अनंतिम टेस्ट गाइड

टीईसी ४८१४१: २०२५

(**सं:** टीईसी/टीजी/आई टी/ एस आर वी- ३०१/०२/मार्च-१८ को अधिक्रमित करता है)

PROVISIONAL TEST GUIDE

TEC 48141:2025

(Supersedes No. : TEC/TG/IT/SRV-301/02/MAR-18)

for

सर्वर

Server

(**जीआर सं: टीईसी ४८१४०: २०२५**)

(Standard No.: TEC 48140:2025)

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र
खुर्शीदलालभवन, जनपथ, नई दिल्ली-११०००१, भारत

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This Test Guide of testing pertains to Test Schedule and Test procedures for **Server.**

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A. HISTORY SHEET

Sl. No.	TSTP No.	Title	Issue
1.	TSTP/TEC/GR/IT/SRV-001/01 FEB-14	Test Guide for SERVERS	1st issue
2.	TEC/TG/IT/SRV-301/02/MAR-18	Test Guide for SERVERS	2nd issue
3.	TEC 48141:2025	Test Guide for SERVERS	3rd issue

B. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance/ functionality/ requirements/ performance of the Servers for deployment in the Indian Telecommunications network as per GR No.: TEC 48140: 2025

C. General information:

Sl. No.	General Information	Details *(to be filled by testing team)*	
1	Name and Address of the Applicant		
2	Date of Registration		
3	Name and No. of GR/IR/Applicant's Spec. against which the approval sought		
4	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5	Any other relevant Information:-		

D. Testing team:(*to be filled by testing team*)

S No.	Name	Designation	Organization	Signature
1.				
2.				

E. List of the Test Instruments:

S No.	Name of the test instrument	Make /Model *(to be filled by testing team)*	Validity of calibration *(to be filled by testing team)*
1			dd/mm/yyy
2			

F. Equipment Configuration Offered:*(to be filled by testing team)*

(a) **<Equipment/product name> Configuration:**

S No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

(b) <**Other equipment name> Configuration**:

S No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

G. Equipment/System Manuals:***(to be filled by testing team)***

Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc.(Y/N)

H. Clause-wise Test Type and Test No.: -

Clause No		Clause	Type of Test	Compliance
			Physical Check / Declaration / Document ation / Report from Accredited Test Lab / Functional Verification / Information / Lab Test (Test Reference)	Compli ed / Not Compli ed / Submitted / Not Submitted / Not Applic a ble (Indicat e Annex u re No for Test Results)
1.0		Introduction:	Information	
1.1		The history of servers moves parallel to the history of computer networks. The server is to serve - so technically it means that the specific computer is serving other computers. For example, the server is a computer that facilitates other computers (in network) by making queue of the printing command of several computers at a time or acts like a file server for those applications that are accessed by other computers.	Information	

1.2		A Server is a computer or a device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server.		
		In a general network environment the following types of servers may be found.	Information	
	a.	Application server- a server dedicated to running certain software applications.	Information	
	b.	Catalog server- a central search point for information across a distributed network	Information	
	c.	Communications server- carrier-grade computing platform for communications networks	Information	
	d.	Compute server- a server intended for intensive (esp. scientific) computations	Information	
	e.	Database server- provides database services to other computer programs or computers	Information	
	f.	File server- provides remote access to files	Information	
	g.	Game server- a server that video game clients connect to in order to play online together	Information	
	h.	Mobile Server or Server on the Go is a server class laptop form factor computer.	Information	
	i.	Name server or DNS	Information	
	j.	Print server- provides printer services	Information	
	k.	Proxy server, acts as an intermediary for requests from clients seeking resources from other servers	Information	
	l.	Sound server, provides multimedia broadcasting, streaming.	Information	
	m	Stand-alone server, a server on a Windows network that neither belongs to nor governs a Windows domain	Information	
	n.	Web server, a server that HTTP clients connect to in order to	Information	

		send commands and receive responses along with data contents		
1.3		For all ITU–T recommendations and TEC standards referred in this document, the latest release/issue with all associated amendments, addendum and corrigendum shall be applicable.	Information	
1.4		The RFC documents of the IETF are subject to periodic revision. Hence where ever RFC' s are mentioned in this document, the offered product shall meet either the referred RFC or its updated version with all amendments/addendum. Wherever a feature of the RFC is mentioned, product shall comply with the part of the RFC specifying the feature.	Information	
1.5		The interpretation of the clauses of the RFC' s shall be as per RFC 2119.	Information	
2.0		Description of Servers	Information	
2.1		Servers are classified as CISC, RISC and EPIC based servers on the basis of CPU used in the Servers.	Information	
2.1.1		CISC based CPU' s CISC based CPU stands for the CPU' s made with Complex Instruction Set Computing Architecture. A complex instruction set computer (CISC) is a computer where single instructions can execute several low-level operations (such as a load from memory, an arithmetic operation, and a memory store) and/or are capable of multi-step operations or addressing modes within single instructions. To design instruction sets that directly supported high- level programming constructs such as procedure calls, loop control, and complex addressing modes, allowing data structure and array accesses to be combined into single instructions. Instructions are also typically highly encoded in order to further enhance the code density. The compact nature of such instruction sets results in smaller program sizes and fewer main memory accesses, which resulted in savings on the cost of computer memory and disc storage, as well as	Information	

		faster execution. It also means good programming productivity even in assembly language similar to high level languages. However low-end versions of complex architectures could lead to situations where it was possible to improve performance by not using a complex instruction (such as a procedure call or enter instruction), but instead using a sequence of simpler instructions.		

		One reason for this was that programmers sometimes "over-designed" assembly language instructions, i.e. including features which were not possible to implement efficiently on the basic hardware available. This had "side effects", such as the setting of a register or memory location that was perhaps seldom used; which would demand extra process cycles every time, and thus be quite inefficient. Even in balanced high performance designs, highly encoded and high-level instructions could be complicated to decode and execute efficiently within a limited transistor budget. Such architectures therefore required a great deal of work on the part of the processor designer in cases where simpler, but slower, solutions based on decode tables and/or microcode sequencing is not appropriate.		

2.1.2		RISC or EPIC based CPU' s Reduced instruction set computing, or RISC is a CPU design based on the insight that simplified (as opposed to complex) instructions can provide higher performance if this simplicity enables much faster execution of each instruction. A computer based on this strategy is a reduced instruction set computer, also called RISC. The term "reduced" in that phrase was intended to describe the fact that the amount of work any single instruction accomplishes is reduced—at most a single data memory cycle—compared to the "complex instructions" of CISC CPUs that may require dozens of data memory cycles in order to execute a single instruction. In particular, RISC processors typically have separate instructions for I/O and data processing A RISC chip will typically have far fewer transistors dedicated to the core logic which originally allowed designers to increase the size of the register set and increase internal parallelism. Other features that are typically found in RISC architectures are: • Uniform instruction format, using a single word with the opcode in the same bit positions in every instruction, demanding less decoding; • Identical general purpose registers, allowing any register to be used in any context, simplifying compiler design (although normally there are separate floating point registers); • Simple addressing modes, with complex addressing performed via sequences of arithmetic and/or load-store operations; • Few data types in hardware, some CISCs have byte string instructions, or support complex numbers; this is so far unlikely to be found on a RISC. Explicitly parallel instruction computing (EPIC) permits microprocessors to execute software instructions in parallel by using the compiler, rather than complex on-die circuitry, to control parallel instruction execution. This was intended	Information	

		to allow simple performance scaling without resorting to higher clock frequencies.		
2.2		Broadly Servers are classified into the following four types based on their size / modularity.	Information	
	a.	Tower Server	Information	

	b.	Rack Server	Information	
	c.	Blade Server	Information	
	d.	High End Servers	Information	
2.2.1		Tower servers: Tower servers look more like desktops than servers. In general, if requirement is for a lot of servers, tower servers shall not be a choice, because they can take up a lot of space and are difficult to manage physically as they cannot be easily stack one on another. Tower servers require individual monitor, keyboard and mouse or a keyboard, video, mouse (KVM) switch that allows them to be managed with a single set of equipment. Also, cabling can be difficult.	Information	
2.2.2		Rack servers: For a data centre of any reasonable size, rack servers are recommended. Rack servers are sized in Us (which is a single 1.75″ rack unit), rack servers can range from 1U to 5U, 8U, and more. Rack servers are placed inside racks along with other data centre equipment such as backup batteries, switches, and storage arrays. Rack servers make it easier to keep things neat and orderly as most racks include cable management some kind. However, rack servers don' t really simplify the cabling morass since you still need a lot of cabling to make everything work — it' s just neater. Each server had to have dual power cables, keyboard, video, and mouse cables and network cables. Like tower servers, rack servers often need KVM capability in order to be managed, although some organizations simply push a monitor cart around and connect to video and USB ports on the front of the server so that they don' t need to worry about KVM. Rack servers are very expandable; some include 12 or more disks right in the chassis and support for four or more processors, each with multiple cores. In addition, many rack	Information	

		servers support large amounts of RAM, so these devices can be computing powerhouses		
2.2.3		Blade servers: A blade server is a server chassis housing multiple thin, modular electronic circuit boards, known as server blades. Each blade is a server in its own right, often dedicated to a single application. The blades are literally servers on a card, containing processors, memory, integrated network controllers, an optional Fibre Channel host bus adaptor (HBA) and other input/output (IO) ports. The blade servers have no expansion challenges when compared to the tower and rack-based options. The blade chassis has a built-in KVM functionality. Speaking of cabling, a blade environment generally has very much less of it than tower or rack environments since a lot of the connectivity is handled internally. Another point is adding a new server consists of simply sliding it into an available slot in the chassis. There is no need to rack a new server and deal with a bunch of new cabling. This small size makes heat dissipation a challenge. Blade chassis can generate a lot of heat. From a cost perspective, blade servers require some initial infrastructure, such as the chassis, so the upfront cost is often higher	Information	

		than for servers of other types.						
2.2.4		High End Servers High End servers have modular Board or Blade based architecture. They are specially designed for mission critical applications like CDR Billing systems, Enterprise Resource Planning applications etc. The processors used in such scenarios are either RISC or EPIC based ones specially designed to cater for such environments. They do not have internal storage and boots from external storage devices					Information	
2.2.5		Choice of Servers The choice of Server depends upon the amount of data processing required and the type of applications. High End Servers are preferred for mission critical applications like large databases etc.					Information	
3.0		Technical Specifications:					Information	
3.1		Tower Server CISC Type					Information	
3.1.1		Server Hardware					Information	
		Server Parameters		Category I	Category II	Category III	Information	
		Processor					Information	
	1	No. of CPU' s	Minimum	1	1	2	Physical Check	
	2	No. of processor cores per CPU	Minimum	4	8	8	Physical Check	
	3	No. of processor cores per Server	Minimum	4	8	16	Physical Check	
	4	Clock speed	Minimum	2 GHz	2 GHz	2 GHz	Physical Check	
	5	Level 1 cache memory per Core	Minimum (instruction + data)	32 KB	32 KB	32 KB	Declaration	
	6	Level 2 cache memory per Core	Minimum	256 KB	256 KB	256 KB	Declaration	
	7	L3 cache memory	Minimum	8 MB	16MB	16MB	Declaration	

		per Socket							

	Memory					Information	
8	Memory Size	Minimum	16 GB expandable to atleast 64 GB	64GB expandable to atleast 128GB	128GB expandable to atleast 512GB	Physical check & Declaration	
9	Memory Types	Minimum	DDR4			Physical Check	
10	Memory slots	Minimum	4 DIMMS	8 DIMMs	16 DIMMs	Physical Check	
11	FBWC	Minimum			1 GB	Declaration	
12	Operating System		Microsoft Windows Server/ Red Hat Enterprise Linux (RHEL)/ SUSE Linux Enterprise Server (SLES)/ Oracle Enterprise Linux (OEL) / Solaris / Unix or its derivative			Physical Check	
13	Instruction Set	Minimum	64 bit			Physical Check	
	I/O					Information	
14	10/100/100 0 0 Base T Ethernet Ports	Minimum	1	2	4	Physical Check	
15	10/100 Base T Ethernet port for the management network	Minimum	1	1	1	Physical Check	
16	PCIe 3.0 slot	Minimum	2	2	4	Physical Check	

	17	USB 2.0/3.0 Ports	Minimum	2	2	4	Physical Check	

		Storage					Information	
	18	Drive bays (SAS/SATA)	Minimum	2	2	4	Physical Check	
	19	RAID Support	Minimum	RAID levels: 0, 1	RAID levels: 0, 1	RAID levels: 0, 1 optional RAID 5, 6, 10	Functional Verification	
	20	Internal storage SAS or SATA	Minimum	300 GB expandable to atleast 1TB	512GB expandable to atleast 2TB	2 TB expandable to atleast 8TB	Physical Check & Declaration	
		Deployment					Information	
	21	Form Factor (fully configured)	Maximum	5U	5U	5U	Physical Check	
3.1.2		Feature Requirements for the Tower Servers					Information	
3.1.2.1		The Processor shall be of the latest generation.					Declaration	
3.1.2		Highest clock speed and largest cache in the proposed cores of the					Declaration	

.2		CPU in the respective category shall be offered.						
3.2		Rack Mount Server CISC Type					Information	
3.2.1		Server Hardware					Information	
		Server Parameters		Category I	Category II	Category III	Category IV	Information
		Processor						Information

1	No. of CPU' s	Mini mum	1	2	4	8	Physical Check	
2	No. of processor cores per CPU	Mini mum	4	8	8	8	Physical Check	
3	No. of processor cores per Server	Mini mum	4	16	32	64	Physical Check	
4	Clock speed	Mini mum	2 GHz	2GHz	2GHz	2GHz	Physical Check	
5	Level 1 cache memory per Core	Mini mum (instr uctio n + data)	16 KB	80 KB (32 KB Instruction Cache and 48 KB Data Cache)	80 KB (32 KB Instruction Cache and 48 KB Data Cache)	80 KB (32 KB Instruction Cache and 48 KB Data Cache)	Declaration	
6	Level 2 cache memory per Core	Mini mum	256 KB	1.25 MB	1.25 MB	1.25 MB	Declaration	
7	L3 cache memory per Socket	Mini mum	8 MB	16MB	16MB	16MB	Declaration	
	Memory						Informatio n	
8	Memory Size	Mini mum	32 GB Expandable To atleast 128GB	512 GB expandabl e to atleast 4 TB(per system)	512GB expandable to atleast 4TB	512GB expandable to atleast 4TB	Physical Check & Declaration	
9	Memory Types	Mini mum		DDR4/ DDR5			Physical Check	
10	Memory slots	Mini mum	8 DIMMs	16 DIMMs	32 DIMMs	64DIMMs	Physical Check	
11	FBWC	Mini mum		1 GB	2 GB	2 GB	Declaration	
12	Operating System		Microsoft Windows Server/ Red Hat Enterprise Linux (RHEL)/	Microsoft Windows Server/ Ubuntu Linux / Red Hat Enterprise Linux (RHEL)/ SUSE Linux Enterprise Server (SLES)/ Oracle Enterprise Linux (OEL) / Solaris /Unix or its derivative			Physical Check	

				SUSE Linux Enterprise Server (SLES)/ Oracle Enterprise Linux (OEL) / Solaris /Unix or its derivative					
	13	Instruction Set	Minimum	64 bit	64 bit	64 bit	64 bit	Physical Check	
		I/O						Information	
	14	0/100/1000 Ethernet Ports	Minimum	2	4	4	8	Physical Check	
	15	10G Fiber with virtual nics supports 10G Base T./25G Ethernet Ports	Minimum	-	4 Nos of 10G/25G Ethernet ports	4 Nos of 10G/25G Ethernet ports	4 Nos of 10G/25G Ethernet ports	Physical Check	
	16	10/100Base-T Ethernet port for the management network	Minimum	1	1	1	1	Physical Check	
	17	PCIe 3.0 /4.0/5.0 slot	Minimum	2	3	3	3	Physical Check	
	18	USB 2.0 /3.0 Ports		2	4	4	2	Physical Check	
		Storage						Information	

	19	Drive bays (SAS/SATA / NLSAS/NVM e)	Mini mum	2	8 Nos (SATA/NV Me)	8 Nos (SATA/NV Me)	8 Nos (SATA/NVMe)	Physical Check	
	20	RAID Support	Mini mum	RAID levels: 0, 1	RAID levels : 0, 1 optional RAID 5, 6, 10	RAID levels : 0, 1 optional RAID 5, 6, 10	RAID levels : 0, 1 optional RAID 5, 6, 10	Functional Verification	
	21	Internal storage	Mini mum	512 GB expandab l e to atleast 1TB	960 GB expandabl e to at least 2 TB (SATA/NV Me)	960 GB expandabl e to at least 2 TB (SATA/NV Me)	960 GB expandable to at least 2 TB (SATA/NVM e)	Physical Check & Declaratio n	
		Deployme nt						Informatio n	
	22	Form Facto r (fully configured)	Maxi mum	2U	2U	4U	5U	Physical Check	
*Note: The exact requirement in these clauses will be specified by the purchaser as mentioned in Guidelines for the Tendering Authority clause No. 11.1									
3.2.2		Server Rack						Informatio n	
		Rack Cabinet Parameters				Category I		Informatio n	
	1	Usable rack units				42 U		Physical Check & Documenta tion	

	2	Width		19 in	Physical Check & Documentation	

	3	Depth		1000-1200mm	Physical Check & Documentation	
	4	Static/ Dynamic load		800 - 1000 Lbs	Physical Check & Documenta	

						tion	
	5	Power Distribution Unit (Zero / One RU; single- and three-phase option)	Minimum		2	Physical Check & Documentation	
3.2.3		Additional Feature Specifications of Rack Mount CISC Servers:				Information	
	1.	Clustering Software for the offered operating system shall be supported. The Cluster Software for the offered operating system shall support metro/ geo/continental cluster solution. The cluster Software shall be compatible with the offered operating System.				Declaration	
	2.	The Servers shall support IO Accelerators / Flash Cards.				Declaration	
	3	The servers shall be offered with the OEM's latest version of management software.					
3.3		Rack Mount Server RISC/EPIC Type				Information	
3.3.1		Server Hardware				Information	
		Server Parameters		Category I	Category II	Category III	Information	
		Processor					Information	
	1	No. of CPU's	Minimum	1	1	2	Physical Check	
	2	No. of processor cores per CPU	Minimum	8	8	8	Physical Check	
	3	No. of processor cores per Server	Minimum	8	16	32	Physical Check	
	4	Clock speed	Minimum	2.4 GHz	2.4 GHz	2.4 GHz	Physical Check	

	5	Level 1 cache memory per Core	Minimum (instruction + data)	32 KB	32 KB	32 KB	Declaration	
	6	Level 2 cache memory per Core	Minimum	128 KB	128 KB	128 KB	Declaration	

	7	L3 cache memory per Socket	Minimum	4MB	8MB	8MB	Declaration	
		Memory					Information	
	8	Memory Size		64GB expandable to atleast 128GB	128GB expandable to atleast 256GB	256GB	Physical Check & Declaration	
	9	Memory Types		DDR4			Physical Check	
	10	Memory slots	Minimum	12 DIMMs	16 DIMMs	32 DIMMs	Physical Check	
	11	Operating System		HP-UX/AIX/Solaris			Physical Check	
	12	Instruction Set		64 bit	64 bit	64 bit	Physical Check	
		I/O					Information	
	13	10/100/1000 Ethernet Ports	Minimum	2	4	4	Physical Check	

	14	10G Fiber with virtual nic support/ 10 G Base T Ethernet Ports	Minimum	-	2	4	Physical Check	
	15	10/100Base-T Ethernet port for the management network		1	1	1	Physical Check	
	16	PCIe 2.0/3.0 slot	Minimum	2	3	6	Physical Check	
	17	USB 2.0 Ports		2	4	6	Physical Check	
		Storage					Information	
	18	Drive bays (SAS/SATA)	Minimum	2	4	6	Physical Check	
	19	RAID Support	Minimum	RAID levels: 0, 1	RAID levels: 0,1 optional RAID 5, 6, 10	RAID levels: 0, 1 optional RAID 5,	Functional Verification	
	20	Internal storage SAS/SATA/ SSD	Minimum	512GB expandable to atleast 1TB	512GB expandable to atleast	1TB expandable to atleast 3TB	Physical Check & Declaration	

					2TB			
		Deployment					Information	
	21	Form Factor (fully configured)	Maximum	2U	2U	4U	Physical Check	
3.3.2		Server Rack Please refer to clause 3.2.2 for details					Tests as per clause 3.2.2	
3.4		Blade Server- CISC Type					Information	
3.4.1		Server Blade					Information	
		Blade Server Parameters		Category I		Category II	Information	
		Processor					Information	
	1	No. of CPU's	Minimum	2		4	Physical Check	
	2	No. of cores per CPU	Minimum	8		8	Physical Check	
	3	No. of processor cores per Server	Minimum	16		32	Physical Check	
	4	Clock speed	Minimum	2GHz		2GHz	Physical Check	
	5	L1 cache memory per Core	Minimum (instruction + data)	32 KB		32 KB	Declaration	

	6	L2 cache memory per Core	Minimum	256 KB	256 KB	Declaration	

	7	L3 cache memory per Socket	Minimum	16 MB	16 MB	Declaration	
		Memory				Information	
	8	Memory Size		64 GB expandable to atleast 256 GB	128 GB expandable to atleast 512 GB	Physical Check & Declaration	
	9	Memory Types		DDR4			
	10	Memory slots	Minimum	12 DIMMS	24 DIMMS	Physical Check	

	11	Operating System		Microsoft Windows Server/ Red Hat Enterprise Linux (RHEL)/ SUSE Linux Enterprise Server (SLES)/ Oracle Enterprise Linux (OEL) / Solaris			
	12	Instruction Set		64 bit	64 bit	Physical Check	
		I/O				Information	
	13	10G Ethernet Ports/ FCoE Ports	Minimum	2	4	Physical Check	
	14	PCIe 2.0/3.0 slots	Minimum	2	2	Physical Check	
		Storage				Information	
	15	Hot-swappable drive bays (SAS-	Minimum	2	2	Physical Check	

		2/SATA-2/NLSAS/SSD)					
	16	Internal storage		512GB expandable to atleast 1TB	512GB expandable to atleast 1TB	Physical Check & Declaration	
	17	RAID Support		RAID levels : 0, 1	RAID levels : 0, 1	Functional Verification	
		Deployment				Information	
	18	Form Factor (fully configured)		Blade	Blade	Physical Check	
3.4.2		Blade Chassis Quantity of the blade chassis shall be determined by the no of blade server required.				Information	
		Blade Chassis Parameters		Category I		Information	
	1	Height		6U - 12U		Physical Check	
	2	Width	Typical	18 in		Physical Check	
	3	No. of Blades per chassis	Minimum	8		Physical Check	
	4	Redundant Cooling modules	Minimum	6		Physical Check	
	5	AC Power		200-240 V		Physical	

					Check	
		Interconnect Interfaces			Information	
	6	SAN Storage Interface (16Gbps)/FCoE	Minimum	4	Physical Check	
	7	10GE Optical LAN Interface/FCoE	Minimum	2	Physical Check	
	8	10/100 Base-T Management Interface	Minimum	1	Physical Check	
3.4.3		Blade Rack			Information	
		Rack Cabinet Parameters		Category I	Information	
	1	Usable rack units	Minimum	42 U	Physical Check	
	2	Height	Typical	75 in.	Physical Check	
	3	Width	Typical	19 in.	Physical Check	
	4	Depth	Typical	38 in.	Physical Check	
	5	Static/ Dynamic load	Maximum	2300 Lbs	Physical Check	
	6	PoweR Distribution Unit (single and three-phase option)	Minimum	2	Physical Check	
3.4.4		Functional Specifications of Blade Server:			Information	
3.4.4.1		The Rack/Chassis shall have internal/external 10Gbps Ethernet switch with redundancy and shall support the VMready standards.			Declaration	
3.4.4.2		The Ethernet switches shall be of L2 and L3 and shall support the L3 functionalities such as VLAN, FCOE, Routing features etc.			Functional Verification	

3.4.4.3		The blade servers offered are to be run with an uptime of 99%.	Declaration	
3.4.4.4		Clustering Software for the offered operating system shall be supported. The Cluster Software for the offered operating system shall support metro/geocontinental cluster solution. The cluster Software shall be compatible with the offered operating System.	Declaration	
3.4.5		Functional Specifications for Blade Chassis	Information	
3.4.5.1		Rack mountable Chassis to accommodate and Support for half/full height/wide blades in the same enclosure.	Declaration	
3.4.5.2		Shall provide common resources essential for the Blade Servers like Power, System Management, Cabling, Ethernet/ FCoE Management and expansion, external Fiber Channel Storage switching and connectivity.	Declaration	
3.4.5.3		Blade chassis shall support Blade Servers of CISC/RISC/EPIC/any combinations based blades.	Declaration	
3.4.5.4		The blade chassis shall be configured with redundant remote management controllers	Declaration	
3.4.5.5		The blade chassis shall be configured with Hot Swap IP Based KVM functionality for management or KVM Management shall be integrated in remote management controller.	Declaration	
3.4.5.6		Hot Swap and redundant variable speed cooling fans and all fans shall be fully populated.	Declaration	
3.4.5.7		The enclosure shall be populated fully with power supplies of the highest capacity available with the vendor. Power Supplies shall support N+N redundancy.	Declaration	
3.4.5.8		The Blade System shall be able to do the dynamic Power Management of the resources as follows	Information	
	a.	Automatically shutdown the servers if required, based on user policies and schedules.	Functional Verification	
	b.	Dynamically optimize the power usage and performance	Declaration	

		based on server workload policy.		
	c.	Cap the power of individual server or a group of servers	Functional Verification	
	d.	Intelligently assign the power to the appropriate server in the pool based on policy settings	Functional Verification	
	e.	Show the actual power usage and actual thermal measurements data of the servers	Functional Verification	
	f.	Show a historical trend of power and temperature and generate comprehensive power reports	Functional Verification	
3.4.5.9		System management tools for configuring the Blade Servers and OS Deployment shall be provided.	Declaration	
3.4.5.10		The system shall provide support for remote console management, Power on/off blades, monitoring the power status, temperature, cooling fans status, I/O status, system diagnostic programs etc. provided through the management software	Functional Verification	
3.4.5.11		The blade chassis shall be configured with cables, connectors and accessories required to connect the Power distribution units to the power supplies	Physical Check	
3.4.5.12		The chassis shall have LED/LCD panel to provide power-on, location, information and system error conditions.	Physical Check	
		Necessary hardware management console software is to be supplied.	Declaration	
3.4.5.13		The chassis with all of the enclosures are to be run with an uptime of 99%	Declaration	
3.5		Blade Server- RISC/EPIC Type	Heading	
3.5.1		Server Blade	Information	

		Blade Server Parameters		Category I	Category II	Information	
		Processor				Information	
	1	No. of CPU	Minimum	1	2	Physical Check	
	2	No. of cores per	Minimum	8	8	Physical Check	

		CPU					
	3	No. of processor cores per blade	Minimum	8	16	Physical Check	
	4	Clock speed	Minimum	2.4 GHz	2.4 GHz	Physical Check	
	5	L1 cache memory per Core	Minimum (instruction + data)	32KB	32KB	Declaration	
	6	L2 cache memory per Core	Minimum	128KB	128KB	Declaration	
	7	L3 cache memory per Socket	Minimum	4MB	8MB	Declaration	
		Memory				Information	
	8	Memory Size	Minimum	128GB expandable to atleast 256GB	256GB expandable to atleast 384GB	Physical Check & Declaration	
	9	Memory Types	Minimum	DDR3		Physical Check	
	10	Memory DIMM slots	Minimum	8	16	Physical Check	
	11	Operating System		HP-UX/AIX/Solaris			
	12	Instruction Set	Minimum	64 bit			
		I/O				Information	
	13	10G Optical Ethernet Ports	Minimum	2	2	Physical Check	
	14	PCIe 2.0/3.0 Slots	Minimum	2	2	Physical Check	
		Storage					
	15	SAS-2/SATA-2/SSD drive bays	Minimum	2	2	Physical Check	
	16	Internal storage	Minimum	512GB expandable to atleast 1TB	512GB expandable to atleast 1TB	Physical Check & Declaration	
	17	RAID	Minimum	OS RAID 0,1	OS RAID 0,1	Functional Verification	

