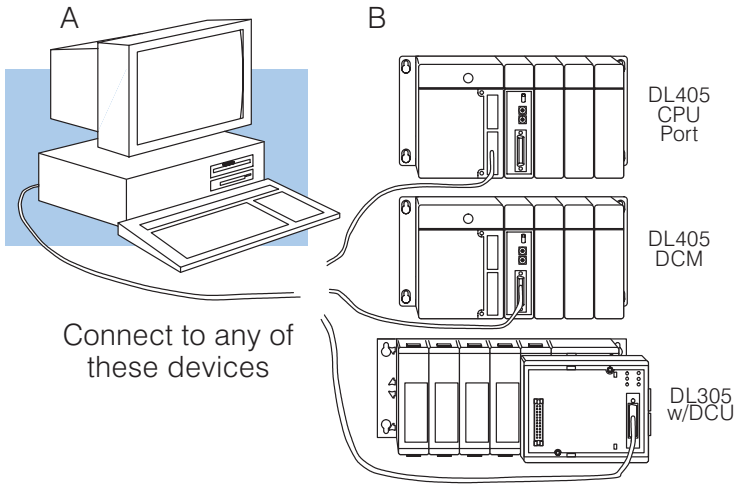
Pin	Signal Definition
1	0 V
2	5 V
3	RS232C Data in
4	RS232C Data out
5	Request to Send out
6	0 V

Pin labeling conforms to the IBM DTE and DCE standards.

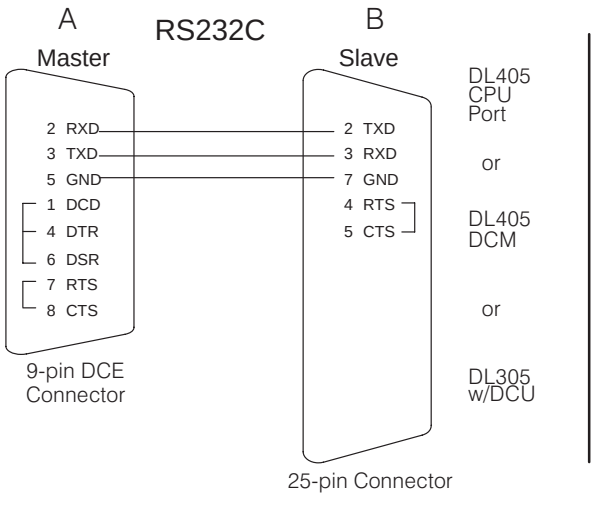
Point-to-point Cables

Host as Master

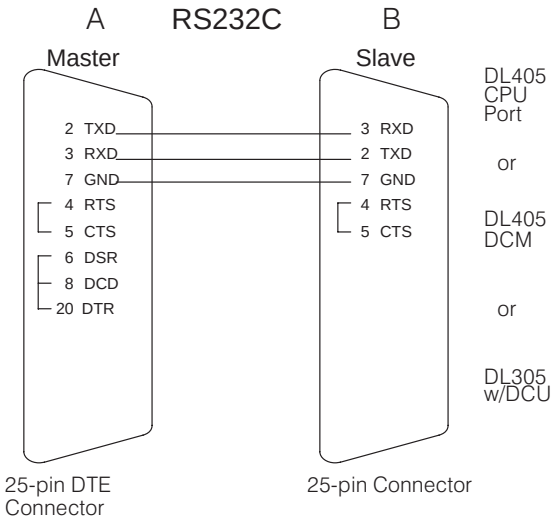
Slaves: DL405 DCM, DL405 CPU Port, DL305 RS232C DCU



9-pin Connector



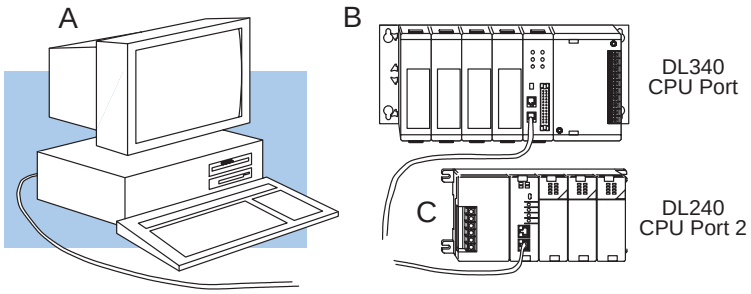
25-pin Connector



Pin labeling conforms to the IBM DTE and DCE standards.

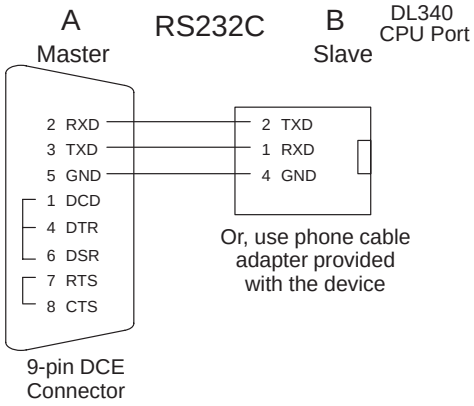
Host as Master (continued)

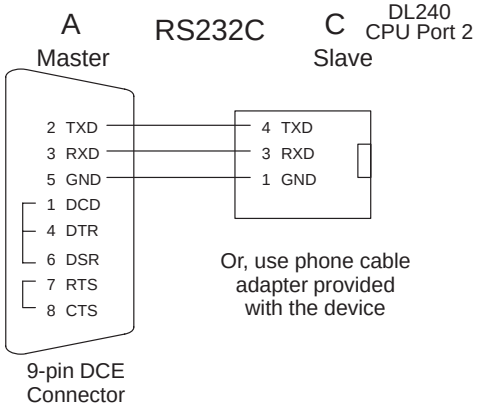
Slaves: DL340 CPU Port, DCM, DL240 CPU Port



