इरिसेट IRISET

TCT6

S D H EQUIPMENT

Indian Railways Institute of
Signal Engineering and Telecommunications
SECUNDERABAD - 500 017

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INDIAN RAILWAYS INSTITUTE OF SIGNAL ENGINEERING & TELECOMMUNICATIONS, SECUNDERABAD - 500 017

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SDH EQUIPMENT

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TCT6: SDH EQUIPMENT

Part I : FIBCOM Focus AC1 STM-1/4 Equipment

Part-II : Teja's STM-1 Equipment TJ100MC-1

Part III : Teja's STM-4/16 Equipment TJ100MC-16

Part IV : Teja's STM-4 Equipment TJ100MC-4L

Part-I : FIBCOM’s STM-1/4 Equipment

CHAPTER 1

INTRODUCTION TO FIBCOM'S STM-1 EQUIPMENT

1.1 SDH Essentials

In T-13D Notes, Synchronous Digital Hierarchy (SDH) is explained in detail. Let us re-state the essentials of SDH before describing FIBCOM's STM-1 Equipment.

1.1.1 SDH Multiplexing Process

SDH is based on a synchronous multiplexing structure, which has the following advantages:

a. The ability to directly access lower order tributaries in higher bit rate signals. This avoids the need for additional multiplexing/demultiplexing.

b. Compatibility with existing digital hierarchies.

c. Dynamic network capacity management, which enables to adapt the system to varying traffic needs.

d. Equipment interfaces, which enables the use of multi-vendor end equipment.

e. Comprehensive operations, administration and maintenance facilities.

The SDH multiplexing structure accommodates the mapping and multiplexing of higher and lower order plesiochronous tributary rates into a synchronous signal. The basic synchronous transmission rate is 155.52 M bit/s, which is organized in frames each designated a Synchronous Transport Module (STM - l). Higher bit rates of N x 155.52 M bit/s are obtained by multiplexing N AUGs into one STM—N signal. Fig. 1.1 shows the SDH multiplexing structure.

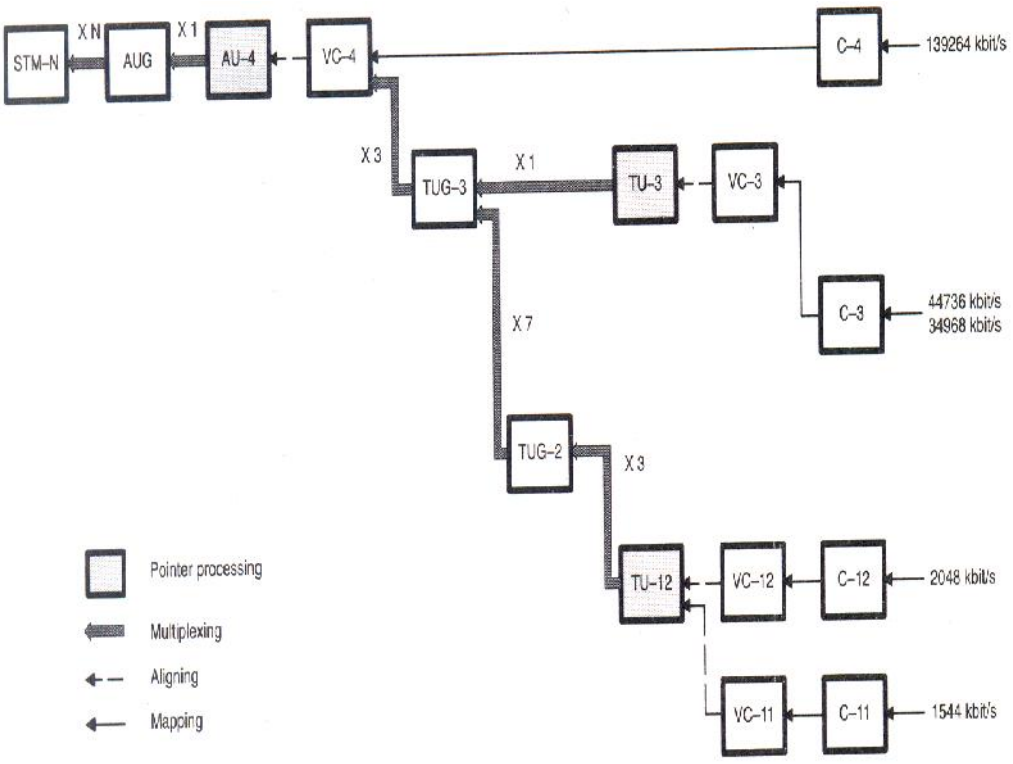


Figure 1.1 SDH Multiplexing Structure

The figure comprises the different multiplexing elements, which are defined according to their functional level.

The C-12 container is a defined (lower order) unit of payload capacity, for carrying 2 M bit/s signals.

The VC-12 comprises a C-12 plus path overhead including information about the origin of the path and a bit interleaved parity over the VC-12 for subsequent error performance monitoring. Within the defined timeslot the VC-12 can drift if the VC-12 and the corresponding C-4 phase/frequency are not the same. This is accounted for by adding the TU-l 2 pointer at a defined place in the C-4 container. The TU-12 pointer points at the start of the VC-12 container.

TUG-2 and TUG-3 describes the multiplexing into the C-4 container (i.e. into which timeslot the VC-l2 goes). 63 VC-12s can be multiplexed into one C-4.

The C-4 container is a defined (higher order) unit of payload capacity, for carrying one 140 M bit/s signal or 3 TUG-3s.

The virtual container (VC-4) comprises a single C-4, including information about the origin of the path and a bit interleaved parity over the VC-4 for subsequent error performance monitoring.

An administrative unit (AU) comprises a VC-4 together with an AU-pointer. The AU-pointer allows the VC-4 to drift within the STM-1 frame. The administrative unit group (AUG) is identical to the AU-4 in the multiplexing structure described in fig.1.1

A synchronous transport module (STM) comprises AUG(s) together with system information (Multiplexer and Regenerator Section Overhead - MSOH / RSOH).

The STM-1 frame is repeated with 8 kHz giving a line speed of the bit serial data stream of 155.520 M bit/s.

Four AUGs can be multiplexed into an STM-4, which together with SOH has a bit rate of 622.08 M bit/s. Sixteen AUGs can be multiplexed into a STM- 16, which together with SOH has a bit rate of 2.488 G bit/s.

1.1.2 Network Architecture -Functional Reference Model

A very brief overview of the architecture of SDH transport networks is presented here. The generic processes in network elements is described and specified in details within ETSI and ITU-T recommendations of relevance.

An SDH transport network can be decomposed into a number of layers, in a client-server relationship as shown in Fig. 1.3

The 2 M bit/s circuit layer is a client in the S12 (= VC-12 path) server layer, which is a client in the S4 (= VC-4) server layer and so on.

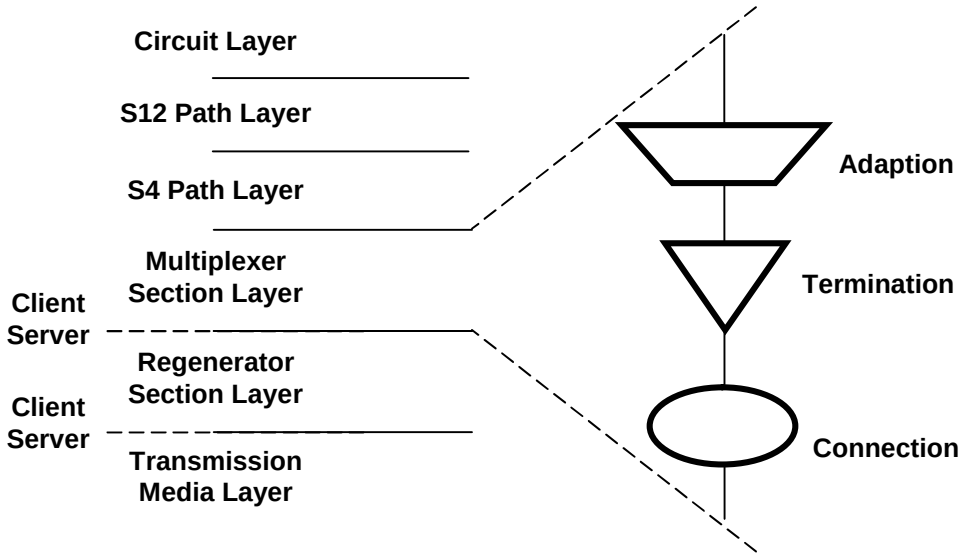


Figure 1.3 Network Architecture Functional model

Within the network element each layer contains atomic functions. These atomic functions perform the actual processing of the system such as multiplexing, framing, transport, muting, timing and protection.

Each layer has its specific set of atomic functions. Three types of generic atomic functions are defined: Adaptation/Termination/Connection.

The adaptation function performs adaptation between two layers. An example is the adaptation of phase deviations between the VC-12 s and the C4 container by adding the TU-12 pointer. Another example is the mapping of 2 M bit/s signals into the Cl2 container.

It is within the termination function that (most of the) path and section overhead information is typically terminated. The connection function can cross-connect signals from/to the server layer, e.g. the demultiplexed VC-12's from a C-4 container.

1.1.3 Performance Monitoring

As an example on the layering approach, Fig. 1.4 shows how parity information is added within each layer when a 2 M bit/s signal is multiplexed into an STM-N signal and subsequently terminated when the signal is demultiplexed to a certain level. VC- 12 path overhead can be used for monitoring the complete path from end-to-end.

1.1.4 Network Management

Using the terms and principles described in G.784, an ADM, TM, REG or SDXC functions as a Network Element (NE) in a Telecommunications Management Network (TMN). The NE can be controlled and monitored via its external interfaces, i.e. the PC, ECC and Q communication interfaces.

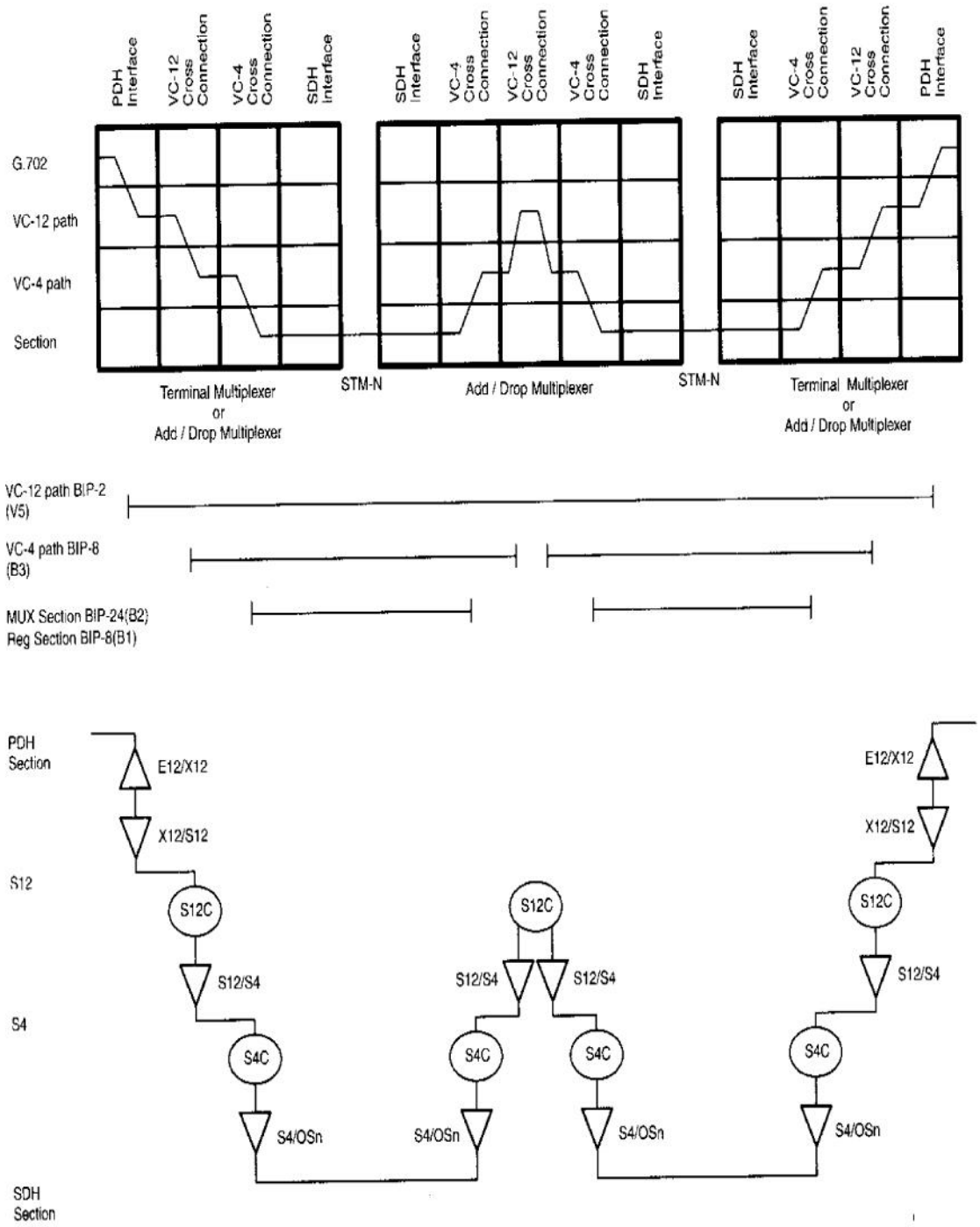


Figure 1.4 Generalized G.702 Layer Service

1.2 Technical Description of FIBCOM's STM-1/4 Equipment

1.2.1 Introduction

The FIBCOM FOCUS AC1 product family is part of the FIBCOM product range for access and regional telecommunication transmission networks based on the standards and recommendations on SDH from ETSI & ITU, under technical collaboration from TELLABS Denmark.

The FIBCOM FOCUS AC1 is a product family where STM- 1 and STM-4 Add/Drop Multiplexers (ADM) and Terminal Multiplexers (TM) are implemented on a single module giving VC-4, VC-3 and VC-12 connectivity. This provides a cost efficient solution especially in small nodes where the requirement is to add/drop a limited number of 2 M bit/s signals. The number of tributary signals can be increased to full capacity by adding additional tributary modules.

The possible protection schemes in the network include SNC Protection of VC-4, VC-3 and VC-12 signals.

Management of the FIBCOM FOCUS AC1 can be performed from a local craft terminal, from a network element manager or from a network management system (FIBCOM FOCUS NM 2100).

1.2.2 Applications

Ring Applications

In access networks it is common to have STM-l and STM- 4 rings where a limited number of e.g. 2 M bit/s signals are collected from different nodes into one central node, which comprises the local exchange. By using the FIBCOM FOCUS AC1 for this application most of the small nodes can be implemented by using only one ADM module.

High availability leased lines requires protection and performance monitoring of the signal at the customer• site. Two customers with different availability requirements are connected to an STM-4 ring, shown in Fig. 1.5, 1.6.

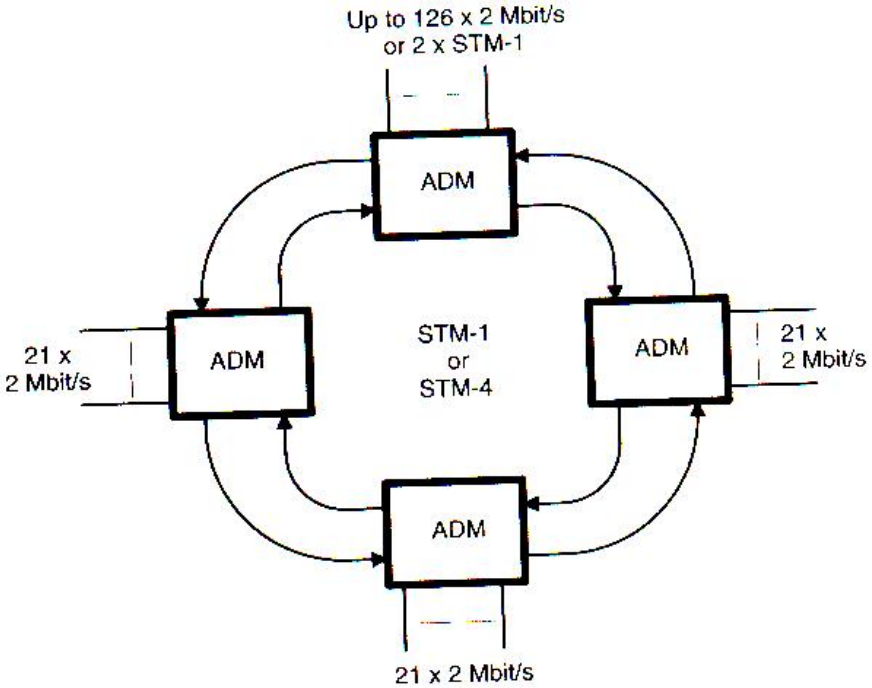


Figure 1.5 STM-1 Ring Applications

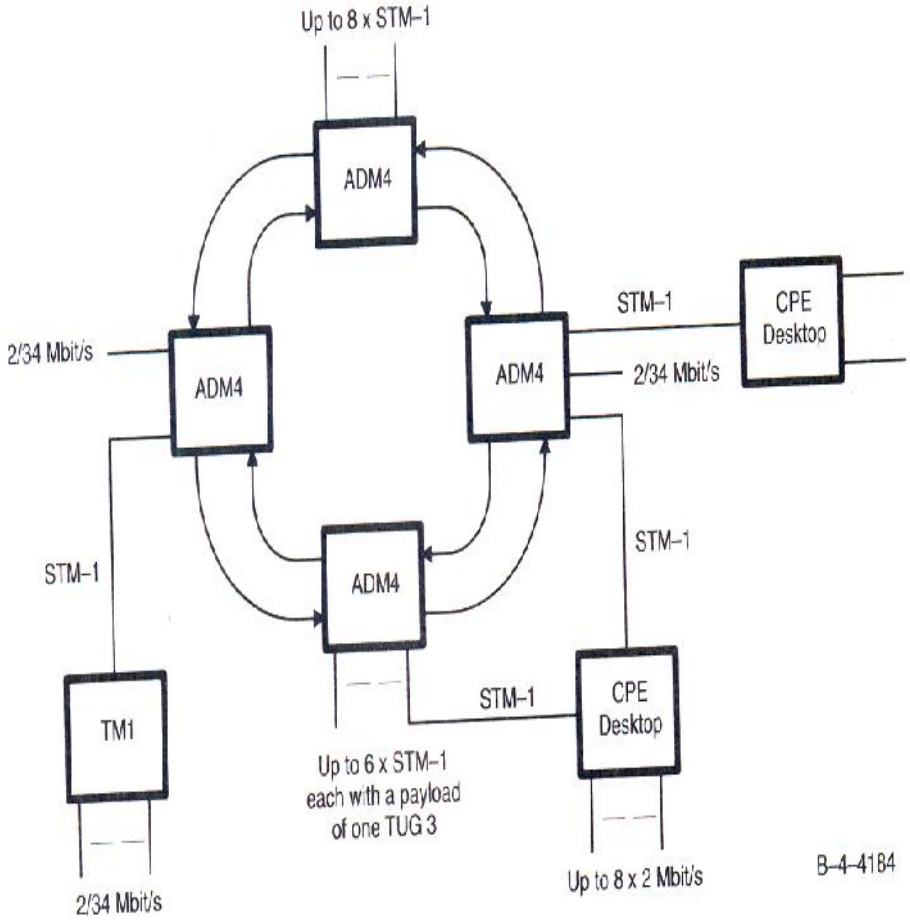


Figure 1.6 STM-4 Ring Applications with STM-1

Line Applications

This type of application is a simple point-to-point system with two terminal Multiplexers. This application can also be expanded with line Add/Drop Multiplexers where an ADM is inserted in the line in order to give access to a number of channels in each direction. (See Fig. 1.6).

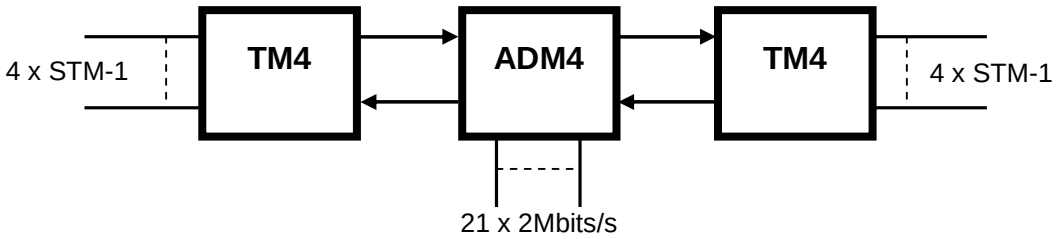


Fig.1.6 Line Application with Terminal Multiplexers and Add Drop Multiplexer.

1.2.3 Definition of Terms used

Aggr. 1: Direction naming of the aggregate signal of a network element. Aggr.1 is the so called S1 port.

Aggr. 2: Direction naming of the aggregate signal of a network element. Aggr.2 is the so called S2 port.

Equipment Protection: Protection of only equipment (for instance module) by use of a redundant module.

Module: A physical unit that can be plugged into a sub rack and pulled out again.

Monitor Point: A protected measurement point accessible while in-service.

Rear Cable Access: A sub rack with the system connection field located at the rear. However, sub rack can be tilted for working from front.

SR sub racks: The SR sub racks are 19-inch wide sub racks having the system connection filed located at the rear.

STM-1 (HO): The STM-l signal carries a VC-4, which has not been terminated.

STM-1 (LO): The STM- 1 signal carries a VC-4, which has been terminated into 3 TUG-3s. 1 TUG-3 can be either 21 x VC-12 or 1 x VC-3. Thus an STM-l (LO) carries:

- 3 x VC-3
- 3 x 2l x VC-12,or
- a combination hereof

STM-1 (LO sub): The STM-1 signal carries a VC-4, which has been terminated into 3 TUG3s, but only 1 TUG3 carries payload

- 2 x TUG-3 are idle
- 1 x TUG3 is 1 x VC-3, or
- 21 x VC-12

1.2.4 System/Network Element

A complete functional unit with transport and element management functionality, power supply; all mounted in one or more sub racks.

A mechanical frame that can be mounted in a rack. The sub rack, which is mounted in the main rack holds the modules of the system. Test Points are provided for out-of-service diagnostics and adjustment.

1.3 System Architecture

1.3.1 Constituents of System

This section describes the architecture of the system. The AC1 system may functionally be subdivided into

- Mechanical sub-system
- Transport sub-system
- Management sub-system
- Power sub-system

Mechanical sub-system: This part covers the mechanical parts

Transport sub-system: This part covers issues related to

- transport of payload traffic
- synchronization
- the lowest level of user channels

Management sub-system: This Part covers

- management interfaces and routing
- alarm interfaces

Power sub-system: This part covers functions related to the power supply

1.3.1 Mechanical sub-system

The FIBCOM FOCUS AC 1 system comprises the following mechanical elements:

- Racks
- Sub racks
- Rack Connection Fields (RCF)
- Sub rack Connection Fields (SRCF)
- Modules
- Cables

Racks

Two types of racks are available from FIBCOM:

- 600 mm x 2200mm rack
- 600 mm x 1600mm rack

Sub racks: Wide Sub rack with system connection field (SCF) at the rear (accessible from the front by tilting the sub rack into service position). The wide sub racks are available for mounting in both 19" and 600mm tacks.

Rack Connection Fields (RCF): Rack Connection Fields for connection of power, protection against surge voltages and with secondary power fuses or circuit breakers are available for the rack. The RCF also includes rack alarm relay outputs and LEDs.

Sub rack Connection Fields (SRCF): Sub rack Connection Fields are available for the wide sub-racks. The SRCF for the wide sub racks with rear cable access performs just like an RCF as described above. Thus, an RCF is not necessary for these sub racks. This SRCF is delivered as a fixed part of the sub rack.

Modules: Modules can be inserted or removed without disturbing other pats of the system.

Cables: For the rear access systems cables for internal interfaces are supplied by FIBCOM. Optical signals are connected on the modules in both rear and front access systems.

1.3.2 Transport sub-system

Transport sub-system performs the Payload Transport Functions, Connectivity, Protection and Modularity.

Transport Function.

- **"TTF"**(Trail Termination Function) performs the termination of the optical STM-4 or STM-l or electrical STM-1 signal and of the regenerator and multiplexer sections and adapts incoming frame frequency and phase to the system frame by AU-4 pointer processing. Automatic Laser Shut-down is supported on optical interfaces.
- "S4C" is the VC-4 connection function, which is also used to make VC-4 SNC protection.
- The VC-4 signal (including VC-4 supervisory signal) POH is terminated in "S4"
- "S4/S12" performs alignment between multiframe phases of incoming VC-4's and system multiframe phase by TU pointer processing
- "S4/S3" performs alignment between the frame phase of the incoming VC-3 and system frame phase by TU-3 pointer processing.
- "S12C" is the VC-l 2 lower order connection function, which is also used to do SNC protection

Connection Function

In both STM-1 and STM-4 equipment a maximum of 2 aggregate and 2 tributary STM-1 equivalent signals (4 in total) can be LO connected. VC-4, VC-3, and VC-12 connectivity is supported.

Protection

The STM- 1 and STM-4 ADM and TM equipment can perform 1+1 SNC/I (Inherently monitored Sub-Network Connection protection) protection of the VC-1 2, VC-3 andVC-4 signals.

SNC/I protection (Inherently monitored Sub-Network Connection protection) is based upon Loss of Pointer and AIS detection in the server layer.

VC-12 SNC protection is possible between any two VC- 12 signals, and with a third VC- 12 signal being the protected signal.

VC-3 SNC protection is possible between any two VC-3 signals, and with a third VC-3 signal being the protected signal.

VC-4 protection is possible between any two aggregate VC-4 signals. The protected signal can be any third VC-4 signal.

Modularity

Fig. 1.7 (a) and (b) illustrates the modularity of the equipment.

The core of the transport system and of the AC-1 products in general as the ADM/TM module.

Depending on the selection of components for the module in the production phase the module can appear in a number of variants. One group of these is the TM module, which is basically an ADM module with only one aggregate interface mounted.

For ADM 1/TM 1 aggregate interfaces can be all optical, all electrical or one of each. For ADM-4/TM-4 the aggregate interfaces are optical.

If more than 21 tributaries are needed this can be obtained by connecting TEX-1 modules on the TISI interface of the ADM module. A TEX-1 module adds extra 2l tributaries.

If 34 M bit/s or STM-1 tributary interfaces are needed, this can be obtained by connecting TEX-3 or RI 1/LI 1 modules respectively to the ADM/TM module. Depending on the equipment practice (see section on Mechanical System) the TISI signals are cabled from ADM/TM module to TEX module or are routed in a motherboard.

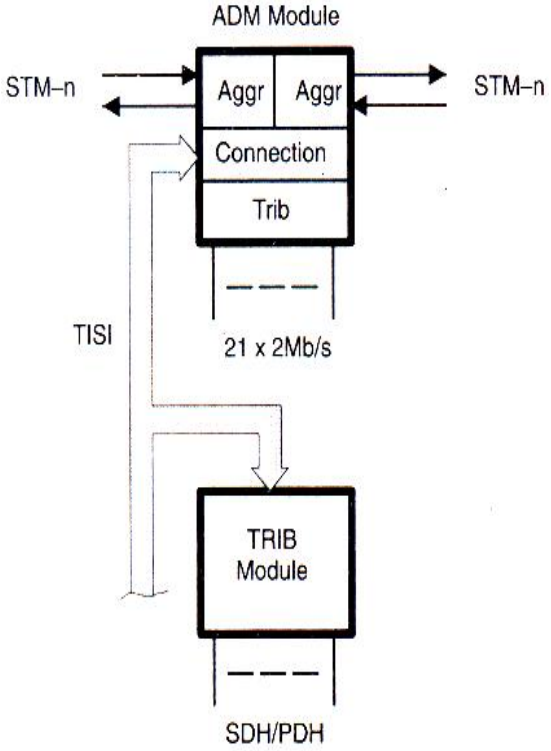


Figure 1.7 (a)Transport of Payload in ADM

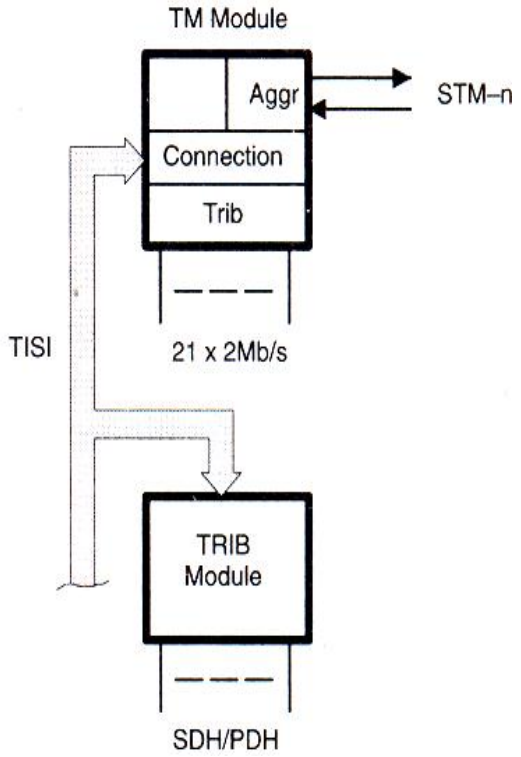


Figure 1.7 (b) Transport of Payload in TM

1.3.4 Management sub-system

Internally the AC1 system is managed by means of a master controller on the ADM/TM module and slave controllers on the TRIB modules. The master controller contains a non-volatile memory for the application SW of the network element. This memory can contain two complete versions of the SW and download of new SW while in service is possible.

Internal management communication between modules takes place via the C-Bus. An exception is the power supply module, which is either controlled (monitored) via the Qecb channel or via the PS-fault interface.

Two types of alarm signaling schemes is provided. For details see Table 1.1 and Fig. 1.8. Up to eight auxiliary user alarm I/Os are available. They can be configured as input and output in groups of 1, 2 or 5. When the user alarm is used as external alarm input, it can be connected to dry contacts. One way to interface to the alarm source is to use external dry contacts.

ALARM SIGNALING

Alarm type	Alarm levels	Acknowledge	Signal interface	LEDs	Coverage
Rack Alarm	Critical (A) Major (B) Remind (R)	Yes	Relay contacts	Red Red or Yellow Yellow	SRCF: one sub rack RCF : one entire rack
Station Supervision Alarms	Critical (A) Major (B)	No	Electronic outputs	None	One network element
System Alarms	Critical (A) Major (B) Minor (H) Warning (W)	No	No	Red Yellow Yellow Yellow	One network element

Table 1.1 System Alarm Interfaces

From the management systems it is possible to configure if the alarm is activated when the contact opens or when the contact closes. When the user alarm is used as external alarm output, the output driver can be set via the management system to be active-high or active-low.

LEDs on Modules

Traffic/controller Module

All traffic/controller modules contains one red LED with the following states, given in table 1.2

Red LED	State
Constantly off	Normal condition or no power
Slow Flashing	The module performs a self test or is in the state of hardware failure
Fast Flashing	The module is either booting or initiating SW
Constantly on	The network element has a non-acknowledged A or B alarm or hardware failure*

Table 1.2 LED Indications on Traffic / Controller Module

* Only relevant for the master module and only to indicate where to acknowledge alarms.

Note: Slow flashing means approximately 1 Hz and fast flashing approximately 4 Hz.

1.3.5 Power Supply sub-system

The power supply is available in two configurations. One using a red LED and the other using a green LED. The states of the power supply LEDs are shown in table 1.3

Red LED	Green LED	State
Constantly Off	Constantly on	Normal condition
Slow flashing	Slow flashing	Service mode (alarm off)
Fast flashing	Fast flashing	Malfunction in module detected during power-up or after system reset/power supply reset.
Constantly ON	Constantly Off	Alarm condition (A or B)

Table 1.3 LED Indications on Power Supply Module

Note: Slow flashing means approximately 1 Hz and fast flashing approximately 4 Hz.

The customer can choose to use one of the two secondary inputs from the station, or use one as main power supply and the other as protection supply (in case the main supply fails). The power supply module (PS) converts secondary supplies to +5/ 0 / -5 V tertiary power. The power supply automatically switches from the main supply to the protection supply, if the main supply is below 36 V. The switching is completed within 500 msec. after the main supply has fallen below 36 V. The switching is revertive, i.e. the input switch selects the main supply again, if the voltage on the main supply increases to more than 40 V. More power supply modules can work in parallel. Enough power supplies must be used to meet the total power consumption specifications of the modules in the system.

More power supplies can be added to provide power supply redundancy (1+1 or N + l protection).

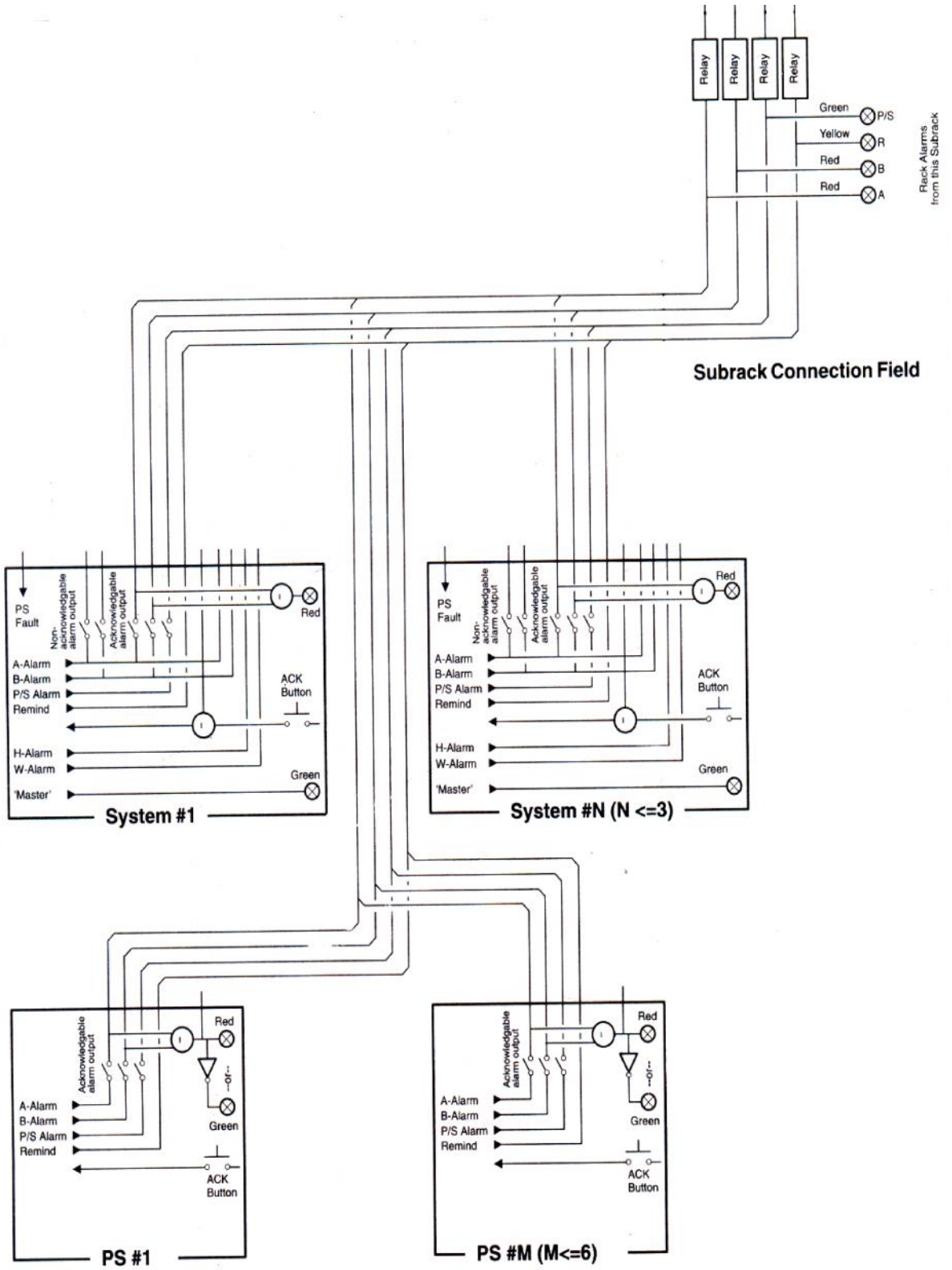


Figure 1.8 Alarm signaling of system in SR1 Wide Sub rack

1.4 SYNCHRONIZATION

The Synchronous Equipment Clock (SEC) generates the system clock T0 used for synchronization of internal processing and of all outgoing SDH signals (plus resynchronized E 1 outputs) and also generates the outgoing synchronization signals T4 (which can be used for synchronization of other equipment or for further filtering in an SSU, Synchronization supply unit).

1.4.1 Synchronization Sources and Outputs

Synchronization Sources

The source for the internal timing reference T0 is derived among:

1. Two 2.048 M bit/s Tributary inputs (T2 references), freely selectable
2. Two STM- 1 and STM-4 aggregates as well as tributary inputs (T1 references)
3. Two external 2.048 MHz reference-timing sources (T3 references)
4. Internal oscillator

Synchronization Outputs

Two synchronization reference outputs T4 are available.

The T4 outputs are individually derived from:

1. Two STM- 1 and STM-4 inputs (the same used for the T0 reference selector)
2. T0

The T4 outputs can be individually squelched.

T0 Timing Information on 2 M bit/s outputs.

If using the 2 M bit/s resynchronization option the 2 M bit/s outputs are resynchronized to the system clock T0 using a slip-buffer. This function is useful when 2 M bit/s signals are used as synchronization source for other equipment that may be sensible or can not tolerate mapping and pointer jitter added to the 2 M bit/s by the SDH network.

1.4.2 Synchronization Function

Synchronization Function for T0.

