

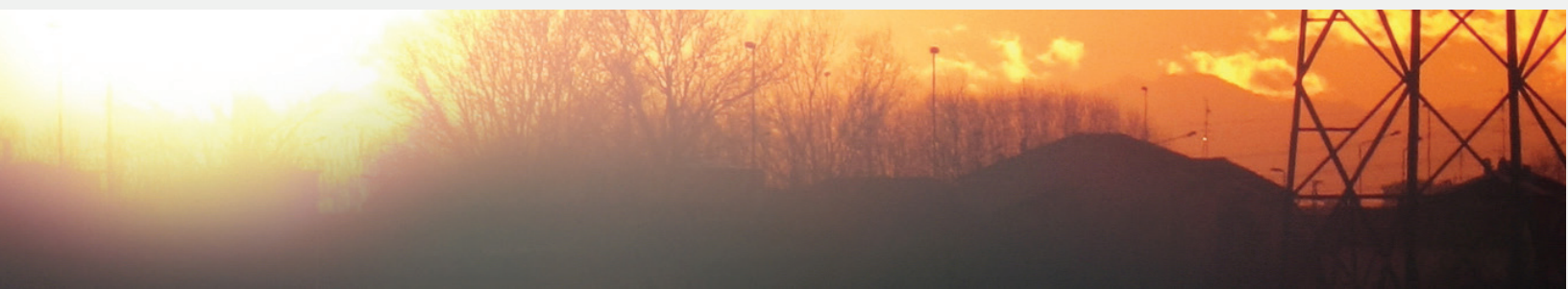
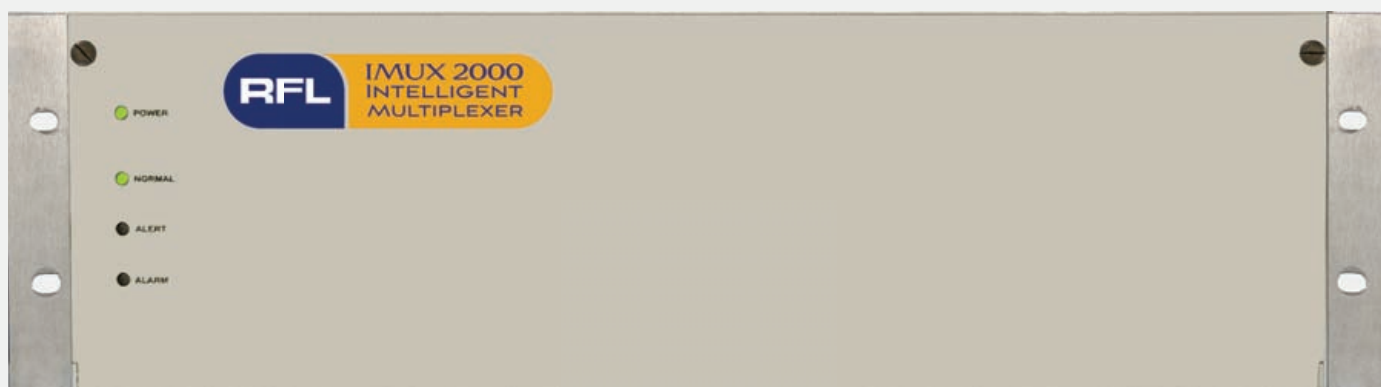


SOLUTIONS FOR AN EVOLVING WORLD

IMUX 2000

T1/E1 MULTIPLEXER

WITH COMMON LOGIC REDUNDANCY





Your world is changing and so are we.

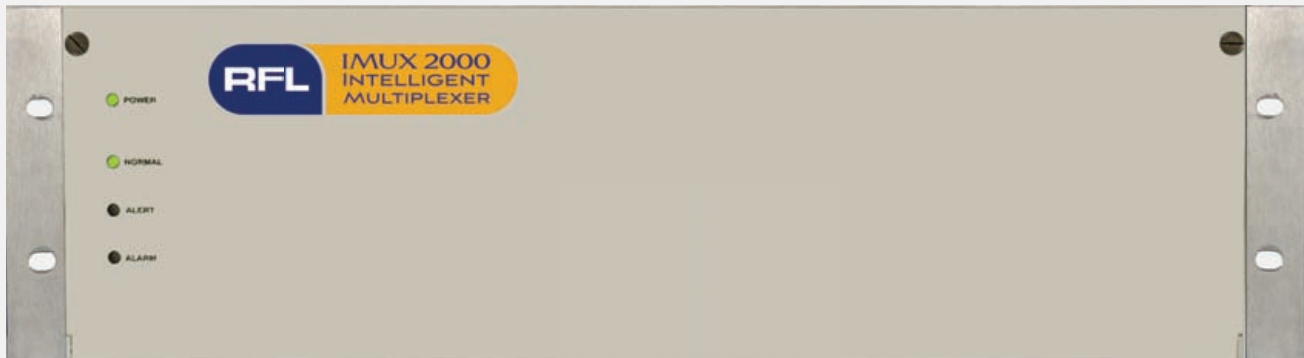
At RFL, we know your needs change much faster than your infrastructure. Our comprehensive line of solutions meets you wherever you are to help you bridge the gap from yesterday to tomorrow.

