



Operation Manual

Superwind 1250

March 2015

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Notices:

This information is believed to be correct and reliable. However, superwind GmbH assumes no responsibility for inaccuracies or omissions. The user of this information and product assumes full responsibility and risk.

All specifications are subject to change without notice.

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Thank you for purchasing a **Superwind 1250**.

The **Superwind 1250** is an advanced wind generator of the highest quality that will reliably generate power for many years. Reliable operation, however, depends not only on product quality, but also on accurate assembling and installation – including proper wiring. Please read this manual completely before starting your installation, paying particular attention to all safety instructions and warning notices. Your safety is our highest priority.

1. General information and references

1.1 Labelling

This manual is for the **Superwind 1250** wind generator.

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The data tag listing the serial number and nominal voltage of your **Superwind** is located on the yaw shaft.



1.2 Range of application

The electric power generated by the **Superwind 1250** can be used to charge batteries and/or directly power 24 VDC or 48 VDC appliances (depending on the system voltage). AC appliances are supplied via an optional inverter. There is a wide range of high quality 24 VDC or 48 VDC equipment available. Examples include energy saving lamps, refrigerators, deep-freezers, water pumps, ventilators, consumer electronics, TV, radio and navigation equipment, etc.

Ideal fields of application range from commercial and government applications (navigational aids, traffic management systems, monitoring stations and transmitters) to private sector use, such as mountaintop cabins, summer cottages or other remote locations.. Other rural uses for the **Superwind 1250** include supplying basic power demands for families, schools, small health care centres, and the like.

The **Superwind 1250** is also fully compatible with installations utilizing solar arrays. At many locations, wind and solar energy complement each other. A wind / solar dual charging system featuring the **Superwind 1250** allows you to optimise available power sources, while requiring minimal battery capacity.

2. Safety instructions

For your safety, please read this manual thoroughly prior to the assembly and installation of your **Superwind 1250**. The information provided is to ensure your safety during mounting and operation, as well as for maintenance and troubleshooting. If you have any additional questions please contact your dealer, a superwind service partner or the manufacturer.

2.1 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 1250** wind turbine.

2.1.1 Mechanical hazards

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

WARNING: Never touch the rotor blades while moving!
 Never try to stop a turning 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 1250** to cope with heavy storms) however it can break if objects are introduced into the rotor at higher rotational speeds.

WARNING: Never let anything strike the rotor while in operation!

2.1.2 Electrical hazards

Even at low wind speeds the generator can produce dangerous open circuit voltages at no-load operation (i.e. with the electric connection to the battery disconnected). The 24 VDC version can produce up to 54 VAC between 2 phases of the wind generator wires and 72 VDC at the battery terminals of the DC-box. The 48 VDC version can produce up to 108 VAC between 2 phases of the wind generator wires and 144 VDC at the battery terminals of the DC-box.

Charging currents can reach up to 43 Amps DC (24 V version) and up to 22 Amps DC (48 V version). As such, all cabling, electrical components and connectors must be rated to 80 Amps (24 V version) and 40 Ampere (48 V version) respectively. Refer to Section 5.3 for additional information.

WARNING: Use of undersized cabling can result in overheating and failure, possibly creating fire and shock hazard!

Fuses are installed in the DC-box to protect the cabling (see Section 5.3.2. for details). Never short-circuit the battery, which can result in fire or explosion of the battery, along with release of acid and toxic gases.

WARNING: Never short-circuit the battery!

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 and that all equipment used in the space is ignition protected.

WARNING: Never install batteries in locations where the danger of sparks exists.
Provide sufficient ventilation at all times.

The dump load (power resistor) of the optional charge regulator can become very hot. For fire protection it must not be mounted on a flammable surface or close to flammable materials.

WARNING: Never mount the power resistor on a flammable surface.
Mount the dump load at least 40mm away from any flammable materials.

2.1.3 Hazards when mounting the wind turbine

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

Use only mast and support designs capable of safely handling the loads of your wind generator. The mast must not only be able to withstand your wind generator's weight, but also the considerable thrust caused by high wind speed. For additional details see Sections 3.2 and 6.1.

General safety precautions

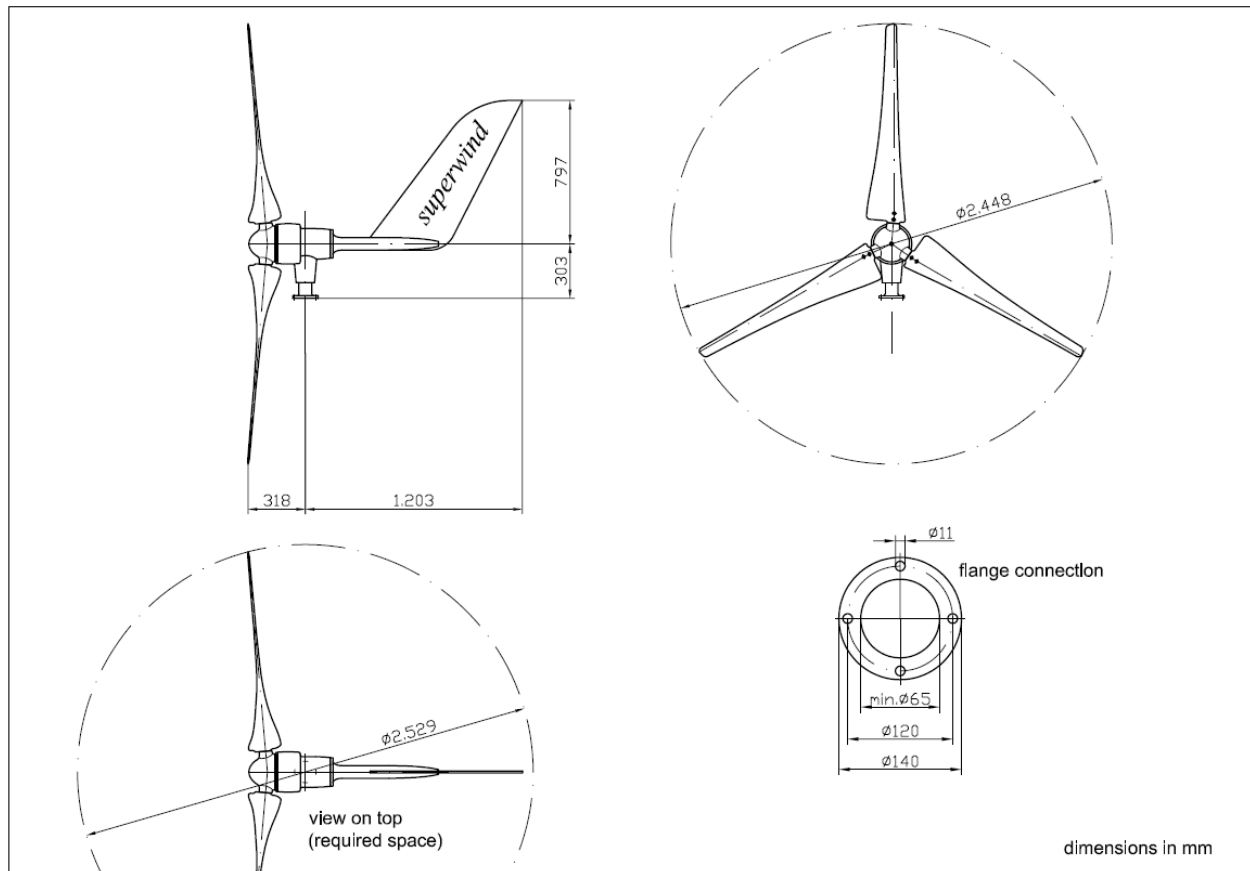
1. Work on the mast or wind generator only on a calm, windless day.
2. Do not allow personnel to step under hanging loads or potential drop hazards (such as a tilted mast).
3. Ensure all batteries are disconnected from the system prior to any work.

To prevent unintended starts, connect the generator to the DC-box and switch the brake switch 1 into the STOP-position before mounting the rotor blades.

WARNING: Never approach a turning rotor!

3. Technical specifications

3.1 Main dimensions



3.2 Technical data

Nominal power	1250 W
Nominal wind speed	11.5 meters per second (22.35 Knots)
Cut in wind speed	3.5 meters per second (6.8 knots)
Cut off wind speed	None
Rotor diameter	2.40 m
Number of blades	3
Blade material	Glass and carbon fiber reinforced plastics
Rotor speed	300 – 600 rpm
Generator	Permanent magnet, 3-phase Neodymium magnets
Nominal voltage	24 VDC or 48 VDC
Speed regulation	Rotor blade pitch
Power regulation	Rotor blade pitch
Brake 1	Generator short-circuit
Brake 2	Disc brake
Weight	45 kg
Rotor thrust (operation)	190 N
Rotor thrust (extreme wind speed)	1700 N

3.3 Functional description / special features

The **Superwind**, like all other wind turbines, uses a part of the kinetic energy of the wind and converts it into electricity. The power generated is approximately proportional to the cube of the wind speed, i.e. doubling the wind speed results in eight times 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 overstressing and damage. The **Superwind** has been designed to achieve optimum power output for a wide range of wind speeds, while providing maximum safety during storm conditions.

a) The rotor blades were developed using modern computerized calculation and simulation methods. The airfoil has been wind tunnel tested and was specifically developed for small size rotors.

Relatively broad rotor blades combined with special pitch angle produces a high start-up torque, enabling the rotor to start at only 3.5 m/s wind speed.

