BATTERIES & SOLAR PANELS
WHAT YOU NEED TO KNOW

TOOLS, TIPS & REFERENCES

MICHAEL WARE, NN3I
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PORTABLE POWER ENABLES

- EMERGENCY BACKUP POWER AT HOME FOR RIGS
- EMCOMM - ARES, RACES, MARS, REACT, SHARES, AUXCOMM, ETC
- HAM RADIO, FIELD DAYS
- DX EXPEDITIONS OR VACATION TRIPS
- COMMUNICATE WITH FRIENDS & FAMILY DURING DISASTER
- POTA, SOTA & IOTA
  - GET OUTSIDE & HAVE FUN
  - FOR POTA INFO: HTTPS://PARKSONTHEAIR.COM/

MY PORTABLE POWER JOURNEY

- STARTED USING THE INTERNAL 2.6Ah LITHIUM ION BATTERY IN MY KX-2, 10W HF TRANSCEIVER

- FIRST UPGRADE
  - 12V, 8Ah SEALED LEAD ACID (SLA) - ABSORBENT GLASS MAT (AGM) BATTERY
  - AGM BATTERIES WIDELY USED BY HAMS IN PAST
    - OVERCHARGE TOLERANT
    - CAN BE TOTALLY DISCHARGED AND LEFT THAT WAY FOR 30 DAYS AND STILL BE RECHARGED
  - 27W SOLAR PANEL WITH SOLAR CHARGE CONTROLLER
  - FOR INFO ON SLA BATTERY TYPES SEE
    - HTTPS://WWW.ITACANET.ORG/ENG/ELEC/BATTERY/BATTERY.PDF

- SECOND UPGRADE
  - BOUGHT 35Ah AGM BATTERY & POWERWERX BATTERY BOX
  - NEEDED TO POWER 50W, VHF/UHF MOBILE RIG


27 WATT SOLAR PANEL
WATT-HOUR METER
BATTERY BOX FOR 35Ah AGM
SOLAR CHARGER
universal battery
Non-Spillable Sealed Lead-Acid Battery
AGM TYPE
1280
12V
8Ah
UB1280
8Ah AGM
SOLAR INPUT
BATPAC SOLAR
SOLAR CHARGER

NOTIONAL GOALS FOR A PORTABLE BATTERY SYSTEM TO POWER MY IC7300

- CAPABLE OF POWERING 100W, HF TRANSCEIVER FOR AT LEAST A WEEK OPERATING 8 HR/DAY
- LOW LIFETIME COSTS COMPARED TO OTHER PORTABLE, POWER SYSTEMS
- SOLAR RECHARGEABLE WOULD BE A PLUS
- EASY TO SET UP & USE
- WATERPROOF
- NO FIRE/EXPLOSION RISKS & EASY TO TRANSPORT BY CAR

WHY NOT USE A GAS GENERATOR?

- HONDA EU2200i COSTS $1,100
  - RATED 1800W CONTINUOUS & WEIGHS 47 LBS EMPTY
  - REQUIRES GAS, OIL & REGULAR MAINTENANCE
  - GENERATES NOISE AND AIR POLLUTION
  - CAN'T USE INDOORS (CARBON MONOXIDE POISONING)
  - STORING & TRANSPORTING GASOLINE A SAFETY HAZARD
  - NO GUARANTEE GAS WILL BE AVAILABLE IN MAJOR DISASTER
- $3.35/GALLON WEIGHING 6.3 LBS/GALLON ADDS UP OVER TIME
  - RUNNING 8 HRS/DAY IN ECO MODE (450W OUTPUT) REQUIRES 1 GALLON OF GAS (EVEN IF THE LOAD POWERED IS LESS THAN 450W)
    - FOR ONE WEEK OF 8HR/DAY OPS REQUIRES 7 GALLONS OF GAS COSTING $23.45 & WEIGHING 44.1 LBS

All these filled with gas (13 gal) will run generator for 104 hours at the minimum generator speed outputting 450w

100w transceiver in “Receive“ mode only needs 12 watts , so “438 watts are being wasted”
if nothing else is being powered!!

