EMERGENCY BACKUP POWER FOR HAM STATIONS

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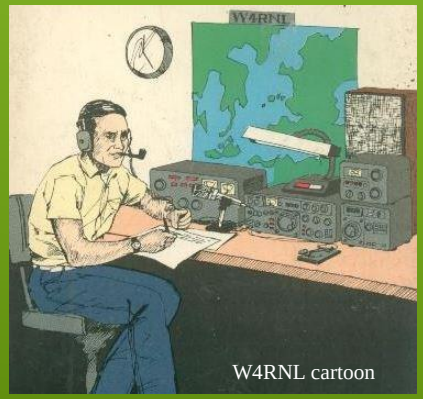
Date: 4/27/2021



W4RNL cartoon

WHY DISCUSS EMERGENCY BACKUP POWER?

- The recent winter and tornadic weather outages of 2021 in Lincoln County, TN caused me to realize that I need emergency (back-up) power for my ham station – Why?
  - To facilitate local/statewide emergency communications
  - To continue to operate and make contacts with other amateur radio operators
  - Power outages had shut me down and I could not operate or assist in the statewide emergency net (Tennessee Phone/CW nets)
- After much thought, I decided to research this subject and add backup power to my station

STEPS TO IMPLEMENTATION OF EMERGENCY BACKUP POWER

- Assess station requirements – How much power is needed?
- Design backup power system – Battery, Generator, or Solar cells?
- Purchase & Install the necessary essential equipment – Components are available from ham radio dealers, junk stores, junk box, etc.
- Test Monthly – To determine function of backup power system

WHAT EQUIPMENT MUST BE POWERED?

- You must make a decision as to which equipment you must provide backup power

AC4G's Ham Shack

AC4G's Power Cabinet w/ 2m VHF Yaesu Rig (bottom)

DETERMINE STATION POWER REQUIREMENTS

- How much auxiliary power do I need during a power outage??
  - Type of operation: Monitoring? Net control? Net Participation? DXing? Contesting? Other? All of the above?
  - Duration and duty cycle: SSB, CW, RTTY, FT8, and other modes which determines battery life (battery & solar backup power)
  - Power for Computer equipment (Desktop or Laptop); displays; and other peripherals
  - Consider other household needs such as antenna switches, antenna rotator, CW keyer, desk lights, etc.?

ITEMIZE EQUIPMENT NEEDING TO BE POWERED WITH BACKUP SYSTEM

- Begin by listing all equipment to be powered
  - Transceivers/tuners/interfaces
  - Computer & monitor
  - Room Lighting
  - Etc.
- For each component, determine:
  - Voltage requirements
  - Peak current consumption
  - Duty cycle Requirements (How long to stay powered?)

TYPICAL TRANSMIT AND RECEIVE POWER CONSUMPTION

Item	Transmit Current	Receive Current
HF Transceiver (100W)	22A	1.5A
HF Tuner	1.0 A plus	
VHF/UHF Mobile Rig (50W)	12A	1.0A
Desktop/Laptop PC	2.5A@120VAC	
Desktop Monitor	?	
Other Components	?	

Check your equipment ratings! Each component may have differing ratings and can be found in the manual or measured.

MUST DECIDE ON TYPE OF BACKUP POWER SYSTEM (1 OF 2)

- Generator
  - Equipment to be plugged-in (Extension chord?)
  - Power Supplies to operate 12V equipment
  - Maintain generator (gas, oil, etc.)
- Battery (Indoor or Outdoor)
  - Use 12V directly vice Power Supplies (120VAC electrical power)
  - Inverter to be used for 120V equipment
  - Requires batteries to be charged
  - Batteries to be replaced every 3 to 5 years

MUST DECIDE ON TYPE OF BACKUP POWER SYSTEM (2 OF 2)

- Solar
  - Requires solar components: charge controller, deep cycle batteries, and solar cells
  - Generates lots of noise affect HF transceivers
  - Cells are currently expensive (Not an option for AC4G)
  - Requires space for solar cells

AC4G selected second option: Battery backup system

INDOOR BATTERY BACKUP SYSTEM MUST:

- Seamlessly auto-switch if AC power (120VAC) is lost in the ham shack
- Provide sufficient voltage and run time to facilitate ham radio operations (Backup run time is based on battery size & condition & operating time)
- Must trickle charge battery to keep it charged and ready for instantaneous use at any time

HOW TO CALCULATE BATTERY RATING

- The amp-hour is a unit of battery energy capacity equal to the amount of continuous current multiplied by the discharge time that a battery can supply before exhausting its internal storage of chemical energy

Amp-hour = I(continuous) X t(discharge) =>[Results in discharge of battery]

- Peukert's Law (states the capacity of a battery in terms of the rate at which it is discharged) - as the discharge rate increases, the battery's available capacity decreases. [Note: A factor of 1.1 is perfect (10%).]

