



EmComm,

CERT, QRP

Battery Box

by Tony Gawel W6TNY

CERT (Community Emergency Response Team)

EmComm (Emergency Communications)

QRP (Low Power Operation; example ham radio; 5 watts output / 10 watts input)

Bio

- Director of Information Technology for a large international school and laboratory
- Interest in electronics since elementary school building kits, TV and radio repair.
- Working in computer and electronics field since the 1970s
- Passion for communications, networking, WI-FI, and digital systems



Background

- Always looking for better ways to plan, prepare and to make our lives easier.
- Looking first to what is already available (off the shelf)
- Repurposing reusable items headed to the **e-waste**
- These attributes are what attracted me to amateur radio (Ham Radio)
- Ability to exercise my engineering and creativity skills to design , experiment and then share it with others.



Lawyers

- Any lawyers in the audience?

DISCLAIMER

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Current Power Options

- Cell phone travel charger
- EmComm Boxes



HARDEN Power Juice Box
<https://www.portableuniversalpower.com/>



Quick Sliver Go-PWR Plus XL™ 80 Ah. Battery Box

Project Concepts

Provide CERT, EmComm teams and amateur radio organizations with a **Emergency** Battery Box project that is:

- Low cost
- Fun and simple to build
- Easy to transport
- Requiring minimal tools to assemble.



Objective

- A good group/club project
- Low cost
- Gets people involved
- Anyone can do it
- Expandable
- Gets people excited
- Provides a platform people can build on, experiment, and personalize



Uses

- Home preparedness
- Emcomm teams
- Races
- Fire Watch
- Race events
- Disasters
- Meet and Greet Events (PD or Fire Open House)
 - Draw people into the booth to charge their phones
 - Attract attention of the curious

Planning and Selection

- Identify potential uses
 - Charge cell phones
 - Charge or operate HT with a battery eliminator
 - QRP
 - Mobile on low power
 - Mesh Node
 - LED lighting
 - Fans
 - ETC.





Challenges

- Creating a simple to build
- Small
- Lightweight
- Easy to transport
- Affordable
- Expandable
- A concepts that can be used in future projects
- Something that anyone can do and have fun



Possible Power Sources



Possible Power Sources

- Dilithium Crystals



Possible Power Sources

- Flux Capacitor



Possible Power Sources

- Power of the Sun



Power Source

- 7 - 12 - 15 Ah AGM battery
 - They low cost (some cases free)
 - Plentiful
 - Lightweight



- Maserati Battery LIPO4
 - 8 Ah LIPO4
 - 12 Ah LIPO4
 - 20 Ah LIPO4



Battery Types

- Before we get too far into the project we need to talk about battery types
- Safety
- What works
- What doesn't



Safety



Safety

- **Never** disassemble a battery under any circumstances. The materials in a battery are often toxic and can cause severe burns and can damage your clothing.
- **Red wire goes to the Positive**
- **Black wire goes to the Negative**
- Never use a fuse larger than one that is rated or recommended for this project
- (Keep some spare fuses in your box)
- **Do not short circuit a battery by crossing the positive and negative terminals** as you can damage the battery and other electrical equipment components. It can also cause burns and/or injury to you.
- Never throw batteries into a fire as they can split, cause toxic fumes and leak acid.
- Don't reverse the polarity of the battery or you can damage your equipment and the battery.
- Don't use old and new batteries together. This can degrade the batteries.
- Always charge the battery at the correct voltage and amperage after use. Don't over-charge the battery as this can damage the battery and cause it to leak. Follow the charging procedures from the manufacturer.
- Store batteries in a sealed cool dry place when not in use (battery box).

Battery Types

- Starting/ Cranking
 - High current and short duration
 - Cars and Truck starters



Battery Types

- Deep Cycle
 - Lower Current steady power over long duration
 - Motor Homes
 - Boats
 - Golf Carts
 - Amateur Radio



Deep Cycle Batteries

- Floated Lead Acid
- Gel Cells
- Absorbed Glass Matt (AGM) *
- LiPO
- LiFePO4 *



BioEnno LiFePO₄



BioEnno Power 12V, 12Ah LFP Battery and BMS

K2 Energy LiFePo4



K2 Energy K2B12V10EB 12V 10Ah Lithium Iron Phosphate Battery and BMS

Zippy Flightmax LiFePo4



ZIPPY Flightmax 8400mAh 4S2P 30C LiFePo4 Pack

Battery Capacity Level

- On standard batteries you can use voltage as an indicator of the charge level of the battery

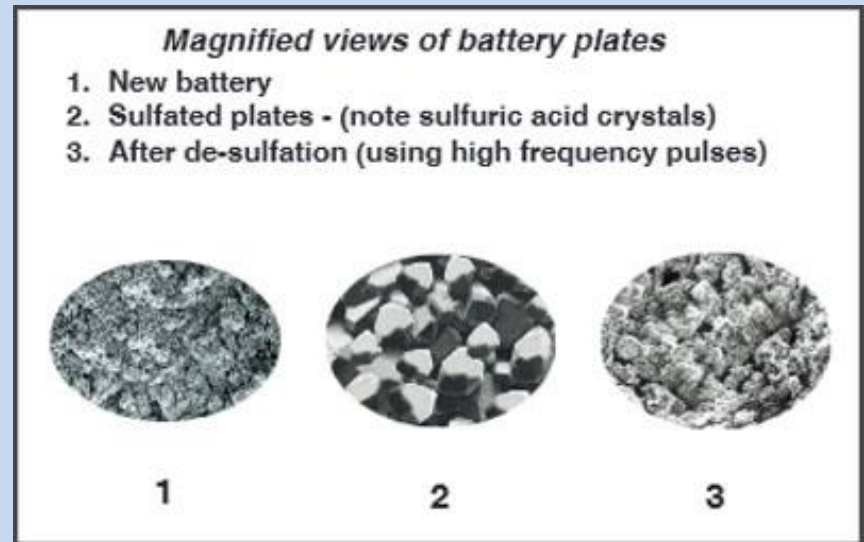
SLA/AGM Battery Charge Level

State of Charge	AGM battery
100%	12.80+
75%	12.6
50%	12.3
25%	12
0%	11.8



Battery Care

- For long battery life store your battery fully charged and check it once quarter
- This minimizes sulfating of the plates which can happen over time



Sulfating

- Sulfating happens when lead sulfate crystals build up on the lead plates.
 - Loss of capacity, shorter run times
 - Premature failure
 - Longer charging times
 - Excessive heat build up
 - cells causing loss of capacity and early failure



Charging

- Flooded Lead Acid
 - Constant current, constant voltage (CC/CV)
 - about 13.8 to 14.4 v Float 13.2 - 13.4
 - 12 to 16 hours
- AGM
 - Sensitive to overcharging
 - Multi stage charger to reduce over heating and prevent gassing
 - Charge 14.4 Float 13.5 - 13.8 v
- LiFePo4
 - Depends on battery



What is C

- The C rating specifies the how fast a battery should discharge or charge
- A 1C rate, the battery will charge or discharge as the marked Ah rating of the battery.
- At .5C the current rate is $\frac{1}{2}$ the marked rate and the time doubles.



Proper Charging

- Single stage charger
 - Single output charge voltage and no shut off when fully charged
 - Can overcharge battery
 - Cause overheating
 - Premature battery failure

