GMC Electrical FAQ
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About this FAQ: This list of frequently asked questions is a compilation of questions that I have been asked on and off the GMC mail list. The answers reflect my opinion. You alone are responsible for determining the safety and effectiveness of any answer given here. Electricity can be dangerous. You could kill yourself. You could kill others. Your coach electrical system could stop working. Your coach could burn. Other BAD things could happen.

If you have the necessary skills to make the repairs and modifications listed here you already know about all the BAD things. If you don't know all of the BAD things or lack needed skills and techniques, get a professional to do the job for you. Always use approved materials and techniques for RV wiring.

Suggestions or comments to hdavis@ix.netcom.com

Converter - Accepts 110V AC and creates 12V DC. Although converters are available, most people buy a charger which also can function as a converter.

Charger - Accepts 110V AC and produces 13+V DC to charge batteries. Automotive chargers are available in several technologies. The lowest cost charger applies a constant current to the battery. If left on too long it will damage the batteries. The most complex and capable chargers are multistage chargers. These devices recharge batteries at maximum rates without damaging them. Many chargers can operate as chargers and converters.

Combiner A combiner is an electrical apparatus used to permit two battery (banks) to be charged "intelligently." The combiner relies on the fact that the voltage across a charging battery will rise as the battery charge increases. When the charging voltage is great enough, the combiner electrically connects both batteries in parallel to permit them both to become charged. When the batteries are not being charged the combiner electrically isolates the two banks. Using a combiner in place of the isolator that is original equipment in the GMC permits the electrical isolation (keeps the engine battery from becoming discharged) when you use the coach 12V electrical AND allows both batteries to be charged when charging voltage is present. This can simplify the electrical system if you want to permit charging of the engine battery from the coach charger.

battery isolator - a diode based device that permits both battery banks to be charged from the alternator (and allows the alternator to provide 12V to the coach wiring) but blocks current flow from one battery to another. This stops the two banks from discharging themselves in a short period of time. The discharge happens because (generally) one battery bank is different electrically from the other. This leads to the "stronger" of the banks experiencing current flow out as the batteries try to reach equilibrium electrically. As one banks discharges into the other it will overshoot a little bit so that it becomes the weaker of the banks. Then the second bank tries to charge the first - and overshoots a little bit. The "seesaw" current flow eventually discharges both battery banks.

Battery bank - in the GMC one 12V battery or 2 6V golf cart batteries in series to create a 12V bank. The GMC has two banks - the engine (usually one battery) and the coach bank (a 12V or 2 6V). Some coaches have added a third bank to extend the time between recharges.

statpower - a company that manufactures a variety of battery related equipment including charger/converters and inverters.

statpower40, TrueCharge 40, TrueCharge 40+ - A series of multistage battery charger/converters that convert 110V to 12V (24V if you have that type of system - GMCs are generally 12V systems). The multistage charger permits rapid charging of battery banks by employing a high current phase until a specific battery voltage is reached. The current is then reduced for another period of time until a different higher voltage is reached. The process continues reducing current with the goal of supplying the maximum charge current without boiling the battery electrolyte. The chief advantage to the multistage chargers is that they can restore a battery to a specific charge level much more rapidly than an automotive trickle or taper charger. In addition, these devices only supply a float current when needed, so batteries aren't overcharged. Charge time for a given battery bank differs based on the type of batteries used, but a typical golf cart battery configuration will recharge to the 75% point in about 2.5 hours assuming a discharge to 25%. This represents the fastest recharge possible and maximum useful battery capacity with

reasonable battery life. The Statpower products also function as a converter to provide 12V from the 110V shore power (or genset). The charger can charge batteries while supplying the coach 12V but it requires more time to charge the batteries when they are operated in the 25-75% range.

Inverter - a device for converting 12V DC from the batteries (or alternator) to 110V AC. There are many different types of inverter, each with different properties. The least expensive inverter supplies a near-square wave output which is passed through a simple filter to make it more sine wave-like. These are very inexpensive but relatively inefficient. The power filtered out to make the output more sine wave-like is turned into heat and is lost. Some inverters lose 45% of converted energy this way (so if you are trying to power a 100W AC item at 110V you will actually expend close to 200 watts of DC - half of which is turned into heat). Small inverters of this type are useful for powering small items used occasionally (or if you don't care to conserve power).

