

Emergency Power

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Without power we
own boat anchors

Emergency Power – What we will Cover Today

- The little guys - HT, AA, and AAA
- The Big Guys – FLA, SLA, and LiFePO_4
- How big does my battery need to be (Size Matters)
- Solar – Let the sunshine in
- Generators big and small
- Putting it all together with an ounce of prevention
- Inverters
- Living in a 13.8v, 5.1v, and 25+v world
- Conclusion





Emergency Power – The Little Guys

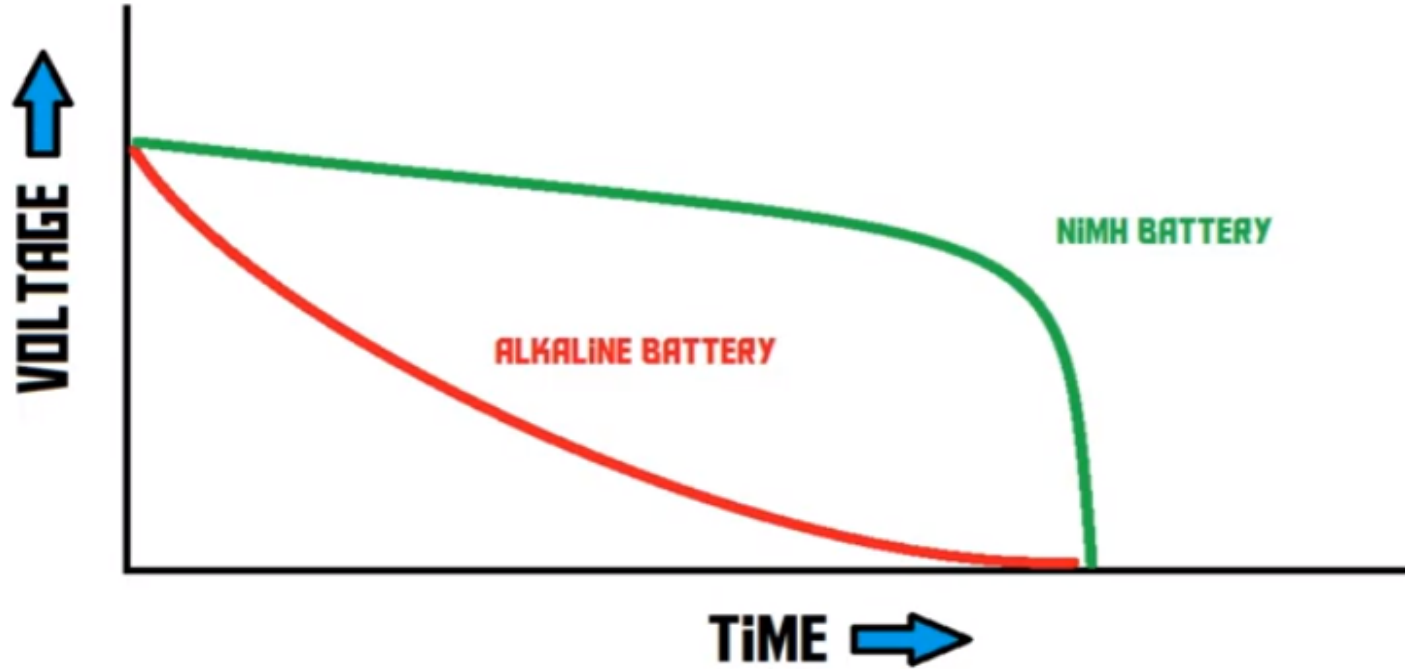


Emergency Power – AA Options

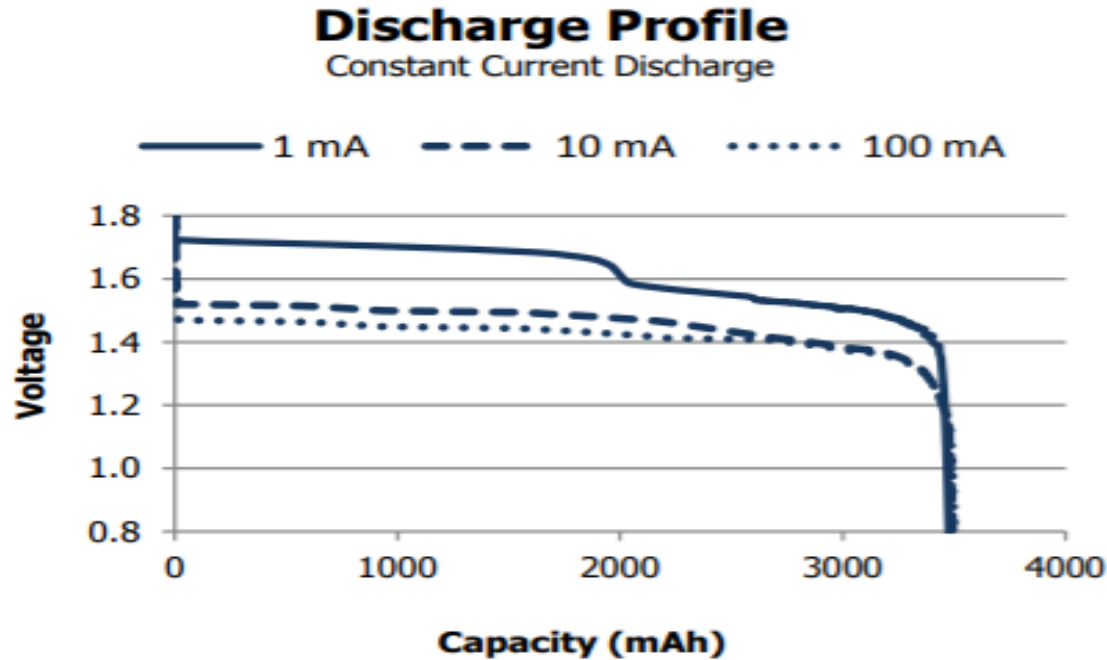
AA Battery	Cost/unit	mAh	Voltage	Recharges	Brand	Charge Retention
Alkaline	\$0.76	2500	1.5	None	Duracell	10 yr
Lithium	\$3.80	3500	1.5	None	Energizer	20 yr
NiMH	\$2.50	2000	1.2	1000	Energizer Recharge	10 yr
NiMH	\$4.37	2550	1.2	500	Eneloop Pro	85% @ 1yr
NiMH	\$2.38	1900	1.2	2100	Eneloop Std	70% @ 10 yr