WHY LIFEPO4 BATTERY CHOSEN

- LIFEPO4 BATTERIES ALSO CALLED: LFP, LiFE-PO, LIFE, LITHIUM IRON PHOSPHATE & LITHIUM FERROUS PHOSPHATE (DON'T CONFUSE WITH LIPO (LITHIUM POLYMER) BATTERIES)

- CAN ALMOST BE FULLY DISCHARGED WITHOUT HARMING BATTERY
  - SEALED LEAD ACID (SLA) BATTERIES SHOULDN'T BE DISCHARGED TO MORE THAN 20-50% OF CHARGE CAPACITY OR IT WILL SHORTEN BATTERY LIFE

- OUTPUT VOLTAGE STAYS ALMOST LEVEL UNTIL 85% OF BATTERY CHARGE CONSUMED
  - HTTPS://WB4SON.COM/WPBLOG/WP-CONTENT/UPLOADS/2014/05/BIOENNO-30AH-AH.JPG
  - WWW.POWERTECHSYSTEMS.EU/WP-CONTENT/UPLOADS/2015/08/LIFELINE-DISCHARGE3.PNG

- LFP POSE NO FIRE OR EXPLOSION RISK DUE TO THEIR OUTSTANDING DESIGN AND CHEMICAL & THERMAL STABILITY. NO TOXIC GAS OR DANGEROUS LIQUID WORRIES EITHER. WATCH VIDEO TO SEE TORTURE TESTING OF LFP BATTERY - PRETTY AMAZING!
  - HTTPS://WWW.YOUTUBE.COM/WATCH?V=R9XZF4P8PKQ&T=46S

- UP TO 10+ YEARS SERVICE LIFE

LIFEPO4 BATTERY (CONTINUED)

- LFP BATTERIES HAVE BUILT-IN BATTERY MANAGEMENT SYSTEM (BMS) ALSO CALLED PROTECTION CIRCUIT MODULE (PCM)
  - PREVENTS OVER VOLTAGE & OVER CURRENT PROTECTION
  - PREVENTS TOTALLY DISCHARGING TO MAINTAIN A LITTLE POWER TO THE BMS (DISCONNECTS BATTERY AT AROUND 10V)
  - PROVIDES PROTECTION FROM DELETERIOUS EFFECTS OF TEMPERATURE EXTREMES DURING CHARGING OR DISCHARGING
    - LFP WILL BE DAMAGED IF CHARGED BELOW FREEZING TEMPERATURES
  - BALANCES ALL THE CELLS INSIDE THE BATTERY TO SAME FULL CHARGE, SATURATION LEVEL
  - IF YOU BUILD YOUR OWN LFP BATTERY FROM INDIVIDUAL CELLS, YOU NEED TO BUY A RELIABLE, FULL-FEATURED BMS TO PROTECT THE CELLS

LIFEPO4 ADVANTAGES OVER AGM

- 4X FASTER CHARGING, 4-6X LIGHTER (FOR SAME USEABLE ENERGY) & 2X LONGER LIFE

- 7000 LIFE CYCLES AT 50% DEPTH OF DISCHARGE VS ONLY 500 CYCLES FOR AGM
- COST MUCH LESS PER WATT-HOUR GENERATED OVER THEIR LIFE TIME COMPARED TO AGM

- AT -4F DEGREES (LOWEST AMBIENT OPERATING TEMPERATURE), LFP BATTERIES STILL HAVE 85% OF CAPACITY VERSUS AGM WHICH ONLY HAVE 35%

- LFP HAS 2-3% SELF DISCHARGE PER YEAR (THIS IS A PERMANENT REDUCTION IN MAX CAPACITY) VERSUS 2-3% PER MONTH WITH AGMs
  - NOTE: CHARGING LFP'S EVERY 2-3 MONTHS PREVENTS LOSS OF ANY SIGNIFICANT CHARGE CAPACITY

- HTTPS://WWW.VICTRONENERGY.COM/BLOG/2015/03/30/BATTERIES-LITHIUM-ION-VS-AGM/

EXPERT POWER'S 100AH LFP SPECS

DIMENSIONS

Length	13 In	Height	8.4 in
Width	6.8 in	Height w/ Terminals	9.3 in

DETAILS

Battery Composition	LiFePO4	Weight	22.6 Lbs
Nominal Voltage	12.8V	BCI Group Size	-
Charging Voltage	14.4V	Storage Duration	12 Months at 77˚F
Rated Capacity	≥ 100Ah (25°C , 0.2°C)	UPC	814832028992
Terminal Type	F12/M8	SKU	LBXLFP12_100
Max. Discharge Current:		Life Cycles	2500 with 100% DOD 3600 with 80% DOD 7000 with 50% DOD
Continue Discharge	50A		
Permanent Discharge	200A 2Sec.		
Max. Charge Current:		Operating Temperature	Discharge: -4 — 140˚F Charge: 32 — 140˚F
Continue Charge	50A		

WARRANTY / CERTIFICATIONS

Certification	UL, CE, DOT, & ISO	Warranty	1 Year

NOTES:

-Permanent Discharge should read "Pulse Discharge"

-The BMS will cut-off the Battery if the current exceeds 250A (it will reset after the load is removed)

-When the Battery voltage drops to 9.6V, the BMS will cut-off the Battery. Only about 1 AH will be left.

