Grounding in a GMC Motorhome

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Ground has 4 main functions

- Provide a safety circuit for shock prevention when connected to 120 / 240 volt shore power.
- Conduct ½ of the circuit for 12 volt DC devices.
- Provide electrical and electronic noise filtration and shielding
- Provide Radio Frequency shielding.

Three GMC Ground Systems

- 1. 120 Volts AC
- 2. Engine-driven 12 volts DC
- 3. House 12 volts DC

- We will also look at the 3 ground system interconnections and special considerations for the Onan, Cruise Control, and Radio Antennas

120 VAC "Green Wire" Ground

- The 120 volt AC ground is a **safety ground**.
- It's purpose is to prevent you from being shocked when there is a problem with any 120 volt device or the 120 volt wiring inside coach.
- The most common 120 VAC item that shorts to ground is the electric hot water heating element but any 120 volt device can cause a problem.

120 VAC "Green Wire" Ground

- The 120 volt AC ground is provided by the connection of the "green wire" (round power pin of the power cable) ***DIRECTLY*** to the ***aluminum coach frame.*** Sometimes this lead is connected through the breaker panel.
- The "green wire" is ***never connected*** to the 120 volt **neutral** wire *anywhere* in the GMC.
- The *green safety to neutral connection is only made at the power source*. This is either in the

120 Volt AC Grounding

- I suggest that you buy a $4.00 to $8.00 120 volt 3 light tester. Check your power prior to and immediately after connecting to a new 120 or 240 VAC shore power source.
- I leave mine plugged into a 110 volt outlet all the time so I can find it when I need it.

12 volt DC Grounding

- In 12 volt DC systems, the ground is 1/2 of the circuit supplying power to 12 V DC accessories.
- The ground path is just as important as the electrical wires when supplying +12 volt power to the accessories.
- It is very common for ground connections to corrode or oxidize over the years causing low or missing voltage problems.
- Previous Owners are also a major problem.

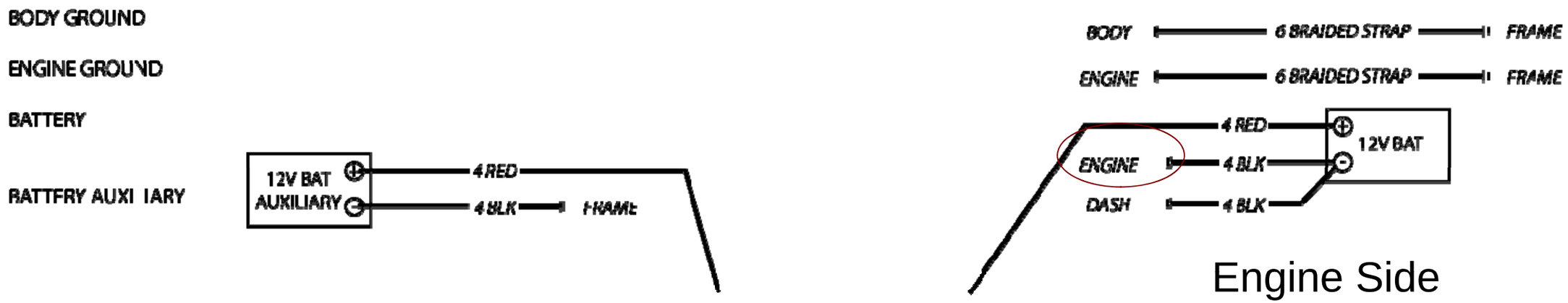
Two 12 volt DC ground systems

- Visualize the coach body removed from the frame. You will now have two, separate coach pieces
- The **ENGINE** and the **HOUSE/BODY**.
- Each is capable of powering itself separate from the other.
- When attaching a new 12 volt device, or trouble shooting an existing one, determine which power source (ENGINE or HOUSE) you are using and use the same ground.

