



# ControlNet Coax Media Planning and Installation Guide

1786-series

**Installation Instructions** 



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



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

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## What's in This Chapter

This manual describes the required components of a ControlNet<sup>TM</sup> Coax media system and how to plan for and install these required components.

For information about this topic:	Read:
Understand the ControlNet Coax Media System	Chapter 1
Plan a ControlNet Coax Media System	Chapter 2
Install a ControlNet Coax Media System	Chapter 3
Reference Mount dimensions (taps and universal mounting bracket)	Appendix A
Maintain the Cable Strip Tool	Appendix B

IMPORTANT

We assume that you understand the fundamentals of electronics and electrical codes. If you do not, you should not attempt the procedures described in this manual.

## **Abbreviations and Symbols**

This	Means
PVC cable	polyvinyl chloride cable
FEP cable	fluorinated ethylene propylene cable
PLC processor	Allen-Bradley programmable logic controller
h ●●● h	network continues

## **Related Publications**

Publication:	Publication Number:
ControlNet Cable System Component List	AG-2.2
Industrial Automation Wiring and Grounding Guidelines	1770-4.1

## Common Techniques Used in This Manual

The following conventions are used throughout this manual:

- bulleted lists provide information, not procedural steps
- numbered lists provide sequential step



This symbol identifies helpful tips.

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- Call your local Rockwell Automation representative
- ControlNet Post-sales Technical Support, 1.440.646.5800
- Web Links: <u>http://www.ab.com</u> as a registered member, go to <u>http://www.ab.com/mem/technotes/techmain.html</u>

#### **Your Questions or Comments about This Manual**

If you find a problem with this manual, please notify us of it on the enclosed "How are We Doing" form (at the back of this manual).

If you have any suggestions about how we can make this manual more useful to you, please contact us at the following address:

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Overview of The ControlNet Coax Media System

## Plan a ControlNet Coax Media System

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Install a ControlNet Coax Media System

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**Mounting Dimensions** 

# Overview of The ControlNet Coax Media System

## What's in This Chapter

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

For information about this topic:	See page:					
Understand the ControlNet Cable System	1-1					
Understand the ControlNet Components	1-2					

## Understand the ControlNet Cable System

The ControlNet cable system gives you the flexibility to design a communication network for your particular application. To take full advantage of this flexibility, you should spend sufficient time planning how to install your network **before** assembling any of the hardware.

Use the following figure and term definitions to understand the ControlNet cable system.



Term	Means								
bridge B	a device that allows traffic to pass from one link to another link								
link	a collection of nodes with unique addresses in the range of 1-99								
network	a collection of connected nodes — the connection paths between any pair of devices may include repeaters and bridges								

Term	Means
node	any physical device connecting to the ControlNet cable system which requires a network address in order to function on the network — a link may contain a maximum of 99 nodes <i>this address must be in the range of</i> <b>1</b> - <b>99</b> <i>and be unique to</i> <i>that link</i>
repeater R	a two-port active physical layer component that reconstructs and retransmits all traffic it hears on one segment side to another segment side
segment	trunk-cable sections connected via taps with terminators at each end and with no repeaters
tap T	the connection between any device and the ControlNet Coax Media system
terminator 🗖	a 75 $oldsymbol{\Omega}$ resistor mounted in a BNC plug
trunk cable	the bus or central part of a cable system
trunk-cable section	a length of a cable between any two taps

## Understand the ControlNet Components

The ControlNet Coax media system is made up of these components. For information on purchasing these components see the ControlNet Cable System Component List (publication AG-2.2).

- nodes
- taps
- trunk cable
- cable connectors
- terminators
- segments
- repeaters
- links
- bridges
- network

#### Nodes

Nodes are physical devices connecting to the ControlNet media system that require a network address in order to function on the network.



#### Taps

Taps connect each node on a network to the Coax media system via an integral 1m (39.6") drop cable.



There are four taps available with a:

• T or Y placement of BNC connectors



• straight or right angle connector on the drop cable



straight

right-angle

40956

#### **Trunk Cable**

The trunk cable is the bus, or central part of the ControlNet Coax media system. The trunk cable is composed of multiple sections of cable. The standard cable that can be used to construct trunk-cable sections is quad shield RG-6 type Coax.

There are also several types of special-use cables you can use depending on the environment in which you are installing your cable system.

#### **Cable Connectors**

A cable connector (cat. no. 1786-BNC) attaches Coax trunk-cable sections to the tap's BNC connector.



#### **Optional Connectors**

Allen-Bradley also offers optional cable connectors for use in your network configuration.

#### Terminators

A 75- $\Omega$  terminator (cat. no. 1786-XT) **must** be installed on the tap at each end of a segment.



#### Segments

A segment is a collection of Coax trunk-cable sections, taps and two terminators.



The total allowable length of a segment depends upon the number of taps in your segment and the Coax cable type used. See page 2-1 for detailed information.

