

M1600 FDDI Concentrator
SMT 7.2/7.3
Users Guide

M1600 FDDI Concentrator SMT 7.2/7.3 Users Guide

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**Manufacturer's Address and
Phone Number:** 13800 Senlac
Dallas, Texas 75234
U.S.A.
214/654-5000

declares, that the product:

Product Name: FDDI Concentrator

Model Number: 1600

conforms to the following Standards:

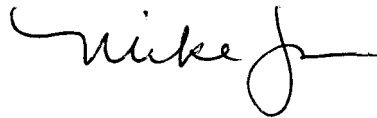
Safety: EN 60950:1988 + A1, A2
IEC 825 -1 & -2 1993

EMC: EN 55022:1988 class A
EN 50082-1 Part 1 1992

Supplementary Information:

This product complies with the requirements of the **Low Voltage Directive 73/23/EEC** and the **EMC directive 89/336/EEC**.

Dallas, December 20, 1995



Mike Jobe, Quality Manager

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Introduction

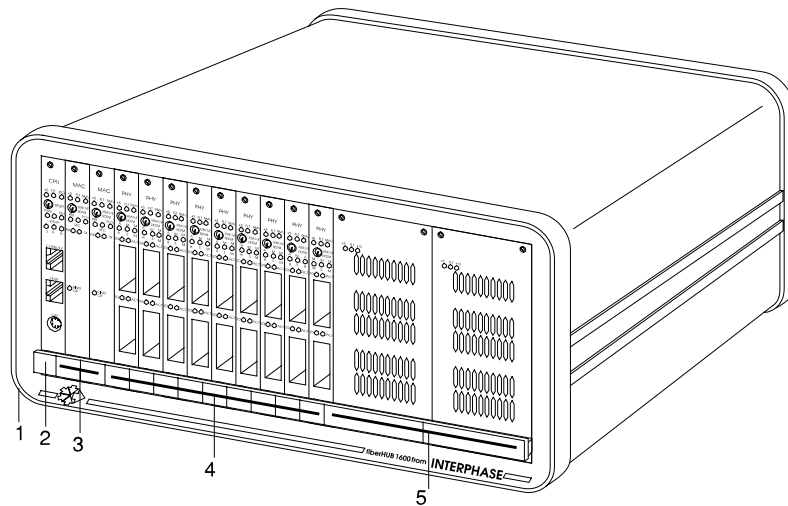
This User's Guide describes the M1600 Fiber Distributed Data Interface (FDDI) Concentrator. The Concentrator facilitates high speed FDDI networking between a variety of computing devices across different types of FDDI media. The Concentrator provides multiport connectivity to an FDDI network.

About The Concentrator

The M1600 FDDI Concentrator is highly modularized for ease of service and expansion, with Central Processing Unit (CPU), Media Access Controller (MAC), Physical Attachments (PHY), and power supply modules. The PHY modules can be removed or added without disconnecting the power source. The Concentrator can be configured in a variety of ways to accommodate the diverse wiring schemes at individual sites. The flexibility in configuring the Concentrator provides easy-to-implement and easy-to-manage FDDI network expansion.

The FDDI Concentrator permits the attachment of multiple Single Attach Stations (SAS), Dual Attach Stations (DAS), or other concentrators to the FDDI Dual Ring. The primary function of the FDDI Concentrator is to provide connectivity to the Dual Ring for large numbers of Single Attach Stations. It permits the network builders to create topologies, usually in the form of Trees, to solve their diverse network requirements. A dual ring of trees topology may be created by cascading concentrators from the dual ring. In contrast, a concentrator in a stand-alone configuration acts as a "wiring hub."

The basic architecture of an FDDI Concentrator includes the Station Management (SMT) software, optional Media Access Control (MAC) entities, and several Physical Layer (PHY) entities. The CPU module provides all SMT and application processing. The MAC modules provide the Media Access Control functionality, and the PHY modules implement pairs of PHY and PMD (Physical Layer Medium Dependent) functionality. The PHY modules provide connectivity in two-port increments.



Index	Description
1	Unit Enclosure
2	Central Processing Unit
3	Media Access Controller modules
4	Physical Attachment modules
5	Power Supplies

Figure 1-1. A Possible Concentrator Configuration

The Concentrator can be configured to support multiple combinations of media, including multi- or single-mode FDDI optical fiber, plus unshielded twisted pair copper.

The Concentrator is designed to the ANSI X3T9 FDDI standard for full interoperability. It also features integrated Station Management (SMT) and a Simple Network Management Protocol (SNMP) response agent.

About This Manual

This manual provides instructions to install and maintain the M1600 Concentrator.

Chapter 1, Introduction gives an overview of the M1600 Concentrator. An overview of the chapters in this manual are also provided.

Chapter 2, Network Topologies provides an overview of various network topologies in which the Concentrator may be installed.

Chapter 3, Installation details the steps needed to install the Concentrator.

Chapter 4, Front Panel Descriptions describes the modules available in a concentrator configuration.

Chapter 5, Console Interface provides commands and procedures to display or set parameters used by the Concentrator.

Chapter 6, Maintenance and Troubleshooting provides information pertinent to maintain and upgrade your Concentrator.

The **Appendices** describe specifications and parameters for the Concentrator.

Acronyms and Terminology

The following acronyms and terminology may be used in this manual instead of the complete title or name:

CFM - Configuration Management

Concentrator - M1600 FDDI Concentrator

concentrator - An FDDI node that provides attachment points for stations that are not directly connected to the dual ring.

DAC - Dual Attach Concentrator

DAS - Dual Attach Station

FDDI - Fiber Distributed Data Interface

SAC - Single Attach Concentrator

SAS - Single Attach Station

SMT - Station Management

SNMP - Simple Network Management Protocol

Technical Assistance

To place an order for an Interphase product, send in a product for repair or upgrade, or for technical assistance, call Interphase Corporation Customer Service. See **Assistance** at the front of this user's guide for contact information.

Related Publications

The following publications are excellent sources of information when working with this product.

ANSI X3T9.5 SMT

The specification for FDDI Station Management.

ANSI X3.139-1987

The standards committee developed this Media Access Control (MAC) specification for information systems based on Fiber Distributed Data Interface.

ANSI X3.148-1988

The standards committee developed this Physical Protocol Layer (PHY) specification for information systems based on Fiber Distributed Data Interface.

ANSI X3.166-1990

The standards committee developed this Physical Layer Medium Dependent (PMD) specification for information systems based on Fiber Distributed Data Interface.

RFC 1213 Internet MIB II

This RFC describes the content of the Internet MIB accessible via an SNMP manager.

RFC 1285 FDDI MIB

This RFC describes the content of the FDDI MIB accessible via an SNMP manager.

Network Topologies

An FDDI topology consists of two separate logical rings, designated the Primary and Secondary rings as shown in Figure 2-1. Two transmission paths are formed by connecting pairs of physical links. A set of dual attach stations connected into a closed loop form two counter-rotating rings, referred to as a Dual Ring. Either of the counter-rotating rings is the basis of a logical ring. If a fault occurs, the dual ring design has the ability to isolate the fault by wrapping the Primary ring to the Secondary ring to maintain the transmission path. Figure 2-2 illustrates a wrapped ring.

A single concentrator may connect one or more (in the case of a Dual Attach Concentrator or DAC) trees into a logical ring. This allows either the Primary, the Secondary, or both logical rings to be extended to include trees.

FDDI topology connection rules enforce the creation of legal topologies. Refer to the Tutorial in the Appendices for additional information.

Normally, *A* port types connect to *B* port types, and *S* port types connect to *M* port types. *A* or *B* port types can connect to *M* port types. Connecting both *A* and *B* ports of a DAS to *M* ports creates a Dual Homing Topology.

Dual Ring

The Dual Ring topology is the typical connection method for FDDI. It allows the connection of a number of Dual Attach Stations (DAS) to form a ring as shown in Figure 2-1. The terminology “Dual Ring” comes from the fact that there are two independent data paths (the Primary and Secondary ring) in an unfaulted network. If a fault occurs in the Dual Ring due to either a station failing (or maybe just being turned off) or a cable problem, the stations on both sides of the problem area will “wrap.” This combines the Primary and Secondary rings to form one data path as shown in Figure 2-1.

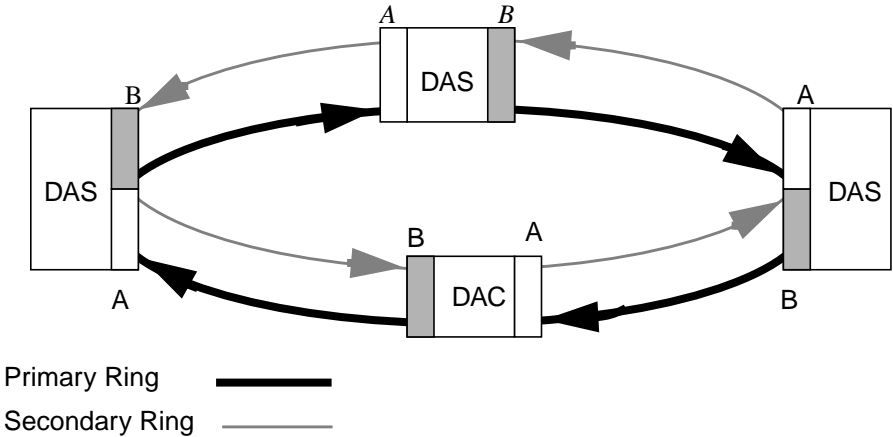


Figure 2-1. Dual Ring Network Topology

This ability to “wrap” the Dual Ring to form one ring is one of the strengths and one of the weaknesses of FDDI. If some kind of fault occurs and the ring wraps, all the remaining stations on the ring will be able to communicate as they could previously. This is one of the fault-tolerance strengths of FDDI. However, if an additional fault occurs somewhere in the remaining single ring, the stations on either side of the fault will again wrap, thus segmenting the network into two pieces that can’t communicate with each other. It is this possibility of segmenting the network that make concentrators so valuable in FDDI applications.

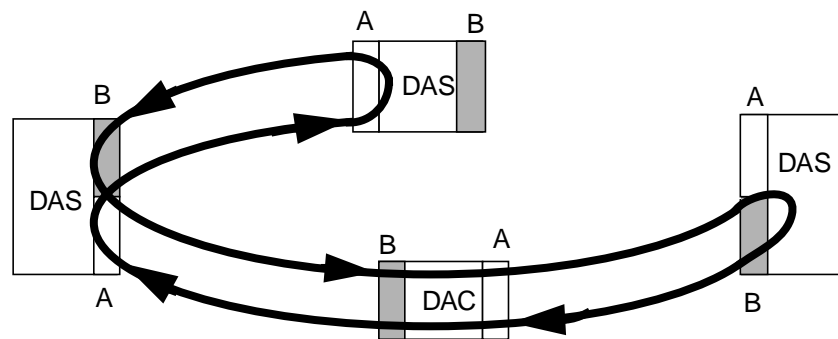


Figure 2-2. Wrapped Dual Ring Network Topology

Cascaded Topology

If there are a number of devices that need to be connected to an FDDI network or the existing cabling doesn't support a Dual Ring, a Cascaded topology may be used. In this topology, a number of concentrators are connected as shown in Figure 2-3 to create a "branch" of a "tree". Cascaded concentrators extend the Dual Ring into a tree to simplify reconfiguration and expansion. Also, this topology fits in well with most existing cabling schemes (multiple "stars" based at wiring closets).

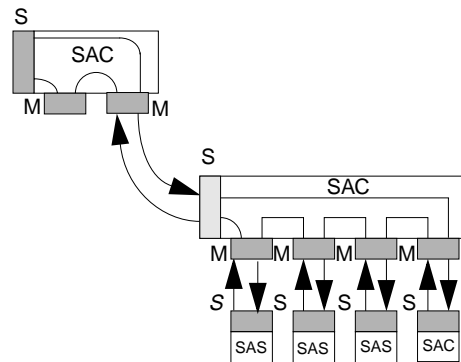


Figure 2-3. Example of a Cascaded Topology

In the Cascaded topology shown above, there is no Dual Ring. Only one data path exists throughout the network. This single data path is not a problem as it was with the Dual Ring because the concentrators manage the connection of all the stations to the data path. If problems occur on the links to the stations, the concentrator (or the network manager) will not allow the offending stations to be connected to the network. As a result, the Cascaded topology can be very useful when building an FDDI network.

Dual Ring of Trees

A variation of the Dual Ring and Cascaded topologies combines the two to form a “Dual Ring of Trees”. This is the most powerful topology available in FDDI and provides the reconfiguration capabilities of a Cascaded topology while still supporting the fault tolerance of a Dual Ring. As shown in Figure 2-4, concentrators are used to build a Dual Ring of Trees by connecting multiple Cascaded topologies to the Dual Ring.

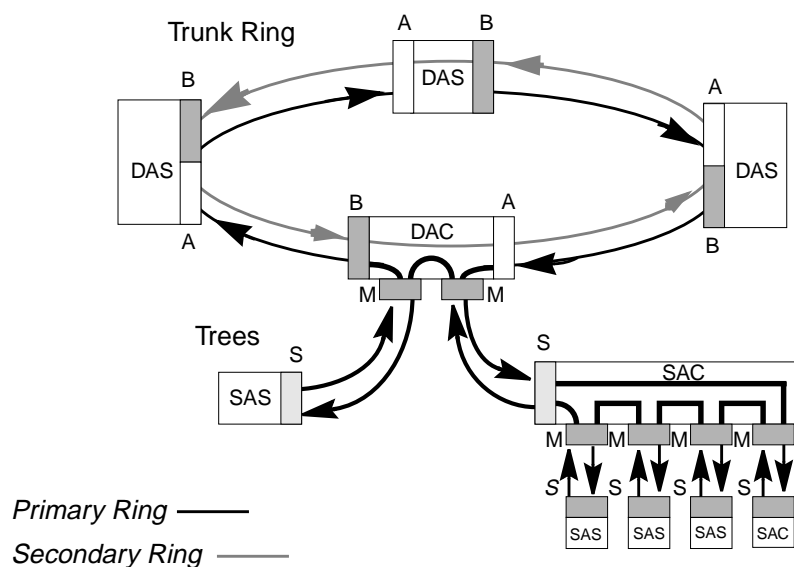


Figure 2-4. Dual Ring of Trees Topology

This topology is useful when connecting the stations in a number of buildings. For instance, the cabling within each building would form a Cascaded topology while the buildings would be connected by a Dual Ring. The Dual Ring could be formed by connecting a single “root” concentrator from each building. All of the other concentrators and systems in the building would be cabled to the buildings’ “root” concentrator. The Dual Ring of Trees is highly recommended for FDDI network installations because it combines the best features of the Dual Ring and the Cascaded topologies.

A concentrator-based FDDI network supports an independent fiber link to each attached station via the concentrator's M ports. If faults occur in either the stations or the fiber connections, the concentrator bypasses the troubled branch of the tree. The Dual Ring is not wrapped in these cases, avoiding segmentation of the FDDI Dual Ring when multiple faults occur. By reducing the number of attachments to the Dual Ring and managing the connections to the stations attached to the ring, a concentrator can provide greater network availability to the remaining stations when multiple faults occur.

Dual Homing

When a station is attached to a concentrator, only one port is required. A single attach station has only one port. However, if the system is a dual attach station, only one of the ports (either A or B) needs to be connected to the concentrator. The remaining port is unused. The FDDI creators decided that it would be a good fault tolerant feature to allow the unused port to become a "backup" for the port that is actually in the data stream. From this evolved *Dual Homing*, in which a dual-attach station's A and B ports are each connected to an M port on a concentrator. The SMT in the dual attach station is responsible for recognizing this connection case and allowing only the B port to become active in the data path. The A port continuously runs testing sequences while the B port is functional. As shown in Figure 2-5, the dual-attach station is able to communicate with the remainder of the network through its B port.

