Owner's Manual

BWC EXCEL 15

Wind Turbine &
Powersync 25
(Single Box Inverter)
Grid-Intertie Inverter

Rev. 3.2
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BERGEY WINDPOWER

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I. INTRODUCTION

This manual contains important information concerning your Bergey EXCEL 15 wind turbine system and its operational characteristics. We strongly recommend that you read and familiarize yourself with its contents.

At several points in this manual, items of special interest or significant impact are highlighted by one of the following indicators:

	**DANGER:**	Hazards or unsafe practices that could cause personal injury or death.
	**WARNING**:	Hazards or unsafe practices which could cause product damage.
	NOTE	Significant points of interest.

Serial Numbers

Each Bergey EXCEL 15 wind turbine has a serial number located on the tower adapter. The turbine serial number can also be found on the outside of the shipping crate and on the warranty registration card. The blade serial numbers are located on the root pad and, are also on the shipping crate. The inverter serial number is written on the box. We recommend that the serial number be copied to this manual for possible future reference.

Bergey EXCEL 15 Serial No.: _____

Bergey EXCEL 15 Blades Serial Numbers: _____

The Powersync 25 inverter has a serial number label on its right side. We recommend that this serial number also be copied to this manual.

Powersync 25 Serial No: _____

II. EXCEL 15 SPECIFICATIONS

PERFORMANCE

START-UP WIND SPEED	12 mph (6 m/s)
CUT-IN WIND SPEED	6 mph (2.5 m/s)
RATED WIND SPEED	24.6 mph (11 m/s)
AWEA RATED POWER (at 11 m/s or 25 mph)	15.6 kW
AWEA ANNUAL ENERGY (at 5 m/s average	29,800 kWh
CUT-OUT WIND SPEED	None
MAXIMUM DESIGN WIND SPEED	134 mph (60m/s)
MAXIMUM POWER	25 kW
ROTOR SPEED	0-150 RPM

MECHANICAL

TYPE	3-Blade Upwind, Horizontal-Axis
ROTOR DIAMETER	31.5 ft. (9.6 m)
WEIGHT	1,400 lb. (636 kg)
GEARBOX	None
BLADE PITCH CONTROL	None
OVERSPEED PROTECTION	Blade stall
MAX AMBIENT TEMPERATURE	40°C

ELECTRICAL

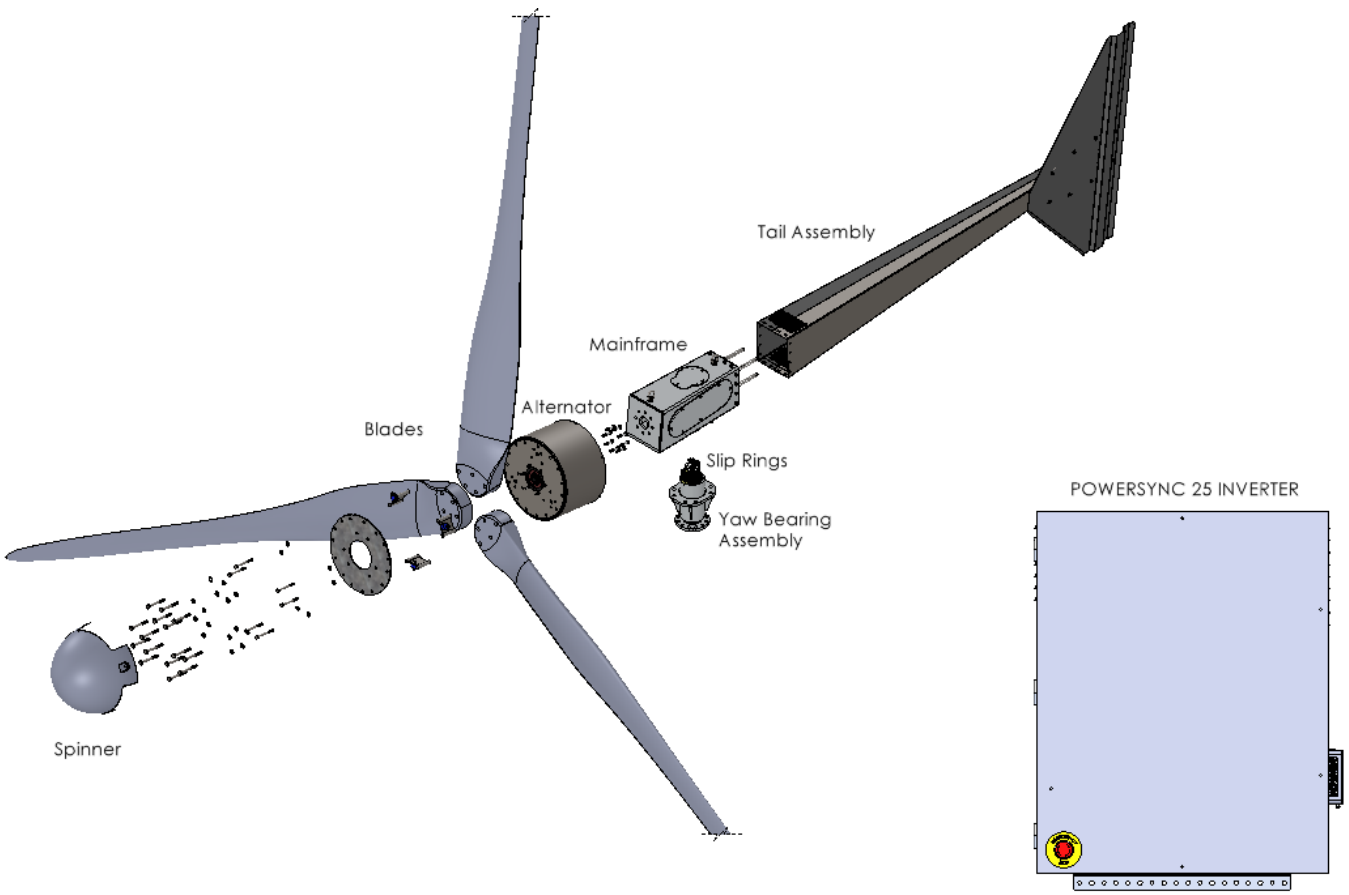
OUTPUT FORM	3 Φ Wild AC
GENERATOR	Permanent Magnet Alternator
VOLTAGE	Operating 110 - 430 V_{AC} (Max 460 VAC)
CURRENT	Operating 0 - 34 A_{AC} (Max 45 A_{AC})
FREQUENCY	0 – 60 Hz

WARNING: The Excel 15 turbine itself is not suitable for and has not been evaluated for utility inter-connection protective functions. This unit shall be provided with an external inverter in accordance with local codes and utility requirements. The Powersync 25 satisfies this requirement.

III. SYSTEM DESCRIPTION

The Bergey EXCEL 15 is an upwind horizontal-axis wind turbine designed for distributed generation applications, connected to the power grid on the customer's side of the utility meter. The complete system consists of the following major components, as shown in the figure below:

1. Spinner
2. PowerFlex® Rotor Blades
3. Alternator
4. Mainframe
5. Back-up Braking
6. Tail Assembly
7. Slip-Rings
8. Yaw Bearing Assembly
9. Powersync® 25 Inverter



A. SPINNER

The spinner (nose cone) is purely cosmetic.

