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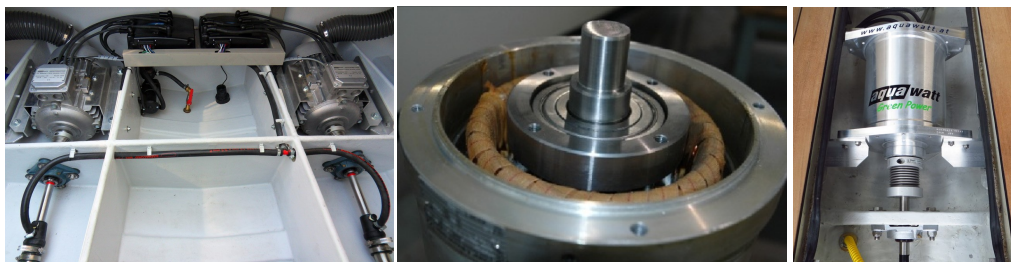
## Operator's Manual

### Electric Direct Drive AC Induction Inboard Boat Engine

**15-25 KW | 96 V DC** (air cooled)

**30 KW | 96 V DC** (water cooled)

**40 KW | 144 V DC** (water cooled)



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. Do not connect the controller, the motor or any appliances to a power source before you have verified that the installation complies with this manual and the manufacturers manuals as well as with the safety regulations for electrical installations.

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): ..... | ..... KW
- ◆ Type: ☐ direct ☐ with gear box
- ◆ Main use: ☐ saltwater ☐ freshwater

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 and the ordernumber.

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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 aquawatt 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 parts 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. A 15 KW induction motor can be compared to a 30 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 to a propeller shaft for boat propulsion. It is specially designed for this purpose. Do not use it for other applications like on road vehicles.

For information about dimensions, weight and power output as well as the recommended boat weights, check the technical data in 9 of this manual.




## 1.4 Motor & accessories

If you purchase one of our advanced AC induction 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 additional material you require. The list below gives you an overview over supplied materials and options, excluding the battery and the shaft with a propeller.

<b>THE FOLLOWING PRODUCTS ARE INCLUDED WITH EVERY ENGINE</b>		
Electric AC induction motor with mounting rails	With vent for air cooled version or waterpump for water cooled version	
Curtis AC controller / inverter  Type 1234   1236   1238 depending on the voltage and current rating of the engine  Water cooling aluminium plate (for water cooled engines only) mounted to controller  Use heat exchanger for salt water use!	Suitable for engine rated voltage and current / water cooled, if engine is water cooled.	  
Harness wire / cables controller to lever and key switch	AMP seal and MOLEX connectors	
Single lever forward and reverse   0 – 5 V output to controller and forward – reverse switch	Other variations available as option such as joy stick, double levers	
400 Amp fuse block with fuse	Suitable for the engine type	
Safety sticker		

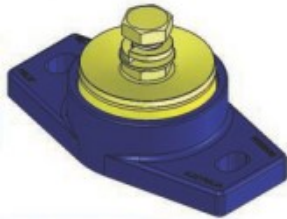




Key Switch	On / Off to controller two positions  Optional: 3 positions including switch on DC DC / pump / ventilation / Battery BMS	
Water pump for cooling 12 V / for 13 mm hose. 10 L / min.  Fresh water only.	Requires 12 volts DC power supply. If not available a DC DC converter is required to connect to main battery (96 V to 12 V DC).	
Documentation	<ul style="list-style-type: none"> <li>◆ Inboard Engine manual</li> <li>◆ Curtis controller manual</li> <li>◆ Monitor / Display manual</li> <li>◆ DC DC converter manual</li> </ul>	
Engine monitor	Displays voltage, engine rpm, controller faults	
Main contactor  Recommended for a safe power switch in case of faults (EEC regulation)	400 A / 12 v coil (1.2 A = 14.4 watts). Switched by controller.	

**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	



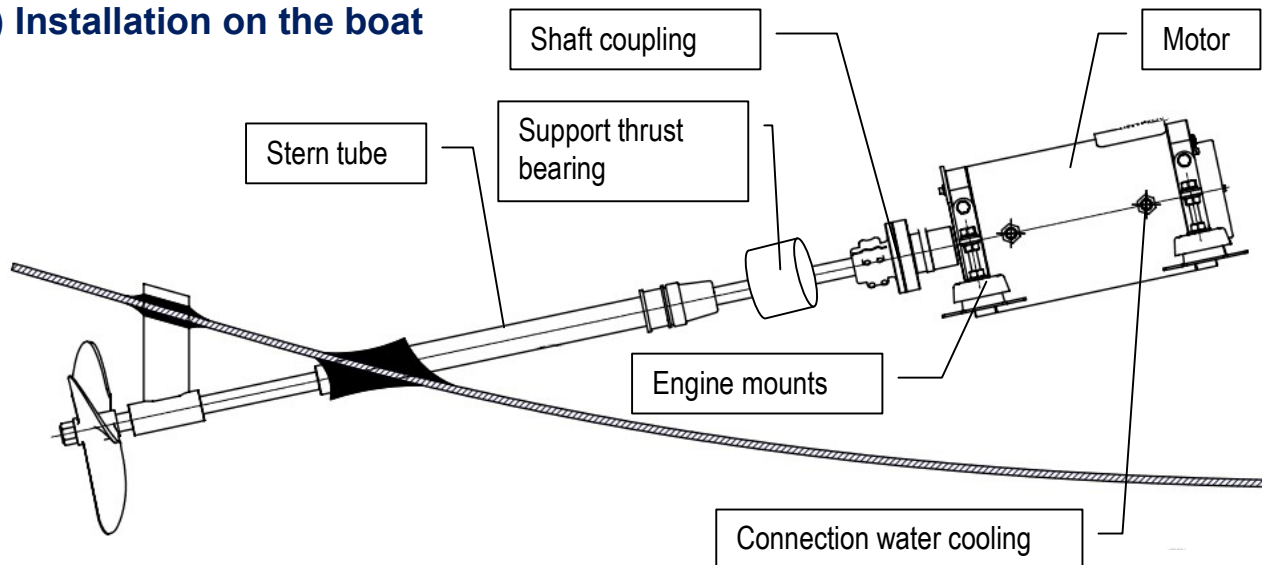
DC DC converter from engine voltage (48/96 V) to 12 V for pump appliances max. 200 Watt  For water cooled engines only.  Including connection cables and plugs	<i>ONLY IF SEPARATELY ORDERED</i>	
13 mm hose for water cooling	<i>ONLY IF SEPARATELY ORDERED</i>	
High Power 350-450 Amp 160 V DC fuse block with fuse. ANL ceramic fuse and fuse block.	<i>ONLY IF SEPARATELY ORDERED</i>	
Main Switch – 150 V / 350 A	<i>OPTIONAL</i>	
Resistor 470 O   10 W	<i>OPTIONAL</i>	
Push button for resistor	<i>OPTIONAL</i>	
Emergency Switch – 250 A (for one battery) incl. resistor	<i>OPTIONAL</i>	
Digital Battery monitor	<i>OPTIONAL</i>	 (48-90 V type)
95 mm <sup>2</sup> flexible cable for 300 Amp / 48-96 volts	<i>OPTIONAL</i>	
50 mm <sup>2</sup> flexible cable for 200 Amp / 48-96 volts	<i>OPTIONAL</i>	
95 mm <sup>2</sup> flexible cable for 250 Amp / 96 volts DC  per meter	<i>OPTIONAL</i>	

Engine mounts (4 units)  40 kg / mount  For 10 mm bolts	OPTIONAL	
Shaft coupling 25 – 38 mm  To attach to a shaft: Male & Female half coupling + coupling disc required.	OPTIONAL	
Bellows coupling from 30 mm shaft to 30-38 mm shaft.  Flexible coupling 150 NM torque  Recommended for 10-30 KW	OPTIONAL	
Heat exchanger   needs to be able to absorb at least 10 KW heat	<i>We use a simple marine hot water system heat exchangers with double setup (4-5 L / min. each).</i>  OPTIONAL	
Water pump (for fresh and salt water) 20 L / minute	<i>12 Volts   ½ " male connection adapter to 13 mm hose required   SS316 grade – to operate from main battery (96 V) a DC DC Converter is required to 12 volts (200 watts recommended).</i>  OPTIONAL	

More parts available like shaft coupling disc and coupling 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 electric engines are mounted on existing frames which are 450 – 550 mm wide. As these engines use less space than a diesel engine there is usually more than enough space available (for dimensions see section 9).

