MarineKinetix MK4+
Marine Wind Turbine

INSTALLATION AND OWNER'S MANUAL

99 SOUTH HARRIS RD
PIEDMONT, SC
USA 29673
(864) 214-5337

Thank you for purchasing the MarineKinetix MK4+ wind turbine.

PLEASE READ THIS MANUAL THOROUGHLY BEFORE INSTALLATION AND KEEP IN MIND ALL SAFETY INSTRUCTIONS AND WARNINGS.

We recommend installation by a qualified professional marine electrician. A professional installation will ensure that you have proper wire-sizing, grounding, and appropriate electrical safety devices. Our warranty does not cover damage resulting from improper installation.

The cruising lifestyle is all about independence; doing your own thing, on your own time, and on your own terms. It is about freedom from the constraints of city-life, and the ties to shore, without giving up all of the creature comforts that make life enjoyable. Unfortunately, many of these comforts require energy, and that is where the MarineKinetix MK4+ comes into play.

The MarineKinetix MK4+ has been developed to provide reliable, abundant 12 or 24 volt power, with virtually no maintenance, so as to ensure many years of quiet enjoyment. Our priorities in development were:

- High output in low wind speeds
- Compact size and attractive appearance
- Quiet in all wind speeds
- Self-regulation with no user activity required
- Reliability without maintenance

While the initial appearance of the MarineKinetix MK4+ may be familiar, the technology and performance are innovative and unique in this market.

We are certain that you will be well satisfied with your purchase and have backed it with a full 3-year warranty on materials and workmanship. However, reliable operation will not only depend on our product quality, but also on your assembly, installation, proper wiring and usage.

NOTICE: The information contained herein is correct at time of publishing. However we assume no responsibility for inaccuracies or omissions. The user of this information and product assumes full responsibility and risk.

1.0 General information and references:

Wind Generator 101

Understanding how a wind generator operates, and having informed expectations, is crucial to gauging performance, and being satisfied with your purchase. The following section provides a primer on wind power. We recommend that you read the following section carefully, and contact us if you have any questions or concerns.

A wind generator's capability to produce power is related to the load it must supply. In other words, the load must be more or less matched to the wind generator's output to take full advantage of the power available. We have all seen the old wind mills on farms which are driving wind-driven water pumps. Now imagine a child's small pinwheel trying to drive that pump. It wouldn't work, of course, but not because the pin wheel itself is not capable of producing some amount of power, but because the load is mismatched to the pinwheel's capacity; or said another way, the pinwheel's blades cannot produce enough torque to operate the pump. This is an extreme example, but it conveys the concept of load – source (or impedance) matching. Interestingly, all wind generators need to be matched to the load they will see. This is true of all types of generators and alternators as well.

Considering the fact that for each and every wind speed there is a differing amount of torque being applied to the blades, you can immediately understand that it would be extremely difficult to always match the load to the wind generators capacity in real-time --especially on a boat. Loads come on and off, wind speed varies, and batteries get discharged or topped-up. Each of these variables is affecting the load, and the output. Too much load, and you begin to stall the generator, losing power, too little load and the power also drops.

One concept to remember before getting into the details of this is that the wind generator's source voltage (from the generator motor itself) varies with speed of the rotor blades. So at high RPM it makes high voltage, and at low RPM it makes low voltage. Also remember that wattage = voltage x amperage (P=VxI). With this understanding, let's say that there is a nice constant 15 knot wind blowing, and the wind generator is happily spinning away. If we now put a huge and constant electrical load on the wind

generator, the load will cause the wind generator to slow down and the voltage and power (wattage) to drop. The wattage drops because the load is constant (in amps), but the voltage goes down as the load causes the wind generator to slow down. So, per P=VxI, the power, or wattage, drops. If, however, we remove all of the loads completely, the wind generator will begin freewheeling in a no-load condition, making lots of volts, but zero amps, which again reduces the power in watts. You can see that this concept is analogous to an electrical motor. If you put a huge load on an electric drill it will stall, meaning is has a big load in amps, but zero rotation (volts), so it has zero power to do any work. On the other hand, if we lift the drill from the work, this removes the load entirely, and it develops a very high no-load rotation speed (volts), but again accomplishes no work. Wind generators work the same way. If you drew a curve describing this relationship, you would see that for any given wind speed there is a specific rotor speed that maximizes power. If the load is too great, power is lost, if the load is too light, power is also lost.