B. ROTOR SYSTEM

The rotor system consists of three high-technology carbon-fiber PowerFlex® blades. Acting like aircraft wings, the blades convert the energy of the wind into rotational forces that drive the alternator. The PowerFlex® blades are rigidly attached to the alternator and they are fixed pitch. The Excel 15 rotor blades have proprietary airfoils, which were custom designed to provide high efficiency and storm protection.

Each blade has a serial number inscribed on its root pad at the inboard end.

C. ALTERNATOR

The alternator converts the rotational energy of the rotor into electricity. The alternator utilizes permanent magnets and has an inverted configuration in that the outside housing rotates, while the internal windings are stationary. It was specifically designed for the Bergey EXCEL 15 and produces power at low speeds, eliminating the need for a speed-increasing gearbox. Since it uses permanent magnets, the alternator is generating voltage whenever the rotor is turning.

DANGER The output wiring of the EXCEL 15 presents a shock hazard whenever the rotor is turning. Caution must be exercised at all times to avoid electrical shock.

D. MAINFRAME

The mainframe is the structural backbone of the wind turbine. It serves as the attachment point for the rotor/alternator assembly, the tail assembly, the yaw bearing assembly. It also houses the yaw-axis slip-ring assembly and the controls for the back-up braking system.

E. BACK-UP BRAKE

The back-up braking system is an added safety system that prevents rotor overspeed in the event of a failure of the primary speed control system (inverter and dump load).

F. TAIL ASSEMBLY

The tail assembly keeps the rotor aligned into the wind.

G. SLIP-RING ASSEMBLY

The slip-rings and brushes conduct the electricity generated in the alternator from the moving (as it orients with the direction) wind turbine to the fixed tower wiring. The slip-rings are enclosed in the steel mainframe housing to help protect them from the weather and lightning.

H. YAW BEARING ASSEMBLY

The yaw bearing assembly allows the turbine to freely align itself to the wind direction.

I. POWERSYNC 25 INVERTER

The Powersync 25 inverter converts the "variable AC" from the Bergey EXCEL 15 turbine into utility grade electricity so that it can be connected to the wiring in your home or business. This conversion requires sophisticated electronics and is designed to operate automatically. The Powersync 25 has a computer that serves as a display, that collects and provides information on the status of the system, its current output power, and various data points regarding system status.

IV. SYSTEM OPERATION

A. NORMAL OPERATION

The Bergey EXCEL 15 / Powersync® 25 system produces utility compatible power in the form of 240VAC, 60 Hz, single phase electricity (other voltage options are available). It is connected with the Powersync® 25 inverter to the utility distribution network in the same manner as electrical machinery. When the wind speed is too low to operate the wind turbine, all of the electrical power needed for the home or business will be supplied by the utility company. During these idle periods the Powersync® 25 will consume approximately 0.3 kilowatt-hours of electricity per day.

When the system begins producing power, the amount of power which must be purchased from the utility is reduced by an amount equal to the output of the wind system. From the perspective of the utility company the wind system output reduces the electrical load they have to supply, just as if you turned off lights and appliances. The output of the wind system fluctuates with the speed of the wind so the instantaneous amount of electricity being saved will be constantly changing. Quite often your home will be served simultaneously by the utility and your Bergey wind turbine.

When the output of the wind system exceeds the power requirements of the house the excess electricity is sent back to the utility. Both the consumer's right to interconnect a wind system and the utilities obligation to purchase excess power are prescribed by federal law (PURPA, Section 210). The amount you will be credited or paid for this excess production varies state-to-state and sometimes utility-to-utility. If your utility company offers "net metering" then your meter is allowed to turn backwards so that you essentially bank energy, at full value, for less windy periods. This banking can be done over a month or over a year depending on the policy of your state or your utility. If you do not get "net metering" then you will have a second utility meter to register excess production and your utility will pay or credit you for this, typically at less than the rate you pay when you purchase their electricity.

If your utility experiences an outage (blackout) the wind system will cease to produce power so that it does not present an electrical safety hazard to utility repair crews. During a power outage the Excel 15 turbine will come to a stop. When utility power is restored, the Powersync 25 will automatically return the wind system to full working status following a five minute countdown. These time delays are dictated in the UL standards required by the utilities.

The rotor of the EXCEL 15 should begin to rotate when the wind speed reaches approximately 12 mph (6 m/s). Once started, the rotor may continue to turn in winds below 5 mph (2.2 m/s), but the system will not be producing power below this wind speed.

NOTE All operational wind speeds given assume steady winds, sea-level conditions and moderate temperatures. Hot weather, high altitude, turbulence and gusting winds will reduce system performance.

NOTE The Excel 15 may exhibit poor start-up performance in light steady winds. The design of the blades is optimized for efficiency and storm protection, which necessitated some sacrifice in start-up characteristics.

The rotor speed will increase with increasing wind speed and the system will produce a higher output. This output increases rapidly because the energy available in the wind varies as the third power (cube) of the wind speed. For example, if the wind speed increased form 5 mph to 10 mph, a factor of two, the energy in the wind would increase from one unit to eight units, a factor of eight (2 to the 3rd power). One result of this relationship is that there is very little energy available in light winds. For the average site, winds in the range of 12-20 mph (5.5 – 9 m/s) will provide most of the system's energy production on an annual basis.

The Excel 15 will operate at variable speed up to about 20 mph (9 m/s) and about 140 RPM. The speed of the rotor is controlled to limit at about 140 RPM.

B. HIGH WINDS

Unlike previous Bergey wind turbines, the Excel 15 does not furl (rotor turned away from the wind). The Excel 15 controls speed and protects itself from high winds by stalling the rotor progressively as wind speeds increase. In sustained high winds the rotor speed is reduced to limit power surges during strong gusts.

C. PROBLEMS WITH POWER GRID

If an abnormal condition occurs on the utility line, such as a voltage fluctuation or a complete interruption, the Powersync 25 inverter will automatically disconnect the wind turbine from the power grid and bring the rotor to a stop.

D. EMERGENCY SHUTDOWN

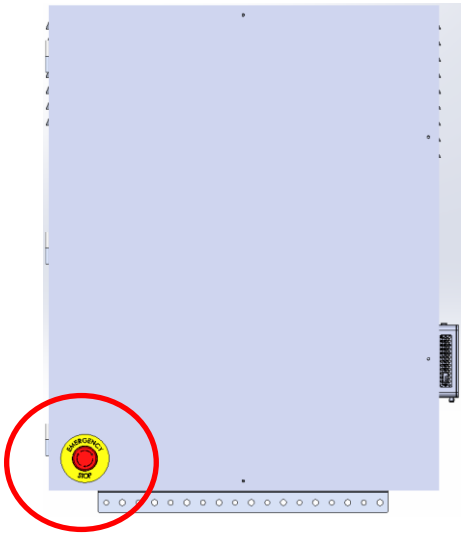
The Bergey EXCEL 15 is designed for unattended operation over an extended period of time. Exceptional situations may occur, however, in which the wind turbine should be shutdown. These situations include:

1. **EXCESSIVE VIBRATION -** Uneven ice build-up, ice shedding, or blade damage may cause the wind turbine to experience excessive vibration. Always shut the turbine down as soon as an increase in vibration is detected. Any new or excessive vibration in the turbine when ice is not present should be investigated immediately.

