S-250 Owner’s Manual

Version 0.6

www.endurancewindpower.com
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Welcome to Endurance

Congratulations on your purchase of an Endurance Wind Power S-250 Wind Turbine System. Your choice of an Endurance wind turbine will reward you with years of reliable wind-generated electricity combined with the peace of mind in knowing that your turbine system has been engineered to the most stringent standards in the world.

To make sure that your Endurance wind turbine system meets all of your - and our - expectations, please fill out the enclosed Warranty Registration. This will ensure that your wind turbine investment is fully protected under our warranty program, and will allow us to keep your system up to date with any necessary product updates. Please know that your information is solely used for this warranty program so that we can keep your turbine operating in top condition, and we will never share, sell or distribute your information with any third party.

If you ever have any questions or comments regarding your Endurance S-250 turbine, our warranty policy, or any of our other products, we welcome you to contact us via email at techsupport@endurancewindpower.com. You may also contact technical support by dialing toll-free **1.866.946.3823**.

For your records, enter your system information below:

Serial Number _____
Model Number _____

Date of Purchase _____
Date of Commissioning _____

Safety Information

Please follow these important safety instructions to ensure safe and reliable service from your Endurance wind turbine.

1. Always read and respect all warnings posted on all equipment.
2. Professional installation of your wind turbine system is highly recommended.
3. Obey all electrical and building codes in your area.
4. Obtain all permits prior to installing your system.
5. Endurance products are designed to strict international IEC 61400-1 wind turbine safety standards and any alteration to the design or installation instructions can compromise safety and jeopardize the warranty.
    a. Use only supplied hardware or replacement hardware supplied and approved by Endurance Wind Power.
    b. Follow all installation instructions including proper torque application to all fasteners.
    c. Do not modify the blades in any way; do not sand or paint the blades.
6. The Endurance wind turbine uses and supplies high voltage; observe all safety precautions to avoid damage, injury or death from electrocution. Employ the services of a licensed electrician to install the Endurance wind turbine, and obey all electrical codes and ordinances in your area.
7. Complete your warranty registration card to ensure your investment is properly protected.

Introduction

Congratulations on your purchase of an Endurance Wind Power S-250 Wind Turbine System. This manual is your reference for understanding your wind turbine system and how it operates.

Please read through this manual to get acquainted with how your S-250 operates so that you understand what to expect from your new wind turbine system. You can later refer to the manual when you have questions about operating characteristics and other aspects of the turbine.

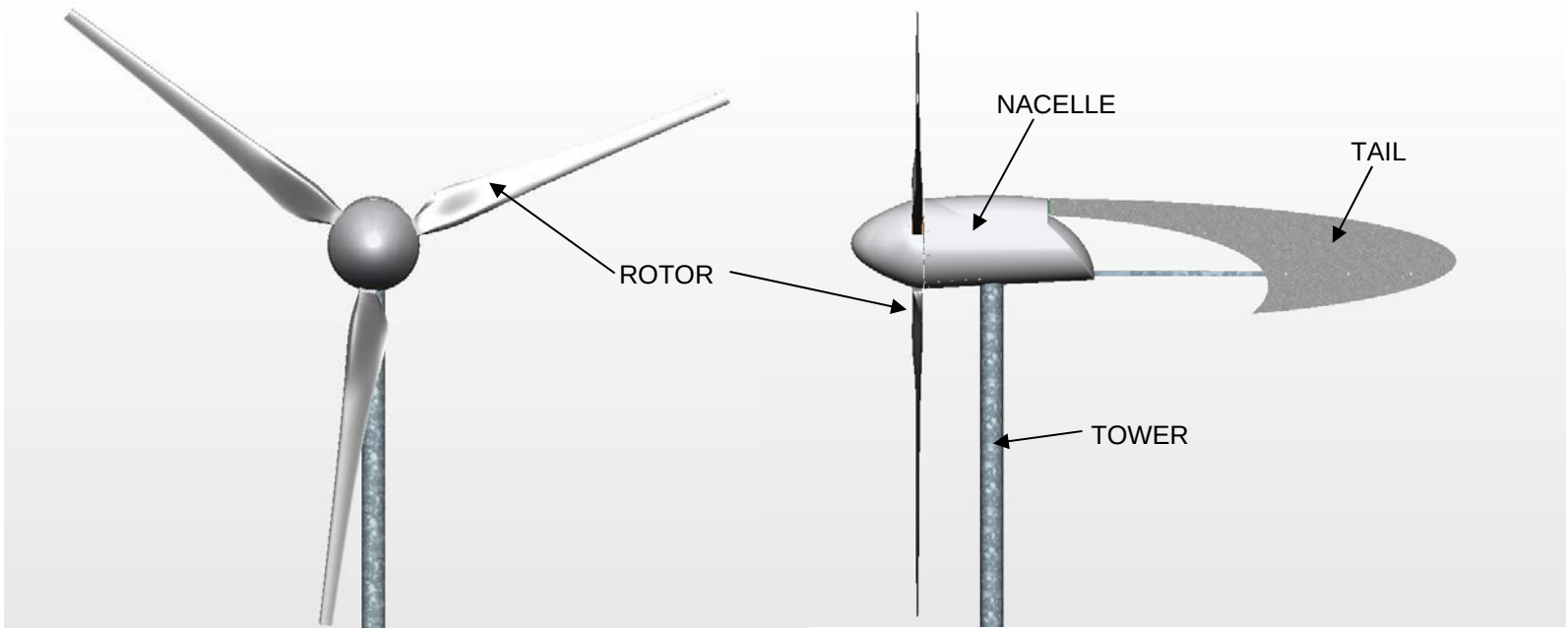
Installation

An Endurance S-250 Tower Installation Manual and Turbine Installation Manual are provided with your wind turbine system. Detailed information on installing your tower, turbine and commissioning the S-250 for service are provided therein. Professional installation is highly recommended and is required to avoid invalidating your warranty.

