Superwind 350 / 48 Volt
Operation Manual

North, Central, South America and the Caribbean Regions

Version 1-2019

www.superwind.com

THIS PAGE INTENTIONALLY LEFT BLANK

Thank you for purchasing a

Superwind 350/48V

The ***Superwind 350/48V*** is an advanced wind generator of the highest quality that will reliably generate power for many years. Reliable operation depends not only on product quality however, but also on correct assembly and installation. Please read this manual in its entirety before starting your installation, paying particular attention to all safety instructions and warning notices. Your safety is our highest priority!

MEANING OF SYMBOLS USED IN THIS MANUAL

Indicates critical information regarding a hazardous situation that could lead to serious personal injury or death if ignored.
Indicates a potentially hazardous situation that could lead to serious personal injury or death if ignored.
Indicates pertinent or otherwise useful information on a given topic or procedure.

INSTALLATION

PLEASE DO NOT PROCEED
UNTIL YOU HAVE READ
ALL INSTRUCTIONS
AND SAFETY INFORMATION

All information provided in this manual is believed to be accurate at time of publication, however superwind GmbH assumes no responsibility for errors or omissions. The user of this information and product assumes full responsibility and risk. All specifications are subject to change without notice.

Member of:

National Defense Industrial Association

Wireless Internet Service Providers Association

WWEA World Wind Energy Association

KEEP THIS MANUAL ACCESSIBLE FOR FUTURE REFERENCE

VERSION 1-2019

(Please visit www.missioncriticalenergy.com to verify the latest manual version)

Table of Contents

1. GENERAL INFORMATION AND REFERENCES

1.1 Company profile

superwind GmbH was established in 2004 after four years of successful research, design and testing of its now internationally patented micro-turbine technology. Since then, thousands of commercially rated **Superwind 350**, **Superwind 353** and **Superwind 1250** turbines have been quietly providing reliable, autonomous wind generated electricity to users in remote locations under harsh conditions on both land and sea world-wide.

As your satisfaction is as important as our reputation, we thank you in advance for reading this Superwind manual in its entirety prior to installing (or even purchasing) our wind generating equipment. We also wish to remind you that wind turbines work best when installed where there is sufficient wind, so please research your planned wind turbine site or vessel installation to help accurately predict how a Superwind turbine can help with you power needs.

On behalf of our Superwind staff and world joint venture partners, we thank you for your interest in our cutting edge, real-world proven wind turbines.

1.2 Labeling

This manual refers to our ***Superwind 350/48V*** wind generator.

Manufacturer:

superwind GmbH
Am Rankewerk 2-4
D-50321 Brühl
Germany
Tel.: +49 / 2232 / 577357
Fax: +49 / 2232 / 577368
E-Mail: power@superwind.com
Internet: www.superwind.com

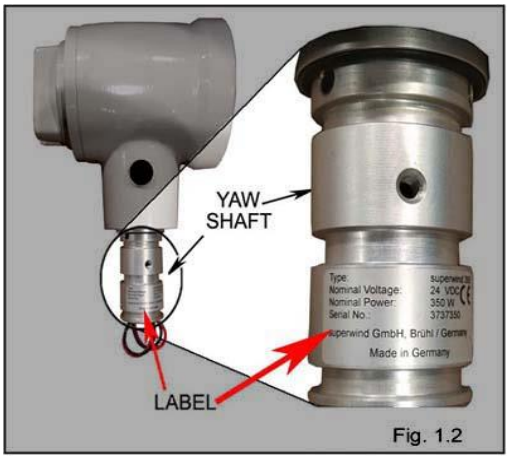


Fig. 1.2

The data tag listing the serial number and nominal voltage of your the ***Superwind 350/48V*** is located on the yaw shaft. (Fig No. 1.2).

The Intent of this manual is to assist technicians with the professional installation of the ***Superwind 350/48V*** in order to ensure the system is both installed correctly and operational as quickly as possible.
For future reference, please record the Serial Number of your Superwind 350/48V in the space provided below prior to installation. Once the yaw shaft is inserted into the bushing and into the mast, this information will not be visible.

Type.....***Superwind 350/48V***

Serial Number..... _____

1.3 Range of application

The electrical power generated by the ***Superwind 350/48V*** is used primarily to charge batteries and/or directly power 48 VDC appliances. AC appliances can be powered via an optional inverter. There is a wide range of high quality, 48 VDC equipment available. Examples include energy saving lamps, refrigerators, deep-freezers, water pumps, ventilators, consumer electronics, TV, radio and navigation equipment, etc.

Ideal applications for the ***Superwind 350/48V*** range from commercial and government needs (navigational aids, traffic management systems, monitoring stations and transmitters) to private sector use, such as mountaintop cabins or other remote, off-grid locations.

The ***Superwind 350/48V*** is also fully compatible with installations utilizing solar arrays. At many locations, wind and solar energy complement each other. A hybrid wind / solar dual charging system featuring the ***Superwind 350/48V*** allows you to optimise available energy sources, while requiring minimal battery capacity.

2. WARRANTY

2.1 Warranty

superwind GmbH warrants this product to be in good working order during the warranty period. In the event that the product is found to be defective within the warranty period, repair service will be provided free of charge by superwind GmbH or an authorized service partner.

Warranty covered repairs may be obtained only upon presentation of the warranty card and the original invoice issued to the customer by the retailer. The warranty card must state the buyer's name, the retailer's name and address, the serial number and purchase date of the product. superwind GmbH reserves the right to refuse warranty service if this information is not complete or has been removed or changed after the original purchase of the product by the purchaser from the retailer.

2.2 Warranty period

The warranty period is three years from the date of purchase, as provided by the above mentioned documents.

2.3 To obtain warranty service

Warranty service is available at **superwind GmbH** and all Superwind authorized service partners. All costs associated with transportation of the product to and from **superwind GmbH** or Superwind authorized service partners will be borne by the customer.

2.4 Limitations

superwind GmbH does not warrant the following:

- Periodic check-ups, maintenance and repair or replacement of parts due to normal wear and tear.
- Defects caused by modifications carried out without Superwind's express written approval.
- Defects caused by improper use, handling or operation and in particular defects caused by improper installation or installation on inadequate masts or support structures.
- To obtain warranty service, the purchaser must provide evidence upon request that the product has been installed on an adequate mast or support structure.
- Accidents, disasters or any cause beyond the control of **superwind GmbH**, including but not limited to lightning, flooding, fire, acts of war, vandalism, etc.
- Costs for disassembly and reassembly of the product to enable shipment for warranty reasons.

2.5 Others

superwind GmbH reserves the right to decide whether the product or parts of the original Superwind system shall be repaired or replaced. Should repair or replacement by **superwind GmbH** not be possible, the original purchaser will be entitled to a full refund from the manufacturer; **superwind GmbH**. This refund is limited to the purchase price of the product only and does not include any associated expenses, such as shipping, installation, bank fees, etc.
This warranty does not affect the purchaser's statutory rights under applicable national legislation in force, nor the buyer's right against the retailer arising from the sales / purchase contract. In the absence of applicable national legislation, this warranty will be the purchaser's sole and exclusive remedy and **superwind GmbH** shall not be liable for any incidental or consequential damages for breach of any expressed or implied warranty of this product.

In addition to the above warranty coverage, the GENERAL CONDITIONS FOR THE SUPPLY OF PRODUCTS AND SERVICES OF THE ELECTRICAL AND ELECTRONICS INDUSTRY produced by the German Federation of the Electric and Electronic Industry (ZVEI) also applies.

2.6 Expenses and Responsibilities

All associated expenses (shipping to and from the repair facility, insurance, etc) are the full responsibility of the buyer or his shipping agent, unless the buyer is notified otherwise by the manufacturer.

Upon receipt of your unit:

- Inspect the outside of the shipping package or container for any damage (dents, scratches, etc,). Document any damage noted on the Bill of Lading before signing and keep a copy. Documenting damage with photos is also highly recommended.
- Open the crate and inspect the contents immediately for any damage.
- Unpack the unit immediately and perform a visual inspection to determine if it is dented, bent or scratched.
- If for any reason the unit should need to be returned, the original crate is the best way to ship it back to the manufacturer.

2.7 Claims

Claims that occur during transportation must be filed by the consignee (the buyer) with the freight company, as shipping terms are FOB EX-WORKS (our distribution point as contracted).

THE BUYER IS RESPONSIBLE FOR ALL SHIPPING EXPENSES, INCLUDING CUSTOMS DUTIES AND VAT (IMPORT DUTIES).

3 SAFETY INSTRUCTIONS

Please read this manual thoroughly prior to assembly and installation of your ***Superwind 350/48V***. The information provided is to ensure your safety during assembly, mounting and operation, as well as during maintenance and troubleshooting. If you have any additional questions please contact your dealer, a Superwind service partner or the manufacturer.

3.1 Potential Hazards

There are a number of potential physical and electrical hazards associated with the installation and operation of a wind turbine. Familiarity with safety practices and procedures beforehand is crucial, both in avoiding injury to personnel and damage to the ***Superwind 350/48V*** wind turbine.

3.1.1 Mechanical Hazards

The main physical hazard is contact with a spinning rotor. The rotor blades can cause serious injury, even at very low speed.

- Never touch the rotor blades while moving!
- Never try to stop the rotor by hand!
- Never mount the rotor in a location where it can accidentally come into contact with personnel!

The rotor blades are constructed of glass fibre and carbon fibre reinforced plastic.
This material is extremely durable (which enables your ***Superwind 350/48V*** to cope with heavy storms) however it can break if objects strike the rotor at higher rotational speeds.

- Never allow objects to come in contact with the rotor while in operation!

3.1.2 Electrical Hazards

Even at low wind speeds, the generator can produce dangerous open circuit voltages (up to 210 VDC) at no-load operation (i.e. with the electric connection to the battery disconnected).
Charging currents can reach up to 7.5 Amps DC. As such, all cabling, electrical components and connectors must be rated to 10 Amps. For correct wiring dimensioning refer to Section 6.3.

- The use of undersized cabling can result in overheating and failure, possibly creating fire and shock hazards!

Fuses are installed to protect the wiring of the system and must be installed as close to the battery as possible. For details see Section 6.3.6.

Never short-circuit the battery, which can result in fire or explosion of the battery, along with release of acid and toxic gases.

Unsealed lead-acid batteries produce and vent flammable hydrogen gas during charging. This creates an explosive mixture that can easily be detonated by even the smallest of sparks (those produced by an electrical switch for example).
To reduce the possibility of explosion, always ensure battery installations are provided adequate ventilation.

- Never install batteries in locations where the danger of sparks exist.
- Provide sufficient ventilation for battery storage areas at all times.
- The diversion load power resistor for the charge regulator can become hot. To prevent the possibility of fire, never mount the power resistor on a flammable surface or close to flammable materials.
- Never mount the power resistor on a flammable surface.
- Mount the power resistor at least 40mm (1.57”) away from any flammable materials

3.1.3 Hazards when mounting the wind turbine

These instructions also apply to future disassembly, inspections or other work carried out on your wind generator.

Use only mast and support designs capable of safely handling the loads associated with the installation of your ***Superwind 350/48V***. The mast not only has to support your wind generator’s weight, but also the considerable thrust generated by high wind speeds. For details see Section 7.3.

3.1.4. General safety precautions

- Conduct all work on the mast or wind generator only on a calm, windless day.
- Do not allow personnel to walk or stand beneath hanging loads or potential drop hazards (such as a tilted mast).
- Disconnect all batteries from the system prior to beginning any work.
- To prevent your wind generator from starting unintentionally, place the stop switch into the STOP position or short circuit the generator output wires (Red and Black) before mounting the rotor blades.
- Do not install the wind generator in areas where it can be easily reached or approached by anyone walking by or working around the turbine structure.