An increase in a battery's discharge rate results in a decrease of a battery's capability to provide power

HOW TO CALCULATE BATTERY RATING

- An amp-hour is one amp for one hour OR 10 amps for 1/10 of an hour (~6 minutes)
- Transmit: Assume a rig drawing 20A and running 20 minutes: Amp-hours used would be 20A X .333 hours (1/3 hour or 20 minutes) = 6.67 AH
- Receive: Receiving 20% of the time on HF:
  - 1.5A X .66 hours (2/3 hour or 40 minutes) = 1.0 amp-hours
- You need 6.67AH + 1.0 AH = 7.67 AH
- Factoring Peukert's Factor yields 7.67AH + 10% Peukart factor = 7.67AH + (7.67AH X .10) = 8.437 AH battery capacity per hour

CONSTRUCTION OF THE AC4G'S BATTERY BACKUP SYSTEM

- Use the components described on the following slide
- Powerpoles make a neat looking project
- Use the correct wire size
- Try using cables less than 6 feet long
- Install fuses at the battery (battery box has this feature built-in)

TYPES OF COMMERCIAL BATTERY BACKUP MODULES

Product Data Sheet

BB-30M BATTERY BACKUP MODULE 13.8 & 27.6 VDC

Key Features

- Automatically switches to the battery source upon power supply failure
- Built-in battery charger for standard 12 and 24V batteries (13.8 and 27.6 Vdc)
- Battery and power supply sources may combine during peak power events
- Built-in fuse protection on battery charging and discharging
- Front Panel 3 WAY LED indicator Indicates Battery Charged, is Charging, and Battery back-up
- Industrial design and metal construction quality
- RoHS (lead free) compliant

Applications

Mission critical power solution
This unit is ideally suited for Battery Backup and Peak Power load-sharing that require high system reliability in industrial and mission critical applications. The battery charger is built-in and continuously charges the external battery. The LED (green) indicates when the battery is charging.

Backup Redundancy
The DC Power Supply source delivers full power to the output load at the same time the external battery is being continuously charged to full power. In the event the power supply source fails, the unit automatically and immediately switches to the battery source assuring no loss of power to the load.

Easy installation, safety and reliability
These units integrate passively and seamlessly with standard 13.8 and 27.6 Vdc power supplies and standard 12 volt and 24 volt sealed lead-acid batteries. The unit's packaging is a rugged metal case with heavy duty connections. The input and output screw-type terminals are easily accessible which ensures a safe and reliable installation.

Electrical

POWER SUPPLY INPUT VOLTAGE:	13.8 VDC or 27.6 VDC, ± 0.7%
OUTPUT VOLTAGE: (based upon the larger of the power supply input or the battery input minus a diode drop of 0.4 Vdc.)	13.4 VDC max at 13.8 Vdc operation 27.2 VDC max at 27.6 Vdc operation
OUTPUT CURRENT	30 A max continuous
CHARGING CURRENT	3.6 A
TEMPERATURE	Operating: -25 to +50ºC, Storage: -40 to +85ºC Overtemperature setting at 60ºC max
REQUIREMENTS for BATTERY and INPUT POWER SUPPLY:	
The battery charging current is limited and is specifically designed for a sealed lead-acid battery. The Power Supply should accommodate the sum of the max output load current plus the battery charge current.	

Mechanical

DIMENSIONS	
W x D x H	3.8in x 4.5in x 1.93 in
Weight	1.5 lbs

ASTRON CORPORATION
WWW.ASTRONCORP.COM
9 Autry, Irvine, CA 92618 • (949) 458-7277 • Fax: (949) 458-0826
5/10 50M

OR

SAMLEX BBM-1225 or BBM-12100

Manufacturer's Part Number:	BBM-1225
Part Type:	Automatic Battery Backup Switch Devices
Product Line:	Samlex Battery Backup Modules
DXE Part Number:	SXA-08151
UPC:	622988081514
Maximum Output Current:	25A
Charging Circuit Type:	Smart charger
Fused Input:	No
Fuses Included:	No
Width (in):	3.900 in.
Height (in.):	1.900 in.
Depth (in):	4.500 in.
Weight:	0.800 lbs.
Quantity:	Sold individually.

