



A DIVISION OF MARINE TECHNOLOGY, INC.

## Mar-Line Family of Galvanic Isolators

### Application Notes and Design Specifications for:

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[Mar-GAL2](#)

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Galvanic Isolators, Shore Power and Zincs  
by Jack Honey

The purpose of a Galvanic Isolator is 1) to prevent excessive zinc consumption, and 2) to prevent reduction of corrosion protection when the shore power grounding connection is brought aboard. So we hope you'll bear with us for a very short review of what's behind it all.

The purpose of the zinc is to protect the boat's underwater metal from galvanic corrosion. The various underwater metal parts ... props, shafts, struts, logs, rudders, through-hull cooling water inlets and so forth ... are each connected by heavy wire (bonded) to a central point, usually the engine. The boat's zinc is also connected to this point, forming a galvanic cell.

Current from the zinc flows through the water to each of the underwater metal parts and back to the zinc through the bonding connections. This current slowly builds up an insulating layer of hydrogen gas on the underwater metal which prevents corrosion and which gradually reduces the zinc current. This process is called 'polarization'. The voltage across this layer is called the 'hull potential' and is a measure of the adequacy of the protection being provided by the zinc. It may be measured with a digital millivoltmeter connected between any underwater metal part and a special probe (a silver/silver chloride reference cell) in the seawater near the boat.

This polarization layer is attacked by dissolved oxygen in the water, turbulence and the like. The zinc current is reduced from the initial value needed to form the polarizing layer to just that needed to replenish it. The zinc, like the zinc case of a flashlight cell, is slowly consumed in the process of delivering the polarizing current. That's why it's called a 'sacrificial zinc anode'. So far, so good.

The boat's shore-power connection brings all the conveniences of 120-volt ac power on board when you're in your slip. To protect of those on board from electrical shock in the event of a ground fault in some ac circuit or appliance, the shore-power grounding conductor (the green wire) is brought on board along with the two current-carrying conductors, and it is connected to the grounding terminal of all convenience outlets and the cases of all electrical appliances. To back up the protection provided by the shore ground, the green grounding wire is also connected (per ABYC standards) to the boat's underwater metal bonding system discussed above.

This leads to a problem.... The boat's zincs are now obliged to deliver current not only to the boat's underwater metal but to the buried-metal grounding system on shore and to any unprotected boats on shore power in the vicinity. The boat's zincs just aren't up to the task of protecting the entire shore-power ground system and own

boat as well. Zinc consumption is very greatly accelerated, and the hull protection voltage is substantially reduced.

Measurements on a typical 42-foot cruiser showed 0.40 amperes dc current in the shore grounding lead, representing the unnecessary loss of 0.77 pounds of zinc a month, plus a substantial reduction in the boat's protection level.

...which the Galvanic Isolator cures!

A Galvanic Isolator, installed on board in the green grounding lead from the shore-power receptacle, blocks any significant current due to voltages less than about one volt, which includes the galvanic potential differences which may exist between a protected boat and the shore grounding connection. Yet in the event of a ground fault in the ac system on board, the voltage across the Isolator is enough for it to pass the full ac fault current with less than 2 volts drop, thus preserving full protection for those on board or alongside.

What size Galvanic Isolator?

The Galvanic Isolator must be capable of carrying any ground fault current to which it may be subjected. Fault current due to a direct short in the wiring will substantially exceed the trip level of the boat's main and branch circuit breakers and the dockside circuit breaker, and one of these will open after a few moments. So the Isolator must carry very high currents for a short period of time. Other ground faults, such as insulation failure in a heater or refrigerator motor, or water penetration into an appliance or wiring fixture, may involve fault currents less than the smallest breaker rating. The Isolator must therefore be capable of handling current up to the service breaker trip level indefinitely without overheating.

Lastly, some boats and more recently some marinas are equipped with Ground Fault Circuit Interruptor (GFCI or GFI) devices in the shore power circuit in place of the conventional breakers. These are similar to those mandated for new-home construction (baths, kitchens, laundrys, pools...) for a number of years. These devices sense ground fault currents as low as 0.005 amps and open the power circuit within 0.03 seconds, providing outstanding ground-fault protection for those on board, for those alongside and for those in the water near the boat as well.

Even with GFCI, a galvanic isolator is required in the shore grounding lead. If the entire boat is protected by on-board (rather than dockside) GFCI devices, the isolator need not be capable of carrying high current for an extended period of time. With dockside GFCI protection, one would still need high-current isolator capability when visiting an unprotected slip.