Turbine

Your turbine is comprised of several main components:

- The rotor, consisting of three aerodynamic blades, spins to capture the energy in the wind.
- The nacelle, or body of the turbine, contains the braking and generating systems, including all the components needed to convert the energy captured by the rotor into electricity.
- The tail keeps the rotor facing the wind direction to maximize energy capture of the rotor.
- The tower places the turbine high in the air where the rotor can catch the strongest winds.
- The control panel, located at or near the base of the tower, monitors and controls turbine operation at all times.



Turbine Components

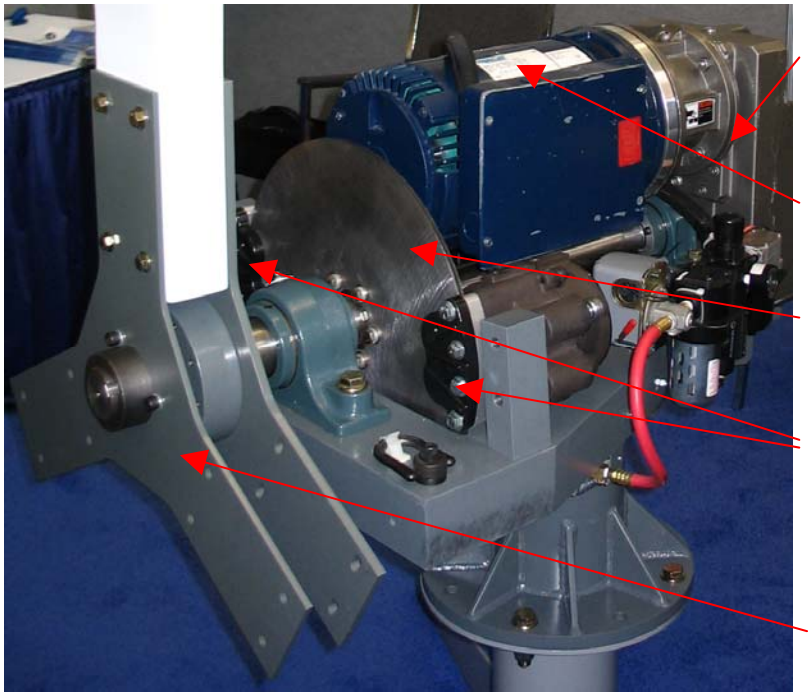
The inner workings of your Endurance wind turbine include carefully chosen components expertly engineered in a configuration to provide reliability and longevity to your wind energy investment.

The rotor is a sandwich-hub arrangement that ensures the blades will stand up to the harshest treatment Mother Nature serves up.

The brake system uses redundant calipers on a single, 16-inch brake disk to guarantee the ability to stop the rotor during any condition.

A speed increaser (gearbox) allows the rotor to turn at a quiet, leisurely pace (around 200 RPM), while the generator spins at a more efficient high speed (near 1800 RPM).

An induction generator provides grid-compatible power directly, eliminating the need for expensive, complicated, inefficient and unreliable power electronics.



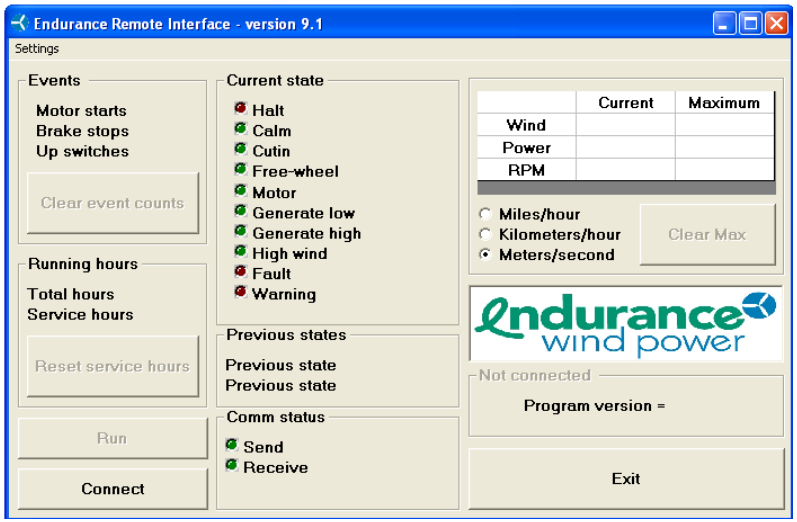
Remote Command Software

Your Endurance S-250 is equipped with wireless communication capability that can be used to link your PC to allow communication with the turbine controller. The wireless modems are capable of communicating over a range of 1000 ft (300 m) or more, though the range can be reduced by obstructions such as walls between the modem antennae.

A software program is available to handle the communication between your computer and the turbine controller. This software provides basic information about the operating state of the turbine, as well as the ability to stop and start the turbine, and to perform commissioning test functions remotely.

The software package is provided on a CD or as an emailed or downloadable package (use your web browser to download the current version from http://www.endurancewindpower.com/code/Endurance_Remote_Interface_9_1.zip). You should install the software according to the instructions provided with the program. You will also need the wireless modem and AC power plug provided with your Endurance wind turbine. A USB to serial converter cable may be needed for some modems if your computer lacks a serial port.

Once the software is installed, connect the modem to your computer and plug the power cord into an AC outlet. Now start the software by clicking on the icon on your computer. The Endurance Turbine Monitor software window will appear (see image at right)



To connect the software to the turbine controller, ensure that the turbine is powered up, then click on the Settings menu and select Serial Port. In the dialog box that appears select the proper serial port where you connected the modem. If you are unsure of which port to use, try each one until connection is established as indicated in the pane in the lower right of the window directly above the Exit button. When the connection is established this window will read “Connected to…” followed by the program version number for the turbine controller firmware.

