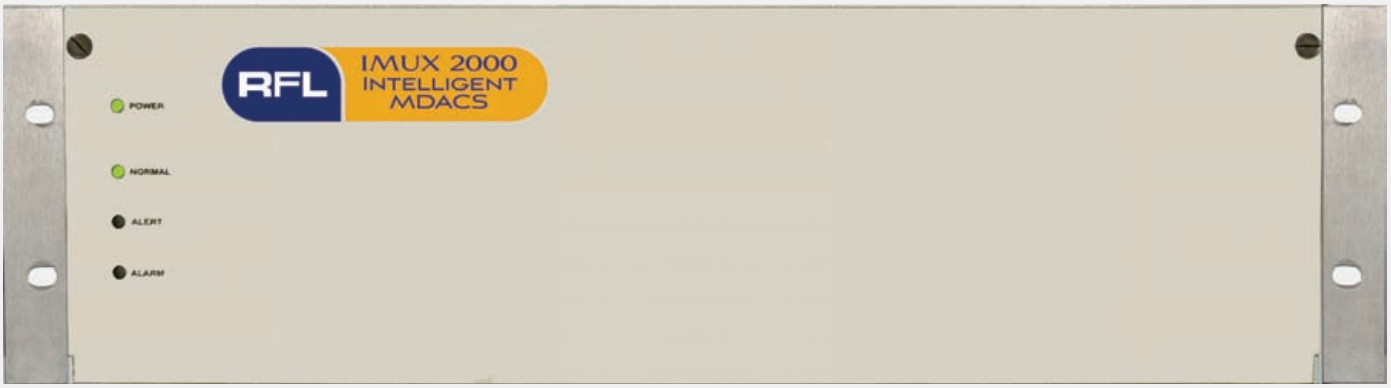
RFL

SOLUTIONS FOR AN EVOLVING WORLD

IMUX 2000

T1/E1 MDACS

Cross-Connect Switch



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.

IMUX 2000

T1/E1 MDACS Multiplexer with Digital Access Cross-Connect Switch

The Fifth Generation Multiplexer designed to meet the needs of your Telecommunications Network

Designed for harsh environments, the new IMUX 2000 T1/E1 MDACS creates a new class of Intelligent Multiplexer with features such as **Digital Access Cross-Connect Switch, built in CSU functionality, and DS0 squelching capability.**

The unit provides full featured, Drop-and-Insert capability for each voice frequency circuit or any signal that can be transmitted in a DS0 channel. The multiplexer has electrical and a wide variety of optical fiber (both singlemode and multimode) interfaces to simplify system configuration. Channel cards are available for voice, data, telemetry, teleprotection, video and ethernet applications. The IMUX 2000 T1/E1 MDACS supports many types of network layouts such as Spur, Hot Standby and Ring topologies. The IMUX 2000 T1/E1 MDACS is both hardware and software configurable. The unit offers the ultimate network management system. It operates in a Windows™ point-and-click environment and provides network visibility from any node which allows for remote provisioning, monitoring and alarm reporting.

The IMUX 2000 T1/E1 MDACS is compact, modular in design and compatible with previous generations of RFL Multiplexers. For a product that meets and exceeds your telecommunication needs, advance into this new class of hardened multiplexer and make the Intelligent choice, the IMUX 2000 Intelligent T1/E1 MDACS.

Key Features and Benefits

Substation Hardened
The IMUX 2000 T1/E1 MDACS is designed for harsh environments and has a wide temperature range of -20°C to +65°C. It meets the IEEE/ANSI standards C.37.90-1989, C.37.90.1 and C.37.90.2 for SWC, fast transient and EMI.

Reliability
The IMUX 2000 T1/E1 MDACS provides enhanced reliability by offering optional redundant power supplies.

Speed
The IMUX 2000 T1/E1 MDACS is designed to handle time sensitive applications such as Protective Relaying. The Drop-and-Insert through-channel delay is less than 25 microseconds. The IMUX 2000 T1/E1 MDACS has an average reframe time of less than 25 milliseconds.

DS0 Squelching
The IMUX 2000 T1/E1 MDACS has the ability to squelch (turn off) the output of a channel module in the Multiplexer upon loss of synchronization. This feature provides security against false tripping on 4-wire analog transfer trip channels and older digital equipment (with limited error checking) during loss of sync and protects against 'pink' noise conditions, which result from cross-talk or the frame search. This feature is ideal for preventing false tripping due to system malfunction.

