F i n i s a r ®

OPTICAL MODULES
REFERENCE GUIDE

SFP and SFP+

SFF

GBIC

SFP Cages

300-PIN

INTRODUCTION

Broad product selection and innovative technology have made Finisar the optical module manufacturer of choice for all major networking equipment vendors worldwide. Finisar has taken a leading role in transforming the data communications and telecommunications equipment markets from utilizing expensive discrete optical components to high-volume pluggable pay-as-you-grow optical modules.

Finisar's optical communication products are compliant with Ethernet, Fibre Channel, SONET/SDH and WDM standards and operate at data rates from 100 Mb/s to 40 Gb/s for datacenter, access, metro-regional, and long haul networks. They feature outstanding performance over extended voltage and temperature ranges, while minimizing jitter, electromagnetic interference (EMI) and power dissipation.

TRANSCEIVER/TRANSPONDER FORM FACTORS

SFP and SFP+ (Small Form Factor Pluggable)

SFP and SFP+ transceivers are designed to be hot-swappable in industry-standard cages and connectors, and offer high-speed performance in a compact package. SFP was the first standardized form factor in this family, and has been used for data rates up to 4 Gb/s. With the need for compact transceivers at high data rates, an enhanced version named SFP+ was developed for applications up to 10 Gb/s and beyond. SFP+ transceivers are interchangeable with SFP transceivers and can be used in the same cages as SFP transceivers. For 10 Gb/s applications, SFP+ transceivers have a smaller footprint and lower power consumption than XFP transceivers. The electrical interface to the host board for SFP and SFP+ modules is a serial interface.

SFF (Small Form Factor)

Small form factor, or SFF, transceivers are designed for a range of data rates up to 4 Gb/s and offer physical compactness and pin-thru hole soldering onto a host board. They are available in several configurations including industry standard 2x5 / 2x10, and de-facto 2x6 and 2x7 pinouts.

GBIC (Gigabit Interface Converter)

The gigabit interface converter, or GBIC, was the original hot-swappable standardized form factor. The GBIC has been widely adopted in a large number of legacy systems, with designs ranging in data rates up to 2.5 Gb/s. The devices are economical because they eliminate the necessity for replacing entire boards at the system level. Upgrading can be done with any number of units at a time, from an individual module to all the modules in a system.

SFP Cages

SFP cages are designed to mechanically hold and support SFP modules in host systems. Finisar cages are designed from a single piece of sheet metal, enabling strong mechanical integrity and rigidity, while reducing unwanted EMI.

XFP

XPAK

X2

XENPAK

Active Optical Cables

300-PIN

300-PIN is a standardized form factor for 10 and 40 Gb/s fiber optic transponders. For 10 Gb/s applications, SONET OC-192, SDH STM-64 and DWDM (including tunable) versions are available. For 40 Gb/s applications, SONET OC-768, SDH STM-256 and DWDM tunable versions are available. 300-PIN modules are used primarily in telecom optical links. The electrical interface to the host board is a 16-lane bus.

XFP

XFP is a standardized form factor for serial 10 Gb/s fiber optic transceivers. It is protocol-independent and fully compliant to the following standards: 10G Ethernet, 10G Fibre Channel, SONET OC-192 and SDH STM-64. XFP transceivers are used in datacom and telecom optical links and their benefits are a smaller footprint than other 10 Gb/s transponders (such as XENPAK, X2, XPAK AND 300-PIN). The electrical interface to the host board is a standardized serial 10 Gb/s interface called XFI.

XPAK

XPAK is a standardized form factor for 10 Gb/s fiber optics transponders. Both 10G Ethernet and 10G Fibre Channel versions are available. XPAK transponders are used in datacom optical links only (not telecom), and their main benefit is a smaller size than other 10G transponder form factors like XENPAK and X2. The electrical interface to the host board is also standardized and is called XAUI (4 x 3.125 Gb/s).