Samlex Battery Backup Modules are connected to the output of a power supply and a battery to provide automatic battery backup capabilities. When the AC power fails, these silent, solid-state modules instantaneously switch the DC power connection of your electronic devices from the power supply to the battery, keeping your essential DC powered electronics working! While the AC power is on, these modules regulate the DC power supply output voltage and current to recharge the backup batteries while supplying the DC load. There are no relays to fail and no contacts to clean.

Functional from well under 12 Vdc up to 28 Vdc, and capable of handling 25A or 100A output depending on model, these units are used to create uninterruptible power supplies that are used in essential communications, automotive, marine, RV, aviation and other applications. Especially well-suited for Emergency Communications and in generator powered systems, and anywhere AC to DC supplies provide crucial power service, Samlex Battery Backup Modules from DX Engineering will keep your electronics up and running!

Others available or homemade?

AC4G'S BATTERY BACKUP BATTERY SYSTEM - COMPONENTS

- West Mountain Radio 4008 Battery Box: $139.95
- Samlex Battery Backup Module (BBM-1225 or BBM-12100) Auto switcher and trickle charger: $59 - $137
- Blue or Yellow Top AGM Battery: $268
- Miscellaneous power cables: $30
- PWRCheck (measures Volts, Amps and alternates between AH and WH. Takes guesswork out of power measurements. Makes it easy to read power consumption and capacity: $184.95

Powerpoles make installation easy and neat!

FUNCTION OF THE BATTERY BOX

- West Mountain Radio 4008 Battery Box: $139.95
- Contains any explosion particles (just in case)
- Makes it easier to move and transport if needed for use in other projects or portable operation
- Powerpoles make connecting devices much easier

Note: Powerpole connectors and fuses

FUNCTION OF THE SAMLEX BACKUP BATTERY MODULE

- The Samlex module is a passive interface between the ham station power supply, the battery, and the DC load (HF transceiver, etc.)
- When power supply is operational, the load is provided with voltage & a float charge to the battery
- When the power supply fails, the battery will supply voltage to the load (HF transceiver, etc.); however, the battery begins discharging
- Once power is provided to the power supply (120VAC), the power supply takes over and the re-charging of the backup battery resumes (up to 4A charging current)

SAMLEX BACKUP POWER MODULE

SECTION 2 | Layout and Dimensions

2.1 LAYOUT

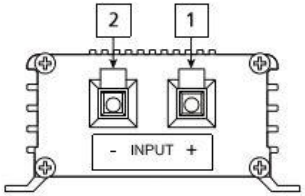


Fig. 2.1: Input Side

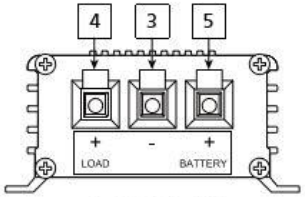


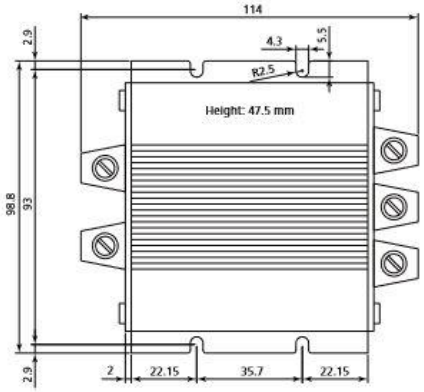
Fig. 2.2: Output Side

LEGEND:

1. Positive Input Terminal
2. Negative Input Terminal
3. Common Negative Output Terminal for Load and Battery
4. Positive Output Terminal for Load
5. Positive Output Terminal for Battery

NOTE: All input and output terminals: Hole size: 5mm / 0.2"; Set Screw: #10, 24 TPI, 5/16" long