-Battery only weighs 22.6 lbs

EXPERT POWER'S 200AH AGM SPECS

DIMENSIONS

Length	20.59 in	Height	8.62 in
Width	9.45 in	Height w/ Terminals	-

DETAILS

Voltage	12V	Color	Black
Capacity	200Ah	Battery Life	Stand By: 3~5 Years
Terminal Type	B5	Chemistry	SLA
Weight	132.28 Lbs	Cycle Use	50% Depth Discharge 500 Times
Cells		UPC	814832022068
Polarity	[+ -]	SKU	BLRFM12_200

WARRANTY / CERTIFICATIONS

Certification	UL, CE, ISO	Warranty	1 Year

NOTES:

-This 200Ah AGM battery is need to produce the same useable Ah as an 100Ah LFP battery

-Battery weighs 132.28 lbs versus only 22.6 lbs for the equivalent LFP battery!

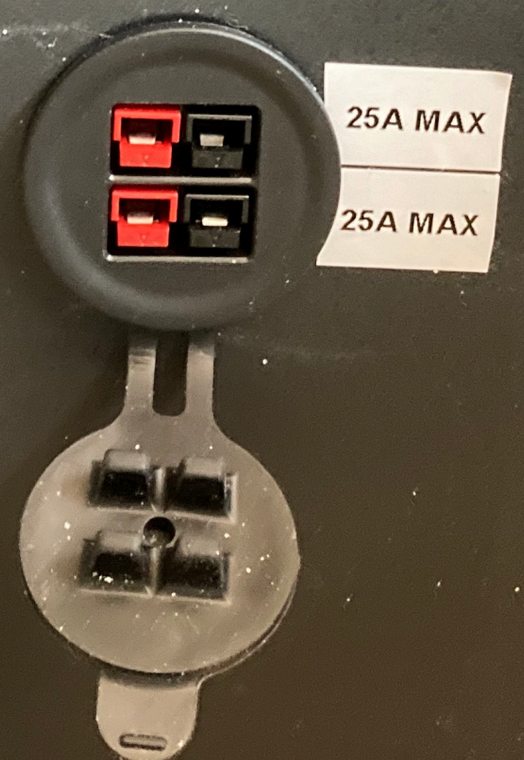
SOLAR PANEL CONSIDERATIONS

- THREE TYPES OF SOLAR PANEL TECHNOLOGY WITH EFFICIENCIES RANGING FROM 10-25%. SOLAR PANELS CAN BE MADE AS FRAMED, FOLDABLE, FLEXIBLE OR ROLLABLE.
  - THIN FILM
    - LOWEST EFFICIENCY & LARGEST PANEL SIZES
    - SHORTEST LIFE EXPECTANCY
    - CAN BE FOLDED OR ROLLED UP SMALL FOR BACKPACKING
    - THIN FILM PANELS MADE BY “POWERFILM” ARE MILITARY GRADE, WATERPROOF & DURABLE, BUT EXPENSIVE -$820 FOR 60W ROLL UP
  - POLYCRYSTALLINE
    - LOWER COST THAN MONOCRYSTALLINE AND MID-RANGE EFFICIENCY
  - MONOCRYSTALLINE
    - HIGHEST EFFICIENCY & SMALLEST PANELS
    - HIGHER IN PRICE COMPARED TO POLYCRYSTALLINE PANELS
- PICK A PANEL THAT SATISFIES YOUR MISSION NEEDS AND BUDGET CONSTRAINTS
  - YOUR MISSION DURATION, BATTERY SIZE, LOAD SIZE, WEATHER CONDITIONS, MISSION UP TIME REQUIREMENTS, SIZE & WEIGHT LIMITATIONS, AND BUDGET SIZE ALL FACTOR INTO YOUR CHOICE OF SOLAR PANELS


RENOGY SOLAR CHARGE CONTROLLER
ROCKPALS 100W SOLAR PANEL
MIKE WARE, 410-707-8967
OVERSIZED DEWALT TOOL BOX HOLDING 100Ah LFP BATTERY

TWO USB PORTS & VOLTAGE METER ON TOP OF BOX

TWO SETS OF ANDERSON POWERPOLE CONNECTORS ON EACH SIDE OF BOX



100AH LFP BATTERY IN LARGE, DEWALT TOOL BOX. BATTERY REQUIRES TALL BOX TO FIT.