		Deployment				

	18	Form Factor (fully configur e d)		Blade	Blade	Physical Check	
3.5.2		Blade Chassis Please refer to clause 3.4.2 for details				Tests as per clause 3.4.2	
3.5.3		Blade Rack Please refer to clause 3.4.3 for details				Tests as per clause 3.4.3	
3.5.4		Functional Specifications of RISC/EPIC Blade Server				Information	
3.5.4 .1		The Rack/Chassis shall have internal/external10Gbps Ethernet switch with redundancy and shall support the VMready standards.				Declaration	
3.5.4 .2		The Ethernet switches shall be of L2/L3 and shall supports the L3 functionalities such as VLAN, FCOE, OSPF etc.				Functional Verification	
3.5.4 .3		The blade servers offered are to be run with an uptime of 99%.				Declaration	
3.5.4 .4		The Solution shall offer clustering software as part of the OS				Declaration	
3.5.4 .5		The Solution shall offer capacity planning tool software as part of the OS				Declaration	
3.5.4 .6		Real time performance management tool is mandatory				Declaration	
3.5.5		Additional Functional Specifications for Blade Chassis: Please refer to clause 3.4.5 for details				Tests as per clause 3.4.5	
3.6		High-end Server- RISC/EPIC Type				Information	
3.6.1		Server Hardware				Information	
		Server Paramet e rs		Category I	ategory II	Category III	Category IV	Information	
		Processor						Information	
	1	No. of CPU Positions	Minimu m	4	8	16	32	Physical Check	

	2	No. of cores per CPU	Minimum	8	8	8	8	Physical Check	
	3	Total processor cores	Minimum	32 expandable to 64	64 expandable to 128	128 expand able to atleast 256	256 expandable to atleast 512	Physical Check	
	4	Clock speed	Minimum	2.5 GHz	2.5 GHz	2.5 GHz	2.5 GHz	Physical Check	
	5	Level 1 cache memory per Core	Minimum (instruction + data)	32 KB	32 KB	32 KB	32 KB	Declaration	
	6	Level 2 cache memory per Core	Minimum	128 KB	128 KB	128 KB	128 KB	Declaration	
	7	L3 cache memory per Socket	Minimum	24MB	24MB	24MB	24MB	Declaration	
		Memory						Information	
	8	Memory Size	Minimum	1TB expandable to atleast 4TB	2TB expandable to atleast 4TB	2TB expandable to atleast 4TB	2TB expandable to atleast 8TB	Physical Check & Declaration	
	9	Memory Types	Minimum	DDR3				Physical Check	

	10	Memory DIMM slots	Minimum	32	64	64	64	Physical Check	

	11	Operating System		HP-UX/ Oracle Solaris/ IBM AIX					
	12	Instruction Set	Minimum	64 bit					
		I/O						Information	
	13	10GE Ethernet Ports	Minimum	8	8	8	16	Physical Check	
	14	PCIe 2.0/3.0 bus	Minimum	8	16	16	24	Physical Check	
Bidder can propose OEM rack also with Standard Specification to cater the solution.									
3.6.2		Server Rack							
		Rack Cabinet Parameters				Category I			
	1	Usable rack units		Minimum		42 U		Physical Check	
	2	Height		Typical		75 in.		Physical Check	
	3	Width		Typical		19 in.		Physical Check	
	4	Depth		Typical		38 in.		Physical Check	
	5	Redundant Cooling modules		Minimum		10		Physical Check	
	6	AC Power				200-240 V		Physical Check	
	7	SAN Storage Interface (8Gbps)		Minimum		4		Physical Check	
	8	10GE Optical LAN Interface		Minimum		2		Physical Check	
	9	10/100 Management Ethernet Interface		Minimum		1		Physical Check	
	10	Static/ Dynamic load		Maximum		2300 Lbs		Physical Check	

	11	Power Distribution Unit (single and three-phase option)	Minimum	2	Physical Check	

3.6.3		Features to be supported for the High-end Server:	Information	
3.6.3.1		The boot shall be through internal /external SAN Storage	Functional Verification	
3.6.3.2		The system shall interface with an External Storage system as described in SAN Storage to be connected for database connectivity.	Functional Verification	
3.6.3.3		Each server shall be configured with highest redundancy components possible in the Server portfolio.	Declaration	
3.6.3.4		The server shall be configured with full redundant PCI Express cards. All adapters shall be PCIe only in external I/O drawers.	Declaration	
3.6.3.5		Power supply shall be hot-swappable and shall be replaceable while the system is running.	Declaration	
3.6.3.6		The virtualisation software shall not have any restriction on adding/removing cores, memory, disks and I/O resources. The virtualisation software shall be licenses to create any number of virtual partitions limited only with the hardware.	Declaration	
3.6.3.7		Operating System:	Information	
	a.	Partitions shall be configured with full core with capability to create sub-CPU partitioning also.	Functional Verification	
	b.	Shall have inbuilt logical volume management capability with the volume manager.	Functional Verification	

	c.	The server shall be configured with 64-bit OEM UNIX/ or its derivatives Operating System with unlimited license.	Functional Verification and Declaration for unlimited License.	
	d.	The vendor shall guarantee the O/S backward compatibility with applications.	Declaration	

	e.	Any configuration change in one partition shall not affect any other partition unless desired.	Declaration	
	f.	An error in one partition shall not bring the entire system or other partitions down.	Declaration	
	g.	Each partition shall be upgradeable separately and independently without affecting other partitions.	Declaration	
	h.	Latest version of 64-bit OEM Unix Operating System with latest patch level must be provided.	Declaration	
	i.	It shall include: Volume Management & OS based File System	Functional Verification	
	j.	The Unix Operating Systems shall be licensed to support unlimited users. Future Patches and upgrades shall also be licensed.	Declaration	
	k.	Partition management software having dynamic configuration feature with GUI / Web interface	Functional Verification	
	l.	Management Consoles for the same shall be provided	Functional Verification	
3.6.3.8		The system shall support PCI error handling	Functional Verification	
3.6.3.9		The system shall support Redundant, hot-swap/pluggable I/O interconnect modules.	Declaration	

3.6.3.10		Server main components shall be Fault-tolerant.	Declaration	
3.6.3.11		The system shall support Redundant AC input.	Declaration	
3.6.3.12		The system shall support Dynamic power management	Declaration	
3.6.3.13		Server shall be populated with full capabilities for highest redundancy	Declaration	
3.7		General Features to be supported for the Rack Mount / Blade / High End Servers	Information	
3.7.1		The Processor generation will be specified by the purchaser as mentioned in Guidelines for the Tendering Authority clause	Declaration	

		no. 11.1. .		
3.7.2		Latest and better clock speed and largest cache CPU available shall be offered.	Declaration	
3.7.3		Each server shall be populated and configured with minimum supported CPUs. The term "CPU" here refers to one physical socket which may be containing minimum cores as specified in the different categories.	Functional Verification	
3.7.4		All servers shall be provided with the capability of being partitioned through virtualisation; each partition shall have its own operating system instance, host name and IP address	Functional Verification	
3.7.5		Each partition using virtualisation shall be able to run same or different versions of OS kernel, patch levels, etc. independently. Any configuration change in one partition shall not affect any other partition	Functional Verification with one OS Kernel and Declaration for rest of kernels.	
3.7.6		Each partition shall have the capability to start-up and shutdown independently without affecting any other partition on the same server	Declaration	
3.7.7		The OS of each partition shall be upgradeable separately and independently without affecting the other partitions.	Declaration	
3.7.8		The server shall support necessary virtualization software to create partitions and manage these partitions.	Functional Verification	
3.7.9		Necessary virtualization, cluster configuration and management software are to be provided with unlimited users.	Declaration	
3.7.10		The virtualisation software shall not have any restriction on adding/removing cores, memory, disks and I/O resources.	Declaration	

		The virtualisation software shall be licenses to create any number of virtual partitions limited only with the hardware.	Declaration	
3.7.11		Operating system/Virtualisation software offered shall include the following features:	Information	
	a.	Virtualisation functionality to allow the creation of multiple shared processor partitions within the server	Functional Verification	
	b.	Workload management for simplification and enhancing the capabilities for managing a system's workload	Functional Verification	
	c.	Patch management system for identifying, acquiring, installing, and verifying patches	Functional Verification	

	d.	Dynamic multipath I/O for fiber channel and SCSI I/O paths for disk and tape devices	Functional Verification	
3.7.12		The Server shall support memory sparing/mirroring and lockstep technology.	Declaration	
3.7.13		The server shall support Agent less management	Declaration	
3.7.14		The server shall support out of band Management	Declaration	
3.8		Server Performance Requirements applicable to Blade Servers and High End Servers	Information	
3.8.1		The Server shall provide unified performance state view in single console, integrate network, server and performance management.	Functional Verification	
3.8.2		The Server shall support TCP based server agents to ensure availability and performance for target server nodes and deliver scalable, real-time management of critical systems.	Functional Verification	
3.8.3		The Server shall monitor various operating system parameters such as processor, memory, files, processes, file system, etc. using agents on the servers to be monitored	Functional Verification	
3.8.4		It shall be possible to configure the operating system monitoring agents to monitor based on user-defined thresholds for warning/critical states	Functional Verification	
3.8.5		The server shall be capability to be integrated with network performance management system and support operating system monitoring	Functional Verification	
3.8.6		The Server shall manage the following parameters	Information	
	a.	Processors: Each processor in the system shall be monitored for CPU utilization. Current utilization is compared with user-defined warning and critical thresholds.	Functional Verification	
	b.	File Systems: Each file system shall be monitored for the amount of file system space used, which is compared	Functional Verification	

		with user-defined warning and critical thresholds		
	c.	Log Files: Logs shall be monitored to detect faults in the operating system, the communication sub-system, and the applications. System agents also analyse the log files residing on the host for specified string patterns	Functional Verification	
	d.	System Processes: System agents shall provide real-time collection of data from all system processes. It identifies whether or not an important process has stopped unexpectedly. It can also automatically restart Critical processes	Functional Verification	
	e.	Memory: System agents shall monitor memory utilization and available swap space and shall raise an alarm in event of threshold violation	Functional Verification	
3.8.7		The Server shall provide automated management to detect, isolate and resolve problems autonomously.	Functional Verification	
3.8.8		The Server shall provide monitoring wherein it will track critical status such as	Information	
	a.	CPU utilization	Functional Verification	
	b.	Memory capacity	Functional Verification	
	c.	File system space	Functional Verification	

3.9		Green Server Requirements	Information	
3.9.1		Power Supply Efficiency The efficiency and power factor of the Power Supplies shall be as per Energy Star or Environment Protection Agency [EPA] Gold standards	Declaration	
3.9.2		The Power Supply shall meet the Energy Star or Environment Protection Agency [EPA] Gold Requirement for idle state efficiency	Declaration	

3.9.3		CPU Power Saving Technology: The CPU shall support speed throttling and power saving technology (DVFS – Dynamic Voltage and Frequency Scaling) that reduces the processor's clock rate and voltage when the processor is idle. The aim is to minimize overall power consumption and lower heat generation, allowing for slower (and quieter) cooling fan operation	Declaration	
3.9.4		Operating System features for Power Saving	Information	
	a.	The operating systems shall take advantage of hardware features to deliver optimal power efficiency for any given workload running on the server.	Declaration	
	b.	The OS shall continuously alter the power states of the processors in the system in response to the utilization level of the workload. This ensures that processor power usage maps to the needs of the workload, with minimal impact on performance.	Declaration	
	c.	The Operating Systems shall achieve additional power savings by combining processor power state control with features that consolidates work onto a smaller number of processor cores when workload utilization is low. This feature places unused processor cores into a deep sleep state, effectively scaling the number of processor cores in active use.	Declaration	
	d.	The OS shall also support features which shall extend the time that processor cores stay in deep sleep states by avoiding waking cores unnecessarily.	Declaration	
	e.	The System shall support automatic fan speed management	Declaration	
	f.	The System shall support Power Saving Measures in High End / Blade Server Configurations such that the Blades/Boards are switched ON/OFF during low workload periods.	Declaration	
3.9.5		Measurement of Power Parameters	Information	
	a.	The supervisory power management system shall be enabled by default.	Functional Verification	

	b.	The system shall have the capability to measure real-time power use, Processor utilization, Temperature etc.	Functional Verification	
3.10		IPv6 Requirements: The supplied operating system of the Servers shall meet the IPv6 requirements as per RFC8200, RFC 4861, RFC 4862, RFC8201 and RFC 4443.	Refer Lab Test 1	
3.11		Synchronisation.	Functional Verification	
	a.	The Server shall Support Network Time Protocol (NTPv4 as per RFC 5905) for synchronizing with a central NTP server.	Functional Verification	
	b.	The Server shall support Precision Time Protocol (PTP) as per IEEE1588-2008 for synchronizing with a central PTP server. This is optional. However exact requirement will be specified by the purchaser as mentioned in Guidelines for the Tendering Authority clause no. 11.1.	Functional Verification	
4.0		Interconnectivity and Inter-Operability Requirements The interconnectivity interfaces for the Servers shall be as per the following Standards.	Information	
4.1		General	Information	
	1.	The Server shall be based on commercially available pluggable SFP optics for all optical interfaces and Pluggable SFP for Electrical Interfaces.	Physical Check	
	2.	The Server shall support full duplex capabilities on all Ethernet ports	Functional Verification	
	3.	All Ethernet interfaces shall be based on IEEE 802.3 Standards	Information	

	4.	Physical Interface: The instrument shall support atleast the following physical interfaces [The exact requirement of the interfaces shall be specified by the purchaser] i. 10/100 Ethernet interface ii. 10/100/1000 Ethernet auto sensing as per IEEE 802.3 full duplex iii. 1G Optical interface iv. 10G Optical interface v. 10G electrical interface vi. 16 GE fiber channel interface towards SAN vii. 32 GE fibre channel interface towards SAN viii. 25 GE Optical Ethernet Interface	Information	
4.2		10/100 Ethernet Interface 10/100 Base-T, 100mt, autosensing	Refer Lab Test 2 & 3	
4.3		10/100/1000 Ethernet Interface 10/100/1000 Base-T, 100mt, autosensing	Refer Lab Test 2 & 3	
4.4		1GE Optical Interface	Information	
	1.	Wavelength: 850 nm multi-mode	Refer Lab Test 4,5 & 6	
	2.	Distance coverage: 500 m	Refer Lab Test 4,5 & 6	
4.5		10GE Optical Interface	Information	

	1	Wavelength: 850 nm multi-mode	Refer Lab Test 4,5 & 6	

	2	Distance coverage: 200 m	Refer Lab Test 4,5 & 6	
	3	The interface shall be based on SFP+	Physical Check	
4.6		10 GE Electrical Interface	Refer Lab Test 2 & 3	
4.7		16GE Fiber Channel Interface towards SAN	Information	
	1.	Wavelength: 850 nm multi-mode	Refer Lab Test 4,5 & 6	
	2.	Distance coverage: 100 m	Refer Lab Test 4,5 & 6	
	3.	Fiber Channel Interface shall be as per standards of T11 Technical Committee of the International Committee for Information Technology Standards (INCITS), an American National Standards Institute (ANSI)- accredited standards committee.	Declaration	
5.0		Qualitative Requirements (QR): The system shall meet the following qualitative requirements:	Information	

	5.1	The manufacturer shall furnish the MTBF value. Minimum value of MTBF shall be specified by the purchaser. The calculations shall be based on the guidelines given in either QA document No. QM-115 {January 1997} "Reliability Methods and Predictions" or any other international standards.	Declaration	
	5.2	The equipment shall be manufactured in accordance with international quality management system ISO 9001:2015 or any other equivalent ISO certificate 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.	Declaration	

	5.3	The equipment shall conform to the requirements for Environment specified in TEC QA standards QM-333 {Issue-March, 2010} (TEC 14016:2010) "Standard for Environmental testing of Telecommunication Equipment" or any other equivalent international standard, for operation, transportation and storage. The applicable environmental category A or B to be decided by the purchaser based on the use case.	Declaration	
6.0		EMI/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 from accredited test lab shall be furnished from a test agency.	Information	
	a.	Conducted and radiated emission(applicable to telecom equipment): Name of EMC Standard: "CISPR 32 (2015) with amendments - Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment". Limits:- i) To comply with Class B of CISPR 32 (2015) with amendments for indoor deployments and Class A of CISPR 32 (2015) with amendments with amendments for outdoor deployments.	Report from Accredited Test Lab	
	b.	Immunity to Electrostatic discharge: Name of EMC Standard: IEC 61000-4-2 {2008) "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;	Report from Accredited Test Lab	

	c.	Immunity to radiated RF: Name of EMC Standard: IEC 61000-4-3 (2010) "Testing and measurement techniques- Radiated RF Electromagnetic Field Immunity test". Limits:- For Telecom Equipment and Telecom Terminal Equipment without Voice interface (s) Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80MHz to 1000 MHz and 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.	Report from Accredited Test Lab	
	d.	Immunity to fast transients (burst): Name of EMC Standard: IEC 61000-4-4 {2012) techniques of electrical fast transients/burst immunity test". "Testing and measurement Limits:- Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0. 5 kV for signal / control / data / telecom lines;	Report from Accredited Test Lab	

	e.	Immunity to surges: Name of EMC Standard: IEC 61000-4-5 (2014) "Testing & Measurement techniques for Surge immunity test". Limits:- i) For mains power input ports : (a) 2 kV peak open circuit voltage for line to ground coupling (b) 1 kV peak open circuit voltage for line to line coupling ii) For telecom ports : (a) 2kV peak open circuit voltage for line to ground (b) 2KV peak open circuit voltage for line to line coupling.	Report from Accredited Test Lab	

	f.	Immunity to conducted disturbance induced by Radio frequency fields: Name of EMC Standard: IEC 61000-4-6 (2013) with amendments) "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.	Report from Accredited Test Lab	
	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) iii) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s. iv) a voltage interruption corresponding to a reduction of supply voltage of >95% for 10s.	Report from Accredited Test Lab	

	h.	Immunity to voltage dips & short interruptions (applicable to only DC power input ports, if any): Name of EMC Standard: IEC 61000-4-29:2000: Electromagnetic compatibility (EMC)- Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests. Limits:- i. Voltage Interruption with 0% of supply for 10ms. Applicable Performance Criteria shall be B. ii. Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. Applicable Performance Criteria shall be C. iii. Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. Applicable Performance Criteria shall be B. iv. Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000ms. Applicable Performance Criteria shall be C. v. Voltage variations corresponding to 80% and 120%of supply for 100 ms to10s as per Table 1c of IEC 61000-4-29. Applicable Performance Criteria shall be B.	Report from Accredited Test Lab	
		Note: - For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/SD/DD/EMC-221/05/OCT-16 (TEC 11016:2016) and the referenced base standards i.e. IEC and CISPR standards and the references mentioned therein unless otherwise specified	Information	

		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 (h) and TEC Standard TEC/SD/DD/EMC-221/05/OCT-16 (TEC 11016:2016). The details of IEC/CISPR and their corresponding Euro Norms are as follows: IEC/CISPR Euro Norm CISPR 11 EN 55011 CISPR 32 EN55032 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 IEC 61000-4-11 EN 61000-4-11 IEC 61000-4-29 EN 61000-4-29		
7.0		Safety Requirements:	Information	
	7.1	The equipment shall conform to relevant safety requirements as per IS/IEC 62368-1:2018 or Latest as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT" : TEC10009: 2024. The manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.	Declaration	

8.0		Security Requirements	Information	
8.1		Physical Security	Information	
	a.	There shall be lock and Key arrangement for the Server Rack.	Physical Check	
8.2		Security of the Operating System	Information	
	a.	The OEM shall identify the vulnerabilities periodically using standard tools. No proprietary tools shall be used.	Declaration	
	b.	The OEM shall supply and assist in the installation of patches in time for all the known vulnerabilities.	Declaration	
	c.	It shall be possible to remove unnecessary services, applications, and network protocols such as File and printer sharing services, Wireless networking services, Remote control and remote access programs, Directory services, Web servers and services, Email services (e.g., SMTP), Language compilers and libraries, System development tools, System and network management tools and utilities, including Simple Network Management Protocol (SNMP) etc.	Functional Verification	
	d.	It shall be possible to configure OS user authentication such as Remove or Disable Unneeded Default Accounts, Disable Non- Interactive Accounts, Create the User Groups, Create the User Accounts, Configure Automated Time Synchronization, and Check the Organization' s Password Policy, Configure Computers to Prevent Password Guessing.	Functional Verification	
	e.	It shall be possible to configure resource controls appropriately.	Functional Verification	
	f.	The Server shall not permit remote monitoring from outside the network.	Functional Verification	
8.3		Security of the System Software	Information	
8.3.1		It shall be possible to secure the system software in the following way:	Information	
	a.	Install the server software either on a dedicated host or on a dedicated guest OS if virtualization is being employed.	Declaration	

	b.	Apply any patches or upgrades to correct for known vulnerabilities in the server software.	Declaration	
	c.	Create a dedicated physical disk or logical partition (separate from OS and server application) for server data, if applicable.	Declaration	
	d.	Remove or disable all services installed by the server application but not required (e.g., gopher, FTP, HTTP, remote administration).	Functional Verification	
	e.	Remove or disable all unneeded default user accounts created by the server installation.	Functional Verification	
	f.	Remove all manufacturers' documentation from the server.	Functional Verification	
	g.	Remove all example or test files from the server, including sample content, scripts, and executable code.	Functional Verification	
	h.	Remove all unneeded compilers.	Functional Verification	

	i.	Apply the appropriate security template or hardening script to the server.	Declaration	
	j.	For external-facing servers, reconfigure service banners not to report the server and OS type and version, if possible.	Declaration	
	k.	Configure warning banners for all services that support such banners.	Declaration	
	l.	Configure each network service to listen for client connections on only the necessary TCP and UDP ports, if possible.	Declaration	
	m.	Limit the access of the server application to a subset of computational resources	Functional Verification	
	n.	Limit the access of users through additional access controls enforced by the server, where more detailed levels of access control are required.	Declaration	
8.3.2		Typical files to which access shall be controlled are as follows	Information	
	a.	Application software and configuration files	Functional Verification	
	b.	Files related directly to security mechanisms	Functional Verification	
	i.	Password hash files and other files used in authentication	Functional Verification	
	ii.	Files containing authorization information used in controlling access	Functional Verification	
	iii.	Cryptographic key material used in confidentiality, integrity, and non-repudiation services	Functional Verification	
	c.	Server log and system audit files	Functional Verification	
	d.	System software and configuration files	Functional Verification	
	e.	Server content files	Functional Verification	
8.3.3		Server host OS access controls shall be used to enforce the following:	Information	
	a.	Service processes are configured to run as a user with a strictly limited set of privileges (i.e., not running as root, administrator, or equivalent).	Declaration	

	b.	Service processes can only write to server content files and directories if necessary.	Declaration	
	c.	Temporary files created by the server software are restricted to a specified and appropriately protected subdirectory (if possible). Access to these temporary files is limited to the server processes that created the files (if possible).	Declaration	
8.4		Maintaining Security of the System	Information	
8.4.1		Logging	Information	
	1.	Logging is a cornerstone of a sound security posture. Capturing the correct data in the logs and then monitoring those logs closely is vital. Procedures and tools need to be in place to process and analyze the log files and to review alert notifications.	Information	
	2.	Server logs shall provide—	Information	
	a.	Alerts to suspicious activities that require further investigation	Functional Verification	
	b.	Tracking of an attacker' s activities	Functional Verification	
	c.	Assistance in the recovery of the server	Functional Verification	
	d.	Assistance in post-event investigation	Functional Verification	
	e.	Required information for legal proceedings.	Functional Verification	
	3.	All servers shall use time synchronization technologies, such as the Network Time Protocol (NTP), to keep their internal clocks synchronized with an accurate time source. This provides accurate timestamps for logs	Functional Verification	
	4.	It shall be possible to back up and archive the Log files regularly.	Functional Verification	

	5.	Many servers receive significant amounts of traffic, and the log files quickly become voluminous. Automated log analysis tools shall be supplied to ease the burden on server administrators. These tools analyze the entries in the server log files and identify suspicious and unusual activity.	Functional Verification	
8.4.2		Server Backup	Information	
	a.	Server shall support RAID feature	Functional Verification	
	b.	The server shall support full, incremental, and differential backup.	Functional Verification	
	c.	Full backups include the OS, applications, and data stored on the server (i.e., an image of every piece of data stored on the server hard drives).	Information	
	d.	Incremental backups reduce the impact of backups by backing up only data that has changed since the previous backup (either full or incremental).	Information	
	e.	Differential backups reduce the number of backup sets that must be accessed to restore a configuration by backing up all changed data since the last full backup.	Information	
8.5		The Server shall comply to the security guidelines issued by DoT vide no. 10-54/2010-CS-III (ILD) dt.31/05/2011 and subsequent amendments if any. Approval against this GR shall not be construed as an authorization to evade surreptitiously, regulations including toll-bypass concerning the telecom services. Functioning or intended use of the SERVER shall conform to the prevailing license conditions/laws/regulation/instructions of Govt. of India.	Declaration	
9.0		Other Mandatory Requirements	Information	
9.1		Engineering Requirements: The system shall meet the following engineering requirements:	Information	
	a.	The equipment shall be fully solid state and adopt state of the art technology.	Declaration	

	b.	The equipment shall be compact, composite construction and light weight. The actual dimensions and weight of the equipment shall be furnished by the manufacturers.	Declaration	
	c.	All connectors shall be reliable, low loss and standard type so as to ensure failure free operations over long operations	Declaration	
	d.	The equipment shall have adequate cooling arrangements, if required.	Declaration	

	e.	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.	Physical Check	
	f.	Each terminal block and individual tags shall be numbered Suitably with clear identification code.	Physical Check	
	g.	All controls, switches, indicators etc. shall be clearly marked to show their circuit diagrams and functions.	Physical Check	
9.2		Operational Requirement (OR): The system shall meet the following maintenance & operational requirements:	Information	
	a.	The equipment shall be designed for continuous operation.	Declaration	
	b.	The equipment shall be able to perform satisfactorily without any degradation at an altitude upto 3000 meters above mean sea level.	Declaration	
	c.	Suitable visual indications shall be provided to indicate the healthy and unhealthy conditions.	Declaration	
	d.	The design of the equipment shall not allow plugging of a module in the wrong slot or upside down.	Declaration	
	e.	The removal or addition of any cards shall not disrupt traffic on other cards in case of card type line driver, except in case of Rack Server, for which this clause is not applicable.	Declaration	
	f.	Special tools required for wiring shall be provided along with the equipment.	Declaration	

	g.	In the event of a bug found in the software, the Manufacturer shall provide patches and firmware replacement if involved, free of cost. Compatibility of the existing hardware shall be maintained with future software/firmware.	Declaration	

	h.	In the event of a full system failure, a trace area shall be maintained in non-volatile memory for analysis and problem resolution.	Declaration	
	i.	A power down condition shall not cause loss of connection configuration data storage.	Declaration	
	j.	The system hardware / software 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 system.	Declaration	
	k.	Wherever, the standardized documents like ITU-T, IETF, QA, TEC etc. documents are referred, the latest issue and number with the amendments shall be applicable.	Declaration	
	l.	Power Supply:	Information	
		i) The equipment shall be able to function over the range specified in the respective chapters, without any degradation in performance.	Declaration	
		ii) The equipment shall be protected in case of voltage variation beyond the range specified and also against input reverse polarity.	Declaration	
		iii) The derived DC voltages shall have protection against short circuit and overload.	Declaration	
9.3		Documentation, Installation and Maintenance:	Information	
9.3.1		Documentation: This chapter describes the general requirements for documentation to be provided for Servers. All technical documents shall be in English language both in CD-ROM and in hard copy.	Documentation	
9.3.1		The documents shall comprise of:	Information	