2.1 DIMENSIONS

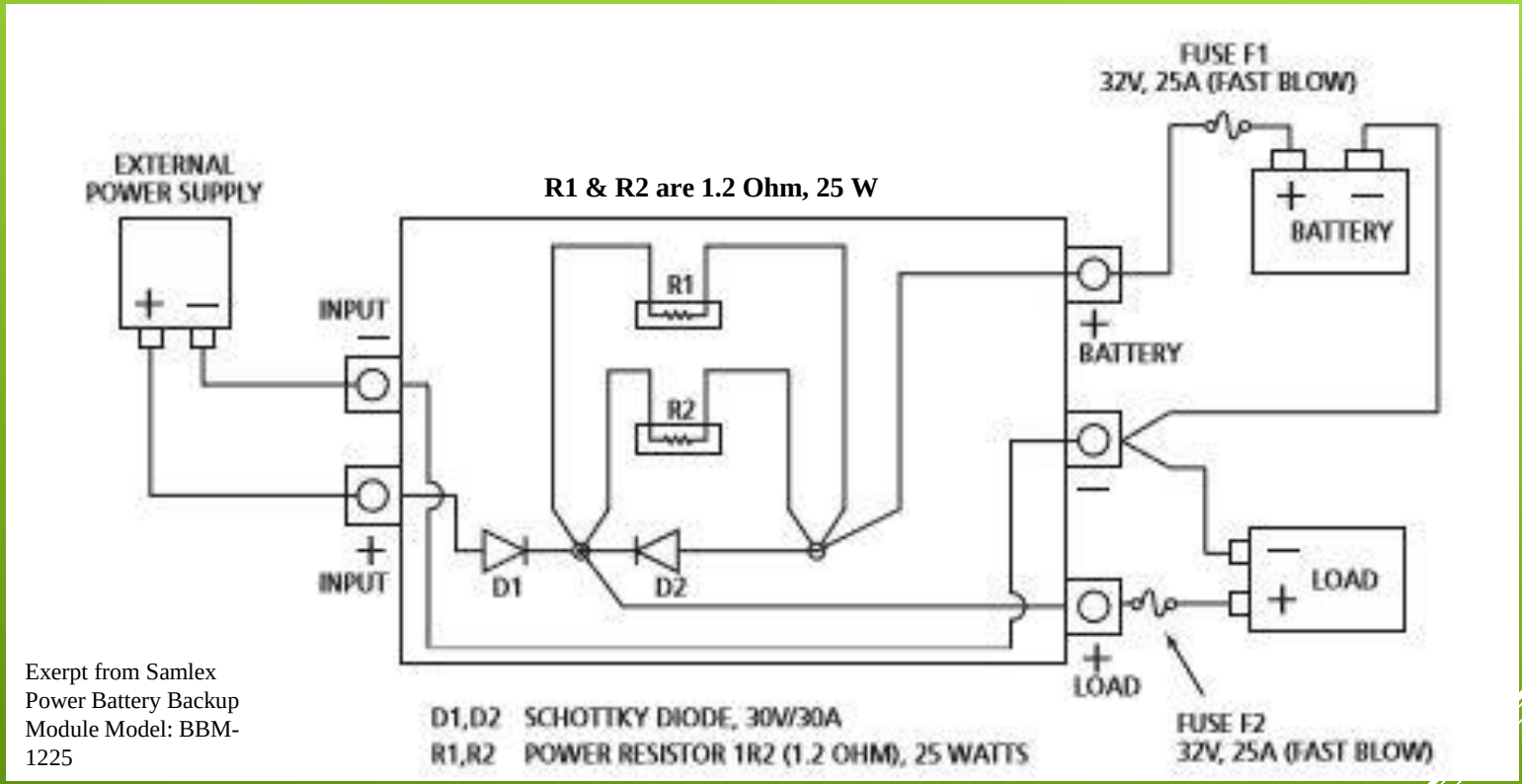


NOTE: All dimensions are in mm.

Fig. 2.3: Dimensions

Exerpt from Samlex Power Battery Backup Module Model: BBM-1225

SCHEMATIC OF THE SAMLEX BATTERY BACKUP MODULE



Exerpt from Samlex Power Battery Backup Module Model: BBM-1225

Voltage is fed through isolating D1 to load and current limiting resistors R1 & R2 (.6 Ohm- Parallel). D1 isolates the power supply & battery. D1 has a voltage drop of 0.5V. Trickle charging voltage is 0.5V lower than the power supply.

If the power supply fails, the load will be supplied by the battery thru D2 with a voltage drop of 0.5V. Since D2 is connected in parallel with R1 & R2, D2 bypasses R1 & R2 when the battery discharges thru the load.

