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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS

IN-SITU TESTING OF OVER VOLTAGE PROTECTION (OVP) UNIT OF ALTERNATORS WITH RRU OF TL & AC COACHES

END USER : TL & AC Maintenance Staff

CAMTECH/E/EP-02/2019-20/OVP/1.0

July, 2019

अग्रमा संRDS
रेल अग्रदूत Transforming Railways
EXCELLENCE IN MAINTENANCE
Indian Railways
Centre for Advanced Maintenance Technology

महाराजपुर, ग्वालियर –474 005
Maharajpur, GWALIOR - 474 005

Back to CONETNT

In-situ testing
of
Over Voltage Protection (OVP) unit of
Alternator with RRU of TL & AC Coaches

QUALITY POLICY

"We at RDSO Lucknow are committed to maintain and update transparent standards of services to develop safe, modern and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards by setting quality objectives, commitment to satisfy applicable requirements and continual improvements of the quality management system to cater to growing needs, demand and expectations of passenger and freight traffic on the railways through periodic review of quality management systems to achieve continual improvement and customer appreciation. It is communicated and applied within the organization and making it available to all the relevant interested parties."

Back to CONETNT

FOREWORD

In Self-Generating Train Lighting and Air Conditioned (SG TL & AC) coaches, over voltage generation from alternators due to failures of control circuit of RRU, may cause failure of lights and fans. In some cases, this may also lead to smoke emission and panic among passengers.

To prevent the over generation, Over Voltage Protection (OVP) unit has been provided in RRU (Rectifier cum Regulator Unit). It is a safety device for both type of coaches and it is essential to test and verify its working periodically.

To ensure wide dissemination of knowledge on In-Situ testing procedure and parameters of OVP, CAMTECH, Gwalior has prepared this handbook on "In-situ testing of Over Voltage Protection (OVP) unit of Alternator with RRU of TL & AC Coaches". This handbook also contains detail procedure of testing with photographs for easy understanding.

I am sure that this handbook will be useful for field maintenance staff of coaching stock in their day to day working and improving the reliability and safety of coaching stock on Indian Railways.

CAMTECH ***Jitendra Singh***
Date: 31.07.2019 ***Principal Executive Director***

Back to CONETNT

PREFACE

In Self Generating (SG) train lighting and air conditioned coaches, the requirement of electricity is achieved by generating it with the help of axle driven alternators while in run. During stationary and low speed conditions, a battery set connected in parallel feed power to the coach. The three phase ac supply generated by alternator is rectified and regulated by Rectifier cum Regulator Unit (RRU)/Electronic Rectifier cum Regulator Unit (ERRU). This regulated DC supply is used for charging batteries and fed to coach for electrical loads.

Static over voltage protection (OVP) unit is a safety device which is provided to stop the over generation in case of any fault of the components in the excitation control circuit causing over generation to protect coach electric appliances and maintain fail safe operation.

This handbook on "In-situ testing of Over Voltage Protection (OVP) unit of Alternator with RRU of TL & AC Coaches" is prepared with the objective to disseminate knowledge on subject.

It is clarified that this handbook does not supersede any existing provisions laid down by Railway Board/ RDSO, OEMs. This handbook is for guidance only and it is not a statutory document.

I am sincerely thankful to all field personnel who helped us in preparing this handbook. Technological up-gradation & learning is a continuous process. Please feel free to write us for any addition/ modification in this handbook.

CAMTECH, Gwalior ***Manoj Kumar***
Date: 26.07.2019 ***Joint Director/ Mechanical***

Back to CONETNT

CONTENT

NEXT PAGE

Back to CONETNT

ISSUE OF CORRECTION SLIP

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/E/EP-02/2019-20/OVP/1.0/C.S. # XX date---

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr.No.	*Date of Issue*	*Page no. & Item no. modified*	*Remarks*

Back to CONETNT

1.0 INTRODUCTION

In Self Generating (SG) train lighting and air conditioned coaches, the requirement of electricity is achieved by generating it with the help of axle driven alternators while in run. During stationary and low speed conditions, a battery set connected in parallel feed power to the coach. The three phase ac supply generated by alternator is rectified and regulated by Rectifier cum Regulator Unit (RRU)/Electronic Rectifier cum Regulator Unit (ERRU). This regulated DC supply is used for charging batteries and fed to coach for electrical loads.

