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TMC
Technical &
Maintenance
Conference

Electrical System Fault Finding

Peter Hart & Ngee Chong

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Peter Hart

Hartwood Consulting

Basic Electrical Fault Finding

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- The complexity comes from ECMs and data buses.
- The base vehicle design has not changed
- Most of the problems have not changed.

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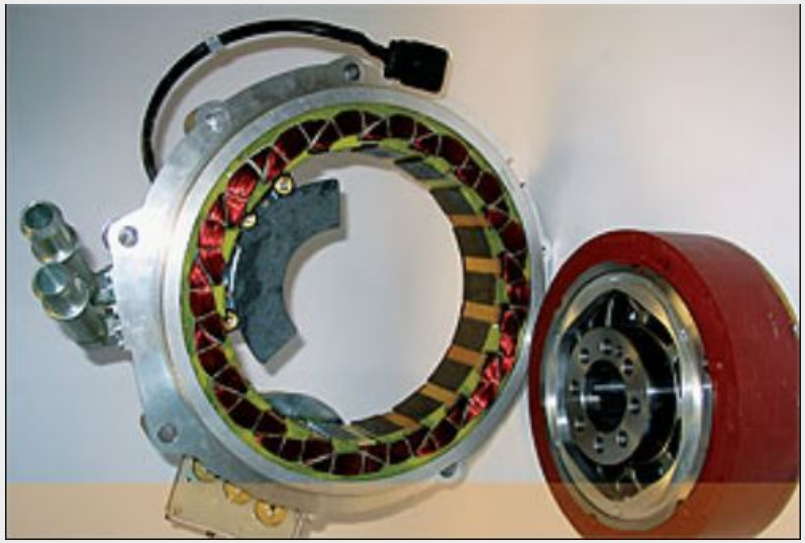
Integrated Starter Generator



Basic Electrical Fault Finding

- Mechanics need to have basic electrical knowledge.

Basic Electrical Fault Finding

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- Only a few mechanics will excess with electrical knowledge.

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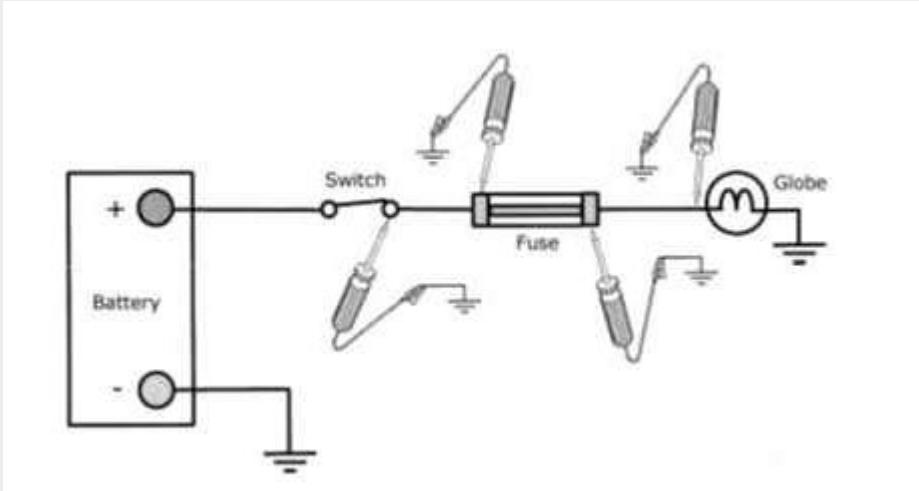