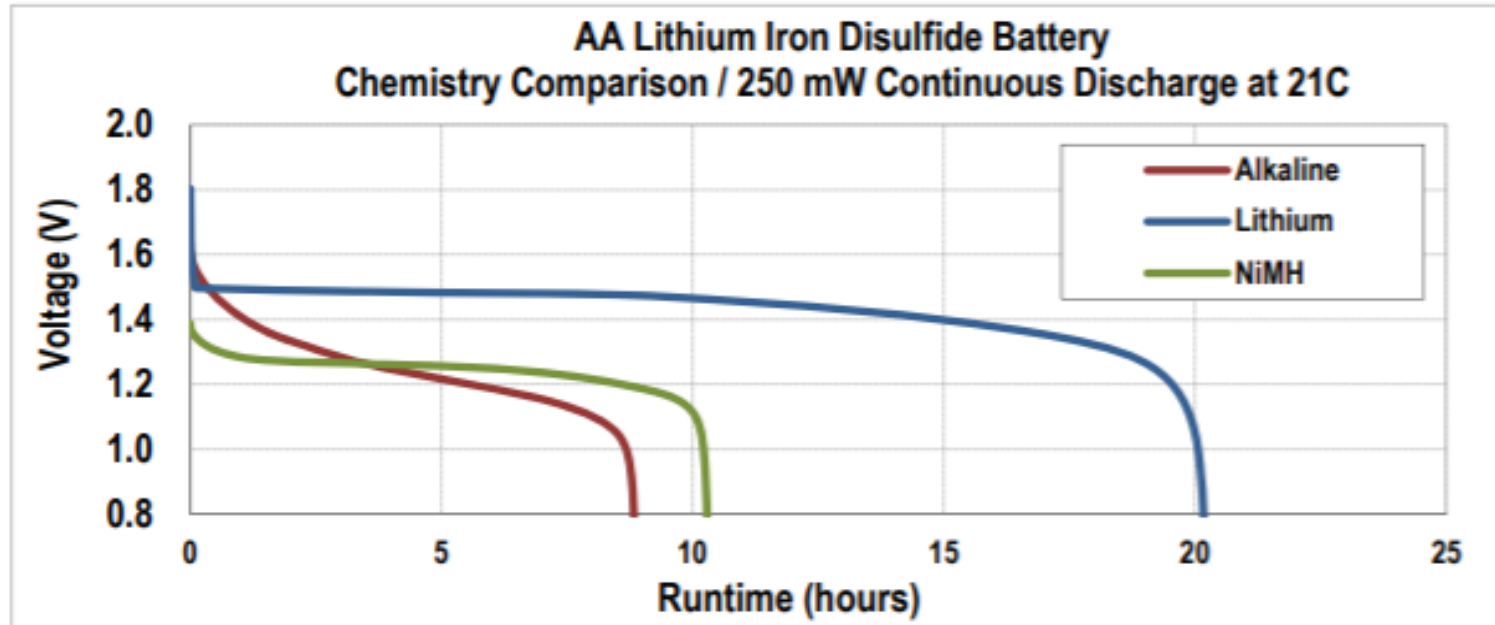
Emergency Power - NiMH/Alkaline Discharge Rates



Emergency Power - AA Lithium Discharge Rates



Emergency Power - Battery Chemistry Discharge



(Fig. 6) Relative Constant Power Performance of an AA Size Battery (different chemistries)

Emergency Power - AA Runtime Costs

Chemistry	Unit	Runtime	#	20 hrs	40 hrs	200 hrs
Lithium	\$3.80	20 hrs	1	\$3.80	\$7.60	\$38.00
Alkaline	\$0.76	5 hrs	4	\$3.04	\$6.08	\$30.40
NiMH	\$2.38	10 hrs	2	\$4.76	\$4.76	\$4.76



Emergency Power - Handheld Charging Options



**AA NiMH
Rechargeable
Batteries**



NiMH Charger

A single NiMH rechargeable battery equals 10 alkaline batteries.