#### Repeaters

Use repeater adapters and modules to increase the number of taps, extend the total length of your segment, or create a star configuration (go off in multiple directions from one point). The number of repeaters and cable length total is limited depending on your network topology. Refer to Chapter 2 of this manual for information on system limitations.



When you insert a repeater into your cable system, you create a new segment. You can attach up to 4 repeater modules to one repeater adapter. Refer to Chapter 2 for topology examples. The same restrictions on the number of taps and cable length apply to this new segment. Refer to Chapter 2 of this manual for information on system limitations.

#### Links

A link is a collection of nodes forming:

- a segment
- multiple segments connected together via repeaters

Each node in a link must have a unique address in the range of 1-99.



## Bridge

A bridge is a device used to connect links.



#### Network



A network is the collection of nodes connected together by repeater adapters, repeater modules and bridges.

## What's Next

Now that you have a general understanding of the ControlNet cable system, you are ready to design a ControlNet cable system for your specific requirements. Go to Chapter 2.

## Notes:

# Plan a ControlNet Coax Media System

## What's in This Chapter

Use this chapter to determine your network requirements.

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After reading this chapter, consult engineering drawings of your facility for specific information concerning the best location for installing your network.

**IMPORTANT** The ControlNet cable system is a ground-isolated Coaxial network. Proper selection of cable, connectors, accessories, and installation techniques is necessary to make sure it is not accidentally grounded.

## Determine the Number of Taps You Need

The number of taps you need depends on the number of devices you want to connect to the network. You need a tap for each node and repeater on a segment.

If you plan to add nodes at a later date, you should order and install the cable and connectors for these additional nodes when you install the initial network. This will minimize disruption to the network during operation.

IMPORTANT	A disconnected drop cable can cause noise on the
	network. Because of this, we recommend having
	only one unconnected drop cable per segment for
	maintenance purposes. Be sure to keep the dust cap
	on any unconnected drop cable. If your cable system
	requires more than one unconnected drop cable,
	unused drop cables should be terminated with a
	dummy load (1786-TCAP).

These tap kits are available:





If you are planning future installation of additional nodes, do not install the tap. Instead, install a BNC bullet connector. See page 2-10 for more information. tap (1786-TPS, -TPR, -TPYS, -TPYR, -TCT2BD1) dust cap tor noise suppression, ferrite beads are molded on the drop cable.

## ATTENTION

Each tap kit contains:



Taps contain passive electronics and must be used for the network to function properly. Other methods of connecting to Coax trunk cable will result in reflected energy that will disrupt communications.

## **Connect Program Devices**

Program devices may be connected to the ControlNet cable system through:

- the maintenance tap on a segment (for a temporary connection)
- a tap on a segment (for a permanent connection)
- the ControlNet network access cable (1786-CP) this connects your programming devices to ControlNet nodes (processors, communication interfaces, and adapters) through network access ports (NAPs 🔘 ) and allows you to gain full access to the network
- IMPORTANTThe 1786-CP cable can be plugged into any<br/>ControlNet product's NAP to provide programming<br/>capability on the ControlNet network. When you<br/>connect a PC connected through this cable, it *is*<br/>counted as a node and *must* have a unique address.<br/>RSNetWorx and RSLinx automatically finds and<br/>assigns a node address for you.



#### ATTENTION



Use the **1786-CP** cable when connecting a programming terminal to the network through NAPs. Using a commercially available RJ-style cable could result in possible network failures.

## Determine What Type of Cable You Need

There are several types of RG-6 quad shield cable that may be appropriate for your installation. Choose the appropriate cable with environmental factors associated with your application and installation site in mind. You should install all wiring for your ControlNet cable system in accordance with the regulations contained in the National Electric Code (or applicable country codes), state codes, and applicable municipal codes.

For:	Use this cable type:1	
light industrial applications	Standard-PVC CM-CL2	
heavy industrial applications	Lay-on Armoured and Interlocking Armour	
high and low temperature applications, as well as corrosive areas (harsh chemicals)	Plenum-FEP CMP-CL2P	
festooning or flexing applications	High Flex	
moisture resistant applications; direct burial, with flooding compound, fungus resistant	Flood Burial	
<sup>1</sup> See the ControlNet Cable Systems Component List (publication AG-2.2) for information on suppliers and part numbers.		

## Determine Trunk Cable Section Lengths

A segment is comprised of several sections of trunk cable separated by taps. The total cable length of a segment is equal to the sum of all of the trunk-cable sections.



Select the shortest path for routing the cable to minimize the amount of cable you need. The specific details of planning such a cable route depends upon the needs of your network. The total allowable length of a segment containing standard RG-6 quad shield cable depends upon the number of taps in your segment. There is no minimum trunk-cable section length requirement. The maximum allowable total length of a segment is 1,000m (3,280ft) with two taps connected. Each additional tap decreases the maximum length of the segment by 16.3m (53ft). The maximum number of taps allowed on a segment is 48 with a maximum length of 250m (820ft).



