



Field Troubleshooting

SCENARIO: Voltage regulator operating in service and it trips the high tension source breaker off line.

RECOMMENDED TEST PROCEDURE:

1. Record basic operating data, position extremes, present position, operation count, approximate load current. Review the service record of the regulator looking for any prior unusual circumstances or events that could have contributed to the fault.
2. Inspect and document the external condition of the regulator.
 - Oil leakage ??
 - Radiators bulged ??
 - Electrical connections good condition ??
 - Oil level??
3. Sample oil and test dielectric.
4. Do a megger test from the bushings to the ground.
5. Do a High Voltage Hi-pot test from the bushings to the case.
6. Perform a low voltage ratio test.
 - a. 120 volts on S to SL bushing.
 - b. Attach a meter from the S to the L bushing and record the voltage at all positions from 16 lower to 16 raise.
 - c. Study the data for discontinuities.
7. Untank and inspect the internal for indications of the fault.
8. If the fault appears to have been caused by over voltage, test the external surge voltage arresters.

New Installation- Start Up Problems

- Assuming power connections and ground made correctly.
- Assuming PT voltage tap set properly and regulator energized OK.

Voltage-Related Issues

- Control burns up when energized
 - PT voltage tap not set per the regulator nameplate.
- Voltage level not correct due to wrong PT tap selected.
 - **Clue:** Voltage at test studs not correct at neutral
- 3-Phase bank not stable or positions not close
 - **Clue:** Regulation poor due to neutral resistance
 - **Clue:** Voltage does not change .75 v per tap change
- Regulator runs to limit: Voltage does not change much when regulator operated
 - “S” and “L” wired backwards
- Tap changer will not operate in automatic or manual
 - Troubleshoot the control and regulator

- Assuming regulator was working OK
- Assuming PT set properly and regulator energized OK.

First make sure the regulator appears OK

- No signs of oil expulsion or internal failure
- No breaker trips
- Ground lead secure !!
- If off line -- Never re-energize if a regulator problem is suspected.
- Electrically test regulator before re-energization.
 - Hi-pot
 - Low voltage ratio
 - Megger

Look at position indicators of other regulators in bank

- If all are the same and a high or low voltage exists on one phase then the problem may be an internal regulator problem.
- If position indicator matches the complaint then problem is most likely the control system.

Position indicators all at about the same position



Measure the VOLTAGE TEST studs to check output of regulator

- If all voltage reading are approximately the same: The issues is most likely not the regulator
- If the voltage readings are significantly different: Internal regulator problem.

The one that does not match the other 2 is suspect

- Before manually operating the regulator to correct the voltage
 - Write down control display voltage and test stud voltage
 - No voltage at test studs ?
 - Check front panel control fuses
 - Check fuse on back panel near disconnect switches
 - Check 0.75 ohm resistor on NN terminal board (If supplied)
 - NN-8 is the voltage supply to the GE-2011
 - NN-9 is the voltage supply for older designs
 - NN-20,21,22 are regulator PT voltages
- *Caution voltages can be as high as 240 volts
- *Consult nameplate on regulator for voltages



If test stud voltage and position of regulator agree then:



- Correct the voltage manually
- If tap changer will not run manually there is most likely a regulator problem
- Check to see if motor is getting voltage
- Check to see if motor capacitor is OK
- Check to see if motor is stalled

After correcting the voltage

1. Leave control in manual and trouble shoot control
2. Measure voltage at test studs
3. Check display voltage, they should agree (within a volt).
4. If not figure out why.
5. Does test stud voltage match other units at same position (or difference is accounted for by the position difference) ?
6. Check voltage level set point
7. May not agree with display voltage due to LDC or other features.
8. Check the GE-2011 “BIAS” screen
9. Check Compensated voltage, it should agree with the voltage set point.
10. Check “Bias” screen to determine if anything is blocking or changing the voltage level.
11. Check Electronic position
12. If at 16L or 16R control will be blocked from operating.

