Government of India
Department of Telecommunications
Telecommunication Engineering Centre
Gate No. 5, Khurshid Lal Bhawan, Janpath, New Delhi-110001.
Fixed Access (FA) Division

File No. 7-7/2023-FA/TEC **Dated: 28.08.2025**

Subject: Revision of Test Guide of Standard for Generic Requirements (GR) on "SMPS Based Power Plant " - Inviting comments.

In exercise of the powers conferred by rule 5(2) of the Telecommunications (Framework to Notify Standards, Conformity Assessment and Certification) Rules 2025, a draft revision of Test Guide (TEC 66111:2025) corresponding to Standard of Generic Requirements (GR) on "SMPS Based Power Plant (Standard No. TEC 66110)" is enclosed herewith (Annexure-I) for stakeholder consultation. It is requested to go through the enclosed draft Standard for revision of Test Guide (draft Standard No. TEC 66111:2025) and offer your inputs/comments. The comments may please be furnished in the template sheet enclosed herewith as Annexure-II.

The comments/inputs may be furnished through email to adgfa-tec-dot@gov.in with copy to dirfa.tec@gov.in and ddgfla.tec@gov.in at the earliest and latest within **sixty days of the date of this reference** please.

Enclosures:
(i) Draft Revision of Test Guide for "SMPS Based Power Plant " (Annexure-I)
(ii) Annexure-II, Template

----Sd----
(Deo Pratap)
AD (FA), TEC
Email:adgfa-tec-dot@gov.in

To,

All Manufacturers & Stakeholders

Copy to:
1. AD (IT), TEC - with request for uploading on TEC Website

ANNEXURE-II

NAME……(OF MEMBER/MANUFACTURER)

Inputs/Comments/Suggestions on Draft Revision of Test Guide for **"SMPS Based Power Plant (TEC 66110)"**.

Clause No.	Clause Description	Modified/ New Clause	Justification

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PROVISIONAL TEST GUIDE

TEC 66111:2025

for

एसएमपीएस बेस्ड पावर प्लांट

(मानक संख्या.: टीईसी ६६११०:२०२५)

SMPS BASED POWER PLANTS

(STANDARD No.: TEC 66110:2025)

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

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खुर्शीदलाल भवन, जनपथ, नई दिल्ली-110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

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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 document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of SMPS based power plants as per the Standard of GR No 66110:20254

CONTENTS

A. HISTORY SHEET

Sl. No.	*Standard/document No.*	*Title*	*Remarks*
1	G/SMP-01/01 JUL 94	SMPS Based Power Plants	First issue
2	G/SMP-01/02 SEP 96	SMPS Based Power Plants	Second issue
3	G/SMP-01/03 MAR 97	SMPS Based Power Plants	Third issue
4	GR/SMP-01/04 FEB 2001	SMPS Based Power Plants	Fourth issue
5	GR/SMP-01/05 JAN 2005	SMPS Based Power Plants	Fifth issue
6	TEC/GR/FLA/SMP – 001/06/June.2010	SMPS Based Power Plants	Sixth issue
7	TEC 66110:2017 (TEC/GR/FA/SMP – 001/07/MAR-17)	SMPS Based Power Plants	Seventh Issue
8	TEC 66111:2024	TSTP of SMPS Based Power Plants	Eighth issue
9	TEC 66111:2025	TSTP of SMPS Based Power Plants	Ninth issue

B. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of SMPS based power plants as per GR/IR/ Applicant's spec. No. TEC-66110:2025.

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)*

Sl. No.	Name	Designation	Organization	Signature
1.				
2.				

E. List of the Test Instruments:

Sl. No.	Name of the test instrument	Quantity	Make / Model (to be filled by testing team)	Validity of calibration (to be filled by testing team) dd/mm/yyyy	Remark
1.					
2.					

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

(a) <Equipment/product name> Configuration:

Sl. 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:

Sl. 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 / Test No. etc.*
1.1	TECHNICAL REQUIREMENTS	
1.1.1	Scope	
1.1.1.1	This document contains the generic requirements of Power Plants, based on High Frequency Switch Mode Techniques, using switching frequencies of 20KHz and above, for the use in Indian Telecom Network. The Power Plant as per this GR shall be compatible with VRLA battery as well as Li-ion battery. However, at any point of time VRLA & Li-ion battery cannot work simultaneously with the SMPS power plant. Purchaser may decide for power plant to be compatible with conventional Lead Acid batteries, if ordered. The power plant compatible with VRLA batteries as well as Li-ion battery shall be certified as "SMPS power plants compatible with VRLA and / or Li-ion battery" as applicable.	Information
1.1.1.2	The DC Distribution cabinet does not form part of this GR.	Information
1.1.1.3	The system shall be capable of meeting the load requirements of various telecom equipment and battery bank in Telecom Network. The system should be expandable at rack level itself or by additional racks using the basic FR/FC and/ or FR/BC modules of the same rating. The prescribed FR/FC and FR/BC ratings are 6.25A, 12.5A, 25A, 50A, 100A and 200A. These power plants may be mainly classified in two categories:	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.1.3.1	Large capacity Power plants systems: "These types of power plants are envisaged for large or very large telecom systems. Power plant systems with ultimate capacity of above 600A are envisaged for this application. Battery back-up for these systems may vary as per specific field requirements, but normally it is 6 hours. SMPS power plants based on 50A, 100A and 200A basic modules are envisaged for these applications. All these modules use three phase supply except 50A module, 50A module may be with single phase or three phase input, modules are equally distributed on three phase input while building power plant system up to 1500A".	Physical Check
1.1.1.3.2	Small capacity Power plants systems: These type of power plants are envisaged to serve small telecom systems in rural and semi-urban areas. Battery back-up for these types of systems is 6 to 72 hours, depending on the electric supply conditions. This type of power plant may also be used with small telecom systems such as mobile base stations etc. in the urban and metros areas. SMPS power plants based on 6.25A, 12.5A, 25A and 50A basic modules are envisaged for these applications. They all use single phase supply except for 50A basic module, which may be with single phase or three phase supply."	Physical Check
1.1.1.4	The power plant system shall consist of a Distribution, Switching, Control, Alarm and Monitoring arrangement (DSCA) and Float	Physical Check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Rectifier-cum-Float Chargers (FR/FCs) in a rack. It shall employ modular configuration for flexible provision of DC power. Note: FR/BC is only used for conventional flooded Lead Acid batteries only. Power plants compatible with VRLA or Li-ion batteries, do not require FR/BC modules and as such only FR/FC are used in such power plants.	
1.1.1.5	The system shall be sufficiently flexible to serve any load from 6.25 A onwards, depending on manufacturer's design, rating, number of FR/FC modules used in a rack and system configuration.	Information
1.1.1.6	To cater to higher load requirements, same type of FR/FCs mounted in the same rack or different racks, shall be capable of working in parallel load sharing arrangement.	Physical Check
1.1.2	Functional and Technical Requirements	
1.1.2.1	Functional Requirements	
1.1.2.1.1	Lightning & Surge Protection The protection of Telecom Site against the lightening and high voltage surges shall be as per GR of Lightening and Surge Protection of Telecom Site (GR No. TEC 66130:2024).	Certificate / Undertaking to be taken from OEM
1.1.2.1.2	Stage–2 Protection: This protection against, low voltage surges of up to 1.5 KV, shall be provided at the power plant level. This protection shall be equipped with thermal disconnection and potential free contact	Physical Check and Certificate / Undertaking to be taken from OEM

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>for arrestor(s) connected between live & neutral and neutral & earth. This protection shall be incompliance of IEC 62305 & 60364-5-53 for the following values of current:
<table><tr><th>Between</th><th>Protection Requirement</th></tr><tr><td>R, Y, B & N</td><td>Greater than or equal to in: 20KA, 8/20µS for each phase</td></tr><tr><td>N & PE</td><td>Greater than or equal to in: 40KA 8/20µS.</td></tr></table>
Where In: Value of nominal discharge current 8/20µS.
Note: Voltage rating of MOVs shall be 320V minimum.</td><td></td></tr>
<tr><td>1.1.2.1.3</td><td>Response time of the Stage II device shall be ≤ 25 nano seconds.</td><td>Information</td></tr>
<tr><td>1.1.2.1.4</td><td>Installation procedures of SPDs
The power plant shall contain Stage-II protective device for protection against low voltage surges of voltage up to 1.5 KV.</td><td>Information</td></tr>
<tr><td>1.1.2.2</td><td>Technical Requirements</td><td></td></tr>
<tr><td>1.1.2.2.1</td><td>System Applications
SMPS is intended to be used in Auto Float-cum-Charge mode as a regulated D.C. Power Source.</td><td>Information</td></tr>
<tr><td>1.1.2.2.1.1</td><td>Switching frequencies of these power plants shall be 20 KHz and above.</td><td>Test Case-2</td></tr>
<tr><td>1.1.2.2.1.2</td><td>The system shall only be based on menu driven Microprocessor Controlled Techniques</td><td>Test Case-1</td></tr>
</table>

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	(both DSCA as well as FR/FC, FR/BC module) for control, monitoring & alarms. DSCA shall display the Software version and checksum number for both DSCA and FR/FC, FR/BC. Setting of all the parameters shall be through menu-driven microprocessor control only. DSCA shall have menu for selection of type of battery between VRLA and Li-ion battery and type of battery should be displayed on DSCA. The failure of Microprocessor or DSCA shall not affect the setting of individual FR/FC, FR/BC. No parameter of FR/FC, FR/BC modules shall be disturbed on the failure of DSCA. In this condition all the FR/FC FR/BC modules shall take care of the load on default settings and share the load collectively. Only the setting of new parameters from DSCA, shall be affected. In case of failure of microprocessor of FR/FC, FR/BC module its last settings shall not be affected. The system shall be RS 485/RS 232 and Ethernet (SNMP) compatible, if remote monitoring is required. It shall be feasible to set any monitoring control parameter from a remote site through RS 485/RS 232 and Ethernet (SNMP). All the information regarding Control and monitoring of Power Plant data shall be accessible on demand from the remote site. The exchange of information and protocol format shall be as given in the Clause 1.3. RS485/RS 232 and Ethernet communication cable of suitable length shall be protected with Pluggable and DIN Rail Mountable	For microprocessor failure refer Test Case-17 For Communication refer Test Case-14

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	surge protection devices (to be decided by purchaser) to be mounted on both side of the cable. SPD shall have surge discharge current capacity of 10KA (8/20 µ sec) and lightening discharge current capacity of equal or more than 0.5 KA per line (10/350 µsec). The SPDs shall have an end-of-life indication either via signal disruption or a visual indication.	
1.1.2.2.2	The DSCA shall be provided for the ultimate capacity of the Power Plant. However, it shall preferably be provided either in the first rack or in a separate rack. The DSCA, in addition to control, monitoring and alarms, shall provide for the following: a) Termination for the batteries*. b) Termination for the exchange load. c) Interconnecting arrangement for power equipment. d) Battery Switching arrangement (Connection to / isolation from system) ** e) Termination for AC input to the rack shall be finger touch proof, flame retardant, insulated. Use of bus-bars for the purpose is precluded. However, for terminating cables of large cross-sectional area, especially in high ultimate capacity power plants, copper bars may be provided as terminal blocks to handle such high currents. f) Termination for AC and DC to FR/FC modules. g) Circuit Breakers/ fuses etc.	Physical Check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	The capacity and number of batteries shall be as per order. For the purpose of Type Approval, it shall be taken as three batteries. ** Only CACT approved DC contactor or `MCBs' (which do not produce spark while cutting in or out) shall be used for manual isolation and reconnection of the battery. The manual isolation/ reconnection of the battery by tripping the contactor through an external switch is not permitted. **Note-1:** Battery shall be protected against the short circuit from any source, including switching equipment such as contactor, MCB coil and their control and sensing circuitry. **Note-2:** Solid state switching device may preferably be used. Relays, if used, shall be UL or CE compliant.	
1.1.2.2.2.1	**Interlocking of batteries:** Necessary interlocking arrangement for batteries shall be provided so as to ensure that at-least one battery remains floated across the load under all working conditions. (Optional)	Test Case-28
1.1.2.2.3	**Power Plant compatibility with Engine alternator:** The power plant system (including FR/FCs, FR/BCs and DSCA), shall be suitable for operation from A.C mains or a DG set (of capacity 1.25 times AC load of power plant).	Information
1.1.2.2.4	**Load Sharing (Parallel operation):** FR/FC modules shall be suitable for operating in parallel with one	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	or more modules of similar type, make and rating, other output conditions remaining within specified limits.	
1.1.2.2.4.1	The current sharing shall be within +/- 10% of the average current per rectifier module in the system (mounted in the same or different racks), when loaded between 50 to 100% of its rated capacity for all working conditions.	Test Case-13
1.1.2.2.4.2	In the event of failure of DSCA, FR/FC, FR/BC modules' parameters shall not be disturbed. All the FR/FC FR/BC modules shall take care of the load on default settings and share the load collectively.	Test Case-17
1.1.2.2.5	**Battery Monitoring:**	
1.1.2.2.5.1	**Battery under voltage isolation:** There shall be a provision for Automatic isolation/reconnection of each battery from the load. The DC contactor used for the purpose shall be of single pole only. The operate and release voltages for the above conditions shall be as follows: **For VRLA Battery:** **Cut-off:** 1.85V/cell (44.4V for 48V units and 11.1V for 12V units). It shall be settable between 1.85V and 1.9V/cell. A tolerance of 0.01V/cell is permissible in this case. **Reconnect:** When the FR/FC voltage has built-up fully. It shall be settable between 2.15V to 2.3V/cell. **For Li-ion Battery:**	Test Case-10

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Cut-off Voltage (V): Between 11.2V to 11.6 V for 12V battery, 22.4V to 23.2 V for 24V battery, 42V to 44 V for 48V battery. **Reconnect:** When the charger voltage has built-up fully. Battery voltage more than 12.8V for 12V battery, 25.6V for 24V battery & 48 V for 48V battery.	
1.1.2.2.5.2	**Battery Health Monitoring in Auto Mode:** **For VRLA:** To keep the battery in healthy state, the battery condition shall be continuously monitored. On restoration of AC mains after an interruption, depending on the sensed battery condition (depth of discharge), the system shall change over to Auto Charge mode to charge the battery at higher voltage of 55.2V till the battery is fully recouped. **For Li-ion battery:** When Li-ion battery selected setting of Float & Charge voltage should be 54.0V or specified by the purchaser based on the requirement.	Information & Physical Check
1.1.2.2.5.3	**Battery Health Check:** There shall be a provision of monitoring the voltage, current, trickle current, conductance and temperature (programmable) of the batteries associated with the power plant at a set periodicity. There shall also be a provision of monitoring of each cell of the battery bank for voltage and temperature. The provision for conducting a partial discharge (about 20%) test, of a pre-determined duration and frequency, shall be made available in the	Test Case-14

