Kathy Ireland Stationary Bike Generator
User Guide

Warnings

- THE GENERATOR MUST BE CONNECTED WITH THE CORRECT POLARITY!
- DO NOT OPERATE THE GENERATOR WITHOUT FIRST CONNECTING THE DISPLAY PANEL (LOAD)! DANGEROUS VOLTAGE WILL BE PRODUCED FROM THE UNLOADED GENERATOR.
- DO NOT PEDAL THE BIKE BACKWARDS! DOING SO WILL DAMAGE THE MOSFET LAMP DRIVERS. YOU MAY ROTATE THE CRANK AS NEEDED TO ENGAGE TOE-CLIPS OVER SHOES.
- WHEN OPERATING IN MANUAL MODE, DO NOT ALLOW LAMP VOLTAGE TO EXCEED 12 VOLTS! LAMP DAMAGE WILL OCCUR.
- WHEN OPERATING IN MANUAL MODE, BE SURE ALL SWITCHES ARE IN THE OFF POSITION AS YOU BEGIN PEDALING.
- EXERCISE CAUTION AROUND MOVING PARTS. TIE BACK LOOSE CLOTHING AT ANKLES AND LEGS.

General Operating Instructions

The stationary bike generator was designed for ease of use (Automatic mode) yet retains flexibility to accommodate special demonstration needs (Manual mode).

Automatic Mode

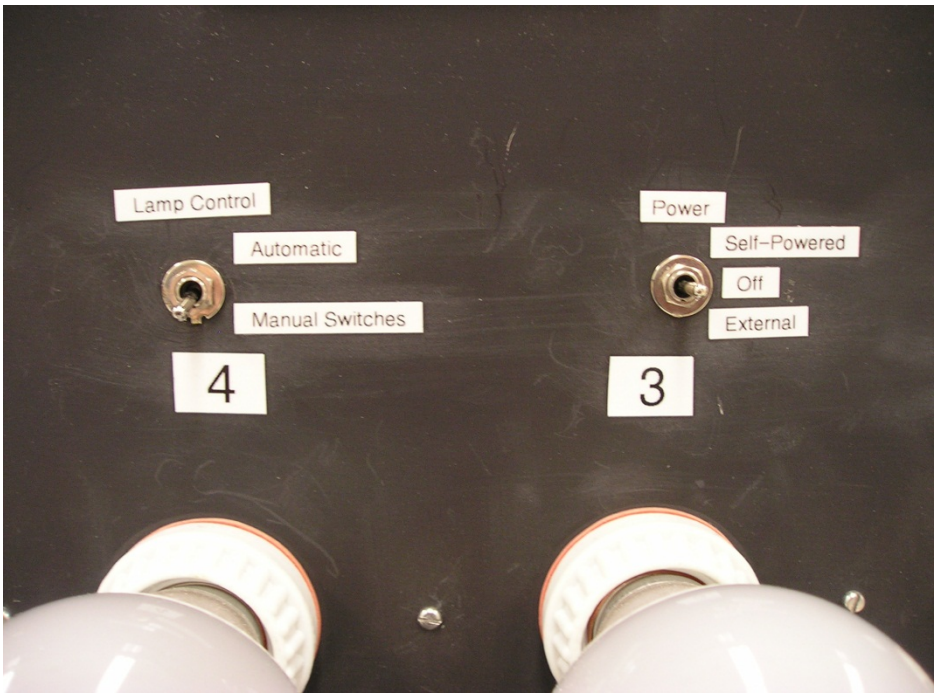
1. Read warnings on page 1 of this guide.
2. Set Lamp Control switch to “Automatic”.
3. Make sure all bike-mounted manual switches are turned off or unplugged from the display panel.
4. Set the Power switch to the desired source.
5. Get on bike and pedal! Lamps will automatically light depending on your work input.

