

Source: Leece-Neville Heavy Duty Systems Division - Arcade, NY USA
Date: September 25, 2008
Bulletin No: TSB-1058
Models: MC-615-PAC Voltage Regulator
Subject: Voltage Regulator Troubleshooting

MC-615-PAC Voltage Regulator Diagnostic Instructions

The MC-615 regulator utilizes advanced technology to meet the demanding needs of today's advanced battery systems and dynamic electrical systems, providing intelligent variable voltage control of the alternator.

The MC-615 constantly monitors the operating temperature and voltage of the battery while managing the alternator and monitoring its temperature, ensuring its maximum efficiency when utilized on today's heavy duty vehicles.

Safety precautions: While trouble shooting always follow the below safety precautions. Failure to do this can result in injury to you, or can damage the MC-615 or the electrical system.

- A. Always wear safety glasses.
- B. Always allow the engine to cool before attempting to troubleshoot when working in the engine compartment.
- C. Never modify any electrical harness on the vehicle without expressed written consent of Leece-Neville and the vehicle manufacturer or owner as it may void warranties.
- D. Read this entire document to ensure you have a complete understanding of the regulator and its operation and ensure you have the essential tools to properly diagnose a problem. Failure to do so could result in equipment damage.
- E. If it is determined that the voltage regulator and or the alternator must be replaced always disconnect the battery ground cables at the battery before you proceed with repairs.

Mounting location: Note the regulator is remote mounted and is not incorporated into the alternator. The regulator is mounted within the hotel battery compartment just forward of the left hand rear wheel.

Operation: The operation of the charging system with this regulator is unlike that of a common charging system. Its advanced alternator control regulates the voltage of the alternator for the specific battery type chosen by the vehicle manufacture and charges the batteries in three stages opposed to a single stage as with a typical alternator. The charge stages are spoken to as Bulk-Absorb & Float. The voltage of each stage will be recognized on the trucks volt meter or gauge at different levels. See Figure 1 which depicts the typical charge profile/voltage targets at 80°F. These voltage targets for each stage will be noticed on the voltmeter of the truck each time the trucks engine is started.

Also note special characteristics of the batteries utilized in this application. "IF" the hotel batteries are discharged to a low voltage point of 12 volts or less due to the HVAC system being utilized while the driver has rested for a long period of time; when the truck engine is started the battery voltage will not instantly increase to 13.5 to 14.5 volts as in most other applications due to the low internal impedance of this battery type. The batteries in this application have the capability of absorbing the entire amperage being produced by the alternator for a time period longer than

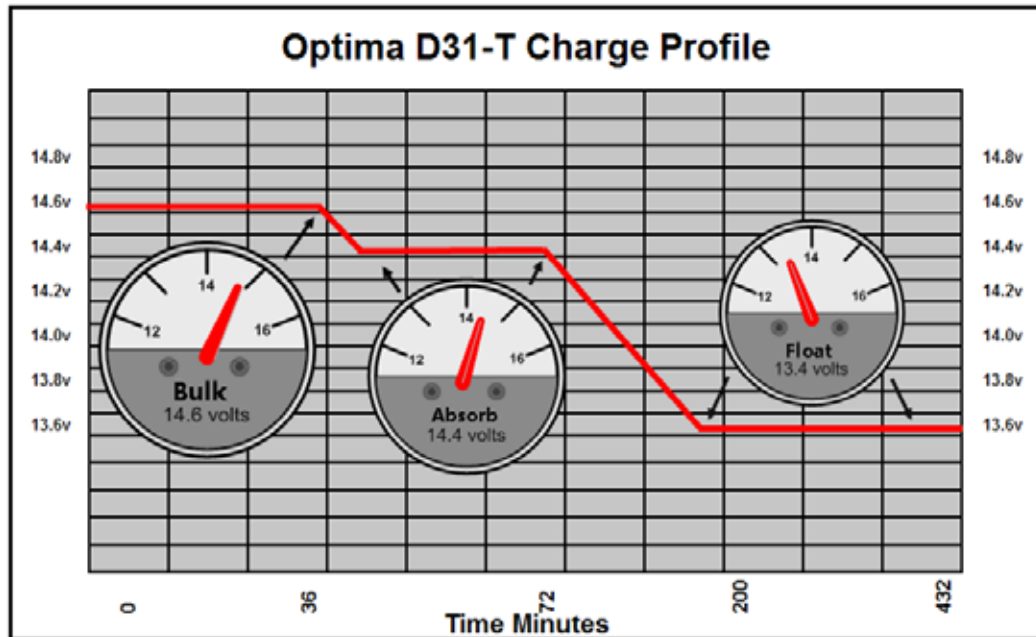
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Operation continued:

one hour. Due to this the volt gauge on the dash of the truck will slowly increase over time opposed to indicating an instant 13.5 volts. It is not uncommon for a time period as long as 1 hour 20 minutes to pass prior to seeing this bulk voltage reading on the in-dash volt gauge if the batteries are deeply discharged. It is also important to note that if the batteries have not been discharged it will only take 3 to 5 minutes for this voltage target to be achieved.

Figure 1



Special Note: when the truck is operated in moderate to cold temperature environments it will not be uncommon to see a voltage indication on the trucks volt meter from 14.8 to 15.2 volts. The reason for this is associated to temperature compensation of the charge algorithm by the voltage regulator. A cold battery will result in a higher volt meter reading. A hot battery will result in a lower voltmeter reading.

