



Battery Charging, 24 Volt nominal



Title:

2kW Wind Turbine Generator Installation Guide

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1. Disclaimer

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2. Introduction

Wind turbines occupy a unique niche in electro-mechanical designs. Built to compete as an energy source, they are subject to the most brutal cost constraints, while at the same time exposure to weather and an expected operating life requirement greater than almost any other mechanical system. This leads to implementation requirements that must be astonishingly robust.

At AE Wind Systems, we are taking a systems approach to address these issues with every new wind turbine design we introduce.

The guiding principle is to use aerodynamic stall control to reduce cost and increase reliability by integrating the electronics; alternator and rotor into a tightly coupled package with the lowest mechanical parts count in its class. As a result, furling, brakes, or other aerodynamic / mechanical speed control systems are eliminated, replaced by a microprocessor controlled switch-mode buck regulator operating at 20kHz.

The alternator is designed with a very high dynamic range in mind, that is, for extremely efficient operation at less than 1kW and continuous operations up to 4kW. The net effect is a wind turbine with only one moving part, the rotor of the alternator. To make this work however, requires a sophisticated electronics package contained in the wind turbine controller. The custom-programmed microprocessor knows the output characteristics of the blade array at any rotational speed. Using an on board programmable pulse width modulator and sophisticated isolated drive electronics, the computer commands the high-power switching regulator to extract optimum power from the rotor at all rotational speeds up to the designed-in limit of 800 RPM. As 800 RPM is approached, the power extraction algorithm changes from optimum to stall control by extracting not the maximum power available in the wind, but the maximum available from the generator.

In short, this Wind Turbine Generator has been designed for greater safety and ease of installation utilizing superior components combined with the finest quality hardware available.

This Wind Turbine Generator System, composed of the Wind Turbine Generator and accompanied Speed and Charge Controller, are intended to be used in a battery charging application with a nominal battery voltage of 24 Volts.

Note:

- This wind turbine system and accompanied speed and charge controller has been designed for the charging of Lead-Acid Batteries with a nominal battery bank voltage of 24V (DC). Other voltages are available upon request.
- This wind turbine system and accompanied speed and charge controller has been designed to be connected to charge a Lead-Acid Battery bank. A grid intertied inverter or a suitable diversion load **MUST** be installed to the battery bank to optimize and maximize the power output of the wind turbine generator.

3. Specifications and Features

3.1 Technical Specifications

Rotor Diameter	3.0 m (9.8 ft.), Glass-fiber blade 3.2 m (10.5 ft.), Carbon-fiber blade
Rotor Swept Area	7.1 sq. m
Peak Output	2.9 kW
Cut-in Wind Speed	2.5 m/s (6 mph)
Cut-out Wind Speed	None
Blades	3
Blade Pitch Control	None. Fixed pitch.
Blade Rotation	Clockwise when looking downwind
Over-speed protection	Aerodynamic stall with electronic breaking
Gearbox	None.
Generator	3 Phase Brushless Permanent Magnet
Generator Output	Variable, 300V maximum, depending on configuration
Controller Output	24 V (DC) nominal for Lead Acid Battery Charging

3.2 Functional Features

Tower Top weight	37kg (82 lbs.)
Shipping Weight	65kg (145 lbs.)
Shipping Dimensions	W x H x L = 20 in x 12 in x 65 in
Warranty	5 Years, unless otherwise specified on the invoice