.1				
	i.	System description documents.	Documentation	

	ii.	Installation, Operation and Maintenance documents.	Documentation	
	iii.	Installation, Operation and Maintenance documents.	Documentation	
	iv.	Repair manual.	Documentation	
9.3.1.2		System description documents: The following system description documents shall be supplied along with the system:	Information	
	a.	Over-all system specification and description of hardware and software.	Documentation	
	b.	Equipment layout drawings.	Documentation	
	c.	Cabling and wiring diagrams.	Documentation	
	d.	Detailed specification and description of all Input / Output devices.	Documentation	
	e.	Adjustment procedures, if there are any field adjustable units.	Documentation	
	f.	Spare parts catalogue of OEM supplied hardware modules and interconnect cables to be provided.	Documentation	
	g.	The list of software/ firmware installed on the Server along with versions and brief description to be provided.	Documentation	
	h.	The list of application software packages installed on the Server along with versions and brief description to be provided.	Documentation	
	i.	Program and data listings.	Documentation	
	j.	Graphical description of the system. In addition to the narrative description a functional description of the system using the functional Specification.	Documentation	

9.3.1.3		System operation documents: The following system operation documents shall be available:	Information	
	a.	Installation manuals and testing procedures.	Documentation	

	b.	Precautions for installation, operations and maintenance.	Documentation	
	c.	Operating and Maintenance manual of the system.	Documentation	
	d.	Safety measures to be observed in handling the equipment.	Documentation	
	e.	Man-machine language manual.	Documentation	
	f.	Fault location and troubleshooting instructions including fault dictionary.	Documentation	
	g.	Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance and unit / card / sub- assembly replacement.	Documentation	
	h.	Emergency action procedures and alarm dictionary.	Documentation	
9.3.1.4		Training Documents		
	a.	Training manuals and documents necessary for organizing training in installation, operation and maintenance and repair of the system shall be made available.	Documentation	
	b.	Any provisional document, if supplied, shall be clearly indicated. The updates of all provisional documents shall be provided immediately following the issue of such updates.	Documentation	
	c.	The structure and scope of each document shall be clearly described.	Documentation	
	d.	The documents shall be well structured with detailed cross- referencing and indexing enabling easy identification of necessary information.	Documentation	
	e.	All diagrams, illustrations and tables shall be consistent with the relevant text.	Documentation	
9.3.1.5		Repair Manual:		
	a.	List of replaceable parts used.	Documentation	
	b.	Detailed ordering information for all the replaceable parts.	Documentation	

	c.	Procedure for trouble shooting and sub-assembly replacement.	Documentation	
	d.	Test fixtures and accessories for repair.	Documentation	
	e.	Systematic trouble shooting charts (fault tree) for all the probable faults with their remedial actions.	Documentation	
9.3.2		Installation:	Information	
	a.	All necessary interfaces, connectors, connecting cables and accessories required for satisfactory installation and convenient operations shall be supplied. Type of connectors, adopters to be used shall be in conformity with the interfaces defined in this GR.	Declaration	
	b.	The diagnostic software utilities and support required for carrying out the testing of the equipment before final commissioning shall be supplied with the equipment	Declaration	
	c.	All installation materials, consumables and spare parts to be supplied.	Declaration	
	d	All literature and instructions required for installation of the equipment, testing and bringing it to service shall be made available in English language.	Declaration	
	e.	For the installations to be carried out by the supplier, the time frames shall be furnished by the supplier including the important milestones of the installation process well before commencing the installations.	Declaration	

	f.	The equipment shall have:	Information	
		i) Proper earthing arrangement.	Declaration	

		ii) Protection against short circuit / open circuit.	Declaration	
		iii) Protection against accidental operations for all switches / controls provided in the front panel.	Declaration	
		iv) The racks housing the server should have the protection against entry of dust, insects and lizards.	Declaration	
9.3.3		Software Maintenance:	Information	

9.3.3.1		All the software updates shall be provided on continuous basis for a minimum period of 5 years from the date of induction of system in the service provider' s network. These updates shall include new features and services and other maintenance updates.	Declaration	
9.3.3.2		The software for the support of all protocols and interfaces mentioned in this GR shall be ensured in the devices.	Declaration	
9.4		Minimum Equipments for Type Approval testing: Any Type and Category of Servers can be offered for Type Approval Certificate at least with the minimum configuration and the same shall be mentioned in the Type Approval Certificate. The Type Approval certificate shall be issued for the offered Type and category.	Information	
10.0		Desirable Requirements	Information	
		This chapter describes the desirable requirements for the Servers and will depend upon the application of the Servers. Hence the tendering authority may choose out of the features mentioned below as per requirement.	Information	
10.1		Database Management Requirement applicable to Servers planned for Database Applications	Information	
10.1.1		The Server shall have the capability to automate monitoring, data collection and analysis of performance from single point.	Declaration	
10.1.2		The Server shall set threshold and send notifications when an event occurs, enabling database administrators (DBAs) to quickly trace and resolve performance-related bottlenecks.	Functional Verification	
10.1.3		The Server shall have the Database performance management solution for Distributed RDBMS includes hundreds of predefined scans for monitoring various database, operating system and network resources. This minimizes the need to write and maintain custom scripts. One can modify an existing script to meet a special monitoring situation or requirements.	Functional Verification	

10.1.4		The Server shall Report conditions that exceed threshold with respect to user-defined parameters and automatically takes corrective actions.	Functional Verification	
10.1.5		The Server shall send alerts for an array of server conditions, including inadequate free space, runaway processes, high CPU utilization and inadequate swap space.	Functional Verification	
10.1.6		The Server shall provide threshold and alarms to proactively react to problems.	Functional Verification	
10.1.7		The Server shall create real-time, historical custom graphs and stacks for comparison, correlation and trending across any collected database or database server.	Functional Verification	
10.1.8		After installation, the Server shall identify database changes automatically.	Functional Verification	
10.1.9		The Server shall support historical archive store for performance information in a compressed time-series form. DBAs can drill down through layers of data to discover the cause of a condition occurring with the databases, operating system or network. The historical reports shall be used to perform trend analysis and capacity planning.	Functional Verification	

10.1.10		The Server shall support trace, analyse and tune resource consuming SQL statements.	Declaration	
10.1.11		The Server shall support platform independent, browser based console to monitor performance, analyse and take corrective actions from remote locations.	Declaration	
10.2		Cloud Ready features	Information	
10.2.1		Infrastructure management	Information	
	a.	The Server shall have the capability to provide proactive notification of actual or impending component failure alerts. Automatic Event Handling shall be supported to configure actions to notify appropriate users of failures through e-mail, pager, or Short Message Service (SMS) gateway.	Functional Verification	
	b.	The Server shall have automatic execution of scripts or event forwarding to NMS as per TEC GR.	Declaration	
	c.	The Server shall support task initiation on multiple systems or nodes from a single command on the management system to eliminate the need for tedious, one-at-a-time operations performed on each system.	Functional Verification	
	d.	The Server shall provide the option of a browser-based GUI or a command line interface (CLI) to make it easy to incorporate into your existing management processes.	Functional Verification	
10.2.2		Remote Management	Information	
	a.	The Server shall support embedded hardware Graphical Remote Console capabilities of the servers that can turn a supported browser into a virtual desktop, giving the user full control over the display, keyboard, and mouse of the host server.	Declaration	
	b.	The Server shall support integration with enterprise-class directory	Declaration	

		services like Microsoft Active Directory and LDAP to provide secure, scalable, and cost effective user management.		
	c.	The server shall support real time Virtual KVM functionality and be able to perform a remote Power sequence. The server shall support both Java / Java-free browsing options.	Declaration	
	d.	The server shall be able to connect using popular mobile devices like Apple IOS and Android based devices.	Functional Verification with one Mobile Device and Declaration for all other popular mobile devices and OS' s.	
	e.	The server shall support management of core system components out-of-band without involving SNMP or WBEM on operating system.	Declaration	
	f.	The server shall have the ability to map the remote media to the server. The server shall support file transfer from the user' s desktop/laptop folders to the remote server with only the Lights-Out network connectivity.	Declaration	
	g.	The server shall have the ability to capture the video sequence of the last failure and the boot sequence and also playback the video capture.	Functional Verification	
	h.	The server shall have the ability for multiple administrators across remote locations to collaborate on the remote session even in a server lights-out mode (with a maximum of 6 sessions)	Declaration	

10.2.3		Power Management	Information	
	a.	The server shall be able to show the actual power usage and actual thermal measurements data of the servers. Must also show a historical trend of power and temperature and generate comprehensive power reports.	Functional Verification	
	b.	The server shall support integration with facilities management software to enable planning on actual power consumption.	Functional Verification	
	c.	The server shall be able to automatically shutdown the servers if required, based on user policies and schedules	Functional Verification	
	d.	The server shall be able to dynamically optimize the power usage and performance based on server workload policy.	Functional Verification	
	e.	The server shall be able to cap the power of individual server or a group of servers. The server shall be able to intelligently assign the power to the appropriate server in the pool based on policy settings.	Functional Verification	
	f.	The server shall be able to support power discovery of servers and blades to help visualize data centre thermals.	Functional Verification	
10.2.4		Performance Management & Alerting	Information	
	a.	The server shall have the ability to perform a hardware level (32 bit & 64 bit) measurement. The server shall also monitor CPU, I/O, Memory, Storage & Network.	Functional Verification	
	b.	The server shall have ability to compare the hardware performance with known performance capabilities of each component.	Functional Verification	
	c.	The server shall have the ability to provide comprehensive recommendations for the issue and the resolution.	Functional Verification	
	d.	The server shall have the ability to automatically trigger events and alerts based on performance issues or thresholds set	Functional Verification	

	e.	The server shall be able to events when the performance state of a server changes. Should detect these changes early, displaying a warning before an actual bottleneck happens.	Functional Verification	
10.2.5		Deployment	Information	
	a.	The server shall have the capability of deploying Operating Systems on multiple servers simultaneously and also be able to schedule deployment as and when needed.	Declaration	
	b.	The server shall have the capability to perform scripted installation of most popular Operations Systems to reduce the time required in deployment.	Declaration	
	c.	The server shall have the capability of capturing and deploying OS images	Declaration	
	d.	The server shall have the capability of configuring the hardware and changing system settings such as RAID level before the deployment of the Operating System. The server shall also have the capability of capturing the hardware settings and replicating it across servers.	Declaration	
10.2.6		Integration with Enterprise Management software	Information	

	a.	The server shall have the ability to get event and traps from the Data Centre equipments and enterprise management software.	Declaration	
	b.	The server shall have the ability to send the alerts directly to the vendor via a secure connection for a quick fix.	Declaration	
10.2.7		Server Migration	Information	
	a.	The server shall have ability to perform a Physical-to-virtual (P2V) migration (Migrates a physical machine to a virtual machine guest in a virtual machine host) and Virtual-to-virtual (V2V) migration. (Migrates a virtual machine guest between virtualization layers)	Declaration	
10.2.8		Virtual Machine Management	Information	
	a.	The server shall be able to provide control functions for virtual machines from a single management software	Declaration	
	b.	The server shall be able to provide failed hosts recovery by assigning alternate hosts to VMs	Declaration	
	c.	The server shall be able to provide central management and control for virtual machines hosted on Microsoft Hyper-V server, VMware ESX Server, or Xeon RHEL or SLES.	Declaration	
10.2.9		Reporting	Information	
	a.	The server shall be able to generate various reports based on formats using the latest industry standards	Functional Verification	
	b.	The server shall support reporting. Reports communicate power and thermal information -- from individual server utilization to data- centre-level summaries and analysis. Reports on under-utilized servers identify those that are power hogs, are idle but still running, or are decommissioned but not powered off.	Functional Verification	
	c.	The server shall have the ability to generate reports for system bottleneck state and overall performance utilization	Functional Verification	
10.2.10		Cloud Security Features: The cloud security features as per international standards shall be supported.	Declaration	

		CHAPTER-2			
11.0		Tendering Information			
11.1		Guidelines for the Tendering Authority		Information	
		The tendering authority shall specify the following parameters			
		1	Type of Server	Information	
		2	Category of Server		
		3	Type of input Power Supply i.e. AC, DC or Both		
		4	Requirement of Operating System in case of CISC Servers		
		5	No of Blades to be populated in case of Blade Server OR No of Blades to be populated shall be decided by the supplier based on the specified performance objectives required for the application		
		6	No. of CPU cores and Memory size to be equipped in case of High end server. OR The CPU core and Memory requirement shall be decided by the supplier based on the specified performance objectives required for the application (E.g. No. of CDR' s to be processed in a CDR application or No. of Customers to be supported in a CRM application etc)		
		7	Requirement of Memory Size corresponding to clause 3.2.1 (8)		
		8	Requirement of Memory Type corresponding to clause 3.2.1 (9)		
		9	Requirement of Type & Number of Ethernet port supported corresponding to clause 3.2.1 (15)		
		10	Requirement of Type & Number of PCIe Slots corresponding to clause 3.2.1 (17)		
		11	Requirement of Internal Storage Capacity corresponding to clause 3.2.1 (21)		
		12	Processor Generation corresponding to clause 3.7.1		

		13	Support for Precision Time Protocol (PTP) corresponding to clause 3.11(b)		
		14	Requirement of Type & No. of Physical Interfaces corresponding to clause 4.1 (4)		
		15	Requirement of database management for servers to be used as database servers as per clause 10.1		
		16	Requirement of cloud ready features as per clause 10.2		
		17	Requirement of clustering software		
		18	For optional features, the requirement if any may be stipulated by tendering/purchasing authority		

I. TEST SETUP & TEST PROCEDURES:

1. Test No.	
2. Test Details	*Name and Other relevant details*
3. Test Instruments Required	1. <Name> 2.
4. Test Setup	
5. Test Procedure	*Testing Steps may be written here….* 1) ..... 2) ..... 3) .....
6. Test Limits	(if any)
7. Expected Results	1. **.....**<values>.....**.....** 2. **.....**<values>...**.....** 3. Other tests (test name)

Further Test Setup & Procedures may be added as per requirement

J. **SUMMARY OF TEST RESULTS**

TEC Standard No._____

TEC Test Guide No._____

Equipment name & Model No. _____

Clause No.	***Compliance*** *(Complied /Not Complied / Submitted/Not Submitted / Not Applicable)*	***Remarks /*** ***Test Report Annexure No.***

[Add as per requirement]

Date:

Place: ***Signature & Name of TEC testing Officer /***
**** Signature of Applicant / Authorized Signatory***

**** Section J as given above is also to be submitted by the Applicant/ Authorised signatory as part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.***

COMPENDIUM OF

TEST SETUP AND TEST PROCEDURES

FOR PRODUCTS WHOSE

SPECIFICATIONS ARE RELEASED FROM 'IT' DIVISION

Telecommunication Engineering Centre
Department of Telecommunications
Khurshid Lal Bhavan, Janpath
New Delhi-110 001
India

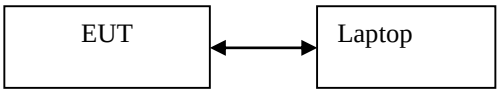
Telecommunication Engineering Centre
(Department of Telecommunications)

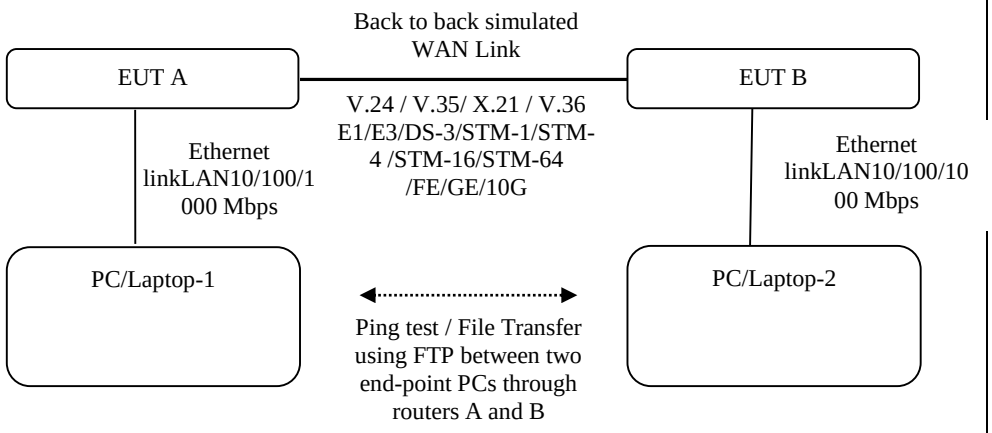
Compendium of Test setup and test procedures for products whose specifications are released from 'IT' division

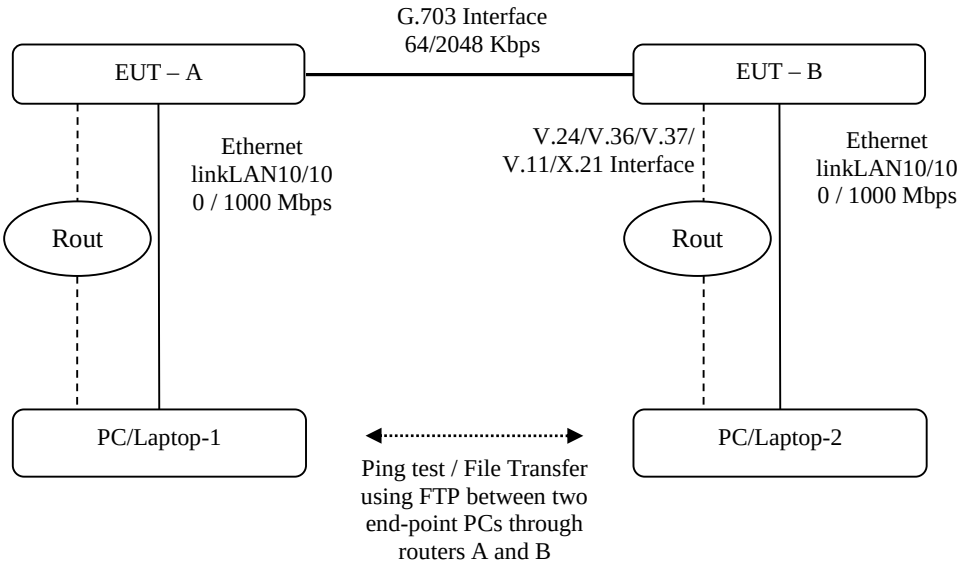
History Sheet

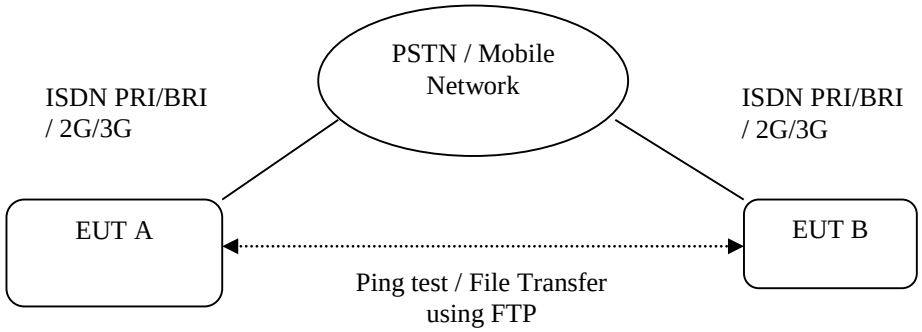
S.No.	No	Remarks
1	Compendium of Tests	1st issue March 2014
2.	Compendium of Tests	2nd issue September 2014
3.	Compendium of Tests	3rd issue November 2014
4.	Compendium of Tests	4th issue December 2014
5.	Compendium of Tests	5th issue April 2015
6.	Compendium of Tests	6th issue April 2016 after incorporation of detailed protocol tests as per RFC's

Table of Contents

Test No.	1
Test Details	Test for 10/100/1000 Auto-negotiation Ethernet Interface
Test Instruments Required	1. Laptop
Test Setup	
Test Procedure	1. Set the Laptop Ethernet interface speed to 10Mbps and see whether the EUT is syncing with the Laptop. I.e. the Ethernet interface lamp of the Laptop shall glow. 2. Repeat the above for 100Mbps 3. Repeat the same for 1000Mbps [In case required]
Expected Results	Enclose the Screen Capture Results

Test No.	2
Test Details	Test for the Availability of Service
Test Instruments Required	1. PC / Laptop – 2 Nos
Test Setup	
Test Procedure	1. Connect the V.24 / V.35 /V.36/X.21/ E1 / E3 / DS-3 / STM-1 / STM-4/STM-16/STM-64/FE/GE/10G interface as the case may be as shown in the setup. 2. Connect the PC/Laptop to the 10/100/1000Mbps LAN link as shown 3. Configure the Interface IP of the EUT as well as the PC/Laptop 4. Carry out the Ping test from PC/Laptop-1 to PC/Laptop-2 and see whether it is reachable as well as there are no packet drop 5. Carry out file transfer from PC/Laptop-1 to PC/Laptop-2 6. In case of Nx64, repeat the test at different speeds
Expected Results	Enclose the Ping Results

Test No.	3
Test Details	Test for the Availability of Service (Devices without Ethernet Interface)
Test Instruments Required	1. PC / Laptop – 2 Nos 2. Router or Interface converter in case the EUT do not have the 10/100/1000 Ethernet interface
Test Setup	
Test Procedure	1. Connect the EUT as shown in the setup. 2. Connect the PC/Laptop to the 10/100/1000 Mbps LAN link as shown 3. In case of V.24/V.36/V.37/ V.11/X.21 Interface, same may be connected to the PC/Laptop through a Router acting as interface converter. 4. Configure the Interface IP of the HSL Driver if required, Routers as well as the PC/Laptop 5. Carry out the Ping test from PC/Laptop-1 to PC/Laptop-2 and see whether it is reachable as well as there are no packet drop 6. Carry out file transfer from PC/Laptop-1 to PC/Laptop-2 7. In case of Nx64, repeat the test at different speeds. 8. Carry out Telnet check also.
Expected Results	Enclose the Results/screenshots

Test No.	4
Test Details	PRI/BRI / 2G/3G interface functional test
Test Instruments Required	1. PSTN / 2G/3G connectivity
Test Setup	
Test Procedure	1. Connect EUT A and EUT B through PSTN in case of PRI/BRI. 2. Connect EUT A and EUT B through Mobile Network in case of 2G/3G. In such case EUT shall be equipped with 2G/3G interface cards along with SIM 3. Test for Ping and File Transfer from EUT A to EUT B
Expected Results	Enclose the Ping Results

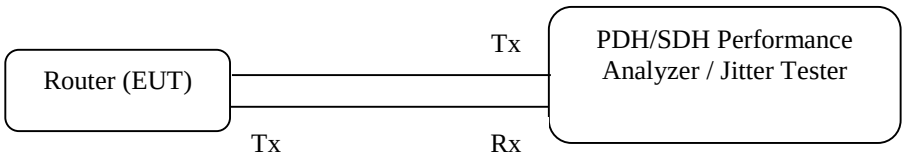
Test No.	5
Test Details	Test for Output Jitter
Test Instruments Required	1. PDH/SDH Performance Analyser or Jitter Tester
Test Setup	PDH/SDH Interface in loopback mode Rx 
Test Limits	Limits for Output Jitter [Maximum Permissible Jitter at Output Interfaces] for PDH interfaces (64Kbps, 2, 34, 45, 140Mbps) — Refer Table 1/G.823 Limits for Output Jitter [Maximum Permissible Jitter at Output Interfaces] for SDH interfaces (STM-1, STM-4, STM-16, STM-64) — Refer Table 1/G.825
Standards Reference	**Table 1/G.823**

Table 1/G.823 – Maximum permissible jitter at traffic interfaces

Interface	Measurement bandwidth, –3 dB frequencies (Hz)	Peak-to-peak amplitude (UIpp) (Note 3)
64 kbit/s	20 to 20 k	0.25
(Note 1)	3 k to 20 k	0.05
2048 kbit/s	20 to 100 k	1.5
	18 k to 100 k (Note 2)	0.2
8448 kbit/s	20 to 400 k	1.5
	3 k to 400 k (Note 2)	0.2
34 368 kbit/s	100 to 800 k	1.5
	10 k to 800 k	0.15
139 264 kbit/s	200 to 3.5 M	1.5
	10 k to 3.5 M	0.075

NOTE 1 – For the codirectional interface only.

NOTE 2 – For 2048 kbit/s and 8448 kbit/s interfaces within the network of an operator, the high-pass cut-off frequency may be specified to be 700 Hz (instead of 18 kHz) and 80 kHz (instead of 3 kHz) respectively. However, at interfaces between different operator networks, the values in the table apply, unless involved parties agree otherwise.

NOTE 3 –

64 kbit/s 1 UI = 15.6 µs
2048 kbit/s 1 UI = 488 ns
8448 kbit/s 1 UI = 118 ns
34 368 kbit/s 1 UI = 29.1 ns
139 264 kbit/s 1 UI = 7.18 ns

	Table 1/G.825

Table 1/G.825 – Maximum permissible jitter at network interfaces

Interface	Measurement bandwidth, –3 dB frequencies (Hz)	Peak-to-peak amplitude (UIpp)
STM-1e (Notes 1, 2)	500 to 1.3 M	1.5
	65 k to 1.3 M	0.075
STM-1 (Note 4)	500 to 1.3 M	1.5
	65 k to 1.3 M	0.15
STM-4 (Note 4)	1 k to 5 M	1.5
	250 k to 5 M	0.15
STM-16 (Note 4)	5 k to 20 M	1.5
	1 M to 20 M	0.15

Table 1/G.825 – Maximum permissible jitter at network interfaces (*concluded*)

Interface	Measurement bandwidth, –3 dB frequencies (Hz)	Peak-to-peak amplitude (UIpp)
STM-64 (Note 4)	20 k to 80 M	1.5
	4 M to 80 M	0.15 (Note 3)

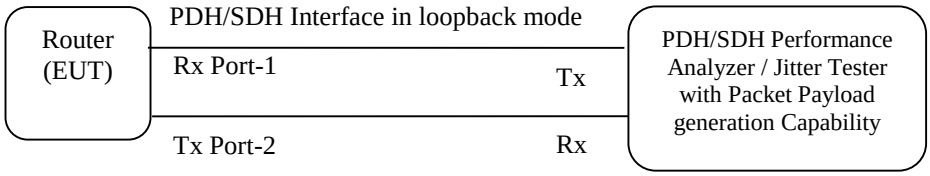
NOTE 1 – Electrical format CMI-encoded, according to G.703.

NOTE 2 – For networks deployed with G.813 Option II clocks or G.812 Type II, III or IV clocks, STM-1 requirements apply to STM-1e.

NOTE 3 – The effect of dispersion and non-linearities on the eye opening and on the choice of this value is for further study.

