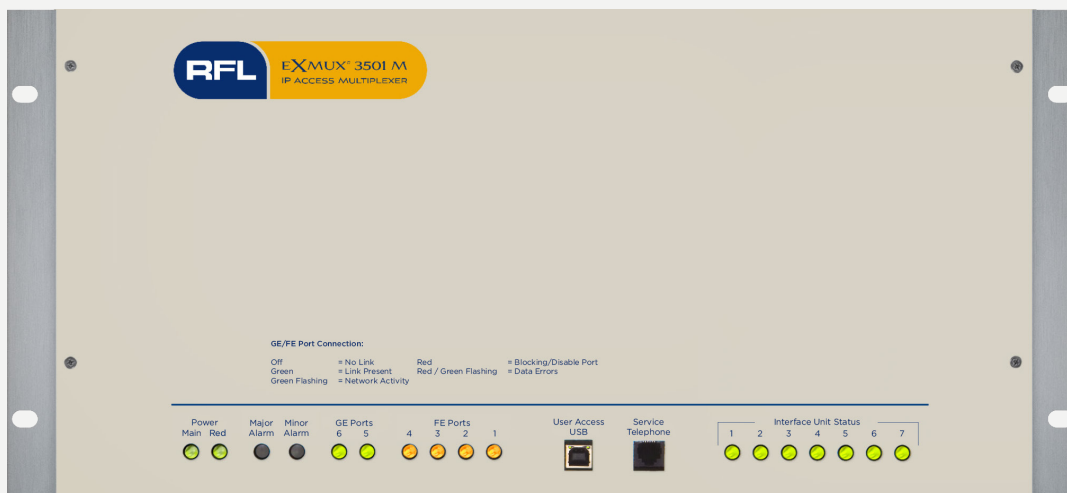




SOLUTIONS FOR AN EVOLVING WORLD

EXMUX[®] 3501

IP ACCESS MULTIPLEXER





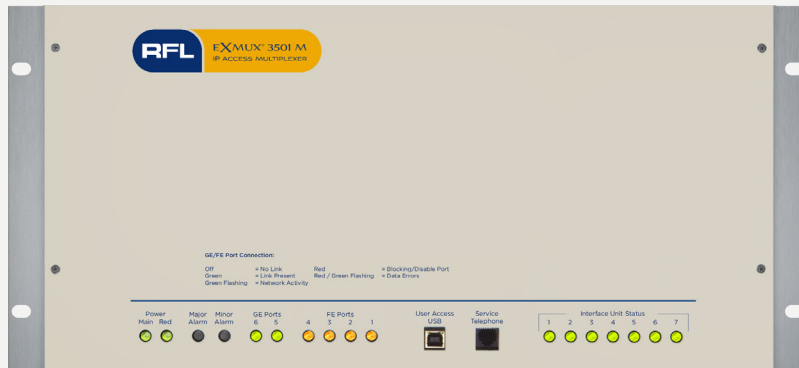
Your world is changing and so are we.

At RFL, we know your needs change much faster than your infrastructure. Our comprehensive line of solutions meets you wherever you are to help you bridge the gap from yesterday to tomorrow.

We aren't just engineering products. We are continuously innovating to give legacy equipment the advantage of today's technologies. Our highly adaptable solutions offer more features for more flexibility and a custom fit for your specific needs.

When we deliver, we also deliver our reputation. So when you open that box, you're opening a custom-engineered solution, factory-tested and ready for deployment.

And as long as you own that equipment, you own the attention of RFL. We see you as our partner and we want to ensure that our solution is working for you - now and over the long haul. RFL - delivering solutions that work. Period.



System Description

The RFL eXmux 3501 is a substation-hardened IP Access Multiplexer engineered for mission critical infrastructures to transport voice, serial, relaying protection, SCADA, video and Ethernet data communications over Ethernet/IP or MPLS networks, providing the flexibility of backward compatibility with legacy devices and forward compatibility with Ethernet devices on the same communications platform. Designed into the eXmux 3501 are features such as “Hitless Switching” for private ring networks with zero-data-loss path recovery technology, dual path communications for routing redundant paths over public networks and a (DACs) function for cross-connecting DSOs between T1/E1 circuits and/or eXmux 3501 interface unit. The product is designed for harsh applications and is available in two chassis configurations; a mission-critical model that offers module hot-swap capabilities for all functional cards and a economical compact model for applications where module hot swap capability is not required.

Both the 3500 and the 3501 models are interoperable within the same network.

Key Features & Benefits

Chassis Configurations / Hot Swap & Compact:

For Mission Critical applications the eXmux 3501 is available with a Hot Swap Module option where all modules of the eXmux 3501 are field replaceable with the unit powered. All interfaces units, power supplies, and switch can be replaced in the field in seconds. The Hot Swap model is a 5RU high 19" rack mount chassis while the compact model is a 3RU high 19" rack mount chassis.

