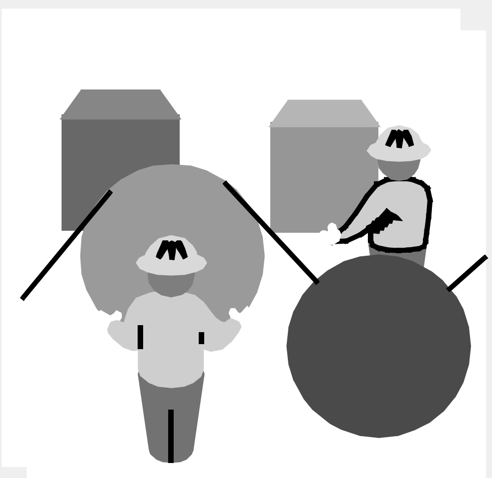
Allen-Bradley

DeviceNet Cable System

Planning and Installation Manual



Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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

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

Attention statements help you to:

- identify a hazard
- avoid the hazard
- recognize the consequences

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

Important: We recommend you frequently backup your application programs on appropriate storage medium to avoid possible data loss.

Summary of Changes

The information below summarizes the changes to the manual since the last release.

New Information

The table below lists sections that document new features and additional information about existing features, and shows where to find this new information.

For this new information	See page
10-pin linear plug (1787-PLUG10R)	1–9
Look-up method graph and table for thin cable	2–11

Updated Information

Changes from the previous release that require you to perform a procedure differently or that require different equipment are listed below.

For this new information	See page
Communication rate for cumulative drop line length and maximum cable distance changed from 200k bit/s to 250k bit/s	2–2
New procedure for attaching mini/micro closed-style connectors	3–4
New procedure for installing PowerTap taps	3–7

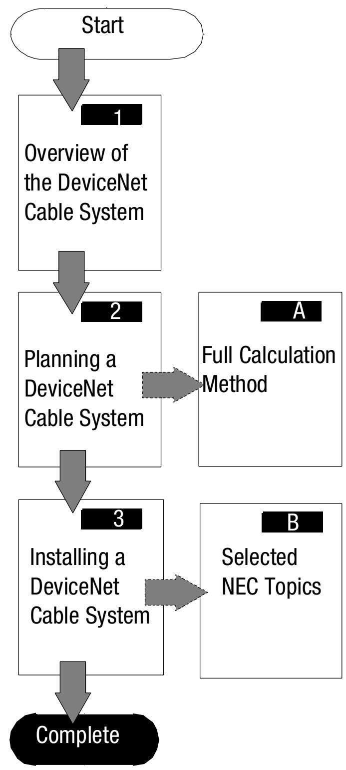
Revision Bars

We use revision bars to call your attention to new or revised information. A revision bar appears as a thick black line on the outside edge of the page as indicated here.

Using This Manual

What's in this Manual

Use this manual to plan and install a DeviceNet™ cable system. This manual describes the required components of the cable system and how to plan for and install these required components.



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.

Important: Be sure that all national and local codes are thoroughly researched and adhered to during the planning and installation of your DeviceNet network.

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

About the Related Publications

Refer to the following publications for more information.

Title	Publication Number
Industrial Automation Wiring and Grounding Guidelines	1770-4.1
DeviceNet Product Overview	DN-2.5
Terms for Use of the DeviceNet Specification	AG-9.16
DeviceNet Media System Component List	DN-2.1
DeviceNet Communication Interface System Component List	DN-2.2
1747-SDN Scanner Module Installation Instructions	1747-5.8
DeviceNet Scanner Configuration Manual (1747-SDN)	1747-6.5.2
DeviceNet RS-232 Interface Module Installation Instructions	1770-5.6
1771-SDN Scanner Module Installation Instructions	1771-5.14
DeviceNet Scanner Configuration Manual (1771-SDN)	1771-6.5.118
DeviceNet Manager Software User Manual	1787-6.5.3
DeviceNet Adapter User Manual	1794-6.5.5
1794-ADN DeviceNet Adapter Installation Instructions	1794-5.14

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.

The instructions and examples in this manual are based on Class 2 power supplies.

Important: Be sure that all national and local codes are thoroughly researched and adhered to during the planning and installation of your DeviceNet network.

Accessing the Web Sites

You can find out more information about the DeviceNet network by visiting the Allen-Bradley web site at http://www.ab.com

Information on additional DeviceNet products can be found at the Rockwell Software web site at http://www.rockwellsoftware.com

Chapter 1

Overview of the DeviceNet Cable System

Chapter 2

Planning a DeviceNet Cable System

Chapter 3

Installing a DeviceNet Cable System

Appendix A

Using the Full Calculation Method

Appendix B

Understanding Select NEC Topics

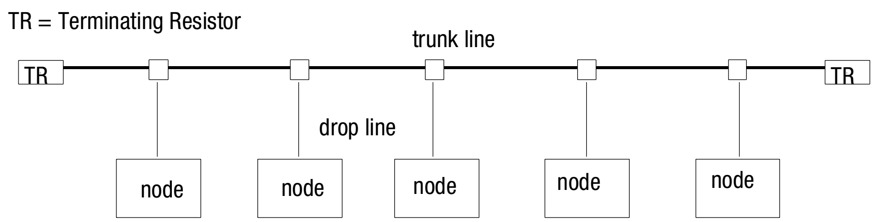
Overview of the DeviceNet Cable System

What's in this Chapter

Read this chapter to familiarize yourself with the DeviceNet cable system.

Understanding the DeviceNet Cable System

This cable system uses a trunk/drop line topology:



Trunk line and drop line lengths are determined by the communication rate used.

For information on multiple nodes and branching on the drop line, see page 2-1.

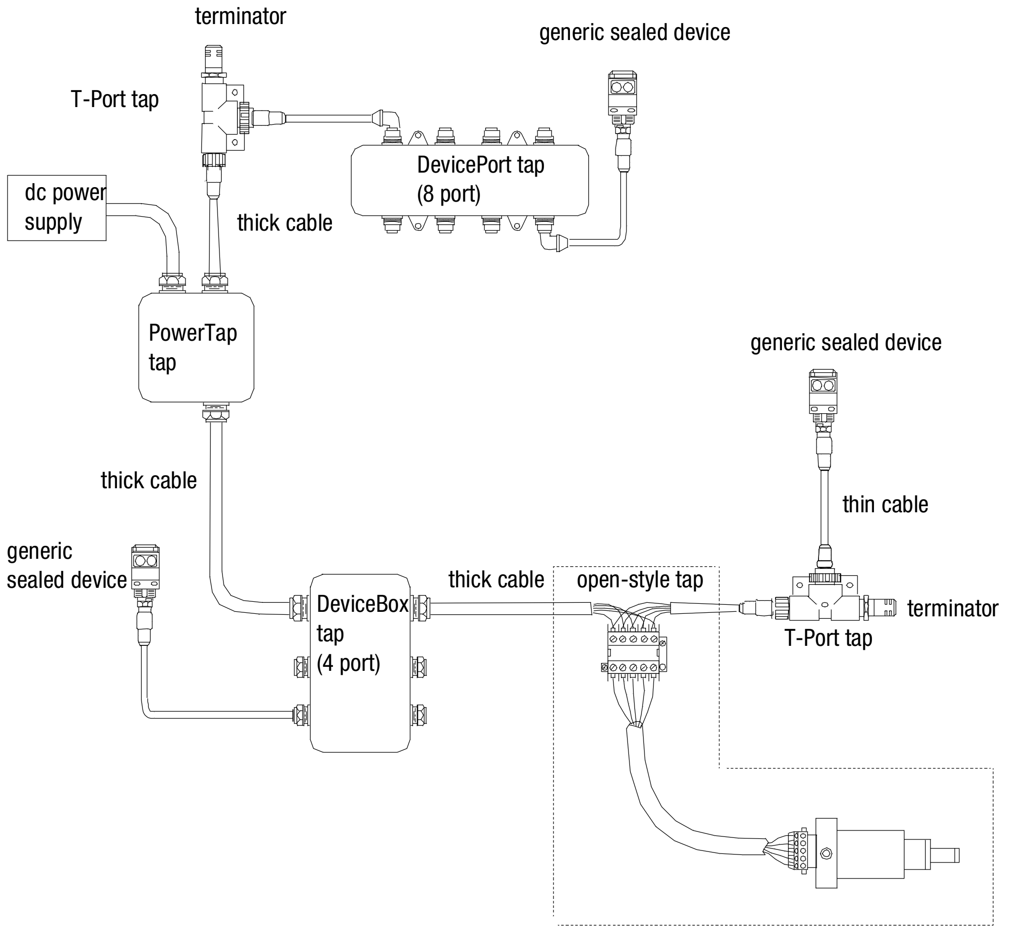
Referring to the Cables

Connect components using two cable sizes:

This cable	Is used
Thick	Generally as the trunk line on the DeviceNet network with an outside diameter of 12.2mm (0.48in). You can also use this cable for drop lines.
Thin	Generally as the drop line connecting devices to the main line with an outside diameter of 6.9mm (0.27in). This cable has a smaller diameter and is more flexible. You can also use this cable for the trunk line.

Understanding the Cable System Components

Use the following diagram and table to understand the DeviceNet cable system.



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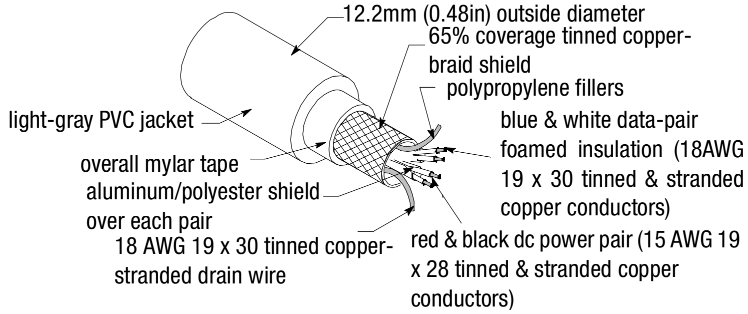
Component	Description	Component	Description
Trunk line	The cable path between terminators that represents the network backbone - it is made up of thick or thin cable - connects to taps or directly to devices	T-Port tap	A single-port connection with sealed connectors
Drop line	The drop line is made up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

About Thick Cable

Thick cable, with an outside diameter of 12.2mm (0.48in), is generally used as the trunk line on the DeviceNet network. *Thick cable can be used for trunk lines and drop lines.*

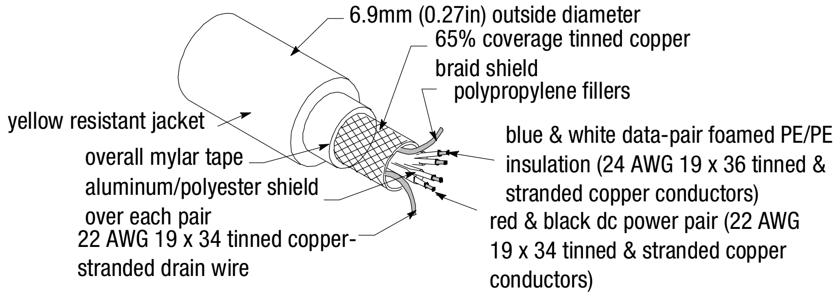
Spool Size	Part Number
50m (164ft)	1485C-P1-A50
150m (492ft)	1485C-P1-A150
300m (984ft)	1485C-P1-A300
500m (1640ft)	1485C-P1-A500



About Thin Cable

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

Spool Size	Part Number
50m (164ft)	1485C-P1-C50
150m (492ft)	1485C-P1-C150
300m (984ft)	1485C-P1-C300
600m (1968ft)	1485C-P1-C600

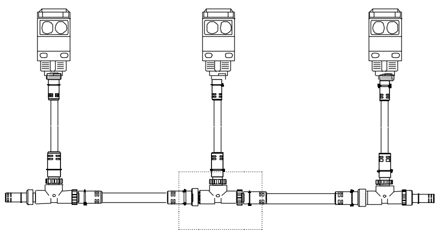
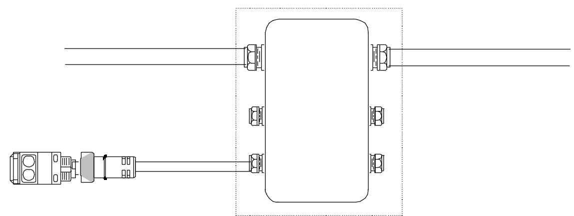
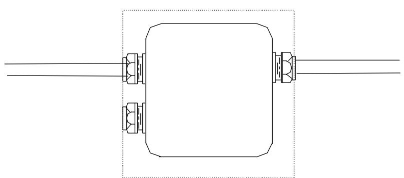
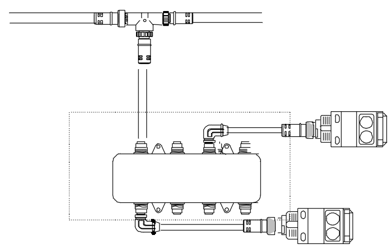
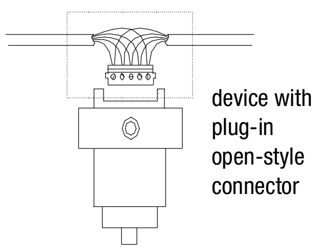
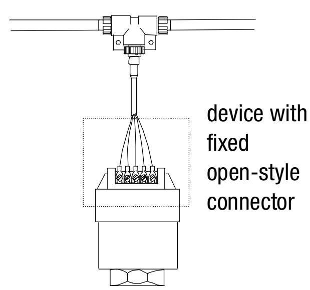


Connecting to the Trunk Line

The cable system design allows replacement of a device without disturbing operation of the cable system.