2. **UNUSUAL SOUND -** If the turbine begins making clinking, growling, or other unusual sound it should be shut down and fully inspected as soon as possible.

3. **INSPECTION AND MAINTENANCE -** Whenever someone must climb the tower the wind turbine must be shut down.

Shut down of the EXCEL 15 is accomplished by operating (pressing) the red Emergency Stop button on the Powersync 25 inverter.



To release the Emergency Stop, turn the red button clockwise until it snaps outward. This will resume automatic operation of the wind turbine.

WARNING: Do not open the disconnect switch on the tower during shutdown. This would allow the turbine to restart and if the turbine tried to overspeed it would trigger the back-up braking system.

E. BACK-UP BRAKING SYSTEM

If the primary overspeed protection system fails, the Excel 15 has a back-up braking system located on the wind turbine. It detects an overspeed situation and applies a dynamic brake to bring the rotor to a near stop. You can tell this has occurred if the Powersync 25 display says "Waiting for wind" and there's plenty of wind [greater than 15 mph (6.7 m/s)], but the rotor does not turn.

It will automatically reset if the wind drops below 2 m/s (4.5 mph). Otherwise, you can manually restart the turbine by activating and then restoring the Emergency Stop button on the Powersync 25 inverter.

If activation of the Back-up Brake occurs repeatedly, we strongly recommend that you contact your dealer or the Service Department at BWC.

V. POWERSYNC 25 INVERTER

The Powersync 25 inverter is connected to the household or building electrical circuits through a dedicated circuit breaker.

DANGER Electric Shock Hazard. Failure to comply will result in death or serious injury. Disconnect all power to the inverter before servicing. Wait at least 5 minutes before opening the inverter door.

Using the utility grid as a reference, the Powersync 25 inverter converts the output of the wind turbine into utility-compatible power (AC). The Powersync 25 inverter has been designed for automatic, unattended operation and it is programmed to provide maximum performance from your Bergey EXCEL 15 wind turbine. It is also programmed to safely disconnect the wind turbine in the event of a problem with the utility power and to automatically reconnect the turbine after the problem is remedied.

The inverter display (NUC computer) provides information on the status of your Bergey EXCEL 15 wind turbine. It is recommended that a computer monitor, mouse and key board are hooked up to the inverter display. The internet should also be hooked up to the inverter display for automatic updates.

Before opening the Powersync 25 enclosure, the breaker must be turned off and the turbine Emergency Stop must be activated, to avoid electrical shock.

POWERSYNC 25 SPECIFICATIONS

Input - AC

Input Voltage Maximum (L-L 3Φ)	480 VAC
Input Operating Voltage Range	270 – 480 VAC
Input High Voltage Trip Point	650 VDC (factory default value)
Input Current Maximum	50 A
Max Input SCC – (At Input VDC)	375 VDC 900 VDC 1.2kA 3kA

Output – AC (Grid-Interactive Mode)

Wiring Connection	1P2W. Neutral is for voltage sense only
Nominal Output Voltage	240 VAC (L-L, Single Phase)
Output Voltage Range (% Vnom)	45-120%
Nominal Frequency	60 Hz
Frequency Range	57-62 Hz
Max Continuous Output Current	96 A
Max Continuous Power	23 kW
Max Peak Power (1 minute)	25 kW
Max Output Overcurrent Protection	150 A
Max Output Fault Current	200 A
Max Output Fault Duration	8 ms
Max Backfeed Current	100 A
Synchronization in Rush Current	100 A
Power Factor	0-1 (Adjustable)

Output Power vs. Panel Circuit Breaker

Most residential circuit breaker panels cannot accept branch breakers larger than 100 A. To simplify installation in these panels, the Powersync 25 is shipped with a default current limit of 80 A and a power limit of 20 kW.

Over Current Protection	100 A
Continuous Output Current	80 A (default limit)
Maximum Continuous Power	20 kW

If installed in a panel that can accommodate larger branch breakers, or with a line-side tap, the current and power limits field adjustable up to:

Over Current Protection	150 A
Continuous Output Current	105 A (field adjusted)
Maximum Continuous Power	25 kW (field adjusted)

Interconnection Certification

Note: utility interconnection may require approval from the authority having jurisdiction (AHJ) – e.g., local electrical utility, PUC or inspection entity.

Voltage and Frequency Trip Thresholds

Powersync 25 inverters are shipped from the factory in compliance with UL1741 and IEEE 1547-2003 requirements.

All voltage and frequency trip conditions result in a 300-second default restart delay time. The following tables lists the "as shipped" default values for voltage and frequency trips. Powersync 25 inverters have adjustable trip threshold and time values. The range of adjustability is also shown:

Default Voltage Settings		
Voltage Range (% of base voltage – 120V L-N)	Clearing Time (s)	Clearing Time (s) adjustable up to and including
V < 45	0.16	0.16
45 ≤ V < 60	1	11
60 ≤ V < 88	2	21
110 < V < 120	1	13
V ≥ 120	0.16	0.16

	Frequency Default Settings		Ranges of Adjustability	
Function	Frequency (Hz)	Clearing Time (s)	Frequency (Hz)	Clearing Time (s) adjustable up to and including
UF1	< 57	0.16	56 - 60	10
UF2	< 59.5	2	56 - 60	300
OF1	> 60.5	2	60 - 64	300
OF2	> 62	0.16	60 - 64	10

Adjustable trip settings should be coordinated with utility requirements.