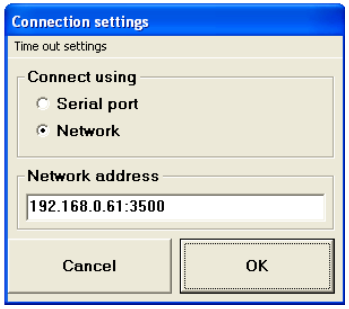
With connection established, turbine information can be monitored, and turbine operation can be controlled.

Settings

In the upper left of the window is the Settings menu. Here you can select the serial port where the modem is attached to your PC, and set up notifications for events that occur if you desire.

Serial Port – for AeroComm wireless modems

Click on Settings>Local Connection Settings and select the Serial Port option. From the dropdown menu select the serial port where you attached the wireless modem. Ensure the modem is plugged into an outlet and the PC and the turbine is powered on with its controller modem properly attached. If you have no communication through the modem, try selecting a different serial port to repair the connection. If you move the modem to a different serial (or USB) port, you may also need to update the serial port setting from this menu.



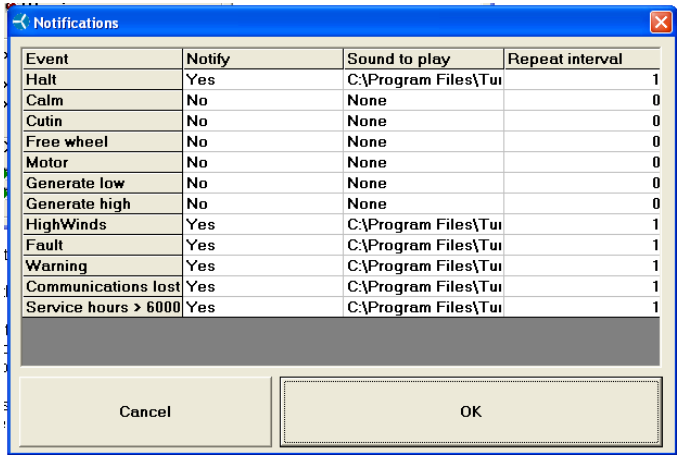
Network – For Trendnet Wireless Access Points

Click on Settings> Local Connection Settings and select the Network option. In the Network Address window type in the address of the turbine controller, which is factory set as 192.168.0.61:3500. Ensure the modem is plugged into an outlet and the PC (or a home network router) and the turbine is powered on with its controller modem properly attached. If you have no communication through the modem, you may need to change network settings on your PC or router. Contact your Endurance Wind Power service technician for assistance.

If the Endurance Remote Interface software is left running it may time out and disconnect communications with the turbine controller. This is to allow access from other computers either local or remote. This setting can be changed from the Settings> Local Connection Settings menu. At the top of the Connection Settings window, click on "Time out settings" where you can change the intervals or bypass time out settings altogether.

Notifications

You can select when and how you would like the Remote Turbine Monitor to notify you on your screen using the menu selection Settings>Notifications. This option pulls up a dialog window similar to the one shown to the right. For each event in the leftmost column you can choose whether to be notified, what sound you would like played and how often to repeat the notification. For example, to be notified whenever the turbine enters a particular state, set the cell in the "Notify" column to Yes by clicking in that cell. The setting will toggle between Yes and No each time you click there. Click in the corresponding cell in the "Sound to play" column to pull up a dialog box to select a custom sound file. Here you can also set the repeat interval (in seconds). Set the interval to zero to be notified just once per occurrence.



Events

In the upper left is a pane showing the counters for events. These values indicate important information about the turbine operation as follows:

Motor Starts: This counter indicates how many times the turbine has been motored up to speed to prepare to produce electricity from the wind. This counter is reset to zero using the Clear Events button.

Brake Stops: This counter indicates the number of times the brakes have been applied. It does not differentiate between brake applications at full speed or when the rotor is stopped. It includes all brake application incidences except for grid power interruptions when the controller itself shuts down. This counter is reset to zero using the Clear Events button.

Up-switches: This counter indicates the number of times the patented Dual-Voltage Switching (DVS) System has switched the turbine generator from 120V output operation to 240V output operation. This counter is reset to zero using the Clear Events button.

At the bottom of the pane is the Clear event counts button. Click on this button to reset all three counters listed above to zero.

RUN/HALT Button

In the lower left is a button used to stop or start the turbine remotely. This button performs the following functions:

Halt: Use to stop the turbine at any time, also to clear any fault conditions detected by the controller. Be careful to always check the turbine appropriately prior to resetting from a Fault state. The source of the fault should be determined and cleared before returning the turbine to service.

Run: When the turbine is placed in a halt state, this button will appear in this location. Clicking on it will start the turbine from the Halt state.

Running Hours

In the center left is a pane showing the time counters for running hours. These values indicate turbine operating time as follows:

Total Hours: This indicates the total lifetime cumulative number of hours the turbine is in an operational state where the rotor is rotating.

Service Hours: This indicates the number of hours since the last service hour reset that the turbine has been in an operational state where the rotor is rotating. This value can be reset to zero using the Reset service hours button.

At the bottom of the pane is the Reset service hours button. Click on this button to reset the Service Hours to zero. This should be done only after the turbine has undergone its regularly scheduled service.

Current State

This top-center pane indicates the current operating state of the turbine. The current state is designated by the "LED" indicator "lighting" (turning bright red or green). The possible states are:

Halt: This state indicates a manual halt command has been issued via remote or at the control panel. A manual restart is required to start the turbine.

Calm: This state indicates the turbine is awaiting sufficient wind speed to warrant releasing the brakes and start spinning.