Note: 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** for battery charging, please do not mistake the initial rotor start-up voltage as that of the start of the output charging voltage as 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 any **Superwind** wind turbine 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 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 and controller mechanism.

Aerodynamic forces act as control variables to automatically adjust the rotor blades for power regulation above the nominal wind speed of the unit. Simultaneously, centrifugal forces (the second control variable for the rotor blade adjustment) are introduced and as both the wind force and rotor speed decrease or increase, the controller automatically limits rotor speed, 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, enabling smooth operation under all weather conditions.

4. Preparations for assembly

4.1 Packing list

Please check your delivery for completeness and transport damage.

Packing list:



1	pcs	Generator unit	item	1
1	pcs	Hub	item	2
1	pcs	Wind vane supporter	item	3
1	pcs	Wind vane	item	4
3	pcs	Rotor blade	item	5
1	pcs	DC-box	item	6
1	pcs	Plug 5-pole "Buccaneer"	item	7
1	pcs	Socket cap screw M12 x 120	item	8
4	pcs	Hexagon head screw M8 x 50	item	9
4	pcs	Washer 8,5	item	10
3	pcs	Socket cap screw M8 x 40	item	11
1	pcs	Socket cap screw M8 x 20	item	12
6	pcs	Socket cap screw M10 x 45 (TUFLOK)	item	13
1	pcs	Operation manual	item	14

4.2 Tools

The following tools are needed for the installation of the **Superwind 1250**:

- Allen key 6 mm
- Allen key 8 mm
- Allen key 10 mm
- Torque wrench with suitable sockets
- Set of screw drivers
- Set of wrenches (mm)
- Wire stripper
- Crimping tool
- Heat shrink or electrical tape
- Multimeter

4.3 Available accessories

Charge regulator Morning Star TS-60 incl. power resistor

5. Electrical components and connections

5.1 General information

Always use caution and abide by industry accepted practices and safety procedures when working on your **Superwind** or the electrical system.

Electrical system installation, maintenance, and repair should only be carried out by competent personnel who have studied and are familiar with the information and instructions provided in this manual. If questions arise, contact **Superwind** for clarification.

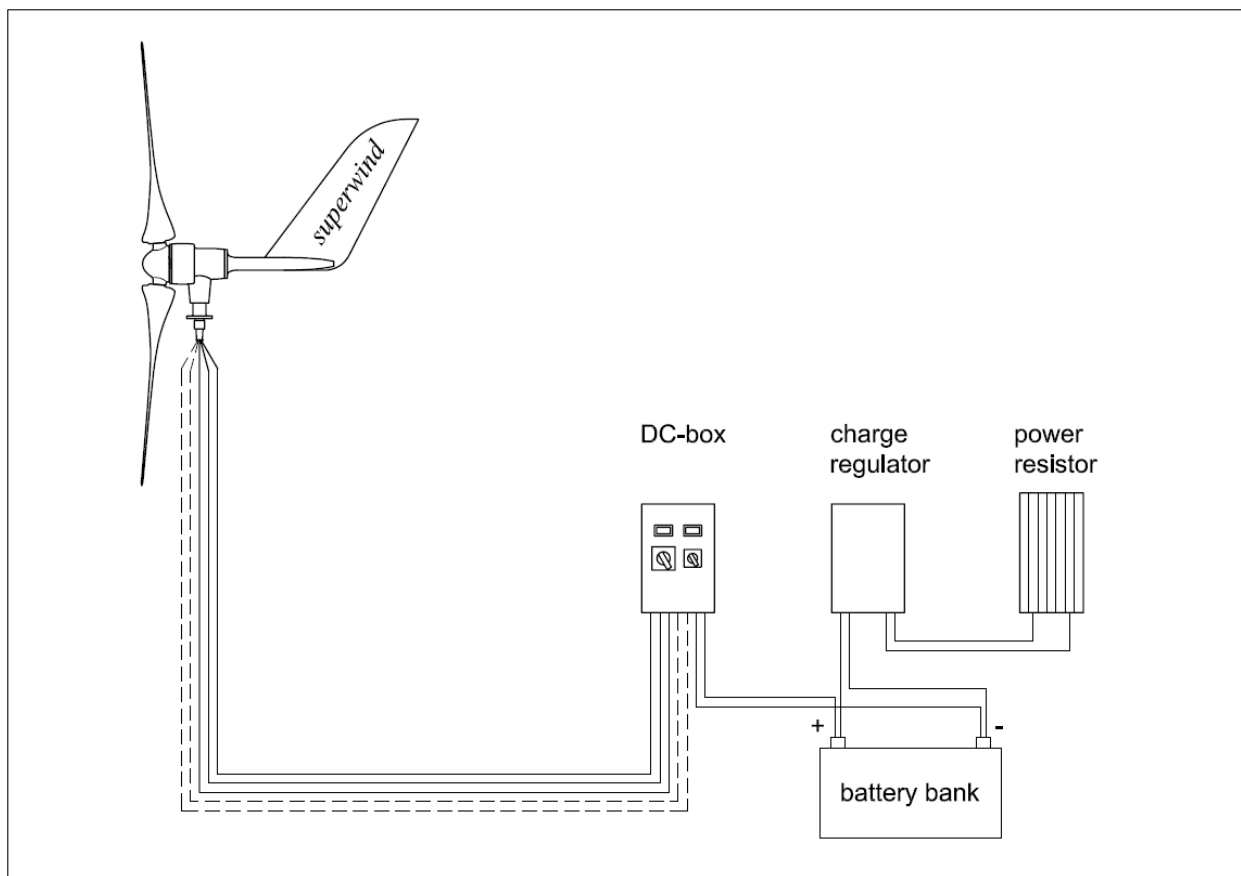
NOTE: All electrical components should be installed at their respective locations before making any electrical connections.

NOTE: Ensure batteries are disconnected until the installation is complete.

WARNING: Only connect to the battery bank after the turbine installation is completed!

5.2 Wiring diagrams

5.2.1 Wiring diagram with a charge regulator in diversion mode (for example Morning Star TS-60)



5.3 System components

5.3.1 Wires

A five wire cable is required to connect the wind generator to the DC-box:

- a) 3 output power lines
- b) 2 lines for electrical control of the disc brake

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

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

- a) 3 power lines:

24 Volt system:

distance from mast top to DC-box	up to 5,8 m	5,9 – 9,6 m	9,7 – 15,4 m	15,5 – 24,1 m	24,2 – 33,7 m	33,8 – 48,1 m
minimum cross section recommended per wire	6 mm ² (AWG 10)	10 mm ² (AWG 8)	16 mm ² (AWG 6)	25 mm ² (AWG 4)	35 mm ² (AWG 2)	50 mm ² (AWG 1)

48 Volt system:

distance from mast top to DC-box	up to 9,8 m	9,9 – 15,5 m	15,6 – 23,2 m	23,3 – 38,6 m	38,7 – 61,7 m	61,8 – 96,4 m
minimum cross section recommended per wire	2,5 mm ² (AWG 14)	4 mm ² (AWG 12)	6 mm ² (AWG 10)	10 mm ² (AWG 8)	16 mm ² (AWG 6)	25 mm ² (AWG 4)

b) 2 lines for electrical control of the disc brake:

For **both systems** (24 Volt and 48 Volt):

distance from mast top to DC-box	up to 11,1 m	11,2 – 16,4 m	16,5 – 27,0 m	27,1 – 43,0 m	43,1 – 64,2 m	64,3 – 106,7 m
minimum cross section recommended per wire	1,0 mm ² (AWG 18)	1,5 mm ² (AWG 16)	2,5 mm ² (AWG 14)	4 mm ² (AWG 12)	6 mm ² (AWG 10)	10 mm ² (AWG 8)

WARNING: Cables with insufficient cross sections can heat up and cause electrical fires!

Cables with tinned braids are recommended for offshore locations or marine applications 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 of ultraviolet resistant materials. Chafe protection should also be provided for the entire cable run. All penetrations into the mast, electronics enclosure, 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.

Due to the weight of the cable, strain relief for the cable must be provided at the top of the mast top so that connections inside the turbine and "Buccaneer" plug system will not be damaged.

