# Dual Batteries

**Article sourced from the LROC SA DIY Archive.**

## Introduction

I wanted a basic dual battery system without any electronics or monitoring that would isolate the 2 batteries when the ignition was off. I also wanted an easy way of disconnecting the batteries in case of fire or a short circuit. I did some research and designed the setup and had an auto electrician check my logic.

I arranged with an auto electrician to do the installation at his shop using his tools, wires and connectors. I supplied the manpower (myself), switches and second battery while he supplied the relay and supervised my installation. The installation was completed within a morning.

**Description**

The main components are an 85Amp relay, a 105Ah battery and 2 marine switches. The relay is activated when the ignition is on and allows the 2$^{nd}$ battery to be charged. When the ignition is off the relay isolates the two batteries and allows the 2$^{nd}$ battery and auxiliary equipment to operate separately. The 4-way switch allows me to cut all power to the primary circuitry, to run the two batteries in parallel or to run the primary circuitry from the secondary battery. The 2-way switch is used to cut power to the secondary circuitry. I purposely used over-designed components to ensure reliability and longevity. (Why use a 3 mm wire when you can use a 5mm?)

**Relay**

85 Amp Cole Hersee heavy-duty diesel relay wired into ignition wire.

· Purpose: Isolates the 2 batteries when the engine is not running

**Battery**

105 Ah Delco marine, maintenance free, deep cycle

· Reason for choice: maintenance free, battery has 2 extra terminals with wing nuts for attaching connecting wires

**4-way Switch**

4-way Guest marine switch with 3 connectors (Bat1, Bat 2 and output)

- Purpose: Cut power to circuitry in case of fire/short, connect primary and secondary batteries in parallel for self jump-starting/heavy winching, allows car primary circuitry to run off secondary battery during camping/emergency
- Settings: 1-Default mode, 2-primary circuitry runs of secondary battery, BOTH-primary and secondary batteries connected in parallel, OFF-cut power to primary circuitry in car

**2-way Switch**

2-way Guest marine switch with 2 connectors (input & output)

- Purpose: Cut power to secondary circuitry in case of fire/short
- Settings: ON-Default mode, OFF-cut power to secondary circuitry in car
- Rating: 300Amps continuous & 450Amps momentary

**Whilst on batteries lets have a look at the following**.

**Q:** If the Alternator is rated at 105 Amps, then it should only take 1 hour to charge a 105 AH battery if fully flat. I think our newer Landy alternators are all rated at 90 Amps or above. Does anyone know how many amps actually reach the battery or batteries, and how they work this out? How long should a second battery take to fully charge when flat? On a petrol engine, the only current consumed during running is the spark plugs, on the diesels nothing. Why then do we have to travel umpteen hours to charge a battery if it theoretically should take just over an hour? - Andre Oberholster.

**A**: The alternator output (in Amps) is relative to the battery state. To illustrate this lets take the Alternator output at 13.8V Firstly one uses the formula V=IR to work out the Resistance of the circuit. So lets assume that with the batteries at 12 Volts, the Alternator puts out 10A.

This gives us a PD of 13.8V - 12V = 1.8 V Right?

At this time 10A is flowing thus R = V/I = 1.8/10 = 0.18 Ohm

So now the battery is at 13 Volts. The resistance of the circuit will not change appreciably so, using the formula, we find that the PD is now 13.8 - 13 = 0.8V but

I = V/R = 0.8 / 0.18 = 4.44 Amps!!!!!!!

So as the voltage of the batteries catches up with the system voltage, (which is preset by the Alternator Regulator,) so the charging current drops. That is why it is not merely a 100AH / 10A = 10 Hours to charge.

Another problem with his system is that if the battery voltage is right down at 6 volts, giving us a PD of 13.8 - 6 = 7.8 Volts, the charging current will be I = V/R = 7.8 / 0.18 = 43.33 Amps!

Too much I would say; that is why my system includes a 15 Amp Current limiting diode until the battery voltage gets to around the 12 v mark. We made the assumption that the resistance is constant, but if I remember the theory, it is not really in constant in practice, as the lower the voltage, the lesser the resistance, and that makes the calculation even more dramatic. - Mike Ilsley

**Another view**.

Although an alternator is rated at say 90 amps it does not charge at that rate. 90amps is the maximum rating of the alternator and it cannot sustain this rate without overheating. The current charging rate will vary depending upon the voltage that the alternator "sees" in both the battery and the charging circuit. At full battery voltage of 12.5 to 13 V the alternator will just trickle charge the battery but if there is a current draw off the battery then the battery voltage drops and the alternator makes up the difference until the voltage again stabilizes at 12.5 to 13V. It is for this reason that it takes "all day" to charge up a flat battery as the charge rate will be high in the beginning but as the battery voltage rises the alternator will reduce the current.

If there is high electrical resistance in the wiring between the battery and the alternator then the alternator will "see" a higher system voltage than is actually the case and reduce the charge. The alternator "sees" the battery voltage plus the voltage drop across the charging circuit wiring. It is very important to have short heavy well-connected leads between the alternator B+ terminal and the battery +ve terminal and a good earth connection too between the engine and the battery -ve terminal.

One of the problems with lead acid batteries as they get older is that they lose storage capacity and so appear to charge up very quickly but in fact have very little charge in them and go flat very quickly when current is drawn. Batteries also have internal leakage current especially as they get older and often the alternator spends its time just replenishing the current leakage in a damaged cell. The leakage is caused by plates disintegrating with age and vibration or distorting from high current draws. Pieces of plate debris fall between plates causing shorts between positive and negative plates.

Modern batteries have the plates encased in some sort of synthetic mesh or built into a resin matrix to reinforce them and reduce the plate buckling. This allows far more robust batteries and smaller cells as the plates' separation can be reduced. Reducing the plate separation also reduces the "internal resistance" of the battery and for a given area of plate more current can be drawn out the cell for the same voltage drop.

The amp hour rating is for a steady draw off a battery and is very misleading. One should rather look at the CCA rating for a battery especially for a motor vehicle. CCA stands for Cold Cranking Amps and is an international standard that draws heavy current off the battery simulating the draw of a starter motor at low temperature.

Amp hour rating should only be used for batteries running small steady loads like alarms systems, lights or radios. Even fridge [compressor variety] batteries should not be rated on amp hours as the instantaneous start up current is high and if the battery is weak the volt drop on starting can damage the compressor electronics, I am told by one of our leading fridge manufacturers.

JOHN MENASCE