Foxboro®

by Schneider Electric

I/A Series® System

Field Control Processor 270 (FCP270) User's Guide

B0700AR

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Contents

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Preface

This document describes how to configure and install the Field Control Processor 270 (FCP270) in a Foxboro Evo™ Process Automation System with The MESH control network. It also describes how the FCP270 functions in The MESH control network. Finally, it describes how to troubleshoot system problems.

Who This Book Is For

This book is intended for the use of process control engineers and operators, instrument and maintenance engineers, and other qualified and authorized personnel involved in installing, configuring and maintaining the FCP270 for operation in The MESH control network.

What You Should Know

Prior to using this book, you should be generally familiar with the Foxboro Evo Process Automation System, and with *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA). Detailed information relating to the various Foxboro Evo software and hardware elements is found in the reference documents listed below.

Revision Information

For this revision of the document (B0700AR-K), the following change was made:

"**Preface**"

- Added "Commissioned" for CAR 1240997/CR HPS#26628 to the "Glossary of Terms" on page xiii.

Reference Documents

The following documents provide additional and related information.

For information about defining control blocks and compounds, refer to:

- *Integrated Control Block Descriptions* (B0193AX)
- *Control Processor 270 (CP270) and Field Control Processor 280 (CP280) Integrated Control Software Concepts* (B0700AG)

For information about configuring and managing the FCP270, refer to:

- *Control Processor 270 (CP270) On-Line Image Update* (B0700BY)
- *System Definition: A Step-by-Step Procedure* (B0193WQ)
- *Letterbug Configurator User's Guide* (B0700AY)
- *Integrated Control Configurator* (B0193AV)
- *I/A Series Configuration Component (IACC) User's Guide* (B0700FE)
- *System Manager* (B0750AP)

- *Process Operations and Displays* (B0700BN)
- *System Management Displays* (B0193JC)
- *Field Control Processor 270 (FCP270) Sizing Guidelines and Excel Workbook* (B0700AV).

For information about associated DIN Fieldbus Modules, the Fieldbus Expansion Module 100, the FBI200 and the FBI100, refer to:

- *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

For information about DIN Fieldbus Modules used to upgrade a 100 Series system and the FBI200A, refer to:

- *100 Series Fieldbus Module Upgrade User's Guide* (B0700BQ).

For information about Y-module Fieldbus Modules, refer to:

- *I/A Series System Equipment Installation* (B0193AC).

For information about system power and earthing (grounding), refer to:

- *Power, Earthing (Grounding), EMC and CE Compliance* (B0700AU)

For information about supported migration products, refer to:

- *SPECTRUM™ Migration Integrator User's Guide* (B0193RC)
- *SPEC 200™ Control Integrator User's Guide* (B0193RD)
- *SPEC 200 MICRO™ Control Integrator User's Guide* (B0193RR)
- *SPEC 200 CCM Control Integrator User's Guide* (B0193VU)
- *DCS Fieldbus Modules for Westinghouse® WDPF Systems User's Guide* (B0400BA).
- *DCS Fieldbus Modules for APACS+™ Automation Systems User's Guide* (B0700BK)
- *DCS Fieldbus Modules for Honeywell® TDC 2000 Systems User's Guide* (B0193VL)
- *DCS Fieldbus Modules for Honeywell TDC 3000 Systems User's Guide* (B0193YW)
- *DCS Fieldbus Modules for Bailey® NET90 and INFI90® Systems User's Guide* (B0193XG)
- *DCS Fieldbus Modules for Fisher PROVOX® Series 10 Systems User's Guide* (B0193WV)
- *DCS Fieldbus Modules for Fisher PROVOX Series 20 Systems User's Guide* (B0193YV)
- *DCS Fieldbus Modules for Fisher PROVOX Controller Series Systems User's Guide* (B0400AR)

For information about The MESH control network, refer to:

- *The MESH Control Network Architecture Guide* (B0700AZ)

Most of these documents are available on the Foxboro Evo Electronic Documentation media (K0174MA). The latest revisions of each document are also available through our IPS Global Client Support at *https://support.ips.invensys.com.*

Glossary of Terms

The following terminology, used throughout this user's guide, relates to the FCP270 controller and associated equipment.

Name	Meaning
AI	Analog input
APACS+™	Siemens® Process Automation System
AW	Application Workstation (For I/A Series software v8.8 and Foxboro Evo Control Core Services v9.0+, WSTA70 and WSVR70)
BPC	Block Processing Cycle
Checkpoint File	The Control Database, that resides on the host workstation, which is downloaded to the FCP270.
Commissioned	A commissioned control processor is a control processor for which all the steps required to place the device into service have been performed. This includes: ♦ Connecting to the baseplate and power ♦ Setting the letterbug ♦ Connecting to the Foxboro Evo Control Network ♦ Receiving and storing the IP address, MAC address, and control database from its host workstation in the CP's Serial SPI flash memory Once these steps have been completed the CP becomes operational.
Control Core Services	See "Foxboro Evo Control Core Services" below.
CP60	Control Processor 60
CSD	Control Strategy Diagram
DIN	DIN is a non-governmental organization established to promote the development of standardization and related activities in Germany.
ECB	Equipment Control Block
EEPROM	Electrically erasable programmable read-only memory
FBM	Foxboro Evo Fieldbus Module
FCM	Fieldbus Communication Module
FCP270	Field Control Processor 270
FDSI	Foreign Device Systems Integrator
FEM	Fieldbus Expansion Module
Fault Tolerant (FT)	A station that is running with two FCP270 controllers.
Foxboro Evo Control Core Services	Core software environment, formerly known as "I/A Series (Intelligent Automation Series) software". A workstation which runs this software is known as a "Foxboro Evo Control Core Services workstation".
Foxboro Evo Control Editors	Formerly known as "FCS Configuration Tools", "InFusion Engineering Environment", or "IEE", these are the Control software engineering and configuration tools built on the ArchestrA Integrated Development Environment (IDE).

Name	Meaning
Foxboro Evo Control Software	Formerly known as “Foxboro Control Software (FCS)” and “InFusion”, a suite of software built on the ArchestrA Integrated Development Environment (IDE) to operate with the Foxboro Evo Control Core Services.
Foxboro Evo Process Automation System	An overall term used to refer to a system which may include either, or both, Foxboro Evo Control Software and Foxboro Evo Control Core Services.
Foxboro Evo System Fieldbus Modules	Foxboro-provided control and interface modules to third-party control solutions, such as Fisher's PROVOX® Series 20 or Honeywell® TDC 2000 systems. Formerly known as Distributed Control System (DCS) FBMs.
GMT	Greenwich Meridian Time (GMT) is an international time standard
GPS	Global positioning system
HART	HART Field Communications Protocol is a standard for digitally enhanced 4 to 20 mA smart instrument communication.
HDLC	High-level Data Link Control protocol - Master/Slave Protocol used on top of several physical layers for FBM communication
IACC	I/A Series Configuration Component
ICC	Integrated Control Configurator
IR	Infrared
LC	Connector for fiber optic cable connection to the FCP270 or splitter/combiner
LED	Light-emitting diode
Letterbug	Alphanumeric string that the user defines to identify a station in a Foxboro Evo Process Automation System.
Letterbug Configurator	Handheld device for setting, modifying and reading the controller letterbug and reading controller status information
Married FT Station	Two healthy FCP270 controllers operating as one station.
MMF	Multimode fiber cable
MTK	Master Timekeeper
MT-RJ	Connector for fiber optic cable connection to Ethernet switches
OLUG	On-Line Image Upgrade; the procedure that allows a fault tolerant FCP270 to update to the latest image with minimal I/O down time.
Remarry	When a newly booted FCP270 module marries with a FCP270 running in Single Primary mode.
ROM	Read only memory
Rx	Receive
Single Primary	A FCP270 module that is running as a single module.
SMDH	System Management Display Handler, the user interface for equipment status and change actions
SOE	Sequence of Events

Name	Meaning
Station	The virtual controller which runs as one or two CP modules. For example, the station may exist on both fault-tolerant modules, but the station itself is considered a single entity.
STK	Slave Timekeeper
SysDEF	System Definition
System Configurator	Software for configuring your system, such as the Foxboro Evo Control Editors, IACC, or ICC.
TDA	Transient Data Analyzer
TDR	Transient Data Recorder
The MESH	The MESH Control Network
Tx	Transmit
UTC	Universal Coordinated Time

1. Introduction

This chapter describes the main features, fault-tolerant operation, network configuration, and time synchronization of the Field Control Processor 270.

Overview

The Field Control Processor 270 (FCP270) is an optionally fault-tolerant station that performs regulatory, logic, timing, and sequential control together with connected Fieldbus Modules (FBMs) and other process interface devices. It also performs data acquisition (via the FBMs and/or other devices) and alarm detection and notification.

The FCP270 supports process control via the standard 2 Mbps HDLC fieldbus for the following products:

- All DIN rail mounted 200 Series FBMs (FBM201, FBM202, and so forth). The FCP270 supports up to 32 modules itself, and supports up to 128 modules when used with a Fieldbus Expansion Module 100 (FEM100); based on the loading of FCP270. Refer to *Field Control Processor 270 (FCP270) Sizing Guidelines and Excel Workbook* (B0700AV).
- Field Device Systems Integrator (FDSI) modules (FBM230/231/232/233)
- DCS Fieldbus Modules for APACS+™ Automation Systems
- DCS Fieldbus Modules for Westinghouse® WPDF Systems

The FCP270 also supports process control via the optional 268 Kbps HDLC fieldbus for the following products:

- All Y-module FBMs, also known as 100 Series FBMs (FBM01, FBM02, and so forth) – up to 64 modules, via an extended fieldbus
- Fieldbus Cluster I/O via FBP10 fieldbus processor module
- Foxboro® Hydrostatic Interface Unit (HIU)
- Foxboro Mass Flowmeter
- Foxboro Panel Display Stations
- SPECTRUM™ Migration Integrators
- SPEC 200™ Control Integrators
- SPEC 200 MICRO™ Control Integrators
- SPEC 200 CCM Control Integrators
- DCS Fieldbus Modules for Honeywell® TDC 2000 and TDC 300 Systems
- DCS Fieldbus Modules for Bailey® Net90 and Infi90 Systems
- DCS Fieldbus Modules for Fisher's PROVOX® Series 10, Series 20, and Controller Series Systems.

NOTE

The FCP270 can support the 2 Mbps and/or the 268 Kbps HDLC fieldbus, while the FBI100 is used on the 268 Kbps HDLC fieldbus between the FCP270 and the 100 Series FBMs or competitive migration modules. However, the FBI200 provides similar functionality as the FBI100 and supports both the 2 Mbps and the 268 Kbps HDLC fieldbus at the same time. For the maximum number of devices supported by each fieldbus, refer to the device specific Product Specification Sheets.

NOTE

Before loading a SaveAll control database from a CP60 or previous control processor onto an FCP270, make sure all the ECBs are supported by the FCP270. For example, ECB110 (for FCM10s) is not supported by the FCP270.
Failing to do this will block ALL the ECBs (invalid and valid) from being loaded into the new FCP270.

Features

The FCP270 provides the following new features and improvements.

- A direct 100 Mbps Ethernet fiber connection to The MESH control network for high speed data communication that is immune to electromagnetic interference over the distance of the fiber cable.
- A fault-tolerant option that delivers improved availability and safety using unique, dual controller comparison on all outgoing messages.
- Optional self-hosting mode allows the FCP270 to start up and run, executing its configured control scheme using the checkpoint file stored in flash memory. This allows the FCP270 to boot itself with a valid control database even if its host workstation is not present.
- On-line image update replaces the executable image (operating system) of a running, fault-tolerant FCP270 controller with a newer image without having to shut down the equipment being controlled by the FCP270.
- Hardened, field-mounted control (100 Mbps Ethernet fiber controller, 2 Mbps fieldbus, 200 Series DIN rail mounted FBMs, Termination Assemblies, and FPS400-24 power supply). The new configuration eliminates the need for a rack room (you only need a control room and a field enclosure).
- Supports up to 128 200 Series DIN rail mounted FBMs, or equivalent modules (depending on the sizing guidelines), when connected to an optional Fieldbus Expansion Module 100 (FEM100) or, depending on the configuration, an FBI200A in a conversion mounting structure (described in *100 Series Fieldbus Module Upgrade User's Guide* (B0700BQ)).
- Dual baud functionality supports communication with both 200 Series FBMs and 100 Series FBMs and migration products. When installed as specified, the FBI200s or FBI100s filter the 2 Mbps communications from the FCP270 to ensure the 100 Series FBMs and similar Migration modules only receive the 268 Kbps signals

intended for them, and extend the 268 kbps Module Fieldbus up to 1830 m (6000 ft).

- Connection to Ethernet or serial devices via FDSIs which allows for new device interfaces. The FDSIs include FBM230, FBM231, FBM232, and FBM233.
- Optional global positioning system allows external time synchronization.
- Sequence of Events (SOE) are optionally time stamped at the FBM (200 Series FBMs only) to 1 ms[1] accuracy throughout the system for later analysis of events.
- Optional Transient Data Recorder (TDR) allows 10 ms sampling of analog data for later analysis of events using Transient Data Analyzer (TDA). TDR data is optionally time stamped (200 Series FBMs only) to 1 ms[1] accuracy.
- Infrared interface to the I/A Series system Letterbug Configurator allows setting and reading the controller letterbug.
- Memory resident image for fast station reboot. Reboot time is less than 10 seconds.
- Improved controller performance. Block executions/second is 10,000 for the FCP270 compared to 3400 for the CP60.
- Up to 4000 blocks can be configured for the FCP270 (or fault-tolerant FCP270 pair)
- A scalable license lets you start small with a full-featured control system. You can grow your system over time.
- Alarm enhancements to the function blocks: re-alarming on changes to alarm priority, re-alarming based on time, alarm suppression based on time.
- Foundation Fieldbus, FoxCom™, HART, Profibus, and Modbus FBMs are supported.
- Y-module FBMs and DCS migration FBMs are supported.
- For enhanced reliability during maintenance operations, a recessed reset button, located at the front of the module, allows you to manually reset the module without removing it from the baseplate.

Fault-Tolerance

Fault-tolerant operation is unique with Foxboro control processors and uses patented technology. Fault-tolerance is superior to redundancy because outgoing messages from the fault-tolerant controller must be identical in both modules for a message to transmit successfully.

The following sections describe the difference between redundancy and fault-tolerance from an applications standpoint and how fault-tolerance is implemented using the FCP270.

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1. Time stamping has 1 ms accuracy only when using the optional GPS external time synchronization. WARNING: ac signals coming into SOE points cannot be synchronized to 1 millisecond in the same manner as dc based points can. The ac SOE points will have a delay of ~8-20 millisecond due to the 50 or 60 Hz ac wave form. If 1 millisecond synchronization is critical when time synchronization is required, avoid the use of ac inputs.
As well, digital data coming from FBMs with ac driven inputs could be delayed due to the dynamics of the ac waveform and filtering in the FBM and therefore may not be recorded until the following 10 millisecond sampling period.

Traditional Redundant Systems

Traditionally, the goal of improved availability through redundancy has been achieved using a second, or "backup" controller. Redundant systems that use a secondary controller may have the following shortcomings:

- Problems with the primary controller are not detected or are only detected after a number of potentially bad messages have been transmitted to the field.
- Secondary controllers may not use the latest "good" data when they take over from the primary controller. Configuring the secondary controller correctly can result in substantial system downtime.
- Secondary controllers may have health problems that are hard to determine after they have been idle for a long period of time.

To remove these shortcomings from critical systems, the FCP270 uses a patented method of fault-tolerance.

FCP270 Fault-tolerant Operation

The fault-tolerant version of the FCP270 consists of two modules operating in parallel (primary and shadow), with redundant connections to both The MESH control network and the HDLC module fieldbus. The two control processor modules, married together as a fault-tolerant pair, provide continuous operation of the unit in the event of a single hardware failure occurring within one module of the pair. When the primary and shadow modules boot up, they join together in a process which is referred to as "marriage."

Both modules receive and process information simultaneously, and faults are detected by the modules themselves. One of the significant methods of fault detection is comparison of communication messages at the module's external interface. Upon detection of a fault, the communication message is aborted, and self-diagnostics are run by both modules to determine which module is defective. The non-defective module then assumes control without affecting normal system operations. An aborted control network communication message is then sent by the non-defective module via the retry mechanisms of the communications protocol. An aborted fieldbus communication message is retried on the next BPC. For more information, see "Diagnostics" on page 82.

Self-Hosting and Non-Self-Hosting Modes

An FCP270 requires the latest control database to download to its local memory when it boots up. This database is provided in a checkpoint file, which the controller acquires based on one of two modes: non-self-hosting mode (the default mode) and the new self-hosting mode introduced with I/A Series software v8.4-v8.8 or Foxboro Evo Control Core Services (hereinafter referred to as the Control Core Services) v9.0 or later. FCP270 controllers running I/A Series software v8.4-v8.8 or Control Core Services v9.0 or later software images support the new self-hosting mode.

When the controller boots up in the traditional non-self-hosting mode, it requests the checkpoint file from its host workstation. When the controller is using the new self-hosting mode of operation, the checkpoint file is stored locally in the FCP270's flash memory. Thus, the controller can boot up in environments where a host workstation is not present. A controller cannot be configured to run in self-hosting mode until after the station boots up the first time in non-self hosting mode. Non-self-hosting mode is the default for a newly commissioned controller. If a controller boots up without a valid checkpoint file in flash, it will load the checkpoint file from the host

workstation. When the database download is complete, the controller issues a checkpoint command automatically, during which the checkpoint file is written to flash.

The new self-hosting feature provides a mechanism for an FCP270 controller to start up and execute its configured control scheme in the absence of a host workstation. A host workstation is only required when you change the control configuration or the controller image.

Controllers running in self-hosting mode require a link to the Ethernet to fully support the self-hosting functionality, and they must be connected to a fully functional switch. The link is required for the fault-tolerant network logic to operate. Without this link, the mechanism that is used to pass the checkpoint file from the primary to the shadow module will not work.

There are certain limitations on the self-hosting mode of an FCP270 controller.

- When you enable self-hosting in a controller, the smallest time interval allowed for the auto-checkpoint option is two (2) hours.
- If the user attempts to set an auto-checkpoint time of less than two hours, the FCP270 will force the time to two hours and send a message to the SMON log identifying the change.
- Flash memory is capable of at least 100,000 write operations. There are two areas of flash in the controller that are used to save checkpoint files. Flash burns alternate between the two flash memory areas, providing a total of at least 200,000 checkpoint file writes. The SMDH display for the primary ECB (FBM0) includes a flash burn counters for the primary and shadow modules.

For more information, refer to “Enabling the FCP270 Self-Hosting Option” on page 21.

Self-Hosting Feature, Available with 200 Series FBMs Only

The self-hosting feature is recommended only for use in FCP270s which are used with 200 Series FBMs, or similar modules such as those included in the intrinsically safe I/O subsystem. It is not recommended for use when the FCP270 is controlling any 100 Series FBMs (Y-module FBMs) or 100 Series FBM based migration cards including Cluster I/O.

All the information that 200 Series FBMs (or similar modules in the intrinsically safe I/O subsystem) need to operate correctly is either burned in the flash of the FCP270 or is included in the checkpoint file. This means that if a 200 Series FBM (or similar module) needs to reboot and go on-line after a power cycle, it will be able to do so without the presence of a boot host workstation. However, 100 Series FBMs have a different behavior. If a 100 Series FBM is power-cycled, it downloads information it needs to operate correctly from a boot host workstation. If the FCP270 is running in self-hosting mode and the boot host workstation is unavailable, the 100 Series FBM will not be able to boot or go on-line.

If desired, you can minimize the risk that 100 Series FBMs will need to boot up by making sure that the 100 Series FBMs are mounted on a rack with a battery back-up or an Uninterruptable Power Supply (UPS). With this type of configuration, as long as the I/O source does not need to boot up, the 100 Series FBMs will reconnect when the FCP270 comes back on-line.

On-Line Image Update

For a fault-tolerant FCP270 controller, on-line image update replaces the executable image (operating system) of a running FCP270 with a newer image without having to shut down the equip-

ment being controlled by the FCP270. This feature allows you to take advantage of product enhancements while interrupting process control for only 1.5 seconds, approximately.

FCP270 Network Configuration

The MESH control network uses redundant communication paths to enhance control reliability. Figure 1-1 shows a simplified FCP270 network configuration using redundant Ethernet fiber switches, 100Mbps fiber cables, splitter/combiners, FCP270 controllers (fault-tolerant), and redundant 2 Mbps fieldbus and redundant 268 Kbps fieldbus. Multiple FCP270s can share the same redundant switch.

The FCP270 uses 100 Mbps Ethernet fiber connections to communicate with Foxboro Evo workstations connected to Ethernet switches in The MESH. For information about general guidelines and specific requirements for designing The MESH above the FCP270 level, including site planning and network installation guidelines, see *The MESH Control Network Architecture Guide* (B0700AZ).

For instructions on installing and cabling the FCP270 in the non-fault-tolerant and fault-tolerant configurations, see Chapter 2 “Installing the Field Control Processor 270”.

Network Path Switching

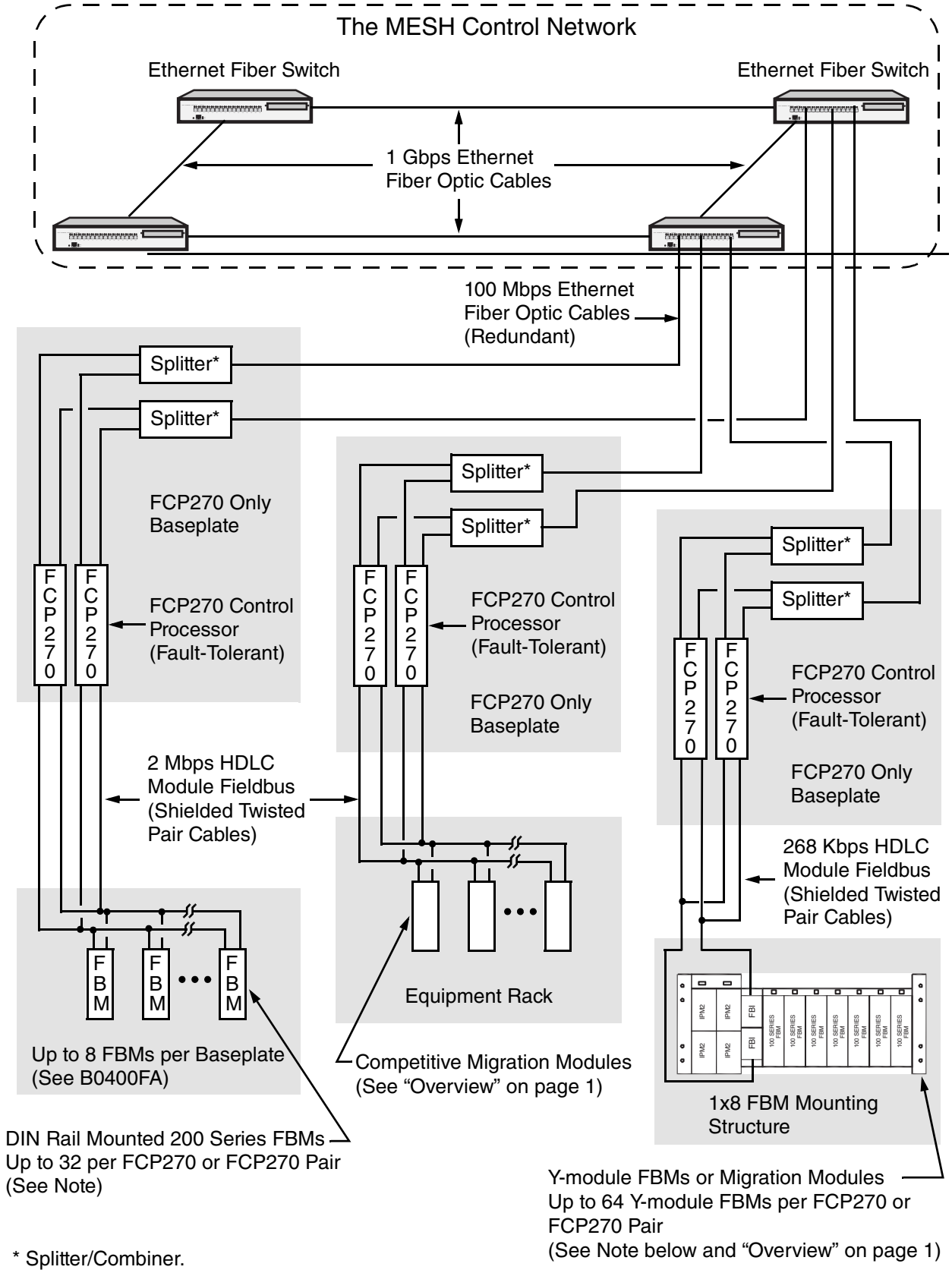
The MESH control network provides redundant communications paths. The MESH architecture and the software in the controller allow it to switch paths when a communications path fails or when replacing modules.

Each FCP270 has two station MAC addresses and two IP addresses, which are not embedded in hardware. When you replace the controller, the new controller acquires its station MAC and IP addresses from the system configuration file based on its assigned letterbug. Software on the FCP270 then selects the network path that is used to transmit outbound communication.

Splitter/Combiner

Fault-tolerant FCP270s require a pair of splitter/combiners, one to connect to each of The MESH control network paths (see Figure 1-1). Non-fault-tolerant FCP270s can optionally use splitter/combiners to provide for a future upgrade to fault-tolerant operation. The splitter/combiner has three 100 Mbps connections: one to the primary module of a fault-tolerant pair, one to the shadow module, and one to The MESH. One splitter/combiner in the pair is connected to one Ethernet switch, the other is connected to another Ethernet switch.

The splitter/combiner is connected via fiber optic cables. Inbound traffic from The MESH is split and sent to each FCP270 controller. Output traffic is sent from the primary module, which can be either physical module, to The MESH.



* Splitter/Combiner.

Note: For additional sizing information, refer to *Field Control Processor 270 (FCP270) Sizing Guidelines* (B0700AV).

Figure 1-1. Typical FCP270 Network Configuration (Simplified)

Fieldbus Expansion Module 100 (FEM100)

When an FCP270 is connected to a Fieldbus Expansion Module 100 (FEM100), the FEM100 increases the number of 200 Series (or equivalent) FBMs supported up to 128 FBMs. (Refer to *Field Control Processor 270 (FCP270) Sizing Guidelines and Excel Workbook* (B0700AV) to determine actual sizing for your system.)

The FCP270 requires a software level 8.3 or higher to support the FEMs.

The FEM100 generates four single fieldbus ports, or *Expanded Fieldbus 1* through *4*. Each Expanded Fieldbus is capable of communicating with up to thirty-two FBMs. The FEM100 and Expanded Fieldbuses are transparent to the 2 Mbps HDLC Module Fieldbus between the FCP270 and the 200 Series (or equivalent) FBMs.

A pair of FEM100s provides redundancy for both paths of the redundant 2 Mbps HDLC module fieldbus network. Both FEM100s are always active. In case of a module's failure, the other provides backup coverage until the failed module is returned to service. The failure is reported as an interruption to one path of the redundant fieldbus network.

Additional information on the FEM100 is provided in the *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

— NOTE

The FBI200A, which is installed exclusively in conversion mounting structures, in the 100 Series Fieldbus Module Upgrade subsystem, can perform a similar function as the FEM100 when used with an FCP270. A redundant pair of FBI200As in a mounting adapter support up to thirty-one 200 Series FBMs in a baseplate chain. However, they can enable their associated FCP270 to support up to one hundred twenty-four (124) 200 Series FBMs as described in the *100 Series Fieldbus Module Upgrade User's Guide* (B0700BQ).
The FEM100 cannot be used in conjunction with the FBI200A in any CP-to-FBM configuration. A CP's subsystem may only have FEM100s or FBI200As.

I/O Communications

The FCP270 contains several I/O communication features and functions:

- Without use in conjunction with the FBI200 or FBI100, support for redundant HDLC fieldbus at only 2 Mbps or 268 Kbps (depending on whether to connect to 200 Series or 100 Series FBM types and protocols, respectively) for connection to the FCP270 module
  With use in conjunction with the FBI200 or FBI100, support for redundant HDLC fieldbus to both 2 Mbps or 268 Kbps for connection to the FCP270 module (for connections to both 100 Series and 200 Series FBM types and protocols)
- Simultaneous support of 200 Series FBM types and protocols (HART, Foundation Fieldbus, Profibus, Modbus, FoxCom, FDSI and standard 200 Series FBMs).
  When used with FBI200 or FBI100, simultaneous support of 100 Series FBMs and 100 Series and 200 Series competitive migration modules types and protocols as well.

- A maximum of 32 DIN railed mounted 200 Series FBMs[2] is allowed per 2 Mbps HDLC fieldbus. The FEM100 provides four Expanded Fieldbuses, which supports up to 128 200 Series FBMs (or equivalent modules) per FCP270. (See the note above for the FBI200As.)
- A maximum of 39 Siemens APACS+ DCS migration FBMs[2] is allowed on the 2 Mbps HDLC fieldbus. The FEM100 provides two Expanded Fieldbuses, which supports up to 78 Siemens APACS+ DCS migration FBMs per FCP270.
- A maximum of 36 Westinghouse DCS migration FBMs[2] is allowed on the 2 Mbps HDLC fieldbus. The FEM100 provides two Expanded Fieldbuses, which supports up to 72 Westinghouse DCS migration FBMs per FCP270.
- A maximum of 64 Y-module (100 Series) FBMs and/or DCS migration FBMs[2] is allowed on the 268 Kbps fieldbus.

I/O communications support the following multiple data streams:

- Real-time I/O
- AI Stream data for the TDR
- Sequence of Events (SOE) data[3]
- I/O maintenance activity
- Pass-through activity for device configuration, and so forth.

Dual Baud Functionality

The FCP270 supports the dual baud functionality, allowing the FCP270 to communicate with both 200 Series FBMs and 100 Series FBMs and migration modules when the FBI200 or FBI100 is properly installed between the FCP270 and the 100 Series FBMs. When installed as specified, the FBI200s or FBI100s filter the 2 Mbps communications from the FCP270 to ensure the 100 Series FBMs and migration modules only receive the 268 Kbps signals intended for them. The FBI200s/FBI100s also extend the 268 kbps Module Fieldbus between the FBI200s/FBI100s and the 100 Series FBMs up to 1830 m (6000 ft). See Figure 1-2 and Figure 1-3.

For a typical redundant module Fieldbus configuration, two FBI200s/FBI100s are needed; one for the A fieldbus and another for the B fieldbus. These FBI200s/FBI100s are installed in their own special baseplate for high speed communication between the FBM modules and FCP270s.

