

# Installing Shore Power - Colin Shead

I recall my first real yacht, a Leisure 17 I bought around 1975. It had no electrics whatsoever (bar a magneto in the outboard), not even an echo sounder. In fact when I fitted a Seafarer echo sounder (dry battery powered) it was the 'bee's knees'. Later on it acquired an outboard charged battery, lights and a Seafarer 550 VHF.

Of course they were the good old days; now the demands for electrical power on boats are continually increasing as we fit up market navigation electronics and the like. Power for battery charging but also for 'life's little luxuries'; like fan heaters for the chilly evenings and even an occasional electric kettle (yes even on a Leisure 17; no names - no pack drill). Fortunately these days shore power is getting to be commonplace, even for smaller boats. Some have marina berths with power 'on tap' and most of us visit marinas from time to time and so can 'plug in'.

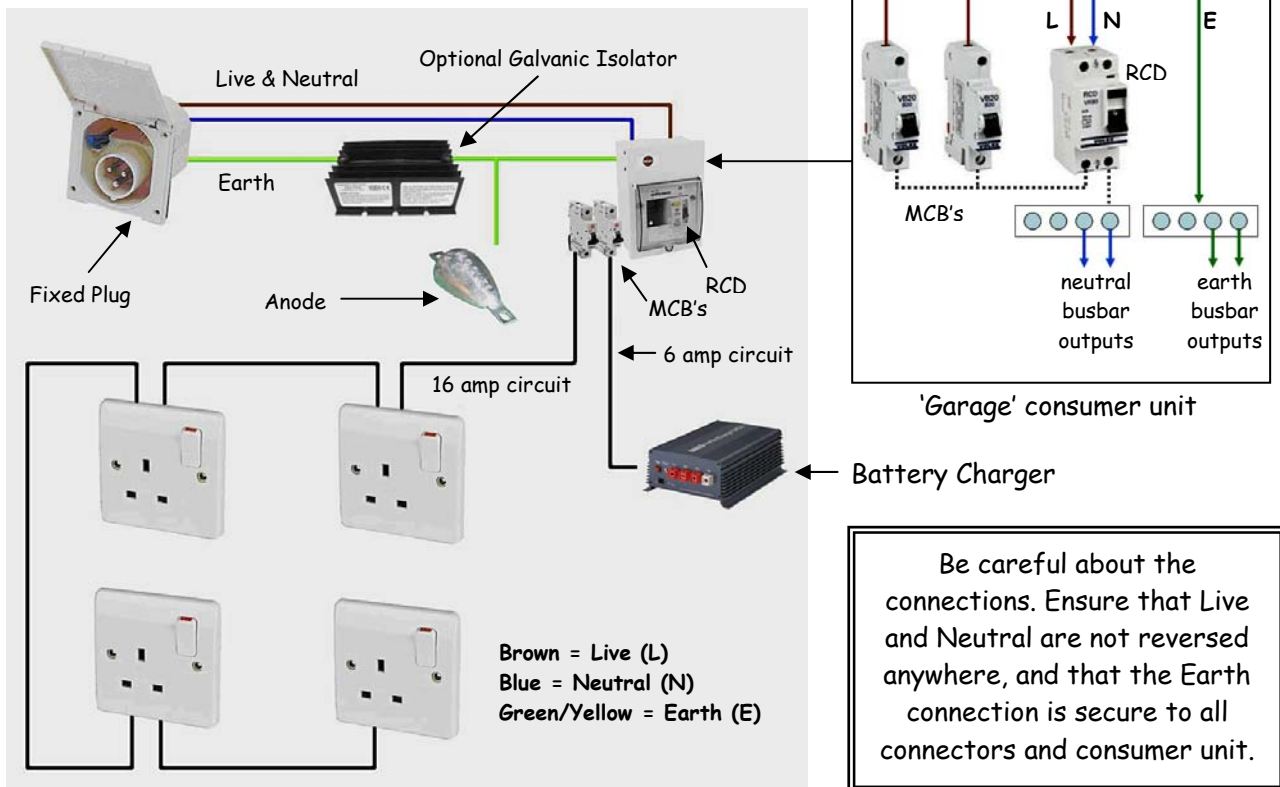
This article was prompted by my purchase of 'Toodle Pip' a Moody 28 (sorry about that!), which amongst many other problems had an absolutely lethal shore power installation. I had condemned it on sight (I am an electrical/electronics engineer by trade), but it was also singled out by the surveyor and subsequently of course by my insurers.

A completely new system was fitted last winter. Even though I had fitted shore power to previous boats, I spent a little time finding out what was expected. I believe that this article describes a design which is broadly compliant to all the relevant standards.

The installation really falls into 3 parts.

