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DOUBLE YOUR ENERGY

MCL's Tim and Ian from IRB show how you can not only fit twin batteries to your Defender but also make them charge and work properly together.

but in the case of an overland expedition vehicle could almost be a life and death situation.

In order to preserve the main starter battery it is good practice to move ancillary loads to a second battery which is isolated from the main starter battery when the engine is stopped. Once the engine is running both batteries need to be charged.

Winching is an emotive subject with many opinions. The fact is that a large winch can demand over 400 Amps and, in order to provide this sort of power for any period of time, you will need an uprated electrical system. As to which battery to attach the winch to, we have gone traditional with Lindsay's 'project' Defender and treated it as an auxiliary load, so therefore we've used the auxiliary battery. When winching, with the engine running, both batteries will be combined in parallel to delivery maximum current and capacity.

TYPES OF BATTERY

- Standard starter battery – just as it says: a battery producing a large current for a short period of time to start an engine, designed to be kept fully charged.
- Leisure / Deep cycle battery – designed to deliver a low current over a long period of time and cope with deep discharge cycles.

As we are using a battery separation charging method (see below), we are using two identical brand new Yellow Top batteries supplied by Optima. Because we are joining the batteries in parallel, the make-up of the batteries used and their internal resistance need to be as similar as possible, so there is no risk of a charge imbalance caused by two different batteries having different charging requirements.

The Optima 4.2 Yellow Top is a dual purpose starter and deep cycle battery, so it's ideally suited to our twin battery setup. Capable of delivering 765CCA (Cold Cranking Amps) – with most standard Defender batteries 'only' delivering 630 CCA – means more cranking power than the original unit on the starting side. At the same

time, the battery is capable of deep cycle discharge with rapid recharge rate for the auxiliary battery function.

The Optima Yellow Top is an AGM or Absorbed Glass Mat battery, meaning the electrolyte is suspended in a mat so is spill proof and is much more resistant to vibration and impact. Optima batteries also utilise a spiral-wound cell as opposed to conventional flat plate, providing more surface area. Optima's will even work under water.

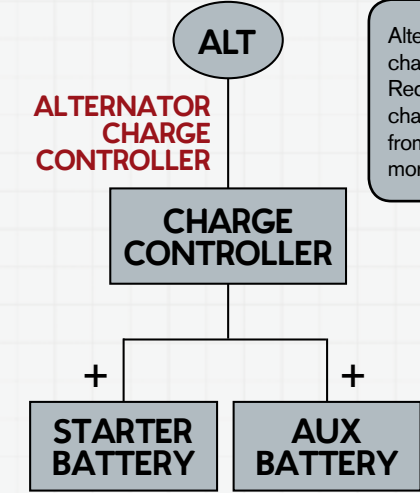
Perhaps these are the reasons why the MOD picked the Yellow Top for its latest Land Rover Defender FFR (Fitted For Radio) vehicles.

- TYPES OF CHARGING**
1. Twin alternator – a dedicated alternator for each battery. Requires extensive fabrication and engineering but very effective.
 2. Alternator charge controller – takes a single alternator output and directs charging current to batteries proportionally depending on state of charge.
 3. Battery separation – connects batteries in parallel via a switch / relay / solenoid.

Battery separation is our preferred choice here because it's cost effective and can deliver the performance required. It also has a higher current carrying capability than the other methods listed here. And using the top of the range Blue Sea system, it incorporates the ability to manually combine the batteries to self jump-start if required.

Battery separation in its simplest form involves the connection of the two batteries manually, via a switch. The process can be semi-automated, using a relay and a suitable trigger such as an ignition live. The option we are using is a fully-automated Automatic Charging Relay or ACR.

The ACR senses when the voltage of either of the batteries rises to a level indicating that a charge source is active, this level being 13.0V for two minutes. When this is the case, the ACR's contacts connect and the ACR allows the charge to both batteries. If the voltage on both of the batteries subsequently



Alternator Charge Controller – single alternator charging output divided between two batteries. Requires alternator output to be re routed to charge controller and then each battery wired from the controller. Slightly more complicated and more expensive to install than battery separation.

Twin Alternator – each battery has a dedicated alternator. Best method but also most expensive and complicated.

ACR – Automatic Charging Relay – as used in the article
ALT 1 – Alternator 1
ALT 2 – Alternator 2

drops to 12.75V for 30 seconds, the ACR will disconnect, isolating the batteries. So, using this system, if you were to connect say a solar panel to your auxiliary battery and the voltage rises above 13.0 Volts for more than two minutes, the relay will combine the two batteries together also topping up your starter battery without even having the engine running.

A side-effect of combining two batteries together is, if one is deeply discharged and the other fully charged, there will be an inrush of current when they are first combined whilst they equalise. High currents through the relay can also be experienced when extreme loads are placed on the system, such as winching, where currents of up to 500 Amps are not uncommon. The majority of relays on the market today are rated at less than half of this, some as low as 30 Amps.