WATT-HOUR METER

12VDC TO 110VAC INVERTER

FT2D HT

SOLAR CHARGE CONTROLLER

SOME OF THE THINGS I CARRY INSIDE MY DEWALT BATTERY BOX

MAIN COMPONENTS OF MY SOLAR POWER SYSTEM

- 100Ah LFP BATTERY
- TWO FOLDABLE 100W FOLDABLE SOLAR PANELS
- LOW RFI EMISSIONS SOLAR CHARGE CONTROLLER *
- LOW RFI EMISSIONS 12VDC-TO-110VAC INVERTER*
- DEWALT TOOLBOX FOR HOUSING BATTERY AND MAKING CONNECTIONS

*FYI: I RECOMMEND USING THE “tinySA” RF SPECTRUM ANALYZER ($55) FOR CHECKING RFI LEVELS
HTTP://WWW.RANDL.COM/SHOP/CATALOG/PRODUCT_INFO.PHP?MANUFACTURERS_ID=147&PRODUCTS_ID=75243&OSCSID=LPV059RU2HLESKHDLUTD91C2D0

NEW PORTABLE SOLAR POWER SYSTEM

FEATURES OF MY POWER SYSTEM

- 1260 WATT-HOURS OF POWER & NO RECURRING COSTS TO RECHARGE BATTERY

- TOTAL WEIGHT 48 LBS
  - BATTERY - 23 LBS
  - BATTERY BOX WITH MODS - 5 LBS
  - TWO SOLAR PANELS - 18 LBS
  - SOLAR CHARGER - 1 LB
  - AMAZONBASICS INVERTER - 1/2 LB
  - CONNECTING CABLES - 1/2 LB

- ENVIRONMENTALLY "GREEN" SOLUTION

- IN HOWARD COUNTY A 200W SOLAR PANEL WILL GENERATE ABOUT 27-41Ah/DAY DEPENDING ON TIME OF YEAR
  - AVERAGE PEAK SUN HOURS/DAY DURING YEAR VARY BETWEEN 3.62 TO 5.56 HRS
  - OPERATING SSB, 8HRS/DAY AT 20% OPERATING CYCLE - REQUIRES 13.5Ah/DAY OF POWER
    - CAN OPERATE ONE WEEK ON BATTERY ALONE
    - CAN OPERATE VIRTUALLY INDEFINITELY WITH SOLAR PANELS RECHARGING BATTERY

- LIMITATIONS
  - NOT ALL COMPONENTS OR CONNECTIONS WATERPROOF
  - CAN'T CHARGE LFP BATTERY WHEN TEMPERATURE IS BELOW 32 DEGREES
  - BUY LARGER BATTERY IF USING OUTSIDE OF MARYLAND WHERE MORE CLOUDS ARE EXPECTED

GOALS MET BY MY SOLAR POWER SYSTEM

- ✓ CAPABLE OF POWERING MY 100W, IC7300 HF TRANSCEIVER, SSB, 8HRS/DAY AT 20% DUTY CYCLE FOR A WEEK ON BATTERY ALONE AND VIRTUALLY INDEFINITELY WITH SOLAR PANELS
- ✓ LOW LIFETIME COSTS COMPARED TO OTHER PORTABLE, POWER SYSTEMS
- ✓ RECHARGEABLE BY SOLAR POWER AT REASONABLE COST
- ✓ EASY TO SET UP & USE
- ✗ WEATHER RESISTANT - SYSTEM IS NOT WATERPROOF
  - CONNECTIONS, SOLAR CHARGER & INVERTER NEED TO BE PROTECTED FROM RAIN. ALSO, PORTABLE SOLAR PANELS NEED TO BE PROTECTED FROM RAIN UNLESS THERE ARE TRULY WATERPROOF (E.G. POWERFILM "ROLLUP" SOLAR PANELS)
- ✓ VERY SAFE & EASY TO TRANSPORT BY CAR