The next most expensive inverter is a modified sine wave inverter. This device is more complex than the simple inverter but is more efficient. Where the square wave inverter loses much energy to heat losses, the modified sine wave inverter is more efficient. It also costs a bit more. It is better for running some type of motors and electronics. most Statpower inverters are modified sine wave inverters.

The most expensive inverter is a sine wave inverter. It produces AC that looks just like the power company. It is generally the most efficient of the inverters. Electronic equipment and motors operate like normal when using these inverters.

You do not need an inverter unless you dry camp AND want to not run your genset often.

Transfer Switch - a device used to select between 110V AC input sources such as the shore power cable, genset, and inverter. Automatic transfer switches sense when AC is present on the lines and switches to the preferred source.

Wire size or gauge - wire must be of a size sufficient to carry the current that will flow through the wire. Wire has a resistance. Resistance means that the wire will lower the voltage from the source to the item using the electricity. Longer wires have more resistance and therefore more voltage losses. The larger the gauge the lower the voltage drop (loss) from source to the item. This means that you lose less battery capacity while getting brighter lights, faster turning motors, etc. Some items like motors can fail when the voltage drops too low because there isn't enough torque to turn the motor but there is enough heat generated to destroy some parts.

Q: I am considering a multistage charger (TrueCharge 40) but my buzz box converter still works. Is it worthwhile to install a new converter?
A: The Statpower charger can still be a very good investment depending on your use of the coach. When you need to replace the existing converter it is worth considering the TrueCharge. In the meantime, how you use your coach determines whether or not a multistage charger is needed to make your coach function well. If you dry camp (camp without electrical hookups) managing your battery banks is an important part of your camping experience. If your stays are short enough that you never need to recharge your house bank you can make do just fine with the old style buzz box. Recharging is done hooked to shore power. If you need to recharge from the genset, a multistage charger will significantly reduce the time required to charge your battery banks.

Q: Where do I get a combiner
A: West Marine carries them. I'm not sure about other suppliers. Part number West marine for 150A combiner 128293 - price on sale is about $100.

Q: How much do multistage chargers cost?
A: Refurbished 40 amp Statpower units are sometimes available for less than $200. New 40 amp Statpower units are in the $400 range depending on where you purchase them.

Q: What is the difference between Statpower and Trucharge?
A: Statpower is a company. They sell their products under several brand names including ProWatt, Statpower, TrueCharge, and ProSine. In general, The ProSine inverters are the highest capability (and capacity) of all inverters

sold by Statpower. The TrueCharge charger/converters include the same battery charging circuitry used in the ProSine inverter/charger combinations.

Q: Is there much of a difference between the TrueCharge 40 and 40 plus? The only major difference I can find is the ability to charge three banks (40+)
A: The internal circuitry is also different. In theory the 40+ should be a bit more reliable than the 40, but an individual is NOT likely to see the difference in a MH use.

Q: Can our configuration use the 3 bank capability of the TrueCharge 40+?
A: You can hook up the 40+ to 1,2,or 3 battery banks. Unless you add a second house bank the third output will not be used.

Q: I found a remote control panel, is it worth installing?
A: I did. It's a great addition. Keep in mind that the panel is really a remote monitor since you can't turn the charger off from it. It does let you see how much current is being supplied to the battery banks (and coach 12V circuits), so when using the genset to recharge. Monitoring the charge rate allows you to shutdown the genset when the charge rate is too low (the banks are nearly charged). This saves significant time and gas.

Q: My buzz box works but I am concerned for the safety of my batteries and also the sound level.
A: The TrueCharge definitely has better battery protection built in. There's no need to disconnect from shore power like there is with the buzz box to avoid damaging your batteries. Do keep in mind that the Statpower units have a fan that will periodically turn on when the unit is running. They are used to cool the electronics. Mine runs pretty continuously at 40 amp charge rate, some of the time at 20 amps, and sometimes at the lower rates. Air temp and how you mount the unit will influence how much the fan runs. FWIW, the fan makes about the same amount of noise as one of the older PC fans. (Not much impact during the day, but can be annoying at night if it's really quiet).

