Freen-9

Installation manual

This document is intended for authorized installers of Freen-9 small wind turbines. It contains information on installation and commissioning, operation and maintenance.

TO BE INSTALLED BY TRAINED PERSONNEL ONLY

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Content

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1. Preface

This installation manual is composed by FREEN OÜ, a manufacturer of small wind turbines and contains information about installation, commissioning, operation and maintenance of Freen-9 small wind turbine.

Any text that is **typed in bold font** contains important information that is vital for personal safety of people and animals and optimal installation of the wind turbine. Also, the following signs are used to signify:

possible electrical hazard

possible general hazard.

Failure to heed these warnings and guidelines means direct danger to people, animals and property! The manufacturer assumes no responsibility for the consequences of these dangers, and any failure to follow this document voids the warranty immediately.

If any part of this text conflicts with local safety regulations, the manufacturer should be contacted immediately via the website

freen.com

or

service@freen.com
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2. Safety regulations

FREEN small wind turbine installations should be performed only by specially trained personnel, approved by the manufacturer. Vehicle drivers and crane operators should have official permissions according to local regulations. Connecting electrical cables, grounding wires and operating electrical switches and circuit breakers is allowed only to qualified electricians.


FREEN small wind turbines should only be used for their intended purpose. No modifications or tampering with any of their parts is permitted without manufacturer's approval. The manufacturer's responsibility ends at the grid connection terminals in the electric cabinet.

Foundation should be grounded according to the local regulations, and this connection must be inspected and measured before connecting turbines to the grid. If any fault in grounding is found either visually or with measurements, the turbine should not be commissioned until faults are eliminated.

Wind turbine equipment has double power supply. Both power supplies should be turned off until all electrical work is finished, and the turbine is fully installed. Grid power supply must be turned off from the grid side and generator brakes must be applied.

All equipment for installation should be checked on-site but before installation work.

There is a high-risk zone in the radius of up to 45 m around the wind turbine, depending on tower and blade configuration. There should be no vehicles, people or animals within that radius during the erection of the turbine tower with hydraulic pump and cylinders except hydraulic pump operator. Safety helmets and other PPE must be always worn in this high-risk zone.


Any visual or audio indications of malfunction (excessive vibration, smoke, loud banging noises, etc.) of installation equipment should lead to immediate stop in all work activities and it should be reported to the

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manufacturer. Presence in the high-risk zone should be avoided until situation is resolved.

Installation is permitted only if there is no fog, heavy rain or thunder; wind speed at tower height does not exceed 10 m/s and air temperature is between -15 °C and +35 °C.

Always wear appropriate safety equipment when handling turbine components. Recommended maximum surface pressure limit to the blade is 1 N/mm^2, exceeding this limit may damage the blade surface.

Do not in any circumstances lift or store the turbine on the trailing edge.
Do always use lifting slings or similar equipment that are approved for lifting purpose.
Do never position yourself under the blade module during any kind of handling of the module.

Lubricants, solvents, and detergents are toxic / harmful to health: - they may cause irritation in direct contact with the skin - they may cause intoxication if inhaled - they may be fatal if swallowed. Handle them with care using suitable individual safety equipment. Do not dump them into the environment and dispose of following applicable legislation.

This work is dangerous and requires special skills and knowledge; please keep unauthorised persons away from the working zone.

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3. Freen-9 scope of delivery

Wind turbine scope of delivery		
Item	Quantity	Description
Tower set	1 set	A set of tower components with fasteners
Generator and cable set	1 pc	Power generator, cables for connecting the generator and control cabinet, corresponding fasteners.
Turbine module set	1 pc	A set of wind turbine components - central rotor hub, upper blade support arms, lower blade support arms, vertical rotor blades, blade mounting hardware
Control panel set	1 pc	Control cabinet with turbine control module, inverter and module of brake resistors. Set of keys for panel door.
Documentation	1 set	Owner´s manual.