HOW TO CALCULATE BATTERY Ah NEEDED

- CURRENT REQUIREMENTS OF MY HF PORTABLE GEAR
  - IC-7300 @ 100W: RX 1.0A, TX 21A (@ 10W, TX 7.7A)
  - KX-2 @ 10W: RX 0.2A, TX 1.9A
  - NOTE: 5X DIFFERENCE IN CURRENT DRAW WHILE IN RX MODE & 4X DIFFERENCE WHILE BOTH RUNNING 10W IN TX MODE

- TO CALCULATE BATTERY Ah CAPACITY NEEDED FOR YOUR TRANSCEIVER, YOU MUST
  - ESTIMATE DUTY CYCLE FOR TX
    - AVERAGE % TIME YOU ARE TRANSMITTING
      - SUGGEST USING 20% FOR CASUAL HAMMING & 50% FOR CONTESTING

  - USE DUTY CYCLE FOR MODE
    - % TIME WHEN TX LIGHT IS ON AND RF IS ACTUALLY BEING OUTPUTTED
      - SSB (20%), CW (40%) & AM, FM & DIGITAL (100%)

CALCULATING BATTERY Ah NEEDED (CONT'D)

- FOR THE MATHEMATICIANS
  - $I_{AVE} = (I_R \times DO_r) + (I_r \times DM_r)DO_t = (I_t \times DO_t)DM_t$
  - BATT Ah CAPACITY NEEDED = $(I_{ave} \times \text{Ops Duration}_{hrs)} + Ah_{spare}$

- FOR THE REST OF YOU, USE THIS ON-LINE CALCULATOR TO CALCULATE I_{AVE} AND TOTAL Ah NEEDED. THEN YOU ADD TO THAT YOUR DESIRED Ah_{spare}:
  - ✱ HTTP://WWW.4SQRP.COM/BATTERY_CAPACITY/INDEX.PHP

- FOR SLAs, BATTERY Ah CAPACITY NEEDED WILL BE GREATER THAN EXPECTED DUE TO THE "PEUKERT EFFECT"
  - THE HIGHER THE CONTINUOUS DISCHARGE AMPERAGE IS, THE LOWER THE EFFECTIVE MAX Ah BATTERY CAPACITY (NOT A PERMANENT REDUCTION)

- ON-LINE CALCULATOR FOR PEUKERT EFFECT: HTTP://WWW.CSGNETWORK.COM/BATTERYLIFECALC.HTML?CX=PARTNER-PUB-8018289210612122%3A1424138921&COF=FORID%3A10&IE=UTF-8&Q=&SA=SEARCH&RBC=40&DR=20&PN=1.1&CRATE=27.660&TLIFETIME1=0.692&MLIFETIME8=0.553&TLIFETIME2=0.519&TLIFETIME3=0.346&TLIFETIME4=0.173

TWO BATTERY OPTIONS FOR 8 HOUR OUTINGS

- BIOENNO 12V, 20Ah LIFEPO4, MODEL BRF-1220A, $193
  - ANDERSON POWERPOLE CONNECTORS
  - WEIGHT 5.4 LBS, SIZE 6.5 X 4.31 X 3.3 INCHES
  - USE 14.6V, 4A AC-TO-DC CHARGER (DC PLUG) FOR 12V LIFEPO4 BATTERIES (BPC-1504DC) $25

- EXPERT POWER 12V, 20Ah LIFEPO4 EP1220, $150
  - F13/M5 TERMINALS
  - WEIGHT 5.8 LBS, SIZE 7.1 X 3 X 6.6
  - USE 14.4V, 2A AC-TO-DC CHARGER FOR 12V LIFEPO4 BATTERIES (EPC122) $23
  - WILL NEED TO WIRE BATTERY WITH ANDERSON POWERPOLE CONNECTORS

- ABOVE BATTERIES WILL POWER IC7300 SSB 100W HF OR TM-D710G FM 50W VHF/UHF AT 20% OPERATOR DUTY CYCLE FOR 11.6 HOURS AND 9.6 HOURS RESPECTIVELY

- NOTE: IF AGM BATTERY USED TO PROVIDE 20Ah OF POWER, IT WOULD NEED TO BE RATED 40Ah. IT WOULD BE LARGER THAN A 20Ah LIFEPO4 AND WEIGH ABOUT 30 LBS. IT WOULD COST AROUND $110