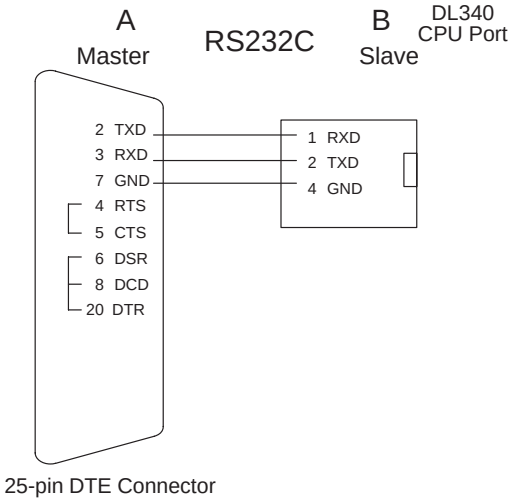
Connect to any of these devices

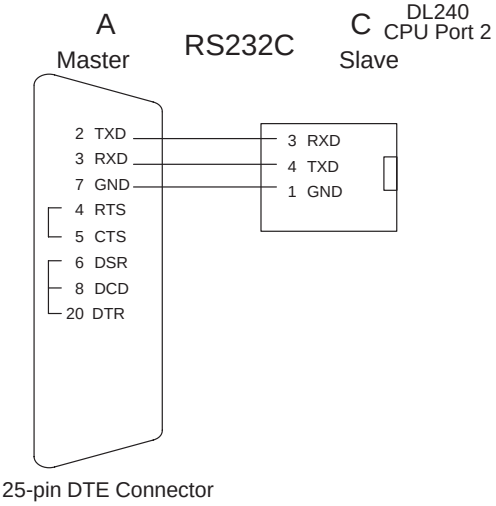
9-pin Connector





25-pin Connector

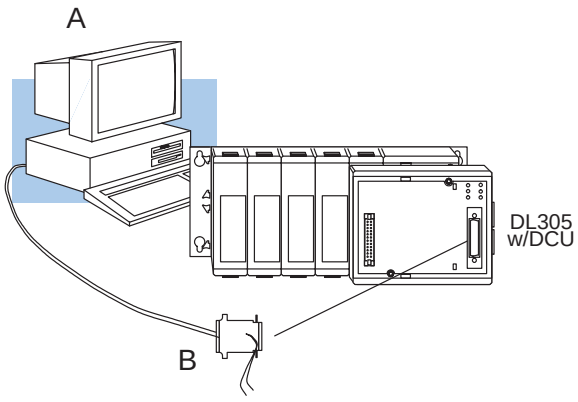




Pin labeling conforms to the IBM DTE and DCE standards.

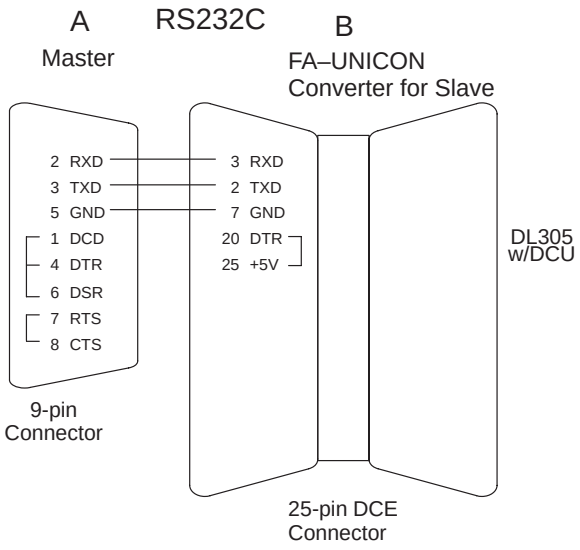
Host as Master (continued)

Slaves: DL305 RS422 DCU

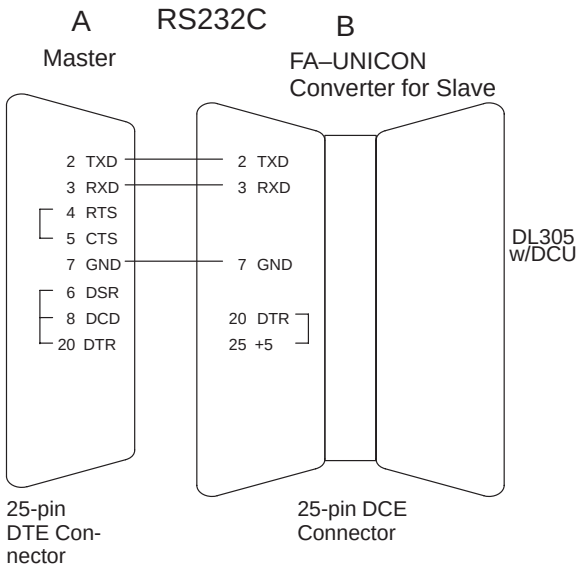


Male connector plugs onto DCU

9-pin Connector



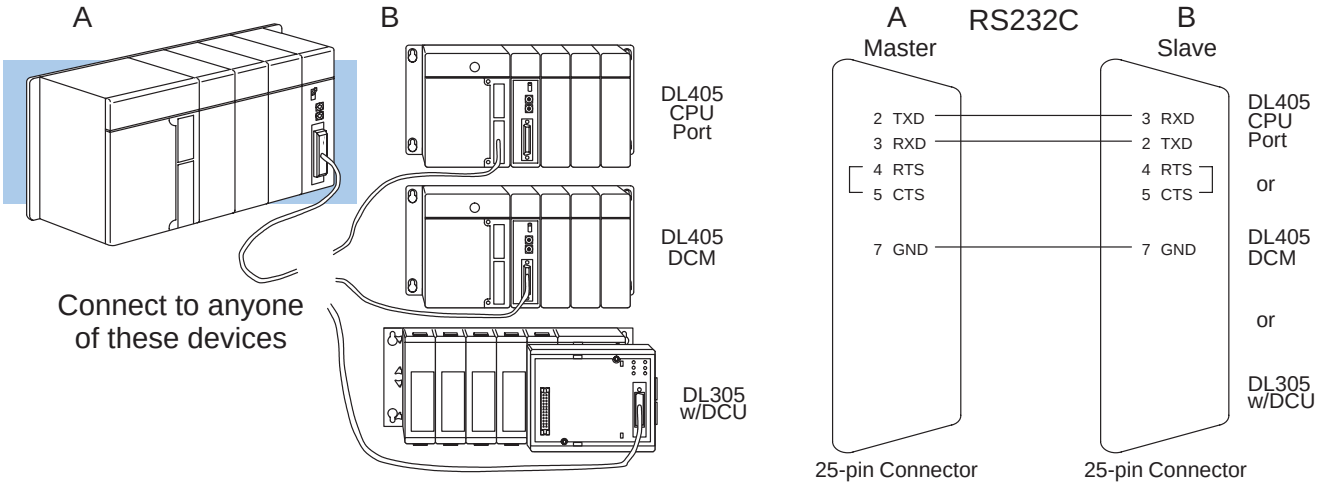
25-pin Connector



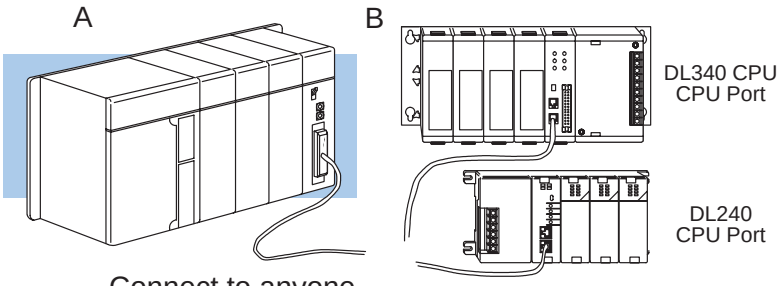
Pin labeling conforms to the IBM DTE and DCE standards.