Cut-in: This state indicates enough wind speed has been sensed to warrant releasing and holding off the brakes. If sufficient wind speed continues, the turbine will freewheel or motor up to speed.

Freewheel: The turbine is operating with the brakes off and is spinning in the wind, but the wind speed is not sufficient to generate electricity.

Motor: The turbine is using the generator as a motor to bring the rotor quickly up to speed to prepare it to generate electricity from the wind.

Generate Low: The turbine is generating electricity at 120V in low winds.

Generate High: The turbine is generating electricity at 240V in higher winds.

High Winds: The turbine controller has detected winds in excess of 55mph (25 m/s; 88kph) and has shut down waiting for the strong winds to subside.

Fault: The turbine controller has detected a serious problem with the turbine and has shut down. A manual reset is required. Be sure to inspect for and repair the source of the fault prior to returning the turbine to service. The type of fault is indicated next to the Fault tag when this "LED" lights. Detectable faults include:

- Over-speed: The turbine rotor speed has exceeded 220rpm.
- RPM Error: The controller has detected a discrepancy between the two turbine rpm sensors.

Warning: The turbine controller has detected a potential problem and has shut down. The turbine will automatically reset once the problem has cleared. No user interaction is required. The type of warning is indicated next to the Fault tag when this "LED" lights. Detectable warnings include:

- Grid Error: The controller has detected that the grid voltage or frequency is outside of the required range specified by utility standards. The turbine is shut down as a precaution, but will restart once the grid returns to expected operating parameters.
- Anemometer Error: The controller has noticed the wind speed measured is too low, but the turbine is generating wind power. This usually indicates the anemometer has iced up, but could indicate an anemometer failure. The turbine will restart once the anemometer starts working again (either by thawing out or being repaired).
- Motoring Error: The controller noticed it took too long to motor the rotor up to speed. This could be the result of a transient condition such as ice in the pneumatic brake lines. The situation may correct itself, but if it persists service may be necessary.

Previous States

The controller keeps track of the two previous states in addition to the current state. This history is presented in this pane in the middle of the window. This pane is useful to know how the turbine arrived at the current state, which may come in handy when trying to diagnose any problem that might occur. The state at the top of the list is the one immediately prior to the current state. The one at the bottom is the one two states prior to the current. (Note: Faults and Warning are indicated here without details as to the type of fault or warning.)

Comm Status

This pane in the lower middle of the window blinks a Send and Receive "LED" for every communication sent and received, respectively, by the remote Commander software. When communicating successfully, the Send "LED" will blink briefly, followed immediately by a brief blink of the Receive "LED."

Turbine Data

In the upper right is the turbine data pane. Here the current and maximum values for wind speed, power and rotor RPM are displayed.

The wind speed displayed is a 5-second average of the wind speed measured at the anemometer on the Endurance tower. The wind speed units are selectable using the radio buttons at the bottom of this pane. Options are miles per hour (mph), kilometers per hour (kph) or meters per second (m/s).

The power displayed is in units of watts. It is important to note that the controller does not measure actual power output of the turbine. The power displayed here is an accurate estimate of generator output based on a calculation using the measured rpm of the rotor and the design slip ratio of the generator.

The RPM shown is the instantaneous (measured every 0.1 seconds) of the wind turbine rotor. The generator rpm is roughly 9 times higher.

Note that a maximum value for wind speed, power and rpm do not necessarily occur simultaneously; in fact it is likely these maximums did NOT occur at the same time. The maximum values can be reset to zero at any time by clicking the Clear Max button in the command button pane.

Communication Connection

Near the lower right is the Connection pane indicating whether connection has been established with the turbine controller. When connected this pane reads "Connected to… Program version n.n.n" where the n.n.n is the version number of the turbine controller firmware. When communication fails, or the program is otherwise not connected, this pane blinks "Not connected." Reasons for a failed connection include:

- Modem not connected or powered up – check modem connections to computer and AC power and check modem power LED.
- Wrong COM port selected – Choose the proper COM port from the Setting – Local Connection Settings menu selection.
- Improper Network Address – correct the network address from the Setting – Local Connection Settings menu.
- Modems too far apart – Try placing the remote modem closer to the turbine.

Exit Button

Located in the bottom right, clicking this button will close the remote Turbine Monitor program.

Commissioning Test Button

During the commissioning phase of turbine installation, your installer can place the turbine in a commissioning test configuration that allows access to the commissioning test menu. That menu will be accessible from an additional button that will appear at the bottom of the remote Turbine Monitor software window. Using this menu, your installer can alter parameters in the controller from normal values to conduct specific tests. Operating the turbine in any state other than NORMAL RUN should not be done except for the sole purpose of running commissioning tests.

If the commissioning test button is available (next to the Exit button) on your Turbine Monitor software screen, contact your Endurance technician to switch the turbine from the commissioning to the normal operating configuration.

Minimizing the Window

Minimizing the Turbine Monitor software window will send the program to the system tray (typically located in the lower right part of your desktop). The program will continue to run in the background. To access the window, right click on the icon in the system tray.

Remote Console (Optional)

Your Endurance S-250 is equipped with wireless communication capability that can be used to link to an optional remote unit that communicates with the turbine controller. The wireless modems are capable of communicating over a range of 1000 ft (300 m) or more. To use the remote, simply plug one end of the power cord into the side of the remote, and the other end into a standard 120V AC wall outlet.

The remote has an LCD display that is backlit whenever it is plugged in, and a series of LED lights below the display. It also has a series of seven buttons: "◀", "▲", "▼", "▶", "-", "+", and "↵". Although it may appear the buttons correspond to the LEDs, they do not.

On power-up, the remote unit will flash LEDs in sequence and display a splash screen reading "Endurance Wind Power" followed by another splash screen displaying the version of the code currently installed in the home unit. It will then display the Main Screen.