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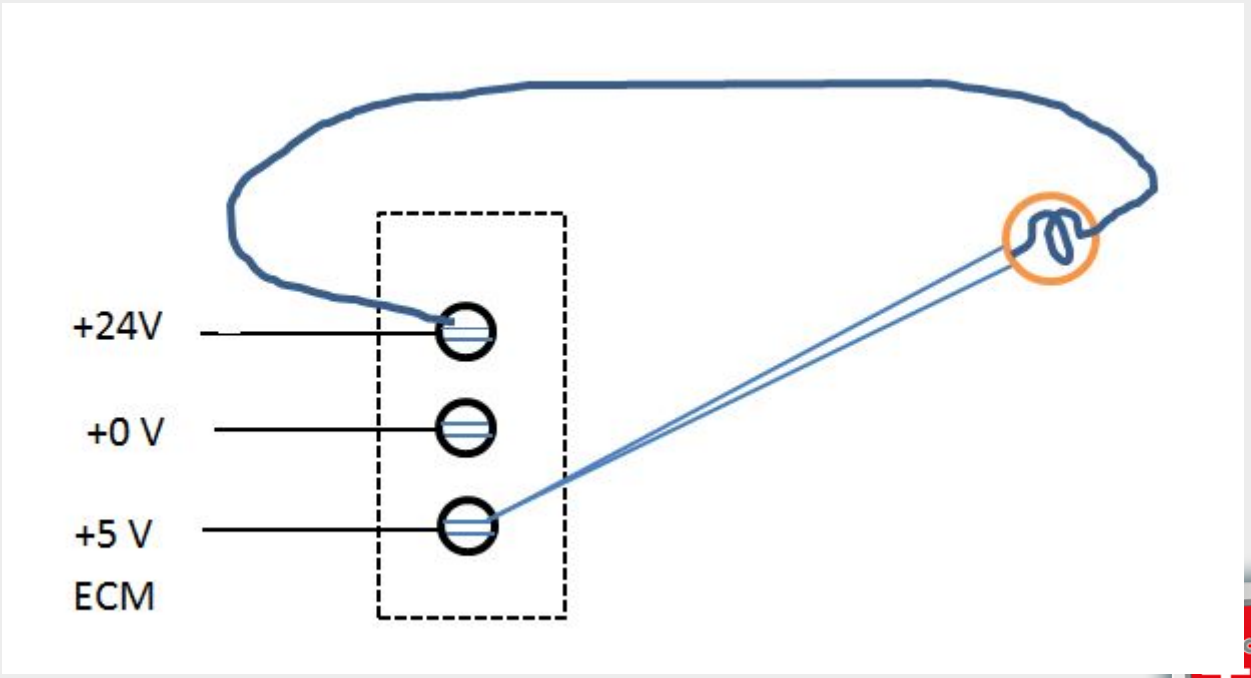

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The multimeter needs to have:

- A peak hold function

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- A frequency measuring feature.

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- A frequency measuring feature.
- A DC current clamp (either integral or external)

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- **AC/DC current:** Clamp-on measurement of ac current up to 1400 A rms and dc current up to 2000 A without breaking the circuit.

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Fluke 190-502 Scope Meter and case

Model: **190-502/AM/S**

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Fluke 190-502 Scope Meter and case

Model: **190-502/AM/S**

$5,090.00 USD

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Used for location of hot terminals and wires.

