



Text Part Number: 78-5383-05

Update to Cisco Network Module Hardware Installation Guide

Product Numbers: NM-1A-OC3MM=, NM-1A-OC3SMI=, NM-1A-OC3SML=

This document contains new information for the *Cisco Network Module Hardware Installation Guide* for Cisco 3600 series modular access routers.



Warning All Cisco 3620 routers installed in the field before April 1999 contain a revision C PCMCIA controller. If you try to configure the ATM OC-3 network module in a Cisco 3620 router with the revision C PCMCIA controller, the system will not recognize the ATM OC-3 network module. A warning message will appear. If this occurs, call the Cisco Technical Assistance Center (TAC) to request a free replacement Cisco 3620 router. Starting in April 1999, all Cisco 3620 routers shipped from the factory will include revision E PCMCIA controllers, which are fully compatible with all three ATM OC-3 network modules.

If you have questions or need help, refer to the “Cisco Connection Online” section on page 8.

This document contains the following sections:

- Updates to the Cisco Network Module Hardware Installation Guide, page 1
- Documentation CD-ROM, page 8
- Cisco Connection Online, page 8

Updates to the Cisco Network Module Hardware Installation Guide

This section contains the following updates to the *Cisco Network Module Hardware Installation Guide*:

- Chapter 1 Updates, page 2
- Chapter 12 Updates, page 2

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Chapter 1 Updates

In Chapter 1, “Overview of Cisco Network Modules,” add the following information to Table 1-1:

Table 1-1 Network Module Options with Cisco IOS Releases for Cisco 3600 Series Routers

Network Module	Cisco IOS Release 11.1	Cisco IOS Release 11.2	Cisco IOS Release 11.3	Cisco IOS Release 11.3T	Cisco IOS Release 12.0T
1-port ATM OC-3	–	–	–	–	12.0(3)T

Chapter 12 Updates

In Chapter 12, “Connecting ATM Network Modules to a Network,” add the following sections after the “ATM-25 Network Module” section on page 12-4:

- ATM OC-3 Network Modules, page 2
- Laser Safety Guidelines, page 3
- Fiber-Optic Transmission Specifications, page 4
- Connection ATM OC-3 Ports to the Network, page 6
- ATM OC-3 Network Module LEDs, page 8

ATM OC-3 Network Modules

This section describes the following 1-port ATM OC-3 (Optical Carrier level 3) network modules for the Cisco 3600 series of modular access routers:

- NM-1A-OC3MM= provides a multimode (MM) fiber uplink port. (See Figure 12-4.)
- NM-1A-OC3SMI= provides a single-mode intermediate-reach (SMI) fiber uplink port. (See Figure 12-5.)
- NM-1A-OC3SML= provides a single-mode long-reach (SML) fiber uplink port. (See Figure 12-6.)

All modules provide full 155-Mbps ATM connectivity, including STS-3c and STM-1 framing, for high-bandwidth data applications and voice-data integration applications.