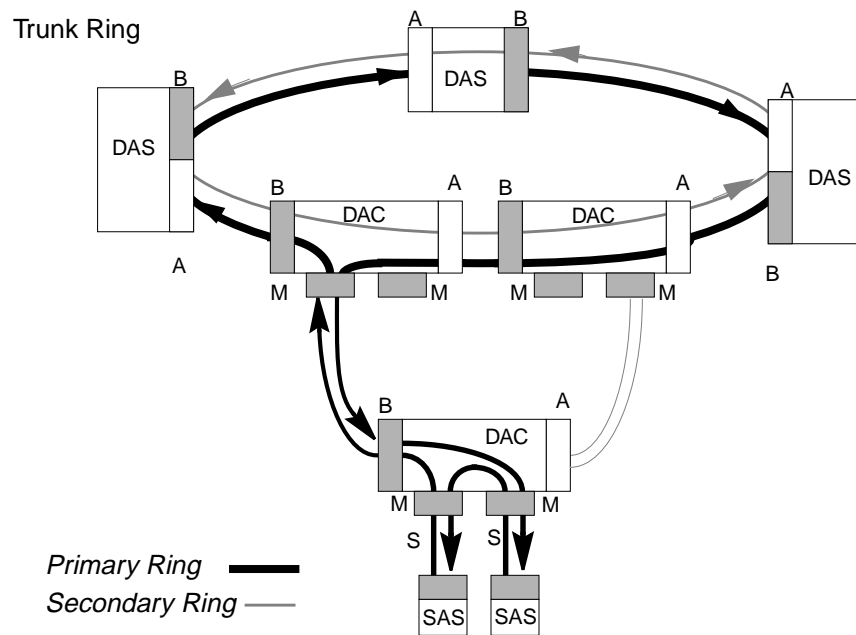


Figure 2-5. Dual Homing Network Topology

If the B port fails or is disconnected, the A port will automatically become active and be switched into the data path by the concentrator's M port. When both ports of a dual-attach station are connected to a concentrator, Dual Homing puts the unused port to good use by providing another form of fault tolerance via the backup link.

Summary

FDDI offers a number of topology options which may be used to build networks that meet a variety of reconfiguration and fault tolerance needs. The options range from the simple Dual Ring to the flexible Dual Ring of Trees. As FDDI networks become more complex, concentrators support growth and expansion without impacting existing cabling.

Notes

Installation

The M1600 FDDI Concentrator is easy to install and operate. It can be installed in a standard nineteen-inch rack or placed on a tabletop. The Concentrator can be configured to support a number of network configurations.

This chapter provides installation and cabling instructions for the Concentrator.

Installation Overview

The steps to install the Concentrator are simple. The Concentrator can be configured and connected in multiple ways. Interphase recommends that the following steps be used as a guide.

1. Unpack and inspect the M1600 FDDI Concentrator.
2. Mount the Concentrator.
3. Apply power.
4. Connect a terminal to the Console Port.
5. Connect to the FDDI network.
6. Attach stations.

It is recommended that the user review and read this user's manual before installing the Concentrator.

Safety Precautions

Before performing the procedures outlined in this chapter, read and understand the following:

Note Only technically qualified persons should perform the installation, maintenance and troubleshooting of this product.

Beachten Sie Installation, Wartungsarbeiten und Fehlersuche sollten nur von qualifiziertem Wartungspersonal durchgeführt werden.

- The power cord should be plugged into a properly wired receptacle to avoid electrical shock. The main power should be disconnected using the power On/Off switch located on the rear panel of the Concentrator.

The Concentrator is designed to operate from a power source that does not apply more than 230 VAC between the conductors or between either supply conductor and ground.



Warning The Concentrator power cord is grounded. If the protective ground connection is broken or malfunctioning, any accessible conductive part (including controls that appear to be insulated) can render an electric shock. To avoid personal injury or damage to the unit, do not operate this instrument unless all covers and panels are secured in place.

This product is electrostatic discharge sensitive (ESD). Before removing or reconfiguring any system component, a grounding device should be attached to the rear panel.

Achtung Dieses Gerät ist über das Netzkabel geerdet.

Bei unterbrochenem Schutzleiter ist die Berührungssicherheit nicht gewährleistet. Vor öffnen des Gehäuses Netzstecker ziehen!

Zur Vermeidung von Beschädigungen durch elektrostatische Entladung ist das Gerät bei Modulwechsel über die Rückwand zu erden.

- The main power should be disconnected and the power cord removed from the unit if the unit experiences a CPU module failure or power supply failure (if the system is configured with a single power supply).
- The correct type of fuse with the proper voltage and current rating should be used to avoid a fire hazard. For 110 VAC use a 4 amp fuse (fast blow). For 230 VAC use a 2.3 amp fuse (fast blow).

Nur folgende Sicherungen verwenden:

Für 110 Volt 4 Ampere, für 230 Volt 2,3 Ampere.

Bei Nichtbeachtung besteht Feuergefahr.

Pre-Installation Considerations

Before installing the Concentrator, several points must be determined. It is recommended that you consider and record decisions made about your configuration and network. Prepare the site for your unit and ensure that you have the proper cables and tools ready before installing the Concentrator.

Network Topologies

Determine the network topology in which the Concentrator is used. Interphase suggests one of the following FDDI network topologies:

- Dual Ring
- Cascaded Concentrators
- Dual Ring of Trees
- Dual Homing

Chapter 2 of this document provide additional information about network topologies.

Environment Requirements

Select a clean, dust free location when planning the location for your Concentrator. Avoid placing it in direct sunlight, near heat sources, or near areas with high levels of electromagnetic interference (EMI).

The front panel of the Concentrator provides status indicators that you may wish to monitor. Place the Concentrator in a visible location. Interphase recommends that your installation:

- be free of obstruction
- have sufficient clearance to operate the power ON/OFF switch
- allow five (5) inches at the front of the Concentrator to compensate for the manufacturer's suggested bend radius of the fiber cable; three (3) inches clearance from the rear and one-half (1/2) inch on all other sides for ventilation (airflow).

Two fans located at the rear of the chassis cool the Concentrator.

System Configuration

The Concentrator may be configured in a variety of ways to be compatible with the networking environment in which it is installed. The system may have multiple MACs and PHYs depending on your needs. Systems are easily reconfigured when necessary. If no MACs are installed, the system acts as an FDDI "wiring hub".

The Concentrator is preconfigured to begin operation immediately when it is turned on. It is designed to require minimal interaction with either the console or a management station once it has been configured with some basic information. To communicate with other stations on an FDDI ring in the simplest scenario, the Concentrator needs the following:

- IP Address
- IP Netmask
- IP Broadcast Address

However, IP addresses do not need to be configured if a MAC is not installed or you do not need to communicate with the Concentrator. The Concentrator performs the actions needed (using SMT) to allow connected stations to communicate among themselves. Some factory settings may need to be changed if you intend to:

- operate the system with an SNMP manager
- download software updates
- TELNET to the system
- use SLIP
- perform any of the above tasks from another network (through a router).

If desired, the Concentrator may be configured with the IP addresses of up to eight (8) SNMP Managers. If the SNMP Response Agent is enabled, these IP addresses are sent SNMP Traps when necessary. The SMT-based management mechanisms are always available if a MAC is installed regardless of whether the SNMP Response Agent is enabled. To use SLIP with the system, the local and host SLIP addresses must be provided. The Concentrator may be configured with the IP address of a device acting as a gateway to communicate with a system from a different network.

Some of the policies implemented by the Concentrator (reaction to the attachment port(s) failing, etc.) are set to default values at the factory, but may be changed by the user. These policies can be tailored to best support the networking environment in which the Concentrator is installed. Refer to the “Set Commands” section in Chapter 5 for details.

For security reasons, a password may be set. This allows the system to only accept console commands via TELNET or a terminal attached to the Console port after a password is entered. A password is not initially set at the factory for either TELNET or the Console port.

Setting the user-defined MIB attributes in the Concentrator may be desirable. These text strings in the MIB are intended to identify and locate the device when an SNMP manager asks for the information. They, like the other items discussed in this section, are stored in nonvolatile memory in the Concentrator so that it is necessary to set them only once.

The Concentrator hardware is configured at the factory according to the user's specification, but some explanation of the network connection and MAC options may be helpful. In most networks in which a concentrator is used, it will be placed on the Dual Ring with other concentrators or Dual Attach stations. If this is the way you intend to use the Concentrator, it will be configured as a Dual Attach Concentrator (DAC). The A and B ports (used by the Concentrator to attach to the Dual Ring) will be on the leftmost PHY module in the system. If the A and B ports become disconnected, the stations connected to the remaining PHY modules (the M ports) will still be able to communicate among themselves provided that the attachment port failure policy is set to the factory default.

If your Concentrator was configured as a Single Attach Concentrator (SAC), it will have one S port and one M port on the leftmost PHY module in the system. The S port is normally intended to connect to an M port of another concentrator. This puts your Concentrator in a "Cascaded" topology (explained in detail in the next section) and may be useful if you already have a fully loaded Concentrator and need to use your new Concentrator to easily increase the number of available M ports. If you leave the S port unconnected, the stations connected to the remaining PHY modules (the M ports) will still be able to communicate among themselves provided that the attachment port failure policy is set to the factory default. In this configuration, the unit will act as a "null attach". There are a number of options for connecting A, B, and S ports.

The MAC addresses are derived by a combination of the unique serial number of the CPU module and the Interphase Organizationally Unique Identifier (OUI) as assigned by IEEE. The MAC addresses do not reside on the MAC module. They are contained within the nonvolatile memory on the CPU module. This means that MAC modules can be exchanged between concentrators without the possibility of having duplicate MAC addresses on the FDDI network. User-defined MAC addresses can be defined through the console interface. Appendix B provides a list of parameters which can be set and the factory set default for each.

After your Concentrator is installed, you may wish to change its configuration. As your network grows and changes, you may need to install additional MACs or M/M port modules into the system. Chapter 6 includes information about reconfiguring the Concentrator.

FDDI Cabling Requirements

Depending on the PHY module options in your system, the following cabling may be used:

- Multimode Fiber
- Single-mode Fiber
- Unshielded Twisted Pair

The Concentrator accepts 62.5/125 or 50/100 micron multimode fiber with standard FDDI MIC connectors. The maximum station-to-station cabling distance is two (2) kilometers with 62.5/125 micron multimode fiber.

The Concentrator accepts 9 micron single-mode fiber. The maximum station-to-station distance is 14 kilometers.

Unshielded twisted pair (UTP) cable may be EIA/TIA (Electronics Industries Association/Telecommunication Industries) Category 5 cable or Underwriters Laboratories cable Level 5. Maximum cabling distance using UTP is 100 meters (330 feet).

Tools Required

The following item may be needed when installing the Concentrator.

- A Phillips screwdriver #2 (for rack mount installations)

Installing Your Concentrator

To install the Concentrator:

1. Unpack and inspect the Concentrator.
 - a. Examine all shipping containers and contents for damage and check for missing items.

If damage occurred to the containers during shipping, please notify your carrier. Do not attempt to use damaged equipment for safety reasons.

- b. Unpack and examine the contents of the containers. You should have the following:

- M1600 Concentrator
- M1600 Concentrator User's Guide
- Rack mounting kit (if applicable)
- Warranty Registration Card
- Power Cord
- 6-foot RJ45 to DB25 cable for the console port

Report any missing parts and any damage not related to shipping to your sales representative. Keep the packing materials for reuse. *All materials returned under warranty must be packed in their original packing materials.*

- c. Please fill out the warranty registration card (last page of this user's guide) and send or FAX it to Interphase Corporation.

United States customers should send or FAX the card to Interphase Corporation, 13800 Senlac, Dallas, Texas 75234 or FAX number 214-654-5500.

International customers should send the warranty registration card to their distributor.

2. Mount the Concentrator

The Concentrator can simply be placed in a convenient location on a tabletop. The Concentrator operates at a very low noise level and is suitable for any tabletop environment.

The Concentrator also can be mounted in an open or closed nineteen-inch rack (per site requirement) using the rack-mount bracket kit. The rack-mount bracket kit consists of two brackets and four screws. If the rack-mount is ordered at the same time as the Concentrator, the rack mount is already installed on the Concentrator in the flush position.

- a. Determine where you want to mount the Concentrator in the rack. If the rack mount is already installed and you wish to use the flush mount position, go to Step 2d.

Follow the instructions in Step 2b to change the mounting position of the Concentrator:

- b. Remove and save the screws from the left and right sides of the Concentrator.

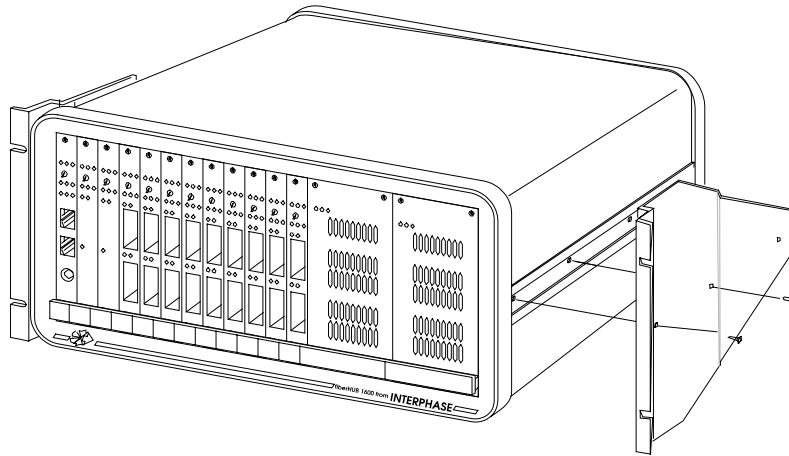


Figure 3-1. Removing the Flush Mount Bracket

The Concentrator and the bracket each have three holes which can be used to secure the bracket to the Concentrator. Position the mounting brackets on the Concentrator. The positions (Figure 3-2) are labeled to identify the position of the Concentrator in the rack.

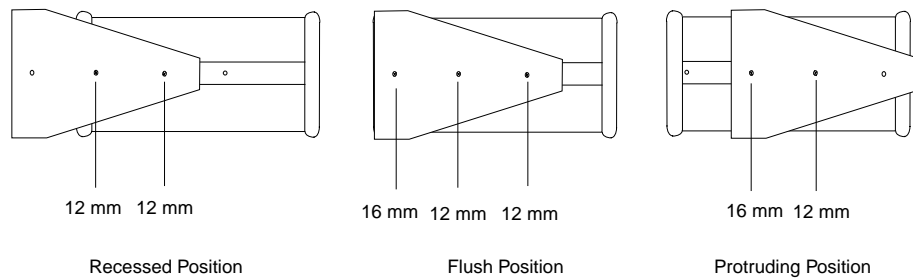


Figure 3-2. Bracket Mounting Positions

- c. Attach mounting brackets using the screws that were removed from the sides of the Concentrator (refer to Figure 3-1).

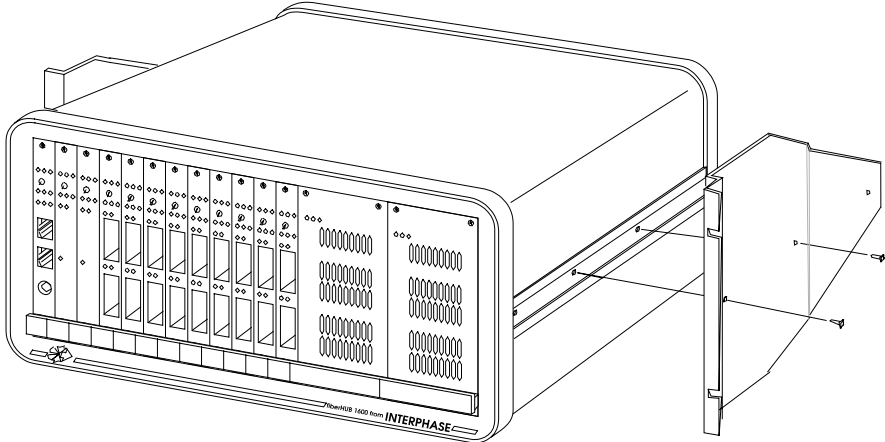


Figure 3-3. Positioning the Bracket for a Protruding Concentrator

- d. Position the Concentrator with the mounting brackets attached.

