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GENERIC REQUIREMENTS FOR STM-1, STM-1/4, STM-1/4/16, STM-1/4/16/64 AND STANDALONE STM-64 SDH ANALYZER WITHOUT JITTER AND WANDER OPERATING AT 1310nm AND 1550nm WAVELENGTHS

GENERIC REQUIREMENTS
No.GR/SDA-04/02.FEB.2009
(Supersedes GRs No.GR/SDA-01/04.JAN.2005 and No. GR/SDA-04/01.FEB.2007)

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History Sheet

Sl. No.	GR No.	Particulars	Remarks
1.	G/SDA-01/03.AUG.99	Generic Requirements for STM-1, STM-1/4 and STM-1/4/16 PDH/ SDH Analyzer Operating at 1310nm and 1550nm Wavelengths	First Release
2.	GR/SDA-01/04.JAN.2005	Generic Requirements for STM-1, STM-1/4 and STM-1/4/16 PDH/ SDH Analyzer without Jitter and Wander Operating at 1310nm and 1550nm Wavelengths	Second Release
3.	GR/SDA-04/01.FEB.2007	Generic Requirements for STM-64 PDH/ SDH Analyzer without Jitter and Wander Operating at 1310nm and 1550nm Wavelengths	First Release
4.	GR/SDA-04/02.FEB.2009	Generic Requirements for STM-1, STM-1/4, STM-1/4/16, STM-1/4/16/64 and Standalone STM-64 SDH Analyzer without Jitter and Wander Operating at 1310nm AND 1550nm Wavelengths	Current Release • GR for STM-1, STM-1/4 and STM-1/4/16 and GR for STM-64 Analysers without jitters are combined. • Requirements for STM-1/4/16/64 and Standalone STM-64 Analysers are introduced. • Requirements for the Tandem Connection Monitoring (TCM) have been withdrawn.

CONTENTS

Applicable Reference Documents

ITU- T Rec. G.691	Optical Interfaces for single channel STM-64, STM- 256 systems and other SDH systems with optical amplifiers.
ITU- T Rec. G.703	Physical, Electrical Characteristics of Hierarchical Digital Interface
ITU- T Rec. G.704	Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels
ITU- T Rec. G.707	Synchronous Digital Hierarchy Bit Rate
ITU-T Rec. G.783	Characteristics of Synchronous Digital Hierarchy (SDH) Multiplexing Equipment Functional Blocks.
ITU- T Rec. G.806	Characteristics of transport equipment – Description methodology and generic functionality
ITU- T Rec. G.811	Timing characteristics of primary reference clock
ITU-T Rec. G.813	Timing Characteristics of SDH Equipment Slave Clocks (SEC).
ITU-T Rec. G.821	Error performance of an international digital connection forming part of an integrated services digital network.
ITU- T Rec. G.824	Control of Jitter and Wander within digital networks which are based on the 1544 Kbps hierarchy.
ITU- T Rec. G.825	Jitter and Wander within Digital network based on Synchronous Digital Hierarchy (SDH).
ITU-T Rec. G.826	End-to-end error performance parameters and objectives for international, constant bit rate digital paths and connections
ITU-T Rec. G.828	Error performance parameters and objectives for international, constant bit rate synchronous digital paths.
ITU-T Rec. G.829	Error performance events for SDH multiplex and regenerator sections
ITU- T Rec. G.841	Types and characteristics of SDH network protection architecture
ITU-T Rec. G.957	Optical Interface for Equipment's relating to Synchronous Digital Hierarchy (SDH).
ITU-T Rec. M.2100	Maintenance philosophy of International Transport Networks
ITU-T Rec.M.2101	Performance limits for bringing into service and maintenance of international SDH paths and multiplex sections.
ITU-T Rec. O.150 and O.151	General Requirements for Performance Measurements on Digital Transmission Equipment.
ITU-T Rec. O.161	In-service Code Violation measurements in 2Mbps HDB3 encoded digital streams.
ITU-T Rec. O.162	- Monitoring of Cyclic Redundancy Check procedure
ITU-T Rec.O.172	Jitter and wander measuring equipment for Digital System which are based upon the Synchronous Digital Hierarchy (SDH).
ITU-T Rec. O.181	Equipment to Access Error Performance on STM-N Interfaces

No.S/EMC-02/03.MAY. 2006	Requirements for Electromagnetic Compatibility.
IS 8437{1993}[equivalent to IEC publication 60479]	"Guide on the effects of current passing through the human body"
CISPR 22 {2006}	Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment.
IEC 61010-1(2001) with Corrigendum 1 (2002) and Corrigendum 2 (2003)	Safety Requirements for Electrical Equipment for Measurement, Control and laboratory use.
IEC 61000-4-2 (2001)	Testing and measurement techniques of Electrostatic discharge immunity test.
IEC 61000-4-3 {2002/2006}	Testing and measurement techniques - Radiated RF Electromagnetic Field Immunity Test.
IEC 61000-4-4 {2004} /[1995) with Amendment-1 (2000) and Amendment-2 (2001)]	Testing and measurement techniques of electrical fast transients / burst immunity test.
IEC 61000-4-5 {2005/2001}	Test & Measurement techniques for Surge immunity tests.
IEC 61000-4-6 (2004) with Amendment-1 (2004) & Amendment-2 (2006)	Testing & measurement techniques-Immunity to conducted disturbances induced by radio- frequency fields .
IEC 61000-4-11 (2004)	Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests.
ASTM D-2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D-2197	Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion

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GR No.GR/SDA-04/02.FEB.2009
*(SUPERSEDES GRs No.*GR/SDA-01/04.JAN.2005 and No. GR/SDA-04/01.FEB.2007)

PART I – TECHNICAL REQUIREMENTS:

1.0 Introduction:

This document describes the generic requirements for a test instrument which can take comprehensive measurements at SDH network interfaces. The instrument is intended for use during installation, commissioning, repair and maintenance of SDH Network Elements. The measurements shall, therefore, support the relevant ITU- T Recommendations in respect of the SDH signals at the network node interfaces (NNI). The instrument shall also support of PDH interfaces which include 2Mb/s, 34Mb/s, 44.736 Mb/s [DS-3] and 140Mb/s whereas the support for SDH interfaces shall be for STM-1, STM-4, STM-16 and STM-64 interfaces. The instrument shall perform measurements within the framework of network element types, functional block characteristics and general requirements of the SDH equipment as specified in various ITU-T recommendations.

This GR stipulates for a non-jitter module of the SDH Analyzer and therefore, the measurement of jitter and wander are out of the scope of this document. However, the instrument shall provide pointer functionalities and shall also facilitate accessing the SOH and POH bytes of the SDH frame and at the same time programming and analysis of the required bytes shall be possible.

2.0 Functional requirements

2.1 This GR calls for a simple and compact instrument which shall support tributary interfaces on the client side at the bit rates of 2 Mb/s, 34 Mb/s, 44.736 Mb/s [DS-3], 140 Mb/s and 155 Mb/s [STM-1] electrical and optical signals.

2.2 On the line side, the instrument shall be capable for measurement at the following line interfaces according to the Type it shall support:

a. STM-1 electrical and optical interfaces at bit rate of 155.520 Mb/s,
b. STM-4 interface at bit rate of 622.080 Mb/s,
c. STM-16 interface at bit rate of 2488.320 Mb/s, and
d. STM-64 interface at bit rate of 9953.280 Mb/s.

2.3 There shall be five types of dedicated instruments such as Type-A, Type-B, Type-C, Type-D and Type-E depending upon the line interfaces they shall support:

Type-A:
The instrument shall support STM-1 electrical and optical line interfaces along with tributary interfaces of 2 Mb/s, 34 Mb/s, 44.736 Mb/s [DS-3] and 140 Mb/s. The DS-3/E3 electrical interfaces may be either auto sensed or software configurable type.

Type-B:
The instrument shall support Type-A capabilities and shall also support STM-4 optical line interface, by addition of suitable plug-in hardware and software.

Type-C:
The instrument shall support Type-B and shall also support STM-16 optical line interface by addition of suitable plug-in hardware and software.

Type-D :
The instrument shall support Type-C and shall also support STM-64 optical line interface by addition of suitable plug-in hardware and software.

Type-E:
This is a standalone type of instrument which shall support STM-64 optical line interface only. The tributary interfaces on the client side shall support STM-1 electrical as well as optical interfaces.

2.4 The Instrument shall support ITU- T Rec. G.703 and G.704 in respect of PDH signals and ITU-T Rec. G.707 in respect of SDH network node interfaces (NNI) and multiplexing structures. The measurements are required to be performed within the framework of network element types, functional block characteristics and general requirements of the SDH equipment specified in ITU-T Rec. G.783.

2.5 The analyzer shall support measurement of optical interface parameters as per ITU- T Rec. G.957 and G.783, the error performance parameters as per ITU-T Rec. G.821, G.826, G.828 and G.829 and performance limits verification as per ITU-T Recs. M.2100 and M.2101. In-service code violation measurements in 2Mbps HDB3 encoded digital streams and monitoring of cyclic redundancy check procedure as given in ITU-T Recs. O.161 and O.162 shall be supported. The instrument shall meet the general requirements for performance measurements of digital transmission equipment, and shall be as per methodologies outlined in ITU-T Recs. O.150/ O.151 and O.181.

2.6 It shall provide for state-of-the-art measurement technologies, with self test diagnostics, in-service and out-of-service testing and monitoring of selected electrical and optical parameters.

a) It shall be possible to map and de-map DS-3 data @ 44736kb/s on to STM-N payload. The instrument shall also support the tributary interface at 44736 Kb/s.
b) It shall be possible to generate and monitor framed and unframed 44736 Kb/s electrical signals.

c) The jitter requirements of DS-3 interface shall be as per ITU-T G.824. It shall be possible to map DS3 payload via AU-3 and AU-4 paths.

