Fiber Driver® - An Optical Multi-Service Platform

Overview

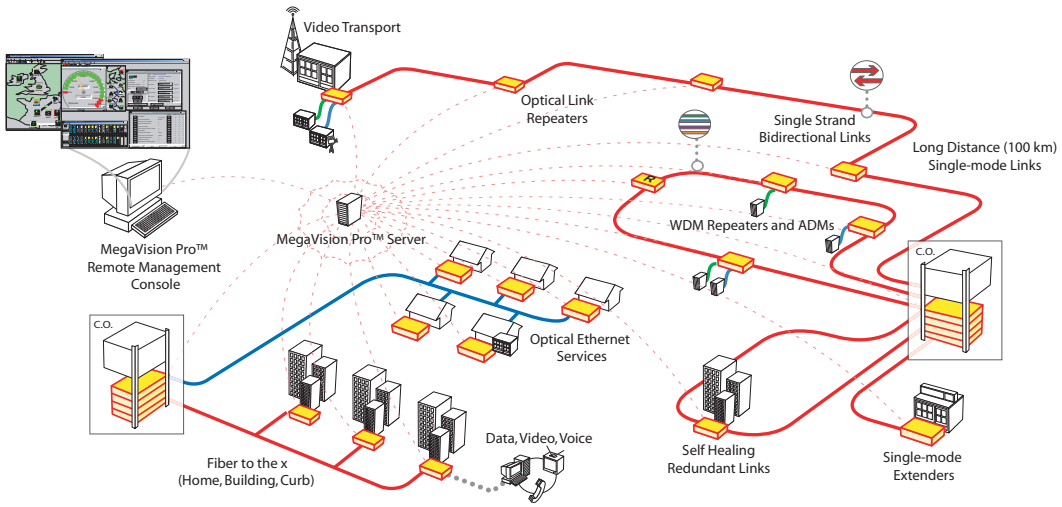
The Fiber Driver product line from MRV is an innovative optical multi-service platform that revolutionizes optical transport. Fiber Driver services include:

- Fiber grooming
  - Media conversion
  - Distance extension
  - Signal repeating
- Converter-based service demarcation
- Advanced CWDM and DWDM solutions
- Digital video distribution

Optical transport platforms from the metro and sub-metro network to the access and enterprise network have traditionally been application-specific and expensive. Each solution was designed and configured for a specific application.

Features

- **Optical Multi-Service Platform**
  - Fiber grooming
  - Intelligent service demarcation
  - Advanced CWDM and DWDM
  - Digital video distribution
- **Multifunction Multi-Protocol Modules**
  - Converters or WDM transponders
  - Any protocol/any rate
  - Built-in redundancy or flexible multicasting
  - Flexible pluggable optical transceivers
- **Protocol Specific Multifunction Modules**
  - Converters or WDM transponders
  - Built-in redundancy
  - Flexible pluggable optical transceivers
  - From T1/E1 to 10 Gbps
- **WDM Solutions**
  - CWDM and DWDM pluggable transponders
  - CWDM and DWDM passive solutions
    - Mux/DeMux
    - OADM
  - Amplified DWDM networks
  - Point-to-point, linear, and ring topologies
  - Redundancy
  - Advanced WDM management
- **Converter-Based Service Demarcation**
  - Based on 802.3AH extended protocol
  - Ethernet demarcation (Fast and Gigabit Ethernet)
  - Ethernet and WAN (T1/E1) TDM demarcation
  - Flexible pluggable optical transceivers
  - WDM capabilities – WDM-PON, linear, and ring
- **Scalable Modular Chassis-Based Platform**
- **Advanced End-to-End Network Management**



Different platforms were built for each of the main optical transport applications including fiber grooming, service demarcation, and WDM. Each of these platforms was built with fixed functionality, distance requirements, and specific protocols, wavelengths, and media.

Altering one of these characteristics required costly replacement of an entire module (converter or transponder), use of an intermediary device (media converter, optical amplifier, or optical attenuator), or use of costly equipment such as tunable lasers. Consequently, deploying a true multi-service optical network with these inflexible systems remained diffcult. Mixing and matching evolving services and the integration of these services from end-to-end across the provider network was challenging and cost-prohibitive.

