



Sail-Gen Water Powered Generator

Users Manual



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WELCOME TO SAIL-GEN!

Congratulations on your choice of the Sail-Gen water generator from Eclectic Energy.

Sail-Gen is capable of producing sufficient electricity to offset most or all of the power used by the typical cruising yacht on passage. This adds greatly to comfort and security on board and frees the owner from running the main engine or generator on a daily basis in order to charge batteries.

Safety Issues

As with all electrical and mechanical equipment, precautions should be taken when handling, installing and operating the Sail-Gen water generator. We advise that you familiarise yourself with the product manual and the safety information it contains. In particular do not underestimate the weight and size of the unit when installing or removing the Sail-Gen from the yacht. Never try to slow or stop the water impeller or drive shaft with your hands.

Installation

When installing the Sail-Gen, due care should be exercised at all times. The Sail-Gen weighs 17.6kg and is awkward in shape with the weight concentrated at one end. It is sensible to approach installation in a methodical manner and to enlist some help when attaching or removing the machine from the transom.

If possible, install the Sail-Gen when the yacht is ashore. If this not practicable, installing in a marina with the yacht secured stern to a pontoon is a good alternative. The pontoon provides a safe and convenient working platform. A dinghy can be lashed across the transom in order to provide additional security, if work has to be done at anchor.

General Handling

The Sail-Gen alternator, yoke and 'c' bracket mountings incorporate pivots to allow freedom of movement both vertically and horizontally. Although designed with generous clearances, care should be taken to avoid trapping hands and fingers when handling the Sail-Gen.

The Sail-Gen is a very robustly engineered product. However the alternator contains high energy ferrite magnetic rotors. Ferrite is a brittle material that can suffer damage if the alternator is dropped or handled heavily.

Electrical Hazards

When operating, the Sail-Gen is capable of producing high voltages, particularly if disconnected from the batteries. Caution should be exercised at all times to avoid electric shock.

Always observe correct polarity when connecting the Sail-Gen to the regulator and the batteries. Reverse polarity connection will result in damage to the water generator.

The Sail-Gen must be appropriately fused at all times.

Connecting cables must be of a suitable gauge and rating. Disconnect at the batteries before attempting maintenance.

Dump resistors associated with charge regulators can become very hot once the batteries are full. Avoid touching these resistors and do not restrict the airflow around them with clothing, sail bags or similar.

Man Overboard

The Sail-Gen should be recovered immediately if people are in the water. The spinning water impeller can cause serious injury.

Renewable Power on Board

The Advantages of Water Generation

Generating electrical power is a constant preoccupation for yachtsman. Many choose to address this by installing renewable energy devices such as photovoltaic panels or wind generators. These technologies can make a valuable contribution to the yacht's power needs.

However both wind and PV work at their best when the yacht is at anchor. On passage with sails deployed, PV panels are often shaded or angled away from the sun. Also PV panels do not work at night!

Wind generators require a fast and uniform wind flow to work optimally, and there is a cubic relationship between the wind velocity and the energy it contains. This means that at low wind speeds there is very little energy available.

Most long passages under sail are made downwind. On this point of sail the wind passing over the deck is effectively reduced by the boat speed.

The yacht's motion in a seaway also produces gyroscopic forces which act on the wind turbine's rotating parts. This affects yaw stability and the ability of the turbine to accurately track the wind.

All of these factors combine to reduce wind generator output when a yacht is on passage.

By contrast water generation works superbly on passage!

Features and performance of the Sail-Gen

The Sail-Gen is a dedicated, water powered generator for cruising yachts designed specifically to maximise electricity production whilst on passage.

At typical passage speeds of 5-6 knots the Sail-Gen's output is usually sufficient to balance the power consumed, i.e. 150-200 amp hours per day. Larger yachts which achieve higher average passage speeds in the 7-8 knot range can expect yields from the Sail-Gen of 300-400 amp hours per day.

The Sail-Gen water generator converts into electricity a proportion of the wind energy captured by the yacht's whole sail plan. It does this by extracting energy from the boat's motion through the water.

One obvious advantage is that the yacht's sail plan intercepts a much greater area of wind flow than a dedicated wind turbine ever could. Also, water is 800 times denser than air, so a small impeller is all that is required to extract a lot of energy from the water

The inertia provided by the yacht's hull evens out the fluctuations in power output typically seen in wind generators. The result is continuous, consistent power production as long as the yacht is underway. Water generation is also quiet and vibration-free.

Water generators for yachts are of three main types: tow rope machines where a heavy impeller is pulled on a 100 foot line, submersible 'outboard leg' type generators, and finally the Eclectic concept characterised by a hydro-dynamic foil to control impeller running depth.

There are many discrete advantages offered by the Eclectic approach.

The Sail-Gen can be installed satisfactorily alongside self-steering systems. Allowing 400 –500mm of lateral spacing between the equipment usually ensures there is no chance of contact between the steering's servo arm and the Sail-Gen.

Unlike tow-rope type water generation systems, the Sail-Gen is truly practical in use and can be deployed and recovered in seconds and with little effort. As the Sail-Gen operates in a controlled way with the impeller close to the transom, drag is minimised and it is possible to trawl fishing lines when on passage with minimal risk of a tangle.

Outboard leg type water generators are only free to pivot laterally whereas the Sail-Gen's mounting is fully gimballed, allowing both vertical and lateral movement. Sail-Gen's dive plane acts to prevent the impeller either surfacing or sinking, and allows the impeller to 'fly' through the waves, independent of the vertical motion of the yacht's transom as she pitches.

Loss of boat speed is kept to a minimum by the Sail-Gen's efficient impeller and low drag design. The adjustable diving plane controls the impeller operating depth and minimises wetted area. Typically, boat speed losses are one tenth of a knot or less.

Water generators that take the form of an outboard motor leg cannot damp out the vertical component of the yacht's motion. This means the water flow seen by the water impeller continually varies and does not remain perpendicular to the impeller plane. These units are free to pivot laterally and as a result have a tendency to yaw to one side as a torque reaction to the rotating impeller. The Sail-Gen's design avoids both of these problems, and ensures the water impeller is presented optimally to the water flow more of the time, increasing efficiency and reducing drag.

In the unfortunate event of collision with floating debris, the Sail-Gen is free to pivot upwards, reducing the impact. For high speed craft the results of impact can be severe damage. It is possible to rig a collision pull rod between the Sail-Gen alternator and dive plane. The collision pull rod offers physical protection for Sail-Gen's drive shaft and impeller. Any floating obstruction is likely to strike the pull rod first. The pull rod transfers this force to the dive plane which will move to its maximum negative angle of attack. This causes Sail-Gen to fly upwards out the water, decreasing the chances of serious damage. A fixed 'outboard leg' type unit relies on a mechanical 'fuse' in the hold-down line to break on impact and mitigate damage.

Finally, with the Sail-Gen, the alternator and electrical connections are placed 500mm above the yacht's water line. With other types of water generator, the alternator is submerged. The serviceability of such units is then wholly reliant on the integrity of the shaft seal to keep the sea water out of the alternator.