Manual Mode

1. Read warnings on page 1 of this guide.
2. Set Lamp Control switch to “Manual Switches”.
3. Make sure bike-mounted manual switches are connected to the display panel and set to the off position.
4. Set the Power switch to the desired source.
5. Get on bike and pedal slowly! There is no honor in producing high voltages so limit your ambitions to 12 volts.
6. Turn manual switches on and off as desired but maintain lamp voltage to 12 volts or less.
7. Set manual switches to off position when finished.

Display Unit Description

Front panel



Power Switch

Self-Powered: When set to this position, power produced by the generator is used to operate the circuitry and LED displays. Actual power consumption is about 200 mA and is included in the "Amps" display.

Off: When set to this position, all sources of power are disconnected from the circuitry and LED displays. The external power source (if used) will remain on and need to be disconnected separately.

External: When set to this position, an external 12 volt DC power source is used to power the circuitry and LED displays. None of the external power is included in the "Amps" display.

Lamp Control Switch

Automatic: When set to this position, lamps will automatically be staged dependent upon the current and voltage being produced by the generator. The first lamp will be energized when generated voltage exceeds approximately 9 volts. Automatic staging will begin after that, adding/removing lamps as needed to maintain the voltage at 9 volts. When all lamps are illuminated, no additional load can be applied and lamp voltage WILL RISE above 9 volts. The maximum voltage should be limited to around 12 volts by one's physical inability to pedal any faster (about 100 RPM at the crank).

Manual: The manual control switches (six, mounted on the bike) are hard-wired directly to the lamps and will control them regardless of any automatic action. If the generator is to be controlled "manually", this switch should be set to the Manual position to prevent unintended operation from the automatic control circuitry.

Displays

Amps: Displays total current flowing through the generator.

Volts: Displays the generated voltage at the point-of-connection to the rear panel. Losses due to generator connecting wires are ignored.

Watts: Displays DC wattage as the result of electronically multiplying voltage times current.

- IMPORTANT NOTE: The meters sample values 2 to 3 times a second and are not synchronized! Due to fluctuations by the prime mover, it is very likely the displays will be inconsistent and should be regarded as approximate values. See example below: Displays 171 watts, should display 183 watts.

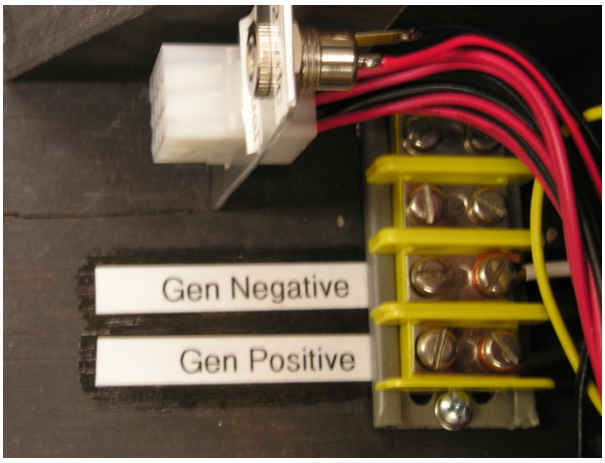
Rear Panel Connections

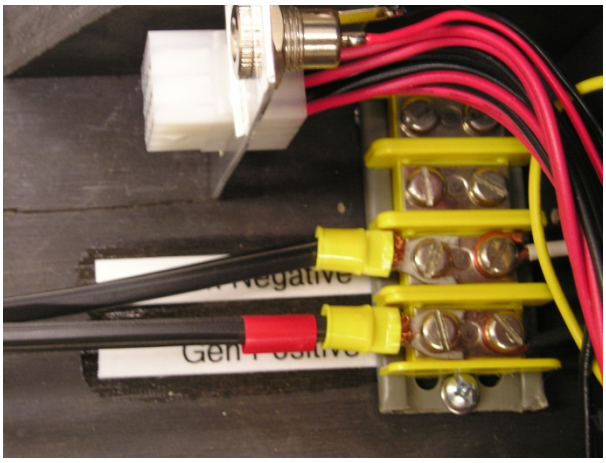
12 Vdc Input

Input power jack for connection of external power source. 12 volts DC, 900 mA, center positive.

