

**SATELLITE TRANSMISSION
ISSUE: SEPTEMBER, 2006**

**DIGITAL CIRCUIT MULTIPLICATION EQUIPMENT (DCME)
WITH 5:1 AND 10:1 GAIN**

**GENERIC REQUIREMENTS
No. GR/DME-01/03.SEP 2006
(Supersedes GR No. G/DME-01/02.JUL 2001)**

© TEC

**DEPARTMENT OF TELECOMMUNICATIONS
GOVERNMENT OF INDIA
TELECOMMUNICATION ENGINEERING CENTRE
KHURSHID LAL BHAVAN, JANPATH
NEW DELHI 110001
INDIA**

All Rights Reserved and no part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without written permission from the Telecommunication Engineering Centre, New Delhi.

**Digital Circuit Multiplication Equipment (DCME) with 5:1 and 10:1 gain
No. GR/DME-01/03.SEP2006**

History Sheet

Title GR	GR No.	Remarks
Digital Circuit Multiplication Equipment (DCME) with 5:1 and 10:1 gain	GR/DME-01/01.FEB1995	First Release of GR
Digital Circuit Multiplication Equipment (DCME) with 5:1 and 10:1 gain Amendment Issued: One	GR/DME-01/02.JUL 2001	Second Release of GR Released on 28.06.04
Digital Circuit Multiplication Equipment (DCME) with 5:1 and 10:1 gain	GR/DME-01/03.SEP.2006	Revised GR with changed Format

Index

1.0	Scope:.....	6
2.0	Functional and Technical Requirements.....	6
3.0	Detailed specifications:	10
4.0	Performance Requirements:-.....	13
5.0	MTBF.....	13
6.0	MARKING.....	13
7.0	(1.0) Scope:	16
8.0	General Requirements	20
9.0	Guidance to the purchaser.....	26
10.0	ABBREVIATIONS	27

References

- a) **TEC GRs/IRs:** None
- b) **QA Documents:**
- i) Latest BSNL QA Guidelines indicated in Quality Manuals QM 118 {Quality and Reliability in product Design.}, QM 205 {Guidelines for Standard of Workmanship for Printed Boards}, QM 206 {Guidelines for Standard of Workmanship for Printed Board Assemblies}, QM 210 {Guidelines for Standard of Workmanship for Surface Mounted Devices} and QM 301 {Transmission Equipment General Documentation}.
 - ii) BSNL QA document QM-333 {latest Issue} “Specification for environmental testing of electronic equipments for transmission and switching use” for operation, transportation and storage
- c) **ITU Recommendations:**
- i. ITU – T Recommendations G.763
 - ii. ITU – T Recommendations G.726
 - iii. ITU – T Recommendations G.766
 - iv. ITU – T Recommendations G.700
 - v. ITU – T Recommendations G.736
 - vi. ITU – T Recommendations G.732
 - vii. ITU – T Recommendations G.822
 - viii. ITU – T Recommendations G.702
 - ix. ITU – T Recommendations G.821
 - x. ITU – T Recommendations G.703
 - xi. ITU – T Recommendations G.704
 - xii. ITU – T Recommendations G.706
 - xiii. ITU – T Recommendations G.711
 - xiv. ITU – T Recommendations G.700
 - xv. ITU – T Recommendations G.811
 - xvi. ITU – T Recommendations G.728
- d) **Other Standards:**
- i) BIS standard IS 12063 {1987}” Classification of degree of protection provided by enclosures of the electrical equipment” {equivalent to IEC – 529} to meet at least the protection level of IP-65.
 - ii) ISO 9001:2000
 - iii) IS 11233 – 1985 (Antenna Mounting)
 - iv) BIS standard IS – 168 {1993} “ready mixed paint, air drying for general purpose-specification (Third revision)” and it is to be tested as per BIS standard IS – 101 {1986} “Method of sampling and test for paints, varnishes and related products (Third revision)”.

PART I
TECHNICAL REQUIREMENT

1.0 Scope:

This document specifies the configuration and performance specification of Digital Circuit Multiplication Equipment (DCME) which can be used for both satellite and terrestrial based trunk network. Capacity gain is achieved by using a combination of Digital Speech Interpolation (DSI), Low Rate Encoding (LRE) and Variable Bit Rate (VBR) techniques. The DCME shall be fully compliant with ITU-T Recommendation G.763 (INTELSAT specifications IESS-501 (Rev.3)). While main document specifies the DCME with 5:1 gain, additional conditions are listed in the Annexure for DCME with 10:1 gain.

