Product Design Report:

PedGen Pedal-Powered Electric Generator and Light

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WRIT 50E

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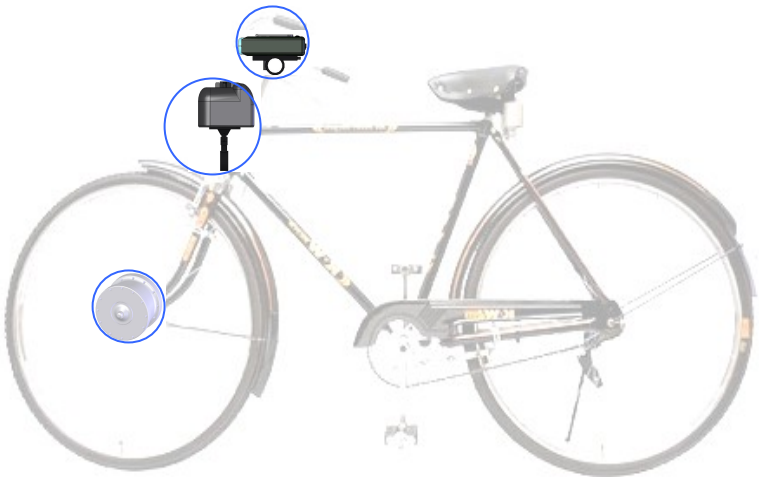
Product Design

The PedGen is a never-before-seen portable battery charger that uses current technology to convert the energy of movement from riding a bicycle to containable electrical energy. A generator is used to harness this power, and electrical components in the handlebar-mounted console are used to charge a versatile battery and power bike light. An AC input plug gives the user the option to charge the battery at home and use the console as a utility power supply, as well as an emergency generator. Other features let the user get the most out of every pedal, and will be described in full detail.

Main Components:

The three main components of the PedGen consist of a generator located at the wheel, a small electronic console attached to the handlebars of the bicycle, and a small electronics carrying case located near the console (See Figure 1). Essentially, when the front wheel of the bicycle turns, it spins an electromagnetic generator located at the center of the wheel which sends a current up to the handlebars. Connecting the generator to the console is an electrical wire, feeding the console current when the wheel is turning. The third component is a durable waterproof electronics carrying case, allowing the user to recharge an Ipod, cell phone, or other small electronics device while riding his or her bicycle.

Figure 1:
The three main components of the PedGen: the wheel-mounted power generator, the handlebar-mounted console and the small electronics holding case mounted near the handlebars. (*Note: not drawn to scale*)



Dimensions

Because the console and electronics case of the PedGen are to be used on the road attached to the handlebars of a bicycle, it is important that they have convenient, compact sizes. The console is approximately a box-shaped device with a length from the light to the back of 100mm (see Figure 2). The width is approximately 80 mm, and it is 35 mm thick. Additional dimensions are described in Appendix A.

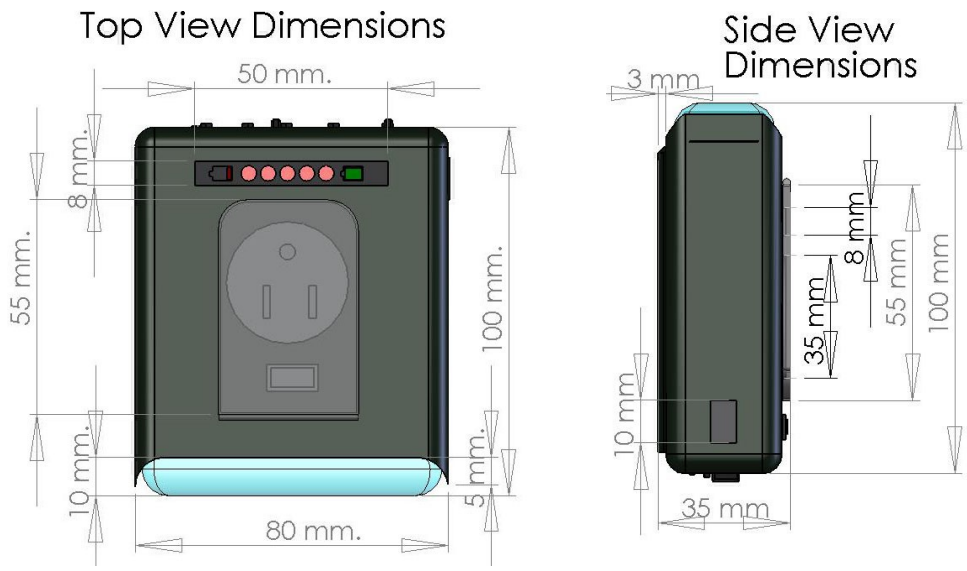


Figure 2 : Dimensions of top and side views of the console unit.