Four Year Cost of Ownership (Wirecutter)

Alkaline \$0.76 X 10 = \$7.60

NiMH \$2.38 x 1 = \$2.38

NiMH \$4.37 x 1 = \$4.37

Emergency Power – Power Up Baofeng



Emergency Power – The Big Guys



Emergency Power - Battery Chemistry

- **Flooded Lead Acid - Wet Cell**
- **Sealed Lead Acid – Valve Regulated Lead Acid**
 - **GEL – Electrolyte in Gel form**
 - **AGM – Absorbed Glass Mat**
- **LiFePO_4**



Emergency Power - Flooded Lead Acid

- **Top side up only**
- **Require regular monthly maintenance**
- **Liquid levels need to be checked monthly and topped off with distilled water**
- **Lead Acid batteries release toxic hydrogen gas when charging**
- **They need to be vented to the outside to prevent hydrogen gas buildup**



Emergency Power - Sealed Lead Acid

- **Absorbed Glass Mat & GEL Batteries**
- **AGM & GEL Orientation independent**
- **AGM & GEL maintenance free**
- **AGM & GEL are Valve Regulated Lead Acid – can vent Hydrogen gas**
- **Absorbed Glass Mat most popular SLA with 90+% of market**



Emergency Power - Sealed Lead Acid

- **GEL are more expensive than AGM**
- **GEL excellent at very slow deep discharge**
- **GEL also last longer in hotter temperatures**
- **GEL - It is critical that the correct charging parameters are used**
- **AGM more resistant to vibration**
- **AGM batteries can handle higher charge and discharge rates than GEL batteries**



Emergency Power - AGM vs LiFePO₄

100 Ah AGM (Absorbed Glass Mat) vs LiFePO ₄		
Characteristic	AGM	LiFePO ₄
Safety	VRLA	Safest Li Chemistry
Weight	60 lbs	27 lbs
Life Cycles(100% DOD)	300	2000 - 3000
Flat Discharge to <12V	1.5 hrs	4 hrs
Capacity usage	50% - 50Ah	85 - 90% - 90Ah
Time for Full Charge	8 hrs	2 hrs



Emergency Power - AGM vs LiFePO₄

100 Ah AGM (Absorbed Glass Mat) vs LiFePO₄

Characteristic	AGM	LiFePO ₄
Self Discharge (80%)	4 months	8 months
Initial Cost/warranty	\$223 1 yr	\$380 10 yr
Cost for 100 Ah (2 x AGM – 1 x LiFePO ₄)	\$446	\$380
10 Yr Cost of Ownership	4 x \$446 = \$1,784	100Ah - \$380



Emergency Power - COO SLA vs LiFePO₄

Battery Chemistry	Usable 100 Ah Cost	Cycles	Life (Yrs)	100Ah Cost	#	COO-10
AGM (Absorbent Glass Mat)	2 x \$223	500	4 to 7 (5)	\$446	4	\$1,784
GEL	2 x \$250	700	2 to 5 (5)	\$500	4	\$2,000
LiFePO ₄	\$380	3000	5 to 10 (5)	\$380	2	\$760



Emergency Power - Main Batteries



12.8V 20Ah Battery
Comparison

300 cycles ❌	2000 cycles ✅
Super Heavy ❌	Extremely lightweight ✅
Might catch fire ❌	Won't catch fire ✅
Potential threat of lead or acid ❌	No poisonous lead / harmful sulfuric acid ✅
Harm to the environment ❌	Environmentally friendly ✅