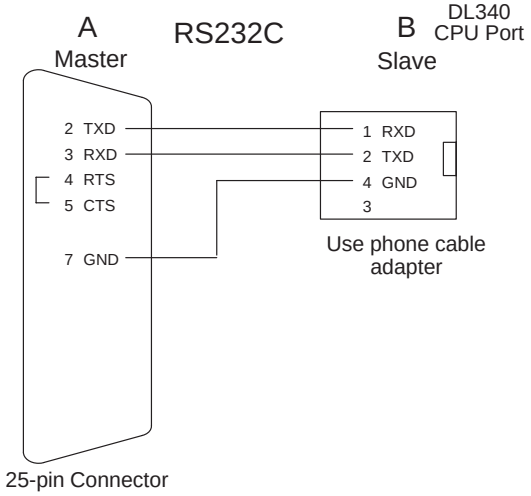
DL405 DCM as Master

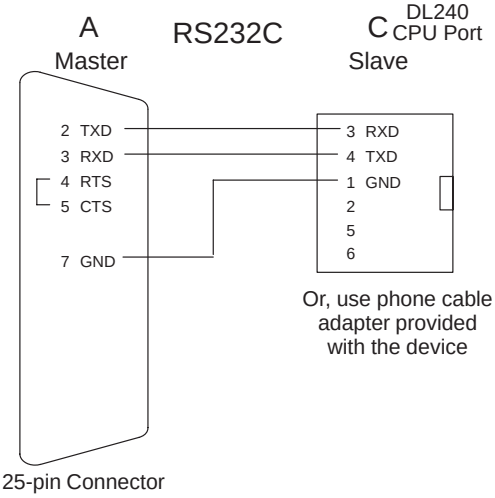
Slaves: DL405 DCM, DL405 CPU Port, DL305 RS232C DCU



Slaves: DL340 CPU Port, DL240 CPU Port, DL205 DCM

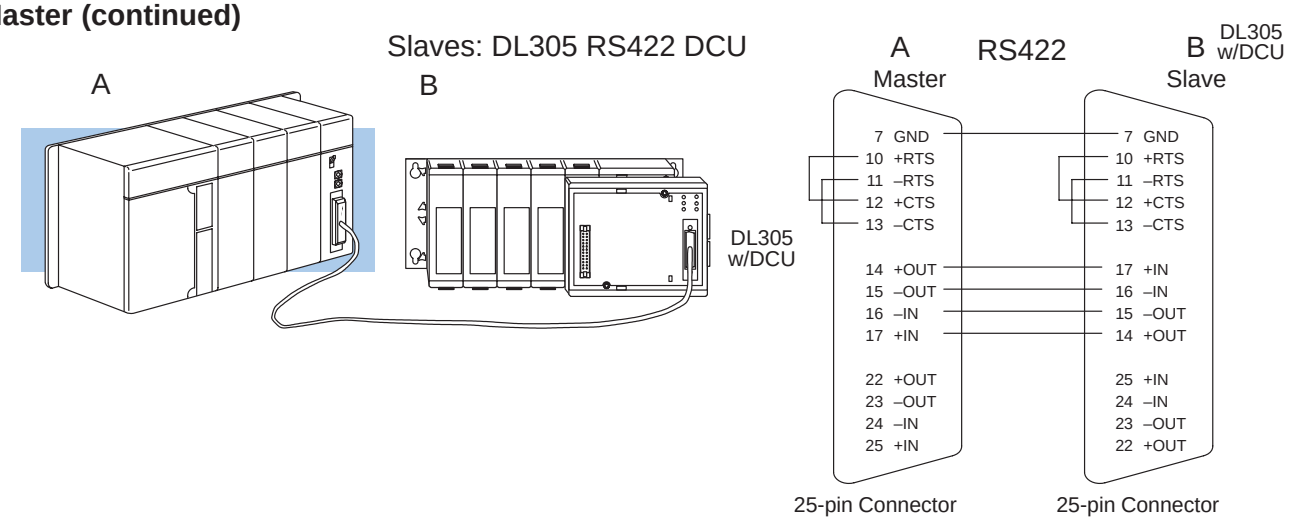






Pin labeling conforms to the IBM DTE and DCE standards.

DL405 DCM as Master (continued)



Pin labeling conforms to the IBM DTE and DCE standards.

Multi-Drop Cables

More Considerations

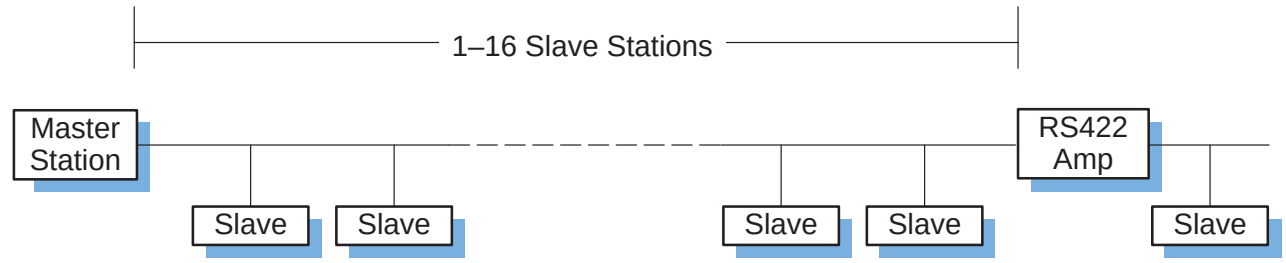
With RS422 you have great flexibility in how you want to design your network cabling. You also have to use:

- Network Amplifiers – if you have more than 16 slave stations
- Cable Termination Resistors – to help to reduce data errors.