NOTE 4 – STM-1 1 UI = 6.43 ns
STM-4 1 UI = 1.61 ns
STM-16 1 UI = 0.402 ns
STM-64 1 UI = 0.100 ns

Test Procedure	1. Connect the setup as shown in the figure. 2. Measure the output jitter on the connected PDH/SDH interface 3. Verify whether the output jitter is within the tolerance limits as specified in the relevant ITU specifications as indicated above. 4. Enclose the test results
Expected Results	Enclose the Test Results

Test No.	6
Test Details	Test for Input Jitter Tolerance
Test Instruments Required	1. PDH/SDH Performance analyser with POS capability for SDH and Packet Payload Capability for PDH
Test Setup	
Test Limits	
Standards reference	

64 Kbps co-directional interface input jitter and wander tolerance limit	Refer Figure 12/G.823
2048 Kbps input jitter and wander tolerance limit	Refer Figure 13/G.823
34.368 Mbps input jitter and wander tolerance limit	Refer Figure 15/G.823
44.736 Mbps input jitter and wander tolerance limit	Refer Figure 9/G.824
STM-1e Jitter Tolerance Requirement for 2048Kbps Networks	Refer Figure 2/G.825
STM-4 Jitter Tolerance Requirement	Refer Figure 3/G.825
STM-16 Jitter Tolerance Requirement	Refer Figure 4/G.825
STM-64 Jitter Tolerance Requirement	Refer Figure 5/G.825

Figure 12/G.823

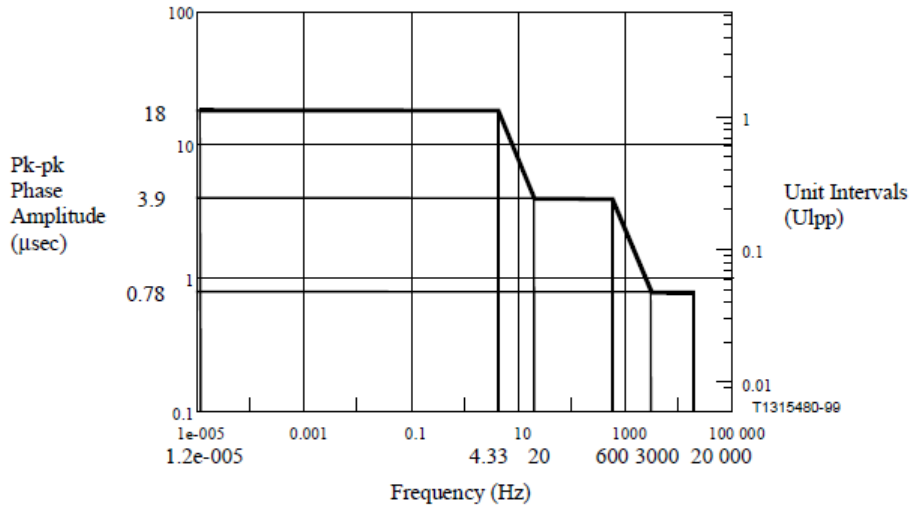


Figure 12/G.823 – 64 kbit/s input jitter and wander tolerance limit

Figure 13/G.823

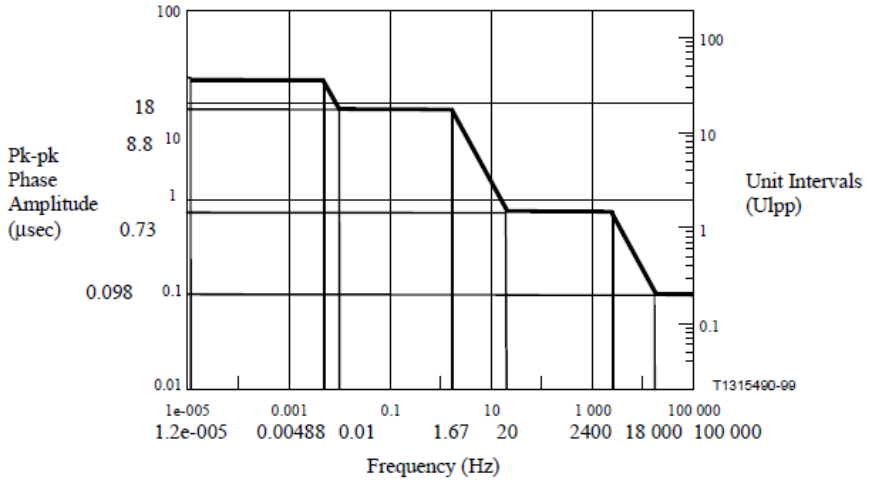


Figure 13/G.823 – 2048 kbit/s input jitter and wander tolerance limit

Figure 15/G.823

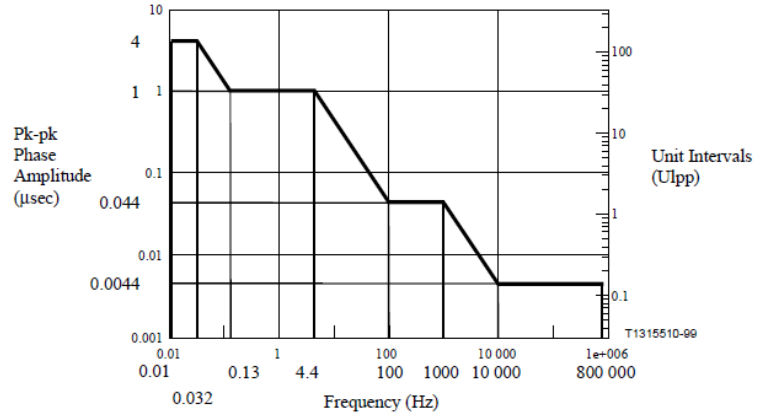


Figure 15/G.823 – 34 368 kbit/s input jitter and wander tolerance limit

Figure 9/G.824

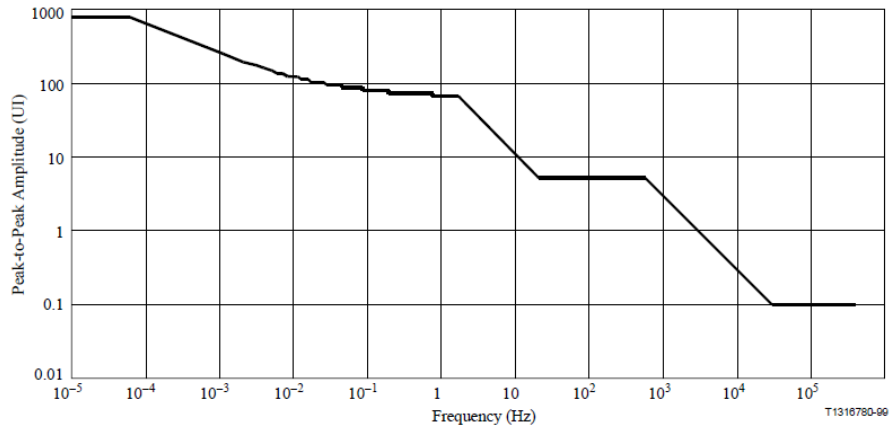


Figure 9/G.824 – Jitter and wander tolerance of 44 736 kbit/s input ports

Figure 2/G.825

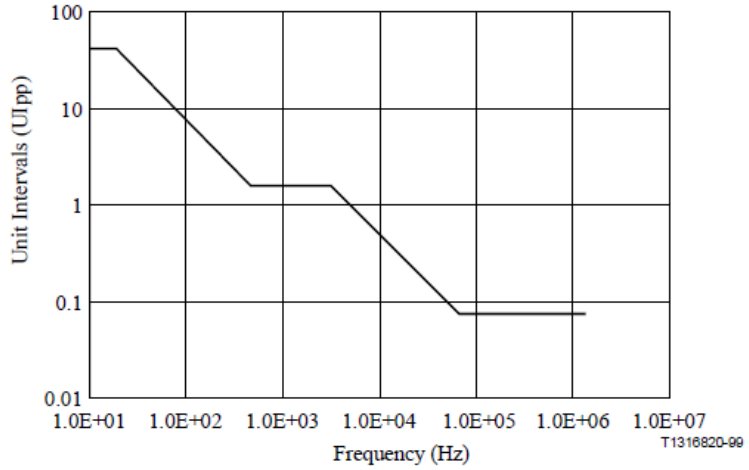
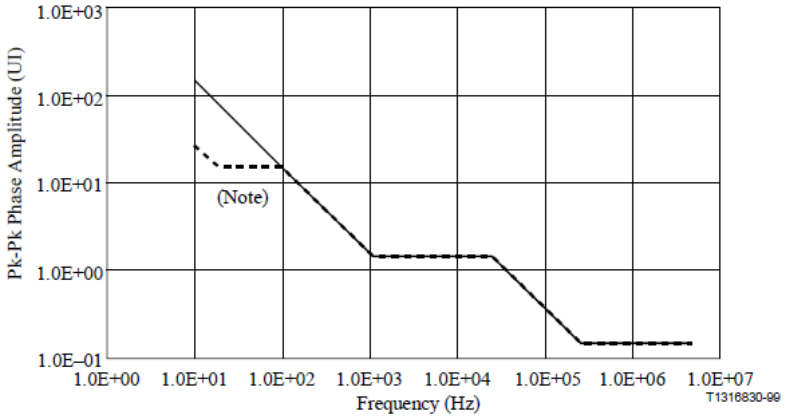


Figure 2/G.825 – STM-1e jitter tolerance requirement (applies to 2048 kbit/s networks only)

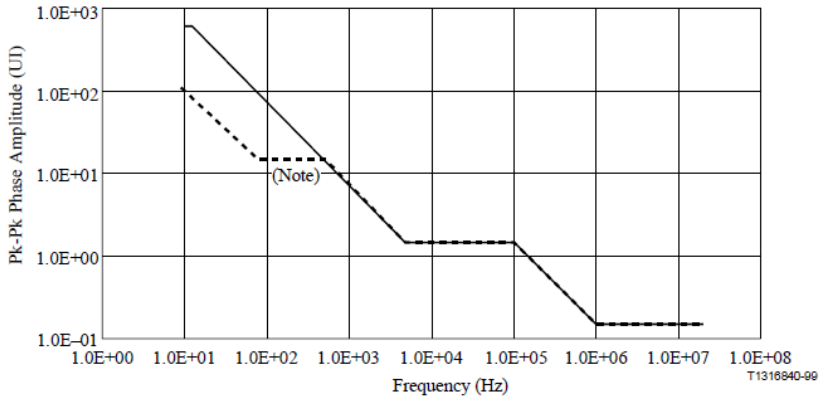
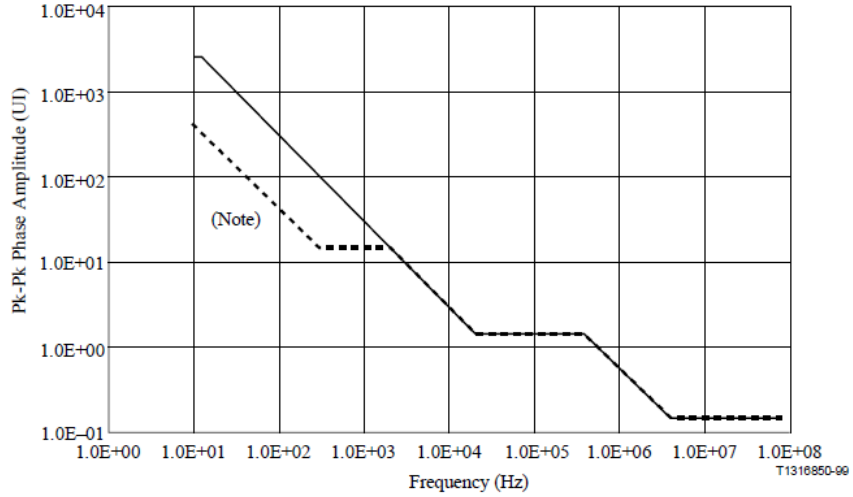
Figure 3/G.825

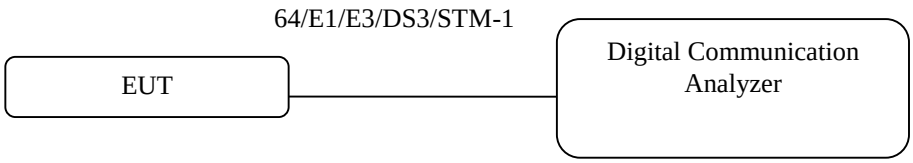


NOTE – The dashed curve is the requirement for 1544 kbit/s networks for frequencies less than 100 Hz.

Figure 3/G.825 – STM-4 jitter tolerance

Figure 4/G.825

	 NOTE – The dashed curve is the requirement for 1544 kbit/s networks for frequencies less than 500 Hz. **Figure 4/G.825 – STM-16 jitter tolerance** **Figure 5/G.825**  NOTE – The dashed curve is the requirement for 1544 kbit/s networks for frequencies less than 2 kHz. **Figure 5/G.825 – STM-64 jitter tolerance**
Test Procedure	1. Connect the setup as shown in the figure. 2. Configure the Router with Port-1 as IP-1 and Port-2 as IP-2 3. Configure the POS in the SDH analyser with Source Address as IP-1 and destination address as IP-2 4. Configure Router-A for Static routing the packets 5. SDH Analyser shall introduce Jitter over the generated packets with PRBS pattern as per G.825 6. Measure the Jitter tolerance as per the Mask and Range of frequencies 7. Take a plot of the Jitter tolerance along with the Mask
Expected Results	Enclose the Test Results

Test No.	7
Test Details	Test for Output Pulse Mask for PDH/SDH interfaces
Test Instruments Required	1. Digital Communication Analyser OR Digital Storage Oscilloscope
Test Setup	

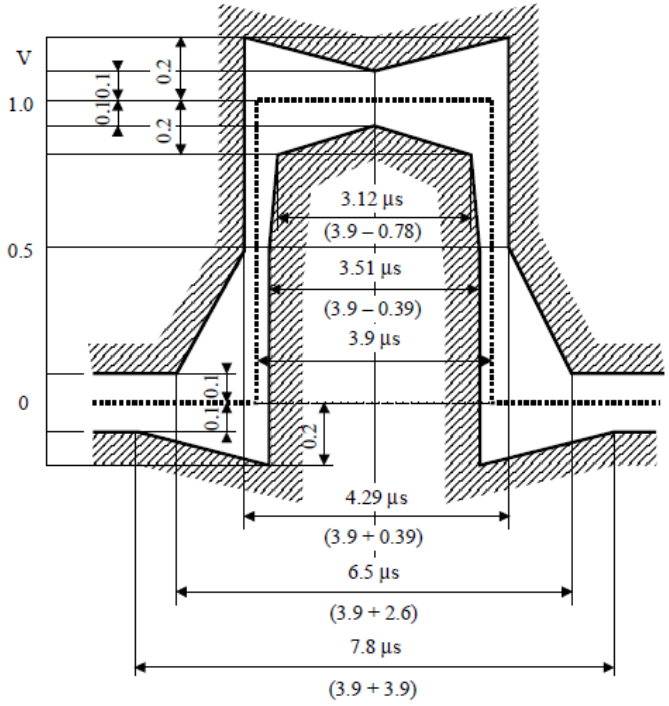
Test Limits		
	Limits for Pulse shape & characteristics for 64Kbps co-directional interface	Refer Table-1 and Figure-5 G.703
	Limits for Pulse shape & characteristics for 2048kbps (E1) interface	Refer Table-7 and Figure-15 G.703
	Limits for Pulse shape & characteristics for 34Mbps interface	Refer Table-9 and Figure-17 G.703
	Limits for Pulse shape & characteristics for 44.736Mbps (DS3) Interface	Refer Table-6 and Figure-14 G.703
	STM-1	Refer Table-12 and Figure-22,23 G.703

Standards reference

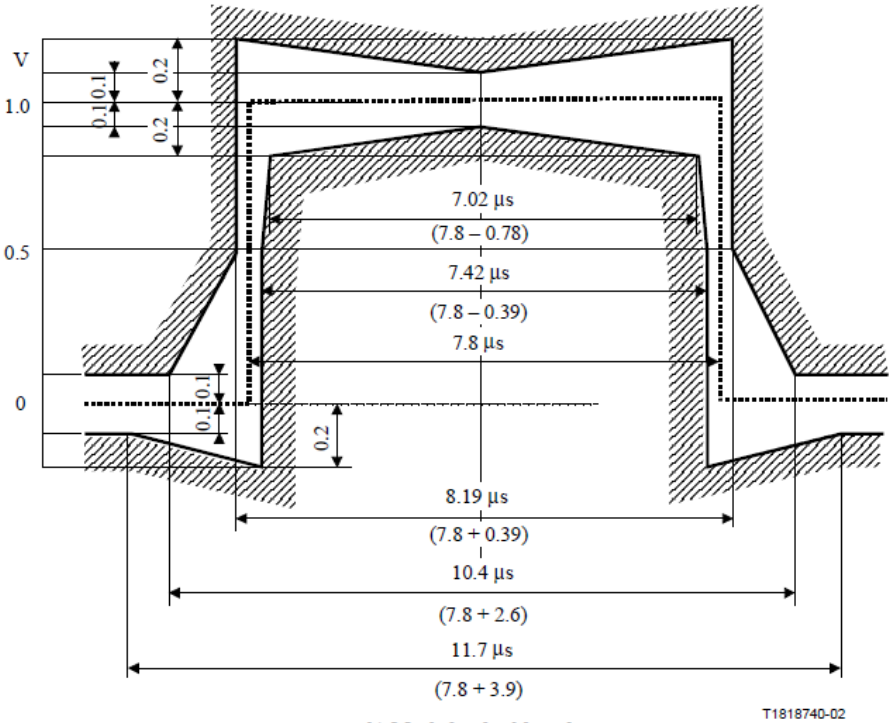
Table-1 and Figure-5 G.703

Table 1/G.703 – Digital 64 kbit/s codirectional interface

Symbol rate	256 kBauds
Pulse shape (nominally rectangular)	All pulses of a valid signal must conform to the masks in Figure 5, irrespective of the polarity
Pair for each direction	One symmetric pair
Test load impedance	120 ohms resistive
Nominal peak voltage of a "mark" (pulse)	1.0 V
Peak voltage of a "space" (no pulse)	0 V ± 0.10 V
Nominal pulse width	3.9 µs
Ratio of the amplitudes of positive and negative pulses at the centre of the pulses interval	0.95 to 1.05
Ratio of the widths of positive and negative pulses at the nominal half amplitude	0.95 to 1.05
Maximum peak-to-peak jitter at the output port (Note)	Refer to 5.1/G.823
NOTE – For the time being these values are valid only for equipments of the 2 Mbit/s hierarchy.	



a) Mask for single pulse



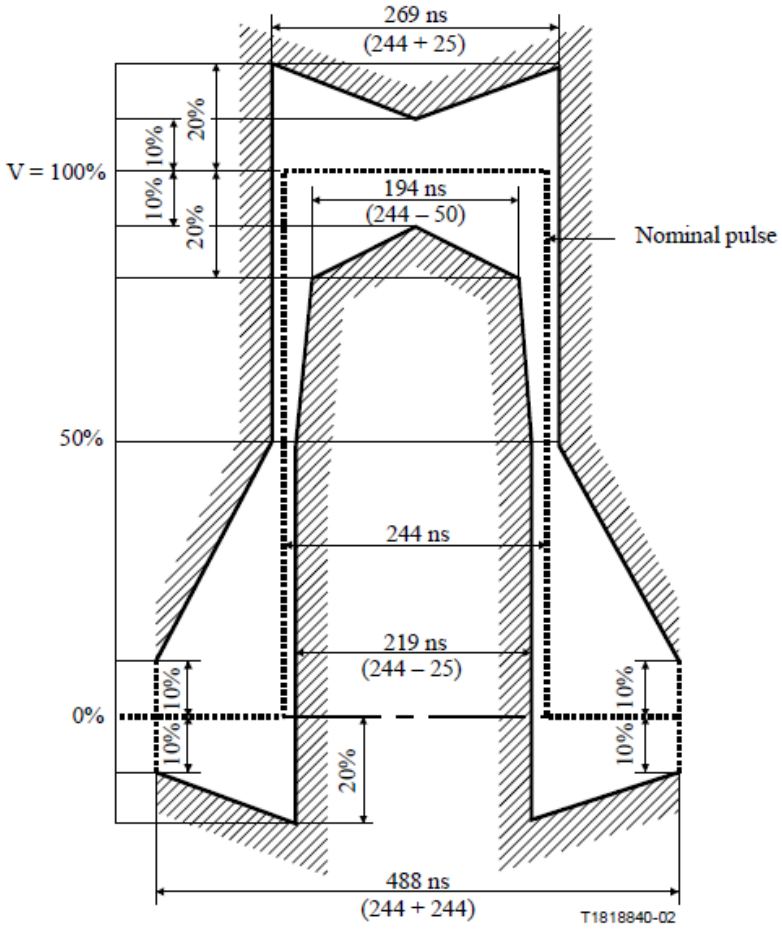
b) Mask for double pulse

NOTE – The limits apply to pulses of either polarity.

Table-7 and Figure-15 G.703

Table 7/G.703 – Digital interface at 2048 kbit/s

Pulse shape (nominally rectangular)	All marks of a valid signal must conform with the mask (see Figure 15) irrespective of the sign. The value V corresponds to the nominal peak value.	
Pair(s) in each direction	One coaxial pair (see 9.4)	One symmetrical pair (see 9.4)
Test load impedance	75 ohms resistive	120 ohms resistive
Nominal peak voltage of a mark (pulse)	2.37 V	3 V
Peak voltage of a space (no pulse)	0 ± 0.237 V	0 ± 0.3 V
Nominal pulse width	244 ns	
Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval	0.95 to 1.05	
Ratio of the widths of positive and negative pulses at the nominal half amplitude	0.95 to 1.05	
Maximum peak-to-peak jitter at an output port	Refer to 5.1/G.823	



NOTE – V corresponds to the nominal peak value.

Figure 15/G.703 – Mask of the pulse at the 2048 kbit/s interface

Table-9 and Figure-17 G.703

Table 9/G.703 – Digital interface at 34 368 kbit/s

Pulse shape (nominally rectangular)	All marks of a valid signal must conform with the mask (see Figure 17), irrespective of the sign.
Pair(s) in each direction	One coaxial pair (see 11.4)
Test load impedance	75 ohms resistive
Nominal peak voltage of a mark (pulse)	1.0 V
Peak voltage of a space (no pulse)	0 V ± 0.1 V
Nominal pulse width	14.55 ns
Ratio of the amplitudes of positive and negative pulses at the center of a pulse interval	0.95 to 1.05
Ratio of the widths of positive and negative pulses at the nominal half amplitude	0.95 to 1.05
Maximum peak-to-peak jitter at an output port	Refer to 5.1/G.823

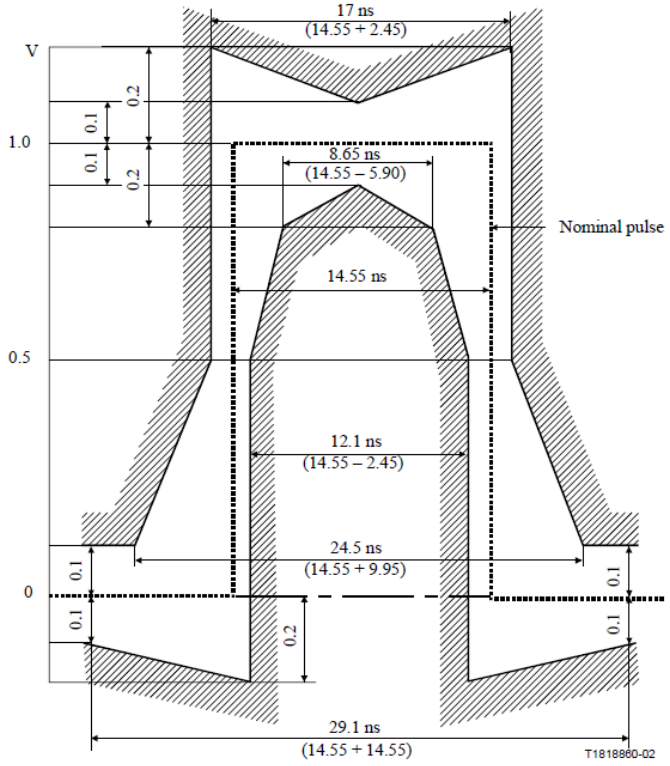


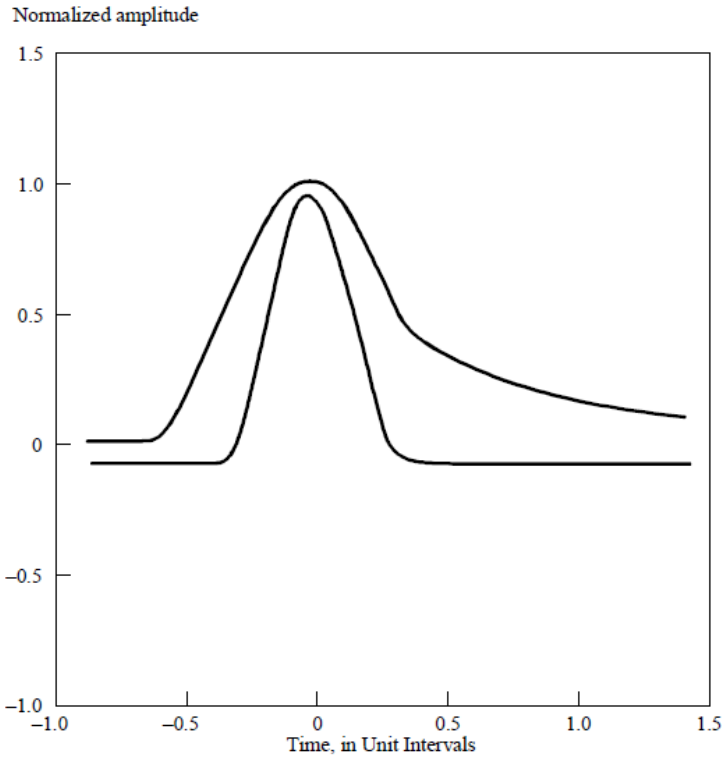
Figure 17/G.703 – Pulse mask at the 34 368 kbit/s interface

Table-6 and Figure-14 G.703

Table 6/G.703 – Digital interface at 44 736 kbit/s

Parameter	Specification
Nominal bit rate	44 736 kbit/s
Bit rate accuracy	In a self-timed, free-running mode, the bit rate accuracy shall be ±895 bits/s (±20 ppm) or better.
Line code	B3ZS (bipolar with three-zero substitutions)
Frame structure	The signal shall have the frame structure defined in ITU-T Rec. G.752 to ensure transmission through all types of 44 736 kbit/s transport equipment. The frame structure is not required for multiplexing to higher level DSN signals.
Medium	One unbalanced coaxial line shall be used for each direction of transmission.
Test load impedance	A resistive test load of 75 ohms ± 5% shall be used at the interface for the evaluation of pulse shape and the electrical parameters specified below.
Pulse amplitude	The amplitude (Note 1) of an isolated pulse shall be between 0.36 V and 0.85 V peak.
Pulse shape	The shape of every pulse that approximates an isolated pulse (is preceded by two zeros and followed by one or more zeros) shall conform to the mask in Figure 14. See 5.2 for allowable procedures to be followed in checking conformance. This mask includes an allowance of ±3% of the peak pulse amplitude at any point on the mask relative to the pulse mask in the earlier version. Equations defining the various line segments making up the mask are listed below the figure.
Power level	A wideband power measurement of an AIS signal (as defined in ITU-T Rec. G.704) using a power level sensor with a working frequency range of 200 MHz shall be between –4.7 dBm and +3.6 dBm, including the effects of a range of connecting cable lengths between 68.6 meters (225 feet) and 137.2 meters (450 feet). A low-pass filter having a flat passband and cutoff frequency of 200 MHz shall be used. The rolloff characteristics of this filter are not important; or an alternate power level specification of the power of an all-ones signal (Note 2) is useful for some equipment qualifications. It requires that the power in a 3 kHz ± 1 kHz band centered at 22 368 kHz be between –1.8 dBm and +5.7 dBm. It further requires that the power in a 3 kHz ± 1 kHz band centered at 44 736 kHz be at least 20 dB below that at 22 368 kHz.
Pulse imbalance	1) The ratio of amplitudes of positive and negative isolated pulses shall be between 0.90 and 1.10. 2) Positive and negative isolated pulses shall both conform to the mask of Figure 14.
DC power	There shall be no DC power applied at the interface.
Verification access	Access to the signal at the interface shall be provided for verification of these signal specifications.

Parameter	Specification
NOTE 1 – While both voltage and power requirements are given to assist in qualification of signals at the interface, the values are not equivalent. Voltage specifications are given for isolated pulses, while power levels are specified for an AIS signal, or alternatively an all-ones signal. NOTE 2 – The all-ones signal is not realizable within the frame structure specified in Recommendation G.752, and is not encountered in North American telecommunication networks.	