X2

X2 is a standardized form factor for 10 Gb/s fiber optics transponders. Both 10G Ethernet and 10G Fibre Channel versions are available. X2 transponders are used in datacom optical links only (not telecom), and they are smaller than XENPAK transponder. The electrical interface to the host board is also standardized and is called XAUI (4 x 3.125 Gb/s).

XENPAK

XENPAK is a standardized form factor for 10 Gb/s Ethernet fiber optics transponders. XENPAK transponders are used in datacom optical links only (not telecom). The electrical interface to the host board is also standardized and is called XAUI (4 x 3.125 Gb/s).
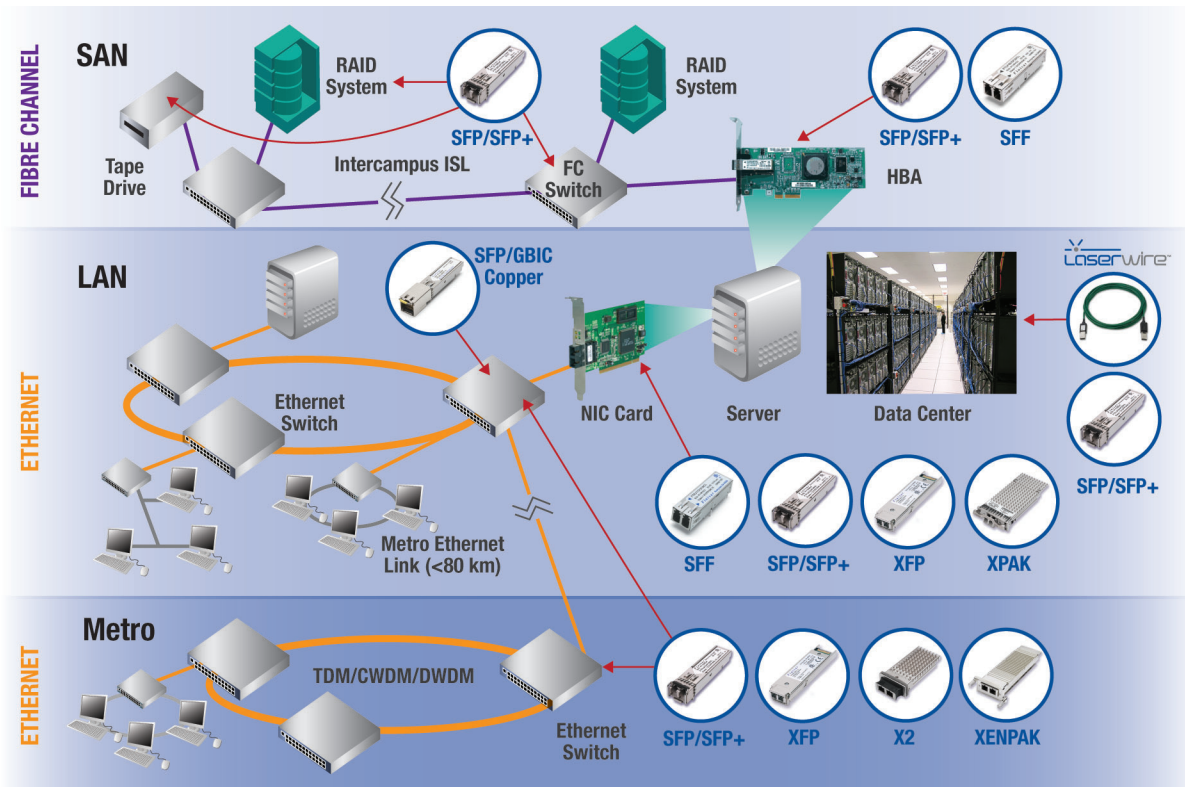
Active Optical Cables