Q: My Statpower charger turns a fan on and off, often in response to me turning on a light. Why does it happen?
A: The fan is used to cool the electronics when higher currents pass through the charger. Fan turn on/off is determined by many factors including the ambient air temp. In general the fan will come on for less time and less frequently when it is cool than when it is hot inside the compartment where the charger is located. When you turn on a light it draws more current from the TrueCharge. Sometimes this additional draw is enough to cause the fan to come on. Likewise, when you turn off the light it reduces current so that the fan is no longer needed.

Q: My TrueCharge works fine when connected to shore power, but stops charging when using the genset. The lights on the status panel blink.
A: Your Onan genset has a small 2 amp charger that feeds through a voltage regulator to the house battery. Remove the wires from the regulator. There should be two terminals - one with a single wire and one with two wires. Remove the single wire and tape the connector at the end of the wire to guard against shorts. Keep the two wires that are connected to one terminal connected to each other. Duane Simmons indicates that failure of the regulator is one significant cause for genset failure. Removing the wires doesn't interfere with the genset operation and makes the unit ignore any regulator failures.

Q: I've heard that the Statpower chargers sometimes catch fire.
A: All battery chargers have components that fail. Power circuits tend to fail with smoke and fire. The Statpower cases are designed to contain any flames. In UL tests, the Statpower cases contained ALL flames so that materials in contact with the unit would not catch fire.

Q: Is there a multistage regulator for my automotive regulator?
A: Yes. West Marine offers several. They range in price up to several hundred dollars. These regulators replace the automotive regulator with the multistage capability. The full output of the alternator is managed by the regulator. Like the statpower charger, these automotive multistage regulators permit the fastest possible battery recharge.

Q: How much of an advantage is an automotive multistage regulator?
A; If you are driving very long distances there is little advantage since the tapered charge from the OEM regulator will fully charge most battery banks in about 20 hours. If your drive distance is shorter, say 3 hours and you move often, the multistage regulator will fully recharge your battery bank without running the genset.

Q: The wire from my alternator to the isolator sometimes gets hot. What's happening?
A: The wire is undersized for the maximum possible current flow. The OEM Alternator is capable of a sustained 85 amp output. When the coach is drawing a heavy load the wire will get hot. The problem is compounded if you have a higher amperage after market alternator. The solution is to replace the OEM wire with a heavier gauge wire. I recommend using a marine engine environment chart for selecting wire sizes in the engine compartment of the GMC. These charts provide a greater safety margin than standard automotive charts. Also, be cautious of the additional heat generated in the GMC engine compartment.

Q: Is there a product that does all of these, charges, inverts and converts?
A: Yes. The Statpower ProSine 2500 and 3500 both provide all functions in one unit.

Q: Why do I need to double the wire length from the battery to my appliance when choosing the hookup wire size?
A: The 12V path is actually the positive line and the ground return. So, resistance for the wire loop needs to accommodate the wire plus the chassis ground. Note: you do not need to use a separate ground wire from your device to the battery bank. The ground may be supplied by the chassis itself. However, you will still need to calculate wire size for the positive wire using the positive plus ground length. It's easiest to just double the positive wire length.

Q: My dash gauges change readings, and they remain changed, when I turn on my headlights. Why?
A: You have a poor gauge cluster ground. Clean all connections between the instruments and the panel, the ground wire in the dash, and add at least one more ground between the chassis and the dash. This should eliminate your problem.

Q: I turned off my Onan and now it starts but doesn't create 110V AC. What's wrong?
A: The Onan failure is probably a Bridge Rectifier failure. They typically fail while turning off the Onan while the AC (or some other heavy duty AC motor) is running. A voltage transit (called inductive kickback) usually causes the failure. The OEM Bridge rectifiers are operating very near to their Peak Inverse Voltage (PIV) rating. A simple solution is to replace the bridge rectifier with one having a much higher rating.