Time axis range (Unit Intervals)	Normalized amplitude equation
Upper curve	
$-0.85 \le T \le -0.68$	0.03
$-0.68 \le T \le 0.36$	$0.5\left\{1+\sin\left[\frac{\pi}{2}\left(1+\frac{T}{0.34}\right)\right]\right\}+0.03$
$0.36 \le T \le 1.4$	$0.08+0.407e^{-1.84(T-0.36)}$
Lower curve	
$-0.85 \le T \le -0.36$	–0.03
$-0.36 \le T \le 0.36$	$0.5\left\{1+\sin\left[\frac{\pi}{2}\left(1+\frac{T}{0.18}\right)\right]\right\}-0.03$
$0.36 \le T \le 1.4$	–0.03

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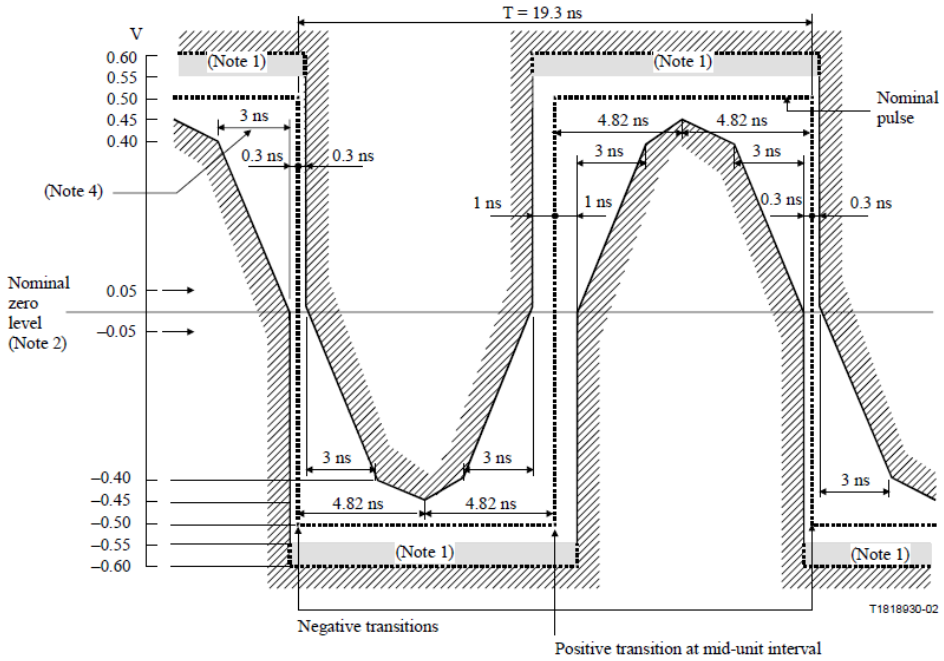
Figure 14/G.703 – 44 736 kbit/s interface isolated pulse mask and equations

Table-12 and Figure-22,23 G.703

Table 12/G.703 – Digital interface at 155 520 kbit/s

Pulse shape	Nominally rectangular and conforming to the masks shown in Figures 22 and 23
Pair(s) in each direction	One coaxial pair
Test load impedance	75 ohms resistive
Peak-to-peak voltage	1 ± 0.1 V
Rise time between 10% and 90% amplitudes of the measured steady state amplitude	≤2 ns
Transition timing tolerance referred to the mean value of the 50% amplitude points of negative transitions	Negative transitions: ±0.1 ns Positive transitions at unit interval boundaries: ±0.5 ns Positive transitions at mid-unit intervals: ±0.35 ns
Return loss	≥15 dB over frequency range 8 MHz to 240 MHz
Maximum peak-to-peak jitter at an output port	Refer to 5.1/G.825



NOTE 1 – The maximum "steady state" amplitude should not exceed the 0.55 Vlimit. Overshoots and other transients are permitted to fall into the dotted area, bounded by the amplitude levels 0.55 V and 0.6 V, provided that they do not exceed the steady state level by more than 0.05 V. The possibility of relaxing the amount by which the overshoot may exceed the steady state level is under study.

NOTE 2 – For all measurements using these masks, the signal should be AC coupled, using a capacitor of not less than 0.01 µF, to the input of the oscilloscope used for measurements.

The nominal zero level for both masks should be aligned with the oscilloscope trace with no input signal. With the signal then applied, the vertical position of the trace can be adjusted with the objective of meeting the limits of the masks. Any such adjustment should be the same for both masks and should not exceed ±0.05 V. This may be checked by removing the input signal again and verifying that the trace lies within ±0.05 V of the nominal zero level of the masks.

NOTE 3 – Each pulse in a coded pulse sequence should meet the limits of the relevant mask, irrespective of the state of the preceding or succeeding pulses, with both pulse masks fixed in the same relation to a common timing reference, i.e. with their nominal start and finish edges coincident.

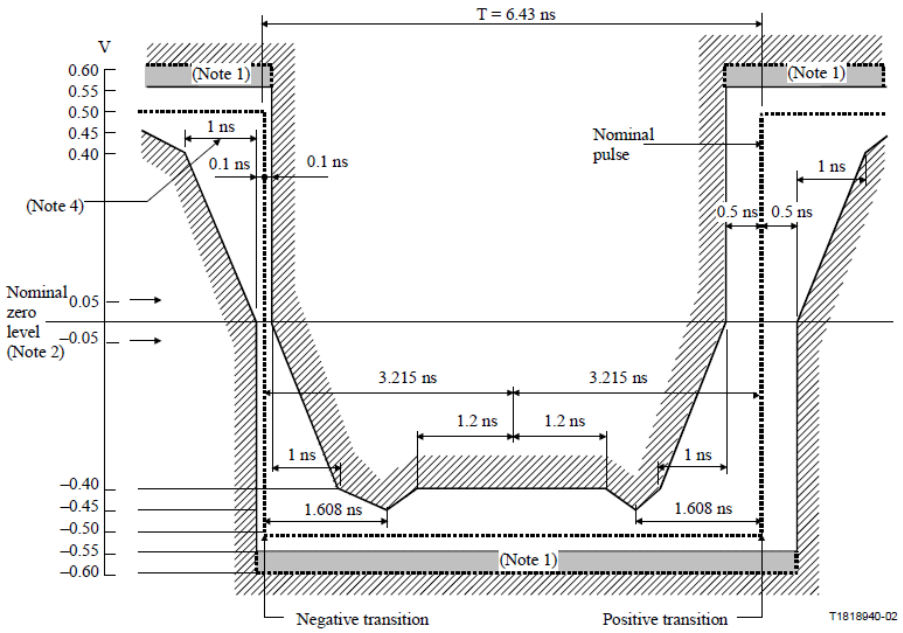
The masks allow for HF jitter caused by intersymbol interference in the output stage, but not for jitter present in the timing signal associated with the source of the interface signal.

When using an oscilloscope technique to determine pulse compliance with the mask, it is important that successive traces of the pulses overlay in order to suppress the effects of low frequency jitter. This can be accomplished by several techniques [e.g. a) triggering the oscilloscope on the measured waveform or b) providing both the oscilloscope and the pulse output circuits with the same clock signal].

These techniques require further study.

NOTE 4 – For the purpose of these masks, the rise time and decay time should be measured between –0.4 V and 0.4 V, and should not exceed 2 ns.

Figure 22/G.703 – Mask of a pulse corresponding to a binary 0 (at the 155 520 kbit/s interface)



NOTE 1 – The maximum "steady state" amplitude should not exceed the 0.55 V limit. Overshoots and other transients are permitted to fall into the dotted area, bounded by the amplitude levels 0.55 V and 0.6 V, provided that they do not exceed the steady state level by more than 0.05 V. The possibility of relaxing the amount by which the overshoot may exceed the steady state level is under study.

NOTE 2 – For all measurements using these masks, the signal should be AC coupled, using a capacitor of not less than 0.01 µF, to the input of the oscilloscope used for measurements.

The nominal zero level for both masks should be aligned with the oscilloscope trace with no input signal. With the signal then applied, the vertical position of the trace can be adjusted with the objective of meeting the limits of the masks. Any such adjustment should be the same for both masks and should not exceed ±0.05 V. This may be checked by removing the input signal again and verifying that the trace lies within ±0.05 V of the nominal zero level of the masks.

NOTE 3 – Each pulse in a coded sequence should meet the limits of the relevant mask, irrespective of the state of the preceding or succeeding pulses, with both pulse masks fixed in the same relation to a common timing reference, i.e. with their nominal start and finish edges coincident.

The masks allow for HF jitter caused by intersymbol interference in the output stage, but not for jitter present in the timing signal associated with the source of the interface signal.

When using an oscilloscope technique to determine pulse compliance with the mask, it is important that successive traces of thepulses overlay in order to suppress the effects of low frequency jitter. This can be accomplished by several techniques [e.g. a) triggering the oscilloscope on the measured waveform or b) providing both the oscilloscope and the pulse output circuits with the same clock signal].

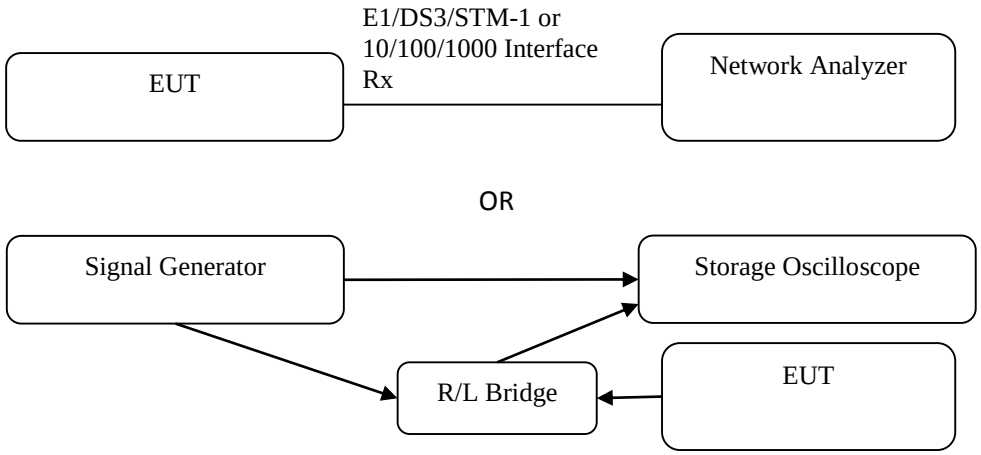
These techniques require further study.

NOTE 4 – For the purpose of these masks, the rise time and decay time should be measured between –0.4 V and 0.4 V, and should not exceed 2 ns.

NOTE 5 – The inverse pulse will have the same characteristics, noting that the timing tolerance at the level of the negative and positive transitions are ±0.1 ns and ±0.5 ns respectively.

Figure 23/G.703 – Mask of a pulse corresponding to a binary 1 (at the 155 520 kbit/s interface)

Test Procedure	1. Connect the EUT as shown in the figure. 2. Enable the Port if required. 3. See whether the output pulse is within the mask/limits as indicated above.
Expected Results	Enclose the Test Results with the Pulse shape & the Pulse Mask

<table>
<tr><td>Test No.</td><td>8</td></tr>
<tr><td>Test Details</td><td>Test for Return Loss (This test is applicable to 64Kbps / 2048Kbps / 34Mbps/45Mbps/STM-1 interfaces)</td></tr>
<tr><td>Test Instruments Required</td><td>1. Network Analyser for PDH/SDH Interfaces
2. Vector Network Analyser with Balun to convert to differential voltage OR Signal Generator, Storage Oscilloscope & Return Loss Bridge</td></tr>
<tr><td>Test Setup</td><td> 
</td></tr>
<tr><td>Test Limits</td><td>
<table>
<tr><td>Minimum Return loss limits at input port for 64Kbps co-directional interface</td><td>Refer clause 4.2.1.3 of G.703</td></tr>
<tr><td>Minimum Return loss limits at output port for 64Kbps co-directional interface</td><td>Refer clause 4.2.1.2 of G.703</td></tr>
<tr><td>Minimum Return loss limits at input port for 2048 kbps (E1) interface</td><td>Refer clause 9.3 of G.703</td></tr>
<tr><td>Minimum Return loss limits at output port for 2048 kbps (E1) interface</td><td>Refer clause 9.2 of G.703</td></tr>
<tr><td>Minimum Return loss limits at input port for 34Mbps interface</td><td>Refer clause 11.3 of G.703</td></tr>
<tr><td>Minimum Return loss limits at output port for 34Mbps interface</td><td>Refer clause 11.2 of G.703</td></tr>
<tr><td>Minimum Return loss limits at input port for STM-1 interface</td><td>≥15 dB over frequency range 8 MHz to 240 MHz</td></tr>
<tr><td>Minimum Return loss limits at output port for STM-1 interface</td><td>≥15 dB over frequency range 8 MHz to 240 MHz</td></tr>
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</td></tr>
<tr><td>Standards Reference</td><td>clause 4.2.1.3 of G.703
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<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>4 to 13
13 to 256
256 to 384</td><td>12
18
14</td></tr>
</table>
clause 4.2.1.2 of G.703</td></tr>
</table>

<table>
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<table>
<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>6.4 to 13
13 to 384</td><td>6
8</td></tr>
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</td></tr>
<tr><td></td><td>clause 9.3 of G.703</td></tr>
<tr><td></td><td>
<table>
<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>51 to 102
102 to 2048
2048 to 3072</td><td>12
18
14</td></tr>
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<tr><td></td><td>clause 9.2 of G.703</td></tr>
<tr><td></td><td>
<table>
<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>51 to 102
102 to 3072</td><td>6
8</td></tr>
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<tr><td></td><td>clause 11.3 of G.703</td></tr>
<tr><td></td><td>
<table>
<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>860 to 1720
1720 to 34 368
34 368 to 51 550</td><td>12
18
14</td></tr>
</table>
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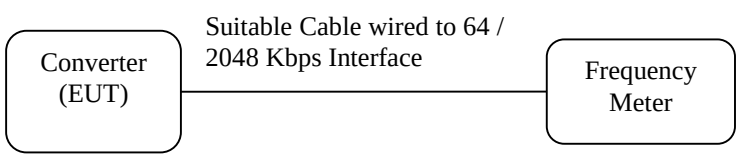
<tr><td></td><td>clause 11.2 of G.703</td></tr>
<tr><td></td><td>
<table>
<tr><th>Frequency range (kHz)</th><th>Return loss (dB)</th></tr>
<tr><td>860 to 1720
1720 to 51 550</td><td>6
8</td></tr>
</table>
</td></tr>
<tr><td>Test Procedure</td><td>1. Connect the Setup as shown in the figure.
2. Measure the input port return loss using the Network Analyser
3. Check whether the Return Loss is within the specified limits</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results</td></tr>
</table>

<table>
<tr><td>Test No.</td><td>9</td></tr>
<tr><td>Test Details</td><td>Test for Output Frequency</td></tr>
<tr><td>Test Instruments Required</td><td>1. Frequency Meter</td></tr>
<tr><td>Test Setup</td><td> 
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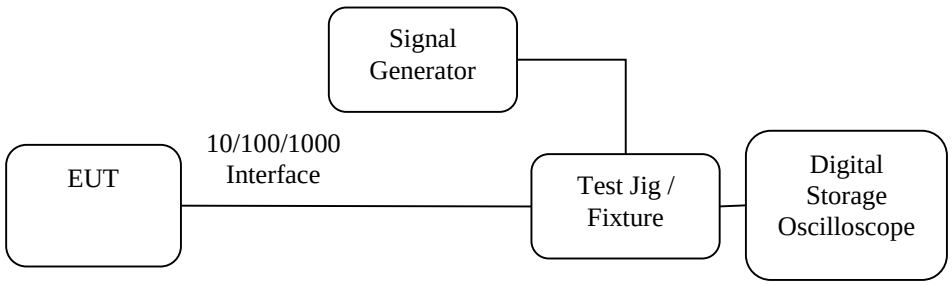
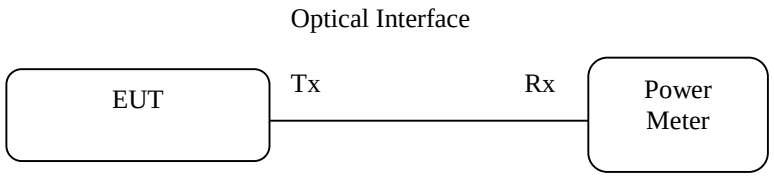
<tr><td>Test Limits</td><td><table>
<tr><td>64Kbps</td><td>±100 ppm</td></tr>
<tr><td>2048Kbps</td><td>±50 ppm</td></tr>
</table></td></tr>
<tr><td>Test Procedure</td><td>1. Connect the test setup as shown in figure using a suitable cable wired to the 64/2048Kbps interface
2. Measure the Output Frequency using the Frequency Meter</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results</td></tr>
</table>

<table>
<tr><td>Test No.</td><td>10</td></tr>
<tr><td>Test Details</td><td>Test for Ethernet Interface
1. Differential output voltage
2. AC Differential input impedance
3. Output Jitter</td></tr>
<tr><td>Test Instruments Required</td><td>1. Digital Storage Oscilloscope
2. Ethernet parameters measurement test Jig/Fixture
3. Signal generator</td></tr>
<tr><td>Test Setup</td><td> 
</td></tr>
<tr><td>Test Limits</td><td>
<table>
<tr><td>Differential output voltage, loaded 10Base-T</td><td>Refer 14.3.1.2.1of IEEE802.3 Section-1 Differential output voltage</td></tr>
<tr><td>Differential output voltage, 100Base-T</td><td>Refer 23.5.1.2.1 of IEEE802.3 Section-2 Peak differential output voltage</td></tr>
<tr><td>Differential output voltage, loaded 1000Base-T</td><td>Refer 40.6.1.2.1 of IEEE802.3 Section-3 Peak differential output voltage</td></tr>
<tr><td>Differential input impedance - 10Base-T</td><td>Refer 14.3.1.3.4 of IEEE802.3 Section-1AC differential input impedance</td></tr>
<tr><td>Receiver differential input impedance - 100Base-T</td><td>Refer 23.5.1.3.3 of IEEE802.3 Section-2 Receiver differential input impedance</td></tr>
<tr><td>10Base-T Output timing Jitter</td><td>Refer 14.3.1.2.3of IEEE802.3 Section 3 Output timing jitter</td></tr>
<tr><td>100base-T Output timing Jitter</td><td>Refer 23.5.1.2.5 of IEEE802.3 Section 3 Output timing jitter</td></tr>
<tr><td>1000Base-T Transmitter output Jitter</td><td>Refer 40.6.1.2.6 of IEEE802.3 Section 3 Transmitter Timing Jitter</td></tr>
</table>
</td></tr>
<tr><td>Test Procedure</td><td>1. Connect the test setup as shown in figure to the 10/100/1000Base-T interface
2. The test Jig / Fixture is an electronics hardware attached to the oscilloscope / Network analyser for the measurement of Ethernet parameters
3. Measure the Ethernet parameters</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results</td></tr>
<tr><td>Note:</td><td>1. Tests can be conducted under one of the following options
a. Test facility in TEC if available.
b. Any Test Location in India including the premises of the trader/manufacturer of the product approved by RTEC where the Test facility is available for testing by RTEC.</td></tr>
</table>

	2. In case it is not possible to carry out the tests as above, the test results from any one of the following options can be accepted. RTEC shall verify whether the test results are within the prescribed limits. a. Results from any Indian/Foreign lab accredited as per ISO 17025 and having Ethernet Physical interface testing included in the scope of accreditation b. In house test results of the Equipment Under Test (EUT) in case of Foreign OEM c. In house test results of the Ethernet chipsets used in the EUT, from the OEM of the Ethernet chipset. The physical availability of the Ethernet Chipset in the EUT shall be verified by the RTEC. The following remark shall be indicated in the TAC. "The chipset number/code of the Ethernet chipset used in the equipment offered for testing: ……..."

Test No.	11
Test Details	Test for output Power [Mean Launch Power]
Test Instruments Required	1. Optical Power Meter
Test Setup	
Test Limits	

STM-1 Short Haul / Long Haul	Refer Table-2/G.957
STM-4 Short Haul / Long Haul	Refer Table-3/G.957
STM-16 Short Haul / Long Haul	Refer Table-4/G.957
FE Short Haul/Long Haul (100BASE-FX/SX/LX)	Refer IEEE 802.3u
GE Short Haul (1000BASE-SX)	Refer clause 38.3.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3
GE Long Haul (1000BASE-LX)	Refer clause 38.4.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3
10 GE Short Haul/Long Haul (10G-SR/LR/ER)	Refer table 52-7 for SR, 52-12 for LR and 52-16 for ER of IEEE 802.3ae specifications
40 GE (SR4/LR4)	Refer Table 86-6 for SR4 and 87-7 for LR4 of IEEE 802.3ba specifications
100 GE (SR10/LR4/ER4)	Refer Table 86-6 for SR10, 88-7 for LR4/ER4 of IEEE 802.3ba specifications

Standards Reference

Table-2/G.957

Table 2/G.957 – Parameters specified for STM-1 optical interfaces

	Unit	Values								
Digital signal Nominal bit rate	kbit/s	STM-1 according to ITU-T Rec. G.707/Y.1322 155 520								
Application code (Table 1)		I-1		S-1.1	S-1.2		L-1.1		L-1.2	L-1.3	
Operating wavelength range	nm	1260[a]-1360		1261[a]-1360	1430-1576	1430-1580	1263[a]-1360		1480-1580	1534-1566/ 1523-1577	1480-1580
Transmitter at reference point S											
Source type		MLM	LED	MLM	MLM	SLM	MLM	SLM	SLM	MLM	SLM
Spectral characteristics:											
– maximum RMS width (σ)	nm	40	80	7.7	2.5	–	3	–	–	3/2.5	–
– maximum –20 dB width	nm	–	–	–	–	1	–	1	1	–	1
– minimum side mode suppression ratio	dB	–	–	–	–	30	–	30	30	–	30
Mean launched power:											
– maximum	dBm	–8		–8	–8		0		0	0	
– minimum	dBm	–15		–15	–15		–5		–5	–5	
Minimum extinction ratio	dB	8.2		8.2	8.2		10		10	10	
Optical path between S and R											
Attenuation range[b]	dB	0-7		0-12	0-12		10-28		10-28	10-28	
Maximum dispersion	ps/nm	18	25	96	296	NA	246	NA	NA	246/296	NA
Minimum optical return loss of cable plant at S, including any connectors	dB	NA		NA	NA		NA		20	NA	
Maximum discrete reflectance between S and R	dB	NA		NA	NA		NA		–25	NA	
Receiver at reference point R											
Minimum sensitivity[b]	dBm	–23		–28	–28		–34		–34	–34	
Minimum overload	dBm	–8		–8	–8		–10		–10	–10	
Maximum optical path penalty	dB	1		1	1		1		1	1	
Maximum reflectance of receiver, measured at R	dB	NA		NA	NA		NA		–25	NA	

[a] Some Administrations may require a limit of 1270 nm.
[b] See clause 6.

Table-3/G.957

Table 3/G.957 – Parameters specified for STM-4 optical interfaces

	Unit	Values							
Digital signal Nominal bit rate	kbit/s	STM-4 according to ITU-T Rec. G.707/Y.1322 622 080							
Application code (Table 1)		I-4		S-4.1	S-4.2	L-4.1		L-4.2	L-4.3
Operating wavelength range	nm	1261[a]-1360		1293-1334/ 1274-1356	1430-1580	1300-1325/ 1296-1330	1280-1335	1480-1580	1480-1580
Transmitter at reference point S									
Source type		MLM	LED	MLM	SLM	MLM	SLM	SLM	SLM
Spectral characteristics:									
– maximum RMS width (σ)	nm	14.5	35	4/2.5	–	2.0/1.7	–	–	–
– maximum –20 dB width	nm	–	–	–	1	–	1	< 1[b]	1
– minimum side mode suppression ratio	dB	–	–	–	30	–	30	30	30
Mean launched power:									
– maximum	dBm	–8		–8	–8	+2		+2	+2
– minimum	dBm	–15		–15	–15	–3		–3	–3
Minimum extinction ratio	dB	8.2		8.2	8.2	10		10	10
Optical path between S and R									
Attenuation range[b]	dB	0-7		0-12	0-12	10-24		10-24	10-24
Maximum dispersion	ps/nm	13	14	46/74	NA	92/109	NA	1600	NA
Minimum optical return loss of cable plant at S, including any connectors	dB	NA		NA	24	20		24	20
Maximum discrete reflectance between S and R	dB	NA		NA	–27	–25		–27	–25
Receiver at reference point R									
Minimum sensitivity[b]	dBm	–23		–28	–28	–28		–28	–28
Minimum overload	dBm	–8		–8	–8	–8		–8	–8
Maximum optical path penalty	dB	1		1	1	1		1	1
Maximum reflectance of receiver, measured at R	dB	NA		NA	–27	–14		–27	–14

[a] Some Administrations may require a limit of 1270 nm.
[b] See clause 6.

Table-4/G.957

Table 4/G.957 – Parameters specified for STM-16 optical interfaces

	Unit	Values					
Digital signal Nominal bit rate	kbit/s	STM-16 according to ITU-T Rec. G.707/Y.1322 2 488 320					
Application code (Table 1)		I-16	S-16.1	S-16.2	L-16.1	L-16.2	L-16.3
Operating wavelength range	nm	1266[a]-1360	1260[a]-1360	1430-1580	1280-1335	1500-1580	1500-1580
Transmitter at reference point S							
Source type		MLM	SLM	SLM	SLM	SLM	SLM
Spectral characteristics:							
– maximum RMS width (σ)	nm	4	–	–	–	–	–
– maximum –20 dB width	nm	–	1	< 1[b]	1	< 1[b]	< 1[b]
– minimum side mode – suppression ratio	dB	–	30	30	30	30	30
Mean launched power:							
– maximum	dBm	–3	0	0	+3	+3	+3
– minimum	dBm	–10	–5	–5	–2	–2	–2
Minimum extinction ratio	dB	8.2	8.2	8.2	8.2	8.2	8.2
Optical path between S and R							
Attenuation range[b]	dB	0-7	0-12	0-12	12-24[d]	12-24[d]	12-24[d]
Maximum dispersion at upper wavelength limit	ps/nm	12[c]	NA	800[c]	NA	1600[c]	450[c]
Maximum dispersion at lower wavelength limit	ps/nm	12[c]	NA	420[c]	NA	1200[c]	450[c]
Minimum optical return loss of cable plant at S, including any connectors	dB	24	24	24	24	24	24
Maximum discrete reflectance between S and R	dB	–27	–27	–27	–27	–27	–27
Receiver at reference point R							
Minimum sensitivity[b]	dBm	–18	–18	–18	–27	–28	–27
Minimum overload	dBm	–3	0	0	–9	–9	–9
Maximum optical path penalty	dB	1	1	1	1	2	1
Maximum reflectance of receiver, measured at R	dB	–27	–27	–27	–27	–27	–27

[a] Some Administrations may require a limit of 1270 nm.

[b] See clause 6.

[c] For wavelengths between the upper and lower wavelength limits, the maximum dispersion is linearly interpolated between the values given for the wavelength extremes. Where the maximum dispersion values are the same, this value is required to be met across the entire wavelength range.

[d] Some Administrations may require 10 dB minimum attenuation instead of 12 dB, to do this, it is required to decrease the maximum output power of the transmitter or to increase the minimum overload of the receiver (or a combination of both).

Clause 38.3.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3

Table 38–3—1000BASE-SX transmit characteristics

Description	62.5 μm MMF	50 μm MMF	Unit
Transmitter type	Shortwave Laser		
Signaling speed (range)	1.25 ± 100 ppm		GBd
Wavelength (λ, range)	770 to 860		nm
T_{rise}/T_{fall} (max; 20%-80%; λ > 830 nm)	0.26		ns
T_{rise}/T_{fall} (max; 20%-80%; λ ≤ 830 nm)	0.21		ns
RMS spectral width (max)	0.85		nm
Average launch power (max)	See footnote [a]		dBm
Average launch power (min)	–9.5		dBm
Average launch power of OFF transmitter (max)[b]	–30		dBm
Extinction ratio (min)	9		dB
RIN (max)	–117		dB/Hz
Coupled Power Ratio (CPR) (min)[c]	9 < CPR		dB

[a]The 1000BASE-SX launch power shall be the lesser of the class 1 safety limit as defined by 38.7.2 or the average receive power (max) defined by Table 38–4.
[b]Examples of an OFF transmitter are: no power supplied to the PMD, laser shutdown for safety conditions, activation of a "transmit disable" or other optional module laser shut down conditions. During all conditions when the PMA is powered, the ac signal (data) into the transmit port will be valid encoded 8B/10B patterns (this is a requirement of the PCS layers) except for short durations during system power-on-reset or diagnostics when the PMA is placed in a loopback mode.
[c]Radial overfilled launches as described in 38A.2, while they may meet CPR ranges, should be avoided.