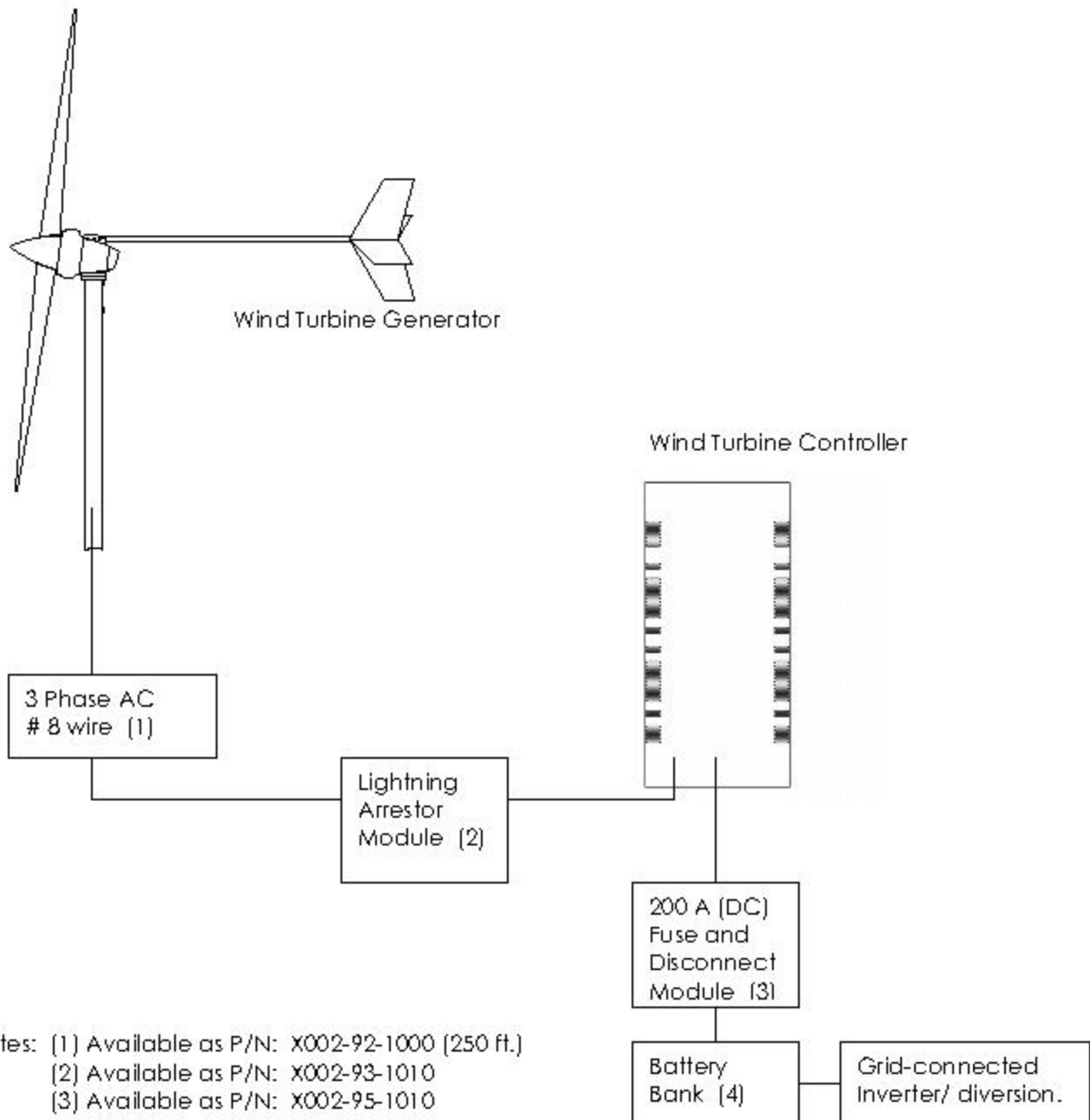
Fiberglass blades, neodymium permanent magnet generator, stainless steel hardware, fully sealed generator head enclosure including slip ring and brush holder assembly, marine grade coating on generator, hub, and tail assembly. In-field adjustable voltage settings.

Note:

- o The manufacturer must approve any change or re-configuration of the wind turbine generator through the brush holder prior the completion of the work.
- o With every change in configuration either the software or the hardware of the wind turbine speed and charge controller must be re-configured.
- o Wind Turbine Generators can be pre-configured to optimize to ambient weather conditions, adapting to high altitude and/ or lower than sea level air densities upon request.

4. Installation Overview

4.1 Schematic Outline



Notes: (1) Available as P/N: X002-92-1000 (250 ft.)

(2) Available as P/N: X002-93-1010

(3) Available as P/N: X002-95-1010

(4) Available as P/N: X002-96-1010 (4 batteries)

(4) Available as P/N: X002-96-1020 (8 batteries)

5. Warranty

The company warrants this product to be free from manufacturing defects in materials and workmanship. Should service be necessary under this warranty for any reason due to manufacturing defect or malfunctioning during the period specified below from the original ship date associated with the purchase, the company will provide repair and/or replacement service at no charge. The specific warranty terms are as following (unless specified differently on the invoice):

- o Wind Turbine Generator Head → 5 Years Parts and Labor
- o Wind Turbine Generator Controller → 5 Years Parts and Labor
- o Wind Turbine Tower Riser → 5 Years Parts and Labor
- o Wind Turbine Blades → 2 Years Parts and Labor

If you experience a problem with your Wind Turbine contact your authorized distributor or AE Wind Systems directly at Info@AEWindSystems.com to determine the nature of the problem. Further contact information is available through our website.

Either the authorized distributor or AE Wind Systems will issue a return authorization number to return the wind turbine generator, component thereof, or send you the necessary parts, at our option, or repair the defective component(s).

All returns will need to be shipped, freight pre-paid to AE Wind Systems. Freight and/or import/export duties remain the obligation of the end user. Except as specified below, the warranty cover all defects in the material and workmanship in the wind turbine generator assembly.

The warranty does NOT cover the following:


- o Damage resulting from negligence, accidents, misuse, abuse, or neglect.
- o Damage resulting from failure to follow instructions supplied with the product and/or otherwise communicated.
- o Damage resulting from repair(s) by anyone not authorized.
- o Damage occurring during shipment of the product.

Note:

Claims must be submitted to the carrier within 10 days of receipt of the wind turbine system.

- o Damage to any unit or component thereof, which has been altered and/or on which the Serial Number has been altered or removed.
- o Damage to or deterioration of the external housings due to excessive, severe, atmospheric degradation from extreme and unusual environments.
- o Damage caused by neglect and or failure to service or periodically inspect the unit.
- o Damage caused by improperly connecting the equipment and/ or sub-components.
- o Damage due to improper or inadequate packaging when returned for RMA purposes.
- o Damage due to an act of God, including but not limiting to lightning, earthquakes, sever storms, or floods.