Symptom – Tap Changer Not Operating Properly

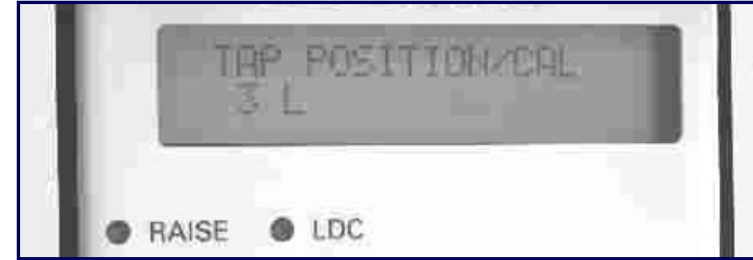
- Observe position indicator during a tap change.
- You should hear the spring wind up and then discharge.
- The position indicator pointer should move quickly to the next position.
- If the tap changer is not switching properly the regulator should be removed from service and the tap changer inspected.

Pointer should move quickly from position to position



Regulator will not operate automatically above a certain position

- Check to see where mechanical limit switches are set.
- Check control to see if control electronic position matches the mechanical position indicator.
- If control electronic position does not agree with the mechanical position indicator, then there is a problem with the position tracking, most likely the counter switch is not adjusted properly.



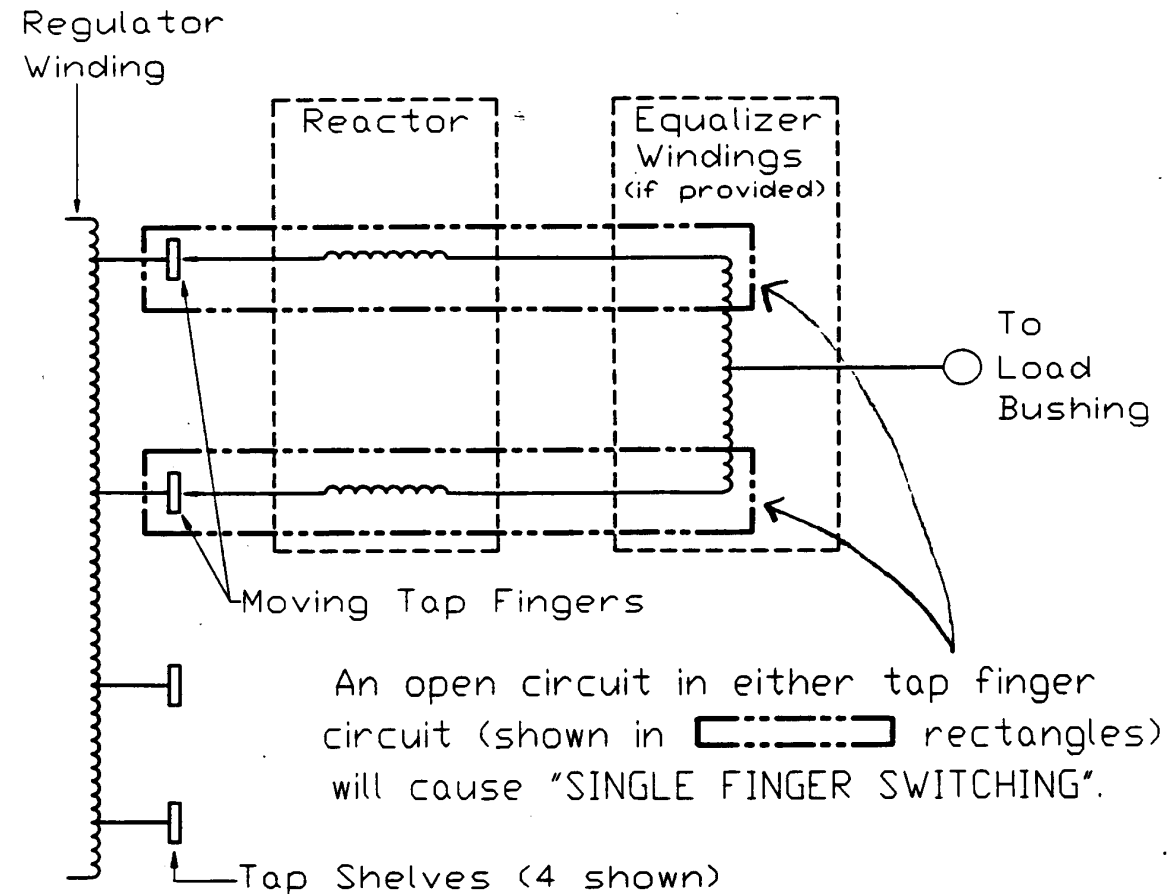
Electronic Position Indication



NOTE: Position limit at 14 Raise

Symptom- Customer Complains of Blinking Lights

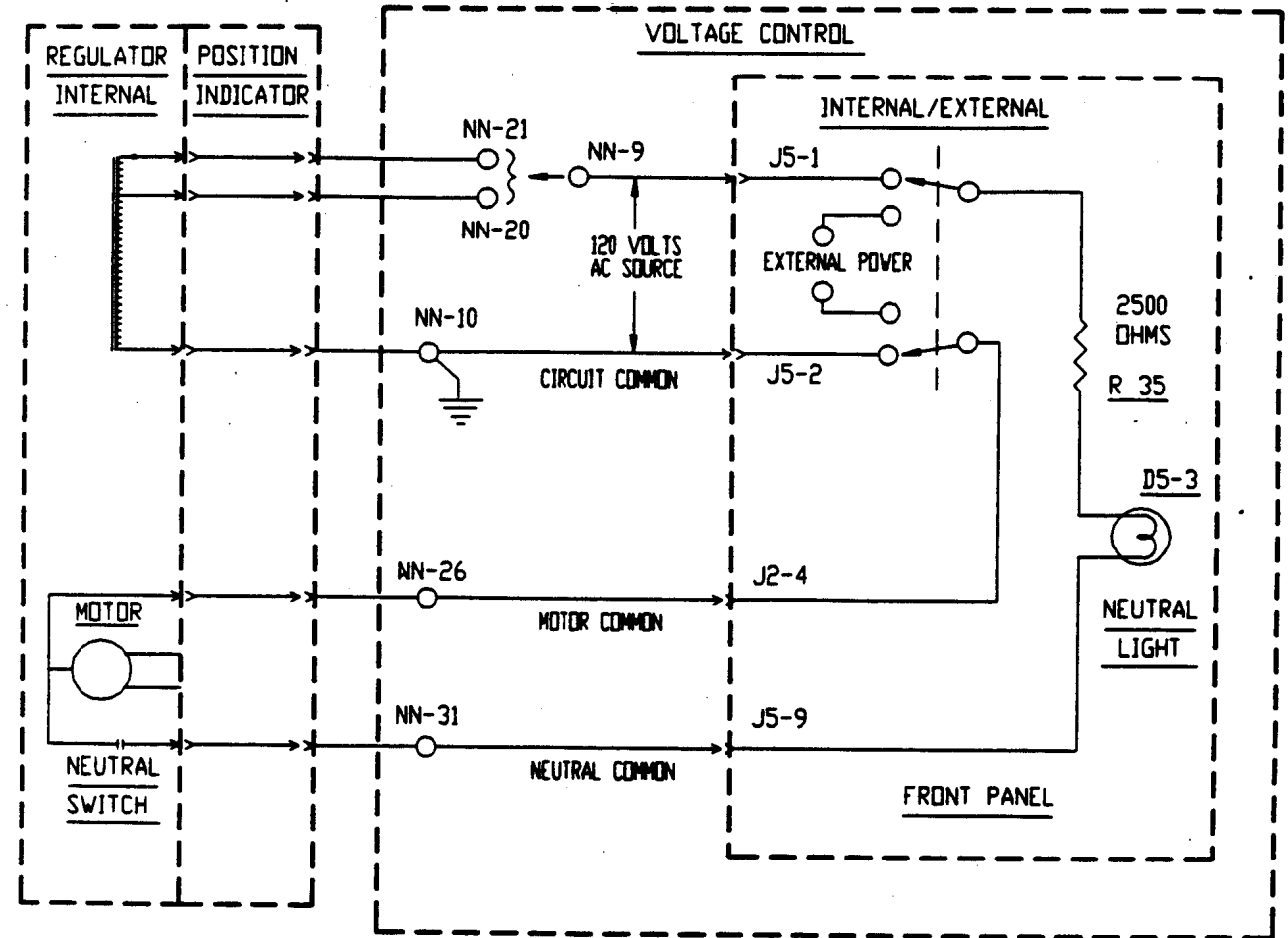
- Can be caused by an OPEN connection in one of the tap changer finger circuits.
- Known as “Single finger switching”
- Clue: Voltage at regulator test studs changes 1.5 volts every other tap change.