Figure 12-4 ATM OC-3 Multimode Fiber Network Module

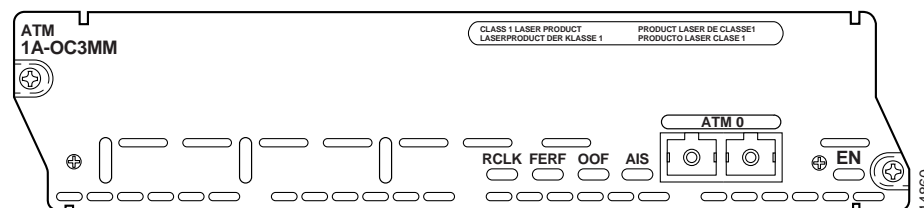


Figure 12-5 ATM OC-3 Single-Mode Intermediate-Reach Fiber Network Module

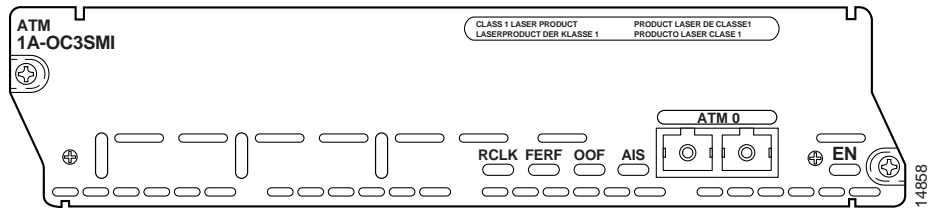
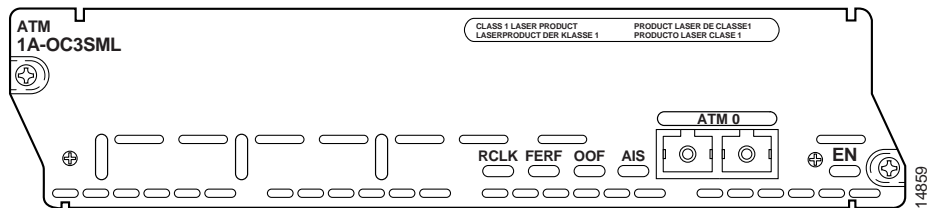


Figure 12-6 ATM OC-3 Single-Mode Long-Reach Fiber Network Module

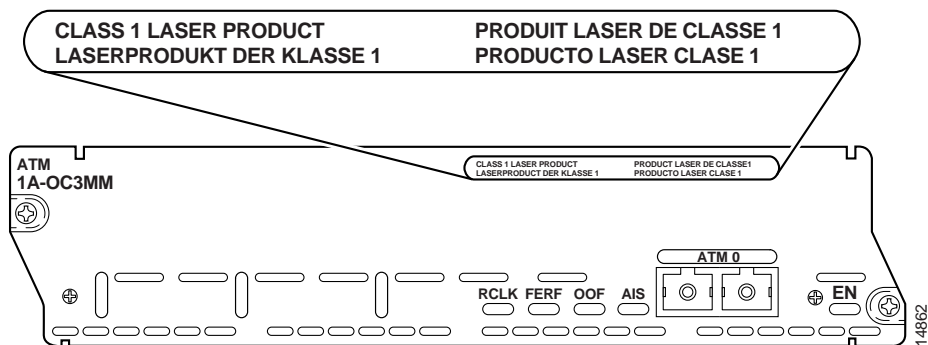


Laser Safety Guidelines

ATM OC-3 network modules use a small laser to generate the fiber-optic signal. Keep the transmit port covered whenever a cable is not connected to it.

The module faceplate carries a Class 1 laser warning label. (See Figure 12-7.)

Figure 12-7 Class 1 Laser Warning Label



Warning Because invisible laser radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to laser radiation and do not stare into open apertures.

Fiber-Optic Transmission Specifications

This section describes Synchronous Optical Network (SONET) specifications for fiber-optic transmissions, defines the power budget, and helps you estimate your power margin for multimode and single-mode transmissions. This section contains the following information:

- SONET Distance Limitations, page 4
- Power Budget and Power Margin, page 4
- Link Loss, page 5
- Estimating the Power Margin, page 6
- Single-Mode Transmission, page 6

SONET Distance Limitations

The SONET specification for fiber-optic transmission defines two types of fiber, single-mode and multimode. Single-mode fiber allows only one bundle of light rays to propagate through the fiber, while multimode fiber allows multiple bundles entering at different angles. Because different bundles (referred to as modes) travel different distances, depending on the entry angle, they arrive at the destination at different times (modal dispersion). Single-mode fiber is therefore capable of higher bandwidth and greater cable run distances than multimode fiber.

Table 12-2 lists typical maximum distances for single-mode and multimode transmissions, as defined by SONET. Use the calculations described in this section to determine the actual maximum for your network. If the distance between two connected stations exceeds this limit, transmission can become unreliable.

Table 12-2 Typical SONET Maximum Fiber-Optic Transmission Distances

Transceiver Type	Maximum Distance between Stations
MM	1.5 mi (3 km)
SMI	9 mi (15 km)
SML	28 mi (45 km)

Power Budget and Power Margin

Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be demodulated. The power budget (PB) is the difference between transmitter power (PT) and receiver sensitivity (PR). For instance, if transmitter power is -20 dB and receiver sensitivity is -30 dB, the power budget is 10 dB:

$$PB = PT - PR$$

$$PB = -20 \text{ dB} - (-30 \text{ dB})$$

$$PB = 10 \text{ dB}$$

The SONET specification requires the signal to meet the worst-case requirements listed in Table 12-3.

