

Australia all4solar | 123 Harbour Drive | Trinity Park 4879 AUS | [www.all4solar.com.au](http://www.all4solar.com.au)



# **Operator's Manual**

## **Advanced Electric Direct Drive Inboard Engine**

**A4S IB 2**  
**A4S IB 3**  
**A4S IB 6**  
**A4S IB 8**

**Low revs**  
**High torque**  
**Maintenance free**  
**Low cost**

Dear Customer

Congratulations! You purchased a high-quality product with exceptional performance. To ensure this for many years, we kindly ask you to read this document carefully and familiarize yourself with the motor before using it.

This manual has been compiled to help you install and operate your inboard engine with safety and pleasure. It contains details for the motor, all equipment fitted or optionally supplied and information on its installation, operation and maintenance.

Please note, that incorrect installation and operation can cause severe damages or injuries and will void any warranty from the supplier.

We wish you a lot of pleasure with this unique „green power“- motor.

all4solar

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Please note the following information in this handbook and report these, as well as any change of ownership to the manufacturer | reseller ([service@all4solar.com.au](mailto:service@all4solar.com.au)) within 4 weeks of purchase to register for full warranty entitlement (see section 8).

◆ Owner: .....

◆ Phone/Email: .....

◆ Date of purchase: .....

◆ Dealer/point of sales: .....

◆ Serial number (see motor): A4S IB ..... | ..... KW

◆ Type: direct drive

◆ Main use: ☐ motor boat ☐ sail boat

Check the actual status of any motor before purchase a used engine – send an email to [service@all4solar.com.au](mailto:service@all4solar.com.au) indicating the serial number.

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## 1) Hazard communication

Before operating your motor, you have to carefully read and understand this operator's manual.

As you read this manual, please note the hazard warnings which alert you to safety precautions related to unsafe conditions or operating procedures. We have included these warnings because we are concerned about your safety.

### 1.1 Hazard signs



#### **DANGER**

Calls attention to immediate hazards that **WILL** result in severe personal injury or death.



#### **WARNING**

Identifies hazards or unsafe practices that **COULD** result in severe personal injury or death.



#### **CAUTION**

Indicates hazards or unsafe practices that **COULD** result in minor personal injury or product or property damage.



#### **INFO**

Indicates important information for a safe and easy operation or highlights special circumstances.

For any third-party equipment (batteries, switches, fuses, cables etc.) read the operations and instructions manual as well as the safety recommendations of those suppliers.

If at any point, you do not understand this documentation or explanations seem unclear, do not proceed the installation or operation prior to contacting your engine dealer!

## 1.2 Unpacking



### WARNING

Do not leave any small parts unattended as small children and animals could swallow. Clean the engine, controller and all parts and check for any damages. Fix the motor to a stable frame that it cannot drop or move. The engine has always to be lifted by two people or with adequate lifting equipment.

If any part of the motor, the controller or the accessories are damaged, do not install or operate. Contact us immediately.

## 1.3 Eligibility of the boat



### WARNING

Only install your motor on boats which are suitable to carry the weight of the engine and the accessories as well as the battery. Please note, that AC induction motors produce more thrust than a diesel or petrol engine with the same KW output. The output power for the electric motors is measured at the propeller shaft. An 8-10 KW direct drive low rpm electric inboard motor can be compared to a 20 HP diesel engine.

Do not connect your motor to the battery or any other power source before you have not read the entire manual.






This engine is suitable for a direct connection of a propeller shaft for boat propulsion. It is specially designed for this purpose. Do not use it for other applications like road vehicles.

For information about dimensions, weight and power output as well as the recommended boat weights, check the engine documentation and section 9 of this manual.





## 1.4 Motor & accessories

If you purchase one of our advanced inboard engines, you receive the basic accessories which will support the easy installation on your boat. The installation of an electric inboard motor system is not “rocket science”, but should be planned and executed by a boat builder or an experienced person. Before ordering, please check what material you require. The list below gives you an overview of everything supplied as standard and required as option.



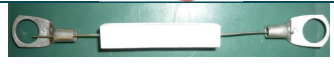


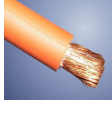


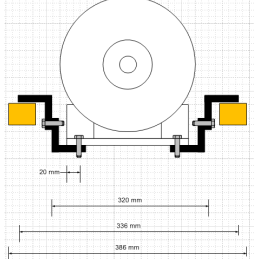
<b>THE FOLLOWING PRODUCTS ARE INCLUDED WITH EVERY ENGINE</b>		
Electric motor with engine mounts and shaft coupling (flexible standard coupling)		
Motor controller unit	Suitable for engine rated voltage and current. Air cooled. Additional ventilation (12 V fans optional). Controller is installed on an aluminium plate and includes the main internal battery fuse, the shunt (display) and connections to the engine, the display, the switches. Optional: Breaker to connect a solar charge system or charger (max. 30 Amps).	
Harness wire / cables controller to lever and key switch including plugs	1.5 meter cables from controller to the electric motor / Sensor cable from controller to electric motor / 2 meter cable to display / 2 meter cable to switches / 2 meter cable to throttle joystick.	
Single joystick throttle forward and reverse with key switch.	Other variations available as option. Comes with a 1 meter 3 wire cable. Cable length upto 20 meter available as option. System set to 5 K Ohm pot – wiper to negative = low / wiper to positive = high. Or hall joy stick 3 wire.	
ANL 100-200 Amp fuse block with fuse	Included in controller unit	
Safety sticker		
Documentation	🔹 Inboard Engine manual	

	<p>☛ Controller manual</p> <p>☛ Monitor / Display manual</p>	
Standard main switch 100-300 Amp (depending on engine type)	<i>Optional. Any DC switch can be used to disconnect the battery from the system. DC rating and Current rating need to comply with the systems max. voltage and amps.</i>	
Digital Battery monitor	Digital battery monitor, showing battery volts, current and watts in/out of battery with cable (4 wire or USB depending on type)	
Main contactor	<p>100-400 A / 48v/72v coil (10-15 watts)</p> <p>Including diode to be used over coil and 10 K resistor over connectors</p> <p><b>+</b> <b>-</b></p> <p>   </p>	

**THE FOLLOWING PRODUCTS NEED TO BE ORDERED SEPARATELY IF THEY ARE REQUIRED**

Anderson type plug 350 A	ONLY IF SEPARATELY ORDERED	
Anderson type plug 175 A	ONLY IF SEPARATELY ORDERED	
Anderson type plug 50 A	ONLY IF SEPARATELY ORDERED	
DC-DC converter from engine voltage (48/72/96 V) to 12 V for pump & appliances max. 240 watts per unit	ONLY IF SEPARATELY ORDERED	
Including connection cables and plugs		
High Power 350-400 Amp 160 V DC fuse block with fuse. Ceramic	ONLY IF SEPARATELY ORDERED	

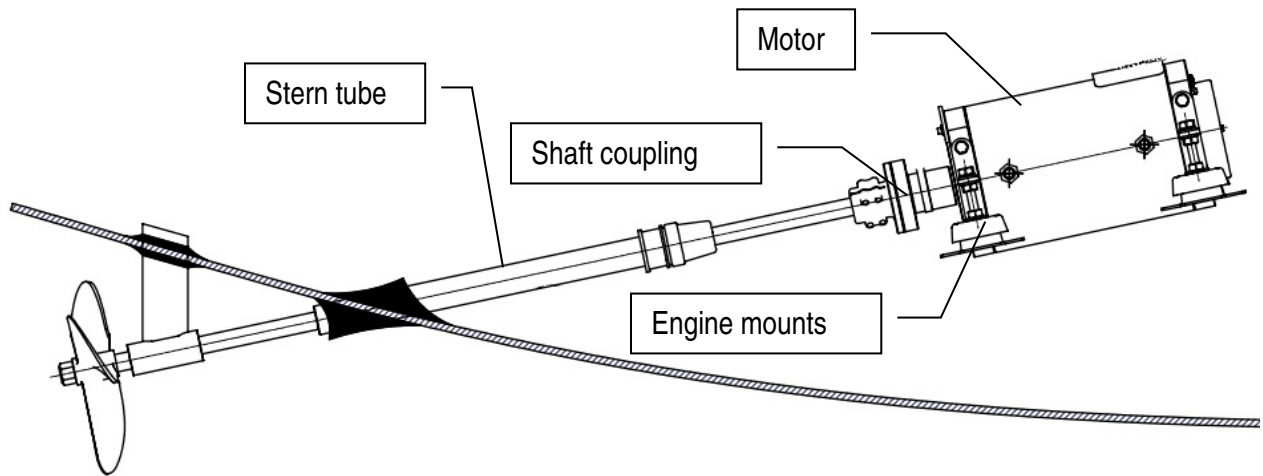


fuse block.		
Main Switch – Blue Sea HD 600 Amp   100 V	<i>ONLY IF SEPARATELY ORDERED</i>	
Main Switch – Blue Sea Mini 350 Amp   50 V	<i>ONLY IF SEPARATELY ORDERED</i>	
Resistor 470 Ω   10 W	<i>SUPPLIED WITH EVERY MAIN SWITCH or CONTACTOR to pre-charge controller capacitors</i>	
Emergency Switch – 250 A (for battery) incl. resistor	<i>ONLY IF SEPARATELY ORDERED</i>	
95 mm <sup>2</sup> flexible cable for 300 Amp / 48-96 volts 3 meter	<i>ONLY IF SEPARATELY ORDERED</i>	
50 mm <sup>2</sup> flexible cable for 200 Amp / 48-96 volts 3 meter	<i>ONLY IF SEPARATELY ORDERED</i>	
32.5 mm <sup>2</sup> flexible cable for 150 Amp / 48-96 volts 3 meter	<i>ONLY IF SEPARATELY ORDERED</i>	
Shaft coupling 15 – 35 mm To attach to a shaft. Engine shaft = 25 mm  Flexible couplings available upto 45 mm <sup>2</sup> shafts (TO ORDER SEPARATELY)	<i>See section 11 &amp; 12 for propeller and prop shaft information</i>	
Engine mount adapters	<i>4 adapters for engine mounts on side of the motor. Existing flexible engine mounts can be used. Bolted to the base plate. Motor cover has to be removed and can be shortened and fixed to the new engine mount bolts.</i>	

More parts available like various shaft coupling discs and couplings to propeller shaft.

