Battery Electrolyte Level Monitor

Most motorhome owners are probably aware of at least three major categories of deep-cycle batteries - the gel-cell battery, lead-calcium/low-antimony battery, and the lead-antimony battery. At FMCA's Sacramento convention in 1990, we encountered another type of battery, which we had not previously seen in recreational vehicles. This battery is used in industrial applications most notably in mining carts. It consists of six or twelve high capacity two-volt cells that are connected in series to provide either 12 or 24 volts. These cells often are 16 to 20 inches tall and weigh between 100 and 180 pounds each. Their dimensions and weight limit their use in many RV applications. However, since the principle determinant of battery life and capacity is the thickness of the positive plate, these batteries off the potential for exceedingly long life.

After reviewing the advantages and disadvantages of the various batteries, our conclusion is that the golf cart battery (and its slightly larger cousin, the floor scrubber battery) offers the best value on a performance-cost ratio. Traditionally, these batteries are of lead-antimony construction and have thick positive plates, are of manageable size and weight, and are reasonably priced. They do have on significant disadvantage-namely, the need to check the water level regularly and to add water periodically. This disadvantage may be minimized by adding a battery electrolyte monitor to indicate when water is needed. Some owners of gel-cell batteries may object to the use of the statement "one significant disadvantage." Some may note that another advantage of gel-cell batteries is that they can be stored in compartments without isolating them from other components. However, it is our belief and personal practice that for safety reasons, ALL batteries should be contained in a ventilated compartment, separate from all other electrical components.

There are circumstances when the rate of water consumption can provide useful information. An electrolyte monitor not only indicates the need for water but also makes one aware of how often water needs to be added. Because the monitor helps the coach owner to keep an eye on the battery, maintenance is reduced to times when a need for water is indicated. Battery water requirements vary depending on the charge rate (amps), charge voltage, and the age of the battery. The rate of water consumption can be used as a rough guide to identify an over-charging condition in newer batteries, and the impending need for replacement of older batteries.

Usually, new batteries require supplemental water every three to four months, and excess water consumption strongly suggests over-charging. This is of particular concern when using high-output chargers that are available as options with inverters. Although various chargers have operational differences, many of them can be adjusted to lower the charge rate and reduce water consumption. Increasing water demand of a battery that previously was functioning satisfactorily is most indicative of battery aging. Thus, a battery electrolyte monitor not only indicates the need for water but also provides additional data for diagnostics.

When we investigated the feasibility of an electrolyte monitor circuit, we discovered that one had previously been available on some Japanese and German cars. In addition, a retrofit kit was available from J.C. Whitney but it has since been discontinued. The electronic circuit is simple and inexpensive and can be modified readily to provide adequate monitoring whether the coach is being driven or is parked for extended periods of time. You can custom-build an electrolyte monitor for approximately $10 depending on what parts are already in you "universal parts box." We wanted an LED (light emitting diode) warning light on the dashboard and another in the plumbing bay. The dash light is visible when driving, and the plumbing bay light can be viewed when we are hooking up the coach and performing other chores in that compartment while camping. The LEDs can be placed in any location the owner feels will be most noticeable on a regular basis. This provides convenience and peace of mind, as the monitor will alert you before your batteries run dry because you forgot to check the water level.

Constructing the electrolyte monitor:

Figure I shows the wiring diagram for the electronic circuit. It includes two resistors and an NPN transistor. The accompanying parts list includes these items as well as two high-intensity LEDs and LED holders. Less expensive LEDs are available. The Super Brites were chosen because they are visible even in bright sunlight. It may be possible to light more than two LEDs, if desired, by varying the 1,500-ohm resistor R2.

It is possible to assemble the transistor/resistor network using a small low-wattage solder iron without using a circuit board; however, this method requires that all connections be insulated. So, we chose to use a circuit board (*Figure II*) that was then placed in a "project box." We divided the Radio shack circuit board into quarters to obtain the desired size, and the transistor and resistors were wired and soldered in a conventional fashion. Supply voltages and ground are obtained directly from the battery bank.

The sensor probe is constructed using one of the battery caps. A small hole, separate from the vent hole, is drilled through the cap. The size of the hole should allow the passage of solid-wire solder (the type used for plumbing applications, as opposed to that used for electronic applications, which has a resin core. Since the diameter of the solder was .093 inches, we used a 3/32 inch drill bit.

This size hole will also accommodate the wooden shaft of a cotton-tipped applicator, which is used to determine the finished length of the probe that extends from the battery cap. Insert the wooden shaft through the hole in the cap. Seat the cap loosely in the correct position on the battery. Gently push the applicator until it touches the top of the plates. Do not use force, and do not allow the applicator to slide between the plates. Mark the applicator at the top of the cap. Pull it out ½ inch and mark again. The bottom, end of the applicator should now be ½ inch above the battery plates. Remove the applicator and the cap from the battery. While holding the applicator in place at the second mark, measure and record the distance the applicator extends from the bottom of the cap. Ultimately, the wire solder probe will be cut to this length. The probe rests 1/2 inch above the plates, so that the LED alerts you to add water before any plates become dry.

Insert a 4-inch piece of the solid wire solder through the cap, leaving approximately 1/2 inch of the solder extending above the cap. This solder is then puddled, using a solder iron to gently heat the upper portion of the solder. When finished, it will look similar to the head of a nail.

Solder a male quick disconnect terminal to the top of the puddle, making sure the male disconnect is pretinned with solder and that *gentle heat* is used to solder to the puddle. If you are not comfortable soldering the male disconnect directly to the puddle, solder a short, tinned piece of insulated wire to the puddle and then solder the male disconnect to the wire.

Cut the solder extending through the bottom of the cap according to the measurement recorded earlier. Cut a piece of shrink tube that will over all but the last 1/8inch of the probe. Slip the tube over the solder wire and apply gentle heat to the shrink tubing. The probe is now held in place by the puddled solder above and the shrink tubing below.

This special cap is now placed in any cell that shows at least six volts. On a 12 volt battery, it should not be placed in the cell that contains the negative post or in is adjacent cell because six volts do not appear until the third cell. We use only one probe, because batteries of approximately the same age and condition will require approximately the same amount of water replacement. We have had this circuit in 9operation for more than two years and have never felt the need to change the location of the single probe, and it

FIGURE I
(Wiring Diagram)

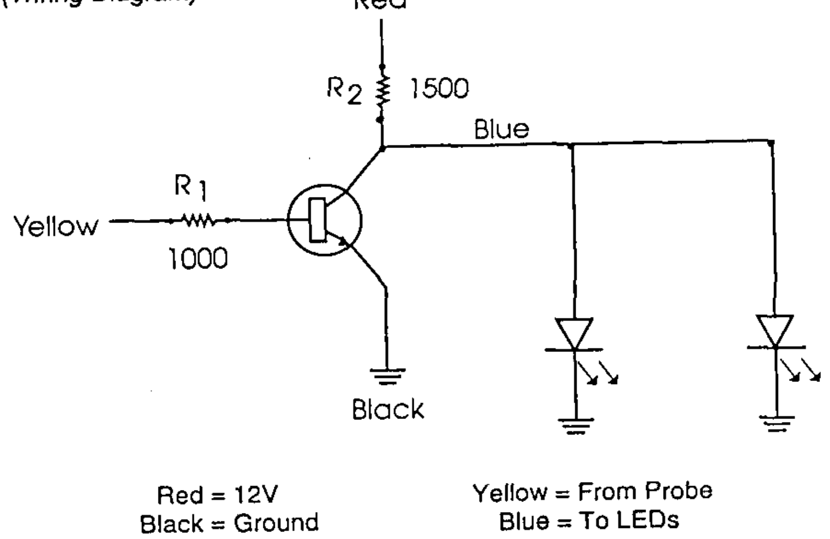
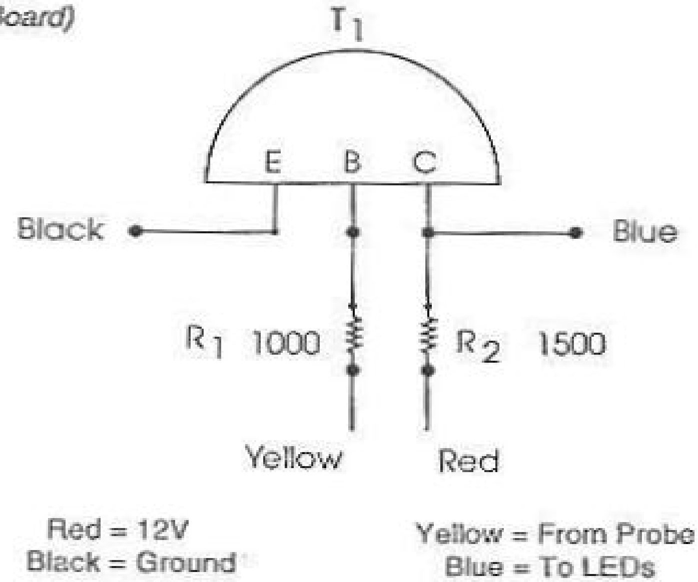


FIGURE II
(Circuit Board)



effectively monitors eight golf carat batteries.

Testing the unit

When the probe is installed in a battery with the proper electrolyte level, voltage will be present at the probe, and the LEDs will be off. Remove the cap from the battery and no voltage will be present, which should cause the LEDs to illuminate. If the LEDs do not light, or if they remain lit all the time, the R2 value should be changed slightly. Note: if LEDs other than the super Brites are used, a different R2 value may be needed.

Conclusion

Since installing the electrolyte monitor, we have had one set of batteries deteriorate and require replacement. Just prior to these batteries being replaced, their water consumption rose significantly. In that situation, the circuit performed flawlessly. Each time the LED indicated a need for battery water, all of the plates of all of the cells were still covered with electrolyte. In other words, the LED warning came before any of the plates suffered the effects of drying. Further, we were able to plan the battery replacement and were not forced into an emergency purchase.

Parts List

Radio Shack

(2) Super Brite LEDs	#276-087	$1.79ea
(1) two-pack LED holders	#276-090	1.19ea
(1) NPN Transistor	#276-2009	.59ea
or (1) 15-pack	#276-1617	2.29
(1) 2-pack 1K resistor	#271-023	.39
(1) 2-pack 1.5 K resistor	#271-025	.39
(1) circuit board	#276-149	1.19
(1) shrink tube assortment	#278-1627	1.79
(1) 8-pack male disconnect	#64-3038	1.39
(1) 8-pack female disconnect	#64-3039	1.39

Total cost: $11.90

Solid-wire solder is available at local hardware stores.

***Optional parts**:*

Radio Shack

(1) enclosure (project box)	#270-220	$1.99
(1) package cleaning sticks	#44-10993	1.29

Note: less expensive LEDs are available from Radio shack. LEDs listed above are visible in bright sunlight and very noticeable when lit on the dashboard.

If a project box is not used, the circuit board will need to be insulated with tape. If a circuit board is not used, all connections need to be insulated with tape or a shrink tube.