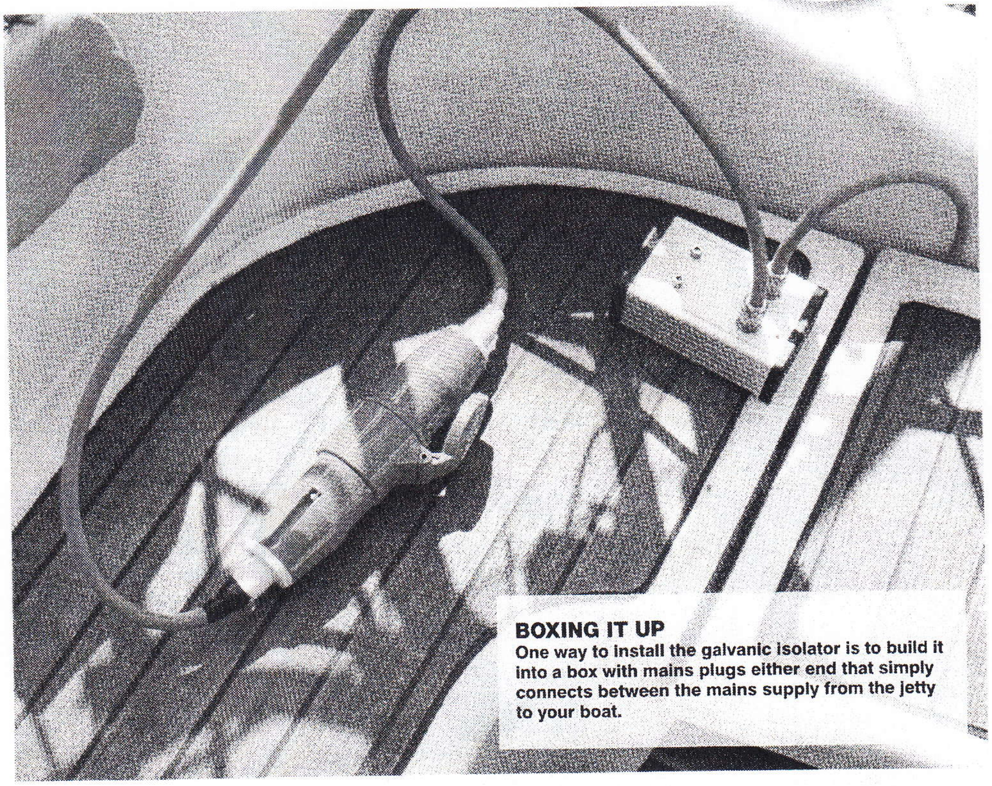
# Make your own galvanic isolator

Considering an isolator to protect your boat from galvanic corrosion, but put off by the high price? David Berry explains how to make a DIY galvanic isolator for a fraction of the cost

What did it cost? under £10

**Much has been said about the risks of stray currents from shore power installations speeding corrosion of metal on moored yachts, and the usual solution is to fit a galvanic isolator. But what does this gadget do?**

A galvanic isolator stops stray electrical currents flowing through the mains earthing system of your boat when it is connected to a shared mains distribution system, such as shore power in a marina. These stray currents can be generated by electro-chemical (or galvanic) reactions caused by different boats having different electrical potentials but being connected together by the earth wire of the marina's shore power distribution system, or by stray currents flowing within the system itself. The currents are always small, driven only by fractions of a volt, but, given time, can be sufficient to do some unwanted damage. The results (depending on the direction of the current flow) can be either an accelerated reduction in anode mass or loss of protection and erosion of the now-unprotected metal hull fixtures and fittings.



**BOXING IT UP**
**One way to install the galvanic isolator is to build it into a box with mains plugs either end that simply connects between the mains supply from the jetty to your boat.**

## Do you need one?

Whether you need a galvanic isolator largely depends on where you moor. A friend discovered he needed one only when he moved away from his normal mooring and started travelling further afield. After a single season his anode had all but dissolved.