The process for setting up dual baud functionality for the FCP270 is discussed in *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

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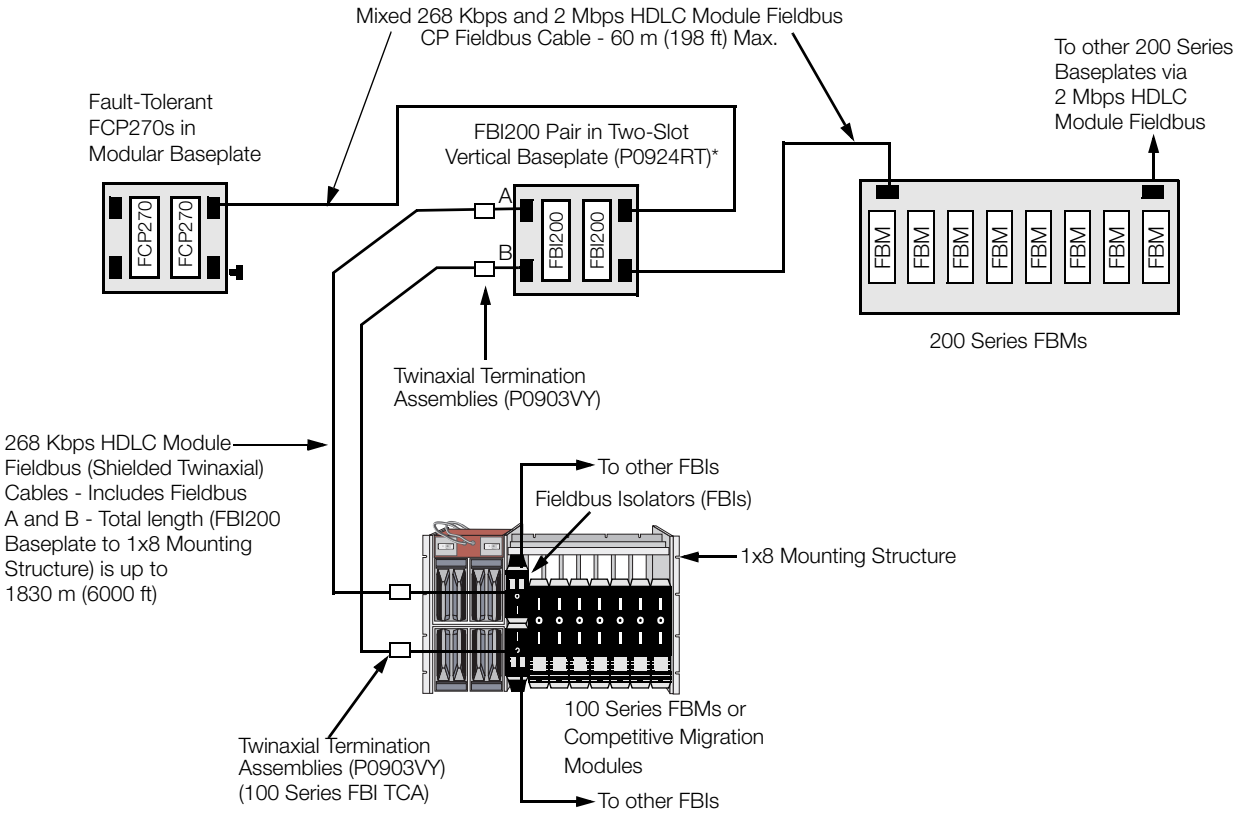
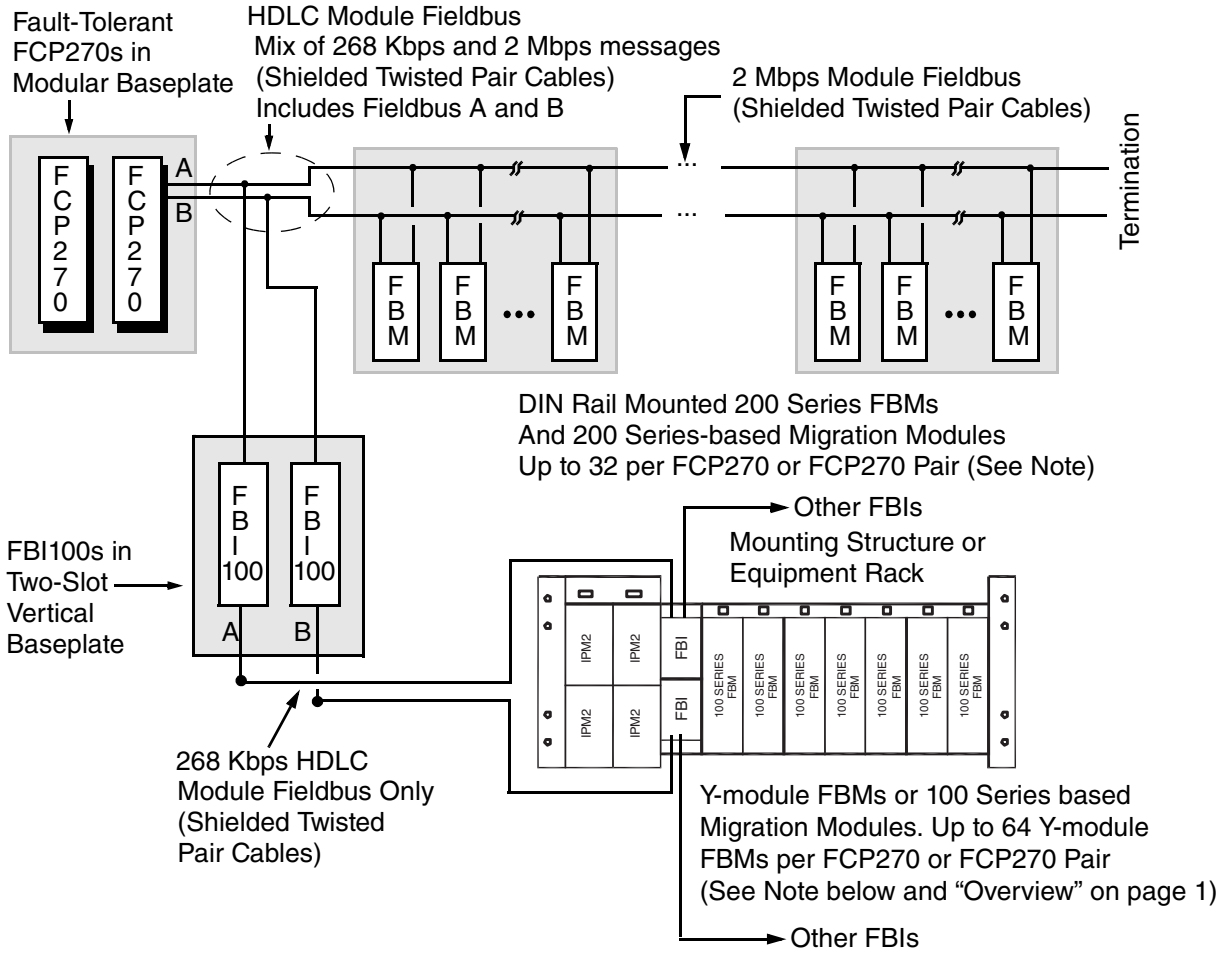
2. Maximums listed are for FCPs connected only to modules of the specified type. Refer to *Field Control Processor 270 (FCP270) Sizing Guidelines and Excel Workbook* (B0700AV) for the appropriate sizing guidelines for the FCP270.
3. Using the new SOE feature or the original SOE via ECB6. Also see the footnote warning on page 3.



* Communications Mode in FBI200 Baseplate must be set to 268 Kbps mode.

Figure 1-2. FBI200 Connections to 200 Series and 100 Series FBMs on Mixed 2 Mbps and 268 Kbps HDLC Module Fieldbus (Conceptual)



Note: For additional sizing information, refer to *Field Control Processor 270 (FCP270) Sizing Guidelines* (B0700AV).

Figure 1-3. Example Network with FCP270 with Dual Baud Functionality (Conceptual)

Communication to 200 Series Fieldbus Modules

The 200 Series DIN rail mounted FBMs connect to the optionally-fault-tolerant FCP270 through the baseplate. The 2 Mbps HDLC fieldbus is connected to both paths of the redundant fieldbus network, providing continuous communication in the event one path fails (see Figure 1-1).

Fieldbus cabling lengths for the FCP270 and 200 Series FBMs are as follows:

- Overall module Fieldbus, shielded twisted-pair (all segments): 60 m (198 ft) maximum
  (For example, this length includes both the 2 Mbps Module Fieldbus for the 200 Series FBMs, and the cable length between the FCP270 and the FBI200s or FBI100s, if present)
- Module Fieldbus, fiber optic segment (between two baseplates): 10 km (6.2 mi) per segment maximum, up to 20 km (12.4 mi) total.
- FCP270 Fieldbus without FCM2Fs
  The cable length of the Fieldbus cannot exceed 60 m (198 ft) (see Figure 1-4).

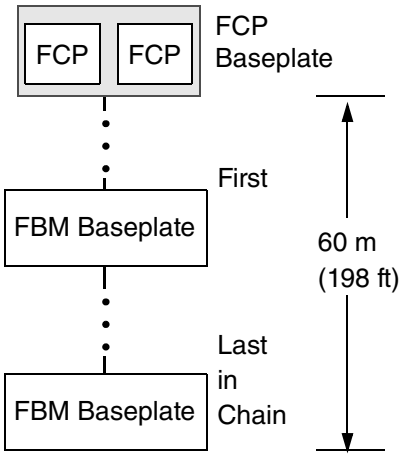


Figure 1-4. Fieldbus Cable Length Restrictions

- FCP270 Fieldbus with FCM2Fs
  Each FCP/FCM drives a segment of interconnected baseplates of up to 60 m (198 ft). Up to four pairs of FCM2Fxs can be used in a Fieldbus (see Figure 1-5).

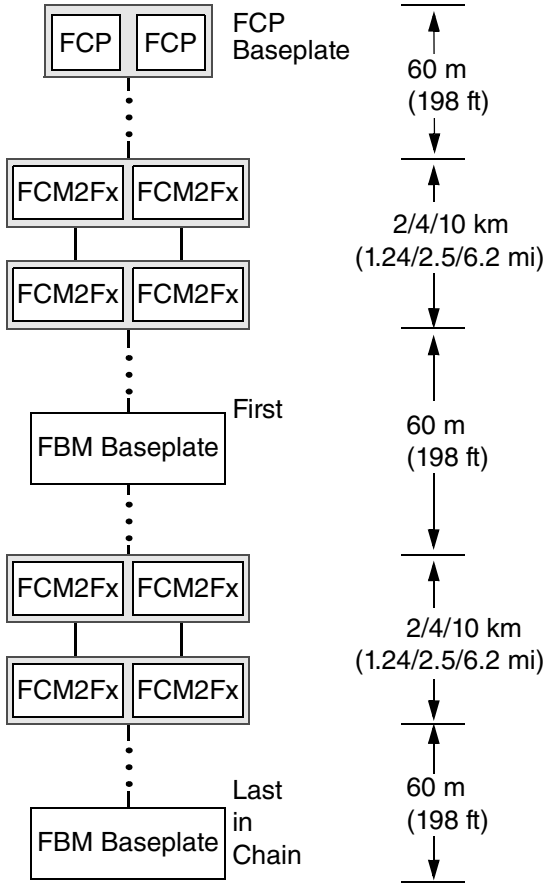


Figure 1-5. Fieldbus Cable Length Restrictions w/FCM2Fs

- FCP270 Fieldbus and Expanded Fieldbuses (1-4) without FCM2Fs
  The cable length of the Module Fieldbus (shielded twisted-pair segment) cannot exceed 60 m (198 ft). See Figure 1-6.

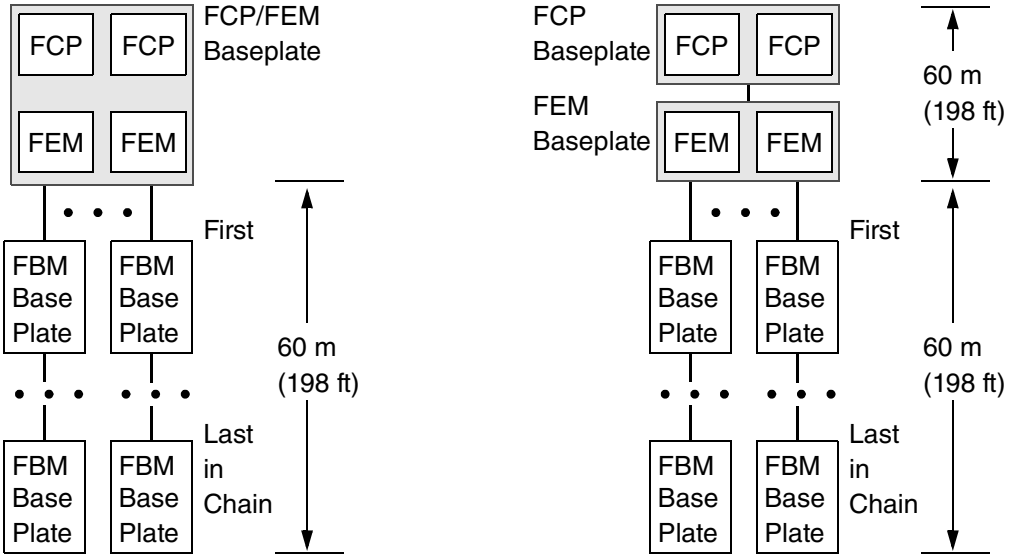


Figure 1-6. Expanded Fieldbus Cable Length Restrictions

- FCP270 Fieldbus and Expanded Fieldbuses (1-4) with FCM2Fs
  Each FCP/FCM drives a segment of interconnected baseplates of up to 60 m (198 ft). Up to four pairs of FCM2Fxs can be used in each Expanded Fieldbus. See Figure 1-7.

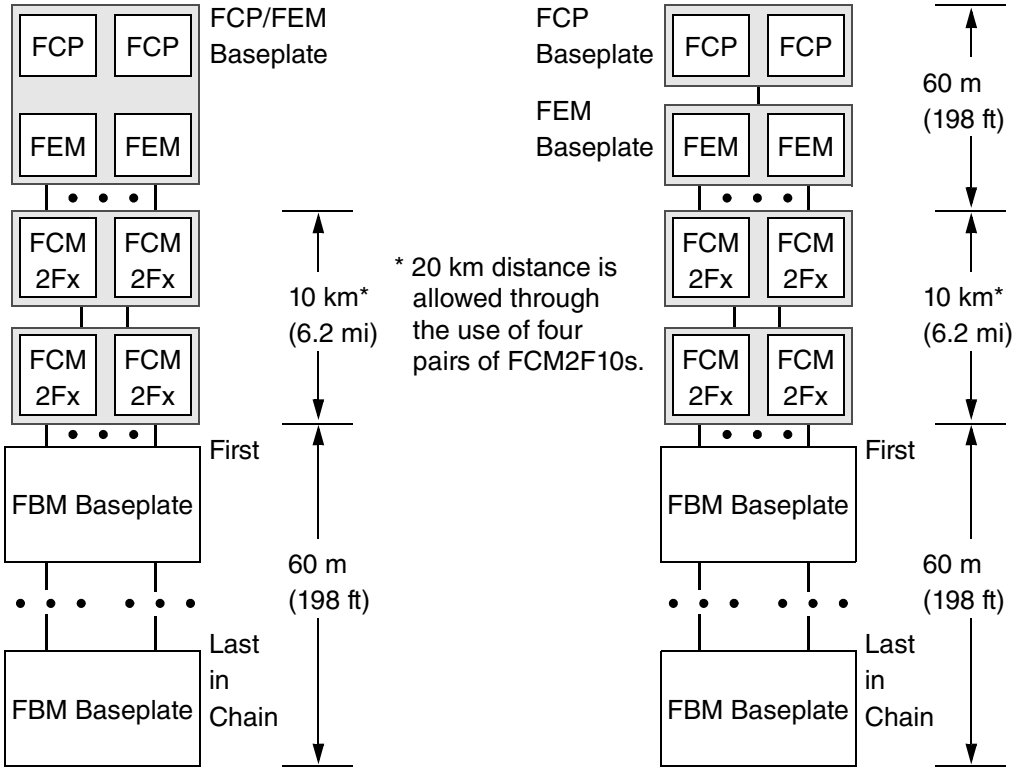


Figure 1-7. Expanded Fieldbus Cable Length Restrictions w/FCM2Fs

For complete information on DIN Rail mounted devices, see *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

Communication to Y-Module (100 Series) Fieldbus Modules

The Y-module FBMs connect to the optionally-fault-tolerant FCP270 through the baseplate. The 268 Kbps HDLC fieldbus is connected to both paths of the redundant fieldbus network, providing continuous communication in the event one path fails (see Figure 1-1). The fieldbus connects to the baseplate via the P0926LC adapter and the P0903VY termination cable assembly (TCA). A 268 Kbps Splitter/Terminator connects the extended fieldbus to 2- position FCP270 only modular baseplate. This splitter/terminator does not support time strobe signals. The extended fieldbus can be up to 1 Km (3200 ft) in length.

For complete information on DIN Rail mounted devices, see *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

Communication to Migration Modules

For communication with migration modules, refer to the appropriate migration module document. For example:

- For Siemens APACS+ DCS migration FBMs, refer to *DCS Fieldbus Modules for Moore APACS+ Systems User's Guide* (B0700BK).
- For Westinghouse DCS migration FBMs, refer to *DCS Fieldbus Modules for Westinghouse WDPF Systems User's Guide* (B0400BA).

Additional documents are listed in the Preface.

Time Synchronization

The Foxboro Evo Process Automation System supports time synchronization using either an optional, externally maintained source of Universal Coordinated Time (UTC) from GPS satellites or an internal source using proprietary software.

Time synchronization within a Foxboro Evo system synchronizes controllers to provide accurate timestamps for event and data reporting throughout the system. Time stamping is used for SOE evaluation, TDA, and alarm messages.

Overview

A Master Timekeeper (MTK), residing in an Application Workstation (AW), maintains the time source and distributes the system time to all other stations in The MESH control network. A Slave Timekeeper (STK) receives time information from the MTK and keeps itself synchronized with the MTK, and thus with all other stations in The MESH. STKs reside in all controllers.

The MTK determines the time for synchronizing all slave stations by using either the AW's real-time clock (internal time source) or the optional GPS receiver and time strobe generator (external time source).

For complete information on time synchronization, refer to *Time Synchronization User's Guide* (B0700AQ).

Internal Source Time Synchronization

For internal source time synchronization (standard), the MTK station uses time from the internal clock in the hosting PC. The MTK distributes time as UTC to all stations in The MESH. This time is displayed as local time.

Date and time is entered using the System Management Set Date and Time display. At run-time, the time can be changed using the Set Date and Time display or time can continue to run on its internal clock.

For procedures on how to set the date and time using System Management, refer to *System Management Displays* (B0193JC).

External Source Time Synchronization

For external source time synchronization (optional), the MTK station uses an externally maintained source of Universal Coordinated Time (UTC) from GPS satellites. Equipment to support this option includes a GPS receiver and time strobe generator.

The MTK uses a hardware connection to the controllers to increase the synchronization accuracy by providing a time strobe pulse, which is sent continuously by the MTK at a precise time interval. The controllers have built-in hardware to receive the sync pulses generated by the MTK.

UTC is the international time standard (commonly referred to as Greenwich Meridian Time or GMT).

FCP270 Sizing Constraints

FCP270 has several aspects that consume its capacity, including BPC settings, the number and type(s) of I/O points, number of blocks, block memory usage, and so forth. Since the FCP270's capacity is consumed based on the configuration of these aspects, it is strongly recommended to review the sizing guidelines described in *Field Control Processor 270 (FCP270) Sizing Guidelines and Excel Workbook* (B0700AV) when determining the FCP270 sizing constraints.

In general, the following apply to FCP270:

- The number of 200 Series FBMs hosted by an FCP270 (or fault-tolerant FCP270 pair) is 32 maximum alone, 124 with FBI200As (used only in the 100 Series Fieldbus Module Upgrade subsystem) or 128 with FEM100s, depending on the selected scan periods.
- The number of 100 Series FBMs and/or DCS FBMs hosted by an FCP270 (or fault-tolerant FCP270 pair) is 64 maximum, depending on the selected scan periods, discussed in "FCP270 Supported Block Processing Cycles" below.
- The maximum number of blocks that can be configured for use with the FCP270 (or fault-tolerant FCP270 pair) is 4000. The maximum number of blocks used in a given configuration depends on scan periods and block type selection. These blocks include all types: control blocks, ECBs, compounds, data blocks, and so forth.

FCP270 Supported Block Processing Cycles

When planning the number of 100 Series FBMs for your FCP270, take into consideration the length of each Block Processing Cycle (BPC). The FCP270 supports BPC settings with 100 Series FBMs from 50 ms up to 1 second:

- An FCP270 with a BPC of 50 ms can support a maximum of five 100 Series FBMs that can be a combination of basic input and output types.
- An FCP270 with a BPC of 100 ms can support a maximum of seventeen 100 Series FBMs that can be a combination of basic input and output types.

FoxCom FBMs are not supported for a 50 or 100 ms BPC, but it is the responsibility of the user to determine capacity and load.

Due to these speeds, the FCP270 is a viable replacement for high-speed CP30/40 applications. Note that the slower 2 second BPCs supported by earlier generations of control processors are not supported by the FCP270.

2. Installing the Field Control Processor 270

This chapter provides installation and cabling information for the Field Control Processor 270.

Overview

The FCP270 is available in two configurations, non-fault-tolerant and fault-tolerant. Communication between the two modules in the fault-tolerant configuration takes place via a module connector in the baseplate in which the modules are installed.

The FCP270 can only be plugged into a baseplate connector that specifically supports the FCP270. This rule is enforced since the FCP270 connectors are located differently from the connectors of FBMs or FCMs. This prevents accidental installation of a module in the wrong baseplate location.

- The FCP270 is designed for installation in Foxboro Evo equipment enclosures. For general information on installing equipment into these enclosures, refer to *Enclosures and Mounting Structures - Site Planning and Installation User's Guide* (B0700AS).
- The FCP270 installs on DIN Rail mounted baseplates. For complete information on these baseplates, refer to *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

System Definition

System Definition identifies the Foxboro Evo system components, system software required by each component, the system component letterbugs, and other system characteristics for correctly loading system software and identifying the system software objects. The letterbug is an alphanumeric string that the user defines to identify a station in a Foxboro Evo system.

System Definition is initially performed prior to installation of the system equipment, and it is updated with any hardware/software system changes. Reports produced by System Definition (SysDef) software define the system network and provide information that can be used in conjunction with equipment installation.

- To use the Foxboro Evo Control Editors to define the system, refer to the "System Development" and "Security" manuals listed under "Foxboro Evo Control Software and Foxboro Evo Control Core Services Specific Documentation" in *Foxboro Evo Process Automation System Deployment Guide* (B0750BA). Refer to the section "Controllers" in *Hardware Configuration User's Guide* (B0750BB) to define the FCP270.
- IACC allows you to import system configuration information from a Foxboro Evo system using SysDEF Export media created with the System Definition configuration application. For importing procedures, refer to *I/A Series Configuration Component (IACC) User's Guide* (B0700FE).
- For a step-by-step procedure for defining a Foxboro Evo system configuration using the System Definition (SysDEF) software, refer to *System Definition: A Step-By-Step Procedure* (B0193WQ).

Installing a Single or Primary FCP270 Module

Figure 2-1 shows how to install a single (non-fault tolerant) or primary (fault-tolerant) FCP270 module on two example FCP270 modular baseplates (P0926HC and P0973CN).

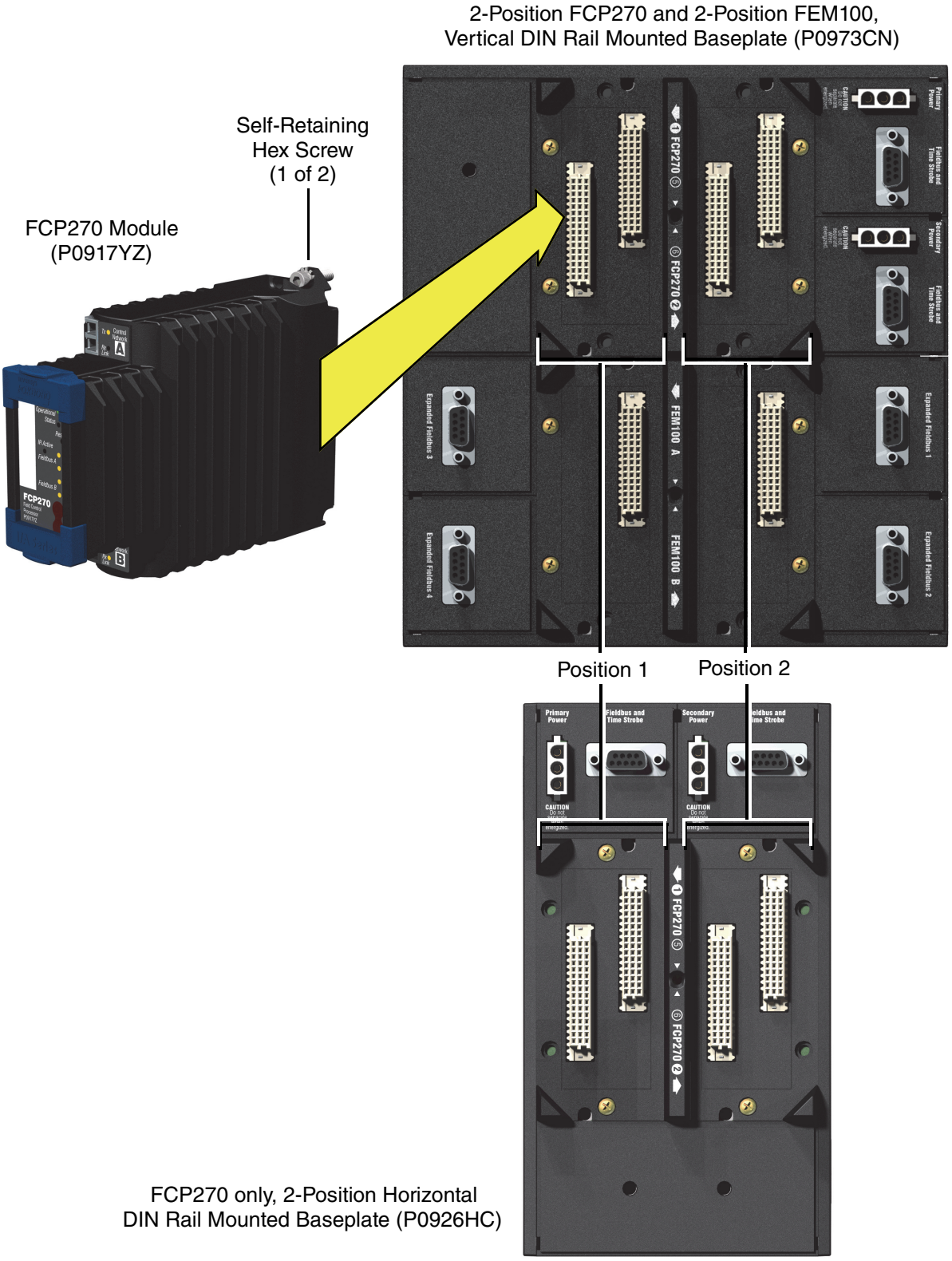


Figure 2-1. FCP270 Module Installation (Typical)

⚠ WARNING

For safety reasons, always consider the possible impact on plant operations before removing an FCP270 module from a baseplate in an active control system.

NOTE

Be aware of the following when working with FCP270 modules in self-hosting mode:
1) When replacing a module in a fault-tolerant pair and the other module remains running as Single Primary, plug in the new module and it will receive the image and checkpoint file from the Primary module prior to marrying. However, when replacing a module and the station is currently powered down, boot up the module that was not replaced first before powering on the replacement module. This ensures that the new module will be given the proper checkpoint file during its marriage.
2) When FCP270 modules are installed for the first time (that is, two fault-tolerant modules are installed together, or one non-fault-tolerant module is installed, where none of these modules have generated or received the checkpoint file for their control scheme) and these modules are intended to run in self-hosting mode, they must be booted initially in non-self-hosting mode (set by default). This ensures that the modules download the most recent checkpoint file from the host workstation. To ensure these modules boot-up in the default mode, change the letterbug to a non-existent letterbug and then back to desired letterbug. This ensures the FCP270 will load the checkpoint file from the host workstation.

To install a single (non-fault tolerant) or primary (fault-tolerant) FCP270 on a modular baseplate:

1. Install the modular baseplate to the DIN rail and connect the dc power cable and the fieldbus/time strobe cable to the baseplate as described in *DIN Rail Mounted Subsystem User's Guide* (B0400FA). Connection to an external time strobe generator is optional.

⚠ CAUTION

Observe the signal and power cable separation and segregation guidelines in *DIN Rail Mounted Subsystem User's Guide* (B0400FA).

2. Install the FCP270 module (P0917YZ) by pressing it into position 1 on the designated modular baseplate.

NOTE

1. The FCP270 can only be plugged into a baseplate connector that specifically supports the FCP270. These baseplate slots are labeled "FCP270" (see Figure 2-1). For example, the 4-position P0973CN modular baseplate supports two FCP270 modules and two FEM100 modules, but their connectors are physically different to prevent a module from being installed in the wrong connector.

3. Tighten the two self-retaining hex screws on the module using a hex driver tool (Foxboro part number X0179AZ).

⚠ CAUTION

1. When using the hex driver tool (Foxboro part number X0179AZ) or other 5/32 hex driver tool, make sure that it does not generate more than 12 inch pound of torque, or you might strip the threaded inserts out of the baseplate.
2. The FCP270 module must be screwed in place for secure operation. Do not rely on the signal connectors to hold the module in place.

4. Assign the FCP270 letterbug through the module's infrared communication port using the I/A Series system Letterbug Configurator. For procedures to assign letterbugs to the FCP270, see *Letterbug Configurator User's Guide* (B0700AY).

⚠ WARNING

Make sure you assign the FCP270 letterbug before connecting the Ethernet fiber optic cables to the FCP270. This avoids potential process control safety issues if a letterbug has previously been assigned to the module. Label space is provided on the front of the module to record the letterbug.
Also, when replacing a non-fault-tolerant FCP270 set to self-hosting mode, change the letterbug to a non-configured letterbug and then to its hosted letterbug. This ensures the correct letterbug is configured and there is no valid checkpoint file in flash. Without following this order, there is no guarantee what letterbug is configured for that module.

5. Connect the FCP270 module to Ethernet switches in The MESH:
   - To connect a single (non-fault-tolerant) module to Ethernet switches in The MESH, see "Cabling a Single (Non-Fault-Tolerant) FCP270 Module" on page 25.
   - To connect a fault-tolerant module to Ethernet switches in The MESH, see "Cabling a Fault-Tolerant FCP270 Module Pair" on page 25.

   The module follows one of the following boot-up sequences:
   - "Case 2 – Connecting an FCP270 with the Same Letterbug" on page 30
   - "Case 3 – Connecting an FCP270 with a New Letterbug" on page 30
6. If replacing an existing non-fault tolerant module, update the FCP270 software image in the new module with the same image as the module you are replacing. See "Image Update Procedure for a Non-Fault-Tolerant FCP270" on page 56.

If the FCP270 will run in non-self-hosting mode, the installation procedure is finished. Otherwise, continue to the next section.

Enabling the FCP270 Self-Hosting Option

Modify the CFGOPT parameter in the Station block to enable or disable self-hosting.

To enable self-hosting in an FCP270, use system configurator software to set the self-hosting bit (Bit 8) of the CFGOPT parameter in the Station block (CFGOPT=0x01XX) and issue a Checkpoint command. Refer to *Integrated Control Block Descriptions* (B0193AX) for additional information on the CFGOPT Station block parameter.

For additional details on the operation of an FCP270 with self-hosting enabled, refer to:

- "Initializing the FCP270 with Self-Hosting Enabled" and "Verifying Self-Hosting Information Using SMDH" below
- "Fault Tolerance Behavior in Self-Hosting FCP270" on page 33
- "Messages Following Checkpoint Operation in Self-Hosting FCP270" on page 58.

Initializing the FCP270 with Self-Hosting Enabled

Be aware that the FCP270's database cannot be initialized with self-hosting enabled. If you try to initialize the database on an FCP270 that is configured for self-hosting, you will get the error message shown below. If the FCP270 is operating in self-hosting mode, you must first disable self-hosting and perform a checkpoint as indicated in Figure 2-2 before initializing the FCP270.

Figure 2-2. Initializing a Self-Hosting Controller

Disabling Self-Hosting

To disable self-hosting in an FCP270, use system configurator software to reset the self-hosting bit (Bit 8) of the CFGOPT parameter in the Station block (CFGOPT=0x00XX). Refer to *Integrated Control Block Descriptions* (B0193AX) for additional information on the CFGOPT Station block parameter.

The SMON log indicates the outcome of the Checkpoint command. For example, the SMON log will contain the following line:

```
2007-11-03 10:03:20 FP0101 Process = Self Hosting RDHSS 000131 - Self Hosting Disabled
```

— NOTE

When an FCP270 has self-hosting enabled (CFGOPT=0x01XX) and auto-checkpoint is set for 2 hours but configured for 1 hour (CKPOPT=1 and AUTCKP=2), and self-hosting is then disabled by resetting CFGOPT to 0x00XX without altering the CKPOPT or AUTCKP values and a checkpoint is performed, the auto-checkpoint frequency continues to be 2 hours (instead of the originally configured 1 hour). For ICC only, if the desired auto-checkpoint frequency is 1 hour, place the cursor at the AUTCKP parameter and press Enter (Return) and DONE without any modifications and then perform a checkpoint operation for the FCP270. Also refer to "Auto-Checkpoint While Enabling/Disabling Self-Hosting" on page 23.

Verifying Self-Hosting Information Using SMDH

The status of the FCP270's self-hosting mode is indicated in the "Equipment Information Display for Primary ECB (FBM0)" on page 63.

The Primary ECB (FBM 0) display for the FCP270 controllers includes three fields related to self-hosting.