2.0 Functional and Technical Requirements

2.1 The DCME functions shall include:

- Digital interpolation of speech signals (DSI);
- transcoding of 64 kb/s PCM to lower bit rate using ADPCM encoding algorithm, in compliance with ITU-T Recommendation G.726, when applicable;
- the means to be compatible with ISDN connection types given below :
 - i) Speech,
 - ii) 3.1 kHz audio (voice-band data and speech)
 - iii) 64 kb/s unrestricted;
- The DCME shall work in the following operating modes:
 - i) point-to-point
 - ii) multi-clique
 - iii) multi-destination
 - iv) a combination of multi-clique and multi- destination.
- speech detection;
- voice-band data detection;
- facsimile demodulation/remodulation (ITU-T Recommendation G.766);
- a means for transmit detection and receive injection of background noise;
- the means to accommodate non-interpolated pre-assigned traffic;
- a means for interterminal communication (control channel);
- a means for exchanging signals with a Switching Centre (SC) for 64 kb/s unrestricted traffic, Dynamic Load Control (DLC) and alarms;
- time slot interchange;
- the ability to transport the signaling scheme described in GR No. S/CCS-02/03.JAN2000.

2.2 The DCME will perform processing on traffic between the trunk interface and bearer interface as defined in Table 1 and explained below:

- a) Speech traffic is ADPCM encoded and subject to DSI. The bit rate of individual bearer channels provided for speech is instantaneously either 32, 24 or 16 kb/s, dependent on traffic loading. If the 16kb/s overload feature is activated, the bit rate of the bearer channels provided for speech is 24 kb/s or 16kb/s dependent on traffic loading.
- b) Voice-band data traffic is initially subject to DSI. Bearer channels provided for traffic recognized as voice-band data are ADPCM encoded at 40kb/s and are

protected against bit reduction and clipping.

- c) Facsimile traffic is initially treated as voice- band data traffic. Once it is recognized as facsimile traffic it may be processed in accordance with Recommendation G.766.
- d) 64kb/s unrestricted traffic may be connected on demand to bearer channels transparently (not subjected to DSI and ADPCM) if an out-of-band control signal to/from the SC is provided to identify the relevant trunk channels.

2.3 It should provide excellent speech calls quality. The total delay associated with the establishment of dynamically assigned ADPCM encoded bearer channels by the transmit DCME shall not exceed 30 ms. The total delay associated with the establishment of dynamically assigned ADPCM encoded bearer channels by the receive DCME shall not exceed 15 ms. The delay values exclude the effects of Doppler and plesiochronous buffers and exclude the delays associated with the establishment and disestablishment of demand assigned 64kb/s unrestricted circuits. For the case of facsimile demodulation/ remodulation the associated processing delay is given in Recommendation G.766.

2.4 The DCME multiple destination capability for multi-queue and multi-destination modes is summarised in Table 3.

2.5 The following operations and maintenance functions shall be performed at the DCME through a network operation and maintenance terminal having access control through password:

- a) configuration of the DCME for operation in a network;
- b) traffic rearrangements under coordinated operator control
- c) Engineering service channel (ESC) communication to correspondent DCMEs, to be pre-assigned for Satellite Network and demand assigned for terrestrial network
- d) Attendance to prompt maintenance alarms resulting from the channel check procedure, the continuous BER measurement, and other fault conditions;
- e) storage and display of status information pertaining to the freeze-out fraction, DLC operation, channel check procedure, and control channel BER and fault analysis;
- f) redundancy switchover facility;
- g) display of statistical information and anomaly reports.

The DCME should provide the following maintenance functions:

- a) Facilities for disabling (terminal out of service tests).
DSI: Digital Speech Interpolation

LRE: Low Rate Encoding (ADPCM)
 VBR: Variable Bit Rate Coding

- b) Facilities for providing fixed connection of:
 specific trunk channels to specific bearer channels, at 64 kb/s without interpolation, 40 kb/s without interpolation. 32 kb/s without interpolation and optionally at 24 kb/s or 16kb/s without interpolation.

2.6 The philosophy of fault conditions and consequent actions from the point of view of maintenance of digital networks is consistent with that contained in the ITU-T Recommendations in G.700 series.

The DCME unit shall detect the following fault conditions:

- a) Failure of incoming trunk primary group - the fault conditions are loss of incoming signal, loss of frame alignment or BER detected in frame alignment signal greater than 10^{-3} as defined in ITU-T Recommendation G.736 for 2048 kbit/s links. Primary group Alarm Indicating Signal (AIS) is not included.
- b) Primary group AIS - AIS detected on trunk primary group.
- c) Loss of 2048 kbit/s multiframe alignment (loss of incoming supervision channel) as defined in ITU-T Recommendation G.732. The circuit supervision may be handled by the Switching Centre Interface (SCI).
- d) Alarm indication from the remote end (bit 3 of TS0), received from the local SC.
- e) Abnormal circuit supervision - abnormal (alarm) conditions of associated incoming trunk circuits detected. The circuit supervision function (for example Q.33 or Q.50) may be handled by the SCI.
- f) Failure of one or more of the incoming bearer signal - the fault conditions are loss of incoming signal, loss of frame alignment, bearer AIS (all time slots) or BER detected in frame alignment signal greater than 10^{-3} as defined in ITU-T Recommendation G.736.
- g) BER detected on the Control Channel (CC) exceeding 10^{-3} .
- h) Loss of DCME frame or DCME multiframe alignment, (the time interval between recognition of an error condition and a fault declaration is under study e.g. 2.5 sec.)
- i) Alarm indication from the remote end, received from correspondent DCME unit(s).
- j) Alarm indication from the remote end received on any incoming bearer.
- k) Indication of fault of affected Trunk Channels (TCs) detected on Intermediate Trunk (IT) related alarm bits in the incoming CC data word.
- l) DCME power failure.