3.0 Requirements of Test Functions:

The test instrument must be able to provide the following test functions-

3.1 The instrument shall consist of a Generator/Transmitter section and an Analyzer/ Receiver section, capable of operating independent of each other.

3.2 Generation and monitoring of 2048 Kb/s, 34368 Kb/s, 44736 Kb/s and 139264 Kb/s framed and unframed PDH electrical signals, 155.520 Mb/s SDH electrical and optical signals, 622.080 Mb/s, 2488.320 Mb/s and 9953.280 Mb/s SDH optical signals shall be possible.

3.3 The instrument shall support Contiguous Concatenated payload generation and analysis at 155.520 Mb/s, 622.080 Mb/s, 2488.320 Mb/s and 9953.280 Mb/s as specified in ITU- T Rec. G.707.

3.4 The instrument shall support optical wavelengths @ 1310nm and 1550nm as per requirement, with facility for on-line monitoring.

3.5 The instrument shall support the selection of any test pattern from a specified set of test patterns.

3.6 It shall be possible to map and de-map PDH test signals onto/from SDH line signals with configurable multiplexing routes. The instrument shall support Mapping/de-mapping of C-12 as well as C-3 containers via AU-3 and AU-4 mapping paths as specified in ITU-T Rec. G.707. The mapping and de-mapping of C-4 container shall be via AU-4 mapping path.

3.7 It shall be possible to inject a number of specified intentional errors in individual overhead bytes of the frame. The monitoring of the consequent actions and associated alarms shall also be possible.

3.8 It shall be possible to create specified alarm conditions and monitor the consequent actions and associated alarms.

3.9 The instrument shall support in-services as well as out-of-service monitoring modes and analyze the performance parameters in respect of any of the signals mapped on to the line signal.

3.10 The instrument shall support setting / monitoring / analysis of contents of SDH overhead bytes and payloads and display of SOH and POH bytes.

3.11 The instrument shall have Justification measurement capability. Justification measurement shall be possible for the pointer value, pointer increment count, pointer decrement count, increment

seconds, decrement seconds, NDF seconds, and VC offset in ppm along with pointer movement as applicable as per ITU-T Rec. G.783.

3.12 Manual and/or auto-sequence pointer operation and measurements/ analysis shall be possible as per ITU-T Rec. G.783.

3.13 The instrument shall have provision for setting of K1 and K2 bytes and monitoring of the same for APS/MSP/MS-SPRING protection performance in respect of STM-1, STM-4, STM-16 and also STM-64 signals. The instrument shall also facilitate measurement of protection switching time.

3.14 The instrument shall facilitate analysis of any selected STM-1 signal from STM-4, STM-16 as well as STM-64 line signals for further analysis.

3.15 This instrument shall support pointer generation and action. It shall be possible to see the pointer in action and the movement in the TU/AU pointer as per the respective limits of frequency off-sets for the 2 Mb/s, 34 Mb/s, 45 Mb/s and 140 Mb/s tributaries as per ITU-T Rec. G.703.

3.16 **Features:** The following features shall be supported by the instrument-

3.16.1 The instrument shall have the online printing facility for numerical, graphical and alarms through an external printer. The instrument shall, therefore, have the provisioning of a printer port and the vendor shall provide the printer as an integral part of the offer.

3.16.2 The built-in display unit shall be of colored type with high resolution, preferably supported by additional LED display of alarms.

3.16.3 Both transmitter and receiver shall be housed in a single cabinet.

3.16.4 User-friendly set-up procedure with pop-up menu, display of errors, alarms and pointer operations, measurement results bar graphs as well as numerical values, with measurement time up to at least 30 days shall be provided.

3.16.5 It shall be possible to download the stored data from an instrument to a personal computer working in windows environment, through RS-232 interface/ USB/LAN 10/100BaseT.

4.0 Technical Requirements:

4.1 Electrical Interfaces:

Bit rate	**Code**	**Impedance**	**Type of Connector**	
2048 Kb/s	HDB3	120 ohms	Bal.	3-PINS
34368 Kb/s	HDB3	75 ohms	Unbal.	Spinner/BNC/Mini spinner

44736 Kb/s	B3ZS	75 ohms	Unbal.	Spinner/BNC/Mini spinner
139264 Kb/s	CMI	75 ohms	Unbal.	Spinner/BNC/Mini spinner
155520 Kb/s	CMI	75 ohms	Unbal.	Spinner/BNC/Mini spinner

Other parameters pertaining to the input as well as the output ports shall offer conformance to ITU-T Rec. G.703.
In case proprietary connectors are in use, suitable adapters/patch-cords shall be provided.

