
Installation Guide for Fiber Mode Converters



Contents

Introduction	1
Key Features	2
Product Features	3
Product Diagrams	3
Connecting to the Network	4
Configuration Guidelines for Link Fault Signaling (LFS) Operation	9
Safety Notes on Laser Singlemode type Connectors	10
Specifications	11
Limitations on Warranty and Liability	13

PLEASE READ THESE LEGAL NOTICES CAREFULLY.

By using a Net Optics Fiber Mode Converter you agree to the terms and conditions of usage set forth by Net Optics, Inc.

No licenses, express or implied, are granted with respect to any of the technology described in this manual. Net Optics retains all intellectual property rights associated with the technology described in this manual. This manual is intended to assist application in installing Net Optics products into your network.

Trademarks and Copyrights

© 2010 by Net Optics, Inc. Net Optics® is a registered trademark of Net Optics, Inc. Additional company and product names may be trademarks or registered trademarks of the individual companies and are respectfully acknowledged.

Additional Information

Net Optics, Inc. reserves the right to make changes in specifications and other information contained in this document without prior notice. Every effort has been made to ensure that the information in this document is accurate. Net Optics is not responsible for typographical errors.

Introduction

Net Optics Singlemode to Multimode Converters are simple and reliable devices for connecting multimode fiber traffic to single mode fiber devices and links. Use these bi-directional media converters individually to connect 100Base-FX multimode and singlemode devices, or in pairs at each end of long-distance singlemode fiber links. These Converters are the perfect solution for dispersed networks where media conversion required between multimode segments separated by long distances.

Fast and Versatile

The Singlemode to Multimode Converters support seamless media conversion at 100 Mbps over link distances up to 2 kilometers with 62.5/125 multimode fiber and up to 15 kilometers with 8.5/125 singlemode fiber. The Singlemode to Multimode Converter supports either full or half-duplex transmission.

Fault Tolerant and Reliable

Net Optics Singlemode to Multimode Converters incorporate Link Fault Signaling, which gives the devices connected to the Converter critical information about link status. If either side of the bi-directional link fails, the Converter immediately communicates the fault to both devices, reducing the time required to activate a redundant path. To control jitter over long optical links, the Converter features Clock and Data Recovery (CDR). CDR ensures that the overall jitter budget is not exceeded when deploying converter pairs with long fiber links.

Key Features

Passive, Secure Technology

- Net Optics' Fast Ethernet FMC series converters are 100Base-FX to 100Base-FX converters. The units comply with all applicable IEEE 802.3u specifications.
- The FMC series converters are designed to be simple plug-and-play products. Just plug the multimode or single mode fiber optic connectors into the appropriate port and the conversion is done.
- Provides transparent conversion at 100 Mbps without data stream interference or introducing a point of failure
- Link Fault Signaling provides critical link status information
- Clock and Data Recovery (CDR) control overall jitter when deploying converter pairs
- Compatible with all 100Base-FX singlemode and multimode fibers
- Fully RoHS compliant

Ease of Use

- LED indicators show link status and redundant power
- Front-mounted connectors support easy installation and operation
- Optional 19-inch rack frames hold up to 3 or 12 Taps
- Tested and compatible with all major manufacturers' monitoring devices, including protocol analyzers, probes, and intrusion detection/prevention systems

Support

- Net Optics offers free technical support throughout the lifetime of your purchase. Our technical support team is available from 8 am to 5 pm Pacific Time, Monday through Friday at +1 (408) 737-7777 and via email at ts-support@netoptics.com. FAQs are also available on Net Optics website at www.netoptics.com.

Product Features

The FMC-SA and FMC-R have one pair (Port 1) of standard, multimode, 1300 nm fiber optic SC type connectors and a pair (Port 2) of fiber optic, 1310 nm singlemode SC connectors. The singlemode, fiber optic connectors are eye-safe Laser driven and have a transmission range of 15Km in full duplex. The standard multimode connectors support a transmission range of 2Km in full duplex.