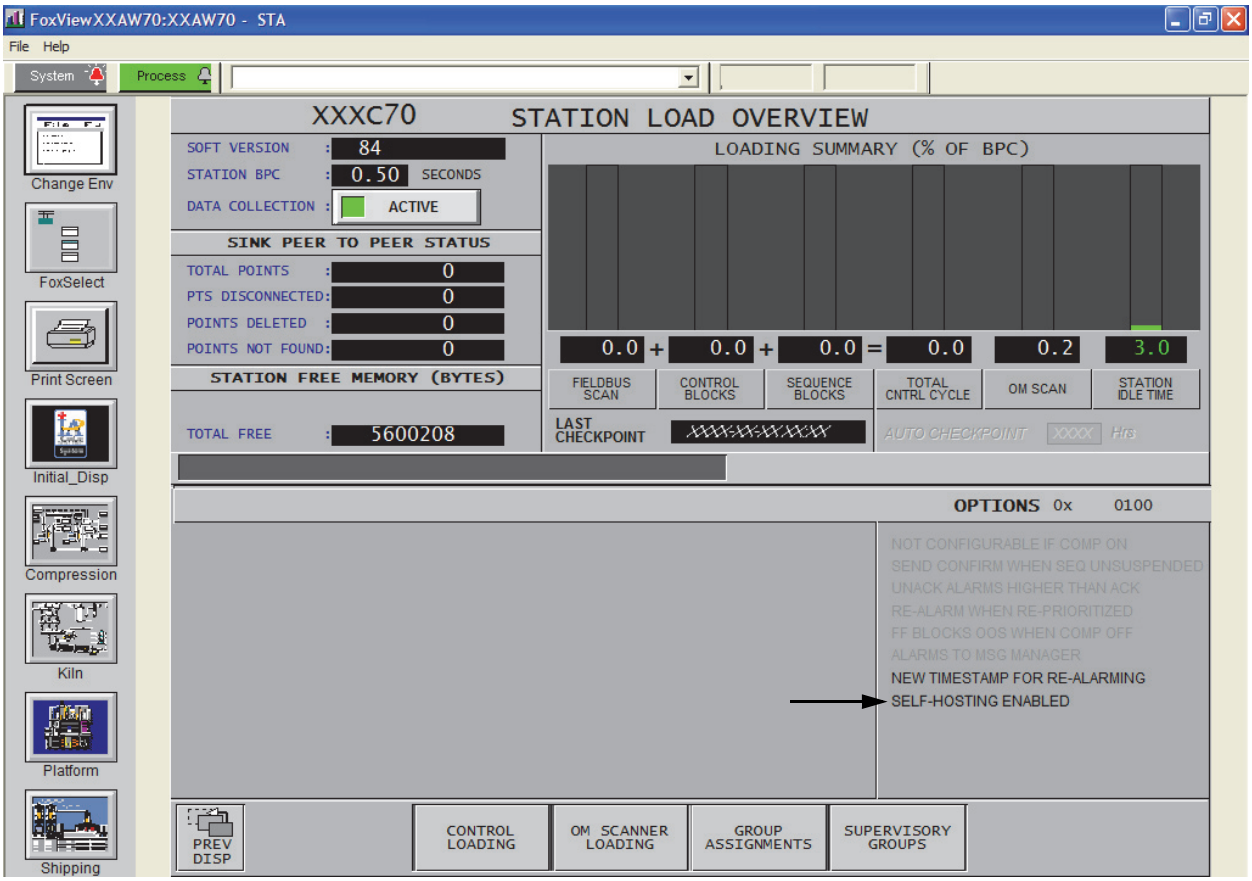
- The **PRIM CHK POINT** and **SHAD CHK POINT** fields are used to display the number of times the Primary (or Single Primary) and Shadow FCP270 module's flash memory has been burned.
- The **SELF HOSTING** field identifies the status of self-hosting. This field is set to Enabled when the FCP270 controller is in self-hosting mode (Bit 8 of the CFGOPT Station block parameter is set to 1), and Not Enabled when the controller is not in self-hosting mode (Bit 8 of the CFGOPT Station block parameter is set to 0, the default).

Verifying Self-Hosting Information Using Station Block Display

The status of the FCP270's self-hosting mode is also indicated in the processor's Station block display. Proceed as follows:

1. Open FoxSelect.
2. Select the FCP270's letterbug.
3. Open the Station block for the FCP270. Refresh if necessary.

The status of self-hosting is shown under Options, as illustrated in Figure 2-3.



If self-hosting is disabled, the following is shown: SELF-HOSTING DISABLE

Figure 2-3. Self-Hosting Status via Station Block Display

Auto-Checkpoint While Enabling/Disabling Self-Hosting

When you enable self-hosting in a controller, the smallest time interval allowed for the auto-checkpoint option is two (2) hours. This is to ensure that the minimum life of a FCP270's flash memory for a module running auto-checkpoint full time is at least 20 years.

If you attempt to set this interval to a smaller amount, the FCP270 will override this command. The following message may appear in the SMON log:

```
2008-01-24 14:56:27 FP0101 Process = Checkpoint CIO_DB 000015 - Auto Check-
point Override to 2 Hours
```

If this occurs, you should do one of the following to ensure the configurator's work file reflects the actual AUTCKP value in the FCP270:

- Using system configurator software, modify AUTCKP to reflect 2 hours and issue a Checkpoint command.
- Perform an "Upload Block/ECB Parameters" operation from system configurator software. This will force the FCP270 to upload its current parameter values to the work file on the workstation.

If either of these steps is not performed when you disable self hosting, the auto-checkpoint intervals will remain at two hours but the value of AUTCKP in the work file will remain unchanged. To verify the time interval set for auto-checkpoint, view the Station Block Display for the current FCP270 value.

Installing a Shadow FCP270 Module

All FCP270 modules are shipped from the factory with the latest software image (operating system) stored in flash memory. If the software image of the shadow and primary modules differ, the shadow module copies the software image from the primary module and burns it to flash memory before marrying the primary.

If self-hosting is enabled and the checkpoint file of the shadow and primary modules differ, the shadow module copies checkpoint file from the primary module and burns it to flash memory before marrying the primary.

If the letterbug of the shadow module differs from the primary module, the shadow copies the primary's letterbug to flash memory before marrying the primary.

Also, if the shadow module is to be run in self-hosting mode, refer to the first note on page 19.

To install a shadow (fault-tolerant) FCP270 module on a modular baseplate:

1. While holding the module (P0917YZ) in hand, install the Ethernet fiber optic cables by connecting them to the shadow module as instructed in "Cabling a Fault-Tolerant FCP270 Module Pair" on page 25.
2. Install the shadow FCP270 module by pressing it into the position next to the primary module on the designated modular baseplate.
3. Tighten the two self-retaining hex screws on the module using a hex driver tool (Foxboro part number X0179AZ).

⚠ CAUTION

1.When using the hex driver tool (Foxboro part number X0179AZ) or other 5/32 hex driver tool, make sure that it does not generate more than 12 inch pound of torque, or you might strip the threaded inserts out of the baseplate.
2. The FCP270 module must be screwed in place for secure operation. Do not rely on the signal connectors to hold the module in place.

4. Verify that the shadow module boots up and marries the primary module as described in one of the following boot-up sequences:
   - "Case 4 – Connecting a Shadow Module with Same Software Image" on page 31
   - "Case 5 – Connecting a Shadow Module with Different Software Image" on page 32
5. Verify that the shadow module is married to the primary module using the Equipment Information display in System Management to confirm the following:

   PRIMARY MODE: Married Prim

   SHADOW MODE: Married Shad

   For more information, see "Equipment Information Display for FCP270" on page 48.
6. Verify the following using the Equipment Information display for the FCP270 in System Management to confirm the following (see Chapter 4 "System Management"):
   - The shadow module is married to the primary module:

     PRIMARY MODE: Married Prim

SHADOW MODE: Married Shad

- The self-hosting mode:

  SELF HOSTING: Disabled (or Enabled)

The installation procedure is finished.

Cabling a Single (Non-Fault-Tolerant) FCP270 Module

⚠ CAUTION

When installing fiber optic cable, do not exceed the minimum bend radius of 5 cm (2 in).

To connect a single (non-fault-tolerant) FCP270 module to Ethernet switches in The MESH:

1. Remove any rubber fiber optic port dust covers from the module's Control Network A and B ports, Ethernet switches ports, and fiber cable connectors. Retain the dust covers for use on any unused ports.
2. Connect the Control Network A connector on the FCP270 to one Ethernet Fiber switch (switch 1) in The MESH using 100 Mbps fiber optic cable with LC to MT-RJ connectors (see Table 2-1).
3. Connect the Control Network B connector on the FCP270 to another Ethernet Fiber switch (switch 2) in The MESH using 100 Mbps fiber optic cable with LC to MT-RJ connectors (see Table 2-1).

Table 2-1. Cables for Connecting the FCP270 or Splitter/Combiners to the Ethernet Switches

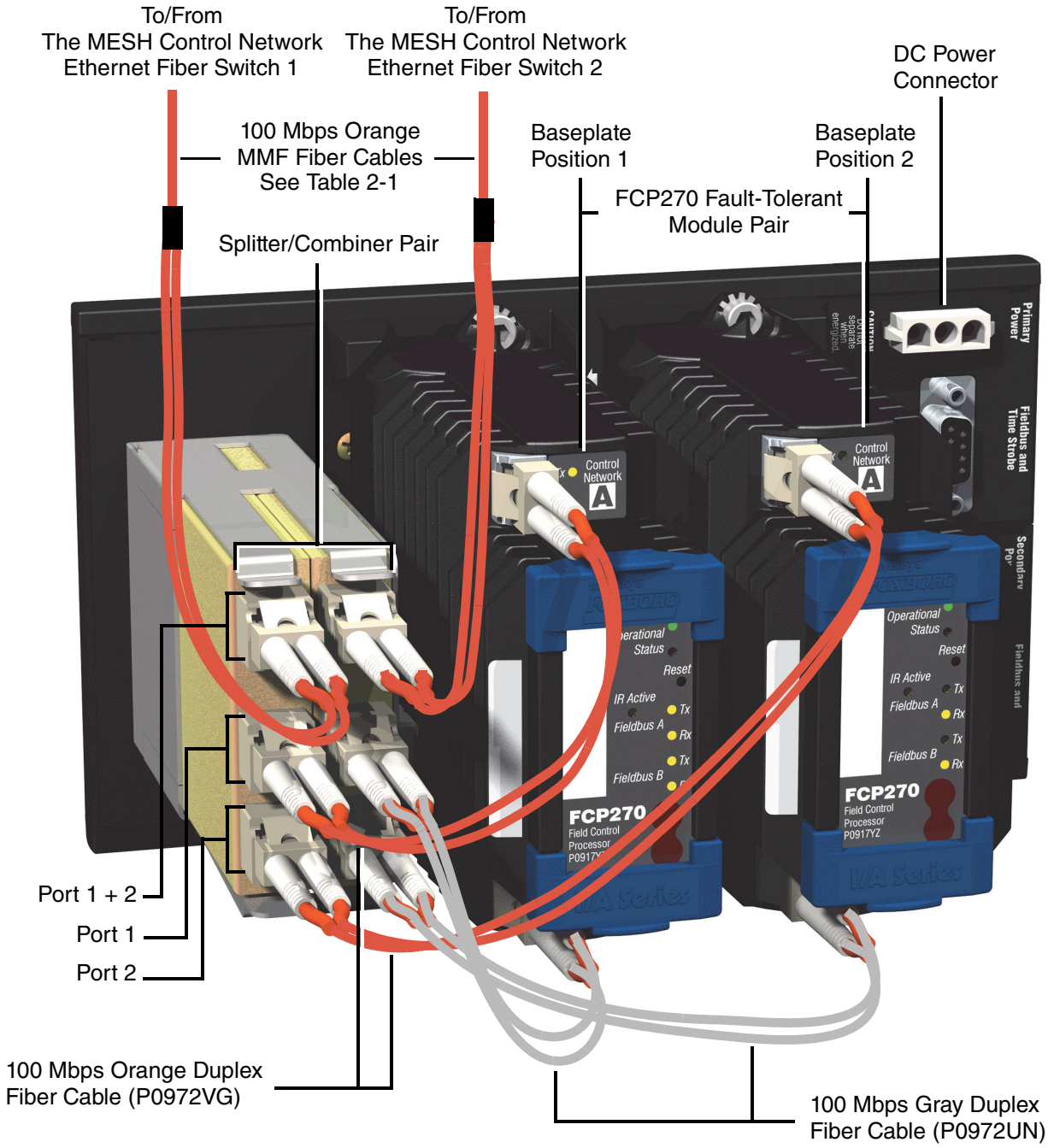
Part Number	Length	Material
P0972TR	3 m (9.8 ft)	MMF 62.5/125 µm, orange riser. Two ceramic type LC connectors on one end with an MT-RJ connector on the other end.
P0972TS	15 m (49.2 ft)	MMF 62.5/125 µm, orange riser. Two ceramic type LC connectors on one end with an MT-RJ connector on the other end.
P0972TT	50 m (164 ft)[1]	MMF 62.5/125 µm, orange riser. Two ceramic type LC connectors on one end with an MT-RJ connector on the other end.

1. For fiber optic cable lengths greater than 50 m (164 ft), use a customer-supplied cable up to a maximum length of 2 km (6562 ft).

Cabling a Fault-Tolerant FCP270 Module Pair

To cable the fault-tolerant FCP270 module pair, you must first install the splitter/combiners to split inbound traffic to the modules and combine outbound traffic from the modules. The splitter/combiners connect the fault-tolerant modules to Ethernet fiber switches in The MESH using fiber optic cables. The cabling scheme for an FCP270 on a two-position baseplate is shown in Figure 2-4, while the cabling scheme for an FCP270 on a four-position baseplate is shown in Figure 2-5.

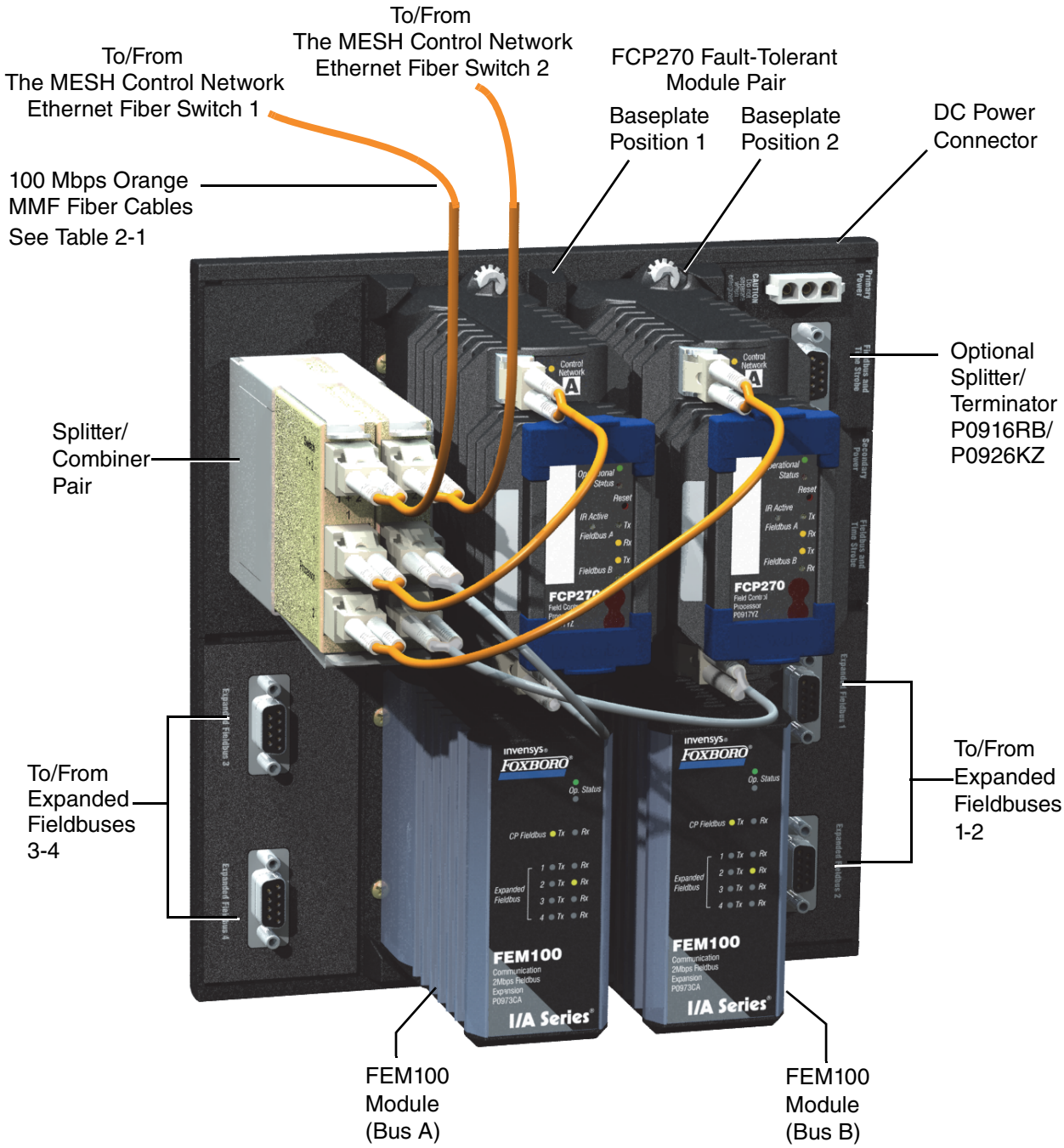
The cable color scheme helps you to properly connect the fiber cables to the splitter/combiners and modules so that the FCP270 can operate in the fault-tolerant mode. However, you can use fiber cables of any color to make these connections.



Notes:

1. Port labeled “1 + 2” on the splitter/combiner connects to one Ethernet Fiber switch.
2. Port labeled “1” on the splitter/combiner connects to the FCP270 mounted in baseplate position 1.
3. Port labeled “2” on the splitter/combiner connects to the FCP270 mounted in baseplate position 2.

Figure 2-4. Cabling the FCP270 Fault-tolerant Controllers (Two-Position Baseplate Example)



Notes:

1. Port labeled “1 + 2” on the splitter/combiner connects to one Ethernet Fiber switch.
2. Port labeled “1” on the splitter/combiner connects to the FCP270 mounted in baseplate position 1.
3. Port labeled “2” on the splitter/combiner connects to the FCP270 mounted in baseplate position 2.

Figure 2-5. Cabling the FCP270 Fault-tolerant Controllers (Four-Position Baseplate Example)

⚠ CAUTION

1. Failure to properly connect the cables will result in the modules not being able to operate in a fault-tolerant mode.
2. When installing fiber optic cable, do not exceed the minimum bend radius of 5 cm (2 in).

The splitter/combiners (P0926AH) install in a Foxboro Evo enclosure on the following:

- DIN rail mounted modular baseplate
- DIN rail
- Chassis assembly.

For detailed mounting procedures for the splitter/combiners, refer to *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

To connect the splitter/combiners to The MESH Ethernet switches and fault-tolerant FCP270 modules, see Figure 2-4 and proceed as follows:

1. Remove any rubber fiber optic port dust covers that are installed in the module's Control Network A and B ports, splitter/combiner ports, Ethernet switch ports, and cable connectors. Retain the dust covers for use on any unused ports.
2. Connect the port labeled "1 + 2" on one splitter/combiner to one Ethernet fiber switch (switch 1) in The MESH using 100 Mbps fiber optic cable with LC to MT-RJ connectors (P0972TR, P0972TS or P0972TT in Table 2-1, or custom cable up to 2 km (6400 ft) in length).
3. Connect port "1 + 2" on the other splitter/combiner to another Ethernet fiber switch (switch 2) in The MESH using 100 Mbps fiber optic cable with LC to MT-RJ connectors (P0972TR, P0972TS or P0972TT in Table 2-1, or custom cable up to 2 Km (6400 ft) in length).
4. Connect port 1 on the splitter/combiner for switch 1 to the Control Network A connector on the FCP270 in baseplate position 1 using orange duplex fiber optic cable with LC to LC connectors (P0972VG in Table 2-2).
5. Connect port 2 on the splitter/combiner for switch 1 to the Control Network A connector on the FCP270 in baseplate position 2 using orange duplex fiber optic cable with LC to LC connectors (P0972VG in Table 2-2).
6. Connect port 1 on the splitter/combiner for switch 2 to the Control Network B connector on the FCP270 in baseplate position 1 using gray duplex fiber optic cable with LC to LC connectors (P0972UN in Table 2-2).
7. Connect port 2 on the splitter/combiner for switch 2 to the Control Network B connector on the FCP270 in baseplate position 2 using gray duplex fiber optic cable with LC to LC connectors (P0972UN in Table 2-2).

Table 2-2. Cables for Connecting the Splitter/Combiners to the FCP270

Part Number	Length	Material
P0972UN	0.5 m (1.6 ft)	MMF 62.5/125 µm, gray riser. Ceramic type LC connectors with clip on each end.
P0972VG	0.5 m (1.6 ft)	MMF 62.5/125 µm, orange riser. Ceramic type LC connectors with clip on each end.

Boot-Up Sequence

The boot up sequence for the FCP270 has the following typical cases:

- Case 1: Rebooting a commissioned FCP270 module.
- Case 2: Connecting a module with the same letterbug to the baseplate with the Ethernet network cables connected.
- Case 3: Connecting a module with a new letterbug to the baseplate with the Ethernet network cables connected.
- Case 4: Connecting a shadow module with the same software image to the baseplate, after the primary module has booted up, loaded the checkpoint file, and initialized on-control.
- Case 5: Connecting a shadow module with different software image to the baseplate, after the primary module has booted up, loaded the checkpoint file, and initialized on-control.

The boot up sequence for above cases are described in the following five sections.

NOTE

For procedures to assign letterbugs to the FCP270, see *Letterbug Configurator User's Guide* (B0700AY).

NOTE

For FCP270s in self-hosting mode, a 14 second delay occurs before the module attempts to download its checkpoint file from flash memory.

Case 1 – Rebooting a Commissioned FCP270

When a Reboot command is issued to a commissioned FCP270 controller running non-fault-tolerant, the operational sequence is as follows:

1. The controller lights the red Operational Status LED while running the on-line diagnostics.
2. If the on-line diagnostics test results are OK, the controller lights the red and green Operational Status LEDs and performs other internal tests.
3. If the internal test results are OK, the controller lights the green Operational Status LED and turns off the red LED.

4. In non-self-hosting mode, the controller loads the checkpoint file (control database) from the host server.
   In self-hosting mode, the controller either loads the checkpoint file (control database) from the host server and performs a checkpoint operation if it does not have the checkpoint file in flash memory, or it loads the checkpoint file from its internal flash memory if the file is present.
5. The controller initializes on-control as defined by the control database.

Case 2 – Connecting an FCP270 with the Same Letterbug

When connecting to the baseplate an FCP270 module with the same letterbug as the removed module, with The MESH network cables connected, the operational sequence is the same as for Case 1.

The controller reboots, loads the checkpoint file from the host, and initializes on-control as described in Steps 1 through 5 in Case 1.

⚠ WARNING

Make sure you assign the FCP270 letterbug before connecting the Ethernet fiber optic cables to the FCP270. This avoids potential process control safety issues if a letterbug has previously been assigned to the module. Label space is provided on the front of the module to record the letterbug.
Also, when replacing a non-fault-tolerant FCP270 set to self-hosting mode, change the letterbug to a non-configured letterbug and then to its hosted letterbug. This ensures the correct letterbug is configured and there is no valid checkpoint file in flash.
Without following this order, there is no guarantee what letterbug is configured for that module. The FCP270 may attempt to boot up with an obsolete checkpoint file that is stored in its flash, which could have an adverse effect on the process running.

Case 3 – Connecting an FCP270 with a New Letterbug

A “new letterbug” is a letterbug for a station which has not been commissioned to date.

NOTE

If the letterbug of a FCP270 is changed, the checkpoint file in flash memory is invalidated. The next time the FCP270 reboots, it will load the checkpoint file from the host workstation.

When connecting an FCP270 module with a new letterbug to the baseplate, with The MESH network cables connected, the operational sequence is as follows:

1. The controller boots up as described in Steps 1 through 3 in Case 1.
2. The controller loads the network addresses from the host server.
3. The controller reboots, loads the checkpoint file from the host, and initializes on-control as described in Steps 1 through 5 in Case 1.

Case 4 – Connecting a Shadow Module with Same Software Image

When connecting a shadow module with the same software image as the primary module to the baseplate – after the primary module has booted up, loaded the checkpoint file, and initialized on-control – the operational sequence is as follows:

1. The shadow module boots up as described in Steps 1 through 3 in Case 1.
2. If the station is in self-hosting mode and the checkpoint file in flash of the shadow module differs from the checkpoint file in flash of the primary module or the shadow module lacks a checkpoint file, the shadow controller lights the red Operational Status LED while the green LED remains on.
3. The shadow module copies the checkpoint file from the primary module and burns it to flash memory.
   If the checkpoint operation succeeds, messages similar to the following examples are sent to the SMON log:

   ```
   2008-01-21 13:53:11 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint update Needed
   2008-01-21 13:53:28 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint File Sent
   ```

   These messages are sent by the primary module and only indicate that the primary has sent the checkpoint file to the shadow module. The shadow module still has to write the checkpoint file to its flash. This process could take more than a minute before the shadow module has completed the write to flash.

   If the checkpoint operation fails, messages similar to the following examples are sent to the SMON log by the primary module:

   ```
   2008-01-21 13:52:43 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint update Needed
   2008-01-21 13:53:00 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint Incomplete - Reboot Shadow
   2008-01-21 13:53:00 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint File Sent
   ```

   Then, one of two scenarios will occur:

   - The shadow module will reboot automatically to reinitiate the marriage process.
   - The shadow module will remain in the red/green LED state and not reboot. In this scenario, you must reboot the Shadow module manually to restart the marriage process.
4. The shadow module boots up again as described in Steps 1 through 4 in Case 1.
5. If the letterbug of the shadow module differs from the primary module, the shadow copies the primary's letterbug to flash memory.
6. The shadow module marries the primary module, as indicated by the single, simultaneous quick flashing of the red Operational Status LED on both modules, then the modules run fault tolerant.

   The marriage should occur within 10 seconds, except for the following conditions when the station is in self-hosting mode:

   - If the primary module (in Single Primary mode) is downloading the checkpoint file from flash memory, the marriage will be held off until the download is com-

plete. The shadow module's LEDs will remain green while it waits for the marriage to occur.

- If the primary module (in Single Primary mode) is performing a checkpoint, which includes a write to its flash, the marriage will be held off until the checkpoint operation is complete. The shadow module's LEDs will remain green while it waits for the marriage to occur.

Case 5 – Connecting a Shadow Module with Different Software Image

When connecting a shadow module with a different software image than the primary module to the baseplate – after the primary module has booted up, loaded the checkpoint file, and initialized on-control – the operational sequence is as follows:

1. The shadow module boots up as described in Steps 1 through 3 in Case 1.
2. Since the shadow module's software image differs from the primary module, the controller lights the red Operational Status LED while the green LED remains on.
3. The shadow module copies the software image from the primary module and burns it to flash memory.
4. The shadow module boots up again as described in Steps 1 through 3 in Case 1.
5. If the station is in self-hosting mode and the checkpoint file in flash of the shadow module differs from the checkpoint file in flash of the primary module or the shadow module lacks a checkpoint file, the shadow controller lights the red Operational Status LED while the green LED remains on.
6. The shadow module copies the checkpoint file from the primary module and burns it to flash memory.
   If the checkpoint operation succeeds, messages similar to the following examples are sent to the SMON log:

   ```
   2008-01-21 13:53:11 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint update Needed
   2008-01-21 13:53:28 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint File Sent
   ```

   These messages are sent by the primary module and only indicate that the primary has sent the checkpoint file to the shadow module. The shadow module still has to write the checkpoint file to its flash. This process could take more than a minute before the shadow module has completed the write to flash.

   If the checkpoint operation fails, messages similar to the following examples are sent to the SMON log by the primary module:

   ```
   2008-01-21 13:52:43 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint update Needed
   2008-01-21 13:53:00 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint Incomplete - Reboot Shadow
   2008-01-21 13:53:00 FP0101 Process = Flash Loader RDHSS  000131 - Shadow Checkpoint File Sent
   ```

   Then, one of two scenarios will occur:

   - The shadow module will reboot automatically to reinitiate the marriage process.

- The shadow module will remain in the red/green LED state and not reboot. In this scenario, you must reboot the Shadow module manually to restart the marriage process.

7. The shadow module boots up again as described in Steps 1 through 3 in Case 1.
8. If the letterbug of the shadow module differs from the primary module, the shadow copies the primary's letterbug to flash memory.
9. The shadow module marries the primary module, as indicated by the single, simultaneous quick flashing of the red Operational Status LED on both modules. Then the modules run fault tolerant.

   The marriage should occur within 10 seconds, except for the following conditions when the station is in self-hosting mode:

   - If the primary module (in Single Primary mode) is downloading the checkpoint file from flash memory, the marriage will be held off until the download is complete. The shadow module's LEDs will remain green while it waits for the marriage to occur.
   - If the primary module (in Single Primary mode) is performing a checkpoint, which includes a write to its flash, the marriage will be held off until the checkpoint operation is complete. The shadow module's LEDs will remain green while it waits for the marriage to occur.

NOTE

Since the shadow module assumes the software image and letterbug of the primary controller, the boot up sequence can be used to identify the shadow controller if its letterbug and ID are both unknown. When the shadow controller is married, its letterbug is now known and its Manufacturing ID can be viewed from the Equipment Information display in System Management, where the ID is the last six characters of the SHAD ROM ADDRESS in Figure 4-2 on page 49.

Fault Tolerance Behavior in Self-Hosting FCP270

When a fault-tolerant FCP270 station is running in self-hosting mode, the primary module ensures that its shadow module has a matching version of the checkpoint file in flash before allowing the shadow module to marry with the primary module. To be sure that the files match, the FCP270s maintain the following behaviors:

- When a fault-tolerant pair of FCP270s are running in self hosting mode, and a checkpoint command is issued, the fault-tolerant station sends the checkpoint file to the host workstation. When the process sending the checkpoint file to the host is complete, the FCP270 station requests that checkpoint file from the host and copies the file to flash in both the primary and shadow module.
- If two fault-tolerant FCP270 modules, with a newly assigned letterbug, are booted up, the modules will marry and load the checkpoint file from the host workstation. If self-hosting is enabled (i.e. the CFGOPT parameter in the checkpoint file has self-hosting enabled), the FCP270 station will automatically issue a checkpoint command at the completion of the checkpoint download. As part of the checkpoint process for self-

hosting, the checkpoint file is burned into both the primary and shadow modules' flash memory.

- When a new FCP270 module is booted up, with the intention of marrying with a FCP270 that is running as Single Primary mode, and the station is configured for self-hosting mode, the Single Primary module first downloads its checkpoint file to the shadow module before the shadow module is allowed to marry the Single Primary module.
  If the Single Primary module is downloading the checkpoint file from flash memory or writing the checkpoint file from the host to flash, the marriage will be held off until all operations to the Single Primary flash have completed. Normally, a marriage takes a maximum of 10 seconds to occur when self-hosting is not enabled. However, in this case the marriage may be held off longer than 10 seconds. Operations should not be adversely affected.
- If one module of a fault-tolerant pair fails to burn a checkpoint file to flash successfully and the other module does succeed, the module that fails to burn to flash will invalidate the checkpoint file in flash and go off-line. The module that successfully burns to flash transitions to Single Primary and sends an error message to the SMON log indicating why the other module went off-line.
- If both modules of a fault-tolerant pair fail to burn the checkpoint file to flash successfully, both modules will invalidate the checkpoint file in flash and send an error message to the SMON log. The station continues to run fault-tolerant and will attempt to load a new checkpoint file on the next checkpoint command or from their host when they are rebooted.
- If a non-fault-tolerant module fails to burn a checkpoint file to flash successfully, the module invalidates the checkpoint file in flash and sends an error message to the SMON log. The station continues to run as Single Primary and will load a new checkpoint file on the next checkpoint command or from its host when it is rebooted.

Cabling Y-Module FBMs to an FCP270 Baseplate

Cabling Y-module FBMs to an FCP270 baseplate consists of extending the remote 268 Kbps fieldbus from the FBM mounting structure (see Figure 2-6). This extension, used between enclosures, involves the use of termination cable assemblies (TCAs) and Fieldbus Isolators (FBIs) to provide cable connections between primary and extended fieldbus segments, for a maximum fieldbus length of 1 km (3200 ft).