Important: The trunk line must be terminated on each end with a 121Ω, 1%, 1/4W resistor. See page 1-13 for more information.

You can connect to the trunk line through a:

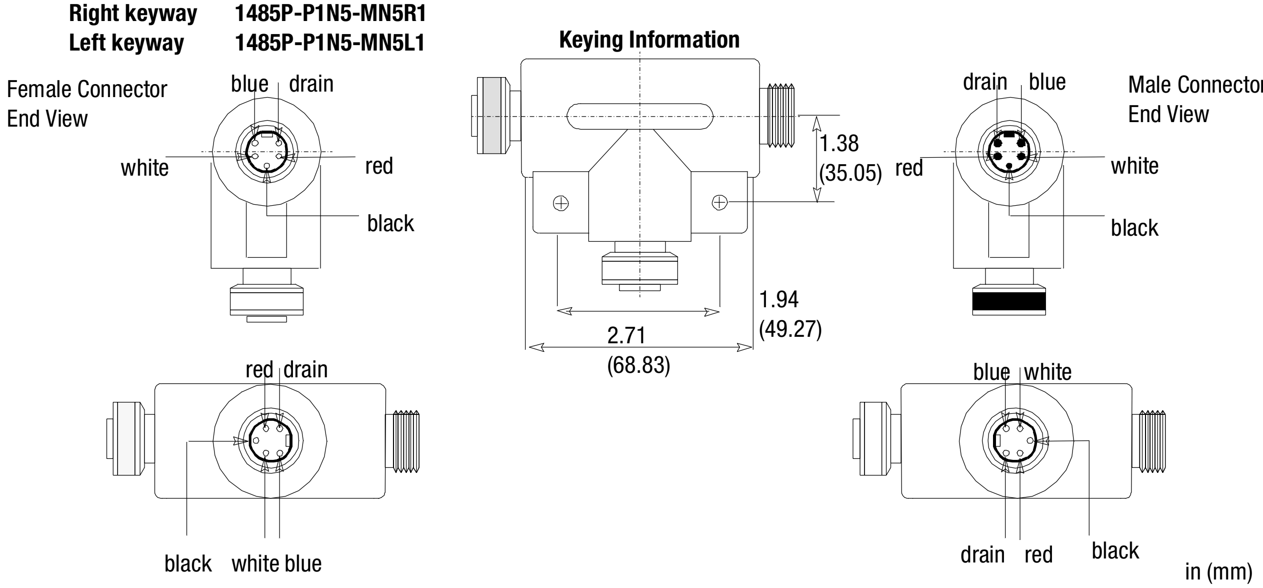
Trunk-line connection	See page	Trunk-line connection	See page
• T-Port tap 	1-5	• DeviceBox tap 	1-6
• PowerTap tap 	1-6	• DevicePort tap 	1-8
• open-style 	1-7		1-7

About the T-Port Tap

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.

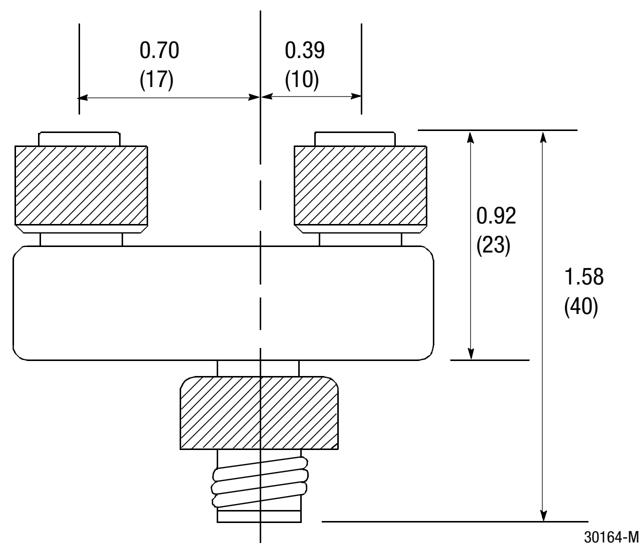
Mini T-Port Tap

Right keyway 1485P-P1N5-MN5R1
Left keyway 1485P-P1N5-MN5L1



Micro T-Port Tap

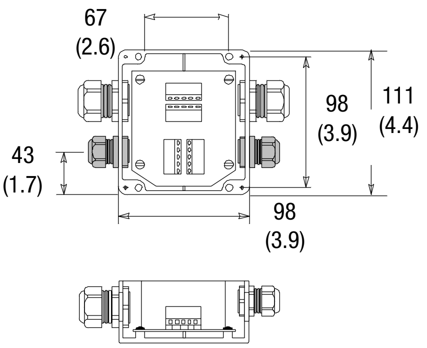
1485P-P1R5-DR5



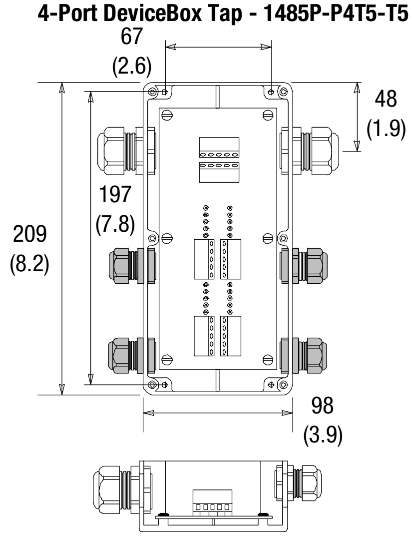
About the DeviceBox Tap

DeviceBox taps are a direct connection to the trunk line, providing terminal strip connections for up to 8 nodes using thin-cable drop lines. They have a removable gasket cover and cable glands to provide a tight, sealed box that can be mounted on a machine.

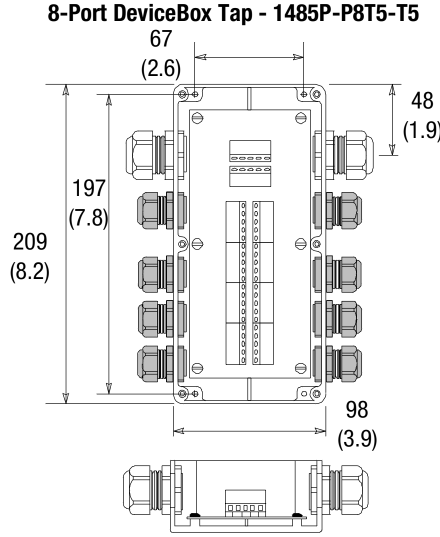
2-Port DeviceBox Tap - 1485P-P2T5-T5



4-Port DeviceBox Tap - 1485P-P4T5-T5



8-Port DeviceBox Tap - 1485P-P8T5-T5

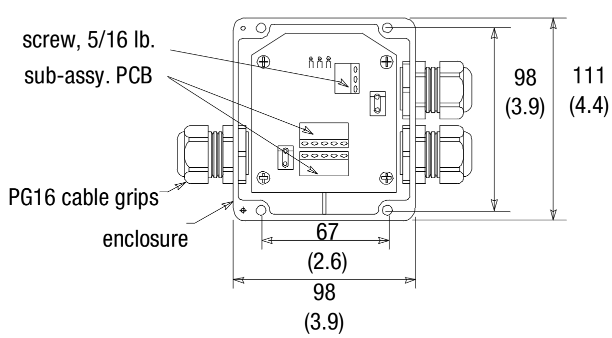


mm (inches)

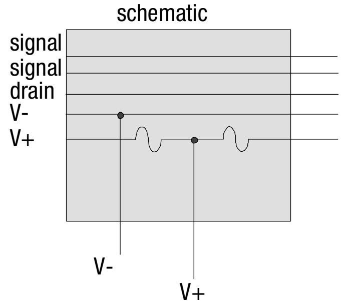
About the PowerTap Tap

The PowerTap tap 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 PowerTap tap.) The PowerTap tap with fuses can also be used to permit the connection of multiple power supplies to the trunk line without back-feeding between supplies.

PowerTap Tap - 1485T-P2T5-T5



schematic



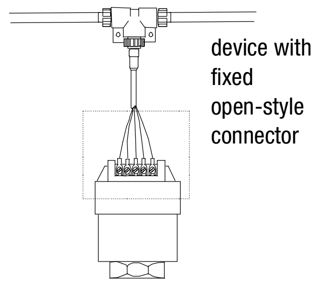
mm (inches)

In cases where the power supply provides current limiting and inherent protection, fuses/overcurrent devices may not be necessary at the PowerTap tap.

About the Direct Connection

Devices can be connected directly to the trunk line only if later removal of the device will not disturb communications on the cable system.

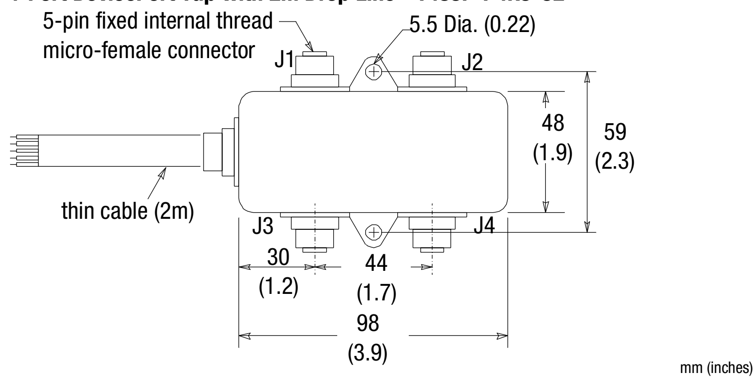
Important: If a device provides only fixed-terminal blocks for its connection, it must be connected to the cable system by a drop line. This allows removal of the device at the tap or device-end of the drop line without disturbing communications on the cable system.



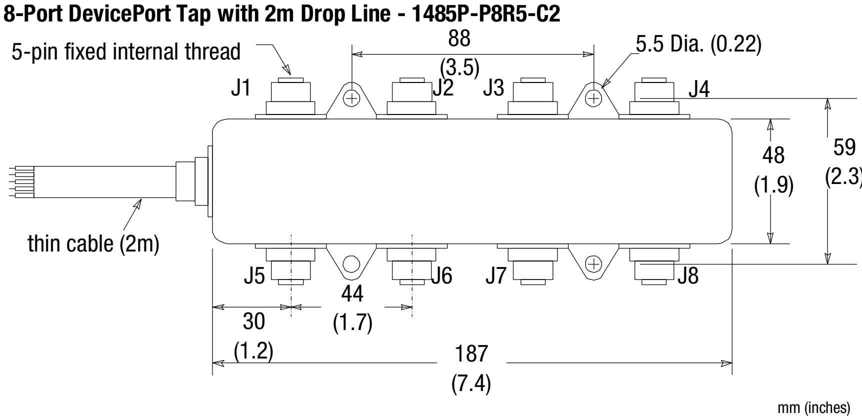
About the DevicePort Tap

DevicePort taps are multiport taps that connect to the trunk line via drop lines. Only a micro male right-angle connector with rotating coupling nut can connect to each port.
Add "-ms" to these part numbers to get a mini-male connector at the end of a 2m cable.

4-Port DevicePort Tap with 2m Drop Line - 1485P-P4R5-C2



8-Port DevicePort Tap with 2m Drop Line - 1485P-P8R5-C2



Using Connectors

Connectors attach cables to other components of the DeviceNet cable system.

Connector		Description
Open	plug-in	Uses screws to attach cable wires to the removable connector
	fixed	Uses wires to attach directly to screw terminals
Sealed	mini-style	Attaches to taps and thick and thin cable
	micro-style	Attaches to thin cable only - has a reduced current rating

These are the field-installable connection options.

- Mini/Micro field-installable quick-disconnect

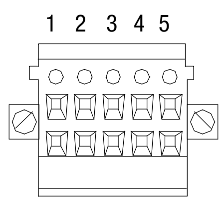
male plug female plug

Screw terminals connect to the cable of the connector with male or female-threaded plugs.

	Thin	Thick
Micro male	871A-TS5-DM1	n/a
Micro female	871A-TS5-D1	n/a
Mini male	871A-TS5-NM1	871A-TS5-NM3
Mini female	871A-TS5-N1	871A-TS5-N3

- 10-pin linear plug with probe holes and jack screws

1787-PLUG10R



1	Black
2	Blue
3	Gray
4	White
5	Red

These plugs come in a package of 10.

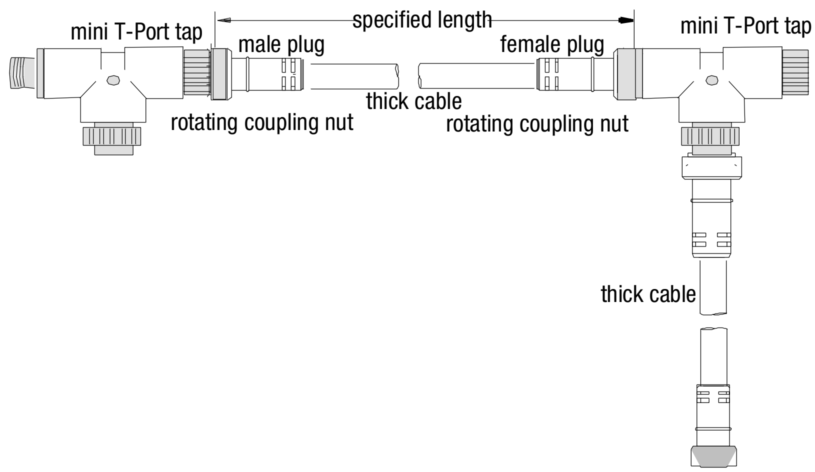
Using Preterminated Cables

Using preterminated cable assemblies saves you the effort of stripping and wiring connectors to the cable ends and reduces wiring errors.