Clause 38.4.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3

Table 38–7—1000BASE-LX transmit characteristics

Description	62.5 μm MMF	50 μm MMF	10 μm SMF	Unit
Transmitter type	Longwave Laser			
Signaling speed (range)	1.25 ± 100 ppm			GBd
Wavelength (range)	1270 to 1355			nm
T_{rise}/T_{fall} (max, 20-80% response time)	0.26			ns
RMS spectral width (max)	4			nm
Average launch power (max)	–3			dBm
Average launch power (min)	–11.5	–11.5	–11.0	dBm
Average launch power of OFF transmitter (max)	–30			dBm
Extinction ratio (min)	9			dB
RIN (max)	–120			dB/Hz
Coupled Power Ratio (CPR)[a]	28 < CPR< 40	12 < CPR < 20	N/A	dB

[a]Due to the dual media (single-mode and multimode) support of the LX transmitter, fulfillment of this specification requires a single-mode fiber offset-launch mode-conditioning patch cord described in 38.11.4 for MMF operation. This patch cord is not used for single-mode operation.

Table 52-7 for SRof IEEE 802.3ae specifications

Table 52–7—10GBASE-S transmit characteristics

Description	10GBASE-SW	10GBASE-SR	Unit
Signaling speed (nominal)	9.95328	10.3125	GBd
Signaling speed variation from nominal (max)	± 20	± 100	ppm
Center wavelength (range)	840 to 860		nm
RMS spectral width[a] (max)	See footnote[b]		
Average launch power (max)	See footnote[c]		
Average launch power[d] (min)	–7.3		dBm
Launch power (min) in OMA	See footnote[b]		
Average launch power of OFF transmitter[e] (max)	–30		dBm
Extinction ratio (min)	3		dB
$RIN_{12}OMA$ (max)	–128		dB/Hz
Optical Return Loss Tolerance (max)	12		dB
Encircled flux	See footnote[f]		
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}		
Transmitter and dispersion penalty[g] (max)	3.9 dB		dB

[a]RMS spectral width is the standard deviation of the spectrum.
[b]Trade-offs are available between spectral width, center wavelength and minimum optical modulation amplitude. See Figure 52–3 and Table 52–8.
[c]The 10GBASE-S launch power shall be the lesser of the class 1 safety limit as defined by 52.10.2 or the average receive power (max) defined by Table 52–9.
[d]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[e]Examples of an OFF transmitter are: no power supplied to the PMD, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shut down conditions.
[f]The encircled flux at 19 µm shall be greater than or equal to 86% and the encircled flux at 4.5 µm shall be less than or equal to 30% when measured into Type A1a (50/125 µm multimode) fiber per ANSI/TIA/EIA-455-203-2001.
[g]TDP(max) and OMA(min) are at the respective wavelength and spectral width as specified in Table 52–8.

Table 52-12 for LR of IEEE 802.3ae specifications

Table 52–12—10GBASE-L transmit characteristics

Description	10GBASE-LW	10GBASE-LR	Unit
Signaling speed (nominal)	9.95328	10.3125	GBd
Signaling speed variation from nominal (max)	± 20	± 100	ppm
Center wavelength (range)	1260 to 1355		nm
Side Mode Suppression Ratio (min)	30		dB
Average launch power (max)	0.5		dBm
Average launch power[a] (min)	–8.2		dBm
Launch power (min) in OMA minus TDP[b]	–6.2		dBm
Optical Modulation Amplitude[c] (min)	–5.2		dBm
Transmitter and dispersion penalty (max)	3.2		dB
Average launch power of OFF transmitter[d] (max)	–30		dBm
Extinction ratio (min)	3.5		dB
$RIN_{12}OMA$ (max)	–128		dB/Hz
Optical Return Loss Tolerance (max)	12		dB
Transmitter Reflectance[e] (max)	–12		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}		

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]TDP is transmitter and dispersion penalty.
[c]Even if the TDP < 1 dB, the OMA(min) must exceed this value.
[d]Examples of an OFF transmitter are: no power supplied to the PMD, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shut down conditions.
[e]Transmitter reflectance is defined looking into the transmitter.

Table 52-16 for ER of IEEE 802.3ae specifications

Table 52–16—10GBASE-E transmit characteristics

Description	10GBASE-EW	10GBASE-ER	Unit
Signaling speed (nominal)	9.95328	10.3125	GBd
Signaling speed variation from nominal (max)	± 20	± 100	ppm
Center wavelength (range)	1530 to 1565		nm
Side Mode Suppression Ratio (min)	30		dB
Average launch power (max)	4.0		dBm
Average launch power[a] (min)	–4.7		dBm
Launch power (min) in OMA minus TDP[b]	–2.1		dBm
Average launch power of OFF transmitter[c] (max)	–30		dBm
Optical Modulation Amplitude[d] (min)	–1.7		dBm
Transmitter and dispersion penalty (max)	3.0		dB
Extinction ratio (min)	3		dB
$RIN_{21}OMA$[e] (max)	–128		dB/Hz
Optical Return Loss Tolerance (max)	21		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}		

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]TDP is transmitter and dispersion penalty.
[c]Examples of an OFF transmitter are: no power supplied to the PMD, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shut-down conditions.
[d]Even if the TDP < 0.4 dB, the OMA(min) must exceed this value.
[e]RIN measurement is made with a return loss at 21 dB.

Table 86-6 for SR4/SR10 of IEEE 802.3ba specifications

Table 86–6—40GBASE–SR4 or 100GBASE–SR10 optical transmit characteristics

Description	Type	Value	Unit
Center wavelength	Range	840 to 860	nm
RMS spectral width[a]	Max	0.65	nm
Average launch power, each lane	Max	2.4	dBm
Average launch power, each lane	Min	–7.6	dBm
Optical Modulation Amplitude (OMA), each lane	Max	3	dBm
Optical Modulation Amplitude (OMA), each lane	Min	–5.6[b]	dBm
Difference in launch power between any two lanes (OMA)	Max	4	dB
Peak power, each lane	Max	4	dBm
Launch power in OMA minus TDP, each lane	Min	–6.5	dBm
Transmitter and dispersion penalty (TDP), each lane	Max	3.5	dB
Extinction ratio	Min	3	dB
Optical return loss tolerance	Max	12	dB
Encircled flux[c]		≥ 86% at 19 µm, ≤ 30% at 4.5 µm	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5×10^{-5} hits per sample	Spec values	0.23, 0.34, 0.43, 0.27, 0.35, 0.4	
Average launch power of OFF transmitter, each lane	Max	–30	dBm

[a] RMS spectral width is the standard deviation of the spectrum.
[b] Even if the TDP < 0.9 dB, the OMA (min) must exceed this value.
[c] If measured into type A1a.2 50 µm fiber in accordance with IEC 61280-1-4.

Table 87-7 for LR4 of IEEE 802.3ba specifications

Table 87–7—40GBASE-LR4 transmit characteristics

Description	Value	Unit
Signaling rate, each lane (range)	10.3125 ± 100 ppm	GBd
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Total average launch power (max)	8.3	dBm
Average launch power, each lane (max)	2.3	dBm
Average launch power, each lane[a] (min)	–7	dBm
Optical Modulation Amplitude (OMA), each lane (max)	3.5	dBm
Optical Modulation Amplitude (OMA), each lane (min)[b]	–4	dBm
Difference in launch power between any two lanes (OMA) (max)	6.5	dB
Launch power in OMA minus TDP, each lane (min)	–4.8	dBm
Transmitter and dispersion penalty (TDP), each lane (max)	2.6	dB
Average launch power of OFF transmitter, each lane (max)	–30	dBm
Extinction ratio (min)	3.5	dB
$RIN_{20}OMA$ (max)	–128	dB/Hz
Optical return loss tolerance (max)	20	dB
Transmitter reflectance[c] (max)	–12	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	

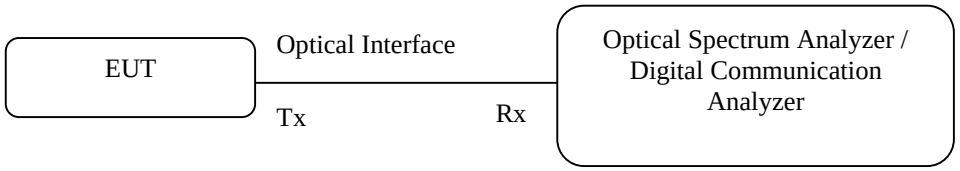
[a]Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Even if the TDP < 0.8dB, the OMA (min) must exceed this value.
[c]Transmitter reflectance is defined looking into the transmitter.

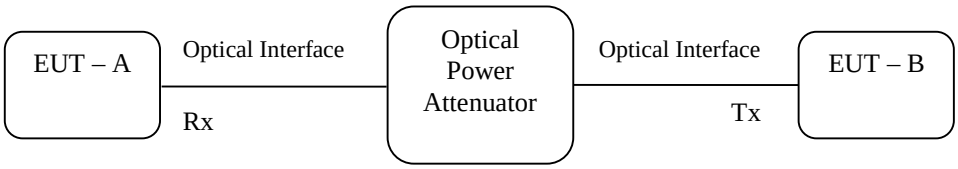
	Table 88-7 for LR4/ER4 of IEEE 802.3ba specifications
	Table 88–7—100GBASE-LR4 and 100GBASE-ER4 transmit characteristics

Description	100GBASE–LR4	100GBASE–ER4	Unit
Signaling rate, each lane (range)	25.78125 ± 100 ppm		GBd
Lane wavelengths (range)	1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19		nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Total average launch power (max)	10.5	8.9	dBm
Average launch power, each lane (max)	4.5	2.9	dBm
Average launch power, each lane[a] (min)	–4.3	–2.9	dBm
Optical Modulation Amplitude (OMA), each lane (max)	4.5		dBm
Optical Modulation Amplitude (OMA), each lane (min)	–1.3[b]	0.1	dBm
Difference in launch power between any two lanes (OMA) (max)	5	—	dB
Difference in launch power between any two lanes (Average and OMA) (max)	—	3.6	
Launch power in OMA minus TDP, each lane (min)	–2.3	—	dBm
Transmitter and dispersion penalty (TDP), each lane (max)	2.2	2.5	dB
Average launch power of OFF transmitter, each lane (max)	–30		dBm
Extinction ratio (min)	4	8	dB
$RIN_{20}OMA$ (max)	–130		dB/Hz
Optical return loss tolerance (max)	20		dB
Transmitter reflectance[c] (max)	–12		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		

[a]Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Even if the TDP < 1 dB, the OMA (min) must exceed this value.
[c]Transmitter reflectance is defined looking into the transmitter.

Test Procedure	1. Connect the Setup as shown in the figure. 2. Enable the output Optical Port 3. Measure the optical output power 4. Check whether the output power is within the specification limits
Expected Results	Enclose the Test Results

<table>
<tr><td>Test No.</td><td>12</td></tr>
<tr><td>Test Details</td><td>Wavelength/Spectrum / Extinction Ratio</td></tr>
<tr><td>Test Instruments Required</td><td>1. Optical Spectrum Analyser or Digital Communication Analyser</td></tr>
<tr><td>Test Setup</td><td> 
</td></tr>
<tr><td>Test Limits</td><td>
<table>
<tr><td>STM-1 Short Haul / Long Haul</td><td>Refer Table-2/G.957</td></tr>
<tr><td>STM-4 Short Haul / Long Haul</td><td>Refer Table-3/G.957</td></tr>
<tr><td>STM-16 Short Haul / Long Haul</td><td>Refer Table-4/G.957</td></tr>
<tr><td>FE Short Haul/Long Haul (100BASE-FX/SX/LX)</td><td>Refer IEEE 802.3u</td></tr>
<tr><td>GE Short Haul (1000BASE-SX)</td><td>Refer clause 38.3.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3</td></tr>
<tr><td>GE Long Haul (1000BASE-LX)</td><td>Refer clause 38.4.1 Transmitter optical specifications of IEEE 802.3 2008 Section-3</td></tr>
<tr><td>10 GE Short Haul/Long Haul (10G-SR/LR/ER)</td><td>Refer table 52-7 for SR, 52-12 for LR and 52-16 for ER of IEEE 802.3ae specifications</td></tr>
<tr><td>40 GE (SR4/LR4)</td><td>Refer Table 86-6 for SR4 and 87-7 for LR of IEEE 802.3ba specifications</td></tr>
<tr><td>100 GE (SR10/LR4/ER4)</td><td>Refer Table 86-6 for SR10, 88-7 for LR4/ER4 of IEEE 802.3ba specifications</td></tr>
</table>
</td></tr>
<tr><td>Standards Reference</td><td>Refer the Standards Reference in Test 11</td></tr>
<tr><td>Test Procedure</td><td>1. Connect the Setup as shown in the figure.
2. Enable the output Optical Port
3. Measure the Wavelength/Spectrum / Extinction Ratio
4. Check whether the Wavelength/Spectrum / Extinction Ratio is within the specification limits</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results</td></tr>
</table>

Test No.	13
Test Details	Test for Receiver Sensitivity
Test Instruments Required	1. Optical Attenuator
Test Setup	

Test Limits

STM-1 Short Haul / Long Haul	Refer Table-2/G.957 (Given under Test-11)
STM-4 Short Haul / Long Haul	Refer Table-3/G.957 (Given under Test-11)
STM-16 Short Haul / Long Haul	Refer Table-4/G.957 (Given under Test-11)
FE Short Haul/Long Haul (100BASE-FX/SX/LX)	Refer IEEE 802.3u
GE Short Haul (1000BASE-SX)	Refer clause 38.3.2 Receiver optical specifications of IEEE 802.3 2008 Section-3
GE Long Haul (1000BASE-LX)	Refer clause 38.4.2 Receiver optical specifications of IEEE 802.3 2008 Section-3
10 GE Short Haul/Long Haul (10G-SR/LR/ER)	Refer table 52-9 for SR, 52-13 for LR and 52-17 for ER of IEEE 802.3ae specifications
40 GE (SR4/LR4)	Refer Table 86-8 for SR4 and 87-8 for LR4 of IEEE 802.3ba specifications
100 GE (SR100/LR4/ER4)	Refer Table 86-8 for SR100, 88-8 for LR4/ER4 of IEEE 802.3ba specifications

Standards Reference

Clause 38.3.2 Receiver optical specifications of IEEE 802.3 2008 Section-3

Table 38–4—1000BASE-SX receive characteristics

Description	62.5 μm MMF	50 μm MMF	Unit
Signaling Speed (range)	1.25 ± 100 ppm		GBd
Wavelength (range)	770 to 860		nm
Average receive power (max)	0		dBm
Receive sensitivity	–17		dBm
Return loss (min)	12		dB
Stressed receive sensitivity[a, b]	–12.5	–13.5	dBm
Vertical eye-closure penalty[c]	2.60	2.20	dB
Receive electrical 3 dB upper cutoff frequency (max)	1500		MHz

[a]Measured with conformance test signal at TP3 (see 38.6.11) for BER = 10^{-12} at the eye center.
[b]Measured with a transmit signal having a 9 dB extinction ratio. If another extinction ratio is used, the stressed receive sensitivity should be corrected for the extinction ratio penalty.
[c]Vertical eye-closure penalty is a test condition for measuring stressed receive sensitivity. It is not a required characteristic of the receiver.

Clause 38.4.2 Receiver optical specifications of IEEE 802.3 2008 Section-3

Table 38–8—1000BASE-LX receive characteristics

Description	Value	Unit
Signaling speed (range)	1.25 ± 100 ppm	GBd
Wavelength (range)	1270 to 1355	nm
Average receive power (max)	–3	dBm
Receive sensitivity	–19	dBm
Return loss (min)	12	dB
Stressed receive sensitivity[a, b]	–14.4	dBm
Vertical eye-closure penalty[c]	2.60	dB
Receive electrical 3 dB upper cutoff frequency (max)	1500	MHz

[a]Measured with conformance test signal at TP3 (see 38.6.11) for BER = 10^{-12} at the eye center.
[b]Measured with a transmit signal having a 9 dB extinction ratio. If another extinction ratio is used, the stressed receive sensitivity should be corrected for the extinction ratio penalty.
[c]Vertical eye-closure penalty is a test condition for measuring stressed receive sensitivity. It is not a required characteristic of the receiver.

Table 52-9 for SR of IEEE 802.3ae specifications

Table 52–9—10GBASE-S receive characteristics

Description	10GBASE-S	Unit
Signaling speed (nominal) 10GBASE-SR 10GBASE-SW	 10.3125 9.95328	GBd
Signaling speed variation from nominal (max)	± 100	ppm
Center wavelength (range)	840 to 860	nm
Average receive power[a] (max)	–1.0	dBm
Average receive power[b] (min)	–9.9	dBm
Receiver sensitivity (max) in OMA[c]	0.077 (–11.1)	mW (dBm)
Receiver Reflectance (max)	–12	dB
Stressed receiver sensitivity in OMA[d] [e](max)	0.18 (–7.5)	mW (dBm)
Vertical eye closure penalty[f] (min)	3.5	dB
Stressed eye jitter[g] (min)	0.3	UI pk-pk
Receive electrical 3 dB upper cutoff frequency (max)	12.3	GHz

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the Average Receive Power (max) plus at least 1 dB.
[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[c]Receiver sensitivity is informative.
[d]Measured with conformance test signal at TP3 (see 52.9.9.2) for BER = 10^{-12}.
[e]The stressed sensitivity values in the table are for system level BER measurements which include the effects of CDR circuits. It is recommended that at least 0.4 dB additional margin be allocated if component level measurements are made without the effect of CDR circuits
[f]Vertical eye closure penalty is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.
[g]Stressed eye jitter is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.

Table 52-13 for LR of IEEE 802.3ae specifications

Table 52–13—10GBASE-L receive characteristics

Description	10GBASE-L	Unit
Signaling speed (nominal) 10GBASE-LR 10GBASE-LW	 10.3125 9.95328	GBd
Signaling speed variation from nominal (max)	± 100	ppm
Center wavelength (range)	1260 to 1355	nm
Average receive power[a] (max)	0.5	dBm
Average receive power[b] (min)	–14.4	dBm
Receiver sensitivity (max) in OMA[c]	0.055 (-12.6)	mW (dBm)
Receiver Reflectance (max)	–12	dB
Stressed receiver sensitivity (max) in OMA[d, e]	0.093 (–10.3)	mW (dBm)
Vertical eye closure penalty[f] (min)	2.2	dB
Stressed eye jitter[g] (min)	0.3	UI pk-pk
Receive electrical 3 dB upper cutoff frequency (max)	12.3	GHz

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the Average Receive Power (max) plus at least 1 dB.
[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[c]Receiver sensitivity is informative.
[d]Measured with conformance test signal at TP3 (see 52.9.9.2) for BER = 10^{-12}.
[e]The stressed sensitivity values in the table are for system level BER measurements which include the effects of CDR circuits. It is recommended that at least 0.4 dB additional margin be allocated if component level measurements are made without the effect of CDR circuits.
[f]Vertical eye closure penalty is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.
[g]Stressed eye jitter is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.

Table 52-17 for ER of IEEE 802.3ae specifications

Table 52–17—10GBASE-E receive characteristics

Description	10GBASE-E	Unit
Signaling speed (nominal) 10GBASE-ER 10GBASE-EW	 10.3125 9.95328	GBd
Signaling speed variation from nominal (max)	± 100	ppm
Center wavelength (range)	1530 to 1565	nm
Average receive power (max)	–1.0	dBm
Average receive power[a] (min)	–15.8	dBm
Maximum receive power (for damage)	4.0	dBm
Receiver sensitivity (max) in OMA[b]	0.039 (–14.1)	mW (dBm)
Receiver Reflectance (max)	–26	dB
Stressed receiver sensitivity (max) in OMA[c,d]	0.074 (-11.3)	mW (dBm)
Vertical eye closure penalty[e] (min)	2.7	dB
Stressed eye jitter (min)[f]	0.3	UI pk-pk
Receive electrical 3 dB upper cutoff frequency (max)	12.3	GHz

[a]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Receiver sensitivity is informative.
[c]Measured with conformance test signal at TP3 (see 52.9.9.2) for BER = 10^{-12}.
[d]The stressed sensitivity values in the table are for system level BER measurements which include the effects of CDR circuits. It is recommended that at least 0.4 dB additional margin be allocated if component level measurements are made without the effects of CDR circuits.
[e]Vertical eye closure penalty is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.
[f]Stressed eye jitter is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.

Table 86-8 for SR4/SR100 of IEEE 802.3ba specifications

Table 86–8—40GBASE–SR4 or 100GBASE–SR10 optical receiver characteristics

Description	Type	Value	Unit
Center wavelength, each lane	Range	840 to 860	nm
Damage threshold[a]	Min	+3.4	dBm
Average power at receiver input, each lane	Max	+2.4	dBm
	Min	–9.5	dBm
Receiver reflectance	Max	–12	dB
Optical Modulation Amplitude (OMA), each lane	Max	3	dBm
Stressed receiver sensitivity in OMA, each lane[b]	Max	–5.4	dBm
Peak power, each lane	Max	4	dBm
Conditions of stressed receiver sensitivity test:			
Vertical eye closure penalty (VECP)[c], each lane	—	1.9	dB
Stressed eye J2 Jitter[c], each lane	—	0.3	UI
Stressed eye J9 Jitter[c], each lane	—	0.47	UI
OMA of each aggressor lane	—	–0.4	dBm
Receiver jitter tolerance in OMA, each lane[d]	Max	–5.4	dBm
Conditions of receiver jitter tolerance test:			
Jitter frequency and peak-to-peak amplitude	—	(75, 5)	(kHz, UI)
Jitter frequency and peak-to-peak amplitude	—	(375, 1)	(kHz, UI)
OMA of each aggressor lane	—	–0.4	dBm

[a] The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
[b] Measured with conformance test signal at TP3 (see 86.8.4.7).
[c] Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver. The apparent discrepancy between VECP and TDP is because VECP is defined at eye center while TDP is defined with ±0.15 UI offsets of the sampling instant.
[d] This is a test of the optical receiver's ability to track low-frequency jitter and is inappropriate for any subsystem that does not include a CRU.

Table 87-8 for LR4 of IEEE 802.3ba specifications

Table 87–8—40GBASE–LR4 receive characteristics

Description	Value	Unit
Signaling rate, each lane (range)	10.3125 ± 100 ppm	GBd
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Damage threshold[a] (min)	3.3	dBm
Average receive power, each lane (max)	2.3	dBm
Average receive power, each lane[b] (min)	–13.7	dBm
Receive power, each lane (OMA) (max)	3.5	dBm
Difference in receive power between any two lanes (OMA) (max)	7.5	dB
Receiver reflectance (max)	–26	dB
Receiver sensitivity (OMA), each lane[c] (max)	–11.5	dBm
Receiver 3 dB electrical upper cutoff frequency, each lane (max)	12.3	GHz
Stressed receiver sensitivity (OMA), each lane[d] (max)	–9.6	dBm
Conditions of stressed receiver sensitivity test:		
Vertical eye closure penalty,[e] each lane	1.9	dB
Stressed eye J2 Jitter,[e] each lane	0.3	UI
Stressed eye J9 Jitter,[e] each lane	0.47	UI

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level

[b]Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

[c]Receiver sensitivity (OMA), each lane (max) is informative.

[d]Measured with conformance test signal at TP3 (see 87.8.11) for BER = 10^{-12}.

[e]Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

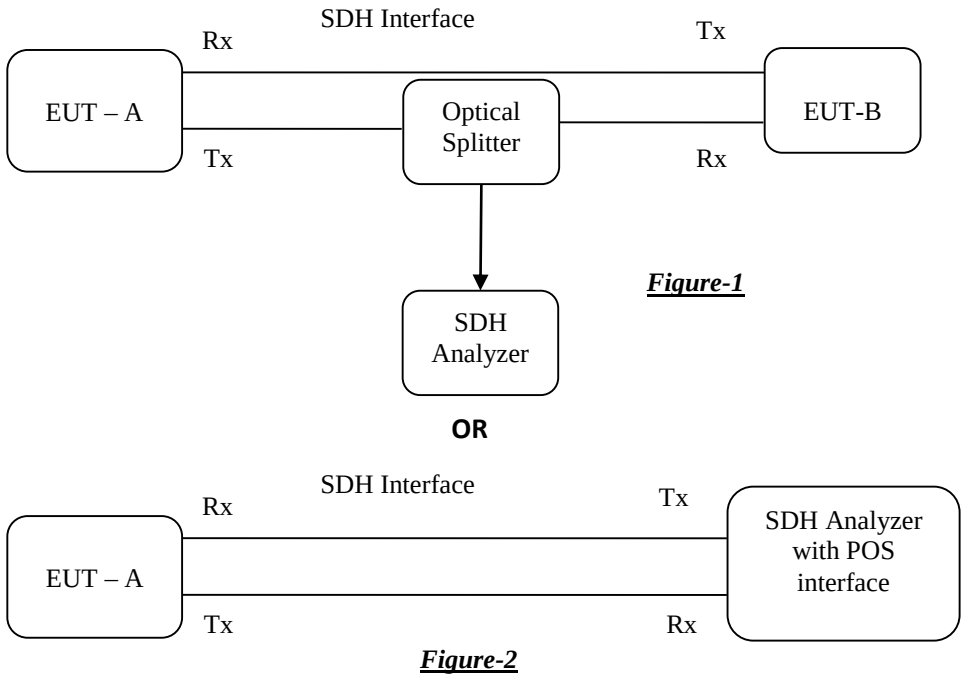
Table 88-8 for LR4/ER4 of IEEE 802.3ba specifications

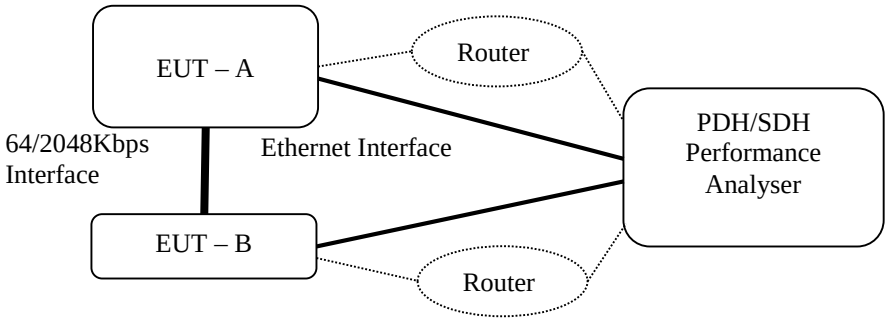
Table 88–8—100GBASE–LR4 and 100GBASE–ER4 receive characteristics

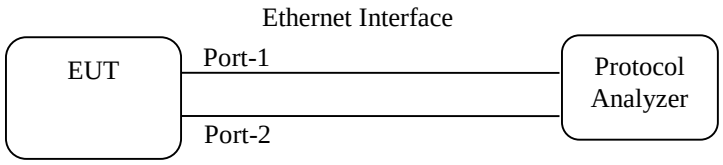
Description	100GBASE–LR4	100GBASE–ER4	Unit
Signaling rate, each lane (range)	25.78125 ± 100 ppm		GBd
Lane wavelengths (range)	1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19		nm
Damage threshold[a]	5.5		dBm
Average receive power, each lane (max)	4.5[b]		dBm
Average receive power, each lane[c] (min)	–10.6	–20.9	dBm
Receive power, each lane (OMA) (max)	4.5		dBm
Difference in receive power between any two lanes (OMA) (max)	5.5	—	dB
Difference in receive power between any two lanes (Average and OMA) (max)	—	4.5	
Receiver reflectance (max)	–26		dB
Receiver sensitivity (OMA), each lane[d] (max)	–8.6	–21.4	dBm
Receiver 3 dB electrical upper cutoff frequency, each lane (max)	31		GHz
Stressed receiver sensitivity (OMA), each lane[e] (max)	–6.8	–17.9	dBm
Conditions of stressed receiver sensitivity test			
Vertical eye closure penalty,[f] each lane	1.8	3.5	dB
Stressed eye J2 Jitter,[f] each lane	0.3		UI
Stressed eye J9 Jitter,[f] each lane	0.47		UI

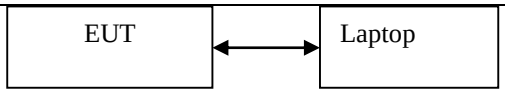
[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
[b]The average receive power, each lane (max) for 100GBASE-ER4 is larger than the 100GBASE-ER4 transmitter value to allow compatibility with 100GBASE-LR4 units at short distances.
[c]Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[d]Receiver sensitivity (OMA), each lane (max) is informative.
[e]Measured with conformance test signal at TP3 (see 88.8.10) for BER = 10^{-12}.
[f]Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