The FBI200 or FBI100 must be installed between the remote 268 Kbps fieldbus and the FCP270 in order to support the dual baud functionality and/or extend the length of the 268 Kbps fieldbus.

If the fieldbus is non-redundant, only one TCA is connected to the fieldbus splitter/terminator (P0926LC - shown in Figure 2-7) or to the FBI200 baseplate (P0924RT) or the FBI100 baseplate (P0923LR). (The connections to these baseplates are also shown in Figure 2-7.) TCA part number P0903VY includes a strain relief bracket, labels for bus A and B, and a 110 ohm terminating resistor. You must install one of the labels on the TCA (see Figure 2-6 for label orientation).

You can mount the FCP270 module(s) on either the two-position, vertical DIN rail mounted baseplate (P0926HW) or the two-position, horizontal DIN rail mounted baseplate (P0926HC).

The optional FBI200 or FBI100 modules(s) are only available on a two-position, vertical DIN rail mounted baseplate (P0924RT for the FBI200, P0923LR for the FBI100).

Remote Fieldbus Extension, Cable Connections

Remote fieldbus extension cable connections are implemented as shown in Figure 2-6 and Figure 2-10. For cable connections to the Fieldbus Isolator TCA, refer to "Remote Fieldbus Extension, Cable Connections" in *System Equipment Installation* (B0193AC).

To make the remote fieldbus extension cable connections:

1. Assemble the termination blocks associated with the termination cable assemblies (P0903VY), snap them onto the mounting rails (DIN rails) in the enclosure (as shown in Figure 2-8), and connect the ground wires. (For future reference, Figure 2-9 illustrates how to remove the TCA termination blocks.)
   If you are not installing the FBI200/FBI100 modules in your configuration, refer to Figure 2-7 to see how to connect the TCAs directly to the fieldbus splitter/terminator (P0926LC).
   If you are installing the FBI200 or FBI100 modules in your configuration, refer to "Cabling the FCP270 to the 268 Kbps or 2 Mbps Fieldbus Via the FBI200 or FBI100" in *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA) for instructions on how to connect the TCAs directly to the FBI200 or FBI100 baseplate.
2. For configurations without FBI200/FBI100 modules, connect the fieldbus splitter/terminator (P0926LC) to the "Fieldbus and Time Strobe" connector on the FCP270 baseplate (see Figure 2-6). Refer to "Cabling the FCP270 to the 268 Kbps or 2 Mbps Fieldbus (Without FBI100)" in *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).
3. For configurations without FBI200/FBI100 modules, make cable connection(s) to the fieldbus splitter/terminator as shown in Figure 2-7.
   For configurations with FBI200/FBI100 modules, make cable connection(s) to the FBI200 or FBI100 baseplate as shown in Cabling the FCP270 to the 268 Kbps Fieldbus Via the FBI200 or FBI100" in *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).
4. Make the fieldbus cable connections between termination cable assemblies (see Figure 2-10).
5. Add the terminating resistors (supplied with the termination cable assemblies) according to the following rules:
   - Terminating resistors are used only at the ends of the bus.
   - The Fieldbus can be extended in two directions from the FCP270. (Refer to Figure 2-11.)
6. Connect an insulated 14 AWG green wire between connection point 3 (shield) on the last Fieldbus Isolator termination cable assembly (or assemblies) and the earth bus in the enclosure. For Foxboro Evo system earthing requirements, refer to *Power, Earthing (Grounding), EMC and CE Compliance* (B0700AU).

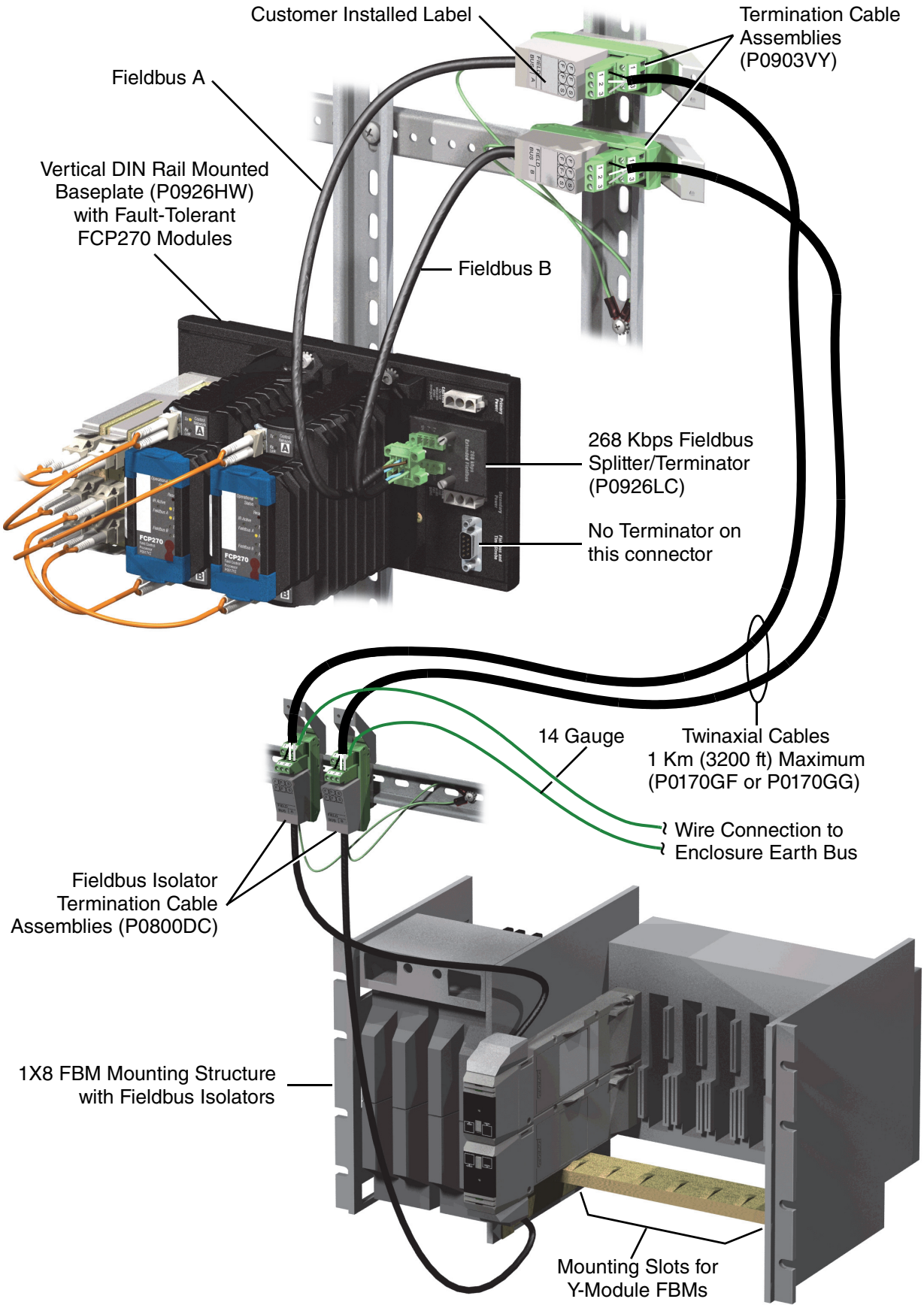


Figure 2-6. Cabling Y-Module FBMs to an FCP270 Baseplate (Without FBI200s/FBI100s)

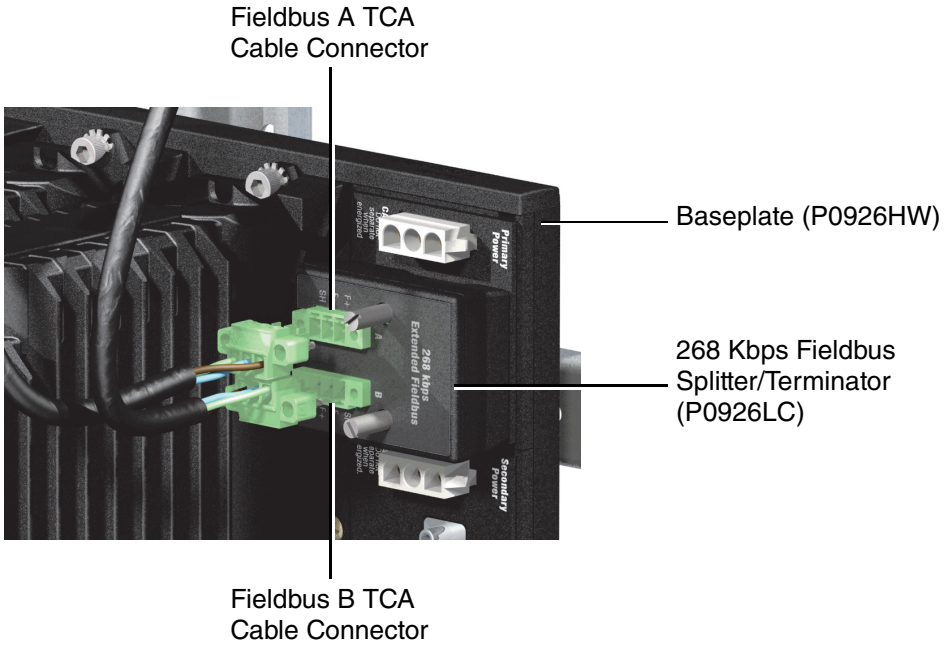


Figure 2-7. TCA Cable Connection to 268 Kbps Fieldbus Splitter/Terminator (Without FBI200s/FBI100s)

1. Slide strain relief bracket onto TCA termination block.
2. Snap assembled termination block onto DIN rail.
3. Connect ground wire to DIN rail using screw, lock washer and nut (customer supplied).

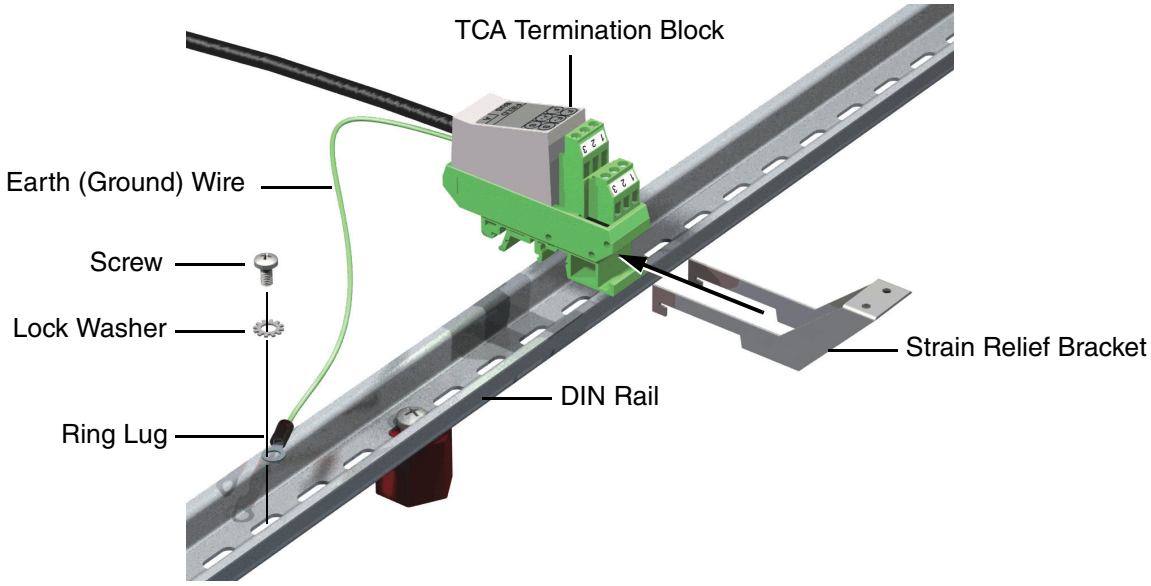


Figure 2-8. TCA Termination Block Assembly Mounting

1. Disconnect the earth wire from from the DIN rail.
2. Insert a medium-size flat-head screw driver as shown.
3. Move the screw drive handle in the direction shown, while lifting the TCA termination block from the DIN rail.

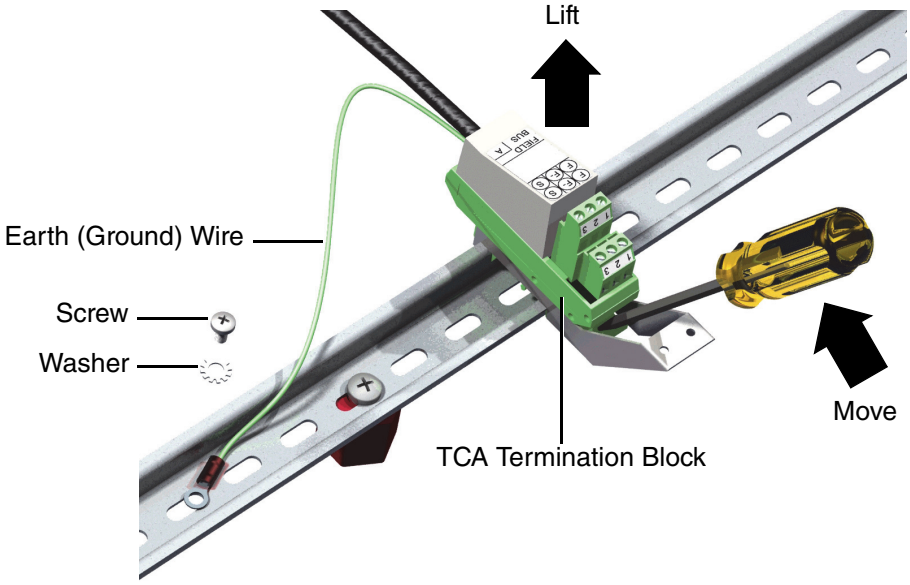
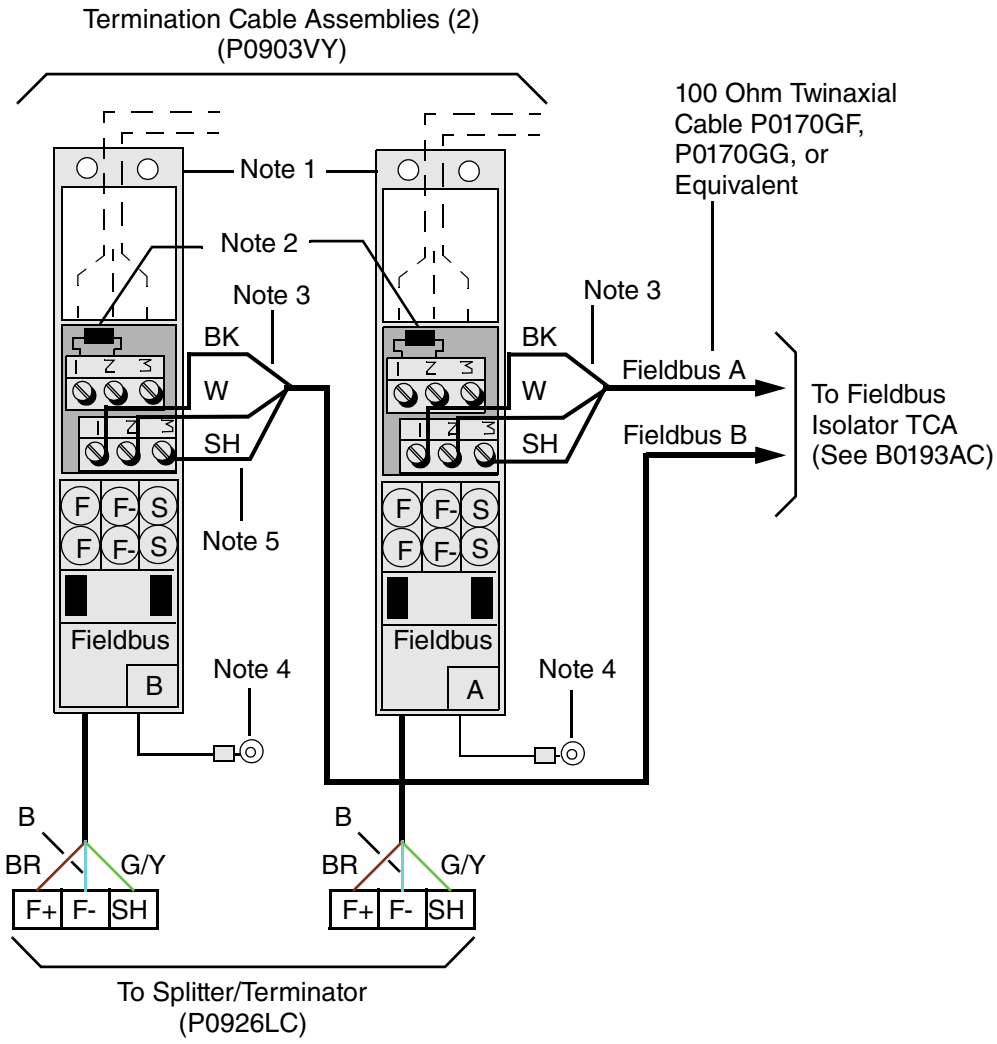


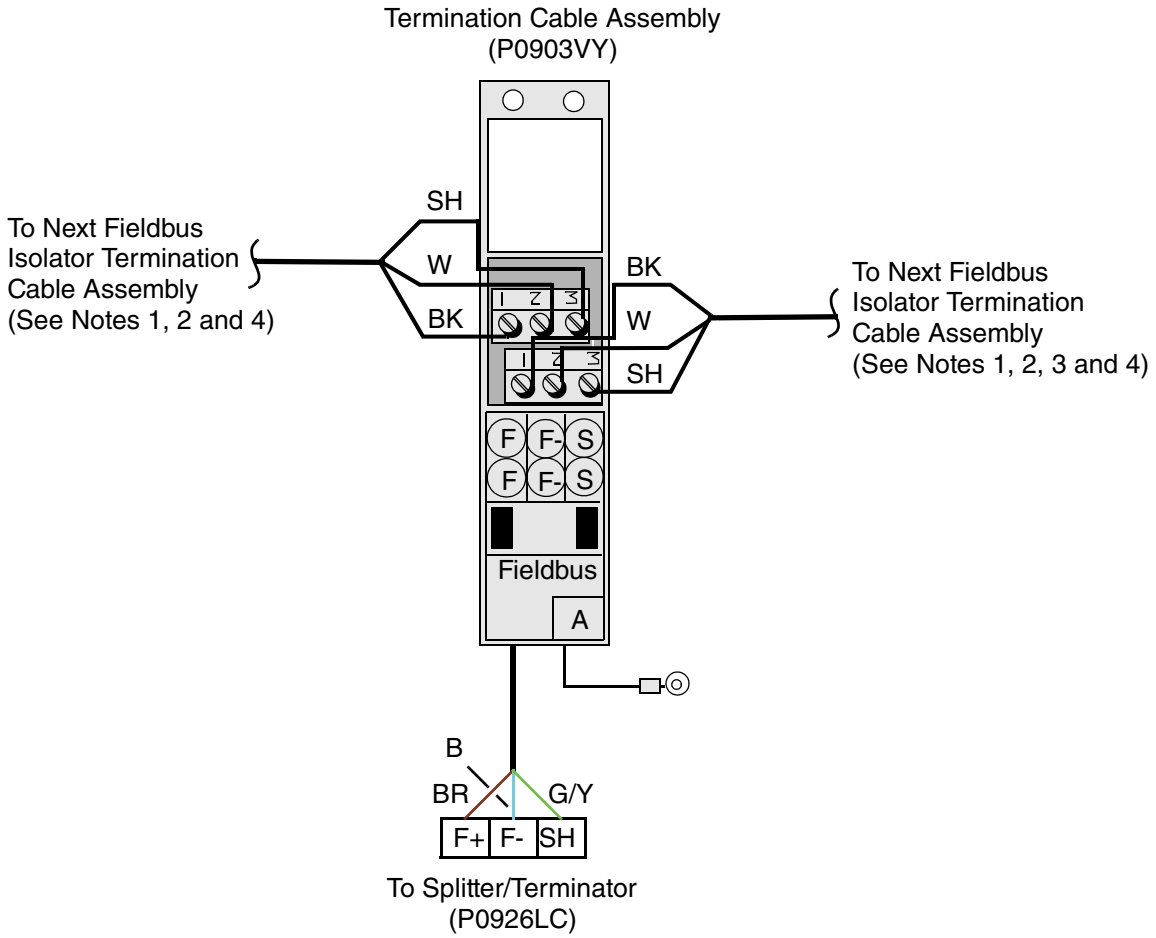
Figure 2-9. TCA Termination Block Removal



Notes:

1. For cable strain relief, it is recommended that the Fieldbus cable(s) be routed over the strain relief bracket and secured using nylon cables ties.
2. TCAs can be daisy chained as indicated by the dashed cable lines, but terminating resistors (110 ohms) must be installed at the ends of the fieldbus.
3. Wire colors shown (BK and W) are for reference purposes only.
4. Earth (ground) the surge protection network contained within the TCAs by attaching the green earth wire to a screw on the DIN rail connected to system earth. For more information on earthing, refer to *Power, Earthing (Grounding), EMC and CE Compliance* (B0700AU).
5. The shield of the twinaxial cable (terminal 3) should be earthed at the farthest end from the FCP270 baseplate. The fieldbus shield must be earthed at one end only. (See text for earthing instructions.)

Figure 2-10. Remote Redundant Fieldbus Cabling (FCP270 End)



Notes:

1. Earth the shield (terminal 3) at the termination cable assembly farthest from the FCP270 baseplate.
2. Install terminating resistors at both ends of the extended fieldbus cable. For the last TCA in the fieldbus, install the termination resistor between terminals 1(F) and 2(F-) and the earth (ground) wire (14 Gauge) must connect to terminal 3(S) as shown in Figure 2-6.
3. If this TCA is the last TCA in the fieldbus, the cable on this side of the TCA will not be added.
4. Earth (ground) the surge protection network contained within the TCAs by attaching the green earth wire to a screw on the DIN rail connected to system earth. For more information on earthing, refer to *Power, Earthing (Grounding), EMC and CE Compliance* (B0700AU).

Figure 2-11. Example of Extending Fieldbus in Two Directions from FCP270

Decommissioning an FCP270 Module

You can decommission an FCP270 module that you no longer plan to use. For example, you want to remove the FCP270 from the system and place it into storage.

Perform the following procedure to guarantee that when you remove the module for use in another application, the module will not load a stale checkpoint file out of its flash memory.

Proceed as follows:

1. Plug the module into the system without connecting to The MESH control network.
2. Set the station letterbug to a non-existent value, such as NOSUCH, using the I/A Series Letterbug Configurator.
3. Allow the module to reboot to accept the new letterbug.
4. Read the module status with the I/A Series Letterbug Configurator. The letterbug should be the non-configured value, and the IP address should be 255.255.255.255.

The FCP270 module can be removed now.

3. Configuration Information

This chapter provides system configuration information (System Definition) and control configuration information.

Overview

In general, "configuration" refers to the act of specifying to the Control Core Services the types of hardware and software modules that comprise the system, and the control blocks that will be used in the control scheme. Prior to performing configuration procedures, you are encouraged to develop I/O signal lists. You should develop loop control schemes and loop drawings to document the control scheme. From the signal lists and loop drawings, you can determine the type and quantity of equipment required for your control scheme.

System Definition

Your system configurator application is used to identify the Foxboro Evo system components, system software required by each component, the system component letterbugs, and other system characteristics for correctly loading system software and identifying the system software objects. System definition with your system configurator produces the Commit media, which is required for software installation and, therefore, must be completed before software installation. It is initially performed prior to installation of the system equipment, and it is updated with any hardware/software system changes. Reports produced by the system configurator define the network of the system and provide information that can be used in conjunction with equipment installation. In the future, if changes are made to the initial hardware layout, the system definition database must be updated to reflect these changes.

Using the system configurator, you define the type and quantity of FCP270s and associated FBMs, their letterbugs, and the software (for example, digital input, ladder logic, and so forth) for the FBMs. Letterbugs are unique, 6-character strings that identify stations, such as FCP270s and FBMs, to the Foxboro Evo system software.

— NOTE

Before loading a SaveAll control database from a CP60 or previous control processor onto an FCP270, make sure all the ECBs are supported by the FCP270. For example, ECB110 (for FCM10s) is not supported by the FCP270.
Failing to do this will block ALL the ECBs (invalid and valid) from being loaded into the new FCP270.

System Definition Procedure

To perform system definition, configure the Foxboro Evo system as described in the corresponding document provided with your system configurator.

After you have completed system definition, install the system software. Refer to the appropriate *Hardware and Software Specific Instructions* for your workstation.

To use Y-module FBMs (100 Series FBMs) with your FCP270s, use your applicable system configurator to create and configure the required ECBs. Refer to the documentation included with your system configurator to complete the process.

System Configuration

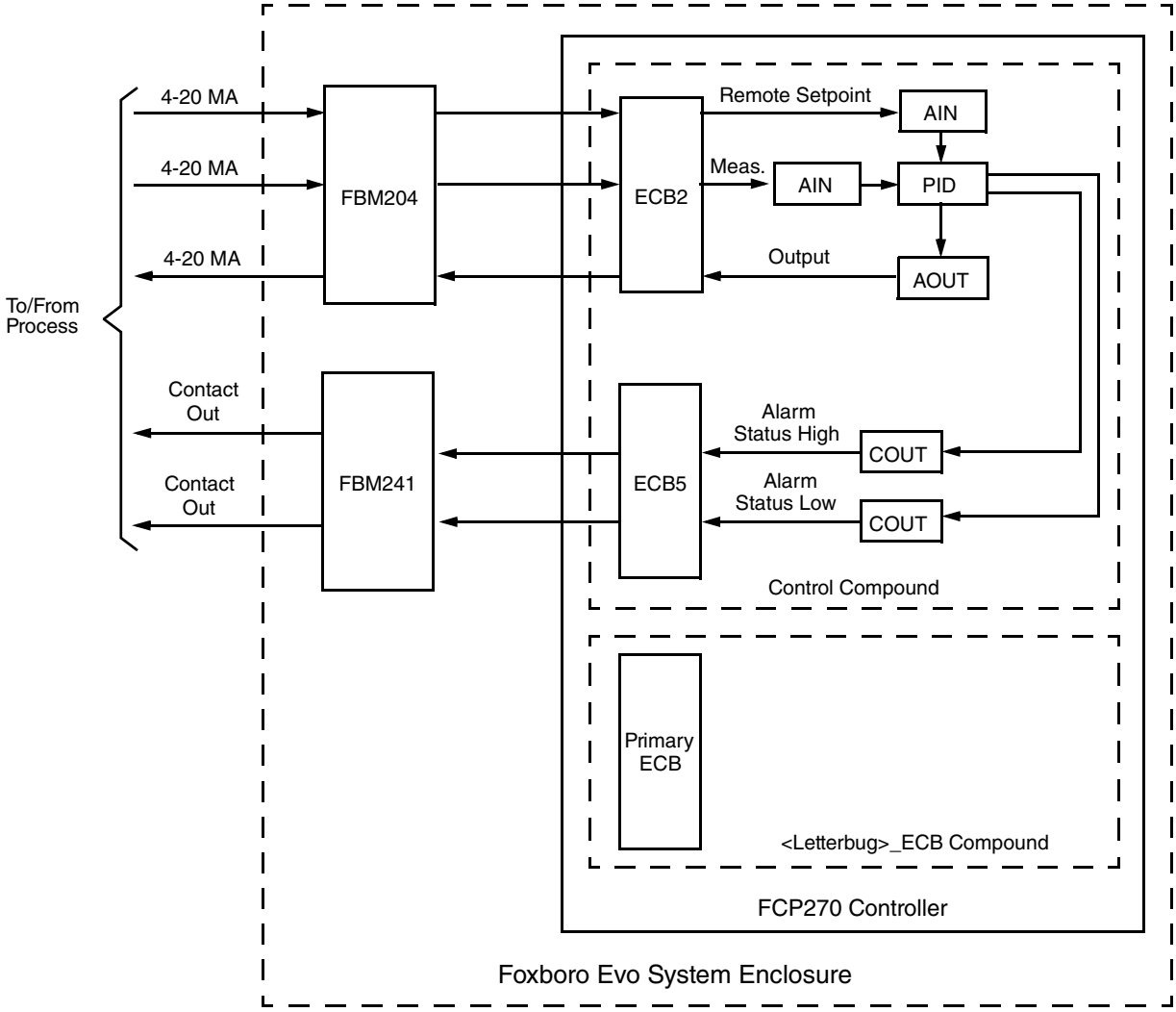
When you have defined and installed the FCP270, you are ready to configure your control system and download the control database to the FCP270. System configuration comprises designing your control strategy loop diagrams and configuring the compounds and control blocks for these loops. The FCP270 control database consists of configuration data for the compounds and associated control blocks, including Equipment Control Blocks (ECBs) required for the FBMs and the FCP270.

As a compound/block editor, the Invensys system configurators provide compound or block building templates along with a full range of editing functions.

In general, you create a compound in which to locate control blocks for a specific control strategy, for example, the blocks required to control the outlet temperature of a heat exchanger. Then, you create the blocks required for implementing the control strategy.

For each FBM, you create a specific ECB which serves as a “holding place” for the FBM data. The primary ECB for the FCP270 control station is automatically created by the system configurator.

The ECBs provide the software interface between the I/O control blocks and the FBMs. Actual control of the process is performed by compounds, consisting of control blocks, which you configure. Figure 3-1 shows a typical application of control blocks.



Notes:
1. For ECB parameters definitions and ECB to FBM assignments, refer to *Integrated Control Block Descriptions* (B0193AX).
2. The Primary ECB is automatically assigned to a compound named <Letterbug>_ECB, for example, if an FCP letterbug is H51FCP, the compound name is H51FCP_ECB.

Figure 3-1. Typical Control Scheme Using an FCP270 and 200 Series FBMs

Available Foxboro Evo Control Blocks

The Control Core Services offer a wide range of control blocks, providing solutions for a broad spectrum of process control applications. For details on the selection and usage of control blocks, refer to *Integrated Control Block Descriptions* (B0193AX) and *Integrated Control Block Descriptions for Foundation fieldbus Specific Control Blocks* (B0700EC).

System Configuration with Dual Baud Functionality

The FCP270 can communicate with both 200 Series FBMs (over 2 Mbps signals) and 100 Series FBMs (over 268 Kbps signals) simultaneously and safely when the FBI200 or FBI100 is properly installed between the FCP270 and 100 Series FBMs. The FBI200 or FBI100 filter out the 2 Mbps signals, allowing only the 268 Kbps signals through.

The process for setting up this hardware configuration with the FBI200 or FBI100 is discussed in *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

The process for setting up this hardware configuration with the FBI200A is discussed in *100 Series Fieldbus Module Upgrade User's Guide* (B0700BQ).

However, additional I/O overhead is incurred each BPC cycle for both inputs and outputs when the FCP270 has to perform baud switching to accommodate the different I/O baud rates (2 Mbps versus 268 Kbps).

The FCP270 scan order is based on the configuration order of compounds and ECBs for the I/O input scan cycle and the I/O output scan cycle. For example, during the I/O input scan cycle, first the ECB compound and all its ECBs are processed, followed by the first compound and all its ECBs, following by the second compound and all its ECBs, and so forth. This is also the case for the I/O output scan cycle.

To eliminate unnecessary baud switching and achieve maximum I/O scan efficiency, you must configure your compounds and ECBs for all 100 Series FBMs, followed by all compounds and ECBs for all 200 Series FBMs.

When upgrading 100 Series FBMs to 200 Series FBMs in a dual baud configuration, you only need to change the configuration order if you wish to increase I/O performance. The increase in 200 Series FBMs performance versus 100 Series FBMs will compensate for any efficiency loss due to baud switching.

4. System Management

This chapter provides general system management information for the Field Control Processor 270. It also provides references to the manuals that describe the tools you use to perform in-depth system management tasks.

Overview

The general Foxboro Evo system management philosophy applies to the Field Control Processor 270 in the Foxboro Evo system. Through the System Management Displays, you can receive status information on the FCP270 and send change requests to the FCP270.

System management for the FBMs is supported on the following system management tools:

- System Manager v2.1 or later (supported on I/A Series system software v8.6-v8.8 and Control Core Services v9.0 or later) - discussed in *System Manager* (B0750AP)
- SMDH - discussed in *System Management Displays* (B0193JC)
- FoxView™ - discussed in *Process Operations and Displays* (B0700BN)

The security of this system is maintained via the standard Foxboro control processor software and the customer-engineered user interface to the control block database. All access to the I/O data is through the control blocks. The end user has no direct access to any of the I/O functions or the data in the FBMs.