The electronics container needs to be large enough to hold most possible small electronics device, and it still needs to be compact enough to fit well mounted on the bicycle. It is slightly larger than the console, with an internal volume of 750 cubic cm.

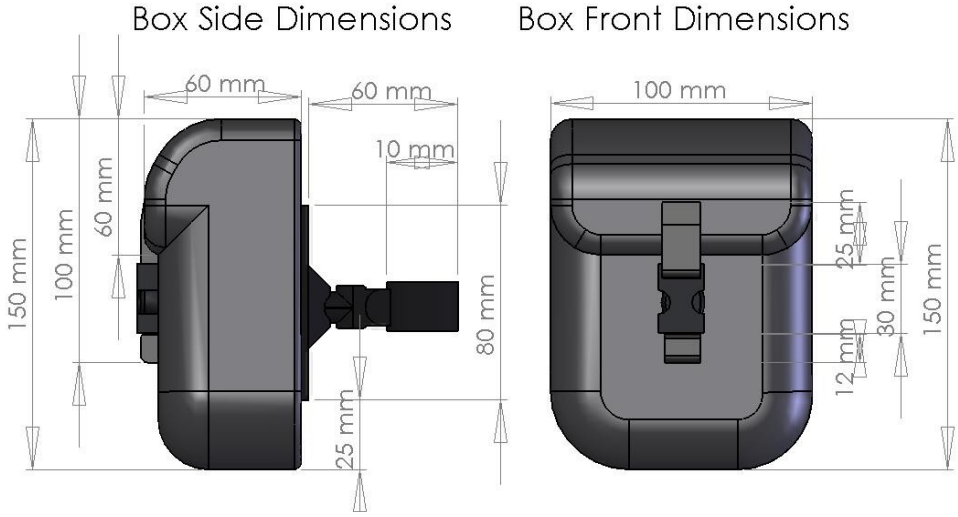


Figure 3 : Dimensions of top and side views of the electronics case unit.

Internal Components

With varying current outputs from the generator, resulting from varying speeds of the bicycle, it is necessary to monitor this current before trying to store it in a battery. The electrical current from the generator enters a voltage regulator which outputs a constant 6V current. The 6V current is converted to 12V with a small converter. From here the current directly charges a 12 Volt battery. This battery then could power three things: a bicycle light, a USB port (also known as an Ipod charger), and a 120 Volt electrical outlet (see Figure 4). In between the USB port / 120V outlet and the battery is a 12V DC – 120V AC inverter, "inverting" the voltage to the necessary 120 volts. Switches mounted on the console allow the user to turn off and on the bicycle light as well as switch between outlets. For a more descriptive drawing of the internal components, please see Appendix B.

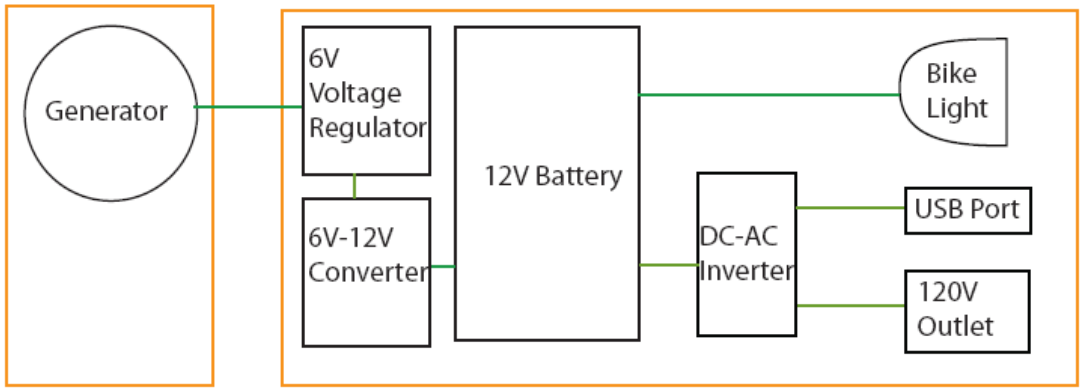


Figure 4: Details from interior of generator and console, a rough wiring diagram.