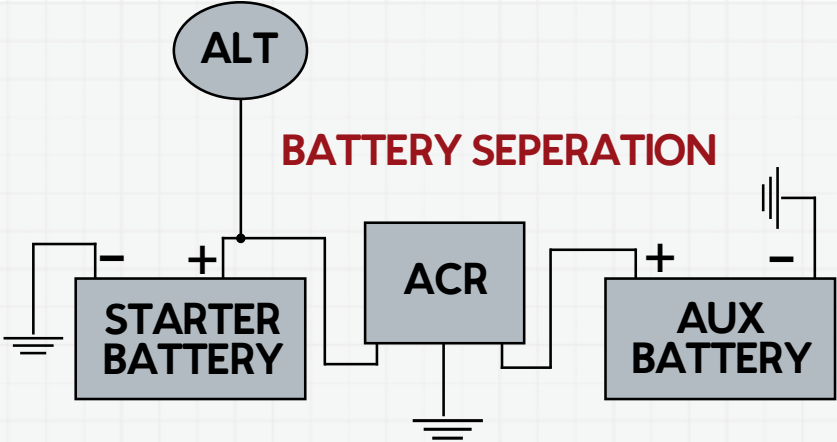
The Blue Sea unit is rated at 500Amps continuous and 2500Amps inrush, making it the highest spec unit on the market today – but at the same price-point of lower spec systems. A lower priced Blue Sea unit is also available rated at 120 Amps continuous and 250 Amps inrush.

Fuses – MCL's choice is for ANL fuse holders, available in ratings up to 750A. MCL would recommend the fitment of a main protection fuse as close to the second battery as possible before any other load is connected.

Blue Sea, as the name suggests, are a manufacturer of high quality marine electrics and as such, their products are designed to the highest standards using some of the best materials available. A by-product of this marine spec. is that a number of products are submersible waterproof, including the charging relays – a great feature on adventure-seeking Land Rovers!

PART 2: THE INSTALLATION

MCL's Tim Consolante uses a system that not only keeps both batteries in tip-top condition but also ensures that if the main battery runs flat, the second battery can be connected as a kind of internal jump start battery merely by pressing a switch on the dashboard. As part of the battery box project, Tim also installed a new fuse box. This is a huge improvement over awed, loose accessory fuses added on an ad hoc basis as new components are fitted to one's Land Rover.



Battery Separation – auxiliary battery connected in parallel with main via a switch or relay battery when engine running. Easiest system to install and most cost effective.

CABLE SIZE AND WINCH POWER

Cable is sold in different sizes of CSA (Cross Sectional Area) this is different to diameter. A 60mm² CSA cable will have an approximate diameter of 15mm. Always try to use the largest cable you can afford; this IS one of those times where big is best.

WINCH HP	AMPS @ 12V	MIN CSA
1	70	16 mm ²
2	140	25mm ²
3	210	30mm ²
4	280	40mm ²
5	350	50mm ²
6	420	60mm ²
7	490	70mm ²
8	560	90mm ²

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→ **PICTURE 1.** In previous issues, we've shown Tim and Ian Baughan of IRB Developments fitting Anderson connectors to the front and rear of the vehicle, providing power as required without the need for connecting jump leads to the battery. It's a minor pain to have to lift the seat base and the battery cover in order to get at the battery terminals in a Defender and crocodile clips can't possibly make as good a contact as Anderson connectors while there is also the risk of creating a short.

PICTURE 2. Dave had helped out by running some of the heavy duty cable that runs from the battery box to both the front and rear of the vehicle.



PICTURE 3. At each end, an Anderson connector was fitted and bolted to a bracket on the bodywork.

PICTURE 4. As I said earlier, it's far quicker and safer to connect up to an Anderson connector than to connect straight up to a battery. Each connector has a weatherproof cover that is fitted in place when the connector is not in use.

PICTURE 5. Each of the cables was sheathed for added security and ends were sealed with shrink-fit tubing.

PICTURE 6. It was necessary, of course, to drill new holes in the battery box to take the heavy duty cables. Ian prefers to use



a stepped hole cutter rather than a tapered one because it gives a square-sided hole and the size can be judged more accurately.

PICTURE 7. Note that each hole was fitted with a grommet to create a seal and prevent chafing before each length of heavy duty cable was fed through into the battery compartment, ready for connecting to the batteries later.

PICTURE 8. Into the bottom of the compartment, Ian lowered the base for the special battery carrier that IRB have had made, specifically to suit batteries such as the...

PICTURE 9. ...highly regarded Optima



batteries supplied by MCL. So far, so conventional!

PICTURE 10. Of crucial importance is the American-built Blue Sea Automatic Charging Relay supplied in the UK by MCL. This has several vital functions and operates in conjunction with a switch on the dashboard which we'll be looking at later. For now, it's enough to point out that Ian had to find a suitable location in the battery box for the relay unit.

PICTURE 11. He also needed to find a location for the heavy duty fuse unit, also supplied by MCL...

