FOREWORD

Power Supply plays a significant role in the efficient working of Railway Signalling System. Integrated Power Supply (IPS) is being progressively installed on Indian Railways due to its compact design and reliability. Failure of IPS may affect the punctuality of trains; hence staff maintaining it should have a thorough knowledge about the system.

CAMTECH is continuously making efforts in documentation and upgradation of information on advanced maintenance practices. The current version of handbook on IPS is a further step in this direction.

The information given in this handbook should reach to the appropriate levels and will help signal personnel in installing and maintaining the above system.

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CAMTECH GWALIOR ***S.C.SINGHAL***
DATE: 31.03.2009 ***EXECUTIVE DIRECTOR***

PREFACE

The RDSO designed and developed Switch Mode Power Supply (SMPS) based Integrated Power Supply (IPS) provides uninterrupted power supply to the signalling system as compared to conventional power supply system, which has its own drawbacks. IPS system has added features of remote monitoring, alarms and display messages which help the maintenance staff in maintenance and troubleshooting.

A maintenance handbook on the subject was developed by CAMTECH in December 2002 which was subsequently reviewed in April 2007. In view of feedback received from various railways a need was felt to incorporate the latest developments in this field and with the approval of RDSO the handbook was again reviewed. In this version, vendor specific troubleshooting and maintenance schedule approved by Railway Board have also been included.

It is clarified that this handbook does not supersede any existing provisions laid down in Signal Engineering Manual, Railway Board publications and RDSO publications. This handbook is not statutory and instructions given in it are for the purpose of guidance only.

We are sincerely thankful to Shri Vipul Goel, Director (Signal)/ RDSO, M/s Amara Raja Power Systems Pvt. Ltd., Tirupati.(A.P.), M/s Statcon Power Controls Ltd., Noida (U.P.), M/s HBL Nife Power System Ltd. Hyderabad (A.P.) and field personnel who helped us in the revision of this handbook.

Since technological upgradation and learning is a continuous process, you may feel the need for some addition/modification in this handbook. If so, please feel free to write us. We shall be highly appreciating your contribution.

CAMTECH GWALIOR ***JAGMOHAN RAM***
DATE: 31.03.2009 ***DIRECTOR (S&T)***

DISCLAIMER

It is clarified that information given in this handbook does not supersede any existing provisions laid down in Signal Engineering Manual, Railway Board and RDSO publications. This document is not statutory and instructions given in it are for the purpose of guidance only. If at any point contradiction is observed, then Signal Engineering Manual, Railway Board and RDSO guidelines or Zonal Rly. instructions may be followed.

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सत्यमेव जयते

भारत सरकार –GOVERNMENT OF INDIA
रेल मंत्रालय– MINISTRY OF RAILWAYS
(कार्यालयीन प्रयोग हेतु)–(For official use only)

MAINTENANCE HAND BOOK
ON
SMPS BASED INTEGRATED POWER SUPPLY

CAMTECH/S&T/S/2009/HB/IPS/3.0
March 2009

Centre for Advanced Maintenance TECHnology

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Chapter – 1

SMPS BASED INTEGRATED POWER SUPPLY

1.1 Introduction

Power supply arrangement is the heart of signalling system. For a reliable signalling system installation, reliable power supply system is most important.

1.1.1 Power supply system in RE Area

In AC electrified area, the main power is derived from the traction supply.

In RE area the source of power supply to signalling system is through auxiliary transformer connected to OHE. This supply is very reliable but its occasional interruption/ low voltage can not be ruled out leading to blank signals.

1.1.2 Power supply system in Non-RE Area.

In non-electrified area, the main supply is obtained from commercial power supply.

The source of power supply is through a remote feeder, which is quite unreliable in respect of its availability and voltage. The battery backup is provided in all the DC circuit, which requires more maintenance. Due to frequent interruptions of supply, the signals are becoming blank till the starting of Diesel Generators.

1.1.3 Integrated Power Supply system

To overcome these problems a comprehensive power supply scheme known as Integrated Power Supply system has been developed by RDSO.

The function of Integrated Power Supply system is to provide a stable and reliable AC and DC power supply to the Railway signalling installations against all AC mains variations or even interruptions. This is very essential for proper movement of trains. As the name indicates, it is designed and developed with a view to provide complete power solutions from single system to all signalling circuits. The IPS for Railway Signalling circuits shall be manufactured as per RDSO specification No. RDSO/SPN/165/2004, Amndt. 5.

1.2. Advantage of IPS using switch mode technology over thyristor based

The main advantages of SMPS based IPS are as follows:

- Integration of various power supply equipments i.e. Battery charger, Transformer, DC-DC Converter, Inverter and Voltage Regulator in one equipment.
- Only one battery set of 110 V of capacity 200/300 AH is used.
- Based on high efficiency 90% SMPS based latest technology with phase correction. Hence power factor (PF) achieved is better than 0.9.
- Modular in design with modules working in n+1 hot standby mode to provide redundancy and future expansion at any time later on even in working installation by adding more modules.
- Enhances safety in train operation by preventing blanking of signals in case of 230 V AC mains failure by provision of built-in on line inverter in hot standby.
- Provision of one set Class B and C Lightning and Surge protection at 230 V AC input supply is in-built.
- Provision of continuous battery health monitoring with indication and alarms on Status Monitoring panel with Station Master.
- Remote monitoring of failures of modules is possible through Data logger as potential free contacts for such failures are provided in the equipment.
- Economy is achieved by reducing hours of DG set running in Non-RE area as approx. 6 hours backup time provided.
- Standard configurations adopted for small and medium size stations to increase reliability, availability and maintainability.
- Reduce maintenance efforts due to centralized maintenance.
- Higher reliability due to in-built redundancy and integrated factory wiring.

1.3. Scope

- This handbook covers the technical and maintenance requirements of SMPS based integrated power supply system (IPS) suitable for Signalling Installations in RE and Non-RE areas as per RDSO/SPN/165/2004 with Amendment 5. Although effort has been made to cover all the technical aspects related to IPS, manufacturer's instruction manual may be referred for detailed study.
- The IPS system is suitable to work with either VRLA Maintenance free cells as per IRS: S 93/96(A) or low maintenance cells as per IRS:S 88/93.

1.4. RDSO approved Firms

At present following are the RDSO approved firms for supply and installation of IPS system on Indian Railways:

1. M/s Amara Raja Power Systems Pvt. Ltd., Tirupati.(A.P.)
2. M/s Statcon Power Controls Ltd., Noida (U.P.)
3. M/s HBL Nife Power System Ltd. Hyderabad (A.P.)

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Chapter – 2

MODULES AND FUNCTIONS

2.1 Modules of IPS System

The SMPS based Integrated Power Supply (IPS) system is modular in design. It consists of the following modules:

- AC Distribution Panel (ACDP)
- SMPS based Float cum Boost Charger (FRBC) Panel
- DC Distribution Panel (DCDP)

2.1.1 AC Distribution Panel (ACDP)

This cabinet consists of:

- Inverters 110 V DC/230 V AC.
- Ferro resonant based Automatic Voltage Regulator (AVR) or Bypass AVR 230 V /230 V AC.
- Transformers 230 VAC/110 V AC for Signals and Track Circuits.

Inverters

Two inverters based on Pulse Width Modulation (PWM) technology are provided in ACDP. The Inverters are designed for continuous operation for an input voltage of 98 V to 138 V DC at a nominal voltage of 110 V DC and shall be rated for an output of 230 V.

The two inverters are operated in Master/Slave configuration such that on failure of one inverter the other supplies to the load automatically within 500 milliseconds.

The following LED indications are provided on front panel:

Description	Nomenclature	Indication
(a) Mains ON	MAINS	Amber
(b) Output OK	OUTPUT	Green
(c) Inverter Fail	INVERTER FAIL	Red
(d) Inverter 'On load'	ON LOAD	Green
(e) Fan fail indication (in case of forced cooling)	FAN FAIL	Red

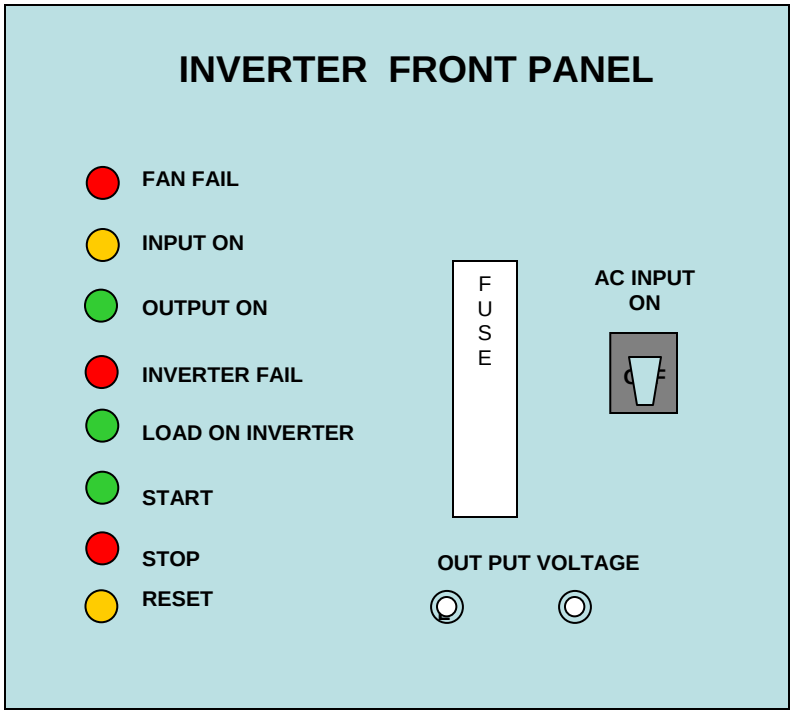

Fig. 2.1.: Inverter Front Panel

Ferro Resonant type Automatic Voltage Regulator (AVR)

The AVR works satisfactorily within a range of 150 V to 270 V input at 50 Hz mains supply. The output voltage shall be maintained within 230V±1% when the unit is connected to rated load. There are two AVRs provided in the ACDP:

- AVR1 Regulator for Signals
- AVR2 Regulator for Track Circuits

The output of AVR1 and AVR2 are fed to step down transformers of Signal and Track Circuits respectively.

A two pole ON/OFF rotary switch is provided for input to the regulator. A red neon lamp to indicate that the unit is ‘ON’ is provided on the front panel.

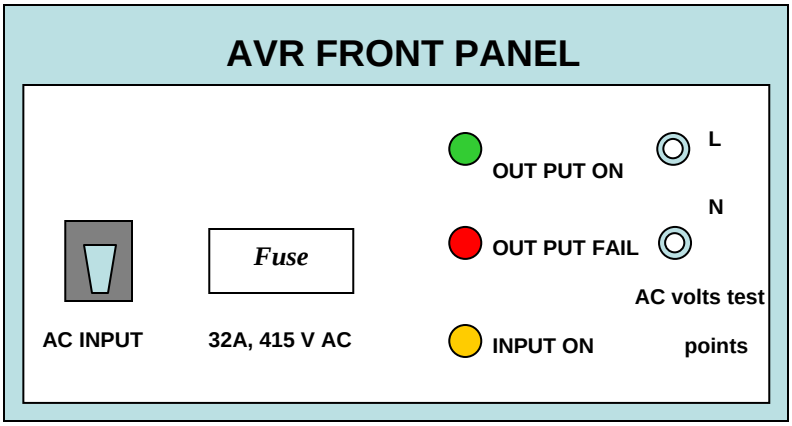

Fig. 2.2 : AVR Front Panel

Transformer

The supply from AC Bus (either from Inverter or from Bypass AVR) is fed to each Transformer through an AC Changeover Contactor. Necessary tapings (100 V, 110 V, 120 V, 130 V) are provided at the secondary of each transformer.

The following LED indications are provided on the front panel:

Description	Nomenclature	Indication
(a) Input ON	INPUT	Amber
(b) Output ON	OUTPUT	Green
(c) Tx Fail	FAIL	Red

A rotary switch of 10 A or above is provided for switching ON/OFF the transformer.

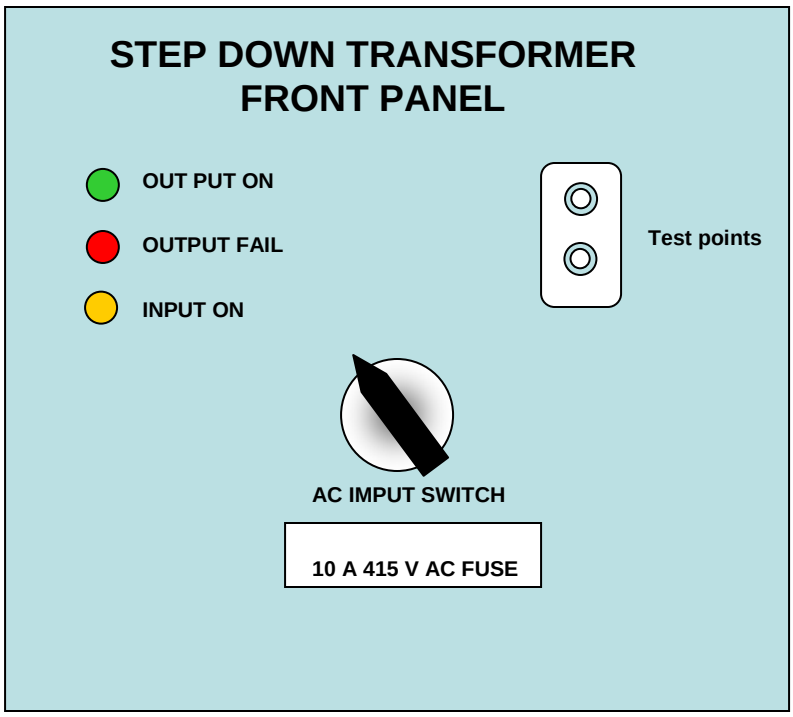

Fig.2.3: Transformer Front Panel

Functioning of ACDP

The incoming Mains of 150-275V is fed to both the AVRs pertaining to signals and Track circuits. Track AVR is always kept in ON condition while signal AVR is made ON only when there is no Inverters output. It is also ensured to cut off the AC input of Signal AVR to avoid no load losses of AVR, when output is not available from any of the inverters.

SMRs/Battery voltage is fed to Inverter 1 and Inverter 2 through respective input MCBs. Normally the AC load of signals is run on Inverter 1. On its failure Inverter 2 takes over immediately. When both inverters fail, the AVR1 finally runs the load.