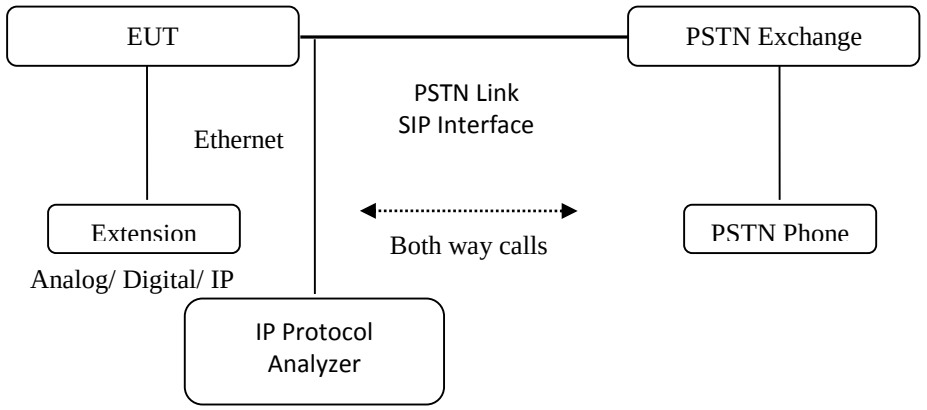
Test Procedure	1. Connect the setup as shown in the figure above. 2. Configure EUT B for sending packets to EUT A 3. Enable the output Optical Port of EUT B 4. Adjust the Optical Power Attenuator 5. Measure the Receiver Sensitivity 6. Verify whether the Receiver Sensitivity is within limits. 7. In case of Ethernet Optical Ports verify whether the Output Power / Receiver Sensitivity combination is able to meet the distance criteria requirements
Expected Results	Enclose the Test Results

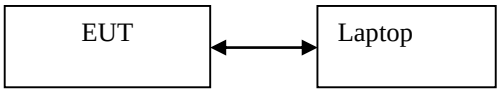
Test No.	14
Test Details	Test for SDH Payload Measurements
Test Instruments Required	1. SDH Network Analyser, Optical Splitter OR 2. SDH Analyser with POS capability
Test Setup	 ***Figure-1*** **OR** ***Figure-2***
Test Procedure	1. Connect the test setup as shown in figure. 2. The test setup in Figure-2 shall be used in case the SDH analyser has the POS interface. [Packet Over SDH] 3. The EUT-A shall be configured in the loopback mode such that the Packets sent from EUT-B / SDH Analyser is sent back. 4. Verify whether the SDH frame structure sent by the EUT is as per G.707 standards.
Expected Results	Enclose the Test Results

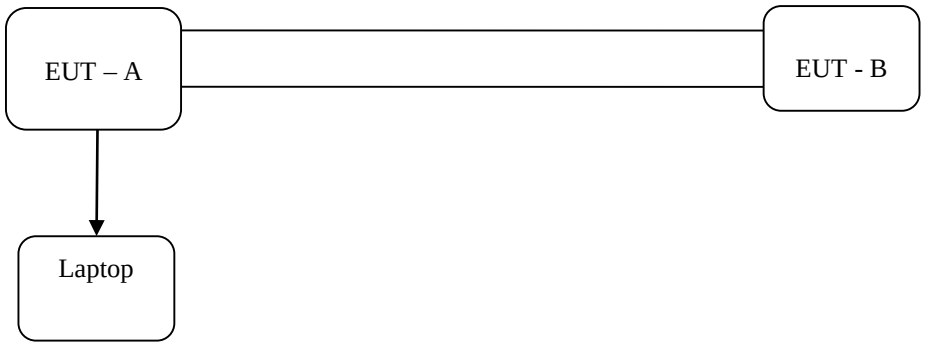
Test No.	15
Test Details	Test for Bit Error Rate [BER]
Test Instruments Required	1. PDH/SDH Performance Analyser
Test Setup	
Test Limits	The EUT shall be able to work with a BER better than $1x10^{-10}$ measured in any 15 minutes interval for all the speed/s of digital interface.
Test Procedure	1. Connect the test setup as shown in figure using a suitable cable wired to the Ethernet interface 2. A Router may be used for interface conversion in case the PDH/SDH Analyser does not have the compatible interface. 3. Perform the BER performance for 15 minutes interval
Expected Results	Enclose the Test Results

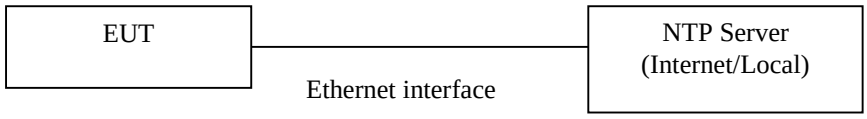
Test No.	16
Test Details	Test for Various Protocols
Test Instruments Required	1. IP Protocol Analyser
Test Parameters	As per various protocols being referred in the respective clause of the Test Schedule (TSTP)
Test Setup	
Test Procedure	1. Connect the test setup as shown in figure 2. The EUT shall be configured through the CLI [Command Line Interface] or SNMP interface for the various tests like IPv4, IPv6, TCP, Static Routing, Dynamic Routing, BGP, PPP etc 3. Various test parameters shall be measured using this setup 4. The test results may be recorded.
Expected Results	Enclose the Test Results
	Note: 1. The test procedure for those RFC's which are forming part of the "compendium of test setup and test procedures for testing of RFC's of IETF" shall be performed as per the same. This test setup (at test no 16) is generic in nature and shall apply in case of RFC's which are not covered in the above referred compendium. 2. TEC New Delhi NGN Lab has this test facility 3. Where ever conformance tests are not available, functional tests shall be carried out. Moreover, wherever the specification requirement is to meet a specific functionality of the RFC, the clause of the RFC refereeing to the function shall be tested as per the functional test procedure. The functional test model available in the "compendium of test setup and test procedures for testing of RFC's of IETF" can be followed for those RFC's which are not covered in the compendium and where functional tests are carried out. 4. The protocol analyser shall be able to send various test packets to the EUT, check the response packet and check the conformance/functionality. Software tools like wireshark has got only the capability to analyse the received packets and do not have the capability to send test packets and measure the response. Hence the tools like wireshark cannot be used for this test. 5. In case the product is offered (with the same product version) is 'IPv6 Readylogo Certified', then the tests against RFC 4862, RFC 4443, RFC 4291, RFC 2460, RFC 4861, RFC 1981 and RFC 5095 (where ever referred in the Test Schedule) which are covered as part of the 'IPv6 Readylogo certification' shall not be carried out. I.e. in this case, the product version of the 'IPv6 Readylogo certificate' and the offered product shall be the same. Later versions than the certified versions will not come under the purview of this condition.

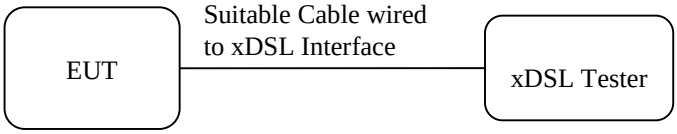
Test No.	17
Test Details	Test for Various Protocols using Wireshark
Test Instruments Required	1. Laptop/PC
Test Parameters	1. TCP as per RFC 793 2. UDP as per RFC 768
Test Setup	
Test Procedure	1. Connect the test setup as shown in figure 2. Load a suitable protocol analysis software such as Wireshark in the Laptop 3. The EUT shall be configured through the CLI [Command Line Interface] or SNMP interface for the TCP & UDP test. 4. The IP Packets may be observed in the Wireshark for TCP/UDP Compliance 5. The test results may be recorded.
Expected Results	Enclose the Test Results

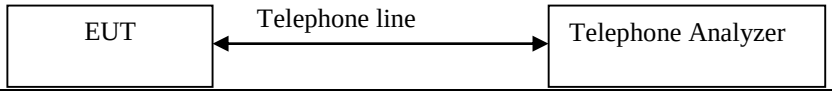
Test No.	18
Test Details	Test for the IP Protocol support for PSTN interface over IP- 1. SIP Protocol 2. IP version 4 3. Audio codecs 4. TCP protocol 5. RTP protocol 6. RTCP protocol
Test Instruments Required	1. IP Protocol Analyzer
Test Setup	
Test Procedure	1. Connect the system, as shown in the above setup and configure the EUT to enable it to send and receive calls to/from PSTN using SIP interface with different audio codecs. 2. Make outgoing and incoming calls from SIP extension to PSTN phone and vice versa. 3. Take message traces from IP Protocol Analyzer for verifying support for a. SIP Protocol b. IP version 4 c. All the Audio codecs (G.711, G.723, G.726, G.729, G.729A, G.729B, G.728AB, G.725A, AMR and T.38) d. TCP protocol e. RTP protocol f. RTCP protocol
Expected Results	Enclose the message traces from IP Protocol Analyzer

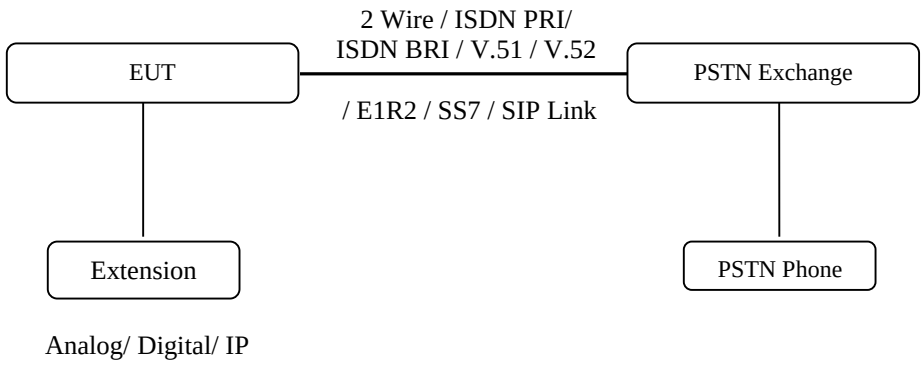
Test No.	19
Test Details	Test for Management Interface
Test Instruments Required	1. Laptop
Test Setup	
Test Procedure	1. Connect the EUT to the Laptop over Ethernet Interface as shown in the setup. 2. Load SNMP management software supplied by the Equipment Manufacturer or any other software [Freely downloadable from the Internet] 3. Configure EUT from the Laptop to act as the SNMP master. 4. Configure the SNMP software for SNMPv2 5. Check for the alarms [Traps] coming from the EUT to the Laptop. 6. Configure some parameters of the EUT from the Laptop through get and set commands.
Expected Results	Enclose the Test Results / Screen Shots

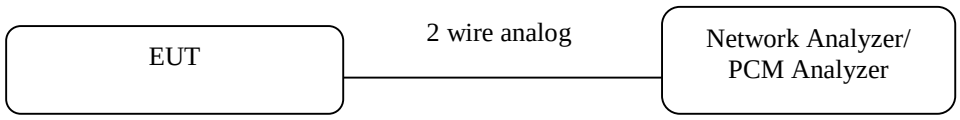
Test No.	20
Test Details	Test for Clock Extraction
Test Instruments Required	1. Laptop
Test Setup	
Test Procedure	1. Connect the test setup as shown in figure 2. Configure EUT-A for using the clock extracted from the interface connected to EUT-B [Slave Mode] 3. Verify the configuration about the usage of the clock 4. Verify whether the EUT-A is able to configure in Master Mode
Expected Results	Enclose the Command Line Interface [CLI] Results / Screenshots

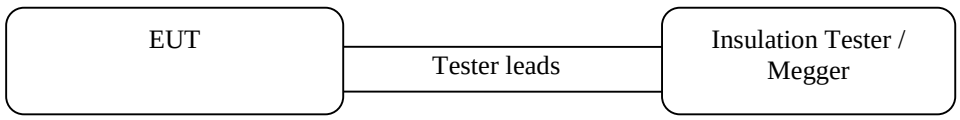
Test No.	21
Test Details	Test for NTP Server Synchronization support
Test Instruments Required	Nil
Test Setup	
Test Procedure	1. Setup the system as shown in the diagram above. 2. Configure the system to synchronize with NTP server, either located locally or on the internet. 3. The system should be able to synchronize with NTP server.
Expected Results	Enclose the Screen Capture Results

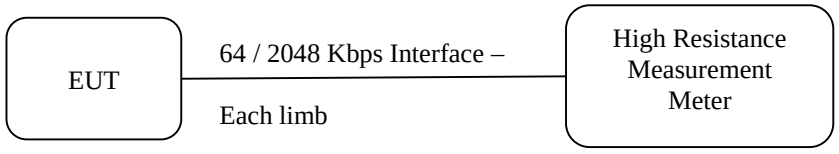
<table>
<tr><td>Test No.</td><td>22</td></tr>
<tr><td>Test Details</td><td>xDSL Line Tests
[The tests shall be limited to the tests specified under the Test Limits below]<table><tr><td>ADSL Tests</td><td>Conformity Tests as per G.992.1, G.992.3, G.992.5</td></tr><tr><td>VDSL Tests</td><td>Conformity Tests as per G.993.1, G.993.2</td></tr><tr><td>SHDSL Tests</td><td>Conformity Tests as per G.991.2 Annex G</td></tr><tr><td>Other Tests for all xDSL interfaces</td><td>Support of Protocols - PPPoE as per RFC2516, PVC, VPI/VCI support
FTP Speed Test
Metallic Loop Tests (Loop Resistance, Insulation Resistance, Capacitance)
Impulse Noise Protection</td></tr></table></td></tr>
<tr><td>Test Instruments Required</td><td>1. xDSL Tester [Capable of testing xDSL CPE’s].
2. In case the tester do not have the capability to measure some of the above tests, separate tester can be used
3. For Impulse Noise Tests test results from the OEM can be obtained.</td></tr>
<tr><td>Test Setup</td><td> 
</td></tr>
<tr><td>Test Limits</td><td><table><tr><td>G.992.1</td><td>PSD [Power Spectral Density] as per Annexure-A</td></tr><tr><td>G.992.3</td><td>PSD</td></tr><tr><td>G.992.5</td><td>PSD</td></tr><tr><td>G.993.1</td><td>PSD and Return Loss as per clause 6.2 and 6.5</td></tr><tr><td>G.993.2</td><td>Profiles as per Clause 6.3, PSD as per clause 7.2</td></tr><tr><td>G.991.2</td><td>Return Loss as per Clause 11.3 and PSD as per Clause 11.5</td></tr><tr><td>PPPoE</td><td>Shall support PPPoE configuration as per RFC2516</td></tr><tr><td>PVC</td><td>Shall support PVC configuration</td></tr><tr><td>VPI/VCI</td><td>Shall support VPI/VCI configuration</td></tr><tr><td>FTP Speed Tests</td><td>1. ADSL2+ interface supporting 16Mbps speeds using 0.5mm copper loop distance of 2Km
2. VDSL2 interface supporting 30Mbps speeds using 0.5mm copper loop distance of 500m
3. SHDSL interface supporting 1.5Mbps speeds using 0.5mm copper loop distance of 2Km</td></tr><tr><td>Loop Resistance</td><td>As per Telephone line requirements</td></tr><tr><td>Insulation Resistance</td><td>As per Telephone line requirements</td></tr><tr><td>Capacitance</td><td>As per Telephone line requirements</td></tr><tr><td>Impulse Noise Protection[INP]</td><td>INP shall be better than 2</td></tr></table></td></tr>
<tr><td>Test Procedure</td><td>1. Connect the test setup as shown in figure
2. Measure the various parameters as per the test details and verify whether they are within the Test Limits.</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results / Screen Shots</td></tr>
</table>

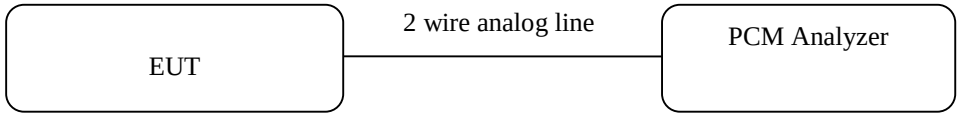
Test No.	23
Test Details	Test for Loop Current (for 2 wire analog interface only)
Test Instruments Required	1. Telephone Analyzer
Test Setup	
Test Procedure	1. Setup the CTI equipment and Telephone analyser as shown in the test setup above, while enabling the 2 wire analog interface on the EUT. 2. Measure the loop current on the telephone analyser
Expected Results	1. The loop current in idle condition (on-hook) should not be more than 0.5 mA. 2. The loop current in the off-hook condition should not be more than 60 mA. 3. When CTI is connected to PSTN line (i.e. when customer calls IVRS facility) the current drawn from the line shall be less than 40 micro Amps. Enclose the test results

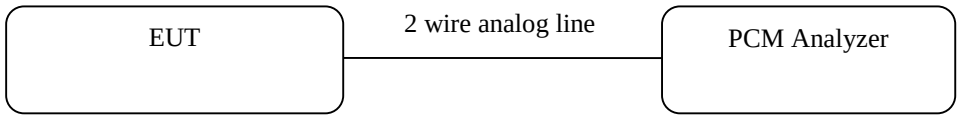
Test No.	24
Test Details	Test for the DTMF support
Test Instruments Required	Nil
Test Setup	
Test Procedure	1. Setup the system as per above diagram and configure the EUT to enable it to send and receive calls to/from PSTN 2. Make an incoming call from PSTN phone to EUT and the Interactive Voice Response System should get activated and should prompt the user to dial a digit soon. 3. Program the IVRS to detect all DTMF tones and respond accordingly. 4. Check that the IVRS system responds properly to all dialled digits. 5. Make an outgoing call from EUT system to PSTN phone and activate the IVRS facility. Prompt the user to dial different digits. The EUTshall respond according to the dialled digits. 6. Make an incoming call from a mobile phone to EUT and check that the call matures.
Expected Results	Enclose the logs from EUT.

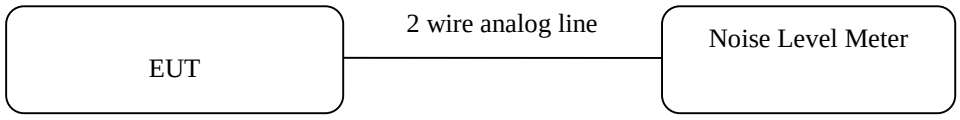
Test No.	25
Test Details	Test for Return Loss (2 wire interface only)
Test Instruments Required	1. Network Analyser or PCM Analyzer
Test Setup	
Test Limits	1. Balance Return Loss > 12 dB in the range 300Hz to 3400Hz 2. Echo Return Loss > 16 dB
Test Procedure	1. Connect the Setup as shown in the figure. 2. Measure the Balance and Echo Return loss using the Test instrument. 3. Check whether the Return Loss is within the specified limits.
Expected Results	Enclose the Test Results

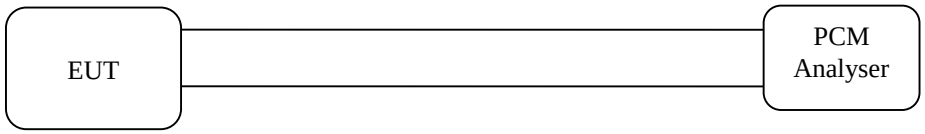
Test No.	26
Test Details	Test for Insulation Resistance (2 wire interface only)
Test Instruments Required	1. Insulation Tester / Megger
Test Setup	
Test Limits	1. Insulation resistance >= 5 Mega ohms
Test Procedure	2. Connect the Setup as shown in the figure. 3. Measure the Insulation resistance (between any two points not electrically connected) using the Test instrument leads. 4. Check whether the Insulation resistance is within the specified limits.
Expected Results	Enclose the Test Results

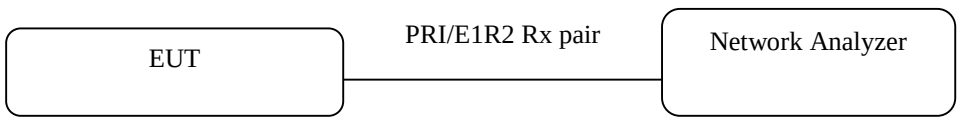
Test No.	27
Test Details	Test for Input Resistance
Test Instruments Required	1. High Resistance measurement Meter
Test Setup	
Test Limits	> 5 Mohm
Test Procedure	1. Connect the test setup as shown in figure for Limb-A 2. Measure the Input resistance 3. Repeat the test for Limb-B
Expected Results	Enclose the Test Results

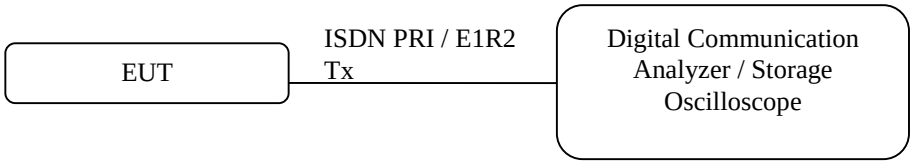
Test No.	28
Test Details	Test for Loudness Rating (SLR and RLR) (2 wire interface only)
Test Instruments Required	1. PCM Analyzer
Test Setup	
Test Limits	1. SLR at zero line +7dB 2. SLR at limiting line +12dB 3. RLR not louder than -6dB 4. RLR not quieter than -1dB
Test Procedure	1. Connect the Setup as shown in the figure. 2. Measure the SLR and RLR values using test equipment. 3. Check whether the values are within the specified limits.
Expected Results	Enclose the Test Results

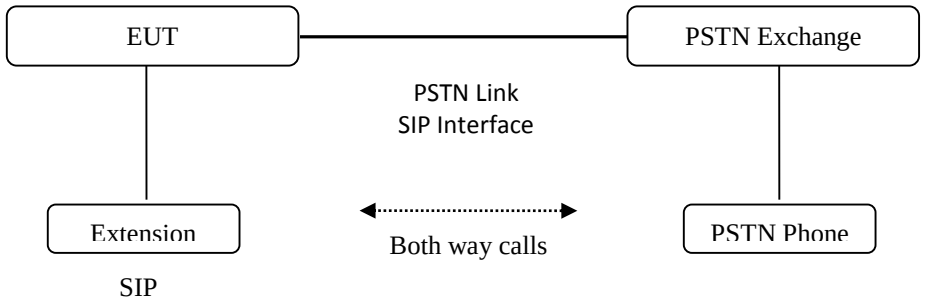
Test No.	29
Test Details	Test for Side Tone Masking Rate (STMR) (2 wire interface only)
Test Instruments Required	1. PCM Analyzer
Test Setup	
Test Limits	1. STMR > +8 dB
Test Procedure	1. Connect the Setup as shown in the figure. 2. Measure the STMR value using test equipment for different line lengths. 3. Check whether the values are within the specified limits.
Expected Results	Enclose the Test Results

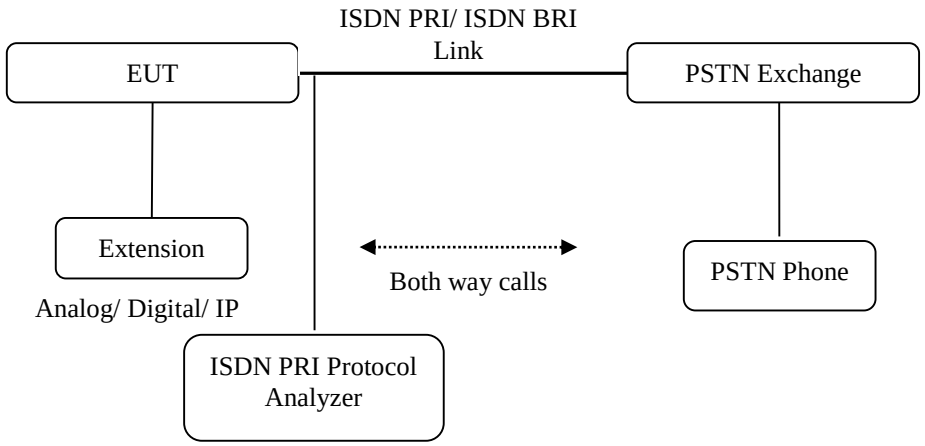
Test No.	30
Test Details	Test for Noise level (2 wire interface only)
Test Instruments Required	1. Noise Level Meter
Test Setup	
Test Limits	1. Noise level less than -65dBm
Test Procedure	1. Connect the Setup as shown in the figure. 2. Measure the Noise level value across 600 ohms termination of EUT using test equipment. 3. Check whether the values are within the specified limits.
Expected Results	Enclose the Test Results

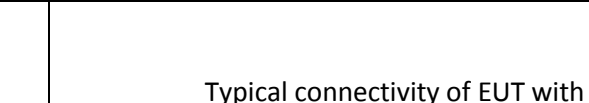
Test No.	31
Test Details	Test for Minimum Longitudinal Loss
Test Instruments Required	1. PCM Analyser
Test Setup	
Test Procedure	1. Connect the test setup as shown in figure 2. Measure the Minimum Longitudinal Loss using the PCM Analyser
Expected Results	Enclose the Results / Screenshots

Test No.	32
Test Details	Test for Return Loss (ISDN PRI/E1R2 interface)
Test Instruments Required	1. Network Analyser
Test Setup	
Test Limits	1. Refer clause 9.3 of ITU-T G.703 [Refer Test-8 for details]
Test Procedure	1. Connect the Setup as shown in the figure. 2. Measure the input port return loss using the Network Analyser 3. Check whether the Return Loss is within the specified limits
Expected Results	Enclose the Test Results

Test No.	33
Test Details	Test for Output Pulse Mask (ISDN PRI/E1R2 interface)
Test Instruments Required	1. Digital Communication Analyser / Storage Oscilloscope
Test Setup	
Test Limits	Refer Figure-15 G.703 [Refer Test-7 for details]
Test Procedure	1. Connect the EUT as shown in the figure. 2. Enable the Port if required. 3. See whether the output pulse is within the mask/limits as indicated above.
Expected Results	Enclose the Test Results with the Pulse shape & the Pulse Mask

Test No.	34
Test Details	Test for support of Traffic report generation
Test Instruments Required	Nil
Test Setup	
Test Procedure	1. Connect the system, as shown in the above setup and configure the EUT to enable it to send and receive calls to/from PSTN using SIP interface. 2. Configure the system to generate traffic reports for IC and OG calls. 3. Make outgoing and incoming calls from SIP extension to PSTN phone and vice versa. 4. Check if the system is able to generate traffic report.
Expected Results	Enclose the traffic report.

Test No.	35
Test Details	Test for the ISDN PRI/BRI Protocols
Test Instruments Required	ISDN Protocol Analyzer
Test Setup	
Test Procedure	1. Connect the system, as shown in the above setup and configure the EUT to enable it to send and receive calls to/from PSTN 2. Make outgoing and incoming calls from EUT extension to PSTN phone and vice versa. 3. Use ISDN PRI protocol Analyzer for verifying support of the following parameters in ISDN PRI / BRI messages - a. Call reference b. Bearer capability c. Called party number d. Calling party number e. Channel identification f. Numbering plan identification
Expected Results	Enclose the results from ISDN PRI / BRI Protocol Analyzer

Test No.	36
Test	Tests with connectivity over E1R2 Signaling
Tests involved	1. Line Signaling 2. Register Signaling 3. Fax Transmission
Test Setup	 Typical connectivity of EUT with E1R2 Signaling Interface
	Note: E1R2 signaling to be tested between EUT and two Switches of different switching technologies.

Line Signaling and Register Signaling as per Chapter 2, Section B of GR G/LLT-01/04.DEC98
(Relevant clauses are given.)

2.5.2.1.1 Line signalling - Digital Type 1

Operating condition	Signaling				
	Forward			Backward	
	af	bf	cf	ab	bb
Idle	1	0	0	1	0
Seizure	0	0	0	1	0
Acknowledgement	0	0	0	1	1
Answer	0	0	0	0	1
Metering Pulse (180 - 270 ms)	0	0	0	1	1
Clear back	0	0	0	1	1
Clear forward	1	0	0	0 or 1	1
Release guard	1	0	0	1	0
Trunk Offering and Re-ringing					
a) TKO press key	0	0	1	1	1
b) False answer	0	0	1	0	1
c) Release key	0	0	0	0	1
d) "B" party on hook	0	0	0	1	1
e) Re-verify	0	0	1	1	1
Blocking	1	0	0	1	1

Notes:

1. For all supervisory signals bf = 0; a change to bf = 1 indicates a fault.
2. The trunk offering signal can be used as a control signal for echo suppresser in case of satellite application.
3 df, cb, db are spare bits, df =db = 1, and cb = 0, are assigned according to ITU-T Recommendation G732.