The synchronization function for T0 operates in one of three modes "Locked", "Holdover", "Free-running" depending on the availability, quality and priority of the reference sources.

* Locked mode

  In this mode the SEC is phase-locked to the selected external timing source. If the source is an STM-l input the Synchronization Status Message (SSM) on this input is output on all STM-1 outputs (in the S1 byte) except the return direction of this input. Here "Do not use for sync" is inserted instead (to avoid timing loops). For other sources (T2, T3) a user defined quality level is inserted.

  The SSM is the quality level transmitted in the S1 section overhead byte.

  When operating in locked mode a holdover value is calculated and stored in the memory based on the difference between the system frequency and the internal reference. The holdover value is used if the mode changes from locked to holdover.

- Holdover mode

  When all synchronization inputs are lost the function enters holdover mode. The holdover value stored in the memory while operating in locked mode is used here to retain the frequency as it was in locked mode. A configurable quality level for holdover is inserted in the S1 byte on STM-l outputs.

- Free—running mode

  When there was never selected any reference sources or a reference source was lost before the frequency was stored the function enters free-running mode. A configurable quality level for free-running is inserted in the S1 byte on STM-1 outputs.

Synchronization Function for T4

The synchronization functions for T4 shall operate in one of two modes "Locked" or "Un-locked" depending at the availability, quality and priority of the reference sources.

- Locked mode

  In this mode the output is phase locked to the selected source.

- Un-Locked mode

  All selected references, but T0 have been lost or have a quality level below configured squelching threshold. If T0 is not selected as source the output is squelched.

1.4.3 Synchronization Architecture

As shown in Fig. 1.9, the SEC function is located on the ADM/TM4 module.

TI and T2 reference sources on tributary modules are brought to the ADM/TM module embedded in the TISI signal.

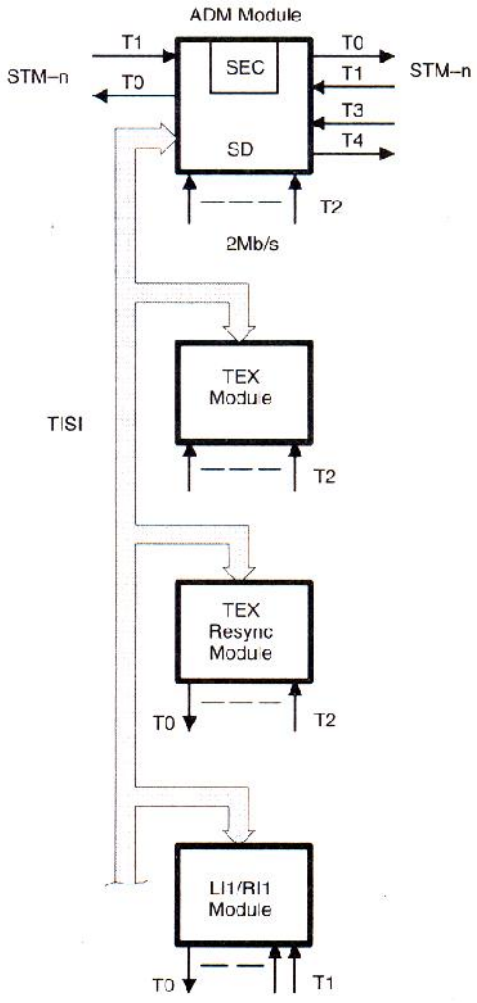


Fig. 1.9 Synchronization Architecture.

1.4.4 User Channels

AC 1 provides access, with various physical interfaces, to a range of embedded channels in section/path overhead or payload.

Embedded Channels

- DCC-R, DCC-M channels in section overhead
- Stuffing bytes in VC-12 payload

Physical Interfaces

* UI: V.11
* UDC-V28: V.28

These channels are available directly from the ADM/ TM/TEX modules (in rear access systems).

External Interfaces

Management/supervision from an Operations System (OS) is possible via 4 types of interfaces:

- F-interface (Craft terminal interface)
- Ethernet
- Embedded Communication Channel (ECC)
- QD2 interface according to SISA specs. (Optional).

As to the ECC channels one channel per **STM-** I interface is available.

The ECC may be transferred in

1. DCCR bytes (Dl-D3) of regenerator section overhead
2. DCCM bytes (D4-D12) of Multiplexer section overhead
3. The payload of a selectable VC-12

Objective:

1. Adaptation of FIBCOM STM system to varying traffic needs is possible due to _____ management.
   a) dynamic network capacity b) static network capacity
   c) limited network capacity d) none of the above
2. _____ numbers of AUGs can be multiplexed into an STM-4
   a) four b) Two c) eight d) six
3. The 2 Mbps circuit layer is a client in the ---------- server layer, which is a client in the S4(=VC-4) server layer and so on.
   a) S12 b) S4 c) S3 d) S3 and S4
4. In an STM network the NE can be controlled and monitored via its PC, ECC and Q communication interfaces.
   a) PC b) ECC c) Q d) PC, ECC and Q
5. ---------- information is added within each layer when a 2 Mbps signal is multiplexed into an STM-N signal.
   a) Parity b) error control c) Jitter d) All three
6. The FIBCOM FOCUS AC1 is a product family where ---------- Add/Drop Multiplexer and Terminal Multiplexer are implemented.
   a) STM-1 and STM-4 b) STM-1 c) STM-4 d) STM-4 and STM-16
7. The possible protection schemes in the STM network of FIBCOM AC1 family include SNC protection ---------- signals.
   a) VC-4 only b) VC-3 only c) VC-12 only d) VC-4, VC-3 and VC-12
8. Management of FIBCOM FOCUS AC1 family can be performed from a ----------.
   a) Local craft terminal only b) Network element manager only
   c) Network management system only d) All the three
9. The STM –1 (HO) module in FIBCOM AC-1 family carries a ----------which is not terminated.
   a) VC-4 b) VC-3 c) VC-2 d) VC-12
10. The STM –1 (LO) module in FIBCOM AC-1 family carries a VC-4, which has been terminated into 3 TUG-3s.
    a) One TUG-3 b) Three TUG3s c) Three TUG-2s d) Three VC12s
11. In FIBCOM AC-1 family an STM-1 (LO) module carries ----------or a combination thereof.
    a) 3 X VC-3 or 3 X 21 X VC-12 b) 1 X VC-4 or 3 X 21 X VC-12
    c) 3 X VC-3 and 6 X 21 X VC-12 d) 3 X VC-3 and 3 X 21 X VC-12

Subjective:

1. Define the following with reference to FIBCOM AC-1 family:
   a) Aggregate 1 and Aggregate 2
   b) Equipment protection.
   c) Module
   d) STM-1 (HO)
   e) STM-1 (LO)
   f) STM-1 (Lo sub)

2. Explain the following with reference to FIBCOM AC-1 family:
   a) Rack connection field
   b) Sub rack connection field

3. Briefly explain the power supply arrangement in FIBCOM AC-1 family.

4. With reference to synchronization function T0 in FIBCOM AC-1 family, explain the following:
   a) Locked mode
   b) Hold over mode
   c) Free running mode.

CHAPTER 2

SYSTEM DESCRIPTION

2.1 STM-1 ADD/DROP MULTIPLEXER MODULE – ADM1

2.1.1 Function

The Add/Drop Multiplexer module contains a complete stand-alone add/drop Multiplexer including two optical or electrical aggregate interfaces, PDH tributary interfaces, switch matrix, timing function, and basic management interfaces. The module has 2 x STM- 1 aggregate interfaces and 21 x 2 M bit/s tributary interfaces. Figure 2.1 shows the front view and figure 2.2 give the block diagram.

The module is available in different versions determined by:

- Optical/Electrical Aggregate
- The type of optical interface
- 120 or *75* Ω 2 M bit/s / 2 MHz ext. clock interfaces

2.1.2 Circuits on the Module

The module comprises the following circuits:

- Aggregate
- Connection
- Overhead Access
- Synchronization
- Management
- Tributary

In configurations with optical aggregate signals, the module holds an optical sub-assembly.

The module also holds a flash memory board, which contains the permanent memory for the application software and the database of the network element.

The module has ‘Acknowledge button’, a push button used to acknowledge the current rack alarm.

LEDs

Master Module (Green LED): This LED indicates that this is the master module of the network element.

Alarm (Red LED): The LED indicates non-acknowledged alarms in the network element.

Connectors

TX Monitor Points: Monitor the transmitted aggregate signal. The “CMI interface” monitor points are used when aggregate interface is electrical.

Opto Connector: Connectors located on the optical sub-assembly connecting the optical

fibers.

F—Interface: A five pole connector for connecting a Craft Terminal. For installation and service purposes only.

Test: For factory test and service purposes only.

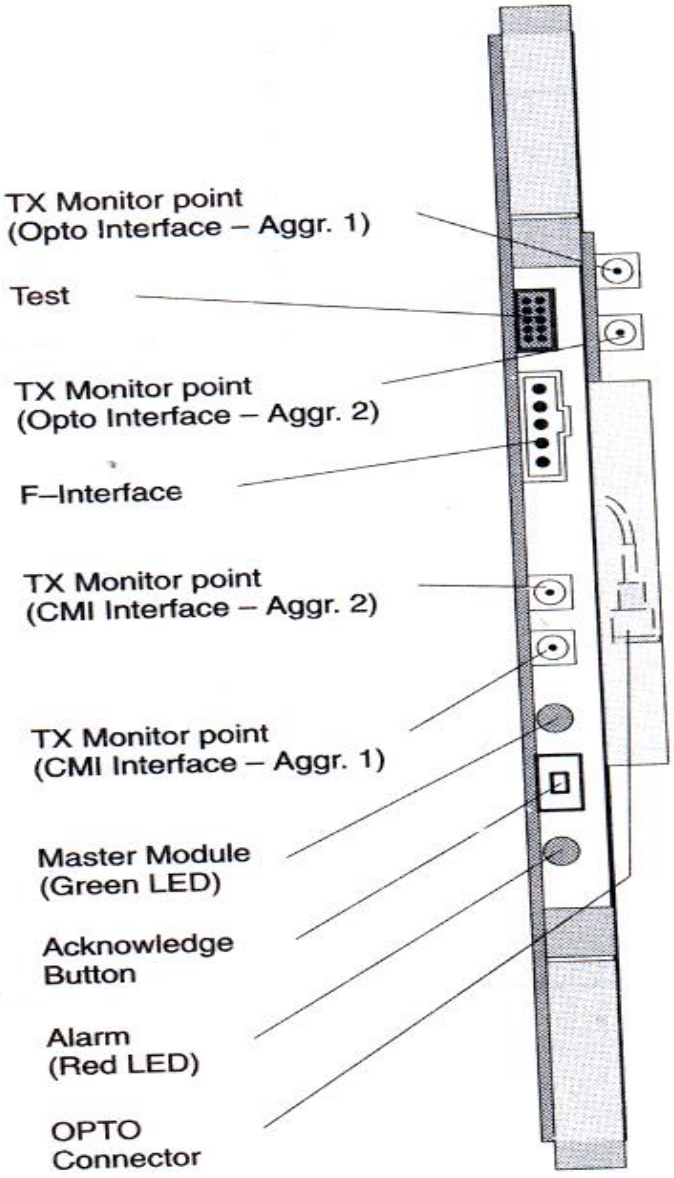


Figure. 2.1 Front View of ADM – 1 Module

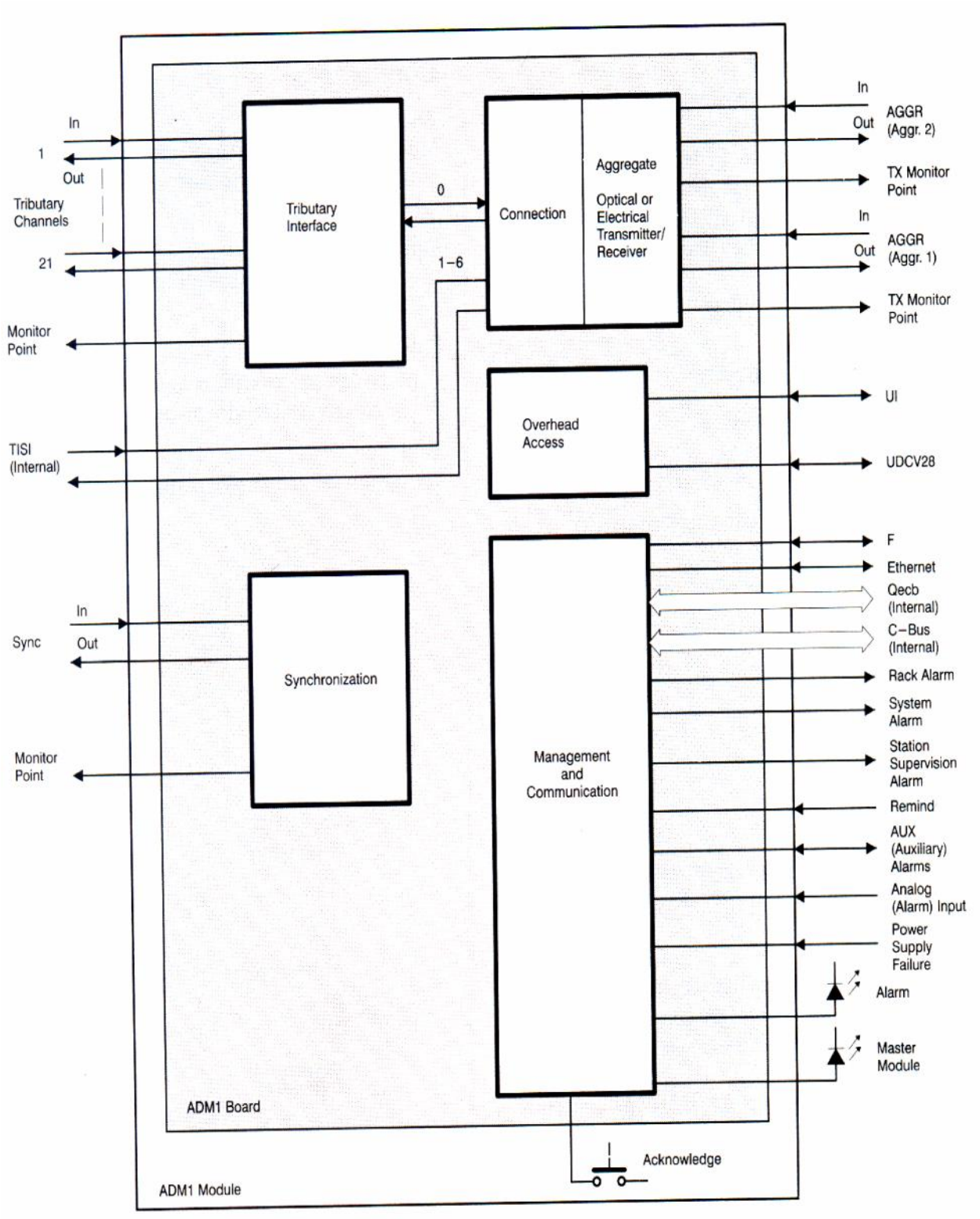


Figure 2.2 Block diagram of the ADM1 Module

2.2 STM-1 TERMINAL MULTIPLEXER MODULE – TM1

2.2.1 Function.

The terminal Multiplexer module contains a complete stand alone terminal Multiplexer including one optical or electrical aggregate interface, PDH Tributary interfaces, switch matrix, timing function and basic management interfaces. The module has 1 x STM-1 aggregate interface and 21 x 2 M bit/s tributary interfaces.Fig.2.3 gives front-view and figure 2.4 gives the block diagram.

The module is available in different versions determined by:

* Optical/Electrical Aggregate.
* The type of optical interface
* 120 or 75 Ω 2 M bit/s / 2 MHz ext. clock interfaces.

2.2.2 Circuits on the module

The module comprises the following circuits:

* Aggregate
* Connection
* Overhead Access
* Synchronization
* Management
* Tributary

In configurations with optical aggregate signal, the module holds an optical sub-assembly. The module also holds a flash memory board which contains the permanent memory for the application software and the database of the network element.

Acknowledge button

A push button used to acknowledge the current rack alarm.

LEDs

Master Module (Green LED): This LED indicates that this is the master module of the network element.

Alarm (Red LED): The LED indicates non-acknowledged alarms in the network element.

CONNECTORS

TX Monitor Points: Monitor the transmitted aggregate signal. The “CMI interface” monitor point is used when aggregate interface is electrical.

OPTO CONNECTOR: Connectors located on the optical sub-assembly connecting the optical fibers.

F-INTERFACE: A five-pole connector for connecting a Craft Terminal. For installation and service purposes only.

TEST: For factory test and service purposes only.

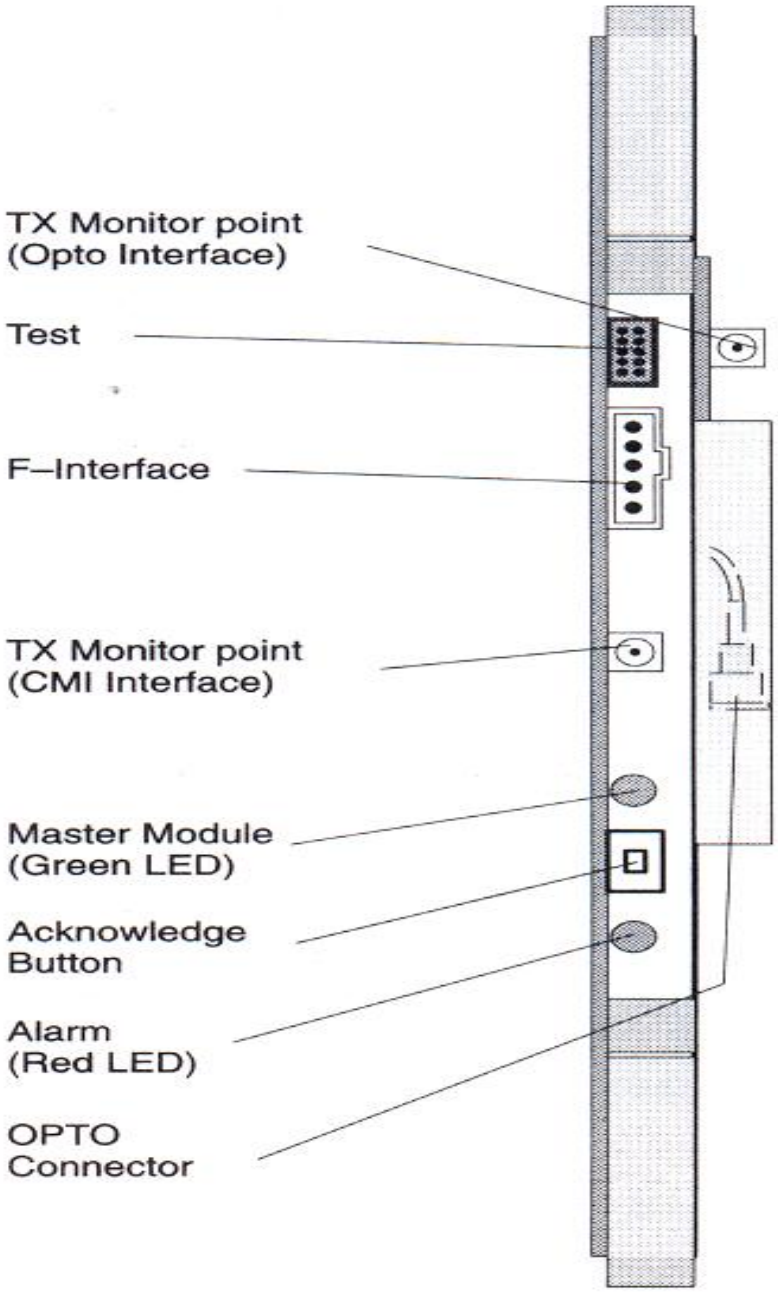


Figure. 2.3 Front View of TM – 1 Module

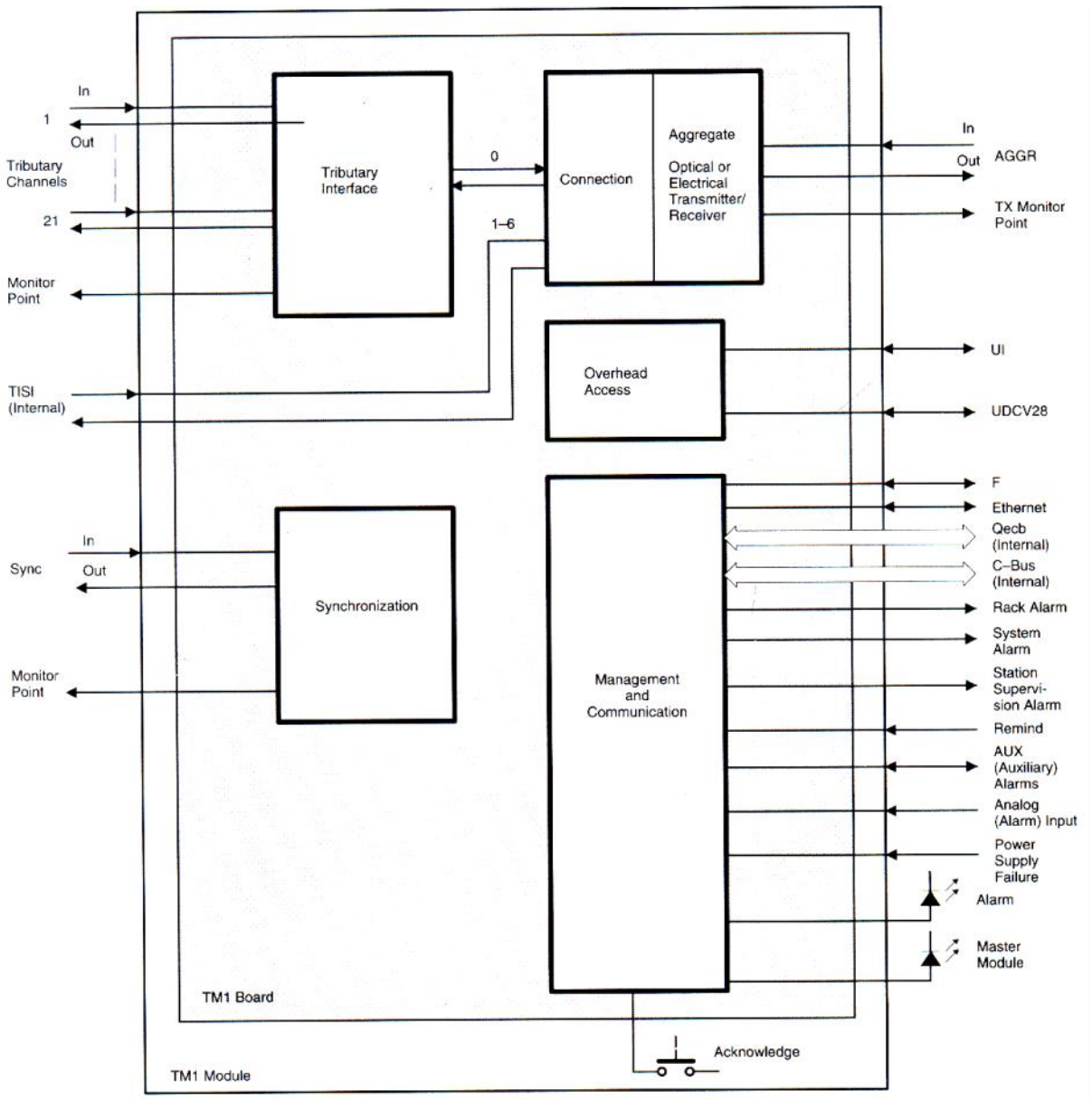


Figure 2.4 Block Diagram of the TM1 Module.

2.3 2 M bit/s Tributary Extension Module — TEX1, TEX1 Resync.

2.3.1 Function

The TEXI Tributary Extension Module is used to increase the number of tributary interfaces. The module has 21 x 2 M bit/s tributary interfaces. Fig. 2.5 shows the front view and Fig.2.6 shows the block diagram.

The module is also available in a TEX 1 resync. variant.

TEX 1 resync. has the capability of resynchronizing the outgoing plesiochronous 2 M bit/s signals to a 2 MHz clock derived from the internal system clock (T0). It contains a two-frame buffer to absorb wander for each 2 M bit/s output. If a wander or frequency difference between SDH frequency T0 and 2 M bit/s signals causes a phase variation of 125 µs a well defined 2 M bit/s frame slip will occur (32 bytes). The resynchronization function will look for frame information in the 2 M bit/s signal and insert AIS upon LOF. Recalculation of a possible CRC-4 is not performed upon a frame slip.

The TEX modules are available in 120/75 Ω variants.

2.3.2 Circuits on the module

The module comprises the following circuits:

- Tributary
- Overhead Access
- Local Control

LED: The LED indicates alarms in the module.

Test: For factory test and service purposes only.

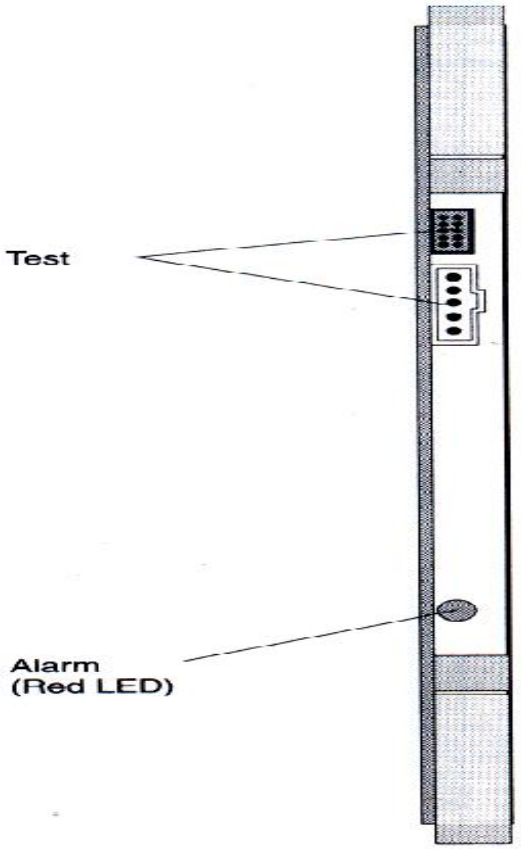


Figure 2.5 Front View of TEX – 1 Module

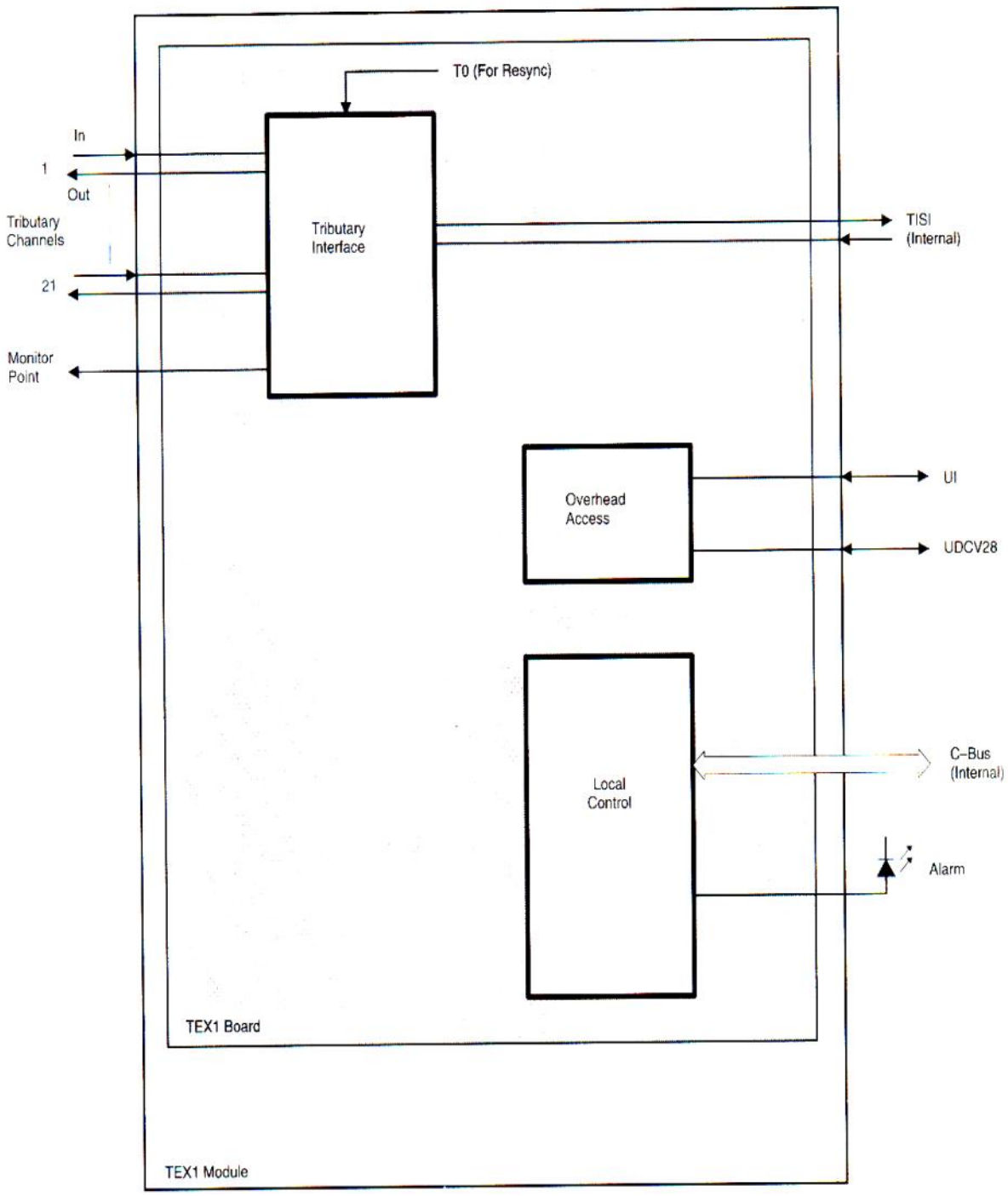


Figure 2.6 Block Diagram of the TEX 1 Module

2.4 34 M bit/s Tributary Extension Module — TEX3

2.4.1 Function

The TEX3 Tributary Extension Module is used to access the VC-3 of the STM-l signal. The TEX3 exist as TEX31 and TEX33 modules. (See Fig. 2.7 and Fig. 2.8)

The TEX31 module accesses one VC-3 whereas the TEX33 accesses three VC-3s.

2.4.2 Circuits on the module

The module comprises the following circuits:

- Tributary
- Overhead Access
- Local Control

LED: The LED indicates alarms in the module.

Test: For factory test and service purposes only.

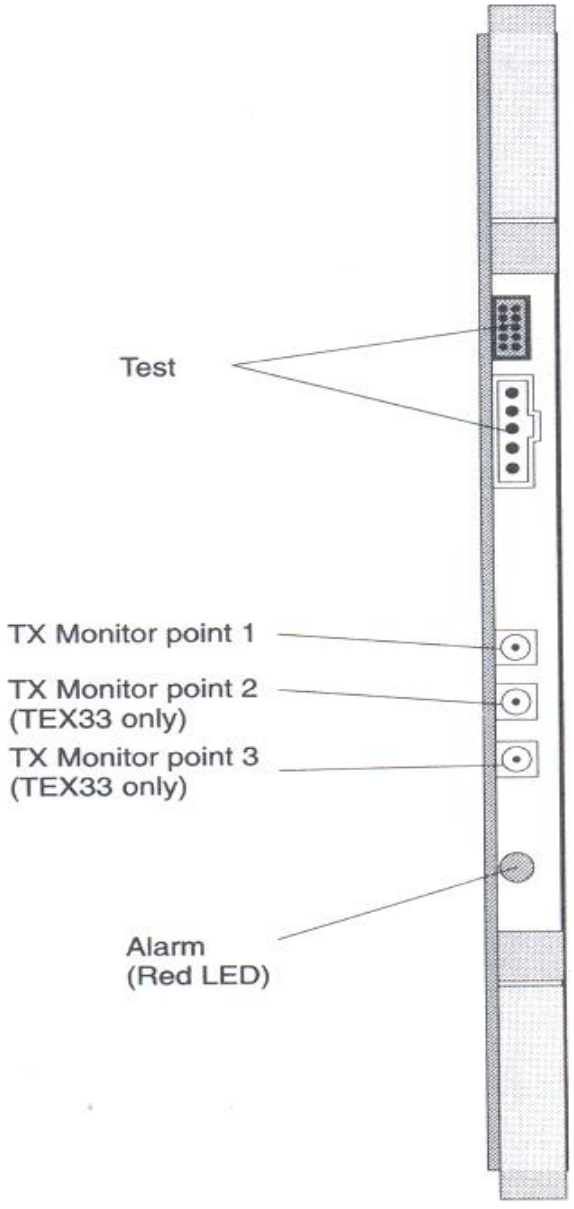


Figure 2.7 Front View of TEX – 3 Module

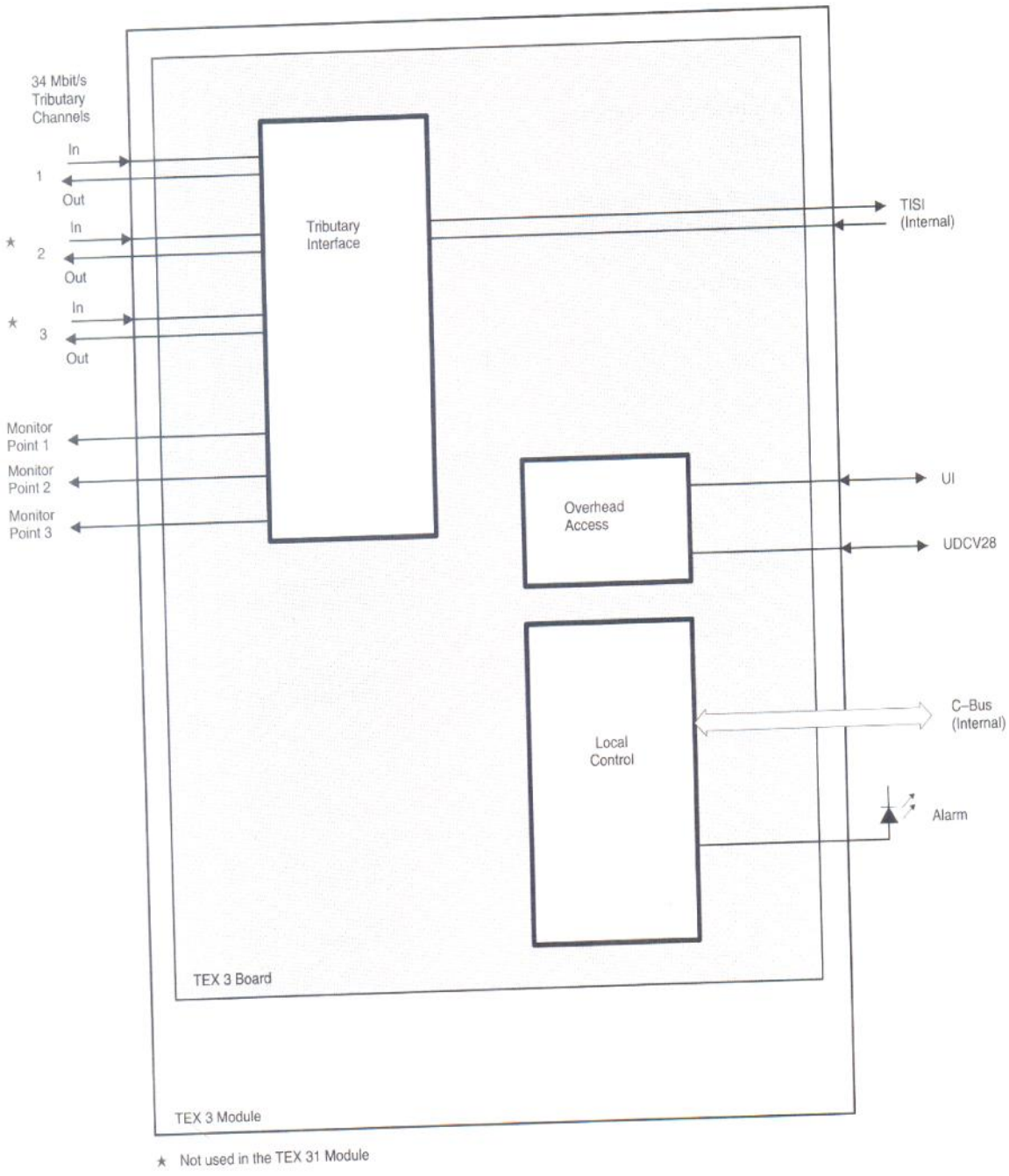


Figure 2.8 Block Diagram of the TEX3 Modules

2.5 STM—1 Ring Interconnect Module-RI1

2.5.1 Function

The Ring Interconnect module provides two optical or electrical STM- 1 tributary interfaces**.** Fig.2.9 gives front view and Fig.2.10 gives block diagram.

In configurations with optical output signals the module holds an optical sub-assembly. The module comprises the following circuits:

- Tributary
- Overhead Access
- Local Control

LED: The LED indicates alarms in the module.

Test: For factory test and service purposes only.