Periodically check relays, connectors, bolted connections,…

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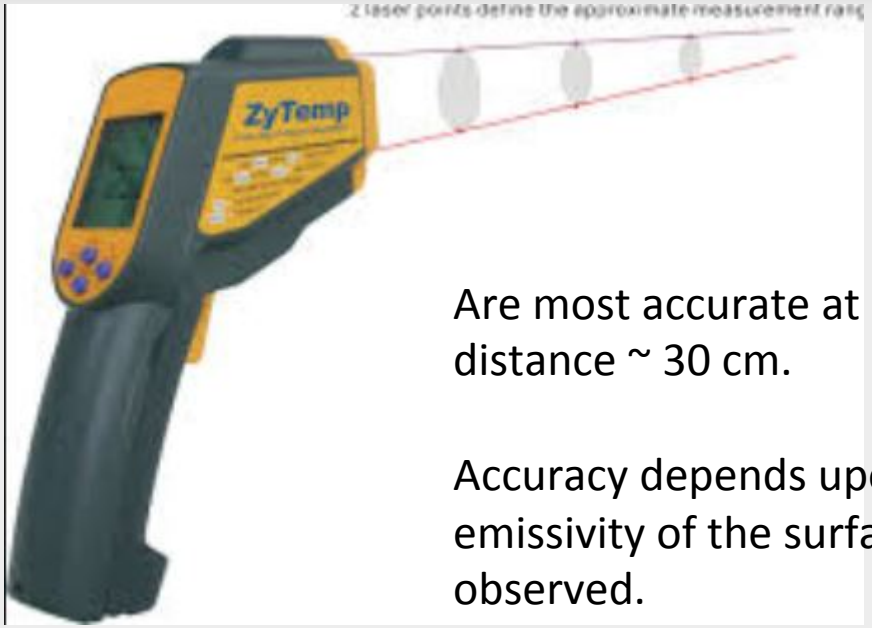
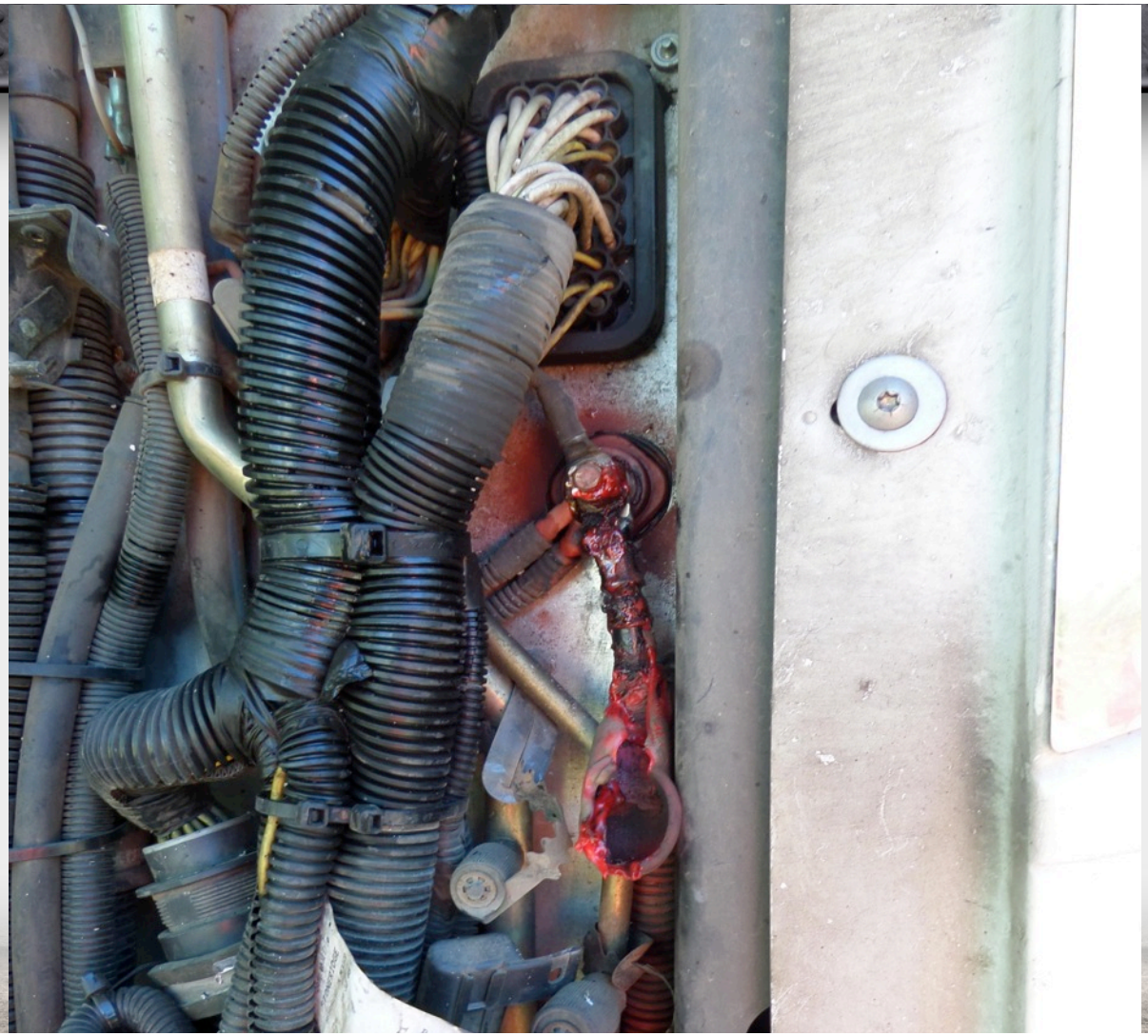


Are most accurate at a given distance ~ 30 cm.