Materials

The outer shell of the console is made of the light yet durable acrylonitrile butadiene styrene, or ABS. This plastic is perfect for our product because it has three important properties: strength, rigidity, and toughness. According to www.wikipedia.com, "the most amazing mechanical properties of ABS are resistance and toughness." It is important for the material to be resistant to the natural forces of the environment, which include but are not limited to rain, sun, dirt or dust, and even snow and sleet. The electrical properties of the plastic are little affected by temperature or humidity, meaning it will protect the internal components even when exposed to water or heat.

The mounting bracket is made mostly of ABS as well, with two small electrical connectors made of stainless steel on both the bracket and the console itself. The electrical connector is housed in a small nonconductive ABS plastic casing, keeping the connection waterproof when the console is not mounted (see Appendix C)

Mounting

Some important attributes of the PedGen include its portability, convenience, and safety. With its heavy weight and necessary portability, it is important to have a mounting bracket that holds the console firmly when desired but still releases it easily. Mounting the console harness onto the handlebars is done with a small bracket, installed firmly to the bicycle with two simple bolts. The main console however is much easier to take off and put on than the bracket, as it is done with only a simple release switch located on the underside of the console (see Figure 5)

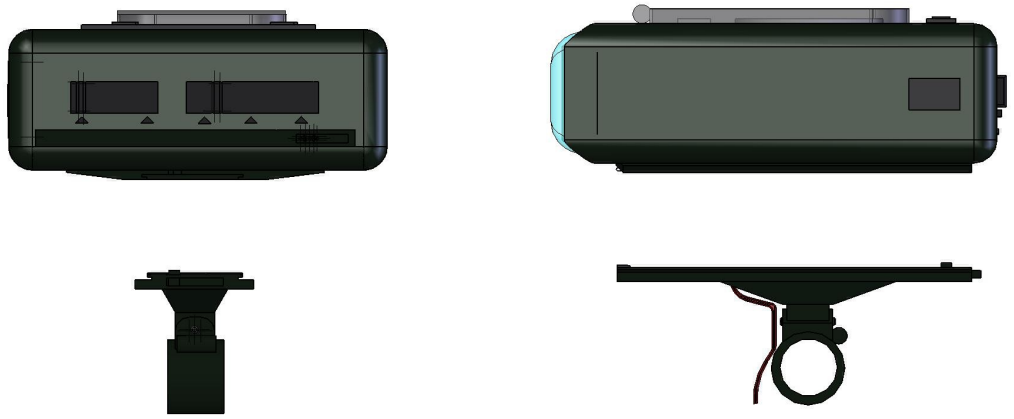


Figure 5: The console and mounting bracket, including wires from bracket leading to generator.

The console is simply but firmly mounted onto the bracket by a simple sliding and latching procedure. To mount the console, the user holds a spring-loaded latch release switch, slides the console into place, and releases the switch, causing the latch to lock the console into place (see Figure 6)

Figure 6: The console mounting latch and release switch of the bracket and the corresponding latch piece of the console.