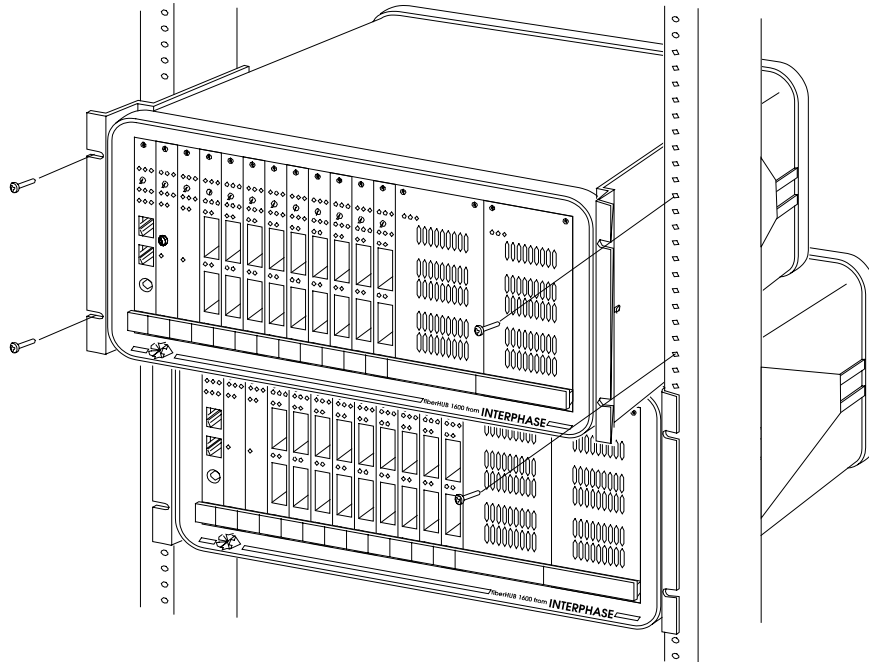


Figure 3-4. Mounting the Concentrator in a Flush Mount Position

- e. Mount the Concentrator to the rack. Please ensure that each of the four bolts is secure and tight.

Please ensure that proper clearances recommended for the Concentrator are maintained: five (5) inches at the front; three (3) inches from the rear; and one-half (1/2) inch on all other sides.

3. Turn on the power to the Concentrator:

- a. Check the power On/Off switch to ensure that the switch is in the OFF position.

- b. Connect the power cord supplied with the Concentrator to the rear of the unit.

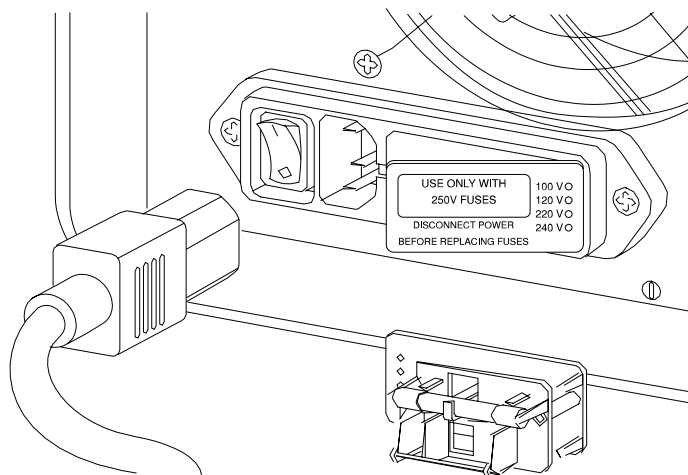


Figure 3-5. Power Cord Connection and On/Off Switch

- c. Connect the Concentrator's power cord to a properly grounded electrical outlet.
- d. Push power On/Off switch to the ON position.

Note If the unit fails to power-up after switching to the ON position, turn the switch OFF and disconnect the power cable. Inspect and replace the fuse if necessary. Refer to Chapter 6, Maintenance and Troubleshooting, if difficulties persist.

Achtung Wenn das Gerät nach dem Einschalten (Netzschalter auf EIN, Stellung 1) nicht betriebsbereit wird, schalten Sie den Netzschalter auf AUS (Stellung 0) und ziehen Sie das Netzkabel ab. Prüfen Sie die Sicherung und ersetzen Sie diese falls nötig. Bei Anhalten der Störung verfahren Sie bitte entsprechend den Angaben in Kapitel 6, "Maintenance and Installation".



Caution For continued protection against risk of fire, replace only with the same type and rating of fuse.



Warnung Schutz gegen Feuergefahr ist nur bei Verwendung der für die jeweilige Betriebsspannung vorgesehenen Sicherung gegeben.

4. Connect a terminal to the Console Port of the CPU Module.
 - a. Connect the RJ45-to-DB25 cable to the Console Port of the CPU Module.

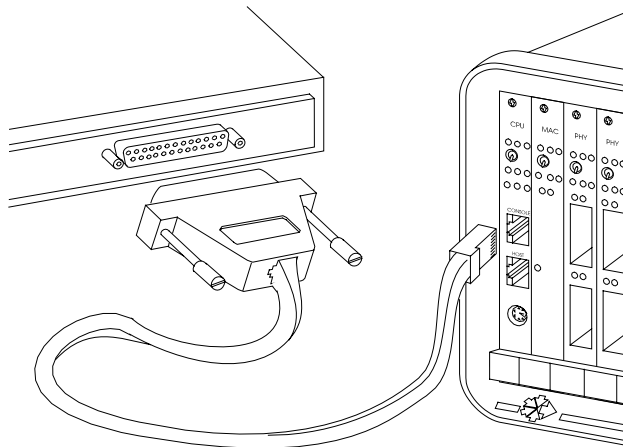


Figure 3-6. Console to Terminal Interface Connections

- b. Connect the cable to the terminal.
 - c. Configure the terminal for 9600 baud, 8-bit data, no parity, and 1 stop bit. Please refer to the terminal user's manual for assistance in changing terminal settings.
 - d. Refer to Chapter 5 of this manual for initial setup commands.

5. Connect the Concentrator to the Network.

At this time, you are only connecting the Concentrator to the network as an FDDI node. To connect other stations to the Concentrator, go to Step 6.

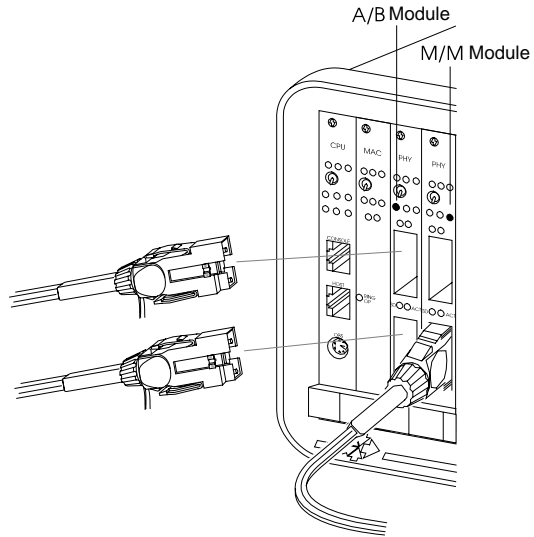


Figure 3-7. Cabling Connectors into the PHY Ports

The cabling and network keying specifics are determined by network topology and media types. The Concentrator is shipped from the factory configured as you specified. The LEDs on the leftmost PHY module indicate how your Concentrator is configured. A/B indicates a dual attach concentrator. M/S indicates a single attach concentrator. Subsequent PHY modules are configured as M/M connections.

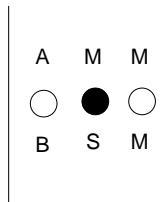


Figure 3-8. PHY Module LEDs: Single Attach Configuration

If the LEDs indicate a configuration other than the one desired, please see Chapter 6, Maintenance and Troubleshooting, for assistance to change the jumpers on the PHY module. The topology examples in Chapter 2 can assist the user in determining the type of configuration required.

FDDI Station Management allows connections between port types for attachment to a network. Refer to the chart below:

Concentrator Configuration	PHY Port Connections	Connecting PHY Port Type
Single Attach	S	M or S
	M	A, B or S
Dual Attach	A	B
	B	A
Dual Homing	A or B	M

A dual attach configuration allows the user to connect the Concentrator to a number of Dual Attach Stations to form a ring. A Dual Ring has two independent data paths: a primary and a secondary path.

The following illustrates connecting a Concentrator to a Dual Ring.

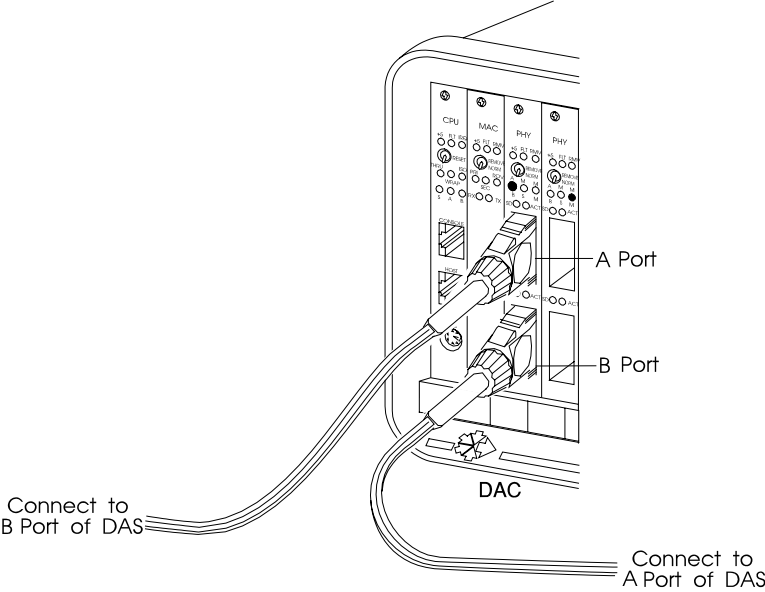


Figure 3-9. Connecting the Concentrator to a Dual Ring

In a cascaded arrangement, a number of concentrators or stations are connected to form a “branch of a tree”. If a number of devices need to be connected to a network or if the existing cabling scheme does not support a Dual Ring, a Cascaded topology may be used.

The following illustration shows an example of concentrators connected in a “Dual Ring of Trees” topology. The Concentrator on the left is attached to the Dual Ring and the other concentrators form the branch of the tree.

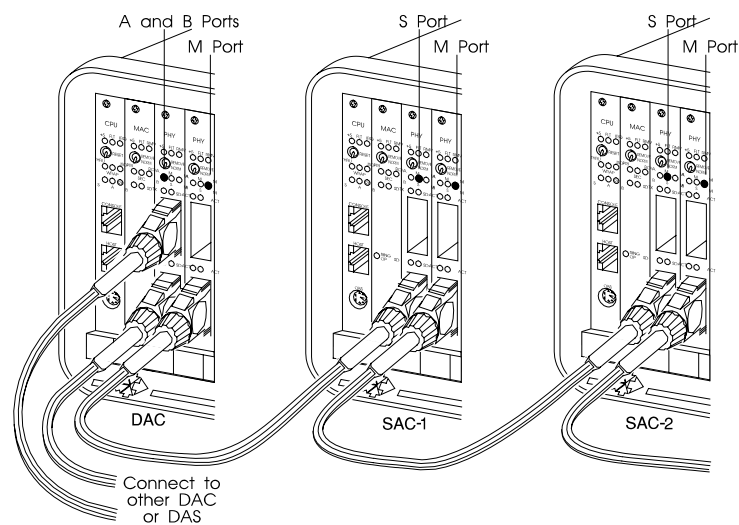


Figure 3-10. Cascading Concentrators in a Dual Ring of Trees

In a Dual Homing topology, the A and B ports of a dual attach station are connected to M ports on a Concentrator. The SMT in the dual attach station allows only the B port to become active in the data path. The A port becomes active only if the B port fails or is disconnected. The A port then is switched into the data path.

The following illustrates an example of concentrators connected in a Dual Homing topology.

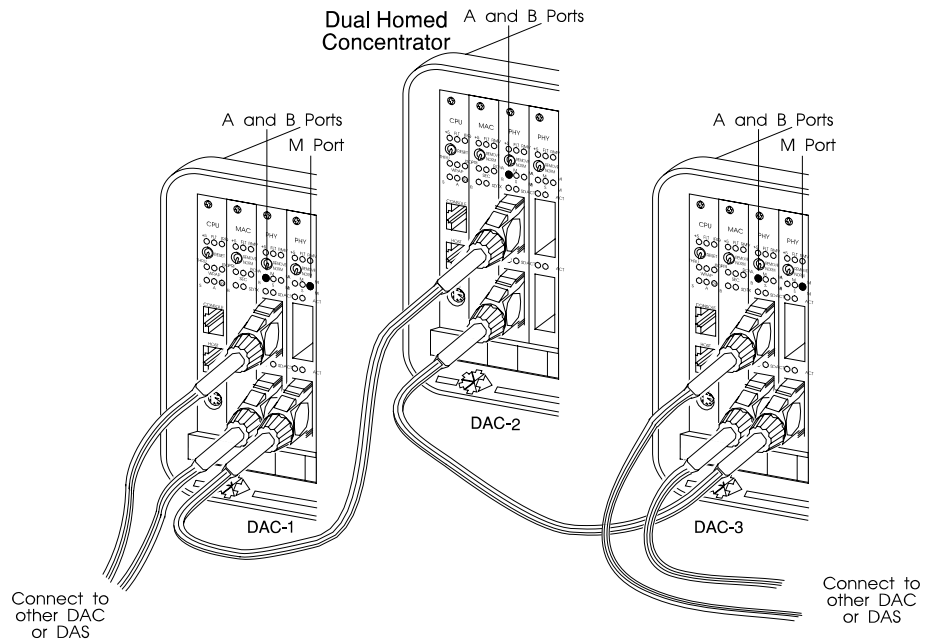


Figure 3-11. Connecting Concentrators in a Dual-Homed Topology

6. Connect the stations to the Concentrator. The PHY modules that are configured as M/M ports can be used to attach other single attach or dual-homed stations.

To attach a single attach station, connect the S port of the station to an M port of the Concentrator. To attach a dual attach station, connect either the A or B port of the station to an M port of the Concentrator. To dual home a dual attach station, connect both the A and B ports of the station to M ports of separate concentrators. As an alternative, the dual-homed station may be connected to M ports of a single concentrator.

Verifying Installation

Once power is applied to the Concentrator or the reset switch is activated, the software will display an Interphase banner and begin power-up diagnostics. After successful completion of the diagnostics, the software will display information about the configuration of the system. An example of the display screen following a reset or power-up sequence is shown below:

```
Interphase FDDI Concentrator Bootrom...
serial chip diagnostics passed
ram diagnostics passed
flash image application launch...starting application

Interphase FDDI Concentrator Software Revision a03 at system reset #436:

cpu local interrupt test...passed

initial system configuration:
slot 1: mac 0
slot 2: phy 0 and 1
slot 3: phy 2 and 3
slot 4: phy 4 and 5
slot 5: phy 6 and 7
slot 6: phy 8 and 9
slot 7: phy 10 and 11

frame memory (MAC 0)...passed
card cage interrupt test...passed
backplane path tests...Primary...Secondary...passed
BIST slots: 00000
MAC RingOp (mac 0)...passed
configuring as dual attach...done
fddi_probe(): found Primary MAC
sbrk(): pMemTop = 9fb800, pImagesEnd = 8ce690, 1233264 bytes available
Primary MAC address: 00-00-77-89-a4-04 (00:00:ee:91:25:20)
IP Address: 157.175.215.14 using gateway: 157.175.215.135
concen:
```

The above screen represents a M1600 system configured as a dual attach Concentrator with a single MAC (primary) and ten (10) master port attachments. The canonical MAC address is 00-00-77-89-a4-04 and the non-canonical MAC address is 00:00:ee:91:25:20. The IP address is 157.175.215.14 and the gateway address is 157.175.215.135. The software revision a03 resides in the Flash EPROM which is preferred for bootup. This is typical of a M1600 that has had a software update. This example M1600 has experienced 436 resets.

Notes

Front Panel Descriptions

The M1600 Concentrator is designed to allow multiple configuration and redundancy options. The M1600 architecture permits system configurations such as single or dual attach, one to three MACs, zero to twenty-one master ports, and single or redundant power supplies. This was accomplished by partitioning the main functional blocks into specific modules:

CPU Module — The Central processing unit governs system operation. This module is mandatory for operation.

MAC Module — The Media Access Controller provides transmission and reception of frames. This module is optional.

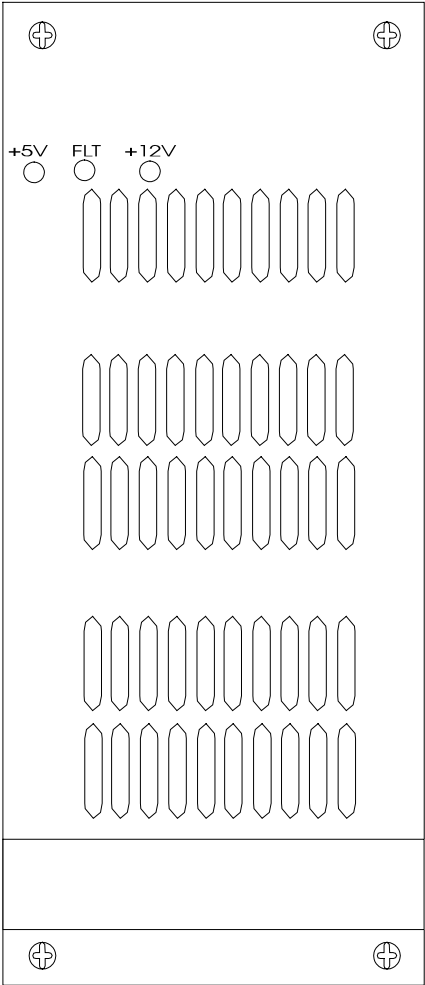
PHY Module — The Physical layer interface provides two independent port attachments.