Operating Status

The operating status of the FCP270 is reported by the Foxboro Evo system using on-screen and printed messages. Refer to the following documents for information on the reporting of equipment operating status and errors:

- *System Manager* (B0750AP)
- *System Management Displays* (B0193JC)
- *Control Core Services V9.x System Error Messages* (B0700AF)
- *Process Operations and Displays* (B0700BN).

System Management Displays for the FCP270

The System Manager and System Management Display Handler (SMDH) allow you to access:

- Equipment information
- Configuration information
- Equipment change actions.

These displays reflect the system's current operating status and provide a valuable maintenance aid by allowing you to observe the current operating status of the various system elements and intervene in system operations.

For information on navigating through the System Manager, see *System Manager* (B0750AP).

For information on navigating through the SMDH screens, see *System Management Displays* (B0193JC).

Equipment Information Display for FCP270

The SMDH Equipment Information display pages (Figure 4-1 and Figure 4-2) for the FCP270 contain operational status, equipment change action status, hardware and software information. Table 4-1 describes the available text fields in the order that they appear on the display pages, from left column to right column.

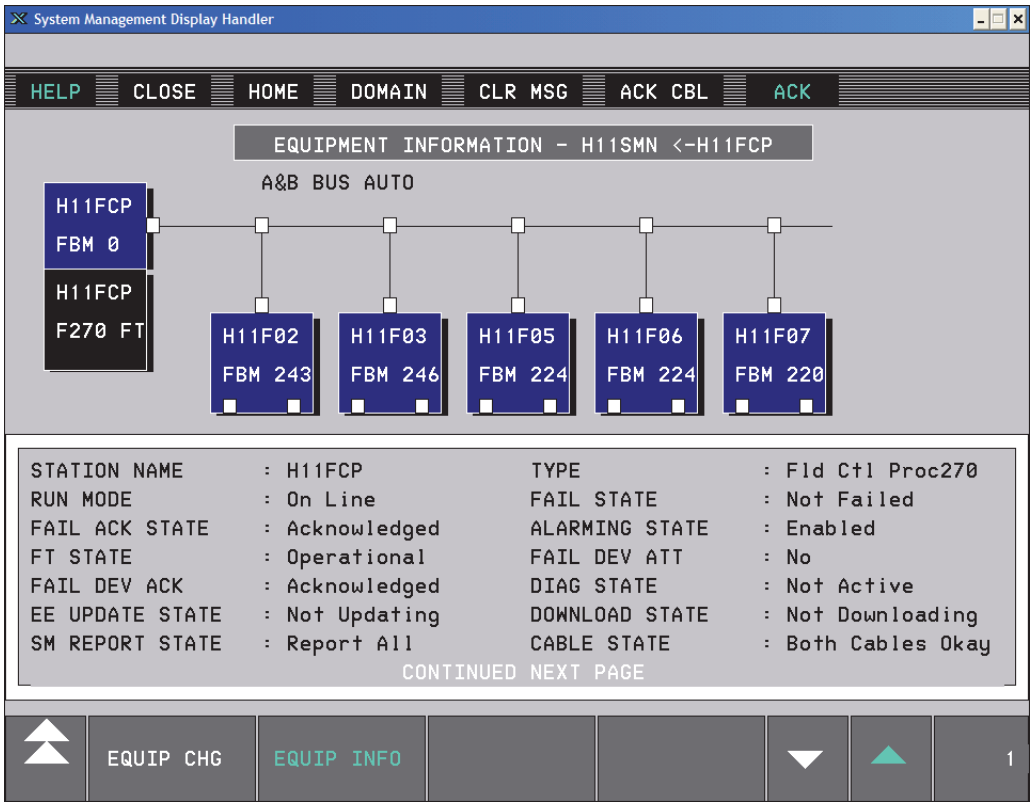


Figure 4-1. Equipment Information Display for FCP270 – Typical (1 of 2)

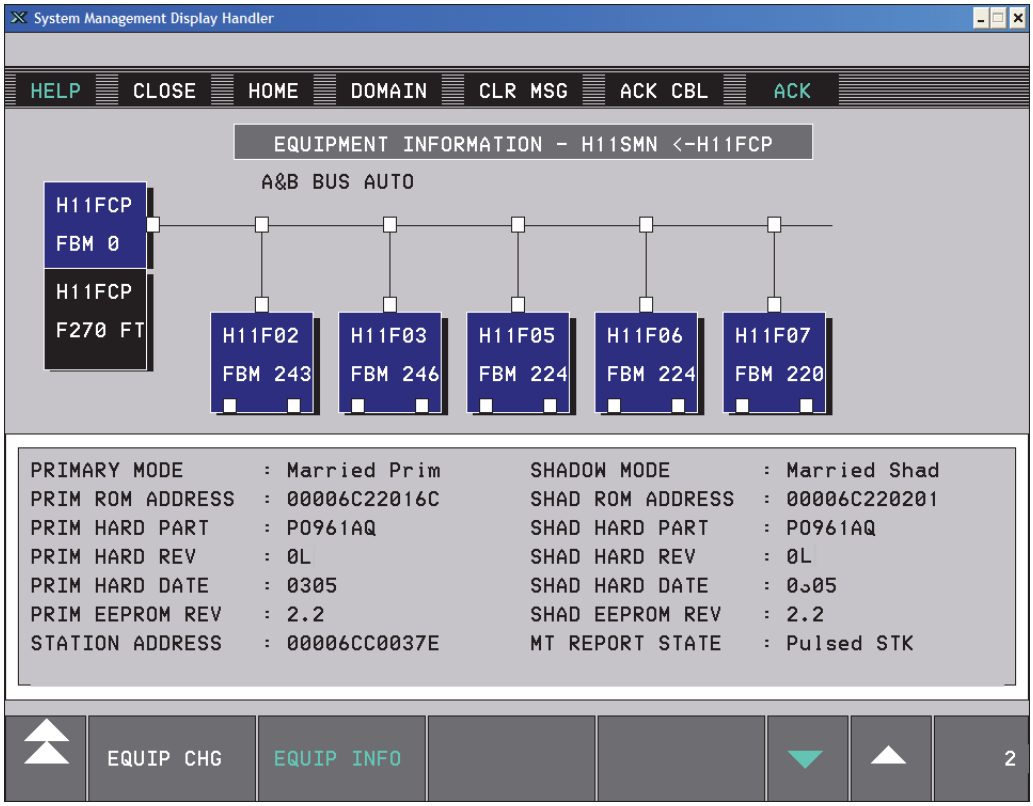


Figure 4-2. Equipment Information Display for FCP270 – Typical (2 of 2)

Table 4-1. Equipment Information Display Fields for FCP270

Field	Description
STATION NAME	Controller letterbug assigned during definition of system hardware.
RUN MODE	On-line or Off-line. This field is initially Off-line. It changes to On-line when the FCP270 reports to the System Monitor after booting up. If reporting is disabled, the last known state appears in this field. RUN MODE and FAIL STATE should be viewed as separate, but related fields. Although certain Equipment Change options change the RUN MODE to Off-line, they do not fail the station. However, a failed station will result in the RUN MODE changing to Off-line. The field changes to Off-line if any of the following occur: ♦ Reboot of the station ♦ EEPROM update ♦ Power failure ♦ Any station hardware failure or communication failure that results in the station no longer being able to send its internal reports for one minute or more. For fault-tolerant stations, see the PRIMARY MODE and SHADOW MODE fields for current RUN MODE of each module of the pair.

Table 4-1. Equipment Information Display Fields for FCP270 (Continued)

Field	Description
FAIL ACK STATE	Acknowledged or Not Acknowledged. This field is initially set to Acknowledged. If the FAIL STATE changes from Not Failed to Failed, the FAIL ACK STATE field changes to Not Acknowledged to indicate this transition. Use the ACK key in the top menu bar of the Equipment Information Display to acknowledge the selected faulted device or use the ACK ALL key in the top menu bar of the initial System Management Display to acknowledge all the unacknowledged devices for which the workstation has responsibility.
FT STATE	Fault-Tolerant State is Operational or Non-Operational for fault-tolerant controllers only. FT STATE indicates Non-Operational if the shadow module is not installed/configured.
FAIL DEV ACK	Acknowledged or Not Acknowledged. This field is initialized to Acknowledged. If any of the attached devices become unacknowledged, the field changes to Not Acknowledged.
EE UPDATE STATE	EE Updating or Not Updating. This field is initially set to Not Updating. When IMAGE UPDATE is selected under Equipment Change options, the status changes to EE Updating until the FCP270 image (operating system software) has been burned to flash memory. For fault-tolerant stations, refer to the PRIMARY MODE and SHADOW MODE fields for the current EEPROM Updating State. For more information, see “Image Update Procedure for a Non-Fault-Tolerant FCP270” on page 56.
SM REPORT STATE	Report All or No Reporting. This refers to the type of internal reporting taking place from the Station Manager to the System Monitor. The various states are selectable from the Equipment Change Display ENABLE ALL REPORTS and DISABLE ALL REPORTS. The default setting is Report All.
TYPE	Type of controller defined when the letterbug is assigned during the site planning and system definition phases. Field Control Processor 270 has the type Fld Ctl Proc270.

Table 4-1. Equipment Information Display Fields for FCP270 (Continued)

Field	Description
FAIL STATE	Failed or Not Failed. This field is initially Not Failed. This field changes to Failed if any of the following occur: ♦ A hardware problem causes the station to fail for more than two minutes ♦ A physical pull/push of the station (requiring more than two minutes to come back on-line) is performed ♦ Any station hardware failure or communication failure that results in the station no longer being able to send its internal reports for one or more minutes. Operator-initiated Equipment Change actions (REBOOT, IMAGE UPDATE) change the RUN MODE to off-line, but do not change the FAIL STATE to Failed. For fault-tolerant stations, refer to the PRIMARY MODE and SHADOW MODE fields for the current FAIL STATE of each module in the fault-tolerant pair.
ALARMING STATE	Enabled or Inhibited. This field indicates whether alarming for system alarms, not process alarms, is Enabled or Inhibited for the station. When alarming is Inhibited, the System Monitor continues to indicate overall system and network health (a green “Sys” bar) while equipment is failed or off-line. Additionally, when alarming is inhibited, System Alarm messages are not logged to the system printer, nor the Historian.
FAIL DEV ATT	Yes or No. Yes if one or more peripherals attached to the controller are failed.
DIAG STATE	Not Active is always displayed because there are no off-line diagnostics for the FCP270 station.
DOWNLOAD STATE	Downloading or Not Downloading. This field is initially set to Not Downloading. When the station is rebooted via an operator-initiated request, the status changes to Downloading until the action is completed. For fault-tolerant stations, refer to the PRIMARY MODE and SHADOW MODE fields for the current Downloading State.
CABLE STATE	Both Cables Okay or Fault. This field indicates if there is a cable Fault on either The MESH control network cables A or B, or both.
PRIMARY MODE	Single Primary, Married Primary, EE Updating, Downloading or Failed appears for fault-tolerant controllers.
PRIM ROM ADDRESS	A six-octet Media Access Control (MAC) address of the Primary controller assigned during manufacturing. The Manufacturing ID, labeled on the left side of the module, is the last six characters of this address, for example, 220626 in Figure 4-2.
PRIM HARD PART	Primary controller hardware part number.
PRIM HARD REV	Primary controller hardware revision number. Typically, for an FCP270 this part number is P0917YZ.
PRIM HARD DATE	Primary controller hardware manufacturing date.
PRIM EEPROM REV	Primary controller EEPROM revision level.

Table 4-1. Equipment Information Display Fields for FCP270 (Continued)

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>STATION ADDRESS</td><td>Six-octet MAC address. This field specifies a unique MAC address that other stations in the system use to communicate with the FCP270.</td></tr>
<tr><td>SHADOW MODE</td><td>Married Shadow, EE Updating, Downloading, Failed, or Off-line appears for fault-tolerant controllers. A non-existent shadow module is marked as Off-line.</td></tr>
<tr><td>SHD ROM ADDRESS</td><td>Last known six-octet MAC address of the shadow controller. This is assigned during manufacturing. The last six characters of this address are the module hardware ID, which is stamped on a label on the module's left side. For a non-existent shadow module, this field is all zeroes.</td></tr>
<tr><td>SHAD HARD PART</td><td>Last known shadow controller hardware part number. This field is blank if the shadow controller does not exist.</td></tr>
<tr><td>SHAD HARD REV</td><td>Last known shadow controller hardware revision number. This field is blank if the shadow controller does not exist.</td></tr>
<tr><td>SHAD HARD DATE</td><td>Last known shadow controller hardware manufacturing date. This field is blank if the shadow controller does not exist.</td></tr>
<tr><td>SHAD EEPROM REV</td><td>Last known shadow controller EEPROM revision level. This field is blank if the shadow controller does not exist.</td></tr>
<tr><td>MT REPORT STATE</td><td>Indicates the status of UTC time and time strobe from the Master Timekeeper (MTK), as received by the FCP270.
<table>
<tr><th>STATE</th><th>Description</th></tr>
<tr><td>Pulsed STK</td><td>FCP270 is receiving UTC time from MTK and time strobe from both ports A and B.</td></tr>
<tr><td>Sync_A_In_Fail</td><td>FCP270 is receiving UTC time from MTK and time strobe only from port B.</td></tr>
<tr><td>Sync_B_In_Fail</td><td>FCP270 is receiving UTC time from MTK and time strobe only from port A.</td></tr>
<tr><td>Sync_AB_In_Fail</td><td>FCP270 is receiving UTC time from MTK, but lost time strobe from ports A and B.</td></tr>
<tr><td>Sync_not_Cfg</td><td>FCP270 is not configured as a Sync Pulse station.</td></tr>
</table></td></tr>
</table>

Configuration Information Display for FCP270

The SMDH Configuration Information display (Figure 4-3) for the FCP270 contains system domain and network configuration information. You can use the information shown in this display when diagnosing system problems. Table 4-2 describes the available text fields in the order that they appear on the display, from left column to right column.

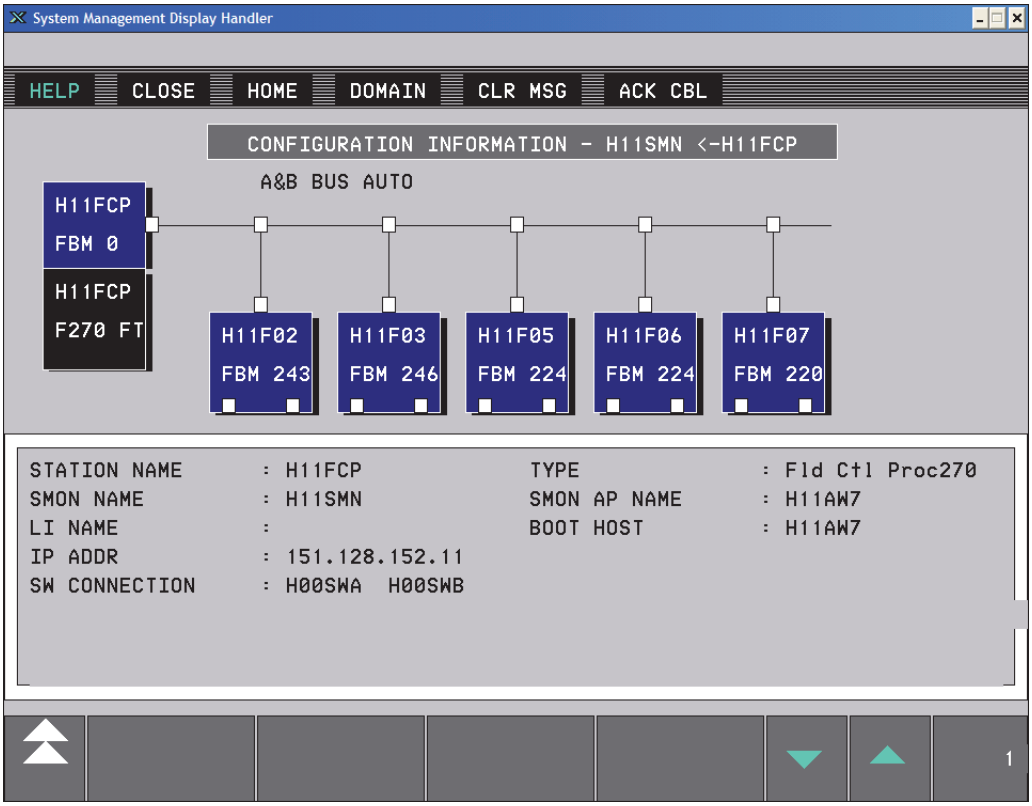


Figure 4-3. Configuration Information Display for FCP270

Table 4-2. Configuration Information Display Fields for FCP270

Field	Description
STATION NAME	Controller letterbug assigned during definition of system hardware.
SMON NAME	System monitor name for the selected FCP270.
LI NAME	Not applicable (N/A)
IP ADDR	Internet Protocol network address. Assigned by system during system definition phases.
SW CONNECTION	Ethernet switches to which the FCP270 is connected, per system configuration.
TYPE	Type of station defined when the letterbug is assigned during site planning and system definition phases. This should read Fld Ctl Proc270.
SMON AP NAME	Name of the application workstation that hosts the controller's system monitor.
BOOT HOST	Boot image host name for the selected FCP270.

Equipment Change Display for FCP270

You can use the SMDH Equipment Change display (Figure 4-4) for the FCP270 to perform equipment change actions on the selected controller. Only workstations designated (during System Monitor configuration) to perform secured actions on this FCP270 can access the equipment change actions. Table 4-3 describes the actions that are available for this display.

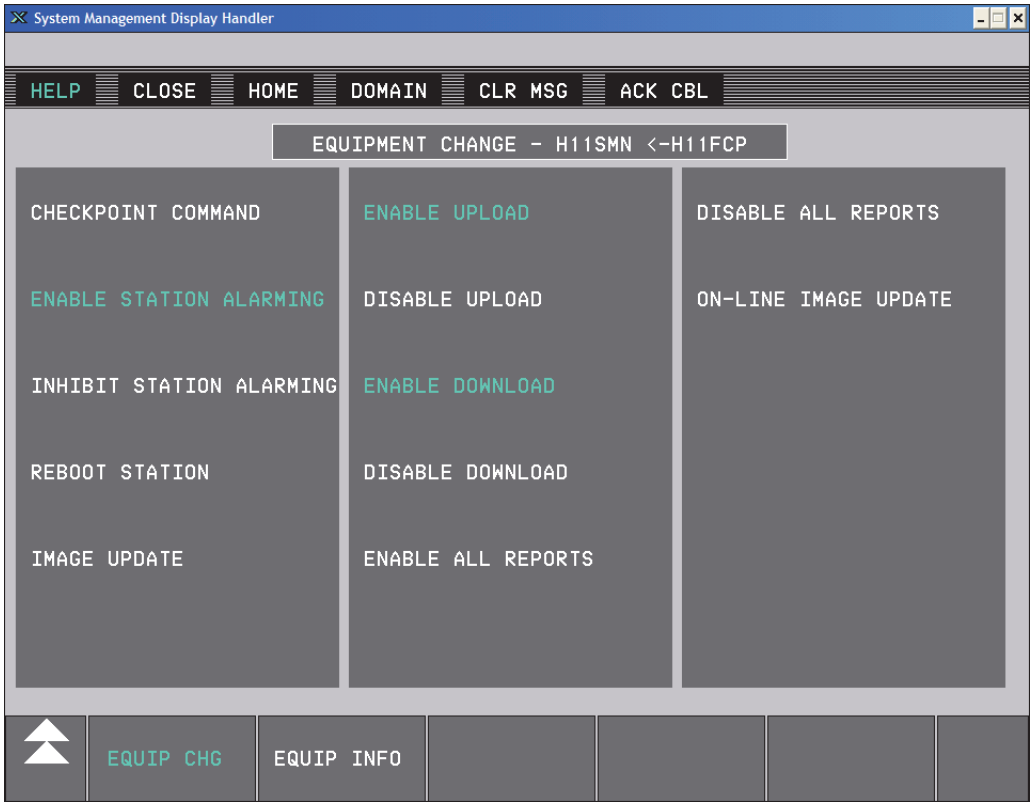


Figure 4-4. Equipment Change Display for FCP270

⚠ CAUTION

Only designated personnel who are aware of the effects of making equipment changes should initiate equipment changes.

Table 4-3. Equipment Change Display Fields for FCP270

Action	Description
CHECKPOINT COMMAND	Saves operator set values and process tuning changes for a controller to the checkpoint file in the host file server. To retain these changes, you must save them to the host file server checkpoint file before you reboot (restart) the controller. This checkpoint file contains an image of the current database. When you reboot (restart) the controller, the system downloads the current checkpoint file to the controller to update its database. Checkpointing takes approximately 5 seconds to 30 seconds depending on the database size.
ENABLE STATION ALARMING	Enables the controller system alarms to be propagated up the equipment hierarchy and enables controller system alarm messages. This action does not affect process alarms.
INHIBIT STATION ALARMING	Prevents the controller system alarms from being propagated up the equipment hierarchy and disables controller system alarm messages. Does action not affect process alarms.

Table 4-3. Equipment Change Display Fields for FCP270 (Continued)

Action	Description
REBOOT STATION	Restarts the FCP270 and reloads the checkpoint file, which contains an image of the controller database, from the host file server if ENABLE DOWNLOAD is active on the Equipment Change display.
IMAGE UPDATE	Updates the existing FCP270 software image in flash memory with new software image if ENABLE DOWNLOAD is active on the Equipment Change display. The update downloads a file and burns it to flash memory. The system printer logs the update results. Selecting IMAGE UPDATE for a fault-tolerant FCP270 and selecting "Yes" in the dialog box initiates the EEPROM update to both modules of the fault-tolerant pair. Once initiated, the IMAGE UPDATE process is entirely automatic. The fault-tolerant FCP270 places the Shadow module off-line and then downloads and burns the new code in the Primary module. After verification, the Primary reboots automatically. When the Primary finishes rebooting it sends the new image to the Shadow. The Shadow reboots and the module pair marries using the new code. IMAGE UPDATE takes approximately 1 minute to 5 minutes depending on database size.
ENABLE UPLOAD	Enables uploading of the station image to a file on the host file server if the controller fails.
DISABLE UPLOAD	Disables uploading of the station image to a file on the host file server if the controller fails.
ENABLE DOWNLOAD	Enables download of files needed for REBOOT STATION, IMAGE UPDATE and ON-LINE IMAGE UPDATE actions.
DISABLE DOWNLOAD	Disables download of files needed for REBOOT STATION, IMAGE UPDATE and ON-LINE IMAGE UPDATE actions.
ENABLE ALL REPORTS	Enables reporting of all status for the controller and any attached devices, and reporting of system and peripheral counters to the System Monitor.
DISABLE ALL REPORTS	Disables reporting of all status for the controller and any attached devices and reporting of system and peripheral counters to the System Monitor.
ON-LINE IMAGE UPDATE	Allows you to update the software image on a fault-tolerant FCP270, safely and with minimum hold-control time. For more information, refer to "Image Update Procedure for a Fault-Tolerant FCP270" on page 57.

The REBOOT STATION, IMAGE UPDATE (EEPROM Update) and ON-LINE IMAGE UPDATE actions and their procedures are described below.

NOTE

For more information and procedures for performing equipment change actions, refer to *System Management Displays* (B0193JC).

Reboot Station Procedure

The REBOOT STATION action restarts the selected FCP270 and reloads its control database from a file server. While the station is rebooting, it is off-line until the reboot is complete; this suspends any access to the station database. Rebooting typically is used during system maintenance and upgrades.

To reboot an FCP270 station:

1. Access the Equipment Change Display for the desired FCP270 (refer to *System Management Displays* (B0193JC).
2. In the Equipment Change Display, ensure that the Enable Download state is active. If it is not, click **ENABLE DOWNLOAD**.

   To ensure that download is currently enabled, verify that the **ENABLE DOWNLOAD** button is back-lighted dark cyan.
3. Click **REBOOT STATION**.

   If this is a fault-tolerant FCP270 station, a dialog box (Figure 4-5) offers choices for primary module, shadow module, or both. The dialog box displays the MAC address and status of the primary and shadow modules.

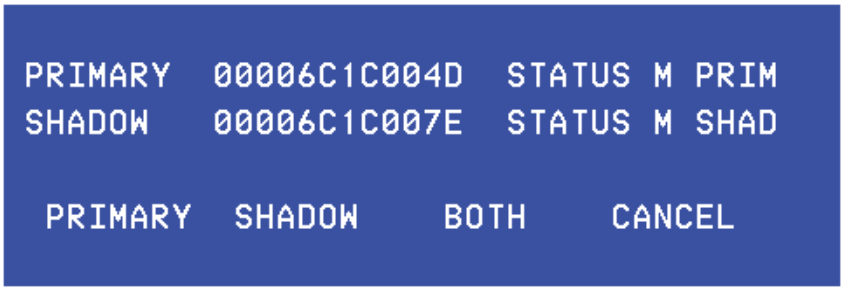


Figure 4-5. REBOOT STATION Dialogue Box – Fault-Tolerant FCP270

   The following module operational statuses can be displayed:

   M PRIM = married primary, M SHAD = married shadow, S PRIM = single primary
4. Click the module to reboot. The system reboots that module.

   If there is an error, the system displays a message on the screen and/or at the system printer. Refer to *Control Core Services V9.x System Error Messages* (B0700AF).

Image Update Procedure for a Non-Fault-Tolerant FCP270

The IMAGE UPDATE action updates the existing image (operating system software) in the selected FCP270's EEPROM flash memory with a new image. The update downloads a file and burns a new image to flash memory.

⚠ CAUTION

The IMAGE UPDATE command allows you to upgrade the existing image (operating system software) in a non-fault-tolerant FCP270, while interrupting process control for the duration of the image update. IMAGE UPDATE takes approximately 1 minute to 5 minutes depending on database size.

To update the existing image in flash memory for a non-fault-tolerant FCP270 station, refer to the *Control Processor 270 (CP270) On-Line Image Update* (B0700BY) document.

NOTE

If self-hosting is enabled during an Image Update procedure, the checkpoint files in flash will be invalidated forcing the checkpoint file to be loaded from the host workstation. When the procedure is complete and the Database Download is complete, a checkpoint command will automatically be issued that will result in the checkpoint file being burned to flash.

Image Update Procedure for a Fault-Tolerant FCP270

The IMAGE UPDATE action updates the existing image (operating system software) in the selected FCP270's EEPROM flash memory with a new image. The update downloads a file and burns a new image to flash memory in both modules of the fault-tolerant FCP270.

The ON-LINE IMAGE UPDATE command allows you to upgrade the existing image (operating system software) in an on-line, fault-tolerant FCP270, while interrupting process control for only 1.5 seconds, approximately.

To update the existing image in flash memory for a fault-tolerant FCP270 station, refer to the *Control Processor 270 (CP270) On-Line Image Update* (B0700BY) document. While IMAGE UPDATE runs, the system sends standard EEPROM update progress messages to the system printer. IMAGE UPDATE takes approximately 1 minute to 5 minutes depending on database size.

NOTE

Selecting IMAGE UPDATE for a fault-tolerant FCP270 automatically updates both modules of the fault-tolerant pair. Once initiated, the IMAGE UPDATE process is entirely automatic.

NOTE

If self-hosting is enabled during an Image Update procedure, the checkpoint files in flash will be invalidated forcing the checkpoint file to be loaded from the host workstation. When the procedure is complete and the Database Download is complete, a checkpoint command will automatically be issued that will result in the checkpoint file being burned to flash.

Messages Following Checkpoint Operation in Self-Hosting FCP270

The Checkpoint action saves the checkpoint file database on the host workstation, and if the self-hosting capability of the FCP270 controller is enabled, the checkpoint file is also burned to the controller's flash memory. When a checkpoint command is issued, the FCP270 sends it's control database to the host workstation and if self-hosting is enabled, the FCP270 will send a request to the host workstation requesting that checkpoint file to be sent back to the FCP270 to be burned into flash memory.

When self-hosting is disabled, you will see a message similar to the following after successfully completing a checkpoint action:

```
10-31-07 09:58:38 0 SYSMON = SYSMN1 CP0008 Software Manager
SYSMON -00021 Checkpoint Successful
```

The following is an example of the series of messages (dates are provided as examples in the format YYYY-MM-DD HH:MM:SS) that are sent to the System Monitor log when performing a checkpoint with self-hosting enabled. It is important to note that the checkpoint operation is **not complete** until the message "Checkpoint installed into flash" appears in the SMON log. When "Checkpoint installed into flash" appears in the SMON log, the checkpoint file has been sent to the host workstation and burned into the FCP270 flash memory.

```
2007-10-17 14:25:51 FP0101 Process = Checkpoint CIO_DB 000015 -
Checkpoint to Flash Requested
2007-10-17 14:25:51 FP0101 Process = Checkpoint CIO_DB 000015 -
Wait For Message 'Checkpoint installed into flash'
2007-10-17 14:26:33 FP0101 Software Manager SYSMON -00021
Checkpoint Successful
2007-10-17 14:26:35 FP0101 Process = Self Hosting RDHSS  000131 -
Checkpoint loading to Flash
2007-10-17 14:27:15 FP0101 Process = Self Hosting RDHSS  000131 -
Backup Checkpoint erased
2007-10-17 14:29:27 FP0101 Process = Self Hosting RDHSS  000131 -
Checkpoint File verified
2007-10-17 14:29:28 FP0101 Process = Self Hosting RDHSS  000131 -
Checkpoint installed into flash
```

These messages are explained in Table 4-4.

Table 4-4. SMON Log Messages Following Checkpoint Operation

Message	Definition	Meaning
`Checkpoint to Flash Requested`	This message indicates a checkpoint command has been issued and self-hosting is enabled. If self-hosting is disabled, this message will not be sent to the SMON log.	The checkpoint process has started. The checkpoint file has not been written to the Host or FCP270 flash. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The loaded checkpoint file from flash will not contain any changes that were made prior to issuing the checkpoint command.

Table 4-4. SMON Log Messages Following Checkpoint Operation (Continued)

Message	Definition	Meaning
`Wait For Message 'Checkpoint installed into flash'`	This message is a reminder to the user that the checkpoint operation will not be complete until the message "Checkpoint installed into flash" has been sent. If self-hosting is disabled, this message will not be sent to the SMON log.	The checkpoint process has started. The checkpoint file has not been written to the Host or FCP270 flash. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The loaded checkpoint file from flash will not contain any changes that were made prior to issuing the checkpoint command.
`Checkpoint Successful`	This message indicates the checkpoint file was successfully sent to the host workstation only. It is not an indication that the complete checkpoint operation is complete if self-hosting is enabled. This message is sent to the SMON log if self-hosting is enabled or disabled.	The checkpoint file has been written to the host but not the FCP270 flash. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The checkpoint file will not contain any changes that were made prior to issuing the checkpoint command. A checkpoint command should be issued to synchronize both checkpoint files. Once the checkpoint command completes, the changes will be lost. If you want to load/use the checkpoint file and contains the latest changes to the host, the flash in the FCP270 must be invalidated (that is, disable self-hosting or reconfigure the letterbug) and the FCP270 must be rebooted. This will force the FCP270 to load the checkpoint file from the host.

Table 4-4. SMON Log Messages Following Checkpoint Operation (Continued)

Message	Definition	Meaning
`Checkpoint loading to Flash`	This message indicates that the process of downloading the checkpoint file from the host to be burned into the FCP270 flash area has begun. If self-hosting is disabled, this message will not be sent to the SMON log.	The checkpoint file has been written to the host but not the FCP270 flash. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The loaded checkpoint file from flash will not contain any changes that were made prior to issuing the checkpoint command. The checkpoint file on the host and the checkpoint file in flash of the FCP270 will not match. A checkpoint command should be issued to sync up both checkpoint files. Once the checkpoint command completes, the changes will be lost. If you want to load/use the checkpoint file that contains the latest changes from the host, the flash in the FCP270 must be invalidated (that is, disable self-hosting or reconfigure the letterbug) and the FCP270 must be rebooted. This will force the FCP270 to load the checkpoint file from the host.
`Backup Checkpoint erased`	The flash area that is to receive the new checkpoint file has been erased and is ready for the checkpoint file to be burned. If self-hosting is disabled, this message will not be sent to the SMON log.	The checkpoint file has not been written to the FCP270 flash. The area that is to receive the checkpoint file has been erased but the previous area still contains a valid checkpoint file. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The loaded checkpoint file from flash will not contain any changes that were made prior to issuing the checkpoint command. The checkpoint file on the host and the checkpoint file in flash of the FCP270 will not match. A checkpoint command should be issued to sync up both checkpoint files. Once the checkpoint command completes, the changes will be lost. If you want to load/use the checkpoint file that contains the latest changes from the host, the flash in the FCP270 must be invalidated (that is, disable self-hosting or reconfigure the letterbug) and the FCP270 must be rebooted. This will force the FCP270 to load the checkpoint file from the host.