Would a galvanic isolator have saved him some cash? Well, perhaps. The problem with diagnosing the need for an isolator is the lack of an easy way to determine whether there are any destructive currents passing through the earth contacts on your boat, so really the only way to discover if a galvanic isolator is of use is to buy one. This is where you get a shock, as like everything to do with sailing they are expensive – typically from £70 upwards.

So now you have to fork out a lot of money for something you may not actually get a benefit from. This article will show you how to make your own for a fraction of the price of a commercial one.

## How they work

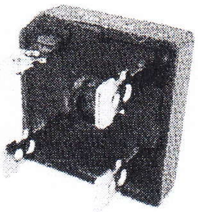
The voltages that drive the current flows are typically less than a volt, so an impediment to current flow in the earth wire of the mains cable that offers a 'wall' of a volt or more will prevent the currents flowing.

A simple diode has a voltage drop of typically 0.6V, so two of these in series will offer a 'wall' of 1.2V. That's the easy bit.

The problem arises because the galvanic isolator is fitted in the earth wire of the mains cable, and so must not prevent the normal mains power earth protection from operating. That means the diodes still have to pass the fault currents that may occur in the mains installation. A mains fault onboard usually sends the fault current down the earth wire to ground, so if the circuit breaker trips at 16A then the earth return must be capable of carrying more than 16A for the time it takes for the circuit breaker to operate (normally less than 100 milliseconds).

Fuses are much slower to operate and the time taken to blow depends on the actual fault current. Standard fuses may carry twice their rated value for around a second, so the galvanic isolator will have to be capable of carrying that current for that time. Hence a supply which is protected at 16A must be fitted with an isolator that can cope with 32A for an extended period and much higher currents (the short circuit current may be as high as 200A) for around 100ms.

## THE DIODE BRIDGE RECTIFIER

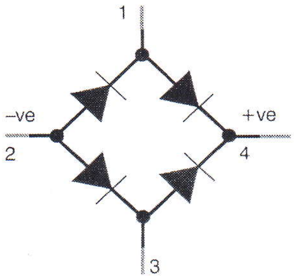


**A typical high current diode bridge rectifier suitable for a 16A supply, in this case a GBPC5010. It has a central mounting hole and four terminals. Two terminals are AC and are marked AC or ~. The other two are DC and marked + and –.**

**You can find these on eBay (from China) for around £4 including postage.**

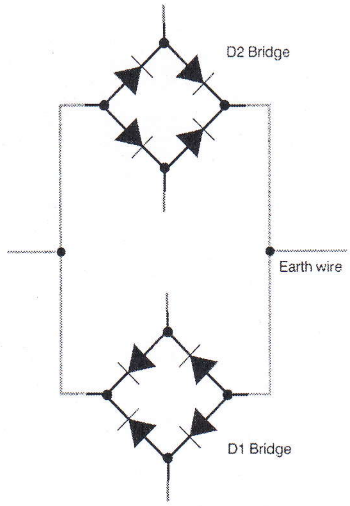
**Incidentally, the 50A in the description refers to the maximum continuous current that will flow though each leg of the bridge. While it is tempting to believe this will make a 50A bridge into a 100A bridge by adding the currents in each leg, this is not necessarily so since minute differences in diodes can lead to the majority of the current flowing through one leg.**

**The circuit symbol for a diode bridge rectifier shows that current can flow across the bridge from – to + (terminals 2 to 4 in this case) dropping by 0.6V through each diode. This means terminal 2 will always be about 1.2V above terminal 4 whenever a current flows, so will provide the protection required. Two of these devices, wired in parallel and facing in different directions, will provide for all Direct and Alternating Currents.**