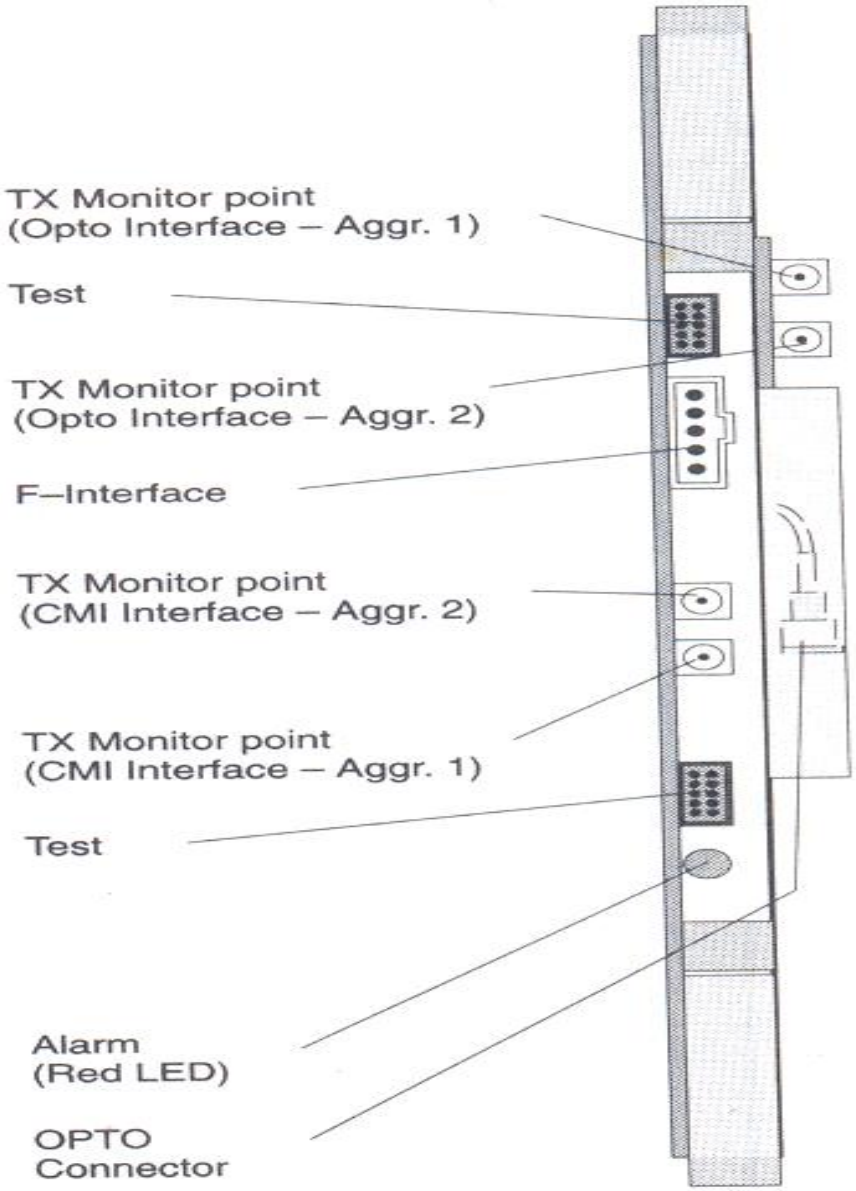


Figure 2.9 Front View of RI Module

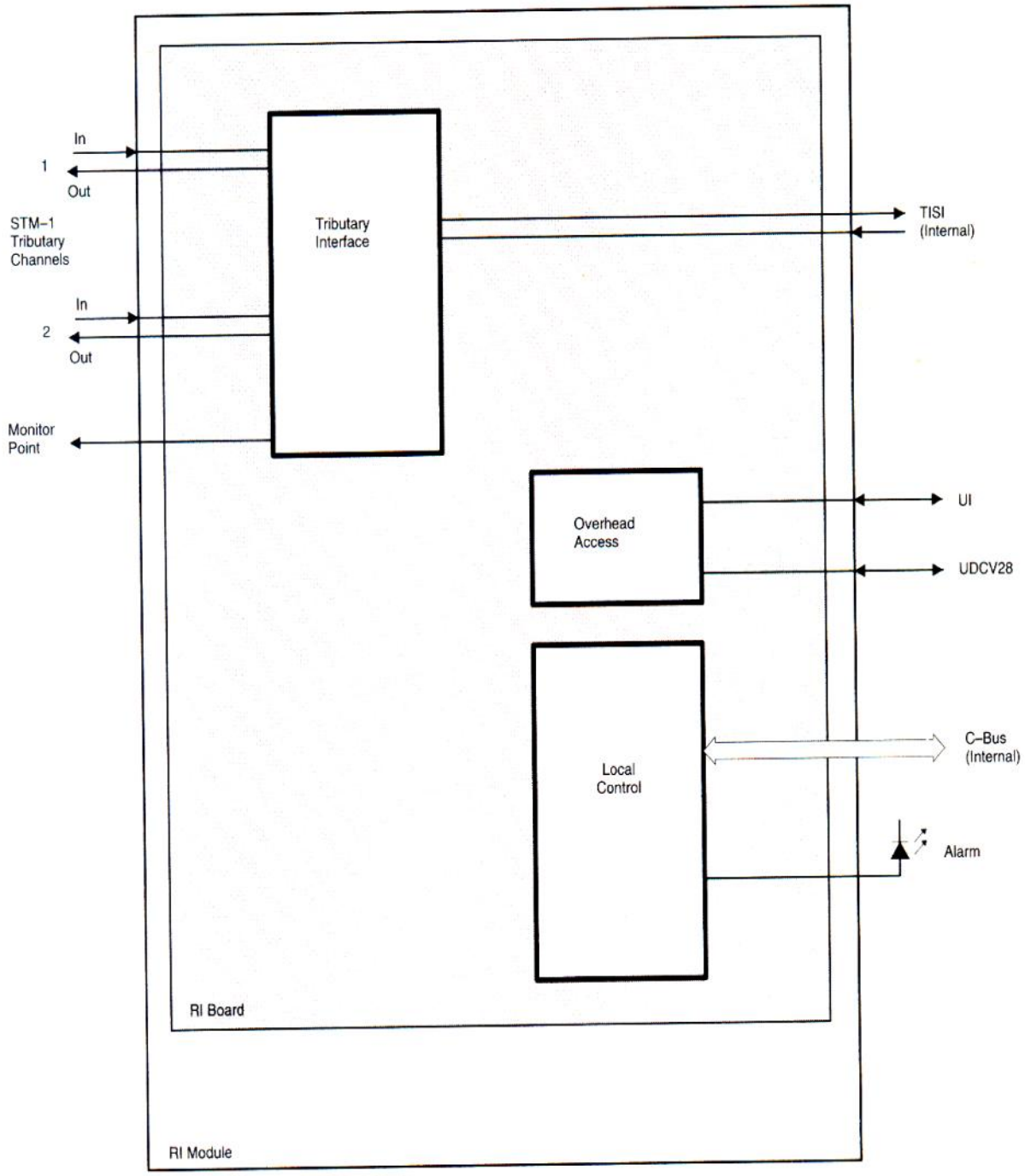


Figure. 2.10 Block Diagram of the RI Module.

2.6 STM-1 Line Interconnect Module - LI1

2.6.1 Function

The Line Interconnect module provides one optical or electrical STM-l tributary interface. In configurations with optical output signal the module holds an optical sub-assembly. (See figure 2.11 and 2.12)

2.6.2 Circuits on the Module

The module comprises the following circuits:

- Tributary
- Overhead Access
- Local Control

LED: The LED indicates alarms in the module.

Test: For factory test and service purposes only.

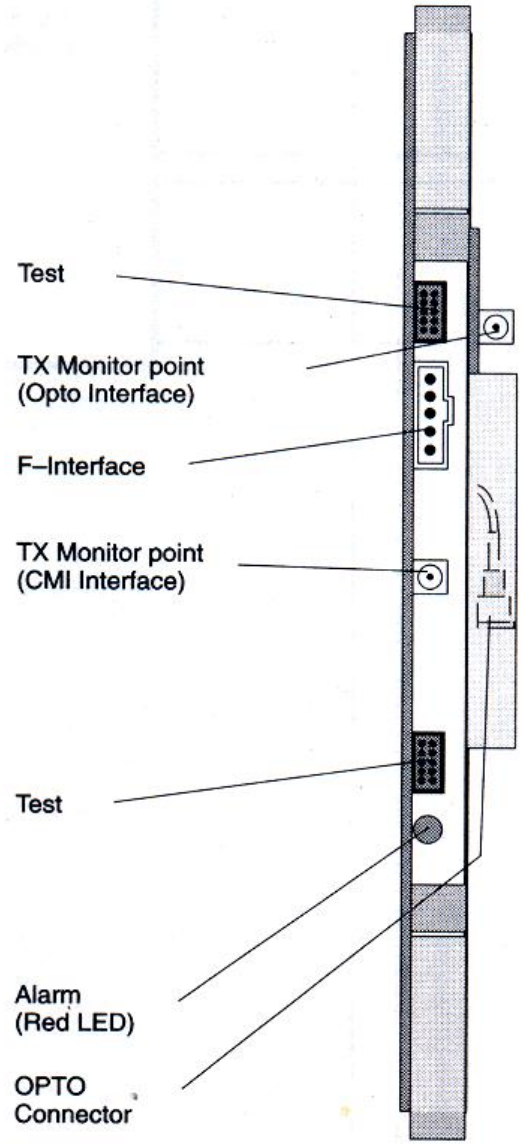


Figure.2.11 Front View of LI Module

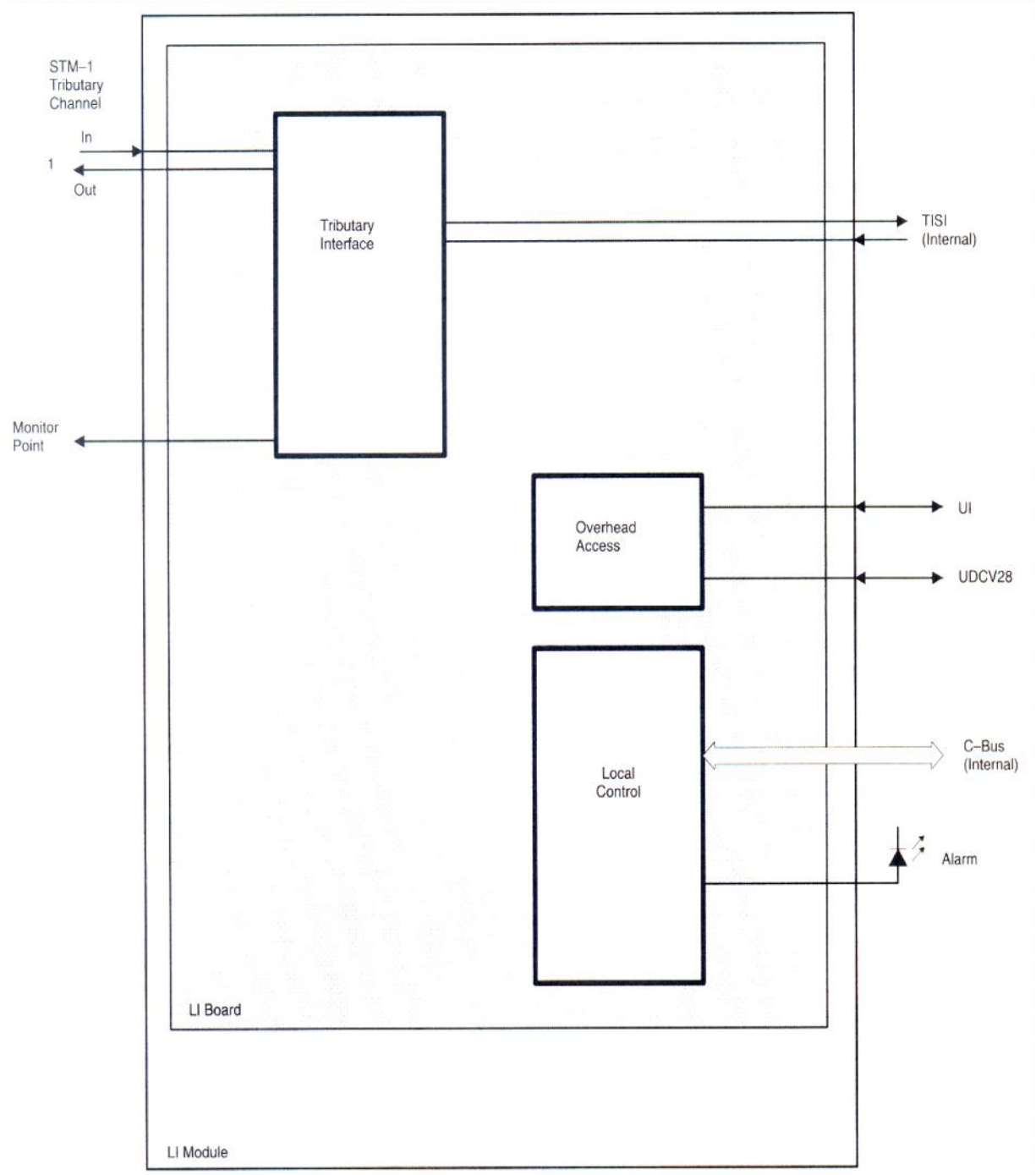


Figure 2.12 Block Diagram of the LI Module

2.7 Power Supply Module - PS

2.7.1 Function

The power supply operates from 48 V. The DC/DC converter block consists of Input Section, Output Section and Control Section. The circuit automatically selects one of two inputs as main or protection. By means of straps, the user can determine whether -UB1 or -UB2 is set as main or protection source. The input is common-mode filtered and protected against over - and reverse voltage. Figure 2.13 gives front view and 2.14 gives block diagram

Two filtered and equal output voltages of +5 V and -5 V are obtained. All outputs are implemented with power-share circuits. This ensures that modules connected in parallel share the actual power level equally. The outputs are protected against short-circuiting. Integrated in the Control Section is a Start Up and a Soft Start circuit to ensure that the power supply can be plugged in/out at any time without interrupting the system. Additionally a Balance Control and an Automatic Bleeder circuit keeps the output voltages within specifications even under asymmetrical and/or low power load.

It is possible to implement N + l protection of power supplies for redundancy purpose.

The power supply is available in two configurations. See the following.

Acknowledge button

A push button used to acknowledge the current rack alarm (only the power supply configuration using the red LED will generate rack alarms).

LEDs: One power supply configuration uses the green LED and another uses the red LED.

Green LED: The LED indicates that both supply voltages are within the specified limits.
Red LED: The LED indicates that at least one supply voltage has exceeded the specified limits.

F-Interface: A five-pole connector for connecting a Craft Terminal.

Monitor Points: Monitor the +5 V and -5 V supply voltages respectively. The polarity of the -5 V monitor voltage is changed in the configuration using the green LED (-5 V is measured as +5 V).

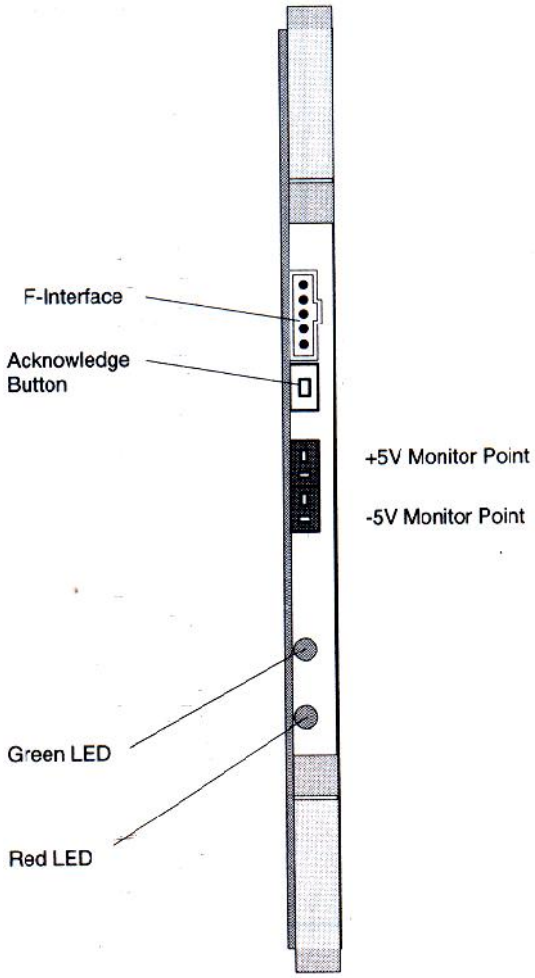


Figure 2.13 Front View of PS Module

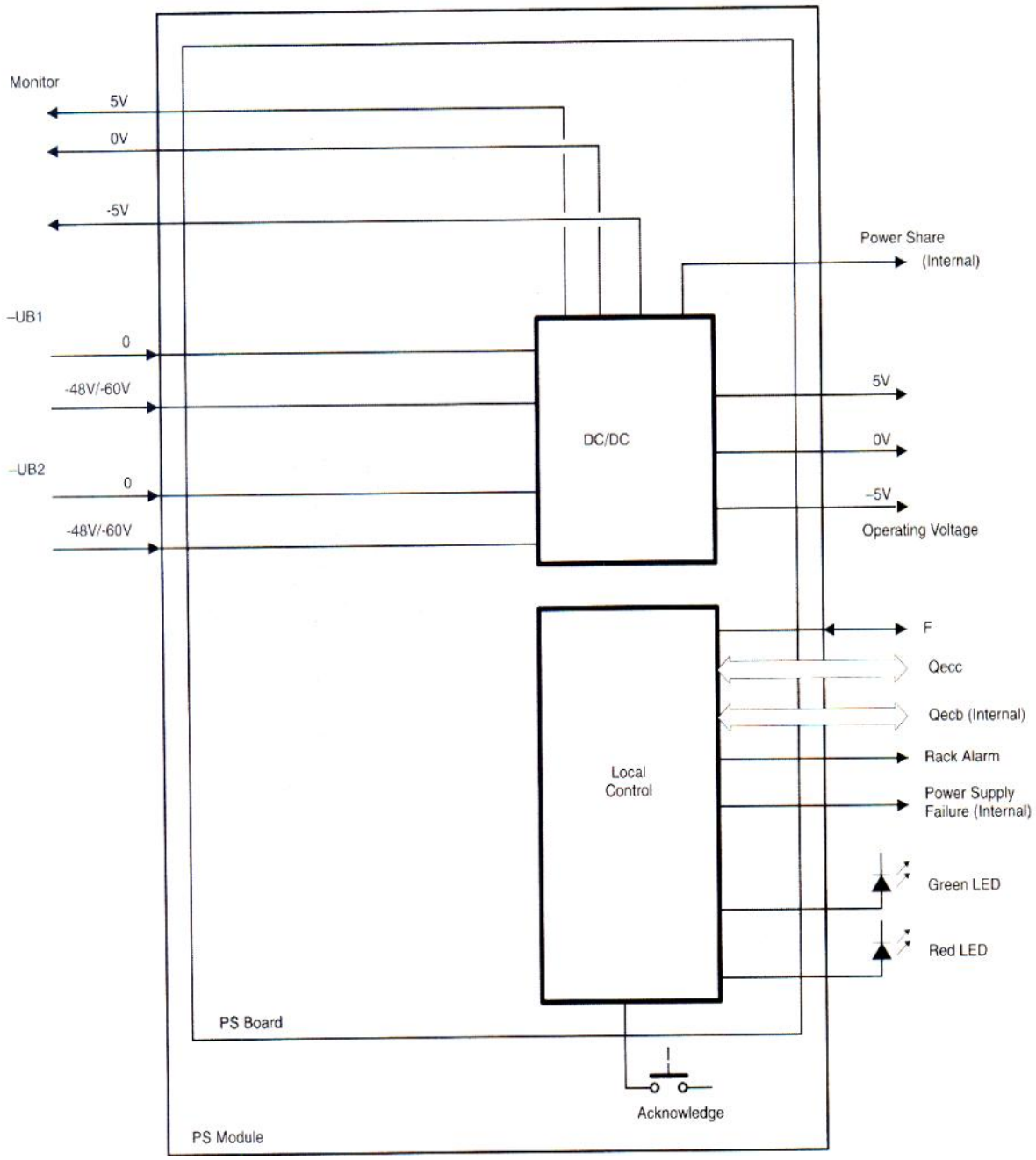


Figure 2.14 Block Diagram of the Power Supply Module.

2.8 SUB RACKS

The sub rack consists of a mechanical unit with a number of slot positions (fixed module guides), that together with the motherboard PCB define where the module can be inserted for the system applications. Each sub rack is provided with a 4 mm socket for the connection of an antistatic bracelet. This bracelet must be used during installation and service. The maximum No. of Network Element (NE) in wide sub rack is between 1-3 and the maximum No. or tributary modules per sub rack is 1-5.

2.8.1 WIDE SUB RACK WITH REAR CABLE ACCESS-SR1

Description of SR1c

Up to three motherboard groups can be mounted in this sub rack. One NE uses one, two or all three motherboard groups in the sub rack. Cables make the connections between motherboard groups. Up to three NEs can placed in the sub rack.

Note: It is not possible to have two individual NEs with only one motherboard group.

The sub rack frame and motherboard groups are regarded as separate items. In the ordering situation they have to be ordered separately. Empty positions in the sub rack are to be covered by a cover plate.

The system connection field is at the rear of the sub rack. Cabling is done from the front with the sub rack in the service position that is achieved by pulling the sub rack out of its tray and tilting it to approximately 45^0 fixed by a wire. All the electrical connections are made by factory made cable assemblies.

Optical cables are inserted in the sub rack through holes at the rear and connected to the optical connectors on the optical modules.

A sub rack connection field is mounted on the right side of the sub rack, handling the alarm signals of all the systems in the sub rack. Power supply cables and alarm connections are connected to screw terminals at the rear of this connection field. Connectors for interconnections between sub racks in the same rack are also at the rear of this connection field. The sub rack has 18 slots (determined by the guides at the top and the bottom). A label on the inside of the front plate shows these slot positions.

2.8.2 SUB RACK CONNECTION FIELD FOR THE SUB RACK SR1c

The sub rack is equipped with a connection field at the far right position, where the power, local station alarms and Qecb from P-MUX are connected. Indication of rack alarms (LEDs), a battery power filter to protect against surge voltages and fuses for the battery voltages – UB1 and -UB2 are also placed in the sub rack connection field. There is a switch for changing the upper LED between alarm indicating function and power indication. The push button switch, accessible from the front, is used to reset the micro-controller system on all modules in the sub rack.

Switches for setting Rack ID, sub rack ID and grounding option are also located on the Sub rack connection field (SRCF). (See figure 2.15)

LEDs

LED Designation	LED Colour	Function
P/S	Green	The LED can indicate either “power on” or AL 3. An internal switch selects this.
R	Yellow	Alarm AL 2. Default programmed to “REMIND”
B	Red	Alarm AL 1. Default programmed to “B-alarm” (deferred)
A	Red	Alarm AL 0. Default programmed to “ A-alarm” (prompt)

RESET SWITCH

When the reset switch is activated the modules in the sub rack will perform a hardware reset.

Figure. 2.15 Front view of the Sub rack Connection Field.

2.8.3 MODULE POSITIONS

Physically the modules can be inserted in the slots as indicated in the following table. The crosses indicate an allowed position.

Position / Module	1	2	3+4	5+6	7	8	9+10	11+12	13	14	15+16	17+18	
TM/ADM											X		SCRF
LI 1/RI 1			X	X			X	X				X	
TEX1,TEX1 resync.			X	X			X	X				X	
TEX31			X	X			X	X				X	
TEX33								X				X	
EOW	X				X				X				
PS	X	X			X	X			X	X			

2.8.4 STM—1 TRANSPORT SYSTEM OPTICAL INTERFACES

The system is provided with an optical connector of the type FC/PC. The parameters are valid when FIBCOM equipment is used at both ends. “na” means “not applicable”. The parameters are specified for BER = 10^{-10} (See Table)

Parameter	Values			Unit
Nominal bit rate	155.520			Mbit/s
Application Code	S-1.1	L-1.1	L-1.2	-
Connector	FC/PC	FC/PC	FC/PC	-
Transmitter at reference point S				
Operating wavelength	1280 - 1335	1280 - 1335	1480 - 1580	nm
Source type	MLM	MLM	SLM	-
Spectral characteristics				
Maximum RMS width	6	3	-	nm
Maximum –20 dB width	-	-	1	nm
Minimum side mode suppression ratio	-	-	30	dB
Mean launched power				
Maximum	-8	0	0	dBm
Minimum	-15	-5	-5	dBm
Pulse Mask and Jitter				-
Pulse Mask	According to figure of G.957			-
Jitter generation	0.01 UI RMS at HP = 12 Khz/G.783 0.5 UI pp at BP 500 Hz to 1.3 MHz 0.1 UI pp at BP 65 KHz to 1.3 MHz			-
Receiver at ref. Pt. R				
Minimum Sensitivity	-28	-37	-37	dBm
Minimum overload	-8	-1	-2	dBm
Maximum optical path penalty	1	1	1	dB
Jitter tolerance	Figure 2 of G.825			-

2.9 EMBEDED SOFTWARE FOR NETWORK ELEMENTS

The Master Modules (ADM/TM modules) of the network element hold the embedded application software for the whole network element in a permanent storage medium. TRIB modules will load software from the master module. The hardware and the embedded application software are regarded as separate items, while ordering both items must be ordered to get an operational system. In general the master modules will be delivered with only basic software that makes it possible to download the application software locally or remotely. The network element is not able to perform any system functions until the embedded application software is downloaded.

Objective:

1. The type of optical connector used in ADM/TM modules in FIBCOM AC-1 family is ----------
   a) LC/PC b) ST/PC c) FC/PC d) BNC
2. The type of source used for S-1.1 and L-1.1 is ---------- in FIBCOM AC-1 family.
   a) SLM b) MLM c) both SLM and MLM
3. Maximum mean launched power for S-1.1 application is –8 dBm in FIBCOM AC-1 family.
   a) –18 dBm b) –28 dBm c) –38 dBm d) – 8 dBm
4. Minimum mean launched power for S-1.1 is ---------- in FIBCOM AC-1 family.
   a) –15 dBm b) –25 dBm c) –35 dBm d) –5 dBm
5. Maximum mean launched power for L-1.1 application is ---------- in FIBCOM AC-1 family.
   a) –1 dBm b) –2 dBm c) –3 dBm d) 0 dBm
6. Minimum mean launched power for L-1.1 is –5 dBm in FIBCOM AC-1 family.
   a) –1 dBm b) –2 dBm c) –5 dBm d) 0 dBm
7. The ---------- Modules of the network element hold the embedded application software for the whole network element in a permanent storage medium in FIBCOM AC1 family
   a) TEX-1 b) RI-1 c) LI-1 d) ADM/TM
8. Operating wavelength for S-1.1 and L-1.1 application is ---------- nm in FIBCOM AC-1 family.
   a) 1280 – 1335 b) 1300 – 1310 c) 1500 – 1550 d) None
9. Receiver minimum overload for L-1.1 is ---------- in FIBCOM AC-1 family.
   a) –20 dBm b) –18 dBm c) –1 dBm d) None
10. Receiver minimum sensitivity at BER 10^{-10} for L-1.2 is ---------- in FIBCOM AC-1 family.
    a) –37 dBm b) –27 dBm c) –17 dBm d) –7 dBm

Subjective:

1. Briefly explain the function of ADM-1 module.
2. Draw the block diagram of ADM-1 module.
3. The RI-1 module comprises of which circuits?
4. Briefly explain the function of RI-1 module.
5. Draw the block diagram of RI-1 module.
6. The LI-1 module comprises of which circuits?
7. Briefly explain the function of LI-1 module.
8. Draw the block diagram of LI-1 module.

CHAPTER 3

FIBCOM 6325 STM1/4 SYSTEM DESCRIPTION

3.0 INTRODUCTION

The FIBCOM 6325 node is a product where SDH Cross-connect (SDXC), Add/Drop Multiplexers (ADM) and Terminal Multiplexers (TM) are implemented in a standalone unit.
The following interfaces are available:

- STM-16
- STM-4
- STM-1 (optical or electrical)
- 2 Mbit/s & 34 Mbit/s Extension
- Gigabit Ethernet
- Fast Ethernet

The FIBCOM 6325 node is housed in a 1 U high sub rack SC2. The supplied flanges can be mounted to adapt to either 19 inch or ETSI wide racks.

The figure below shows an example of the layout of a FIBCOM 6325 node. The modules to be installed in the sub rack depend on the required configuration.

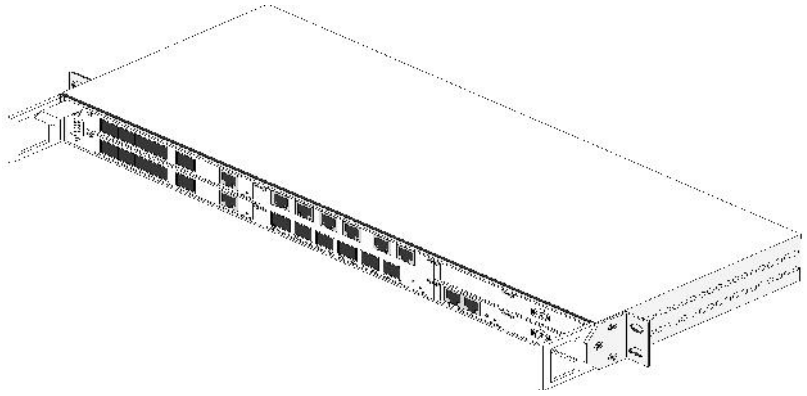


Fig 3.1 SC2 SUB RACK

The SC2 sub rack, 1U high, comprises 9 slots for modules.

The slot positions are shown in figure below.

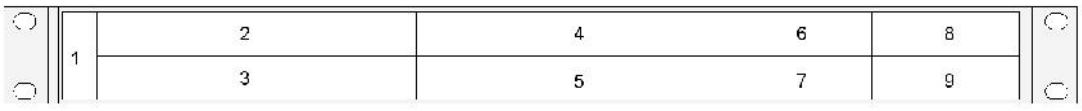


Fig 3.2 Slot positions of sub rack

- Slot-1 Fan Module
- Slot-2 Traffic Module
- Slot-3 Traffic Module
- Slot-4 Traffic Module
- Slot-5 Traffic Module
- Slot-6 Reserved slot
- Slot-7 CMCC Module
- Slot-8 PS-DC Module
- Slot-9 PS-DC Module (Redundant module)

Install the traffic module performing the cross-connect function in slot 3. If the configuration requires protection of the module performing the cross-connect function, then install the traffic module performing the protection of the cross-connect function in slot 2. Install other traffic modules, extending the number of interfaces, in position 2, 4 and 5.

The traffic modules available for 6325 node are

- SIMX-16
- SIMX-4
- SPMIX with 4E1s
- SPMIX with 21E1s
- PIM1
- EMAP
- ETEX10S

3.1 DESCRIPTION OF MODULES

3.1.1 SIMX-16 is the SDH interface module with cross-connect functions containing the interfaces:

- 1 x STM-16 (with SFP)
- 4 x STM-1 /STM-4 (with SFP)

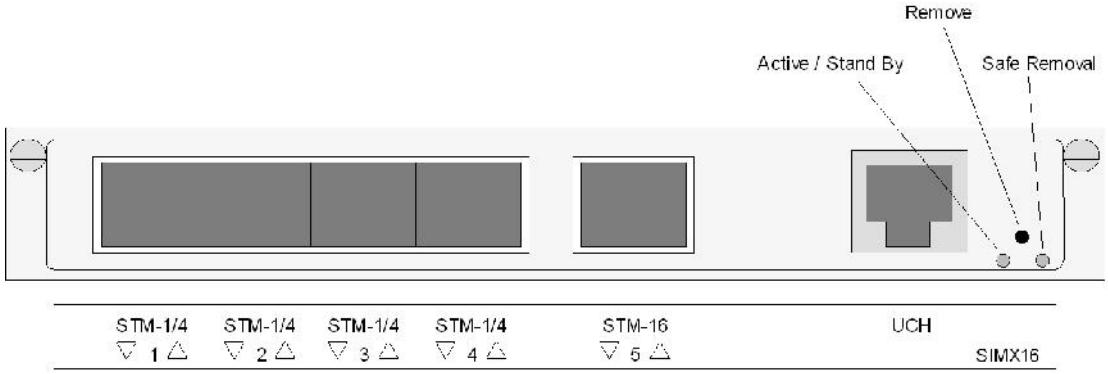


Fig 3.3 Front view of SIMX-16 module

3.1.2 SIMX-4 is the SDH interface module with cross-connect functions containing the interfaces:

- 4 X STM-1 /STM-4 (with SFP)

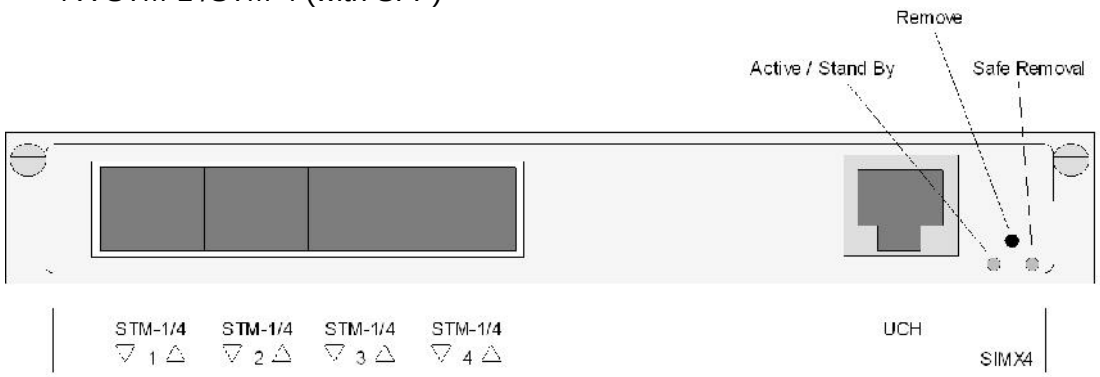


Fig 3.4 Front view of the SIMX4 module.

3.1.3 SPIMX with 4E1s is the SDH and PDH interface module with cross-connect functions containing the interfaces:

- 2 X STM-1 /STM-4 (with SFP)
- 4 x 2 Mbit/s (E1) 120 Ohm

The figure below shows the front view of the SPIMX module with 4 x 2 Mbit/s interfaces

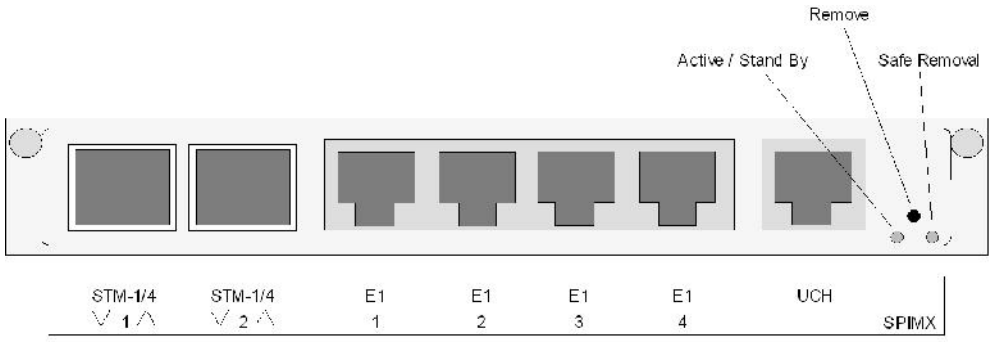


Fig 3.5 Front view of the SPIMX module

3.1.4 SPIMX with 21E1s is the SDH and PDH interface module with cross-connect functions containing the interfaces:

- 2 X STM-1 /STM-4 (with SFP)
- 21 x 2 Mbit/s (E1) 120 Ohm

The figure below shows the front view of the SPIMX module with 21 x 2 Mbit/s interfaces.

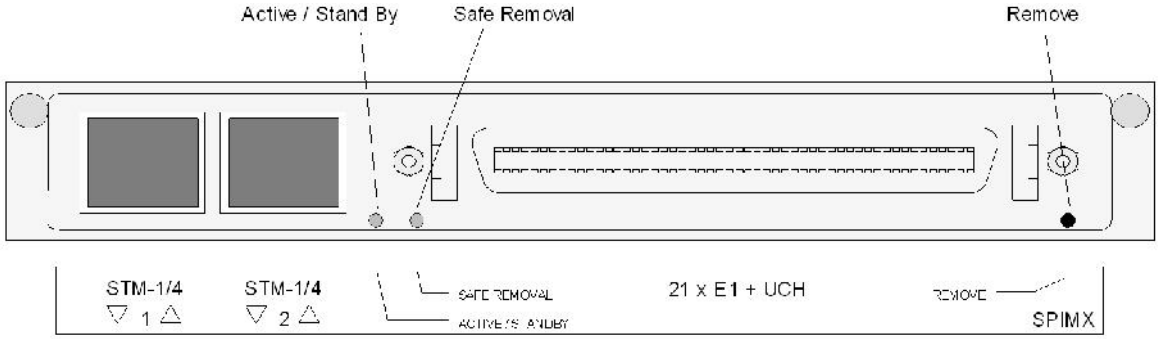


Fig 3.6 Front view of the SPIMX module

3.1.5 PIM1 is the PDH interface module with the interfaces:

- 21 x 2 Mbit/s (E1) 120 Ohm

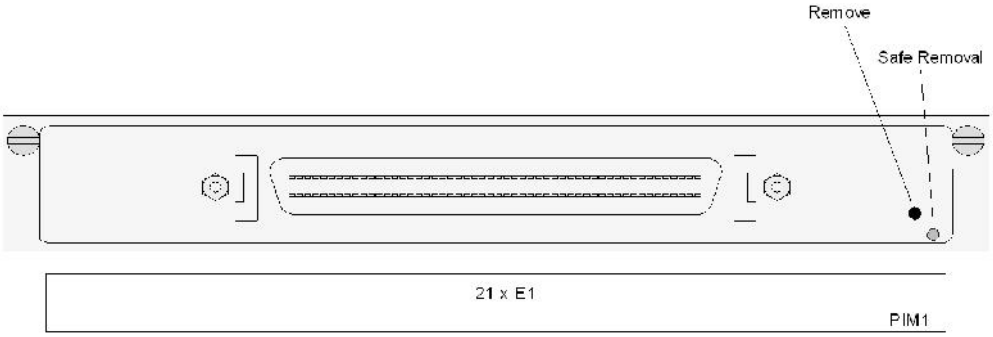


Fig 3.7 Front view of the PIM1 module.

