FOM16 ™

User's Manual

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User's Manual

1. System Description
2. Installation & Operation Manual

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1 Introduction

FOM16™ (universal fiber multiplexer) is a transmission equipment, which can multiplex 4/8/16 2.048Mb/s (E1) tributaries over a single-mode optical fiber for telephone and data services. The system features are

- E1 G.703 channel interface
- Redundant fiber 1+1 (Option) protection
- Link distance up to 50 Km
- Working temperature up to 60°C for outdoor applications
- Low Bit Error Rate (BER < 10^{-10})
- Software configuration.
- Desk-top or mountable on standard 19”/23” rack conforming to ETS recommendation 300119
- Easy to configure and maintain
- Access maintenance functions locally and remotely.
- Performance monitoring and data storage
- Compatible with Gregorian calendar dates and 2000 A.D.
- Power supply: AC and/or DC
- Available synchronization to external clock (option)
- Linear add/drop and ring topology (option)
- Network management (option)

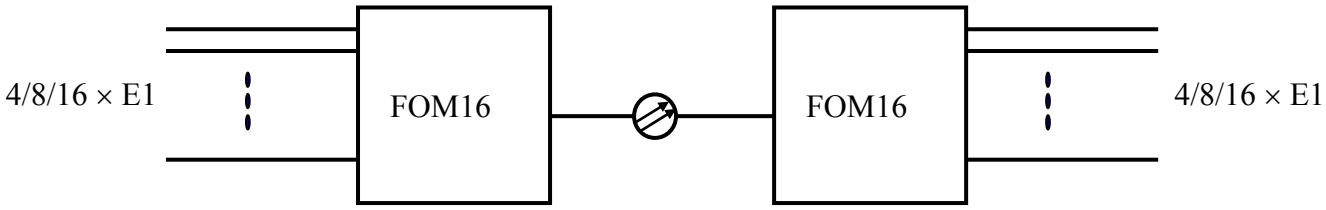


Fig.1 FOM16 with 4/8/16 E1 interfaces

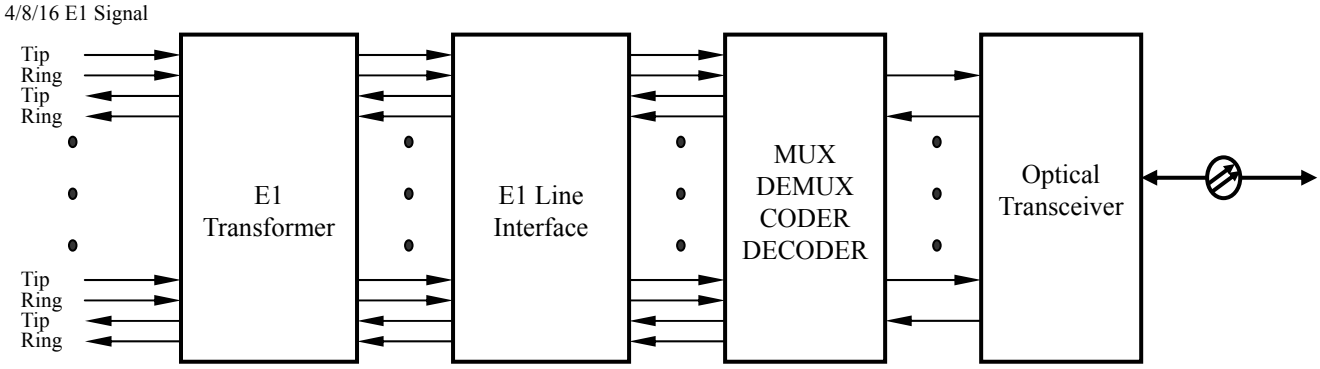


Fig.2 FOM16 system block diagram

2 System Application

FOM16™ consists of high-speed interface, MUDEM (multiplex / demultiplex), and low-speed interface. The low-speed interface provides electrical interfaces for transmit/receive 4, 8, or 16 E1 signals, and the high-speed interface uses a laser diode (LD) transmitter and a PINFET receiver to provide optical interface. The MUDEM multiplexes / demultiplexes low-speed tributaries into a high-speed signal.