Q: How do I replace my OEM bridge rectifier?
A: (Courtesy of Duane Simmons)You have two choices - replace with an exact pin compatible device having the same low PIV, or use one that is higher. After market bridge rectifiers with the same OEM pin-outs have PIV limitations. To avoid the limitations you have to modify the Onan.. A 1/4" hole in the base for each wire allows you to install a heavy duty bridge rectifier. To remove the OEM bridge rectifier, slide out the Onan as far as you can & remove the BR mounting screw which is located aft of the Control Board on the rear Generator Housing (1/4" screw head). Remove the plastic cover on the side of the generator housing & the BR can be moved to where you can ID the terminal from the side of the BR. Carefully transfer the terminal ID to each wire (i.e. + , - , AC , AC). Transferring the proper ID is very important since the Onan will not operate with crossed wires & the wires are very hard to trace for ID. Now individually remove the wires from the base (relive tab on each wire terminal from the front/BR engagement side & push terminals out the rear). Now drill 1/4" holes for each wire. Slide the wires through the proper hole & attach/slide on the 4 wires to the BR. Slide the BR & wire terminals back down through the base to where the Original mounting screw will secure the BR to it's original position on the housing. An after market BR w/1,000 volt (PIV) rating is available from many Electronics stores at less than $10. The PIV is greater than 3 times the OEM BR & should never fail (well almost never). NTE # 5328 is the after market BR that Duane uses.

You can see how to change the bridge rectifier at Scott Nehoda's site:
http://members.aol.com/adohen2/page/newpage3.htm

Q: I want to install an inverter. How do I decide on the wattage?
A: Determine what AC appliances you want to operate simultaneously. Add their wattage together and buy an inverter with 20% more capacity. For example, suppose that you want to operate a desk top computer with standard monitor, a color TV and home stereo at the same time. Assuming a few numbers for our example: 120W + 120W (computer + Monitor maximum values) + 220W + 80W = 520 watts. So, select an inverter of at least 625 watts. For

most types of invert the 20% additional capacity accounts for many manufacturer's practice of over-reporting the real capacity of their inverter.

Q: What kind of wire do I use to connect my inverter to the batteries?
A: I recommend marine grade fully tinned wire of the appropriate gauge. The wire is more flexible than the automotive variety and resists corrosion better. The improved flexibility will aid during installation. The tinned wire reduces resistance caused by corrosion. High resistance connections for high amperage devices like inverters can cause fires. I recommend using one gauge larger than the chart to minimize voltage drop. Voltage drop wastes power and causes the inverter to operate outside its ideal design parameters.

Q: Can I power my Air Conditioner with an inverter?
A: Not economically. Compressor surge power is quite high and requires an inverter in the 2kW range. The problem is that the battery drain would require large banks to run the AC for any appreciable amount of time. A typical 2 golf cart battery bank would be discharged to 50% of full capacity in just half an hour. If you need to run the roof AC, start your genset and charge your battery banks at the same time.

Q: How do I wire my coach for an inverter?
A: Decide where you will use inverter supplied power. You can then either wire separate outlets for the inverter or separate out a branch circuit from the existing wiring.

Q: Which branch circuit is best to use for inverter wiring?
A: It depends on what you want to use the AC power for. One convenient circuit is the branch that powers the kitchen wall and dinette (curb side) wall in the Palm Beach models. To use this circuit for your inverter, you will need to separate the branch wiring from the existing bundle and install a sub panel for the inverter circuit. This type of installation requires a way to switch between the inverter output (11V AC) and the house mains 110V AC. Inverters with a built-in transfer switch simplify this type of installation. Otherwise you can install a separate transfer switch.