Material, size and colour may vary, without changes to the performance and functionality. The manufacturer reserves the right to change without prior notice.

## 2) Installation on the boat



Usually inboard engines are mounted on existing frames which are 400 – 600 mm wide. As these engines use less space (see dimensions) than a diesel engine there is usually more than enough space available.

The engine can be installed in any angle. Please note, that the engine should be mounted with the engine mounts supplied onto a stable frame.

### 2.1 Installation of motor

Take the dimensions of the engine frame with the engine mounts. Then adapt the existing frame in the engine compartment of the boat. Drilling additional holes to the engine frame weakens the stability and should be avoided.

Do never install the engine without engine mounts, even electric engines do not produce the vibration experienced by combustion engines, the lack of flexibility can damage the rotor / shaft bearings.

**Engine mounts:** We supply 4 engine mounts. Depending on the size of the engine and the application. If full torque is required, rubber engine mounts should be installed on top and bottom of the plate to secure the torsion forces of the electric motor.

The engine should have space to any part of the engines compartment of at least 40 mm. Allow more space for the air-cooled versions, as well as adequate ventilation in the engine room.

For the connection to the propeller shaft or a gear box a suitable shaft coupling must be used. Please check section 9 to comply with the maximum torque / force of the engine.



This motor has open turning parts and when operated must be protected to avoid damages or serious injuries.

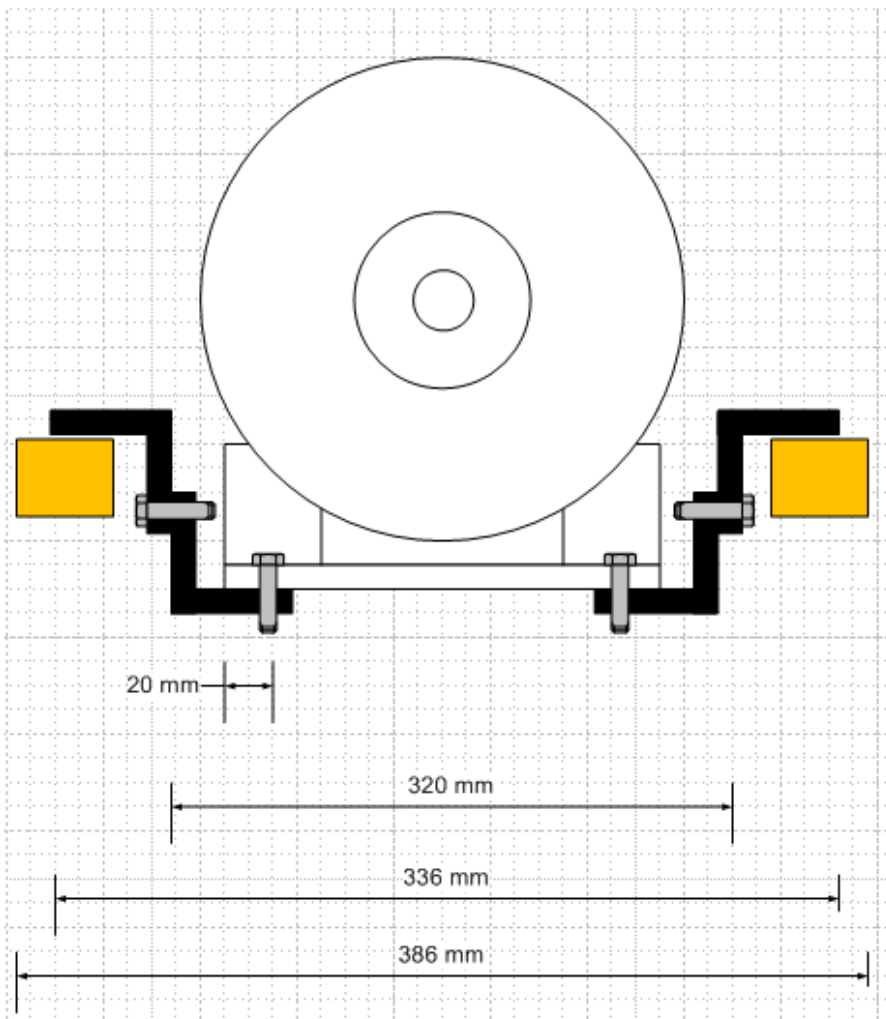
**Important:** When running the motor without load, due to the high weight of the rotor unit, there can be an imbalance. Please check the controller settings and reduce the maximum speed setting use wheel balancers to compensate.



Only release on rotor bolt at the time and fix the balance weight. For low speeds glue on balance weights can work, but need to be checked from time to time.

The engine can be supplied with extended engine mounts:

Example for IB8 – 4 units required – supplied with bolts. Remove the existing engine mounts and mount the brackets. Bolt the engine mounts to the top part of the brackets. The engine cover needs to be shortened and fixed on top of the brackets. The engine cover can be removed, if the engine compartment is sufficiently secured.





## **DANGER**

When running the motor, keep a distance of at least 1 meter or close the compartment.

### **2.2 Installation water pump (water cooled engines only)**

Not applicable

## 2.3 Electric power supply



### CAUTION

This guide helps you to setup your electric boat propulsion respecting the highest safety levels. Do not connect this engine directly to a battery without a main switch, a safety switch and a fuse! With the Kräutler inboard engines all the gear is supplied and included in the price!

The motor may only be connected to onboard power systems and accessories of 48 or 72 volts which comply with the CE / ISO standard. For the correct voltage of your system check the technical data in section 9.

Between the battery and the main switch a 100-300 Amp fuse (suitable for 50 to 100 volts DC) has to be connected (depending on the maximum current for the engine). **All engines / controllers are supplied with a main fuse, but we still recommend to use another fuse to the battery connection.**

350 A | 100 V

100 – 400 A | 50 V



- All installations and insulations must comply with low voltage (up to 100 volts) and marine electric installation regulations.
- The main switch must be rated for 50 or 100 DC | 300 Amp continuous current.
- A safety switch should be connected between the main switch and the battery. The switch has to be accessible to the operator always! The controller safety switch does not replace the battery safety switch!



Or similar switch suitable for 300 A | 50 volts

- The cables should be as short as possible. B&S tinned cables are to be used with a sufficient square size of 32.5 mm<sup>2</sup> (50 volts | 150 Amp). For permanent full power use of 200 Amps, up to 100 volts or cable lengths over 3 meter 50 mm<sup>2</sup> cables are recommended.
- The lugs and battery terminals need to be eligible for 200 Amp / 50 to 100 volts DC.
- The motor is supplied with SB 175 Anderson type plugs. All connections must be mounted at a dry place under deck / covered against rain and sea water. The controller board should be made of conducting material (plastic or wooden board 10 – 15 mm).
- The maximum battery idle voltage may not be higher than 60 volts DC for 48 V engines

or 84 volts for 72 volt engines.

- The maximum battery voltage under power is 56 volts for 48 volt engines and 80 volts for 72 volt engines. The minimum battery voltage is 40 volts DC for 48 volt engines and 64 volts for 72 volt engines. Variations of these voltages can cause severe damage to the controller and the electric motor.
- The onboard installation of the power supply should be supervised by an authorized specialist.

Operation is only allowed with a battery power supply. The direct supply from solar panels or generators can damage the controller if the voltage limits are controlled. If the battery is charged with a battery charger or solar panels, the motor should be disconnected by the main switch unless suitable charge controllers are used.