Pluggable optics (SFPs and XFPs) change this old approach by separating the network interface from the optical transport platform. Protocol, wavelength, media, and distance choices are addressed with a small, inexpensive component that is independent from the optical transport platform and may be easily changed. Solutions that support OC-3 today can support Gigabit Ethernet tomorrow. 20-kilometer links can extend to 120 kilometers. A specific DWDM wavelength link can easily be converted to any other DWDM wavelength.

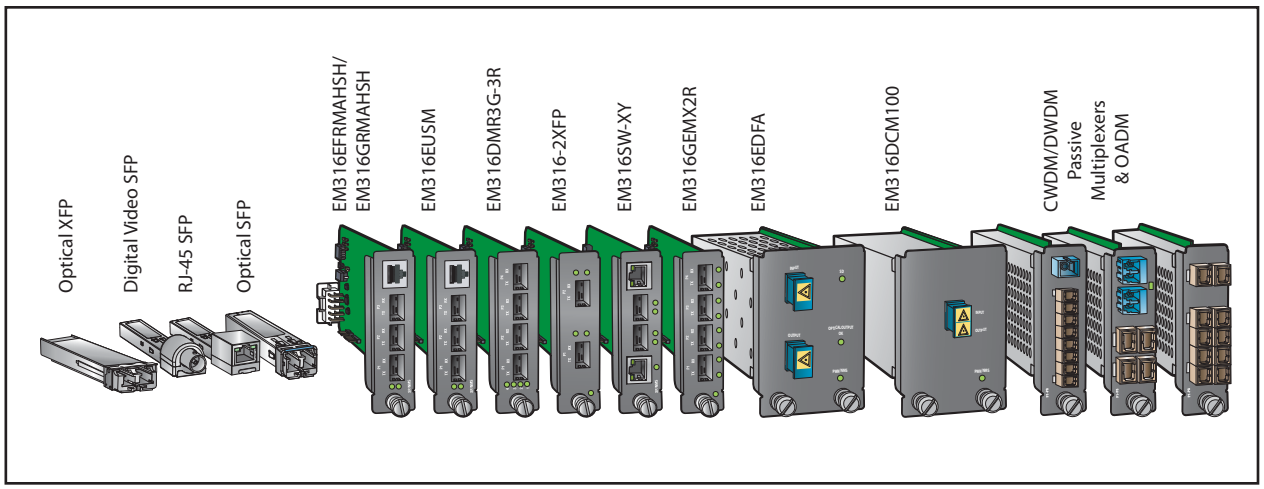
A module with pluggable optics (such as a DWDM platform for metro networks, a CWDM platform for a city network, or a demarcation device at the customer site) can be used as a media converter, distance extender, transponder, or lambda (wavelength) converter.

Inexpensive MUX/DeMUX and Optical Add/Drop Multiplexer (OADM) technologies combined with the flexibility of modular optical transceivers simplify modernization from legacy optical networks to new CWDM/DWDM transports.

The Fiber Driver optical multi-service platform combines these complex technologies. It handles a wide range of applications that can be easily and cost-effectively reconfigured to meet changing demands. This innovative platform offers an optical transport toolkit that contains the building blocks for modular solutions driven by application requirements.

The basic components for building a multi-service optical transport network are organized into five general categories:

1. Pluggable Transceivers
2. Multi-rate Multifunction Pluggable Optics Modules
3. Passive WDM Devices and Accessories
4. Converter-Based Service Demarcation
5. System and Management



SELECTED FIBER DRIVER DEVICES (Contact sales@mrv.com for a complete list of Fiber Driver devices)

Pluggable Transceivers

Pluggable transceivers and the devices that use them are the keys to deploying a multi-service optical network. SFP and XFP technology offers compelling advantages over fixed optical interfaces. They enable deployment flexibility; the same pluggable module may be used for multi-mode, single-mode, single fiber, WDM, or even copper interfaces.

MRV pluggable transceivers easily cover the typical metro network area with transmission distances beyond 120 km. They are available for virtually all protocols in use today, in a variety of interface types, and in both "gray" and "colored" optics. Multi-rate pluggables -- some with supported data-rate ranges as wide as 100 Mbps to 2.7 Gbps -- open a whole new level of in-service flexibility, including the ability to upgrade line rates without trunk rolls for network maintenance.

