DUAL BATTERIES - In A Tinnie ?

Special Report By Mike Levy

"I have always believed that the safety, redundancy and flexibility factors inherent in a dual battery setup should also be applied in small craft if at all possible. For a few hundred dollars (what price your life and pride?) you can install a very smart dual battery charging and distribution system as well as facilitate a dual auto bilge pump installation - removing a lot of the niggling concerns out of every trip. In addition, you can isolate your electronics from starting current spikes! This is my take on the process."

What you need

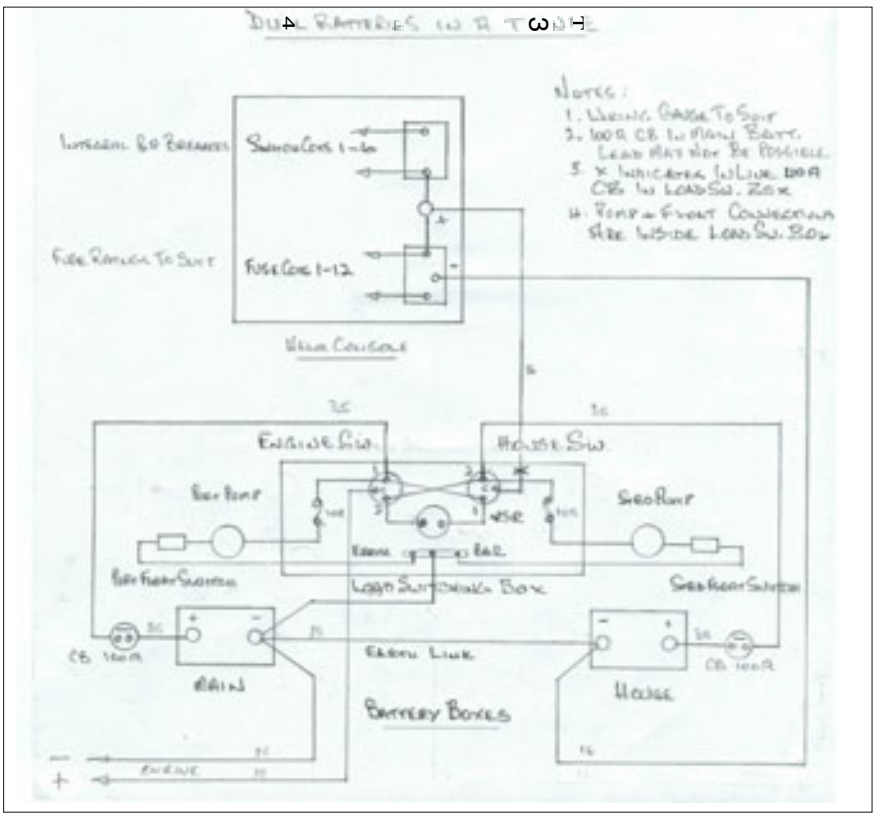
Where you locate the main and house battery depends on vessel layout, but most small craft have them aft to starboard. In whatever position, they should be installed in plastic battery boxes to prevent catastrophic results if upset.

I use NS50P batteries to kick over the 50HP Honda – I think replacements in due course will be calcium low maintenance types.

There are various brands of battery isolators, voltage sensitive relays (VSR's) or charge coupling devices on the market, but they all essentially have the same purpose – to charge the batteries from the alternator by coupling them together when a pre-determined voltage is reached on the main battery, and isolating the batteries from each other when the engine is shut down. The object of course, is to preserve a fully charged starter battery by isolating it from house loads.

Mechanical battery isolate switches are required to ensure all voltage with reference to ground is removed from the vessel when not in use – this helps protect the hull from galvanic corrosion.

It is also a vital safety feature in an emergency – all current flows can be instantly stopped with a flick of the fingers. In many cases a simple on/off switch is suitable for each battery, but I prefer to have maximum diversity and I install a 4 position battery switch for each battery/load combination. Any load can be switched to any battery or all paralleled if necessary. It involves only slightly more cabling between switches.