3.1.6 ETEX10S is the Ethernet switching and mapping module with interfaces:

- 4 x GbE (with SFP)
- 2 x FE (with SFP)
- 4 x FE (RJ-45)

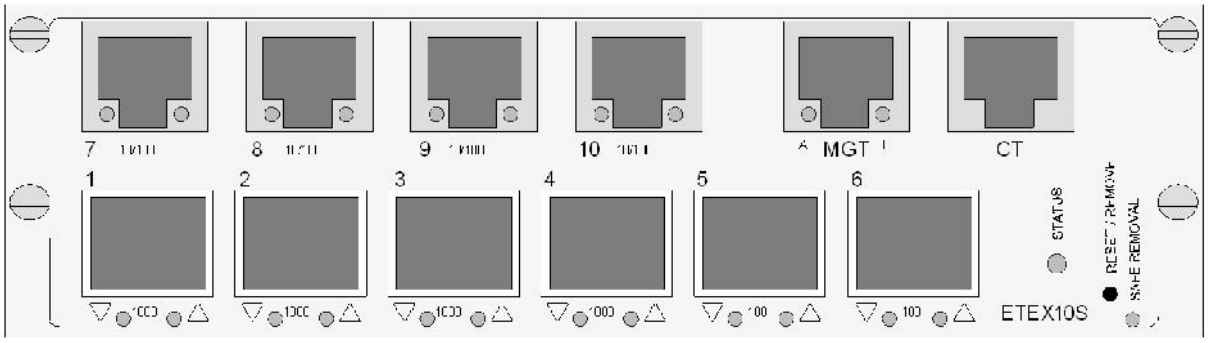


Fig 3.8 Front view of the ETEX10S module

3.1.7 EMAP is the Ethernet mapping module with interfaces:

- 2 x FE (RJ-45 or with SFP)
- 2 x FE (RJ-45)

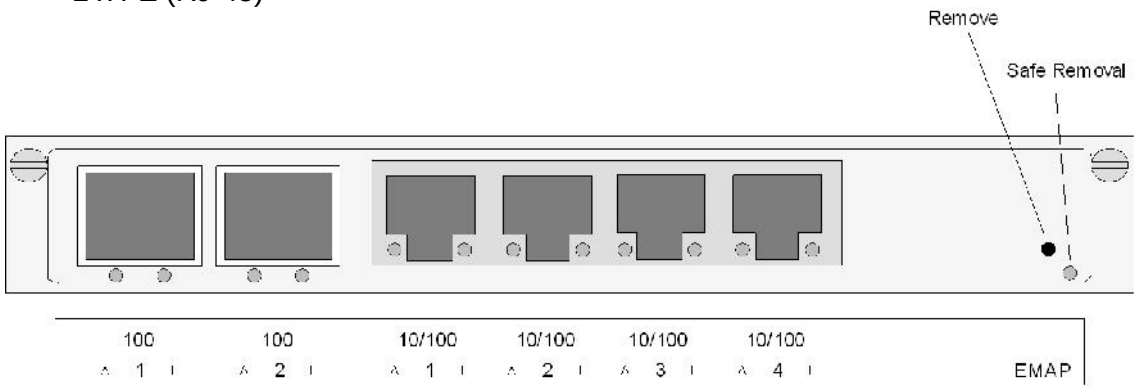


Fig 3.9 Front view of the EMAP module

3.1.8 CMCC is the Central management and communications control module.

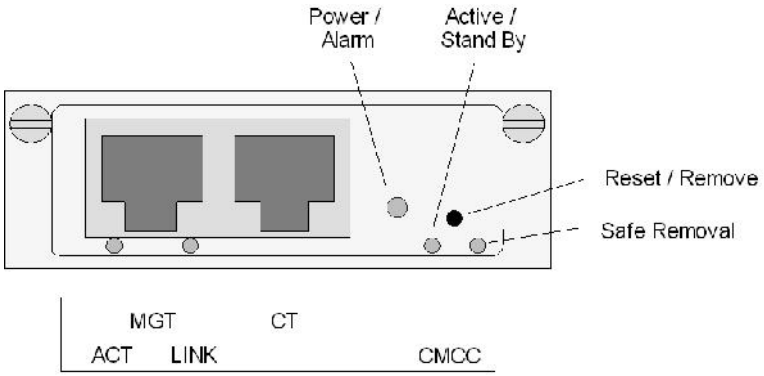


Fig 3.10 Front view of the CMCC module

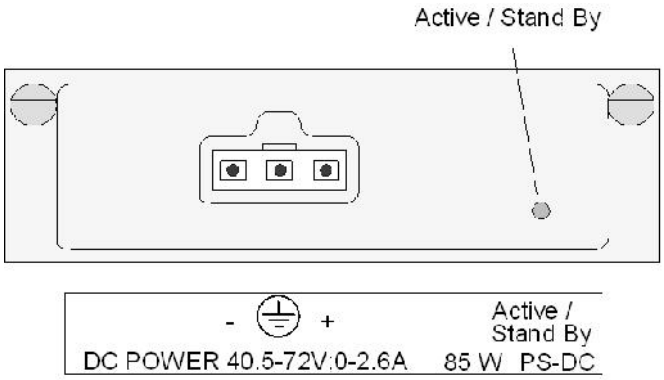


Fig 3.11 Front view of the PS-DC module

The figure below shows the front view of the fan module with the synchronization and alarm connector.

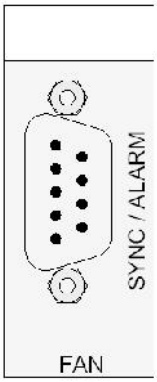


Fig 3.12 FAN MODULE

3.2 A generalized view of the 6325 node with module locations

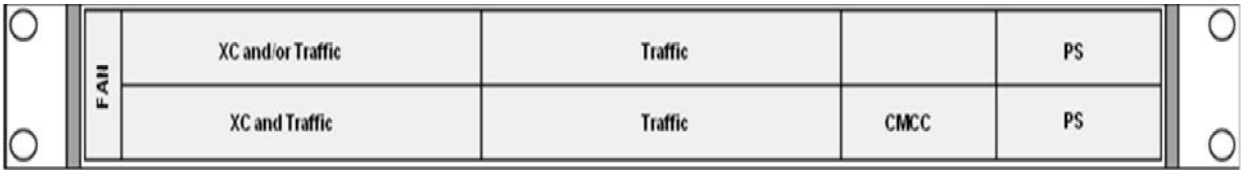


Fig 3.13 Front view of 6325 NODE

Configuration examples

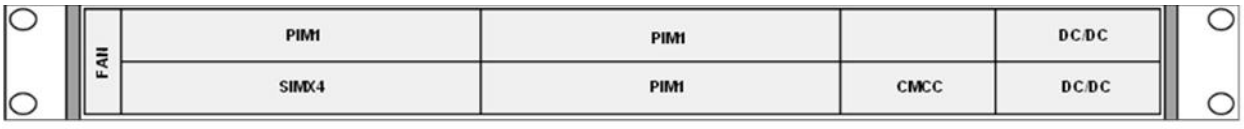


Fig 3.14 ADM1 w/63xE1

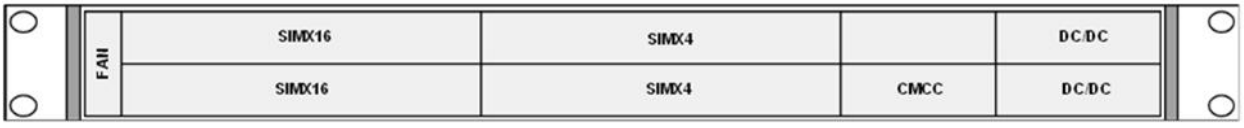


Fig 3.15 ADM16 w/16xSTM-1

Fig 3.16 ADM w/4xE1 and 10xGbE/FE incl. Ethernet Switching

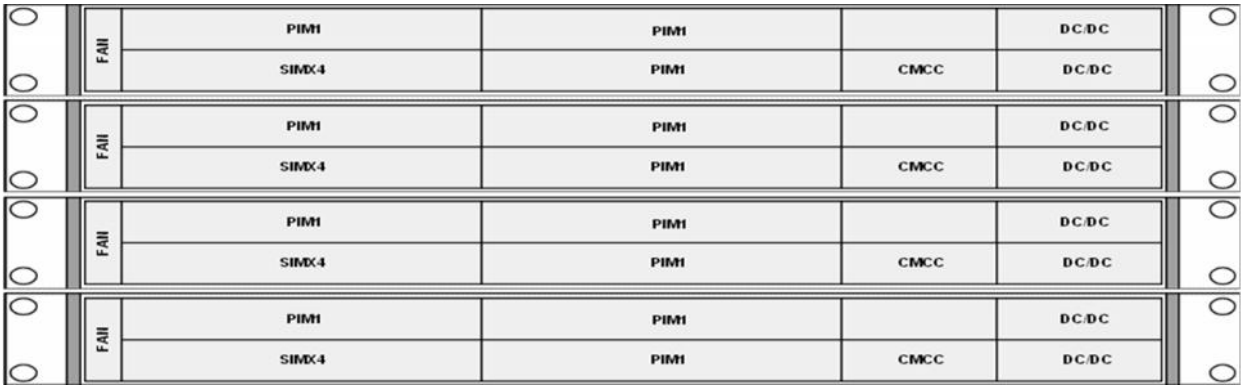


Fig 3.17 ADM4 w/252xE1 in just 4U

Fig 3.18 DETAILED VIEW OF 6325 NODE

3.3 SFP MODULE

The **small form-factor pluggable** (**SFP**) is a compact, hot-pluggable transceiver used for both telecommunication and data communications applications. It interfaces a network device mother board (for a switch, router, media converter or similar device) to a fiber optic or copper networking cable. It is a popular industry format supported by many network component vendors. SFP transceivers are designed to support SONET, Gigabit Ethernet, Fibre Channel, and other communications standards.

SFP (Small Form Pluggable) optical modules are the most used fiber optic transceiver modules in the fiber communications industry. SFP's come in a variety of data rates and different fiber coverage.

SFP fiber transceiver modules make the fiber optic network or fiber-Ethernet network easier to upgrade or maintain users can replace a single SFP module during the process instead of replace the whole board with many modules on it. Application codes can be mixed on same module.

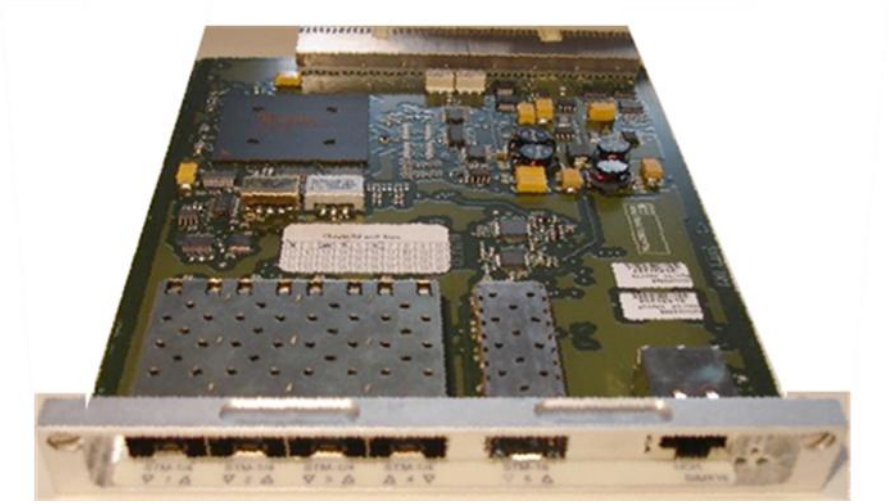


Fig 3.19 SIMX-16 Card

Fig 3.20 SFP

3.4 Available SFP Transreceivers

SDH:

S-1.1, L-1.1, L-1.2
S-4.1, L-4.1, L-4.2, L-4.2 C-band
S-16.1, L-16.1, L-16.2, L-16.2 C-band
STM-16 CWDM (8 wavelengths)

Ethernet:

100BASE-FX, 100BASE-LX10
1000BASE-T, 1000BASE-SX,
1000BASE-LX, 1000BASE-ZX

3.5 BLOCK DIAGRAM OF 6325 NODE

The figure 3.21shows a simplified block diagram of the FIBCOM 6325 node. The interfaces available depend on the modules installed in the FIBCOM 6325 node.

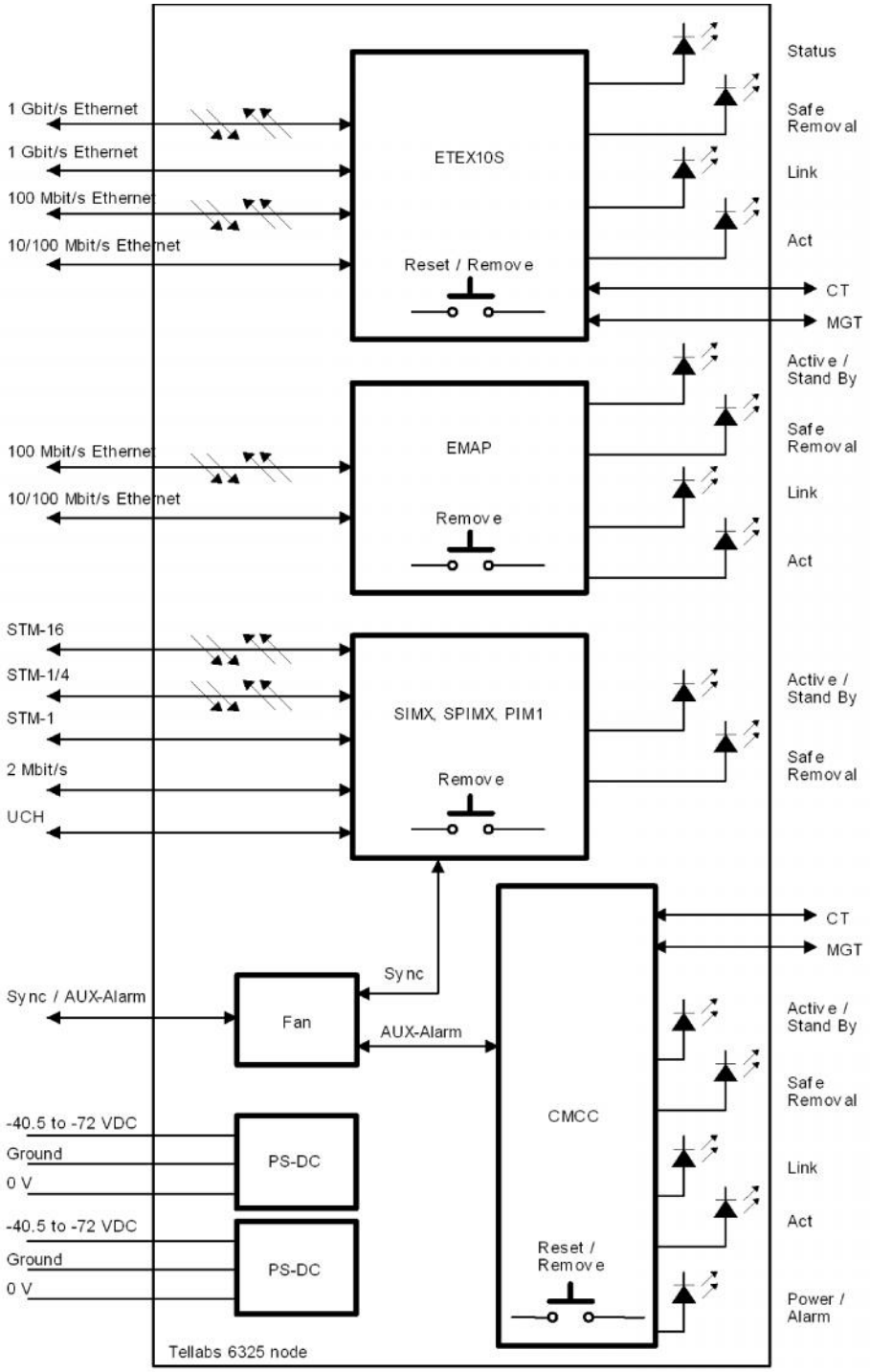


Fig 3.21 BLOCK DIAGRAM OF 6325 NODE

3.6 Power system description

The following figure shows the power system of the FIBCOM 6325 node. The FIBCOM 6325 node may house two PS-DC modules, each capable of providing full power to the node. This allows for power supply protection. Each PS-DC module has one DC power input, therefore two PS-DC modules must be used if supply protection is needed. If AC powering is needed then the external AC/DC adapter must be used. The external AC/DC adapter provides -48 V DC to the input of the PS-DC module installed in the FIBCOM 6325 node.

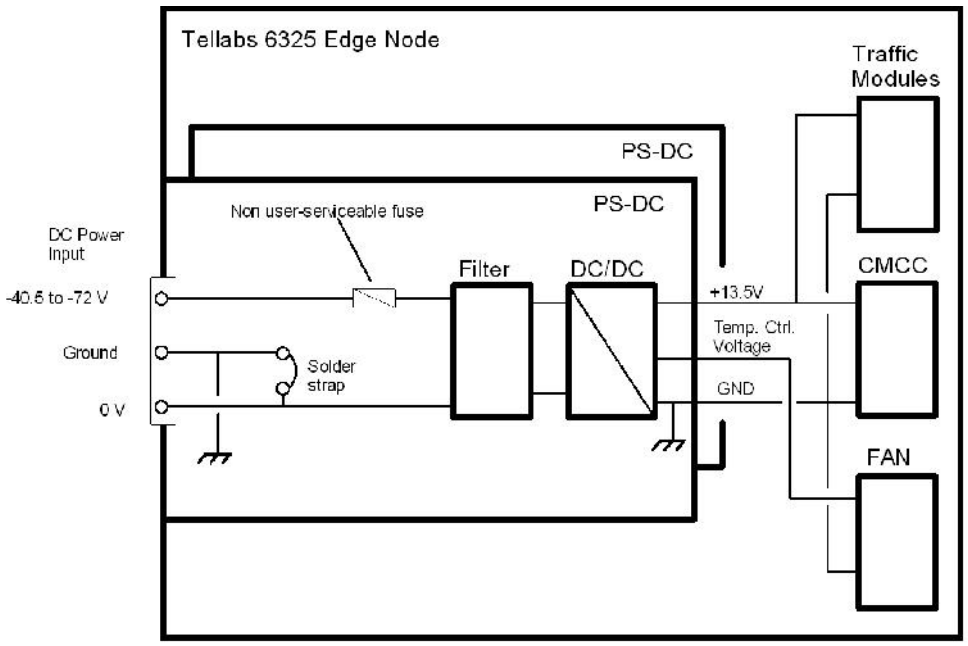


Fig 3.22 BLOCK DIAGRAM OF POWER SUPPLY MODULE

Power supply configurations

The FIBCOM 6325 node may be powered from an AC input or DC input. We can choose between the following configurations:

- AC input only. This may be the case in many non telecommunications offices. Protection requires extra set of PS-DC module and AC/DC adapter.
- Combined AC and DC powering. AC input as main supply and a DC input as protection supply (extra PS-DC module required) in case the AC supply fails.
- DC input only. One DC input as main power supply and another DC input (extra PS-DC module required) as protection supply in case the main supply fails.

3.7 LEDs, Switches and Connectors

3.7.1 LEDs and switch on CMCC module

The figure below shows the location of the LEDs and switch on the front of the CMCC module.

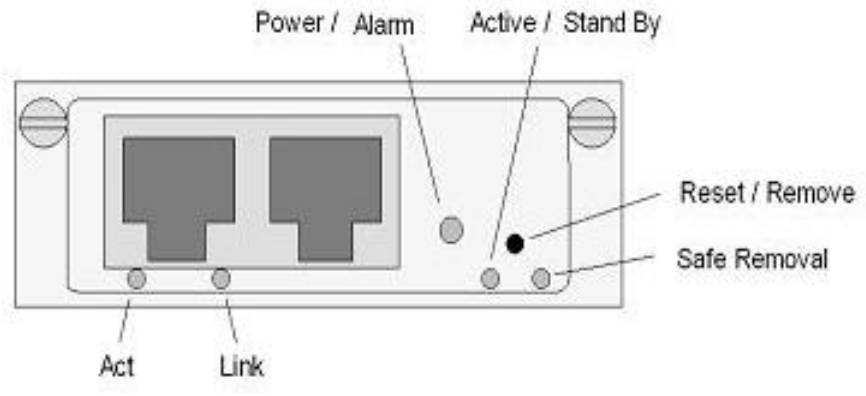


Fig 3.23 LEDs on CMMCC module

The functions of the LEDs and switch are described in the table below.

LED or Switch	Indication	Description
Power / Alarm	Off	Module not powered
	Constantly green	Normal condition
	Constantly red	• Alarm (critical or major) • Module performing self-test
	Fast Flashing (4 Hz) green	• Module booting • Initializing application software
	Slow Flashing (1Hz) green	Module synchronizing
	Slow Flashing (1Hz) red	Module self-test failed
Active / Stand By	Off	• Module not powered • Module not ready for stand by
	Constantly green	Module is active
	Slow Flashing (0.5Hz) green	Module is in standby mode
Reset / Remove	-	• Switch to be activated before the module is removed from the sub rack • Performs a reset of the module
Safe Removal	Yellow	LED indicating that it is safe to remove the module from the sub rack.
Act	Green	LED indicating activity/traffic on the management connection
Link	Green	LED indicating that link is up.

Table 3.1

3.7.2 LED on PS-DC module

The figure below shows the location of the LED on the front of the PS-DC module.

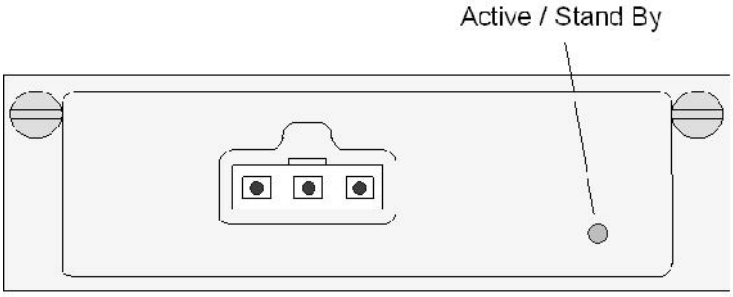


Fig 3.24 LED on the front of the PS-DC module

The functions of the LED are described in the table below.

LED	Indication	Description
Active / Stand By	Off	• Module is not providing power (either the input power is missing or the module has a defect) • Module is in stand by mode (when the CMCC module is not installed
	Constantly green	Module is active
	Slow Flashing (0.5Hz) green	Module is in standby mode

Table 3.2

3.7.3 LEDs and switch on SIMX, SPIMX, PIM1 and EMAP modules

The figure below shows the location of the LEDs and switch on the front of the SIMX, SPIMX, PIM1 and EMAP modules.

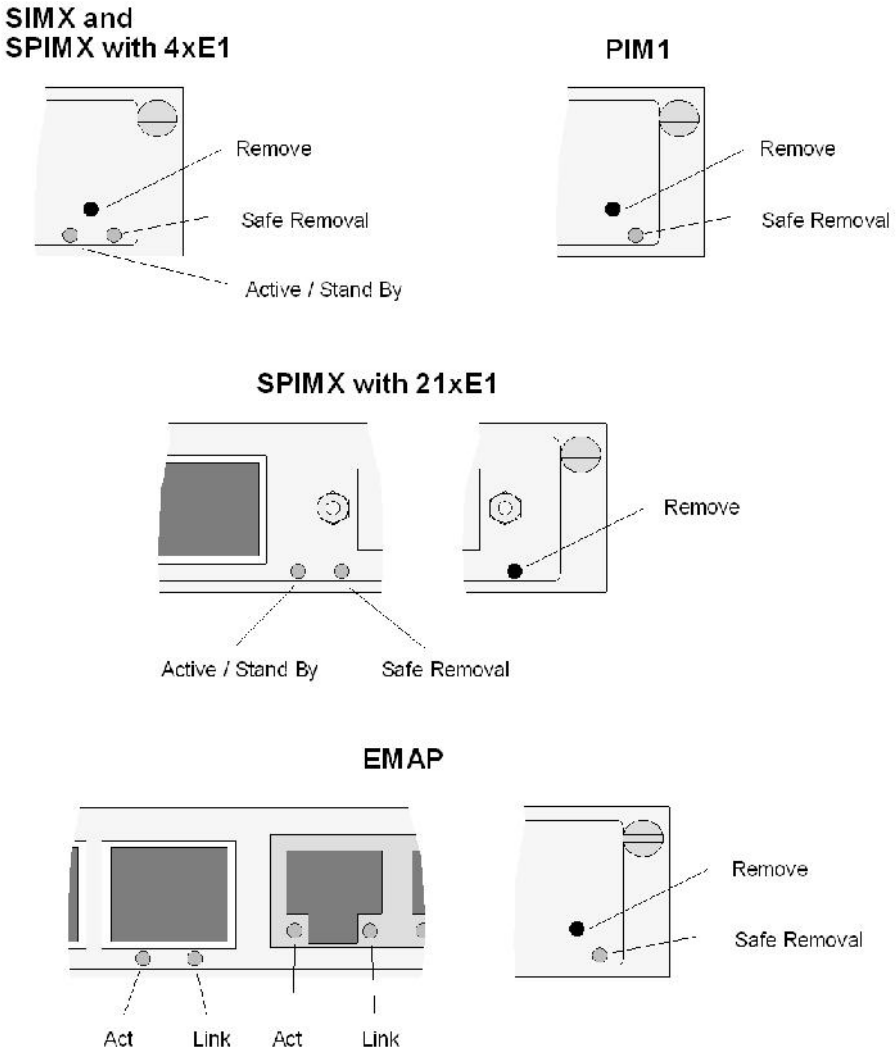


Fig 3.25

The functions of the LEDs and switch are described in the table below.

LED/Switch	Indication	Description
Remove	-	Switch to be activated before the module is removed from the sub rack.
Safe Removal	Yellow	LED indicating that it is safe to remove the module from the sub rack.
Active /Stand By (SIMX and SPIMX only)	Off •	Module is not powered • Module is in standby mode (when the CMCC module is not installed)
	Constantly green	Module is active
	Slow Flashing (0.5Hz) green	Module is in standby mode
Act (EMAP only)	Green	LED indicating activity/traffic on the Ethernet connection
Link (EMAP only)	Green	LED indicating that link is up

Table 3.3

3.7.4 LEDs and switch on ETEX10S module

The figure below shows the location of the LEDs and switch on the front of the ETEX10S module.

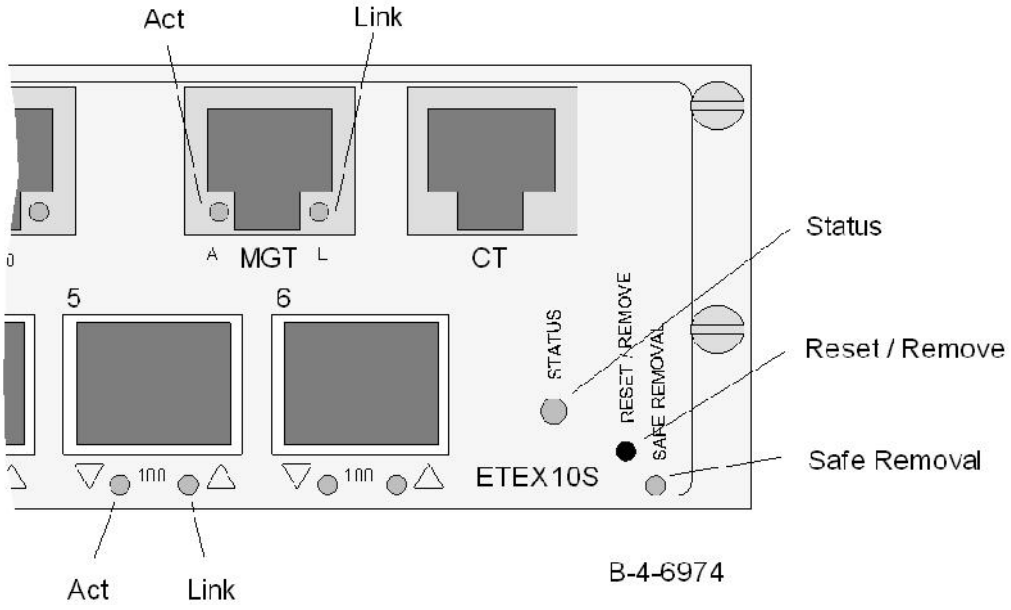


Fig 3.26

The functions of the LEDs and switch are described in the table below.

LED/Switch	Indication	Description
Reset/Remove	-	• Switch to be activated before the module is removed from the sub rack • Performs a reset of the module: A short duration push (< 1 sec.) performs a reset of the module (traffic affecting) and restarts module software. A long duration push (> 1 sec.) performs a reset of the module (traffic affecting) and brings the software into maintenance mode. This mode is only intended to be used by FIBCOM service persons.
Safe Removal	Yellow	LED indicating that it is safe to remove the module from the sub rack.
Status	Off	Module is not powered
	Constantly green	Module is active
	Fast Flashing (2 Hz) green	Module is booting
	Red	Module is in reset
Act	Green	LED indicating activity/traffic on the Ethernet connection
Link	Green	LED indicating that link is up.

Table 3.4

3.7.5 Connectors on modules

The functions of the connectors are described in the table below. See the modules 'Front Layout'.

Connector	Description	On module
STM-16	STM-16 optical interface with SFP transceiver	SIMX16
STM-1/4	STM-4 optical or STM-1 optical/electrical interface with SFP transceiver	SIMX4, SIMX16, SPIMX
E1	2 Mbit/s interface, 120 ohm	SPIMX(4xE1)
21 x E1	21 x 2 Mbit/s interface, 120 ohm	PIM1
21 x E1 +UCH	21 x 2 Mbit/s interface, 120 ohm and interface for user channels and engineering ordering wire (DTMF-EOW).	SPIMX(21xE1)
UCH	Interface for user channels and engineering ordering wire (DTMF-EOW).	SIMX4, SIMX16, SPIMX(4xE1)
1000	1000BASE-SX, 1000BASE-LX, 1000BASE-ZX or 1000BASE-T Ethernet interface with SFP transceiver	ETEX10S
100	100BASE-FX or 100BASE-LX10 Ethernet interface with SFP transceiver	EMAP, ETEX10S
10/100	10BASE-T or 100BASE-TX Ethernet interface	EMAP, ETEX10S
MGT	Management Ethernet interface	CMCC, ETEX10S
CT	Craft terminal interface	CMCC, ETEX10S
SYNC / ALARM	2 MHz synchronization input/output and alarm interface	FAN
DC	Power DC power 40.5 - 72 V; 0 - 2.6 A	PS-DC

Table 3.5

3.7.6 STM-4 transmission characteristics

The following table describes the transmission characteristics of the modules with STM-4 transceivers.

Parameter	Value				Unit
Transceivers	TR-0004	TR-0005	TR-0006	TR-0017	
Nominal Bit Rate	622080				kbit/s
Class	S-4.1	L-4.1	L-4.2	L-4.2 C-Band	
Transmitter at reference point S					
Source Type	MLM	SLM	SLM	SLM	
Parameter	**Value**				**Unit**
Wavelength range	1274-1356	1280-1335	1480-1580	1530-1565	nm
Mean launched power range	-15 to -8	-3 to +2	-3 to +2	-3 to +2	dBm
Min. extinction ratio	8.2	10	10	10	dB
Pulse Mask	According to Fig.2/ G.957				
Jitter Generation	G.813 option 1				

Optical Path between S and R					
Attenuation range	0 to 12	10 to 24	10 to 24	10 to 24	dB
Maximum dispersion	74	na	2200	2200	ps/nm
Receiver at reference					
Minimum point R sensitivity at BER =10^{-10}	-28	-28	-28	-28	dBm
Min. overload	-8	-8	-8	-8	dBm
Max. receiver reflectance measured at R	na	-14	-27	-27	dB
Jitter Tolerance	G.825				

Table 3.6

3.7.7 STM-1 transmission characteristics

The following table describes the transmission characteristics of the modules with STM-1 transceivers.

Parameter	**Value**				**Unit**
Class	S-1.1	L-1.1	L-1.2	CWDM	
Specifications according to	G.957				
Nominal Bit Rate	155520				kbit/s
Transmitter at reference point S					
Source Type	MLM	MLM	SLM	SLM	
Wavelength range	1261-1360	1263-1360	1480-1580	1471, 1491, 1511, 1531, 1551, 1571, 1591, 1611 +/- 6.5	nm
Mean launched power range	-15 to -8	-5 to 0	-5 to 0	0 to 5	dBm
Min. extinction ratio	8.2	10	10	10	dB
Pulse Mask	According to Fig.2/ITU-T G.957				
Jitter Generation (EN300462-5)	HP 12 kHz 0.01 UIrms /G.783 BP 500 Hz to 1.3 MHz 0.5 UIPP /EN 300462-5 BP 65 kHz to 1.3 MHz 0.1 UIPP /EN 300462-5				
Optical Path between S and R					
Attenuation range	0 to 12	10 to 28	10 to 28	15 to 33	d B
Maximum dispersion	96	246	na	3200	ps/nm
Receiver at reference					
Min. overload	-8 -	10	-10	-10	dBm
Class	**S-1.1**	**L-1.1**	**L-1.2**	**CWDM**	
Jitter Tolerance	Figure 2/ ITU-T G.825				

Table 3.7

3.7.8 To remove a module from the sub rack

Please follow the procedure described below when you have to remove a module from the sub rack.

To avoid damage on components sensitive to static electricity, use an antistatic bracelet connected to the chassis of the FIBCOM 6325 node.

1. Disconnect all cables connected to the module.
2. Unscrew the screws that fasten the module to the sub rack.
3. Push the switch (Remove) on the module using the reset tool and wait for the LED (Safe Removal) to switch on.

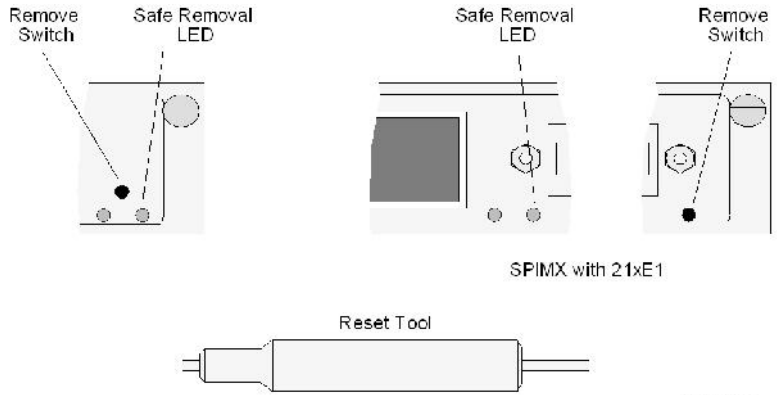


Fig 3.27

4. When the LED (Safe Removal) is ON, you can pull out the module using the ejector tool.

Warning: The LED will be on for only 10 seconds. In this period of time you can pull out the module. If the module is not removed, it will return to normal mode (LED turns off) and you will have to repeat the last 2 steps given above to pull out the module.

If an extraction tool was delivered with the sub rack (instead of the ejector tool) then use the extraction tool as shown below.

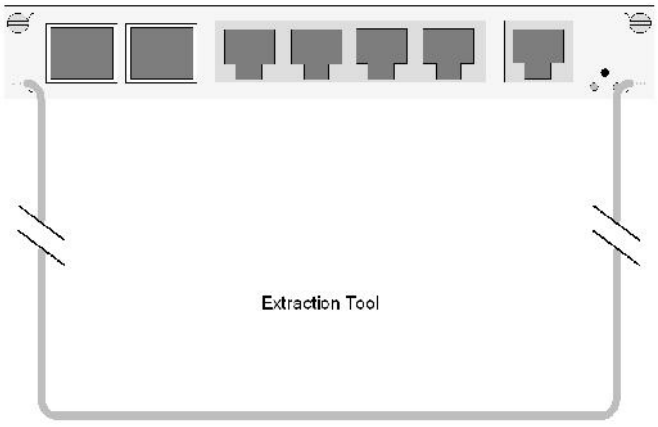


Fig 3.28

- Place the pin of the ejector tool in the hole on the module and turn the ejector tool down or up (depending whether the module to be extracted is placed in an upper or lower slot of the sub rack) pressing one of the legs of the tool against the front of an adjacent module in the sub rack.

- Use one end of the tool (small) if you need to press against a module above/below the one to be extracted or use the other end of the tool (large) if you need to press against a module placed diagonally opposite to the one to be extracted. The large end must always be used extracting an ETEX10S module.
- This will disconnect the module from the sub rack backplane.
- There is a hole for the tool on both left and right side of the module.
- Pull out the module.

Parameter	Value
Nominal voltage	-48 V or -60 V
Rated voltage	-40.5 V to -72 V
Power consumption	max. 100 W

Table 3.8

3.9 Master controller: Internally the FIBCOM 6325 node is managed by the CMCC module. The CMCC contains a non-volatile memory for the application SW of the network element. This memory can contain at least two versions of the SW and download of new SW while in service is possible.

3.9.1 Protection: SNC/I and SNC/N protection schemes are available at S12/S3/S4 levels. All protection mechanisms are straightforward and flexible with 1+1 protection, i.e. with one protection path for each working path. The protection is applicable to individual VC-12, VC-3 or VC-4 paths. Both revertive and non-revertive protection operations are supported.

3.9.2 Synchronization sources: The source for the internal timing reference T0 is derived among.

- 2.048 Mbit/s Tributary inputs (T2 references), freely selectable
- 2.048 Mbit/s Tributary inputs (T2 references), freely selectable
- External 2.048 MHz reference timing source (T3 reference).