Physics determines the performance of any wind generator. While there are certain incremental gains that can be made by improvements in design, the basic laws of physics dictate wind generator performance, and these laws are irrefutable and constant across all brands and types. At the end of the day, there are 4 principal factors which determine wind generator performance, regardless of make, model and size. They are: 1) Wind Velocity; 2) Swept Area; 3) Tip Speed Ratio; and 4) Battery Acceptance Rate or Load.

Wind Velocity

The power inherent in the wind is a cube relationship to its velocity. So, there is 27 times more available power in a 15 knot wind than there is in a 5 knot wind. Or, to say it another way, there is 27 times *less* power in a 5 knot wind than in a 15 knot wind. The wind's power is what develops the torque on the blades, and the torque is what produces electrical power. As you can see, because of the cube relationship of wind speed to power, you need significant wind to generate appreciable power. While the start-up speed of the MK4+ is the lowest in the industry, it is not expected to make much power at this speed, because the torque available in the wind itself is minimal. The good news is that it will, in fact, be collecting power at low speeds, and it will do so 24/7, provided that there is wind, which eventually adds up to Amp-Hours.

While one would think it is simple to effectively gauge true wind speed on-board, it is actually quite difficult. This is because what you think is an 8 knot breeze could really be a 6 knot breeze followed by a momentary 9 knot gust, followed by another lull. Because of the cube relationship described above, an average of the wind speed is not necessarily a simple average of the power. Additionally, a masthead anemometer may read up to 30% higher than the wind on deck. Wind also needs a wide and unobstructed area to effectively transmit power to the wind generator. So, the higher and clearer you can mount the wind generator, the better. Any obstructions, of any type, either upwind or downwind, above or below, will rob the generator of some amount of power.

Swept Area

For a given wind speed, the swept area is the primary factor in the design of the wind generator which most affects the power it can produce. Physics again dictates that the longer the blade is, the more torque it can muster, and therefore, the more power can be produced. The trouble is that longer blades are handling more torque, so must be stronger. Additionally, they weigh more, which means they could potentially give up light wind performance. The key here is to make a very lightweight and strong blade, and make it as long as possible. A longer blade means a larger swept area, which means more power. The interesting thing is that while the MK4+ rotor blades are only about 8" longer than the competitor's blades, they sweep an area that is more than 40% bigger, yet still have lower rotational inertia. The MK4+ is able to do this effectively, while maintaining a very low start-up speed, by using a 20% carbon fiber filled lightweight and super-strong plastic blade weighing only 300g.

The takeaway here is that if you lined up 20 marine wind generators, with different designs and different claims, and tested their maximum power output, the one with the largest swept area would win every time.

Tip Speed Ratio

Tip Speed Ratio is the one area of wind generator design where the manufacturer can really affect overall performance. This is the ratio of the speed of the tips relative to the speed of the wind. The best way to understand this is to realize that for any given wind speed there is an optimum RPM that captures the most power from the wind. If the rotor

blades are spinning too fast, they begin to look like a solid disc to the wind, and not enough wind can pass through at high enough velocity to develop the lift needed to extract the power available from the wind. These blades essentially begin blocking their own wind. Additionally, the turbulence, or wake, from one blade has no chance to dissipate downwind before the next blade hits it, reducing lift forces further. This is why multi-bladed wind generators are not effective at higher wind speeds. Alternatively, if the blades spin too slowly, relative to the wind, much of the wind is passing through the gaps between the blades, with its energy un-captured. So, the blades, by rotating too slowly, have missed much of the available power as the wind passes by.

The optimum Tip Speed Ratio is accomplished by having a good blade design that matches the blade torque to the load resistance for each wind speed. The MK4+ has a computer-modeled blade design, which provides a near perfect Tip Speed Ratio. This allows it to extract as much power as possible from the wind.

Battery Acceptance Rate

This simple concept is probably one of the most misunderstood when wind generator buyers try to gauge wind generator performance. First it is important to understand that amps, or electrical current, is "drawn". This means that there must be a load present for current (or amps) to be present. Secondly, it is important to know that as a battery bank charges, its "acceptance rate", which is its ability to draw amps, is reduced logarithmically. This means that a nearly full bank is capable of drawing very few amps. So, regardless of the size of the source, be it a wind generator, or a nuclear power plant, the amount of amps that can go into the battery will be limited by the battery's acceptance rate. Said another way, if you had a 20 knot wind, few loads, and the battery is charged, you may think the wind generator is not performing. On the contrary, the batteries are full and the beer is cold.