PICTURE 12. 110 DSC_5714 ...and after



removing the batteries once more from the battery box, a suitable location was found for the fuse unit alongside the battery carrier.

PICTURE 13. Having worked out, when the batteries were still in place, where the Automatic Charging Relay would be situated, Ian now screwed that into position on the side of the battery box.

PICTURE 14. This is the new, comprehensive auxiliary fuse box supplied by MCL.

PICTURE 15. It came mounted on a substantial bracket which was also fixed to the side of the battery box but high



enough for one of the batteries to be installed beneath it.

PICTURE 16. Both batteries have to be lowered into place into the rear half of the battery box because of the location of the fuse box. Tim lowered the first Optima battery into position on the battery carrier base, then slid it to the front of the battery box...

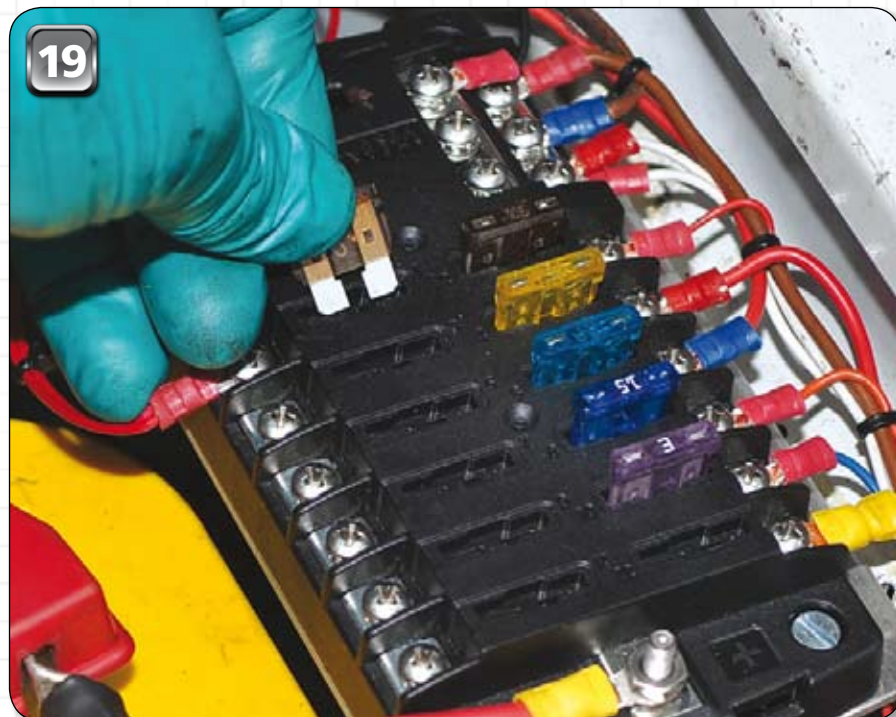
PICTURE 17. ...before lowering and locating the second battery on the battery carrier base.

PICTURE 18. A purpose-made battery strap runs front-to-rear and here, it's being carefully tightened down over the centres of the two batteries.





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→ **PICTURE 19.** Once the main cable connections had been made to the fuse, the Blue Sea Automatic Charging Relay and the two batteries, and the subsidiary supply connections had been made to the auxiliary fuse box, fuses of an appropriate size were fitted to provide power to relevant accessories.

PICTURE 20. 190 DSC_6536 The fuse box lid has provision for labelling the fuses to indicate which fuse is for which accessory and that's something we need to do in the very near future.

PICTURE 21. (inset) Here's the switch I mentioned earlier, fitted to the dash panel. In normal use, the rocker switch remains in its central position and allows both batteries to be properly charged by the vehicle's alternator. When it's in the down position, the charging relay in the battery box is turned off and there is no connection to the second battery. In the up position, the solenoid in the Automatic Charging Relay engages and power is supplied from the second battery to the first - a fantastic way of charging your Land Rover in the event of a flat battery.

PICTURE 22. Of course, if there is next to no power remaining in the first battery, the switch on the dashboard can't operate the solenoid in the Automatic Charging Relay. In this event, the knob on the top of the relay can be pushed in, and the lever turned to operate the relay manually, bringing the secondary battery into play.

Without doubt, this MCL-developed system is a hugely superior way of running two batteries to most others on the market. With this system in place, you have the benefits of:



- Being able to use your secondary battery for all auxiliary activities such as jump starting, winching, running a cockpit heater or auxiliary lighting .
- Charging both batteries to their fullest capacity – essential to ensure battery longevity.
- Being able to use the secondary battery as a full back-up for the main battery next time you leave an interior light on and drain the main battery. (As if...)
- Having both batteries properly clamped in place – vital for safety and, again, battery life because a rattling battery is not only an acute safety hazard, having a battery on the loose will severely diminish its life expectancy.

I'm delighted with this top-class battery system and if you want to buy the bits of have one installed by IRB Developments, just contact Tim at the address shown here.

LRM

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