There are a total of six screens you can page through.

LEDs

Of the seven LEDs on the remote, only four are used to provide information about the turbine as follows:

LED location from left	Color	Functionality	Purpose
1	Red	Steady	When this light is lit there is no communication between the remote and the turbine, and any information displayed on the remote will not be current. Check for power to the turbine and that the remote is not too far from (out of range of) the turbine.
2	Green	Steady	When this light is lit the turbine and remote are communicating successfully and all information displayed on the remote is current.
3	Green	Rapid blink once or twice approximately every 2 seconds	The first blink of this light every two seconds indicates an attempt by the remote to communicate with the turbine. A rapidly occurring second blink indicates the turbine has successfully responded to the remote.
6	Amber	Steady	This light indicates 6,000 hours of turbine operating time has elapsed since the service interval was last reset. Conduct annual maintenance as required before resetting the service interval (see Hours Log Screen description below).

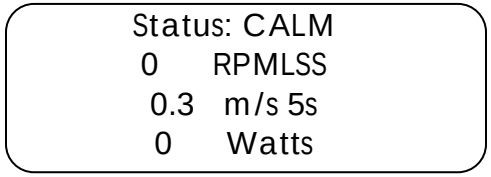
Multi-screen Description

The left (◀) and right (▶) arrow buttons can be used to switch to additional screens on the home unit. These screens (paging from first to last using the right arrow button - ▶) are:

Main Screen

The Main screen displays four lines each providing information on current turbine operation:

1. Operating state of the turbine,
2. RPM of the turbine rotor,
3. Wind speed as measured by the anemometer on the tower, and
4. Estimated power output of the wind turbine.



The operating states of the turbine are summarized in the table below.

Operating Condition	Operating State	Display	Brake Status	Turbine Power State	Conditions
Normal Operation	Calm	Status: CALM	Applied	Off	Winds too light to start
	Cut-in	Status: CUTIN	Released	Off	Rotor not spinning in low winds
	Freewheel	FREEWHEELING	Released	Off	Idling in low winds
	Motoring	MOTORING	Released	120V motor	Motor up to starting speed
	Generating Low	GEN 120V	Released	120V generating	Producing low power
	Generating High	GEN 240V	Released	240V generating	Producing high power
	High Winds	HIGH WIND	Applied	Off	Winds too strong
User HALT	Halt	Status: HALT	Applied	Off	Manual input commands needed to exit HALT or FAULT state and return to Normal Operation state.
FAULT	RPM Error	Err: RPM ERROR	Applied	Off	
	Over Speed	Err: LSS OSPEED Err: HSS OSPEED	Applied	Off	
	Unknown	UNKNOWN XX	Applied	Off	
WARNING	Grid Error	Err: GRID FAULT	Applied	Off	Auto restart after 5 min.
	Anemometer Error	Err: ANEM ERROR	Applied	Off	Auto restart after 1 min.
	Motoring Error	Err: MOTOR ERR	Applied	Off	Auto restart after 3 hr.

RPM display

The rpm displayed on the remote is an instantaneous value measured by a high accuracy encoder mounted on the turbine shaft. The rpm of the rotor will range from 0 to approximately 215 during normal operation. The turbine produces power at speeds above approximately 200 rpm, and freewheels (spins freely in the wind) at speeds below approximately 200 rpm. If rotor speed ever exceeds 220 rpm for a short period of time, the turbine will shut down in an Over Speed FAULT state.

Wind Speed display

Wind speed is measured by an anemometer mounted below the turbine on the tower. The wind speed displayed on the remote is a 5-second average value. Note that many decisions made by the turbine controller are based on a 1-minute average of wind speed.

The wind speed can be displayed in either meters per second (m/s) or miles per hour (mph). You can toggle between the two on this screen using the "▲" or "▼" buttons on the keypad. The turbine will start at around 4 m/s (9 mph) and will shut down for high winds exceeding approximately 25 m/s (55 mph).

Power display

The power displayed on the remote is a calculated estimate based on a well-defined equation relating generator speed to power output. This is a very useful value of the power being produced by your turbine at that moment in time.

Remote HALT Command

When viewing the main screen, the turbine can be halted by pressing the "-" button. The turbine will go into the HALT state, applying the brake and stopping the rotor. The turbine will remain in the HALT state until a manual run command is given via the remote or at the control panel.

If the turbine encounters a FAULT condition requiring a manual reset, the turbine must first be given a HALT command to clear the FAULT. Be sure to check for the source of the fault and take any corrective action before clearing the FAULT.

Occasionally after a power interruption the turbine may revert to the HALT state, as it may be the last saved state in flash memory, or as a safety precaution. If you find the turbine in an unexpected HALT state, visually check the turbine before returning to normal operation using the run command described next.

Do not rely on a HALT command from the remote to shut down the turbine for extended periods. Instead, disconnect power to the turbine using the service circuit breaker or electrical disconnect switch to avoid any unexpected start-up of the turbine.

Remote RUN Command

From the HALT state, the RUN command can be given when viewing the Main Screen by pressing the "+" button. This will place the turbine in the normal operating state where it will switch operating states according to wind conditions.

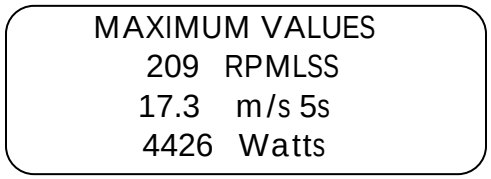
If attempts to give a RUN command via the remote are not successful (the turbine remains in a HALT state) and communication between the remote and turbine is verified by the green LED on the remote, it is possible the HALT switch in the controller is activated, thus overriding the remote RUN command. Have your Endurance technician check the status of the HALT switch in the controller.

Additional information regarding operating states and HALT and RUN commands is provided further on in this manual.