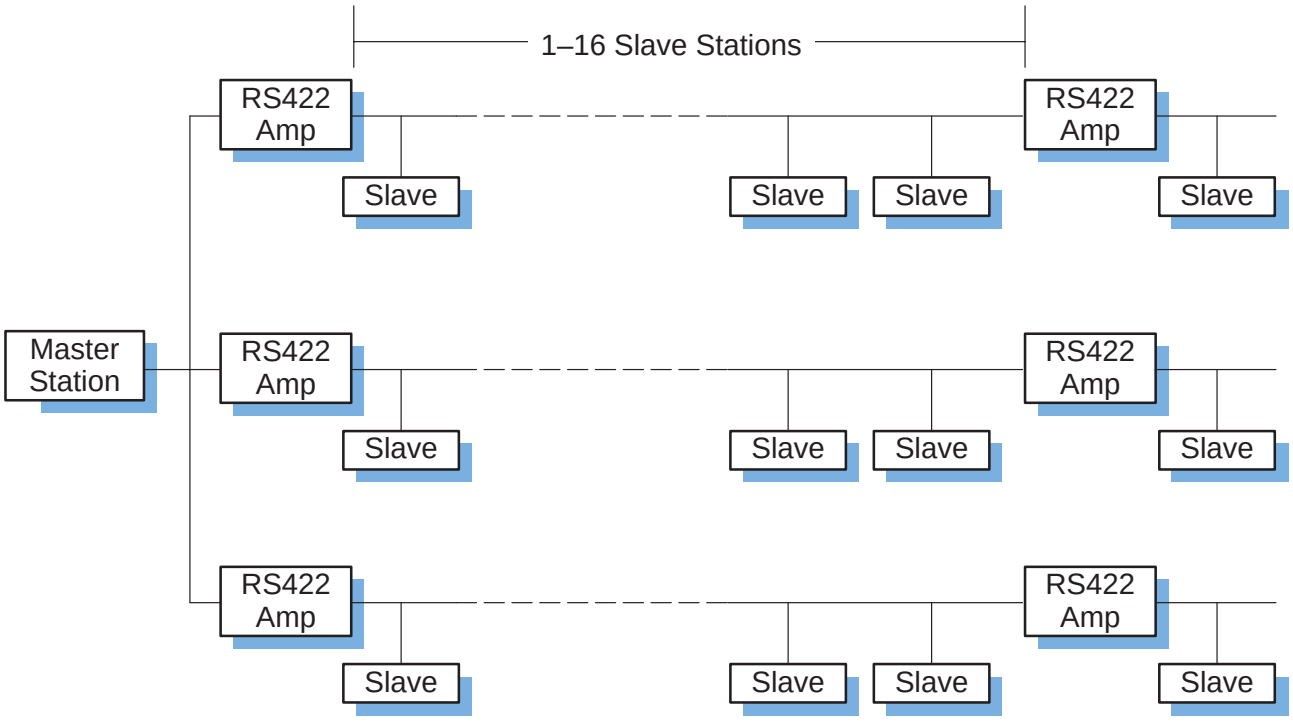
Network Amplifiers

If you have more than 16 slave stations, you should use an RS422 amplifier to maintain the signal levels. The best amplifiers are regenerative, that is, they recover the signal and try to reduce any noise signals that are present. Some amplifiers are not regenerative and amplify the noise as well as the signal. (You can get amplifiers from several sources. The Black Box catalog is one of many good places to start.) The following diagram shows some instances where an amplifier is necessary.

Serial Slave Connection



Parallel Slave Connection



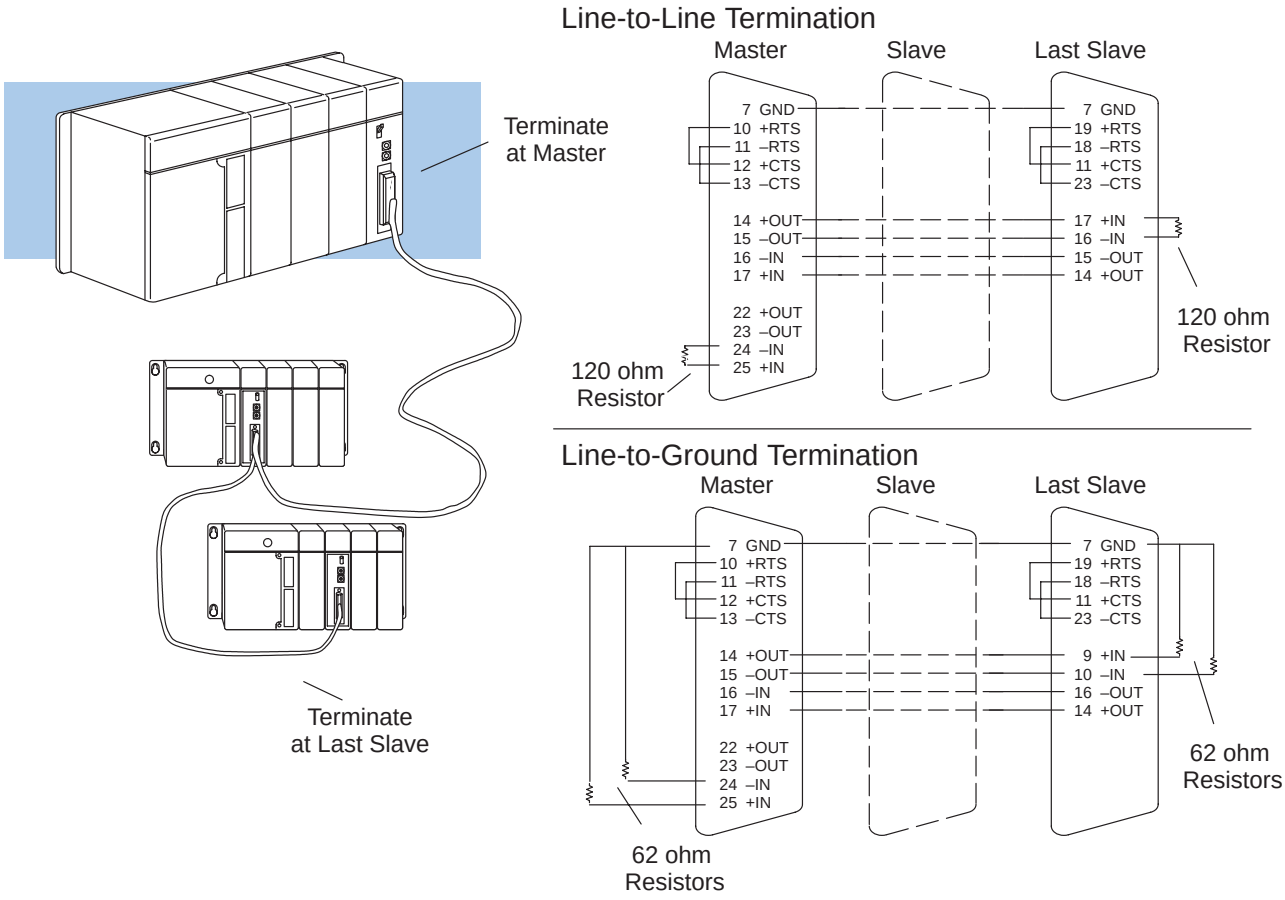
Cable Termination Resistors

It is important you add termination resistors at each end of the RS422 line. This helps reduce data errors during data transmission. You should select resistors that match the cable impedance. For example, a typical 22 AWG solid conductor cable with 4.5 twists per foot has a typical impedance of about 120Ω.

There are two ways to actually connect the resistors.