Marine Technology, Inc. manufactures a line of Galvanic Isolators suited to all present-day boating requirements as follows:

- Mar-GAL50 for all 50-amp shore-power services.
- Mar-GAL30 for all 20 and 30-amp shore-power services.
- Mar-GAL2 for boats fully protected by on-board GFCI devices.

The 30 and 50-amp units are distinguished by the large heat-dissipating fins required to handle continuous fault currents up to 30 and 50 amps respectively. In addition, the Mar-GAL30 and the Mar-GAL2 can handle momentary fault currents up to 150 amps for 1.6 seconds, 300 amps for 0.16 second and 600 amps for .016 second as may be required until the service breaker opens. The 50-amp model is rated at twice these momentary currents.

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## The Mar-Gal2

Mar-GAL2 Galvanic Isolator for GFCI Shore Power

- to prevent zinc deterioration and loss of protection due to the shore power grounding connection.
- only for vessels with on-board Ground Fault Circuit Interrupter protection on all shore power connections.
- an Application Note

### **The Problem . . .**

When 120v ac shore power is brought aboard a vessel, the shore power green grounding conductor is connected to the vessel's sea water ground in order to assure ground fault protection for those on board. The vessel's zinc sacrificial anodes, intended to protect the underwater metals from galvanic corrosion, are thus required to protect the shore buried-metal grounds and all nearby vessels as well. This overloads the zincs, resulting in:

- (1) their rapid deterioration, and
- (2) in substantially reduced corrosion protection voltage for the vessel.

### **The Solution . . .**

The Mar-GAL series of Galvanic Isolators prevent the flow of galvanic current in the shore power grounding lead without interfering with the ground-fault protection it offers. The Mar-GAL2 is intended for use on vessels having full Ground Fault Circuit Interrupter (GFCI or GFI) protection on board for all shore power connections.

Some modern marinas have shore power connections equipped with GFCI devices at each dockside connection. The Mar-GAL2 would be fine in the home slip, but since the vessel may visit other docks not so equipped, it is suggested that the Mar-GAL30 (30-amp) or Mar-GAL50 (50-amp) galvanic isolator be installed.

### **Specifications . . .**

Size: 2.0"w x 2.8"l x 1.5"h overall.

Current carrying capacity: 2 amperes ac continuous  
150 amps ac for 1.6 seconds  
300 amps ac for 0.16 seconds  
600 amps ac for 0.016 seconds

Voltage drop: 2.5 v rms maximum at 150 amps ac  
+/- 1 v dc at 10 microamps

The Mar-GAL2 is designed for use in all 20-amp, 30-amp or 50-amp 120 or 240 volt, single or three-phase 50 or 60 Hz shore power systems protected by GFCI devices.

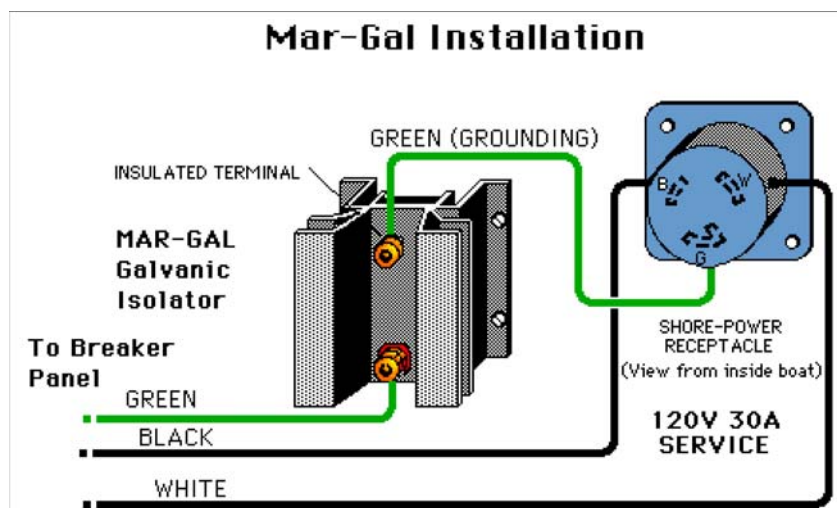
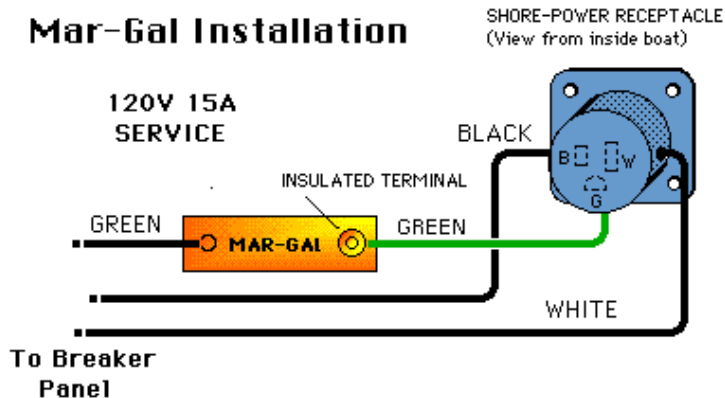
The GFCI device functions to open the shore power circuit almost instantaneously (about 0.03 seconds) on very low fault current (over 0.005 amperes), further assuring ground-fault protection for those in the vessel, alongside, and in the water near the vessel. Thus, the Mar-GAL2 Galvanic Isolator is not required to carry continuous ac fault current up to service breaker rating as are the Mar-GAL30 (30-amp) and Mar-GAL50 (50-amp) models for use without GFCI protection. So the Mar-GAL2 doesn't need large heat fins which characterize the other units.