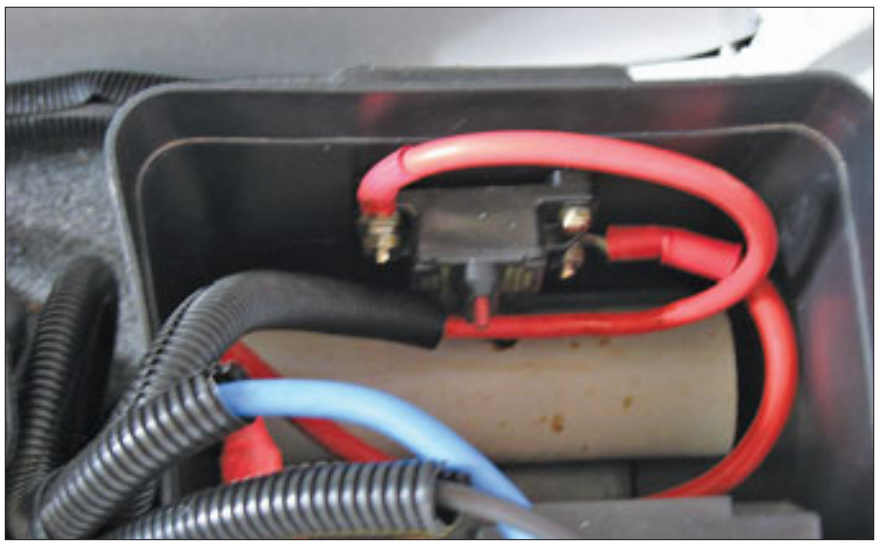
For protection of the batteries from possible high discharges on the house bus, use high current circuit breakers in series with the VSR leads – any major fault will trip the breakers.

While best in the switch box, I found it a bit "tight' and because my Honda only pulls around 65Amps on starting (peak 85), in practice I have installed these breakers in series with the main battery leads inside the battery boxes.

Note, the breakers will not trip instantaneously at their rated current – don't overdo their current rating to fencing wire equivalents! I would not normally place a breaker in series with a starter battery, but with this set up I

Above: Cable ducting to switch box
Below: View of House battery and high current breaker

Below: Close up view of House battery and breaker



wanted a bit more than just physical protection for cables and batteries. In addition, the mechanical trip switches on the breakers provide a convenient isolation point as well. *(Another option is to use Maxi Blade fuses or similar, but with the advantage of the manual isolate trips, the breakers seem the way to go).*

Although good VSR's and battery switches are nominally water proof, for physical protection as well as terminal corrosion and isolation reasons, they need to be in a box. A convenient container is a plastic electrical distribution (about 270 x 170mm) with a rubber sealed clear lid – this gives you enough room to manoeuvre the various cables and components into position and terminate them.

The type I used is equipped with a fibre resin backboard mounted internally to isolate all components. There is enough room in the box to allow inter-connection of bilge pumps and float switches as well. You will need an electrician's earth bar that has a couple of heavy cable lug bolts and several smaller bolts for other cables.

As you have gone this far, why not get the bilge pumps right as well? Float switches in the bilge along with good capacity electric pumps and manual over-ride switches make much happier skippers! Particularly if, like me, your vessel has the scalloped transom so popular with manufacturers and loathed by people who fish! Remember, in interests of redundancy, two are always better than one!

You will also need some good copper cable preferably marine grade (tinned) and of the appropriate gauges, as well as crimp terminals and lugs to hook this together.

Anyone with a practical turn of mind can handle the connections, but if you don't have access to a lug crimper you may need to cut the cables to length and get a sparky to terminate them. I recommend using heat shrink material on terminations, and the resin filled shrink is the best (but most expensive) way to go.

Now, let's hook it all up.

Putting it together

The cost summary (see box) including only quality components, looks a little expensive, but much of the gear you may have already, or can "find". There are generally specials

Above: Bilge pump and float switch setup
Below: 4-way battery selector switch

Above: View of battery switch box.

Above: Dual battery boxes installed.

around. By default, layout of cabling and equipment in amateur boats is inherently always going to be a messy "prototype" – but if you have a think about how and where the various bits are going to be located, and running cables in the most efficient manner you will end up with a reasonably neat installation.

Bearing in mind this is simply the way I choose to do it and generally with materials that are available rather than optimum, the cable dimensioning should be more than adequate. I tend to choose cable sizes more for limiting volt drop, as determining current carrying capacity involves a number of variables.

When in doubt, I always over dimension. For instance, cables used for starting need to be at least the same gauge as your standard engine to battery cable throughout their complete path. Don't forget, earth (negative) cables are part of the circuit, and need to be similarly dimensioned.

A hint before starting *- bolt the switch box in place and run all cables, then remove it and work on terminations inside from a convenient position, e.g. on top of the thwart. You will save a lot of energy and bad language! Then bolt it back in place, cut the other end of the cables to length and terminate.*

Locate your new large house battery box in place conveniently close by the large main battery box. Actual location is not critical, but it is nice to keep the cables short.

Ensure ALL battery terminals on both batteries are disconnected and safely isolated!!

Install the earth link bar, VSR and the two battery switches in the electrical box. I sealed the switches to the box with a small amount of silicone. Ensure the earth bar is insulated from the hull.

Install the terminal common link cables on both switch terminals 1 and 2.

Connect the VSR main terminal to switch termina1 1, and VSR house (aux) terminal to switch terminal 2 (on either switch, they are common points).

Remember, if the batteries are coupled electronically by the VSR or manually by switches, it is theoretically possible that high

currents could be drawn from both batteries.