Accuracy depends upon the emissivity of the surface being observed.



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Top Ten Electrical Problems

1. Bad earth connections

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- The resistance in the wiring earth system should be no more than 0.5 ohms.

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1. Bad earth connections

- Often causes several problems that seem to be unrelated.
- What they have in common is a bad earth.
- The resistance in the wiring earth system should be no more than 0.5 ohms.
- Can result in bad audio-system performance.

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Top Ten Electrical Problems

2. Voltages being fed into the earth system.

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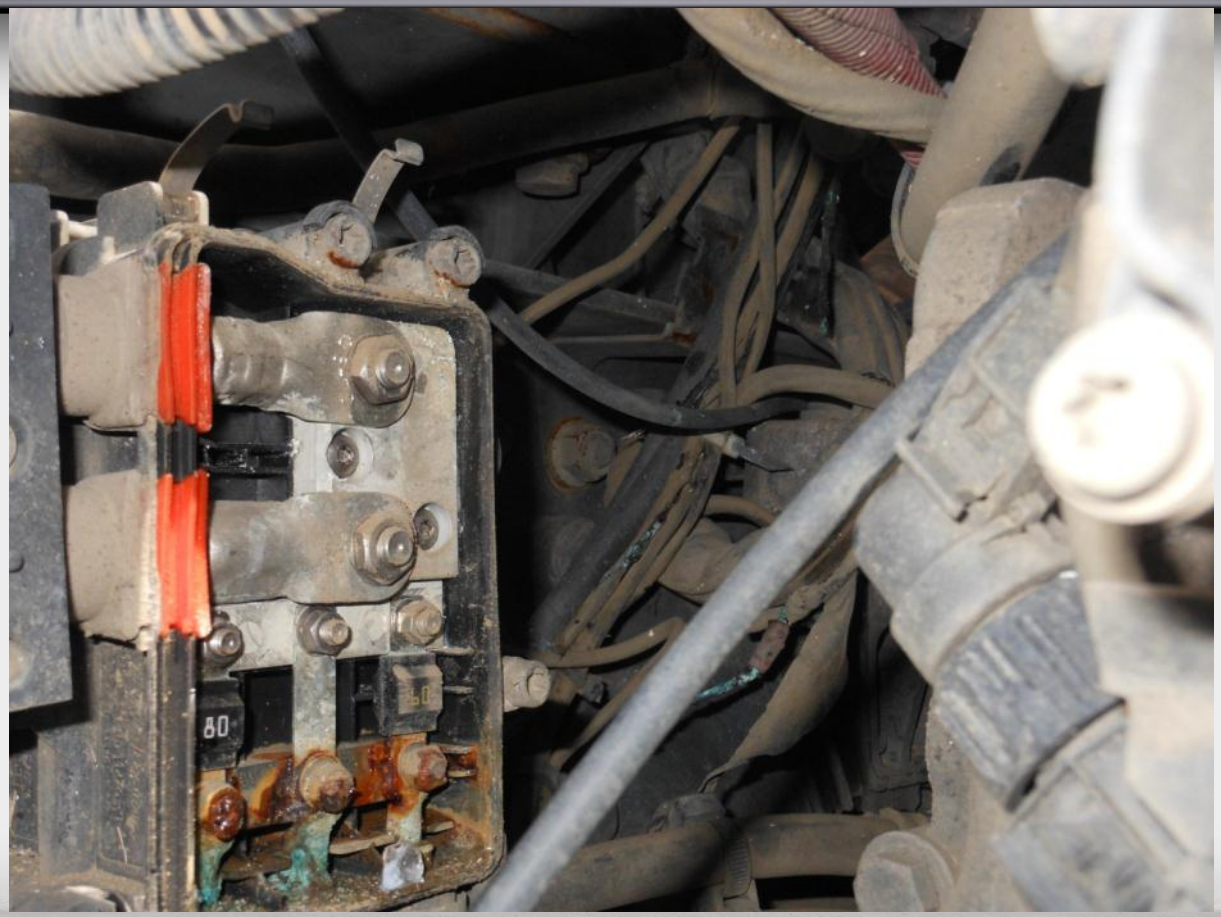