PS Module — The Power Supply module provides DC current to power the system electronics and fans.

The user can determine how the Concentrator is functioning using the indicators and controls on the front panel of the Concentrator. The LEDs on the front panels of the CPU, MAC, PHY, and Power Supply modules provide visual information about the DC voltage status, individual faults for each module, physical removal acknowledgment, and FDDI specific indications.

The Power Supply

The power supply LEDs indicate if DC power is applied to the system electronics. A fault LED indicates the status of the power supply.



Indicators	Function
+5V	Green LED. Power has been applied to the system.
FLT (Fault)	Amber LED. A fault exists in the power supply.
+12V	Green LED. Power has been applied to the fans.

Figure 4-1. Power Supply Indicators

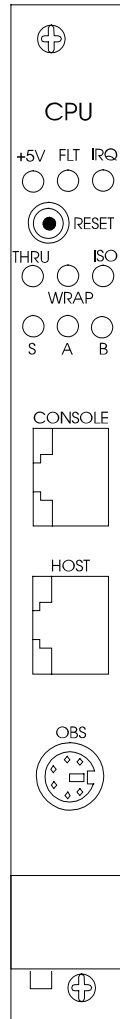
The Central Processing Unit (CPU)

The Central Processing Unit (CPU) module provides the microprocessor platform for executing the system software. Additionally, the CPU module features a 512 Kilobyte Flash EPROM circuit used for network downloading of software images. The CPU module also contains a configuration control element (CCE) to allow access to the Concentrator's primary and secondary FDDI paths for backplane diagnostics and PHY port loopback testing.

The CPU module provides the bus master interface circuitry to communicate with the MAC and PHY modules. The bus interface is implemented as a 32-bit data, 24-bit address, asynchronous master/slave communication link. Bus arbitration is not required since the CPU module is the only bus master on the backplane.

The CPU module must be positioned in the leftmost slot for operation.

The CPU module controls the Optical Bypass Switch, if connected.



Control/Indicators	Function
+5V	Green LED. 5 VDC is present.
FLT (Fault)	Amber LED. The CPU has either experienced a fault or an attention event has occurred within the Concentrator. The operator should connect a terminal to the Console port and display the message(s).
IRQ Interrupt	Green LED. CPU Interrupt processing is in progress.
RESET	Depressing the recessed push-button causes a total system reset of the Concentrator.
THRU	Green LED. The FDDI Station Configuration State is THRU.
WRAP	Green LED. The FDDI Station Configuration State is WRAP. Used with either the S, A or B indicator.
ISO (Isolated)	Green LED. The FDDI Station Configuration State is ISOLATED.
S	Green LED. Concentrator configuration is Single Attach. Used with the WRAP indicator.
A	Green LED. Concentrator configuration is Dual Attach. Used with B, WRAP and THRU indicators.
B	Green LED. Concentrator configuration is Dual Attach. Used with A, WRAP and THRU indicators.
CONSOLE	RS232 port for connection to a terminal.
HOST	RS232 serial port connector provided for SLIP.
OBS	6-Pin DIN connector for control of an optional external optical bypass switch.

Figure 4-2. CPU Indicators

The Configuration Management (CFM) LEDs provide a visual indication of the Concentrator's current CFM state. Refer to Appendix E for a description of Configuration Management.

Table 4-1. CFM LEDs

State of CFM LEDs	Description												
<p>○ = LED ● = LED ON</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	●	●	●	S	A	B	<p>Occurs when the system power is turned on or reset.</p>			
THRU	WRAP	ISO											
●	●	●											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>○</td> <td>○</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	○	○	S	A	B	<p>CPU board malfunction.</p>			
THRU	WRAP	ISO											
○	○	○											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>○</td> <td>●</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	○	●	S	A	B	<p>The attachments are not inserted into any path. Applicable for SAC and DAC. CFM State = ISOLATED</p>			
THRU	WRAP	ISO											
○	○	●											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>●</td> <td>○</td> <td>○</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	●	○	○	S	A	B	<p>The primary path enters the A port and emerges from the B port. The secondary path enters the B port and emerges from the A port. Applicable for DAC. CFM State = THRU</p>			
THRU	WRAP	ISO											
●	○	○											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>●</td> <td>○</td> </tr> <tr> <td>●</td> <td>○</td> <td>○</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	●	○	●	○	○	S	A	B	<p>The primary path is wrapped to the S port. Applicable for SAC. CFM State = WRAP_S</p>
THRU	WRAP	ISO											
○	●	○											
●	○	○											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>●</td> <td>○</td> </tr> <tr> <td>○</td> <td>●</td> <td>○</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	●	○	○	●	○	S	A	B	<p>The primary and secondary paths are joined internal to the station and wrapped to the A port. CFM State = WRAP_A</p>
THRU	WRAP	ISO											
○	●	○											
○	●	○											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>●</td> <td>○</td> </tr> <tr> <td>○</td> <td>○</td> <td>●</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	●	○	○	○	●	S	A	B	<p>The primary and secondary paths are joined internal to the station and wrapped to the B port. CFM State = WRAP_B</p>
THRU	WRAP	ISO											
○	●	○											
○	○	●											
S	A	B											
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>THRU</td> <td>WRAP</td> <td>ISO</td> </tr> <tr> <td>○</td> <td>●</td> <td>○</td> </tr> <tr> <td>○</td> <td>●</td> <td>●</td> </tr> <tr> <td>S</td> <td>A</td> <td>B</td> </tr> </table>	THRU	WRAP	ISO	○	●	○	○	●	●	S	A	B	<p>The primary path is wrapped to the B port and the secondary path is wrapped to the A port. Applicable for DAC. CFM State = WRAP_AB</p>
THRU	WRAP	ISO											
○	●	○											
○	●	●											
S	A	B											

Media Access Controller (MAC) Controls and Indicators

The MAC module provides the Media Access Control and buffer memory for the purpose of providing fair and deterministic access to the medium, address recognition, and generation and verification of frame check sequences. Its primary function is the delivery of frames, including frame insertion, repetition, and removal.

The MAC module includes the memory management hardware for handling received frames and frames to be transmitted.

Most concentrators will have at least one MAC module to allow it to be managed using SNMP or SMT. The M1600 MAC modules are installed immediately beneath the CPU module, which is always in the upper left slot.

If a single MAC module is present in the subrack, it is configured to be used as the Primary MAC and provides media access for the M1600 on the primary ring. If two MAC modules are present in the system, they are configured to be used as Primary and Secondary/Roving MACs, respectively. A MAC configured as a Secondary MAC provides media access for the concentrator on the secondary ring. A Roving MAC provides access to the local path and supports *graceful insertion* when the concentrator's M ports are connected. If a third MAC module is present, it will be configured as a spare. The Secondary/Roving MAC will be a spare for the Primary MAC if the third MAC is not installed.

Note The M1600 architecture supports only two physical paths. That is, the user cannot have a Secondary MAC and a Roving MAC functioning in the concentrator. Furthermore, graceful insertion is only supported for insertion into the Primary token path.

Graceful Insertion

The graceful insertion mechanism supported by SMT 7.2/7.3 allows a station (or a branch) connected to an M port to be switched into the token path of the main ring while reducing the possibility of token loss and a claim sequence.

This mechanism involves achieving Ring Op on the local ring, capturing the token on both the primary ring and the local ring, switching the M port's CCE to place it onto the primary token path, and then releasing a token from one of the MACs.

Note There is no guarantee that the graceful insertion process will succeed under normal conditions. Additionally, there is no guarantee that there will not be a claim process with any graceful insertion mechanism.

The user has the option of configuring the purpose of the secondary/local path via the set config path <secondary | local> command [See p. 5-24]. If two MACs are present and the secondary/local path is configured as a local path, the second MAC, behaves as a Roving MAC and graceful insertion **is** activated upon each insertion of a port.

If two MACs are present and the secondary/local path is configured as a secondary path, the second MAC behaves as a secondary MAC, and graceful insertion is **not** used. In this case, each insertion of a port will generate a claim process and is likely to bounce the ring.

See **NOTE:** on p. 4-6.

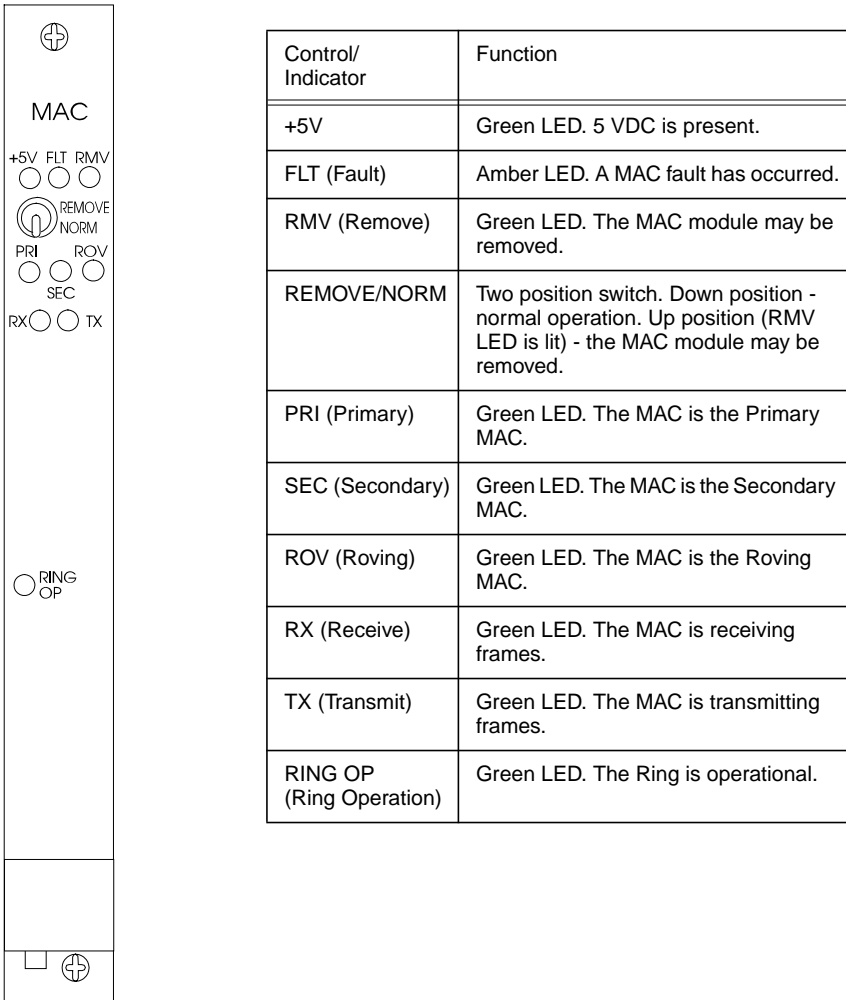


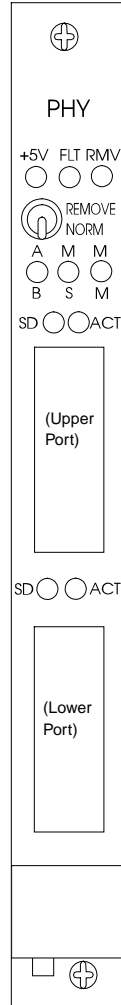
Figure 4-2. MAC Controls and Indicators

**Physical
Interface
Module (PHY)
Controls And
Indicators**

The PHY module consists of two separate physical attachment interfaces to the FDDI network. Each PHY module is capable of functioning as two PHY M (Master) ports, a PHY M and PHY S (Slave) attachment, or as a PHY A and PHY B attachment. The PHY module configuration is hardware selectable via jumper options.

The PHY module currently supports Fiber Optic MIC transceivers, and Unshielded Twisted Pair (UTP) media connectors. It can also support ST-style receiver/transmitter pairs and single-mode transceivers.

The PHY module provides the necessary interface between the media and the data paths in the Concentrator.



Control/Indicator	Function
+5V	Green LED. 5 VDC is present.
FLT (Fault)	Amber LED. A PHY fault has occurred.
RMV (Remove)	Green LED. The PHY module may be removed.
REMOVE/NORM	Two position switch. Down position - normal operation. Up position (RMV LED is lit) - the PHY module may be removed.
A/B	Green LED. The upper port is type A. The lower port is type B.
M/S	Green LED. The upper port is type M. The lower port is type S.
M/M	Green LED. The upper and lower ports are type M.
UPPER PORT	This port may be configured as an A or M port type.
SD (Signal Detect)	Green LED. The upper port is receiving a signal from an attached FDDI port.
ACT (Active)	Green LED. The PCM has completed and the upper port is inserted into a path.
LOWER PORT	This port can be configured as a B, S, or M port type.
SD	Green LED. The lower port is receiving a signal from an attached FDDI port.
ACT	Green LED. The PCM has completed and the lower port is inserted into a path.

Figure 4-3. PHY Module Indicators and Controls

Notes

Console Interface

The Concentrator is designed to require very little user interaction with either the console or a management station once it has been configured with some basic parameters. In the simplest case, the Concentrator needs only an IP address, netmask, and broadcast address to interoperate on an FDDI ring. If desired, the Concentrator may be configured with up to eight (8) SNMP Manager IP addresses, and the SNMP Response Agent may be enabled to allow the system to be managed via SNMP. Furthermore, the IP address of a device acting as a gateway can be identified to the Concentrator.

It is desirable to set the user-defined MIB attributes in the Concentrator. These are text strings in the MIB that are intended to help identify and locate the device. These strings are stored in nonvolatile memory in the Concentrator and may be changed.

Some of the policies implemented by the Concentrator (reaction to the attachment port(s) failing, etc.) are set to default values when the system is built, but may be changed via console commands. It may be desirable to change these policies depending on the networking environment in which the Concentrator is expected to operate.

The password expected by the Concentrator before commands are accepted from the console may be changed from the default (no password) via a console command.

Console Commands and Conventions

The console interface implements a command-line style in which the user types the desired command followed by the options appropriate to that particular command. Multiple commands per line are not allowed, but there is a type-ahead feature bounded only by the input buffer size.

In the description of the commands and their various options, the conventions described below are assumed. Items for which input is

expected as either a numeric quantity or a text string are denoted by angle brackets, for example:

<example>

Optional items in a command line are denoted by boldface type in square brackets, for example:

[example]

When items in a command line have more than one option for the user to choose from, the choices are separated by the logical “OR” symbol (“|”), for example:

enable <mac | phy>

The user would type **enable mac** or **enable phy**.

Keywords expected to be typed literally are **bold**, for example:

di config

Expected numerical quantities are described in the form ***whatever_number***.

