Allen-Bradley

DeviceNet Media

Design and Installation 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.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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 equipment to alert people that dangerous voltage may be present.

BURN HAZARD

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

What's in This Manual

Use this manual to design and install a DeviceNet™ cable system. This manual describes the required components of the cable system and how to design for and install these required components. This manual also contains a chapter on general network troubleshooting tips.

TIP Throughout this manual, we use the terms "unsealed" and "open" interchangeably.

TIP The catalog numbers listed in this document are representative of the full range of available DeviceNet media products. For a complete list of DeviceNet media, refer to the On-machine Connectivity Catalog, publication M115-CA001.

Who Should Read This Manual

We assume that you have a fundamental understanding of:

- electronics and electrical codes
- basic wiring techniques
- ac and dc power specifications
- load characteristics of the devices attached to the DeviceNet network

For Your Reference

Rockwell Automation provides many useful tools for planning and configuring your DeviceNet network.

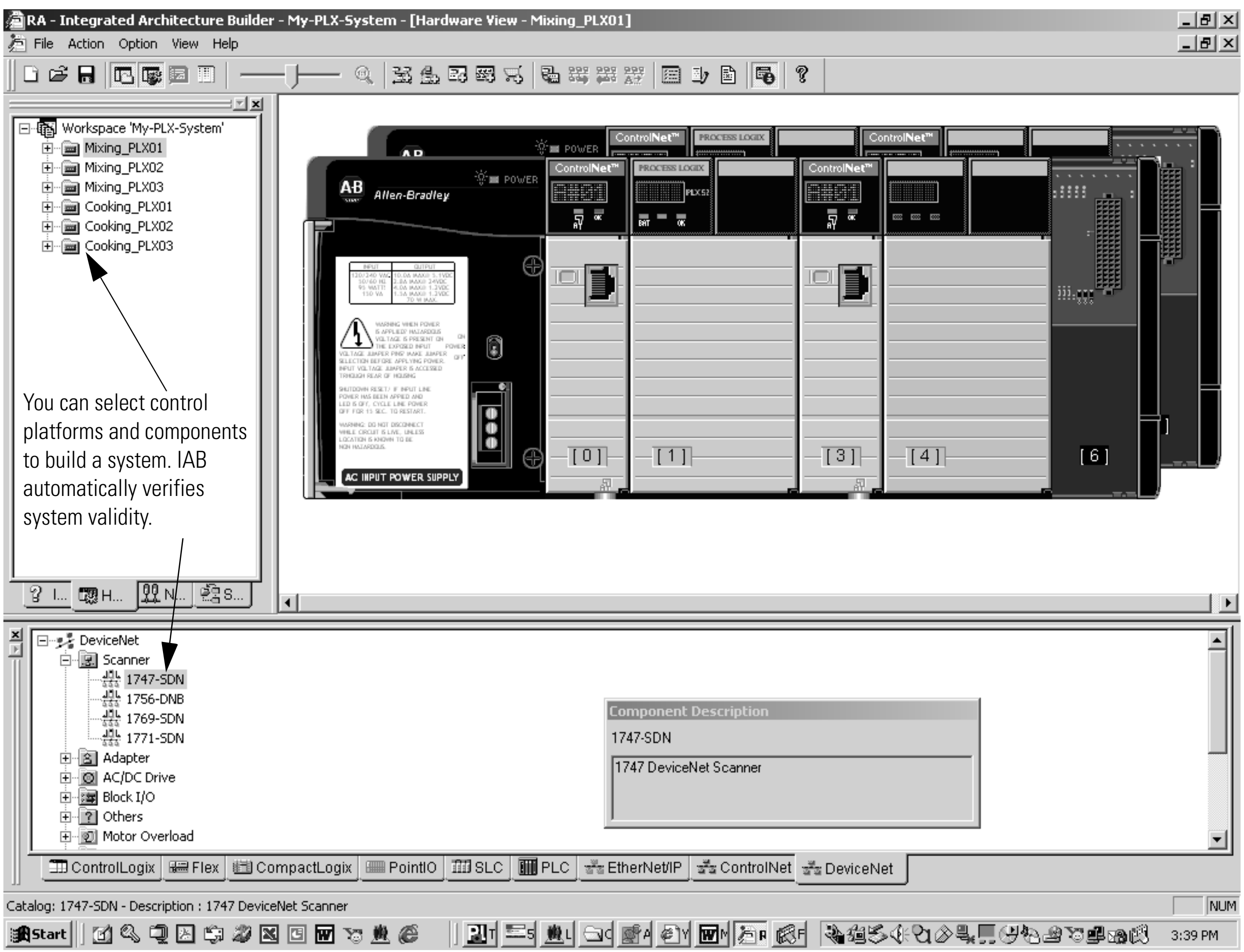
for information on	refer to	go to
selecting a DeviceNet network, as well as the individual devices you can use on the network	NetLinx Selection Guide, publication NETS-SG001	www.rockwellautomation.com/literature
	DeviceNet Media, Sensors, and Distributed I/O Catalog, publication 1485-CG001	www.rockwellautomation.com/literature
	On-machine Connectivity Catalog, publication M115-CA001	www.rockwellautomation.com/literature
	Integrated Architecture Builder	www.ab.com/logix/iab/download.html
available DeviceNet-enabled and conformance-tested products from Rockwell Automation and other vendors	The Open DeviceNet Vendor Association product catalog	www.odva.org
developer information, standards, electronic data sheet (EDS) files, etc.	Rockwell Automation's networks home page	www.ab.com/networks
guidelines and safety tips for wiring and grounding your network	Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	www.rockwellautomation.com/literature

Using Integrated Architecture Builder (IAB)

Integrated Architecture Builder is a graphical tool designed to help you configure and quote Logix-based control systems, including validation of DeviceNet cable power requirements. With IAB, you can build a control system using a wizard and other common Microsoft Windows tools such as tree views, drag-and-drop, and cut-copy-paste. IAB also allows you to open product manuals to help you configure a system. Once you configure the system, the software performs validity checking, and you can generate a report to be used in quoting the control system.

Figure Preface.1 shows a sample of the IAB interface you use to build a system.

Figure Preface.1 Integrated Architecture Builder



About the National Electric Code

Much of the information provided in this manual is representative of the capability of a DeviceNet network and its associated components. The National Electric Code (NEC), in the United States, and the Canadian Electric Code (CECode), in Canada, places limitations on configurations and the maximum allowable power/current that can be provided. Refer to Appendix A for details.

IMPORTANT During the planning and installation of your DeviceNet network, research and adhere to all national and local codes.

About the DeviceNet Network Hazardous Environment Rating

ATTENTION The DeviceNet network is not rated for use in hazardous environments, such as Class1, Div 2 installations.

Chapter 1
Get Started

Chapter 2
Identify Cable System Components

Chapter 3

Make Cable Connections

Chapter 4

Determine Power Requirements

Chapter 5

Correct and Prevent Network Problems

Appendix A

Understand Select NEC Topics

Appendix B

Power Output Devices

Index

Get Started

What's in This Chapter

This chapter introduces the DeviceNet cable system and provides a brief overview of how to set up a DeviceNet network efficiently. The steps in this chapter describe the basic tasks involved in setting up a network.

TIP The catalog numbers listed in this document are representative of the full range of available DeviceNet media products. For a complete list of DeviceNet media, refer to the On-machine Connectivity Catalog, publication M115-CA001.

Before You Begin

Before you begin laying out your DeviceNet network, take a few minutes to consider the following decisions you must make.

1. What control platform should I use?

- ☐ For help with choosing the correct control platform for the application, refer to Chapter 2 of the NetLinx Selection Guide, publication NETS-SG001.

- ☐ After selecting the control platform, use Chapter 2 of the NetLinx Selection Guide, publication NETS-SG001, to help you choose the DeviceNet communication interface for that platform.

TIP	Once you have selected all DeviceNet devices for your network, calculate the total data size required by the DeviceNet-networked devices. Compare the total data size required against the total amount available from the DeviceNet scanner module you have selected.

2. What I/O devices will I need?

- ☐ For help with choosing the correct I/O devices for the application, refer to Chapter 2 of the NetLinx Selection Guide, publication NETS-SG001.

- ☐ If you plan to hard-wire certain devices to I/O modules, calculate the total number of discrete I/O points, such as sensors, photoeyes, etc., in your application.

TIP	All DeviceNet-capable devices require a unique network node number, which counts against the total node count of 63. If the I/O points are standard discrete versions, they will be connected to t he DeviceNet network via a discrete I/O-to-DeviceNet adapter. In this case, only the I/O adapter would require a network node number, allowing you to connect multiple I/O points with one adapter.

- ☐ Calculate the total required analog I/O channels.

- ☐ Calculate the total I/O points being brought into I/O modules versus direct connections to the network.

- ☐ Decide which type of discrete I/O you will use in your application: sealed (such as FLEXArmor or MaXum), or open-style (typically contained in enclosures).

☐ Decide whether to use DeviceLogix™/EE-capable I/O to run internal, programmable logic within the actual devices for fast execution rates.

☐ Document the data table requirements for each node. This information will help you develop the control platform user program.

3. What type of network media is best for my application?

☐ For help in determining which media best fits your application, refer to the following publications:

for	refer to
media characteristics and specifications	DeviceNet Media, Sensors, and Distributed I/O Catalog, publication 1485-CG001
	On-machine Connectivity Catalog, publication M115-CA001
guidelines for wiring and grounding your network	Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1

☐ Determine whether you need a Class 1 or Class 2 cabling system.

☐ Choose sealed or unsealed media for your application's environment.

☐ Choose the maximum trunk length allowable within specifications for the cable type and communication baud rate.

☐ Ensure that your cumulative cable drop length is within specifications for the network baud rate.

☐ Ensure that all individual drop line lengths are </= 20 ft. (6m).

☐ Ensure that you have one 121Ω terminating resistor at each end of the trunk line.

4. Which power supply will be adequate for my application?

☐ Refer to this publication for further details on selecting a power supply.

5. How do I configure my network?

☐ You can use RSNetWorx for DeviceNet software to generate an offline configuration file which contains all the I/O mapping for your system. This file will help you develop a control platform user program. Refer to the online help accompanying RSNetWorx for DeviceNet software for assistance in adding and configuring devices.

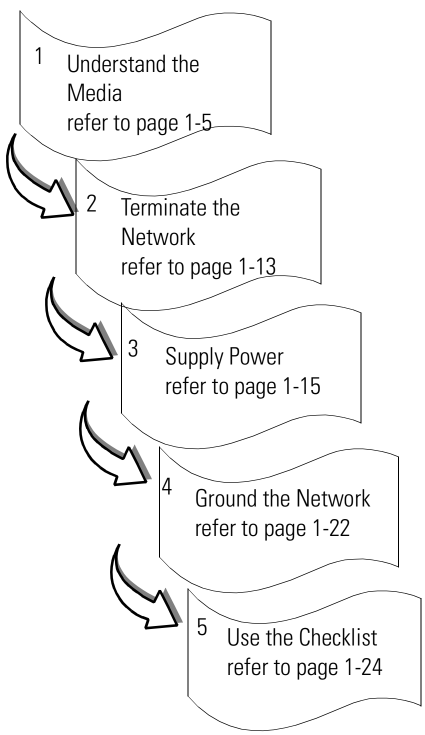
- ☐ Once you have added devices, use either RSNetWorx for DeviceNet software or the device's hardware mechanism to commission a node for that device.
- ☐ Use RSNetWorx for DeviceNet software to create and download a scanlist to the master scanner.

6. How do I check system performance?

- ☐ To obtain Rockwell Automation's off-line performance simulation tools, visit www.ab.com and click on Support ⇒Knowledgebase ⇒DeviceNet Performance.

Set Up a DeviceNet Network

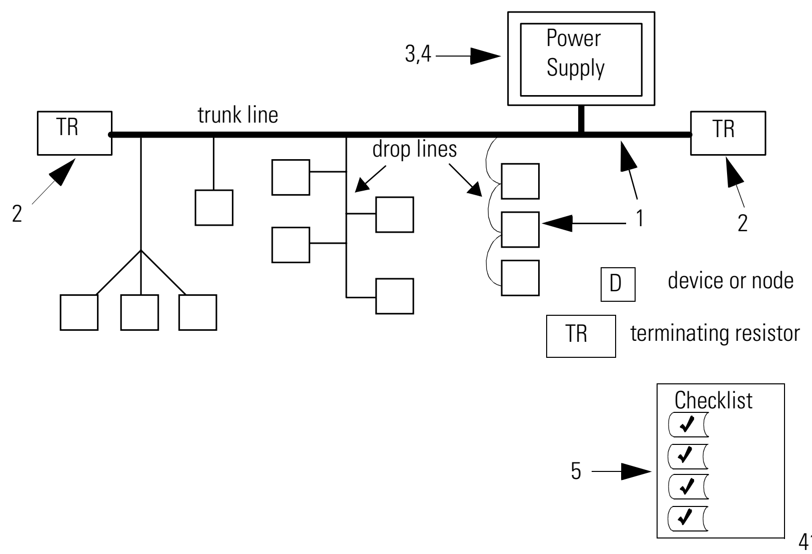
The following diagram illustrates the steps that you should follow to plan and install a DeviceNet network. The remainder of this chapter provides an overview and examples of each step.



1 Understand the Media	Refer to page 1-5
2 Terminate the Network	Refer to page 1-13
3 Supply Power	Refer to page 1-15
4 Ground the Network	Refer to page 1-22
5 Use the Checklist	Refer to page 1-24

Basic DeviceNet network

This figure shows a basic DeviceNet network and calls out its basic components.



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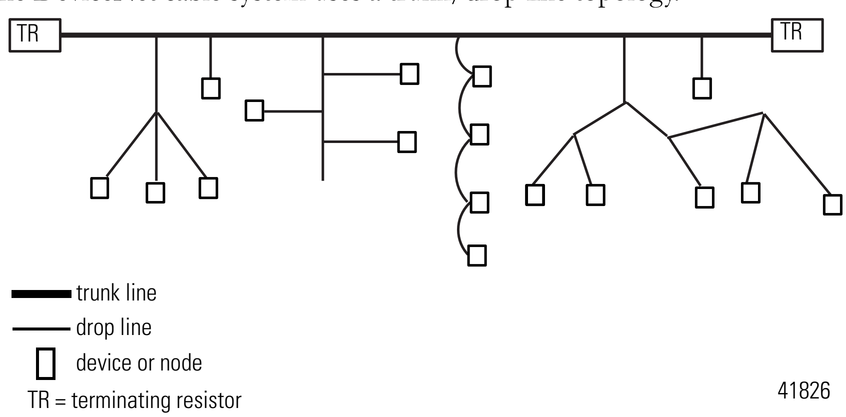
1 Understand the Media

You must terminate the trunk line at both ends with 121Ω, 1%, 1/4W or larger terminating resistors.

Understand the topology

The DeviceNet cable system uses a trunk/drop line topology.



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Understand the cable options

All Allen-Bradley media, including KwikLink, meets or exceeds the specifications defined in the ODVA DeviceNet Specification.

You can connect components using three cable options.

Use this cable	As
Round (thick)	the trunk line on the DeviceNet network with an outside diameter of 12.2 mm (0.48 in.). You can also use this cable for drop lines.
Round (thin)	the drop line connecting devices to the main line with an outside diameter of 6.9 mm (0.27 in.). This cable has a smaller diameter and is more flexible than thick cable. You can also use this cable for the trunk line.
Flat Class 1 power supplies allow for an 8A system and the use of Class 1 flat cable. Class 2 flat cable must not exceed 4A.	the trunk line on the DeviceNet network, with dimensions of 19.3 mm x 5.3 mm (0.76 in. x 0.21 in.). This cable has no predetermined cord lengths, and you are free to put connections wherever you need them.
KwikLink drop cable	a non-shielded, 4-conductor drop cable for use only in KwikLink systems.
Unshielded drop cable	a non-shielded, 4-conductor drop cable (with an outside diameter specified by the vendor) for use only in flat cable systems

Determine the maximum trunk line distance

The maximum cable distance is not necessarily the trunk length only. It is the maximum distance between any two devices.

TIP

Round cable (both thick and thin) contains five wires: One twisted pair (red and black) for 24V dc power, one twisted pair (blue and white) for signal, and a drain wire (bare).

Flat cable contains four wires: One pair (red and black) for 24V dc power; one pair (blue and white) for signal.

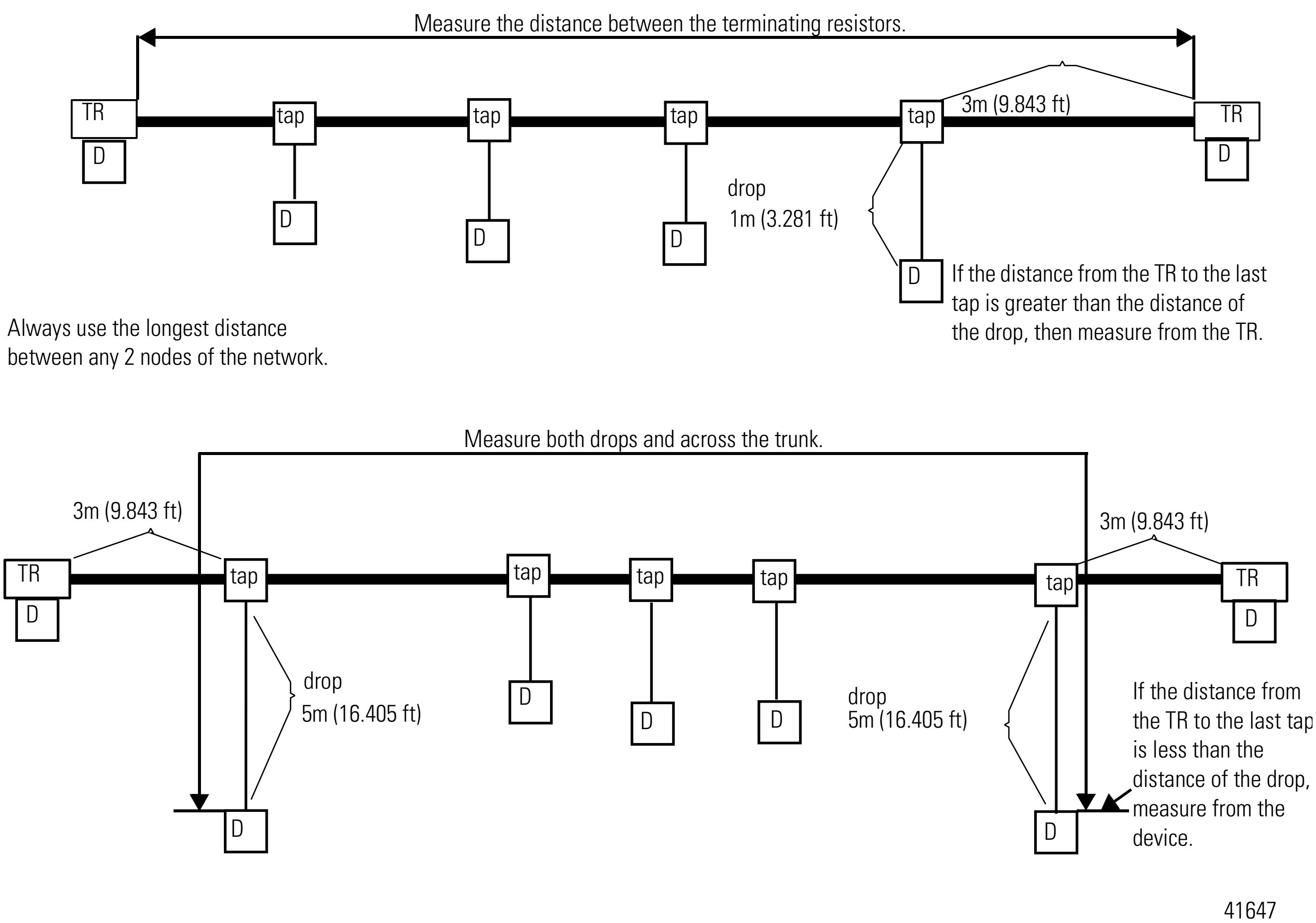
Drop cable for KwikLink is a 4-wire unshielded gray cable. It is used only with KwikLink flat cable systems.

Wire Color	Wire Identity	Usage Round	Usage Flat
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power

The distance between any two points must not exceed the maximum cable distance allowed for the data rate used.

Data rate	Maximum distance (flat cable)	Maximum distance (thick cable)	Maximum distance (thin cable)
125k bit/s	420m (1378 ft)	500m (1640 ft)	100m (328 ft)
250k bit/s	200m (656 ft)	250m (820 ft)	100m (328 ft)
500k bit/s	75m (246 ft)	100m (328 ft)	100m (328 ft)

In most cases, the maximum distance should be the measurement between terminating resistors. However, if the distance from a trunk line tap to the farthest device connected to the trunk line is greater than the distance from the tap to the nearest terminating resistor (TR), then you must include the drop line length as part of the cable length.



TIP

To extend the length of your network and allow longer drop line lengths, you can purchase a bus extender or wireless DeviceNet modem from various vendors, such as Western Reserve Controls, one of Rockwell Automation's Encompass partners. Contact your Rockwell Automation representative for details.

Determine the cumulative drop line length

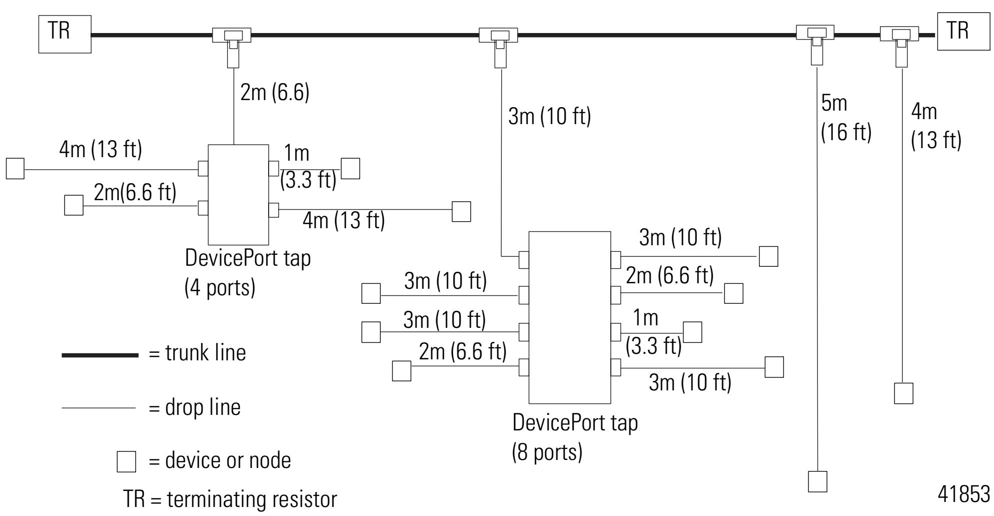
The data rate you choose determines the trunk line length and the cumulative length of the drop line.

The maximum cable distance from any device on a branching drop line to the trunk line is 6m (20 ft).

The cumulative drop line length refers to the sum of all drop lines, thick or thin cable, in the cable system. This sum cannot exceed the maximum cumulative length allowed for the data rate used.

Data rate	Cumulative drop line length
125k bit/s	156m (512 ft)
250k bit/s	78m (256 ft)
500k bit/s	39m (128 ft)

The following example uses four T-Port (single-port) taps and two DevicePort™ (multi-port) taps to attach 13 devices to the trunk line. The cumulative drop line length is 42m (139 ft) and no single node is more than 6m (20 ft) from the trunk line. This allows you to use a data rate of 250k bit/s or 125k bit/s. A data rate of 500k bit/s cannot be used in this example because the cumulative drop line length (42m) exceeds the total allowed (39m) for that data rate.



Wire Color	**Wire Identity**	**Usage Round**	**Usage Flat**
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power

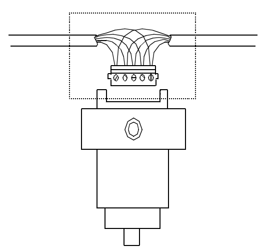
About direct connection

Connect devices directly to the trunk line only if you can later remove the devices without disturbing communications on the cable system.This is called a "zero-length" drop, because it adds nothing (zero) when calculating cumulative drop line length.

IMPORTANT If a device provides only fixed-terminal blocks for its connection, you must connect it to the cable system by a drop line. Doing this allows you to remove the device at the tap without disturbing communications on the trunk line of the cable system.

About connectors

Connectors attach cables to devices or other components of the DeviceNet cable system. Field-installable connections are made with either sealed or open connectors.



device with removable open-style connector

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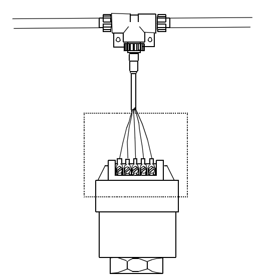

device with fixed, open-style connector

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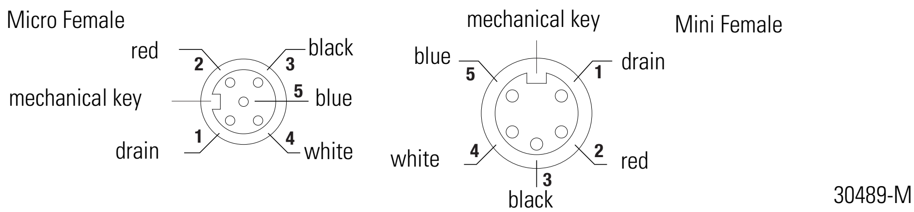
Connector	**Description**
Sealed	Mini-style: Attaches to taps and thick and thin cable. Micro-style: Attaches to thin cable only - has a reduced current rating.
Open	Plug-in: Cable wires attach to a removable connector. Fixed: Cable wires attach directly to non-removable screw terminals (or equivalent) on device.

Mini/Micro field-installable quick-disconnect (sealed) connectors (round media only)

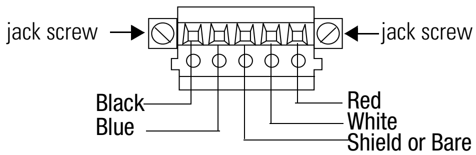
Screw terminals connect the cable to the connector. See Chapter 3 for information about making cable connections.



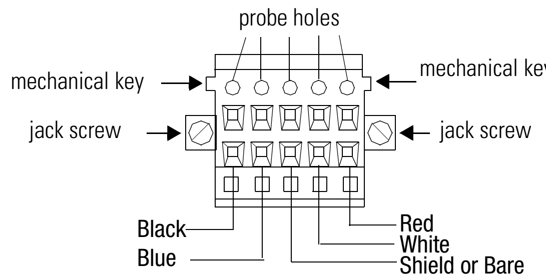
Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.		
	Catalog number	
Description	**Thin**	**Thick**
Straight micro male	871A-TS5-DM1	n/a
Straight micro female	871A-TS5-D1	n/a
Right-angle micro male	871A-TR5-DM1	n/a
Right-angle micro female	871A-TR5-D1	n/a
Straight Mini male	871A-TS5-NM1	871A-TS5-NM3
Straight Mini female	871A-TS5-N1	871A-TS5-N3

Plug-in field-installable (open) connectors

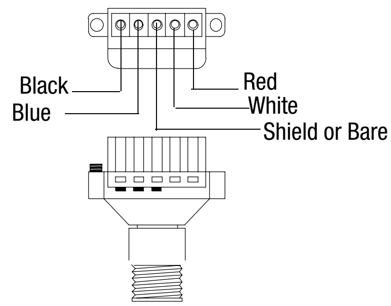
Most open-style devices ship with an open-style connector included. These connectors are also shipped in packages of 10.