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	power plant (Frequency and duration of partial discharge test shall be programmable). During this test, the current and voltage of the battery as well as each individual cell shall be recorded. It shall also record the conductance and temperature of each cell. Conductance measurements/observations shall be off-line to prevent noise interference. First observations of conductance, recorded by the power plant system, for the battery shall form the base values for future comparison. The provision of partial test discharge shall be implemented in such a way that at a time only one battery is put to discharge, so as to ensure that necessary battery reserve is available in case of power failure during or immediately after the test discharge. Provision shall be made for observing the state of charge of battery before commencing this test. In case the battery is not fully charged this test may be deferred till the battery is fully recouped. Any abnormality observed during above observations shall be highlighted by initiating an alarm. All the above information shall be made available to the remote site through RS 485 / RS 232 and Ethernet (Refer Clause 1.3 for specified protocol). Note-1: The manufacturer will give the list of hardware equipment required, for the purpose, at the time of procurement. Purchaser shall clearly	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	indicate the requirement of battery health check feature while ordering the power plant. The manufacturer shall also undertake that the above provision will become fully function by adding the hardware/software, for the purpose, if ordered by purchaser. Note-2: This clause is optional and applicable to VRLA battery.	
1.1.2.2.5.4	SMPS Management (Optional) The purchaser may decide the requirements for optional SMPS Management features like i. Energy saving Management, ii. DG Efficiency & Fuel Saving Management, iii. Battery Efficiency & Management, iv. Rectifier Control – Efficiency Management, etc. v. Data Logging to all the SMPS parameters and alarms which may be downloadable in excel or any new readable format. vi. Ability to calculate and display run hrs. SMPS on EB, Battery, DG (if DI provided) vii. Redundancy supervision to calculate no. of redundant and no. of lacking rectifiers Based upon load current and battery AH setting. viii. USB port or any other secured mode to download log file in pen drive, other authorized storage devices, etc.	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.2.5.5	**Battery path Current Limiting Circuit:** In Auto Mode the current in each battery path (For VRLA type battery) shall be settable as per the battery capacity and DG capacity as applicable so that the battery path current is kept at 5~~10~~% of battery AH capacity. When Li-ion battery selected setting the current in each battery path should be settable as per the battery capacity and DG capacity as applicable so that battery path current is kept at 5~~10~~% to 50% of battery AH capacity and actual battery path current will be decided by the purchaser. Further, purchaser will give the capacity of the battery and DG set if applicable to be used for this purpose. For the Type approval the manufacturer shall demonstrate the facility and undertake to make provision as per order."	Test Case-11
1.1.2.2.5.6	**Temperature Compensation for Battery:** **For VRLA**: In auto float/charge mode there shall be provision for monitoring the temperature of battery and consequent arrangement for Automatic temperature compensation of the FR/FC, FR/BC output voltage to match the battery temperature dependent charge characteristics. The output voltage of the rectifier in Float/Charge operation shall decrease or increase at the rate of 72mV (3mV/cell, 24 cell battery) per degree increase or decrease in temperature over the set voltage. The output voltage shall decrease till the open circuit voltage of the battery is reached. The open circuit voltage range shall be settable	Test Case-12

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Clause No.	*Clause*	*Type of Test / Test No. etc.*
	between 2.1V/cell to 2.2V/cell. At this voltage, the power plant voltage gets locked and further increase in temperature shall not decrease the voltage any further. This voltage shall also remain locked till the temperature falls below the value corresponding to set value. When the output voltage reaches 55.8V, due to increase in the output voltage owing to decrease in temperature, it shall get locked at this voltage & any further decrease in temperature shall not lead to further rise in the output voltage of the power plant. This voltage shall also remain locked till the temperature rises above the value corresponding to set value. A tolerance +/- 5 mV may be acceptable over the specified rate of 72mV/degree C. The nominal distance between the battery & power plant may be 20 meters. The manufacturer shall provide the necessary sensor and cord for the purpose with the power plant. Failure of temperature compensation circuit including sensors (including the open or short circuit) shall create an alarm and shall not lead to abnormal change in output voltage. Proper sign-writing shall be made in DSCA and both ends of temperature compensation cord for its easy termination. **For Li-ion battery:** Temperature compensation for battery should be disable when Li-ion battery selected. Temperature sensor is not required.	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.2.6	**Protections**: Failure of control and sensing circuitry shall not cause any hazard. The voltages of the system shall not abnormally increase to endanger the load.	Information
1.1.2.2.6.1	**AC Input:** FR/FC module should be automatically cut off as the AC input of the FR/FC module is beyond the specified operating range (230V+10 % to 230V-15% for single phase and 415V ±10% for three phase Supply systems). However, keeping in view of specific requirement for rural area, purchaser may specify the requirement as a special case as: - "The Power Plant shall operate from single phase AC mains supply 230 V with variation from 120 V to 290 V with ~~applied~~ linearde-rating and frequency as 50 Hz +/-2Hz". Suitable alarm indication shall also be provided. The FR/FC module shall resume normal working automatically when the input is restored within the working limits. Hysteresis within specified working limits shall prevent shutting down of the FR/FC. A tolerance of +/- 5V is acceptable for protection & alarm operation. Reconnection shall occur at a voltage, 10V lower than the set voltage for high isolation limit and 10V higher than the lower set limit, to avoid hunting. The circuitry used for sensing the voltage for operation of isolation/ reconnection device shall be able to withstand a	Test Case-6

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	voltage 15% higher than the specified extreme limit of isolation.	
1.1.2.2.6.1.1	The module shall be isolated (if required for the protection of the unit) in the event of unbalance beyond 10% and shall restore when the input is within limits. (Applicable only for three phase module or system)	Information
1.1.2.2.6.2	D. C. Over voltage: Each rectifier module shall be fitted with an internal over- voltage protection circuit.	Information
1.1.2.2.6.2.1	In case output DC voltage exceeds –56V, the over voltage protection circuit shall operate and shut-off the faulty module. A tolerance of +/-0.25V is permitted in this case. Restoration of the module may be through manual or through DSCA".	Test Case-5
1.1.2.2.6.2.2	Shutting-off of faulty FR/FC module shall not affect the operation of other FR/FCs operating in the rack.	Test Case-33
1.1.2.2.6.2.3	Operation of over-voltage shut down shall be suitably indicated on the module and also extended monitoring/control unit.	Physical Check
1.1.2.2.6.2.4	The circuit design shall ensure protection against the discharge of the Battery through the FR/FC module in any case.	Information
1.1.2.2.6.2.5	The over voltage protection circuit failure shall not cause any safety hazard.	Information
1.1.2.2.6.3	Fuse / Circuit Breakers:	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Fuses or circuit breakers shall be provided for each FR/FC, FR/BC module as follows: a. Live AC input line (MCB)b. b. Negative D.C output (enclosed ultra-fast blow fuse assembly or DC circuit-breaker). c. Against failure of Control sensing circuit.	Information & Physical check
1.1.2.2.6.3.1	All fuses/circuit breaker used shall be suitably fault rated.	Physical Check
1.1.2.2.6.4	**Overload/Short Circuit:** The FR/FC shall be protected for Overload/short circuit as per clause 1.1.2.2.9.9.2.	Test Case-18 (for overload)
1.1.2.2.7	**Monitoring Alarms and Indicating Lamps** Visual indications / display shall be provided by means of bright LCDs/LEDs on each FR/FC module and DSCA to indicate:	Information
1.1.2.2.7.1	**Functional Indications:** The following functional indications shall be provided on FR/FC & DSCA: a) Mains available b) FR/FC, FR/BC On Auto Float c) FR/FC, FR/BC On Auto Charge **Note:** The functional indication a) shall be provided on both DSCA & FR/FC/BC module, while b) & c) may be provided either on DSCA or on both FR/FC and DSCA.	Test Case- 31
1.1.2.2.7.2	**Alarm Indications:** **A. On FR/FC:**	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	a. LED Green - Healthy b. LED Amber - Warning c. LED Red – Major Functional Indications and alarm indications shall be extended to DSCA **B. On DSCA:** a) Load Voltage High (above 56V)/Low (below 45.6V) b) Alarms on FR/FC, FR/BC (As per clause 1.1.2.2.7.2 (A)) c) Mains Out of range d) System Overload e) Mains "ON"/Battery Discharge f) Fan Fail (in case fan provided at rack level) g) Temp. sensor fail (for VRLA battery only) h) Battery Fail or No Battery (separate for each Battery) i) Battery isolated from the load j) Lightning and surge protection Stage II Fail.	Test Case - 32
1.1.2.2.7.3	All the alarms shall be DC operated only. Also, all alarm circuits shall be provided with suitable delay to ensure that they do not operate with transients.	Information & Physical Check
1.1.2.2.7.4	All the alarms and protection limits shall be settable through a menu driven program.	Physical Check
1.1.2.2.7.5	All the protections/alarms shall be within tolerance of 0.25V in case of DC voltage and 1% in case of current. For AC voltage it shall be +/- 5V.	Information
1.1.2.2.7.6	Every Alarm condition shall be accompanied with	Physical Check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	an Audio alarm, with Auto/manual audio cut-off facility.	
1.1.2.2.7.7	Potential free contact two (one for alarm and one redundant) shall be provided for extending the common fault alarm to Switch room.	Test Case-34
1.1.2.2.8	**Remote control and monitoring**	
1.1.2.2.8.1	The power plant shall be RS 485/ RS 232 and Ethernet (SNMP) compatible. It shall provide for the monitoring, alarm and control of the power plant and its associated batteries from a remote site through RS 485/ RS 232 and Ethernet (SNMP). The exchange of information and protocol format between the power plant and remote site shall be as given in the Clause No. 1.3.	Test Case-14
1.1.2.2.9	**Electrical Requirements**	
1.1.2.2.9.1	**AC input Supply:** The Power Plant using FR/FC modules of 6.25, 12.5 and 25A, 50Ashall operate from single phase AC input & FR/FC modules of 50A, 100A & 200A capacity shall operate from three phase/4wire AC input. The nominal input frequency is 50Hz, which may vary from 48-52Hz. The input voltage range shall be as given below: a) Single Phase (Nominal 230V-15% to 230V+10%): 196V to 253V b) Three Phase/4 wire (Nominal 415V±10%) : 374V to 457V	Physical Check Test Case-6
1.1.2.2.9.1.1	For three phase/4 wire FR/FC, FR/BC modules	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	only delta connections are permitted. FR/FC, FR/BC modules shall work satisfactorily for unbalance of +/- 10% of nominal input. Phase current unbalance, under all working conditions, mentioned in this document, shall not be more than 10%. Neutral phase current shall not exceed 100mA under all specified input and load conditions.	Test Case-16
1.1.2.2.9.2	**DC output Characteristics (Auto Float Charge operation):** The Module shall be capable of operating in "Auto Float-cum- Charge" mode. It shall be programmed to operate as a float rectifier or a charger, depending on the condition of the battery sets being sensed by the DSCA.	Information
1.1.2.2.9.2.1	**Auto Float Mode:** The float voltage of each rectifier module shall be continuously adjustable and pre-settable at any value in the range of -48 to -56V from FR/FC, or DSCA. There shall also be a provision of setting the float/charge voltages globally from DSCA. There shall also be a provision so that DSCA may override the values set by individual module. The prescribed float voltage settings are -52.8V for conventional battery and -54V for VRLA battery respectively. Float Voltage adjustment may be made globally, and not for individual rectifiers.	
1.1.2.2.9.2.2	**Auto Charge Mode:** In Auto charge mode FR/FC shall supply battery &	Test Case-36

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>equipment current till terminal voltage reaches set value, which is normally 2.3V/cell (-55.2V, this value shall be settable between -48V and -56V) and shall change over to constant voltage mode. It shall remain in this mode till a changeover to float mode signal is received. (“This Clause is applicable for VRLA Battery only”)</td><td></td></tr>
<tr><td>1.1.2.2.9.2.3</td><td>The DC output voltage at the terminals shall be maintained within +/-1% of the half load preset voltage from 25% load to full load condition when measured over the full-specified input range.</td><td>Test Case-15</td></tr>
<tr><td>1.1.2.2.9.3</td><td>Efficiency:
The efficiency of the single phase and three phase unit shall be as given below:
(a) Rectifier rating < 50A
<table>
<tr><th>Condition</th><th>Single Phase AC</th><th>Three Phase AC</th></tr>
<tr><td>At nominal input, output and full rated load</td><td>better than 90%</td><td>better than 91%</td></tr>
<tr><td>Other specified Input, output conditions and load between 50% to 100%.</td><td>better than 85%</td><td>better than 87%</td></tr>
</table>
(b) Rectifier rating 50A and above
<table>
<tr><th>Condition</th><th>Single Phase AC</th><th>Three Phase AC</th></tr>
</table></td><td>Test Case-7 (for 3-phase) & Test Case-8 (for single phase)</td></tr>
</table>

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	<table><tr><td>At nominal input, output and full rated load</td><td>better than 93%</td><td>better than 93%</td></tr><tr><td>Other specified Input, output conditions and load between 50% to 100%.</td><td>better than 88%</td><td>better than 88%</td></tr></table>	
1.1.2.2.9.4	**Input Power Factor:** The true input Power Factor at nominal input, output voltage and rated load shall be better than 0.98 and shall be better than 0.95 in any other working condition and load between 50% to 100%. Active Power factor correction only shall be employed for the purpose.	Test Case-7 & Test Case-8
1.1.2.2.9.5	A resistor shall be provided to discharge the capacitors after the Rectifier modules have stopped operation and output is isolated.	Information
1.1.2.2.9.6	**Electrical Noise:** The Rectifier (FR/FC) Modules shall be provided with suitable filter on the output side.	Information
1.1.2.2.9.6.1	**Psophometric Noise:** Psophometric Noise (e.m.f. weighted at 800Hz), with a battery of appropriate capacity connected across the output should be within 2mV, while delivering the full rated load at nominal input	Test Case-7 & Test Case-8