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.

T1/E1 Multiplexer with Common Logic Redundancy



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

Designed for harsh environments, the new IMUX 2000 T1/E1 Multiplexer creates a new class of Intelligent Multiplexer with features such as **Redundant Common Logic Module, built in CSU functionality, DSO squelching capability and Fast Reframing Channel.**

The unit provides full featured, Drop-and-Insert capability for each voice frequency circuit or any signal that can be transmitted in a DSO 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. When combined with our IMUX 2000 8-Port DACS-R, the IMUX 2000 T1/E1 Multiplexer supports many types of network layouts such as Spur, Hot Standby and Ring topologies. The IMUX 2000 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 Multiplexer 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 Multiplexer.

Key Features and Benefits

Substation Hardened

The IMUX 2000 T1/E1 Multiplexer is designed for harsh environments and has a wide temperature range of -20°C to +65°C (-4°F to +149°F). 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. It is CE approved and has been tested to BS EN 5002:1995. It is also FCC part 15 Class A approved.

Reliability

The IMUX 2000 provides enhanced reliability by offering optional redundant power supplies and common logic modules.

Speed

The IMUX 2000 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 has an average reframe time of less than 25 milliseconds and also has the ability to enable a Fast Reframing Channel (FRC) for less than 1 millisecond reframing.

DSO Squelching

The IMUX 2000 T1/E1 Multiplexer 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 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 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.

Fiber Optic or Electric Interfaces

The IMUX 2000 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, single-mode, 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 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 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 bridges the gap between SONET and substations providing DSO gateways onto the network. Also, through its own switching techniques, can overcome the longer switch times and unequal channel delay issues associated with SONET.

Automation

The IMUX 2000 offers the ultimate GUI Network Management system which operates in a Windows™ 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.

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

Telecommunications Solutions



Electric Power Utilities

Designed specifically for the unique need of the harsh substation environments, the IMUX 2000 T1/E1 Multiplexer 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 DSO 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 Multiplexer, 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