#### EXAMPLE

If your segment requires 10 taps, the maximum segment length is:

1000m (3280ft) - 16.3m (53.5ft) x [10 - 2] 1000m (3280ft) - 130.4m (427.7ft))= 869.6m (2852.3ft)

The amount of high-flex RG-6 cable (1786-RG6F) you can use in a system is less than the amount of standard RG-6 cable, so you should keep high-flex cable use to a minimum. Use BNC bullet connectors to isolate areas that require high-flex RG-6 cable from areas that require standard RG-6 cable; this allows the high-flex RG-6 section to be replaced before flexture life is exceeded.

An allowable total length of RG-6 flex cable segment in your application can be determined using the equation below. Each additional tap decreases the maximum length of the segment. The maximum number of taps allowed on a segment is 48. Each additional tap decreases the maximum length of the segment by different lengths depending on the attenuation of your high-flex cable.

maximum allowable segment length of

(20.29 db - number of taps in segment \* .32 db)

cable attenuation @ 10MHz per 304 m (1000 ft)

Note: Cable attenuation is defined as the signal loss measured at 10 MHz per 1000 ft (304 m) of cable. Cable attenuation for ControlNet cables are listed in publication AG-2.2, ControlNet Cable Systems Component List.

EXAMPLE	If your segment requires 3 taps using 1786-RG6F/B cable, the maximum segment length is:	
	([20.29 db - 3*.32 db] / 7.18 db] * 1000) (19.33 db / 7.18 db) * 1000 = 820 m (2692 ft)	
	The total trunk-cable length or number of taps can be increased by installing repeaters on the segment. This creates another segment.	

## Determine How Many Terminators You Need

You must use  $75\Omega$  terminators (cat. no. 1786-XT) at the end of each segment for the ControlNet cable system to work.



After you have determined how many segments will be in your network, multiply this number by two to figure out how many terminators you will need for your network.

## Determine if You Need Repeaters

You need to install repeaters if your system requires more than 48 taps per segment, or a longer trunk cable than the specifications allow.



The maximum number of addressable nodes per link (not counting repeaters) is 99. Since repeaters **do not require** an address, they do not count against the total of 99. If each segment is less than 250m, each segment could contain up to 47 nodes (48 connections are allowed on a 250m segment - 1 tap for the repeater).



Do not power both repeaters at the same time. Powering both repeaters at the same time disrupts communication on the network. Use the fault-relay contact of the primary repeater to control power to the backup repeater.

#### **Configure Your Link With Repeaters**

When you configure your link using repeaters, you can install them in one of three ways:

You can install repeaters in:	See page:
series	2-8
parallel	2-9
a combination of series and parallel	2-9

A repeater can be connected to a segment at any tap location.



The maximum system size is based on the distance between any two nodes. The total amount of cable used in the network is limited only by the distance between the farthest two nodes.

Install Repeaters in Series

When you install repeaters in series, use your ControlNet Network management Software (RSNetWorx) to verify that the system is an allowable configuration. The system size is based on the maximum number of repeaters (5) in a series and length of the media used between any two nodes.

Refer to the Installation Instructions that shipped with your repeater for an example series toplogy drawing.

#### Install Repeaters in Parallel

When you install repeaters in parallel, **you can install a maximum of 48 repeaters** (the maximum number of taps per 250m segment) on any one segment.

If your link is configured using repeaters in parallel, you count one of the repeater taps for one segment and the other repeater tap for the parallel segment that the repeater is connecting to the backbone network.

Refer to the Installation Instructions that shipped with your repeater for an example parallel toplogy drawing.

#### Install Repeaters in a Combination of Series and Parallel

You can install repeaters in a combination of series and parallel connections to form a link. Follow the guidelines listed for each type. For mixed topologies (series and parallel), you can verify the maximum number of repeaters and media by using RSNetWorx.



If your network is configured using repeaters in combination of series and parallel, you need to count the taps and repeaters in all segments.

Refer to the Installation Instructions that shipped with your repeater for an example combination series/parallel toplogy drawing.

#### Install Repeaters in a Ring

For a ring toplogy, you must use the ControlNet Long-distance Fiber Repeater (catalog number 1786-RPFRL) or Extra-long-distance Fiber Repeater (catalog number 1786-RPFRXL).

Refer to the Installation Instructions that shipped with your repeater for an example ring toplogy drawing.

These connectors are available:

IMPORTANTYou can order dust-tight (IP65) and<br/>corrosion-resistant (IP67) versions of these<br/>connectors. See the Allen-Bradley ControlNet Cable<br/>System Component List (publication AG-2.2) for a<br/>complete list of part numbers.

Use this connector:	To:
cable connector	attach trunk-cable sections to a tap's BNC or TNC connector
bullet (jack-to-jack)	reserve a space in the trunk cable for future installation of a tap or to splice a trunk cable
barrel (plug-to-plug)	connect two adjacent taps without a trunk-cable section between them
isolated-bulkhead (jack-to-jack)	go through grounded panel walls while maintaining the shield isolation of the trunk-cable.
tap dummy load	cap off installed taps that have yet to be connected to a node
right angle (jack-to-plug)	provide a 90° bend in your cable (prevents bending your cable excessively). See Chapter 3 for the bend radius specification.