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4. Installation equipment checklist

Item	Quantity	Check?
Torque multiplier or torque wrench to tighten M30 nuts at 1597Nm	1 pc	
Socket reversible ratchet wrench ¼” with sockets set up to 13	1 set	
Socket reversible ratchet wrench ¾” with sockets set up to 50	1 set	
Socket reversible ratchet wrench ½” with sockets set up to 36	1 set	
Socket adapter ¾”-½”	1 pc	
Socket adapter ½”-¾”	1 pc	
Socket extension ¾” 200 mm	1 pc	
Socket extension ¾” 100 mm	1 pc	
Combination wrench set 6-55 mm	1 set	
Construction water level 1 m	1 pc	
Hammer 2 kg	1 pc	
Side-cutting pliers 175 mm	1 pc	
Combination pliers 175 mm	1 pc	
Measuring tape 10 m	1 pc	
Vernier caliper 150 mm	1 pc	
Knife	1 pc	
Hammer drill at least 750 W	1 pc	
Hand screw tap set M3-M30	1 set	
Zinc spray paint	1 bottle	
White spray paint RAL9010	1 bottle	
Brake cleaner detergent	1 bottle	
Aluminum round tip lever 680 mm	1 pc	
Aluminum lever 800 mm	1 pc	
Set of screwdrivers	1 set	
Hexagonal L-key set 1.5-10	1 set	
Rope	30 m	
Round lifting sling WLL 2T EWL 2 m	2 pcs	
Round lifting sling 8 m	2 pcs	
Chain sling 2H	1 pc	
Extension cord, 25m, 16A	1 pc	
Angle grinder at least 1400 W with cutting discs	1 pc	
Heat gun at least 1500 W	1 pc	
Cordless impact wrench ½”	1 pc	
Cable tie nylon 4.8x300 6.6	1 pack	
Cable tie nylon 9.0x433 6.6	1 pack	

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Marker	1 pc	
Brush	1 pc	
Shackle d16 3250 kg	2 pcs	
Paper towel	1 roll	
Rag	1 pc	

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5. Work conditions checklist

Before starting assembly works, the following conditions shall be verified and confirmed. Assembly may only start once all listed requirements are fulfilled to ensure safe and correct installation.

1	Condition	Check?
2	All the parts from the scope of delivery (part 4)are on site.	
3	All the equipment required (part 5) is on site.	
4	The lifting equipment (crane or similar) with trained operator is present.	
5	Are installers (approved by the manufacturer) on site with appropriate safety gear.	
6	All non-authorized personnel (including land owners, bystanders and animals) are removed from the high-risk zone.	
7	There is no thunder, heavy rain or dense fog and none are forecasted.	
8	Wind speed does not exceed 10 m/s and there is no forecast of it going above 10 m/s.	
9	Air temperature is between -15 and + 35 °C and is forecasted to stay in this range.	

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6. Requirements for handling and storing wind turbine parts at the site

All wind turbine components must be handled and stored in a manner that prevents mechanical damage, environmental exposure, and unauthorized access.

Proper storage conditions are essential to ensure the integrity of structural, mechanical, and electrical parts before installation. The following requirements shall be observed at all times:

6.1. General Handling Requirements

i. All components must be lifted and moved using only certified lifting equipment and approved lifting points.
ii. Parts shall be handled carefully to avoid impacts, excessive bending loads, or surface damage.
iii. Any signs of damage, deformation, corrosion, or moisture ingress must be reported to the manufacturer before installation.

6.1.4. Protective covers must remain in place until the moment of installation.

6.2. Storage of Mechanical Components

6.2.1. Mechanical parts (tower piles, turbine module components, generator components) must be stored on stable, level ground, preventing sliding or tipping.
6.2.2. Components shall be supported using appropriate certified support (wooden blocks, steel stands, or factory-approved transport frames.)
6.2.3. Tower sections and blades must not be placed directly on the ground to avoid moisture absorption and structural stress.

6.2.4. Sharp edges, tools, or foreign objects must not be placed on wind turbine surfaces, especially on rotor blades or other critical parts and components of turbine (generator, control panel etc.)

6.3. Protection Against Environmental Conditions

6.3.1. Components should be protected from rain, snow, high humidity, and direct sunlight using breathable covers or shelter.
6.3.2. Avoid condensation inside electrical and composite components by preventing rapid temperature fluctuations.

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6.3.3. Blades and movable parts must not be stored in areas exposed to strong winds that could cause movement or instability.

6.4. Storage of Electrical Panels and Components

6.4.1. Electrical cabinets and control panels must remain in their original packaging until installation.

6.4.2. Storage areas must be dry, dust-free, and protected from vibration and temperature extremes.

6.4.3. Ensure no moisture, debris, or foreign materials can enter the enclosures.

6.4.4. Special care must be taken to protect door seals, bushings, connectors, locking mechanisms from physical damage or contamination.

6.5. Security and Access Control

6.5.1. All wind turbine parts must be stored in a restricted-access area to prevent unauthorized handling.

6.5.2. Only trained personnel are permitted to inspect, move, or install components.

6.5.3. Storage zones must be clearly marked and kept free of unnecessary equipment or obstructions.

6.6. Documentation and Traceability

6.6.1. All delivered parts must be checked against the delivery list, and discrepancies must be documented and reported to the manufacturer.