4. TECHNICAL SPECIFICATIONS

4.1 Operational free space required

4.1.1 Main dimensions

Dimensions Table No. 4.1.1		mm	inches
a	Distance between centre of mast and blade tip	168	6.61”
b	Distance between centre of mast and extreme upper part of wind vane	556	21.9”
c	Distance from mast-top to centre of rotor	136	5.35”
d	Distance from the centre of hub and extreme upper part of the wind vane	530	20.9”
e	Length of yaw shaft	76	2.99”
f	Rotor diameter including blades	1220	48”
g	Outside diameter (OD) of yaw shaft with damping rings	44	1.73”
h	High for Plastic Bushing to be inserted into mast	71	2.79”
i	Required space for yawing	1263	49.72”

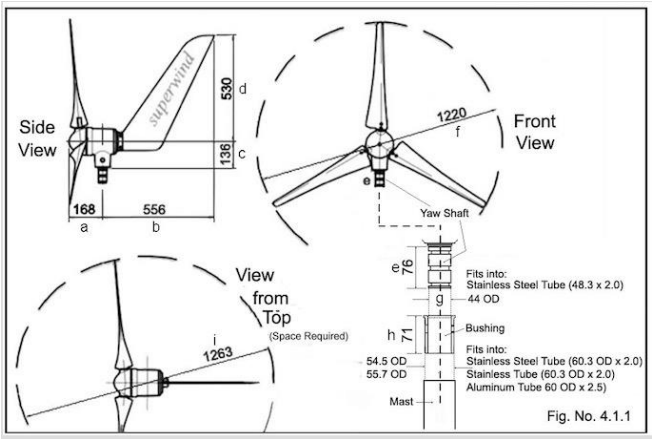


Fig. No. 4.1.1

4.2 Technical Data

Nominal power	350 W
Nominal wind speed	12.5 m/s (24.29 knots)
Cut in wind speed	3.5 m/s (6.80 knots)
Cut off wind speed	None
Rotor diameter	1,20 m (47.24”)
Number of blades	3
Blade material	Carbon fibre reinforced plastics
Rotor speed	500 – 1300 rpm
Generator	Permanent magnet 3-phase with rectifier neodymium magnets
Nominal voltage	48 V DC
Speed regulation	Rotor blade pitch
Power regulation	Rotor blade pitch
Brake	Generator short circuit
Weight	11.5 kg (25.35 lb)
Rotor thrust (operation)	70 N (15.7 lbf)
Rotor thrust (extreme wind speed)	220 N (49.5 lbf)

4.3 Functional description / special features

Like all wind turbines, the ***Superwind 350/48V*** uses the kinetic energy of the wind to generate electricity. The power generated is approximately proportional to the cube of the wind speed (i.e. doubling the wind speed results in eight times the power output). This means that relatively little energy can be generated during the varying wind speeds of a moderate breeze. A heavy storm however, contains such a high quantity of energy that the wind generator must be protected against overstress and damage.

The ***Superwind 350/48V*** has been designed to achieve optimum power output for a wide range of wind speeds while providing maximum safety and survivability during storm conditions.

a) The rotor blades were developed using modern computerized calculation and simulation methods. The airfoil has been wind tunnel tested and specifically developed for small size rotors. Relatively broad rotor blades combined with a special pitch angle produces a high start-up torque, enabling the rotor to start turning at only 3.5 m/s (7.8 mph) of wind speed.

Optimum start-up performance will be reached after a break-in period of the bearings and their seals. The duration of the break-in period can vary depending on site wind conditions

When using the ***Superwind 350/48V*** for battery charging, do not confuse the initial rotor start-up voltage for the output charging voltage. The wind speed required to start charging depends on the battery's state of charge and may be slightly higher than the rotor start-up wind speed.

b) A key innovation of the ***Superwind 350/48V*** is its patented aerodynamic rotor control system, which (similar to large wind turbines) automatically adjusts the pitch angle of the rotor blades based on wind speed. The mechanical controller is fully integrated into the hub and works without expensive, failure-prone electrical or hydraulic components. Instead, the controller is actuated by forces arising from operation of the wind turbine itself. These forces are affected by the geometric and kinematic lay-out of the rotor controller mechanism.

Aerodynamic forces act as control variables to automatically adjust the rotor blades for power regulation above the nominal operating wind speed of the unit. Simultaneously, centrifugal forces (the second control variable of the rotor blade adjustment) are introduced and as both the wind force and rotor speed decrease or increase, the controller automatically limits rotor speed. This occurs even at extreme wind velocities. This unique system is crucial in protecting the wind turbine from over-speed conditions, even during no-load operation. As a result, the controller limits the mechanical loads at high wind speeds and enables smooth operation under all weather conditions.

5. PREPARATIONS FOR ASSEMBLY

5.1 Inspection and Unpacking

5.1.1 Inspection

Visually inspect each shipping container immediately upon delivery for damage that may have occurred during transportation. If damage is found, request a complete inspection by the carrier's driver and have him acknowledge the type and extent of damage in writing on the Bill of Lading. If a claim needs to be filed with the carrier, it must be filed within 24 hours of arrival. Claims for damage that occur during transit are the sole responsibility of the buyer.

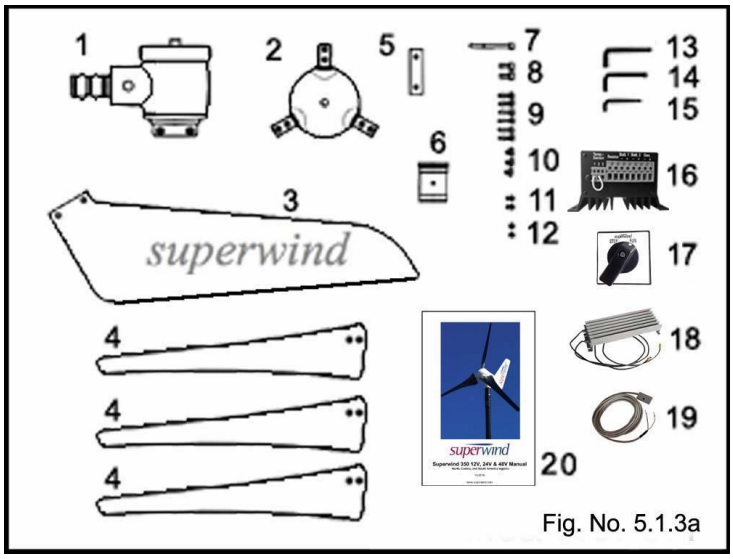
5.1.2 Unpacking

Upon opening the shipping container(s), visually inspect all system components for signs of physical damage that may have occurred during shipping (scratches, loose hardware, broken parts, etc).

5.1.3 Packing list:

PACKING LIST
Table 5.1.3

ITEM	DESCRIPTION	SIZE	QTY	☑
1	Generator unit	48V	1	
2	Hub		1	
3	Wind vane		1	
4	Rotor blade		3	
5	Wind vane mounting plate		1	
6	Plastic bushing (optional stainless steel bushing)		1	
7	Socket cap bolt – [Rotor Hub Mounting Bolt]	M8 x 80	1	
8	Socket cap bolt	M8 x 20	2	
9	Socket cap bolt	M6x 25 (TUFLOK)	6	
10	Socket cap screw with rubber ring	M6 x 8 (TUFLOK)	3	
11	Hexagon socket button head screw	M6 x 12	2	
12	Hexagon socket button head screw	M6 x 6	2	
13	Allen key	6 mm	1	
14	Allen key	5 mm	1	
15	Allen key	4 mm	1	
16	SCR 48V Charge Regulator		1	
17	Stop Switch		1	
18	Power resistor	5.6 Ohm, 400 Watt	1	
19	Temp-Sensor		1	
20	Operation manual		1	



NOTE!

The trailing edges of the rotor blades are very thin and sharp. Use caution when unpacking, both to avoid injury and damage to the blades.

5.2 Tools

A set of Allen wrenches is supplied to assist with the installation of your ***Superwind 350/48V***.

The following additional tools will also be required:

- Screw drivers
- Set of wrenches
- Wire strippers
- Wire crimpers
- Heat shrink or electrical tape
- Multi-meter
- Torque wrench

Tools for the mast installation are not listed here. Refer to applicable mast installation instructions.

5.3 Available accessories

Mast-Sets:

- Mast kit for guyed tubular mast 6 m (19.68 FT) [other heights on request]
- Mast kit for self-supporting tubular mast 7.5 m (24.60 FT).

5.4 Electrical Components:

- Superwind SCR 48V Charge Regulator with diversion load power resistor
- 10 amp slow-blow fuse and holder
- Stop-switch
- Temperature Sensor

5.5 Shipping

5.5.1 Measurements:

- **Superwind 350/48V**
  Box: 23” x 13” x 9” - 1.55 Cubic Feet

5.5.2 Weight

- **Superwind 350/48V**
  Box: 38 lbs (17.2 Kg)
- Add 1 lb if optional Stainless Steel Bushing is included

5.5.3 Shipping Class and Commodity or HB Number

- Shipping Class: 77.5
- HS Code: 85023100

6. Electrical Components and Connections

6.1 General information

Always use caution and follow all industry accepted practices and safety procedures when working on your ***Superwind 350/48V*** unit or installation system. Electrical system installation, maintenance and repairs should only be carried out by competent personnel who have studied and are familiar with the information and instructions provided in this manual. Contact Superwind for clarification if any questions arise.

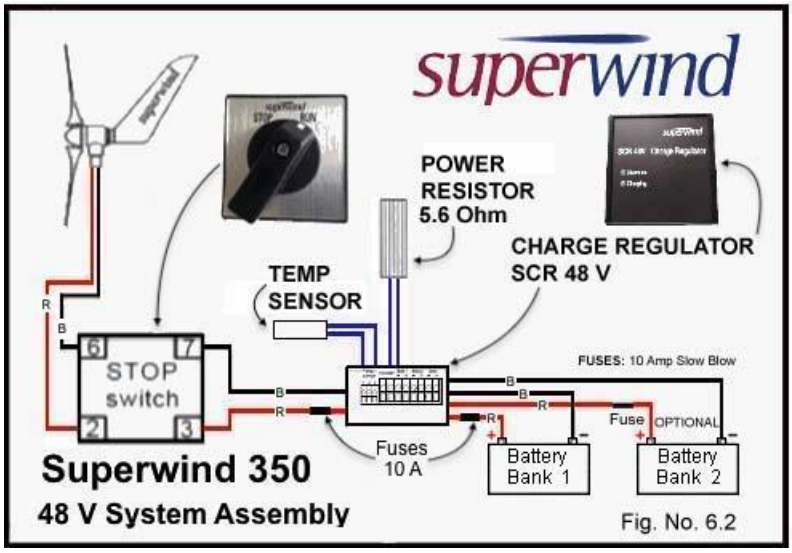
All electrical components should be mounted at their respective locations prior to making any electrical connections.

Ensure batteries remain disconnected until the installation is complete.

Do not connect the battery / battery bank to the system until installation of the turbine is complete!

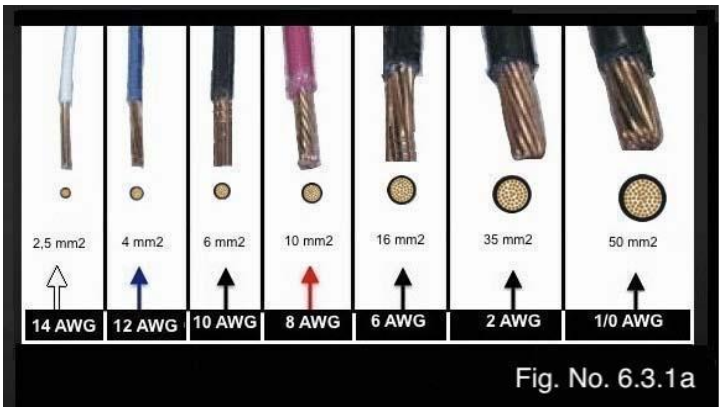
6.2 Wiring diagram

Figure 6.2 shows the wiring diagram for a typical ***Superwind 350/48V*** system.



6.3 System components

6.3.1 Wires

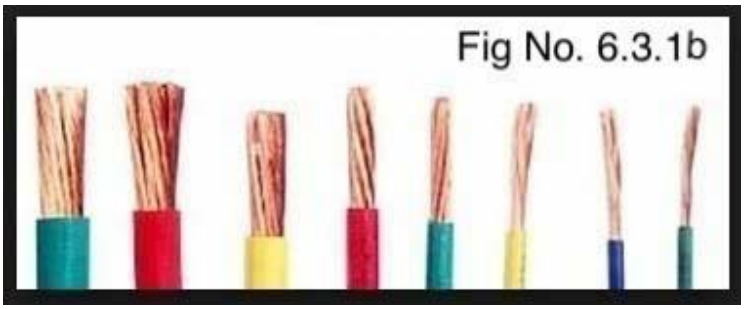


The cross section (also known as diameter or gauge) of the wires to be used will depend on the length of the wire run and the rated voltage of your wind generator. After deciding on a location, measure the distance from the top of the mast to the battery and select the minimum cross section required as provided in the table below. In order to keep power loss to a minimum and maintain safety, never use wires with under-sized cross sections.

Cables with insufficient cross sections can heat up and cause a fire!

All values given in the tables below are based on a voltage drop of 3%.