Figure 2



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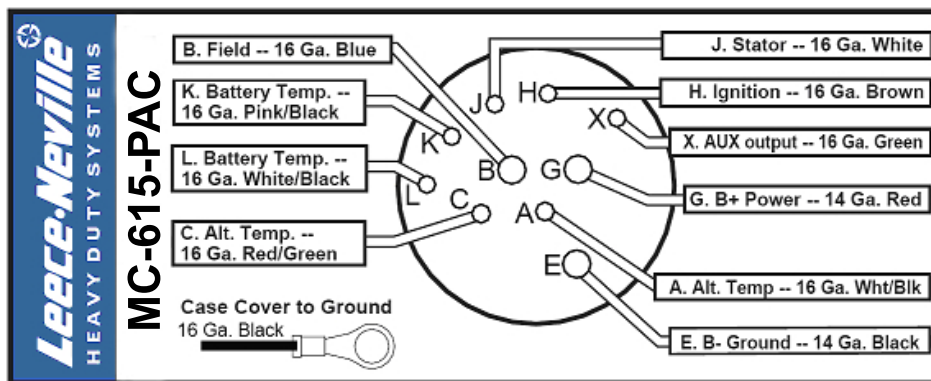
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Wiring and connections for the MC-615-PAC:

Basic wiring of regulator harness: The connected harness is supplied and integrated into the truck by the truck manufacturer. However, it is essential to understand each circuit prior to trouble shooting.

Pin Identification: Primary connector- also as printed on the face of the voltage regulator.

Figure 3



Wiring continued:

(X) Green- Aux Output. This PIN leads to and connects to the parking cooler control system. It provides an earth signal only when the AON is displayed in the regulators display sequence and the regulator has surpassed the bulk charge needs of the batteries. There is no signal present when AOF is displayed. The purpose of this circuit is to ensure that each time the trucks engine is started that the batteries are charged appropriately and ample amperage from the alternator is available to do so. Once the battery amperage needs have been met the regulator will then allow the sleeper HVAC compressor to operate (assuming all other compressor control interlocks are closed).

(B) Blue – Field positive (F+). This PIN leads to and connects to the (F+) terminal of the alternator. This is the primary control circuit of the alternator.

(H) Brown – Ignition. This PIN connects to an ignition /switched source. Battery voltage is present only when the Ignition switch of the truck is in the ON/RUN position.

(G) Red – Battery Sense. This PIN connects to the (B+) Battery Positive connection point. This circuit is fuse protected external of the regulator with a 10 amp fuse and has battery voltage present at all times.

(E) Black – Ground. This PIN connects to (B-) Battery Negative / Earth and is present at all times.

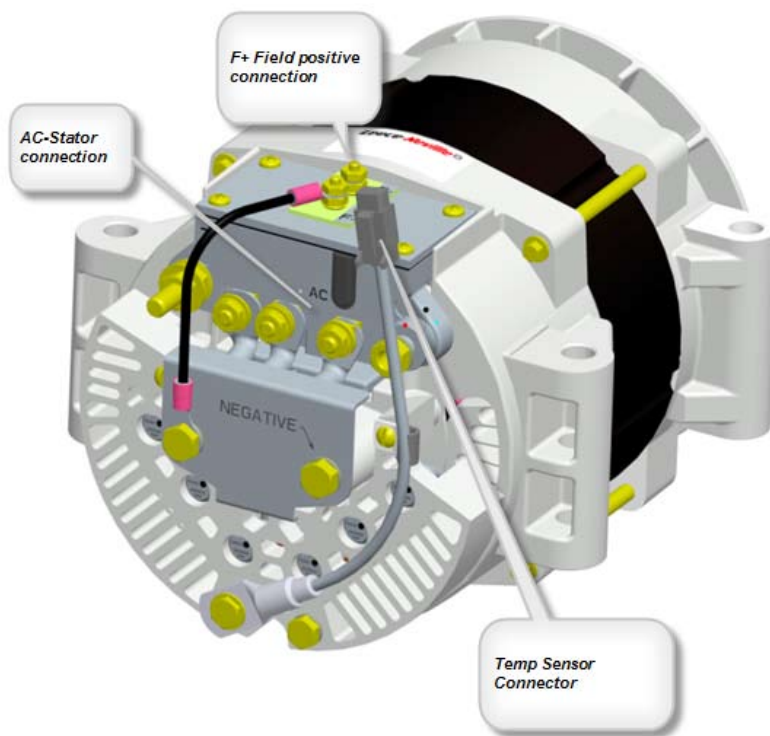
(J) White – Stator. This PIN connects to one of the three alternator AC taps on the rear of the alternator. (Reference Figure 4 alternator illustrating AC terminal connection point.) Its function is for feedback of alternator speed / frequency for advanced operation and diagnostic purposes. Note either of the three center terminals can be utilized.

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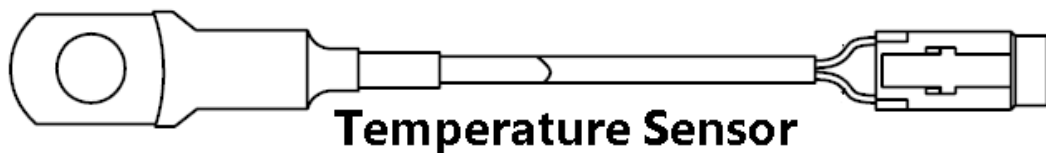
Figure 4



Temperature sensors:

Alternator temperature: PINS A & C connect to a temperature sensor located on the alternator. Below is an image of the sensor. This is a serviceable part and has a two pin connector at the alternator.