That said, for ease and flexibility I have used 10mm2 cables to connect my VSR. Should the batteries be coupled electronically and there was a catastrophic "short" drawing major current, presumably the VSR would switch "off" due to the voltage drop and the battery breaker would trip.

Chances are very small, in my view.

Install a high amp (rating as small as suits your starter current draw – I used a hundred amp for the main and 85 amp for the house because they were available).

Note, if the batteries are coupled via the switches the starter current will be more or less half from each battery. Trip the breaker switches in each battery box "off" for the moment. You will probably need to restrict the physical movement of the battery in the large battery box so it can't bash the breaker and accidentally trip it – not that I find my batteries move around. I used a bit of 50mm pvc pipe.

A word of caution – I find the cheapy high current breakers from the chandlers unsatisfactory. They are easily broken, the terminal nuts are difficult to access and they tend to jam. I think the Blue Sea version is the better option even if twice the price.

Cable the away side of the breaker on the main battery to Main Switch 1 and from the house battery to House Switch 2.

Cable each battery positive terminal to their respective circuit breakers.

Cable and connect the house positive bus to the common C terminal on the House Switch – 16mm2 should be more than adequate. Similarly the engine positive bus to C on the Main Switch using the original starter cable

Cable an earth link from the main battery negative terminal and connect to the earth bar – this link is the earth for anything connected in the electrical box, i.e bilge pumps. 16mm2 should be plenty.

Connect an earth cable link between the two battery negative terminals – maintain suitable dimensioning. An option is to cable a separate earth from house battery to the earth bar.

Connect the engine negative earth cable to the main battery negative, and the house bus negative to the house battery

Slip some split corrugated ducting over all cables to pretty it up and provide physical protection.

If required, cable the float switches and bilge pumps to the box and connect to switch terminals 1 and 2 via INLINE FUSES – I used 10 amp fuses in water resistant fuse holders. Use the earth bar for the earth connection of the pump. The box is a convenient marshalling point for these cables, although it's hard to make it neat.

Don't forget the SPARE fuses (tape them inside the box?).

Cable from bilge pump positives back to manual switches on your console. 6mm2 cable is more than sufficient for the pumps.

If required, connect an audible alarm to the operating leads to the bilge pumps. Alarm sounders are available from chandlers. If using one alarm for both pumps they will need to be separated by diodes.

Check and TEST all connections. If you have access to a clamp meter, set it on DC amps and clamp each positive battery lead in turn as you switch on circuit breakers and switches. Stop whatever you are doing if currents look abnormal.

Test the starting and house circuits on main, house and both batteries combined via the switches with the clamp meter.

Approximate Budget

Battery box – house (1)	$20.00
Battery - house (1)	$100.00
Box electrical (1)	$20.00
VSR (1)	$130.00
Switch battery 4 way (2)	$100.00
Circuit breaker high current (2)	$160.00
Earth coupling bar (1)	$15.00
Lugs, terminals & Connectors	$25.00
Cable various	$40.00
Flexible ducting & sundries	$10.00
Bilge pump 1100 gph (2)	$140.00
Float switch (2)	$100.00
Fuse holders & fuses (2)	$15.00
Manual switch	(switch panel?)

What is the result?

This is a Load Switching arrangement, not Battery Switching – it provides the option to switch either or both loads (house and main) to either battery, couple both batteries electronically on charging, or physically via the manual switches.

With no charge applied the batteries are isolated from each other unless manually coupled (switched).

If all cabling checks out ok, switch the Main switch to (1) and the House switch to 2 – there should be main battery to the engine and house battery to your console equipment.

Test by tripping the manual switches on the battery breakers. Start the engine. Depending on the type of VSR (see the spec. sheet with your VSR), voltage will rise across the main battery (to about 13.5v) at which time the VSR will switch and couple both batteries – there will probably be a light on your VSR to indicate this. Each battery should receive some current depending on their relative state of charge. When the engine is turned off the voltage across the batteries will decay until the VSR reaches its "de-coupling" voltage and the batteries will be isolated from each other.

Try reversing the switches – main to 2 and house to 1 and check starting and console operation again. Use the manual tripping option again on the breakers to check each battery is going where you expect!

Bear in mind, none of this will make a jot of difference if you leave both switches in the "1 and 2 coupled positions" – you will simply short the VSR and have a permanently coupled pair of batteries on both the house and main bus!

The set up does give you the option though of using either battery as house or main, or using one battery for both loads. Get in the habit, when starting switch the Main switch to (1) and House switch to (2). When closing down for the day, switch both OFF.

At the completion of this bit of fun you will have achieved greatly improved peace of mind, in the knowledge that with properly maintained batteries your chances of calling up with the dreaded "help - my battery is flat" will be much reduced. Now you can concentrate on how much fuel you have!

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