Symptom- Neutral Indicator

- Check position around Neutral, mechanical position indicator could be defective.
- Check voltages at NN terminal board NN-31, indicator could be defective.

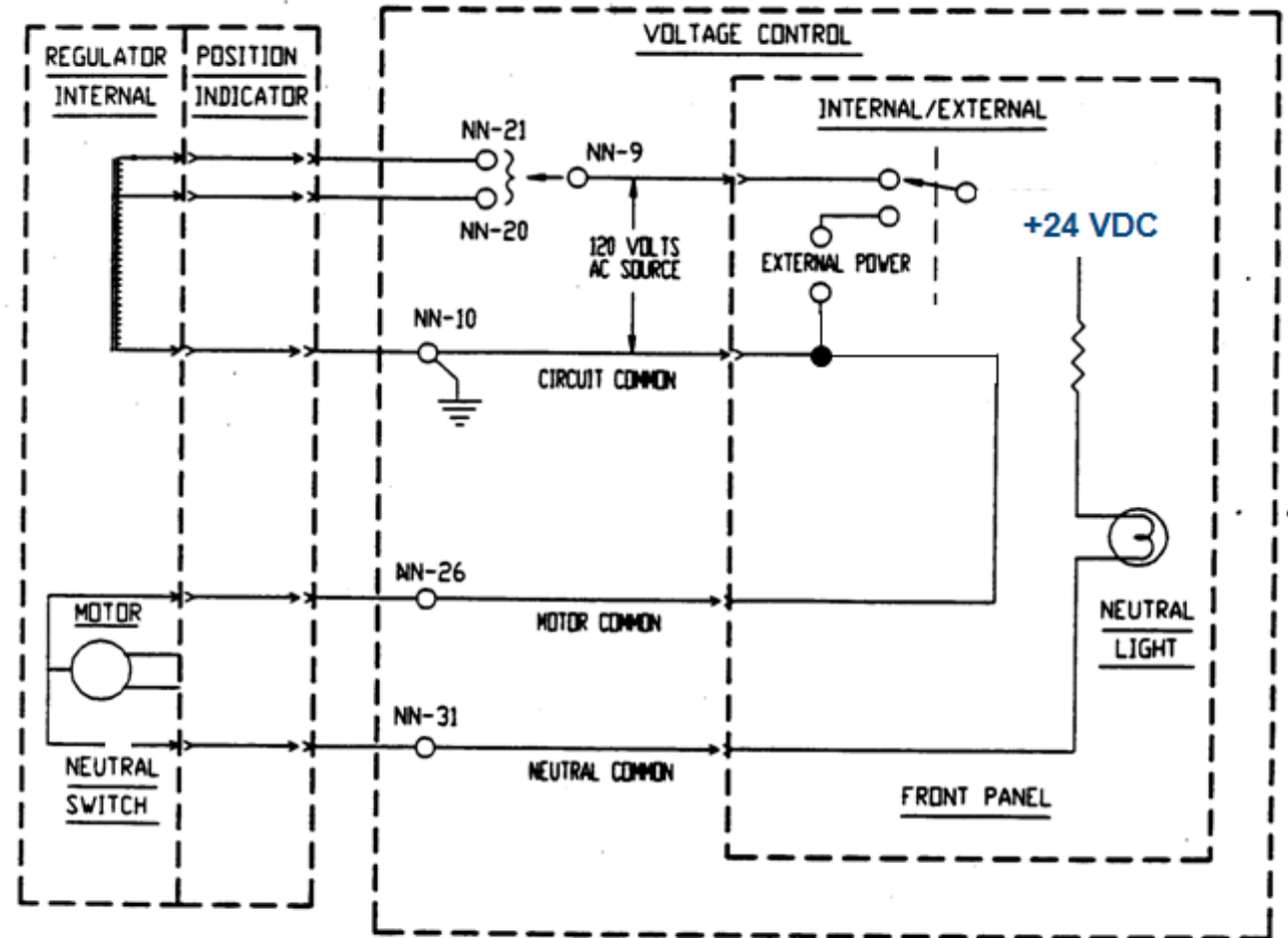
**ML-32, VR-1
SM-1, SM-2
& SM-3
Controls**