Table 12-3 SONET Signal Requirements

	MM	SMI	SML
Transmitter power	-20 dBm	-15 dBm	-5 dBm
Receiver sensitivity	-30 dBm	-31 dBm	-34 dBm
Power budget	10 dB	16 dB	29 dBm

The difference between the power budget and the link loss (LL) is called the power margin (PM). If the power margin is zero or positive, the link should work. If it is negative, the signal may not arrive with enough power to operate the receiver.

Link Loss

Power loss over a fiber-optic link arises from the following causes:

- **Passive components** — Attenuation caused by cables, cable splices, and connectors is common to both multimode and single-mode transmission. Attenuation is significantly lower for optical fiber than for other media.
- **Chromatic dispersion** — The signal spreads in time because of differing speeds of the different wavelengths of light.
- **Modal dispersion** — In multimode fiber, the signal spreads in time because of the different propagation modes.
- **Higher-order mode loss (HOL)** — This loss results from light radiated into the fiber cladding.
- **Clock recovery at the receiver** — This recovery consumes a small amount of power.

The power lost over the data link is the sum of all these losses. Table 12-4 gives an estimate of the amount of loss attributable to each cause.

Table 12-4 Link Loss Causes and Values

Cause	Amount of Loss
Fiber attenuation	0.5 dB/km (SM), 1 dB/km (MM)
Splice	0.5 dB
Connector	0.5 dB
Modal and chromatic dispersion	Depends on fiber and wavelength ¹
Higher-order mode losses	0.5 dB
Clock recovery	1 dB

¹ Dispersion is usually negligible for single-mode fiber. For multimode fiber, the product of bandwidth and distance should be less than 500 MHz-km.

Estimating the Power Margin

The following example calculates a multimode power margin based on these values:

- Power budget 10 dB (SONET worst-case specification for multimode fiber)
- Link length 3 km
- Four connectors
- Three splices
- Higher order loss (HOL)
- Clock recovery

The power margin is:

$$PM = PB - LL$$

$$= 10 \text{ dB} - [3 \text{ km} \times (1.0 \text{ dB/km}) + 4 \times (0.5 \text{ dB}) + 3 \times (0.5 \text{ dB}) + 0.5 \text{ dB} + 1 \text{ dB}] = 2 \text{ dB}$$

The positive result means this link should have enough power for transmission. The product of bandwidth and distance is 155 MHz x 3 km = 465 MHz-km; this is within the dispersion limit of 500 MHz-km.

Single-Mode Transmission

Single-mode transmission is useful for longer distances, because there is a single transmission path within the fiber and modal dispersion does not occur.

The maximum receive power for SML is -10 dBm, and the maximum transmit power is 0 dBm. The SML receiver can therefore be overloaded when using short lengths of fiber. Overloading the receiver does not damage it, but can cause unreliable operation. To prevent overloading an SML receiver, insert a minimum 10-dB attenuator on the link between any SML transmitter and the receiver.

The SMI receiver cannot be overloaded by the SMI transmitter and does not require a minimum fiber cable length or loss.

The following example of a single-mode power margin assumes these values:

- Power budget 16 dB (SONET worst-case specification for SMI)
- Two buildings 8 kilometers apart
- Connections through a patch panel in an intervening building with a total of 12 connectors

$$PM = PB - LL$$

$$= 16 \text{ dB} - 8 \text{ km} \times (0.5 \text{ dB/km}) - 12 \times (0.5 \text{ dB})$$

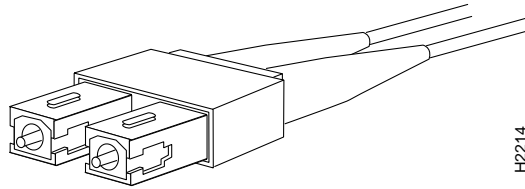
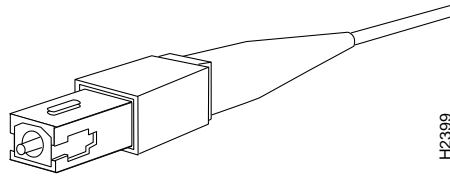
$$= 6 \text{ dB}$$

The positive value means this link should have enough power for transmission.