Wind Generator Expectations

All of the above matters because the wind generator user is normally provided with a factory curve, which describes the maximum output of their wind generator over a range of wind speeds. It is then understandable that

the first thing the customer wants to do is to test the unit on-board against the expected performance shown in the curve, right? Of course. But it is not realistically possible to match each point on the curve exactly. The reason is that the manufacturer necessarily has to characterize their product by plotting a two-dimensional curve that shows the true performance of the wind generator itself. Just like the manufacturer of the drill motor. He can only realistically provide data of maximum performance of the drill in watts, because it is not practical to provide the wattage data by each specific load and speed. So, in order to produce a useful and understandable power curve, wind generator manufacturers use a wind tunnel with laminate airflow, and instrumentation that is providing matched impedance for every wind speed in order to find the maximum power point that the wind generator can provide at each speed. While the curves are an industry standard, and remain a great way to compare competitive offerings, the user can never duplicate these curves exactly in the real world. While these curves cannot typically be duplicated on-board with day-to-day activities and use, they are the only appropriate and practical way to characterize maximum wind generator performance.

At the end of the day, however, what the user wants is a supplemental charging source that is quiet, effective, and can provide renewable power, even at night. The MK4+ is the quietest, most productive, and cost-effective marine wind generator available. It has the lowest start up speed, the best performance, and the largest swept area of any competitive marine wind generator on the market. We look forward to you enjoying your MK4+, and we hope that you are now better informed about the science of wind energy.

1.1 MarineKinetix MK4+ Wind Turbine Features & Dimensions

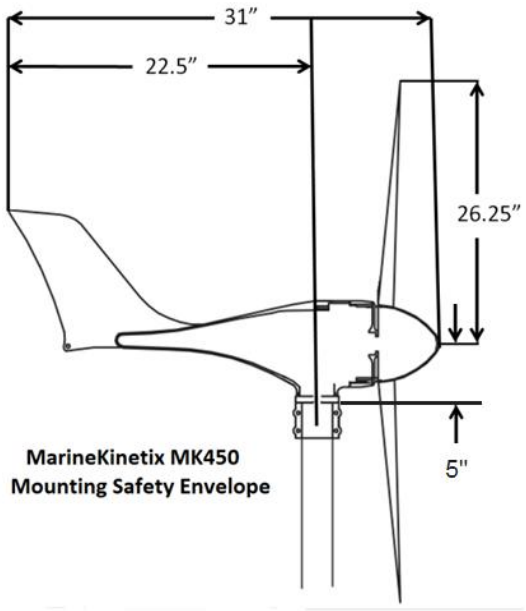
The electricity generated by the MarineKinetix MK4+ is converted from 3-phase AC to 12 volt DC power by the Microprocessor Controller. Depending on wind-speed, this DC power can be used to operate 12 volt appliances directly, charge 12V batteries, or operate AC appliances with the use of an AC Inverter (not supplied). A 24 volt model is also available.

Ideal applications include sailing vessels, campers or RVs, summer homes and cabins, industrial or agricultural applications; basically anywhere power is required off-the-grid.

The MarineKinetix MK4+ can also operate in combination with solar arrays, or water generators. Such "Hybrid" systems take advantage of available renewable energy whenever it is available, thus minimizing your required battery capacity.

Features:

- Compact design 1.33M (52.5") diameter wing-span
- Innovative quiet blade design with aero'coustic leading edges and tips
- Pre-balanced blade set with 20% carbon fiber reinforcement (CFRP)
- Upright high-aspect tail section for low yaw-error and clean tracking
- Double shaft bearings
- Double yaw bearings
- Slip-ring to allow 360 degree rotation
- Marine grade powder-coated aluminum/magnesium alloy housing
- Maintenance free operation



1.2 Microcomputer Controller Features

Features and Functions:

- Rectifies 3-phase AC to 12 or 24 Volt DC power
- Automatic set-points for VRLA, Flooded, Gel and AGM batteries
- Step-less Pulse Width Modulation Current Control
- Slows or stops turbine automatically when current limit point exceeded
- Slows or stops turbine automatically when voltage limit point exceeded
- Manual Brake Mode
- Cannot overcharge batteries
- LCD screen with backlight displays:
    - Battery Voltage
    - Wind Generator Voltage
    - Wind Generator Power (W)
    - Wind Generator Current (A)
    - Setting Functions

2 Safety Instructions

Please follow these instructions carefully. The information provided is for your safety during mounting, operation, and in case of trouble. If you have any additional questions, please contact your dealer directly by phone or e-mail before proceeding.