## Determine What Type of Connectors You Need



## **Using Redundant Media** (Optional)

You can run a second trunk cable between your ControlNet nodes for redundant media. With redundant media, nodes send signals on two separate segments. The receiving node compares the quality of the two signals and accepts the better signal to permit use of the best signal. This also provides a backup cable should one cable fail.

Trunk cables on a redundant cable link are defined by the segment number and the redundant trunk-cable letter.

Actual ControlNet products are labeled with these icons (the shaded icon representing redundant media).



В.



In this figure, the redundant cable trunk cable is trunk cable

Observe these guidelines when planning a redundant media system.

- Route the two trunk cables (trunk cable A and trunk cable B) differently to reduce the chance of both cables being damaged at the same time.
- Each node on a redundant-cable link must support redundant Coax connections and be connected to both trunk cables at all times. Any nodes connected to only one side of a redundant-cable link will result in media errors on the unconnected trunk cable.
- Install the cable system so that the trunk cables at any physical device location can be easily identified and labeled with the appropriate icon or letter. Each redundant ControlNet device is labeled so you can connect it to the corresponding trunk cable.
- Both trunk cables (trunk cable A and trunk cable B) of a redundant-cable link must have identical configurations. Each segment must contain the same number of taps, nodes and repeaters. Connect nodes and repeaters in the same relative sequence on both trunk cables.
- Install cable on each side of a redundant cable so that each cable is about the same length. The total difference in length between the two trunk cables of a redundant-cable link goes down as the number of repeaters increases.





• Avoid connecting a single node's redundant trunk cable connections on different segments; this will cause erratic operation.



A node supporting redundant trunk-cable connections will function even if trunk cable A is connected to the B connector on the node and vice-versa. This makes cable fault indications (on the hardware or in software) difficult to interpret and makes locating a bad cable segment very difficult.

## **Using IP67 Media**

Sealed media components are ControlNet taps and connectors suitable for use in harsh environments. The sealed tap contained in the ControlNet IP67 Tap and Connector Installation Kit (cat. no. 1786-TCT2BD1) protects the BNC connector, which is not water-tight.

The following figure shows a sample installation featuring IP67-rated sealed media components.



#### IMPORTANT

Refer to the ControlNet IP67 tap and Connector Kit Installation Instructions (supplied with the kit), publication 1786-IN017A-EN-P, for more information on IP67 installations.

## **Application Considerations**

The following guidelines coincide with the guidelines for "the installation of electrical equipment to minimize electrical noise inputs to controllers from external sources" in IEEE standard 518-1982. When planning your cable system, take into account certain installation considerations, depending on your application.

Category:	Includes:			
1	ac power lines			
	<ul> <li>high-power digital ac I/O lines</li> </ul>			
	<ul> <li>high-power digital dc I/O lines</li> </ul>			
	<ul> <li>power connections (conductors) from motion drives to motors</li> </ul>			
2	<ul> <li>analog I/O lines and dc power lines for analog circuits</li> </ul>			
	<ul> <li>low-power digital ac/dc I/O lines</li> </ul>			
	<ul> <li>low-power digital I/O lines</li> </ul>			
	<ul> <li>ControlNet communication cables</li> </ul>			
3	low-voltage dc power lines			
	<ul> <li>communication cables to connect between system components within the same enclosure</li> </ul>			

There are three categories of conductors:

#### **General Wring Guidelines**

Follow these guidelines for wiring all ControlNet cables.

- If cable must cross power feed lines, it should do so at right angles.
- Route at least 1.5m (5ft) from high-voltage enclosures, or sources of rf/microwave radiation.
- If the conductor is in a metal wireway or conduit, each section of the wireway or conduit must be bonded to each adjacent section so that it has electrical continuity along its entire length, and must be bonded to the enclosure at the entry point.

For more information on general wiring guidelines, see the following publications:.

Publication title:	Publication number:
Industrial Automation Wiring and Grounding Guidelines	1770-4.1
System Design for Control of Electrical Noise	GMC-RM001A-EN-P

#### Wiring External to Enclosures

Cables that run outside protective enclosures are relatively long. To minimize cross-talk from nearby cables, it is good practice to maintain maximum separation between the ControlNet cable and other potential noise conductors. You should route your cable following these guidelines:

Cable in a contiguous metallic wireway or conduit?	Route your cable at least:	From noise sources of this strength:
Yes	0.08m (3")	Category-1 conductors of less than 20A
	0.15m (6")	ac power lines of 20A or more, up to 100 KVA
	0.3m (12")	ac power lines greater than 100 KVA
No	0.15m (6")	Category-1 conductors of less than 20A
	0.3m (12")	ac power lines of 20A or more, up to 100 KVA
	0.6m (24")	ac power lines greater than 100 KVA

#### Wiring Inside Enclosures

Cable sections that run inside protective equipment enclosures are relatively short. As with wiring external to enclosures, you should maintain maximum separation between your ControlNet cable and Category-1 conductors.