6.6.2. Serial numbers of critical components (generator, control panel, blade module) should be recorded upon arrival.

6.6.3. Any incidents during transport or storage must be logged and communicated to the manufacturer.

6.7. Temporary support for the Turbine module assembly

For the assembly of the Turbine module on the ground before lifting it onto the tower, it is necessary to have stable support with following parameters:

Height – min.1440 cm from the ground

Length/Width – max. 1200 cm

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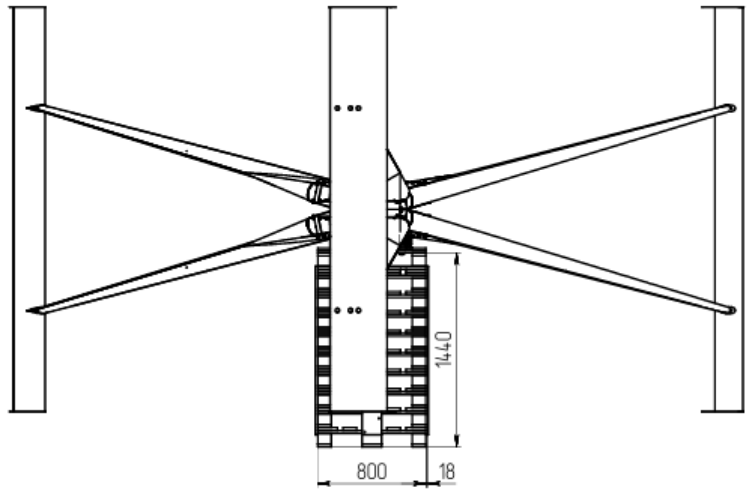
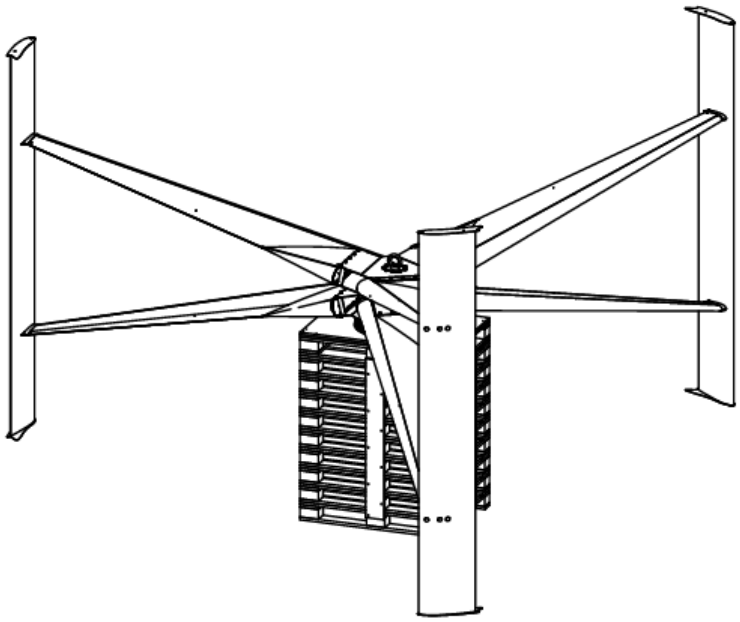
Load capacity – min. 700 kg.

Possible options – The stack of 10 euro pallets securely tied together to prevent falling





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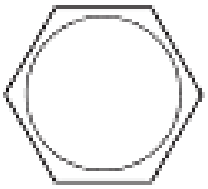
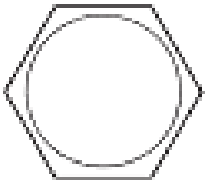
7. Bolts Torque Table

During assembly of the structure and bolt tightening, refer to the tightening torque table shown below.