2.1 Mechanical Dangers

The main danger is the spinning blades. The blades are sharp and can be revolving at extremely high speeds capable of causing serious injury.

Never touch the turning rotor or attempt to stop it manually. Under no circumstances should you mount the wind turbine where it is within reach, or can be accidentally touched, while in operation.

2.2 Electrical Dangers

A running wind generator can generate significant AC voltages and currents which can be very dangerous. If you are not familiar with electrical wiring and electrical safety practices, do not attempt to connect components yourself, and seek further assistance from a professional. Never touch electrical connections on the wiring or controller terminals. Wiring and connection components must be able to safely carry a current of 40A.

Cable sizing is important use our chart below to find the appropriate sized cables for your installation. Undersized cables can reduce power and can heat-up and cause fire. IMPORTANT: Be especially careful that there is chafe and wear protection on cables when running wires through arches, poles, and through other sharp openings. Chafed or damaged wires pose a severe safety risk, and may permanently damage your controller or generator.

Care should be taken NEVER to short-circuit the batteries.
Batteries should be located in a ventilated area as charging may produce hazardous gas. Do not install the charge controller near flammable vapors.

2.3 Installation Dangers

When mounting, be sure that the mounts, poles, and supports consider safety, as well as the large loads that heavy winds, and heavy seas can exert on the structure. Contact us for pole kits, or use the services of a professional marine fabricator if you are not familiar with the design and construction of proper mounting arrangements.

Installation of the generator and mounts should only be attempted on a calm day. Disconnect the batteries from the controller when working on the generator. Take precautions to prevent hardware from falling overboard. You must tie off one of the blades to the pole during installation. Never approach the wind generator, or attempt any service on a windy day. Never leave the generator disconnected from the controller and batteries in a free-wheeling state without first securing the blades to prevent rotation.

3.0 MarineKinetix MK4+ Technical Data

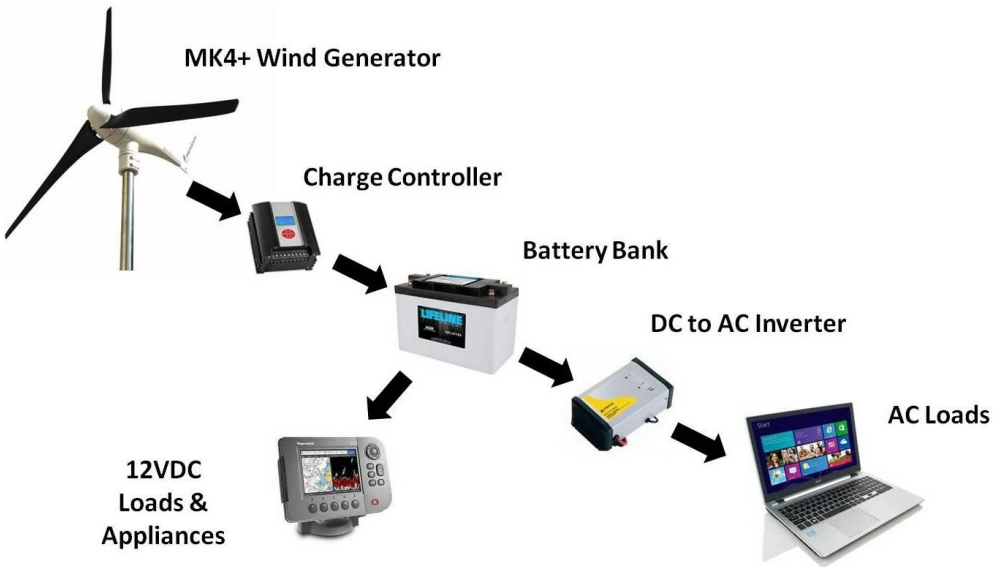
Model	MK4+
Rated power	390 watts
Maximum Power	400 watts
Rated wind speed	14 m/s (28 kts)
Start-up wind speed	2.5 m/s (5 kts)
Cut-in wind speed	3.4 m/s (6.5kts)
Rotor diameter	1.33 m (52-3/8”)
Number of blades	3
Blade material	Carbon-fiber reinforced composite (CFRP)
Blade weight	10.58 oz. /blade
Body material	Double Powder-coated magnalium
Machine (Motor)	Neodymium Iron Boron, 3-phase AC output
Rated voltage	12V DC or 24V DC
Brake	Electromagnetic brake
Weight	16 lbs.