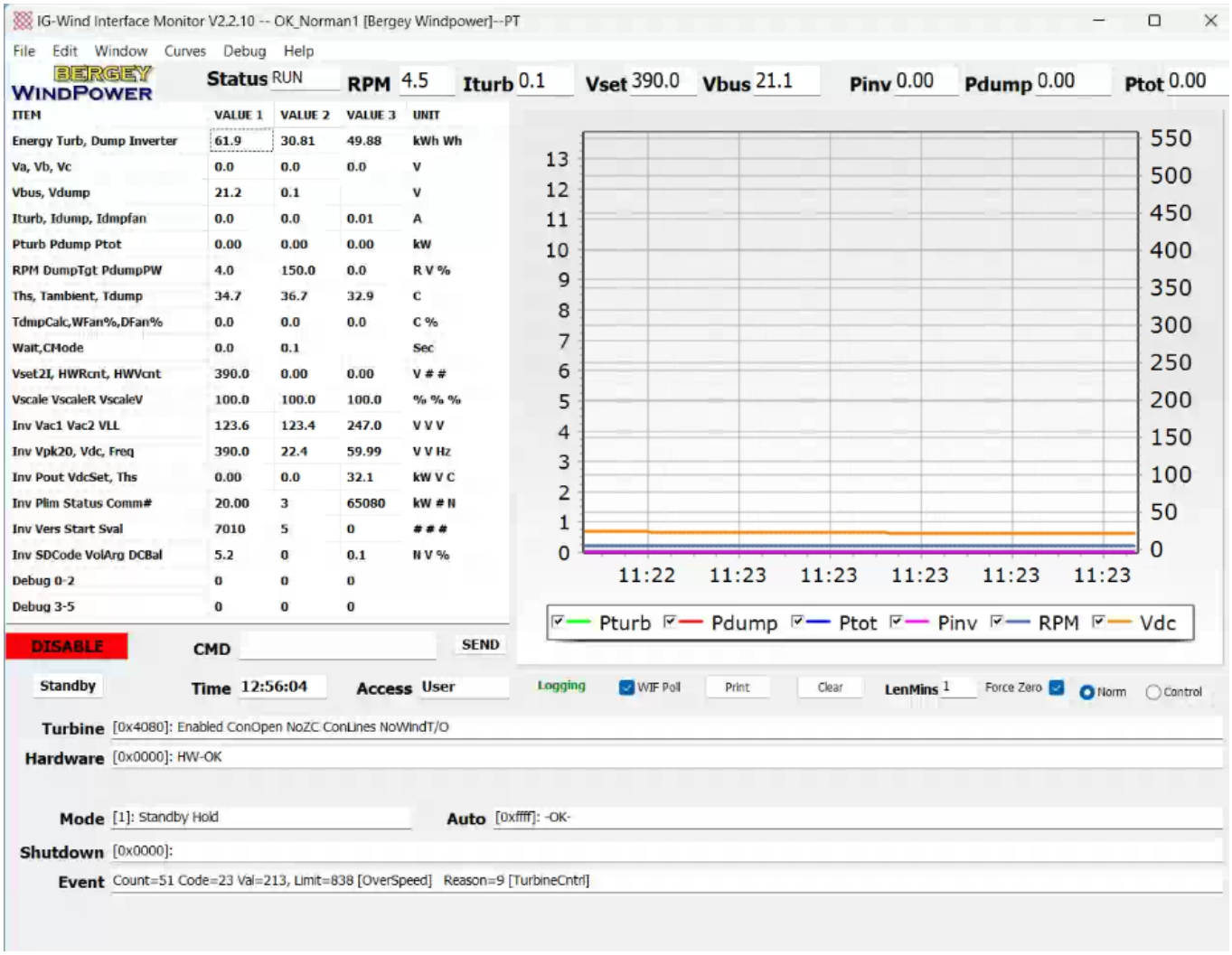
Powersync 25 inverters have a frequency trip accuracy of +/- 0.05 Hz and a voltage trip accuracy of +/- 2% of nominal (i.e., +/- 2.4 Volts for 120V nominal). The time trip accuracy is +/-1% of trip time +/- 50 ms. During synchronization, the maximum inrush current is 50 Amps for no more than 16 ms.

Other Specifications

Dimensions	32"H x 24.25"W x 9" D 813 x 616 x 230 mm
Weight	95 lbs. / 43.1 Kg
Enclosure	NEMA Type 1

NEMA 1 indicates that the enclosure is constructed for indoor use only. It provides protection to personnel against incidental contact with the enclosed equipment.

In normal operation the Powersync 25 will show the status as "Running" and will display the instantaneous Output Power in Watts.