CSU Functionality
The IMUX 2000 T1/E1 MDACS offers a built in CSU functionality that meets applicable standards for protection including FCC Part 68 approval for direct connection into the Public Switched Telephone Network (PSTN). When enabled, the unit will respond to generated loopback codes compliant to either ANSI T1.403 or AT&T TR 54016. It will also maintain and allow local and remote retrieval of performance measurements in accordance with either ANSI T1.403 or AT&T TR 54016.

Modular Design
The IMUX 2000 T1/E1 MDACS incorporates a midplane motherboard design. Channel modules plug into the front of the unit, and matching module adapter for I/O connections plug into the rear. This eliminates the need for internal chassis wiring when adding new channel cards, simplifying the upgrade..

Automation
The IMUX 2000 T1/E1 MDACS offers the ultimate Network Management system which operates in a Windows TM point-and-click environment. The optional SNMP based management reporting software can be used when integrated as part of a larger enterprise system. Network visibility is available from any node which allows remote provisioning, monitoring and alarm reporting. Intuitive graphical user interface with color coded DACS maps.

Fiber Optic or Electric Interfaces
The IMUX 2000 T1/E1 MDACS can be equipped with either electrical T1/E1 interfaces or Optical Interface Adapters (OIA's). The electrical T1 interface is equipped with Line Build-Out (LBO) networks for operation of up to 6,000 feet from the DSX. The OIA's are available in a wide range of multimode, singlemode, LED or laser combinations to accommodate 1300nm and 1550nm wavelengths.

Channel Interfaces
A wide range of interfaces unique to the utility and the transportation market is offered. It also offers a wide range of Voice and Data, Status, Telemetry, Ethernet, Transfer Trip and Video channel interfaces to meet most communications requirements.

Fast Restoration
When applied to diverse communication routes, such as Ring or Hot-Standby networks, the IMUX 2000 is capable of switch times programmable down to 1 millisecond.

Diverse Networks
The IMUX 2000 T1/E1 MDACS supports many types of network layouts such as Linear, Spurs, Hot-Standby and Ring topologies. It is also designed for operation over SONET/SDH networks taking into consideration the critical time-delay issues associated with Protective Relaying.

SONET and SDH Applications
Protective Relaying can finally be applied over non-proprietary SONET/SDH equipment. With emphasis placed on rapid break healing, the IMUX 2000 T1/E1 MDACS addresses the critical time issues associated with Protective Relaying making it the ideal and Intelligent choice when interfacing to SONET/SDH networks. The IMUX 2000 T1/E1 MDACS bridges the gap between SONET/SDH and substations providing DS0 gateways onto the network. Also, through its own switching techniques, can overcome the longer switch times and unequal channel delay issues associated with SONET/SDH.

Digital Access Cross-Connect Switch
Functionality provides full cross-connect capability as well as a reliable level of system restoration. The IMUX 2000 T1/E1 MDACS enables the termination of up to four [4] T1/E1 ports while also providing full DS0 Time Slot Interchange capability. System restoration is accomplished through the use of alternate DS0, Time Slot Interchanged maps. The alternate maps are predetermined and pre-programmed through our user friendly Network Management Software. An alternate DS0 map is invoked automatically upon detection of T1/E1 failures (e.g. AIS, Loss of Frame, excessive BER). The time necessary to switch to an alternate map, upon detection of failure, is programmable down to 1 millisecond.