FOM16™ is a high-quality, reliable, and robust digital signal transmission equipment which is suitable for inter-office and access network applications. FOM16™ system applications are as follows:

- Connections between mobiles switch centers and base stations in cellular phone networks.
- Connections between the COT (Central Office Terminal) and RT (Remote Terminal) of DLC (Digital Loop Carrier) systems.
- Trunk connections between digital switches.
- Optical transmission for LAN/WAN applications.
- Transmission media for ATM networks

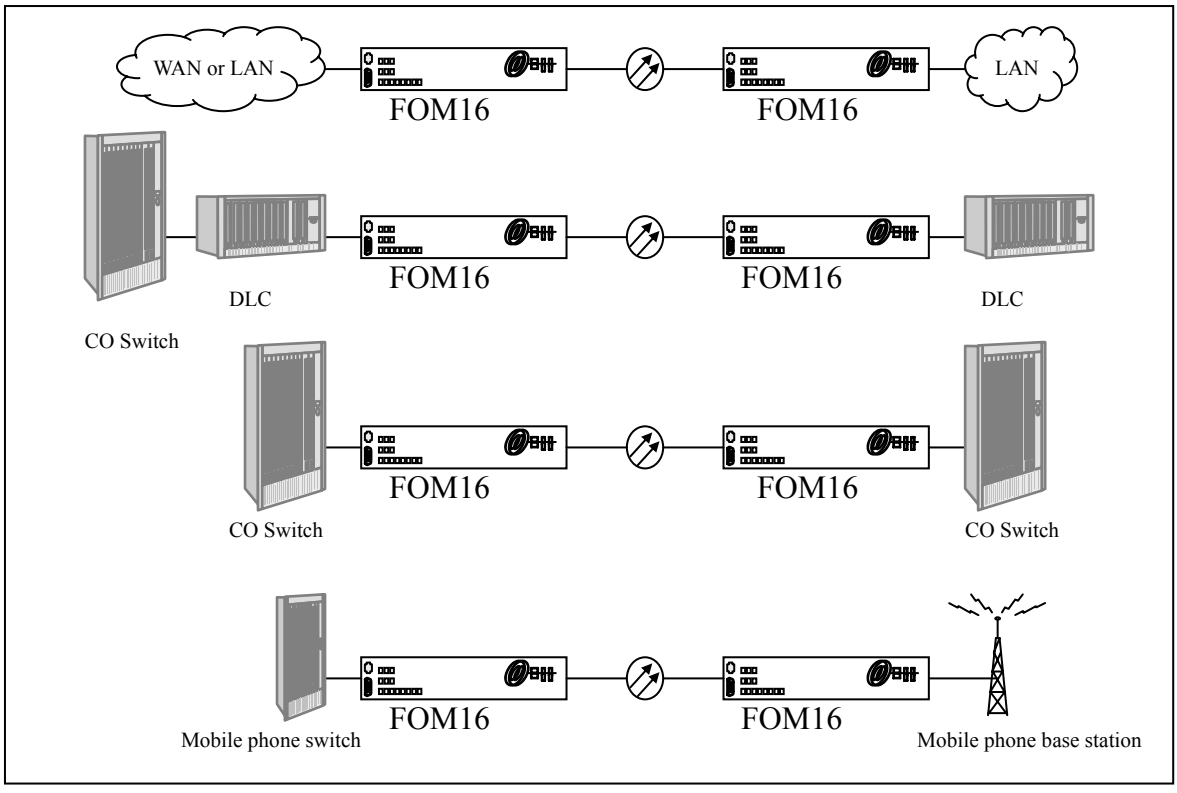


Fig.3 System Applications

3 Specifications and Characteristics

3.1 Mechanical Specifications

Shelf size: 45mm (Height) × 436mm (Width) × 330mm (Depth)