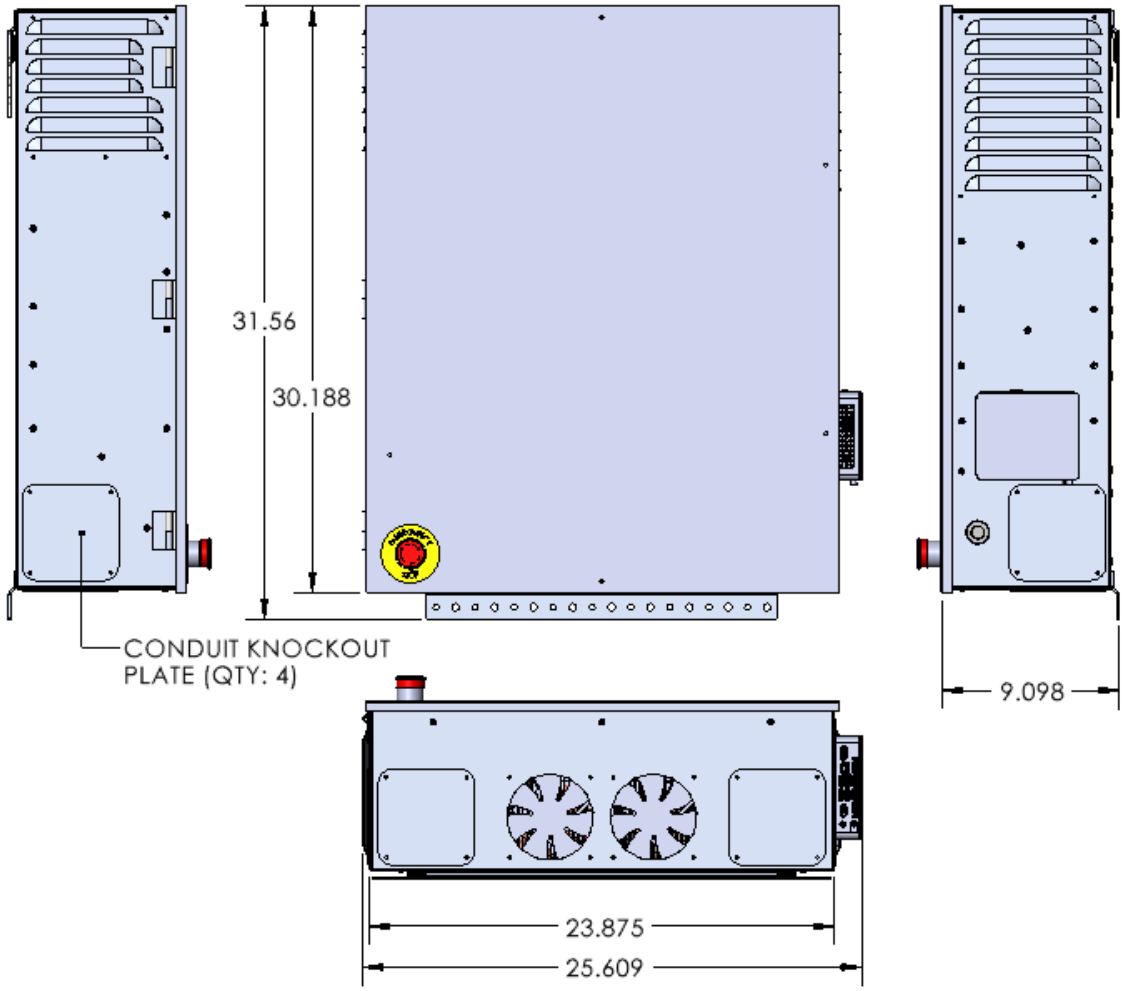


A. Important Inverter Safety Instructions

SAVE THESE INSTRUCTIONS This manual contains important instructions for Models PS25-240-1B (PowerSync 25) that shall be followed during installation and maintenance of the inverter.
The output field wiring terminal can be used for connection of a maximum of: One 2 AWG wire per terminal (1 wire for each line)
The input field wiring terminal can be used for connection of a maximum of: One 2 AWG wire per terminal (1 wire per phase per terminal provided).
The field-wiring terminals shall be connected using the following wire types: Copper Conductors Only (Input connection) Use No. 6 - 2 AWG, copper wire only Copper Conductors Only (Output connection) Use 3 AWG, Copper Conductors
The following symbols are used as markings on this product with the following meanings: Equipment grounding conductor – 
This inverter is intended for operation in an indoor NEMA 1 compatible environment having a maximum ambient temperature of 45° C (113° F).
This unit or system is provided with fixed trip limits and shall not be aggregated above 30 kW on a single Point of Common Connection
CAUTION To reduce the risk of fire, connect only to a circuit provided with 100 amperes maximum branch-circuit over-current protection in accordance with the National Electrical Code, ANSI/NFPA 70.
 Hot surfaces – To reduce the risk of burns – Do not touch The enclosure and internal components can exceed 70° C (150° F).
Note that the input and output circuits are isolated from the enclosure. In accordance with Clause 15.2.1.1 of CAN/CSA-C22.2 No. 107.1, system grounding, when required by the *Canadian Electrical Code, Part I,* is the responsibility of the installer.

B. Installation

1. Dimensions



2. Locating

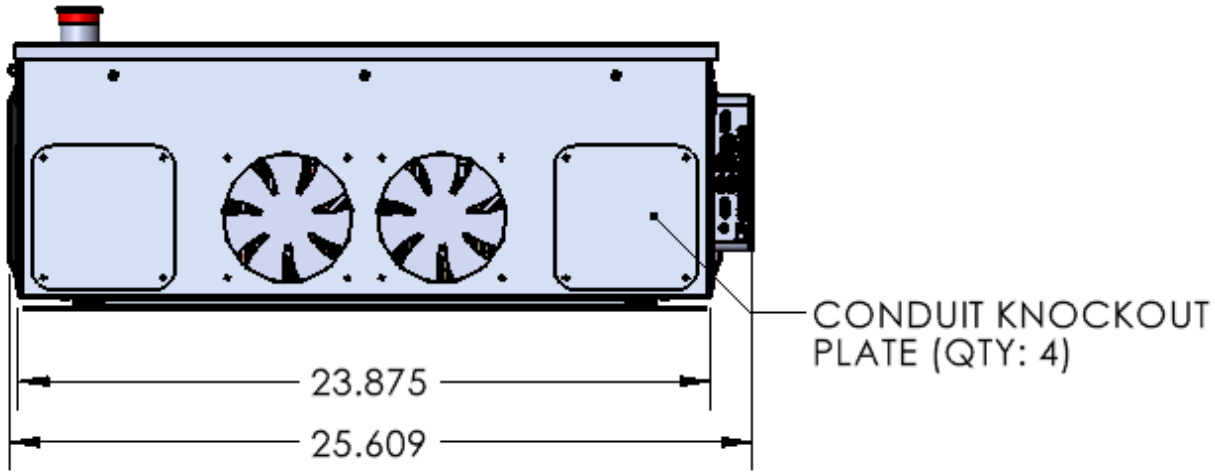
- The inverter must be installed in a weather protected environment.
- The inverter emits audible noise when operating. Do not locate the inverter in living spaces or on walls directly connected to living spaces.
- For maximum energy production, avoid installing in direct sunlight or in locations that are likely to exceed 45ºC (113ºF) local ambient temperature.
- The inverter will automatically shut down if the temperature is below -20ºC (-4ºF). Protect from extreme cold exposure if this is undesirable.
- Enclosure ventilation is to be provided such that the following guidelines are satisfied.
    - Provide a minimum of 12 inches clearance to the bottom air inlet filters.
    - Provide a minimum of 6 inches clearance to the outlet side vents.
    - Use in a well-ventilated area within the maximum ambient temperature rating.
- If the inverter is installed in a small structure or out building, the structure must be provided with top and bottom venting of at least 100 square inches at each opening.

3. Mounting

- The enclosure, having a NEMA 1 rating, is designed for indoor installation.
- The enclosure is provided with a wall mounting bracket that the inverter hangs on and is secured with at least 2 bolts in the bottom bracket.
- For mounting to a 0.10" thick metal surface, use M6, ¼-20 or ¼-28 bolts grade 3 or higher with nuts and flat washers.
- For mounting to concrete, use M6 or ¼" bolts using concrete anchors with an 800 pound or greater tension rating.
- The required bolt length is such that the internal threads need to be 100% engaged.
- The enclosure is to be oriented with the fans facing toward the floor.

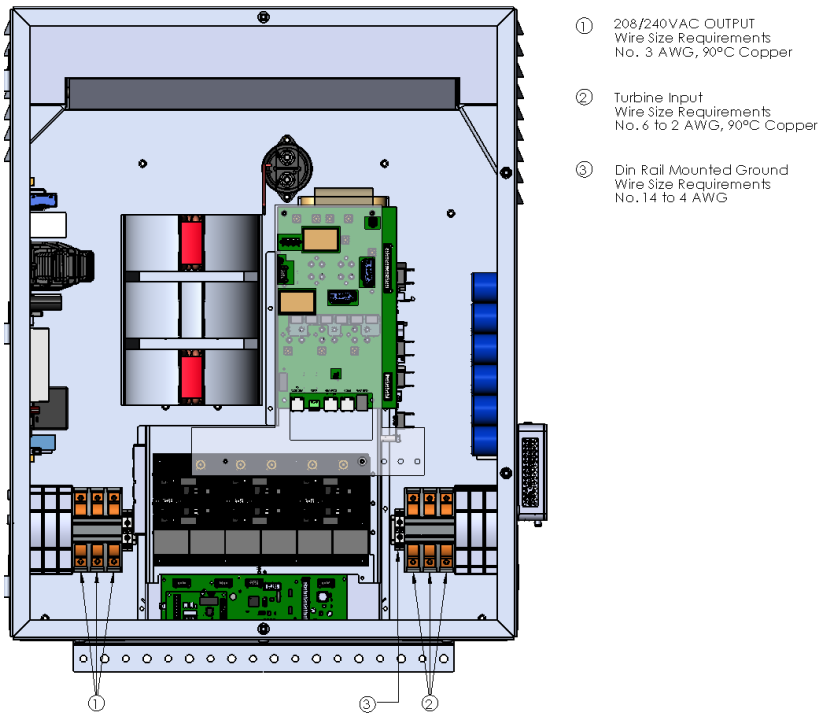
4. Electrical Connections

- Connections are made to the unit via the conduit knockout plates in the bottom and sides of the enclosure.
- **Holes are to be drilled where needed on knockout plates.** Wiring methods in accordance with the National Electrical Code, ANSI/NFPA 70 are to be used.
- It is recommended that at least 12" of flexible conduit be used below the inverter to make alignment easier.
- Cutting additional holes outside of the conduit knockout plates in the enclosure is not recommended and voids the warranty on the enclosure against corrosion and water damage. Any damage to the electronics caused by the modification will be **your** responsibility.