Size	Class	Newton Meters		Foot Pounds (approx.)		Class Image
		Zinc Plated	Unplated	Zinc Plated	Unplated	
M4 x .70 Pitch	8.8	3.1	2.2	2.30	1.65	
M5 x .80 Pitch	8.8	6.1	5.5	4.58	4.13	
M6 x 1.00 Pitch	8.8	10.4	9.5	7.80	7.13	
M7 x 1.00 Pitch	8.8	17.0	15.5	12.75	11.63	
M8 x 1.25 Pitch	8.8	25.0	23.0	18.75	17.25	
M8 x 1.00 Pitch	8.8	27.0	24.5	20.25	18.38	
M10 x 1.50 Pitch	8.8	51.0	46.0	38.25	34.50	
M10 x 1.00 Pitch	8.8	57.0	52.0	42.75	39.00	
M10 x 1.25 Pitch	8.8	54.0	49.0	40.50	36.75	
M12 x 1.75 Pitch	8.8	87.0	79.0	65.25	59.25	
M12 x 1.25 Pitch	8.8	96.0	87.0	72.00	65.25	
M12 x 1.50 Pitch	8.8	92.0	83.0	69.00	62.25	
M14 x 2.00 Pitch	8.8	140.0	125.0	105.00	93.75	
M14 x 1.50 Pitch	8.8	150.0	135.0	112.50	101.25	
M16 x 2.00 Pitch	8.8	215.0	195.0	161.25	146.25	
M18 x 2.50 Pitch	8.8	300.0	280.0	225.00	210.00	
M20 x 2.50 Pitch	8.8	430.0	390.0	322.50	292.50	
M22 x 2.50 Pitch	8.8	580.0	530.0	435.00	397.50	
M24 x 3.00 Pitch	8.8	740.0	670.0	555.00	502.50	
M6 x 1.00 Pitch	10.9	15.5	14.0	11.63	10.50	
M8 x 1.25 Pitch	10.9	37.0	34.0	27.75	25.50	
M10 x 1.50 Pitch	10.9	75.0	68.0	56.25	51.00	
M12 x 1.75 Pitch	10.9	160.0	117.0	97.50	87.75	
M14 x 2.00 Pitch	10.9	205.0	185.0	153.75	138.75	
M16 x 2.00 Pitch	10.9	310.0	280.0	232.50	210.00	

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7. Foundation

The wind turbine is mounted on the foundation, provided by the customer.
The foundation is designed according to the tower loading diagram provided by Freen.

Turbine load diagram on lattice tower – (doc.# 300139-0)
Turbine load diagram on the monopole tower – (doc.# 300136-0)

The foundation planner and manufacturer may submit additional requirements to installation conditions (regarding weather conditions, access to the installation site, special characteristics of ground) and necessary documentation.

When laying the foundation, cable sleeves are installed into the foundation, which enable cables entering the turbine tower from the bottom. Normally, also a cable trench is constructed and grounding wire installed during laying the foundation.

For the earthing measurements it is suitable to use voltage drop measurement where measured ohmic value must adhere to local regulations, but less than 15 ohms under circumstance. If suitable value is not reached additional grounding wire circuit must be placed around foundation in 600 mm depth and 30 m length (5 m in parallel of each side of foundation in 1 m distance). Grounding wire size should be selected according to local regulations (standard IEC 60364-5-54 or other).

Cable between the grid connection point and wind turbine (foundation) should be chosen and installed according to local regulations and by an authorized service provider. Below are some possible configurations based on IEC 60364-5-52; these values should be used for reference only.

Designation	Length	Material	Cross-section	Earthing system
AXPK 4G16	≤ 150 m	Al	4 x 16 mm^2	3P + N
AXPK 4G25	≤ 250 m	Al	4 x 25 mm^2	3P + N
AXPK 4G35	≤ 400 m	Al	4 x 35 mm^2	3P + N
AXPK 4G50	≤ 550 m	Al	4 x 50 mm^2	3P + N
AMCMK 4G16+10	≤ 150 m	Al + Cu	4 x 16 + 1 x 10 mm^2	3P + N + PE

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8. Erection of the wind turbine

For the wind turbine installation, a crane with approximately 35 meters of lifting height and a lifting platform with an operating height of at least 25 meters for the technicians are required.

WLL-1000kg.

Crane lifting capacity depends on the different conditions at the location and must be verified and agreed with company providing lifting equipment during installation planning activities.

8.1. Foundation Check

Before starting the erection, verify that the foundation is ready for installation.

(Foundation provided by the customer)

8.1.1. Check that the foundation surface is clean, free of debris and has no visible defects.

8.1.2. Verify correct position of anchor bolts.

Following p.2-7 are related to the installation of lattice tower, p.8- are related to the installation of monopole tower

8.2. Assemble One Side of the Tower on the Ground Using Two Tower Piles (Legs)

8.2.1. Position two assembled piles on level ground in their correct orientation.

8.2.2. Temporarily support the piles to prevent movement.

8.2.3. Attach the top flange (upper triangular connection frame) to the two piles.

8.2.4. Install the side angle bars between the two piles.

8.2.5. All bolts shall be inserted but not fully tightened at this stage. **(See figure 1.)**

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8.3. Install the Third Tower Pile to Complete the Tower Structure

8.3.1. Position the third pile using a small crane or lifting device.

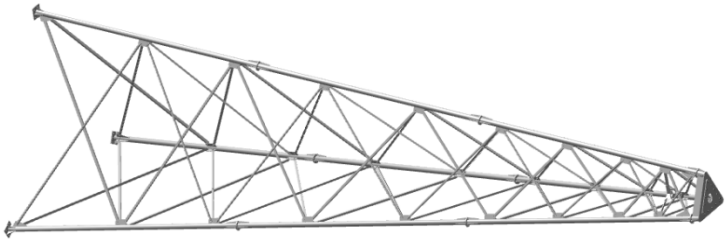
8.3.2. Align the third pile with the top flange.