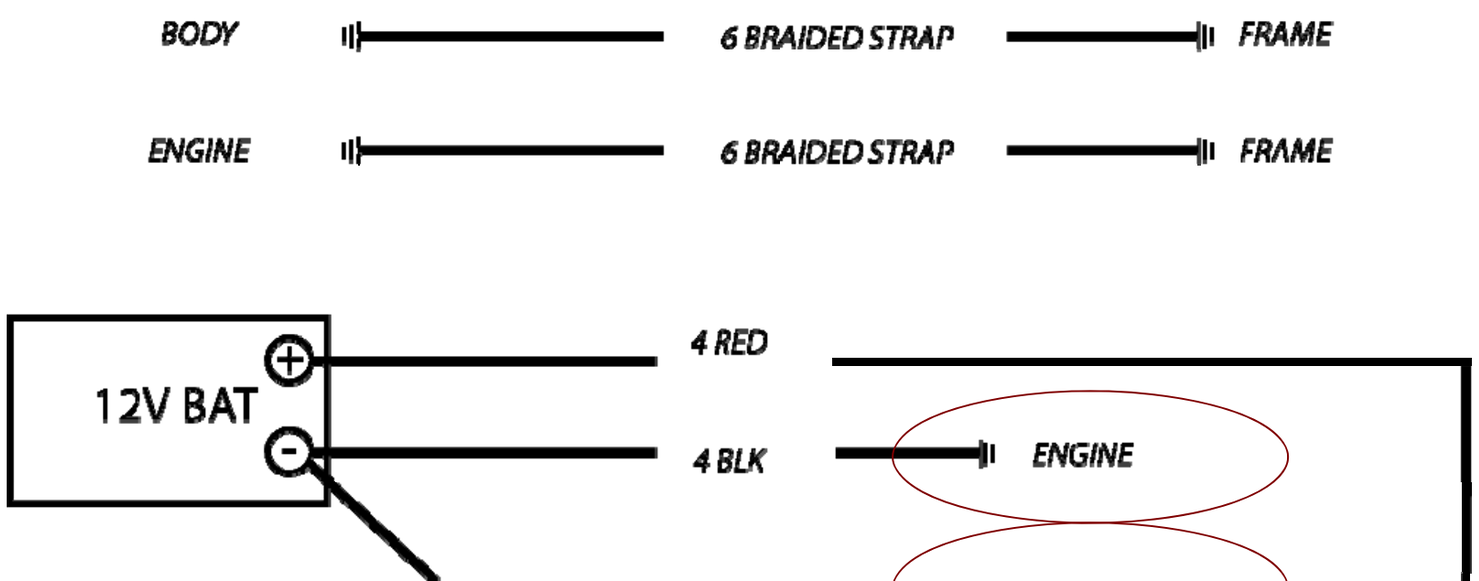
12 volt DC Engine Ground

- The **MAIN GROUND** for ALL engine 12 VDC powered devices is the **ENGINE** itself. This generally includes all devices from the inside steps forward, PLUS the brake, tail, and clearance lights.
- All 12 volt DC devices should have a connection back to the engine on the shortest path as practical.
- The engine battery negative lead is connected to the engine block and not the frame .
- There should NEVER be multiple ground paths to the engine from any device.

GMC 12 Grounding Diagram



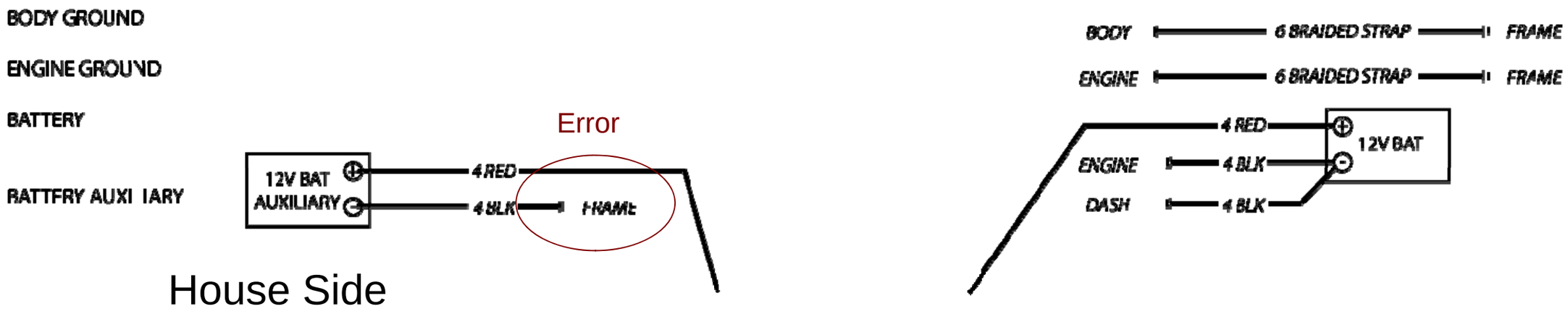
1975-76 COMMERCIAL TRANSMODE VEHICLE
(WITH HIGH ENERGY IGNITION SYSTEM) NOVEMBER 1975