Initial Setup Commands

Normally, the M1600 factory defaults are adequate for most applications. If the user wants to tailor the parameters to meet a specific network configuration, the following commands are useful for reconfiguration:

help

The **help** command displays a summary description of the commands that are available through the console interface. For additional detail about the commands, individual help menus are available by typing **<command> help**.

```
concen: help
Console commands:
-----
? - display this stuff
arp - set, delete, or dump arp table, "arp help" for usage
connect - connect to ring
d - display, "d help" for more info
disable - disable a MAC or PHY board, "disable help" for usage
disconnect - disconnect from ring
enable - enable a MAC or PHY board, "enable help" for usage
help - display this stuff
lo - end console session
ping - send echo packets, "ping help" for usage
reset - reset the concentrator
route - add/delete IP routes, "route help" for usage
s - set, "s help" for more info
snmp - enable or disable SNMP Response Agent
trap - issue an SNMP trap, use "trap <number>"
. - end console session

concen:
```

d ip

The **d ip** command provides the current IP settings.

```
concen: d ip
IP: 157.175.215.14, netmask: 255.255.255.0, broadcast: 157.175.215.0
concen:
```

Typically, the IP address, netmask, and broadcast address are the only parameters that need to be changed to meet unique network applications.

s ip help

The **s ip help** command provides a description of the command line syntax required to change the IP address, netmask, and broadcast address.

```
concen: s ip help
usage: set ip <IP address> <netmask> <broadcast address>
concen:
```

s ip

The **s ip** command is used to change the current settings. To change the settings to an IP address of 123.456.789.10, netmask of 255.255.255.0, and broadcast address of 123.456.789.0, perform the following command:

```
concen: s ip 123.456.789.10 255.255.255.0 123.456.789.0 <return>
concen:
```

Note A reset is required to initialize the software with the new parameter settings.

s config help

The **s config help** command lists the configuration parameters that can be altered by the user and the command line syntax. A detailed explanation of the commands may be found in the “Console Commands” section of this chapter.

```
concen: s config help
usage: set config attach <normal | b | all>
       set config launch <eprom | flash>
       set config gateway <IP address>
       set config slip <IP address> <netmask> <host address>
       set config password <up to 10 chars>
       set config <primary | secondary> <xx xx xx xx xx xx>
       set config syscontact <up to 128 chars>
       set config syslocation <up to 64 chars>
       set config sysname <up to 32 chars>
       set config userdata <up to 32 chars>
       set config community <up to 32 chars>

concen:
```

Commonly Used Commands

The following commands are often used to monitor performance of the Concentrator. Screen replications are samples of typical command output.

d ports

The **d ports** console command is used to get information on the status of all of the ports in the Concentrator. Even though only a few ports may actually be installed in the system, information will be presented for what would be a Concentrator with 38 ports. Ports 22 through 37 are not available in the present hardware design.

```

concen: d ports
PHY Type Status Neigh PCM CCE | PHY Type Status Neigh PCM CCE
-----|-----
0 A Active B PC8/ACTIVE X | 1 B Connecting ? PC3/CONNECT I
2 M Connecting? PC3/CONNECT I | 3 M Connecting ? PC3/CONNECT I
4 M Active A PC8/ACTIVE P | 5 M Connecting ? PC3/CONNECT I
6 M Connecting? PC3/CONNECT I | 7 M Active S PC8/ACTIVE P
8 M Connecting? PC3/CONNECT I | 9 M Connecting ? PC3/CONNECT I
10 M Standby ? PC3/CONNECT I | 11 M Active S PC8/ACTIVE P
12 Disabled PC0/OFF | 13 Disabled PC0/OFF
14 Disabled PC0/OFF | 15 Disabled PC0/OFF
16 Disabled PC0/OFF | 17 Disabled PC0/OFF
18 Disabled PC0/OFF | 19 Disabled PC0/OFF
20 Disabled PC0/OFF | 21 Disabled PC0/OFF
22 Disabled PC0/OFF | 23 Disabled PC0/OFF
24 Disabled PC0/OFF | 25 Disabled PC0/OFF
26 Disabled PC0/OFF | 27 Disabled PC0/OFF
28 Disabled PC0/OFF | 29 Disabled PC0/OFF
30 Disabled PC0/OFF | 31 Disabled PC0/OFF
32 Disabled PC0/OFF | 33 Disabled PC0/OFF
34 Disabled PC0/OFF | 35 Disabled PC0/OFF
36 Disabled PC0/OFF | 37 Disabled PC0/OFF
concen:

```

Each PHY is represented by a number while each line shows the information for a PHY module. The SMT concentrator software assigns the numbers to the PHYs on the modules so that the leftmost ports have odd numbers and the rightmost ports have even numbers for 2-port PHY modules. For example, when the system first begins operation, PHY 6 refers to the upper PHY on the fourth PHY module (from the left) installed in the system.

The “Type” column refers to the type of the PHY in the Concentrator. From the example, you can see that this Concentrator is a dual attach system with ten (10) M ports. The “Status” column gives the current connection status of the PHY and allows you to easily determine (from the console) if the station attached to a port in the FDDI ring. The “Neigh” column indicates the port type of the other end of the connection. If the other end is not active or has not completed PCM signaling, a “?” will be shown. Otherwise, the letter (A, B, S or M) indicates the neighbor port type. The “PCM” column presents the state of the PCM state machine that is controlling the port. The “CCE” column indicates the current state of the port’s Configuration Control Element (CCE). This information is useful if there is a question about the configuration of the system and the destination path of a port. Refer to Table 5-1 for the description of the CCE states.

Table 5-1. CCE States

I	The port is not inserted into any path.
P	Inserted on the primary path.
S	Inserted on the secondary path.
X	Used only on Port A or B attachments as a special CCE state.

d mib counters

The **d mib counters** console command is useful for examining some of the more basic statistics associated with the MAC(s) installed in the Concentrator.

```
concen: d mib counters
Primary MAC:
  Total Frames 1960554, Xmit Frames 11844, Copied Frames 110664
  Error Frames 1, Lost Frames 0, Not Copied 0
  Ring Ops 207, Tokens 227244444

Secondary MAC not present
concen:
```

The first two lines printed for each MAC (after the name of the MAC) are frame-related and present information maintained in the SMT MIB by the software. The first number, "Total Frames," indicates how many frames the MAC has seen on the FDDI ring. It does not necessarily count the frames transmitted or received by this MAC, just the frames that have gone past this point on the ring. The "Xmit

Frames” value gives the total number of SMT and LLC (Logical Link Control) frames that have been transmitted by this MAC. “Copied Frames” counts the number of frames (SMT and LLC) that have been received by this MAC. All of the counters shown on the next line (Error Frames, Lost Frames, and Not Copied) are counters of erroneous conditions and should never be very large or increment quickly. The “Ring Ops” counter indicates how many times the FDDI ring has gone through a claim sequence and a token has been generated. The last counter, “Tokens”, indicates how many tokens have been seen by this MAC. In a small, lightly loaded ring, this counter will increment very quickly. In larger, more heavily loaded rings, this counter will increment more slowly because the MAC sees the token less often.

d neigh

The **d neigh** console command prints the non-canonical MAC address of both the upstream and downstream MACs in the FDDI ring.

```
concen: d neigh
Primary MAC upstream neighbor: 00:00:ee:48:09:80
Primary MAC downstream neighbor: 00:00:ee:68:c0:99
Secondary MAC not present
concen:
```

If the MAC immediately downstream of this Concentrator’s MAC does not respond to NIF requests, it is not possible (except in 2-MAC rings) for the Concentrator to determine the downstream MAC’s address. If this is the case, 0’s will be printed as the MAC address. If the MAC upstream of this Concentrator’s MAC is not transmitting

NIF announcements or requests, this Concentrator's MAC cannot determine the upstream MAC's address.

arp dump

The **arp dump** console command shows the IP address as well as the canonical MAC address and the non-canonical MAC address for each station in the ARP cache.

```
concen: arp dump
157.175.215.228 at 00-00-77-48-2c-6a (00:00:ee:12:34:56)
157.175.215.135 at 08-00-20-06-42-68 (10:00:04:60:42:16)
concen:
```

Even though the non-canonical address (00:00:ee:12:34:56 in the above example) is used by the FDDI network (and SMT), the protocol stack uses the canonical form internally.

ping

The **ping** command sends ICMP echo frames to a station on the network.

```
concen: ping 157.175.215.13 200 15
PING 157.175.215.13: 200 data bytes
concen: 208 bytes from 157.175.215.13: icmp_seq=0.
208 bytes from 157.175.215.13: icmp_seq=1.
208 bytes from 157.175.215.13: icmp_seq=2.
208 bytes from 157.175.215.13: icmp_seq=3.
208 bytes from 157.175.215.13: icmp_seq=4.
208 bytes from 157.175.215.13: icmp_seq=5.
208 bytes from 157.175.215.13: icmp_seq=6.
208 bytes from 157.175.215.13: icmp_seq=7.
208 bytes from 157.175.215.13: icmp_seq=8.
208 bytes from 157.175.215.13: icmp_seq=9.
208 bytes from 157.175.215.13: icmp_seq=10.
208 bytes from 157.175.215.13: icmp_seq=11.
208 bytes from 157.175.215.13: icmp_seq=12.
208 bytes from 157.175.215.13: icmp_seq=13.
208 bytes from 157.175.215.13: icmp_seq=14.

----157.175.215.13 PING Statistics----
15 packets transmitted, 15 packets received, 0% packet loss
```

The example above shows the output from a **ping** command intended to bounce ICMP Echo frames off the station on the network with the 157.175.215.13 IP address. A total of 15 ping frames were received from 157.175.215.13 and each frame was 200 bytes (plus 8 bytes of header) long.

d config

The **d config** console command prints out some of the information stored in the non-volatile memory on the CPU module. A number of operational parameters of the Concentrator are maintained in this memory.

```
concen: d config
Software Revision: a3
bootrom serial diagnostics results: 00
bootrom ram diagnostics results: 00
flash image is preferred for boot
ram size: 2097152 bytes
we've seen 435 resets
User-defined Primary MAC address: 00:00:00:00:00:00
User-defined Secondary MAC address: 00:00:00:00:00:00
SNMP Response Agent is enabled.
SNMP Enterprise ID path vector: 1 3 6 1 4 1 185 1
IP Address: 157.175.215.14, SLIP Address: 10.0.0.14
IP Broadcast Address: 157.175.215.0
IP netmask: 255.255.255.0, SLIP netmask: 255.255.255.0
Gateway: 157.175.215.135, SLIP Host: 10.0.0.19
SMTStationIdGrp_UserData is "Engineering"
SNMP SysContact is "User Name (x183 or 161)
"
SNMP SysName is "Net Traffic "
SNMP SysLocation is "Network Computer Area
"
The user-programmable community string is "ReadMeWriteMe".
The attachment fault policy is to break no M port connections.

concen:
```

The display shows the current status of the parameters, most of which may be modified using other console commands. Some of this information may be very useful if it becomes necessary to contact Interphase for assistance with the system. The Software Revision level (shown on the first line) is very important to note when calling for assistance. The IP-oriented parameters (about halfway down) are vital for correct operation of the SNMP Response Agent, TFTP download, TELNET, and SLIP. Whether or not the SNMP Response Agent is enabled is indicated on line 9. The "User Data" string, the SNMP strings, and the community string may be tailored (via console commands) to suit the needs of the network.

The attachment fault policy (indicated on the last line) is responsible for determining how the Concentrator reacts to a failure (or disconnection) of the system's attachment port(s) (A and B, or S).

d slots

The **d slots** command will list the modules in the system and their slot numbers. This mapping information shows the relationship between PHY pairs and subrack slots.

```
concen: d map
Slot Device
0 CPU
1 MAC 0 (Primary)
2 PHY 0 and 1
3 PHY 2 and 3
4 PHY 4 and 5
5 PHY 6 and 7
6 PHY 8 and 9
7 PHY 10 and 11
8 empty
9 empty
10 empty
11 empty
12 empty
13 empty
14 empty
15 empty
16 empty
17 empty
18 empty
19 empty
concen:
```

For example, PHY 10 and PHY 11 have been assigned to the PHYs on the PHY module in slot 7. PHY 10 is the upper port and PHY 11 is the lower port on the PHY module.

Special Console Messages

The Concentrator does not require a console to be connected to the CPU board at all times. When special circumstances require that an important message be sent to the console, that message is also buffered internally. When this occurs, a terminal may be connected to the CPU Console serial port and the "Return" key pressed to

retrieve the messages. The messages are then displayed on the console.

The text messages that are buffered internally are stored in chronological order. Only the first 20 messages are stored to avoid scrolling too many lines on the console and losing the first few. The mechanism was designed to work this way because the first few messages are the most important and the latter messages are often caused by earlier events.

Console Commands

The console interface implements a “command-line” style in which the user types the desired command followed by the options appropriate to that particular command. Multiple commands per line are not allowed, but there is a “type-ahead” feature bounded only by the input buffer size.

In the description of the commands and their various options, the conventions described below are assumed. Items for which input is expected as either a numeric quantity or a text string are denoted by angle brackets (< and >). Optional items in a command line are denoted by square brackets ([and]). Items in a command line that may have replacements (at the user’s discretion) are separated by the logical “or” symbol (|). Keywords expected to be typed literally are **bold**. Expected numerical quantities are described in form *whatever_number*.

Console Help Commands

? or **he** or **help**

These commands respond with a summary description of the commands available via the console. The **help**, **he**, and **?** commands are identical. Note that in the console display not all of the commands are described in exhaustive detail due to space constraints. If additional help is desired on the display, set, or various MIB commands, type **di help**, **s help**, or **di mib help** for additional information on those commands.

ARP Table Commands

arp del <host_address>

This command will delete an entry in the ARP table corresponding to *host_address*. If *host_address* is not found in the table, no changes are made to the ARP table and a notification message is displayed on the console.

arp dump

This command responds with the contents of the ARP table as IP address/MAC address pairs. Both the canonical and non-canonical representation of the MAC address(es) are provided.

arp help

This command responds with a summary of the commands used to manipulate or examine the ARP table. The same information is also available by typing **arp** alone.

arp set <host_address> <hardware_address>

This command enters a new *host_address/hardware_address* pair into the ARP table. If the table is full, no modifications are made to it, and a notification message is displayed on the console.

FDDI Ring Connection/Disconnection Commands

connect

This command instructs the Concentrator to connect to the ring and allows connections to become active on the M ports. When the system is powered up, the Concentrator automatically attempts to connect.

disconnect

This command instructs the Concentrator to disconnect from the ring and disallows connections to the M ports. Any active connections to all ports on the Concentrator are broken.

Display Commands

Note that the **d** and **di** commands are equivalent. The **di** style is used below, but the **d** style is also accepted for all display commands.

di ? or **di he** or **di help**

This command responds with a summary of all the display commands available via the console.

di b <address> [count]

This command displays a number (*count* = number of bytes to display) of 8-bit bytes of memory starting at the defined *address*.

di config

This command responds with the contents of the Configuration RAM used by the Concentrator software.

di fsi <mac_number | **primary** | **secondary** | **roving** > [regs]

This command responds with the contents of the selected MAC's controlling data structure. The FSI selected is the one associated with the MAC denoted by *mac_number*, or the keywords **primary**, **secondary**, or **roving**. If the **regs** option is requested, some of the FSI's registers are displayed on the console. Reading certain registers would alter the normal operation of the device, so these registers are not displayed. See the Motorola FSI (MC68839) Specification for more information.

di fstats [mac_number]

This command responds with the raw frame reception and transmission statistics for the selected MAC in the Concentrator. If the *mac_number* parameter is omitted, the statistics for the Primary MAC will be displayed on the console.

di ip

This command responds with the IP address, netmask, and broadcast address used by the Concentrator.

di m <address> [count]

This command displays a number of 32-bit words of memory starting at the defined address.

di mac <mac_number | **primary** | **secondary** | **roving**> [regs]

This command responds with the contents of the selected MAC's controlling data structure. The MAC selected is the one associated with the MAC denoted by *mac_number*, or the keywords **primary**, **secondary**, or **roving**. If the **regs** option is requested, some of the MAC's registers are displayed on the console. Reading certain registers would alter the normal operation of the device, so these registers are not displayed.

di mib ? or **di mib he** or **di mib help**

This command responds with a summary of all the MIB display commands available via the console.

di mib cfm

This command responds with the current SMT CFM state using information drawn from the MIB. Note that the displayed CFM state depends on the configuration of the Concentrator (single, dual, or null attach) as well as the active status of the attachment ports.

di mib counters

This command responds with some of the more interesting MIB counters for each of the MAC's installed in the Concentrator.

di mib ler <port>

This command responds with link error information for the PHY selected by the *port* parameter. The information is drawn from the MIB.

di mib rmt

This command responds with the status of the primary and secondary rings. The information is drawn from the MIB and actually indicates the state of the RMT state machines running with the primary and secondary MACs. This command is identical to **di ring**.

di neigh

This command responds with the MAC addresses of the upstream and downstream neighbors of each MAC in the Concentrator.

di phy <phy_number> [regs]

This command responds with the contents of the selected ELM's controlling data structure. If the **regs** option is requested, some of the ELM's registers are displayed on the console. Reading certain registers would alter the normal operation of the device, so those registers are not accessed by this command.

di ports

This command responds with information about all of the PHYs in the Concentrator. The information is taken directly from the MIB and represents the PHY ID, operational status, type, neighbor type (if the port is active), PCM State, and CCE mode. Note that the information on the screen will indicate more PHYs than are physically present in the current hardware configuration of the Concentrator.

di ring

This command responds with the status of the primary and secondary rings. The information is drawn from the MIB and actually indicates the state of the RMT state machine running with the primary and secondary MACs. This command is identical to the **di mib rmt** command.

di slots

This command responds with the mapping of slot numbers to device numbers (PHY and MAC) for all of the possible slots in the Concentrator. In addition, internal mapping information is displayed for the MACs and the PHYs.

di vitals

This command responds with statistics maintained for memory management, serial port buffer management, and time since reset.

di w <address> [count]

This command displays a number of 16-bit words of memory starting at the defined address.

