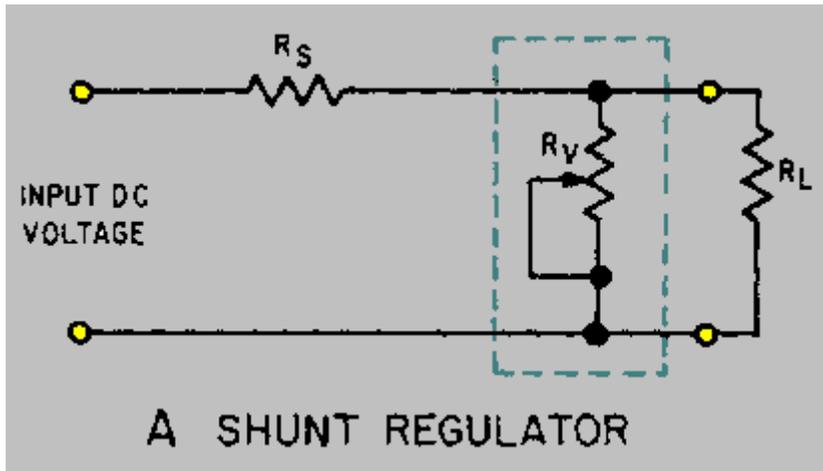


Supercap Overload Protection Circuits:

Series and Shunt Voltage Regulators



There are two basic types of voltage regulators. Basic voltage regulators are classified as either SERIES or SHUNT, depending on the location or position of the regulating element(s) in relation to the circuit load resistance. Figure 4-31 (view A and view B) illustrates these two basic types of voltage regulators. In actual practice the circuitry of regulating devices may be quite complex. Broken lines have been used in the figure to highlight the differences between the series and shunt regulators.

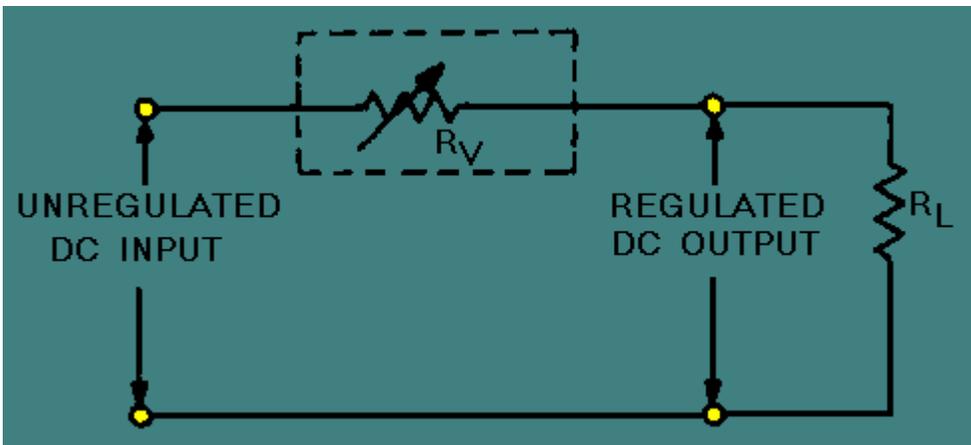
Figure 4-31A. - Simple series and shunt regulators. SHUNT REGULATOR

Figure 4-31B. - Simple series and shunt regulators. SERIES REGULATOR

The schematic drawing in view A is that of a shunt-type regulator. It is called a shunt-type regulator because the regulating device is connected in parallel with the load resistance. The schematic drawing in view B is that of a series regulator. It is called a series regulator because the regulating device is connected in series with the load resistance.