Legacy Interfaces:

Accommodates up to 7 different DSO or T1/E1 legacy interface units; plus a standard T1/E1 interface and a 2-wire telephone service channel.

Advanced VNMS with DSO Grooming:

An advanced Visual Network Management Software for effortless configurations, port mapping, maintenance and remote firmware upgrade that includes an Integrated Digital Access Cross-Connect System (DACs), allowing individual DSO circuits from any legacy T1/E1 system to be connected to any DSO circuits within the eXmux 3501 network or to another TDM network.

Interface Units (IU):

Supports legacy IUs such as: RS-232, RS-485, Serial Server, RS-422/530, V.35, X.21, G.703, C37.94, Teleprotection, 2W & 4W E&M, 2W FXO, 2W FXS and T1/E1.

Teleprotection System:

An integrated end-to-end teleprotection function that provides 4 bi-directional transfer trips commands in addition to 2 controlling inputs logic and 2 outputs for alarming & status. It is mid-span compatible with the IMUX 2000 T1/E1 multiplexer MTS Teleprotection System.

Value:

A lower cost solution than SONET/SDH or even T1/E1; Along with a simple and more efficient network that reduces maintenance cost and increases user productivity.

Cyber Security:

SNMPv3 for Authentication and Encryption along with an embedded User Access Management System and other cyber security features meeting NERC requirements.

Real Time Critical Applications:

Designed for real-time critical data applications such as SCADA/RTU, Relaying and Teleprotection with minimum latency.

Hitless Switching:

A field proven path redundancy feature for private ring networks with zero-data-loss, making it ideal for critical infrastructure and protective relay applications.

Key Features & Benefits (continued)

Dual-Path Communications:

A field-proven path redundancy feature designed for public networks, making it ideal for critical infrastructure and protective relay applications.

Resilient & Dependable:

Enhanced reliability by offering optional redundant power supplies and path redundancy using MSTP (Multiple Spanning Tree Protocol) or RSTP (Rapid Spanning Tree Protocol) technology.

Bandwidth:

Backbone communications is at a Gigabit Ethernet (GigE) speed, equivalent to about twice the speed of a SONET/SDH OC-12/STM-4.

Compliance:

Designed for harsh environment with Immunity from SWC, ESD & RFI; convection cooling with operating temperature: -30 C to +65 C.

IEEE P1613; IEC61850-3; ANSI C37.90.2; ANSI C37.90.3

Technology

Uses TDM over IP technology that allows point-to-point legacy equipment to communicate over an IP network that includes an Integrated Layer 2 Managed Ethernet Switch including two GigE Uplink (WAN) Ports and four fast Ethernet (LAN) ports.

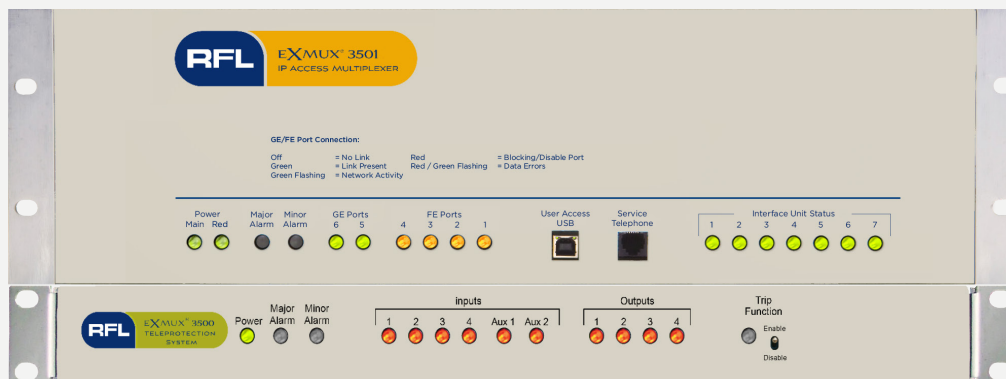
System Description (continued)

Converging two important traffic types into one infrastructure provides the benefit of connecting traditional Voice, Video, Serial data, and relaying protection circuits over Ethernet networks taking advantage of the simplicity and efficiency of IP routing and Ethernet switching. This proven concept offers a cost-effective and feature-rich solution that bridges the gap between the TDM legacy and the modern IP world, achieving the best of both.

The eXmux 3501 comes with an advanced Graphical Visual Network Management Software (VNMS) for Operations, Administration, Maintenance and Provisioning (OAM&P). The VNMS is intuitive and user-friendly, making configuration, interface port mapping and diagnostics effortless. VNMS communications uses the latest SNMPv3 for authentication and encryption along with cyber security features meeting NERC-CIP requirements.