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Prolec GE-2011
Controls

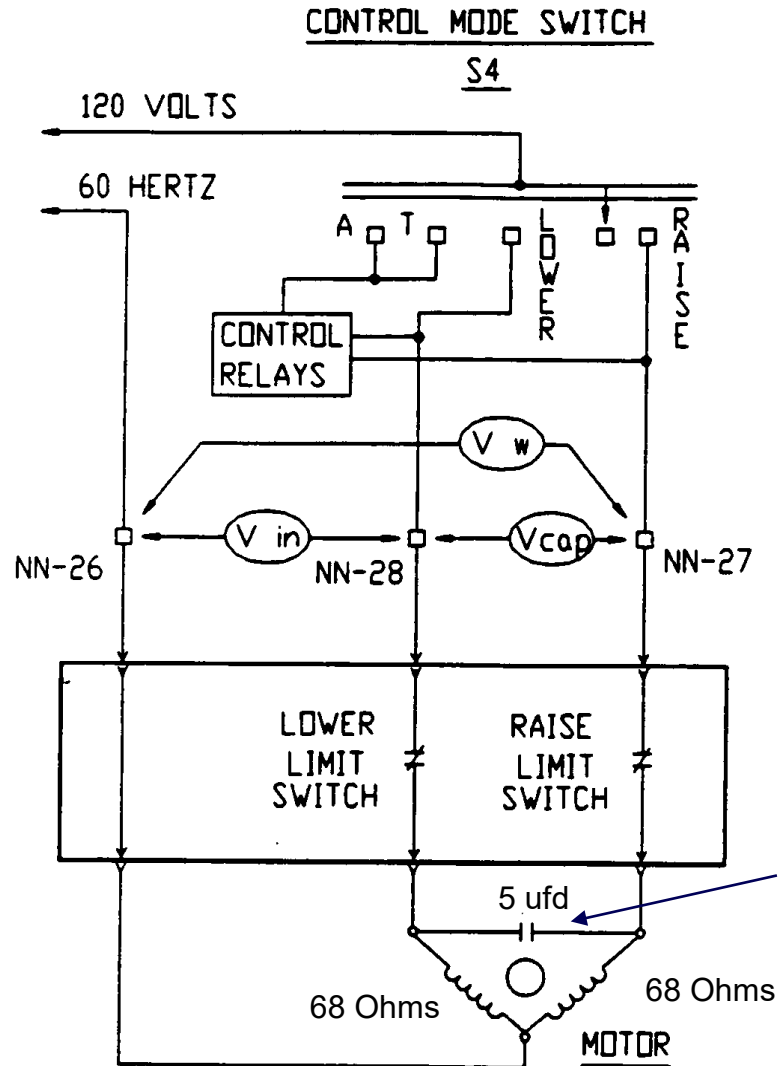


Symptom:

Regulator Will Not Operate Automatically Or In Manual

- In manual, check to see if the motor is getting voltage, NN-27 or NN-28 to NN-26.
- See motor diagrams on next pages.