Sail-Gen Variants and Installation Options

For optimum performance it is important that Sail-Gen is competently installed in line with the recommendations contained in this guide.

The Sail-Gen is supplied complete with standard mount hardware. In most cases this will be sufficient to achieve an excellent installation. However, yachts differ widely in form and size, and in some cases additional brackets or packing pieces may be required.

Eclectic Energy can offer advice and suggestions on installation. A photograph or dimensioned sketch of the transom of your yacht will be useful to evaluate mount options.

Note that Sail-Gen is available in 12 and 24 volt versions. There is also a choice of water impeller dependent on the potential speed of the vessel. The 'standard' 290mm diameter impeller is recommended for yachts capable of a maximum sustained speed of nine knots or less. The 240mm diameter 'High-Speed' impeller allows for sustained boat speeds up to fifteen knots. Ensure the correct voltage/impeller combination has been ordered for your yacht.

Standard Impeller and large dive plane



High Speed Impeller small dive



Assembling Sail-Gen

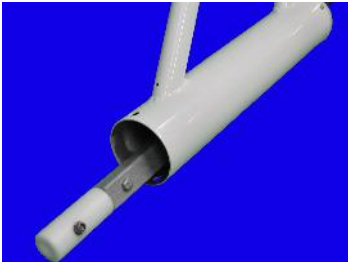
For ease of handling, your Sail-Gen is supplied in three cartons, and requires preliminary assembly before installation on the yacht.

One carton contains the alternator, the second the main frame and drive shafts, the third contains the water impeller, dive plane and mount sundries.

Unless you have access to a large workbench, we suggest you undertake the assembly on the floor, as the completed machine will be around 1.4 metres long.

Avoid assembling on a pontoon or a sloping deck as dropped fasteners can easily find their way into the water!

1. Unpack the box marked 'Alternator'. Check the identification label on the back to ensure the alternator is the correct voltage for your yacht's system. Also, take a note of the alternator's serial number and enter it into the instruction manual for future reference.
2. Open the second carton and remove the main frame and drive shaft assembly.
3. Arrange the alternator such that the shaft is aligned with the tower tube and driveshaft. Pull the outer part of the telescopic drive shaft out of the bottom of the tower tube. This exposes the shaft coupler.



4. Remove the lower M6 nut and bolt from the shaft coupler and then slide the coupler onto the alternator drive shaft. Align the holes through the coupler and alternator shaft, and re-fit the M6 bolt and nut.
5. Remove the two M8 tower cap screws and plastic washers from the base of the alternator nose. Apply Tef-Gel anti-seize compound to the machined aluminium surface at the base of the alternator nose. This will prevent corrosion and ease subsequent disassembly. Also, apply a little Tef-Gel to the tapped M8 holes.



6. Slide the tower tube onto the alternator nose. Note that as you do so the upper drive shaft sleeve needs to pass through the spherical bearing at the top of the tower tube. If the tower will not slide all the way onto the alternator nose, check the alignment of this bearing and get an assistant to 'wobble' the upper drive shaft to get it to enter the top bearing. *Do not force it.*
7. Align the alternator such that the cable gland is on the right hand side when viewed from the rear. Rotate the tower tube and frame such that the lifting eye is uppermost.

Refit the two M8 tower cap screws and plastic washers, having first smeared the threads with a little Tef-Gel.



8. Rotate the black conical connector on the upper drive shaft to ensure that the drive shafts rotate smoothly. Should the drive shaft bind, suspect the coupler installation, and re-check for the correct fitting of the coupler bolt.
9. Using the M10 pivot pins, washers and split pins provided, attach the alternator yoke to the alternator lugs. Take care to orientate the yoke correctly depending on whether the yoke needs to cant up or droop down to facilitate the installation.
10. Fit the dive plane to the frame beneath the impeller, using the supplied M5 shoulder bolt. Do not over tighten this bolt. The dive plane should pivot freely.



Sail-Gen positioning considerations

The Sail-Gen uses Eclectic's unique and proven approach to water generation where the water impeller depth is controlled by a hydro-foil we refer to as a 'dive plane'.

In order to provide the correct geometry which enables Sail-Gen to operate optimally, it is preferable to mount the Sail-Gen as close to a mono hull's centre line as possible. This minimises the difference in the running depth of the water impeller from tack to tack. On most yachts, it is both impractical and undesirable to mount directly on the centre line, but if the installation is made within 500mm either side of the centre, the Sail-Gen will perform optimally. Where the installation needs to be made further outboard, the Sail-Gen will still work well, but there will be a greater difference in the running depth of the water impeller from tack to tack. This will result in higher outputs, but also higher drag on one tack and the reverse condition on the opposite tack.

The Sail-Gen mounting consists of a yoke and a 'c' bracket which allows for two degrees of freedom – the Sail-Gen is free to pivot both laterally and vertically to allow for steering and wave action. The cast aluminium yoke which supports the alternator is reversible. It can be fitted with the yoke arms either canted upwards, or drooping down. Given that the alternator pivot point is required to be 500mm above the static water line, this means the underside of the 'c' bracket can be attached at the yacht at either 400mm or 540mm above the water line, depending on which option is most practical.



Tilt up



Tilt down

The owner should be aware that this hinging creates a potential trap hazard for hands and fingers. The Sail-Gen is provided with generous clearances between yoke and alternator in order to minimise the risk of accidental crush injuries. However, hands should not be placed on the alternator or yoke when the Sail-Gen is operating.



Do not place hands here

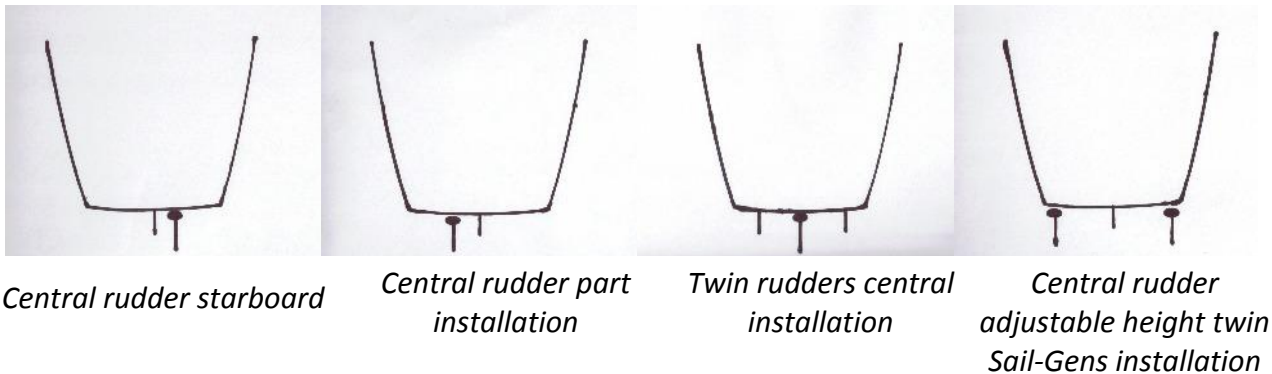
Water Turbulence

When considering the best mount position for the Sail-Gen on avoid making the installation directly in line with a central rudder or skeg. Any obstruction ahead of the Sail-Gen impeller will introduce turbulence into the water flow and this will reduce the Sail-Gen's efficiency and output.