MAXIMUM CHARGING CURRENT

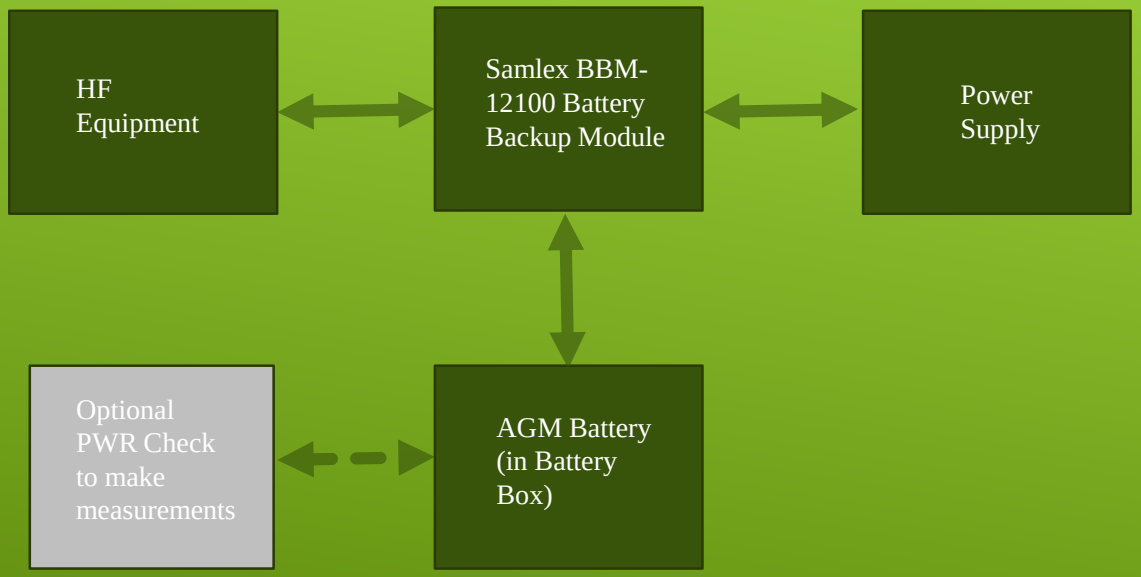
- Maximum battery charging current Maximum battery charging current Ib ={(Vp – Vd) – Vb} divided by Rs
- Vp = Output voltage of the power supply (13.8V for 12V battery
- Vd = Forward voltage drop across Schottky Diode D1 (up to 0.5V)
- Vb = Battery voltage
- Rs = Equivalent series resistance. R1 (1.2 Ohm) and R2 (1.2 Ohm) in parallel = 0.6 Ohm.
- Assuming the voltages of fully discharged 12V batteries to be 11.1V (at Discharge Rate of around C/10 (0.1C) Amps), the maximum charging currents will be as follows:
  - (13.8V – 0.5V – 11.1V) divided by 0.6 Ohm = 3.67 A

AC4G'S INDOOR BATTERY BACKUP SYSTEM (BATTERY)

- Backup Battery is Absorbed Glass Mat (AGM) (Uses GEL electrolyte)
  - Designed for indoor use
  - Non-spill electrolyte
  - Does not emit hazardous, explosive gases inside ham shack
  - AGM batteries can take more abuse than Gel-type battery
  - Gel-type battery must be charged at a lower rate otherwise, heat damage can occur

AC4G's battery backup system uses a battery box with this battery

BLOCK DIAGRAM OF THE AC4G BATTERY BACKUP SYSTEM



MAINTAINING THE BACKUP SYSTEM

- Test the Charge/Discharge cycle routinely
  - Test under load
  - Record data
  - Compare with previous test results
- Clean dirty contacts
- Inspect cables
  - Check for corrosion
  - Look for signs of overcharging and venting
- Keep spare fuses on hand

CONCLUSION(S)

- There are many articles covering many designs on the internet discussing emergency and backup power for amateur radio stations
  - Many designs from the past use discreet electrical components, while modern equipment provides an easy solution to build an emergency and backup power solution for the ham radio station
- A backup power system enables the radio amateur to participate in emergency events
- AC4G ‘s design is simple and makes use of modern equipment to switch from local power utilities to battery backup
- Although generator, battery, and solar power backup systems can be designed and built, each ham operator must decide which is best for their situation

REFERENCES

- AGM Batteries: www.windsun.com
- Battery Box: Westmountainradio.com
- Powerpole: www.powerwerx.com
- Dxengineering: www.dxengineering.com
- Gigaparts: www.gigaparts.com
- ARRL: www.arrl.org

QUESTIONS?