3.9.3 Overhead Access: The modules include an interface for external user channels. The user channel interfaces are used for EOW channel access in the STM-N interfaces terminated on the module. Two EOW interfaces are available via a front connector on each of the SPIMX, SIMX4 and SIMX16 modules. The interfaces are bidirectional and the format is the EOW interface format. The two interfaces are statically connected to the E2 SOH bytes in STM-N channel no. 1 and 2 in SIMX4 and SPIMX modules and to STM-N channel no. 1 and 5 in the SIMX16 module.

3.9.4 Management Interface types: Management/supervision of the FIBCOM 6325 node is possible via three types of interfaces.

- Craft Terminal interface
- Ethernet interface
- Embedded Communications Channel (ECC) of STM-1/4/16 line.

The ECC may be transferred in DCCR or DCCM bytes of the STM-1/4/16 line overhead or in selectable VC-12.

3.9.5 Management software: The FIBCOM 6325 node can be managed by 6300 manager, 8000 manager and F6300EM. The purpose of the management software is to monitor and control the behavior of the FIBCOM 6325 node and the associated transport signals and to manage software downloading and upgrading. Proper installation of embedded software is required to enable the unit to operate.

3.9.6 Secondary supply: Dual DC supply with dual PS-DC module. One supply can be used as protection supply for the other. The PS-DC module (CM3561-A) can provide maximum 85 W to the internal +13.5 V power distribution net.

3.9.7 Power consumption: The power consumption of the different types of modules is shown in the following table.

Module	Power consumption (W)
CM3563 (SPIMX with 4 x E1)	6.5
CM3564 (CMCC)	1.5
CM3565 (Fan)	5.5
CM3566 (PIM1)	4.2
CM3567 (SIMX4)	6.4
CM3568 (SIMX16)	8.6
CM3571 (EMAP)	6.4
CM3572 (ETEX10S)	53.0
CM3574 (SPIMX with 21x E1)	9.0

Table 3.9

3.10 Connectors: The table specifies the connectors on the front of the modules.

Note: Shielded cables are required on all interfaces except DC and AC power.

For craft terminal interface shielded cable is only necessary if permanently connected.

Function	Equipment Connector Type	Module
STM-16 optical interface	LC (with SFP transceiver)	SIMX16
STM-1 or STM-4 optical interface	LC (with SFP transceiver)	SIMX4, SIMX16, SPIMX
STM-1 electrical interface	1.0/2.3 coaxial (with SFP transceiver)	SIMX4, SIMX16, SPIMX
E1, 2 Mbit/s interface, 120 ohm	RJ-45	SPIMX(4x E1)
	MDR	PIM1, SPIMX(21xE1)
E1, 2 Mbit/s interface, 75 ohm	Coaxial 1.0/2.3 (IEC 169-29 and CECC 22 230) (female) via external balun	SPIMX(4x E1)
	Coaxial BNC via external balun	PIM1, SPIMX(21xE1)
UCH, Interface for user channels and engineering ordering wire (DTMF- EOW).	RJ-45	SIMX4, SIMX16,SPIMX(4xE1)
	MDR	SPIMX(21xE1)
10/100 Mbit/s Ethernet interface	RJ-45	EMAP, ETEX10S
100 Mbit/s Ethernet interface	LC (with SFP transceiver)	EMAP, ETEX10S
1000 Mbit/s Ethernet interface	LC or RJ-45 (with SFP transceiver)	ETEX10S
MGT, Management Ethernet interface	RJ-45	CMCC, ETEX10S
CT, Craft terminal interface	RJ-45	CMCC, ETEX10S
2 MHz synchronization input/output and alarm interface	9 pole DIN 41652 (male)	FAN
DC power input	3 pole Molex mini-fit (male)	PS-DC

Table 3.10

REVIEW QUESTIONS

OBJECTIVE:

1. Fibcom 6325 Node is containing _____ number of slots for its modules.
   a) 18 b) 15 c) 9 d) 8

2. In Fibcom 6325 Node the number of slots made available for traffic modules is _____
   a) Four b) Five c) Three d) Nine

3. PIM1 Module of Fibcom 6325 Node contains _____ number of STM1/4 Optical ports.
   a) Two b) Four c) Two d) Nil

4. In Fibcom 6325 node the optical connectors used are of the type _____
   a) FC b) SC c) LC d) ALL the three

5. In Fibcom 6325 node CMCC module is responsible for _____
   a) Management of the system b) Interfacing the STM ports
   c) Transporting the Fast Ethernet data of the user

6. SIMX-4 Module of Fibcom 6325 node provides _____ number of optical ports.
   a) Four STM1/4 b) Four STM-1only c) Four STM-4 only d) Four STM-16

7. PIM1module can be installed in slot No. _____ of Fibcom 6325 node.
   a) 6 b) 9 c) 8 d) 2

8. CMCC module can be installed in slot No. _____ of Fibcom 6325 node.
   a) 7 b) 9 c) 8 d) 2

9. When the power/Alarm LED on CMCC module of Fibcom 6325 node is red and slow flashing, it indicates that _____
   a) Module self-test failed b) Module synchronizing
   c) Initializing application software d) None

10. When the Active/ standby LED on CMCC module of Fibcom 6325 node is green and slow flashing, it indicates that _____
    a) Module is active b) Module is in standby mode
    c) Module not powered d) Module not ready for standby

11. The power consumption of CMCC module of 6325 is _____ Watt.
    a) 6.5 b) 5.5 c) 1.5 d) 53.0

12. The power consumption of ETEX10S module of 6325 is _____ Watt.
    a) 6.5 b) 53.0 c) 9.0 d) 11.0

13. In SPIMX module of Fibcom 6325 a combination of STM-1 and STM-4 capacity can be used. (T/F)

14. Any module of Fibcom 6325 can be removed only after the safe removal LED glows. (T/F)

SUJECTIVE:

1. Explain the following modules of Fibcom 6325.

    a) SIMX-16
    b) SIMX-4
    c) SPIMX
    d) CMCC
    e) EMAP
    f) ETEX10S

2. Draw the block diagram of 6325 node.

3. Explain the functions of the following LED on various modules.

    a) Active/ Standby
    b) Safe removal
    c) Act/Link LED on CMCC module

4. Explain the Power supply arrangement in Fibcom 6325 Node.

Part – II

Teja's STM-1 Equipment TJ100MC-1

CHAPTER 1

INTRODUCTION TO TJ100MC-1 STM EQUIPMENT

1.1 TJ100 MC-1 Equipment and modules

TJ100MC-1 is STM-1 equipment from M/s Tejas' Networks suite of products in the synchronous fiber optic transmission. This equipment has the following modules:

- PSU (Power Supply Unit)
- Lite Tributary Card (LTC)
- 1 E3/DS3 Tributary Card (TE31)
- E1 Tributary Cards (TET16, TET21, TET28)
- STM-1 Aggregate/Tributary Cards (A011)
- STM-1e/E4/EC 3C Tributary Card (A1E4)
- Ethernet Tributary Card (TP01)
- Ethernet Tributary Card (TP01FT)

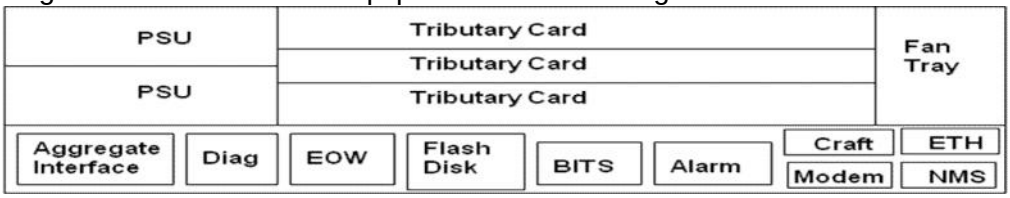
Rest of chapters in part-I provide detailed technical description of the modules:

- Chapter 2: Power Supply Unit (PSU)
- Chapter 3: Lite Tributary Card (LTC)
- Chapter 4: 1 E3/DS3 Tributary Card (TE31)
- Chapter 5: E1 Tributary Cards (TET16, TET21, TET28)
- Chapter 6: STM-1 Aggregate/Tributary Cards (A011)
- Chapter 7: STM-1e/E4/EC 3C Tributary Card (A1E4)
- Chapter 8: Ethernet Tributary Card (TP01)
- Chapter 9: Ethernet Tributary Card (TP01FT)

View of TJ100MC-1 is presented in fig.1.1

Fig.1.2 Modular arrangement in TJ100MC-1 Equipment

Modular arrangement in TJ100MC-1 Equipment is shown in fig.1.2



1.2 Power Supply Specifications

The power dissipation of fully loaded configuration of TJ100MC-1 system is around 120 watts. TJ100MC-1 has redundant power supplies in its 2 slots. The following table lists the power specifications required for safe and proper operation :

Parameter	Specification
Input Tolerance	-40V to –60V
Power Consumption	120W Max.
Power Requirements	Suggested Source Fusing
Fuse Rating	6A slow, Blow
Power Cable Type	$1.5mm^2$
Power Connector Type	3-pin Power D-connector
Chassis Ground Connector Type	Ring Terminal.

Table 1-1 Power Supply Specifications for TJ100MC-1

1.3 Physical Specifications

Physical specifications are given in table 1.2

Specification	Description
Chassis Height	132.5
Chassis Depth	231.0mm
Chassis Width (including mounting flanges)	482 mm
Chassis Width (excluding mounting flanges)	438.0mm
Weight (Minimum Configuration)	8 Kg
Weight (Minimum Configuration)	10 kg

Table 1-2 Physical Specifications

The EMI specifications are as follows:

EMI Specifications	ETS1 EN 300386 V1.32, EN55022, EN55024
Safety	IEC/EN 60950

CHAPTER 2

POWER SUPPLY UNIT (PSU)

2.1 Introduction

The power supply units (PSU) are part of the base TJ100MC-1. The PSU forms one part of a redundant, load-sharing (not true current sharing) supply and provides a stable D.C. power to other cards in the system.

2.2 Operating Parameters

- Input voltage: -40V to –60V d.c, with either the positive or the negative input earthed.
- +12 V d.c, 6.25A maximum
- Total output power: 75W

A 6.3A slow-blow glass fuse is used on the positive line of the input Power.

2.3 Construction

The front view of the PSU is shown in fig.2.1 below.

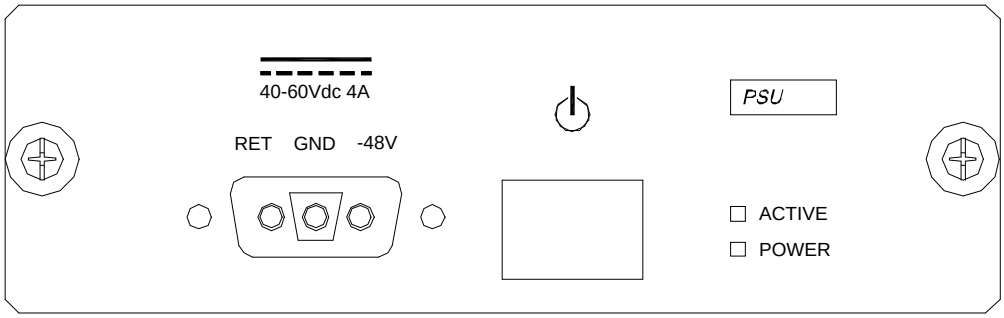


Figure 2.1 Front view of PSU Module

The unit fits in Slot1 and Slot2 of the TJ100MC-1. The unit is fitted with a front panel that has a power connector, an ON/OFF switch and two LED indications. The ‘power’ LED turns green when the internal power converter is on and turns off if the converter is off. The ‘Active’ LED turns green when the outputs of the supply are working and within range. It turns red when an output voltage abnormality is detected.

The connection with the TJ100MC-1 backplane is made with a single 16-pin power connector.

2.4 Functional Description

Power connection to the PSU is via a 3-pin power D-connector located on the front of the unit. For redundancy requirements, two separate units should be installed in the sub-rack and connected to each of the station power units. The power inputs should be fused or automatic circuit breakers should be installed.

The PSU is a single output isolated DC-DC convertor. The power input is applied via fuses, input protection and filtering circuitry to the DC-DC convertor. The convertor provides 12V D.C output. The output circuits have blocking diodes for protection when two PSUs are connected in parallel via the backplane.

The serial EEPROM is used to store the part number, serial number and the manufacturing/testing data.

2.5 **Detailed Specifications:** Detailed specifications are given in Table 2.1

Specification	Range
Input Voltage Range	Normal Operation: -40V to –60V DC Protected Range : -75V to –80V DC
Reverse Polarity Protection	Up to 75V
Input Current	Normal: 3A rms max
Operating Ambient Temp.	0ºC to 50ºC
Input Voltage Monitoring	Full Normal operating range
Output Voltage	12V +/0.5V/-1.2V
Output Current	6.25 A max
Line Regulation	+/-5%
Ripple	650mVp-p
Spike	1000m V peak
Load Regulation	+/-7.5%+15C
Efficiency	65% (50% load to 100% load)
Fuse	6A Slow Blow Glass fuse. Field replaceable.
Input Under Voltage Protection	Shutdown: -35V+/-4V, hysterisis: 4V
Input Over Voltage Protection	Shutdown: -65V+/-4V, hysterisis: 4V
EMI/EMC Compliance	EN55022 Class A
Hot Swap Capability	Present
Redundancy	Present
ON/OFF Control	Rocker switch with protective flaps on the Front Panel.
Status Indication	Power LED: Indicates presence of voltage on the output of the DC-DC convertor RED: Derived voltage not good/short circuit/over-load GREEN: Working Properly.
Power Interface	-48V: 3-pin Power D-connector 12V: 16-pin Power Connector
Output Over-Current	15A +/6-A
Over-Temperature	110C +15C/-5C

Table 2.1 Detailed specifications of PSU Module

2.6 Load Sharing, Alarms and protection: True current sharing is not available in the PSUs. By virtue of the blocking diodes, the load will be shared in an uncontrolled manner across the two power supply units. The PSU is protected against output short circuit, over voltage and under voltage. Input over voltage and under voltage protection is provided. Output over voltage protection is latched and the unit will not restart until power to the unit is removed and reconnected.

Input voltage monitoring is provided. An isolated V-F convertor modulates an output frequency as a function of the input voltage. This frequency is measured on the system card and is available as a voltage indication via the user interface. User selectable thresholds are also available. Refer to ‘User Interface Guide’, 000-TTDUG001, 001-TTDUG001 for more details.

2.7 **Precautions:** Following precautions are to be taken while handling PSU module:

1. The PSU normally operates with 48V d.c. Take all precautions when working on live equipment.
2. Static charge can damage the equipment. While unpacking and handling cards, or making system interconnections, wear a grounding wrist strap to discharge the static buildup
3. When removing a PSU, the unit should not be replaced into the system for at least 5 seconds to ensure that unit capacitors have discharged**.**
4. Do not touch the heat sinks on the unit just after removal.

Objective:

1. The power dissipation of fully loaded configuration of TJ100MC-1 system is around 120 watts. (T/F)
2. The TJ100MC-1 has redundant power supplies. (T/F)
3. The input power supply tolerance for TJ100MC-1 system is – 40 V to – 60 V DC (T/F)
4. The power LED on the PS module of TJ100MC-1 turns off when the internal power converter is off. (T/F)
5. The active LED on the PS module of TJ100MC-1 turns green when the outputs of the supply are working and within range. (T/F)
6. An EEPROM is used in PS module of TJ100MC-1 system to store the part number, serial number and the manufacturing /testing data. (T/F)
7. The output circuits of the PS module in TJ100MC-1 system have blocking diodes for protection when two PS modules are connected in parallel via the back plane. (T/F)
8. True current sharing is not possible in the PS modules of TJ100MC-1 system. (T/F)

Subjective:

1. Explain the power supply arrangement of TJ100MC-1 system.
2. What precautions are to be taken while handling PS module of TJ100MC-1 system?
3. What are the protections available in the power supply module of TJ100MC-1 system?

CHAPTER-3

LITE TRIBUTARY CARD (LTC)

3.1 Introduction

The system card (LTC) is the heart of the TJ100MC-1. It is the card that plugs into Slot3 and provides the aggregate interfaces, clocks, processing and monitoring capability to the system.

The LTC provides the following interfaces:

- Processor bus for control path communication to the other cards in the subrack (to the backplane)
- Two Telecom buses for the data path interface to the tributary cards
- System clocks and timing signal (to the backplane)
- Two STM-1 optical interfaces, SC-PC type
- Four STM-1 electrical interfaces, BNC type
- BITS clock and data inputs and outputs on 9 pin D connector
- External alarm inputs and alarm outputs on 15 pin D connector
- 10/100BaseT Ethernet interface (RJ45) for communication with the network management system via a local area network (LAN)
- RS232C port for local craft terminal
- Diagnostic port (Diag)
- Modem port
- Engineering Order-wire (EOW) interface for 2-wire communication

3.2 Power Supply Requirements

Supply Voltages: 12V +/-20%, supplied via two 12-pin power connector.

Power Consumption: 16W typical

3.3 Module Description

The front view of the LTC is shown in the figure 3.1

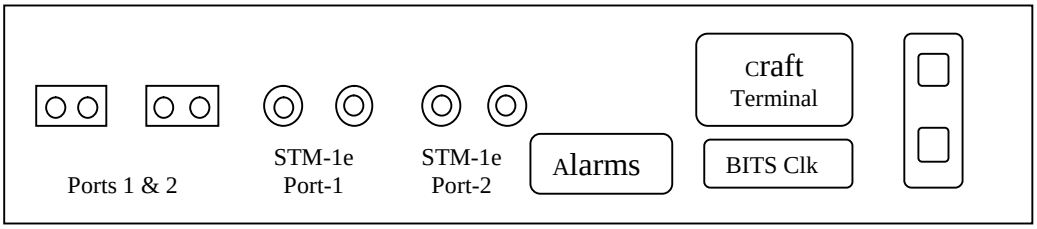


Fig.3.1 Front Panel of LTC Card

The unit fits in Slot3 of the TJ100MC-1. The LTC has front panel connections for the user interfaces along with visual indications. The connectivity to the sub-rack backplane is via three Euro connectors and two power connectors.

3.3.1 Visual Indications

The LTC has visual indications for alarms and status of the card. The following visual indications are available

Status LED

Card (and system) State		STATUS LED
Booting	Service Disruptive	Red
	Service Non-Disruptive	Red
Control /Data Path Initialized		Green

Power LED

Card State	Power LED
Onboard 3.3V Power NOT OK	OFF
Onboard 3.3V Power OK	Green

Alarm LEDs

Card State	Alarm LEDs			
	Critical Alarm RED	Major Alarm AMBER	Minor Alarm YELLOW	Deferred BLUE
Power up	ON	ON	ON	ON
Critical Alarm Present	ON	NA	NA	NA
Critical Alarm Absent	OFF	NA	NA	NA
Major Alarm Present	NA	ON	NA	NA
Major Alarm Absent	NA	OFF	NA	NA
Minor Alarm Present	NA	NA	ON	NA
Minor Alarm Absent	NA	NA	OFF	NA
Deferred Alarm Present	NA	NA	NA	ON
Deferred Alarm Absent	NA	NA	NA	OFF

3.4. Interfaces

3.4.1STM –1 Optical Interfaces

The LTC has two SC-PC STM-1 optical interfaces on the front panel. The STM-1 transceivers are shipped with S1.1, L1.1 or L1.2 specifications. The type of the transceiver installed with the LTC will be indicated on the front panel and is also available via the web user interface.

Optical Interface Specification

Specifications	S1.1	L1.1	L1.2
Output Power			
Minimum	-15 dBm	-5dBm	-5dBm
Typical			
Maximum	-8 dBm	0 dBm	0 dBm
Receiver Sensitivity	-28 dBm	-34 dBm	-34 dBm
Receiver Overload	-8 dBm	-10dBm	-10dBm
Optical Path Penalty	1 dB	1 dB	1 dB
Section Loss	0 to 12 dB	10 to 28 dB	10 to 28 dB
Wavelength (nominal)	1310 nm	1310 nm	1550 nm
Spectral Range	1261-1360 nm	1263-1360 nm	1480-1580 nm
Connector Type	SC-PC	SC-PC	SC-PC
Fiber Type	Single mode	Single mode	Single mode

3.4.2 STM-1E interface

This card is designed to provide STM-1e interface. The STM-1e interface is provided through BNC connectors. For details regarding the connectors refer to the Installation Procedures, '103-TTDIP-001'. It provides 2 STM-1e interfaces through BNC connectors (75 Ohms).

Note : *It can be configured either for the two STM-1o optical interface or for two STM-1e electrical interface*.

3.4.3 Network Management Interface

The network management interface (NMS Interface) provides a CSMA/CD based LAN transceiver of an Ethernet link. This is available as an RJ45 connector on the LTC. The Ethernet address is available in the non-volatile memory on the LTC.

The NMS interface physical layer is completely implemented in hardware. The physical layer device provides clock recovery, bit timing, equalization and a 'jabber' circuit. The media access control (MAC) function is implemented in software available as part of the microcontroller.

'Jabber' circuitry ensures that the transmitter does not hold up the interface for more than a full frame of data.

Two LEDs are used on this connector to indicate link status, as given below :

Card State	NMS LED	
	Green	Amber
Link Speed 10 Mbps	OFF	NA
Link Speed 100Mbps	ON	NA
Receiver Activity	Na	Blink on packet received

3.4.4 Craft Interface

This is a RS232C connector. The default baud rate setting is 9600 bauds, 1 stop bit, no parity and no hardware/software flow control.

3.4.5 BITS interface

The LTC provides BITS data and clock interface on a 9 pin D connector.

The BITS clock input/output is at 2.048MHz and can be nominated as a reference for node synchronization. Loss-of-Signal (LOS) is detected on the clock input and this alarm is used as a trigger to change over to the next synchronization reference. The LOS alarm is reported on the user interface.

The BITS data input/output is at 2.048Mbps and uses G704 for framing. Both PCM30 and PCM31 (with/without CRC) can be used on the input. LOS is detected on this input. This alarm is reported on the user interface.

3.4.6 External Alarm Interface

Two external alarm inputs and five alarm outputs ports are available from the system card. These are available on a DB-15 connector.

The alarm inputs connect to the LTC to external triggers for events (such as open door or a shelf high temperature). When a trigger trips, the network element raises an environmental alarm. The external inputs can be enabled or disabled from the Network Element User Interface.

The alarm outputs can be used to trigger the operation of external equipment, such as audible alarm. The alarm outputs are caused by alarms detected by the network element. These alarms are classified as minor, major, critical and deferred. For each of these alarm types, an output alarm is triggered. Each output is a two-set signal supplied by a form-C relay. a common contact (COM) and a normally open (NO) contact. Outputs operate in latched mode. The relay is released only when the Network Element clears the alarm. Orderwire phone ring is provided as an alarm output from the Network Element. For classification of alarms, refer to 'User Interface Guide', 000-TTDUG001, 001-TTDU001.

There are 4 alarm indications coming from the processor to the management interface block. They are:

- Critical Alarm.
- Major Alarm.
- Minor Alarm.
- Deferred Alarm.

3.4.7 Order-wire Interface

This is an operations communication channel that directly supports a 2-wire analog telephone. It has the full battery, over voltage, ringing, supervision, code, hybrid and test (BORSCHT) functions.

Voice and signaling traffic is carried over E1 or E2 bytes of the SDH overhead.

2-wire analog interface is handled by hardware using a ringing SLIC and code. The line impedance can be set according to local conventions from the user interface.

Two LEDs are used to indicate status on the Order-wire.

Card State	**OW LED**	
	Green	Amber
Telephone On hook	ON	OFF
Telephone Ringing	Blink	OFF
Telephone Off hook	OFF	ON

3.4.8 Network Element Reset

A push –to-reset button is provided on the front panel of the LTC. The reset button is recessed to prevent accidental operation. Use a pointed object (such as the tip of a ball point pen or a pencil) to operate the switch.

This switch causes a processor reset and will force a reload of the operating system and the application software. This reset is service non-affecting. This reset is to be used in the case of a NE 'hang'. A 'hang' will get resolved within 1024 Seconds when the hardware timer expires and a service non-disruptive reset is triggered.

'Hang' is defined as a condition where the node does not respond to user commands, but provisioned traffic continues to work.

3.5 Functional Description

3.5.1 Microprocessor sub-system

The Processor Sub System performs the configuration, control & processing of all the other subsystems on the LTC. The PSS consists of a 32-bit micro controller and on board external memory to implement the required functions. The software residing in this block controls the overall management of the system.

A 1024 second timer is implemented on the LTC to check for software errors. If this timer expires, the operating system (OS) and application software restarted. This restart is service non-affecting, except for loss of management connectivity during the restart time. The time required for restarting the OS and the application software is around 3 minutes.

In the software, hardware errors are checked in every 10 seconds. The minor, major or critical or deferred LED indication will glow depending on the type and severity of error detected.

A real time clock (RTC) is available on board for time stamping of alarms and events. The RTC maintains time in the event of power failure (or powering off). The backup battery for this is a "super cap" of value 1F. This capacitor will maintain RTC time and calendar functions for approximately 4 weeks after the LTC is powered off.

3.5.2 Cross-Connect Function

The LTC has a 4x4 STM-1 level cross-connect capable of switching VC-12s from any input port to any output port. It is implemented as a column level Time Slot Interchanger (TSI) and a space switch to achieve full 1080 x 1080 column cross connections.

Each telecom bus is organized as two hundred and seventy columns and nine rows of bytes, transmitted row-wise in serial fashion. Since all the telecom busses received by the cross-connect are multi-frame aligned and no AU pointer movements are allowed, each column in any row is equivalent to the corresponding column in any other row. Hence, a 270 column cross-connect is sufficient for a whole telecom bus.

The cross-connect is memory based and uses two banks of data memory and one bank connection memory. Incoming data is written into one bank of the data memory and read out (in the order specified in the connection memory) from the other data memory. The latency through the cross-connect is therefore 270 clocks of 19.44MHz pr 13.88 microseconds for any telecom bus.

3.5.3 Synchronization Function

The LTC has a Stratum-3 complaint clock generation unit. This unit can synchronize to a variety of timing sources, selected via the user interface. Synchronization Status Messaging (SSM) is implemented in the LTC software to handle loss of synchronization signal and any alarms reported on it. SSM is used to ensure that a network runs synchronously and does not create timing loops that are catastrophic to stable operation of networks. The synchronization is commonly called the timing module.

The timing module operates off a stable Stratum-3 complaint 20MHz oscillator. A digital and an analog PLL are used to synchronize the node clock to the selected reference. The selected reference is divided down to 8 KHz and provided to the digital PLL.

The digital PLL implements a controlled rate of change phase to lock to reference. It also has Time Interval Error (TIE) correction circuitry to ensure that phase errors are minimized. The digital PLL is composed of two PLLs - the acquisition PLL and the core PLL. The acquisition PLL does coarse tracking of the incoming reference and provides an Out-Of-Range (OOR) alarm. The OOR alarm is raised when the incoming reference is more than +/-12ppm away from the local oscillator. The OOR alarm is used to report an alarm on the user interface and the PLL will be moved to the 'holdover' state. The core PLL does fine acquisition of the reference and ensures that phase error accumulation is maintained within the ITU-T G.812 standards.

The digital PLL by itself is not sufficient to generate the required quality of clocks for the system. It generates too much jitter on its output. So it is followed by an analog PLL that acts as a jitter attenuator. The analog PLL uses a parallel resonant crystal at 19.44MHz for the jitter reduction operation.

PLL states

The synchronization of PLL can be done in following states:

- Free Run: in this state, the NE is not synchronized to an external clock and its output clock will meet Stratum-3 requirements for free-run accuracy i.e. +/-4.6 ppm. The NE outputs will also meet all jitter requirements on its outputs.

- Locked: in this state, the node is synchronized to a selected external source and is tracking the frequency changes on the reference. The NE outputs will meet Stratum-3 requirements on phase error accumulation, phase noise, jitter and timing deviation.

- Holdover: in this state, the NE has lost lock to the selected reference and is maintaining its last known input frequency. The synchronization PLL could have lost lock because of an alarm on the selected reference (LOS, AIS or DoNot Use Synchronization Status Message) or because of an unacceptable phase or frequency jump on the reference. Unacceptable here means that the input clock does not confirm to G.813 standards or SDH/SONET Minimum Clock (SMC) requirements.

Objective:

1. Lite Tributary Card (LTC) is the heart of the TJ100MC-1 system. (T/F)
2. LTC card of TJ100MC-1 system plugs into the slot No. 3 (T/F)
3. LTC card of the TJ100MC-1 system provides the aggregate interfaces, clocks, processing and monitoring capability to the system. (T/F)
4. LTC card of TJ100MC-1 provides the interface RS232C port for local craft terminal. (T/F)
5. Two STM-1 optical interfaces in LTC card of TJ100MC-1 system have SC-PC type connectors. (T/F)
6. The power consumption of LTC card of TJ100MC-1 system is 16 W typical (T/F)
7. Minimum typical output power of LTC card of TJ100MC-1 for S1.1 type is –15 dBm. (T/F)
8. Minimum typical output power of LTC card of TJ100MC-1 for L1.1 type is –5 dBm. (T/F)
9. Maximum typical output power of LTC card of TJ100MC-1 for L1.2 type is 0 dBm. (T/F)
10. Receiver sensitivity of LTC card of TJ100MC-1 system is –28 dBm for S1.1 type application. (T/F)
11. LTC card of TJ100MC-1 is made available either for two STM-1o optical interfaces or for two STM-1e electrical interfaces. (T/F)
12. The NMS interface is available as an RJ45 connector on the LTC card of the TJ100MC-1 system. (T/F)
13. The Ethernet address of the network element is available in the non-volatile memory on the LTC card of the TJ100MC-1 system. (T/F)
14. The default baud rate setting for the craft interface on the LTC card of TJ100MC-1 is 9600 bauds. (T/F)
15. When the telephone of the order-wire circuit is on the hook, Green OW LED is ON in the LTC card of the TJ100MC-1 system. (T/F)
16. Green OW LED blinks when ringing takes place on the order-wire circuit of LTC card of TJ100MC-1 system. (T/F)

Subjective:

1. List the various interfaces provided in the LTC card of TJ100MC-1 system.
2. Draw the front panel view of the LTC card of TJ100MC-1 system.
3. Give the significance of the visual indication on the LTC card of TJ100MC-1 system.
4. Briefly explain the Craft interface and BITS interface on LTC card of TJ100MC-1 system.
5. Explain the function of push-to-reset button provided on the front panel of the LTC card of TJ100MC-1 system.

CHAPTER 4

E3/DS3 TRIBUTARY CARD (TE31)

4.1 Introduction

The 1 port E3/DS3 card is a generic tributary card that can be used across all the Tejas STM-1/4 products. TE31 provides line interface to an E3/DS3 channel in both, add and drop directions. The port is software configurable to support E3/DS3 rates correspondingly. The card maps E3/DS3 tributaries into a AU-3/AU-4. This card can be plugged into any of the slots from 10 to 14 of the TJ100MC-1 chassis.

Power Supply Requirements

Supply Voltages: 12V ± 10%, supplied via a Type-N connector.

Power Consumption: The maximum power consumed by TE31 is 6W.

4.2 Sub-rack Interface: The TE31 uses 2 Euro connectors to connect to the backplane of the subrack. In addition, there is a power connector for +12V d.c.input to the card. The subrack interface has the following:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz
- Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card-present, Alarm, Slot-identifier)

4.3 Traffic Interfaces

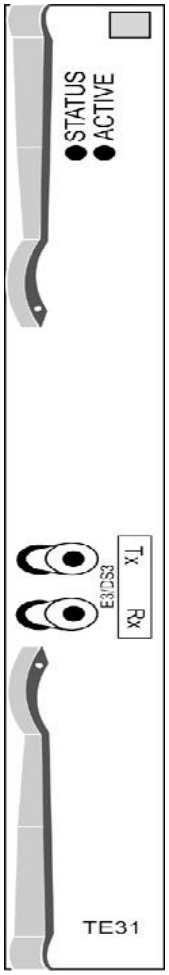
The TE31 card has two BNC connectors for the 75 ohm E3/DS3 interface. For details regarding the connectors refer to the Installation Procedure. These interfaces confirm to ITU-T G.703 standard.

4.5 Functional Description

TE31 maps E3/DS3s into VC-3/AU-4. It also does the reverse functionality of extracting the E3/DS3 from the VC-3/AU-4. The TE31 is user configurable for either E3 or DS3 application. E3/DS3 High Density Bipolar 3 (HDB3) or B3Zs coded signals enter the TE31 from the BNC connectors. They are magnetically coupled into the Line Interface Unit (LIU), which does clock recovery, HDB3/B3Zs decoding and alarm detection. Alarms detected by the LIU are Loss of Signal (LOS) and Alarm Indication Signal (AIS). These alarms optionally cause an AIS signal to be generated towards the SDH side and the PDH side. The LIU sends out digital NRZ E3/DS3 signals, along with the extracted clock, to the Mapper ASIC. The Mapper ASIC receives system frame, payload and multi-frame indication from the timing block in the TE31. The incoming E3/DS3 signal is mapped into the VC-3. A synchronous mapping of the E3/DS3 is performed and bit stuffing is used to compensate for the plesiochronous rate differences in the system VC-3 rate and the incoming E3/DS3 rate. This TUG-3 is mapped on to a specific time slot on the ‘Add’ telecom bus. The time slot chosen is according to the telecom bus slot selection algorithm and depends on the existing cross-connects in the system and the available slots to the mapper ASIC.

4.4 Front panel of E3/DS3 card

Front panel of E3/DS3 card, description of indications and interfaces is given in table 4.1

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td> 
</td><td>Visual Indicators:

The visual indicators on the TE31 card includes two LEDs, the ACTIVE and the STATUS LEDs. The possible LED status and their significance is given below:
<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td rowspan="3">ACTIVE</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td>Green</td><td>Initialization complete/in use</td></tr>
<tr><td>Red</td><td>Card Inactive/Admin Down</td></tr>
<tr><td rowspan="3">STATUS</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td>Green</td><td>Initialization Complete</td></tr>
<tr><td>Red</td><td>Hardware error/Admin down</td></tr>
</table>
E3/DS3 Interface:

This card provides line interface to an E3/DS3 channel in both, add and drop directions along with visual indicators. The E3/DS3 interface is provided through BNC connectors. For details regarding the connectors refer to the Installation Procedure.

The TE31 provides the following interfaces::
• 1 E3/DS3 interface through 75 ohm BNC connectors
• Processor bus for control path communication to the other cards in the subrack (to/from the backplane)
• System clocks and timing signals (to/from the backplane)</td></tr>
</table>

Table 4.1 Front panel of E3/DS3 card, description of alarms and indications

Objective:

1. TE31 card is a generic tributary card that can be used across all the Tejas STM-1/4 products. (T/F)
2. TE31 is a ---------- port card which provides line interface to an E3/DS3 rates in both add and drop directions of all Tejas STM-1/4 systems.
   a) One port b) Two port c) Three port d) Four port
3. TE31 card can be plugged into any of the slots from ---------- of the TJ100MC-1 chassis.
   a) 1 to 4 b) 4 to 8 c) 10 to 14 d) 1 to 14
4. The power consumption of TE31 card of TJ100MC-1 system is ----------.
   a) 6 W b) 16 W c) 8 W d) 26 W
5. The status of the Active LED of TE31 card of TJ100MC-1 system will be ---------- if the card is in use.
   a) Amber b) Blue c) White d) Green
6. The status of the Active LED of TE31 card of TJ100MC-1 system will be red if the card is inactive/Admin down.
   a) Amber b) Red c) Green d) No indication

Subjective:

1. Explain the function of TE31 tributary card of TJ100MC-1 system.
2. Give the significance of the visual indicators on the TE31 card of TJ100MC-1 system.

CHAPTER 5

E1 TRIBUTARY CARD (TET16, TET21, TET28)

5.1 Introduction

The E1 cards, TET16, TET21, and TET28 are generic tributary cards that can be used across all the Teja's STM-1/4 products. E1 tributary interface cards provide line interfaces to 16 E1, 21 E1, and 28 E1 channels respectively in both, add and drop directions. These cards map and de-map the E1 channels into SDH/SONET frame (at programmed slots) for the tributary card to make the cross connects. The interface to the trunk card is through 19.44 MHz Telecom bus for the SDH/SONET data path. The software control is with the trunk card through a generic processor bus. This card can be plugged into any of the slots from 10 to 14 of the TJ100MC-1 chassis.

Power Supply Requirements

Supply Voltages: +12V ± 10%, supplied via a Type-N connector.

Power Consumption: The power consumed by an E1 Tributary card is 8W.

5.2 Sub-rack Interface

The E1 Tributary cards use 2 Euro connectors to connect to the backplane of the sub-rack. In addition, there is a power connector for +12V d.c. input to the card. The sub-rack interface has the following:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card present, Alarm, Slot-identifier)

5.3 Functional Description

The E1 signals terminate on the card through two 62 way D-type connectors.

The E1 mapper supports mapping/demapping of 21/28 E1 tributaries into 19.44 MHz telecom bus at programmed slots. The card supports dual telecom bus interface. A hardware-multiplexing scheme is implemented to interface E1 mapper with the dual telecom bus.

The CPLD performs address decoding of the devices on the card along with some support functionality for inter card communication.

The I^2C serial EPROM contains card ID information like the serial number, part number and number of E1 ports.

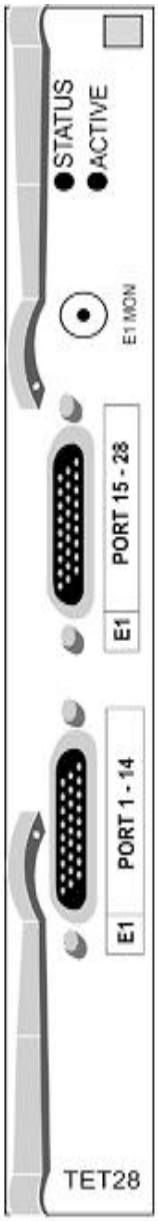
Note 1: Number of E1's are factory configurable.