Tap Change Motor Circuit Voltages

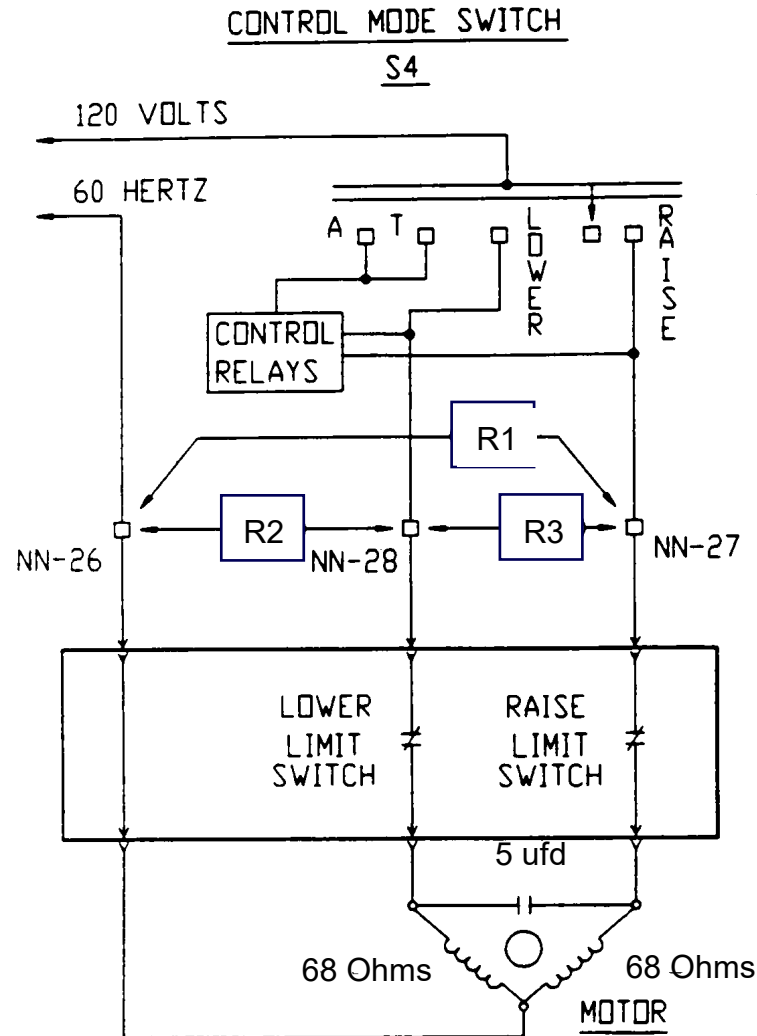


Apply voltage to LOWER regulator

V	Volts	Meaning
V _{in}	120	Normal
	0	No Supply voltage
V _w	129	Normal
	120	Capacitor shorted Wiring shorted
	34	Motor stalled
	0	Capacitor open Limit Switch open
V _{cap}	196	Normal
	135	Motor stalled
	120	Capacitor open
	0	Capacitor shorted Wiring short

Motor Capacitor

Tap Changer Motor Resistance



Resistance +/- 30%

R	Ohms	Meaning
R1	68	Normal
	0	Wiring short
	Open	Limit Switch open Winding open Wiring open
	Other	Wiring short
R2	68	Normal
	0	Wiring short
	Open	Limit Switch open Winding open Wiring open
R3	136	Normal
	Other	Wiring Short
	0	Capacitor shorted Wiring short
	Open	Limit Switch open
	Other	Wiring short Wiring open

Note: Some earlier motors may have a 47 ohm winding.

Information required when calling for product support:

- Voltage class
- kVA
- Current
- Serial number (match with tank serial #)
- Control Type
- Control Data
- If possible, a picture of the inside of the control cabinet and terminal blocks
- New or existing installation?
- Problem experienced