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	(400V AC for three phase supplies and 230V for single phase supply). For test purposes, this shall be taken as equivalent to 4mV when the battery is not connected, other conditions remaining the same as per ITU-T Rec. O.41.	
1.1.2.2.9.6.2	**The Peak-to-Peak Ripple:** Voltage at the output of the rectifier module, without battery connected, shall not exceed 300 mV at the Switching Frequency measured by an Oscilloscope of 50/60 MHz bandwidth (Typical).	Test Case-7 & Test Case-8
1.1.2.2.9.7	**Transient Response**	
1.1.2.2.9.7.1	**Soft Start Feature:** Slow start circuitry shall be employed such that FR/FC module input current and output voltage shall reach their nominal value within 10 seconds. The maximum instantaneous current during start up shall not exceed the peak value of the rectifier input current at full load for the lowest input voltage specified.	Test Case-9
1.1.2.2.9.7.2	**Voltage overshoot/Undershoot:** The requirements of this clause shall be achieved without a battery connected to the output of FR/FC module. The FR/FC modules shall be designed to minimize output voltage Overshoot/ Undershoot such that when they are switched on the DC output voltage shall be limited to +/-5% of the set voltage & return to their steady state within 20 MS for any load of 25% to 100%.	Test Case-9

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.2.9.7.3	The DC output voltage overshoot for a sudden change in AC mains from specified lowest to highest and vice-versa shall not cause shut- down of FR/FC module and the voltage overshoot shall be limited to +/- 5% of its set voltage and return to steady state within 20 MS	Test Case-9
1.1.2.2.9.7.4	The modules shall be designed such that a sudden load change of 25 to 100% shall not result in DC output voltage Overshoot/ Undershoot of not more than 5% and return to steady state value within 10 MS without resulting the unit to trip.	Test Case-9
1.1.2.2.9.8	**Total Harmonic Distortion**	
1.1.2.2.9.8.1	**Total Voltage Harmonic Distortion:** The Total line harmonic voltage distortion shall not be more than 10% in conformity with CIGRE's limits. **Note:** The above Harmonic Distortion limits are as per communication received from Central Electricity Authority vide their office letter No. GO2/Comm.I/1/1-95/962 dated 22.12.92.	Test Case-7 & Test Case-8
1.1.2.2.9.8.2	**Total Current Harmonic Distortion:** The total harmonic distortion shall be limited as per EN 61000-3-2 Ed.2:2000. The total current harmonic distortion contributed by the unit at the input shall not exceed 10% for input voltage range 1290V-~~30~~290V for single phase units and ~~320~~374V to 457~~480~~V for three phase systems; for load between 50 to 100% of the rated capacity.	Test Case-7 & Test Case-8

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.2.9.9	Current limiting (Voltage Droop): The Current limiting (Voltage Droop) shall be provided for Float/Charge operation. The float/charge current limiting shall be continuously adjustable between 50 to 100% of rated output current for output voltage range of -44.4 to -56 volts. For test purposes upper limit of 100% + 5% and lower limit of 50% - 5% shall be acceptable.	Test Case-18
1.1.2.2.9.9.1	The float and charge current limit adjustment shall be provided: Either on the front panel of the individual FR/FC, FR/BC module through a menu driven program OR Through a provision at the centralized location on front panel of DSCA through a menu driven program capable of adjusting the float and charge current limits of each FR/FC, FR/BC module individually, irrespective of the rating and number of modules located in the same rack or in other racks of the power plant for the ultimate capacity of the system.	Test Case-36
1.1.2.2.9.9.2	The FR/FC modules shall be fully protected against short circuit. It shall be ensured that short circuit does not lead to any fire hazard. The unit shall start delivering output automatically when the short circuit is removed.	Test Case-21
1.1.2.3	Power Plants Compatible with Conventional Batteries	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.3.1	The conventional lead acid batteries have special requirement of periodic Boost charging @ 2.7V/cell. To meet this requirement, the power plant shall be so configured that in addition to the specification requirements, shall also have a provision of a group of FR/BC (as per battery capacity) for charging the batteries (one set at a time) @2.7V/cell after isolating both the battery and FR/BC group from the load bus. In addition to FR/FCs the power plant shall have the following additional units.	Information
1.1.2.3.2	Float Rectifier-Float Charger-Boost charger (FR/BC): The FR/BC module shall be programmable to work as FR/FC or BC.	Information
1.1.2.3.2.1	When programmed, FR/FC it shall be capable of working as FR/FC with other FR/FC and shall comply with all the requirements of FR/FC. The rated capacity of the FR/BC as FR/FC shall be same as that of the other FR/FCs. The prescribed Float voltage setting for conventional batteries is 52.8V.	Information
1.1.2.3.2.2	It shall also be programmable as a Boost Charger (BC) under manual control after isolating it from the float bus.	Information
1.1.2.3.2.2.1	As a Boost charger its output voltage shall be continuously adjustable and pre-settable at constant current up to 100% for voltage range 44.4V to 56V and up to 50% of the rated capacity at any value in the range 56V to 64.8V.	Test Case-22

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.3.2.2.2	The Boost voltage shall be maintained within +/- 1% of the set value over the full boost current range as specified in clause.	Information
1.1.2.3.2.2.3	The Float and Boost current limit adjustment shall be provided on the front panel of the FR/BC module.	Information
1.1.2.3.2.3	Parallel operation in BC mode: When programmed in BC mode FR/BC modules shall be working in parallel load sharing arrangement with other FR/BC modules in the same mode, other output conditions remaining within specified limits.	Test case-23
1.1.2.3.2.3.1	The current sharing shall be within +/- 10% of the average current per FR/BC module (in BC mode) in the system (mounted in the same or different racks) when loaded between 50 to 100% of its rated capacity (as BC) for all other working conditions.	Test Case-23
1.1.2.3.2.4	In addition to the Visual indications/display specified for FR/FC the following shall also be provided: Functional Indications: FR/BC on Boost mode Alarm Indications: Following Alarms shall actuate in BC mode: a. FR/BC over voltage b. FR/BC Over Load (Voltage Droop)	Test Case-24
1.1.2.3.2.5	Protection: The module shall also be protected against D. C. Over voltage in BC mode.	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.1.2.3.2.5.1	Shutting-off of faulty FR/BC module in FR/FC mode shall not affect the operations of other FR/FC & FR/BC in FR/FC mode and other BC while working in BC mode.	Information
1.1.2.3.3	Distribution, Switching, Control, Alarm and Monitoring Unit: The Distribution/ switching/ Control and alarm unit, in addition to the facilities specified earlier shall also provide for:	Information
1.1.2.3.3.1	Switching Arrangement: The switching arrangement may have handled enclosed knife fuse assembly or any other suitable arrangement in the same or separate rack for the following facilities: a) FR/BCs in Auto Float b) Selection and switching a Group of FR/BC for Boost or Float Charge operation. To achieve the above the switching arrangement shall be capable of selecting the required facilities.	Test Case-24
1.1.2.3.3.1.1	Battery Auto Float Charge/Boost selection arrangement for selecting: i) All the batteries in Auto Float Charge Mode ii) Battery-1 on Boost others on Auto Float Charge. iii) Battery-n on Boost others on Auto Float Charge	Test Case-27
1.1.2.3.3.1.1.1	The above arrangement shall be provided with a suitable inter-locking arrangement so that one of the batteries is always on Float. In case interlocking arrangement is not feasible due to the rack size, a provision of Alarm shall be made	Test Case-27

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	in the event of all the batteries are isolated accidentally.	
1.1.2.3.3.1.1.2	The capacity and number of batteries shall be as per order. For the purpose of Type Approval, it shall be taken as three batteries.	Information
1.1.2.3.3.1.2	FR/BC switching arrangement: This switching arrangement shall be provided for connection of FR/BC group to the Float bus for Auto Float Charge operation or Boost Charge bus for Boost Charging of the battery after its isolation from the Float Bus.	Information
1.1.2.3.3.2	Alarms: The following additional alarms shall be provided for Boost Charge operation FR/BCs. Functional Indications: FR/BCs in Boost Charge Mode Alarm Indication: a) Boost Load Voltage High (above 66V)/Low (below 44.4V)	Test Case-25
1.2	GENERAL REQUIREMENTS	
1.2.1	**Radio Frequency Interference (RFI) Suppression:** The system (FR/FC, FR/BC & DSCA modules) shall be designed to minimize the level of electromagnetic interference (EMI), both conducted and radiated, detected in its vicinity and generated by the module and shall comply the following clauses:	Certificates from accredited test labs are to be submitted.
1.2.1.1	**Conducted and Radiated Emission from the single phase and three phase Power equipment.**	Certificates from accredited test

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Name of EMC Standard: CISPR 32 (2015) with A1(2019) "Electromagnetic compatibility of multimedia equipment – Emission requirements; Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment". Limits: - i) To comply with Class A of CISPR 32 (2015) with A1(2019). ii) The values of limits shall be as per relevant tables under CISPR 32 (2015) with A1(2019). **Test Procedure:** Test setup, Test procedure & Measurements shall be conducted as per IEC-CISPR 32 (2015) with A1(2019).	labs are to be submitted.
1.2.1.2	**Conducted Susceptibility Limits:** Power equipment used in Telecom Network shall not malfunction when high voltage surge as specified below is superimposed at the input power mains to the power equipment, for more than two seconds as per IEC 61000- 4-18. The equipment shall also not fail or degrade in performance after the surge is withdrawn. **Test levels:** Voltage Rise time (First peak): 75 nano sec +/- 20%. Oscillation Frequencies: 100KHz & 1 MHz +/- 10% Repetition rate: at least 40/s for 100KHz and 400/s for 1 MHz	Certificates from accredited test labs are to be submitted.

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>Decaying: 50% of the peak value between the 3rd & 6th periods
Burst duration: not less than 2 s
Surge amplitude: 250V (-10%) to 2.5 KV (+10%)
Wave shape: Damped
Test Procedure: Test set up; test procedure & Measurements shall be as per IEC 61000-4-18. EMI surge of specified levels injected on power leads of test sample shall not cause degradation of performance or malfunction.</td><td></td></tr>
<tr><td>1.2.1.3</td><td>Electrostatic discharge (ESD) immunity limits:
The limits shall be as per IEC 61000- 4-2, 9(1) (both Contact discharge method and Air discharge method) as given below:
Test level:
<table>
<tr><td colspan="2">Contact discharge</td><td colspan="2">Air discharge</td></tr>
<tr><td>Level</td><td>Test voltage (KV)</td><td>Level</td><td>Test voltage</td></tr>
<tr><td>4</td><td>8</td><td>4</td><td>15</td></tr>
</table>
Test Procedure: This test shall be conducted as per IEC 61000-4-2 for both requirements & unit shall comply of clause 9(1) of IEC 61000-4-2</td><td>Certificates from accredited test labs are to be submitted.</td></tr>
<tr><td>1.2.1.4</td><td>Electrical fast transient/Burst immunity limits:
The limits shall be as specified in IEC 61000-4-4.
Test level:
<table>
<tr><td>Open–circuit output test voltage (+/-10%) &repetition rate of impulses (+/-20%)</td></tr>
</table></td><td>Certificates from accredited test labs are to be submitted.</td></tr>
</table>

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>
<table>
<tr><td rowspan="2">Level</td><td colspan="2">On Power supply port, Protection Earth</td></tr>
<tr><td>Voltage peak KV</td><td>Repetition rate KHz</td></tr>
<tr><td>4</td><td>4</td><td>2.5</td></tr>
<tr><td colspan="3">Rise time of one Pulse - 5 ns +/- 30%
Impulse duration - 50 ns +/- 30%</td></tr>
</table>
Test Procedure: This test shall be conducted as per IEC 61000-4-4. Test results shall be compliance of clause 9(1) of IEC 61000-4-4.
</td><td></td></tr>
<tr><td>1.2.1.5</td><td>Radiated radio-frequency Electromagnetic field immunity limits:
The limits as per IEC 61000-4-3.
Test level:
<table>
<tr><td colspan="2">Frequency range: 80 MHz to 1000 MHz</td></tr>
<tr><td>Level</td><td>Test field strength V/m</td></tr>
<tr><td>3</td><td>10</td></tr>
</table>
Test Procedure: This test shall be conducted as per IEC 61000-4-3. Test results shall be incompliance of clause 9(a) of IEC 61000-4-3.
</td><td>Certificates from accredited test labs are to be submitted.</td></tr>
<tr><td>1.2.1.6</td><td>Surge immunity limits: The limits as per IEC 61000-4-5.
Test level:
<table>
<tr><td>Level</td><td>Open circuit test voltage (+/- 10%) KV</td></tr>
</table>
</td><td>Certificates from accredited test labs are to be submitted.</td></tr>
</table>

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>
<table>
<tr><td>1</td><td>0.5</td></tr>
<tr><td>2</td><td>1.0</td></tr>
<tr><td>3</td><td>2.0</td></tr>
<tr><td>4</td><td>4.0</td></tr>
</table>
Voltage surge - 1.2/50 µs
Amplitude - 2 KV(DM)
- 4 KV(CM)

- After testing for 4KV, the amplitude shall also be increased to 6 KV (1.2/50 µs) Combined wave form as per IEEE C62.41- 1991 to cover Lightening/ Surge protection test also.

- Test results shall be incompliance of clause 9(b) of IEC 61000-4-5.

Test Procedure: This test shall be conducted as per IEC 61000-4-5. After testing for 4KV, the amplitude shall also be increased to 6 KV (1.2/50 µs) Combined wave form as per IEEE C62.41-1991(to cover Lightening/ Surge protection test also).

Note: The rated voltage of the MOVs used for the above shall not be less than 320V.</td><td></td></tr>
<tr><td>1.2.1.7</td><td>Radiofrequency Conducted Susceptibility immunity limits: The limits as per IEC 61000-4-6.

