Enhanced Camper Battery Wiring Scheme

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This wiring scheme can provide several benefits:

- Faster bulk charge of camper batteries from engine alternator(s).
- Full charge assured by the use of solar to complete charge process after engine shut off.
- Maintenance charging of starter battery(s) from shore or solar power without the need for additional components or systems.
- Fully automatic operation with options for manual override.

Note/Disclaimer:

The information contained in this paper is correct to the best of my knowledge. It is compiled for the specific purpose of designing an electrical system for my own Overland Camper. It may or may not be useful or applicable for any other camper or RV. I have drawn from what I believe to be accurate sources, but my conclusions or understanding may be faulty and the sources may be mistaken. All conclusions and resulting assumptions are strictly my own, and cannot be taken as direct advice from any source. Nor can you assume that any of the sources agree with my conclusions or interpretation of their data. This document may be freely shared, I ask only that you:

- *Cite it as a source, and,*
- *Provide feedback, confirming or disproving my conclusions.*

*Finally, electricity is **always** dangerous, high voltage, of course, but also low voltage, high amperage circuits. Mistakes can easily result in fire and catastrophic damage to expensive equipment.*

You use this information entirely at your own risk.

Wiring

The first, key element of this scheme is to lower the resistance between the starter battery and the camper batteries. Given an alternator output of 200+ amperes, a wiring round trip length of over 50 feet, and a need to keep the voltage drop to a minimum, ideally no more than 0.5 volts, you need a cable of at least 75mm2. This comes out to between AWG 2/0 and 3/0.

So if you have two starter batteries, run a 1/0 or 2/0 cable from each battery back to the camper batteries. If a single starter battery, use a 3/0 or 4/0 cable, or simply run a pair of 1/0 or 2/0 cables*. If in doubt, as in the case of the new RAM trucks that advertise a pair of 200A alternators, always go larger.*

Control

There are several ways to achieve automatic control of the battery combination process, but one of the easiest is with a Blue Sea Automatic Charging Relay. Other options include the SmartBank (not on retail sale in the U.S) and the Magnum Smart Battery Combiner, coupled with a relay. The SmartBank offers adjustable combine and disconnect voltages, along with a "Hold" feature that prevents the relay from reopening for up to 90 seconds. When combined with the SmartGuage, it also offers a high voltage cut off and other features. The Magnum SBC offers adjustable combine, disconnect, and high voltage disconnect settings. The settings on the Blue Sea are not adjustable.

Generically called "Voltage Sensing Relays" all of these devices incorporate intelligent circuitry that measures the voltage at either side of the relay, over time. When, according to its proprietary criteria, it detects charging (typically a sustained voltage over 13 volts and rising), at either end, it closes the relay, combining the batteries and making them, in effect, one big battery. It then keeps them combined until the voltage, again at either side, drops below a certain point, typically about 12.7 volts for a specified length of time. The result is that a charge delivered to either battery is shared with the other.

Blue Sea makes two 500-amp models, one with a manual control, and one without. Both have a remote control switch to permit automatic function, forced combine (start boost), and forced isolation.

http://www.bluesea.com/products/7622/ML-ACR_Automatic_Charging_Relay_with_Manual_Control_-_12V_DC_500A

http://www.bluesea.com/products/7620/ML-ACR_Automatic_Charging_Relay_-_12V_DC_500A

The ACR can be mounted wherever convenient; I would mount in the rear, near the camper batteries and mount the remote switch inside the camper. There is a "Start Isolation" option which forces the relay to open whenever the ignition key is switched to the "Start" position. Based on the experience with my system, which does not have this option, I would not bother to wire it.

Fuses

The cable running under the camper is live from both ends and should be fused at ***both*** ends, within 18 inches of the battery. The easiest way that I have found to do this is a Blue Sea terminal fuse.

http://www.bluesea.com/products/5191/MRBF_Terminal_Fuse_Block_-_30_to_300A

This can be used for up to 300 amperes and can be mounted directly on the battery post. It uses these fuses:

http://www.bluesea.com/products/category/Marine_Rated_Battery_Fuses

Over 300 amperes and you will need something like this:

http://www.bluesea.com/products/5503/ANL_Fuse_Block_with_Insulating_Cover_-_35_to_750A

Performance

Crude testing shows that a 20-foot length of AWG 1/0 cable will pass around 75A. On my truck, with the 600Ah battery bank down 150Ah, a pair of 1/0 cables connected to a pair of 70Ah starter batteries, charged by a pair of 125A alternators shows a charge rate, at idle, of 150 amps, either with a clamp on meter or through the TriMetric battery monitor. As the batteries are connected together, it takes a moment for the charge rate to rise as the camper batteries first draw down the starter batteries and then, when the voltage of the starter battery begins to drop, the alternators ramp up their production of current. This, of course, has the advantage of buffering the alternator from sudden loads.

Does this really work? In sixty days of constant use, cooking all meals with an induction cook top and a microwave, running fans or heaters all night, and the usual background loads of refrigerator, lights, composting toilet, etc. we averaged about 150Ah energy consumption overnight. Typically, this was recouped by noon with normal driving. Most important of all, even if the batteries are not fully recharged by the engine alternator, the process is completed by the solar kit. Obviously, solar performance is dependent on daylight, but if the alternator has accomplished the bulk stage, then the current required of the solar kit to complete acceptance charge and move to float is actually very low. More important is the extended charge time and a solar kit accomplishes this automatically as it is charging as long as there is any light at all.

Does this work in the real world with an older vehicle? Rick Howe upgraded the wiring of his Tiger CX with a single 1/0 cable in parallel with the original Provan wiring (6AWG?) and a Blue Sea ACR. He also replaced his alternator. He reports that he now sees 50A at idle, as opposed to the previous 30A at highway speeds.

> We haven't gotten the batteries low enough to have any sense of what maximum charge rate might be, but have already seen over 50 amps charge to the house batteries at idle as opposed to a max of 30 amps at highway speed before. Charge voltage peaks at 14.5 and in the morning, always the low voltage time, the house batts are still at 12.7, a full half-volt higher than before. The engine batteries are even stronger; the engine cranks and starts noticeably faster now.

While a stronger alternator helps, he could not have gotten that increased output to the camper batteries without the upgraded wiring. I suspect that he would do even better with a pair of 1/0 cables.