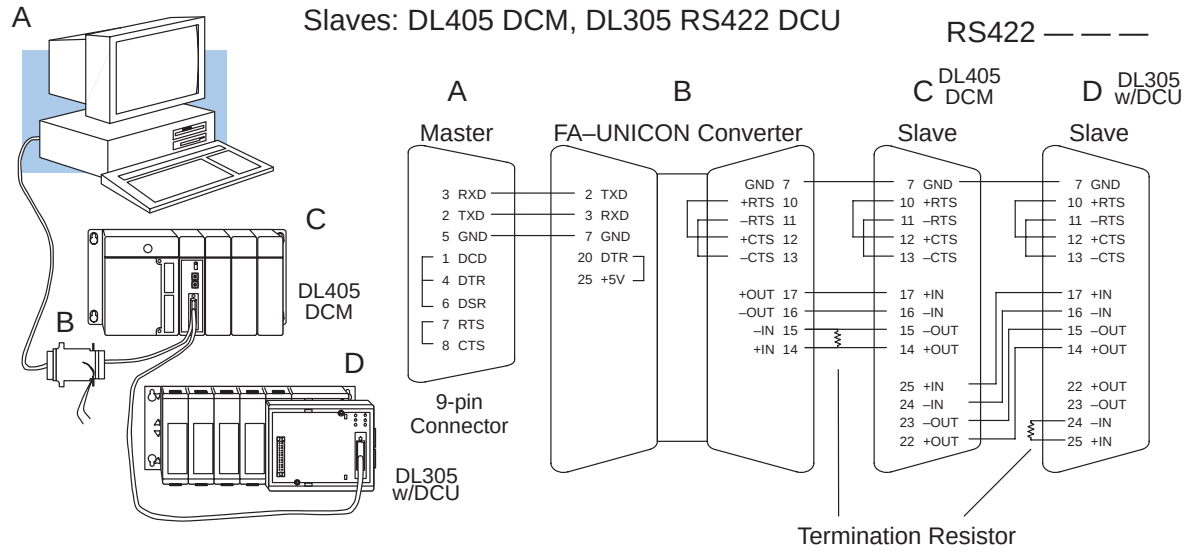
- Line-to-Line — this method balances the receive data lines (IN+ and IN–) and requires one resistor at each end of the line. (The cable diagrams we've provided show this method, but you can use either.)
- Line-to-Ground — this method also balances the receive data lines, but common mode noise rejection is improved significantly. This method requires two resistors at each end of the line. Also, since there are two resistors, the sum total of both resistors should match the cable impedance.

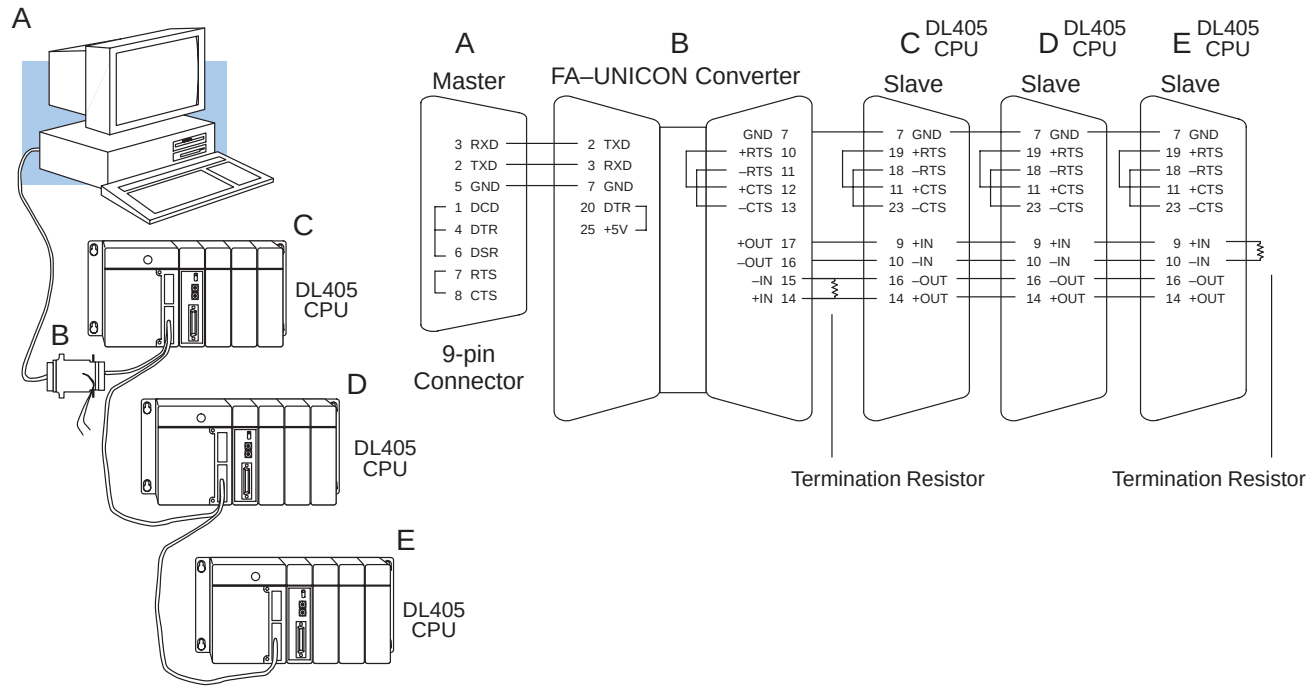
The following diagram illustrates the two options.



Pin labeling conforms to the IBM DTE and DCE standards.