The voltage induced in the alternator winding is dependent on the speed of revolution of rotor and on the field excitation current.The field excitation is regulated by magnetic amplifier with associated electronic control circuitry in RRUs. An excitation transformer is used to match the voltage for the magnetic amplifier control.

Static over voltage protection (OVP) circuit is provided to stop the generation in case of any fault of the components in the excitation control circuit causing over generation. When the voltage exceeds the set value, the OVP relay energizes and stops the supply to field winding. Alternator stops generation. This controls over generation which will be harmful for the coach appliances and maintain fail safe operation.

ThusOVP (Over Voltage Protection) Relay is a protective relay used to protect the electrical equipment from over voltages in the coaches. It is a safety device.

2.0 OVER VOLTAGE/ PROBLEMS

- Over voltages are voltages that exceed the normal values.
- These normal values determine the insulation, which is designed and tested according to the appropriate regulations.
- The degree of insulation varies depending on the type of electrical equipment.
- Over voltage generation in coach may cause failure of light ballasts & fans which may also lead to smoke emission in some cases.

3.0 CAUSES FOR OVER VOTAGE GENERATION IN COACHES

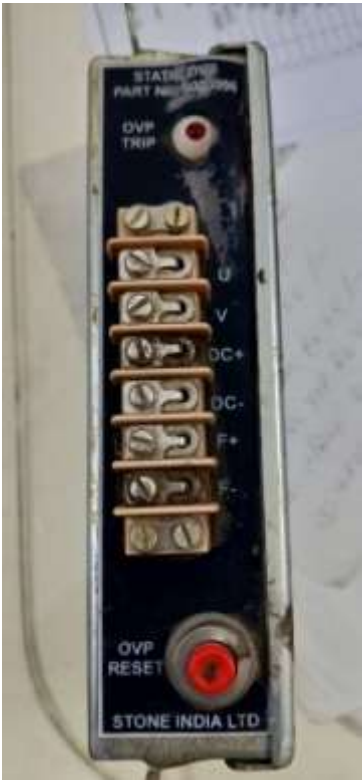
- Control winding of Magnetic Amplifier (MA) in RRU is in open circuit condition.
- Failure of Zener Diode in voltage detector.
- Opening of resistances/ potentiometer in the control unit.
- Failure of control rectifier diodes.
- Opening of field diode or freewheeling diode.

4.0 TYPES OF OVER VOLTAGE PROTECTION RELAY

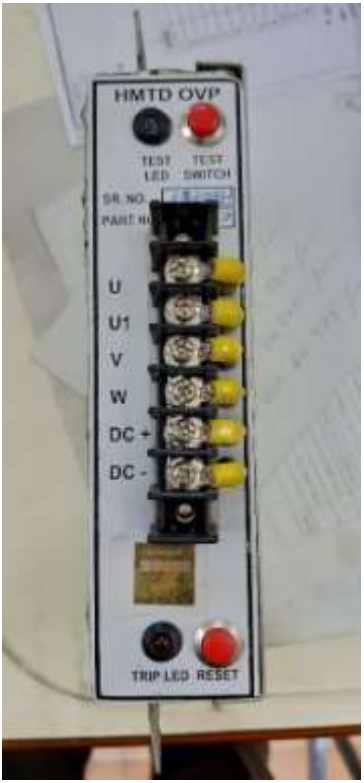
It is of two types:

1) Shunt type

2) Series type



Shunt Type OVP



Series Type OVP

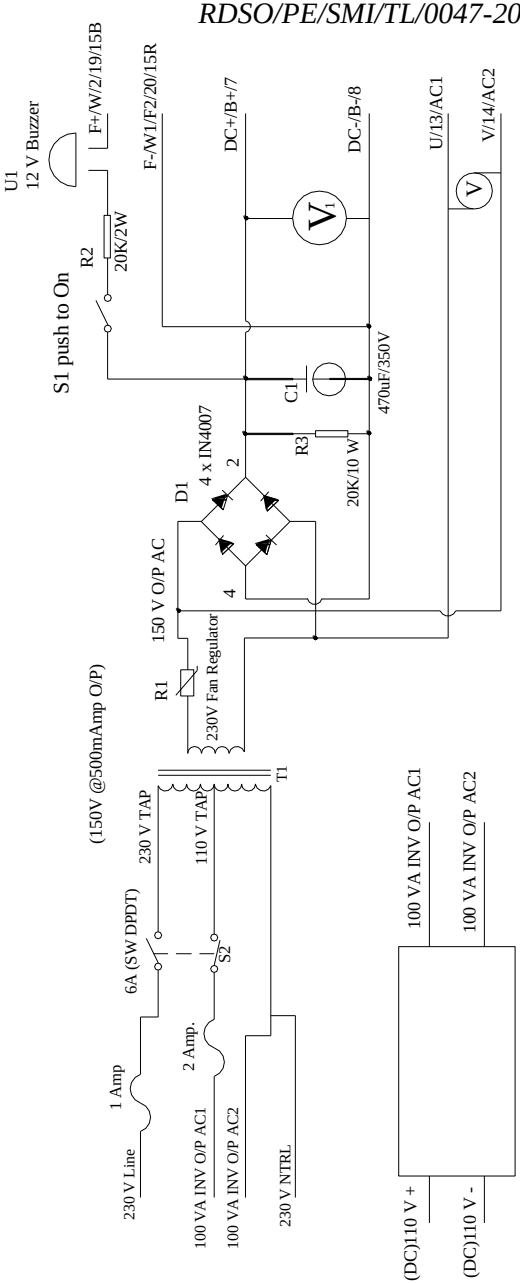
5.0 RRU WITH OVP

6.0 ERRU WITH OVP

7.0 OVP TESTING KIT

- Universal test unit with variable DC and AC voltage supply to test the working condition of OVP in-situ condition (on position).
- This unit is enable to identify the defective OVP so that the same can be repaired or replaced.
- This unit can be assembled in a portable and easy to carry case/box. Alternatively, this unit can be purchased from any of RRU/ ERRU manufacturer.

Circuit Diagram of Universal Testing Kit (Ref: SMI No. RDSO/PE/SMI/TL/0047-2013, Rev. 0)



Bill of Material for OVP testing kit

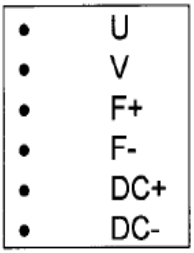
Used part type	Designator	Description
1 (150V @ 500m Ampa O/P)	T1	Isolation transformer
1 4 x IN4007	D1	Diode bridge (4 x IN 4007)
1 6A(SW DPDT)	S2	DPDT Toggle switch
1 20 K/2W	R2	CFR
1 20K/10W	R3	Wire wound resistor
1 230V Fan Regulator	R1	Domestic fan regulator
1 470uF/350V	C1	Electrolyte capacitor
1 Buzzer	U1	12V Buzzer
1 Push to On (1A Push button switch)	S1	
1 AC Voltmeter (0-230V)	V	
1 DC Voltmeter (0-200V)	V1	

8.0 PROCEDURE FOR TESTING (SHUNT TYPE OVP)

(Ref: SMI No. RDSO/PE/SMI/TL/0047-2013, Rev.0)

