PROTECTING
Voltage-Sensitive Equipment

Tips for avoiding damage to 12-volt electronic devices during the process of battery charging and equalizing.

By CAROL F. MAXWELL & E.S. GURDJIAN, F76350

More complex electrical systems and all-electric coaches have placed increased demands on recreational vehicle house batteries. Premature battery failure has become more common. However, coaches with high electrical demands usually are equipped with inverter-chargers capable of three-stage charging and periodic equalization. These techniques can significantly reduce sulfation and extend battery life (see "Enhancing 12-Volt Charging System Performance," FMC, December 1994, page 166).

During normal three-stage charging, the bulk and absorptive stages can deliver 14.2 to 14.6 volts DC. The voltage encountered while equalizing can reach 16.2 to 16.5 volts DC. (Equalization is not recommended for gel batteries.) The increase in voltage can damage some electronic equipment.

To determine the best way to protect electronic devices during the charging and equalizing processes, you must learn whether they are sensitive to any voltage in excess of 12 volts DC, or whether they can tolerate moderate increases up to 14.2 volts DC. This information may be found in instruction manuals or you may need to contact the manufacturer.

Devices that can withstand a moderate voltage increase most likely will tolerate routine three-stage charging. However, during a 16.5-volt equalization charge, most charger manufacturers and many component manufacturers recommend turning off all 12-volt DC equipment. Many devices, such as furnaces, refrigerators, and spark ignition water heaters, have accessible on-off switches, so the individual components can be protected. Other items, such as carbon monoxide (CO) monitors, LP gas detectors, digital clocks, driving computers, and burglar alarms, do not have on-off switches.

Some coaches are equipped with a 12-volt DC master switch that can be utilized during an equalization charge. The wiring diagram of the individual coach should be reviewed carefully, because there may be some devices that bypass the 12-volt-DC master and will remain powered. In our coach, the CO monitor, LP-gas detector, dash clocks, radio displays, driving computers, and burglar alarm remain on when the 12-volt master switch is off.

Components without power control switches, those that cannot be disabled by a 12-volt master switch, and those that are sensitive to any voltage in excess of 12 volts can be protected by a simple, inexpensive 12-volt integrated circuit regulator available from Radio Shack. This device is suitable for loads under 1 amp and allows 12-volt operation with input voltages from 12 to 35 volts DC.

We use the following Radio Shack parts:

7812 IC voltage regulator, #276-1771, $1.49
Heat sink, #276-1363, 99 cents
Mounting hardware set, #276-1373, $1.39

As shown in the wiring diagram for the voltage regulator (Figure 1), the input voltage at Terminal 1 may be from 12 to 35 volts DC. Terminal 2 is ground, and Terminal 3 is the output voltage at constant 12 volts DC. During assembly, it's important to protect the regulator from excessive heat while soldering the components. Leave the 7812 leads long while carefully soldering the wires. Attach a solder heat sink to further minimize the possibility of heat damage. After soldering is complete, use shrink tube from the wire insulation all the way to the IC body. This technique prevents shorting the leads.

Next, attach the IC regulator to the heat sink using the hardware set. If you have questions about this procedure, ask your Radio Shack dealer at the time of purchase.

Incorporating the heat sink allows the 7812 IC regulator to run a 1-amp load. The power required by carbon monoxide monitors, LP detectors, and display LEDs is rated in milliamps. In the dash area, we have combined the radio memory, digital clock, digital thermometer, and driving computer circuits on one regulator. Since these devices lose memory if they are disconnected from the power source, the IC regulator provides convenience as well as protection by allowing these components to remain operational during high voltage charging. To avoid overloading the regulator, the burglar alarm is on a second regulator. The CO monitor and the LP detector have their own IC regulator, because of their scattered locations.

Heavy-duty exterior 12-volt bulbs actually are rated at 14.4 volts DC. Equalization procedures are

performed while the coach is stationary, so these exterior bulbs are not affected. However, they are affected by high output alternators, which can charge at 14-plus volts. This can be detrimental to all bulbs, especially the expensive halogen headlamps. Ample Technology (2442 NW Market St., #43, Seattle, WA 98107; 206-784-4255) has a feature in its Next Step regulator that reduces the alternator output voltage to 13.2 volts DC when the headlamps are powered. By reducing the operating voltage, bulb life can be extended significantly.

Three-way refrigerators can operate on AC, DC, or propane and present special considerations. The electronic circuit board determines which power source runs the refrigerator, and it requires its own 12-volt power supply to function. Our refrigerator has a circuit board that will tolerate more than 16 volts, so it can remain powered during an equalization charge. Since this may not be true of all refrigerators, to avoid possible damage to the circuit board, the tolerance of your unit should be verified with the manufacturer before equalizing. If the information cannot be found, or if it is not necessary to operate the refrigerator, it can be turned off during an equalization charge.

Another solution is to install the 1C regulator to temporarily power the circuit board to maintain AC service during equalization, and then switch back to standard DC after the charge is complete. The IC regulator cannot be used for normal operation if the refrigerator operates on DC while traveling. The IC regulator limits the voltage to 12, and 12.8 volts to 13.2 volts are required to activate the DC mode.

An alternative to using the 7812 IC regulator is to have a second battery bank to power DC equipment while the first bank is being equalized. Before we installed the IC regulators, we used a parallel switch to the generator battery to provide power when the house batteries were being equalized. Any time you are not confident that a component can tolerate voltage above 12 volts DC, it would be wise to err on the side of protection.

FIGURE 1 **Typical 12-Volt DC Wiring Diagram**