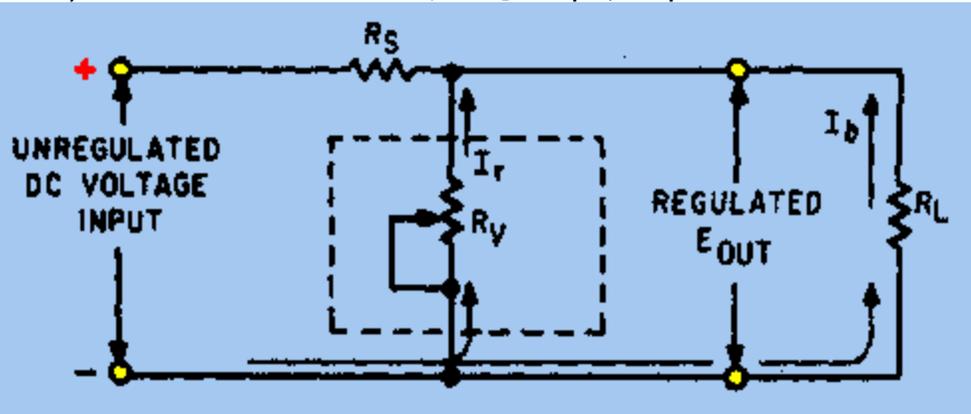
Figure 4-32 illustrates the principle of series voltage regulation. As you study the figure, notice that the regulator is in series with the load resistance (R_L) and that the fixed resistor (R_S) is in series with the load resistance.

Figure 4-32. - Series voltage regulator.



You already know the voltage drop across a fixed resistor remains constant unless the current flowing through it varies (increases or decreases). In a shunt regulator, as shown in figure 4-33, output voltage regulation is determined by the current through the parallel resistance of the regulating device (R_V), the load resistance (R_L), and the series resistor (R_S). For now, assume that the circuit is operating under normal conditions, that the input is 120 volts dc, and that the desired regulated output is 100 volts dc. For a 100-volt output to be maintained, 20 volts must be dropped across the series resistor (R_S). If you assume that the value of R_S is 2 ohms, you must have 10 amperes of current through R_V and R_L . (Remember: $E = IR$.) If the values of the resistance of R_V and R_L are equal, 5 amperes of current will flow through each resistance (R_V and R_L).

Figure 4-33. - Shunt voltage regulator.



The supercapacitor is protected from overcharging by using a zener diode coupled to the solar panel to produce a maximum voltage of 2.5v at 70ma. Once the unit sits in full sun for a full 12 hours (summer sun) the unit will operate up to 24 hours on a single charge. The unit automatically turns on/off by using the solar panel voltage to bias a mosfet connected to the on/off pin of the

As I understand it, a zener diode is designed to be used as a voltage regulator. (or a current regulator depending on design). You place it in reverse polarity to the current flow, and it only allows a certain specific voltage drop across its terminals.

So if I had a memory cap I didn't want to fry, I would put the memory cap terminals in parallel with the terminals of the zener so that the voltage across the capacitor's terminals remain constant?

So... if I put a zener diode in reverse, parallel to the capacitor, I can protect the capacitor from over voltage,

Additional search terms: supercapacitor protected overcharging + zener diode

Supercapacitor overcharge protection:
LTC3226 - 2-Cell Supercapacitor Charger with Backup PowerPath Controller
\$3.00

Features
1x/2x Multimode Charge Pump Supercapacitor Charger
Automatic Cell Balancing
Ideal Diode Main PowerPath™ Controller (VIN to VOUT)
Internal 2A LDO Backup Supply (CPO to VOUT)
Automatic Main/Backup Switchover
Input Voltage Range: 2.5V to 5.5V
Programmable SCAP Charge Voltage
Programmable Input Current Limit (315mA Max)
No Load IVIN = 55µA (Typical)
Low Profile, 16-Lead 3mm x 3mm QFN Package
<http://www.linear.com/product/LTC3226>

Description

Supercapacitor Charger
\$3.00

The LTC3226 is a 2-cell series supercapacitor charger with a backup PowerPath controller. It includes a charge pump supercapacitor charger with programmable output voltage, a low dropout regulator, and a power-fail comparator for switching between normal and backup modes.

The constant input current supercapacitor charger is designed to charge two supercapacitors in series to a resistor-programmable output voltage from a 2.5V to 5.3V input supply. The charger input current limit is programmable by an external resistor at up to 315mA.