Table 4-4. SMON Log Messages Following Checkpoint Operation (Continued)

Message	Definition	Meaning
`Checkpoint File verified`	The checkpoint file has been burned to flash and has been verified that it is an exact copy of the checkpoint file on the host workstation. The checkpoint file in flash will be marked as valid. If self-hosting is disabled, this message will not be sent to the SMON log.	The checkpoint file has been written to the FCP270 flash and marked valid. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The checkpoint file will contain all changes that were made prior to issuing the checkpoint command. The checkpoint file on the Host and the checkpoint file in flash of the FCP270 are identical.
`Checkpoint installed into flash`	The checkpoint operation is complete. The checkpoint file has been sent to the host workstation and burned into the FCP270 flash.	The checkpoint file has been written to the FCP270 flash and marked valid. If the FCP270 is rebooted after this message, the FCP270 will load the checkpoint file out of flash. The checkpoint file will contain all changes that were made prior to issuing the checkpoint command. The checkpoint file on the Host and the checkpoint file in flash of the FCP270 are identical.

NOTE

If self-hosting is enabled, the message “Checkpoint Successful” only indicates that the checkpoint file has been sent to the host workstation. If a station reboot were to occur prior to the message “Checkpoint installed into flash”, the newest checkpoint file would not be burned in the FCP270 flash. Always wait for the message “Checkpoint installed into flash” to ensure the latest checkpoint file is burned correctly into the FCP270 flash area.

Checkpoint Invalidation in Self-Hosting FCP270

There are some conditions that exist that will result in the checkpoint in flash to be invalidated. An invalid checkpoint file in flash results in the FCP270 loading the checkpoint file from the host workstation on reboots.

The following is a list of conditions that result in the checkpoint file in flash to be invalidated:

- If the letterbug of an FCP270 is changed, the checkpoint file in flash is invalidated. This ensures the checkpoint file from the host workstation is loaded and not a leftover checkpoint file in flash.
- If an FCP270 in self-hosting mode fails to load the checkpoint file from flash successfully, the checkpoint file in flash is invalidated. The failure of the checkpoint file to load from flash properly indicates there is some form of corruption on the database. The station will be rebooted forcing the FCP270 to load the checkpoint file from the host workstation.
- If an FCP270 with a valid checkpoint file in flash marries into a Single Primary FCP270 operating with self-hosting disabled, the newly booted module will invalidate the checkpoint file in flash and reboot to complete the marriage. This prevents that

module from loading the checkpoint file from flash in the event the station is rebooted causing that module to come up as the primary module.

- If an On-line Image Update or Image Update operation is performed, the checkpoint file in flash is invalidated forcing the checkpoint file to be loaded from the host workstation. Only after the On-line Image Update or Image Update operation is complete will the checkpoint file be burned to flash.
- If one module of a fault-tolerant pair fails to burn to flash successfully and the other module successfully burns to flash memory, the module that fails to burn to flash will invalidate the checkpoint in flash and go off-line. The module that successfully burns to flash will switch to Single Primary mode and send a message to the SMON log indicating why the other module went off-line.
- If both modules of a fault-tolerant pair fail to burn to flash successfully, both modules will invalidate the checkpoint in flash and send a message to the SMON log. The station will continue to run fault-tolerant.
- If a Single Primary module fails to burn to flash successfully, the module will invalidate the checkpoint in flash and send a message to the SMON log. The station will continue to run single.
- If one side of a fault-tolerant pair goes off-line while running in self-hosting mode, the off-line modules flash will be invalidated the next time the Single Primary module performs a checkpoint.

If any of the above conditions occurred and:

- a checkpoint command is issued before the station has been rebooted, there will be an attempt to burn the checkpoint file to the flash of the FCP270 if self hosting is enabled.
- the station is rebooted before a checkpoint command is issued, the checkpoint file will be loaded from the host workstation. In addition, if self hosting is enabled, a checkpoint command will be automatically issued after the Database Download is complete. This will result in the checkpoint file getting burned to flash.

These actions can prevent an incorrect checkpoint file from being loaded.

System Management Displays – Primary ECB (FBM0)

The System Management Display Handler allows you to access the following displays for FBM0, which is actually the primary ECB (ECBP), which resides in the FCP270 station.

- Equipment information
- Equipment change actions
- On-line diagnostics (PIO).

These displays reflect the current operating status of the Fieldbus and its attached devices, and provide a valuable maintenance aid by allowing you to intervene in Fieldbus operations. For information on navigating through the SMDH screens, see *System Management Displays* (B0193JC).

Equipment Information Display for Primary ECB (FBM0)

The SMDH Equipment Information display pages (Figure 4-6 and Figure 4-7) for the Primary ECB (FBM0) contain operational status, equipment change action status, device status, and power status fields. The following fields are updated when a status change occurs:

- RUN MODE
- FAIL ACK STATE
- CP POWER 1
- SWITCHING MODE
- PRIM CHK POINT
- SELF HOSTING
- DEVICE STATE
- ALARMING STATE
- ACTIVE PIO BUS
- CP POWER 2
- DIAG STATUS 1
- SHAD CHK POINT

All other fields are either static, updated when the display is recalled, or unused. Table 4-5 describes the available text fields in the order that they appear on the display pages, from left column to right column.

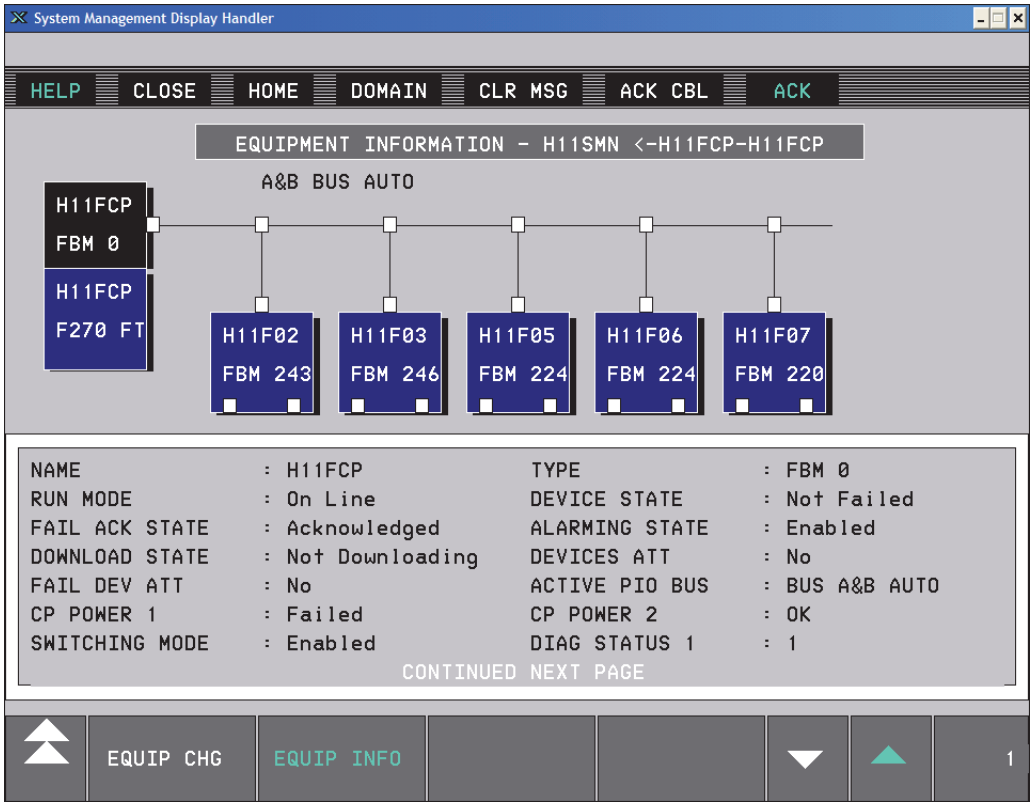


Figure 4-6. Equipment Information Display for Primary ECB (FBM0) – Typical (1 of 2)

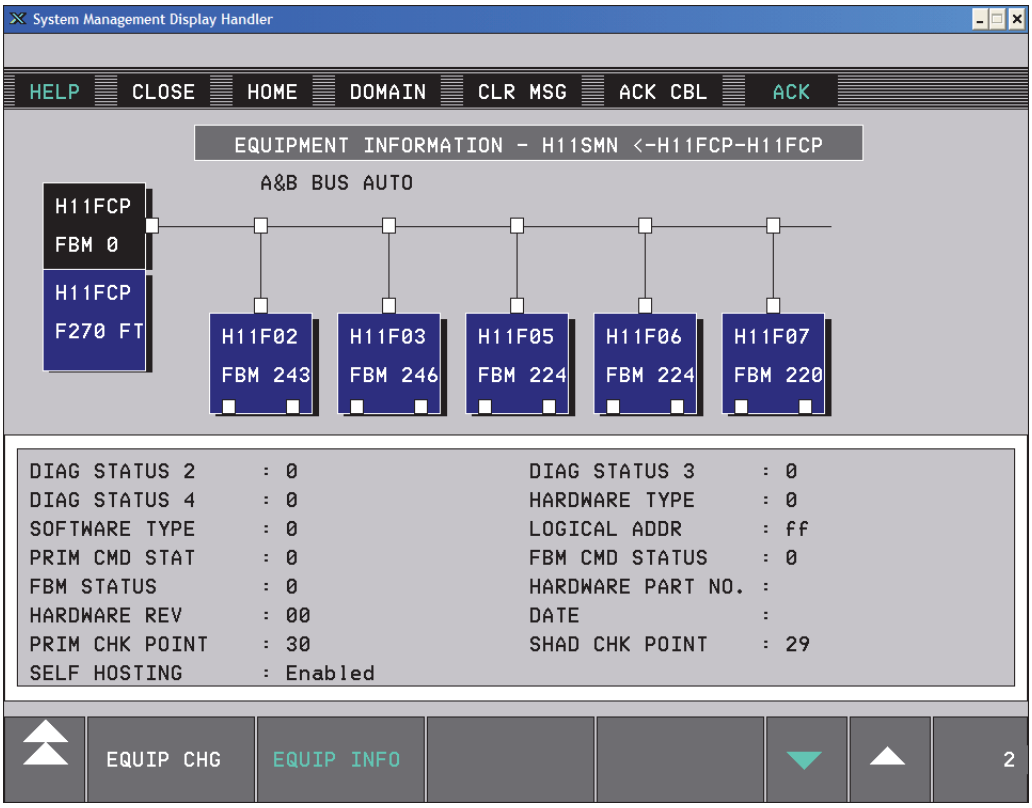


Figure 4-7. Equipment Information Display for Primary ECB (FBM0) – Typical (2 of 2)

Table 4-5. Equipment Information Display Fields for Primary ECB (FBM0)

Field	Description
NAME	The letterbug of the FCP270 in which the primary ECB (FBM 0) is located.
RUN MODE	On-line or Off-line. The primary ECBP is installed as On-line after it is configured. For the primary ECB (FBM0) located in an FCP270, changing the FBM0 status to Off-line stops all communication to the Fieldbus. Subsequently, all attached FBMs fail. As a result, a number of messages appear at the printer indicating communication failures and peripheral equipment failures. Changing an FBM status to Off-line causes communications to that specific device to stop. You can change the RUN MODE using the GO ON-LINE and GO OFF-LINE options in the Equipment Change Display. If station reporting is disabled, the last known run state appears in this field. The system updates this field when a status change occurs.
FAIL ACK STATE	Displays Acknowledged (default) or Not Acknowledged. If the DEVICE STATE value changes from Not Failed to Failed, the value in this field changes to Not Acknowledged. Click ACK in this display to acknowledge the selected faulted device; or click ACK ALL in the initial system management display to acknowledge all unacknowledged devices for which the workstation is responsible. The system updates this field when a status change occurs. Not Acknowledged Status: Check printed/historical log for type of failure. To clear, click ACK or ACK ALL on the configured application workstation (AW).
DOWNLOAD STATE	This field does not apply to FBM0. It displays “Not Downloading”.
FAIL DEV ATT	This field does not apply to FBM0. It displays “No”.
CP POWER 1	OK or Failed indicates the state of primary power to FCP270.
SWITCHING MODE	Displays Enabled (default) or Not Enabled. If Enabled, automatic switching can occur in the event of a bus fault for the BUS AUTO SELECT mode. You can change this field to Not Enabled by selecting SELECT BUS A ONLY or SELECT BUS B ONLY in the Equipment Change Display.
DIAG STATUS 2	This field does not apply to FBM0. It displays “0”.
DIAG STATUS 4	This field does not apply to FBM0. It displays “0”.
SOFTWARE TYPE	This field does not apply to FBM0. It displays “0”.
PRIM CMD STAT	This field does not apply to FBM0. It displays “0”.
FBM STATUS	This field does not apply to FBM0. It displays “0”.
HARDWARE REV	This field does not apply to FBM0. It displays “00”.
SERIAL NUMBER	This field does not apply to FBM0.

Table 4-5. Equipment Information Display Fields for Primary ECB (FBM0) (Continued)

Field	Description
EEPROM REV	This field does not apply to FBM0.
TYPE	FBM0 represents the primary ECB.
DEVICE STATE	The system updates this field when a status change occurs. The possible mutually exclusive states are: ♦ Not Failed: The device is healthy. ♦ On Scan: The device is connected to the control strategy, though measurements are not guaranteed to be good. ♦ Comm Failures: No real device information is available. ♦ Failed: Fatal hardware or other fatal fault reported by the device. Presupposes that communication has not failed. ♦ Not Ready: A transition state. The device is healthy and normal automatic start-up procedures are bringing the device On Scan. ♦ Out of Service: The device is healthy, but is operating in a mode incompatible with its normal control functions.
ALARMING STATE	Indicates whether alarming is enabled or inhibited for this device. When alarming is inhibited, the System Monitor continues to indicate overall system and network health while equipment is failed or off-line, and any system alarm messages are not logged to the system printer or to the Historian. The system updates this field when a status change occurs. Not Responding or Not Acknowledged status: Check the hardware.
DEVICES ATT	This field does not apply to FBM0. It displays “No”.
ACTIVE PIO BUS	Indicates the current Fieldbus, either BUS A ONLY, BUS B ONLY, or BUS A & B AUTO. This value is set initially to BUS A ONLY or to the value saved in the checkpoint file. If SWITCHING MODE is enabled, this field updates automatically if you switch communications on the current Fieldbus to the other Fieldbus. BUS A & B AUTO indicates that both Bus A and Bus B are active, and the FCP270 determines which bus to use for each transaction.
CP POWER 2	OK or Failed indicates the state of secondary power to FCP270.
DIAG STATUS 1	Indicates CP Power status: 0 = CP Power 1 okay & CP Power 2 okay 1 = CP Power 1 Failed 2 = CP Power 2 Failed
DIAG STATUS 3	This field does not apply to FBM0. It displays “0”.
HARDWARE TYPE	This field does not apply to FBM0. It displays “0”.
LOGICAL ADDR	This field does not apply to FBM0. It displays “ff”.
FBM CMD STATUS	This field does not apply to FBM0. It displays “0”.
HARDWARE PART NO.	This field does not apply to FBM0.
DATE	This field does not apply to FBM0.
SOFTWARE REV	This field does not apply to FBM0.

Table 4-5. Equipment Information Display Fields for Primary ECB (FBM0) (Continued)

Field	Description
PRIM CHK POINT	Indicates the number of flash write operations which have occurred to the primary module's flash memory.
SHAD CHK POINT	Indicates the number of flash write operations which have occurred to the shadow module's flash memory.
SELF-HOSTING	Indicates the station mode - "Disabled" (default) or "Enabled".

Equipment Change Display for Primary ECB (FBM0)

You can use the SMDH Equipment Change display (Figure 4-8) for the Primary ECB (FBM0) to perform equipment change actions on Fieldbus communications and FBMs attached to the Fieldbus. Only workstations designated (during System Monitor configuration) to perform secured actions on this FCP270 can access the equipment change actions for FBM0. Table 4-6 describes the actions that are available for this display.

In Figure 4-8, the following fields are not used:

- DOWNLOAD
- EEPROM UPDATE
- RESET ATTENTION BIT
- SWITCH ROLES

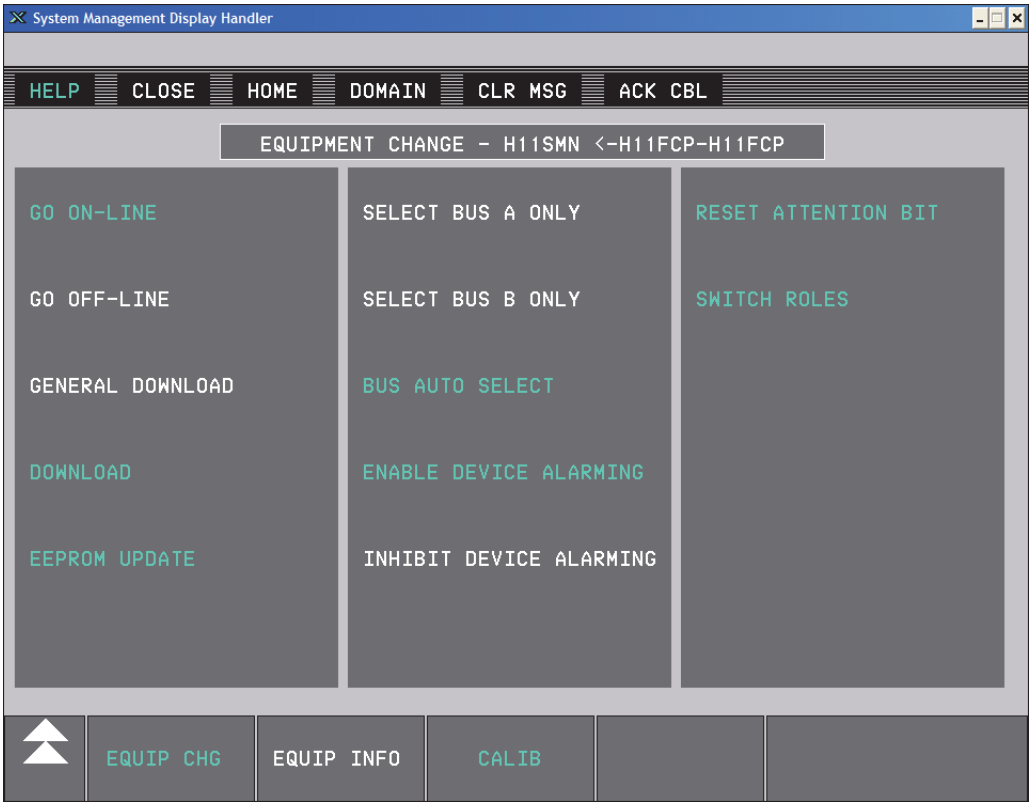


Figure 4-8. Equipment Change Display for Primary ECB (FBM0)

⚠ CAUTION

Only designated personnel who are aware of the effects of making equipment changes should initiate equipment changes.

Table 4-6. Equipment Change Display Fields for Primary ECB (FBM0)

Action	Description
GO OFF-LINE	Stops all communication to the Fieldbus, which causes all attached FBMs to fail. As a result, a number of messages appear at the printer indicating communication failures and peripheral equipment failures. It is recommended that you place an FBM0 off-line for diagnostic purposes only.
GO ON-LINE	Starts Fieldbus communication to all attached FBMs. The system sends a message to the designated printer.
GENERAL DOWNLOAD	Downloads FBM images for all off-line/failed FBMs attached to the selected FCP270. Use GENERAL DOWNLOAD when you add a new FBM to the FCP270 and the FBM data is not already in the checkpoint file. Typically, you use GENERAL DOWNLOAD action to download FBM images after you perform integrated control configuration on each of the new FBMs.
SELECT BUS A ONLY	Designates Fieldbus A as the current bus and deactivates automatic switching. If the selected bus is not available or is not functioning, the previous bus selection is maintained. If there is an error, the system displays a message.
SELECT BUS B ONLY	Designates Fieldbus B as the current bus and deactivates automatic switching. If the selected bus is not available or is not functioning, the previous bus selection is maintained. If there is an error, the system displays a message.
BUS AUTO SELECT	Automatically switches between Fieldbus A and B. The FCP270 determines which bus to use for each transaction. If the selected bus is not available or is not functioning, the previous bus selection is maintained. If there is an error, the system displays a message.
ENABLE DEVICE ALARMING	Enables device alarming from FBMs attached to the Fieldbus. System alarm messages are logged to the system printer or Historian.
INHIBIT DEVICE ALARMING	Prohibits device alarming for FBMs attached to the Fieldbus. When you select to prohibit alarming, the system filters alarm conditions so that the System Monitor continues to indicate overall system and network health while equipment is failed or off-line. While alarming is prohibited, system alarm messages are not logged to the system printer or the Historian.

— NOTE

For more information and procedures for performing equipment change actions, refer to *System Management Displays* (B0193JC).

Overview of Fieldbus Switching Mode

The FCP270 records the number of FBM access failures per Fieldbus A and/or B and determines whether switching occurs. The system checks the other bus (cable) to eliminate switching to a bad or worse bus.

The following scenarios can occur:

- If the current Fieldbus has a failure(s) and the other bus has fewer or no failures, the station automatically switches to the better bus if the BUS AUTO SELECT mode is selected.
- If both buses have an equal number of FBM access failures, the station continues transmission over the existing bus if the BUS AUTO SELECT mode is selected.
- If SELECT BUS A ONLY or SELECT BUS B ONLY are selected the station attempts to continue transmission over the selected bus regardless of the failure.

Using the Fieldbus Switching Options

There are three Fieldbus switching options available from the Equipment Change Display.

To automatically switch between Module Fieldbus A and B:

- In the Equipment Change Display, click **BUS AUTO SELECT**. Both Bus A and Bus B are active, and the FCP270 determines which bus to use for each transaction. If the selected bus is not available or is not functioning, the previous bus selection is maintained. If there is an error, the system displays a message.

To designate Fieldbus A as the current bus and deactivate automatic switching:

- In the Equipment Change Display, click **SELECT BUS A ONLY**. The system does not check the current health of the bus. The system displays a message if an error occurs.

To designate Fieldbus B as the current bus and deactivate automatic switching:

- In the Equipment Change Display, select **SELECT BUS B ONLY**. The system does not check the current health of the bus. The system displays a message if an error occurs.

Use the **SELECT BUS A ONLY** or **SELECT BUS B ONLY** switching actions for diagnostic purposes, or when only one bus is available (such as when you are replacing a defective cable or Modular Baseplate).

Overview of the General Download

The GENERAL DOWNLOAD action downloads FBM images for all off-line/failed FBMs attached to a selected FCP270. This action is available from the primary FBM (FBM0) for the FCP270.

Use the GENERAL DOWNLOAD action when you add a new FBM to the FCP270 and the FBM data is not already in the checkpoint file. Typically, you use the GENERAL DOWNLOAD action to download FBM images after you perform integrated control configuration on each of the new FBMs.

If the file information in the station already includes the selected FBM data (that is, checkpointing was performed while the FBMs were on-line), downloading occurs automatically, when necessary.

Downloading all FBM Images

You can download FBM images for all off-line, failed FBMs attached to a selected FCP270 from the Equipment Change display. This option applies to the primary FBM (FBM0) for the FCP270.

To download FBM images for all off-line/failed FBMs:

1. In the SMDH Equipment Change display, select **GENERAL DOWNLOAD**. This loads the FBM images to all off-line/failed FBMs.

   Messages indicating the success or failure of the action for each downloaded FBM appear. If the GENERAL DOWNLOAD action is successful, each FBM goes on-line. If there is a failure, the system displays a "Not Responding" message.

2. If you use the GENERAL DOWNLOAD action during initial start-up, perform a checkpoint from the FCP270 after downloading to all the FBMs. This preserves the on-line state of the FBMs in the checkpoint file. See CHECKPOINT COMMAND in Table 4-3 on page 54.

On-Line Diagnostics (PIO) Display for Primary ECB (FBM0)

You can use the SMDH On-line Diagnostics (PIO) display (Figure 4-9) for the Primary ECB (FBM0) to inhibit or enable PIO bus (Fieldbus) cable alarms. Only workstations designated (during System Monitor configuration) to perform secured actions on this FCP270 can access the on-line diagnostics actions for FBM0. Table 4-7 describes the actions that are available for this display.

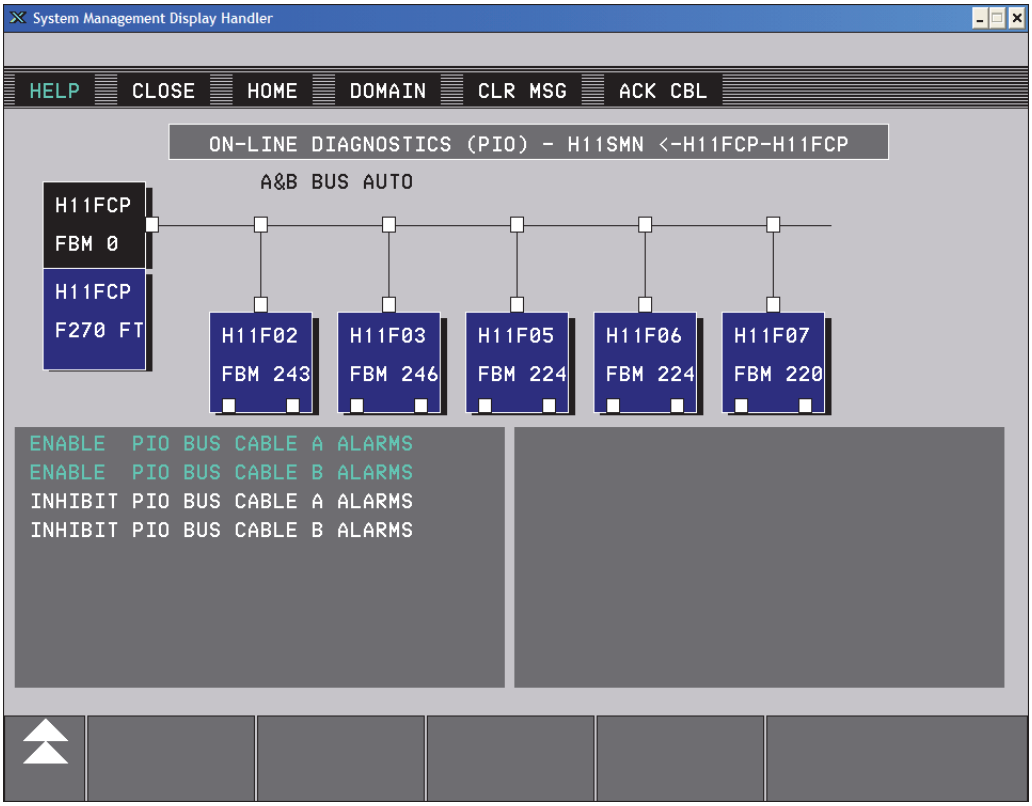


Figure 4-9. On-line Diagnostics Display for Primary ECB (FBM0)

⚠ CAUTION

Only designated personnel who are aware of the effects of running on-line diagnostics should initiate diagnostic actions.

Table 4-7. Equipment Change Display Fields for Primary ECB (FBM0)

Action	Description
ENABLE PIO BUS CABLE A ALARMS	Enables PIO Bus A (Fieldbus A) cable alarms to monitor cable faults. System alarm messages are logged to the system printer or Historian.
ENABLE PIO BUS CABLE B ALARMS	Enables PIO Bus B (Fieldbus B) cable alarms to monitor cable faults. System alarm messages are logged to the system printer or Historian.
INHIBIT PIO BUS CABLE A ALARMS	Prohibits PIO Bus A (Fieldbus A) cable alarms. System alarm messages are not logged to the system printer or Historian.
INHIBIT PIO BUS CABLE B ALARMS	Prohibits PIO Bus B (Fieldbus B) cable alarms. System alarm messages are not logged to the system printer or Historian.

NOTE

For more information and procedures for performing on-line diagnostic actions, refer to *System Management Displays* (B0193JC).

5. Troubleshooting

This chapter describes possible FCP270 failure situations and provides diagnostic routines that allow you to locate and resolve unit failures quickly.

Overview

In most cases, problems occur because the controller is misconfigured or there are faulty network connections. In the event of a true hardware failure, the Foxboro Evo maintenance approach is oriented toward module replacement. Any module can be replaced without affecting the operation of any other module, including the other module of a fault-tolerant pair.

The Station Block displays provide information to help you evaluate FCP270 performance. For more information, refer to *Integrated Control Block Descriptions* (B0193AX) and *Process Operations and Displays* (B0700BN).

LED Indicators, Reset Button, and Infrared Ports

Light-emitting diodes (LEDs) on the front of the FCP270 module (Figure 5-1) provide visual indication of the module's operational status and transmit/receive communications activity of The MESH control network A and B links. The red Reset button enables you to restart the FCP270. The infrared communication ports enable you to assign or read the controller letterbug and read controller status information using the I/A Series system Letterbug Configurator. Table 5-1 describes these LEDs and controls.

The control network path Tx LEDs indicate which controller is primary as well as the network path it is using; these LEDs are only active on the primary module.

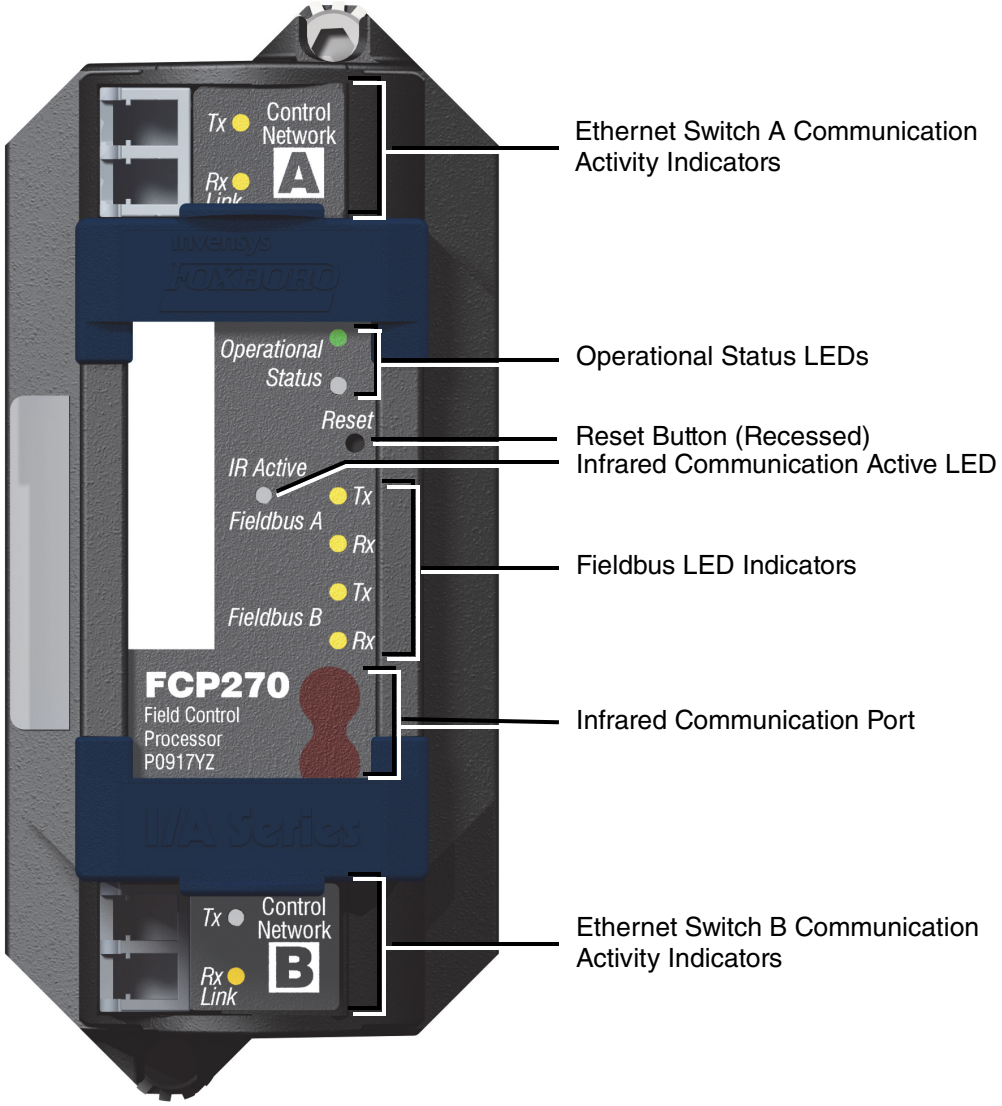


Figure 5-1. FCP270 LED Indicators, Reset Button, and Infrared Port

Table 5-1. FCP270 LED Indicators, Reset Button, and Infrared Communication Ports

Item	Description
The MESH Control Network A or B Tx	LED is on when the primary controller is transmitting data over control network A or B. LED is active only on the primary controller.
The MESH Control Network A or B Rx/Link	LED is blinking when the controller is receiving data over control network A or B. The LED is on when the link is established. If the LED is off for more than 1 s, the link is broken.
Green and Red Operational Status LEDs	LEDs indicate the health of the controller. See “Using the Operational Status LEDs” on page 76.