Host as Master

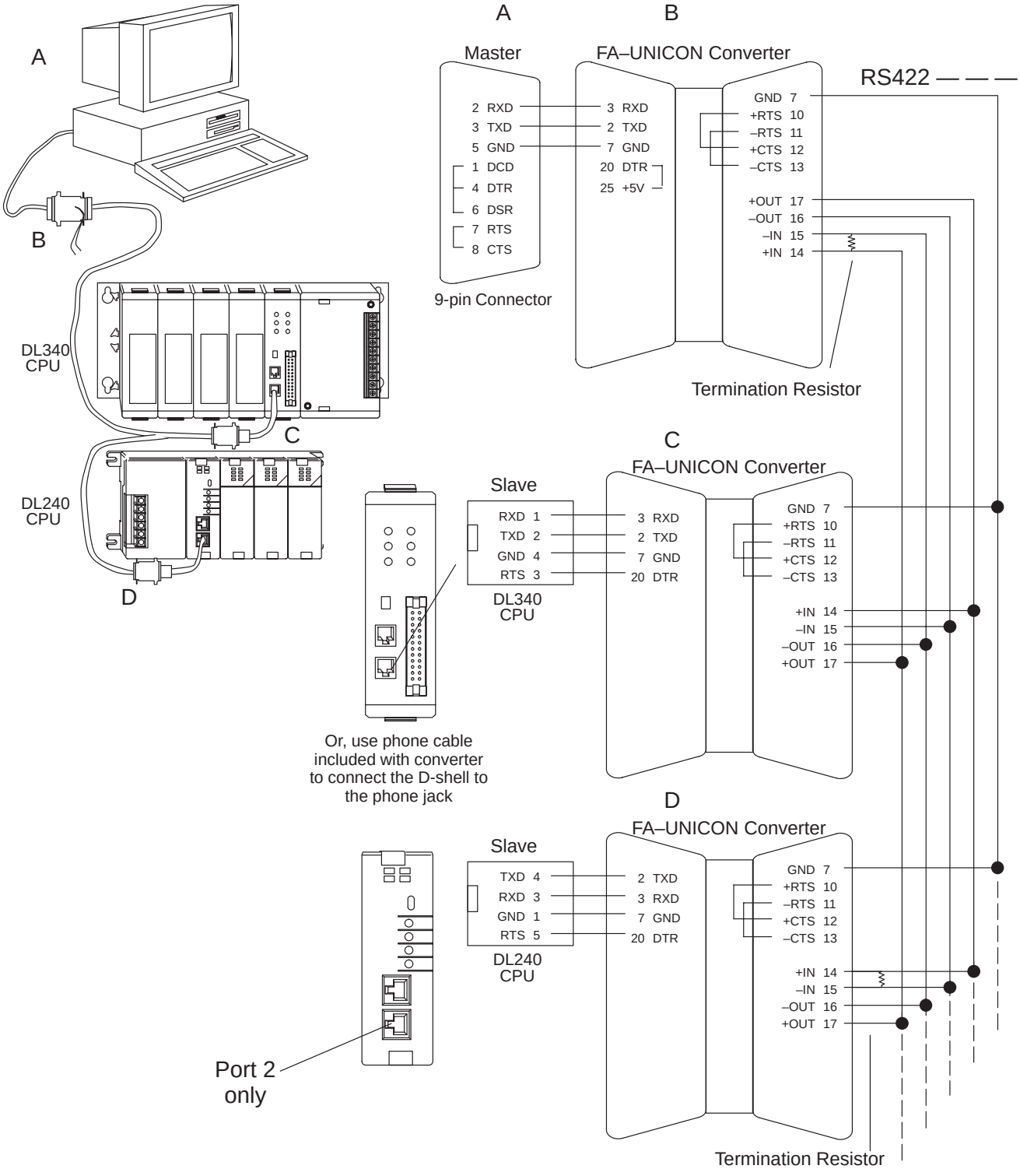




Pin labeling conforms to the IBM DTE and DCE standards.

Host as Master (continued)

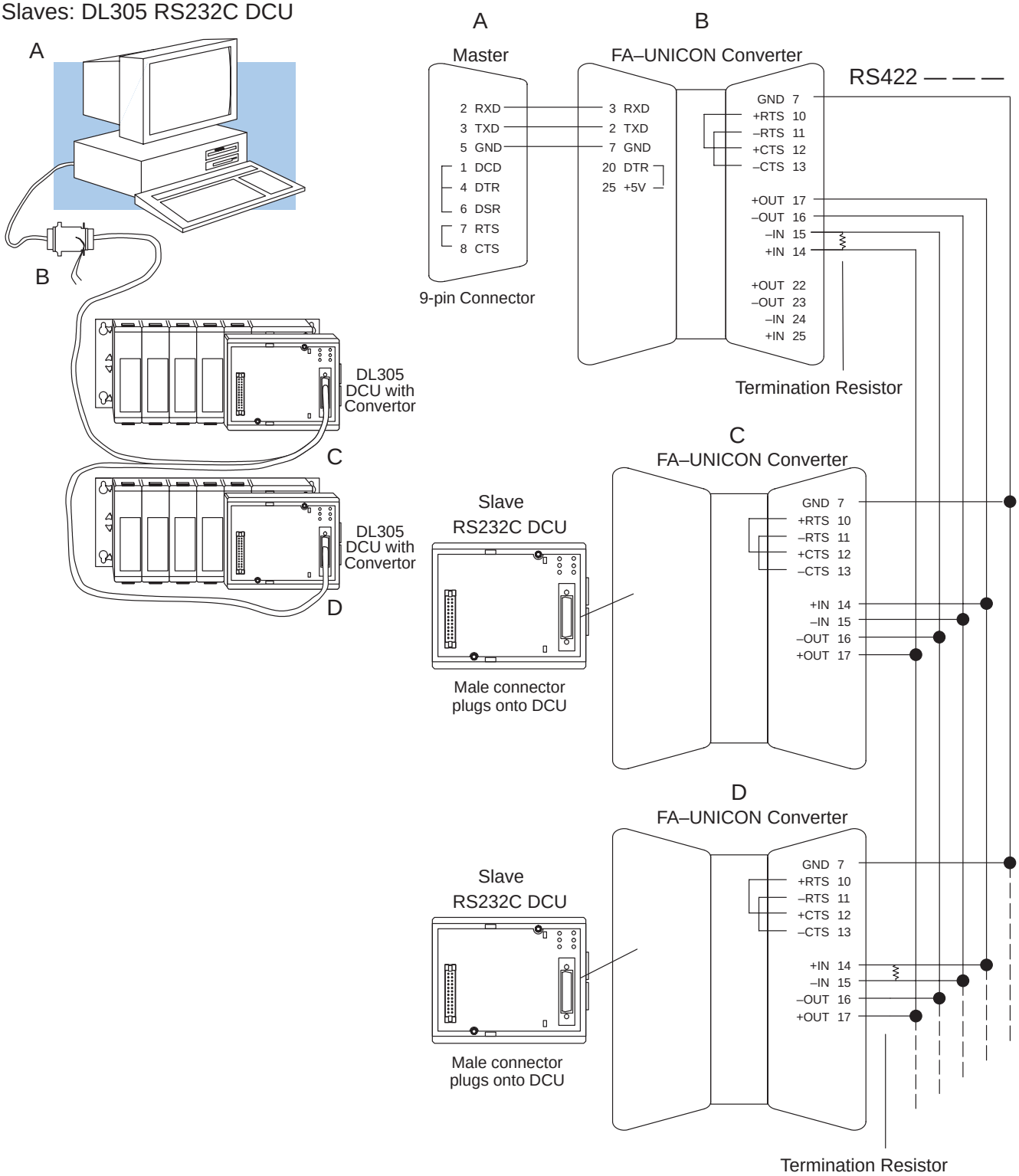
Slaves: DL340 CPU Port, DL240 CPU Port, DL205 DCM



Pin labeling conforms to the IBM DTE and DCE standards.