The internal backup LDO is powered from the supercapacitors and provides up to 2A peak output current with an adjustable output voltage. When the input supply falls below the power-fail threshold, the LTC3226 automatically enters a backup state in which the supercapacitors power the output through the LDO. The input supply power-fail voltage level is programmed by an external resistor divider.

Low input noise, low quiescent current and a compact footprint make the LTC3226 ideally suited for small, battery powered applications. Internal current limit and thermal shutdown circuitry allow the device to survive a continuous short-circuit from the PROG or CPO pins to ground.

<http://www.linear.com/purchase/LTC3226>

Super Capacitor Charge Controller Kit
\$7.50 eu dollars
Product Code: 2137



Use this kit as a rechargeable power source for your Electronic projects. Connect the kit to a USB port to charge the 1F Super Capacitor in roughly one minute!

Using a Joule Thief to Harvest Energy from a Candle

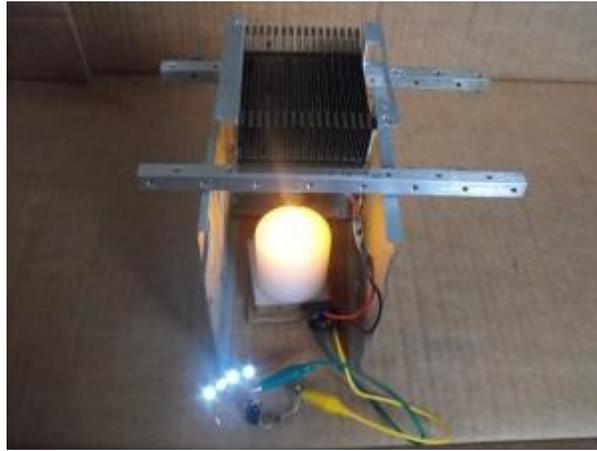
Today I made a compact thermal electric generator (TEG) using a thermal electric cooler (TEC a.k.a Peltier device) and a Joule Thief.

This TEC produces about 1.8VDC when heated on one side and cooled on the other (this setup uses a candle as the heat source and cooling is from ambient air). The advantage of using the Joules Thief circuit in this setup is that it will boost low voltages to higher usable voltages. The open circuit output voltage of the Joule Thief in this circuit was about 31V Peak. It takes about 14VDC to forward bias and light the four LEDs.

The down side of this circuit is that there are conversion losses, but still it costs a lot less to buy one TEC then to buy nine of them and put them in series to get to the voltage required.

From the time I light the candle it takes ~36 seconds to light the LEDs, and they continue to get brighter from there. The LEDs stay lit for ~2 minutes after I blow the candle out, as the residual heat moves from the bottom heat sink through the TEC to the top heat sink, not shown in the video.

Here is a picture of the major components, from left to right: top heat sink, thermal electric cooler, Joule Thief, bottom heat sink, and candle. (to see full size images click images, then click image on following page, still have to figure out why you have to do this to get a full size image?)



TEC Joule Thief Generator Components

Here is a picture of the assembled cooler and heat sinks, I added several pieces of 12AWG solid wire and a 3/4inch copper coupler to direct the heat.