Note 2: Number of ports in TET 16 and TET 21 are 16 and 21 respectively.
Except this change, Hardware description for TET-16 and TET-21.
Remains same as given above.

Note 3: E1 traffic can be managed using digital distribution frame (DDF).

5.4 Front panel indications and interfaces

The front panel of the TET28 card and description of indications and connectors (interfaces) are given in table 5.1

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td rowspan="2"> 
</td><td>
Visual Indications
The visual indicators on the TET28 card includes two LEDs, the ACTIVE and the STATUS LEDs. The possible LED status and their significance is given below
<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td>ACTIVE</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td></td><td>Green</td><td>Initialization complete/In use</td></tr>
<tr><td></td><td>Red</td><td>Card Inactive/Admin Down</td></tr>
<tr><td>STATUS</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td></td><td>Green</td><td>Initialization Complete</td></tr>
<tr><td></td><td>Red</td><td>Hardware error/Admin down</td></tr>
</table>
Interfaces:
This card provides line interface to 28 E1 channels in both, add and drop directions along with visual indicators. The E1 interface is provided through 62 way D-type connectors. For details regarding the connectors refer to the Installation Procedure.

The TET28 provides the following interfaces:
E1 interfaces on 120 ohm 62 way D-type connectors

Processor bus for control path communication to the other cards in the sub-rack (to/from the backplane)

System clocks and timing signals (to/from the backplane)
</td></tr>
<tr><td>E1 Monitor Interface:

Rev-2, E1 tributary cards have an E1 monitoring port that enables monitoring desired E1 port (software configurable) through a 75 Ohm BNC connector.</td></tr>
</table>

Table 5.1 Front panel of TET28 card and description of indications & interfaces

Objective:

1. E1 tributary interface cards of Tejas STM-1/4 system are classified as TET16, TET21 and TET28. (T/F)
2. E1 tributary interface cards can be plugged into any of the slots from 10 to 14 of the TJ100MC-1 chassis. (T/F)
3. The power consumed by an E1 tributary card of TJ100MC-1 system is 8 W. (T/F)
4. TET 28 card of TJ100MC-1 system provides line interface to 28 E1 channels in both add and drop directions along with visual indicators. (T/F)
5. The impedance of the E1 interface on TET 28 of TJ100MC-1 system is 120 Ohms. (T/F)

Subjective:

1. Give the functional description of E1 tributary interface card TET16 of TJ100MC-1 system.
2. Give the significance of the visual indicators on the TET16/21/28 card of TJ100MC-1 system.

CHAPTER 6

STM-1 AGGREGATE/TRIBUTARY CARD (A011)

6.1 Introduction

The STM1-Aggregate/Tributary card is generic tributary card that can be used across all the Teja's STM-1/4 products. The STM-1 Aggregate/Tributary card, A011 is designed to function as 1 port STM-1 tributary card.

Power Supply Requirements

Input Voltage: 12V± 10%, supplied via a Type-N connector.

Power Consumption: The maximum power consumed by an STM-1 tributary card is 12W.

6.2 Sub-rack Interface

The STM-1 aggregate/tributary card uses 2 Euro connectors to connect to the backplane of the sub-rack. The following sub-rack interfaces are supported:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz, Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card-present, Alarm, Slot-identifier)

6.3 Functional Description

The SDH subsystem comprises of the optical transceiver for the STM-1 interfaces, the STM-1 Overhead Processors, Pointer Processing Devices and Protection Switching devices.

The STM1 aggregate/Tributary Card has two optical transceivers operating at STM-1 rate for the tributary interface. The STM-1 Transceiver complies the L1.1 and S1.1 requirements of the G.957 standard set for optical interfaces for SDH Systems. The overhead termination device provides a Telecom Bus interface for downstream devices. The pointer processors adapt the payload to the system clock and frame rate. The STM1 Tributary Card gets a 19.44 MHz clock from the backplane.

The programmable logic subsystem comprises of a CPLD and a Multifunction FPGA that performs different functions.

The CPLD on the board performs the following functions. The different functions are register controllable using a processor interface.

- Address Decoding and Chip select generation
- Reset Generation
- Backplane Connector Interfacing
- Miscellaneous Signals Interfacing
- Interrupt Controller

The Multifunction FPGA on this card board performs the following functions.

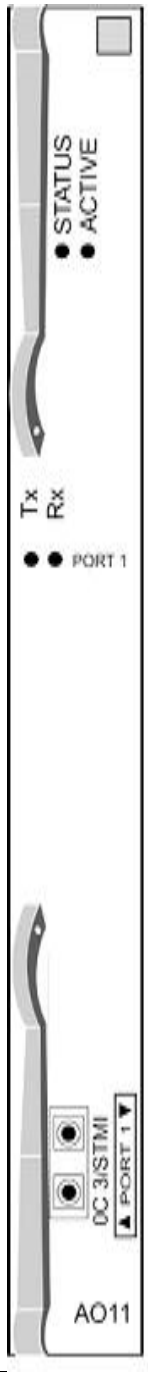
- In-band control (IBC) channel Logic
- Alarms Processing
- Order wire Channel
- Telecom Bus Timing
- HDLC Controller

The A012 can be configured to work as an aggregate card as well as a tributary card. The bus switch does the following functions.

- The Backplane bus selection for the telecom bus from the different ports.
- On reset, it prevents the ADD timing signals to be driven out of the card. This can be enabled when floating timing mode is selected in the A012 FPGA register.

6.4 Front panel indications and interfaces

The front panel indications and interfaces of STM-1 tributary card are shown in table 6.1:

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td> 
</td><td>Visual Indicators:

The visual indicators in the STM-1 cards include the Active and the Status LEDs and an LED each for Tx and Rx for the STM interfaces. The possible LED status and their significance is given below:

<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td rowspan="3">ACTIVE</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td>Green</td><td>Initialization complete/In use</td></tr>
<tr><td>Red</td><td>Card Inactive/Admin Down</td></tr>
<tr><td rowspan="3">STATUS</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td>Green</td><td>Initialization complete</td></tr>
<tr><td>Red</td><td>Hardware Error/Admin down</td></tr>
<tr><td>Tx</td><td>Green</td><td>Laser is ON, and the corresponding port is transmitting.</td></tr>
<tr><td></td><td>Red</td><td>Laser is OFF.</td></tr>
<tr><td>Rx</td><td>Green</td><td>The corresponding port is receiving a signal.</td></tr>
<tr><td></td><td>Red</td><td>The corresponding port is not receiving a signal.</td></tr>
</table>

Interfaces:

This card is designed to provide a 1 port STM-1 tributary card. The STM-1 interface is provided through SC connectors. For details regarding the connectors refer to the Installation Procedure.

• 1 STM-1 interfaces through SC connectors.
• Processor bus for control path communication to the other cards in the subrack (to/from the backplane)
• 2 telecom buses for the data path interface to the tributary card (to/from the backplane)
• System clock and timing signals (to/from the backplane)</td></tr>
</table>

Table 6-1 Front panel of STM-1 Aggregate card & description of indications, interfaces

6.5 Optical Power Specifications

The optical interface specifications are given below in tables 6.2 and 6.3:

Field	Unit	Values					
Digital signal Nominal bit rate	Mbps	155.52					
Optical Interface		S1.1	S1.2		L1.1		L1.2
Operating wavelength	nm	1310	1550		1310		1550
Source type		MLM	MLM	SLM	MLM	SLM	SLM

Table 6.2 Optical Interface characteristics

Spectral Characteristics:	Maximum RMS width() Maximum –20dB width	nm	7.7 -	2.5 -	- 1	3 -	- 1	- 1
Mean Launched Power:	Maximum Minimum	dBm	-8 -15	-8 -15		0 -5		0 -5
Minimum extinction ratio		dBm	8.2	8.2		10		10
Minimum sensitivity		dBm	-28	-28		-34		-34
Minimum overload		dBm	-8	-8		-10		-10

Table 6.3 Spectral characteristics

Objective:

1. The STM-1 aggregate/tributary card A011 of TJ100MC-1 system is designated to function as ---------- port STM-1 tributary card.
   a) Three port b) Two port c) One port d) Four port
2. The maximum power consumed by an STM-1 tributary card A011 of TJ100MC-1 is ----------
   a) 2 W b) 12 W c) 22 W d) 32 W
3. The STM-1 aggregate/tributary card A012 of TJ100MC-1 system is designated to function as 2 ports STM-1 tributary card. (T/F)
4. When the LASER is ON and the corresponding port is transmitting, the green TX indicator of A011 of TJ100MC-1 system will glow. (T/F)
5. When the LASER is off, the red TX indicator of A011 of TJ100MC-1 system will glow. (T/F)

Subjective:

1. Explain the functional description of A011card of TJ100MC-1 system.
2. Give the significance of the various visual indicators available on A011 card of TJ100MC-1 system.

CHAPTER 7

STM-1E/E4 TRIBUTARY CARD (A1E4)

7.1 Introduction

The A1E4 card is designed to support STM-1e/E4 interfaces and can be *used* across all the Teja's STM-1/4 products. This card can be plugged into any of the slots from 10 to 14 of the TJ100MC-1 chassis.

Power Supply Requirements

Input voltage: 12V±10% , supplied via a Type-N connector

Power Consumption: The maximum power consumed by an A1E4 card is 12W.

7.2 Sub-rack interface

The A1E4 card uses 2 Euro connectors to connect to the backplane of the subrack. The following sub-rack interfaces are supported:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi - Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card-present, Alarm, Slot-identifier)

7.3 Functional Description

The A1E4 card is designed to support STM-1e/E4 interfaces. The electrical interface is designed to receive 139.264 Mbps or 155.52 Mbps data to be transmitted to the E4 Mapper and the STM1 Overhead terminator.

The programmable logic subsystem comprises of a CPLD and a Multifunction FPGA that performs different functions. The CPLD on the board performs the following functions.

- Address Decoding and Chip select generation
- Reset Generation
- Backplane Connector Interfacing
- Miscellaneous Signals Interfacing
- Interrupt Controller

The Multifunction FPGA on the A1E4 board performs the following functions.

- In-band control (IBC) channel Logic
- Alarms Processing
- Orderwire Channel
- Telecom Bus Timing
- HDLC Controller

7.4 Front panel of A1E4 card

The front panel of STM-1e/E4 (A1E4) card , description of indications and interfaces is given in table 7.1 :

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td> 
</td><td>Visual Indicators:

The visual indicators in the A1E4 card include the Active and the Status LEDs and an LED each for Tx and Rx for the interface. The possible LED status and their significance is given below:
<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td>ACTIVE</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td></td><td>Green</td><td>Initialization Complete/In use</td></tr>
<tr><td></td><td>Red</td><td>Card Inactive/Admin Down</td></tr>
<tr><td>STATUS</td><td>Amber</td><td>On insertion/power ON</td></tr>
<tr><td></td><td>Green</td><td>Initialization Complete</td></tr>
<tr><td></td><td>Red</td><td>Hardware error/Admin Down</td></tr>
<tr><td>Tx</td><td>Green</td><td>Port transmit is ON, and the corresponding port is transmitting.</td></tr>
<tr><td></td><td>Red</td><td>Port transmit is Off</td></tr>
<tr><td>Rx</td><td>Green</td><td>The corresponding port is receiving a signal.</td></tr>
<tr><td></td><td>Red</td><td>The corresponding port is not receiving a signal.</td></tr>
</table>
Interfaces:

This card is designed to provide STM-1/E4 interface. The STM-1/E4 interface is provided through BNC connectors. For details regarding the connectors refer to the Installation Procedure.

• 1 STM-1e/E4 interface through 75 BNC connectors.
• Processor bus for control path communication to the other cards in the subrack (to/from the backplane)
• 2 telecom buses for the data path interface to the tributary cards (to/from the backplane)
• System clocks and timing signals (to/from the backplane)</td></tr>
</table>

Table 7.1 Front panel of A1E4 card and description of indications & interfaces

Objective:

1. The A1E4 card is designed to support STM-1e/E4 interfaces and can be used across all the Tejas STM-1/4 systems. (T/F)
2. The A1E4 card can be plugged into any of the slots from 10 to 14 of the TJ100MC-1 chassis. (T/F)
3. The maximum power consumed by an A1E4 card of TJ100MC-1 system is 12 W. (T/F)

Subjective:

1. Explain the functional description of A1E4 card of TJ100MC-1 system.
2. Give the significance of the various visual indicators available on A1E4 card of TJ100MC-1 system.

CHAPTER 8

ETHERNET TRIBUTARY CARD (TP01)

8.1 Introduction

The Ethernet tributary card, TP01 is a generic tributary card that can be used across all the Tejas Networks' STM-1/4/16 products.TP01 tributary interface cards provide line interfaces to eight 10/100Mbps Tx port. This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC 12/VC 3/VC 4 or VT 1.5/STS1/STS-3c) of the SDH/SONET frame. The VC in which the data is mapped/de-mapped is programmable through software.

Power Supply Requirements

Input Supply Voltages: Input supply voltage is –12V ± 10%

Power Consumption: The maximum power consumed by a TP01 card is 8W.

8.2 Sub-rack interface

The Ethernet Tributary card uses 2 Euro connectors to connect to the backplane of the chassis. The sub-rack interface has the following:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card-present, Alarm, Slot-identifier)

8.3 Functional Description

From the Ethernet line side the Ethernet data is taken into the TP01 card using RJ-45 connector. This is interfaced to an octal PHY that in turn supplies the raw Ethernet data to the Ethernet mapper via SMII interface. PHY will support both auto – negotiations and auto MDI/MDIX cross over on systems.

The mapper supports connection up to eight 10/100 Mbps Ethernet ports. In the mapper Ethernet frames are encapsulated using GFP, LAPS or LAPF protocol. The encapsulated Ethernet frames are then mapped into either virtually concatenated low or high order payloads, such as VT1.5 SPE/VC-12/STS-1 SPE/VC-3, or into contiguously concatenated payloads such as STS-3c SPE/VC-4.

In the other direction, the SDH/SONET data from the backplane interface will go to the mapper and the MAC (MAC is the part of mapper). This will decode the Ethernet frames. This Ethernet frame then via PHY will reach RJ-45 connector.

8.4 Front panel of TP01 Card

The front panel of the TP01 card, description of indications is given in table 8.1 :

Card	Description
	Visual Indicators: The details of the visual indicators on the ETC card is given below:

LED	Color	Status
Active	Amber	Card jacked in/initialize
	Green	Card initialized
	Red	Admin down
	Off	Card Failure
Status	Green	Card recognized
	Red	Admin down
	Off	Card Failure
RJ45-Amber	Off	10 Mbps mode enabled
	Amber	100 Mbps mode enabled
RJ45-Green	Off	Link Failure
	Green	LED on if Link pulses Detected (10 or 100 Mbps). LED Blinks, if there is an activity on the link.

Table 8.1 Front panel of TP01 Card, description of indications

Objective:

1. The TP01 tributary interface card of TJ100MC-1 system provide line interfaces to ---------- 10/100 Mbps signals.
   a) Four b) Six c) Eight d) Ten
2. The TP01 card of TJ100MC-1 system maps and demaps the Ethernet data into the virtual containers of different granularity of the SDH frame.
   a) VC-12 only b) VC-3 only c) VC-4 only d) different granularity
3. The maximum power consumed by a TPO1 card of TJ100MC-1 system is ----------
   a) 8 W b) 18 W c) 28 W d) 12 W
4. The RJ 45 green LED indicator on TP01 card of TJ100MC-1 system is ON if link (10 or 100 Mbps) pulses are detected. (T/F)
5. The RJ 45 green LED indicator on TP01 card of TJ100MC-1 system is blinking if there is an activity on the link. (T/F)

Subjective:

1. Explain the functional description of TP01 card of TJ100MC-1 system.
2. Give the significance of the various visual indicators available on TP01 card of TJ100MC-1 system.

CHAPTER 9

ETHERNET TRIBUTARY CARD (TP01FT)

9.1 Introduction

The Ethernet tributary card, TP01FT is a generic tributary card that can be used across all the Tejas Networks' STM-1/4/16 products. TP01FT tributary interface cards provide to four 10-Base T/100 base T Ethernet ports and four 100BASE-FX Ethernet ports. This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC 12/VC3/VC 4 or VT 1.5/STS1/STS-3c) of the SDH/SONET frame. The VC in which the data is mapped/de-mapped is programmable through software.

Power Supply Requirements

Input Supply Voltages: Input supply voltage is –12V ± 10%

Power Consumption: The maximum power consumed by TP01FT card is 10W.

9.2 Front panel of TP01FT Card

The front panel of the TP01FT card and description of indications is given in table 9.1:

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="12"> 
</td><td colspan="3">Visual Indicators:
The details of the visual indicators on the ETC card is given below:</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td rowspan="3">Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green</td><td>Card initialized</td></tr>
<tr><td>Off/Red</td><td>Card Failure</td></tr>
<tr><td rowspan="2">Status</td><td>Green</td><td>Card recognized</td></tr>
<tr><td>Off/Red</td><td>Card Failure</td></tr>
<tr><td rowspan="2">RJ45-Amber</td><td>Off</td><td>10Mbps Mode is enabled</td></tr>
<tr><td>Amber</td><td>100Mbps Mode is enabled</td></tr>
<tr><td rowspan="3">Tx</td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Green</td><td>Transmit enabled on Fx port.</td></tr>
<tr><td>Red</td><td>Transmit disabled on Fx port</td></tr>
<tr><td rowspan="3">Rx</td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Green</td><td>Signal detected on Fx port.</td></tr>
<tr><td>Red</td><td>Loss of signal on Fx port.</td></tr>
</table>

Table 9.1 Front panel of TP01FT Card and description of indications

Objective:

1. The TP01FT tributary interface cards of TJ100MC-1 provide four 10-BaseT/100-Base T Ethernet ports and four 100-Base-FX Ethernet ports. (T/F)
2. The maximum power consumed by a TP01FT card of TJ100MC-1 system is 10 W. (T/F)
3. If the RJ45 Amber LED on the TP01FT card of TJ100MC-1 system is off, it indicates 10 Mbps mode is enabled. (T/F)
4. If the RJ45 Amber LED on the TP01FT card of TJ100MC-1 system is ON, it indicates 100 Mbps mode is enabled. (T/F)

Subjective:

1. Explain the functional description of TP01FT card of TJ100MC-1 system.
2. Give the significance of the various visual indicators available on TP01FT card of TJ100MC-1 system

Part – III

Teja's STM-4/16 Equipment TJ100MC-16

CHAPTER 1

INTRODUCTION TO TJ100MC-16X

1.1 Brief description of TJ100MC-16X

TJ 100MC-16X is STM 4/16 Equipment from M/s Tejas suite of products in the synchronous fiber optic transmission. TJ 100MC-16X comes with two different processor cards options:

XCC128L card, which is the cross-connect controller card designed to implement 20G VT1.5/VC-12 granularity cross-connect for TJ100MC-16X system.

XCC64L card, which is the cross-connect controller card designed to implement 10G VT1.5/VC-12 granularity cross-connect for TJ100MC-16X system.

The equipment has the following modules:

Power Filter Unit (PFU1)
Multi Function Card (MFC1)
20G VC12 Cross-Connect and Control Card (XCC128L)
Cross-Connect and Control Card (XCC-64L)
Card population rule
Adapter Card (ADP1)
Two-port E3/DS3 Card (TE33)
Ethernet Tributary Card (TP01)-GFC (TP01FT is Old version card)
2 port 1000 Base LX Card (LQ02)
84 port E1/T1 Card (LB84)
8 port E4/STM-1E interface Card (PC1L8SA)
4 Port E4/STM-1e and 8 Port STM-1_0 SFP Interface Card (LC1L12)
16 Port STM-1_0 SFP Interface Line card (LC1L16FP)
4 port STM-4 SFF Line interface Card (LC4L4FF)
1 port STM-16 MSA Optics Interface Card (LC16L1N)
1 port STM-16 SFF Line interface Card (LC16L1FF)

The equipment is supplied in a rack as per dimensions given below:

Dimension	Description
Chassis Height	623mm
Chassis Depth	301mm
Chassis Width	482mm

Physical view of the equipment is shown in fig.1.1

Fig.1.1 Physical view of the equipment TJ 100MC-16X

Slot allocation for each card/module is shown in fig.1.2. It may please be noted that:

- Slot 1- 6 and 9-14 are for tributary cards
- Slot 7& 8 are for cross connect card
- Slot 15 is for Multi function card
- Slot 16 & 17 is for Power Filter Unit
- Slot 18,19 & 20 for FTU

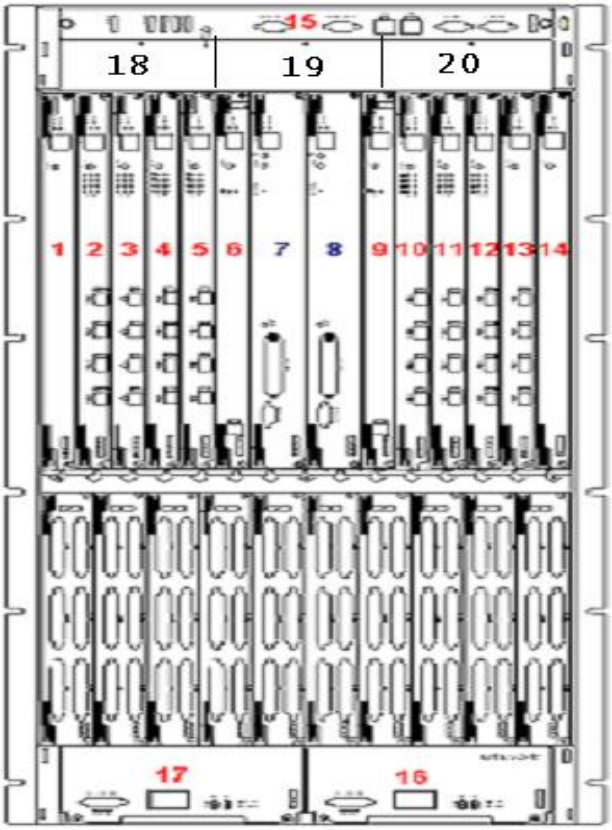


Fig.1.2 Slot allocation for each card/module in TJ 100MC-16X Equipment

1.2 Power Supply Specifications

The power dissipation of fully loaded configuration of TJ100MC-16X system is around 600 watts. TJ100MC-16X has redundant power filter units to supply power.

The following table gives the input power supply specifications required for safe and proper operation.

Parameter	Specification
Input Voltage Tolerance	-40V to –60V
Power Consumption	Depends on configuration 150W to 780W
Power Cable Type	$3mm^2$
Power Connector Type	D-sub
Chassis Ground Connector Type	Screw/LUG

Table 1.3 Input Power Supply Specifications for TJ 100MC-16X

The EMI specifications are as follows:

EMI Specifications	EN55022 Class A, EN 300 386
Safety	CSA 60950, CSA 60825-1

1.3 Card population rules / Telecom bus allocation details

This section provides details regarding the card population rules to be followed while using a TJ100MC16 system.

1.3.1 XCC-128L

The system supports 32 telecom buses each with STM-4 capacity. The bus distribution details are as described in Table 1.4.1. Some telecom buses are shared between the slots. While populating the cards consider the following details relative to the telecom buses used by the aggregate cards

Slot No	1	2	3	4	5	6	9	10	11	12	13	14
Telecom Bus Number	1	2	3	5	9	13	17	21	25	29	31	32
		1	4	6	10	14	18	22	26	30	32	
				7	11	15	19	23	27			
				8	12	16	20	24	28			
No. of telecom bus	1	1	2	4	4	4	4	4	4	2	1	1

Table 1.4.1 Telecom bus allocation details when using XCC 128L Module

Note : Each telecom bus capacity = 1**xSTM4** capacity

1.3.2 XCC-64L

Telecom bus allocation details when using XCC 64L module are shown in Table 1.4.2

Slot No	1	2	3	4	5	6	9	10	11	12	13	14
Bus allocation	1	8	2	3	4	5	9	13	14	15	16	12
					3	6	10	14				
					2	7	11	15				
					1	8	12	16				
No of Telecom Bus	1	1	1	1	1	3	3	1	1	1	1	1

Table 1.4.2 Telecom bus allocation details when using XCC-64L Module

1.4 Scope of part-II of T13E Notes

Rest of chapters in part-II provide detailed technical description of the following:

Chapter 2: Power Filter Unit (PFU1)

Chapter 3: Multi Function Card (MFC1)

Chapter 4: 20G VC12 Cross-Connect and Control Card (XCC128L)

Chapter 5: Cross-Connect and Control Card (XCC-64L)

Chapter 6: Adapter Card (ADP1)

Chapter 7: 3 port E3/DS3 Card (TE33)

Chapter 8: Ethernet Tributary Card (TP01)-GFC

Chapter 9: Ethernet Tributary Card (TP01FT)-Old version

Chapter 10: 2 port 1000 Base LX Card (LQ02)

Chapter 11: 84 port E1/T1 Card (LB84)

Chapter 12: 8 port E4/STM-1E interface Card (PC1L8SA)

Chapter 13: 4 Port E4/STM-1e and 8 Port STM-1 SFP Interface Card (LC1L12)

Chapter 14: 16 Port STM-1_0 SFP Interface Line card (LC1L16FP)

Chapter 15: 4 port STM-4 SFF Line interface Card (LC4L4FF)

Chapter 16: 1 port STM-16 MSA Optics Interface Card (LC16L1N)

Chapter 17: 1 port STM-16 SFF Line interface Card (LC16L1FF)

Objective:

1. TJ 100 MC-16X system comes with two different processor cards options as XCC128L and XCC64L. (T/F)
2. In TJ 100MC-16X system the tributary cards can be inserted in Slot 1 to 6 and Slot 9 to 14 only. (T/F)
3. The Cross-connect card of TJ 100MC-16X systems can be inserted in slots 7 and 8 only. (T/F)
4. The Multifunction card of TJ 100MC-16X systems can be inserted in Slot 15 only. (T/F)

Subjective:

1. List the various cards that can be used with TJ100MC-16X system
2. Give the slot allocation of the cards of TJ100MC-16X system

CHAPTER 2

POWER FILTER UNIT (PFU1)

2.1 Introduction

The power filter units (PFU1) are part of the base TJ100MC-16X. The units provide a filtered input voltage of –40V to –60V to all the cards. The units provide a 12V supply to the MFC1 Card, Termination panels and Fan tray units.

There are two PFU1 cards in each TJ100MC-16X system to provide input source redundancy. The cards are provided with a mechanical circuit breaker to cut off supply in the event the Card draws more current than the stated limit. An electrical circuit breaker provides protection from over voltages and under voltage at the input.

An EMI filter is used to restrict conducted emissions. The filters have transient voltage suppressors to prevent voltage surges affecting the system. The cards have reverse polarity protection to protect the system from damage in the event the input is given with reversed polarity.

The 12V supply is generated through an isolated DC-DC converter.

2.2 Operating parameters:

- Input voltage: -40 to –60V D.C
- Output voltage, input pass through 12V: -40 V to –60V D.C
- Output current: 22A maximum at –48V
- Output current: 4A maximum at 12V

DC circuit breaker provides short-circuit/over-current protection. An input over-voltage protection is provided to shutoff the module if the input voltage is beyond the operating limits.

2.3 Module details

The PFU1 Card fits in the horizontal slots at the top of the TJ100MC-16X chassis. The slots are numbered 16 and 17. The front panel of this Card includes:

- Power connector
- Power ON/OFF switch
- 2 LED indicators
- -48V and 12V voltage monitoring ports

The switch provided in the front panel controls power supply of the Card. The two monitoring ports in the front panel facilitate the verification of the output voltage from the Card.

The front view of the PFU1 is shown in fig.2.1:

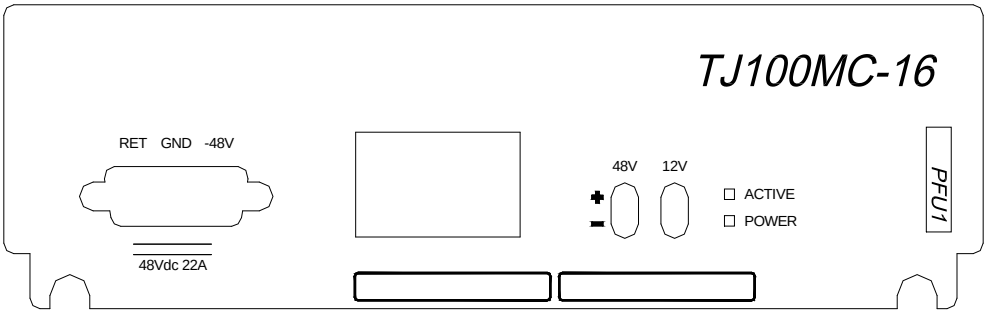


Fig.2.1 Front view of the PFU1

The two LEDs viz., Status and Active LEDs provide a visual indication of the input, the output voltages and the state of the Card. Details are in table 2.1

LED	Color	Indication
Status	Green	OK
	Off	Trip Condition
Active	Green	OK
	Red	12V generation has failed
	Off	Trip condition

Table 2.1 LED indications and interpretation of PFU Module

Power connection to the PFU1 is via a 3-pin power D-connector located on the front of the unit. For redundancy requirements, two separate units should be installed in the sub rack and connected to each of the station power units.

The connection with the TJ100MC-16X back plane is made with a single 33-pin Goldfish connector.

2.4 Detailed specifications:

Detailed specifications are given in Table 2.2

Specification	Range
Input Voltage Range	Normal Operation: -40V to –60V DC Safe Input Range: up to –70V
Reverse Polarity Protection	Yes, upto 70V
Maximum operating Ambient Temperature	0ºC to 50ºC Natural convection upto 15A, forced convection recommended.
Output Voltages	-40 to –60V Filtered Input Pass through 12V +0.5/-1V Isolated from the input
Output Current	-48V:22A Nominal, 25A Max ; 12V:4A Max
Line Regulation (12V)	± 3%
Load Regulation (12V)	± 5%
Fuse	None, Circuit breaker provided instead
Input Under Voltage Protection	-36V+/-3V, Recovery before –42V
Input Over Voltage Protection	-64V+/-3V. Recovery before –58V
Hot Swap Capability	Present
Redundancy	Present
ON/OFF Control	Circuit Breaker on the front panel
Over-Temperature (12V)	120ºC+/-10ºC
Status Indication	Switch: Red when OFF, Blank when ON
	Status: Green if OK, Off if in Trip Condition
	Active: Green if OK, Red if 12V Fails, Off in Trip cond.
Monitoring Points	48V Output: Internal Resistance = 20k 12V Output: Internal Resistance = 2k

Table 2.2 Detailed Specifications of PFU Module

Objective:

1. Power filter units of TJ 100MC-16X system can be inserted in ----------
   a) slot No. 16 and 17 only b) Any slot c) slot No. 14 and 15 only
   d) slot No. 18 only
2. The power dissipation of fully loaded configuration of TJ 100 MC-16X system is ----------
   a) 300 W b) 600 W c) 800 W d) 1000 W
3. The TJ 100MC-16X system has redundant power supply filter units to supply power. (T/F)
4. The Power supply filter units of TJ 100MC-16X system are provided with a mechanical circuit breaker to cut off supply in the event the card draws more current than the stated limit. (T/F)
5. Reverse polarity protection is provided in the Power filter unit of TJ 100MC-16X system to protect the system from damage in the event the input is given with reversed polarity. (T/F)
6. The output voltage of the Power filter unit of TJ 100MC-16X system is 12 V (T/F)

Subjective:

1. Explain the function of power filter unit.
2. Give the significance of Active and Status LEDs of power filter unit

CHAPTER 3

MULTIFUNCTION INTERFACE CARD (MFC1)

3.1 Introduction

The MFC1 in TJ100MC-16X is used to implement miscellaneous Interfaces. This card is plugged into to horizontal slot (Slot 15) on top of the TJ100MC-16X chassis. This card supports the following interfaces along with the visual alarm indicators:

- Order Wire interface
- 10/100Mbps NMS interface
- Two serial interfaces for craft interfaces
- Alarm input and output interfaces

Power consumption: MFC1 consumes a maximum power of 8W, at 12V dc.

3.2 Module details: The MFC1 fits into the slot15 of the TJ100MC-16X system.

The MFC1 has front panel connections for the user interfaces along with the visual indications. The front view of the MFC1 is shown in fig.3.1

Fig.3.1 Front view of MFC1 Module

The NMS interface is associated with two LEDs, Green and Amber: the possible LED status and their significance is given in table 3.1 :

Card Status	NMS LED	
	Green	Amber
Transmit Activity	Blink on packet transmitted	NA
Receiver Activity	NA	Blink on packet received

Table 3.1 NMS LED Indications and interpretation

The Order Wire interface is associated with single bi-color LED. Interpretation of LED indications is given in table 3.2:

LED Name	LED Color	Status
Power	Green	Card is powered-up
	Off	Card is not powered-up
Critical Alarm	Red	Critical Alarm is present
	Off	Critical Alarm is not present
Major Alarm	Orange	Major Alarm is present
	Off	Major Alarm is not present
Minor Alarm	Yellow	Minor Alarm is present
	Off	Minor Alarm is not present
Deferred Alarm	Blue	Deferred Alarm is present
	Off	Deferred Alarm is not present

Table 3.2 Interpretation of Order-wire LED Indications

Alarm contacts

The MFC1 card of the TJ100MC-16X has two D-15 connectors in the front panel for dry alarm contacts, the Alarm In and Alarm Out interfaces.

The connector for Alarm In is used to feed in alarms to the MFC1. The connector for Alarm Out is used to derive alarms out of the MFC1.

3.3 Interfaces to MFC1 Card

3.3.1 Network management interface

The network management interface (NMS Interface) provides a CSMA/CD based LAN transceiver of an Ethernet link through an RJ45 connector on the MFC1.

3.3.2 Order wire interface

This is an operations communication channel that directly supports a 2-wire analog telephone. It has the full battery, over voltage, ringing, supervision, codec, hybrid and test (BORSCHT) functions.

Voice and signalling traffic is carried over E1 or E2 bytes of the SDH overhead.

2-wire analog interface is handled by hardware using a ringing SLIC and codec. The line impedance can be set according to local conventions from the user interface.

3.3.3 Craft interfaces

The craft interface provides a RS232C based interface for configuration using a local craft terminal. The default baud rate setting is 9600 bauds, with 1 stop bit, no parity and no hardware/software flow control.

3.4 Functional description

The MFC1 card supports the following interfaces:

- Order Wire interface
- 10/100Mbps NMS Ethernet interface
- Two serial interfaces for modem and craft interfaces
- Alarm input and output interfaces

The card consists of a CPLD to implement the above functionalities. The CPLD has processor accessible registers that monitor and control the Alarm interface. The MFC1 gas a SLIC device converts the analog voice-data to PCM samples and vice-versa.

Objective:

1. The Multifunction Interface Card (MFC1) in TJ100MC-16X system is used to implement miscellaneous interfaces. (T/F)
2. 10/100 Mbps NMS interface is provided in the MCC1 card of TJ 100MC-16X system. (T/F)
3. Order-wire interface of TJ100MC-16X system is provided in MFC1 card. (T/F)
4. Two serial interfaces for craft interface of TJ 100MC-16X system are provided in the MFC1 card. (T/F)
5. The power consumption of MFC1 of TJ 100MC-16X system is 8 W. (T/F)

Subjective:

1. Give the significance of the LEDs associated with NMS interface of MFC1 card of TJ100MC-16X system.
2. Give the significance of order-wire interface LED of MFC1 card of TJ100MC-16X system.
3. Explain the order interface and craft interface of MFC1 card of TJ100MC-16X system.

CHAPTER 4

20G VC12 CROSS-CONNECT AND CONTROL CARD (XCC128L)

4.1 Introduction

XCC128L Card is cross-connect controller card designed to implement 20G VT1.5/VC-12 granularity cross-connect for TJ100MC-16X system. This card has 40G space switching capabilities and thus provides, 20G strict sense non-blocking switch capacity. It also has the main processing power to perform APS/IBC routing /Inter-card communication / node management etc., which are functions required for the TJ100MC-16X system. The TJ100MC-16X Chassis has provision to use two of such Cards to provide the cross-connect redundancy and processor redundancy. The XCC128L Card also supplies system timings/system frame signals to all Line Cards in the system.

Two high-end processors are used on XCC128L card. This card terminates OHXC TDM HDLC channels, which will be used for various purposes like IBC / ICC / AIP /OH byte processing. The onboard routing processor subsystem will be handling these functions. The onboard Management processor subsystem will be handling APS / provisioning / Node mgmt functions for TJ100MC-16X system.

Power consumption: The XCC128L consumes a maximum power of 45W.

4.2 Sub rack interface

The XCC128L requires – 48V supply. This is provided from the back Plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through four high-speed differential ZD type connectors. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector. Three Type B connectors provide interface with the back plane of the sub rack for miscellaneous status and other signals.

4.3 Functional description: XCC128L is cross-connect controller card for TJ100MC-16X system. The *'128'* stands for its cross-connect capacity, which is the number of STM-1 links supported by the card. So this card can cross-connect 128STM-1 links (which is 128*155Mbps = 20G capacity). The L stands for lower order cross-connect capability i.e. VC-12/VT1.5 level grooming capacity. Apart from Cross-connect fabric, the card has processor daughter-board, system timing module, input BITS clock processing, programmable devices, back plane interface connectors and on-board power supply module. The Card is responsible for Protection switching, IBC/ICC processing, Alarm processing, EOW byte and other OH byte handling. UI, provisioning, node management and disk handling in TJ100MC-16X system. TJ100MC-16X chassis has 2 slots for XCC128L to support the redundancy.