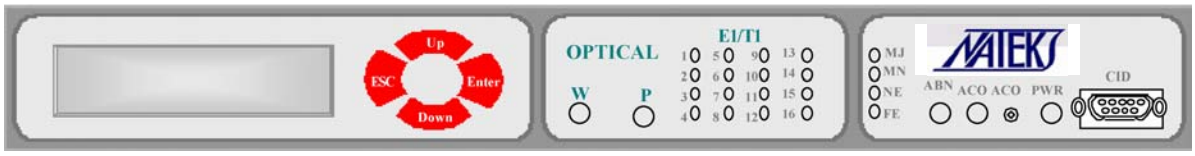


Fig.4 FOM16 Front View

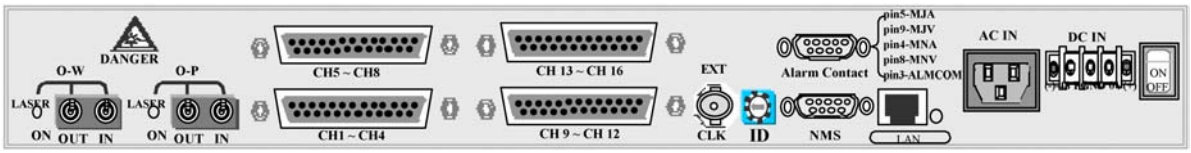


Fig.5 FOM16 Rear View

3.2 Interface connector

E1 interface: DB-25 female connector

Optical Interface: FC/PC type (single-mode)

Alarm interface: DB-9 female connector

Power interface: DC power terminal or AC Plug

CID: RS-232 DB-9 male connector

NMS: RS-232 DB-9 male connector

LAN: RJ-45 female connector

3.3 Interface specifications

3.3.1 System Capacity: Four, eight, or sixteen 2.048Mb/s (E1)

3.3.2 E1 signal interface:

(1) Bit Rate: 2.048Mb/s±50ppm.

(2) Line code: HDB3.

(3) Pulse Shape: ITU-T G.703 shown as Fig. 6

(4) Impedance: 120 Ω ± 5%, symmetrical pair

(5) Nominal pulse width: 244ns

(6) Ratio of the amplitudes of positive and negative pulse at the center of the pulse interval: 0.95 to 1.05

(7) Ratio of the width of positive and negative pulses at the nominal half amplitude: 0.95 to 1.05

(8) The allowable attenuation range of an E1 input signal: 0 ~ 12 dB @1024KHz, i.e. E1 copper (0.65mm) can transmit up to 400 meters.

(9) E1 jitter characteristics: G.742 and G.823.

(10) Minimum return loss for E1 input:

51 ~ 102KHz → 12dB

102 ~ 2048KHz → 18dB

2048 ~ 3072KHz → 14dB

(11) The 2.048Mbps input/output interface offers compensation circuit.

(12) Provision to input/output port with connection to the earth at the outer connector of the screen