The engine can be installed in any angle, but there should be no vertical tension to the engine shaft.



For shaft lengths over 500 mm always use a supporting bearing.

### 2.1 Installation engine

Take the dimensions of the engine frame with the engine mounts. Then adapt the holes in the engine frame to the requirements of the existing frame in the engine compartment of the boat. The aluminum frame can be easily adapted. If a wider frame is required, the aluminum profiles have to be of adequate size to cope with the forces of the engine. Drilling additional holes to the frame weakens the stability.

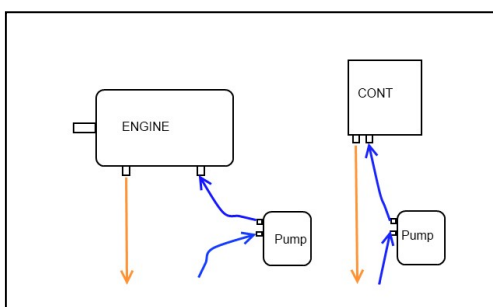
Do never install the engine without flexible engine mounts, even electric engines do not produce the vibration experienced by combustion engines, the lack of flexibility can damage the rotor / shaft bearings. Avoid vertical force to the engine shaft – this should be absorbed by a thrust bearing.

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 has to be used. Please check section 9 to comply with the maximum torque / force of the engine.

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

The water pump is powered by a 12 volt power source (24 volt pump optional). The water pump has to be able to pump 6-10 liters of water per minute. The engine and the controller have to be cooled with engine coolant or fresh water. If used in salt water a heat exchanger has to be used. If directly connected to fresh water, a suitable water filter is to be used. If the engine / controller are not cooled by water from an outside source or the engine is used at full



load for longer periods, a separate cooling string should be installed for the engine and the controller.

Example for two strings (controller / engine).



## DANGER

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

## 2.3 Electric power supply

This guide helps you to setup your electric boat propulsion respecting the highest safety standards. Do not connect this engine directly to a battery without a main switch, a safety switch and a fuse!



## CAUTION

The motor may only be connected to onboard power systems and accessories of 96 volts which comply with the CE / ISO standard.

Between the battery and the main switch a 350 Amp fuse (suitable for 150 volts DC ) has to be connected.

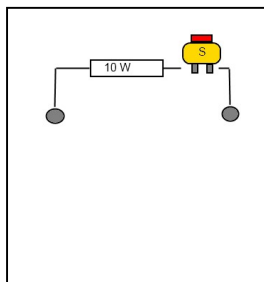
350 A | 100 V (example)



- All installations and insulations have to comply with low voltage (upto 100 volts) and marine electric installation regulations.
- The main switch has to be rated for 150 DC | 400 Amp continuous current.
- A safety switch has to be connected between the main switch and the battery. The switch has to be accessible to the operator at all times!
- A resistor should be connected to the main switch to enable the precharge of the motor controller capacitors. To avoid the battery to be slowly discharged the capacitor can be switched with a small push button. Not necessary for CURTIS controllers, which are programmed to charge capacitors.



DC 400 A min.



Resistor to be connected to both terminals of the main switch. If continuously connected, this can discharge the battery. Disconnect the battery with the emergency switch or use a push button for the resistor.

- The cables should be as short as possible. B&S tinned cables or sealed copper cables are to be used with a sufficient square size of 70 mm<sup>2</sup> to 95 mm<sup>2</sup> (96 volts | 250 Amp).
- The lugs and battery terminals need to be eligible for 350 Amp / 150 volts DC.

- ◆ To connect the controller to the battery SB 350 plugs should be used. All connections have to be mounted to a dry place under deck / covered against rain and sea water. The switch board should be made of non conducting material (plastic or wooden board 10 – 15 mm).
- ◆ The maximum battery idle voltage may not be higher than 110 volts for 96 volt engines.
- ◆ The maximum battery voltage under power is 103 volts for 96 volt engines. The minimum battery voltage 87 volts for 96 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 experienced 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.

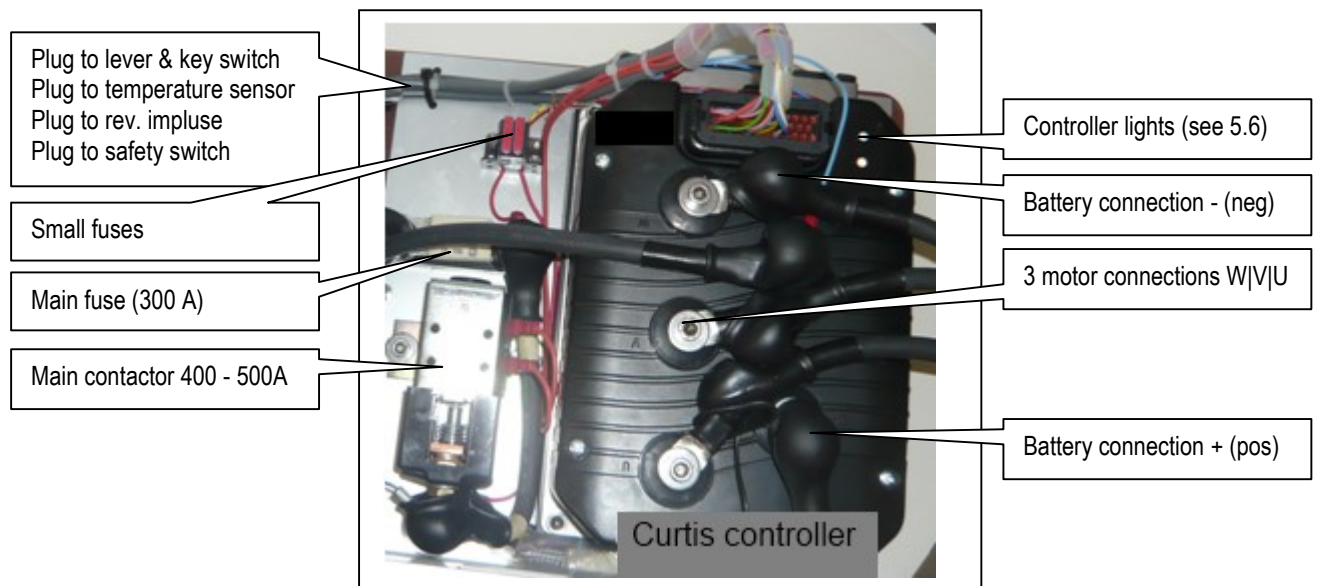
Only use battery chargers and cables, suitable for the use in the marine environment. The safe installation and operation of those is not part of this manual.

***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!***

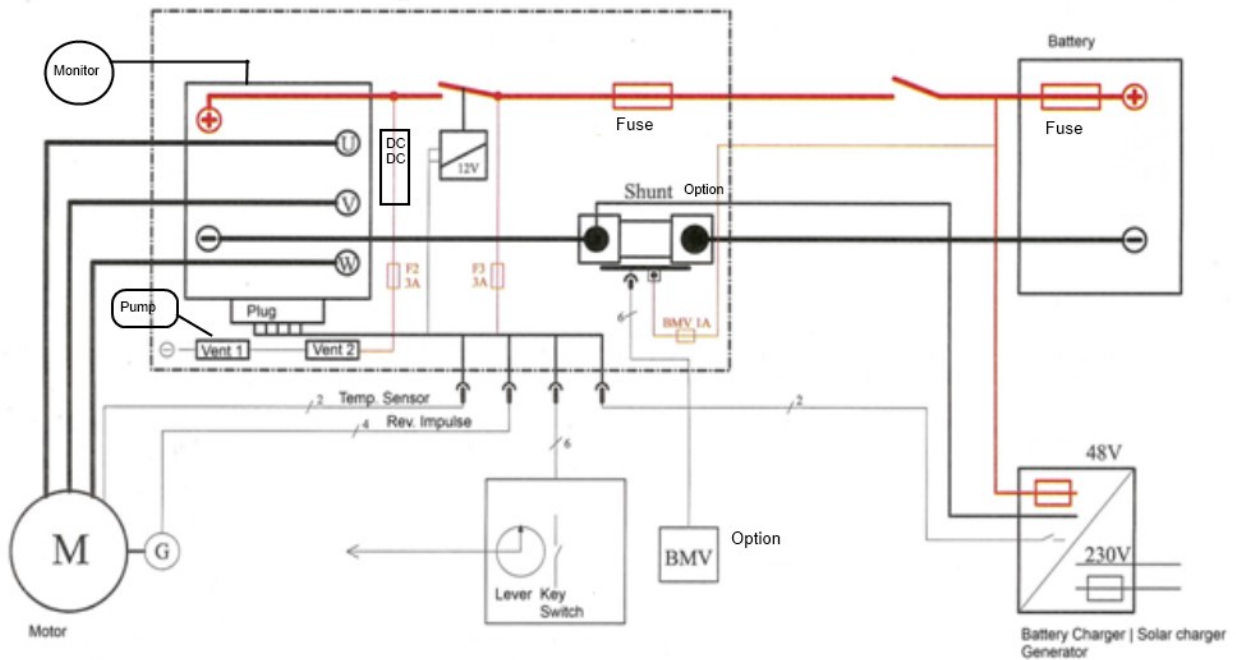


### CAUTION

The controller is supplied mounted on a supporting aluminum or PVC board (air cooled version only), containing the main fuse, the main contactor (if ordered) and the internal power supply (if ordered) as well as the auxiliary fuses. All the connections are prewired with plugs.