3.1 Charge Controller Technical Data

Rated power	400 W Wind/ 150W Solar
Maximum power	600 watts
Dimensions	142×150×82mm
Weight	1.9 kg (4.18 lbs)
Voltage	12V DC (24V DC model available)
Wind turbine braking voltage	14.5 V (29V on 24V model)
Recovery voltage after braking	13.5V (26V on 24V model)
Charge current max	30 Amps (15Amps on 24V model)
Controller Dump Mode	Stepless Pulse Width Modulation
Display	Backlit LCD
Working temperature/humidity	-20 to +55C / 35 to 85% RH
Standby current	< 20 mA
Protection function	Battery overcharge protection Battery undercharge protection Overload protection Turbine current limiting Turbine automatic brake

4 Installation & Setup

Typical major components on a boat-level system show below:



4.1 Carton Contents

A.	Generator	1 piece
B.	Hub	1 piece
C.	Nose Cone	1 piece
D.	Bolts	10 pieces
E.	Nylox Nuts	10 pieces
F.	Rubber Isolator	1 piece
G.	User Manual	1 piece
H.	Blades	3 pieces
I.	Controller	1 piece

Extra bolts & nuts are provided. If you are missing any components, please contact your dealer immediately.

Please check all contents before beginning your installation

4.2 Additional Required Materials (not supplied)

You will require materials specific to your application and choice of mounts. These will include the following:

- A marine-grade terminal block or suitable connecting terminals to connect the wind turbine wires to your cables. Note that this junction may connect wires of different sizes.
- 3-Wire 10 AWG (min.) marine wiring to run from the wind turbine to the Charge Controller (up to 30'). Use 8 AWG if using two turbines
- 2-Wire 8 AWG (min.) wiring to run from the charge controller to the battery (up to 30'). Use 6 AWG wire if installing two turbines
- Four (4) mounting screws or bolts for mounting charge controller
- One 1½" Schedule 40 **pipe** (1.90" OD), or 48-50mm OD **tubing** of adequate height to mount the generator
- One base mount for the pole
- Two 7/8" diameter poles with brackets for lateral support

- Two base mounts and collars for the lateral supports
- Assorted screws, connectors and wire wraps for installation
- Waterproof gasket or gland for wires to enter deck or hull
- Fuse (50A) or manual reset type circuit-breaker is recommended between Charge Controller and positive (+) terminal on battery
- Marinekinetix recommends using Eck® Corrosion Inhibitor or similar product on all fasteners to prevent galling and corrosion. It can be ordered through www.marinebeam.com
- A length of light line to act as a lanyard between the tail hole and the pole. Be sure the pole end has a large enough loop around the pole to allow the wind generator to rotate indefinitely. In light winds, this line can be used to carefully turn the generator out of the wind for maintenance, etc.

Recommended Minimum Wire Sizes:

Distance from wind generator to controller	0-30 feet	31-60 feet	61-95 feet
Wire Size (AWG)	10	8	6
Distance from charge controller to battery	0-30 feet	31-60 feet	61-95 feet
Wire Size (AWG)	8	6	4

Important notes about wire sizing:

All electrical systems lose some energy due to the resistance in the conductors.

- Wires with a larger cross section (more copper) have less resistance and a lower voltage drop, but are more expensive and may be more difficult to deploy. The above wire size recommendations are the minimum size recommendations.
- It is important to understand that resistance losses increase with increasing current, therefore, if you expect high winds at all times at your site, it may be worthwhile to go with a larger wire size in order to take advantage of the higher energy production potential.

Conversely, in low wind sites it may not be cost effective to increase the wire size since power production will be low.

- The above wiring sizes provide maximum losses of 5% or less for sites with a 15 mph annual average wind speed, which is sufficient for most applications.
- While we offer the above minimum wire size recommendations; for optimal performance we recommend that you use the largest wires that are practical and affordable.
- Depending on your exact system configuration, including other charging sources in your system, wiring resistance may affect the regulation set point of the wind generator charge controller. The recommended wiring sizes should have little or no effect on the regulation set point, but all installations should be observed over time to ensure that the batteries are charged to the proper voltage
- In general, the heavier the wire (smaller AWG #), the lower the voltage drop, and the better the performance. The above sizes are our minimum recommendations based on a typical cruising boat and its needs. If in doubt, go up with the next bigger size (smaller AWG#).