TIPS

- COMPANIES SELLING QUALITY LFP BATTERIES IN ORDER OF INCREASING COST AS OF TODAY FOR A 100Ah BATTERY ARE: EXPERT POWER ($500), RENOGY ($550), SOK BATTERY ($570), BIOENNO ($863) & BATTLE BORN ($874)

  - BIOENNO BATTERIES ARE VERY POPULAR WITH HAMS. THEIR 60Ah & BELOW BATTERIES CAN BE PURCHASED NICELY PACKAGED & SEALED WITH TWO SETS OF LEADS - ONE WITH ANDERSON POWERPOLE CONNECTORS AND THE OTHER WITH A BARREL CONNECTOR TO MATE WITH A BATTERY CHARGER

- COMMERCIAL, PORTABLE POWER STATIONS (AKA SOLAR GENERATORS)

  - GENERALLY DESIGNED TO PROVIDE PURE SINE WAVE, 110VAC POWER TO SMALL APPLIANCES AND ELECTRONICS. THE ALSO HAVE USB 5V POWER PORTS AND A 12VDC CIGARETTE LIGHTER RECEPTACLE PROVIDING UP TO 10A (NOT ADEQUATE FOR POWERING 100W TRANSCEIVER)

    - MOST USE LI-ION BATTERIES (REDUCES SIZE & WEIGHT), THEREFORE, HAVE FIRE RISKS

    - MAKING YOUR OWN PORTABLE BATTERY SYSTEM WILL SAVE YOU UP TO HALF THE COST OF A COMMERCIAL ONE AND WILL BETTER MEET YOUR SPECIFIC HAM & OPERATIONAL NEED

TIPS

- JULIAN, OK8STN, RECOMMENDS USE OF QRP TRANSCEIVER FOR FIELD OPS, AND IF MORE POWER IS NEEDED, USE AN EXTERNAL AMPLIFIER
  - ELECRAFT KX2, ONLY CONSUMES 0.2A WHILE RECEIVING. WHEREAS IC7300 CONSUMES 0.9A
  - MIDSIZED 100W TRANSCEIVERS AVERAGE ABOUT 1.6A IN RECEIVE MODE
  - KX2 WITH KEY DOWN CONSUMES 2A @ 10W OUTPUT, WHEREAS IC7300 CONSUMES 9A
  - RECEIVING 80% OF TIME AND TRANSMITTING 20% WITH 100W FOR 8 HOURS WITH SSB
    - IC7300 CONSUMES 13.6Ah
  - 8.24Ah KX2 WITH A 100 W (KXPA100) AMPLIFIER CONSUMES 7.9Ah

- RUNNING DIGITAL MODES REQUIRES A LAPTOP, TABLET OR RASPBERRY PI. THEY CAN CONSUME 0.4 - 1.OA.
  - LAPTOPS MUST BE HEATED IF THE AMBIENT TEMPERATURE FALLS BELOW THEIR MINIMUM SPECIFIED OPERATING TEMPERATURE WHICH IS NORMALLY BETWEEN 32 & 50 DEGREES FAHRENHEIT. HEATING MIGHT REQUIRE ANOTHER AMP OR MORE OF POWER FOR A 12V HEATING PAD
  - DIGITAL MODES REQUIRE ACCURATE TIME OF DAY, SO CONSIDER USB GPS RECEIVER (E.G., GLOBALSAT BU-353-S4 AND NMEATIME2 SOFTWARE) TO SYNC LAPTOP TIME WHEN YOU DON'T HAVE INTERNET CONNECTIVITY
  - IN FIELD, USE LAPTOP CHARGER DESIGNED TO RUN ON 12VDC (PW+ MODEL PWR-12USBC99) FOR 93% EFFICIENCY

TIPS (CONT'D)

- USE UNIQUE CONNECTORS BETWEEN SOLAR PANELS & SOLAR CHARGER TO PREVENT SOLAR PANEL'S HIGH VOLTAGE FROM BEING INADVERTENTLY CONNECTED TO BATTERY OR LOAD

- SOLARS CHARGERS ARE EITHER PULSE WIDTH MODULATION (PWM) OR MAXIMUM POWER POINT TRACKING (MPPT). THE EFFICIENCY OF PWM IS 75-80% COMPARED TO MPPT 93-98%. FOR PORTABLE, SHORT-TERM OPS & HAM GEAR POWER LEVELS, THE 3-4X GREATER COST AND WEIGHT OF USING MPPT IS NOT WORTH IT