Finisar has active cables for different applications, including Laserwire,™ a 10G serial active cable for distances up to 30 meters and Quadwire,™ a 40G parallel active cable for distances up to 100 meters. These cables include optics imbedded inside the cable assembly, which has many significant advantages for datacenter applications, including:
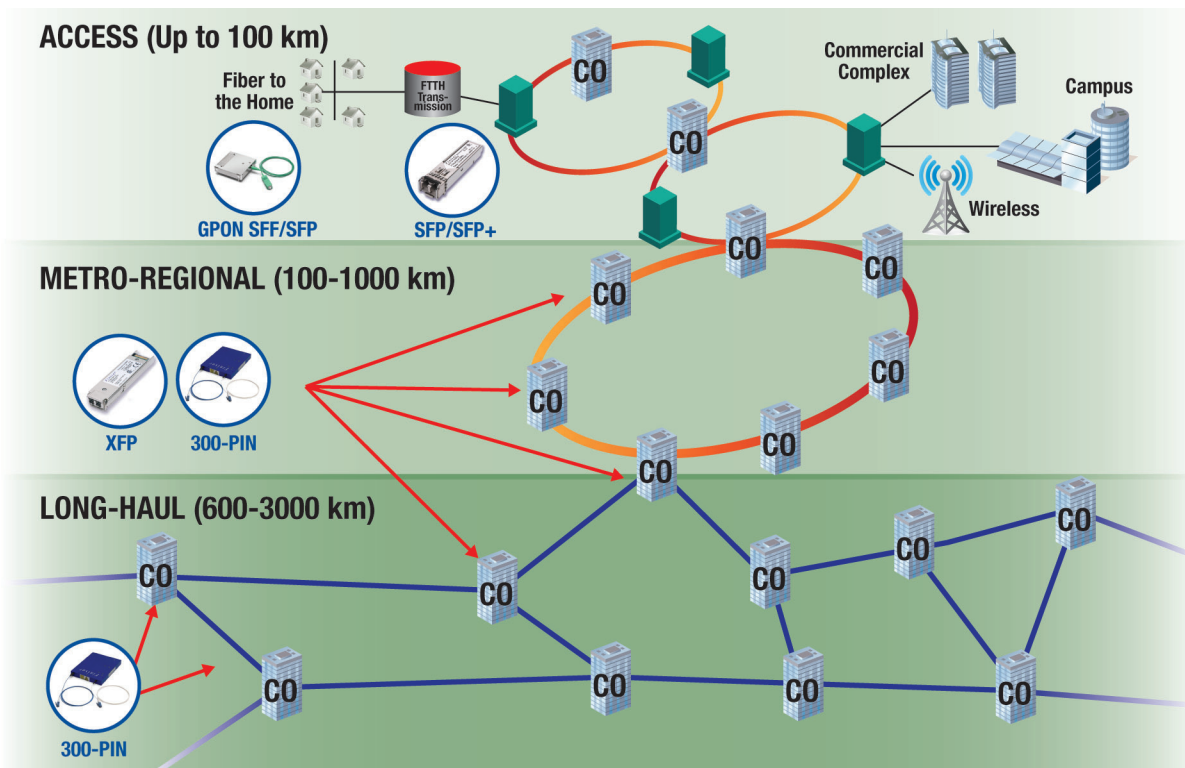
▶ Elimination of expensive connectorization of fiber optic cables.

▶ Cost optimization through component matching and test margin elimination.

▶ Elimination of dirt/dust issues common to existing fiber assemblies.

In addition, active optical cables are capable of longer reach, lower EMI, lower power dissipation and are significantly lower in weight and less bulky than competing copper solutions.

EXAMPLE OF A DATACOM NETWORK DIAGRAM

FIBRE CHANNEL

SAN

RAID System
RAID System
SFP/SFP+
SFF
Tape Drive
Intercampus ISL
FC Switch
HBA

ETHERNET

LAN

SFP/GBIC Copper
Ethernet Switch
NIC Card
Server
Data Center
Laserwire™
SFP/SFP+
Metro Ethernet Link (<80 km)
SFF
SFP/SFP+
XFP
XPAK

ETHERNET

Metro

TDM/CWDM/DWDM
Ethernet Switch
SFP/SFP+
XFP
X2
XENPAK

EXAMPLE OF A TELECOM NETWORK DIAGRAM

ACCESS (Up to 100 km)

Fiber to the Home
FTTH Trans-mission
CO
Commercial Complex
Campus
GPON SFF/SFP
SFP/SFP+
CO
CO
Wireless

METRO-REGIONAL (100-1000 km)

XFP
300-PIN
CO
CO
CO
CO
CO
CO
CO

LONG-HAUL (600-3000 km)

CO
CO
CO
CO
CO
CO
CO
CO
CO
CO
300-PIN

DEFINITIONS

▶ **DATACOM:** Data traffic typically transmitted using Fibre Channel or Ethernet protocols.