Product Diagrams

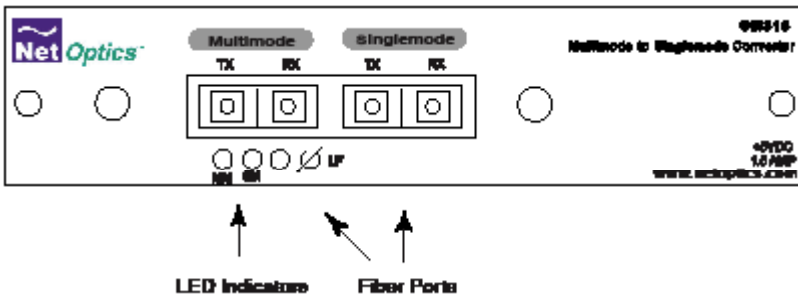


Figure 1. Front Panel of FMC-R Converter

Connecting to the Network

1. Unpack the Fiber Mode Converter, verify that you have all components, and obtain the required cables needed to successfully install the unit. Your package should contain: one Converter, one power supply, one power cord and one users Manual (this manual).
2. Multimode Ports: Using a duplex SC multimode cable, connect the appropriate switch, server, or router to the Fiber Mode Converter's Multimode Port.
3. Singlemode Ports: Using a duplex SC singlemode cable, connect the appropriate switch, server, or router to the Fiber Mode Converter's Singlemode Port.
4. Supply power to the Fiber Mode Converter using the power supply included with the unit.
5. Compare the LEDs on the Fiber Mode Converter to the chart below to verify correct setup.
 - **PWR:** Power.
Power LED (in side of unit) illuminates green when device is powered on.
 - **MM:** Multimode Fiber Link.
This LED illuminates green when a good fiber optic link is established.
 - **SM:** Singlemode Fiber Link.
This LED illuminates green when a good fiber optic link is established.
 - **LF:** Link Fault.
This LED illuminates yellow when a link fault is present.

Connecting to the Network

The FMC series converters with F/O connections operate over duplex fiber optic cable. This means that two separate fiber optic cables are used for data transmission. One cable is for transmitting data and the other is for receiving data. The transmit port is designated with TX and the receive port is designated with RX. When attaching the FMC converter to another fiber optic device, the TX port on the FMC converter must be attached to the RX port on the other device and vice-versa. When the connection is correct, the F/O link LED will remain lit.

Fiber optic cable connectors must match the card type i.e. (SC), and the cable type (multimode) or (single mode). The fiber optic cable must not be bundled with too tight of a bend radius. This may attenuate the light intensity resulting in link failure. A tight bend radius can also result in accelerated stress fracture of the glass cable fibers making premature cable failure likely.

Note: For 100 Mb/s, half-duplex operation, linking two DTEs via a fiber optic segment; the maximum transmission range is approximately 412 meters. If an FMC converter is used to link two DTEs in half-duplex, a bit budget (bit time delay) calculation should be made to confirm the validity of the network topology.

Maximum Round Trip Delay

There are certain rules of Fast Ethernet installation a user must understand in order to be able to calculate valid cable lengths in a given set up situation. Maximum round trip delay in bit times is 512; late collisions and/or CRC errors are indicators that the path delays exceed 512 bit times.

For a network to be valid the worst-case path delay value (PDV) must be 512 bit times or less. Examine the network topology and choose the pair of DTEs with the largest collision domain diameter, that is the two DTEs that are farthest apart, and apply the following formula/rules to determine whether the network is valid.

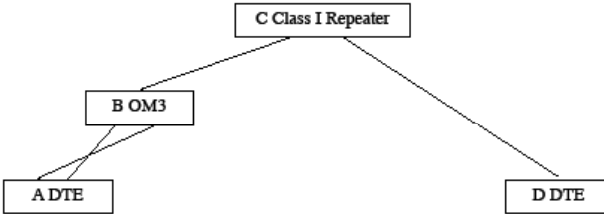
Network Component Delays

Component	Maximum round trip delay in bit times
DTE TX to TX	100
DTE TX to FX	100
DTE FX to FX	100
FMC Converter	10
Class I repeater	140
Class II repeater (all TX/FX ports)	92

Cable	Round trip delay in bit times per meter
Cat5	1.112
STP	1.112
F/O	1.0
MII (.5m)	0 (delay included in DTE times)