1. On board wiring, power sockets etc.
2. Protection - to protect against electric shock, and the fuse the circuits.
3. The cable needed to connect the shore side power socket.

The figure shows the overall scheme.



Earth bonding is by far the most important safety feature both on the boat and in the home and it is no coincidence that it is mandatory under the European Recreational Craft Directive. The principal of earth bonding is to ensure that all extraneous metal objects are at the same electrical potential thereby eliminating the possibility of a person catching hold of two objects at different electrical potential and thereby getting an electric shock across the chest. Earth bonding requires the mains earth inside the boat to be connected to either a ground plate or to the anode. Generally all other metal objects e.g. in-board engine, fuel tank, rudder stock will already be bonded back to a zinc anode (if not they ought to be!). Connecting the incoming mains earth to this point will therefore suffice. Note though that it is also essential that all the 13 amp sockets around the boat are themselves earthed.

This is an important consideration for those who erroneously believe that using a flying lead from the marina supply, as an alternative to a properly installed system, is safe. Anyone using such a system will not have the benefit of any of the safety features inherent in a properly installed system and may be seriously at risk should a fault develop in the onboard electrical equipment.

### **Galvanic Isolation**

Galvanic isolation is only an important issue if you leave your boat more or less permanently plugged into the mains at a marina. Because earth bonding creates a circuit between neighbouring boats and other earthed metal in the marina small currents can circulate which can cause zinc anodes (and if you don't watch out your propeller etc. too!) to be eroded very rapidly.

An optional galvanic isolator is shown in the first figure. It **MUST** be fitted where shown, directly in the incoming earth feed from the shore and **NOT** in series with your anode. Only with this installation will you be protected against both a component failure in the isolator and a fault in the shore supply. If not fitted, just wire the earth directly from the incoming connector plug, to the consumer unit and anode.

### **1. On Board Wiring**

The most practical arrangement has just two power circuits.

- The first distributes power to a number of conventional 13 amp sockets and is 'fused' by a 16 amp Miniature Circuit Breaker (MCB).
- The second provides a feed to a battery charger/shore power unit and is 'fused' by a 6 amp MCB.

Note the supply from the shore is normally rated at 16 amps (often less), so that the most you can possibly draw from your sockets is around 3kW; so if using appliances like kettles be wary of the ratings.

Unlike in the home, where the consumer circuits are not subject to vibration, solid core cable (commonly called twin and earth) must never be used on a boat as the normal vibration of the boat will cause the wire to break. Instead all wiring should be in flexible 3 core cable.

The choice of wire size is important because the MCB's are not a safety feature (that is the job of the Residual Current Detector (RCD) and earth bonding). Their principal role, over and above that of a switch, is to protect the wiring. Wiring should preferably use 2.5sq mm cable which has a very adequate capacity. Note that 1.5sq mm is sometimes used but is marginal at 16 amps. In practice this is unlikely to be a problem as most if not all marina supplies will trip out on the pontoon long before 16

amps, however, a professional installation will always use wire rated higher than the breaker as there is always the risk that someone has tampered with the marina supply.

I used 2.5sq mm three core Artic cable from Screwfix (quote 80638), which I reckon is the cheapest buy. You can get 50m for £54.77 (much more expensive than it used to be, as the price of copper has doubled in a year). What you don't use on the boat wiring you can use for the shore side cable. In fact assuming you use about 10m wiring the boat (it takes more than you first imagine) you would have enough for two decent shore side cables. Alternatively you can buy cable at the likes of B&Q and ready made shore side cables from chandlers. By the way you might think a 40m shore side cable is excessive, not so! At times, for example in Woodbridge Marina (depending on the berth), it has barely been sufficient. Generally a cable about 10/15m long will suffice.



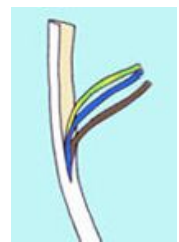
13 amp sockets can be obtained in many styles from Screwfix, or elsewhere, either flush or surface mounted. Flush mounted sockets must be installed using a cavity wall box (the sort designed for mounting on plasterboard walls) to eliminate the risk of accidental contact with live terminals.

It is not acceptable to simply offer wires up to a 13A socket flush mounted on a vertical surface. With such an installation, is it only a matter of time before either the cable becomes disconnected or someone

accidentally places their hand across the back of live contacts.

All cables must be physically clamped (use a cable tie) within the socket (either surface or flush), to reduce the risk of a cable becoming detached as a result of snatch.