Figure 5



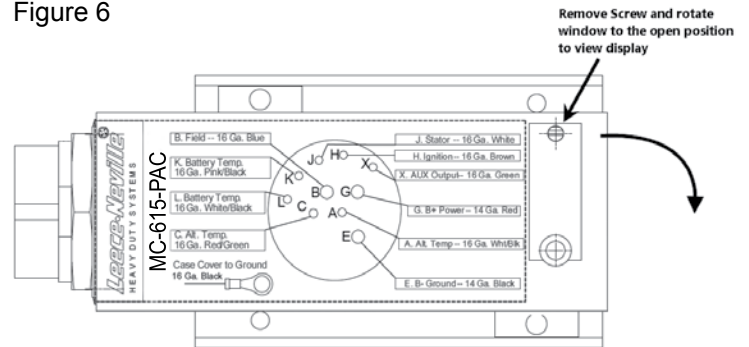
Battery Temperature: PINS K & L connect to a temperature sensor located at the battery. This is a serviceable part and has a two pin connector at the alternator. See above figure 4.

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Regulator operation and display: once the engine has started and the regulator recognizes the AC signal from the alternator the advanced logic display will illuminate. This display will continually scroll through each preset function to be displayed. It is extremely important that you become familiar with this display, as it continuously provides operational information. This information also is utilized for diagnostics. The display codes and their associated regulator operations are shown below.

Figure 6

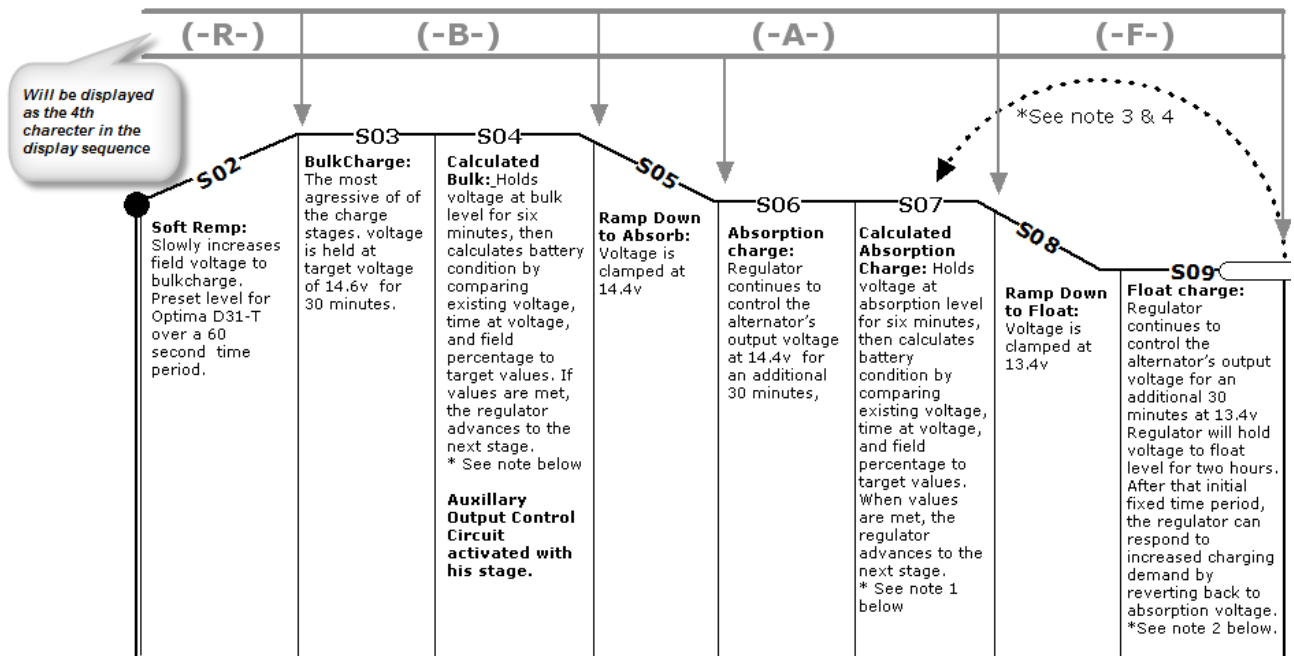


- LN1 -- Indicates Leece-Neville.
- 615 -- Indicates Model number.
- OPS -- Indicates battery program set to Optima
- -B- -- Indicates stage of charge. This value changes with battery state of charge. Stages: Bulk (-B-), Absorb (-A-) & Float (-F-). For a more detailed explanation see Charge Stage State Diagram below.