Table 5-1. FCP270 LED Indicators, Reset Button, and Infrared Communication Ports (Continued)

Item	Description
Reset Button	Resets the controller. The controller's database is reloaded from the boot host workstation or from the primary module.
IR Active LED	LED is on when the I/A Series system Letterbug Configurator is communicating with the controller to assign, modify or read its letterbug.
Fieldbus A or B Tx	LED is on when the primary controller is transmitting data over fieldbus A or B. LED is active only on the primary controller.
Fieldbus A or B Rx	LED is on when the controller is receiving data over fieldbus A or B.
Infrared communication port	Enables assigning, modifying or reading the controller letterbug and reading controller status information using the handheld Letterbug Configurator.

Operational Status LED Indicators

The Operational Status LEDs (red and green) on the front of the FCP270 indicate the module's operational status. Table 5-2 describes the operational conditions indicated by these LEDs.

Table 5-2. FCP270 Operational Status LEDs

Red LED	Green LED	Status
OFF	ON	Module is on-line and functional. (This is the normal run state.)
OFF	OFF	No power, or a fault exists in which the green or red LED is not turned on.
ON	ON	Start-up, or a fault exists in which the green LED is not turned off. On power-up, the default condition of both LEDs is on. Once the system is running, software turns off the red LED.
ON	OFF	Module is in failed state, or it is running on-line diagnostics during boot up.

FCP270 Troubleshooting

The following troubleshooting information is intended as a service guide for some of the most commonly encountered system problems. Problems that surface in many cases are faults associated with communication paths (cables, connectors, internal data and power buses, and so forth). At the module (FCP270) level, the quickest way to determine and correct the problem is by replacement. When spare parts are not available, the following checks may provide a practical approach.

⚠ CAUTION

1. Do not attempt to repair modules in the field!
2. To reboot the FCP270, use System Management displays if possible.

Using the Operational Status LEDs

The Operational Status LEDs (red and green) on the front of the FCP270 (see Figure 5-1) indicate the module's operational status.

Red off, Green off

When the red and green LEDs are off, this typically indicates loss of dc power. Perform the following checks. (These checks need not be followed in order.)

1. If other module(s) in the modular baseplate are operating correctly, then:
   - Cycle power to the failed FCP270 module off then on by pulling the module from the baseplate and pushing the module back on the baseplate. Make sure you unscrew the two self-retaining hex screws on the module before pulling the module from the baseplate (see "Replacing a Failed Module" on page 79).
   - Replace the failed FCP270 module with a known good module to test that slot in the baseplate (see "Replacing a Failed Module" on page 79).
   - Remove the FCP270 module and check the connector for bent pins. For module removal procedures, see "Replacing a Failed Module" on page 79).
2. Verify that the operational status LEDs on the front of the Invensys power supply (FPS400-24) are in the normal state (green LED is on, and red LED is off).
3. Use a multimeter to verify that the dc voltage at the output connector is within the range 21.6 to 25.2 V dc. For connector pin assignments, refer to *DIN Rail Mounted Subsystem User's Guide* (B0400FA).
4. Verify that the power cable is firmly connected to the baseplate and power supply.
5. If all modules on the baseplate have failed and the Foxboro power supply is operating normally, disconnect the power cable from the power supply and baseplate, and use a multimeter to verify continuity of the cable conductors, or replace the cable. For more information, refer to *DIN Rail Mounted Subsystem User's Guide* (B0400FA).

If none of the above checks resolve the failure, you must replace the module.

Red on, Green off

When the red LED is on and the green LED is off, this indicates that the module was unable to pass the startup diagnostics. This usually indicates a hardware fault of some kind. Hardware faults are typically internal to the FCP270 module, but you can try the following tests to correct the problem:

1. Reboot the FCP270 module using either the module Reset button (see Figure 5-1) or the System Management displays (see "Reboot Station Procedure" on page 56).
2. Cycle power to the FCP270 module off then on by pulling the module from the modular baseplate and pushing the module back on the baseplate. Make sure you unscrew the two self-retaining hex screws on the module before pulling the module from the baseplate (see "Replacing a Failed Module" on page 79).

3. If the module is part of a fault-tolerant pair, replace it and verify that the new module marries successfully.

⚠ WARNING

If the failed FCP270 module is part of a fault-tolerant module pair, disconnecting the time strobe cable from the baseplate causes the primary FCP270 module on control to loose time synchronization.

4. Check for insufficient voltage, as shown in Steps 1 through 4 in the previous section.

Red on, Green on

On power-up, the default condition of both LEDs is on. Once the FCP270 module is running, software turns off the red LED. If this state persists, a processor fault probably exists. Please be patient with this state – if the module is updating its software, it may stay in the red-green state for as long as five minutes.

Processor faults can occur for several reasons when fault-tolerant modules are married, but such faults are unlikely to occur when the module is operating single.

1. Verify that the module is properly configured using System Management.
2. Check the cabling to the splitter/combiner. If married, the module can persist in the red-green state when the cables are improperly connected, for example, by swapping MESH control network A and B cables on one module.

If these steps fail to bring the green LED on and the red LED off, you must replace the module.

Cycling Red, Red/Green

When the LEDs cycle between red and red/green being on, this indicates that the probable cause is a fault on the IOC (fieldbus) side of the FCP270 module. The module passes its main processor diagnostics, then it tries to load software into the IOC. For whatever reason, this load is either failing or the cooperative diagnostics between the two processors reaches a bad conclusion. Also, the fieldbus Tx and Rx/Link LEDs probably flash once.

1. If the module is married to its fault-tolerant partner, make sure that the fieldbus cabling is properly connected to the baseplate.
2. Cycle power to the FCP270 module off then on by pulling the module from the baseplate and pushing the module back on the baseplate. Make sure you unscrew the two self-retaining hex screws on the module before pulling the module from the baseplate (see “Replacing a Failed Module” on page 79).

If these steps fail to bring the green LED on and the red LED off, you must replace the module.

Red off, Green on

When the red LED is off and the green LED is on, this indicates that the module is on-line and functional. This is the normal operating state.

Using the Ethernet Tx and Rx/Link Status LEDs

The normal idle state of the yellow TX and Rx/Link LEDs on the front of the FCP270 module (see Figure 5-1) is to have all of the Tx LEDs dark and all of the Rx/Link LEDs lit, which indicates that the fiber links are established. Every time the module transmits on any Ethernet cable, the Tx LED for that cable lights up; whenever the module receives a packet of data, the Rx/Link LED for that cable blinks.

In normal operation, you should see the LEDs start as dark. Then each of the control network and fieldbus LEDs flash in unison (diagnostics), followed by the LEDs settling into their light (Rx/Link) and dark (Tx) states. Normal operation quickly causes all of the LEDs on a primary or single module to start flashing busily. On the shadow module, the Rx/Link LEDs flashes.

If the LEDs on your module are not behaving this way:

1. There is no data being processed. Make sure that some FBMs and workstations connected to the FCP270 are on-line using System Management.
2. The cabling for that port is disconnected, broken, or otherwise compromised. Check the cable to the splitter/combiner or Ethernet switch for that port.
3. If the same LEDs are dark on both the primary and shadow modules of a married fault-tolerant module pair, check the cabling between the Ethernet switch and the splitter/combiner.

If none of the above issues caused the failure, you must replace the module.

Using the Fieldbus Tx and RX Status LEDs

The yellow Tx and Rx LEDs for Fieldbus A and B only indicate communication activity on their respective links.

In normal operation, the Tx LED is on when it is transmitting data over fieldbus A or B. The Rx LED is on when the controller is receiving data over fieldbus A or B. For a fault-tolerant FCP270, the Tx LEDs are active only on the primary module, but the Rx LEDs are active on both the primary and shadow modules.

If the LEDs on your module are not behaving this way:

1. There is no data being processed. Make sure that some FBMs and workstations connected to the FCP270 are on-line using System Management.
2. The fieldbus cabling is disconnected, broken, or otherwise compromised. Check the fieldbus cabling between baseplates and the termination cable connections between the baseplate and Termination Assemblies. For more information, refer to *DIN Rail Mounted FBM Subsystem User's Guide* (B0400FA).

If none of the above issues caused the failure, you must replace the module.

Fault-Tolerant FCP270 Troubleshooting Addenda

Fault-tolerance in the FCP270 uses software synchronization to keep the two modules executing exactly the same software, using exactly the same data. If the software is not synchronized, synchronization is restored when the primary module transmits its database to the shadow module in a sequence commonly referred to as a "hot remarry." The hot remarry is essentially the same as the initial station marriage.

— NOTE

The fault-tolerant control processor marriage is broken if five hot remarries occur within one minute. When the marriage is broken, the shadow is placed in off-line state and the message "Error Escalation Threshold has been exceeded" is printed on the system printer. You may then use the System Management Displays to reboot (restart) the shadow module.

If either module in a fault-tolerant pair fails, the failed module's red LED turns on. If this occurs, proceed with the following checks. (These checks need not be followed in order.)

1. Make sure that the FCP270's Ethernet network fiber cables are correctly connected.
2. Check for error messages at the system printer.
3. Replace the module if all else fails.

Replacing a Failed Module

To replace a failed module in an FCP270 fault-tolerant pair:

1. Disconnect the fiber optic cables from the Control Network A and B connectors on the front of the failed module. To release the LC connector latch, push on the latch with your finger until the connector springs apart slightly to an unlatched position. Then, grasp the LC connector by hand and pull it to disconnect it from the module.

— NOTE

If you grasp the connector and squeeze to unlatch it, the spring-apart action may be defeated.

2. Loosen the module base mounting screws completely using a 5/32 hex driver tool (Foxboro P/N X0179AZ).
3. Using both hands, pull on the module to remove it from the baseplate.
4. Install the new module using the appropriate procedure.

   See "Installing a Shadow FCP270 Module" on page 24.

After the new module (shadow) is installed, it automatically boots up, acquires its letterbug, image and control database from the primary module, and marries the primary module.

Available Memory Error Messages

The following error messages indicate any issues that arise with regards to the available memory in the FCP270. The available memory in a FCP270 is required not to go below 500Kb and these messages are sent to SMON when various memory thresholds (below 500Kb) are passed. They may precede various failures induced by CPs operating with reduced available memory, such as communications slow-downs, loss of connections and potential serious issues when the memory drops below 100Kb. The error messages and their thresholds are as follows:

- `Available Memory is below recommended limits` - indicates that there are less than 400Kb available
- `Available Memory far below recommended limits` - indicates that there are less than 200Kb available

- `Available Memory is critically low` - indicates that there are less than 100Kb available

Memory Dumps and Last Gasp Messages

The following sections describe memory dumps and last gasp messages.

Last Gasp Messages

Last gasp messages are a way of sending information about a failure before the FCP270 restarts. Last gasp messages contain the controller ID and error code.

In the case of a failed module within a fault-tolerant pair, the failed controller passes the last gasp message to the primary controller. The primary controller then transmits the message to a workstation. Last gasp messages from a non-fault-tolerant controller are transmitted directly.

Memory Dumps

There are two kinds of memory dumps. If the module experiences a SW error while running (such as WDT time-out or a memory violation), it saves a memory image of the FCP270 so that a thorough failure analysis can be performed. To preserve the information about this event, the controller quickly compares its code image to the code image in flash memory. Any differences are burned into the flash memory for later analysis. The failed controller also compresses and burns the entire data space into flash memory for later analysis. The controller will reboot immediately after writing the memory dump into the flash memory (elapsed time approximately 30 seconds). Upon reboot, the module sends a message to the error log indicating that it experienced a memory violation or WDT time-out.

The other kind of memory dump is when a “Forced” dump is initiated, whereby the current contents of memory are compressed and saved into flash. Forced dump analysis IS NOT useful to analyze hardware failures of RED only or RED/GREEN modules. Forced dumps erase any previous memory violation information stored in flash, so should only be initiated at the express request of Invensys development.

The memory dump information can be extracted from the controller in one of two ways.

1. The controller is replaced by another controller and its dump information extracted off-line.
2. The controller can be uploaded on-line while still running all normal control functions.

⚠ WARNING

For safety reasons, always consider the possible impact on plant operations before placing the primary FCP270 module off-line or rebooting it after the shadow module has failed.

   a. If the module was married at the time of the violation, only the information from the primary can be uploaded (the shadow module will be placed off-line during the dump upload). If the violation was in the shadow module, it must become the primary to upload the memory dump. To make the shadow module become primary, push the Reset button on the front of the current primary module or use the

SMDH Equipment Change display to reboot the primary module.

b. To initiate the dump upload from the command line prompt, execute the iaboot_upld <letterbug> command from directory opt/fox/bin/tools.

The module sends its entire flash memory contents to a 16 MB file in directory usr/fox/sp/files with the title <letterbug>_dumpX where X is a sequential number with the current dump having the greatest number.

The entire upload process takes approximately 3 minutes and its status is indicated by messages at the system printer.

Syntax

```
iaboot_upld <letterbug> action
```

where:

- *<letterbug>* = 6-character letterbug of the controller
- *action* = `U` to upload existing dump image from single/primary module. This is the command that should always be used to extract memory violation information.
- *action* = `F` to create a new dump image and restart single/shadow module

— NOTE

The “F” option forces a dump of the current module state and WILL ERASE any information from a previous memory violation. ONLY USE the “F” option when directed by Invensys Development personnel.

After successful launch of the program it issues a double-check message as follows.

If action = F:

“Create a new dump image and restart single/shadow module - enter Y/N:”

If action = U:

“Set controller to run single and upload existing dump image - enter Y/N:”

If Y (or y) is entered, a final message is issued

“Create new dump image initiated.”

or

“Upload dump initiated”

c. If the original fault occurred while the modules were married, you can now restart the off-line module, which remarries its partner. To restart the module, use the “Reboot Station Procedure” on page 56.

— NOTE

Non-fault-tolerant controllers can transmit their memory dump at any time.

Diagnostics

The FCP270 diagnostic routines are broken down into four areas as follows:

- Start-up
- Error Recovery Local
- Error Recovery Cooperative

— NOTE

There are no user scheduled diagnostics required for the FCP270.

Start-Up Diagnostics

Start-up diagnostics run every time the module is powered up or restarted. Start-up diagnostics test the basic core functionality of the module prior to running control or attempting marriage. They consist of boot flash checksum, code flash checksum, main and I/O shared memory tests, Interrupt controller tests, and other low level functionality. The start-up diagnostics complete in approximately five seconds. A failure is indicated by the Operational Status LEDs (red LED remains on and green LED remains off).

Error Recovery Local Diagnostics

Error recovery local diagnostics run at initial installation and whenever a fault is detected by the run-time mechanisms (output miscompare, sync time-out, and so forth). These diagnostics attempt to identify any faults that can be isolated to a particular controller. Examples are Ethernet port loopback tests, state sequencer tests, interrupt controller tests, shared memory tests, and I/O interface tests. A failure is indicated by the Operational Status LEDs (red LED is on and green LED is off) and by messages at the system printer.

Error Recovery Cooperative Diagnostics

Error recovery cooperative diagnostics run when a fault is detected by the run-time mechanisms (output miscompare, sync time-out, and so forth). These diagnostics tests work cooperatively to identify any faults that inhibit normal fault-tolerant operations.

If a failure is localized to a particular controller, that controller is sent to the failed state. An example of this type of failure is a detected compare logic failure. In this case, logic is that controllers A and B perform cooperative loopback tests with comparison logic enabled; controller B passes all tests and controller A fails due to a miscompare.

If a fault is detected in the mechanisms but it cannot be isolated to a particular controller, the shadow controller is sent to the off-line state. An example of this is inter-link exchange failure.

If no fault is detected then a PASSED indication is returned which results in a Hot-Remarry where all variable data from the primary controller are copied into the shadow controller.

A failure is indicated by the Operational Status LEDs (red LED is on and green LED is off) and by messages at the system printer.

Appendix A. Upgrade Diagrams

This Appendix contains cabling diagrams for upgrading various Control Processors to the FCP270.

Multiple options are available for upgrading (converting) systems containing various control processors to the FCP270 in a Foxboro Evo network. The figures in this Appendix illustrate how to perform these upgrades (conversions) to the FCP270, including their parts and cables necessary to interconnect the various modules. The illustrations are as follows:

- Figure A-2 “Converting CP10/30/40 with Local I/O to FCP270s” on page 85
- Figure A-3 “Converting CP60 with DCM10E to FCP270” on page 86
- Figure A-4 “Converting CP60 with DCM10Ef to FCP270” on page 87
- Figure A-5 “Converting CP60 with DCM10Ef with Fiber Optic Hub to FCP270” on page 88
- Figure A-6 “Converting CP60 with FBI10E and 100 Series FBMs to FCP270s” on page 89
- Figure A-7 “Converting CP60 with 200 Series DIN Rail Mounted Equipment to FCP270” on page 90
- Figure A-8 “Converting Micro-I/A Station to FCP270” on page 91
- Figure A-9 “Converting AW51/AW70 to FCP270s” on page 92

NOTE

Systems with combinations of FCM10- and DCM10-type modules are not supported.

The order in which to replace equipment when upgrading (converting) systems with the Control Processor 60 to the FCP270 is illustrated in Figure A-1 “Equipment Replacement Order for CP60-to-FCP270 Conversions” on page 84.