TEC Generator

Here is a picture of the TEC Generator connected directly to a

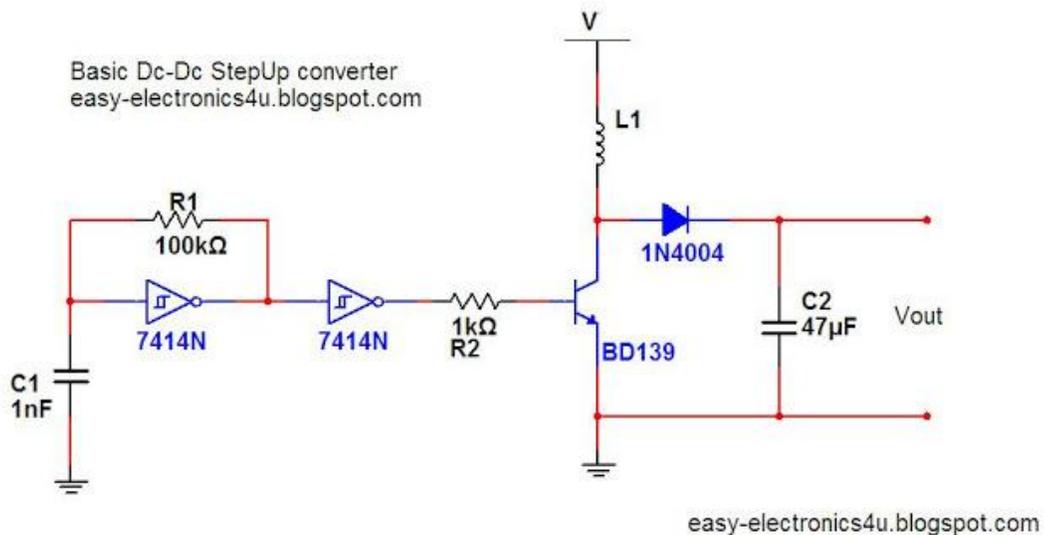
DMM without the Joule Thief boost circuit. The DMM is reading 1.792 VDC

TEC Generating 1.8VDC

And here the circuit is operation, producing ~14VDC to light four white LEDs. :

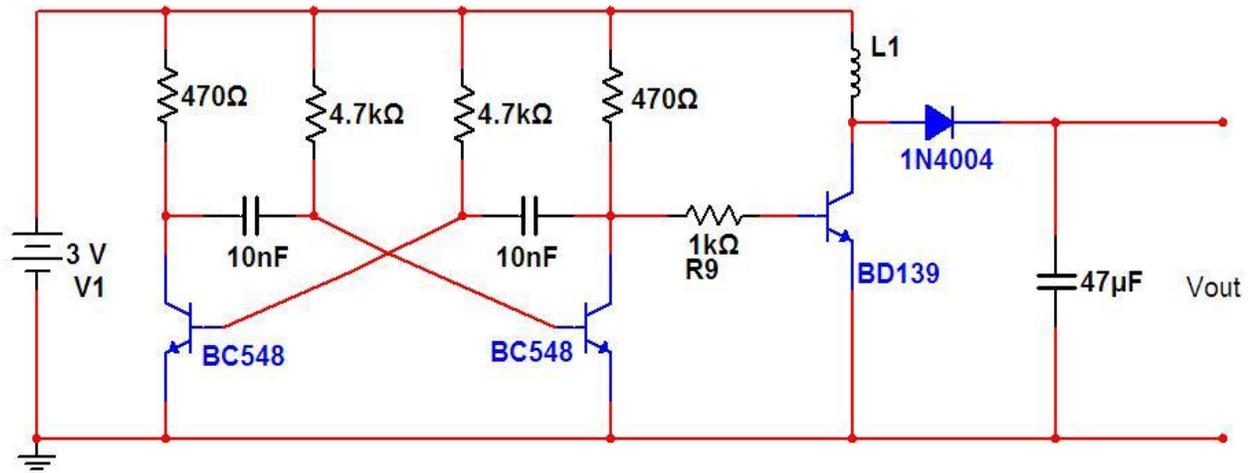
Joule Thief TEC Generator in Operation

This is a basic circuit of a step up DC-DC converter which the output voltage is more than the input, the circuit could be used to power a 9v or more devices from a 6v or even a 1.5v battery, charge batteries (3-12v) with 1.5v solar cell... The circuit uses an oscillator using Schmitt trigger, all types of oscillators works, one transistor (Ex: BD139 or similar), resistors, coil (many different types of coils work even a small DC motor works! or you can wind 60 turn on ferrite)



R1 and C1 determine the oscillation frequency, different types of coils perform differently at frequencies changes. I used 5v input and toroid ferrite, the output exceed 60v (no load). The output voltage will drop as the load go higher. Here is another:

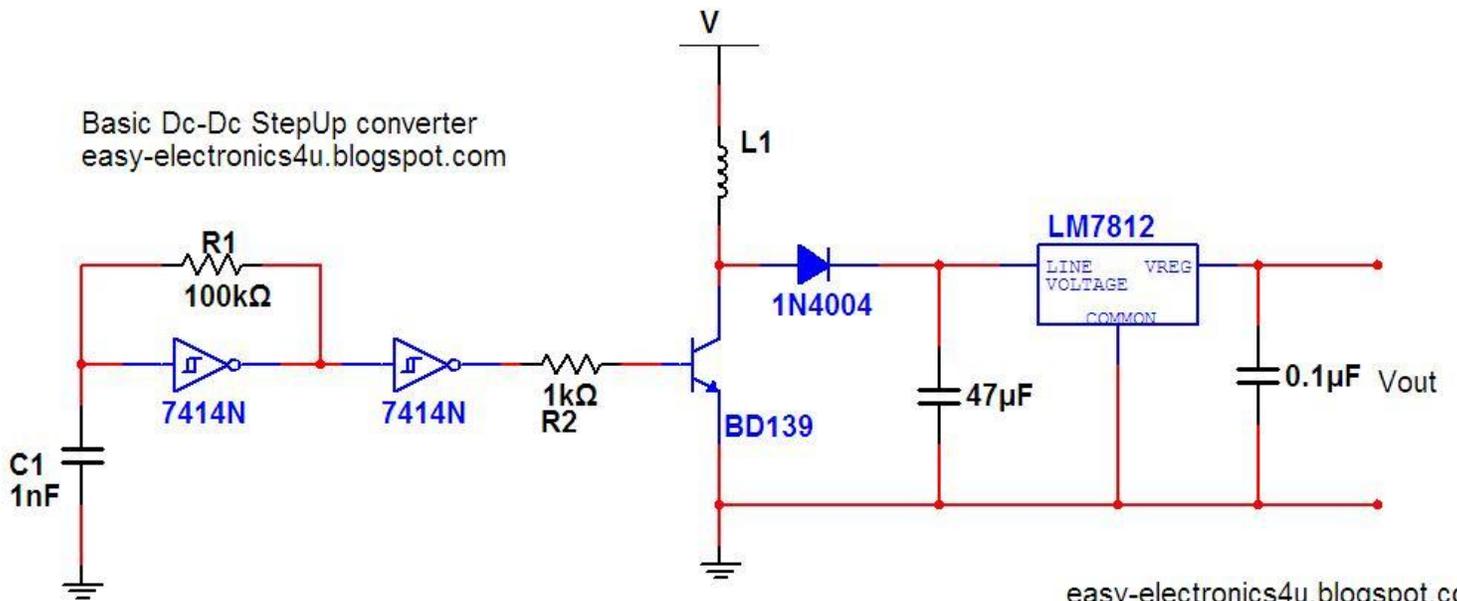
Basic Dc-Dc StepUp converter
 easy-electronics4u.blogspot.com



easy-electronics4u.blogspot.com

7812 or 7805 regulators can be used to stabilize the output voltage. (remember not to exceed the maximum input voltage)