Manual

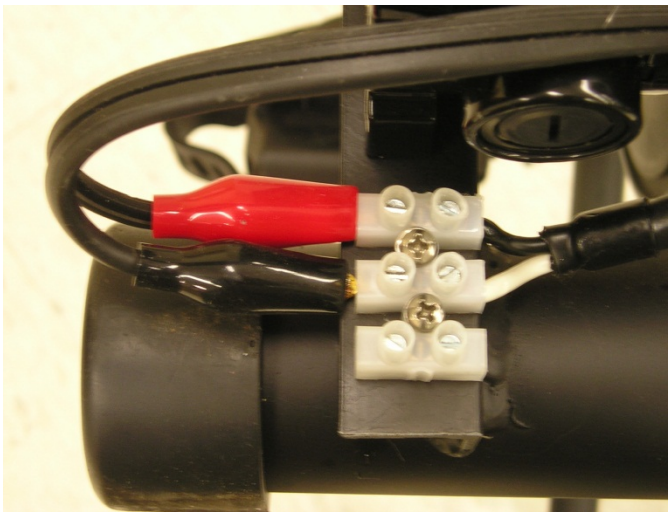
Mating connector for bike-mounted toggle switch cable.





Generator Connections (Display Panel)

THE GENERATOR MUST BE CONNECTED WITH THE CORRECT POLARITY!
Terminals are labeled and should be connected as illustrated above. Black is positive, white is negative.



Generator Connections (at Generator)

The bike end of the generator connecting cable is attached to a terminal block located on the front support under the generator (see above illustration). Positive output from the generator (black wire, right side of terminal block) connects to the red insulated wire of the connecting cable (left side of terminal block). This color coding matches the display panel generator connections described above.

- NOTE: An observant user may notice the direction of rotation marked on the generator is opposite the actual rotation. Windstream Power applied this label specific to their application (conventional bicycle) however conversion to a stationary cycle required the generator be mounted with reversed rotation. There is no difference in performance but the generated polarity is reversed.

General Description

Several initial conditions were established as design criteria for automatic mode:

1. Maximum crank speed would be 100 RPM based on information found on the Internet.
2. Maximum generated voltage would be limited to 12 volts (protect lamps).
3. Target current (six lamps lit) would be 20 amps (generator full-load capacity)

A single lamp was profiled to determine what voltage, delivered to six lamps, would draw 20 amps from the generator. Result was about 9 volts, so that became the automatic control threshold.

Single Lamp Current/Voltage Profile

I_{set} (Amps)	V_{result} (Volts)	Visible?
1.0	1.03	N
1.25	1.50	N
1.5	2.15	N
1.75	2.90	Y
2.0	3.67	Y
2.25	4.58	Y
2.5	5.55	Y
2.75	6.50	Y
3.0	7.56	Y
3.25	8.70	Y
3.33	9.18	Y
3.5	9.99	Y
3.75	11.30	Y
3.86	12.00	Y

A voltage comparator monitors the generated voltage, compares it to a reference voltage representing 9 volts, then decides whether to turn the first lamp on or off. If the voltage exceeds 9 volts, the comparator turns the lamp on, which causes a drop in generator voltage, which causes the comparator to turn the lamp off, which initiates an oscillation creating a frequency modulated “soft-start” to smoothly illuminates the lamp. This action also masks an undesired effect of tungsten filaments (positive temperature coefficient) that causes the above lamp to draw about 30 amps cold, reducing to about 3 amps once heated.

Another comparator monitors the current flowing through the lamp. If the lamp's full load current is reached (3.33 amps) this (current) comparator turns the first lamp on 100% and transfers the output of the voltage comparator (described above) to the second lamp. Now the second lamp begins to illuminate just like the first one did. There is a string of current comparators, one for each lamp, staggered at 3.33 amp intervals. Control will be passed back and forth across the comparators in response to changes in the generator output.