AWG Wire Size Chart for Superwind 350/48V Table No. 6.3.1						
Distance from mast top to the battery						
From: To:	up to 19.8 m	19.9 m 31.7 m	31.8 m 47.6 m	47.7 m 79.3 m	79.4 m 126.8 m	126.9 m 198.2 m
	Up to 64 ft	65 ft 104 ft	105 ft 156 ft	157 ft 260 ft	261 ft 416 ft	417 ft 650 ft
Minimum gauge (cross section)	2.5 mm²	4 mm²	6 mm²	10 mm²	16 mm²	25 mm²
Recommended per wire	AWG 14	AWG 12	AWG 10	AWG 8	AWG 6	AWG 4
See Fig. No. 6.3.1b						



The use of multi-strand, marine grade wire is recommended.
Solid wire is not recommended!

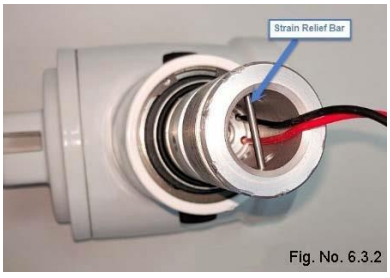
Tinned multi-strand, marine grade wiring is recommended for all marine insulations to reduce corrosion issues.

For underground installations, the cable must be installed in conduit or be suitable for direct bury applications. All cables and materials (heat shrink, insulating tape, etc) should be ultraviolet resistant.

Chafe protection should be provided for the entire cable run. All penetrations into the mast, electronics enclosures, etc, should be de-burred and the cable protected against chafe using rubber sleeves, grommets, etc.

All wire terminations and connections must be made using suitable (preferably marine grade) crimp on connectors.

6.3.2 Strain Relief



Depending on mast length and cable cross section, the weight of the cable inside the mast can be considerable. If the cable weighs more than 5 kg (11 lbs) strain relief must be provided inside the mast to prevent damage to the internal connection point of your ***Superwind 350/48V*** (Fig. No. 6.3.2)

6.3.3. Polarity

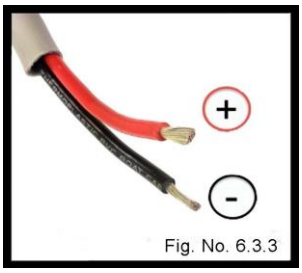


Fig. No. 6.3.3

Always pay attention to the correct polarity of the wires. Reversing polarity at the battery connections or anywhere in the system will destroy the electronic rectifier of your ***Superwind 350/48V***. During installation or when changing out batteries, clearly mark all wire ends as POSITIVE (+) or NEGATIVE (-) to prevent connection errors. Fig. No. 6.3.3.

Marking of the connecting wires at the ***Superwind 350/48V:***

POSITIVE Line (+)	**RED**
NEGATIVE Line (-)	**BLACK**

The internal electronic rectifier of the ***Superwind 350/48V*** will be destroyed by the application of reverse polarity anywhere within the system.
Rectifiers damaged due to reverse polarity are not covered under warranty!

6.3.4 Batteries

6.3.4.1 Charging the batteries

The ***Superwind 350/48V*** is primarily used to charge batteries. For proper battery protection, installation of the provided Superwind SCR 48V Charge regulator and diversion load power resistor is mandatory.

The SCR 48V Charge Regulator allows the ***Superwind 350/48V*** to operate automatically and completely unsupervised. The SCR 48V Charge Regulator is suitable for use with all battery types and its use ensures batteries are charged optimally and protected against overcharging and damage.

6.3.4.2 Selecting the batteries

When selecting batteries, always ensure their voltage matches the rated voltage of the system (48 volts in this case). The rated voltage of your ***Superwind*** is specified on the data label located on the yaw shaft.

Flooded lead-acid batteries are the most commonly used battery type world-wide. They work well in a wide variety of applications and are very cost effective, however they require periodic maintenance (electrolyte level checks, etc).

The use of AGM (Absorbent Glass Matt) batteries has many advantages. AGM batteries are sealed, virtually maintenance free, have a long service life and can better survive the occasional deep discharge.

All batteries should be ‘deep cycle’ rated. Automobile type ‘starting batteries’ are not suitable for use as storage batteries and will fail rapidly due to the cyclic operations associated with renewable energy-based charging.

6.3.4.2.1 Battery Capacity

Another important factor of battery selection is capacity, which is expressed in amp hours (Ah). This value represents the quantity of energy a battery can store. The required battery capacity depends on individual site requirements and factors such as location, wind availability, power consumption, power generating systems, etc. Consult your battery supplier for assistance with questions regarding load support, battery selection and installation.

Follow all manufacturer recommendations when selecting a location for your battery installation. Charging flooded lead-acid batteries generates flammable and potentially explosive hydrogen gas. Unsealed lead-acid batteries have vent caps to release this gas, which can detonate if it is mixed with air and a spark is present (from an electrical switch for example) or other ignition source (open hot exhaust).

Never install batteries in a location where the danger of spark formation exists. Ensure battery installations are provided adequate ventilation at all times.

Batteries store a large quantity of energy, which can be suddenly discharged in the event a battery is accidentally shorted. This sudden discharge can destroy the battery (resulting in the release of battery acid and gas) and even set the battery and cabling on fire. To protect against accidental short-circuiting, do not attach battery terminal connections until all work on the electric system has been completed.

Never short-circuit the battery or terminals across a bank of batteries!

Connect cabling to battery terminals only after all work on the electrical system has been completed.

6.3.4.3 Protection

Fuses (or appropriate circuit breakers) must be installed in the positive (+) wires to the battery to protect the system against excessive current and/or short-circuits. For fuse installation requirements, refer to the wiring diagrams provided in Section 6.2 and Section 6.3.5.5. As a fuse can cause an electrical spark when failing (blowing) do not install fuse holders in the same area as the battery or bank.

Use caution when handling battery acid, adding distilled water or performing other battery maintenance. Follow all battery manufacturer instructions and wear protective clothing and suitable eye protection.

Use caution when conducting battery maintenance.
Wear protective clothing and suitable eye protection.

6.3.5 Charge regulator SCR 48 V

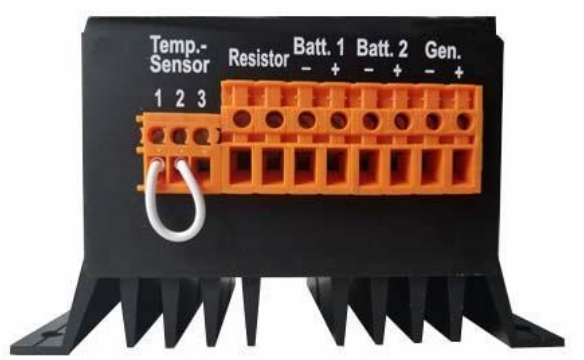


Fig. No. 6.3.5

6.3.5.1 Technical data

Nominal voltage	48 V
Max. Charging voltage (25°C)	57.6 V
Temperature compensation	144 mV/°C
Max. Current	10 A
Resistance of dump resistor	5.6 Ohm
Number of charging outputs	2
Method of voltage regulation	PWM
Connecting terminals	4mm² AWG12

The illuminated **GREEN** "Charging" LED as shown in Fig No. 6.3.5a indicates charge current is being sent to the battery.

Fig. No. 6.3.5a

Fig. No. 6.3.5b

The illuminated **ORANGE** "Diversion" LED as shown in Fig No. 6.3.5b indicates the PWM circuit is limiting the charge voltage sent to the battery by diverting excess power to the power resistor.
The default diversion set point level for the maximum charging voltage can be adjusted as required to meet customer requirements. As special equipment is required for proper calibration, this adjustment can only be performed by the manufacturer or a ***Superwind*** authorized service partner.

6.3.5.2 Functional description

The **SCR 48 V** charge regulator provided with your system has been specifically designed for use with the ***Superwind 350/48V*** wind generator and guarantees optimum charging of the batteries. As long as the actual charge voltage is below the maximum charge voltage level, the current from the wind turbine is routed directly to the battery or bank. Charge current flow to the battery is indicated by an illuminated **GREEN** "Charging" LED (Fig. No. 6.3.5.a).

Once the battery or bank has reached maximum charge voltage, the PWM circuit diverts the wind turbine's surplus power to the diversion load power resistor in order to keep the voltage constant. This state of charge is indicated by an illuminated **ORANGE** "Diversion" LED (Fig. No. 6.3.5.b).

When the batteries are fully charged, the wind turbine continues operating (electrically loaded by the power resistor) and is ready to provide useable power as soon as the maximum battery charge voltage level drops.

6.3.5.3 Installation Location

The **SCR 48 V** charge regulator is designed for indoor use and must be mounted in a location where it is well protected from the elements. The charge regulator's temperature sensor has a cable length of 400 cm [157"] and should be mounted close to the batteries (see Section 6.3.9).

- The distance between the charge regulator and the battery should be a minimum of 30 cm [12"], but must not exceed 400 cm [157"].
- The distance between the charge regulator and the diversion load power resistor should not exceed 200 cm [78" approximately].

The diversion load power resistor is IP 54 rated and can be mounted outdoors (e.g. outside a switch cabinet). Due to the heat produced while in use, the power resistor must be adequately ventilated. Never mount the power resister on a flammable surface or near flammable items, as the resistor will dissipate all of the wind turbine's power into heat once the battery is fully charged.

6.3.5.4 Connecting the Charge Regulator

Before connecting the charge regulator, secure the wind generator by turning the safety switch to the STOP position or by shorting the two generator cables together (see Section 7.1.1).

Mount the regulator and the power resistor to a dry, non-flammable surface. The resistor may also be mounted outdoors in a vertical position with the cable outlets at the bottom.

Connect the charge regulator per the wiring diagram as shown in Fig. No. 6.3.5.5.

Use appropriate terminations for all wires connected to the charge regulator.

To prevent damage to your system during installation, cables must be connected in the following order:

1. <u>Connect the Temperature Sensor</u>

Connect the two cables of the temperature sensor to terminals 1 and 3 **Temp.-Sensor**. If for any reason the temperature compensation function will not be used, a jumper must be installed between terminals 1 and 2.

<u>Note: The temperature sensor must be connected or the jumper installed for the SCR 48 to function properly (Fig. No. 6.3.5.4).</u>

2. <u>Connect the Power Resistor</u>

Connect both of the resistor wires to the terminals labelled **Resistor** (Fig. No. 6.3.5.4). The wires for the resistor are non-polarity specific, meaning the connections at the charge regulator are interchangeable. Should the length of the wires provided with the power resistor be insufficient, replace them with new wires possessing a minimum cross section of 4 mm² (12 AWG) (refer to Section 6.3.1).

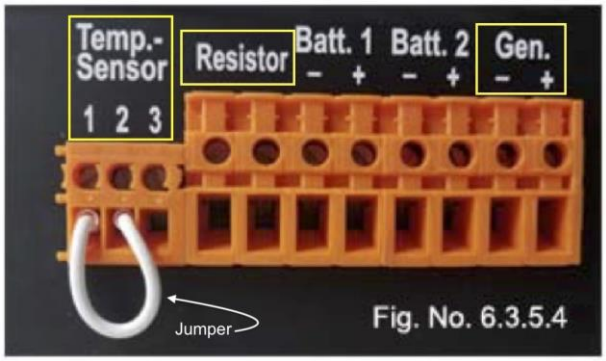


Fig. No. 6.3.5.4

3. <u>Connect the Superwind 350/48V wind generator</u>

Connect the wind generator to the charge regulator terminals labelled **- Gen.** and **+ Gen.** DO NOT reverse the polarity of these wires. Reversing the polarity of the wires will destroy the charge regulator and void the warranty. As a precaution, label the wire ends POSITIVE (+) or NEGATIVE (-) in order to prevent reverse polarity connection errors (Fig. No. 6.3.5.4).

Mark the connecting cables of the ***Superwind 350/48V*** as follows:

POSITIVE (+) .....**RED**
NEGATIVE (-) .....**BLACK**

If unsure about the polarity of the cables from the wind generator, you can identify POSITIVE (+) and NEGATIVE (-) easily using a multi-meter.
Select DC (10 VDC range) on your multi-meter. Connect the multi-meter positive lead (red) and negative lead (black) to the cables coming from the wind turbine, then ask an assistant to turn the rotor of the wind turbine slowly

by hand clockwise. If the voltage shown is positive (+), then the meter's positive lead is connected to the POSITIVE (+) turbine cable. If the voltage shown is negative (-), then the meter's positive lead is connected to the NEGATIVE (-) cable of the wind turbine.

4. **Connect the batteries**

One or two batteries (or battery banks) can be connected to the **SCR 48 V**. Use the terminals **Batt. 1 -** and **Batt. 1 +** to connect your first battery (or bank) and the terminals **Batt. 2 -** and **Batt. 2 +** to connect your second battery or bank (see Fig. No. 6.3.5.4 and Fig. No. 6.3.5.5 Wiring Diagram).

If two batteries or banks are connected to the **SCR 48 V**, each is charged independently and is isolated from the other (to prevent discharge should one battery or bank fail or have low charge voltage).

NOTE!

Connect the cables to the charge regulator and then to the battery to prevent short-circuiting the battery during installation.

6.3.5.5. Wiring diagrams

Figure 6.3.5.5A shows the wiring diagram for a ***Superwind 350/48V*** with **SCR 48 V** Charge Regulator.

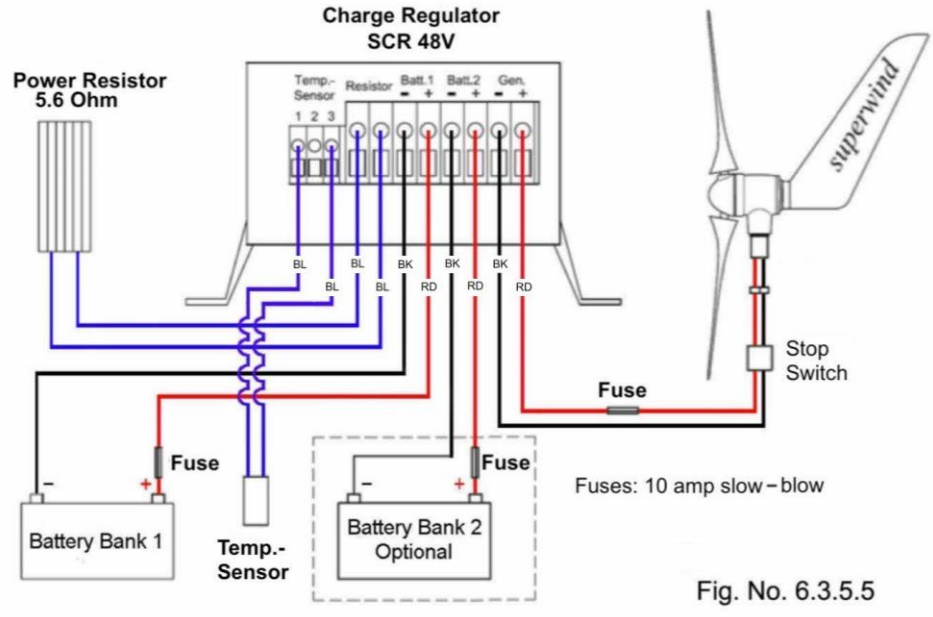


Fig. No. 6.3.5.5

NOTE!

The above diagram for the power resistor refers to a system utilizing only one **Superwind 350/48V** as the power source.

6.3.6 Fuses

To protect the battery against short-circuits, fuses must be installed in the POSITIVE line between the wind generator and the charge controller and in the POSITIVE line between the charge regulator and the battery. These fuses must be 10 amp slow-blow type or appropriate circuit breakers. See Fig. No. 6.3.5.5.

The fuses or breakers must be installed as close to the battery as possible, but not within the same compartment, due to the possible generation of explosive hydrogen gas while charging the batteries.

6.3.7 Stop Switch

Fig. No. 6.3.7

The stop switch is used to shut down the wind generator or to prevent starting of the rotor during maintenance, repairs or when working in the turbine operational area.

In the STOP position, the switch connects the positive and negative output wires of your ***Superwind 350l48V***, short-circuiting its generator and substantially reducing rotor speed. In the stop position, the switch also disconnects the shorted generator from the battery circuit.

Installation of the provided Stop Switch is mandatory for safe operation of your ***Superwind 350l48V.***

6.3.7.1 Mounting

The stop-switch is designed for indoor panel mounting only. The stop switch shaft is adjustable to fit panels up to 7/8” (22 mm) thick. Fig. No. 6.3.7.1a.

6.3.7.2 Dimensions

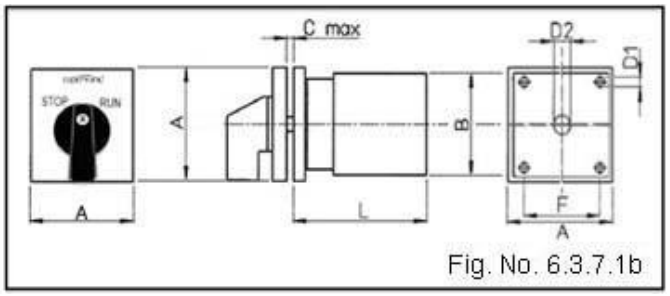


Fig. No. 6.3.7.1b

Side	Dimensions Table No. 6.3.7.2	mm	inches
A	FRONT VIEW: length & width	48	1.88”
B	REAR VIEW: length & width	42	1.65”
C	Panel Maximum Fitting Space	22	0.86”
D1	Screw fitting hole1 OD	4.1	1.61”
D2	OD Switch axle	20	0.78”
F	Screws fitting holes distance OC	36	1.41”
L	Inside cabinet	55	2.16”

Fig. No. 6.3.7.1c

Before installing the switch, adjust the shaft to the length required and secure it by means of the mounting screw (Fig No. 6.3.7.1c).

NOTE!

For very thin panels, it may be necessary to cut off the mounting screw head afterwards for proper mounting.

6.3.7.3 Electrical Connection

The stop switch has two positions:

STOP

The positive and the negative wires from the wind generator are short-circuited (generator short-circuit brakes the rotor). The positive and the negative lines from the battery or battery bank are open and disconnected from the wind generator.

RUN

The positive and negative wires from the wind generator are connected to the battery or battery bank via the **SCR 48V** charge regulator.

WARNING!

All electrical work must be completed only by properly trained technicians!
Disconnect all battery or battery bank terminals from the system prior to making any system connections!

PRECAUTION!

INSTALLATION OF THE INCLUDED STOP SWITCH AND SCR 48V CHARGE REGULATOR IS MANDATORY!

PRECAUTION!

IF THE CHARGE REGULATOR BECOMES INOPERATIVE, TURN THE TURBINE OFF UNTIL THE CHARGE REGULATOR CAN BE REPLACED.
DO NOT OPERATE THE SUPERWIND 350/48V WITHOUT AN OPERATIONAL CHARGE REGULATOR INSTALLED!

Never substitute or install a non-Superwind stop switch. The Superwind stop switch is specifically designed to disconnect the ***Superwind 350/48V*** from the battery while simultaneously shorting the turbine leads, shutting down the rotor. The stop switch must be installed in line between the wind generator and the **SCR 48V**, as close to the wind generator as possible (see Fig. 6.3.7.5).

The wires between the Superwind generator and the stop switch must be kept as short as possible. For appropriate conductor cross-section refer to section 6.3.1.

- Installation of 10 amp slow-blow fuses in the positive (+) wire between the stop switch and SCR 48V and the positive (+) wire between the **SCR 48V** and the battery is mandatory!
- Never install a circuit breaker or fuse between the stop switch and the Superwind generator!

6.3.7.4 SWITCH TERMINALS

SWITCH TERMINALS
Table 6.3.7.4

Line	Description	Terminal Number
1	Superwind generator (+) Positive	2
2	Superwind generator (-) Negative	6
3	Charge regulator input (+)	3
4	Charge regulator input (-)	7
5	No connection allowed	4
6	No connection allowed	8

Do not remove the bridge connecting terminals 1 and 5! The stop switch will not operate properly without it!

Fig. No. 6.3.7.4

- There are 8 wiring posts on the stop-switch. Only those described in Table 6.3.7.4 should be used.
- Ensure all terminal screws are properly tightened. If terminal screws are loose (**even those for terminals not in use)** your Superwind unit may not perform correctly.
- Check the tightness of **all** stop switch terminal screws as part of your annual **Superwind** inspection.

NEVER INSTALL A CIRCUIT BREAKER OR FUSE BETWEEN THE STOP SWITCH AND THE WIND TURBINE.

- Never install a non-Superwind stop switch!

6.3.7.5 Component locations

The **SCR 48V** Charge Controller is installed between the battery bank and the wind turbine. The Stop Switch is installed between the ***Superwind 350/48V*** and the charge controller. The required 10 Amp slow-blow fuses are installed before and after the **SCR 48V** Charge Controller as shown in Fig. No. 6.3.7.5

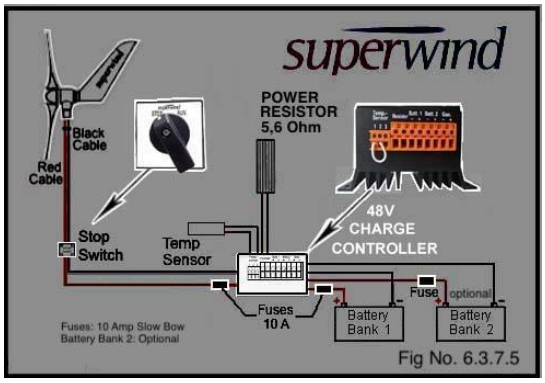


Fig No. 6.3.7.5

6.3.8 Diversion Load Power Resistor

The resistance of the wires connecting the power resistor to the charge regulator can affect the charging voltage. As such, the length of the wires connecting the power resistor should not exceed the provided 1 meter (3 feet). If it is necessary to extend the resistor wires run beyond 1 meter, please refer to the AWG Wire Size Chart (Table No. 6.3.1 and Figs. 6.3.1a and 6.3.1b).


Fig. No. 6.3.8

6.3.9 Temperature Sensor

The remote temperature sensor is a 6.4 meter (25') long cabled sensor designed to provide battery temperature compensation charging from the **SCR 48V** charge regulator. The sensor cable wires are non-polarity specific, meaning the two plug connections at the charge regulator are interchangeable.


Fig. No. 6.3.9

6.4 Grounding

Your Superwind should be properly grounded to protect the system against damage due to lightning, over voltage, etc. Grounding system design depends on factors such as local conditions, place of installation, type of soil, depth of groundwater table or the availability of a pre-existing grounding bus. Consult a competent electrician or electrical system technician should questions exist concerning the design or installation of the grounding system.

7. SUPERWIND 350/48V GENERATOR ASSEMBLY

7.1 Precautions

Please read this manual in its entirety prior to installing your ***Superwind 350/48V*** and note all recommended safety precautions to be followed during installation. Ensure the mast and support structure is capable of safely handling the loads of your wind generator. The mast not only has to withstand the weight of the wind generator and its mass moment of inertia (i.e. when installed on a yacht) but also the thrust generated by high wind speed. For example, the maximum wind thrust during normal operating parameters will be approximately 70 N of force, however in an extreme gust (wind speed of 49 m/s [95.24 Kn]) the thrust can rise up to 220 N!

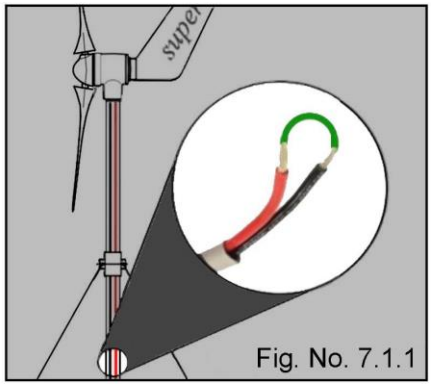
- Conduct work on the mast or wind generator on a calm, windless day
- Do not step or allow others to stand beneath hanging loads (e.g. a tilted mast).
- Disconnect all batteries from the system prior to conducting any work.

- Never approach a turning rotor – Stay away from moving blades!
- Never try to stop a turning rotor by hand.
- Never secure the wind turbine by tying off a blade to the mast. This will damage or distort the aerodynamic design of the blade and affect the performance of the turbine.

- Never install the wind generator in a location where persons can accidentally come into contact with rotating blades.

7.1.1 Short-Circuit

TO PREVENT THE GENERATOR FROM STARTING UNINTENTIONALLY (PRIOR TO INSTALLATION OF THE STOP SWITCH) "SHORT-CIRCUIT" THE GENERATOR BY CONNECTING THE TWO GENERATOR WIRES TOGETHER AS SHOWN IN FIG. 7.1.1



DISCONNECT ALL BATTERIES OR BATTERY BANKS BEFORE SHORT-CIRCUITING THE TWO GENERATOR WIRES!

7.2 DELRIN® BUSHINGS

7.2.1 Bushing Basics

A bushing is the piece of equipment that anchors the Superwind yaw shaft to the mast, allowing it to freely rotate 360º on its vertical axis. The bushing slides over the yaw shaft of the turbine, where it is then fastened in place utilizing three screws. Once attached to the yaw shaft, the bushing is then inserted into the mast tube and screwed in place for support, stability and safety (Fig. No. 7.2.1).

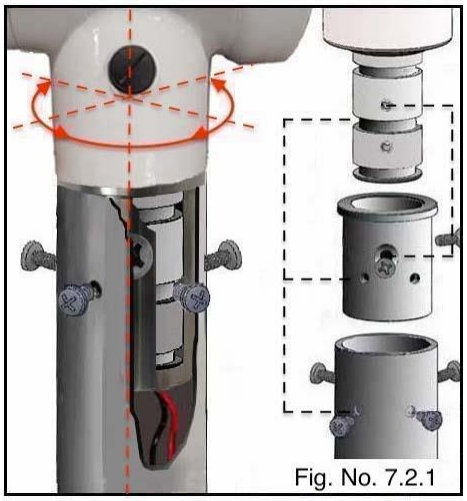


Fig. No. 7.2.1

The original bushing used with the Superwind 350 turbine was designed to help with noise reduction when installed aboard sailing yachts. The concept and design of these bushings has evolved considerably since then.

7.2.2 Bushings Types

There are currently three types of bushings available for use with the ***Superwind 350/48V*** allowing installations that can accommodate a wide variety of mast configurations These are the American Delrin® (White), the American Stainless Steel, and the American Delrin® (Black) bushings (Fig. 7.2.2a, 7.2.2b and 7.2.2c). Bushing selection depends on the type of location the turbine will be deployed in.

Fig. 7.2.2a Fig. 7.2.2b Fig. 7.2.2c

American Delrin® (White) ***American Stainless Steel*** ***American Delrin® (Black)***

American Delrin® bushings are used for integration on ships and other salt water applications. The optional American Stainless Steel bushing is used on tall towers and in locations subject to higher wind speeds, as well as mobile platforms (such as trailers).

The American Stainless Steel bushing is an option for use in areas that experience extreme wind conditions. A detailed description and installation instructions for this bushing are provided with the unit.

The American Delrin® (White) and the American Delrin® (Black) bushings come with predrilled holes to facilitate attachment to the yaw shaft and to the mast with their respective hardware as follows (Fig. No. 7.2.2d).

- Three (3) M6 x 8 Socket cap screws (with TUFLOK coated threads and rubber rings) are included and are used to attach the bushing to the yaw shaft.
- Two (2) M6 x 6 hexagon socket button head screws (also included) are used to attach the bushing to the mast. These screws will extend into the groove of the yaw shaft, but will not touch it. Optional M6 x 12 screws are also included and may need to be used, depending on installation requirements.

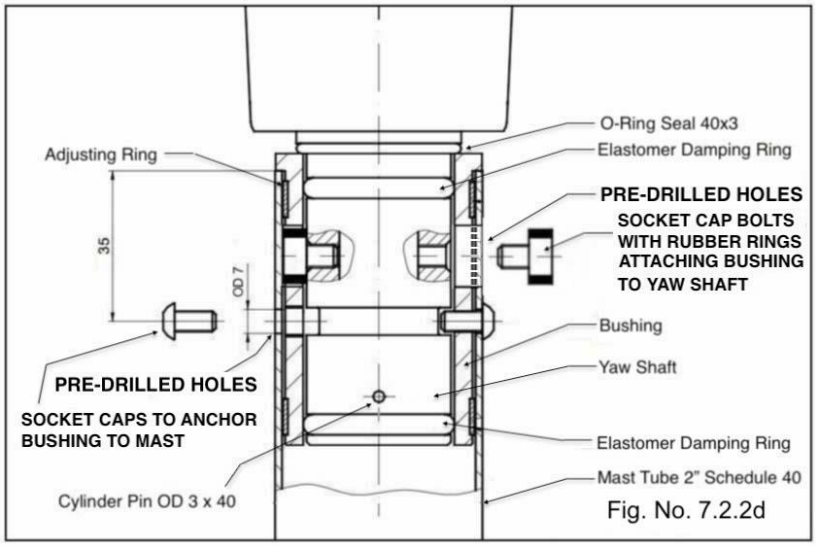


Fig. No. 7.2.2d

The default bushing for the ***Superwind 350/48V*** is either the 2.08 inch (52.832mm) Delrin® White bushing ***or*** the 2.055 inch (52.197mm) Delrin® Black bushing, depending on the customer's specific needs (if a stainless or aluminum pipe mast is being used for example).

BUSHING QUICK GUIDE

BUSHING QUICK GUIDE Chart No. 7.2.2			
Type of Bushing	**Dampener Rings On/Off**	**Inner Hardware**	**Outer Hardware**
American Delrin® (White) Fig. No. 7.2.2a	**ON**	(3) – Socket Cap Screw with rubber rings (M6 X 8)	(2) – Hexagon socket button head screw (M6 x 6 or M6 x 12)
American Stainless Steel Fig. No. 7.2.2b	**OFF**	(3) – M6 x 14	(4) – Pan head ¼" 20 screw (*or alternative*) with TUFLOK
American Delrin® (Black) Fig. No. 7.2.2c	**OFF**	(3) – Socket Cap Screw with rubber rings (M6 X 8)	(2) – Hexagon socket button head screw (M6 x 6 or M6 x 12)

7.2.2.1 American Delrin® (White) Bushing

The ***Superwind 350/48V*** comes with two (2) black elastodamphner rings installed on the yaw shaft (Fig. No. 7.2.2.1). When using the American Delrin® (White) bushing, both of the black elastodamphner rings installed on the ***SW350/48V*** **must stay** on the yaw shaft during installation. Coating the elasto-damphner rings and inside of the bushing with Vaseline® (supplied) prior to installation will lessen resistance when inserting the yaw shaft into the bushing. Delrin® will swell slightly in salt water applications. This can be useful in helping to reduce any non-circular dimensions of the mast. When installed correctly, the bushing provides both sound and vibration dampening.

Fig. No. 7.2.2.1

The inner diameter of the American Delrin® (White) bushing is 44.2 mm (1.74 inches). The maximum outer

diameter of the bushing is 52.9 mm (2.08 inches). It is to be used with a 2" schedule 40 stainless steel tubing mast.

When required, the outer diameter of the bushing can be reduced slightly by sanding to help accommodate installation inside the mast.

Hardware provided in this kit includes three (3) M6 x 8 Socket cap screws with TUFLOK coated threads and rubber rings used to attach the bushing to the yaw shaft. Two (2) M6 x 6 hexagon socket button head screws are used to attach the bushing to the mast (optional M6 x 12 hexagon socket button head screws are also included). These screws will extend into the groove of the yaw shaft, but should not touch it.

7.2.2.2 American Delrin® (Black)

The ***Superwind 350/48V*** comes with two (2) black elastodamphner rings installed on the yaw shaft. When using the American Delrin® (Black) bushing, both of the black elastodamphner rings installed on the ***SW350/48V*** **must be removed** from the yaw shaft prior to installation. The American Delrin® (Black) will swell slightly in salt water applications. This can be useful in helping to reduce the non-circular dimensions of the mast. If required, the outer diameter of the bushing can be reduced slightly by sanding help accommodate installation inside the mast. The inner diameter of a American Delrin® (Black) bushing is 42.2 mm (1.66 inches). The outer diameter of an American Delrin® (Black) bushing is 52.1 mm (2.05 inches). Hardware included are three (3) Socket cap screws with rubber rings (M6 x 8 with TUFLOK) and two (2) hexagon socket button head screws (M6 x 6) or (M6 x 12).

Fig. No. 7.2.2.3

7.3 Mast mounting

Before mounting the ***Superwind 350/48V*** on the mast or support, the wiring from the generator to the stop switch must be led through the mast tube (Fig. No. 7.3) and be connected to the switch with correct polarity (see Section 6.3.3).

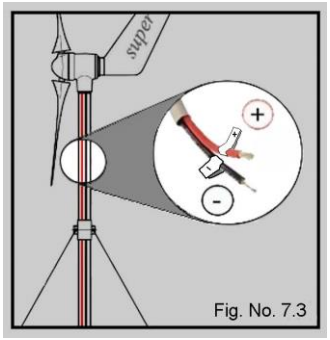


Fig. No. 7.3

NOTE: The following applies to all mast and support structures:

Before assembling the wind generator, ensure there are no fittings, stays, etc, in the area from the top of the mast top to a point 650 mm below the mast top. This clearance is crucial, because as the rotor controller pitches the blades at high wind velocities, the distance between the blades and the mast will be reduced.

7.3.1 Mounting on a 60.3mm or 60.0mm mast tube

The yaw shaft of your ***Superwind 350/48V*** fits multiple sizes of mast tubes:

Mounting on a mast tube 60.0 mm or 60.3 mm
Chart No. 7.3.1.

Outer-OD *	Thickness	Inner-ID **	Material
60.3 mm	2.3 mm	55.7 mm	steel, welded
60.3 mm	2.0 mm	56.3 mm	stainless steel, welded
60.0 mm	2.5 mm	55.0 mm	aluminum, seamless
* OD: Outside Diameter			
** ID: Inside Diameter			

7.3.1.1 Preparations at the mast head:

- Deburr the end of the tube carefully (inside and outside).
- File off the welding seam if necessary.

With welded tubes, ensure the welding seam does not prevent insertion of the yaw shaft. Smooth the seam with a round file or similar tool if necessary.

The included bushing (Delrin® White or Black) has to be mounted onto the yaw shaft of the generator unit. Before installing the plastic bushing onto the yaw shaft, align the three 16 mm OD holes of the bushing with the respective threaded M6 holes of the yaw shaft. Then gently push the plastic bushing onto the yaw shaft (with the collar facing the turbine) until reaching the stop limit stop at the O-ring seal. In the case of the American Delrin® (White) bushing, take care not to damage the damping rings during installation.

Next, insert the three rubber gasketed M6 x 8 socket cap bolts into each of the holes and tighten until the heads are tight against the yaw shaft (Fig. 7.3.1.1a). Once installed correctly, the screw heads will be flush with the OD of the bushing and will not interfere with insertion into the mast tube.

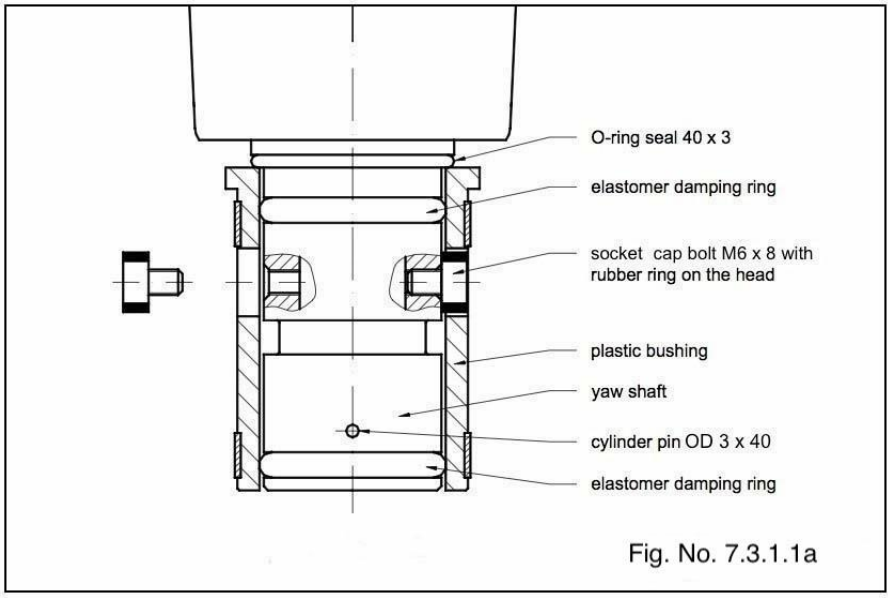


Fig. No. 7.3.1.1a

Insert the yaw shaft of the ***Superwind 350/48V*** with the plastic bushing to the limit stop (collar) and align the tapped holes with the drilled holes of the mast (Fig. No. 7.3.1.1b).

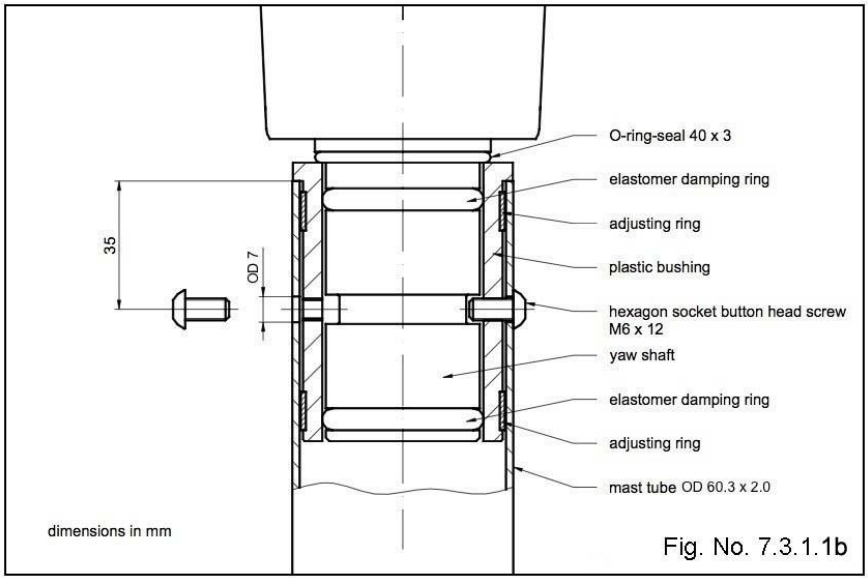


Fig. No. 7.3.1.1b

Apply a small amount of Locktite® to the threads of the two hexagon socket button head bolts (M6 x 12), insert and tighten for axial attachment. The bolts now extend into (but do not touch) the groove of the yaw shaft.

7.3.2 Mounting on a 48.3mm mast tube

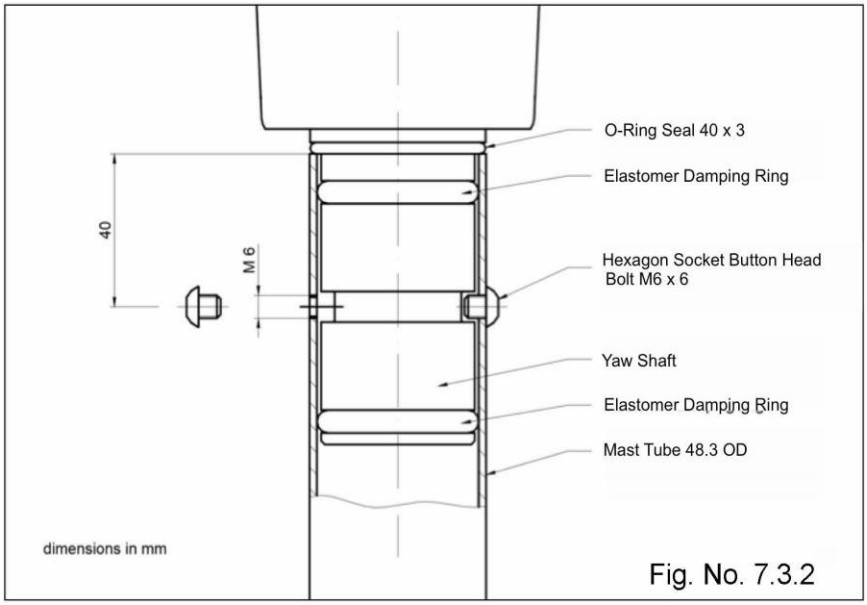


Fig. No. 7.3.2

The ***Superwind 350/48V*** can also be mounted to a stainless steel 48.3 mm mast, (Fig, 7.3.2) provided the wall thickness is 2.0 mm and the inner diameter is at least 44.0 mm.

7.3.2.1 Preparations at the mast head:

- Deburr the end of the tube carefully (inside and outside)
- File off the welding seam if necessary.
- Drill two 5 mm holes and tap M6. The distance to the mast top is 40 mm.

With this configuration the plastic bushing and three rubber gasketed M6 x 8 socket cap screws are not needed. For easier assembly, lubricate the two elastomer damping rings on the wind turbine yaw shaft and the inside of the mast tube with Vaseline® or a similar petroleum jelly product. Now gently push the yaw shaft into the mast until reaching the stop limit at the O-ring seal, taking care not to damage the damping rings during installation.

Next, apply a small amount of Locktite® to the threads of the two hexagon socket button head bolts (M6 x 6), insert and tighten for axial attachment. The bolts will extend into the groove of the yaw shaft, but will not touch it. Once assembled correctly, this installation provides both sound and vibration dampening (Fig. No.7.3.2).

7.3.3 Mounting on other mast tubes

If other mast sizes are used to mount the ***Superwind 350/48V,*** ensure the inside diameter is of the required size (to prevent excessive movement). The **OUTSIDE** diameter of the tube must not be greater than 70 mm (2.75”) to ensure there is sufficient space between the mast and rotor blades. There must also be no exterior fittings, stays, etc, which could obstruct operation of the rotor (Fig. No. 7.3.3)

7.3.3.1 Preparations at the mast head:

- Deburr the end of the tube carefully (inside and outside).
- File off the welding seam if necessary.
- Drill two holes at 7 mm.

Depending on the size of the tube, it is possible that the two hexagon socket button head screws provided for attachment (M6 x 12) may be too short. Should this be the case, screws of the appropriate length must be used. Ensure that the replacement screws are of sufficient length for the installation, but are not long enough to touch the inner part of the yaw shaft. Otherwise the sound and vibration dampening ability of the installation will be compromised. Apply a small amount of Locktite® to the threads of the bolts prior to installation.

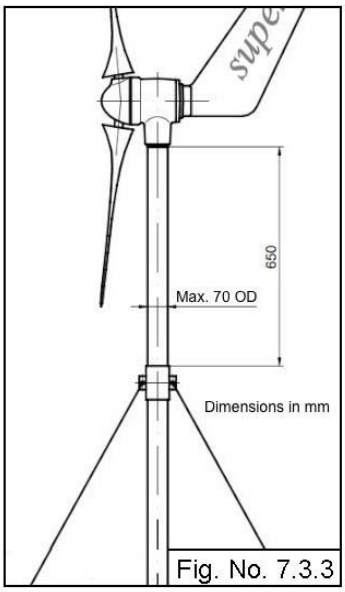


Fig. No. 7.3.3

7.3.4 Mast Tube Specifications

The proper sizing for a mast selection is 2" schedule 40 stainless steel or aluminum piping. Stainless steel tubing can be used as well, provided the size is 2 ¼", 316L, 16 Gauge. However, any type of high quality, commercial grade metal can be used, provided it is 2" schedule 40.

Common American Masts Chart No. 7.3.4			
Mast Type	**Inner Diameter***	**Outer Diameter****	**Wall Thickness****
Stainless Steel Pipe **(2" sch 40)**	**52.46 mm** *2.065 in*	**60.3 mm** *2.37 in*	**3.92 mm** *0.15 inch*
Stainless Steel Tube **(2 ¼", 316L, 16 Gauge)**	**52.50 mm** *2.066 in*	**57.15 mm** *2.25 in*	**2.325 mm** *0.09 inch*
Aluminum Pipe **(2" sch 40)**	**52.50 mm** *2.066 in*	**60.325 mm** *2.375 in*	**3.912 mm** *0.15 inch*
**Inches are rounded to nearest thousandth*			
***Inches are rounded to nearest hundredth*			

7.4 Rotor Blades


Fig. No. 7.4

The trailing edges of the rotor blades are very thin and sharp. Exercise caution when unpacking the blades to avoid injury. Fig. 7.4

Superwind rotor blades are manufactured as sets of three and are balanced by weight and pitch deflection. The three blades can be fixed to the hub in any order, however do not mix and match blades from different **Superwind** blade sets as this could cause the rotor to become unbalanced. This means that if a single blade is damaged, the entire set must be replaced.

7.4.1 Mounting of the wind vane

The wind vane is fastened to the rear cover of the generator. Insert the wind vane and the mounting plate into the groove. As viewed from the rear (Fig. No. 7.4.1), the mounting plate must be on the right side. Next, insert the M8 x 20 socket cap screws into the mounting plate and torque to 30nm (22 ft lb). The screws have TUFLOK (blue color) thread lock applied to prevent loosening once installed and during operation. Due to this coating, some resistance during installation is normal.

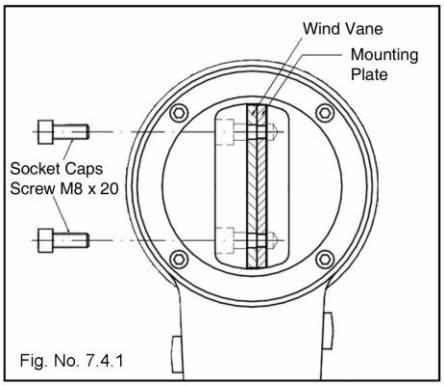


Fig. No. 7.4.1

Note: Check the tension of the socket cap screws M8 x 20 holding the mounting plate and wind vane annually as part of the generator's routine maintenance schedule.

7.5 Rotor assembly

There are two methods to that can be used to assemble the rotor of your Superwind:

a) The hub is mounted to the generator shaft and the rotor blades are attached to the hub afterwards.

b) The rotor blades are attached to the hub first and the assembled rotor is then mounted to the generator.

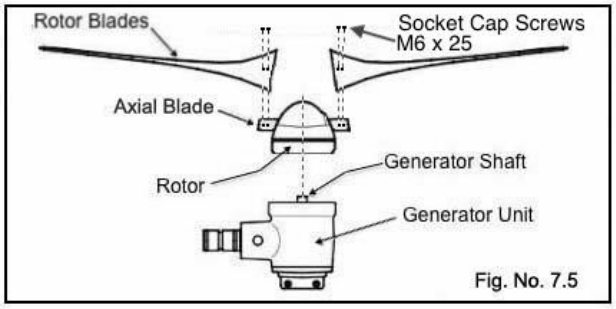


Fig. No. 7.5

We recommend method "b" as it is easier in most cases to first assemble the rotor completely at a convenient place, then mount the rotor to the generator.

7.5.1 Attaching the rotor blades to the hub

Accurate positioning and mounting of the rotor blades to the hub is ensured by their design, which allows for one way installation only. The flat portions of the axles sticking out (Fig. No. 7.5.1a) of the hub have two cylindrical counter bores each. The rotor blades have rectangular recesses with two cylindrical Tenon's, which fit into the cylindrical counter bores of the axle when pressed with light force.

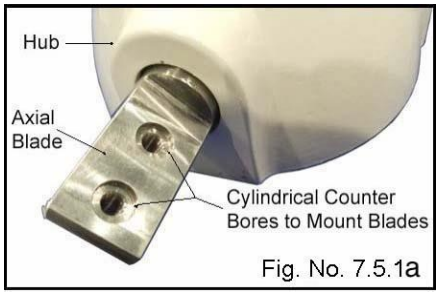


Fig. No. 7.5.1a

The rotor blades are attached by two M6 x 25 socket cap screws, the threads of which are coated with TUFLOK to prevent loosening during operation (Fig. No. 7.5.1.b). Due to this coating, some resistance during installation is normal.

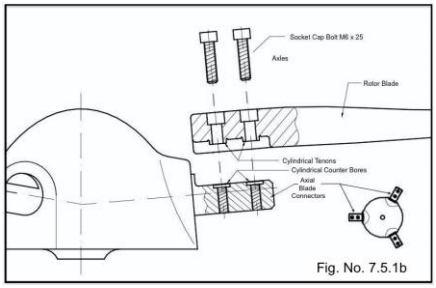


Fig. No. 7.5.1b

To begin assembly of the rotor:

1. Place the hub with the flat side down on a soft surface with the three flat axles horizontal and pointing upwards.
2. Attach the first rotor blade by aligning the cylindrical tenons of the blade to the cylindrical counter bores of the axel and lightly pressing the blade into place. Use caution, as the use of too much force can damage the threads.
3. Once both tenons are aligned correctly with the counter bores, screw in the two socket cap screws M6 x 25 (Fig. No. 7.5.1b). Stainless steel threads are very soft, so make sure the screws are first started by hand and not cross threaded. If mounting the blade for the first time, it is recommended to insert the screws and alternatively give each a half turn until the tenons are completely pressed into the counter bores.
4. When the rotor blade is attached to the axle, do not simply tighten the screws, as excessive force could damage the blade material. For the correct initial tension, use a torque wrench to tighten the screws to a torque of 4.5 Nm. [3.31 lb/ft].

If a torque wrench is not available, the following method is recommended:

1. To ensure the contact surface on each blade face and adjoining axle fits properly, insert both screws slowly, with offset pressure - one after the other - until snug. Once properly positioned, increase the pressure slightly on each screw until it starts to feel tight.
2. At this point, turn the screw exactly one quarter turn in order to adjust to the correct final tension.
3. Continue mounting the other two blades the same way.

- Ensure that the cylindrical tenons on each of the blades are correctly inserted into the axle counter bores.
- Do not use excessive force when installing the blades.
- Do not over tighten the screws.

7.5.2 Mounting the hub to the generator shaft

In order to prevent the rotor from turning unexpectedly during installation, place the stop switch into the STOP position before assembly of the hub to the generator shaft. Another option is to disconnect the batteries, then short circuit the two generator cables.

DISCONNECT THE BATTERIES BEFORE SHORT CIRCUITING THE TWO GENERATOR CABLES!

Once the rotor has been assembled, hold the rotor by the hub and center the hub hole onto the generator shaft (Fig. No. 7.5.2), paying close attention to the alignment with the generator shaft key. Avoid holding or carrying the rotor by the rotor blades. Doing so will place unnecessary loads on the blades and can cause possible injury (as the edges of the blades are sharp).