12 volt House Grounding

- The **MAIN GROUND** for everything in the coach aft of the inside steps is the **ALUMINUM *coach chassis***. (I'm not talking about the steel frame that has the wheels attached to it.)
- All items powered by the converter or house batteries should go on the shortest practical path to the aluminum body for a ground.
- The converter and house battery(s) should be

GMC 12 Grounding Diagram



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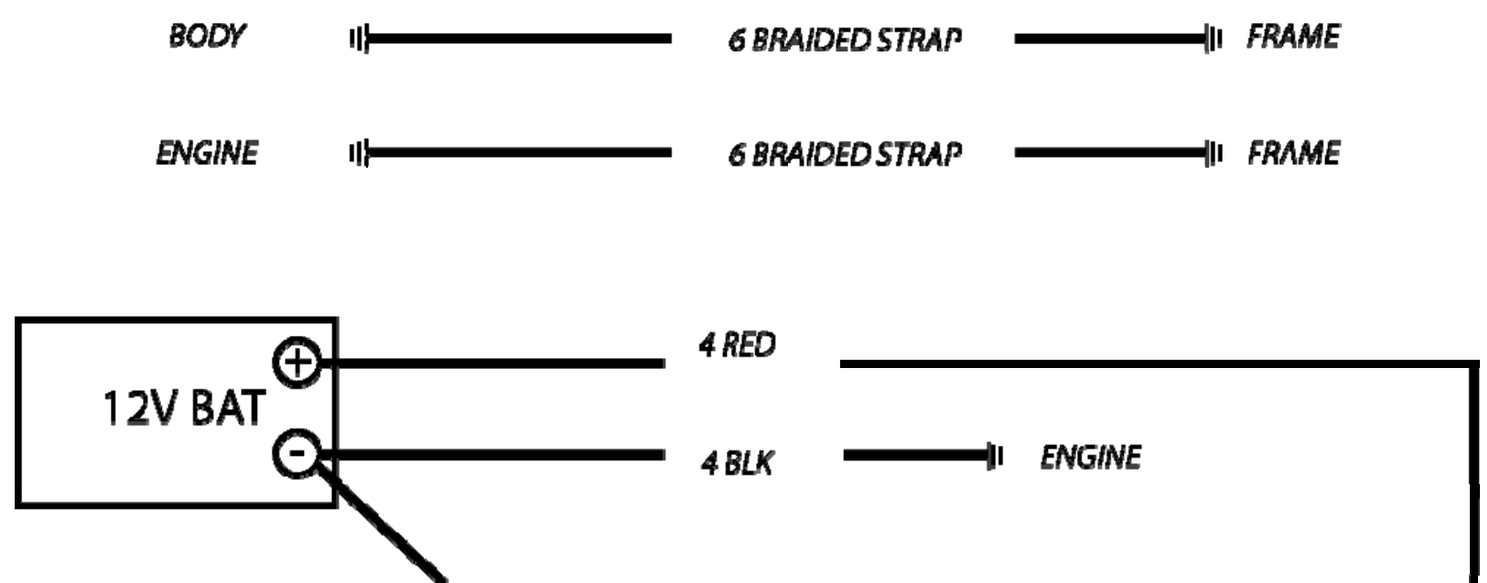
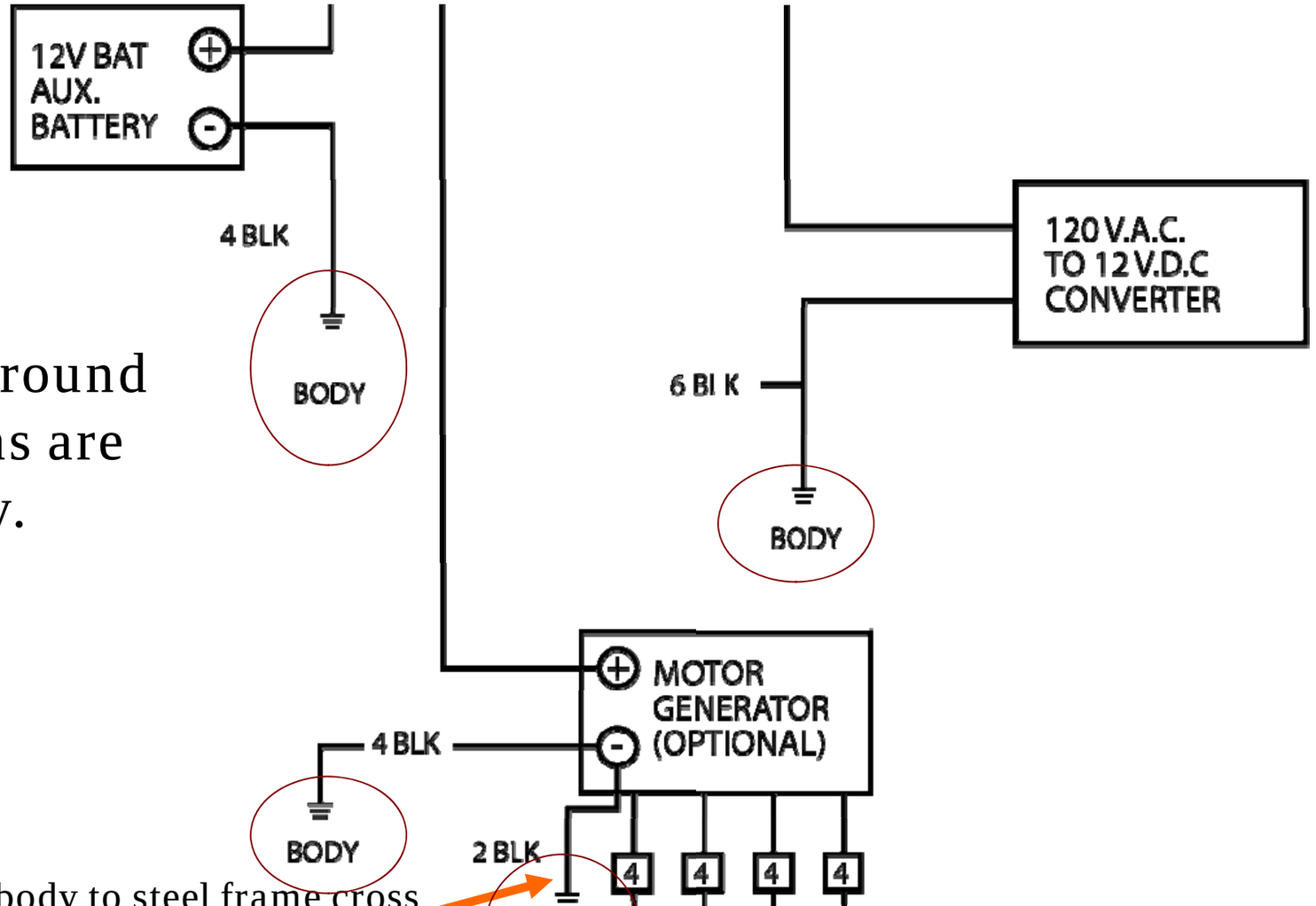