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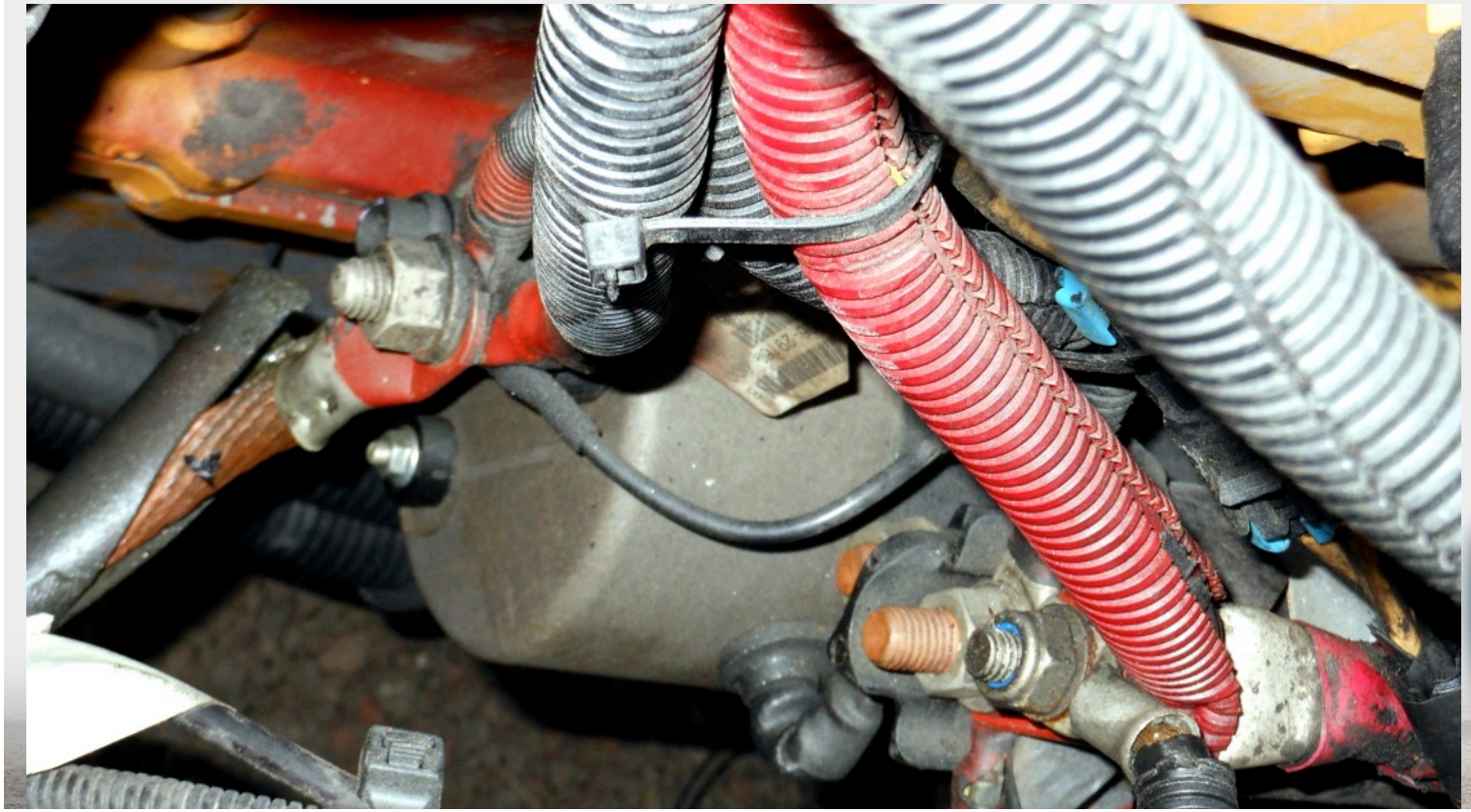
Top Ten Electrical Problems

3. Short-circuits on heavy cables around the starter motor.

These cables are often not electrically protected.