▶ **TELECOM:** Data/telecommunications traffic transmitted using SONET/SDH protocols or WDM interfaces.

▶ **DATACENTER:** Facility in a data communications network housing switches, servers and related datacom equipment.

▶ **CENTRAL OFFICE:** Facility in a telecommunications network housing switching, transmission, and related telecom equipment.

▶ **ACCESS:** Portion of a telecommunications network connecting end-users using typically Ethernet, SONET/SDH or GPON protocols at distances <80 km.

▶ **METRO-REGIONAL:** Portion of a telecommunications network connecting suburbs or cities using WDM interfaces at distances between 80 and 600 km.

▶ **LONG HAUL:** Portion of a telecommunications network connecting cities using WDM interfaces at distances between 600 and 2000 km.

▶ **LAN:** Local Area Network (using Ethernet protocol), typically within <500 meters for enterprise or datacenter applications.

▶ **SAN:** Storage Area Network (using Fibre Channel protocol), typically within <300 m for datacenter applications.

▶ **PIN-THRU HOLE OPTICS:** Transceivers with pins that are directly soldered into mounting holes on the host board (e.g. SFF—Small Form Factor transceivers).

▶ **HOT-SWAPPABLE/PLUGGABLE:** Modules that can be manually inserted or removed from cages or sockets in host systems that are running (i.e. powered up and in operation).

▶ **OPTICAL TRANSCEIVERS:** Integrated modules incorporating optical laser transmitters and photodiode receivers. These modules convert physical signals from electrical to optical and vice-versa in a network and couple the optical signals into (and out of) optical fiber. Transceivers have serial electrical interfaces on the host board.

▶ **OPTICAL TRANSPONDERS:** Integrated modules incorporating optical laser transmitters and photodiode receivers. These modules convert physical signals from electrical to optical and vice-versa in a network and couple the optical signals into (and out of) optical fiber. Transponders have parallel electrical interfaces to the host board.

▶ **ETHERNET:** Dominant communications protocol for networking over copper or optical fiber.

▶ **SONET:** Synchronous Optical Network. Widely used protocol for telecommunications carriers in North America to transport data and voice traffic over optical fiber.

▶ **SDH:** Synchronous Digital Hierarchy. Widely used protocol for telecommunications carriers outside North America to transport data and voice traffic over optical fiber.

▶ **FIBRE CHANNEL:** Dominant protocol for transmitting storage data over optical fiber in enterprises.

▶ **GPON:** Protocol for Passive Optical Networking (PON). Passive optical networking is a method of deploying Fiber to the Home (FTTH) using a passive splitter and single fiber interfaces to each home.

▶ **WDM:** Wavelength Division Multiplexing. Enables multiple data streams of varying wavelengths ("colors") to be combined into a single fiber, significantly increasing the overall capacity of the fiber. WDM is used in applications where large amounts of traffic are required over long distances in carrier networks. There are two types of WDM architectures: Coarse Wavelength Division Multiplexing (CWDM), typically handling up to 8 wavelengths, and Dense Wavelength Division Multiplexing (DWDM), supporting 40, 80, or even 160 wavelengths.

▶ **TUNABLE:** DWDM transceiver/transponder that can be electronically tuned to a specific wavelength. This has the advantage of significantly reducing the required inventory of products for a provisioned DWDM system or for inventory sparing applications.

▶ **DIGITAL DIAGNOSTICS:** Developed by Finisar, this functionality enables real-time monitoring of 5 parameters critical to transceiver operation: transmitter output power, receiver sensitivity, laser bias current, transceiver input voltage and transceiver temperature.