**12V 20Ah Deep Cycle
LiFePO₄ Battery (\$70) vs
SLA (\$40)**



**12V 100AH
Deep Cycle
AGM SLA
Battery (\$223)**

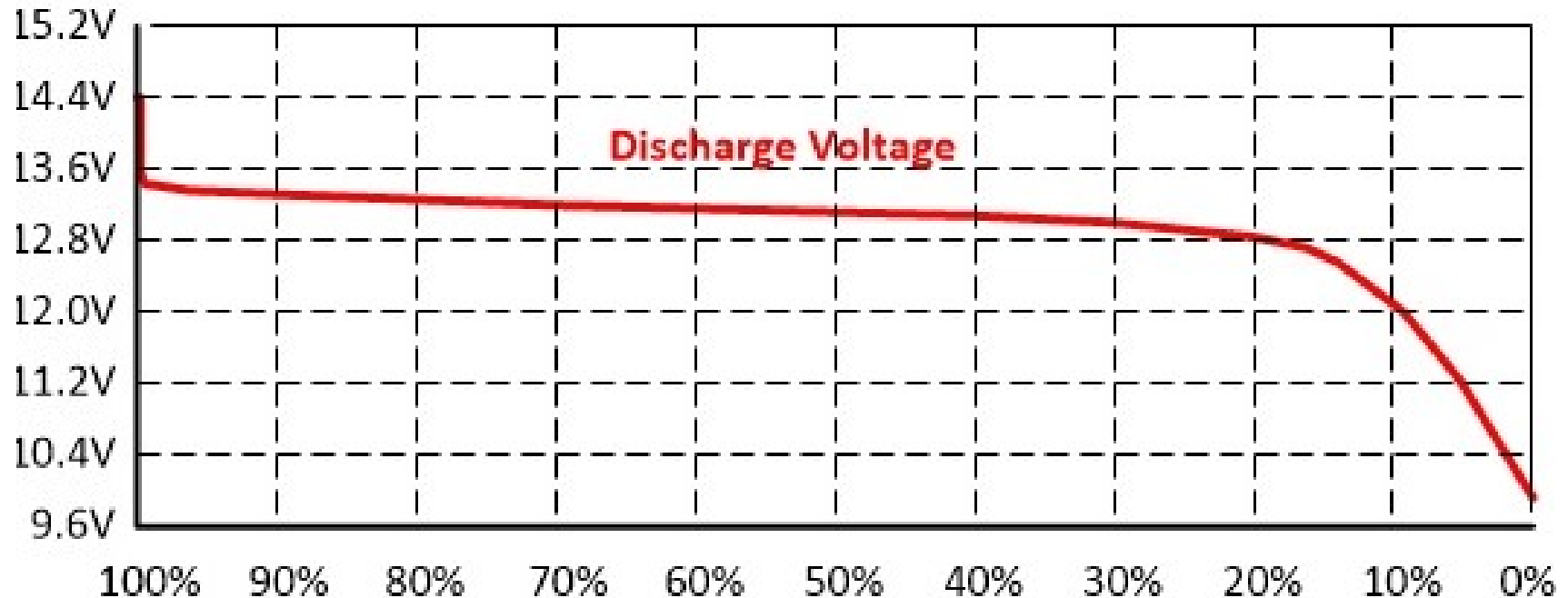


**12V 36Ah
LiFePO₄
Battery (\$130)**



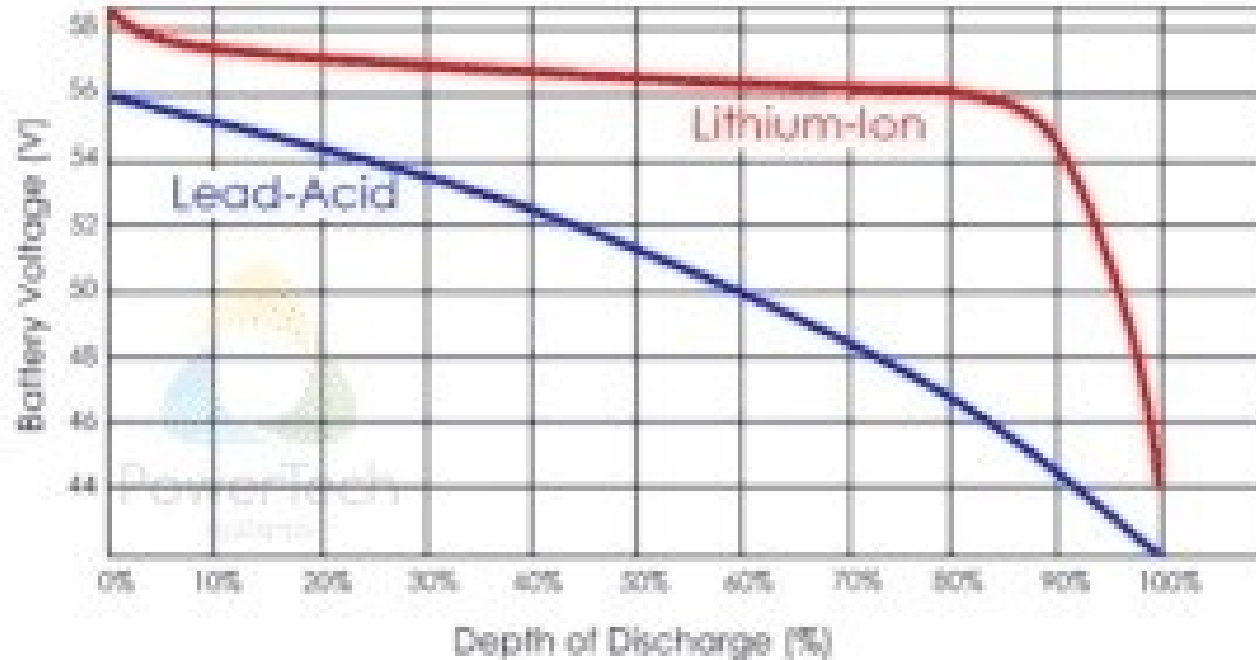
**12V 100Ah
Lithium LiFePO₄
Battery (\$380)**