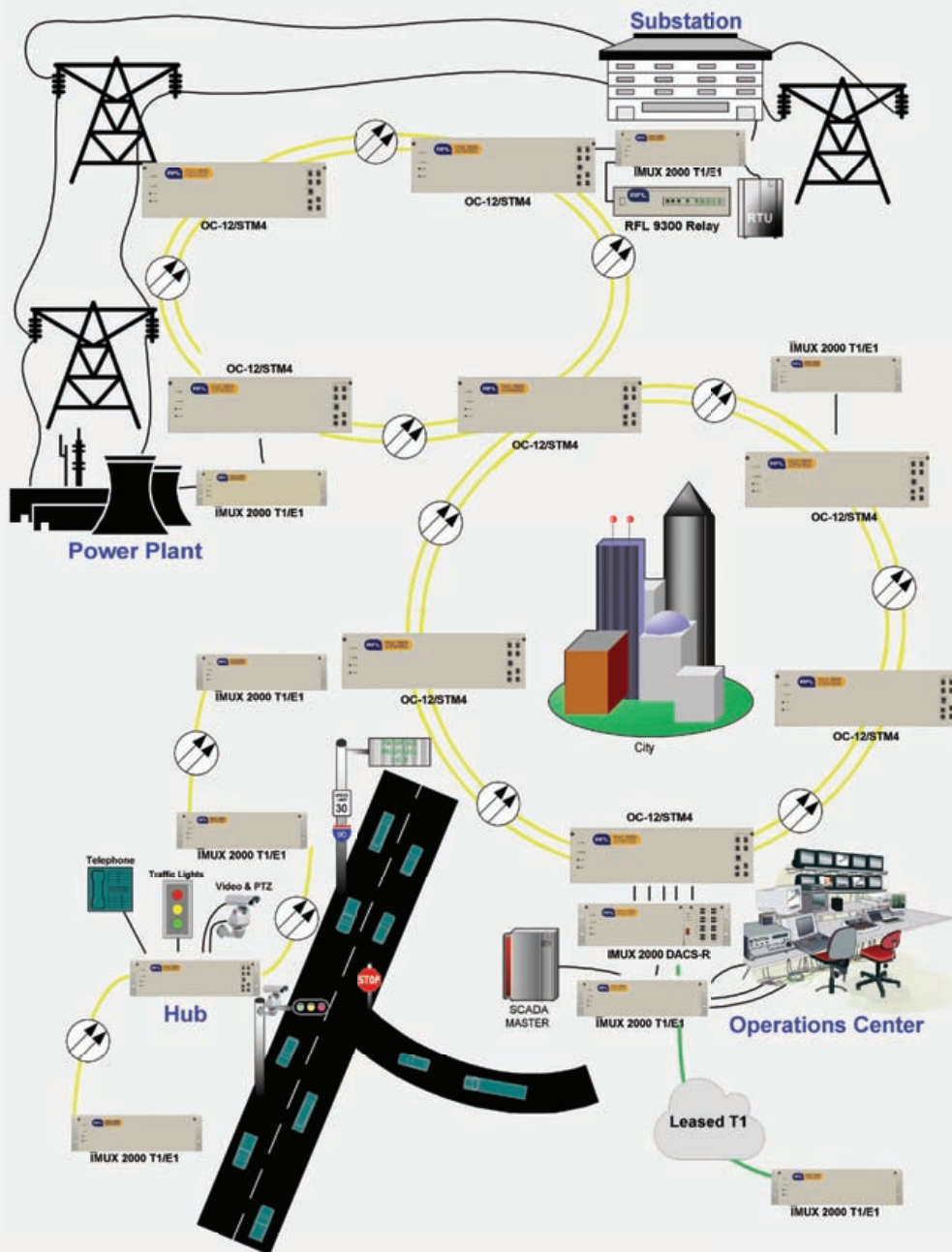
With the increasing demand for faster, more efficient ways to manage the flow of traffic, customers need a communication infrastructure that allows the system to advance as the technology develops. That is why the IMUX 2000 T1/E1 Multiplexer, with its unique harsh environments design, is the preferred choice of communication for the Transportation Industry. The IMUX 2000 T1/E1 multiplexer 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 multiplexer 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.



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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.

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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:

Without Fast Reframing Channel (FRC) enabled:
Less than 25 milliseconds. With Fast Reframing
channel (FRC) enabled: Less than 1ms.

TIMING

Primary Timing:

Internal, External, Loop or Through

Fallback:

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 DSO's:

0.3 ms with fast reframe

0.6 ms without fast reframe

Multi-frame based signals (Signaling): 5ms

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.

USER INTERFACE

Functionality:

Remote monitoring, configuration
and alarm reporting.

Local access:

Switch settings

Remote Access:

RS-232C port

Optional 10 BaseT Ethernet Interface

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Technical Specifications (continued)

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

DSO 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

Technical Specifications (continued)

DSO Channel Module Functionality

Status:

Contact Input/Output
16 input
16 output
8 input / 8 output

Ethernet:

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

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
Optional I-RIG B synchronization module

Video:

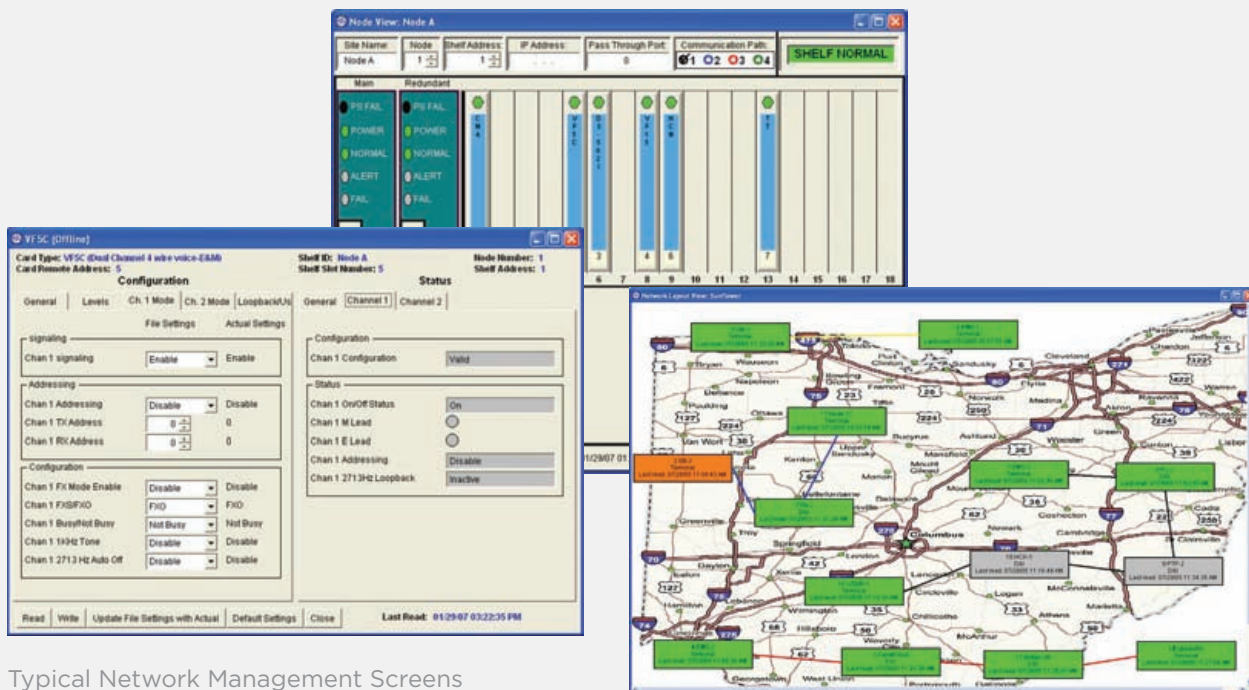
NTSC or PAL analog video signal transport
ITU H.261 compression algorithm
1-20 frames/second
64 to 1536 Kbps bandwidth
352 x 288 resolution

Network Management

Windows™ based PC NMS
3 User Level Password
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
Network password protection for added security

Analog Telemetry

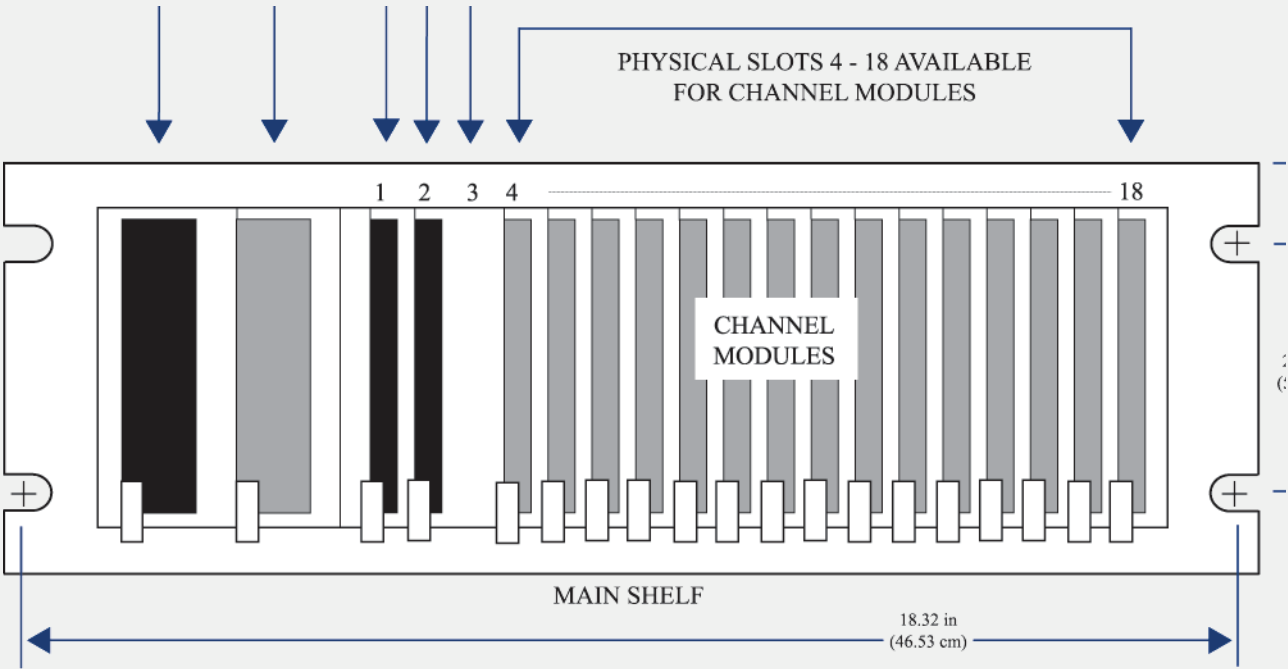
Transport of telemetry voltage or current
Bus voltage remote synchronizing application