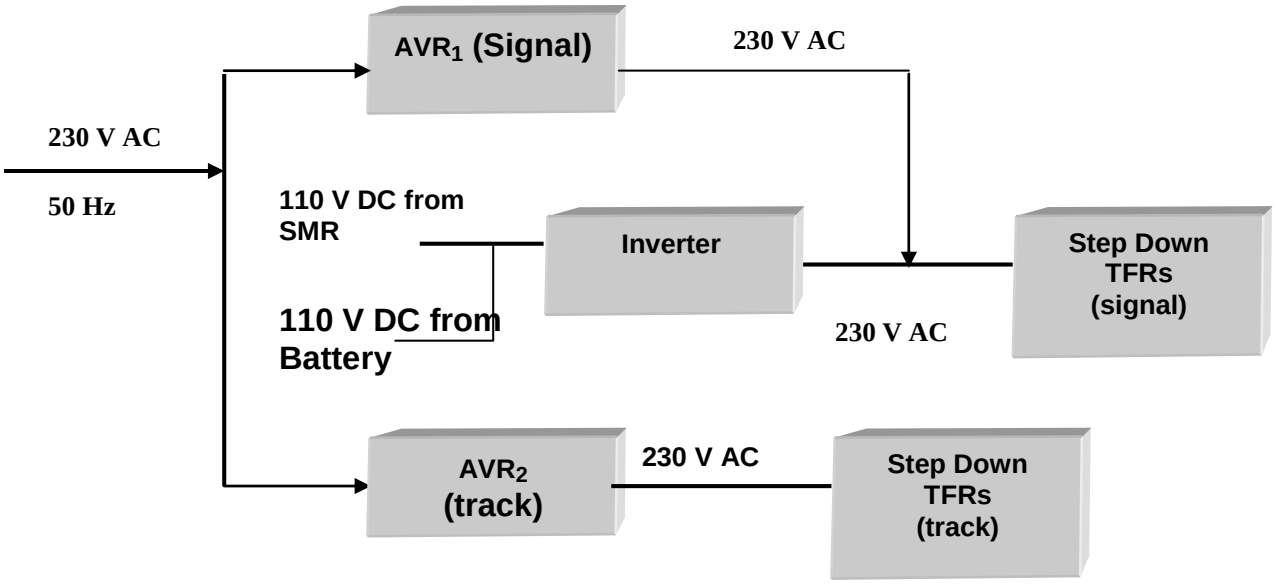

Fig. 2.4 : Block Diagram for functioning of ACDP

2.1.2 SMPS based Float cum Boost Charger (FRBC) Panel

This panel consists of

- FRBC (Float Rectifier cum Boost Charger) module.
- Distribution/Supervisory control/Alarm (DSA) unit.

FRBC or SMR Module

The FRBC module is of 110 V/20 A rating. The module is capable of operating in "Auto Float cum Boost Charger" mode. It is programmed to operate as a float rectifier or a Boost charger depending on the condition of the battery being sensed by the switching/control unit. Sometimes it is also called as Switch Mode Rectifier (SMR) Module. The module comprises of a number of SMRs in (n+1) configuration where n is the load at 110 V DC including battery charging in boost mode (C/10).

Auto Float Mode

The float voltage of each rectifier module shall be set as given in the following table:

No. of cells	Auto Float mode voltage	
	VRLA Cells	Conv. LA Cells
55	123.8 V	118.25 V

Normal Float voltage for VRLA battery is 2.25 V/Cell and for conventional battery it shall be 2.15 V/Cell.

Auto Boost Mode

The Boost voltage of each rectifier module shall be set as given in the following table:

No. of cells	Auto Boost mode voltage	
	VRLA Cells	Conv. LA Cells
55	126.5 V	133.1 V

Normal Boost voltage for VRLA battery is 2.3 V/Cell and for conventional battery it shall be 2.42 V/Cell

Distribution/Supervisory control/Alarm (DSA) unit

This is a microprocessor based module to control and monitor various parameters of FRBC/SMR.

Alarms and Indication of DSA unit

Status Indication

Description	Nomenclature	Indication
(a) Mains available	MAINS	Amber
(b) Mains fail	MAINS FAIL	Red

Alarm Indication

Description	Nomenclature	Indication
(a) Load voltage high	OUTPUT VOLT HIGH	Red
(b) Mains out of range	MAINS VOLT LOW/HIGH	Red
(c) System overload	OVERLOAD	Red
(d)Mains 'on'/battery discharging	MAINS ON & BATTERY ON LOAD	Red
(e)Low voltage battery disconnection	BATTERY DISCHARGED & DISCONNECTED	Red
(f) Battery/load fuse fail	FUSE FAIL	Red
(g)Temperature compensation fail	TEMP. COMPENSATION FAIL	Red

All the above indications can be displayed on an LED or LCD type alphanumeric display through microprocessor based control and supervisory unit.

Functions of DSA unit

Battery health monitoring in Auto mode

On restoration of AC mains after an interruption, changeover from float charging to boost and vice-versa depending upon the battery condition.

Battery Current limiting circuit

The battery charging current limit is settable (5-15% of battery AH capacity) for the safety of the battery.

Battery under voltage isolation

The system has provision for battery isolation which shall be effective at

(i) For VRLA battery: 1.8 V/cell (±0.012 V/cell)
(ii) For low maintenance lead acid battery : 1.85 V/cell (±0.012 V/cell)

Battery under voltage adjustment is provided inside the switching control unit and it is adjustable from 1.80 to 2.0 V/cell. Battery shall get reconnected after restoration of mains.

Temperature compensation for battery

Arrangement is provided for automatic temperature compensation of the FRBC output voltage to match the battery temperature dependent charge characteristics. Output voltage of the FRBC decrease or increase as per the type of battery in use. Failure of temperature compensation including sensor creates an alarm.

Battery reverse polarity protection

Protection for battery reverse polarity is provided in the system. The battery reverse polarity indication is provided near the battery terminal.

This panel also has following facilities:

- Local and remote (via modem) monitoring of any alarm condition of each of the rectifier.
- Local and remote (via modem) monitoring of the output current of each rectifier.
- Setting of parameters of all the rectifiers using front panel or an optional remote PC.
- Monitoring of DC Load current and voltage.
- Facility to send fail signals of modules, provided in AC and DC panels to remote indication panel provided in ASM room.

Functioning of FRBC Panel

A Static switch is mounted in the SMPS panel. It protects the IPS system from AC under voltage or over voltage. The operating voltage of the static switch is 150±5V to 275±5V. it automatically cuts-off if the AC input supply goes out of above limit. It reconnects the AC supply to system automatically with a time delay of 10-15 seconds as soon as AC supply falls within the limit.

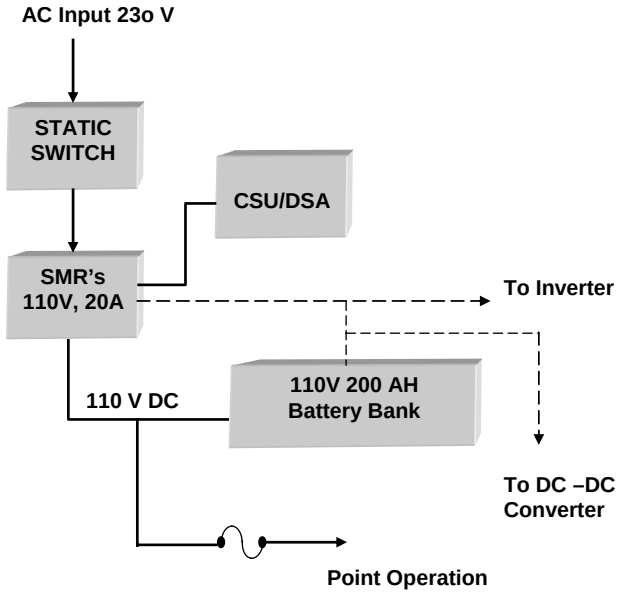

Fig. 2.5 : Block Diagram for functioning of FRBC panel

The AC incoming supply of 150-275V AC is fed to SMPS panel. This voltage is further fed to SMRs Modules individually. Outputs of all SMRs are paralleled and fed to DC-DC Converters, Point operation through a fuse and Inverters. Battery is connected to SMRs through a fuse and a low voltage disconnect contactor.

2.1.3 DC Distribution Panel (DCDP)

This panel consists of

- DC-DC converters.
- Common Digital Voltmeter for measurement.

DC-DC Converters

DC-DC Converters provide different DC voltage from input DC voltage range of 98 V to 138 V.

DC-DC Converters are connected in the following order:

Sr. No.	Equipment	Rating
1.	Relay Internal	24-32V, 5/10A OR 60-66V,5A
2.	Relay External	24-40V, 5/10A OR 60-66V,5A
3.	Axle Counter	24-32V, 5/10A
4.	Block Local UP	12-40V, 1 A
5.	Block Local DN	12-40V, 1A
6.	Panel Indication	12-28 V,5/10A
7.	Block Line UP	12-40V, 1 A
8.	Block Line DN	12-40V, 1A
9.	Block Tele UP	3-6V, 0.1A
10.	Block Tele DN	3-6V, 0.1A

DC-DC Converter of 12-40V, 1A is suitable for double line block instrument. For other type of block instruments any of the following ranges can be selected:

- 40-60V
- 60-100V
- 100-150V

Whenever block proving by axle counter is used , the DC-DC Converter of 24V/5A (2 Nos.) is used in place of block line DC-DC Converters.

Digital Voltmeter

A DC voltmeter of 3 1/2 digit with LCD/LED display is provided on the front panel with extendable cords for measurements of output voltages of DC-DC converters.

Fig.2.6: Measurement of output voltage of DC-DC converter

Each converter is provided with a proper plug in arrangement for DC input and output. A toggle switch is provided for switching ON/OFF the unit.

Following visual indications are provided on the front panel of DC-DC Converter:

Description	Nomenclature	Indication
(a) Input power ON	INPUT	Amber
(b) DC-DC Converter Output OK	OUTPUT	Green
(c) DC-DC Converter Fail	FAIL	Red

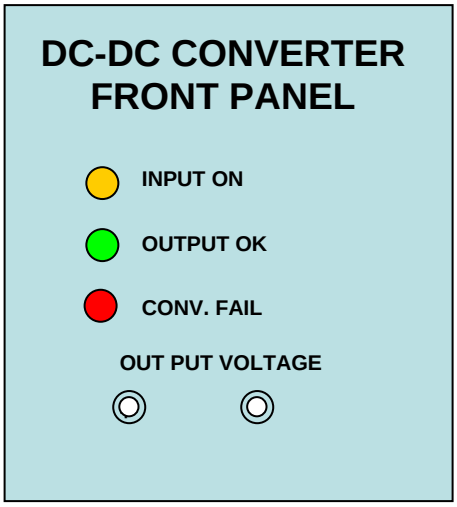

Fig 2.7.: DC-DC Converter Front panel

Functioning of DCDP

The 110V DC power supply taken from the SMPS panel is fed to DC-DC converters pertaining to Relay INT., Relay EXT., Axle Counter, Block Line Up & Dn, Block Tele**,** Panel Indication and HKT etc. DC-DC converters in n+1 configuration is paralleled for each application so that in case of failure of one converter, the other shall takeover immediately without delay

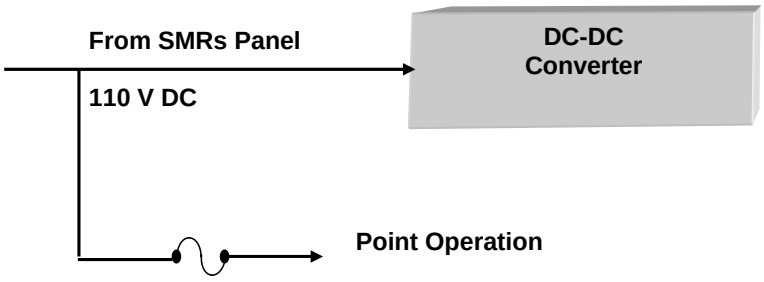

Fig. 2.8 : Block Diagram for functioning of DCDP panel

2.2. Status Monitoring panel for ASM's Room

This panel consists of status indications and critical alarms of IPS to be provided in ASM's room. The monitoring panel shall be of wall mounting type. DC-DC converters for Block Tele may also be accommodated in the Status Monitoring Panel.

The following indications are provided on the panel to enable the ASM to prompt signalling staff as and when there is a fault condition and help him to switch ON Generator only when it is required:

S. No	Instruction	Condition	LED indication	Remark
1.	Start Generator	50% DOD of battery	RED	Audio/Visual Alarm. Alarm can be acknowledged by pressing reset push button.
2.	Emergency Start Generator	60% DOD of battery	RED	-do-
3.	System Shut Down	70% DOD of battery	RED	Signal feed cut-off and all DC-DC Converters to work. Audio alarm will continue till Generator is started.
4.	Call S&T Staff	When any of the sub modules like SMRs, DC-DC Converters, AVR and Step down transformers fail	RED	Audio alarm with indication appears on Status monitoring panel in ASM room. The alarm can be acknowledged.
5.	Stop Generator	FRBC changeover to float mode	GREEN	Audio/Visual alarm

Note:
DOD stands for Depth of Discharge

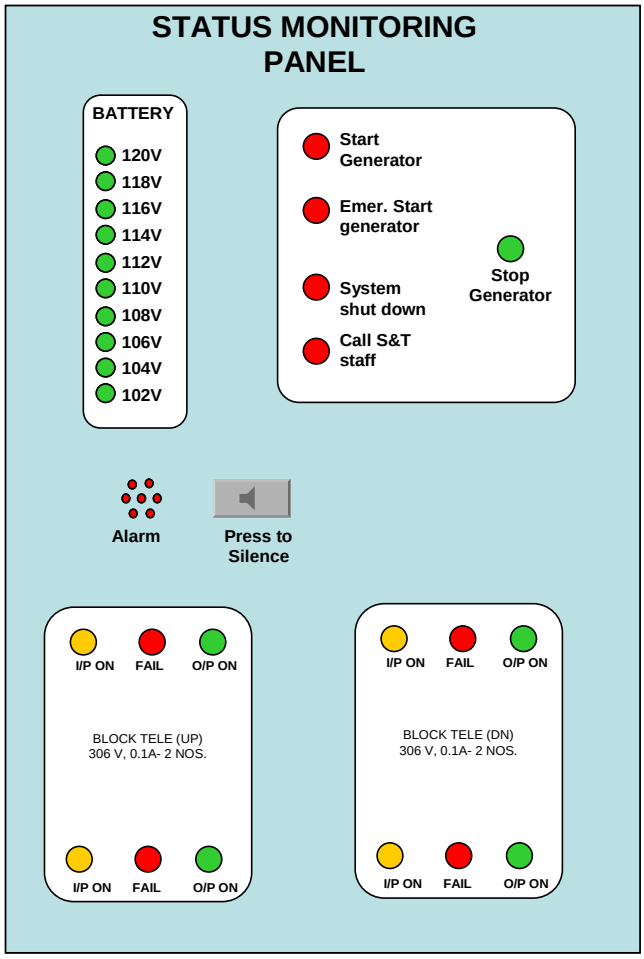

Fig. 2.9.: Status monitoring panel front view

2.3. Battery bank

IPS system is suitable for charging 110 V battery bank of Low maintenance cells as per as per IRS S88/93 or VRLA Maintenance free cells as per IRS:S-93/96A. Purchaser shall specify about type of batteries to be used. The battery is to be installed in a separate room.