Emergency Power - LiFePO₄ Discharge Curve



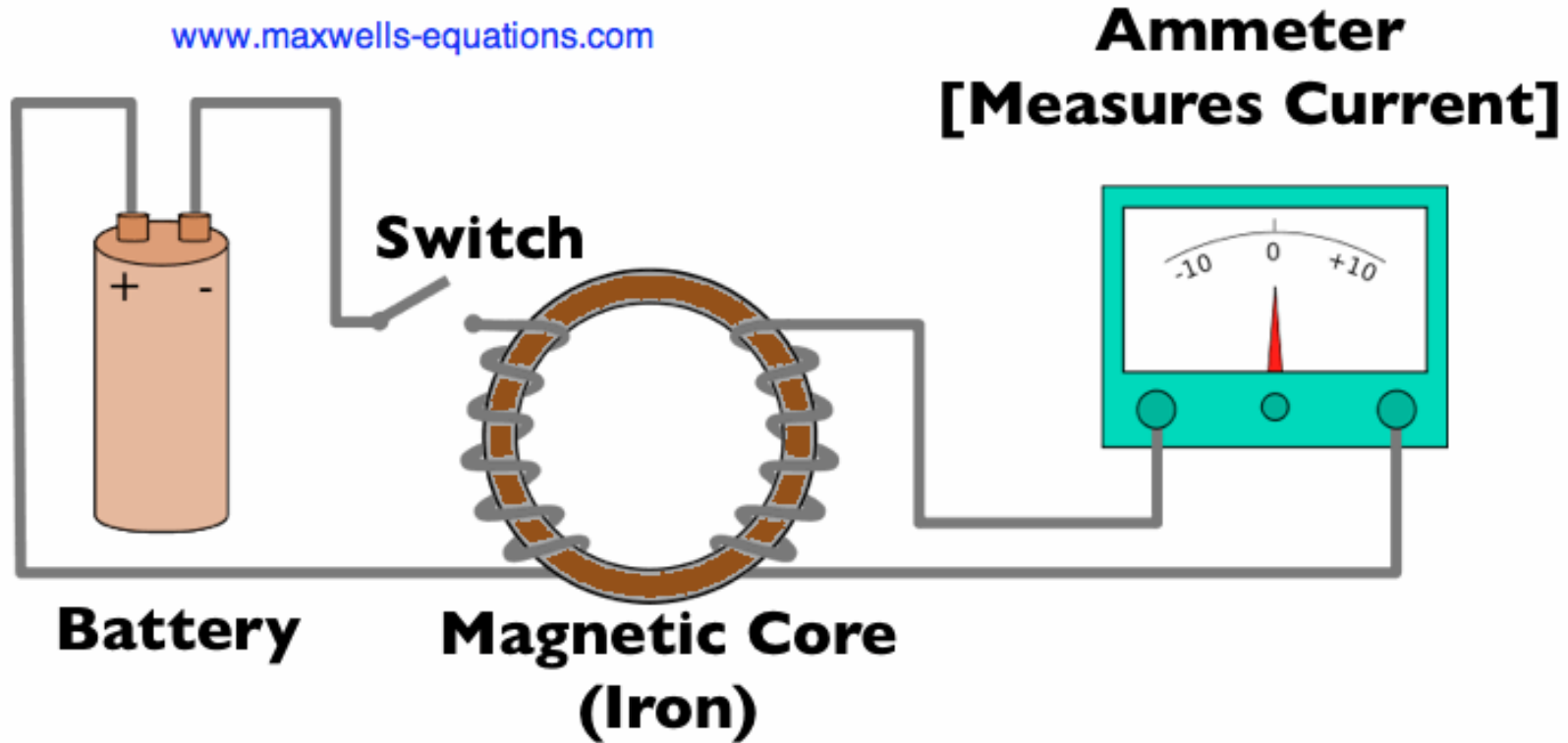
Emergency Power - LiFePO_4 vs Lead Acid Discharge

Discharge curve : Lithium-Ion vs Lead Acid



Emergency Power - Sizing My Battery

www.maxwells-equations.com

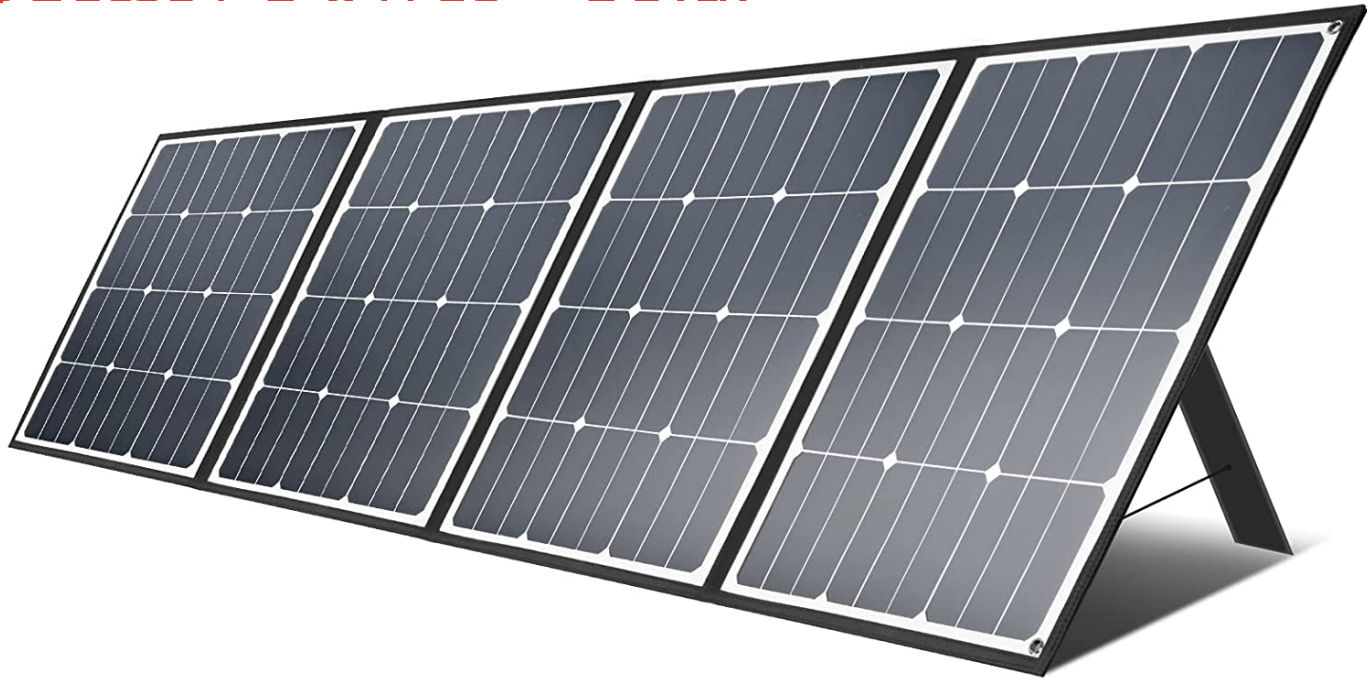


Emergency Power - Go Box DC Wh Calculations

Usage					Deployed		
12 Volt Device	Watts	Amps	Hours	Mins	Ah/ Day	3 Days	7 Days
IC-706 Tx	240	20	1	10	23	69	161
IC-706 Rx	24	2	6		12	36	84
Misc loads	36	3	2		6	18	42
Total Ah for IC-706MKIIG					41	123	287
Total Wh for IC-706MKIIG					492	1476	3444