Notes on Pole Mounting:

MarineKinetix now offers a professional 316 SS Pole Mount Kit, which includes the necessary mounting hardware and brackets for building a generator mount where you supply the actual mast and stays (available at any metal supply house). We can also supply semi-custom mizzen mast mounts, or direct you to a custom fabricator. Contact us for ordering or for further information.

For marine applications we recommend 1.5" Schedule 40 aluminum or stainless-steel pipe (1.90" OD), or 48mm - 50mm tubing, supported by at least two 7/8" triangulated lateral supports. Marine fabricators or handy sailors can configure a simple mounting solution.

Pay careful attention when selecting the mounting location to be sure that the blades cannot come in contact with crew or rigging under any circumstances, and that the turbine's wind is not blocked by major obstructions in any direction. Generally the turbine should be mounted as high as practical, and the mounting system should be exceptionally sturdy, and take into consideration the forces generated by high velocity winds and heavy seas.

4.3 Layout and Preparation for your project

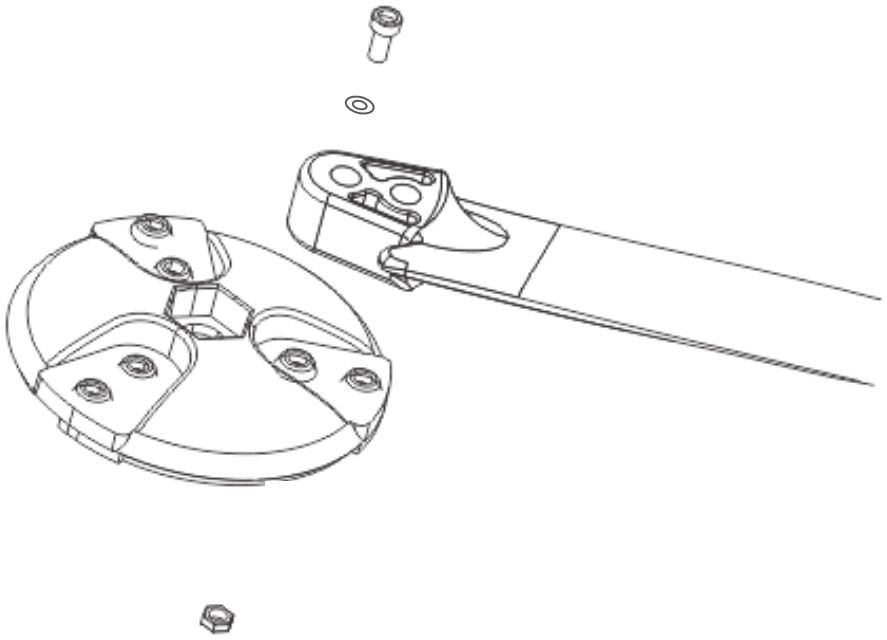
- Locate base mount and support pole positions, and install pole. These support areas should have solid laminate, or backing plates installed from below
- Locate a suitable spot for controller located as close to the turbine as practical. It should be mounted in an area with easy access, and a good line-of-sight to the display. Provide a good buffer of open space around the controller for air movement and cooling.
- Measure wiring runs, including bends, etc., and gather appropriate tools.
  Route all cables with proper wiring practices (large radius bends, chafe protection, tie-wraps, cable-glands, fuse-protection, etc.), and use properly-sized marine grade cables. Use waterproof cable glands where wires penetrate the deck.

  PLEASE NOTE: More than 90% of installation issues and troubleshooting calls to MarineKinetix are eventually traced to chafing of the wires against sharp surfaces, or loose or improper connections. So please take care to protect the wires and make secure connections with proper strain-relief.

4.4 Assembly

- Wait for a calm day before mounting the turbine
- Disconnect the batteries during installation
- Install all required 3-phase AC wiring from the top of the pole to the controller site, and route the DC wiring to the area adjacent to the battery.