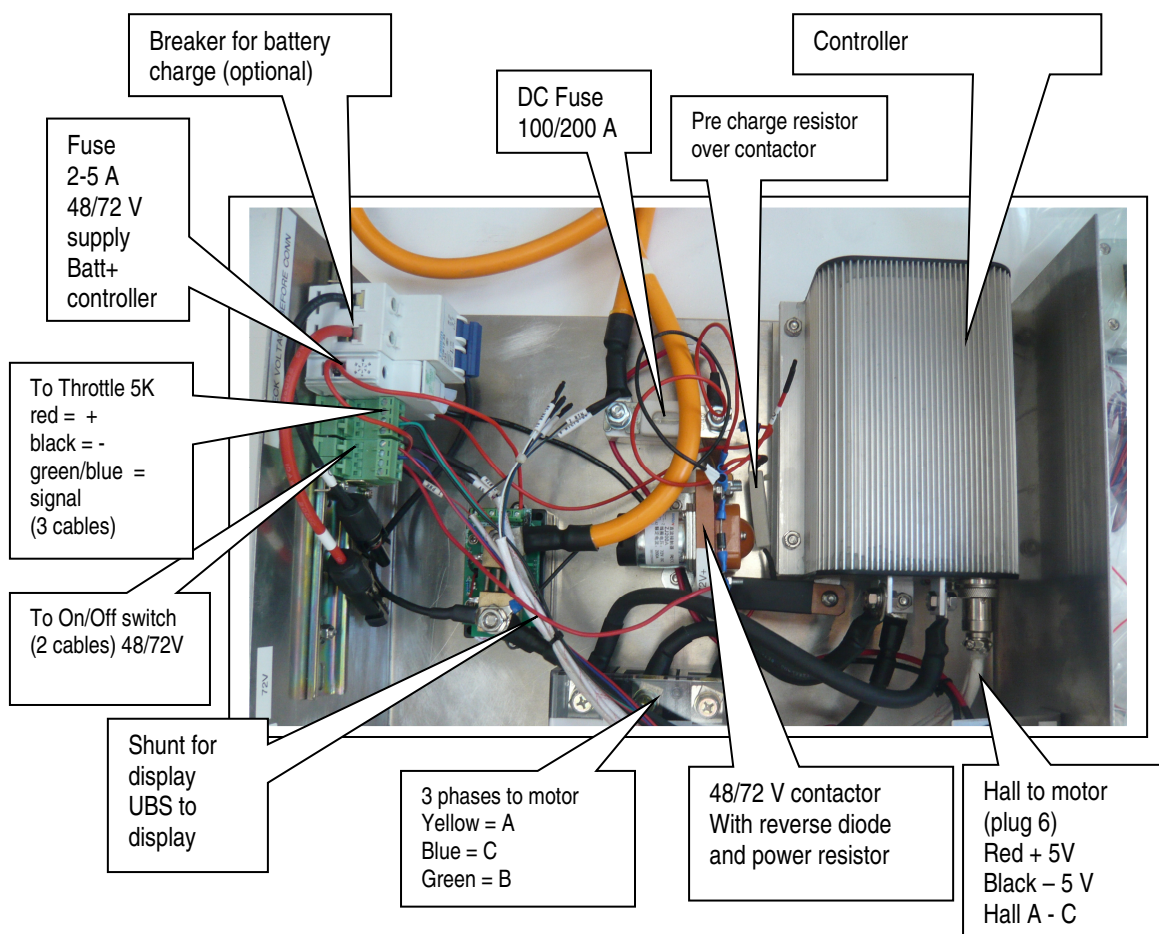
Only use battery chargers and cables, suitable for the use in the marine environment. The safe installation and operation of those is not part of this manual.

***Do not connect the engine to the propeller shaft until you have finished all of the electric installation and tested the engine to run in both directions!***



### CAUTION

The controller is supplied with a supporting aluminum frame, containing the internal fuse, the fuses, a main contactor or main switch and the distribution connectors for the motor, battery, sensor, switch and throttle connections. All the connections are prewired with plugs.



**See the supplied controller documentation for a wiring diagram operation and safety information.**

- ◆ Connect the controller to the motor by first connecting the 6 wire sensors plug (either white plug Or green plug if DIN rail setup).
  - Black = Neg / Ground
  - Red = 5 V pos from controller
  - Yellow = Phase A
  - Blue = Phase C
  - Green = Phase B
- ◆ Connect the three-phase motor power connection with the 6 mm lugs to the controller.
  - Phase A = YELLOW
  - Phase B = GREEN
  - Phase C = BLUE
- ◆ Connect the lever and the key switch (green plugs on main board).
- ◆ As safety switch a standard toggle switch can be used or any other switch to comply with safety Regulations instead or in line with the key switch. The safety switch will switch off the controller and stop the motor. Still the main power switch should be close to the operator for main power disconnection.
- ◆ Connect the digital monitor (USB Plug to shunt).
- ◆ Before connecting the system to the battery, make sure you have a separate battery switch installed. Make sure the + and - on the plug are connected to the positive and negative pole of the battery!

**When switching on the battery power, the controller switch (key switch) should be off. The digital display should start and when the voltage shows between 48 and 55 volts (48 V system) or between 72 and 82 volts (72 V system), the switch can be switched on.**

**The controller unit should show a green light. If a red light is flashing continuously, the controller manual needs to be checked for the error code.**



**The controller unit must be covered to ensure, no metal parts, humidity, water or people can touch any part of this unit during operation or when under power.**



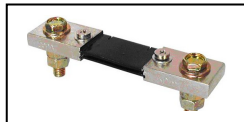
## OVERVIEW ELECTRIC SETUP

### **NEGATIVE (-) CONNECTION DC STRING**

BATTERY



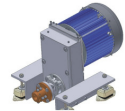
SHUNT



CONTROLLER



MOTOR



### **POSITIVE (+) CONNECTION DC STRING**

BATTERY



ENGINE MAIN SWITCH



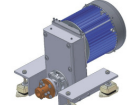
FUSE



CONTROLLER



MOTOR



THROTTLE / KEY SWITCH





## 2.4 Initial system start

- ◆ Check all connections and make sure, the engine shaft can turn freely.

- 1 – Switch off main switch
- 2 – Switch off controller switch
- 3 – Connect engine
- 4 – Move throttle lever in neutral position
- 5 – Connect battery and switch on battery switch
  - ⇒ The battery monitor starts operating
  - When it shows the battery, voltage continue
- 6 – Check if the engine shaft is not blocked
- 7 – Switch on controller switch (key switch)
  - ⇒ The green controller led turns on
  - ⇒ The display shows a small energy Consumption & the contactor switches on
- 8 – Slowly move throttle forward
  - ⇒ The motor starts running

- ◆ Test the engine by shifting the lever forward and backward. When changing from forward to back always stop in the neutral position. Do not shift directly from full forward to full reverse – move the throttle slowly.
- ◆ Disconnect the battery (reverse the procedures above) and then connect the propeller shaft. Turn the propeller manually and make sure there is no blockage or resistance.
- ◆ Proceed with the above start procedure again.
- ◆ When the engine is connected, the procedure starts with point 4. See also Section 5.1.



### CAUTION

Also, check the separate manual for the digital motor controller as well as the manual for the digital monitor.

## 2.5 Safety stickers

The following safety stickers are recommended to be fixed to the system. The operator is responsible for a safe installation, operation and proper indication of any dangerous parts.

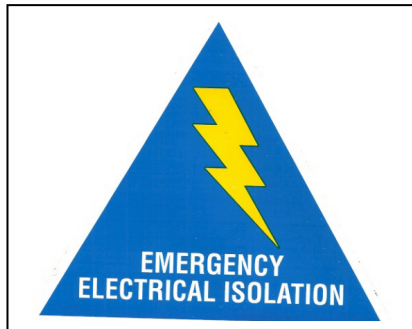
### High voltage sign (example only)

- In motor compartment
- On battery box
- On switch board

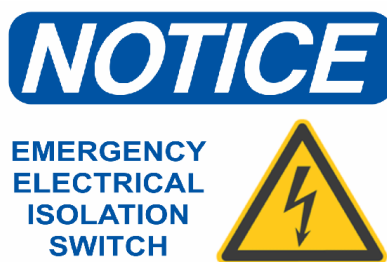


### Emergency switch (example only)

- On switch board | battery pack



All4solar supplies two vinyl stickers with each motor kit (approx. 18 x 25 cm)



## 2.6 Warranty information operation | installation

Incorrect installation, use of unsuitable accessories or variations in voltage voids the warranty.

Electrolysis is the decomposition of metals exposed to an electric current. When your boat is connected to a shore power AC electrical system, it is also connected to an earth ground circuit. This can cause an electrolytic current which causes the decomposition of all submerge metal. The manufacturer's warranty does not cover any corrosion. Check and change anodes periodically.

For details about the warranty conditions see section 8.



### **WARNING – CAUTION – MOTOR OPERATION**

Never operate the motor without water cooling under load. Only for test purposes. Secure the area around the propeller and the engine. No person is allowed closer than 1 meter if the engine is running. When turning the key switch, and the lever, the motor starts truing immediately.

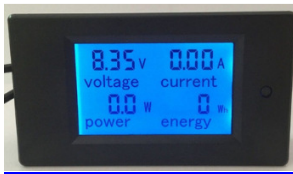
Make sure the water intake (s) are free and the pump is pumping water through the system (only for water cooled engines).



**DO NOT OPERATE  
BEFORE YOU HAVE  
READ THE ENTIRE  
MANUAL**

## 2.7) Digital battery monitor

The manual for the battery monitor is included in the pack containing the monitor and the shunt.

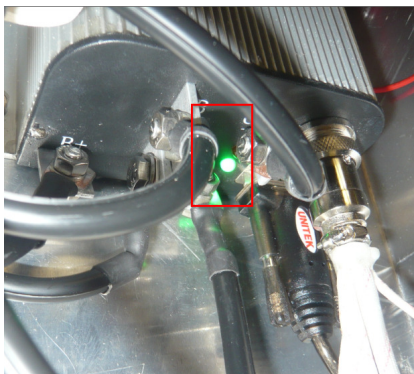


The shunt is installed between the negative battery pole and load. The battery charger must be connected on the load side and not directly to the negative battery pole, as otherwise the meter cannot count the amp hours charged. **IMPORTANT:** Use a DC breaker when connecting a charger system to the shunt on the main board. **DO NOT** run the motor off a charger directly, without a battery connected.

See separate manual for battery installation and operation instructions for the installation, programming and operation of the monitors.

## 2.8) Controller messages

Two signalization lights are positioned on the side of the controller. Flashing of the red light indicates a fault.



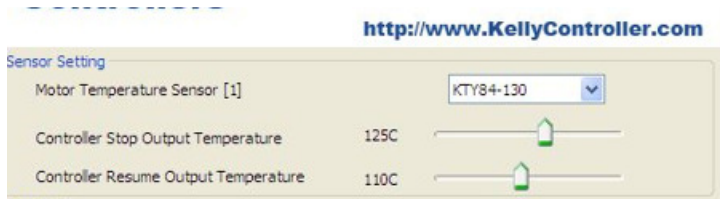
If the green light is on, the system operates normally.

The coding for the error information (flash sequence of red led).