5. AC Output Connection

- The AC output is single phase and not bonded to ground.
- Connect the two single phase 240VAC or 208VAC wires from the distribution panel to the dual fuse block located on the lower left side of the enclosure.
- Tightening torque, allowable wire size, and type, for the Field-Wiring Terminals:
- 3 AWG for Copper Conductors Only
- 120 lbf-in tightening torque



6. AC Input Connection (Turbine)

- Connect the three phase turbine wires to the terminal block located on the lower right side of the enclosure.
- The inverter's wind turbine input must be connected to a galvanically isolated 3-phase "delta" or "wye" connection without a neutral.
- The inverter must be provided with 3, UL listed fuses rated, 400 VAC minimum, 45 Amp maximum for proper protection from the wind turbine input to the unit as well as an appropriate UL listed fuse holder to accommodate the fuses.
- Tightening torque, allowable wire size, and type, for the Field-Wiring Terminals:
- 6 AWG - to a maximum of 2 AWG for Copper Conductors Only
- 120 lbf-in tightening torque

7. Earth Ground Connection

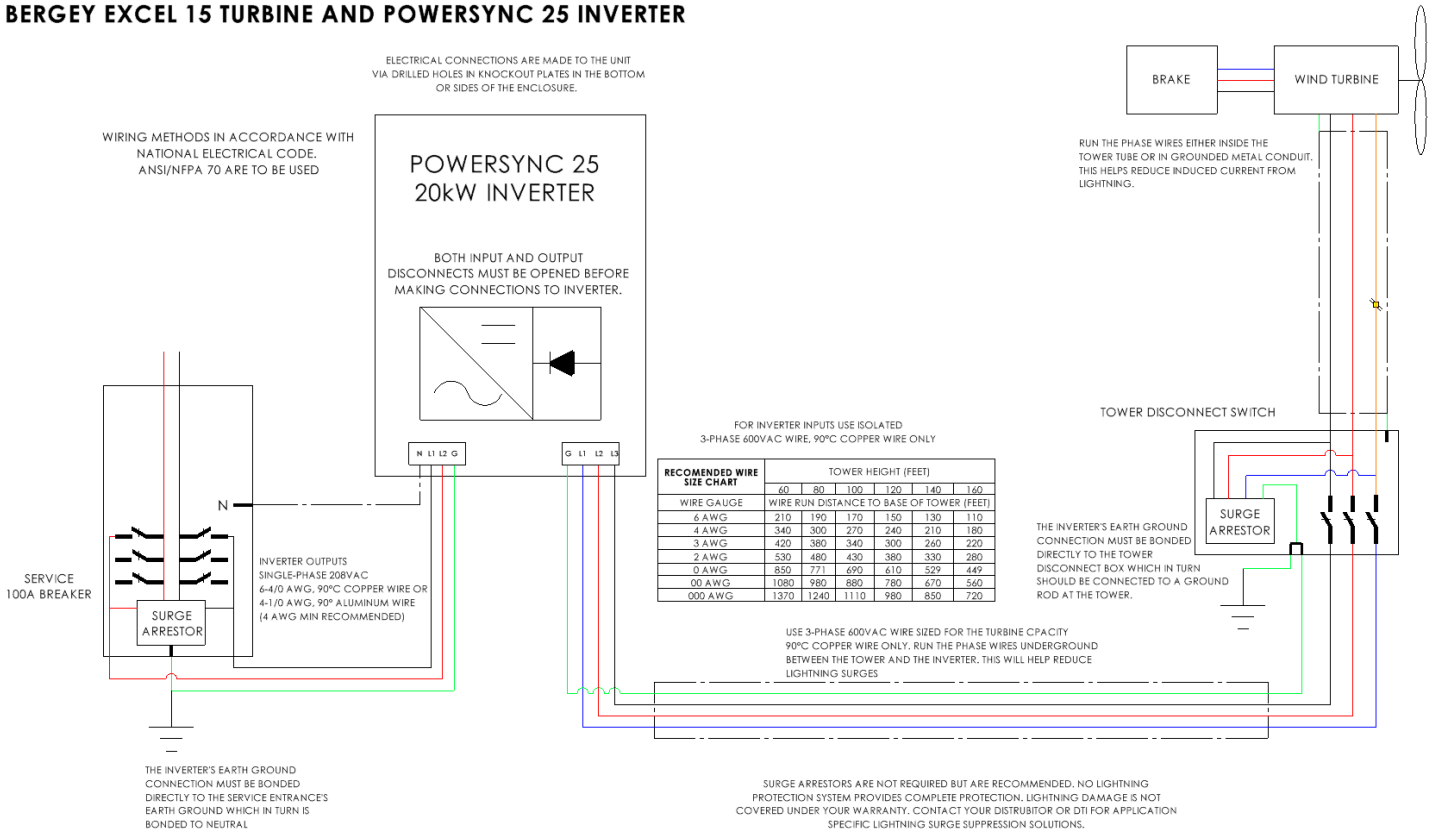
- Earth ground is to be connected to two of the 4 din rail mounted terminals provided inside the enclosure indicated by green and yellow casing.
- Allowable wire size range is 14 AWG – 4 AWG.
- 22 lbf-in tightening torque
- The inverter's earth ground connections available on both the input and output terminals must be bonded directly to the service entrance's earth ground which in turn is bonded to neutral. With a second bond, the inverter's earth ground connection must be bonded directly to the tower disconnect ground lug which in turn is bonded to the tower's ground rod.
- The input and output circuits are isolated from the enclosure. System grounding is the responsibility of the installer.

8. Fuse replacement

- **Warning:** For continued protection against risk of fire, replace only with same type and ratings of fuse.
- Three input fuses are located in a separate fuse box provided by the installer. Fuse type may vary, but must be UL listed fuses rated, 600 VAC minimum, 45 Amp maximum

9. Connection example

240 VAC, 1P ELECTRICAL SCHEMATIC
BERGEY EXCEL 15 TURBINE AND POWERSYNC 25 INVERTER



RECOMENDED WIRE SIZE CHART	TOWER HEIGHT (FEET)					
	60	80	100	120	140	160
WIRE GAUGE	WIRE RUN DISTANCE TO BASE OF TOWER (FEET)					
6 AWG	210	190	170	150	130	110
4 AWG	340	300	270	240	210	180
3 AWG	420	380	340	300	260	220
2 AWG	530	480	430	380	330	280
0 AWG	850	771	690	610	529	449
00 AWG	1080	980	880	780	670	560
000 AWG	1370	1240	1110	980	850	720

As typically the tallest structure in the area, lightning damage is a concern to most inverter customers; especially those customers in areas with frequent cloud to ground lighting. BWC's warranty does not cover lightning damage to the inverter. A direct lightning strike can easily be in excess of 100kV at 100kA. Proper grounding of the turbine to the tower and running the input wires down the tower in grounded metal conduit will take care of most of this energy. The standard inverter is capable of withstanding input line to ground surges of about 6kV at 3kA. Input and output Surge Protective Devices are included in the Powersync 25.

C. Inverter Operation

This equipment is a UL 1741 certified[1] Utility Interactive Inverter and complies with the requirements of IEEE1547 which is the standard for interconnecting distributed resources with electric power systems. It will not operate in an off-grid or backup power configuration.