- Attach each of the 3 blades carefully on the hub by placing Nylox nuts

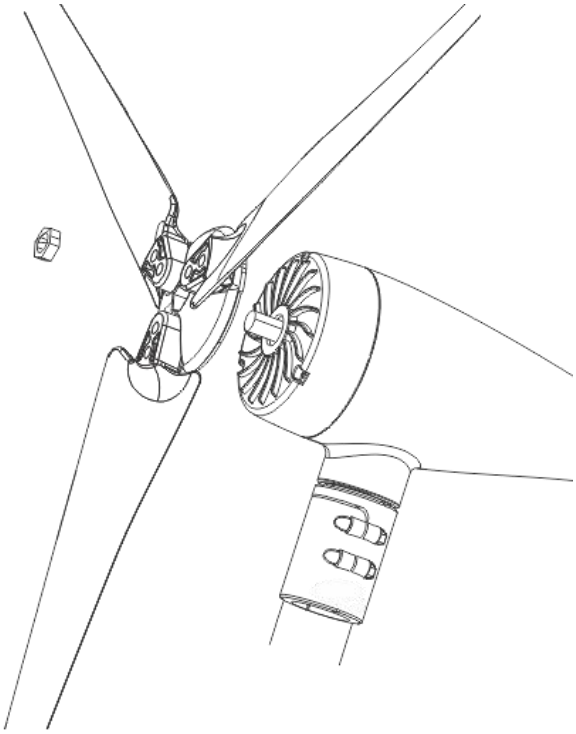


in the captive sockets and screwing the bolt (with washer) securely (~5 ft-lbs.) using the Allen key provided, making sure that the blades retain their alignment. Just before the bolts are fully tightened, you can bias the blade to one edge of the pocket to assure that all blades are accurately placed in the same position within their respective pockets. Now tighten each bolt evenly and alternately until the blade is fully tightened. Note that the counter-sunk hole on the blade faces up, and accepts the cap bolt and washer. We recommend a corrosion inhibitor like Eck, or Tef-Gel to prevent potential galling of the A2 stainless fasteners.

- Attach the Rotor assembly (hub and blades) onto the generator shaft and torque the nut (shaft) securely with included Allen wrench (~35ft-lbs.) A light waterproof grease or corrosion inhibitor (Eck) can be used on the shaft to prevent future galling or corrosion. This hub

bottoms out on the bearing face, so tighten it fully when installing, and check again after several hours of running.

NOTE: The hub may show signs of light sanding in the inner-bore diameter and on the face where the bearing will contact it. This is done at the factory to remove some of the paint inside the bore so as to ensure a matched fit of the hub-bore to the shaft.



- With the help of an assistant, connect the 3 wires to the 3 wires exiting the top of your pole (no polarity required). We recommend a terminal strip, wire nuts, or plug connection here, as you may need to disconnect this junction at a later date. Insulate with electrical tape, or heat-shrink tubing, and protect from corrosion.
- You must also fashion **some sort of strain-relief** and chafe protection for your wiring connection at the top of your pole. This prevents the heavy wiring from pulling the connections apart, or the edge of the pole cutting the wiring. The strain-relief can be something simple, such as a knot tied in the wiring and then a block of foam wedged in the pole and against the wiring. A through bolt and wire ties work too.

- Place the white rubber anti-vibration cap around the pole, and slide the wind generator clamping collar over the rubber cap and onto the pole, guiding the wires as you do so. Fully seat the collar to find the fully seated position, and then lift it about 1/16" to unseat it slightly before tightening the clamp bolts using the Allen wrench (this provides a slight gap between the pole and the collar allowing the cushion to dampen any vibrations). Tighten each screw in small increments until the collar is tight (about 3-5 ft-lbs).
- It is important at this point to secure the blades using a shock cord or light line to prevent the blades from spinning until the electrical installation is completed. The connections to both the controller and to the active battery provide the necessary load for the wind generator and controller to operate without damage.
- Clip on the nose cone securely**.** It will clip onto all three edges.
- Connect the 2 wires (positive and negative) from your battery to the Charge Controller, **carefully observing correct polarity.** We recommend a 50A fuse or circuit breaker between the controller and the battery positive terminal (+). Locate the fuse or breaker as close to the battery as possible. PLEASE NOTE: Never ever allow the wind generator to operate with the breaker open, or the fuse removed or blown. This could allow the wind generator to over-rotate and produce excessive voltage, which will permanently damage the controller.
- Connect the 3 wires from the wind generator to the Charge Controller.
- Read the included Charge Controller manual fully before start-up. If you are unsure of any feature or function, please contact us for assistance.