About Thick Cable

You can order thick cables in five lengths with mini connectors at each end. Thick cable shorter than 6m (20ft) can also be used as drop lines.

Mini Male to Mini Female	Part Number
1m (3.28ft)	1485C-P1N5-M5
2m (6.56ft)	1485C-P2N5-M5
3m (9.84ft)	1485C-P3N5-M5
5m (16.41ft)	1485C-P5N5-M5
10m (32.81ft)	1485C-P10N5-M5

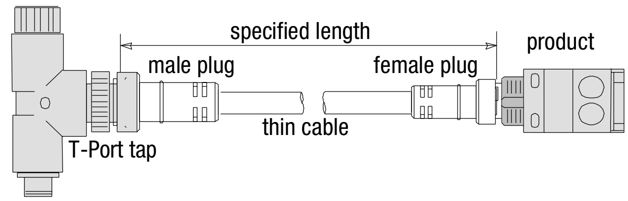


About Thin Cable

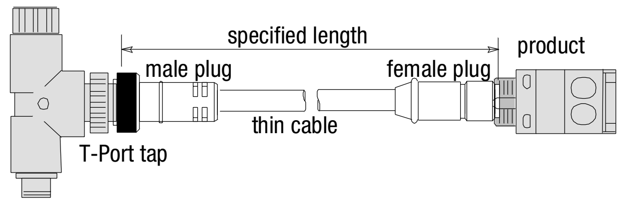
Preterminated thin cable assemblies for use as drop lines are available with various connectors in lengths of 1, 2, 3, and 4m. Preterminated thin cable assemblies can also be used as trunk lines.

Connecting to a T-Port Tap from a Sealed Device

Mini Male to Mini Female	Part Number
1m (3.28ft)	1485R-P1N5-M5
2m (6.56ft)	1485R-P2N5-M5
3m (9.84ft)	1485R-P3N5-M5

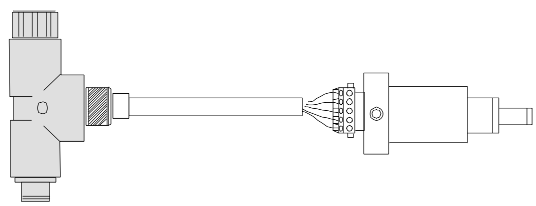


Mini Male to Micro Female	Part Number
1m (3.28ft)	1485R-P1M5-R5
2m (6.56ft)	1485R-P2M5-R5
3m (9.84ft)	1485R-P3M5-R5



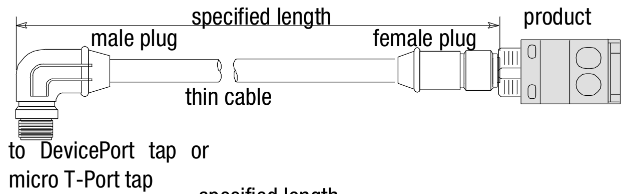
Connecting to a T-Port Tap from an Open Device

Mini Male to Conductors	Part Number
1m (3.28ft)	1485R-P1M5-C
2m (6.56ft)	1485R-P2M5-C
3m (9.84ft)	1485R-P3M5-C

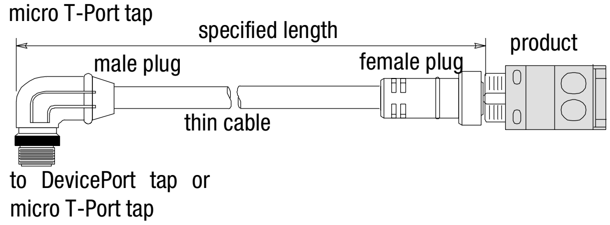


Connecting to a DevicePort Tap from a Sealed Device

Micro Male (90°) to Micro Female	Part Number
1m (3.28ft)	1485R-P1R5-F5
2m (6.56ft)	1485R-P2R5-F5

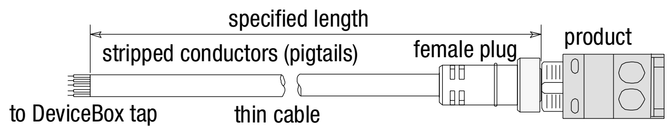


Micro Male (90°) to Mini Female	Part Number
1m (3.28ft)	1485R-P1N5-F5
2m (6.56ft)	1485R-P2N5-F5

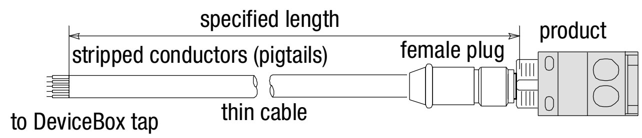


Connecting to a DeviceBox Tap from a Sealed Device

Stripped Conductors to Mini Female	Part Number
1m (3.28ft)	1485R-P1N5-C
2m (6.56ft)	1485R-P2N5-C
3m (9.84ft)	1485R-P3N5-C

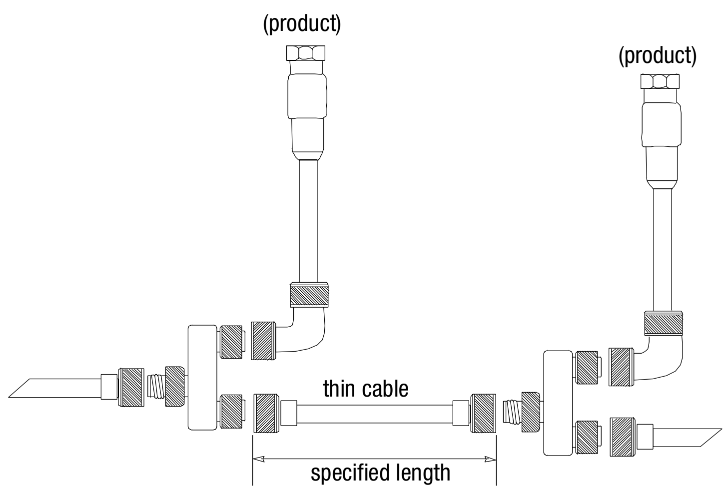


Stripped Conductors to Micro Female	Part Number
1m (3.28ft)	1485R-P1R5-C
2m (6.56ft)	1485R-P2R5-C
3m (9.84ft)	1485R-P3R5-C



Connecting to Micro T-Port Taps

Micro Taps	Part Number
1m (3.28ft)	1485R-P1R5-D5
2m (6.56ft)	1485R-P2R5-D5
3m (9.84ft)	1485R-P3R5-D5
4m (13.12ft)	1485R-P4R5-D5



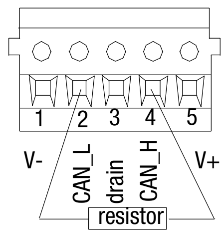
Using Terminating Resistors

The resistor:

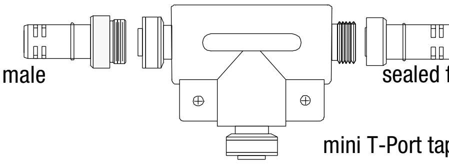
- reduces reflections of the communication signals on the network
- connects the two signal conductors
- may be sealed when the end node uses a sealed T-Port tap or open when the end node uses an open-style tap

Important: The trunk line of your DeviceNet network ***must*** have a resistor attached to each end that terminates the two signal lines. The DeviceNet network will not operate without these terminating resistors.

When using the open-style terminating resistor, connect a 121Ω, 1%, 1/4W resistor to the CAN_H and CAN_L between blue and white data-pair wires.



Terminating Resistors	Part Number
Sealed Male	1485A-T1M5
Sealed Female	1485A-T1N5
Open	1485A-C2



What's Next

Now that you have seen the basic components of a DeviceNet cable system, you can begin planning the layout for your network components and the distribution of power to the network. Read the next chapter for requirements and considerations.

Planning a DeviceNet Cable System

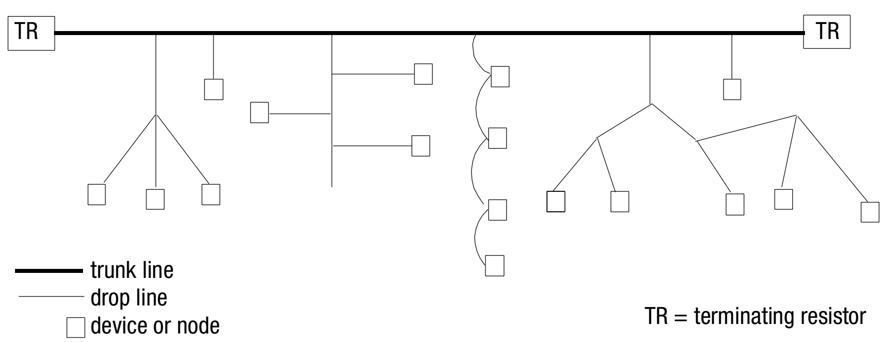
What's in this Chapter

To plan your cable system, you need to know the specifications of your devices including how much current each node requires from the cable system. This chapter will show you how to calculate your power requirements and determine:

- power distribution
  - maximum current curves
  - current calculations
- effects of device distribution on your cable system
- power components needed to assemble a DeviceNet cable system

Understanding Topologies

- The maximum cable distance from any device on a branching drop line to the trunk line is 6m (20ft).
- The trunk line must be terminated at both ends with a 121Ω terminating resistor. See page 1-13 for more information.
- The maximum cable distance is not necessarily just the trunk line length. It is the maximum distance between any two devices or terminating resistors.



Communication rate	Maximum distance (thick cable)	Maximum distance (thin cable)	Cumulative drop line length
125k bit/s	500m (1640ft)	100m (328ft)	156m (512ft)
250k bit/s	250m (820ft)	100m (328ft)	78m (256ft)
500k bit/s	100m (328ft)	100m (328ft)	39m (128ft)

Guidelines for Supplying Power

Follow these guidelines to protect your devices and achieve the best results when supplying power to the DeviceNet cable system.

- Use power supplies rated at 24V (±1%).
- Select a power supply that provides sufficient current for all attached devices. In the U.S. and Canada, be sure to adhere to NEC and CECode limits respectively.
- The power supply should only power the DeviceNet network.
- Use a power supply that has its own current limit protection.
- Make sure you derate the supply for temperature using the manufacturer's guidelines.
- Provide fuse protection for each segment of the cable system.
  - Any section leading away from a power supply must have protection (part of the PowerTap tap).

Important: See page 2-19 for details on selecting a power supply.

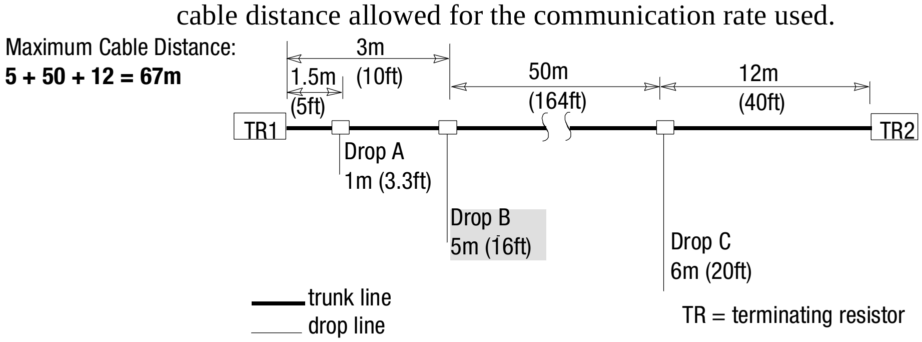
Important: The DeviceNet system requires a power supply to have a rise time of ≤250ms to within 5% of its rated output voltage.

Determining the Maximum Cable Distance

If the distance from a trunk line tap to the farthest device connected to it is greater than the distance from the tap to the nearest terminating resistor, then the drop line length must be included as part of the cable length.