4.1.1 Output bit-rate offset : ± 50 ppm in steps of 1 ppm .

4.1.2 Input pulling range of clock recovery: ± 50 ppm

4.2 SDH Optical Interfaces:

4.2.1 STM-1 optical interface:

Bit-rate accuracy : 155520 kb/s ± 4.6 ppm
Optical Interfaces : Short haul or long haul
Transmit offset : ± 50 ppm in steps of 1 ppm
Receive pull-in range : ± 50 ppm in steps of 1 ppm

Note: Purchaser shall specify the optical interface and application code from Table-2/ITU-T Rec. G.957.

4.2.2 STM-4 optical interface:

Bit-rate accuracy : 622088 kb/s ± 4.6 ppm
Optical interfaces : Short haul or long haul
Transmit offset : ± 50 ppm in steps of 1 ppm
Receive pull-in range : ± 50 ppm in steps of 1 ppm

Note: Purchaser shall specify the optical interface and application code from Table-3/ITU-T Rec. G.957.

4.2.3 STM-16 optical interface:

Bit-rate accuracy : 2488320 Kb/s ± 4.6 ppm
Optical interfaces : Short haul or long haul
Transmit offset : ± 50 ppm in steps of 1 ppm
Receive pull-in range : ± 50 ppm in steps of 1 ppm

Note: Purchaser shall specify the optical interface and application code from Table-4/ITU-T Rec. G.957.

4.2.4 STM-64 optical interface:

Bit-rate accuracy : 9953280 Kb/s ± 4.6 ppm
Optical interfaces : S-64.2 b as per ITU-T Rec. G.691
Transmit offset : ± 20 ppm in steps of 1 ppm
Receive pull-in range : ± 20 ppm in steps of 1 ppm

Note: The optical STM-N interface shall be either 1310nm or 1550nm as per requirement. Other optical parameters shall conform to the Tables 2,3&4/ ITU-T Rec.G.957 in respect of STM-1, STM-4 and STM-16 respectively. The parameters for STM-64 interface port shall support S-64.2b optical interface specifications and requirements as specified in ITU-T Rec. G.691. The receiver sensitivity, however, shall be 2-4 dB better than the end-of-life values specified in these tables.

4.2.5 Jitter specifications:

4.2.5.1 Input jitter specifications:

The jitter at the input interface port of STM-1/4/16/64 shall be as per ITU-T Rec. G.825, G.813 and G.783.

4.2.5.2 Output jitter specifications:

The jitter at the output interface port of STM-1/4/16/64 shall be as per ITU-T Rec. G.825, G.813 and G.783.

4.3 Connectors at optical interfaces:

Bit rate	Code	Type of Connector
STM-1 : 155520 Kb/s	NRZ	SC/LC
STM-4 : 622080 Kb/s	NRZ	SC/LC
STM-16 : 2488320 Kb/s	NRZ	SC/LC
STM-64 : 9953280 Kb/s	NRZ	SC/LC

Note-1: The optical connectors shall be field replaceable.
Note-2: Vendor may optionally provide programmable SFPs in the instrument.

4.4 Receive power measurement:

The instrument in the receive mode shall be able to measure the received optical power and the accuracy of the measured power shall be ± 1dB. However, while pluggable SFP is in use, the

accuracy shall be ± 2dB

4.5 Pattern Generation:

4.5.1 Patterns on selected channel: It shall be possible to generate test patterns as per ITU-T Rec. O.150 on the selected signals.

4.5.2 Pseudo Random Bit Sequences (PRBS): The instrument shall be able to generate PRBS test signals @ 2^{11-1}, 2^{15}-1, 2^{23}-1 and 2^{31} -1.

4.5.3 Programmable word: The programmable word shall of 16 bits long.

4.6 Signal Generation:

4.6.1 PDH Signals:

The instrument shall generate framed and unframed PDH data output at 2 Mbps, 34 Mbps, 45 Mbps and 140 Mbps each filled with PRBS of applicable length as per ITU-T Rec.O.150. It shall also be capable to generate CRC-4 signal at 2 Mbps.

4.6.2 SDH Signals:

The instrument shall generate SDH framed data output at STM-1, STM-4, STM-16 and STM-64 [as relevant for specific instrument 'Type'], with payload area filled with PRBS of applicable length as per clause 4.6.2 above. The instrument shall also be capable to generate bulk signals filled with PRBS of applicable length. The interface requirements at STM-1e, STM-1o, STM-4o, STM-16o and STM-64o shall be as indicated earlier. The PRBS data / bulk signals filed in the SDH tributaries at STM-1, STM-4 and STM-16 shall be possible to be mapped onto the STM-64 payload. Also, it shall be possible to fill PRBS/bulk signals in STM-64 payload.

However, as far as Type-E Analyzer is concerned, it shall be capable to work only with the higher order mappings such as VC-4, VC-4-4c, VC-4-16c & VC-4-64c.