*Setup can look different depending on the engine type. Schematics and functionality is identical for all engines. Air cooled engines use vents and water cooled engines water pump (s). Water cooled controllers are not installed on a supporting board.*



Example for 48 volt setup. Similar for 96 volt setup – please check voltage of controller & DC DC converter!

- Connect the controller to the motor by first connecting the temperature and the rev. impulse plug
- Connect the three motor power connections (W|V|U) with the 6/8 mm lugs to the controller. Use an allen key to fix the bolts and use contact spray to prevent corrosion.



**CAUTION – Keep the distance between the controller and the motor short. Do not extend those power cables! The 3 phase power cables have to be mounted with a distance to each other, as they can get hot. If the main contactor gets hot, it has to be replaced. The main contactor has, after the main fuse, to be the weakest part in the connection string. Do not use oversized contactors.**

- Connect the lever and the key switch. The Key switch on / off is connected to the controller. A 3-position key switch to optionally connect the DC DC converter first, which starts the cooling system and optional the battery BMS.
- A standard toggle switch can be used as safety switch or any other switch to comply with safety regulations. The safety switch will switch off the main contactor (if installed) and the controller and stop the engine. Always use a main contactor between the battery and the engine. The main contactor is closed with 12 volts supplied from the BMS (battery monitor system and/or the controller). The controller switches off in case of faults, when the key switch is turned off or the safety switch is turned off.  
**CHECK THESE FUNCTIONS BEFORE OPERATING THE SYSTEM.**
- Connect the shunt (included in the battery monitor package if ordered) to the negative main power string.
- The connection of the positive power string to the battery has to include the main switch and a battery fuse.

**MAKE SURE, THE TEMPERATURE SENSOR AND THE IMPULSE SENSOR CABLES ARE SECURELY INSTALLED AWAY FROM ANY POWER CABLE TO AVOID INTERFERENCE OF THE IMPULSE.**



**DANGER – Do not ground the negative power to the boat hull or any metal frame**

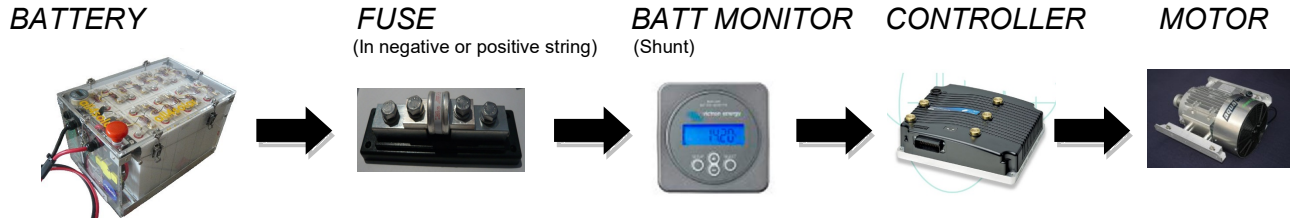
The (fused) connection of a battery charger has to be done to the load side of the negative shunt connection and the positive battery connection. For details about batteries and chargers, we offer a separate documentation.



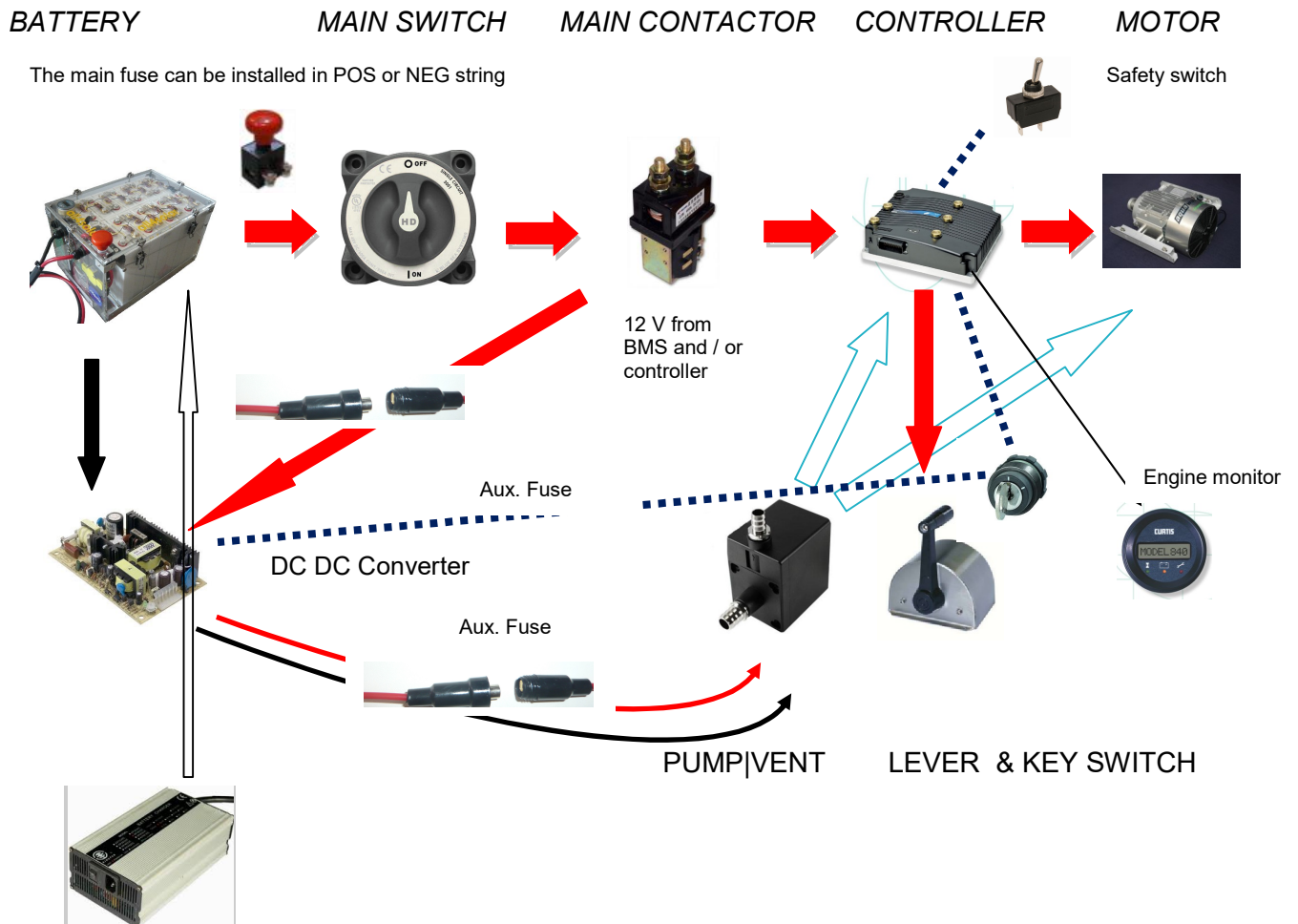
*WE CAN PREWIRE THE BATTERY CONNECTION, THE MAIN CONTACTOR AND THE SHUNT CONNECTION IF REQUESTED. BUT AS INSTALLATION IS DIFFERENT ON EACH BOAT WE RECOMMEND TO DO THIS AFTER ALLOCATING ALL EQUIPMENT IN THE ENGINE COMPARTMENT.*

## OVERVIEW ELECTRIC SETUP

### NEGATIVE (-) CONNECTION DC STRING



### POSITIVE (+) CONNECTION DC STRING



BATTERY CHARGER | SOLAR SYSTEM | GENERATOR (to be fused!)



Basic setup information only! Check your individual installation, which can vary.

**CONNECT THE BATTERY LAST WITH ALL SWITCHES OFF!**



## 2.4 Initial system start

- 💧 Check all connections and make sure, the engine shaft can turn free.
- 💧 The water pump (s) or the ventilators have to be connected to the controller and the engine.

- 1 – Switch off main switch
- 2 – Switch off emergency switch (if installed)
- 3 – Connect engine
- 4 – Move lever in neutral position
- 5 – Connect battery
- 6 – Switch on emergency switch
- 7 – Check if the engine shaft is not blocked
- 8 – Switch on main switch
  - ⇒ The engine monitor starts operating
  - ⇒ The led on the lever flashes (if appl)
  - ⇒ The battery BMS has to be on
  - ⇒ The water pump starts operating (or vent)
- 9 – Switch on engine via the key switch/forward
  - ⇒ The main contactor switches on
  - ⇒ The controller starts working
  - ⇒ The engine is ready to run

- 💧 Test the engine by shifting the lever forward and backward. When changing from forward to back always stop in the neutral position.
  - ⇒ Disconnect the water pump, if the boat is not in water
- 💧 The engine can be run without the water cooling system operating at idle power for a short time.
- 💧 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 7. See also Section 5.1.



### CAUTION

Also check the separate manual for the digital motor controller (Curtis) as well as the manual for the monitor (s).

## 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.

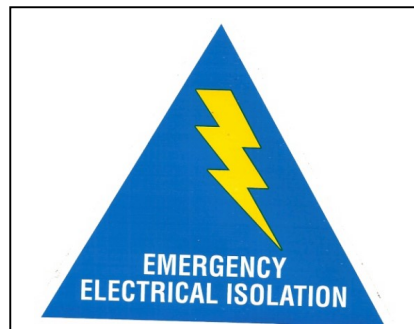
### High voltage sign (example only)

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

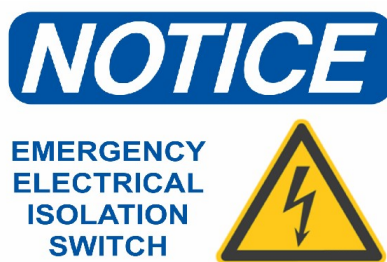


### Emergency switch (example only)

- On switch board | battery pack



Aquawatt 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.

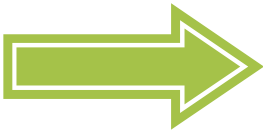
For details about the warranty conditions see section 8.



### **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 turning 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**

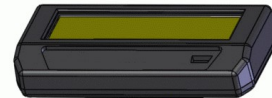
## 2.7) Digital battery monitor

### OPTIONAL

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



48 – 80 V DC



48 – 155 V DC

The shunt included with the meter has to be installed between the negative battery pole and the fuse / main switch. The battery charger has to be connected on the fuse side and not directly to the negative battery pole, as otherwise the meter cannot count the amp hours charged.

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

## 2.8) Multi functional engine display

### INCLUDED

The Curtis multi functions display is not required to operate the engine, but returns some useful information in addition to the digital battery monitor. We recommend installing both, the engine monitor and the digital battery monitor with an electric inboard engine.

If only the yellow light flashes, this shows a normal operation. The display indicates the most important information. Besides the selected information, the battery charge status is always shown on the top of the screen between 0 (empty) and 1 (full). This applies **for lead acid batteries only**, as this value is calculated on the drop of voltage, where lithium batteries do a very low drop of voltage and therefore a digital battery monitor with a shunt is the only 100% accurate way to determine the state of any battery type. This also applies to the information about the battery and motor current. We recommend to set the display to the rotations per minute. It is also useful to return the operation hours of the system and error messages from the controller.

When starting the engine, the monitor shows the motor rotation speed per minute.

To change to another reading, push the button to the right. To move back, push the left button.



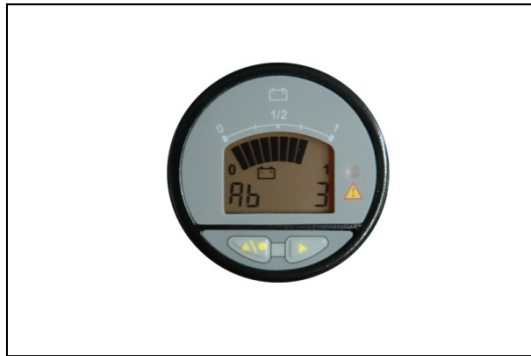
Motor rotation speed / minute



Battery charge status in %



Hours of operation (full hours)



Battery power in Amps (Lead acid only!)



Motor power in Amps (Lead acid only)



Battery voltage in volts

**IMPORTANT:** All values refer to AGM (lead acid) batteries. To indicated the battery charge capacity of a LI Ion or LIPO or LIFEPO battery pack, a separate monitor has to be installed! (see 2.7)

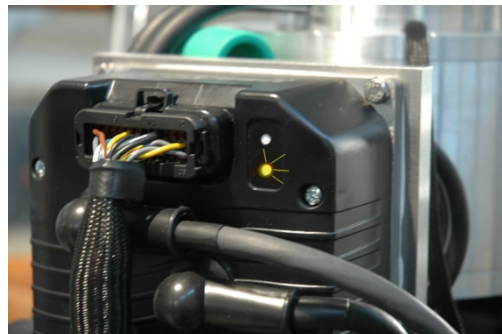
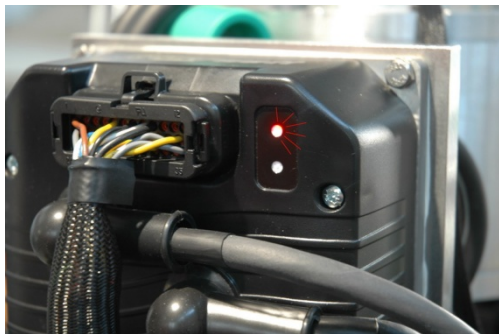
## 2.9) Error messages from the controller

An error or damage is reported by a red light. If the battery is completely empty this warn light is also switched on.



The housing of the motor controller has two indication lights. If the red light and the yellow light flash, this indicated an error.

Two signalization lights are integrated in the controller cover. Flashing of the red and the yellow light indicates a fault.



If both lights are switched of, the motor is not connected or insufficient voltage is supplied to the system.

## 3) Section not used for this engine

xxx

## 4) Operational area

The electric inboard motor can be used in fresh water and if equipped with a suitable heat exchanger for the cooling system in salt water.

The engine room has to 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. Check the filters of the water pump.



### ATTENTION

The motor should only be used in water not colder than 5 degrees Celsius and not warmer than 30 degrees Celsius. Variations of these limits can result in damage of the motor and the cooling system.

## 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 have to 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 have to 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 lever in neutral position
- 2 – Switch on emergency switch (es)
- 3 – Switch on main switch
  - ⇒ The battery monitor starts operating
  - ⇒ The water pump starts operating
- 4 – Switch on main switch
  - ⇒ The battery monitor starts operating
  - ⇒ The led on the lever is lit
  - ⇒ The controller led is lit
  - ⇒ The water pump starts operating
- 5 – Switch on engine via the key switch
  - ⇒ The main contactor switches on
  - ⇒ The controller starts working
  - ⇒ The engine is ready to run

Make sure the water pump is running. The engine's temperature and the controller temperature are monitored by the system to avoid over heating. This can result in a sudden stop of the engine.

We recommend to have a spare pump and hose on board for longer trips.

## 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 AC induction 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 backward. Do not drive backwards 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!

### **5.6) Error messages on display**

See section 2.9.

## 5.7) Low voltage alert (optional)

If a battery is discharged under 42 volt (48 volt system) / 84 volt (96 volt system) this can damage the battery. If the voltage gets close to this value you will hear a warning sound. Slow down the motor to help the battery to regain voltage. We recommend using two battery blocks with two battery positions. So you can operate on one battery block and then switch to the second block as reserve.

Below 40 volts / 80 volts, the controller will stop to work!

We recommend to use the alarm function on the digital battery monitor (if applicable).

## 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 upto 95% in one hour.

When using lithium batteries 95 mm<sup>2</sup> cables should be used for engines over 10 KW.

See our battery – information document for more detailed information.

12 tonne cat – 2 x 10 KW inboard



2 tonne 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 according to 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

The service should only be done by an authorized service centre with original or recommended spare parts and lubricants.

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

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

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

### **6.1.1 Motor / Controller**

The AC induction 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 5-10 Amps.

NEVER open the motor or the controller.

### **6.1.2 Cooling system**

If a closed cooling system is used, the coolant has to be replaced from time to time. In this case a expansion tank should be installed to make sure, there is no air in the system. The connections to the engine and the controller have to be fully sealed.

Check for any leaks in the system after each trip.

If the motor is stored for a longer period or over winter in places, where the temperature falls below 5 C, the water cooling system has to be completely emptied!

### **6.1.3 Bearings & electric connections**

All cable plugs, electric connections and main fuses to be checked for corrosion and to be treated with a protection and lubrication spray if necessary. Any damaged plugs, cables or connections to be replaced.

The engines industrial ball bearings do not require maintenance.

### **6.1.4 Water**

Please note, that these engines as well as the controller, even fully enclosed, are NOT water tight. The water cooling system is fully enclosed, but still the engines will be damaged if drowned in water. There is no problem with splash water, but a powerfull bilge pump has to avoid, the engines get in touch with sea / fresh water.

## 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 water cooling system & filters		
	Check the electric contacts and switches		
Each 100 hours 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, cooling hoses and pumps. Those parts can last for over 10 years, if well maintained	Exchange the main switch, the emergency switch, the water pump and the hoses Replace the belt	
	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

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 is 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.

The warranty does not include wear parts such as: Joints & gaskets, hoses, electrical connections 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 applies.

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

*These electric direct drive boat engines are programmed for a certain average range of boat sizes. Most parameters are fully programmable and we can adjust these according to your information. The standard setup is optimized for fast and efficient boats running 8 – 20 knots, 6 – 10 meter length and 1 – 3 tonnes weight. The performance of a boat is determined by a lot of factors and all4solar cannot guarantee the expected performance, even AC induction motors are able to adapt torque and power to the conditions. The perfect optimization of an electric propulsion system can be achieved by measuring and setting the controller parameters when the boat is moving.*



## 9) Technical data

### 9.1) AW IB 15 KW

#### ▶ **15 – 25 KW | 96 V system**

AC electric induction motor | incl. blower (shaft or el).

AC controller 96 V | 550 A max. | 250 A nom.

air cooled (water cooled as option)

Size motor: IEC 132 | 4 pole low voltage

Voltage supply: 96 V DC | 290 A max. 175 A nom.

Power output: 25 KW max. (1/2 h 2500 rpm)  
15 KW nom. 2000 rpm

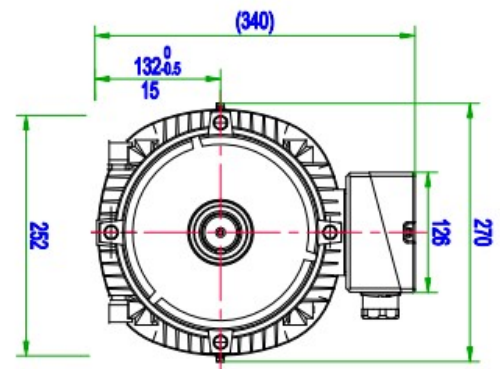
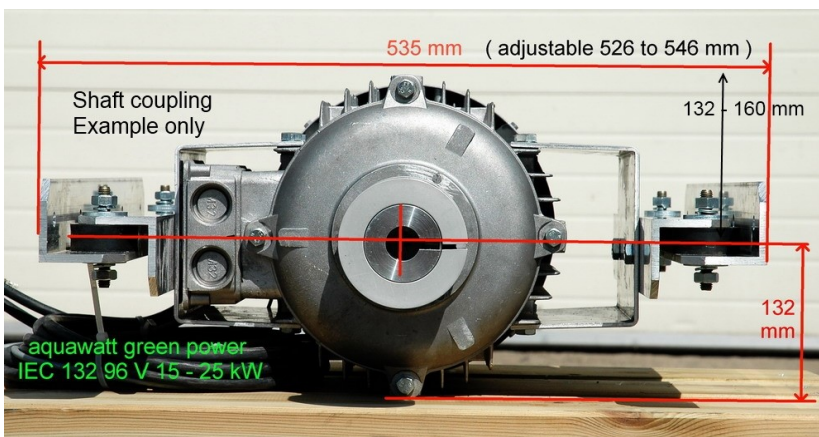
Weight: 50 kg (motor & mounts)  
8 kg (controller)

Torque: 75 Nm | 100 Nm (1/2 h)

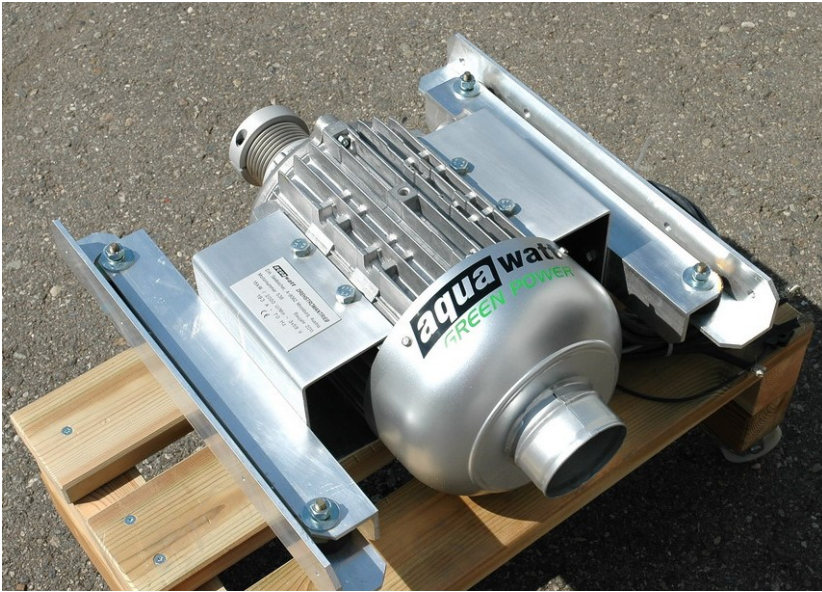
Air cooling motor and controller

Shaft: 30 mm (35 mm length)

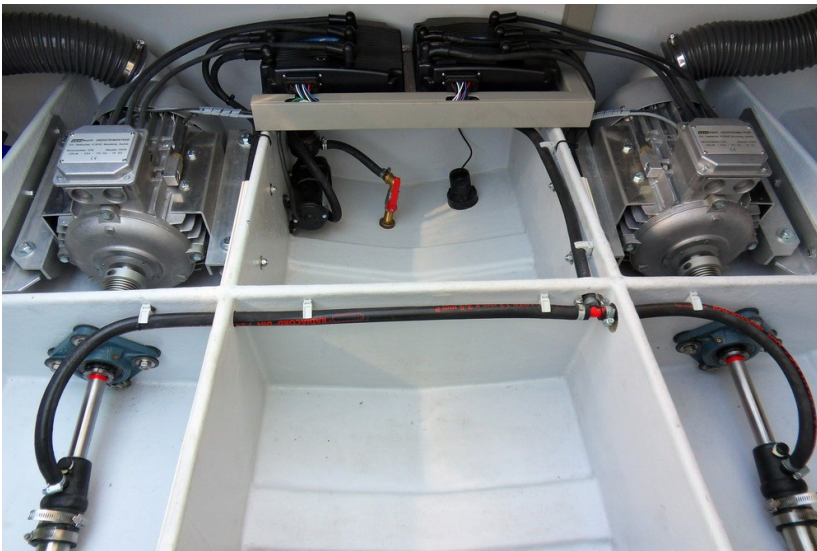
Recommended propeller: 12-13'



Rail width: 526 – 546 mm  
Overall height: 270 mm  
Engine mounts: 40 mm high  
Shaft height: Centre of engine mounts  
Overall length: Hose to shaft 600 mm  
With coupling see 9.3  
Rail length: 530 mm  
Inside rail length: 430 mm  
Bolts: M 10



Twin setup example upright with support bearings

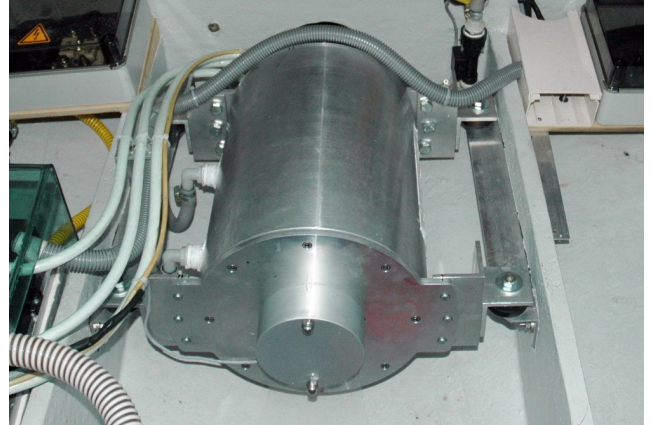




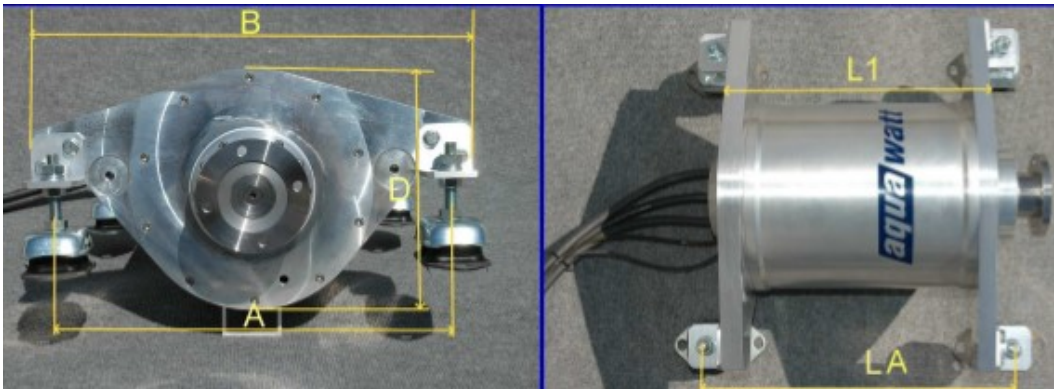
## 9.2) AW IB 30 KW

### ▶ **30 KW | 96 V system**

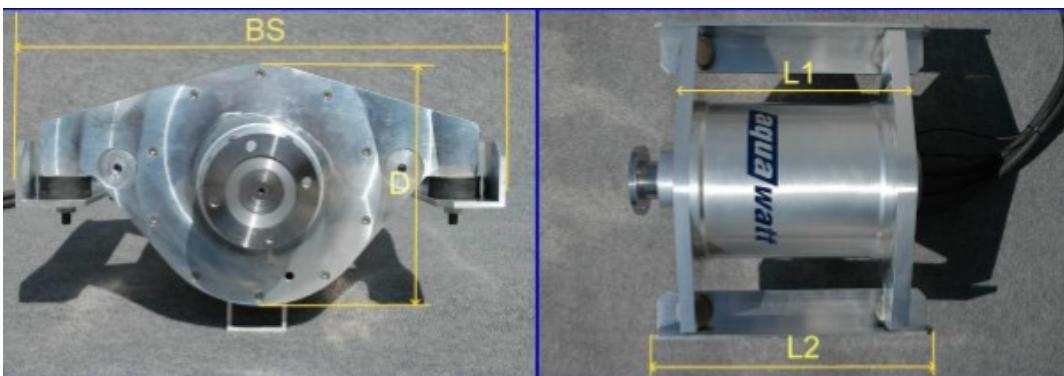
AC electric motor | incl. water pump  
AC controller 96 V | 550 A max. 250 A nom.  
Size: IEC 132  
Voltage: 96 V DC | 350 A max. 290 A nom.  
Power output: 30 KW max. 2500 rpm  
25 KW nom. 2000 rpm  
Water cooling | pump 12 V | DC DC conv.  
Motor / 12 l / min.  
Weight: 60 kg (Motor)  
10 kg controller & equipm.  
Torque: 120 NM  
Shaft: 30 mm (35 mm length)  
Recommended propeller: 12-14' (see below)



### **Dimensions for the 30 KW water cooled motor.**



**A = 370 mm | B = 420 mm | D = 233 mm | L1 = 310 mm | LA = 366 mm**



**BS = 450 mm | D = 233 mm | L1 = 310 mm | L2 = 400 mm**

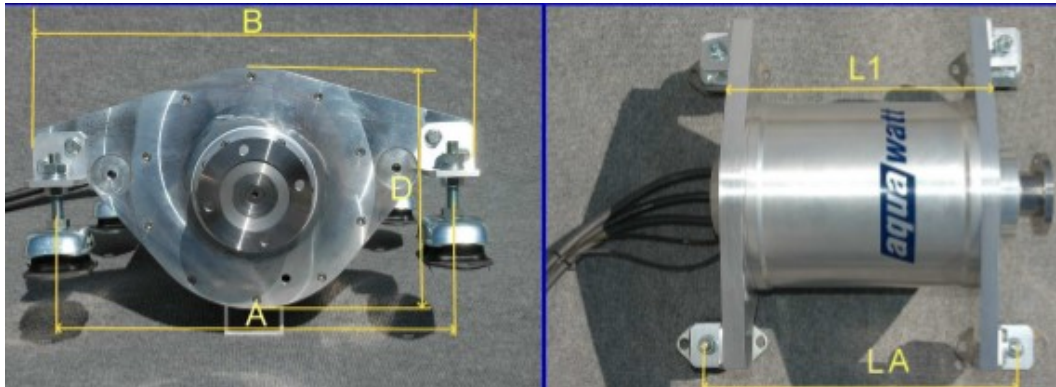
### 9.2) AW IB 40 KW

**▶ 40 KW | 96 V system**

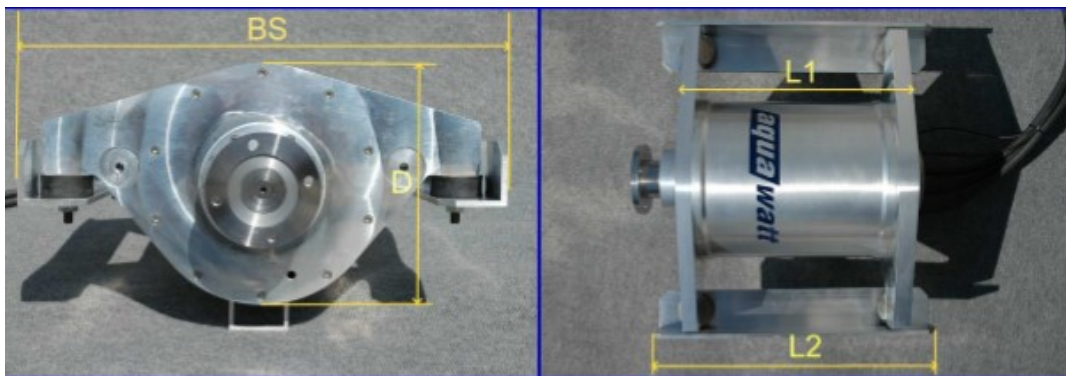
AC electric motor | incl. water pump  
AC controller 144 V | 550 A max. 250 A nom.  
Size: IEC 160  
Voltage: 144 V DC | 310 A max.  
Power output: 40 KW max. 2000 rpm  
25 KW nom. 1600 rpm  
Water cooling | pump 12 V | DC DC conv.  
Motor / 12 l / min.  
Weight: 85 kg (Motor)  
10 kg controller & equipm.  
Torque: 150 NM  
Shaft: 30 mm (35 mm length)  
Recommended propeller: 14-16' (see below)



### Dimensions for the 40 KW water cooled motor.



**$A = 370 \text{ mm} \mid B = 420 \text{ mm} \mid D = 273 \text{ mm} \mid L1 = 350 \text{ mm} \mid LA = 406 \text{ mm}$**



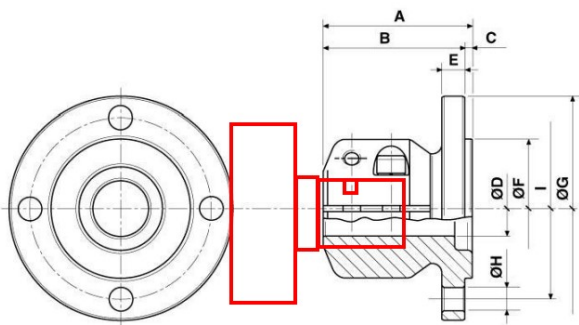
**$BS = 450\text{ mm} \mid D = 273\text{ mm} \mid L1 = 350\text{ mm} \mid L2 = 440\text{ mm}$**

- For fast boats, use propellers 16' / 11 pitch (boat can run upto 22 knots).
- For slower boats use 14-15' props.
- Below 14' this engine will not reach peak performance.