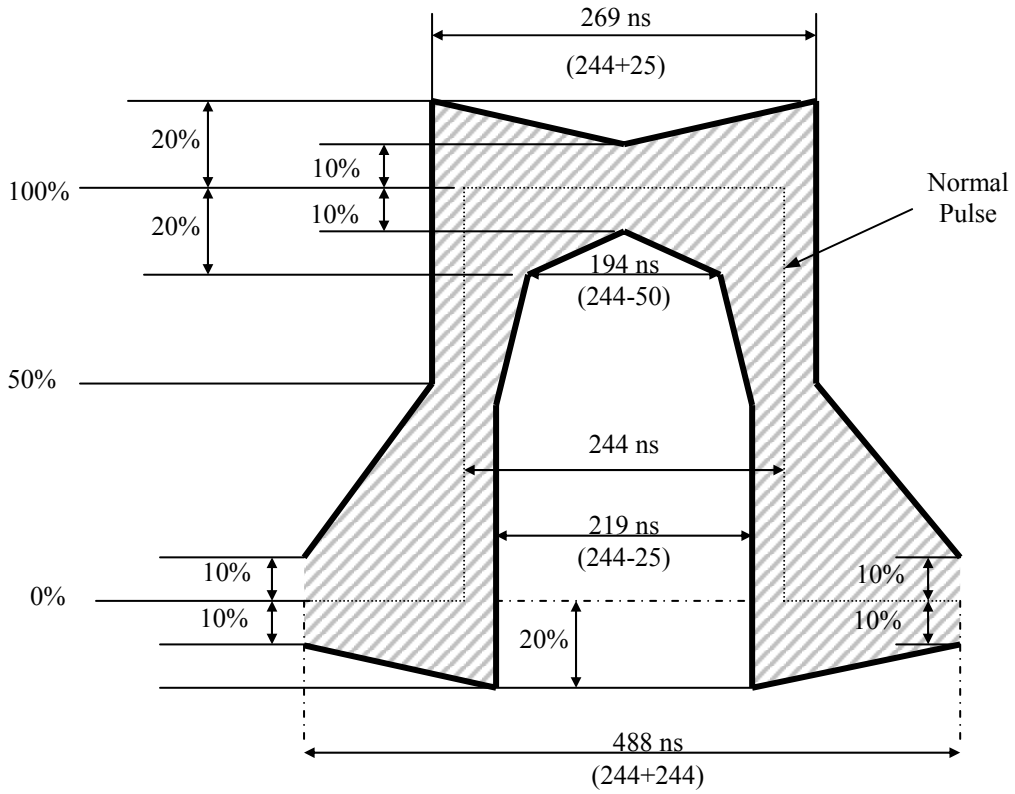


Fig. 6 Mask of the pulse at the E1 interface

3.3.3 E1 jitter requirements: ITU-T G.823 & G.742

(1) Jitter generation

The jitter of the E1 output signal in the absence of input jitter shall not exceed the following limits in both bands simultaneously. The characteristics weighting functions of Band 1 and Band 2 are shown as Fig. 7.

Band 1: 0.25 unit intervals peak-to-peak.

Band 2: 0.05 unit intervals peak-to-peak with a probability of 99.9% during a measurement period of 10 seconds.

(2) Jitter tolerance

The E1 signal interface should accommodate input jitter of a least magnitude shown as Fig.8.

(3) Jitter transfer

For E1 interface, the result of jitter transfer performance should be under the curve shown as Fig. 9.

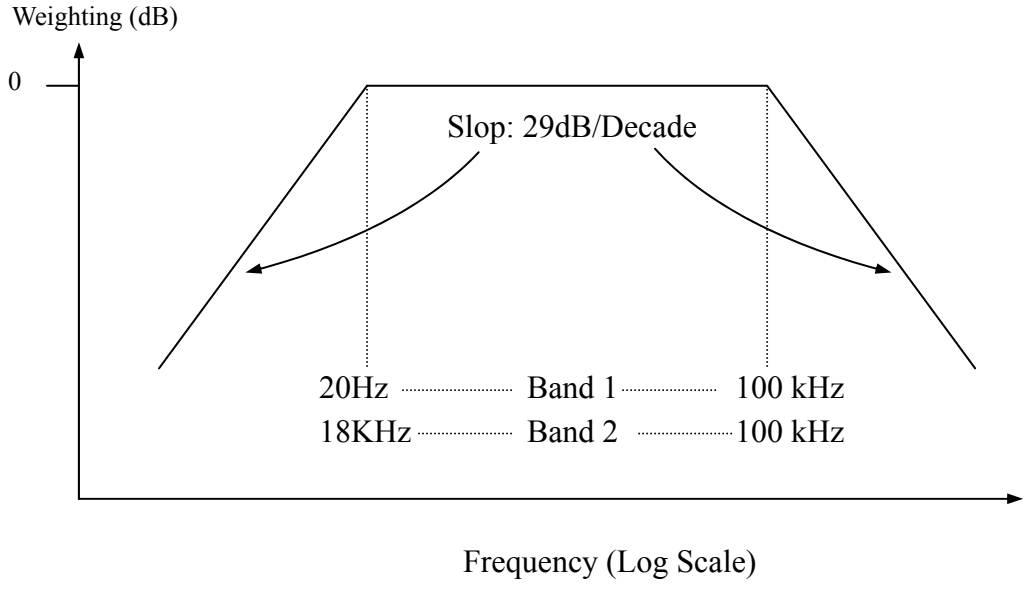
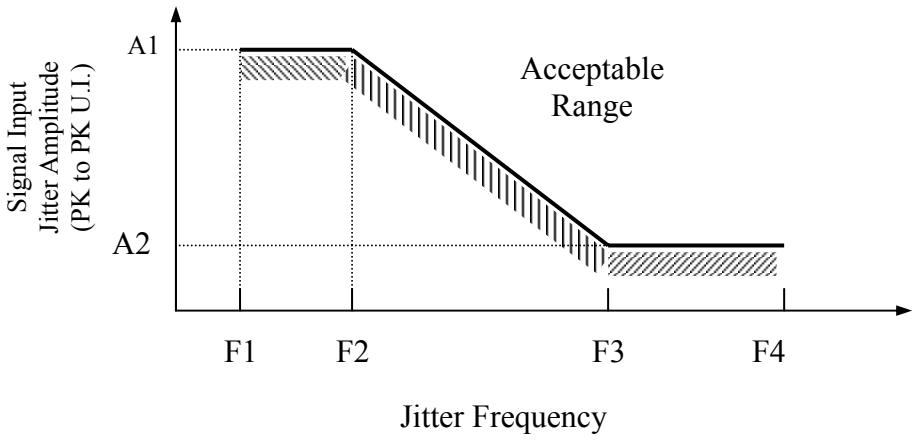