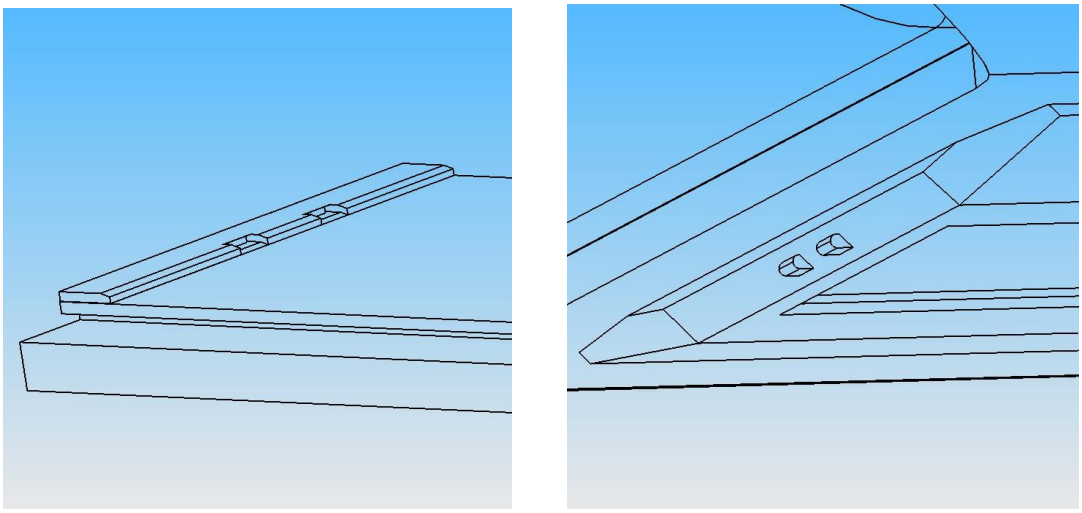


Figure 7: The electrical connection between the mounting bracket (left) and the console (right) consist of the two male prongs of the console and two female connectors of the bracket. The bracket is kept waterproof by a surrounding plastic casing, which repels collecting water and keeps the system from short-circuiting.

With so many different bike frames out on the market, it is important to accommodate the mounting process to every possibility (see Figure 8). The electronics case has a dual hinge in its bracket, allowing level mounting no matter what angle the frame is at. The single hinge of the console bracket mounts it level as well, assuming the handlebars are relatively even (see Appendix C for more detailed bracket renderings).

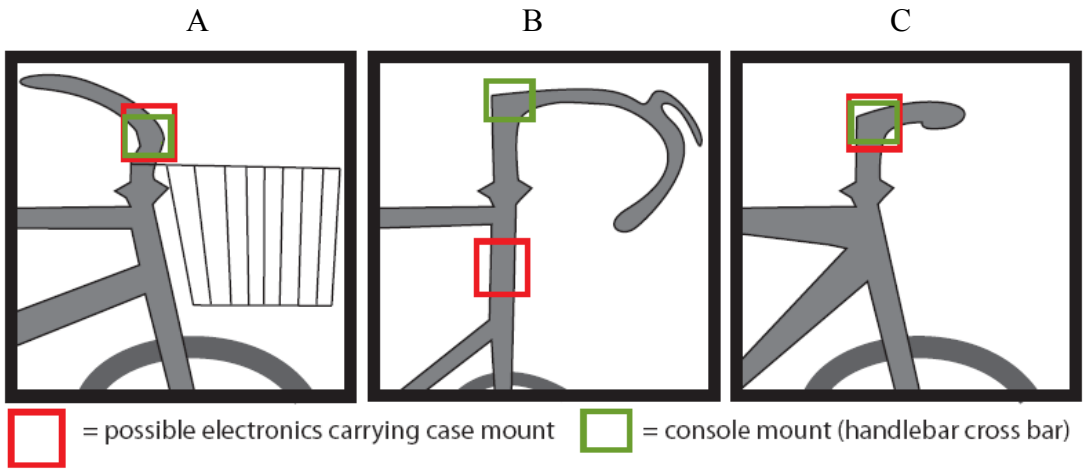


Figure 8: Mounting options: the carrying case and console can be mounted side-by-side on the handlebars for cases that there is a basket (A) or the frame does not allow frame-mounting (C). For bicycles with skinny handlebars, however, it is recommended to mount the electronics case on the frame (B)

Additional Features

Power Input Plug

An AC adaptor can plug in to the side of the console to charge the battery while at home or in any building with an outlet. Because pedaling only generates small amounts of power best used in emergency situations, recharging the battery before taking it with the bicycle can extend its use greatly.

Outlet

Since the PedGen is to be used primarily outside attached to a bicycle, it is important to keep the internal components dry. A watertight cover over the outlet and USB port is used when there is nothing plugged in to them. However, if there was a case where water did get to the outlet, an easily replaceable fuse would burst inside, with no harm done to the more important components of the console.