- o Cost incurred by de-installation, re-installation, and shipping of the product for service or repair to and from the customer.

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The warranty is void altogether if the product is:

- o Damaged through misuse, abuse, use other than intended, or accidental mishaps.
- o Utilized in an unauthorized commercial or rental application.
- o Modified or repaired by anyone not authorized.
- o Modified or altered any component of the wind turbine system, not limited to Wind Turbine Generator and/ or Controller.
- o Damage because it is improperly connected to the equipment of other fabricators, installers, or manufacturers, or other components of an existing renewable energy system.

If your unit requires service, it should be returned to AE Wind Systems in the United States. Please do not return the unit to the factory without prior authorization. Whenever service is required you must be able to provide the full Serial Number as shown in the inside cover of the Wind Turbine Controller.

Returning a Wind Turbine Generator or component thereof without a proper return authorization will be considered as non-warranty repair order and processed as such.

6. Package Contents

The 2 kW Wind Turbine Generator System contains the following components:

- Wind Turbine Generator Head with pre-installed Hub and containing:
 - 1 Spinner with three Button Socket Screws, M5 x 12
 - 3 Wind Turbine Blades
- Wind Turbine Generator Controller for Battery Charging, 24V nominal
- Wind Turbine Tower Riser with a length of about 50 inches
- Certificate of Conformance
- Wind Turbine Installation Guide

One or more of the following tools are required for Assembly (not included in the package).

Hub and Blade Array Assembly

- 1/2 in or 13 mm Socket head wrench → for M8 Hex Head Screws
- 3mm Hex Wrench → for Spinner assembly

Tower Riser and Yaw Assembly

- Adjustable or 15mm wrench → for Cable Strain Relieve Socket with Nut
- 9/16 in Socket wrench → for 3/8 in Hex Head Screws

Controller

- 9/16 in Socket wrench → for 3/8 in Hex Nuts

Optionally, the following components are available:

- Digital read-out for current produced, both instantaneous and over a 24-hour interval.
- Digital read-out for battery voltage, both instantaneous and over a 24-hour interval.
- DC Disconnect (200 A) between Wind Turbine Controller and Battery Bank including fuse.
- Three Phase Input Lightning Arrestor module.

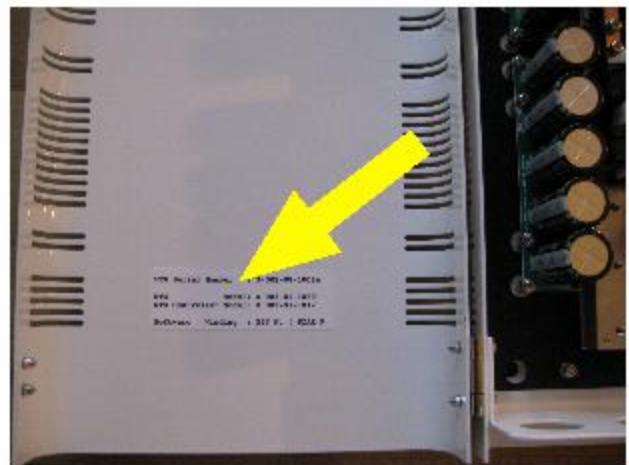
7. Identification

Each Wind Turbine Generator System is equipped with its unique Model and Serial Number. There are several locations throughout the system where the serial number is visible to the end user. The most noticeable are on the Brush Cover Cap of the Wind Turbine Generator and on the inside cover of the Speed and Charge Controller. Refer to the picture below to locate the Serial Number of your Wind Turbine Generator System.

On the Wind Turbine Generator Head



On the Wind Turbine Speed and Charge Controller



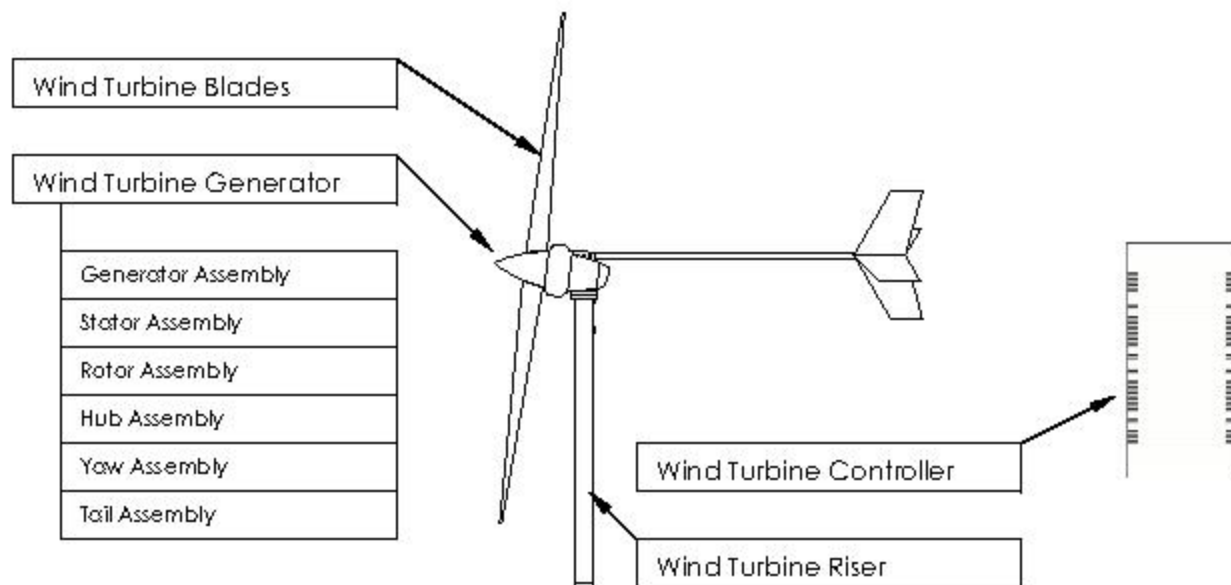
For your reference, the Model and Serial Number of your Wind Turbine Generator System are as following:

Wind Turbine Serial and Model number

Wind Turbine Controller Software Parameters

8. System Components and Description

The Wind Turbine System is composed of the following main components:



8.1 Wind Turbine Riser

The Wind Turbine Riser connects the Wind Turbine Generator Assembly to the Wind Turbine Tower.

8.2 Wind Turbine Generator

The Wind Turbine Generator includes the following assemblies: Generator Assembly, Stator Assembly, Rotor Assembly, Hub Assembly, Yaw Assembly, Brush Holder Assembly, and Tail Assembly.

8.3 Wind Turbine Blades

The Wind Turbine Blades convert the kinetic energy from the wind into rotational energy that can be extracted by the Wind Turbine Generator.

8.4 Wind Turbine Speed and Charge Controller

The Wind Turbine Speed and Charge Controller converts the electrical energy produced by the Rotor and Stator and converts it into usable energy that can be stored in conventional Lead-Acid batteries. The controller is able to continuously manage 180A in direct current.

9. System Operations

9.1 Wind Turbine Generator

The Wind Turbine Generator has been designed to be a reliable and dependable source of electric power generation. The wind turbine generator system operates on the DC soft-stall principle.

The Generator Assembly holds the Stator, Rotor, and Yaw Assembly.

The Stator Assembly is a core technology component of the Wind Turbine Generator and has been designed to allow for multiple applications. The Stator Assembly encompasses the permanent magnet Rotor Assembly.

The Rotor Assembly is composed of just three components, the drive shaft and the rotor holding the permanent magnets. The drive shaft is made of high-grade stainless steel.

The Hub Assembly is pre-assembled onto the Rotor Assembly by the factory. Unless otherwise specified by the customer, the Hub Assembly is black. There are two different Hub Assemblies for wind turbine blades manufactured with either a round or a rectangular hub interface. The Wind Turbine Blades connect with six M8 bolts - distributed in a unique pattern - to the Hub Assembly.

The Yaw Assembly transmits the power produced by the Wind Turbine Rotor/ Stator through a ground insulated three-phase AC conductors. The three insulated AC conductors, carrying variable voltage, frequency, and current, transmit the power through the three output leads to the speed and charge controller. The end user/ installer is responsible to properly connect the three output leads on the Yaw Assembly to the three input leads on the Controller.

The Brush Holder Assembly gives access to the wind turbine stator configurable wiring options. Unlike other wind turbine generators, this wind turbine generator can be re-configured to meet the end user site-specific requirements including but not limiting to battery charging voltages of up to 120V DC and ambient weather conditions.

Note:

- The manufacturer must approve any change or re-configuration of the wind turbine generator through the brush holder prior the completion of the work.
- With every change in configuration either the software or the hardware of the wind turbine speed and charge controller must be re-configured.
- Wind Turbine Generators can be pre-configured to optimize your ambient weather conditions, adapting to high altitude and/ or lower than sea level air densities upon request.

The Tail Assembly is composed of just three unique part numbers consisting of the tail, boom, and end plug. All components are coated with a weather durable, marine grade coating.

9.2 Controller

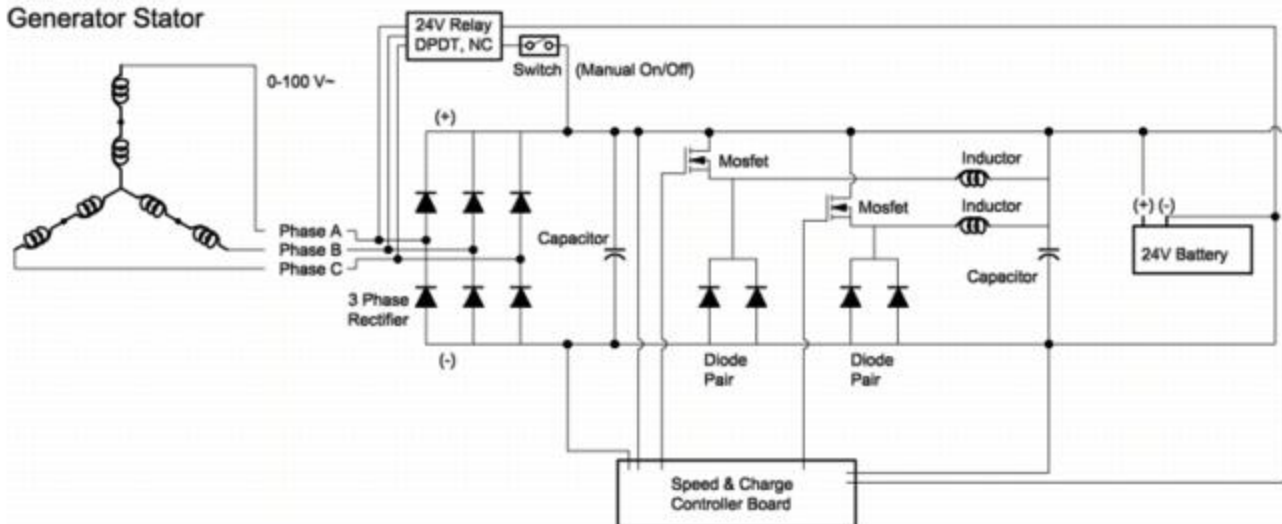
The Wind Turbine Speed and Charge Controller has been designed with simplicity and functionality in mind. The variable Wind Turbine Generator output is rectified and controlled via a direct current (DC) switch-mode Buck Regulator. The Speed and Charge Controller manages the Wind Turbine Generator by simultaneously measuring not only the Wind Turbine operating conditions, but also the charging state of the battery as well as other input parameters.