8.1 Testing of 4.5 kW M/s PIPL Make OVP

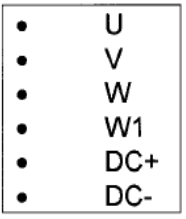
- Connect DC (+)ve & DC (-)ve output terminals of the test unit to the DC (+)ve & DC (-)ve terminals to OVP.
- Connect U&V AC output terminals of the test unit to the U&V terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F (+)ve & F (-)ve terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **146 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.2 Testing of 25 kW M/s PIPL Make OVP

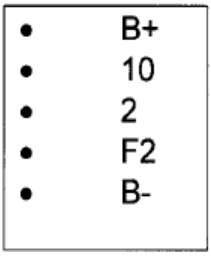
- Connect DC (+)ve & DC (-)ve output terminals of the test unit to the DC(+)ve & DC(-)ve terminals to OVP.
- Connect U&V AC output terminals of the test unit to the U&V terminals of OVP.
- Connect F (+)ve& F (-)ve of the test unit to the W&W1 terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC**, Buzzer sounds and wait for a short time until OVP trips and Buzzer not sounds. This shows that OVP is healthy.

8.3 Testing of 4.5 kW M/s HMTD Make OVP

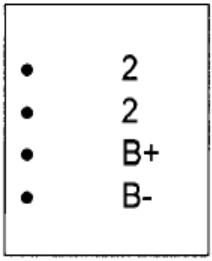
- Connect DC (+)ve & DC (-)ve output terminals of the test unit to the B(+)ve & B(-)ve terminals to OVP.
- Connect DC (+)ve output terminals of the test unit to the 10 number terminals to loop wire.
- Connect F (+)ve & F (-)ve of the test unit to the 2 & F2 terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC**, Buzzer sounds and wait for a short time until OVP trips and Buzzer not sounds. This shows that OVP is healthy.

8.4 Testing of 25 kW M/s HMTD Make OVP

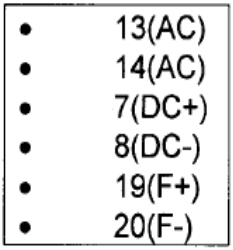
- Connect DC (+)ve & DC (-)ve output terminals of the test unit to the B(+)ve & B(-)ve terminals to OVP.
- Connect F (+)ve & F (-)ve of the test unit to the 2 & 2 terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC**, Buzzer sounds and wait for a short time until OVP trips and Buzzer not sounds. This shows that OVP is healthy.

8.5 Testing of 4.5 kW M/s KEL Make OVP

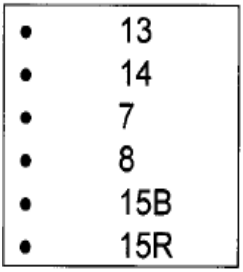
- Connect DC (+)ve & DC (-)ve output terminals of the test unit to the 7 & 8 terminals to OVP.
- Connect loop wire in between OVP terminals 8 & 13.
- Connect F (+)ve & F (-)ve of the test unit to the 19 & 20 terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.6 Testing of 25 kW M/s KEL Make OVP

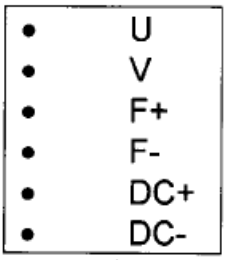
- Connect DC(+)ve& DC(-)ve output terminals of the test unit to the 7 & 8 terminals to OVP.
- Connect loop wire in between OVP terminals 8 & 13.
- Connect U & V AC output terminals of the test unit to the 13 & 14 terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the 15B & 15R terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC**, Buzzer sounds and wait for a short time until OVP trips and Buzzer not sounds. This shows that OVP is healthy.