Fig. 2.10 : VRLA battery bank

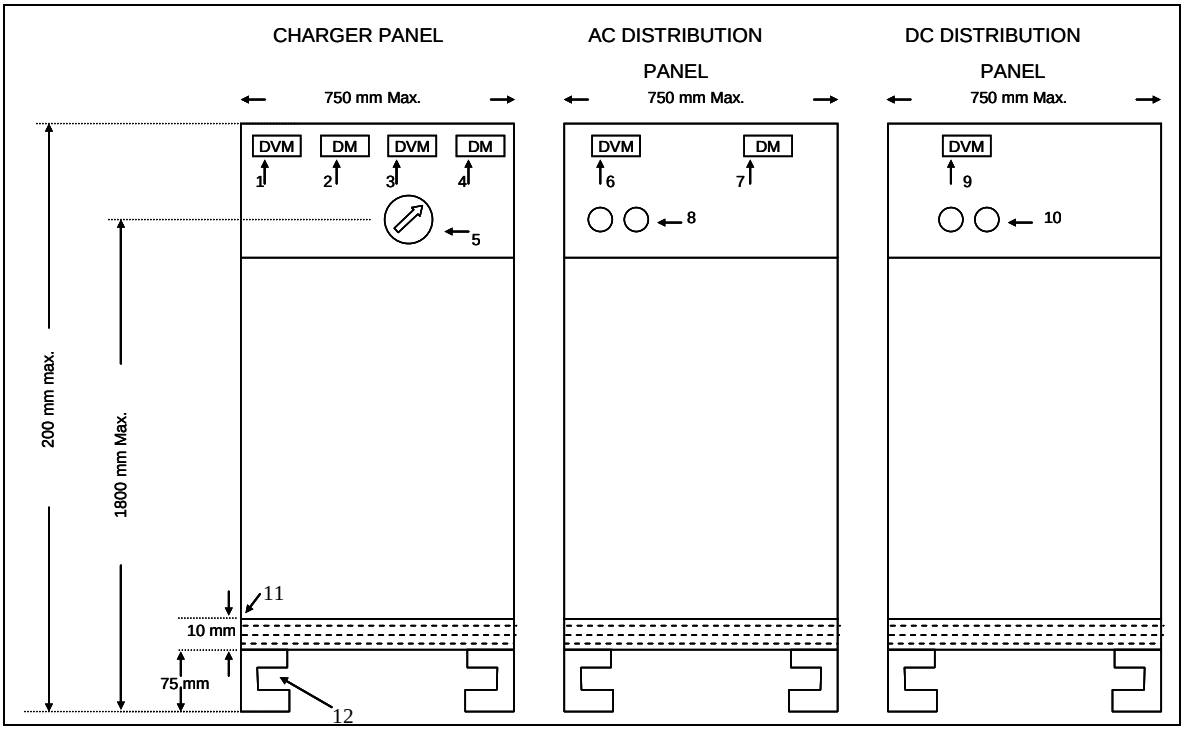

Fig. 2.11: Layout of IPS cabinets (Ref. RDSO drawing No SDO/IPS/PI/Layout/007)

1. AC DVM (0-300V) for AC input voltage.
2. AC DAM (0-50A) for AC input current.
3. DC DVM (0-200V) for charger output voltage.
4. DC DAM (0-50A) for Total/Charge/Discharge current with Selector switch.
5. Toggle type Selector switch for selection of Total/Charge/Discharge current.
6. AC DVM (0-300V) for AC output voltage measurement of INVT/CVT/TX with Selector switch.
7. Test point for AC voltage measurement.
8. AC DAM (20A) for Signal load current.
9. DC DVM (0-150V) for DC-DC Converter output.
10. Test point for DC voltage measurement.
11. 10 mm thick anti-vibrating pad.
12. 75X5 mm bottom channel.

Note:

1. Dimensions not to scale
2. DVM stands for Digital Voltmeter, DAM stands for Digital Ammeter.
3. Overall dimension of IPS cabinets = 2000 mm. (Max.) X 750 mm (Max.) X 750 mm. (Max.)
4. The height of all cabinets should be equal and width of DC distribution panel may vary as per indenter's requirement.
5. All the measuring meters are 3 ½ Digit, ± 3 count, ± 1% accuracy.

2.4. Standard Configurations

RDSO has standardized five configurations for SMPS based IPS according to the type of station to cater for the power supply requirements of signalling gears.

Details of Sub system of IPS for wayside PI/SSI station upto 4 & 6 lines RE/Non-RE are as per sketch No. SDO/IPS/SMPS/PI-4L/NRE/001, SDO/ IPS/SMPS/PI-4L/RE002, SDO/IPS/SMPS/PI-6/NRE 003 & SDO/IPS/ SMPS/ PI-6L/RE 004 respectively. SDO/IPS/SMPS/005 provides a typical arrangement for 4 line RE/Non-Re station with DC lit LED signals (Refer ANNEXURE A). The DC-DC converter for Axle Counters, SSI and Data loggers are optional. The distribution cabinet shall have provision for accommodation of optional DC-DC converters. For 60 V operated metal to metal relay installation, the ratings of DC-DC converter for relay internal and relay external shall be 60-66 V/5A in lieu of 24-32V/5A modules.

2.5. Working

The IPS unit has a number of 110V/20A FRBC modules as required for meeting a particular load which keeps one set of 110V, 200/300 AH battery under charged condition. These modules shall be housed in (n+1) parallel configuration in a single rack where 'n' is the actual required number of FRBC modules. One additional FRBC module (spare) is provided as a cold standby. Normally the chargers remains on and supply DC load as well as charge the battery.

The DC thus available is fed to an inverter in hot standby which generates 230 V sine-wave AC power. The uninterrupted AC supply is maintained at the load bus. In case of failures of both the inverters, signalling load is transferred to AVR to avoid signal blanking. If changeover Contactor also fails a manual bypass switch is provided to maintain the AC load bus. As soon as any of the inverter is healthy, the AC load automatically transferred to inverter. Similarly a number DC-DC Converters are floated across 110V battery bank, have been used for all DC supplies in addition to FRBC output voltage used for battery charging. DC-DC converters are available in modules. DC-DC Converters are used in load sharing in N+1 configuration in hot standby, to improve the reliability and availability of the system.

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Chapter - 3

INSTALLATION AND COMMISSIONING

3.1. General

- Pre-commissioning checklist as per Annexure 'B' should be ensured jointly by railways and firms before commissioning of IPS.
- Good quality, maintenance free earth with earth resistance less than 1 ohm should be provided as per the Code of practice for earthing and bonding system for signaling equipments RDSO/SPN/197/2008.

3.2 Unpacking

For unpacking the IPS follow the below mentioned steps.

- Remove the wooden packing carefully and place the rack vertically.
- Observe panels for any damages.
- Check the materials received are as per packing list.
- Check and tighten all the nuts/screws of the rack.
- Ensure that there are no damages in all the modules.
- After the above checks are completed, the panel and battery are to be stored in dry place in a shelter under normal atmosphere conditions. The panel and the battery are brought to the installation site.
- Packages are to be handled with care without toppling them, always keep in erected position.
- Ensure that the cases/ equipment/cells do not hit any other objects while moving with or without erection tools.
- Open the package only at the final site (erection place). Thus avoiding any damage while moving the panels from stores to erection place.
- Use proper tools for opening the packages. Avoid hammering. There will be a thin bitumenised sheet and a thin polyethylene sheet covering the panel immediately below the wooden crates. Take care that no scratches appear on the panel while unpacking.

When removing equipment from packing case check carefully those loose items such as connectors, cables, manuals, spare parts etc. are removed and kept at safe and retrievable places before discarding packing material.

3.3 Installation

- The system should be installed with sufficient space at rear and front for easy maintenance and servicing. The location selected for placing the system should be away from dropping or falling substances as well as heat generating equipment.

- Keep the cabinets side by side leaving a gap of about one foot in between. Grout the cabinets to floor using the holes provided in U-channels.
- Keep the entire front panel switches in DC-DC Converters, Step Down Transformers, AVRs and MCBs of SMRs in OFF position. Remove Battery Input Fuse and Point Operation Fuse.
- Make the Input, Output and interconnections, except the loads connected to DC-DC Converters, and step down transformers as per the installation diagram. Refer the interconnection drawings for connectivity details.
- Insert the Rectifier Modules (SMRs) in their respective slots in SMPS panel. Follow the procedure for SMR as given in instruction manual.
- Insert the DC-DC converters in their respective slots in DCDP. Keep the voltage adjustment potentiometer fully anti clock wise so as to keep the output voltage minimum. This potentiometer is located on the front panel. Follow the procedure mentioned in the instruction manual.
- Place the Battery temperature sensing probe on Batteries and connect the other end of the probe connector to respective socket in SMPS panel.
- Mount the Status monitoring panel in ASM chamber at appropriate place. Connect the multi core cable, one end to Status monitoring panel first and then to SMPS panel.
- Connect Generator Output Supply to SMPS panel at appropriate terminal with 1 sq. mm.
- Separate earth is to be provided for IPS as per RDSO guide lines.(refer Chapter 5)

Following clauses of SEM Part II may also be referred:

16.7 Installation of Secondary Cells
16.8 Installation of Power Supply Equipment
16.9 Installation of DG Set

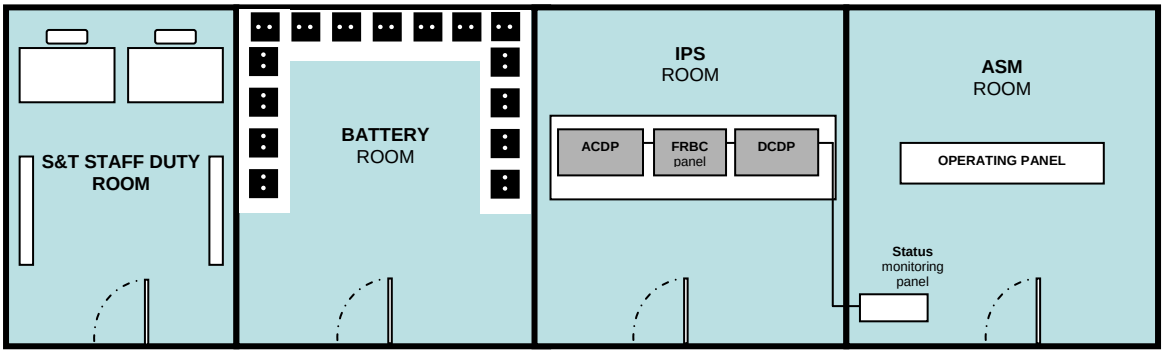

Fig 3.1.: Building plan for IPS installation

3.4 Commissioning

- Ensure that the Mains voltage is within the specified limits of 150 V to 275 V AC. Connect the mains to the system. In case of dropping of the input voltage beyond its limits on loading, the cable sizes at the transformer tappings to be checked and adjusted to keep the voltage within limits.
- Connect the Battery with proper polarity and insert the Battery Fuse. All the input LEDs in DC-DC Converters will glow. Press Batt. Push button in DSA unit; Battery voltage will be displayed.
- Switch ON DC-Dc Converters one by one and adjust the voltages as required. Refer Para 3.5.2 for adjustment procedure of DC-DC Converter. Digital Voltmeter with Patch Cards on DC-DC Converter output voltage.
- Connect the relays and equipment loads one by one to DC-DC Converters.
- Throw the input ON/OFF switch in TRACK AVR to ON position. Output ON LED will glow. Monitor the output voltage of this AVR with the help of Digital Voltmeter provided on the front panel. This will be around 230 V AC.
- Throw the input ON/OFF switch in TRACK UP Step down Transformer to ON position. Output ON LED will glow. Monitor the output voltage of this Step down Transformer with the help of Digital Voltmeter provided on the front panel. This will be around 110 V AC. Switch OFF this unit and select appropriate voltage tapping in the transformer, accessible from backside.
- Repeat the above step for TRACK DOWN step down transformer.
- Repeat the above three steps for checking Signal CVT/AVR and Signal step Down Transformers.
- Switch OFF the AVRs and Step down Transformers.
- Press reset push button in the inverter and switch ON Inverter 1 by throwing the MCB into ON position and then press Start button gently, after a short delay of around 10 seconds, the inverter will come ON. Output ON LED will glow. Keep the voltage switch in Inverter 1 position and monitor the output voltage of this Inverter1 in digital voltmeter provided on the front panel. This will be around 230 V AC.
- Switch OFF Inverter1 and repeat the above step for Inverter2.
- Keep both the Inverters and both AVRs in ON condition. In this condition,Inverter1 will supply to the load and Inverter2 will be in hot standby mode.
- Switch OFF Inverter1 at this moment. Inverter 2 should take over the load.
- Switch OFF Inverter2 also. Now Signal Bypass AVR will take load.
- Switch ON both the inverters one by one. Inverter1 will take the load and Inverter2 will be in Hot standby mode. Bypass signal AVR will go into Standby mode.
- Throw the MCBs of SMRs to ON position one by one. Observe the parameters like Float Voltage, Boost(Equalize) Voltage, SMR currents etc. Change the parameters, if required, depending upon the site conditions as per instruction manual.

- Make connections of Status monitoring panel (in ASM room) to DCDP as per the interconnection diagram. Discharge the battery by switching OFF the SMRs/FRBCs and check for various indications at different voltage.

3.5 Adjustments of output parameters

3.5.1 SMR/FRBC Module

Float and boost voltage adjustment

Available range of adjustment	**Voltage to be set to**	
	For VRLA battery	**For Conventional Lead Acid battery**
Float 98 – 138 V	Floa2.25 x 55 = 123.8 V	Float 2.15 x 55 =118.25 V
Boost 98 – 138 V	Boost 2.3 x 55 = 126.5 V	Boost 2.42 x 55 = 133.1 V

To set the DC output voltage of SMR/FRBC, disconnect the battery and switch on one SMR at a time. Turn the potentiometer anti-clockwise for reducing the values and clock-wise for increasing. Set voltage as per above table. Increase voltage in all the modules by 1.0 volt above the settings for blocking diodes voltage drop.

Note: All modules must be set at same voltage preferably by monitoring voltage at voltage monitoring jack through multimeter.

Float and boost current adjustment

Available range of adjustment
Float - 9 A – 22A
Boost - 9 A – 22A
Turn the potentiometer anti-clockwise for reducing the values and clock- wise for increasing.
The current settings shall have to be same for all SMR modules

3.5.2 DC-DC Converter

All converter voltages are factory set. However, the user can adjust Converter voltages as per requirement. Each DC-DC Converter is provided with a potentiometer. Turning clockwise will increase the voltage, while the output voltage reduces in anti-clockwise direction.

Initial Adjustment during commissioning:

Remove Converter from magazine and by holding the converter in hand connect the converter into card extender to its respective I/P connector. Before switching ON the converter, turn the voltage potentiometer anti-clockwise fully.

Connect the test points provided on the converter to Digital Voltmeter/Multimeter. Switch ON the Converter. Digital meter will show the minimum voltage of that respective converter. Set the potentiometer to the required value. Switch OFF this Converter, remove card extenders and insert the Converter in its place.

Follow the above steps for rest of the converters.

3.5.3 Inverter

The inverter output voltage can be varied by rotating the voltage adjustment potentiometer mounted on the front panel of the inverter with the help of preset driver (range allowed is 200 – 400 V) factory setting is at 230 V.

Rotate the pot in clock-wise direction to increase the output set voltage and anti-clockwise direction to decrease the output set voltage.

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Chapter - 4

MAINTENANCE

4.1 Maintenance Check Points for DC-DC Converters

Sr	Check Point	Action Required	Frequency
1.	Converter O/P voltage	Check if the O/P voltages are set as per requirement. If not, correct them	Once in 15 days
2.	Paralleling of Converters	Switch OFF main Converter and observe if the stand-by is taking the load.	Once in a month
3.	Paralleling of Converters	Switch OFF Stand-by Converter and observe if the main is taking the load.	Once in a month
4.	Converter Mechanical Alignment	Check if all the converters are inserted properly	Once in 3 months
5.	Converter Cleaning	Remove one by one and clean the converter using a soft cloth . Gently blow some air from top or Bottom to remove the dust inside.	Once in 3 months
6.	Converter failure	Check for failure Signal	Once in 3 months

Adjustment during system working (without disturbing loads)

- Pull DC-DC Converter from front for adjustment.
- Connect the Converter to the rack with both I/P and O/P card extenders.
- Connect the test points to Digital Voltmeter.
- Adjust the potentiometer to get the desired output.
- Check all the converters voltages pertaining to individual applications will be equal.

4.2 Maintenance Check Points for ACDP

Sr.	Check Point	Action Required	Frequency
1.	O/P voltages of Inverters, AVRs , Step-Down Transformers as per requirement	Check if the O/P voltages are set as per requirement. If not , check for fuses contactors.	Once in 15 days
2.	Inverter O/P current	Check if the DPM is	Once in 15

Sr.	Check Point	Action Required	Frequency
		showing the signal current as per original settings.	days
3.	Auto changeover between Inverters and Bypass CVT	Check for this changeover operation as described in instruction manual	Once in a month
4.	Connector Mechanical Alignment	Check if all the connectors of various sub systems are inserted properly	Once in a month
5.	Sub System Cleaning	Remove one by one and clean them using a soft cloth . Gently blow some air to remove the dust inside.	Once in 3 months

4.3 SMR Maintenance

SMRs are fully alarmed and operate in an active loop sharing arrangement. However , some regular checks can be an early warning of problems waiting to happen. Check for failure signal by switching off one SMR at a time once in a month.