Maximum Values Screen

The Maximum Values Screen displays four lines (including the header), providing information on three maximum values encountered during operation:

1. Maximum RPM of the turbine rotor,
2. maximum wind speed as measured by the anemometer on the tower, and
3. maximum estimated power output of the wind turbine.



Maximum values are noted by the controller and sent to the remote when they occur, but are only recorded at eight hour intervals, so some values may be lost if a power interruption to the turbine occurs before a new maximum has been recorded to the controller memory.

The values can be reset to zero by pressing the "-" button on the keypad while viewing this screen.

The wind speed units can be toggled between m/s and MPH by pressing the "▲" or "▼" buttons on the keypad while viewing this screen.

Events Log Screen

The controller keeps track of the number of occurrences of certain events and these are displayed on the remote on this page. The four lines display the header and the following three items of information:

EVENTS	
Starts:	13
Stops:	9
UpSwitch:	105

1. Starts - number of times the turbine motored the rotor up to speed,
2. Stops - number of times the turbine applied the brakes to park the rotor, and
3. Upswitch - number of times the controller switched the generator from low voltage power to high voltage power.

Starts

In light and variable winds the turbine will motor more often than in strong and steady winds, and this will be reflected in the number of Starts.

Stops

Stops include all instances of the brakes being applied. These do not always indicate events where brakes are used to stop the rotor from full speed, but also include instances where the brakes are applied to a rotor that has stopped due to lack of wind.

Upswitches

During power production in moderate to strong winds, the controller may switch between high and low voltage many times. As a result, the number of Upswitches recorded on this screen can add up quickly. A large number of upswitches is perfectly normal and indicates your turbine has experienced good power-producing winds.

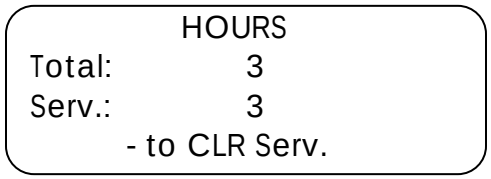
As with the maximum values, the events are only saved to memory every eight hours, so some values may be lost if a power interruption occurs prior to them being saved to memory. The values in the Event Log can be reset to zero by pressing the "-" button on the keypad while viewing this screen.

The operating states of the turbine are summarized in the table below.

Hours Log Screen

The controller keeps track of the number of hours the turbine operates in states where the brakes are released and the rotor is free to rotate. This screen displays these values as follows:

1. total number of operating hours, and
2. total number of hours since last service reset.

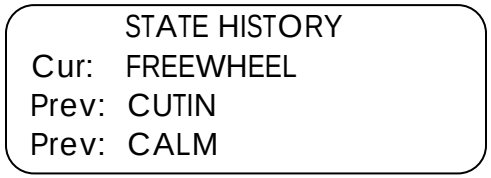


The service hours can be used to keep track of when to service the turbine (i.e. grease bearings, etc.). When the service hours exceed 6,000 the amber LED (second from right) on the remote will light to remind you it is time to service the turbine. Typically this interval will occur around or before the time annual maintenance is required. Whenever service has been completed on the turbine, remember to reset the service hours on this screen by pressing the "-" button on the keypad (as the text at the bottom of the screen indicates).

State History Screen

The controller keeps track of the previous tow operating states of the turbine in addition to the current state. This screen displays this information (below a header line) as follows:

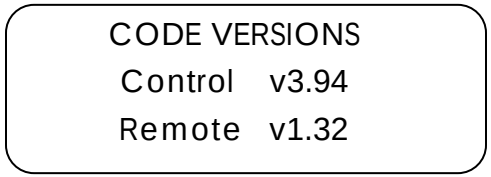
1. Current operating state of the turbine,
2. operating state of the turbine immediately prior to the current state, and
3. operating state of the turbine prior to that state.



This brief history of operating states can be a useful diagnostic tool for troubleshooting. Should you encounter any conditions that concern you, note the state history in order to help your Endurance technician better understand your situation.

Code Version Display Screen / Commissioning Test Selection Screen

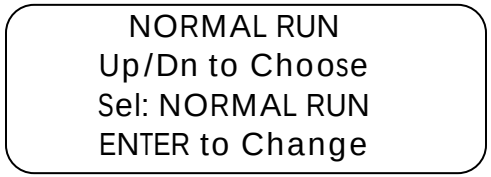
When configured for normal operation, the final page on the remote display screen shows the versions of firmware running in both the turbine controller and remote. This information is useful to your Endurance technician in evaluating any problems with your controller or remote, or when upgrading either of these firmware packages.



If the final page of the remote screen does not display the code versions, but instead displays the commissioning test selection menu described below, contact your Endurance technician to remedy this situation. The turbine should not be left to operate in the commissioning test configuration.

Commissioning Test Menu

During the commissioning phase of turbine installation, your installer can place the turbine in a commissioning test configuration that allows access to the commissioning test menu. That menu will be displayed in the final page of the remote screen in this configuration. Using this menu, your installer can alter parameters in the controller from normal values to conduct specific tests. Operating the turbine in any state other than NORMAL RUN should not be done except for the sole purpose of running commissioning tests.



If the final page of your remote shows the commissioning test menu, contact your Endurance technician to switch the turbine from the commissioning to the normal operating configuration.

Turbine Operation

Endurance wind turbines are designed to operate automatically without the need for any interaction from you. The control system continuously monitors the wind and rotor speed to make decisions on turning the turbine on or off, as well as other aspects of operation. If any unforeseen event is encountered, the control system will automatically shut the turbine down and may require a manual reset once the detected fault is fully investigated and cleared. Information on these conditions is provided in this manual.