Fig.7 Frequency characteristic weighting functions



Digital Rate (kbit/s)	Peak-to-peak amplitude unit interval		Frequency (Hz)				Pseudo-random test-signal ITU-T Q.151
	A1	A2	F1	F2	F3	F4	
E1	1.5	0.2	20	2.4k	18k	100k	$2^{.15}$-1

Fig.8 Input jitter tolerance at E1 interface

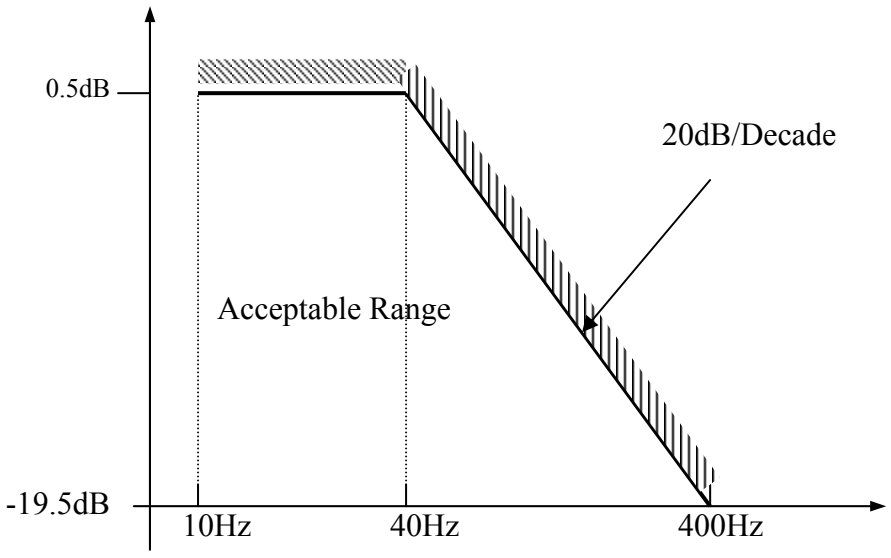


Fig.9 E1 Jitter Transfer Performance

3.3.4 Optical signal interface: ITU-T G.981

Optical source: MLM-1310 nm type LD

Optical wavelength range: 1260 nm to 1360 nm

Optical connector: FC/PC type

Line coding format: Scrambled NRZ

Short -haul

Output power: -7 ~ -15 dBm @ 1310 nm

Minimum receive sensitivity: -34 dBm @ 10^{-10} BER

System Gain: > 19 dB (at 1×10^{-10} BER)

Long -haul

Output power: 0 ~ -5 dBm @ 1310 nm

Minimum receive sensitivity: -36 dBm @ 10^{-10} BER

System Gain: > 30 dB (at 1×10^{-10} BER)

Protection type: 1+1 automatic switching

3.4 Alarm and indicators

3.4.1 The system monitors all alarms, such as loss of signals, optical signal loss remote alarm, etc. in real time. The system also provide the following four alarm relay contacts:

MJA: Audible Major Alarm

MJV: Visible Major Alarm

MNA: Audible Minor Alarm

MNV: Visible Minor Alarm

3.4.2 Shown as Table 1 ~ Table 3, FOM16 activates the LEDs and LCM on the front panel when system or signal failures are detected.

3.4.3 Shown as Table 1 ~ Table 3, FOM16 also active LEDs and LCM on the front panel when alarm and status indications for local and remote monitoring happen.