8.7 Testing of 4.5 kW M/s SIL, Stesalit& ICECPL Make OVP

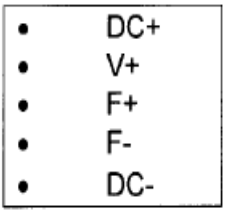
- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the DC (+)ve & DC (-)ve terminals to OVP.
- Connect DC(+)ve output terminals of the test unit to the U terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **116/119 volt AC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.8 Testing of 25 kW M/s SIL Make OVP

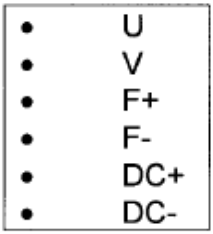
- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the DC (+)ve & DC (-)ve terminals to OVP.
- Connect loop wire in between OVP terminals DC (+)ve & V+.
- Connect F (+)ve & F (-)ve of the test unit to the F (+)ve & F(-)ve terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **150 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.9 Testing of 25 kW M/s Stesalit Make OVP

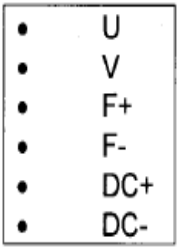
- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the DC (+) ve & DC (-)ve terminals to OVP.
- Connect DC(+)ve output terminals of the test unit to the U terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **123 volt AC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.10 Testing of 25 kW M/s ICECPL Make OVP

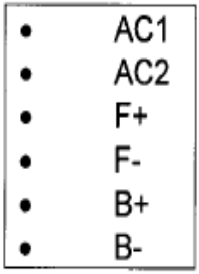
- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the DC (+)ve & DC (-)ve terminals to OVP.
- Connect DC(+)ve output terminals of the test unit to the U terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **116/119 volt AC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

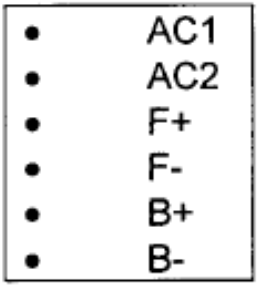
8.11 Testing of 4.5 kW M/s Best & Crompton Make OVP

- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the B(+)ve & B (-)ve terminals to OVP.
- Connect U&V output terminals of the test unit to the AC1 & AC2 terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.
- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **140±1 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.



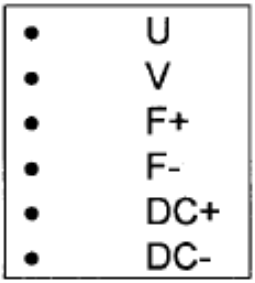
8.12 Testing of 25 kW M/s Best & Crompton Make OVP

- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the B (+) ve & B (-)ve terminals to OVP.
- Connect U&V output terminals of the test unit to the AC1 & AC2 terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.
- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **145±1 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.



8.13 Testing of 4.5 kW M/s Kapson Make OVP

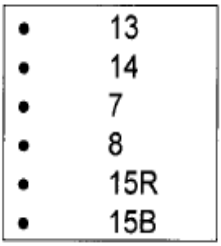
- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the DC (+) ve & DC (-)ve terminals to OVP.
- Connect U&V output terminals of the test unit to the U&V terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the F(+)ve & F(-)ve terminals of OVP.
- Switch 'ON' the test unit.



- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **143-144 volt DC** and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.

8.14 Testing of 25 kW M/s BHELEML Make OVP

- Connect DC(+)ve & DC(-)ve output terminals of the test unit to the 7 & 8 terminals to OVP.
- Connect U&V AC output terminals of the test unit to the 13&14 terminals of OVP.
- Connect F (+)ve & F (-)ve of the test unit to the 15R & 15B terminals of OVP.



- Switch 'ON' the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads **145 volt DC**, Buzzer sounds and wait for a short time until OVP trips and Buzzer not sounds. This shows that OVP is healthy

9.0 DETAIL PROCESS FOR TESTING (SHUNT TYPE)

1. Disconnect all terminal wires at OVP.

2. Connect the OVP Test Kit wires to corresponding OVP terminals as per SMI-0047-2013 (Rev.0).This is also mentioned earlier.