Connection ATM OC-3 Ports to the Network

To connect an ATM OC-3 network module to the network, insert a fiber-optic cable with one duplex SC connector (see Figure 12-8) or two simplex SC connectors (see Figure 12-9) into the ATM interface, color-coded light green.

Note The network modules are shipped with a dust plug to protect this interface. Pull to remove it.

Figure 12-8 Duplex SC Connector**Figure 12-9 Simplex SC Connector**

Cisco Systems does not sell these fiber-optic cables, but they are available from many cable vendors. Cables should perform to the specifications listed in Table 12-5.

Table 12-5 Fiber-Optic Cable Specifications

Standard	Maximum Path Length	Cabling
ISO/IEC 9314-3	1.24 mi (2 km) all cables in a connection, end to end	62.5-micron core with an optical loss of 0 to 9 dB, or 50-micron core with an optical loss of 7 dB
IEC 793-2	27.9 mi (45 km) for SML and 9.3 mi (15 km) for SMI	9-micron core
ANSI/TIA/EIA-492CAAA	27.9 mi (45 km) for SML and 9.3 mi (15 km) for SMI	9-micron core

Note A single fiber link should not mix 62.5- and 50-micron cable.

ATM OC-3 Network Module LEDs

Figure 12-10 shows ATM OC-3 network module LEDs, and Table 12-6 describes their functions.

Figure 12-10 ATM OC-3 Network Module LEDs

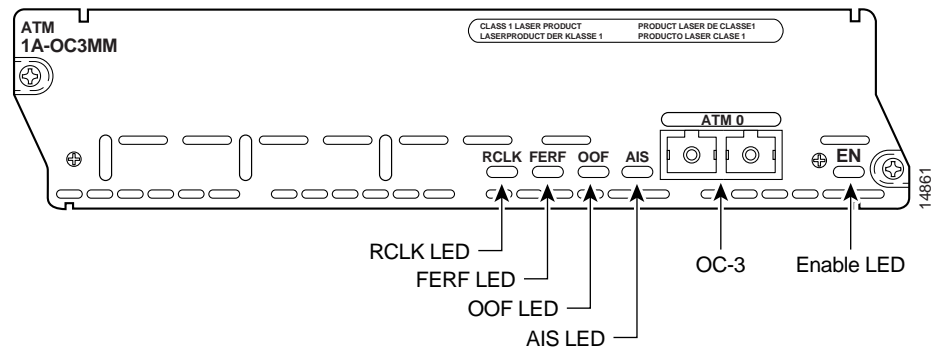


Table 12-6 ATM OC-3 Network Module LED Meaning

LED	Color	Meaning
EN (Enable)	Green	Module has passed its self-tests and is available to the router.
RCLK	Green	Receive clock has been detected.
FERF	Yellow	Far End Receive Failure.
OOF	Yellow	Out Of Frame.
AIS	Yellow	Alarm Indication Signal.

Documentation CD-ROM

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM, a member of the Cisco Connection Family, is updated monthly. Therefore, it might be more current than printed documentation. To order additional copies of the Documentation CD-ROM, contact your local sales representative or call customer service. The CD-ROM package is available as a single package or as an annual subscription. You can also access Cisco documentation on the World Wide Web at <http://www.cisco.com>, <http://www-china.cisco.com>, or <http://www-europe.cisco.com>.

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- WWW: <http://www-europe.cisco.com>
- WWW: <http://www-china.cisco.com>
- Telnet: cco.cisco.com
- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and connection rates up to 28.8 kbps.

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Use this document in conjunction with your router installation guide, the *Cisco Network Module Hardware Installation Guide*, the *Software Installation Guide for Cisco 3600 Series and Cisco 2600 Series Routers*, the *Regulatory Compliance and Safety Information* document for your router, and the Cisco IOS configuration guides and command references.

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