When you are running cable inside an enclosure, route conductors external to all raceways in the same enclosure, or in a raceway separate from Category-1 conductors.

Route your cable at least this distance:	From noise sources of this strength:
0.08m (3")	Category 1 conductors of less than 20A
0.15m (6")	ac power lines of 20A or more, up to 100 KVA
0.6m (24")	ac power lines greater than 100 KVA

#### Surge Suppression

Transient electromagnetic interference (EMI) can be generated whenever inductive loads such as relays, solenoids, motor starters, or motors are operated by "hard contacts" such as pushbutton or selector switches. These wiring guidelines assume you guard your system against the effects of transient EMI by using surge-suppressors to suppress transient EMI at its source. Inductive loads switched by solid-state output devices alone do not require surge suppression. However, inductive loads of ac output modules that are in series or parallel with hard contacts require surge-suppression to protect the module output circuits as well as to suppress transient EMI.

#### Ferrite Beads

Ferrite beads can provide additional suppression of transient EMI. Fair-Rite Products Corporation manufactures a ferrite bead (part number 2643626502) which can be slipped over category-2 and category-3 (RG-6 type trunk cable) conductors. You can secure them with heat-shrink tubing or tie-wraps. A cable transient EMI induced onto the cable can be suppressed by a ferrite bead located near the end of the cable. The ferrite bead will suppress the EMI before it enters the equipment connected to the end of the cable.

**Order Components** Now that you are ready to order components, use these guidelines to help you select components.

#### **Create a General Plan**

The ControlNet cable system is isolated from earth and *must* be protected from inadvertent ground connections.

#### **Plan Your Segments**

- all connections to the trunk cable require a tap
- taps may be installed at any location on the trunk cable
- tap drop-cable length must not be changed
- maximum number of taps = 48, with 250m (820ft) of standard RG6 trunk cable
- maximum number of taps = 48, with 166.6m (546.75ft) of RG6F high- flex trunk cable
- maximum trunk-cable length of standard RG6 trunk cable = 1000m (3280 ft), with 2 taps

- maximum trunk-cable length of high-flex RG6F trunk cable = 666m (2187ft), with 2 taps
- $75\Omega$  terminators are required on both ends
- one tap with an unconnected drop cable may be installed for maintenance purposes
- use BNC bullet connectors at future tap locations
- do not mix redundant and non-redundant nodes
- use dummy loads (1786-TCAP) for all other unconnected drop cables
- avoid high noise environments when routing cables

#### Link Planning

- maximum of 99 nodes (excluding repeaters)
- repeaters require a tap but are not counted as nodes they are included in the number of devices allowed per segment (48)
- repeaters may be installed at any tap location along a segment
- there can only be one path between any two points on a link
- the configuration of both sides of a redundant segment must be the same
- The total difference in length between the two trunk cables of a redundant-cable link goes down as the number of repeaters increases. See the illustration on page 2-13.

### **Order Parts**

ltem	Cat. No.	Guidelines	Quantity needed $^1$
Tapstraight T-tap straight Y-tap right angle T-tap right angle Y-tap		You need a tap for each connection to the trunk cable (nodes and repeaters). Each tap kit contains: two BNC connector kits, 1 dust cap, 1 universal mounting bracket, ControlNet cable labels and 2 screws	number of repeaters x 2 + number of nodes
repeater8	and the	Use a repeater to: increase the number of nodes attached extend the allowable cable length	Follow guidelines on page 7.
terminators	ControlNet Cable	You need a terminator for each end of each segment.	number of segments x 2
network access cable	<i>Component List</i> (publication AG-2.2)	Use this cable to temporarily connect programming devices (through NAPs) to ControlNet nodes.	number of programming devices
cable connector		Two cable connectors are shipped with each tap — you need to order additional cable connectors for each bullet and isolated-bulkhead connector you will be using. <sup>2</sup>	number of bullet connectors x 2 + number of isolated-bulkhead connectors x 2 + any spares
optional bullet cablebarrel connectors	-	Use these as specified on page 10.	depends on your network requirements
isolated-bulkhead			
right angle extender	-		
trunk cable	Use the <i>ControlNet Cable System</i> <i>Component List</i> (publication AG-2.2) to order your required length of cable.		See page 5 to select your cable type. Follow guidelines on page 5 to determine cable length.
tap dummy load	1786-TCAP (quantity of 5)	Use the dummy load to plug into drop cables that are not attached to a node	one for every drop cable that is not attached to a node
Coax tool kit	1786-CTK	Use the tool kit to create your create your trunk cable to your specifications	one

<sup>1</sup> You will need to double your quantities when ordering components for a redundant cable system.

<sup>2</sup> The connector kit may be shipped with two ferrules. The smaller diameter ferrule should not be used with ControlNet applications.

## What's Next

After you gather all of the parts for your ControlNet Coax media system, you are ready to install your network. Go to Chapter 3.
## Install a ControlNet Coax Media System

## What's in This Chapter

Follow the instructions in this chapter to install your ControlNet Coax Media system.