The eXmux 3501 can support any network topology such as Linear, Star, Rings and Mesh. When configured in a ring topology over a private network each interface port can be individually configured for "Redundancy", allowing the device to transmit data to both WAN ports simultaneously. If a failure occurs, data continues to reach its destination with no interruptions. The average port interface latency (back-to-back channel delay) is less than 10 milliseconds (ms). When the eXmux 3501 is setup for optimal configuration, latency can be less than 5ms. The low latency capability and the unique "Hitless Switching" mechanism allow critical real-time applications such as SCADA, Teleprotection and Relaying over an IP network just as they are done today on TDM networks. The eXmux 3501 can support dual path communications for use over a private or public network. By transmitting dual IP addresses from a single WAN port and routing each IP address differently, a backup path will be available at all times without the need for any failover routing.

The eXmux 3501 uses TDM over IP technology and an integrated Layer 2 Managed Switch, which allows the unit to support Legacy Interfaces such as T1/E1, RS-232, RS 485, Serial Server, RS-530/422, V.35, X.21, G.703, C37.94, Teleprotection and various Voice interfaces, along with native IP solutions. A two-wire telephone service channel is incorporated to provide in-band voice communication to any eXmux 3501 connected to the network, creating the classic feel of a legacy communications device.



eXmux 3501 with Modular Teleprotection System (TPS)

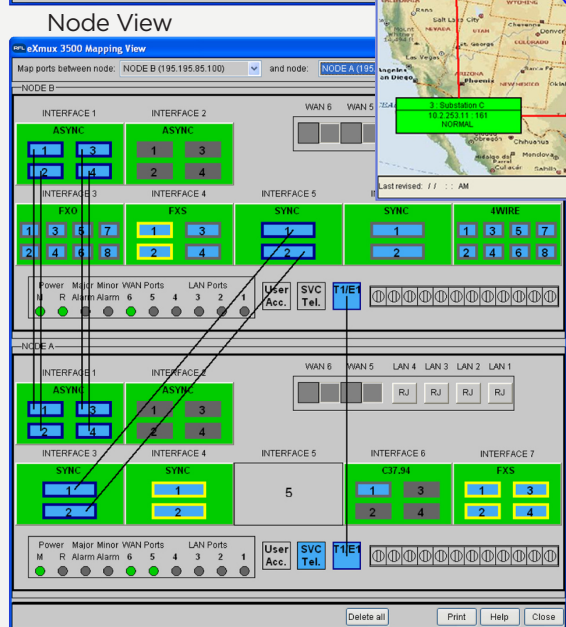
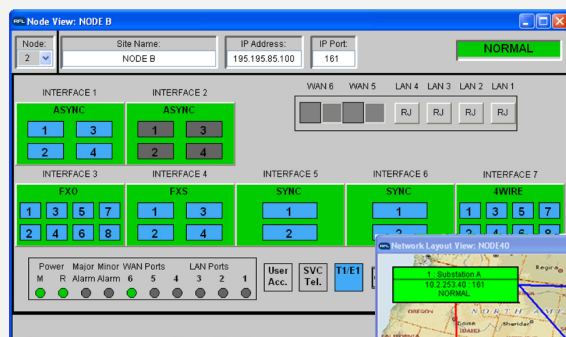
eXMUX® 3500 Visual Network Management Software

The eXmux 3501 IP Access Multiplexer comes with an advanced Graphical User Interface (GUI) Network Management Software for Operations, Administration, Maintenance and Provisioning (OAM&P). The intuitive and user friendly eXmux 3501 VNMS is designed to allow the user to manage their eXmux 3501 network, making configuration, port mapping, network monitoring and diagnostics simple and easy. Network Management Software V6.1 and above is required to manage both 3500 and 3501 models within the same network.

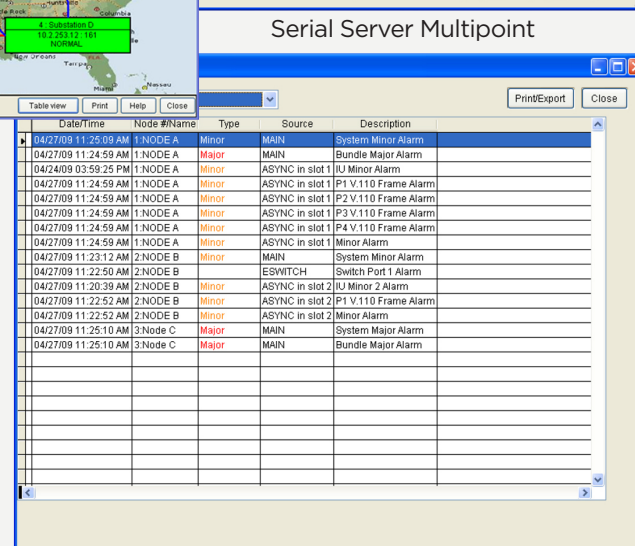
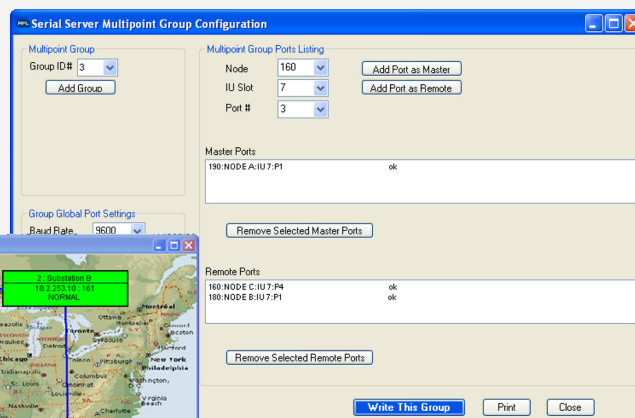
eXmux 3501 Visual Network Management Software Feature Summary:

The VNMS communicates using the latest SNMPv3 for authentication and encryption along with cyber security features meeting NERC requirements. The Network view provides the user an overall view of the network and the status of each node in the network and is further enhanced by allowing the user to graphically represent the physical interconnection of each node in the network. The Node view displays a virtual physical view of the unit as configured with real-time status information. Programming details of each module are easily accessible by a simple double click on the module.

The uniquely designed Port Mapping interface allows the user to easily map any port on an eXmux 3501 to any other eXmux 3501 on the network by a simple point and click ("Map this Port") function. The dynamic Current Active Alarm view gives the user specific information as to which node is in alarm, the type of alarm, the source and the description so that diagnostic can be straightforward and quick. The "Tooltip" function provides the user "On-demand" information on any setting, status and alarm from any screen without the need for a manual or cumbersome Help function.

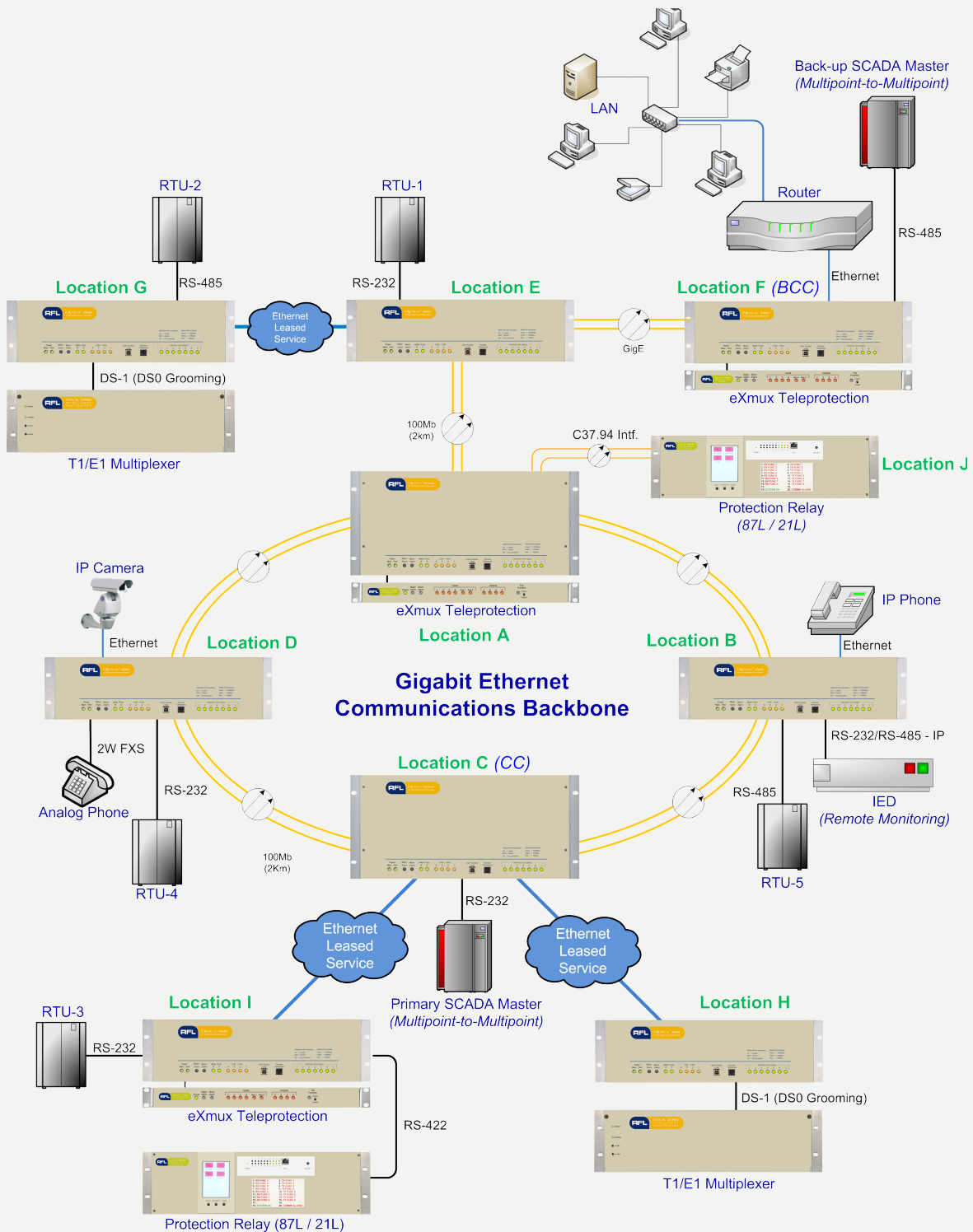


Mapping View



Current Active Alarm View

Network Diagram Example



The above example is a typical communications network using the eXmux 3501 configured with GigE Fiber Interface for the communication backbone and 100Mb FX on the linear and star setups. The communications network is able to transport both existing legacy devices with RS-422, RS-232, RS-485, 2W-FXS, specific DS0's from the DS-1 & C37.94 interfaces, Teleprotection commands and IP devices using the eXmux 3501 common IP platform.

Technical Specifications

Interface Units (IU)

4 Port Synchronous Interface

Protocol supported: RS-422/RS-530, V.35, X.21
Signal Interconnection: DCE / DTE
Control line: RTS and CTS
Connector: DB-25 Female
Slot(s) occupied: 2
Data Rates: 56Kbps, Nx64Kbps (N=1 to 31)
Loopback: Local and Remote

4 Port RS-485 Interface

Protocol supported: RS-485
Operating mode: 2 or 4 Wire
Connector: Compression terminal blocks
Slot(s) occupied: 1
Data Rates: 600bps to 38.4Kbps
Loopback: Local and Remote