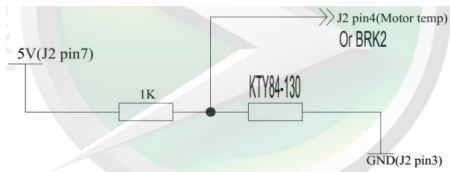
## 2.9) Cooling

These motors are air cooled. If they are operated at full load without sufficient air flow, the motor and the controller can overheat. The controller has an internal temperature control and reduces the output, if it gets too hot. This can be avoided by adding some ventilation

The motor has no temperature sensor installed, unless this is ordered. KTY84-130 temperature sensor can be used and installed to the motor stator shaft. The temperature of the shaft should not exceed 50 degrees Celsius (can be set in the controller). Internal sensors should not exceed 100 degrees celsius.



The KTY84-130 temperature sensor must be connected to the controller as follows:

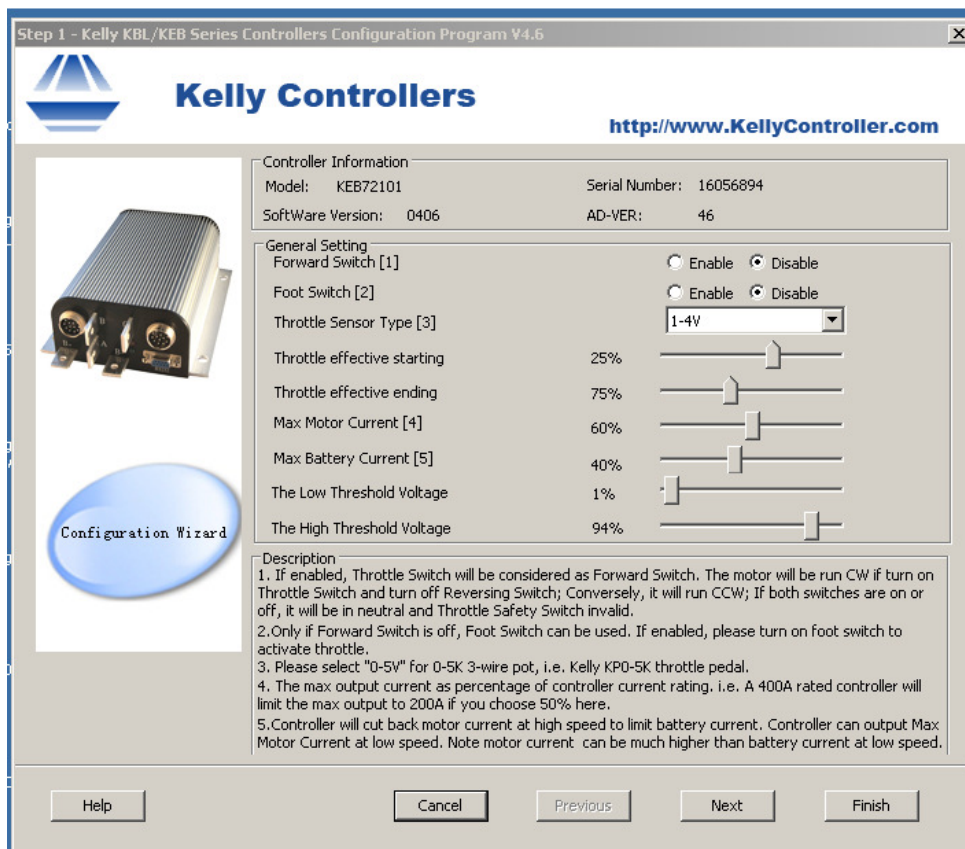


### 3) Controller setting

The Kelly controller supplied, allows the connection to a computer system via the supplied RS232 (controller) to USB plug. If necessary, the driver software supplied has to be installed.

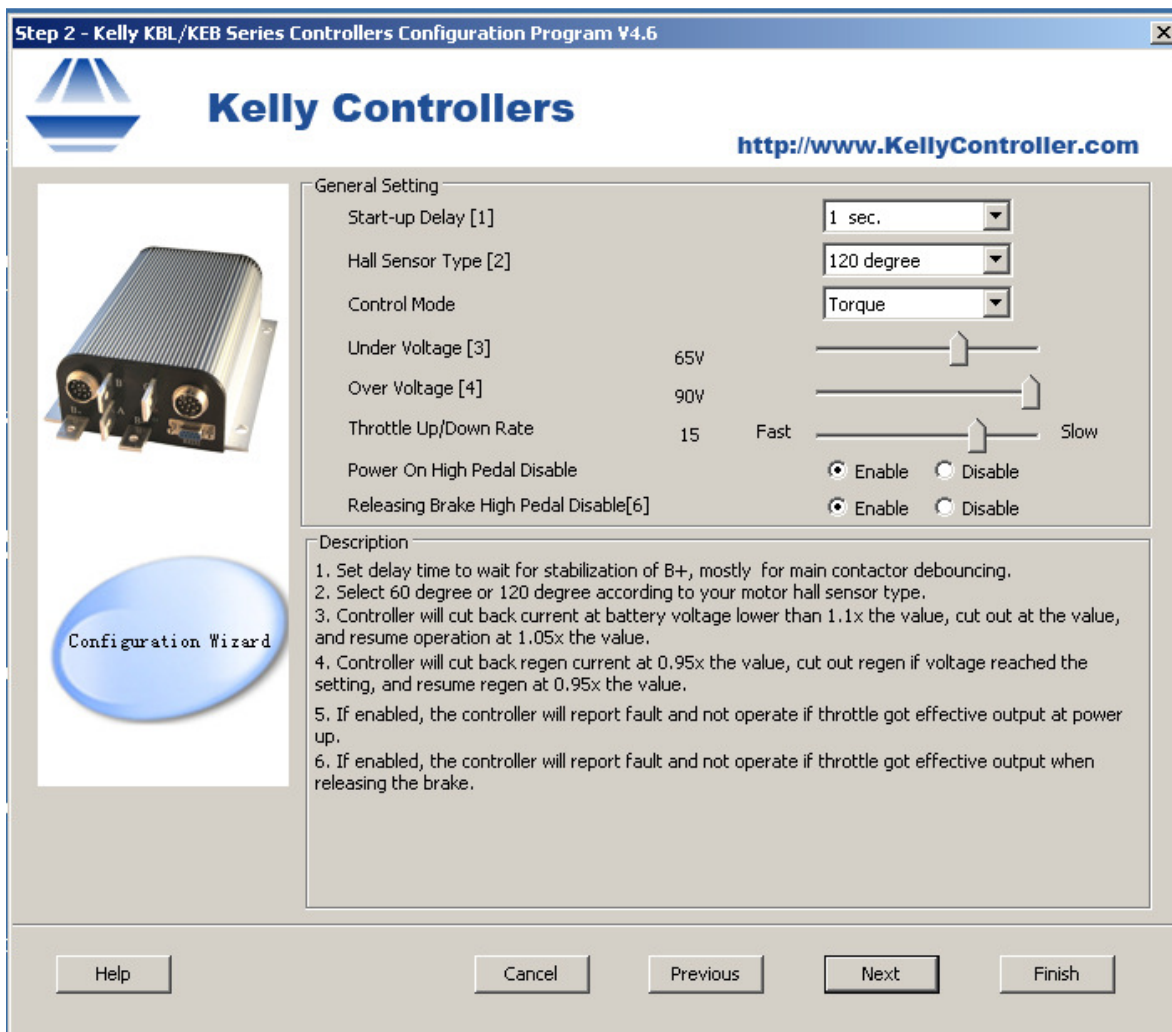
The motor must be stopped and at least one phase has to be disconnected, when changing the settings.

As every boat setup is different, adjustments can be necessary.



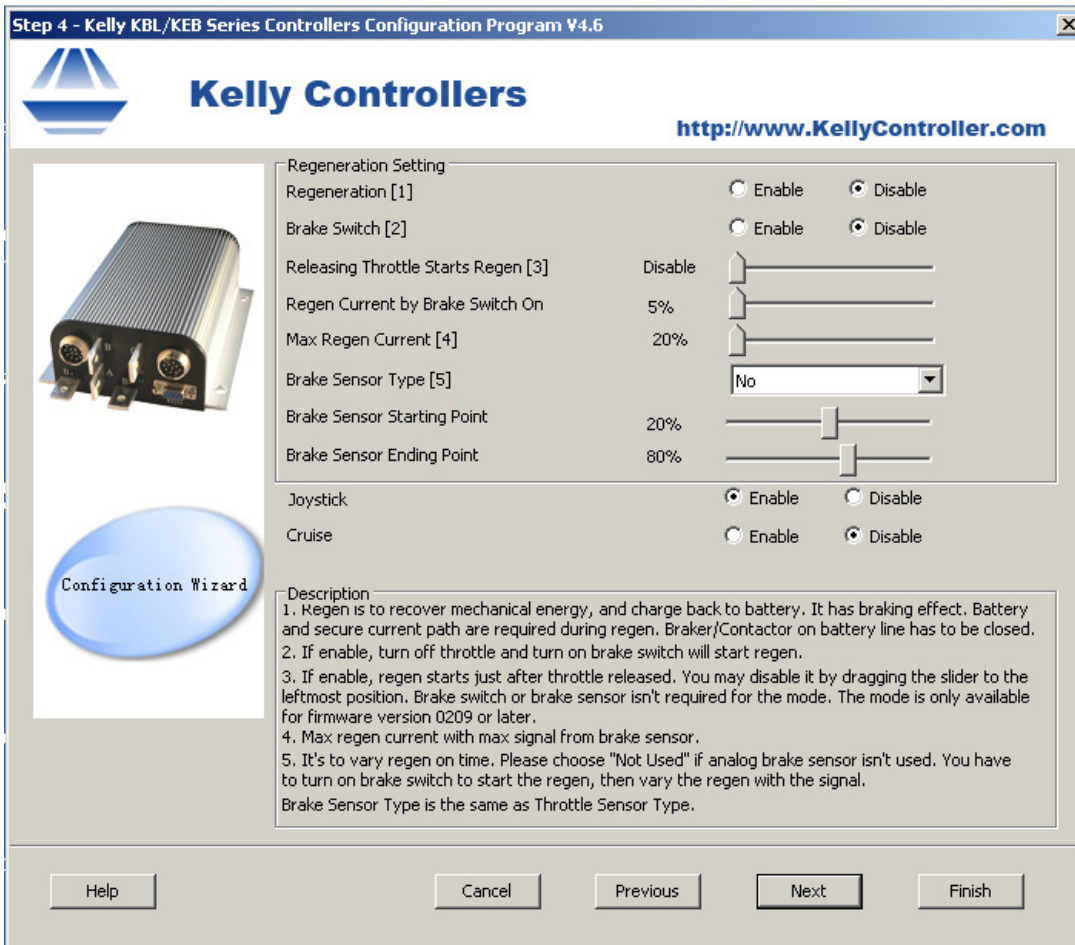
- 1 = disable
- 2 = disable
- 3 = For hall sensor type throttles / joy sticks 1-4 V setting is required  
For 5K ohm 3 wire potentiometer the 1 -5 V setting is required
- Throttle starting: 10-25% recommended
- Throttle ending: 75-90% recommended
- 4 = 60% of the controller's maximum capacity. The IB 8 requires 50%
- 5 = Max. battery current. 40% for low rev application