Electric Power Utilities

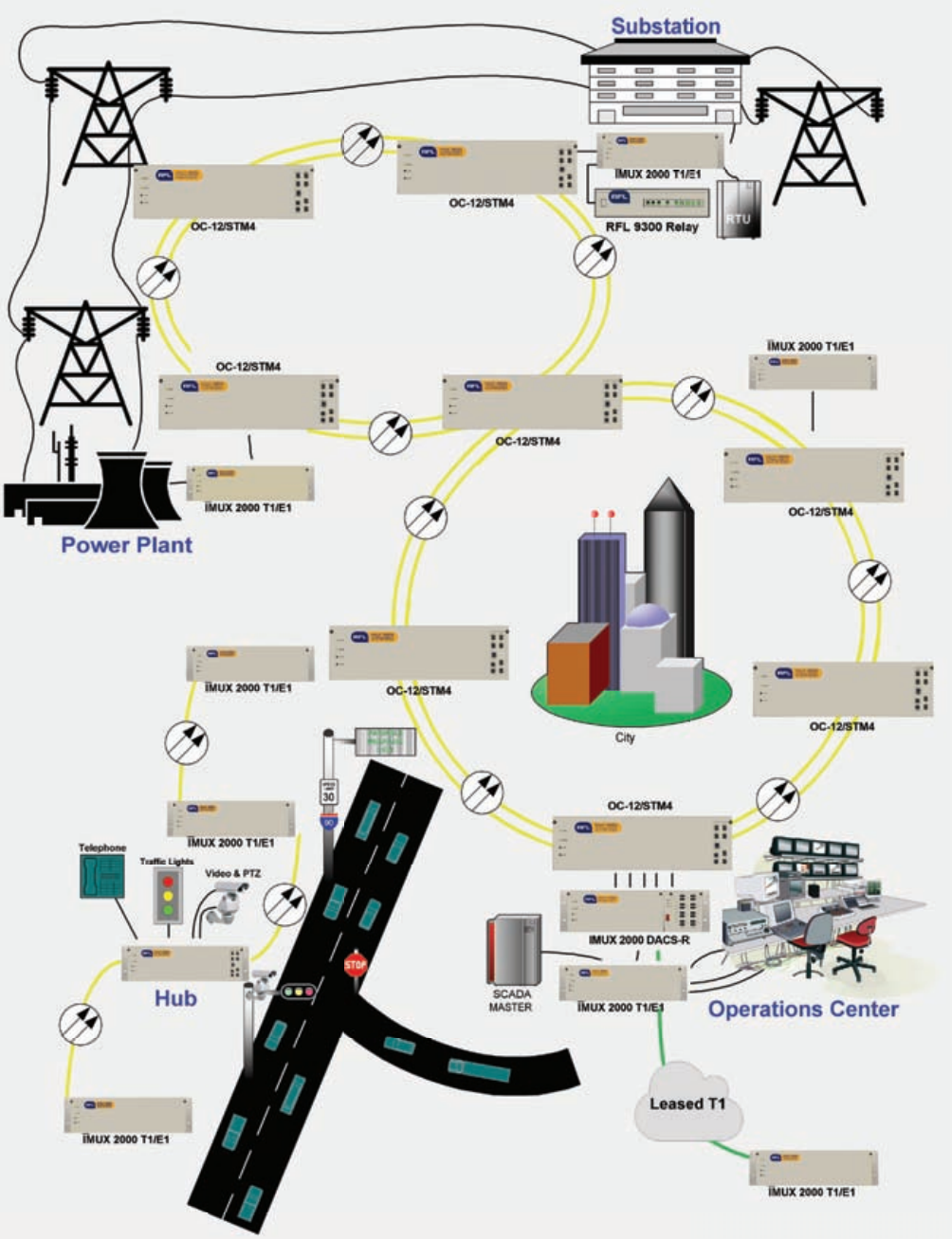
Designed specifically for the unique need of the harsh substation environments, the IMUX 2000 T1/E1 MDACS incorporates special design characteristics which allow it to meet ANSI / IEEE / IEC standards for operation in harsh environments (RFI, SWC, EMI and Fast Transient). The Drop-and-Insert through delay is less than 25 microseconds, including the fiber heads (excluding the communications medium). Along with the minimal through delay, a software programmable Fast Reframing channel is available to allow the multiplexer to reframe in less than 1 millisecond. The DS0 squelching (patent pending) capability allows the Common Logic Module to squelch (turn off) the output of a channel module in the Multiplexer upon loss of synchronization. This feature provides security against false tripping on 4-wire analog transfer trip channels and older digital equipment (with limited error checking). These features in the IMUX 2000 T1/E1 MDACS, address the critical time issues associated with protective relaying, making it ideal to be used in the electric power utilities industry. In addition, the multiplexer has the Transfer Trip and Current Differential interfaces required for the utility market.