Figure 7



Figure 8



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(Operational Display continued)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------|--|-----|--|-----|---|-----|---|-----|--|-----|-----------------------------|-----|------------------------------|-----|--|-----|--|-----|--|-----|------------------------------|-----|---------------------------------------|-----|--|-----|-----------------------------|-----|---------------------------|-----|--|-----|-------------------------------------|-----|--|
| BV | Indicates "real time" battery system voltage. Followed by actual voltage reading. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CV | Indicates calculated voltage (target voltage based on preset program levels). Followed by temperature compensated target voltage. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B1 | Indicates ambient temperature at battery bank. Followed by actual temperature shown in Celsius. If no sensor is present NC will be displayed indicating that sensor is not connected. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AL1 | Indicates ambient temperature at #1 alternator. Followed by actual temperature shown in Celsius. If no sensor is present NC will be displayed indicating that sensor is not connected. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FE | Indicates percentage of regulator field output. In % 0 -100. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AON or AOF | Indicates present state of Auxiliary Output. If "ON" earth signal is present, if "OF" earth signal is not present. Note this signal is utilized to enable the A/C compressor of the No Idle HVAC system while the engine is operating. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R0.0 | Indicates software revision number. The revision number will change with engineering updates. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SP | Indicates temperature of the regulator. Temperature reading is shown in Celsius. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| aiP | Number of times alternator exceeded Aux Pin maximum temperature 115c following. If the number of counts exceeds 255 this position will display ovR . | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SLP | Voltage Compensation Slope. Indicates value in milliamps of compensation applied per °C per cell (as in a single battery cell of 1 battery). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hr | Indicates total regulator hours. Will be followed by display in tens of hours and an additional Display indicating 10ths of hours. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AHC | Highest alternator temperature followed by temperature shown in Celsius. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acn | Number of times the alternator exceeded 120c following. If the number of counts exceeds 255 this position will display ovR . | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FBA | Indicates field threshold for bulk and absorption modes. Field threshold signifies the minimum field percentage required by the regulator to maintain the current state of charge. When field voltage drops below the field threshold in calculated bulk or absorption stages, the regulator advances to the next charging stage. Factory set threshold for calculated bulk and calculated absorption is 77%. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FFL | Indicates field threshold for the calculated float stage. If field voltage surpasses the Maximum threshold value for calculated float percentage, the regulator will increase target voltage to absorption level. Factory set threshold for maximum calculated float is 77%. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E-- | <p>(Followed by a numeric designation) indicates a specific Event/Advisory code relating to the regulator's operation. The regulator will list active events in order of occurrence while in operation. These codes are shown to make the operator or a technician aware of an Event (symptom) that is currently active. IF the called out event is either corrected or operational temperatures return to a normal state the event/advisory code automatically clears within 3 seconds. These codes are described in more detail below, and troubleshooting details can be found on pages 8-10 of this document.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">E10</td> <td style="width: 50%;">Battery temp sensor shorted for battery 1</td> <td style="width: 25%;">E24</td> <td style="width: 50%;">Regulator exceeding allowable temperature limit</td> </tr> <tr> <td>E11</td> <td>Battery #1 temp sensor open or not found</td> <td>E30</td> <td>Voltage too high at battery</td> </tr> <tr> <td>E12</td> <td>Battery #2 temp sensor short</td> <td>E31</td> <td>Open field at alternator. Possible grounding issue</td> </tr> <tr> <td>E13</td> <td>Battery #2 temperature open or not found</td> <td>E32</td> <td>Open stator at alternator. Possible stator wire open</td> </tr> <tr> <td>E14</td> <td>Alternator temp sensor short</td> <td>E34</td> <td>Battery voltage below minimum allowed</td> </tr> <tr> <td>E15</td> <td>Alternator temp sensor open or not found</td> <td>E40</td> <td>Voltage too high at battery</td> </tr> <tr> <td>E20</td> <td>Battery #1 exceeding temp</td> <td>E41</td> <td>Field voltage exceeded maximum allowable</td> </tr> <tr> <td>E22</td> <td>Alternator exceeding operating temp</td> <td>E42</td> <td>Stator voltage exceeds maximum allowable</td> </tr> </table> | | | E10 | Battery temp sensor shorted for battery 1 | E24 | Regulator exceeding allowable temperature limit | E11 | Battery #1 temp sensor open or not found | E30 | Voltage too high at battery | E12 | Battery #2 temp sensor short | E31 | Open field at alternator. Possible grounding issue | E13 | Battery #2 temperature open or not found | E32 | Open stator at alternator. Possible stator wire open | E14 | Alternator temp sensor short | E34 | Battery voltage below minimum allowed | E15 | Alternator temp sensor open or not found | E40 | Voltage too high at battery | E20 | Battery #1 exceeding temp | E41 | Field voltage exceeded maximum allowable | E22 | Alternator exceeding operating temp | E42 | Stator voltage exceeds maximum allowable |
| E10 | Battery temp sensor shorted for battery 1 | E24 | Regulator exceeding allowable temperature limit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E11 | Battery #1 temp sensor open or not found | E30 | Voltage too high at battery | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E12 | Battery #2 temp sensor short | E31 | Open field at alternator. Possible grounding issue | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E13 | Battery #2 temperature open or not found | E32 | Open stator at alternator. Possible stator wire open | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E14 | Alternator temp sensor short | E34 | Battery voltage below minimum allowed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E15 | Alternator temp sensor open or not found | E40 | Voltage too high at battery | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E20 | Battery #1 exceeding temp | E41 | Field voltage exceeded maximum allowable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E22 | Alternator exceeding operating temp | E42 | Stator voltage exceeds maximum allowable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*** Other codes may be present but are for factory use only

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Troubleshooting Reference

The following is a guide which lists common issues or symptoms that may occur. Becoming familiar with this guide will assist you in locating and resolving the issue in a timely manner.

In the majority of cases most issues with the system can be attributed to wiring and connections. Chances are the event/advisory code in the previous table will lead you to the root cause of the issue. You can use the following information to help you discover additional details and help you to resolve the issue.