Ping Commands

ping <*host_address*> [*size*] [*count*]

This console command causes the pinging mechanism to issue “count” ping frames of the length *size* to *host_address*. Response statistics are accumulated and displayed when all of the frames have been sent. The timeout for reception of a response frame from the node being pinged is approximately one (1) second. Note that while the ping mechanism is running, all other console commands are accepted by the Concentrator and any response text from a command will be intermixed with the ping response frame status text. Also, only one ping command to a single host is allowed at a time. If a ping command is typed while a ping is currently active, the console will respond with a warning message and continue with the original ping.

ping stop

This command causes the ping mechanism to stop sending ping frames. The same effect may be achieved by typing “CTRL-D” (the “CTRL” key is held down while typing “d”). When the ping operation is terminated prematurely, the current frame transmission and reception statistics are displayed.

PHY and MAC Control Commands

disable <**mac** | **phy**> <*device_number*>

This command causes the Concentrator to disable a MAC or PHY. Disabling a PHY that is currently maintaining an active connection will cause the PHY to break the connection before it is disabled. This will, of course, cause the node(s) that were on the ring due to the active connection to disappear. Disabling a MAC causes the ring to which it belongs to bounce as the MAC is removed from the token path. The keywords **mac** and **phy** select which device type is to be disabled while the *device_number* option selects the specific device. (Device numbers can be determined with the **d slots** command.) Note that this command will not allow a MAC or PHY that is not physically present in the card cage to be disabled.

enable <**mac** | **phy**> <*device_number*>

This command causes the Concentrator to enable a MAC or PHY that was previously disabled due to a diagnostic fault or the **disable**

command. The keywords **mac** and **phy** select which device type is to be enabled while the *device_number* option selects the specific device. Note that this command will not allow a MAC or PHY that is not physically present in the card cage to be enabled. Be aware of the risk of enabling a MAC or PHY that has been disabled due to a diagnostics fault. Doing this could have dire consequences on the integrity and operational characteristics of the FDDI ring and the Concentrator. This is because FDDI makes the assumption that all devices in the ring are well-behaved. Malfunctioning PHYs and especially MACs will likely cause the fault recovery mechanisms of SMT to come into play, probably disrupting useful communication on the FDDI ring for some period of time.

Concentrator Reset Command

reset

This command causes a reset of the Concentrator. The system will restart as if it had been powered up.

IP Routing Table Commands

route [help]

This command responds with a summary of the commands available for manipulating or examining the IP routing tables. This same information is also available by typing **route** alone.

route add <destination> <gateway> <metric>

This command causes a new entry to be added to an IP routing table if it is not already full. The *metric* entry indicates the number of hops to the destination. Zero (0) is used for a normal host. An entry with a metric of one (1) or greater represents a gateway. If the keyword **default** is substituted for a destination IP address, zero (0) is used for the routing table entry instead of an actual IP address.

route del <destination> <gateway> <metric>

This command causes the removal of the entry associated with *destination* from the IP routing table.

route dump <net | host>

This command responds with the content of the network or host IP routing table. If neither the **net** nor the **host** options are provided, the command defaults to printing the content of the network IP routing table.

Set Commands

Note that the **s** and **set** commands are equivalent. The **set** style is used below, but the **s** style is also accepted for all set commands.

set ? or set he or set help

This command responds with a summary of all the **set** commands available via the console.

set b <address> <value>

This command sets a byte of memory at the defined address to a specific value.

Note that this command allows direct access to the internal memory space of the system. Users are cautioned against using this command.

set config ? or set config he or set config help

This command responds with a summary of all the **set config** commands available via the console. The **set config** commands affect the user-set configuration options stored internally.

set config <primary | secondary> <xx xx xx xx xx xx>

This command is used to change the MAC address of the selected MAC by modifying the address stored in non-volatile memory in the concentrator. The address that the MAC will adopt is given by the hexadecimal value `xx xx xx xx xx xx`, which must be entered with spaces between the hexadecimal character pairs. The address is expected to be in canonical format. The FDDI ring will not reinitialize when the MAC address is changed, as this command only affects the user-defined MAC address stored in non-volatile memory. If the MAC address entered is zero (all bytes zero), the concentrator (after it is reset) will revert to using the default MAC address programmed at the time of manufacture. The new values will be used only after the system is reset.

set config attach <normal | b | all>

This command tells the Concentrator how to react when the attachment port(s) (A/B or S) is disconnected or fails. The **normal** option directs the system to not break any of the connections that are active on the M ports of the Concentrator. This is the mode of operation that the SMT specification intends and should be adequate for most FDDI topologies. To support special networking environments, the **b** option directs the Concentrator to break all active connections on the M ports which have B port neighbors. This might be useful in certain topologies to force dual-homed stations to revert to their A ports to prevent false segmentation of those stations from the main ring. The **all** option directs the Concentrator to break all active M port connections if the attachment port(s) fails.

set config community <up to 32 characters>

This command changes the community string used by the SNMP Response Agent in nonvolatile memory. The community identified by this string has both read and write access to the MIB.

set config gateway [IP address]

This command directs the Concentrator to store a gateway address to be used as the default entry in the IP network routing table at power-up or reset. The *IP address* argument should be in IP address "dot" notation. For example, the command "**set config gateway 65.12.3.14**" would set the gateway IP address to 0x410c030e. If an IP address is not provided, the gateway address initialization will not be done. Note that this command does not actively modify information currently being used by the Concentrator. The new values are used after the system is reset.

set config launch <eprom | flash>

This command directs the Concentrator to prefer either the EPROM or Flash EPROM image for execution when the system is reset or powered up. If problems with the Flash image are suspected, usually the first course of action is to launch the EPROM image and look for a change in behavior.

set config password <up to 10 characters>

This command changes the password required by the console before any commands are accepted. If the string following the

password keyword is empty, (i.e., **set config password**), a password is not expected by the console when the system starts.

set config path <secondary | local>

This console command is used to determine if the M1600 attempts to affect graceful insertion of stations connecting to the M ports. If graceful insertion is selected (via the **local** option), the M1600 will use a second MAC (if installed) and the second local internal symbol path to support graceful insertion. If the **secondary** option is selected, the M1600 will use the second internal path as the normal secondary path and a second MAC (if installed) as the secondary MAC.

set config slip <local address> <netmask> <destination address>

This command changes the IP address, netmask, and destination (host) address used by the Concentrator software for the SLIP interface using the Host serial port. It is not required to enter all three (3) attributes. The data will be accepted in left-to-right order. So, if the user enters only one (1) option, it will be taken as the IP address of the SLIP interface. Two options will be taken as the IP address and the netmask, while three (3) options will be accepted as the IP address, netmask, and destination address, in that order. All addresses should be entered in IP address “dot” format (each byte of the 32-bit IP address typed in decimal, separated by a “.”). Note that this command does not actively modify information currently being used by the Concentrator. The new values are used after the system is reset.

set config syscontact <up to 128 characters>

This command changes the SNMP system contact MIB attribute in nonvolatile memory.

set config syslocation <up to 64 characters>

This command changes the SNMP system location MIB attribute in nonvolatile memory.

set config sysname <up to 32 characters>

This command changes the SNMP system name MIB attribute in nonvolatile memory.

set config userdata *<up to 32 characters>*

This command changes the user data string in nonvolatile memory for the SMTStationIDGrp MIB attribute.

set ip *<IP Address> <netmask> <broadcast address>*

This command changes the IP address, netmask, and broadcast address used by the Concentrator software. It is not required to enter all three (3) attributes. The data will be accepted in left-to-right order. So, if the user enters only one (1) option, it will be taken as the IP address. Two options will be taken as the IP address and the netmask, while three (3) options will be accepted as the IP address, netmask, and broadcast address, in that order. All addresses should be entered in IP address “dot” format (each byte of the 32-bit IP address typed in decimal, separated by a “.”). Note that this command does not actively modify information currently being used by the Concentrator; it simply sets values to be used when the system is reset.

set mgrip *<manager number> <IP address>*

This command changes the IP address of the selected SNMP management station. There are up to eight (8) SNMP managers (numbered 0 through 7) that the Concentrator will remember. If the IP address of a manager is 0, the manager will be ignored. The IP address should be entered in IP address “dot” format, even if the address is being zeroed out. The SNMP Manager(s) IP Address(es) set by this command cannot be explicitly retrieved by any other command.

set m *<address> <value>*

This command sets a 32-bit longword of memory at the defined address to a specified value.

Note that this command allows direct access to the internal memory space of the system. Users are cautioned against using this command.

set manager *<manager number> <IP address>*

This command allows the addition of an IP address to the list of IP addresses used when transmitting SNMP traps.

set tnotify <seconds>

This command changes the MIB attribute associated with T-notify used by the Primary MAC in the Concentrator. The *seconds* argument should represent the desired value of T-notify in seconds, with a value between 2 and 30 (inclusive). Note that this value is stored in nonvolatile memory and will still be used if the Concentrator is reset or powered up.

set w <address> <value>

This command sets a 16-bit word of memory at the defined address to a specific value

Note that this command allows direct access to the internal memory space of the system. Users are cautioned against using this command.

SNMP Response Agent Control

snmp [on | enable | off | disable]

This command allows the user to display or modify the current operational status of the SNMP response agent. The **snmp** command, when entered without any options, will indicate whether the SNMP agent is active or not. If the options **on** or **enable** are typed, the Concentrator will enable operation of the SNMP Agent and then reset the Concentrator so that initialization of the SNMP response agent may occur correctly. If the options **off** or **disable** are typed, the Concentrator will disable operation of the SNMP Agent and then reset the Concentrator.

SNMP Trap Command

trap <value>

This command causes the Concentrator to issue an SNMP trap using the argument *value* as the SNMP trap number in the transmitted frame.

Password-Related Commands

When the Concentrator is first started, the console software will issue a prompt to the connected terminal and wait for the commands to be typed in by the user. The console software supports a password mechanism to provide some measure of security. This mechanism requires the user to type the correct password followed by a carriage return (if a password has been set) before any other commands are accepted by the software. If a string is typed that does not match the password, the Concentrator software will respond with a message indicating that a password is required and wait for the correct password to be typed in. Only after a correct password is entered will the Concentrator accept console commands. Once the user completes all console interaction with the Concentrator software, **lo** or **."** may be typed to return the console software to its power-up state, i.e., waiting for a password.

Note that the Concentrator does not echo characters typed on the console terminal while it is waiting for the correct password. The software will begin to echo typed characters to the terminal only after the correct password has been entered.

lo or **."**

This command is used to end the console session begun by typing the password expected by the console. If the password mechanism is disabled (see below) this command has no effect.

set config password <up to 10 characters>

This command changes the password required by the console before any commands are accepted. If the string following the **password** keyword is empty, (i.e., **set config password**), a password is not expected by the console when the system starts.

Notes:

Maintenance and Troubleshooting

Note Only technically qualified persons should perform the installation, maintenance and troubleshooting of this product.

Beachten Sie Installation, Wartungsarbeiten und Fehlersuche sollten nur von qualifiziertem Wartungspersonal durchgeführt werden.

Although the Concentrator is configured to the user's specifications, your unit can be expanded or reconfigured. Modules may be added or reconfigured, and firmware may be updated.



Warning The Concentrator power cord is grounded. If the protective-ground connection is broken or malfunctioning, any accessible conductive part (including controls that appear to be insulated) can render an electric shock. To avoid personal injury or damage to the unit, do not operate this instrument unless all covers and panels are secured in place.

This product is electric static discharge sensitive (ESD). Before removing or reconfiguring any system component, a grounding device should be attached to the rear panel.

Achtung Dieses Gerät ist über das Netzkabel geerdet. Bei unterbrochenem Schutzleiter ist die Berührungssicherheit nicht gewährleistet. Vor öffnen des Gehäuses Netzstecker ziehen!

Zur Vermeidung von Beschädigungen durch elektrostatische Entladung ist das Gerät bei Modulwechsel über die Rückwand zu erden.

Troubleshooting Tips

Symptom	Indicators	Cause	Resolution
Power Supply			
No power to the Concentrator.	The +5V LED (GREEN) on the Concentrator power supply does not illuminate.	1) The Concentrator power is not switched on. 2) The AC cord is not plugged in. 3) Blown AC protection fuse.	1) Switch on the power at the rear of the Concentrator. 2) Make sure the AC cord is attached to the Concentrator and has been inserted into an acceptable AC power source.
No power to the fans.	The +12V LED (GREEN) on the Concentrator power supply does not illuminate and the cooling fans do not operate.	4) Faulty AC power source or Concentrator power supply.	3) Inspect or replace the fuse. 4) Check the power source and/or replace the Concentrator power supply.
The Concentrator is inoperative, but power is available.	The FLT LED (AMBER) on the Concentrator power supply is illuminated.	Faulty Concentrator power supply.	Replace the Concentrator power supply.

Symptom	Indicators	Cause	Resolution
CPU			
No power to the CPU module.	The +5V LED (GREEN) on the CPU module does not illuminate.	<ol style="list-style-type: none"> 1) The Concentrator power is not switched on. 2) The AC cord is not plugged in. 3) Blown AC protection fuse. 4) Faulty AC power source or Concentrator power supply. 5) Faulty CPU module. 	<ol style="list-style-type: none"> 1) Switch on the power at the rear of the Concentrator. 2) Make sure the AC cord is attached to the Concentrator and has been inserted into an acceptable AC power source. 3) Inspect or replace the fuse. 4) Check the power source and/or replace the Concentrator power supply. 5) Replace the CPU module.
Apparent problems with system operation.	The FLT LED (AMBER) on the CPU module is illuminated.	<ol style="list-style-type: none"> 1) An event has occurred within the Concentrator causing output and/or status that should be viewed on the console. 2) The Concentrator CPU has experienced a fault/abnormality. 3) Faulty CPU module. 	<ol style="list-style-type: none"> 1) Connect a terminal to the console port of the Concentrator and display the message(s). 2) Reset the Concentrator CPU module. 3) Replace the CPU module.
Inconsistent system behavior.	The IRQ LED (GREEN) on the CPU module is on for an extended time.	<ol style="list-style-type: none"> 1) Incorrectly seated CPU, MAC, or PHY module(s). 2) Faulty CPU module. 	<ol style="list-style-type: none"> 1) Ensure that all modules are firmly seated in the backplane. 2) Replace the defective CPU, MAC, or PHY module.
The CPU module reset button has no visible effect.	Most or all of the LEDs remain illuminated.	<ol style="list-style-type: none"> 1) Faulty CPU module. 2) Faulty backplane. 3) Faulty software image. 	<ol style="list-style-type: none"> 1) Connect a terminal to the console port of the Concentrator and observe the power up diagnostics. 2) Replace the CPU module.

Symptom	Indicators	Cause	Resolution
CPU (continued)			
Nodes connected to the PHY modules are unable to communicate with hosts on the main FDDI dual ring or a level higher in the tree.	The CFM LEDs (GREEN) are incorrectly illuminated.	1) The Concentrator attachments are not cabled correctly. 2) The attachment PHY module is faulty.	1) Check the attachment cabling. 2) Replace the faulty attachment PHY module.

Symptom	Indicators	Cause	Resolution
MAC			
The MAC is not transmitting and/or receiving frames.	The Fault LED may be illuminated.	1) Incorrectly seated MAC module. 2) Incorrect placement of the MAC module. 3) Faulty MAC module.	1) Verify slot order rules. 2) Ensure that all modules are firmly seated in the backplane. 3) Replace the faulty MAC module.
No frame transmission.	The Transmit LED never flickers on the primary or secondary MAC.	1) Incorrectly seated MAC module. 2) Faulty MAC module.	1) Ensure that all modules are firmly seated in the backplane. 2) Replace the faulty MAC module.
The system does not get ring op.	The Ring OP LED is not illuminated.	There is a fault somewhere on the ring.	Check your ring configuration and cable connections.