Transportation Industry

With the increasing demand for faster, more efficient ways to manage the flow of traffic, customers need a communication infrastructure that allows the system to advance as the technology develops. That is why the IMUX 2000 T1/E1 MDACS, with its unique harsh environments design, is the preferred choice of communication for the Transportation Industry. The IMUX 2000 T1/E1 MDACS is designed to be used as part of a large traffic management system working in conjunction with higher bandwidth SONET/SDH networks or in stand-alone T1/E1 networks.

Applications for the product include: roadside signal acquisition and transmission from vehicle loop detectors, compressed digital video, camera control, toll collection, status and alarm reporting, tunnel ventilation control, and voice and data traffic signal control systems. The compact and robust design and the ability to work under harsh conditions makes the IMUX 2000 T1/E1 MDACS the best multiplexer for transportation applications. The network management software provides ease of maintenance with Windows™ based GUI software. The optional SNMP based management reporting software can be used when integrated as part of a larger enterprise system.

Application Solutions



Above is an example of a typical utility / traffic system solution. It is made up of two SONET/ SDH rings as the communications backbone. The IMUX 2000 T1/E1 Multiplexers are configured to work in a Point-to-Point, Star and Stand-Alone Linear topology over the SONET/SDH system.

The IMUX 2000 carries RTU and phone circuits from several substations to the operations center. It also carries current differential relay data between substations.

The IMUX 2000 carries roadside signals, transmission data from vehicle loop detectors, compressed digital video, camera control, toll collection information, status and alarm reporting, voice and data traffic signal controls back to the operations center.

Technical Specifications

T1 INTERFACE

Interface:
DSX-1 interface per ANSI T1.102-1993

Rate:
1.544 Mbps per ANSI T1.102-1993
(Transmit ± 30 PPM using internal timing)

Transmit Pulse Shape:
Per ANSI T1.102-1993

Formats:
Extended Superframe (ESF) per AT&T 62411,
D4/ Superframe (SF) per AT&T 43801

Line Codes:
Bipolar with 8 Zero Substitution (B8ZS)
& Alternate Mark Inversion (AMI)

Output Impedance:
100 Ohms nominal per ANSI-T1.102-1993

Reframe Time:
Less than 25 milliseconds.

TIMING

Primary Timing:
Internal, External, Loop

Fallback:
Internal, External, Loop
Automatically enabled in case of primary timing failure.

Timing Output:
T1: 1.544 Mbps, (RJ11 connector)
E1: 2.048 Mbps, G.703 (RJ11 connector)

ENVIRONMENTAL

Temperature:
-20°C to +65°C (-4°F to +149°F) operating

SWC & Fast Transient:
Power supply, alarm contacts, pilot wire interface & transfer trip interface meet the requirements of ANSI C.37.90-1989 & ANSI C.37.90.1. EIC 1000-4-2:1995, IEC 1000-4-3:1997, IEC 1000-4-4:1995, IEC 1000-4-6:1996, IEC 1000-4-8:1994, DD ENV 50204:1996.

EMI:
The chassis & modules meet ANSI C.37.90.2.

FCC Compliance:
FCC Part 15 class A

Humidity:
0-95% Non-condensing

Shock & Vibration:
The chassis and channel modules shall meet requirements of IEC 255-21-2 and IEC 255-21-1.

E1 INTERFACE

Interface:
Conforms to ITU G.703

Rate:
2.048 Mbps ± 50 PPM input and output

Jitter Tolerance:
Exceeds ITU G.823

Attenuation:
Greater than 18 dB at 40Hz

Formats:
Frame format per ITU G.704 in 30-channel and 31-channel modes.

Line Codes:
HDB3 (High Density Bipolar, Order 3 per ITU G.703, or AMI (Alternate Mark Inversion)

Connection:
75/100 ohm BNC connector or DB-15 connector for twisted pair.

Frame Synchronization:
Average reframe time non-signaling DS0's: 0.6 ms
Multi-frame based signals (Signaling): 5ms

DIGITAL ACCES CROSS-CONNECT SWITCH

Propagation Delay (DS1/E1 through Delay):
DACS: 1 to 3 frames average (250 msec) for each pass through.

Switch Time:
DACS DS0/T1, DS0/E1 Alternate Maps: Programmable down to 1ms.

Tests and Diagnostics:
Loopbacks: Remote, Local. and Anolog DS0 & DS1/E1
Test Pattern: PRBS pattern generation/detection.
16-bit loop-up and loop-down code generation and detection.