Basic Dc-Dc StepUp converter
 easy-electronics4u.blogspot.com



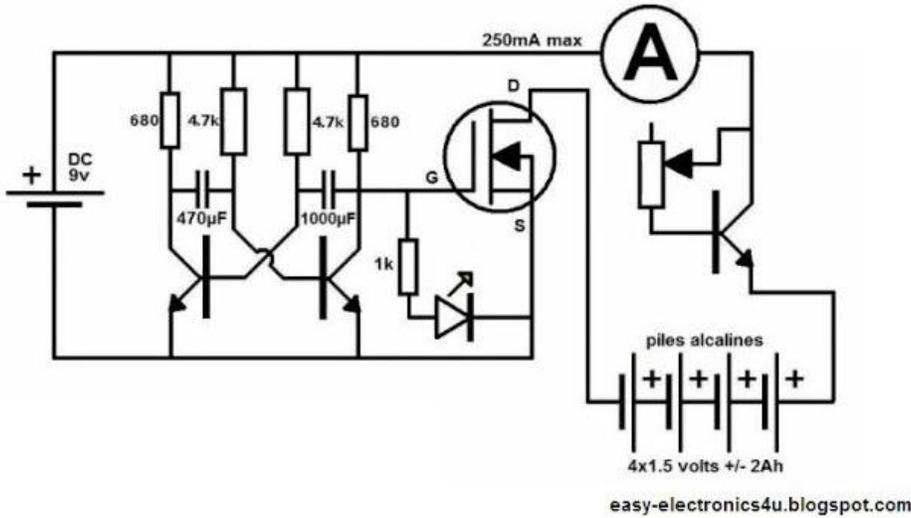
easy-electronics4u.blogspot.com

+++++
 Charge your non-rechargeable Alkaline batteries (new method) Posted by Ilias-Man On Wednesday, February 8, 2012 0 comments We thought that limiting the current of recharging the batteries did the trick, but no! the electrolyte leaks from the end of the negative terminal, when the battery leaks, it loses in the best case 50% of its capacity. more leakage always ends with a small explosion, so another method is needed!!!

The technique of a discontinuous contact: thanks to this technique the battery could suffer much less stress when recharging but on condition of leaving the battery two times longer to rest than to recharge (2 seconds of 6) 2s charging, 4s resting, And it works! batteries recharged without problems! weather when recharging AA, AAA or 9 volt, no problem it works and it does not leak. In the worst case we can always limit the intensity.

The circuit consists of a simple oscillator that charges the batteries for 2 seconds and stop for 4 seconds.
The oscillator drives the Mosfet that charges the batteries.

Choose any mosfet Type, and any small transistor, that handle the charging current, if you want to charge a lot of batteries choose a high current transistors. Another transistor and a potentiometer control the charging current, to charge all types (AAA AA 9V):
I recommend: AA: maximum 250mA AA: 110mA max. 9V: 70mA max.