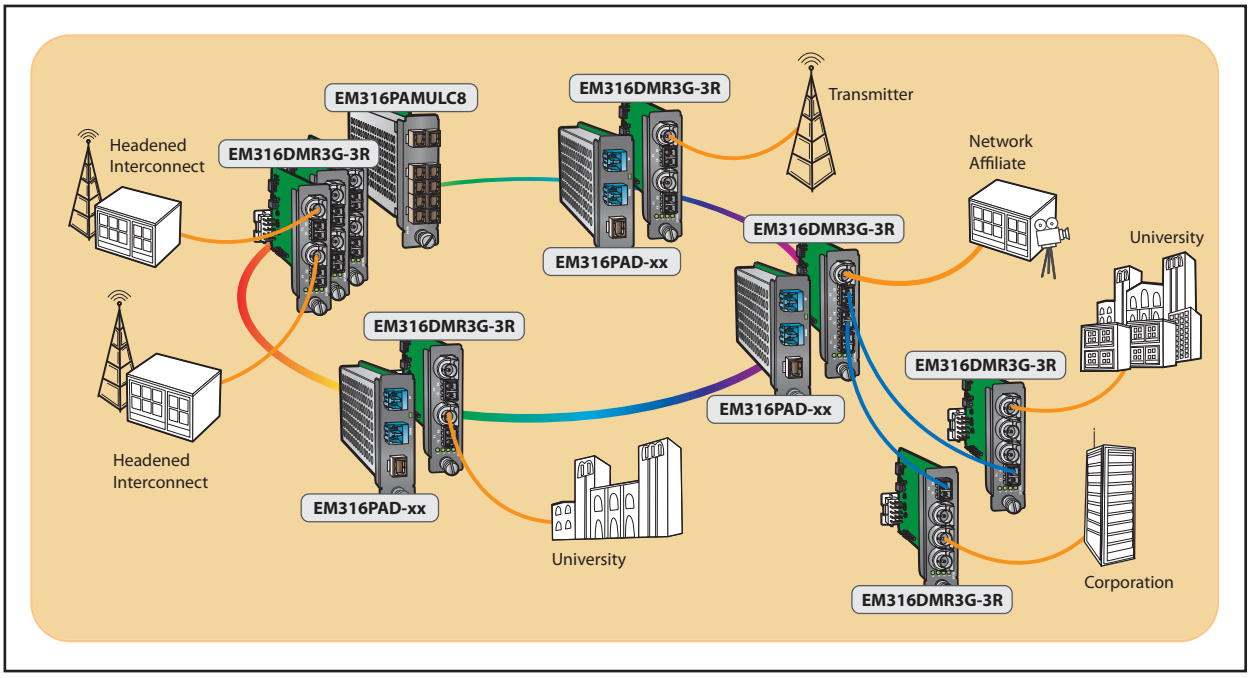
The hot-swappable, plug-and-play nature of pluggable transceivers allows an interface to be changed quickly and easily with minimal interruption to service. Pluggable transceivers greatly reduce the need of spare ports. Instead of requiring complete duplication of each application-specific line card, an entire service network could be serviced with one spare line card and a small selection of pluggable transceivers covering the range of applications in use.

Multi-rate, Multifunction, Pluggable Optics Modules

Converters and transponders, like optics, were once designed and configured for a specific service. Upgrading a connection from OC-3 to OC-12 meant swapping out line cards. There are now transponders that support protocol speeds from 100 Mbps to more than 3 Gbps by interchanging pluggable optics.

MRV multi-rate transponder modules (Category 1, table page 6) ease the transition to a new protocol or service. Simply select the desired data rate or module function through software management. For example, the EM316DMR3G-3R module is a functional chameleon, transformed itself by a graphical interface click from a dual transponder to a redundant repeater or a layer 1 signal multicasting engine.

When combined with MRV's unique digital video SFPs, multi-rate and multifunction modules become sophisticated engines for delivery of digital video services over fiber-optics. With its unidirectional multicasting capacity and with the flexibility of coax or fiber optic SFPs, the combined solution becomes the industry's most flexible digital video deployment solution. It allows point-to-point redundant links, linear add/drop, or multicasting of digital video signals over coax and fiber.