Normal Operating States

During normal operation the S-250 will operate in one of six states:

1. CALM – the turbine is waiting for sufficient wind to release the brakes
2. CUT-IN – there is sufficient wind to release the brakes and prepare to start spinning the rotor
3. FREEWHEEL – the brakes are released and the rotor is free to spin up to operating speed
4. MOTORING – the generator is being temporarily powered as a motor to help bring the rotor up to operating speed
5. GENERATE 120V – the turbine is producing 120V electrical power from the wind
6. GENERATE 240V – the turbine is producing 240V electrical power from the wind

Time-Out Conditions

The Endurance S-250 control system will temporarily shut down the turbine for specific operating conditions. Once these conditions clear, the turbine will revert to normal operation following a prescribed time-out period:

1. HIGHWINDS – the turbine will shut down when winds exceed approximately 55 MPH (25 m/s) to protect the rotor from potentially damaging gusts. Once wind speeds subside to less than 45 MPH (20 m/s) for at least 30 minutes, the turbine will return to normal operation.
2. GRID FAULT – the Endurance control system monitors grid voltage and frequency for compliance with IEEE 1547 standards to ensure safety of the electrical system. If the voltage or frequency is determined to be out of range, the turbine will shut down. Once normal grid conditions resume for at least five minutes, the turbine reverts to normal operation.
3. ANEMOMETER ERROR – if the control system ever detects the turbine is producing power without any measurable wind speed to do so, the turbine is shut down as a precaution. Normally this condition signifies the anemometer has stopped due to icing (though a more permanent failure of the anemometer could also trigger this condition). Once the icing (or other condition) has cleared for one minute, the turbine will resume normal operation.
4. MOTORING ERROR – if the turbine attempts to motor to bring the rotor up to speed and fails to turn the rotor, or fails to accelerate it to speed in a specified time, this error is registered and the turbine is shut down. This error could result from a failure to release the brakes (due to icing in the pneumatic system for example) or an electrical problem with the motoring circuits. The turbine will revert to normal operation after a time-out period of three hours, allowing time for transient conditions (such as pneumatic system icing) to clear. The condition can be cleared manually through HALT and RUN commands from the remote. If the motoring error condition is persistent, contact your Endurance technician to correct the problem.

Manual Reset Fault and Halt Conditions

There are some conditions that are serious enough to require a manual reset of the turbine to return it to operation. Prior to doing so, however, it is important to assess what caused the initial fault condition (refer to the Troubleshooting Guide in this manual for assistance) and take any necessary steps to rectify the problem to ensure it will not occur again upon manually resetting the controller:

1. OVERSPEED – if the turbine rotor ever exceeds 220.7 RPM for 0.2 seconds, the controller registers an error and stops the turbine. This error should not occur during normal operation of the turbine and indicates a serious problem that should be addressed before returning the turbine to service.
2. RPM ERROR – the turbine control system uses redundant rotor speed sensors to ensure the control system always knows the actual rotor speed. If these two rotor speed signals do not agree with each other, the controller registers an error and shuts the turbine down. This error indicates a serious problem with one of the rotor speed sensors or signals that should be rectified prior to returning the turbine to service.
3. HALT – the turbine controller can be placed in a manual halt condition which requires a manual run command to clear and return the turbine to service. If the control system gets confused upon start-up (due to grid electrical problems for example) the controller may place the turbine in this state as a precaution. If the turbine is discovered in a HALT condition, do a cursory check of the turbine prior to restoring it to service.

Clearing a Fault or Halt

There are two methods for clearing a fault or halt condition:

1. Using the Remote – to clear any of the Fault conditions, first place the turbine in a HALT state. To do this using the remote, ensure the turbine is on and communicating with the remote. From the main screen press the "-" button and wait several seconds. Once the remote confirms the turbine is in a HALT state, press the "+" button and wait several seconds. The turbine should now be in normal operating mode.
2. From the Control Panel – Fault and halt states can be cleared from the control panel, but **extreme caution is required with this method as the control panel carries high voltage electricity that is extremely dangerous. This method is NOT recommended for safety reasons.** If the remote reset method above cannot be used for some reason, this option can be used by an experienced electrician or turbine repair specialist to reset the turbine. With the turbine powered, the switch atop terminal block #37 can be opened and then closed. Opening this switch places the turbine in a HALT state, clearing any fault. Closing the switch clears the HALT, returning the turbine to normal operation.

Troubleshooting Guide

Problem	Possible Cause	Potential Solution
Remote not working	Remote not plugged in	Plug remote into working 120VAC power outlet.
Remote does not display the Code Version page	Commissioning Test jumper not installed in turbine controller.	Have service technician install the Commissioning Test jumper in the turbine controller before running the turbine. Turbine should not be operated with the jumper removed except to conduct specific tests.
Remote reading “unknown” for states and history	Remote not communicating with turbine	See below.
Remote not communicating with turbine controller/ Red LED (#1 from left) lit on remote	Remote out of range of turbine. Turbine not powered on. Modem or antenna not properly connected in turbine controller.	Place remote in a location closer to turbine. Check that turbine is powered on at the service breaker and disconnect switch. Have service technician check modem connections in the turbine control panel.
Green LED (#2 from left) lit on remote	Remote is communicating normally with turbine controller.	Situation normal.
Green LED (#3 from left) blinking on remote	Remote is communicating normally with turbine controller.	Situation normal.
Amber LED (#6 from left) lit on remote	Turbine has operated for over 6,000 hours since service interval was last reset.	This LED indicates it is time to perform annual maintenance. The maintenance schedule is presented in this manual. Once maintenance is completed, the service interval can be reset and the LED turned off from the Hours Log Screen by pressing the “-“ button.