1975-76 GMC House Grounds

This was taken from the GMC 1975-76 Living area wiring diagram.



Note: All ground connections are to the body.

This is the rear body to steel frame cross

Ground System Interconnections

If there are 3 separate ground systems why do we need any ground interconnections?

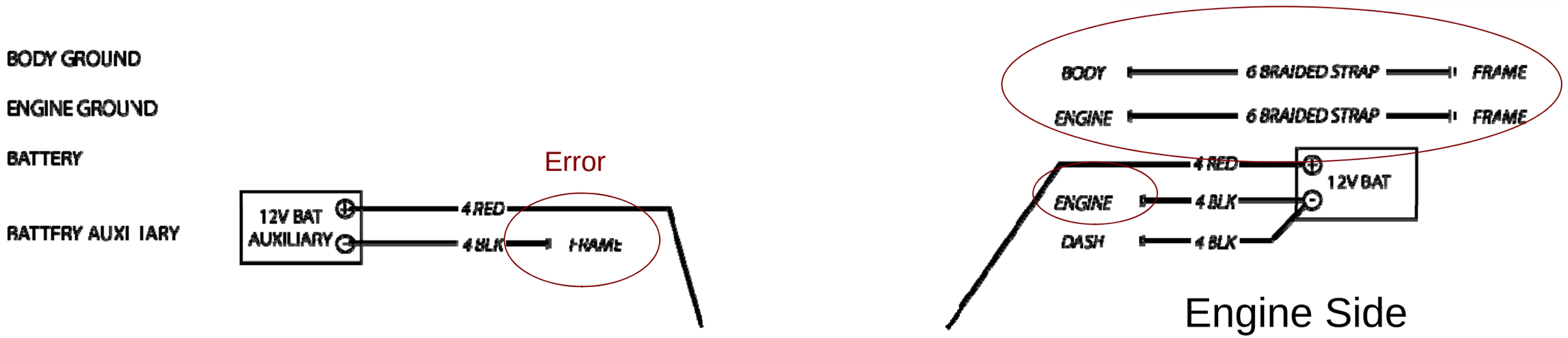
Charging the house batteries from the engine driven alternator.