### **Installation . . .**

First, turn off the dockside shore power switch and disconnect the shore power cord!

Locate the inboard side of the shore power receptacle and identify the green grounding conductor. It goes to the receptacle grounding prong which is shaped differently than the others. It must NOT be confused with the two or three other current-carrying conductors, which may be color-coded black, white, red, blue, etc.

Mount the Mar-GAL2 at any convenient spot near the green grounding wire from the receptacle. Arrange it so that the green wire can be cut and its two ends connected to the two Isolator terminals. The green wire from the receptacle should go to the terminal having the insulating washer. Crimp the two ring terminals provided to the two green wire ends and assemble. Double check your wiring and then reconnect the shore power cord.



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## The Mar-GAL30 and Mar-GAL50

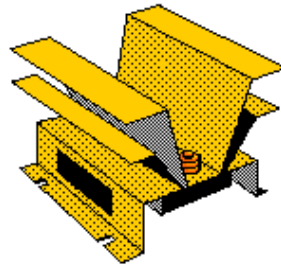
### Shore Power Galvanic Isolators

- - - to prevent zinc deterioration and loss for protection on vessels due to the shore power grounding connection.  
----- an Application Note

### The Problem . . .

A ground fault in a ac electrical appliance or circuit can expose people on board of alongside to severe electrical shock. To help minimize this danger -- and in accordance with NFPA and ABYC recommendations -- the shore power grounding connection (the green wire) is brought on board and grounded to all ac appliances and outlets and to the vessel's sea water ground.

However, if sacrificial zinc anodes are used to protect the vessel's underwater metal from galvanic corrosion, this shore grounding connection will overload the zinc, very greatly increasing the zinc consumption and reducing the protection



Mar-GAL30

level available to the boat. In effect, the zinc is also trying to protect the entire shore buried-metal ground and nearby vessels.

### The Solution . . .

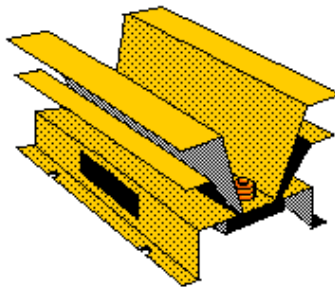
The Mar-GAL30 or the Mar-GAL50 Galvanic Isolator prevents any flow of galvanic current in the shore grounding connection, yet fully preserves the ground-fault protection which this connection provides. The Mar-GAL2 Galvanic Isolator may be used on any vessel equipped with on-board Ground Fault Circuit Interrupters (GFCI) on all shore power connections since it will not be required to carry appreciable fault current.

### Specifications. . .

The Mar-GAL30 is designed for use in the green grounding conductor of the following shore power ac services:

- 20A or 30A 125V single phase 2 pole 3 wire
- 20A or 30A 250V single phase 2 pole 3 wire
- 20A or 30A 125/250V single phase 3 pole 4 wire
- 20A or 30A 250V three-phase delta, 3 pole 4 wire
- 20A or 30A 120/208V three-phase Y, 4 pole 5 wire

Mar-GAL50



The Mar-GAL50 is designed for use in the green grounding conductor of the following shore power services. (It may be used in any of the services listed above as well.)

- 50A 125V single phase 2 pole 3 wire
- 50A 125/250V single phase 3 pole 4 wire

The Isolators must be capable of carrying continuous fault current up to the rating of the circuit breaker in the circuit in which they are used. Current ratings for the two models are:

- Continuous 1.6 secs 0.16 sec 0.016 sec
- Mar-GAL30 30 Amp 150 Amp 300 Amp 600 Amp
- Mar-GAL50 50 Amp 300 Amp 600 Amp 600 Amp

The momentary ratings are significant in that it takes appreciable time for the typical thermal circuit breaker to open, even under short-circuit conditions.

Size: Mar-GAL30: 3.2"h x 4.5"w x 4.0"l;

Mar-GAL50: 3.2"h x 4.5"w x 7.0"l.

A ground-fault condition should be located and cleared promptly, as it is potentially dangerous and as it overrides the ability of the isolator to oppose galvanic currents. The voltage drop across either isolator at full rated current will not exceed 2.5 volts rms.

## INSTALLATION . . .

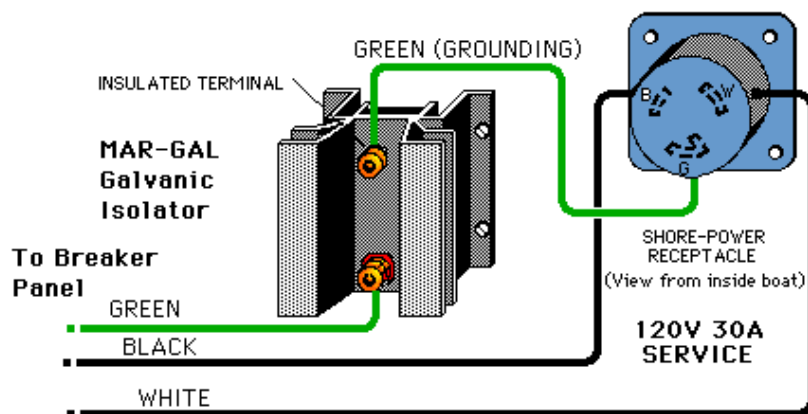
First, turn off the dockside shore power switch and disconnect the shore power cord!

Locate the inboard side of the shore power receptacle and identify the green grounding conductor. It goes to the receptacle grounding prong which is shaped differently than the others. It must NOT be confused with the two or three other current-carrying conductors, which may be color-coded black, white, red, blue, etc.

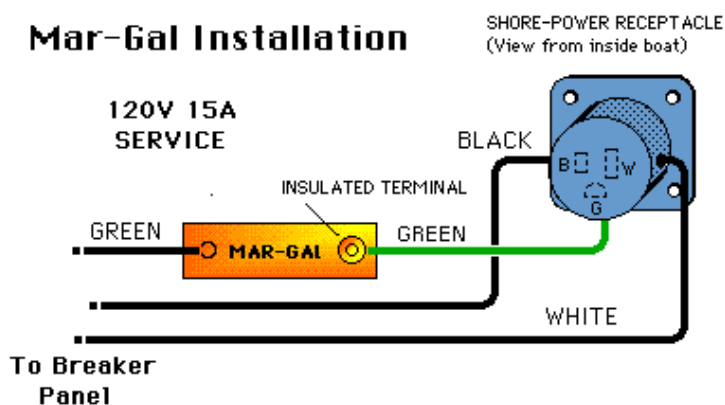
Mount the Mar-GAL with its fins vertical on a vertical bulkhead in a convenient ventilated area near the green grounding wire from the shore power receptacle. In fiberglass boats, the Isolator can be mounted to a small board which can be cemented to a bulkhead with an adhesive like "Goop". Arrange it so the green wire can be cut and its two ends connected to the Isolator terminals.

The green wire from the receptacle should go to the terminal if the Isolator having the insulating washer. Crimp the two ring terminals provided to the ends of the green wires and assemble. Double check your wiring and then reconnect the shore power cord.

### Mar-Gal Installation



### Mar-Gal Installation



[Click here to check price for MAR-GAL30!](#)

[Click here to check price for MAR-GAL50!](#)

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