Host as Master (continued)

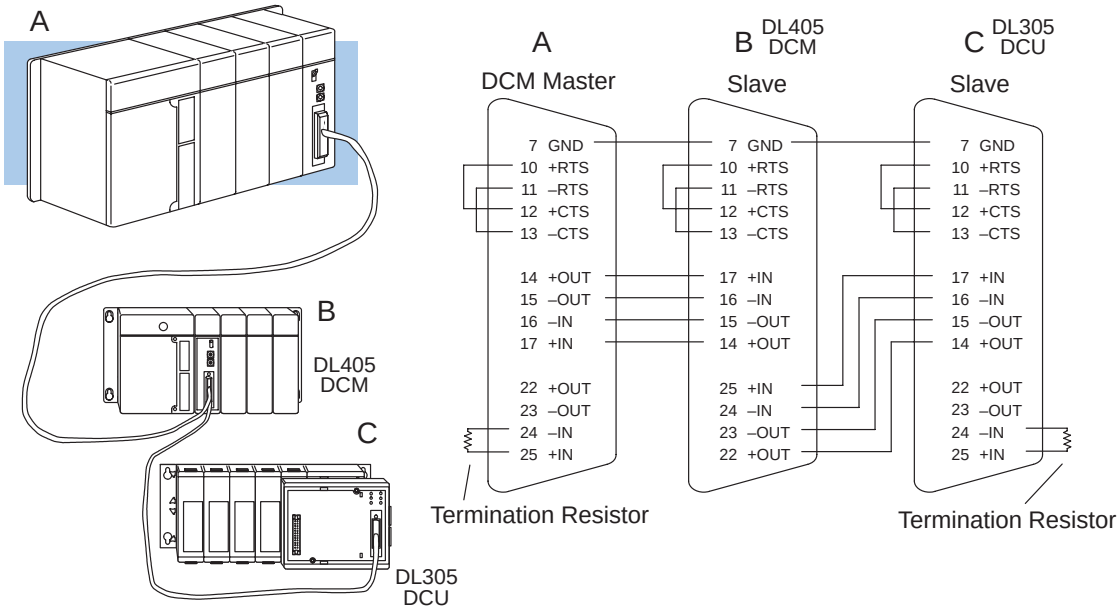
Slaves: DL305 RS232C DCU



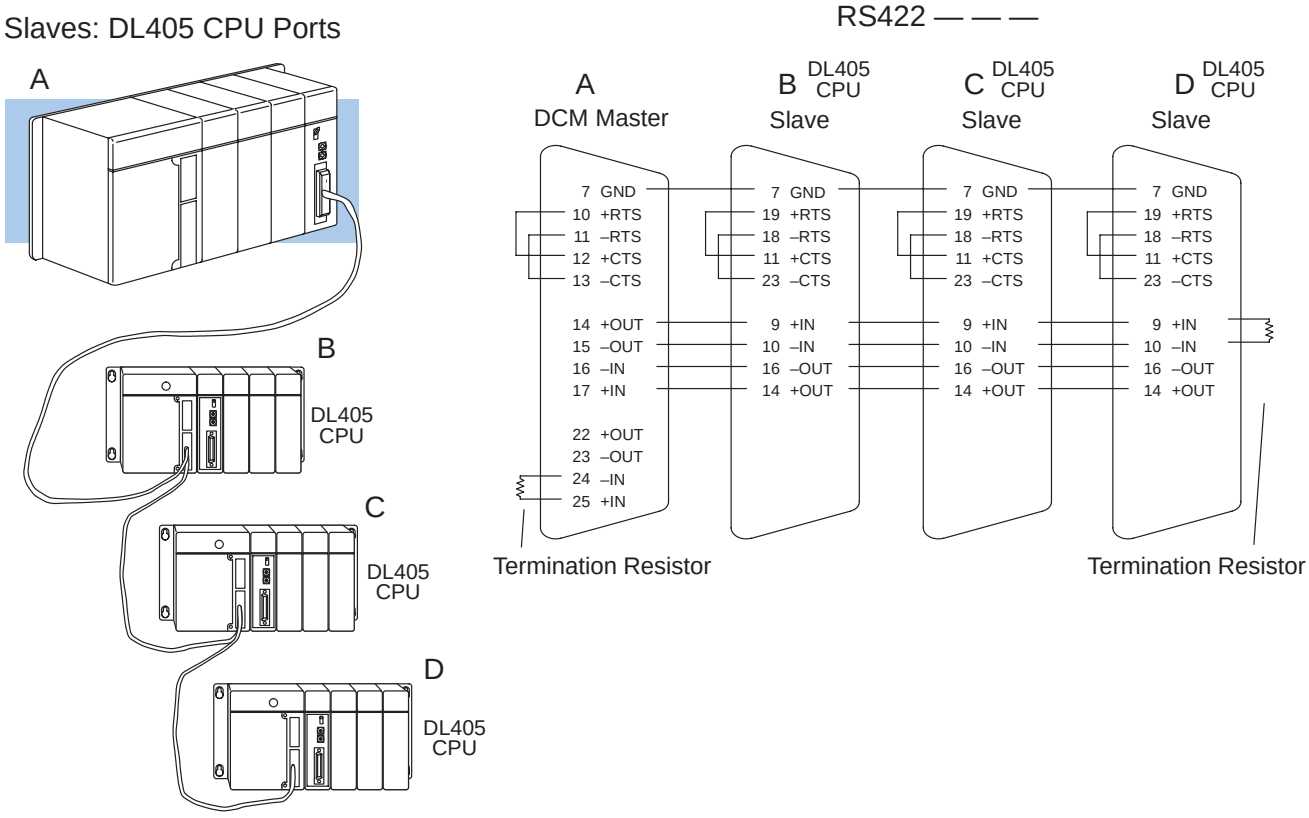
Pin labeling conforms to the IBM DTE and DCE standards.