Channel LED (1~16) / E1 Channel(1~16)	LED Action
E1 out of service	Off
E1 in service without LOS	Green On
E1 in service with LOS	Red On
E1 in service with LLB or RLB	Green Blinking

Table 1 LEDs about E1 Channel Operations

Channel LED / Optical Channel (Working or Protection)	LED Action
Out of service	Off
Channel in service without LOS	Green On
Channel in service with LOS	Red On
Channel in standby status without LOS	Yellow On
Channel in standby status with LOS	Red On
Channel in service with LLB or RLB	Green Blinking

Table 2 LEDs about Fiber Optical Operations

System LED / System Status	LED Action
System Power On	PWR LED Green On
Alarm Cut Off	ACO LED Green On
RLB or LLB	ABN LED Green On
Optical Working and Protection channels are in service with LOS or LOF	MJ LED Red On
Either of Optical Working and Protection channels are in service with LOS or LOF	MN LED Yellow On
Any E1 channel is in service with LOS	MJ LED Red On
Alarms happen in Near End	NE LED Yellow On
Alarms happen in Far End	FE LED Yellow On

Table 3 LEDs about System Operations

3.5 Automatic protection switching

The system can offer optical 1+1 automatic protection switching when optical signal fails. The mechanism of protection switching prevents unwanted oscillation between service and protection facilities and the switching time is less than 60 ms.

3.6 System Performance

FOM16 provides high transmission performance (less than 1 error per 10^{10} bits) for each E1 digital signal through the system. (ITU-T G.826)

3.7 Loopbacks

Shown as Fig.10a ~ Fig.10d, FOM16 provides local and remote loopback tests by CID or via LCM and push bottoms. These functions are used to test the integrity and connectivity of E1 and optical signals.