### 9.3) Coupling

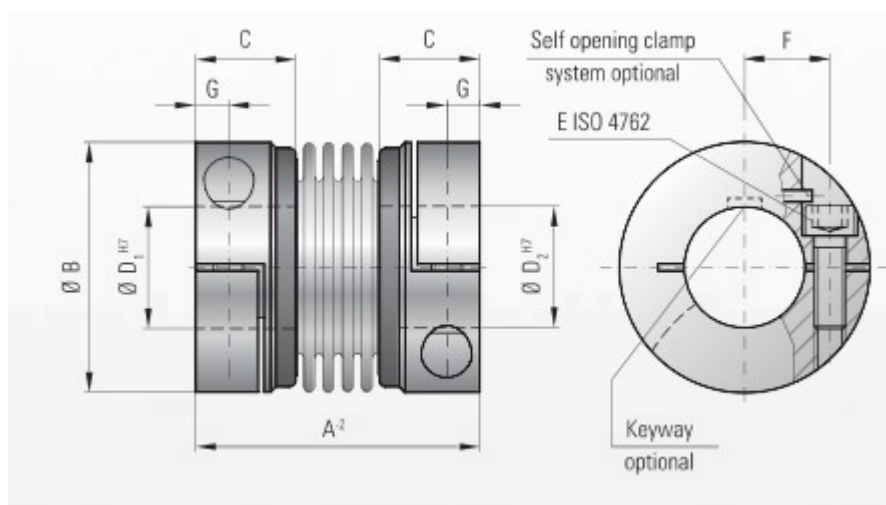
The use of the Bellows- or Spider coupling is the preferred and recommended method of connecting these engines to the prop shaft. Alternatively two half couplings with a flexible coupling disc can be used. Make sure, the coupling and the shaft are balanced.

#### 9.3.1 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

#### 9.3.2 Bellows Coupling



Standard: no 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			M3	M4	M4	M5	M6	M8	M10	M10	M12	M16
Tightening torque of the fastening screw (Nm)	E		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 ( $10^{-3} \text{ kgm}^2$ )	$J_{\text{total}}$		0.002	0.007	0.016	0.065	0.12	0.3	0.75	1.8	7.5	11.7
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	3.8	4.9
Torsional stiffness ( $10^3 \text{ Nm/rad}$ )	$C_t$		1.5	7	9	23	31	72	80	141	360	410
Axial  ± (mm)			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)	$C_s$		8	35	30	30	50	67	44	77	112	72
Lateral spring stiffness (N/mm)	$C_s$		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.

### 9.3.3 Flexible Spider Coupling

An economic option with high grade aluminium 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
Tolerance	mm	0.02	0.02	0.02	0.02
Weight	gramm	362	582	966	1820

### 9.3.5 Cardan Coupling / Universal Joint

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.

**IMPORTANT:** Do not connect the engine shaft to the propeller shaft without a supporting bearing. See picture in section 9.1.

## 9.4) Controller

The AC controller (Curtis 1238xxxx range) is supplied with the main Ampseal plug and the harness wire. Check the connections carefully.

### Low power connections

◆ Keyswitch	Battery + to J1-1 and Interlock J1-9 (Emergency switch) <b>FUSE THIS CONNECTION</b>
◆ Motor Temp. Sensor	Motor to J8 and J7
◆ Encoder	J-1 31/J-1 32/J-1 26/J-1 7
◆ Lever (Throttle)	Lever to J1-15 / J1-16 / J1-18
◆ Brake (Regen)	OPTION ONLY: Lever to J1-27/J1-17/J1-18
◆ Main Contactor	OPTION ONLY: J1-6 and J1-13 to main contactor coil
◆ Display	Display to J1-25/J1-28/J1-7

With a forward / reverse lever or Joy Stick option, no separate forward / reverse switch is required (J1-22 / J1-33 to batt+)

### Power connections

◆ Battery +	Via main switch, main fuse, main contactor to battery +
◆ Battery -	via shunt (optional) to battery -
◆ U Motor	To motor U phase (do not extend cables)
◆ V Motor -	To motor V phase (do not extend cables)
◆ W Motor	To motor W phase (do not extend cables)

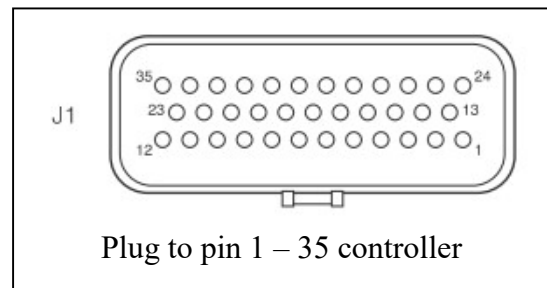
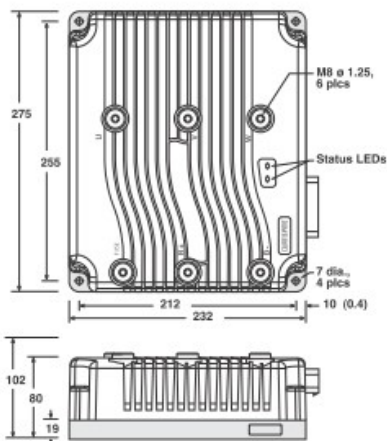
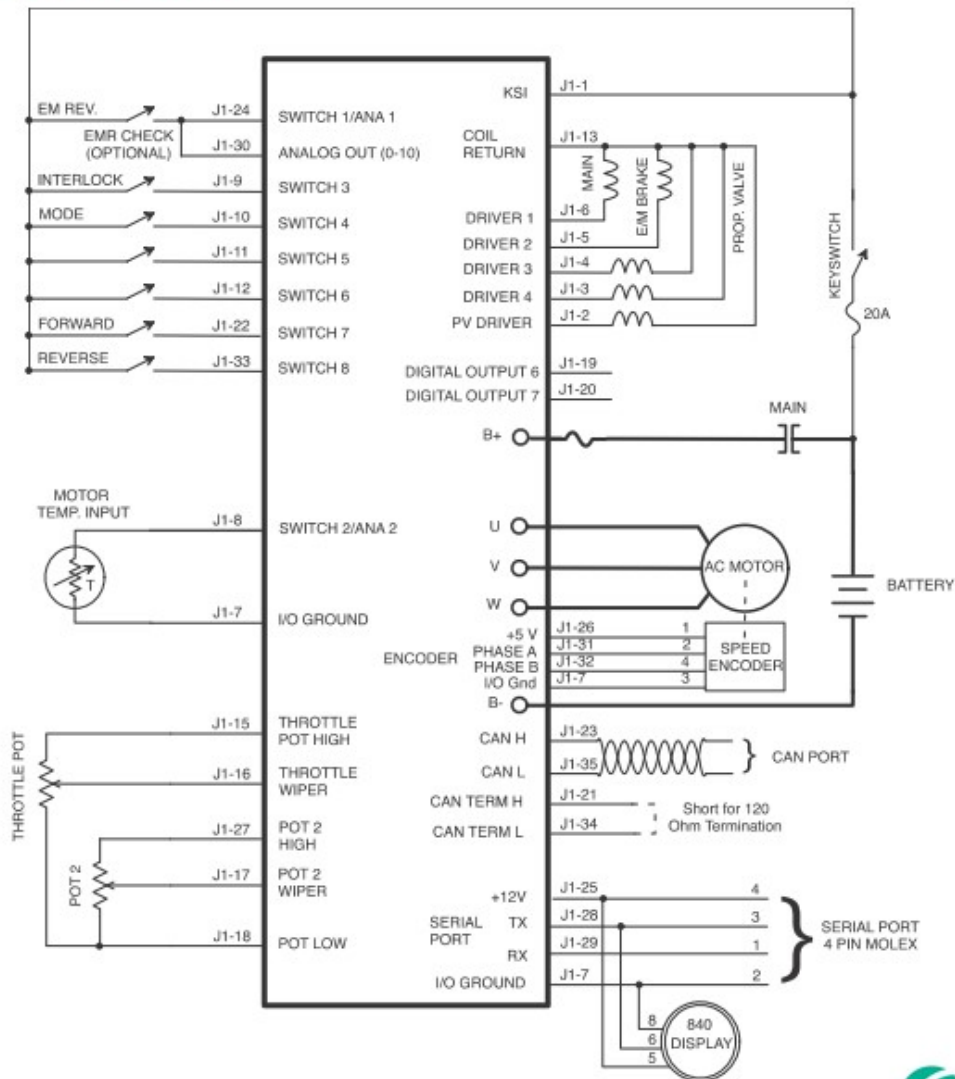


### CAUTION

If the controller is programmed with the option to connect a main contactor, the system only works, if the main contactor is connected. If the contactor is operated by the BMS (battery management system) or a main switch, no connection to the motor controller is required. In this case we recommend to use a resistor with the contractor to precharge any load capacitors.

