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Operating Manual: OP-0116
Date: July 2019

OPERATIONS MANUAL VR31 Troubleshooting Guide

Purpose

The purpose of this document is to outline on locomotive troubleshooting of the VR31. The information in this report should be used to incorporate into locomotive maintenance manuals.

Reference

1. PD773, VR31 Auxiliary Generator Regulator Product Guide

Test Equipment

1. Digital Multimeter (DMM)
2. Banana jack test leads

Description of VR31

1. The VR31 system is an upgraded Auxiliary Generator regulator that provides 3-stage battery charging for legacy EMD locomotives. It works in conjunction with the EBCS-3 current sensor that provides battery charging current feedback to the VR31. After each engine start, the VR31 transitions through the 3 stages with each stage being indicated by an LED on the front panel.
2. Test jacks provide measurement of AuxGen voltage, battery voltage, battery current, AuxGen field voltage, and AuxGen AC1, AC2, and AC3 voltage.
3. If the VR31 detects a current sensor or wiring fault, a fault LED is illuminated and transition to stage 3 is made. This is done in order to prevent battery overcharging. This fail-safe mode allows continued locomotive operation until the EBCS-3 and associated wiring can be evaluated and repaired.
4. The EBCS-3 is powered from the VR31 through pin 9 and protected by a 2 amp mini-fuse, CP1. Fuse CP1 and a spare are located near the back of the regulator module.
5. VR31 output voltage is calibrated at the factory and is not adjustable in the field.

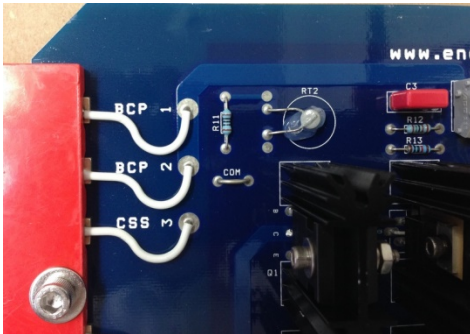
Normal Operation

Normal operation is indicated by illumination of one of the 3 charge stage LED's and a nominal AuxGen voltage range output. Stage 1 is constant battery current and Stage 2 and 3 are constant rectifier voltage. AuxGen voltage output is measured between jacks RP (rectifier positive) and BN (battery negative). Battery voltage is measured between jacks BP (battery positive) and BN. Battery voltage can be 1-6 VDC lower than rectifier voltage depending on battery charging current. Battery current is measured between jacks +IB and BN with 100 ADC scaled to 1 VDC. Nominal range output for each stage is outlined below:

Stage 1 (Bulk):	Rectifier Voltage	~68-78 VDC
	Battery Current	80-95 amps (0.80 – 0.95 VDC on front panel)
Stage 2 (Absorption):	Rectifier Voltage	77.5 - 78 VDC
	Battery Current	25 to 95 amps (0.25 - 0.95 VDC on front panel)
Stage 3 (Float):	Rectifier Voltage	72 - 72.8 VDC
	Battery Current	0 to 25 amps (0- 0.25 VDC on front panel)

Troubleshooting

- 1. General.** For any abnormal AuxGen issues on AC AuxGen locomotives, verify AuxGen AC outputs. Measure the 3 AuxGen phase to phase AC voltages (AC1 to AC2, AC2 to AC3, and AC1 to AC3). If measurements are not equal, troubleshoot AuxGen.
- 2. Current Sensor Fault.** Current sensor fault is indicated by the Current Sensor Fault and Stage 3 LEDs being illuminated. RP voltage should be 72-72.8 VDC. If fuse CP1 is open, RP will read 0 VDC even with good output.
 - a. Verify EBCS-3 current sensor wiring on back panel: white wire to Pin 3, red wire to Pin 9, black wire to Pin 14.
 - b. If wiring incorrect, correct per above, check fuse CP1, restart engine and re-evaluate VR31.
 - c. If wiring correct, check fuse CP1 and replace EBCS-3.
- 3. No LEDs and no Output.** Temporarily increase engine RPM. If VR31 begins operation as indicated by Stage 1 LED illuminating, note idle RPM. If idle RPM is below normal range, correct idle. If idle RPM is normal, replace VR31 with one that has the low-idle upgrade modification. The low idle upgrade is identified by components R11 and R2 on the upper back of the circuit board. On a standard VR31, R11 is light blue and RT2 is small. On a modified VR31, R11 is tan and RT2 is larger as shown below.



Standard VR31



Low-Idle Upgrade VR31



Low-Idle Upgrade Marking

- 4. Tripped Circuit Breaker.** A tripped circuit breaker is caused by RP overvoltage or field over current. An overvoltage may be caused by a locomotive wiring fault, excessive load dump, or a faulty VR31. Shut down engine, reset circuit breaker and restart engine. If circuit breaker trips again, verify back panel wiring AC1, AC2, and AC3 inputs. These inputs (pins 4, 6, and 10) should only have the single AC inputs connected. If back panel wiring is correct, remove and replace VR31.

5. **Output Out of Range.** Voltage outside the ranges listed above may be due to VR31 malfunction, a defective AuxGen (Step 1) or a defective or damaged battery. Note that the output measured is rectifier voltage, not battery voltage. Because of diode drop and cabling resistance, battery voltage may be as much as 6 volts lower than rectifier voltage depending on battery state of charge and health.
- a. **Stage 1 voltage low.** With the Stage 1 LED illuminated, check battery current IB. If IB is normal (0.8- 0.95 VDC, 80-95 amps), check RP voltage. If RP voltage is 68 VDC or above, allow to run and check again in 1 hour. If RP is below 68 VDC or does not increase after 1 hour, test battery for shorted cells or other defects.
 - b. **Stage 1 battery current out of range.** If Stage 1 is illuminated and IB is out of range (0.8- 0.95 VDC, 80-95 amps), remove and replace VR31.
 - c. **Stage 2 or 3 voltage out of range.** Remove and replace VR31.