Building a Single Bike Generator

Building your own generator requires a number of items. A person, a bike, a way of supporting your bike off the ground, a motor, an energy smoothing system and an inverter if you want to use your bike generator to power mains equipment. Each of these parts needs to work efficiently in order to generate between 50 and 100 watts of usable energy for your generator. We'll discuss the parts and how to assemble a single bike generator in this D.I.Y. Guide

1. PEOPLE

At the end of the day if there are no motivated cyclists you cannot create electricity. Each person can create between 20 and 100 watts over extended periods and we've got as much as 250w from athletes in short bursts.

2. A BICYCLE

Type of bike:
Road bikes are most suitable type of bike for generating electricity because they have slick tires. Slick tyres help keep friction and noise to a minimum level. Road bikes are designed to be efficient on smooth roads. You will generally get more watts from a road bike than a town (designed for comfort) or a mountain bike (designed for bumps and bashes).

Gears:
- Geared bikes have the advantage that cyclists of different abilities can use them.
- Single speed bikes have the advantage that the cyclist cannot change gear and make life easier for him/herself. Therefore you can almost guarantee the same power out from each person.

Magnificent Revolution has a set of second hand road bikes. You can get a good bike for just over £100. We got ours from places such as the bicycle ambulance in Cambridge and Bike Works in London.

3. A MOTOR (OR ALTERNATOR OR STEPPER MOTOR)

We've always used permanent magnet (pm) motors in our generation systems. There are a number of other methods using car alternators or stepper motors. Each method has its pros and cons. See http://www.scienceshareware.com/ and http://www.c-realevents.demon.co.uk/

However, in this D.I.Y. guide we're only going to talk about pm motors. We've only always used a 24V, 250W scooter motors which run at 2650rpm creating 24v. Part MY1068, which you can find on e-bay. A motor is designed to spin when electricity is passed through it. However, if we spin the motor, we can create electricity and use the motor as a generator.

The speed at which the motor is revolving (the amount of rotations through 360 degrees undertaken in a set time) normally measured in revolutions per minute (rpm) is directly proportional to (increases and decreases) the voltage output of the pm motor. Assuming the cyclists legs continue at a constant speed a downhill gear creates a larger voltage output for the motor than an uphill gear. The torque (amount of effort) the cyclist applies to the pedals normally measured in Newton Meters (Nm) relates to the current created by a pm motor.
4. TRAINING STANDS

You can buy a new stand, a second hand one from e-bay, or weld your own. We've tried all of these options over time. Minoura design and build the best stand for this application. Minoura stands fit most bikes and have a simple tensioning system, which can be kept intact once you retrofit your motor. This eliminates the need to use a bungee rope to tension the motor roller against the bicycle wheel.

5. ROLLERS

Attaching a roller to the scooter motor can be quite difficult. We have approached this using a number of different bespoke designs:

a. A conversion pin which slides onto the motor shaft and is secured in place using a grub screw. Over this pin we slide a skateboard wheel.
b. A roller which slides over the motor shaft and is secured in place using a grub screw.

Designs of these components, and any future designs, can be downloaded from the D.I.Y. Page.

6. ASSEMBLING THE MOTOR INTO THE STAND

The motor needs to be attached to your stand somehow and then tensioned up to the back wheel of your bike. The location of the motor is critical and you may need to make a number of mounting points suitable for different bicycles. The motor needs to be located correctly from left to right, so the bike wheel is located as close to the motor body as possible. You may need to consider the vertical location of the motor to compensate for back wheels of different diameters. Once the motor is in the appropriate position, it needs to be tensioned. If you haven't got a Minoura stand with incorporated tensioning device, you'll need a bungee rope, which will do the same job.
7. SMOOTHING ELECTRICITY

There are a number of options for smoothing electricity in a single bike generator system. The options that we have tried are as follows:

Voltage Regulator Option

This option uses a DC to DC Converter such as part 445-9787 from RS or part L22BR from Maplin. The voltage regulators we have tried so far are Step Down voltage regulators. This means that the regulator can only produce a voltage lower than that supplied to it. So, if you require an output voltage of 12V then the regulator will need to be supplied with a voltage constantly greater than 12V on order to work. The voltage created by a permanent magnet (PM) motor is directly proportional to the rotating speed of the motor (RPM). The scooter motors we use in our system are designed to provide a 24V output at 2850RPM, so in order to create a voltage constantly higher than 12V the motor must rotate at a speed of at least 1425 RPM. How fast the motor rotates depend on:

- the speed the cyclist is spinning his or her legs (faster = greater motor RPM)
- the size of the rear wheel of the bike you are using (larger = greater motor RPM)
- what gear the bike is in (downhill/higher gears = greater motor RPM)

If your appliance or inverter keeps switching on and off when using a DC-DC converter it is usually for one of three reasons.

- you are not providing the board with a high enough voltage (the motor isn't spinning fast enough)
- the cyclist is not capable of powering the device you are attempting to power
- the device you are powering demands, momentarily, more watts than your cyclists can generate. Often it may not be that the cyclist cannot power these momentary surges, but that the cyclist is unable to adapt fast enough to supply these surges when they are demanded. For example, a cyclist powering a small PA may have problems should a big bass note come along and the PA may cut out!
This option utilizes a capacitor. 2 Fährad or greater should do the trick for a single bike. We've used a capacitor, which is designed to provide extra bass in a car audio system and has a handy voltage display.

A capacitor can be used to smooth the output voltage from the motor and has the added benefit of providing a reservoir of energy for those bass notes.

The capacitor doesn't supply a constant output voltage. Once charged it corresponds to the voltage output from the motor, which is relative to its RPM. If you are using an inverter (designed to work between 9 and 14V) or sensitive 12V equipment you will need to keep an eye on the voltage across the capacitor and adjust your pedalling speed or gear to keep the voltage steady.

It is possible to over charge a capacitor by applying a high voltage to it. Most capacitors suitable for creating a single bike generator have been designed for 12V car audio systems and come with a safety cut out to protect against over voltage linked to rpm for a pm motor. Another reason why car audio capacitors are a good buy as they often come with their own built in volt meter.
In the same way that a capacitor can smooth the voltage output from the motor, a battery can do the same with the added benefit of providing long term energy storage. Again it is possible to overcharge the battery which can result in battery fizz. For a 12v lead acid battery the voltage across the it should be kept between 12 and 15volts.

8. AN INVERTER

If you are wishing to use AC mains powered appliances you will need to purchase an inverter. There are 2 types of inverters. A pure sine wave inverter creates a smooth AC output. A quasi sine makes a square wave. Some devices may not work with a quasi sine.

Inverters are designed to work with batteries so they usually work with voltages between 9 and 14volts.

9. CABLES AND CONNECTORS

We used 30A Anderson Connectors when connecting the bikes into either a multiple or single bike system. The connectors hold a good connection but are also designed to 'pop' easily, if you foot trips on a cable for example, so you don't damage any soldering.

It's a good idea to get fairly chunky cable for your 'Bike Power Cables', especially if the lengths start to get long. You want to avoid voltage drop as it's a waste of energy. The smaller the cable diameter, the more it will heat up, the more energy you loose. It's also possible to knock out 25A on a bike for bursts, so your cable should be able to handle that. We managed to get some paired (black & red wires in the same sheath) 4mm core speaker cable, which meant the cable kept nice and neat.