To prepare the cable ends first cut carefully through the outer sheath with a Stanley knife. Take great care not to cut through into the insulation of the individual conductors themselves. Pull back this outer sheath and trim by folding over the blade the knife and cutting. When stripping the conductors try not to cut any strands of the fine copper wire, nor strip more than is necessary to make the connection. You should twist the stripped ends before fixing into a connector. The bare wire should be totally retained with no part sticking out. The insulated section should butt right up to the terminal.



Make sure that no odd 'stands' of copper wire are left poking out, or lying around, it is easy to create short circuits. The cable should be clamped up tightly, but be careful not to strip the brass screws in the connectors.

You must protect the cable where it passes through holes cut in the very abrasive glass fibre. Wherever possible clip or tie the cable down. Good practice dictates that cable should be routed through flexible plastic tubing or trunking, but personally I think this is not entirely necessary (or practicable) as the Artic cable is very tough. However in cockpit lockers and other areas where cable might be damaged it is a good idea to use trunking. On previous boats I have used round hard plastic tube about 20mm in diameter (overflow pipe from B&Q) and bonded lengths into position in the back of lockers with small straps of glass fibre. Once secure it is easy to thread cables through.

## 2. Protection



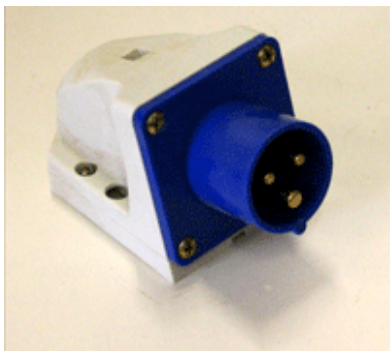
Protection is easily achieved using a conventional domestic consumer unit. The ideal unit for this purpose is one of the small consumer units specifically designed for outbuildings and garages. These normally come ready fitted with a 30mA RCD, one 6amp MCB (intended for the lighting circuit in the outbuilding), and one 16 amp circuit breaker (intended for the ring main in the outbuilding).

Screwfix currently have a Volex unit (quote 63138) at £31.45 (which I used, see the photograph) and an MK unit (quote 33248) at £32.19. These units are much more cost effective than buying the bits, and making up your own unit.

This unit needs to be mounted somewhere basically dry, although the odd few splashes of water are no problem as they are nominally shower proof. You also need to mount the fixed shore power plug. I mounted both on a piece of plywood, itself screwed to a couple of battens bonded to a convenient bulkhead.

I think the best places can be found in cockpit lockers. For example on my Leisure 23SL I found space on the small bulkhead between the cockpit and stern lockers. This is under the 'fixed' part of the cockpit seat, so is reasonably well sheltered. Don't forget to make sure though that there is enough clearance to allow the cable to exit from under the locker lid. Most Leisure's have moulded in hand grips on the locker lids through which the cable can exit, or sometimes the cable can exit down the lid side.

If you cannot find a way of bringing the cable out from within a locker, then probably best to use one of the flush mounted connector plugs, mounted through the cockpit, but this means cutting a hole of course!



The fixed shore power inlet plug on the boat (not a socket; the cable has a trailing socket which mates to the fixed plug on the boat) you will probably have to buy at a chandler, as they are seldom used in industrial practice. Electrical wholesalers (not Screwfix) also keep them.

There are two types. The cheapest (and personally I think the best) is the type shown on the left which is only nominally shower proof and should not ideally be mounted in a very exposed position. You



can also buy the flush mounting variety having a protective cover which may be more waterproof!

## 3. Shore Power Cable

You can either buy made up cables from chandlers or trade electrical outlets, or simply make up your own using your 'left over' Artic cable. You need regular (i.e. trailing) plugs, and trailing (i.e. free) sockets often known as couplers. Screwfix have plugs quote 12227 at £1.35 and inline couplers quote 15521 at £1.99. You can buy these at a chandler, or in B&Q but I doubt you will match the price.



## Using Shore Power

For safety:

- Powering Up - Connect the cable to the boat end first, then plug into the shore power socket.
- Powering Down - Disconnect the shore end first, followed by the boat end.
- If you drop the cable connector(s) in the water, please don't use it until dismantled, washed in clean fresh water, doused in WD40, and thoroughly dried out.
- Avoid trip hazards by routing the cable carefully.
- Test your RCD occasionally by pressing the 'Test' button when powered up. It should switch off immediately.

Screwfix is a good source of most of the connectors and bits and pieces you will need, and no,.... I do not have shares in Screwfix! [www.screwfix.com](http://www.screwfix.com) or telephone 0500 414141. The catalogue is a DIY'ers dream. More DIY information also is [www.diyfixit.co.uk](http://www.diyfixit.co.uk), including useful advice on electrics.

I was assisted by an excellent article by Grenville Hancock (Moody Owners Association). Some of his material has been reproduced with permission, in this article.

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