Low threshold voltage 1-5%  
High threshold voltage 90-95%



- 1 – Delay when starting up
- 2 – Do not change has to be 120 degrees
- Control Mode – usually Torque mode for boat motor
- 3 – Undervoltage - 44 V for 48 V system / 65 V for 72 V system
- 4 – Over Voltage – 58 volts for 48 V system / 87 volts for 72 volt system

- 5 – Disable for boat motor
- 6 – Disable for boat motor




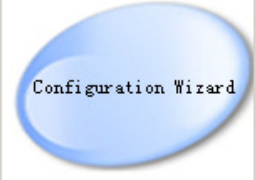
- 1 – Regeneration requires an additional setup with safety switches and brake throttle
- 2 – Disable
- 3 – For regeneration only


Joystick            Enable for wig / wag operation (joy stick)  
Cruise             Disable



Step 5 - Kelly KBL/KEB Series Controllers Configuration Program V4.6

 **Kelly Controllers** <http://www.KellyController.com>

 Configuration Wizard



**Sensor Setting**

Motor Temperature Sensor [1] Disable

Controller Stop Output Temperature 96C

Controller Resume Output Temperature 89C

**CAN Setting**

**Smooth Setting**

Auto\_Identify ☐ Enable ☒ Disable

Identify\_Rev ☒ Enable ☐ Disable

Smooth ☒ Enable ☐ Disable

Inflection Point 10

Low Accel 100

Low Decel 127

High Accel 100

High Decel 127

**Description**

1. Thermistor is optional. Default to KTY84-130.  
Alternative to a thermistor, voltage signal 4.5V to 30V on the motor temperature input pin (J2 Pin 4) will disable the controller.

Help Cancel Previous Next Finish

1 – If motor temperature sensor is installed – enable here

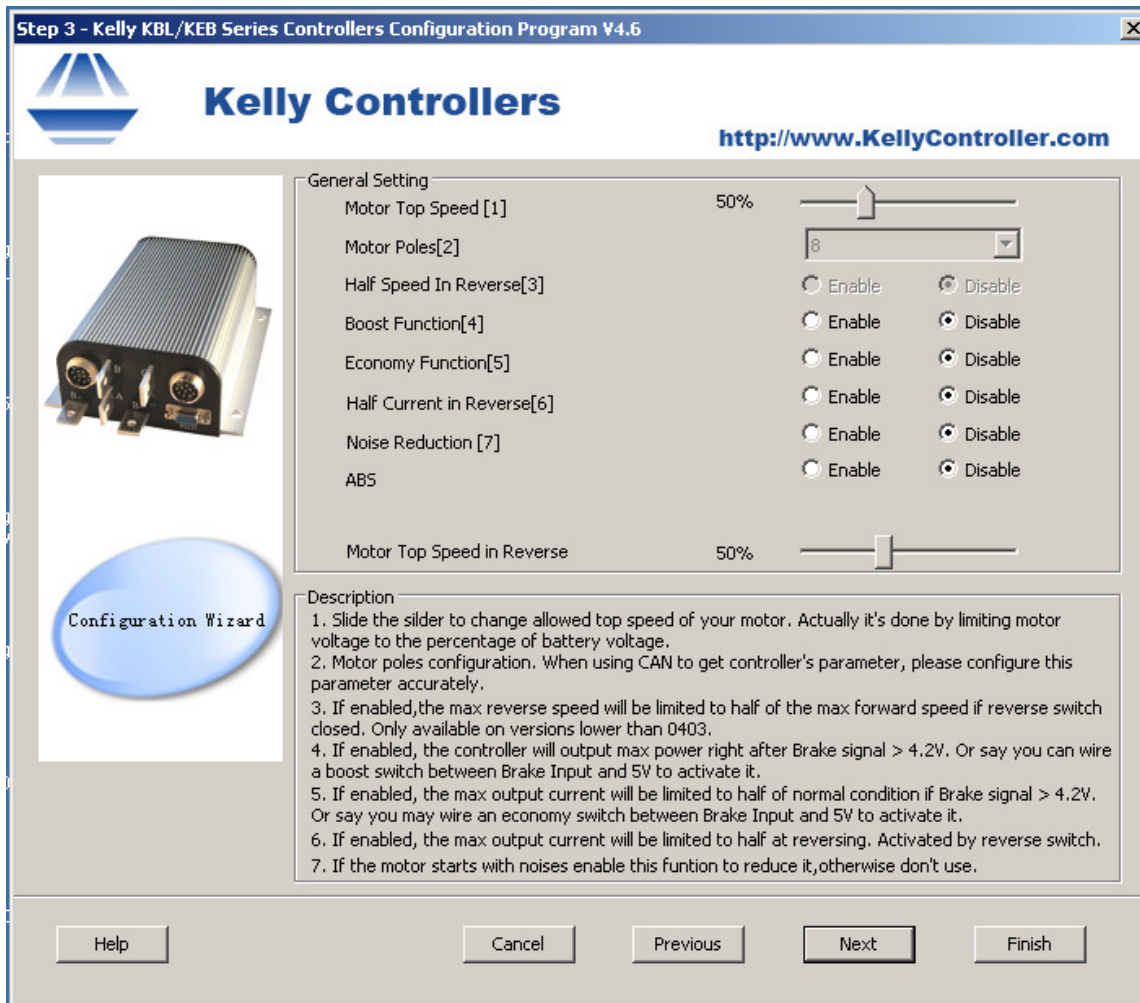
Auto Identify – only enable if motor requires adjustment

Identify Rev – enable

Smooth – enable

Inflection points allow the optimization of the acceleration of the motor.





Motor top speed and top speed reverse set to 50%. All other functions disabled.

## 4) Area of operation

The engine room must be equipped with a bilge pump. The engine, the controller and the accessories must not be exposed to water.

If the boat is moored, the system should be completely disconnected from the battery.



### ATTENTION

These motors are air cooled. Sufficient ventilation is required if operated at full throttle.

## 5) Drive with the inboard motor



### DANGER

As boat operator, you are fully responsible for the security of all passengers on board as well as to any other water craft, swimmers or animals within your area of operation.

You must be aware of all rules & regulations for operating a water craft. The detailed knowledge of this operator's manual and the instructions for the boat and all equipment is a very important part of your responsibility.

A swimming person cannot avoid very quickly even if a boat runs at low speed. Therefore, you must switch off the motor if a person is close to your boat.

ANY CONTACT WITH A MOVING VESSEL, THE PROPELLER OR ANY OTHER PART OF THE MOTOR OR THE BOAT CAN LEAD TO SEVERE INJURY.

Always equip your boat with safety gear!

## 5.1) Turn-on procedure

**For first time start or reconnection of the engine to the battery see section 2.4**

**The following procedure applies to installed systems**

- 1 – Move throttle lever in neutral position
- 2 – Connect battery and switch on battery switch
  - ⇒ The battery monitor starts operating
  - When is shows the battery, voltage continue
- 3 – Switch on main engine power switch (or contactor)
- 4 – Check if the engine shaft is not blocked
- 5 – Switch on controller switch
  - ⇒ The green controller led turns on
  - ⇒ The display shows a small energy consumption
- 6 – Slowly move throttle forward
  - ⇒ The motor starts running

## 5.2) Drive forward

Move the lever from the neutral position slowly forward. Unlike with combustion engines, the motor will react immediately. Please remember, that these electric direct drive motors produce more thrust at low revs than petrol or diesel engines.

*We recommend to not operate the engine at full power (max. Amps on display) for more than 30 minutes. This would indicate, that the prop is not suitable for the setup as full torque is required to run the boat. At full throttle (= max. rpm of the engine) the boat should just use maximum power up to the nominal speed is reached and then reduce the power requirement to 70-80%.*

## 5.3) Reverse

The same procedure as driving forward, but move the lever backwards backward. Do not drive backward at high speeds! The engine can handle this, but this might be dangerous as the maneuverability of the boat is limited.

When changing from forward to the reverse stop at the neutral position for two seconds.



### CAUTION

Changing direction at high speeds can cause heavy damage or injury!

## 5.4) Safety Switch

The use of a safety switch is highly recommended. Please note, that the operation of the safety switch will stop the engine immediately.



### CAUTION

An accidental activation of the safety switch can cause loss of control and injury to the passengers!

## 5.7) Low voltage alert (optional)

If a battery is discharged under 42 volts (48-volt system) / 66 volt (72-volt system) this can damage the battery. If the voltage gets close to this value, the motor controller will reduce the output and eventually stop working.