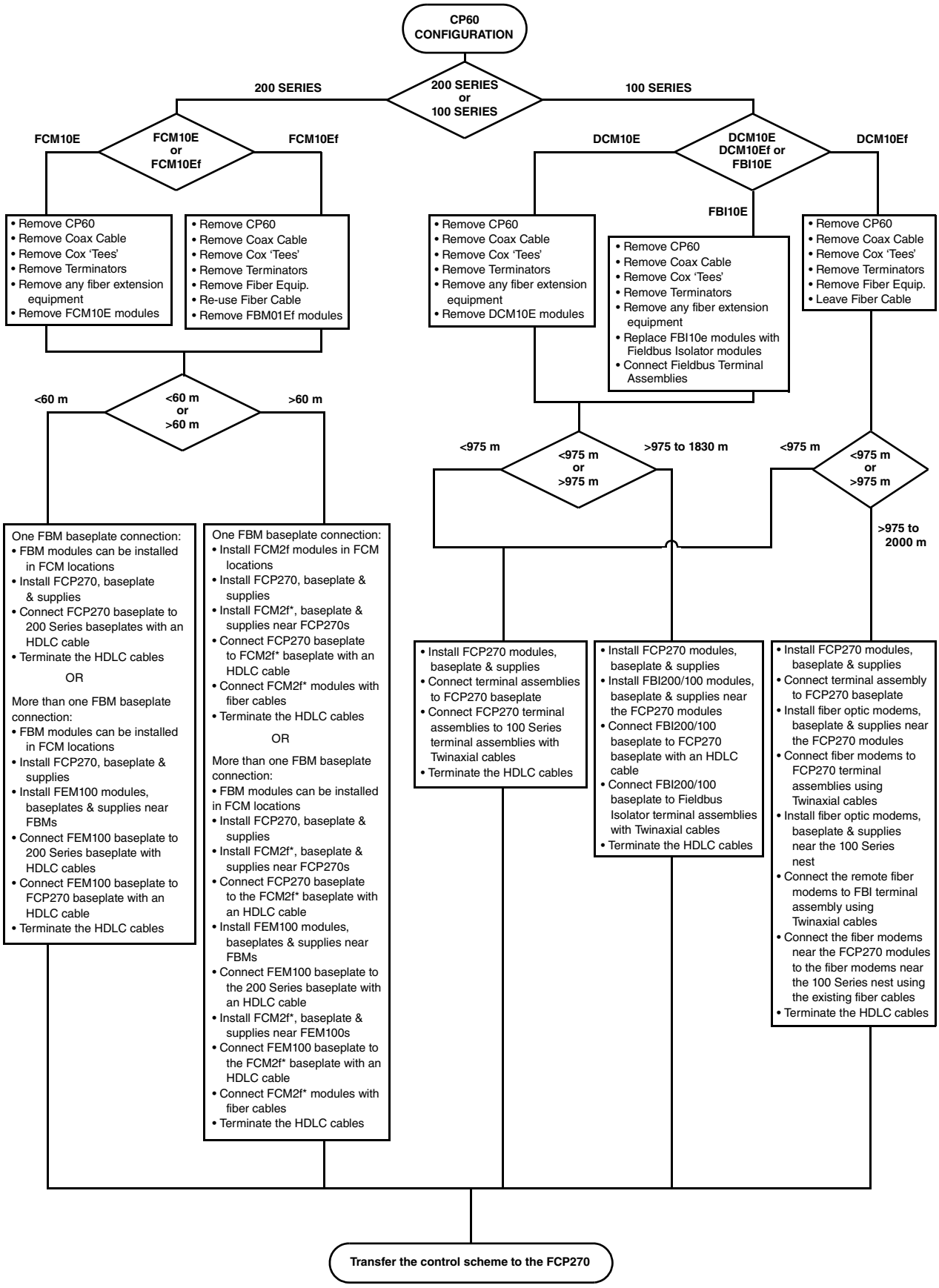


Figure A-1. Equipment Replacement Order for CP60-to-FCP270 Conversions

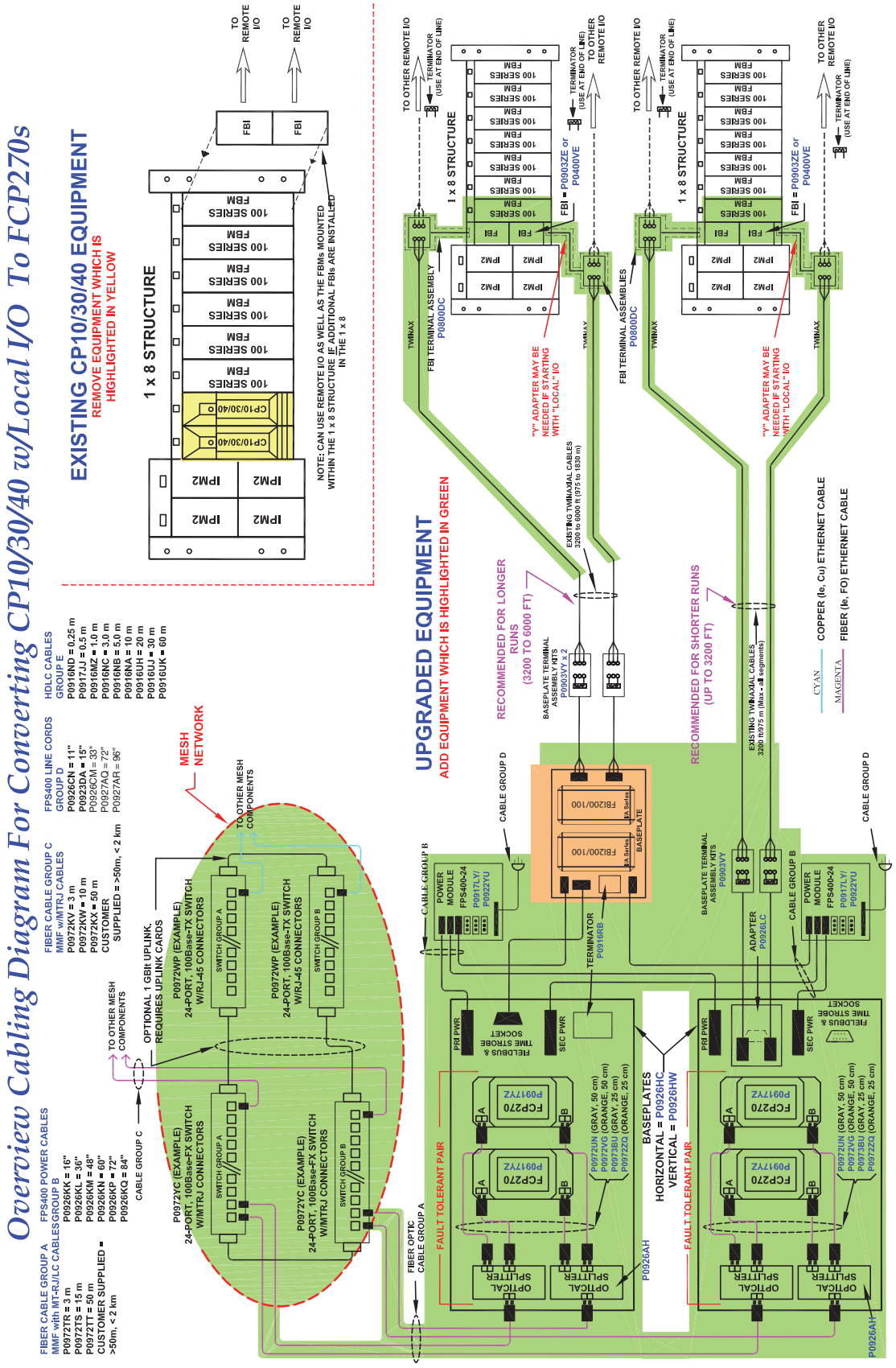


Figure A-2. Converting CP10/30/40 with Local I/O to FCP270s

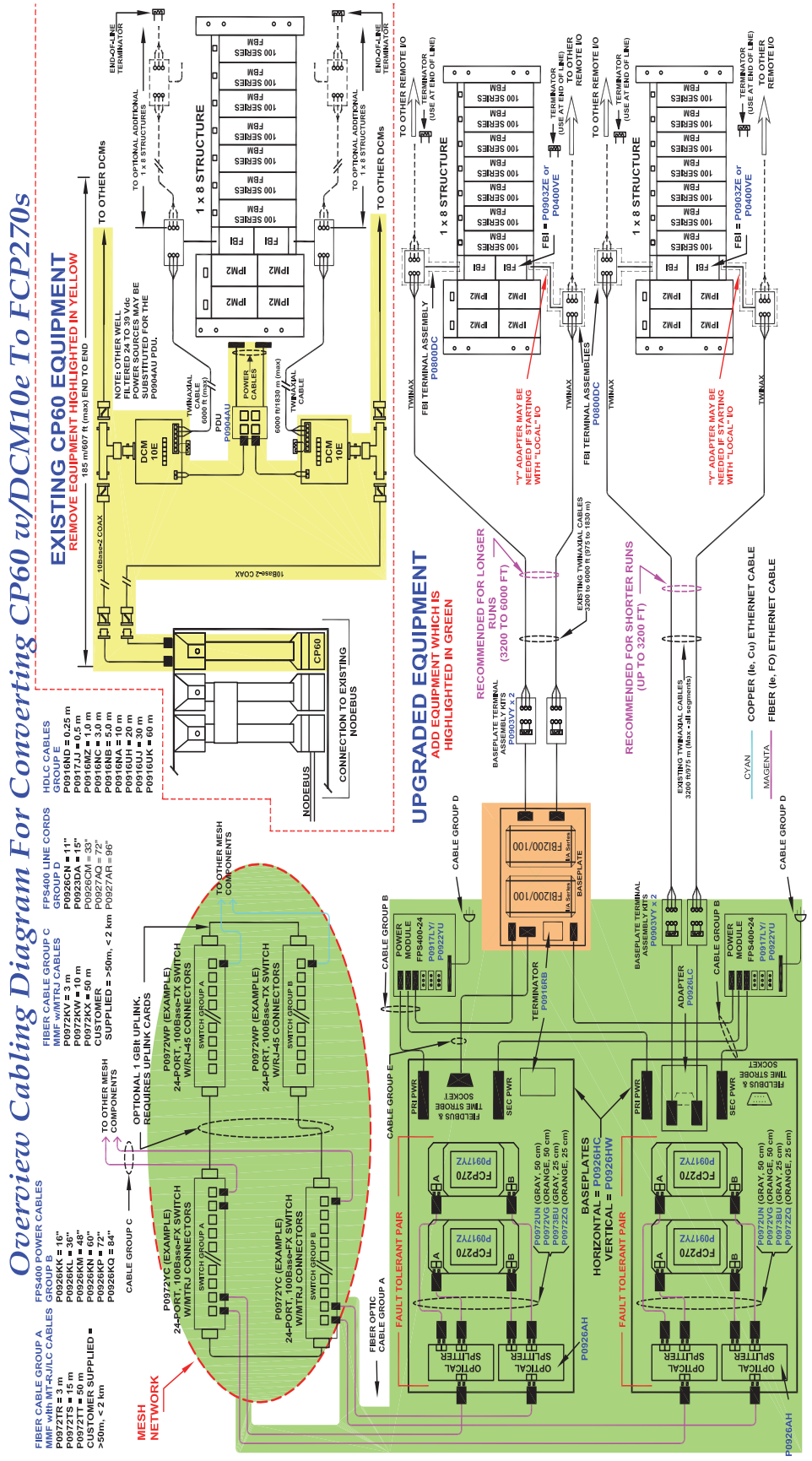


Figure A-3. Converting CP60 with DCM10E to FCP270

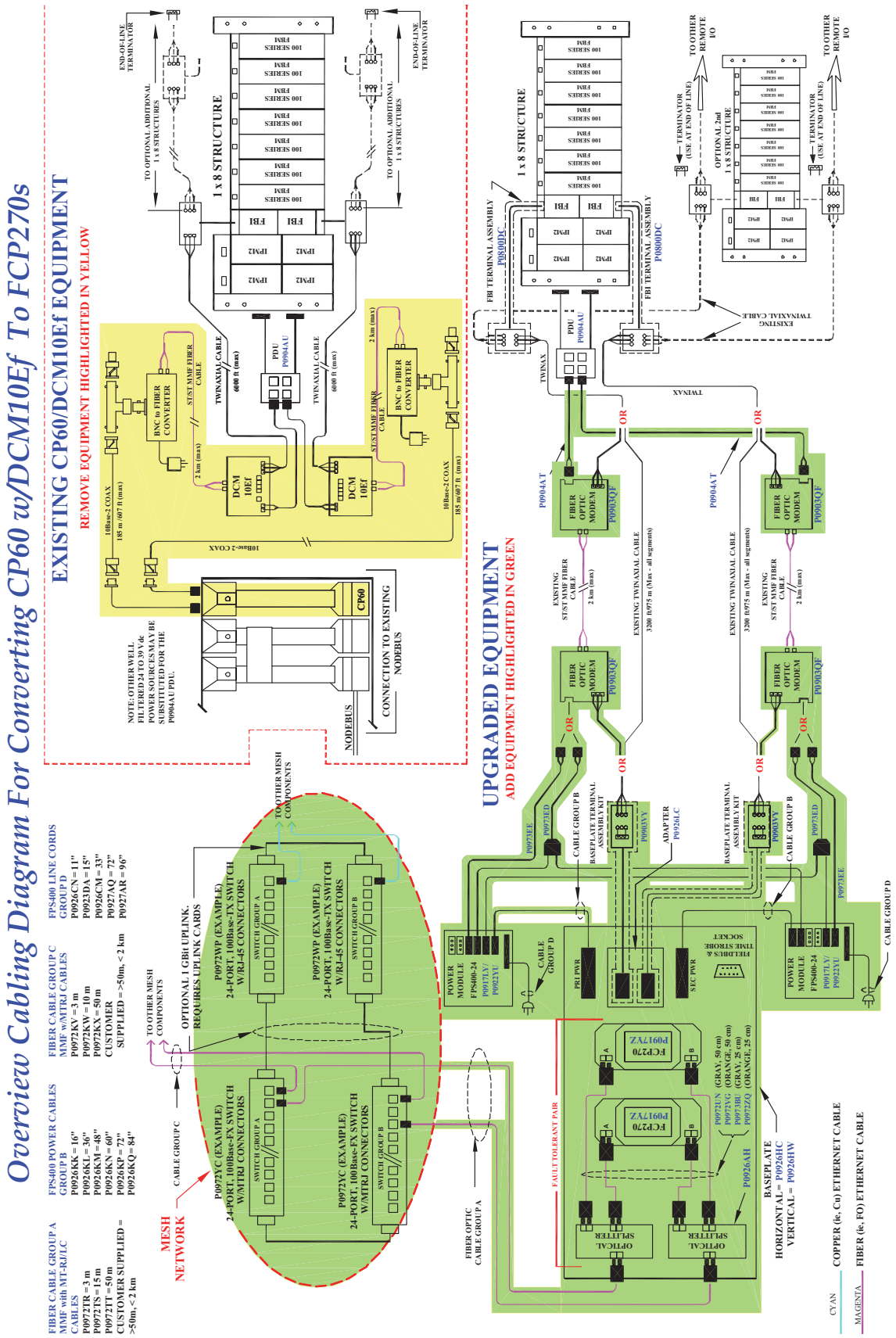


Figure A-4. Converting CP60 with DCM10Ef to FCP270

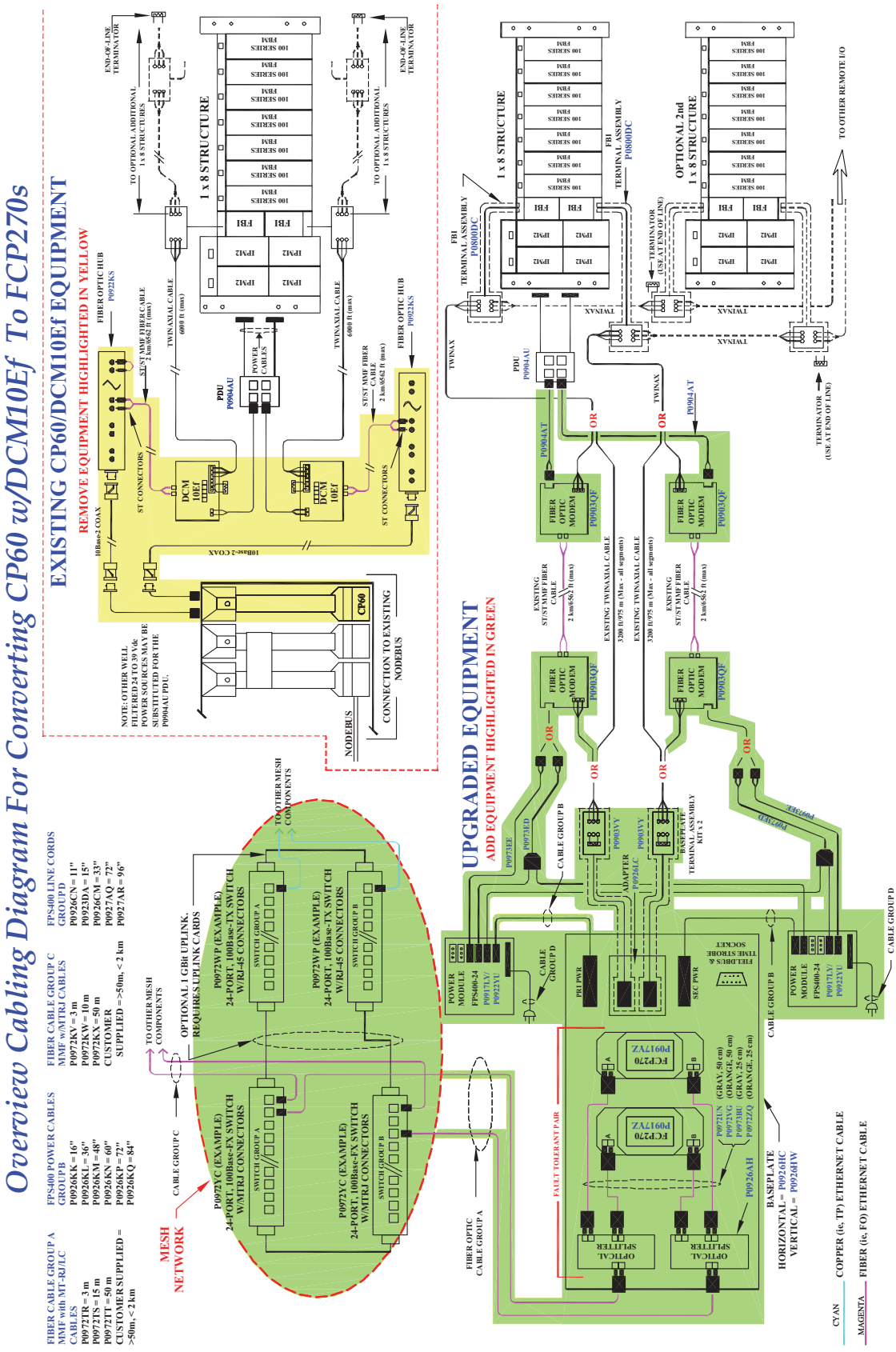


Figure A-5. Converting CP60 with DCM10Ef with Fiber Optic Hub to FCP270

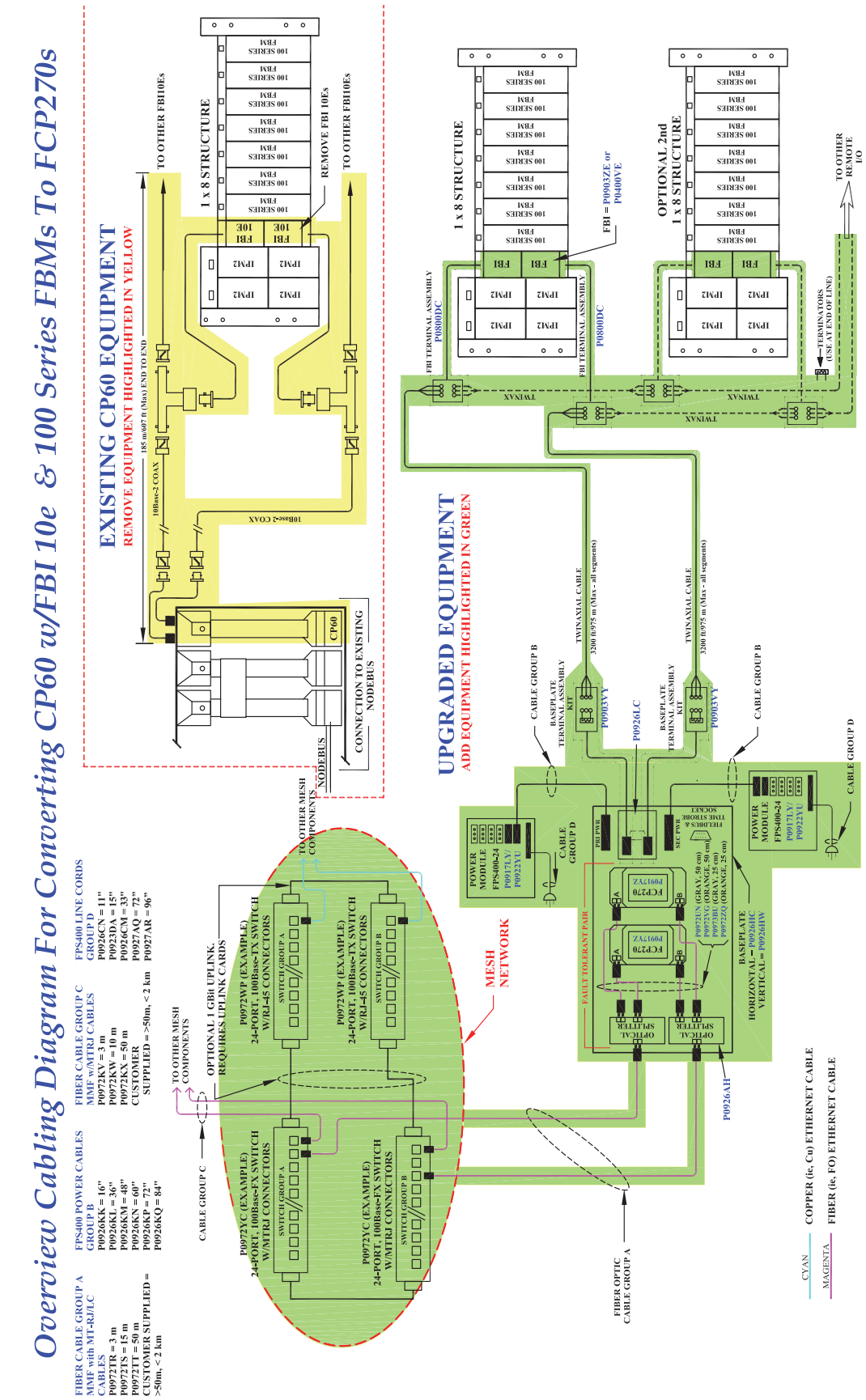


Figure A-6. Converting CP60 with FBI10E and 100 Series FBMs to FCP270s

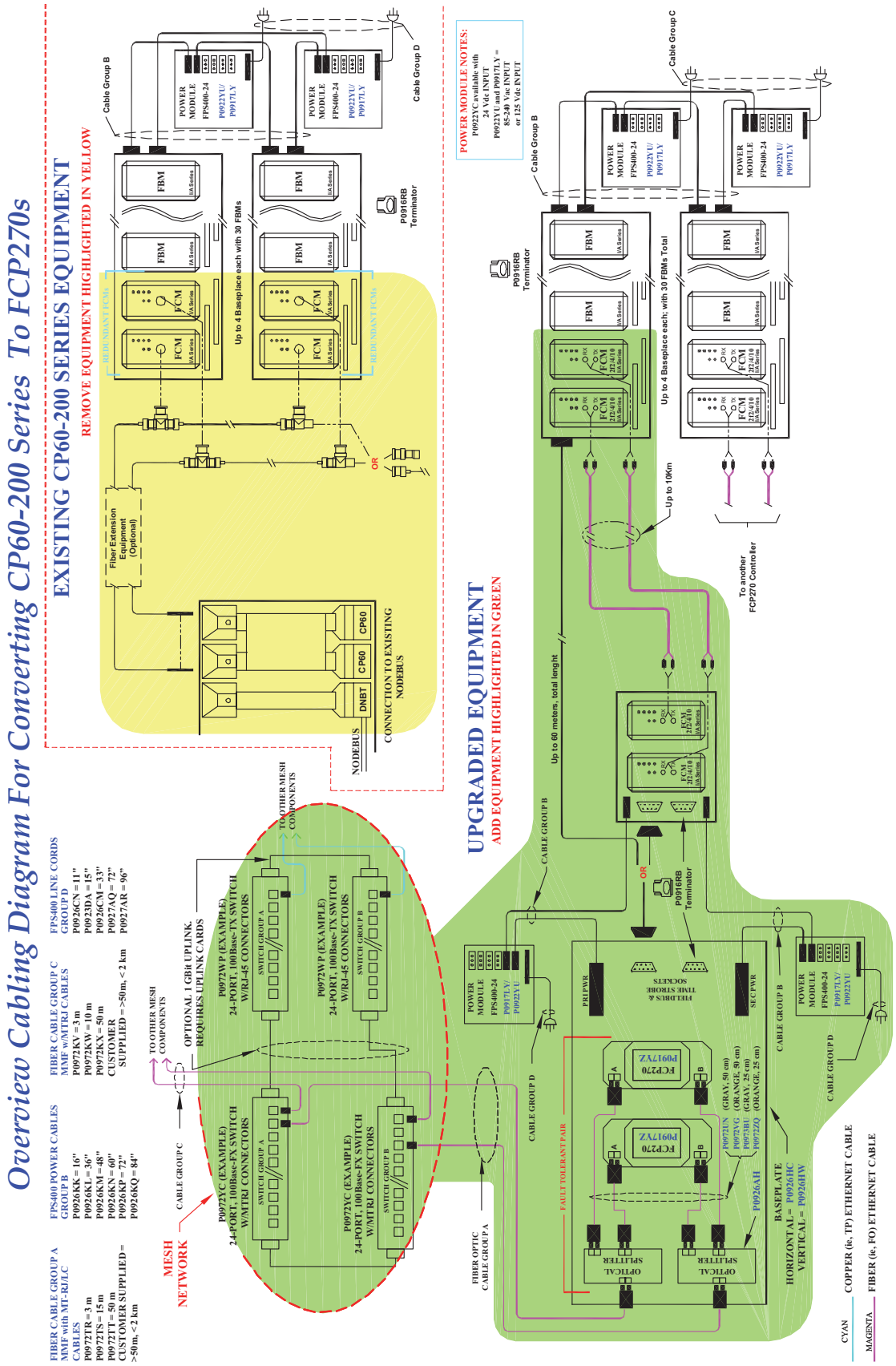


Figure A-7. Converting CP60 with 200 Series DIN Rail Mounted Equipment to FCP270

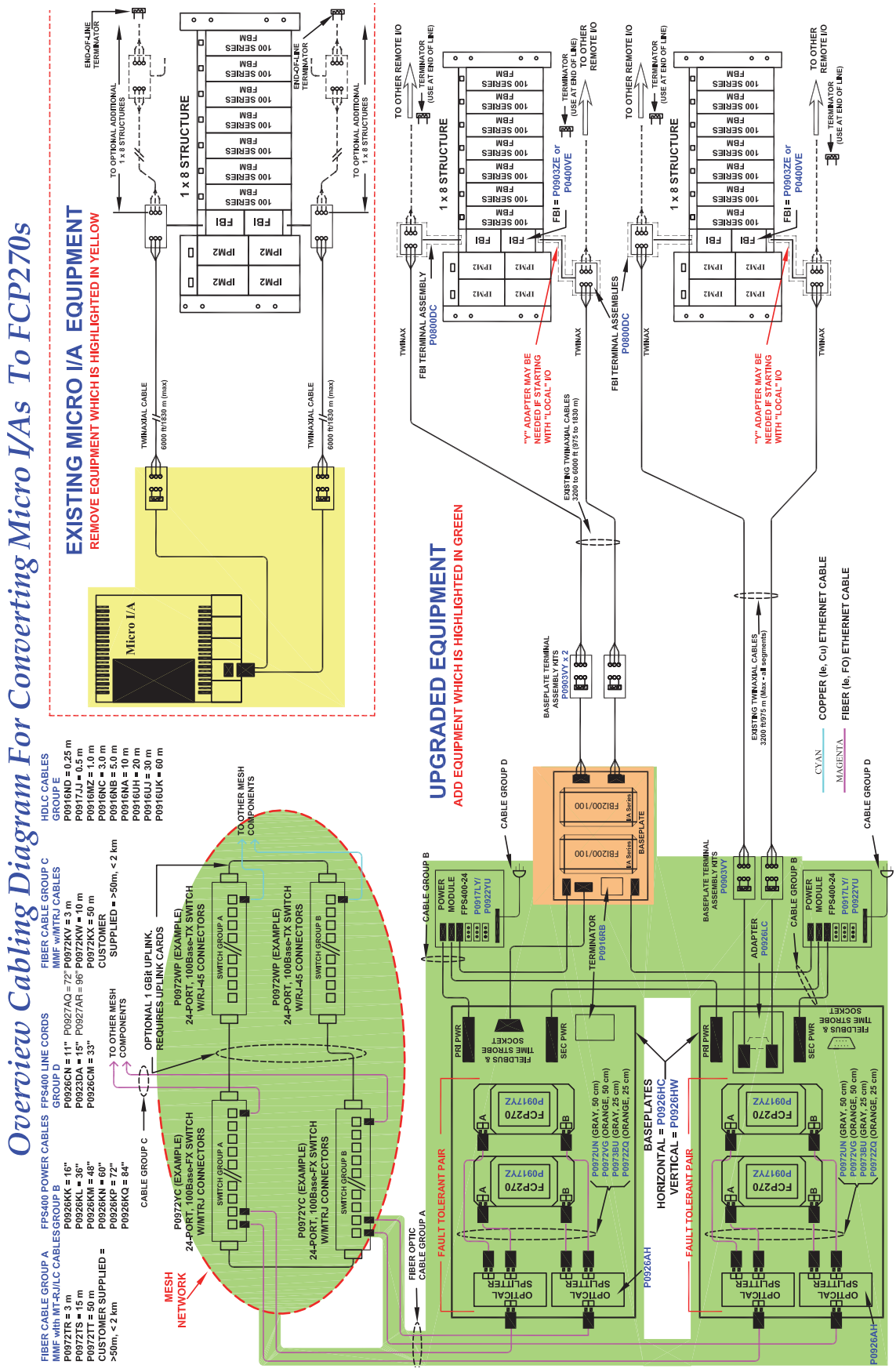


Figure A-8. Converting Micro-I/A Station to FCP270

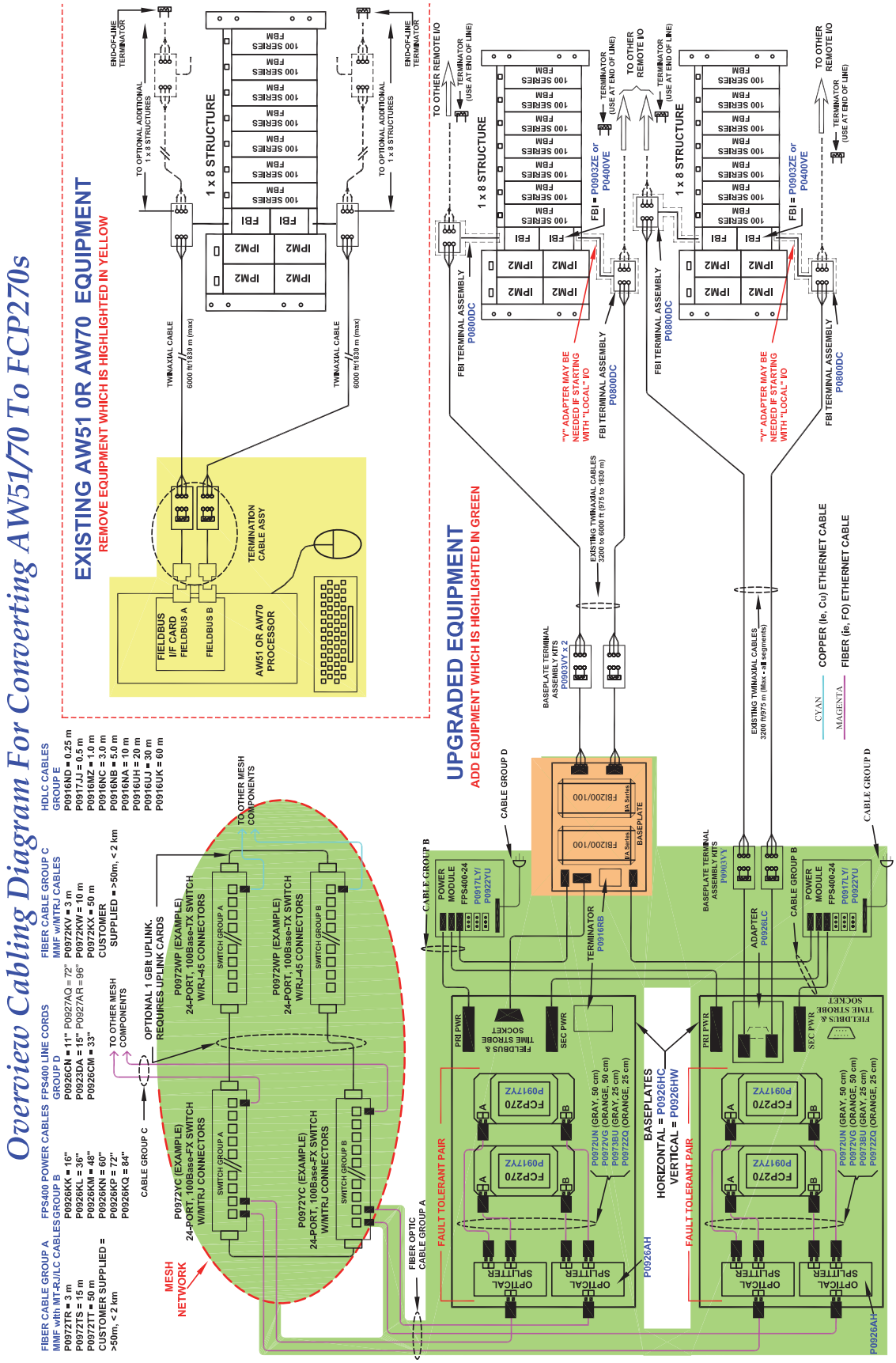


Figure A-9. Converting AW51/AW70 to FCP270s

Appendix B. FEM100 and FBI100 Connection Diagrams

This Appendix contains cabling diagrams for connecting the FEM100 and FBI100 modules to the FCP270.

The figures in this Appendix illustrate typical configurations for connecting the FEM100 and FBI100 modules to the FCP270, including their parts and cables necessary to interconnect the various modules. The illustrations are as follows:

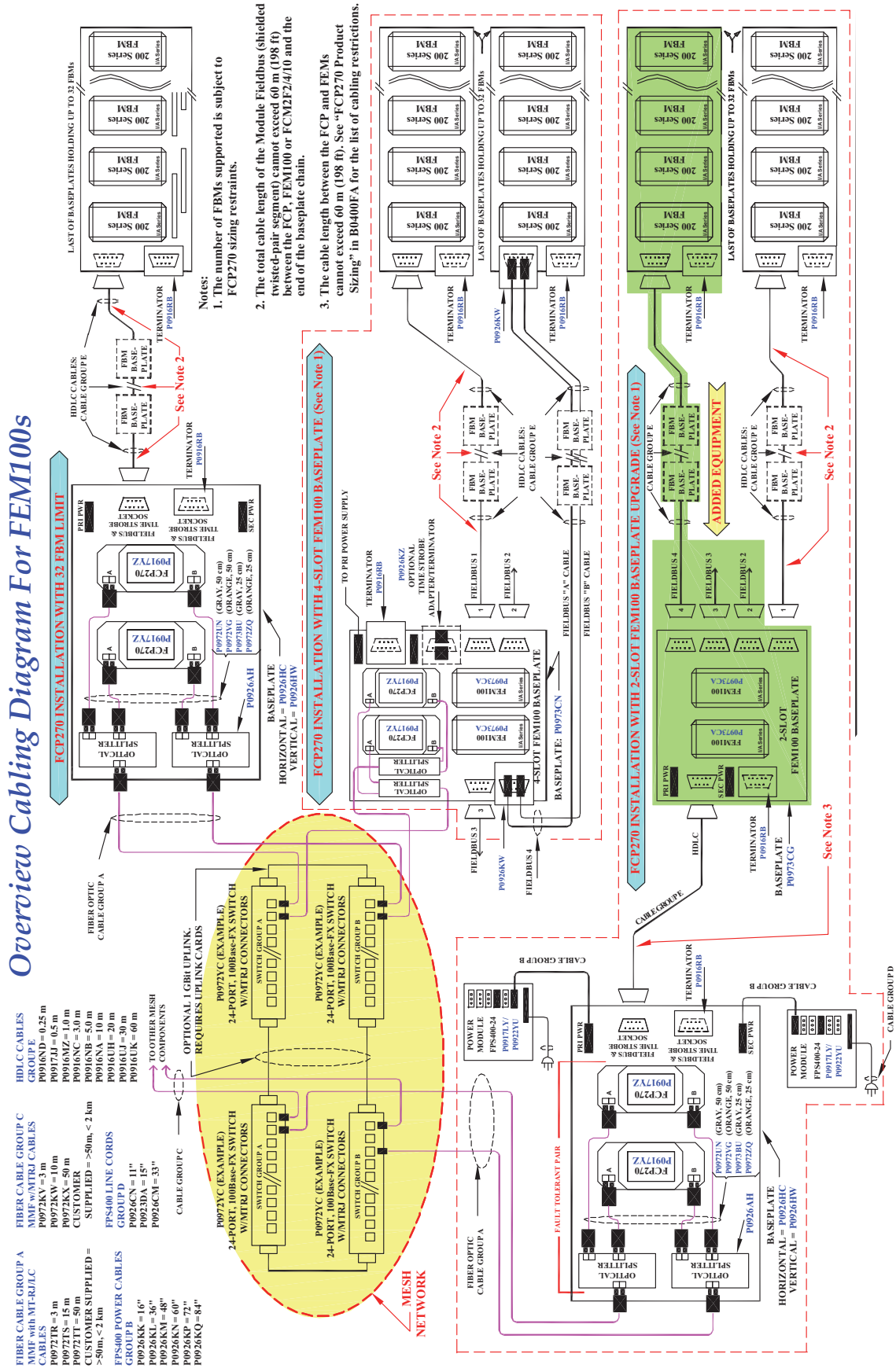


Figure B-1. Overview for FCP270-to-FEM100 Cabling

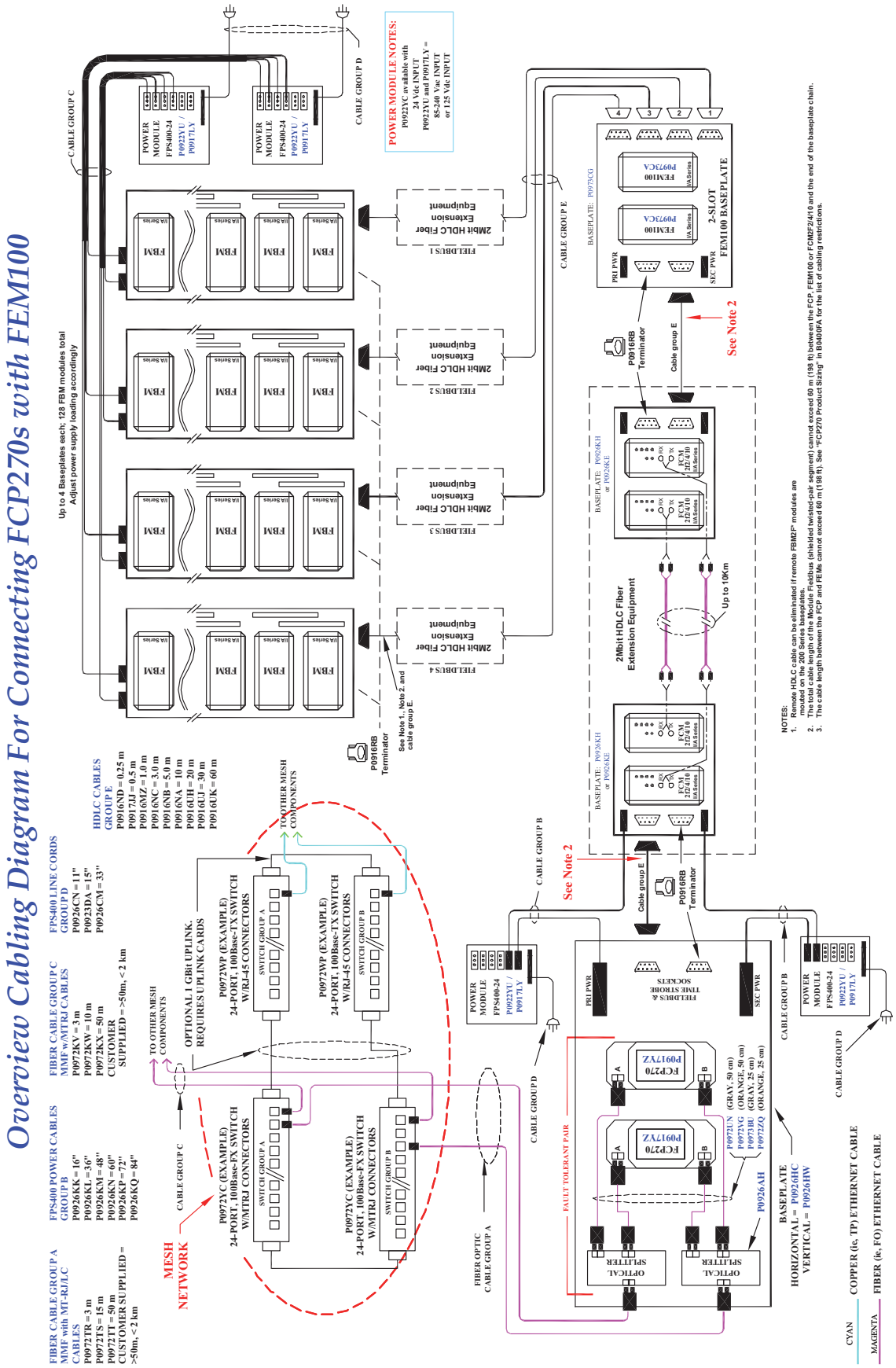


Figure B-2. Overview for Expanded Fieldbus Cabling (FCP270 to Four FEM100s)

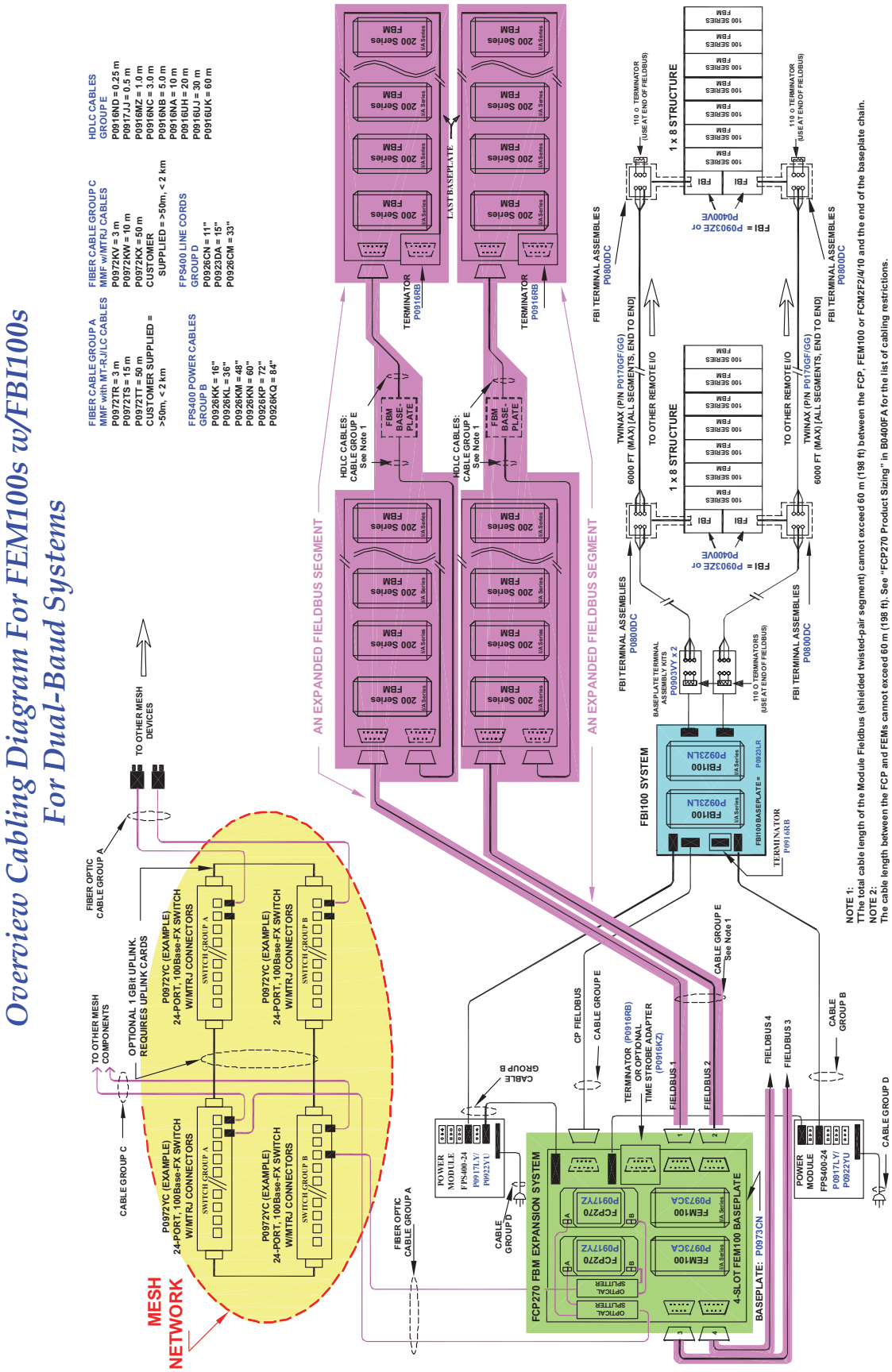


Figure B-3. Overview for Dual Baud Cabling (FCP270 to FEM100 and FBI100)

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