For information about this topic:	See page:
Install the Trunk Cable	3-2
Mount the Taps	3-2
Install a Repeater Adapter	3-5
Install Cable Connectors	3-6
Collect Your Tools	3-6
Calibrate the Cutting Blades	3-7
Strip the Cable	3-19
Attach the Connectors to the Cable	3-14
Test for Electrical Shorts and Continuity	3-18
Connect Cable Sections	3-19
Terminate Segments	3-20
Connect Devices	3-21

IMPORTANT

Read Chapter 2, Plan a ControlNet Coax Media System, before you install your network.

IMPORTANT

To ensure the integrity of your ControlNet connection, use only Rockwell Automation cables and connectors, as well as the ControlNet Coax Toolkit, catalog number 1786-CTK.

## Install the Trunk Cable

Install your trunk cable, observing your cable supplier's installation instructions and these guidelines.

#### Wire the External to Enclosures

When you pull the RG-6 type Coax cable through multiple conduit bends, follow these specifications.

For this Coax cable:	The pull strength should not exceed:	The bend radius should not exceed:
PVC	42.75kg (95lbs)	76.2mm (3.0")
FEP	61.65kg (137lbs)	69.9mm (2.75")

#### **Wire Inside Enclosures**

When you do not pull the RG-6 type Coax cable through conduit, follow these specifications.

For this Coax cable:	The bend radius should not exceed:
PVC	38.1mm (1.5")
FEP	35.6mm (1.4")
Tap drop-cable	25.4mm (1.0")

## Mount the Taps

To mount the taps you:

- select where you want to mount the taps based on the topology design that you planned in Chapter 2 of this manual.
- mount the taps

#### **Select Where To Mount The Taps**

- There is no spacing requirement between taps; you can install two adjacent taps if necessary by using a barrel connector (1786-BNCP).
- Be certain that the location where you are going to mount a tap is convenient for your cable route.

- Be certain that the location where you are going to mount does not cause any cable bend radii to exceed the limits listed on page 3-2.
- Do not mount the tap in a position that routes the drop cable over any ac power terminals on nearby modules.



Do not allow any metal portions of the tap, such as the universal mounting bracket screws or connectors, to contact any conductive material. This contact could cause noise on the network.

## Mount the Taps

You can mount your ControlNet taps (Y-tap and T-tap):

- to a universal mounting bracket, and then mount the tap and bracket as an assembly
- through the body holes in the tap using:
  - screws and flat washers
  - a tie wrap



See Appendix A for universal mounting bracket and tap mounting dimensions.

#### Mount a Tap With a Universal Mounting Bracket

**1.** Align the universal mounting bracket with the mounting holes on the tap.



**2.** Using the screws provided with the tap, attach the tap to the universal mounting bracket.

Use only the screws that are packaged with the tap. They are the proper length and head style.

#### 3. Mount the tap and bracket assembly to:

1492-DR7



#### Mount a Tap Through the Body Holes

Mount the tap to a suitable fixture using:



**Install a Repeater Adapter** 

Refer to the ControlNet Modular Repeater Adapter Installation Instructions, publication 1786-IN013A-EN-P, for instructions on installing the repeater adapter.

## **Install Cable Connectors**

After you have mounted the taps, you need to attach cable connectors to the ends of your trunk-cable sections.

То:	See page:
collect your tools	3-6
calibrate the cutting blades	3-7
strip the cable	3-9
attach the cable connectors	3-14
test for electrical shorts and continuity	3-18

## **Collect Your Tools**

To install the cable connectors, we recommend that you use the tools in the ControlNet Coax Toolkit, catalog number 1786-CTK.



### **Locally Available Tools**

You will also need these local-purchase tools (not supplied in the kit):

- 3/32" Allen wrench
- heat gun (if you are installing IP65 or IP67 corrosion-resistant connectors)

# Calibrate the Cutting Blades



Be certain to perform the calibration procedure the first time you use the tool and every time you change the blade for both memory cartridges. Due to slight differences between Coax cables, calibration should be performed when changing:

- part numbers
- from one cable manufacturer to another

Use the following procedure to calibrate your cable strip tool to cut FEP or PVC cable.

- **1.** Turn the three screws outward to back the blades out. This prevents the calibration tool from bottoming out.
- **2.** Place the calibration tool into the cable strip tool with the narrow end installed and facing forward for FEP cable (use the wider end for PVC).



**3.** Tighten the chamber gauge ring so that the calibration tool is locked in place. Close all the way to the chamber gauge stop.

**IMPORTANT** When aligned properly, the grooves of the calibration tool should align with the blades.

**4.** Adjust the screws of the memory clip so that the blades just touch the calibration tool.



- 5. Retract the handle of the cable strip tool.
- **6.** Remove the calibration tool from the cable strip tool.

When you are finished, the blade should make a cut of the following dimensions in your cable.



#### IMPORTANT

The first and second cut adjustments need to be precise. Adjustments as small as 1/12 to 1/8 of a turn can make the difference between a perfect and an imperfect cut.

## **Strip the Cable**



When cutting cable sections, make them long enough to route from one tap to the next with sufficient length so that the bend radius is not less than:

- 76.2mm (3") for wiring external to enclosures
- 38.1mm (1.5") for wiring inside enclosures
- 1. Verify that you have the proper memory blade holder installed for the type of cable you are using (PVC-CL2 or FEP-CL2P). If you need to change the memory blade holder, see Appendix B.



**2.** Straighten out the end of the cable.

**3.** Insert the cable into the cable strip tool's cutting chamber so that approximately 25.4mm (1") of extra cable extends beyond the edge of the tool.



**4.** Lock the cable into place by moving the chamber-gauge ring forward until it meets the cable with slight resistance.



**5.** Holding the cable in one hand, place the index finger of your other hand inside the chamber-gauge ring and turn the strip tool 360° around the cable. Turn four or five full rotations until the strip tool glides easily around the cable.



- **6.** After you have moved the chamber gauge ring to the last position and turned the strip tool the final time:
  - a. Move the chamber gauge ring backward to release the strip tool and remove it from the cable.
  - b. If you are using Allen-Bradley IP65 and IP67 corrosion-resistant connectors, slide the heat shrink tubing over the cable.
  - c. Slip the crimp ferrule onto the cable. Push it back to the sheath area of the cable to keep it out of the way for the moment.



d. Strip away the appropriate portion of the cable without using the strip tool.

e. Clean the remaining cable parts from the strip chamber after each use.

This procedure should appropriately strip the cable, exposing these layers of the cable:





If you do not see the three distinct layers of cable or if the outer braid has been scored or cut, snip off the exposed end with the wire cutters and repeat the entire cable-stripping process. It is very important that the outer braid be intact before crimping connector.

If stripping problems persist, the strip tool may need adjustment. Refer to Appendix B of this manual for instructions on how to adjust the strip tool.

If you are using:	Go to step:
FEP cable	7
PVC cable	8

7. If you are using plenum FEP cable, cut off an additional 3.1mm (approximately 1/8") of the outer sheath with the knife from the toolkit



**8.** Be certain that the center conductor is 4.0 mm. Use the imprint guide on the back of the ControlNet tap or the calibration tool to verify this.





Check for any braid stranding that may not have been cut to the proper length. If one strand comes in contact with the center conductor, it could short out the cable. If you find any such strands, cut them to the correct length.



# Attach the Connectors to the Cable

This section tells you how to install standard or corrosion-resistant connectors.

**1.** Push the flare tool onto the cable and with a slight twisting motion (with sufficient inward pressure) to expand the braid.



2. Place the center pin over the center conductor.

conductor.





**3.** With the center pin in place, use the crimp tool to crimp the pin into place.



**4.** Slide the ControlNet connector onto the cable.



**5.** Slide the crimp ferrule over the three outer shields and connector base until it meets the shoulder on the connector.



**6.** Using the crimp tool, crimp the ferrule. Position the crimp tool on the ferrule as close as possible to the connector base and ferrule meeting line. Press the tool tightly around the ferrule until the crimp tool allows release.



The larger hexagonal crimping notch is for crimping the ferrule which holds the connector to the cable.



Many network problems are due to improperly installed connectors. You should have tight-fitting connectors on the ends of all your cables. Pull the connector to verify that it is attached. If it is loose or comes off, snip off the connector and install a new one. The connector should withstand a minimum 60lbs pull force if properly installed.

- 7. If your installation requires IP67-rated connectors:
  - a. If your installation requires IP67-rated connectors, slide the heat-shrink tubing onto the cable.
  - b. Place the crimp ring on to the cable.
  - c. Strip the cable using the 1786-CTK stripper tool.
  - d. Remove an extra 1/8 inch of the jacket from the cable. Be careful not to cut the braid.
  - e. Trim the center conductor to the required length as directed on the connector bag..

**IMPORTANT** Use only the ACUM heat-shrink tubing provided in the IP67 Tap and Cable Kit. Do not substitute other types of heat-shrink tubing. Substitutions may cause a loss of the IP67 rating.

ATTENTION

Be careful when using heat guns. High temperatures can lead to burns, risk of fire, or other property damage.

- **8.** Follow these guidelines when heating the tubing:
  - a. Place the tubing against the shoulder of the TNC connector.
  - b. Allow the heat gun to come to a temperature of between 110 and 160 degrees Celsius.
  - c. Hold the cable assembly approximately 2 inches away from the heat exhaust area of the heat gun while shrinking the tubing.
  - d. Continuously rotate the cable assembly around the heat exhaust area of the heat gun. The entire process should take about 4 minutes.

e. Inspect the heat-shrink tubing to ensure that there are no voids where the glue has incompletely melted. Voids could cause a loss of the IP67 rating.