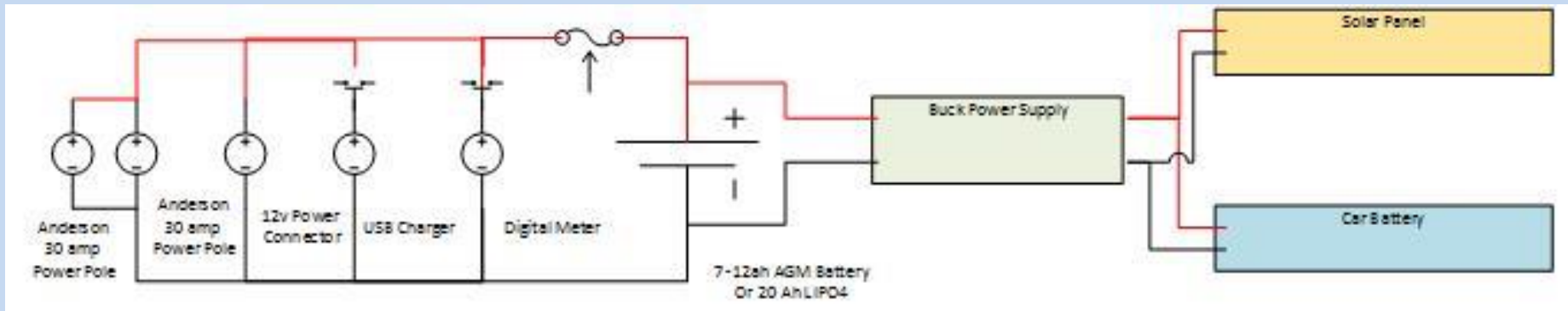
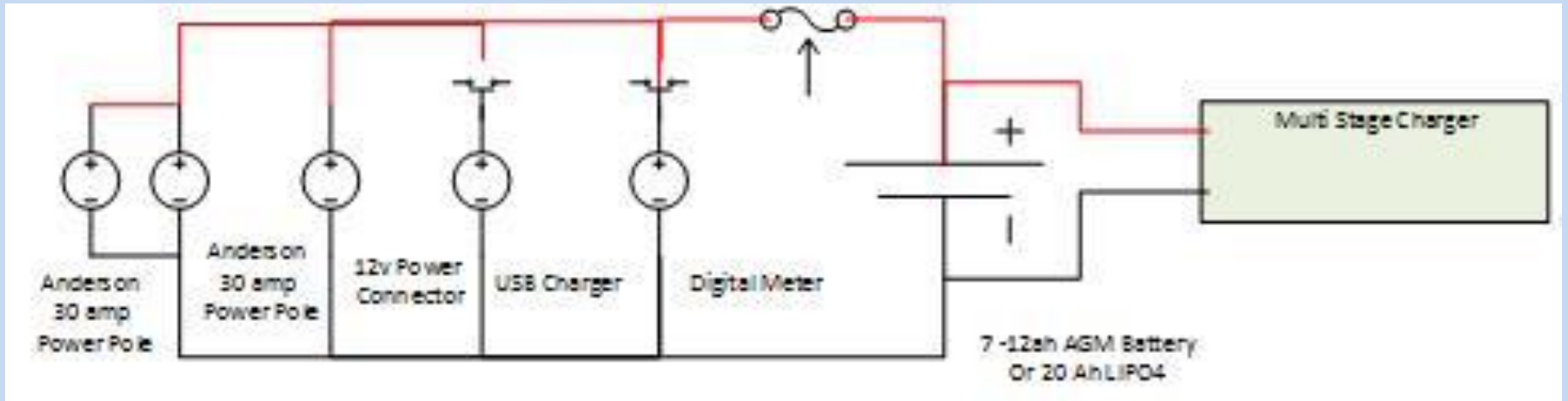


Charging

- Multistage Charger (Low and Slow)
 - Bulk
 - Additional Stages
 - Trickle
 - Float
 - De-sulfate



Charging Schematic

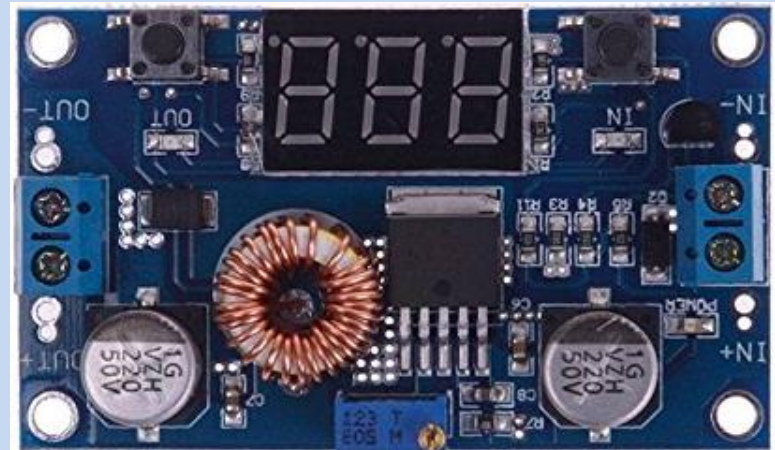


Solar Charging

- 5 Watt solar panel



- Charge Controller



Discovery

- Experimenting to find the right combination



Mounting

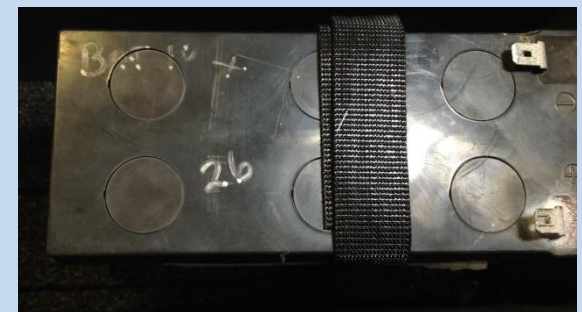
- Solid
 - Dense foam to protect the box and the accessories you can pack inside



- Spray in Foam
 - It was fun
 - Messy and it takes overnight to set up

Battery Tie Down

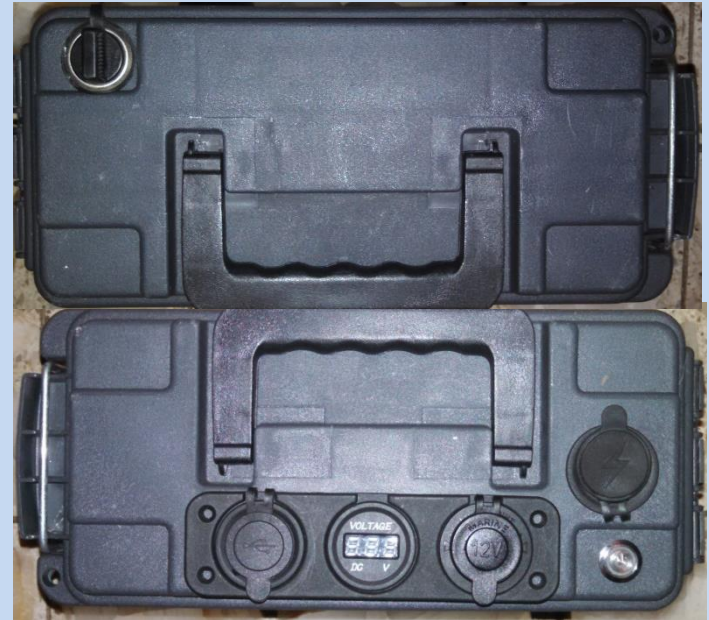
- Tie wrap and cable tie mounts
- Nylon strap and buckle
- Moved to double sided Velcro





Project Selection

- Basic
 - Simple Battery
 - Fuse
 - 12v Socket
- Cadillac
 - Battery
 - Fuse
 - 12v socket
 - USB Charger
 - Anderson



Battery Capacity

- With a bigger box you can add a larger battery and more accessories





Basic Parts List

- Ammo box
- Battery
- Fuse holder and fuse
- 12 v Marine Grade Cigarette Lighter Socket
- Velcro Battery trap
- Dense Foam padding





Parts

- Plastic ammo boxes are available at Harbor Freight and sporting good stores
- Most of the other parts are available on Amazon

A coupon for a Bunker Hill Security Ammo Box. The coupon features a yellow banner at the top that says 'SUPER COUPON' and a black banner below it that says 'SAVE 69%'. The product name 'AMMO BOX' is displayed in bold, with the item number 'ITEM 63135/61451 shown' below it. A black image of the ammo box is shown with the 'Bunker Hill' logo. To the left of the box, there is a green 'NEW' badge, a red price tag showing '\$399' with a crossed-out '\$799' below it, and the text 'Compare \$12.88'. To the right of the box, there is a 'Customer Rating' section with five blue stars. At the bottom of the coupon is a barcode and the alphanumeric code '22739840-101098929301021'.

Available at
amazon





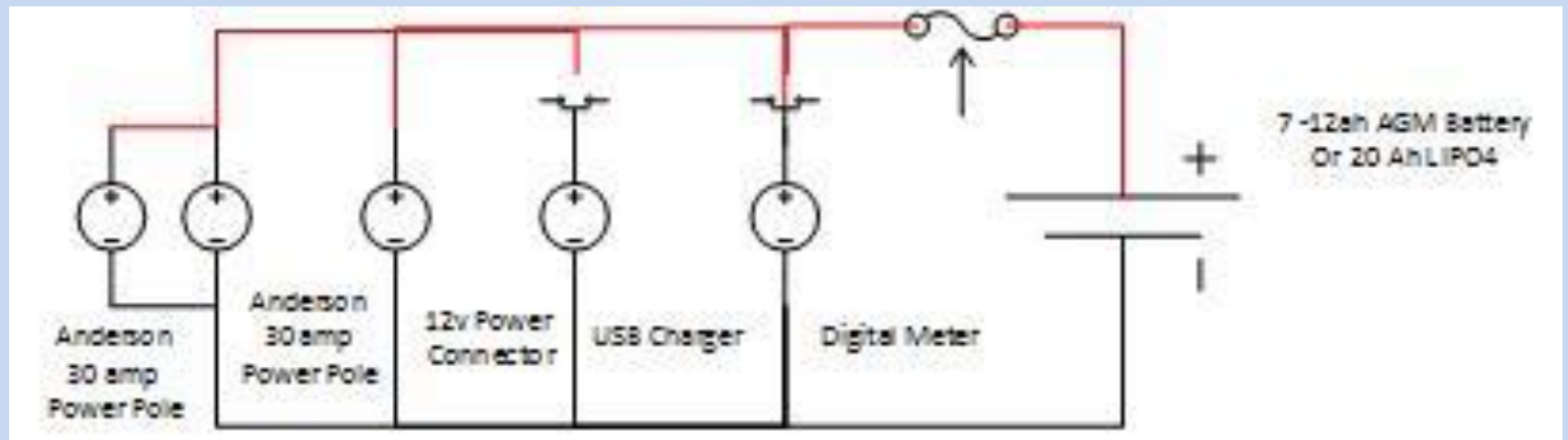
Cadillac Parts List

- Ammo box
- Battery
- Fuse holder and fuse
- Astra Depot Triple Function Dual USB Charger + Voltmeter + 12V Outlet Socket Panel
- Anderson connectors (optional)
- Battery strap
- Foam padding





Schematic



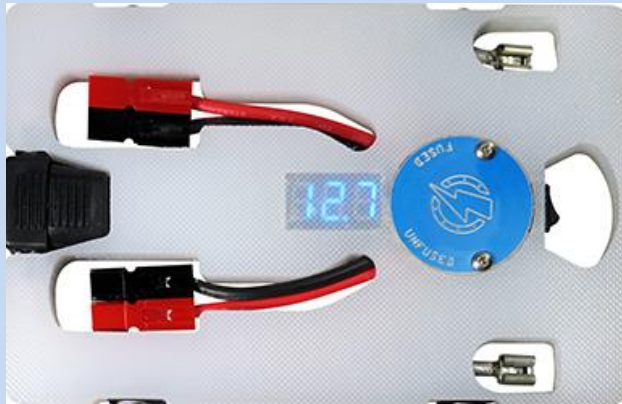
Battery Pack Adapters



Harden Power BatPac RBC2



Harden Power RBC2 (7 & 9AH) battery:

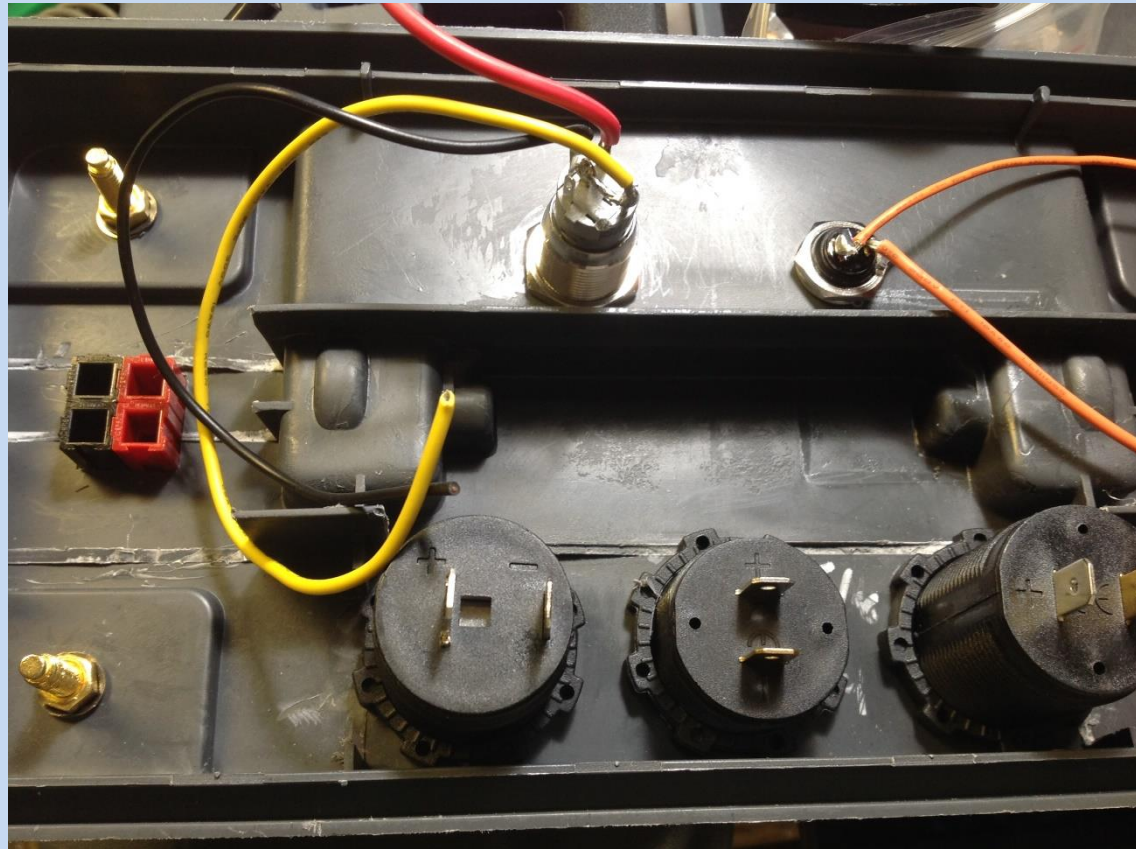


Quick Sliver Batt-Mon 12Ah Battery Plate

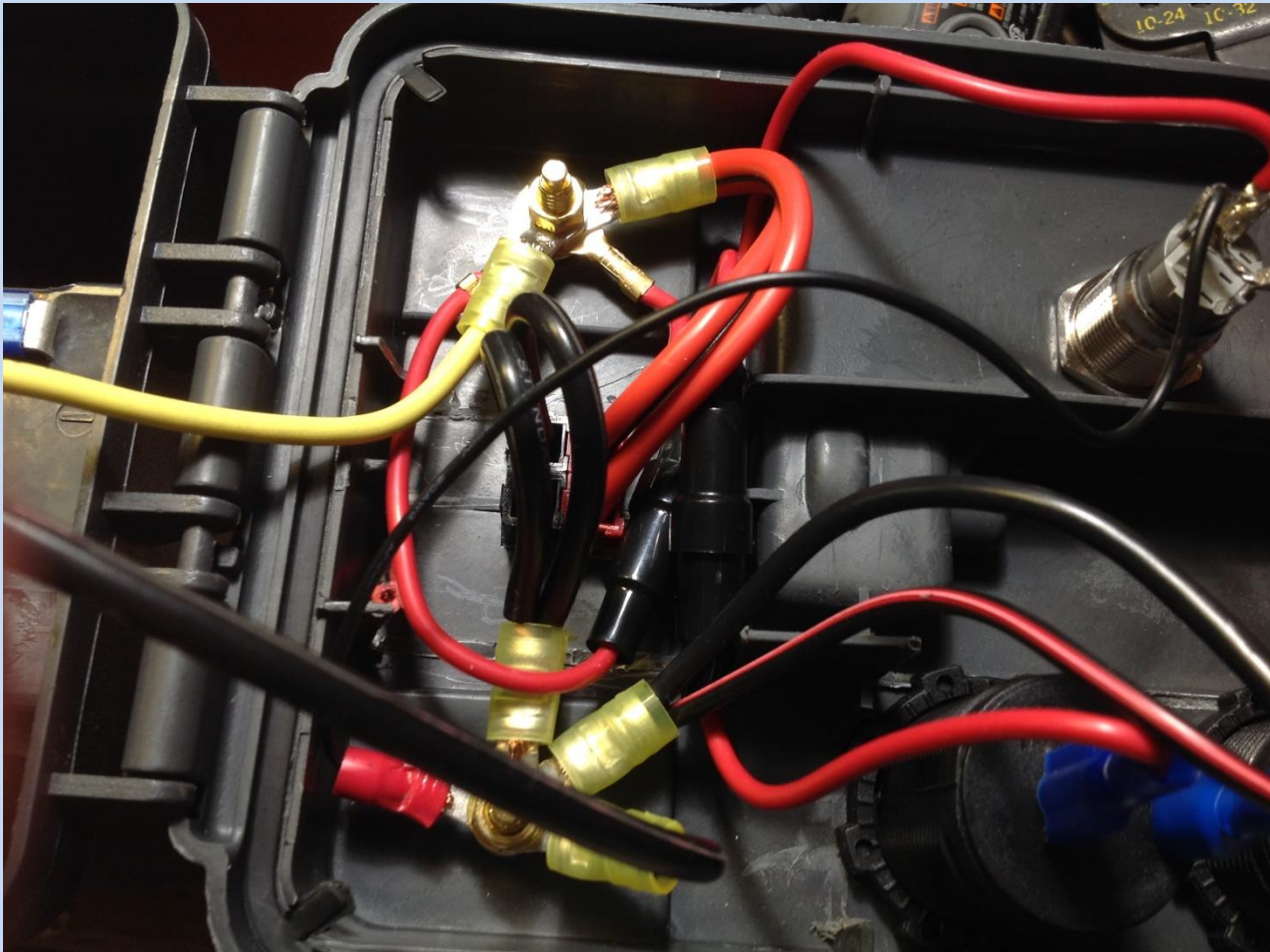


Harden Power BatPac Solar

Binding Post



Binding Post Wiring



QTY	Description	Source	Price
	130 Cal Plastic Ammo Box	Harbor Freight	6.00
	17 ah battery AGM	Amazon	18.00 http://www.amazon.com/ExpertPower-EXP1270-Black-Rechargeable-Battery/dp/B003S1RQ2S/ref=sr_1_1?s=electronics&ie=UTF8&qid=1443466649&sr=1-1&keywords=7+ah+battery
	112 ah Battery AGM Optional	Amazon	27.00 http://www.amazon.com/gp/product/B01AQ94ERY?keywords=4%20position%20pre%20insulated%20terminal%20barrier%20strip%20red%20black%2025a&qid=1454610405&ref=sr_1_1&sr=8-1
	1 Inline ATC Fuse holder 12 AWG	Walmart/ Amazon	4.00 http://www.amazon.com/dp/B004ZIUJYU/ref=wl_it_dp_o_pC_nS_ttl?encoding=UTF8&colid=1H2RIQGSD42FN&coliid=I3LBPC3EV9JDF3
	120 amp ATC Fuse	Walmart/ Auto Parts	
	Nylon Strap	Walmart/Harbor Freight	
1	Astra Depot Triple Function Dual USB Charger + Voltmeter + 12V Outlet Socket Panel Jack	Amazon	17.00 http://www.amazon.com/Astra-Depot-Function-Charger-Voltmeter/dp/B00QKDXB8E/ref=sr_1_4?ie=UTF8&qid=1451949675&sr=8-4&keywords=marine+power+meter
1	Powerwerx Anderson connector	HRO	20.00 http://www.powerwerx.com/powerpole-accessories/panelpole-powerpole-panel-mount-weather-resistant.html
	125 Amp terminal barrier strips	Amazon	8.00 http://www.amazon.com/Anderson-Powerpole-Connectors-Pair-Genuine/dp/B005P9CATU/ref=sr_1_2?s=electronics&ie=UTF8&qid=1443461054&sr=1-2&keywords=anderson+power+pole
	18 position double row screw terminal covered barrier	Amazon	6.00 http://www.amazon.com/dp/B005I03W0I/ref=wl_it_dp_o_pd_nS_ttl?encoding=UTF8&colid=1H2RIQGSD42FN&coliid=I1KYHRPUKATBH9&psc=1
1	Momentary push button (optional for meter)	Amazon	http://www.amazon.com/Generic-Waterproof-Momentary-Button-Switch/dp/B00GTEQXYS/ref=sr_1_2?ie=UTF8&qid=1443461502&sr=8-2&keywords=momentary+push+button+switch
	Female F2 Push on Fully Insulated connector 12 AWG	Walmart/AutoParts	
	12 AWG Forked Terminal connectors (Accessories)	Walmart/AutoParts	
	12 AWG Red and Black stranded 2 conductor speaker wire	Walmart/ Amazon	http://www.amazon.com/niceeshop-TM-Gauge-Silicone-Wire/dp/B00FGLSKUA/ref=sr_1_6?ie=UTF8&qid=1456264612&sr=8-6&keywords=12+awg+red+and+black+wire
1	AFUNTA 5 pcs Mini USB LED Light Adjust Angle Portable Flexible Led Lamp with usb	Amazon	5.00 http://www.amazon.com/AFUNTA-Portable-Flexible-powerbank-Notebook/dp/B00EDJBPP8/ref=sr_1_2?ie=UTF8&qid=1451952001&sr=8-2&keywords=usb+LED+light



Future Improvements

- Charging circuit
- Larger battery box
- Larger battery
- Led lighting
- Solar charging
- LIPO4 battery
- Inverters
- Additional battery packs for increased capacity
- Internal and external accessories