4.5 Redundancy control: TJ100MC-16X provides for a redundancy on the XCC128L Card. The Maser and the slave Card configuration can be forced using the hot swap switch on the front panel of the XCC128L. When the hot swap switch is activated, the respective Card renders the peer Card as the master and takes over as a slave. The switch is functional only on the Card that is active provided another Card is available in the stand-by configuration.

Module description

The XCC128L fits into the slots 7 and 8 in the TJ100MC-16X chassis. The front panel of the XCC128L and description of indicators & switches is presented in table 4.1

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td>  </td><td>
Visual Indicators

The visual indicators on the XCC128L card include two LEDs, the ACTIVE and the STATUS LEDs. The possible LED status and their significance is given below:
<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td>ACTIVE</td><td>Amber</td><td>Card is in standby mode (Slave)</td></tr>
<tr><td></td><td>Green</td><td>Card is active (Master)</td></tr>
<tr><td>STATUS</td><td>Amber</td><td>Card is in booting process</td></tr>
<tr><td></td><td>Green</td><td>Boot process complete</td></tr>
<tr><td></td><td>Red</td><td>Card failure</td></tr>
<tr><td>DISK STATUS</td><td>Amber</td><td>Disk present/absent</td></tr>
</table>
Hot Swap Switch:

The master and the slave Card configuration of the redundant XCC128L cards can be forced using the hot swap switch. When the hot swap switch is activated, the respective Card renders the peer Card as the master and takes over as a slave. The switch is functional only on the Card that is active provided another Card is available in the stand-by configuration.

Soft Reset switch:

The switch forces the Card into a soft reset.

BITS Interface

TJ100MC-16X supports a BITS clock interface on the cross-connect cards through a 9-pin D-type connector.

The BITS clock input/output is at 2.048MHz and can be nominated as a reference for node synchronization. Loss-of-Signal (LOS) is detected on the clock input and this alarm is used as a trigger to change over to the next synchronization reference. The LOS alarm is reported on the user interface.

The BITS data input/output is at 2.048Mbps and uses Extended Super Frame (ESF) for framing. Both PCM30 and PCM31 (with/without CRC) can be used on the input. This input can be nominated as a reference for node synchronization. LOS, LOF and AIS are detected on this input and this alarm is used as a trigger to change over to the next synchronization reference. The alarms are reported on the user interface.

Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.
</td></tr>
</table>

Table 4.1 Front panel of XCC128L card, indicators & switches

Objective:

1. The XCC128L card of TJ 100MC-16X system is a cross-connect controller card designed to implement 20G VC-12 granularity cross-connect for TJ 100MC-16X system. (T/F)
2. The XCC128L card of TJ 100MC-16X system has 40G space switching capabilities and thus provides 20G strict sense non-blocking switch capacity. (T/F)
3. The XCC128L card of TJ 100MC-16X system supplies system timings/system frame signals to all Line cards in the system. (T/F)
4. When the Active LED of XCC128 L of TJ 100MC-16X system turns to green it indicates that the card is active. (T/F)
5. When the Status LED of XCC128L of TJ 100MC-16X system turns to amber it indicates that the card is in booting process. (T/F)
6. When the Status LED of XCC128L of TJ 100MC-16X system turns to green it indicates that booting process is completed. (T/F)

Subjective:

1. Explain the function of XCC128L cross-connect card of TJ100MC-16X system.
2. Explain the function of hot swap switch on XCC128L card of TJ100MC-16X system.

CHAPTER 5

CROSS-CONNECT AND CONTROLLER CARD (XCC64L)

5.1 Introduction

XCC64L is cross-connect controller card designed to implement 10G VT1.5/VC-12 granularity cross-connect for TJ100MC-16X system. This card will have 20G space switching capabilities and thus provides, 10G strict sense non-blocking switch capacity. This card also has the main processing power to perform APS / IBC routing/ Inter-card communication / node management etc. functions required for the TJ100MC-16X system. The TJ100MC-16X Chassis has provision to use 2 of such XCC64L cards to provide the cross-connect redundancy and processor redundancy. XCC64L card will also supply system timings / system frame signals to all line cards in the system.

Two high-end processors will be used on XCC64L card. This card will terminate OHXC TDM HDLC channels, which will be used for various purposes like IBC / ICC/ AIP / OH byte processing. The routing processor subsystem will be handling these functions. The Management processor subsystem will be handling APS / provisioning / Node mgmt functions for TJ100MC-16X system.

Power consumption: The XCC64L consumes a maximum power of 48W. The Typical card power dissipation is approximately 70% of maximum power, which is 34W

5.2 Sub rack interface: The XCC64L requires –48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through four high-speed differential ZD type connectors. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector. Three Type B connectors provide interface with the back plane of the sub rack for miscellaneous status and other signals.

5.3 Module description: The two redundant XCC64L cards will be placed in slot 7 and slot 8 of TJ100MC-16X chassis. Front panel of the XCC64L and indicators & interfaces are given in table 5.1:

5.4 Functional description: XCC64L is cross-connect controller card for TJ100MC-16X system. The 64 stands for its cross-connect capacity, which is the number of STM-1 links supported by the card. So this card can cross-connect 64 STM-1 links (which is 64*155Mbps = 10G capacity). The **L** stands for lower order cross-connect capacity i.e. VC-12/VT1.5 level grooming capacity. Apart from Cross-connect fabric, the card has processor, daughter-board, system timing module, input BITS clock processing, programmable devices, back-plane interface connectors and on-board power supply module.

The XCC card is responsible for Protection switching, IBC/ICC processing, Alarm processing, EOW byte and other OH byte handling, UI, provisioning, node management and disk handling in TJ100MC-16X system.

The card has 20G space switching capabilities and thus provides 10G strict sense non-blocking VT/TU level cross-connect. TJ100MC-16X chassis has 2 slots for XCC64L to support the redundancy.

<table>
<tr><th>Card</th><th>Description</th></tr>
<tr><td>  </td><td>
Visual Indicators

The visual indicators on the XCC64L card include three LEDs, the ACTIVE the STATUS and DISK STATUS LEDs. The possible LED status and their significance is given below:
<table>
<tr><th>LED Name</th><th>LED Color</th><th>Status</th></tr>
<tr><td rowspan="4">ACTIVE</td><td>Green</td><td>Card is active</td></tr>
<tr><td>Amber</td><td>Card is Standby</td></tr>
<tr><td>Blinking Amber</td><td>Card is Booting-up</td></tr>
<tr><td>Off</td><td>Card failure</td></tr>
<tr><td rowspan="3">STATUS</td><td>Green</td><td>Card is Good</td></tr>
<tr><td>Red</td><td>Card failed</td></tr>
<tr><td>Blinking Amber</td><td>Card is Booting-up</td></tr>
<tr><td>DISK STATUS</td><td>Amber</td><td>Disk Present/absent</td></tr>
</table>
Hot Swap switch:

The master and the slave Card configuration of the redundant XCC64L cards can be forced using the hot swap switch. When the hot swap switch is activated, the respective Card renders the peer Card as the master and takes over as a slave. The switch is functional only on the Card that is active provided another Card is available in the stand-by configuration.

Soft Reset switch:

The switch Provides soft reset to the card.

BITS Interface

TJ100MC-16 supports a BITS clock interface on the cross-connect cards through a 9-pin D-type connector.

XCC has provision of two BITS clock inputs through E1 data and clock timing interfaces. The front panel will have one connector (D-type), which will support 2 BITS interfaces (1 E1 clock and 1 E1 data) and two BITS-OUT interfaces (1 CLK-OUT and Data-OUT). The BITS-OUT interfaces can be used by down-stream equipment for synchronization. The two XCC cards in the system in redundant configuration, allow us to support new GR requirement of source-redundant BITS clock inputs. The architecture ensures that any failure of these clocks does not cause XC switch-over and hence possible disruption of traffic. For this purpose both BITS clock references on XCC0 will be routed to XCC1 card also and vice versa. So in case BITS interface on XCC0 fails, then corresponding BITS interface of XCC1 card will be used for synchronization.

XCC64L card can also derive synchronization from any of the received STM-1/4/16 interfaces available on the line cards apart from received E1 interfaces. For this, every line card supplies one 8 kHz reference clocks to both XCC cards.

Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.
</td></tr>
</table>

Table 5.1 Front panel of XCC64L card & description of indicators, interfaces

5.5 Redundancy control: TJ100MC-16X provides for a redundancy on the XCC64L Card. The master and the slave Card configuration can be forced using the hot swap switch on the front panel of the XCC64L. When the hot swap switch is activated, the respective Card renders the peer Card as the master and takes over as a slave. The switch is functional only on the Card that is active provided another Card is available in the stand-by configuration.

Objective:

1. The XCC64L card of TJ 100MC-16X system is a cross-connect controller card designed to implement 10G VC-12 granularity cross-connect for TJ 100MC-16X system. (T/F)
2. The XCC64L card of TJ 100MC-16X system has 20G space switching capabilities and thus provides 10G strict sense non-blocking switch capacity. (T/F)
3. The XCC64L card of TJ 100MC-16X system supplies system timings/system frame signals to all Line cards in the system. (T/F)
4. A management processor subsystem in XCC64L card of TJ 100MC-16X system will be handling APS and node management functions. (T/F)
5. The power consumption of XCC64L card of TJ 100MC-16X system is 48 W. (T/F)

Subjective:

1. Explain the function of XCC64L cross-connect card of TJ100MC-16X system
2. Explain the function of BITS interface and Diagnostic interface of XCC64L card of TJ100MC-16X system.

CHAPTER 6

ADAPTOR CARD (ADP1)

6.1 Introduction

ADP1 Card provides an interface for using MC-4L line cards into the TJ100MC-16X systems. ADP1 Card occupies 2 slots in the TJ100MC-16X chassis. It has a small back plane into which any TJ100MC-4L card can be jacked in. It converts parallel telecom buses from TJ100MC-4L line cards to serial telecom bus for TJ100MC-16X backplane and vice-versa. It also uses a power converter to step down the input voltage from 48 V provided by the TJ100MC-16X back plane to 12 V required by TJ100MC-4L line card. This card can be plugged into any of the slots from 1 to 8 and 10 to 14.

Power consumption

The ADP1 consumes a maximum power of 40W.

6.2 Sub rack interface

The ADP1 requires – 48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

Traffic interface

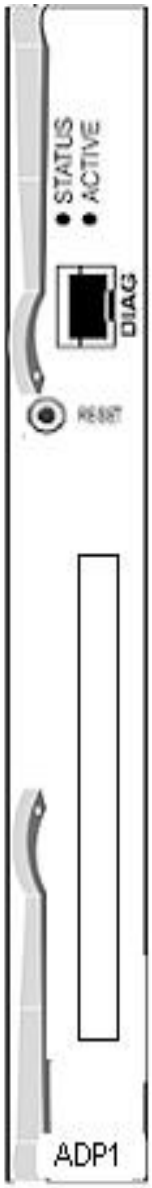
There are no traffic interfaces on this Card. The traffic interfaces are present on the TJ100MC-4L cards mounted on ADPI.

6.3 Functional description

The TJ100MC-16X system provides for the functionality to reuse cards used in other Tejas Networks systems. The ADP1 Card is specifically meant to interface all the line cards used in the TJ100MC-4L system. The Card provides the line cards with 12V supply. The Card also generates secondary voltages required by onboard devices. The telecom busses interfaced to this card are serial telecom busses. The line cards from the TJ100MC-4L, which are to be interfaced, require a parallel telecom bus. This Card does the conversion of serial to parallel and parallel to serial for the telecom busses. The generation of clocks required for the line cards is also generated in the ADP1 Card.

6.4 Module description

Front panel of the ADP1 and description of indicators & interfaces are given in table 6.1 :

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="11"> 
</td><td colspan="3">Visual Indicators</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td>Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td></td><td>Green</td><td>Software download complete</td></tr>
<tr><td></td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Status</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td></td><td>Green blinking</td><td>Card communication with XCC128L/XCC64L in process</td></tr>
<tr><td></td><td>Green</td><td>Card communication with XCC128L/XCC64L complete</td></tr>
<tr><td></td><td>Red</td><td>Card Failure</td></tr>
<tr><td colspan="3">Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.</td></tr>
<tr><td colspan="3">Reset Switch:

The Reset switch, when activated provides a non-service disruptive reboot on the Card.</td></tr>
</table>

Table 6.1 Description of ADP1 Front-panel

Objective:

1. Adaptor card ADP1 provides an interface for using MC-4L line cards into the TJ100MC-16X systems. (T/F)
2. The ADP1 card occupies 2 slots in the TJ100MC-16X chassis. (T/F)
3. The ADP1 card can be plugged into any of the slots from 1 to 8 and 10 to 14 of TJ100MC-16X system. (T/F)
4. The ADP1 card of TJ100MC-16X system consumes a maximum power of 40 W. (T/F)
5. The ADP1 card of TJ100MC-16X system has a small back plane into which any TJ100MC-4L card can be jacked in. (T/F)
6. No traffic interfaces are provided on ADP1 card of TJ100MC-16X system. (T/F)

Subjective:

1. Explain the function of Adaptor card ADP1 of TJ100MC-16X system.
2. Give the significance of Active and Status LED indicators of ADP1 card of TJ100MC-16X system.

CHAPTER 7

3E3/DS3 TRIBUTARY CARD (TE33)

7.1 Introduction

The 3 port E3/DS3 card is a generic tributary card that can be used across all the Tejas's STM-1/4/16 products. TE33 provides line interface to 3 E3/DS3 channels in both, add and drop directions. Each of the three ports on the card are independently software configurable to support E3/DS3 rates correspondingly. The card maps E3/DS3 tributaries into a VC-3/AU-4.

Power supply requirements

Input voltage : 12V ± 20%, supplied via a Type-N connector.

Power consumption : The TE33 consumes a maximum power of 8W.

7.2 Subrack interface

The TE33 uses two Euro connectors to connect to the backplane of the sub-rack. In addition, there is a power connector for +12V d.c. input to the card. The sub-rack interface has the following:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card Present, Alarm, Slot Identifier)

7.3 Traffic interfaces

The TE33 card has six BNC connectors for the 75 ohm E3/DS3 interfaces. For details regarding the connectors refer to the Installation Procedure. These interfaces confirm to ITU-T G.703 standard.

7.5 Functional description

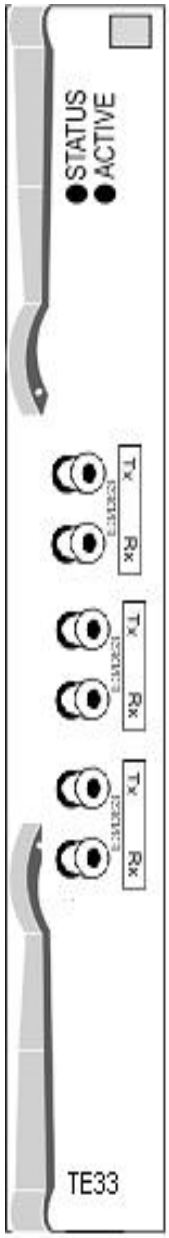
This card provides line interface to three E3/DS3 channels in both, add and drop directions along with visual indicators. The E3/DS3 serial data terminates on LIUs via the transformers on the card. The LIU can be configured to take either E3/DS3 data. The LIU provides adaptive equalization. The data from LIU is passed on to the Mapper which maps E3/DS3 data into STS-1 (AU-3) frame. The Mapper also provides jitter attenuation feature. Even though the Mapper provides 77.76MHz telecom bus interface, it is capable of inter-operating with 19.44MHz telecom bus of backplane.

The CPLD on the card controls the devices on the card by providing following functionalities:

- Address decoding and chip selection of various devices on the card.
- Give reset to all the devices
- Generate single interrupt to processor from various on card interrupts
- Configure LIUs
- Provide timing signals to Mapper

7.4 Module description

This card can be plugged into TJ100MC-16X chassis only through the ADP card. The front panel of the TE33 and description of indicators, interfaces is given in table 7.1

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="2"> 
</td><td colspan="3">Visual Indicators:

The visual indicators on the TE33 card includes two LEDs, the ACTIVE and the STATUS LEDs. The possible LED status and their significance</td></tr>
<tr><td colspan="3">
<table>
<tr><th>LED</th><th>Color</th><th>Status</th></tr>
<tr><td rowspan="3">ACTIVE</td><td>Amber</td><td>ON insertion / Power ON</td></tr>
<tr><td>Green</td><td>Initialization Complete/In use</td></tr>
<tr><td>Red</td><td>Card Inactive</td></tr>
<tr><td rowspan="3">STATUS</td><td>Amber</td><td>On insertion / Power ON</td></tr>
<tr><td>Green</td><td>Initialization Complete</td></tr>
<tr><td>Red</td><td>Hardware error</td></tr>
</table>

E3/DS3 Interface:

This card provides line interface to 3 E3/DS3 channels in both, add and drop directions along with visual indicators. The 3 E3/DS3 interfaces are provided through BNC connectors. For details regarding the connectors refer to the Installation Procedure.

The TE33 provides the following interfaces:

• 3E3/DS3 interfaces through 75 ohm BNC connectors
• Processor bus for control path communication to the other cards in the sub-rack (to/from the backplane)
• System clocks and timing signals (to/from the backplane)</td></tr>
</table>

Table 7.1 TE33 Card front panel and description of indicators & interfaces

Objective:

1. TE33 card (3 port E3) is a generic tributary card that can be used across all the Teja's STM-1/4/16 systems. (T/F)
2. The TE33 card of TJ100MC-16X system maps E3 tributaries into a VC-3/AU-4 of STM-1 frame. (T/F)
3. The TE33 card of TJ100MC-16X system consumes a maximum power of 8 W (T/F)

Subjective:

1. Give the functional description of TE33 card of TJ100MC-16X system.

CHAPTER 8

ETHERNET TRIBUTARY CARD (TP01)

8.1 Introduction

The Ethernet tributary card, TP01 is a generic tributary card that can be used across all the Tejas Network's STM-1/4/16 products. TP01 tributary interface cards provide line interfaces to eight 10/100Mbps Tx port. This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC 12/VC 3/VC 4 or VT 1.5/STS1/STS-3c) of the SDH/SONET frame. The VC in which the data is mapped/ de-mapped is programmable through software.

Power supply requirements

Input supply voltages : Input supply voltage is –12V ± 10%

Power consumption : The maximum power consumed by a TP01 card is 8W.

8.2 Sub-rack interface

The Ethernet Tributary card uses 2 Euro connectors to connect to the backplane of the chassis.

The subrack interface has the following:

- 16-bit parallel address/data bus for inter-card communication.
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card Present, Alarm, Slot Identifier)

8.3 Functional description

From the Ethernet line side the Ethernet data is taken into the TP01 card using RJ-45 connector. This is interfaced to an octal PHY that in turn supplies the raw Ethernet data to the Ethernet mapper via SMII interface. PHY will support both auto-negotiations and auto MDI/MDIX cross over on systems.

The mapper supports connection up to eight 10/100 Mbps Ethernet ports. In the mapper Ethernet frames are encapsulated using GFP, LAPS or LAPF protocol. The encapsulated Ethernet frames are then mapped into either virtually concatenated low or high order payloads, such as VT1.5SPE/VC-12/STS-1 SPE/VC-3, or into contiguously concatenated payloads such as STS-3c SPE/VC-4.

In the other direction, the SDH/SONET data from the backplane interface will go to the mapper and the MAC (MAC is the part of mapper) which decodes the Ethernet frames. This Ethernet frame then passes via PHY and reach RJ-45 connector.

8.4 Module description

This card can be plugged into TJ100MC16-X chassis only through the ADP card. Front panel and details of Visual Indicators on the TP01 card is are shown in table 8.1

Card	Card State	All Card types	When Concept of redundancy does not apply
	Visual Indicators: The details of the visual indicators on the TP01 card is given below:		
		Status LED	Active LED
	Power On: First LED activity noticed on card insertion. *Note*: the AMBER LED should be wired to be activated by default during hardware power-up/reset until software is up and running and can override it.	AMBER	AMBER
	Card OOS: Initialization Complete and circuit pack in out-of-service state (and not failed)	GREEN	AMBER
	Card IS: Initialization complete and circuit pack in service (and not failed)	GREEN	GREEN
	Circuit pack mis-match	AMBER	AMBER
	Pack Fail during boot up.	RED	AMBER
	Pack Fail IS: Circuit pack failed while in-service	RED	GREEN
	Card OOS: circuit-pack out of service and failed	RED	AMBER
	Hard Reset: All devices reset, FPGAs cleared and reprogrammed. *Note*: goes to initializing state next.	AMBER	AMBER
	Soft Reset: Software is restarted, devices are reinitialized with provisioning. Note: goes to Initializing state next.	AMBER	AMBER

Table 8.1 Front panel of TP01 card and description of indicators

CHAPTER 9

ETHERNET TRIBUTARY CARD (TP01FT)

9.1 Introduction

The Ethernet tributary card, TP01FT is a generic tributary card that can be used across all the Tejas Networks' STM-1/4/16 products. TP01FT tributary interface cards provide to four 10-Base T/100 base T Ethernet ports and four 100BASE-FX Ethernet ports. This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC 12/VC 3/VC 4 or VT 1.5/STS1/STS-3c) of the SDH/SONET frame. The VC in which the data is mapped / de-mapped is programmable through software.

Power supply requirements

Input supply voltages: Input supply voltage is –12V ± 10%

Power consumption: The maximum power consumed by a TP01FT card is 10W.

9.2 Sub-rack interface

The Ethernet Tributary card uses 2 Euro connectors to connect to the backplane of the chassis.

The sub-rack interface has the following:

- 16-bit parallel address/data bus for inter-card communication
- Control signals for the inter-card communication bus.
- All equipment clocks (19.44MHz, 2.048MHz, 1.544MHz, 2kHz Multi-Frame sync)
- 2 bi-directional telecom bus and associated control signals. Each telecom bus carries one STM-1 worth of traffic.
- Status signals (Card-present, Alarm, Slot-identifier)

9.3 Functional description

From the Ethernet line side, MAC frame data is taken into the TP01FT card using RJ-45 connector and short-form factor transreceivers. This is interfaced to an octal PHY that in turn supply the raw Ethernet data to the Ethernet mapper via SMII interface. PHY Supports both auto-negotiations and auto MDI/MDIX cross over on the Tx port. Fx port always works at 100Mbps.

The mapper supports connection up to eight 10/100 Mbps Ethernet ports. In the mapper Ethernet frames are encapsulated using GFP, LAPS or LAPF protocol. Encapsulated Ethernet frames are then mapped into either virtually concatenated low or high order payloads, such as VT1.5 SPE/VC-12/STS-1 SPE/VC-3, or into contiguously concatenated payloads such STS-3c SPE/VC-4.

In the other direction, the SDH/SONET data from the backplane interface will come to the mapper and the MAC (MAC is the part of mapper). This will decode the Ethernet frames. This Ethernet frame then via PHY will reach RJ-45 connector or the SFF transreceiver.

9.4 Module Description

This card can be plugged into TJ100MC16-X chassis only through the ADP card. The front panel of the TP01FT card and description of indicators is given in table 9.1:

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="14"> 
</td><td colspan="3">Visual Indicators:

The details of the visual indicators on the TP01FT card is given below:</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td rowspan="3">Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green</td><td>Card initialized</td></tr>
<tr><td>Off/Red</td><td>Card Failure</td></tr>
<tr><td rowspan="2">Status</td><td>Green</td><td>Card recognized</td></tr>
<tr><td>Off/Red</td><td>Card Failure</td></tr>
<tr><td rowspan="2">RJ45-Amber</td><td>Off</td><td>10Mbps Mode is enabled</td></tr>
<tr><td>Amber</td><td>100Mbps Mode is enabled</td></tr>
<tr><td rowspan="2">RJ45-Green</td><td>Off</td><td>Link Failure</td></tr>
<tr><td>Green</td><td>LED on if Link Detected (10 or 100). LED Blinks if there is an activity on the link</td></tr>
<tr><td rowspan="2">Tx</td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Green</td><td>Transmit enabled on Fx port.</td></tr>
<tr><td rowspan="3">Rx</td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Green</td><td>Signal detected on Fx port.</td></tr>
<tr><td>Red</td><td>Loss of signal on Fx port.</td></tr>
</table>

Table 9.1 Front panel of the TP01FT Card and description of indicators

CHAPTER 10

2-PORT 1000BASE LX INTERFACE CARD (LQ02)

10.1 Introduction

The LQ02 Card provides 1000BaseLx interface to the TJ100MC-16X system. The incoming Ethernet packets are mapped into VC3/VC4 with LAPS/GFP framing. The Card can be slotted in any of the line slots of the TJ100MC-16X system.

Power consumption

The LQ02 consumes a maximum power of 30W.

10.2 Sub rack interface

The LQ02 requires-48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

10.3 Traffic interface

There are two 1000BaseLx optical ports on the front panel. The interface is provided with LC type connectors.

10.4 Functional description

The LQ02 Card provides two Gigabit interfaces for the TJ100MC-16X system. This receives the Ethernet packets form a LAN and maps them on to SDH. The framing protocol used is LAPS or GFP. This is a configurable option. The framed data is mapped on to multiple VC3/VC4s using virtual concatenation. Each port can be mapped to either eight VC4s or 24VC3s. The Card is interfaced to the XCC128L/XCC64L Card for cross connection to other line interfaces. In the reverse path it takes in the data contained in the multiple of VC3/VC4s from the XCC128L/XCC64L Card and extracts the LAPS/GFP frames and transmits the Ethernet payload on the GigE ports. It buffers the data in the incoming VCs to support differential delay. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V.

10.5 Module Description

The front panel of the LQ02 and description of indicators, and interfaces are presented in table 10.1

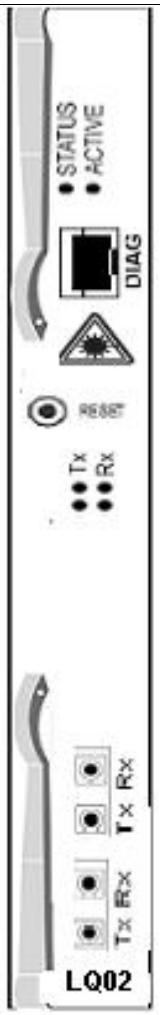
Card	Description		
	Visual indicators		
	LED	**Color**	**Status**
	Active	Amber	Card jacked in
		Green	Software download Complete
		Off	Card Failure
	Status	Amber	Card jacked in
		Green blinking	Card communication withXCC128L/XCC64L in process
		Red	Card Failure
	Tx	Red	Laser OFF
		Green	Laser On
	Rx	Red	Optical power not detected
		Green	Optical power detected
	Diagnostic Interface: The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.		
	Reset Switch: The Reset switch, when activated provides a non-service disruptive reboot on the Card.		

Table 10.1 2-Port 1000 Base Lx Card (LQ02) Front panel description

Objective:

1. The LQ02 card maps the incoming Ethernet packets into VC3 with LAPS/GFP framing. (T/F)
2. The LQ02 card can be inserted into any of the line slots of the TJ100MC-16X system. (T/F)
3. The LQ02 card of TJ100MC-16X system consumes a maximum power of 30 W. (T/F)
4. There are two 1000Base LX optical ports on the front panel of LQ02 card of TJ100MC-16X system. (T/F)
5. The optical interfaces of LQ02 card of TJ100MC-16X system are provided with LC type connectors. (T/F)
6. The framing protocol used in LQ02 card of TJ100MC-16X system is LAPS or GFP, which is configurable. (T/F)

Subjective:

1. Give the functional description of LQ02 card of TJ100MC-16X system.
2. Give the significance LED indicators available on the LQ02 card of TJ100MC-16X system.

CHAPTER 11

84 PORT E1/T1 INTERFACE CARD (LB84)

11.1 Introduction

The LB84 Card provides E1/T1 interfaces for the TJ100MC-16X system. The card maps and de-maps these 84 E1/ T1 channels into SDH/SONET frame (at programmed slots in any AU3/AU4) for the cross-connect card to do the cross connection. The Card can be slotted in line slots 1-5, and 10-14 of the TJ100MC-16X system.

Power consumption

The LB84 consumes a maximum power of 30W.

11.2 Sub rack interface

The LB84 requires – 48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

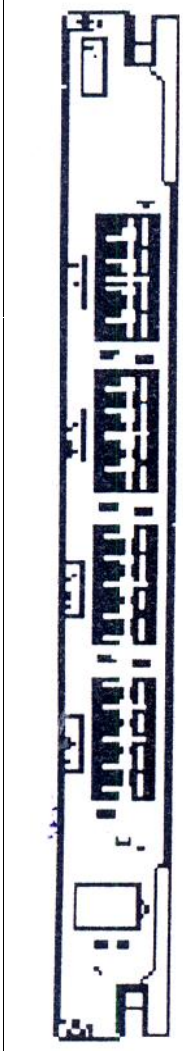
The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

11.3 Traffic interface

There are eighty four E1 electrical ports on the front panel. The interface is provided with Metal type connectors.

11.4 Module description

The front panel of the LB84 and description of indicators, and interfaces is presented in table 11.1

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="9">  </td><td colspan="3">Visual Indicators</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td rowspan="3">Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green</td><td>Software download complete</td></tr>
<tr><td>Off</td><td>Card Failure</td></tr>
<tr><td rowspan="3">Status</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green blinking</td><td>Card communication with XCC128L/XCC64L in process</td></tr>
<tr><td>Green</td><td>Card communication with XCC128L/XCC64L complete</td></tr>
<tr><td></td><td>Red</td><td>Card Failure</td></tr>
<tr><td colspan="3">Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.</td></tr>
<tr><td colspan="3">Reset Switch:

The Reset switch, when activated provides a non-service disruptive reboot on the Car.</td></tr>
</table>

Table 11.1 LB84 Front panel description

11.5 Functional description

The LB84 Card provides E1/T1 interfaces to the TJ100MC-16X system. The E1/T1s are mapped through E1/T1 mappers to the telecom bus for interfacing with the XCC128L/XCC64L Card. The interfacing is done through serial buses. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel.

Objective:

1. The 84 Port E1 interface (LB84) CARD OF TJ100MC-16X system provides 84 E1 channels, which are mapped into SDH frame. (T/F)
2. The LB84 card of TJ100MC-16X system can be inserted into line Slots 1 to 5 and 10 to 14. (T/F)
3. The LB84 card of TJ100MC-16X system consumes a maximum power of 30 W. (T/F)
4. A local power supply unit is incorporated in the LB84 card of TJ100MC-16X system to generate 3.3 V. (T/F)
5. The LB84 card of TJ100MC-16X system can communicate to the controller card through inter card communication channel. (T/F)

Subjective:

1. Give the functional description of LB84 card of TJ100MC-16X system.
2. Explain the Sub rack interface of LB84 card of TJ100MC-16X system.

CHAPTER 12

8- PORT E4/STM-1E INTERFACE CARD (PC1L8SA)

12.1 Introduction

The PC1L8SA Interface Card provides E4/STM-1e interface to the TJ100MC-16X system. The Card is port configurable for E4 and STM-1e operation. The Card can be slotted in any of the line slots of the TJ100MC-16X system.

Power consumption

The PC1L8SA consumes a maximum power of 35W.

12.2 Sub rack Interface

The PC1L8SA requires-48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

12.3 Traffic interface

There are eight E4/STM-1e electrical ports on the front panel. The interface is provided with SMB type connectors.

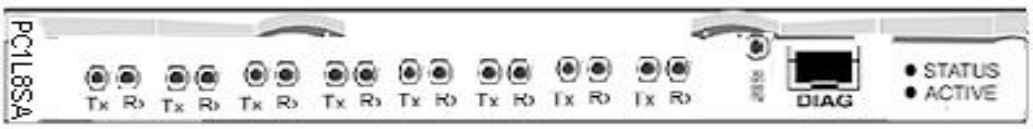
STM-1e/E4 Electrical interface parameters are given in table 12.1

Line Code	CMI
Access Impedance	75 ohms Resistive
Input Return Loss	Greater than 15dB in the range of 8MHz to 240MHz for STM-1e Greater than 15dB in the range of 7MHz to 210 MHz for E4
Output Return Loss	Greater than 15dB in the range of 8MHz to 240MHz for STM-1e Greater than 15dB in the range of 7MHz to 210MHz for E4
Cable Loss to Input	Max. of 12.7 dB at 78 MHz for STM-1e Max. of 12 dB at 70MHz for E4
Connector Type	SMB

Table 12.1 STM-1e/E4 Electrical interface parameters

12.4 Module description

The front panel of the PC1L8SA is as shown below:

<table>
<tr><td>Card</td><td colspan="3"> 
</td></tr>
<tr><td rowspan="13">Description</td><td colspan="3">Visual Indicators:</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td>Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td></td><td>Green</td><td>Software download Complete</td></tr>
<tr><td></td><td>Off</td><td>Card Failure</td></tr>
<tr><td>Status</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td></td><td>Green blinking</td><td>Card communication with XCC128L/XCC64L in process</td></tr>
<tr><td></td><td>Green</td><td>Card communication with XCC128L/XCC64L complete</td></tr>
<tr><td></td><td>Red</td><td>Card failure</td></tr>
<tr><td>Tx</td><td>Red</td><td>Port Admin down</td></tr>
<tr><td></td><td>Green</td><td>Port Admin up</td></tr>
<tr><td>Rx</td><td>Red</td><td>Electrical power not detected</td></tr>
<tr><td></td><td>Green</td><td>Electrical power detected</td></tr>
<tr><td colspan="3">Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector.. Note that the diagnostic interface is meant for use by authorized maintenance personnel only.</td></tr>
<tr><td colspan="3">Reset Switch:

The Reset switch, when activated provides a non-service disruptive reboot on the Card.</td></tr>
</table>

Table 12.2 Front panel description of 8- Port E4/STM-1e interface card (PC1L8SA)

12.5 Functional description

The PC1L8SA Card provides eight E4/STM-1e interfaces for the TJ100MC-16X system. The ports are individually configurable for operation at E4 or STM-1e rates. The Card has multirate LIUs to interface the incoming signal with the onboard Mapper/OHT. The FPGAs map incoming E4 data into the telecom bus to interface with the XCC128L/XCC64L Card. The same devices can be configured to act as an overhead terminator for incoming STM-1e data. This is interfaced to the XCC128L/XCC64L Card through serial telecom busses. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of-48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel.

Note: The Card can also be configured to offer lesser number of ports as per customer requirements. The maximum number of ports is eight.

Objective:

1. 8-Port E4/STM-1E interface card (PC1L8SA) provides E4/STM-1e interface to the TJ100MC-16X system. (T/F)
2. PC1L8SA card of TJ100MC-16X system is port configurable for E4 and STM-1e operation. (T/F)
3. The PC1L8SA card of TJ100MC-X system consumes a maximum power of 35 W. (T/F)
4. The PC1L8SA card of TJ100MC-16X system provides eight E4/STM-1e electrical ports on the front panel. (T/F)
5. The PC1L8SA card of TJ100MC-16X system is provided with SMB type connectors for E4/STM-1e electrical port connections. (T/F)

Subjective:

1. Explain the function of PC1L8SA card of TJ100MC-16X system.
2. Give the significance of LEDs indicators on PC1L8SA of TJ100MC-16X system.

CHAPTER 13

4 PORT E4/STM-1E AND 8 PORT STM-1_0 SFP INTERFACE CARD (LC1L12)

13.1 Introduction

The LC1L12 Card provides E4/STM-1e and STM-1_0 interface to the TJ100MC-16X system. The Card is port configurable for STM-1e or E4 operation for the electrical ports. The optical ports have provision of SFP optics and thus field configurable for the type of interface required. Up to eight optical interfaces can be mounted. The Card can be slotted in any of the line slots of the TJ100MC-16X system.

Power consumption: The LC1L12 consumes a maximum power of 45W.

13.2 Sub rack interface: The LC1L12 requires –48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

13.3 Traffic interface: There are four E4/STM-1e electrical ports on the front panel. The interface is provided with SMB type connectors.

There are eight STM-1 optical ports on the front panel. The interface is provided with LC type connectors.

13.4 Electrical Interface: STM-1e/E4 Electrical interface parameters are given in table 13.1

Line Code	CMI
Access Impedance	75 ohms Resistive
Input Return Loss	Greater than 15dB in the range of 8MHz to 240MHz for STM-1e Greater than 15dB in the range of 7 MHz to 210MHz for E4
Output Return Loss	Greater than 15dB in the range of 8MHz to 240MHz for STM-1e Greater than 15dB in the range of 7MHz to 210 MHz for E4
Cable Loss to Input	Max. Of 12.7 dB at 78 MHz for STM-1e Max. of 12 dB at 70MHz for E4
Connector Type	SMB

Table 13.1 Electrical interface parameters of LC1L12 card

13.5 Optical Interface: Optical interface parameters for short haul (S1.1) are given in table 13.2

Output Power (Maximum)	-8dBm
(Nominal)	-11.5dBm
(Minimum)	-15dBm
Receiver Sensitivity	-28dBm (error rate of 1 in 10^{10})
Receiver Overload	-8dBm
Optical Path Penalty	1dB
Section Loss	0-12dB
Wavelength (Nominal)	1310nm
Connector Type	LC

Table 13.2 Optical Interface Parameters of LC1L12 Card for Short Haul (S1.1)

Optical interface parameters for Long Haul (L1.1) are given in table 13.3

Output Power (Maximum)	0dBm
(Nominal)	-2.5dBm
(Minimum)	-5dBm
Receiver Sensitivity	-34dBm (error rate of 1 in 10^{10})
Receiver Overload	-10dBm
Optical Path Penalty	1dB
Section Loss	10-28dB
Wavelength (Nominal)	1310nm
Connector Type	LC

Table 13.3 Optical Interface Parameters of LC1L12 Card for Long Haul (L1.1)

Optical interface parameters for Long Haul (L1.2) are given in table 13.4

Output Power (Maximum)	0dBm
(Nominal)	-2.5dBm
(Minimum)	-5dBm
Receiver Sensitivity	-34dBm (error rate of 1 in 10^{10})
Receiver Overload	-10dBm
Optical Path Penalty	1dB
Section Loss	10-28dB
Wavelength (Nominal)	1550nm
Connector Type	LC

Table 13.4 Optical Interface Parameters of LC1L12 Card for Long Haul (L1.2)

Note: Additional receiver sensitivity of up to 3dB can be provided on specific customer requirement.

13.6 Functional description

The LC1L12 Card provides four E4/STM-1e interfaces and up to eight STM-1 optical interfaces for the TJ100MC-16X system. The electrical ports are individually configurable for operation at E4 or STM-1e rates. The optical ports have field replaceable SFP modules. The operator can decide on the kind of SFP transceier to be mounted.

The Card has multirate LIUs to interface the incoming signal with the onboard Mapper/OHT. The FPGAs map incoming E4 data into the telecom bus to interface with the XCC128L/XCC64L Card. The same devices can be configured to act as an overhead terminator for incoming STM-1e data. This is interfaced to the XCC128L/XCC64L Card through serial telecom busses. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel.

Note: The Card can be configured to offer combinations a lesser number of electrical and optical ports depending on customer requirement. The maximum number of electrical ports can be four and the maximum number of optical ports can be eight.

13.7 Module Description

The front panel of the LC1L12 and description of indicators is presented in table 13.6 :

Card	Description		
	Visual Indicators		
	LED	Color	Status
	Active	Amber	Card jacked in
		Green	Software download Complete
		Off	Card Failure
	Status	Amber	Card jacked in
		Green blinking	Card communication withXCC128L/XCC64L in process
		Green	Card communication withXCC128L/XCC64L complete
		Red	Card failure
	STM1_0 Tx	Red	Laser OFF
		Green	Laser ON
	STM-1_0 Rx	Red	Optical power not detected
		Green	Optical power detected
	STM-1e/E4 Tx	Red	Port Admin down
		Green	Port Admin Up
	STM-1e/E4 Rx	Red	Electrical power not detected
		Green	Electrical power detected
	Diagnostic Interface: The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the 'Installation Procedure'. Note that the diagnostic interface is meant for use by authorized Networks personnel only. Reset Switch: The Reset switch, when activated provides a non-service disruptive reboot on the Card.		

Table 13.6 Front panel description of LC1L12 Card

Objective:

1. The LC1L12 card provides E4/STM-1e and STM-1o interface to the TJ100MC-16X system. (T/F)
2. There are four E4/STM-1e electrical ports in LC1L12 card of TJ100MC-16X system. (T/F)
3. There are eight STM-1 optical ports in LC1L12 card of TJ100MC-16X system. (T/F)
4. The type of connector used for optical ports on LC1L12 card of TJ100MC-16X system is LC connector. (T/F)

Subjective:

1. Give the functional description of LC1L12 card of TJ100MC-16X system.
2. Give the significance of LED indicators of LC1L12 card of TJ100MC-16X system.

CHAPTER 14

16 PORT STM-1_0 SFP INTERFACE LINE CARD (LC1L16FP)

14.1 Introduction

The LC1L16FP Card provides STM-1_0 interface to the TJ100MC-16X system. The optical ports have provision of SFP optics and are thus field configurable for the type of interface required. Up to sixteen optical interfaces can be mounted. The Card can be slotted in any of the line slots of the TJ100MC-16X system.

Power Consumption: The LC1L16FP consumes a maximum power of 45W.

14.2 Sub rack Interface

The LC1L 16FP requires – 48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

14.3 Traffic Interface

There are sixteen STM-1 optical ports on the front panel. The interface is provided with LC type connectors.

14.3.1 Optical Interface for Short Haul (S1.1)

Parameters of optical interface for short-haul(S1.1) are given in table 14.1

Output Power (Maximum)	-8dBm
Output Power (Nominal):	-11.5dBm
(Output Power Minimum):	-15dBm
Receiver Sensitivity:	-28dBm(error rate of 1 in 10^{10})
Optical Path Penalty:	1dB
Section Loss:	0-12dB
Wavelength (Nominal):	1310nm
Connector Type:	LC

Table 14.1 Parameters of optical interface for short haul (S1.1)

14.3.2 Parameters of Optical Interface for Long Haul (L1.1)

Parameters of Optical Interface for Long Haul (L1.1) are given in Table 14.2

Output Power (Maximum):	0dBm
Output Power (Nominal):	-2.5dBm
Output Power (Minimum):	-5 dBm
Receiver Sensitivity:-	-34dBM (error rate of 1 in 10^{10})
Receiver Overload:	-10dBm
Optical Path Penalty:	1 dB
Section Loss:	10-28dB
Wavelength (Nominal):	1310nm
Connector Type:	LC

Table 14.2 Parameters of Optical Interface for Long Haul (L1.1)

14.3.3 Parameters of Optical Interface for Long Haul (L1.2)

Parameters of Optical Interface for Long Haul (L1.2) are given in Table 14.3

Output Power (Maximum):	0dBm
Output Power (Nominal):	-2.5dBm
Output Power (Minimum):	-5 dBm
Receiver Sensitivity:-	-34dBM (error rate of 1 in 10^{10})
Receiver Overload:	-10dBm
Optical Path Penalty:	1 dB
Section Loss:	10-28dB
Wavelength (Nominal):	1550nm
Connector Type:	LC

Table 14.3 Parameters of Optical Interface for Long Haul (L1.2)

Note: Additional receiver sensitivity of up to 3dB can be provided on specific customer requirement.

14.4 Functional Description

The LC1L16FP Card provides sixteen STM-1 optical interfaces for the TJ100MC-16X system. The optical ports have field replaceable SFP modules. The operator can decide on the kind of SFP transceiver to be mounted.

The OHT FPGAs map incoming STM-1o data into the telecom bus to interface with the XCC128L/XCC64L Card. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel.

Note: The Card can be configured to offer lesser number of optical ports depending on customer requirement. The maximum number of optical ports can be sixteen.

14.5 Module description

The front panel of the LC1L16FP and description of indicators and interfaces are presented in Table 14.4

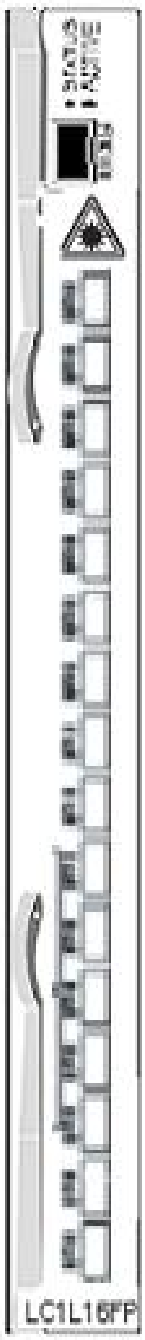
Card Description	Visual Indicators:		
	LED	Active	Status
	Active	Amber	Card jacked in
		Green	Software download Complete
		Off	Card Failure
	Status	Amber	Card jacked in
		Green blinking	Card communication with XCC128L/XCC64L in process
		Green	Card communication with XCC128L/XCC64L complete
		Red	Card failure
	STM-1$_o$ Tx	Red	Laser OFF
		Green	Laser ON
	STM-1o Rx	Red	Optical power not detected
		Green	Optical power detected
		Green	Port Admin up
	Diagnostic Interface: The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.		
	Reset Switch: The Reset switch, when activated provides a non-service disruptive reboot on the Card.		

Table 14.4 Front panel description of LC1L16FP Card

Objective:

1. The LC1L16FP card provides STM-1o interface to the TJ100MC-16X system. (T/F)
2. Sixteen optical interfaces can be mounted on LC1L16FP card of TJ100MC-16X system. (T/F)
3. The LC1L16FP card can be inserted in any of the line slots of TJ100MC-16X system. (T/F)
4. The LC1L16FP card of TJ100MC-16X system consumes a maximum power of 45 W. (T/F)
5. The LC1L16FP card of TJ100MC-16X system can be configured to offer lesser number of optical ports depending on the requirement. (T/F)

Subjective:

1. Explain the function of LC1L16FP card of TJ100MC-16X system
2. Explain the function of diagnostic interface and reset switch functions of LC1L16FP

CHAPTER 15

PORT STM-4 SFF INTERFACE CARD (LC4L4FF)

15.1 Introduction

The LC4L4FF Card provides the STM-4 optical interface to the TJ100MC-16X system. The Card provides different optical interfaces based on customer requirement. The optical interfaces supported are ITU-T G.957 and equivalent Bellcore GR-253-CORE complaint S4.1, L4.1 and L4.2 types. The optics used in the Card is of SFF type.

Power consumption: The LC4L4FF consumes a maximum power of 40W.

15.2 Sub rack interface

The LC4L4FF requires-48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

15.3 Traffic interface

There are four STM-4 optical ports on the front panel. The interface is provided with LC type connectors.

15.3.1 Optical Interface – Short Haul (S4.1)

Parameters of Optical Interface – Short Haul (S4.1) are given in table 15.1

Output power (Maximum)	-8dBm
Output Power (Nominal)	-11.5dBm
Output Power (Minimum)	-15dBm
Receiver Sensitivity	-28dBm (error rate of 1 in 10^{10})
Receiver Overload	-8dBm
Optical Path Penalty	1dB
Section Loss	0-12dB
Wavelength (Nominal)	1310nm
Spectral Range	1260-1360nm

Table 15.1 Parameters of Optical Interface – Short Haul (S 4.1)

15.3.2 Optical Interface – Long Haul (L 4.1)

Parameters of Optical Interface – Long Haul (L 4.1) are given in table 15.2

Output power (Maximum)	+2dBm
Output Power (Nominal)	-0.5dBm
Output Power (Minimum)	-3dBm
Receiver Sensitivity	-28dBm (error rate of 1 in 10^{10})
Receiver Overload	-8dBm
Optical Path Penalty	1 dB
Section Loss	10-24dB
Wavelength (Nominal)	1310nm
Spectral Range	1280-1335nm
Connector Type	LC

Table 15.2 Parameters of Optical Interface Long Haul (L 4.1)

15.3.3 Optical Interface – Long Haul (L 4.2)

Parameters of optical interface – Long Haul (L4.2) are given in table 15.3

Output power (Maximum)	+2dBm
Output Power (Nominal)	-0.5dBm
Output Power (Minimum)	-3dBm
Receiver Sensitivity	-28dBm (error rate of 1 in 10^{10})
Receiver Overload	-8dBm
Optical Path Penalty	1 dB
Section Loss	10-24dB
Wavelength (Nominal)	1550nm
Spectral Range	1480-1580nm
Connector Type	LC

Table 15.3 Parameters of Optical Interface Long Haul (L 4.2)

Note: Additional receiver sensitivity of up to **3dB** can be provided on specific Customer requirement.

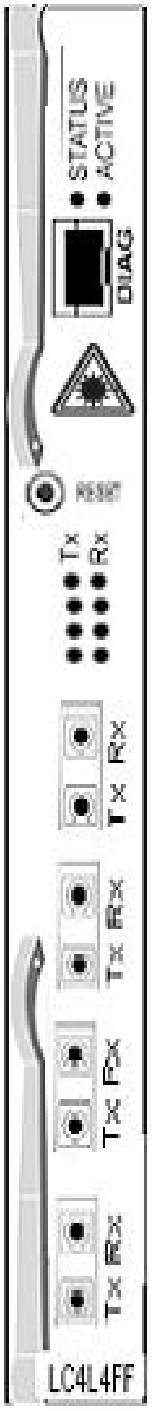
15.4 Functional description

The LC4L4FF Card provides STM-4 optical interface to the TJ100MC-16X system.

The onboard OHT provides termination and insertion for the SDH Regenerator, Multiplexer and Path Overheads or SONET Section, Line and Path Overheads. The lower order pointer processing is done on the Card to fix the AU pointers. This enables easy column switching for the lower order payloads. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane interface of the sub rack. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel.

15.5 Module Description

The front panel of the LC4L4FF is as shown below:

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td rowspan="11"> 
</td><td colspan="3">Visual Indicators:</td></tr>
<tr><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td rowspan="3">Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green</td><td>Software download complete</td></tr>
<tr><td>Off</td><td>Card Failure</td></tr>
<tr><td rowspan="4">Status</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green blinking</td><td>Card communication with XCC128L/XCC64L in process</td></tr>
<tr><td>Green</td><td>Card communication with XCC128L/XCC64L complete</td></tr>
<tr><td>Red</td><td>Card Failure</td></tr>
<tr><td rowspan="2">Tx</td><td>Red</td><td>Laser OFF</td></tr>
<tr><td>Green</td><td>Laser ON</td></tr>
<tr><td rowspan="2">Rx</td><td>Red</td><td>Optical power not detected</td></tr>
<tr><td>Green</td><td>Optical power detected</td></tr>
<tr><td colspan="3">Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.</td></tr>
<tr><td colspan="3">Reset Switch:

The Reset switch, when activated provides a non-service disruptive reboot on the Card.</td></tr>
</table>

Table 15.4 Front panel description of LC4LFF Module

Objective:

1. The LC4L4FF card provides the STM-4 optical interface to the TJ100MC-16X system. (T/F)
2. The LC4L4FF card of TJ100MC-16X system consumes a maximum power of 40W. (T/F)
3. The LC4L4FF card of TJ100MC-16X system has four STM-4 optical ports. (T/F)

Subjective:

1. Explain the function of LC4L4FF card of TJ100MC-16X system
2. Explain the significance of various indicators on LC4L4FF card.

CHAPTER 16

1-PORT STM-16 MSA OPTICS INTERFACE CARD (LC16L1N)

16.1 Introduction

The LC16L1N Card provides the STM-16 optical interface to the TJ100MC-16X system. The Card provides different optical interfaces based on customer requirement. The optical interfaces supported are ITU-T G.957 and equivalent Bellcore GR-253-CORE compliant S16.1, L16.1, L16.2 and L.16.2JE types. The optics used in the Card follow the industry standard MSA configuration for the transmitter and the receiver.

Power consumption: The LC16L1N consumes a maximum power of 40W.

16.2 Sub rack interface

The LC161L1N requires -48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

16.3 Traffic interface: There is a single STM-16 optical port on the front panel. The interface is provided with LC type connectors.

16.3.1 Optical Interface – Short Haul (S 16.1)

Parameters of optical interface – short haul (S 16.1) are given in table 16.1

Output Power (Maximum):	0dBm
Output Power (Nominal):	-2.5dBm
Output Power (Minimum):	-5dBm
Receiver Sensitivity:	-18dBm (error rate of 1 in 10^{10})
Receiver Overload:	0dBm
Optical Path Penalty:	1dB
Section Loss:	0-12dB
Wavelength (Nominal):	1310nm
Connector Type:	LC

Table 16.1 Parameters of optical interface – short haul (S 16.1)

16.3.2 Optical Interface – Long Haul (L16.1)

Parameters of Optical Interface – Long Haul (L16.1) are given in table 16.2

Output Power (Maximum):	+3dBm
Output Power (Nominal):	+0.5dBm
Output Power (Minimum):	-2dBm
Receiver Sensitivity:	-27dBm (error rate of 1 in 10^{10})
Receiver Overload:	-9dBm
Optical Path Penalty:	1dB
Section Loss:	10-24dB
Wavelength (Nominal):	1310nm
Connector Type:	LC

Table 16.2 Parameters of Optical Interface – Long Haul (L16.1)

16.3.3 Optical Interface – Long Haul (L16.2)

Parameters of Optical Interface – Long Haul (L16.2) are given in table 16.3

Output Power (Maximum):	+3dBm
Output Power (Nominal):	+0.5dBm
Output Power (Minimum):	-2dBm
Receiver Sensitivity:	-28dBm (error rate of 1 in 10^{10})
Receiver Overload:	-9dBm
Optical Path Penalty:	2dB
Section Loss:	10-24dB
Wavelength (Nominal):	1550nm
Connector Type:	LC

Table 16.3 Parameters of Optical Interface – Long Haul (L16.2)

16.3.4 Optical Interface – Long Haul (L16.2 JE)

Parameters of Optical Interface – Long Haul (L16.2JE) are given in table 16.4 The L16.2JE interface is envisaged in conditions where the section loss is greater than 24dB and less than 31dB.

	L16.2JE-1(Tx+Rx)	L16.2JE-2(SFP)
Output Power (Maximum):	+10dBm	+4dBm
Output Power (Nominal):	+7.5dBm	+3dBm
Output Power (Minimum):	+5dBm	+2dBm
Receiver Sensitivity:	-28dBm(BER of 1 E10)	-28dBm
Receiver Overload:	-9dBm	-9dBm
Optical Path Penalty:	2dB for 1800 ps/nm Dispersion	2dB for 3600 ps/nm Dispersion
Section Loss:	10-31 dB	10-28dB
Wavelength (Nominal):	1550nm	1550nm
Connector Type:	LC	LC

Table 16.4 Parameters of Optical Interface – Long Haul (L16.2 JE)

It may please be noted that in all the above interfaces, additional receiver sensitivity of up to 3dB can be provided on Specific customer requirement.

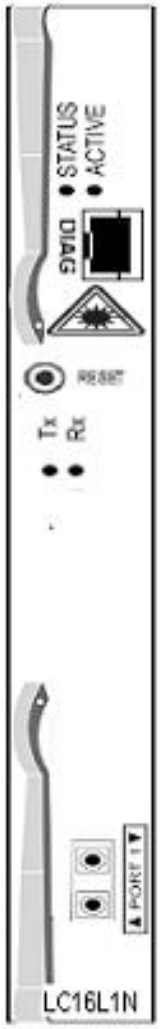
16.4 Functional description

The LC16L1N Card provides STM-16 optical interface to the TJ100MC-16X system.

The onboard OHT provides termination and insertion for the SDH Regenerator, Multiplexer and Path Overheads or SONET Section, Line and Path Overheads. The lower order pointer processing is done on the Card to fix the AU pointers. This enables easy column switching for the lower order payloads. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane interface of the sub rack. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel. The full STM-16 optical bandwidth of the Card can be realized if it is slotted in slots 4 through 6 and slots 9 through 11.

16.5 Module Description

The LC16L1N Card can be plugged into any of the line slots of the TJ100MC-16X chassis supporting STM-16 Bandwidth (Slots 4-6, 9-11). The line slots defined are the slots numbered 1 through 6 and 9 through 14. The front panel supports visual indicators that reflect the status of the Card, a diagnostic interface through an RJ45 connector, and a single optical interface of the LC type. The front panel of the LC16L1N Card and description of indicators are presented in table 16.5.

<table>
<tr><th>Card</th><th colspan="3">Description</th></tr>
<tr><td></td><td colspan="3">Visual Indicators:</td></tr>
<tr><td rowspan="11"> 
</td><td>LED</td><td>Color</td><td>Status</td></tr>
<tr><td rowspan="3">Active</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td>Green</td><td>Software download Complete</td></tr>
<tr><td>Off</td><td>Card Failure</td></tr>
<tr><td>Status</td><td>Amber</td><td>Card jacked in</td></tr>
<tr><td rowspan="3"></td><td>Green blinking</td><td>Card communication with XCC128L/XCC64L in process</td></tr>
<tr><td>Green</td><td>Card communication with XCC128L/XCC64L complete</td></tr>
<tr><td>Red</td><td>Card Failure</td></tr>
<tr><td>TX</td><td>Red</td><td>Laser OFF</td></tr>
<tr><td></td><td>Green</td><td>Laser ON</td></tr>
<tr><td>RX</td><td>Red</td><td>Optical power not detected</td></tr>
<tr><td></td><td>Green</td><td>Optical power detected</td></tr>
<tr><td colspan="3">Diagnostic Interface:

The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.

Reset Switch: The Reset switch, when activated provides a non-service disruptive reboot on the Card.</td></tr>
</table>

Table 16.5 Description of LC16 L1N Module

Objective:

1. The LC16L1Ncard provides the STM-16 optical interface to the TJ100MC-16X system. (T/F)
2. The LC16L1N card of TJ100MC-16X system consumes a maximum power of 40 W. (T/F)
3. Only one single STM-16 optical port is provided on the LC16L1N card of TJ100MC-16X system. (T/F)

Subjective:

1. Explain the function of LC16L1N card of TJ100MC-16X system
2. Briefly give the parameters of optical interfaces of LC16L1N card.

CHAPTER 17

1 PORT STM-16 SFF INTERFACE CARD (LC16L1FF)

17.1 Introduction

The LC16L1FF Card provides the STM-16 optical interface to the TJ100MC-16X system. The Card provides different optical interfaces based on customer requirement. The optical interfaces supported are ITU-T G.957 and equivalent Bellcore GR-253-CORE compliant S16.1, L16.1 and L16.2 types. The optics used in the Card is of SFF type.

Power consumption: The LC16L1FF consumes a maximum power of 40W.

17.2 Sub rack interface

The LC161L1FF requires-48V supply. This is provided from the back plane of the sub rack. The power is provided through two universal power module headers.

The interface with the back plane of the sub rack for high-speed signals is through a single high-speed differential ZD type connector. Control and other signals are provided to and from the back plane of the sub rack through a Type A connector.

17.3 Traffic Interface: There is a single STM-16 optical port on the front panel. The interface is provided with LC type connectors.

17.3.1 Optical Interface – Short Haul (S 16.1)

Parameters of Optical Interface – Short Haul (S 16.1) are given in Table 17.1

Output Power	(Maximum)	0dBm
	(Nominal)	-2.5dBm
	(Minimum)	-5dBm
Receiver Sensitivity		-18dBm(error rate of 1 in 10^{10})
Receiver Overload		0dBm
Optical Path Penalty		1dB
Section Loss		0-12dB
Wavelength	(Nominal)	1310nm
Connector Type		LC

Table 17.1 Parameters of Optical Interface – Short Haul (S 16.1)

17.3.2 Optical Interface – Long Haul (L 16.1)

Parameters of Optical Interface – Long Haul (L 16.1) are given in Table 17.2

Output Power	(Maximum)	+3 dBm
	(Nominal)	+0.5dBm
	(Minimum)	-2dBm
Receiver Sensitivity		-27dBm (error rate of 1 in 10^{10})
Receiver Overload		-9dBm
Optical Path Penalty		1dB
Section Loss		10-24dB
Wavelength	(Nominal)	1310nm
Connector Type		LC

Table 17.2 Parameters of Optical Interface – Long Haul (L16.1)

17.3.3 Optical Interface – Long Haul (L 16.2)

Parameters of Optical Interface- Long Haul (L16.2) are given in Table17.3

Output Power	(Maximum)	+3 dBm
	(Nominal)	+0.5dBm
	(Minimum)	-2dBm
Receiver Sensitivity		-28dBm (error rate of 1 in 10^{10})
Receiver Overload		-9dBm
Optical Path Penalty		2dB
Section Loss		10-24dB
Wavelength	(Nominal)	1550nm
Connector Type		LC

Table 17.3 Parameters of Optical Interface – Long Haul (L16.2)

It may please be noted that additional receiver sensitivity of up to **3dB** can be provided on specific customer requirement

17.4 Functional description

The LC16L1FF Card provides STM-16 optical interface to the TJ100MC-16X system.

The onboard OHT provides termination and insertion for the SDH Regenerator, Multiplexer and Path Overheads or SONET Section, Line and Path Overheads. The lower order pointer processing is done on the Card to fix the AU pointers. This enables easy column switching for the lower order payloads. The Card has its own generation system for clocks required on board. It receives the system timing signals from the XCC128L/XCC64L Card through the back plane interface of the sub rack. The Card has its local power supply unit to generate 3.3V. The local power supply unit has input of –48V. The Card can communicate to the Controller Card in the TJ100MC-16X system through Inter Card Communication channel. The full STM-16 optical bandwidth of the Card can be realized if it is slotted in slots 4 through 6 and slots 9 through 11.

17.5 Module Description

The LC16L1FF Card can be plugged in any of the line slots of the TJ100MC-16X chassis supporting STM-16 Bandwidth (Slots 4-6, 9-11). The line slots defined are the slots numbered 1 through 6 and 9 through 14. The front panel supports visual indicators that reflect the status of the Card, a diagnostic interface through an RJ45 connector, and a single optical interface of the LC type. The front panel of the LC16L1FF Interface Card and description of indicators, interfaces are given in Table 17.4

Card	Description		
	Visual Indicators:		
	LED	Color	Status
	Active	Amber	Card jacked in
		green	Software download Complete
		Off	Card Failure
	Status	Amber	Card jacked in
		Green blinking	Card communication with XCC128L/XCC64L in process
		Green	Card communication with XCC128L/XCC64L complete
		Red	Card Failure
	Tx	Red	Laser OFF
		Green	Laser On
	Rx	Red	Optical power not detected
		Green	Optical power detected
	Diagnostic Interface: The diagnostic interface facilitates debugging through an RJ45 connector. For details regarding the pin configuration and connection refer to the Installation Procedure. Note that the diagnostic interface is meant for use by authorized Networks personnel only.		
	Reset Switch: The Reset switch, when activated provides a non-service disruptive reboot on the Card.		

Table 17.4 Description of front panel of LC16L1FF Module

Objective:

1. The LC16L1FF module consumes a maximum power of ----------
   a) 40 mW b) 40 µW c) 40 nW d) 40W
2. The number of STM-16 optical ports available on the front panel of LC16L1FF module is ----------
   a) four b) three c) two d) one

Subjective:

1. Give the significance of the LEDs on the LC16L1FF module.
2. Give the functional description of LC16L1FF module.

PART IV:

Teja’s MC4L STM-4 Equipment

CHAPTER-1

TEJAS MC4L STM-4 EQUIPMENT

1.0. INTRODUCTION

The TJ100MC-4L is a carrier class, cost effective and modular bandwidth provisioning equipment designed to manage and derive services from the optical core to the access. It supports end-to-end provisioning and management of services across all segments of the optical network. It combines innovative optical networking software with the resilience of SDH to deliver a flexible solution to today's service providers. The TJ100MC-4L can be configured as a Terminal Multiplexer (TMUX), Add-Drop Multiplexer (ADM), Regenerator, In-Line Amplifier or as a standalone Cross-connect. A variety of service interfaces such as E1/DS1, E3/DS3, E4, STM-1e/o and 10/100 Mbps Ethernet tributary interfaces and trunk interfaces at STM-1/4 rates are supported. It features non-blocking cross-connect at VC-3, VC-4 and VC-12 granularity and supports drop and continue functionality.

1.1 FEATURES

- Multi slot chassis system.
- Flexibility, modularity and scalability in configurations
- Allows easy upgrade from STM-1 to STM-4 without service disruption.
- Capability enhancement in traffic drops can be achieved with expansion chassis.
- Compact size Half depth rack allows two TJ100MC-4Ls to be placed back-to-back on a standard rack
- Better utilization of available rack space
- Integrated multi-service delivery
- Provision of both voice and data services from the same
- Efficient use of transport bandwidth by supporting per-port rate adaptive Ethernet Services
- Redundant cards with hot insertion capability
- Guaranteed availability and superior network resilience
- Carrier-class redundancy and high network uptime with minimum loss of revenue
- Point-to-point, linear, ring & mesh topologies
- Diverse topology support to cater to all customer network scenarios
- Flexible and cost-effective network solutions
- Multi-level protection schemes MSP, SNCP
- Advanced protection schemes enable differing protection requirements
- Creation of differentiated services to enhance the portfolio of service offerings
- Advanced networking software with support for open standards such as GMPLS and OSPF
- Enables automatic topology discovery, shared mesh restoration and Point- and Click Provisioning (PNCP)
- User friendly GUI based Network Element Software for local and remote provisioning
- Reduction in operational costs and increase in efficiency through lower provisioning time and operator intervention
- 11 Traffic Slots 252 E1s from single chassis.

1.2. EQUIPMENT DESCRIPTION:

The MC-4L system of Tejas networks consists of the following units

1. Power supply unit (PSU)
2. Multifunction Card (MFC1)
3. Ethernet Tributary Card (TP01)
4. STM-1 Aggregate Card (A012)
5. STM-4 Aggregate card (A041)
6. Cross-connect Card (XCC16L)
7. System Control Unit (SCU4)
8. E1 Tributary Card (TET28)

Fig : MC-4L EQUIPMENTFRONT VEIW

Multi Function Card (MFC)														
TP 01	AO11 STM I			AO41 STM 4	XCC	XCC	SCU	SCU	AO41 STM 4					TET
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Supply unit (PSU)						Power Supply unit (PSU)								

1.3. Power Supply unit (PSU)

The power supply units (PSU) are part of the base TJ100MC-1. The PSU forms one part of a redundant, load-sharing (not true current sharing) supply and provides a stable DC power to other cards in the system. In general, the power supply units are required to provide independent power sources. Normally only one source of power supply is used. Each PSU delivers 150W power output with primary and secondary voltages being 48 V and 12 V respectively.

Operating parameters

- Input voltage, 48 V DC with either the positive or negative input earthed.
- Output voltage, +12 V DC at 12.5 A maximum.
- Output power 150 W.

A 6.3 A slow-blow glass fuse with maximum sustained dissipation of 1.6 W is used on the positive line of the input power. This card fits in the slots 16 and 17 of TJ 100 mc-4L chassis.
The front panel of this card includes:

- Power connector
- Power ON/OFF switch.
- Two LED indicators.
- Primary voltage monitoring port
- Secondary voltage monitoring port.

The two LEDs, Power and Active LEDs provide a visual indication of the input and the output voltages relative to the card.

LED	COLOUR	STATUS
POWER	GREEN	The DC-DC converter is active
	OFF	The DC-DC converter is in-active
ACTIVE	GREEN	The output voltage is within specified range
	RED	The output voltage is out of range

The PSU is protected against output short circuit, over voltage and under voltage. Input over voltage and under voltage protection is provided. The output over voltage protection is latched and the unit will not restart until power to the unit is removed and reconnected.

1.4. Multi Function Card (MFC1)

The MFC1 is used to implement miscellaneous interfaces. This card is plugged into the slot 18 of the TJ100MC-4L chassis. This card supports the following interfaces along with the visual alarm indicators.

- Order- wire interface
- 10/100 NMS Ethernet interface
- Two serial interfaces for modern and craft interfaces
- Alarm input and output interfaces.

MFC1 consumes a maximum power of 4 W, at 12 V DC.

The NMS interface is associated with two LEDs, Green and Amber. The possible LED status and their significance is given below.

Card Status	NMS LED	
	Amber	Green
Link speed 10 Mbps	OFF	NA
Link speed 100 Mbps	ON	NA
NMS port UP	NA	ON
Receiver Activity	NA	Blink on packet received

The Order-wire interface is associated with a single bicolor LED Green and Red. The possible LED status and their significance is given below.

Card State	OW LED
Telephone On hook	Green

Telephone Ringing	Green blinking
Telephone Off hook	Red

The MFC1 has visual indications for alarm and the power on the card. The following visual indications are available.

LED Name	LED Colour	Status
Power	Green	Card is powered-up
	OFF	Card is not powered-up
Critical Alarm	Red	Critical Alarm is present
	OFF	Critical Alarm is not present
Major Alarm	Orange	Major Alarm is present
	OFF	Major Alarm is not present
Minor Alarm	Yellow	Minor Alarm is present
	OFF	Minor Alarm is not present
Deferred Alarm	Blue	Deferred Alarm is present
	OFF	Deferred Alarm is not present

The MFC1 has a SLIC device to handle the two-wire analog Order Wire Interface. The SLIC device converts the analog voice data to PCM samples and vice-versa.

1.5. Ethernet Tributary Card (TP01)

TP01 tributary interface card provides line interfaces to eight 10/100 Mbps Rx and Tx port. This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC-12/VC-3/VC-4) of the SDH frame.

1.6. STM-1 Aggregate Card (A011, A012)

The STM-1 Aggregate cards are generic aggregate cards that can be used across all the Tejas's STM-1/4 products. The STM-1 aggregate cards, A011 and A012 are designed to function as one port STM-1 and Two port STM-1 aggregate cards respectively. This card can be plugged into any of the slots from 1 to 5 and 10 to 15 of the TJ100 MC-4L chassis. Visual Indicators are provided on the front panel of the STM-1 aggregate card. The visual indicators include the Active and the Status LEDs and an LED each for Tx and Rx for the STM interfaces.

The possible LED status and their significance is given below.

LED	COLOUR	STATUS
ACTIVE	Amber	On insertion/power ON
	Green	Initialization complete/In use
	Red	Card Inactive
STATUS	Amber	On insertion/Power ON
	Green	Initialization complete
	Red	Hardware error
TX	Green	Laser is ON and the corresponding port is transmitting
	Red	Laser is Off

RX	Green	The corresponding port is receiving a signal
	Red	The corresponding port is not receiving a signal

1.7. STM-4 Aggregate Card (A041)

The STM-4 tributary card is designed to function as one port STM-4 aggregate card. The A041 card has one optical Transreceiver operating at STM-4 rate for the aggregate interface. The optical Transreceiver mounted on the card can be of L/S4.1/4.2 types. The maximum span can that be achieved with L4.2 Tran receiver is 24 dB (80 Km). The front panel of STM-4 aggregate card is having visual indicators. They include the Active and the Status LEDs and an LED each for Tx and Rx for the STM interfaces. The possible LED status and their significance is given below.

LED	COLOUR	STATUS
ACTIVE	Amber	On insertion/power ON
	Green	Initialization complete/In use
	Red	Card inactive
STATUS	Amber	On insertion/power ON
	Green	Initialization complete
	Red	Hardware error
Tx	Green	Laser is ON and the corresponding port is transmitting
	Red	Laser is OFF
Rx	Green	The corresponding port is receiving a signal
	Red	The corresponding port is not receiving a signal

1.8. Cross-connect Card (XCC16L)

The XCC16L is the cross-connect card that occupies the slots 6 and 7 in the TJ100 MC4-L chassis. The card consists of the cross-connect sub-system and the timing sub-system. The system provides for redundancy on the XCC16L card. The cross connect subsystem consists of a non-blocking switch at VC-12 granularity. The timing subsystem has a stratum-3 timing module that generates the reference clocks for the entire equipment, including the SDH timing signals.

The front panel of the XCC16L consists of visual indicators. They include two LEDs, the Active and the Status LEDs. The possible LED status and their significance is given below.

LED	COLOUR	STATUS
ACTIVE	Amber	Card is booting-up
	Green	Card is active (Master)
	Off	Card is in standby mode (slave)
	Red	Card failure
STATUS	Amber	Card is booting-up
	Green	Card is active (Master)
	Off	Card is in standby mode (slave)
	Red	Card failure

Hot Swap switch: The master and slave card configuration of the redundant XCC16L cards can be forced using the hot swap switch. When the hot swap switch is activated, the respective

card renders the peer card as the master and takes over as a slave. The switch is functional only on the card that is active provided another card is available in the standby configuration.

1.9. System Control Unit (SCU4)

The SCU4 card initiates the configuration and control of the other cards on the TJ100MC-4L system at boot-up. The SCU4 card houses the processor sub-system (PSS) that handles the control path. The system provides for redundancy on the SCU4 cards. The SCU4 cards can be plugged into the slots 8 and 9 of the TJ100MC-4L chassis. The front panel supports visual indicators that reflect the status of the card, a diagnostic interface through an RJ-45 connector and two push button switches for soft reset and redundancy control. Visual indicators are provided on the front panel. The possible LED status and their significance is given below.

LED	COLOUR	STATUS
ACTIVE	Amber	Blinking. Card is booting
	Green	Booting process complete (Master)
	Off	Booting process complete (Slave)
STATUS	Amber	Blinking. Card is booting
	Green	Booting process complete
	Off	Card failure

The SCU4 consists of a 32 bit micro controller and an on board external memory to implement the required functions. The software residing in this block controls the overall management of the system.

Hot Swap Switch: The master and the slave card configuration of the redundant SCU4 cards can be forced using the hot swap switch. When the hot swap switch is activated, the respective card renders the peer card as master and takes over as slave. The switch is functional only on the card that is active provided another card is available in the stand-by configuration.

Reset switch: The reset switch, when activated provides a non-service disruptive reboot on the card.

1.10. E1 Tributary Card (TET16, TET21, TET28)

The E1 cards, TET16, TET21 and TET28 are generic tributary cards that can be used across all the Tejas STM1/4 products. E1 tributary interface cards provide line interfaces to 16 E1, 21E1 and 28 E1 channels respectively in both add and drop directions. These cards map and demap the E1 channels into SDH/SONET frame for the tributary card to make the cross-connects. This card can be plugged into any of the slots from 1 to 5 or 10 to 15 of the TJ100MC-4L chassis. The front panel of the tributary card is having visual indicators. They include two LEDs, the Active and Status LEDs. The possible LED status and their significance is given below.

LED	COLOUR	STATUS
ACTIVE	Amber	On insertion/power ON
	Green	Initialization complete/In use
	Red	Card inactive
STATUS	Amber	On insertion/power ON
	Green	Initialization complete

	Red	Hardware error

The E1 interface is provided through 62 way D-type connectors on 120 Ohms.

Checking the card LED status

Card	LED Status	Remarks
PSU	Power LED	Glows green when powered ON
	Status LED	Glows green when active
MIC	Status LED	Glows green Card UP
	Link LED	Glows green when the Ethernet Card is enabled else it glows RED
PSS	Status LED	Blinks on power ON and becomes green after the card boots
	Active LED	Glows Amber on power ON and turns green when card is active else is off when card inactive
XC4	Status LED	Glows Amber on power ON and glows green after the Software initialization, glows Red if fault on the card
	Active LED	Glows Amber on power ON, Green when card is active and OFF when card is inactive
A041	Status LED	Glows Amber on power ON and then green after software initialization and Red if fault on the card
	LED indicator	The TX glows green when carrying traffic, else LED is OFF
		The RX glows green when receive power is present and is RED when no receive power
A011 or A012	Status LED	Glows Amber on power ON and then green after software initialization and RED if fault on the card
	LED indicator	There are pairs of TX and RX LEDs on this card and the TX glows green when carrying traffic, else LED is OFF
		The RX glows Green when receive power is present and RED when no receive power