Emergency Power - Solar



<https://qsl.net/nf4rc/2021/SolarPowerEducationalModule.pdf>



Emergency Power - Solar Panels

- **Monocrystalline solar panels 12.5% - 20%**
- **Polycrystalline solar panels 11% - 18%**
- **Thin-film (amorphous) solar panels 5% - 9%**
 - **Thin-film has lower losses & performs better in:**
 - **Hot climates and higher temperatures (FL)**
 - **Low irradiation conditions, i.e. early in the morning, at sunset and in cloudy weather**
 - **Partial shading conditions**
 - **Low cost, low weight and high durability**



Emergency Power - Charge Controllers

- **PWM – Pulse Width Modulation**

- **Less Expensive**
- **Pulses generate RFI**
- **Inefficient operation**



Renogy 30A
12V/24V
PWM \$54

- **MPPT - Maximum Power Point Tracking**

- **Input Power equals Output Power**
- **Support higher voltage panels efficiently**
- **Less RFI**

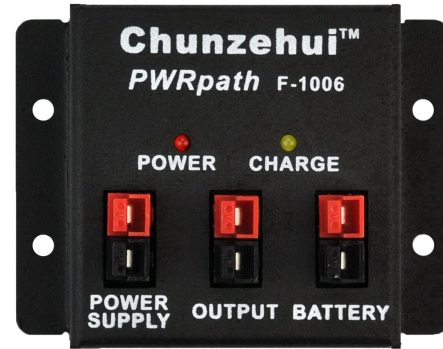


Renogy Rover 40A
12V/24V DC Input
MPPT \$170

Emergency Power - PWRGate Transfer Switches



Epic PWRgate \$190
Multiple Charge Options
Solar Panel Connection
40A
MPPT Controller