Battery Meter

A meter measuring battery capacity is connected to the circuit and in parallel to a series of small lights, letting the user know how much battery is left. This meter is connected in such a way that it turns off when there is no current being drawn from the battery and no current recharging the battery. The dim LED lights take minimal energy to glow, and only one light is on at a time to give the user adequate knowledge of the battery's status.

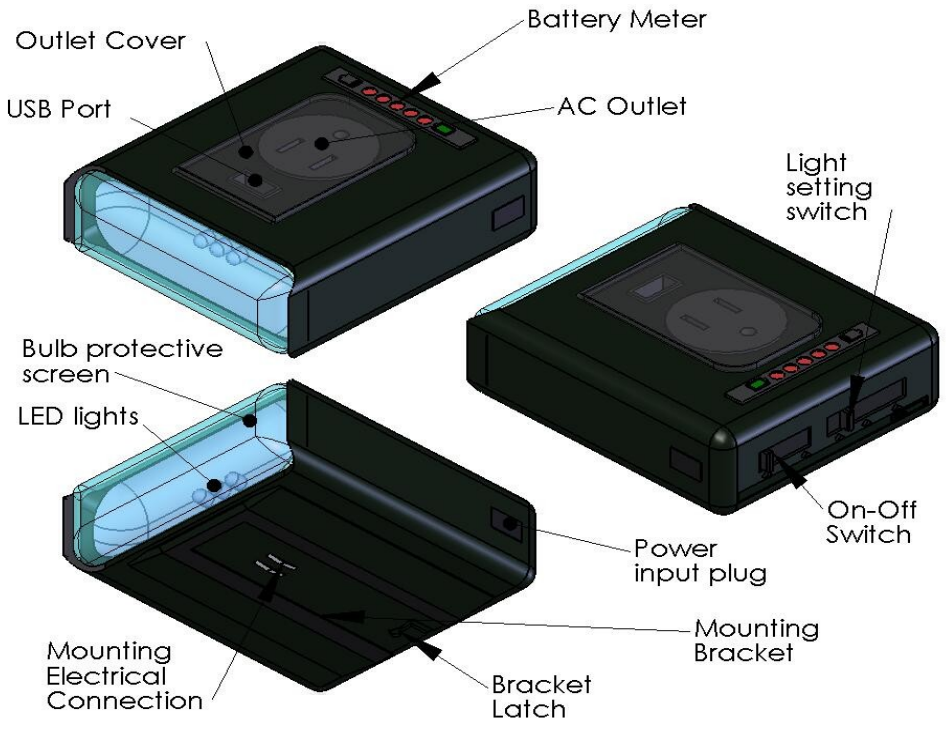


Figure 9: Additional components of the console

Design Options

Electronics Carrying Case

Available with the console is a small electronics carrying case so it is possible to charge a cell phone or Ipod while actually riding the bicycle (see Figure) The outer shell is made of a thick waterproof vinyl and the mounting bracket is ABS. Inside is a soft machine washable foam and velvet sleeve, designed to draw moisture and grime away from the housed electronics. On the back are three x-shaped slits for power cords to pass through the waterproof seal without letting water pass the other way. To close the lid is a small plastic helmet-style clip and a strip of Velcro to ensure maximum safety for the electronics. As previously mentioned, the mounting bracket has two hinges to allow for level installation onto the frame or handlebars of the bike. See Appendix A for more detailed renderings.