4.7 Multiplexing/De multiplexing of STM-1 signal:

Provision to position one structured STM-1 signal into a selected time-slot in a specific STM-4/16/64 with remaining channels in other time slots kept unequipped, shall be possible. It shall also be possible to de-multiplex any STM-1 signal from any time slot of STM-4/16/64 line signal for further analysis.

4.8 Specifications of synchronization clock ports:

4.8.1 Internal Clock-

The instrument shall provide internal clock in free-running mode with an accuracy of ± 4.6ppm, offset capability of ± 50 ppm and resolution of 1 ppm.

4.8.2 External Clock input port-

The instrument shall provide input clock ports which shall accept 2048 KHz and 2048Kb/s external clocks; this clock shall maintain an accuracy and stability traceable to ITU-T Rec. G.811 clock, when fed through a PRC. The other electrical parameters shall be as per ITU-T Rec. G.703.

4.8.3 External Clock output port-

While configured in the internal clock mode, the instrument shall provide external clock output which shall have the accuracy and stability as per ITU-T Rec. G.813. The electrical parameters shall be as per ITU-T Rec. G.703.

The instrument shall optionally provide the clock output at 2048 KHz as well as 2048 Kb/s. The impedance shall be 75Ω unbalanced or 120Ω balanced. The clock outputs shall be traceable to G.811 PRC clock, when the instrument is locked to external 2048 KHz or 2048 Kb/s clocks.

The instrument shall also be capable to derive the SDH clock from the STM-N input data and its accuracy shall be the same as that of selected STM-N signals used for the objective.

4.9 Measurements modes:

4.9.1 Single, Repeat or Time-gated, Manual modes of measurements shall be supported by the instrument.

4.9.2 Maximum history: 30 days with 1 min resolution with provision for real time stamp at start and end of an event.

4.9.3 Display Resolution: 1 sec with user defined durations.

4.9.4 The instrument shall be able to be configured for both in-service and out-of-service measurements. It shall also be possible to be configured to measure in terminated mode as well as though mode.

4.10 Multiplex Section Protection control:

It shall be possible to monitor the mechanism relating to Protection Control through K1 & K2 bytes, for all span and ring protection topologies. The instrument shall have the provisioning of displaying the status of APS command in action as specified in ITU-T Rec. G.841, along with

its assigned binary/ HEX code logical representation.

4.11 Pointer generation and action:

4.11.1 The instrument shall support generation of pointer test sequences at AU and TU levels as per Table-1/0.172.

4.11.2 It shall be possible to set the pointer value, NDF and SS, increment and decrement of the pointer value, simulation of test sequences as per Figure-6.2/ITU-T Rec. G.783. The time interval between G.783 pointer justification events shall be as per Table-2/0.172.
The instrument shall be capable to provide the relevant set of pointer sequences as per Table-1/ O.172.

4.11.3 The pointer sequences as stated in the Table-1/O.172 shall be able to be triggered singly or repetitively..

4.11.4 Measurement of Pointer actions:
Display of a number of pointer operations with respect to time, and instantaneous pointer value shall be as stated in the Table-2/0.172.

4.12 Generation and monitoring of Defects:

The instrument shall be able to generate, simulate and detect the following alarms as per ITU-T Rec.G.783. The instrument shall have the provision of dynamic injection of the following SDH defects:

1. LOS
2. LOF
3. MS-AIS
4. MS-RDI
5. AU-LOP
6. AU-AIS
7. HP-UNEQ
8. HP-RDI
9. HP-TIM
10. HP-LOM
11. TU-AIS
12. TU-LOP
13. TU-LOM
14. LP-UNEQ
15. LP-RDI
16. LP-TIM

4.13 Generation and monitoring of Anomalies:

The instrument shall be capable to monitor the errors in the form of anomalies as listed below. It shall be possible to insert continuous error or repetitive errors to result in error ratios from 1E-5 to 1E-9 as per ITU-T Rec.G.806. Provision shall also be available in the instrument to monitor the errors and display the same.

1. B-1 error
2. B-2 Err* (Excessive) 1x 10^{-3}
3. B-3 Err* (Excessive) 1x 10^{-3}
4. MS-REI
5. FAS
6. HP-REI
7. LP-BIP
8. LP-REI

4.14 Performance monitoring parameters:

The instrument shall be able to analyze, monitor and display the error performance as per ITU-T Rec. G.821, G.826,.G.828, G.829. The performance analysis of 2 Mbps PDH signal shall be as per ITU-T Rec.G.821 giving error counts, ES, SES, UAS and EFS. The analysis in respect of other PDH signals shall be as per ITU-T Rec.G.826. The performance analysis of the SDH paths, multiplex and regenerator sections shall be as per ITU-T Rec.G.828 and G.829.

The instrument shall also be capable to analyze the performance as per ITU-T Rec. M.2100, M.2101.

4.15 Overhead byte management:

4.15.1 Overhead setup:

The instrument shall facilitate user programmable in hexadecimal all the SOH, HO-path and LO-path overhead bytes. However, restriction shall be there with B-1, B-2, B-3, H-1 (SS-bits programmable), H-2, H-3, V-1 to V-4, V-5 (bits 5-7 programmable).