DL405 DCM Master

Slaves: DL405 DCM, DL305 RS422 DCU



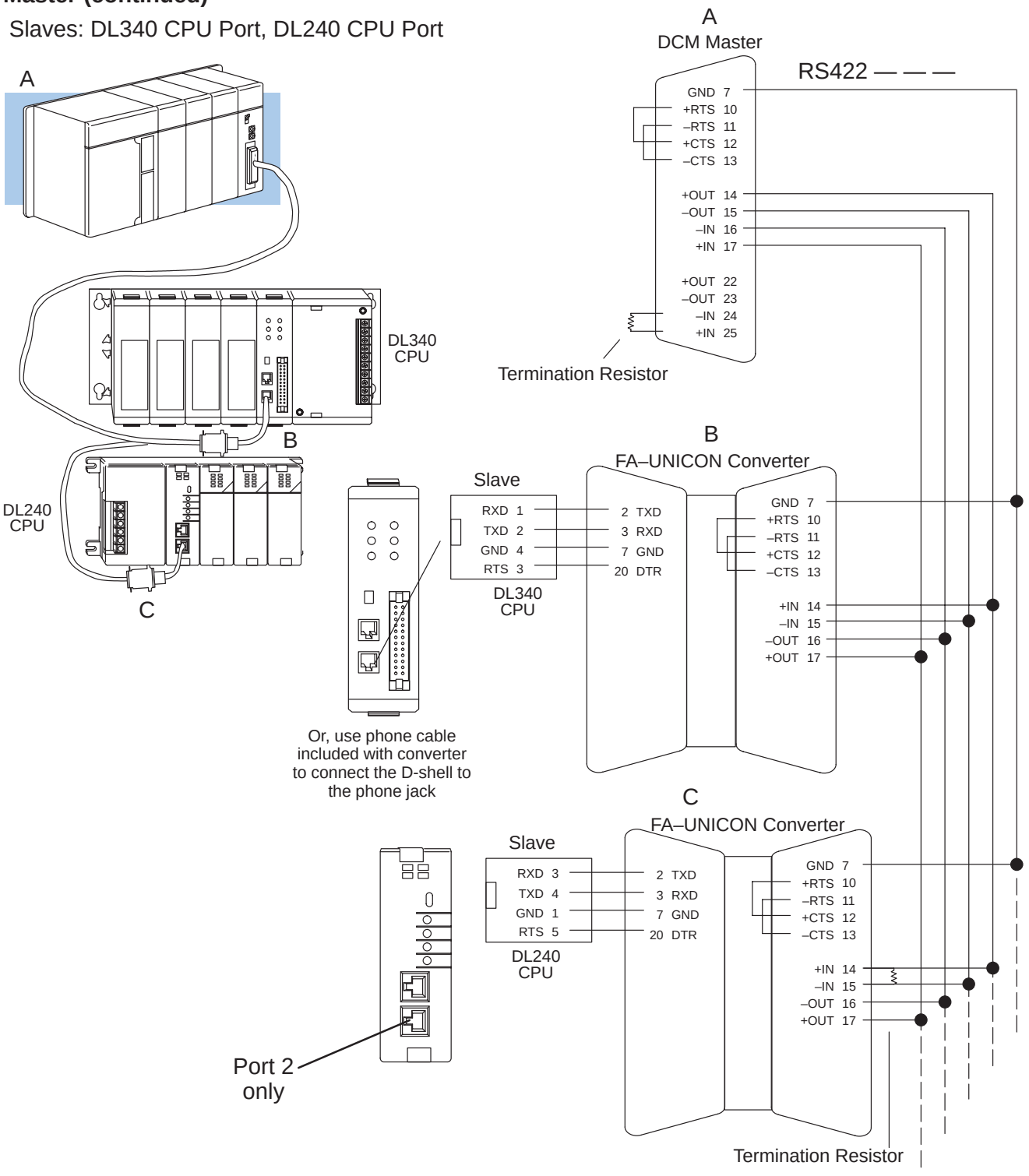
Slaves: DL405 CPU Ports



Pin labeling conforms to the IBM DTE and DCE standards.

DL405 DCM as Master (continued)

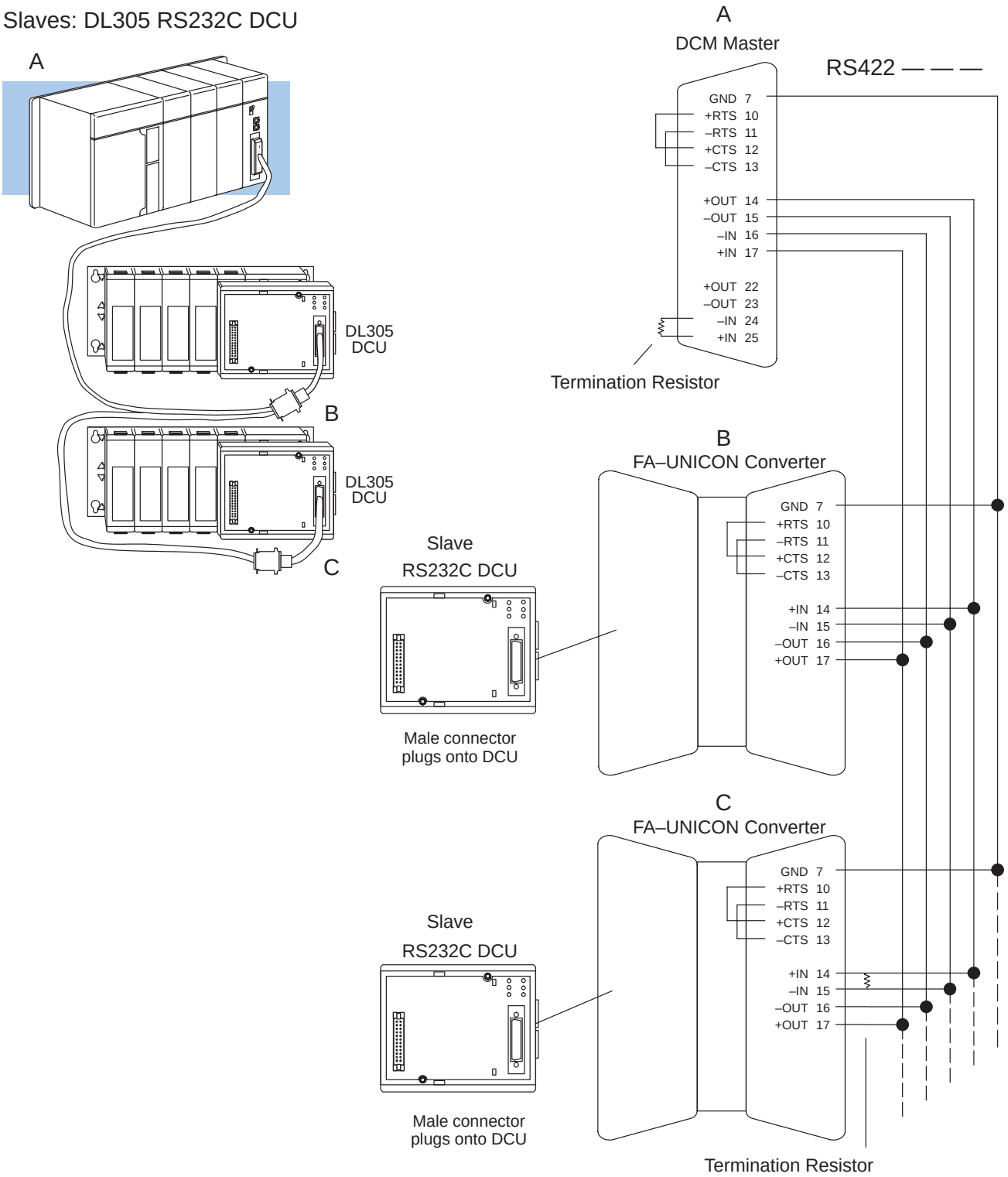
Slaves: DL340 CPU Port, DL240 CPU Port



Pin labeling conforms to the IBM DTE and DCE standards.

DL405 DCM Master (continued)

Slaves: DL305 RS232C DCU



Pin labeling conforms to the IBM DTE and DCE standards.

Network Design Checklist

You can avoid problems

Incorrect network cabling causes many problems. It's important to make sure your network design and cable selection is complete before proceeding to the next chapters. Have you .....

1. Drawn the network so you can easily identify the types of networks involved?
2. Used the cable diagrams to understand the network cabling requirements?

Once you have designed the network, you're ready to set the communications switches for each of the network stations. Chapter 4 shows you how to set the switches for the various types of stations.