Top Ten Electrical Problems



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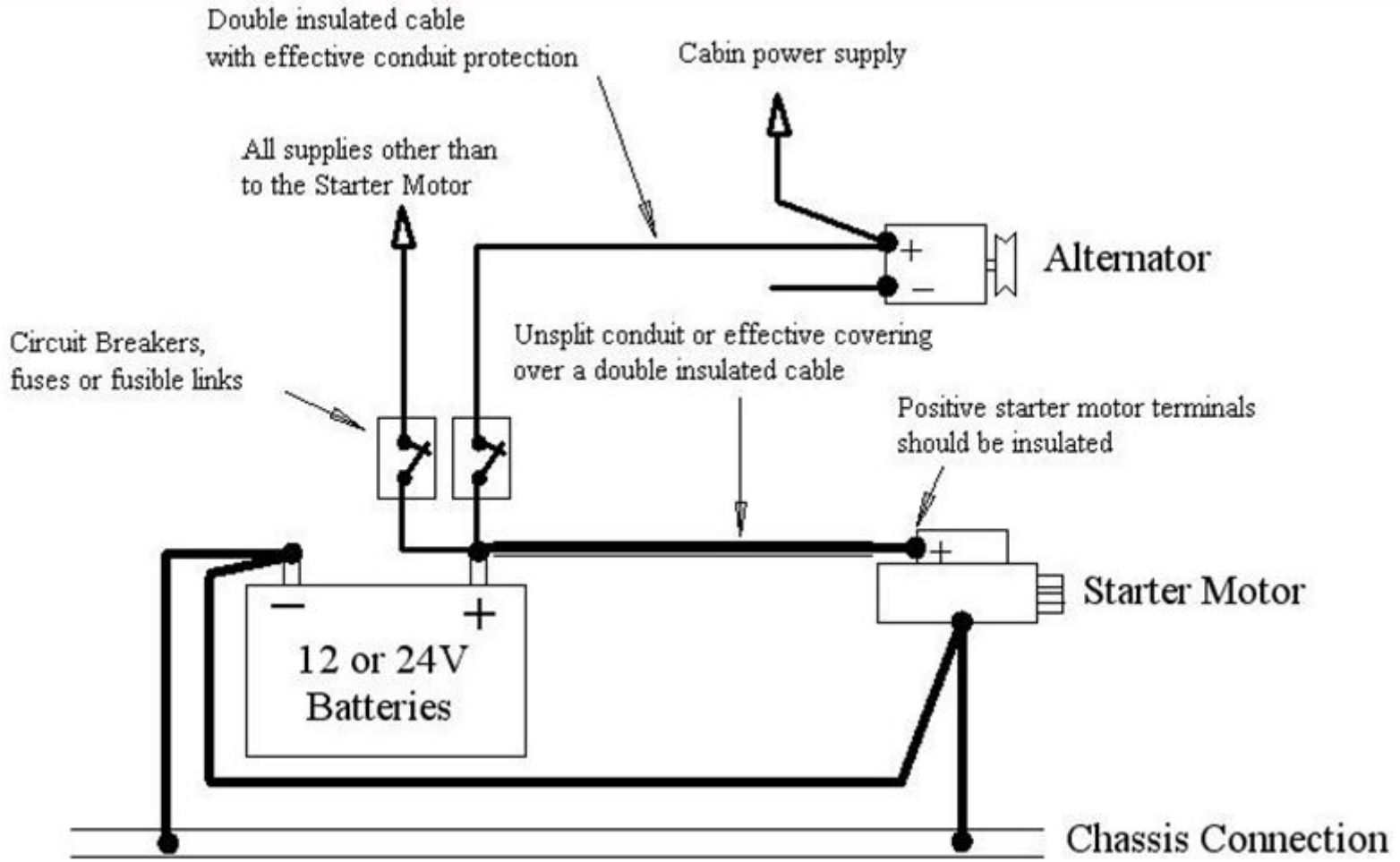
Double insulated cable
with effective conduit protection
Cabin power supply
All supplies other than
to the Starter Motor
Alternator
Circuit Breakers,
fuses or fusible links
Unsplit conduit or effective covering
over a double insulated cable
Positive starter motor terminals
should be insulated
Starter Motor
12 or 24V
Batteries
Chassis Connection

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Top Ten Electrical Problems

4. Voltage drops on the main charging path.

   Due to bad terminal connections.

Top Ten Electrical Problems

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The voltage difference between the charging alternator and the batteries should not exceed 0.5 V.

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Take note of the brightness of headlamps. Loss of 2V is clearly observable.