Test level:

<table>
<tr><td colspan="2">Frequency range: 150 KHz- 80 MHz</td></tr>
<tr><td>Level</td><td>Voltage level (e.m.f.)</td></tr>
<tr><td>3</td><td>10</td></tr>
</table>
</td><td>Certificates from accredited test labs are to be submitted.</td></tr>
</table>

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Test Procedure: This test shall be conducted as per IEC 61000-4-6. Test results shall be in compliance of clause 9(a) of IEC 61000-4-6.	
1.2.1.8	At the time of Type approval, the testing officer shall ensure that the power plant is in compliance of the clauses 1.2.1.1 to 1.2.1.7 given above.	Information
1.2.2	**Power Plant System Configuration:**	
1.2.2.1	The system shall employ a modular configuration to provide flexibility, keeping in view the future load requirements of D.C. Power.	Information
1.2.2.2	The FR/FC, FR/BC modules shall be accommodated in a rack. DSCA, for the ultimate capacity, shall be provided in first rack or in a separate rack as per manufacturer's design. AC and DC distribution may, however, be provided in First/separate rack or in the individual racks. In case, distribution arrangement is provided in First/separate rack, it shall be for the ultimate system capacity. In case the Distribution is provided in the individual racks DC distribution/switching shall be for the ultimate system capacity, while AC distribution shall be for fully equipped rack. All factory wiring for the rack shall be for the ultimate capacity so that only plugging-in of FR/FC or FR/BC module shall enhance the DC power output.	Physical Check
1.2.2.3	The requirement for Single Rack & Auxiliary Rack will be defined by purchaser, depending upon the	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	requirements and ultimate capacity of power plant.	
1.2.3	**Rack Configuration:** Rack is composed of following units, accommodated in 19" (482.6 mm) Sub-rack in general or as per the purchaser's requirement in specifi c if any.: a) Float Rectifier-cum-Float Charger (FR/FC) and/or Float Rectifier-cum-Battery Charger modules (FR/BC). b) b) Distribution, Switching, Control, Alarm and Monitoring (DSCA) unit.	Physical Check
1.2.4	**Constructional features:**	

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Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.2.4.1	Rack (Indoor and Outdoor): The rack structure shall be made up of rigid framework of steel profiles and shall be free of sharp edges or sharp corners. The structural strength of the rack shall be able to withstand the ultimate mechanical load capacity of the rack without any deformity. The rack shall have suitable ventilating arrangements (forced cooling from the sides is not permitted). The front door (if provided) and rear door may be of hinged or removable type. The gauge of metal sheet for load bearing part shall not be less than 1.5 mm and for rest of the parts shall not be less than 1.2mm. The unit may be floor-mounted or wall-mounted as specified by the purchaser. The unit may be either expandable or of ultimate size, as per purchaser's requirement". Sheet used in cabinet manufacturing should be Galvanized Iron (GI – 120gsm) for Outdoor Rack and GI/MS for Indoor Rack duly powder coated as per the colour given in clause no. 1.2.12.4.	Physical Check and Declaration from Manufacturer
1.2.4.1.1	The base of rack shall ensure uniform floor loading of not more than 975 kg/Sq meter. Lifting facilities shall be provided by removable eyebolt located at the top of the rack. The necessary arrangement for fixing the rack on the floor shall also be provided. The rack shall also be provided with bottom clearance of 110 mm with a tolerance of +/- 10mm.	Physical Check and Declaration from Manufacturer

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.2.4.1.2	"Indoor Rack: - The top of the rack shall be fully covered except for proper ventilation and bus bar or cable entries. Each air flow vent shall be covered by a grill to prevent foreign material larger than 5 mm dropping into the rack. Outdoor rack: - Rack shall be protected from dust & water complying to IP55 in accordance with IEC 60529.	Physical Check Certificates from accredited test labs are to be submitted for IP in accordance with IEC60529.
1.2.4.1.3	Indoor Rack: The rack shall be designed for easy maintenance and installation. Rack mounting arrangement shall provide easy access from front, rear and top for Installation and Maintenance. Outdoor Rack: The rack shall be designed for any maintenance and installation. Rack mounting arrangement shall provide easy access from front and rear for Installation and Maintenance.	Physical Check
1.2.4.1.4	The individual FR/FC module shall be easily mounted to/removed from the front side of the rack. The FR/FC module shall be designed to slide into the rack on a suitable mechanical arrangement. The associated AC input, DC output connections, Control, alarms & interface cable connecting the modules shall be connected/disconnected easily without causing any interruption in the supply and damage to load or other working module.	Physical Check
1.2.4.1.5	Proper thermal engineering of hardware design shall be done by the manufacturer so as to ensure the uninterrupted use of the equipment. The rack completes with all panels fitted shall be designed	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	to allow cooling by natural convection. For the systems, using 25A, 50A, 100A & 200A FR/FC, FR/BC modules force cooling is permitted. For Outdoor racks, use of temperature-based speed-controlled DC Fans are only permitted for the purpose. There shall be an arrangement for automatic Switching-OFF of fans during AC input failure. If required, individual modules may be separated by air baffle to provide effective convection. The manufacturer shall also ensure that the failure of fan does not cause any fire hazards. The failure of any of the fans shall draw immediate attention of the maintenance staff.	
1.2.4.1.6	Facility shall be made to connect external AC power at the top/bottom of rack and alarm cable & DC output distribution module at the top of the rack. Where cables pass through metal panels suitable bushing shall be provided to protect cables from damage. Busbars, if used, shall be suitably spaced, insulated and bushed (where it passes through holes) to prevent any possibility of short circuit between busbar and/or rack.	Information
1.2.4.1.7	**Indoor Racks:** With doors in position, all Visual alarms & meters shall be clearly visible. In case of hinged door meters & alarm indications are permitted on door provided, the fixtures on the door do not restrict the movement of door in any way.	Information

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>Outdoor Rack: - Meters and alarm indications (if any) shall remain inside the cabinet and shall not be positioned on the door.</td><td></td></tr>
<tr><td>1.2.4.1.8</td><td>Dimensions / Configurations:
Purchasing authority shall clearly specify the height of the rack as per his power room/equipment room requirements. The configuration of racks shall be as given below:
<table><tr><th>System Type</th><th>System capacity (Module Rating/ultimate system capacity)</th></tr><tr><td>Small Power plants systems</td><td>6.25A/25A (Single Phase);
12.5A/75A (Single Phase);
12.5A or 25A/100A (Single phase);
50A/100A (Single / Three phase);
25A / 150 A (Single phase) or
50A/150A (Single /Three phase);
25A / 200 A (Single phase) or
50A/200A (Single /Three phase);
50A / 300A (single/Three phase)
50A/450A (Single/ Three Phase);
50A/600A (Single /Three Phase)</td></tr><tr><td>Large Power plants systems</td><td>50A/800A (Single Phase/ Three Phase);
50A/1500A (Single Phase/ Three Phase); 100A/800A (Three phase);
100A/1500A (Three phase);
100A/3000A (Three phase);
200A/3000A (Three phase);
200A/4800A (Three phase)</td></tr></table></td><td>Information</td></tr>
</table>

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Note: Phase mentioned in brackets referred to rectifier module design. **Single phase:** Rectifier module is single phase **Three phase:** Rectifier module is three phase"	
1.2.4.2	**FR/FC, FR/BC Module:**	
1.2.4.2.1	The FR/FC, FR/BC modules shall be cooled by natural convection for smaller capacities i.e., 6.25A, 12.5A. FR/FC or FR/BC modules of 25A, 50A, 100A and 200A may have natural or forced cooling.	Physical Check
1.2.4.2.2	AC input to FR/FC or FR/BC shall be through composite type hot plug-in connectors. DC output shall be through hot plug-in connector on the FR/FC or FR/BC side and through lugged termination on the busbar/termination end. Control, alarm and monitoring connections shall only be through polarized connectors.	Physical Check
1.2.4.2.3	The FR/FC, FR/BC module shall be removable from the front of the rack only. All AC input, DC output and alarm/control/ monitoring cables interconnecting the modules and racks shall be easily disconnected by plugs or connectors.	Physical Check
1.2.4.3	**Distribution, Switching, Control, Alarm and Monitoring (DSCA)**	
1.2.4.3.1	The Distribution/Switching sub-system of DSCA shall preferably be modular but Control, alarm and monitoring sub-system shall only be modular. The Distribution/Switching sub- system may be	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	accommodated in a rack with other FR/FCs, FR/BC or in a separate rack. These sub-systems shall be rack mountable.	
1.2.4.3.2	DSCA shall preferably be housed in the upper portion of the rack above the FR/FC or FR/BC modules.	Information
1.2.4.3.3	DSCA shall be provided for the ultimate system capacity as explained in Clauses 1.2.2.2 and 1.2.2.3. All AC, DC or control/alarm cabling/wiring shall be pre-wired for the ultimate capacity so that mere plugging-in of FR/FC, FR/BC module shall add to the DC power output. It shall be ensured that the modules are not site specific.	Information
1.2.5	**Accessibility**	
1.2.5.1	All the termination points shall be easily accessible from front, rear or top.	Information
1.2.5.2	AC and DC terminals shall be separated by physical barriers to ensure safety.	Information
1.2.5.3	All the terminals except AC earth shall be electrically isolated.	Information
1.2.6	**Terminations:**	
1.2.6.1	**AC Terminations**	
1.2.6.1.1	The input terminals shall be clearly marked as R, Y, B & N for three phase and L and N for single phase as applicable.	Physical Check
1.2.6.1.2	AC input termination shall be suitably protected against the accidental touch/contact with the working staff for their protection & shall also have	Physical Check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	clear & prominent "DANGER" marking. AC terminations shall be through standard finger safe lock-in type connectors conforming to BIS or any other international standard, with the concurrence of CACT.	
1.2.6.1.3	Screening shall be provided between AC & DC components to prevent accident.	Information
1.2.6.1.4	The AC input connection to the rectifier module shall be by a composite type hot plug-in connectors and socket arrangement.	Information
1.2.6.1.5	All the connections between Distribution and FR/FC, shall be through proper rated cables only.	Information
1.2.6.1.6	Fuses and Circuit-breakers for each FR/FC, FR/BC shall be easily accessible and properly rated.	Information
1.2.6.1.7	Proper terminations for AC at the input of the circuit-breakers and its output to the FR/FC.	Information
1.2.6.2	DC Terminations	
1.2.6.2.1	The male connectors shall be mounted in the FR/FC, FR/BC module and female connectors be terminated to the cable.	Information
1.2.6.2.2	The DC output to Battery and Load shall be through cable/bus-bars up to the rack capacity of 450A ultimate capacity and bus-bar only for higher capacities or as per user's requirement. However, for inter-rack connections, cables of proper rating are permitted.	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.2.6.2.3	The provision for interconnection between exchange and FR/FC, FR/BC or battery (along with switching arrangement) and terminations for Exchange, Battery & FR/FCs, FR/BCs shall be made. The isolation of any of the battery from the load shall create an alarm.	Physical check
1.2.6.2.4	All DC +ve and –ve leads shall be clearly marked.	Physical check
1.2.6.3	All the AC, DC Control & alarm cabling shall be supplied with the rack.	Physical check
1.2.7	**Bus Bars:** Tinned Bus-bars or tinned High conductivity electrolytic copper strips with purity of 99.90% (min) as per BIS 613 latest issue, be able to withstand maximum Load current. The Bus-bar shall be capable to carry current density of 2 Amps/mm square but shall not be less than 25mmX5mm in any case. Nuts & bolts shall be of stainless steel with tinned copper washers only. The size of bus-bars chosen for battery and load path shall be capable to take care of the current of maximum power plant capacity for which it is designed. The Bus-bar/cable size shall also ensure that the voltage drop between the output of the farthest FR/FC module riser and also between battery and exchange riser, as per the layout drawing shall be less than 500mV. The tinning shall be in compliance of IS 1359: 1992 and its thickness shall be 10µm (minimum).	undertaking to be taken from OEM & Test Case-26
1.2.7.1	Bus-bar Riser height, wherever applicable, shall be 250 mm for both exchange and battery. Bus-bar	Physical check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Riser can should be used for higher capacity of exchange load and battery more than 450 Amp, if specified by purchaser. There shall be no bus-bar in outdoor units.	
1.2.8	**Cabling and Wiring:** All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current and voltage during fault and overload. All the wires and cables used shall be fire retardant as per IS 1554 with amendment 1 (June 94). All the cables & wires used shall also be Rodent & reptiles repellent. Uninyvin cables are also allowed to use in system."	Physical check
1.2.8.1	All wiring shall be neatly secured in position and adequately supported. Where wires pass through any part of metal panel or cover the hole through which they pass shall be suitably bushed.	Physical check
1.2.9	**Earthing** Proper Earth terminal (two in each rack), in effective electrical contact with framework, shall be provided. All metal parts of the components, which do not carry current, shall be bonded thereto. Nominal cross-sectional area of earth continuity conductor, not contained within the cable, shall be half (minimum) of each current carrying conductor to be protected but in no case, it shall be less than 3 mm diameter. Continuity conductor used for the purpose shall only be of	Physical check

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Clause No.	*Clause*	*Type of Test / Test No. etc.*
	copper. Suitable terminals shall be provided for terminating earth conductor.	
1.2.10	**Mounting of component & layout**	
1.2.10.1	Component mounting and fixing methods shall be secured.	Information
1.2.10.2	Suitable mechanical structure/ arrangement for holding modules in position shall be provided so that the module is held firmly by sliding through it.	Information
1.2.11	**Documentation** Technical literature in English and Hindi with complete layout, detailed block schematic and circuit diagrams of its assemblies with test voltages at different test points of the units shall be provided. Additionally, a soft copy /QR code on the system in respect of technical literature shall also be provided both in Hindi and English. ~~A soft copyas well as a hard copy of the above shall also be provided~~. All aspects of installation, operation, maintenance, trouble shooting, and repair shall be covered in this manual. The manual shall also include the following: **a) Installation, Operation and Maintenance manual part shall include:** i) Safety measures to be observed in handling of the equipment. ii) Precautions at the time of installation, operation and maintenance. iii) Required Test Jigs and fixtures.	Required documents to be provided by OEM.