## 5.8) Power and output

The motor controller automatically adapts the power output / torque to the boat you use. Unlike combustion engines, the lever controls the engine speed by changing the frequency of the three phases and not the power.

With slow and heavy boats the motor produces more thrust. If the boat floats easily, the motor speed is automatically increased.

### ***For technical details see section 9***

With lithium batteries, the power output is increased by 20% compared to lead acid.

Please note, that lead acid batteries only supply about 60% of their capacity in 1-2 hours of use. Lithium batteries can be discharged up to 95% in one hour.

See our battery – information document for more detailed information.

12-ton cat – 2 x 10 KW inboard



2 ton cruiser – 50 KW inboard



## 5.9) Swimming & passengers



### WARNING

Prior to swimming of the boat, always switch off the motor and pull the key. Do not leave children or untrained passengers in the boat without attendance.

While swimming close to the boat or while loading, or unloading procedure any connection to a battery charger has to be disconnected.

All passengers should know the position and function of the emergency switch as well as the basic safety rules. Small children should always wear personal floating devices / life jackets.

## 6) Maintenance & inspection

The boat operator is fully responsible for the safety check and the maintenance of the motor, the boat and all equipment and accessories.

Make sure that all installations are in good condition prior to starting for a trip. Ensure the batteries have adequate charge for the distance planned to travel including reserve.

Periodical maintenance and inspection as well as treatment and operation per this manual reduce problems and minimize of costs. This guarantees a long and reliable operation of your motor.

### 6.1) Service, spare parts and lubricants

As owner of this inboard motor you should be aware of all recommended maintenance and repair instructions, even an electric brushless motor needs hardly any maintenance.

If a boat propulsion system is not checked on a regular basis, a safe and trouble free operation cannot be expected.

The prescribed services will ensure that any costly repair is unlikely to be needed.

The DC brushless motor and the controller do not need any maintenance. Keep the engine and the controller clean.

Only clean with water and if required dish washer liquid. Make sure there is no corrosion and spray non-corrosion contact spray to the contacts from time to time.

When idling without load, the motor should not use more than 2-5 Amps.

**NEVER** open the motor or the controller.

## 6.2) Service chart

Relates to the electric motor, controller and supplied accessories only.

<b>Shedule</b>	<b>by Operator</b>	<b>by authorized dealer or specialized workshop</b>	<b>by manufacturer</b>
After each trip			
	Check the electric contacts and switches		
	Make sure no water is in the controller unit		
Each 100 hour or at least once a year	Clean the engine and the controller Grease transmission bearings (if applicable)		
	Check the electric cables & switches for damage or corrosion	Replace plugs / connectors if corroded	Replace internal sensors, switches, cables
Every 5 years	Replace main electric switches. Those parts can last for over 10 years, if well maintained	Replace the main switches and the key switch.	
	Check the shaft coupling	Replace the shaft coupling	
Mechanical repairs		Basic maintenance & replacements of mechanical parts	Repair after mechanical damage or overheat
Electrical repairs			Any repair on electric motor, controller, sensors, monitor, DCDC converter (if applicable)

In case other spare parts are needed or the motor has any damage, send an email with a digital photo to [info@all4solar.com.au](mailto:info@all4solar.com.au) indicating the motor number, name of the owner and the parts needed or damaged.

## 7) Boat transport & trailering



### ATTENTION

When transported on a road trailer we recommend to disconnect the shaft coupling and fix the motor additional to the engine mounts to avoid damages. Always disconnect from the battery system.

## 8) Warranty

Your inboard motor and the material supplied as per 1.4 in this document are backed by a 1 year warranty for workmanship and material. The warranty does not cover any damaged which result from faulty handling, operating or maintenance. The following points will void the warranty:

- 1) Operation or maintenance differing from the information and instructions in this manual or any other manufacturer's documentation.
- 2) Preparation and participation in competitions or races or any form of competition.
- 3) Water damages to the motor.
- 4) Damages caused by collision, accidents, contact with any solid materials.
- 5) Capsize of the boat or drowning the motor into the water.
- 6) Grow of any kind of marine organism on the motor surface.
- 7) Incorrect use of the motor or use on unsuitable boats.
- 8) Normal aging process.
- 9) If serviced by none authorized or specialized workshop.
- 10) Damage by corrosion.
- 11) Fuses.

The warranty does not include wear parts such as: Joints & gaskets, hoses and rubber parts. The warranty only covers the motor and the controller. It does not cover damaged to the boat or and accessories, the batteries, switches, fuses, battery charger, trailer or any kind of equipment not supplied by all4solar.

Transport to all4solar for damaged parts is to be paid by customer. The redelivery to the customer is paid by all4solar, if warranty applies.

If all4solar supplies any third-party product (battery, chargers, cables etc.) the warranty conditions of these supplier apply.

all4solar cannot be held liable for any damage or injury caused by the use of this motor.





## 2/3 KW ENGINE

- Advanced electric 3 phase brushless DC motor for 48 V DC or 72 V DC
- Shaft coupling (15 mm to 35 mm)
- Ready to install with engine mounts (M8 female)
- Cables with plug to battery|Main Switch|Contactor
- Single lever joystick with key switch
- Digital motor controller & battery monitor
- 2-3 KW output / thrust similar to a 4-6 HP diesel \*
- 2.2 – 3.35 KW power consumption 700 rpm max.
- Weight 25 kg (engine & controller unit)
- For boats upto 3.0 t (one engine)
- Prop size 10-14'
- 60-80 NM max. torque on shaft
- Run time at an average 40% throttle 5 h 30 min.

\* performance thrust with lithium battery 5.1 KW h

### DIMENSIONS

Length including shaft coupling	380mm (shaft coupling 70 mm) allow upto 90 mm for coupling!!
Width	240 mm
Height without engine mounts (Type M10 30 mm)	260 mm (290 mm with engine mounts)
Engine shaft 25 mm diam. With 8 x 3 mm key	
Shaft coupling shaft diameter 15 – 35 mm (define with order)	

## 6 KW ENGINE

- Advanced electric 3 phase brushless DC motor for 72 V DC
- Shaft coupling (15 mm to 35 mm)
- Ready to install with engine mounts (M8 female)
- Cables with plug to battery|Main Switch|Contactor
- Single lever joystick with key switch
- Digital motor controller & battery monitor
- 6 KW output / thrust similar to a 10-12 HP diesel \*
- 6.70 KW power consumption 1000 rpm max. (set to 700 rpm)
- Weight 42 kg (engine & controller unit)
- For boats upto 6.0 t (one engine)
- Prop size 11-15'
- 120 NM max. torque on shaft
- Run time at an average 40% throttle 4 h 20 min.

\* performance thrust with lithium battery 10.2 KW h

### DIMENSIONS

Length including shaft coupling	430mm (shaft coupling 90mm)
Width	325mm
Height without engine mounts (Type M10 30 mm)	350mm (380 mm with engine mounts)
Engine shaft 25 mm diam. With 8 x 3 mm key	
Shaft coupling shaft diameter 15 – 35 mm (define with order)	

## 8 KW ENGINE

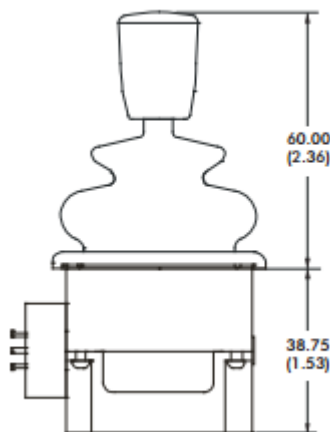
- Advanced electric 3 phase brushless DC motor for 72 V DC
- Shaft coupling (20 mm to 35 mm)
- Ready to install with engine mounts (M10 female)
- Cables with plug to battery|Main Switch|Contactor
- Single lever joystick with key switch
- Digital motor controller & battery monitor
- 8 KW output / thrust similar to a 16-20 HP diesel \*
- 8.95 KW power consumption 1250 rpm max. (set to 700 rpm)
- Weight 42 kg (engine & controller unit)
- For boats upto 8.0 t (one engine)
- Prop size 12-16'
- 250 NM max. torque on shaft
- Run time at an average 40% throttle 4 h 15 min.

\* performance thrust with lithium battery 15.3 KW h

## DIMENSIONS

Length including shaft coupling	430mm (shaft coupling 90 mm)
Width	325mm
Height without engine mounts (Type M10 30 mm)	350mm (380 mm with engine mounts)
Engine shaft 25 mm diam. With 8 x 3 mm key	
Shaft coupling shaft diameter 15 – 35 mm (define with order)	

## Joystick throttle lever (APEM)



With enclosed below surface box = optional

### 9.3) General technical facts

#### Static thrust and torque

“The measured thrust produced by a propeller when movement is prevented”

1 Newton = weight power of 102 grams (standard force of gravity) = thrust

1000 lb ft (pound / feet) = 1356 Nm (Newton meter) = torque

1 Newton meter = power to lift 102 grams on an 1 meter moment arm

1 Lb-Ft = 1.35582 Nm

#### Power

Electric motors are moved by electric power. For boats, we need to use a DC (direct current) power supply, as the electricity needs to be stored in batteries which can only provide DC power. As AC motors have some advantages, the motor controller can have an AC output to the motor (see AC / DC motors) which acts like an inverter (converting DC to AC power).