Network Cable Maximums

Cable Segment	Maximum cable length in meters
DTE TX to TX; Cat 5 or STP	100 (half or full-duplex)
DTE FX to FX; Fiber Optic	412 (half-duplex) 2007 (full-duplex)

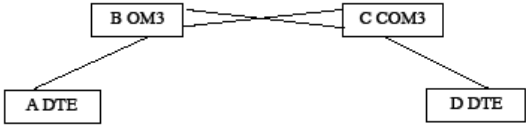
Examples


Maximum of 512 total bit times between the two farthest DTEs
 DTE TX to DTE FX has 100 bit times delay
 CFT converter has a 50 bit time delay
 Class I repeater has 140 bit times delay
 TX cable has 1.112 bit times delay per meter
 F/O cable has 1.0 bit times delay per meter

If cable B to C is 5 meters of Cat 5, and cable C to D is 87 meters of Cat 5,
 then how long can the F/O cable, A to B be?

Total maximum bit time	+512
Less DTE TX to DTE FX	-100
Less Class I repeater	-140
Less CFT converter	-10
Less (5m x 1.112)	-5.56
Less (87m x 1.112)	-96.74
Remaining bit time	+159.7

Remaining bit time divided by the cable delay time per meter of F/O cable
 yields 159 meters of total fiber optic cable available to use.
 (159.7/1.0 = 159.7 m)

Examples (continued)


If cable A to B is 10 meters of STP and cable B to C is 150 meters of F/O, then what is the maximum length of the Cat 5 cable C to D?

Total maximum bit time	+512
Less DTE TX to TX	-100
Less (2 x CFT converters)	-20
Less (10m x 1.112)	-11.12
Less (150m x 1.0)	-150
Remaining bit time	+230.88

Remaining bit time divided by 1.112 (the bit time delay per meter of Cat 5 cable) yields a maximum C to D cable of 207 meters.

Configuration Guidelines for Link Fault Signaling (LFS) Operation

Link Fault Signaling (LFS) circuitry provides visual indication of link condition on both segments as well as alerting each host DTE when the remote link (segment) is down.

1. The FMC series converter operates when it receives a link signal from a device attached to either port (100Base-FX), then turns-on the link signal to the device on the other (port) segment. Both (F/O) segments must be connected to the FMC converter before proper link across both segments can be established AND at least one end device must provide a link signal to initiate link across all segments.

2. The FMC converter does not auto-negotiate data rate.

If two FMC converters or a combination CCM card and FMC converter are used in series to connect two twisted pair nodes then:

A. If at least one of the (100Base-FX) ports can initiate the link signal, then the converter will establish link and properly support the LFS function across all segments including both FMC converters or CCM/FMC converter combination in sequence.

B. If both end nodes are using 100/half duplex/full duplex speed selection ports, pairs of FMC converters or CCM/FMC combinations (with LFS) connected in series, will work only if both are set to the same speed. If CSMA/CD is being run; consult the bit time calculation guide for valid network configurations.

Note: The FMC series does not have a full duplex/ half duplex switch. They receive and transmit data 10/100Mbps/half/full duplex transparently, up to OC-3 speeds.

Safety Notes on Laser Singlemode type Connectors

The FMC-SA uses 1300 nm wavelength, eye-safe type laser, fiber optic single mode connectors.

When connecting pairs of devices using laser type connectors or connecting pairs of devices using LED type connectors, simply plug in the fiber optic connectors in the normal manner. However, if mixed LED and eye-safe laser driven devices are connected, the laser emitter has the potential (may in some installations) to saturate the Rx (Receive) port on the LED driven device. In effect, the LED port might be “dazzled” by the intensity of the laser source.

Net Optics’ recommends that an attenuator providing a (4-7db reduction) be inserted in the F/O cable segment between the two units to reduce the light intensity propagating from the eye-safe laser driven device. The attenuator only needs to be inserted on the fiber optic cable strand linking the Tx (Transmit) port on the laser driven device, and the Rx (Receive) port on the Net Optics’ LED driven device.

Note:

Non-eye safe 1300-1500nm laser driven devices will permanently damage Net Optics’ LED driven single mode equipment. Such damage will not be covered by warranty.