PHYSICAL

Dimensions:

Height:	5.25"	(144 mm)
Width:	19"	(483 mm per EIA RS-310)
Depth:	14.50"	(370 mm)

Available in 23" width mounting.

Weight:
15 lbs (6.8 kg). for typical fully loaded shelf.

Specifications subject to change without notice.

Technical Specifications (continued)

User Interface

Functionality:
Remote monitoring, configuration and alarm reporting.

Local Access:
Switch Settings.

Remote Access:
RS-232c port.
Optional 10 BaseT Ethernet Interface.

Power Requirements

All shelves can be equipped with a secondary plug-in power supply for redundancy.

Input Voltage:	Range:
24 Vdc	19 to 29.0 Vdc
48/125 Vdc	38 to 150 Vdc
250 Vdc	200 to 300 Vdc
120 Vac	90 to 130 Vac
220 Vac	180 to 265 Vac

Optical Interface Adapters (OIA)

Emitter	Wavelength	Fiber	System Gain
LED	1300 nm	MM	25dB (12mi; 19km)
LED	1300 nm	SM	18dB (17mi; 27km)
Laser	1300 nm	SM	36dB (37mi; 62km)
Laser	1550 nm	SM	30dB (56mi; 90km)
Laser2mw	1550nm	SM	39d (70mi; 113km)

Alarms and Diagnostics

Status Monitoring:
Constant monitoring of equipment with alarm reporting.

Alarm Types:
Alert, cautionary conditions that do not prevent multiplexer operation.
Alarm, conditions that directly affect multiplexer operation.

Interface:
Front panel indicators and alphanumeric display
RS-232 port for remote access and interrogation
Form C relays for shelf alarm and alert.

Loopbacks:
T1: Line, Equipment and Payload
E1: Line and Equipment

DS0 Channel Module Functionality

Voice Units:

2W VF

Type I, II, III & V E & M signaling

2W Foreign Exchange

Loop start signaling
Automatic ring down option

4W VF

Type I, II, III & V E & M signaling
Point-to-point and multi-point
4W FXO and FXS
Channel addressing for added protection
2713Hz detection loop-back mode
Optional SWC rated connection for analog teleprotection

Orderwire:
2W party line voice circuit over a 64 kbps channel
DTMF signaling
Uses a regular 2W phone

Data Units:

Low Speed Data

RS-232 interface Async. and Synchronus
RS-422 interface
RS-485 interface 2 or 4 wire
Sub-rate multiplexing
Point-to-point and multi-point

High Speed Data (56/64 kbps rates)

RS-449, V.35, X.21 and G.703
Channel addressing for added protection
ANSI C37.94 optical interface

High Speed Data (N x 64 kbps Rates)

N = 1 to 24 64 kbps
RS-449 & V.35 interfaces
ANSI C37.94 optical interface

Office Channel Unit Data Port (OCUDP)

ANSI T1.410

Specifications subject to change without notice.

Technical Specifications (continued)

DSO Channel Module Functionality

Status:

Contact Input/Output

- 16 input
- 16 output
- 8 input / 8 output

Teleprotection Units:

Modular Teleprotection System

- Application: DTT, POTT, PUTT, DCB & DCU
- Four independent bidirectional function
- Solid state or relay output
- Channel delay measurements
- Sequence of events log
- Channel addressing for added protection

Analog Telemetry

- Transport of telemetry voltage or current
- Bus voltage remote synchronizing application

Ethernet:

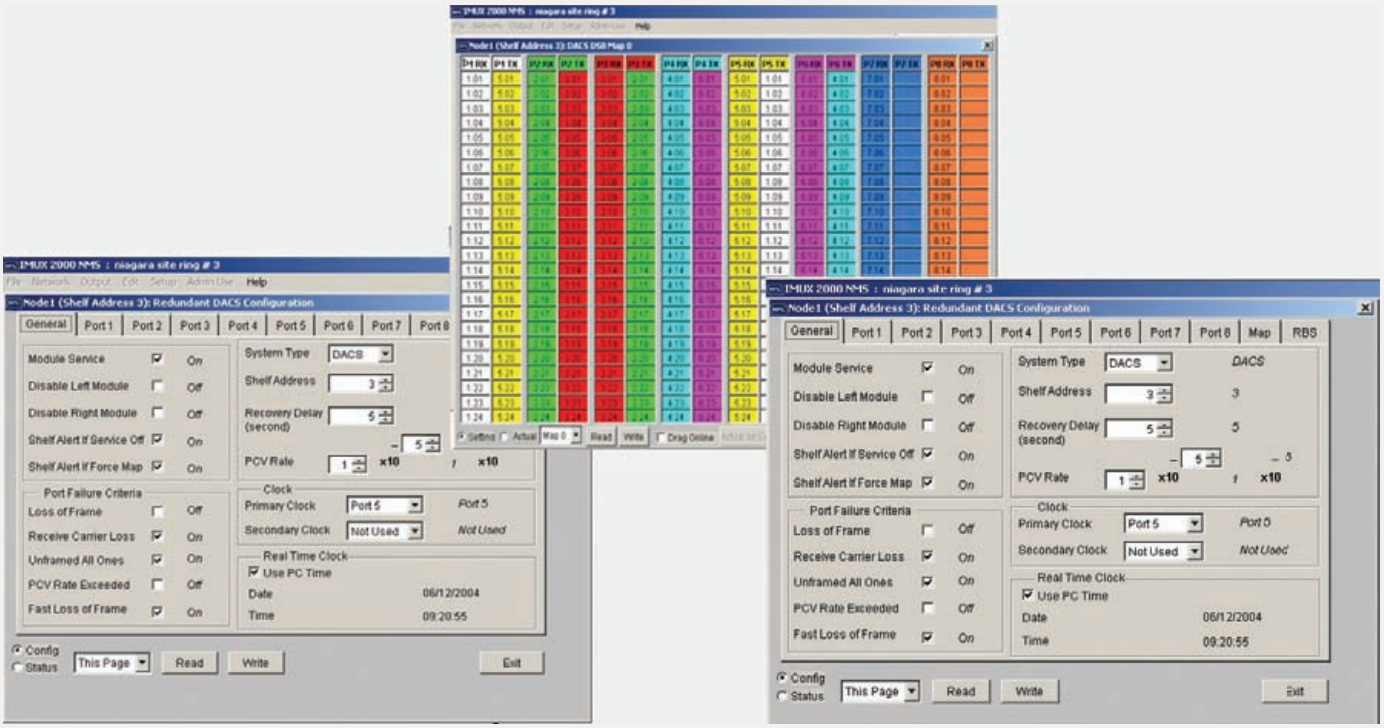
- IP connectivity
- LAN / WAN interconnect
- 10 BaseT Ethernet learning bridge
- Support half or full duplex
- IEEE 802.3

Video:

- NTSC or PAL analog video signal transport
- ITU H.261 compression algorithm
- 1-20 frames/second
- 64 to 1536 Kbps bandwidth
- 352 x 288 resolution

Network Management

- WindowsTM based PC NMS
- Access from any node for full system provisioning, monitoring and diagnostics
- Alarm logging and time stamping
- RS-232 craft interface
- Optional faster NMS communication using a single 64 kbps channel
- Optional 10 BaseT Ethernet Interface
- Optional interface for SNMP manager