4.15.2 Overhead monitoring:

The instrument shall display all SOH overhead bytes in a selected STM-1 group, plus all HO-path and LO-path overhead bytes. It shall display the received byte values in hexadecimal. The instrument shall be capable to display the following overhead bytes:

1. 9 bytes: D-4 to D-12
2. 3 bytes: D-1 to D-3
3. 2 bytes: A1-A2, K1-K2, H1-H2
4. 1 byte: J0, E1, F1, S1, M1, Z0, J1, C2, G1, F2, H4, F3, K3, N1, N2, H3.

PART II -GENERAL REQUIREMENTS:

1.0 Reference Documents:

1.1 Whatever that has been specifically stated in this document, shall deem to be as per relevant latest ITU-T Recommendations.

1.2 Relevant ITU-T Recommendations and other specifications are detailed in the "List of applicable reference documents".

1.3 All references to TEC GRs and other Recommendations imply for their latest issue.

2.0 Engineering requirements:

2.1 The instrument shall adopt state-of-the-art technology.

2.2 The instrument shall be portable and light in weight. The actual dimensions and weight of the equipment shall be furnished by the manufacturers.

2.3 All connectors and switches shall be reliable and of standard type to ensure failure free operation for over 1000 mating for connectors and 1000 on-off operations for switches. This shall be under environmental conditions specified in this GR.

2.4 All connectors and the cable used shall be of low loss type and suitably shielded.

2.5 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

2.6 The instrument shall have self-cooling arrangement. If the self-cooling arrangements are found inadequate, usage of internal fans may be allowed provided-

- MTBF of the fans is in excess of 80000 hrs.
- Provision of fans does not deteriorate the MTTR/MTBF values of the instrument.

2.7 Important Do's and Don'ts about the operation of the equipment shall be clearly indicated at a convenient place on the instrument.

3.0 Operational Requirements:

3.1 The instrument shall be designed for continuous operation.

3.2 The manufacturer shall guarantee the satisfactory performance of the instrument shall without any degradation at an altitude up to 3000 meters above mean sea level. A test certificate from the manufacturer shall be acceptable.

3.3 Power cords shall have molded plugs .

3.4 Visual indication to show power ON/OFF status shall be provided.

3.5 Provision for self-check of the instrument shall be provided.

3.6 The software/hardware in instrument 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 instrument.

4.0 Quality Requirements:

4.1 The manufacturer shall furnish the MTBF values. The calculations shall be based on the guidelines as contained either in the DoT-QA document No.: QM-115 (January'1997) - "Reliability Methods and Predictions" or any other international standard.

4.2 a) The instrument 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 followed by the manufacturer would be required to be submitted.

b) The instrument shall be manufactured as per the latest DoT QA Guidelines indicated in Quality Manuals QM-118 { Quality and Reliability in product design}, QM-205 { Guidelines for Standards of Workmanship for Printed Boards}, QM-206 { Guidelines for Standards of Workmanship for Printed Board Assemblies}, QM-210 {Guidelines for Standards of Workmanship for Surface Mounted Devices} and QM-301 { Transmission Equipment General Documentation}.

4.3 The instrument shall conform to the requirements for environment as specified in the DoT-QA document No.: QM-333 (Latest issue) - "Specification for environmental testing of electronic equipment for transmission and switching use". The applicable tests shall be taken for environmental category B2 including vibration test and the qualification test shall stand guaranteed over the temperature range of 0° to 45°C.

5.0 Maintenance requirements:

5.1 The calibration of the instrument shall be valid for one year.

5.2 The instrument shall have easy access for servicing and maintenance. It may be specifically noted that replacement of fuses etc. can be done quickly and conveniently. This is essential as these items may go faulty during operation and quick replacement helps in early restoration.

Note: Ratings and types of fuses used are to be indicated by the supplier.

6.0 Power Supply:

The instrument shall be powered by the single phase AC mains and optionally, shall also have provision of functioning in a battery operational mode. On AC operational mode, the instrument shall meet the following requirements:

a) The instrument shall operate over a single phase AC power supply without any degradation with nominal 230 volts AC with a variation of -15% to +10% of 230 V, 50 Hz ± 2 Hz;

b) The instrument may use an in-built or an external AC adapter or may even work on direct AC mains [150-270 V AC].

c) The power consumption shall be minimal. The actual power consumption shall be furnished by the manufacturer.

In the battery operational mode, the instrument shall meet the following requirements:

1. The instrument shall operate on rechargeable battery pack,

2. In-built rechargeable battery capacity shall be of minimum 3 hours on full-load condition (all ports in operation).

3. The battery used shall be Ni- MH type or Li-Ion type.

7.0 Accessories :

7.1 The supplier shall provide one complete set of all items mentioned in (a) below along with the instrument in a carrying case. The supplier shall also ensure proper protection against bumps etc.

