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Specification For Primary Digital Multiplexing Equipment			

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**



**INDIAN RAILWAY
STANDARD SPECIFICATION
FOR
PRIMARY DIGITAL MULTIPLEXING
EQUIPMENT**

Specification No. IRS : TC 68/2012

ISSUED BY

TELECOM. DIRECTORATE

**RESEARCH DESIGNS & STANDARDS ORGANIZATION
LUCKNOW – 226 011**

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Summary:

The specification covers the general and technical requirement for 2048 kilo bit per second primary drop / insert Multiplexer with conference facility. Different type of voice and & data interfaces to be provided with this multiplexers are also included. The specification also prescribes various type and acceptance tests to be conducted for accepting the material.

Source:

This specification is issued under the fixed serial no. IRS: TC 68 followed by the year of adoption as standard or in the event of revision, the year of last revision. This specification was first adopted in the year 1994. The first revision took place in the year 1997.

The second revision is issued on the recommendations of 31st Telecom Standards Committee Meeting held at IRISSET Secunderabad, on 22 & 23rd December 2003 and Railway Board's approval letter no. 2002/Tele/TCM/2 dated 26/02/2004.

The third revision is issued on the (i) recommendations of 36th Telecom Standards Committee Meeting held at Bangalore, on 12th & 13th May 2011 and Railway Board's approval letter no. 2011/Tele/9(2) dated 07.07.2011 (ii) Amendment No. 1 issued vide this office letter No. STT/DC/MUX/Proto-Test/245 Dated : 31.07.2007 (iii) Vendors meeting held in this office on 8th & 9th September 2011 in this office & minutes circulated vide this office letter No. STT/DC/Proto-Test/245 dated 25.11.2011.

Foreword:

Research Design and Standards Organisation (RDSO) is an attached office of Ministry of Railways, engaged in design and standardization of equipment on Indian Railways.

Indian Railway Standard specification is issued after recommendation of Telecom Standards Committee Meeting (TCSC) and approval of Railway Board.

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**INDIAN RAILWAY
STANDARD SPECIFICATION
FOR
PRIMARY DIGITAL MULTIPLEXING EQUIPMENT**

1. SCOPE:

- 1.1 This specification covers the requirement for 2048 kbit per second primary drop / insert Multiplexer (Programmable) with conference facility.

The equipment is proposed to be used either as a terminal Multiplexer or as a drop insert Multiplexer in tandem on a 2 MB stream on digital transmission media with or without conference facility.

- 1.2 This equipment shall multiplex 30 analogue and / or data channel to 2048 kbps ITU-T compatible digital stream on send side and on receive side it shall demultiplex ITU-T compatible 2048 kbps digital stream to 30 analogue/data channels.
- 1.3 This equipment shall have at least two 2048 kbps ports (P1 and P2 port) each for send and receive. It shall be possible to drop / insert any channel from / to P1/P2 port or make any time slot through from P1 port to P2 port and vice-versa.
- 1.4 This equipment shall have facility of at least 3 party conference between any combination of time slots of either P1 port or P2 port and voice interfaces.
- 1.5 Programming of MUX shall be either through RS-232C/USB port or other ITU-T compatible port for MUX-configuration, diagnostic and performance evaluation. Compatibility between the ports provided in the MUX and NMS/Local Craft Terminal shall be ensured either by use of same type of ports in both or with use of suitable port converters. It should also be possible to access the multiplexer from remote location through the supervisory channel. Facility for extension of alarms to the remote monitoring and control centre shall be provided.

2. References:

In preparing this standard, assistance has been derived from the following:

Rec. G. 703 (11/2001)	ITU -T
Rec. G. 704 (10 / 98)	ITU -T
Rec. G. 706 (1991)	CCITT
Rec. G. 711 (Fascicle III.4, Blue Book)	ITU -T
Rec. G. 712 (11 / 2001)	ITU -T
Rec. G. 732 (Fascicle III.4, Blue Book)	ITU -T
Rec. G. 735(Fascicle III.4, Blue Book)	ITU -T
Rec. G. 736 (03 / 93)	ITU -T
Rec. G. 821 (08 / 96)	ITU -T
Rec. G. 823 (03 / 2000)	ITU -T
Rec. G. 961	ITU - T
Rec. V. 10 (03 / 93)	ITU -T
Rec. V. 11 (10 / 96)	ITU -T
Rec. V. 24 (02 / 2000)	ITU -T
Rec. V. 28 (03 / 93)	ITU -T
Rec. V. 35(Fascicle VIII.1, Red Book)	CCITT
Rec. V. 36(Fascicle VIII.1, Blue Book)	ITU -T
IEC 870-2-1 1995 part 2	IEC
RS232 c	EIA/TIA
ISO 2110	ISO
ISO 2593	ISO
ISO 4902	ISO
QM 333 (September 1990)	BSNL
QM 115 (January 1997)	BSNL
RDSO/SPN/48/2003	RDSO

3. **TERMINOLOGY:**

The terminology used in this specification is as used by International telecommunication Union (ITU -T).

4. **ENVIRONMENTAL CONDITIONS:**

- 4.1 The ranges of ambient temperature and humidity within which the equipment performance specification shall be met as well as the ranges within which the equipment is to remain operational without any irreversible damage are as under (As per QM 333 Table 4.3 Category B):

a)	Ambient temperature range over which specification are guaranteed (50% RH at max. temp.)	0°C to 50°C	
b)	Ambient temperature range over which equipment is to remain operational without irreversible damage (50% RH at max. temp.)	-5°C to 55°C	Applicable for thermal cycle only
c)	Storage temperature (50% RH at max. temp.) without causing irreversible damage.	-5°C to 60°C	
d)	Max. temperature for which specification is guaranteed at 95% humidity.	35°C	Applicable for damp heat steady state.
e)	Maximum temp. range at which equipment shall survive at 95% RH.	40°C	

4.2 The environmental testing shall be conducted as per specification No. QM 333 for environmental testing of electronic equipments for transmission and switching use issued by DOT in September 1990. The testing shall be as per category 'B2' and following tests shall be carried out:

- a) Cold
- b) Dry heat
- c) Damp heat (cyclic)
- d) Rapid temp. Cycling
- e) Damp heat steady state
- f) Vibration

5. GENERAL REQUIREMENTS:

- 5.1 The system shall conform to all the relevant and current ITU-T recommendations.
- 5.2 Manufacture and assembly of this equipment shall be made according to the standard practices adopted by International Electro-technical Commission (IEC) and in accordance with RDSO / SPN / 48 / 2003.

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- 5.3 The equipment shall be fully solid state, field proven and adopt state of the art technology.
- 5.4 Plug-in units and sub racks shall be properly marked to avoid errors.
- 5.5 Each functional unit shall be self –contained (e.g. arranged on a single Plug-in card) and shall be replaceable without readjustments of the entire equipment.
- Manufacturer shall indicate the method of Electronically sealing and safe packaging for transport of the cards from station to Central Repair Center.
- 5.6 The equipment shall offer ergonomic ease in its operation and maintenance.
- 5.7 Sudden failure of power supply shall not result in any damages. The failure of a component or a card shall not lead to damage / failure of other components/cards of the equipment.
- 5.8 Failure of any channel unit associated with primary Multiplexer, should not affect the operation of Primary Multiplexer.
- 5.9 The mechanical design and construction of each unit subassembly shall be inherently robust, rigid and precise. The cards shall slide in the slots effortlessly. All types of interface cards shall be capable of being used in any of interface card slots.
- 5.10 The connectors used shall be of professional grade telecom connectors of international standard (Euro type, Millimetric type).
- 5.11 The equipment shall have self-cooling arrangement. No forced cooling using fan etc. is envisaged.
- 5.12 The equipment shall be mounted on standard 19-inch rack. The number of system that can be installed on each rack shall be specified. Racks shall be provided with suitable covers on all sides to protect entry of dust, rodents, etc.
- 5.13 The equipment shall be able to work in a saline atmosphere in coastal areas and shall be protected against corrosion.
- 5.14 The equipment shall be compact and composite construction including power supply, switching circuits, control unit, ringer and remote supervisory facility (where required). The system shall have redundant power supply units (1+1) or each individual card shall have it's own in built DC-DC converter.

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- 5.15 The channel interface units associated with Primary Multiplexer should be hot replaceable without affecting the operation and reliability of Primary Multiplexer.
- 5.16 Painting and plating of the equipment shall be of approved quality and shall be such that it makes the surface anti corrosive.
- 5.17 Following documents shall be supplied with each of the Multiplexer:
- a) Routine test results.
 - b) Operating and user manual
 - c) Installation manual
 - d) Fault localization and trouble shooting manual
 - e) PCB layout, circuit diagram and parts list as required for installation operation and maintenance.

6. TYPE OF INTERFACES:

6.1 Following type of interfaces shall be available on the primary Multiplexer:

a) VOICE INTERFACES:

- 2W E&M
- 4W E&M
- 2W subscriber loop
- 2W exchange loop
- 2W hot line

b) DATA INTERFACES:

- Low speed data interface
- 64 Kbps data interface
- Nx64 Kbps data interface
- E1 branching Interface

c) DIGITAL SUBSCRIBER LINE INTERFACE:

- IDSL along with Network Termination Unit

6.2 It shall be possible to connect any combinations of these interfaces on any primary Multiplexer.

- 6.3 The supplier shall specify the number of circuits on a single card. The supplier should specifically bring out any limitation in the above.
- 6.4 The purchaser shall specify the number and types of circuits for each Multiplexer. The supplier shall indicate the configuration of each Multiplexer to meet the above requirement.

7. TECHNICAL REQUIREMENTS OF PRIMARY MULTIPLEXER – AGGREGATE SIDE

7.1 PULSE CODE MODULATION (PCM):

It shall be in accordance with ITU –T G. 711. The main characteristics are as under:

- a) Sampling rate 8000 samples per second \pm 50 ppm
- b) Encoding law A law as per table 1a/1b of ITU-T G. 711

7.2 DIGITAL INTERFACE AT 2048 KBPS:

It shall be in accordance with clause 9 of ITU –T G. 703. The main characteristics are as under:

7.2.1 General Characteristics

- a) Bit Rate : 2048 kb/s \pm 50 PPM
- b) Code : HDB3

7.2.2 Specification of output ports (Table 7 / ITU –T G.703):

I.

- a) Nominal Impedance : 120 Ohms balanced
- b) Peak voltage of a mark
(Pulse) : 3.0 \pm 0.3 V
- c) Peak Voltage of a space : 0 \pm 0.3 V
- d) Nominal Pulse width : 244 ns.
- e) Pulse Mask : Figure 15 / ITU –T G. 703
- f) Output jitter : Shall be as per clause
7.1 of ITU – T, G.735, as given
below.

- i) In the case where transmitting timing signal is derived from an internal oscillator, the peak to peak jitter at the 2048 kbps output should not exceed 0.05 UI when it is measured with in the frequency range from $f_1 = 20$ Hz to $f_4 = 100$ kHz.
- ii) In the case where the transmitting timing signal is derived from an external source having no jitter, the peak to peak jitter at the 2048 kbps out put should not exceed 0.05 UI when it is measured with in the frequency range from $f_1 = 20$ Hz to $f_4 = 100$ kHz.
- iii) In the case where transmitting timing signal is derived from the incoming 2048 kbps signal having no jitter, the peak to peak jitter at the 2048 kbps out put should not exceed 0.10 UI when it is measured with in the frequency range from $f_1 = 20$ Hz to $f_4 = 100$ kHz. The equivalent binary content of the test signal applied at the 2048 kbps input shall be a pseudo-random bit sequence of length $2^{15} - 1$ as specified in ITU – T recommendation O. 151.
- g) Output wander : Shall be as per clause 5.2.1 of ITU-T G 823

II.

- a) Nominal Impedance : 75 Ohms Unbalanced
- b) Peak voltage of a mark (Pulse) : $2.37 \text{ V} \pm 0.237 \text{ V}$
- c) Peak Voltage of a space : $0 \pm 0.237 \text{ V}$
- d) Nominal Pulse width : 244 ns.
- e) Pulse Mask : Figure 15 / ITU -T G. 703
- f) Output jitter : As per Cl. No. 7.2.2 I (f)
- g) Output wander : As per cl. no. 7.2.2 I (g)

7.2.2.1 The return loss at out put port should have the following minimum values:

Frequency Range (kHz)	Return Loss (dB)
51 to 102	6
102 to 3072	8

7.2.3 Specification at the input port:

It shall be in accordance with clause 9.3 of ITU – T G. 703. The main characteristics are as under:

a) Permissible attenuation : Input signal to follow \sqrt{f} law and Permissible attenuation at 1024 KHz shall be more than 6 dB.

b) Return Loss:

Frequency Range (kHz)	Return loss
51 to 102	≥ 12 dB
102 to 2048	≥ 18 dB
2048 to 3072	≥ 14 dB

c) Jitter & Wander tolerance:

The jitter and wander tolerance of input port shall be as per clause 7.1.2 of ITU-T G823. The values of frequencies shall be as applicable to “ different operator network”.

7.2.4 Jitter Transfer Function:

Jitter transfer function shall be as per clause 7.3.1 & 7.3.2 of ITU – T G. 735.

7.3 FRAME STRUCTURE:

7.3.1 The frame structure shall be as per Clause 2.3 and 5.1 of ITU -T G.704 and the allocation of bits number 1 to 8 shall be as per Table 5A of ITU -T G. 704. The Si bit shall be usable as per 2.3.3.2 / G.704 for a CRC4 check bit procedure. Provision for selection of CRC4 / non-CRC4 mode shall be provided. The Si bit shall be set to 1 in case of non-CRC4 mode. Sn bits can be used for specific point-to-point application. If any of these bits are not used, they shall be fixed to 1.

7.3.2 The frame shall consist of 32 time slots numbering from time slot 0 to time slot 31. Time slot 0 shall be used for the transmission of frame synchronization word and alarm etc. Time slot 16 shall be used for the transmission of channel associated signaling information. Remaining slots shall be used as speech/data channels.

7.3.3 A multi frame shall comprise of 16 consecutive frames and shall be numbered from 0 to 15. A multi frame alignment signal 0000 shall occupy bit 1 to 4 of channel time slot 16 in frame 0.

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7.3.4 The details of bit allocation for time slot 16 when it is used for channel associated signaling shall be as per Table 14 of ITU -T G. 704.

7.4 TIMING INFORMATION:

7.4.1 The equipment shall have provision of deriving timing signals from internal and external sources. It shall also have capability to derive timing signals from the incoming digital signal. The equipment shall automatically switch over from one timing signal source to another in case on failure of the primary source. It shall also be possible to fix the priorities of various timing sources.

7.4.2 Specification of the input port for external clock:

The signal presented at the input port shall be as per ITU – T specification for digital 2048 kHz clock interface Table 11, 11a, 11b of G. 703 and figure 20 of G.703 with impedance of 120 Ohm balanced but modified by the characteristics of the interconnecting pair as per clause 13.3 of G. 703.

7.4.3 Specification at the out put port:

The equipment shall also provide clock out put for external equipment synchronization as per table 11,11a / G. 703 and fig. 20 / G. 703.

7.5 LOSS AND RECOVERY OF FRAME ALIGNMENT:

7.5.1 Loss and recovery of frame alignment shall be as per Clause 3 of ITU - T G. 732 / clause 4.1 of G. 706.

7.5.2 Loss and recovery of multi-frame alignment in case of channel associated signaling shall be as per Clause 5.2 of ITU - T G. 732. If CRC4 mode has been selected, the CRC4 multiframe alignment shall be as per clause 2.3.3.4 of G. 704.

7.6 ALARMS:

7.6.1 The alarms for following conditions shall be essentially incorporated:

- a) Power supply unit failed
- b) Loss of incoming signal at 64 Kb/s input port (for 64 K interface Co-directional G. 703)
- c) Loss of incoming signal at 2048 kbps
- d) Loss of frame alignment
- e) Loss of multi-frame alignment
- f) Excessive error ratio alarm in framing pattern for bit error rate of 10E-3.
- g) Remote failure

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- h) AIS alarm
- i) The list of other alarms, if any, shall be indicated by the supplier.

7.6.2 Consequent action:

On detection of the fault appropriate action shall be taken as specified in ITU –T Table 1/G. 732 and Table 2/G. 732.

7.6.3 Two programmable contacts out put shall be provided one each for major and minor alarms. These shall be used to extending alarms to bay top or to the central alarm monitoring panel.

7.7 PROGRAMMABLE FEATURES, NETWORK MONITORING AND CONTROL:

7.7.1 There shall be a maintenance portable terminal for local monitoring, control and configuration of individual multiplexers at same station or remotely. Following features shall be provided.

- Configuration of Multiplexer including circuit configuration.
- Monitoring of alarms
- Monitoring of link performance and statistic
- Maintenance and test facilities.
- Indication for faulty card and diagnostic

7.7.2 The operation form maintenance portable terminal shall be user friendly.

7.7.3 All configurations shall be stored in a NV RAM/ EEPROM/ Flash ROM, which will cover the operation of the Multiplexer. Configuration data shall not erase even when no power supply or battery is connected to the Multiplexer.

7.7.4 Facilities shall be provided to connect maintenance portable terminal remotely using modems or through a TCP/ IP network such as intranet or Internet.

7.7.5 It shall be possible to monitor

- a. All alarms as indicated in clause 7.6 (except 7.6 a) for efficient operation and maintenance of the network.

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- b. It shall be possible to designate any alarm as major or minor.
 - c. It shall also maintain the history of all alarms so that the same can be displayed as and when required.
 - d. Facilities for clearing and acknowledging the alarms shall also be provided.
- 7.7.6 It shall be possible to monitor the link availability parameters such as available time, error free seconds, severely eroded seconds etc. as per ITU-T G.821 for 2048 Kbps port.
- 7.7.7 Facility for local and remote loop back of 2048 Kbps as well as any of the channels shall be provided for testing purpose. The loop back facility should have programmable time outs.
- 7.7.8 The number of maintenance portable terminal to be supplied shall be specified by the purchaser. If the same is not specified, one maintenance portable terminal shall be supplied for a minimum 10 number of multiplexers.
- 7.7.9 There shall be a network management system/ NMS which shall continuously monitor the health of all the network elements. Besides all the features of maintenance portable terminal as mentioned from clause 7.7.1 to 7.7.7, it shall have following additional features:
- a. It should be possible to create users with different access capabilities. At least three level of access should be provided.
 - b. All login, logout and the command issued by the user shall be logged into a LOG file accessible only to the highest level user.
 - c. NMS shall provide a graphical view of the network.
 - d. It should be possible to manage all the interfaces inclusive of NTU connected to IDSL interface through NMS.
- 7.7.10 The system shall provide network monitoring and control facility by using spare bits available in the frame structure only. The system shall not use any data / voice channel out of the user channel.

8.0 TECHNICAL REQUIREMENT – CHANNEL SIDE

8.1 4 WIRE VOICE FREQUENCY INTERFACE

8.1.1 The performance characteristics of the 4 wire voice frequency interface between the voice frequency ports shall be according to ITU -T recommendation G. 712, unless specified otherwise in this specification.

8.1.2 The nominal / minimum / maximum input / output levels shall be as under:

Input (Nominal)	:	- 3.5 dbr
Input (Minimum)	:	- 14.0 dbr
Out put (Nominal)	:	- 3.5 dbr
Output (Maximum)	:	+ 4.0 dbr

Adjustment of level with minimum 15 dB range for both input and output port in steps of 0.5 dB or less through maintenance portable terminal shall be provided.

8.1.3 E & M Signalling:

- a) The system shall use channel associated signaling as described above.
- b) The outgoing one bit information shall be as under:
 - Logic “0” with closed internal m-contact.
 - Logic “1” with open internal m-contact.
- c) The incoming one bit information shall be translated as follows:
 - Logic “0” corresponds to closed electronic e-contact.
 - Logic “1” corresponds to open electronic e-contact.

8.1.4 Remote and local loop back shall be provided.

8.2 2 WIRE VOICE FREQUENCY INTERFACE:

8.2.1 The performance characteristics of the 2 wire voice frequency interface between the voice frequency ports shall be according to ITU -T recommendation G. 712 unless specified otherwise in this specification.

8.2.2 The nominal / minimum / maximum input / output levels shall be as under:

Input (Nominal)	:	0.0 dbr
Input (Minimum)	:	- 11.0 dbr

Out put (Nominal) : - 2.0 dbr
Output (Maximum) : + 0.0 dbr

Adjustment of level with minimum 15 dB range for both input and output port in steps of 0.5 dB or less through maintenance portable terminal shall be provided.

8.2.3 E/M Signaling:

It shall be as per clause 8.1.3.

8.2.4 Remote and local loop back on digital level through NMS/ local craft terminal shall be provided.

8.3 2 WIRE SUBSCRIBER LOOP INTERFACE:

8.3.1 This shall be interfaced with the decadic and DTMF (both) type of telephone instrument. This card shall accept the loop and dialing and shall output ring voltage

8.3.2 The performance characteristics and levels shall be as per Clause 8.2.1& 8.2.2.

8.3.3 The other important parameters are as under:

Operating Voltage : - 48 V DC (Nominal)
Maximum Loop resistance : 1200 Ohms minimum at a minimum
feed current of 20 mA
Ring Voltage : 75 V RMS \pm 5 V
Ring Frequency : 17-25 Hz
Dial Pulse Speed : 8 – 12 pps

8.3.3.1 Through appropriate software or hardware settings at site, on receipt of In-coming E-lead signal on channel time slot, as per requirement it shall be possible to extend either (i) Battery Reversal or, (ii) Ring voltage, from the concerned interface card to the User end of the subscriber line. The normal setting shall be for Battery Reversal.

8.3.4 Line signaling code on time slot 16 for various signaling conditions shall be specified by the manufacturer.

8.3.5 Remote and local loop back on digital level through NMS/ local craft terminal shall be provided.

8.4 2 W EXCHANGE LOOP INTERFACE

8.4.1 This shall be interfaced with subscriber interface of electronic exchange. It shall detect the ring voltage and output the loop.

8.4.2 The performance characteristics and levels shall be as per Clause 8.2.1& 8.2.2.

8.4.3 The other important parameters are as under:

Operating Voltage	:	- 48 V DC (Nominal)
Open Loop resistance	:	More than 10K Ohms
Closed Loop resistance	:	800-ohm max
Ring Voltage detection (Minimum)	:	15 V RMS
Dial Pulse Speed	:	8 – 12 pps

8.4.3.1 Through appropriate software or hardware settings at site, it shall be possible to originate outgoing M-Lead signal in the channel time slot on receipt of either (i) In-coming Ring voltage or, (ii) Battery reversal, as per requirement, at the concerned interface card from the Exchange end of the subscriber line. The normal setting shall be for Battery Reversal.

8.4.4 Line signaling code on time slot 16 for various signaling condition shall be specified by the manufacturer.

8.4.5 Remote and local loop back on digital level through NMS/ local craft terminal shall be provided.

8.5 2 W HOT LINE INTERFACE:

8.5.1 This shall be interfaced with auto telephone instrument on either side to provide hot line circuit.

8.5.2 The performance characteristics and levels shall be as per Clause 8.2.1& 8.2.2.

8.5.3 The other important parameters are as under:

Operating Voltage	:	- 48 V DC (Nominal)
Maximum Loop resistance	:	1200 Ohms minimum
Ring Voltage	:	75 V RMS \pm 5 V
Ring Frequency	:	17-25 Hz

8.5.4 Line signaling code on time slot 16 for various signaling conditions shall be specified by the manufacturer.

8.5.5 Remote and local loop back on digital level through NMS/ local craft terminal shall be provided.

8.6 LOW SPEED DATA INTERFACE:

This interface shall be used for point to point low speed data communication between stations. The interface shall also be configurable as multi drop polled data circuit for use in SCADA applications. The interface shall meet the following specifications:

- | | | | | | | | | |
|---------------|--------------------------|---|--------|--------------------|-----------|--------|---------------|--------|
| 1. | Data Rate | 1200/2400/4800/9600/19200 bps | | | | | | |
| 2. | Interface | RS232c / V.24, ISO 2110; X.21, ISO4903 | | | | | | |
| 3. | Mode | <ul style="list-style-type: none"> i Asynchronous point to point ii Asynchronous point to multi point iii Synchronous point to point | | | | | | |
| 4. | Signal and pin out | As per annexure I | | | | | | |
| 5. | Clocking | Asynchronous, synchronous using DCE timing, | | | | | | |
| 6. | Asynchronous data format | <table border="0" style="margin-left: 20px;"> <tr> <td>Parity</td> <td>Odd, even, or none</td> </tr> <tr> <td>Data bits</td> <td>7 or 8</td> </tr> <tr> <td>Stop elements</td> <td>1 or 2</td> </tr> </table> | Parity | Odd, even, or none | Data bits | 7 or 8 | Stop elements | 1 or 2 |
| Parity | Odd, even, or none | | | | | | | |
| Data bits | 7 or 8 | | | | | | | |
| Stop elements | 1 or 2 | | | | | | | |

8.6.1 Data rate and mode should be software selectable.

8.6.2 For asynchronous point to multi point application data transmitted from the master shall be available at all slave stations. If a slave station wants to transmit data it should raise RTS and send data on getting CTS. Any station can be assigned to work as master or slave.

8.6.3 Local and remote loop back shall be provided.

8.7 64 KBPS DATA INTERFACE:

8.7.1 64 Kbps Co-Directional data interface as per ITU-T G703

8.7.1.1 This shall be according to ITU –T Rec. G. 703 (10 / 98).

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8.7.1.2 The requirements shall be as under:

- a) Functional requirements : Clause 4.1 and 4.1.1.1 of ITU – T G. 703
- b) Electrical characteristics : 4.2.1 of ITU – T G. 703
- c) Nominal impedance : 120 Ohm balanced

8.7.1.3 Jitter at 64 kbps out put shall be as per clause 7.2.1 of ITU – T G. 735.

8.7.1.4 Jitter transfer function between 2048 kbps and 64 kbps out put shall be as per clause 7.3.3 of ITU – T G.735.

8.7.1.5 Input Jitter tolerance shall be as per clause 7.1.1 ITU-T,G.823

8.7.2 64 Kbps V.35/V.36 data interface

This interface shall provide a 64 Kbps data channel as per following specification:

- a) Data rate : 64 Kbps
- b) Interface : V.35, ISO 2593;
V.36, ISO 4902.
- c) Signal and pin out : Annexure I

8.7.3 Clocking shall be synchronous internal slaved from E1 network.

8.7.4 Local and remote loop back shall be provided.

8.8 NX64 KBPS DATA INTERFACE:

The interface shall meet the following specification:

1. Data rate : n x 64 Kbps (n = 1 to 30)
2. Interfaces : V.35, ISO 2593;
V.36, ISO 4902.
3. Mode : Synchronous point to point
4. Signals and pin out : Annexure I

- | | | |
|----|---|---|
| 5. | Clocking | Synchronous internal i.e. slaved from E1 Network. |
| 6. | Loop backs | Local or remote |
| 7. | Data rate shall be software selectable. | |

8.9 E1 BRANCHING INTERFACE:

The E1 branching interface is 2048 Kbps G 703 interface used for providing spur links in the chain networks. The interface shall meet following specification:

- | | | |
|----|--------------------------------|---|
| 1. | General characteristics | As per clause 7.2.1 |
| 2. | Specification of out put ports | As per clause 7.2.2 |
| 3. | Specification at input port | As per clause 7.2.3 |
| 4. | Frame structure | As per clause 7.3 |
| 5. | Alarms | As per clause 7.6 |
| 6 | Synchronisation | Branch E1 out put timing is slaved to E1 main stream

Branch E1 input timing must be the same average rate as the branch E1 output timing |

8.9.1 The peak to peak jitter value for the 2048 kbps branching signal when there is no jitter at the 2048 kbps input signal should not exceed 0.10 UI when measured with in the range from $f_1 = 20$ Hz to $f_4 = 10$ kHz (clause 6.2.2 of ITU –T G.736).

8.9.2 The jitter transfer function between the 2048 kHz external synchronization signal and the 2048 kbps branching signal should not exceed the gain/ frequency limits given in figure 1/G. 736 (clause 6.3.1 of ITU – T G. 736).

8.9.3 The jitter transfer function between the 2048 kHz input signal and the 2048 kbps branching signal should not exceed the gain/ frequency limits given in figure 1/G. 736 (clause 6.3.1 of ITU – T G. 736).

8.9.4 All 30 channels shall be capable of being configured on the spur link.

8.9.5 Spur link shall also be available through the NMS.

8.9.6 Remote and local loop back shall be provided.

8.10 ISDN DIGITAL SUBSCRIBER LINE (IDSL):

The interface shall provide a digital subscriber line (DSL) as per ISDN U interface (ITU-T G961). This interface is to be used for remote extension of full duplex 64 Kbps / 128 Kbps data circuits along with a suitable Remote Data Unit / Network Termination Unit. The interface shall meet the following specification:

1.	Line code	2B1Q as per G961
2.	Line Requirement	24 AWG (0.5 mm) unconditioned unloaded single twisted pair
3.	Line impedance	135 Ohm
4.	Operating Range	At least 4 Km on 24 AWG / 0.5 mm cable
5.	Data rate	64 / 128 Kbps
6.	Modes and timing	LT: system clock

8.10.1 Data rate shall be software selectable

8.10.2 Remote and local loop back shall be provided.

8.11 NETWORK TERMINATION UNIT / REMOTE DATA UNIT:

Remote data unit shall work with IDSL to meet the objectives given in 8.10 above. It shall meet the following specification:

1.	Line code	2B1Q as per G961
2.	Line Requirement	24 AWG (0.5 mm) unconditioned unloaded single twisted pair
3.	Line impedance	135 Ohm
4.	Operating Range	At least 4 Km on 24 AWG / 0.5 mm cable
5.	Data rate	64 / 128 Kbps

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- | | | |
|----|-------------------|---|
| 6. | Data interfaces | 64 Kbps G 703 Co-directional as per clause 8.7.1
64 / 128 Kbps V.35, ISO 2593;
V.36, ISO 4902 as per clause 8.7.2 |
| 7. | Modes and timing | NT: Clock extracted from line |
| 8. | Loop back | Remote or local |
| 9. | Operating Voltage | 220 V AC \pm 10 %, 50 Hz |

9. DROP / INSERT REQUIREMENT:

- 9.1 It shall be possible to insert channels in the same time slot in both directions on the same D/I Multiplexer.
- 9.2 Intermediate stations shall be digitally transparent to the time slots, which are not dropped.
- 9.3 The end-to-end performance of any channel for which intermediate Multiplexer is transparent shall not deteriorate. However, the absolute group delay might be more than specified value due to delay introduced due to storage at each Multiplexer.
- 9.4 In case of total node failure, the two primary rate ports (P1 and P2) shall be directly connected.
- 9.5 It shall be possible to drop / insert any number of channels from / to either direction (up to total 30) at any intermediate station.
- 9.6 It shall support full cross connect between P1 port or P2 port or VF time slot. Any time slot on P1 / P2 port can be mapped to VF port and also any time slot of P1 port can be mapped to any other time slot of P2 port or vice-versa.
- 9.7 The equipment should have protection to ensure the availability of user channels on detection of failure on P1 or P2 stream in a link in conjunction with an external alternative 2 Mbps stream on back up media.

10. REQUIREMENT FOR CONFERENCE FACILITY:

- 10.1 Conference facility shall be used to configure the omnibus control circuits.

- 10.2 It shall be possible to set up 3-way voice conferencing with one time slot each of P1 port, P2 port and VF side. The summing shall be conducted on PCM coded signals in accordance with A – Law so as to reduce distortion etc.
- 10.3 It shall be possible to configure minimum 18 three-way conference circuits as defined in 10.2 above on a Multiplexer.
- 10.4 It shall also be possible to configure 4 way conference circuits with one or more time slot on P1 port, P2 port , E1 Branching or VF side. The supplier may indicate the reduction in number of conference circuits in such a case.
- 10.5 Conference facility shall be provided on 4 W voice interfaces. Any 4 W E & M channel shall be capable of being configured as a conference channel.
- 10.6 The conferencing shall also be carried out for the respective channel associated signaling bits of the time slot. Following logic shall be used for combination of digital bits:

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

- 10.7 The end-to-end performance of the omnibus circuit shall meet the required parameters for 4 W point-to-point circuits as defined in this specification under 8.1.

11. RELIABILITY:

- 11.1 MTBF of the Primary digital Multiplexer shall be as under:

Basic system including power supply and ringer	> 25 years
Interface cards each channel	> 80 years

- 11.2 The supplier shall furnish MTBF / MTTR values. The calculations shall be based on either the guidelines issued by DOT – QA no. QM-115 (January 1997) or any other international standard.

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12. POWER SUPPLY:

12.1 The equipment shall be designed to operate at following DC voltage:

12.1.1 Input DC voltage : (-) 48 V DC (Nominal)

12.1.2 Range of Input : (-) 36 V to (-) 72 V DC

12.2 DC-to-DC converter shall be used for deriving DC voltages required for the operation of equipment. For the line and load regulations, the output voltage variation shall be within $\pm 5\%$ of output nominal voltage.

12.3 Power supply shall be provided with protection arrangement for over voltage and short circuit.

12.4 Power consumption of equipment shall be indicated.

12.5 Insulation resistance shall be greater than 10 Mega Ohms.

13 ELECTROMAGNETIC COMPATIBILITY (EMC) REQUIREMENTS:

13.1 DC to DC converter module shall be immune to:

- a) Fast variations of the power supply as per A.1.4 / Table 11 of IEC 870 –2 –1 1995 part 2 for level 1.
- b) Faults in the LV, MV, HV networks as per A.1.5 / Table 11 of IEC 870 –2 –1 1995 part 2 for level 1.
- c) 1.2 /50 – 8 /20 μ s surges as per A.2.2 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.
- d) Fast transient bursts as per A.2.3 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.
- e) Ring waves as per A.2.4 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.

13.2 Telecom lines shall be immune to:

- a) Fast transient bursts as per A.2.3 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.
- b) Damped oscillatory waves as per A.2.5 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.

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- c) 10/ 700 μ s surges as per A.2.8 / Table 12 of IEC 870 –2 –1 1995 part 2 for level 2 in common mode and differential mode.

14 TESTS:

The test procedure shall be as specified in ITU -T or IEC and approved by the testing authority.

14.1 TYPE TESTING:

Such numbers of equipment shall be offered for type tests so as to completely test the requirement of this specification subject to a minimum of two numbers. In case, all the interfaces as defined in clause 6.1 are not available, the interfaces as offered by supplier shall be evaluated and necessary remarks shall be given in the type approval certificate and list of approved supplier issued by RDSO.

The following shall constitute the type tests. Any other test to be specified by testing authority at the time of type approval shall also be carried out.

14.1.1 Environmental Testing (Clause 4):

The environmental testing of the equipment shall be conducted in accordance to DOT specification No. QM-333 for Category B2 and following parameter shall be tested for the specified values:

14.1.1.1 System Test

- a) Bit Rate
- b) Mask of Pulse
- c) Residual output jitter
- d) Alarms

14.1.1.2 Test for data Interfaces:

- a) BER

14.1.1.3 Test for voice interfaces:

Following parameter shall be measured for one channel of each type of E&M 4 W, 2 W, subscriber loop interface, exchange interface etc.

- a) Variation of gain / level
- b) Idle channel noise

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14.1.2 Visual Tests:

The parameter stated in clause 1,5,6 of the specification shall be examined.

14.1.3 System Tests

- a) Bit rate and stability (cl. 7.2.1)
- b) Mask of Pulse (cl 7.2.2)
- c) Return loss (cl. 7.2.2.1, cl 7.2.3)
- d) Permissible attenuation (cl 7.2.3)
- e) Output jitter and wander (cl 7.2.2)
- f) Input jitter and wander (cl 7.2.3)
- g) Jitter Transfer function (7.2.4)
- h) Jitter with permissible variation in incoming bit rate

14.1.4 Test for frame structure (Cl. 7.3)

14.1.5 Test for timings signal and priority of clock (Cl. 7.4)

14.1.6 Test for loss and recovery of frame alignment (cl. 7.5)

14.1.7 Test for alarms (Cl. 7.6)

14.1.8 Test for Network Monitoring System, maintenance portable terminal and Programmable features (Cl. 7.7).

14.1.9 Test for Voice Interfaces:

14.1.9.1 Transmission performance characteristics of pulse code modulation channels shall be conducted for all parameters defined in ITU –T Recommendation G 712. The parameters to be tested are as under: (Clause 8.1.1, 8.2.1, 8.3.2, 8.4.2, 8.5.2).

- a) Short term variation of loss with time
- b) Return Loss
- c) Longitudinal conversion loss
- d) Longitudinal conversion transfer loss
- e) Attenuation Vs frequency distortion
- f) Absolute Group Delay
- g) Group Delay Distortion
- h) Idle Channel Noise
- i) Discrimination against out of band signals
- j) Spurious signal at the channel out put port

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- k) Total distortion including quantisation distortion
 - l) Variation of gain with input level
 - m) Cross Talk
 - n) Terminal Balance Return Loss of 2W ports
- 14.1.9.2 Nominal / minimum / maximum / input / output levels for 4W and 2W interface (cl. 8.1.2 and 8.2.2)
- 14.1.9.3 E&M signaling test for 2 W and 4 W interface (Clause 8.1.3 and 8.2.3)
- 14.1.9.4 Local and remote loop back test for 2W and 4W interface (cl. 8.1.4 and 8.2.4)
- 14.1.9.5 Test for 2 W Subscriber loop interface (Clause 8.3)
- a) Functional test (Clause 8.3.1)
 - b) Operating voltage (8.3.3)
 - c) Loop resistance (8.3.3)
 - d) Battery reversal capability (8.3.3)
 - e) Ringing voltage and frequency (8.3.3)
 - f) Performance check with Pulse Dialing as well as DTMF dialing.
 - g) Remote and local loop back (8.3.5)
 - h) Signaling on time slot 16 (8.3.4)
 - i) Transmission performance characteristics and relative levels (Clause 8.3.2)
- 14.1.9.6 Test for 2 W Exchange loop interface (Clause 8.4)
- a) Functional test (Clause 8.4.1)
 - b) Operating voltage (cl. 8.4.3)
 - c) Open and closed Loop resistance (cl. 8.4.3)
 - d) Ringing voltage detection (cl. 8.4.3)
 - e) Performance check with Pulse Dialing as well as DTMF dialing.
 - f) Remote and local loop back (cl. 8.4.5)
 - g) Signaling on time slot 16 (8.4.4)
 - h) Transmission performance characteristics and relative levels (Clause 8.4.2)
- 14.1.9.7 Test for 2 W Hotline interface (Cl. 8.5)
- a) Functional test (Clause 8.5.1)
 - b) Operating voltage (cl. 8.5.3)
 - c) Max. Loop resistance (cl. 8.5.3)
 - d) Ringing voltage and frequency (cl. 8.5.3)
 - e) Remote and local loop back (cl. 8.5.5)

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- f) Signaling on time slot 16 (8.5.4)
- g) Transmission performance characteristics and relative levels (Clause 8.5.2)

14.1.10 Test for low speed data Interface (cl. 8.6)

- a) Functional Test
- b) Data Rate
- c) Interface
- d) Mode
- e) Signal and pin out
- f) Clocking
- g) Asynchronous data format
- h) Test cl. 8.6.1
- i) Test cl. 8.6.2
- j) Loop back
- k) BER

14.1.11 Test for 64 kbps data interface (cl. 8.7)

14.1.11.1 Test for 64 kbps co-directional (cl. 8.7.1)

- a) Functional Requirement (cl. 8.7.1.2 a)
- b) Electrical Characteristics (cl. 8.7.1.2 b)
- c) Output jitter (cl. 8.7.1.3)
- d) Input Jitter (cl.8.7.1.5)
- e) Jitter transfer function (cl. 8.7.1.4)
- f) Clocking (8.7.3)
- g) Loop back (cl. 8.7.4)
- h) BER

14.1.11.2 Test for 64 kbps V.35/V.36 (cl. 8.7.2)

- a) Functional Test
- b) Interface
- c) Signal and pin out
- d) Clocking (cl. 8.7.3)
- e) Loop back (cl. 8.7.4)
- f) BER

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14.1.12 Test for n x 64 kbps Interface (cl.8.8)

- a) Functional
- b) Data Rate
- c) Interface
- d) Signal and pin out
- e) Clocking
- f) Loop back
- g) BER

14.1.13 Test for E1 branching Interface (cl. 8.9)

- a) General characteristics (cl. 7.2.1)
- b) Specification of out put ports (cl. 7.2.2)
- c) Specification at input ports (cl. 7.2.3)
- d) Frame structure (cl. 7.3)
- e) Loss and recovery of frame alignment (cl. 7.5)
- f) Alarms (cl. 7.6)
- g) Synchronisation
- h) Jitter branching signal (cl. 8.9.1)
- i) Jitter Transfer function (cl. 8.9.2, 8.9.3)
- j) Test cl. 8.9.4
- k) Test cl. 8.9.5
- l) Loop back (cl. 8.9.6)
- m) BER

14.1.14 Test for IDSL (cl.8.10)

- a) Functional Test
- b) Line code
- c) Operating Range
- d) Data Rate
- e) Modes and timing
- f) Test cl. 8.10.1
- g) Loop back
- h) BER

14.1.15 Test for Network Termination unit (cl. 8.11)

- a) Functional test
- b) Line requirement
- c) Line impedance
- d) Operating range
- e) Data rate
- f) Data interfaces

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- g) Modes and timing
- h) Loop back
- i) Operating voltage
- j) BER

14.1.16 Drop / Insert Requirements (Clause 9)

- a) Functional Test (Clause 9.1, 9.2, 9.3, 9.5,)
- b) Bypass function test (Clause 9.4)
- c) Cross talk on Drop / Insert channels in same time slot in different directions.
- d) Cross connect facility (Clause 9.6)
- e) Loop protection (Clause 9.7)

14.1.17 Requirement for conference facility (Clause 10)

- a) Functional tests (Clause 10.1, 10.2, 10.4, 10.5)
- b) Maximum number of conference circuits (Clause 10.3)
- c) Signaling test (Clause 10.6)
- d) End to end performance in 4 W omnibus mode (Cl. 10.7)

14.1.18 Power Supply test (Clause 12)

- a) Output voltages with variation in input supply (Clause 12.1)
- b) Output voltages (Cl. 12.2)
- c) Test for short circuit and over voltage (Clause 12.3)
- d) Power Consumption (Clause 12.4)
- e) Insulation resistance (Clause 12.5)

14.1.19 Test for Electro Magnetic Compatibility (EMC)(Clause 13)

- a) EMC for DC power lines (clause 13.1)
- b) EMC for telecom lines (clause 13.2)

14.1.20 Field Trial

Primary Multiplexer shall be tested for 4 weeks either under actual field environment or under simulated field condition. Efforts shall be made to test it under actual field environment. Number and type of primary multiplexers and interface cards shall be so chosen so as to completely monitor the requirement of this specification. After completion of Type tests by RDSO; field trial equipment shall be transported to the trial site by normal packing and transport as will be done in regular production. Testing shall be done as follows:

14.1.20.1 Pre field trial tests:

After installation of the equipments in the field, following tests shall be done on the equipment:

- | | |
|--|--|
| a) System tests | Clause 14.1.3 a, b, c, d, e, f, g
Clause 14.1.7
Clause 14.1.8 |
| b) Voice interface tests | Clause 14.1.9.1 a, b, e, g, h, i, j, k, l, m, ;
Clause 14.1.9.2
Clause 14.1.9.5 i
Clause 14.1.9.6 h
Clause 14.1.9.7 g |
| c) Data interface tests | Clause 14.1.10 a, k
Clause 14.1.11.1 b, c, e, h
Clause 14.1.11.2 a, f
Clause 14.1.12 a, g
Clause 14.1.13 a, b, c, f, g, h, i, m
Clause 14.1.14 a, c, d, e, h
Clause 14.1.15 a, b, d, j |
| d) Drop / Insert Requirement | Clause 14.1.16 a, b, c, e |
| e) Requirement for Conference facility | Clause 14.1.17 a, b |
| f) Power supply | Clause 14.1.18 a, c, d, e |

14.1.20.2 Stability tests:

The BER performance shall be monitored on at least one time slot for 24 hours to conform to ITU –T Rec. G. 821. The system shall not be disturbed during this period. If the performance requirements are not met, stability test shall be repeated before proceeding further.

14.1.20.3 Traffic loading:

After successful pre field trial test and stability test, actual traffic or simulated traffic should be loaded and system should be put to use for 4 weeks. System should be loaded for at least 25% capacity. No tests are to be conducted during this period. A log of alarms and problems observed shall be made. During this period any required maintenance of the link is done and recorded.

14.1.20.4 Post field trial tests:

After 4 weeks of traffic loading, all the tests as per pre field trial tests (Clause 14.1.20.1) shall be carried out and results recorded. The results of all the steps above shall be used to determine if the field trials are successful or otherwise.

14.2 ROUTINE TESTS:

14.2.1 The under mentioned tests shall constitute routine tests which shall be carried out by the manufacturer on each equipment in addition to any other tests which have to be carried out by him to ensure that the equipment meets the requirement of the specification.

- | | | |
|----|-----------------------|--|
| a) | System tests | Clause 14.1.3 a, b, c, d, e, f, g
(Jitter test only)
Clause 14.1.5
Clause 14.1.6
Clause 14.1.7 |
| b) | Voice interface tests | Clause 14.1.9.1 a, b, c, d, e, h, j, k, l, m, o
Clause 14.1.9.2
Clause 14.1.9.3
Clause 14.1.9.4
Clause 14.1.9.5 a, b, c, d, e, f, g, i
Clause 14.1.9.6 a, b, c, d, e, f, h
Clause 14.1.9.7 a, c, d, e, g |
| c) | Data interface tests | Clause 14.1.10 a, b, c, d, f, g, h, i, j, k
Clause 14.1.11.1 a, b, f, g, h
Clause 14.1.11.2 a, b, d, e, f
Clause 14.1.12 a, b, c, e, f, g
Clause 14.1.13 a, b, c, e, f, g, h, i, j, k, l, m
Clause 14.1.14 a, c, d, e, f, g, h
Clause 14.1.15 a, d, e, f, g, h, i, j |

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- d) Drop/Insert Requirement Clause 14.1.16 b, e
- e) Requirement for Conference Facility Clause 14.1.17 d {Cl. 14.1.9.1 e, h, k, l}
- f) Power supply Clause 14.1.18 a, b, c (short circuit Protection).

14.3.3 Rejection Criteria- If any equipment of the selected sample fails in any of the Acceptance Test listed vide clause 14.3.2, the entire lot shall be rejected.

15. INFORMATION TO BE GIVEN BY PURCHASER

15.1 As per indenting description check list as given at Annexure II

16 INFORMATION TO BE GIVEN BY SUPPLIER:

- 16.1 Method of safe transport of cards (Clause 5.5)
- 16.2 Number of systems on each rack (Clause 5.12)
- 16.3 Configuration of each Multiplexer to meet circuit requirements specified in Clause 5.1 by purchaser (Clause 6.4)
- 16.4 List of other Alarms [Clause 7.6.1 (i)]
- 16.5 MTBF of Multiplexer with breakup and the basis (Clause 11)
- 16.6 Power consumption of the Multiplexer (Clause 12.4)
- 16.7 Reduction in number of simultaneous conferences on D/I mux with omnibus facility with more than 3 way conference (Clause 10.4).
- 16.8 Details of common cards interface cards and other accessories :-

Type of cards	Description of cards	Part no.	Quantity	Slot no.
Common cards				
Interface cards				
Other accessories				

ANNEXURE – I

SIGNAL & PIN OUT

RS – 232 C / V. 24 / V. 35 / V. 36 / X.21

RS 232 C / V. 24	V. 35		V. 36		ITU – T V. 24 V. 35 V. 36	ITU – T X.21			
	34 Pin		37 Pin			Abbr.	Circuit name	15 - PIN	
	A	B	A	B				A	B
7	B		19		102	G	GROUN	8	
			37		102a				
			20		102b				
2	P	S	4	22	103	T	TRANS	2	9
3	R	T	6	24	104	R	RECEI	4	11
4	C		7	25	105	C	CONTR	3	10
5	D		9	27	106				
6	E		11	29	107				
20	H		12	30	108/2				
8	F		13	31	109	I	INDIC	5	12
22	J		15		125				
24	U	W	17	35	113				
15	Y	a	5	23	114	S	SIGMA	6	13
17	V	X	8	26	115		TIMIN		
ISO –2110	ISO – 2593		ISO – 4902		ITU-T V.24	ISO 4903 (X.21/ X.27)			

D. DSL Interface

S.No.	Description	No. of ccts. at Stn. 1	No. of ccts at Stn. 2	No. of ccts at Stn. 3	No. of ccts at Stn. 4	No. of ccts at Stn. 5	No. of ccts at Stn. 6	No. of ccts at Stn. 7	No. of ccts at Stn. 8	No. of ccts at Stn. 9	No. of ccts at Stn. 10	Total No. of ccts	Total No. of Cards
1.	IDSL												
2.	NTU / G. 703												
3.	NTU / V. 35												
4.	NTU / V. 36												

E. Maintenance Portable Terminal & NMS

S. No.	Description	Numbers
1.	Maintenance Portable Terminal*	
2.	NMS	

*If the same is not specified, one maintenance portable terminal shall be supplied for a minimum 10 number of multiplexers.

1. The requirement of individual circuit should be indicated station wise as given above.
2. Number of circuits at each station may be calculated with the help of channeling plan.
3. Different manufactures provide different number of circuits on each card. As such the column concerning no. of cards may be left blank, unless specific number of cards are required.
4. For works tenders it will be advisable to enclose channeling plan with the tender.
5. Normally subscriber loop Interface, Exchange loop Interface and IDSL Interface, NTU are used in combination. It should be indented in combination unless specifically required.
6. The requirement of 19" rack may be calculated separately.