Before proceeding always first verify the following:

- A. Cables and connections:** visually inspect and ensure that all wires are connected to the proper locations of the alternator and batteries are tight with no presence of corrosion.
- B. Review event / advisory codes:** as it will minimize efforts associated.
- C. Verify that battery voltage:** is above 9.4 volts at the battery or higher.

| Problem | Possible Cause | Solution |
|--|--|--|
| No Charge Condition with engine running and no regulator display | Loose or poor connections. | Remove, clean and tighten all cable and wire connections at battery and alternator. |
| | Blown 10 amp Fuse at battery sense. | Replace fuse. Verify with voltmeter that battery voltage is present and above 9.4 volts at PIN G of connector on regulator. |
| | Blown 2 amp Fuse at ignition signal depending on installation and adaptation to truck's original equipment wiring circuit. | Replace Fuse. Verify that battery voltage is present above 9.4 volts with the ignition key in the "on" – run position. |
| No Charge Condition with engine running but regulator display is illuminated (also see alternator testing below) | No ground | Verify earth on PIN E of regulator connector. |
| | No Stator signal | Verify stator circuit has continuity from regulator to alternator. Clean and tighten connections. |
| | No Field signal | Verify that the F terminals are connected properly to the alternator and regulator. Test circuit with engine running: With a voltmeter set to DC, measure voltage between F- to F+ at the alternator field terminal plate. If no voltage present, repair open circuits. Also See Section G of this document. |
| | Engine not running | Start engine and run at normal engine speed; if regulator display does not turn on – proceed to cell below Engine running |
| | Engine running | Start engine. If regulator random display illuminates regulator OK, increase engine speed to 1100 RPM. If regulator display does not illuminate. Check for loose or missing alternator drive belt. (See also alternator testing.) |
| High voltage 14.9 volts or above indicated on dash instrument with engine running. | Battery Voltage too Low; less than 9.4 volts | Charge batteries to above 12.0 volts and continue with diagnostics. |
| | Excessive voltage drop in primary charge path positive or negative circuit leading from alternator to battery. | Perform alternator cable test (see alternator trouble shooting). Voltage drop should be less than .25 volts. Check all cable connections for tightness and cleanliness. |
| | Outside temperature less than 65°F | Verify CV voltage of regulator displays 14.8 volts. May be normal condition due to thermal compensation. |

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Troubleshooting Reference

(Troubleshooting Chart Continued)

| Problem | Possible Cause | Solution |
|--|--|--|
| High voltage 14.9 volts or above indicated on dash instrument with engine running.(cont) | Check Truck In dash volt meter accuracy | With engine operating at high idle view BV voltage of regulator. This is the actual battery voltage real time. This should never exceed 14.8 volts. In dash volt meters are indicators only and typically should be within .3 volts of actual BV value of the regulator. View CV voltage of regulator. This is the target voltage the regulator is driving the alternator to achieve. This should never exceed 14.8 volts. |
| | Loose battery sense wire connection at primary battery connection point. | Clean and tighten sense wire connection on vehicle. This leads to PIN G of regulator. |
| Alternator Voltage 12.5 volts with engine running | Alternator Exceeding Temperature Limit | Increase engine speed. Turn on engine fan with dash switch or turn dash A/C to low fan speed and engage A/C compressor switch. |
| Erratic voltage increase /decrease reported while driving or notice on the voltmeter | Damaged circuit or defective / damaged temperature sensor | Perform wiggle test. See Temp sensor test section within this article. Alternator or battery temp sensor may need to be replaced. |
| | Loose electrical connection | Remove, clean and tighten all cable and wire connections at battery and alternator. |

Temperature sensors: as referenced in the display section of this article the actual temperature being monitored at the alternator and battery sensor is displayed as a Celsius value on the regulator display. To verify that the temp sensor is not damaged with a separate temperature measuring device (surface temp probe or infrared); measure the actual temperature of the sensor terminal and compare to the actual value displayed on the regulator following B1 and AL1 in the regulators display sequence.

Temp Sensor verification and test: as referenced in the display section of this article the actual temperature being monitored at the alternator and battery sensor is displayed as a Celsius value on the regulator display. To verify that the temp sensor is not damaged with a separate temperature measuring (surface temp probe or infrared) device; measure the actual temperature of the sensor at the alternator and the battery terminal and compare to the actual value displayed on the regulator. This temperature should be accurate to within 5°C.

Troubleshooting Temperature Event Codes

Battery codes

E10 - Battery Temp sensor shorted: Indicates that the Sensor has been damaged or wire/ circuit leading to sensor are damaged. Additionally the regulated charge voltage will be clamped at 12.8 volts:

1. Trace harness from regulator to battery and verify that circuit has not been crushed, pinched or severed. Repair damaged circuit.
2. **Engine running and regulator functioning:** Disconnect sensor at battery temp sensor two pin connector with voltage regulator operating and monitor system voltage. If sensor is defective system voltage will increase and event code will go away. A new event code will appear E11 indicating that battery temp sensor is not present.
3. Replace sensor with Leece-Neville part number LN-TSB.
4. Verify that event code goes away when replacing sensor.

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Troubleshooting Reference

Battery codes continued:

E11 - Battery Temp Sensor open or not found: Indicates that the sensor has been damaged or wire / circuit are open. If this code is present when observing the display sequence following the designator for Alternator (AL1) and Battery (B1) NC will be displayed (Not Connected):

1. Trace circuit and inspect connections. Check for continuity with independent circuits. Repair open connections.
2. If no open connections are found replace sensor with Leece-Neville part number LN-TSB.
3. Verify that event code goes away when replacing sensor.

E20 - Battery exceeding temperature: Indicates that batteries are over temperature based on design:

1. Inspect and verify that exhaust of engine is not damaged or routed adjacent to battery location. If exhaust is routed near battery compartment insulation or heat shield may need to be installed.
2. Ventilate battery compartment. Allowing the batteries to operate in an excessively high temperature will contribute to progressive damage of the battery.

Wiggle Test: utilized to test that a connection from the wire leads to the actual sensor within the mounting terminal have not been stressed or damaged by accident:

1. **Engine running and regulator functioning:** Connect a voltmeter to the batteries positive and negative connections to monitor the charging system voltage.
2. While monitoring battery voltage grasp wire lead at end of black heat shrink of battery temp sensor and wiggle up and down and side to side. If voltage is erratic with the wiggle movement the sensor has been damaged.
3. Replace sensor with Leece-Neville part number LN-TSB.
4. Verify that event code goes away when replacing sensor.