- THERE'S A HUGE JUMP IN PRICE & WEIGHT BETWEEN "MODIFIED" SINE WAVE DC-TO-AC INVERTERS VERSUS A "PURE" SINE WAVE INVERTERS. TEST YOUR GEAR TO DETERMINE IF YOU REALLY NEED A "PURE" SINE WAVE INVERTER. NOTE: THEY ARE ONLY 40-50% EFFICIENT POWER WISE

- TO COMPARE BATTERIES OF DIFFERENT VOLTAGES, USE WATT-HOUR RATING NOT AMP-HOUR RATING

- FOR EMCOMM USE, BEST TO STORE LFP BATTERIES AT 100% FOR READINESS PURPOSES. HOWEVER, RECHARGE THEM EVERY 2-3 MONTHS TO REBALANCE THE CELLS & PREVENT PERMANENT LOSS OF TOTAL CHARGE CAPACITY OF 2-3% PER YEAR. NO NEED TO USE A FLOAT CHARGE WITH LFP BATTERIES.

- FOR ARES/RACES & OTHER EMCOMM MISSIONS RECOMMEND ALL GEAR BE FITTED WITH ANDERSON POWERPOLE CONNECTORS FOR INTEROPERABILITY

- WEST MOUNTAIN RADIO'S "EPIC PWRGATE" PROVIDES SEAMLESS TRANSFER OF POWER FROM GRID TO BATTERY WHEN GRID GOES DOWN. IT CHARGES BATTERY WHEN GRID IS UP. GREAT FOR EMCOMM

TIPS (CONT'D)

- WHEN DETERMINING BATTERY CAPACITY NEEDED, BE SURE TO ADD AMP-HOURS TO COVER POWERING ANY ANCILLARY GEAR (E.G. LAPTOP & INVERTER). ALSO NEED TO DETERMINE ADDITIONAL POWER NEEDED BASED ON BATTERY EFFICIENCY, SOLAR CHARGER EFFICIENCY & WIRING LOSSES. BATTERY EFFICIENCY (AHs USED DIVIDED BY THE AHs NEEDED TO RECHARGE) WHICH IS UP TO 98% FOR LFP BATTERIES.

- MAKE SURE WHATEVER BATTERY YOUR BUY IS RATED FOR A MAXIMUM CONTINUOUS DISCHARGE AMPERAGE THAT EXCEEDS THE MAXIMUM CURRENT REQUIRED BY YOUR TRANSMITTER PLUS ALL ACCESSORIES

- TO LEARN MORE ABOUT BATTERIES, SOLAR PANELS, SOLAR CHARGERS & PORTABLE POWER STATIONS SEE URLs BELOW. (NOTE: DOWNLOAD KM6UFF'S SPREADSHEET FOR DETAILED SOLAR POWER CALCULATIONS)
  - HTTPS://WWW.FALLBROOKARC.ORG/HOME/PRESENTATIONS/KM6UFF-PRESENTATIONS/
  - HTTPS://WWW.YOUTUBE.COM/WATCH?V=FR_WZMDZXRS
  - HTTPS://WWW.YOUTUBE.COM/C/WILLPROWSE
  - HTTPS://WWW.YOUTUBE.COM/C/HOBOTECH/VIDEOS
  - HTTPS://BATTERYUNIVERSITY.COM/
  - HTTPS://WWW.MPOWERUK.COM/
  - HTTPS://WWW.YOUTUBE.COM/WATCH?V=4G904HVCXO0

PARTS LIST FOR MY SOLAR POWER SYSTEM

BATTERY SUPPLY

-ExpertPower 12V 100Ah LiFePO4 - EP12100 $500

-ExpertPower 12V 20A Smart Charger for Lithium LiFePO4 Deep Cycle Rechargeable Batteries $85

-DEWALT (DWST17806) Tstak Tool Box, Deep $34

-LiDiVi [Upgraded Version] Quick Charge 3.0 Dual USB Car Charger, Waterproof 36W 12V USB Outlet Fast Charge with Voltmeter & Switch for 12V/24V $13

-2ea Powerwerx Panel Mount Housing for Two Anderson Powerpole Connectors with cover $26ea

-2ea RGBZONE 150 Amps Power Analyzer, High Precision RC with Digital LCD Screen $17 ea (Note: used to monitor amount of charge solar panels are providing and amount of battery charge consumed by load. Measuring the voltage of LFP battery which doesn't drop much until 85% of charge is consumed will not reveal it's state of charge)

SOLAR CHARGING

-2ea ROCKPALS RP082 100w Foldable Solar Panels (Monocrystalline) 2020 upgraded with built-in Kickstands, Parallel Cable, QC 3.0 and USB-C, Upgraded Portable Solar Panel $185ea

-Renogy Wanderer Li 30A 12V PWM Solar Charge Controller. $40

I2VDC-TO-11OVAC INVERTER

-AmazonBasics 175w Pocket Power Inverter, "Modified" Sine Wave (Note: No longer available. Amazon recommends Geloo 300w modified sine wave inverter $30)

-Samlex PST-300-12 PST Series "Pure" Sine Wave Inverter - 300 Watt $255 (Note: only needed for gear that requires pure sine wave power. Higher wattage inverters are available).

SMALL PARTS & TOOLS

SMALL PARTS:

-InstallGear 10 Gauge AWG Crimp Ring Terminals Connectors - 10-Pack (5 Positive, 5 Negative) 5/16 inch

-GS Power 100% Copper 10 AWG OFC Wire;25 FT Red & 25 FT Black Bonded Zip Cable

-Nilight 270 pcs 3:1 Dual Wall Adhesive Heat Shrink Tubing kit, 6 Sizes,

-Baomain 75pcs Copper Metal Uninsulated Wire Ferrule Cable Crimp Terminals Butt Connector(10-12 AWG (4.0-6.0 mm2) / 14-16 AWG (1.5-2.5 mm2) / 18-22 AWG (0.5-1.0 mm2), Each Size 25 PCS

-2ea MCIGICM 10ga Inline Fuse Holder Waterproof Pigtail Fuse Relay with 40A Blade Fuse, 3 Pack

-JABINCO 35Pcs -Blade Fuse Set, 5/7.5/10/ 15/20/ 25/30 AMP Fuse,Assorted Car Truck

-Anderson Powerpole Connectors 10 Pair Genuine 30 amp

TOOLS I USED:

-IWISS Ratcheting Wire Crimper Tools Works for Anderson AMP 15, 30 and 45 Cable Connectors

-Klein Tools 11063W Wire Cutter / Wire Stripper, Heavy Duty Wire Stripper Tool for 8-20 AWG Solid and 10-22 -AWG Stranded Electrical Wire

-Klein Tools 1005 Cutting / Crimping Tool for 10-22 AWG Terminals and Connectors, Terminal Crimper for -Insulated and Non-Insulated Terminals

-Hole Saw Set, plus Hole Saw Arbor with Adapter, 3/8-Inch Klein Tools 31905

CARRYING LITHIUM BATTERIES ON PLANES

- FAA PERMITS
  - CARRY-ON
    - 100Wh BATTERIES, BOTH THOSE INSTALLED INSIDE EQUIPMENT & SPARES
    - WITH AIRLINE APPROVAL, 101-160Wh BATTERIES ARE PERMITTED IF INSTALLED IN EQUIPMENT. ALSO, UP TO TWO SPARES MAY BE ALLOWED
    - 12Ah LFP BATTERY IS 154Wh

  - CHECKED:
    - 100Wh BATTERIES INSTALLED INSIDE EQUIPMENT*
    - WITH AIRLINE APPROVAL, 101-106Ah BATTERIES MAYBE ALLOWED IF INSTALLED IN EQUIPMENT
    - NO SPARES ARE PERMITTED

- NOTES
  - CHECK FOR UPDATE FAA & AIRLINE RULES PRIOR TO TRAVELING!
  - SPARES MUST BE PROTECTED FROM SHORTING & DAMAGE
  - E-CIGARETTES & VAPORIZERS ARE NOT PERMITTED IN CHECKED BAGGAGE REGARDLESS OF BATTERY SIZE
  - FOR LIFEPO4 BATTERIES, FAA LIMITS TRANSLATE TO 7AH & 8-12AH
  - IF BATTERY DOESN'T SHOW WATT-HOUR RATING ON IT, TSA MAY QUESTION IT
  - FAA IS CONSIDERING REMOVING RESTRICTIONS OF LFP BATTERIES

QUESTIONS?

Please contact me at winebike@hotmail.com with any comments or corrections.

Special thanks to Bryan at Expert Power and Kevin at Bioenno for kindly answering my questions about LFP batteries.