CAUTION: NEVER ATTEMPT TO VERIFY ANY FIBER OPTIC CONNECTION BY LOOKING DIRECTLY INTO A FIBER-OPTIC PORT OR CABLE. IF THE LIGHT SOURCE IS A NON-EYE SAFE, LASER EMITTER, PERMANENT EYE DAMAGE MAY RESULT.

NEVER LOOK INTO THE BORE OF A FIBER OPTIC CONNECTOR!

Specifications

Environmental

Operating Temperature: 0°C to 40°C
Storage Temperature: -10°C to 70°C
Relative Humidity: 5% min, 95% max, non-condensing

Power

Power Supply Input: 100-240 VAC, 0.6A, 50-60 Hz
(AC100-125V~30VA, 50-60 Hz, for Japan)
Output: 5V, 2A (5V, 2.4A for UK and Japan)

Mechanical

Dimensions: 1.0" high x 5.3" deep x 2.9" wide

Connectors

(2) Duplex SC connectors

Fiber Optic Interfaces (100Base-FX)

Port #2 for: FMC-SA

Connector:	Two SC type (Singlemode) eye-safe Laser emitter type
Cable:	8.7-10.0um/125um singlemode fiber
Link length:	412 m half duplex max, 15km full duplex (nominal)
Optical transmitter:	Wavelength: 1300nm (Laser)
Output power (single mode):	15 dBm min, -8 dBm max (10/125 fiber)
Optical receiver input sensitivity (singlemode):	31 dBm max

Port #1

Connector:	Two SC type (multimode)
Link length:	412m half duplex max, 2km full duplex max
Optical transmitter:	Wavelength: 1300 nm
Output power (multi mode):	19 dBm min, 14 dBm max (62.5/125 fiber)
Optical receiver input sensitivity (multi mode):	33.5 dBm typ, 31dBm max

Certifications

- The Net Optics' converters are designed to comply with all the following safety, emissions and susceptibility specifications: UL 1950, CSA-C22.2 No. 950-93, CEMark EN60950 and EN55022, and FCC Class B.
- Fully RoHS compliant

Limitations on Warranty and Liability

Net Optics offers a limited warranty for all its products. IN NO EVENT SHALL NET OPTICS, INC. BE LIABLE FOR ANY DAMAGES INCURRED BY THE USE OF THE PRODUCTS (INCLUDING BOTH HARDWARE AND SOFTWARE) DESCRIBED IN THIS MANUAL, OR BY ANY DEFECT OR INACCURACY IN THIS MANUAL ITSELF. THIS INCLUDES BUT IS NOT LIMITED TO LOST PROFITS, LOST SAVINGS, AND ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OR INABILITY TO USE THIS PRODUCT, even if Net Optics has been advised of the possibility of such damages. Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Net Optics, Inc. warrants this Fiber Mode Converter to be in good working order for a period of ONE YEAR from the date of purchase from Net Optics or an authorized Net Optics reseller.

Should the unit fail anytime during the said ONE YEAR period, Net Optics will, at its discretion, repair or replace the product. This warranty is limited to defects in workmanship and materials and does not cover damage from accident, disaster, misuse, abuse or unauthorized modifications.

If you have a problem and require service, please call the number listed at the end of this section and speak with our technical service personnel. They may provide you with an RMA number, which must accompany any returned product. Return the product in its original shipping container (or equivalent) insured and with proof of purchase.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, EXPRESS OR IMPLIED. No Net Optics reseller, agent, or employee is authorized to make any modification, extension, or addition to this warranty.

Net Optics is always open to any comments or suggestions you may have about its products and/or this manual.

Send correspondence to
Net Optics, Inc.
5303 Betsy Ross Drive
Santa Clara, CA 95054 USA
Telephone: +1 (408) 737-7777
Fax: +1 (408) 745-7719
Email: info@netoptics.com
Internet: www.netoptics.com

All Rights Reserved. Printed in the U.S.A. No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form, by any means, without prior written consent of Net Optics, Inc., with the following exceptions: Any person is authorized to store documentation on a single computer for personal use only and that the documentation contains Net Optics' copyright notice.

www.netoptics.com