The normal operation of the inverter is as follows: When single phase utility power is applied to the output of the inverter, the display will power up and a message stating that the unit is initializing is shown. If there are no faults, i.e. grid voltage and frequency are in tolerance, a countdown timer set for 5 minutes (300 seconds) starts before the inverter is ready to transfer power to the utility grid. The inverter will automatically transfer power to the utility when AC voltages in the range of 30VAC to 600VAC are present at the Turbine input.

As the inverter heats up after exporting significant power for a period of time the internal cooling fans will activate. The inverter is be able to operate at full power continuously if provided with adequate ventilation and the local ambient temperature stays below 45ºC (113ºF). If the inverter exceeds 60°C, the inverter will automatically reduce its output power.

When the Powersync 25 is starting up after initialization, or after the RESET button has been pushed, or after a power outage, it will go through a 300 second (5 minute) countdown that is required by UL 1741. This UL standard also dictates high and low limits for utility voltage and frequency, outside of which the inverter is required to shut down until they return to the acceptable range. This is called a FAULT condition.

There are a number of possible FAULT conditions during which the Powersync 25 will be protecting itself or the power grid. When a FAULT occurs the Powersync 25 will shut down (no power production) and a Fault Code will be displayed on the inverter display. FAULTS will reset themselves automatically; assuming the underlying cause of the fault has been cleared.

CAUTION If a manual reset is required we highly recommend that you contact the Bergey Service Department for assistance.

One unique feature of the Powersync 25 inverter is its Soft Grid power limiting capability that can reduce the number of nuisance FAULTS on weak power lines during periods of high turbine power output. On a weak power line the EXCEL 15 wind turbine can, on a windy day, raise the local utility voltage above the UL 1741 threshold, causing a FAULT. The Soft Grid feature tries to prevent these FAULTS by reducing power output from the wind turbine.

The DISABLE button on the inverter display will shut down the Powersync 25 inverter and EXCEL 15 turbine. Press the ENABLE button to restart (which will start the 300 sec. countdown).

If the circuit breaker in your home or business load center (circuit breaker panel) trips, it should be reset by first switching it to the OFF position and then to the ON position. If the breaker trips again immediately, or if it continues to trip after brief periods of normal operation, switch the breaker OFF and contact your Bergey dealer for assistance.

The following recommendations will help ensure the safe operation of the Powersync 25 inverter:

1. Keep all sources of moisture away from the Powersync 25 enclosure.

2. Do not work near the Powersync 25 with gasoline, paint thinner, or any material which produces flammable vapor. Do not store flammable materials near the Powersync 25 enclosure.

3. Do not open the Powersync 25 enclosure unless the circuit breaker and Accessible Disconnect Switch (ADC) at the base of the tower have been switched OFF. **Note that even with the circuit breaker and ADC switched OFF, a shock hazard may still be present inside the Powersync 25 enclosure for approximately 15 minutes (as the capacitor voltage drains down). The E-stop switch will reduce the voltage within 1 second.**

4. Do not block airflow around the Powersync 25 enclosure in any way. A six-inch clearance must be maintained around the sides, top, and bottom of the enclosure for adequate air circulation.

5. Install the Powersync 25 in a clean area. Keep the area under the inverter clean and without dirt. Installing in a building with a dirt floor is NOT recommended. There are filters on the fan inputs, they should be cleaned or replaced if clogged.

VI. INSPECTIONS AND MAINTENANCE

The Bergey EXCEL 15 turbine and tower should be inspected once 90 - 180 days after installation to ensure that no hardware was missed and there are no issues with the turbine.

Following this post-installation inspection, the complete system should be inspected every four years and after any particularly severe weather. Inspections should be done on days when the wind is below 20 mph (9 m/s).

Check List for Inspections

1. On guyed towers inspect each of the anchor points. Ensure that all hardware is secure and the guy wires are properly tensioned. Check to ensure that no strands are broken and the turnbuckle safety cables are in place.

WARNING: Loose guy wires or unsecured turnbuckles can lead to tower failure.

2. Disconnect the inverter at the breaker panel, which will bring the turbine to a stop. Climb the tower. Always use proper safety climbing gear and safe climbing practices.

DANGER Only qualified personnel with proper safety equipment should climb the tower. Never climb the tower when the rotor is turning.

3. Inspect the blades for:
   A. Cracks in the inner 4 ft. of each blade. This is the most highly stressed portion of the blade.
   B. Leading or trailing edge damage. Pay particular attention to the leading edge near the tip of each blade.
   C. Condition of the paint.

4. Remove the spinner and hang it from the machine. Check the marker lines on each of the blade attachment and torque plate bolts, retorquing and remarking any bolts that have loosened. Check the front bearing for seal integrity and excessive grease loss. Reattach the spinner and check that it is secure.

5. Open the cover plate on the mainframe. Inspect the slip-rings and brushes. Inspect the back-up brake circuit boards.

6. Check the rear alternator bearing for seal integrity and excessive grease loss.

7. Inspect the mainframe:
    A. Check for cracks
    B. Check capacitors for good connection and no dents
    C. Check slip rings for any excessive wear and dust build up.
    D. Check brushes for proper alignment and no excessive wear.
    E. Check backup brake resistors connection.

8. Check for cracks or loose hardware on the tail boom and fin.

9. Check for corrosion on the alternator. Clean and repaint as needed.

10. While descending the tower, inspect the following:
    A. Check that the tower wiring is properly secure.
    B. Check all fasteners.
    C. Look for any cracks in the tower structure.
    D. Check the condition of the guy wire attachment (guyed towers).

11. Check the connection on all ground rods and hardware.

12. Check the disconnect switch.

13. Inspect the wire run, particularly all electrical connections.

14. Check condition of all wiring connections into and out of the Powersync 25.

15. Check the fan filters on the Powersync 25.

16. Switch the turbine breaker in the breaker panel to ON. Move to a spot where you can observe the turbine. Listen to the sound of the machine as it speeds up. No mechanical sounds, such as a "clunking" or "banging," should be heard. Also watch for any new or significant vibration. The turbine operation should be smooth.

VII. Trouble-Shooting Problems

The following guide can help to pin-point the cause of operational problems with the Bergey EXCEL 15 wind turbine and the Powersync III inverter For problems or symptoms not found in the following listing please contact the Service Department at Bergey Windpower Co. at Tel. No. 1-405-364-4212, Telefax No. 1-405-364-2078, or E-mail: service@bergey.com

Problem	Cause(s)	Diagnosis	Remedy
Turbine makes an unusual blade sound, such as whistling or buzzing	1. Damaged blade leading edge 2. Blade structural damage	1. Have leading edge inspected 2. Have blades inspected. Cracks outboard of the hub can lead to blade failure.	1. Consult Bergey Service Department 2. If blade damage is suspected, the turbine should be stopped until it is inspected. Contact your dealer.
Rotor is unbalanced, causing the turbine to move slightly back and forth as it spins	1. Uneven ice build-up on blades 2. Blade damage	1. Ice on turbine and tower. Turbine ran smoothly before ice storm. Slow rotor speed. 2. No ice. Turbine ran smoothly before	1. Do nothing – ice will dislodge in a few days. No not approach the tower. 2. If blade damage is suspected, the turbine should be stopped until it is inspected. Contact your dealer.