Current sharing (when number of modules is more then one number)

Under normal conditions the currents contributed by every rectifier should be within +/-2 Amps of each other.

4.4 Battery maintenance

For maintenance of Battery, manufacturer's maintenance manual and instructions of Zonal Railways to be followed.

Some important points for battery maintenance are given below:

VRLA battery

- Cleaning of all cells near its terminals.
- Reading of all cell's voltage with Charger ON.
- Reading of all cell's voltage with Charger switched OFF.
- Boosting of Sick cell using Sick cell Charger.
- Replacement of the faulty cell with new cell.

Low Maintenance Battery

- Cleaning of all cells around top cover and terminals periodically.
- Applying petroleum jelly over the terminals.
- Periodically recording of all cell voltages and their specific gravity.
- Periodically checking of electrolytic level of cells.
- Periodically recording of all cell voltages with Battery Charger switched OFF.
- Boosting of Sick cell using Sick cell Charger.
- Replacement of non-reparable cell in a bank by fresh charged cell.

4.5 Cleanliness

Apart from these instructions regular cleaning of IPS and battery room should be done. Cleaning of dust collected inside the IPS panels (SMPS, DCDP & ACDP) should be done with the help of blower once in a month.

4.6 Checking of earth resistance

Check earth resistance every 3 months with earth resistance meter. it should be less than 2 Ohm.

4.7 Do's & Don'ts

4.7.1 SMR Module

Do's

- Keep all the modules in ON position.
- Set equal voltage for float and boost in all modules for proper current sharing.
- Set battery path current to AH/10.
- Set battery voltages according to type of battery. For SMF battery float voltage is 2.25 V/cell and boost voltage is 2.3 V/cell. For low maintenance battery float voltage is 2.15 V/cell and boost voltage is 2.5 V/cell.

Don'ts

- Do not take out plugs of modules when working.
- Do not connect battery when modules are ON.
- Do not connect battery in reverse polarity.
- Do not disturb battery under-cut setting.

4.7.2 Inverters

Do's

- Keep the Inverter Input MCBs always ON.
- Ensure correct DC polarity to inverter input.

Don'ts

- Do not switch OFF the MCBs of both or any one since both inverters are working in master-slave configuration.
- Do not remove the Inverter input/output connectors with Inverter Input MCB ON.
- Do not switch OFF the incoming of CVT.
- Do not remove input/output connectors when unit is ON.
- Always keep manual mode selector to Auto position.

4.7.3 Step Down Transformers

Do's

- Keep the AC Input switches always ON in Step Down Transformers.
- Always ensure 230V supply to transformer.
- Always load only up to rated current.

Don'ts

- Do not short output of transformer.

4.7.4 DC-DC Converters

Do's

- Always connect connectors and then switch on DC-DC converters.
- Keep the DC Input switches always ON in Converters.
- Ensure input DC voltage is within the range of 98-138V.
- Always set voltage for modules working in parallel.

Don'ts

- Do not put connectors of different circuits in one paralleling group of connectors on a paralleling card.
- Do not disturb voltage of Converter when working beyond 0.5 V.

4.7.5 Automatic Voltage Regulators (AVRs)

Do's

- Keep the AC Input switches always ON in Track AVR.
- Ensure proper input supply.
- Ensure frequency of supply is within 50 Hz $\pm$2.

Don'ts

- Do not run AVR at no load.

4.7.6 Miscellaneous

Do's

- Keep all input MCBs in ON position.
- In case of emergency or any problem, switch OFF all the MCBs
- Remove control cable connector accessible from backside, before pulling out inverters/ step Down Transformers / Bypass AVRs.
- Whenever any module is removed and inserted again, ensure that it is properly inserted and fixed on to the rack.
- Whenever any PCB is replaced, connect the wires as per schematic drawing only. Else a severe damage to PCBs may occur.
- In case of emergency or any problem, switch OFF all the switches
- Check the healthiness of SPD periodically and whenever you feel surge is occurred.
- Do check temperature of Room/Shelter regularly. It should be less than 50 deg. C.
- Keep Maintenance record as per Annexure C.

Don'ts

- Do not connect the Battery Bank to the IPS without removing the battery fuse.
- Do not disturb the potentiometers used in PCBs. They have to be adjusted at factory only.
- Do not restart the system without knowing the basic cause.
- Do not use wire fuses.
- Do not install the equipment in a poor ventilated site.
- Do not remove any fuse from panel in IPS.
- Check all incoming and outgoing connections, they should be tightened properly once in six months.
- Check for function of exhaust fan once in 15 days.
- Check for function of Spare Modules once in a month.

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Chapter - 5

SURGE PROTECTION AND EARTHING

5.1 Lightning and Surge protection

Lightning and Surge protection for IPS shall be as per Sr.ED/Sig./RDSO letter No. STS/E/SPD dated 22.06.2004 and Amendment 5 to RDSO/SPN/165/2004 for IPS.

IPS system shall be provided with Class B and Class C type two stage protection.

5.1.1 Stage 1 Protection (Power line protection at Distribution level)

The protection of Class B type, against Lightning Electromagnetic Pulse (LEMP) and other high surges shall be provided at the power distribution panel. Wherever available, the modules shall have an indication function to indicate the prospective life and failure mode to facilitate the replacement of failed Surge Protection Devices (SPDs).

5.1.2 Stage 2 Protection (Power line protection at Equipment level)

The protection of Class C type against low voltage surges shall be provided at the equipment level connected between line and neutral. This shall have an indication function to indicate the prospective life and failure mode to facilitate the replacement of failed SPDs. This shall be thermal disconnecting type and equipped with potential free contact for remote monitoring.

Note: Co-ordinated type Class B and C arrestor shall be provided in a separate enclosure in IPS room adjacent to each other. This enclosure should be wall mounting type.

5.2 Earthing

The IPS systems and its individual modules have earth terminals and these should be properly earthed to the IPS cabinet.

Zonal Railways shall provide earthing arrangement as per IS:S 3043. The earth resistance shall not be more than 2 ohm. Earth provided shall preferably be maintenance free using earth resistance improvement material.

No earth shall be connected to the system. The system earth shall be connected to Class B protection module and Class B module only shall be connected to earth.

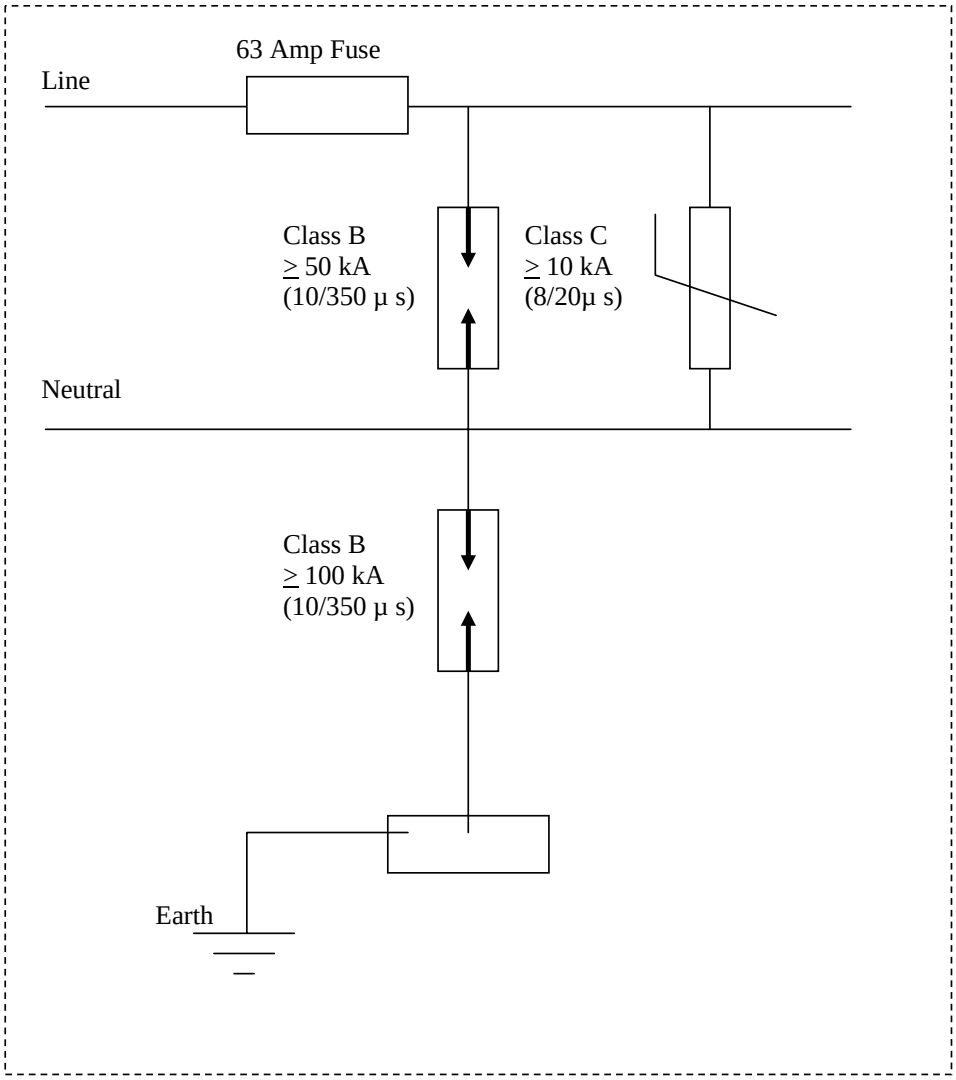
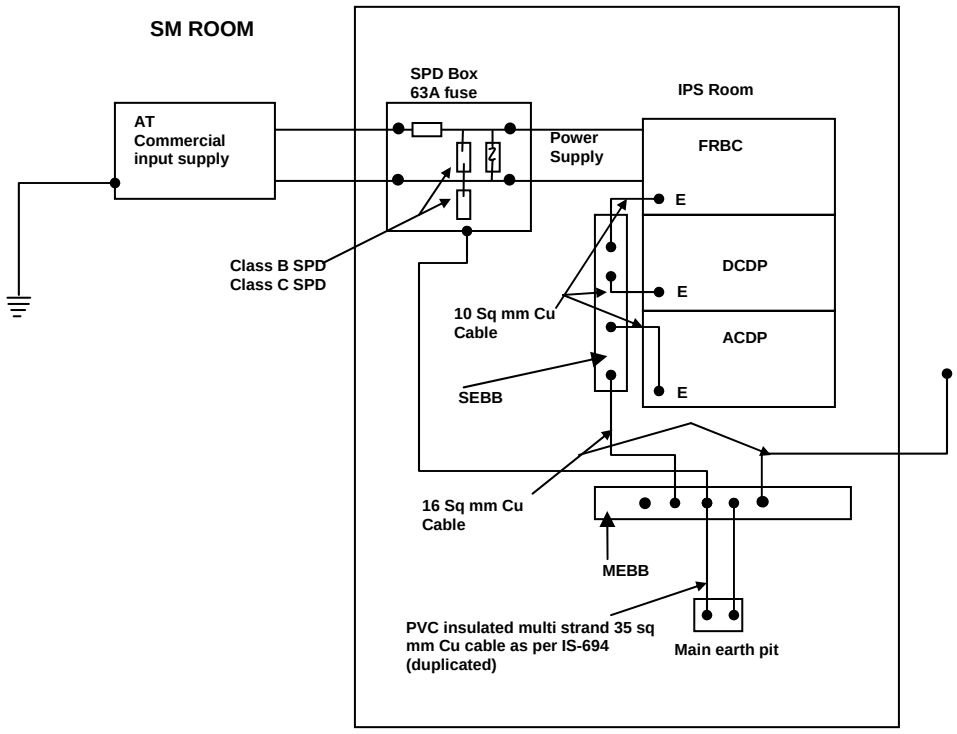


Fig. 5.1 – Connection of Lightning Arrestors
Ref. RDSO Drg. No. SDO/IPS/LA/006



1. Class B & C SPDs shall be provided as per the guidelines of RDSO and from RDSO recommended sources.
2. All the armoring of the cables shall be connected to SEBB
3. MEBB stands for Main Equipotential Earth Bus Bar
4. SEBB stands for Sub Equipotential Earth Bus Bar

Fig.5.2 – Typical bonding and earthing connections for signalling equipments (IPS) Ref.: RDSO Drg. No. SDO/RDSO/E&B/002

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Chapter - 6

TROUBLE SHOOTING

6.1 General Checks

In case of malfunction, first check the following:

- All inter cell and inter tray battery connection. These connections are positive to negative (in series) and must be securely tightened.
- Connection between battery, SMR panels, AC distribution panel and DC distribution panel should be as per interconnection drawing provided in the instruction manual.
- Individual cell voltage-
- In normal float : VRLA cell- 2.10 to 2.2V/cell
  Conv.LA cell- 2.15 to 2.2 V/cell
- If there is more than 0.05V variation between the cell with lowest reading and cell with highest reading, boost charge the battery for 24 hours and recheck.
- The AC input voltage of the system should be from 150V Ac to 275V AC.

If all the above connections are correct and cell voltages and AC input voltages are within specified limits then try to rectify the fault as per troubleshooting charts.

6.2 Troubleshooting

Since IPS systems are supplied by three different RDSO approved firms, their indications/alarms and troubleshooting may differ slightly from one another. Trouble shooting charts for these IPS systems are given below for the guidance of maintenance staff.

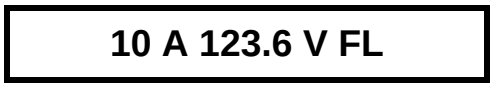
6.2.1 Trouble shooting for IPS system of M/s Amararaja Power Systems (P) Ltd.

Control & Supervisory Unit (CSU) Alarms

Before proceeding for troubleshooting one should be familiar with the meaning of alarms and indications given by CSU.

Alphanumeric display

A single line 16 characters alphanumeric backlit display with large 9 mm high characters normally display output voltage and current as well as the system status Float(FL) or Equalise (EQ). this is the default or “Home” screen.



“Home Screen”

Fig – 1 Alphanumeric Display

Front Panel Push Buttons

There are push buttons associated with the LCD screen for the purpose of entering different Menus and for scrolling through the menus.

The layout of the push buttons is shown below:

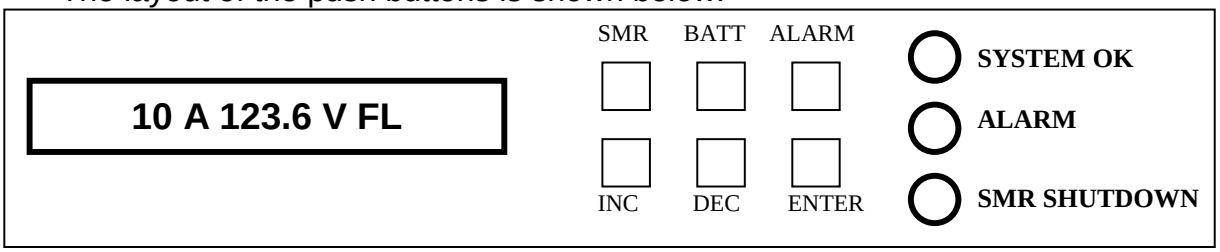


Fig – 2 Front Panel push buttons

Apart from CSU or “Home” menu, which mostly include system oriented parameters, there are three other menus which can be accessed by momentarily pressing the relevant push buttons.