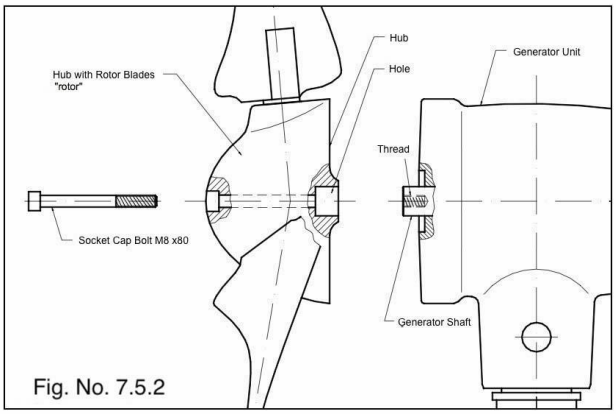


Fig. No. 7.5.2

Gently slide the rotor onto the generator shaft, being careful not to push the generator shaft into the housing of the generator unit. Next, insert the socket cap bolt M8 x 80 (Fig. No, 7.5.2) through the hub and tighten it until all axial play is removed. Torque the socket cap bolt to 18 Nm. [13.27 lb/ft]. The socket cap hub bolt has TUFLOK (blue color) thread lock applied to prevent loosening once installed and during operation. Due to this coating, some resistance during installation is normal.

Do not push the generator shaft into the generator housing during hub installation or damage to the generator will result.
This type of damage is not covered by the Superwind warranty!

8. COMMISSIONING

Before initial operation of your new ***Superwind 350/48V*** verify correct installation using the check list below.

8.1 Check List

done ☑	**Check List Chart No. 8.1**	Section:
	Mast:	
	Assembled and erected in accordance to the respective manuals. Bolts, joints, anchors and braces checked. Mast vertically adjusted.	7.3
	Grounding / lightning protection:	
	Mast / support grounded.	6.4
	Ground wire connected to the grounding bus.	6.4
	Electrical system:	
	Batteries correctly installed and (if applicable) electrolyte at correct levels.	6.3.4
	Charge Regulator SCR 48V correctly mounted and connected.	6.3.5
	Power resistor correctly mounted and connected. Installation location provides adequate heat dissipation.	6.3.8
	10 amp fuse holders correctly installed and connected.	6.3.6
	Stop switch correctly installed and connected.	6.3.7
	Ammeter correctly installed and connected (optional).	
	Cabling in accordance with wiring diagram and correctly connected.	6.2
	Polarity of all cables and connections verified as correct.	6.3.3
	Wind Generator:	
	Cables connected with correct polarity.	6.3.3
	Strain relief for cables provided (if necessary).	6.3.2
	Yaw shaft correctly inserted into bushing and secured with screws.	7.2.
	Wind vane correctly fastened with mounting plate screws tightened.	7.4.1
	Rotor blades correctly fastened.	7.5
	Rotor blade screws tightened at 4.5 Nm [3.32 lb/ft].	7.5.1
	Hub mounted on the generator shaft and tightened at 18 Nm [13.27 lb/ft].	7.5.1

Once all installation work has been completed correctly and verified, install all fuses and place the stop switch into the RUN-position. Your new ***Superwind 350/48V*** is now ready for operation.

CONGRATULATIONS!

9. OPERATION

9.1 Safety instructions

Do not operate the ***Superwind 350/48V*** until first verifying that personnel cannot touch or come in contact with the rotor.

Do not operate the ***Superwind 350/48V*** unless it is properly connected to an electrical load. Examples of improper operation include running the generator with no load connected or when connected to a fully charged battery in a system without a charge regulator and power resistor installed.

9.2 RUN and STOP

While the ***Superwind 350/48V*** is designed for autonomous, unattended operation in all weather conditions, there will be situations where you would like to stop it (extreme weather, maintenance, repairs, etc). As such, installation of the provided stop switch is mandatory for all installations.

In the RUN-position the wind generator supplies power to the battery and consumers connected. Placing the switch into the STOP-position simultaneously disconnects the wind generator from the battery and short-circuits the generator leads, shutting down the rotor. In very high wind conditions the rotor may continue to rotate, although at very low revolutions.

Never try to stop a spinning rotor by hand. Even when slowed down by the stop switch, a slowly running rotor can cause serious injuries.

9.3 Power control

As described earlier in Section 4.3b the ***Superwind 350/48V*** is equipped with a unique aerodynamic feathering rotor control system. This over speed control helps ensure constant electrical output at high wind speeds, adding to the unit's autonomous operation and safety.

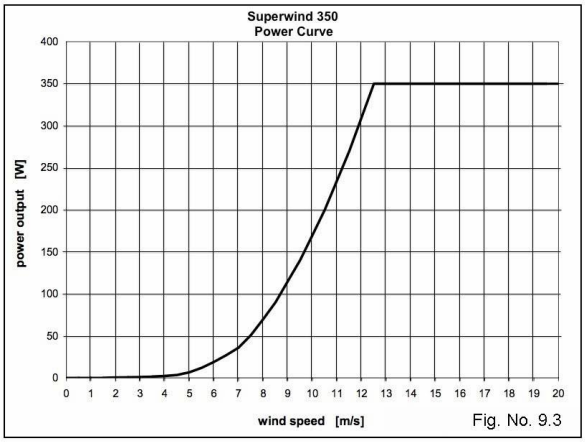


Fig. No. 9.3

9.4 Over-Speed Protection

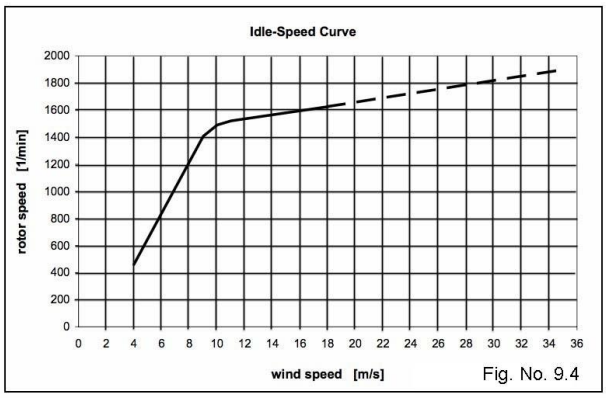


Fig. No. 9.4

The ***Superwind 350/48V*** is equipped with a rotor control system which incorporates an over speed control mechanism. The over speed controller works at all wind speeds, even without an electrical load on the turbine. Although it is not a normal operational mode, an unloaded turbine (meaning the turbine is disconnected from the batteries) could occur under certain conditions (e.g. blown fuses, malfunction of the charge regulator or electrical failures caused by overvoltage or a lightning strike). It is important to avoid an unloaded turbine condition at all times. The rotor control system responds to both aero dynamical and centrifugal forces affecting the rotor blades. Due to the special geometric rotor blade layout and matched rotor controller mechanism, the rotor at no-load operation first accelerates to an increased idle-speed. The idle-speed will be kept on a nearly constant level, speeding up only slightly during increases in wind speed. In this way the rotor control system provides extra protection against high centrifugal forces during no load operation, ensuring a very high level of safety and survivability

9.5 Annual Power Production

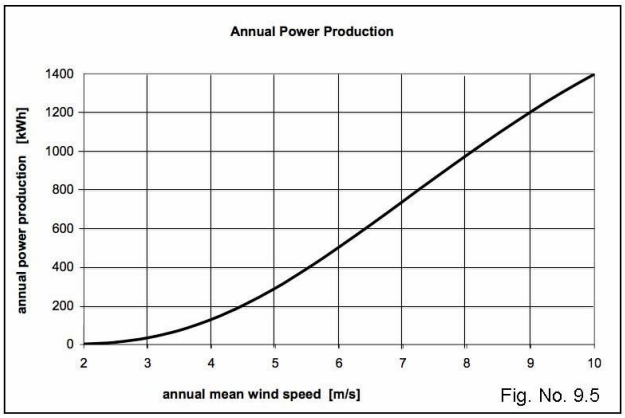


Fig. No. 9.5

In DC-systems the electrical power is the product of voltage and current. Actual output however, is a function of generator speed and the load connected, including the battery state of charge (i.e. the electric resistance of the consumers, including the battery). Therefore, the actual annual power produced will be determined by the wind conditions at your site in combination with what is being powered and/or the battery bank being charged.

Fig. No. 9.5 shows the annual power production versus Rayleigh distributed annual mean wind speeds.

10. INSPECTIONS AND MAINTENANCE

10.1 Periodic inspections

While your ***Superwind 350/48V*** has been designed to run for years without maintenance, periodic inspections are required for reliability and safety. The inspections described below should be performed annually or after any event that could result in damage to the unit (lighting strike, foreign objects striking the rotor, etc).

In some turbine applications (such as operation on a yacht) daily inspections in and around the working area of a turbine is recommended. Look for equipment or rigging that may have been moved by others that could impact the turbine's use and operation. Keep the working area of the turbine free and clear!

Before performing any inspection, disconnect the ***Superwind/48 V*** from the batteries by shutting down the rotor as described in Section 9.2).

Do not approach a turning rotor.
Never attempt to stop the rotor by hand.

- Conduct inspections of the mast or wind generator on a calm and windless day only.
- Do not step or allow other persons to place themselves under hanging loads (such as a tilted mast).

10.1.1 Rotor blades

Check each rotor blade for damage (cracks, broken edges, unusual discoloring etc.). If any blade damage is found, stop operation of your ***Superwind/48 V*** until the rotor blade set has been replaced. As discussed previously, rotor blades must be replaced as a set. Never mix rotor blades from different sets as decreased performance or damage due to an unbalanced rotor will likely result.

Dirt on the blades affects airfoil performance and reduces power output. Remove dirt by cleaning the blades with a sponge using soap and water. Do not use abrasive cleaners or those containing strong chemicals.

10.1.2 Bolted connections

Check all accessible bolted connections, ensuring each is tightened to the correct torque. Pay particular attention to the bolts securing the rotor blades, hub, wind vane and yaw shaft. Refer to Section 7 for additional information.

10.1.3 Bearings

The generator and yaw shaft bearings are sealed and lifetime lubricated. Check the bearings for smooth operation, clearance, or leakage. Defective bearings must be replaced at an authorized service facility.

10.1.4 Slip rings

Electrical power is transmitted from the yawing nacelle to the stationary mast via slip rings. The carbon brushes used to accomplish this are designed to last the life of the generator, however periodic checks for unusual wear or loss of contact material is recommended. Unscrew the two black cylindrical screw caps (see fig. 10.1.4) and remove the carbon brushes to inspect. Worn or damaged carbon brushes must be replaced. Carbon brushes should be replaced in pairs (replacement brushes are sold in pairs and include new screw caps). Inspect the cap O-ring seals for damage prior to reinstallation.

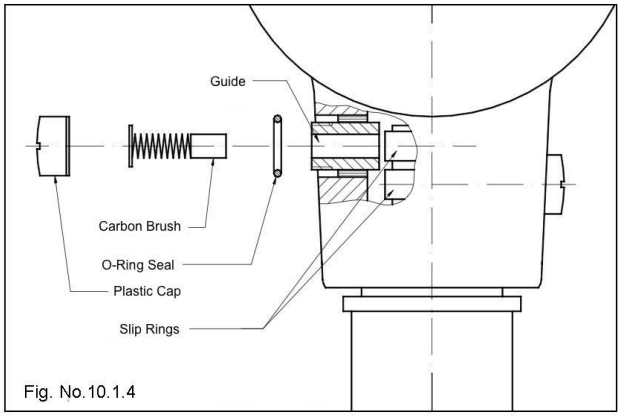


Fig. No.10.1.4

Use caution when unscrewing the two plastic screw caps. The carbon brushes are spring loaded and can rapidly exit the unit, resulting in loss of the brush assembly.

10.1.5 Corrosion protection

The generator housing and wind vane are constructed of a corrosion resistant, marine grade aluminum alloy that is also powder coated for additional corrosion protection. Inspect this powder coating and touch up any damaged areas noted with a suitable lacquer paint.

All steel parts (e.g. ball bearings, shafts, axles and bolts) are stainless steel and need no special corrosion protection.

10.1.6 Mast

Check the mast or support structure for damage, corrosion, loose hardware, etc. Refer to the appropriate mast or support installation guides.

10.1.7 Electrical system

Electrical system inspections must be performed by qualified personnel. Before performing any inspection, verify that all lines are safe and that the wind generator is secured and cannot start unexpectedly.