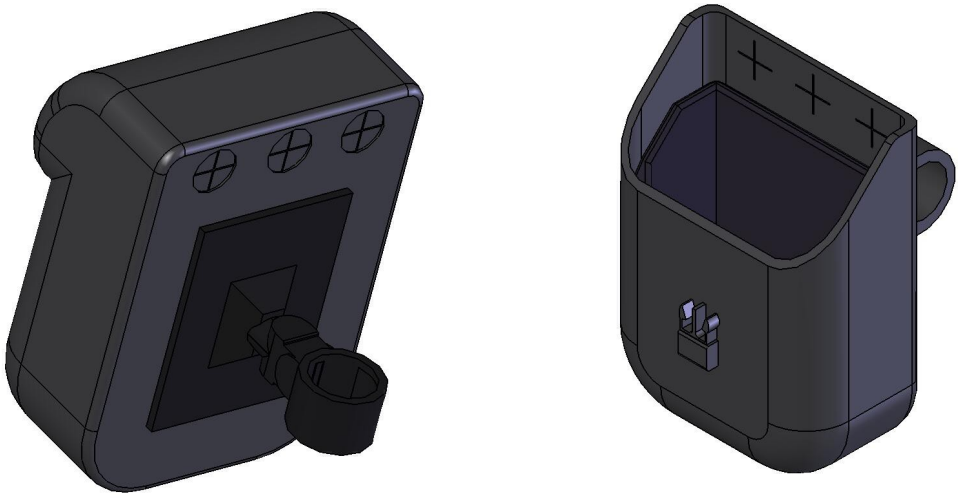


Figure 10: The Electronics Carrying Case, with mounting bracket and inner sleeve.

Battery Options

With so much of our product based around the battery, there are upgradeable options with the battery to increase its life expectancy. A larger battery is available for additional weight and price, which provides more kw/hr than the original battery size.

Generator Options

(CJ)^2 will promote one generator company based on the generator that would work best with the PedGen. However, there are many more options of generators to choose from. We decided to promote the SON28, by Schmidt Maschinenbau based on results from extensive testing. Though it is a minor inconvenience to have it located inside the wheel, the overall efficiency and reliability make it worth it. See Figure for comparative results:

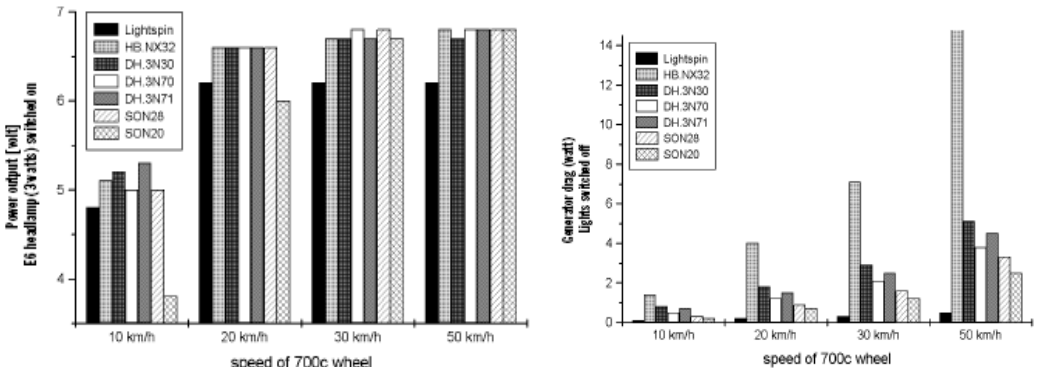
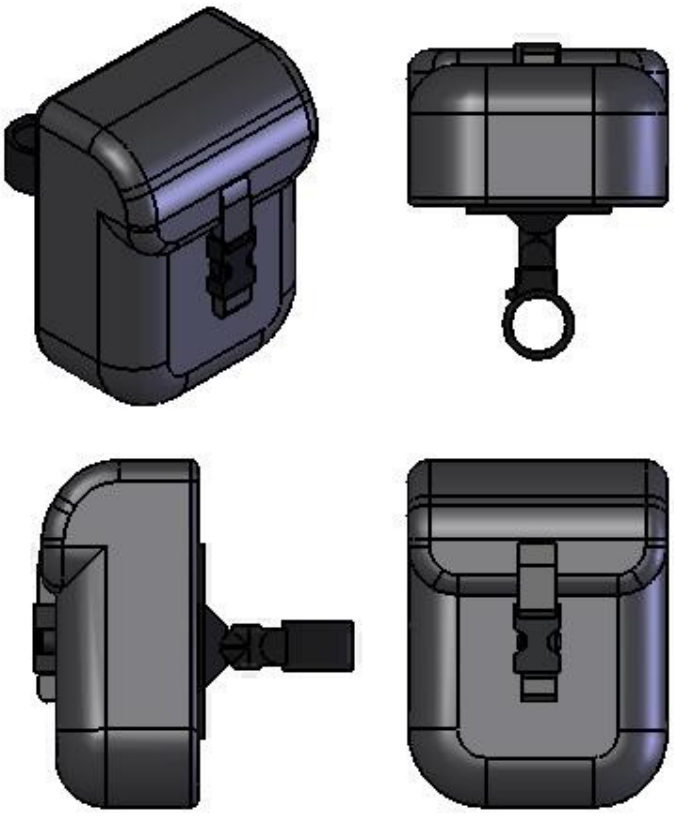
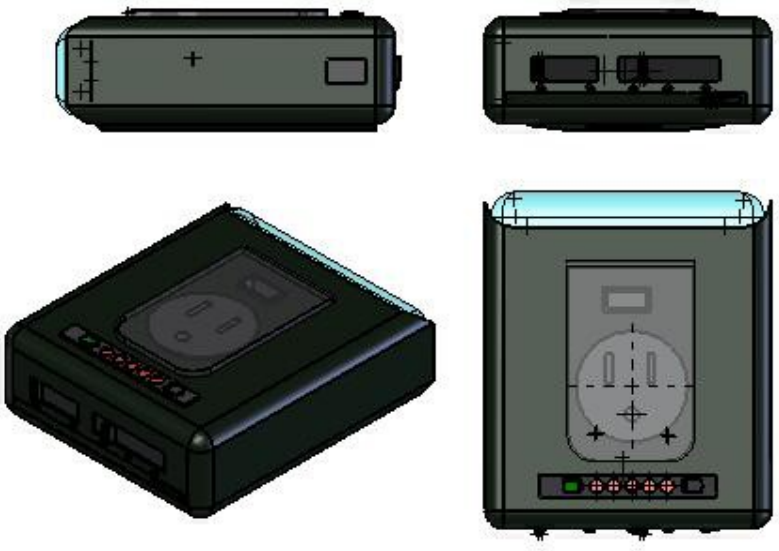