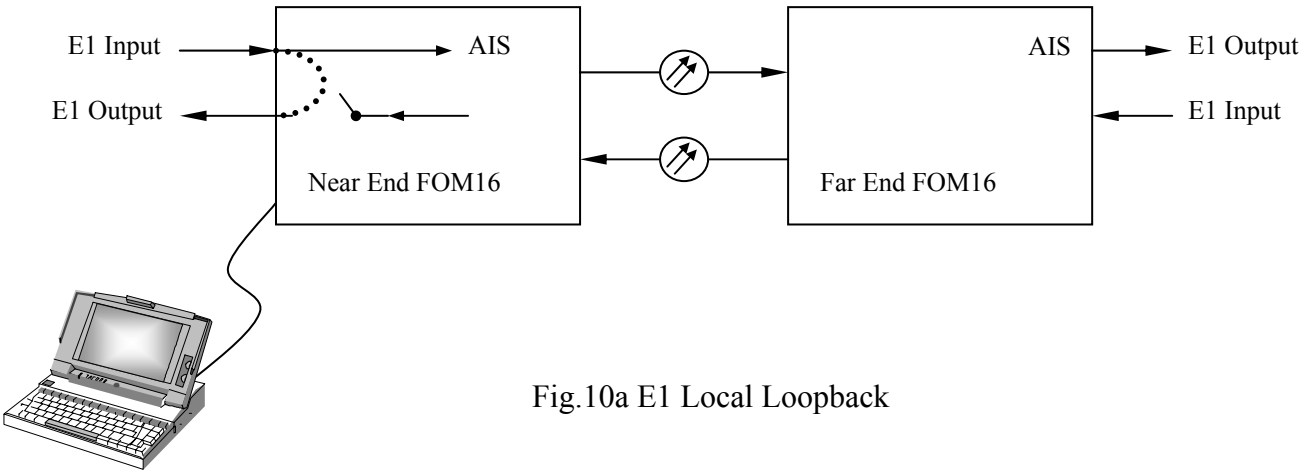


Fig.10a E1 Local Loopback

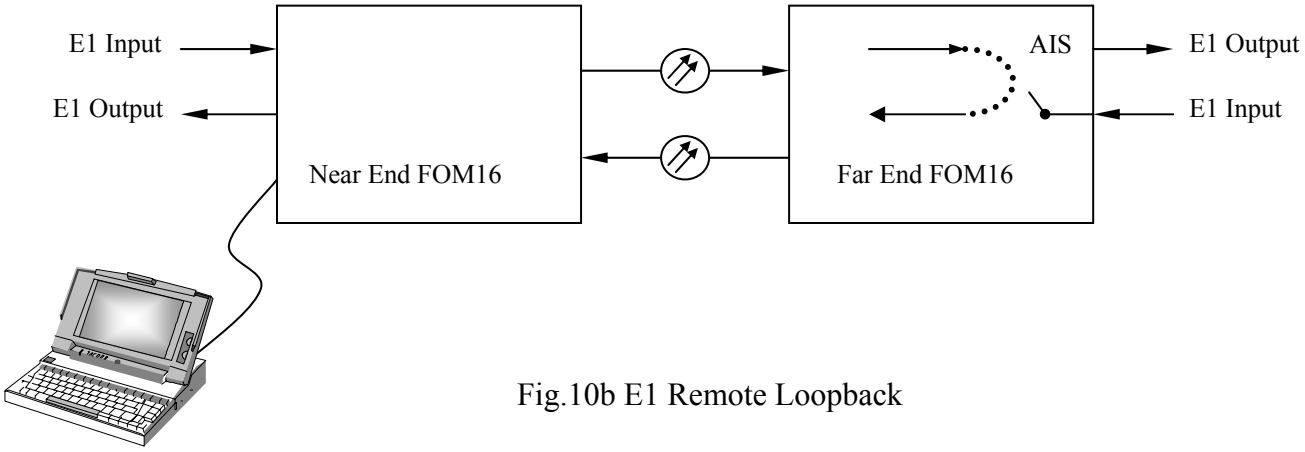


Fig.10b E1 Remote Loopback

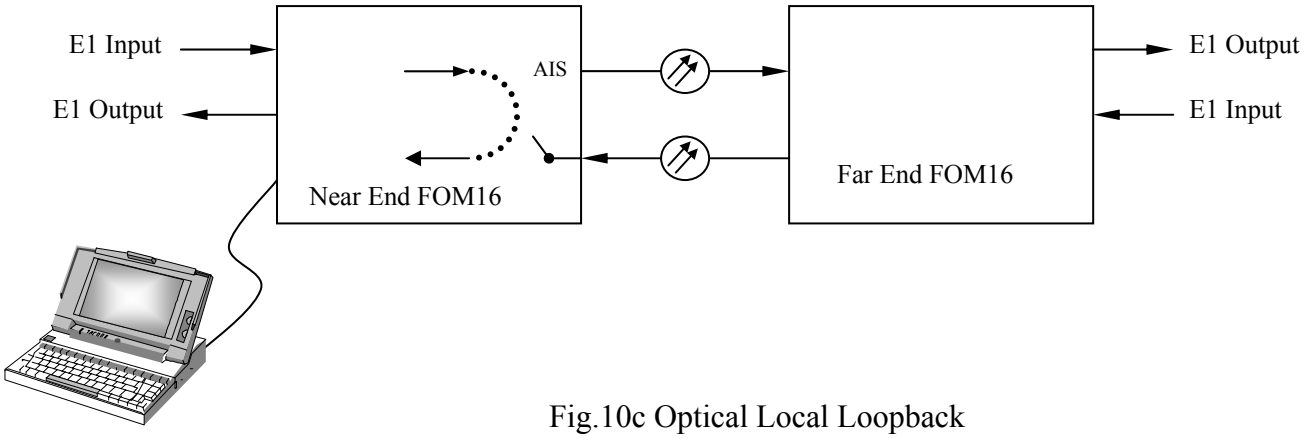


Fig.10c Optical Local Loopback

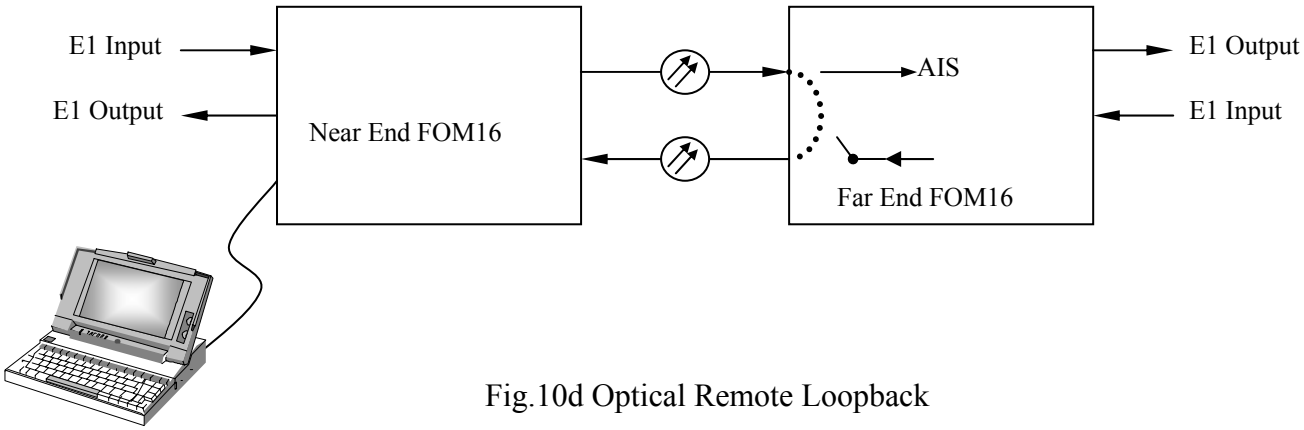


Fig.10d Optical Remote Loopback

3.8 Power supply

3.8.1 Input power

DC: –36 V to –72 V, AC ripple up to 0.5 Vp-p

AC: 220V ± 10%, 50 Hz ± 10%

3.8.2 Power consumption: < 30 Watt

3.9 Performance Monitoring(option)

3.9.1 FOM16 provides the performance monitoring parameters as follows

(1) Near-End Line

Code Violation (CV)

Errored Second (ES)

(2) Near-End Path

Code Violation (CV)

Errored Second (ES)

Severely Errored Second (SES)

Unavailable Second (UAS)

(3) Far-End Line

Code Violation (CV)

Errored Second (ES)

(4) Far-End Path

Code Violation (CV)

Errored Second (ES)

Severely Errored Second (SES)

Unavailable Second (UAS)

3.9.2 Parameter Descriptions

(1) CV: HDB3 line coding violation or path coding violation.

(2) ES: An ES is a second during which at least one CV occurred.

(3) SES: A SES is a second with X or more CV. Candidate different values of X to correspond to BER thresholds respectively. The values for X are specified in Table 4. The number of CVs within a second constitutes a SES can be configured.

(4) UAS: UAS is a count of one-second intervals for which the line or path is unavailable. The line or path is said to become unavailable at the onset of 10 consecutive SESs.

BER / Channel	1×10^{-3}	1×10^{-5}	1×10^{-6}	1.5×10^{-7}
Optical	X=68736	X=687	X=68	X=10
E1Channel	X=2048	X=2	N/A	N/A

Table 4 X values about BER

3.9.3 Threshold Setting