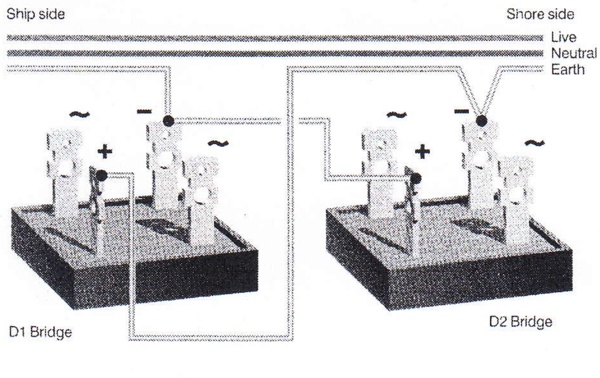



## THE GALVANIC CIRCUIT

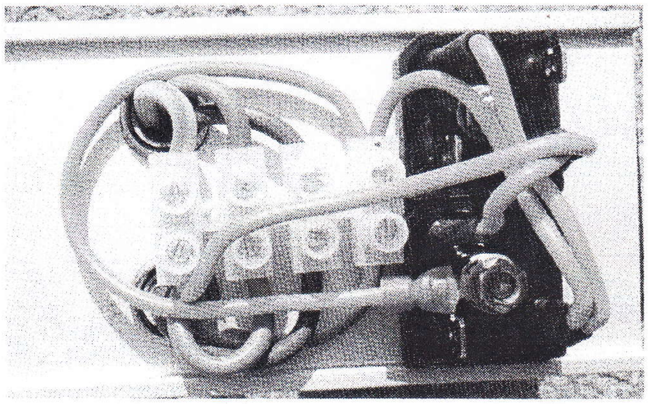
**The two diode bridges are wired 'back to back'. The mains cable live and neutral wires are left untouched, only the earth wire is cut. Use good quality, high current capacity cable such as speaker cable. It must be rated to at least 32A for a 16A supply.**




NOTES:
1. Each leg of each diode bridge is minimum 50A
2. The AC (~) connections of the bridge are not used
3. The circuit is inserted in the ground wire of the three-wire mains cable




**Connection to the terminals can be by crimp terminals, wire wrap or soldering, but it is important that the connections are well made and capable of carrying the potentially heavy fault currents**



**The diode bridges on the right and the entry and exit cables on the left; the whole connected by a connector block. One important point to note is the grounding wire running from the mounting screw of the lower bridge to the earth wire in the dockside connecting cable – this is necessary to ground the metal box in case of faults.**

This calls for some chunky diodes. High current diodes are quite expensive and four are needed. However, high current integrated diode bridge rectifiers are available at much lower prices and these can be configured to make a galvanic isolator using one bridge of four diodes in place of the normal pair of diodes in a commercial isolator.

A diode bridge contains four diodes and is normally used to rectify AC into DC.

## Making the isolator

The circuit is simple (see diagram above). Two diode bridges are used, wired in opposing directions so that current flows in either direction are correctly handled (this includes alternating currents).

To assemble the isolator, carefully identify the terminals. The positive terminal on one bridge must be wired to the negative terminal on the other bridge, and vice versa. The assembly is then inserted into the earth wire of the mains cable as the first electrical unit after the external mains connection to the boat (ie nothing must be wired between it and the connector). This involves cutting the earth wire, then connecting one end to the negative terminal on one diode bridge, and the other end to the negative terminal on the other bridge. The AC terminals are marked ~ or AC and must be left unconnected, and preferably sealed to prevent them shorting.

## Keeping it cool

The unit should not get hot except when a fault exists and a high current flows through the diodes. By mounting the two bridges on some convenient metal surface, or by providing a sheet of aluminium to act as a heat sink, you can effectively remove heat from the unit, but if it gets hot in normal use then something is wrong and the mains supply should be investigated by a competent electrician. In the meantime disconnect the power supply, just to be safe!

Use suitable tape or sleeving to insulate the terminals. There will never be more than around 2V at the terminals of the unit even under fault conditions, so heavy insulation is not required, but they should be insulated to prevent their contact with other equipment.

An alternative to mounting the unit within the boat is to include it in the flexible mains cable that connects the boat to the shore. Just buy a suitably-sized metal box from a supplier such as Maplins and use glands to take the cable in and out. Secure the two diode bridges to the box wall. PBO