SMR Menu, which includes the rectifier related parameters as well as the output current and heat-sink temperature for each rectifier.

Battery menu, in which all the parameters pertaining to the battery are found.

Alarm log, which stores all the individual alarm information together with date and time starting with the most recent alarm. A total of 99 alarms are stored in memory.

Status Indicating LEDs

In addition to the alphanumeric display there are also three LEDs to indicate system status as follows:

- System OK - Green
- Alarm – Amber
- SMR Shutdown – Red

When all the three LEDs are off, the unit is off and there are a number of possible reasons for this:

- DC is not present
- Internal failure of CSU

The amber LED indicates any alarm condition, either system or rectifier related. The Red LED indicates that one or more of the rectifiers in the system is shut down.

A list of all the possible alarms, which can be annunciated is given in the following table:

R = Red LED ON A = Amber LED flashing

Alarm Name	Comments	LED
SMR Alarm	Combination of one or more SMR alarms	A
SMR Alarm-Urgent	One or more SMRs have shut down	A+R
SMR HVSD	SMR shut down due to output over voltage	A+R
UNIT OFF	SMR is off	A+R
No Response	A particular SMR is not responding to the CSU	A
Power Limit	SMR is in Power Limit	A
SMR I Limit	SMR in current limit	A
Volts High	Voltage measured by SMR too high	A
Volts Low	Voltage measured by SMR too low	A
EEPROM Fail	EEPROM failed (CSU or SMR)	A
No Demand	Control loop in SMR not in normal state	A
H/S Temp High	SMR heat sink temperature too high	A
DDC Controller	SMR DC/DC converter fault	A+R
Temp Sensor Fail	Temp sensor in SMR faulty - S/C or O/C	A+R
Reference Fail	Voltage reference in SMR microprocessor cct faulty	A+R
HVDC not OK	DC/DC converter (boost) voltage in SMR not OK	A+R
High volts SD	Shut-down of SMR due to output volts too high	A+R
AC Fail	None of SMRs are responding (AC fail assumed)	A+R
Temp Sensor Fail	Temp sensor in MUIB not plugged in	A
Battery Switch	One or more battery switches open	A
LVDS Open	Low Voltage Disconnect switch open	A

Sys Volts High	System output volts too high	A
Sys Volts Low	System output volts too low	A
Battery Disch	Batteries are discharging	A
SMR Comms Fail	One or more of SMRs are not responding	A
AC Volt Fault	AC voltage lower or higher than preset value	A+R
Batt Temp High	Battery temperature higher than preset limit	A
Batt I-Limit	Battery charging current is being limited to preset value	A
Equalise	System is in equalize mode	A *

***not flashing**

SMR ModuleTroubleshooting through alarm conditions

Some possible causes for alarms that may occur from time to time and procedures that should be followed to clear the alarms are given in the following table:

Alarm Condition	Possible Cause	Action Suggested
UNIT OFF	No AC power to SMR	Check AC supply to SMR; if necessary reset CB supplying SMR
	SMR faulty	Replace SMR
Equalise Mode	Automatic cycle in progress due to recent AC power failure	No action required
	Automatic Periodic Equalise cycle in progress	Check on CSU if system is in AUTO or MAIN mode -If in AUTO mode, display will show remaining Equalise time. Check log for previous cycle date. If cycle too early, replace CSU
	Manual initiation of Equalise cycle	Check Operator log; in BATT menu, scroll to “Manual Stop EQ” screen and press ENTER to terminate cycle if necessary
SMR Alarm – Urgent	All SMRs off due to AC power failure	If possible restore AC power
	1 or more SMRs off due to faults;	Check Individual SMRs for obvious problem; replace SMRs if necessary
	All SMRs off due to incorrect Inhibit signal from CSU	Replace CSU
	One or more SMRs in Current Limit	Check Current Limit settings and adjust if necessary; or batteries being recharged
SMR Warning	Any of the above or non critical problem with one or more SMRs	Check SMRs
	Any of the above or No Load alarm	If unit is not sharing correctly, replace SMR
	Any of the above or unit is in Equalise mode	Check Equalise/Float Mode and change if in incorrect state; change SMR if CSU is not requesting Equalise mode

Alarm Condition	Possible Cause	Action Suggested
AC Fail	Total AC power failure or AC voltage not within operating limits	Check AC supply and confirm condition; If AC is OK replace SMR units if only two show alarm condition
	Communications link failure	Check 4-way communications cable between CSU and all SMRs
Battery Switch	Any one of 3 battery switches is open	Close if appropriate
	Bad connection to MUIB	Repair connection
Batt Temp High	Battery sensors is reporting temperature higher than pre-set level	Check battery temperatures and if necessary increase ventilation and cooling
	Set point is too low	Check Batt Temp High threshold level and re-adjust if necessary
	Temperature sensor is faulty	Replace sensor
	Connection to MUIB faulty	Repair connection
Volts High	SMR fault	SMR Fault Chart
	One SMR in Equalise Mode	Switch SMR back to Float mode
	Float level set too high on CSU	Check and adjust if necessary
	CSU fault	Replace CSU
Volts Low	AC power has failed; system on battery power	Restore AC power if possible
	Alarm threshold level set too high	Check set point and adjust if necessary
	All SMRs are off due to CSU Inhibit signal	Check reason for signal; if necessary replace CSU
	Inhibit signal	Replace CSU
	Battery charging current limit LED on due to faulty battery current signal - this will depress float voltage	Check battery currents. If one of them shows figure higher than Batt Chg Curr Lim set point, check corresponding current transducer; check connections to transducer; check MUIB connections
	Battery Temperature Compensation too high due to faulty battery temperature monitoring	Check battery temperature readings in Batt menu; Check and if necessary replace faulty sensor; check connection to MUIB
	Battery Temperature Compensation too high due to faulty MUIB	Replace MUIB
SMR HVSD	Output voltage too high due to SMR fault	Replace faulty SMR
	HVSD threshold level on SMRs set too low	Check and re-adjust threshold level
	CSU fault	Replace CSU
SMRs not sharing load current	Faulty CSU voltage and current control loop IODEM signal	Replace CSU

Alarm Condition	Possible Cause	Action Suggested
	Float or Equalise level on SMRs not set sufficiently high	Check and re-adjust Float or Equalise level
	Float or Equalise level on CSU set too high	Check and re-adjust Float or Equalise level on CSU
No Response	SMR not responding to CSU	Check and if necessary replace comms cable at back of magazine faulty
	Faulty DSCC card in SMR	Replace SMR
Power Limit	Unit not current sharing (if only one showing power limit)	Replace SMR
	Load current too high (if more than one unit showing alarm)	Reduce load
		Reduce battery charging current limit if it is too high
No Load	Load circuit breakers have tripped and there is no load	Reset circuit breakers
	If only one unit showing alarm, comms line to SMR faulty	Check and replace comms line
	Faulty SMR	Replace SMR
Current Limit	Batteries being recharged if more than one unit showing alarm	No action required
	If only one unit shows alarm, internal control loop faulty	Replace SMR
No Demand	Internal control loop faulty	Replace SMR
EEPROM Fail	Faulty EEPROM or DSCC	Replace SMR
DDC Controller	Fault in DC/DC converter	Replace SMR
H/S Temp High	SMR Heat sink temperature too high.	Check that air intake by the fans into SMR is not blocked and the fan is healthy.
	Ambient temperature is too high	Try to reduce ambient temperature
	DSCC card is faulty	Replace SMR
Temp Sensor Fail	Temperature sensor is faulty	Replace SMR or temperature sensor in SMR
Reference Fail	Reference voltage source in DSCC is faulty or DSCC is faulty	Replace SMR
HVDC not OK	Faulty boost controller;	Replace SMR
	Inrush limiting fuse or resistor O/C	Replace SMR
High Volts SD	Feedback voltage circuit faulty	Replace SMR
Temp Sensor N/A	Temperature Sensor in CSU not attached or faulty	Plug in temperature sensor if required; Replace temperature sensor
	Faulty MUIB connection(s)	Replace MUIB
	Faulty CSU card	Replace CSU

Alarm Condition	Possible Cause	Action Suggested
LVDS Open	Battery discharged to the limit voltage level due to no AC power	Check AC voltage and reset if possible
	Battery voltage OK, and CSU faulty	Replace CSU
	Battery voltage OK, and CSU faulty	Replace CSU
	LVDS threshold level set too high	Reset level in BATT menu
Sys Volts High	Volts High threshold in CSU set too low	Reset level to correct value
	Temperature compensation coefficient set too high	Set correct temperature compensation coefficient
	Faulty MUIB or CSU	Replace CSU
Sys Volts Low	Volts Low threshold in CSU set too high	Reset level to correct value
	Temperature compensation coefficient set too high	Set correct temperature compensation coefficient
	Faulty MUIB or CSU	Replace CSU or MUIB
Battery Disch	Output voltage low due to SMRs off	Check AC voltage and restore if possible;
	Float level set too low	Set float level to correct value
	Battery Disch level set too high	Set correct Battery Disch level
	Faulty control loop in CSU	Replace CSU
SMR Comms Fail	Comms cable faulty	Replace cable
	Faulty MUIB or CSU	Replace CSU or MUIB
AC Volt Fault	AC voltage out of tolerance	Check AC voltages and fix if possible
Batt I-Limit	Battery charging current is being limited to preset value	No action necessary
	Battery current limit set too low	Set correct limit
	Battery current sensor faulty	replace sensor
Alarm Condition	Possible Cause	Action Suggested
	Faulty MUIB or CSU	Replace CSU or MUIB
Batt Dis 1 Fail	Battery 1 is faulty	Check battery and repair/replace if necessary
(For all Batteries)	Battery 1 current sensor is faulty	Check and replace sensor if necessary
	Fault y MUIB or CSU	Replace CSU or MUIB

MUIB – Main User Interface Board – interface card between CSU and external transducers/other inputs

Troubleshooting of other modules

DC-DC Converters

Sr. No.	Symptom	Possible Cause	Action Suggested
1.	I/P ON LED glowing. O/P OK LED not glowing. But voltage is available at Test Points.	Output OK LED is defective.	Get it changed by the manufacturer
2	Converter Fail LED blinks	Over Voltage Condition	Replace the faulty Converter.
3	Converter Fail , I/P ON , O/P OK LEDs glowing continuously. But voltage at test points is available.	Conv. Fail LED is defective.	Get it changed by manufacturer
4	Converter Fail , I/P ON , O/P OK LEDs glowing continuously in Main and Stand-by converters. Voltage at test points is less than 3 V.	Converter output is short circuited.	Disconnect the load and check if the voltage is restored. If so, check for the short in load.
5	No LED glows on the front panel	Improper plugging of connectors	Insert the connectors firmly
6	Converter Fail or Converter is in Restart mode	Failure of I/P, O/P surge suppression circuit	Get it changed by the manufacturer

Inverters

Sr. No.	System fault	Probable Cause	Remedy
1.	DC Fuse fail.	a) Skin effects due to prolong use.	a) Replace fuse.
		b) Short circuit or excessive overload on Inverter.	b) Check Inverter O/P for excessive over loading & reduce the load to the limit or Check Inverter Power Transistors for short circuit & replace defective Transistors.
2.	DC UNDER Voltage comes immediately after Inverter is switched ON & Inverter trips	a) DC Input Cable is less than rated capacity.	a) Replace the cable. Use the cable of proper rating.
		b) Loose contact at input side.	b) Tighten all connections.
3.	Inverter not ON.	a) Break in DC supply either due to blown fuse or disconnected wire.	a) Replace fuse & check wiring as may be necessary.
		b) Power Supply Transistors faulty.	c) Replace them.
		c) Control card defective.	d) Replace control card.
4.	Inverter output high	a) Feedback loop broken.	a) Check Feedback X'mer or break in wiring of X'mer or voltage adjust Potentiometer.

Sr. No.	System fault	Probable Cause	Remedy
		b) Inverter card not functioning properly.	b) Replace control card.
		c) False indication due to defective O/V sensing circuit.	c) Check the set right O/V sensing circuit.
5.	Inverter trips before loaded fully.	a) Over Load trip setting not proper.	a) Set the overload tripping by means of adjusting pot on the Inverter card. Check power requirement of the load. Switch on the load one by one after the output reaches 220V.
6.	Unit not working neither on Inverter nor on Mains.	a) Output Fuse is blown.	a) Replace the fuse.

ACDP

Sr. No.	Symptom	Possible Cause	Action to be taken
1	Inverter I/P ON LED is glowing. O/P OK LED is not glowing . But voltmeter shows the O/P voltage.	O/P LED is defective.	Check the connections and change the LED.
2	Inv-1 Fail Indication glowing. Inv-2 is taking the load.	Faulty Inverter –1	Send it for repair.
3	Inv-1 is faulty . But Inv-2 is not taking the load though O/P LED is glowing.	Contacts of Relay – 4/5 may not be proper.	Change Relay 4/5
4	Though both inverters are in working condition , only inverter-2 is taking the load.	Defective Contactor (Relay - 4) or PC -1	Check if the coil is getting + 24V DC to Relay - 4. If yes , Change the Relay. If not replace the PC–1
5	Though both inverters are in working condition , only bypass CVT is ta he load.	Either Con-1 or Con-2 or both are defective.	Change the defective contactor.

6.2.2 Troubleshooting for IPS system of M/s Statcon Power Controls Ltd.

Sr. No.	Observation	Possible Cause	Action suggested
SMR Module			
1.	No output	(a) Main supply may be out of range.	Check Mains Supply. It should be within specified range of 150-275V.
		(b) Incoming MCB may be OFF	Check MCB. If OFF, switch ON the MCB.
		(c) O/P fuse may be blown	Check O/P fuse. If blown off, replace the same.
2.	O/P is coming but it is low	(a) Module may be working in current limit	Adjust float or boost current limit as the case may be with pre-set provided on front.
		(b) Voltage adjustment may not be proper.	Adjust voltage in float to 2.25 V/cell and boost 2.3 V and 2.4V/cell for VRLA and Low Maintenance Battery.

Sr. No.	Observation	Possible Cause	Action suggested
3.	O/P comes but module trips	O/P voltage setting may be high.	Set voltage to proper level. Reset the push button to defeat Over Voltage which has occurred due to transient.
4.	Unit is not sharing current properly.	Modules voltage setting may be different.	Set the voltage of individual module and keep float and boost voltage of all module to same value within 0.1V with 4½ digit multimeter.
DC-DC Converters			
1.	DC is not coming	(a) Input connector may be loose and not inserted.	Insert incoming connector properly.
		(b) Input fuse may be blown.	Check fuse if fail, replace the same.
2.	Converter O/P is low	Voltage may not be adjusted.	Adjust voltage with preset provided on the side of the unit.
3.	Converter voltage is not settable through preset.	Converter Voltage loop may be faulty.	Replace DC-DC Converter.
Inverter Module			
1.	Inverter is not getting ON even after lifting on the input MCB	It may be tripping due to one of these causes	
		(a) Input DC supply across termination points is not available.	Check 110 V DC across termination points. If not available check it across terminals at rear side of first PANEL. Check fuses. If blown replace them.
		(b) Input MCB inside the inverter might have tripped.	Check input MCB, MCB -1. If tripped, put it to ON position.
		(c) Input fuse inside the inverter is blown.	Check input fuse F1 inside the inverter module. If blown, replace it.
		(d) DC Under Voltage	Check input DC voltage across the terminal points. It should be above 98 V DC.
		(e) DC Over Voltage	Check input DC voltage across the terminal points. It should be lower than 138 V DC.
		(f) AC Over Voltage	Check inverter output AC voltage. If exceeding 250 V, replace driver card.
Transformer module			
1.	No output	(a) Input connector may be loose.	Check and firmly insert the connector.
		(b) Input fuse may have been loose.	Check and replace the fuse if blown.