With support for pluggable optics, multi-rate and multi-function pluggable-optic transponders enable a wide range of optical transport functions. They can serve as media converters to connect network segments of different media types, or as lambda converters to connect network elements operating at different wavelengths. For example, using the appropriate pluggable transceiver, a Gigabit Ethernet multi-mode link operating at 850 nm can be connected to a single-mode link operating at 1550 nm. The same module could just as easily be configured with long-haul optics and be deployed as a repeater in a SONET/SDH link spanning hundreds of kilometers.

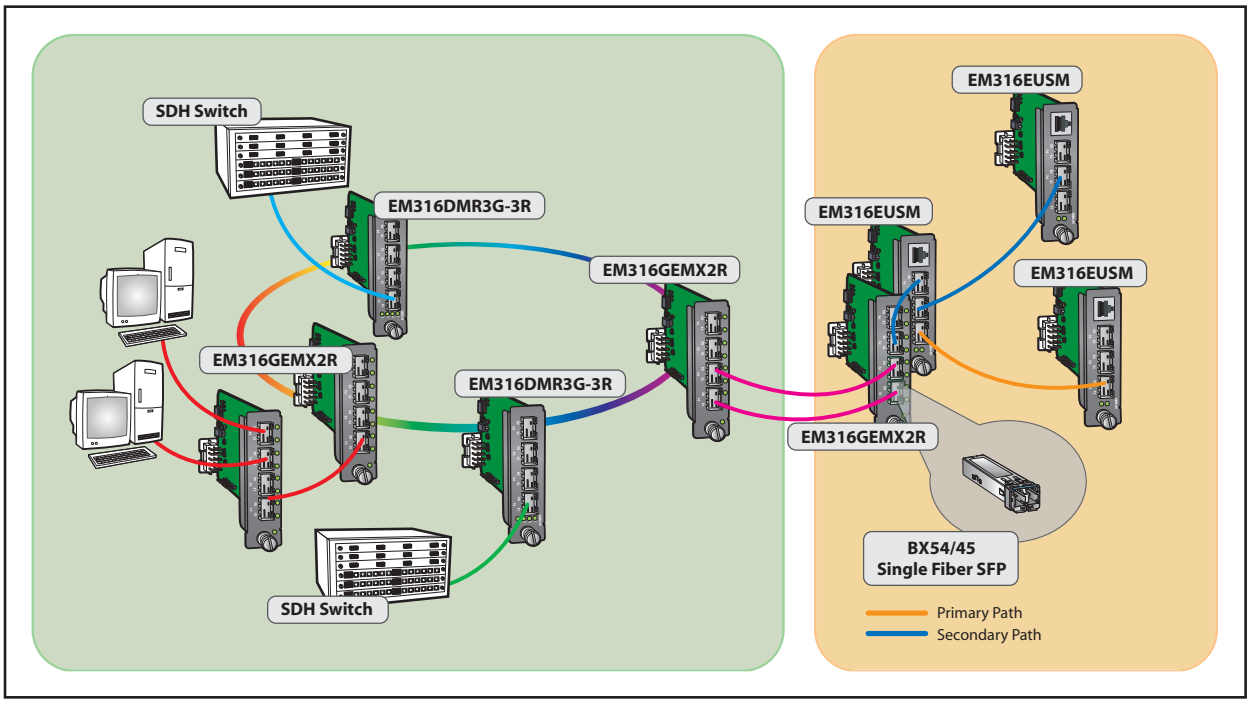
Configured with wavelength-specific pluggable optics and connected to a WDM, a multi-rate transponder can be used to create a static trunk WDM system, a wavelength or trunk-switching WDM system, or a WDM repeater with or without lambda conversion. Deployed along a WDM trunk at demarcation points, it can also be used to create a sophisticated add/drop topology.

Pluggable optics transponders also come in protocol-specific versions (Category 2). These modules serve any 10Gbps protocols (Ethernet, Fibre Channel, SONET, or SDH) through multi-rate XFP pluggable optics. Modules like EM316SW-XY or EM316GSW-XY are multifunction solutions focused on legacy protocols like Fast or Gigabit Ethernet with chameleon capabilities similar to the EM316DRM3G3R (dual converter, redundant repeater, copper and fiber optic repeater). Fiber Driver incorporates solutions called sub-wavelength aggregators (Category 3) that use time division multiplexing (TDM) to combine two or more channels of Gigabit Ethernet or Fibre Channel to optimize the fiber optic transport.