Top Ten Electrical Problems

5. Battery Degradation.

As batteries age the internal resistance rises.

- The batteries become less able to crank the engine.
- For vented lead acid batteries, the alternator is set to 13.8V.
- The battery voltage during cranking should be 13.2 V
- The charged battery voltage should be ~ 12.8V.

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Top Ten Electrical Problems

5. Battery Degradation.

As batteries age the internal resistance rises.

- For high calcium (sealed) batteries, the alternator is set to 14.2 V.
- The battery voltage during charging should be 13.6 V
- The charged battery voltage should be ~ 13 V.

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Top Ten Electrical Problems

5. Battery Degradation.

As batteries age the internal resistance rises.

- Overcharging (i.e. excessive alternator voltage) causes heating in the battery and long-term degradation.

- A load test is the best way to test the battery. Turn the engine off. Turn on all loads. Measure the battery voltage and current. Calculate the battery resistance

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Top Ten Electrical Problems

4. Battery Degradation.

As batteries age the internal resistance rises.

- A load test is the best way to test the battery. Turn the engine off. Turn on all loads. Measure the battery voltage and current. Calculate the battery resistance:

Internal Resistance = $\Delta V / I$.

Good ~ 0.2 ohms. Bad ~ 1 ohm.

Top Ten Electrical Problems

5. Wiring Rubs

Short-circuits occur when the truck is moving.

Use a multimeter to measure resistance between a wire of interest and earth, as the truck is moving.

Top Ten Electrical Problems

6. High resistance connections on minor current paths

Poor connections.

Hand crimping has a long-term failure rate of ~ 10%

A touch of solder on the non-entry end of a crimp terminal improves reliability.

Top Ten Electrical Problems

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Top Ten Electrical Problems

6. High resistance connections on minor current paths

Poor connections.

Hand crimping has a long-term failure rate of ~ 10%

A touch of solder on the non-entry end of a crimp terminal improves reliability.

Loose screw terminals

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Top Ten Electrical Problems

7. Inadequate wire, terminal and component ratings.

This result in excessive temperature and eventually in insulation degradation.

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12V, 7 Pin (Pole), Aluminum, N-Type (Black), ISO 1724		
	**6-201005** replaces old # 6-00710	Plug, 12V, 7 Pin (Pole) Aluminum N-Type (Black), ISO 1724 **Screw Terminal**
	6-00711	**DISCONTINUED** Plug, 12V, 7 Pin (Pole), Aluminum N-Type (Black), ISO 1724 **Spade Terminal**
	**6-101028** replaces old # 6-00720	Socket, 12V, 7 Pin (Pole) Aluminum N-Type (Black), ISO 1724 **Screw Terminal**
	6-00721	**DISCONTINUED** Socket, 12V, 7 Pin (Pole) Aluminum N-Type (Black), ISO 1724 **Spade Terminal**

24V, 7 Pin (Pole), Aluminum, S-Type (White), ISO 1185		
	**6-00011**	Plug, 24V, 7 Pin (Pole) Aluminum S-Type (White), ISO 3731 **Screw Terminal**
	6-00511	Plug, 24V, 7 Pin (Pole) Aluminum S-Type (White), ISO 3731 **Spade Terminal**
	**6-00021**	Socket, 24V, 7 Pin (Pole) Aluminum S-Type (White), ISO 3731 **Screw Terminal**
	6-00521	Socket, 24V, 7 Pin (Pole) Aluminum S-Type (White), ISO 3731 **Spade Terminal**

Electrical Ratings - Trucks

- The continuous current level should not exceed 1/3 of the rating for electrical relays and switches and terminals.

  E.g. 30A relay is good for no more than 10A.
  ¼ blade terminal is good for no more than 10A.

- Go up one wire gauge for laden circuits (such as lights).

  E.g. A 2.5 mm^2 is rated at 25A. In fact, the wire should not carry more than 15A.

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Top Ten Electrical Problems

8. Mechanical failure of switches

- Dust ingress into switches / relays / gauges.
- Vibration damage leading to mechanical degradation / failure.
- Temperature is also a factor as excessive temperature makes the components more vulnerable.

Top Ten Electrical Problems

9. Worn Commentators on Blower Motors

Commentators wear out.