Communication rate	Maximum distance (thick cable)	Maximum distance (thin cable)
125k bit/s	500m (1640ft)	100m (328ft)
250k bit/s	250m (820ft)	100m (328ft)
500k bit/s	100m (328ft)	100m (328ft)

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



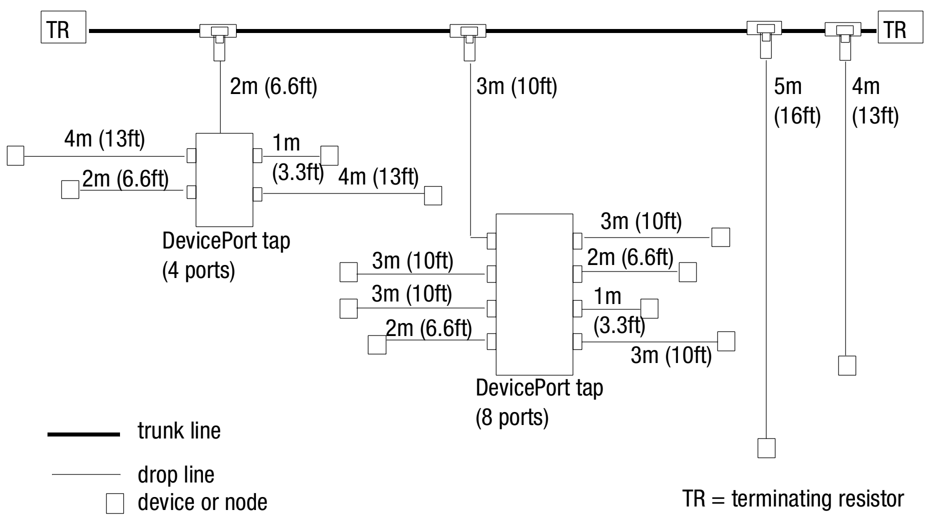
- **Drop A** - *is not* included in the approximate maximum cable length **1.5m > 1m**
  The trunk line's distance from the tap to the terminating resistor exceeds the length of Drop A.
- **Drop B** - *is* included in the approximate maximum cable length. **3m < 5m**
  The trunk line's distance from the tap to the terminating resistor does not exceed the length of Drop B.
- **Drop C** - *is not* included in the approximate maximum cable length. **12m > 6m**
  The trunk line's distance from the tap to the terminating resistor exceeds the length of Drop C.

Determining the Cumulative Drop Line Length

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 given communication rate used.

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

The following example uses four T-Port taps and two DevicePort taps to attach 13 devices to the trunk line. The cumulative drop line length is 42m (139ft) where no node is more than 6m (20ft) from the trunk line tap. This allows you to use a communication rate of 250k bit/s or 125k bit/s.



About the Power Ratings

The power capabilities of the DeviceNet cable system include:

- power supplies rated at 24V dc (see page 2-19 for specifications)
- power supply taps that optionally:
  - prevent back-feeding of current between multiple power supplies if supplied with Schottky diode
  - provide overcurrent protection for the trunk line
- thick cable trunk line rating of 8A

  Important: Check your national and local codes for additional information. In the United States and Canada, the DeviceNet cable system must be installed as a Class 2 circuit. This requires limiting the current to 4A. The rating of the power conductors is 8A.

  Although the thick cable rating is 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 tap. Very large loads can be handled as long as no more than 8A is drawn through any single segment of the trunk line. Due to cable resistance, voltage drops may limit your application to less. Details are provided later in this chapter.
- thin cable drop line rating of 3A

  Resistance losses may limit your application to less. Details are provided later in this chapter.
- drop line rating of 3A depending on the drop line length.
  The maximum current decreases as the drop line length increases. This applies to both thick and thin cable.

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

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

I = 15/L   L = drop line length (ft)

I = 4.57/L   L = drop line length (m)

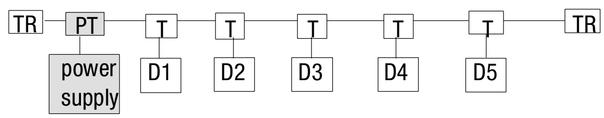
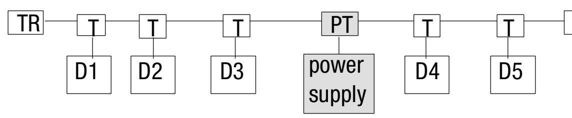
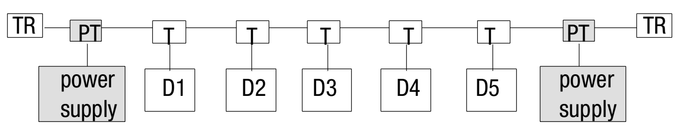
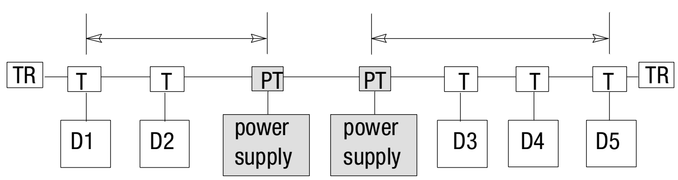
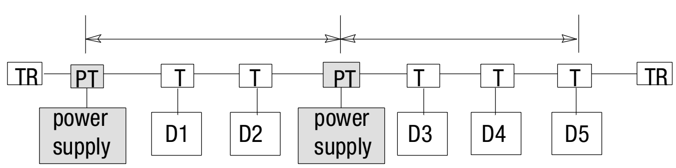
The maximum allowable current applies to the sum of currents for all nodes on the drop line. As shown in the example on page 2-3, the drop line length refers to the maximum cable distance from any node to the trunk line, not the cumulative drop line length.

- high maximum common mode voltage drop on the V- and V+ conductors
  - the voltage difference between any two points on the V- conductor must not exceed the maximum common mode voltage of 5V
- voltage range between V- and V+ at each node within 11 to 25V

Determining Power Supply Locations

The DeviceNet cable system allows several options for supplying power. To determine which option meets your needs, consider the distribution of the loads, power supply location, and the number of supplies used. Power supplies must be 24V (in the United States and Canada, the power supply must also be Class 2). See page 2-19 for more information.

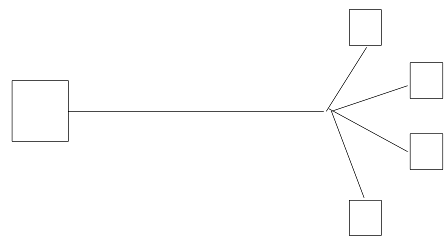
Important: Whenever two or more power supplies are connected to the same segment (no break in V+), a diode must be used at the PowerTap tap to prevent back-feeding.

If you're using	Location can be
1 power supply	at the end, in the middle, or anywhere but the end or middle
	
	
2 power supplies	at the ends
	
	next to each other
	
	at the end and middle
	
3 or more power supplies	anywhere on the trunk line

Using the Look-Up Method

To determine if you have adequate power for the devices in your cable system, refer to 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.



Important: This method may underestimate the capacity of your network by as much as 4 to 1. Use appendix A to do the full-calculation method if your supply doesn't fit under the curve.

For this configuration example	See page	Thick cable uses figure	Thin cable uses figure
One power supply (end-connected)	2-12	A	D
One power supply (middle-connected)	2-13	A	D
NEC/CECode current boost configuration	2-15	A	D
Two power supplies (end-connected)	2-16	B	*
Two power supplies (not end-connected)	2-17	B, C	*

* Up to 3A can be drawn from a thin cable trunk line if the power supply separation is below 70m (230ft).

Maximum Allowable Current

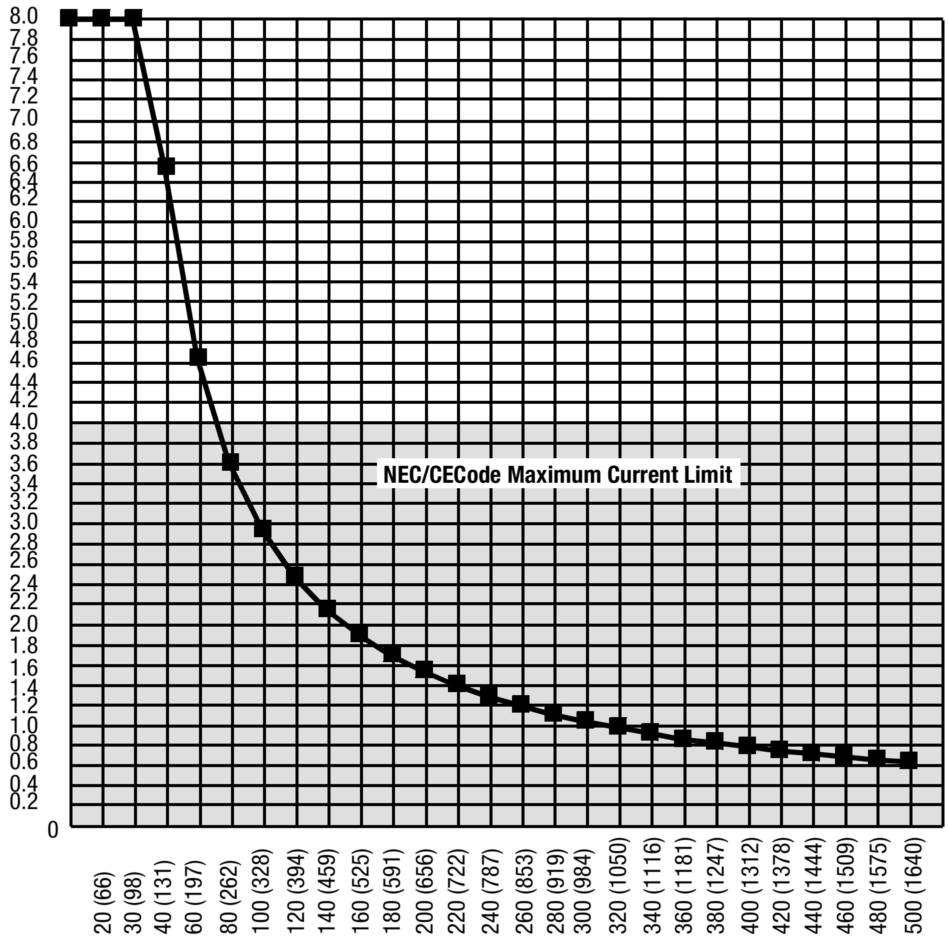
Find the value next largest to your network length using the appropriate figure below to determine the maximum current allowed for the system (approximately).

A One Power Supply (End Segment) *Thick Cable*

Important: 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*
30 (98)	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
240 (787)	1.28
260 (853)	1.19
280 (919)	1.10
300 (984)	1.03
320 (1050)	0.97
340 (1116)	0.91
360 (1181)	0.86
380 (1247)	0.82
400 (1312)	0.78
420 (1378)	0.74
440 (1444)	0.71
460 (1509)	0.68
480 (1575)	0.65
500 (1640)	0.63

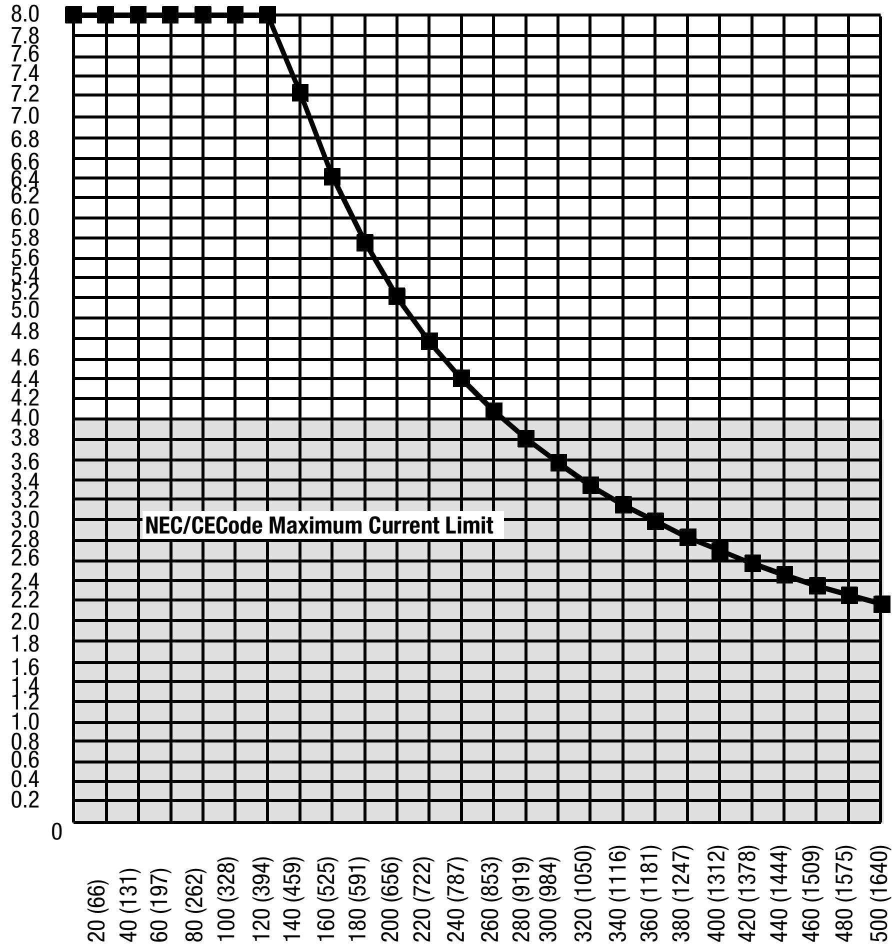
*Exceeds NEC/CECode 4A limit.



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)	7.23*
160 (525)	6.41*
180 (591)	5.76*
200 (656)	5.23*
220 (722)	4.79*
240 (787)	4.42*
260 (853)	4.10*
280 (919)	3.83
300 (984)	3.59
320 (1050)	3.37
340 (1116)	3.18
360 (1181)	3.02
380 (1247)	2.86
400 (1312)	2.73
420 (1378)	2.60
440 (1444)	2.49
460 (1509)	2.38
480 (1575)	2.29
500 (1640)	2.20

*Exceeds NEC/CECode 4A limit.