Passive WDM Devices and Accessories

Fiber Driver offers a wide selection of passive multiplexer and OADM solutions (Category 4) common to WDM optical transport networks. Protocol and topology independence makes them transparent to both the network and the end user. These technologies enable a new level of fiber optimization that goes beyond the single fiber paradigm without the historical complexity of DWDM systems.

The transparent operation of passive optical multiplexers and their plug-and-play nature provides significant flexibility for network deployment and migration. With passive multiplexers, lambda aggregation and separation are abstracted from the underlying data services, making it much easier to mix-and-match multiple services during transport across the metro area network.



WDM passive multiplexer and OADM components require no power, which allows their deployment virtually anywhere without interruptions from power outages.

Passive multiplexer and OADM solutions are offered for CWDM and DWDM applications. Using pluggable transceivers as the transponders that feed into a passive multiplexer makes it trivial to swap the optics as needed to achieve the necessary end-to-end link budget. Combined with the EDFA amplifiers, dispersion compensation module, and the self-healing switch, the passive modules and pluggagle transceivers provide powerful new fiber optimization solutions and a unique Fiber Driver transition from single fiber solutions to multiple data channel aggregation utilization.

Converter-Based Service Demarcation

The demarcation interface is the edge of the metro or sub-metro transport network. It is where the various user-subscribed services are defined and implemented. Accordingly, there is a wide range of demarcation devices from 802.3ah-enabled single-service LAN devices to multi-service devices (Category 5) that may, for example, use TDM to combine WAN (ex. T1/E1 aggregated voice channels) and an Ethernet data channel. The top end of the demarcation product range includes devices that incorporate advanced services such as quality-of-service controls, VLAN tag processing, and SLA Assurance tools.

Whatever the services provided, it is essential that the demarcation device supports pluggable transceivers for connecting to the carrier network for multi-service optical transport. This feature extends the benefits of optical transport flexibility and serviceability to the edge of the provider network and simplifies the task of aggregation and grooming at the central office (CO).

System and Management

These elements are the foundation of the Fiber Driver platform; they contain and manage the specific optical transport solutions. Fiber Driver offers a wide range of chassis (Category 7) that can host from one to sixteen modules. The three-slot, four-slot, and sixteen-slot chassis offer optional redundant, hot-swappable AC or DC power supplies.

Fiber Driver devices are SNMP manageable through a network management (NM) module (Category 8). The Fiber Driver NM modules offer sophisticated end-to-end management for reliable, low cost network maintenance and excellent network performance. The Fiber Driver NM remotely monitors and manages an optical Fiber Driver infrastructure through SNMP or a command line from a central location. It supports an extensive array of system alerts and traps, and it can be used to configure a Fiber Driver chassis system for any optical transport applications.

The optical multi-service platform management module also incorporates features especially for WDM optimized optical transport:

- Built-In SFP-based two-sided optical service channel (OSC)
- OSC Ring Redundancy Protocol
- Auto-discovery of peer network managers over the OSC
- Built-in MegaVision-J for single-node management and easy WDM network installation

MegaVision Pro® is a comprehensive network management system (NMS) supporting the entire Fiber Driver product family. It combines complete end-to-end network viewing and performance monitoring with robust configuration and fault management features. It incorporates the ability to discover network devices and to perform many management functions with virtually any device supporting SNMP or TCP/IP from any vendor. Each Fiber Driver chassis and module is represented in full graphical detail showing every chassis slot, module port, and LED indicator with their latest reported color code status.

Fiber Driver - the Optical Multiservice Platform

Pluggable transceivers, multi-rate transponders, passive optical multiplexers, and intelligent demarcation devices make multiservice optical networks an obtainable reality. Today, MRV's Fiber Driver single optical transport platform performs many functions from WDM and lambda conversion to media conversion and fiber optimization.

Fiber Driver allows different protocols and services to easily coexist in metro and sub-metro networks.

As the variety of pluggable transceivers continues to expand and the capabilities of transponders and other supporting components continue to improve, so too will the opportunities for advancing the Fiber Driver services provided across the world's ever-growing fiber infrastructure.