The Speed Controller controls the Wind Turbine Generator over the entire operating envelope using a soft-stall control algorithm using Generator Output to known Wind Turbine performance at various operating conditions, thus optimizing the energy extraction from the wind at any ambient condition.

The Charge Controller charges the battery bank using the most optimum charging methods known for Lead-Acid batteries, adjusting not only for voltage variations, but also compensating for high charging currents.

A simplified control schematic of the High Power control modules is shown below. The 24V Controller is equipped with two High Power control modules. Each module is capable of handling up to 100 amps at 24V DC at ambient operating conditions. The maximum operating condition of each High Power control module has been designed in such a way that they are capable of easily managing up to 200 V DC.

**Wind Turbine
Generator Stator**



For stand alone systems, for example, off-grid applications, an optional load diversion module should complement the renewable energy system. It is not a requirement to operate the Wind Turbine with a diversion load module, but it is highly recommended to ensure the proper operation of the wind turbine. This is more so important on smaller battery bank systems and/or older Lead-Acid battery systems.

10. Planning your Installation

10.1 Overall System Considerations

10.2 Wire Selection from Wind Turbine Generator to Controller

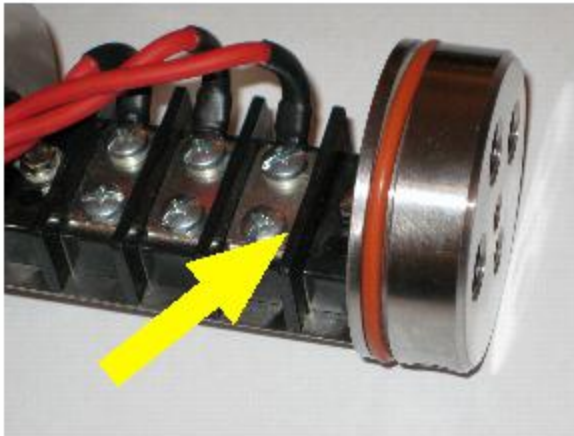
10.3 Wire Selection from Wind Turbine Controller to DC Disconnect to Battery Bank



Properly installed wind turbine generator using a guyed tilt tower and weather station.

11. Final Assembly of Wind Turbine Yaw Assembly

a)



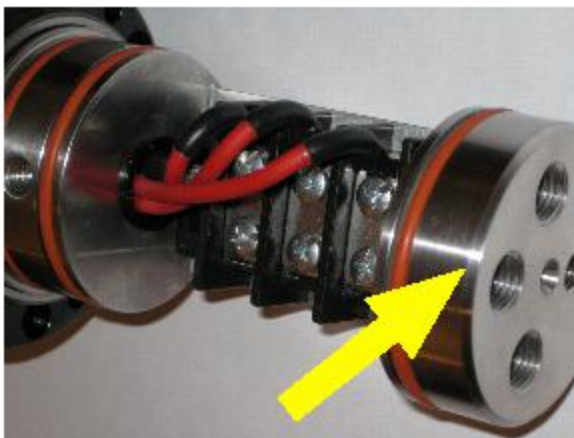
Prior to the wire connection assembly of to the yaw base, remove the five 3/8"-16 x 5/8" hex head screws from the yaw base.

These will be used to connect the yaw base to the wind turbine tower riser later on.

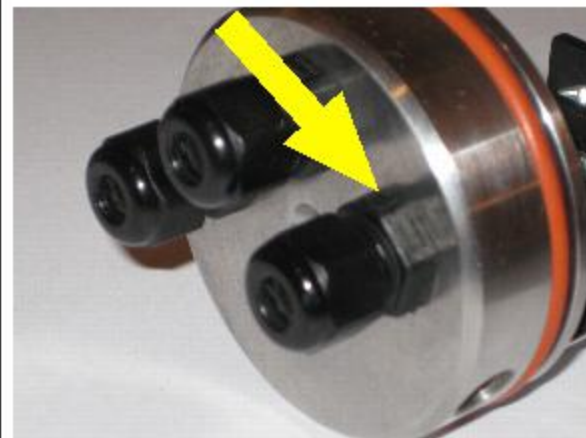
Step 1: Remove the strain relief from the small 6 in x 6 in x 6 in package.