4 Port Serial Server Interface

Protocol supported: Raw socket mode, SSH, Telnet, DNP3-Serial to DNP3-IP
Application: Point-to-point, PC Client, Multipoint-to-multipoint
Operating Mode: RS-232 or RS-485 4-Wire
Connector: DB-9 Female
Slot(s) occupied: 1
Data Rates: 300bps to 115Kbps
Loopback: Local and Remote

4 Port G.703 Co-directional Synchronous Interface

Signal Interconnection: DCE / DTE
Connector: DB-15 Female
Slot(s) occupied: 2
Data Rate: 64Kbps
Loopback: Local and Remote

4 Port C37.94 Synchronous Relaying Interface

Connector: ST
Slot(s) occupied: 1
Data Rates: Nx64Kbps (N=1 to 12)
Conforms to ANSI C37.94
Loopback: Local and Remote

8 Port Asynchronous Interface

Protocol supported: RS-232, V.24
Control line: RTS and DTR
Connector: DB-9 Female
Slot(s) occupied: 2
Data Rates: 600bps to 38.4Kbps
Loopback: Local and Remote

8 Port 4-Wire & 4 Port 2-Wire E&M Audio Interface

Coding: PCM
Signaling: Type I, II, III & V
Connector: RJ-45
Slot(s) occupied: 1
Conforms to AT&T Publication 43801
Loopback: Local and Remote

8 Port 2-Wire FXO Interface

Coding: PCM
Signaling: Loop start
Connector: RJ-11
Slot(s) occupied: 1
Conforms to AT&T Publication 43801

4 Port 2-Wire FXS Interface

Coding: PCM
Signaling: Loop start
REN per Port: 4
Connector: RJ-11
Slot(s) occupied: 1
Conforms to AT&T Publication 43801

T1/E1 Interfaces

Built-in single T1/E1:

Framer type: Electrical T1 or E1
Framer mode: Pass-thru or DSO grooming
T1 framer: Conforms to ANSI T1.102-1993, AT&T 62411 & 43801
E1 framer: Conforms to ITU G.703, G.823 & G.704
Connector: RJ-48C
Loopback: Local and Remote

Single Port T1/E1 Interface:

Framer type: Electrical T1 or E1
Framer mode: Pass-thru or DSO grooming
T1 Mode: Conforms to ANSI T1.102-1993, AT&T 62411 & 43801
E1 Mode: Conforms to ITU G.703, G.823 & G.704
Connector: RJ-48C and DB-15
Loopback: Local and Remote

Digital Teleprotection System

2 Port eXmux TPS Interface Unit:

Signal Interconnection: RS-485
Interface Connector: DB-9 Female
Slot(s) occupied: 1
Data Rate: Two independent 64Kbps channel
Records: 1500 SOE records
SOE synchronization: NTP/SNTP/IEEE 1588
Loopback: Local and Remote
Compatibility: IMUX 2000 MTS

eXmux TPS I/O Box:

Interface Connector: DB-9 Male
Inputs: 4 Optically isolated (voltages: 24V, 48V, 125V or 250V), 2 auxiliary controlling inputs
Outputs: 4 Solid state or Relay
Terminal Block: Compression or Screw type
Status: Inputs, Outputs, Power, and alarms
Alarms: Minor and Major alarm and form C contacts
Trip Function Disable Switch



Technical Specifications Continued

Layer 2 Managed Ethernet Switch

GE Ports

Number of Ports: 2
Copper Ports: 10/100/1000 Base-TX
Fiber SFP Ports: 100 Base-FX or 1000
Base-FX Fiber Connector: LC

Dual Fiber

1000 Base-FX distance options: 550m (0.34mi), 10km (6.2mi), 20km (12.4mi), 60km (37.3mi), 80km (49.7mi), 120km (74.5mi)

FE Ports

Number of Ports: 4
Copper Ports: 10/100 Base-TX

Features

VLAN, QoS, CoS, ToS/DS, SNMPv3, IGMP Snooping and Querying, Port Mirroring, Broadcast and Multicast Storm Protection, Full duplex w/flow control, 802.1x Port Based Authentication with EAP, MAC Address Base Authentication, supports RSTP, MSTP and Rapid per VLAN Spanning Tree Plus (Rapid-PVST+).

Standards

All IEEE 802.3 compliant devices are supported

Power Supply

19-32 VDC
38-150 VDC / 88-130 VAC
200-300 VDC
200-275 VAC

Mechanical

Standard

19" Rack Mount (3RU)
H: 5.25"(144mm) W: 19"(483mm) D: 11"(279mm)
Status LEDs (front and rear for either front mount or rear/wall mount)

Hot Swap

19" Rack Mount (5RU)
H: 8.75" (222mm) W: 19: (483mm) D: 11" (279mm)
Status LEDs (front and rear for either front mount or rear/wall mount)

User Interface / Service Channel

USB Port User Access for IP address setup
FE/GE port for Visual NMS GUI
2-Wire Telephone Service Channel

Environmental

Convection cooling (No Fans)
Operating temperature: -30 C to +65 C (-22 F to +149 F)
ANSI/IEC SWC, ESD, RFI compliant
IEEE1613, IEC61850-3 compliant

Environmental & Safety Compliance

System and Chassis

EN 60950: 2002 Safety of information technology equipment
EN 60825-2: 2004 Safety of laser products — Part 2
EN 55022: 1998 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN 55024: 1998 Information technology equipment - Immunity characteristics - Limits and methods of measurement IEC 61850-3 Environmental standard
EN 61000-4-2 (8/15 KV ESD) (front of chassis)
EN 61000-4-3 / EN 61000-6-4 - Radiated RFI immunity.
EN 61000-4-6 / EN 61000-6-2 - Conducted RFI immunity
ANSI C37.90.2 - EMI Withstand
ANSI C37.90.3 - (ESD Withstand, front of chassis)
IEEE P1613 - (Environmental, ESD, RFI, Shock & Vibration)

Power Supply and Alarm contacts

EN 61000-4-4 / ANSI P1613 / ANSI C37.90.1 (4 KV EFT)
EN 61000-4-5 (Surge withstand)
EN 60255-5 / ANSI P1613 (5 KV Impulse)
EN 60255-5 / ANSI P1613 (2.8 KV High Pot)
EN 60255-22-1 (Damped Oscillatory Disturbance)
ANSI C37.90.1 / ANSI P1613 (Oscillatory)
IEC 60834-1 (Power supply disturbance tests)

Synchronous Data Ports

All Common Mode Using Capacitive Clamp and Shielded Cable
EN 61000-4-4 / ANSI P1613 / ANSI C37.90.1 (4 KV EFT)
EN 60255-22-1 (2.5 KV, 1 MHz Damped Oscillatory)
ANSI C37.90.1 / ANSI P1613 - (2.5 KV Oscillatory)

Four Wire Audio Ports, T1/E1 Ports

EN 61000-4-2 / ANSI C37.90.3 / ANSI P1613 (8/15 KV ESD)
EN 60255-5 / EN 60834-1 / ANSI P1613 (0.72 KV High Pot, common mode)

VF Ports and Asynchronous Ports

EN 61000-4-2 / ANSI C37.90.3 / ANSI P1613 (8/15 KV ESD)