FIBER DRIVER PRODUCT LINE CATEGORIES

(1) MULTI-PROTOCOL MULTIFUNCTION MODULES	
EM316-2SFP	Protocol transparent, two SFP pluggable optical interfaces
EM316DMR3G-3R	Dual Multi-Rate, multifunction, 42 Mbps to 3.2 Gbps, quad-CDR, four SFP pluggable optical interfaces
EM316FC400	1/2/4 Gigabit Fibre Channel, two SFP pluggable optical interfaces
EM316-2XFP-ET	10 Gigabit, two XFP pluggable optical interfaces, 10 Gigabit Ethernet LAN PHY optimized
(2) PROTOCOL-SPECIFIC MULTIFUNCTION MODULES	
EM316T1E1-XY	T1/E1/J1 multifunction media converter two copper (RJ-45), two SFP pluggable interfaces
EM316SW-XY	Fast Ethernet multifunction, two 10/100Base-TX (RJ-45), two 100Base-FX (SFP) interfaces
EM316GSW-XY	Gigabit/Fast Ethernet multifunction converter/repeater/transponder/multi-media switch
EM316-10G-XY	10 Gbps Repeater, Converter, or Transponder, two XFP pluggable optical interfaces, one SFP+ pluggable interface
EM316-10G8SW-XY	Gigabit/10 Gbps Ethernet Multi-Function Media Module, two XFP and eight SFP pluggable optical interfaces
(3) TIME DIVISION MULTIPLEXERS / SUB-WAVELENGTH AGGREGATORS	
EM316GEMX2R	Gigabit Ethernet Time Division Multiplexer (TDM), two Gigabit Ethernet SFP data interfaces, two redundant SFP trunk interfaces
EM316MRMX2R	Multi-rate Time Division Multiplexer (TDM), two Gigabit Ethernet or two 1-Gigabit Fibre Channel SFP data interfaces, two redundant SFP trunk interfaces
(4) PASSIVE WDM DEVICES and WDM ACCESSORIES	
CWDM MUX/DEMUX	CWDM multiplexers (Contact MRV for details)
CWDM ADD/DROP	CWDM add/drop (Contact MRV for details)
DWDM MUX/DEMUX	DWDM multiplexers (Contact MRV for details)
DWDM ADD/DROP	DWDM add/drop (Contact MRV for details)
EM316EA & EM316EDFA Family	C-Band optical amplifiers
EM316OSSH	Wide-band self-healing optical switch, 1270 – 1610 nm
EM316DCM Family	C-Band dispersion compensation
EM316OSA-40DC21	Optical Spectrum Analyzer, DWDM, C-Band
EM316-OSW8	8-to-1 Optical Selector Switch

(5) CONVERTER-BASED SERVICE DEMARCATION	
ETHERNET SERVICES	
EM316EUSM	Fast and Gigabit Optical Ethernet Universal Service Module, two access ports (copper or fiber SFP), two redundant optical (SFP) trunk ports, advanced 802.3AH remote management with MRV extensions, SLA assurance tools
EM316EUSM-10G	10G Optical Ethernet Universal Service Module - fiber (SFP+) access ports and redundant XFP optical trunks; advanced remote management 802.3AH with MRV extensions
EM316EFRMAHSH-5	User port selectable between 10/100 Base-TX copper and 100Base-FX SFP-based fiber to redundant SFP based fiber trunk with 802.3AH extended remote management
EM316GRMAHSH-5	User port selectable between 10/100/1000 Base-TX copper and 1000Base-X SFP-based fiber to 1000Base-X Redundant SFP based fiber trunk with 802.3AH extended remote management
(6) CLASSICAL FIBER DRIVER MEDIA CONVERSION (FIXED OPTICS, ETC.)	
FIXED OPTICS MEDIA CONVERTERS	
EM316F/xx	100Base-TX (RJ45) to 100Base-FX
EM316GCL/xx	1000Base-T to 1000Base-X Gigabit Ethernet with LIN (Link Integration Notification)
EM316E1/T1xx Family	T1 (RJ-48) or E1 (BNC) to fiber
EM316DS3/E3/xx Family	DS3 (BNC) or E3 (BNC) to fiber
EM316G/MX	1000Base-SX (850nm; DSC) to extended multi-mode fiber (1310nm; DSC; 500m/2km)
EM316O3C/xx	SONET/SDH OC-3/STM-1 (BNC) to fiber
IP-LESS REMOTELY MANAGED FIXED OPTICS ETHERNET CONVERTERS	
EM316ERM/xx & EM316WERM/xx Family	10Base-Tx (RJ-45) to 100Base-Fx, dual fiber or single fiber trunk, IP-Less remote management
EM316EFRM/xx & EM316WEFRM/xx Family	10/100Base-Tx (RJ-45) to 100Base-Fx, dual fiber or single fiber trunk, IP-Less remote management
EM316FRM/xx & EM316WFRM/xx Family	100Base-Tx (RJ-45) to 100Base-Fx, dual fiber or single fiber trunk, IP-Less remote management