Chunzehui F-1006
(\$45) Low Loss
Power Gate
PWRpath

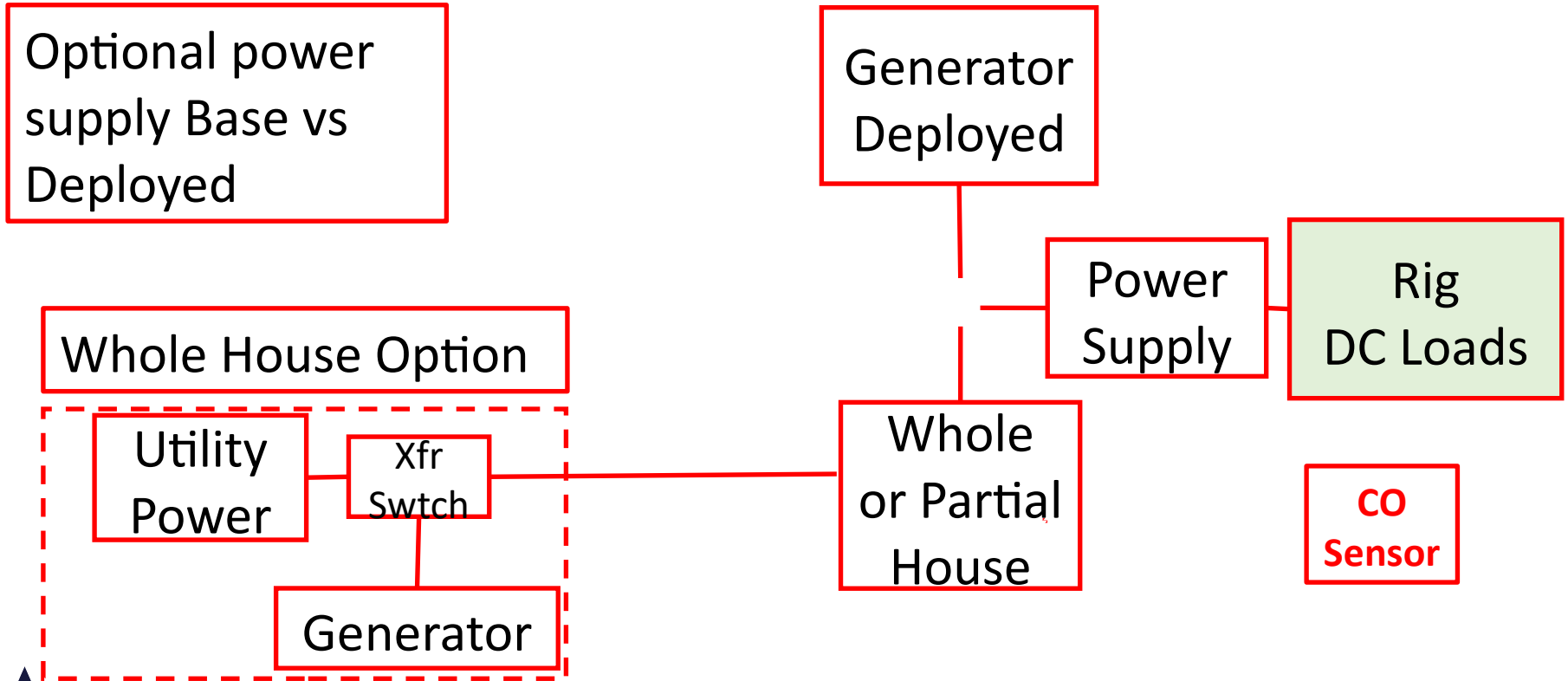
Emergency Power - Solar Backup

Battery Calculation		Ah	Wh	Comments	
IC-706MKIIG GO Box		41	492	Load in Wh	
2 Days Autonomy		82	984	2 cloudy days	
Battery LiFePO4 (90%)		1x100Ah	1x1200 Wh		
Battery Lead Acid (50%)		2x50Ah	2x600 Wh		
Battery Size			1200 Wh	Size Battery in Wh	
Solar Panel Sizing		Amps	Watts	Comments	
Solar Panel (5 day Index)		16	240	Battery Wh/5	
Round up for safety		25	250	Round up	
MPPT Controller (Amps)			21 amps	Panel Watts/12 V	

Emergency Power - Generators



Emergency Power - Generator Backup 120v



Emergency Power - Fixed and Portable Generators



**23KW Propane (500 gal)
Whole House Generator**

Whole House Surge
Protection



**Transfer
Switch**

What about
RFI/Noise?