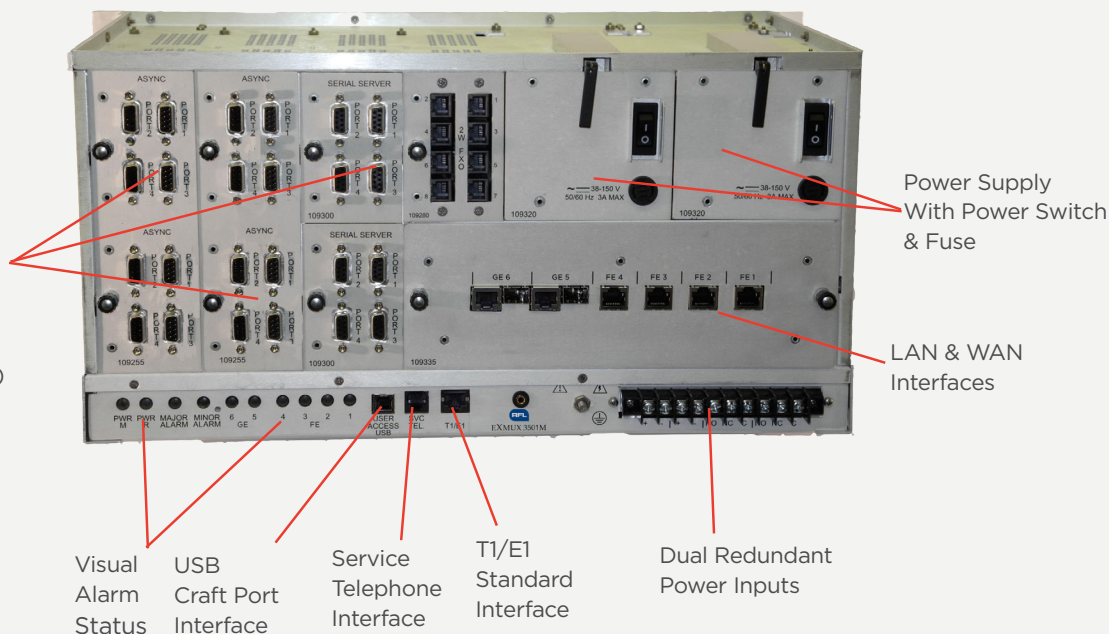
User Interface Ports

EN 61000-4-2 / ANSI C37.90.3 / ANSI P1613 (8/15 KV ESD)

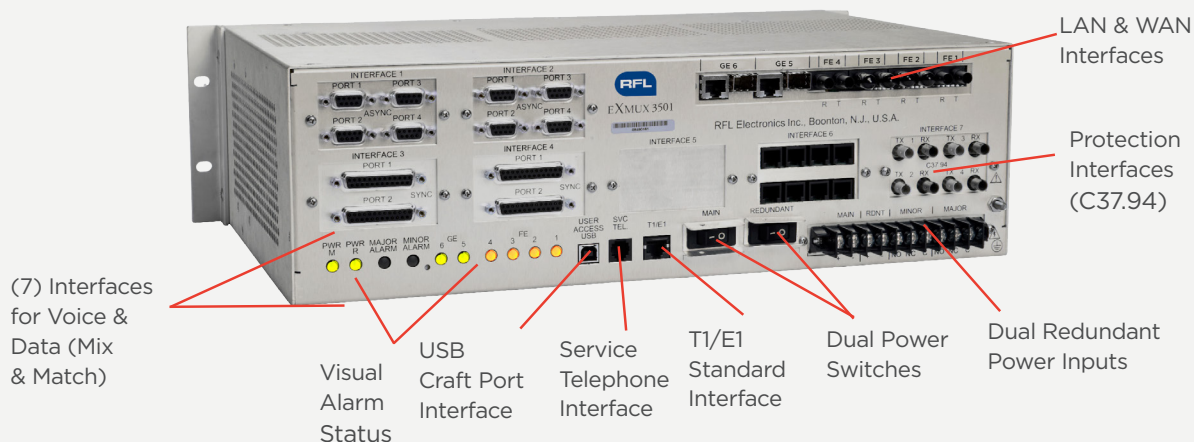


EXMUX® 3501M Chassis Interface Overview

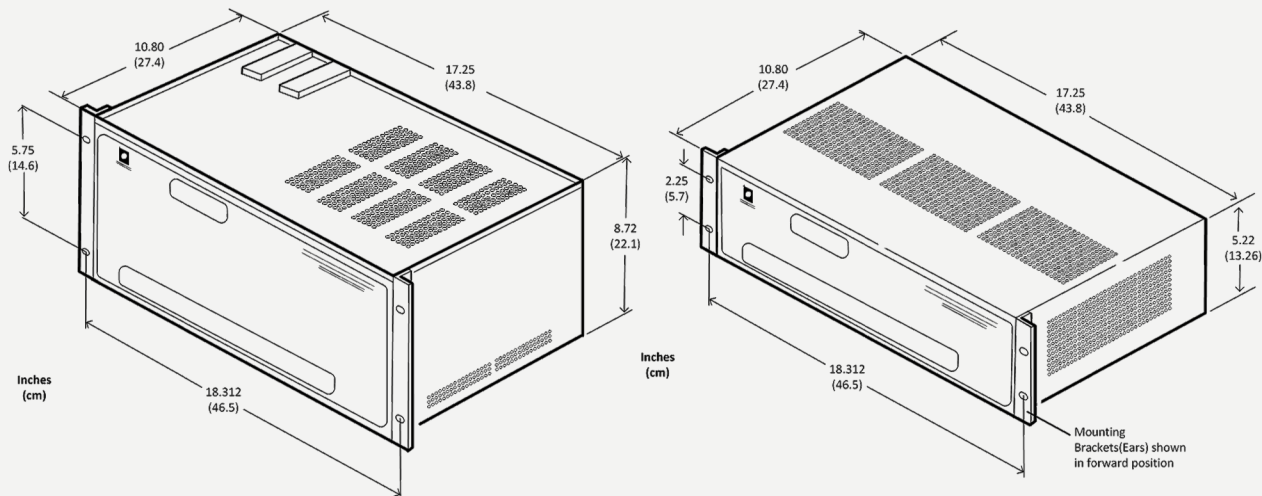
(7) Field Replaceable Interfaces for Voice, Data (Mix & Match), & Protection (C.37.94)