Step 2: Loosen the dome nut as required
Step 3: Tighten the base hex nut to the yaw base using the adjustable wrench.

b)



c)



Step 4: Feed the three wind turbine cables through the three strain relief couplers as shown. It is important to note that the dome nuts must be loose as shown on picture d).

Note:

The recommended wire size is #8.
The maximum wire diameter is 0.26 in.

The maximum operating voltage is less than 200 Volts.

d)



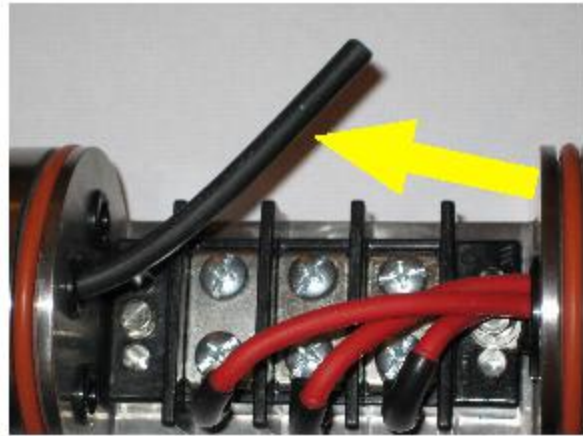
Step 5: Ensure that the wire is pulled through in order for the wire lug to be installed. Reference picture e).

Step 6: Install the appropriate wire lug. Reference picture f) with two of the wires shown out of the cable guide.

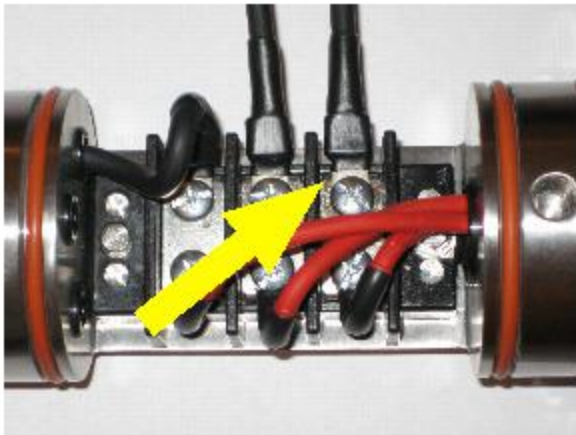
Step 7: Bend the wires back through the yaw base. Ensure a continuous smooth transition of the wire from the terminal block through the strain relief.

Reference picture g).

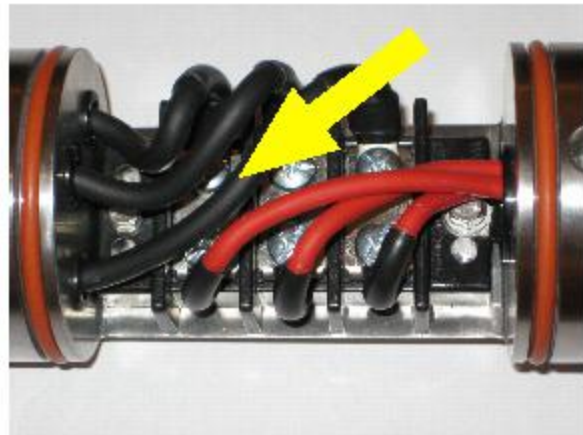
e)



f)



g)



h)



Step 8: Pull the wire as required through the strain relief.

Step 9: Hand-tighten the hex dome nut of the strain relief.

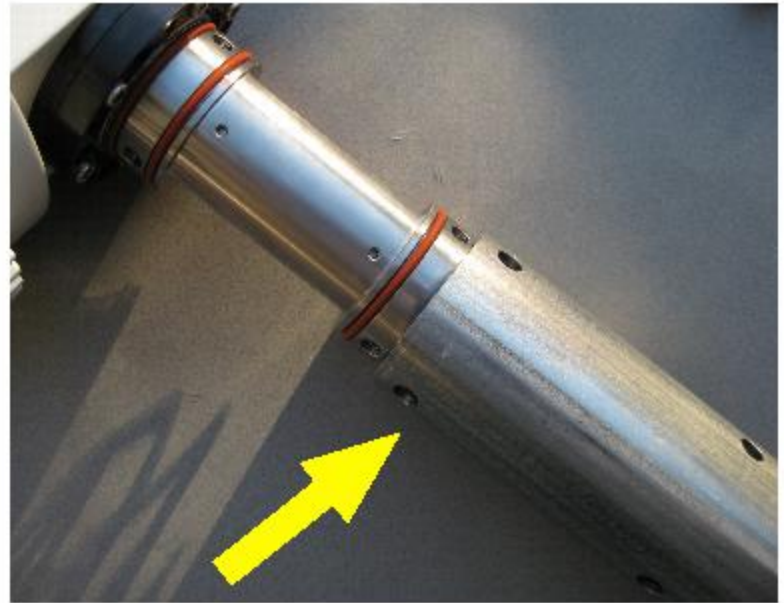
An additional wire strain relieve can be installed at the yaw base using an eye bolt and an appropriate cable-support grips, depending on the unsupported wire length.