**1.8KW Portable
Generator
3 – 8 hours/gal**

Emergency Power - RFI Low Pass Filter

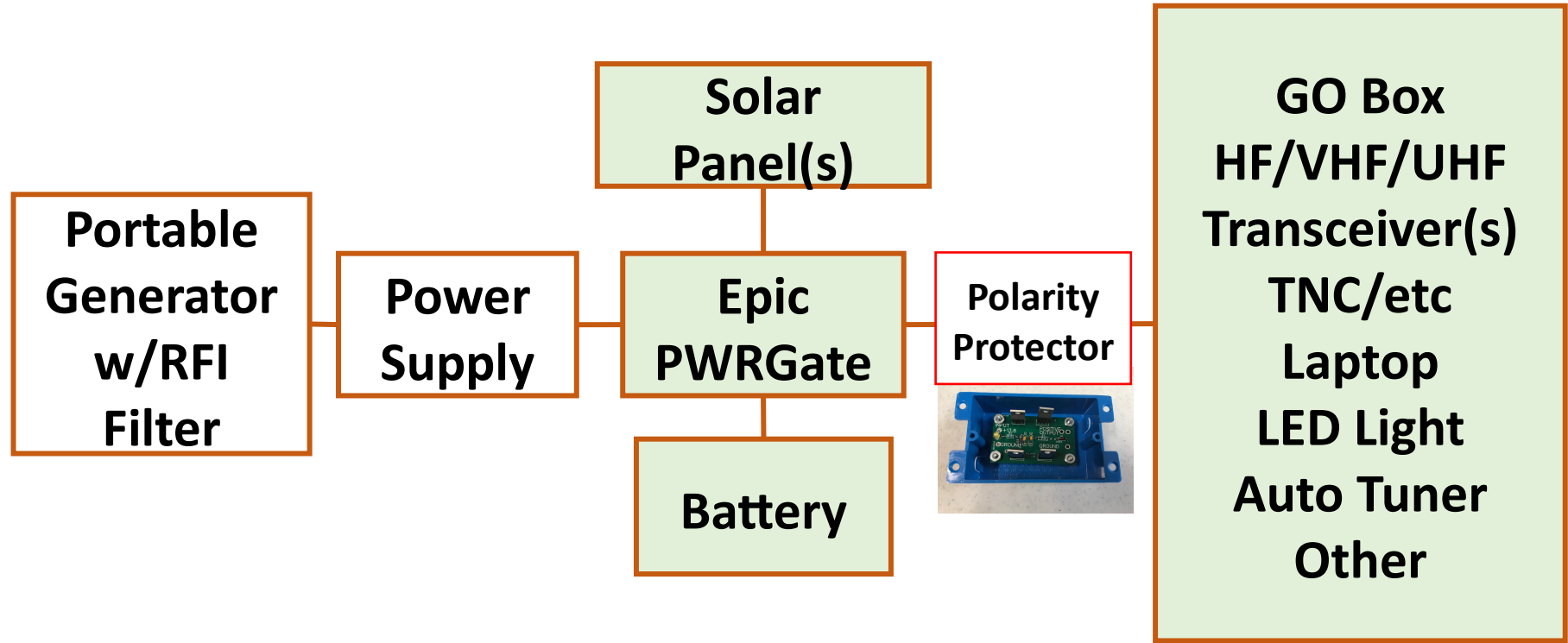


Extension
Cord on
ground



<https://qsl.net/nf4rc/2020/LabNLunchACCommonModeChoke.pdf>

Emergency Power - Putting it all Together



<https://qsl.net/nf4rc/2021/ConstructionManual.pdf>



Emergency Power - 120v Inverters



**300W Pure Sine
Wave Inverter (\$50)**



**1000W Pure Sine
Wave Inverter (\$162)**



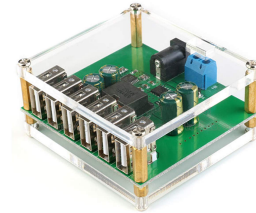
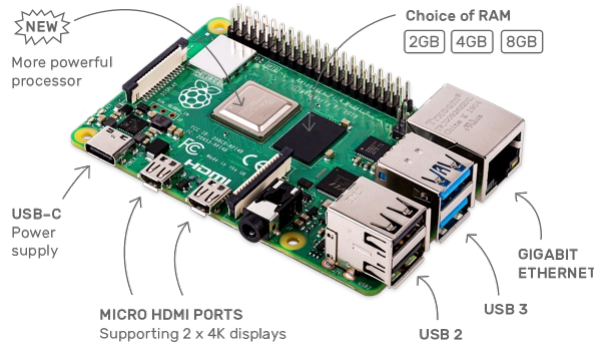
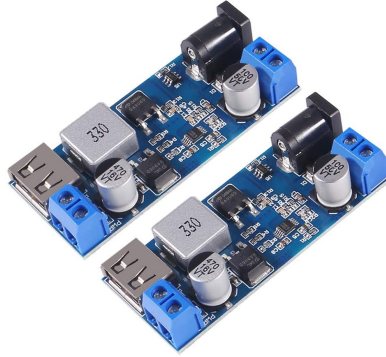
**2000w Pure Sine
Wave Inverter (\$595)**

Emergency Power - 120V Load Calculations

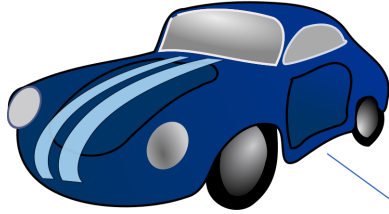
120VAC Device		TX Watts	RX Watts
Diamond PS TX		120	
Diamond PS RX			31
USB Power (included in PS)		10	10
Laptop Charger		30	30
Battery Charger		30	30
LED Light		14	14
Total Watts for IC-7300 Go Box		204	115



Emergency Power - Low Voltage World



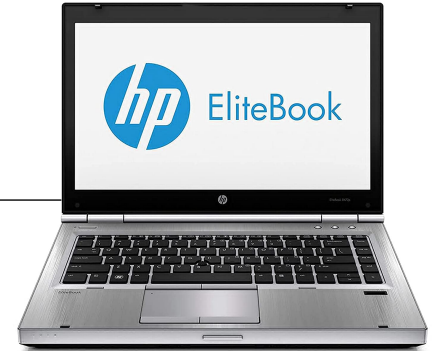
Emergency Power - Laptop Charging



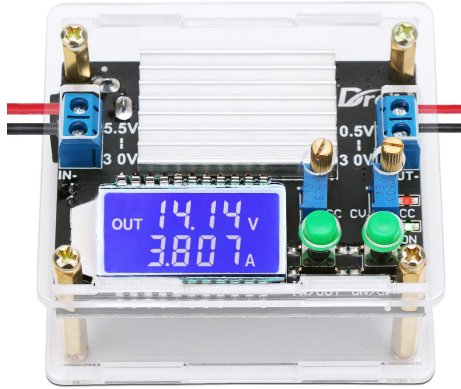
**12V
Battery**



**Laptop DC Adapter Car
Charger or Power Pole
adapter for out of car power**



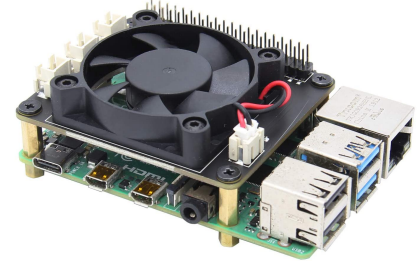
Emergency Power - Other Devices



**Boost Buck Converter,
DROK DC 5.5-30V to 0.5-
30V Adjustable Power
Supply Regulator Module,
4A 35W Step Up Down
Converter Board (\$15)**



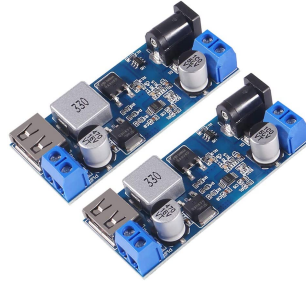
**Geekworm Raspberry Pi
UPS, X728 18650 UPS &
Power Management Board
with AC Power Loss, Auto
On & Safe Shutdown (\$46)**



**Geekworm
Raspberry Pi
Cooling Fan**

Emergency Power - USB Devices

- **Raspberry Pi**
- **Phone Chargers**
- **Other USB**



**Buck Converter 12v to
5v 5A USB Voltage
Regulator (2 for \$11)**



**DC Converter with
Battery Clips (\$15)
(Replace with Power
Pole Connectors)**

Emergency Power - Conclusion

Be Prepared

- **Keep battery(s) charged**
- **Keep Extra non-rechargeable batteries**
- **Keep computers updated and charged**
- **Test Generators un-Loaded and Loaded**
- **Test Go Box and all supporting equipment**
- **Keep equipment organized with check list and readily available**



Emergency Power - Handy URLs

- North FL Radio Club – <https://qsl.net/nf4rc/EducationalArticles.html>
- How to Size your Solar Power System – <https://www.youtube.com/watch?v=TJBGbufexEM>
- Complete LiFePO₄ Solar Battery System Design - https://www.youtube.com/watch?v=_PgthByAYz4
- Emergency Lighting - <https://www.youtube.com/watch?v=ZNa-JHPnpgM>
- Will Prowse - <https://www.youtube.com/watch?v=TJBGbufexEM>



Thank You!

May the
Electromotive Force
be with you!

Be Prepared!



Emergency Power