Datasheet

(7) FIBER DRIVER CHASSIS	
NC316BU-1/15AC	One-slot chassis, 15 Watts with AC power supply
NC316BU-1/15DC	One-slot chassis, 15 Watts with DC power supply
NC316BU-1/15ACE	One-slot chassis 15 Watts with AC power supply (European version)
NC316BU-1/15NP	One-slot chassis without power supply (passive application only)
NC316BU-1/AC	One-slot chassis, 10 Watts with AC power supply
NC316BU-1/DC	One-slot chassis, 10 Watts with DC power supply
NC316BU-1/AC/EU	One-slot chassis, 10 Watts with AC power supply (European version)
NC316BU-1HP/AC	One-slot chassis, 10 Watts with AC power supply
NC316BU-1HP/DC	One-slot chassis, 10 Watts with DC power supply
NC316BU-1/NP	One-slot chassis without power supply (passive application only)
NC316BU-2/15AC	Two-slot chassis with 15 Watts per slot, AC power supply
NC316BU-2/15DC	Two-slot chassis with 15 Watts per slot, DC power supply
NC316BU-2/AC	Two-slot chassis, 10 Watts per slot with AC power supply
NC316BU-2/DC	Two-slot chassis, 10 Watts per slot with DC power supply
NC316BU-3/AC	Three-slot Telco chassis for 19" rack, 15 Watts per slot with AC power supply
NC316BU-3/DC	Three-slot Telco chassis for 19" rack, 15 Watts per slot with DC power supply
NC316BU-4S/AC	Four-slot chassis for 19" rack, 15 Watts per slot with AC power supply
NC316BU-4S/DC	Four-slot chassis for 19" rack, 15 Watts per slot with DC power supply
NC316BU-4S/NP	Four-slot chassis, non-powered with two empty power supply bays
NC316BU4PMC/NP	Four-slot chassis, non-managed, non-powered for passive Mux/Demux modules
NC316BU-16/AC	Sixteen-slot chassis for 19" rack, 10 Watts per slot with AC power supply
NC316BU-16/DC	Sixteen-slot chassis for 19" rack, 10 Watts per slot with DC power supply
NC316BU-16/NP	Sixteen-slot chassis for 19" rack, non-powered with two empty power supply bays
NC316DOOR	Transponder protection door (with cable tray) for 19" rack, sixteen-slot chassis
(8) NETWORK MANAGEMENT AND FIBER DRIVER ACCESSORIES	
EM316LNXNM-OT	Fiber Driver optical multiservice platform Linux-based network management card
EM316-4SW-R	4-port 10/100Base-TX (RJ-45) auto-sensing Ethernet switch

Please visit http://www.mrv.com to learn more about the Fiber Driver Optical Multiservice Platform, and contact sales@mrv.com for details about the extensive selection of SFP and XFP pluggable devices that support the Fiber Driver modules.

MRV has more than 50 offices throughout the world. Addresses, phone numbers and fax numbers are listed at www.mrv.com. Please e-mail us at **info@mrv.com** or call us for assistance.

MRV Los Angeles
20415 Nordhoff Street
Chatsworth, CA 91311
800-338-5316
818-773-0900

MRV Boston
300 Apollo Drive
Chelmsford, MA 01824
800-338-5316
978-674-6800

MRV International
Business Park Moerfelden
Waldeckerstrasse 13
64546 Moerfelden-Walldorf
Germany
Tel. (49) 6105/2070
Fax (49) 6105/207-100