4.5 Start-Up

- Carefully remove the restraining device from blades during calm weather to allow blades to turn freely
- Discharge batteries to below 13V (26V for 24V model) to begin automatic charging from turbine. This can be done by running high-wattage appliances, lights, etc.
- Once the wind begins turning the blades, the blue LED indicator on the bottom of the turbine will begin to blink, and then go steady as the wind picks up. This confirms that the machine is making power

- The controller display will indicate an animated wind generator icon and the word CHARGE, along with voltage, and the battery icon on the display will indicate the state of battery charge.
- If the brake notification indicates, then the batteries are nearing full charge, and the controller will begin slowing down or stopping the turbine via hysteresis braking.
- Your controller will also automatically stop the turbine in an electrical short condition, and overspeed/over-current conditions provided it is attached to an active battery.
- Charging voltage and current are a function of not only wind-speed, but also of battery acceptance rate (% of charge). If you believe that the wind generator is not creating enough current, then it is most likely that your loads are low, and your batteries are reaching a high state of charge. In other words, the batteries acceptance rate is limiting the output of the generator.
- If you experience any abnormal vibration, check that the blades are fully seated, fully tightened, and flat on the hub.
- New generators need a short break-in period to free-up and reduce mechanical friction as the grease is distributed within the bearings. Wait for several days of really good wind and good rotor RPM before expecting the best low-speed start-up. Over the course of a few good windy days you will notice the start-up speed improving.
- Wind shear noise can be expected during abrupt changes in wind speed, rotor-speed (such as during braking), wind-direction, or in cases of deflected wind off of nearby structures (boom, mast, etc).

4.6 **Maintenance and Operation**

- You will immediately notice that the MarineKinetix MK4+ wind system is a super-quiet, self-regulating, and hands-off system that needs no regular interaction from the user. There are no diversion loads, and no need for extra relays, switches or buttons. There is generally no need for manually furling, however, in tropical storm and hurricane conditions we recommend removing the unit completely from the pole. Never, ever, attempt to stop the unit by hand.
- After several hours of initial operation, check all of the wiring terminal connections, as well as the mounts, blades, and associated hardware. Re-tighten connection terminals, blades, mount, and hub if necessary. Fasteners are made of A2/304 stainless steel, which are

much stronger than 316 fasteners. They may show some surface rust stains, but these stains are easily removed, and don't affect the fasteners themselves.

- Blades and turbine mounts should be cleaned and inspected every month or so. Wash off any salt deposits regularly with fresh water, and check the security of any fasteners**.** It is also a good practice to wax the surface regularly using a carnauba or polymer wax to maintain its luster and to protect the finish.
- While your MK4+ uses a special marine-grade double-epoxy powder coating finish over a zinc-aluminum nano-coating, corrosion in the marine environment is inevitable if proper preventative maintenance routines are not followed. Be sure to quickly address any nicks, pits, and blisters as necessary, by sanding, priming and coating using a Bright White enamel touch up paint.
- Let your generator operate as normal when left un-attended in the marine environment, if possible. An idle generator is more vulnerable to moisture, corrosion and bearing issues. If leaving for an extended period, dismount the unit and store below, or remove the hub, tie off the tail, and cover the shaft/bearing interface with waterproof grease, and snap on the nose cone cover.

Warranty

Marinekinetix warrants your product to be free from defects in material and/or workmanship for a period of 3 years from original date of purchase. Warranty coverage is extended only to customer (original purchaser).

If product proves defective during warranty period, Marinekinetix, at its option will:

1. Replace wind turbine with new or refurbished product.
2. Correct reported problem

Customers warranty continues to be valid on repaired or replaced product from original warranty date.

Restrictions

This warranty covers defects in manufacturing discovered while using the product as recommended by the manufacturer. The warranty does not apply to:

a) Equipment, materials, or supplies not manufactured by Marinekinetix.
b) Product that has been modified or altered other than by Marinekinetix, or without prior Marinekinetix approval.
c) Has been exposed to winds exceeding 100MPH
d) Lightning or hail damage
e) Repairs performed by other than authorized Marinekinetix support staff
f) Normal wear and tear, and corrosion from exposure to the marine environment
g) Acts of God; misuse, negligence, and accidents

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Limitation of Liability

UNDER NO CIRCUMSTANCES WILL THE MANUFACTURER OR ITS AFFILIATES OR SUPPLIERS BE LIABLE OR RESPONSIBLE FOR ANY LOSS OF USE, INTERRUPTION OF BUSINESS, LOST PROFITS, LOST DATA, OR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, RESULTING FROM THE DEFECT, REPAIR, REPLACEMENT, SHIPMENT OR OTHERWISE, EVEN IF THE MANUFACTURER OR ITS AFFILIATE OR SUPPLIER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

INSTALL NOTES:

WIRING NOTES/SKETCHES: