



In under two hours, I had gotten most of the way there, and just need to attach the solar panel and cut out the Altoids case.

As a "maker" n00b, I can't express how awesome it is to build a homemade solar-powered iPhone charger. The little 2W solar panel currently sits in the window of my west-facing home office (more on that later). Now, every afternoon, as the sun starts blazing onto my desk, I soak up a little power.

I know probably hundreds (or maybe thousands) of people have built similar chargers before. After all, 20,000 people attended the first San Francisco Maker Faire in 2006, and it's only grown since. Nationwide, there are tens or hundreds of thousands of makers out there. But there are probably plenty more would-be DIYers who are intrigued but haven't yet taken the plunge. I'm here to tell those people that for just \$90 in parts and three hours of time, you too can keep your iPhone going, wherever you go. Seriously.

1% inspiration: Getting started

I know what you're thinking. Sure, I could just get an official Apple charger for \$30. Maybe there's a third-party option for less. And yes, I could throw down \$80 for a [Mophie Juicepack](#) to meet my external battery desires. But where's the fun or satisfaction in any of that?

who admired the craftsmanship involved in many DIY projects, but thought that they were a bit too involved for me. I've always felt that wordsmithing—rather than electrosmithing—is my best skill. I mean, sure, I've swapped some RAM on my own computer before, but nothing that involved a heat gun and melting metal! But you really don't need *any* background to start. It only takes an idea.

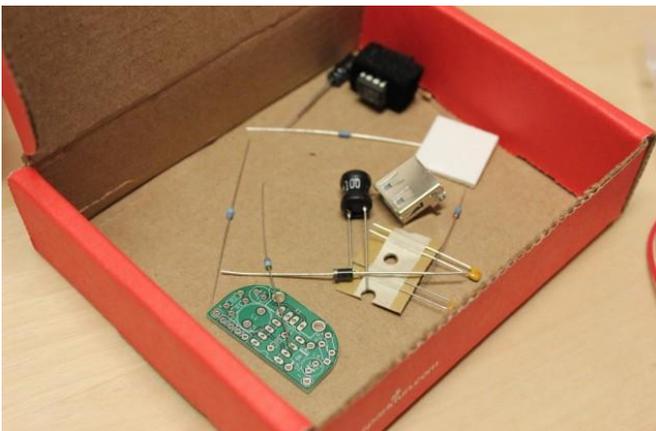
I'd been holding mine for awhile. A few years ago, I met [Drake Martinet](#) (now of NowThisNews) for lunch in Oakland. The area often gets called the "sunny side" of the San Francisco Bay, and Martinet came sporting a [bag with a flexible solar panel cut into the top flap](#). He said he used it to charge his phone while out and about.

I loved the idea. He keeps his phone charged and doesn't have to think about it. My phone constantly runs low. I pretty much *have* to carry a charger with me when I'm on the run. If I get really power-conscious, I go into no-Internet/no-GPS mode. If I'm really desperate—here comes Airplane Mode, turning it off again just to quickly send/receive text messages.

Ever since I saw Martinet's, I couldn't shake the thought. How cool would it be to have a similar setup?

Enlisting help and assembling the pieces

Earlier this summer, I mentioned this idea to my friend Malcolm Knapp, an electrical engineer here in Berkeley. Malcolm didn't think it would be terribly difficult. A few Google searches proved him correct. Not only was it not difficult, but back in 2009, someone already put together a nice [Instructables page](#) outlining each step. To boot, it has a cutesy name: the MightyMintyBoost. Crucially, the page includes a shopping list (crucially, because, I didn't find the instructions Martinet gave me until well after completing this project).



Of course, Instructables or a knowledgeable friend aren't the only places to get started. Websites like [HackADay](#) and magazines like [Make](#) offer great resources, too. So why did I eventually keep Malcolm involved? Mostly, I wanted his expertise for two reasons: first, to make sure I didn't do any serious damage to myself or the electronics. And second, well, I don't own a soldering iron. As the [assistant organizer of MakeSF](#), Malcolm couldn't have been a better teacher. And when we sought equipment help through the folks at [Tech Liminal](#) (an Oakland co-working space), we had a great place to do it.

[Enlarge](#) / The MintyBoost comes with loose resistors, capacitors, and a diode.

Cyrus Farivar

[Soldering 101](#)

After waiting for all the parts to show up at my door (and for Malcolm to get back from his honeymoon), we finally sat down last week to do this together. Here's what we started with (taxes and shipping included, and we also had to sacrifice a Micro USB cable that was kicking around):

[2.0 Watt, 6 Volt Solar Panel](#)—\$29, Voltaic Systems
[MintyBoost](#)—\$23, Adafruit

Cable/LiPoly charger/battery—\$36, Sparkfun
Altoid tin—\$3.70, your corner liquor store

With all the parts gathered, it was time to assemble the MintyBoost. This little green circuit board, first designed [way back in 2006](#), is meant to take in power from batteries or solar panels and "boost" power to the 5V that the iPhone is made to take. When it arrived in the mail, it was just a bunch of loose wires (I learned those were resistors and diodes), a female USB connector, and some padding. So, step one was to solder the resistors to the board.

"I always say that soldering is a three-hand job," Malcolm first told me, as he produced a weird little holding device. "And this, is called a 'third hand.'"

In front of us was a little stand with clips that I could secure my MintyBoost to as I worked on it. Malcolm showed me how to bend the resistor legs down and thread them through the board. Then, carefully, I'd touch the soldering iron to the filaments and, voilà, sleek tin would flow onto the little pads on the board.

It got easier as I worked on it—and I quickly learned what happens when you mis-solder something (*hint*: you need to [remove](#) it). A spool of copper strips was produced, and through a combination of pressing heat to one side, the solder would jump to the copper.



[Enlarge](#) / The MintyBoost, once I had soldered on all the resistors.

Cyrus Farivar

The MintyBoost is alive

Once we'd finished assembling the MintyBoost—following essentially the same soldering steps for the four resistors, one diode, and two capacitors—it was time to wire it up to the LiPoly board.

"Now we have to do the 'smoke test,'" Malcolm told me. "That basically means, if you see smoke, unplug everything—you've done something wrong."

No smoke, no fire, and we were well on our way. It took probably less than a minute to twist the electrical wires and connect all three elements of this setup to each other. Officially, this combination was the MintyBoost connected to the LiPoly, which in turn also connected to the already-charged battery. The moment of truth arrived and—it worked! Eureka! In less than two hours we had successfully created a functioning triad.

But I'd forgotten to get an Altoids tin. OK, it didn't *have* to be an Altoids tin. But I needed some sort of container to put the three electronic devices (the battery, the LiPoly converter, and the MintyBoost itself) into. So I ran a block down to the nearest liquor store to get an Altoids tin. Once I'd distributed the mints among the co-workers and had washed out the tin container, we needed to fix the cable feeding power out of the solar cell. Malcolm showed me how to take that [Micro USB cable and splice it](#) onto the cable coming out of the solar panel, so we could get power from the panel into the LiPoly charger, which would then feed power to the iPhone and to the battery.

And with that, it functioned, solar panel and all. Malcolm put the foam pads onto the two boards so they wouldn't short in the Altoids tin, made a few cutouts for each port, and we were done.



[Enlarge](#) / Malcolm Knapp (left) helped me bring the MightyMintyBoost to life!

Cyrus Farivar

And for my next trick...

All that's left now is for me to adhere the boards and the battery to the Altoids tin; then I could easily keep the whole thing in my bag when I'm out and about. I also need to sort out how best to adhere it to my backpack if I want to mimic Martinet accurately; though maybe velcro strips or clasps of some kind will work fine.

So far, I haven't had a chance to adequately test my MightyMintyBoost and see how many hours I need to leave it plugged in to fully charge my phone. In fact, after the first few days of trying to use the charger on my desk, it didn't seem like it was fully getting adequate power. Frequently I'd get a "Charging is not supported with this accessory" error message on the phone, or it would alternate between charging and not.

So I rang up [Jerome Kelty](#), a Colorado-based jeweler by trade and the author of that original Instructable. Kelty told me that I should use it primarily outside.

Want your own solar-powered charger?

Remember, Cyrus utilized [this Instructables page](#). It's a simple five-step set of instructions, and the materials (soldering iron *not* included) cost under \$100. Project run time: under three hours.

"Small panels like that, they pretty much have to be in direct, outdoor sunlight," he said. "If I have it in my kitchen window, it doesn't work nearly as well."

He explained that being indoors simply doesn't draw enough power, and that anything blocking the light—windows, trees, shade—diminishes the current. The iPhone is also quite finicky about how much power it draws on its own.

Kelty said that this Instructable continues to get a lot of attention, and people still frequently leave him comments. He addresses *every single one*. Apparently I'm like a lot of DIY newbies out there.

"The MintyBoost is a great introduction to soldering," he added. "This is an extension of that. Basically all you're adding is a circuit, but it's a really good starting point."

Now that I've completed my first project, I feel confident in my abilities to do basic soldering and follow related instructions. I still am not 100 percent clear on what all the elements do, but Malcolm has been very patient with my sometimes inane questions. ("So, a capacitor is different than a resistor, right?")

I guess I'm ready to take my next step into the DIY world. I may not own a soldering iron yet, but I know that the nearest one is just a 10 minute bike ride away. Kelty suggested that for my next project, as a cyclist, I might try to tackle his "[Ultimate Night Vision Headlamp](#)"—it's a cheap, lightweight, and crazy-bright light. This involves not only soldering, but gluing LEDs to an old CPU heat sink. (Coincidentally, I haven't been this excited about gluing since elementary school!)

So take note, Oakland. If you see someone wearing a ridiculous blue lamp on two wheels, you've been warned. There's a new, very junior member of the maker movement in the neighborhood.

Fire Power 40 (generates the electricity from burning woods)



Price: US\$720, EUR
550

Production of
electricity: ~40W
Usage: Outdoor
Woodstove

Specifications

Generate the electricity
from heat of burning
wood/charcoal/gas etc
Portable
Water pump/hose
included
Both 12V battery and
DC12V/AC inverter is
needed for
international
customer(Except
Japan)

[Fire Power40 E](#)

- Directly convert heat into electricity.
- Output Power ~40W.
- DC12v/AC100~220V.
- Power supply for a note computer.
- Silent system due to the use of thermoelectric principles
- Charge iPad tablet PCs, smart phones, mobile phones with USB connection.
- Use wood, charcoal and gas as a fuel.
- Portable

Components

Thermoelectric unit

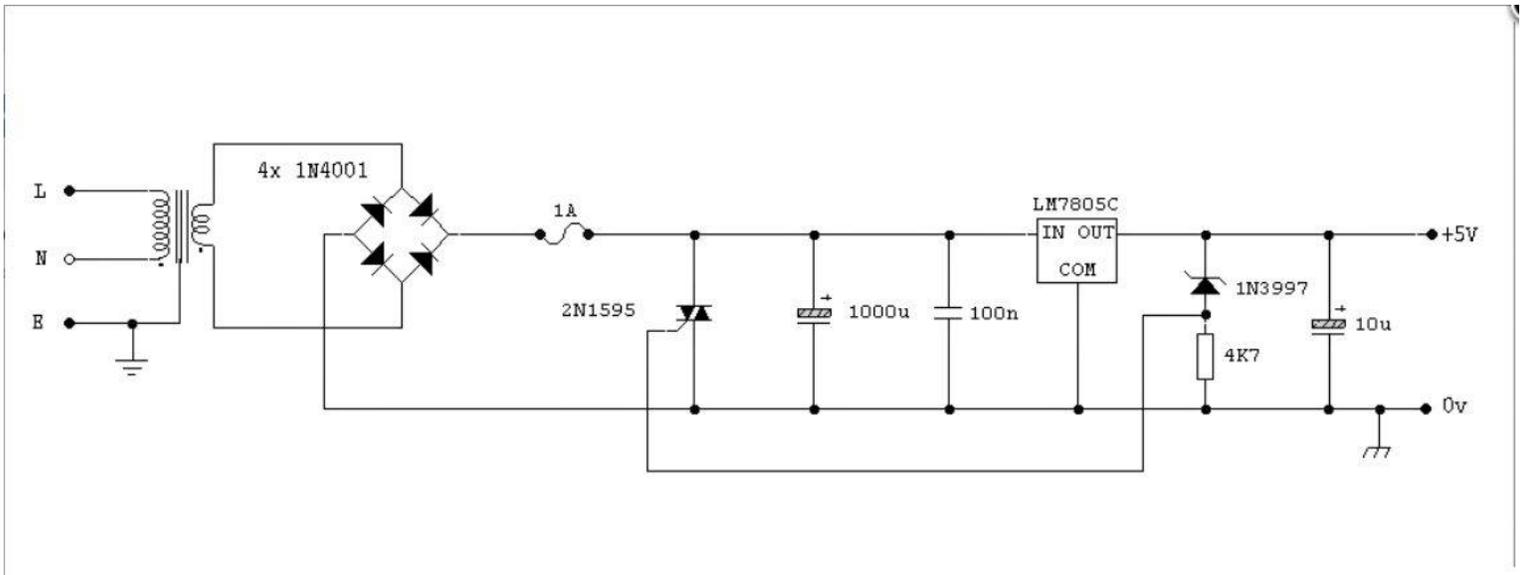
Charge control box

USB socket

Cool water pump/hose

(Battery): You have to purchase 12V battery in your country

(DC12V/AC Inverter) : You have to purchase DC12V/AC inverter in your country



An overvoltage protection of power supply unit is shown in the figure with a regulated 5V output.

As the zener diode detects a surpassed voltage beyond its limit, the circuit will get affected in a few microseconds while a fuse needs hundred milliseconds to react when it gets busted due to the exceeded current rating. The circuit must maintain a regulated power supply and lenient momentary voltages for both transistors consisting of low-power Schottky (LS) Transistor-Transistor Logic (TTL). The crowbar method used by the circuit showed the essence of a thyristor as it blows the fuse by short circuiting the supply because of the large current passing through the thyristor, thereby providing much protection.

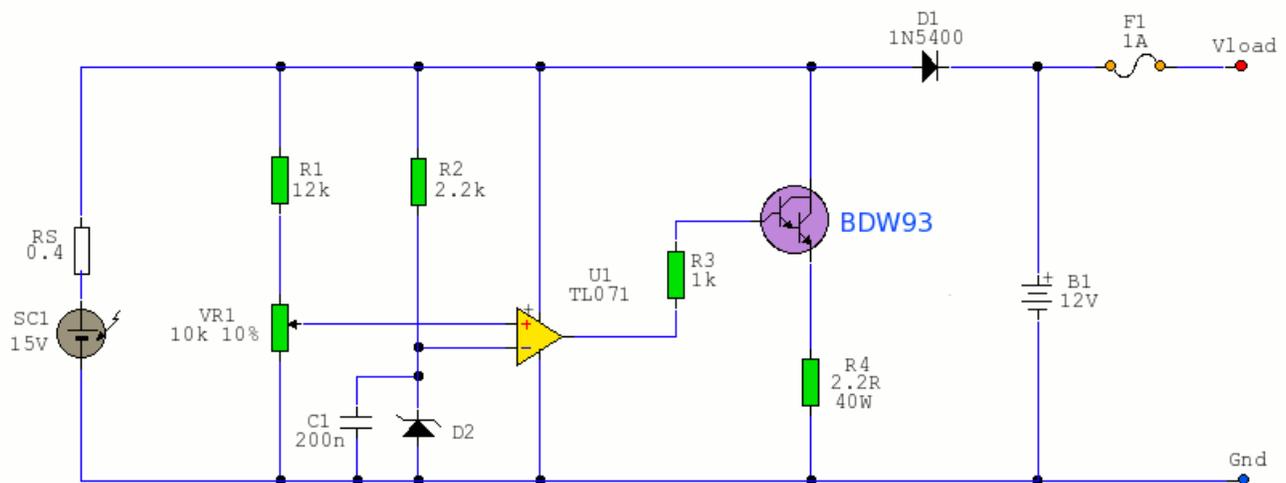
The process happens in a few microseconds or less. The sensitive IC's are saved when the zener diode performs under the excess voltage, toggling the thyristor and setting the output voltage to zero volts. Even if the fuse blows at this stage, it will not take an effect as the voltage has been lowered to zero volts.

In cases where high voltage regulators are used, a transformer with secondary voltage will be required. Overvoltage thresholds can be determined by deciding on a different regulator and zener diode.

For above you can also use a breaker switch which trips when over charged

Description

A solar battery charger that uses a shunt regulator to prevent overcharging. Circuit uses a 12V solar battery, but can be adapted for other voltages.



Notes

This is a simple, solar charger circuit that uses a shunt regulator to prevent overcharging. SC1 is a 12 Volt solar panel with a rating of 40 Watt. RS is not in the circuit but represents the solar cells internal resistance. The solar cell, powers a simple op-amp voltage regulator. R2 and D2, hold the non-inverting input of the op-amp at 5.1 Volt. The voltage on the inverting input is set by VR1 and R1. Under charging conditions, the output of the op-amp is low and all voltage, reaches battery B1. Diode D1 prevents the battery from powering the circuit when there is no output from the solar cell.

When there is an excess of sunlight, the op-amp output will swing high, switching on the BDW193 darlington transistor, and excess energy is dissipated into the load, R4. This is a 2.2 ohm resistor and should be rated at the solar cells full power, which is 40 Watts in this circuit.

Setting Up

Under bright sunlight, remove battery B1, and replace with a 40h watt 27 ohm load resistor. Adjust VR1 until the output voltage across the 27 ohm load resistor is 14.4 Volt. This is the maximum voltage the battery should reach during a charge. All excess power from the solar cell will then be dissipated via R4.

Excellent Source of simple Circuits:

<http://www.zen22142.zen.co.uk/Circuits/Power/power.html>

Motor type and mounting:

Buy a motor with a bicycle chain sprocket on the output shaft. Most motors come with no sprocket or a sprocket that only fits No. 25 or No. 35 chain (which is used on go-karts and scooters). Sticking to bicycle chain will make your life a lot easier. The Unite MY1018 is available as a 250Watt-350Watt motor on several scooter parts stores online.

Monocrystalline Flexible Solar Panel - with full refund if order not received - Sold By

lyssa liu's store-Solar energy expert

<http://www.aliexpress.com/item/5-w-monocrystalline-silicon-half-flexible-solar-panel-12-v-battery-charger-ultra-thin-ultra-light/1557903890.html>

Drive Attachment system will be friction drive based

Friction Drive Attachment Ideas:

<http://www.electricbike.com/friction-drive/>

Motor will have knurled aluminium pipe or cylinder attached to motor output shaft, than attached to wheel.

1 minute .5 into video shows adjustable friction drive motor mount:

<http://www.youtube.com/watch?v=vDqtc6c0QJE>

<http://www.electricbike.com/friction-drive/>

This is a light weight high performance friction drive for all types of push bikes. It is designed to be used as a pedal assist and can push the bike along at speeds up to 50 kph for short periods. Its primary purpose is to for use as a hill assist basically turning most hills into an easy climb. Voltage range is between 18V and 24V and best suits light weight lithium iron or liPo batteries. Total weight of the drive is 1350 grams and completely decouples from the tire when switched off. The drive has next to no impact on the ridability of the donor bike and can be removed in less then 20 seconds whenever required.

<http://www.youtube.com/watch?v=e6TV6lgXOgM>

If a screw adjust for fence is not necessary use springs attached to holes in rear bike frame

IMages with friction motor mounts attached:

<http://endless-sphere.com/forums/viewtopic.php?f=6&t=29574>

Motors that can be fitted with knurled cylinder to motor output shaft:

Hyperion Motor

http://www.allerc.com/advanced_search_result.php?keywords=ZS2213-22&x=9&y=10

Scorpion motor

https://www.hobbyking.com/hobbyking/store/_457_59_Electric_Motors-Scorpion_Motors.html

AXI 5345/14 motors

http://www.hobbyexpress.com/axi_motors_277_ctg.htm

This scooter was at the 2008 Maker's Faire. It is powered by a large AXI RC airplane motor and A123 cells. The frame is aluminum.

Well Built System using airplane motor

<http://www.youtube.com/watch?v=e6TV6lgXOgM>

I was just wondering if I can use a Thermoelectric peltier device instead of solar panels to charge up that Lithium Ion Battery (using USB / DC / Solar Lithium Ion/Polymer charger)?

I want to come up with a system that allows me to charge up a 1200mAh battery using a peltier device. Charging time is not that important, what I mean is, it doesn't matter if it takes 2 weeks to charge up the battery, as long as it does it.

is this viable? if yes, what kind of battery is most suitable for this kind of charging? (continuous and very slow trickle charging). and would I need a booster to boost peltier's output or not?

The voltage & current output will be proportional, to the heat differential. But even with good heatsinks on either side to help with the thermal transfer, you will need a boost converter to get enough voltage to charge a battery. If you use something like a mintyboost, you should be able to charge a LiPo cell with the #390 charger.

This should give you an idea of what is possible from the peltier junction: <http://www.greenoptimistic.com/2012/06/...itELZKsg18>

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Thanks Bill, for your prompt response. I do have a couple of more questions:

1- lets say I have charged the lithium battery to some level and now I want to charge my iphone through that LiPo battery, how can I achieve this? is there any kit in adafruit that works hand to hand with #390 charger for this purpose?

2-Also you suggested to use "mintyBoost" with #390 charger, however for the project that I have in my mind, mintyboost with those two AA batteries look so bulky, i was just wondering if there is anything smaller?

3-if I am going to use peltier device, which charger would be more suitable? charger #390 or (USB Lilon/LiPoly charger -v1.2 ID: 259)
<http://www.adafruit.com/products/259#Description>

the #390 charger is probably the best choice for this application. To use the MintyBoost, you would omit the 2xAA batteries and connect it directly to the Load terminals on the charger. The boost controller part of the MintyBoost is fairly compact. The load-sharing circuit in the charger will allow you to charge the phone with or without input from the peltier generator.