Problem	Possible Cause	Potential Solution
Turbine is not spinning	Insufficient wind	This is normal – remote should read CALM or CUT-IN.
	There is sufficient wind but turbine has just been turned on	Turbine will remain in a CALM state for five minutes after initially connected to the power grid (manually or after a grid outage) to comply with electrical service regulations.
	Turbine is in an error or time-out state	Check the state of the turbine using the remote. Time-out states (HIGHWINDS, GRID FAULT, ANEMOMETER ERROR, MOTORING ERROR) will reset themselves, so wait for the situation to clear. FAULT conditions (OVERSPEED, RPM ERROR) require a manual reset following assessment of the condition.
Remote reads “HALT”	Turbine was remotely placed or “woke up” in a HALT state.	From the Main Screen on the remote, press the “+” button to place the turbine in normal operation. Be sure to check the turbine before placing it back in operation.
	Turbine was placed in manual HALT state from the turbine control panel.	Have service technician reset the HALT switch in the control panel.
Remote reads “HIGHWINDS”	Anemometer detected winds exceeding the maximum allowable (~55 MPH) and is waiting for the winds to subside.	This is normal and will reset once winds subside to below ~45 MPH for 30 minutes.
Remote reads “:ANEMOMETER ERROR”	Anemometer has iced up	Turbine will return to normal operation once ice has melted from anemometer and wind spins it.
	Anemometer is broken.	Have service technician replace anemometer.
	Anemometer signal is not reaching the controller.	Have service technician check the anemometer signal in the control panel and replace any faulty equipment.

Problem	Possible Cause	Potential Solution
Remote reads “GRID FAULT”	Grid voltage or frequency is out of range	Utility service at your site is outside of specified permissible voltage or frequency limits. Turbine will return to service once this problem clears for 5 minutes.
Remote reads “OVERSPEED”	Turbine has encountered a condition where its rotational speed exceeded allowable limits	Have a service technician thoroughly check the turbine including the brake system for problems, and take corrective action prior to returning the turbine to service.
Remote reads “RPM ERROR”	One of the two turbine rpm signals is not reading properly at the controller.	Have a technician check the turbine speed signal encoders and signals for the source of the problem and take corrective measures prior to restoring the turbine to service.
Remote reads “MOTOR ERROR”	The brakes did not release properly when the turbine attempted to start up in cold weather. The brakes did not release properly when the turbine attempted to start up in all conditions.	Attempt to restart the turbine once temperatures warm up to assess this condition. If the turbine does start in warmer weather, have a technician service the pneumatic system to prevent icing problems. Have a service technician assess the problem and correct any issues with the brake or electrical system. Causes can include a non-functioning pneumatic compressor, lack of +12VDC current at the turbine at the tower top, or faulty contactors, SSRs or capacitors in the control panel.
Electrical power is on for the turbine, but the turbine controller is not powered up.	The overspeed protection relay tripped cutting power to the controller.	Have a service technician assess the cause of the overspeed and why the controller did not detect this condition and take corrective measures before returning the turbine to service.
Grease is oozing from the yaw bearing seals.	Normal yaw behavior.	The yaw bearing is fully packed with grease from the factory, and some will normally be pushed out as the ball bearings are exercised during normal turbine yaw behavior. No corrective action is necessary.

Servicing the Turbine

Like any mechanical device, your Endurance wind turbine will function at is best efficiency for a long time when properly cared for with regular maintenance and inspections. Adhering to the prescribed maintenance schedule also ensures your warranty remains in effect.

Maintenance and inspection necessitates access to the turbine itself and the inside of the nacelle. This access is made easier with the Endurance tilting tower system.

Tilting Tower

Tilting the Endurance tower up and down is best left to an authorized service technician familiar with the details of the procedure. The turbine and tower are heavy making the procedure dangerous if not done properly. The necessary equipment to tilt down the turbine will vary with your tower height, but will include:

- Winch and sufficient cable of proper rated capacity for the job (typically 2000 lbs minimum line pull and 300ft of cable)
- Properly rated shackles, pulleys and other rigging accessories for the lift and lowering process.
- Additional guys for stabilizing the gin pole
- Properly positioned stand to support the weight (minimum 2000 lbs) of the lowered tower such that the turbine is ~4 – 5 ft off the ground

A tilted down turbine and tower system should be properly prepared and secured if left unattended in the lowered position for any period of time. An improperly prepared and secured system could be subject to damage from winds that try to push the tower off its stand. A properly prepared turbine will be locked in yaw with the rotor axis horizontal and the tail removed. The tower must be adequately strapped to a stable stand. The gin pole should be either lowered or properly secured with cables in all directions.

Maintenance Schedule

Many components of your Endurance wind turbine system are designed for a life exceeding 20 years. The maintenance schedule will help ensure all parts meet or exceed their expected lifetimes.

Maintenance should be performed by an experienced Endurance service technician. Adhering to the maintenance schedule will ensure that your Endurance wind turbine system provides you with the most reliable service life and ensures that you don't jeopardize your warranty status.

Interval	Maintenance Item	Notes
1-year	Grease shaft bearings Grease yaw bearing Replace pneumatic desiccant Full turbine and tower inspection	 Replacement recommended immediately prior to winter in climates prone to sub-freezing temperatures Check all guy wires and rigging accessories for damage or wear. Test pneumatic system for any leaks. Check bolt torques at tower flange. Check brake pads and disk for unusual or excessive wear. Treat exposed surfaces with rust inhibitor.
5-years	Replace gearbox oil and high speed shaft seal	
20-years	Full turbine and tower system inspection and overhaul	Replace all worn components including: ▪ Cracked or worn hoses in pneumatic system ▪ Frayed or severely rusted guy wires or rigging accessories ▪ Cracked or damaged anemometer ▪ Worn out pneumatic compressor Repair or replace any damage including ▪ Worn or cracked turbine rotor blades ▪ Worn sliprings ▪ Shaft and yaw bearings ▪ Worn, aged or cracked brake pads