Check all electrical connections, making sure that they are tight and free from corrosion. Pay particular attention to battery terminals, which are especially prone to corrosion. Clean all terminals of corrosion and coat with a suitable battery terminal grease to prevent future corrosion.

Check the battery electrolyte levels (where applicable) and add distilled water as necessary. Refer to the maintenance instructions provided by the battery manufacturer for specific instructions.

10.2 Maintenance

Your ***Superwind 350/48V*** requires no special maintenance, however the above inspections should be performed annually unless events dictate that additional inspections should be conducted.

11. TROUBLE SHOUTING

Most issues that occur after installation of your new ***Superwind 350/48V*** can be resolved by following the below trouble shooting guide.

Use caution and remain aware of electrical and mechanical hazards at all times:

Never approach a turning rotor.
Never attempt to stop the rotor by hand.

Exercise extreme caution when working on the electrical system as most of the lines are energized.

Never short-circuit the batteries.

The following tools will be useful for troubleshooting:

- A multi-meter (for checking voltage, current and resistance).
- An anemometer (for checking wind speed).

11.1 Wind generator does not start

Possible issue	Test	Solution
Not enough wind	Measure wind speed	Wait for more wind Note: Start-up wind speed is 3.5 m/s [11.5 ft/s - 7.8 m/h] (slightly higher during break-in period)
Stop switch in STOP position	Observe stop switch position	Place stop switch to RUN position
Stop switch wired incorrectly	Check stop switch connections	Wire stop switch correctly

Debris between generator housing and hub	Inspect the generator housing and hub for debris	Remove the hub from the generator shaft and clear the debris
Generator shaft is stiff / difficult to rotate.	Rotate generator shaft by hand. (for this test the generator must not be short-circuited)	Repair by authorized service facility if defective
Yaw bearing is stiff, wind generator does not follow the wind direction	Move by hand	Repair by authorized service facility if defective

11.2 No power output

Possible issue	**Test**	**Solution**
Not enough wind	Measure wind speed	Wait for more wind Note: Minimal wind speed of 4.5 to 5.5 m/s [10 to 12 m/h] is required for charge output (depending on battery state of charge)
Broken wire or loose connection	Check all cables and connections	Replace defective wire or tighten loose connection
Blown fuse	Check fuses	Replace blown fuse
Worn carbon brushes	Check the carbon brushes and the springs	Replace the worn carbon brushes
Defective internal rectifier	No increased torque noted when generator cables have been short-circuited.	Repair by authorized service facility if defective.
Loose stop switch connections	Check tightness all stop switch connections	Tighten loose stop switch connections

11.3 Low power output

Possible issue	**Test**	**Solution**
Bad electrical connection	Measure the electric resistance of the cabling and devices	Replace defective lines or devices, clean connectors and terminals
Cable resistance too high	Check the cable cross section (diameter) to cable length	Install larger gauge cables with higher cross sections

11.4 Battery fails to fully charge

Possible issue	Test	Solution
Electrolyte level is low (wet-cell type battery) Battery is old or defective	Check electrolyte level (if applicable). Test the battery for proper operation.	Add distilled water (if applicable). Replace battery if defective.
Blown fuse	Check fuses	Replace blown fuse
Charge regulator not connected correctly	Verify charge regulator connections are accurate (refer to wiring diagram)	Connect the charge regulator correctly
Charge regulator defective	See manual for trouble shooting steps	Repair by authorized service facility if defective

11.5 Checking open circuit voltage

A simple test to check for internal generator defects is measuring the open circuit voltage. Disconnect the cables from the generator and connect a voltmeter to the positive and negative line. To avoid injuries dismantle the rotor blades beforehand. Next, turn the hub by hand and count the revolutions within a certain period (e.g. 30 revs within 10 seconds = 180 rpm). Watch the voltage. The voltage and the speed should correspond to Fig. 11.5.

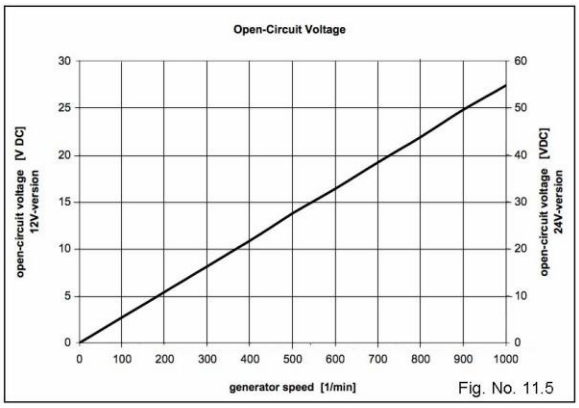


Fig. No. 11.5

12. REPAIRS AND RECOMMENDED SPARE PARTS

12.1 Repairs

If your ***Superwind 350/48V*** fails, you may replace all parts that are accessible from the outside (e.g. rotor blades, carbon brushes, damping rings). Should any other defect occur, please consult your dealer, an authorized service facility or the manufacturer.

Do not open the hub housing.

The hub is a safety relevant component requiring specialized knowledge and tools to repair. To ensure safe operation, all repairs to the hub must be performed by authorized service partners or the manufacturer.

12.2 Spare Parts List

Spare Parts Table No. 12.2		
Item No	**Description**	**Part No.**
1	Set of rotor blades (including M6 x 25 socket cap screws)	0300.05.00.00
2	Set of carbon brushes (including screw caps)	0300.01.03.03
3	Rectifier (including capacitors)	0300.01.04.01
4	Generator bearing (front)	0300.03.02.03
5	Generator bearing (rear)	0300.03.02.04
6	Set of damping rings (includes O-ring) 40 x 3	0300.02.01.02
7	Socket cap screw M8 x 80 V4A DIN 912	0300.04.01.10
8	Hexagon socket button head screw M6 x 6 V4A ISO 7380	0300.02.01.12
9	Hexagon socket button head screw M6 x 12 V4A ISO 7380	0300.02.01.10
10	Charge Controller SCR 48 V	SW35-SCR48v
11	Temperature Sensor	SW35-RTS25
12	Stop Switch	0300.12.00.00

13. FREQUENTLY ASKED QUESTIONS

13.1 Basic use

Q. Can I mount a wind turbine on top my house?

A. The Superwind 350/48V is not for residential, grid-tied applications. This unit was designed to charge batteries in off-grid environments only.

In situations where sufficient wind exists - such as farms, cabins, structures on cliff edges, bluffs, or near the ocean – the **Superwind 350/48V** can be an asset.

Unless architecturally engineered to be part of the structure, no wind turbine should be mounted to the roof of a house.

Q. What is the Superwind 350/48V used for?

A. The **Superwind 350/48V** was designed to be a commercial-grade micro wind generator that has the ability to withstand extreme environmental conditions for many years. Its applications are numerous, and it has been successfully utilized by governments, militaries, disaster preparedness & response agencies, aquaculture and agriculture industries throughout the world.

13.2 Installation

Q. How large should my battery bank be?

A. Battery capacity specifications are unique to each individual situation and therefore cannot be easily determined by Superwind without more details. However, a typically installation consists of a minimum of 400Ah (3 to 4 large batteries).

Q. Do I need a charge controller, stop-switch, and resistor?

A. Installation of a charge controller, stop-switch, and power resistor is mandatory to protect your batteries, as well as the turbine. A charge controller and diversion load power resistor will safely dissipate excess power to avoid overcharging when the batteries are completely full. A stop switch is mandatory and will allow you to safely perform maintenance near or around your unit.

The use of a Superwind 48V SRC marine charge controller enables your system to be completely autonomous and helps ensure a full state of charge and long battery life.

Q. What size wire do I run to the Superwind and the charge controller?

A. This Superwind manual specifies wire sizing for various distances (the wire run). The proper wire size is important to optimize charging and eliminate the risk of fire. Refer to the wiring specifications provided in this manual. Please do not hesitate to contact us for recommendations regarding your specific project.

Q. Can I hook up to my hot water tank and avoid overcharging?

A. No. The internal electrical components in hot water tanks will not withstand overcharging and will fail. This will, in turn, shed power to your batteries, which can be very dangerous. Always install the provided Superwind power resistor for use as the system diversion load.

13.3 Operation

Q. Can the Superwind be left ON while unattended?

A. The Superwind 350/48V kit allows for safe autonomous operation 24/7 when installed properly with the SRC marine charge controller and diversion load resistor (included in the kit).

The Superwind 350 is a commercial turbine designed for off-grid use in remote areas. When installed properly, it is maintenance-free and can be left unattended. While you can always use the safety-stop switch to temporarily shut down the unit, it is not required.

Q. Do I need to tie down the Superwind in high winds or storms?

A. No. Tying down a Superwind 350/48V blade or vane can actually damage the unit. Instead, utilize the safety-stop switch to enable the dynamic (magnetic) brake. The **Superwind 350/48V** is designed to operate in wind conditions nearing hurricane force speeds. In most circumstances, the unit can be left on without endangering the turbine or the batteries.

Q. How long do the bearings last?

A. The **Superwind 350/48V** 'auto-feathers' during high wind conditions, which prevents over speed of the turbine and lessens the wear on the bearings. This technology allows Superwind units to have a long life – many have been in the field for over a decade and are still going strong.

Q. If one blade breaks do I replace just one?

A. Superwind rotor blades are manufactured as sets of three balanced by weight and axial run-out. These 3 blades can be fixed to the hub in any order. However, do not mix and match blades from different Superwind blades sets as this could cause the rotor to be out of balance. This means that if a single Superwind blade is damaged, the entire blade set needs to be replaced - not just one blade.

13.4 Troubleshooting

Q. The Superwind 350/48V is not producing power.

A. A common installation oversight preventing power production is related to the safety-stop switch. Ensure all screws on the safety-stop switch are tightened down securely – even the screws that are not in use. Loose screws can prevent a closed circuit, and deny power throughout the system. Refer to the manual for specific stop-switch procedures, if necessary. Again, two of the screws with no wire attached are actually forming a jumper within the switch; ensure they are tight.

Q. How can I test to ensure the Superwind unit is producing power?

A. A clamp-on DC amp meter is an inexpensive tool that can be used to test the power output from the unit. Make sure the amp meter that you purchase is capable of reading DC amps.

If the batteries are fully charged and the unit is still working in efficient wind, the charge controller will display an indicator light. When lit, a solid LED light represents a full state of charge and indicates power is being diverted to the resistor.

NOTE:

The use of calibrated shunts – when in combination with other charging sources - is **NOT** recommended for monitoring power output from the wind turbine. Calibrated shunts will negatively affect the charge controller, causing significantly reduced charging and incorrect readings. An amp coil sensor (often an option with many battery monitoring systems) is recommended instead.

Q. The Superwind 350/48V is not producing the expected power

A. The **Superwind 350/48V** turbine has extremely high quality bearing sets to allow for a long, nearly maintenance free service life. These special bearings do require some weeks or months of a “break in period” to achieve the highest charging levels at lower wind speed conditions. Leaving the Superwind turbine in the autonomous “Run” position through all types of weather, including high winds and storms, will help shorten this break in period.

14. ABBREVIATIONS USED ON THIS MANUAL

A. ..... Answer
Ah ..... Ampere-Hours
AGM ..... Absorbed Glass Mat
AWG..... American Wire Gauge
DC ..... Direct Current
e.g. ..... For example
EU ..... European Union
ft/s..... Feet per second
ID..... Inside Diameter
ITAR ..... International Traffic in Arms Regulation
Kg ..... Kilograms
Kn..... Knots
Lb/ft ..... Pound per feet
lbf..... Pound-Force
LED ..... Light-Emitting Diode
M ..... Meter or Meters
m/s..... Meters per Second
mi/h..... Miles per Hour
mm ..... Millimetre or Millimeter
mm^2 ..... Square millimetres
OC ..... On Centre
Ohm..... Unit of Electrical Resistance
OD ..... Outside Diameter
Q. ..... Question
PV..... Photovoltaic
PWM..... Pulse Width Modulation
revs..... Revolutions
rpm ..... Revolutions per minute
Sch ..... Schedule
SCR..... Superwind Charge Regulator
SOC..... State of charge
V ..... Volt (s)
VDC..... Volt Direct Current
W ..... Watt (s)
ZVEI ..... German Federation of the Electric and Electronic Industry

15. SCOPE OF CHANGES

This section will reflect future changes to the present manual and the date when the new version comes into effect.

Current Manual Version: Version 1-2019.

superwind GmbH
Am Rankewerk 2-4
D-50321 Brühl
Germany
Tel: +49 / 2232 / 577357
Fax: +49 / 2232 / 577368
Email: power@superwind.com
www.superwind.com

Mission Critical Energy Inc
1801 North French Rd
Getzville, NY 14068 USA
Tel: +1-716-276 8465
Email: power@missioncriticalenergy.com
www.missioncriticalenergy.com