This is the #390 charger: USB / DC / Solar Lithium Ion/Polymer charger PRODUCT ID: 390 \$17.50

Power Boosting Systems

The solar systems may also be configured into the pelztier systems.....

just bypass the battery recharging circuit and put into motor and supercap circuit.

Constructed a Super Minty Boost as a Christmas present. Project was fairly simple; utilized a 6V 2W solar panel and some simple power electronics, after that it was only about hacking the Minty Boost pcb to accept the Solar panel power conditioning circuit. Simple tests yielded a 5 hour fully charged (in direct sunlight) 1300 mAh Li-ion battery which is 91% full Iphone 4 battery - not bad at all.

Minty Boost Solar Charger Kit, that boosts voltage enough to turn motor/charge batteries: \$17.00

may not work with flexible solar panels, but gives an idea of how to use minty boost to boost solar charge to turn motor.

<https://learn.adafruit.com/usb-dc-and-solar-lipoly-charger>

Parts list for solar power minty boost kits:

unnan IKEA Lamp (available here) soldering iron, solder, solder wick/pump pliers, wire cutters, wire strippers, utility knife phillips head screwdrivers (medium and small) rotary tool (dremel, etc.), cutting wheel, routing bit epoxy putty (quick setting is the best, we use JB Weld) power drill, 5/16" bit MintyBoost v3 by Adafruit (available here) 2x Schottky Barrier Diodes (1N5817) 1x 39K Ohm resistor Small piece of circuit prototyping or perf-board USB

<http://voltaicsystems.com/blog/mod-the-ikea-sunnanto-charge-an-ipad2/>

Minty boost kit also available at:

http://www.makershed.com/product_p/mkad2b.htm?Click=37845

Video showing using a 2000mAh Li-Ion battery and a 7"x9" solar panel.

Here is a solar powered charger I made using components and guides from Sparkfun.com and Adafruit. It is a modified Mintyboost charger using a 2000mAh Li-Ion battery and a 7"x9" solar panel. This is pretty much the main guide I used: <http://www.adafruit.com/blog/2010/07/09/how-to-make-a-solar-mintyboost-a-solar-power-charger-for-your-gadgets/>

<https://www.youtube.com/watch?v=ghrvq4CCpNk>

Wiring in Series

2 Peltizers put out 500ma

max mintyboost output is 500ma

with 4 modules you get 2000ma

Additional Search Word TERms:

Electric Friction Drive Attacahment'

modify mintyboost charge from solar panel

radio control truck battery

With a fixed charge rate of 2 amps (2000mA), it theoretically would take 72 minutes to charge a fully depleted pack (2400mAh/2000mA = 1.2 hour = 72 minutes). There are other factors that affect the actual charge time, but 72 minutes is a good ballpark estimate. runs for about 10 minutes until fully discharged.

Helicopter battery: Battery: 3S LiPo 11.1V, at least 2000mAh

Motors:

When pulling power matters and looks.. well.. just don't, then the HobbyKing Donkey ST4010 is the work horse for you. This tough-as-rawhide motor features a heavy duty mount, a huge 6mm shaft and self oiling bushings that just wont give up like some of the bearings in those little "Show Pony" motors.

Specs:

RPM/v: 820kv Dimensions: 51 x 23mm Shaft: 6.0mm Voltage: 11.1~14.8V Weight: 194g No-load current: 2.8a @ 11.1v Max Current: 60A Max Watts: 680W Mounting Holes: 65mm

Prop Data: 12x8 - 11.1v - 39a - 1750g Thrust 11x5 - 14.8v - 44a - 2250g Thrust 10x5 - 14.8v - 30a - 1850g Thrust

https://www.hobbyking.com/hobbyking/store/__15201__HobbyKing_Donkey_ST4010_820kv_Brushless_Motor.html

Motors by size:

https://www.hobbyking.com/hobbyking/store/__517__59__Electric_Motors-Outrunners_by_size.html

Research further +

emergency cell phone charger and _ MAY BE ABLE TO WIRE IN SERIES TO BOOST VOLTAGES – COST \$2.00 FROM HONG KONG, OR USE SOLAR GARDEN LIGHTS MODIFIED IN REVERSE TO CHARGE

REVERSE JOULE THEIR BATTERY CHARGER –SERACH TERM

joule their cell phone charger