Q: How do I wire an inverter into a branch circuit?
A: Wiring is best done by a professional. If you are skilled, the following is a general guide. First trace the outlets that you want to use as a branch circuit. This can be done by disconnecting the coach from ALL 110V sources including gensets and inverters. Open the distribution panel and disconnect all wire bundles except the bare copper grounds. Insert a wire jumper in the outlet that you want to use as a branch. NOTE: MAKE CERTAIN THAT THERE IS NO 110V PRESENT IN THE COACH WHEN PERFORMING THIS OPERATION! Use an Ohm meter to identify the circuit that you have jumpered by testing wire pairs for continuity at the main distribution box. Label the wires. Move the jumper to the next outlet and repeat the process. When you have identified all outlets and wiring that you are interested in using on the inverter, double check to make certain that no other outlets are wired to your selected circuits. You can do this by moving jumpers to other outlets while monitoring the selected branch circuit wire for continuity. Remove the selected branch circuits and their associated grounds from the main distribution box. Wire the inverter AC input to one of the breakers that previously protected the branch circuit. Wire the output from the inverter to the sub panel as the input. Connect the branch circuit(s) wire that you chose previously to breakers in the sub panel.

Q: How much capacity do I need to power a microwave?
A: It depends heavily on the individual microwave, but a good rule of thumb is to double the cooking power to determine AC power requirements. For example, a Sharp 850 watt microwave uses 1500 watts of input current. You can size the inverter by reading the AC panel on the microwave. Some 600 watt microwaves consume just under 1000 watts of input current.

Q: I want to run my inverter with a transfer switch as a battery backup for my computer. Will it work?
A: It may. Automatic transfer switches are fast, but not fast enough for many computer power supplies. The result may be a power glitch that causes your computer to reboot. The glitch is very short (a few tens of milliseconds) but still long enough to affect some computers. Other computers may not be affected.

Q: How do I eliminate transfer switch glitches that affect my computer?

A: Run your inverter all the time, or install a small UPS (Uninterruptable Power Source) between the computer and the outlet it's plugged in to.

Q: My TV (or stereo) works fine when running on shore power, but when the inverter is running I get audio noise/snowy picture. What causes it?
A: Lower cost inverters use square waves or modified sine waves for their output. The noise that you hear is the high frequency components of these lesser quality outputs coupling through your TV or stereo. You may be able to reduce the problem by installing a power line filter from Radio Shack. These filters are often used to reduce radio interference from HAM radio operators. They sometimes work for low cost inverters. The best solution (and much more expensive) is to operate from a better inverter such as a sine wave inverter.

Q: I have a dash radio that is draining my engine battery.
A: Switch your 12V source for the radio to the house battery.

Q: My radio is turned off but my batteries still discharge. What's going on?
A: It could be several different things. First, the LCD displays on new automotive radios often create interesting patterns when they are turned off. To reduce current draw, open the faceplate. This disconnects the LCD. NOTE: many newer radios include a remote control using infrared light. These systems may have significant drain due to the remote control. For best effect install a radio kill switch.

Q: I want lots of light at night, but how do I conserve my battery?
A: Florescent lights are the most energy efficient for a given amount of light. Halogens are the next most efficient, while incandescent are the worst. The GMC OEM lights are ordinary incandescent. Use warm bulbs in florescent fixtures where possible. When brighter more focused task lighting is required use halogens. Use incandescent where the original fixtures are the only alternative.

Q: How do I save energy when using the range hood?
A: If you can replace the hood vent fan and motor do so - new motor/fan combinations move just as much air but use less than 30% of the energy.

Q: I saw an article about slowing the range hood fan by installing a two position switch. Is this a good idea?
A: Not if you need to conserve energy. The design works by reducing the operating voltage using a resistor. This wastes energy as heat. As an alternative, look for a motor controller using Pulse Width Modulation (PWM) technology. With this approach the fan motor uses only the electricity needed and wastes very little.

Q: What areas of the OEM coach configuration can be improved most to save battery power?
A: Most motors (range hood, vent fans), the incandescent lights, and water pump. Most of these motors can be replaced with new units that consume 30% of the power while still delivering the same or better than OEM performance. A similar savings is possible with the water pump. Fantastic fans replace OEM vents with a larger opening that has less air resistance. Many times the Fantastic fan cover can be simply opened without running the fan to get good airflow.