Threshold values of registers, current 15 minutes, current hour and current day, for E1 parameters CV, ES, SES, and UAS are settable. A threshold alarm is generated when threshold violation occurs.

3.9.4 Performance Data Storage

FOM16 provides a sufficient size of internal memory to store the current and historical performance data. The historical performance data includes 15-minuts interval ES, SES, and UAS of the latest 24 hours as well as total 24-hour interval ES. SES, and UAS of the latest 7 days that derives from the errored messages on incoming and outgoing digital paths.

3.10 Network Management System

3.10.1 FOM16 reports the alarm automatically to a CID and controller of RS-232 (V.24) interface. Operation, administration, maintenance, and provision (OAM & P), including querying and monitoring and loopbacks, can also be accessible through RS-232 interface locally and/or remotely.

3.10.2 Network management protocol provides SNMP. About the Management Information Base (MIB) version and contents of SNMP agent, please refer FOM16 Monitoring Software Operation Description.

3.10.3 FOM16 can identify the time of various errors or events, which happened to the E1

facilities, and the far-end performance message and management, are submitted through the DCC overhead channel of FOM16.

3.11 Operation environment

Ambient temperature: 0°C to 60°C

Relatively humidity: 5% to 95% (Non-condensing)

3.12 Reliability

MTBF (Mean Time between Failure): 47,000 hours

MTTR (Mean Time to Repair): 5 hours

3.13 EMI

The FOM16 complies with the specifications of the Class A of CISPR 22 and the Class A of subpart B of Part 15 of the FCC Rule of U.S.A.