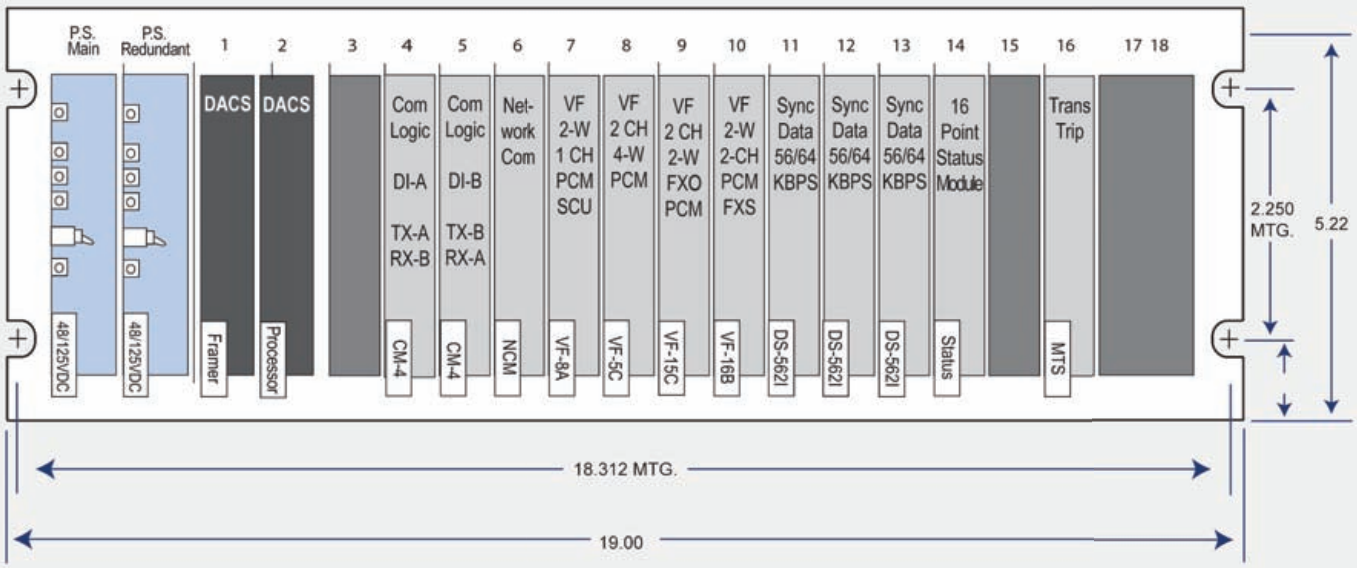


Typical Network Management Screens

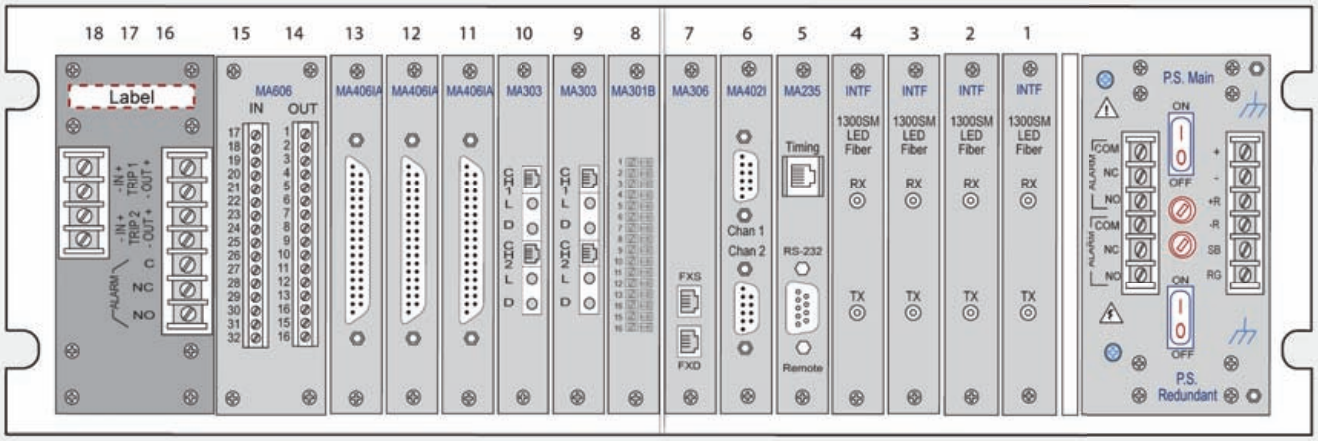
Because RFL™ and Hubbell® have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

Layout and Dimensions

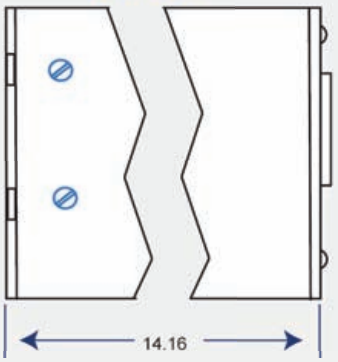
FRONT VIEW



REAR VIEW



SIDE VIEW



Because RFL™ and Hubbell® have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

Notes

RFL Electronics Inc.
353 Powerville Road
Boonton, NJ 07005, USA

Tel: 973.334.3100
Fax:973.334.3863
www.rflelect.com