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Clause No.	*Clause*	*Type of Test / Test No. etc.*
	iv) Procedures for routine maintenance, preventive maintenance, trouble shooting and replacement. v) Illustration of internal and external mechanical parts. vi) Complete layout, detailed block schematic and circuit diagrams of its assemblies with test voltages at different test points. vii) Circuit description and working of FR/FC module at various stages staring from AC mains input to the DC output with Block Schematic. viii) Circuit description and working of DSCA. ix) Instructions for the termination of Temperature compensation Probes at DSCA as well as battery. x) A Table giving details of size/dimension of maintenance of cables and Busbar used in the design. xi) Earthing Guidelines for the Power Plant as per BIS Specification. xii) Co-ordination distance (length & gauge of the cable to be used)/ de-coupling inductance between stage –I & Stage – II surge protection. **b) Repair manual:** i) List of replaceable parts used with the source of procurement. ii) Detailed ordering information for all replaceable parts for ordering of spares as and when required. iii) Procedure with flowchart for trouble shooting	

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	and sub-assembly replacement. iv) Test Instruments, Test fixtures, accessories and tools required for maintenance and repair. v) Systematic trouble shooting charts (fault tree) for probable faults and their remedial action. vi) Address and telephone numbers of Maintenance center.	
1.2.11.1	Hard copy of the documentation shall be prepared using good quality paper with clear and crisp printing. All the drawings in clear printing shall be attached to the hand-book binding. The binding of the manual shall be long lasting and presentable. One set of flow chart drawings necessary for troubleshooting shall be provided with lamination, with each manual.	Information
1.2.12	Quality Requirements	
1.2.12.1	**Components:** The component parts of the equipment shall be of professional grade of reputed manufacturer to ensure prompt and continuous service and delivery of spare parts. Use of potentiometer is precluded. Switching components used on the input side shall be rated at 600V (minimum).	undertaking to be taken from OEM
1.2.12.1.1	**Power transformers and Chokes:** Power transformers & chokes shall use class B or higher grade of insulation. The transformers and chokes shall be wound with copper wire and provided with adequate insulation.	undertaking to be taken from OEM
1.2.12.1.2	Fuses or circuit breakers shall be provided wherever appropriate for the protection against	Physical check and undertaking

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	failure of control/sensing circuit. Fuses shall conform to B.I.S specification.	to be taken from OEM
1.2.12.1.3	**Meters:** There shall be provision to monitor AC voltage of the system and DC current as well as voltage with the help of Digital meters to read the voltage and current of the System, any of the Battery or any of the individual FR/FC (at individual FR/FC module also permitted). Digital meter's display/resolution should be such that it is clearly and unambiguously readable from a distance of 1 meter. Normally the meters mounted at DSCA shall indicate the System voltage and current. a. **Current:** +/- 1.5% of the range or better, shall be able to read up to full digit for meter range 50A & above and 1 place decimal for lower meter range. b. **Voltage:** +/- 1.5% of the range or better with a resolution of one decimal point in case of DC voltmeter and full digit in case of AC voltmeters.	Physical Check and Test Case-4
1.2.12.1.4	**Component Approval:** The components used in SMPS Power Plant, shall be certified by recognized National/International Institutions. Components shall neither be combustible nor support combustion. NABL approved test reports are also be acceptable as an alternative to approval of CACT wing of BSNL.	undertaking to be taken from OEM

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.2.12.2	Quality and Workmanship: a) The equipment shall manufacture in accordance with international quality management systems ISO-9001-2015, for which the manufacturer shall be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. b) The equipment shall be manufactured as per the latest BSNL QA Guidelines indicated in Quality Manuals QM-118 (Quality reliability in product design), Manuals QM-202 (Pictorial guidelines for Visual assessment of quality of printed board assemblies (PBA) and discrete terminal assemblies), QM-204 (Guidelines for workmanship standards for repair & modification of printed wiring board assemblies), QM-205 (Guidelines for standard of workmanship for printed boards), QM-206 (Guidelines for standard of workmanship for printed boards assemblies), QM-207 (Guidelines for soft solder and fluxes for Telecom Equipment) and QM 210 (Guidelines for standard of workmanship for surface Mounting Devices). All wiring shall be neatly secured in position and adequately supported. Metal panel or cover holes through which the wires or cables pass shall be suitably bushed. c) All materials and workmanship shall be of	undertaking to be taken from OEM

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	professional quality to ensure the MTBF requirements.	
1.2.12.3	**Quality Assurance Tests:** Each of the units supplied against the specific order after type approval shall be inspected and tested to ensure that the requirements of this document have been met.	Physical check
1.2.12.4	**Finish and painting:** The finish of the structure and panels shall conform to the latest issue of IS 101 and IS 168. The structure and panels shall only be powdered coated. The thickness of powder coating shall be between 60 to 100 Micron for Indoor rack and 80 to 120 Micron for outdoor rack. The Colour used shall conform to IS 5 latest issues. Colour scheme shall be as follows: a. Rack & Door: Satin Blue, No. 177 b. Modules and inside: Shall harmoniously match with rack colour c. Outdoor Rack: - Light Grey (RAL7035)	Physical Check
1.2.12.5	**Marking and Labelling:**	
1.2.12.5.1	It shall be possible to locate each component on the PCB with the help of layout and circuit drawing. All terminals shall be properly sign-written, and all components properly labelled so that it shall be easy to identify them with reference to the supplier's Instruction and Maintenance Manuals. Designation of keys, switches and other components mounted on the front/inside panel	Physical check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	and their operating positions shall be clearly engraved or sign- written. The wiring shall be clearly and permanently identified with the designation or colour code which corresponds to the equipment circuit diagram. Where non-standard colours are used cable functions shall be clearly and permanently labelled at both ends.	
1.2.12.5.2	Fuse holder identification shall include details of fuse rating and type. In case of fuses on PCBs the rating shall be either on the fuse or PCB.	Information
1.2.12.5.3	A cabling diagram, screen printed or any other better arrangement ensuring better life expectancy shall be placed in the inside of the front door or any other convenient place for ready reference of the maintenance staff.	Physical Check
1.2.13	Name Plate A name plate anodized, screen printed or any other better arrangement ensuring better life expectancy shall be suitably fixed inside / on each rack & on each module and contain following information: 1. Specification Number: 2. Type of the Unit: 3. Manufacturer's name and identification: 4. Model No.: 5. Unit Serial No.: 6. TAC No. 7. Input voltage and phase: 8. Output Voltage and Current:	Physical Check

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	9. Year of manufacture:	
1.2.13.1	On the front top of the Rack an anodized, screen printed or any other better arrangement ensuring better life expectancy Designation plate in BOLD letters showing **"LARGE/ SMALL CAPACITY SMPS POWER PLANT SYSTEM, COMPATIBLE WITH (VRLA AND LI-ION BATTERY)/ (VRLA AND CONVENTIONAL LEAD ACID) BATTERIES"** shall be provided.	Physical Check
1.2.14	**Module Replacement Time & MTBF**	
1.2.14.1	**Module Replacement Time:** The mean time to replace / restore (MTTR) a faulty rectifier module shall be less than 20 minutes	undertaking to be taken from OEM
1.2.14.2	**MTBF (Mean Time between Failures):** MTBF of the system shall not be less than 100,000 hours. The MTBF for fans shall be better than 70,000 hours at 40-degree C. The MTBF shall be verified as per QM-115. MTBF, predicted and observed values shall be furnished along with calculations by the manufacturer. Based on these figures three years maintenance spares shall be specified by the equipment supplier. The equipment availability shall exceed 99.9%.	undertaking to be taken from OEM
1.2.15	**Field Observations.** For new products field observation may be carried out by purchaser.	Information
1.2.16	**Packing**	Information

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	Packing shall be done in accordance with latest guidelines for the SMPS Power Plants issued by QA wing of BSNL.	
1.2.17	**Environmental requirements** Each system shall be capable of operating in conditions conforming to TEC 14016:2010 (old no. QM-333:2010), category B2 or D whichever applicable. It shall also comply with vibration requirements of clause 12.0 of TEC 14016:2010 (old no. QM-333:2010), category B2 or D whichever applicable. The system shall also be capable of working in saline atmosphere of coastal areas and up to an altitude of 3000 Meters in compliance of TEC 14016:2010 (old no. QM-333:2010), category B2 or D whichever applicable. The environmental tests shall be performed by configuring the power plant as follows: (i) DSCA for ultimate capacity (ii) One FR/FC, FR/BC (Conventional Battery Power Plant) module	Undertaking to be taken from OEM
1.2.17.1	**Burn-in tests** The fully equipped rack shall be capable of withstanding a burn-in test for 72 hours at an ambient temperature of 50 µ C when the equipment is working at full rated load. This test may be performed in a temperature-controlled room with free air flow. The ambient temperature shall be measured at a distance of 1 foot from the equipment under test. The necessary set-up for	Test Case-19 & Test Case-20

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	the purpose shall be provided by the manufacturer. The temperature rise of the heat dissipating components above the ambient, measured directly or at heat sink in the first eight hours of the test, shall not be more than: a) **Transformers and Chokes:** 70 deg C for Grade B insulation. For higher grade of insulation, higher temperature rise may be permissible, subject to the following conditions: (i) It is at least 20 deg C below the permissible limit for the grade of insulation used. (ii) The temperature rise shall be at least 30 deg C below Curie temperature of the magnetic material. (iii) This temperature shall neither affect other components nor shall lead to fire hazard. b) **Semiconductor devices:** 60 deg C or as per component spec.	
1.2.17.2	**Insulation Resistance and Voltage Proof Tests:**	
1.2.17.2.1	**The insulation resistance test** The insulation resistance of a fully wired FR/FC, when tested with a 500V DC megger, shall be as given below: a) AC Input & Earth - Greater than 2 meg Ohm b) DC Output & Earth - Greater than 1 meg Ohm c) AC Input & DC output - Greater than 5 meg Ohm	Test Case-3

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.2.17.2.2	Voltage Proof Test: With EMI/RFI capacitors and MOVs/Trans Zorb removed from the circuit a test voltage of 1500V/50Hz is applied for one minute. - Between earth and interconnected output terminals. - Between interconnected input and output terminals. Alternatively, without removing EMI/RFI capacitors, the lightning protection circuitry and Trans Zorbs etc., but with EMI/RFI discharge resistors removed: **a)** A 2150V DC can be applied for one minute between interconnected input & output terminals. **b)** 650V DC can be applied for one minute between interconnected output terminals & earth. This DC voltage test is in accordance with UL 950 & IEC 950 Standards. No breakdown or abnormal temperature rise shall occur.	Test Case-30
1.2.17.3	Noise and Vibration The fully equipped rack at full load shall not contribute more than 15 dB (weighted) to the ambient noise level taken as 45dBA. It shall be measured at a distance of 1 meter from the unit & 1.25m above the floor level in the Acoustic Range. The correction factor for Total Noise when	Test Case-29

<table>
<tr><th>Clause No.</th><th>Clause</th><th>Type of Test / Test No. etc.</th></tr>
<tr><td></td><td>the ambient noise level is more than 45dBA, shall be as given below:
<table>
<tr><th>Ambient Noise</th><th>Correction Factor</th><th>Ambient Noise</th><th>Correction Factor</th><th>Ambient Noise</th><th>Correction Factor</th></tr>
<tr><td>45 dBA</td><td>0dB</td><td>51 dBA</td><td>1.41 dB</td><td>57 dBA</td><td>3.69 dB</td></tr>
<tr><td>46 dBA</td><td>0.18 dB</td><td>52 dBA</td><td>1.73 dB</td><td>58 dBA</td><td>4.17 dB</td></tr>
<tr><td>47 dBA</td><td>0.39dB</td><td>53 dBA</td><td>2.07 dB</td><td>59 dBA</td><td>4.68 dB</td></tr>
<tr><td>48 dBA</td><td>0.61 dB</td><td>54 dBA</td><td>2.43 dB</td><td>60 dBA</td><td>5.21 dB</td></tr>
<tr><td>49 dBA</td><td>0.86 dB</td><td>55 dBA</td><td>2.82 dB</td><td></td><td></td></tr>
<tr><td>50 dBA</td><td>1.12 dB</td><td>56 dBA</td><td>3.25 dB</td><td></td><td></td></tr>
</table>
Note: The correction Factor shall be added to the limit of 60 dBA to arrive at the limit when the ambient is greater than 45 dBA.</td><td></td></tr>
<tr><td>1.2.18</td><td>Safety Requirements: The equipment shall conform to relevant safety requirements as per IS/IEC 61204 : Part 7 : 2016 as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024'. ~~IS 13252-part 1:(2010) "information technology Equipment Safety Part 1: General Requirements (equivalent to IEC 62368) and IS 10437(1986) "Safety~~</td><td>Physical Check and Certificate / Undertaking to be taken from OEM</td></tr>
</table>

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	~~requirements for radio transmitting equipment" equivalent to IEC 60215.~~	
1.3	**SNMP and RS232/RS485 Modbus Communication Specifications for sequence of Exchange of information between Power Plant & Remote Site monitoring equipment**	Information
1.3.1	**Simple Network Management Protocol (SNMP):** Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior. Devices that typically support SNMP include cable modems, routers, switches, servers, workstations, printers, and more. SNMP is widely used in network management for network monitoring. SNMP exposes management data in the form of variables on the managed systems organized in a management information base (MIB), which describes the system status and configuration. These variables can then be remotely queried. Three significant versions of SNMP have been developed and deployed. SNMPv1 is the original version of the protocol. More recent versions, SNMPv2 and SNMPv3, feature improvements in performance, flexibility and security. Communication of information for remote monitoring through SNMP and RS232/RS485 is	Test Case-14

Clause No.	*Clause*	*Type of Test / Test No. etc.*
	explained through the block diagram is given in the standard of GR. No. 66110:2024.	
1.3.2	**Technical Specifications for SNMP:** i. All future SMPS shall be compatible with SNMP protocol. ii. System shall support both SNMP V2 or SNMPV3 or latest SNMP protocol. iii. Ethernet port of SMPS controller shall support 10/100Base-T or Gigabit Ethernet. iv. System shall have the option to assign both Static IP and Dynamic IP. v. SMPS Controller should have the option to assign minimum 3 trap destination IP & corresponding ports. vi. Controller shall support both IPv4 & IPv6 interface. vii. Each alarm trap should have unique SNMP & Trap OID. viii. OEM shall share Alarm OID and Trap OID to the purchaser for SNMP protocol and Modbus addresses for RS232/RS485 protocol as applicable.	Information
1.3.3	**RS232/RS485 Modbus:** RS 232 / RS485 Modbus communication interface at Baud rate of 9600 2 (minimum) shall be used for both monitoring & control between power plants and Remote site monitoring & control unit. The data format shall be as given in the standard of GR. No. 66110:2024.	Undertaking to be taken from OEM

Clause No.	*Clause*	*Type of Test / Test No. etc.*
1.3.4	List of alarms to be extended over (a) SNMP and (b) RS232 or RS485 MODBUS shall be given in the standard of GR. No. 66110:2024.	Visual inspection of the alarm

I. TEST SETUP & PROCEDURES:

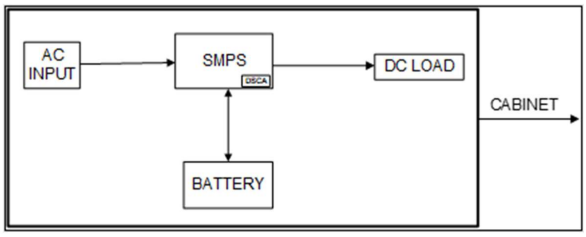
Note:

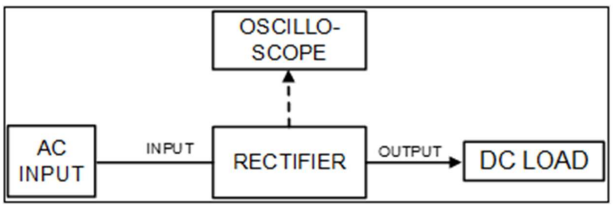
(a) The test set-up given in this document are tentative and may be changed by testing officer, taking into account, network/testers/ analyzer/simulator availability. In case of any discrepancy between this TSTP and GR, GR clause shall prevail.