Watt = voltage X ampere or amps

1 kilo watt = 1000 watts = 1.341 hp (Use for el. outboards 1.5 hp for inboards 1.7-2 hp)

1 kw h = 1 kilo watt output per hour (f.e. battery capacity)

#### AC / DC motors

DC = direct current / positive and negative / electricity always flows in one direction (battery)

AC = alternating current / the electricity changes direction by alternating at a certain wave frequency (like the 240 V power supply)

DC motors are equipped with permanent magnets on a stator and electric magnets on a rotor (rotating) which are switched on and off in a sequence related to the rotation of the stator. The brushed DC motors (the cheapest option) have brushes to the rotor switching the electric coils (magnets) on and off to create a force with the permanent magnets. The controllers for these motors just need to limit the power input to change the power output of the motor. The brushless DC motors do have the electric coils in the stator and the permanent magnets fixed on the rotor which makes the construction simpler and more efficient. But the motor controller is more complex and needs to switch the electric power per the information of the position of the rotor by sensors. The AC induction motor has electric coils on the stator and a rotor driven by the magnetic field (induction). The rotation is related to the frequency of the alternation. There are a lot of subtypes, synchronous, two or three phase or induction with usually 4 or 6 poles. But the following points are important: An DC motor is a cheaper option, but changes the torque with the rotation speed, where an AC motor can create a more stable torque over a wide range of rotation speed. The AC motor is maintenance free as the shaft bearings are the only moving parts. This makes this motor ideal for engines over 10 KW.

The low voltage DC brushless motor is the best option for motors upto 10 KW.

#### Efficiency

Efficiency is defined by the percentage of energy output compared to the energy input. An electric drive system has several components, so the overall efficiency is important to look at.

Batteries – efficiency input (charge) and output - Lead acid = 90% - Lithium = 99%

DC brushed motor including controller = 60 – 85 % - only max. efficient at specific rotation speeds

DC brushless motor including controller = 65 – 95% - only max. efficient at specific rotation speeds

AC motor including controller = 84-88% - efficient over a wide range of rotation speeds

The AC motor for larger or the DC brushless motor for smaller applications in combination with a lithium battery are the most efficient systems for boat propulsion.

## 10) Spare parts

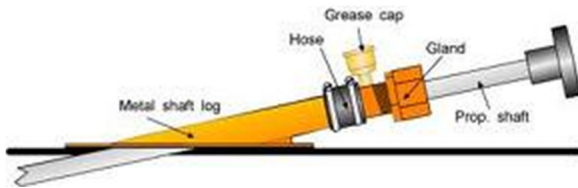
As mentioned before, these electric inboard engines only require a limited maintenance.

All spare parts, related to the engine and the controller need to be supplied and replaced by all4solar. All other parts can be replaced with any SIMILAR product which usually are available everywhere. Please refer to the list in section 9.

If ordering from all4solar refer to the latest product list in section 1.4. If something is unclear, send an email with a digital photo to [info@all4solar.com.au](mailto:info@all4solar.com.au). The use of unsuitable spare parts will void the warranty.

Only use original high quality spare parts.

## 11) Propeller shaft



<http://www.cassellmarine.com.au/>

The propeller shaft can be connected to the supplied flexible shaft coupling. If required an universal joint can be used – the electric inboard motor can, unlike a petrol or diesel engine, be installed in practically any position.

[www.tea.net.au](http://www.tea.net.au)

## 12) Propeller information

The most important thing to know about props. There is no way to exactly calculate the performance of a propeller on a certain boat with a specific engine. Only testing will give you the accurate results.

Material:	Aluminum	Cheap and light
	Stainless Steel	5 times stronger than Aluminum / efficient
	Composite	Light & efficient
Blades:	2 – Small trolling motors   large folding props   Sail drives   efficient high speed   less drag	
	3 – Fast outboard motors   larger props on inboard engines   Sail drives   more thrust	
	4 – High Thrust applications or large props for displacement and semi displacement	

Size: Diameter of the prop

Pitch: The pitch is the distance the boat could theoretically travel for each revolution of the propeller without the slip (loss).

The increase of the pitch by one inch usually results in 150 – 250 higher rpm at full throttle for props from 9 to 12 inches at 2000-2400 rpm and less for larger props at less rpm.

Increasing the pitch will result in less thrust but higher maximum speed.

Regeneration: This is a quite controversy issue. The main problem is, that a propeller builds up water pressure to speed up the water faster than the speed of the boat. When “braking” to achieve the power, regeneration function the water pressure is build up on the “wrong” side of the prop where usually you have an under pressure. The slip is increased dramatically reducing the performance. The result is, that the regeneration produces drag, but this cannot be converted completely into rotations of the propeller. The hull speed must be at least 7-9 knots to achieve a frequency over usually 10 Hz which will allow the motor to produce enough power output to charge the battery. The efficiency can be increased by using a completely turntable sail drive.

Prop sizes to be used:

2-3 KW            10 – 13 inch  
5-8 KW            13 – 16 inch

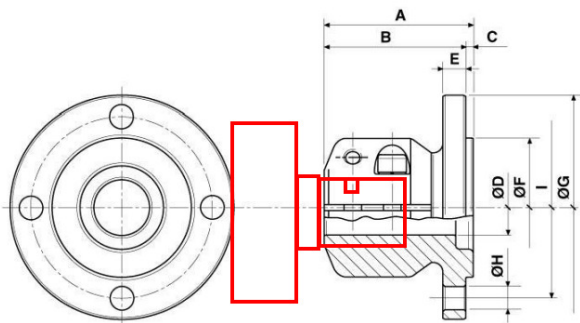
Propellers:            [www.seahawk.com.au/](http://www.seahawk.com.au/)            [www.flexofold.com/  
http://www.australpropeller.com.au/](http://www.flexofold.com/http://www.australpropeller.com.au/)

Calculations:            [https://www.vicprop.com/displacement\\_size.php](https://www.vicprop.com/displacement_size.php)

## 13) Coupling

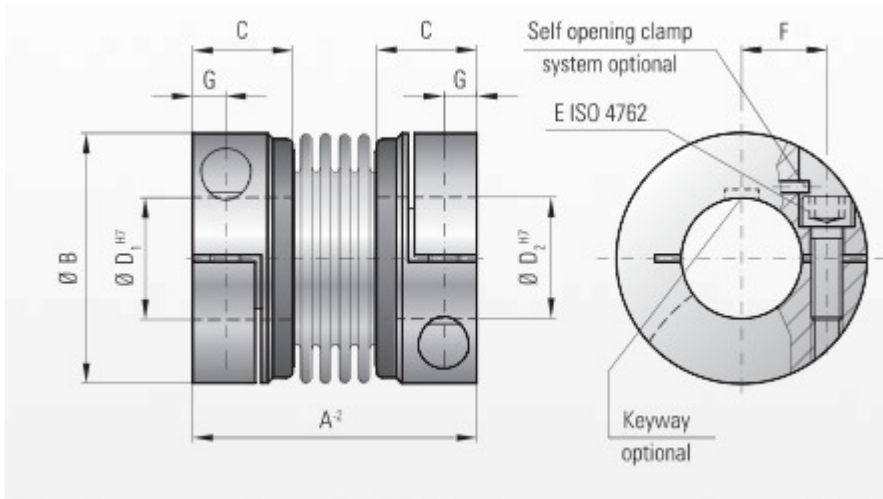
The following types of couplings can be used to join the engine with the prop shaft. Make sure, you choose the coupling with sufficient radial torque and if no thrust bearing used, sufficient stability to handle the forward and reverse axial thrust. If no thrust bearing is used, we recommend to use rigid couplings or universal joints.

### 13.3.1 Half Coupling (fits Polyflex © flexible couplings)






A	B	C	D	E	F	G	H	K
68	65	3	25	10,5	63,5	102	10,5	82,5
68	65	3	25	10,5	50	100	10,5	78
68	-	-	25	10,5	60	100	10,5	80
68	65	3	30	10,5	63,5	102	10,5	82,5

### 13.3.2 Bellows Coupling



Option: keyway / pin

Model BKL		Series									
		2	4.5	10	15	30	60	80	150	300	500
Rated torque (Nm)	$T_{KN}$	2	4.5	10	18	30	60	80	150	300	500
Overall length (mm)	A	30	40	44	58	68	79	92	92	109	114
Outside diameter (mm)	B	25	32	40	49	56	66	82	82	110	123
Fit length (mm)	C	10.5	13	13	21.5	26	28	32.5	32.5	41	42.5
Inside diameter possible from Ø to Ø H7 (mm)	$D_{1/2}$	4-12.7	6-16	6-24	8-28	10-32	14-35	16-42	19-42	24-60	35-62
Fastening screw ISO 4762	E	M3	M4	M4	M5	M6	M8	M10	M10	M12	M16
Tightening torque of the fastening screw (Nm)		2.3	4	4.5	8	15	40	70	85	120	200
Distance between centerlines (mm)	F	8	11	14	17	20	23	27	27	39	41
Distance (mm)	G	4	5	5	6.5	7.5	9.5	11	11	13	17
Moment of inertia ( $10^{-9}$ kgm²)	$J_{steel}$	0.002	0.007	0.016	0.065	0.12	0.3	0.75	1.8   0.8	7.5   3.1	11.7   4.9
Hub material		Al optional steel	Al optional steel	Al optional steel	Al optional steel	Al optional steel	Al optional steel	Al optional steel	steel optional Al	steel optional Al	steel optional Al
Approximate weight (kg)		0.02	0.05	0.06	0.16	0.25	0.4	0.7	1.7   0.75	3.8   1.6	4.9   2.1
Torsional stiffness ( $10^3$ Nm/rad)	$C_s$	1.5	7	9	23	31	72	80	141	360	410
Axial  ± (mm)	Max. values	0.5	1	1	1	1	1.5	2	2	2	2.5
Lateral  ± (mm)		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Angular  ± (degree)		1	1	1	1	1	1	1	1	1	1
Axial spring stiffness (N/mm)	$C_k$	8	35	30	30	50	67	44	77	112	72
Lateral spring stiffness (N/mm)	$C_l$	50	350	320	315	366	679	590	960	2940	1450

Do not use the 300 NM version due to the higher stiffness. Even these couplings allow upto 150% load on the nominal rating, the 80 NM units should not be used for direct drive applications.