Note: In case of further problem, module should be returned to STATCON, since any of the SMR/DC modules need special Anti-static Set-up.

6.2.3 Troubleshooting for IPS system of M/s HBL NIFE Power Systems Ltd.

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
A.	**SMR Module**		
1.	Mains ON (Indicates availability of the mains to the module)	Mains available but LED not glowing. Module working normally.	Replace LED.
2.	Float Mode (Indicates that the module is in Float Mode). This indication glows even while the battery is discharging. Ignore in this condition.	System working normally in float mode but LED not glowing.	Replace LED.
3.	Boost Mode (Indicates that the module is in Boost Mode)	System working normally in boost mode but LED not glowing.	Replace LED
4.	DC output under voltage (Module O/P <120 V)	Audio/visual indication appears and also	
		Overload appears.	Reduce the loads to normal levels.
		i. O/P fail appears.	Refer corrective action at Sr. No.7.
		i. Overload and O/P fail do not appear.	Adjust float voltage module to specified limit using 'Float Voltage Adj.' potentiometer provided on the front panel using preset driver supplied in tool kit.
5.	DC output over voltage (>130 V)	Audio/visual indication appears; modules trips and O/P fail also appears along with Call S&T staff indication in Status Monitoring Panel of ASM room.	Switch OFF O/put MCB of corresponding module. Press the o/put high reset push button. Fault may disappear on its own and system works normally. If not take a Multimeter and connect same to test sockets provided on front panel then reset the push button again by observing the O/P voltage. If the output voltage is beyond 130 V and module trips again, then adjust the float voltage adj. potentiometer anti-clockwise 3 to 4 times and reset the push button again. O/P high will disappear and reduced O/P will come at this juncture. Readjust the float voltage to its specified value.

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
6.	DC O/P Over Load (O/P current is >21A)	Audio/visual alarm appears	Reduce the loads to the prescribed values.
7.	Output Fail (When DC O/P is Zero or O/P MCB in OFF position)	Audio/visual indication appears. Also 'Call S & T Staff' indication appears in Status Monitoring Panel in ASM Room.	Check that O/P MCB is in ON condition. If fault persists check as follow: i. I/P AC voltage to be brought to within specified limits. ii. Check and remove any short circuits at the O/P side. iii. Check voltage at I/P and O/P side of MCB. Replace if it is faulty.
8.	Fan fail (When any one or both the fans fail)	Audio/visual alarm appears	Check if there are any visual damages/objects in the fan. Remove/replace if any. Also check for visual loose contacts if any. For any abnormal observations replace fan.
SMR Supervisory Control Unit			
Status indications			
1.	Mains ON (Healthy input supply available)	----	----
2.	Float (System is in float mode)	----	----
3.	Boost (System is in boost mode)	----	----
Alarms			
1.	Mains fail (Non-availability of Mains to the rack)	Input not available to the rack due to i.I/P main MCB in off position ii.I/P contactor is off due to mains out of range iii. I/P not available.	i. switch on MCB after checking any short circuit at input after MCB ii. check the Mains and restore it iii. Restore mains or alternative supply.
2.	Float rectifier cum battery charger (FRBC) fail (Output from any SMR is not available)	LED glows due to 1. O/P MCB of module is OFF 2. I/P MCB of module is OFF 3. Internal fault of module.	i. Check for any short circuit and switch on. ii. ----------do---------- iii. See fault condition on modules concerned and take corrective action accordingly as described in corrective actions described for SMR modules above. (A/1 -8
3.	Battery/load fuse fail	LED glows due to failure of i. Battery fuse ii. Load fuse	i. Check the cells of battery set and replace the fuse. ii. Check all loads for any excess loads/short

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
			circuits and replace the fuse.
4.	Battery Low Pre Alarm (Battery condition ~ 50% DOD)	LED glows cautioning the discharge condition of the battery.	Start generator.
5.	Low Voltage Battery Disconnection. (End Cell Voltage 1.8 V/Cell)	LED glows alarming non-availability of battery to the loads except for Block Tele.	Call S&T staff
6.	Temp. Comp. Fail (Failure of Temperature compensator)	LED glows	Check sensor is properly connected.
7.	Mains out of range (Mains beyond specified limits)	LED glows	Restore mains within 150 VAC -275 VAC (150 V on full load and 275 V on no-load)
8.	System Over Load (Load more than specified value)	i) LED glows but system works normally due to availability of redundant extra module If one module fails under this condition, the O/P voltage will drop and FRBC FAIL indication will appear	i. Reduce load to the extent that the current on the 110 V bus will be [(No. of modules provided-1) x 20A] ii. Take action as per details under SMR module troubleshooting..
9.	Load Voltage High (O/P DC from SMR is beyond 132V/138V for VRLA/LMLA respectively)	LED glows and the particular FRBC where this has occurred will have its output zero along with FRBC fail indication.	Take action as per details under SMR module troubleshooting.
10.	Mains on Battery discharge (Mains available but system working on battery discharge)	LED glows due to (a) Output not available from SMR. (b) Output of SMR lower than battery voltage.	Take action as per details under SMR module troubleshooting
11.	60% DOD (Battery condition at 60% Discharge)	LED glows cautioning the discharge condition of the battery.	Emergency Start Generator
12.	70% DOD (Battery condition at 60% Discharge)	LED glows cautioning the discharge condition of the battery.	System Shutdown.
DC-DC Converter			
Status indications			
1.	Input ON (Input DC available to the module)	----	----
2.	Output ON (DC output available)	----	----
Alarms			
1.	Output Fail (Output not available)	LED glows indicating output non-availability due to	

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
		(a) Drift in output voltage adj. pot.	a)Check the output voltage adj. pot. For any physical changes and correct the setting.
		(b) Short circuit at the output.	(b) Remove the short circuits if any on the output side.
Inverter Module			
Status indications			
1.	Input ON (DC input to the module available)	----	----
2.	Output ON (AC output available)	----	----
Alarms			
1.	Output fail (Output voltage is less than specified limit)	LED glows whenever the output voltage is below 180V AC. This can be on account of (i) Drift in set value. (ii) Voltage droop due to overload. LED glows whenever the output voltage is above 180V AC.	(i) Adjust O/P volt. Adj. Pot. (ii) Reduce loads. Adjust O/P volt. Adj. Pot. and switch OFF/ON I/P MCB.
2.	Output fail	LED glows whenever output is Zero on account of DC I/P beyond limits.	Restore I/P within specified limits (100V-132V). check for short circuit and switch ON MCB.
3.	Over Load	LED Glows whenever load increases beyond 110% and O/P voltage droops.	Load should not be more than 100%.
4.	Fain Fail	LED glows whenever Fan fail condition.	Replace the fan.
5.	Reset Switch	Reset the output short circuit latch.	Replace the switch.
Transformers			
Status Indications			
1.	Input ON (Input is available)	----	----
2.	Output ON (Output is available)	----	----
Alarms			
1.	Output Fail (Non-availability of output)	Indication appears (a) On any loose connection. (b) On fuse failure. (c) Any internal failure.	(a) Reconnect properly. (b) Check for any short circuit. (c) Replace module.

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
Status Monitoring Panel			
1.	Start Generator/Run Gen. Set	Alarm and Red LED indication appear. Battery discharged to 50% DOD.	ACK. Alarm by pressing ACK/RESET push button for audio cut-off and Start Generator.
2.	Emergency Start Generator	Alarm and Red LED indication appear. Battery discharged to 60% DOD.	ACK. Alarm by pressing ACK/RESET push button for audio cut-off and Start Generator
3.	System Shutdown	Alarm and Red LED indication appear. Supply to signals is cut off. DC feed to DCDP will continue. Battery discharged to 60% DOD.	Start Generator (Alarm continues till GENERATOR is started.)
4.	Call S&T Staff	Alarm and Red LED indication appear for any equipment fail in IPS sub-modules.	Alarm can be acknowledged for audio cut-off.
5.	Stop Gen. Set	Alarm and Green LED indication appear when battery fully charged on D.G. Set.	Stop the D.G. Set.
Ferro Resonant Voltage Regulator			
1.	No AC Output	Green Lamp OFF but I/P switch in ON position due to: (a) One or more capacitors shorted. (b) Secondary winding shorted. (c) Entire regulator overloaded. (d) Entire regulator short circuited. (e) Green lamp fused. (f) Green lamp holder shorted. (g) No input power.	(a) Identify the faulty capacitor and replace. (b) Remove the main transformer and send for replacement. (c) Remove over-loading. (d) Remove short-circuit. (e) Replace Green lamp. (f) Replace Green lamp holder. (g) Check input connections.
2.	Low AC Output indication at unit voltmeter	Unit voltmeter calibration not correct. Input line frequency below 50 Hz.	Calibrate from a standard voltmeter or Zero adjustment.
3.	Low AC Output at 50 Hz/Green light OFF or Dim	(a)Capacitor open. (b)Indicating voltmeter faulty. (c)Partly overloaded. (d)Input voltage below specified limit.	(a)Identify capacitor and replace. (b)Replace. (c)Remove overloading. (d)Higher input of 160/150V required.
4.	No Voltmeter indication. Green light ON.	Voltmeter defective.	Replace.

Sr. No.	Alarm/Indication & description	Fault symptom /Probable cause	Corrective action
5.	No Ammeter indication. Green light ON but O/P volts OFF.	(a)Ammeter defective. (b)Very low load connected.	(a)Replace. (b)Increase load.
6.	Fuse at input line blowing repeatedly on turning on the unit. No Green light.	Primary coil shorted.	Replace.

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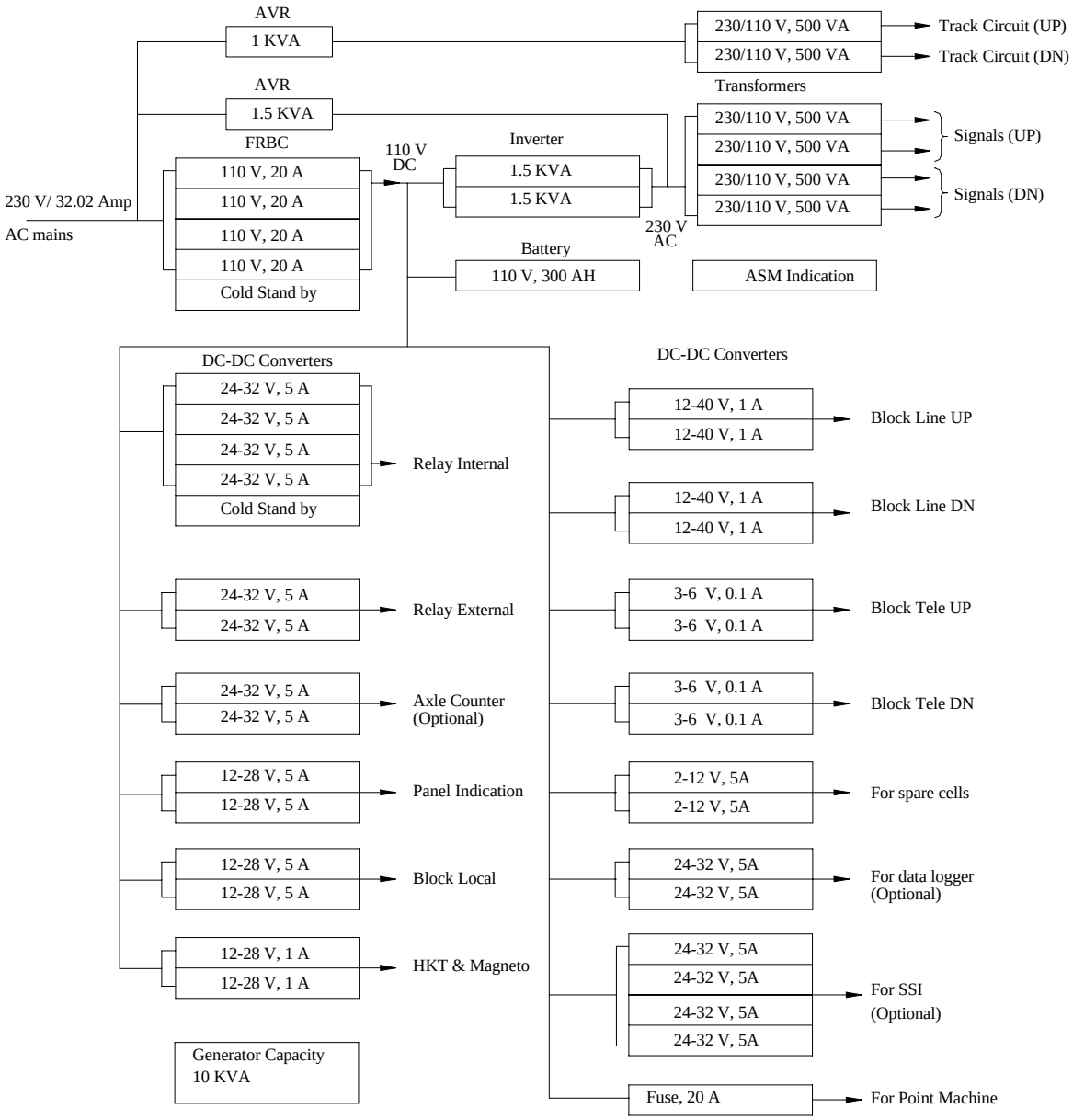
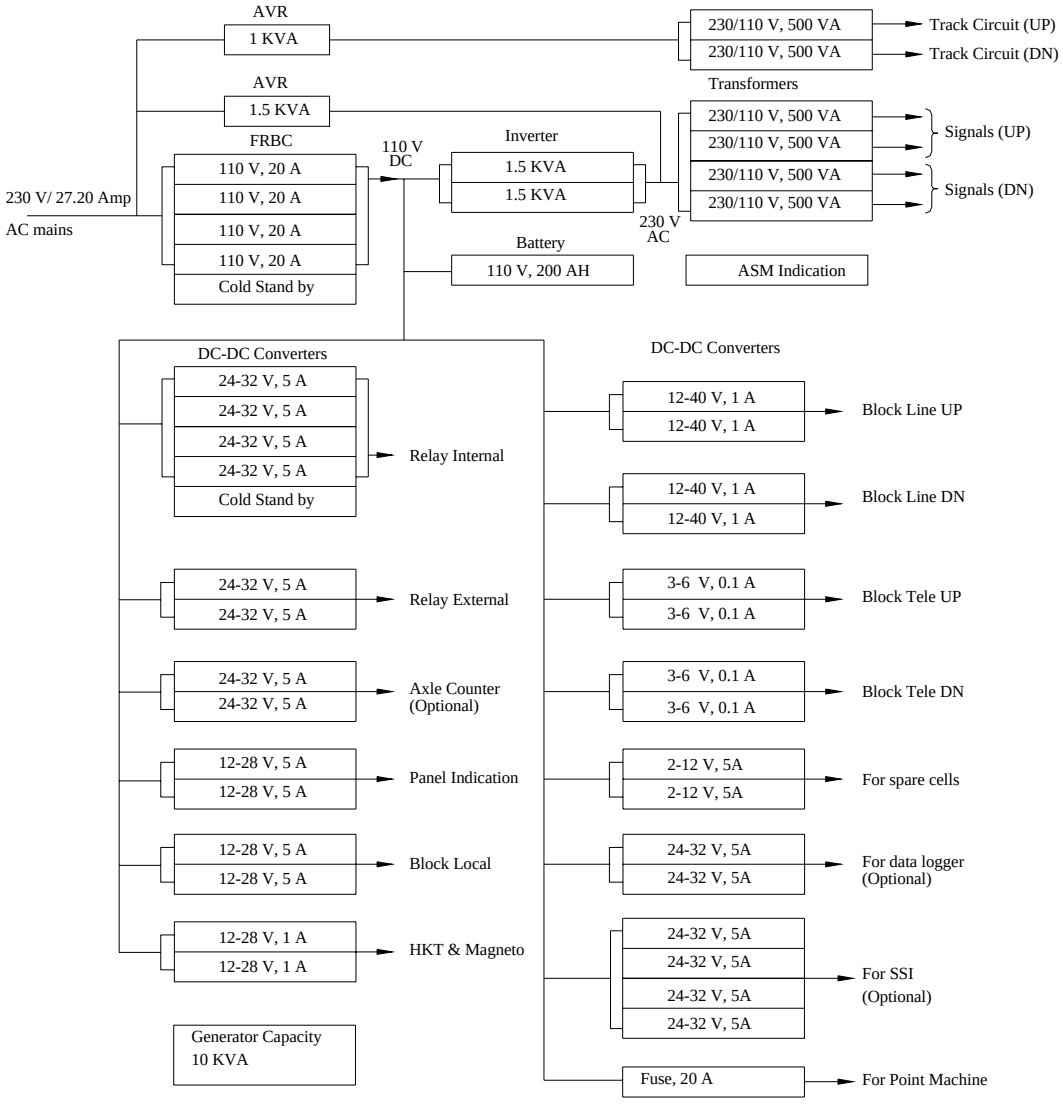
ANNEXURE A