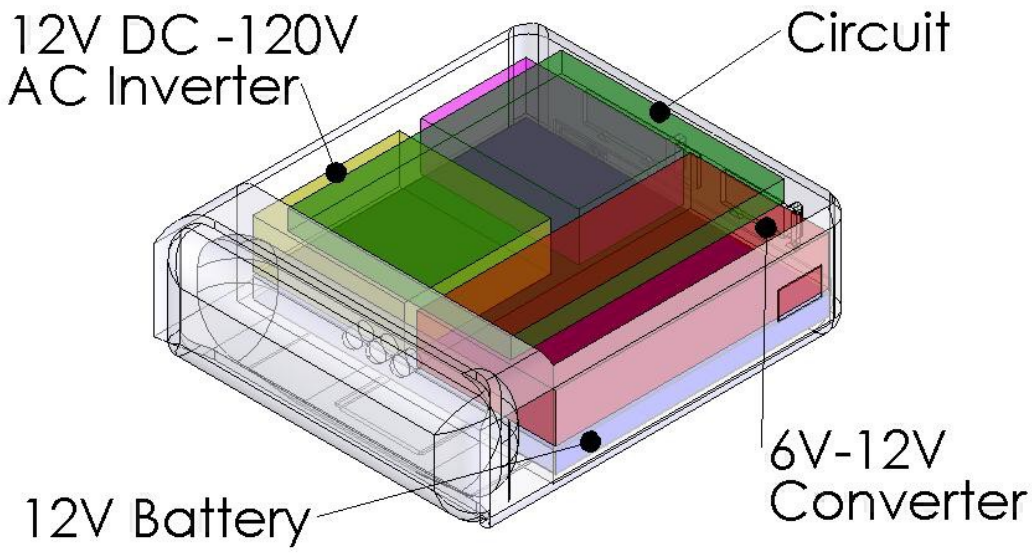
Figure 11: Results from a test done in 2005 by Vintage Bicycle Press shows that the SON28 would be the best generator for the job.