(a) All the necessary interfaces, connectors, connecting cables and accessories required for satisfactory and convenient operation of the instrument. 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.

Note: Additional sets may be ordered optionally.

7.2 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 instrument.

7.3 Special tools, extender boards, extender cables and accessories essential for repair of the instrument shall be clearly indicated and supplied in case the same are ordered.

8.0 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 by the manufacturer. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The same shall also be made available in a CD. The manuals shall include the following:

ii) Installation, Operation and Maintenance Manual:

a) Safety measures to be observed in handling the instrument;
b) Precautions for setting up, measurements and maintenance;
c) Test equipment required for routine maintenance;
d) Illustration of internal and external mechanical parts;
e) The detailed description about the operation of the software used in the equipment including its installation, loading and debugging etc.

ii) Repair Manual:

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 to facilitate recording of spares as and when required.
c) Systematic procedure for trouble-shooting and sub-assembly replacement shall be provided. Test fixture and accessories required for repair shall also be indicated. Systematic trouble-shooting chart (fault-tree) shall be given for the probable faults with their remedial actions.

9.0 Protection Requirements

9.1 The instrument panel shall have a terminal for grounding the chassis.

9.2 Protection against short circuit and open circuit in the accessible points for measurements shall be provided.

9.3 All switches and controls on front panel shall have suitable safeguards against accidental operation.

9.4 The instrument shall be adequately covered to safeguard against entry of even dust, insects etc.

10.0 Safety Requirements

10.1 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 60479].

10.2 The instrument shall conform to the relevant clauses of the document No. IEC 61010-1(2001) with corrigendum-1(2002) and corrigendum-2 (2003) - “Safety Requirements for Electrical

Equipment for Measurement, Control and laboratory use".

11.0 General Electromagnetic Compatibility (EMC) Requirements:

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 an accredited test laboratory.

a) Conducted and radiated emission:

Name of EMC Standard: "CISPR 22 {2006}-Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".

Limits:-
i) To comply with Class A of CISPR 22 {2006}.
ii) The values of limits shall be as per TEC Standard No. SD/EMI-02/03 May.2006 with Amendment No. 1 dated 01.01.2008.

Alternatively, the testing conducted against the CISPR 22 (2003) or its later editions with associated limits for Class A, as given in tables 4(a) or 4 (a1), 5(a) or 5(a1) , 6 and 7 of TEC Standard No. SD/EMI-02/03 May.2006 with Amendment No. 1 dated 01.01.2008, shall also be acceptable till March, 2009.

b) Immunity to Electrostatic discharge:
Name of EMC Standard: IEC 61000-4-2 {2001) "Testing and measurement techniques of Electrostatic discharge immunity test".

Limits: -
i) Contact discharge level 2 {± 4 kV} or higher voltage;
ii) Air discharge level 3 {± 8 kV} or higher voltage;

c) Immunity to radiated RF:

Name of EMC Standard: IEC 61000-4-3 (2006) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test"

Limits:-
i) Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and
ii) Under test level 3 (10 V/m) for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.

Alternatively, till March 2009, the testing against 6100-4-3 (2002) or its later editions with the following test limits shall also be acceptable.

Limits: -
i)Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and
ii)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,

d) Immunity to fast transients (burst):

Name of EMC Standard: IEC 61000- 4- 4 {2004) "Testing and measurement techniques of electrical fast transients/burst immunity test"

Limits:-
Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0. 5 kV for signal / control / data / telecom lines;

Alternatively, till March 2009 , the testing against 61000-4-4 (1995) with Amendment No. 1 (2000) & Amendment No.2 (2001), or its later editions with the test level as mentioned above in this case, shall also be acceptable.

e) Immunity to surges:

Name of EMC Standard: IEC 61000-4-5 (2005) "Testing & Measurement techniques for Surge immunity test"

Limits:-
i) For mains power input ports : (a)1.0 kV peak open circuit voltage for line to ground coupling (b) 0.5 kV peak open circuit voltage for line to line coupling
ii) For telecom ports : (a) 0.5 kV peak open circuit voltage for line to ground (b) 0.5 KV peak open circuit voltage for line to line coupling.

Alternatively, till March 2009 , the testing against 61000-4-5 (2001) or its later editions with the limits as mentioned above in this case shall also be accepted.

f) Immunity to conducted disturbance induced by Radio frequency fields:

Name of EMC Standard: IEC 61000-4-6 (2004) with amendment 1 (2004) & amd. 2 (2006) "Testing & measurement techniques-Immunity to conducted disturbances induced by radio-frequency fields "

Limits:-
Under the test level 2 {3 V r.m.s.}in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.