Symptom	Indicators	Cause	Resolution
PHY			
The PHY module appears inoperative.	The Fault LED may be illuminated.	<ol style="list-style-type: none"> 1) The PHY module is jumpered incorrectly. 2) Incorrectly seated PHY module. 3) Faulty PHY module. 	<ol style="list-style-type: none"> 1) Make sure that only one PHY module is jumpered as A/B or M/S. 2) Ensure that all modules are firmly seated in the backplane. 3) Replace the faulty PHY module.
No signal is being received from the connected PHY.	SD LED is not illuminated.	<ol style="list-style-type: none"> 1) The cable is broken or inserted incorrectly. 2) The PHY on the Concentrator or the neighboring PHY is faulty. 	<ol style="list-style-type: none"> 1) Check the cables. 2) Check the connector keying and cable connections. 3) Try connecting a known active station to the port to see if the port is active. 4) Replace the PHY module.
The station connected to the port cannot communicate.	The ACTIVE LED is not illuminated.	<ol style="list-style-type: none"> 1) The cable is broken or inserted incorrectly. 2) The port type is incompatible with this PHY. 3) The PHY on the Concentrator or the neighboring PHY is faulty. 	<ol style="list-style-type: none"> 1) Check the cables. 2) Check the connector keying, cable connections and neighboring port type. 3) Try connecting a known active port to see if the port is active. 4) Replace the PHY module.

Reconfiguring the Concentrator

The Concentrator is designed to accept multiple MAC and PHY modules for ease of expansion, increasing the number of M ports, and/or adding MAC entities (either for adding a single MAC or adding two MACs). The CPU module may also be replaced. Certain

restrictions must be adhered to by the user who elects to reconfigure the Concentrator.

CPU Module Insertion/Removal

Insertion or removal of the CPU module while the Concentrator is operating is not allowed. The software does detect if the CPU module has been placed in any slot other than the leftmost slot. The CPU module must reside in the leftmost slot for proper operation of the system. Placing more than one CPU module in the subrack is not allowed since damage to the backplane hardware interface may result. Removal of the CPU module while the Concentrator is operating will result in an immediate loss of functionality.

Reset/Power up PHY Configuration

When the Concentrator software executes during a reset or powerup, it examines the entire subrack to determine the types and slot locations of all PHY modules. The software expects to find only a single PHY module configured as the FDDI ring attachment module (PHY A/B or M/S). Any PHY modules beyond the first (scanning the subrack from left to right) of type A/B or M/S are ignored and the fault LED on those modules remains illuminated. The existence of the A/B or M/S PHY module determines the operating mode of the Concentrator, dual attach or single attach, respectively. If both A/B and M/S PHY modules are present, the software has no way of determining the operating mode of the Concentrator. It will print a complaint to the console serial port and shut down. The user should then determine the desired mode of operation and remove and/or reconfigure the PHY modules that are in conflict with the configuration policy.

MAC/PHY Relative Placement

After the software determines whether the leftmost PHY module is A/B or M/S, it will examine the relative slot placement of the MAC and PHY modules. This is done to ensure that all MACs in the system are located to the left (lower slot numbers) of the A/B or M/S PHY module and there are no M/M PHY modules between the MACs and the A/B or M/S PHY module. If the software encounters a module arrangement that conflicts with this rule, it will print a notification message to the console serial port and shut down. It is the user's responsibility to correct MAC and PHY module location problems and reset the Concentrator.

PHY Module Insertion/Removal

Insertion or removal of the PHY modules while the concentrator is operating is allowed. The response of the software will vary according to the PHY module type (A/B, M/S, or M/M), the PHY module types currently installed, and a set of rules designed to prevent incompatible configurations.

While the concentrator is operating, the software continuously scans the entire subrack. Any changes in the PHY modules are handled by the software to avoid disturbing the remainder of the system. If only M/M PHY modules are inserted or removed, there are no drastic effects on the normal concentrator operation, except when inserting an M/M PHY module that violates the MAC/PHY relative placement rules.

If the user wishes to place a new PHY module into the system, it should first be verified that there is not a slot ordering conflict. If the chosen slot is acceptable, the user may simply insert the module into the subrack. The software will detect the presence of the module and execute any diagnostics available for that module before it is configured into the system. If the newly inserted PHY module fails the diagnostics, it is left out of the system configuration and the fault LED is illuminated.

If the user wishes to remove a PHY module, the correct method is to flip the “Remove Request” switch up, wait for the “Remove OK” LED to be illuminated, and then physically remove the module from the system. If the user wishes to cancel the module removal, simply return the “Remove Request” switch to the normal position (down). This will cause the software to reconfigure and re-insert the module into the system.

Reset/Power up MAC Configuration

When the concentrator software runs after a reset or powerup, it examines the entire subrack to determine the slot locations of all the MAC modules. If a single MAC module is found, it is configured to be used as the Primary MAC. If two MAC modules are present in the subrack, they are configured to be used as the Primary and Secondary MAC, respectively. Under SMT 6.2, additional MAC modules are ignored by the software and disabled.

At system start-up, the Primary MAC will be the first MAC encountered by the software during its left-to-right scan of the

subrack, and the Secondary MAC will be the next MAC encountered during the scan.

MAC Module Insertion/Removal

Insertion or removal of a MAC module while the concentrator is operating is currently not allowed. SMT 6.2 does not correctly support the reconfiguration of MACs in any system.

Control Parameters

The Concentrator is initialized with all the appropriate SMT parameters required to interoperate within an FDDI network. The user can alter the following control parameters used by SMT:

- T-notify - Time in seconds that the Neighbor Notification Process uses. (Range is 2 to 30 seconds)
- T-request - Time in milliseconds that the Primary MAC (and Secondary MAC, if present) will provide as this station's requested token rotation time during a ring initialization (claim process).

Keying the connectors

The MIC ports on the PHY Module connect the concentrator to the dual ring or tree. The J1 and J2 jumpers on the module determine the port types. In addition, the ports should be keyed to match the jumper settings.

1. Set Jumpers, J1 and J2, on the PHY Module. The location of the jumpers is illustrated in Figure 6-1.

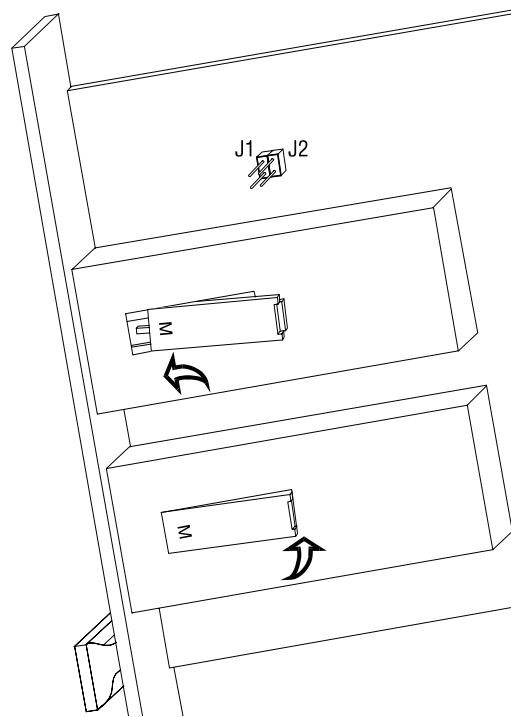
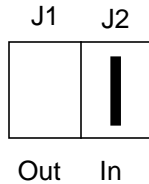
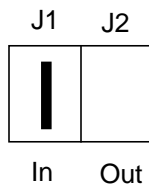


Figure 6-1. PHY Module Jumpers and MIC Keying

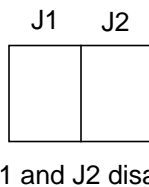
To configure the first PHY module to type A/B (dual attach connection) J1 is out and J2 is in.



To configure the first PHY module to type M/S (single attach), J1 is in and J2 is out.



To configure subsequent PHY modules to type M/M, both J1 and J2 are out.



2. The keying on the MICs must match the port types determined by the jumper setting. Insert the M, A, or B key as shown in Figure 6-1. S port MICs are not keyed.

Installing Software Updates

A software update may be installed on the concentrator via TFTP or by EPROM replacement. A TFTP download does not affect normal operation of the concentrator. The concentrator may be reset at a later time to activate changes. However, the concentrator must be powered off when replacing the EPROM.

TFTP Download Procedure

A TFTP download requires that a binary TFTP Write Request be issued to the concentrator, followed by subsequent data packets as the download progresses.

For example, to *tftp* a file:

1. Copy the file from the distribution media to a system that is networked to the concentrator.
2. *tftp* from the networked system to the IP address of the concentrator. Indicate binary transfer and using the *put* command, copy the file. For example:

```
system# tftp 128.10.2.228
tftp> binary
tftp> put filename
```

When the download completes, the concentrator will validate the image it received and then program it into the Flash EPROM. Messages printed to the console will indicate the steps of the download as it progresses. The protocol used is detailed in RFC783. Successful completion of a TFTP download and Flash programming automatically selects the Flash image for launch the next time the concentrator system is restarted. The concentrator is **not** restarted by the TFTP download to allow the user to schedule an appropriate time for a system restart after the software image update.

EPROM Removal/Replacement

1. Remove power from the concentrator.
2. Unscrew the upper and lower tapped screws. The screws should remain in the front panel.
3. Push downward on the front panel ejector and pull to remove the CPU module from the subrack.

4. Locate the EPROM and remove it from the socket with a screwdriver or appropriate IC extractor tool.

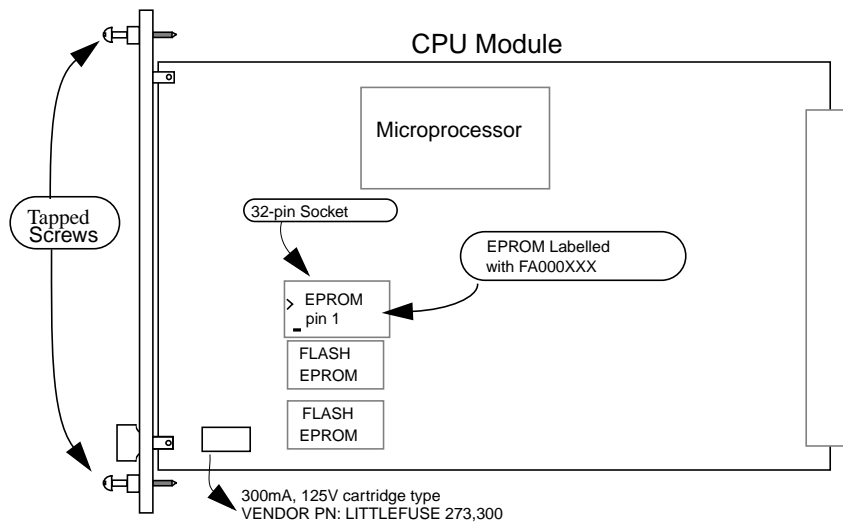


Figure 6-2. Removing/Replacing an EPROM

5. Replace the EPROM. Note the position of pin 1.
6. Return the CPU module to the leftmost position in the subrack and insert *firmly* into the backplane.
7. Screw and secure the upper and lower tapped screws.
8. Apply power to the concentrator.

Building a Cable

If you wish to build your own RJ45 to DB25 cable, the following illustrates the pinouts for the connectors.

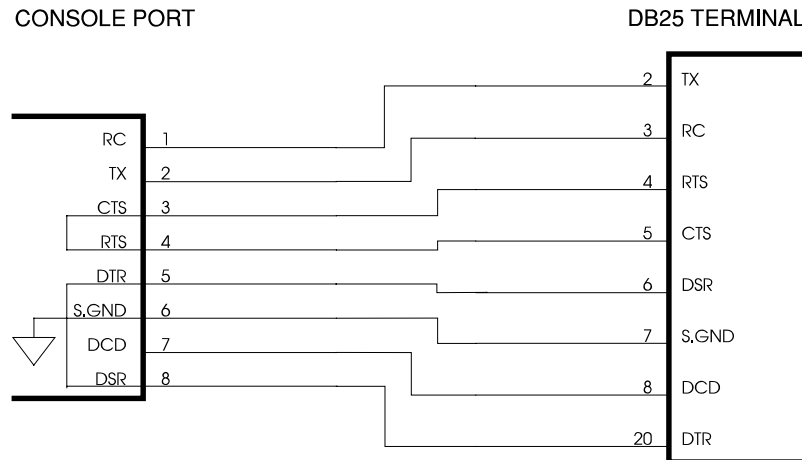


Figure 6-3. Console/Host Terminal Signal Flow

Table 6-1. RJ45 Electrical Pinout

Pin No.	Signal Name
1 (Top)	Receive Data
2	Transmit Data
3	CTS
4	RTS
5	DTR
6	Signal Ground
7	DCD
8	DSR

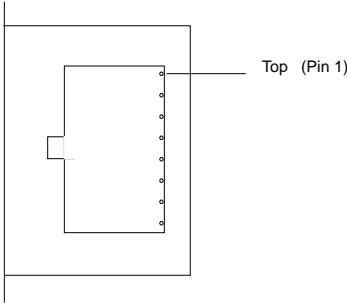


Figure 6-4. Diagram for RJ45 Electrical Pinout

Table 6-2. CPU Console/Host RJ45 Electrical Pinout

Pin No.	Signal	Direction
1	Receive Data	IN
2	Transmit Data	OUT
3	Looped to 4	IN
4	Looped to 3	OUT
5	Looped to 8	IN
6	Signal Ground	
7	Not Connected	
8	Looped to 5	OUT

Concentrator Specifications

The Concentrator cabinet consists of the following:

Size

188.9 mm High x 448.8 mm Wide x 411 mm Deep

19 Inch Rack Mount Support (17.5 inches wide)

Table Top Support

Replaceable Modules

Size 144.45mm x 220mm Modules (4U High x 220mm Deep)

Backplane Connector, 180 Pin with Extended Power and Ground Pins

Power Supply

250 Watts at 5 Volts

20 Watts at 12 Volts

N+1 Redundant

Industry Standard Form Factor

110-120 VAC Input, 5.0 Amp Max, 60 Hz.

200-230 VAC Input, 2.5 Amp Max, 50 Hz.

Fans

12 VDC

5-Inch Low-Noise

2 fans @ 56 CFM each

Weight

40 lbs. maximum (fully populated)

Operating Environment

Temperature 5 - 40 degrees Celsius

Humidity 5% - 95% Noncondensing

Storage Environment

Temperature 5 - 60 degrees Celsius

Humidity 5% - 95% Noncondensing

Fuses

110 VAC - 5 amps

230 VAC - 2.5 amps

Optional Settings

The following parameters may be altered by the user to suit the intended application:

Table B-1. Configurable Parameters and Defaults

Parameter	Default	New Definition
IP Address	157.175.215.19	
IP Netmask	255.255.255.0	
IP Broadcast Address	157.175.215.0	
Local SLIP Address	10.0.0.19	
SLIP Netmask	255.255.255.0	
SLIP Host Address	10.0.0.14	
Route Table entries		
Gateway address ^a	157.175.215.135	
SNMP Manager Addresses ^b		
SMT UserData		
SNMP MIB Attribute SysContact		
SNMP MIB Attribute SysName		
SNMP MIB Attribute SysLocation		
SNMP Community String	“WriteMeReadMe”	
Attachment Policy ^c	Break None	
Continued on next page . . .		

Table B-1. Configurable Parameters and Defaults (Continued)

Parameter	Default	New Definition
Console Password	(None)	
SNMP Agent Enable	Enabled	
T-notify ^d	30 sec.	

- a. Applicable if the M1600 is located on an FDDI network that utilizes Routers.
- b. Up to eight may be defined.
- c. Options are break none, break all, break “tree’d” B connections. This is an advanced feature for use in certain dual homing applications.
- d. Time in seconds that the Neighbor Notification Process will occur. (Range is 2 to 30 seconds, inclusive.)
- e. Time in milliseconds that the Primary MAC (and Secondary MAC, if present) will provide as the station requested token rotation time during ring initialization (claim process). (Range is 1 to 167 ms, inclusive.)

Cabling

FDDI can be transported over multiple types of physical media. The most common media include optical fiber and unshielded twisted pair (UTP) copper wire.

Note If you need cabling information for older Interphase modules not included below, please contact Customer Support at the location(s) listed in the front of this user's guide.

Unshielded Twisted Pair

The transmission of 100 Mbps over twisted pair cable is accomplished by using methods described in the TP-PMD (Twisted Pair-Physical Media Dependent) specification. It is made up of three components: Data Scrambling, MLT-3 Encode/Decode, and Adaptive Equalization.

Data Scrambling is a method of randomizing the NRZI data stream which has the effect of spreading the frequencies which emit energy across the frequency band.

MLT-3 encode/decode is a method of converting the scrambled NRZI (two-level signals) data into three level signals. MLT-3 has the effect of reducing the fundamental frequency of NRZI to one-half of its unconverted value. With MLT-3 coding, 90 percent of the spectral energy lies below 40 MHz. See Figure C-1.