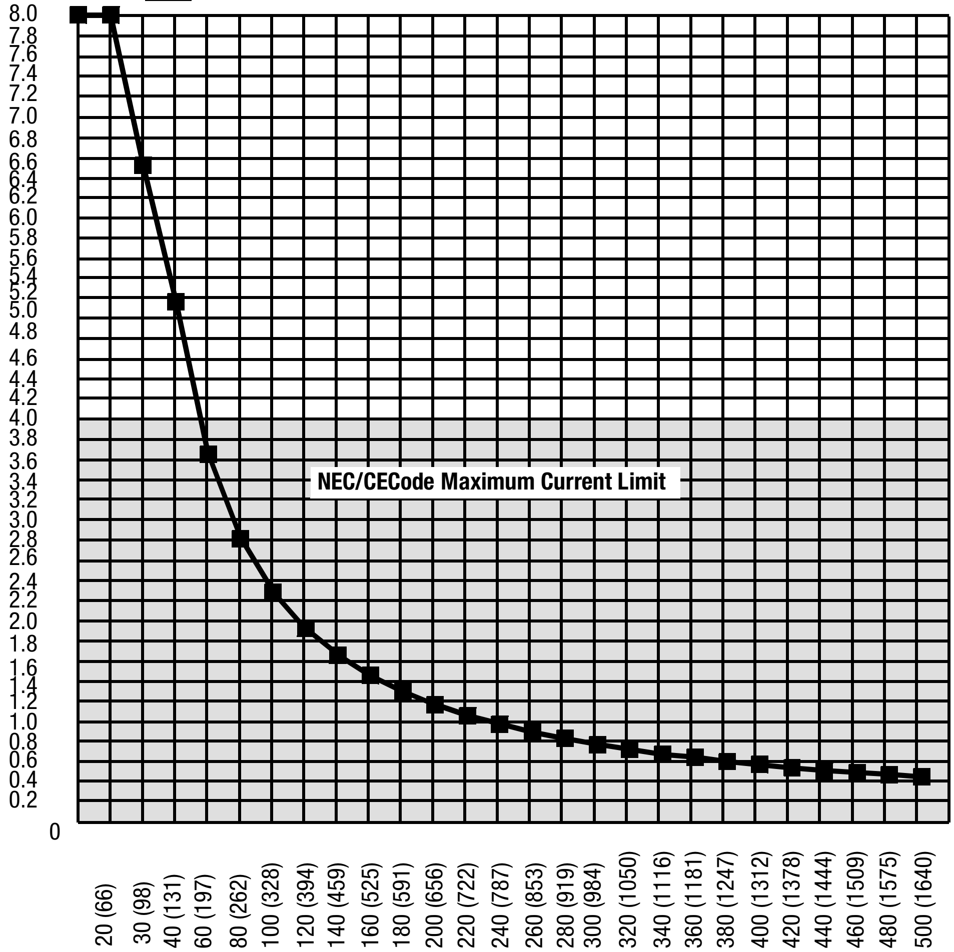
B Segment Between Two Power Supplies *Thick Cable*



C End Segment in Two Power Supply System *Thick Cable*

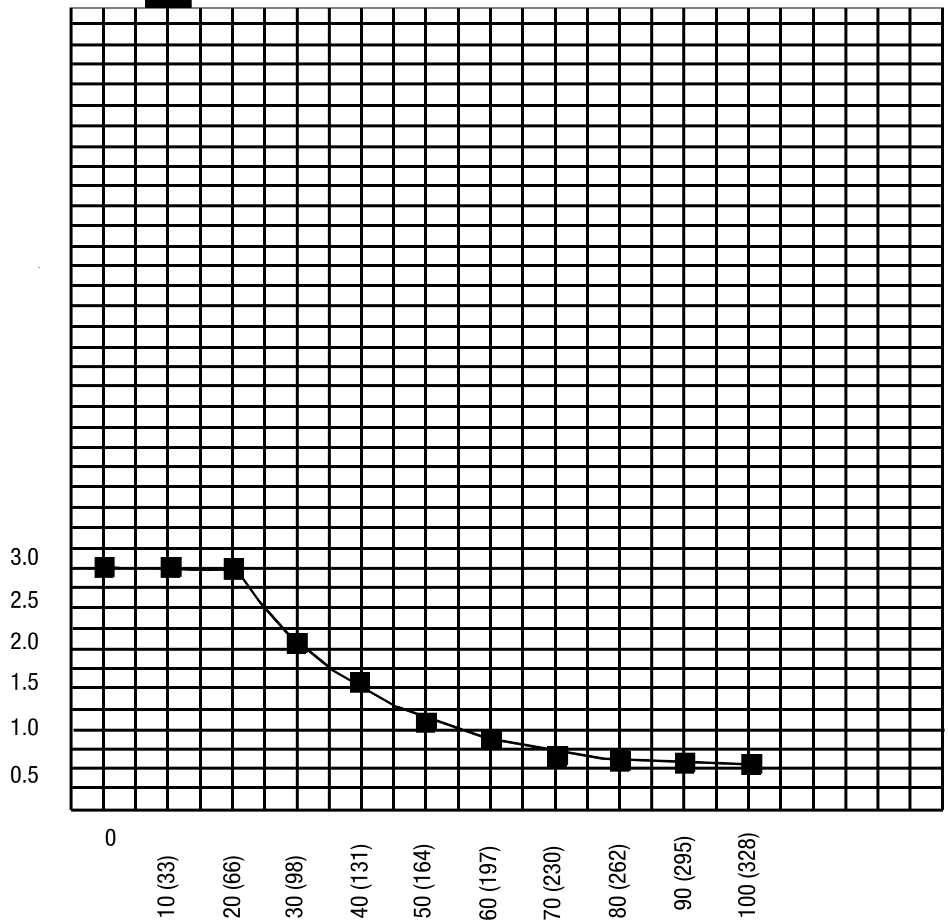
Network Length m (ft)	Maximum Current (A)
0 (0)	8.00*
20 (66)	8.00*
30 (98)	6.52*
40 (131)	5.18*
60 (197)	3.68
80 (262)	2.85
100 (328)	2.32
120 (394)	1.96
140 (459)	1.70
160 (525)	1.50
180 (591)	1.34
200 (656)	1.21
220 (722)	1.10
240 (787)	1.02
260 (853)	0.94
280 (919)	0.88
300 (984)	0.82
320 (1050)	0.77
340 (1116)	0.72
360 (1181)	0.69
380 (1247)	0.65
400 (1312)	0.62
420 (1378)	0.59
440 (1444)	0.56
460 (1509)	0.54
480 (1575)	0.52
500 (1640)	0.50

*Exceeds NEC/CECode 4A limit.



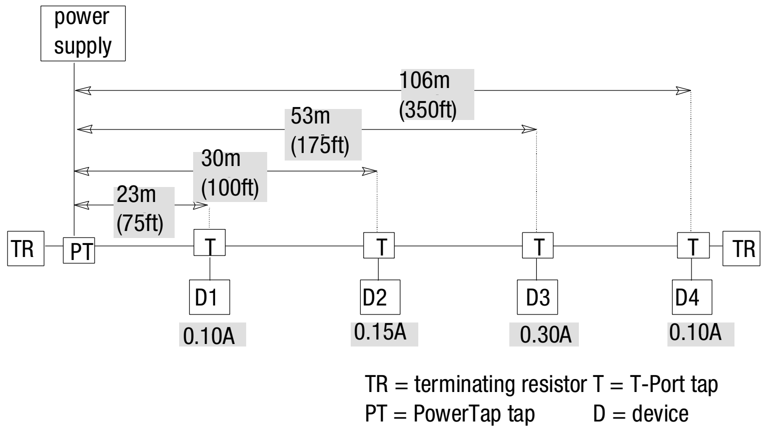
D One Power Supply (End Segment) *Thin Cable*

Network Length m (ft)	Maximum Current (A)
0 (0)	3.00
10 (33)	3.00
20 (66)	3.00
30 (98)	2.05
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 = *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 value next largest to the network length using figure A on page 2-8 to determine the maximum current allowed for the system (approximately).	**120m (2.47A)**

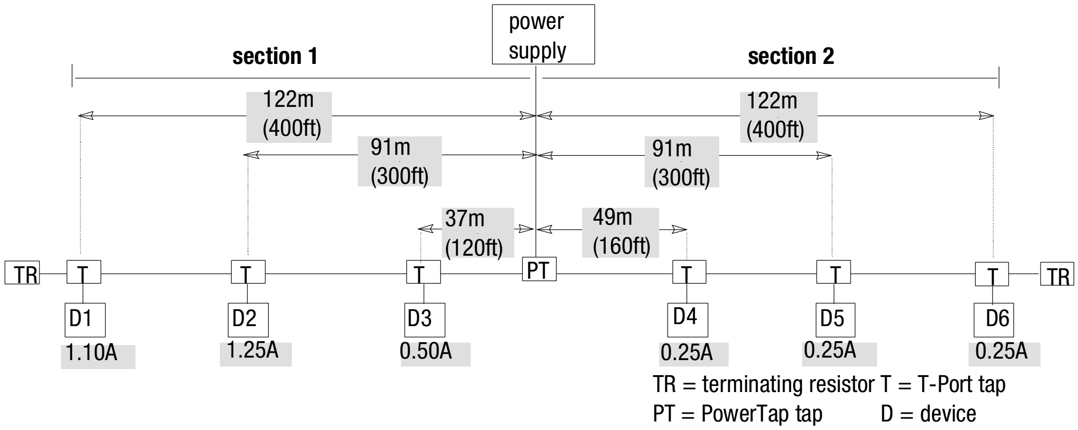
Results ⇨ Since the total current does not exceed the maximum allowable current, the system will operate properly (0.65A ≤ 2.47A).

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

- do the full-calculation method described in Appendix A
- 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.



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 using figure A on page 2-8 to determine the maximum current allowed for each section (approximately). **Section 1 = *140m (2.14A)*** **Section 2 = *140m (2.14A)***

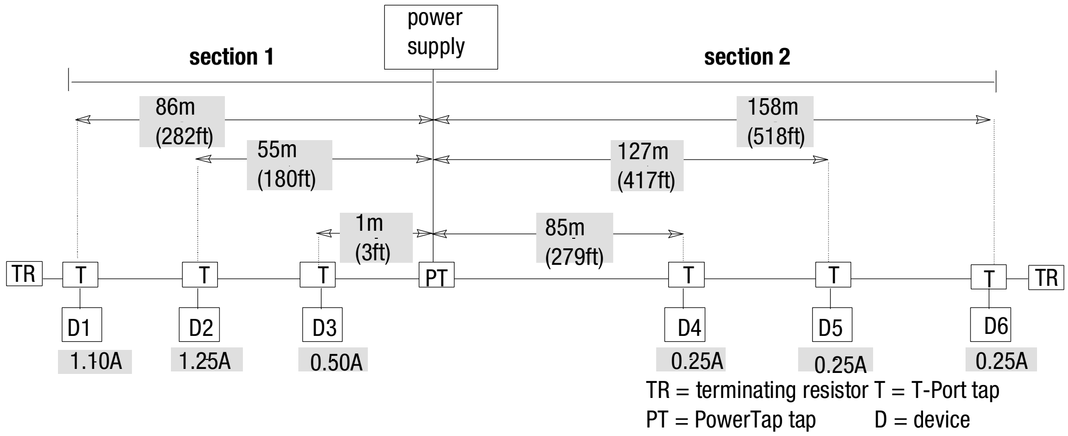
Important: Section 1 + Section 2 < 3.6A. This is ≤ 4A for NEC/CECode compliance.

Results

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

Section 2 is operational since the total current does not exceed the maximum current (0.75A ≤ 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 A on page 2-8 to determine the maximum current allowed for each section (approximately). **Section 1 = *100m (2.93A)*** **Section 2 = *160m (1.89A)***

Important: Section 1+ Section 2 < 3.6A. This is $\leq$ 4A for NEC/CECode compliance. **However, if due to derating of the power supply, you had to use over a 4A power supply, 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 $\leq$ 2.93A).