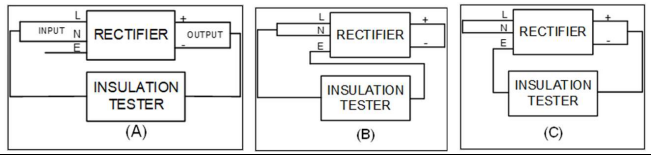
(b) Since this is provisional TSTP. On the basis of input received setup was prepared. Whenever the first testing was offered this provisional TSTP would be revised.

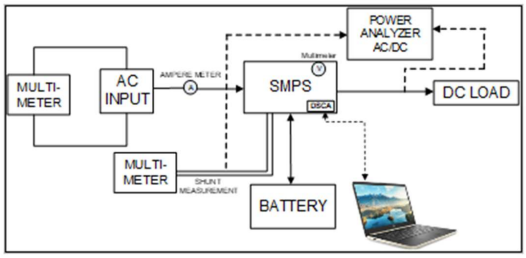
(c) Actual setup and tester/simulator may vary at the time of testing.

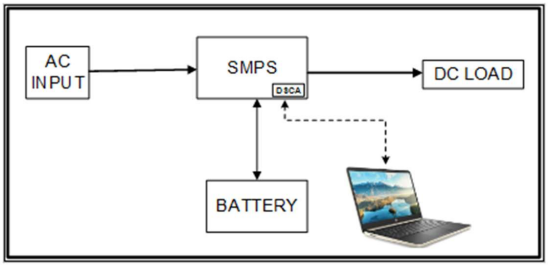
(d) Testing of SMPS power plant will be done on the basis on testing facility available for testing SMPS. If no testing facility is available for testing SMPS, the undertaking from OEM may be taken.

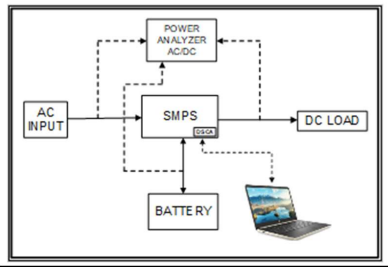
Test No.	**Test Case-1**
Test Details	Clause no. 1.1.2.2.1.2
Test Setup	
Test Procedure	1. Connect SMPS with AC input supply, Battery and DC load. 2. Connect Laptop to DSCA to monitor system parameter. 3. Monitoring of system alarm, parameter over DSCA display. 4. System information on DSCA SW version, FR/FC SW version, module rating, Battery detail.
Test limits	1. FR/FC module rating, Controller information should be as specified in GR. 2. Setting of all parameter shall be through DSCA
Expected Results	Check FR/FC module rating and parameter as specified in GR.

Test No.	Test Case-2
Test Details	Clause no. 1.1.2.2.1.1
Test Setup	
Test Procedure	1. Connect AC input supply to FR/FC module and DC load at FR/FC output. 2. Connect Oscilloscope across switching device. 3. Monitor the switching frequency of FR/FC module at PFC stage & at DC-DC converter stage.
Test limits	Switching frequencies of these power plants shall be 20 KHz and above
Expected Results	Switching frequency should be in limit as specified in GR

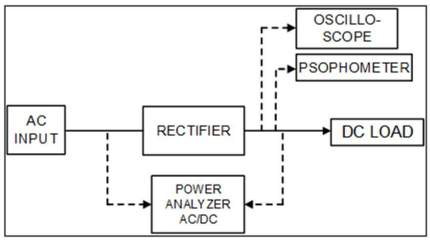
Test No.	Test Case-3
Test Details	Clause no. 1.2.17.2.1
Test Setup	
Test Procedure	1. Short AC input terminal and AC output terminal separately as shown in figure A, B & C. 2. Connect insulation tester between shorting terminal of AC input and DC output (figure-A). Now check insulation as per clause. 3. Connect insulation tester between shorting terminal of AC input & earth (figure-B). Now check insulation as per clause. 4. Connect insulation tester between shorting terminal of DC output & earth (figure-C). Now check insulation as per clause.
Test limits	1. AC Input & Earth - Greater than 2 meg Ohm 2. DC Output & Earth - Greater than 1 meg Ohm 3. AC Input & DC output - Greater than 5 meg Ohm
Expected Results	System should pass without any fault.

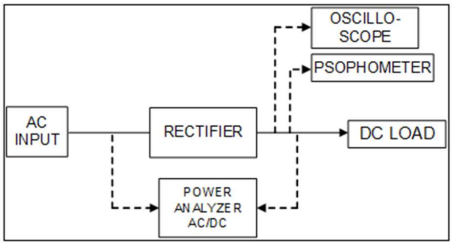
Test No.	**Test Case-4**
Test Details	Clause no. 1.2.12.1.3
Test Setup	
Test Procedure	1. Connect multimeter at AC input side to measure AC voltage. 2. Connect multimeter or analyzer/clamp meter at load path to measure DC output voltage and current. 3. Connect multimeter or analyzer at battery path shunt to measure mV for battery current measurement. 4. Check voltage, current over DSCA and compare with value showing in meter for accuracy.
Test limits	The Meters & Shunts shall comply with 1. Current: +/-1.5% of the range or better, shall be able to read up to full digit for meter range 50A & above & 1 place decimal for lower range. 2. Voltage: +/-1.5% of the range or better with a resolution of one decimal point in case of DC voltmeter and full digit in case of AC voltmeter.
Expected Results	Check measurement accuracy as specified in GR

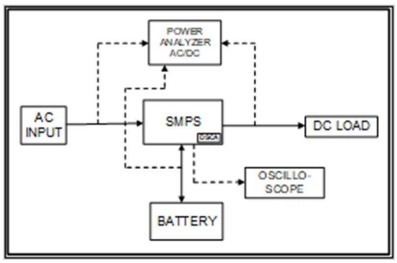
Test No.	**Test Case-5**
Test Details	Clause no. 1.1.2.2.6.2.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. With DSCA, change output voltage to (-56V +/-0.25V) 4. Check over voltage shutdown and monitor LED indication over module. 5. Monitor FR/FC fail alarm over DSCA display. 6. After verification of over voltage, restoration of module requires hard (manual) reset.
Test limits	In case output DC voltage exceeds –56V, the over voltage protection circuit shall operate and shut-off the faulty module
Expected Results	Faulty module will not impact on other module functionality.

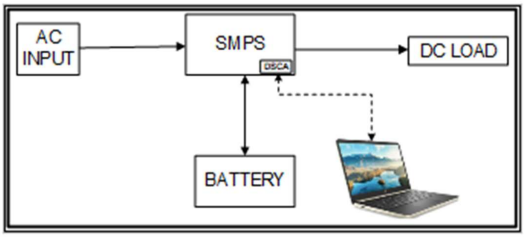
Test No.	**Test Case-6**
Test Details	For Clause no. 1.1.2.2.6.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS input and DC load to output of SMPS. 2. Connect Laptop to change or monitor system parameter and performance. 3. Connect power analyzer at AC input, DC output and battery. 4. Apply single phase AC mains input supply 230 V with variation from 120 V to 290 V with linear ~~applied~~ de-rating and frequency as 50 Hz +/-2Hz". Power plant will operate on specified range. 5. While increasing/decreasing AC input on above specified range with tolerance, FR/FC module will shut down with RED LED indication on the same. 6. Mains Fail alarm will generate on DSCA in above case during shutdown. 7. When AC input becomes nominal, FR/FC module operate and will charge battery and will power up DC load.
Test limits	1. A tolerance of +/- 5V is acceptable for protection & alarm operation. Reconnection shall occur at a voltage, 10V lower than the set voltage for high isolation limit and 10V higher than the lower set limit, to avoid hunting. 2. The circuitry used for sensing the voltage for operation

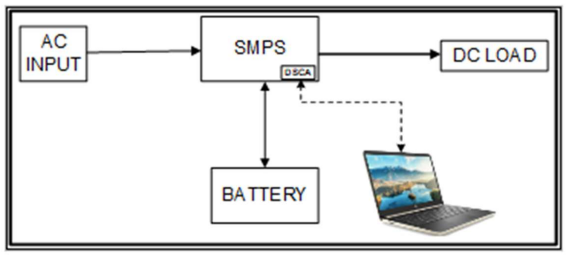
	of isolation/ reconnection device shall be able to withstand a voltage 15% higher than the specified extreme limit of isolation.
Expected Results	Power plant will work as normal during cut in after high/low cutoff range as specified in GR

Test No.	Test Case-7 for 3-phase FR/FC
Test Details	For Clause no. 1.1.2.2.9.3, 1.1.2.2.9.4, 1.1.2.2.9.6.1, 1.1.2.2.9.6.2, 1.1.2.2.9.8.1, 1.1.2.2.9.8.2
Test Setup	
Test Procedure	1. Connect Power analyzer between AC input and DC Output of FR/FC. 2. Connect Oscilloscope at output of FR/FC to measure ripple. 3. Measure efficiency of 3 phase FR/FC module separately as per GR. 4. measure input power factor on power analyzer. 5. Measure Psophometric Noise with meter. 6. Measure Vthd & Ithd through power analyzer.
Test limits	1. CHD: < or = 10% 2. VHD: < or = 10% 3. Peak to Peak: < or = 300mV 4. Psophometric Noise: < or = 4mV without Battery connected & < or = 2mV with Battery connected. 5. Float Voltage: 54.0V. 6. Charge Voltage: 55.2V. 7. Efficiency: As prescribed in the clause no. 1.1.2.2.9.3 8. Power factor: As prescribed in the clause no. 1.1.2.2.9.4 9. Three Phase/4 wire (Nominal 415V+10%): 374V to 457V, V1-380V, V2-415V, V3-450V
Expected Results	Check system performance and limit as specified in GR

Test No.	Test Case-8 for 1-phase FR/FC
Test Details	For Clause no. 1.1.2.2.9.3, 1.1.2.2.9.4, 1.1.2.2.9.6.1, 1.1.2.2.9.6.2, 1.1.2.2.9.8.1, 1.1.2.2.9.8.2
Test Setup	
Test Procedure	1. Connect Power analyzer between AC input and DC Output of FR/FC. 2. Connect Oscilloscope at output of FR/FC to measure ripple. 3. Measure efficiency of single-phase FR/FC module separately as per GR. 4. Measure input power factor on power analyzer. 5. Measure Psophometric Noise with meter. 6. Measure Vthd & Ithd through power analyzer.
Test limits	1. CHD: < or = 10% 2. VHD: < or = 10% 3. Peak to Peak: < or = 300mV 4. Psophometric Noise: < or = 4mV without Battery connected & < or = 2mV with Battery connected. 5. Float Voltage: 54.0V. 6. Charge Voltage: 55.2V. 7. Efficiency: As prescribed in the clause no. 1.1.2.2.9.3 8. Power factor: As prescribed in the clause no. 1.1.2.2.9.4 Note: Mark with NA whichever parameter is not applicable
Expected Results	Check system performance and limit as specified in GR.

Test No.	**Test Case-9**
Test Details	Clause no. 1.1.2.2.9.7.2, 1.1.2.2.9.7.3, 1.1.2.2.9.7.4
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS. 2. Connect power analyzer between AC input and DC output to Battery & DC load of SMPS. 3. Connect Laptop on DSCA or through DSCA display to change RM output voltage 4. Measure transient response as per respective clause when load switch ON 5. Now change in AC input through AC source as per GR and respective clause and output voltage of SMPS. 6. Now change AC input voltage of SMPS through AC source and check output voltage of SMPS for overshoot and undershoot at specified load mention in GR.
Test limits	1. The Step Load change of 25 to 100% shall not result in DC output voltage Over Shoot / Under Shoot of not more than + / - 5% and return to steady state value within 10mS without resulting the unit to trip. 2. If value not capture in CRO then write you observation (not traceable).
Expected Results	Check system parameter and limit as specified in GR

Test No.	**Test Case-10**
Test Details	Clause no. 1.1.2.2.5.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and turn on DC load. 2. Connect laptop to DSCA to change LVD setting (if required) or through DSCA display. 3. Set LVD disconnect setting at any value within range as specified in GR. 4. Turn off AC supply and turn on DC load to discharge battery. 5. When battery reach to lower threshold, LVD will operate and DC load will isolate from battery. 6. Now turn on AC input supply, FR/FC will power on and LVD will reconnect at defined threshold.
Test limits	1. In above case battery isolation alarm shall be created. 2. There shall be provision for Automatic Isolation / reconnection of each battery from the load. The DC contactor (for each Battery) used for the purpose shall be of single pole only.
Expected Results	Check system parameter and limit as specified in GR

Test No.	**Test Case-11**
Test Details	Clause no. 1.1.2.2.5.5
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect laptop to DSCA to change current limit or through DSCA display. 3. Set battery charging limit (~~5~~10% - 50%) in step as per AH capacity. Set charging limit at 10% for testing purpose. 4. Turn on AC input supply and check battery charging current limit.
Test limits	Battery path current is kept between ~~5~~10% to 50% of battery AH capacity.
Expected Results	Check system parameter and limit as specified in GR