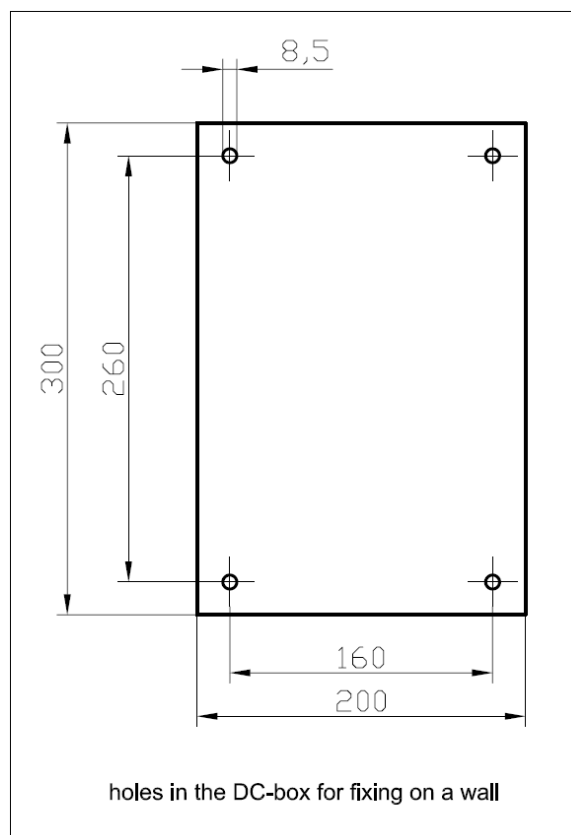
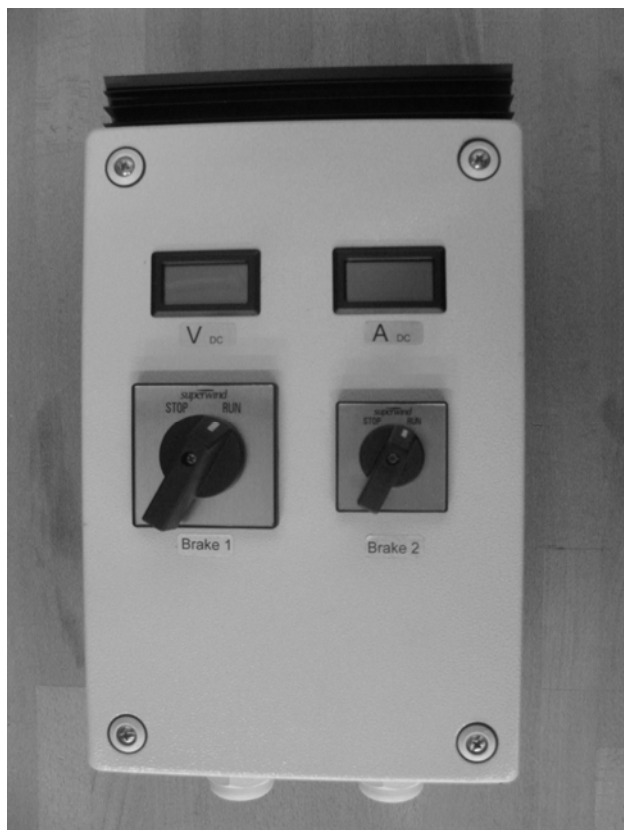
Always pay attention to the correct polarity of the lines. Reversing plug connections or the positive and negative connections at the battery will destroy the electric rectifiers inside the DC-box. During installation or when changing out batteries clearly mark all line ends as POSITIVE (+) and NEGATIVE (-) to prevent connection errors.

WARNING: The rectifiers inside the DC-box will be destroyed by the application of reverse polarity anywhere within the system and if so acted upon are no longer covered under warranty!

5.3.2 DC-box

The main function of the DC-box is to rectify the 3-phase AC current coming from the wind turbine into DC current for battery charging.

The DC-box must be installed vertically and in a location where the heat sink (located on the top) is well ventilated.



The front of the box contains a Voltmeter (to read battery voltage) and an Ampere meter to read DC charging current.

The DC-box has two brake switches. These are used to shut down the wind generator should it be necessary due to conditions, while conducting maintenance or working near the turbine, etc.

Brake switch 1 is for the generator short-circuit breaking system:

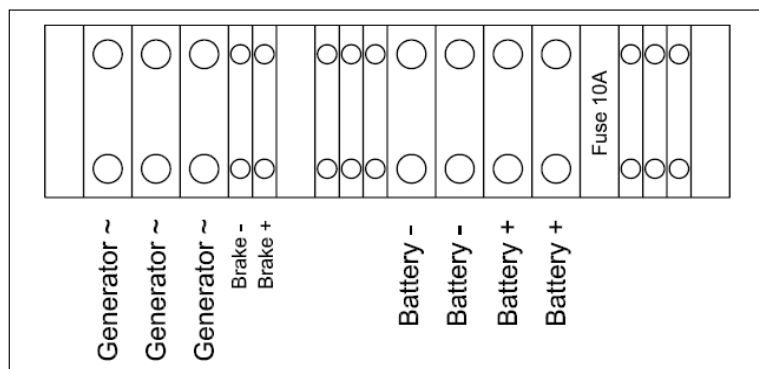
- a) RUN The 3 lines from the generator are connected to the rectifier set.
- b) STOP The 3 lines to the wind generator are short-circuited

Brake switch 2 is for the electrically actuated mechanical disc brake:

- a) RUN The disc brake is open.
- b) STOP The disc brake is closed.

NOTE: The disc brake (switch 2) can only be activated after the generator has been shorted. As such, the disc brake can only be switched after brake switch 1 has been switched into the STOP-position.

Internal view of a control cabinet showing a terminal block, a fuse block, and a fuse unit. Labels point to 'Fuse 80A (40A)' and 'Fuse 10A'.



5.3.3 Batteries

The most common application of the **Superwind** is charging batteries. For proper battery protection, a suitable charge regulator is mandatory. The charge regulator allows the **Superwind** to operate automatically and completely unsupervised. With a proper charge controller, batteries are charged optimally and protected against overcharging and damage, which also increases battery service life. The Morning Star TS-60 (our recommended charge regulator) is suitable for use with all battery types.

When selecting batteries, always ensure their voltage matches the rated voltage of the system (24 V or 48 V). The rated voltage of your **Superwind** is specified on the unit's data label (on the yaw shaft).

Flooded Lead-acid batteries are the most commonly used battery type known world-wide, however we recommend the use of 'deep cycle' rated batteries designed for stationary use. We also recommend Deep Cycle AGM batteries; sealed Absorbent Glass Matt batteries sometimes referred to as 'solar system batteries' as they have a long life span and are usually maintenance-free and better survive an occasional deep discharge. Car batteries (also rated as 'starting batteries') are not suitable because they wear out very fast by cyclic operations associated with renewable energy based charging. Again, The Morning Star TS-60, our recommended charge regulator, is suitable for use with all deep cycle battery types.

Another important criterion for battery selection is capacity, which is expressed in ampere-hours (Ah). This value represents the quantity of energy a battery can store. The required capacity depends on your individual situation (wind location, consumption structure, combination with other generators like PV etc.). Consult your battery supplier for assistance with questions regarding load support, battery selection and installation.

Follow all manufacturer's recommendations when selecting a location for your battery installation. Charging flooded lead acid batteries releases 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 (such as from an electrical switch) or other ignition source (open hot exhaust).

WARNING: Never install batteries in a location where the danger of spark formation exists. Ensure all 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 short-circuited. This sudden discharge can destroy the battery (resulting in the release of battery acid and gas) and even set the battery and the cabling on fire. To protect against accidental short-circuiting do not make battery terminal connections until all work on the electric system has been completed.

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

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

A fuse is installed inside the DC-box for protection against high current and/or a short-circuit in the system. As a blowing fuse can cause an electrical spark, the DC-box cannot be installed in the same area as the battery bank.

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

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

5.3.4 Charge regulator

Every installation should include a charge regulator to protect the batteries against overcharging. We recommend the Morning Star TS-60 charge regulator.

NOTE: When purchased at superwind GmbH, the charge regulator Morning Star TS-60 already comes with the correct setup for a system with the **Superwind 1250** being the only power source to charge the batteries.
In case that additional power sources and charge regulators (for example Solar-PV, Diesel genset, etc.) are connected to the batteries, the parameters of these devices have to be considered for the correct setup of the Morning Star TS-60.

Please read the charge regulator installation and operation manual thoroughly and follow all installation requirements when installing the charge regulator.

If using a charge regulator other than the Morning Star TS-60, ensure that it is a shunt-regulator design. The series controllers often used in photovoltaic systems are unsuitable as they interrupt the electric circuit for voltage regulation, placing the wind generator in a dangerous no-load operation condition. The charge regulator must also be rated for current of at least 60 A (24 V version) or 30 A (48 V version).

For other suitable charge regulators, setups and system integration information please refer to our 'alternate integrations and special applications installations instructions' – available by contacting superwind directly.

5.4 Grounding

Every wind turbine installation should be properly grounded to protect the system against damage by lightning or over voltage. The design of the grounding system will depend on a number of factors, including local conditions, the type of installation, soil, groundwater table, and the condition of any pre-existing grounding systems. Always consult a local electrician if any grounding questions exist.

6. Wind generator assembly

6.1 Precautions

Before starting the installation of your wind generator, keep in mind the potential dangers and proceed with caution. Use a mast and support structure capable of safely withstanding all the force loads placed on it by your wind generator. The mast must not only be able to withstand the weight of the wind generator, but also the thrust caused by high wind speeds as well. For instance; the maximum wind thrust during normal operating parameters will be approx. 190 N of force. In an extreme gust (wind speed of 70 m/s) the thrust can rise up to 1700 N!

Only 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.

Make sure all batteries are disconnected from the system prior to conducting any work.

Prevent the wind generator from starting unintentionally during your installation. Connect the generator to the DC-box and place the brake switch 1 into the STOP-position before mounting the rotor blades.

WARNING: Never approach a turning rotor – stay away from moving blades!
Never try to stop a turning rotor by hand.
Never install the wind generator in a location where persons can accidentally come into contact with rotating blades.

6.2 Mast mounting

Before your **Superwind** is finally installed on the mast or support, the electric cables must be led through the mast tube and connected to the DC-box (see Section 5.3).

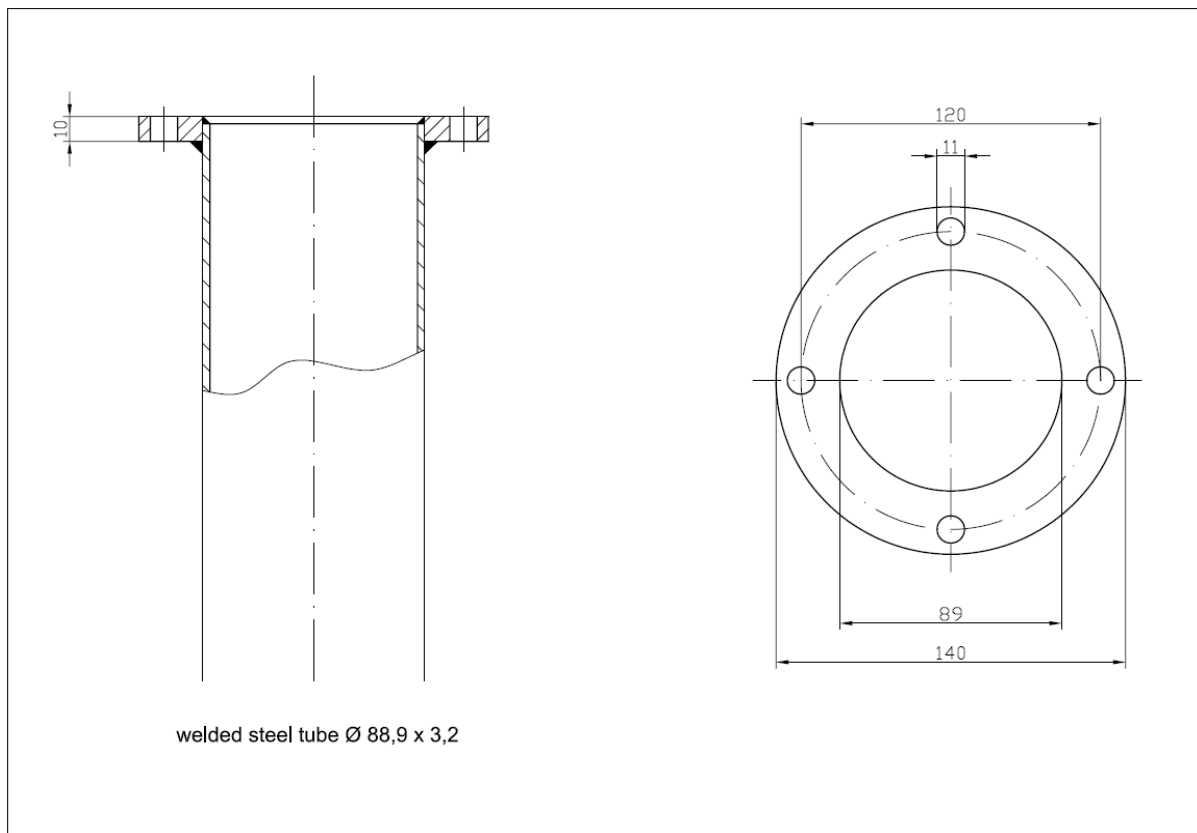
NOTE: The following applies to all types of mast or support installations:

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 1300 mm below the mast top. This is important because as the rotor controller pitches the blades at high wind velocities, their distance from the mast will be reduced.



6.2.1 Mast recommendations

Refer to the drawing below for the recommended dimensions of the steel mast tube. The yaw shaft of your **Superwind 1250** has a flange which must be attached with four M10 screws and nuts (not included).



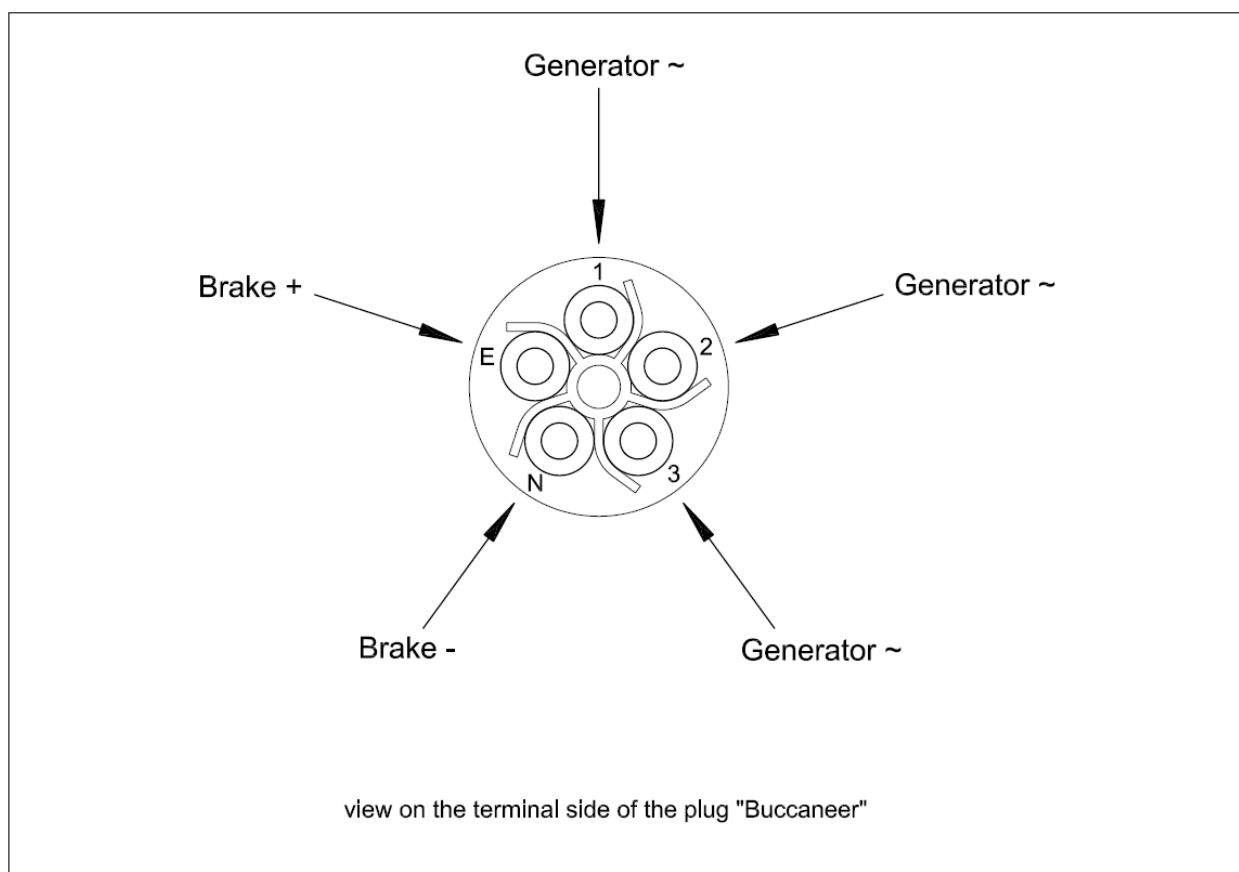
6.2.2 Mounting the generator to the mast

The following instructions refer to a tilt-able (tip-tower) mast system.

1. Lower the mast.
2. Insert the turbine output and electric brake power cables into the mast tube.
3. Install the "Buccaneer" plug onto the cable (refer to the below drawing for wiring terminations).

The terminals of the plug are suitable for wires of cross section up to 6mm² (AWG 10) with ferrules.

If your cable has larger AC wires in order to minimize the voltage drop (due to table 5.3) it will be necessary to crimp short pieces of 6mm² (AWG 10) wires to connect with the plug.



Position the generator unit close to the mast flange.

Screw the plug onto the socket of the generator unit.



Move the generator unit carefully towards the mast flange.

Attach the yaw shaft flange to the mast flange with 4 screws M10 with washers and nuts. (The length of the screws required will depend on the thickness of your mast flange.)
Tighten the screws to 50 Nm. (SAE: 36.9 foot-pounds).



6.3 Assembling the wind vane

6.3.1 Mounting the wind vane to the wind vane supporter

Insert the wind vane into the slot of the wind vane supporter and align the 4 holes.

Insert the three M8 x 40 socket cap screws and the one M8 x 20 socket cap screw into the holes.

Note: the single M8 x 20 socket cap screw fits in the hole at the end of the supporter.

Torque the three long screws to 25 Nm (SAE 18.4 foot-pounds) and the short one to 10 Nm (SAE 7.4 foot-pounds).



WARNING: Remember that many of the wind turbine components are made of high quality aluminium as well as stainless steel. Damage may result if torque specifications are ignored!

6.3.2 Mounting the wind vane supporter to the generator unit

Lubricate the O-ring seal of the wind vane supporter with supplied grease.

Raise the tilted mast into a working position (approximately 1.2 m) place a temporary support structure beneath it and secure against movement.



Rotate the housing so that the rear of the housing (the wind vane attachment point) is facing upwards as shown in the above picture. Orientate the wind vane (so that it will point upwards when the generator is raised into position), align the screw holes, and then carefully slide the wind vane onto the housing support flange.

WARNING: Take care not to damage the brake system motor or its connectors when sliding the wind vane into position.



Place one each 8.5mm washer on the four M8 x 50 hexagon screws and inset into the four flange holes. Ensure each of the four screws are installed and hand tight prior to final torqueing. To ensure proper seating of the O-ring seal, tighten the screw alternately a half turn each until snug, then torque to 25 Nm (SAE 18.4 foot-pounds).

WARNING: Remember that many of the wind turbine components are made of high quality aluminium as well as stainless steel. Damage may result if torque specifications are not followed!

Allow the generator to slowly turn 180°, ensuring that the wind vane does not touch the ground.

6.4 Rotor assembly

6.4.1 Mounting the hub to the generator shaft

NOTE: To prevent unintentional rotation of the rotor during the remainder of the installation, short circuit the three generator cables or turn the brake switch 1 into the STOP-position.

Verify that the parallel key on the generator shaft is in the correct position (as shown below).

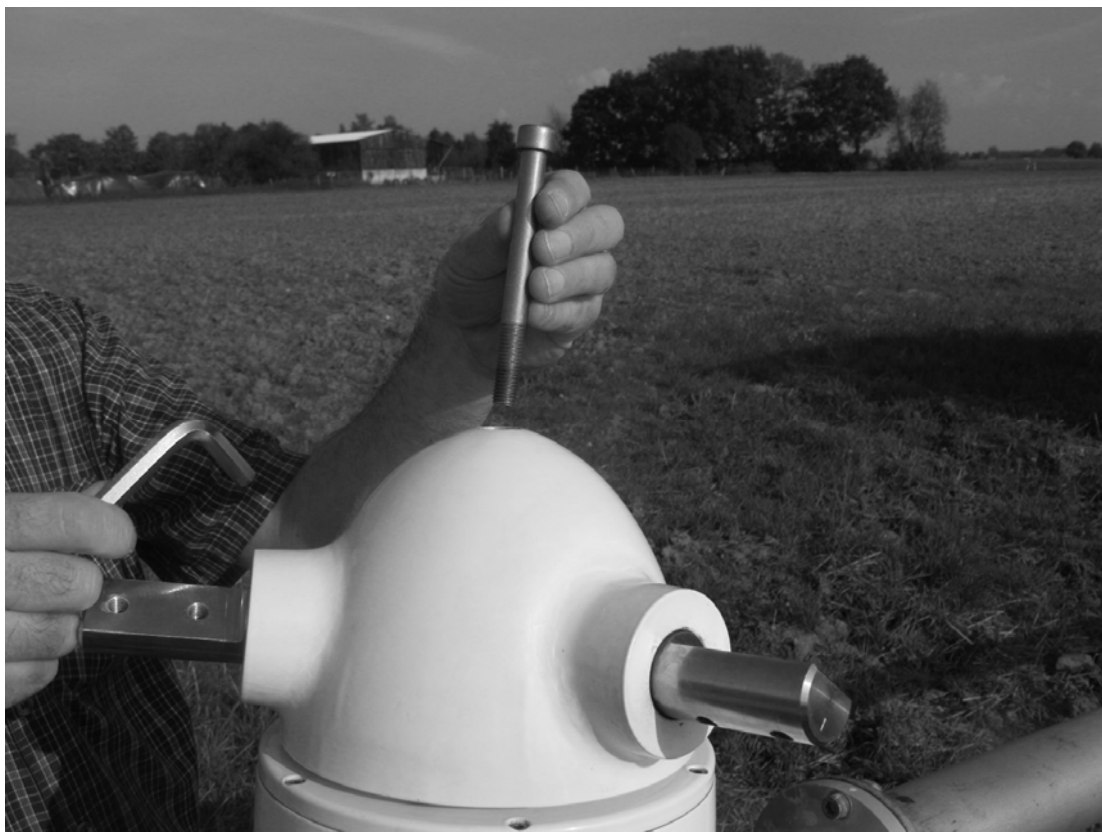


Align the hub and carefully slide onto the generator shaft.



NOTE: When sliding the hub onto the generator shaft ensure the parallel key slides into the corresponding keyway (groove) of the hub.

Insert the M12 x 120 socket cap screw through the central hole of the hub and screw into the threaded generator shaft.



Tighten and torque the screw to 50 Nm (SAE 36.9 foot-pounds).



6.4.2 Attaching the rotor blades to the hub

The three rotor blades are matched as a set (per their mass) and balanced at the factory. As such, the rotor blades can be fixed to the hub in no particular order, however rotor blades from different sets cannot be mixed. Individual replacement blades can be ordered, but these must be properly matched to your existing set. Contact your **Superwind** dealer for additional information.

Each rotor blade is attached using two M10 x 45 socket cap screws. Each screw is TUFLOK-coated to prevent loosening during operation. This coating will cause a slight drag while inserting and torquing the screws.

Install two M10 x 45 screws into the holes of the first blade to be mounted.

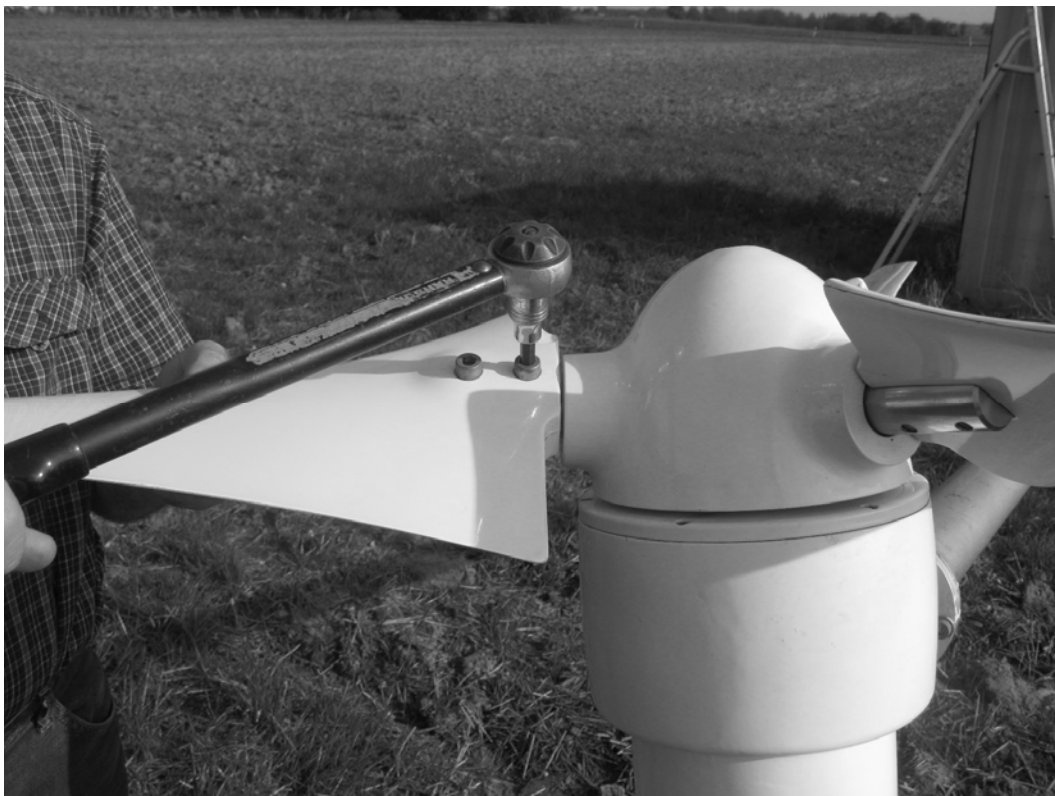
Hold the blade in a position and align the rectangular recess parallel to the flat side of the axle (as shown below).



Feed both screws a few millimetres into the threads of the axle, then slide the rotor blade towards the axle.

Tighten the screws alternately (a half turn each) until the rotor blade is snug against the axle.

Torque the screws to 24 Nm. (SAE 17.7 foot-pounds)



NOTE: Ensure each axle is correctly inserted into the recess of its respective blade.
 Do not use excessive force when installing the blades.
 Do not over torque the screws.

Mount the remaining two rotor blades the same manner.

Your Superwind 1250 is now assembled and ready to be raised into position by lifting the mast.



7. Commissioning

Before initial operation of your new **Superwind** unit, verify the following installation checklist has been completed.

7.1 Check List

done <input checked="" type="checkbox"/>		also see Section:
	<u>Mast:</u>	
	Assembled and erected in accordance with all applicable manuals. Bolts, joints, anchors and braces checked. Mast vertically adjusted.	
	<u>Grounding / lightning protection:</u>	
	Mast / support grounded	5.4
	Earth wire ground connected to the grounding bus	5.4
	<u>Electrical system:</u>	
	DC-box installed and wires connected correctly	5.3.2
	Batteries correctly installed and electrolyte level verified (if applicable)	5.3.3
	Charge regulator correctly installed and connected	5.3.4
	Power (dump load) resistor bank correctly installed and connected Installation point provides adequate heat dissipation	5.3.4
	Cabling in accordance with wiring diagram and correctly connected	5.2.1
	All cables and connections correctly sized and installed	5.3.1
	<u>Wind Generator:</u>	
	Cables connected to Buccaneer plug with correct polarity observed	6.2.2
	Buccaneer plug screwed onto the socket	6.2.2
	Strain relief provided for cables	5.3.1
	Yaw shaft flange fixed to the mast flange correctly	6.2.2
	Wind vane correctly installed with screws torqued to 25 Nm / 10 Nm	6.3.1
	Wind vane supporter correctly installed with screws torqued to 25 Nm	6.3.2
	Hub mounted on the generator shaft and torqued to 50 Nm	6.4.1
	Rotor blades correctly fastened	6.4.2
	Rotor blade screws torqued to 24 Nm	6.4.2

After all installation work has been completed and verified, make the final connections to the battery, being sure to observe the correct polarity. Place both brake switches into the RUN-position. Your new **Superwind** is now ready for operation.

8. Operation

8.1 Safety instructions

Do not operate your **Superwind** until verifying that no persons can touch or come into contact with the spinning rotor blades.

Do not operate your **Superwind** without an electrical load.

8.2 RUN and STOP

While your **Superwind** is designed for unattended, automatic operation in all weather conditions, it can be stopped if desired (routine inspections, etc.) by using the dual brake switches on the DC-box.

In the RUN-position the wind generator supplies power to the battery and any connected equipment. Placing the brake switch 1 to the STOP-position simultaneously short-circuits the wind generator and completely disconnects the wind generator power output from the battery. The generator short circuit shuts down the rotor. At high wind speeds the rotor will not stop completely, but will continue turning at very low revolutions.

To shut down the rotor completely, place the brake switch 2 to the STOP-position. This will engage the disc brake and the rotor will stop.

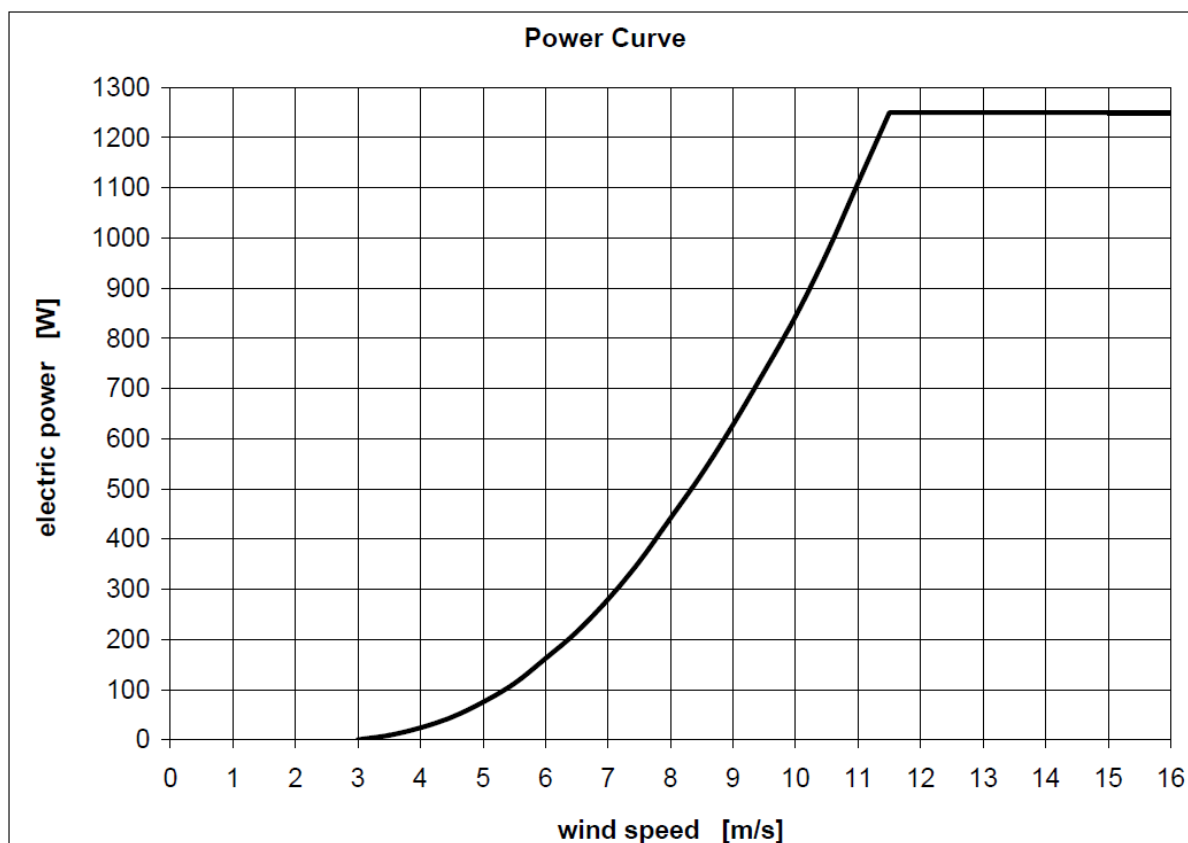
WARNING: Never try to stop a turning rotor by hand. Even at slow revolutions, a turning rotor can cause serious injuries!

8.3 Power control

As described in Section 3.3 the **Superwind 1250** is equipped with a unique automatic aerodynamic rotor control system. This special safety feature ensures power absorbed from the flowing air is directly regulated at the point of impact, namely the rotor blades. Thus, the entire mechanical structure and generator is protected against overload. To ensure proper operation of the power control feature, the generator must also be adequately loaded (i.e. connected to batteries to be charged, or to a charge regulator demand, etc.).

Function:

The rotor blades are pivoted and can adjust their pitch angle to leeward. Below nominal operating wind speeds, the controller keeps the pitch angle in the normal position. Above nominal operating wind speed the rotor control system adjusts the blade pitch exactly to the specific angle required to keep power output constant.



8.4 Overspeed Protection

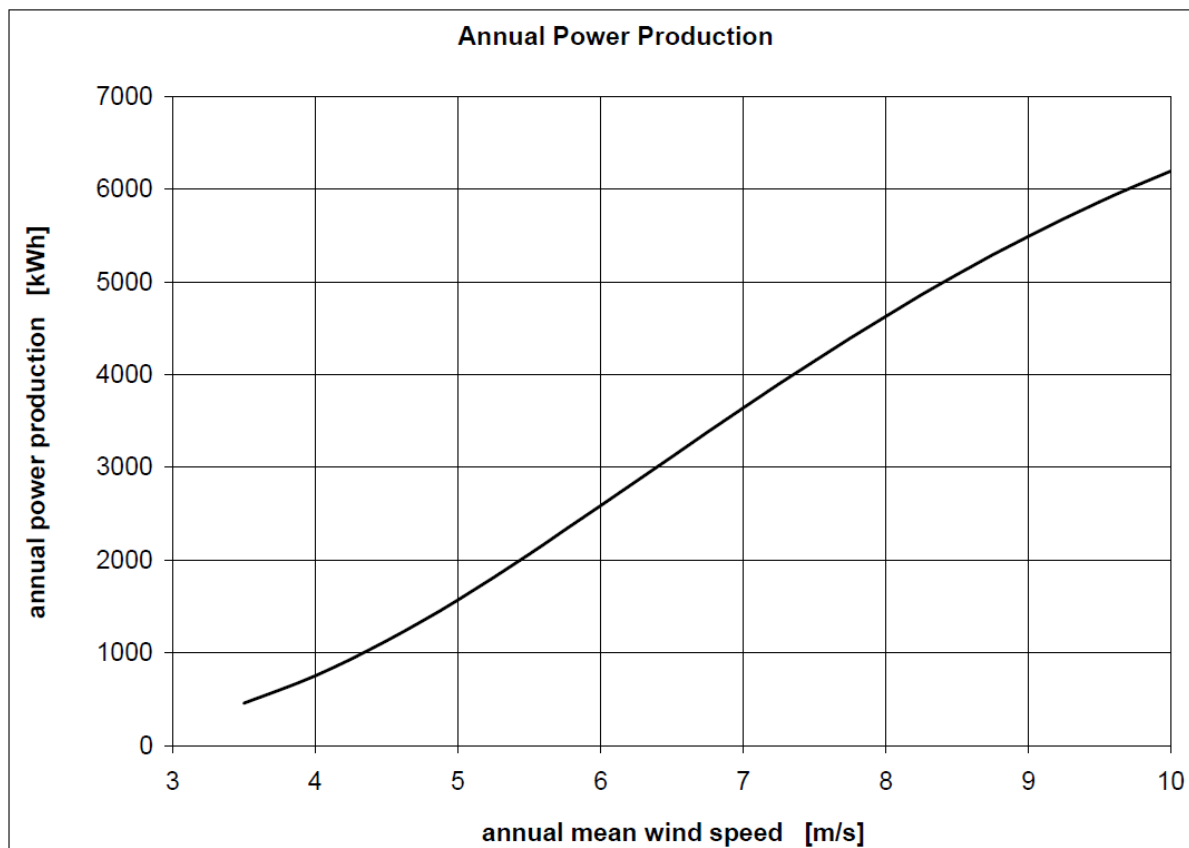
The **Superwind** is additionally equipped with an automatic rotor control system, which includes an over-speed controller. The over-speed controller works at all wind speeds even without electrical loads. Although it is not a normal operation mode, load throw-off could occur under certain conditions, such as a blown fuse, malfunction of the charge regulator or electrical failures caused by overvoltage or a lightning strike.

Function:

The rotor control system responds to both aerodynamically induced and centrifugal forces affecting the rotor blades. Due to the special geometric rotor blade layout and matched rotor controller mechanism, during no-load operation the rotor first accelerates to an increased idle-speed. The idle-speed will remain at a nearly constant level, speeding up only slightly if wind speed increases. In a no-load situation the rotor control system provides an extra layer of safety against high centrifugal forces.

8.5 Annual power production

In DC systems the electrical power is the product of voltage and current. Power output will depend on generator speed and the load connected (i.e. the electric resistance of the “consumers” demand). Power generation is determined by the wind conditions at your site. The annual power production is the amount of power your wind generator can produce at a specific annual mean wind speed. The diagram below shows the annual power production versus Rayleigh distributed annual mean wind speeds.



9. Maintenance

9.1 Periodic inspections

Your **Superwind** has been designed to run for years without maintenance, but simple periodic inspections are required for reliability and safety.

Before performing any inspection shut down the rotor as described in Section 8.2.

WARNING: Do not approach a turning rotor or moving Blades!
Never try to stop the rotor by hand!

Only work on the mast or on your wind generator on a calm and windless day.

Do not step or allow others to stand beneath any hanging loads e.g. a tilted mast.

The inspections described below should be performed every 12 months.

9.1.1 Rotor blades

Check the rotor blades for damage (e.g. cracks, broken edges, unusual discolouring etc.). If you see any damage, your **Superwind** must be put out of operation. Small gel coat defects can be repaired by using an off-the-shelf gel coat repair set. If structural damage exists, the blade will have to be replaced. When ordering a spare blade you will need to provide the blade number to your dealer. Each rotor blade is registered at the manufacturer. Providing the blade number of the damaged unit ensures the replacement blade will have the same technical properties and will correctly match the remaining blades.

Dirt on the blades spoils the airfoil performance and reduces power output. If necessary, clean the blades with a sponge using only soap and water. Do not use abrasive or chemical cleaners.

9.1.2 Bolted connections

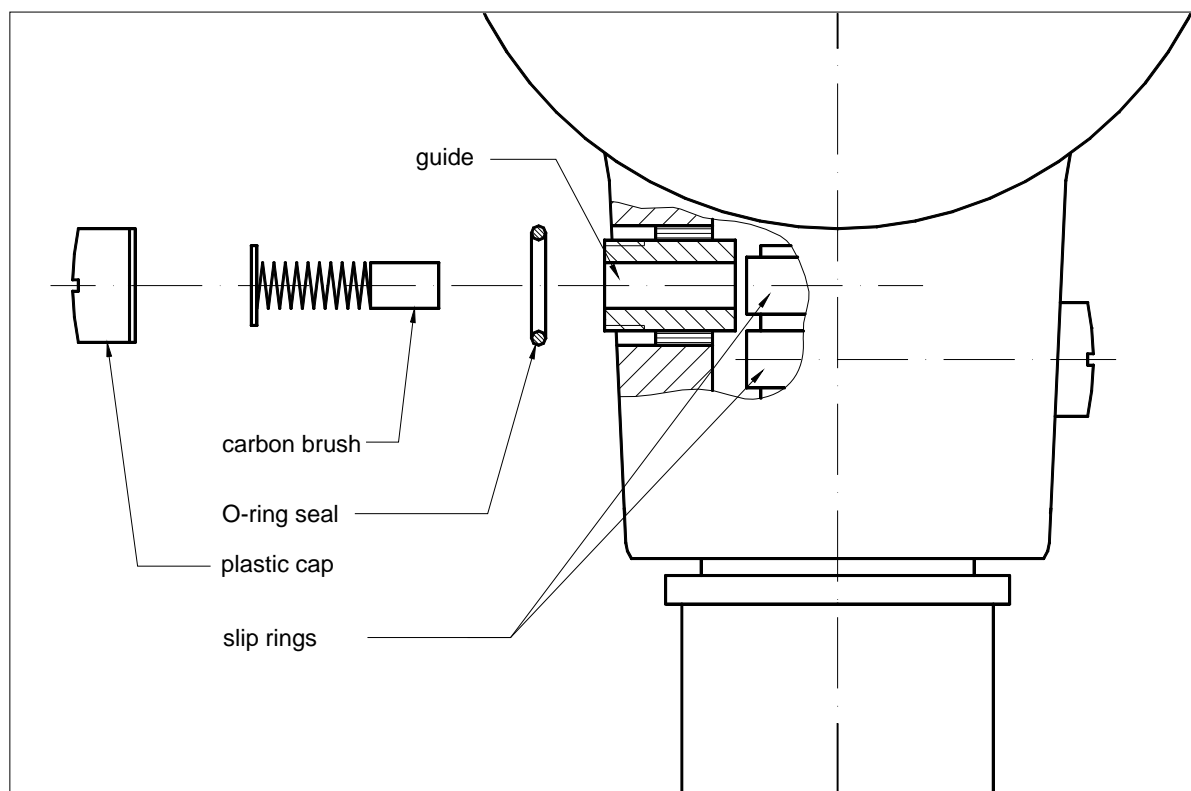
Check all accessible bolted connections, ensuring they are tightened at the correct torque. This is particularly important with regards to the bolts for the rotor blades, hub and wind vane. Also check the bolts securing the yaw shaft. Refer to Section 6.

9.1.3 Bearings

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

9.1.4 Slip rings

Electrical power is transmitted from the yawing nacelle to the stationary mast via slip rings. The carbon brushes are designed for lifetime use. Even though a periodical check for unusual wear or loss of contact material is recommended. Unscrew the five black cylindrical screw caps (see drawing below) and pull out the carbon brushes. Worn or damaged carbon brushes must be replaced. Each time the caps are removed, check the condition of the O-ring seals as well.



9.1.5 Corrosion protection

All housings are constructed of marine grade aluminum alloy that is additionally protected against corrosion by a powder coating. To ensure the integrity of this powder coating, check it regularly and touch up any damaged spots with suitable lacquer paint.

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

9.1.6 Mast

Check your mast or support. Refer to the respective instructions.

9.1.7 Electrical system

Inspections of the electrical system should only be performed by qualified persons. Before conducting any electrical inspection make sure that all live wire connections are off, breaking systems engaged, be safe and aware that the wind generator cannot start unintentionally.

Check all electrical connections making sure that they are tight and free from corrosion, paying particular attention to the battery terminals. Clean all corroded connections and coat with battery terminal grease (where appropriate). It should be noted that one of the most common causes of renewable energy charging system failures is battery terminals and other connections loosening over time! Please follow the manufacturer's recommendations for connection torque.

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

Inspections of the overall electrical system should be conducted annually (or if unusually low charging levels are noticed). In addition, depending on the type of battery being used in your system, you may want more frequent checks of the batteries themselves (refer to the manufacturer's recommendations to avoid damage).

Check battery electrolyte levels (where applicable) and add distilled water when necessary. Refer to the battery manufacturer's instructions for specific maintenance requirements

9.2 Long Term Maintenance and Records

There is no special long term maintenance required if the periodic inspections are made. We do however recommend a long-term 'turbine log book' to record the unit's serial number, date of purchase, date of installation and commissioning as well as operational and maintenance notes. This is a professional piece of equipment - worthy of tracking its use, output and other important data.

10. Trouble shooting

If problems occur after installation of your new **Superwind** you probably can solve most of them following the trouble shooting list below.

Be aware of electrical and mechanical hazards at all time:

WARNING: Do not approach a turning rotor.
Never try to stop a turning rotor by hand.

WARNING: Be careful when conducting work on the electrical system, since most of the lines are live.

WARNING: Never short-circuit the batteries.

Useful tools for trouble shooting include a multimeter (voltage, current, electrical resistance) and an anemometer (wind speed instrument).

10.1 Wind generator does not start

Possible source of errors	Test	Solution
Not enough wind	Measure wind speed	Wait for more wind. Annotation: start-up wind speed 3,5 m/s (during running-in period slightly higher)
Brake switches in STOP position		Place switch in RUN position
Debris between generator housing and hub	Inspect the unit for debris	Remove the hub from the generator shaft and eliminate debris
Generator shaft is stiff	Turn generator shaft by hand (for this test the generator must not be short-circuited or braked)	Repair by authorized service facility
Yaw bearing is stiff, wind generator does not follow the wind direction	Move by hand	Repair by authorized service facility

10.2 No power output

Possible source of errors	Test	Solution
Not enough wind	Measure wind speed	Wait for more wind Annotation: Charging possibly will start only with 4,5 to 5,5 m/s. (depending on the battery's state of charge)
Current linkage is interrupted	Check the cabling	Replace defective line or devices
Fuse in DC-box is blown	Check the fuse	Replace the fuse
Carbon brushes fail to make contact	Check the carbon brushes and the springs	Replace the carbon brushes
Rectifier in DC-box is defective	Test by electrician	Have electrician replace rectifier

10.3 Low power output

Possible source of errors	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 sections (diameter) and cable lengths	Use cables with higher cross sections

10.4 Battery fails to (fully) charge

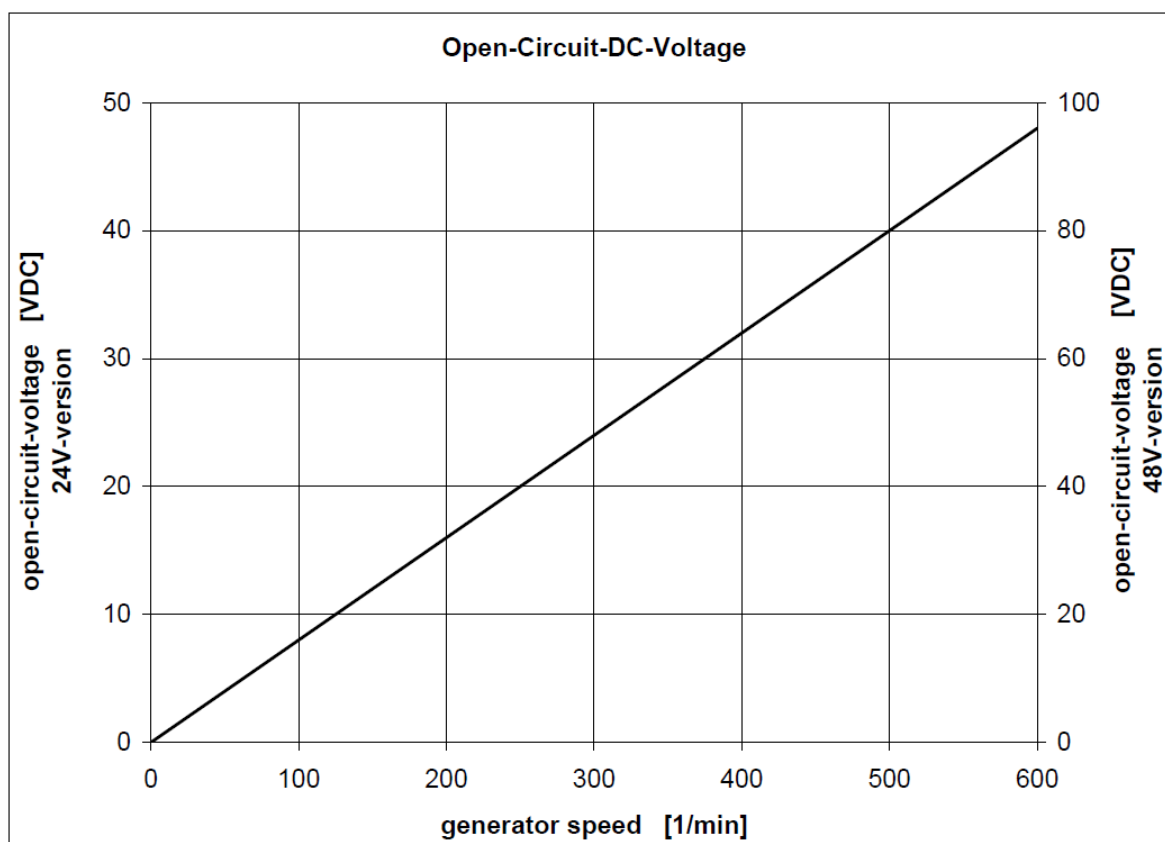
Possible source of errors	Test	Solution
Battery is too old or defective	Check battery according to battery manual	Replace defective battery
Fuse in DC-box is blown	Check the fuse	Replace blown fuse
Charge regulator is not connected correctly	Check connection referring to the wiring diagram	Connect the charge regulator correctly
Charge regulator setup incorrect	For trouble shooting see respective manual	Set up correctly

10.5 Checking the open circuit voltage

A simple test to detect an internal defect of the generator or the rectifiers in the DC-box is measuring the open circuit voltage.

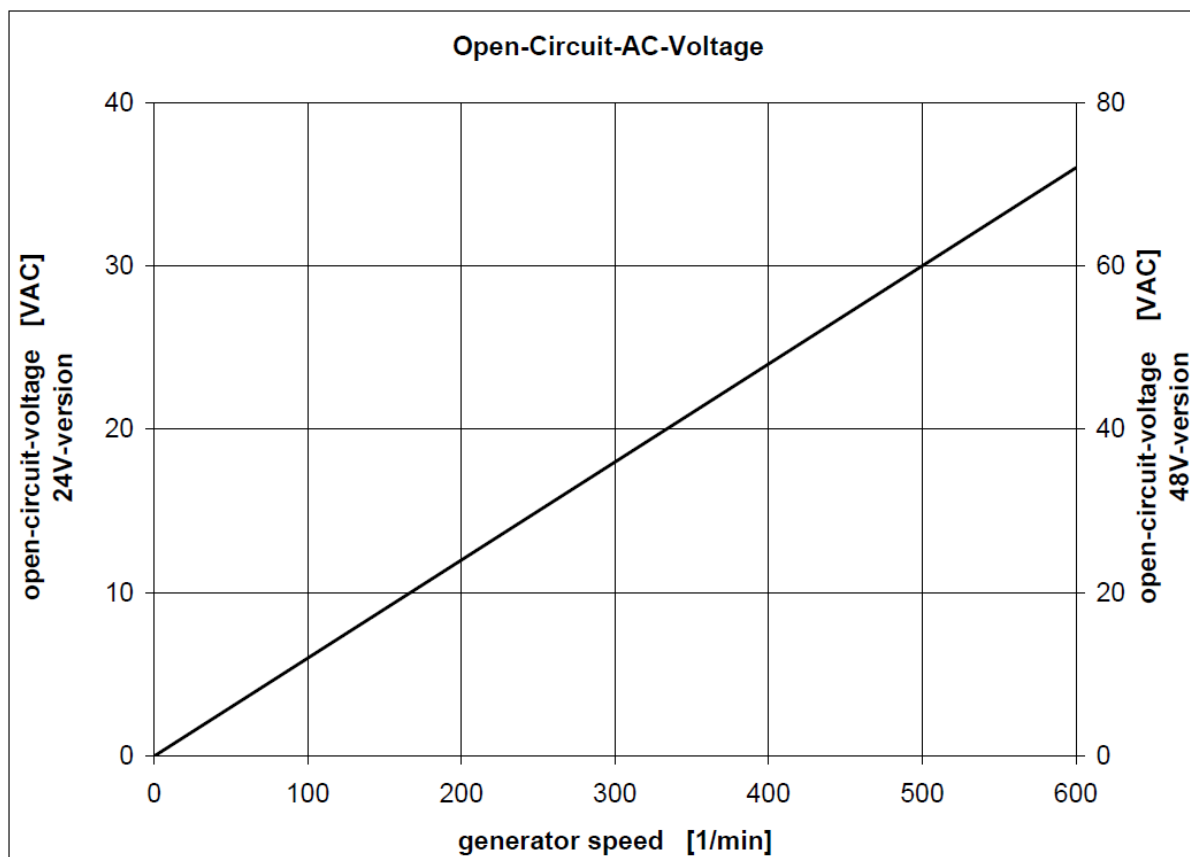
WARNING: Due to the danger of high voltage, the following tests must only be carried out by a skilled electrician.

1. Stop the wind turbine by means of the two brake switches.
2. To avoid injuries during the following test dismantle the rotor blades.
3. Place both brake switches into RUN position.
4. Disconnect the PLUS and MINUS cables between the DC-box and the battery from battery terminals.
5. Disconnect the PLUS and MINUS cables from the DC-box.
6. Connect a voltmeter in DC-mode to the terminals "Battery +" and "Battery –" in the DC-box.
7. Turn the hub by hand and count the revolutions within a defined period (e.g. 30 revs within 10 seconds = 180 rpm).
8. Observe the voltage. The voltage and the speed should correspond to the following diagram:



If the DC voltage / speed ratio does not comply with the diagram, an AC open voltage test can be performed.

1. Disconnect the 3 AC power lines from the DC-box.
2. Connect a voltmeter in AC-mode between phase 1 and phase 2 of the three AC-power lines coming from the generator.
3. Turn the hub by hand and count the revolutions within a certain period (e.g. 30 revs within 10 seconds = 180 rpm).
4. Watch the voltage. The voltage and the speed should correspond to the following diagram:



Repeat the procedure measuring between phase 1 and 3 and phase 2 and 3.

11. Repairs and recommended spare parts

11.1 Repairs

If your **Superwind** should fail or be damaged all parts accessible from the outside are designed to be user replicable (e.g. rotor blades, carbon brushes, etc). In case of any other defects please consult your dealer, an authorized service partner or the manufacturer.

WARNING: Do not open the hub housing. The hub is a safety relevant component that requires special know-how and tools to repair. To ensure safe operation, hub repairs may only be performed by authorized service partners or by the manufacturer.

11.2 Spare parts list

Set of rotor blades (to include M10 x 45 socket cap screw with TUFLOK	part-no. 1050.06.00.00
Single rotor blade (matched to set using serial number)	part-no. 1050.06.00.01
Set of big carbon brushes (including screw caps)	part-no. 1050.01.03.01
Set of small carbon brushes (including screw caps)	part-no. 1050.01.03.02
Generator bearing front	part-no. 1050.04.03.02
Generator bearing rear	part-no. 1050.04.03.03
Socket cap screw M12 x 120 V4A DIN 912	part-no. 1050.05.01.06
Set of bridge rectifiers	part-no. 1050.07.01.09

12. Warranty

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

Free repair service may be obtained only against presentation of the warranty card together with the original invoice issued to the customer by the retailer. The warranty card must state the purchaser's name, the retailer's name and address, the serial number and the date of purchase 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.

Warranty period

The warranty is valid for three years from the date of purchase by the purchaser, as evidenced by the above mentioned documents.

To obtain warranty service

Warranty service is available at superwind GmbH and superwind authorized service partners. Any costs of secure transportation of the product to and from superwind GmbH / superwind authorized service partners will be borne by the customer.

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 approval.
- Defects caused by improper use, handling or operation, in particular defects caused by improper installation and installation on inadequate masts or support structures.
To obtain warranty service the purchaser has to provide evidence that the product has been installed on adequate masts or support structures.
- Accidents or 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.

Others

superwind GmbH reserves the right to decide whether the product or parts of it shall be repaired or replaced instead. In case neither repair nor replacement could be performed by superwind GmbH the purchaser solely will be entitled to cancel the purchase.

This warranty does not affect the purchaser's statutory rights under applicable national legislation in force, nor the purchaser'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.

Besides apply the

GENERAL CONDITIONS FOR THE SUPPLY OF PRODUCTS AND SERVICES OF THE ELECTRICAL AND ELECTRONICS INDUSTRY

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