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

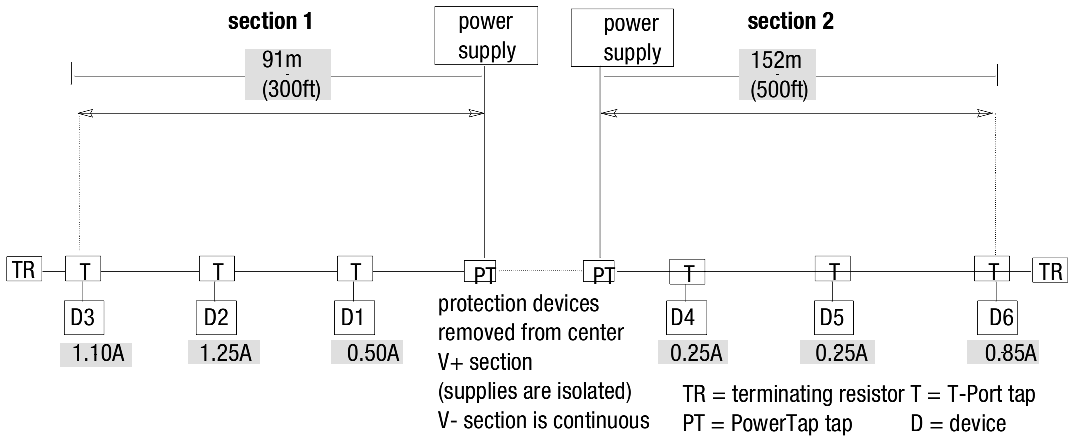
Adjusting the Configuration

Some ways to make your system operational include:

- 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 in Appendix A 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

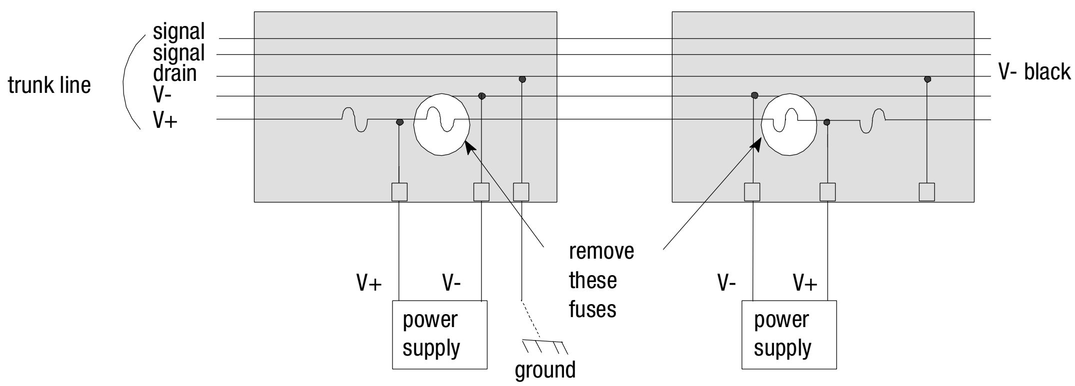
NEC/CECode Current Boost Configuration

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



This configuration effectively doubles the available current. It has the following characteristics:

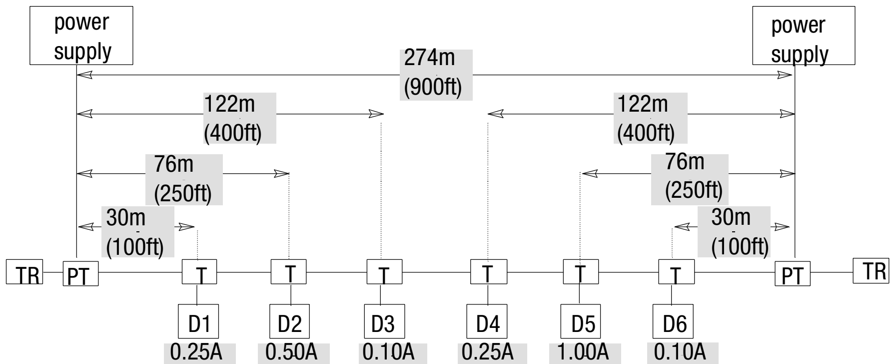
- no loads are allowed between the PowerTap taps
- fuses between the two PowerTap taps must be removed to segment the V+ conductor in the trunk line between the taps
  - Also cut V+ (red) flush with cable jacket. These are the PowerTap tap modifications.



- essentially two independent segments, each of which is a "one power supply end-connected system"
  - use figure A on page 2-8 for each segment
- each power supply can be rated up to 4A and still meet NEC/CECode Class 2 current restrictions

Two Power Supplies (End-Connected)

The following example uses the look-up method to determine the configuration for two end-connected power supplies. Diodes must be used 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.



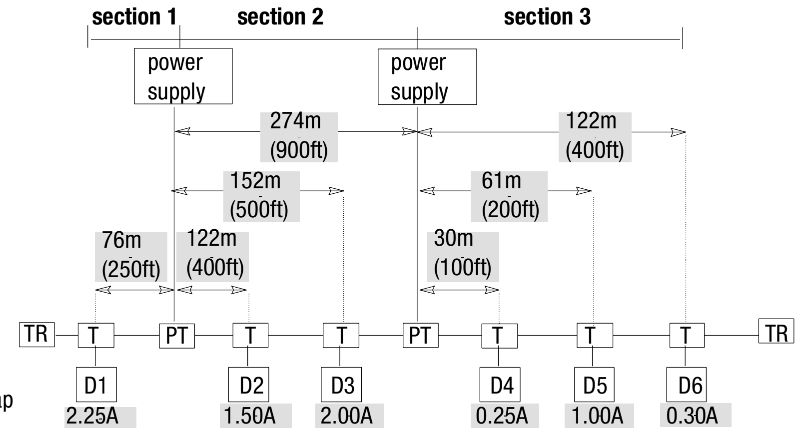
1. Determine the total length of the network. ***274m***
2. Add each device's current together to find the total current. **0.25+0.50+0.10+ 0.25+1.00+0.10 = *2.20A***
3. Find the value next largest to each section's length using figure B on page 2-8 to determine the maximum current allowed for each section (approximately). **280m (3.83A)**

Results Since the total current does not exceed the maximum current, the system will operate properly (2.20A ≤ 3.83A).

Important: Place the Schottky diodes in series with each power supply to keep back-feeding of current to power supplies. The total capabilities of both supplies must be less than or equal to 4A in North America and supplies must be listed for parallel operation.

Two Power Supplies (Not End-Connected)

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.



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

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 C on page 2-10 to determine the maximum current allowed (approximately). **140m (1.70A)**

   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 ≤ 1.70A). Loading is 91% (1.55/1.70).

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 C on page 2-10 to determine the maximum current allowed (approximately). **80m (2.85A)**

   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 ≤ 2.85A). Loading is 80% (2.25/2.85).

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 B on page 2-9 to determine the maximum current allowed (approximately). **280m (3.83A)**

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 ≤ 3.83A). Loading is 91% (3.50/3.83).

If the middle section is still overloaded after moving 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.

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	80% (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)

Choosing a Power Supply

The total of all 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 its own current limit protection.

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

If a single power supply is used, add up 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.

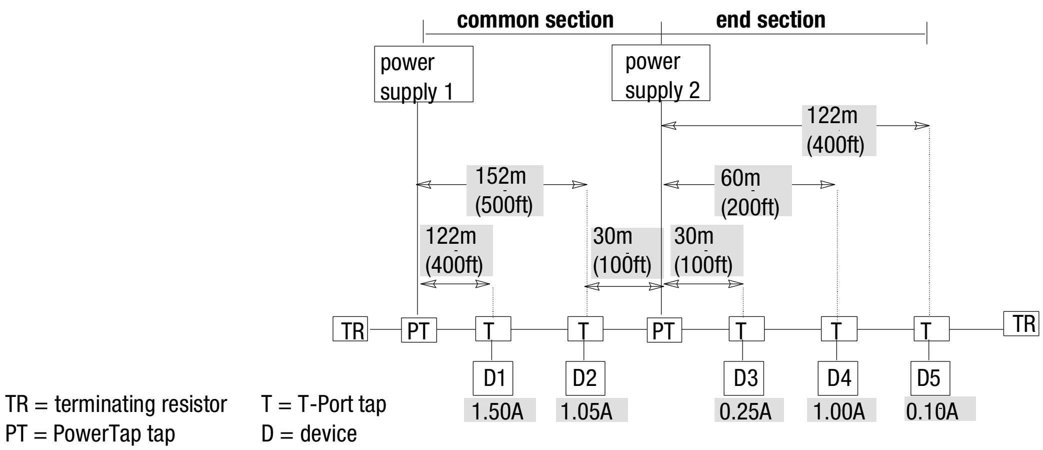
Your national and local codes may not permit the full use of the power system capacity. For example, **in the United States and Canada, the power supplies used must be Class 2 listed per the NEC and CECode, respectively**. The total current available to the system must not exceed 4A. In addition, if multiple power supplies are used, they must be listed for parallel applications.

These are some recommended 24V dc power supplies with NEC/CECode Class 2 characteristics.

Brand	Phone Number	Part Number	Description
Acopian	(610) 258-5441	B24G350	3.5A linear
		A24MT350	3.5A linear
Astec	(619) 757-1880	ACV24N3.6	3.6A linear
		LPS65	2.5A switcher
Lambda	(800) 526-2325	LFS-41-24	3.8A switcher
Power General	(617) 828-6216	FLU1-100-4	4.2A
		FLU1-80-4	3.3A

Sizing a Power Supply

Follow the steps below to determine the minimum continuous current rating of a power supply servicing a common section. Repeat these steps for each power supply.



Power Supply 1

1. Add each device's current together in the common section that are more than 20m (65ft) from the other power supply (in most cases, the current for devices in the middle of a common section is included in both power supply capacities). **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 considering maximum short circuit current allowed by your national and local codes.

Power Supply 2

2. Add each device's current together in the end section. **0.25+1.00+0.10 = *1.35A***
3. Add each device's current together in the common section that are more than 20m (65ft) from the other power supply. (In most cases, the current for devices in the middle of a common section is included in both power supply capacities.) **1.50+1.05 = *2.55A***
4. Add the results from Steps 1 and 2. **1.35+2.55 = *3.90A***

Results 3.90A 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.

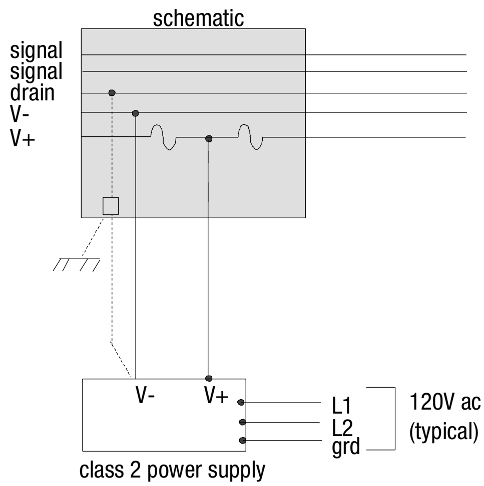
Important: In the United States and Canada, this configuration would not be allowed as the total current from power supply 1 and power supply 2 is 2.55 + 3.90 = 6.45A. This is greater than the 4A maximum current allowed.

Grounding the Cable System

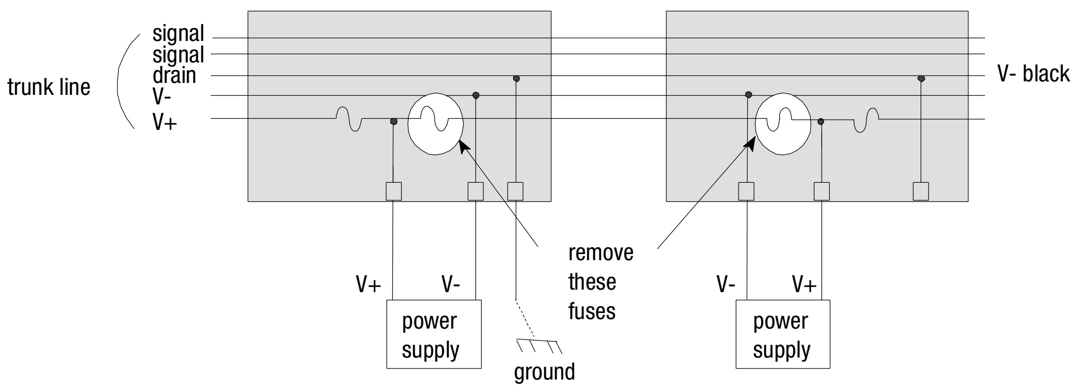
Important: If you use more than one PowerTap tap, only one of them should be attached to an earth ground. Ground the V- conductor, shield, and drain wire at only one place - at the PowerTap tap that is closest to the physical center of the network (if possible) to maximize the performance and minimize the effect of outside noise.

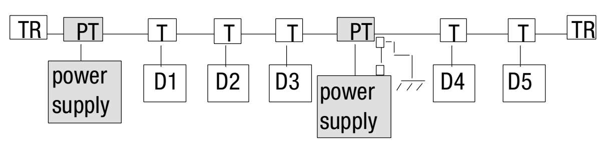
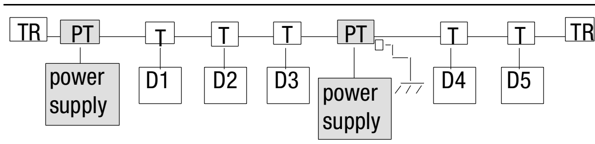
You must ground your DeviceNet cable system at only one location.

One Power Supply



Two Power Supplies



Description	Grounding
Recommended	near center of cable system, attached to PowerTap tap and earth ground
	
Acceptable	internal grounding between V- and drain conductors
	

To ground the network:

- connect the network shield and drain wire to an earth or building ground using a 25mm (1in) copper braid or a #8 AWG wire up to 3m (10ft) maximum in length
- use the same ground for the V- conductor of the cable system and the dc ground of the power supply. If possible, this should be at the PowerTap tap.

Important: For a non-isolated device, make sure that additional network grounding does not occur when mounting the device or through external connections to the device. Check the device manufacturer's instructions carefully for grounding information.

Terminating the Cable System

Install terminating resistors at the end of the trunk line.

Important: Do not put the terminating resistor on a node. Doing so risks network failure if you remove the node. The resistor must be at the end of the trunk line. Use a(n):

- **sealed terminating resistor -** when the trunk line ends at a T-port tap
- **open-style terminating resistor -** when the trunk line ends in an enclosure or a DeviceBox tap

Refer to page 3-12 for details.

What's Next

Now that you have determined the layout of your cable system and how to supply enough power to the devices, read the next chapter to learn how to connect devices, attach cables to connectors and taps, and ground and terminate the cable system.

Installing a DeviceNet Cable System

What's in this Chapter

To complete the installation of your DeviceNet cable system, follow the instructions in this chapter. For mounting dimensions and wiring diagrams for all taps, refer to Appendix A.