5-pin linear plug (open) 41707



10-pin linear plug (open) 41708



5-pin linear to micro adapter

Description	Catalog number
5-pin linear plug (open; with jack screws)	1799-DNETSCON
5-pin linear plug (open; without jack screws)	1799-DNETCON
10-pin linear plug (open)	1787-PLUG10R
5-pin linear to micro male adapter	1799-DNC5MMS

2 Terminate the Network

The terminating resistor reduces reflections of the communication signals on the network. Choose your resistor based on the type of cable (round or flat) and connector (open or sealed) you use.

For round cable:

- the resistor may be sealed when the end node uses a sealed T-port tap
- the resistor may be open when the end node uses an open-style tap

For flat cable:

- the resistor is a snap-on cap for the KwikLink connector base, available in sealed and unsealed versions

To verify the resistor connection, disconnect power and measure the resistance across the Can_H and Can_L lines (blue and white wires, respectively). This reading should be approximately 50-60Ω.

Do not put a terminating resistor on a node with a non-removable connector. If you do so, you risk network failure if you remove the node. You must put the resistor at the end of the trunk line.

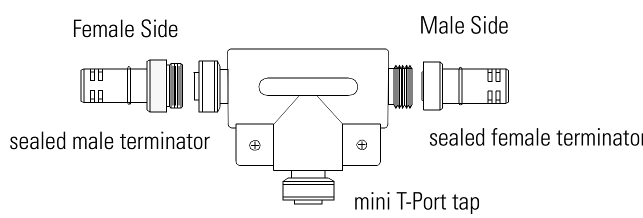
You must attach a terminating resistor of 121Ω, 1%, 1/4W or larger, to each end of the trunk cable. You must connect these resistors directly across the blue and white wires of the DeviceNet cable.

ATTENTION

If you do not use terminating resistors as described, the DeviceNet cable system will **not** operate properly.

The following terminating resistors provide connection to taps and the trunk line.

- sealed-style terminating resistors. Male or female connections attach to:
  - trunk line ends
  - T-Port taps



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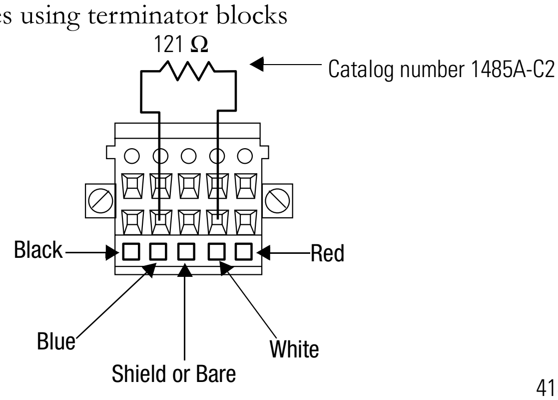
Description	Catalog number
Sealed male terminator	1485A-T1M5
Sealed female terminator	1485A-T1N5

- open-style terminating resistors. 121Ω, 1%, 1/4W or larger resistors connecting the white and blue conductors in micro- or mini-style attach to:
  - open-style T-Port taps
  - trunk lines using terminator blocks

Wire Color	Wire Identity	Usage Round	Usage Flat
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power



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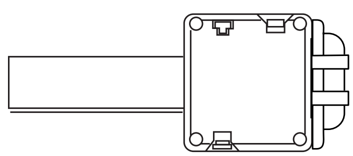
- KwikLink flat cable terminating resistors

The 121Ω resistor is contained in the snap-on interface module:

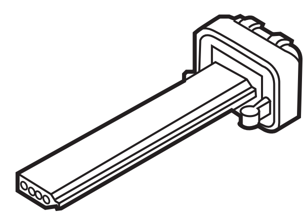
- sealed terminator with an Insulation Displacement Connector (IDC) base (NEMA 6P, 13; IP67) catalog number 1485A-T1E4
- unsealed terminator with IDC base (no gaskets) (NEMA 1; IP60) catalog number 1485A-T1H4

Network end caps are included with each KwikLink terminator; see page 3-14 for complete installation instructions.



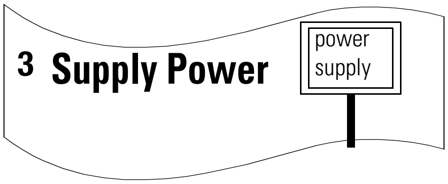
terminating resistor with end cap

30490-M



end cap

30479-M

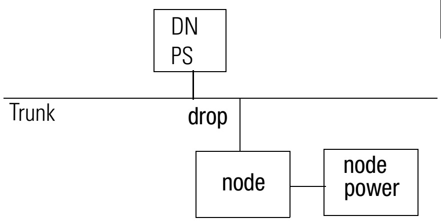


Guidelines for supplying power

The cable system requires the power supply to have a rise time of less than 250 milliseconds to within 5% of its rated output voltage. You should verify the following:

- the power supply has its own current limit protection
- fuse protection is provided for each segment of the cable system
  - any section leading away from a power supply must have protection
- the power supply is sized correctly to provide each device with its required power
- derate the supply for temperature using the manufacturer's guidelines

Use the power supply to power the DeviceNet cable system only. If a device requires a separate 24V power source other than the DeviceNet power source, you should use an additional 24V power source.



IMPORTANT	For thick cable and Class 2 flat cable, your national and local codes may not permit the full use of the power system capacity. For example, in the United States and Canada, the power supplies that you use with Class 2 thick cable must be Class 2 listed per the NEC and CECode. The total current allowable in any section of thick cable must not exceed 4A. Class 1 power supplies allow for an 8A system, and the use of Class 1 flat cable. See Appendix A for more information about national and local codes. Appendix B, "Power Output Devices", provides important information to the installer.

Choose a power supply

The total of all of the following factors must not exceed 3.25% of the nominal 24V needed for a DeviceNet cable system.

- initial power supply setting - 1.00%
- line regulation - 0.30%
- temperature drift - 0.60% (total)
- time drift - 1.05%
- load regulation - 0.30%

Use a power supply that has current limit protection as described in national codes such as NEC, Article 725.

IMPORTANT The dc output of all supplies must be isolated from the ac side of the power supply and the power supply case.

To determine the required power supply current:

1. Add the current requirements of all devices drawing power from the network.
   For example:
   6.3A
2. Add an additional 10% to this total to allow for current surge.
   e.g. 6.3A x 10% = 6.93A
3. Make sure the total of 2 is less than the minimum name-plate current of the power supply you are using.
   e.g. 6.3A < 8A and NEC/CECode

If you use a single power supply, add the current requirements of all devices drawing power from the network. This is the minimum name-plate current rating that the power supply should have. We recommend that you use the Allen-Bradley 24V dc power supply (catalog number 1787-DNPS) to comply with the Open DeviceNet Vendor Association (ODVA) power supply specifications and NEC/CECode Class 2 characteristics (if applicable).

About power ratings

Although the round thick cable and Class 1 flat cable are both rated to 8A, the cable system can support a total load of more than 8A. For example, a 16A power supply located somewhere in the middle of the cable system can supply 8A to both sides of the PowerTap™. It can handle very large loads as long as no more than 8A is drawn through any single segment of the trunk line. However, cable resistance may limit your application to less than 8A.

Drop lines, thick or thin, are rated to a maximum of 3A, depending on length. The maximum current decreases as the drop line length increases.

Drop line length	Allowable current
1.5m (5 ft)	3A
2m (6.6 ft)	2A
3m (10 ft)	1.5A
4.5m (15 ft)	1A
6m (20 ft)	0.75A

You may also determine the maximum current in amps (I) by using:

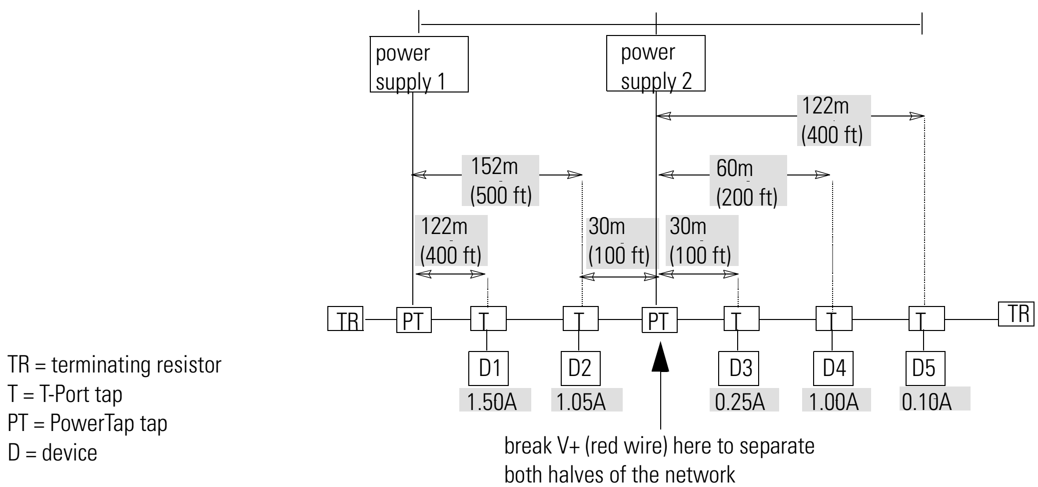
$I = 15/L$, where L is the drop line length in feet
$I = 4.57/L$, where L is the drop line length in meters

The maximum allowable current applies to the sum of currents for all nodes on the drop line. As shown in the example on page Page 1-7, the drop line length refers to the maximum cable distance from any node to the trunk line, not the cumulative drop line length.

- high maximum common mode voltage drop on the V- (black) and V+ (red) conductors
  – the voltage difference between any two points on the V- conductor must not exceed the maximum common mode voltage of 4.65V
- voltage range between V- and V+ at each node within 11 to 25V

Size a power supply

Follow the example below to help determine the minimum continuous current rating of a power supply servicing a common section.



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Power supply 1

Add each device's (D1, D2) DeviceNet current draw together for power supply 1 (**1.50+1.05=2.55A**)

Results

2.55A is the minimum name-plate current rating that power supply 1 should have. Remember to consider any temperature or environmental derating recommended by the manufacturer.

IMPORTANT	This derating factor typically does not apply when you consider the maximum short circuit current allowed by the national and local codes.

Power supply 2

Add each device's (D3, D4, D5) current together for power supply 2 (**0.25+1.00+0.10=1.35A**).

Results

1.35A is the minimum name-plate current rating that power supply 2 should have. Remember to consider any temperature or environmental derating recommended by the manufacturer.

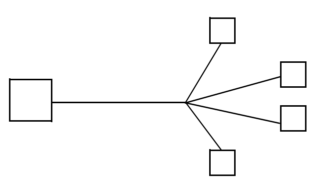
Place the power supply

DeviceNet networks with long trunk lines or with devices on them that draw large currents at a long distance sometimes experience difficulty with common mode voltage. If the voltage on the black V- conductor differs by more than 4.65 volts from one point on the network to another, communication problems can occur. Moreover, if the voltage between the black V- conductor and the red V+ conductor ever falls below 15 volts, then common mode voltage could adversely affect network communication. To work around these difficulties, add an additional power supply or move an existing power supply closer to the heavier current loads.

If possible, power supplies should be located at the middle of the network to shorten the distance from the power supply to the end of the network.

To determine if you have adequate power for the devices in your cable system, use the look-up method which we describe more fully in Chapter 4. See the following example and figure (other examples follow in Chapter 4). You have enough power if the total load does not exceed the value shown by the curve or the table.

In a worst-case scenario, all of the nodes are assumed to be together at the opposite end of the power supply, which draws all current over the longest distance.

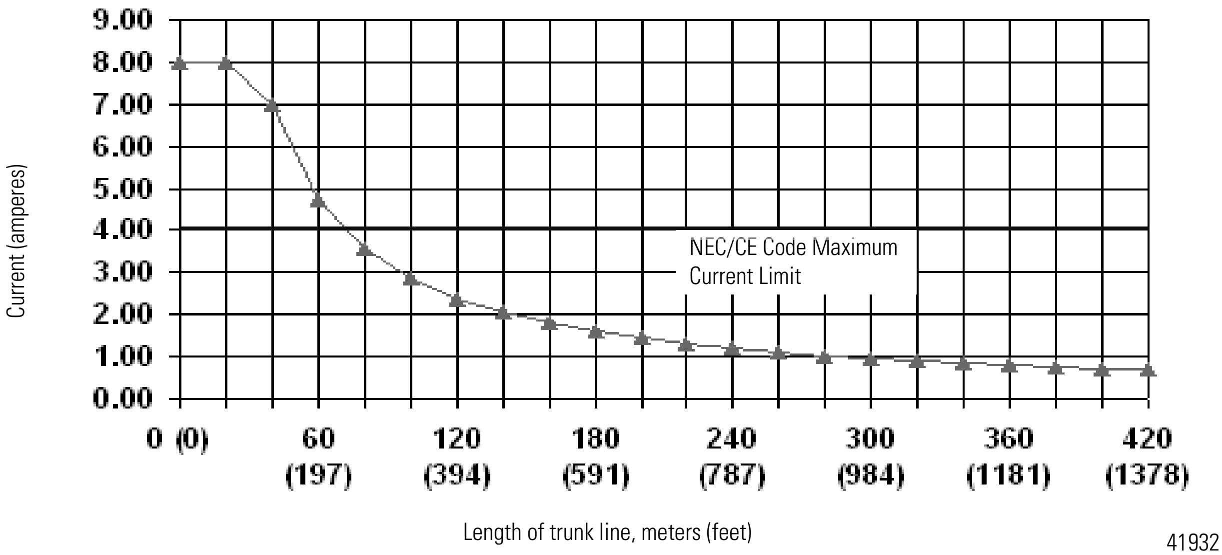


4171

IMPORTANT This method may underestimate the total current capacity of your network by as much as 4 to 1. See Chapter 4 to use the full-calculation method if your supply does not fit under the curve.

A sample curve for a single, end-connected power supply is shown on the next page.

Figure 1.1 One Power Supply (End Segment) KwikLink Cable (Flat)

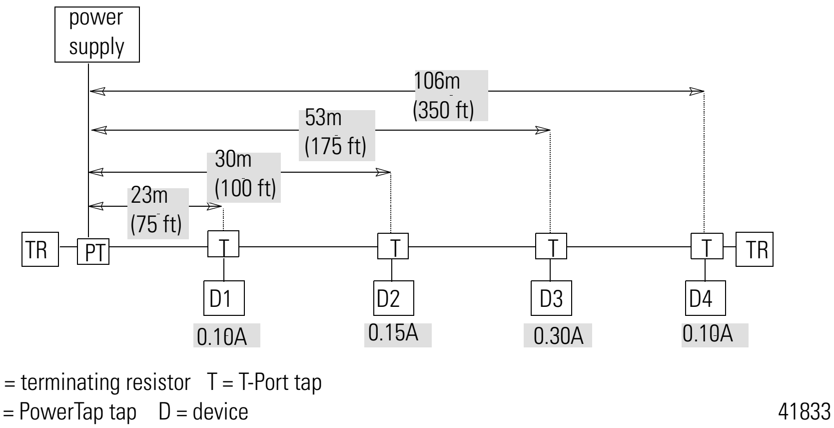


Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*
20 (66)	8.00*
40 (131)	7.01*
60 (197)	4.72*
80 (262)	3.56
100 (328)	2.86
120 (394)	2.39
140 (459)	2.05
160 (525)	1.79
180 (591)	1.60
200 (656)	1.44
220 (722)	1.31
240 (787)	1.20
260 (853)	1.11
280 (919)	1.03
300 (984)	0.96
320 (1050)	0.90
340 (1115)	0.85
360 (1181)	0.80
380 (1247)	0.76
400 (1312)	0.72
420 (1378)	0.69

*Exceeds NEC CL2/CECode 4A limit.

IMPORTANT	This configuration assumes all nodes are at the opposite end of the cable from the power supply.

The following example uses the look-up method to determine the configuration for one end-connected power supply. One end-connected power supply provides as much as 8A near the power supply.



1. Determine the total length of the network.

   106m

2. Add each device's current together to find the total current consumption.

   0.10 + 0.15+ 0.30 + 0.10 = 0.65A

IMPORTANT	Make sure that the required power is less than the rating of the power supply. You may need to derate the supply if it is in an enclosure.

3. Find the next largest network length using the table on page 1-19 to determine the approximate maximum current allowed for the system.

   120m (2.47A)

Results

Since the total current does not exceed the maximum allowable current, the system will operate properly (0.65A ≤ 2.47A).

IMPORTANT	If your application doesn't fit "under the curve," you may either: • Do the full-calculation method described in Chapter 4. • Move the power supply to somewhere in the middle of the cable system and reevaluate as described in the previous section.

Connect power supplies

To supply power you will need to install and ground the power supplies. To install a power supply:

ATTENTION

Make sure the ac power source remains off during installation.

1. Mount the power supply securely allowing for proper ventilation, connection to the ac power source, and protection from environmental conditions according to the specifications for the supply.

2. Connect the power supply using:
    - a cable that has one pair of 12 AWG($4mm^2$) conductors or the equivalent or two pairs of 15 AWG ($2.5mm^2$) conductors
    - a maximum cable length of 3m (10 ft) to the power tap
    - the manufacturer's recommendations for connecting the cable to the supply

Metric sizes are for reference only. Select a wire size big enough for the maximum current.

4 Ground the Network

power supply

You must ground the DeviceNet network at only one location. Follow the guidelines described below.

ATTENTION

To prevent ground loops,

- **For Round media** - Ground the V- conductor, shield, and drain wire at **only one** place.
- **For Flat media** - Ground the V- conductor at **only one** place.

Do this at the power supply connection that is closest to the physical center of the network to maximize the performance and minimize the effect of outside noise.

Make this grounding connection using a 25 mm (1 in.) copper braid or a #8 AWG wire up to a maximum 3m (10 ft) in length. If you use more than one power supply, the V- conductor of **only one** power supply should be attached to an earth ground.

If you connect multiple power supplies, V+ should be broken between the power supplies. Each power supply's chassis should be connected to the common earth ground.

To ground the network:

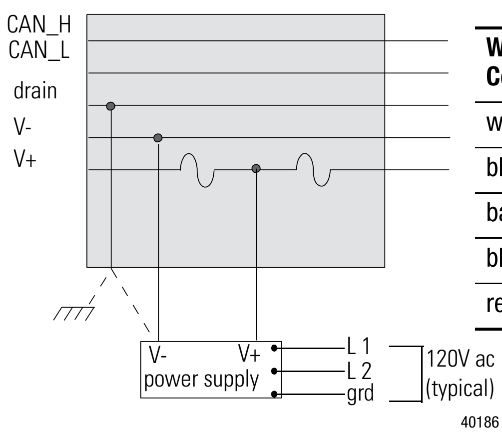
- Connect the network shield and drain wire to an earth or building ground using a 25 mm (1 in.) copper braid or a 8 AWG(10mm^2) wire up to 3m (10 ft) maximum in length.
- Make this ground connection using a 25mm (1 in.) copper braid or an 8 AWG (10mm^2) wire up to3 m (10 ft) maximum in length.
- If you use more than one power supply, the V- conductor of only one power supply should be attached to an earth ground.

ATTENTION

For a non-isolated device, be certain that additional network grounding does not occur when you mount the device or make external connections to it. Check the device manufacturer's instructions carefully for grounding information.

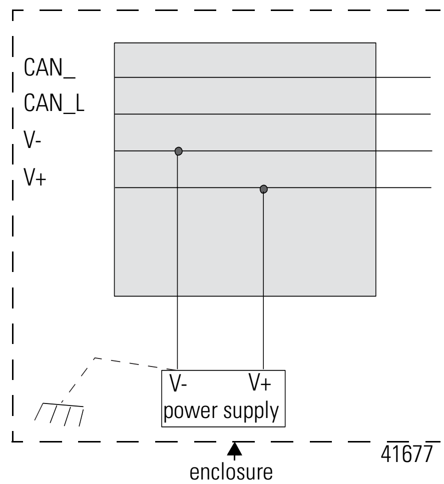
One Power Supply

Round media wiring terminal block



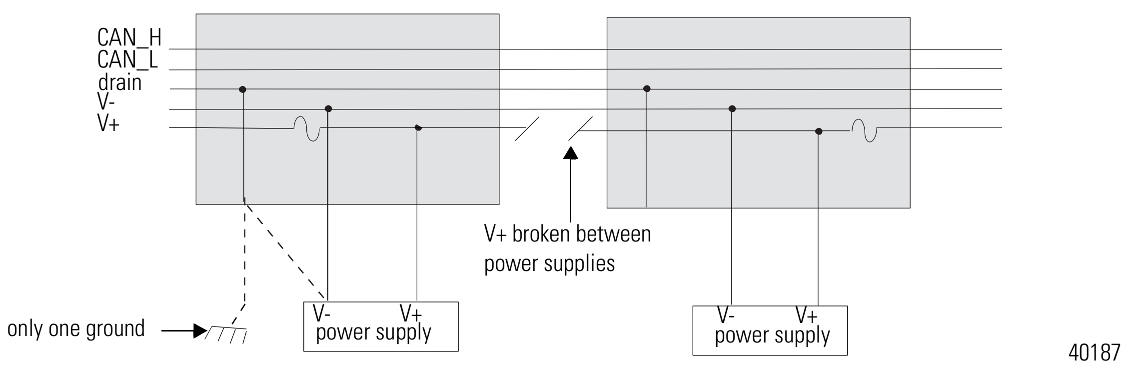
Wire Color	Wire Identity	Usage Round	Usage Flat
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power

Flat media wiring terminal block open-style connector*

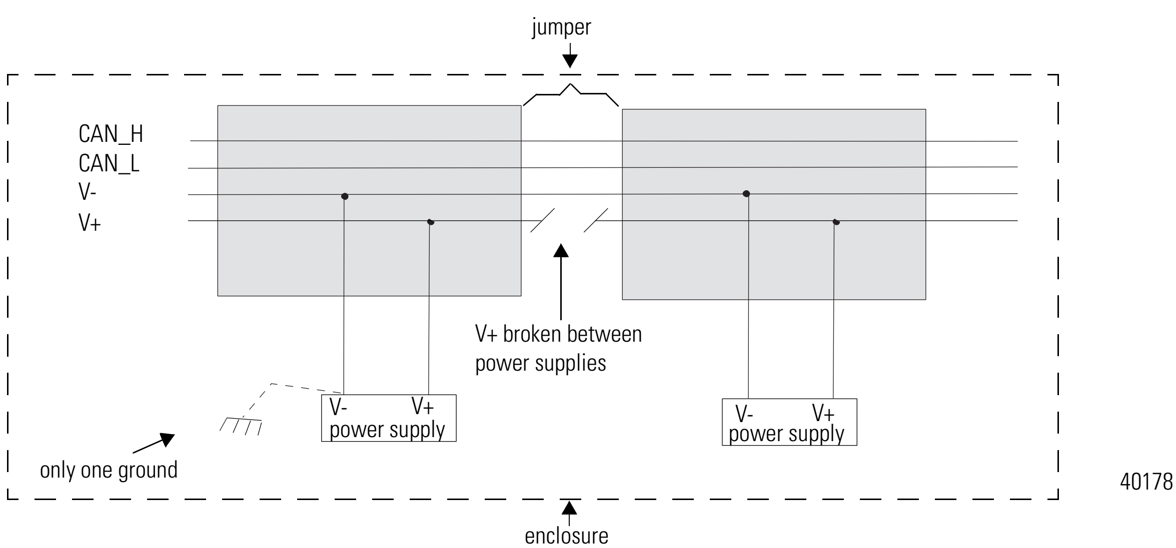


*A micro style connector may be used for power supply connections requiring less than 4A. Use open-style connectors for up to 8A.

Two or more Power Supplies for Round Media



Two or more Power Supplies for Flat Media



5 Use the Checklist

Use this checklist when you install the DeviceNet network. You should complete this checklist prior to applying power to your network.

- [ ] Total device network current draw does not exceed power supply current limit.
- [ ] Common mode voltage drop does not exceed limit.
- [ ] Number of DeviceNet nodes does not exceed 64 on one network.

  The practical limit on DeviceNet nodes may be 61 devices since you should allow one node each for the scanner, the computer interface module, and an open node at node 63.*****

- [ ] No single drop over 6m (20 ft).
- [ ] Cumulative drop line budget does not exceed network baud rate limit.
- [ ] Total network trunk length does not exceed the maximum allowable per the network data rate.
- [ ] One 121Ω, 1%, 1/4W or larger terminating resistor is at each end of the trunk line.
- [ ] Ground at only **one** location, preferably in the center of the network

  - V- connector for flat media
  - V- connector drain and shield for round media

- [ ] All connections are inspected for loose wires or coupling nuts.
- [ ] No opens or shorts.
- [ ] Proper terminating resistors.

☐ Spacing of DeviceNet cable from ac conductors, as specified in publication 1770-4.1.

☐ Both the programmable controller and DeviceNet scanner module are in run mode.

IMPORTANT * Devices default to node 63. Leave node 63 open to avoid duplicate node addresses when adding devices. Change the default node address after installation.

IMPORTANT If your DeviceNet system does not run properly, see the scanner module's display and network and status LEDs for help in troubleshooting.

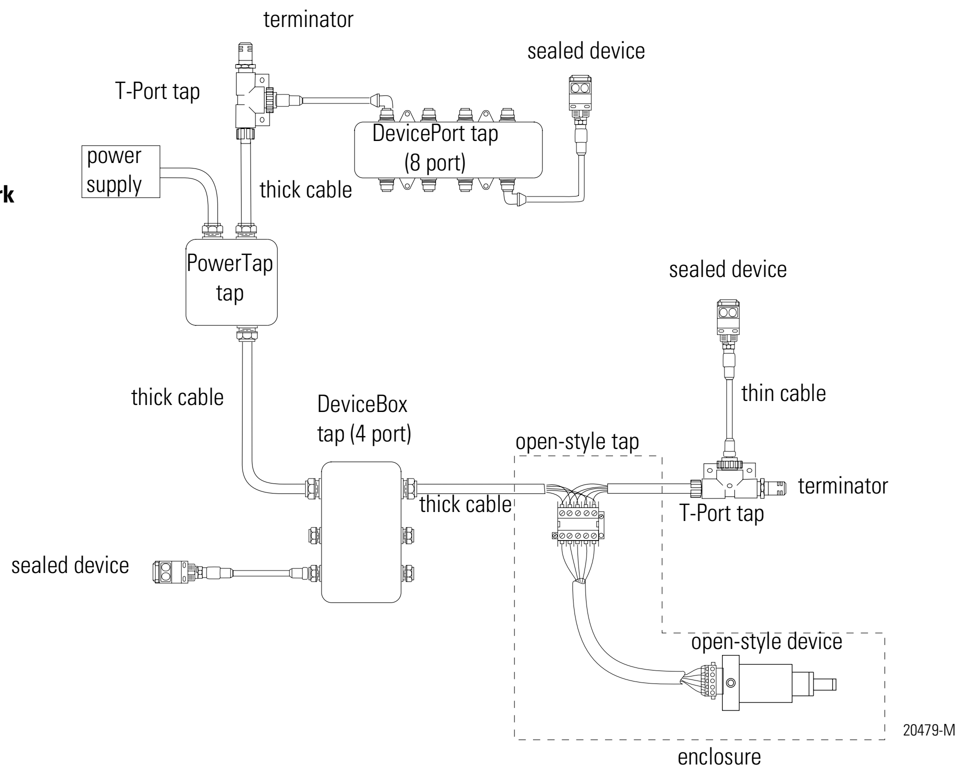
Notes:

Identify Cable System Components

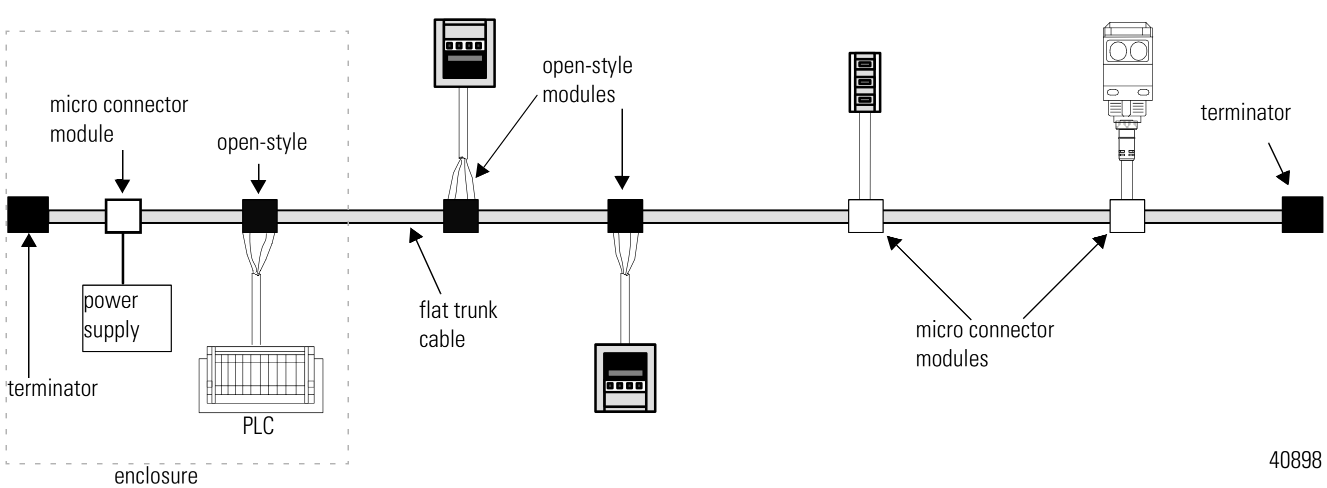
Integrated Architecture Builder (IAB) software can be used to lay out a DeviceNet System and generate a BOM. Download IAB from www.ab.com/logix/iab/.

Use this chapter to identify and become familiar with the basic DeviceNet cable system components.

Round (Thick and Thin) Cable Network



KwikLink Flat Media Network



TIP The catalog numbers listed in this document are not representative of the full range of available DeviceNet media products. For a complete list of DeviceNet media, refer to the On-machine Connectivity Catalog, publication M115-CA001.

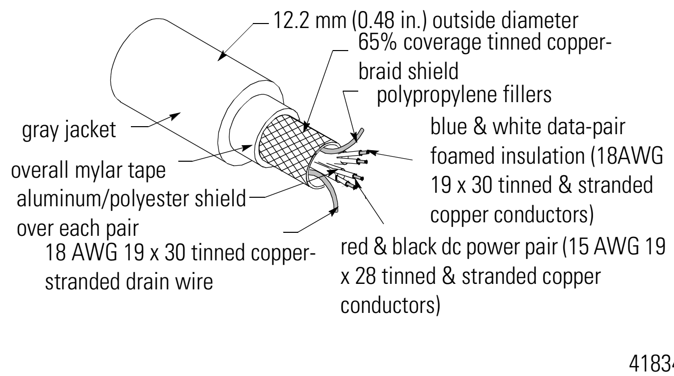
Component	Description	Component	Description
Trunk line	The cable path between terminators that represents the network backbone - can be made of thick, thin, or flat cable - connects to taps or directly to device	DeviceBox tap	A junction box that allows 2, 4, or 8 drop lines to connect to the trunk line.
Drop line	The drop line is made up of thick or thin cable. - connects taps to nodes on the network.	DevicePort tap	A junction box with sealed connectors that allows 4 or 8 drop lines to connect to the trunk line.
Node/device	An addressable device that contains the DeviceNet communication circuitry.	PowerTap tap	The physical connection between the power supply and the trunk line.
Terminating resistor	The resistor (121 W, 1%, 1/4 W or larger) attaches only to the ends of the trunk line.	Open-style tap	Screw terminals that connect a drop line to the trunk line.
Open-style connector	Used with devices not exposed to harsh environments.	KwikLink Micro tap	A single-port connection to flat cable available in both sealed and unsealed versions.
Sealed-style connector	Used with devices exposed to harsh environments.	KwikLink Open-Style tap	A single terminal connection to flat cable available only in unsealed versions.
T-Port tap	A single-port connection with sealed connector.	KwikLink Terminator	A terminating resistor for use with flat cable, available in both sealed and unsealed versions.

About Thick Cable

Thick cable, with an outside diameter of 12.2 mm (0.48 in.), is generally used as the trunk line on the DeviceNet network. Thick cable can be used for trunk lines and drop lines. High-flex thick cable offers greater flexibility than traditional thick cable.

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Class 2 Thick Cable	
Spool Size	**Catalog Number**
50 m (164 ft)	1485C-P1A50
150 m (492 ft)	1485C-P1A150
300 m (984 ft)	1485C-P1A300
500 m (1640 ft)	1485C-P1A500

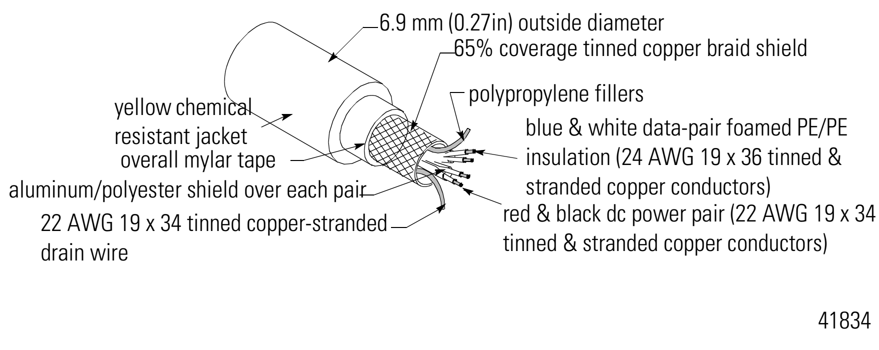


About Thin Cable

Thin cable, with an outside diameter of 6.9 mm (0.27 in.), connects devices to the DeviceNet trunk line via taps. Thin cable can be used for trunk lines and drop lines.

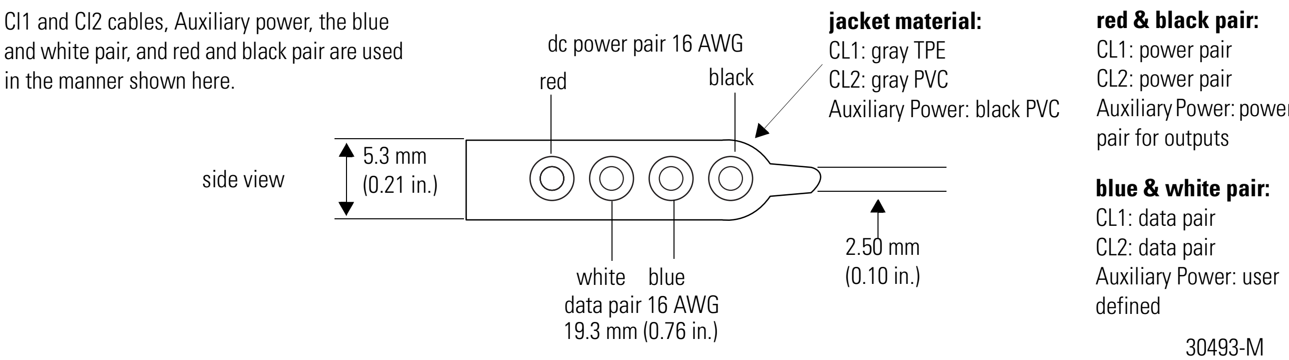
Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Class 2 Thin Cable (Yellow CPE)	
Spool Size	**Catalog Number**
50 m (164 ft)	1485C-P1C50
150 m (492 ft)	1485C-P1C150
300 m (984 ft)	1485C-P1C300
600 m (1968 ft)	1485C-P1C600



About Flat Cable

KwikLink flat cable is physically keyed to prevent wiring mishaps. KwikLink cable is available in both heavy-duty and general purpose versions. All variations of KwikLink cable are unshielded and contain four conductors. Flat cable is used exclusively for the trunk line.



Class 1 (CL1) KwikLink Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1E75
200 m (656 ft)	1485C-P1E200
420 m (1378 ft)	1485C-P1E420

Class 1 (CL1) Heavy-duty Cable: Per NEC specifications for a Class 1 circuit (see Appendix A), the power source must have a rated output of less than 30V and 1000VA. Based on the size of the flat cable conductors, the maximum current through the network must be no more than 8A. Class 1 KwikLink cable is UL listed for 600V and 8A at 24V dc. Use Class 1 drops in conjunction with Class 1 flat cable.

Class 2 (CL2) KwikLink Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1G75
200 m (656 ft)	1485C-P1G200
420 m (1378 ft)	1485C-P1G420

Class 2 (CL2) Heavy-duty Cable: More flexible than the CL1 cable, this design adheres to NEC Article 725, which states that for a Class 2 circuit, the power source must have a rated output of less than 30V and 100VA. In the case of DeviceNet, running at 24V, the maximum allowable current is 100VA/24V or 4A. KwikLink CL2 cable is rated to 4A at 24V dc.

Class 2 (CL2) KwikLink General Purpose Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1K75
200 m (656 ft)	1485C-P1K200
420 m (1378 ft)	1485C-P1K420

Class 2 (CL2) General Purpose Cable: Well-suited for less-demanding applications than heavy-duty cable, this design features a micro-style connector (catalog number 1485P-K1E4-R5) optimized for use with this pliable cable.

IMPORTANT 1485-P1Kxxx cable cannot be used with KwikLink heavy-duty connectors.

Class 1 (CL1) KwikLink Power Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1L75
200 m (656 ft)	1485C-P1L200
420 m (1378 ft)	1485C-P1L420

KwikLink Power Cable (CL1): Used to run an auxiliary bus to power outputs, i.e. valves, actuators, indicators. KwikLink power cable is a Class 1 cable capable of supplying 24V of output power with currents up to 8A.

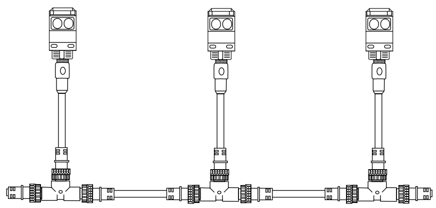
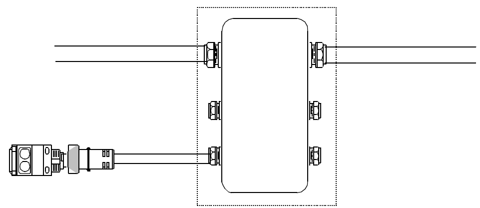
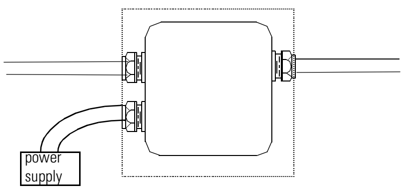
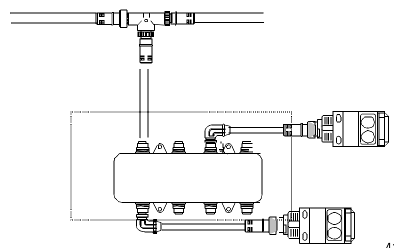
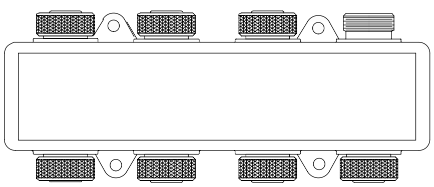
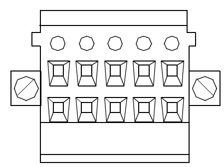
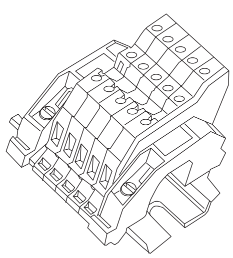
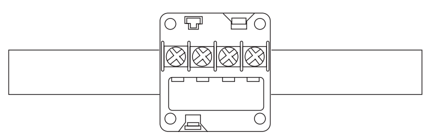
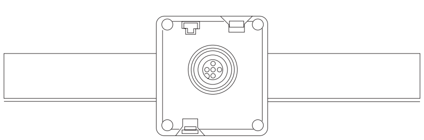
TIP The ArmorBlock MaXum cable base, 1792D-CBFM, is designed to use both the KwikLink network and Auxiliary Power cables. Use this cable base with all ArmorBlock MaXum output modules.

Connect to the Trunk Line

The cable system design allows you to replace a device without disturbing the cable system's operation.

IMPORTANT You must terminate the trunk line on each end with a 121 Ω, 1%, 1/4W or larger resistor.

You can connect to the trunk line through a:

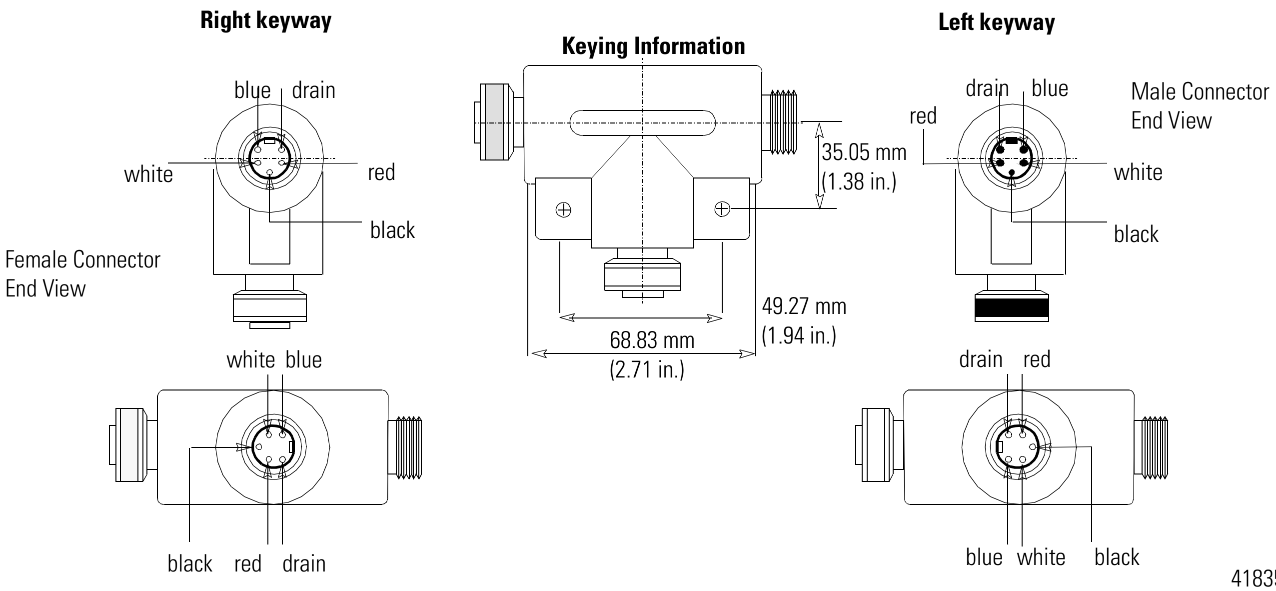
Trunk-line connection	See page	Trunk-line connection	See page
• T-Port tap  31410-M	2-7	• DeviceBox tap  41867	2-8
• PowerTap  41868	2-9	• DevicePort tap  41869	2-9
• Thru-trunk DevicePort tap 	2-12	Open-style connector  41708	2-13
• Open-style tap  30849-M	2-13	• KwikLink open-style connector 	2-15
• KwikLink micro connector 	2-15		

About the T-Port tap

Description	Catalog Number
Mini T-port tap (right keyway)	1485P-P1N5-MN5R1
Mini T-port tap (left keyway)	1485P-P1N5-MN5L1
Mini T-port tap (w/micro drop connection	1485P-P1R5-MN5R1

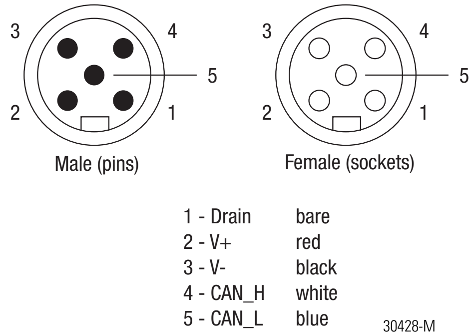
The T-Port tap connects to the drop line with a mini or micro quick-disconnect style connector. Mini T-Port taps provide right or left keyway for positioning purposes. Mini T-Ports are also available with a micro (M12) drop connection.

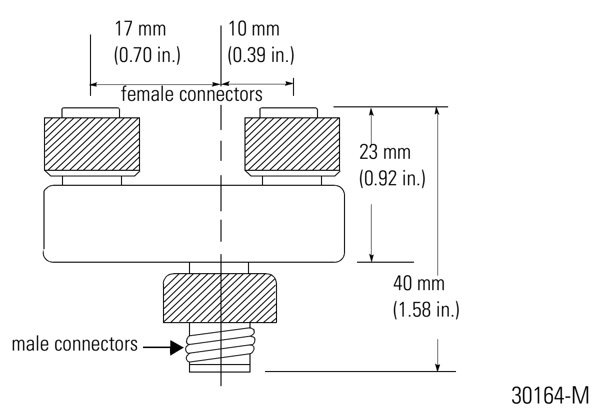
Mini T-Port tap



Micro T-Port tap

Description	Catalog Number
Micro T-port tap	1485P-P1R5-DR5

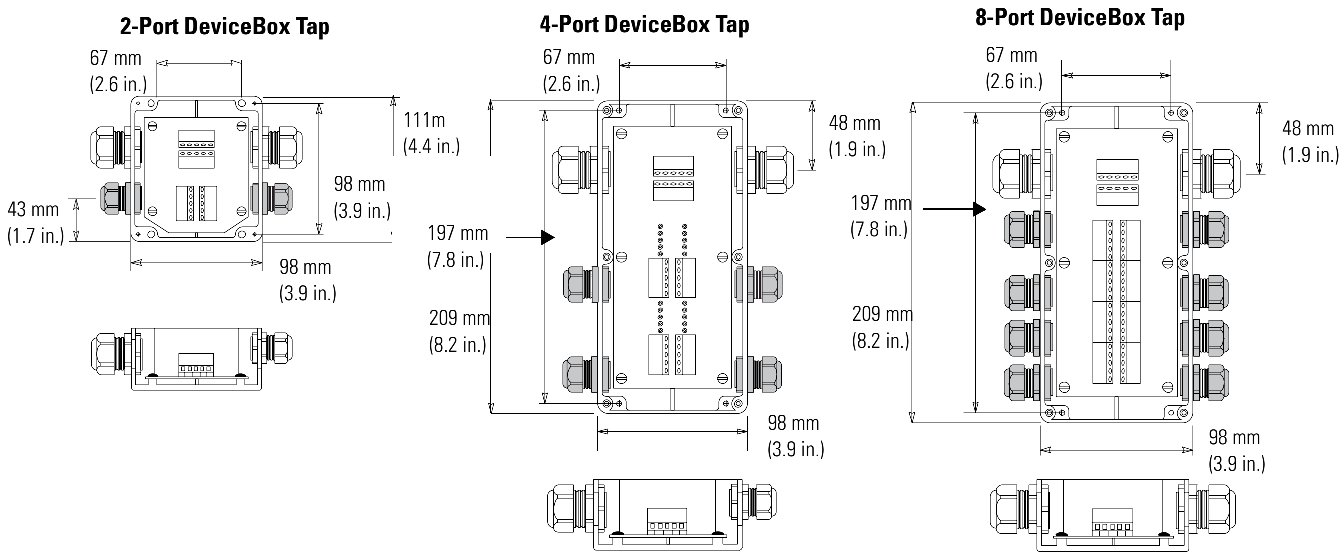




About the DeviceBox tap

Description	Catalog Number
2-port DeviceBox tap (thick trunk)	1485P-P2T5-T5
2-port DeviceBox tap (thin trunk)	1485P-P2T5-T5C
4-port DeviceBox tap (thick trunk)	1485P-P4T5-T5
4-port DeviceBox tap (thin trunk)	1485P-P4T5-T5C
8-port DeviceBox tap (thick trunk)	1485P-P8T5-T5
8-port DeviceBox tap (thin trunk)	1485P-P8T5-T5C

DeviceBox taps use round media only for a direct connection to a trunk line. They provide terminal strip connections for as many as 8 nodes using thin-cable drop lines. Removable gasket covers and cable glands provide a tight, sealed box that you can mount on a machine. Order DeviceBox taps according to the trunk type (thick or thin).

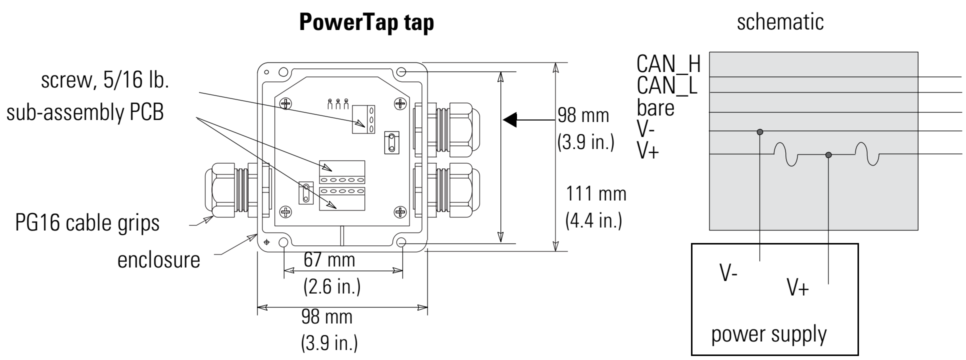


41836

About the PowerTap

Description	Catalog Number
Thick trunk PowerTap tap	1485-P2T5-T5
Thin trunk PowerTap tap	1485T-P2T5-T5C

The PowerTap can provide overcurrent protection to the thick cable, 7.5A for each trunk. (Country and/or local codes may prohibit the use of the full capacity of the tap.) You can also use the PowerTap tap with fuses to connect multiple power supplies to the trunk line without back-feeding between supplies. PowerTap taps are used only with round media.



Wire Color	Wire identity	Use
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power

41837

In cases in which the power supply provides current limiting and inherent protection, you may not need fuses/overcurrent devices at the tap.

About the DevicePort tap

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

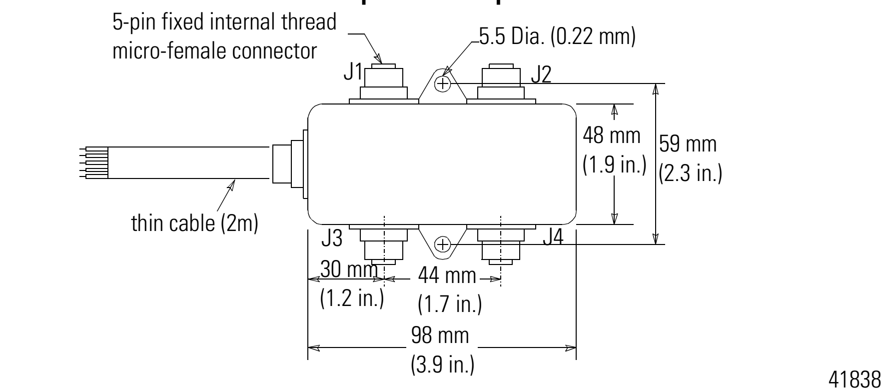
Description	Catalog Number
4-port DevicePort tap with 2m drop line	1485P-P4R5-C2
8-port DevicePort tap with 2m drop line	1485P-P8R5-C2

DevicePort taps are multiport taps that connect to a round or flat media trunk line via drop lines. DevicePorts connect as many as 8 devices to the network through mini or micro quick disconnects.

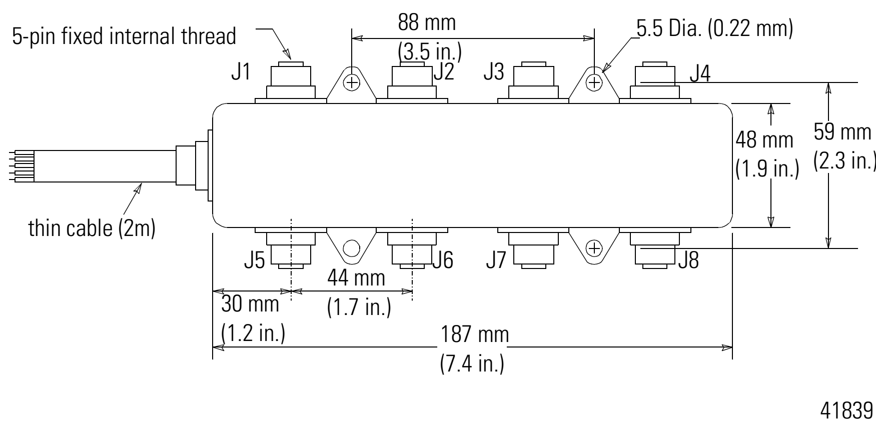
Micro DevicePorts

All device connections are micro female receptacles; only micro male connectors with rotating coupling nuts can interface with each port. A number of trunk connection style options are available.

4-Port DevicePort Tap with 2m Drop Line



8-Port DevicePort Tap with 2m Drop Line

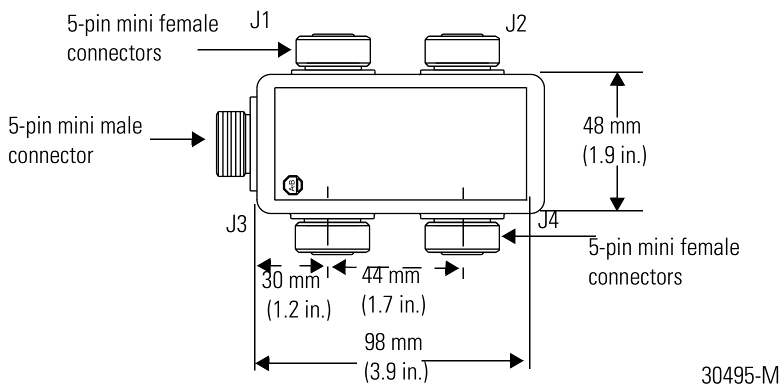


Description	Catalog Number
4-port DevicePort tap with mini drop connection	1485P-P4N5-M5
8-port DevicePort tap with mini drop connection	1485P-P8N5-M5

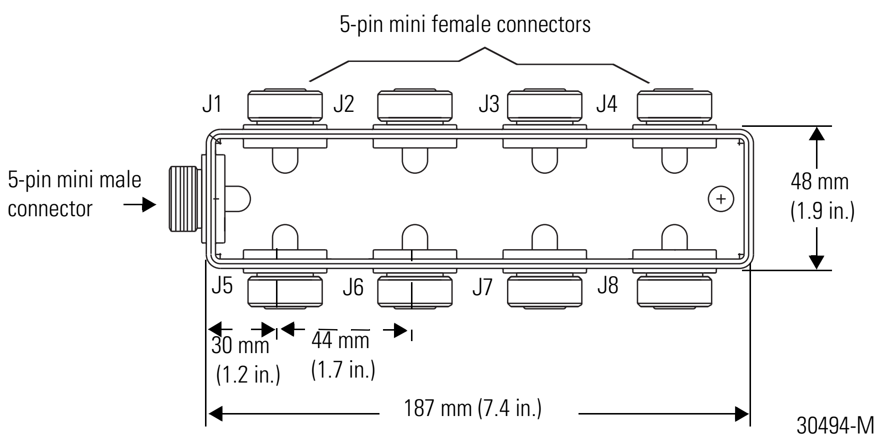
Mini DevicePorts

All device connections are mini female receptacles; only mini male connectors can interface with each port. Trunk connection is a mini male quick disconnect.

4-Port DevicePort tap with mini drop connection



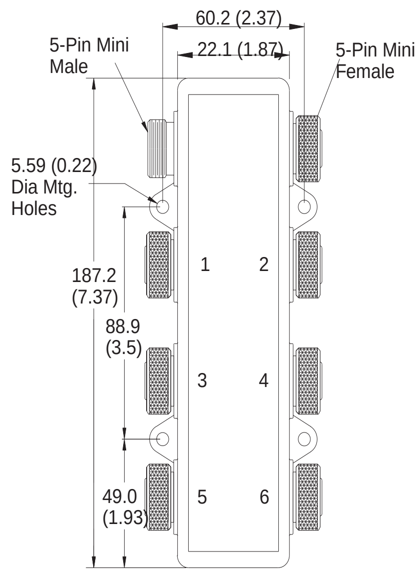
8-Port DevicePort Tap part number



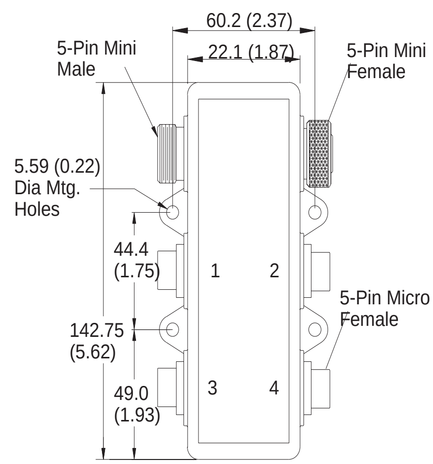
Description	Catalog Number
4-port Thru-trunk DevicePort tap, mini male/mini female to mini female	1485P-P4N5-MN5
6-port Thru-trunk DevicePort tap, mini male/mini female to mini female	1485P-P6N5-MN5
4-port Thru-trunk DevicePort tap, mini male/mini female to micro female	1485P-P4R5-MN5
6-port Thru-trunk DevicePort tap, mini male/mini female to micro female	1485P-P6R5-MN5

Thru-trunk DevicePort tap

Thru-trunk DevicePort taps are passive multiport taps which connect directly to the trunk. These DevicePort taps are offered with 4 or 6 quick-disconnect ports in sealed versions to connect up to 6 physical nodes.Using the thru-trunk DevicePort tap reduces the number of physical taps on the trunk line from as many as six taps to one.

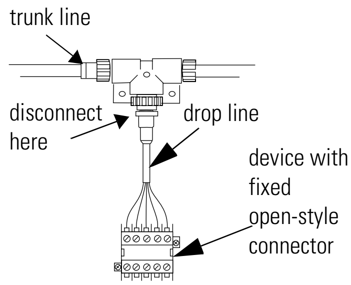


6-port mini thru-trunk DevicePort



4-port micro thru-trunk DevicePort

About direct connection



31411-M

Connect devices directly to the trunk line only if you can later remove the devices without disturbing communications on the cable system.

IMPORTANT If a device provides only fixed-terminal blocks for its connection, you must connect it to the cable system by a drop line. Doing this allows you to remove the device at the tap without disturbing communications on the cable system.

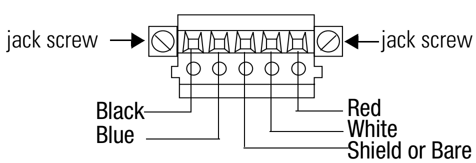
About open-style connectors

Wire Color	Wire Identity	Usage Round
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power

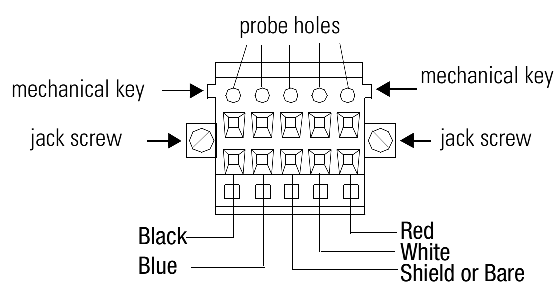
Open-style connectors come in two primary varieties:

- five-position (5 pin linear plug)
- ten-position (10 pin linear plug)

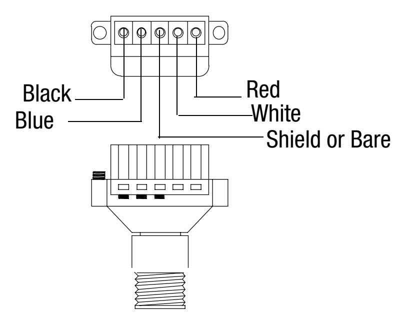
Ten-position connectors provide easier daisy-chaining because there is an independent wire chamber for each wire (entering cable and exiting cable).



5 pin linear plug (open) 41707



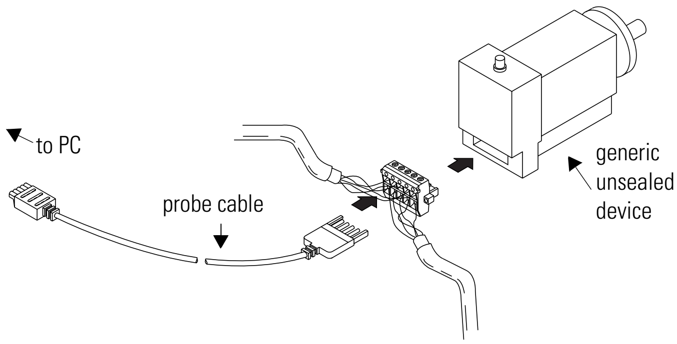
10-pin linear plug (open) 41708



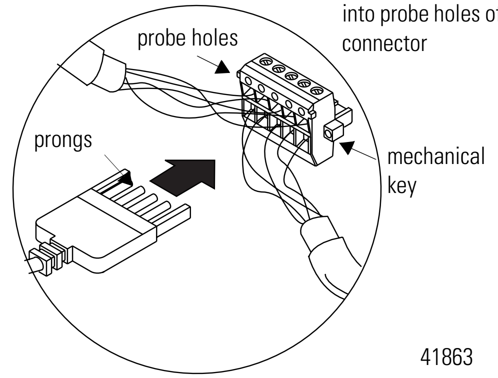
5-pin linear to micro adapter

Description	Catalog number
5-pin linear plug (open; with jack screws)	1799-DNETSCON
5-pin linear plug (open; without jack screws)	1799-DNETCON
10-pin linear plug (open)	1787-PLUG1OR
5-pin linear to micro adapter	1799-DNC5MMS

Some open-style connectors provide a temporary connection for a PC or other configurable tool using probe holes. For connection, insert the prongs of a probe cable into the probe holes of a connector. Mechanical keys on the connector prevent improper insertion.



41864

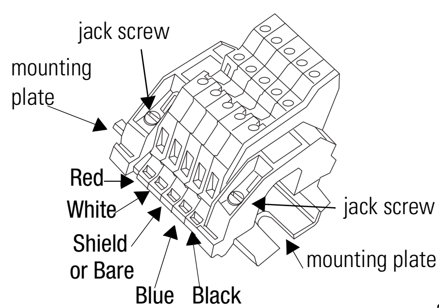


41863

About open-style taps

Description	Catalog Number
Open-style tap	1492-DN3TW

Open-style taps provide a way for drop cables to be connected to the trunk line using open-style wiring connections. Three sets of 5-position color-coded wiring chambers accommodate all wires (for entering trunk cable, exiting trunk cable, and drop cable). The open-style tap can be mounted on a DIN rail.



30849-M

Jack screws on open-style taps and connectors provide additional physical support.

About KwikLink Insulation Displacement Connectors (IDCs)

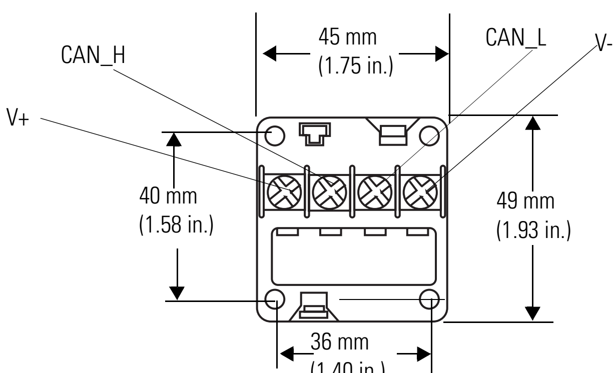
Description	Catalog Number
NEMA 6P, 13; IP67 Micro module w/base	1485P-P1E4-R5
NEMA 1; IP60 Micro module w/base (no gaskets)	1485P-P1H4-R5
Open-style module w/base (no gaskets)	1485P-P1H4-T4
KwikLink General Purpose Connector, Micro[1]	1485P-K1E4-R5

[1] Use this connector also with KwikLink General Purpose Flat Cable (1485C-P1K).

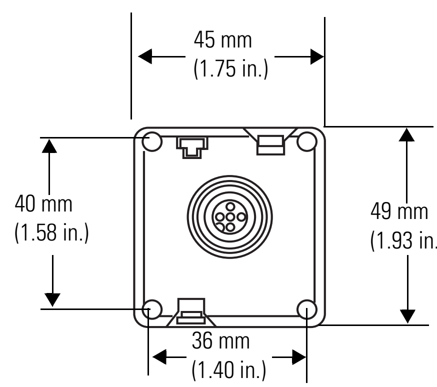
KwikLink Insulation Displacement Connectors (IDCs) interface drop cables and devices to the flat cable trunkline. The hinged, two-piece base snaps around the flat cable at any point along the trunk. Contact is made with the cable conductors by tightening two screws that drive the contacts through the cable jacket and into the conductors. The snap-on interface provides the connection to the drop cable and is available in micro-, open-, and general-purpose style connectors.

Allen-Bradley KwikLink connectors are approved only with the following DeviceNet flat cables:

Catalog Number	Description
1485C-P1E	CL1
1485C-P1L	Aux. Power
1485C-P1G	CL2



41711



41717

Use Preterminated Cables

Using preterminated cable assemblies saves you the effort of stripping and wiring connectors to the cable ends. Because pre-terminated cables are normally factory-tested, using them also helps reduce wiring errors.

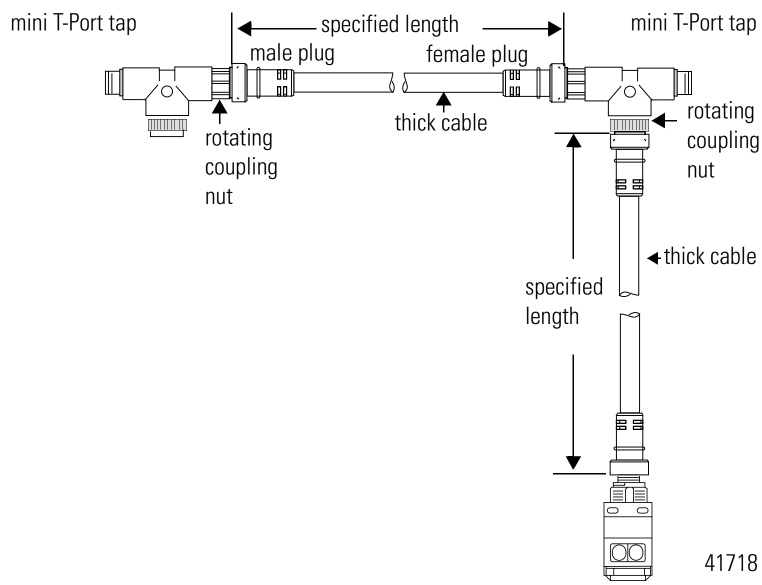
TIP	Additional cable lengths and configurations, other than those shown, are available from Rockwell Automation.

About thick cable

You can order thick cable in multiple lengths with mini connectors at each end. Single-ended versions are also available for simplified connection to DeviceBox or open-style connections. Thick cable that is 6m (20ft) or shorter can also be used as drop lines.

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Description	Catalog Number
Mini male to mini female	1485C-PxN5-M5
Mini male to conductor	1485C-PxM5-C
Mini female to conductor	1485C-PxN5-C
x indicates length in meters (1-10, 12, 15, 18, 24 and 30 are standard).	



41718

About thin cable

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

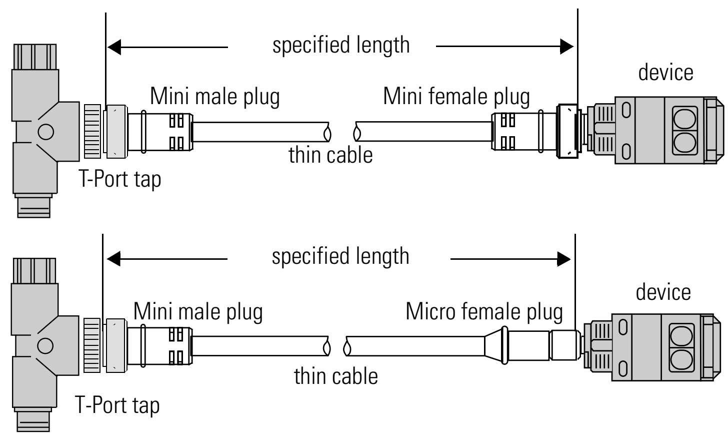
Class 2 Preterminated Thin Cable

Description	Catalog Number
Mini male to mini female	1485R-PxM5-M5
Mini male to micro female	1485R-PxM5-M5-R5
Mini male to conductor	1485R-PxM5-C

x indicates length in meters (1-6 is standard).

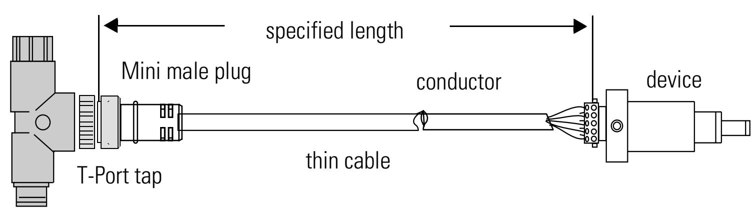
Preterminated thin cable assemblies for use as a drop line are available with various connectors in lengths of 1, 2, 3, 4, 5 and 6m. Preterminated thin cable assemblies can also be used as trunk lines.

Connecting to a T-Port tap from a sealed device



30488-M

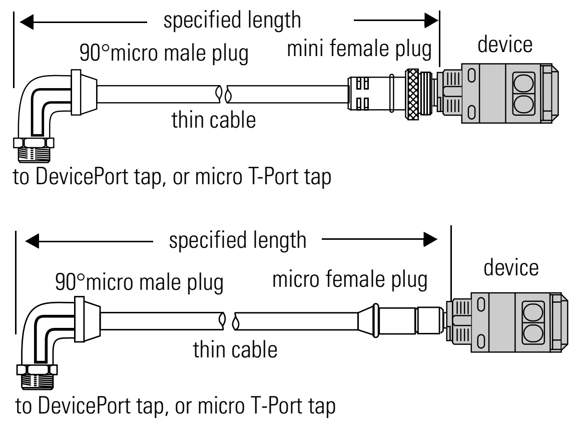
Connecting to a T-Port tap from an open device



Connecting to a DevicePort tap or Micro T-Port tap from a sealed device

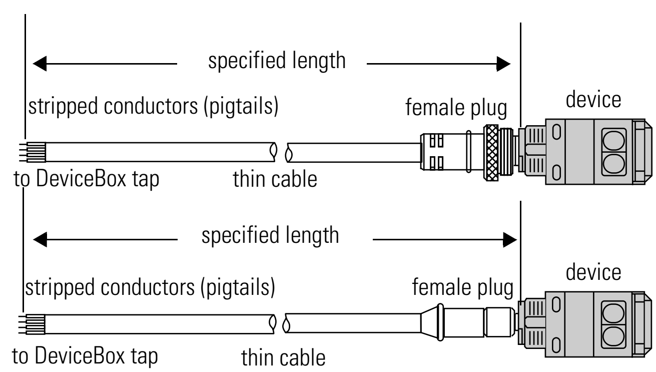
Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Description	Catalog Number
Micro male 90° to mini female	1485R-PxN5-F5
Micro male 90° to micro female	1485R-PxR5-F5
Mini female to conductor	1485R-PxN5-C
Micro female to conductor	1485R-PxR5-C
x indicates length in meters (1- 6 is standard)	



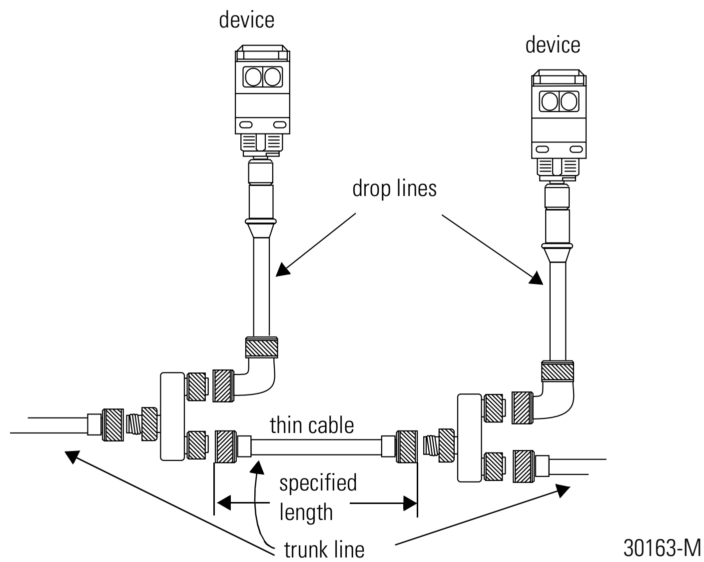
41720

Connecting to a DeviceBox tap or open-style tap from a sealed device



41721

Connecting to micro T-Port taps



Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Description	Catalog Number
Micro male 90° to micro female	1485R-PxR5-F5
Micro male to micro female	1485R-PxR5-D5
x indicates length in meters (1- 6 is standard)	

About KwikLink drop cables

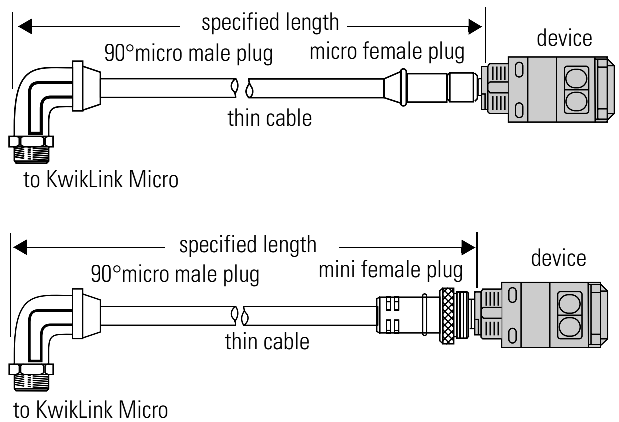
These unshielded four-wire PVC drop cables were designed specifically for use with KwikLink connectors. Trunkline connections are 90° micro male to straight female, micro female or conductors at the device.

IMPORTANT	These drop cables (1485K) are for use only with the KwikLink flat cable system. They are not suitable for use with standard DeviceNet round cable systems.

Connecting to a KwikLink tap from a sealed device

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Description	Catalog Number
Micro male 90° to micro female	1485K-PxF5-R5
Micro male 90° to mini female	1485K-PxF5-N5
x indicates length in meters (1- 6 is standard)	

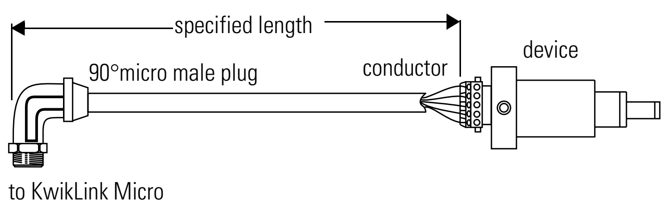


41720

Connecting to a KwikLink tap from an open device

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Description	Catalog Number
Micro male 90° to conductors	1485K-PxF5-C
x indicates length in meters (1, 2, 4 and 6 are standard)	

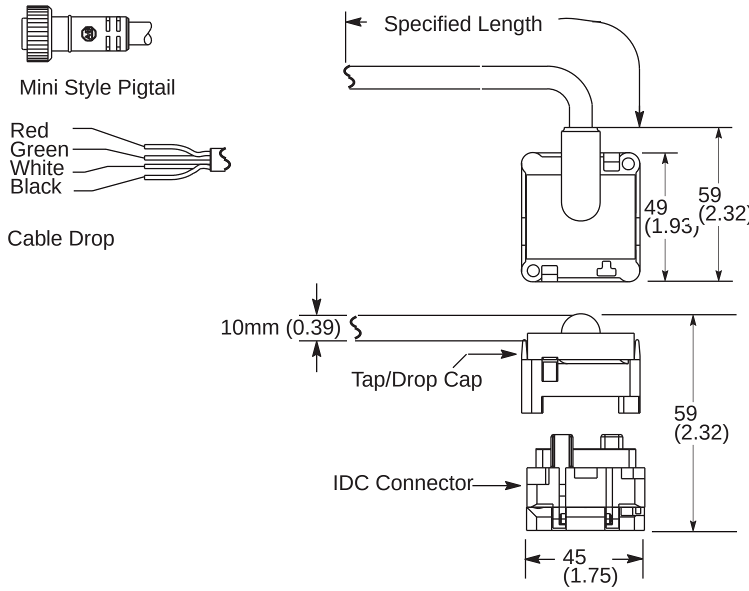


41631

Connecting to a KwikLink Cable Drop or Mini-style Pigtail Drop

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

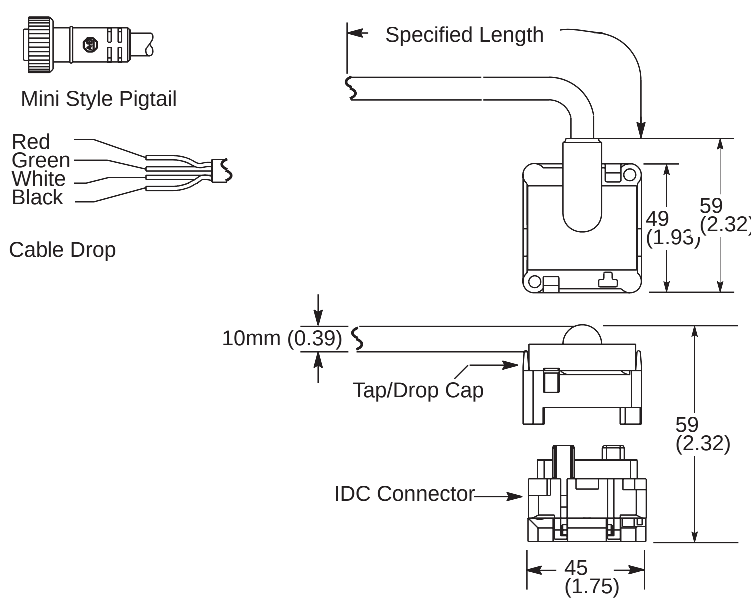
Cable Length	Catalog Number
Class 1 KwikLink sealed cable pigtail drop cable	1485T-P1E4-Bx
Class 1 KwikLink unsealed cable pigtail drop cable	1485T-P1H4-Bx
Class 1 KwikLink sealed 5-pin mini pigtail drop cable	1485P-P1E4-Bx-N5
Class 1 KwikLink unsealed 5-pin mini pigtail drop cable	1485P-P1H4-Bx-N5
x indicates length in meters (1- 6 is standard)	



Connecting to a KwikLink Auxiliary Power Cable

Additional configurations are available. Refer to the On-machine Connectivity catalog, publication M115-CA001.

Cable Length	Catalog Number
Class 1 KwikLink auxiliary power cable pigtail	1485T-P1E4-Cx
Class 1 KwikLink auxiliary power 4-pin mini pigtail	1485T-P1E4-Cx-N4
x indicates length in meters (1, 2, 3 and 6 are standard)	



Wire Color	Wire Identity	Usage Round	Usage Flat
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power

About terminators

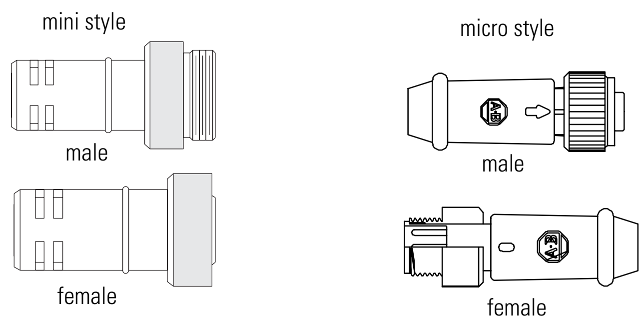
Electrically stabilize your DeviceNet communication with terminating resistors.

IMPORTANT You must terminate the trunk line on each end with a 121ohms, 1%, 1/4W or larger resistor.

Sealed-style terminators (round media)

Male and female sealed terminators have gold plated contacts for corrosion resistance.

Description	Catalog Number
Mini male	1485A-T1M5
Mini female	1485A-T1N5
Micro male	1485A-T1D5
Micro female	1485A-T1R5



Unsealed-Style terminator (round and flat media)

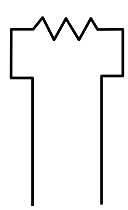
IMPORTANT You must connect these resistors directly across the blue and white wires of the DeviceNet cable.

An open-style terminator is suitable for use with:

- DeviceBox taps
- open-style plugs or taps
- KwikLink open-style Insulation Displacement Connectors (IDC)

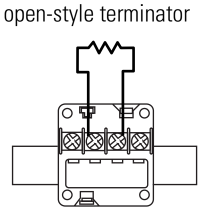
Description	Catalog Number
Open-style terminator	1485A-C2

121ohms



41870

KwikLink IDC with open-style terminator

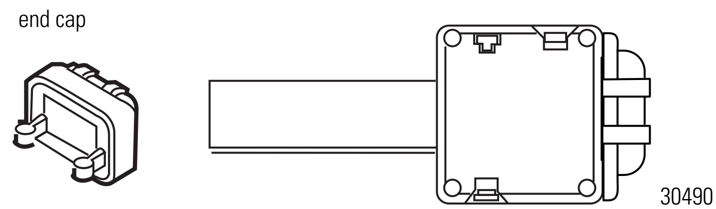


41873

Sealed and unsealed flat media terminators

These terminators have an IDC base and are shipped with an end cap. Unsealed terminators do not have gaskets.

Description	Catalog Number
Sealed terminator (IP67)	1485A-T1E4
Unsealed terminator (no gasket IP60)	1485A-T1H4



Notes:

Make Cable Connections

Prepare Cables

In Chapter 1, you determined the required lengths of trunk line and drop line segments for your network. To cut these segments from reels of thick, thin and flat cable, use a sharp cable cutter and provide sufficient length in each segment to reduce tension at the connector.

TIP Select an end of the cable segment that has been cleanly cut. The positions of the color-coded conductors should match the positions at the face of the connector.

IMPORTANT Before beginning, make sure:

- the DeviceNet cable system is inactive
- all attached devices are turned off
- any attached power supply is turned off
- you follow the manufacturer's instructions for stripping, crimping, and/or tightening

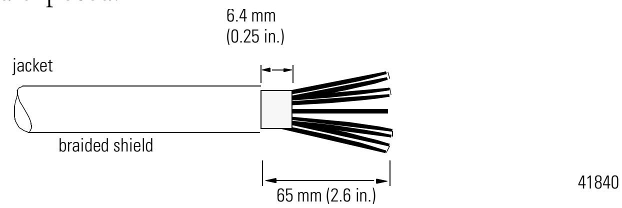
TIP Adhere to the cable routing and spacing guidelines described in Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

TIP The catalog numbers listed in this document are representative of the full range of available DeviceNet media products. For a complete list of DeviceNet media, refer to the On-machine Connectivity Catalog, publication M115-CA001.

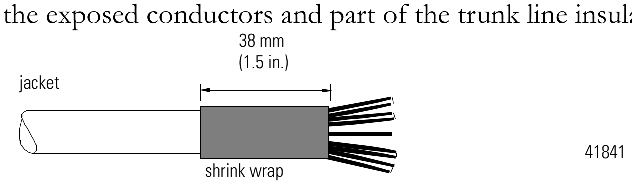
Install Open-Style Connectors

To attach a plug-in open-style connector to a round media (thick or thin) trunk line:

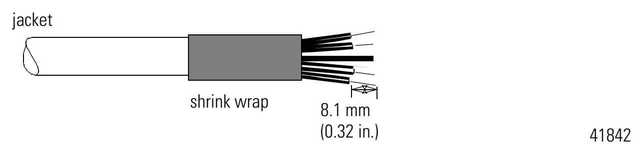
1. Strip 65 mm (2.6 in.) to 75 mm (2.96 in.) of the outer jacket from the end of the cable, leaving no more than 6.4 mm (0.25 in.) of the braided shield exposed.



2. Wrap the end of the cable with 38 mm (1.5 in.) of shrink wrap, covering part of the exposed conductors and part of the trunk line insulation.



3. Strip 8.1 mm (0.32 in.) of the insulation from the end of each of the insulated conductors.

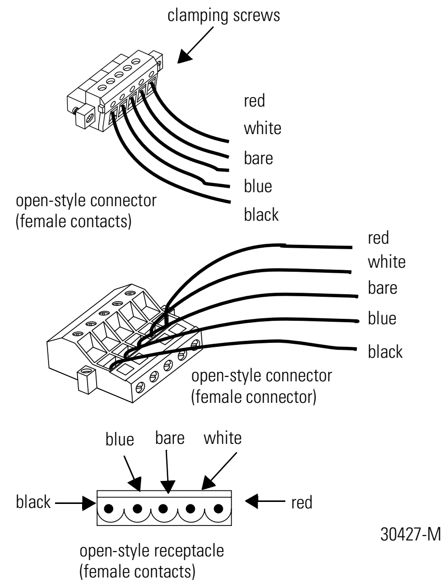


4. Tin the last 6.5 mm (0.26 in.) of the bare conductors so that the outside dimension does not exceed 0.17 mm (0.045 in.).

5. Insert each conductor into the appropriate clamping cavity of the open-style connector or the screw terminal on the device, according to the color of the cable insulation.

Wire Color	Wire Identity	Usage Round
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power

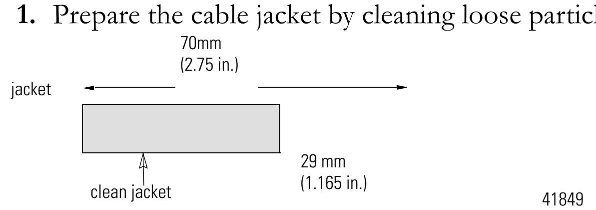
6. Tighten the clamping screws to secure each conductor. The male contacts of the device connector must match the female contacts of the connector.



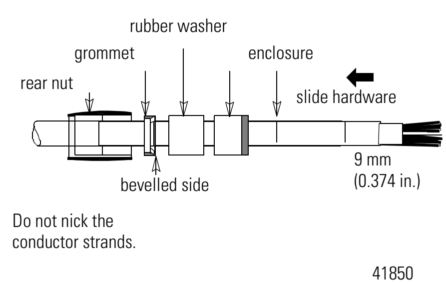
Install Mini/Micro Sealed Field-Installable Connectors

To attach a mini/micro sealed-style connector to round media:

1. Prepare the cable jacket by cleaning loose particles from the jacket.



2. Strip 29 mm (1.165 in.) of the cable jacket from the end of the cable.
3. Cut the braided shield and the foil shields surrounding the power and signal conductors.
4. Trim the conductors to the same length.
5. Slide the connector hardware onto the cable in the order shown.
6. Strip 9 mm (0.374 in.) of insulation from the ends of all conductors except the bare drain wire.

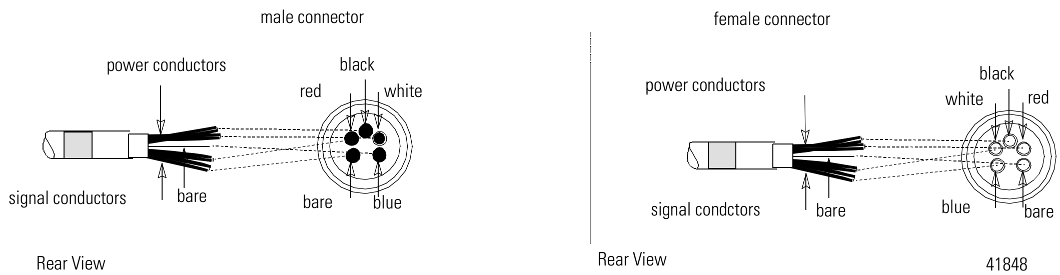


Wire Color	Wire identity	Usage Round
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power

IMPORTANT Do not twist or pull the cable while tightening the gland nut.

7. Attach wires to the connector using screw terminals as seen in the following diagram.

TIP The following illustration shows a mini male and female connector. Connections are similar for micro connectors.



41848

8. Screw the enclosure body to the connector.

9. Screw the rear nut into the connector enclosure.

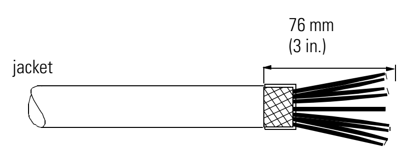
IMPORTANT Do not twist or pull the cable while tightening the rear nut.

Install DeviceBox and PowerTap Taps

Cable preparation and attachment is the same for PowerTap taps and DeviceBox taps which use hard-wire connections of round media. To install your taps, perform the following steps and then proceed to the appropriate section for wiring the specific tap.

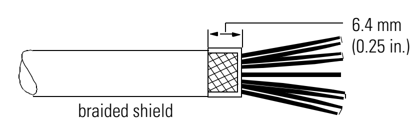
1. Remove the cover from the tap.

2. Prepare the ends of the cable sections.
   a. Strip 65 mm (2.6 in.) to 76 mm (3 in.) of the outer jacket and braided shield from the end of the cable.



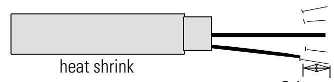
41843

   b. Leave no more than 6.4 mm (0.25 in.) of the braided shield exposed.

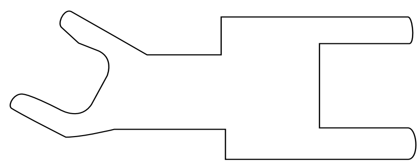


41844

c. Strip 8.1 mm (0.32 in.) of the insulation from the end of each of the insulated conductors.



3. Attach cables to the enclosure.
   a. Loosen the large gland nuts.
   b. Insert cables through the large cable glands so that about 3.3 mm (0.13 in.) of the cable jackets extend beyond the locking nut toward the inside of the enclosure.
   c. Hold the hex flange in place with the cable gland wrench, and firmly tighten the gland nut. The cable gland wrench is supplied with the accessories kit, part number 1485A-ACCKIT.



4. Go to the appropriate section.

For information about	See page
installing PowerTap taps	3-5
installing DeviceBox taps	3-8
installing DevicePort taps	3-9

Install PowerTap Taps

The PowerTap tap contains terminal blocks that connect the trunk line conductors and the input from a power supply. It is used only with round media. Gland nuts secure cables to the PowerTap enclosure.

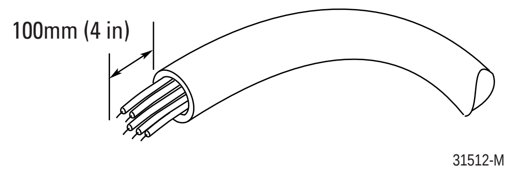
IMPORTANT As you make the attachments inside the tap, be certain that:

- conductors inside the enclosure loop around the fuses for easy access to the fuses.
- the bare conductor is insulated in the enclosure with the insulating tubing supplied in the accessory kit.
- the blue plastic covers are firmly attached to the fuse assemblies before applying power.

IMPORTANT	The two fuses used in the PowerTap tap are 7.5A fast-acting automotive type (ACT type), which you can order from your local fuse supplier.

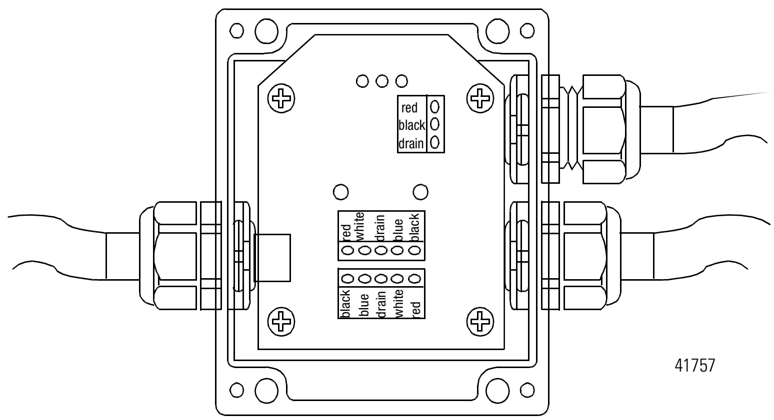
To attach a PowerTap:

1. Cut and strip the thick cable back approximately 100 mm (4 in.).



Wire Color	Wire identity	Use
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power

2. Loosen the gland nut.



3. Insert the cable into the PowerTap through the large cable gland until approximately 3 mm (0.12 in.) of the cable jacket protrudes.

TIP	Cable used for input from a power supply should have the white and blue leads cut off short.

4. Firmly tighten the gland nut to provide strain relief and sealing.

ATTENTION	You must hold the hex flange with the cable gland wrench during tightening.

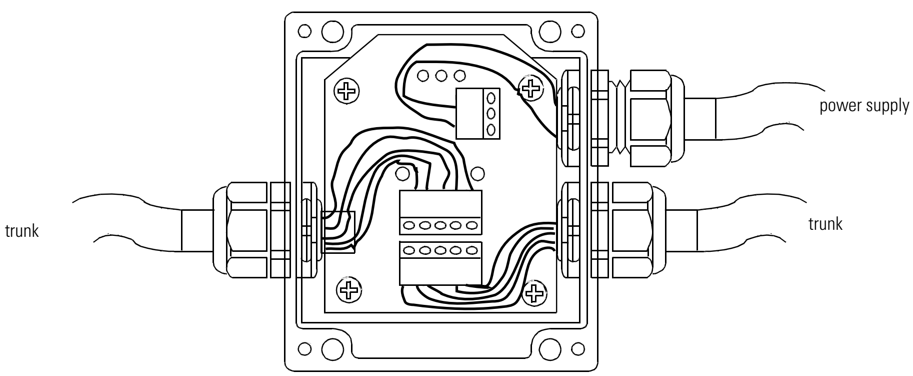
5. Firmly twist the bare wire ends to eliminate loose strands.

ATTENTION

Be certain that you use insulating tubing (included with the accessory kit) on bare drain wire.

6. Loop each bare wire as shown below so you may insert the terminal block into the clamping cavity.

PowerTap Tap - 1485T-P2T5-T5



41758

7. Firmly tighten the terminal block screw to clamp the bare wire end in place.

8. After all cables are terminated, secure the cover and tighten the screws to obtain the washdown rating.

9. Tighten all wire glands.

Install DeviceBox Taps

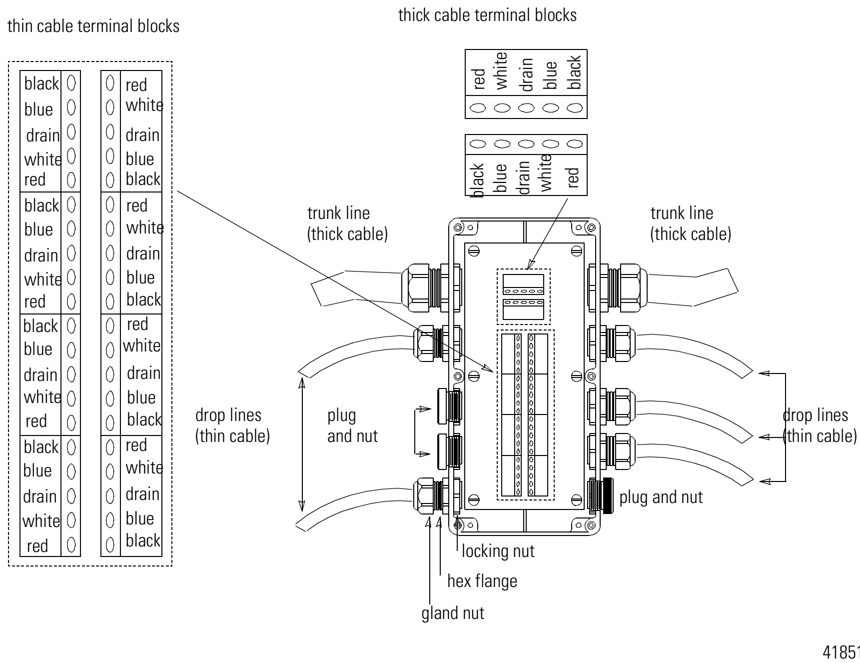
The DeviceBox tap contains terminal blocks that connect the trunk line and as many as eight drop lines. It is used only with round media. Gland nuts secure the cables entering the ports of the DeviceBox tap.To attach a DeviceBox tap:

1. Cut the required lengths from reels of trunk line using a sharp cable cutter providing sufficient length in each segment to reduce tension at the connection.

IMPORTANT Cover the bare drain wire in the enclosure with the insulating tubing supplied in the accessory kit.

2. Insert conductors into the terminal block clamping cavities, following the color coding specified for the terminal blocks at the incoming and outgoing thick cables and as many as eight thin cables.

Wire Color	Wire identity	Use
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power



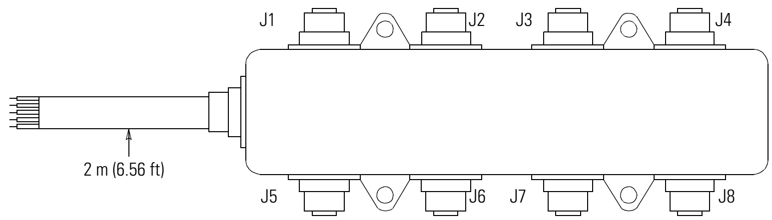
3. Tighten all clamping screws to secure conductors to the terminal blocks.

4. Seal unused ports with nylon plugs and nuts in the accessory kit.

5. Tightly secure the cover to the enclosure.

Install DevicePort Taps

The DevicePort tap connects as many as eight quick-disconnect cables to the trunk line.



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Connect Drop Lines

Drop lines, made up of thick or thin cable, connect devices to taps. Connections at the device can be:

- open-style
  - pluggable screw connectors
  - hard-wired screw terminals
  - soldered
- sealed-style
  - mini quick-disconnect connectors
  - micro quick-disconnect connectors

ATTENTION

Although it is possible to make a screw-terminal connection while the cable network is active, you should avoid this if at all possible.

IMPORTANT

It is best to connect drop lines when the cable system is inactive. If you must connect to an active cable system, make all other connections before the connection to the trunk line.

To connect drop lines:

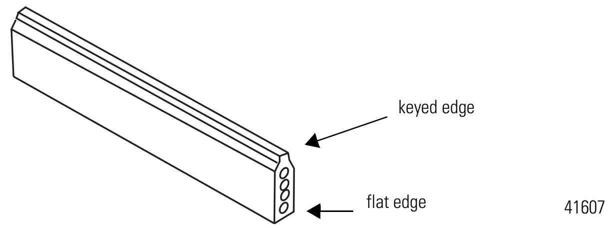
1. Attach contacts as described earlier in this section.
2. Connect the cable to the device.
3. Make any intermediate connections.

4. Make the connection to the trunk line last.

IMPORTANT	Follow the wiring diagrams for each connection, and make sure you do not exceed the maximum allowable length from the device connection to the trunk connection.

Install KwikLink Cable and KwikLink Heavy-Duty Connectors

Install KwikLink cable with the wider, flat edge of the cable on the bottom.



Follow these steps to properly install KwikLink cable into a connector:

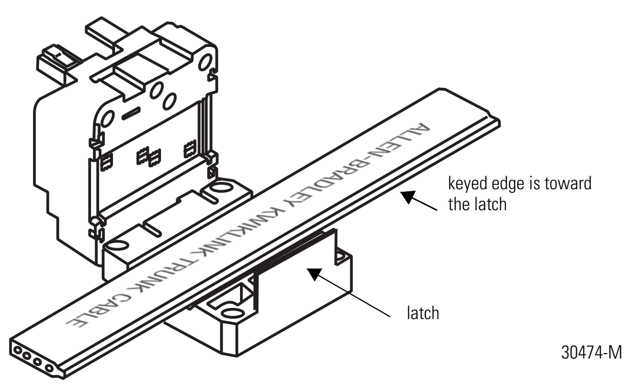
Class 1 (CL1) KwikLink Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1E75
200 m (656 ft)	1485C-P1E200
420 m (1378 ft)	1485C-P1E420

IMPORTANT	1485-P1Kxxx cable cannot be used with KwikLink heavy-duty connectors.

1. Lay the cable in the hinged base, paying attention to the keyed profile. The unkeyed edge is closer to the hinge; the keyed edge is toward the latch.

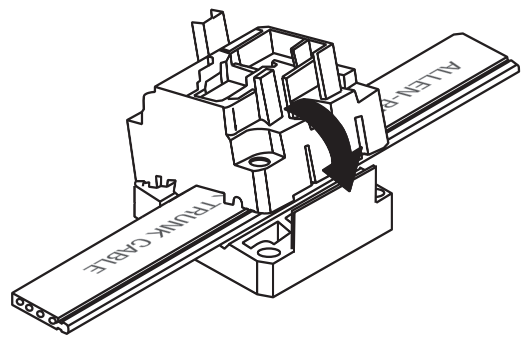
Class 2 (CL2) KwikLink Cable	
Spool Size	**Catalog Number**
75 m (246 ft)	1485C-P1G75
200 m (656 ft)	1485C-P1G200
420 m (1378 ft)	1485C-P1G420

IMPORTANT	Prior to closing the connector, make sure the IDC blades do not protrude from the housing. If the blades are exposed, gently push them back into the base. In the event that the blades do not retract easily (or retract only partially), verify that the IDC screws are not partially driven.



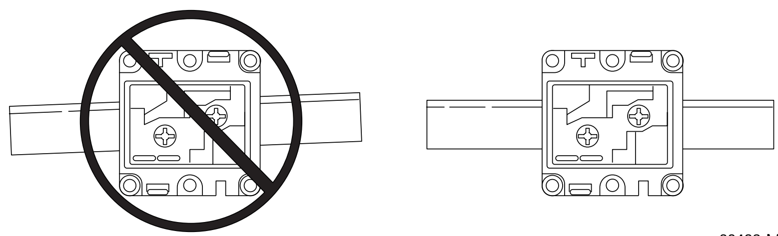
2. Close the hinged assembly, applying pressure until the latch locks into place.

IMPORTANT	The latch has two catches. The first catch loosely holds the connector on the cable. The second catch needs more pressure applied to close the connector tightly. If the cable is not in the correct position, the connector will not close.



30475-M

3. Make sure the cable is straight before moving on to step four.



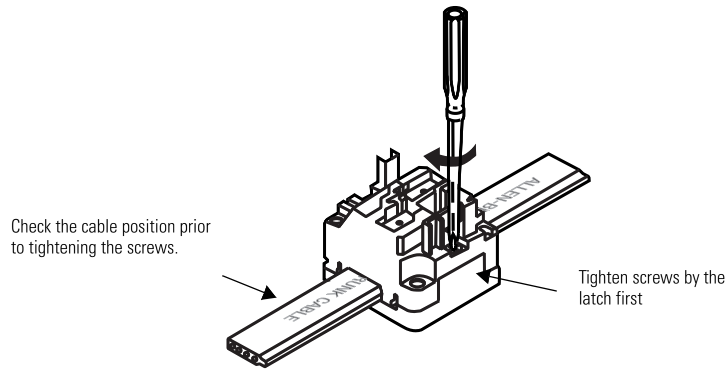
30492-M

ATTENTION	You must make sure the cable is straight before tightening the screws. Improper seating of the cable may cause a weak seal and impede IP67 requirements. A mis-aligned cable may also cause shorts due to the mis-registration of the IDC contacts.

4. Tighten down the two screws at the center points of the hinge and latch sides of the base; tighten down the latch side first.

IMPORTANT	Take care to avoid stripping the screws. Ample torque should be 5.56 N (15 in-lbs).

5. Mount the base to the panel by driving screws through the corner holes not containing the metal inserts.

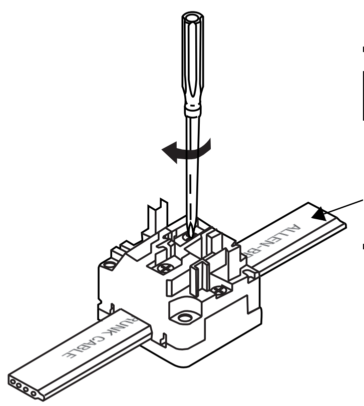


30476-M

6. Drive the IDC contacts into the cable by tightening down the two screws in the center of the base assembly. .

IMPORTANT	Take care to avoid stripping the screws. Ample torque should be 5.56 N (15 in-lbs).

The module should not be removed after connection is made. Determine the exact placement of the connector **before** engaging the IDC contacts.



ATTENTION	Once the IDC contacts are driven into the cable, the module should not be removed. Connectors are single-use only and cannot be removed or re-used.

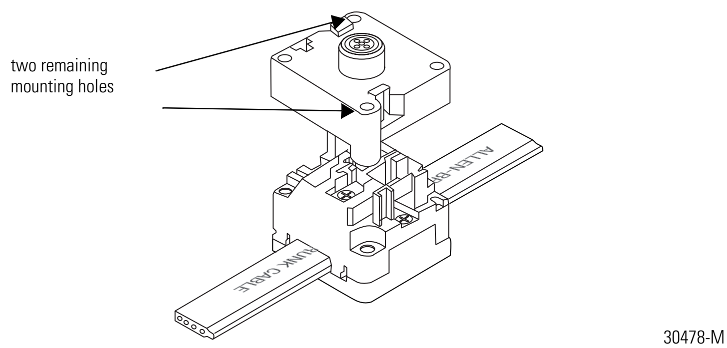
30477-M

7. Follow these guidelines for installing the connectors:

- We recommend you only install the connectors at temperatures of 0°C to 75°C.
- Make sure the cable is free of debris or scratches before attaching the connector to ensure a proper seal.
- The recommended distance between mounts is 3-5 m (10-16 ft). To mount flat cable, use flat cable mount 1485A-FCM.
- When running cable into an enclosure, use flat cable gland 1485A-CAD.
- Connectors are designed for single use and cannot be reused. Once installed, connectors should not be removed from the trunkline.

8. Line up the keyed rectangular holes of the micro/open/terminator connection interface with the matching posts on the base and snap the micro module into place. **Optional:** Secure the micro/open/terminator module by driving an 8-32 x 1-3/4 screw through each of the two remaining mounting holes.

TIP When using the cable in applications with a large amount of flexing, secure the cable to a fixed reference point, using an 8-32 x 1-3/4 screw through each of the two remaining mounting holes. Attach the cable 10-15 cm (4-6 in.) from the connector.



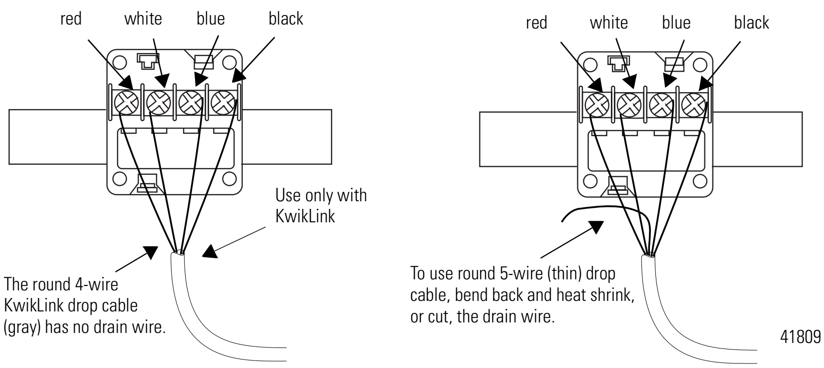
Install a KwikLink open-style connector to a drop cable

Install the KwikLink open-style connector to the flat media using the directions starting on page 3-10. Prepare the drop cable following the directions on page 3-2 numbers 1 through 5. For flat media connections you can use:

- round 4-wire (KwikLink) drop cable (1485K series)
- round 5-wire (thin) drop cable (1485R series)

– You must cut or heat shrink the drain wire when you use round 5-wire (thin) drop cable.