### 13.3.3 Flexible Spider Coupling

An economic option with high grade aluminum clamping ends and Elastomer flexible coupling.



VALUE	UNIT	A4S-55	A4S-65	A4S-80	A4S-95
Inner Bore Min.	mm	12	14	24	30
Inner Bore Max	mm	28	38	45	55
Outer Diametre	mm	2455	65	80	95
Overall Lenth	mm	78	90	114	126
Lenth of Clamps	mm	30	35	45	50
Lenth Centre Part	mm	18	20	24	26
Length from Centre bolt to outside Clamp	mm	10.5	11.5	15.5	18.0
Metric Bolts Size	M	M6	M8	M8	M10
Max Torque Bolts	NM	8	15	15	25
Nominal Rotation Torque Coupling	NM	34	95	135	230
Max. Rotation Torque Coupling	NM	68	190	270	460
Max. RPM	RPM	8000	6000	4600	3800
Flexibility	mm	0.8	1.0	1.0	1.0
Tollerance	mm	0.02	0.02	0.02	0.02
Weight	gramm	362	582	966	1820

### 13.3.4 Disc Coupling

If no thrust bearing is used for smaller inboard engines.



### 13.3.5 Cardan Coupling / Universal Joint / Rigid coupling

If connected to a combustion engine or gear box (hybrid), or to adapt to a different shaft angle, a cardan coupling / cross axle universal cardan joint is the preferred option. Can be used in combination with a flexible coupling on one side of the shaft.



## 14) High power batteries

Instead of lead acid batteries, lithium – based systems offer a much higher energy density and a stable power output as well as much higher efficiency.

A 100 Ah lead acid battery can only supply approximately 60 Ah in one hour with a voltage dropping continuously.

Lithium based batteries can deliver up to 95% of their capacity within a very short time and with a stable voltage. The disadvantage of this effect is the lack of reserve, if the battery is discharged.

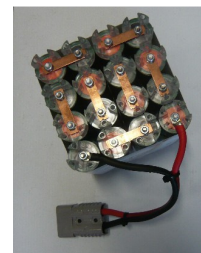
Some important information related to lithium based batteries:



LIPO batteries need a controller (BMS) which checks the single voltage of each unit and keeps the voltage leveled. These battery packs supply up to 180 watt-hours per kilo weight, but need attention. We do not recommend using these packs for marine installations.



LiFePo batteries do not essentially require a controller (even this is recommended) and are not as sensitive as LIPO batteries. They supply about 100 watt-hours per kilo weight and can last over 2000 cycles. We recommend to use this reliable technology for power supply for boats.



16 cells deliver 51.2 volts and 30 cells deliver 96 volts. Make sure, your battery pack allows discharging with the maximum Amps required for the engine.

If you use LIFEPO4 batteries, we recommend to carry a second battery as backup as well as a suitable battery monitor to measure the battery capacity.

## 15) Battery charging / solar power

### 14.1) Standard grid chargers

For charging the batteries you must use a suitable charger. Always make sure, the charger is fully protected from water and covers the battery voltage and type. If AGM lead acid batteries are installed, each battery can alternatively be charged individually with a 12-volt battery charger, but all batteries must be charged up to the same level to keep the full potential of the batteries and assure the maximum power output.

Always use automatic digital chargers with several charging modes (charge, float etc.) to extend the life of your batteries and get the complete charge at all times.

48 V chargers used for golf carts are powerful, reliable and economic. For Lithium batteries use suitable digital chargers (We supply those with our batteries).

Do not use cheap 12 V chargers for car batteries.

Maximum charge voltage for a 48 V battery:

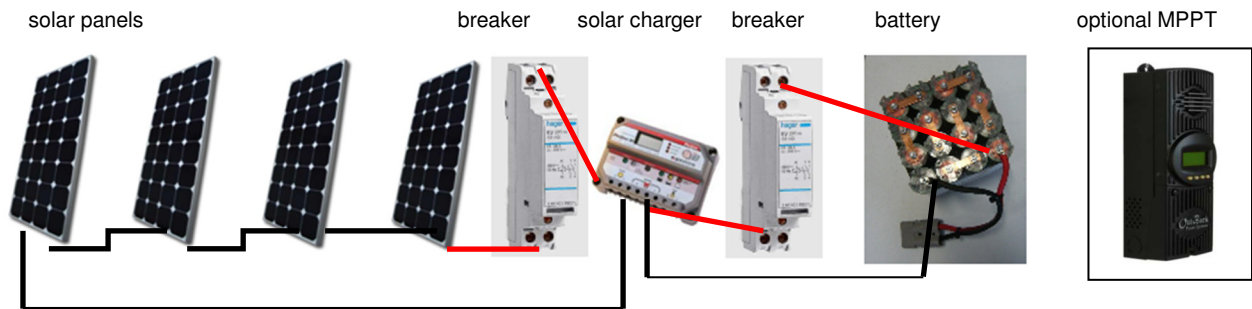
59 Volts max. charge voltage	Lithium 3.7 volts/cell
54 Volts floating	Lithium 3.4 volts/cell



### 15.2) Charging with solar power

Charging your batteries with solar power is the perfect solution for the all4solar concept of sustainable boat propulsion. Either you mount light weight panels on your boat or use a fix solar system on shore.

Any type of photovoltaic solar panels can be used, but we recommend a minimum power of 200 Watts (4 x 12 Volts nominal / 50 Watts in series). Please note, that at full sunshine a 48 V / 100 Ah battery pack needs 2-3 days for a 50% charge with a 200 watt (4 x 50 watt panels) solar system.



We recommend that you install an automatic circuit breaker between the battery and the solar charge controller and between the solar charge controller and the solar panel (Either DC breakers or 250 V AC automatic breakers).

Do not connect the solar panels directly to the batteries always use either a charge controller (48 V DC) or a Maximum Point Power Tracker System MPPT (to optimize the solar power output).

All4solar is not responsible for any installation of batteries or battery charge systems on your boat. Always contact a specialized or authorized (if applicable) installer prior to any installation or purchase.

### 15.3) Generators

The generator should be suitable to charge the DC voltage or to supply the 240 V battery charger. Remote control option with battery monitor available.



## 15.4) Solar panels

There are different types of photovoltaic solar panels on the market. The sunlight has a maximum power of 900 – 1100 Watts per m<sup>2</sup> when shining on a surface. If 10% can be converted to electricity, that means that about 90 – 110 Watts output can be produced per m<sup>2</sup> of solar panels.



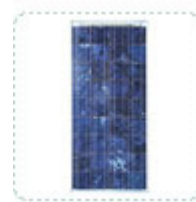
### **Mono Crystalline**

High efficiency – converts upto 20 % of solar light  
To use if only limited surface is available (f.e. on a boat)  
Best solution for a fix long term installation



### **Poly Crystalline**

Less efficiency – converts upto 16 % of solar light  
Somewhat cheaper than mono crystalline – needs more space  
Economic solution for fix long term installation



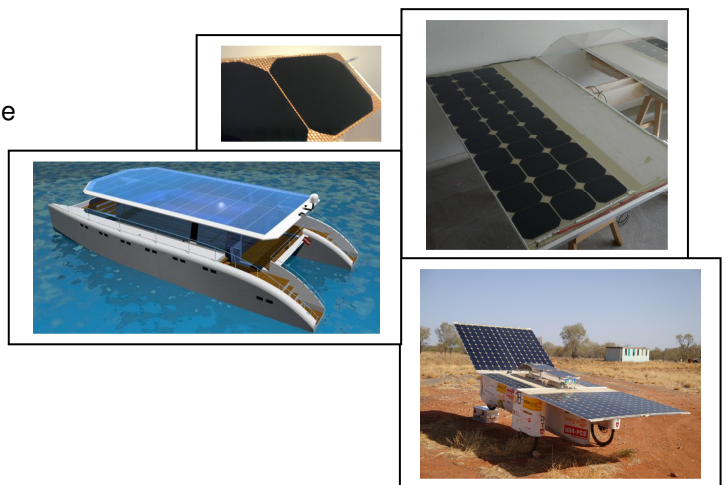
### **Thin film**

Converts between 5 – 10% of solar light  
Very light and flexible constructions possible  
Many different types available  
Best solution for transportable systems or mounting on vehicles



### **Individual solar panels**

Can convert upto 28% of the sunlight  
Very light and flexible constructions possible  
For integrated projects  
More expensive solution



## 15.5) Wind generators

Wind generators generate free power for 24 hours and are the ideal solution in combination with a solar pv system.

Silentwind offers high tech wind generators which are not only light and quiet, but also very efficient. The system includes the controller which can be directly attached to the all4solar battery- and electric propulsion systems.

[www.silentwind.com.au](http://www.silentwind.com.au)



Example power calculation:

600 watt / 48-volt DC system

10-14 knots wind output average 300 watts over 24 hours = **7.2 KW**

## 16) Conformity Declaration

A4S electric low voltage DC inboard engines (3 / 5 / 8 KW)

BLDC (Brushless DC motor) EMC compliance  
EN 61000-6-1:2007  
EN 61000-6-3:2007

BLDC controller unit  
TÜV – EN 1175-1:1998/A1:2010  
EN ISO 13849-1:2008

Cables, fuses, switches, joystick CE compliant

This system runs on low voltage DC (48 or 72 volts DC). In most countries, the installation does not require a certified electrician. We still recommend that the installation is done by a certified marine electrician. The system complies with Australian regulations. For any overseas regulations to install and operate this engine, the purchaser of the engine has the full responsibility to comply.

all4solar



Dominic de Vries