Adaptive Equalization is required to compensate for amplitude attenuation and phase distortion of high-speed signals transported over twisted-pair copper cable.

MLT-3 encoding is shown in Figure C-1

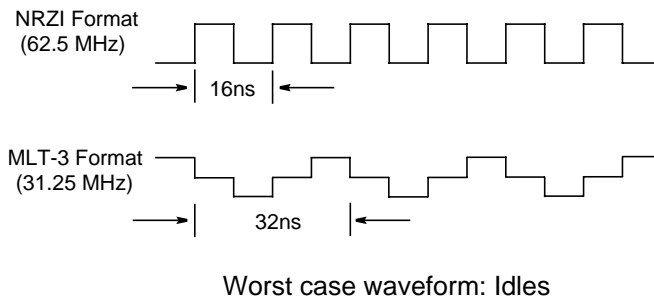


Figure C-1. MLT-3 Encoding

TP-PMD allows the use of an RJ45 connector for transmission over UTP cable. However, it does not provide any differentiation between an S port and an M port. It is the responsibility of the user to insure that the appropriate *crossover* cables, as shown in Figure C-2, are installed.

Caution For crossover cabling to meet EMI specifications, the unused twisted pairs must be connected to the RJ-45 connectors as shown in Figure C-2.

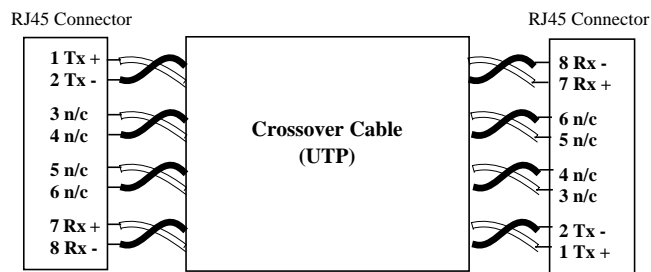
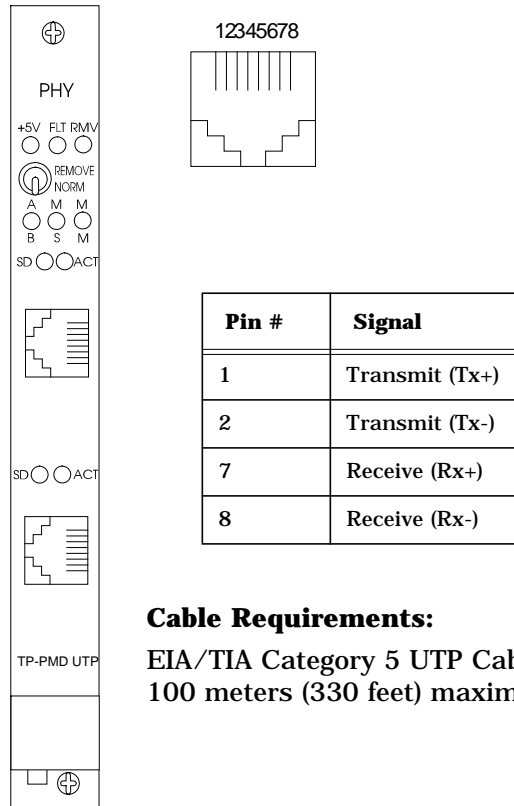


Figure C-2. UTP Crossover Cabling

TP-PMD UTP Cabling

Unshielded twisted pair (UTP) uses an 8-pin modular RJ45 style connector.



Cable Requirements:

EIA/TIA Category 5 UTP Cable Level 5
100 meters (330 feet) maximum distance

Figure C-3. PHY Module with TP-PMD UTP Connectors

UTP DO's

Following is a list of DOs to observe when using UTP:

1. RJ45 modular jacks must be EIA/TIA 568A or 568B type. This will ensure compliance with ANSI/EIA/TIA-568 and EIA/TIA/TSB-40.
2. Ensure the category 5 cable has 4-5 turns per inch and no portion of the cable has any untwisted lengths greater than 0.5 inches.
3. It is a good practice to indicate the type of service at each wall jack and cross connect.
4. Ensure modular jack patch panels are category 5.
5. Ensure patch cabling is category 5.
6. Ensure that the appropriate crossover cable between UTP ports is used.
7. All cables, punchdown blocks, patch panels, and wall plates **must be** Category 5.

UTP DON'Ts

Following is a list of DON'Ts to observe when using UTP:

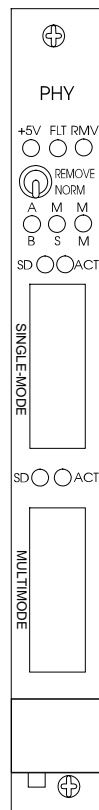
1. Do not use 66 blocks as a cross connect block. The 66 block does not conform to EIA/TIA 568 requirements for crosstalk (TSB-40).
2. Do not use 25 pair wire to the wiring closet. This type of wire will enhance the possibility of data errors due to crosstalk.
3. Do not share the 8 conductor cable use with any other function (e.g., local PBX or Ethernet).
4. Do not mix services on the same wall jack, or Ethernet, and UTP in a dual wall jack. This could cause interference on either or both data lines. Also the possibility of wrong connection exists.
5. Do not exceed 100 meters for Category 5 UTP cables.
6. Failure to follow the above cable length will increase the possible data error rate and degrade the throughput of the link.

Single-Mode and Multimode Fiber

The following three figures illustrate Single-Mode/Multimode, Multimode/Single-Mode, and Single-Mode/Single-Mode PHYs.

Single-Mode/Multimode Fiber Cabling

Single-Mode/Multimode fiber with MICs may be used with the Concentrator.



Cable Requirements:

Single-Mode

9 micron fiber

14 kilometers maximum distance

Cable Requirements:

Multimode

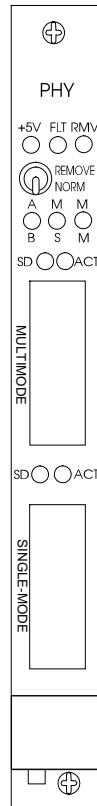
62.5 micron fiber

2 kilometers maximum distance

Figure C-4. Single-Mode/Multimode Fiber Connectors

Multimode/Single-Mode Fiber Cabling

Multimode/Single-Mode fiber with MICs may be used with the Concentrator.



Cable Requirements:

Multimode

62.5 micron fiber

2 kilometers maximum distance

Cable Requirements:

Single-Mode

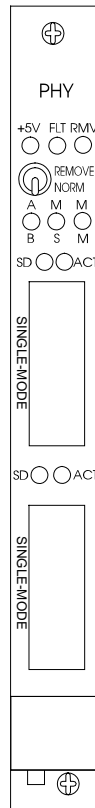
9 micron fiber

14 kilometers maximum distance

Figure C-5. Multimode/Single-Mode Fiber Connectors

Single-Mode Fiber

Single-Mode fiber with MICs may be used with the Concentrator.



Cable Requirements:

Single-Mode

9 micron fiber

14 kilometers maximum distance

Figure C-6. Single-Mode Fiber Connectors

Notes:

TELNET Console Interface

All of the commands available via a terminal connected to the Console serial port on the CPU module can be executed from a “virtual” console. This “virtual” console is accessed by establishing a TELNET protocol session with the concentrator. Note that anything printed as a result of the command typed on the virtual console will also appear on the physical console, if one is connected. The converse is also true. Also note that the password mechanism functions independently on the two consoles, except when ending a console session.

Someone typing the password on the physical console will be able to operate the console, but the system will ask for the password again if a TELNET console is activated. If the console session is ended on either console (**!o** or **.”**), both sessions will be terminated by the system. Operation of the TELNET interface requires that the IP attributes used by the concentrator software be programmed correctly.

SLIP Interface

A Serial Line IP (SLIP) interface is available via the Host serial port on the CPU module to allow communication with the SNMP Agent in an “out-of-band” fashion. The SLIP interface operates at 9600 baud, 8-bit data, no parity, and 1 stop bit. Before operation of the SLIP interface is attempted, the local SLIP address, netmask, and SLIP host address should be programmed via the console commands discussed earlier.

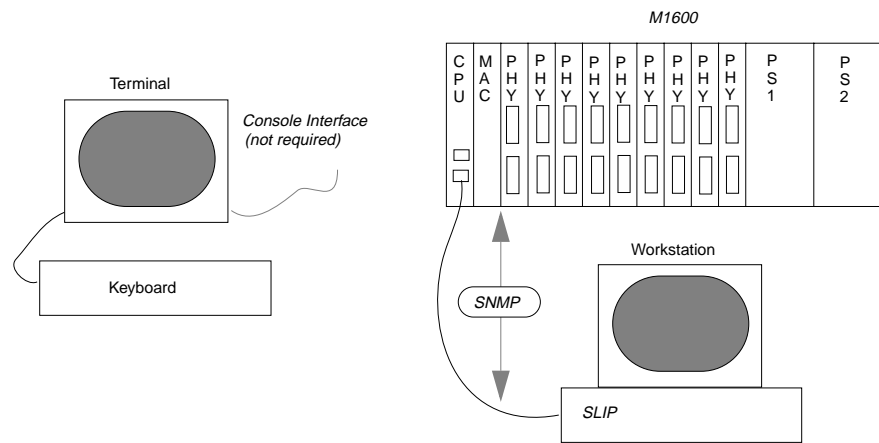


Figure D-2. SLIP Interface Connection

Notes

Glossary

American National Standards Institute

Organization which coordinates, develops and publishes standards used in the United States.

ANSI

American National Standards Institute.

Attenuation

Power lost in a transmission medium as a signal travels from sender to receiver.

Backbone

A network configuration that connects LANs into an integrated network.

Beacon

A special type of frame used to announce to stations on a ring that the ring has broken.

Bridge

An internetworking device used to connect two or more computer networks and to forward packets among the networks.

Bypass

The ability of a station to isolate itself optically from the FDDI network while maintaining the continuity of the cable plant.

Bypass Switch

A device used to isolate a station or concentrator from the network without breaking the ring.

CCE

Configuration Control Element.

Claim Process

A process used to determine which station will initialize the ring.

Code Bit

The smallest signaling element used by the Physical Layer for transmission on the medium.

Concentrator

An FDDI node that provides attachment points for stations not directly connected to a ring.

Configuration Control Element

A device used by SMT to configure a MAC or PHY into a path in the concentrator.

Connector Receptacle

The fixed or stationary half of a connection that is mounted on a panel. Receptacles mate with plugs.

Connection Management

The portion of Station Management (SMT) that controls insertion, removal, and connection of the PHY and MAC entities within a station.

Counter-Rotating Ring

A dual ring where the signal paths travel in opposite directions.

DAC

Dual Attach Concentrator.

DAS

Dual Attach Station.

Downstream

A term referring to the relative position of two stations in a ring. A station sends/passes a token to its downstream neighbor.

Dual Attach Concentrator

A concentrator that offers two connection to an FDDI ring (A and B ports) and M ports for connections to other stations.

Dual Attach Station

A station that offers two attachments capable of accommodating a dual (counter-rotating) ring connection to an FDDI network.

Dual Homing

An FDDI connection option in which both attachments of a dual attach station are connected to M ports on a concentrator. It offers greater fault tolerance than single attach.

Dual Ring

FDDI Dual Ring. A pair of counter-rotating logical rings.

Dual Ring of Trees

An FDDI network topology in which connections to the dual ring are formed by cascading nodes from concentrators.

EIA

Electronics Industries Association.

ELM

Elasticity Buffer and Link Management. The Motorola chip that implements the PHY layer functionality.

Entity

An active service or management element within an Open Systems Interconnection (OSI) layer or sublayer.

FDDI

Fiber Distributed Data Interface.

Fiber

Dielectric material that guides light.

Fiber Optic Cable

A cable containing one or more optical fibers.

Frame

A data message that includes the source address, destination address, data, frame check sequence and control information.

FSI

FDDI System Interface. The chip that assists frame transmission and reception.

LLC

Logical Link Control

Logical Link Control

The upper of the two sublayers of the Data Link Layer of the OSI Reference Model which defines the transmission of data between two stations with no intermediate switching nodes.

MAC

Media Access Control.

Management Information Base

The set of variables that describe the behavior and current state of a node.

Mbps

Megabits per second.

Media Access Control

The Data Link Layer sublayer responsible for scheduling, transmitting and receiving data on a shared media LAN. Also, the Motorola chip responsible for transmitting and receiving frames.

Media Interface Connector

An optical fiber connector pair that links the fiber media to an FDDI node.

MIB

Management Information Base.

MIC

Media Interface Connector.

Multimode

A large-core (62.5 micron) optical fiber through which multiple modes will propagate.

Neighbor Information Frame

A set of FDDI frames that support neighbor information polling and neighbor notification in SMT.

Network

An interconnection of multiple stations or systems that are able to send messages to or receive messages from one another.

NIF

Neighbor Information Frame.

Node

A device, such as a station or concentrator, connected to a network.

Packet

A group of bits, including data and control elements, that are transmitted together.

PCM

Physical Connection Management.

PHY

Physical Layer Protocol.

Physical connection

The full-duplex physical layer association between adjacent PHY entities (in concentrators or stations) in an FDDI network, i.e., a pair of Physical Links.

Physical Connection Management

The portion of Connection Management (CMT) that manages the physical connection between adjacent PHYs.

Physical Layer

Layer 1 of the OSI reference model.

Physical Layer Medium Dependent

FDDI standard that defines the medium and protocols used to transfer symbols between PHYs.

Physical Layer Protocol

FDDI standard that defines symbols, line states, clocking requirements and encoding of data for transmission.

PMD

Physical Layer Medium Dependent.

Ring

Connections between two or more stations that form a circular topology.

Ring Management

A portion of SMT that is responsible for managing and reporting the status of the MAC. There is an RMT portion of SMT for each MAC in a station.

RMT

Ring Management.

SAC

Single Attach Concentrator.

SAS

Single Attach Station.

SDDI

Shielded Twisted Pair FDDI (Fiber Distributed Data Interface).

Serial Line Internet Protocol

A protocol for transmitting and receiving IP datagrams via a serial interface.

Simple Network Management Protocol

A high-level standards-based protocol for network management, usually used in TCP/IP networks.

Single Attach Concentrator

A concentrator that offers one S port to attach the concentrator to an FDDI network and M ports to attach stations to the concentrator.

Single-mode

A small-core (9 micron) optical fiber through which only one mode will propagate.

SLIP

Serial Line Internet Protocol.

SMT

Station Management.

SNMP

Simple Network Management Protocol. A high level standards-based protocol for network management, usually used in TCP/IP networks.

Station

An addressable node on an FDDI ring capable of transmitting, receiving and repeating data. A station has at least one SMT entity, one PHY and PMD, and an optional MAC entity.

Station Management

An entity within a station on an FDDI ring that monitors station activity and exercises control of station activity.

STP

Shielded Twisted Pair.

Stuck Beacon

A condition where a station locks into sending continuous beacon frames.

Target Token Rotation Time

A value used by the MAC receiver to track the time it takes for a token to make one trip around the ring.

TELNET

A protocol that supports remote terminal operations via a network.

TFTP

Trivial File Transfer Protocol.

TIA

Telecommunications Industries Association.

Timed Token Protocol

A protocol defining how the target token rotation time is set, how long a station can hold a token, and how the ring is initialized.

T-Notify

The interval between transmissions of NIF requests or NIF announcements by SMT.

Token

A special frame that circulates around the ring. When a station holds the token, it can transmit data on the ring.

Token Holding Timer

A timer that controls the amount of time a station can hold the token in order to transmit asynchronous frames.

Token Passing

A method where each station, in turn, receives and passes the token around a ring.

Token Rotation Timer

Hardware that times the interval between consecutive receptions of a token by a station.

Trace

A diagnostic process used to recover from a stuck beacon condition.

T-Request

Time in milliseconds that the Primary MAC (and Secondary MAC, if present) will provide as this station's requested token rotation time during a ring initialization (claim process).

Trivial File Transfer Protocol

A simple file transfer protocol used to download software updates to the concentrator.

TRT

Token Rotation Timer.

TTRT

Target Token Rotation Time.

Upstream

A term referring to the relative position of two stations in a ring. A station receives a token from its upstream neighbor.

UTP

Unshielded Twisted Pair.

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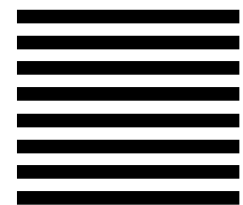
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