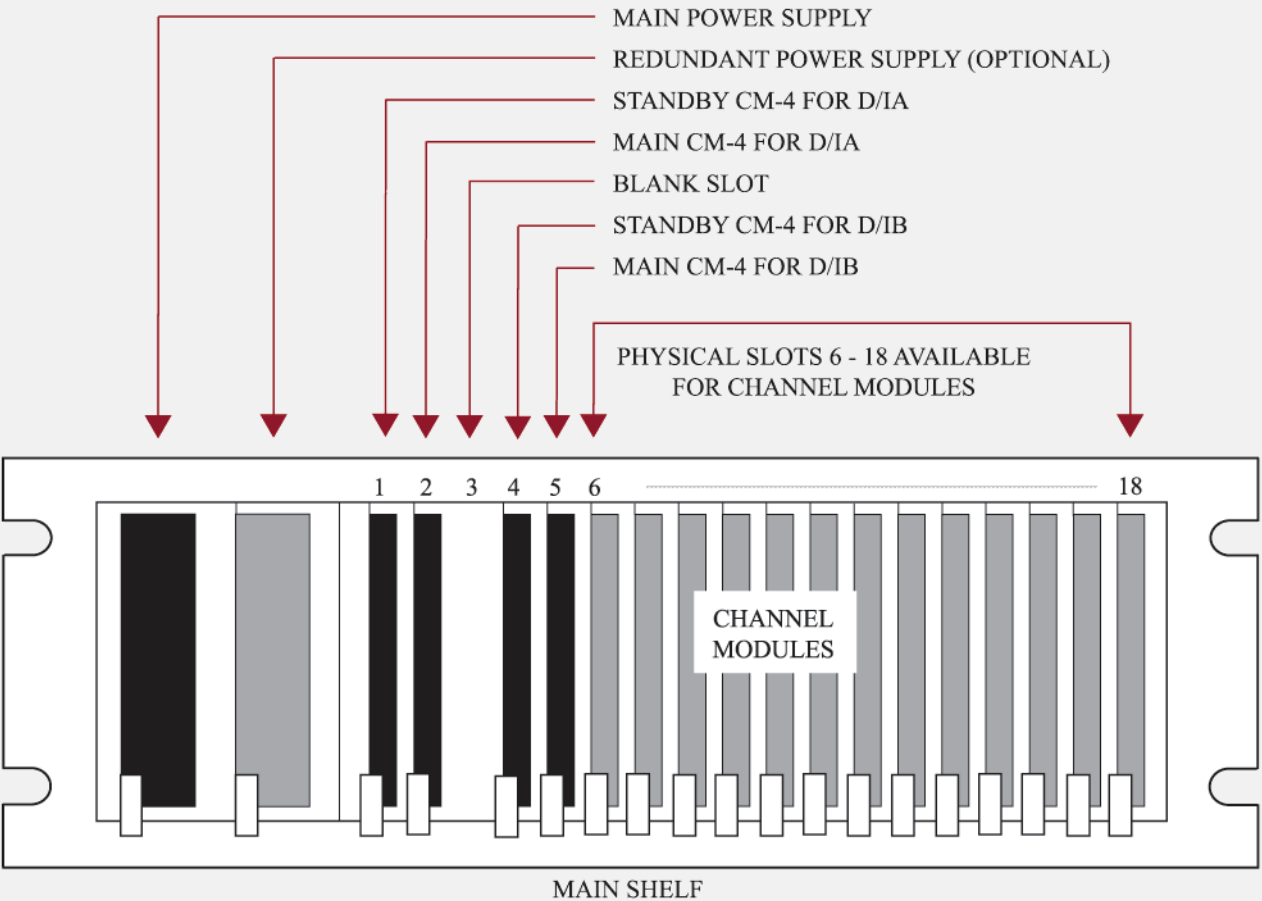
Typical Network Management Screens

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Layout and Dimensions



a. Terminal



b. Drop and Insert

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