Alternator codes:

E14 - Alternator Temp sensor shorted: Indicates that the Sensor has been damaged or wire / circuit leading to sensor are damaged. Additionally the regulated charge current is reduced by 50% and regulator will not advance to high charge stages:

1. Trace harness from regulator to battery and verify that circuit has not been crushed-pinchd or severed. Repair damaged circuit.
2. **Engine running and regulator functioning:** Disconnect sensor at alternator temp sensor two pin connector and monitor alternator output current with a DC amperage clamp within 15 inches of alternator. If sensor is defective the alternator output current will increase and event code will go away. A new event code will appear E15 indicating that alternator temp sensor is not present.
3. Replace sensor with Leece-Neville part number LN-TSB.
4. Verify that event code goes away when replacing sensor.

E15 - Alternator Temp sensor open or not found: Indicates that the sensor has been damaged or wire / circuit are open. If this code is present when observing the display sequence following the designator for Alternator (AL1) and Battery (B1) NC will be displayed (Not Connected):

1. Trace circuit and inspect connections. Check for continuity with independent circuits. Repair open connections.
2. If no open connections are found replace sensor with Leece-Neville part number LN-TSB.
3. Verify that event code goes away when replacing sensor.

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Alternator codes continued:

E22 - Alternator exceeding temperature: indicates that the alternator is operating at above its programmed upper limit temperature threshold. This is a feature designed into the system to protect the alternator from improper application or abuse. This could be a result of the following:

1. Amperage demand of vehicle exceeds the capability of the equipped alternator. Inspect to verify that additional electrical demands have not been added to the vehicle. If so an alternator with a higher output capacity may be required.
2. Is a normal symptom if at initial engine startup if battery voltage has been depleted and engine is allowed to idle. Increase engine speed to 1100 RPM or higher and turn on engine cooling fan. Event code should go away within 5 to 10 minutes.
3. Is a normal symptom if vehicle is allowed to idle in queue at fuel lines or in traffic congestion. When vehicle resumes normal highway speeds symptom will go away.
4. Could indicate that a charge air cooler tube is leaking allowing hot air or gas to increase the temperature environment underneath the engine cover at or around the alternator. Inspect for open or loose clamps and punctured charge air cooler tubes.
5. If symptom occurs frequently contact Leece-Neville Technical Service for further instruction.

Wiggle Test: utilized to test that a connection from the wire leads to the actual sensor within the mounting terminal have not been stressed or damaged by accident.

1. **Engine running and regulator functioning:** Connect a DC amperage clamp to the alternators positive cable within 15 inches of the alternator to monitor the alternator amperage output.
2. While monitoring Alternator amperage output, grasp wire lead at end of black heat shrink of alternator temp sensor and wiggle up and down and side to side. If amperage is erratic with the wiggle movement the sensor has been damaged.
3. Replace sensor with Leece-Neville part number LN-TSB.
4. Verify that event code goes away when replacing sensor.

Other Event Codes

E30, E40 - Voltage high at battery: This indicates that here is a possible loose connection in the primary positive and negative charge path from the alternator to the batteries. Check all cable connections. Also see cable test section of this document.

E31 - Open field at alternator: check F- minus connections and jumper connections at the alternator and verify that regulator ground circuit is present at voltage regulator primary connection.

E32 - Open stator at alternator: check to ensure that stator circuit has continuity from regulator to alternator. Ensure connection at stator terminal is tight and not damaged. Also see alternator field test section of this article.

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Troubleshooting Reference

Voltage at regulator test: Remove main connector of regulator; with a voltmeter set to DC voltage follow the below steps to ensure that circuits are complete to enable regulator operation.

1. With the ignition OFF, perform continuity test from (black PIN E) ground wire at regulator plug to primary ground connection of battery.
2. With the ignition OFF, check voltage on the (red PIN G sensing) wire and the ground wire at the regulator. The reading should be within .25 volts of battery voltage measured at the battery positive primary connection terminal. See Figure 9 illustration.
3. With the ignition in the ON position (engine not running), check for voltage on the brown (ignition PIN H) wire at the regulator connector. The voltmeter should read: Battery voltage above 11.0 volts. Utilize the ground connection within the connector for reference (earth PIN E) See Figure 10 illustration.