Problem	Cause(s)	Diagnosis	Remedy
Turbine makes a banging or rattling sound once per revolution, particularly at low speeds	1. Loose spinner	1. Sound is once per revolution. Inspect spinner.	1. Have spinner inspected
	2. Alternator rear bearing ring fasteners loose or missing	2. Sound is once per revolution. Inspect rear of alternator	2. Have alternator inspected
	3. Alternator bearings	3. Excessive grease leakage. Squeaking sounds at low speed.	3. Have alternator inspected
Turbine makes a "fog horn" sound at certain, typically low, wind speeds	Electro-mechanical interaction between alternator and inverter that causes transient vibrations in the turbine	Sound comes and goes, but occurs at the same wind speed(s)	This is normal, but contact your dealer or the Bergey Service Department if the noise is excessive
Turbine makes a continuous growling or rumbling sound, which reduces at higher wind speeds		Switch fused disconnect on tower to OFF. If growling disappears an electrical problem is indicated. If growling continues a mechanical problem is indicated	
	1. Wiring fault	1. Check fuses. Check wiring for continuity, phase-to-phase fault, or short to ground.	1. Repair or replace as needed
	2. Inverter fault	2. After completing the wiring check, disconnect the inverter and reconnect wiring to the turbine. If the noise disappears an inverter problem is indicated.	2. Contact your dealer
	3. Alternator bearings	3. Check for excessive grease loss	3. Have the alternator inspected

Problem	Cause(s)	Diagnosis	Remedy
Rotor turns slowly and does not speed up in higher winds	1. Ice build-up on blades	1. Check for ice	1. Do nothing – ice will dislodge in a few days. No need to furl the turbine.
	2. Short circuit in wiring or inverter	2. Open tower disconnect. If turbine spins freely an electrical system problem is indicated	2. Contact your dealer
	3. Short circuit in tower wiring, slip-rings, or alternator	3. The most likely problem is a shorted alternator.	3. Contact your dealer
Rotor does not turn at all	Mechanical failure inside alternator	Rotor does not turn even when winds exceed 15 mph (6.7 m/s)	Contact your dealer
Powersync 25 display not functioning	1. No power to inverter		1. Turn off utility power to inverter, using the dedicated breaker in your breaker panel, for a minimum of 20 seconds. Then turn power back on using the breaker. Wait 300 seconds (5 minutes).
	2. Display or other inverter component not functioning properly		If inverter does not resume operation, with full display functionality, contact your dealer

VIII. Appendix

5 Year Limited Warranty

Excel 15 Wind Turbine

Bergey Windpower Company

Excel 15 wind turbines, their associated electronics and towers supplied by Bergey Windpower Company (BWC) are warranted against defects in design, material and workmanship under normal use for which intended. BWC Excel 15 wind turbines and blades carry a five (5) year warranty after date of installation. Electronic components and towers supplied by BWC also carry a five (5) year warranty after date of installation. During the warranty period BWC will repair or replace, at its discretion, defective components or assemblies. BWC will also pay one-way shipping charges. For customers not in the USA, shipping and insurance charges will be pre-paid to the port of entry into the customer's country. This limited warranty is transferable.

Warranty coverage is extended only to customers who have submitted a properly completed BWC Warranty Registration Form and acceptable proof of correct system installation as requested in the BWC Registration Form. Customer must also perform and document recommended inspections and any maintenance tasks that may be identified during inspections.

This limited warranty does not cover:

1. **Normal wear and tear and corrosion;**
2. **Towers and equipment, materials or supplies not manufactured or supplied by BWC;**
3. **Damage or loss caused by installation errors or deficiencies;**
4. **BWC equipment that has been modified without prior factory approval;**
5. **Repairs performed by personnel not authorized by BWC;**
6. **Damage resulting from use of equipment not supplied by BWC;**
7. **Damage resulting from the use of towers not supplied or approved by BWC;**
8. **Equipment not installed within three (3) years of shipment from factory;**
9. **Damage or loss of function sustained during periods when wind speed exceeds 60 m/s (135 mph);**
10. **Acts of God (including lightning);**
11. **Incidental or consequential damages.**

This limited warranty is in lieu of all other BWC guarantees or warrantees expressed or implied. No employee, agent, dealer, or other person is authorized to offer warranties on behalf of BWC. BWC reserves the right to make design changes, improvements and additions to its products without obligation to install such in products previously manufactured.

RETURN THIS CARD TO BWC ALONG WITH PHOTOS DOCUMENTING INSTALLATION
NOTE: DIGITAL PHOTOGRAPHS PREFERRED IF AVAILABLE)

Rev. 0 – 6.25.2018
Return to: Bergey Windpower Company
2200 Industrial Blvd.
Norman, Oklahoma 73069
(405) 364-4212

BWC EXCEL 15 WIND TURBINE WARRANTY REGISTRATION CARD

OWNER NAME _____

Address _____ _____

City, State _____

Postal Code, Country _____

Phone (____) _____

E-mail _____

DEALER NAME _____

Address_____

City, State _____

Postal Code, Country _____

Phone (____) _____

LOCAL UTILITY COMPANY INFORMATION (if grid-connected system)

Name of Utility _____

Net Metering? ☐ Yes ☐ No

HYBRID SYSTEM (If applicable)

Is turbine part of hybrid wind-PV-diesel system? ☐ Yes ☐ No

PV array? ☐ Yes ☐ No PV Power rating _____ kW

Diesel Gen-set? ☐ Yes ☐ No Generator rating _____ kW

Wind Turbine Model: **Excel 15**

Serial No. (e.g. 2018-0012; near top of yaw tube)

_____

Controller: ☐ PowerSync III ☐ Other _____

Controller Serial No._____

Blade Serial Numbers (e.g. 10080025; stamped on blade root pad)

_____ _____ _____

Tower Type _____ Height _____

Anchor Type _____

Wiring Run Length (Tower-to-Controller): _____ ft

Wire Size _____ gauge

Wire Type ☐ Copper ☐ Aluminum

BATTERY BANK INFORMATION (if applicable)

Battery Manufacturer & Model _____

Battery Bank Voltage ☐24V ☐48V ☐120V ☐240V

Battery Bank Amp Hours _____

Number of Battery Strings _____

Inverter Manufacturer and Model_____

OWNER'S or DEALER'S SIGNATURE _____

DATE SYSTEM INSTALLED _____

WARRANTY REPAIR IS PERFORMED ONLY AFTER FACTORY AUTHORIZATION. PLEASE RETURN THIS CARD AND PHOTOGRAPHS OF INSTALLATION PROMPTLY IN ORDER TO ASSURE COVERAGE.

Required Photographs

1. Complete tower - turbine system view
2. Distance photos showing terrain and obstructions
3. Anchor photos including all anchor hardware
4. Photos showing all grounding connections
5. Turnbuckle photos showing safety cables
6. Controller location and environment
7. Controller interior showing wiring connections
8. Interior of tower-base disconnect switch showing fuses and wiring connections