8.3.3. Insert bolts connecting the third pile to the top flange.

8.4. Install All Remaining L-Bars Between the Third Pile and the Other Two Piles

8.4.1. Ensure correct orientation of all bracing elements.

8.4.2. At this stage, the full tower structure is assembled on the ground. **(See figure 2.)**



(Figure 2.)

8.5. Lifting and Installation of Tower onto Foundation

Once the complete tower structure is assembled:

8.5.1. Verify the overall geometry and alignment of the tower.

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8.5.2. Tighten all bolts to the specified torque values according to the torque requirements provided by the manufacturer.

8.5.3. Bolt tightening shall be performed in a crosswise manner.

Installation of the Tower

8.5.4. Lift the fully assembled tower using a suitable crane:

8.5.5. Attach lifting slings at designated lifting points.

8.5.6. Slowly lift the tower to vertical position.

8.5.7. Lower the tower onto the foundation anchor bolts.

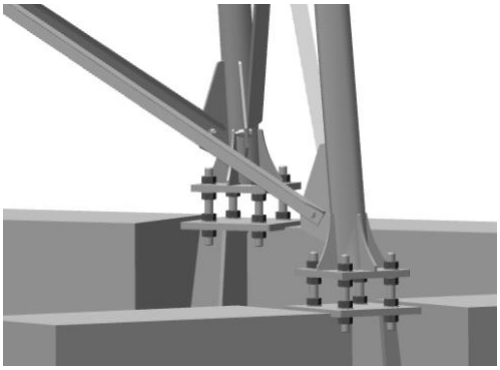
8.6. Tower Levelling and Final Fixation

After the tower is positioned on the foundation:

8.6.1. Check vertical alignment and level of the tower.

8.6.2. Adjust leveling nuts or shims as required.

8.6.3. Once correct alignment is achieved, fully tighten foundation anchor nuts. **(See figure 3.)**



(Figure 3.)

8.7. Installation of Generator Support

8.7.1. Mount the generator support adaptor onto the top flange of the tower.

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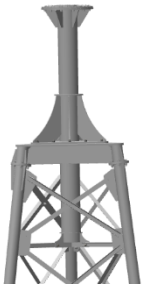
8.7.2. Secure the generator support with bolts.

8.7.3. Lift and install the generator onto the support.

8.7.4. Tighten all mounting bolts to specified torque. **(See figure 4.)**



(Figure 4.)

Tighten all bolts on the turbine frame structure to a torque of 230 Nm.

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8.8 Monopole tower assembly

Freen monopole tower does not require any additional assembly process, and is ready for installation.

8.8.1. For assembly work, choose a level area near the foundation, considering that the full length of the tower is 10 meters.
The tower is assembled in a horizontal position on temporary technological supports.

8.8.2. Carefully lower tower of the wind turbine onto the foundation anchor bolts.

8.9. Turbine Module Assembly

8.9.1. Place the central hub on temporary support and secure it to prevent falling. **(See figure 5.)**

8.9.2. Install the upper and lower blade support arms onto the hub, forming the main rotor structure.

8.9.3. Lay out the rotor blades individually and check correct orientation.

8.9.4. Install each blade onto the support arms, one by one, ensuring correct alignment and equal spacing.

8.9.5. Check overall rotor geometry and clearances.

8.9.6. Prepare the assembled rotor blade module with generator for lifting and installation.

8.9.7. Ensure the blade angle of attack is adjusted to 2.5° as specified.

8.9.8. Verify correct identification and alignment of the blade leading and trailing edges before final fixation.

(Figure 5.)

8.10. Installation of Turbine Module

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8.10.1. Lift the module using appropriate lifting equipment.

8.10.2. Align the module with the mounting interface.

8.10.3. Attach the lifting equipment to the central eyebolt (See figure 6.)

Always lift the blade module only from the dedicated lifting point.

(Figure 6.)

Attach the support tag lines, so that the riggers can control and stabilize the blade module during lifting, preventing any rotation or swinging. (See figure 7.)