Step 10: Align the yaw base with the tower riser as shown. The rear side of the three phase terminals will need to face upward.

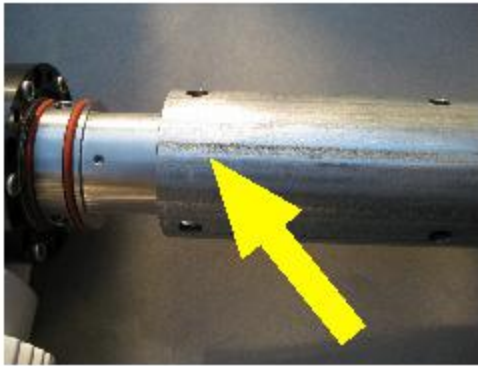
The tower riser is aligned with four of the five through holes facing upward.

Reference picture i).

i)



j)



Step 11: Slowly slide the wind turbine generator assembly into the tower riser and align all five through holes with the threads on the yaw base.

k)



Step 12: Assemble all five hex head screws through the tower riser and into the yaw base.

Tighten the five hex head screws to 20 ft-lb torque setting.



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2kW Wind Turbine Generator Installation Guide

12. Final Assembly of Wind Turbine Blades

13. Final Connection of the Wind Turbine Speed and Charge Controller

Connecting the Wind Turbine Speed and Charge Controller entails mounting the Controller near the battery bank as well as connecting it to the battery bank. The Controller must be installed in a well-ventilated area with easy access.

13.1 Mounting the Wind Turbine Speed and Charge Controller

The Controller is equipped with four mounting holes that are spaced six (6) inches horizontally and thirteen (13) inches vertically apart. Reference the four yellow arrows.

To ease the installation of the Controller, a paper template is accompanied to this installation guide to aid in the installation of the Controller.

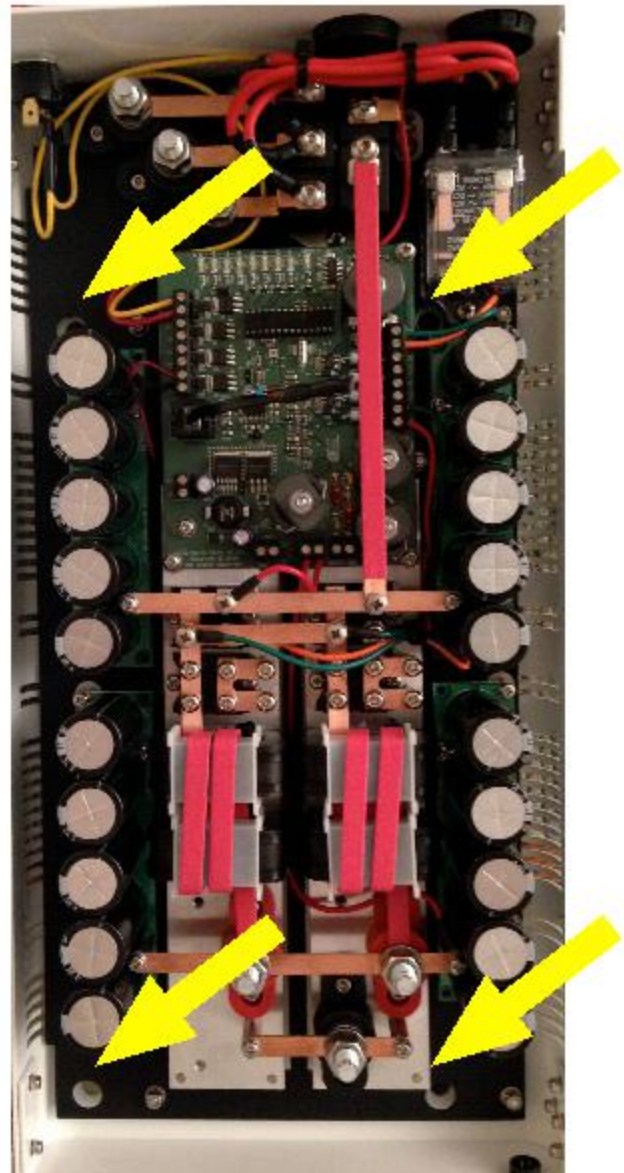
It is the responsibility of the end user to ensure that the Controller is properly mounted to the wall.

Note:

The controller is designed to control the speed of the wind turbine as well as to charge Lead-Acid Batteries. If you are using any other type of batteries, you will need to request modified software parameters to optimally charge your batteries.

Do not ground the Wind Turbine Charge Controller.

Do not modify the Wind Turbine Charge Controller.