Alternatively, till March 2009 , the testing against 61000-4-6 (2001) or its later editions with the above mentioned voltage & frequency limits shall also be acceptable.

g) Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any):

Name of EMC Standard: IEC 61000-4-11 (2004) "Testing & measurement techniques-voltage dips, short interruptions and voltage variations immunity tests"

Limits:-

i) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms(i.e. 70 % supply voltage for 500 ms)

ii) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e. 40% supply voltage for 200ms) and

iii) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s.

Note-1: The test agency for EMC tests shall be an accredited agency and details of accreditation shall be submitted.
Alternatively, EMC test report from a non-accredited test lab, which is audited by an accredited lab / accrediting authority for the availability of all the essential facilities (test equipment, test chamber, calibrations in order, test instructions, skilled personnel etc.), required for performing the tests according to the EMC test methods audited, may be acceptable.

However, such accredited lab / accrediting authority should take responsibility of the test results of the "non accredited lab" along with indication of period of such delegation and the submitted test report should be of such valid period of delegation. The audit report, mentioning above facts, should be provided along with EMC test report.

Note-2: For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. SD/EMI-02/03 MAY 2006 with amendment No. 1 Dt. 01.01.2008 and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (g) and TEC Standard No. SD/EMI-02/03 MAY 2006 with amendment No. 1 Dt. 01.01.2008. The details of IEC/CISPR and their corresponding Euro Norms are as follows:

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

12.0 Marking, Surface Finish, Packaging and Shipping:

12.1 Marking:

SDH Analyzer, carrying-case and tools-kits shall be marked for the following and shall be legible:

a) The name of the products, manufacturer's model and serial number.
b) The name of the supplier / manufacturer
c) The date of manufacturing
d) Any other relevant information.

12.2 Surface Finish:

12.2.1 The inside and outside surfaces shall have uniform color and texture.

12.2.2 The painted finish on metallic surfaces shall be resistance to impact and shall not exhibit radial cracking when subjected to 2.8 N- meter load and tested in accordance with ASTM D-2794 or any other equivalent International Standard.

12.2.3 The finish and markings shall adhere to the base-metal and shall not show any separation of coats when tested as per ASTM D 2197 or any other equivalent International Standard.

12.2.4 The Surface finish and markings shall be resistant to chemicals that are normally found in the telephone plant and shall not exhibit any perceivable changes when exposed to ultra-violet light.

12.3 Packaging & Shipping

12.3.1 Packaging of the instrument shall be adequate to ensure that no damage shall occur under shipping, handling and storage in reasonably dry unheated quarters.

12.3.2 SDH Analyzer shipping container and packing shall be reusable, recyclable and biodegradable.

12.3.3 A suitable molded carrying case for the instrument shall be provided.

ABBREVIATIONS

AC	: Alternating Current
APS	: Automatic Protection Switching
ASTM	: American Society for Testing Material
AU	: Administrative Unit
AU-AIS	: Administrative Unit Alarm Indication Signal
AU-LOP	: Administrative Unit Loss of Pointer
BIS	: Bureau of Indian Standards
BNC	: Bayonet N-type Connector
CISPR	: International Special Committee on Radio Interference
CMI	: Coded Mark Inversion
EMC	: Electro-Magnetic Compatibility
EMI	: Electromagnetic Interference
EN	: European Standards
GR	: Generic Requirement
HDB	: High Density Bipolar
HP/LP LOM	: Higher order Path/Lower order Path Loss of Multiframe
HP/LP RDI	: Higher order Path/Lower order Path Remote Defect Indication
HP/LP UNEQ	: Higher order Path/Lower order Path Unequipped
HP REI	: Higher order Path Remote Error Indication
IEC	: International Electro-Technical Commission
IS	: Indian Standards
ISO	: International standard Organization
ITU-T	: International Telecommunication Union- Telecom Standardization Sector
Kbps	: Kilo bits per second
kV	: Kilo Volt
LAN	: Local Area Network
LED	: Light Emitting Diode

LOF	:Loss of frame
LOS	: Loss of signal
Mbps	:Mega bits per second
MS-AIS	: Multiplex Section Alarm Indication Signal
MSP	: Multiplex Section Protection
MS-RDI	: Multiplex Section Remote defect Indication
MS REI	: Multiplex Section Remote Error Indication
MS-SPRING	:Multiplex Section Shared Protection Ring
MTBF	: Mean Time Between Failures
MTTR	: Mean Time To Repair
nm	: nano metre
NNI	: Network Node Interface
Path AIS	: Path Alarm Indication Signal
PDH	: Plesiochronous Digital Hierarchy
POH	: Path Over head
PRBS	: Pseudo Random Bit Sequences
SDH	: Synchronous Digital Hierarchy
SOH	: Section Over Head
STM	: Synchronous Transport Module
TU	: Tributary Unit
TU -AIS	: Tributary Unit Alarm Indication signal
TU-BIP	: Tributary Unit Bit Interleaved Parity
TU -LOP	:Tributary Unit Loss of Pointer
TU-LOM	: Tributary Unit Loss of Multi-frame
USB	: Universal Serial Bus

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