The same advice applies where a yacht has twin rudders placed to port and starboard

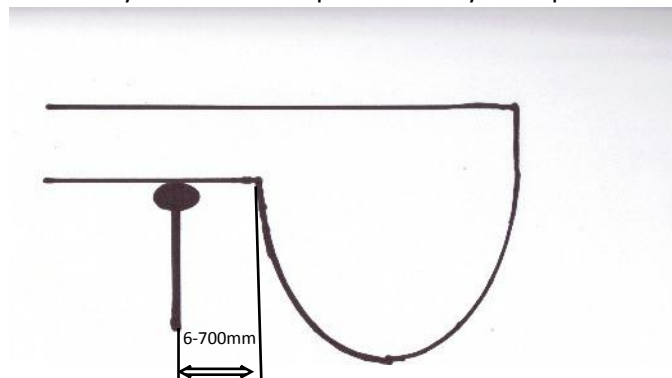
Installing Sail-Gen on Mono-hulls

Wherever possible Sail-Gen should be positioned in accordance with the dimensions recommended. If the installation has to be made slightly further out board Sail-Gen will still work acceptably well, particularly at the modest heel angles associated with trade wind sailing. However if the only viable mount position is right out at the yachts quarter then the best solution may be to install two Sail-Gen and deploy the leeward unit selectively whilst recovering the windward.



Installing Sail-Gen on Multi-hulls

As multi-hulls do not heel to the same extent as mono hulls the mount position for Sail-Gen is less critical. Usually installations are made off the bridge deck. Note that Sail-Gen must be mounted at least 700mm inboard from either hull to provide the clearance necessary for the unit to pivot laterally in response to steering and wave action.



Davits

Where a yacht is fitted with davits and a dinghy is carried, Sail-Gen can often be installed beneath. It is sometimes possible to mount off the blocks at the transom to which the davit is attached. A recovery line can be run through a small block and cam cleat which enables the Sail-Gen to be 'parked' in a horizontal position under the dinghy or arm of the davit. With some minor modification it is also possible to stow the Sail-Gen across the transom, below the bottom of the dinghy.

Sail-Gen Mounting Options

Also refer to information contained in the electrical installations section:

1) The Sail-Gen alternator is supported by a cast aluminium yoke and secured via 10 mm stainless steel pins which pass through plastic bearing bushes in both yoke and alternator lugs. This provides for the Sail-Gen's freedom of movement on the vertical axis.

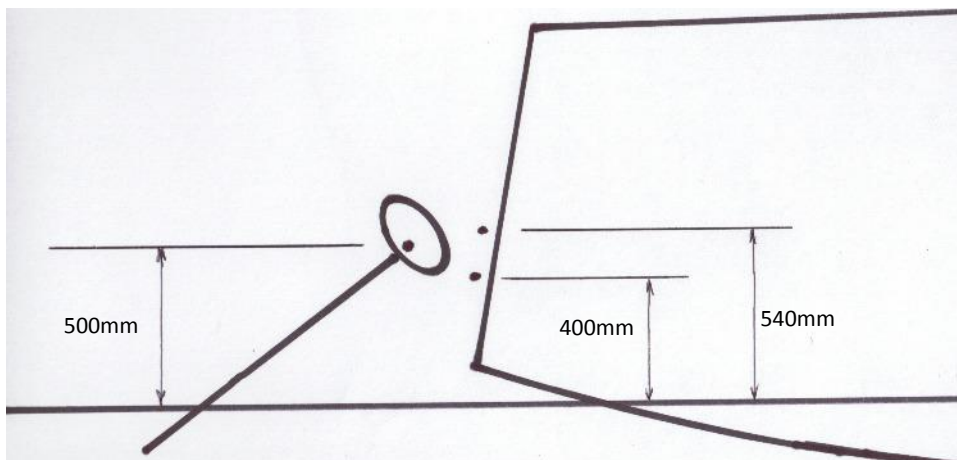
The yoke is in turn attached to an anodised aluminium 'C' bracket with a 10 mm stainless steel pivot pin. This pin passes through plastic bearing bushes in both the 'C' bracket and the central boss of the yoke. This allows for freedom of movement on the horizontal axis.

2) The 'C' bracket is used to attach the Sail-Gen to the yacht. Where possible, installation should be made within 500 mm of the yachts centre line.

The lower edge of the 'C' bracket should be attached such that it is either 400 or 540 mm above the static water line. The architecture of the yacht will suggest which is the best option.

If the lower 'C' bracket position offers the most practical mount solution, the yoke is subsequently fitted in its 'tilt up' position. This will bring the alternator pivot point up to the required height of around 500 mm. Alternatively if the upper 'C' bracket position is a better option, the yoke is then fitted in its 'tilt down' position and the alternator pivot point will again be approximately 500 mm above the static water line.

Mount height diagram

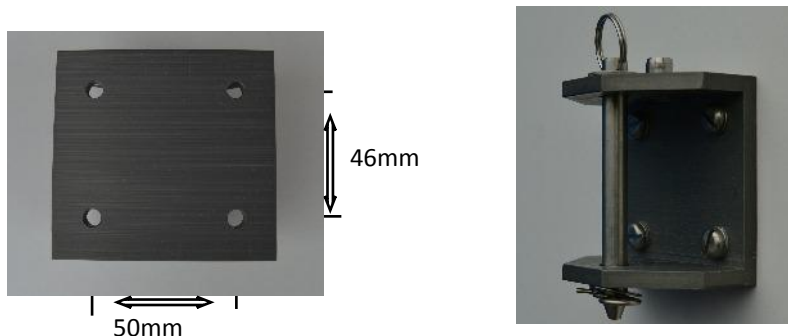


Mounting Hardware

The Sail Gen is supplied complete with basic mount hardware. Where these prove insufficient to enable the desired installation, additional brackets and clamps are available which allow the owner to produce bespoke mountings.

Option A - mount direct to transom

The Sail-Gen 'C' bracket can be bolted directly to the yacht's transom. The 'C' bracket measures 76 mm x 80 mm x 51 mm. The bracket is secured with 4 x M6 stainless steel bolts. The fixing centres are 50 mm horizontally and 46 mm vertically.



It is necessary to ensure that the 'C' bracket is installed such that it is aligned vertically when viewed from the rear and the side. On some yachts, it may be necessary to introduce an angled pad or wedge between the bracket and transom to achieve this. Such a pad could be made in hardwood, plastic or aluminium.



The 'C' bracket transmits all the loads from Sail-Gen to the yacht. We therefore recommend that a backing pad is used on the inside of the hull to distribute the load of the fastener to the laminate. As a minimum ,large 'penny' washers should be placed under the nuts.