- Running the rear radio speakers on pre-1976 coaches.
- OEM Cruise control and electric fuel pump
- Brake, tail, and rear clearance lights.
- Car radio antenna and battery boost function.

Ground System Interconnections

- The steel frame of the coach is used for interconnection between the house and engine systems.
- There are two braided straps between the steel frame and the aluminum chassis.
- There is one braided strap between the engine/transmission and the steel frame.
- Do not add additional ground straps.
- No electrical device (including batteries) is ever connected directly to the steel frame.

GMC 12 Grounding Diagram



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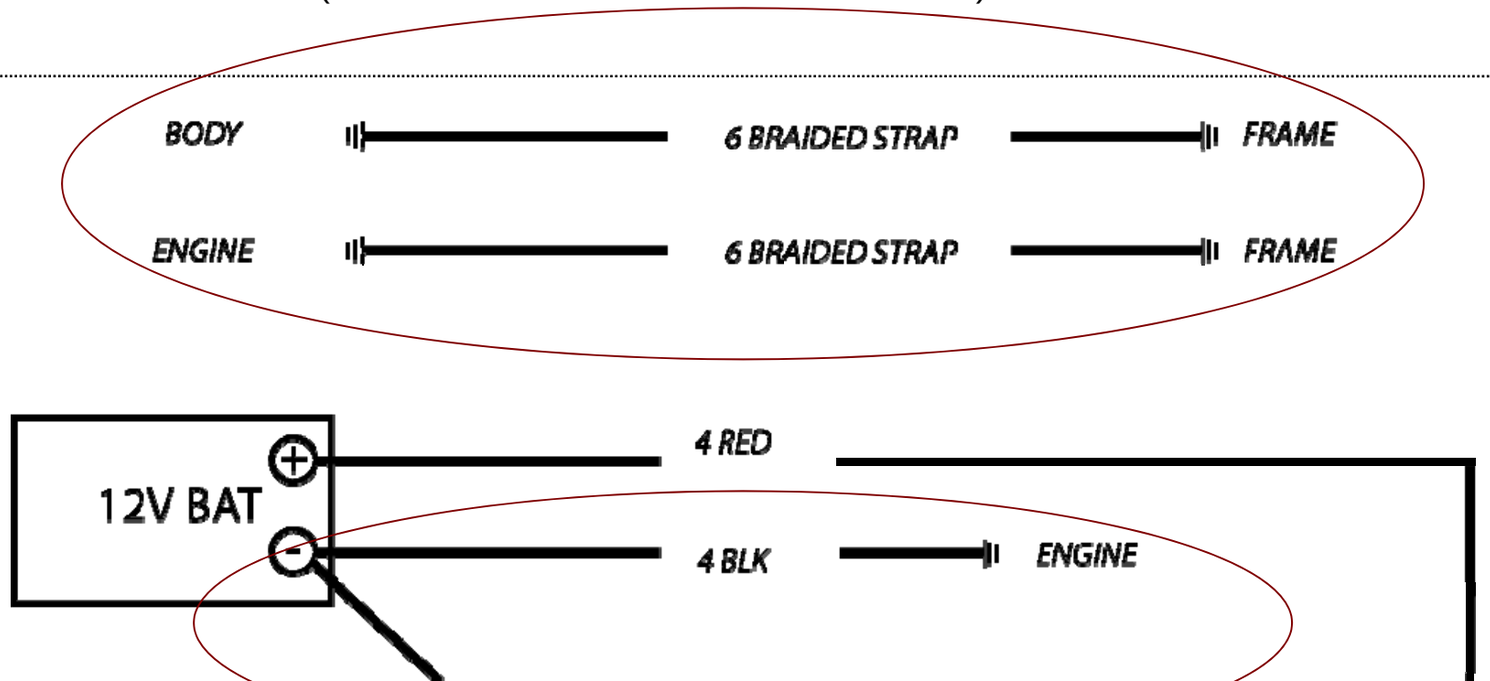
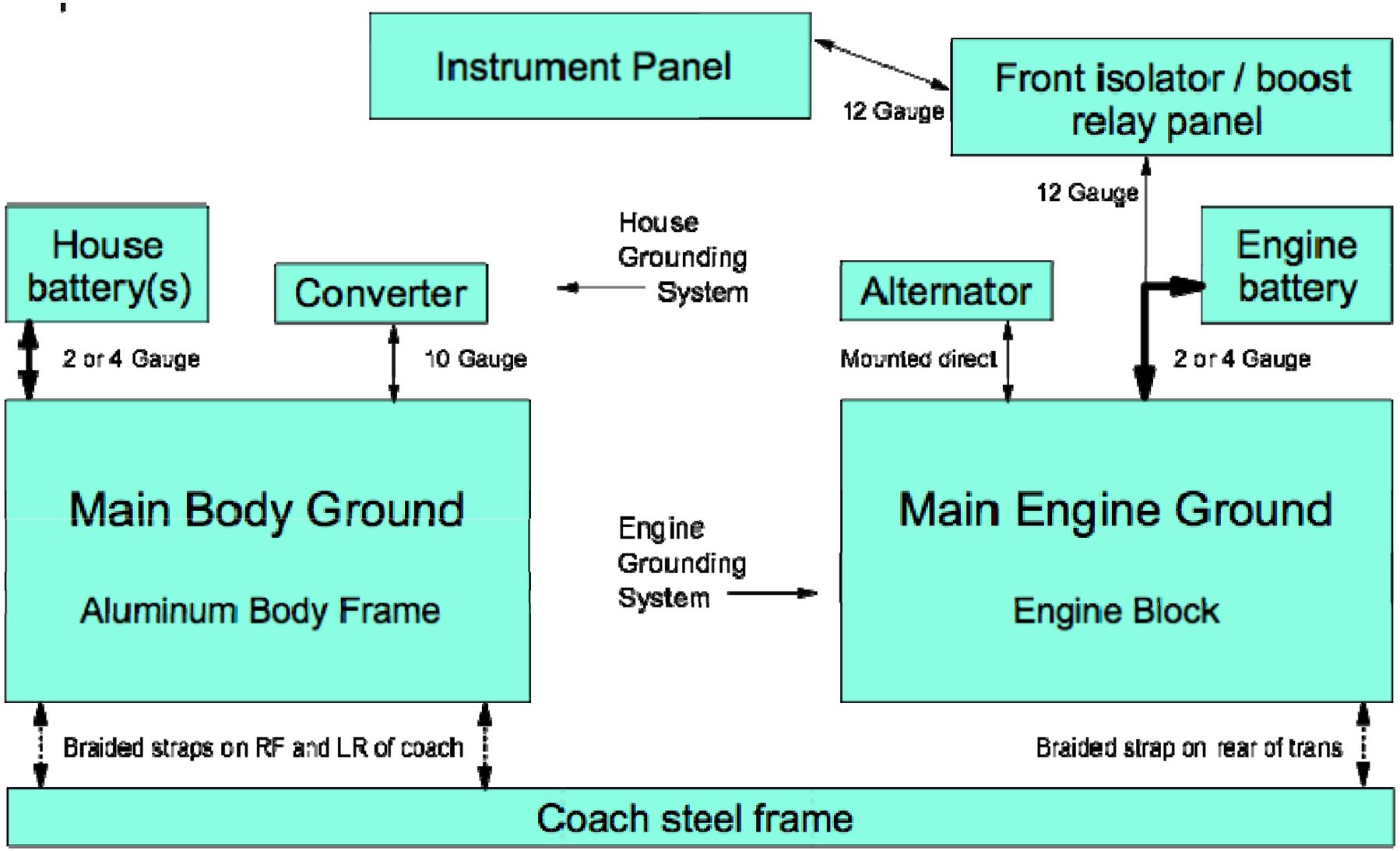


12 volt Grounding Diagram



Ground Loops

A ground loop occurs when there are multiple return paths from a device to the master ground.

1. Multiple ground paths can set up a high gain antenna at random frequencies. These can radiate electrical noise throughout the coach.