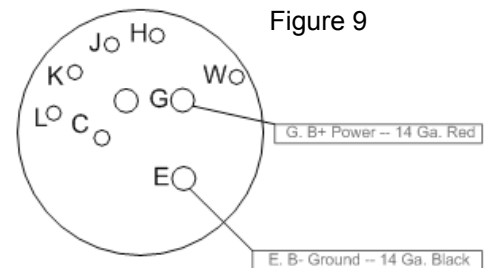


Figure 9

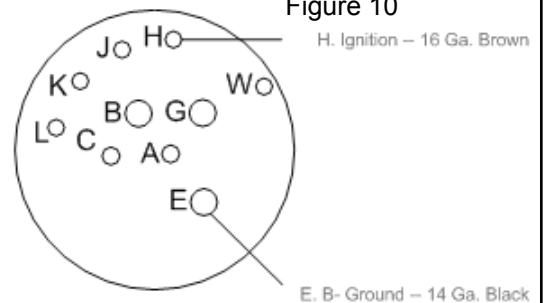


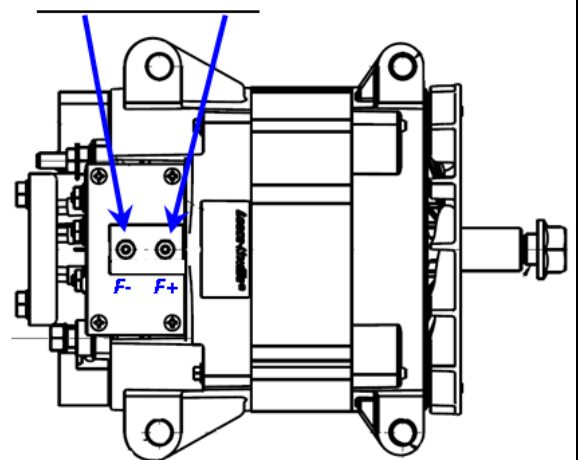
Figure 10

Regulator Field operation test: Once all of the above is verified and only then perform the below test to verify that the regulator is functioning properly before proceeding to Alternator diagnostics. Verification of this test will confirm that the regulator is working properly.

Turn the ignition key to the ON position; but do not start the engine.

1. Verify that the regulator display illuminates. If it does not, verify the above steps ensuring voltage and earth are present on the appropriate PINS. If the display does not illuminate with voltage present the regulator is defective.
2. With the display illuminated the regulator is now on. With voltmeter set to DC and connected between the F+ and F- terminals initially there will be no voltage. As the regulator advances over a 90 second time period the voltage will increase to within 1 volt of battery voltage. For verification of battery voltage, measure voltage at the battery or at the alternators positive and negative primary connections. If this is verified the Regulator is OK. See Figure 11 illustration.

Measure / monitor voltage between the F- and F+ terminals. Figure 11



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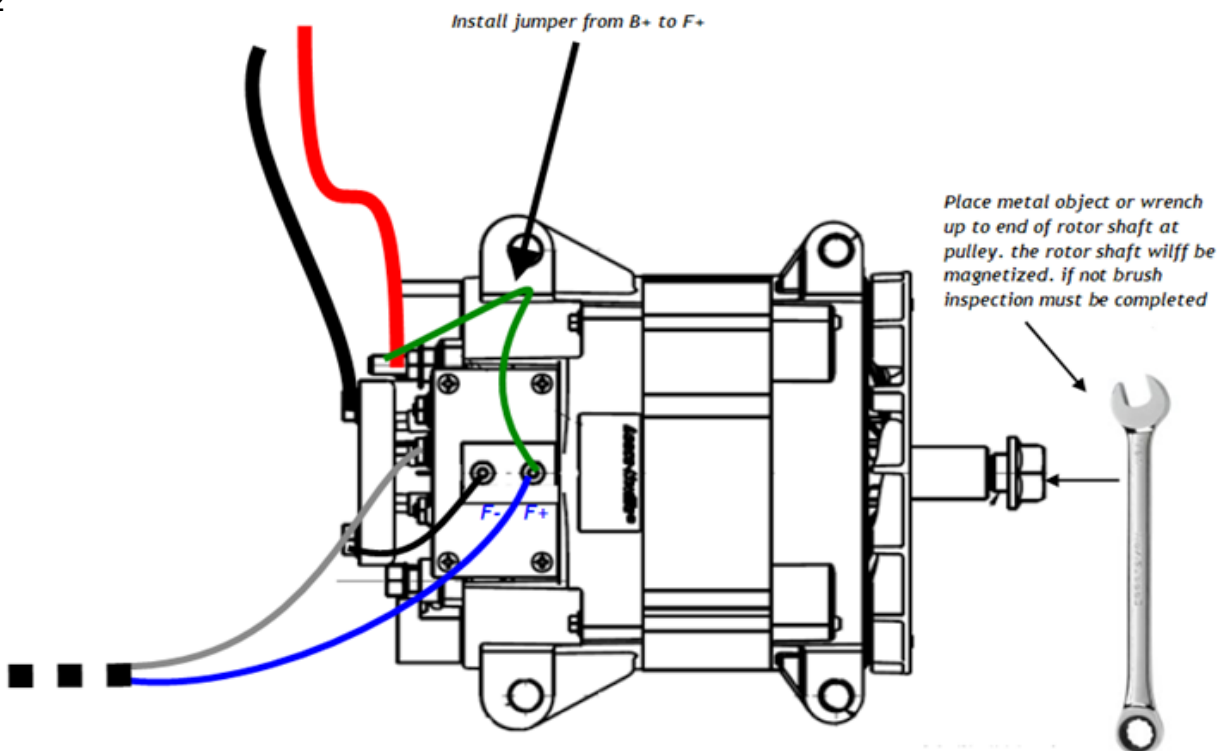
Troubleshooting Reference

Alternator brush contact to rotor test:

Engine off:

1. Measure battery voltage at the batteries primary positive and negative connection points and record reading. Voltage should be above 11.3 volts for this test; if not charge batteries before proceeding.
2. Install a jumper wire between the Blue (F+) and the Red (B+) terminals. See illustration below. **Caution:** do not leave jumper installed for more than 60 seconds for this test.
3. Inspect to ensure brush contact to rotor slip rings. With voltage present on F+ hold a small metal object such as a small mechanics wrench to the end of the alternators rotor shaft. If there is a magnetic pull brush contacts are OK, if there is no magnetic pull see brush and rotor inspection section below to inspect brushes. (Figure 12 illustration.)

Figure 12



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Troubleshooting Reference

Brush Inspection and Replacement: It is recommended that the alternators brushes be inspected for wear on an annual basis. To do this, follow the instructions below.