- 2.7 It should have redundant subsystems for ensuring Service Continuity besides having N to 1 redundancy in cluster configuration.
- 2.8 It should have high level of modularity that assures immediate system expansion in response to changes in traffic profile and volume.
- 2.9 It should have powerful operator work station, with high resolution graphic user interface, incorporating advanced user interface technologies. The operator work station shall provide the following facilities with option of centralised monitoring.
- a) Configuration (operating modes) setting and changes thereto.
 - b) Performance monitoring
 - c) Fault monitoring and Alarm Indication
 - d) Security features
- 2.10 There should be proper access from the rear panel for cabling and other installation purposes.
- 2.11 The racks when installed should have provision for entry of signal cables and power cables from bottom as well as from the top of the rack as per the site requirement.
- 2.12 The hardware configuration of each DCME terminal should be common for all the terminals including 'normal' and 'standby'.
- 2.13 Channel Assignment Map (CAM) change function for facilitating channel management between DCME's shall be provided as per ITU-T Recommendation G.763.
- 2.14 A cluster configuration of DCME terminals should have order wire and test control panel having order wire facility with the remote terminal and digital or analog test access to the channel pool.
- 2.15 There should be an option of having local Operator Maintenance Console (OMC) which is connected to the DCME directly when needed for diagnosing the problem during maintenance or fault identification act.
- 2.16 The DCME reference clock shall be derived from a source which meets the requirement of ITU-T Recommendation G.811. In case of failure of reference clock the equipment shall continue to work with an internal clock.
- 2.17 The slip rate shall not exceed the requirement of ITU-T Recommendation G.822. Controlled slips at 2048 kb/s on the trunk side shall not introduce any loss of frame alignment.

3.0 Detailed specifications:

- 3.1 Network Operating modes : Single-Destination (SD)
Multi-Destination (MD) upto 4
Multi-Clique (MC)
Interoperation (Mixed MC and MD)

- 3.2 DCME gain:

Table 2 gives approximate non-analytical formulas for calculation of voice part of the DCME gain (LRE & DSI gain combined).

The Digital Circuit Multiplication Equipment should provide minimum gain as given below:

% VBD	Gain		Speech Activity = 33%
	FEC On	FEC Off	
0	6.0	6.0	FAX = 90% of VBD
40	5.0	5.8	FAX TX % = 70% of FAX
80	4.5	5.5	NON-FAX VBD = 40 kb/s FDX
			ABS = 3.6, Freeze Out < 0.1%

The actual circuit multiplication gain achieved will be dependent upon traffic loading, speech activity, the percentage and type of voice-band data (e.g. facsimile traffic with and without demodulation / remodulation), the number of on-demand unrestricted 64 kb/s channels, and the number of pre-assigned channels and the size of the interpolation pools.

Compression Ratio : 5:1 Typical for 150 trunks (40% FAX)

- 3.3 Channel Capacity : Trunk Channels: 240 minimum;
Intermediate Trunks: Maximum.216;
(Processed Trunks)
Bearer Channels: Maximum.122;
(61 Normal+61 Overload)
- 3.4 Digital Group Interface : ITU-T Recommendation G.703, 120 ohms balanced,
HDB3 coding.
Framing complies with ITU-T Recommendations
G.704 and G.706. Encoding of voice frequency
signals shall conform to A-Law system described in
ITU-T Recommendation G.711
- Number : Trunk side: 12 minimum
Bearer side: 1 (transmit)
4 (receive)
- 3.5 External Clock Interface : 2048 kb/s as per ITU-T Recommendation G.703

- 3.6 Plesiochronous Buffer : Trunk side:
 Transmit = 2 PCM frames
 Receive = 2 PCM frames
 Bearer side:
 Receive = 2 PCM frames
- 3.7 Doppler Buffers : Trunk side:
 (ON/OFF selectable) Transmit = 6 msec
 Receive = 6 msec
 Bearer side:
 Receive = 6 msec
- 3.8 Bearer Services : Voice:
 1) Dynamically Assigned Channel:
 ADPCM (ITU-T Recommendation G.726) at
 32, 24 or 16 kb/s
 2) Pre-Assigned Channel:
 ADPCM at 32 kb/s
 VBD (Non-Fax):
 1) Dynamically Assigned Channel:
 ADPCM (ITU-T Recommendation G.726) at 40 kb/s
 2) Pre-Assigned Channel
 ADPCM at 40 or 32 kb/s
 VBD (Group 3 Fax):
 32 kb/s Transparent Fax Banks according to
 ITU-T G.766 (FEC selectable)
 64 kb/s:
 1) Dynamically Assigned Channel:
 Q.50 protocol required.
 2) Pre-Assigned Channel at 64 kb/s rate.
 N*64 kb/s:
 N Pre-Assigned Channels at 64 kb/s rate.
- 3.9 **Speech Detector:**
- | | |
|------------------------|--|
| Average Signal Power | Operate time |
| ≤ -40 dBmO | off |
| ≥ -40 dBmO, ≤ -30 dBmO | Adaptive with Noise Level
(As per ITU-T Recommendation G.763) |
| ≥ -30 dBmO | 2 ms ≤ t ≤ 4 ms |
- 3.10 Noise Injection : Matched to far end (ITU-T Recommendation G.763)
- 3.11 Facsimile Call Processing :
 a) FAX Demodulation by waveform or protocol analysis (ITU-T Recommendation

- G.766);
- b) Group 3 Facsimile, standard and non-standard protocols shall be demodulated:
- i. Upto 180 fax calls: V.29/V.27;
 - ii. Upto 90 fax calls : V.17
- 3.12 DCME-SC Link:
- a) ITU-T Recommendation Q.50 protocol via TS.16
 - i. Q.50 type 1
 - ii. Q.50 type 2, Annex A
 - iii. Q.50 type 2, Annex B
 - b) DLC dry contacts (per destination)
- 3.13 Inter-Exchange Signaling :
- a) ITU-T Signaling System No.7, via pre-assigned 64kb/s channel
 - b) ITU-T R2 D, via R2 D User Signaling Module Optional DLC activation via unused bits of TS.16
 - c) Capable of supporting all the signaling schemes described in GR No. S/CCS - 02/03.JAN2000.
- 3.14 Alarm Interface :
- a) Relay closures for visual and audio alarms
 - b) Alarm classification:
 - i. Prompt
 - ii. Deferred
 - iii. Service
- 3.15 Engineering service channel (ESC)
- a) Type : Digital
 - b) Capacity : Omnibus with selective calling facility alongwith a provision to also call all the stations simultaneously
 - c) Features : Passband of 0.3 to 3.4 kHz with calling facility on either buzzer or ringer with visual indication (with reset facility) and handset. Potential free contact for extension of buzzer / ringer calling facility to a centralised place shall be provided. Contact points for extension of audio shall also be provided.

- d) Nominal 4W Trans/ receive line up level at monitoring points (600 Ohms) : -3 dBm preferable. Level adjustment facility to be provided. The range of adjustment may be indicated. suitable access for line-up shall be provided
- 3.16 DCME terminal protection : N+1 (N=1 to 7) cluster protection switching by means of change over matrix
- 3.17 DCME Terminal Operation & Maintenance : To operate DCME cluster upto size 8
- 3.18 Cluster Communication Link : Ethernet 10 Base-2 or Ethernet 10 Base-T for remote operation

4.0 Performance Requirements:-

- 4.1 BER performance in the field shall conform to ITU-T Recommendation G.821.
- 4.2 BER performance in the laboratory 50°C for 48 hour duration on each channel at reference receive level over simulated hop shall be error free.

5.0 MTBF

50,000 hours maximum.

6.0 MARKING

Equipment shall be marked suitably as under

- 6.1 Name of manufacturer
- 6.2 Year of manufacturing
- 6.3 Frequency of operation

TABLE 1
(TABLE 1 / G.763: DCME traffic handling)

Traffic Type	Dynamic assignment	Pre-assignment
Speech	32 kb/s ADPCM with DSI 24 and 16 kb/s ADPCM with DSI	32 kb/s ADPCM (Note 3)
3.1 kHz Audio (Voice-band data) (Note 1)	40 kb/s ADPCM	40 kb/s ADPCM or 32 kb/s ADPCM
Group 3 Fax (Note 4)	32 kb/s transparent fax banks	
64 kb/s unrestricted	64 kb/s on-demand (Note 2)	64 kb/s Pre-assigned

Note 1- 40 kb/s ADPCM will accommodate voice-band data at rates ≤ 9.6 kb/s and 32 kb/s ADPCM (pre-assigned only) will accommodate voice-band data at rates ≤ 4.8 kb/s.

Note 2 - Subject to the provision of a dedicated control system to / from the SC.

Note 3 - 24 or 16 kb/s ADPCM pre-assignment may be used for maintenance purposes only.

Note 4 - Facsimile traffic is processed in accordance with ITU-T Recommendation G.766.

TABLE-2
(TABLE 1 of Supplement No.2 to ITU-T Recommendation.G.763)
DCME Gain for Voice (G_v)

Bits/ Sample	No. of Trunks	Formula	Activity Factor (AF)			
			33%	35%	37%	40%
3.6	N < 80	$G_v = a + b \times \ln(N)$	a = 0.23 b = 0.61	a = 0.04 b = 0.60	a = 0.30 b = 0.51	a = 0.30 b = 0.51
	N ≥ 80	$G_v = \frac{1.1388 \times N}{N \times AF \times \sqrt{(N \times AF)}}$	AF = 0.33	AF = 0.35	AF = 0.37	AF = 0.40
3.7	N < 80	$G_v = a + b \times \ln(N)$	a = 0.23 b = 0.61	a = 0.04 b = 0.60	a = 0.27 b = 0.52	a = 0.27 b = 0.52
	N ≥ 80	$G_v = \frac{1.1081 \times N}{N \times AF \times \sqrt{(N \times AF)}}$	AF = 0.33	AF = 0.35	AF = 0.37	AF = 0.40
3.8	N < 80	$G_v = a + b \times \ln(N)$	a = 0.24 b = 0.59	a = 0.01 b = 0.61	a = 0.28 b = 0.51	a = 0.28 b = 0.51
	N ≥ 80	$G_v = \frac{1.0789 \times N}{N \times AF \times \sqrt{(N \times AF)}}$	AF = 0.33	AF = 0.35	AF = 0.37	AF = 0.40

TABLE 3
(TABLE 2/G.763)
**DCME Multiple Destination Capability for
Multi-Clique and Multi-Destination Modes**

a) Transmit

	Total no. of Destinations	No. of pools in bearer	No. of destinations in pool
Multi-clique	1	1	1
	2	2	1,1
Multi destinations	4 max	1	1 to 4
		2	1 to 3,1

b) Receive

	Total no. of Origins	No. of received bearers	No. of pools in each bearer
Multi-clique	2	1	1 or 2
Multi destinations	4 max	4 max	1

ANNEXURE-A

Additional requirement for DCME with gain of 10:1

The following clauses will supersede corresponding clauses in main GR.

7.0 (1.0) Scope:

The DCME shall comply with ITU-T Recommendation G.728 for LD-CELP for toll quality voice coding at the rate of 16 kb/s (12.8 / 9.6 kb/s) when applying variable bit rate(VBR).

7.1 (2.2.a) Traffic handling requirements:

- a) Speech Traffic: The speech traffic to be LD-CELP encoded and for that bearer channels provided for speech shall be 12.8 or 9.6 kb/s when applying variable bit rate(VBR) depending upon the traffic loading.
- b) Voice Band Data Traffic: The limit may be indicated as 19.2 kb/s for DCME with LD-CELP having gain as 10:1.
- c) VBD Compression: VBD calls at rates up to and including 19.2 kbit/s should be compressed using LD- CELP compression algorithm, at ratio of 1.6:1.

7.2 (2.5) Operation and maintenance functions:

VBR: The VBR creates additional bearer channels to cope with periods of traffic overload. The process reduces the bandwidth of the encoded speech signal from 16 kbit/s to 12.8 kbit/s, and should distribute the reduced samples among all active speech channels, to ensure equal speech quality for all users.

7.3 Revised table 3 for the DCME multiple destination capability for multi clique and multi destination modes incorporating multi destination, multi clique upto 4 with LD-CELP.

7.4 (3.2)DCME Gain:

The Digital Circuit Multiplication Equipment should provide minimum gain as given below:

% VBD	Gain		Speech Activity = 33% FAX = 90% of VBD FAX TX % = 70% of FAX NON-FAX VBD = 40 kb/s FDX ABS = 3.6, Freeze Out < 0.1%
	FEC On	FEC Off	
0	10	10	
40	8.2	8.5	
80	6.8	7.1	

Compression ratio: 10:1 typical for 360 trunks channels with LD-CELP

7.5 (3.3)Channel capacity:

10:1 typical for 360 trunks with LD-CELP

7.6 (3.8) Bearer Services:

Bearer service requirements for DCME having gain 10:1 with LD-CELP
Voice and Voice Band Data: 12.4, 9.6 kb/s with LD-CELP.
Supporting 200 channels (120 normal + 80 overload)

7.7 (3.11) Facsimile call processing:

FAX Demodulation Method: The 10:1 compression system should demodulate fax calls at rates up to 14.4 kbit/s. Using a Waveform Analysis algorithm allows identifying and demodulating of Standard and Non-Standard fax calls (according to ITU-T Recommendation T.30). The compression ratio for fax calls will preferably exceed 6:1.

7.8 (3.12) DCME-SC Link:

Q.50 protocol: Q. 50 protocol shall provide the following capabilities:

DLC signaling: The support of an ISC-DCME data link interfacing is according to ITU-T Recommendation Q.50 protocol. In order to cope with the traffic overload conditions, a DLC (Dynamic Load Control) is issued by the 10:1 compression system towards the ISC, in order to temporarily block additional calls, for the time of overload condition. The DLC signal should be in accordance to ITU-T Q.50 protocol via trunks T.S.16.

Unrestricted clear channel: Unrestricted traffic (at 64 kbit/s) may be transparently connected on demand from the ISC to the bearer channels (not subjected to DSI and LRE), by using the Q.50 protocol for ISC-DTX interfacing (if provided).

7.9 (3.13) Inter-Exchange Signaling:

Signaling Compression: R1 and R2D signaling types should be transmitted with in the control channel. HDLC based PRI CCS can be compressed using Idle-Flag suppression. This will allow a significant improvement of the over all system gain.

TABLE 3
(TABLE 2/G.763)
**DCME Multiple Destination Capability for
Multi-Clique and Multi-Destination Modes**

a) Transmit

	Total no. of destinations	Pools in the Bearer	No. of destinations in the pool
Multi-Clique	1 to 4	1 to 4	1
Multi - Destination	4 max.	1 2	1 to 4

b) Receive

	Total no. of origins	No. of received Bearers	No. of pools in each bearer
Multi-Clique	4 max.	1	1 to 4
Multi - Destination	4 max.	4 max.	1

Part-II
General Requirements:

8.0 General Requirements

8.1 Engineering requirements

- 8.1.1 The equipment shall adopt state of the art technology.
- 8.1.2 The equipment shall be of compact and composite construction and light weight. The actual dimensions and weight of the equipment shall be furnished by the manufacturer.
- 8.1.3 All connectors shall be reliable and of standard type to ensure failure free operation over 500 matings and under environmental conditions specified in this GR.
- 8.1.4 All connectors and the cable used shall be of low loss type and suitably shielded.
- 8.1.5 The equipment shall be housed in standard 19” rack, 600 mm rack or slim rack with a maximum height of 2250 mm and with front access.
- 8.1.6 The equipment shall have self cooling arrangement including usage of internal fans with rear intakes and exhaust.
- 8.1.7 The supervisory indications and other control switches shall be provided at convenient locations on the bay preferably at a height around 1500 mm for ease of maintenance.
- 8.1.8 The plug-in units shall be hot swappable to allow their removal/insertion while the equipment is in energized condition.
- 8.1.9 The mechanical design and construction of each card/ unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport and conforming to para 12 of DTO QA document No. QM 333 {issue-1: September 1990} “Specification for environmental testing of electronic equipment’s for transmission and switching use”.
- 8.1.10 Each sub-assembly shall be clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram in the handbook.
- 8.1.11 Each terminal block and individual tags shall be numbered suitably with clear identifying code and shall correspond to the associated wiring drawings.
- 8.1.12 All controls, switches, indicators etc. shall be clearly marked to show their circuit designation and functions.

8.2 Operational Requirements

- 8.2.1 The manufacturer shall guarantee the satisfactory performance of the equipment without any degradation at an altitude upto 3,000 meters above mean sea level.
- 8.2.2 The equipment should be able to work without any degradation in saline atmosphere near coastal areas and should be protected against corrosion.
- 8.2.3 Visual indication to show power ON/OFF status shall be provided.
- 8.2.4 Wherever the visual indications are provided, green colour for healthy and red colour for unhealthy conditions should be provided. Some other colour may be used for non urgent alarms.
- 8.2.5 The software/hardware in equipment shall not pose any problem due to changes in date and time caused by events such as changeover of millennium/century, leap year etc. in the normal functioning of the equipment.
- 8.2.6 The SSPA shall be supplied with the proper dummy load connecting facilities, cooling arrangements, input/output, isolation /monitoring ports.

8.3 Quality Requirements

- 8.3.1 The manufacturer shall furnish the MTBF value. MTBF shall meet the values specified in GR. The calculations shall be based on the guidelines in either DTO QA document No. QM-115 {January 1997} “Reliability Methods and Predictions” or any other international standard.
- 8.3.2 The equipment shall be manufactured in accordance with international quality management system ISO 9001:2000 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system, being followed by the manufacturer, should be submitted.
And
The equipment shall meet the latest BSNL QA Guidelines indicated in Quality Manuals QM 118—Quality and Reliability in product Design., QM 205—Guidelines for Standard of Workmanship for Printed Boards, QM 206—Guidelines for Standard of Workmanship for Printed Board Assemblies, QM 210—Guidelines for Standard of Workmanship for Surface Mounted Devices and QM 301—Transmission Equipment General Documentation. The supplier shall furnish a certification from the manufacturer to this effect, which shall be verified at the time of technical specifications evaluation.
- 8.3.3 The equipment shall conform to the requirements for Environment specified in BSNL QA document QM-333 {Issue-1: September 1990} “Specification for environmental testing of electronic equipments for transmission and switching use” for operation, transportation and storage. The applicable tests shall be for environmental category B2 including vibration and corrosion (salt mist).

8.4 Maintenance Requirements:

Maintenance philosophy is to replace faulty units/subsystems after quick on-line analysis through monitoring sockets, alarm indications and Built-in Test Equipment. The actual repair will be undertaken at centralised repair centers.

- 8.4.1 The corrective measures at site shall involve replacement of faulty units/sub-systems.
- 8.4.2 The equipment shall have easy access for servicing and maintenance.
- 8.4.3 Suitable alarms shall be provided for identification of faults in the system and faulty units.
- 8.4.4 Suitable potential free contact points shall be provided for extension of summary alarms.
- 8.4.5 As and when software bugs are found/determined, the manufacturer shall provide patches/firmware replacement if involved free of cost for three years. Modified documentation wherever applicable shall also be supplied free of cost.
- 8.4.6 Ratings and types of fuses used are to be indicated by the supplier.
- 8.4.7 The manufacturer/supplier shall furnish the list of recommended spares for three years maintenance.
- 8.4.8 The supplier shall have maintenance/repair facility in India.
- 8.4.9 Supplier shall guarantee the spares so long as the equipment is in service, at least for 10 years from the date of supply. The purchaser would like to stock spares as and when the supplier decides to close down the production of the offered equipment. In such an event, supplier shall give a two years notice to the purchaser so as to stock the spares.

8.5 Power supply:-

- 8.5.1 The power supply to the equipment shall be fed from the station power plant. The equipment shall meet the following requirements in respect of the power supply.
- 8.5.2 Nominal power supply is -48 Volts DC, with a variation over the range -44V to -57V. The equipment should operate over this range without any degradation in performance.
- 8.5.3 The equipment shall be protected in case of voltage variation beyond the above-specified range and also against input reverse polarity. The manufacturer shall furnish the value of guaranteed input voltage up to which no irreversible damage to the equipment will occur.

- 8.5.4 The actual power consumption shall be furnished by the manufacturer.
- 8.5.5 The derived DC voltages in the equipment shall have protection against over-voltage, short-circuit and overload.
- 8.5.6 The equipment shall have the option of operating from two independent sources of input power supply.
- 8.5.7 The equipment requiring AC mains shall operate from AC power supply without any degradation in the performance.
 - (a) Nominal AC voltage for Single Phase shall be 230V with variation of -15% to +10%, at 50 ± 2 Hz.
 - (b) Nominal AC voltage for Three Phase shall be 415V with variation of -15% to +10%, at 50 ± 2 Hz.

8.6 Accessories

- 8.6.1 The supplier shall provide one complete set of:
 - a) All the necessary interfaces, connectors, connecting cables and accessories required for satisfactory and convenient operation of the equipment. Types of connectors, adopters to be used and the accessories of the approved quality shall be clearly indicated in the operating manuals which should be in conformity with the detailed list in the GR;
 - b) Software and the arrangement to load the software at site.

Additional sets may be ordered optionally.

- 8.6.2 Special tools, extender boards, extender cables and accessories essential for installation, operation and maintenance of the equipment shall be clearly indicated and supplied along with the equipment.
- 8.6.3 Special tools, extender boards, extender cables and accessories essential for repair of the equipment shall be clearly indicated and supplied in case the same ordered.

8.7 Documentation:-

Technical literature in English with complete layout, detailed block schematic and circuit diagram of various assemblies with test voltages/waveforms at different test points of the units shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The manuals shall include the following:-

- 8.7.1 Installation, Operation and Maintenance Manual
 - a) Safety measures to be observed in handling the equipment;
 - b) Precautions for installation, operation and maintenance;
 - c) Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance, troubleshooting and sub-assembly replacement;

d) Illustration of internal and external mechanical parts.

8.7.2 Repair Manual (to be supplied when ordered)

- a) List of replaceable parts used including their sources and the approving authority;
- b) Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate reordering of spares as and when required;
- c) Procedure for troubleshooting and sub-assembly replacement shall be provided. Test fixtures and accessories required for repair shall also be indicated. Systematic trouble shooting charts (fault tree) shall be given for the probable faults with their remedial actions.

8.8 Protection requirements

8.8.1 The equipment shall have a terminal for grounding the rack.

8.8.2 Protection against short circuit/ open circuit in the accessible points shall be provided.

8.8.3 All switches/controls on front panel shall have suitable safeguards against accidental operation.

8.8.4 The equipment shall be adequately safeguarded to prevent entry of dust, insects and lizards.

8.8.5 The acoustic noise level generated by SSPA shall not exceed 68dBA, measured at a distance of one meter from the front of the equipment.

8.9 Safety requirements:-

8.9.1 The operating personnel should be protected against shock hazards as per IS 8437 {1993} "Guide on the effects of current passing through the human body" [equivalent to IEC publication 479-1 {1984}].

8.9.2 The equipment shall conform to IS 13252 {1992} "Safety of information technology equipment including electrical business equipment" [equivalent to IEC publication 950 {1986}] and IEC 215 {1987} "Safety requirements of radio transmitting equipment's" {for Radio Equipments only}.

8.9.3 The equipment should follow proper construction practice to minimize unintended radiations due to leakage from any gap or monitoring points. All unused if/rf ports and monitoring points should be terminated. The power flux density shall not exceed 1mW/cm² at a distance of 2.5 cms.

8.10 Electromagnetic Compatibility (EMC)

- 8.10.1 The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished from test agency which should be an accredited one, and details of accreditation shall be submitted. Following test results should be furnished:-
- 8.10.2 Conducted and radiated emissions: To comply with Class 'A' of CISPR 22 (2003) – Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipments.
- 8.10.3 Electrostatic discharge: To comply with IEC 61000-4-2 (2001) – Testing and measurement techniques of Electrostatic discharge immunity test – under following test levels
- a) Contact discharge level 2 (± 4 kV)
 - b) Air discharge level 3 (± 8 kV)
- 8.10.4 Immunity: IEC 61000-4-3 (2002) – Radiated RF Electromagnetic Field Immunity test – under test level 2 (test field strength of 3 v/m) for general purpose in frequency range 80 MHz to 1000 MHz and under test level 3 (10 v/m) for protection against digital radio telephones in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 2.0 GHz.
- 8.10.5 Fast transients common mode (burst): To comply with IEC 61000-4-4 {(1995 with Amendment 1 (2000) and Amendment 2 (2001)} – Testing and measurement techniques of electrical fast transients/burst immunity test – under Level 2 (1 kV for DC power lines; 1 kV for signal control lines).
- 8.10.6 Surges line to earth coupling and line coupling: To comply with IEC 61000-4-5 (2001) – Test & Measurement techniques for Surge immunity tests – under test levels of 0.5 kV for line to line coupling and 1 kV for line to earth coupling.
- 8.10.7 Radio frequency common mode: To comply with IEC 61000-4-6 (2001) – Immunity to conducted disturbances induced by radio frequency fields – under the test level 2 (3V r.m.s.) clamp injection method for DC lines and Signal Control lines.
- 8.10.8 For tests for checking compliance to above EMC requirements, the method of measurements shall be in accordance with IEC/CISPR and TEC standard no. SD/EMI-02/02.SEP.2001 with Amendment No. 1 dated 30.05.2003 and Corrigendum dated 06.05.2005, and the references mentioned therein. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that above mentioned frequency ranges and test levels are met as per the above referred TEC standard. The details of IEC/CISPR and corresponding Euro Norms are as under.

IEC/CISPR	Euro Norm
CISPR 22	EN 55022
IEC 61000-4-2	EN 61000-4-2
IEC 61000-4-3	EN 61000-4-3

IEC 61000-4-4	EN 61000-4-4
IEC 61000-4-5	EN 61000-4-5
IEC 61000-4-6	EN 61000-4-6

9.0 Guidance to the purchaser

(To form part of the GR)

The clauses contained in this Annex are for the reference of the purchaser only and these clauses shall not be tested during Type Approval testing.

- a) As and when software bugs are found/determined, the manufacturer shall provide patches/firmware replacement if involved as mutually agreed between purchaser of equipment and supplier. Modified documentation wherever applicable shall also be supplied.
- b) The manufacturer/supplier shall furnish the list of recommended spares.
- c) The supplier shall have maintenance/repair facility in India.

10.0 ABBREVIATIONS

ABS	Average bits per sample
ADPCM	Adaptive Differential Pulse Code Modulation
AIS	Alarm Indicating Signal
BER	Bit Error Rate
CAM	Channel Assignment Map
CC	Control Channel
CCS	Common channel signalling
CEPT	Conference European Post and Telegraph
cms	Centimeters
CISPR	International Special Committee on Radio Interference
CS-ACELP	Conjugate structure-Algebraic Code Excited Linear Prediction
dBmo	decibels referenced to the zero test level point
dBW	decibels referenced to a Watt
DC	Direct Current
DLC	Dynamic Load Control
DOM	Digital office Monitor
DSI	Digital Speech Interpolation
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESC	Engineering Service Channel
FDX	Full Duplex
FEC	Forward Error Correction
GR	Generic Requirements
HDLCL	High level data link control
IEC	International Electrotechnical Commission
IESS	Intelsat Earth Station Standards
IS	Indian Standard
ISC	International Switching Centre
ISDN	Integrated Service Digital Networks
ISO	International Standardisation Organisation
IT	Intermediate Trunk
kb/s	kilo bits per second
kHz	kilo Hertz
kV	kilo volt
LD-CELP	Low Delay Code Excited Linear Prediction
LRE	Low Rate Encoding
MC	Multi Clique
MD	Multi Destination
MTBF	Mean Time Between Failure
mw	milliwatt
OMC	Operator Maintenance Control
PCM	Pulse Code Modulation
PRI	Primary rate interface
QA	Quality Assurance
QM	Quality Manual
RF	Radio Frequency
Rx	Receive

SC	Switching Centre
SCI	Switching Centre Interface
SD	Single Destination
TC	Trunk channels
TEC	Telecommunication Engineering Centre
TX	Transmit
V	Volts
VBD	Voice Band Data
VBR	Variable Bit Rate
V/m	Volts per meter
VOW	Voice Order Wire
W	Watt