2. Electrical current can return to the power source on unexpected routes.

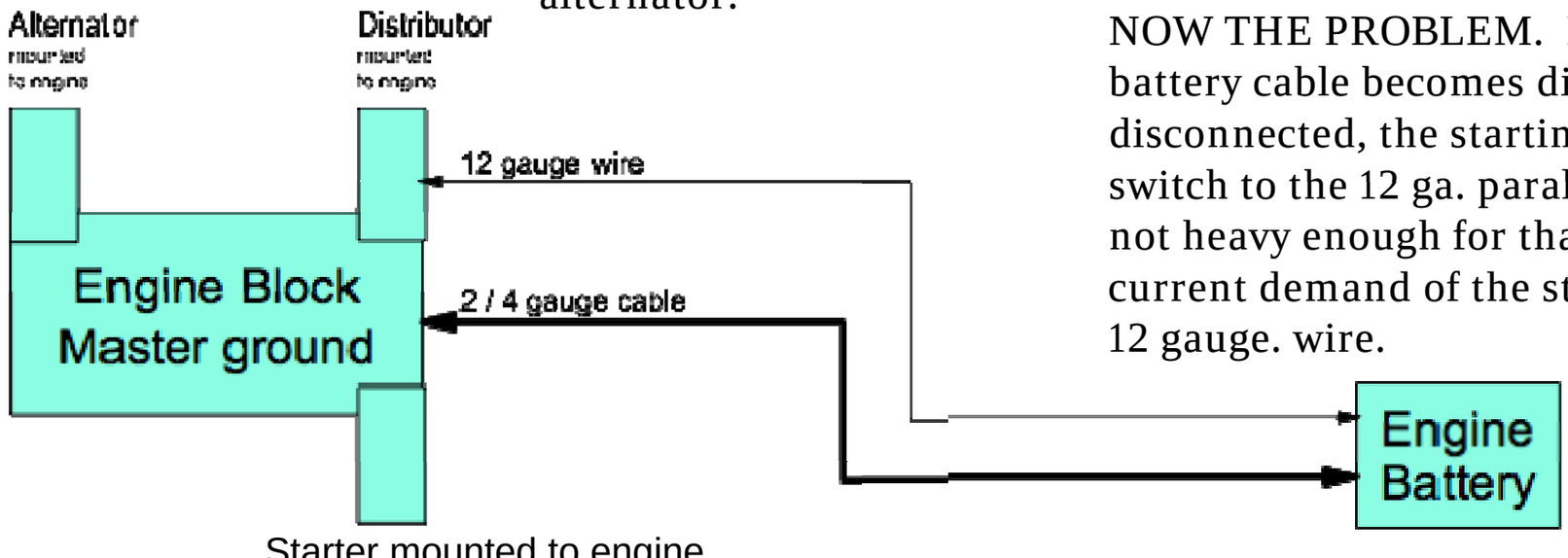
Ground Loops

- Dick P. says to run a wire direct from the base of the distributor to the battery.
- I say DO NOT DO THIS because this provides an alternate ground path to the battery.
- What would happen if the negative battery cable becomes corroded or disconnected?
- I say connect the *base of the distributor* to the master ground which is the engine.

Ground Loops

- Here is one example of a ground loop established by grounding the distributor to the battery.

Under normal circumstances the 2 gauge cable supplies around 200 plus amps (Short term) for starting and 50 or 60 amps for charging the battery from the alternator. The added 12 gauge cable is suppose to insure that there is a good connection to ground for distributor when the engine is starting and running. The power source when starting is the battery. Once the engine is running the power source switches to the engine mounted alternator.



NOW THE PROBLEM. If the 2 gauge battery cable becomes dirty, corroded, or disconnected, the starting current will switch to the 12 ga. parallel wire which is not heavy enough for that load. The high current demand of the starter will burn the 12 gauge. wire.

Some Problems Caused by Multiple Ground Paths

- Sparking or burned transmission shift cables. Common problem on some GM cars.
- Sparking throttle linkage/cable.
- Burned distributor ground wire (shown in previous slides).
- Noise in radios, TV, and audio devices.
- Electrolysis that eats up radiators.
- Faulty readings on dash gauges.

GMC Antenna Grounding

- All *vertical* monopole *antennas* (with a few rare exceptions) *require a good ground* to operate properly.
- On a vertical antenna the metallic body of the vehicle is 1/2 of the total antenna.
- The antenna requires a good connection to the body (ground) at it's base.
- Horizontal antennas, like over the air TV, which have 2 equal sections are called dipoles do not require a ground.