The Sail-Gen is supplied with a frame clip which secures the unit when in its vertical 'parked' position and not in use. For some installations it may be practical to attach this clamp directly to the push pit or other pre-existing steelwork. Where this is viable, the 'C' bracket can be bolted directly to the transom without including the 'C' clamp blocks or 25mm up-stand tube.



Frame clip on stand up tube



Frame clip on pushpit rail



Stand up tube

If there is no suitable attachment point for the frame clamp, the 'C' bracket should be installed together with the supplied clamp blocks and 25 mm up-stand tube. This up-stand tube is then used to mount the frame clamp which facilitates the parked position.

Option B - freestanding mount to a Bathing platform and/or bridge deck with stand up tube and frame clip



Mount off vertical or horizontal face as appropriate.

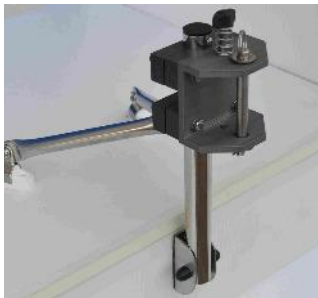
Where there is an existing tubular stainless steel structure on the yacht at the specified mount heights, it may be possible to mount the 'C' bracket directly off these, either through the use of a second set of clamp blocks or other proprietary tube clamps.

Where the recommended central mount positions are not practical, it is possible to mount Sail-Gen further outboard and utilise mast track. This track enables the Sail-Gen mount height to be adjusted to suit the point of sail and heel angle.

Option C - short free standing mounting off a bathing platform or cat bridge deck



Option D - mounting off a vertical face off a bathing platform or bridge deck



Option E - mounting off a sloping transom



Option F - installation using 180 degree bearing blocks to allow stowage cross transom



Electrical Installation

As with the installation of all renewable energy equipment, the Sail-Gen wiring should be considered as essentially independent of the rest of the vessel's electrical system.

Dedicated cables should be used to connect the Sail-Gen directly to the batteries via a dump type charge regulator. The cables should not pass through the yacht's main isolation switches.

As Sail-Gen forms part of a low voltage system the owner can undertake the electrical installation him or her self. Be aware however that most faults associated with renewables on yachts are eventually traced to poor wiring or connections. If you are unsure of your competence to do this work, it is best left to a professional marine electrician.

The Sail-Gen is supplied with a 2 metre long output lead. This should be brought into the yacht via a proprietary deck gland, either at the deck or transom. Note we do not recommend the use of deck plugs and sockets. These constitute a shock hazard should they become disconnected. Note also that any connectors used must be of a suitable rating. For a 12 volt Sail-Gen this should be at least 40A DC, and 20A DC for a 24 volt system.

We recommend a hardwired connection is made in the lazarette/ stern locker area between Sail-Gen output cable, and the extension connecting cable which runs through to the regulator and batteries.

Wire Sizing

The Sail-Gen is capable of generating high current and it is important that the connecting cables are sized appropriately to allow for this. Note that the longer the cable run, the greater the cross-sectional area of the cable should be. Refer to the table below for guidance.

Cable Selection Table

This table reflects the minimum wire cross-sectional areas which should be used. Lengths quoted are total circuit, i.e. positive battery terminal to the turbine plus the return to negative battery terminal.

Sail-Gen	0-20m	20-40m	40-60m	60-80m	80-100m	100-120m
12V	4 ² m	6 ² m	10 ² m	16 ² m	25 ² m	35 ² m
24V	2.5 ² m	2.5 ² m	4.0 ² m	6.0 ² m	10 ² m	16 ² m

Try to route the cables from Sail-Gen separately from data and aerial cables if possible. This will minimise the chance of interference to radio and GPS signals. Also avoid routing cables through lockers where cable could be damaged by heavy items like anchors or outboards etc. Alternatively run the cable through some plastic tube or conduit to provide protection.

Fuses

The supplied primary fuse should always be fitted inbetween the batteries (or regulator input where fitted) and the Sail-Gen. This primary fuse protects the circuit in the event of a short circuit occurring at or within the Sail-Gen.

Typically secondary fuses are fitted inbetween the regulator output and batteries.

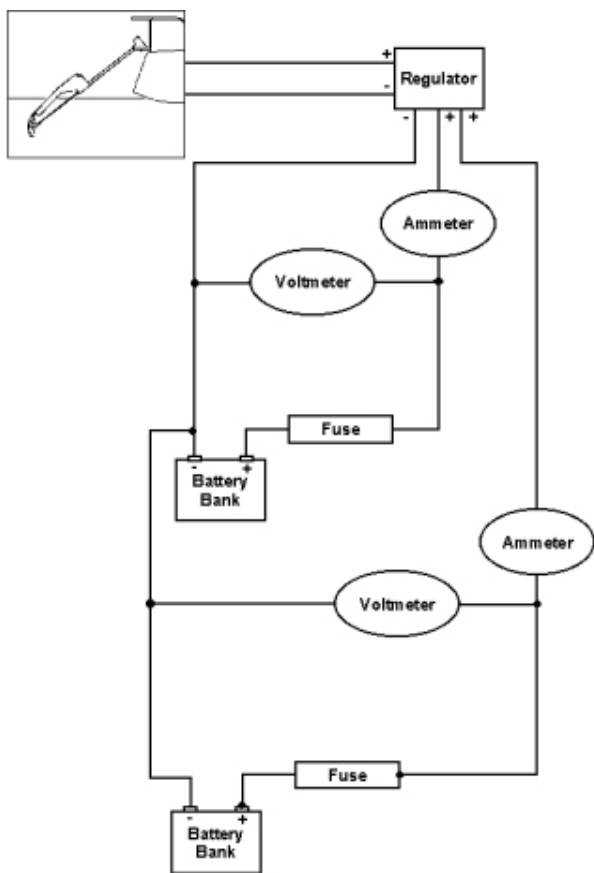
The primary and secondary fuse values are 40A for a 12 volt system and 20A for a 24 volt system.

Multiple Charging Sources

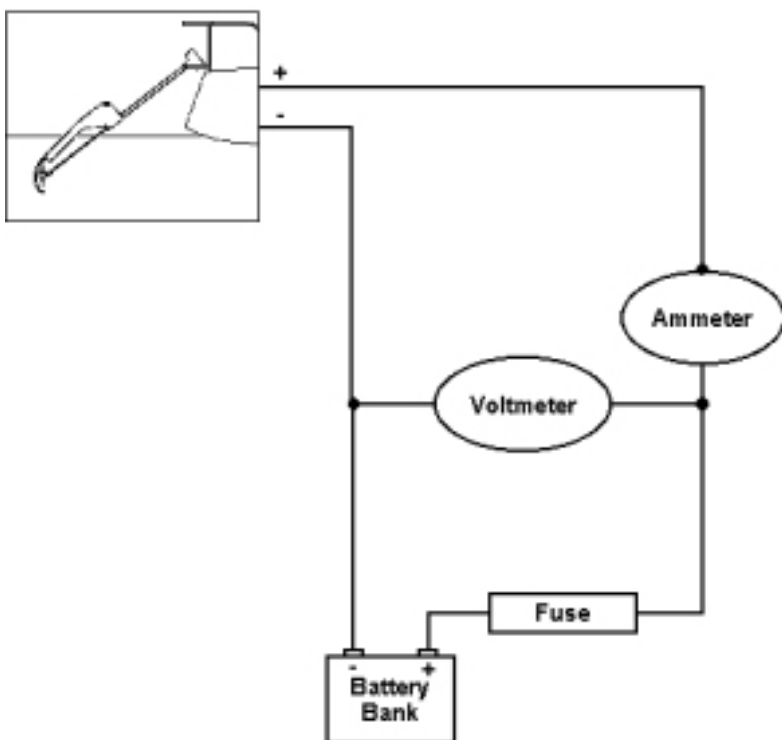
There is no problem in installing multiple renewable charging systems on your boat. Many seasoned long distance cruisers install solar PV, wind and water generators. These devices are simply connected to the batteries in parallel via their individual dedicated charge regulators, or a lesser number of high capacity charge regulators.