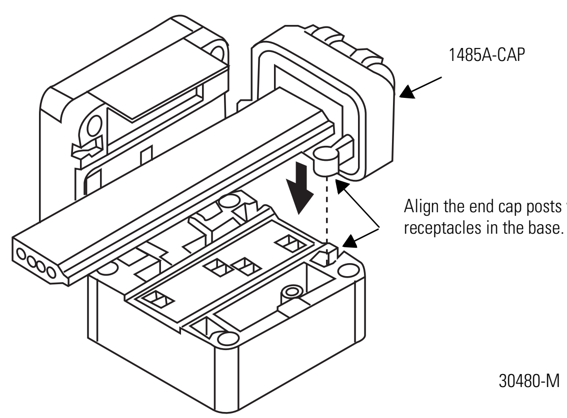
Wire Color	Wire identity	Use	Flat
white	CAN_H	signal	signal
blue	CAN_L	signal	signal
bare	drain	shield	n/a
black	V-	power	power
red	V+	power	power



Install end caps

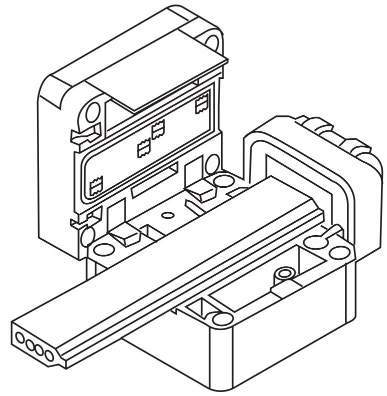
Each KwikLink terminator module is supplied with an end cap designed to cover the exposed end of the cable. To install the end cap:

1. Fit the end cap (1485A-CAP) on the cable as keyed. Align the end cap posts with the receptacles in the lower IDC base and press down until the end cap is firmly seated (the upper surface of the posts will be flush with the upper surface of the base).

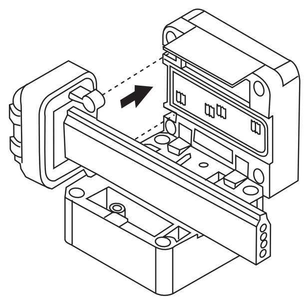


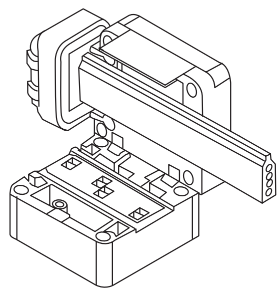
2. Close the IDC base and continue with the connection process as illustrated on page 3-10.

IMPORTANT When installing an end cap on the other end of the cable, note that the guide receptacles are on the upper portion of the IDC base.


30481

3. Repeat the end cap installation process as outlined previously. Close the IDC base and continue with connection as illustrated in the standard installation instructions starting on page 3-10.


30482


30483

Class 1Auxiliary Power Cable	
Spool size	**Catalog number**
75 m (246 ft)	1485C-P1L75
200 m (656 ft)	1485C-P1L200
420 m (1378 ft)	1485C-P1L420

Auxiliary Power Cable		
Wire Color	**Wire identity**	**Use**
white	user defined	user defined
blue	user defined	user defined
black	V-	output power
red	V+	output power

Install Class 1 KwikLink power cable

Install Class 1 KwikLink power cable as you would network cable. Refer to page 3-10 for installation instructions. You can use auxiliary power cable with the ArmorBlock MaXum cable base (1792D-CBFM) and I/O modules (1792D series). When running cable into an enclosure, use flat cable gland 1485A-CAD.

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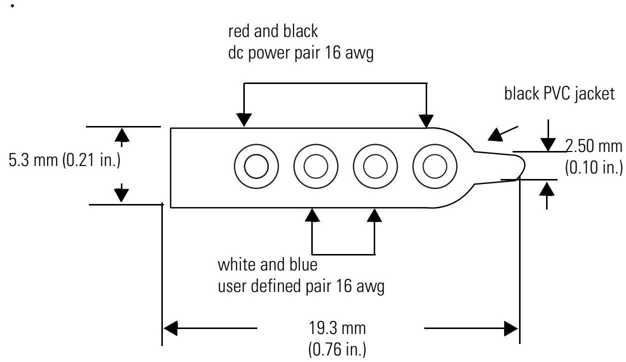
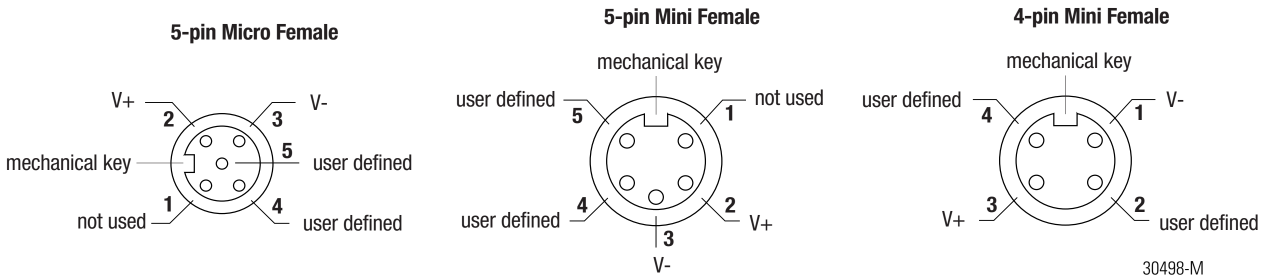


30493-M

Pinout diagrams for mini and micro connections to the power cable are shown below.



Connect a Power Supply to Round Media

To supply power you will need to install and ground the power supplies as well as connect all PowerTap taps. If you haven't determined power supply placement, see Chapter 4.

To install a power supply:

ATTENTION

Make sure the ac power source remains off during installation.

1. Mount the power supply securely allowing for proper ventilation, connection to the ac power source, and protection from environmental conditions according to the specifications for the supply.

2. Connect the power supply using:
   - a cable that has one pair of 12 AWG (3.3mm^2) conductors or the equivalent or two pairs of 15 AWG (1.7mm^2) conductors
   - a maximum cable length of 3m (10 ft) to the PowerTap tap
   - the manufacturer's recommendations for connecting the cable to the supply

Connect Power Supplies to KwikLink Flat Media

Class 1, 8A System

For a Class 1, 8A System, power may only be interfaced with the network using a KwikLink open-style connector.

Class 2, 4A System

For a Class 2, 4A System, power may be applied to the network using KwikLink micro or open-style connectors.

Notes:

Determine Power Requirements

In this chapter, we describe two methods for determining your system's power requirements:

- the look-up method
- the full calculation method

Try the look-up method first, then move on to the full calculation method if you cannot meet your configuration requirements.

IMPORTANT You must consider two areas when powering output devices using the DeviceNet power supply:

- (1) Wide DeviceNet voltage range of 11-25V dc
- (2) Noise or transient protection at each device

You must calculate a worst-case situation, and maintain voltage within the 11-25V dc range on all segments. This can be accomplished using diodes or other similar techniques. See Appendix B, Powering Output Devices, for more information.

Class 1 (CL1) cable

Per NEC specifications for a Class 1 circuit (see NEC Article 725), the energy at any point in the circuit is limited to 1000 VA. A Class 1 circuit requires that the cables used must have jacketing with 600V isolation and pass the CL1 burn test.

The DeviceNet specification indicates that the power source must be a regulated maximum of 24V dc, and the power circuit be limited to 8A. Applying this to a Class 1 circuit running at 24V dc, a DeviceNet-certified cable with a 600V jacket isolation rating meets all requirements to be used in a Class 1 circuit. So, based on the DeviceNet specification, the cable's power-carrying conductors are sized for an 8A maximum load.

Class 2 (CL2) Cable

Per NEC specifications for a Class 2 circuit (see NEC Article 725), the energy in the circuit anywhere is limited to 100 VA and the cable's jacketing must have a 300V minimum isolation rating. Based on a 30V dc system, your circuit would be limited to 3.3A.

The DeviceNet specification indicates the power source be a maximum of 24V dc. Applying this to a Class 2 circuit running at 24V dc, the maximum allowable current is 4A. A DeviceNet-certified cable with a 300V jacket isolation rating meets all requirements for use in a Class 2 circuit. So, based on the DeviceNet specification, the cable's power carrying conductors are sized for a 8A maximum load.

The current Allen-Bradley Thick cable power conductors are sized to handle at least 8 amps of power. However, NEC and CEC regulations force this cable to be a CL2 (100 VA, 4 amp max) cable due to the construction of the cable. Specifically, the insulation on the data pair is a foam PE, which will not pass at CL1 burn test. As a result, any system using a Thick trunk and Thin drop must be a CL2 installation in US and Canada.

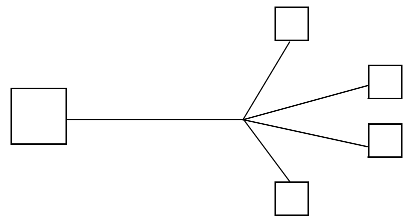
KwikLink trunk cable is rated for CL1 applications and the conductors can carry 8 amps of power.For more information, see Appendix A.

The DeviceNet specifications provide for both open- and closed-style wiring terminations. You can design a wiring system for a DeviceNet installation that lays out a trunk line in accordance with the requirements of the Class 1 guidelines and uses drop lines in accordance with Class 2 guidelines. Care must be taken at the point where the two guidelines meet. At that point you must limit the energy on each wire to be in accordance with the NEC guidelines. Energy in the drop line must be limited to no more that 100 VA. How you accomplish that is your decision. Most people resolve this issue by isolating the trunk from the drop line with different power sources. Other ways to limit energy may give you the same protection.

Use the Look-up Method

To determine if you have adequate power for the devices in your cable system, see the following examples and figures. You have enough power if the total load does not exceed the value shown by the curve or the table.

In a worst-case scenario, all of the nodes are together at the opposite end of the power supply.

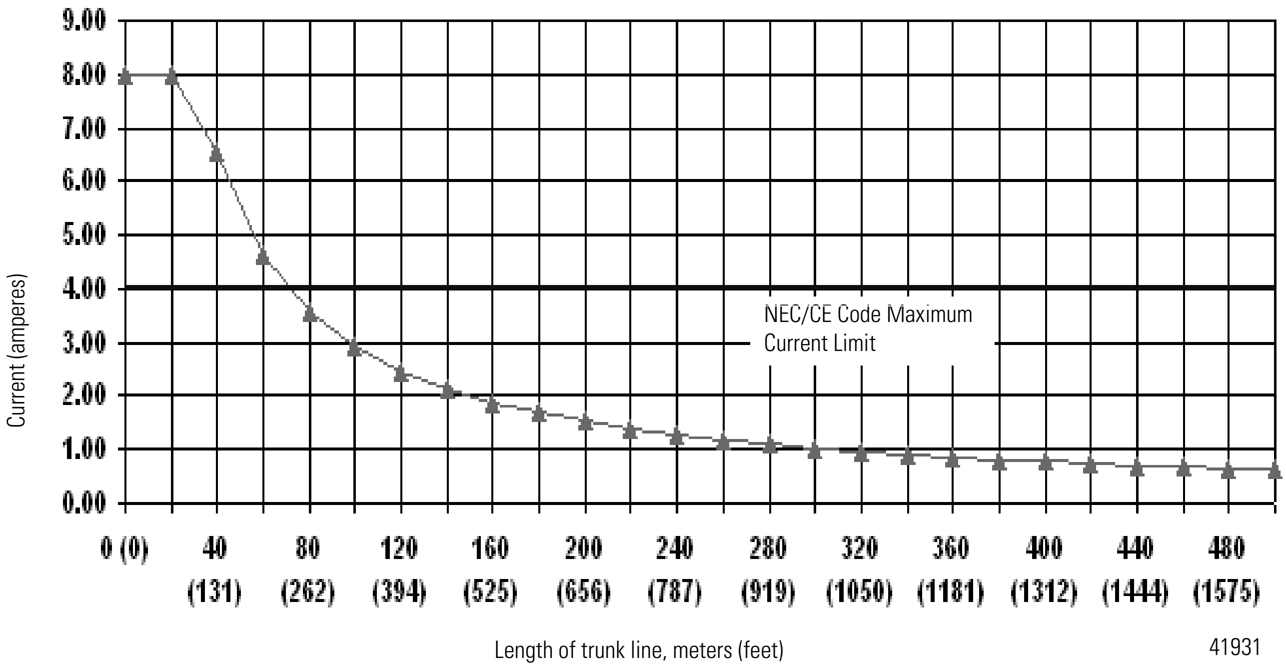


TIP This method may underestimate the capacity of your network by as much as 4 to 1. See the following section to use the full-calculation method if your supply does not fit under the curve.

For this configuration example	Flat cable uses figure	Thick cable uses figure	Thin cable uses figure
One power supply (end-connected)	Figure 4.2	Figure 4.1	Figure 4.7
One power supply (middle-connected)	Figure 4.2	Figure 4.1	Figure 4.7
NEC/CECode current boost configuration (V+ cut)	Figure 4.2	Figure 4.1	Figure 4.7
Two power supplies (end-connected)	Figure 4.6	Figure 4.5	*
Two power supplies (not end-connected)	Figure 4.4	Figure 4.3	*

* You can draw as much as 3A from a thin cable trunk line if the power supply separation is below 70m (230 ft).

Figure 4.1 One Power Supply (End Segment) Round Cable (Thick). Assumes all nodes are at the opposite end of the cable from the power supply.

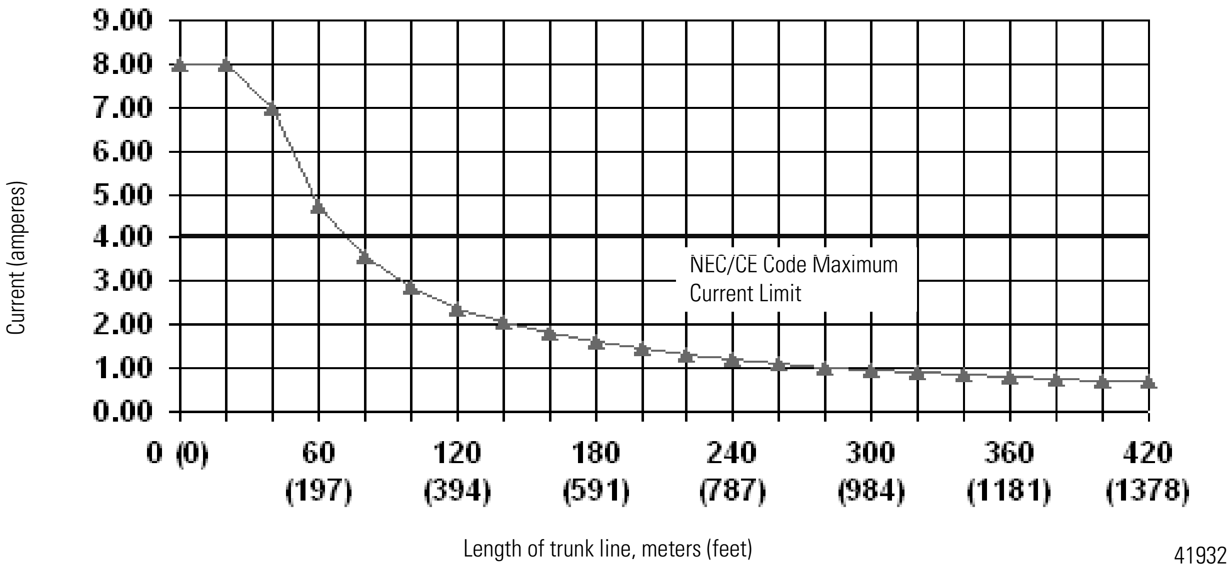


Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*
20 (66)	8.00*
40 (131)	6.53*
60 (197)	4.63*
80 (262)	3.59
100 (328)	2.93
120 (394)	2.47
140 (459)	2.14
160 (525)	1.89
180 (591)	1.69
200 (656)	1.53
220 (722)	1.39

Network Length m (ft)	Maximum Current (A)
240 (787)	1.28
260 (853)	1.19
280 (919)	1.10
300 (984)	1.03
340 (1115)	0.91
360 (1181)	0.86
380 (1247)	0.82
420 (1378)	0.74
440 (1444)	0.71
460 (1509)	0.68
480 (1575)	0.65
500 (1640)	0.63

*Exceeds NEC CL2/CECode 4A limit.

Figure 4.2 One Power Supply (End Segment) KwikLink Cable (Flat). Assumes all nodes are at the opposite end of the cable from the power supply.

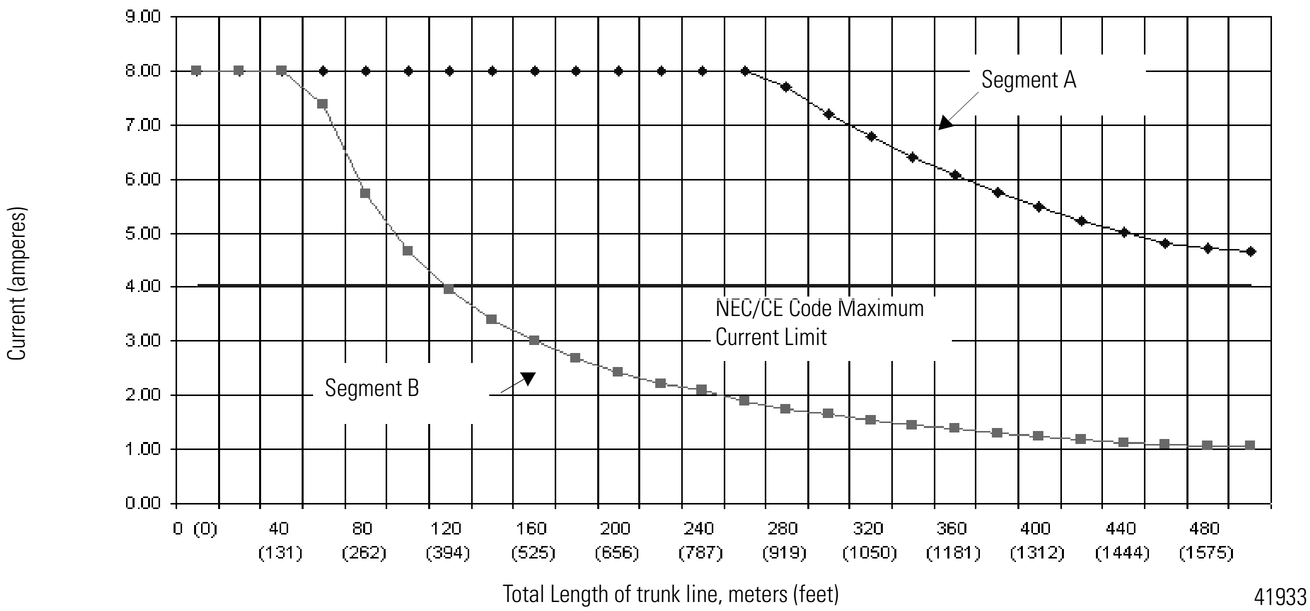


Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*
20 (66)	8.00*
40 (131)	7.01*
60 (197)	4.72*
80 (262)	3.56
100 (328)	2.86
120 (394)	2.39
140 (459)	2.05
160 (525)	1.79
180 (591)	1.60
200 (656)	1.44

Network Length m (ft)	Maximum Current (A)
220 (722)	1.31
240 (787)	1.20
260 (853)	1.11
280 (919)	1.03
300 (984)	0.96
320 (1050)	0.90
340 (1115)	0.85
360 (1181)	0.80
380 (1247)	0.76
400 (1312)	0.72
420 (1378)	0.69

*Exceeds NEC CL2/CECode 4A limit.

Figure 4.3 Two Power Supplies, (One-End Connected, One Middle-Connected); Two Cable Segments, Round Cable (Thick).



Power Supply A

Network Length m (ft)	Maximum Current (A)	Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*	260 (853)	8.00*
20 (66)	8.00*	280 (919)	7.69*
40 (131)	8.00*	300 (984)	7.21*
60 (197)	8.00*	320 (1050)	6.78*
80 (262)	8.00*	340 (1115)	6.41*
100 (328)	8.00*	360 (1181)	6.07*
120 (394)	8.00*	380 (1247)	5.76*
140 (459)	8.00*	400 (1312)	5.49*
160 (525)	8.00*	420 (1378)	5.24*
180 (591)	8.00*	440 (1444)	5.01*
200 (656)	8.00*	460 (1509)	4.80*
220 (722)	8.00*	480 (1575)	4.73*
240 (787)	8.00*	500 (1640)	4.66*

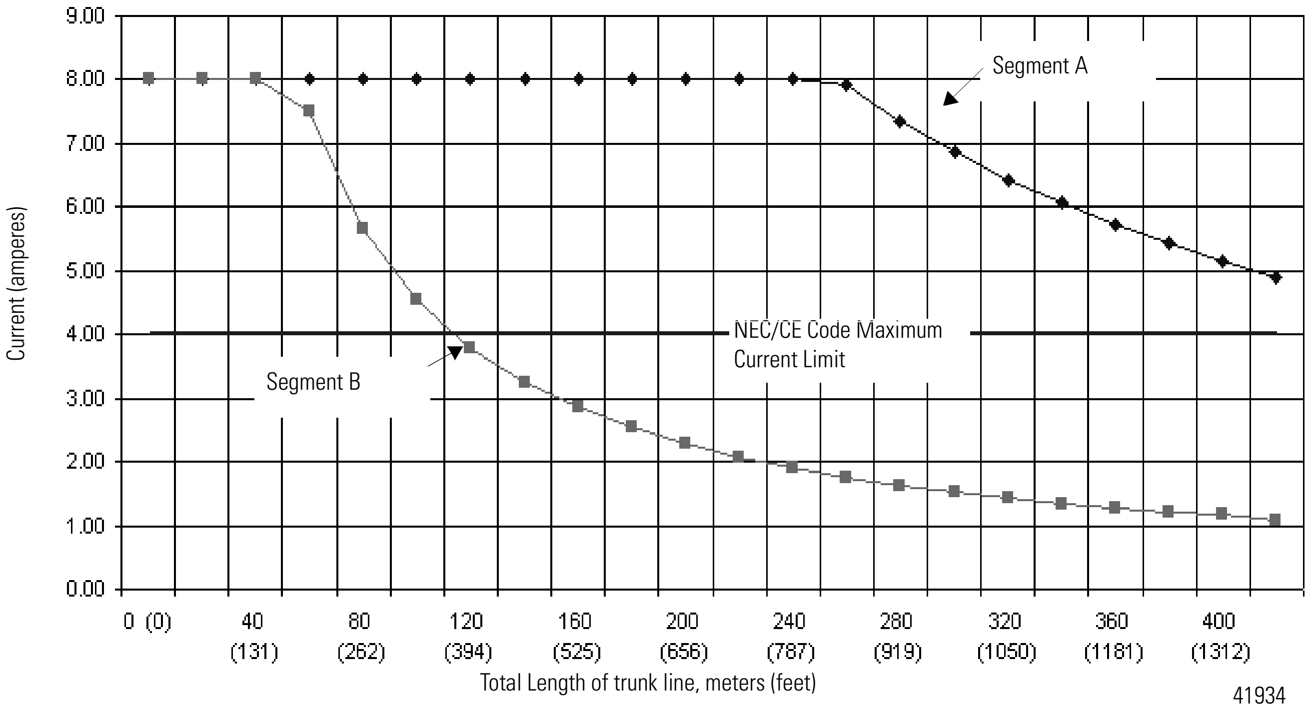
*Exceeds NEC CL2/CECode 4A limit.

Power Supply B

Network Length m (ft)	Maximum Current (A)	Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*	260 (853)	1.89
20 (66)	8.00*	280 (919)	1.76
40 (131)	8.00*	300 (984)	1.64
60 (197)	7.38*	320 (1050)	1.54
80 (262)	5.71*	340 (984)	1.46
100 (328)	4.66*	360 (1050)	1.38
120 (394)	3.94	380 (1247)	1.31
140 (459)	3.40	400 (1312)	1.24
160 (525)	3.00	420 (1378)	1.18
180 (591)	2.68	440 (1444)	1.13
200 (656)	2.43	460 (1509)	1.08
220 (722)	2.22	480 (1575)	1.07
240 (787)	2.08	500 (1640)	1.05

*Exceeds NEC CL2/CECode 4A limit.

Figure 4.4 Two Power Supplies, (One End-Connected, One Middle-Connected); Two Cable Segments, KwikLink Cable (Flat).



Segment Supply A

Network Length m (ft)	Maximum Current (A)	Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*	220 (722)	8.00*
20 (66)	8.00*	240 (787)	8.00*
40 (131)	8.00*	260 (853)	7.91*
60 (197)	8.00*	280 (919)	7.35*
80 (262)	8.00*	300 (984)	6.86*
100 (328)	8.00*	320 (1050)	6.43*
120 (394)	8.00*	340 (1115)	6.06*
140 (459)	8.00*	360 (1181)	5.72*
160 (525)	8.00*	380 (1247)	5.43*
180 (591)	8.00*	400 (1312)	5.16*
200 (656)	8.00*	420 (1378)	4.91*

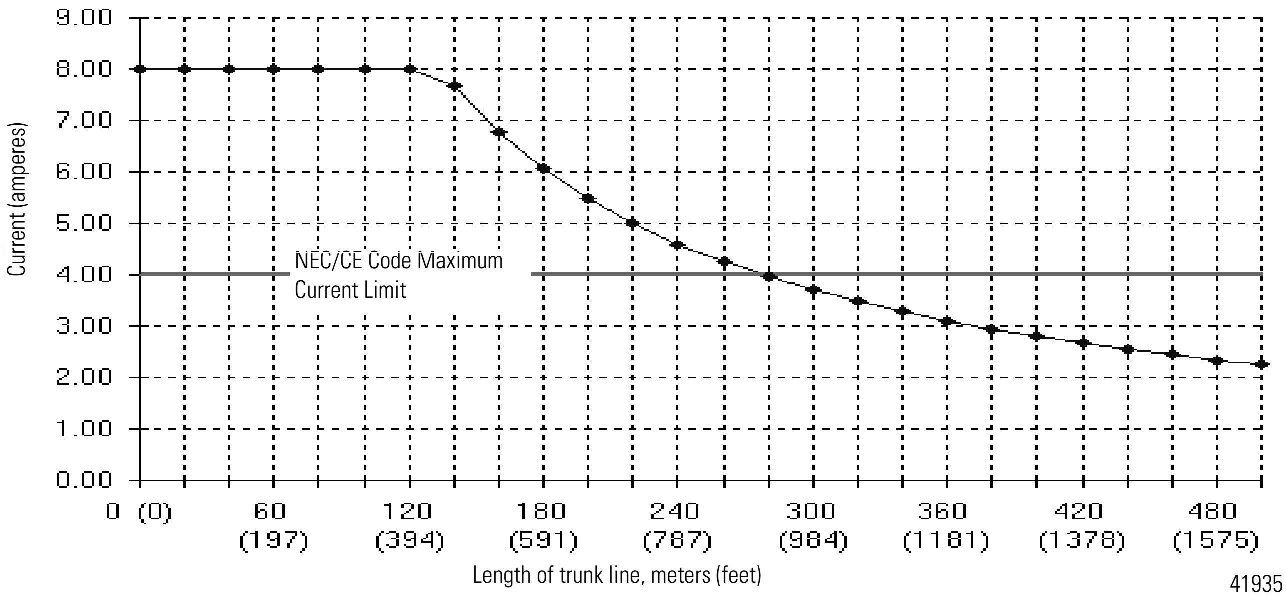
*Exceeds NEC CL2/CECode 4A limit.

Segment Supply B

Network Length m (ft)	Maximum Current (A)	Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*	220 (722)	2.08
20 (66)	8.00*	240 (787)	1.91
40 (131)	8.00*	260 (853)	1.76
60 (197)	7.52*	280 (919)	1.64
80 (262)	5.67*	300 (984)	1.53
100 (328)	4.55*	320 (1050)	1.43
120 (394)	3.80	340 (984)	1.35
140 (459)	3.26	360 (1050)	1.28
160 (525)	2.86	380 (1247)	1.21
180 (591)	2.54	400 (1312)	1.19
200 (656)	2.29	420 (1378)	1.09

*Exceeds NEC CL2/CECode 4A limit.

Figure 4.5 Two End-Connected Power Supplies, Round Cable (Thick).

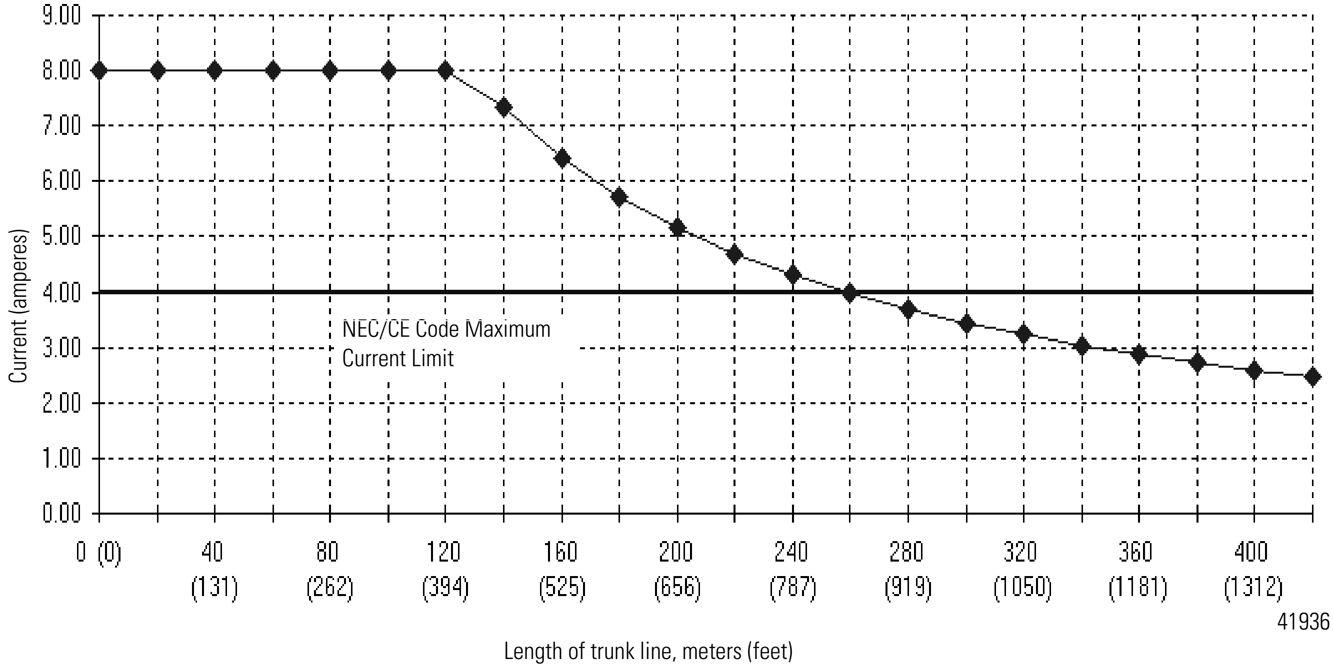


Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*
20 (66)	8.00*
40 (131)	8.00*
60 (197)	8.00*
80 (262)	8.00*
100 (328)	8.00*
120 (394)	8.00*
140 (459)	7.68*
160 (525)	6.77*
180 (591)	6.05*
200 (656)	5.47*
220 (722)	4.99*
240 (787)	4.59*

Network Length m (ft)	Maximum Current (A)
260 (853)	4.25*
280 (919)	3.96
300 (984)	3.70
320 (1050)	3.48
340 (1115)	3.28
360 (1181)	3.10
380 (1247)	2.94
400 (1312)	2.79
420 (1378)	2.66
440 (1444)	2.55
460 (1509)	2.44
480 (1575)	2.34
500 (1640)	2.25

*Exceeds NEC CL2/CECode 4A limit.

Figure 4.6 Two End-Connected Power Supplies, KwikLink Cable (Flat)

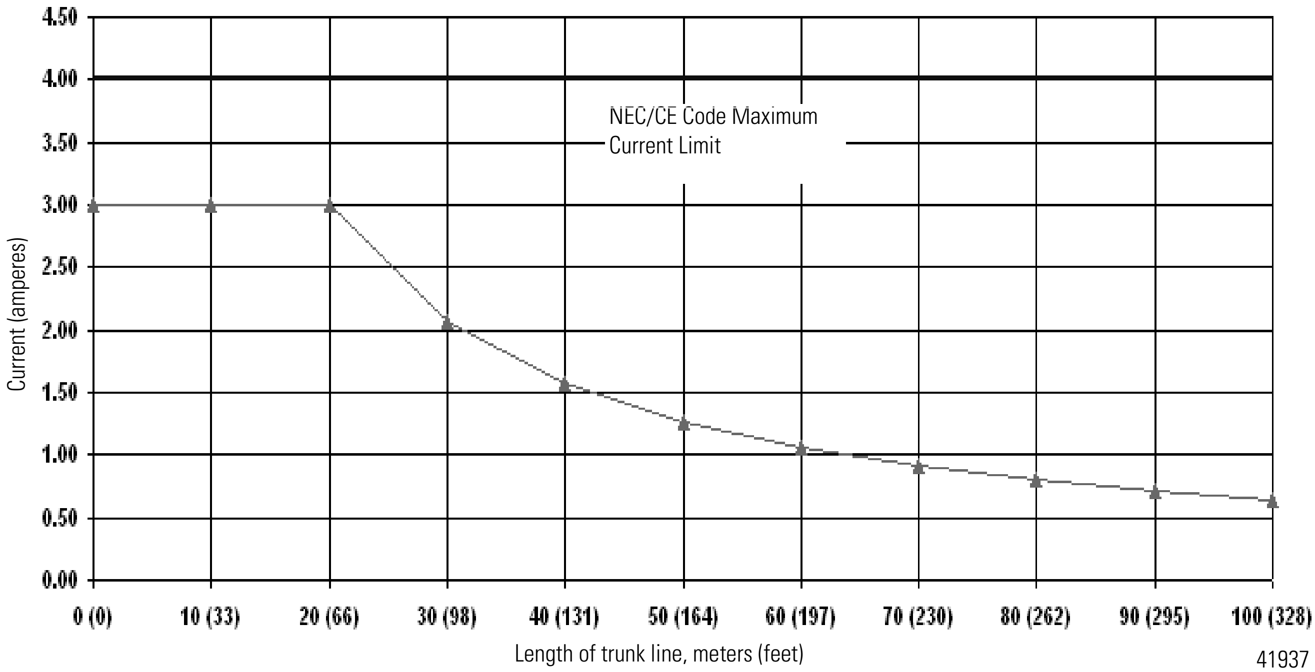


Network length m (ft)	Maximum current (A)
0 (0)	8.00*
20 (66)	8.00*
40 (131)	8.00*
60 (197)	8.00*
80 (262)	8.00*
100 (328)	8.00*
120 (394)	8.00*
140 (459)	7.35*
160 (525)	6.43*
180 (591)	5.72*
200 (656)	5.16*

Network length m (ft)	Maximum current (A)
220 (722)	4.69*
240 (787)	4.30*
260 (853)	3.97
280 (919)	3.69
300 (984)	3.44
320 (1050)	3.23
340 (1115)	3.04
360 (1181)	2.87
380 (1247)	2.72
400 (1312)	2.59
420 (1378)	2.46

*Exceeds NEC CL2/CECode 4A limit.

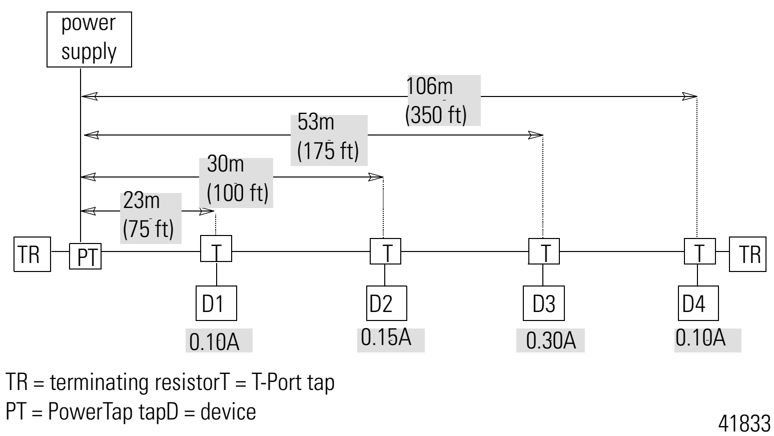
Figure 4.7 One Power Supply (End Segment) Round Cable (Thin)



Network length m (ft)	Maximum current (A)
0 (0)	3.00
10 (33)	3.00
20 (66)	3.00
30 (98)	2.06
40 (131)	1.57
50 (164)	1.26
60 (197)	1.06
70 (230)	0.91
80 (262)	0.80
90 (295)	0.71
100 (328)	0.64

One power supply (end-connected)

The following example uses the look-up method to determine the configuration for one end-connected power supply. One end-connected power supply provides as much as 8A near the power supply.



1. Determine the total length of the network.

   106m

2. Add each device's current together to find the total current.

   0.10 + 0.15 + 0.30 + 0.10

IMPORTANT	Make sure that the required power is less than the rating of the power supply. You may need to derate the supply if it is in an enclosure.

3. Find the value next largest to the network length using Figure 4.1 on Page 4-4 to determine the approximate maximum current allowed for the system.

   120m (2.47A)= 0.65A

Results

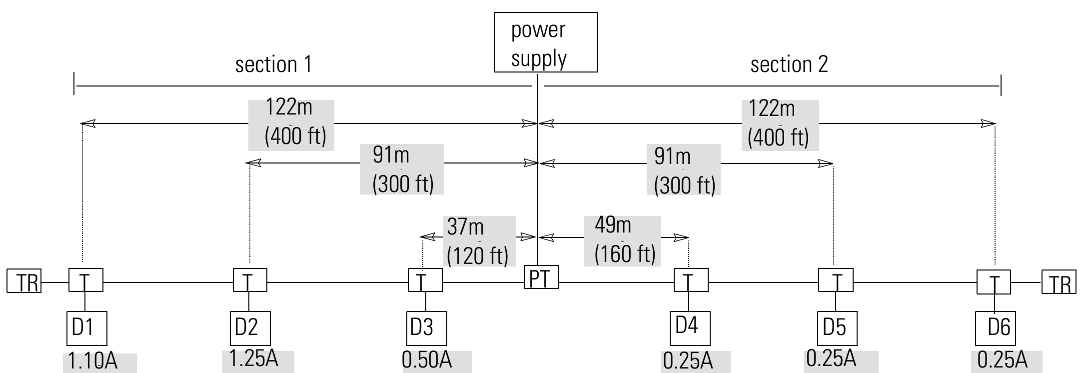
Since the total current does not exceed the maximum allowable current, the system will operate properly (0.65A ≤ 2.47A).

IMPORTANT If your application doesn't fit "under the curve", you may either:

- do the full-calculation method described later in this chapter, or
- move the power supply to somewhere in the middle of the cable system and reevaluate per the following section

One power supply (middle-connected)

The following example uses the look-up method to determine the configuration for one middle-connected power supply. One middle-connected power supply provides the maximum current capability for a single supply.



TR = terminating resistor T = T-Port tap
PT = PowerTap tap D = device

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1. Add each device's current together in section 1.

   1.10 + 1.25 + 0.50 = 2.85A

2. Add each device's current together in section 2.

   0.25 + 0.25 + 0.25 = 0.75A

3. Find the value next largest to each section's length to determine the approximate maximum current allowed for each section.

   Section 1 = 140m (2.14A)

Section 2 = 140m (2.14A)

IMPORTANT Section 1 + Section 2 $<$ 3.6A. This is $\le$ 4A for NEC/CECode compliance.

Results

Section 1 is overloaded because the total current exceeds the maximum current (2.85A $\ge$ 2.14A).

Section 2 is operational since the total current does not exceed the maximum current (0.75A $\le$ 2.14A).

Balance the system by moving the power supply toward the overloaded section (section 1). Then recalculate each section.

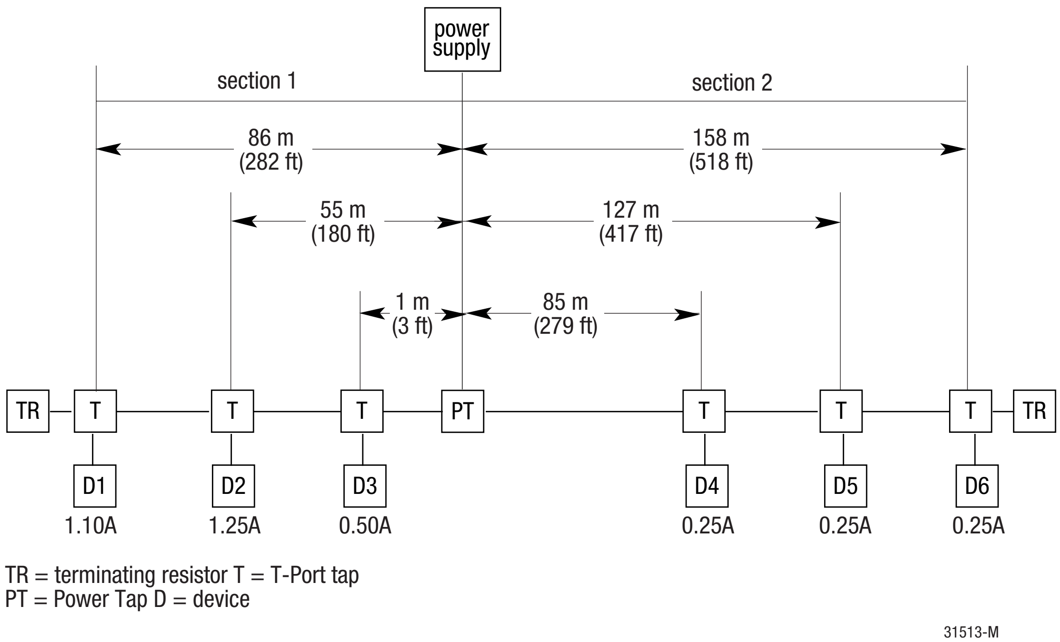
4. Add each device's current together in section 1.

   1.10+1.25+0.50 = 2.85A

5. Add each device's current together in section 2.

   0.25+0.25+0.25 = 0.75A

6. Find the value next largest to each section's length using Figure 4.1 on Page 4-4 to determine the approximate maximum current allowed for each section.



Section 1 = 100m (2.93A)

Section 2 = 160m (1.89A)

IMPORTANT	Section 1+ Section 2 < 3.6A. This is ≤ 4A for NEC/CECode compliance. However, if due to derating of the power supply, you used a power supply larger than 4A, you would exceed the NEC/CECode maximum allowable current.

Results

Section 1 is operational since the total current does not exceed the maximum current (2.85A ≤ 2.93A).

Section 2 is operational since the total current does not exceed the maximum current (0.75A ≤ 1.89A).

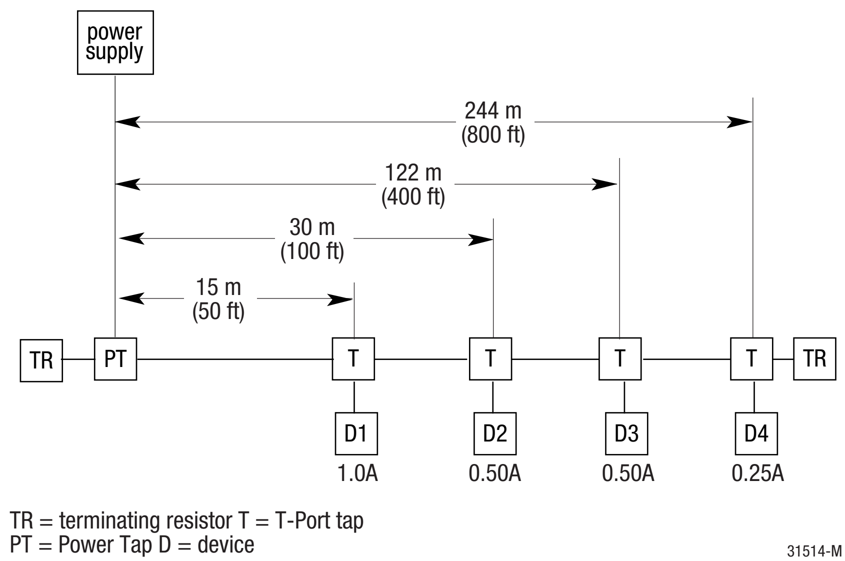
Adjusting the configuration

To make the system operational, you can:

- move the power supply in the direction of the overloaded section
- move higher current loads as close to the supply as possible
- move devices from the overloaded section to another section
- shorten the overall length of the cable system
- perform the full-calculation method for the segment described later in this chapter for the non-operational section
- add a second power supply to the cable system (do this as a last resort) as shown in the following three examples

NEC/CECode current boost configuration

If the national or local codes limit the maximum rating of a power supply, use the following configuration to replace a single, higher current power supply.



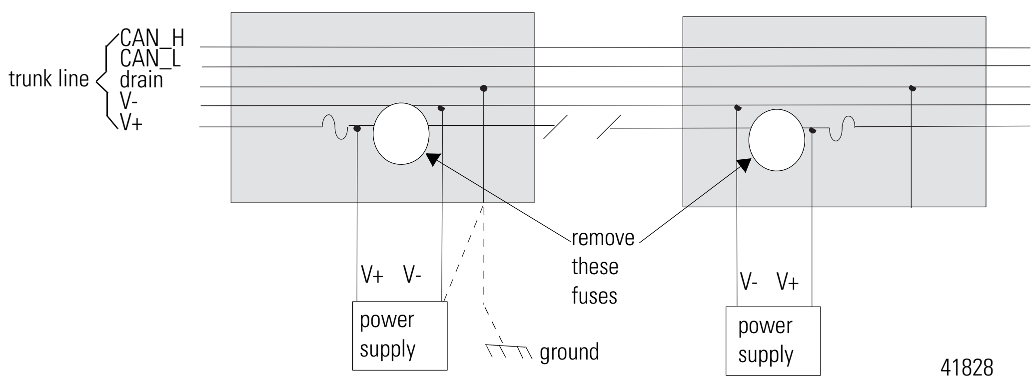
This configuration effectively doubles the available current. Essentially, each segment is independent of the other and is a "one power supply end-connected system". Use Figure 4.5 on page 4-8 for each segment. Each power supply can be rated up to 4A and still meet NEC/CECode Class 2 current restrictions.

.

IMPORTANT To use this configuration, you must make the following PowerTap tap modifications:

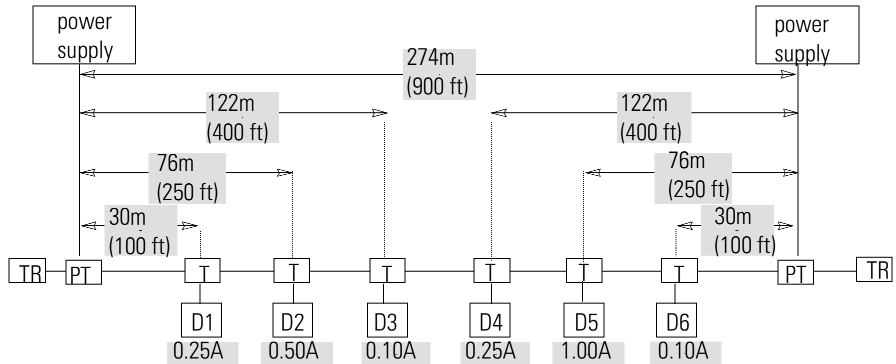
- place no loads between the PowerTap taps
- remove fuses between the two PowerTap taps to segment the V+ conductor in the trunk line between the taps
- cut V+ (red) flush with cable jacket

Wire Color	Wire identity	Use
white	CAN_H	signal
blue	CAN_L	signal
bare	drain	shield
black	V-	power
red	V+	power



Two power supplies (end-connected) in parallel with no V+ break

The following example uses the look-up method to determine the configuration for two end-connected power supplies. You must use diodes at the power taps to prevent back-feeding of the power supplies. Check your national and local codes for any restrictions on the use of parallel power supplies. The NEC/CECode requires that the power supplies must be listed for parallel operation.



TR = terminating resistorT = T-Port tap
PT = PowerTap D = device

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1. Determine the total length of the network.

   274m

2. Add each device's current together to find the total current.

   0.25+0.50+0.10+0.25+1.00+0.10 = 2.20A

3. Find the value next largest to each section's length using Figure 4.5 on page 4-8 to determine the approximate maximum current allowed for each section.

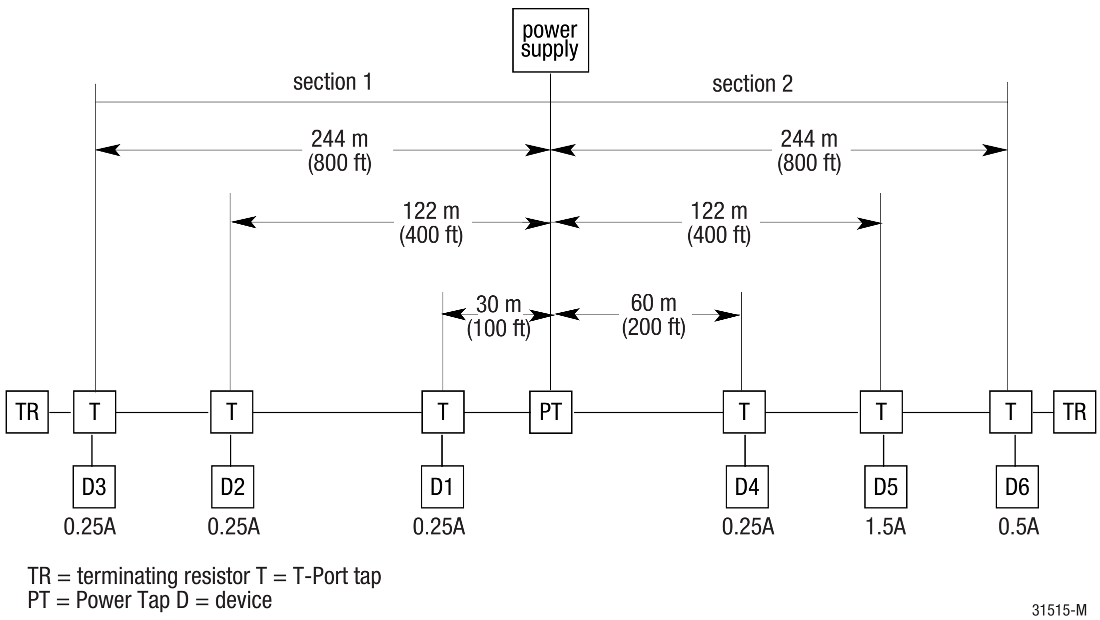
   280m (3.96A**)**

Results

Since the total current does not exceed the maximum current, the system will operate properly (2.20A ≤ 3.96A).

Two Power supplies (not end-connected) in parallel with no V+ break

The following example uses the look-up method to determine the configuration for two power supplies that are not end-connected. This configuration provides the most power to the cable system. You must use diodes at the power taps to prevent back-feeding of the power supplies. Check your national and local codes for any restrictions on the use of parallel power supplies.



1. Determine the trunk line length of one end section (for this example we will use section 3).

   122m

2. Add each device's current together in section 3.

   0.25+1.00+0.30 = 1.55A

3. Find the value next largest to the length of section 3 using Figure 4.3 on page 4-6 to determine the approximate maximum current allowed (approximately).

   140m (3.40A)

IMPORTANT	If the total current in the section exceeds the maximum current, move the power supply closer to the end and repeat steps 1-3 until the total current in the section is less than the maximum allowable current.

Results

Since the total current does not exceed the maximum current, section 3 will operate properly (1.55A ≤ 3.40A).
Loading is 46% (1.55/3.40).

4. Determine the trunk line length of the other end section (section 1).

   76m

5. Add each device's current together in section 1.

   2.25A

6. Find the value next largest to the length of section 1 using Figure 4.1 on page 4-4 to determine the approximate maximum current allowed.

   80m (3.59A)

IMPORTANT	If the total current in the section exceeds the maximum current, move the power supply closer to the end and repeat steps 4-6 until the total current in the section is less than the maximum allowable current.

Results

Since the total current does not exceed the maximum current, section 1 will operate properly (2.25A ≤ 3.59A). Loading is 63% (2.25/3.59).

7. Determine the length of the middle section (section 2).

   274m

8. Add each device's current together in section 2.

   1.50+2.00 = 3.50A

9. Find the value next largest to the length of section 2 using Figure 4.3 on page 4-6 to determine the approximate maximum current allowed.

   280m (7.69A)

IMPORTANT If the total current in the section exceeds the maximum current, move the power supplies closer together and repeat steps 7-9 until the total current in the section is less than the maximum allowable current.

Results

Since the total current does not exceed the maximum allowable current, section 2 will operate properly (3.50A ≤ 7.69A).
Loading is 46% (3.50/7.69).

If the middle section is still overloaded after you move the power supplies closer together, add a third power supply. Then recalculate each segment.

IMPORTANT Section 1 + Section 2 + Section 3 = 7.3A. This is ≥ 4A and does not comply with the NEC/CECode for Class 2 installations.

IMPORTANT To determine spare capacity for future expansion, subtract the actual current from the maximum allowable current. To determine the percentage loading for each segment, divide the maximum allowable current into the actual current.

Segment	Maximum Current - Actual Current =	Spare Capacity	% Loading/Segment
1	2.85A - 2.25A=	0.60A	79% (2.25A/2.85A)
2	3.83A - 3.50A=	0.33A	91% (3.50A/3.83A)
3	1.70A - 1.55A=	0.15A	91% (1.55A/1.70A)

Use the Full-calculation Method

Use the full-calculation method if your initial evaluation indicates that one section is overloaded or if the requirements of your configuration cannot be met by using the look-up method.