eXmux 3501 Chassis Interface Overview



Mounting Information



RFL eXMUX 3501/3501M - IP Access Multiplexer

Ordering Information

RFL Smart Number Description (fill in blanks):		CM	MP	RP	FE	G5	G6	S3	S4	S1	S2	S5	S6	S7
CHASSIS & MOTHER BOARD STYLE														
Non-Modular		N												
Modular Hot-Pluggable		M												
MAIN POWER SUPPLY														
24 VDC w/Terminal Block			1											
38-150VDC / 110VAC w/Terminal Block			2											
200-300VDC w/Terminal Block			3											
24 VDC w/Compression Block			4											
38-150VDC / 110VAC w/Compression Block			5											
200-300VDC w/Compression Block			6											
220VAC w/Terminal Block			7											
220VAC w/Compression Block			8											
REDUNDANT POWER SUPPLY OPTION														
None			0											
24 VDC			1											
38-150VDC / 110VAC			2											
200-300VDC			3											
220VAC			4											
ETHERNET SWITCH WITH FE PORTS (1 -4)														
4-RJ-45 10/100 Base TX					A									
ETHERNET SWITCH GE PORT 5 & Port 6 Option														
Electrical RJ-45 10/100/1000 Base TX							A							
One[1] SFP - 1000Base-SX 850nm 550m/1800ft MM LC Connector							B							
One[1] SFP - 1000Base-LX 1310nm 10km/6.2mi SM LC Connector							C							
One[1] SFP - 1000Base-LX 1310nm 20km/12.4mi SM LC Connector							D							
One[1] SFP - 1000Base-FX 1550nm 60km/37.3mi SM LC Connector							E							
One[1] SFP - 1000Base-ZX 1550nm 80km/49.7mi SM LC Connector							F							
One[1] SFP - 1000Base-ZX 1550nm 120km/74.5mi SM LC Connector							G							
DS0 INTERFACE UNIT (IU) OPTIONS														
SLOT 1 - 7 DOUBLE AND SINGLE POSITIONS														
SLOT(S)														
4-Port Multi-Protocol Sync IU (RS-422/530, X.35, X.21) D (See note 1 below) A 1														
4-Port G.703 Sync. IU D (See note 1 below) B 1														
8-Port Async. RS-232 IU D (See note 1 below) C 1														
4-Port C37.94 MM Sync. IU S D														
8-Port 4-Wire Audio E&M IU S E														
8-Port 2-Wire FXO IU S F														
4-Port 2-Wire FXS IU (See note 2 below) G														
4-Port C37.94 SM Sync. IU S H														
4-Port RS-485 IU S J														
1-Port T1/E1 IU (See note 3 below) K														
4-Port RS-232/485 Serial Server IU S L														
4-Port 2-Wire Audio E&M IU S M														
2-Port TPS IU with One[1] SS I/O Box N Terminal T Compression N or T														
2-Port TPS IU with One[1] RLY I/O Box P Terminal U Compression P or U														
2-Port TPS IU with Two[2] SS I/O Box Q Terminal V Compression Q or V														
2-Port TPS IU two Two[2] RLY I/O Box R Terminal W Compression R or W														
2-Port TPS IU with One[1] SS I/O Box and One[1] RLY I/O Box S Terminal X Compression S or X														
None S Z														

CM = Chassis & Motherboard Style

MP = Main Power

RP = Redundant Power

FE = Fast Ethernet Ports

GX = GigE Port X (where x=5 or 6)

SX = Slot X (where x=1-7)

D = Can fit double slot module (3501 Only: Double slot IUs can only start in S1, S3 or S5)

Note 1: If A, B or C is selected for S1, S2 must be 1

If A, B or C is selected for S3, S4 must be 1

If A, B or C is selected for S5, S6 must be 1

Note 2: Only a maximum of two(2) FXS IU is allowed per chassis





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