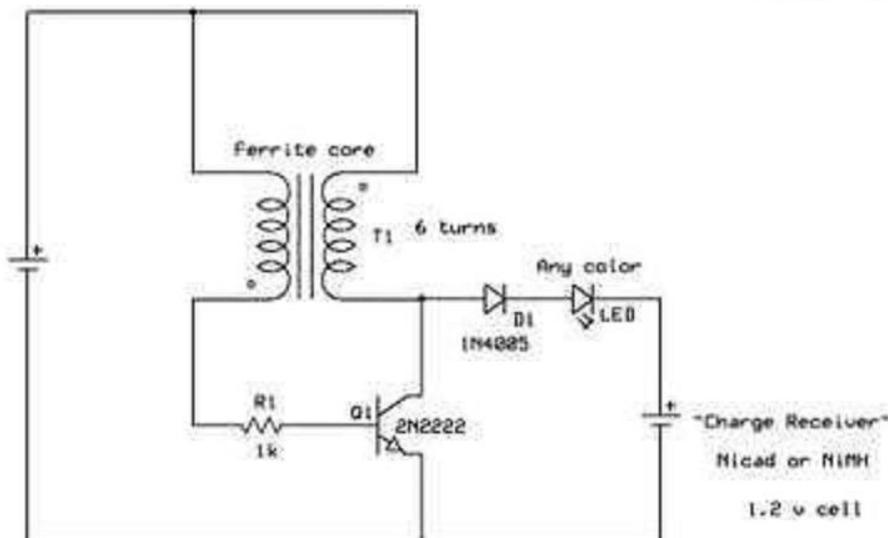
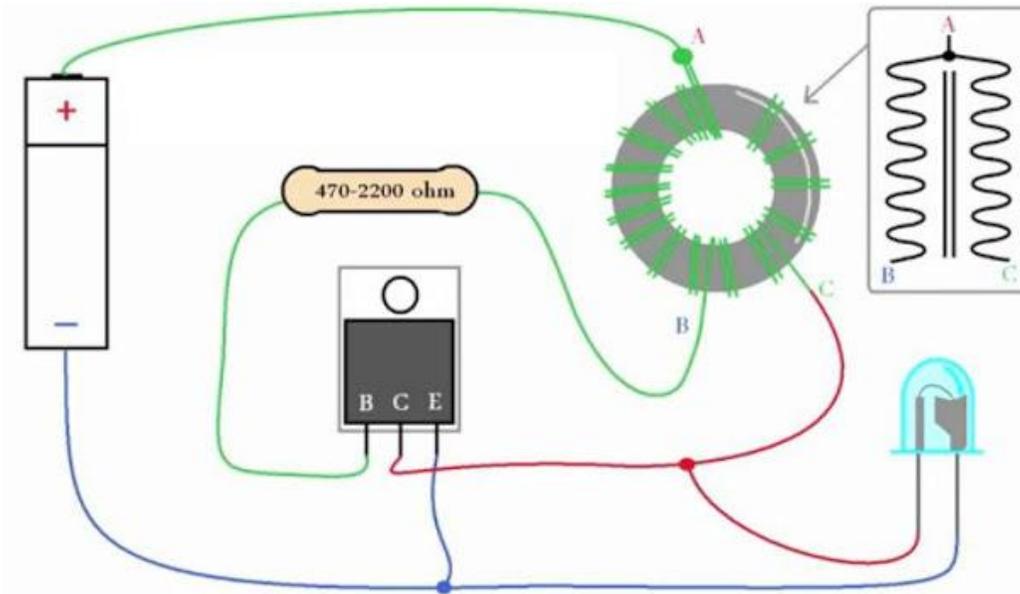


Make a joule thief

Joule thief is a simple step up converter, that converts DC to DC, for example you can drive a 3.4V Led with single 1.2V battery, even if the battery is almost dead. It extract all the energy stored in batteries.

You need:

- 1Kohm resistor.
 - small NPN transistor (for example 2N3904).
 - ferrite toroid, (can be found on power supplies, radio), and wire to wrap around the toroid, (big toroid and more turns = more output power and voltage you get) the method of wiring is shown under, (if you don't have the toroid try the other methods under).
 - and Led or anything you can't drive with one battery like: leds, lighting a neon lamp, charging capacitors with high voltage, charging other batteries
- Ex: charging 3.6V batteries with 1.2V battery... you can change the 1.2V battery with 9V to get high voltage output that can drive neon lamps... you can charge batteries...IMAGE ON BOTTOM OF PAGE IS RELATED TO THE SAME ONE BELOW:



Calculating Battery Charge Time:

In general, you can calculate the time it takes to charge a battery thus:

$(\text{Battery milliAmphour capacity}) / \text{minimum (solar panel current output, charger maximum output)} * 1.20 \text{ (inefficiencies)} = \text{hours}$

The solar panel current output will be less than the 'short circuit current' which is what is usually quoted. You can get it by dividing the wattage by the voltage ($2W/6V = 330mA$) but again, that assumes that the Wattage is correct and for some cheaper panels, they are lower than what the manufacturer tells you

For example, a 1200mAh battery, charged by a 300mA current output takes $\rightarrow 1200 / 300 * 1.2 = \text{about 5 hours}$

Of course, this assumes you are in bright direct sunlight at all times. In reality, the panel may not be pointing right at the sun and it might be a little cloudy. The charger will automatically 'dial down' the charge rate to match what the panel can give. Watch the "Power Good" and "Charging" LEDs on the charger board to see how you're doing. They'll get dimmer and brighter depending on how much light you're giving them. When its done, the "Done" LED will be lit!