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(Figure 7.)

Do not lift the module by the blades.

Always wear appropriate safety equipment when handling the blades.

Recommended maximum surface pressure limit to the blade is 1 N/mm2, exceeding this limit may damage the blade surface.

Do not in any circumstances lift or store the blade module on the trailing edge.

Do always use lifting slings or similar equipment that are approved for lifting purpose.

Do never position yourself under the turbine module during any kind of handling of the module.

8.11. Completion of Erection

After all turbine components have been installed and secured:

8.11.1. Perform a final visual inspection.

8.11.2. Verify that all mechanical connections are tightened.

8.11.3. Confirm that no tools or foreign objects remain on, or under the structure.

At this point, the erection of the wind turbine is complete.

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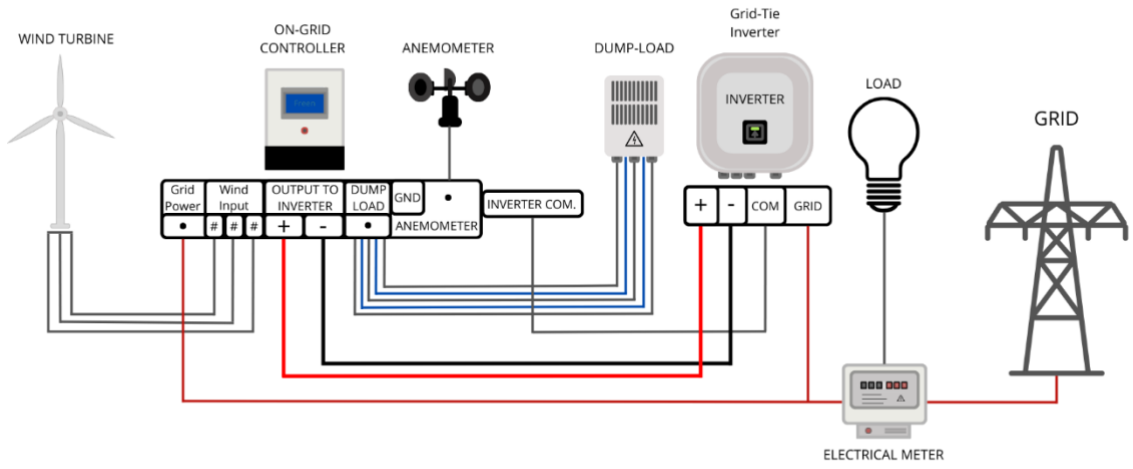
9. Control system installation

System consists of the control panel, equipped with the GreeF GT-PCTC controller and inverter interface, must be installed in strict accordance with the manufacturer's guidelines to ensure correct communication, stable grid interaction, and safe turbine operation.

Interconnection of system elements shall be done in accordance with following diagram:



9.1. Mounting the Control Panel

9.1.1. Position the control panel on the designated mounting area.

9.1.2. Secure the enclosure using the provided mounting hardware.

9.1.3. Verify that the panel is installed vertically and that cable entry points face downward to prevent moisture ingress.

9.2. Connecting Tower Cables

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9.2.1. Route all tower cables through the appropriate cable glands in the bottom part of the enclosure.

9.2.2. Connect all the generator output cables to the corresponding terminals on the GT-PCTC controller as marked in the wiring schematic.

9.2.3. Ensure that PE (grounding conductor) is brought through its dedicated bushing and bonded to the main grounding terminal inside the control panel.

9.3. Power and Grid Connection

9.3.1. Bring the incoming grid supply cable through the designated gland and connect it to the input terminals of the inverter or AC input block, following local grid connection requirements.

9.3.2. Install all required protection devices (main switch, circuit breakers, surge protection) following local electrical standards.

9.4. Communication and Controller Setup

9.4.1. Confirm that the communication link between the inverter and GT-PCTC controller is securely connected.

9.4.2. The inverter must be powered first. Wait until the green operation indicator is lit, confirming successful grid synchronization.

9.4.3. Once the inverter status is stable, turn on the controller power supply.

9.5. Brake Resistors

9.5.1. Connect the resistor to the brake output of the inverter/controller using properly rated cable.

9.5.2. Use a contactor or fuse if required for circuit protection.

9.6. Anemometer Connection

9.6.1. Connect power (if active sensor) and signal wire to the controller.

9.6.2. Connect shielded cable to ground at one end to prevent interference.

9.6.3. Test operation by rotating the sensor and verifying correct signal reading.

9.7. Final Checks

9.7.1. Inspect all cable glands to ensure they are fully tightened and sealed.

9.7.2. Verify that insulation is not damaged during installation.

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9.7.3. Confirm that warning labels and safety markings are applied according to local regulations.