***The controller is programmed for the engine supplied. Any change to the program setup can result in damaging the system or malfunction.***

## TYPICAL WIRING



Dims. without water- or air cooling system

## **Performance**

Operation time 30 KW - motor at 26 C – output 25 KW nominal (30 KW max)

*Note: Lead acid batteries delivery only about 60-65% of their capacity in 2 hours  
Lithium (LiFePo4) batteries deliver upto 95% of their capacity in 2 hours*

Power consumption 1 KW (Kilo Watt) = 1000 Watt 1 Ah = Ampere hours 1 Watt = Voltage * Amps	Battery 96 V 2 x 8 x 250Ah AGM 1210 kg (47.0 KW H)	Battery 96 V 30 cells   400 Ah LifePo4 400 kg (38.4 KW H)	Performance Multihull boat 4 tonne   10 meter
100 % - 28 KW	1 h : 6 min	1 h : 20 min.	16 knots
70 % - 19.6 KW	1 h : 45 min	2 h : 5 min.	14 knots
45 % - 12.6 KW	2 h : 40 min	3 h : 10 min.	11 knots
20 % - 5.6 KW	7 h : 20 min	7 h : 10 min.	7 knots

*Please note, that above figures are indications only and can vary according to the various battery types and suppliers as well related to conditions and age of batteries. The performance on a boat is influenced by the water (fresh, salt), the weather conditions, the hull material, the hull type, the size etc. A rough indicator is, that the KW output of a diesel engine can be multiplied with a factor 0.70 to get the KW required for an AC induction electric inboard engine.*

*Example: 20 HP diesel = 14.8 KW output  
Can be replaced by a 10 KW inboard*

*The reason for this is, that a diesel engine does only produce the full thrust at a very limited range of revs. Electric motors offer the full torque at a much wider range of revs. Then unlike AC induction engines, diesel engines loose power with age and for this reason boats are often overpowered.*

*This does not apply to DC electric motors or brushless DC motors which have permanent magnets and do not like overloads. Those engines are not really suitable for larger boat engines.*



## 10) Spare parts

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.

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 spareparts will void the warranty.

Only use original high quality spare parts.

## **11) Installation diagram**

See section 2

## **12) Propeller information**

The size of the propellers to be used is specified in section 9. For inboard engines with direct drives, propellers from 11 to 14' are to be used, depending on the size of the engine, the boat hull performance and the rotation speed.

## 13) 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.

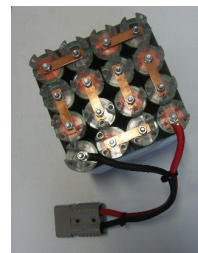
Some important information related to lithium based batteries:



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 actually 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.

## 14) Battery charging / solar power / wind power

### 14.1) Standard grid chargers

For charging the batteries you must use a suitable charger. Always make sure, the charger is fully water protected 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 chargers with several charging modes (charge, float etc.) to extend the life of your batteries and get the complete charge at all times.

Do not use cheap 12 V chargers for car batteries.

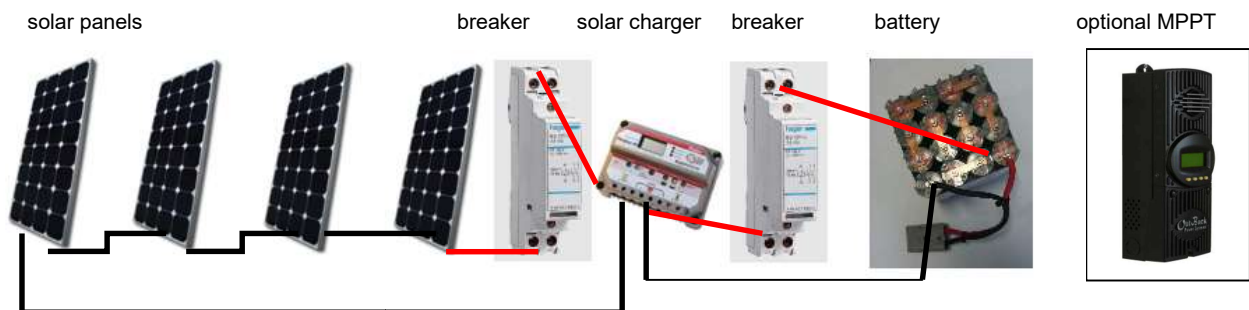
See our battery documentation for LIFEPO4 battery packs



### 14.2) Charging with solar power

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

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 for a 48 volt system). Please note, that with full sunshine a 48 V / 100 Ah battery pack needs about 2 days for a 50% charge with a 200 watt solar system.



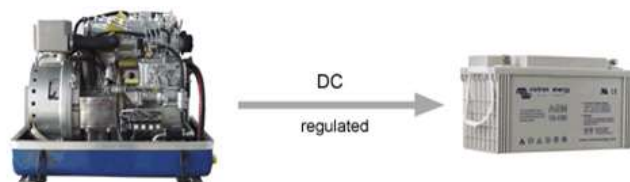
We recommend that you install an automatic circuit breaker between the battery and the solar charge controller and between the solar charge controller and the solar panel (Either DC breakers or 250 V AC automatic breakers).

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

Aquawatt is not reliable for any installation of batteries or battery charge systems. Always contact a specialized or authorized (if applicable) installer prior to any installation or purchase.

### 14.3) 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.



## 14.4) 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.



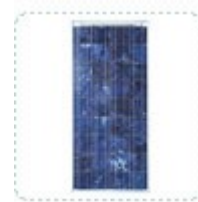
### Mono Crystalline

High efficiency – converts upto 18 % 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 14 % of solar light  
Somewhat cheaper than mono crystalline – needs more space  
Economic solution for fix long term installation



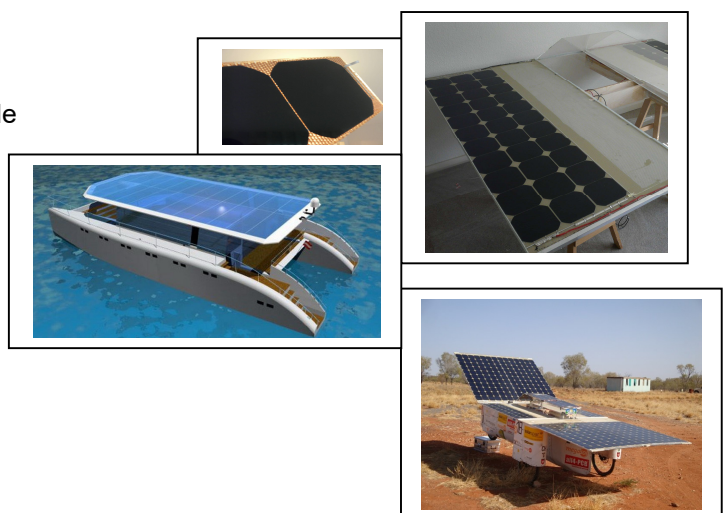
### Thin film

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



## 14.5) 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**

Over 14 knots wind output upto 600 watts over 24 hours = **14.4 KW**

## **15) CE conformity declaration for aquawatt electric – outboard motor**

According to EU-directive 98/37/EG

Valid for motor type 25 / 30 KW inboard

**Manufacturer:** D.H. Seebacher – Mechatronik, Wasserstrasse 1 ,  
9062 Moosburg Austria

**Type of machine:** Electric AC induction inboard boat motor

### **The machine complies with the following regulations:**

EG 98/37/EG (mechanics) Inspection authority Amitri Veritas 0463  
73/23/EWG changed by RL 93/68/EWG ( E – motor )

The E – motor complies with :  
EN 60204-1, EN 50081-2 EN 50082-2

The electronic controller complies with :  
EMC emission EN 50081-2/08.93, EN 12895/2000  
EMC Immunity : EN 50082-2 1995  
Safety EN 1175  
UL listed Ref. AU1841, complies with UL 583 dielectricity

### **The conformity declaration is subject to the following conditions:**

The electric outboard motor may only be used with boats and with connected to batteries which are secured by a safety switch.  
The cables have to be equipped with suitable fuses. Positive and negative cables are to be installed side by side.  
The motor may only be powered by batteries and not directly by generators, chargers etc.

  
Dieter Seebacher

Issued 08.06.2010 by manufacturer