Radiator Grounding

- The *radiator* is mounted in rubber and is electrically insulated from the coach body, engine, and steel frame. The radiator is grounded to the ENGINE by the steel transmission cooler lines.
- Changing the lines to rubber or connecting any other +12 volt or ground circuits to the radiator can cause electrolysis which will eat holes in the radiator.
- If you suspect a problem, measure with a voltmeter between the coolant and the radiator for voltage. Also measure between the coolant and the engine.
- Any reading over .15 volts DC or AC is a problem.

Testing for Electrolysis

(Stolen from Somewhere on the Internet)

A voltmeter capable of reading both AC and DC currents is required to test cooling systems. The meter needs to read zero to the maximum voltage of the system being tested in tenths of a volt. The meter leads must be long enough to reach between the coolant (radiator filler cap) and the engine. An ohm function of a voltmeter is very helpful to pinpoint areas of resistance in as electrical system that will cause an electrical current to ground through the coolant rather than the engineered electrical circuit.

- Procedure
  - With the digital voltmeter set to 20 volts or above, attach the negative meter lead to the engine.
  - Install the second lead in the coolant touching the coolant only by reaching through the radiator fill.
  - Read the DC and AC voltage with all systems off. If a block heater is present, also take a reading with the heater turned on. If an automatic battery charger is present, as a standby system, also take a reading with this system running.
  - Read the DC and AC voltage with the electrical starter engaged.
  - Read the DC and the AC voltage with the engine running and all systems turned on: lights, coolers, fans, heaters, air conditioning, cell phone, two-way radio, including the phone and radio on both standby and transmit.
  - Voltage of zero to .3 is normal in the coolant of a cast iron engine. Such an engine will be destroyed with time by .5 volts, and engine manufactures are reporting .15 volts will destroy an aluminum engine.
  - The current / voltage will be AC if the problem is due to static electricity.
  - If the coolant shows an electrical problem with all the equipment turned on; turn off one system at a time until you finally turn off the system that stops the electrical current. When the current stops, this will indicate the electrical system causing the problem.
  - Be partially careful of starters. They can cause as much damage to a cooling system as a direct connection to an arc welder. This is due to the amperage present.

Diagnosing Bad Grounds

You will Need a inexpensive VOM (Volt Ohm Meter)

These are available from many sources:

Harbor Freight has a cheap one that ranges from $2.99 to $7.99
http://www.harborfreight.com/7-function-multimeter-98025.html

I like the Sears one because it can also read frequency to set the Onan speed.
http://www.sears.com/shc/s/p_10153_12605_03482139000P?mv=rr

Diagnosing Bad Grounds

Make sure that there are no parallel circuits when taking readings.

- Connect a voltmeter from the ground terminal of the suspect device to the master ground (engine or aluminum frame).
  - Turn on the device and read the voltage on the meter.
  - The value read is the voltage drop in the ground circuit. **Any reading over .1 or .2 volts is a problem.**

Diagnosing Bad Grounds

If the ground path does not normally move much current (like the shield of an antenna), then use the following ohm meter procedure:

- Connect a voltmeter between the device ground connection and master ground. Look for voltage.
  - IF NO VOLTAGE is observed, switch the meter to ohms x1 scale. Connect the leads together and ZERO the meter.
  - Reconnect the leads and read the resistance across the above two points. **Any reading over .1 or .2 ohms is a bad circuit.**

Fixing Bad Ground Connections

- Disassemble and Clean, CLEAN, **CLEAN** ALL connection components until they are SHINY.
- *Use star or tooth washers* between the terminals and the item being grounded.
- *Use anti-oxidation grease* on all connections to prevent or retard new oxidation/corrosion.

Anti-oxidation grease is available at Menards, Lowes, or Home Depot in the electrical department

Summary

- There are 3 GMC ground systems. Treat each of them as an independent system.
- The 120 volt “Green Wire” Ground connects direct to the coach body.
- The 120 volt “Green Wire” Ground and NEUTRAL are NOT CONNECTED together anywhere inside the GMC except inside the Onan.
- The master ground for engine powered devices is the ENGINE.
- The engine battery negative cable connects direct to the engine.
- The master ground for house powered devices is the ALUMINUM BODY.
- The house battery(s) negative cable connects to the Aluminum body.
- Clean and grease any suspect ground connection even if it looks good.
- An improperly grounded radiator can develop holes from Electrolysis.
- Do NOT run multiple or parallel ground paths.
- Never attach any electrical device to the steel frame.
- Vertical antennas require a good ground connection at their base.
- Never trust that a PO did it correctly.