Installing a DeviceNet Cable System

For your safety and the successful installation of your DeviceNet network, follow these guidelines.

- **Cable placement**

  When determining placement of the trunk lines and drop lines, consider:

  - **cable rating**

    As the cable rating is 300V, do not put a cable in a cable tray or conduit that contains higher voltage cables unless you can physically isolate them.

  - **data signaling**

    Both trunk and drop lines carry data and should be kept at least 76mm (2.99in) from power cables. Put the cable in a separate conduit or cable tray or isolate it from other cables in a cable tray.

- **Codes**

  Follow local codes and the standards (such as NEC and CECode) where applicable.

- **Wiring**

  Do not install wires on an active network, if possible.

- **Voltage testing**

  After installation, make sure that the minimum voltage and maximum voltage drops at each node meet the system requirements.

Using the Quick Check List

If you are an experienced installer, you can use the following check list when installing your DeviceNet network.

- ❑ 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
- ❑ No single drop over 6m (20ft)
- ❑ Cumulative drop line budget does not exceed network baud rate limit
- ❑ Total network trunk length does not exceed network baud rate
- ❑ Terminating resistors are on each end of the trunk line
- ❑ All connections are inspected for loose wires or coupling nuts
- ❑ Opens and shorts check if any field wiring was done
- ❑ Network is grounded at only one location
- ❑ System is powered on
- ❑ Both the programmable controller and DeviceNet scanner module are in run mode

Important: If your DeviceNet system does not run properly, refer to the scanner module's display and network and status LEDs to aid in troubleshooting.

Preparing Cables

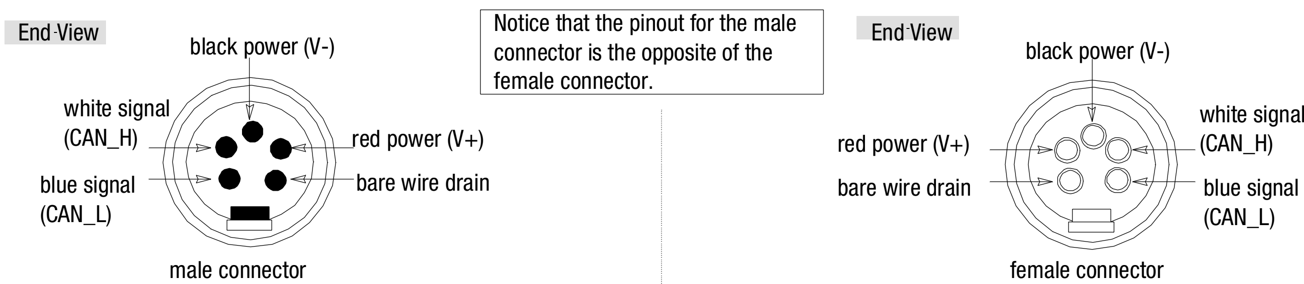
In Chapter 2, you determined the required lengths of trunk line and drop line segments for your network. To cut these segments, from reels of thick cable and thin cable, use a sharp cable cutter and provide sufficient length in each segment to reduce tension at the connector.

► 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: Follow the manufacturer's instructions for stripping, crimping, and/or tightening.

Using Pinouts

These pinouts are available with the DeviceNet network.



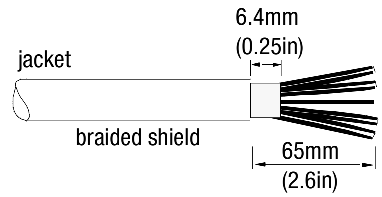
Attaching Connectors

To attach	See page
Open-style connectors	3-3
Mini/micro closed-style connectors	3-4

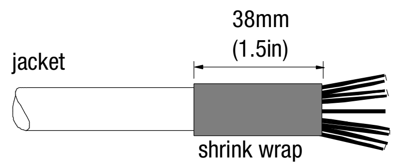
Attaching Open-Style Connectors

To attach a pluggable screw-connector to a trunk line:

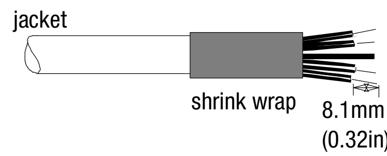
1. Strip 65mm (2.6in) to 75mm (2.96in) of the outer jacket from the end of the trunk line, leaving no more than 6.4mm (0.25in) of the braided shield exposed.



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

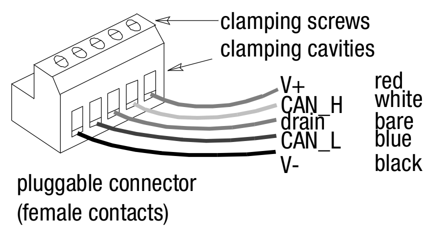


3. Strip 8.1mm (0.32in) of the insulation from the end of each of the insulated conductors.

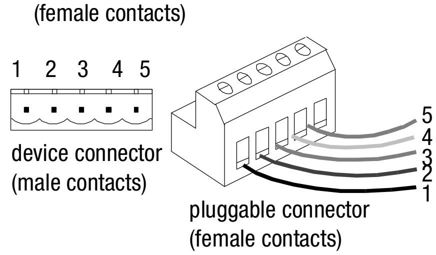


4. Tin the last 6.5mm (0.26in) of the bare conductors so that the outside dimension does not exceed 0.17mm (0.045in).

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



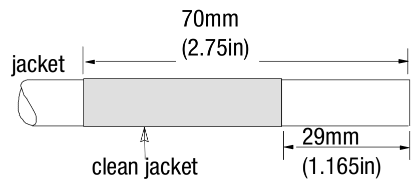
6. Tighten the clamping screws to secure each conductor. The male contacts of the device connector must match the female contacts of the pluggable connector.



Attaching Mini/Micro Closed-Style Connectors

To attach a mini/micro closed-style connector to the trunk line:

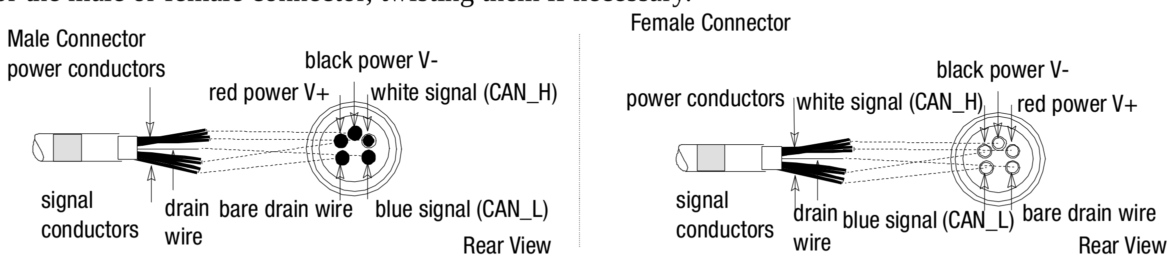
1. Prepare the cable jacket by cleaning loose particles from the jacket.



2. Strip 29mm (1.165in) of the cable jacket from the end of the cable.

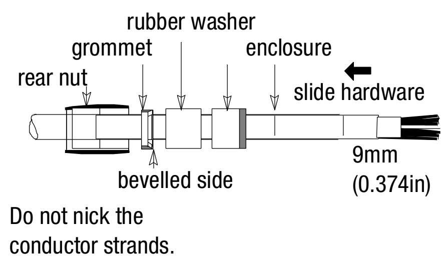
3. Cut the braided shield and the foil shields surrounding the power and signal conductors.

4. Position the five trunk line conductors to match the corresponding positions at the back end of the molded insert for the male or female connector, twisting them if necessary.



5. Trim the conductors to the same length.

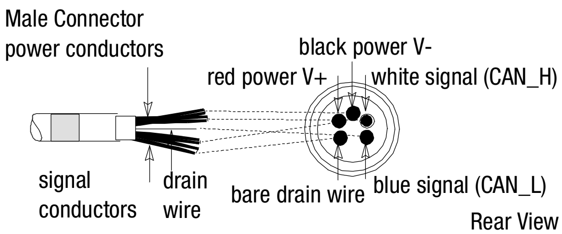
6. Slide the connector hardware onto the trunk line in the order shown.

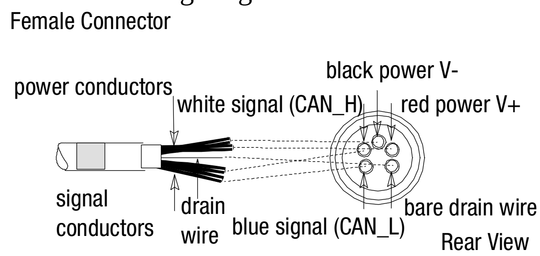


7. Strip between 9mm (0.374in) of insulation from the ends of all conductors except the bare drain wire.

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

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





9. Screw the enclosure body to the connector.

10. Screw the rear nut into the connector enclosure.

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

Installing Hard-Wire Taps

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

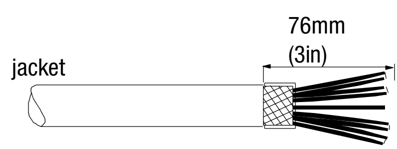
Important: Before beginning, make sure that:

- the DeviceNet cable system is inactive
- all attached devices are turned off
- any attached power supply is turned off

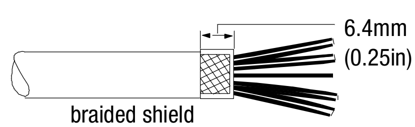
1. Remove the cover from the tap.

2. Prepare the ends of the cable sections.

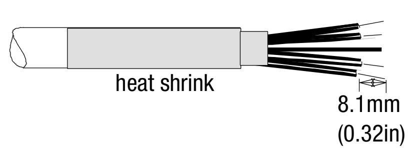
A. Strip 65mm (2.6in) to 76mm (3in) of the outer jacket and braided shield from the end of the cable.



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



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



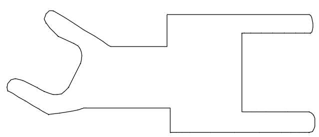
3. Attach cables to the enclosure.

A. Loosen the large gland nuts.

B. Insert cables through the large cable glands so that about 3.3mm (0.13in) 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.

1485A-AccKit



cable gland wrench

4. Proceed to the appropriate section.

For information about	See page
Attaching PowerTap taps	3-7
Attaching DeviceBox taps	3-9
Attaching DevicePort taps	3-10

Installing PowerTap Taps

The PowerTap tap contains terminal blocks that connect the trunk line conductors and the input from a power supply. Gland nuts secure cables to the PowerTap enclosure.

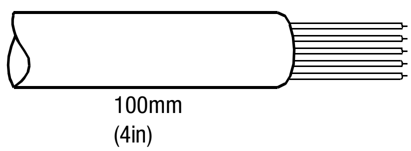
Important: As you make the attachments inside the tap, make sure:

- 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.

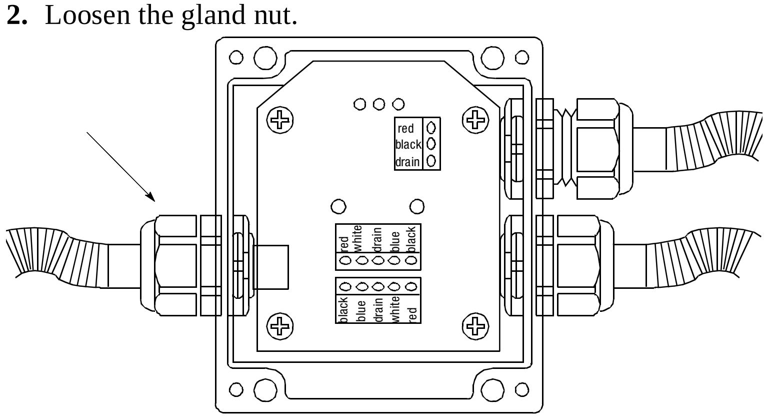
Important: The two fuses used in the PowerTap tap are 7.5A fast-acting automotive type which can be acquired from your local fuse supplier (ACT type).

To attach a PowerTap tap:

1. Cut and strip the gray PVC trunk cable back approximately 100mm (4in).



2. Loosen the gland nut.



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

Important: Trunk cable used for input from a power supply should have white and blue leads cut off short.

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

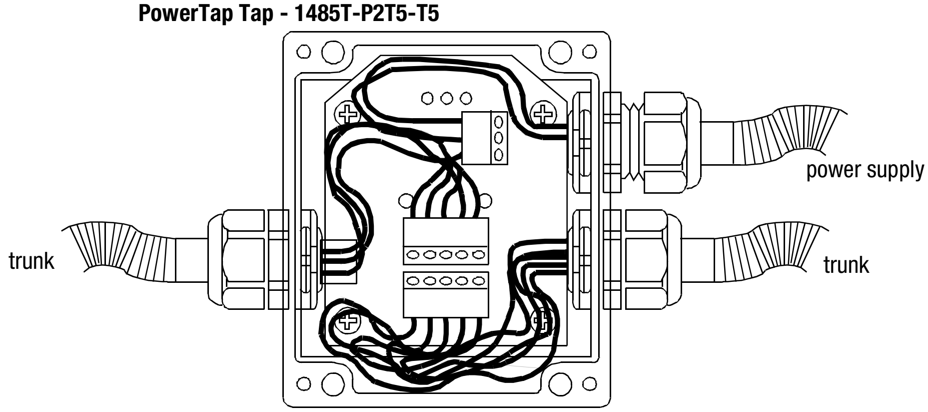
ATTENTION: You must hold the hex flange with the cable gland wrench during tightening.