Multiple renewables maximise power provision whether at anchor or on passage, and compliment dedicated diesel generators shore power and the main engine alternator.

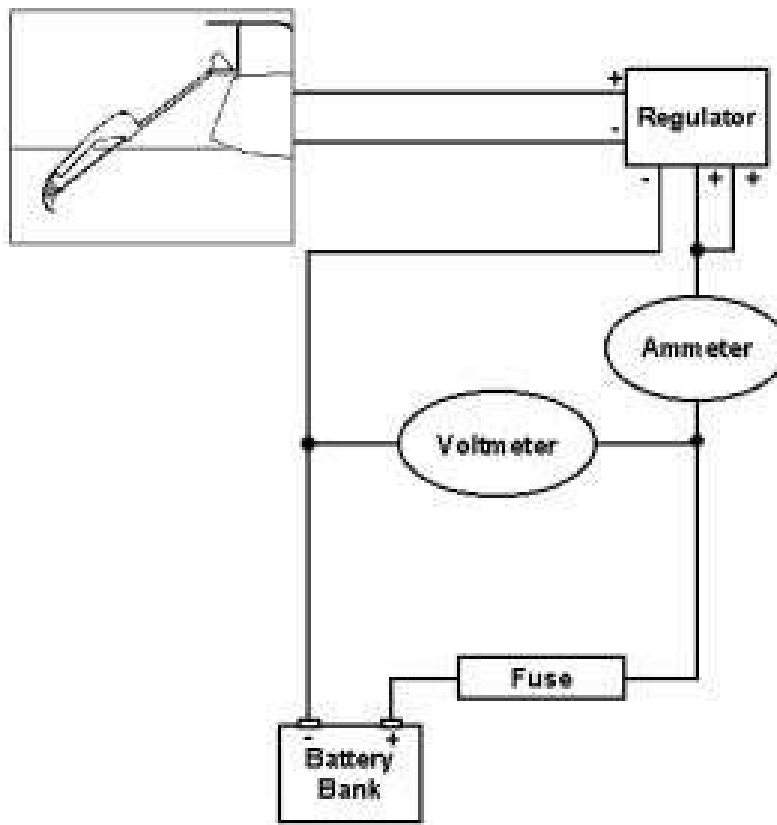
Wiring diagram showing twin battery bank installation with regulator



Wiring diagram showing single battery bank without regulator



Wiring diagram showing single battery bank with regulator



Charge Regulation

The Sail-Gen is capable of delivering sustained levels of high power. Therefore it is important to ensure that overcharging of the batteries does not occur.

Overcharging is characterised by excessive battery terminal voltages causing internal heating and loss of electrolyte. Permanent battery damage can result. The two main strategies to avoid this are:

Manual Monitoring

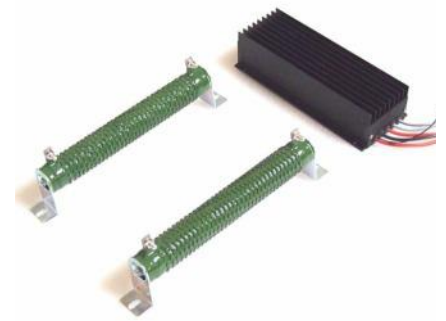
This entails monitoring battery state and simply starting or stopping the Sail-Gen as required. For owners who live aboard, this is a viable option, particularly if the battery bank is of high capacity.

Dump Regulation

Eclectic Energy Limited or your local distributor can supply a dump regulator which is installed in close proximity to the batteries. The regulators are factory set at 14.2 (12V) and 28.4 (24V). The 12 volt regulator is adjustable between 11.5 and 17V. You set the voltage in accordance with the battery manufacturer's recommendations and as this pre-set voltage is reached, the regulator progressively diverts the Sail-Gen's output to a pair of large wire wound resistors

The Pros and Cons of Regulation

The Sail-Gen will operate perfectly well if connected directly to the batteries. However Eclectic strongly recommends that the Sail-Gen is used in conjunction with a charge regulator. The charge regulator's function is to prevent possible battery damage through overcharging. Charge regulators monitor the system voltage and divert power from the Sail-Gen away from the battery and into dump load resistors once the batteries are full and an upper pre-set voltage limit has been reached. The 6TB dump type regulator typically supplied by Eclectic also features an integral charge splitter allowing connection to two independent battery banks.



Regulator Interaction - Bypass switch

Where there are multiple charging sources and multiple charge regulators, there is a possibility of regulator interaction. This is only likely to occur as the batteries approach fully charged and is not dangerous or damaging to any of the systems. However it does result in some potentially useful power being lost.

Interaction occurs because any charging source has to apply a voltage higher than the battery terminal voltage in order to pass a charging current around the circuit and through the battery. As charge regulators work by sensing battery terminal voltage, any charging device producing an elevated voltage (such as solar panels) can cause another regulator to dump power prematurely.

For this reason, where possible, a single charge regulator of suitable capacity should be used. The 6TB type regulator usually supplied with the Sail-Gen is rated at 40 amps (12V) or 20 amps (24V). As well as the Sail-Gen, this regulator will also accept the input of up to 100 watts of solar panel.

If it is impractical to use a single charge regulator, an alternative solution is to fit one or more of the regulators with a bypass switch. On passage when the system can be monitored, the switch can be used to bypass the regulator and avoid unwanted dumping of power. When the boat is left, the bypass switch is reversed so the dump function is restored and the batteries protected.

Note that where a bypass switch is fitted, the charge splitting function of the regulator is lost when the switch is activated.

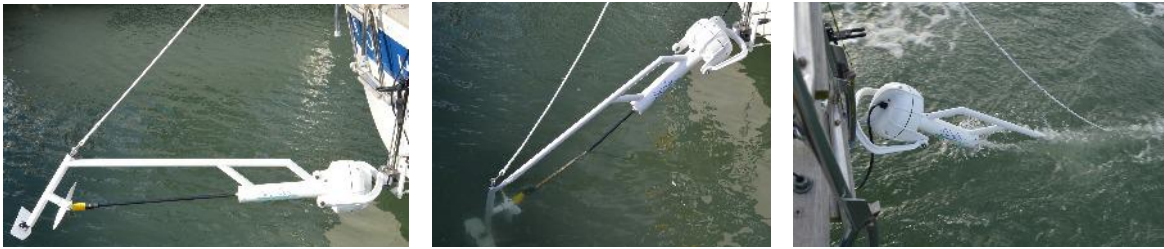
We recommend that the bypassed output is fed to the largest bank (usually the service batteries). Alternatively, a dedicated charge splitter can be installed to distribute the unregulated 'bypassed' regulator output across two banks. A bypass switch is also useful for applying a periodic 'equalisation' charge to the batteries. This is where the owner deliberately allows an overvoltage condition to occur for a limited time (30-40 minutes), in order to mix and re-distribute the battery electrolyte.

Deploying Sail-Gen

Once installed the Sail-Gen is intended to remain permanently in position at the transom. However, the unit can be easily removed if this is required for racing etc.

Important:

It is recommended that a security lanyard is rigged. This would comprise a length of strong line attached through one of the holes in the alternator back plate flange secured to a strong point on the yacht. The safety line offers additional security in the event of a severe collision with floating debris. If the Sail-Gen mounting is broken by impact the security lanyard increases the chances of recovering Sail-Gen as it will remain attached to the yacht.



To deploy, Sail-Gen the retaining shock cord lanyard is released from the cam cleat on the frame clip. The frame can then be pushed out of the frame clip and the impeller unit lowered towards the water, pivoting at the alternator. This lowering is controlled by the recovery lanyard connected at the lifting eye. The weight of the Sail-Gen's alternator acts as a counter-balance, making deployment and subsequent recovery very easy.

When operating, the diving plane controls the running depth of the water impeller. The Sail-Gen's diving plane can be adjusted to either increase or decrease the angle of attack. Increasing the angle of attack will encourage the impeller to run deeper.

Diving plane adjustment is straightforward. An adjustment screw and lock nut is provided at the attachment point of the recovery lanyard.

The Sail-Gen's dive plane produces a very substantial hydrodynamic force which keeps the impeller submerged. This force increases with boat speed, and recovering the unit would be very difficult without slowing the yacht. To address this, the Sail-Gen features a recovery mechanism on the diving plane.

To Deploy:

- Ensure the recovery lanyard shackle is attached to the lifting eye above the water impeller. Note that tension on the lifting eye alters the pitch of the diving plane which facilitates both deployment and recovery.
- Release the shock cord from the cam cleat on the upper frame clamp which retains the Sail-Gen in its vertical parked position.
- Release the lock which holds the yoke centrally.
- Using the recovery lanyard, gently lower the Sail-Gen into the water.
- The tail of the recovery lanyard should be secured such that it limits the maximum downward travel of the Sail-Gen.
- Deploy the Sail-Gen after the yacht has left her berth or mooring and is making way forwards
- Avoid deployment where the yacht is manoeuvring in a marina or where there is a possibility of the yacht making sternway.

The Sail-Gen is usually deployed at the beginning of a passage and recovered at the end. With tow-rope type generators, recovery is difficult and requires the yacht to be slowed or stopped. The Sail-Gen is recovered easily regardless of boat speed.

The ability to rapidly and effortlessly deploy and recover the Sail-Gen greatly adds to the utility of the unit. This is of particular value where floating seaweed or other debris is present and need to be removed periodically from the water impeller.

The Sail-Gen pivots in the vertical plane from the mounting lugs which form part of the alternator housing. This arrangement places most of the alternator's weight behind the pivot point and enables it to act as a counter-balance to the rest of the machine. This means that the Sail-Gen requires very little effort to raise and lower when the yacht is stationary.



When underway, the Sail-Gen impeller depth is controlled by a diving plane. Typically, the unit will run 300-400mm beneath the surface of the water. At boat speeds above 3 – 4 knots plus, the hydro-dynamic force produced by a dive plane becomes increasingly substantial, and this would make recovering the unit from the water very difficult. However, with the Sail-Gen the dive plane is active in pitch. Tension on the recovery lanyard causes the dive plane to move to a negative angle of attack, and this drives the impeller unit to the surface. It is then very easy to lift the Sail-Gen out of the water and into the vertical parked position.

Run



Recover



Positive dive angle



Negative dive angle

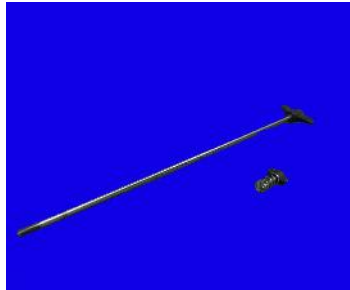


'C' Bracket Lock

The Sail-Gen is free to pivot laterally at the 'C' bracket. This degree of movement enables Sail-Gen to track in the yacht's wake and allows for steering and wave action. However, when Sail-Gen is recovered and in its fore and aft 'parked' position it is often desirable to lock the yoke to prevent the alternator moving as the yacht rolls. Depending on the installation and available access the 'C' bracket lock screw may be of the short mini wing type, or an extended form allowing operation from coaming level.



Extended lock screw



Standard lock screw

Important Note

It is vital that the 'C' bracket lock screw is fully released before the Sail-Gen is deployed. Operating Sail-Gen with the lateral pivot locked can result in serious damage to the unit.

Stowing Sail-Gen horizontally across the transom

Where it is desirable to 'park' Sail-Gen athwartships across the yacht's stern rather than vertically, special bearing blocks are available which allow 180 degrees of lateral movement of the alternator and yoke. The standard 'C' bracket only allows for 90 degrees of movement.



Standard 'C' bracket



180 degree bearing blocks

Note where bearing blocks are employed the 'C' bracket and yoke are left permanently locked together with a miniwing.

Sail-Gen Correct use of the recovery lanyard

When the yacht is underway, the Sail-Gen will 'fly' on its dive plane. However, when the yacht is stationary, the Sail-Gen will pivot downwards towards a vertical position. This is generally undesirable. To prevent this occurring, secure the recovery lanyard to the push pit rail or other convenient fixed point and adjust the length of the lanyard such that the Sail-Gen will not pivot down beyond 70° of the horizontal.



Secure the tail of the recovery lanyard

Adjusting the Dive plane

Typical setting angles for the dive plane are in the range of 6 – 12 degrees, i.e. 96 – 102 degrees from the forward face of the vertical strut which carries the water impeller.



Running shallow



Running deep

Having set the dive plane angle and achieved an acceptable impeller running depth, the dive plane is unlikely to require any further adjustment. A satisfactory impeller depth is around 300mm when the yacht is on an even keel and under way.

Adjustment of the dive plane angle is made holding the adjustment nut beneath the lifting eye and unscrewing the eye anti-clockwise by several turns. The lock screw can then be rotated to make the actual adjustment. Turning the adjustment nut anti-clockwise increases the angle of attack of the dive plane, causing the impeller to run deeper. Turning the adjustment nut anti-clockwise decreases the angle of attack of the dive plane, resulting in more shallow operation. Note, after each adjustment the lifting eye should be screwed down firmly clockwise onto the adjustment nut to lock it in position. When tension is applied to the lifting eye as the Sail-Gen is recovered, the dive plane moves from a negative to a positive angle of attack, making it surface which facilitates recovery.



Dive plane adjustment

Maintenance

The Sail-Gen is built from high quality and corrosion-resistant materials. The unit is designed to require minimal maintenance, but a little attention will pay dividends in terms of appearance and performance. The alternator requires no routine maintenance and is hermetically sealed. The alternator is fitted with rubber-shielded, stainless steel bearings which are protected by a twin lip, radial shaft seal. A dry-running spherical, self-aligning bearing is fitted at the top of the tower. Elsewhere, dry-running bearing bushes are used. The water impeller unit utilises a specially designed transmission which presents the impeller perpendicular to the water flow. The transmission element is robust and maintenance free. It is lubricated by a combination of synthetic oil held within the bearing material itself and water. When dry following immersion in sea water, the unit may feel stiff. This stiffness is usually due to dried salt deposits and the drive should free up when the unit is returned to the water.

The Sail-Gen's water impeller rotates about 5 million times for every thousand miles sailed, and like all mechanical devices, the water transmission is prone to wear.

Eclectic Energy recommends that the transmission elements are replaced every 8 - 10,000 nautical miles, after approximately 40 - 50 million revolutions, in order to maintain optimum performance. This is a straightforward procedure that can be undertaken by the owner.

A full range of spare parts are available for the Sail-Gen. All spare parts are supplied with fitting instructions.

Sail-Gen System monitoring

The performance of the Sail-Gen is best assessed and monitored by installing a dedicated ammeter placed in line between the Sail-Gen and the charge regulator. The ammeter will display the total charging current produced by the Sail-Gen. Note that if the ammeter is placed in the circuit between the regulator and the batteries, then it will not record any power that has been diverted and dumped by the regulator as the batteries approach fully charged.

Where the ship is fitted with a battery monitor, this can be used to assess Sail-Gen performance. A battery monitor displays and records all current flowing into and out of the battery. By comparing current drawn with current supplied, the monitor will display the remaining useable charge available.

Log Calibration

As the Sail-Gen's output is critically dependent on the boat speed. Any inaccuracy in the reading produced by the ship's log may lead you to think that Sail-Gen is either under or over performing.

Consider this before deciding there is a problem with your Sail-Gen.

Battery Monitor

If your yacht is fitted with a digital battery monitor, it will be driven from a shunt installed close to the batteries. Shunts are typically about 100mm long, consisting of a brass bar with a terminal post at each end. One side of the shunt is connected directly to the battery terminal. All other connections should be made to the opposite side of the shunt, which may be connected to a busbar to allow for multiple connections. The shunt is most usually placed in the negative line. When wiring the Sail-Gen to a system fitted with a shunt, observe polarity and connect the appropriate Sail-Gen output cable to the non-battery side of the shunt.

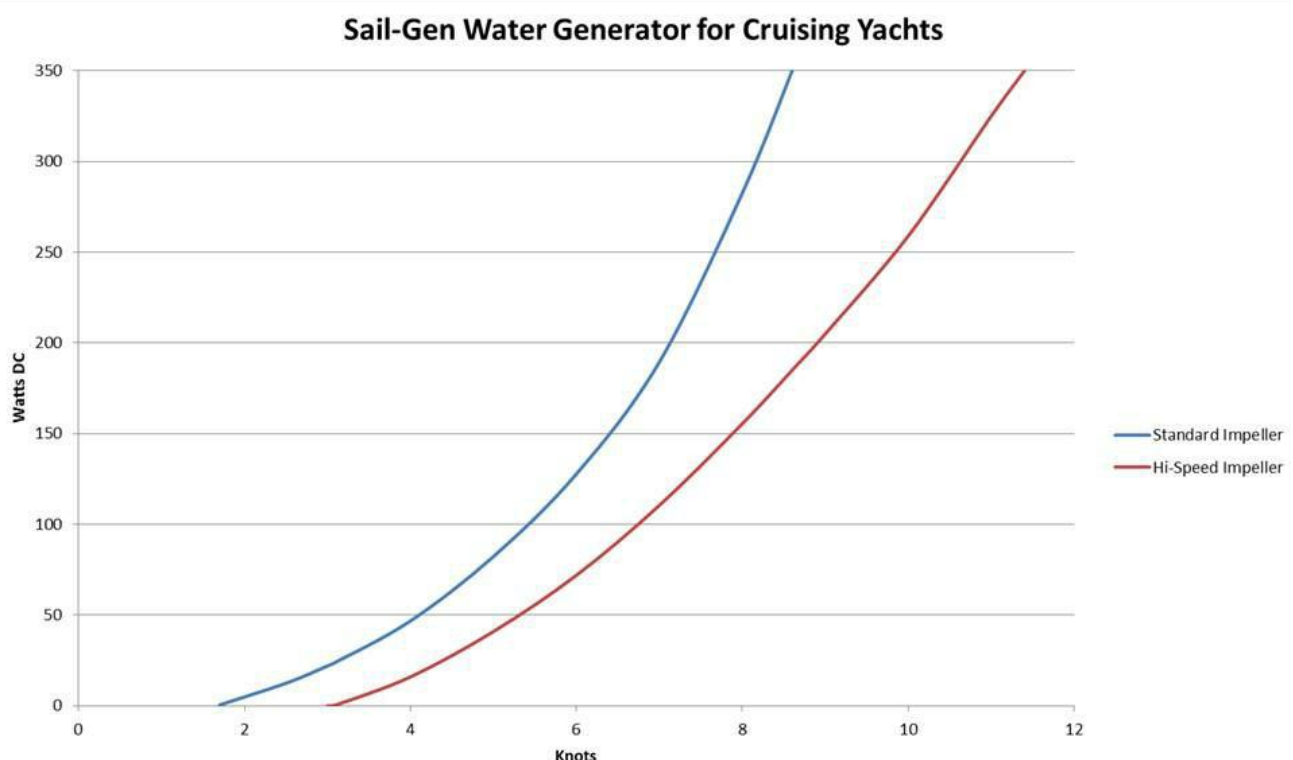
Observing polarity, the other Sail-Gen output cable should be made directly to the battery terminal or associated busbar. The Sail-Gen's output will now pass through the shunt and the battery monitor will display a reading. If the shunt is bypassed by connecting both positive and negative output leads directly to the battery, the meter will fail to 'see' the Sail-Gen, and register no output. Note that where a battery regulator is fitted, dumped energy from the Sail-Gen will not be seen by the battery monitor.

Performance and Expectations

Reference to the charge current on a dedicated ammeter or battery monitor, in conjunction with a reading of boat speed from the ship's log, should produce figures which correspond to the published power performance data.

If the charge current appears low for the boat speed, consider the following checks before deciding there is a fault:

- When measuring performance, the state of charge of the batteries should be taken into account. A discharged battery accepts charge current more readily than a charged one.
- When evaluating Sail-Gen performance, ensure that the batteries are discharged by 30 – 40%. Alternatively, switch on multiple electrical appliances in order to reduce the battery terminal voltage.
- Note that where a charge regulator is fitted, it will act to prevent battery damage through overcharging. Surplus power diverted by the regulator to the dump resistors will not be seen by a battery monitor. A dedicated inline ammeter may also show a reduced reading when the regulator is active and the dump resistors are connected. This is because the electrical load provided by the dump resistors retards the alternator, lowering the Sail-Gen's efficiency.
- Where low outputs are evident, first suspect loose or corroded connections. Check and re-make these connections as necessary. Also, check the cabling for broken insulation or other damage.
- Ensure that the batteries are in good condition. A defective cell within a battery will greatly reduce overall charging efficiency.



The values given are representative of performance but actual outputs will vary depending on individual installations and sea state.

Specifications

Performance and Power outputs	At 6 knots boat speed	125 W	
	At 8 knots boat speed	280 W	
	Daily yield at 7 knots	350 amp hours @12V	
	Maximum Rotational speed	approximately 1100 RPM	
	Cut-in Boat Speed	Standard impeller 1.7 knots High speed impeller 3.1 knots	
Water impeller	Standard for 0–9 knots	290 mm diameter	
	High speed for 0–15 knots	240 mm diameter	
	Material	LM6 alloy casting, hard anodised & powder-coated	
Dive plane	Adjustable trim	Minus 10° to plus 20°	
	Active Recovery	Actuated by recovery lanyard	
	Material	Aluminium, anodised and powder-coated	
Drive shaft	Drag	<15 kg @ 6 knots	
Vectored drive	Telescopic	GRP and carbonfibre	
	Eclectic pin drive	Robust and reliable – user serviceable	
Dimensions	Overall length	1690 mm	
	Maximum width	335 mm	
	Weight	16.7 kg	
	Weight including mounting	19.3 kg	
Mounting	Type	Yoke gimbal	
	Movement	Vertical/ horizontal	
	Materials		LM6 alloy, powder-coated
			Aluminium, hard anodised Stainless steel
	Alternator pivot point	500 mm above static water line	
	Installation position	Recommended within 500 mm of the yacht's centre line	
	Bracket height on yacht	400 mm or 540 mm	
Alternator features	Alternator type	Reversible alternator yoke	
		Direct drive, axial field	
	Design	12 pole permanent magnet generator	
		3-phase AC with rectification	
		Outputs direct current (DC)	
	Voltages available	Annular high energy magnet rotors	
		Encapsulated stator windings	
		12 V, 24 V	
Materials	Aluminium alloy housing, fully sealed		
	Alocrom 1200 corrosion protection and polyester powder-coated		
	316 stainless steel shafts, A4 stainless fasteners		
Electromagnetic emissions	C.E. compliant		
Finish	Colour, white		
Warranty		12 months	

Trouble Shooting - Points to check if you suspect a problem

Mechanical Issues

If the Sail-Gen water impeller continually surfaces and will not 're-bury' check the dive plane adjustment, Also check that the dive plane actuating rod moves freely and returns fully under the pressure of its spring.

Typical operating dive plane angles are between 6-12 degree positive (i.e. leading edge of dive plane lower.) This means the angle between the vertical frame member which carries the water impeller, and the face of the dive plane should be in the range of 96-102 degrees when there is no tension on the recovery lanyard.

If the water impeller continues to surface, check that the alternator pivot point is the specified distance above the static water line, and that the installation is within 500mm of the yachts centre line.

Finally suspect turbulent water flow from a rudder or skeg, and re-locate the unit so it operates in clearer water.

Always ensure the 'C' bracket/ yoke lock screw has been released prior to deployment and ensure Sail-Gen is free to pivot laterally.

- If power output is low check for weed or debris fouling the water impeller. Also check for undue friction when the impeller is rotated. If the rotation is stiff or hard spots are present suspect bent or damaged drive pins. Also check for axial play at the impeller. There should be 1-2mm of free movement of the impeller along the axle. If this is not present suspect fishing line or similar wound around the impeller shaft at the thrust bearing.

Electrical Issues

- If there is no power output evident first suspect poor or broken connections or blown fuses.
To test the alternator disconnect at the end of Sail-Gen's output lead. Then connect a multi-meter set to the 0-20 VDC range connected between the positive and negative cable.
Spinning the drive shaft by hand should produce 3-5 volts on a 12 volt machine and 6-10 volts on the 24 volt variant. If you can produce voltages of this order it indicates that the Sail-Gen is OK and the fault lies elsewhere.
- Next check i.e. the charge regulator for a possible fault. The easiest way to do this is to connect Sail-Gen directly to the battery by passing the regulator. If the charging current now flows check the regulator manual and regulator trouble shooting guide (Available on Eclectic Website, www.eclectic-energy.co.uk).
If no charging current is shown on the ships battery monitor, ensure Sail-Gen is connected to the non-battery side of the shunt which drives the monitor. Refer to body of this manual for further information.
Also the 6TB12 and 24 type regulators have an integral charge splitting function, i.e. can charge two battery banks simultaneously. If only one battery bank is monitored any 'missing' charge may be passing to the other battery bank.
Where the water impeller rotates very slowly but no mechanical friction is evident there may be a short circuit in the Sail-Gen's output cables. To check disconnect Sail-Gen at the end of its output cable and see if the rotation frees up. **Note - Short circuiting the output of Sail-Gen produces an electro magnetic braking effect.**

Spares

A full range of Sail-Gen spare parts are available from Eclectic Energy. Refer to website for help in identifying specific components and part numbers. All spares are provided with fitting instructions. For extended cruising it is advisable to carry a small number of those parts most likely to be lost or wear.

Recommended spares include:

80037 - Water drive bearings

80132 - Conical connector kit

80023 - Drop nose pin & lanyard

80060 - S/G alternator bearing & seal kit

80148 - 'O' ring housing seal

DECLARATION OF CONFORMITY

We declare that this product complies with the following standards/directives:
89/336/EEC

Product description: 'Sail-Gen' Alternator

Part number: 80170/1/4/5

Serial number:

Signed: *Peter J Anderson*

Director

Eclectic Energy Limited

Unit 22 Sherwood Networkcentre

Sherwood Energy Village Ollerton

Nottinghamshire

United Kingdom

+44 (0) 1623 835400

NG22 9FD

GUARANTEE

SailGen is guaranteed against faulty parts and manufacture for a period of twelve months from date of purchase. The unit should be returned prepaid to:

Eclectic Energy Ltd Unit 22 Sherwood Networkcentre
Sherwood Energy Village Ollerton
Nottinghamshire United Kingdom NG22 9FD

Damage caused by mishandling, faulty installation or accident is not covered. Eclectic Energy can not be liable for damage caused by SailGen in the event of accidental contact, incorrect installation or insufficient care.

However, Eclectic Energy Limited is committed to provide after sales care as fully and efficiently as possible in order to support our customers.

This guarantee does not affect your statutory rights.