The output of the battery will range from 3.7V to 4.2V (when fully charged) - which makes them great for projects that run on 3.3v, you just need a low-dropout 3.3v regulator that have 400mV of drop-out or less such as the MCP1700-330. For projects that require 5V, you will have to use a 5V DC/DC

Peltzier/TEC Modules:

TEC 12706 is also used - order one of these also

Uses of DC to DC Converter/Step Up Voltage Regulators:

it costs a lot less to buy one TEC then to buy nine of them and put them in series to get to the voltage required.

Solar panels
Generators
Batteries
Peltier elements (TEC/TEG modules)

NCP1402-3.3V Step-Up Breakout \$5.00

PRT-10967 RoHS

Description: The NCP1402 is a 3.3V DC-DC converter. The breakout board will accept voltage inputs between 1 and 3 Volts (such as 1 or 2 AA batteries) and output a constant, low ripple 3.3V output capable of sourcing up to 200 mA. This board is great for supplying power to 3.3V sensors or providing 3.3V from a single AA battery.

The breakout board includes the necessary peripheral components. The input, output and ground pins are broken out on a 0.1" grid to allow easy access on a breadboard.

LiPower - Boost Converter \$15.00

Description: The LiPower board is based on the incredibly versatile TPS61200 boost converter. The board is configured to be used with a LiPo battery, has solder jumper selectable 5V and 3.3V output, and an under voltage protection of 2.6V. However, the board can also be used as a general purpose buck and boost regulator with an input voltage as low as 0.3V (default UVLO is 2.6V). With such a low input voltage and quiescent current, the board also works well in energy harvesting applications that use low input voltages.

<https://www.sparkfun.com/products/10255>

To find other voltage boosters (6 volts to 12 volts etc.) search for:

Boost Power Supply DC-DC Converter Step-up Module

Adjustable Voltage Step-up (0.7-5.5V to 2.7-5.5V) How to make your own:

<http://www.instructables.com/id/Adjustable-Voltage-Step-up-07-55V-to-27-55V/?ALLSTEPS>

Thermoelectric USB charger - off grid electricity

<http://www.instructables.com/id/Thermoelectric-USB-charger/?ALLSTEPS>

Extra High Quality Peltier Modules for extremely high temperatures:
<http://www.smtzone.com/>
\$27.00

below are \$40.00
<http://www.marlow.com/>
<http://www.tecteg.com/>

For fastening use aluminum tape or 2000 degree tape called:
Thermo Tec 13500 Adhesive Backed Heat Barrier

Using Induction and CFL lights to charge peltier
<https://www.youtube.com/watch?v=rCvfBGDXpg8>

Below uses solar fan to keep heatsink cool.



by Amico - \$6.00

4 Peltziers will charge a cell phone and 12 volt marine battery = 12 volts or more. This is when run through a car DC cigarette lighter.

Motors:

You could wire 3 of these motors in series attached to the chain to increase power via independent units

1700-7300RPM 1.5-6.5V High Torque Cylinder Electric Mini DC Motor - Product Name : DC Motor;Rated Voltage : DC 1.5-6.5V;Speed : 1700-7300RPM by Amico - amazon.com - \$4.00

Motor, DC Solar, Miniature, 1040RPM, Shaft 0.08" dia By Solar Made - \$8.00
Miniature DC Solar Motor - • Body measures 0.8" L x 12\1v" Dia., shaft is 0.43" L x 0.08" Dia. Power requirements: 1.5-4V. At 1.5V it has a no load speed of 1300 RPM and a current of 25mA. At 1.5V with its rated full load, it has a speed of 1040 RPM. Current of 87mA. Operates on a single solar cell.

R140 1.5V-6V High Torque Speed RC Helicopter DC Motor by Amico - \$4.00
Product Name : DC Motor;Model No. : R140
Working Voltage Range : 1.5-6V;Rated : DC 3V 38500RPM,DC6V 17000RPM

Product Name : DC Motor;Rated Voltage : DC 3-12V;Speed : 1500 -10000RPM
Amico 1500 -10000RPM 3-12V High Torque DC Motor w Propeller for Model Aircraft