1. Remove 4 screws which attach field terminal plate and lift field terminal plate from alternator. (Figure 13.)
2. Remove brushes from brush box and inspect length. The brushes must be replaced if the entire length is 3/16 of 1 inch or less. (Figure 14.)
3. Reinstall brushes into brush holder. If existing brushes are reinstalled after inspection make certain to match wear pattern to slip ring as illustrated below. With brush placed into holder compress entire spring into holder and retain brush contact into opening with a 1/16" drill bit or mechanics wire. Install second brush following same procedure, slipping retaining pin forward through front opening of brush box to secure both brushes as illustrated (Figure 15).

Figure 13

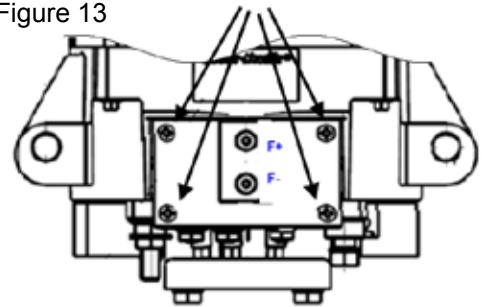


Figure 14

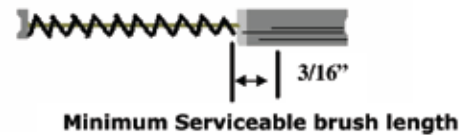
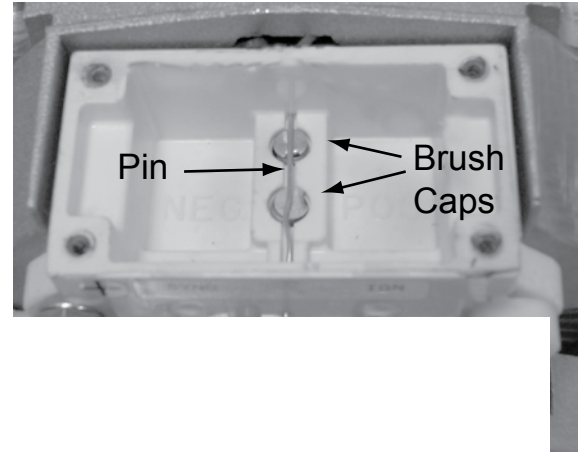
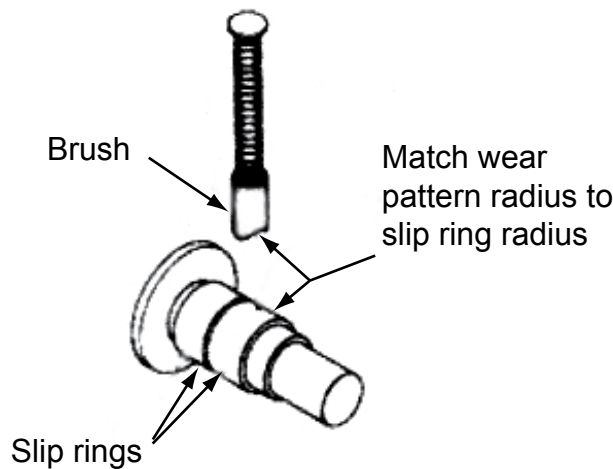


Figure 15



4. Place field terminal plate back onto alternator and hold firmly into place. Remove holding pin retaining brushes. Install 4 mounting screws. **NOTE:** Make certain to remove holding pin from brush box while firmly holding cover plate into place as when attachment screws are tightened without removing holding pin damage occurs. Damage as a result of this is not a warrantable item.

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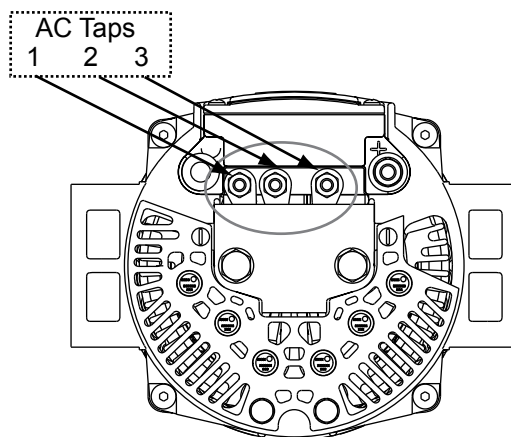
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Troubleshooting Reference

Alternator Full Field and AC output test: Please read this entire section and make certain you have all of the essential tools and connections in place before starting engine to begin test. This test must be completed with batteries above 12.50 volts and all electrical accessories in the off position. Failure to follow these instructions can result in damage to the alternator or electrical accessories on the vehicle.

- Step A.** --▶ With volt meter set to DC record voltage of the alternators primary positive and negative output terminals and record reading.
- Step B.** --▶ Start engine and set operating speed between 1000 and 1200 RPM.
- Step C.** --▶ With volt meter set to DC record voltage of the alternators primary positive and negative output terminals and record reading.
- Step D.** --▶ With volt meter set to DC measure voltage between primary ground connections and each AC terminal on the back of alternator. All readings should be similar and are balanced.

Figure 16



Full Field Test Results and Explanation

| |
|---|
| 1. DC voltage higher in step C than in step A and AC terminal voltages measured in step D are balanced and approximately 1/2 of output voltage measured in step C. Alternator OK and Stator OK. |
| 2. DC voltage higher in step C than in step A and AC terminal voltages are not balanced. Alternator is defective. |
| 3. DC voltage lower or the same in step C as in step A and AC terminal voltage is balanced. Alternator is defective. |
| 4. DC voltage lower or the same in step C as in step A and AC voltages are not balanced. Alternator is defective. |

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