Temperature and dust are factors.

Sparking occurs, which may disturb the radio.

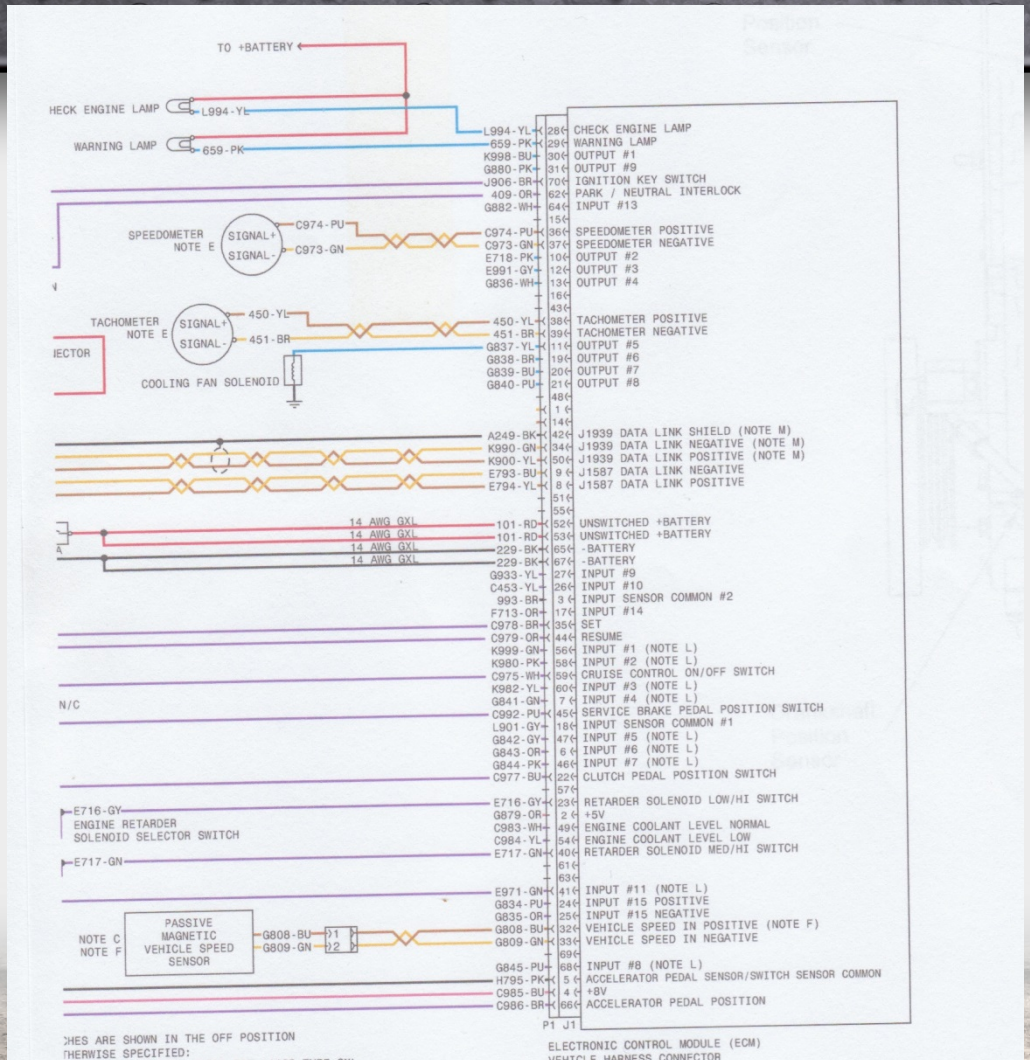
Check that the blower motor is turning at a sensible speed.

Top Ten Electrical Problems

10. Sensor failures

- Bad measurements disrupt engine, transmission, instruments, etc.
- Rectification is to replace the sensor.
- The key questions for the serviceman are:
- How can I determine whether it is the sensor or the ECM that is at fault ?
- Can I damage the ECM by fault finding ?

Black-Box Fault Finding Methodology



Black-Box Fault-Finding Methodology

Developing a clear-headed methodology for assessing this information is the challenge.

Black-Box Fault-Finding Methodology

Thanks for your attention !