9.7.4. Ensure that the main switch is easily accessible and clearly labeled

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10. Commissioning/operating the turbine

Grid Connection and Initial Power-Up

Make sure that the power cable you want to connect to the grid connection point is not powered from the network side before it is connected to the separated terminals panel.

Energize the system by switching ON the power supply at the grid connection point and power up the turbine control system.

Following is the short introduction to the control display of the turbine.

The Freen-9 wind turbine is equipped with the GT-PCTC controller manufactured by GREEF (China), which serves as the main user interface and control unit.

For detailed wiring diagrams, parameter settings, alarms, and operating logic, refer to the original manufacturer documentation.

GREEF GT-PCTC Controller and Inverter User Manual
(supplied with the controller)

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The instructions below provide only a brief operational overview and do not replace the original controller manual.

1. ON-GRID Controller and Inverter instructions:

ON-Grid Controller and Inverter Start-Up Procedure

1. Verify that all electrical and communication cables are correctly connected and secured.

2. Switch ON the AC side of the inverter, then switch ON the controller power supply and wait until the inverter powers up. (light is always to be green).

3. Wait until the inverter indicates successful grid connection.
   The inverter status indicator must show a steady green light.

4. Once the inverter status light is green, turn on the generator and allow the turbine to rotate at low speed.

5. Observe the system for normal operation and gradually increase rotor speed.

6. If the inverter display shows “LimByEPM”, this indicates correct communication between the controller and the inverter and does not represent a fault condition.

Make sure to switch off the turbine from the main switch and make sure that the power cable is not powered from the network side while making corrections on phase sequence on the panel side terminals.

IMPORTANT SAFETY NOTICE:
Do not allow the generator to rotate until the inverter status light is green and grid connection is confirmed.

2. Interface Display

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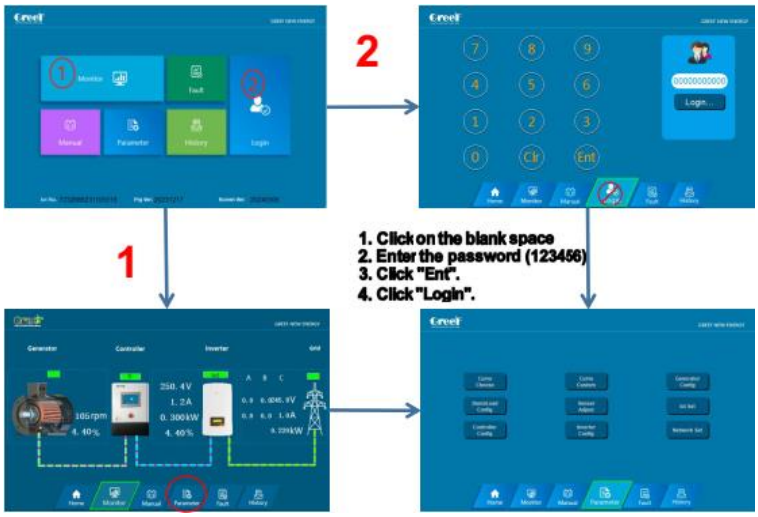

Functional Test and Grid Disconnection Check

When the turbine reaches a rotor speed above 30-40 rpm:

1. Verify power production on the monitoring display.
2. Check for abnormal vibration, noise, or oscillation.

If all operating parameters are within specified limits and no abnormal behaviour is observed, perform a grid disconnection test:

1. Switch OFF the grid power using the main switch located on the right-hand side of the control panel.

2. Verify that the rotor brake is applied immediately and the rotor comes to a complete stop or slow rotation (in case of strong wind conditions)

3. Wait at least 10 seconds.

4. Restore grid power by switching the main switch ON and verify normal system recovery.

Each turbine function is tested in the manufacturer's factory and is equipped with Quality control factory checklist signed by the person who has performed the quality control. This eliminates the need to re-

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check all the functions of the turbine besides the rotor rotation direction check to validate correct phase sequence.

The turbine can be installed and commissioned with surveillance SCADA system, which allows both turbine manufacturer and approved service provider to monitor and control the turbine 24/7. Customers have limited access to the SCADA system to monitor the turbine without any control functionality over the turbine.