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

ATTENTION: Make sure 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



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.

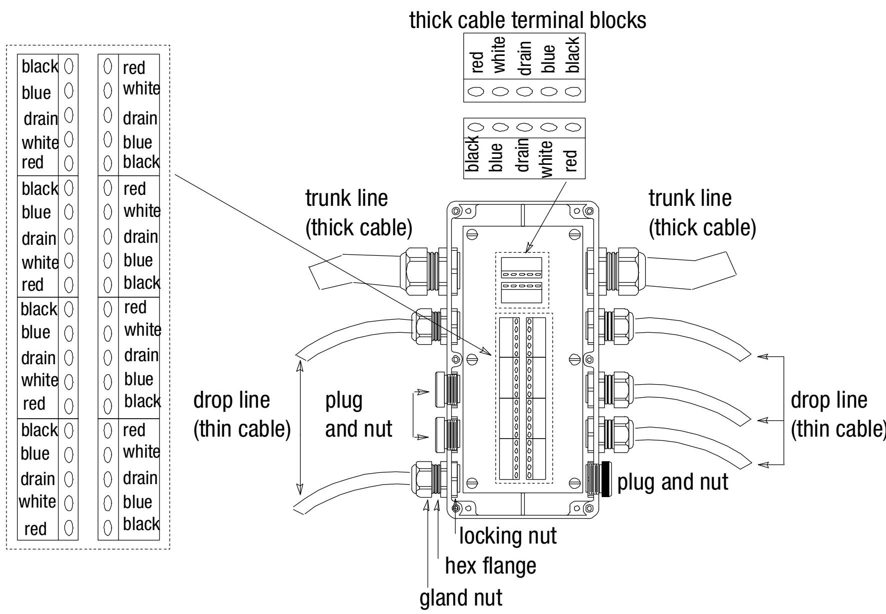
Attaching DeviceBox Taps

The DeviceBox tap contains terminal blocks that connect the trunk line and as many as eight drop lines. 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.



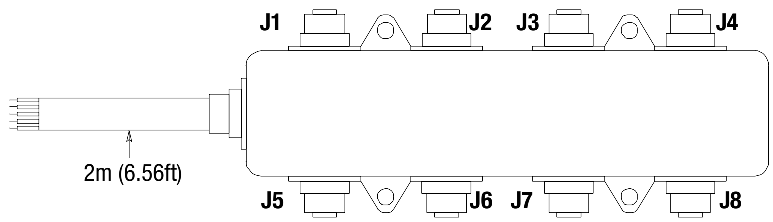
3. Tighten all clamping screws to secure conductors to the terminal blocks.

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

5. Tightly secure the cover to the enclosure.

Attaching DevicePort Taps

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



Connecting 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

Important: 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.

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.

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.

Connecting Power Supplies

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 page 2-6.

To install a power supply:

Important: 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 conductors or the equivalent or two pairs of 15 AWG conductor
- a maximum cable length of 3m (10ft) to the PowerTap tap
- the manufacturer's recommendations for connecting the cable to the supply

Grounding the Cable System

You must ground your DeviceNet cable system at only one location, preferably near the physical center of the network using a PowerTap tap.

Important: Do not put a terminating resistor on a node. Doing so risks network failure if you remove the node. You must place the resistor at the end of the trunk line.

- The shield of the cable system and the V- ground conductor of the power supply should be grounded at the same location.
- Only one location on the cable system should be grounded. Do not connect the grounding terminals of additional PowerTap taps or additional power supplies to an earth ground.
- For a non-isolated physical layer device, make sure that additional grounding does not occur due to mounting of the device or external connections to the device.
- Check each manufacturer's product instructions carefully for device grounding information.
- Follow the manufacturer's guidelines for installing and derating the power supply, including how to:
  - wire, fuse, and ground the ac side of the supply
  - mount the supply

To ground the cable system:

1. Connect the network shield and drain wire to an earth or building ground using a 25mm (1in) copper braid or an 8 AWG wire up to 3m (10ft).

2. Use the same ground for the V- conductor of the cable system and the ground of the power supply. If possible, this should be at the PowerTap tap.

Important: If you have multiple power supplies, only ground one of the power supplies.

Terminating the Cable System

To function properly, the cable system must have terminating resistors at the ends of the trunk line.

Important: Do not put a terminating resistor on a node. Doing so risks network failure if you remove the node. The resistor must be at the end of the trunk line.

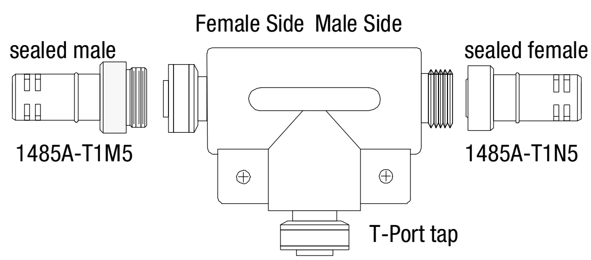
These terminating resistors provide connection to taps and the trunk line.

- **sealed-style terminating resistors**

  Male or female connections attach to:

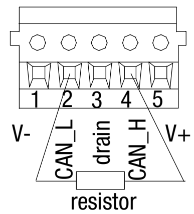
  – trunk line ends

  – T-Port taps



- **open-style terminating resistors**

  121Ω, 1%, 1/4W resistors connecting the CAN_H and CAN_L conductors in mini- or micro-style attach to:
  - DeviceBox taps
  - open-style T-Port taps
  - trunk lines using terminator blocks
  - Powertap taps



Applying Power

Apply power only after you have:

- made all connections
- installed terminating resistors
- connected devices

Using the Full Calculation Method

What's in this Appendix

Use the full calculation method if your initial evaluation in Chapter 2 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.

Supplying Power

Follow these guidelines to protect your devices and achieve the best results when supplying power to the DeviceNet cable system:

- Use power supplies rated at 24V (±1%)
- Select a power supply that provides sufficient current for all attached devices
- Make sure you derate the PowerTap tap and the power supply using the manufacturer's guidelines
- Provide fuse protection for each segment of the cable system - any section leading away from a power supply must have protection unless the power supply is inherently limiting to less than the cable rating
- Use a Schottky diode coupled to the V+ line with a power supply (when power supplies are used in parallel, can be part of the PowerTap tap)
- Use a power supply that has its own current limit protection

Adjusting the Configuration

When the sections have a voltage drop less than 4.65V, your configuration will operate properly. Ideally, the voltage drops for each section should be within 10% of each other.
If one section has a substantially greater voltage drop than the other, you should attempt to balance the load of the cable system by moving the power supply or devices.

Some ways to make your system operational include:

- shorten the overall length of the cable system
- move the power supply in the direction of the overloaded section
- move devices from the overloaded section to the another section
- move higher current loads as close to the supply as possible
- add a second power supply to the cable system
- break the network into two separate networks to reduce the number of devices on each

Using the Equation

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

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

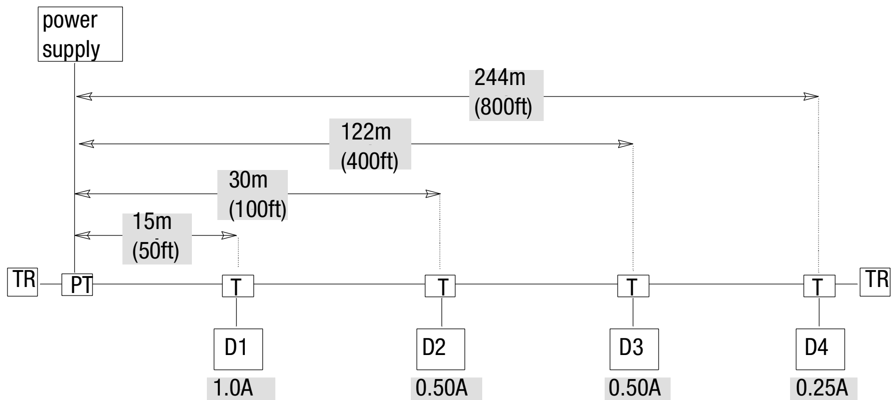
Term	Definition
L_n	L = The distance (m or ft) between the device and the power supply, excluding the drop line distance. n = The number of a device being evaluated, starting with 1 for the device closest to the power supply and increasing by 1 for the next device. The equation sums the calculated drop 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
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 1 for the device closest to the power supply and increasing by 1 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 of 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.



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

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** x (0.0045)) + (**1** x (0.005))] x **1.00** = ***0.23V***

   D2 0.50A

   B. [(**100** x (0.0045)) + (**2** x (0.005))] x **0.50** = ***0.23V***

   D3 0.50A

   C. [(**400** x (0.0045)) + (**3** x (0.005))] x **0.50** = ***0.91V***

   D4 0.25A

   D. [(**800** x (0.0045)) + (**4** x (0.005))] x **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 ≤ 4.65V).

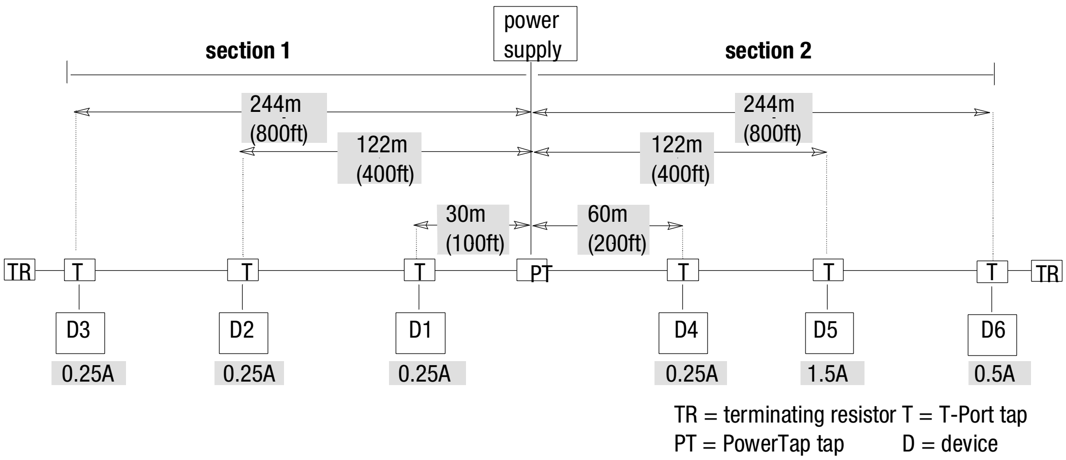
The percent loading is found by dividing the total voltage by 4.65V.

%Loading = 2.28/4.65 = ***49%***

One Power Supply (Middle-Connected)

Example of 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.

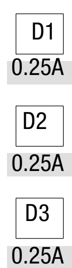


According to the look-up method, section 1 is operational while section 2 is overloaded.

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.

   SUM {[(L_n x (0.0045)) + (N_t x (0.005))] x I_n} ≤ 4.65V.



   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.

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

   D4 0.25A

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

   D5 1.5A

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

   D6 0.5A

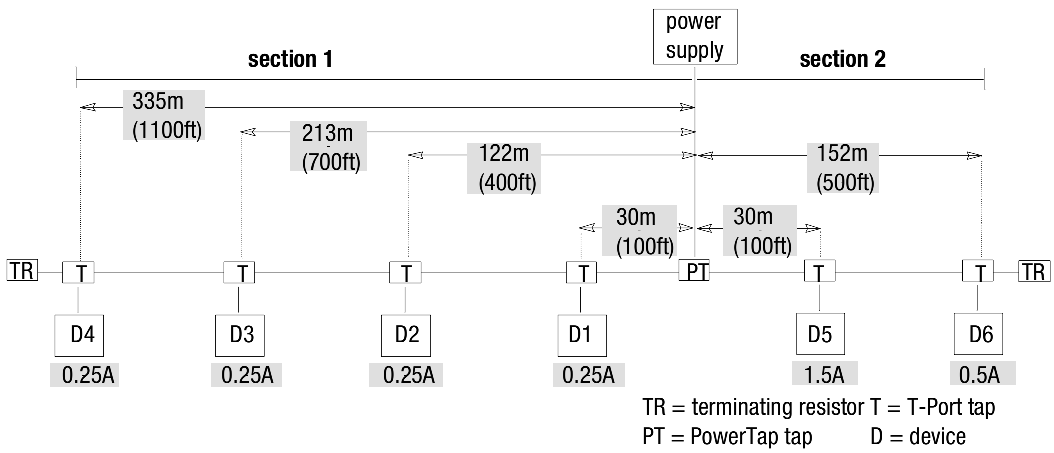
   C. [(**800** x (0.0045)) + (**3** x (0.005))] x **0.5** = ***1.81V***

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 4 devices in section 1 and 2 devices in section 2. Once you’ve moved the power supply, try the calculations again.



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

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

   D1 0.25A

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

   D2 0.25A

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

   D3 0.25A

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

D4
0.25A

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.

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

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 ≤ 4.65V)
section 2 (1.81V ≤ 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%**

Understanding Select NEC Topics

What's in this Appendix

The following topics from the National Electric Code (NEC) section 725 (revision 1993) are known to impact the configuration and installation of DeviceNet systems in the United States. There may also be additional NEC sections and local codes that must be met. Other codes exist outside of the United States that may also affect your installation.

Specifying Section 725 Topics

- 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

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