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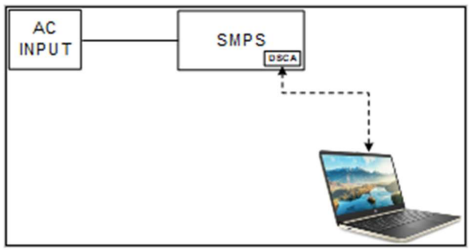
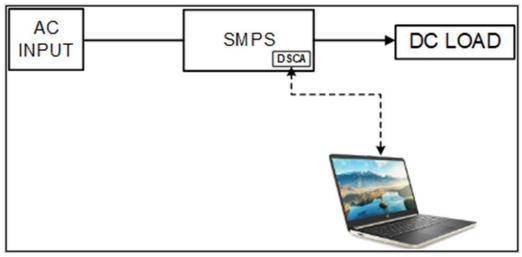
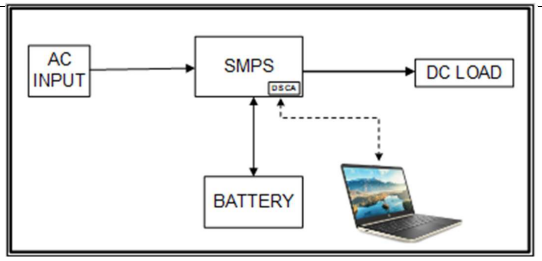
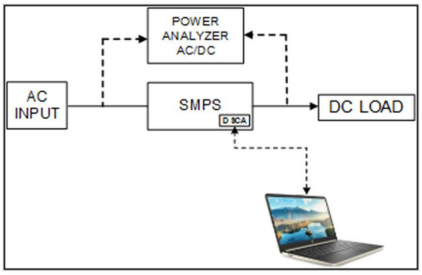
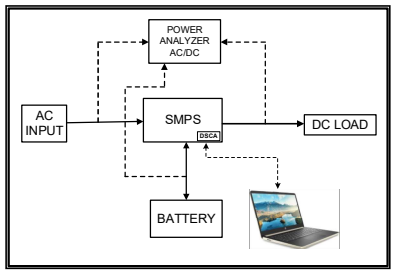
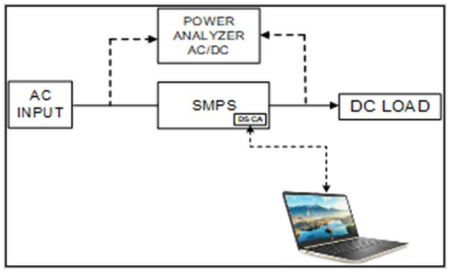
Test No.	**Test Case-12**
Test Details	Clause no. 1.1.2.2.5.6
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS. 2. Check system voltage at different temperature during float & charging operation. The voltage will increase when temp decrease and vice versa as per value provided in GR. 3. Check mV also at different temperature range as per test cases.
Test limits	1. The output voltage of the rectifier in Float/Charge operation shall decrease or increase at the rate of 72mV (3mV/cell, 24 cell battery) per degree increase or decrease in temperature over the set voltage. 2. The open circuit voltage range shall be settable between 2.1V/cell to 2.2V/cell 3. When the output voltage reaches 55.8V, due to increase in the output voltage owing to decrease in temperature, it shall get locked at this voltage & any further decrease in temperature shall not lead to further rise in the output voltage of the power plant. 4. A tolerance of +/ - 5mV may be acceptable over the specified rate of 72mV/deg C. 5. The above limits may be taken as reference only. For the actual limits the relevant Clauses of the latest TEC GR with amendments if any, shall be referred.
Expected Results	Check system parameter and limit as specified in GR.

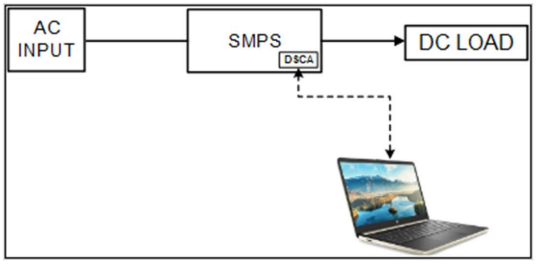
Test No.	**Test Case-13**
Test Details	Clause no. 1.1.2.2.4.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect Laptop to DSCA to check module sharing load or through DSCA display. 3. Turn on AC supply and DC load. 4. Check FR/FC module sharing load from 50% to 100% on DSCA.
Test limits	The current sharing shall be within +/- 10% of the average current per rectifier module in the system when loaded between 50 to 100% of its rated capacity.
Expected Results	Check system parameter and limit as specified in GR.

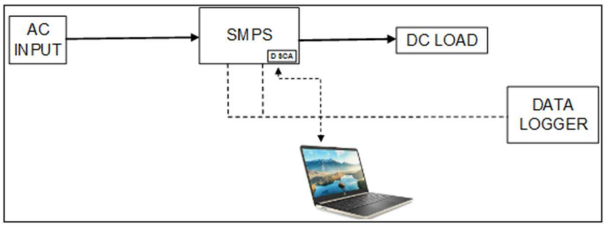
Test No.	**Test Case-14**
Test Details	For Clause no. 1.1.2.2.1.2, 1.1.2.2.5.3, 1.1.2.2.8.1, 1.3.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect Laptop to DSCA to check system parameter load or through DSCA display. 3. Check DSCA and FR/FC SW version. 4. Monitor the SMPS & battery parameter on SNMP or RS-485/RS-232 as applicable as per GR.
Test limits	The system shall be RS 485/RS 232 and Ethernet (SNMP) compatible.
Expected Results	Check system parameter and limit as specified in GR

Test No.	**Test Case-15**
Test Details	For Clause no. 1.1.2.2.9.2.3
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect Power analyzer between AC input and DC Load. 3. For load regulation test, provide nominal AC input voltage 230Vac to SMPS. Once DC voltage build up, connect DC load of 25% of full capacity. Now measure DC output voltage. 4. In above test at same AC supply, now increase DC load to 100% and measure DC output voltage.
Test limits	The DC output voltage at the terminals shall be maintained within +/-1% of the half load preset voltage from 25% load to full load condition when measured over the full-specified input range.
Expected Results	Check system performance and limit as specified in GR

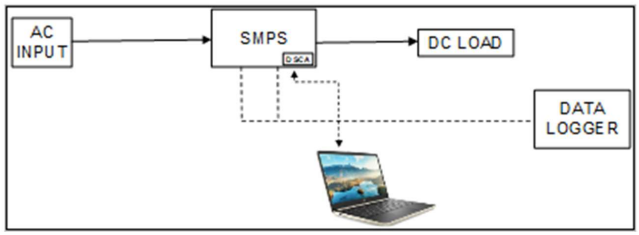
Test No.	**Test Case-16**
Test Details	For Clause no. 1.1.2.2.9.1.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect Power analyzer between AC input, Battery and DC Load. 3. Provide varying AC input to SMPS and DC output parameter. 4. Create unbalance of 10% on input AC side and check FR/FC module working at this unbalance AC input voltage.
Test limits	1. FR/FC, FR/BC modules shall work satisfactorily for unbalance of +/- 10% of nominal input. 2. Neutral phase current shall not exceed 100mA under all specified input and load conditions.
Expected Results	Check system performance and limit as specified in GR.

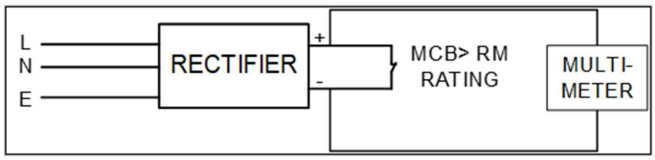
Test No.	**Test Case-17**
Test Details	Clause no. 1.1.2.2.1.2 (for microprocessor failure), 1.1.2.2.4.2
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect laptop to DSCA or through controller display to monitor rectifier parameter and alarms. 3. Turn on AC input supply, check default voltage of rectifier. Now turn on DC load and check load sharing. 4. Now remove controller to check rectifier default voltage and same load must be supplied by the rectifier. DC load should remain power on.
Test limits	1. In the event of failure of DSCA, FR/FC, FR/BC modules' parameters shall not be disturbed. 2. All the FR/FC FR/BC modules shall take care of the load on default settings and share the load collectively.
Expected Results	Check system parameter and limit as specified in GR.

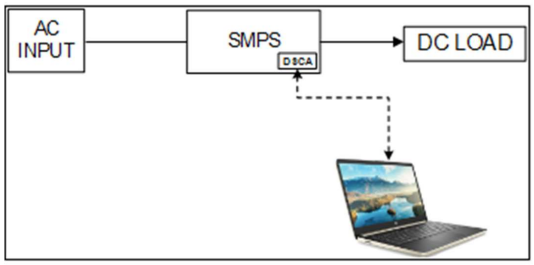
Test No.	**Test Case-18**
Test Details	Clause no. 1.1.2.2.6.4 (overload), 1.1.2.2.9.9
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and DC load to output of SMPS. 2. Connect Laptop on DSCA or through DSCA display to change FR/FC output voltage. 3. Set current limit from 50% from 100% & DC output of rectifier from 44.4V to 56V through DSCA. For test purposes upper limit of 100% + 5% and lower limit of 50% - 5% shall be acceptable. 4. Measure voltage droop while increasing the load as per Test Case-18 5. Overload protection test will also be applicable with this test.
Test limits	1. Shall be settable between 50% to 100% of rated Output Current (45% to 105% for test purpose) for Output Voltage range of -44.4V to -56.0V. 2. Further increase in Load shall not increase the Current and should result only in further Voltage Droop. 3. Test shall be performed at 100% setting in case of Auto Float Charge Mode and 50% for Manual Boost Mode (for FRBC).
Expected Results	Check system parameter and limit as specified in GR.

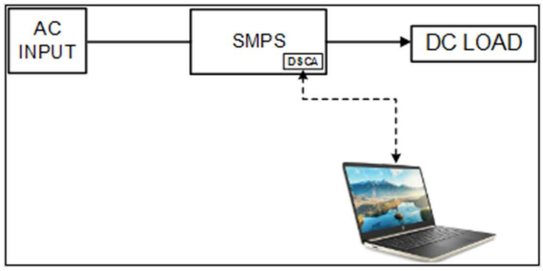
Test No.	**Test Case-19**
Test Details	Clause no. 1.2.17.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and DC load to output of SMPS. 2. Connect thermocouple as per detail mention in GR. 3. Data should be logged as per detail mention in GR.
Test limits	The Temperature rise of the heat dissipating components above the ambient measured directly or at Heat Sink in the first eight hours of the test shall not be more than: 1. Transformers & Choke: 70 Deg. C for Grade B insulation. For Higher grade of insulation, higher temperature rise may be permissible subject to the following conditions: i. It is at least 20 Deg. C below the permissible limit for the grade of Insulation used. ii. The temperature rise shall be at least 30 Deg. C below Curie temperature of the Magnetic material. iii. This temperature shall neither affect other components nor shall lead to fire hazard. 2. Semiconductor devices: 60 Deg. C above the outside Ambient temperature or as per Component Specification.
Expected Results	The Unit under test shall be subjected to Heat run for first 8 Hours of Elevated Burn-in at full load. All temperature readings shall be recorded in Deg. C. Reading are to be recorded for every 15 minutes for first 2 Hours and every hour interval for

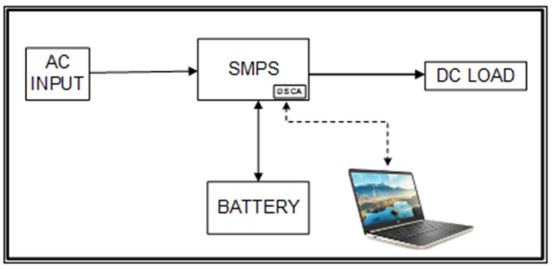
	remaining 6 hours as specified in GR.

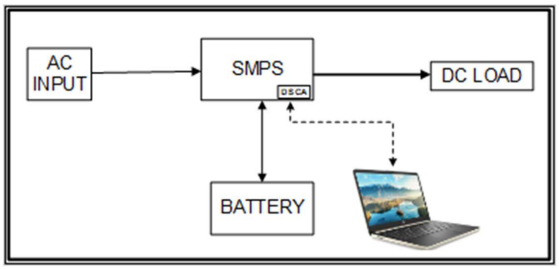
Test No.	**Test Case-20**
Test Details	Clause no. 1.2.17.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and DC load to output of SMPS. 2. Data should be logged as per detail mention in GR. 3. Fully equipped rack should be run for 72 hr with loading as per ultimate capacity.
Test limit	1. The Burn-In Test shall be conducted in Power "On" condition at full Load (Ultimate System Capacity of the Power Plant), by placing the Power Plant in Burn-In Chamber at 50 Deg +/- 2 Deg. Centigrade. 2. The AC Mains input Voltage shall be 230V in case of Single Phase and 400V in case of three Phase Power Plant. 3. All the Input & Output Parameters shall be recorded throughout the Burn-in test. 4. No of FR/FC Module will be as per system capacity.
Expected Results	Check system performance and limit as specified in GR

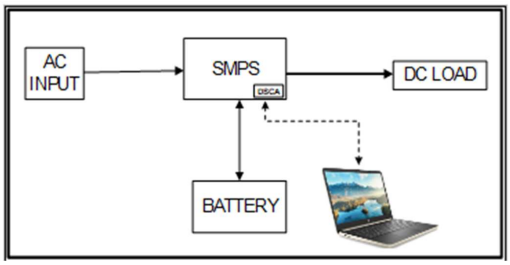
Test No.	Test Case-21
Test Details	Clause no. 1.1.2.2.9.9.2
Test Setup	
Test Procedure	1. Connect nominal AC supply at FR/FC module separately. 2. Terminate DC output (+ & -) both at single MCB (MCB rating should higher than module rating to avoid trip during short circuit condition. 3. Now switch on AC supply and check DC Output voltage. It should be nominal. Now switch on MCB connected at DC output of module. 4. Check DC output Voltage with multimeter, it should be zero. 5. When test complete, switch off MCB and DC output should be nominal.
Test limits	Ensure that short circuit shall not lead to any excessive temperature rise or fire Hazard.
Expected Results	Check system performance and limit as specified in GR

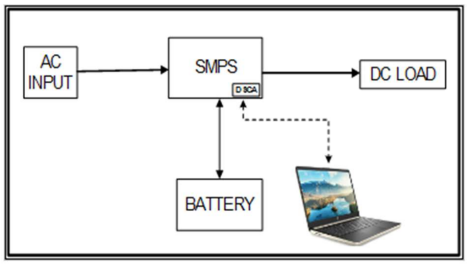
Test No.	**Test Case-22**
Test Details	Clause no. 1.1.2.3.2.2.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and DC load to output of SMPS. 2. Connect Laptop on DSCA or through DSCA display to change FR/FC output voltage. 3. Set current limit to 100% & DC output of FR/BC range from 44.4V to 56V through DSCA. 4. Set current limit to 50% & DC output of FR/BC range from 56V to 64.8V through DSCA.
Test limits	Boost charger its output voltage shall be continuously adjustable and pre-settable at constant current up to 100% for voltage range 44.4V to 56V and up to 50% of the rated capacity at any value in the range 56V to 64.8V.
Expected Results	Check system performance and limit as specified in GR.