IMPORTANT Before constructing the cable system, repeat all calculations to avoid errors.

Use the Equation

A supply that is not end-connected creates two sections of trunk line. Evaluate each section independently.

SUM $\{[(L_n \text{ x } (R_c)) + (N_t \text{ x } (0.005))] \text{ x } I_n\} \leq 4.65\text{V}$

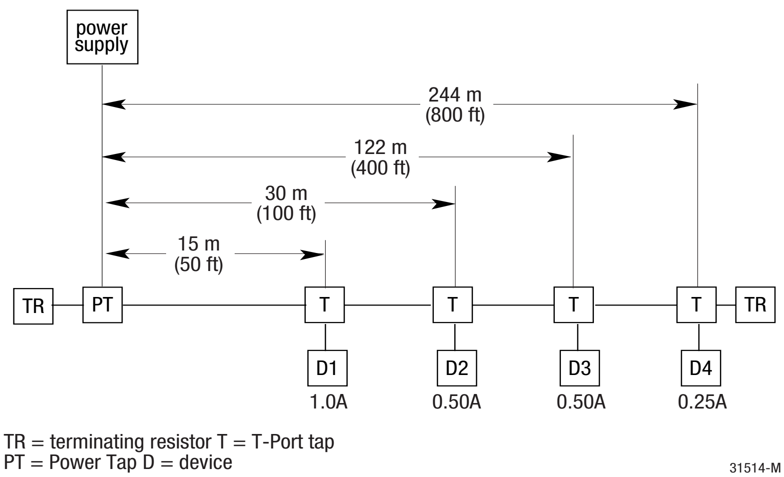
Term	Definition
L_n	L = The distance (m or ft) between the device and the power supply, excluding the drop line distance. n = The number of a device being evaluated, starting with one for the device closest to the power supply and increasing by one for the next device. The equation sums the calculated drop for each device and compares it to 4.65V.
R_c	Thick cable Metric 0.015 Ω/m English 0.0045 Ω/ft Thin cable Metric 0.069 Ω/m English 0.021 Ω/ft Flat Cable Metric 0.019 Ω/m English 0.0058 Ω/ft
N_t	The number of taps between the device being evaluated and the power supply. For example: when a device is the first one closest to the power supply, this number is 1 when a device has one device between it and the power supply, this number is 2 when 10 devices exist between the evaluated device and the power supply, this number is 11. For devices attached to a DeviceBox tap or DevicePort tap, treat the tap as one tap. The currents for all devices attached to one of these taps should be summed and used with the equation only once.
(0.005)	The nominal-contact resistance used for every connection to the trunk line.
I_n	I = The current drawn from the cable system by the device.For currents within 90% of the maximum, use the nominal device current. Otherwise, use the maximum rated current of the device. For DeviceBox taps or DevicePort taps, sum the currents of all the attached devices, and count the tap as one tap. n = The number of a device being evaluated, starting with one for the device closest to the power supply and increasing by one for the next device.
4.65V	The maximum voltage drop allowed on the DeviceNet trunk line. This is the total cable system voltage drop of 5.00V minus 0.35V reserved for drop line voltage drop.

One power supply (end-connected)

Example using thick cable

The following example uses the full calculation method to determine the configuration for one end-connected power supply on a thick cable trunk line.

- Device 1 and Device 2 cause the same voltage drop but Device 2 is twice as far from the power supply and draws half as much current.
- Device 4 draws the least amount of current but it is furthest from the power supply and causes the greatest incremental voltage drop.



1. Find the voltages for each device using the equation for thick cable.

   SUM $\{[(L_n \times (0.0045)) + (N_t \times (0.005))] \times I_n\} \leq 4.65V$.

   D1 1.0A — **A.** $[(50 \times (0.0045)) + (1 \times (0.005))] \times 1.00 = 0.23V$

   D2 0.50A — **B.** $[(100 \times (0.0045)) + (2 \times (0.005))] \times 0.50 = 0.23V$

   D3 0.50A — **C.** $[(400 \times (0.0045)) + (3 \times (0.005))] \times 0.50 = 0.91V$

   D4 0.25A — **D.** $[(800 \times (0.0045)) + (4 \times (0.005))] \times 0.25 = 0.91V$

2. Add each device's voltage together to find the total voltage.

$0.23V + 0.23V + 0.91V + 0.91V = 2.28V$

Results: Since the total voltage does not exceed 4.65V, the system will operate properly ($2.28V \leq 4.65V$).

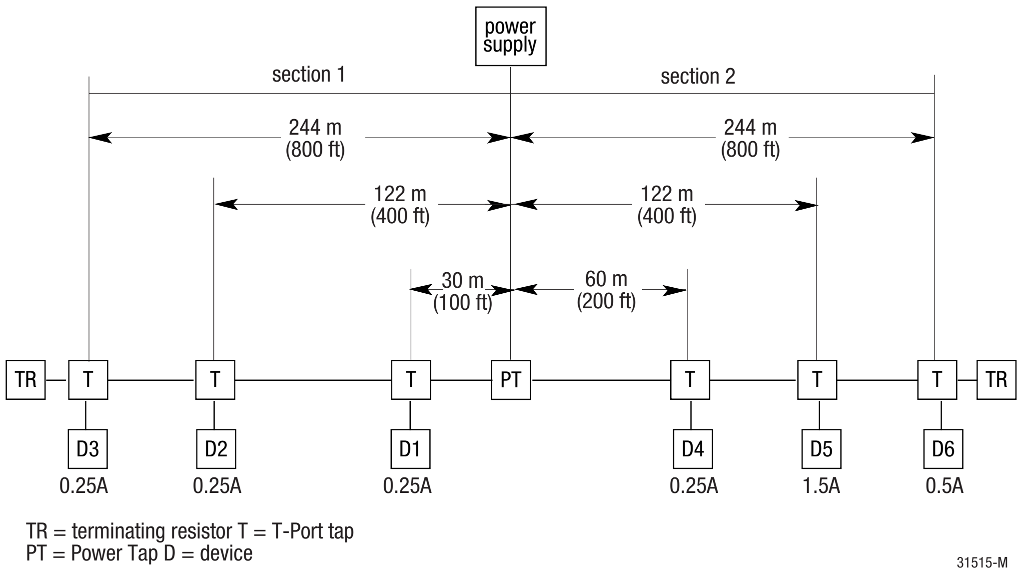
The percent loading is found by dividing the total voltage by 4.65V.

%Loading = 2.28/4.65 = 49%

One power supply (middle-connected)

Example using thick cable

This example is used to check loading on both sides of a middle-connected supply on a thick cable trunk line. Keep the loads, especially the higher ones, close to the power supply. If the device location is fixed, put the power supply in the center of the highest current concentration.



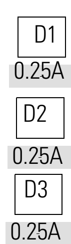
TR = terminating resistor T = T-Port tap
PT = Power Tap D = device

According to the look-up method, section 1 is operational while section 2 is overloaded.

Value of	Section 1	Section 2
Total maximum current	1.25A (approximately)	1.25A (approximately)
Total current required	0.75A	2.25A

1. Find the voltages for each device in section 1 using the equation for thick cable.

   $$\text{SUM } \{[(L_n \times (0.0045)) + (N_t \times (0.005))] \times I_n\} \leq 4.65\text{V}.$$



   A.[(**100** x (0.0045)) + (**1** x (0.005))] x 0.25 = 0.12V

   B.[(**400** x (0.0045)) + (**2** x (0.005))] x 0.25 = 0.45V

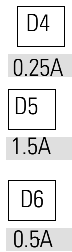
   C.[(**800** x (0.0045)) + (**3** x (0.005))] x 0.25 = 0.90V

2. Add each device's voltage together to find the total voltage for section 1.

   0.12V + 0.45V + 0.90V = 1.47V

3. Find the voltages for each device in section 2 using the equation for thick cable.

SUM $\{[(L_n \times (0.0045)) + (N_t \times (0.005))] \times I_n\} \leq 4.65V$.



A.[(**200** x (0.0045)) + (**1** x (0.005))] x 0.25 = 0.23V

B.[(**400** x (0.0045)) + (**2** x (0.005))] x 1.5 = 2.72V

C.[(**800** x (0.0045)) + (**3** x (0.005))] x 0.5 = 1.81V

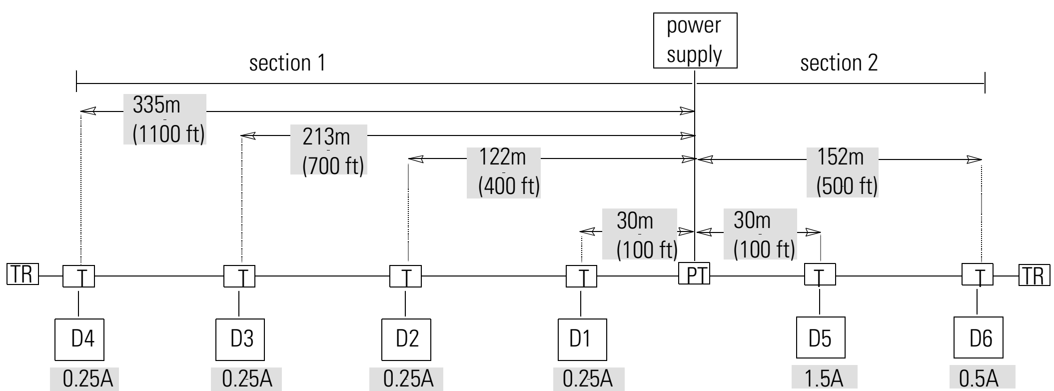
4. Add each device's voltage together to find the total voltage for section 2.

0.23 + 2.72 + 1.81 = 4.76V

Results

Since the total voltage in section 2 exceeds 4.65V, the system will not operate properly (4.76V > 4.65V).

Attempt to correct this overload by moving the power supply 91m (300ft) toward the overloaded section. Now there are four devices in section 1 and two devices in section 2. Once you've moved the power supply, try the calculations again.

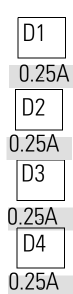


TR = terminating resistorT = T-Port tap
PT = PowerTap D = device

41859

1. Find the voltages for each device in section 1 using the equation for thick cable.

SUM $\{[(L_n \times (0.0045)) + (N_t \times (0.005))] \times I_n\} \leq 4.65V$.



A.[(100 x (0.0045)) + (1 x (0.005))] x 0.25 = 0.11V

B.[(400 x (0.0045)) + (2 x (0.005))] x 0.25 = 0.45V

C.[(700 x (0.0045)) + (3 x (0.005))] x 0.25 = 0.79V

D.[(1100 x (0.0045)) + (4 x (0.005))] x 0.25 = 1.24V

2. Add each device's voltage together to find the total voltage for section 1.

   0.11 + 0.45 + 0.79 + 1.24= 2.59V

3. Find the voltages for each device in section 2 using the equation for thick cable.

   $\text{SUM } \{[(L_n \text{ x } (0.0045)) + (N_t \text{ x } (0.005))] \text{ x } I_n\} \leq 4.65\text{V}.$

   D5 1.5A

   A.[(100 x (0.0045)) + (1 x (0.005))] x 1.5 = 0.68V

   D6 0.5A

   B.[(500 x (0.0045)) + (**2** x (0.005))] x 0.5 = 1.13V

4. Add each device's voltage together to find the total voltage for section 2.

   0.68 + 1.13 = 1.81V

Results

Since the total voltage does not exceed 4.65V in either section, the system will operate properly - section 1 (2.59V $\leq$ 4.65V) section 2 (1.81V $\leq$ 4.65V).

The percent loading is found by dividing the total voltage by 4.65V.

Section 1%Loading = 2.59/4.65 = 56%
Section 2% Loading = 1.81/4.65 = 39%

Notes:

Correct and Prevent Network Problems

Use this chapter if you are experiencing problems with network operation. In this chapter, we tell you how to locate and correct problems associated with improper system design.

ATTENTION

Verify that all devices on the network have been certified by the Open DeviceNet Vendor Association (ODVA), and carry the DeviceNet Conformance Check on their nameplate.

General Troubleshooting Tips

Observe the following general tips when troubleshooting your DeviceNet network.

- ☐ Distinguish, as soon as possible, a device problem from a media problem.
- ☐ Try to isolate the problem by removing nodes, drop lines, taps, or trunk lines.
- ☐ Use RSNetWorx for DeviceNet software and the 1770-KFD or 1784-PCD communication interfaces to identify the functioning nodes on the network.
- ☐ Refer to the documentation that shipped with your DeviceNet scanner for an explanation of DeviceNet scanner status/error codes.
- ☐ Refer to the documentation shipped with your DeviceNet-enabled device for an explanation of the device's network LED.
- ☐ When troubleshooting a particular portion of the network, you can substitute known good devices, cables, connectors, etc. for bad ones until you isolate the problem.
- ☐ If you suspect a media problem, always inspect the media first. Verify lengths, topology, and proper termination.

- ☐ Use Rockwell Automation's Media Checker (catalog number 1788-MCHKR; available from your local Rockwell Automation distributor) to test network problems that result from miswiring, loose connections, opens or shorts.
- ☐ Be careful when setting network addresses and baud rates. Incorrectly set addresses or baud rates will cause other nodes to appear to be bad.
- ☐ Pressing the reset button on the scanner does not reset the network
- ☐ Cycling power to the rack does not reset the network
- ☐ Cycling network power could cause the scanner to go bus off. In this state, nodes will not re-allocate, even if they are functioning correctly.
- ☐ If, after you replace a node that has gone bus off, the problem persists, the problem is not the node itself. Rather, the problem could be the address or baud rate setting, or a network topology, grounding, or noise problem.

Diagnose Common Problems

Use the following tips to diagnose and correct some of the most commonly occurring network problems.

TIP Most devices have some type of status display, such as LEDs or alpha-numeric message displays. If any of your devices display error messages, refer to the documentation provided by the manufacturer to interpret the error codes.

problem	symptom	do this
common mode problems	• nodes near the end of the trunk line stop communicating after operating normally • the network communicates only when the number of nodes is decreased or the trunk length is reduced • properly configured slave devices are not detected by the scanner	• check communications at the end of the network • check common mode voltage • move nodes from the overloaded section to the less-overloaded section • shorten the overall length of the network cable • move power supply in the direction of the overloaded section of the network • move high-current nodes (e.g., valve banks) close to the power supply • add a second power supply • break the network into 2 separate networks
bus errors	• node operates intermittently (drops off suddenly and unexpectedly) • LEDs or other displays indicate buss off errors	• Check that baud rates are set correctly. A device with an incorrectly set baud rate affects other nodes when the device attempts to go online. • replace the suspected faulty device and re-check error rates • check cables for intermittent operation by shaking, bending or twisting the suspected cable or connection and checking error rates

problem	symptom	do this
bus traffic problems	• nodes stop communicating • device times out	• check scanner configuration to ensure scan rate is set correctly – inter-scan/delay scan interval too short can cause device timeouts – inter-scan/delay scan interval too long can reduce system performance and make inefficient use of available bandwidth • check change-of-state devices consuming excessive bandwidth • increase production inhibit time or change these devices to polling, cyclic, or bit strobe communication • check for nodes with excessive bandwidth or a much-higher than average MAX value
bus power problems	• nodes near the end of the trunk line stop communicating after operating normally • the network communicates only when the number of nodes is decreased or the trunk length is reduced	• check network power voltage at the node • check common mode voltage • check for output devices (e.g., contactors) powered from the network • check for interference caused by network cables routed too closely to high-voltage and RF lines • use an oscilloscope to check the power supply trace for ripple increasing over time against the baseline • check cables for intermittent operation by shaking, bending or twisting the suspected cable or connection and checking peak-to-peak voltages
shield voltage problems	• nodes operate intermittently • properly configured slave devices are not detected by the scanner	• check shield voltage • check for additional V- or shield wire connections • check for loose connections (in particular, field-attachable connections) • ensure that only shield and V- wires are connected together at earth ground and the power supply

Check System Design

You can avoid many network problems by verifying that you have properly designed your network. Begin by walking the physical network, and making a sketch of your network layout. Then follow the checklist below.

Table 5.1 Troubleshooting your system design

	check	to ensure that
☐	number of nodes	you do not exceed the recommended maximum of 64 nodes. The practical limit of DeviceNet nodes may be 61 devices, since you should allow one node each for the scanner, the communication interface module, and an open node at node 63.
☐	cumulative drop line length	you do not exceed the recommended maximum
☐	individual drop line length	you do not exceed the recommended maximum of 6m (20ft)
☐	branched drop line length	you do not exceed the recommended maximum
☐	total trunk length	you do not exceed the recommended maximum
☐	termination resistors	the trunk line is terminated at both ends with a 121Ω, 1%, 1/4W or larger resistor
☐	power supply cable	you are using the proper cable length and gauge
☐	power cable to the trunk line	you are using the proper cable size and length
☐	power supply cable	you do not exceed recommended electrical noise levels. Use an oscilloscope or power disturbance analyzer to spot-check the cabling
☐	V- and shield wires	these wires are properly connected and grounded. Break the shield to V- connection at the power supply and use an ohmmeter to verify resistance is less than 1MΩ with 24V dc removed.
☐	earth ground wire	you are using the proper length and gauge
☐	CAN_L and CAN_H to shield and/or V- wires	no shorts are present. Use an ohmmeter to verify resistance is less than 1MΩ.
☐	total current load	the current load does not exceed the power supply rating
☐	trunk and drop line currents	you do not exceed recommended current limits
☐	voltage at middle and ends of network	voltage measures higher than 11V dc but lower than 25V dc. If voltage falls below 15V dc, a common mode problem may exist on the network. Refer to Chapter 4 of this manual for more information.
☐	lead dress at junction boxes	you have made proper connections
☐	connectors	connectors are screwed together tightly
☐	glands	glands are screwed together tightly
☐	glands	there is no foreign material (e.g., electrical tape, RTV sealant) in gland
☐	nodes	nodes do not contact extremely hot or cold surfaces
☐	physical media (prior to applying power)	there are no loose wires or coupling nuts
☐	physical media	no opens or shorts are present.

Table 5.1 Troubleshooting your system design

	check	to ensure that
☐	cables	cables are properly routed. Verify that all cables: • are kept away from power wiring, as described in publication 1770-4.1 • are not draped on electric motors, relays, contactors, solenoids, or other moving parts • are not constrained so that cables place excessive tension on connectors
☐	connectors	connectors are properly installed and are tight. Wiggle connectors to check for intermittent failures.
☐	scanner	configuration is correct. 1. Verify the scanlist. 2. Check for correct: • baud rate • node addresses • series/revision of the 1747/17711-SDN scanner 3. Cycle power to the 24V dc power supply to reset the scanner and initialize the network. Then examine scanner display codes to identify problem nodes. For a listing of scanner display codes, refer to the documentation shipped with your Rockwell Automation DeviceNet scanner. If you see the following at problem nodes, do this: **Solid green** (node is allocated by scanner) normal operation; do nothing **Blinking green** (node is not being allocated by the scanner) • check that the node is in the scan list • check that the scanner is not bus off • ensure that the connection is not timing out **Blinking red** (no communication) • check for missing power on all nodes • check all nodes for proper connection to trunk or drop lines • check for proper baud rate • check scanner for a code 91, which means that communication with this node has errored out. To reset the scanner, cycle power to the 24V dc power supply. **Solid red** at power up (two nodes have the same address) Re-assign an available node address. **Solid red** at allocation (bus off) Check for proper baud rate. If node problems persist, do the following: • replace T-tap • check topology • use an oscilloscope or power disturbance analyzer to check for electrical noise • replace the node. Set the node address and baud rate on the replacement node, if necessary.

Use Terminating Resistors

The DeviceNet network may operate unpredictably without terminating resistors installed at each end of the trunk cable. You can order terminating resistors, part number 1485A-C2, from your local Rockwell Automation distributor.

To install terminating resistors:

1. Attach a 121Ω, 1%, 1/4W or larger terminating resistor at each end of the trunk cable, across the blue (CAN_H) and white (CAN_L) wires of the cable.

2. Verify resistor connection.
   a. Disconnect DeviceNet power.
   b. Measure the resistance across the blue (CAN_H) and white (CAN_L) wires of the cable. Resistance should equal approximately 50 - 60Ω. Resistance will approach 50Ω as more devices are connected to the network.

Ground the Network

You must ground the DeviceNet cable at only one location, closest to the center of the network.

To ground the network:

1. Using an 8 AWG ($10mm^2$) wire up to a maximum of 3m (10 ft.) in length, connect the following:

   a. Connect the network shield and drain wires to an earth ground.
   b. Connect the V- conductor (black wire) of the trunk cable to an earth ground.
   c. Connect the DC ground of the power supply to an earth ground.

Diagnose Power Supply Problems

The DeviceNet network requires 24V dc power. Ensure that the power supply you are using meets the following requirements.

The DeviceNet power supply must:

- be sized correctly to provide each device with its required power
- be rated 24V dc (+/- 1%)
- have its own current limit protection
- have a rise time of less than 250mS to within 5% of its rated output voltage

When choosing a power supply, keep the following tips in mind:

IMPORTANT	We recommend that the DeviceNet power supply be used to power only the DeviceNet network.

- The thin wire trunk line is rated to 3A current flow. The thick wire trunk line is rated to 8A current flow. In North America, however, current is limited to 4A. You can install multiple power supplies on a DeviceNet network, but no section of cable should allow more current flow than that for which the trunk line is rated.
- If you install multiple power supplies on the network, break the red V+ wire between the power supplies to isolate one power supply from the other.
- On DeviceNet networks with multiple devices or extra long trunk lines, which result in drawing large currents at longer distances, common mode voltage can affect network operation.

if voltage	then	so you should
on the black V- wire differs from one point of the network to another by more than 4.65V	communications problems could result	• move an existing power supply closer to the heavier current loads • add an additional power supply
between the red V+ wire and the black V- wire drops below 15V		

Verify Network Voltages

The DeviceNet network communicates using a three-wire signal voltage differential among the CAN_H (white), CAN_L (blue), and V- (black) wires. DeviceNet messages consists of ones and zeros. A one is recessive, meaning that the difference in voltage between CAN_H and CAN_L should be as close to 0V as possible. A zero is dominant, meaning that the difference in voltage between CAN_H and CAN_L must be within certain limits when the zero bit is set.

Out-of-range differential voltages can be caused by such factors as:

- opens or shorts in signal wires
- faulty devices (particularly transceivers)
- severe interference
- incorrect media

To check for proper voltage, use a voltmeter in dc mode. Measure voltages at the DeviceNet scanner.

Table 5.2 lists nominal voltage readings.

TIP Because the differential voltages are constantly shifting among the three wires, the voltages on your scope trace may differ from the nominal voltages shown in Table 5.2.

These voltages assume no common mode effect on the V- and are for reference only.

Table 5.2 Nominal DeviceNet voltage readings

when a network master	CAN_H to V- voltage should read	CAN_L to V- voltage should read
is not connected to the network	between 2.5 - 3.0V dc	between 2.5 - 3.0V dc
is connected to, and is polling the network	approximately 3.2V dc	approximately 2.4V dc

If voltages are too low

If the CAN_H to V- and CAN_L to V- voltages are too low (less than 2.5V dc and 2.0V dc, respectively), the transceiver or wiring may be bad.

To check the transceiver for proper operation:

1. Remove one DeviceNet node from the network.
2. Use an ohmmeter to check for resistance greater than 1MΩ between:
   - V+ and CAN_HI
   - V+ and CAN_LO
   - V- and CAN_HI
   - V- and CAN_LO

Notes:

Understand Select NEC Topics

Be aware that the following topics from the National Electrical Code (NEC) 725 (revision 1999) impact the configuration and installation of DeviceNet systems in the United States. There also may be additional NEC sections and local codes that you must meet. Other codes exist outside of the United States that may also affect your installation.

Specify Article 725 Topics

Round (thick & thin) and Class 2 flat media

Power limitations of Class 2 circuits

The power source for Class 2 circuits must be either inherently limited, thus requiring no overcurrent protection, or limited by a combination of a power source and overcurrent protection.

Marking

Class 2 power supplies must be durably marked where plainly visible to indicate the class of the supply and its electrical ratings.

Interconnection of power supplies

Class 2 power supplies must not be paralleled or otherwise interconnected unless listed for such applications.

Class 1 flat media

Power limitations of Class 1 circuits

- The overcurrent protection shall not exceed 10 amperes per NEC article 725-23.
- Consult the product manufacturer to determine if the device is suitable for installation with a Class 1 power source.

Notes:

Power Output Devices

Use DeviceNet Power Supplies to Operate Output Devices

You can power some output devices on the DeviceNet network. The application must allow the voltage to remain within the DeviceNet specification limits of 11-25V dc. Because most actuators usually require more power than is practically available from the DeviceNet network, they must be powered by a separate power supply. Also, the large voltage variation of 11-25V that DeviceNet allows is typically beyond the range over which most available actuators or output devices can safely operate.

You can use DeviceNet power to operate output devices such as hydraulic and pneumatic solenoid valves, pilot and stack lights, and motor starter coils with the following caution:

ATTENTION

Do not let DeviceNet voltage at the relevant node exceed the output device's acceptable voltage range. Output devices rated 24V dc rarely are specified to operate below 19.2V dc or -20% of their 24V dc rating. Many only operate down to 20.4V dc or -15% of the rated voltage. This means that the DeviceNet network design must not allow the available voltage to drop below 19.2 volts, for example, instead of the 11 volts that the DeviceNet specification allows. This higher lower voltage limit which is within the DeviceNet specification will actually restrict the distance of the DeviceNet network from what would be possible if actuators were not utilizing the DeviceNet power

IMPORTANT

Design your network to make sure that sufficient voltage is available to operate the output device wherever it is installed. This is especially important when it is connected at the farthest location from the power supply.

The DeviceNet common mode drop voltage specification limit of 10 volts, 5 volts in each power supply V+ and V- conductor, will never be a concern. This is because in the design process we start with a 24V dc power supply and allow for the 4% stack-up tolerance which leaves 23V dc to work with. From here we consider the output device's minimum required operating voltage of 19.2 volts. This gives 23V dc-19.2V dc = 3.8V dc for the common mode voltage or 1.9V dc in each conductor. This is far more restrictive than the 5 volts of the DeviceNet specification and will result in shorter allowable distances for the installation.

Noise or Transient Protection

The typical actuators used in DeviceNet control systems utilize inductive coils that generate transients when de-energized. You must use appropriate protection to suppress transients during coil de-energization. Add a diode across the inductive coil to suppress transients on the actuator's dc coils. Use a MOV varistor module suppressor for a 24V dc coil if this added drop out time with the diode is unacceptable. This varistor module must clamp the transient voltage across the coil at 55 volts to prevent the output contact from arcing on switch separation.

Typical actuators used in DeviceNet control systems use inductive coils and limit current transients on energization by their inherent L/R time constant. Any transients due to contact bounce on energization will be suppressed by the transient protection utilized for coil de-energization.

ATTENTION

Do not use DeviceNet power on dc coil actuators that use economizing coils to operate. They have high inrush currents.

Numerics

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If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running:

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
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