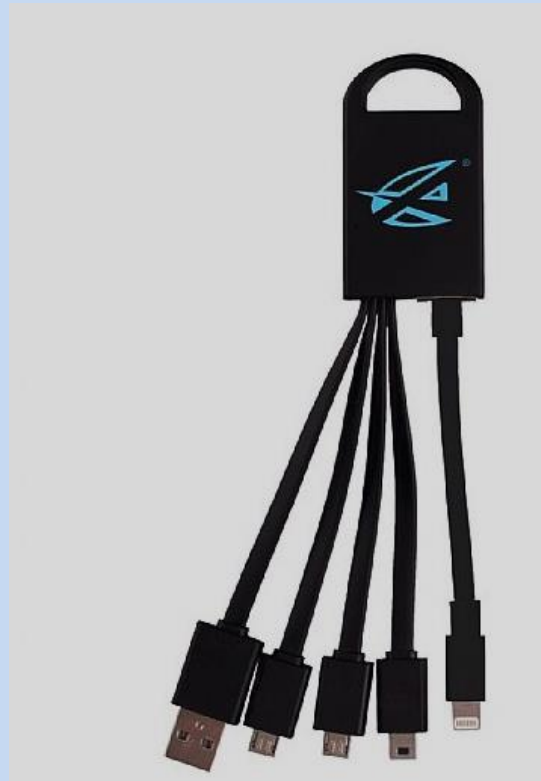
Essential Accessories

- Led Lighting



Accessories

- Cellphone universal charging cable



Essential Accessories



Essential Accessories



Accessories

Adapter to add Power Pole Connectors to 12 socket



Accessories

Adapter to Parallel multiple boxes through Power Pole connectors
To increase battery capacity

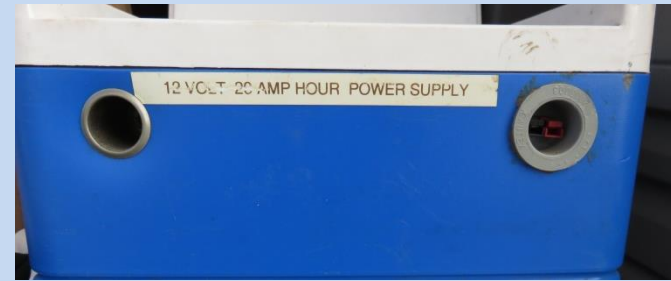


Accessories

12v DC to 110volt AC inverter



Other Designs



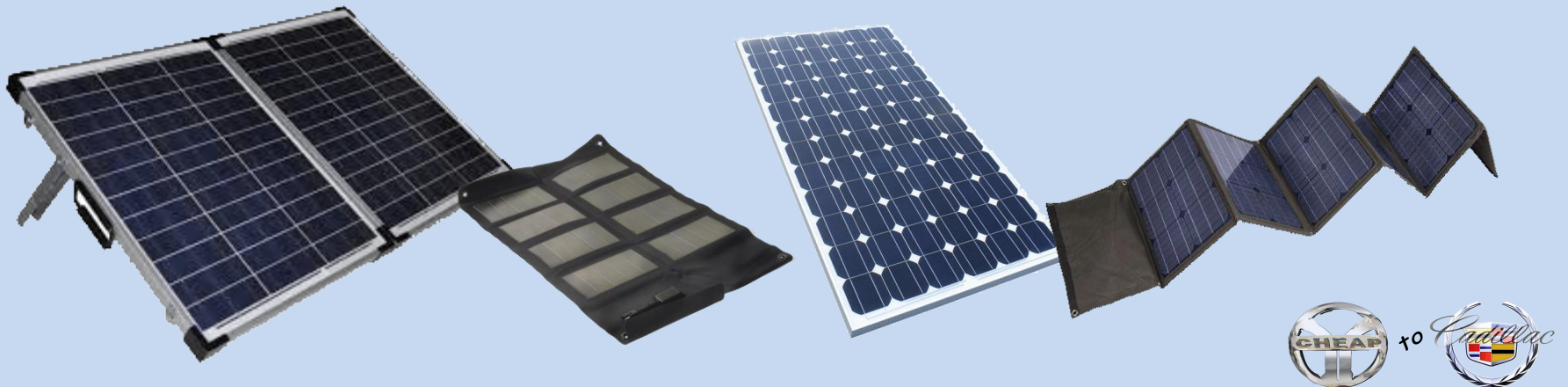
Other Designs

- Hammo-can
- Quick Silver Radio



Solar Charging

- The solar part was an afterthought on how to keep the battery topped off in the trunk of my car without over charging the battery. I was going to leave the charger on the rear deck of my car and run the wire through to the trunk.



Thanks

- Special Thanks

- Joe Gardeski N6JO K6FRI Oceanside CERT
- Tom Cowart W6ETC OCARC
- Nicholas Haban AF6CF OCARA
- Ray Hutchinson AE6H SOARA
- Charley E Speelman WA6RUZ SOARA MV Races
- Craig Leventhal KI6WPL SOARA Red Cross

- And a host of others thanks for your inspiration

- Material came from over 30 years of personal experience and a number of web sources including BatteryUniversity.com

Questions



THANK YOU



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