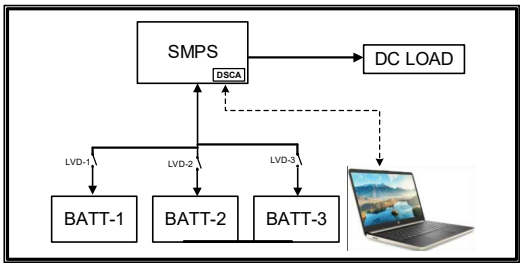
Test No.	**Test Case-23**
Test Details	Clause no. 1.1.2.3.2.3, 1.1.2.3.2.3.1
Test Setup	
Test Procedure	1. Connect AC input supply to SMPS and connect DC load. 2. Connect Laptop to DSCA to check module sharing load or through DSCA display. 3. Turn on AC supply and DC load. 4. Check FR/FC module sharing load from 50% to 100% on DSCA and voltage range from 52.8V to 55.2V 5. Check FR/FC module load sharing at 64.8V with 50% loading.
Test limits	The Current Sharing (Load Sharing) shall be within +/-10% of the average current per Rectifier Module individual capacity of each Rectifier Module in the System (mounted in the same or different Racks) when loaded between 50 to 100% of its rated capacity for all input and Output conditions. Considering derating factor, 75% & 100% loading shall not applicable at this voltage.
Expected Results	Check system performance and limit as specified in GR

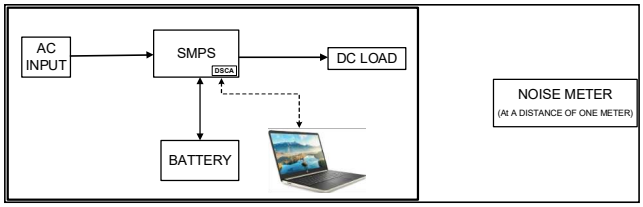
Test No.	**Test Case-24**
Test Details	Clause no. 1.1.2.3.2.4, 1.1.2.3.3.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Check over voltage shutdown and monitor LED indication over module. 4. Monitor FR/FC fail alarm over DSCA display. 5. Apply DC load and check overload/voltage drop of FR/BC module. 6. Check FR/FC for auto float mode and Selection and switching a Group of FR/BC for Boost or Float Charge operation.
Test limits	1. Indication (a) Mains available shall be provided on both DSCA & FR/FC/BC Module 2. FR/BC Over voltage 3. FR/BC Overload The above limits may be taken as reference only. For the actual limits the relevant Clauses of the latest TEC GR with amendments if any, shall be refer.
Expected Results	Check system performance and limit as specified in GR

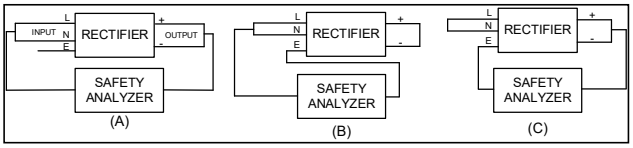
Test No.	**Test Case-25**
Test Details	Clause no. 1.1.2.3.3.2
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Check load voltage high and check load voltage low at defined threshold. 4. Monitor FR/FC fail alarm over DSCA display.
Test limits	1. Boost Voltage high alarm at 66V. 2. Boost Voltage low alarm at 44.4V. The above limits may be taken as reference only. For the actual limits the relevant Clauses of the latest TEC GR with amendments if any, shall be referred.
Expected Results	Check system performance and limit as specified in GR.

Test No.	**Test Case-26**
Test Details	Clause no. 1.2.7
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Measure mV drop between battery and exchange riser. 4. Measure mV drop between the output of the farthest FR/FC Module and Exchange riser.
Test limits	The Load in each Battery path shall be taken as 70% of the Ultimate System Capacity of Power Plant offered.
Expected Results	Check system performance and limit as specified in GR.

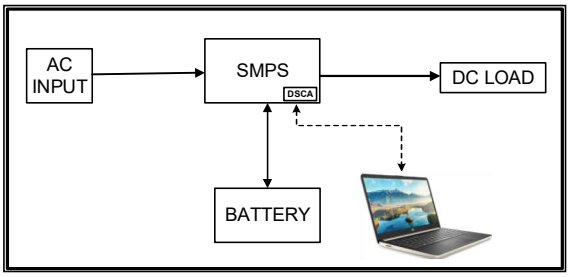
Test No.	**Test Case-27**
Test Details	Clause no. 1.1.2.3.3.1.1, 1.1.2.3.3.1.1.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Initially both batteries will undergo into float charging mode. 4. During Boost charging requirement, a LVD will operate and both batteries will isolate before undergo into boost charging. 5. After boost charge finish, LVD will again connect and both batteries will undergo into float charging mode.
Test limits	1. Float and Boost mode voltage is given for reference only while actual value can set as per connected battery float & mode requirement. 2. After Boost charger finish, LVD will operate and both batteries will undergo into float charge mode.
Expected Results	Check system performance and parameter as specified in GR.

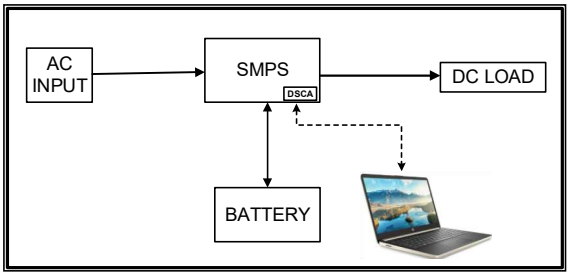
Test No.	**Test Case-28**
Test Details	Clause no. 1.1.2.2.2.1
Test Setup	
Test Procedure	1. Connect SMPS with 3 NOS of battery and power on DC load. 2. Simulate test command in such a way so that when command-1 execute one LVD will operate and one battery connected to that LVD will isolate from DC load. 3. Now simulate 2nd test command in such a way so that when command-2 execute 2nd LVD will operate and one more battery connected to that LVD will isolate from DC load. 4. In above two condition, two battery has isolated from load. Now simulate commnad-3 to disconnect 3rd LVD. However, this time LVD will not operate and battery will remain connected in circuit to supply power to DC load.
Test limits	Necessary interlocking arrangement for batteries shall be provided so as to ensure that at-least one battery remains floated across the load under all working conditions.
Expected Results	Load will remain power up during disconnection of battery as specified in GR.

Test No.	**Test Case-29**
Test Details	Clause no. 1.2.17.3
Test Setup	
Test Procedure	1. Connect nominal AC input supply to SMPS and connect DC load at output. 2. Set noise meter at distance as specified in GR. 3. Turn on AC input supply & turn on DC load. 4. Connect Laptop to monitor system performance. 5. In all Operating condition of SMPS at different loading and voltage as per GR and measure noise.
Test limits	Noise shall be measured at a distance of 1 meter from the unit & 1.25m above the floor level in the Acoustic Range. The fully equipped rack at full load shall not contribute more than 15 dB (weighted) to the ambient noise level taken as 45dBA.
Expected Results	For result and limit, please refer GR.

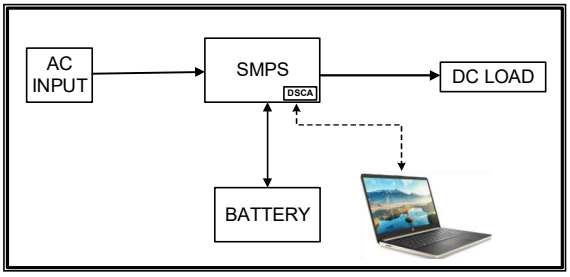
Test No.	Test Case-30
Test Details	Clause no. 1.2.17.2.2
Test Setup	
Test Procedure	1. Short AC input terminal and AC output terminal separately as shown in figure A, B & C. 2. Connect HV tester between shorting terminal of AC input and DC output (figure-A). Now check voltage proof test as per clause. 3. Connect insulation tester between shorting terminal of AC input & earth (figure-B). Now check voltage proof test as per clause. 4. Connect insulation tester between shorting terminal of DC output & earth (figure-C). Now check voltage proof test as per clause.
Test limits	1. For HV test, it shall be performed by removing EMI/RFI Capacitors and MOVs/Tran zorbs from the circuit. For DC voltage without removing EMI/RFI Capacitors, the Lightning Protection Circuitry and Tran zorbs etc., but with EMI/RFI discharge resistors removed, test shall be conducted. 2. Voltage Proof was conducted by applying 1500V / 50Hz, with Power Supply connection; All communicable cable of DSCA shall be removed and connections to Fan Control Board and AC Auxiliary Supply card shall also remove. 3. 2150V DC can be applied for one minute between interconnected input & output terminals. 4. 650V DC can be applied for one minute between interconnected output terminals & earth.

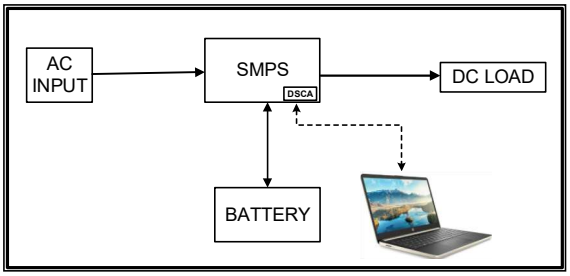
	This DC voltage test is in accordance with UL 950 & IEC 950 Standards. No breakdown or abnormal temperature rise shall occur.
Expected Results	System shall pass with no breakdown or abnormal temperature rise shall occur as per GR.

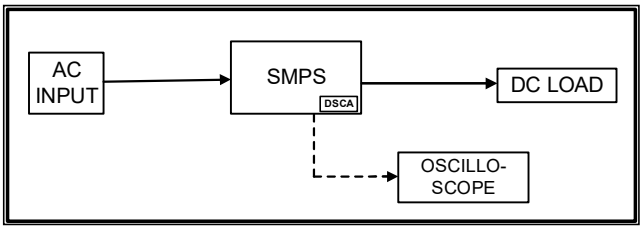
Test No.	**Test Case-31**
Test Details	Clause no. 1.1.2.2.7.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Switch on AC input mains supply and check indication over DSCA and FR/FC or FR/BC module. 4. Check battery charging in auto float mode. 5. Check battery charging in auto charge mode/boost mode.
Test limits	1. Mains available shall be provided on both DSCA & FR/FC/BC Module while 2. "FR/FC On Auto Float" 3. "FR/FC On Auto Charge", may be provided either on DSCA or on both FR/FC & DSCA.
Expected Results	All above alarm indication shall be available on DSCA or FR/FC module as specified in GR.

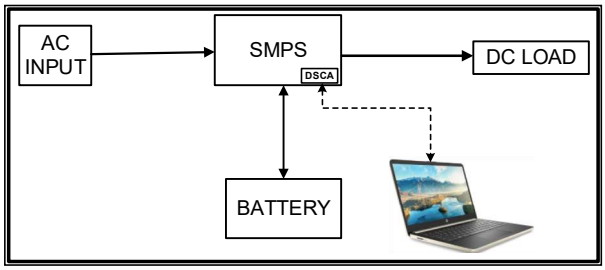
Test No.	Test Case-32
Test Details	Clause no. 1.1.2.2.7.2
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to DSCA to change or monitor parameter or through controller display. 3. Check LED indication over FR/FC module for a. LED Green - Healthy b. LED Amber - Warning c. LED Red – Major 4. On DSCA increase voltage to 56V for load voltage high and 45.6V for load voltage low and check system performance. 5. Increase/decrease AC input voltage and check alarm for Mains out of range on DSCA 6. Increase DC load to check system overload alarm on DSCA. 7. For Mains On/and battery discharge test, increase DC load over the system capacity and check alarm on DSCA. 8. For OD system (if applicable), while FAN running, stop one FAN manually for FAN fail alarm at rack level. 9. Remove temp sensor and check Temp sensor fail alarm on DSCA. 10. With DSCA setting, disconnect BLVD and check battery isolation or no battery over DSCA.

	11. For SPD fail, remove on SPD module and check alarm over DSCA.
Test limits	1. LED indication shall be available on FR/FC module 2. DC Over Voltage alarms shall operate within + or - 0.25Volts of the nominal set value. 3. Overload, Mains On & Battery discharge alarm will be available on DDCA. 4. Fan fail, Temp sensor fail alarm will be available on DSCA. The above limits may be taken as reference only. For the actual limits the relevant Clauses of the latest TEC GR with amendments if any, shall be referred.
Expected Results	All indication and alarm shall be available on FR/FC module or DSCA as specified in GR

Test No.	**Test Case-33**
Test Details	Clause no. 1.1.2.2.6.2.2
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to change or monitor system parameter and performance. 3. Now power on AC input and check normal working of all module supply power to DC load. 4. Set voltage to one FR/FC module to cutoff range so that it will becomes faulty. 5. If one module gets faulty, other connected FR/FC module will support load and battery charging.
Test limits	1. One module will shut down on overvoltage protection. 2. Other module will support battery charging and DC load.
Expected Results	If one module gets faulty another FR/FC module will support DC load as specified in GR.

Test No.	**Test Case-34**
Test Details	Clause no. 1.1.2.2.7.7
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Laptop to change or monitor system parameter and performance. 3. Now power on AC input and check normal working of all module with connected DC load. 4. Generate PFC alarm as specified in GR.
Test limits	PFC alarm shall be as per GR.
Expected Results	Check PFC as specified in GR.

Test No.	Test Case-35
Test Details	Clause no. 1.1.2.2.9.7.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect Oscilloscope at DC output of SMPS to measure voltage buildup time. 3. Turn on AC input supply and measure DC output build up time on Oscilloscope.
Test limits	1. FR/FC module input current and output voltage shall reach their nominal value within 10 seconds. 2. The maximum instantaneous current during start up shall not exceed the peak value of the rectifier input current at full load for the lowest input voltage specified.
Expected Results	DC Voltage will buildup and DC current within specified duration as specified in GR

Test No.	**Test Case-36**
Test Details	Clause no. 1.1.2.2.9.2.2, 1.1.2.2.9.9.1
Test Setup	
Test Procedure	1. Connect AC input to SMPS and DC load to output of SMPS. 2. Connect laptop to DSCA to change current limit or through DSCA display. 3. Check battery charging on auto charge mode to Boost mode. 4. When boost charge finish, battery turn to float mode charging. 5. Battery charging current limit shall be adjustable through Laptop or DSCA display.
Test limits	1. During Auto charge mode battery & equipment voltage reaches set value, which is normally 2.3V/cell (-55.2V, this value shall be settable between -48V and -56V). 2. Boost charge setting shall be settable through Laptop or DSCA display.
Expected Results	Check Boost charging and setting through DSCA display as specified in GR.

J. Summary of test results

GR/~~IR~~ No._____

TSTP 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/ Authorized signatory as part of in-house test results along with Form-A. The Authorized signatory shall be the same as the one for Form 'A'.