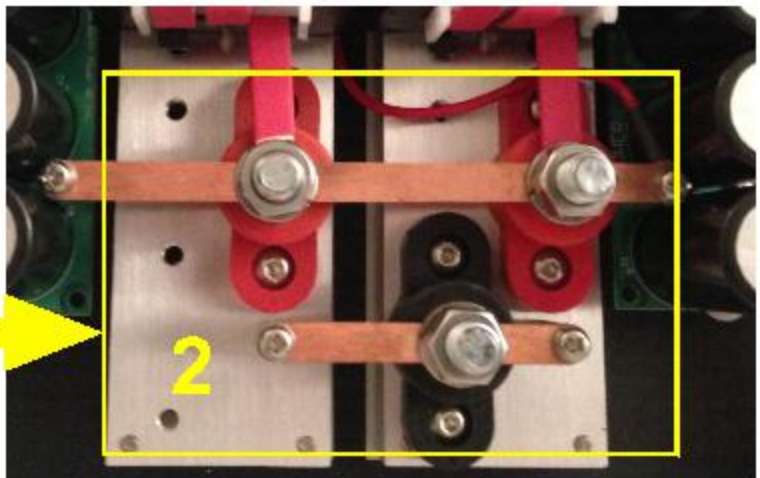
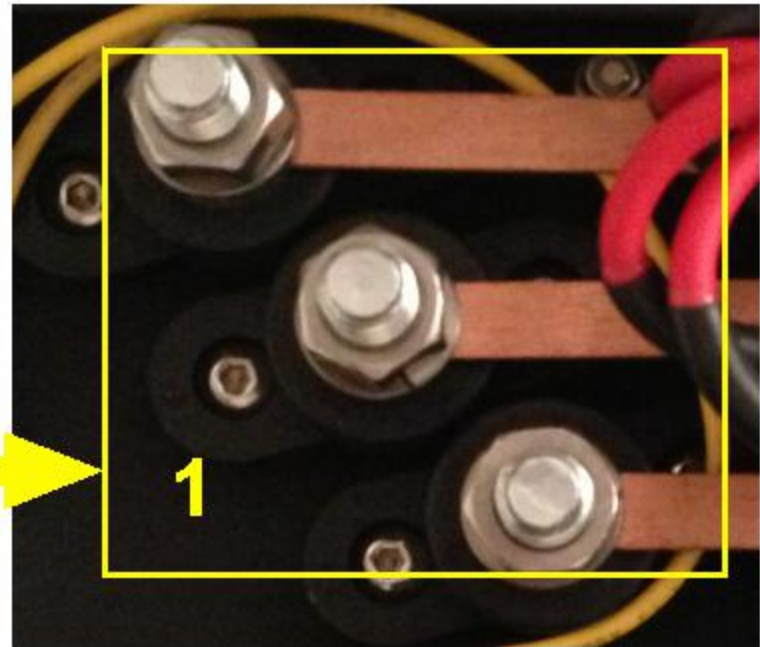
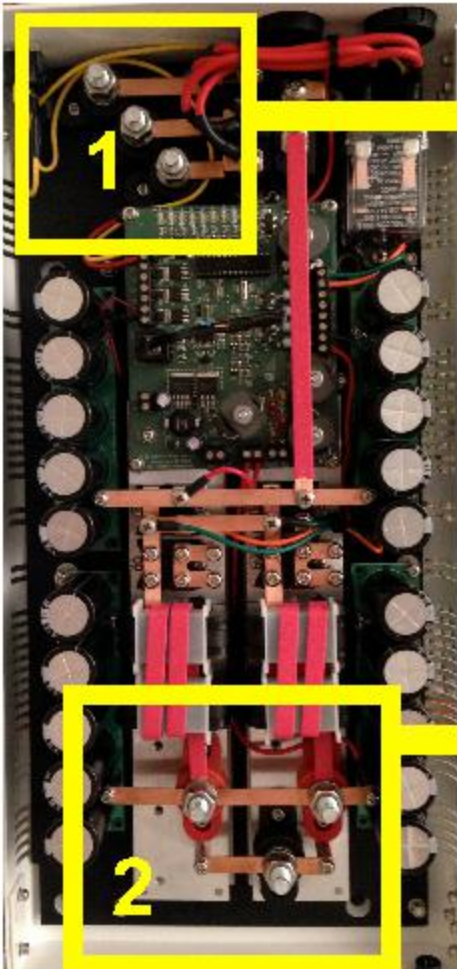


13.2 Connecting the Controller to the Battery Bank

Connect the three AC phases from the Wind Turbine Generator to the three studs on the upper half of the Controller, in the box labeled (1). The order or sequence is not important.

Note:

We recommend that you use #8 minimum wire diameter.



Connect the Positive Battery Terminal to the RED Stud.
Connect the Negative Battery Terminal to the BLACK stud.

DO NOT switch the polarity of the battery terminals, as it will result in irreversible damage to the controller!

13.3 Important Note with respect to Battery Temperatures compensation

The Wind Turbine Speed and Charge Controller has several unique charge control features. Among the charge control features is the capability to adjust the charging current and compensated voltage with respect to the ambient battery temperature. Lead-Acid batteries rely on a unique

14. Wind Turbine Generator Maintenance

14.1 Within 30 days after Installation

14.2 After half a year of operations

15. Trouble Shooting Problems

The following table can be used to troubleshoot operation or installation problems of your 2kW Wind Turbine Generator System. For problems or symptoms not found in the following table, please contact AE Wind Systems via email at Info@AEWindSystems.com.