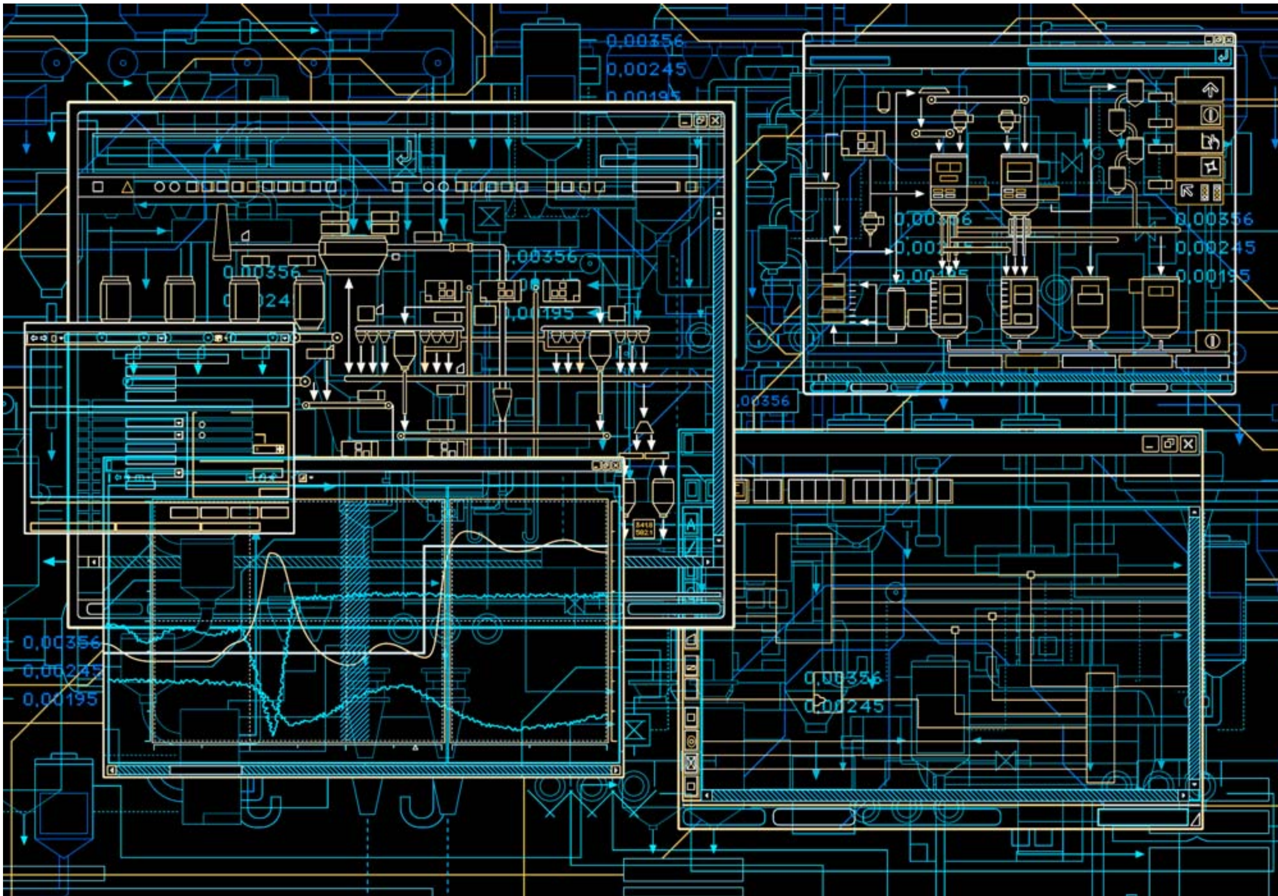

AC 800M

Interfacing SATT I/O

System Version 6.0

Power and productivity
for a better world™

AC 800M

Interfacing SATT I/O

System Version 6.0

NOTICE

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Safety Summary

E S D	**Electrostatic Sensitive Device** Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS	**Equipment Environment** All components, whether in transportation, operation or storage, must be in a noncorrosive environment. **Electrical Shock Hazard During Maintenance** Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS	Page 85: The cable strip tool is delivered with the proper blade cutting depth already set and there is no need to adjust it. Page 107: Do not look directly into the fiber ports. Light levels may cause damage to eyesight. Page 111: Do not insert or remove units with power connected to the attached repeater adapter. Page 121: Because of the risk of electrostatic discharge, we recommend that you wear an ESD bracelet when handling the I/O boards. Page 126: Switch off the mains supply voltage power before any operation with the PSF unit. Page 130: For safety reasons, and in order to meet the Low Voltage Directive, the precautions in this subsection must be taken in the application. Page 136: For safety reasons, and in order to meet the Low Voltage Directive, the precautions in this subsection must be taken in the application.

SPECIFIC WARNINGS cont.	Page 207: Read the section Safety Summary, before performing operations which can be dangerous for personnel or cause damage to equipment. Page 241: Note that the units are “Open type equipment” and must be mounted in suitable cabinets. Page 241: Note also that external power supplies used to provide 24 V DC must be CE-marked. Page 228: The blades should be on top as you slide the cartridge.

SPECIFIC CAUTIONS	Page 43: Backup the existing application before disconnecting the old system. Page 58: Proper selection of ControlNet cable, connectors, accessories, and installation techniques is necessary to make sure it is not accidentally grounded. Page 59: Taps must be purchased from ABB for the network to function properly. The drop cable must not be extended or shortened. Page 60: When interconnecting equipment in different buildings, use fiber optic cables to obtain galvanic isolation. Page 60: When determining the cable length of trunk cable sections, make sure you measure the actual cable path as it is routed on your network. Page 62: The use of high-flex cable should be kept to a minimum. Page 63: Note the restrictions of the network size in subsection “Planning the Repeaters and the Network Size of a ControlNet”. Page 65: Do not let any metallic surfaces on the BNC connectors, plugs, or optional accessories touch grounded metallic surfaces. All connectors for ControlNet must be of type 75 ohm. Page 70: Fiber optic links are mandatory to avoid lightning problems when interconnected equipment is placed in different buildings. Page 76: Do not change the Network Parameters while the factory process is running

SPECIFIC CAUTIONS cont.

Page 80: You should have read the section “Planning the Coax Cable System of the ControlNet” before you install your cable system.

Page 82: Do not allow any metal portions of the tap, such as the universal mounting bracket screws or connectors, to contact any conductive material.

Page 82: Use only the screws supplied with the tap. They are of proper length and head style.

Page 90: Check for any braid stranding that may not have been cut at the proper length. Even one strand coming in contact with the center conductor could short out the cable.

Page 91: Replace the trunk cable section if problems persist with the cable after completing these tests.

Page 92: Make sure that the center pin slips onto the center conductor completely. The back shoulder of the center pin should be up against the white insulation.

Page 94: Note that the center pin, when installed in the connector, must be sufficiently pushed forward. If the visible part of the center pin is too short then a reliable connection can not be guaranteed.

Page 95: All cables ends must have tight-fitting connectors. Pull the connector to verify that it is attached.

Page 98: It is necessary to disconnect all devices from the drop cables before the cable segment is tested.

Page 103: Do not allow any metal portions of the tap to contact any conductive material. This may cause noise on the network.

Page 107: Observe the minimum cable bend radius specified. Do not touch the ends of the fiber optic strands and do not let the ends come in contact with dust, dirt or other contaminants.

SPECIFIC CAUTIONS cont.

Page 110: The adapter and repeater units must be secured with DIN rail anchors. Failure to do so may result in the loss of communications and/or cause damage to the units.

Page 111: If you exceed the unit or power limit, you may cause damage to the repeater adapter and units.

Page 112: Make sure all fiber units are attached and secured prior to applying power to the adapter.

Page 114: Never connect the fiber cable between channel 1 and 2 on the same RPFM, or between channels on different RPFMs attached to the same RPA.

Page 144: Both clear inputs on the Pulse Counter Board, IPA4, must be activated to reset a 16-bit counter.

Page 146: Do not reset the counters on the Pulse Counter Board, IPA4, when counting!

Page 157: The signal cables for the Analog Input Board, IBA must be shielded twisted pair and grounded at both ends.

Page 174: The boards PTC and IVAPOT do not meet the EMC directive 89/336/EEC.

Page 225: The first and second blade adjustments need to be very precise.

About This User Manual

General

This manual describes how to take advantage of re-using old Satt I/O units (Rack I/O, Series 200 I/O, and I/O 200C) and how to install the new hardware needed on the field level, preparing for the installation of the new controller AC 800M. Please refer to the AC 800M Controller Hardware (3BSE036351*) manual regarding installation of the AC 800M controller and the CI865. Refer to the AC 800M EtherNet/IP DeviceNet Configuration (9ARD000014*) manual for the CI873 configuration.

How to Use This User Manual

Section 1, Introduction: Provides an overview of the hardware needed to rebuild the I/O system.

Section 2, Rebuilding the I/O System: Description of how to prepare the I/O systems for communication via Satt ControlNet. Read this section if there is no Satt ControlNet connected to the I/O system.

Section 3, Connecting AC 800M to the I/O System: A guide to the planning and installation of the ControlNet. It also provides information about how to connect the CI865 unit and the I/O systems to the ControlNet.

Appendix A, Limitations - Appendix H, Directive Considerations

- List of the limitations of the Satt ControlNet and the I/O systems.
- Description the I/O boards and units suitable for the Rack I/O system.
- Technical data about the parts of the ControlNet and Rack I/O systems.
- Description of the troubleshooting procedure of the ControlNet and Rack I/O systems.

- Standards and lists of cable components.

Safety

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.

Important User Information

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

European Union Directive Compliance

Units mentioned in this document for which product is marked with the CE logo comply with the electromagnetic compatibility directive 89/336/EEC and the low-voltage directive 73/23/EEC, see Appendix H, Directive Considerations.

UL Listing

Units mentioned in this document are UL listed if product is marked with the UL logo. UL indicates UL approval for the USA, and cULus for Canada as well. The logo cUL indicates UL approval for Canada only.

The applied standard is UL508, Industrial Control Equipment. Units approved for use in hazardous locations also comply with the standard UL1604.

CSA Certification

Units mentioned in this document are CSA certified if product is marked with the SP® logo. The applied standard is C22.2, No. 142-M1987.

Units approved for use in hazardous locations also comply with the standard C22.2, No. 213-M1987. To fulfill the CSA requirements for hazardous locations, the instructions in Appendix G, Standards must be followed.

Document Conventions

Microsoft Windows conventions are normally used for the standard presentation of material when entering text, key sequences, prompts, messages, menu items, screen elements, etc.

Warning, Caution, Information, and Tip Icons

This publication includes **Warning**, **Caution**, and **Information** where appropriate to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

Electrical warning icon indicates the presence of a hazard which could result in *electrical shock.*

Warning icon indicates the presence of a hazard which could result in *personal injury.*

Caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in *corruption of software or damage to equipment/property.*

Information icon alerts the reader to pertinent facts and conditions.

Tip icon indicates advice on, for example, how to design your project or how to use a certain function

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, **fully comply** with all **Warning** and **Caution** notices.

Terminology

A complete and comprehensive list of Terms is included in the Industrial^{IT} Extended Automation System 800xA, Engineering Concepts instruction (3BDS100972Rxxxx). The listing included in Engineering Concepts includes terms and definitions that apply to the 800xA system where the usage is different from commonly accepted industry standard definitions and definitions given in standard dictionaries such as ***Webster's Dictionary of Computer Terms*.**

Term/Acronym	Description
200-ACN	ControlNet Adapter for Series 200 I/O.
200-RACN	Rack Adapter ControlNet.
200-AENTR	EtherNet/IP Adapter for Series 200 I/O.
CI865	AC 800M communication interface for Satt ControlNet
CI873	AC 800M Communication interface for EtherNet/IP.
Coax repeater	A two port active component that reconstructs and retransmits all traffic it receives on one segment side to another segment side.
ControlNet	ControlNet is a high-performance network for industrial applications. ControlNet is a registered trademark from Allen-Bradley, Inc. (http://www.allen-bradley.com).
DDC	Direct Digital Control.
Fiber optic link	Links two or more coax segments together.
Fiber unit RPFM or RPFS	Connects a fiber repeater adapter to other fiber units via two fiber channels.
Fiber repeater adapter RPA	Connects up to 4 fiber units to a trunk cable tap.

Term/Acronym	Description
Network	A collection of nodes – with unique addresses in the range of 01–99.
Node	Any physical device connected to the ControlNet cable system which requires a network address in order to function on the network – a network may contain a maximum of 32 nodes. Examples of nodes are CI865, 200-ACN and 200-RACN.
PIOS35	A Rack with space for 16 I/O boards.
PSF	Power Supply Unit used in PIOS35.
PTU2	A cable with two ready-wired edge connectors at one end and screw terminal blocks at the other end. Suitable for rack I/O boards.
Segment	Trunk cable section connected via taps with terminators at each end, and with no repeaters included.
Tap	The connection between any device and the ControlNet coax cable system.
Terminator	A 75 ohm resistor mounted in a BNC plug.
Trunk cable	The bus or central part of a cable system.
Trunk cable section	The length of a cable between any two taps.

Related Documentation

A complete list of all documents applicable to the 800xA Industrial^{IT} Extended Automation System is provided in Released User Documents, 3BUA000263Rxxxx. This document lists applicable Release Notes and User Instructions. It is provided in PDF format and is included on the Release Notes/Documentation media provided with your system. Released User Documents are updated with each release and a new file is provided that contains all user documents applicable for that release with their applicable document number. Whenever a reference to a specific instruction is made, the instruction number is included in the reference.

Section 1 Introduction

Product Overview

This section gives an overview of the hardware needed on the field level to control the Satt I/O units with an AC 800M controller. The Satt I/O system consists of Rack I/O and Series 200 I/O family (S200 I/O, S200L I/O and I/O 200C).

There is a list at the end of this chapter (see Prerequisites for Connecting to AC 800M on page 41) containing the essential parts needed for rebuilding of Satt I/O.

Series 200 I/O connectivity can be established through ControlNet and through EtherNet/IP using 200-AENTR EtherNet/IP adapter. Rack I/O connectivity can be established through ControlNet only.

CI865

The CI865 unit is the AC 800M communication interface for Satt ControlNet. The CI865 unit makes it possible to use older Satt I/O system (Rack I/O and Series 200 I/O) with the AC 800M controller platform. The unit handles I/O scanning of up to 31 distributed I/O nodes. CI865 supports online replacement (Hot Swap), and does not require any configuration before installation.

The CI865 is mounted on a DIN rail and connects to the CEX bus via a shielded DB25P connector towards the master side and a shielded DB25S connector towards the expansion side. In the front of the unit there is a BNC-type connector to connect the ControlNet cable, see Figure 1. The base plate has a code lock that prevents installation of an incorrect type of unit onto it.The CI865 expansion unit contains the CEX-Bus logic, ControlNet bus logic, CPU and a DC/DC converter that supplies appropriate voltages from the +24 V supply, via the CEX-Bus. Please refer to the manual AC 800M Controller Hardware, Hardware and Operation (3BSE036351*) for more information about the CI865.

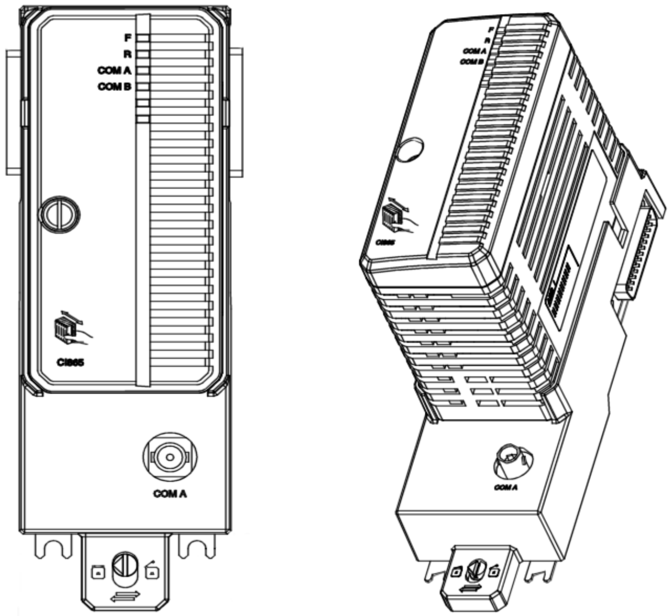


Figure 1. The CI865 unit from different angles.

CI873

The 200-AENTR device interfaces with the AC 800M controller, through the CI873 communication interface module. CI873 acts as an EtherNet/IP I/O scanner class device. It originates connections to EtherNet/IP enabled devices and exchanges real time I/O data with them.

For more information refer to the *AC 800M EtherNet/IP DeviceNet Configuration (9ARD000014*)* manual

Satt ControlNet

Satt ControlNet is a fieldbus for industrial applications which provides transport of application information. The connected devices are handled as I/O in the controller.

Please observe that the Satt ControlNet described in this manual is only applicable for communication between Satt I/O systems and AC 800M.

Two types of information will be transferred over the network:

- Control and I/O data
- Non-time critical data (client/server messaging) such as configuration.

Performance

- Bit rate: 5 Mbit/s.
- 32 nodes per network (including the controller)[1].
  - Up to 31 *200-ACN* nodes, or
  - up to eight *200-RACN* nodes, or
  - a mix of 200-ACN and 200-RACN containing together a maximum of 3968 binary I/O channels or equivalent, see Figure 2.
- Up to 48 taps in a 250 m coax segment.
- RG6 coaxial cable (75 ohm) and BNC connectors - simple to install.
- Up to 1 km network length without repeaters.
- Fiber optic links may be included to increase network length and obtain galvanic isolation. The total attenuation of a fiber cable section must be less than 13.3 dB, implying section lengths up to about 7000 m.
- 62.5/125 mm multi mode optic fiber is used with ST connectors, operating at 1300 nm wavelength.

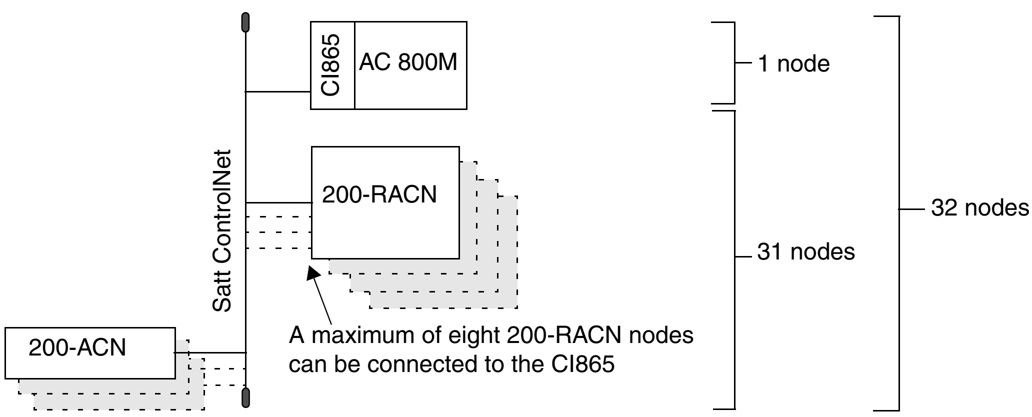


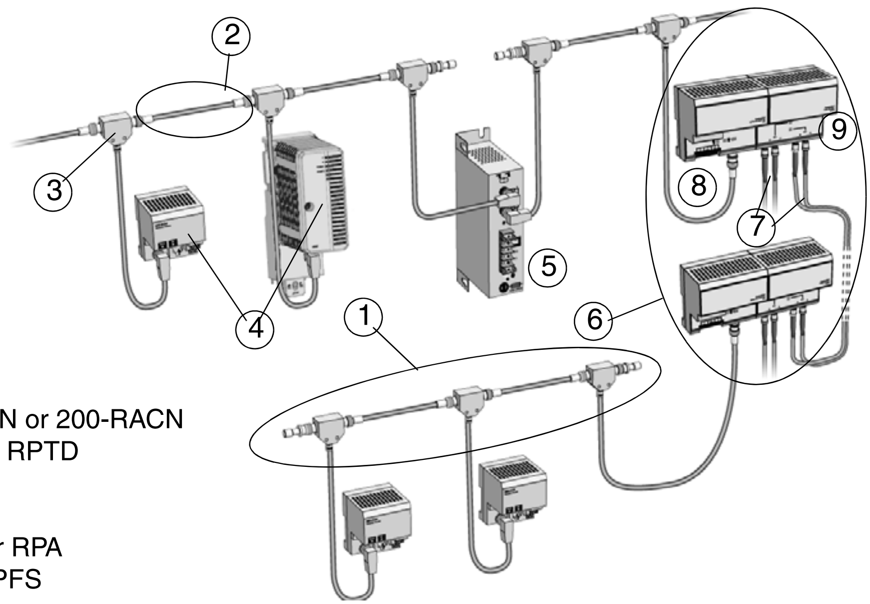
Figure 2. One network can handle up to 32 nodes.

1. Each node must be designated a unique address between 01 and 99. Node number 01 is always reserved for the CI865. See also the manual *AC 800M Controller Hardware, Hardware and Operation*.

The ControlNet Cable System

The ControlNet cable system gives a flexibility while designing a communication network for your particular application. To take full advantage of this flexibility, you should spend sufficient time planning how to install your cable system before assembling any of the hardware, see Section 3, Connecting AC 800M to the I/O System.

Use Figure 3 to understand the ControlNet cable system:



1. Coax segment
2. Trunk cable section
3. Tap
4. Nodes CI865, 200-ACN or 200-RACN
5. Coax repeater RPT or RPTD
6. Fiber optic link
7. Fiber optic cable
8. Fiber repeater adapter RPA
9. Fiber unit RPFM or RPFS

Figure 3. ControlNet network

The ControlNet Components

The ControlNet cable system comprises the following components:

- nodes,
- taps[1],
- trunk cable[1],

1. For information on purchasing these components, see Appendix E, ControlNet Cable Components.

- cable connectors[1],
- terminators[1],
- segments,
- repeaters[1],
- networks.

Nodes

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

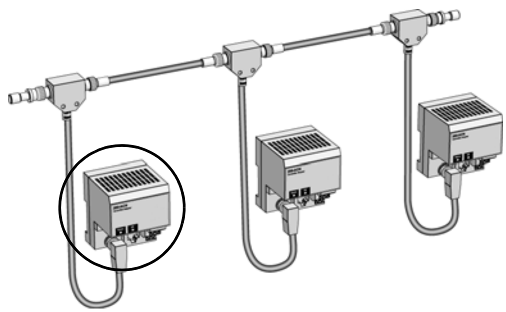


Figure 4. Example of a node is the ControlNet adapter 200-ACN. Refer to the S200 I/O, Hardware and Installation, User's Guide (3BSE021356Rxxxx) for information about 200-ACN.

Taps

Taps connect each node on a network to the cable system via an integral one meter drop cable.

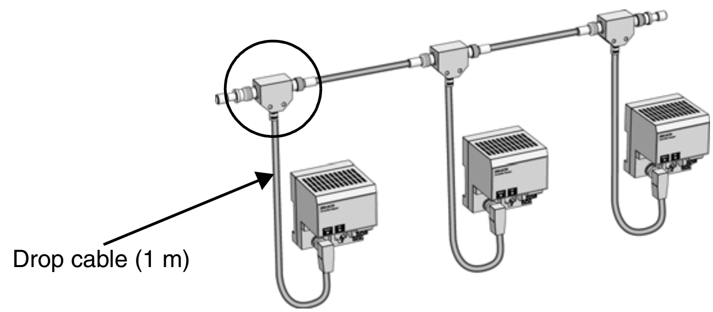


Figure 5. Tap connections via drop cable.

There are four different taps available:

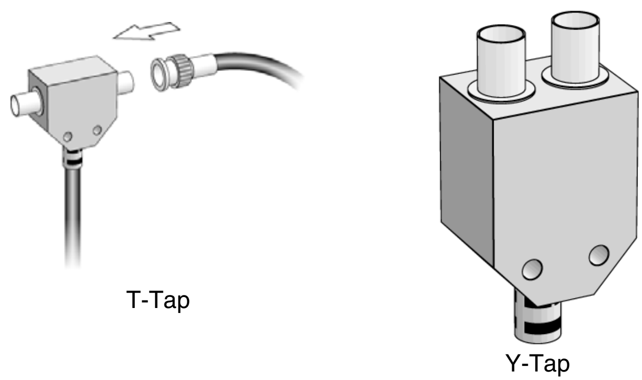


Figure 6. Taps with T or Y placement of BNC connectors.

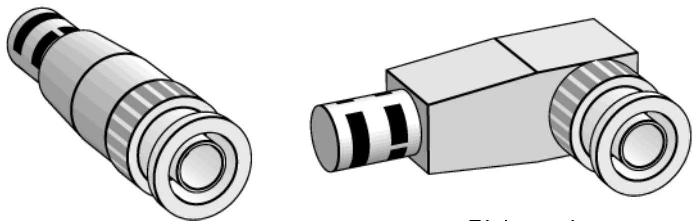


Figure 7. Taps with a straight or right angle connector on the drop cable.

Also see the section Determining the Number of Taps on page 58.

Trunk Cable

The trunk cable is the bus, or central part of the ControlNet cable system. The trunk cable is composed of multiple sections of cable. See Appendix E, ControlNet Cable Components for ordering cables.

There are several types of cables you can use depending on the environment in which you are installing your cable system. See section Determining the Type of Cable on page 59.

Cable Connectors

A cable connector attaches trunk cable sections to the tap. The tap is connected through a BNC connector.

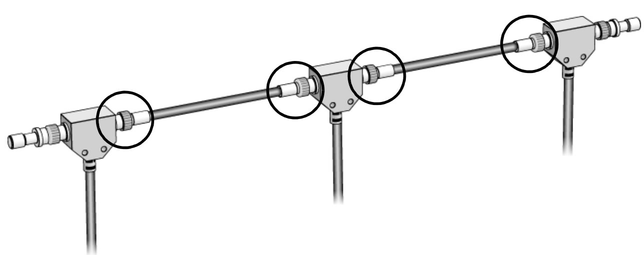


Figure 8. Cable Connectors

Optional Connectors

ABB also offers optional cable connectors for use in your network configuration. See the section Determining the Type of Connectors on page 64, for available connectors.

Terminators

A 75-ohm terminator **must** be installed on the tap at each end of a segment.

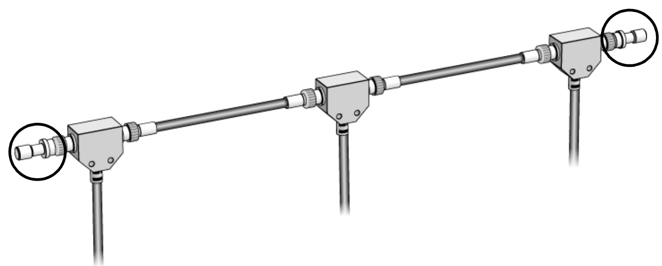


Figure 9. Terminators

Segments

A segment is a collection of trunk cable sections and taps, delimited by two terminators.

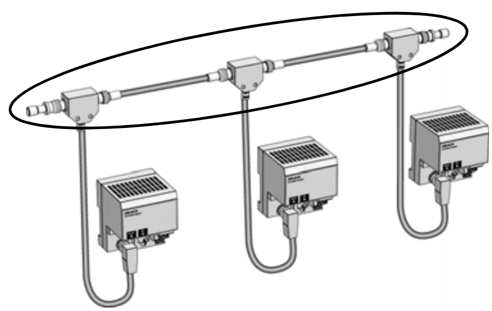


Figure 10. Segments

The allowed total length of a segment is depending on the number of taps in your segment. See the section Determining Trunk Cable Section Lengths on page 60 for detailed information.

Network

A network is a collection of nodes forming:

- a segment,
- multiple segments connected together via repeaters.

Each node in a network must have a unique address in the range of 1-99[1]. In the example in the figure below, two segments are linked by a coax repeater to form a node network.

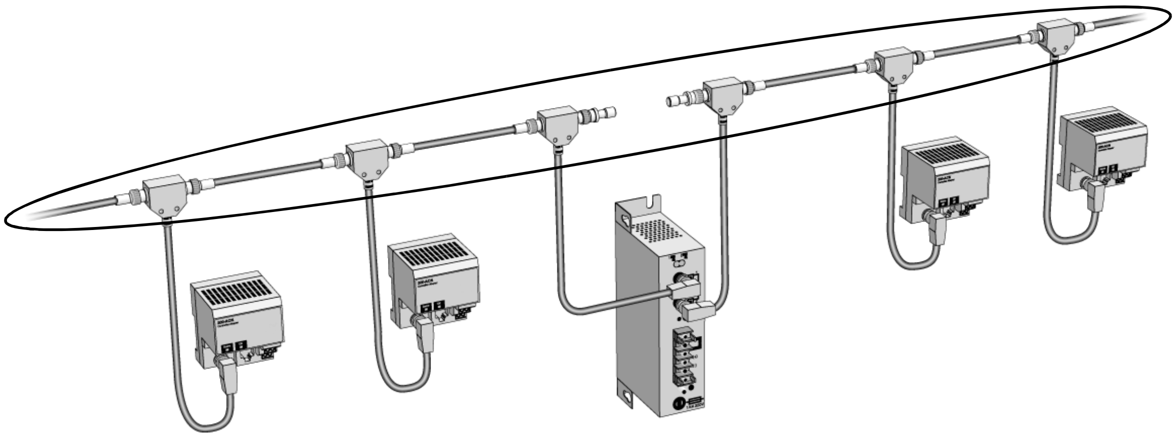
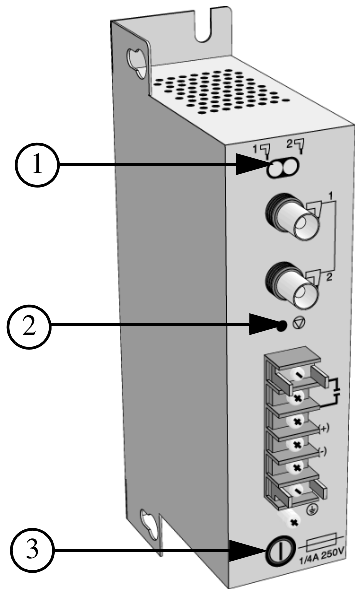


Figure 11. Network

1. Note that the communication interface unit CI865 limits the number of nodes in a network. Node number 1 is reserved to CI865. For more information, please refer to the manual AC 800M Controller Hardware, Hardware and Operation (3BSE036351Rxxxx)

Coax Repeater



Front panel
1 = Status indicators
2 = Reset switch
3 = Replaceable fuse

Figure 12. Coax Repeater

Table 1. Coax Repeater, Indicators

Indication	Function
Flashing red/green	The repeater is being powered-up or reset. The LEDs alternately flash red and green for about 5 s.
Steady green	Normal operation mode.

For error conditions see Troubleshooting the Repeaters on page 204.

A repeater is used to increase the number of nodes, extend the total length of your segment or create a star or tree configuration (goes off in multiple directions from one point). Use a repeater in your ControlNet cable system to connect segments together to form networks. The number of repeaters is limited depending on your network topology.

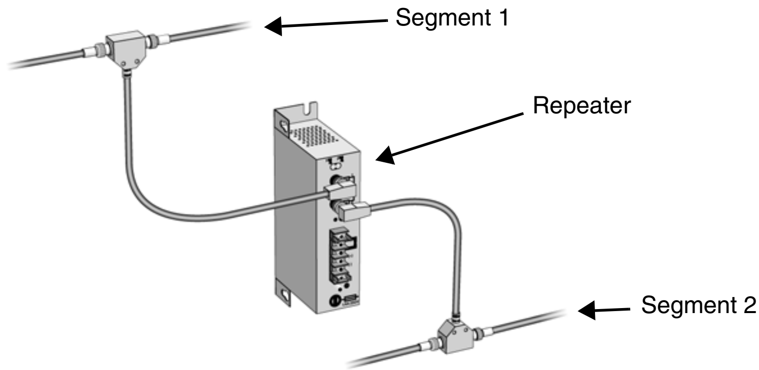


Figure 13. Segments Connected with a Repeater

When you insert a repeater into your cable system, you create a new segment. The same restrictions on the number of taps and cable length apply to this new segment as segments without repeaters.

The repeater provides:

- An internal power supply,
- a fuse (replaceable) for over-current protection,
- two indicators for status and trouble-shooting,
- a relay contact indicating fault.

The ControlNet Fiber Components

A fiber optic link connects two or more coax segments together and comprises the following components:

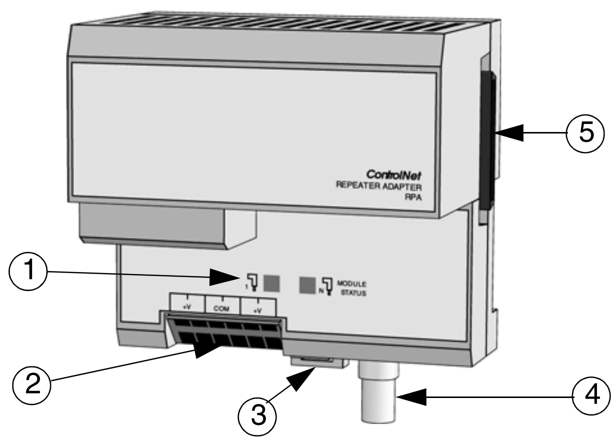
- fiber repeater adapter,
- fiber module,
- fiber optic cable.

Fiber optic links must be used to interconnect equipment in different buildings, in order to obtain galvanic isolation and to avoid problems with lightning and electrical interference. They can also increase the total network length. The fiber repeater adapter connects up to 4 fiber modules to a coax segment by means of a drop cable and tap.

Fiber Repeater Adapter RPA

The repeater adapter is used to connect repeater modules to a ControlNet coax trunk cable. The adapter provides:

- Backplane power,
- coax interface,
- LED indicators for the coax port and media modules,
- arbitration and data jitter removal of repeated packets.



1. Status indicators for the coax port and the fiber modules, respectively.
2. Power connections.
3. Locking tab for the DIN rail.
4. BNC connector for the drop cable from the coax segment.
5. Backplane socket connector for the fiber module.

Figure 14. Fiber Repeater Adapter RPA

Table 2. Fiber Repeater Adapter RPA, Indicators

Indication	Function
Flashing red/green	The repeater is being powered-up and in self test. The LEDs alternately flash red and green for about 5 s.
Steady green	Normal operation

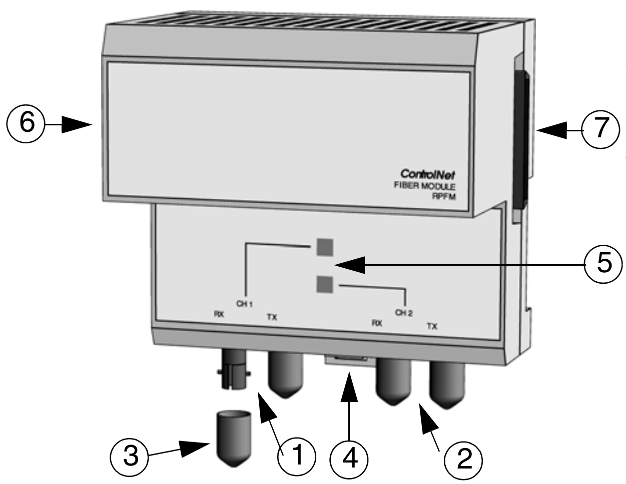
For error conditions see Troubleshooting the Fiber Repeater Adapter on page 205.

Note that a faulty fiber channel can be masked by several good fiber channels, if the repeater has more than one fiber module connected.

Fiber Module RPFM and RPFS

The module provides:

- two fiber channels,
- activity LED indicators for each fiber channel.



1. Channel 1 fiber port.
2. Channel 2 fiber port.
3. Protective cap.
4. Locking tab for the DIN rail.
5. Status indicators for channel 1 and 2, respectively.
6. Left-side backplane plug connector for the fiber repeater adapter or another fiber module.
7. Right-side backplane socket connector for another fiber module.

Figure 15. Fiber Module RPFM and RPFS

The indicators are steady green during normal operation with data activity. For error conditions see Troubleshooting the Fiber Module on page 207.

Fiber Optic Cable

Use fiber optic cable to connect fiber modules at a great distance from each other, housed in different buildings or separated by hazardous or electrically noisy areas.

There are different types of cable for use in different environments, see also Cable and Connector Types on page 72 and Fiber Optic Cable on page 107. 62.5/125 µm multi mode fiber is used with ST connectors (plastic or ceramic), operating at 1300 nm wavelength.

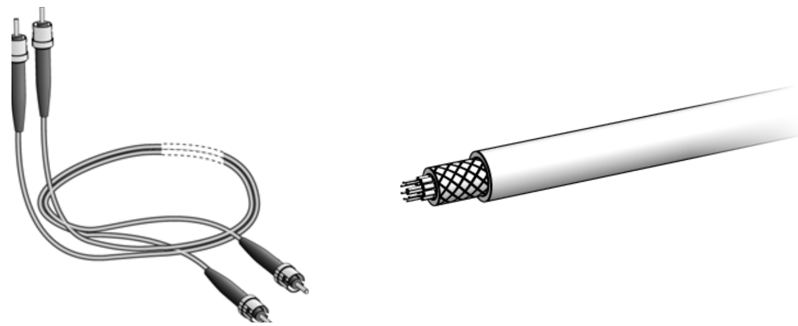
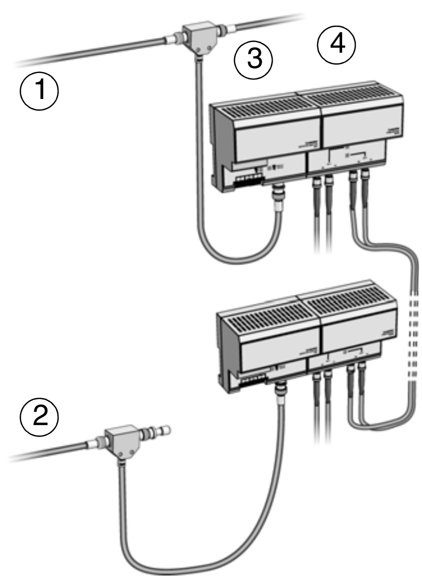


Figure 16. Fiber Optic Cable

Network Configuration

A functionality similar to that of a coax repeater (see Planning the Repeaters and the Network Size on page 75) is achieved by means of two fiber repeater adapters and two fiber modules:



1. Coax segment 1.
2. Coax segment 2.
3. Fiber repeater adapter RPA.
4. Fiber module RPFM or RPFS.

Figure 17. Network Configuration

A new coax segment is added to the network, with the normal restrictions on cable length and number of taps.

Rack I/O

The rack-based I/O system consists of a 19-inch central rack intended for double sized Euro-boards. The rack-based I/O system is intended for industrial use and meets the EMC directive 89/336/EEC and the Low-Voltage Directive, LVD, 73/23/EEG with supplement 93/68/EEG.

AC 800M System with Remote Rack-based I/O System

To use the AC 800M controller for a rack-based I/O system a 200-RACN unit (Rack Adapter ControlNet) needs to be mounted in the rack. The 200-RACN unit is a remote ControlNet I/O adapter for rack-based I/O boards. See Rack Adapter Board, 200-RACN on page 121 for more information about the 200-RACN unit.

The rack that is suited for 200-RACN is called PIOS35. The PIOS35 rack has space for 16 I/O boards, see Figure 18. The I/O boards are connected to the rack via two different connectors (X1 and X2), see Figure 19. The upper connector (X1) is used for connection of the input/output signals of the process and the lower connector (X2) is used to connect the rack's internal bus and power supply.

Each rack contains a power supply unit, PSF, located on the outermost right side of the rack. The rack can be supplied via the mains or 24 V DC. Filters and mains connections are located at the rear of the rack. See Power Supply Unit, PSF on page 125 for more information about the PSF.

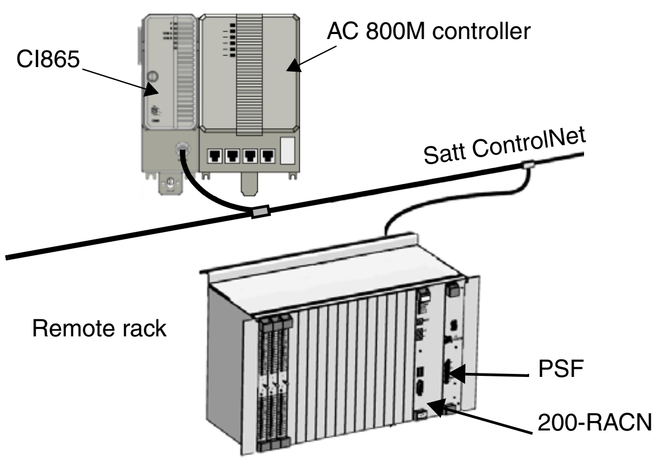


Figure 18. Rack-based I/O system connection alternative.

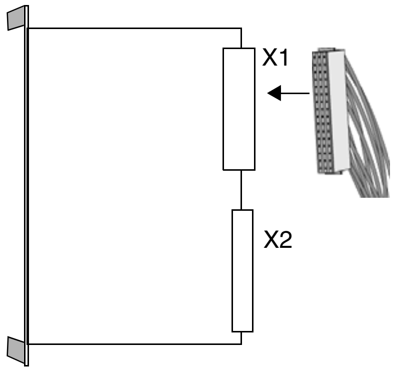


Figure 19. X1 and X2 connectors.

Series 200 I/O

The Series 200 I/O is a flexible, modular I/O system for central and distributed applications. The Series 200 I/O units are mounted on a DIN rail and have to be connected to a 200-ACN unit to be able to communicate via Satt ControlNet. The 200-ACN is a remote I/O adapter unit, intended for connection of terminal base units equipped with I/O units. Also connected to Satt ControlNet is the CI865, making it possible to use the AC 800M controller to control the Series 200 I/O units, see Figure 20. S200 I/O modules can also be connected to 200-AENTR to communicate through EtherNet/IP.

For more information about the Series 200 I/O, please refer to any of the manuals S200 I/O Hardware (3BSE021356*), S200L and I/O 200C I/O Hardware (3BSE021357*), I/O 200C Installation and Maintenance (493104811).

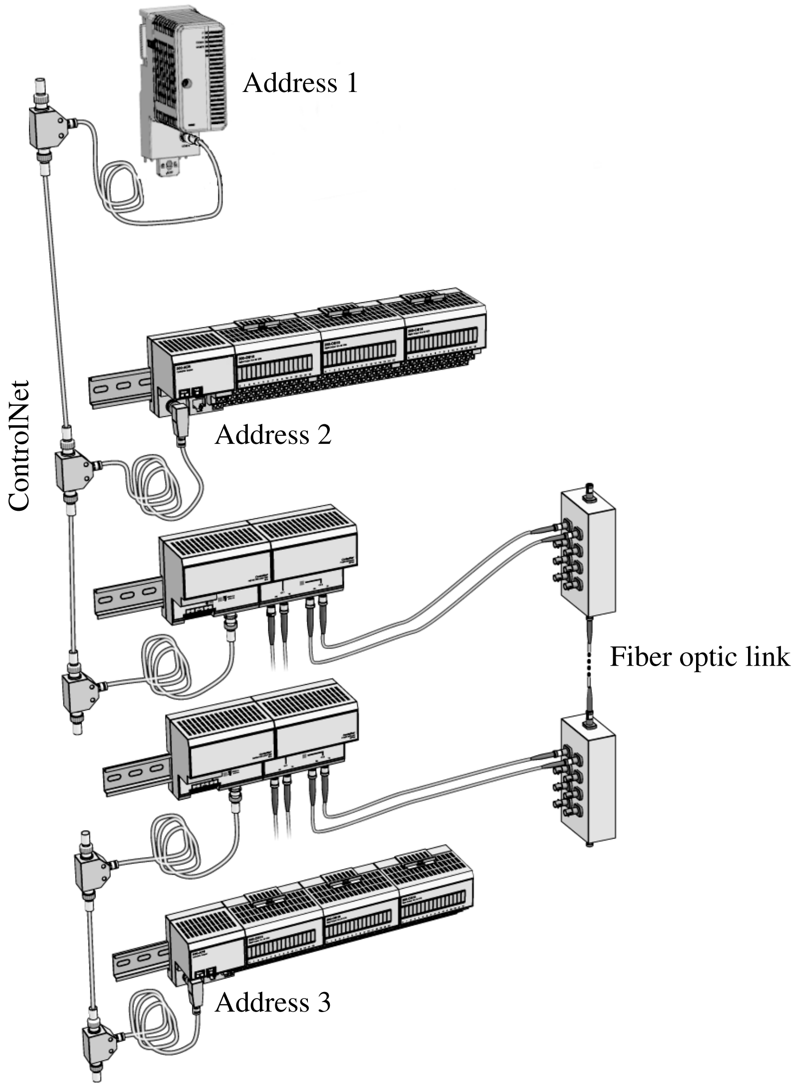


Figure 20. Series 200 I/O connected to ControlNet

Prerequisites for Connecting to AC 800M

Rack I/O

If the existing system is based on Rack I/O the following equipment is needed to rebuild the system:

- The rack has to be a PIOS35 rack.
- A 200-RACN unit (+ maybe an ADSF attached to the 200-RACN, see Mounting the Analog-to-digital Converter, ADSF on page 124), to be mounted in every rack.
- A CI865 unit.
- A ControlNet cable system, which is to be connected between the 200-RACN in the rack and the CI865.

Series 200 I/O

If the existing system is based on Series 200 I/O the following equipment are needed to rebuild the system using ControlNet.

- A 200-ACN unit, to be connected to every Series 200 I/O node.
- A CI865 unit.
- A ControlNet cable system, which is to be connected between the 200-ACN unit and the CI865.

The following equipment are needed to rebuild the system using EtherNet/IP.

- A 200-AENTR unit, to be connected to every Series 200 I/O node.
- A CI873 unit.

Existing ControlNet Installation

If there is an existing Satt ControlNet installed between the I/O units and legacy controller (such as SattCon 200 and Advant Controller 250), just move the coax cable from the old controller system to the new CI865 unit. In that case it is no need to rebuild anything on the field level.

Section 2 Rebuilding the I/O System

This section describes how to rebuild an existing Satt I/O system (Rack I/O or Series 200 I/O and I/O 200C) making it possible to connect to the Satt ControlNet. Please read Installation Precautions below before you continue to the rebuilding part.

For the rebuilding of:

- Rack I/O see page 46 and Rebuilding Process on page 45.
- Series 200 I/O see page 55 and Rebuilding Process on page 45.

It is strongly recommended to backup the existing application before disconnecting the old system.

Installation Precautions

A system installed according to the instructions in this document will meet the ABB Automation environmental specifications for industrial equipment. These specifications are concerned with electrical environment, climate and mechanical tests.

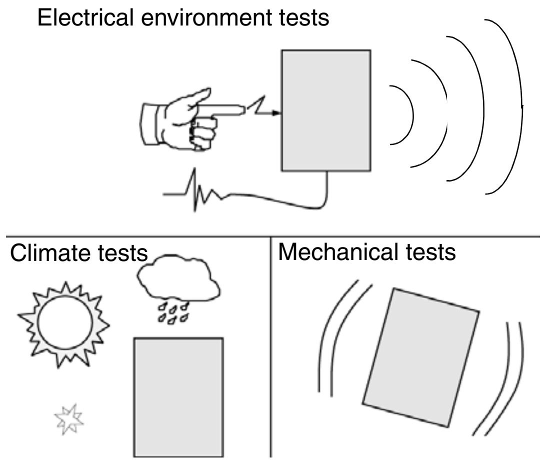


Figure 21. A system installed according to the instructions in this document will meet the ABB environmental specifications for industrial equipment.

With the proper precautions, the system can operate safely and reliably in normal industrial environments. These precautions can be minimized, if the following locations are avoided:

- Where the ambient temperature is outside the range +5 to +55°C,
- where the relative humidity exceeds 90%,
- where condensation may occur following sudden temperature changes,
- where high-power electrical interference may occur,
- where corrosive or inflammable gases exist,
- where there is dust, conductive particles, oil mist or organic solutions present,
- where high electrostatic or magnetic fields exist,
- where the equipment is exposed to direct sunlight,
- where vibrations and mechanical shocks may be transmitted to the equipment,
- where the equipment can be exposed to water,
- close to powerful high- frequency sources (possible problems can be solved with external filters).

Rebuilding Process

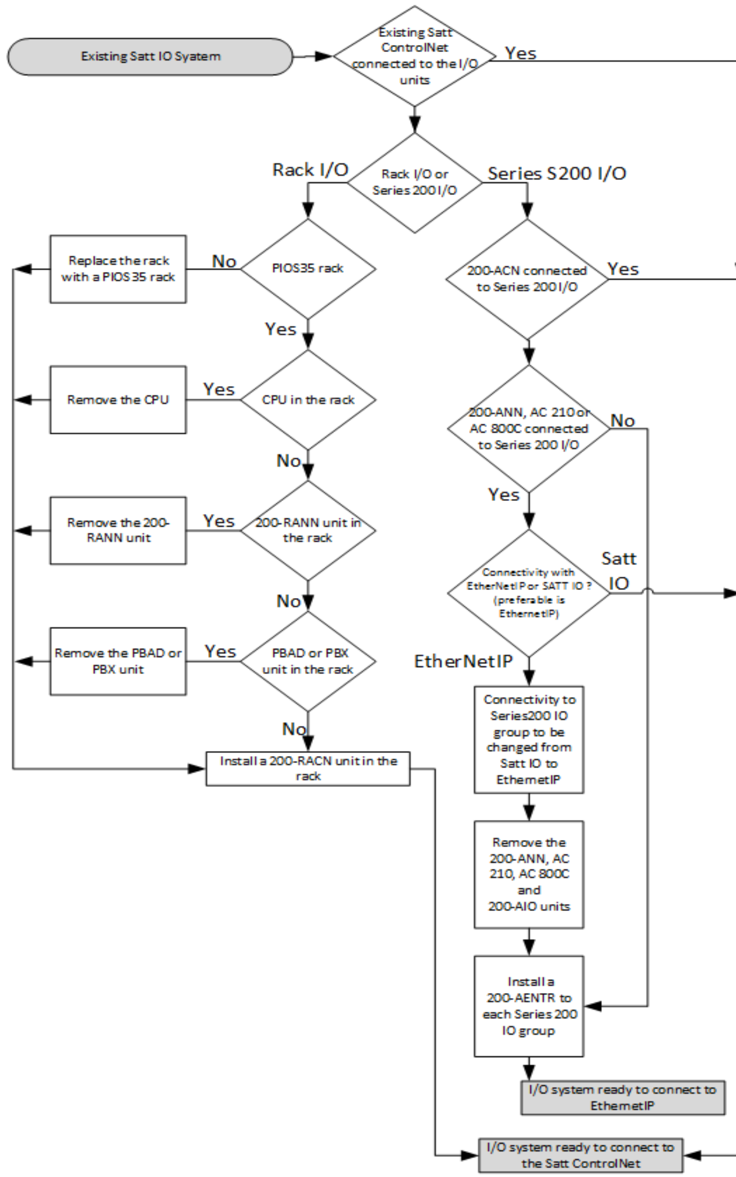


Figure 22. Graphic representation of the rebuilding process.

Rack I/O

The following text deals with rebuilding Rack I/O so it can be connected to the Satt ControlNet. When connected to the Satt ControlNet the I/O boards can connect to the CI865 and the AC 800M controller.

This subsection starts with listing some common components for Rack I/O supported by the Satt ControlNet. It also contains information about how to handle the mains supply and the I/O signal connections.

This subsection describes two cases before rebuilding the Rack I/O system:

- The existing rack is a PIOS35 rack. Changing to 200-RACN on page 50 describes the different alternatives to connect a 200-RACN unit to the rack.
- The rack is not a PIOS35 rack. The whole rack needs to be replaced as described in Installing Rack I/O with 200-RACN on page 50.

Common Rack I/O Components

See the Appendix F, Rack I/O Parts List for a complete list of supported components.

Table 3. Important Components for Rack I/O Supported by the Satt ControlNet

Order code	Name/Function
200-RACN	Rack adapter board for remote rack-based I/O connected to a AC 800M system.
200-RACN/A	Rack adapter board, 200-RACN with analog to digital converter, ADSF, mounted.
ADSF	Central A/D converter. To be mounted on rack adapter board 200-RANN.
Modules to IBA	12 accessory modules for analog input board IBA.
PIOS35	Empty basic rack.
PSF	Power supply unit.
PTU2	Two ready-wired I/O connectors with cables and screw terminal blocks mounted on an aluminium profile.

Table 4. Combined Products

Order code	Name/Function
PIOS/RC	Basic rack, PIOS35, with power supply, PSF, and 200-RACN
PIOS/RCA	Basic rack, PIOS35, with power supply, PSF and 200-RACN/A

Table 5. Supported I/O Boards

Board code	Name/Function
IAPG	Digital input board with 16 inputs
IDLD	Digital input board with 16 inputs
IDP	Digital input board with 32 inputs
IDPG	Digital input board with 32 inputs
IDN	Digital input board with 32 inputs
IDI	Digital input board with 32 inputs
PTC	Digital input board with 32 inputs
ORG	Digital output board with 16 outputs
ORGH	Digital output board with 16 outputs
OATG	Digital output board with 16 outputs
ODP2	Digital output board with 16 outputs
ODPG2	Digital output board with 16 outputs
ORM	Digital output board with 16 outputs
ODP.5	Digital output board with 32 outputs
ODP.8	Digital output board with 32 outputs
ODPG.8	Digital output board with 32 outputs
ODPL.5	Digital output board with 32 outputs

Table 5. Supported I/O Boards (Continued)

Board code	Name/Function
ODPLD	Digital output board with 32 outputs
ODN.2	Digital output board with 32 outputs
ODLD.5	Digital output board with 32 outputs
ODSG	Digital output board with 32 optocoupled outputs, short circuit proof
IBA	Analog input board with 8 inputs
IRA	Analog input board with 8 inputs
ICA	Analog input board with 8 inputs
IVA	Analog input board with 8 inputs
IVAPOT	Analog input board with 8 inputs
OCVA	Analog output board with 2 outputs
OCAHG	Analog output board with 4 outputs
OCAH	Analog output board with 4 outputs
OCAH with hand station	Analog output board with 4 outputs
IPA4	Input pulse analyzer board with 4 inputs, 8 bit counters

I/O Addressing

Every input/output signal is assigned a unique I/O address. This address is used when the I/O board is called by the control system. Above each board position in the racks there is a number (octal). The address number is obtained by adding the number of the board position to the number of the input/output on the board.

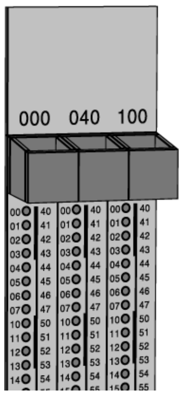


Figure 23. I/O addressing

A digital input/output board can have a maximum of 32 inputs/outputs. These are numbered from 0 to 37 (octal). The board positions are accordingly numbered in steps of 40 (octal). All board positions which end in 00 are marked with black numbers and those which end in 40 are marked with red numbers to simplify reading the addresses. The same color coding is used on the front panel of the I/O board.

Analog input addresses are always a multiple of 4 (octal), as an analog input board contains eight inputs (channels 00 - 04 - 10 - 14 - 20 - 24 - 30 - 34).

The analog output signals consist of eight or twelve bits. This means that an analog output board has two or four outputs. The address of an analog output signal must therefore be a multiple of 10 (octal). Each rack can have a maximum of 512 (777 octal) input/output signals.

Changing to 200-RACN

If the existing rack is a PIOS35 rack there are three solutions to rebuild the rack depending on present conditions.

If the existing PIOS35 rack is equipped with:

- A CPU:
  - Disconnect the CPU and connect a 200-RACN unit.
- A 200-RANN unit:
  - Disconnect the 200-RANN unit and connect a 200-RACN unit.
- A PBAD unit or PBX unit:
  - Disconnect the PBAD or PBX unit and connect a 200-RACN unit.

For more information about the 200-RACN unit, see Appendix B, I/O Board Installation and Function.

Installing Rack I/O with 200-RACN

If the existing rack is not a PIOS35 rack, the rack needs to be replaced with a PIOS35 rack with 200-RACN. To install a PIOS35 rack with the existing I/O boards, follow this procedure:

1. Disconnect all X1 contacts from the new PIOS35 rack, they are not needed anymore.
2. Mark up each old X1 contact and I/O board carefully to keep track of which X1 contact that belongs to which I/O board. Remove the I/O boards from the rack.
3. Disconnect all X1 contacts from the existing rack, by removing the two screws. Do not remove or change the signal wires on the X1 contact!
4. Read Handling the Mains Supply on page 51 and Handling I/O Signal Connections on page 52. Then remove the old rack and replace it with a new PIOS35 rack.
5. Connect the old X1 contacts to the new PIOS35 rack.

6. Connect all old I/O boards to the new PIOS35 rack. Be careful about the position, so that every I/O board is connected to the same X1 contact as it was in the old rack.

Handling the Mains Supply

Each rack must have a mains power supply. The power supply unit, PSF, located on the right side of the rack, requires a mains supply voltage 230 or 110 V AC, or 24 V DC. Select the correct mains supply voltage, see "Mains Supply Selection for PSF", on page 126. It can be seen from Figure 24 how the power supply is connected to the rack.

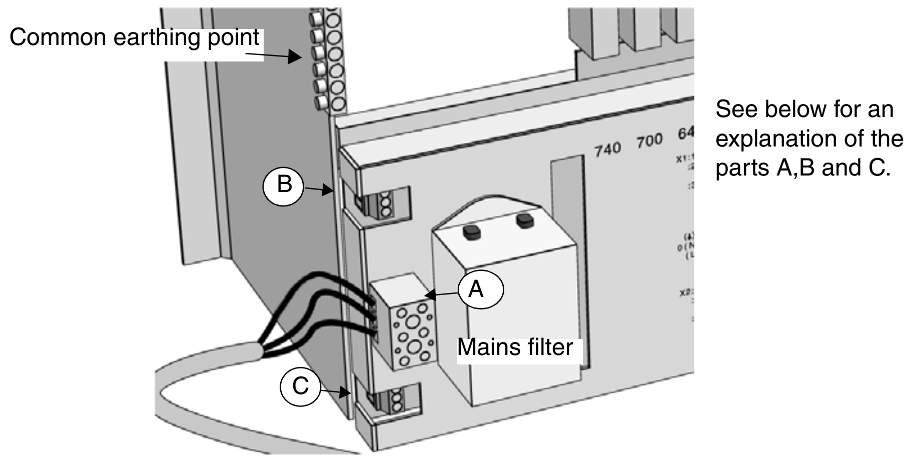


Figure 24. The mains supply connection.

Figure Explanation

The connection of the AC supply cable is shown Figure 24. The lower connector X2 is used when a 24 V DC supply is connected.

- **Part A:** Terminal for incoming AC mains supply (PE) = protective earth, 0 (N) = neutral and ~(L) = line voltage. Power supply, PSF, has mains supply settings for 110 V and 230 V, and can also be powered by 24 V DC.
- **Part B:** X1:1 (+VR) and X1:2 (0V) are the incoming DC supply lines for I/O boards using relays, mounted in the central rack. X1:2 is internally connected to the chassis. It can not be disconnected.

- **Part C:** When using a 24 V DC supply, +24 V is connected to terminal X2:2 and 0 V to terminal X2:3. Note that the protective earth terminal must still be connected to the common earthing point. Terminal X2:1 is internally connected to the cabinet's common earthing point.

- If supplied with 24 V DC from an external power source, 24 V DC must be supplied via an external filter, similar to the included mains filter, in order to meet the noise immunity restrictions.
- 24 V DC for SICB is available on X2 when PSF is supplied from the mains.
- If I/O board ORG24 is used, the external power supply that feeds the relay coils on the board, must not be used for the process I/O signals, if the signals are to be galvanically isolated from the control system.

Handling I/O Signal Connections

Connection of I/O Signals to the Rack

The I/O signals are connected to the I/O boards via edge connectors at the rear of the rack. The edge connectors are the upper row of connectors (X1). Connection is made via a crimped sleeve which is snapped on the edge connector after the wire has been crimped on the sleeve. For tools required for crimping, attaching and removing the sleeves, see Accessories on page 53.

The cabling can be channelled either via screw terminals or directly out into the process. Cable trunking should be located on top of the rack.

When connecting analog and pulse counter signals, a shielded twisted-pair cable should be used to enable optimal suppression of noise. The cable shield should be clamped to the grounding profile, at the rear of the rack, with a spring (ground) clamp (see Figure 25). Remove 10-30 mm of the cable insulation to ensure proper shield contact with the chassis.

One spring clamp is enclosed with each analog or counter board delivery.

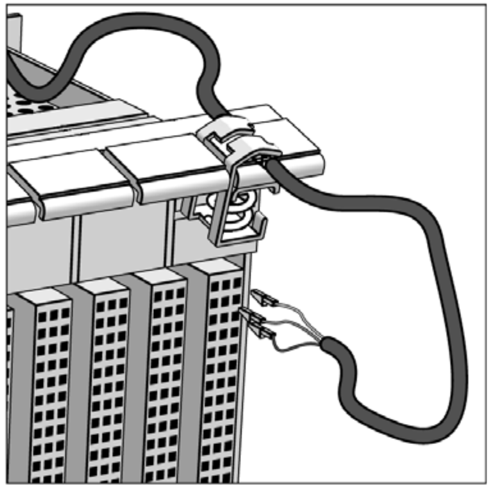


Figure 25. A shielded cable where the shield is grounded with a spring clamp. Crimp sleeves are crimped to the three wires of the cable.

Accessories

CRT01 and CRT02 are crimp tools and CRIMP1 and CRIMP2 are crimp sleeves for I/O signal connections to the rack. CRT01 and CRIMP1 are used for 0.14-0.5 mm^2 cables. CRT02 and CRIMP2 are used for 0.75-1.5 mm^2 cables. CRRE is a crimp removal tool.

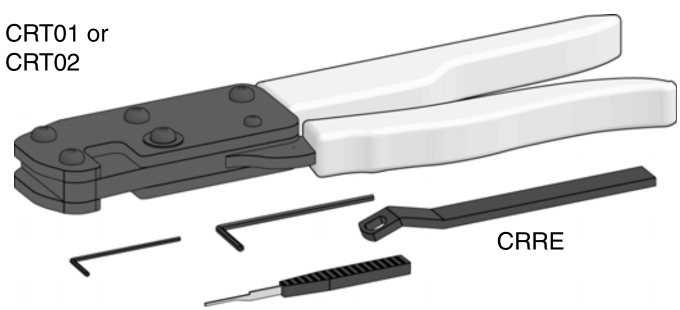


Figure 26. Crimp tools

Ready-wired Connectors for I/O Boards, PTU2

A PTU2 kit comprising a cable with two ready-wired edge connectors at one end and screw terminal blocks at the other end (see Figure 27), can be ordered from ABB Automation. This kit can be used for most digital I/O boards but if there is any doubt, contact ABB Automation before ordering. The amount of installation work can be considerably reduced using PTU2.

A PTU2 kit contains two ready-wired connectors for two board positions and a connection block with screw terminals for the signal leads, see Figure 27.

- The PTU2 kit is only for digital boards.
- The “b” column of the connector X1 (power supply voltage and 0 V) must be adapted to each board type.

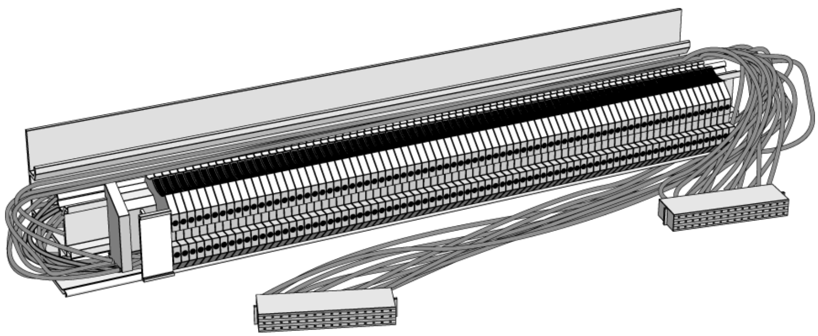


Figure 27. PTU2 kit.

Series 200 I/O

To connect the Series 200 I/O system to the CI865, associated with the AC 800M controller, the Series 200 I/O needs to communicate via Satt ControlNet. If the set up has 200-ANN or 200-AIO units, then it is preferable to replace these with 200-AENTR and use EtherNet/IP instead. If the S200 I/Os are connected using 200-ACN, then they do not need to be replaced with 200-AENTR.

How to remove and mount these adapters is described in the chapter Mounting Instructions in the manual S200 I/O Hardware, Hardware and Installation (3BSE021356*).

In addition to the replacement, the 200-ACN / 200-AENTR unit also needs a power source to be installed. This is also described in the manual S200 I/O Hardware, Hardware and Installation, chapter General Installation Instructions. Note that the 200-ACN / 200-AENTR and the I/O system should, if possible, have separate 24 V DC supplies.

If the old system is based on any of the controllers SattCon, Sattline or AC 250, replace the controller with a AC 800M controller.

If the old system contains Advant Controller 210, AC 800C or 200-AIO units, replace each of them with a 200-AENTR unit. It is also possible by replacing each of them with 200-ACN, but most preferable is with 200-AENTR.

Section 3 Connecting AC 800M to the I/O System

The ControlNet is based on a coax cable system. However, in some cases parts of the system also needs optic fibre links. As described later in this section fiber optic links may be included in a ControlNet system to increase network length and to obtain galvanic isolation in a highly noisy environment. Its use is mandatory to avoid lightning problems when interconnected equipment is placed in different buildings.

This section contains the following parts:

- Planning the ControlNet
  - Planning the Coax Cable System on page 58.
  - Planning the Fiber Optic Links on page 70.
  - Planning the Repeaters and the Network Size on page 75.
- Installing the ControlNet
  - Installing the Coax Cable System on page 80.
  - Installing the Fiber Optic System on page 107.
- Connect the nodes to the ControlNet
  - Connecting the Satt I/O Units and CI865 on page 116.

Planning the Coax Cable System

Use this section to determine your network requirements. After reading this section, consult engineering drawings of your facility for specific information concerning the best location for installing your cable network.

The ControlNet cable system is a ground isolated coaxial network. Proper selections of cable, connectors, accessories, and installation techniques are necessary to make sure it is not accidentally grounded.

Determining the Number of Taps

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

The maximum number of nodes on the entire Satt ControlNet is restricted to 32, including the CI865 unit. However, since a repeater is not a node but needs a tap, the maximum number of taps can be higher than the number of nodes.

If you plan to add nodes at a later date, you should consider ordering and installing the cable and connectors for these additional nodes when you install the initial cable system. This will minimize disruption to the network during operation. If you are planning future installation of additional nodes, do not install the tap. Instead, install a BNC bullet connector (see “Determining the Type of Connectors” on page 64 for more information). Figure 28 shows the contents of each tap kit:

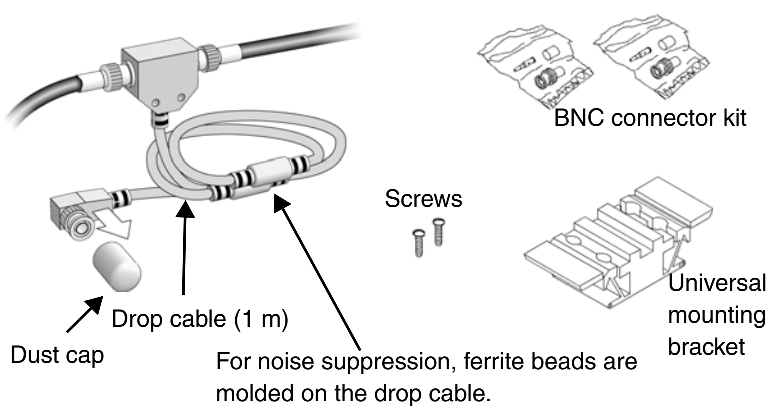


Figure 28. Tap kit

Taps must be purchased from ABB for the network to function properly. The drop cable must not be extended or shortened.

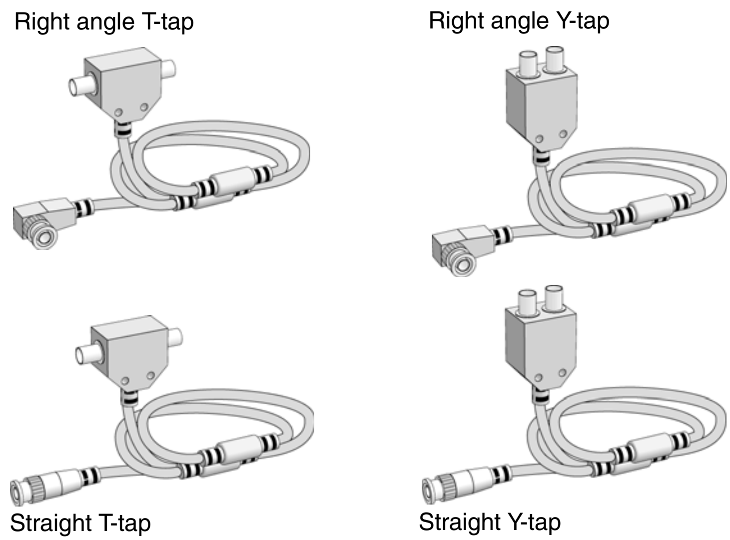


Figure 29. Different types of taps

Determining the Type of Cable

There are a number of cable types available to meet different requirements:

- Standard RG6 cable for normal indoor industrial applications, –40° to +80°C.
- Flooded burial, moisture resistant for outdoor applications, –55° to +80°C.
- Plenum-FEP, fire resistant for high- and low-temperature applications, as well as corrosive areas (harsh chemicals), –70° to +200°C.
- High-Flex RG-6 cable for mobile device applications, –40° to +75°C.
- Messenger cable for aerial runs where a great tensile strength is required, –40° to +80°C.
- Standard cable armored PVC/aluminum or PVC/steel for heavy duty applications, –40° to +80°C.

- Siamese, dual standard cable, –40° to +80°C.

Only use cable types listed in Appendix E, ControlNet Cable Components. Note that different manufacturers may specify somewhat different temperature limits.

Observe the local country regulation codes for installation work.

Keep high-flex cable use to a minimum because it reduces the allowed cable section length. Connect the high-flex cable by means of BNC bullet connectors (BNCJ) to make it easy to replace it before its flexure life is exceeded.

When interconnecting equipment in different buildings, use fiber optic cables to obtain galvanic isolation, see Section “Planning the Fiber Optic Links” on page 70.

Determining Trunk Cable Section Lengths

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

Total trunk cable length or number of taps may be increased by installing repeaters on the segment. This creates another segment.

When determining the cable length of trunk cable sections, make sure you measure the actual cable path as it is routed on your network. Consider vertical dimensions as well as horizontal dimensions. The three dimensional routing path distance should always be calculated when determining cable lengths.

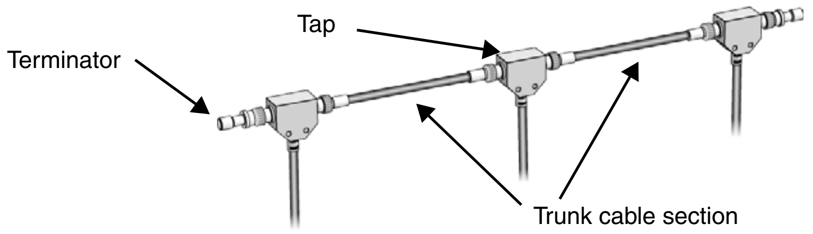


Figure 30. Determining trunk cable section lengths

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 demands of your network.

RG-6 Cable except High-Flex

The maximum allowed length of the cable system depends on the number of taps connected. There is no minimum trunk cable section length requirement. The maximum allowed total length of a segment is 1000 m with two taps connected. Each additional tap decreases the maximum length of the segment by 16.3 m. The maximum number of taps allowed on a segment is 48 with a maximum length of 250 m.

Maximum allowed segment length is:

1000 m – 16.3 m × (number of taps – 2)

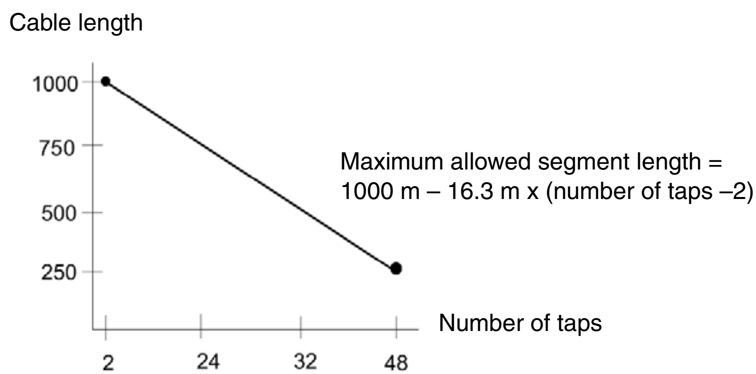


Figure 31. Number of taps

High-Flex RG-6

High-flex cables are used where a connected device is movable, for example a jib. In such cases both standard and high-flex cables are used.

The total allowed length of a segment depends on the number of taps connected and the length of high-flex RG-6 cable.

The maximum allowed total length of a high-flex cable segment is 625 m with two taps connected. Each additional tap decreases the maximum length of the segment. The maximum number of taps allowed on a segment is 48.

Maximum allowed segment length for standard RG-6 in a mixed configuration with high-flex/standard cables is:

(1000 m - (L × 1.6[1])) – ((16.3 m × (number of taps – 2)) where L=total length of high-flex cable sections in the network segment.

The amount of high-flex RG-6 cable possible to use in a system, is less than the amount of standard RG-6 cable, and the use of high-flex cable should be kept 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 flexure life is exceeded.

Both Standard and High-Flex Cables in the Same Segment

Example:

- The segment has three nodes (requires three taps).
- The segment requires 200 m of high-flex RG-6 cable.

To calculate the maximum cable length of standard RG-6 cable:

1000 m – 200 m × 1.6 – 16.3 m × (3–2) = 663.7 m.

Determining the Number of Terminators

75 ohm terminators must be used at both ends of each segment for the ControlNet cable system to work.

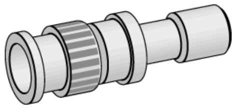


Figure 32. Terminator

After determining how many segments there will be on the network, multiply this number by two to figure out how many terminators are necessary for the network.

1. This calculation (length x 1.6) makes the necessary length adjustment for high-flex RG-6 cable.

Determining Whether Repeaters are Needed

Installing repeaters is necessary if the system requires more than 48 taps per segment, or a longer trunk cable than the specifications allow.

Note the restrictions in Section “Planning the Repeaters and the Network Size” on page 75.

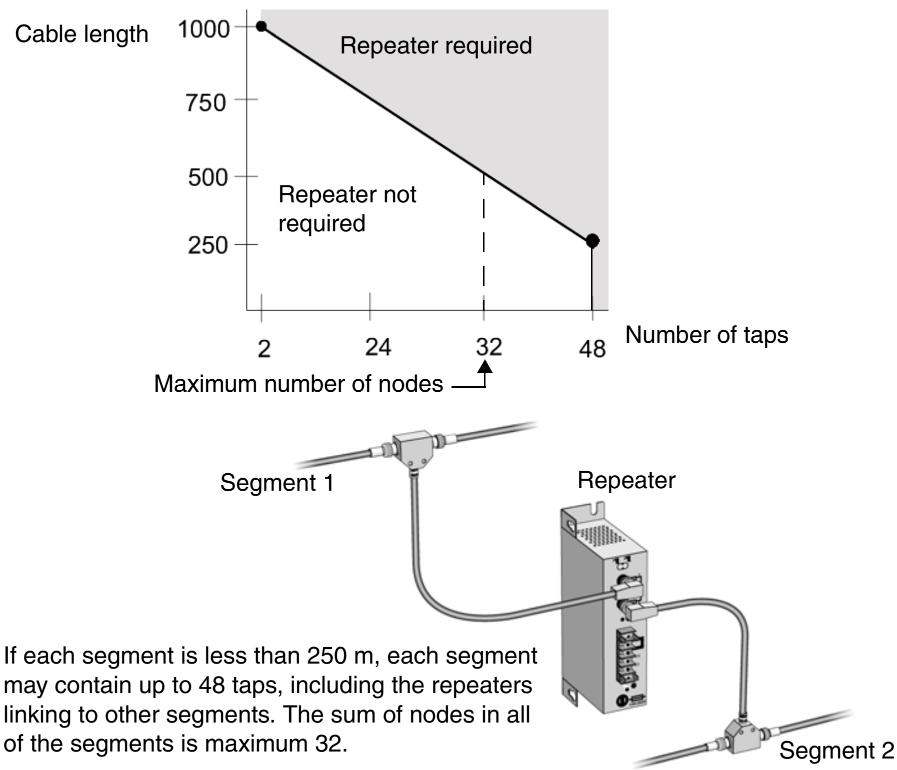


Figure 33. Determining whether repeaters are needed

Configuring Network with Repeaters

When you configure your network using repeaters, the following applies:

- Only one path is allowed between two nodes.
- Max. 32 nodes are allowed on the network (Each node must be designated a unique address between 01 and 99, where the node address 01 is reserved for the CI865.).
- The propagation delay limits the combination of cable length and the number of repeaters in series between two arbitrary nodes, see Section "Planning the Repeaters and the Network Size" on page 75.

For segment lengths, see "Determining Trunk Cable Section Lengths" on page 60. See also the examples of installing coax repeaters on page 104 and fiber repeaters on page 114.

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

Determining the Type of Connectors

These connectors are available:

Table 6. Determining the Type of Connectors

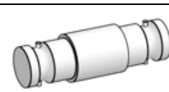
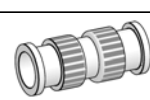
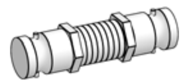
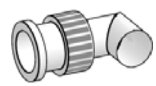
BNC connector:		**Function**
cable connector		connects trunk cable sections to a tap's BNC connector
Optional BNC connector:		**Function**
bullet (jack-to-jack)		reserves a space in the trunk cable for future installation of a tap or to splice a trunk cable
barrel (plug-to-plug)		connects two adjacent taps without a trunk cable section between them

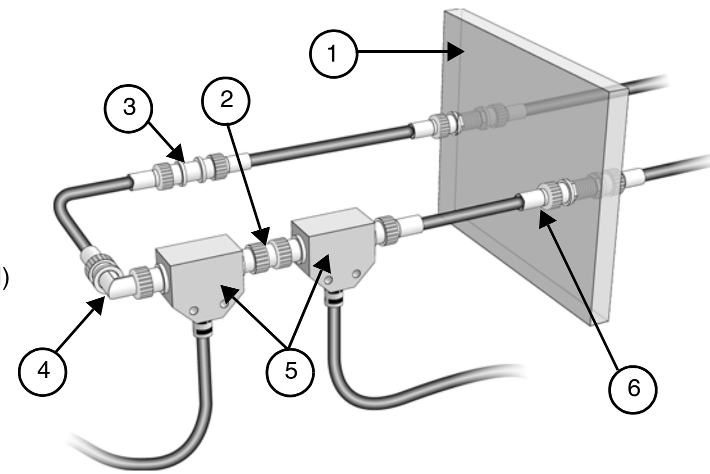
Table 6. Determining the Type of Connectors (Continued)

BNC connector:		**Function**
isolated bulkhead (jack-to-jack)		goes through grounded panel walls while maintaining the shield isolation of the trunk cable
right angle (jack-to-plug)		provides a 90° bend in your cable (prevents excessive bending of your cable)

Do not let any metallic surfaces on the BNC connectors, plugs, or optional accessories touch grounded metallic surfaces.
All connectors for ControlNet must be of type 75Ω.

In the example below, the ControlNet cable:

- Enters and exits the panel enclosure from the side using isolated bulkhead connectors,
- contains two adjacent taps connected by a barrel connector,
- reserves one future tap location with a bullet connector,
- makes a sharp bend with a right angle connector.



1. Panel wall
2. Barrel connector (BNCP)
3. Bullet connector (BNCJ)
4. Right angle connector (BNCRJP)
5. Taps
6. Isolated bulkhead connector (BNCJI)

Figure 34. Example of how to use different connectors.

Application Installation Considerations

When planning your cable system there are certain installation considerations depending on your application. There are three categories of conductors:

Table 7. The three categories of conductors.

Category	Includes
III	• AC power lines • high-power digital AC I/O lines • high-power digital DC I/O lines • power cables to motors

Table 7. The three categories of conductors. (Continued)

Category	Includes
II	• low-power digital AC/DC I/O lines • ControlNet communication cables
I	• analog I/O lines and DC power lines for analog circuits • low-voltage DC power lines • communication cables to connect between system components within the same enclosure

General Wiring Guidelines

Follow these guidelines for wiring all ControlNet cables:

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

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. The cable should be routed according to the guidelines in Table 8.

Table 8. Wiring External to Enclosures

Cable in a contiguous metallic wireway or conduit?	Route your cable at least:	From noise sources of this strength:
Yes	0.08 m	Category-III conductors of less than 20 A
	0.15 m	AC power lines of 20 A or more, up to 100 kVA
	0.3 m	AC power lines greater than 100 kVA
No	0.15 m	Category-III conductors of less than 20 A
	0.3 m	AC power lines of 20 A or more, up to 100 kVA
	0.6 m	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-III conductors.

Inside an enclosure, route Control Net Cables outside cable trunks, or in a cable trunk separated from Category-III conductors.

Table 9. Wiring Inside Enclosures

Route your cable at least this distance:	From noise sources of this strength:
0.08 m	Category III conductors of less than 20 A
0.15 m	AC power lines of 20A or more, up to 100 kVA
0.6 m	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 push button 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 units that are in series or parallel with hard contacts, require surge-suppression to protect the unit output circuits as well as to suppress transient emi.

Planning Guidelines

Now that you are ready to begin ordering components, use these guidelines to help you select components.

General Planning

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

For repeaters, observe the temperature and humidity specifications in Appendix C, Technical Specifications. Also avoid high electrostatic and electromagnetic fields, corrosive and inflammable gases, dust, conductive particles, oil mist and organic solutions. The repeaters must not be exposed to water or to direct sunlight. See also the installation instructions on page 103.

Segment Planning

- 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.
- The CI865 can be connected to the trunk cable anywhere in the segment, not only at the ends. The node number does not need to follow the physical placement of the unit.
- Maximum number of taps = 48, with max. 250 m of trunk cable.

- Maximum trunk cable length = 1000 m, with 2 taps.
- 75 ohm terminators are required on both ends.
- Unconnected drop cables are not allowed with one exception; one tap with an unconnected drop cable may be installed for maintenance purposes.
- Use BNC bullet connectors at future tap locations.
- Avoid high noise environments when routing cables.

If you are installing a bullet connector for future tap installations, count the bullet as one of the tap allotments on your segment (and decrease the maximum allowed cable length by 16 m). This helps you avoid reconfigure your network when you install the tap.

Network Planning

- Max. 32 nodes are allowed on the network (each node must be designated a unique address between 01 and 99).
- Repeaters require a tap, but are not counted as nodes.
- Repeaters may be installed at any tap location along a segment.
- Only one path is permitted between any two nodes on a network.
- Maximum propagation delay between two arbitrary nodes must not be exceeded, see Section “Planning the Repeaters and the Network Size” on page 75.

For segment lengths, see page 60, and the installation examples on pages 104 and 105.

Planning the Fiber Optic Links

Fiber optic links may be included in a ControlNet system to increase network length and to obtain galvanic isolation in a highly noisy environment. Its use is mandatory to avoid lightning problems when interconnected equipment is placed in different buildings.

Point-to-point, multidrop and star configurations are created by use of standard fiber cable, fiber repeater adapters and fiber units. The fiber repeater adapter (RPA) is connected to a coax trunk cable by means of the standard tap and drop cable. Up to four fiber units (RPFM or RPFS) with two fiber ports each may be directly plugged to a repeater adapter. Each port needs two fiber connections, one for receiving and one for transmitting signals.

The simplest configuration connects two coax segments point-to-point by means of two fiber repeater adapters and two fiber units:

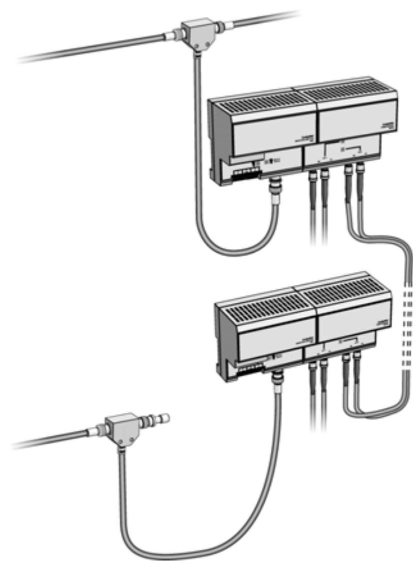


Figure 35. Two coax segments connected point-to-point.

This is equivalent to the use of a coax repeater, except for the fiber cable length being added to the maximum network length.If the fiber repeaters are connected to coax segments, the same rules apply to a network containing fiber repeater configurations as for coax repeaters:

1. Only one path is allowed between two nodes.
2. Max. 32 nodes are allowed on the network (each node must be designated a unique address between 01 and 99, where the node address 01 is reserved for the CI865).

3. The propagation delay limits the combination of cable length and the number of repeaters in series between two arbitrary nodes, see Planning the Repeaters and the Network Size on page 75.

See also the example of installing fiber repeaters on page 114.

It is not necessary to connect fiber repeaters to coax segments if they are used only to increase the fiber cable length. It is possible to connect two coax segments by a chain of fiber repeaters as shown below:

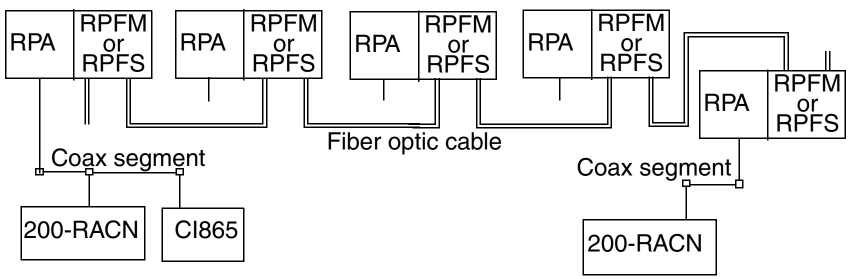


Figure 36. Connection of two coax segments by a chain of fiber repeaters.

If the total cable length (coax + fiber) is 10 km and if there are 5 fiber repeater adapters, the actual propagation delay is 59 µs according to Table 11. If the network update time NUT=5 ms, then you must choose the highest node address $S_{max} \leq 17$ to be found by interpolation in Table 12 or by use of the formula on page 79.

Cable and Connector Types

The fiber units RPFM and RPFS are designed for use with 62.5/125 µm multi mode optic fiber and plastic or ceramic connectors type ST. The wavelength used is 1300 nm.

Multi-fiber cables for backbone use are available with a wide range of fiber counts, e.g. 4, 16, 72, or 216 fibers. They should contain a suitable amount of spare fibers and should be installed between connector panels, to which the local equipment is connected by means of shorter, flexible one- or two-fiber interconnect cables, see Figure 37 and Figure 38.

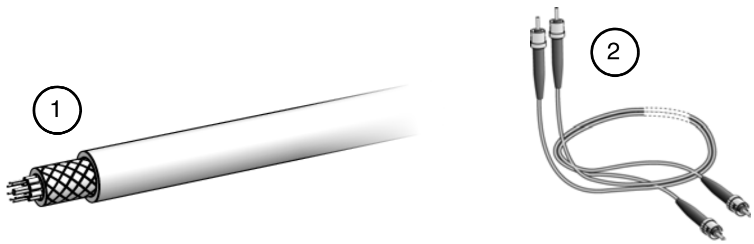


Figure 37. Multi-fiber backbone cable (1) and two-fiber interconnect cable (2).

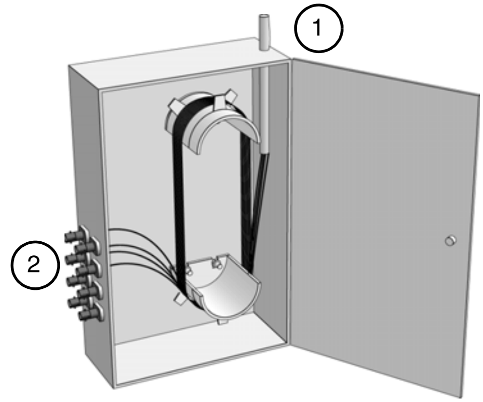


Figure 38. Connector panel with incoming multi-fiber backbone cable (1) and connectors for interconnect cables (2).

There is a big choice of fiber optic cables designed for use in different environments, e.g. indoor or outdoor industrial applications, high-temperature applications, aerial runs, or direct burial.

Fiber optic cables should be installed by specially trained personnel, capable of taking full responsibility. Consult the specialists what cable type should be used for the specific application.

Estimating Length of Fiber Cable

The maximum length of a fiber cable section depends on the quality of the fiber, number of splices, and connectors. The total attenuation of the cable section must be less than 13.3 dB. Typically, the cable attenuation is less than 1.5 dB/km at 1300 nm wavelength. If the installation is excellent with few connectors and splices, the fiber cable can be up to about 7 km in length. Since a connector may cause a considerable attenuation, the cable should not be jointed unnecessarily.

It is essential to check the total attenuation of the different cable sections by power loss measurements after the cable has been installed, see page 107.

Example:

- Maximal cable attenuation is 1.5 dB/km.
- 4 connectors contribute 0.3 dB each to the attenuation.
- 6 splices contribute 0.2 dB each.

The total attenuation due to connectors and splices is 4×0.3 + 6×0.2 = 2.4 dB, leaving 13.3 - 2.4 = 10.9 dB for the cable. This means the cable can be up to 10.9/1.5 = 7.2 km in length.

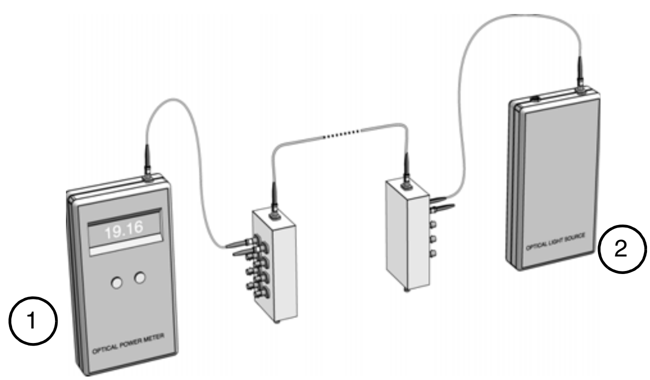


Figure 39. Power meter (1) and 1300 nm light source (2).

Planning the Repeaters and the Network Size

There are restrictions on network size with respect to:

- The length of coax and fiber cable sections,
- the number of coax and fiber repeaters,
- the number of coax cable taps,
- the number of addressable nodes,
- the desired network update time (NUT).

The first three restrictions are due to the physical attenuation of signals in the cable and are independent of software and the control system used. Refer to the sections “Determining Trunk Cable Section Lengths” on page 60 and “Estimating Length of Fiber Cable” on page 74 for coax and fiber cables respectively. See also the examples of installing coax repeaters on page 104 and fiber repeaters on page 114.

The control system can handle a maximum of 32 nodes. Each node must be designated a unique address between 01 and 99, where the node address 01 is reserved for the CI865. Please refer to the manual AC 800M Controller Hardware, Hardware and Operation (3BSE036351Rxxxx) for more information.

The last two restrictions depend on a number of parameters which may be specified in the controller hardware configuration. How to calculate those parameters is described below.

Network Parameters

The physical configuration and topology determines the propagation delay of the network. The propagation delay is the time needed for a signal to travel between the two end nodes of the network, furthest from each other. The propagation delay also determines possible network update times, and the highest node address. Therefore, the network has to be carefully planned in order to be able to use short update times, and many nodes in the network.

The settings listed in Table 10 affect the performance of the Satt ControlNet network. When changing any of the first four parameters in Table 10 all connections are disconnected and are then reconnected after up to 25 seconds.

Do not change these settings when the factory process is running.

To change these settings, double-click the CI865 icon in the Control Builder, see Figure 40, and choose the *Settings* tab in the Editor. Refer to the Control Builder online help for further information.

Table 10. Available network parameters

Parameter	Description
Network Update Time (NUT)	Sets the desired update time of Satt ControlNet in ms. The lowest setting for this parameter is dependent on the network parameters Highest Node Address (S_{max}), cable length and number of repeaters. If the value of this parameter is too low, a compiler error message is displayed during compilation. Try a higher value or change some of the other parameters. Nodes can be assigned update times that are multiples of this setting, see Default Expected Packet Rate below. The EPR cannot be assigned values smaller than the Network Update Time.
Highest Node Address (S_{max})	The highest addressable node on the network. Nodes with addresses higher than this cannot be connected. If this setting is lower than the highest defined node, a compiler error message is displayed during compilation. To optimize the network it is recommended that you keep this setting as low as possible by setting the addresses in consecutive order starting with the number 2.
Cable length	The maximum cable length on the network. Calculate the total cable length between all combinations of end points in the network. Set the parameter to the maximum of these values.

Table 10. Available network parameters (Continued)

Parameter	Description
# Repeaters	Number of repeaters on the longest segment of the network. Set this parameter to the actual number of repeaters between the two end points that generated the value for cable length above.
Default Expected Packet Rate (EPR)	Default update time for nodes that do not specify an Expected Packet Rate of their own. Changing this parameter causes all nodes that use default Expected Packet Rate to be reconnected. Can only have values which are multiples of the Network Update Time. If this value causes the bandwidth to become full, a compiler error message is displayed during compilation.

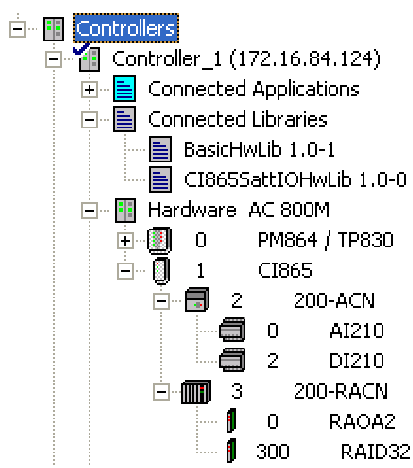


Figure 40. Example of hardware connected to the Satt ControlNet.

The propagation delay is calculated as the sum of the time delays derived from the fiber and the coax repeaters and time delays derived from coax and fiber cables. Since fiber medium is slower than coax, calculations may be approximated to treat all media as fiber. Between the two end nodes of the network, furthest from each other, the formula for the propagation reads:

Propagation delay $= 1.1 \times (R + 2) + 5.1 \times L$ µs

L = Cable length (both fiber and coax) [km]
R = Number of repeaters in series (both fiber and coax)

This formula gives the information in Table 11.

Table 11. Actual propagation delay as a function of cable length and number of repeaters in series.

		Number of repeaters in series (R)											
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**
Cable length (L) km	**1**	7	8	10	11	12	13	14	15	16	17	18	24
	2	12	14	15	16	17	18	19	20	21	22	23	29
	3	18	19	20	21	22	23	24	25	26	27	28	34
	4	23	24	25	26	27	28	29	30	31	32	34	39
	5	28	29	30	31	32	33	34	35	36	38	39	44
	6	33	34	35	36	37	38	39	40	42	43	44	49
	7	38	39	40	41	42	43	44	46	47	48	49	54
	8	43	44	45	46	47	48	50	51	52	53	54	60
	9	48	49	50	51	52	54	55	56	57	58	59	65
	10	53	54	55	56	58	59	60	61	62	63	64	70
	15	79	80	81	82	83	84	85	86	88	89	90	95
	20	104	105	106	108	109	110	111	112	113	114	115	121

When the actual propagation delay of the network has been calculated, it is possible to choose the network update time and the highest node address. It is done with the formula for the maximum allowed propagation delay as a function of network update time and the highest node address:

Max allowed propagation delay $= 225 \times (NUT / S_{max}) - 6.4\ \mu s$

NUT = Network update time [ms]
S_{max} = Highest node address

This formula gives the information in Table 12. Also, due to physical limitations, the propagation delay is limited to:

Max allowed propagation delay $= 121\ \mu s$

Table 12. Maximum allowed propagation delay as a function of NUT and SMAX.

Network update time (NUT) ms	Highest node address (S_{max}) 2	5	10	15	20	25	30	40	50	60	70	80	90
5	121	121	106	69	50	39	31	22	16	12	10	8	6
10	121	121	121	121	106	84	69	50	39	31	26	22	19
15	121	121	121	121	121	255	218	163	130	107	42	36	31
20	121	121	121	121	121	121	121	224	179	148	58	50	44
30	121	121	121	121	121	121	121	121	121	230	90	78	69
40	121	121	121	121	121	121	121	121	121	121	121	106	94
50	121	121	121	121	121	121	121	121	121	121	121	121	119

The actual propagation delay from Table 11 must be smaller than the maximum value from Table 12.

Example: The longest segment in the network has a cable length of 2 km, and a total of 4 repeaters in series. This will give a propagation delay of 17 µs from Table 11. If the user wants the highest node address to be 25, Table 12 indicates that the network update times can be 5 ms and more.

The above mentioned network configuration parameters are later needed by the user to configure his network in the hardware configuration tool. The user has to know the actual cable length (L), the number of repeaters (R) and possible values for NUT and S_{max}.

Note: Even if the tables above indicate that the network will work with some values of NUT and S_{max}, there is no guarantee that the bandwidth will be sufficient. Especially if the user uses a short network update time and wants to send a lot of data on the network. The tables are only tools to help checking if the physical network is possible to configure.

See also the examples of installing coax repeaters on page 104 and fiber repeaters on page 72 and 114.

How to set the required parameters is described in the manuals for the different controller systems.

Installing the Coax Cable System

You should have read the Section "Planning the Coax Cable System" on page 58 before you install your cable system.

Installation of Trunk Cable

Install the trunk cable, observing the cable supplier's installation instructions and the following guidelines.

Wiring External To Enclosures

When the RG-6 type coax cable is being pulled through multiple conduit bends, follow these specifications.

Table 13. Installation of Trunk Cable, Wiring External To Enclosures.

For this coax cable:	The pulling force should not exceed:	Bending radius should not be less than:
PVC	42 kg	76 mm
FEP	61 kg	70 mm
High-Flex	Not available	Not available

Wiring Inside Enclosures

When the RG-6 type coax cable is not being pulled through conduit, follow these specifications (they may vary slightly from different manufacturers).

Table 14. Installation of Trunk Cable, Wiring Inside Enclosures.

For this coax cable:	The bending radius should not be less than:
PVC	38 mm
FEP	35 mm
High-Flex	Not available
Tap drop cable	25 mm

Mounting the Taps

Selecting Where to Mount the Taps

- There is no spacing requirement between taps. It is possible to install two adjacent taps by using a barrel connector.
- Make sure the mounting location is convenient for the cable routing.

- Make sure the mounting location does not cause any bending radius to be less than the limits listed on page 81.
- Do not mount the tap in a position that routes the drop cable over any AC power terminals on nearby units.

Do not allow any metal portions of the tap, such as the universal mounting bracket screws or connectors, to contact any conductive material.

The ControlNet taps (Y-tap and T-tap) can be mounted:

- To a universal mounting bracket, and then the tap and bracket are mounted as an assembly.
- Through the body holes in the tap using:
  – Screws and flat washers.
  – A tie wrap.

Use only the screws supplied with the tap. They are of proper length and head style.

See "Mounting Dimensions" on page 181 in Appendix , Technical Specifications for universal mounting bracket and tap mounting dimensions.

Mounting a Tap Using 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, see Figure 41.

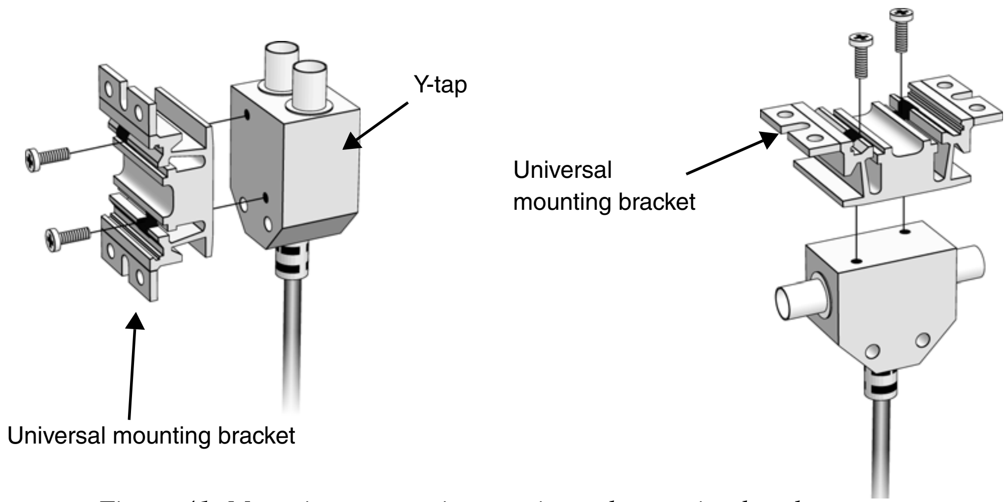
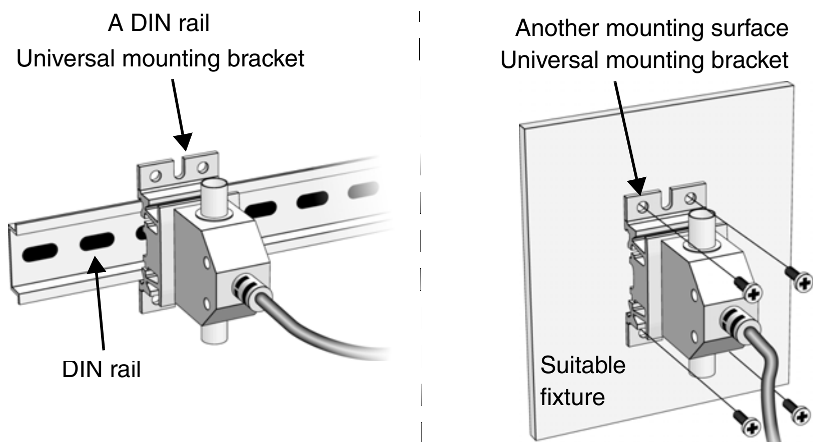


Figure 41. Mounting a tap using a universal mounting bracket.

3. Mount the tap and bracket assembly to:



Mount the universal mounting bracket (figure 3-3) on specified mounting rails or DIN rails #3 style symmetrical (3.5 x 7.5 mm). Use four screws (figure 3-4) to attach the universal mounting bracket to another mounting surface.

Figure 42. Mounting the tap and bracket assembly.

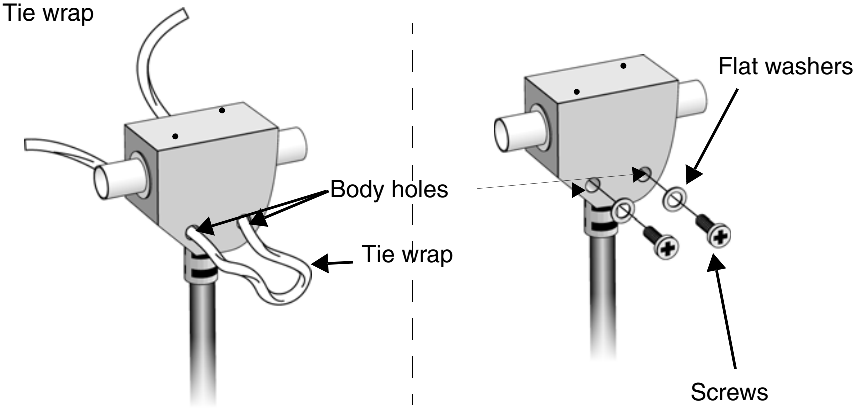


Figure 43. Mounting a tap through the body holes.

Installing Cable Connectors

After mounting of the taps, the cable connectors should be attached to the ends of the trunk cable sections.

Collecting Tools

To install the cable connectors, use the tools in the ControlNet Tool Kit, see Figure 44 and Appendix E, ControlNet Cable Components.

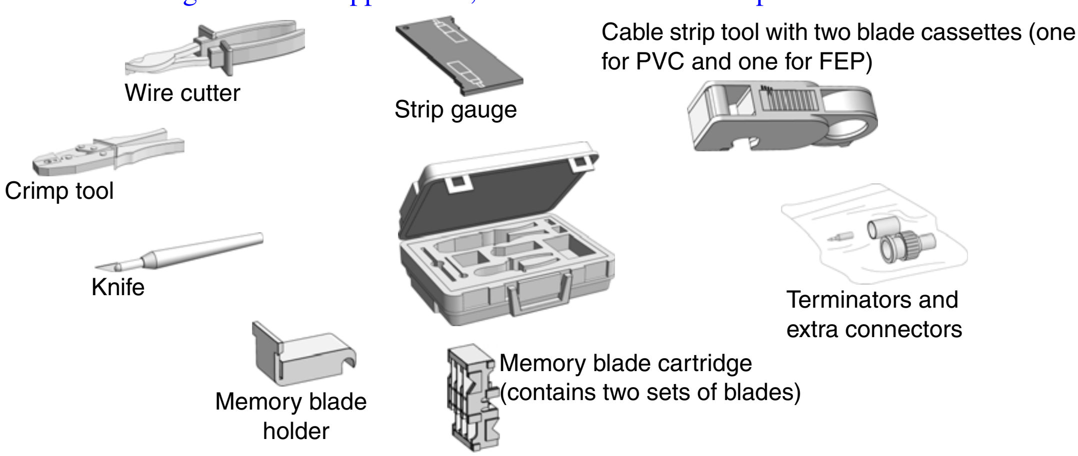


Figure 44. ControlNet Tool Kit Complete

Stripping the Cable

The cable strip tool is delivered with the proper blade cutting depth already set and there is no need to adjust it. However, if later adjustment is necessary, see Appendix E, ControlNet Cable Components.

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

- 76 mm for wiring external to enclosures,
- 38 mm for wiring inside enclosures.

When stripping the cable proceed as follows:

1. Verify that the strip tool is set correctly for the diameter of the cable.

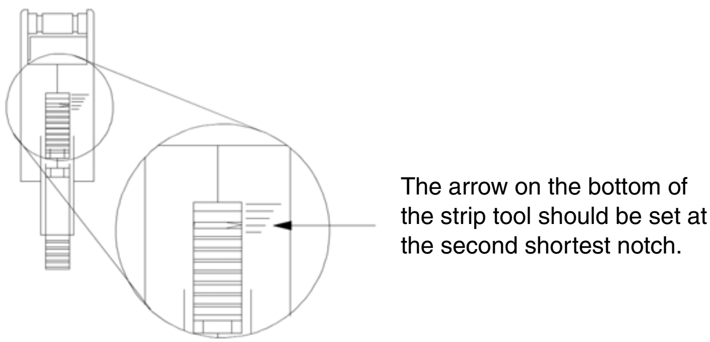


Figure 45. Stripping the cable, step 1.

2. Verify that the proper memory blade holder is installed for the type of cable used. If you need to change the memory blade holder, see Appendix E, ControlNet Cable Components.

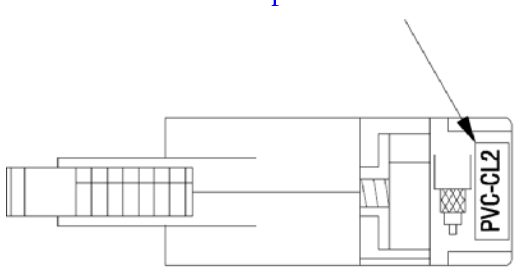


Figure 46. Stripping the cable, step 2.

3. Insert the cable into the cable strip tool's cutting chamber so that extra cable, approximately 25 mm, extends beyond the edge of the tool.

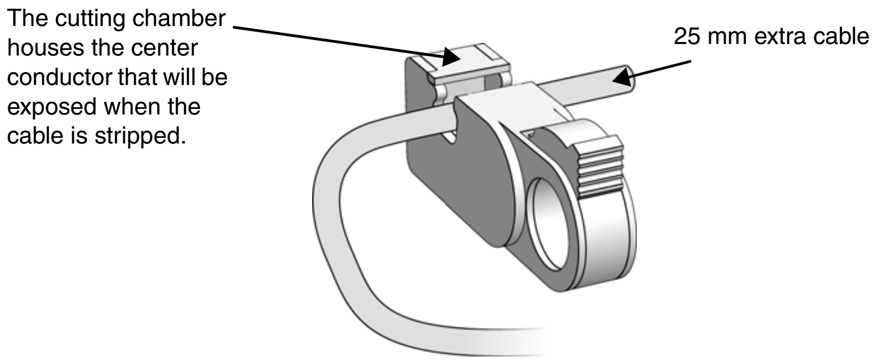


Figure 47. Stripping the cable, step 3.

4. Lock the cable into place by moving the chamber gauge ring forward until it meets the cable with slight resistance. This gauge moves two rollers toward the cable and regulates the depth of the cut. The gauge will "click" as it moves from one stage to the next.

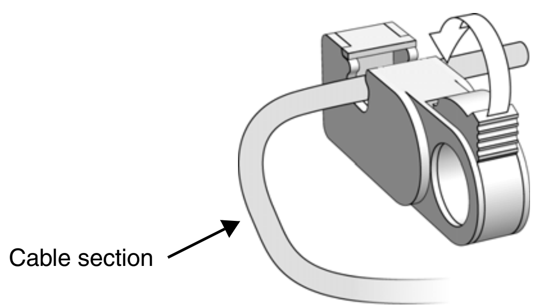


Figure 48. Stripping the cable, step 4.

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. Make 4 or 5 full rotations, or until the strip tool glides easily around the cable.

On your last repetition of steps 4 and 5, apply sufficient pressure on the chamber gauge ring to make sure the ring has reached the last stage.

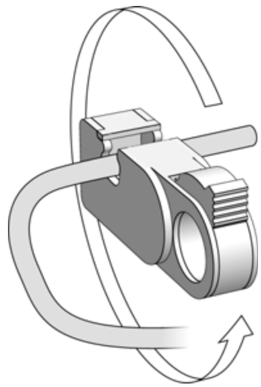


Figure 49. Stripping the cable, step 5.

6. Continue repeating Steps 4 and 5, moving the chamber gauge ring forward one notch for each time the steps are repeated, until reaching the last notch. Each time the chamber gauge ring is moved forward a notch, the strip tool makes a deeper cut into the cable.
7. After you have moved the chamber guide ring to the last position and turned the strip tool the final time, maintain pressure on the strip tool and pull it off of the cable. Use a scraping motion to strip away the appropriate portion of the cable.

Remove remaining cable parts from the strip chamber after each use.

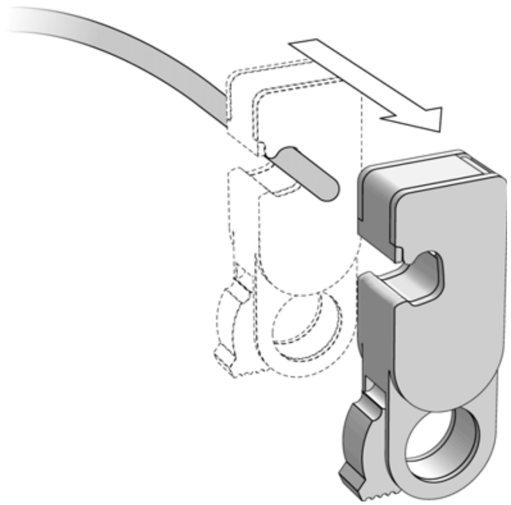


Figure 50. Stripping the cable, step 7.

This will strip the cable properly, exposing the layers of the cable:

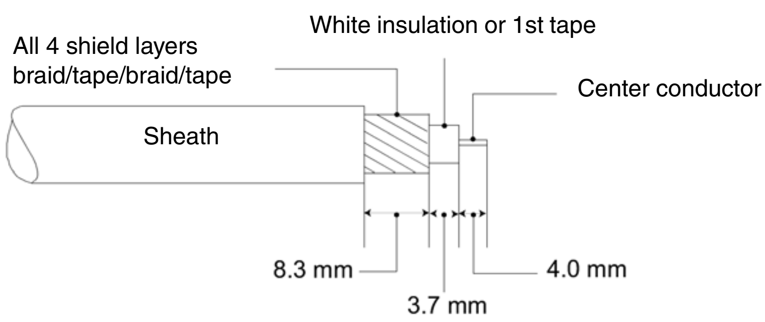


Figure 51. The layers of the cable.

If you do not see the three distinct layers of cable, snip off the exposed end with the wire cutters and repeat the entire cable-stripping process.

If stripping problems persist, the strip tool may need adjustment. See Appendix E, ControlNet Cable Components for instructions on how to adjust the strip tool.

If you are using PVC cable, skip step 8.

8. If you are using plenum FEP cable, cut off an additional 3 mm of the outer sheath with the knife from the tool kit.

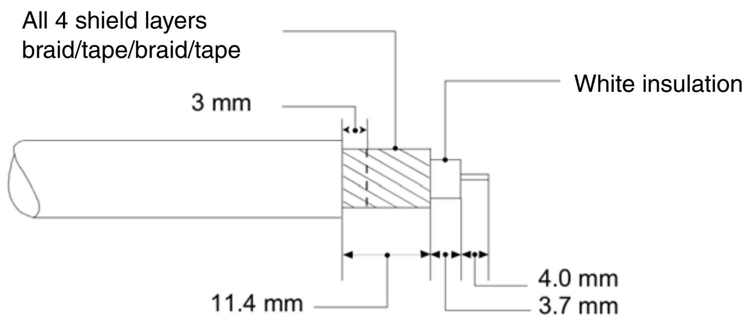


Figure 52. The layers of the FEP cable.

9. Make sure the center conductor is 4.0 mm. Use the imprint guide on the back of the ControlNet tap or the strip gauge to verify this.

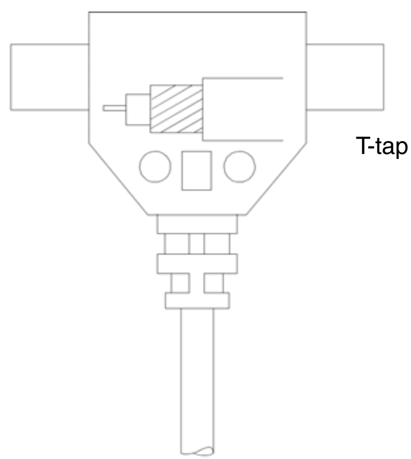


Figure 53. The length of the center conductor.

If the center conductor is too long, cut off the excess with the wire cutter from the cable kit. If it is too short, repeat the entire cable-stripping process.

Check for any braid stranding that may not have been cut at the proper length. Even one strand coming in contact with the center conductor could short out the cable. If any such strands are found, cut them to the correct length.

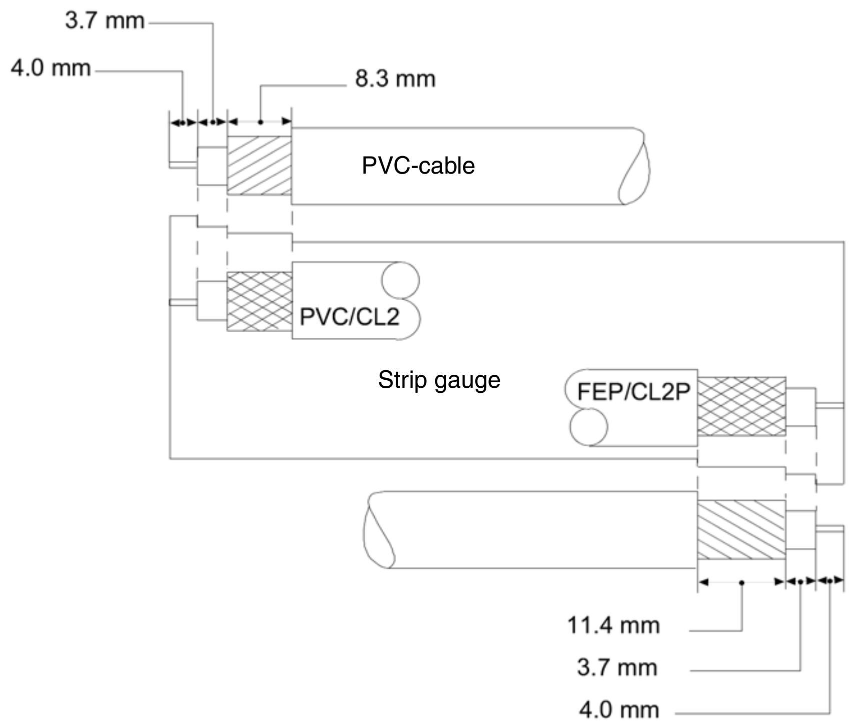
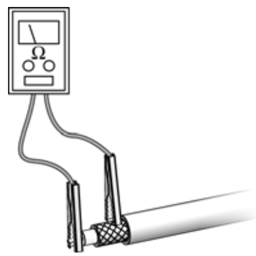


Figure 54. Template for PVC and plenum FEP cable.

Testing for Electrical Shorts and Continuity

1. Using an ohmmeter or continuity tester, test for a short between the center conductor and the shield.

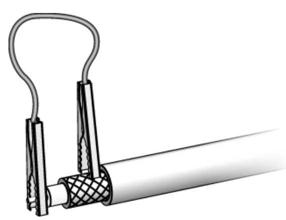


If the resistance readings indicate there is no short circuit – continue to step 2.

If the resistance readings indicate that a short exists – inspect the ends of the cable for short circuits. If you are unable to locate a short circuit, replace the trunk cable section.

Figure 55. Testing for electrical shorts and continuity, step 1.

2. Connect a temporary short between the center conductor and the shield at one end of the cable. At the other end of the cable, use an ohmmeter or continuity tester to test for electrical continuity.



If the resistance readings indicate that there is no short circuit – replace the trunk cable section.

If the resistance readings indicate that a short circuit exists (max 25 W/100 m cable) – continue to next section.

Figure 56. Testing for electrical shorts and continuity, step 2.

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

Attaching the Connectors to the Cable

1. 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.

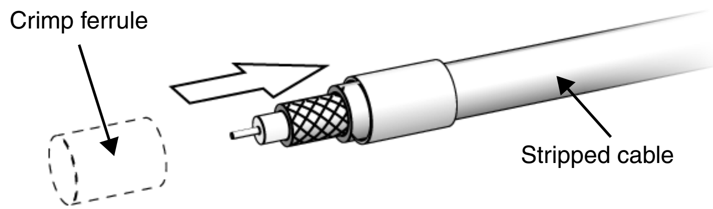


Figure 57. Slip the crimp ferrule onto the cable.

2. Place the center pin over the center conductor.

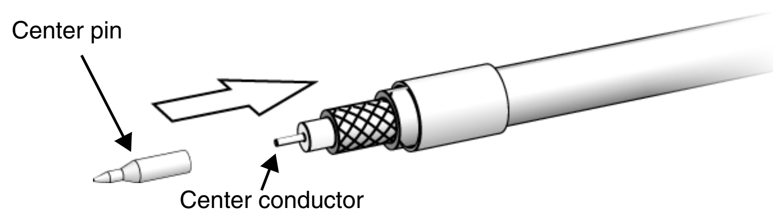


Figure 58. Place the center pin over the center conductor.

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

Make sure that the center pin slips onto the center conductor completely. The back shoulder of the center pin should be up against the white insulation. If it is not, recheck the length of the center conductor.

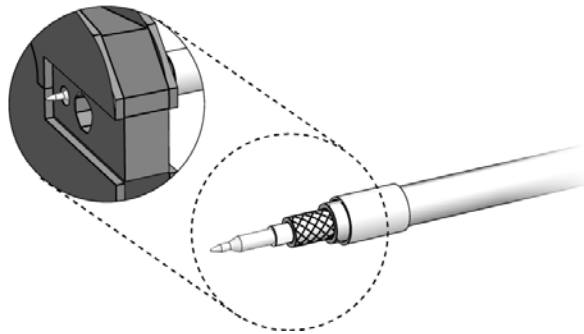


Figure 59. The smaller hexagonal crimping notch is for crimping the center pin onto the center connector.

4. Slide the ControlNet connector onto the cable.

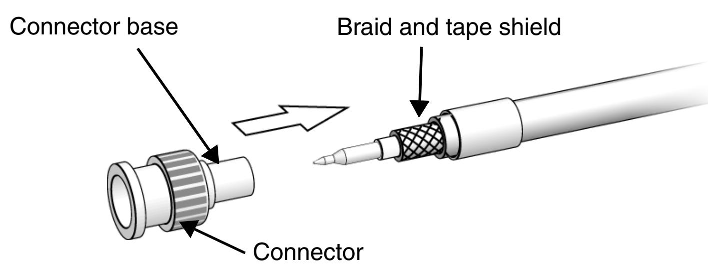


Figure 60. Slide the ControlNet connector onto the cable.

5. Move the connector in a circular motion (*without any inward pressure*) to work the connector base underneath the three outer shields. Once a gap has opened up between the inner shield tape and the three outer shields, start applying inward pressure to seat the connector base **under** the three outer shields (braid/tape/braid).

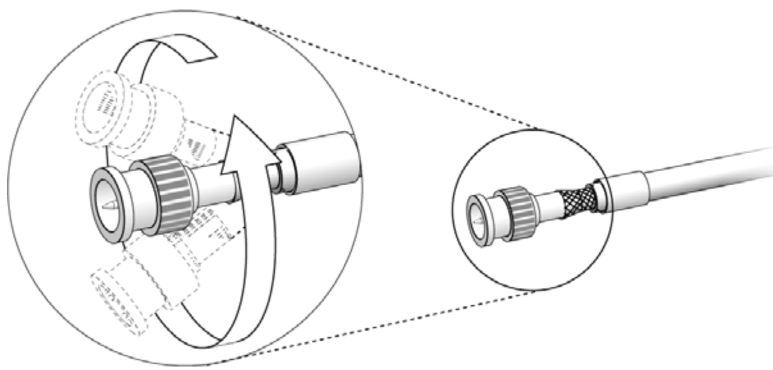


Figure 61. The wire is pliable and may fray slightly.

6. **S**lide the crimp ferrule over the three outer shields and connector base until it meets the shoulder of the connector.

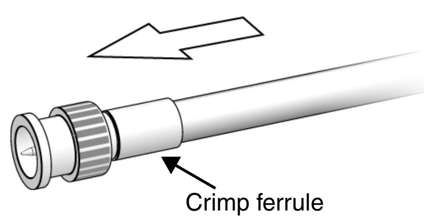


Figure 62. Slide the crimp ferrule into place.

Note that the center pin, when installed in the connector, must be sufficiently pushed forward. If the visible part of the center pin is too short then a reliable connection can not be guaranteed. See Figure 62 to get an estimation of the position of the center pin.

7. 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.

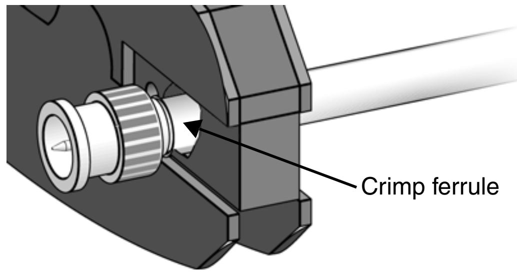
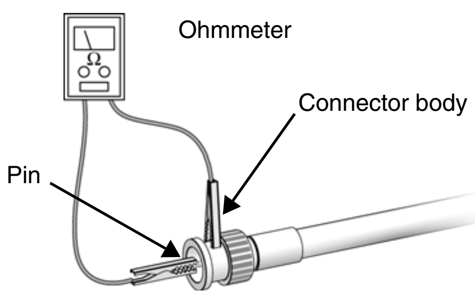


Figure 63. The larger hexagonal crimping notch is for crimping the ferrule which holds the connector to the cable.

Many network problems are due to improperly installed connectors. All cables ends must have tight fitting connectors. 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.

Testing for Electrical Shorts and Continuity

1. Using an ohmmeter or continuity tester, test for a short between the connector body and pin.

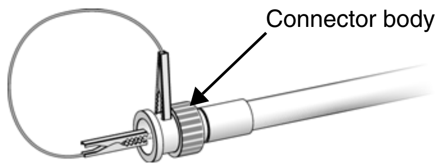


If the resistance readings indicate that there is no short circuit – continue to next section.

If the resistance readings indicate that a short exists – use your wire cutters to cut off the connector, install a new connector and begin testing again.

Figure 64. Testing for electrical shorts and continuity, step 1.

2. Connect a temporary short between the pin and connector body at one end of the cable. At the other end of the cable, use an ohmmeter or continuity tester to test for electrical continuity.



If the resistance readings indicate that there is no short – use your wire cutters to cut off the connector, install a new connector and begin testing again.

If the resistance readings indicate that a short exists (max 25 W/100 m cable) – continue to next section.

Figure 65. Testing for electrical shorts and continuity, step 2.

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

TDR Measurement

A very useful tool to document and verify a ControlNet installation is the *time domain reflectometer (TDR)*. There are a number of testers on the market with varying features and benefits. Often they can also be used for twisted pair cables in addition to different kinds of coax and twinaxial cables.

The TDR sends a fast rise time pulse down the cable and measures the intensity of reflections. Its output is typically an oscilloscope-like screen or a printout. The greatest reflection indicates the end of an unterminated cable. Earlier reflections could indicate changes in crimping, stretching, corrosion, or breaks in shielding and other defects which are often visually undetectable. Also the location and quality of connectors and taps can be estimated.

Commercially available testers often combine different measurement methods to automatically render an overall pass/fail result in addition to the individual test results regarding:

- DC loop resistance,
- cable length,

- capacitance,
- attenuation,
- relative impedance along the cable.

To perform an auto test, it is necessary to specify the cable used. If the tester does not allow you to immediately select the manufacturer and the cable type, you must enter a number of parameters such as nominal impedance, capacitance and velocity of propagation.

Automatic testers usually have a main unit to be connected to one end of the cable segment under test, and a remote unit to be connected to the other end. The remote unit changes the termination between shorted, open or matching resistance depending on the actual measurement ordered from the main unit. It can also send a signal of known amplitude from the far end of the cable to be measured by the main unit at the near end.

After installation, test each trunk cable section of any substantial length individually, to make possible a detailed verification of changes when required. To be able to quickly find defective areas you may also record measurements of complete segments including taps with integral drop cables.

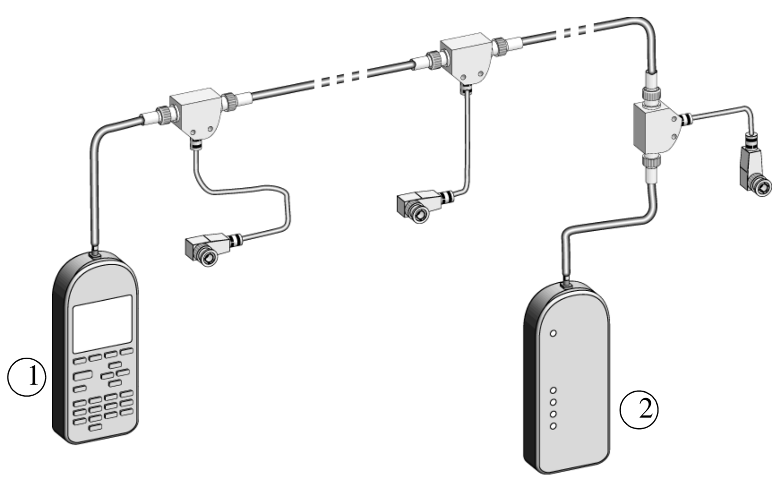


Figure 66. Example of a TDR with main unit (1) and remote unit (2).

It is necessary to disconnect all devices from the drop cables before the cable segment is tested.

Connect the test units to the end taps of the cable segment after the terminators have been removed. If convenient, you can split the segment where appropriate and test each part separately. This may be necessary due to the limited measuring range of the TDR, often 0–600 m.

If taps and drop cables are included in the segment being tested, the cable length measurements will show a value about 1.4 m too large per connected tap. The measurements are, however, reproducible if performed in exactly the same way, and therefore useful for troubleshooting. If you need more accurate measurements, you can replace the taps with bullet connectors, see page 64.

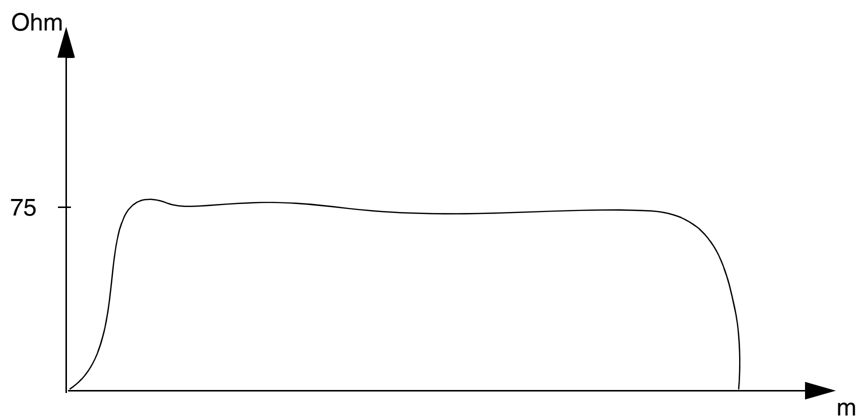


Figure 67. Normal trace of the relative impedance along a single trunk cable section.

Documentation and Verification

System verification begins with installation. Even the smallest system needs to be documented when it is installed, so records are available when it fails or is to be modified. The documentation should include wiring maps showing all taps and connected devices, and all cables and wires should be carefully labeled. Before start-up, a certification test of the cable system should be performed by means of TDR, with careful recording of results, and of procedures and parameters used.

It is a good practice to survey the cable system and its documentation together with the installation people, writing a detailed standardized report which lists the integral components with notes of acceptance and complaints.

Connecting Cable Sections

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

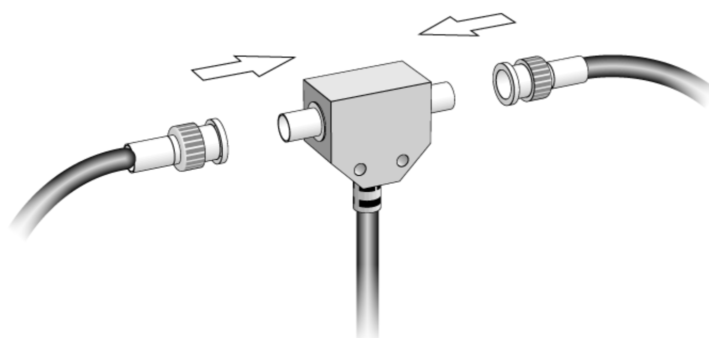


Figure 68. Connecting cable sections

Terminating the Segment

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, see Figure 69. 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 75Ω terminator to the first and last taps on the segment, see Figure 70. The terms "first" and "last" refer to the physical location of the node along the trunk cable.

Repeat at the other end of the segment.

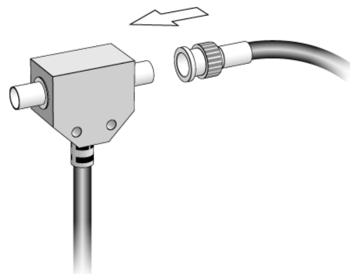


Figure 69. Connect one end of the trunk cable section to one of the tap's BNC connectors.

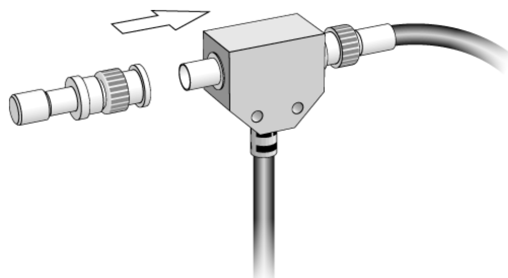


Figure 70. Install a 75Ω terminator onto the tap's other BNC connector.

Installing Repeaters

Use the mounting dimensions provided (see "Mounting Dimensions" on page 181) to mount the repeater horizontally or vertically in the selected area.

The repeater should be mounted to meet the following conditions:

- Air has to be able to flow in/out of the air holes on the top and bottom of the repeater. For proper ventilation, make sure there is a minimum of 5 cm from surrounding equipment.
- Mounted in an enclosure (e.g. NEMA) to provide protection from dust, moisture or corrosive atmospheres.
- Mounted to a grounded metal plate if possible.

Ground the Repeater

Use a wire (e.g. #14 AWG) to connect the repeater to the ground bus.

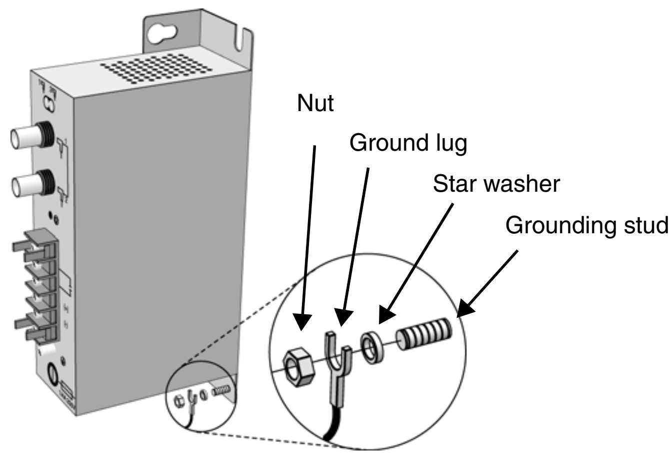


Figure 71. Ground the repeater

Connect Power and Relay Circuitry

1. Remove the terminal strip cover, see Figure 72.
2. Connect the power to the repeater, see Figure 73.
3. Replace the terminal strip cover.

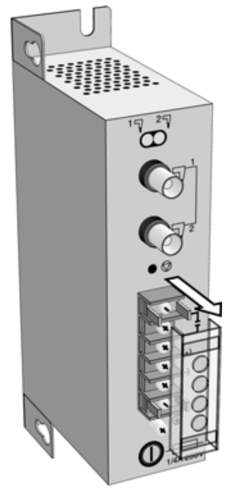


Figure 72. Removal of the terminal strip cover.

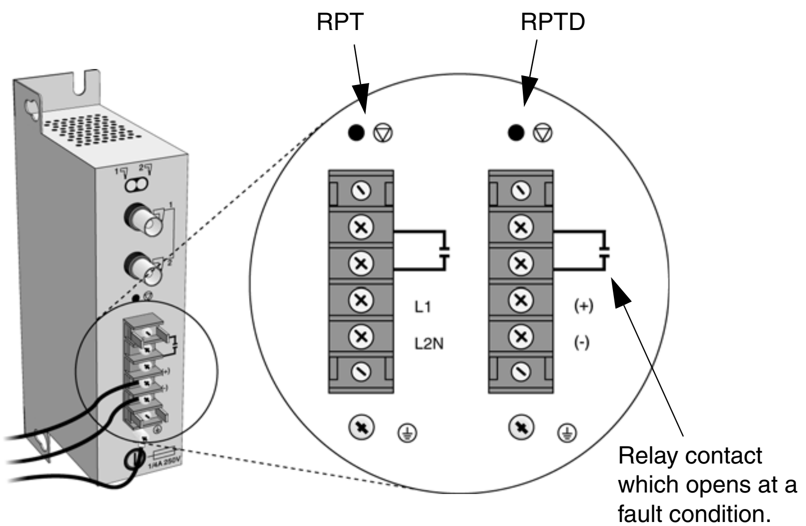


Figure 73. Connection of the power to the repeater.

Connecting the Repeater to the ControlNet Segments

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), see Figure 74.

Do not allow any metal portions of the tap to contact any conductive material. This may cause noise on the network.

If you disconnect the tap from the repeater, place the dust cap back on the straight or right-angle connector to prevent the connector from accidentally contacting a metallic grounded surface.

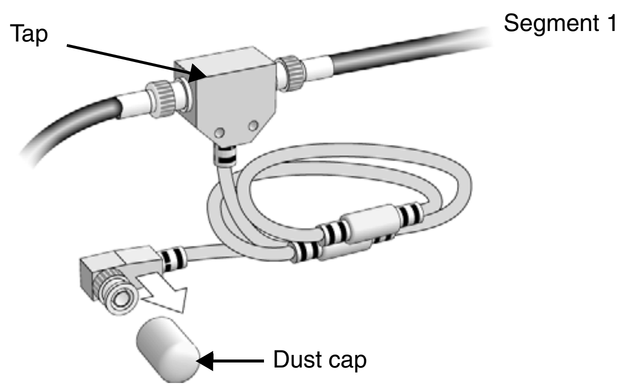


Figure 74. Remove the dust cap from the connector for segment 1.

2. Remove and discard the dust caps from the repeater's BNC jacks.

3. Connect the straight or right angle connector of the tap to the BNC connector of the repeater, see Figure 75.

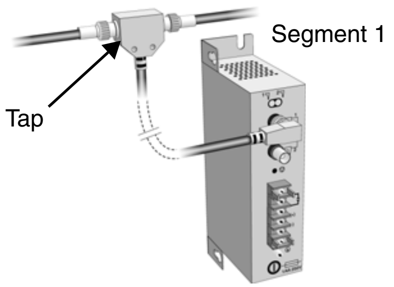


Figure 75. Connect the first tap to the repeater.

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).

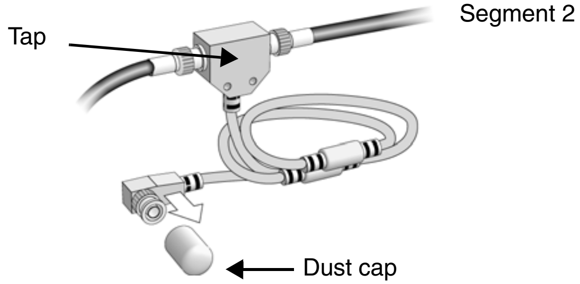


Figure 76. Remove the dust cap from the connector for segment 2.

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

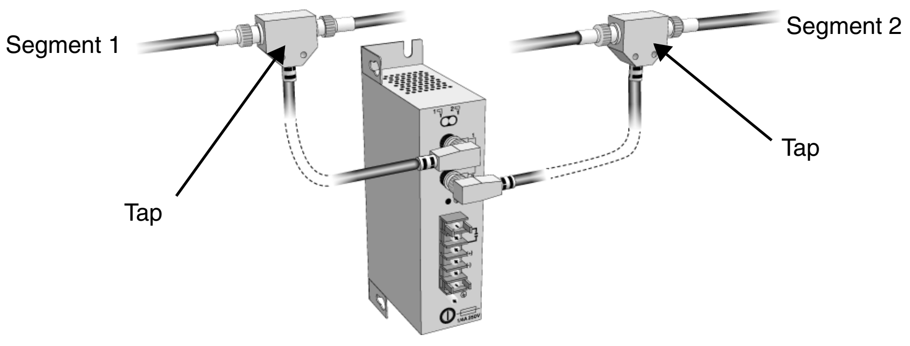


Figure 77. Connect the second tap to the repeater

Installing Coax Repeaters, Example 1

In this network example:

- Segments 1 and 4 each have 2 taps, and each = 1000 m,
- segments 2 and 3 each have 3 taps, and each = 983 m,
- the cable length between end nodes = 3966 m (1000+2×983+1000),
- there are 3 repeaters in series (A, B, C).

Table 11 indicates an actual propagation delay of 26 µs. If network update time (NUT) is 5 ms and the highest node address (S_{max}) is 20, Table 12 indicates a maximum allowed propagation delay of 50 µs, which is well above the actual value.

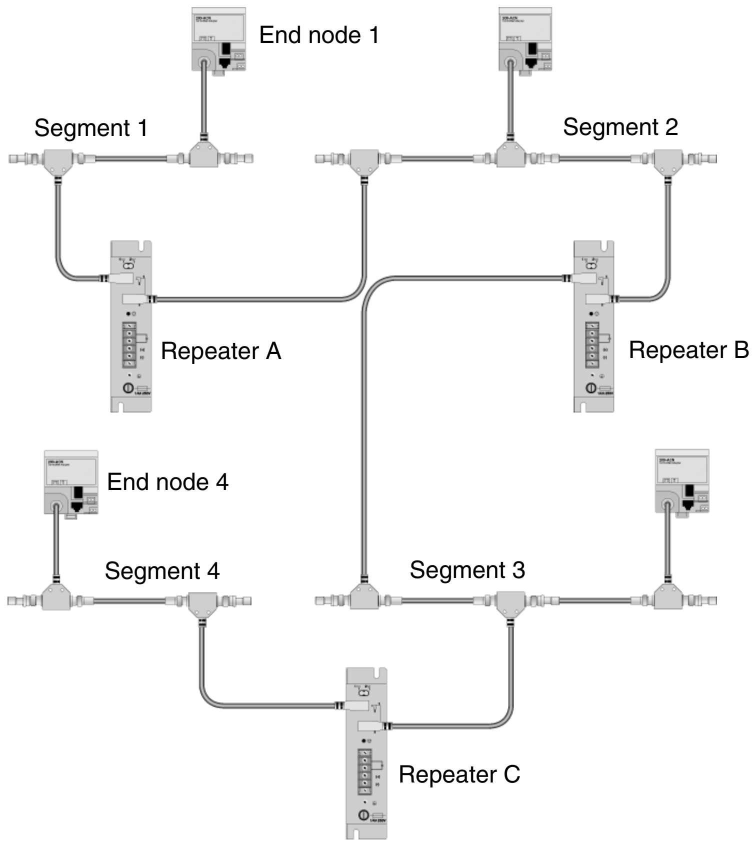


Figure 78. Installing coax repeaters, example 1.

Installing Coax Repeaters, Example 2

When repeaters are installed as described below, there can be a maximum of 48 repeaters in segment 4.

In this network example:

- Segment 4, having 3 repeaters in parallel, is max 983 m,

- if there are 10 nodes (i.e. 11 taps) in each of segments 1, 2, and 3, they cannot exceed 853 m each (only two taps are shown in the figure below),
- the cable length between end nodes is 2689 m (983+2×853),
- there are 2 repeaters i series.

Calculate, using the formula in “Network Parameters” on page 75, or interpolate in Table 11 gives an actual propagation delay of 18 µs. If the network update time (NUT) is 5 ms and the highest node address (S_{max}) is 30, Table 12 indicates a maximum allowed propagation delay of 31 µs, which is well above the actual value.

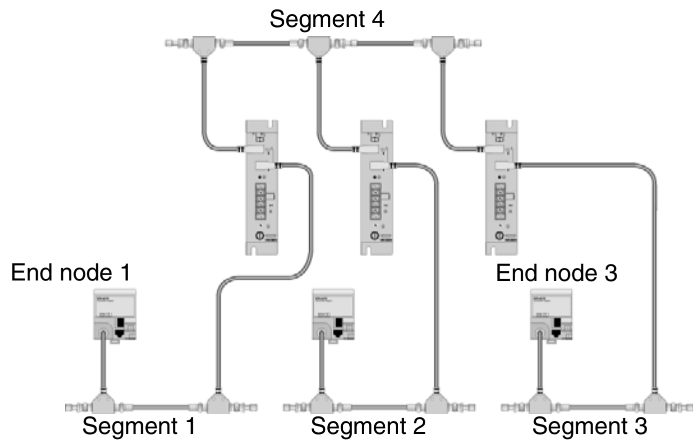


Figure 79. Installing coax repeaters, example 2.

Connecting Devices

After terminating the segments, connect the devices.

1. Remove and discard the tap’s dust cap (located on the straight or right angle connector).
2. Connect the tap’s straight or right angle connector to the device.

Installing the Fiber Optic System

Fiber Optic Cable

Let specialists take the full responsibility to choose cable types suitable for the actual installation with regard to the need for moisture and flame resistance, high- and low temperature exposure, tensile strength, armouring, etc. Let also trained personnel install the cable system and terminate it, following the supplier's installation instructions.

The installation should include complete documentation of cable routing and the position of every cable strand connection.

Local equipment can be connected to the nearest connector panel by less experienced people using interconnect cables which have been purchased ready-terminated in required lengths.

Observe the minimum cable bend radius specified. Do not touch the ends of the fiber optic strands and do not let the ends come in contact with dust, dirt or other contaminants. Always put protective caps onto fiber cable connectors and fiber ports when they are disconnected. If the ends become contaminated, clean them with a soft, clean, lintless cloth and alcohol.

Do not look directly into the fiber ports. Light levels may cause damage to eyesight.

Power Loss Measurement

After installation, test each fiber cable section by means of an optical power meter to assure the total attenuation to be less than 13.3 dB at 1300 nm. Connect a 1300 nm optical light source to one end of one strand of the cable section. Connect the other end of the same strand to an optical power meter and read the attenuation. Exchange the two units to measure from the opposite direction. Keep records of the attenuation for each cable section strand. This is invaluable for future maintenance and troubleshooting of the network.

Considerable power loss may indicate:

- Poor splices,
- bending losses,
- broken fibers,
- poor connections,
- dust or dirt.

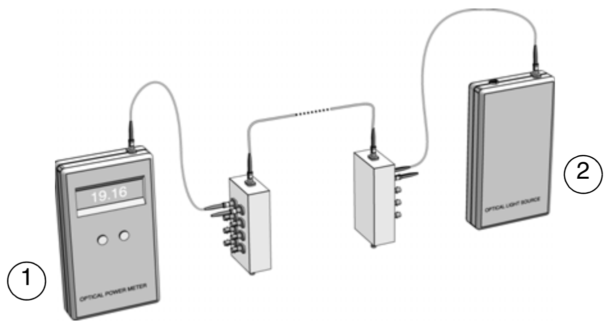


Figure 80. Power meter (1) and 1300 nm light source (2).

OTDR Measurement

In addition to power loss measurement, it is recommended to examine the total fiber network by means of an *optical time domain reflectometer (OTDR)*. This instrument emits light into a strand of a fiber cable and displays the reflected light.

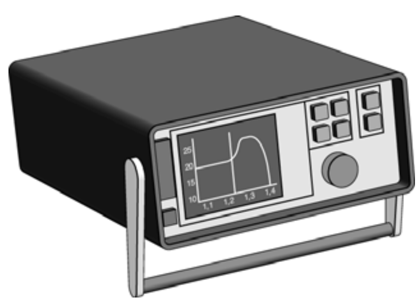


Figure 81. Example of an optical time domain reflectometer.

It is necessary to disconnect fiber units (RPFMs) from the fiber cable before it can be tested.

From the traces the following information can be obtained:

- Total distance along the cable to the other end or to a fiber break.
- Distance to an event which attenuates the light, such as a splice, a bend, or a connector. Also the distance between two such events can be measured.
- Light attenuation between two points of the cable.
- Total reflected light or light reflected from a single event.

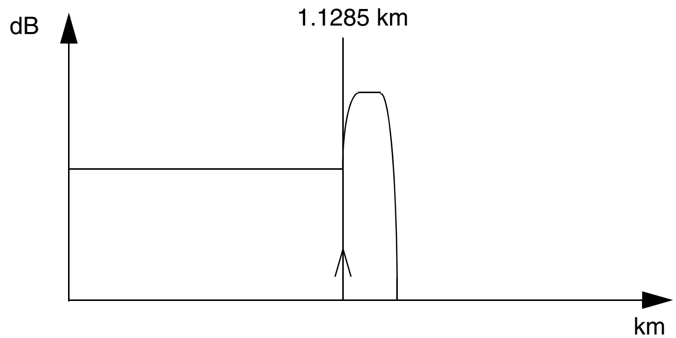


Figure 82. Trace with the marker indicating the total cable length.

Keep records of the traces for each cable section strand in form of hardcopy printouts or disk files. This is invaluable for future maintenance and troubleshooting of the network. Observe "Documentation and Verification" on page 98.

OTDR instruments differ regarding features and benefits. Some offer, for instance, built in printer and software for trace analysis and trace comparison.

ControlNet Fiber Units

The fiber repeater adapter (RPA) and the fiber repeater unit (RPFM or RPFS) are used to incorporate fiber optic links on a coax network. They are mounted on a DIN rail 35×7.5 mm according to the EN 50022 standard.

1. Position the unit at a 30° angle. Hook the lip at the rear of the unit onto the top of the DIN rail, and rotate the unit onto the rail.

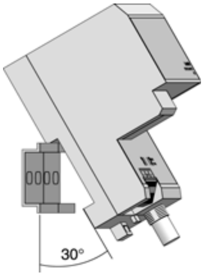


Figure 83. Installing ControlNet fiber units, step 1.

2. Press the unit down to the DIN rail until flush. The locking tab should snap into position and lock the unit to the DIN rail. If not, use a screwdriver to move the locking tab down while pressing the unit. Release the locking tab to lock the unit in place. If necessary, push up on the locking tab to lock.

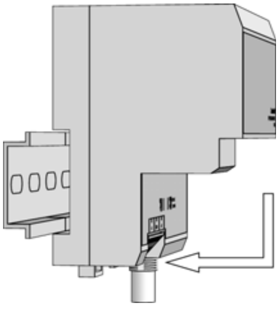


Figure 84. Installing ControlNet fiber units, step 2.

3. Up to four repeater units can be mounted on the DIN rail and plugged together with the repeater adapter. Remove the protective backplane caps from the connectors that will be used. Attach a repeater unit to the rail and slide it to the left to mate with the repeater adapter or another repeater unit, see Figure 85.

Make certain that the adapter and repeater units are secured together with DIN rail anchors. Failure to do so may result in the loss of communications and/or cause damage to the units.

Do not insert or remove units with power connected to the attached repeater adapter.

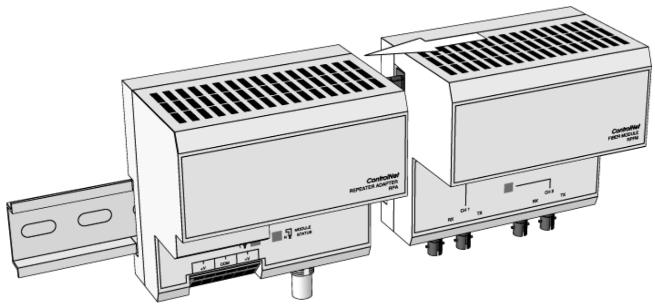


Figure 85. Installing ControlNet fiber units, step 3.

When installing the units, observe the environmental specifications in Appendix C, Technical Specifications. Also avoid high electrostatic and electromagnetic fields, corrosive and inflammable gases, dust, conductive particles, oil mist and organic solutions. The units must not be exposed to water or to direct sunlight. It is recommended to mount the units in an enclosure, for instance type NEMA. Allow for a minimum space of 5 cm from surrounding equipment to achieve proper ventilation.

The total number of units that can be attached to the repeater adapter can not exceed four or the total power consumption of the units can not exceed 1.6 A at 5 V DC, whichever comes first.

If you exceed the unit or power limit, you may cause damage to the repeater adapter and units.

Repeater Adapter RPA

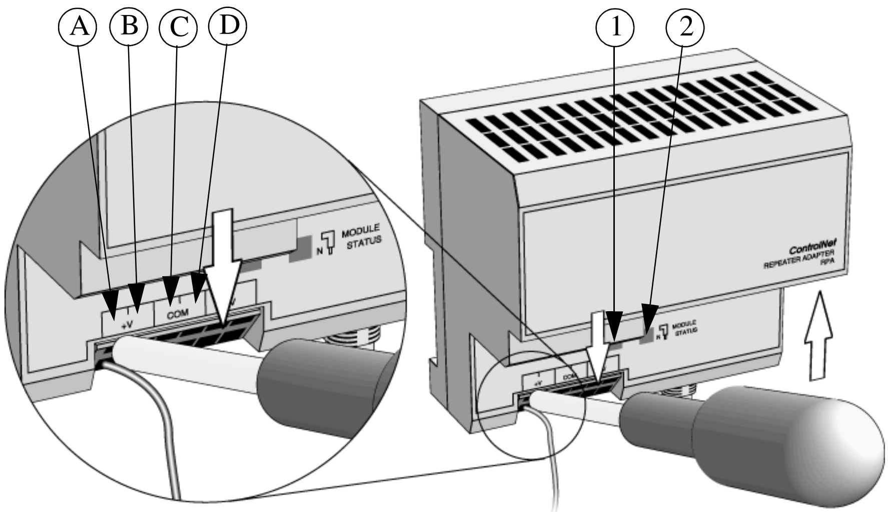


Figure 86. Power terminals A-D, and indications for coax connector (1) and fiber channels (2).

To connect the adapter:

1. Connect the coax network drop cable to the BNC connector.
2. Connect the +24 V DC input to terminal A of the connector by inserting a screwdriver into the slot and prying up so the clamp is opened enough to accept the wire.
3. In the same way, insert the common wire into terminal C.
4. Terminals B (+24 V DC) and D (common) can be used to pass the power to other units. Terminals E and F are reserved for future use.

Make sure all fiber units are attached and secured prior to applying power to the adapter.

Fiber Units RPFM and RPFS

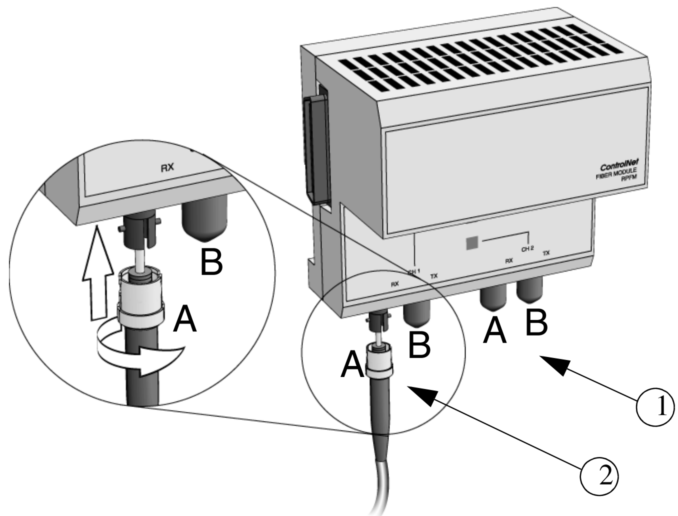


Figure 87. Fiber channels (1) and (2), receive connectors (A) and transmit connectors (B).

To connect the unit:

1. Remove the protective caps from the fiber connectors that will be used and save the caps in a clean place for future use.
2. Align the knob of the ST cable connector with the groove of the receive connector A, insert it and turn to lock it.
3. In the same way, insert the relevant cable connector into the transmit connector B.
4. Connect the other ends of the fiber cable to channel 1 or 2 of another fiber unit.

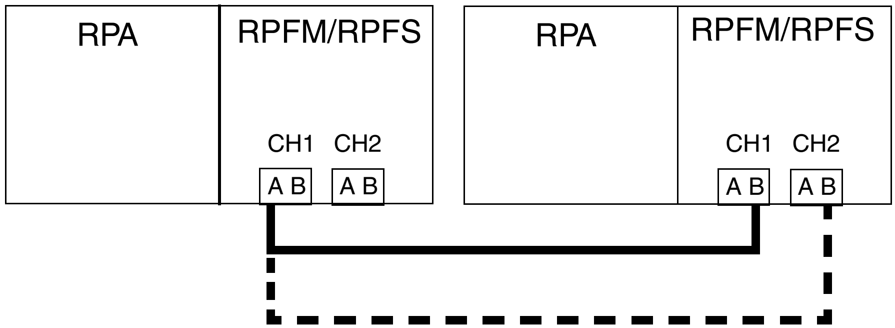


Figure 88. Connection of two fiber units.

Be sure the fiber connected to A (receive) on one RPFM or RPFS is connected to B (transmit) on the other RPFM. Channel 1 or channel 2 can be used on either unit. Never connect the fiber cable between channel 1 and 2 on the same RPFM, or between channels on different RPFMs attached to the same RPA.

Installing Fiber Repeaters, Example 1

The configuration below is equivalent to example 1 on page 104, but with fiber repeaters instead of coax repeaters.

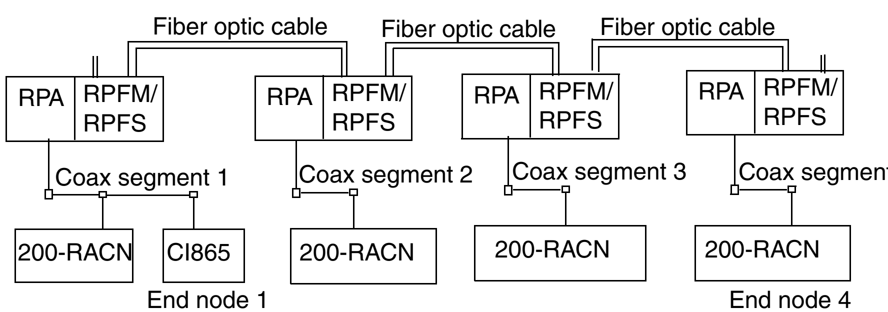


Figure 89. Installing fiber repeaters, example 1

In this network example:

- Coax segments are 300 m each,
- fiber optic cables are 4.8 km each,
- the cable length between end nodes is 15 km,
- there are 4 repeaters in series.

Table 11 indicates 83 µs propagation delay. Since one node is 200-RACN, network update time (NUT) must be set to 5 ms. If the highest node address (S_{max}) is 10, Table 12 indicates a maximum allowed propagation delay of 106 µs, which is above the actual value.

Installing Fiber Repeaters, Example 2

The configuration below is equivalent to example 2 on page 105, but with fiber repeaters instead of coax repeaters. The repeater hub (4) is the center of the star configuration, corresponding to the segment 4 on page 105.

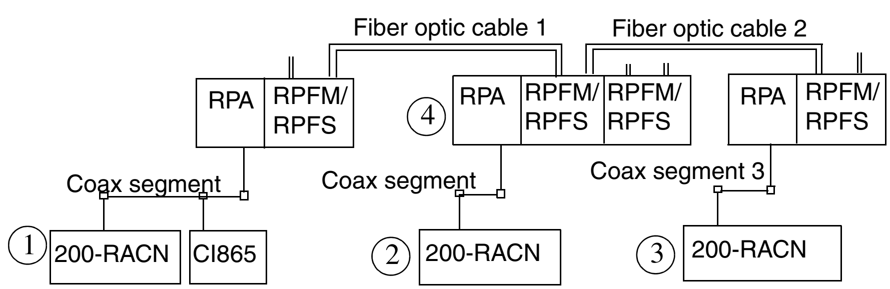


Figure 90. Installing fiber repeaters, example 2

In this network example:

- Coax segment 1 and 2 are both 500 m,
- coax segment 3 is 100 m,
- fiber optic cable 1 is 3 km,
- fiber optic cable 2 is 100 m.

The total cable length between fiber units (1) and (3) is 3.7 km with 3 repeaters in series. The longest (and relevant) cable distance is however between fiber units (1) and (2). The total cable length between these units is 4 km and there are 2 repeaters in series. Table 11 indicates 25 µs propagation delay.

If network update time NUT = 5 ms, the highest node address allowed is S_{max} = 32, indicated by Table 12, or the formula on page 79:

$$\text{Max. allowed propagation delay} = 225\times(5/32) - 6.4 = 25{,}7\ \mu s$$

Note that the CI865 does not allow more than 32 nodes (where each node must be designated a unique address between 01 and 99) and that S_{max} should be kept as low as possible to optimize network performance.

Connecting the Satt I/O Units and CI865

This section describes how to connect the ControlNet to the BNC connector of the I/O systems and the CI865.

The BNC connector is located:

- Rack I/O - at the rear of the 200-RACN unit, see Figure 91.
- Series 200 I/O - at the front of the 200-ACN unit, see Figure 92.
- CI865 - at the front of the CI865 unit.

1. Select a suitable location for the tap within one meter from the ControlNet BNC connector. When selecting the tap location, keep in mind the routing of the drop and trunk cables. They should not be routed close to high-voltage cables. Avoid bending the trunk cable too much. Distance from high-voltage cables and other important information about ControlNet installation is given in Section “Application Installation Considerations” on page 66.
2. The tap can be mounted in various ways, for example using a DIN rail or screwed into a suitable structure, see Figure 91 for an example. Even if the tap is not mounted on a DIN rail, the universal mounting bracket should be used to avoid galvanic connection to a conducting structure. For example, the tap can be mounted on the cabinet door frame on the side of the frame that is closest to the cabinet hinge, see Section “Mounting the Taps” on page 81.

3. Connect the tap drop cable to the BNC connector. Before starting up the system, all ControlNet cable connections should be tested. Check the pulling strength of applied connectors. Test for short circuits and open circuits using resistance measurements.

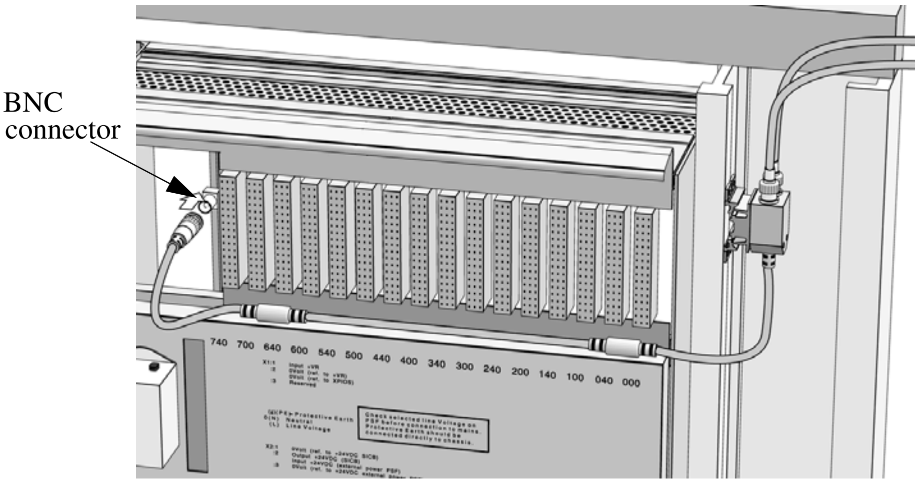


Figure 91. Mounting of the ControlNet tap and the connection to 200-RACN.

4. Define the network node address:

- Rack I/O - by turning the two switches (x10 and x1) on front of the 200-RACN unit to the correct position. A node address in the range 02-99 should be selected for the 200-RACNs, see Section “Rack Adapter Board, 200-RACN” on page 121. Example: Node address 04 should be defined. Set the switch ”x10” to 0 and switch ”x1” to 4.
- Series 200 I/O - by clicking the push button switches on the front of the 200-ACN unit, see Figure 92. A node address in the range 02-99 should be selected for the 200-ACNs.
- CI865 - The node address is fixed to 01.

It is highly recommended to select addresses in a consecutive manner to minimize network load, see “Node Address Switches” on page 123.

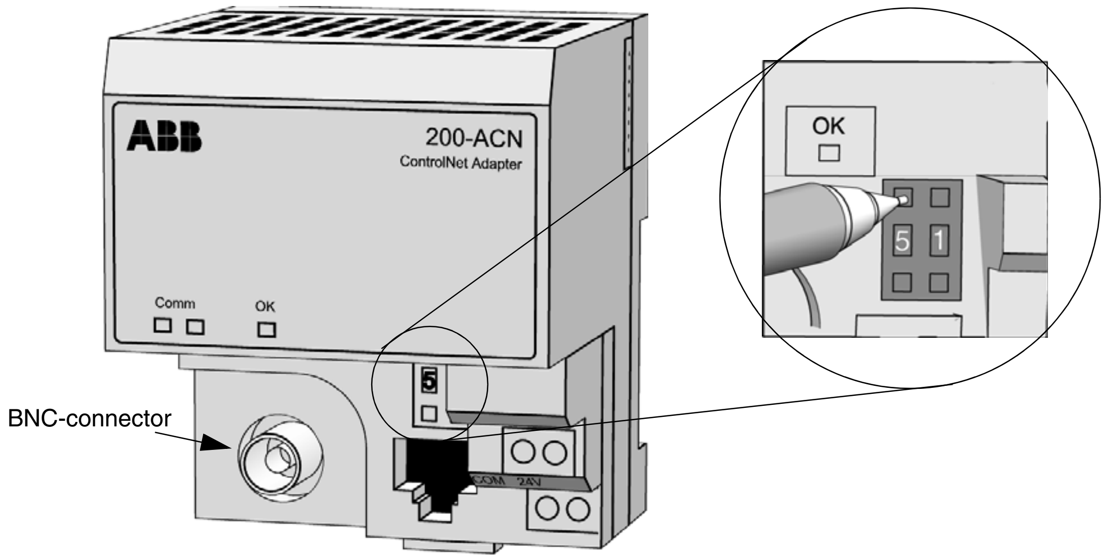


Figure 92. The push button switches on the 200-ACN to change its node address.

Appendix A Limitations

ControlNet

- A maximum of 32 nodes per network is allowed: The CI865, the 200-ACN adapters (slaves) and the rack-based 200-RACN can share these number of nodes.
  - One (1) ControlNet node must be assigned for the CI865 unit.
  - A maximum of eight (8) nodes can be assigned for 200-RACN.
  - The remaining nodes can be assigned to the 200-ACN.
  - Each node must be designated a unique address. The node address 01 is reserved for the CI865. The 200-RACN nodes and 200-ACN nodes can be addressed between 02 and 99.
- Maximum cable length without repeaters:
  - 1000 meters with coax cable.
  - Fiber optic links can be included to increase network length and obtain galvanic isolation. The length can be increased to about 7000 meters.
- Number of repeaters:
  - 5 (maximum) in series
  - 6 segments (5 repeaters) in series
  - 48 segments in parallel
- Maximum cable length with repeaters:
  - 5000 meters (coax) at 5 Mbit/s
  - At least 30 km (optical fiber)

Support for Rack I/O

Every rack gets the same settings of the I/O board addresses. All other methods of I/O board addressing than described in the subsection I/O Addressing on page 49 are not supported. This prerequisite affects expansion I/O racks (racks equipped with PBAD or PBX units) and I/O racks equipped with SLS which are not supported by Satt ControlNet. When the PBAD and PBX units are replaced with 200-RACN units the I/O board addresses may need to be changed to fit the supported addressing method.

EtherNet/IP Limitations

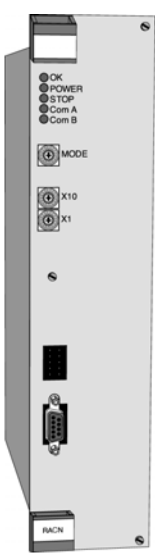
Refer to the *AC 800M EtherNet/IP DeviceNet Configuration (9ARD000014*)* manual for limitations.

Appendix B I/O Board Installation and Function

This appendix describes the installation and function of the I/O boards and other units to be used with the rack-based I/O system. See Rack I/O section of Appendix C, Technical Specifications for additional technical information about the I/O boards.

Because of the risk of electrostatic discharge, we recommend that you wear an ESD bracelet when handling the boards.

Rack Adapter Board, 200-RACN



The rack adapter board, 200-RACN, handles the communication between system AC 800M and the remote rack-based I/O system via ControlNet.

There are two versions of the rack adapter board: 200-RACN and 200-RACN/A. The latter is equipped with a central A/D converter (ADSF). It is used if analog signals are to be connected to the I/O system.

A 200-RACN (or 200-RACN/A) can control 16 Rack I/O boards corresponding to 512 digital I/O signals.

The power supply part of 200-RACN (200-RACN/A) takes its power from the power supply PSF, and generates the required internal voltages.

The 200-RACN (200-RACN/A) board should be fitted between the last I/O board position and the PSF power supply unit in the central rack.

Indicators

Indicator	LED status	Function
OK	Off	No power or reset
	Flashing green	Self-test OK but no connection established with the system.
	Solid green	On-line, link OK, connected.
	Flashing red	Recoverable fault, e.g. erroneous board configuration is detected.
	Solid red	Self-test error, rack error or I/O board error.
		Note 1: OK indication will be lit at start up during self-test.
		Note 2: If an I/O board- or I/O rack error is detected, the I/O copy will be terminated. Then the STOP indication will also be lit.
POWER	Off	Power off
	Solid green	Power applied
STOP	Off	I/O copy running
	Solid red	No I/O copy is performed, i.e. I/O copy has not started yet, or watchdog time-out due to hardware failure.
Com A and B simultaneously	Off	No power or reset
	Flashing red-green	200-RACN self-test
	Flashing red	Node configuration error, i.e. duplicated node address.
	Solid red	Hardware failure
Com A (B disabled)	Off	No power or reset
	Solid green	Channel OK
	Flashing green	Temporary network error (communication error or network configuration not downloaded.
	Flashing red	Cable fault or lone node
	Solid red	Board failure

Mode switch

For normal applications there is no choice. The switch must always be in position 0 (the other positions are used for test purposes).

Node Address Switches

The network node address is defined by 2 rotary switches. The address can be set between 02 and 99. It is recommended that addresses be selected in a consecutive manner, i.e. 02, 03, 04 etc.

Indication	Function
X10	Most significant part of node address
X1	Least significant part of node address

The node address 01 can physically be set on the rotary switch, but must not be used, since it is used by the CI865.

Connections

- 200-RACN is connected to ControlNet through the BNC coaxial connector located at the rear of the board.
- A 9-pin female D-sub type connector on the front may be used for asynchronous serial RS232 communication. It is used for test purposes and fault diagnosis.

Pin	Function
2	Receive data (out)
3	Transmit data (in)
5	Ground
7	Request to send (out)
8	Clear to send (in)
1, 4, 6, 9	Not connected

- Network Access Port, NAP with an RJ-style connector. It is used for test purposes and is normally unconnected.

Mounting the Analog-to-digital Converter, ADSF

When analog signals are processed, ADSF is used to convert the analog signals to digital signals. ADSF is mounted on the lower part of the rack adapter board, 200-RACN, see Figure 93.

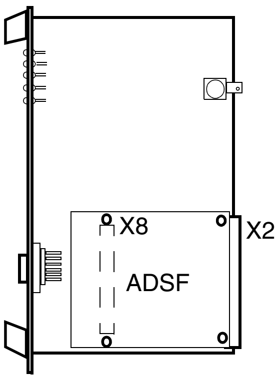


Figure 93. ADSF - analog-to-digital converter mounted on rack adapter board, 200-RACN.

Proceed as follows to mount ADSF on the rack adapter board, 200-RACN:

1. Loosen the two screws in the distance pillars on each side of the X2 connector.
2. Position ADSF over the X8 connector on the 200-RACN board and press firmly to ensure proper contact with the connector pins. The component sides of the boards must be facing each other.
3. Tighten the two screws in the distance pillar so that the ADSF board is held firmly in position.

Power Supply Unit, PSF

PSF is a power supply unit for the PIOS35 rack. The unit can be powered either by a 230 V AC or a 24 V DC supply and produces outputs of 5 V DC and 12 V DC, together with a power failure signal. The maximum load when supplied with 230 V AC is
50 W, and the maximum load when supplied with 24 V DC is 70 W.

Indicators

The front panel includes indicators for the +5 V, +5 VL and +12 V supplies and a Power Failure indicator which lights up when the power supply falls below the permitted lower limit.

Indicators	Function
+5V	Green when the supply voltage is present.
+5VL	Green when the supply voltage for LED’s on I/O board is present.
+12V	Green when the supply voltage is present.
POWER FAIL	Red when input power is low.

Connections

For connection of the mains supply cables on the rear of the rack, see "Handling the Mains Supply", on page 51. PSF is connected automatically after being mounted and secured in the extreme right rack position.

Description

PSF is a power supply unit which is supplied either from the mains via a toroid transformer, or from a separate 24 V DC power unit.

There is no galvanic separation for a 24 V DC source but a mains supply source is separated by the transformer.

The voltage regulators are mounted on the front panel which serves as a heat sink.

Test points for the +5 V DC, +5 VL and +12 V DC outputs are provided on the front panel.

Mains Supply Selection for PSF

There are two holes on one side of the PSF power supply unit. The lower hole provides access to a screw used to set the mains supply voltage for PSF to 110, 220/230 or 240 V. The selected mains supply is indicated in the other hole.

Switch off the mains supply voltage power before any operation with this unit.

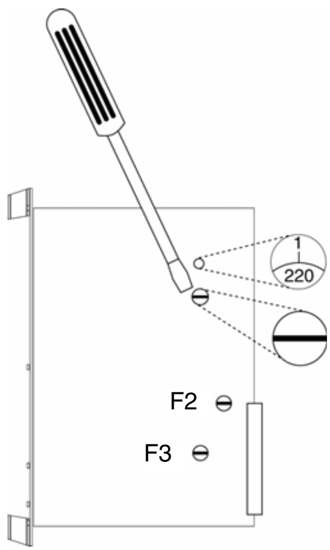


Figure 94. PSF mains supply selection.

Protection Circuits

The mains supply is protected by a 0.8 AT IEC 5x20 mm fuse. If a 110 V AC supply is used, the fuse must be exchanged for a 1.6 AT IEC fuse. The fuse (F1) is fitted on the front panel for easy access. The secondary side of the mains transformer is protected by a 5 AT IEC 5x20 mm fuse. This fuse (F2) is fitted on the side of PSF.

A 24 V DC source supply is protected by a 4 AT IEC 5x20 mm fuse. This fuse (F3) is also fitted on the side of the PSF.

The PSF has semiconductor over-voltage protection for the +5 V DC, +5 VL and +12 V DC supplies.

Digital Input Boards, IDPG24 and IDPG48

IDPG is a digital input board for 32 DC inputs using positive logic. The inputs are galvanically separated using optocouplers. The board is available in two versions for signal levels of 24 and 48V.

IDPG may be used in applications where the 0 V level of the process is not connected to the 0 V level of the system, or where there is a special requirement for galvanic signal separation. IDPG is used to interface signals from devices such as limit switches, photocells, etc.

Indicators

The state of each input is indicated by a LED on the front panel. This is lit when the input is activated. The address of each input is shown next to the LED.

Switch

The switch on the front panel should normally be in the ”I” position. When the board is installed or exchanged, the switch should be in the ”0” position. The input status is then frozen in the central unit.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

Pin	d	b	z
	Input number		
2	01	0 V(1)	00
4	03	0 V(1)	02
6	05	0 V(1)	04
8	07	0 V(1)	06
10	11	0 V(1)	10
12	13	0 V(1)	12
14	15	0 V(1)	14
16	17	0 V(1)	16

18	21	0 V(1)	20
20	23	0 V(1)	22
22	25	0 V(1)	24
24	27	0 V(1)	26
26	31	0 V(1)	30
28	33	0 V(1)	32
30	35	0 V(1)	34
32	37	0 V(1)	36

(1) Separated 0 volt for each pair of inputs (00-01, 02-03…), see Figure 95.

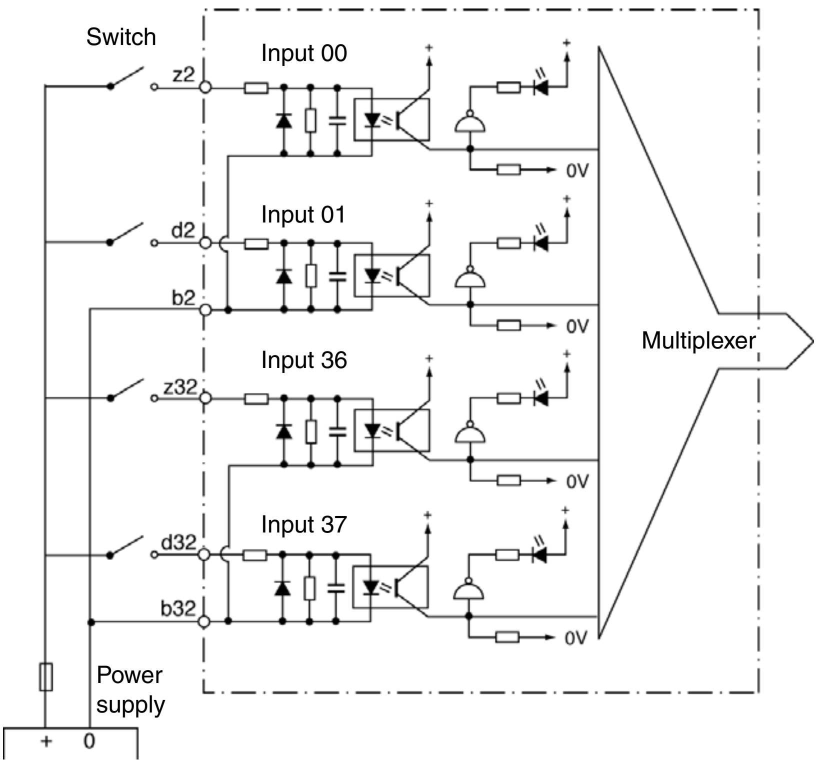


Figure 95. Block diagram IDPG24 or IDPG48.

Digital Input Board, IAPG230

IAPG230 is a digital input board for 16 AC inputs (230 V) using positive logic. The inputs are galvanically separated by optocouplers.

IAPG230 is used to interface signals from devices such as power switches, relay contacts, etc.

Indicators

The state of each input is indicated by a LED on the front panel. This is lit when the input is activated. The address of each input is shown next to the LED.

Switch

The switch on the front panel should normally be in the ”I” position. When the board is installed or exchanged, the switch should be in the ”0” position. The input status is then frozen in the central unit.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves

Pin	d	b	z
	Input number		
2	00		00
4	01		01
6	02		02
8	03		03
10	04		04
12	05		05
14	06		06
16	07		07
18	10		10

20	11		11
22	12		12
24	13		13
26	14		14
28	15		15
30	16		16
32	17		17

Safety Precautions

For safety reasons, - and in order to meet the Low Voltage Directive, the following precautions must be taken in the application.

- Different input channels on the same board must not be used for connections to different phases on the mains! Maximum voltage difference between the terminals may not exceed 300 V AC.
- The clearance and creepage distance between individual channels is on1y 1.6 mm (minimum), compared with 3.2 mm, which is the minimum spacing between process I/O and the internal logic of the board.

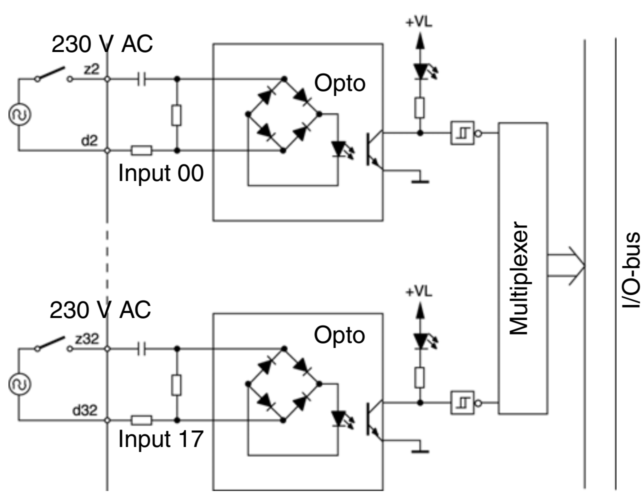


Figure 96. Block diagram IAPG230. The d-pins can be tied together if a neutral reference is required.

Digital Output Board, ODPG.8

ODPG.8 is a digital output board for DC voltage with 32 optocoupled outputs, divided into four separate groups of eight. The maximum output capacity is 0.8 A per output, subject to a maximum of 3.2 A per group, and 8 A for the entire board.

ODPG.8 is constructed for supply voltages between 10 and 60 V. Since the four groups are completely separated from each other, it is possible to use four different supply voltages for the same board.

Several outputs can be connected to the same load if they are fed from the same voltage source. If not, a protective diode is required in series with the output.

Fully loaded boards should preferably not be fitted next to each other in the rack. If this cannot be avoided the rack may be fitted with a cooling fan. See ”Operating temperature” in "General Technical Specifications", on page 185.

Indicators

There are 32 red LED's on the front of the board for status indication of their outputs. The octal address of the output is marked next to each LED.

Switch

Normally, the switch on the front panel should be in the ”I” position.

When the board is installed or exchanged, the switch should be set to the ”0” position. In this position, the outputs are reset to zero.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

Ground Reference

0 V DC for the outputs and supply must be referenced to ground, either directly or through a bipolar capacitor of 0.01 µF and with a voltage rating above the potential

difference between 0 V DC and ground (e.g. use Phoenix TT-SLKK 5-C 12n 230 AC). This is required to meet the specified interference standard.

Pin	d	b	z	Comments
2 **4**	01 03	+U 00 - 07	00 02	b2-4 power supply for output 00-07
6 **8**	05 07	10- 17	04 06	b6-8 power supply for 10-17
10 **12**	11 13	20- 27	10 12	b10-12 power supply for 20-27
14 **16**	15 17	30 - +U 37	14 16	b14-16 power supply for 30-37
18 **20**	21 23	0 V 00- 07	20 22	b18-20 0 V for output 00-07
22 **24**	25 27	10- 17	24 26	b22-24 0 V for 10-17
26 **28**	31 33	20- 27	30 32	b26-28 0 V for 20-27
30 **32**	35 37	30- 0 V 37	34 36	b30-32 0 V for 30-37

Figure 97. Connector X1. Max. 5 A may go through a pin in the X1 connector.

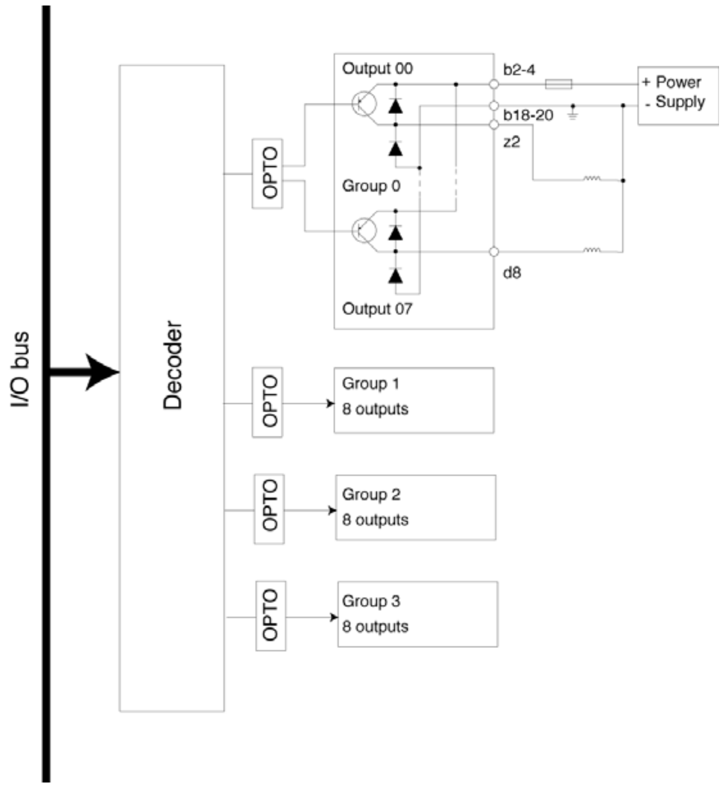


Figure 98. Block diagram ODPG.8

Relay Output Board, ORG24

ORG24 is a digital output board with 16 relay outputs. The relays have single-pole change-over contacts and are provided with varistor protection.

The supply voltage to the relay coils (24 VDC) is connected to a terminal marked VR (voltage relay) located at the rear of each rack and always has an external supply.

Indicators

There are 16 red LEDs on the front of the board which indicate output status. The octal address of the output is marked beside each LED.

Switch

The switch on the front panel should normally be in the ”I” position.

When the board is installed or replaced, the switch should be in the “0” position. In this position, the outputs are set to zero.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

Pin	Output number (octal)		
	d	b	z
2	00	00	00
4	01	01	01
6	02	02	02
8	03	03	03
10	04	04	04
12	05	05	05
14	06	06	06
16	07	07	07
18	10	10	10

20	11	11	11
22	12	12	12
24	13	13	13
26	14	14	14
28	15	15	15
30	16	16	16
32	17	17	17

X1 connector

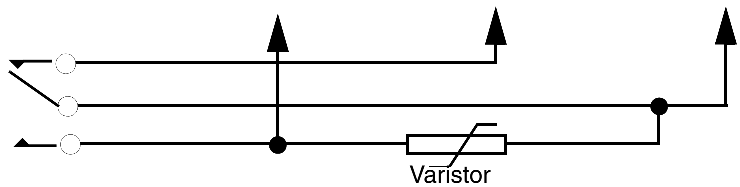


Figure 99. Scheme for X1 connector

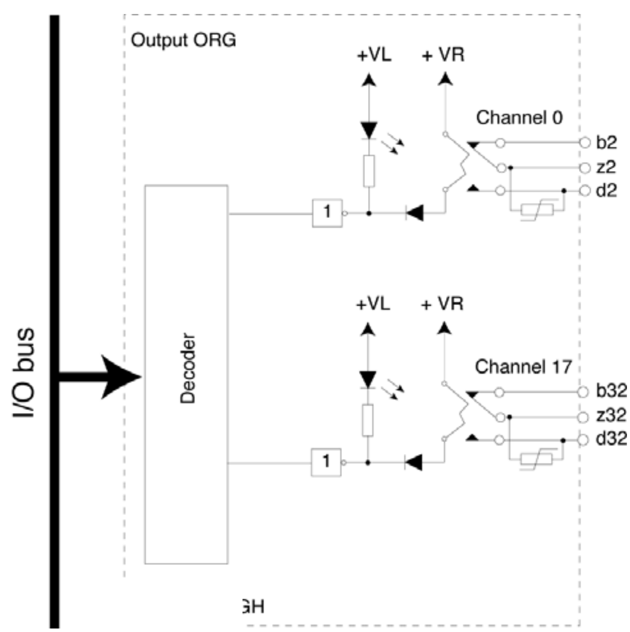


Figure 100. Block diagram ORG24

Safety Precautions

For safety reasons, and in order to meet the low voltage directive, the following precautions must be taken.

- Relay channels on the same board should not be connected to signals which (due to different voltage ranges) have to be separated from each other, as the clearance and creepage distance between individual channels is only 1.6 mm compared with 3.2 mm, which is the minimum spacing between process I/O and the internal system logic.
- Special care must be taken if different relays are to be used for 230 V AC mains and 24 V DC. This is especially important if the 24 V DC is not separated from the system internal 0 V.
- Relays on the same board must not be used to control outputs connected to different phases of the mains! Maximum voltage difference between terminals may not exceed 300 V AC.
- Field wiring should be connected via (terminal block) fuses to limit the circuit current in case of a short circuit situation.

Digital Output Board, Short-circuit-proof, ODSG

ODSG is a digital output interface board with two groups of 16 optocoupled outputs powered by an external supply. Each group is monitored by an overload/short-circuit-detection bistable circuit, which produces a fault signal and fault indication when an overload or short-circuit occurs at any output in the corresponding group. The maximum load is 0.8 A for each output and 16 A for the complete board.

ODSG is intended for loads such as lamps, relays, solenoid valves etc.

- The board includes short-circuit and overload protection.
- Overload /short-circuit faults can easily be monitored by connecting the fault bistable circuits to, for example, a supervisory system.
- Outputs can be connected in parallel.
- The outputs are ideal for driving lamps and capacitive loads.

ODSG is designed for a supply voltage of +19 V to +30 V DC. The same power supply unit must be used for both groups. The unit must have a rating of at least 10 A and must not include any foldback current limitation. The galvanic separation is between the outputs and the system electronic circuits.

Fully loaded boards should preferably not be fitted next to each other in the rack. If this cannot be avoided the rack may be fitted with a cooling fan. See ”Operating temperature” in "General Technical Specifications", on page 185.

Indicators

The octal address of each output is shown on the front panel next to the LED that lights up when the corresponding output is active, provided the external supply is applied (green LED PWR lit).

When an overload or short-circuit occurs, the LED for the corresponding channel dims. If the Man/Auto input is high (+24 V), fault output F00 (group 0-17) or F20 (group 20-37) also goes high and a yellow fault LED for the group lights up.

The fault bistable circuit is reset to cancel the fault signal when the Man/Auto signal remains low for at least 2 ms provided:

- The overload or short-circuit has ceased
- The output is switched off
- The fault bistable circuit is switched to ”off”

If the fault bistable circuit is not reset, no further faults can be detected. Fault detection can be inhibited by setting the Man/Auto input to 0 V or by leaving it disconnected.

Switch

The change-over switch on the front panel should normally be in the ”I” position. When the board is installed or replaced the switch is set to the ”0” position to maintain the outputs and fault bistable circuits in a reset status.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected, by means of crimp sleeves, to the X1 connector on the I/O rack.

d	b	z	Pin
01	+24V	00	2
03	+24V	02	4
05	+24V	04	6
07	+24V	06	8
11	+24V	10	10
13	+24V	12	12
15	F00	14	14
17	F20	16	16
21	Man/Auto reset F00	20	18
23	Man/Auto reset F20	22	20
25	0V	24	22
27	0V	26	24
31	0V	30	26
33	0V	32	28
35	0V	34	30
37	0V	36	32

Output

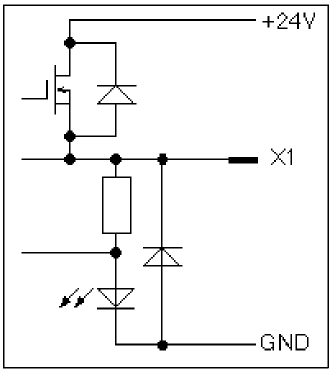


Figure 101. Connector X1 pin assignment and output block diagram ODSG.

Ground Reference

0 V DC for the outputs and supply must be referenced to ground, either directly or through a bipolar capacitor of 0.01 µF ±20% and with a voltage rating above the potential difference between 0 V DC and ground (e.g. use Phoenix TT-SLKK 5-C 12n 230AC). This is required to meet the specified interference standard.

Pulse Counter Board, IPA4

IPA4 is a digital input board designed to detect and count pulses, which may have a frequency higher than the cycle time of the connected PLC system. The board fits into any slot intended for I/O boards in a standard rack-based I/O system from ABB Automation.

Features

- IPA4 has 4 inputs, each with an 8-bit counter capable of counting up to 255 pulses.
- The inputs can be combined in pairs of two 16-bit counters with a capacity of up to 65535 pulses.
- To suppress electrical interference, transmitters with complementary signals should be used.
- Phase displaced pulse trains can be used for up/down counting.
- The counters can be started, stopped and reset individually.
- The common signal reference voltage level can be adjusted.
- Detection of positive- and/or negative edges can be selected individually for each input.
- Pulse frequencies up to 10 kHz can be detected.

Applications

- Pulse detection/pulse counting
- Quantity counting
- Positioning
- Speed calculation

Front panel

The four counter channels are numbered 0 - 3 and have two inputs each, A and B, with LED indicators on the front panel. The inputs A and B can be combined in different ways, for instance to record movements in two directions. The counter channels also have gate inputs, 0G - 3G to start and stop the counting, and clear inputs 0C - 3C to reset the respective counter. The change-over switch is normally in the operating “I” position. The “0” position resets all the counters. A potentiometer marked “REF” and measurement sockets marked “+” and “0 V” are used to adjust the internal comparator reference voltage, which is common to all the counter channels.

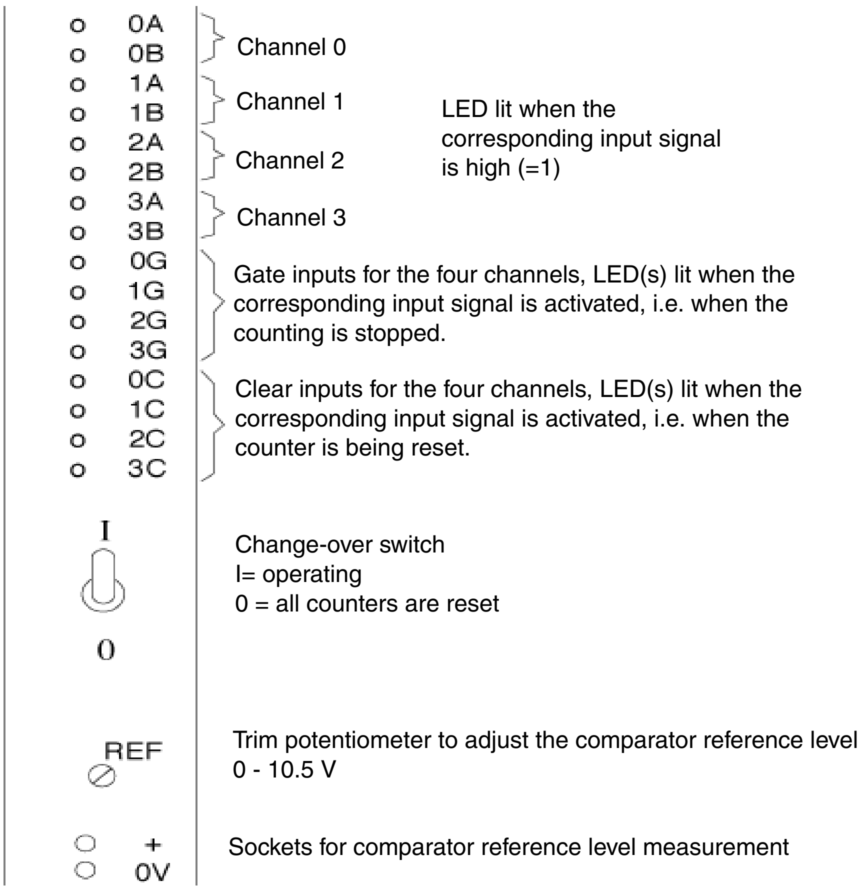


Figure 102. IPA4 front panel

Input Circuits

All the inputs are provided with comparators for transmitters with complementary signals, which provides a means of effectively suppressing electrical noise. The complementary (inverted) signals of 0A, 0B, 0G and 0C are designated $\overline{0A}$, $\overline{0B}$, $\overline{0G}$ and $\overline{0C}$, respectively.

For complementary transmitters, the jumpers (1) or (2) must be in the position Ext. ref (see Figure 103 on page 143 and Figure 104 on page 148), and the logic status is changed when the input signal and its inverse change polarity.

For non-complementary transmitters, the input signal is compared with the common reference voltage, which can be measured across the sockets on the front panel and adjusted by means of the potentiometer. The corresponding jumper (1) or (2) must be in the position Adj ref. The transmitter signal is connected between input A (or B, G, C) and the signal ground of the rack system. If the inverted signal input ($\overline{A}$, $\overline{B}$, $\overline{G}$ or $\overline{C}$) is left unconnected, maximal input impedance is obtained (see Figure 103 and Figure 104).

The input impedance can be matched to the output impedance of the transmitters by means of the jumpers (3). Closing the jumper changes the impedance from 1 kΩ to about 90 Ω. If one of these input values is desired for non-complementary transmitters, the inverted input ($\overline{A}$, $\overline{B}$, $\overline{G}$ or $\overline{C}$) should be connected to the signal ground (see Figure 104).

All unused A and B inputs must be connected directly to the signal ground. If inputs A and B are left unconnected, the jumpers Adj ref are closed and the reference voltage is adjusted to > + 1 V, the comparator will not generate pulses due to electrical noise (see Figure 104).

Unused inputs G, $\overline{G}$, C and $\overline{C}$ can be left unconnected if the jumpers (2) Adj ref and Ground ref are closed and the reference voltage is adjusted to > +1V (see Figure 104).

The input signals are evaluated at a frequency of about 50 kHz.

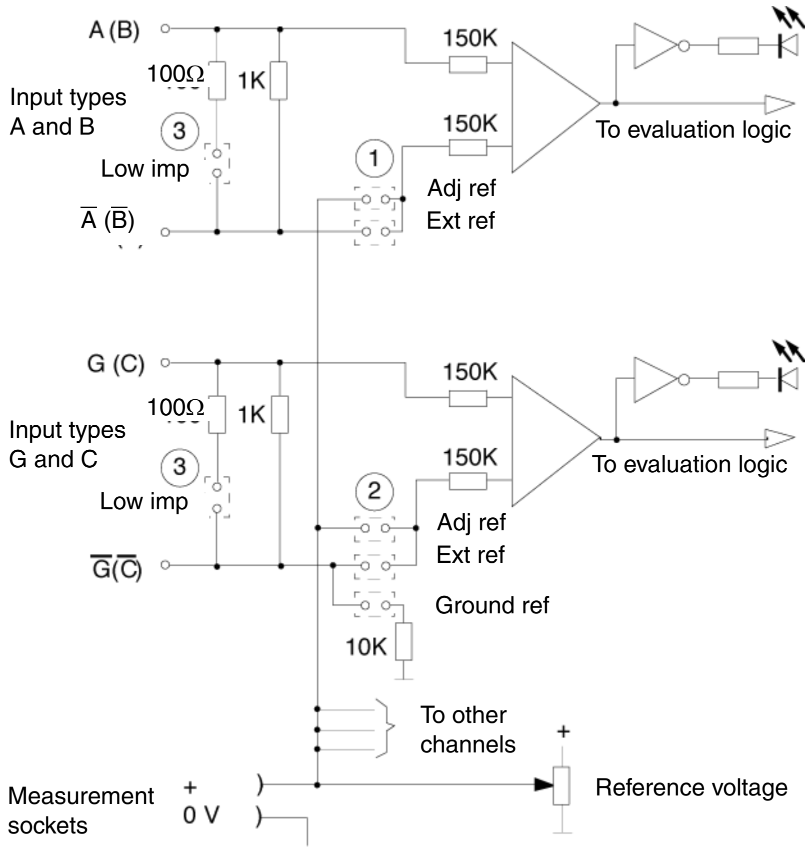


Figure 103. Input circuits, block diagram

Evaluation Logic

The logic signals A and B from the comparators are stored in a memory. They are used to detect status changes between the read cycles. The incoming pulses are combined in different ways by the evaluation logic, depending on the mode selected by means of the DIP switches (5), see Subsection "Board Layout", on page 150. Up/down pulses are sent to the four counters from the logic.

The input signal A, or the combination of A and B signals if they are dependent, must be guaranteed stable for at least 25 µs to be detected correctly by the evaluation logic.

Input signals must be stable for at least 25 µs to be detected correctly.

The 8-bit counters for channels 0 and 1 can be combined into one 16-bit counter by means of jumpers (6). In this case, the inputs 0A and 0B are not used. In the same way, channels 2 and 3 can be combined, while the inputs 2A and 2B are left unused. Note that both inputs 0C and 1C must be activated to reset the first 16-bit counter, and both inputs 2C and 3C to reset the second one. To stop the counters, use inputs 1G and 3G, respectively.

Both clear inputs must be activated to reset a 16-bit counter.

The different counting modes are described in the table below. "↑" means counting up, and "↓" means counting down.

Mode	Description
1111	Only if B=0: ↑ Positive edges from signal A ↓ Negative edges from signal A
1011	↑ Positive edges from signal A if B=0, negative if B=1 ↓ Positive edges from signal A if B=1, negative if B=0
1101	Edges from both signals A and B are counted: ↑ Positive edges from signal A if B=0, negative if B=1 ↑ Positive edges from signal B if A=1, negative if A=0 ↓ Positive edges from signal A if B=1, negative if B=0 ↓ Positive edges from signal B if A=0, negative if A=1
1110*	↑ Positive edges from signal A if B=0 ↓ Positive edges from signal A if B=1

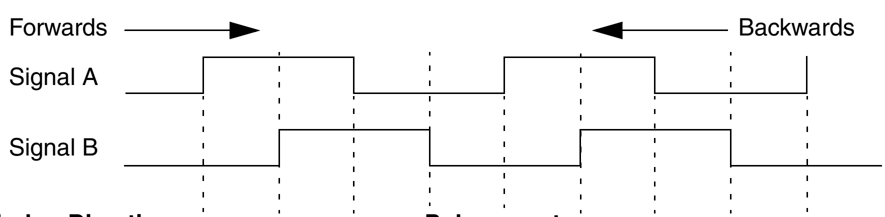
Mode	Description
0110	↑ Positive edges from signal A irrespective of B
1010	↓ Positive edges from signal A irrespective of B
0010	↑ Positive and negative edges from signal A irrespective of B
1100	↓ Positive and negative edges from signal A irrespective of B
0100*	↑ Positive and negative edges from both signals A and B
1000*	↓ Positive and negative edges from both signals A and B
0000	↑ Positive edges from signal A irrespective of B ↓ Positive edges from signal B irrespective of A

*Changes in the signals A and B must be separated by at least 25 µs in time

When the mode number is set on the DIP switch, “1” means “on”.

Mode settings not specified in the table lead to undefined functions.

Example: An incremental disc encoder has two pulse outputs A and B with a phase shift of 90°. When the direction is changed from forwards to backwards, positive edges are changed to negative, and vice versa. Refer to the illustration on the next page.



Mode	Direction					Pulse counts				
1111↑	Forwards	↑				↑				↑
	Backwards	↓				↓				↓
1011	Forwards	↑		↑		↑		↑		↑
	Backwards	↓		↓		↓		↓		↓
1101	Forwards	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Backwards	↓	↓	↓	↓	↓	↓	↓	↓	↓
1110	Forwards	↑				↑				↑
	Backwards			↓				↓		

The evaluation logic can be schematically described as in the table below:

Mode	Signal A Pos. and Neg. edge	Level B	Signal B Pos. and Neg. edge	Level A
1111	↑ ↓	=0 =1		
1011	↑ ↓ ↓ ↑	=0 =1		
1101	↑ ↓ ↓ ↑	=0 =1	↓ ↑ ↑ ↓	=0 =1
1110	↑ ↓	=0 =1		
0110	↑ ↑	=0 =1		
1010	↓ ↓	=0 =1		
0010	↑ ↑ ↑ ↑	=0 =1		
1100	↓ ↓ ↓ ↓	=0 =1		
0100	↑ ↑ ↑ ↑	=0 =1	↑ ↑ ↑ ↑	=0 =1
1000	↓ ↓ ↓ ↓	=0 =1	↓ ↓ ↓ ↓	=0 =1
0000	↑ ↑	=0 =1	↓ ↓	=0 =1

Clear Signals

The counters should not be reset during counting, as incoming pulses may be lost. The clear inputs may, however, be used for instance during calibration. Normally, the counter values are compared with the previous values by the control program, which also detects when the counters pass their maximum values (256 = 0 for 8-bit counters, and 65536 = 0 for 16-bit counters).

Do not reset the counters when counting!

Output Circuits

The counters are addressed from the control system as follows.

Counter type	Input channel No.	Address
4 × 8 bits	0	00-07 (00 is most significant)
	1	10-17 (10 is most significant)
	2	20-27 (20 is most significant)
	3	30-37 (30 is most significant)
2 × 16 bits	1	00-17 (00 is most significant)
	3	20-37 (20 is most significant)

IPA4 is provided with a special output memory to separate the counters from the output circuits. The values from all the counters are instantaneously transmitted to the memory every time the first 4 bits of data are to be read. This ensures that the data from a counter refer to the same point in time and that incoming pulses are not lost because of internal data transfer.

Rack Mounting

The IPA4 board fits into any slot intended for I/O boards in a standard rack-based I/O system from ABB Automation. The upper connector (X1) is used for process signals, and the lower one (X2) connects to the standard backplane of the I/O rack. The board is supplied with 12 V DC by the backplane.

Cable Connection

Twisted-pair cable, with individual shielding for each pair of wires, is recommended. Each pair is used for the signal and its inverse (complementary transmitters), or alternatively, for the signal and the common signal ground (non-complementary transmitters). The shield is to be connected at one end, in the shortest possible way, to the chassis of the rack system. Only if high-frequency interference is a problem, may the shield be connected to ground at both ends.

A spring clamp is enclosed with the board. Use this clamp to connect the signal cable shield to the rack chassis, see "Handling I/O Signal Connections", on page 52.

The connection of complementary signals, non-complementary signals and unused inputs is shown in the illustration below. Refer also to the Subsection "Input Circuits", on page 142.

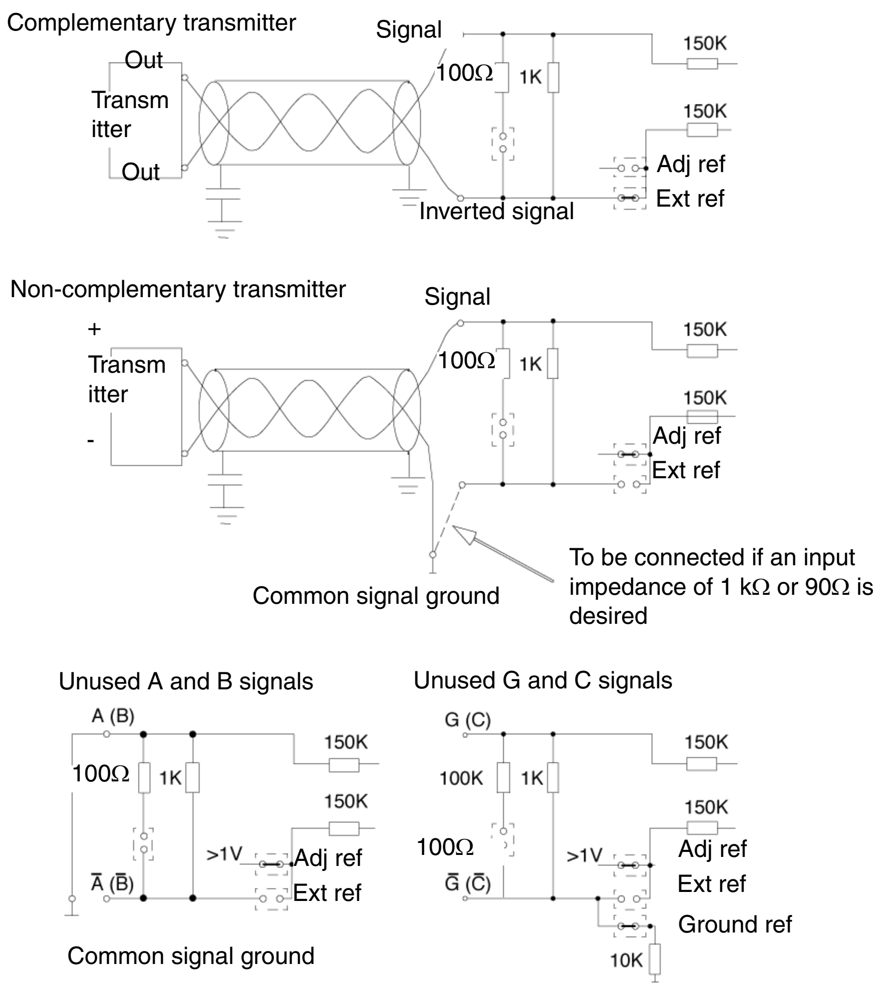


Figure 104. Cable connection

The process signals are connected to the X1 connector through the edge connector at the rear of the rack. The pin layout is shown below.

	Channel No.	Row d	No. b	z	Pin No.
Pulse inputs	0	$\overline{0A}$	Not connected	0A	2
		$\overline{0B}$		0B	4
	1	$\overline{1A}$		1A	6
		$\overline{1B}$		1B	8
	2	$\overline{2A}$		2A	10
		$\overline{2B}$		2B	12
	3	$\overline{3A}$		3A	14
		$\overline{3B}$		3B	16
Gate inputs to stop counting	0	$\overline{0G}$		0G	18
	1	$\overline{1G}$		1G	20
	2	$\overline{2G}$		2G	22
	3	$\overline{3G}$		3G	24
Reset inputs	0	$\overline{0C}$		0C	26
	1	$\overline{1C}$		1C	28
	2	$\overline{2C}$		2C	30
	3	$\overline{3C}$		3C	32

Connector X1 with pin numbers for the process signals

Board Layout

When a new board is installed, the input circuits are adapted to the connected transmitters and the counting mode is specified by means of jumpers and DIP switches. They are located on the board as shown in the illustration below.

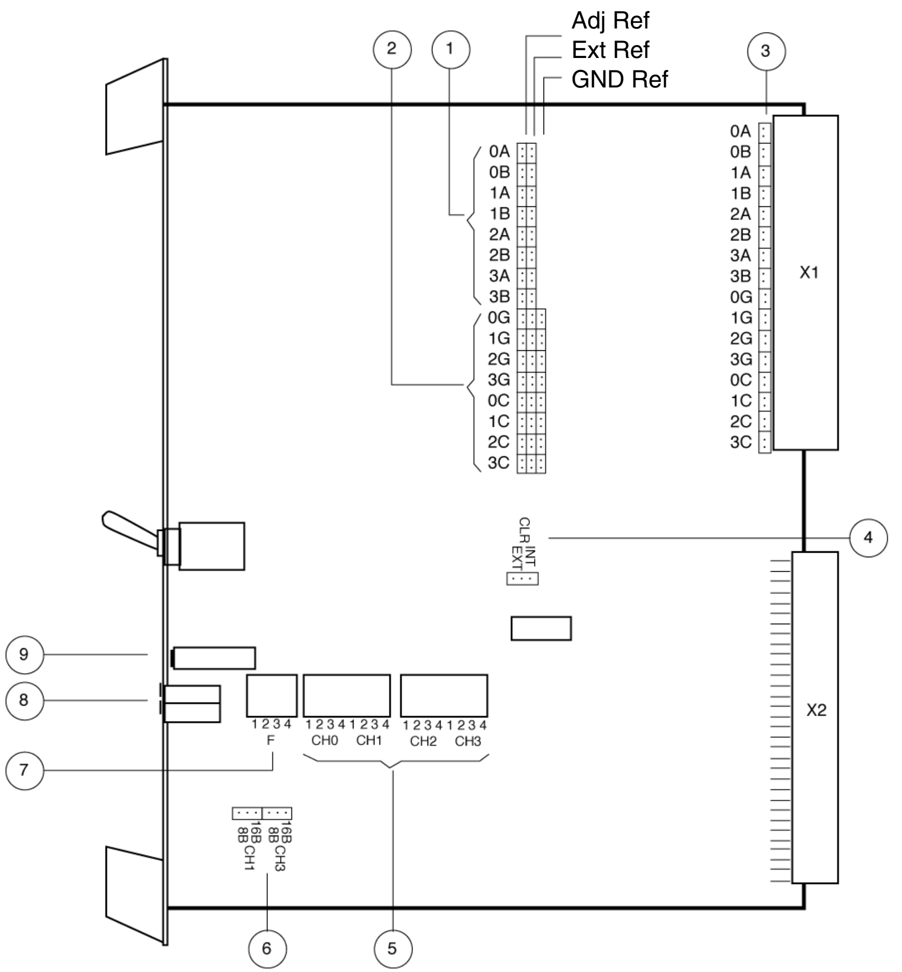
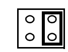
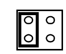
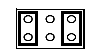
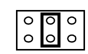
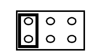
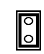
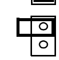
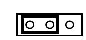
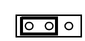
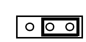


Figure 105. Location of jumpers and DIP switches

Jumpers

The Subsection "Input Circuits", on page 142 provides information about the use of different modes. An overview is given in the table below.

	Use	Inputs	Position	
1	Complementary transmitters and unused inputs*	A,B	EXT REF*	
	Non-complementary transmitters	A,B	ADJ REF	
2	Unused inputs*	G,C	ADJ REF* GND REF*	
	Complementary transmitters	G,C	EXT REF	
	Non-complementary transmitters	G,C	ADJ REF	
3	Low impedance*	A,B,G,C	LOW IMP*	
	High impedance	A,B,G,C		
4	Always EXT*		EXT*	
6	8-bit counter*	Channels 0,1,2,3	8B*	 

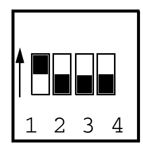
DIP Switches

Refer to Subsection "Evaluation Logic", on page 144 for more information about the use of different modes. When the mode number is set on the DIP switch, “1” means “on”.

Example:

Channel	Mode	DIP switches		5
0	1111	ON	ON	
1	1011			
2	1101	1 2 3 4 5 6 7 8 1 2 3 4 1 2 3 4	1 2 3 4 5 6 7 8 1 2 3 4 1 2 3 4	
3	1110	CH0 CH1	CH2 CH3	

The DIP switches (7) must always be as shown: ON
Switch 1 is set to ON
Other switches are set to OFF



1 2 3 4

Reference Voltage

Non-complementary input signals are compared with a reference voltage 0–10.5 V which should be adjusted to about half the pulse amplitude by means of the potentiometer (9). It can be measured across the sockets (8). New boards are delivered with the reference voltage adjusted to about +6 V DC.

Analog Input Board, IBA

IBA is an analog input board with eight inputs. IBA can either be used on its own, or with associated units, e.g. for galvanic separation (MCVG), differential input (MCV200), temperature measurements (MP, MN) or resistance measurements (MR).

When IBA is used without associated units, the following inputs can be connected: 0–20 mA, 4–20 mA, 0–10 V, 0–5 V and 1–5 V. Each channel is individually selectable.

Features

- Boards can be replaced during operation.
- High flexibility.
- Very high reproducibility.
- High temperature stability.

Indications

There are LEDs on the front panel for individual indication of current signals. Each input which uses the LED input (current) is represented by a LED on the front panel, the intensity of which varies with the value of the input signal. The octal address of each input is shown by the respective LED.

Switch

Normally, the switch on the front panel must be in position “I”. When the board is installed or replaced the switch must be in position “0”.

Jumpers

There are two types of jumpers on the board, one which is changed by moving the jumper or link using pliers or tweezers, and another jumper or strap which is changed by cutting it.

This instruction for jumpers is only valid for CE marked IBA boards.

The movable links are arranged in two directions, see Figure 106, Figure 107 and Figure 108.

The channels are numbered as follows: 00 - 04 - 10 - 14 - 20 - 24 - 30 - 34.

The input level (0-5 V, 1-5 V, 0-20 mA and 4-20 mA) (0-10 V) is selected by Sxx1 and current input or voltage input is selected by Sxx2.

xx denotes the channel number, 10 V denotes 0-10 V, C means Current input and V means Voltage input.

Figure 106. The jumpers Sxx1 and Sxx2.

The zero point is selected by Sxx3. 0-20 means 0-20 mA, 0-5 V or 0-l0 V and 4-20 means 4-20 mA or 1-5 V.

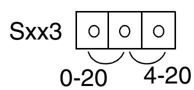


Figure 107. The Sxx3 jumpers.

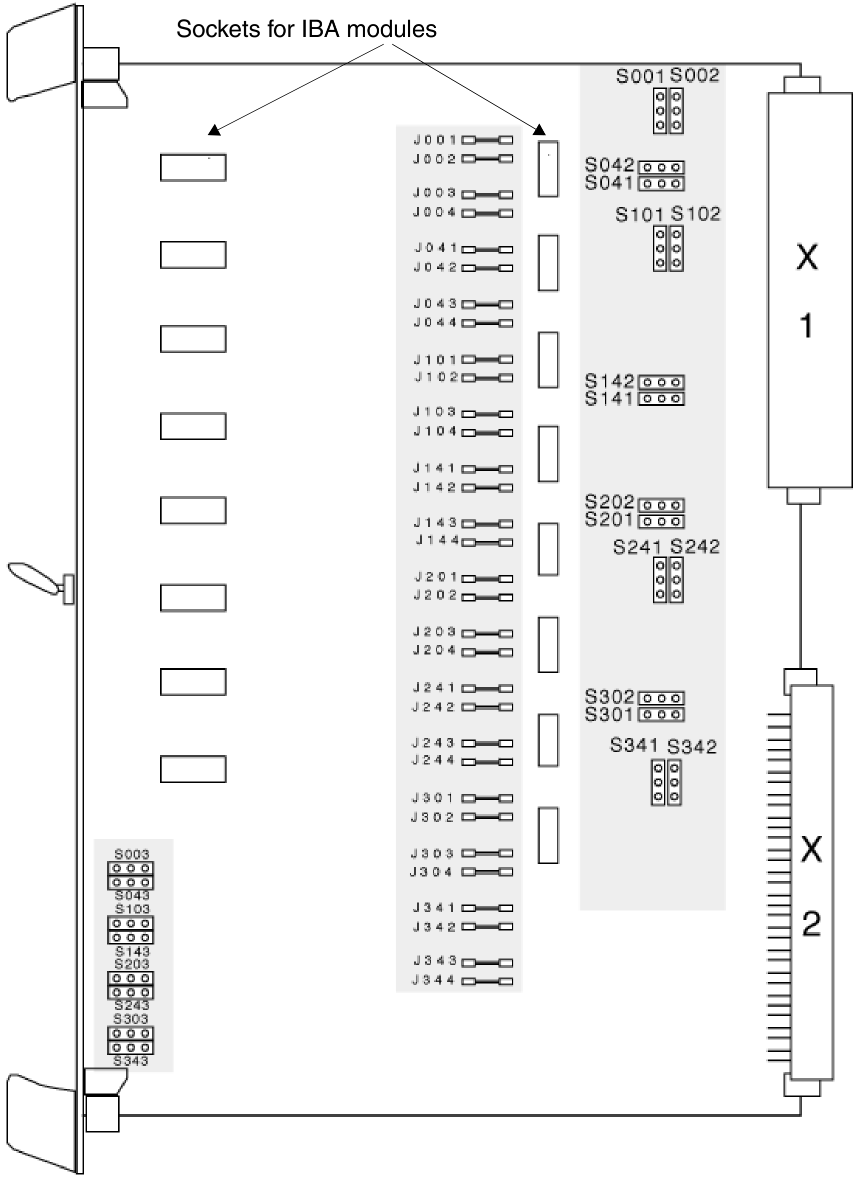


Figure 108. IBA shown with protection plate removed. The three groups of jumpers are marked. See strapping examples on next page.

Examples:

Figure 109. 0-20 mA on channel 24

Figure 110. 4-20 mA on channel 14

Figure 111. 0-10 V on channel 00

Link all unused channels for 0–20 mA.

Connections

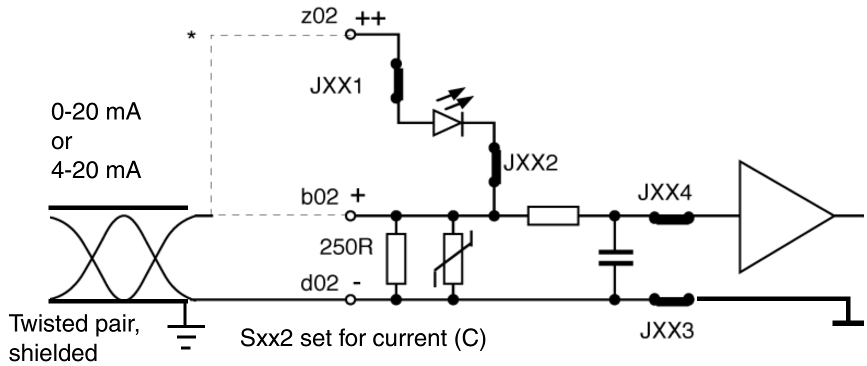
The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

The cables must be shielded twisted pair and grounded at both ends. If special protection against low frequency signals (50 Hz) is required, a capacitive earth can be used in order to split the earthing. A spring clamp is enclosed with the board. Use this clamp to connect the signal cable shield to the rack chassis, see "Handling I/O Signal Connections", on page 52.

Pin	d	b	z	channel	Explanations
2	-	+	++ (+LD)	00	NC = No connection *Note*! Inputs not used, should always be selected for 0-20 mA, regardless of how the others are used. Jumpers Jxx1-Jxx4 affect the connection of accessory units and whenever applicable, the jumpers should be removed. In order to prevent short-circuit s, jumpers should be cut as near as possible to the printed circuit board and carefully lifted away from the board
4	NC	NC	NC		
6	-	+	++ (+LD)	04	
8	NC	NC	NC		
10	-	+	++ (+LD)	10	
12	NC	NC	NC		
14	-	+	++ (+LD)	14	
16	NC	NC	NC		
18	-	+	++ (+LD)	20	
20	NC	NC	NC		
22	-	+	++ (+LD)	24	
24	NC	NC	NC		
26	-	+	++ (+LD)	30	
28	NC	NC	NC		
30	-	+	++ (+LD)	34	
32	NC	NC	NC		

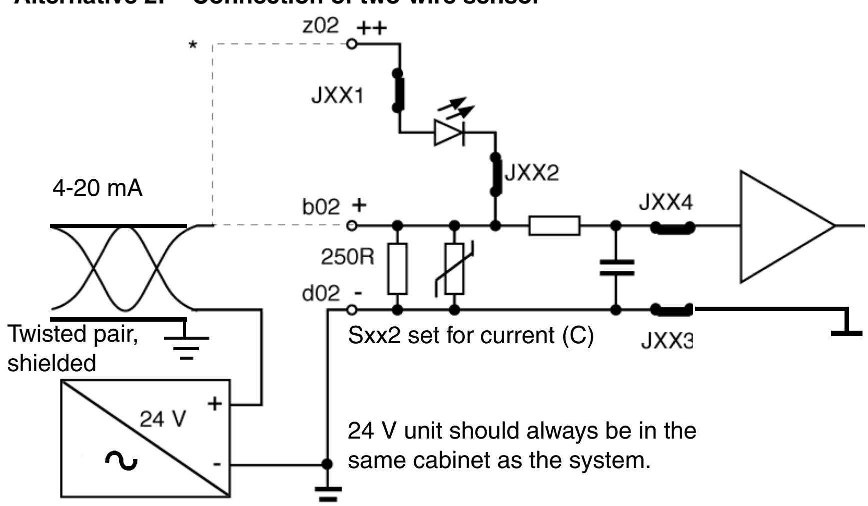
Connection of units for high common mode voltage as well as for connection without optional units:

Alternative 1: Connection of four-wire sensor



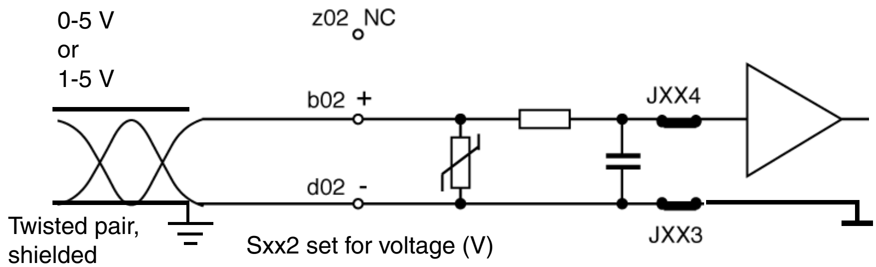
* The positive lead can be connected to two different points, depending on whether or not LED indication is required.

Alternative 2: Connection of two-wire sensor

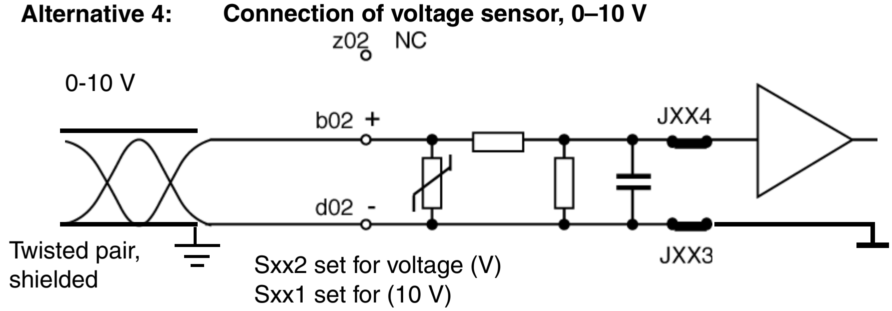


* The positive lead can be connected to two different points, depending on whether or not LED indication is required.

Alternative 3: Connection of voltage sensor, 0–5 V (1–5 V)

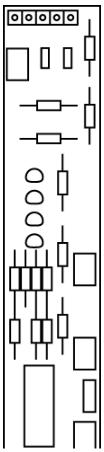


Alternative 4: Connection of voltage sensor, 0–10 V



* The positive lead can be connected to two different points, depending on whether or not LED indication is required.

Modules for IBA



The analog input board IBA has several accessory modules. The MCV200 permits large common-mode voltages, the MCVG provides individual electrical separation by transformer, MP and MN are used for temperature measurements and MR for resistance measurements.

MCV200

The MCV200 module is an analog module which permits up to 200 V DC common-mode voltage for each channel. It also adds the ± 5 V range.

MCVG

The MCVG module is an analog module which permits a maximum common mode voltage of 750 V DC per channel.

MP

The MP module measures temperatures with a Pt100 sensor (DIN 43760, α=0.00385). MP is linearized. There are six modules giving a total temperature range from -30°C to +600°C. See "Modules MP, MN and MR", on page 196.

MN

The MN module measures temperatures with a Ni1000 sensor. MN is not linearized: 1000 ohm at 0 °C, 871.7 ohm at -30°C and 1390.1 ohm at 80°C.

MR

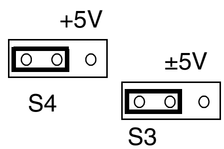
The MR module measures resistance and is used for position sensing, pressure measurements, etc. There are three modules giving a total range from 100 ohm to 1000 ohm.

Installation of MCV200

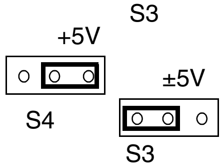
On installation of an MCV200 module the JXX3 and JXX4 jumpers on the IBA board must be cut (refer to the IBA description). The JXX1 and JXX2 jumpers remain intact.

The signal type is selected both on the IBA board (refer to the IBA description) and on the MCV200 module:

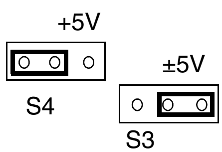
Settings of S3 and S4 Jumpers on MCV200



For input signals of 0-10 V, IBA is jumpered for 0-5 V



For input signals of 0-5 V, 1-5 V, 4-20 mA, IBA is jumpered for selected input signal.



For input signals of ±5 V or ±20 mA, IBA is jumpered for 0-5 V respective 0-20 mA

Figure 112. Note that the 0-10 V setting on the IBA is not used.

When the signal type has been selected, the MCV200 module can be inserted at the IBA board connectors marked xXX1 and xXX2, component side to component side.

Interconnections are made according to alternatives 1, 2 or 3 in the IBA description.

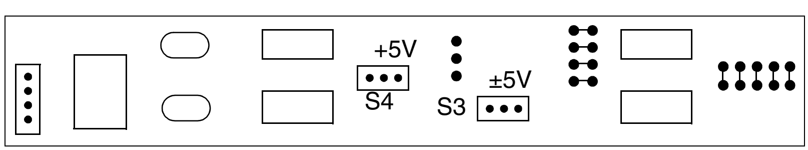


Figure 113. Locations of jumpers S3 and S4 on the MCV200.

Installation of MCVG

On installation of an MCVG module, the JXX3 and JXX4 jumpers on the IBA board must be cut (refer the IBA description).

The maximum common mode voltage may be selected as either 250 V DC or 750 V DC. If 250 V DC is selected, inputs with or without LEDs may be used. The LED inputs may not be used with 750 V DC common mode voltage. Jumpers JXX1 and JXX2 must, in this case, also be cut.

Once this is done, the MCVG can be inserted into the IBA board at the connectors marked xXX1 and xXX2, component side to component side.

Refer to the IBA description for selection of signal type.

Interconnections are made according to alternatives 1, 2, 3 or 4 in the IBA description.

Installation of the MP, MR and MN Modules

1. Remove the IBA board insulation plate.

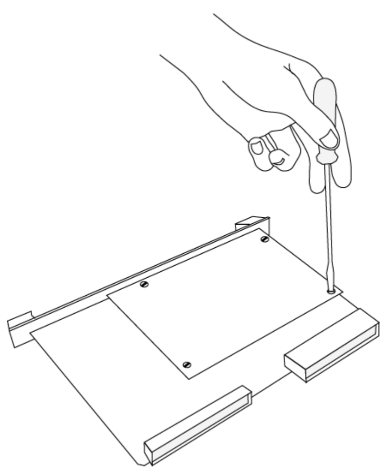


Figure 114. Removing the insulation plate.

2. Disconnect (cut and remove) links Jxx1[1], Jxx2, Jxx3 and Jxx4 for the channels to be used on the IBA board. See Figure 108 on page 155.

The distance between two cut ends must be at least 5 mm. Do not leave any pieces of wire on the board!

3. Link Sxx1, Sxx2 and Sxx3 for 0 - 5 V for the channels to be used on the IBA board. See figure on page 155.
4. Link all unused channels for 0-20 mA.
5. Fit the module in the connectors on the IBA board. Press hard.

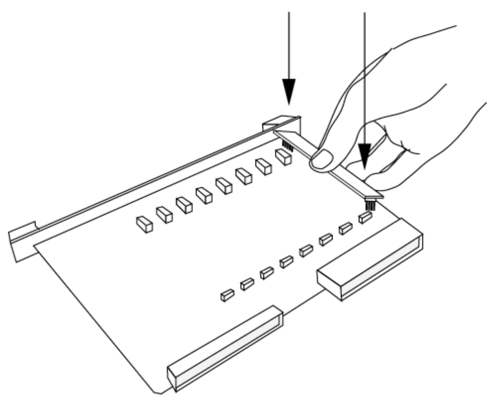


Figure 115. Fitting the module to the IBA board.

6. Tighten the insulation plate.

1. xx is channel No. 00, 04 …34.

Connection of Modules for Temperature or Resistance Measurements

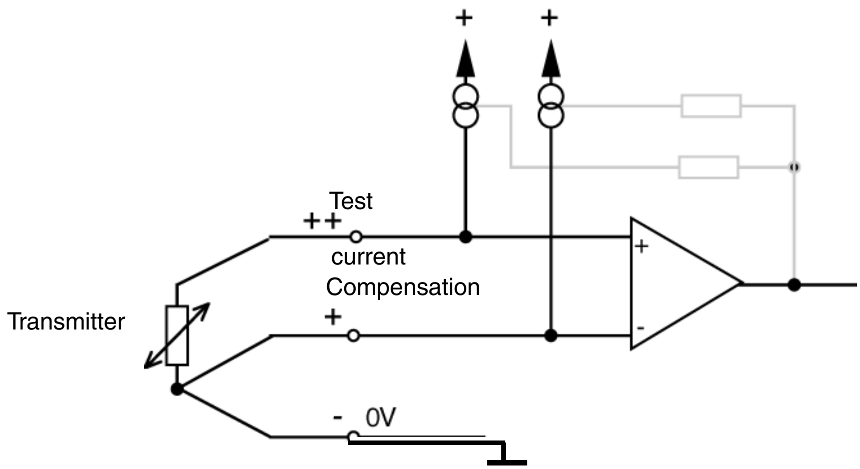


Figure 116. Connecting a temperature or resistance transmitter.
Note. Max 50Ω cable resistance. All three wires must have the same resistance.

For modules without connected transmitter, the compensation current (marked + in the IBA description), should always be connected to 0 V. In other cases the current consumption rises approximately 10 mA each module and then it is **not** possible to have a full rack with IBA.

Analog Output Board, OCAHG

OCAHG is an analog output board for current signals of 0–20 or 4–20 mA and voltage signals of 0–10 V. The outputs are as a group of four, separated from the I/O bus by optocouplers. They are numbered 00, 10, 20 and 30. Outputs of 0–20 or 4–20 mA are selected by straps on the board. The resolution is 8 bits.

OCAHG generates analog signals to control devices, instruments, etc. By means of the signals DDC[1] and MAN, control can either be automatic (from the control system) or manual via the INCREASE/DECREASE inputs. See figure "Example of manual control connection.", on page 169.

OCAHG retains its output values in the event of a CPU failure.

Switch

Normally, the switch on the front panel should be in position “I”. When the board is installed or replaced the switch must be in position “0”.

Note: If the board is operating and analog signals are transmitted and the switch is placed in position “0”, it should remain there for 2-3 seconds before switching over to position “I” (to clear the internal analog filter).

1. DDC = Direct Digital Control

Jumpers

There are 4 jumpers on the board, one for each output (00, 10, 20 and 30), for selection of 0-20 mA or 4-20 mA.

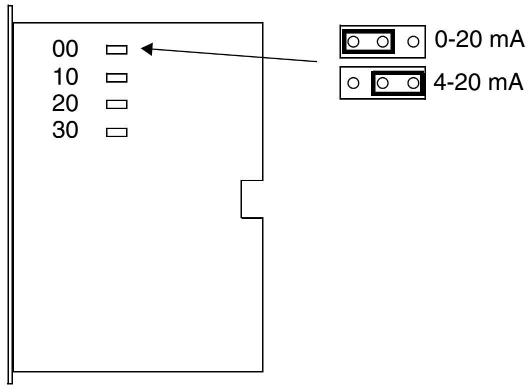


Figure 117. Jumpers on OCAHG.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

Each analog output signal must be connected to the system with both signal and return leads. The two leads must be run together throughout their entire length.

Installation Notes

- The cables must be shielded twisted pair cables grounded at both ends. If special protection against low-frequency signals (50 Hz) is required, a capacitive earth can be used in order to split up the earthing.
- A spring clamp is enclosed with the board. Use this clamp to connect the signal cable shield to the rack chassis, see "Handling I/O Signal Connections", on page 52.

The connections +24 V and DDC (see table below) must be strapped if the manual operation facility is not used or if the channel is not used at all.

24 V and 0 V are internally connected between the channels.

Strap +24 V and DDC if the manual operation facility is not used or if the channel is not used at all.

Channel	d	b	z	Pin
Output designation				
00	MAN	DDC	+24 V	2
	MAN Mode	DDC Mode		4
	INCREASE	DECREASE	0-20 mA or 4-20 mA	6
	0-10 V	0 V	+24 V	8
10	MAN	DDC	+24 V	10
	MAN Mode	DDC Mode		12
	INCREASE	DECREASE	0-20 mA or 4-20 mA	14
	0-10 V	0 V	+24 V	16
20	MAN	DDC	+24 V	18
	MAN Mode	DDC Mode		20
	INCREASE	DECREASE	0-20 mA or 4-20 mA	22
	0-10 V	0 V	0 V	24
30	MAN	DDC	+24 V	26
	MAN Mode	DDC Mode		28
	INCREASE	DECREASE	0-20 mA or 4-20 mA	30
	0-10 V	0 V	0 V	32

Description

The input signals MAN, DDC, INCREASE and DECREASE can be controlled from a hand module, or a push-button set that connects to the OCAHG board according to connection instructions overleaf. It is also possible to control the board from digital outputs, e.g. from a digital output board.

When connecting a hand module or a push-button set, the signal cable is to be shielded and the shield connected to the earth bar in the system cabinet near the OCAHG board's X1 connector. 0V for each output should be connected to a common signal ground with the shortest lead possible.

MAN mode is obtained when MAN = 1 and DDC = 0. The DDC mode is obtained when MAN = 0 and DDC = 1. Control of the analog output (in MAN mode) is accomplished with the INCREASE and DECREASE inputs.

In MAN mode, each output can still be controlled, in the event of a power failure, if the board is powered from an external 24 V DC source. When switching from DDC to MAN, the output signals remain at the last value set in DDC mode.

At power up, the board is automatically placed in MAN mode and the outputs are zeroed (output signal 4 mA or 0 mA).

In MAN mode, it takes approximately 20 seconds to drive an output from 0 to 100%. The 0–10 V output follows the current output and can be used for indication purposes.

If the 24 V DC supply is switched off, let it remain off for at least 2–3 seconds before you switch it on again, or else the output value may be erroneous. If this is not acceptable, use a UPS if necessary.

The digital inputs MAN, DDC, INCREASE and DECREASE have filters on their inputs. The time taken to activate an input is 200 ms.

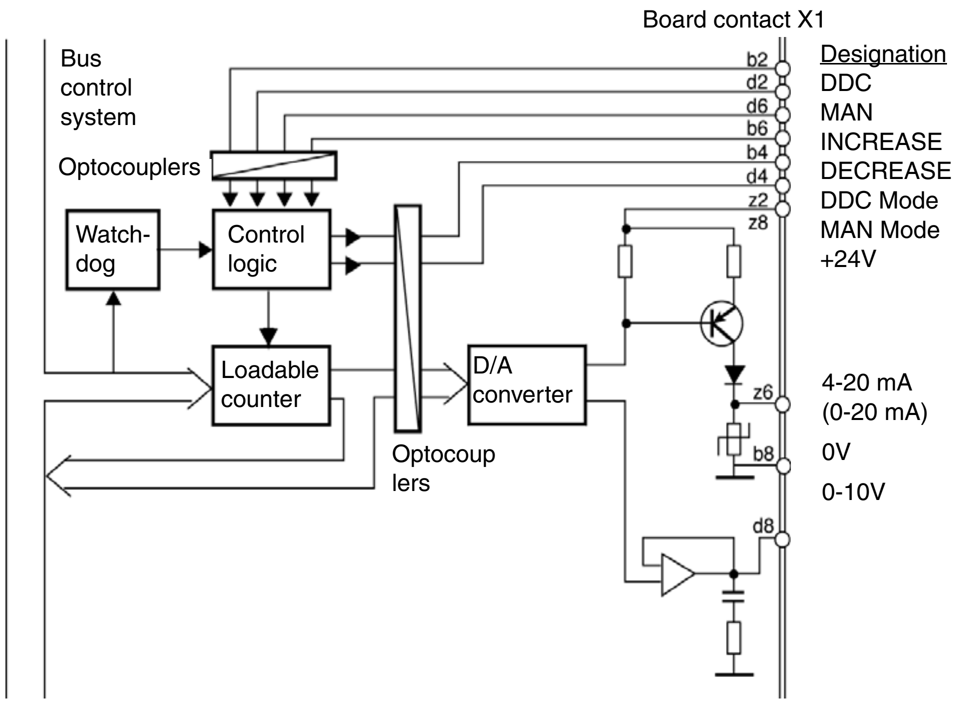


Figure 118. Block diagram of OCAHG.

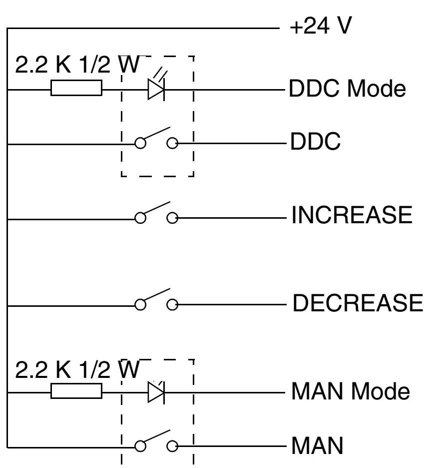


Figure 119. Example of manual control connection.

Analog Output Board, OCVA

OCVA is an analog output board with two channels for current signals of 0–20 mA or 4–20mA and voltage signals of ±10 V or 0–10 V. The various ranges are selected using connections in the process connector.

Features

- The analog circuits of OCVA are electrically separated by optocouplers from the digital control logic and the control system. The channels are not galvanically separated from each other.
- OCVA can be set up so that the outputs either go to zero or remain at the selected safety values during CPU shutdown.
- OCVA has 12-bit resolution for the ±10 V ranges and 11-bit resolution for the other current and voltage ranges.

Switch

Normally, the switch on the front panel should be in position “I”. When the board is installed or replaced the switch must be in position “0”.

Connections

The upper connector at the rear of the board, the X1 connector, is used for process connection. The corresponding connector is at the rear of the I/O rack. All signal cables are connected to the X1 connector on the I/O rack by means of crimp sleeves.

Table 15. Connector X1 pin assignment OCVA

Channel	d	b	z	Pin
00	Current range select		(+24V)	2
	Voltage range select	Current range select		4
		Voltage range select	Current output	6
	Voltage output	Current GND	(+24V)	8
			(+24V)	10
		Voltage GND		12
				14
		(0V)	(+24V)	16
20	Current range select		(+24V)	18
	Voltage range select	Current range select		20
		Voltage range select	Current output	22
	Voltage output	Current GND	(0V)	24
			(+24V)	26
		Voltage GND		28
		Stop selection	Stop selection	30
		(0V)	(0V)	32

The cables must be shielded twisted pair and grounded at both ends. If special protection against low frequency signals (50 Hz) is required, a capacitive earth can be used in order to split the earthing. A spring clamp is enclosed with the board. Use this clamp to connect the signal cable shield to the rack chassis, see "Handling I/O Signal Connections", on page 52.

Ground Reference

0 V DC for the outputs and supply must be referenced to ground, either directly or through a bipolar capacitor of 0.01 µF ±20% and with a voltage rating above the potential difference between 0 V DC and ground (use e.g. Phoenix TT-SLKK 5-C 12n 230AC). This is to meet the specified interference standard.

Description

Each channel can supply both current and voltage output signals at the same time. When using a current output the corresponding voltage range must be set to 0-10 V.

The output signal is controlled by writing to the appropriate channel memory word (00 or 20 respectively).

Since the bit resolution is less than a 16-bit memory word, only the most significant bits of a word are used for digital-to-analog conversion.

The voltage range is selected by connecting or leaving open two “Voltage select” terminals in the process connector. If the terminals are linked, a ±10 V signal is produced, otherwise the range is 0-10 V.

Selection of the minimum current is performed in a similar manner using the two “Current select” terminals in the process connector. If the terminals are linked, a 0–20 mA signal is produced, otherwise the range is 4-20 mA. In a similar manner, “Zero output” or “Hold the present output” during CPU shutdown can be selected.

The required setting is selected by connecting or leaving open the “Stop selection” terminals in the process connector. If the terminals are linked the outputs go to 0 V/0 mA during CPU shutdown, irrespective of the other settings. If the terminals are not connected the levels of the outputs are maintained during CPU shutdown.

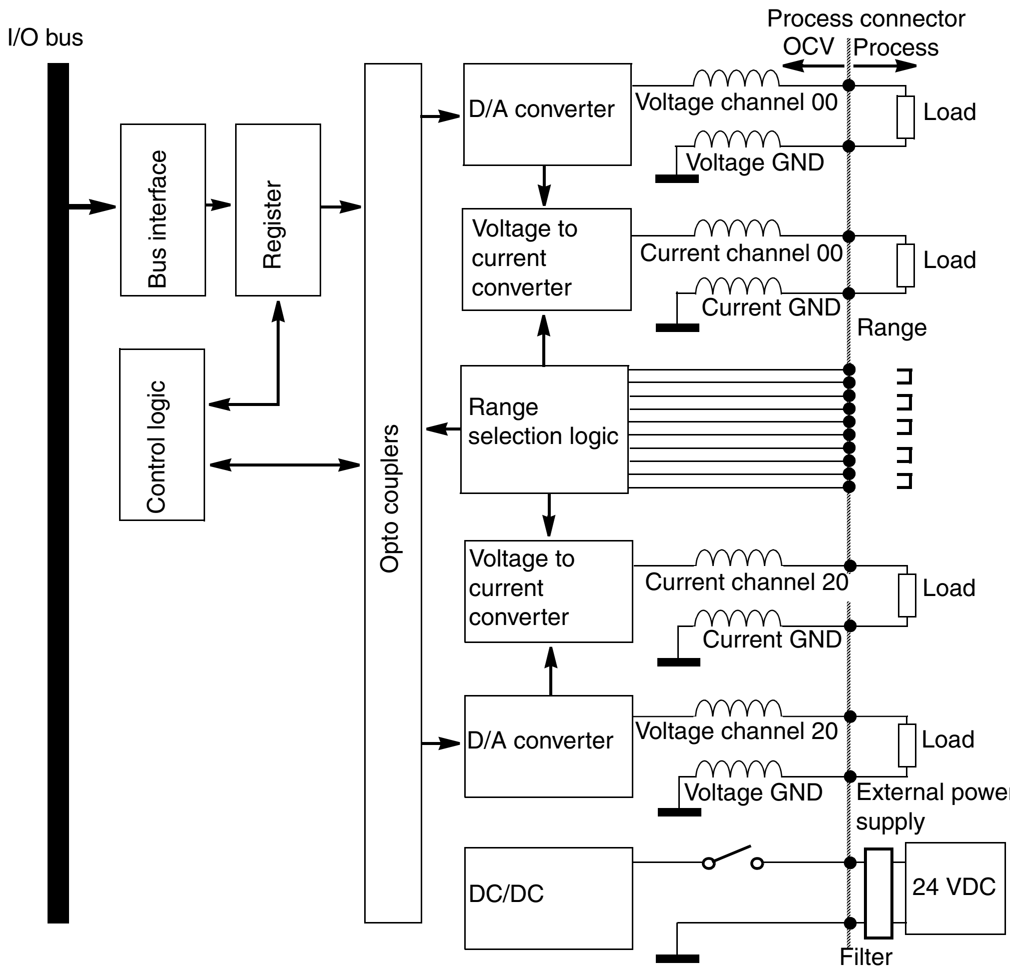


Figure 120. OCVA block diagram.

Installation Instructions

The selection link connections to the board must be as short as possible, and definitely not more than 15 cm.

Each analog output signal must be connected to the system with both signal and return leads. The two leads must be run together throughout their entire length.

The return lead for the current signal is connected to “Current GND” and the return lead for the voltage signal to “Voltage GND” in the process connector. “Current GND” and “Voltage GND” connections are provided for each channel (see connection instructions).

To maintain board accuracy, the “Current GND” and “Voltage GND” terminals must not be connected to any other terminals. The return lead must only be connected.

The supply voltage for the OCVA card is 24 V which is connected to the +24 V and 0 V terminals on the process connector. To obtain the best tolerance of wire-borne interference the +24 V is connected to Z26 and the 0V to Z32.
All +24 V terminals are connected together on the board and all 0 V terminals are also connected together.

A filter is required for the +24 V supply.

When the 24 VDC supply is switched on, all outputs adopt levels 0 V/0 mA, irrespective of the board selections. These values are maintained until a new value is written to the board. This also applies if the switch on the front is changed from “0” to “I”.

Test and Simulation Equipment, PTC and IVAPOT

Two boards are available for test and simulation. They are used to facilitate starting up, testing and troubleshooting the system.

These two boards do **not** meet the EMC directive 89/336/EEC.

- PTCDigital simulation board. A panel with 32 switches to simulate inputs is connected to the board. The board must be placed in a digital input board location.
- IVAPOTAnalog simulation board. 8 potentiometers for simulation of analog inputs are mounted on the front of the board. The board must be placed in an analog input board location.

Appendix C Technical Specifications

This appendix contains technical specifications of CI865 on page 175, ControlNet on page 177 and I/O Systems - Rack I/O on page 185. For information about technical specifications of Series 200 I/O see I/O Systems - Series 200 I/O on page 201 for references to relevant manuals.

CI865

Table 16. CI865 Interface Specifications

Item	Value
Type	Satt I/O Communication Interface
Galvanic isolation	Yes
Status indicators	Run normally green, FAIL exceptionally red, COM A/COM B
Connector	BNC
Current consumption (from CEX-Bus 24 V DC)	120 mA typical (200 mA max.)
Power dissipation	2.9 W typical
Capacity	Max 5 I/O racks with 20 I/O units each
Protection Rating	IP20 according to EN60529, IEC 529

Table 16. CI865 Interface Specifications (Continued)

Item	Value
Weight	700 g (1.5 lb) (package CI865K01 with CI865 and TP865)
Dimensions	W 59 x H 185 x D 127.5 mm (W 2.9 x H 7.3 x D 5.0 in)

Please refer to the manual AC 800M Controller Hardware, Hardware and Operation (3BSE036351Rxxxx) for more information about technical specifications of the CI865.

ControlNet

RPT

Table 17. Technical Data, RPT

Power Voltage Current	 85–250 V AC 60 mA max.
Fault relay	132 V AC, 150 mA max. or 186 V DC, 150 mA max.
Barrier strip conductors	#14 AWG to #22 AWG
Replacement fuse	1/4 A, 250 V 3AG
Environmental conditions Operating temperature Storage temperature Relative humidity	Industrial 0 to 60 °C (32 to 140 °F) –40 to 85 °C (–40 to 185 °F) 5 to 95%, non-condensing
Approvals (when product or packaging is marked)	CE-marked and meets EMC directive 89/336/EEC according to the following standards: EN 50081-2 and EN 50082-2. Low voltage directive 72/23/EEC with supplement 93/68/EEC according to EN 61131. UL listed according to UL 508 as open equipment. CSA certified; class I div 2 hazardous.
Weight	0.87 kg
Dimensions	W 50.8 x H 215.9 x D 101.6 mm

RPTD

Table 18. Technical Data, RPTD

Power Voltage Current	 20–72 V DC 100 mA max.
Fault relay	132 V AC, 150 mA max. or 186 V DC, 150 mA max.
Barrier strip conductors	#14 AWG to #22 AWG
Replacement fuse	2 A, 250 V (slow blow)
Environmental conditions Operating temperature Storage temperature Relative humidity	Industrial 0 to 60 °C (32 to 140 °F) –40 to 85 °C (–40 to 185 °F) 5 to 95%, non-condensing
Approvals (when product or packaging is marked)	CE-marked and meets EMC directive 89/336/EEC according to the following standards: EN 50081-2 and EN 50082-2. UL listed according to UL 508 as open equipment. CSA certified; class I div 2 hazardous.
Weight	0.82 kg
Dimensions	W 50.8 x H 215.9 x D 101.6 mm

RPA

Table 19. Technical Data, RPA

Power supply Nominal input voltage Input voltage range Current Backplane output current Wire size	 24 V DC 18.0–36.0 V DC Max. 700 mA at 24 V DC based on worst case module loading Max. 1.6 A at 5 V DC 12–28 AWG
Communication rate	5 Mbit/s
Environmental conditions Operating temperature Storage temperature Relative humidity Shock Operating Non-operating Vibration	Industrial 0 to 60 °C (32 to 140 °F) –40 to 85 °C (–40 to 185 °F) 5 to 95%, non-condensing 30 g peak acceleration, 11±1 ms pulse width 50 g peak acceleration, 11±1 ms pulse width Tested 5 g at 10–500 Hz per IEC 68-2-6
Approvals (when product or packaging is marked)	CE-marked and meets EMC directive 89/336/EEC according to the following standards: EN 50081-2 and EN 50082-2. UL listed according to UL 508 as open equipment. CSA certified; class I div 2 hazardous.
Weight	0.23 kg
Dimensions	W 99 x H 96 x D 69.0 mm

RPFM / RPFS

Table 20. Technical Data, RPFM/RPFS

Communication rate	5 Mbit/s
Backplane power requirements	400 mA at 5 V DC
Environmental conditions Operating temperature Storage temperature Relative humidity Shock Operating Non-operating Vibration	Industrial 0 to 60 °C (32 to 140 °F) –40 to 85 °C (–40 to 185 °F) 5 to 95%, non-condensing 30 g peak acceleration, 11±1 ms pulse width 50 g peak acceleration, 11±1 ms pulse width Tested 5 g at 10–500 Hz per IEC 68-2-6
Approvals (when product or packaging is marked)	CE-marked and meets EMC directive 89/336/EEC according to the following standards: EN 50081-2 and EN 50082-2. UL listed according to UL 508 as open equipment. CSA certified; class I div 2 hazardous.
Weight	0.23 kg
Dimensions	W 99 x H 96 x D 69.0 mm

Mounting Dimensions

Use the mounting dimensions to help you mount your taps and universal mounting brackets. Make copies of these templates as necessary to help you mark placement for these components. All measurements in millimeters.

Taps

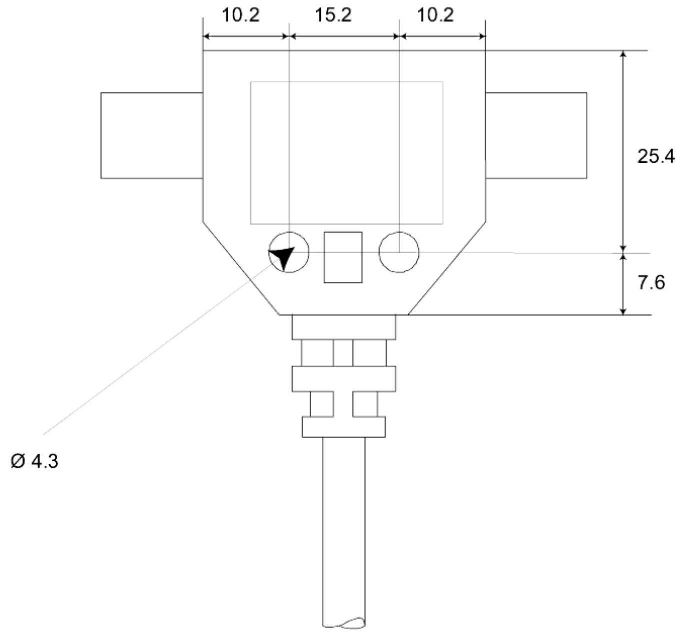


Figure 121. Mounting Dimensions, T-tap

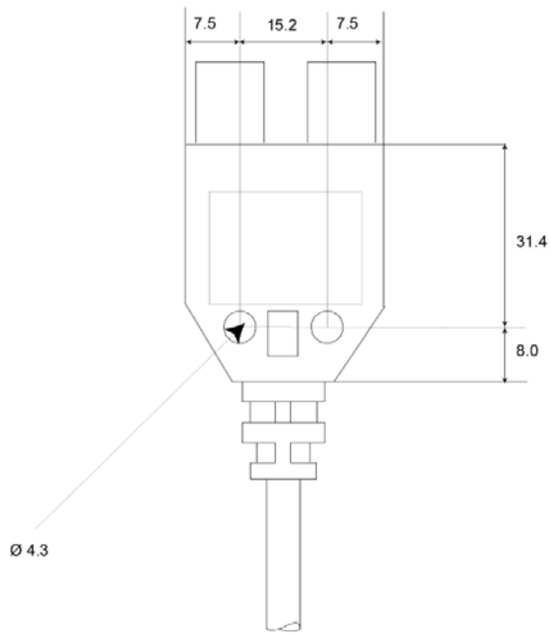


Figure 122. Mounting Dimensions, Y-tap

Universal Mounting Bracket

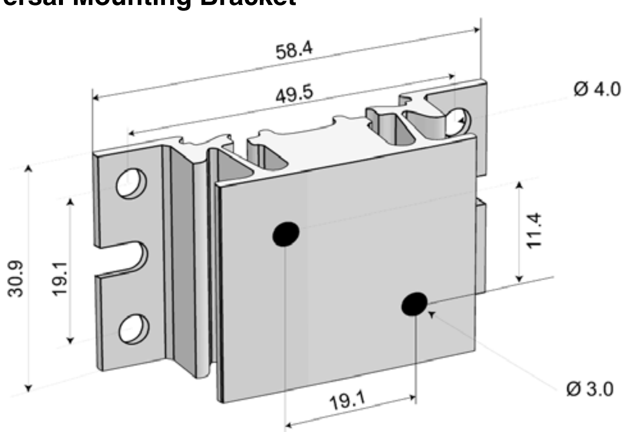


Figure 123. Mounting Dimensions, Universal Mounting Bracket

Coax Repeaters

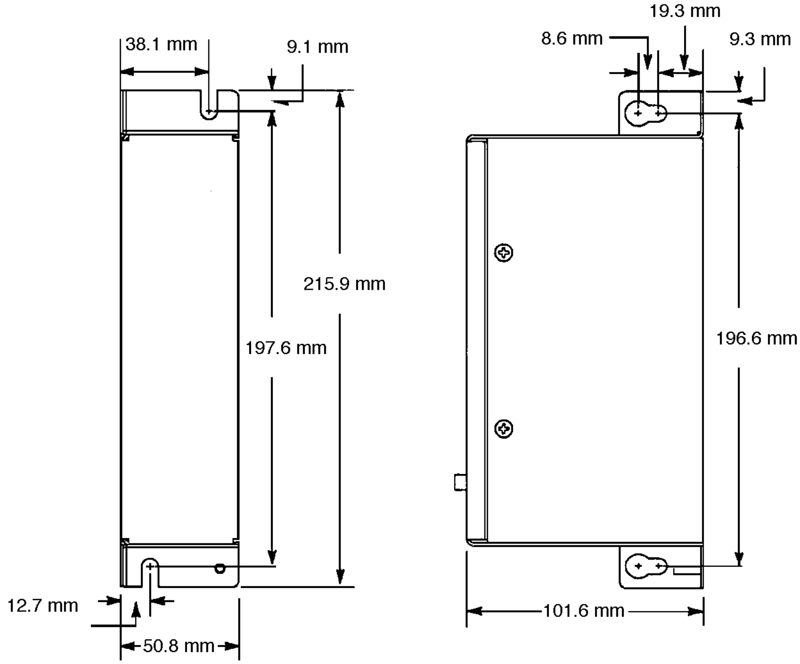


Figure 124. Mounting Dimensions, Coax Repeaters

Fiber Repeater and Fiber Module

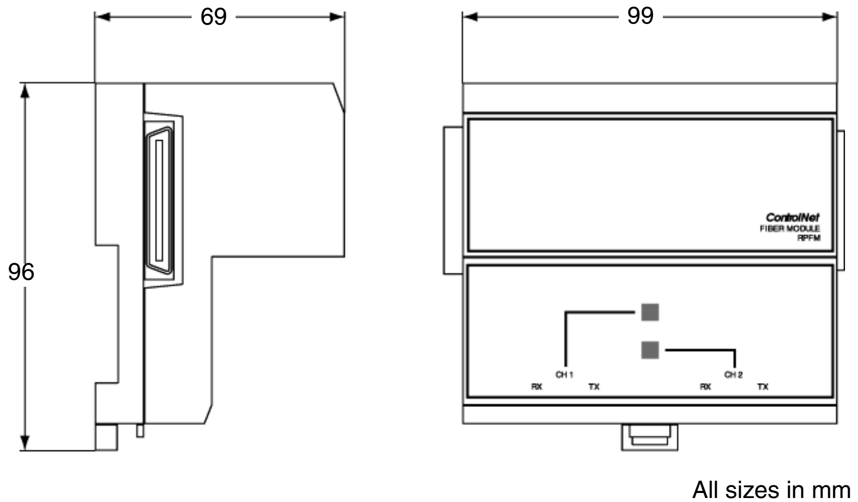


Figure 125. Mounting Dimensions, Fiber Repeater and Fiber Module

I/O Systems - Rack I/O

General Technical Specifications

Function	Data
Temperature	Operating: +5-55°C (max. mean temp. over 24 hours is 50°C) Non-operating: -25- +70°C
Humidity	Max 90%, non-condensing
Protection class	IP20
Design standard	Fulfils the EMC directive 89/336/EEC for industrial environment and the low voltage directive, LVD, 73/23/EEG with supplement 93/68/EEG
Continuous working voltage	Combination of application nominal signal voltage and common mode voltage relative to system logic ground reference.
Isolation test voltage	Isolation withstand voltage verified by design measurement of clearance and creepage distances or by specified high-voltage type test and/or production test. For low-level I/O voltage (max 50 V AC/ 75 V DC), the corresponding test voltage is 350 V AC/500 V DC for one minute. For higher level I/O voltage (> 50 V AC/ 75 V DC), the test voltage is 1000 V AC + 2xUe (=1000+2x250=1500 V AC at 250 V AC signal voltage) for one minute. The one-minute test may be replaced by a one second test using 20% higher test voltage or any other compatible test method.
Rated current for crimp sleeves	5 A
Board type	Double-sized Euro board

Rack Adapter Board, 200-RACN

Function	Data
Number of channels	1
Communication protocol	ControlNet
Access method	CTDMA (Concurrent Time Division Multiple Access)
Serial interface	Separation via a signal transformer
Speed of transfer	5 Mbit/s
Status indicators	Green/Red LED for board status (OK) Red LED for I/O copy information Green/Red LED for communication information (COM A and B) Power LED
Power supply	From Power supply unit PSF
Internal current consumption (from PSF)	
200-RACN	400 mA/+5V; max. 100mA/+12V
200-RACN/A	600 mA/+5V; max. 100mA/+12V
ControlNet connector	BNC 75 ohm
Dimensions	H 262 x W 60 x D 190 mm
Order codes	200-RACN 200-RACN/A

Power Supply Unit, PSF

Function	Data
Supply voltages	
Mains supply	110/220/240 V AC +15/-10% selectable. 220 V AC accepts also 230 V AC +10/-15%
Frequency	50 Hz ±5% or 60 Hz ±5%
24 V DC	24 V DC +20/-15% excl. ripple
Ripple on 24 V DC	Peak 5% of nominal voltage
Current consumption (nominal input voltage)	
230 V AC mains	Typ. 0.5 A for max. load 50 W
24 DC supply	Typ. 3.5 A for max. load 70 W
Output voltages(1)	
+5 V DC, 5 VL	5.1 V DC + 0.1/-0.3 V DC during normal operation
	4 A (+5 V DC and + 5 VL combined)
Max. current output	0.2 A
Min. current output	12.5 V DC ± 0.5 V DC max. 4 A, min. 0.2 A
+12 V DC	
Output power	
Mains supply	Max. 50 W
24 V DC	Max. 70 W
Dimensions (incl. panel)	H 262 x W 40 x D 190 mm
Continuous working voltage	240 V AC
Isolation test voltage	1776 V AC for one second, between mains input and protective ground and DC side
Front panel temperature	< 40°C above ambient
Order code	PSF

(1) Note that the total output power can limit the current.

Digital Input Boards, IDPG24 and IDPG48

Function	Data
Numbers of inputs	32
Input voltages	
IDPG24	24 V DC - 25/+20%
IDPG48	48 V DC - 25/+20%
Overvoltage rating	220 V AC max. 10 s (IDPG24/48)
Input current ”1” level	Typ. 10 mA (-25/+20%)
Filter time constant	Typ. 10 ms
Logical levels	01
	Typ. IDPG24 < 5 V DC > 16 V DC
	Typ. IDPG48 <10 V DC > 32 V DC
Continuous working voltage	< 75 V DC relative to system logic
Isolation test voltage	500 V DC (one minute)
Current consumption	40 mA (internal + 12 V DC)
System power	4 mA/active input + 5 VL (=typ 130 mA, max. 190 mA + 5 VL)
Miscellaneous	Galvanic separation in pairs with one common connection
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order codes	IDPG24 IDPG48

Digital Input Boards, IAPG230

Function	Data	
Number of inputs	16 optocoupled	
Input voltage	230 V AC -15%/ +10%	
Overvoltage rating	500 V AC max. 10 s	
Input current for activated input (typically 10 mA)	6.5-14 mA at 230 V AC -15%/+10% 47-63 Hz	
Frequency range	47-63 Hz	
Filter time constant	Typ. 20 ms	
Logical levels		0 1
	Typ.	< 70 V > 130 V
Continuous working voltage	230 V AC	
Isolation test voltage	1752 V AC for 1 second, between inputs and between any input and system logic or front panel	
Current consumption	20 mA (internal + 12 V DC)	
System power	5-15 mA/active input + 5 VL (typ. 160 mA, tot. max. 80-240 mA)	
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm	
Order code	IAPG230	

Digital Output Board, ODPG.8

Function	Data
Number of outputs	32 optocoupled
Number of separate groups	4
Supply voltage (external)	10-60 V DC The groups can have common or separate supplies
Peak voltage	75 V DC (mean value, max. 60 V DC as above)
Load current	Max. 0.8 A per output Max. 3.2 A per group Max 8 A per board
Surge current	Max. 2 A for 50 ms
Leakage current	Max. 2 mA, typically < 0.5 mA
Recommended external fuses	3.2 A fast-blow for each group
Voltage drop, output	Max 2.5 V DC, typically <1 V DC
Activation time	Max 10 μs, typically 5 μs
Deactivation time	Max. 400 μs, typically 200 μs
Continuous working voltage	< 75 V DC relative to system ground
Isolation test voltage	500 V DC for one minute, between input groups and between each group and system logic
Current consumption	30 mA (internal +12 V DC) 2-7 mA/active output (+5 VL) Tot max. 60-230 mA, typ. 140 mA
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	ODPG.8

Relay Output Board, ORG24

Function	Data
Numbers of outputs	16
Relay coil supply	24 V DC
Current drawn from relay supply (VR) per energized relay coil	17-25 mA at 24 V DC (VR=24 V DC, -15%, +20%)
Contact voltage ratings	AC: 250 V max. DC: 120 V max.
Contact current ratings	AC: 2 A max. resistive load DC: 2 A max. (24 V DC +20%), resistive load DC: 0.6 A max. (48 V DC +20%), resistive load Internal varistor for surge suppression. External overload protection required for all loads and external surge suppression for inductive loads
Min. contact current	100 mA at 12 V DC
Relay operating time	15 ms max. typ. 8 ms
Relay release time	10 ms, typ. 4 ms
Contact bounce period	2.5 ms max.
Relay working life (resistive load)	DC: 2 A: 1 500 000 operations AC:2 A: 800 000 operations
Continuous working voltage	250 V AC max.
Isolation test voltage	1800 V AC for 1 second, between each individual relay contact and between any relay contact and system logic or front panel
Current consumption	20 mA at +12 V DC 5-15 mA per active output, typ. 10 mA (for +5 VL) Total: 80-240 mA, typ. 160 mA
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	ORG24

Digital Output Board, Short-circuit-proof, ODSG

Function	Data
Number of outputs	32 optocoupled and 2 optocoupled error bistables
Number of inputs	2 optocoupled 24 V DC 10 mA reset signals
External supply voltage	19-30 V DC
Voltage limit	50 V DC max. for 1 min. (25°C)
Load current	0.8 A per output max.16 A per board max.
Short circuit current	Typ. 4 A, max. 10 A, fuse trip delay ð20 ms (25°C)
Leakage current	Max. 100 µA, typ. 10 µA. Typical value for a short circuited output is 10 mA
External fuse	16 A per board (slow fuse)
Resistance	Typ. 0.4 Ω, max. 0.6 Ω at 0.5 A. Typ. 0.6 Ω, at 0.8 A (25°C)
Rise time	Typ. 10 µs
Fall time	Typ. 150 µs
Current consumption System (12 V DC) LED (5 VL)	 40 mA 7 mA per active output, typ. 140 mA
Continuous working voltage	< 75 V DC relative to system ground
Isolation test voltage	500 V DC for one minute, between I/O and system logic
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	ODSG

Pulse Counter Board, IPA4

Function	Data
Number of inputs	4 (with 8-bit counter) 2 (with 16-bit counter)
Galvanic separation	No
Input impedance	1 kΩ or about 90 Ω
Power dissipation	0.25 W max. across connected terminating resistor
Max. pulse amplitude, complementary inputs	33 V DC (1 kΩ input impedance) or 10 V DC (90 Ω impedance)
Max. pulse amplitude, non-complementary inputs	24 V DC
Input voltage difference	1 V DC min. rel. inverted input or rel. transition level
Max pulse frequency	10 kHz
Process cabling	Twisted-pair cable with individual shielding for each pair of wires
Current consumption	150 mA,12 V DC (1.8 W)
Reference voltage level	0-10.5 V DC, adjustable
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	IPA4

Analog Input Board, IBA

Function	Data
Number of inputs	8
Input impedance	
Current	250 Ω without LED
Voltage	300 kΩ
Voltage drop	5 V DC max. without LED 8 V max. with LED
Accuracy	±0.2% FS at 25°C
Temperature stability	±0.002% FS/°C
Max. permanent permissible overload	
Current	30 mA
Voltage	30 V DC
Input type	Single-ended common earth
Input filter (time to 63% of FS)	70 ms ± 10% filter of first order Breaking point at about 2.3 Hz
Input connector	Harting, crimp pin
Crosstalk between channels	79 dB attenuation
Non-linearity	0.02% FS
Repeating accuracy	0.001% FS
RFI immunity	Error of less than 0.8% of FS at 10 V/m, 27-1000 MHz
Current consumption	90 mA (12 V DC) typ. for the board. When modules are used, the current consumption increases
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	IBA

Module MCV200

Function	Data
Common mode suppression	72 dB attenuation with 0-10 V ± 5 V DC, otherwise 66 dB
Continuous working voltage	< 75 V DC relative to system ground
Common mode voltage relative to ground	Max. 200 V DC (by design)
Impedance: Common mode Differential mode	 400 kΩ 800 kΩ
Temperature stability	Max. ± 0.003% FS / °C
Current consumption	12 V DC: + 4 mA per module
Miscellaneous	All other technical data are the same as for IBA
Dimensions	H 107 x W 18 x D 13 mm
Order code	MCV200

Module MCVG

Function	Data
Continuous working voltage	< 75 V DC relative to system ground
Common mode voltage relative to ground	750 V DC without LED (by design) 250 VDC with LED (by design)
Common mode suppression	94 dB attenuation
Leakage current	220 V, 50 Hz, 2 μA typ.
Accuracy	±0.3% FS at 25°C
Temperature stability	Max. ±0.002% FS/°C
Non-linearity	Max. 0.1% FS
Current consumption	12 V DC: 18 mA per module

Function	Data
Miscellaneous	All other technical data are the same as for IBA.
Dimensions	H 107 x W 18 x D 13 mm
Order code	MCVG

Modules MP, MN and MR

Function	Data
Input impedance	Min. 10 MΩ
Accuracy at 25°C	
MP100-MP400	±0.4% FS, DIN 43760, α=0.00385
MP600	±0.6% FS, DIN 43760, α=0.00385
MN80	Follows the curve shown below, ±0.4% FS
MR100-MR1000	±0.5% FS
Temperature stability	Max. ±0.01% FS/°C
Influence of conductor resistance	Max. ±0.1% FS per 10 Ω
Sensor current (typical)	
MP160	4 mA
MN80	0.5 mA
MR1000	0.5 mA
Other	3 mA

Function	Data
Measuring ranges	
MP100	0 to +100 ^{o}C
MP130	-30 to +130 ^{o}C
MP160	0 to +160 ^{o}C
MP200	0 to +200 ^{o}C
MP400	0 to +400 ^{o}C
MP600	0 to +600 ^{o}C
MN80	-30 to +80 ^{o}C
MR100	0 to 100 Ω
MR140	0 to 140 Ω
MR1000	0 to 1000 Ω
Input filter (time to 63% of FS)	Second order filter ±20%, first breakpoint
MP100	500 ms
MP130	300 ms
MP160	300 ms
MP200	300 ms
MP400	200 ms
MP600	180 ms
MN80	200 ms
MR100	200 ms
MR140	200 ms
MR1000	150 ms
All	Second breakpoint at 3.4 Hz
Cabling	Shielded, no joints. Max. conductor resistance 50Ω. Uniform length.
Non-linearity	
MP	Max. 0.3% FS
MN	See figure below
MR	Max. 0.3% FS

Function	Data
Current consumption	+12 V DC for all modules except MP160. With a sensor connected, 20 mA each module and without a sensor, 30 mA. MP160 with a sensor, 24 mA, and without a sensor, 34 mA(1).
Miscellaneous	All other technical data are the same as for IBA
Dimensions	H 107 x W 18 x D 13 mm
Order codes	MP100, MP200, MP400, MP600, MP130, MP160, MN80, MR100, MR140, MR1000

(1) With MP160 it is not possible to have more than 14 boards in a rack with 8 modules each

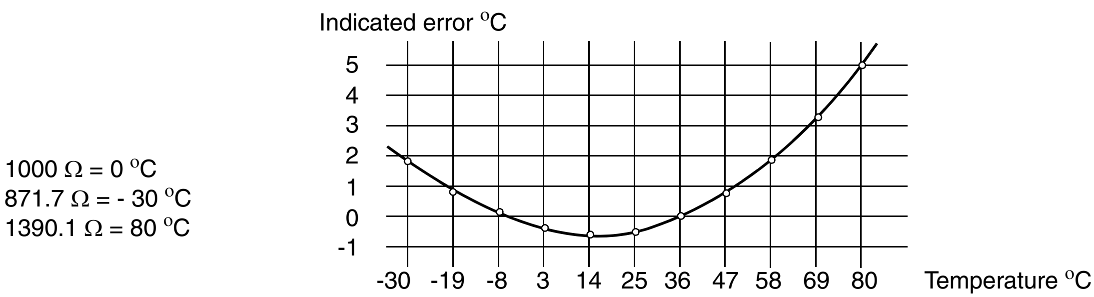


Figure 126. Temperature diagram for MN80.

Analog Output Board, OCAHG

Function	Data
Number of outputs	4
Supply voltage	20-30 V DC
Supply current	Max. 200 mA at 24 V DC (except MAN/DDC indication)
Analog outputs Time to 63% of FS in DDC mode	 Approx. 150 ms
Load current for voltage outputs	Max. 7 mA/output
Load resistance for current outputs	Max. 750 Ω
MAN/DDC indication	Max. 50 mA/output
Continuous working voltage	< 75 V DC relative to system ground
Common mode voltage relative to ground	500 V DC
Accuracy	±0.5% of FS within the temperature range +5 - +55°C
Resolution	8 bits
Current consumption	+12 V DC, 1 mA
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm
Order code	OCAHG

Analog Output Board, OCVA

Function	Data
Number of outputs	2
Supply voltage	24 V DC +20 -10%
Max ripple	5% of nominal voltage
Supply current	Max. 140 mA (24 V DC)
Response time to 63% of FS of output	1.5 ms
Load current for voltage outputs	Max. 5 mA per output

Function	Data	
Load resistance for current outputs	Max. 750 Ω	
Continuous working voltage	< 75 V DC relative to system ground	
Common mode voltage relative to ground	500 V DC	
Max. recommended cable length	500 m	
Accuracy	Max. ±0.3%, typ. ±0.15% of FS at 25°C	
Temperature stability	±0.002% of FS/°C	
Linearity error	Max. 0.05%, typ. 0.02% of FS in the temperature range +5 - +55°C	
Offset	Max. 19.5 mV and 19.5 µA (±4 LSB)	
Resolution	-10 V - +10 V DC:	12 bits
	0-10 V DC:	11 bits
	4-20 mA:	11 bits
	0-20 mA:	11 bits
Current consumption		
+12 V DC	45 mA	
+ 5 VL	70 mA	
Dimensions (incl. panel)	H 262 x W 20 x D 190 mm	
Order code	OCVA	

I/O Systems - Series 200 I/O

Regarding the technical specifications of the S200 I/O, please refer to any of the manuals:

- S200 I/O Hardware (3BSE021356*)
- S200L and I/O 200C Hardware (3BSE021357*)
- I/O 200C Installation and Maintenance (493104811).

Appendix D Troubleshooting

This appendix describes the troubleshooting process for the CI865 on page 203, ControlNet on page 204 and I/O System - Rack I/O on page 207. For more information about troubleshooting Series 200 I/O see I/O System - Series 200 I/O on page 216 for references to relevant manuals.

CI865

Table 21. Satt I/O CI865 – Fault Finding

Designation/Color	Function
Neither R(un) nor F(ault) LED's are ON	The CI865 unit is in the process of being configured. Allow time for this to finalize. If the condition persists, and no other unit LED on the CEX-Bus is lit: • Check the CEX-Bus fuse inside the PM8xx processor unit • Initiate a reset signal (INIT) from the PM8xx processor unit • Replace the CI865 unit
F(ault) LED is ON	The CI865 unit is in the process of being restarted. Allow time for this to finalize. Replace unit if the condition persists.
COM A LED OFF	Power OFF or Reset Mode
COM B LED OFF	Normal state (channel B not used)
COM A LED is solid green	Channel OK

Table 21. Satt I/O CI865 – Fault Finding (Continued)

Designation/Color	Function
COM A LED is solid red	Module is broken, has to be replaced
COM A LED is flashing green	Temporary error or needs initial setup
COM A LED is flashing red	Bad channel cable or node is lonely
COM A LED is flashing red/green	Network has data flow problem
COM A/COM B LED is railroad red	Bad node configuration, for example, duplicate node ID.
COM A/COM B LED is railroad red/green	Self test

Please refer to the manual AC 800M Controller Hardware, Hardware and Operation (3BSE036351Rxxxx) for more information about troubleshooting of the CI865.

ControlNet

Coax System

Troubleshooting the Repeaters

Follow the troubleshooting step by step. Continue if the error still persist.

Table 22. Troubleshooting the Repeaters

Symptom	Measure
Both LEDs are off	Unit not powered. 1. Check the power line for correct voltage. 2. Check the fuse and replace if blown.
Both LEDs are red	Repeater fault. 1. Press the reset switch. 2. Replace the repeater or troubleshoot the network.

Table 22. Troubleshooting the Repeaters (Continued)

Symptom	Measure
Either LED flashing green/off	Experiencing temporary network errors. This situation will normally correct itself. If the situation persists, troubleshoot your nodes and cable system. When troubleshooting your cable system, make sure: • all BNC connector pins are properly seated. • all taps are connected properly. • all terminators are 75 Ω and are installed at both ends of all segments. • the coax cable has not been inadvertently grounded.
Either LED flashing red/off	Experiencing a high level of network errors. This may indicate a broken cable, broken tap or missing segment terminator. **Important!** The indicators will flash red/off on a system that has no network activity. This would be normal for a system that has no ControlNet nodes installed or enabled.

Fibre System

Troubleshooting the Fiber Repeater Adapter

The repeater adapter has one LED for the coax cable connection and one for the accumulative indication of the fiber channels.

Note that any faulty fiber channel normally causes fault indication, but that a faulty channel can be masked by several good fiber channels.

Follow the troubleshooting step by step. Continue if the error still persists.

Table 23. Troubleshooting the Fiber Repeater Adapter

Symptom	Measure
Both LEDs are off	Unit not powered, check the power line for correct voltage.
Both LEDs are red	1. If the fault indication is caused by a jabber condition, it will automatically be cleared when the jabber condition is removed. 2. Repeater fault. Replace the repeater or troubleshoot the network.
Either LED flashing green/off	Experiencing temporary network errors. This situation will normally correct itself. If the situation persists, troubleshoot your nodes and cable system. When troubleshooting your cable system, make sure: • all connector pins are properly seated. • all taps are connected properly. • all coax terminators are 75 Ω and are installed at both ends of all coax segments. • the coax cable has not been inadvertently grounded.
Either LED flashing red/off	Experiencing a high level of network errors. This may indicate a broken cable, broken tap or missing segment terminator. Important! The indicators will flash red/off on a system that has no network activity. This would be normal for a system that has no ControlNet nodes installed or enabled.

Troubleshooting the Fiber Module

The status indications are individually related to channel 1 or 2:

Table 24. Troubleshooting the Fiber Module

Symptom	Measure
LED is off	1. Unit not powered from the repeater adapter. 2. Faulty module, replace it.
LED is flashing green/off	No data activity on associated channel.

I/O System - Rack I/O

Read the section Safety Summary in the beginning of this manual, before performing operations which can be dangerous for personnel or cause damage to equipment.

This section is useful when finding faults that can be detected by the control system or by detection circuits in the rack-based I/O system. Faults which are caused by unintentionally unconnected or faulty inputs/outputs, have to be detected through measures in the application program.

I/O board or I/O rack errors will force the outputs to a safe state. To avoid unpredictable behavior of the process controlled by the system during the troubleshooting, disconnect those parts of the process that are affected by the faulty I/O rack.

The first step, when troubleshooting the rack-based I/O system, is to make sure that the rack(s) are installed properly. Check the cables and the address switches on the PBAD boards. Ensure that the power supplies, PSF, are powered before or simultaneously with the control system. Refer to the LED indicators described in "Power Supply Unit, PSF", on page 125.

Note that there can be additional error information available through the control system software. Refer to the user documentation for the control systems.

General Instructions

If the I/O communication ceases to function, check the following:

- That connectors are correctly fitted.
- That the indicators on the power supplies in the racks show that the power supply is on.

Rack Adapter Board, 200-RACN

Indications

Symptom	Explanation/Measure
OK: Off	No power or reset. 1. Check the 24 V DC power (if applicable) 2. Check the power supply 3. Replace the board
OK: Flashing green	Self-test OK but no connection established with the system. 1. Check the AC 800M system 2. Check the application program 3. Check the network - is there any connection with the AC 800M system?
OK: Solid green	On-line, link OK, is connected
OK: Flashing red	Recoverable fault, e.g. erroneous board configuration is detected. 1. Check if the expected I/O board configuration, as set up in the program, corresponds to the current configuration in the rack. Make corrections in the program or in the I/O board configuration in the I/O rack. 2. Check the PBAD address.

Symptom	Explanation/Measure
OK: Solid red	Self-test error, rack error or I/O board error. **Note 1**: OK indication will be lit at start up during self-test. **Note 2**: If an I/O board- or I/O rack error is detected, the I/O copy will be terminated. Then the STOP indication will also be lit. **Note 3**. If one or more external racks are connected, then they must be powered. Otherwise, the OK indication will be solid red.
OK: Solid red **Error indication at start-up**	1. Check the node address switches for a valid address. Selected address must be in the interval 02 to 99. After adjusting the switch, the 200-RACN board must be restarted. 2. Check the mode switch. It should be in position 0. After adjusting the switch, the 200-RACN board must be restarted. 3. Check that the power supply units, PSF, in the central rack and external rack(s), are switched on. Switch on the power to all power supplies PSF, and restart the control system. 4. I/O board failure: Check I/O boards by removing the boards and restart the AC 800M system. Replace the faulty board(s). 5. Replace 200-RACN 6. Rack error: Replace the I/O rack.
OK: Solid red **Error indication at run-time**	Perform items 3-8 above.
POWER: Off	No power 1. Check the 24 V DC power (if applicable) 2. Check the power supply 3. Replace 200-RACN
POWER: Solid green	Power applied
STOP: Off	I/O copy is running

Symptom	Explanation/Measure
STOP: Solid red	No I/O copy is performed, i.e. the I/O-copy has not started yet, or watchdog time-out due to hardware failure. 1. Wait until the PLC program has been downloaded and started. 2. Check the mode switch. It should be in position 0. After adjusting the switch, the 200-RACN board must be restarted. 3. Follow steps 3 to 8 under ”OK: Solid red” indication above.
Com A and B simultaneously:	
Off	No power or reset 1. Check the 24 V DC power (if applicable) 2. Check the power supply 3. Replace 200-RACN
Flashing red-green	200-RACN self-test. Wait until the board self-test is completed.
Flashing red	Node configuration error, i.e. duplicated node address. Check the node address.
Solid red	Hardware failure. Replace 200-RACN
Com A (B disabled)	
Off	No power or reset 1. Check the 24 V power (if applicable) 2. Check the power supply 3. Replace 200-RACN
Solid green	Channel OK

Symptom	Explanation/Measure
Flashing green	Temporary network error (communication errors) or network configuration is not downloaded. 1. If constantly flashing, check if the AC 800M system has downloaded the configuration. Check the node addresses on the network. There must be a node No. 1 on the network (the control system). 2. If single flashes (communication error), check the cable system; bad connectors, broken taps, no termination resistor etc.
Flashing red	Cable fault or lone node 1. Check if 200-RACN is connected to the network cable. 2. Check if there are other active nodes connected to and active on the network. 3. Check the cable system; bad connectors, broken taps, no termination resistor etc. 4. Replace 200-RACN
Solid red	Board failure. Replace 200-RACN

Power Supply Unit, PSF

Test Points

Test points for the +5 V DC, +5 VL and +12 V DC outputs are provided on the front panel. The measuring instruments used must have an internal impedance of at least 1 MΩ.

Protection Circuits

The mains supply is protected by a 0.8 AT IEC 5x20 mm fuse. If a 110 V DC supply is used, this fuse should be replaced by a 16 AT IEC fuse. The fuse (F1) is fitted on the front panel for easy access.

The secondary side of the mains transformer is protected by a 5 AT IEC 5x20 mm fuse. This fuse (F2) is fitted on the side of PSF.

A 24 V DC source supply is protected by a 4 AT IEC 5x20 mm fuse. The fuse (F3) is also fitted on the side of PSF.

PSF has semiconductor over-voltage protection for +5 V DC, 5 VL and 12 VDC.

Digital Input Boards, IDPG24 and IDPG48

The system is running**:**

Symptom	Measure
The LED status on the input is ON and the control system status is not active	1. Check that the input is not forced to OFF 2. Check that the input voltage is not within the transition region 3. Replace the board
If the LED status on the input is OFF and the control system status is active	1. Check that the input is not forced to ON 2. Replace the board
LED status is OFF and input is active	Replace the board

Digital Input Board, IAPG230

Symptom	Measure
LED status on an input is ON and the control system is not active	1. Check that the input is not forced to OFF 2. Check that the input voltage is not within the transition region 3. Replace the board
If the LED status on an input is OFF and the control system status is active	1. Check that the input is not forced to ON 2. Replace the board
LED status is OFF and input is active	Replace the board

Digital Output Board, ODPG.8

The system is running, the supply voltage is on (10-60V) and the output should be activated (by the program):

Symptom	Measure
LED status at the output is ON. The output is not active.	1. Check if the output is short circuited to 0 V DC. * No short circuit - replace the board * Short circuit - go to step 2 2. Release the cable from the channel and check if the cable is short circuited to 0 V DC * No short circuit - check the cabling. Correct failures. OK?
LED status at the output is OFF and the output is active	Replace the board
LED status at the output is OFF and the output is not active	Check that the outputs is not forced to OFF

The system is running and the output should not be activated (by the program).

Symptom	Measure
LED status at the output is ON and the output is active	Check that the output is not forced to ON Replace the board
LED status at the output is OFF and the output is active	Loosen the cable attached to the output. Check the voltage level at the output * +24 V DC - replace the board * 0 V DC - check the cables

Relay Output Board, ORG24

Symptom	Measure
LED not lit, no output signal	1. Check that ORG24 is enabled by the switch on the front 2. Check that the signal is activated in the control system 3. Replace the board
LED lit, but no output signal	1. Check that 24 V DC is connected at the rear of the rack on the VR screw terminal 2. Replace the board

Digital Output Board, ODSG

Symptom	Measure
PWR LED is not lit	Check 24 V DC power supply Replace the board
Channel LED is not lit, i.e. no output signal	Check that the switch on the front is set to enable position Check that the signal is activated in the control system Replace the board
LED lights faintly (if the error flip-flop is active the yellow LED is also lit and F00 for the outputs 00-17 and F20 for 20 - 37 are set high for each group)	Remove overload Reset the output Reset the fault bistable circuit if it is used by setting Man/Auto input low for at least 2 ms
Channel LED lit, no output signal	Replace the board

Pulse Counter Board, IPA4

Refer to the illustrations "Front panel", on page 141, "Connector X1 with pin numbers for the process signals", on page 149 and "Location of jumpers and DIP switches", on page 150.

The IPA4 board needs no maintenance and a faulty board must be replaced. During normal operation, the change-over switch (10) on the front panel must be in the “I” position. The “0” position resets all the counters and is recommended when the board is removed from the rack.

All inputs have LED indicators on the front panel, which facilitates troubleshooting. The pin numbers for the corresponding cable connections at the rear of the rack are shown on page 148.

The jumpers and DIP switches on a new IPA4 board must be set identically to those of the replaced faulty board. Check the jumpers (1), (2), (3), (4), (6) and the DIP switches (5), (7) carefully according to the illustration on page 150.

Input pulses are compared with a reference voltage 0-10.5 V, which should be adjusted to about half the pulse amplitude by means of the potentiometer (9). The voltage can be measured across the sockets (8). New boards are delivered with the reference adjusted to about +6 V DC.

Analog Input Board, IBA

To be able to trouble-shoot this board, the board should be strapped for 4-20 mA.

Symptom	Measure
Erroneous measurement result is registered	Check connections Check strappings Jxx1, Jxx2, Jxx3, Jxx4, Sxx1, Sxx2 and Sxx3. Check that units used are properly installed Replace IBA

Analog Output Board, OCAHG

To be able to trouble-shoot this board, the board should be strapped for 4-20 mA.

Symptom	Measure
0 mA out constantly	Check that OCAHG is enabled by the switch on the front Check 24 V DC Check connections Replace OCAHG
4 mA out constantly	Check that 24 V DC is connected to the input ”DDC” on the X1 connector (if run in auto mode and controlled from the system) Check if the analog signal is activated in the control system. Replace OCAHG
Erroneous level out (mainly in the lower area)	Check strapping for 4-20 and 0-20 mA

Analog Output Board, OCVA

Symptom	Measure
Erroneous signal out	Check 24 V DC Check that the straps are properly connected on the ”process connector” for selection of voltage and current Replace OCVA

I/O System - Series 200 I/O

Regarding the troubleshooting of the Series 200 I/O, please refer to any of the manuals:

- S200 I/O Hardware- Hardware and Installation (3BSE021356Rxxxx),
- S200L I/O Hardware- Hardware and Installation (3BSE021357Rxxx),
- I/O 200C Installation and Maintenance (493104811).

Appendix E ControlNet Cable Components

This document contains information of ControlNet cable components. Most items contains a brief description and the ABB order code. Component manufacturers are also listed. Since each brand might be represented through different distributors for different countries, no list of distributors is included. In the subsection Tools on page 222 and forward there is a detailed description of how to adjust the cable strip tool.

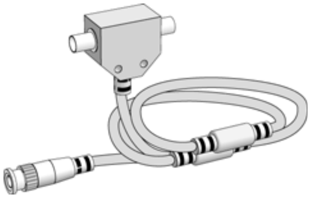
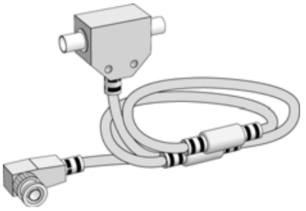
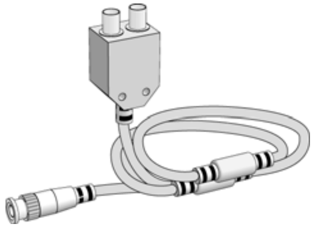
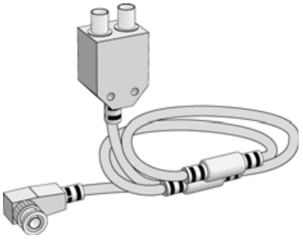
Taps

Each tap kit contains:

- 1 m of integral drop cable,
- 2 BNC connector kits,
- 1 dust cap,
- 1 universal mounting bracket,
- 2 screws.

Quantity needed: Number of devices + (number of repeaters x 2).

Table 3. Taps

Straight T-tap Order code	TPS	
Right angle T-tap Order code	TPR	
Straight Y-tap Order code	TPYS	
Right angle Y-tap Order code	TPYR	

Cables

Table 4. Cables

Trunk cable RG-6: **Standard PVC, –40 to +80 °C** ABB Belden Comm/Scope	Order code RG6-PVC 1189A 5740	
Trunk cable RG-6: **Flooded burial, –55 to +80 °C** Belden Comm/Scope	Order code 1190A 5740B	
Trunk cable RG-6: **Plenum-FEP, –70 to +200 °C** ABB Belden Comm/Scope	Order code RG6-FEP 1152A 2227K	
Trunk cable RG-6: **High-Flex, –40 to +75 °C** ABB Belden Comm/Scope	Order code RG6F YR28890 5740F	
Trunk cable RG-6: **Messengered, –40 to +80 °C** Belden Comm/Scope	Order code 1191A 5740M	

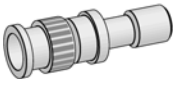
Table 4. Cables (Continued)

Trunk cable RG-6: Armored, –40 to +80 °C	Order code	
Belden PVC/aluminum	121189A	
Belden PVC/steel	131189A	
Comm/Scope	5740A	
Trunk cable RG-6: Siamese, –40 to +80 °C	Order code	
Belden	9072	
Comm/Scope	5740S	

Terminators

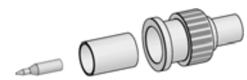
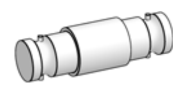
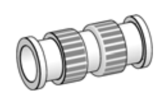
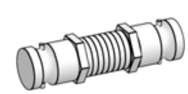
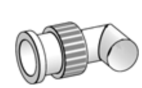
Quantity needed: One for each end of a segment.

Table 5. Terminators

BNC-75 Ω terminator	Order code	
ABB	BNCT	
Global Comp.	09C-034	
Amphenol	46650-75RFX	
AMP	221629-5	

Connectors

Table 6. Connectors

BNC/RG6-PLUG ABB Global Comp. Amphenol	Order code BNC-RG6 09C-033 31-71000-RFX	
Bullet (jack to jack) ABB Global Comp. Amphenol Amp	Order code BNCJ 09C-036 31-219-RFX 221551-3	
Barrel (plug to plug) ABB Global Comp. Amphenol	Order code BNCP 09C-32 31-218-75RFX	
Isolated bulkhead (jack to jack) ABB Global Comp. Amphenol	Order code BNCJI 09C-038 31-4803-1101	
Right angle (jack to plug) ABB Global Comp. Amphenol Amp	Order code BNCRJP 09C-037 31-9-RFX 222165-2	

Tools

Table 7. Tools

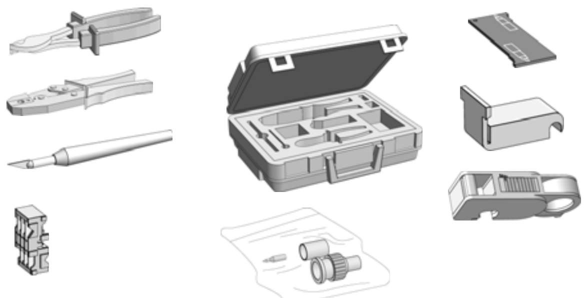
<table>
<tr><td colspan="3">ControlNet Tool Kit Complete: Tools for installation of cable connectors, including extra connectors

Order code: CTK</td></tr>
<tr><td>Crimp tool

ABB
Weidmüller-Paladin Tools</td><td>Order code

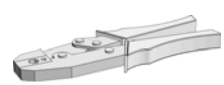
CTOOL
1349AB</td><td></td></tr>
<tr><td>Crimp die

ABB
Weidmüller-Paladin Tools</td><td>Order code

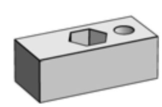
CDIE
2082</td><td></td></tr>
<tr><td>Strip tool with blade cassette and PVC memory blade holder

ABB
Weidmüller-Paladin Tools</td><td>Order code

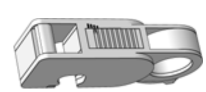
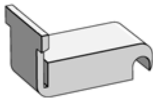
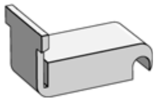
STOOL
1247AB</td><td></td></tr>
</table>

Table 7. Tools (Continued)

Memory blade holder -PVC ABB Weidmüller-Paladin Tools	Order code BHPVC 2245AB2	
Memory blade holder -FEP ABB Weidmüller-Paladin Tools	Order code BHFEP 2245AB	
Blade cassette (cartridge) ABB Weidmüller-Paladin Tools	Order code BC 2247X	

Adjusting The Cable Strip Tool

Follow the instructions described below to adjust the cable strip tool, supplied with the ControlNet Tool Kit.

Adjusting the Cutting Blades

Adjust the blade cutting depth by turning the three screws located in the memory blade holder, see Figure 127. Each screw adjusts the corresponding blade in the blade cassette.

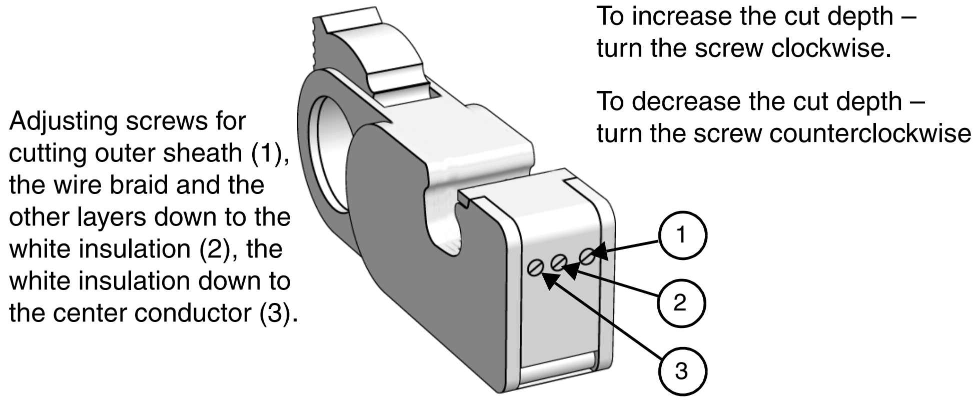


Figure 127. Cable strip tool, adjusting the cutting blades.

Adjust the three screws until the strip tool makes these cuts in the cable:

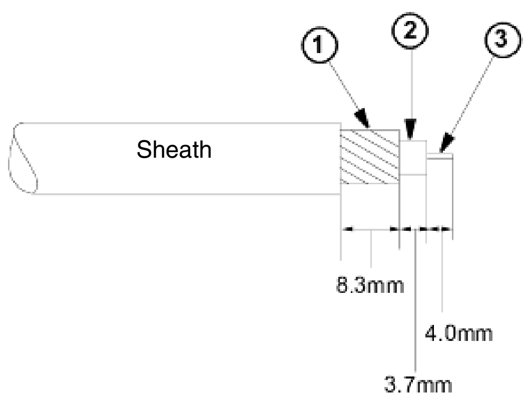


Figure 128. Stripped cable; layers and dimensions.

1. Braid/Tape/Braid/Tape The first cut should cut the outer sheath without cutting the outer wire braid.
2. White insulation or 1st tape. The second blade should cut the sheath, the three outer shields and possibly the inner tape shield. The insulation can be scored slightly, but should not have a deep cut.
3. Center conductor. The third blade should cut all layers of the cable down to the center conductor. This cut should not score the center conductor.

Important: The first and second blade adjustments need to be very precise. Adjustments as small as 2 to 3 mm can make the difference between a perfect and an imperfect cut.

Reversing/Replacing the Cutting Blades

To reverse or change the cutting blades:

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

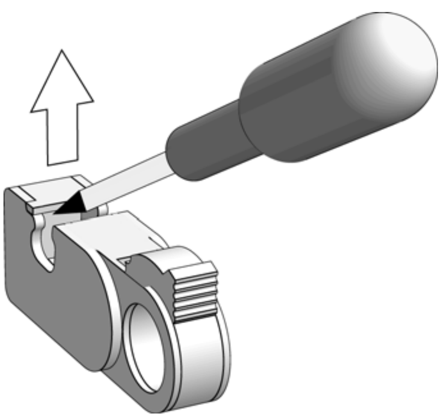
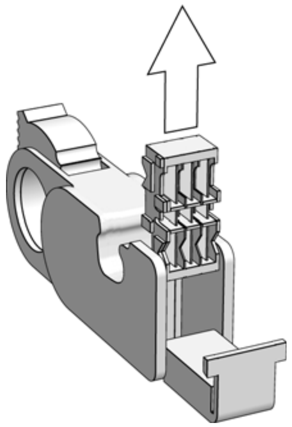


Figure 129. Lifting the memory blade holder.

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



If you are reversing the memory blade cartridge to use the second set of blades – go to step 3.

If you are replacing the memory blade cartridge – go to step 4.

Figure 130. Taking out the memory blade cartridge.

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

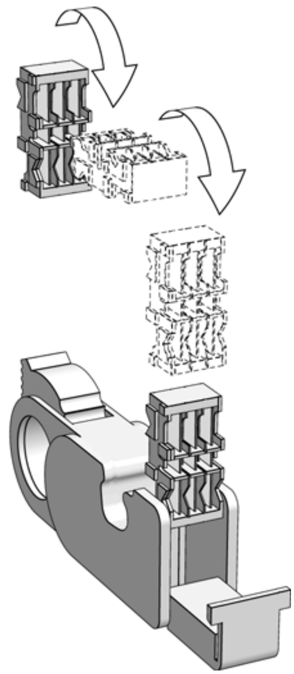


Figure 131. Reversing the memory blade cartridge.

If you are replacing the memory blade cartridge – go to step 4, otherwise go direct to step 5.

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.

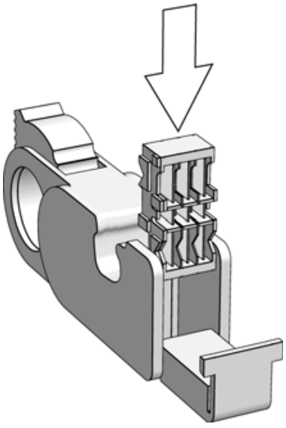


Figure 132. Replacing the memory blade cartridge.

5. Swing the memory blade holder closed.

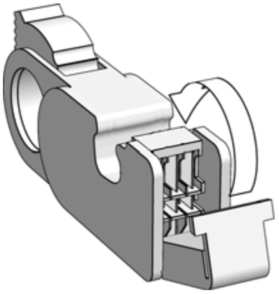


Figure 133. Closing the memory blade holder.

Changing 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.

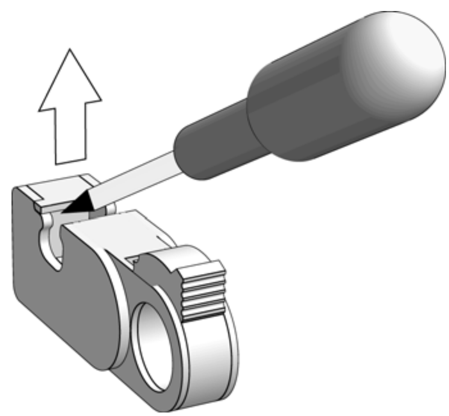


Figure 134. Lifting the memory blade holder.

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

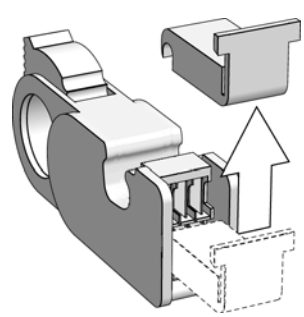


Figure 135. Removing the memory blade holder.

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

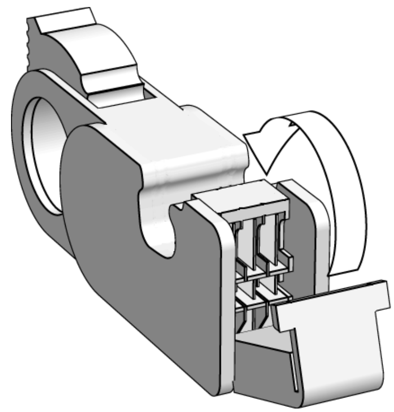


Figure 136. Closing the memory blade holder.

Coax Repeaters

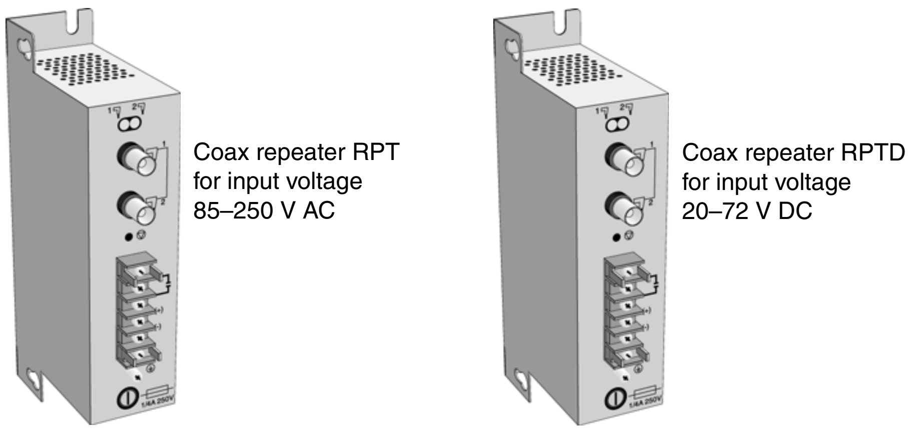


Figure 137. Coax Repeaters

Fiber Repeaters

Fiber repeater adapter RPA

Fiber repeater module RPFM and RPFS

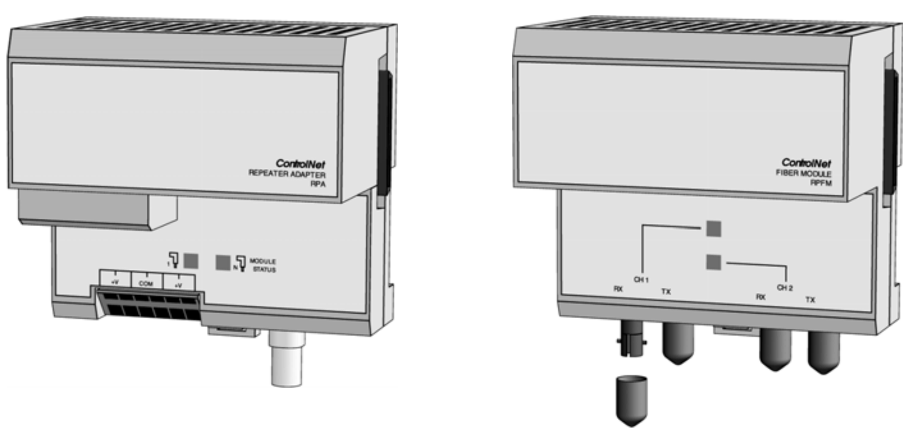


Figure 138. Fiber Repeaters

Appendix F Rack I/O Parts List

Order code	Product description
200-RACN	Rack adapter board for remote rack-based I/O system connected to the AC 800M system
200-RACN/A	Rack adapter board, 200-RACN, with analog-to-digital converter ADSF mounted
PSF	Power supply unit
IDPG24	Digital input board with 32 inputs, 24 V DC
IDPG48	Digital input board with 32 inputs, 48 V DC
IAPG230	Digital input board with 16 inputs, 230 V AC
IPA4	Pulse counter board with 4 inputs, 8-bit counters
IBA	Analog input board with 8 inputs
MCV200	Analog module for IBA, which permits up to 200 V DC common-mode voltage for each channel, individually
MCVG	Analog module for IBA, which provides individual galvanic separation of up to 750 V DC per channel
MP100, MP200 MP400, MP600 MP130, MP160	Temperature modules for IBA, to be used when measuring the temperature with Pt100 sensor. MP is linearized
MN80	Temperature module for IBA, to be used when measuring the temperature with Ni1000 sensor. MN is not linearized
MR100 MR140 MR1000	Resistance modules for IBA, to be used when measuring resistance (position sensing, pressure measurement etc.)
ODPG.8	Digital output board with 32 outputs

Order code	Product description
ORG24	Relay output board with 16 outputs
ODSG	Digital output board with 32 optocoupled outputs, short-circuit-proof
OCAHG	Analog output board with 4 outputs
OCVA	Analog output board with 2 outputs
PIOS/RC	Basic rack PIOS35 with address panel, power supply, PSF, and 200-RACN
PIOS/RCA	Basic rack PIOS35 with address panel, power supply, PSF, and 200-RACN/A
PIOS/P	Basic rack PIOS35 with address panel, power supply, PSF, bus interconnection socket XPIOS and bus decoder board, PBAD (also includes screws and mounting devices)
PIOS35	Empty basic rack (to be used as external or central rack)
ADSF	Central A/D converter. To be mounted on rack adapter board 200-RACN
PTU2	Two ready-wired I/O connectors with cables and screw terminal blocks mounted on an aluminium profile
CRT01	Crimp tool for 0.14-0.5 mm^2 cables
CRT02	Crimp tool for 0.75-1.5 mm^2 cables
CRIMP1	Crimp sleeve for 0.14-0.5 mm^2 cables
CRIMP2	Crimp sleeve for 0.75-1.5 mm^2 cables
CRRE	Crimped connection removal tool
AP1740	Address panel 1000-1740
AP2740	Address panel 2000-2740
I/OPAN6HE4TE	Blanking panel, PANEL1. Covers one slot, 6U
I/OPAN6HE8TE	Blanking panel, PANEL2. Covers two slots, 6U
FPA1S to FPA9S	Blanking panel between racks. Covers 19”, 1 U to 9 U

Order code	Product description
PTC	Digital simulation board with a panel which has 32 switches for simulation of digital inputs
IVAPOT	Analog simulation board with 8 potentiometers for simulation of analog inputs

Components to the ControlNet network is listed in Appendix E, ControlNet Cable Components.

Recommended Components

Order code	Name/Function
–	Ground clamps (spring clamps) for shielded cables - Weidmüller KLB 1-8 (for cables 1 - 8 mm) - Weidmüller KLB 4-13.5 (for cables 4 - 13.5 mm)
_	Capacitor for earth reference. - Phoenix TT SLKK 5-C12n230VAC

Appendix G Standards

CSA Hazardous Location Approval

CSA certifies products for general use as well as for the use in hazardous locations. **Actual CSA certification is indicated by the product label** as shown below, and not by statements in any user documentation.

Example of the CSA[1] certification product label:

CL 1 DIV 2
GP A,B,C,D
TEMP
[redacted]

To comply with CSA certification for use in hazardous locations, the following information becomes a part of the product literature for this CSA-certified industrial control product.

- This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, D, or non-hazardous locations only.
- The products having the appropriate CSA markings (that is, Class 1, Division 2, Groups A, B, C, D) are certified for use in other equipment where the suitability of combination (that is, application or use) is determined by the CSA or the local inspection office having jurisdiction.

Important: Due to the modular nature of a programmable control system, the product with the highest temperature rating determines the overall temperature code rating of a programmable control system in a Class 1, Division 2 location. The temperature code rating is marked on the product label as shown.

1. CSA logo is a registered trademark of the Canadian Standards Association.

Temperature code rating:

CL 1 DIV 2
GP A,B,C,D
TEMP

Look for temperature code rating here

The following warnings apply to products having CSA certification for use in hazardous locations.

Warning: Explosion hazard

- Substitution of components may impair suitability for Class 1, Division 2.
- Do not replace components unless power has been switched off or the area is known to be non-hazardous.
- Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not disconnect connectors unless power has been switched off or the area is known to be non-hazardous. Secure any user-supplied connectors that mate to external circuits on this equipment by using screws, sliding latches, threaded connectors, or other means such that any connection can withstand a 15 N (3.4 lb. - 1.5 kg) separating force applied for a minimum of one minute.
- Batteries must be changed only in an area known to be non-hazardous.

Approbation d'utilisation dans des emplacements dangereux par la CSA

La CSA certifie les produits d'utilisations générale aussi bien que ceaux qui s'utilisent dans des emplacements dangereux. **La certification CSA en vigueur est indiquée par l'étiquette du produit** et non par des affirmations dans la documentation à l'usage des utilisateurs.

Example d'étiquette de certification d'un produit par la CSA[1]:

Pour satisfaire à la certification de la CSA dans des endroits dangereux, les informations suivantes font partie intégrante de la documentation des produits industriels de contrôle certifiés par la CSA.

- Cet équipement convient á l'utilisation dans des emplacements de Classe 1, Division 2, Groupes A, B, C, D, ou ne convient qu'á l'utilisation dans des endroits non dangereux.
- Les produits portant le marquage approprié de la CSA (c'est à dire, Classe 1, Division 2, Groupes A, B, C, D) sont certifiés à l'utilisation pour d'autres équipements où la convenance de combinaison (application ou utilisation) est déterminée par la CSA ou le bureau local d'inspection qualifié.

Important: Par suite de la nature modulaire du système de contrôle programmable, le produit ayant le taux le plus élevé de température détermine le taux d'ensemble du code de température du système de contrôle programmable dans un emplacement de Classe 1, Division 2. Le taux du code de température est indiqué sur l'étiquette du produit.

Taux du code de témperature:

1. Le sigle CSA est la marque déposée de l'Association des Standards pour le Canada.

Les avertissements suivants s’appliquent aux produits ayant la certification CSA pour leur utilisation dans des emplacements dangereux.

Avertissement: Risque d éxplosion:

- La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe 1, Division 2.
- Couper le courant ou s’assurer que l’emplacement est désigné non dangereux avant de remplacer les composants.
- Avant de débrancher l’équipment, couper le courant ou s’assurer que l’emplacement est désigné non dangeruex.
- Avant de débrancher les connecteurs, couper le courant ou s’assurer que l’emplacement est reconnu non dangereux. Attacher tous connecteurs fournis par l’utilisateur et reliés aux circuits externes de l’appareil à l’aide de vis, loquets coulissants, connecteurs filetés ou autres moyens permettant aux connexions de résister à une force de séparation de 15 N (3,4 lb. - 1,5 kg) appliquée pendant au moins une minute.
- Afin d’éviter tout risque d’éxplosion, s’assurer que l’emplacement est designé non dangereux avant de changer la batterie.

Appendix H Directive Considerations

Electromagnetic Compatibility (EMC)

Units mentioned in this document for which the product is marked with the CE logo are tested to meet Council Directive 89/336, Electromagnetic Compatibility (EMC) using a technical construction file, and meet the following EMC standards, applicable in whole or in part:

- EN 61131-2 Product Standard, Programmable Controller – Industrial Environment
- EN 61000-6-2 EMC – Generic Immunity Standard, Part 2 – Industrial Environment
- EN 61000-6-4 EMC – Generic Emission Standard, Part 2 – Industrial Environment

Low-Voltage Directive (LVD)

Units mentioned in this document for which the product is marked with the CE logo comply with the LVD where applicable, i.e. if they are connected to 50 - 1000 V AC and/or 75 - 1500 V DC.

Note that the units are “Open type equipment” and must be mounted in suitable cabinets.

Note also that external power supplies used to provide 24 V DC must be CE-marked. The CE low-voltage directive prescribes that a safety extra low voltage (SELV) or a protected extra low voltage (PELV) power supply be used.

INDEX

Numerics

A

B

C

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www.abb.com/controlsystems

3BSE042821-600

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