BLOCK DIAGRAMS FOR STANDARD CONFIGURATIONS OF SMPS BASED IPS

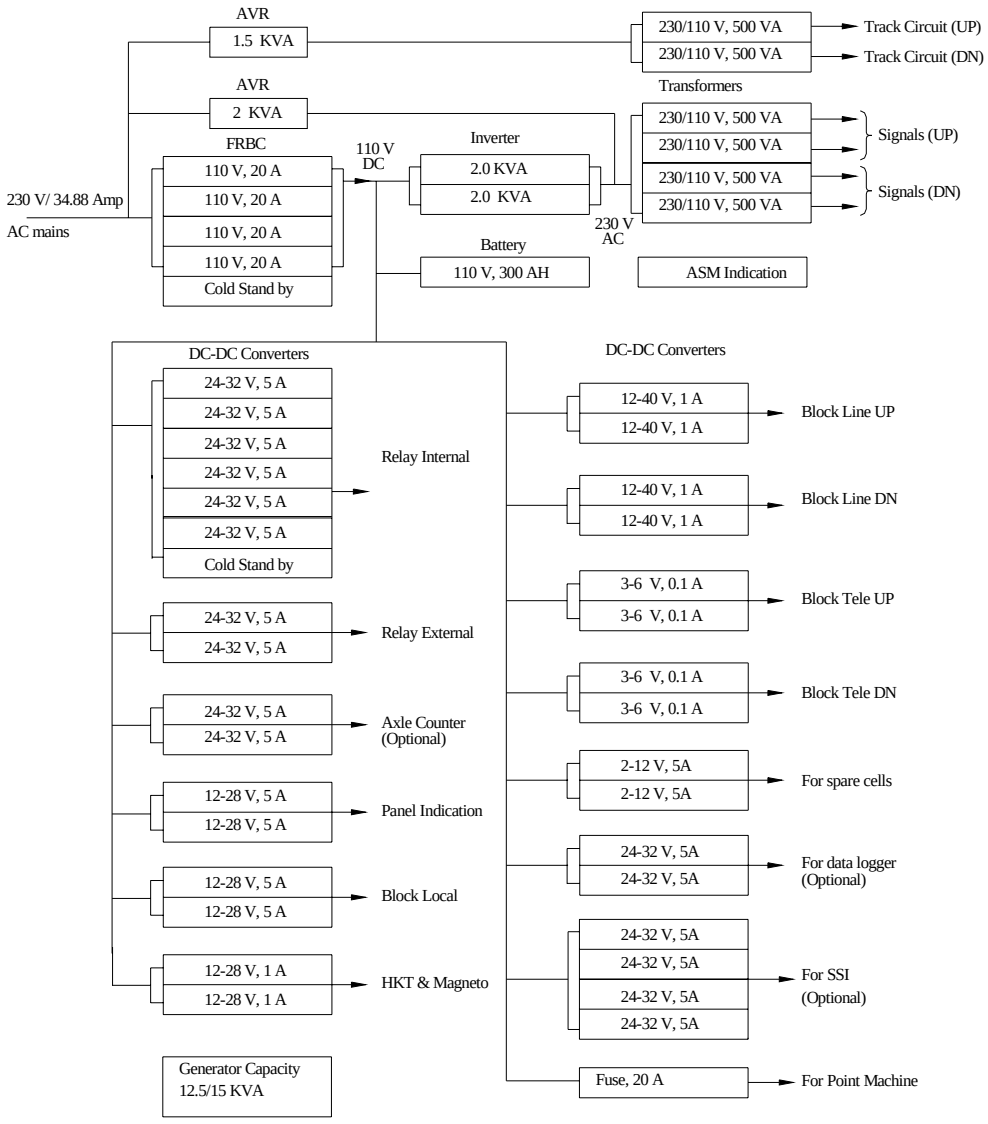
IPS for up to 4 lines without AFTC Nom - RE area
(SDO/IPS/SMPS/PI/NRE/001)



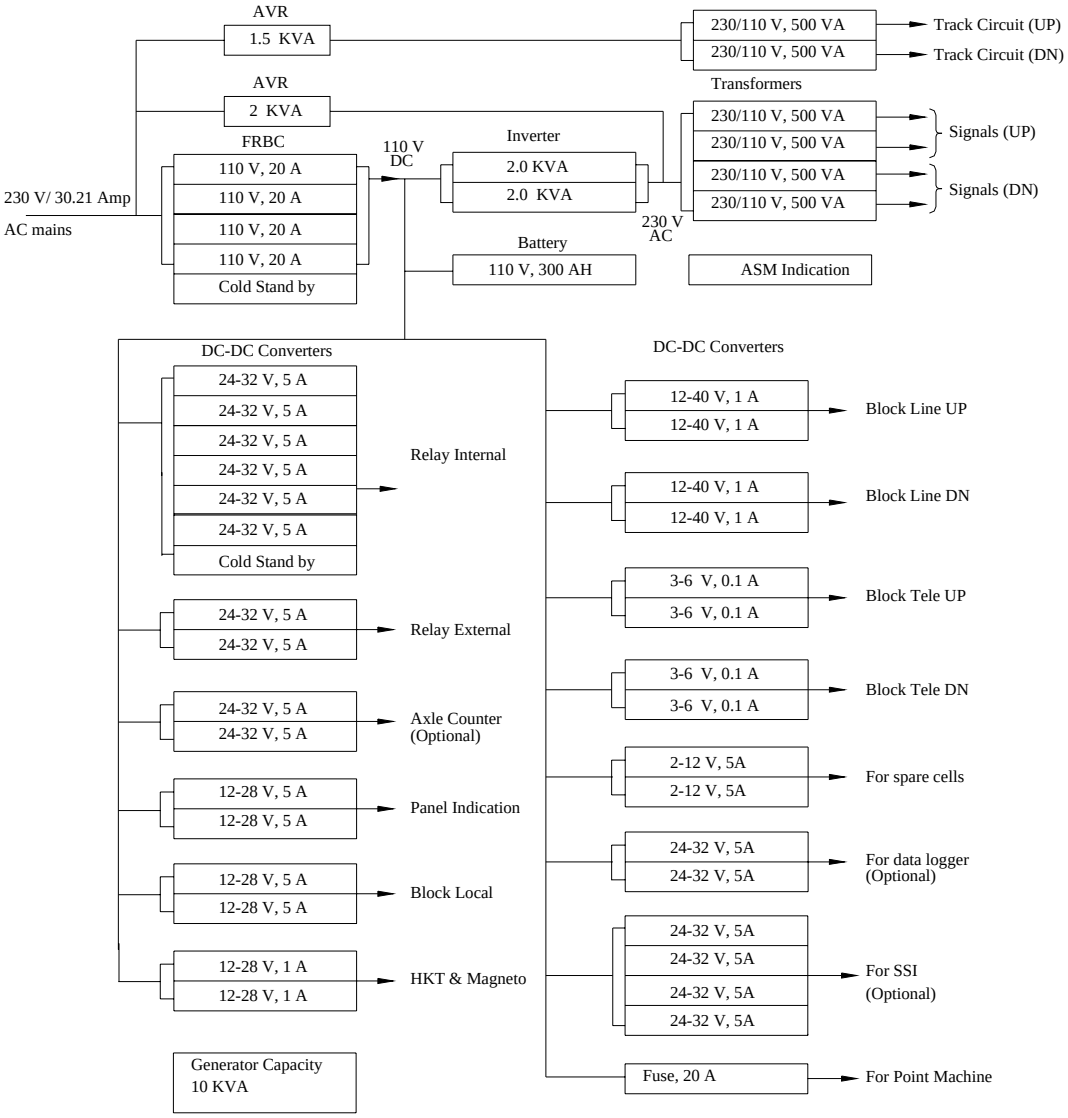
IPS for up to 4 lines without AFTC RE area (SDO/IPS/SMPS/PI/RE/002)



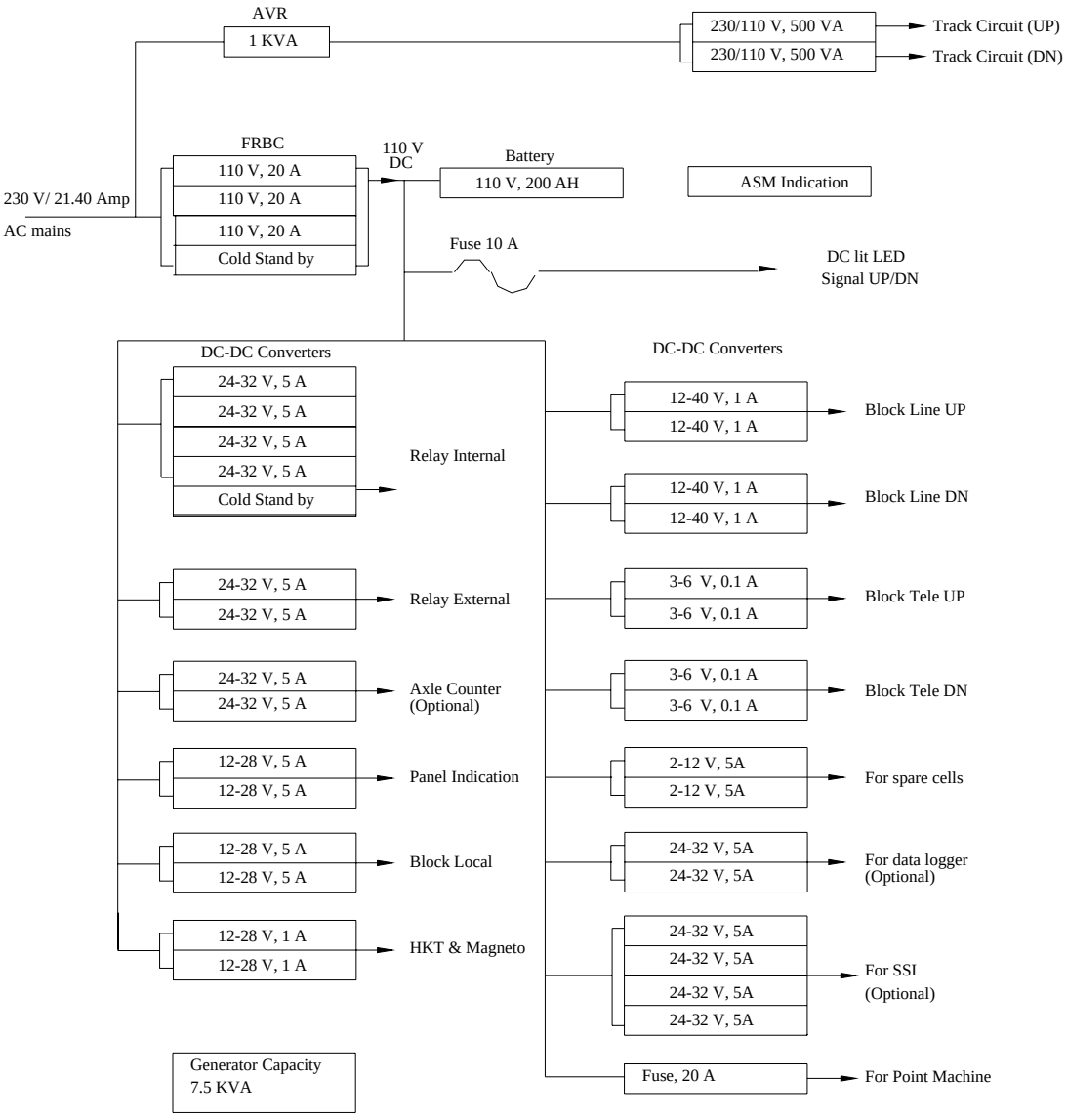
IPS for up to 6 lines without AFTC Non RE area (SDO/IPS/SMPS/PI/RE/003)



IPS for up to 6 lines without AFTC RE area (SDO/IPS/SMPS/PI/RE/004)



IPS for up to 4 lines RE/Non-RE area with DC lit LED Signal (SDO/IPS/SMPS/PI/RENon RE/005)



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ANNEXURE B

PRE-COMMISSIONING CHECKLIST FOR SMPS BASED IPS SYSTEM

1. STATION DETAILS

Zonal Railway		Number of main signals	
Division		Number of shunt signals	
Station Name		Number of point machines	
IPS Make		Number of Axle Counters	
RE/Non RE		Number of Track Circuits	
No. of lines / Roads		Type of Track Circuit (AFTC/DC)	
Power availability hours / day		Number/Type of Indoor relays	
DG set rating		Number/Type of outdoor relays	
Type / capacity of battery (LM/VRLA)		Interlocking (RRI/SSI) Interlocking (RRI/SSI)	

2. PRE-COMMISSIONING REQUIREMENTS

	ITEM	**Specified Value/provision**	**Measured Value / Observation**	**Remark (OK/Not OK)**
A) Ambience of IPS Room				
A1	Availability of working space for maintenance.	1 m (min.) from sides and rear. 2 m (min.) in front of the IPS		
A2	Provision of flooring to ensure proper cleaning	Pucca floor/ Ceramic tiles		
A3	Provision of forced ventilation	Fresh Air fans with dampers		
A4	Arrangement for protection against dust.	(i) Tight closing of doors & windows; use gaskets if necessary. (ii) Washable dust filters on windows. (iii) Provision of double door or entry through adjoining room to reduce dust ingress.		
A5	Provision of Ventilators	As per RE Drg. No. RE/Civil/S-129-2001 (Annexure-I).		
B) Batteries				
B1	Installation of	Installed in separate		

	ITEM	Specified Value/provision	Measured Value / Observation	Remark (OK/Not OK)
	secondary cell as per para 16.6 of SEM Pt. II	room / apparatus case. Acid proof flooring and tiles Exhaust fan Initial charging as per instruction of battery manufacturer Use of battery grade sulphuric acid conforming to IS: 266. Use of distilled or de-mineralised water conforming to IS: 1069		
B2	Storage period of VRLA batteries for IPS	Less than 03 months (If the battery is being stored for more than 3 months, freshening charge should be given once in 3 months as given below. The charging current should be 10% to 20% (max.) of rated capacity:- Float Charge @ 2.25V/cell for 24 hours Boost Charge - @ 2.30V/cell for 15 hours)		
B3	Measured capacity of battery after capacity test on batteries.	Rated AH		
B4	Feeder cable from battery to charger 120AH 200AH 300AH	10 sq.mm copper 16 sq.mm copper 25 sq.mm copper		
B5	B5 Availability of Spare cell in charged condition at site 05 Nos.	05 Nos.		
C) Commercial /AT Supply				
C1	Availability of commercial supply (Ref: RB letter No. 2002/SIG/SGF/3 dt. 24.6.03).	More than 6 hours in 24 hours with least fluctuations (Note: Nominal incoming AC supply shall be 230V, 50Hz single phase AC. The specified AC voltage range for IPS is 150V-270V.)		