Appendix A: External

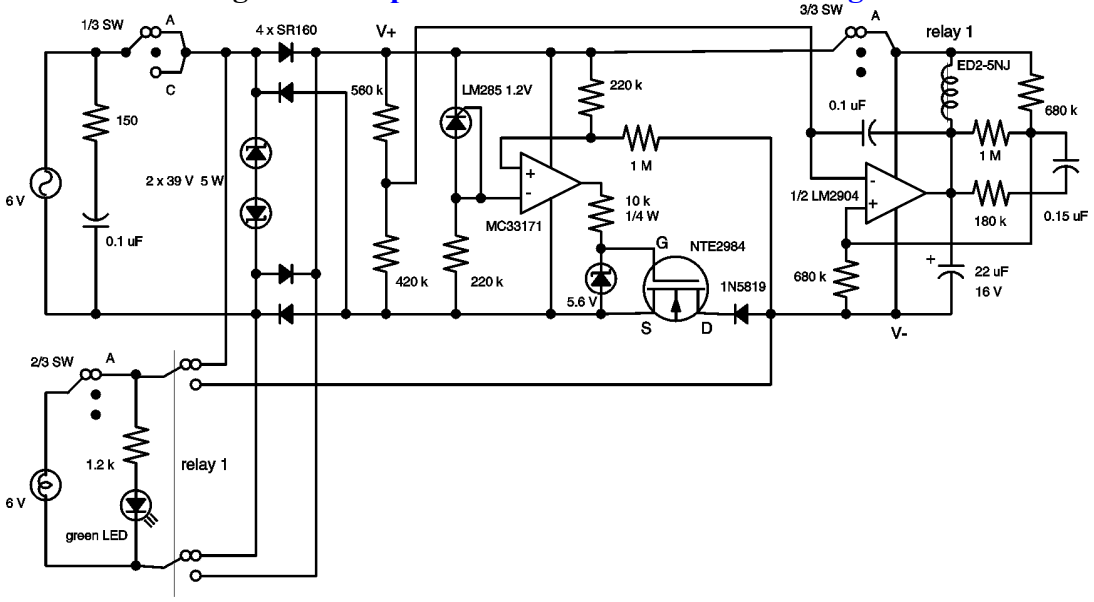


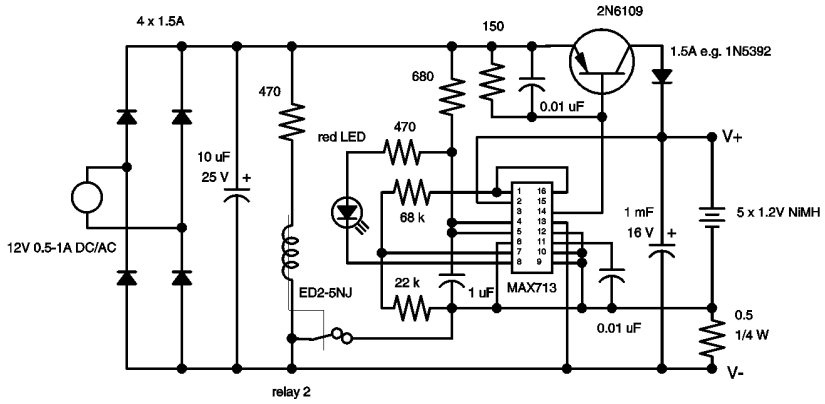


Appendix B: Internal

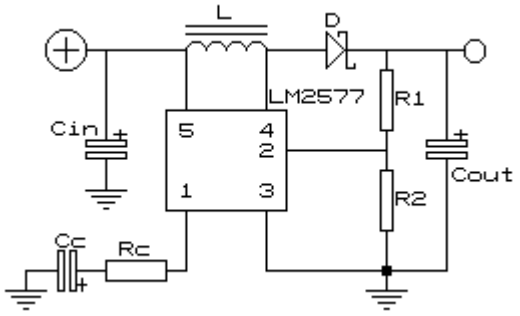


Schematic for regulator: http://www.nscl.msu.edu/~daniel/sreg.htm





Schematic for 6V -12V converter:
http://www.electronics-lab.com/projects/power/030/



Schematic for 12V – 110 V AC Inverter:
http://members.misty.com/don/inverter.gif
http://members.misty.com/don/schfil.htm