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11. Commissioning control checklist example

Freen-9 Wind Turbine

Commissioning checklist

Turbine identification number: Freen

Date and time: 05.08.2025

Name: Valeria Mazeina Signature:

Name: KARL BAUER Signature:

	Condition	Check	Sign
1.	Is the turbine foundation earth correctly installed?	√	
2.	Is the turbine installed per manufacturer's instructions?	√	
3.	Do any of the components need any modification during the installation process?	√	
4.	Have all the bolts been torqued per manufacturer's instructions?	√	
5.	Tower bolts / Foundation bolts / Turbine bolts / Turbine mounting bolts / torqued?	√	
6.	Is the turbine electrically functioning tested?	√	
7.	Are grid cable connections properly done?	√	
8.	Are warning labels in place (acc. to local regulations)?	√	
9.	Is lightning/surge protection correctly installed? (if relevant?)	√	
10.	Are the interconnections performed correctly and all electrical connections secure?	√	
11.	Is the control unit in a suitable location and base, with an appropriate case?	√	
12.	Is the control unit mounted appropriately?	√	
13.	Is the anemometer correctly installed? (if relevant?)	√	
14.	Electrical brake system function tested	√	
15.	There is no abnormal vibration	√	
16.	Does turbine control unit works properly	√	
17.	Safe operation and shutdown of the turbine have been explained to the customer?	√	
18.	Is the point of AC isolation suitably labelled (acc to local regulation)?	√	
19.	Are all signs suitably fixed and durable (acc to local regulation)?	√	
20.	Has a grid fail protection been checked	√	
21.	Visual inspection of wind turbine components completed?	√	
22.	The initial test run completed successfully.	√	
23.	Emergency stop function tested.	√	
24.	Emergency procedures are explained.	√	
25.	Maintenance intervals and inspection requirements are explained.	√	
26.	Site restored after installation (no debris, safe access)	√	
27.	Data logging and communication (SCADA / monitoring) tested. (if relevant?)	√	
28.	The owner's manual and schematics been supplied.	√	

Name: Valeria Mazeina Signature:

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12. Maintenance

The Freen-9 vertical axis wind turbine is designed for low-maintenance operation.

Routine maintenance is limited primarily to visual and functional inspections and periodic lubrication of rotating components.

No scheduled replacement of parts is required under normal operating conditions.

Maintenance activities are focused on early detection of abnormal wear, environmental influence, or installation-related issues, ensuring long-term reliability and safe operation.

Inspection Scope

Inspections shall be carried out at defined intervals or after extraordinary events (e.g. storms, lightning strikes, earthquakes).

The following inspections and maintenance shall be performed:

Visual Inspection

1. Inspection of blades and rotor surfaces for cracks, deformation, or impact damage.
2. Inspection of the tower, support structure, and foundation for corrosion, cracks, or settlement.
3. Inspection of the fasteners for loosening, corrosion, or missing elements.
4. Inspection of the protective covers, seals, and enclosures for damage or moisture ingress.
5. Inspection for accumulation of dust, salt, ice, or foreign objects inside any turbine components.

Mechanical Inspection

1. Verification of smooth and unobstructed rotor rotation.
2. Check for abnormal noise, vibration, etc. during operation.
3. Inspection of bearings and rotating interfaces for signs of abnormal work or appearance.

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4. Verification of correct alignment of rotating components.

5. Bolted connections shall be inspected and torque-checked as part of routine maintenance.

6. Verificate that warning labels and safety signage remain legible, easily readable and securely fixed.

Lubrication (Greasing)

Suitable lubrication is essential for the longevity of generator bearings lifespan.

Recommended grease:

ESSO BEACON EP2 or equivalent NLGI Grade 2 grease.

Greasing shall be performed in accordance with the following procedure:

1. A light extrusion of new grease must be visible at the all designated greasing points

2. After re-greasing, all excess grease shall be wiped off, and the area shall be inspected for contamination such as sand, salt, dust, or metallic particles.

Maintenance Intervals

Maintenance intervals shall be defined based on site-specific environmental conditions.

Typical guidance:

1. Initial inspection: within the first 3-6 months of operation.

2. Routine inspection: once per year under normal environmental conditions.

3. Greasing: once per year, or more frequently in harsh environments.

4. Extraordinary inspection: after severe weather events or abnormal turbine behavior.

In harsh environments (coastal areas, high salinity, heavy dust, frequent storms, or extreme temperature variations), inspection and greasing intervals shall be reduced accordingly.

Maintenance Records

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All inspections and maintenance actions shall be documented, including:

1. Date and operating hours.
2. Observations and findings.
3. Lubricant type and quantity used.
4. Corrective actions taken (if any).

These records shall be retained for the lifetime of the turbine and used to refine the site-specific maintenance schedule.

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