2.5.2.2.1 Line signalling - Digital Type 2

Operating condition	Signaling			
	Forward		Backward	
	af	bf	ab	bb
Idle	1	1	1	0
Seizure	0	1	1	0
Acknowledgement	0	1	1	1
Answer	0	1	0	1
Metering Pulse	0	1	1	1
Clear back	0	1	1	1
Clear forward	1	1	0 or 1	1
Release guard	1	1	1	0
Trunk Offering and Re-ringing				
a) TKO press key	0	0	1	1
b) False answer	0	0	0	1
c) Release key	0	1	0	1
d) "B" party on hook	0	1	1	1
e) Re-verify	0	0	1	1
Blocking	1	1	1	1

Forward	cf = 0
	df = 1
Backward	cb = 0
	db = 1

2.5.2.3.1 Line signalling - Digital Type 3

Operating condition	Signaling			
	Forward		Backward	
	af	bf	ab	bb
Idle	1	1	1	1
Seizure	0	1	1	1
Answer	0	1	0	1
Metering Pulse	0	1	1	1
Clear back	0	1	1	1
Clear forward	1	1	0 or 1	1
Release guard	1	1	1	0
Trunk Offering and Re-ringing				
a) TKO press key	0	0	1	1
b) False answer	0	0	0	1
c) Release key	0	1	0	1
d) "B" party on hook	0	1	1	1
e) Re-verify	0	0	1	1
Blocking	1	1	0	1

2.5.2.4.1 Line Signalling - Digital Type 4 (E&M signalling)

This signalling scheme is used over carrier circuits and is basically the same as that specified for ITU-T signalling system R2, analogue version as per recommendations Q.411, Q.412, Q.414, Q.415 and Q.416. It is of the out of band and low level continuous type (3825 Hz + 4 Hz) with tone-OFF in the answered condition (tone-ON-idle signalling). The system provides for link-by-link transmission of the line signals. The tone OFF condition in the forward (backward), direction is signalled by connecting earth to the send (receive) leg of the signalling channel. The signalling scheme available on the analogue media and corresponding sequence on TS16 of the 2048 kbit/s PCM stream is outlined in the table below :

Signal	Forward	Backward	af	bf	ab	bb
Idle	Tone ON	Tone ON	0	0	0	0
Seizure	Tone OFF	Tone ON	1	0	0	0
Answer	Tone OFF	Tone OFF	1	0	1	0
Metering Over channel	Tone OFF	Tone ON during the meter pulse followed by Tone OFF	1	0	1/0/1	0
Clear forward	Tone ON	Tone ON or OFF	0	0	0 or 1	0
Clear back	Tone OFF	Tone ON	1	0	0	0
Release guard	Tone ON	On recognition of clear forward Tone OFF followed by Tone ON	0	0	1/0	0
Blocking	Tone ON	Tone OFF	0	0	1	0
Echo canceller control						
(On O/G side)	Tone OFF	Tone ON	1	1	0	0

(On I/C side)	Tone OFF	Tone ON	1	0	0	1

Notes:

1. The period of backward tone off for release guard is 450 $\pm$ 90 ms, as per ITU-T R2 Recommendation Q.412. However, in existing electromechanical exchanges in the Indian network this may be of the order of 70-100 ms only. E-10B TAXs may provide the timing as per ITU-T R2 Recommendation Q.412.
2. The recognition time for a changed condition is 20 ms.
3. In transit exchanges, the answer signal is immediately repeated to the preceding exchange.
4. The metering signal has a duration of 180 to 270 ms.
5. A signal to switch "in" or "out" echo-suppresser is to be sent, while working over satellite circuits. The echo-suppresser is assumed to be provided along with the transmission equipment outside the exchange. The signal to switch echo-suppresser is carried out on M 2 wire.

2.0 : Register Signalling - Indian R2 Modified MFC Signalling

2.5.1.2.2.1 Indian R2 Modified MFC Signalling

2.5.1.2.2.1(a) The register signalling uses multi-frequency compelled sequence self-checking code. Generally end to end signalling is used except on national and international calls established through a TAX, in which case, the signalling is end-to-end between the originating exchange and the originating TAX and between originating TAX and the last exchange (TAX or local) using MFC.

2.5.1.2.2.1(b) In the existing TAXs, only 5 forward and 5 backward frequencies have been equipped (allowing 10 MF signals in each direction in 2/5 code), though provision exists for introduction of sixth frequency as per R2 scheme. In local MFC type exchanges, only 5 forward and 4 backward frequencies have been equipped.

2.5.1.2.2.1(c) The frequencies used in the backward direction are 660, 780, 900, 1020 and 1140 Hz. Those used in forward direction are 1380, 1500, 1620, 1740, and 1860 Hz. (Provision exists for addition of 1980 Hz in forward and 540 Hz in backward direction).

2.5.1.2.2.1(d) Forward signals

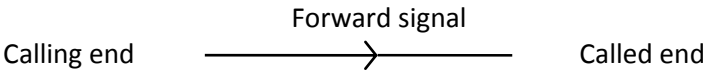
The forward frequencies can be used to send digits (when used as Group-I forward signals) or to send the category of calling subscriber (when used as group-II forward signals).

2.5.1.2.2.1(e) Backward signals

The backward frequencies can be used to make further demands (when used as Group-A backward signals), or to report back the called line condition to the calling side (when used as Group-B backward signals). In electronic exchanges all 5 backward frequencies shall be equipped.

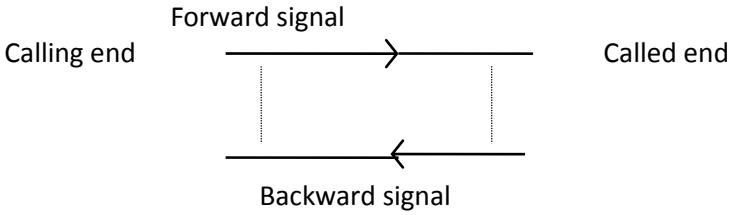
2.5.1.2.2.1(f) Signalling sequence

i)



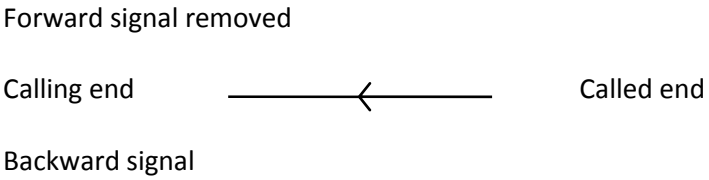
Calling end applies the forward signal as per the demand previously made by the called end (or the first digit start with). At the called end, this signal is examined for relevance and 2/5 validity.

ii)



Called end applies backward signal as per next requirement. The application of backward signal is recognised at calling end as the acknowledgement for reception of forward signal. The 2/5 validity is checked and the demand is decoded.

iii)



Forward signal is removed as an acknowledgement to the receipt of a backward signal.

iv) When the removal of a forward signal is recognised, the backward signal is also removed and this removal is recognised by the calling end, to end the sequence.

2.5.1.2.2.1(g) Significance of the Multi-frequency signals:

The significance of the forward signals and backward signals, as interpreted in the Indian network, are given in tables below :

Group I - Forward Signals

Signals	Indian National MFC scheme
I.1	Digit 1
I.2	Digit 2
I.3	Digit 3
I.4	Digit 4
I.5	Digit 5
I.6	Digit 6
I.7	Digit 7
I.8	Digit 8
I.9	Digit 9
I.10	Digit 0

Group II - Forward Signals

Signals	Indian National MFC scheme
II.1	Ordinary Subscriber
II.2	Priority Subscriber
II.3	Spare at present (proposed for use in future for 'maintenance equipment call')
II.4	Spare at present
II.5	Operator
II.6	STD coin box.
II.7	Spare
II.8	Spare
II.9	Spare
II.10	Spare

Group A - Backward Signals

Signals	Indian National MFC scheme
A.1	Send next digit (n+1)
A.2	Restart
A.3	Change over to reception of B-signals
A.4	Calling line identification-see note
A.5	Send category of the calling subscriber
A.6	Switch-through the speech path
A.7	Send last but two digit (n-2) } Not
A.8	Send last but three digit (n-3) } available in
A.9	Send last but one digit (n-1) } local exchange
A.10	Spare at present (may be used for } at present trunk congestion if network permits) }

Group B - Backward Signals

Signals	Indian National MFC scheme
B.1	Spare
B.2	Changed number
B.3	Called line busy
B.4	Congestion
B.5	Unallotted number
B.6	Normal subscriber, free, with metering
B.7	Spare
B.8	Spare; not available in local exchange
B.9	Spare; not available in local exchange
B.10	Spare; not available in local exchange

Test No.	37
	SIGNALLING TEST FOR CONNECTIVITY BY CCS7
Test Setup	
Tests	1. Protocol Data Check 2. MTP Level 2 Tests 3. MTP Level 3 Tests 4. ISUP Tests 5. Interface Tests
Test arrangement:	At least 2 signaling link sets should be available to check various capabilities of CCS7 signaling. A suitable CCS7 protocol Simulator and Analyser is required to be connected to IP based Integrated Media Gateway for simulating and monitoring the messages. The testing shall be carried out as per the test description given in each Test sheet of the ITU-T document given in the following Test Schedule.

1. Protocol Data check: Check the document or obtain certificate from the vendor in support of the following sub paras:

1.1. Signalling network Management messages:

Check messages implemented in the system with Table 1 of ITU-T recommendation Q.704 (1988). Following signalling network management messages are optional for interface approval.

CNP, CNS, CSS, DLC, RSR, TFR and UPU.

1.2 ISUP messages: Check Heading Code implemented in the system with Table 3 of ITU-T recommendation Q.763 (1988). Following ISUP messages are optional for interface approval:

CMC, CMRJ, CMR, CQM, CQR, COT, DRS, FAA, FAR, FRJ, FOT, LPA, OLM, PAM, USR and UCIC.

1.3 Timer values: Check the values of Level 2 Timers, Level 3 Timers and Application call processing timers implemented in the system with the following documents:

Timer	**Document Reference**
Level 2 Timers	Page 3 MTP para 12.3 of National CCS7 specification for Local/Tandem exchanges No. G/CCS-01/01.JUN93.
Level 3 Timers	Para 16.8 of ITU-T recommendation Q.704 (1988). Timers T11, T15, T16 are not applicable. Timers T7, T18, T19, T20, T21 & T24 are optional.

Application call Annex A to ITU-T recommendation Q.764 of call 1988. Timers T3 and T4 timers processing are not used. Timers T28, T31 and T32 are optional.

2. MTP Level 2 tests: The compatibility tests given in ITU-T Q.781 (1988) will be done on the CCS7 links of Integrated Media Gateway with a suitable CCS 7 protocol Simulator and Analyser. The protocol shall conform to the ITU-T test sheets mentioned below.

Tests for MTP2

Clause No.	**Description**		**Test results**
2.3 Clause from S/CCS-02/03	The functions and procedures relating to transfer of signaling messages over a data link shall be as per ITU-T Rec. Q.703 (1993). This provides the layer 2 functions for the CCS7 protocol Stack.		ITU-T Rec. Q.781 validates the protocol specification in ITU-T Rec Q.703
	ITU-T Rec Q781 Test Cases		
Sl No	Test case Description	Limits	Compliance Test Results
MTP2-1	Timer T2 - Q781:1.2	5-150sec	
MTP2-2	Timer T3- Q781:1.3	1-2sec	
MTP2-3	Timer T1 and T4 (Normal) – Q781:1.4	7.5-9.5sec	
MTP2-4	Normal Alignment - correct procedure (FISU) - Q781:1.5		
MTP2-5	Emergeny Alignment – Timer T4 - Q781:1.19	400-600msec	
MTP2-6	AERM: Error rate above normal threshold - Q781:7.3		
MTP2-7	Negative Acknowledgement - Q781:8.2		
MTP2-8	Retransmission Buffer Full - Q781:8.3		
MTP2-9	Excessive delay of acknowledgement - Q781:8.12		
MTP2-10	Restart of Timer T7 - DelayQ781:10.2		
MTP2-11	Timer T6 -Congestion Control Timer Q781:10.3	3-6sec	

3. MTP Level 3 tests: The compatibility tests given in ITU-T Q.782 (1988) will be done on the CCS7 links of Integrated Media Gateway with Suitable CCS7 Simulator and Analyser. The protocol shall conform to the ITU-T test sheets mentioned below.

Tests for MTP3

Clause No.	Description	Test Results
2.4 Clause from S/CCS-02/03	The functions and procedures relating to transfer of signaling messages between the signaling points shall be as per ITU-T Rec. Q.704 (1993). This provides the layer 3 functions for the CCS7 protocol stack	ITU-T Rec. Q.782 validates the protocol specification in ITU-T Rec Q.704
	ITU-T Rec Q782 Test Cases	
Sl.No	**Test Cases Description**	
MTP3-1	Signalling linkset deactivation - Q782:1.2	
MTP3-2	Signalling linkset activation- Q782:1.3	
MTP3-3	Message with invalid DPC - Q782.2.2 – use a SLTM message.	

MTP3-4	Message with errorneous SI-Q782.2.3	
MTP3-5	Reception of an additional Changeover Order – Q782.3.6	
MTP3-6	Changeover to several links within a linkset - Q782:3.15	
MTP3-7	Additional CBD – Q782.4.3	
MTP3-8	No Acknowledgement to first CBD – Q782.4.4	
MTP3-9	Inhibition of an available link - Q782:7.1.1	
MTP3-10	Inhibition of an unavailable link – Q782:7.1.2	
MTP3-11	Local reject on available link – Q782:7.2.1	
MTP3-12	Forced unhibition of a link - sending LFU - Q782:7.10.1	
MTP3-13	Forced unhibition of a link - reception of LFU - Q782:7.10.2	
MTP3-14	Management Inhibiting Test: Periodic sending and receiving of LLI and LRI-Q 782: 7.17.1	
MTP3-15	Signalling link test: After activation of a Link-Q782:12.1	
	Miscellaneous MTP Test Cases	
MTPMisc-1	It shall be possible to assign the signaling data link to any timeslot of the PCM except timeslot 0.	

4. ISUP tests:

The compatibility tests given in ITU-T Q.784 (1991) will be done on the CCS7 links of Integrated Media Gateway with A Suitable CCS7 Simulator and Analyser. The protocol shall conform to the ITU-T test sheets mentioned below.

Test Cases for ISUP

Clause No.	Description	**Test Results**
	Clause from S/CCS-02/03	
5.1	ISUP shall be as per the functional description given in ITU-T Rec. Q.761 (09/97).	ITU-T Rec. Q.784 validates the protocol specification in ITU-T Rec Q.761-Q.764
5.2	The messages, parameters and the parameter information used by ISUP shall be as per ITU-T Rec.Q.762(09/97)	
5.3	The formats and codes of ISUP messages and the parameters required to support basic bearer services and the supplementary services shall be as per ITU-T Rec. Q763(09/97)	
5.4	The ISUP signaling procedures for setting up and clearing down of national and international ISDN connections shall be as per ITU-T Rec. Q764(09/97)	
	ITU-T Rec.Q784 Test Cases	
SL.No.	Test Cases Description	
ISUP-1	Reset received on an idle circuit – Q784.1.2.1	
ISUP-2	Reset sent on an idle circuit – Q784.1.2.2	
ISUP-3	Circuit group reset received-Q784:1.2.5	
ISUP-4	Circuit group reset sent-Q784.1.2.6	
ISUP-5	CGB and CGU received - Q784:1.3.1.1	
ISUP-6	CGB and CGU sent - Q784:1.3.1.2	
ISUP-7	Circuit Blocking received– Q784.1.3.2.1	

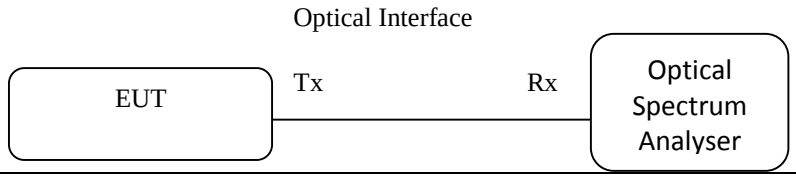
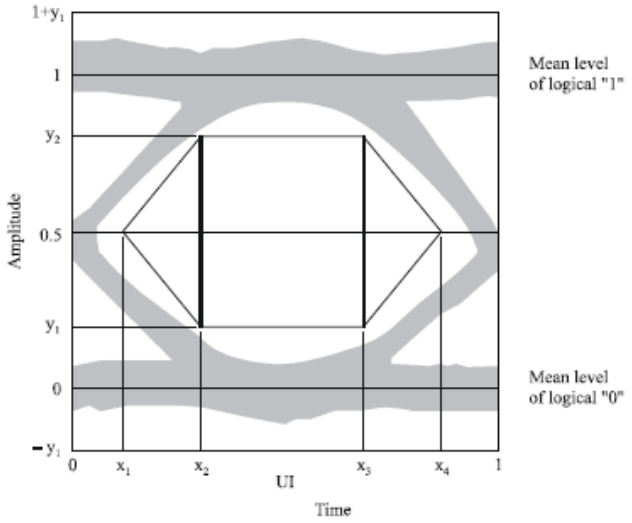
ISUP-8	Circuit blocking sent – Q784.1.3.2.2	
ISUP-9	Continuity Check Test: CCR received: Q784:1.4.1	
ISUP-10	Continuity Check Test: CCR sent: Q784:1.4.2	
ISUP-11	Normal Call setup:Overlap operation(with SAM)-Q784:2.2.2	
ISUP-12	T7: Waiting for ACM - Q784:5.2.1	
ISUP-13	T9:Waiting for an answer message-Q784:5.2.2	
ISUP-14	T16 and T17: failure to receive a RLC – Q784.5.2.8	
ISUP-15	Reset of circuits during a call – outgoing circuit- Q784:5.3.1	
ISUP-16	Reset of circuits during a call – incoming circuit- Q784:5.3.2	
ISUP-17	Automatic repeat attempt - blocking of a circuit - Q784:6.2.2	
ISUP-18	Dual Seizure for controlling SP-Q784:6.3.1	

Test For ISUP Supplementary Services

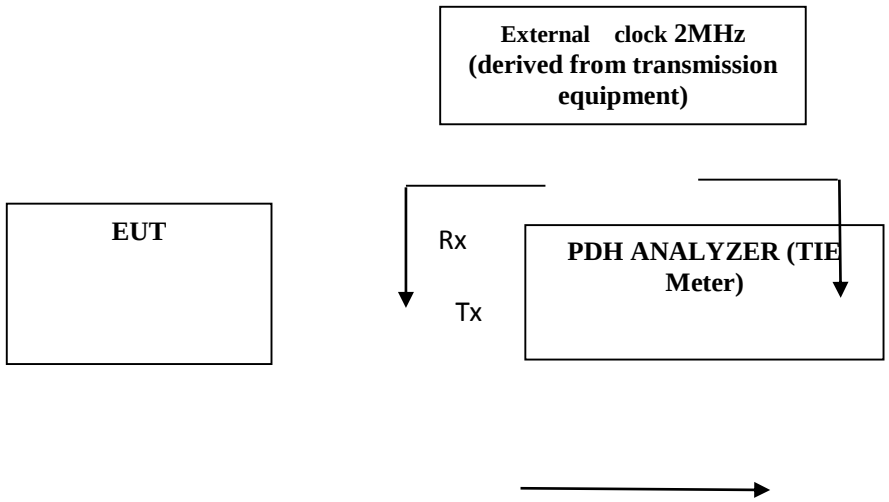
Clause No.	Description	Test Results
	Clause No. S/CCS-02/03	
Chapter4	The general format for ISDN user part (ISUP) supplementary services shall be as per ITU-T Rec.Q.730(9/97)The implementation of the supplementary services shall be as per IT-T Rec. Q.731 to Q.737.	
Sl.No.	Test Case Description	
SUPP-1	Calling Line Identification Presentation (CLIP)-Q731.3(3/97)	
SUPP-2	Calling Line Identification Restriction(CLIR)-Q.731.4(3/97)	
SUPP-3	Connected Line Identification Presentation(COLP)-Q.731.5(3/97)	
SUPP-4	Connected Line Identification Restriction (COLR)-Q.731.6(3/97)	
SUPP-5	Malicious Call Identification (MCID)-Q.731.7(2/97)	
SUPP-6	Sub addressing (SUB)-Q.731.8(6/97)	

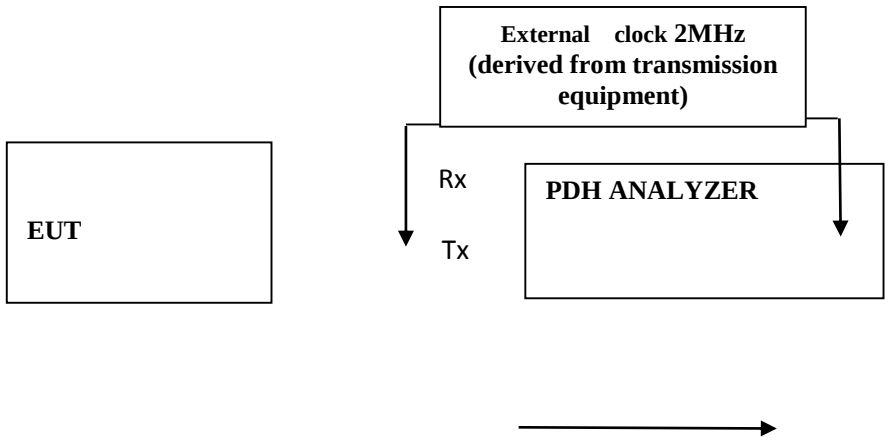
5 : Interface Tests for CCS7 Signaling

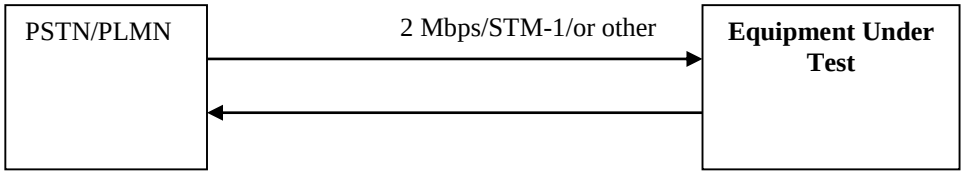
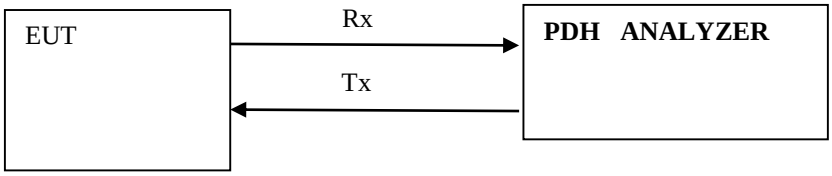
Clause No.	*Description*		**Test Results**
1	**Completed Call**	Check for ISUP Messages	
2	A-Party Release	Check for ISUP Messages	
3	B-Party Release	Check for ISUP Messages	
4	B-Party Engaged	Check for ISUP Messages	
5	Incomplete Dialling	-	
6	Call with 10 digit CLI	Check for ISUP Messages	
7	B Party No answer	Check for ISUP Messages	
8	Fax	Fax Transmission	
9	Modem connection	Set the codec to G711 & initiate call from Modem A to Modem B through VOIP network. The data transfer should be tested between the two modems.	
10	Modem Connection	Set the codec to G729 & initiate call from Modem A to modem B through VOIP network. The data transfer should be tested between the two modems.	

<table>
<tr><td>Test No.</td><td>38</td></tr>
<tr><td>Test Details</td><td>Eye Pattern for Optical Interfaces</td></tr>
<tr><td>Test Instruments Required</td><td>1. Optical Spectrum Analyser</td></tr>
<tr><td>Test Setup</td><td> 
</td></tr>
<tr><td>Test Limits</td><td><table>
<tr><td>STM-1 Short Haul / Long Haul</td><td>Refer Figure-2/G.957</td></tr>
<tr><td>STM-4 Short Haul / Long Haul</td><td>Refer Figure-2/G.957</td></tr>
<tr><td>STM-16 Short Haul / Long Haul</td><td>Refer Figure-2/G.957</td></tr>
</table></td></tr>
<tr><td>Standards Reference</td><td> 

<table>
<tr><td></td><td>STM-1</td><td>STM-4</td></tr>
<tr><td>x1/x4</td><td>0.15/0.85</td><td>0.25/0.75</td></tr>
<tr><td>x2/x3</td><td>0.35/0.65</td><td>0.40/0.60</td></tr>
<tr><td>y1/y2</td><td>0.20/0.80</td><td>0.20/0.80</td></tr>
</table>
<table>
<tr><td></td><td>STM-16</td></tr>
<tr><td>x3–x2</td><td>0.2</td></tr>
<tr><td>y1/y2</td><td>0.25/0.75</td></tr>
</table>
G.957_F02
NOTE – In the case of STM-16, x3 and x1 of the rectangular eye mask need not be equidistant with respect to the vertical axes at 0 UI and 1 UI. The extent of this deviation is for further study. In view of the frequencies involved in STM-16 systems and the consequent difficulty of realizing this filter, the parameter values for STM-16 may need slight revision in light of experience.
Figure 2/G.957 – Mask of the eye diagram for the optical transmit signal</td></tr>
<tr><td>Test Procedure</td><td>1. Connect the Setup as shown in the figure.
2. Enable the output Optical Port
3. Measure the optical spectrum / eye pattern
4. Check whether the spectrum / eye patternis within the specification limits</td></tr>
<tr><td>Expected Results</td><td>Enclose the Test Results</td></tr>
</table>

Test No.	39
Test Details	Test for Frequency Stability in Holdover Mode
Test Instruments Required	PDH Analyzer
Test Setup	
Test Procedure	1. Connect the Setup as shown in the figure. Synchronies both the EUT & PDH Analyser (Testing equipment) as per test setup from external timing reference which may be extracted from transmission equipment.) 2. After the EUT is synchronised and stabilised, remove the reference input. 3. It will go to holdover mode. 4. Now run the TIE measurement in holdover mode, which should be started at this point for 24 Hrs. 5. Measure Time Interval Error (TIE) on PDH analyzer 6. Clock stability should be calculated as follows: Clock stability= Time Interval Error (TIE)/Measurement Duration
Test Limits	Frequency Stability in Holdover Mode. Minimum stability of clock in holdover mode shall be 1*10-9 per day. The term 'minimum stability' implies that the stability should be equal to or better than the value specified.

Test No.	40
Test Details	Test for Bit Slip Measurement
Test Instruments Required	PDH Analyzer
Test Setup	
Test Procedure	1. Connect the Setup as shown in the figure. Synchronize both the EUT & PDH Analyser (Testing equipment) as per test setup from external timing reference which may be extracted from transmission equipment.) 2. After the EUT is synchronised and stabilized, run the measurement (PRBS bit pattern) which should be started at this point for 96 Hrs. 3. Measure Slipon PDH analyzer for a period of atleast 96 hours of operation. In synchronised mode of operation, not more than 2 slips per day are permitted.
Test Limits	Under synchronized condition, slips observed at the 2048 Kbits interface of digital exchange/ EUT shall be less than or equal to 2 slips in 24 hours.

Test No.	*41*
Test Details	*Test for junction test*
Test Instruments Required	PDH Analyzer
Test Setup	(a)  (b) 
Test Procedure	1. *First connect the Setup as shown in the figure (a) as per interface applicable 2Mbps/STM-1/or other. Break the interface continuity either by soft command or physically removing the wire. Verify the status of link in break condition; alarm should appear, when reconnect the alarm should disappear.* 2. *Now connect the Setup as shown in the figure (b) as per interface applicable 2Mbps/STM-1/or other through PDH analyzer. Verify the status of link in healthy condition of interface from PDH analyzer. Now increase the BER gradually through PDH analyzer and observe the alarm condition. Note down the BER threshold level when alarm appear. This value of BER should be within accepting limits.*
Test Limits	Check all alarms and note down the values of thresholds regarding junction testing.