3. Connect 110V DC supply/ 230 V AC supply (as per requirement) to Testing Kit.

4. Switch "ON" the input supply. (Keep the Variac position at minimum).

5. Increase the Variac gradually to trip the OVP.

6. Note the AC and DC voltage reading at the time of OVP tripping.

7. Finally decrease the voltage with Variac and switch "off" the supply of testing kit.

8. Reset the OVP by pressing the Reset button.

9. Reconnect the wires of OVP by disconnecting the Test kit wires.

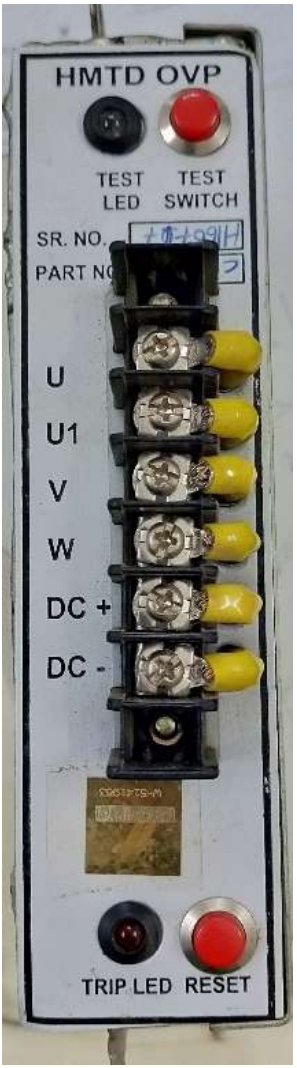
10. Write down the testing date on OVP side wall.

10.0 PROCEDURE FOR TESTING (SERIES TYPE OVP)

(Ref: FRS No. RDSO/PE/FRS/AC/0005-2013)

Testing procedure for test switch (push button type) of OVP as given below, is the same for all the makes:

- OVP shall be connected in RRU. Alternator and battery shall also be connected with RRU.
- Press test switch, amber LED will glow.
- Keep test switch pressed for 2 to 5 seconds.
- Healthy OVP – amber LED will turn off and OVP tripped indication LED will glow.
- Faulty OVP – amber LED does not turn off and continue to glow even if OVP tripped indication LED glows.



11.0 OVP MALFUNCTIONING

Reasons for not working of OVP:

- ❖ Terminal connections of OVP are not connected properly.
- ❖ Incoming supply AC/DC to the OVP may not be available.
- ❖ Relay used in the OVP circuit may be faulty.
- ❖ Electronic circuit used in the OVP may be faulty.
- ❖ Reset push button may be defective.

12.0 OVP MALFUNCTIONING AFFECTS

- ❖ It leads to over generation.
- ❖ Causing burning of lights and fans.
- ❖ Cells may over charge causing cell burst/internal short circuit.
- ❖ Insulation damage, joints may lead to earth leakage.
- ❖ There is a chance to smoke emission.

REFERENCES

1. RDSO SMI No. RDSO/PE/SMI/TL/0047-2013 (Rev.0) dtd. 01.05.2013 for 4.5 kW/25kW RRU In-situ Testing of Over Voltage Protection (OVP) Unit on TL & AC Coaches.

2. RDSO Functional Requirement Specification (FRS) No. RDSO/PE/FRS/AC/0005-2013,May 2013 for Design, Development and Manufacturing of Over Voltage Protection for 25 & 4.5 kW RRU/ERRU 110V DC TL/AC Coaches.

3. Data & literature collected from field units and OEMs.

4. Suggestion & comments received during the Seminar on the subject held on 15.07.2019 at CAMTECH, Gwalior.

NOTE

OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilisation and efficiency.

CAMTECH is continuing its efforts in the documentation and up-gradation of information on maintenance practices of electrical assets. Over the years a large number of publications on electrical assets have been prepared in the form of handbooks, pockets books, pamphlets & video films etc. These publications have been uploaded on the internet as well as rail net.

For downloading these publications please do following:

1. On internet visit : www.rdso.indianrailways.gov.in
   Go to Directorates → CAMTECH → Publications for download→ Electrical Engineering
2. On Railnet visit RDSO website at 10.100.2.19
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Back to CONETNT