	ITEM	Specified Value/provision	Measured Value / Observation	Remark (OK/Not OK)
C2	C2 Voltage drop in input feeder at full load.	Less than 30 volts		
C4	Provision of sources of power supply as per para 16.2 of SEM Pt. II.	RE Area Power supply drawn from AT Up/Dn/ Commercial supply/Genset with auto/ manual changeover facility in the control panel. On double/multiple line sections, at least one AT is available to ensure power supply in the event of power block. On single line sections where power supply is drown from a single AT, a DG set of suitable capacity has been provided In big yards, a DG set of adequate capacity in addition to supply from AT's and local source **Non RE Area** Power supply drawn from commercial feeder. In addition two standby diesel generators have been provided		
C4	C4 Size of input feeder cable as per TI Directorate's note no. TI/PSI/Project/CLS/ 01 dt. 04.01.02.(Annexure II) from Auxiliary Transformer (AT) / Distribution transformer to IPS room for 5 KVA AT 10KVA AT 50KVA AT	2X25 sq.mm Al 2x70 sq.mm Al 2x300 sq.mm Al		
C5	Sanctioned Commercial feeder load (KVA)=S			
	General Electrical Lighting load			

	ITEM	Specified Value/provision	Measured Value / Observation	Remark (OK/Not OK)
	(KVA)=L			
	Balance available for Signalling Load(KVA) = S-L 4 Line Non-RE 4 Line RE 6 Line Non-RE 6 Line RE	7.4 KVA 6.25 KVA 8.1 KVA 7.0 KVA		
C6	MCB/ Changeover switch (Ref: RB letter No. 2004/SIG/SGF/3 dt. 25.3.2004.	63 Amp of Merlin Gerlin (Telemecanique) / Siemens, Schneider or ABB.		
D) DG Set supply				
D1	Provision of adequate capacity DG set (without AFTC) 4 Line Non-RE 4 Line RE/ 6 Line RE 6 Line Non-RE With AFTC in yard	 10 KVA 10 KVA 12.5/15 KVA At least 25 KVA		
D2	Checking of DG set at 5KW dummy load: Waveform Voltage Regulation Frequency	Sinusoidal within 3% 50Hz ± 5% from no load to full load		
D3	Proper termination of earth and neutral.	Good workmanship		
E) Earthing				
E1	Earth resistance of earthing arrangement.	Less than 2 Ohm (without adding water prior to measurement) Preferably maintenance free earth.		
E2	Extension of earth to equipotential bus bar.	Provided		
E3	E3 Connection of individual equipment to equipotential bus bar: -IPS racks	with individual copper insulated cable of size 4 Sq.mm 4 Sq.mm 16 Sq.mm		

	ITEM	Specified Value/provision	Measured Value / Observation	Remark (OK/Not OK)
	-DG sets -Surge protection devices			
F) Lightning & Surge Protection				
F1	F1 Provision of lightning & surge arrestors (As per Cl. 3.12 of RDSO/SPN/165/2004 Ver 2)	One Set		
	G. Instruction Manual			
	G1 Instruction Manual consisting of Layout drgs., Circuit/ System diagram, PCB Layout etc. (Ref: Cl. 7.1 of RDSO/SPN/165/2004 Ver 2)	Two Sets		
H) Training				
H1	Imparting on job training to SE/SSE/JE and ESM	3 Days		

3. IPS LOAD DETAILS

N= Number of modules provided in hot standby

S.No	ITEM	Specified Value/provision	Measured Value/Observation	Remark (OK/Not OK)
1.	Signalling Equipment load (KVA)	80% of the DG Set capacity provided at station		
2.	Relay internal 24-32V/5A	5 *(N-2) Amp		
3.	Relay external 24-32V/5A	5 *(N-1) Amp		
4.	Axle counter 24-32V/5A	5 *(N-1) Amp		
5.	Block local 12-28V/5A	5 *(N-1) Amp		
6.	Panel Indication12-28V/5A	5 *(N-1) Amp		
7.	HKT/magneto 12-28V/1A	1 *(N-1) Amp		
8.	Block UP 12-40V/1A	1 *(N-1) Amp		
9.	Block DN 12-40V/1A	1 *(N-1) Amp		
10.	Block Tele UP 3-6V/0.1A	0.1*(N-1) Amp		
11.	Block Tele DN 3-6V/0.1A	0.1*(N-1) Amp		
12.	Data logger 24-32V/5A	5 *(N-1) Amp		
13.	SSI 24-32V/5A	5 *(N-2) Amp		
14.	Load on each Signal Tx UP	500 VA		

S.No	ITEM	Specified Value/provision	Measured Value/Observation	Remark (OK/Not OK)
15.	Load on each Signal Tx DN	500 VA		
16.	Load on Inverter 4 Line 6 Line	 1.5 KVA 2.0 KVA		
17.	Load on Signalling AVR 4 Line 6 Line	 1.5 KVA 2.0 KVA		
18.	Load on Track Tx UP DN	 500VA 500VA		
19.	Load on Track AVR 4 Line 6 Line	 1.0 KVA 1.5 KVA		
20.	High voltage disconnect	275 V		
21.	Low voltage disconnect	160V		
22.	Battery capacity	300/200AH		
23.	Battery charging current	30/20A =Y		
24.	Total current drawn from FRBC at 110 V after one hour of discharge.	20* (N-2) Amp=X		
25.	Current drawn from FRBC at 110 V when battery is in float condition	X -Y		
26.	Input feeder current at full load 4 Line Non-RE 4 Line RE 6 Line Non-RE 6 Line RE	 32 Amp 27.2 Amp 35 Amp 30.2 Amp		
27.	Input feeder voltage at full load	160 Volts (Minimum)		
28.	Functioning of dynamic current control	Operational		
29.	Supply fuse	63 A		
30.	Working of Status Monitoring Panel (Para 4.10 of spec.) DOD 50% 60% 70% Stop DG Set	 RED & Audio alarm RED & Audio alarm RED & Audio alarm till DG is started GREEN & Audio alarm		
31.	Call S&T due to failure of any module	RED & Audio alarm		
32.	Changeover inv. 1 to 2 and vice versa	Inverter failure		

S.No	ITEM	Specified Value/provision	Measured Value/Observation	Remark (OK/Not OK)
33.	Changeover inv. to CVT and vice versa	Both inverter fail		
34.	DC-DC Converter for spare cells 2-12V, 5Amp	02 Nos.		
35.	Temperature compensation	Provided for VRLA battery		

4. Performance Monitoring of IPS

S.No	ITEM	Specified Provision	Observ-ation	Remark
1.	Monthly calculation of MTBF/MTTR and sending it to Zonal Railways for onward transmission to RDSO	As per Annexure III		

Signature of IPS Manufacturer's Representative
Name
Designation

Signature of Railway Supervisor
Name
Designation

ANNEXURE C

MAINTENANCE RECORD FOR SMPS BASED IPS SYSTEM

(Approved by Rly. Board vide Letter No.2005/Sig./SEM/8/Pt. dated 31.01.2007)

Battery Bank

S. No.		IPS make	
Load		No. of cells	
Capacity		Make of cells	
Date of installation		IPS rating	
Initial Specific gravity			

Cell No.1.	Voltage											
	Sp. Gravity.											
Cell No.2.	Voltage											
	Sp. Gravity.											
Cell No.3.	Voltage											
	Sp. Gravity.											
Cell No.4.	Voltage											
	Sp. Gravity.											
Cell No.5.	Voltage											
	Sp. Gravity.											
Cell No.6.	Voltage											
	Sp. Gravity.											
Cell No.7.	Voltage											
	Sp. Gravity.											
Cell No.8.	Voltage											
	Sp. Gravity.											
Cell No.9.	Voltage											
	Sp. Gravity.											
Cell No.10.	Voltage											
	Sp. Gravity.											
Cell No.11.	Voltage											
	Sp. Gravity.											
Cell No.12.	Voltage											
	Sp. Gravity.											
Cell No.13.	Voltage											
	Sp. Gravity.											
Cell No.14.	Voltage											
	Sp. Gravity.											
Cell No.15.	Voltage											
	Sp. Gravity.											
Cell No.16.	Voltage											
	Sp. Gravity.											

Cell No.17.	Voltage											
	Sp. Gravity.											
Cell No.18.	Voltage											
	Sp. Gravity.											
Cell No.19.	Voltage											
	Sp. Gravity.											
Cell No.20.	Voltage											
	Sp. Gravity.											
Cell No.21.	Voltage											
	Sp. Gravity.											
Cell No.22.	Voltage											
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Cell No.23.	Voltage											
	Sp. Gravity.											
Cell No.24.	Voltage											
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Cell No.25.	Voltage											
	Sp. Gravity.											
Cell No.26.	Volt age											
	Sp. Gravity.											
Cell No.27.	Voltage											
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Cell No.28.	Voltage											
	Sp. Gravity.											
Cell No.29.	Voltage											
	Sp. Gravity.											
Cell No.30.	Voltage											
	Sp. Gravity.											
Cell No.31.	Voltage											
	Sp. Gravity.											
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Cell No.37.	Voltage											
	Sp. Gravity.											
Cell No.38.	Voltage											
	Sp. Gravity.											
Cell	Voltage											

No.39.	Sp. Gravity.											
Cell No.40.	Voltage											
	Sp. Gravity.											
Cell No.41.	Voltage											
	Sp. Gravity.											
Cell No.42.	Voltage											
	Sp. Gravity.											
Cell No.44.	Voltage											
	Sp. Gravity.											
Cell No.45.	Voltage											
	Sp. Gravity.											
Cell No.46.	Voltage											
	Sp. Gravity.											
Cell No.47.	Voltage											
	Sp. Gravity.											
Cell No.48.	Voltage											
	Sp. Gravity.											
Cell No.49.	Voltage											
	Sp. Gravity.											
Cell No.50.	Voltage											
	Sp. Gravity.											
Cell No.51.	Voltage											
	Sp. Gravity.											
Cell No.52.	Voltage											
	Sp. Gravity.											
Cell No.53.	Voltage											
	Sp. Gravity.											
Cell No.54.	Voltage											
	Sp. Gravity.											
Cell No.55.	Voltage											
	Sp. Gravity.											
Total Voltage												
Check battery path current. It should be AH/10.												
Check Main Supply. It should be within specified range of 150 – 275 V												
IPS wiring & its working												
Cleaning of battery & its terminals												
Topping up of battery												

SMPS Charger Panel

No. of SMPS module in use. It should be (N+1).											
Check with SMPS Charger switched ON, all DC load should work on it.											
Check the voltage of each module & keep voltage setting for float and boost to same value within 0.1 V.											
Check the voltage of each module & keep voltage setting for float and boost to same value within 0.1V.											
Check with SMPS charger switch OFF, all load should work on battery.											
Check AC Voltage											
Check AC Current											
Check DC Voltage											
Check DC Current											
Check mode of charging (Float/Boost)											
Check battery voltage setting according to type of battery											
Check all the indication on SMPS module.											

AC Distribution Panel

Check for auto-changeover in IPS											
Check provision of lightning and surge protection arrangement											
Check input to inverter on display unit (V).											
Check all the indication on the panel.											
Check input to CVT on display unit (V).											
Check the frequency of supply of CVT is within 50 Hz $\pm$ 2											
Check Signal load current.											
Switch Off 1st Inverter, AC load should transfer on 2nd Inverter.											
Switch Off 2nd Inverter, AC load should transfer on 1st Inverter.											
Check Inverter output AC current. If exceeding 250 V AC, replace driver card.											
Switch Off both the Inverter, AC load should transfer on CVT.											

DC Distribution Panel

Check all the indication on the panel.											
Check No. of DC to DC converter for each circuit. It should be in N+1 configuration.											
Check DC voltage is within the range of 98V – 138V.											
Check DC-DC converters for spare/sick cell charging.											
Check DC under voltage across terminal point. It should be above 98V.											
Check DC over voltage across terminal point. It should be below 138V.											
Check output voltage of each DC-DC converters (Plug provided on the front)											

Remote Alarm Panel

Check for failure signal of Inverter/CVT/Transformer modules n ASM Panel.											
Check connection of earth to the panel. Measure earth resistance (should be 2 ohms without adding water).											
Check with 50% depth of discharge of battery. Audio/visual alarm starts, which can be acknowledged with audio cut off.											

Check with 60% depth of discharge of battery. It warns for emergency with audio/visual alarm, which can be acknowledged with audio cut off.											
Check with 70% depth of discharge of battery. Signal feed is cut off and all DC-DC converters continue working. Audio alarm continues till generator is started.											
Check ventilation of battery room. It should be free from water, oil and dust.											
Check connecting cable of battery to be flexible and sufficiently long to prevent strain on the battery terminals.											
Check electrical connection for tightness.											
Check Vaseline or Petroleum jelly on terminals and connections.											
Clean power equipment by blower to remove dust etc.											
Description about reference of message and given to whom in case of any defect.											

Date											
Signature & Designation											

ABBREVIATIONS USED

AC	Alternating Current
ACDP	AC Distribution Panel
AH	Ampere Hour
Amndt.	Amendment
ASM	Assistant Station Master
AVR	Automatic Voltage Regulator
CSU	Control & Supervisory Unit
CVT	Constant Voltage Transformer
DAM	Digital Ammeter
DC	Direct Current
DCDP	DC Distribution Panel
DC-DC	DC to DC
DG	Diesel Generator
DOD	Depth Of Discharge
DSA	Distribution/Supervisory Control Alarm
DVM	Digital Voltmeter
EEPROM	Electrically Erasable Programmable Read Only Memory
EXT	External
FRBC	Float Rectifier cum Boost Charger
HKT	Happer's Key Transmitter
HVDC	High Voltage Disconnect Contactor
INT	Internal
INVT	Inverter
IPS	Integrated Power Supply
LA	Lead Acid
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LVDS	Low Voltage Disconnect Switch
MCB	Miniature Circuit Breaker
MEBB	Main Equipotential Earth Bus Bar
MUIB	Main User Interface Board
OHE	Overhead Equipment
PCB	Printed Circuit Board
PI	Panel Interlocking
PWM	Pulse Width Modulation
RE	Railway Electrification
RDSO	Research Design & Standards Organisation
SEBB	Sub Equipotential Bus Bar
SMF	Standard Maintenance Free
SMPS	Switch Mode Power Supply
SMR	Switch Mode Rectifier
SPD	Surge Protection Device
SSI	Solid State Interlocking
TX	Transformer
VRLA	Valve Regulated Lead Acid

REFERENCES

- IRS specification No. RDS/SPN/165/2004 with Amendment 5.

- Operational Instructions & Maintenance Manual for SMPS based IPS for Railway Signalling application – M/s Amararaja Power Systems (P) Ltd., Tirupati (A.P.)

- Integrated Power Supply :Operation and Maintenance Manual – M/s Statcon Power Controls Ltd., Noida (U.P.).

- Operation and Maintenance Manual for SMPS based IPS system – M/s HBL NIFE Power Systems Ltd.

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