# Test for Electrical Shorts and Continuity

1. Using the NetLinx Media Checker (catalog number 1788-MCHKR) is the preferred method for continuity testing. Attach the connector end of the cable to the port on top of the Media Checker.



- **2.** As a secondary method, you can also use an ohmmeter or continuity tester to test for a short between the connector body and pin.
- **3.** Use shorting clips to connect a temporary short between the pin and connector body at one end of the cable.



**4.** At the other end of the cable, use the NetLinx Media Checker, an ohmmeter, or continuity tester to test for electrical continuity.

If resistance reading indicates:	Then:
that a short exists	continue to next section
there is no short	use your wire cutters to cut off the connector, install a new connector and begin testing again.

## IMPORTANT

Replace the trunk cable section if problems persist with the cable after completing these tests.

## **Connect Cable Sections**

Connect the cable sections to the tap's BNC connectors.



## **Terminate Segments**

The taps on the ends of the segment have only one cable connector attached to them. This leaves an open, or unterminated, end on the segment. Signals transmitted along the cable will reflect off these unterminated ends and interfere with transmission.

To eliminate signal reflections from the ends of the segment, you must attach a 75 $\Omega$  terminator to the first and last taps on the segment. The terms "first" and "last" refer to the physical location of the node along the trunk cable.

**5.** Connect one end of the trunk-cable section to one of the tap's BNC connectors.



**6.** Install a  $75\Omega$  terminator onto the tap's other BNC connector.



Repeat steps 1 and 2 at the other end of the segment

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## **Connect Devices**

After terminating your segments, you connect your devices.

To connect a	See
programming terminal through the NAP	page 3-21
repeater	page 3-22
ControlNet processor, adapter or programming terminal via a communication interface	procedure below

- **1.** Remove and save the tap's dust cap (located on the straight or right-angle connector).
- **2.** Connect the tap's straight or right-angle connector to your device.

If your node supports:	Connect the tap's straight or right-angle connector:
non-redundant media	to the <b>channel A</b> connector on the device <i>(</i> channel B is not used) <sup>1</sup>
redundant media	<ul> <li>from trunk cable A to channel A on the your device</li> <li>from trunk cable B to channel B on the your device</li> </ul>
1 While both channels are activ media.	ve, Allen-Bradley recommends using channel A for non-redundant

## **Connect Programming Terminals Through the NAP**

Use the ControlNet<sup>™</sup> network access cable (1786-CP) to connect a programming terminal to any intelligent device (i.e. workstation, PLC<sup>®</sup> processor, or adapter) on a ControlNet link through the network access port (NAP).

**1.** Connect one end of the 1786-CP cable to the NAP on the front of the ControlNet node.

**2.** Connect the other end of the 1786-CP cable to the NAP on the ControlNet communication interface installed in (or connected to) your programming terminal.



#### **Connect the Repeater to a ControlNet Link**

**1.** Remove (and save) the dust cap located on the straight or right-angle connector of the designated tap on the first segment (segment 1).





- 2. Remove and discard the dust caps from the repeater BNC jacks.
- **3.** Connect the designated tap's straight or right-angle connector to the BNC connector on the repeater.
- **4.** Remove (and save) the dust cap located on the straight or right-angle connector of the designated tap on the second segment (segment 2).



**5.** Connect this tap's straight or right-angle connector to the BNC connector on the repeater.

## Notes:

# **Mounting Dimensions**

## What's in This Appendix

Taps

Use these mounting dimensions to mount your taps, universal mounting brackets, and repeaters.

Make copies of these templates as necessary to help you mark placement for your taps.



## Universal Mounting Bracket



## Maintain the Cable Strip Tool

## What's in This Appendix

Follow the instructions in this appendix to perform the following tasks on the cable strip tool, supplied with the ControlNet Coax Toolkit (1786-CTK):

For information about this topic:	See page:
Reverse/Replace the Cutting Blades	B-1
Change the Memory Blade Holder	B-3

## Reverse/Replace the Cutting Blades

To reverse or change the cutting blades:

**1.** Use a screwdriver to lift the memory blade holder and swing it back.



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2. Slide the memory blade cartridge out of the strip tool.



If you are:	Go to:
reversing the memory blade cartridge	the next step
to use the second set of blades	
replacing the memory blade cartridge	step 4

**3.** Flip the memory blade cartridge and slide it back into the strip tool.





**4.** Align the memory blade cartridge (the side with the raised notches) to the raised area on the inside of the strip tool and slide the new memory blade cartridge in — *the blades should be on top as you slide the cartridge in.* 



5. Swing the memory blade holder closed.



## Change the Memory Blade Holder

You received two memory blade holders with your cable strip tool; one is for PVC-CL2 cable, and the other is for plenum FEP-CL2P cable. You need to install the appropriate memory blade holder for the type of cable you are stripping (PVC or FEP).

**1.** Lift the latches on the memory blade holder and swing it back.



**2.** Snap the memory blade holder off the rod and remove it from the strip tool.



- **3.** Position the appropriate memory blade holder on the rod and snap the holder into place.
- 4. Swing the memory blade holder closed.



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