Bioenno Power®

Overview of LiFePO4 Batteries for Solar/Radio Applications
Presented to DESERT RATS
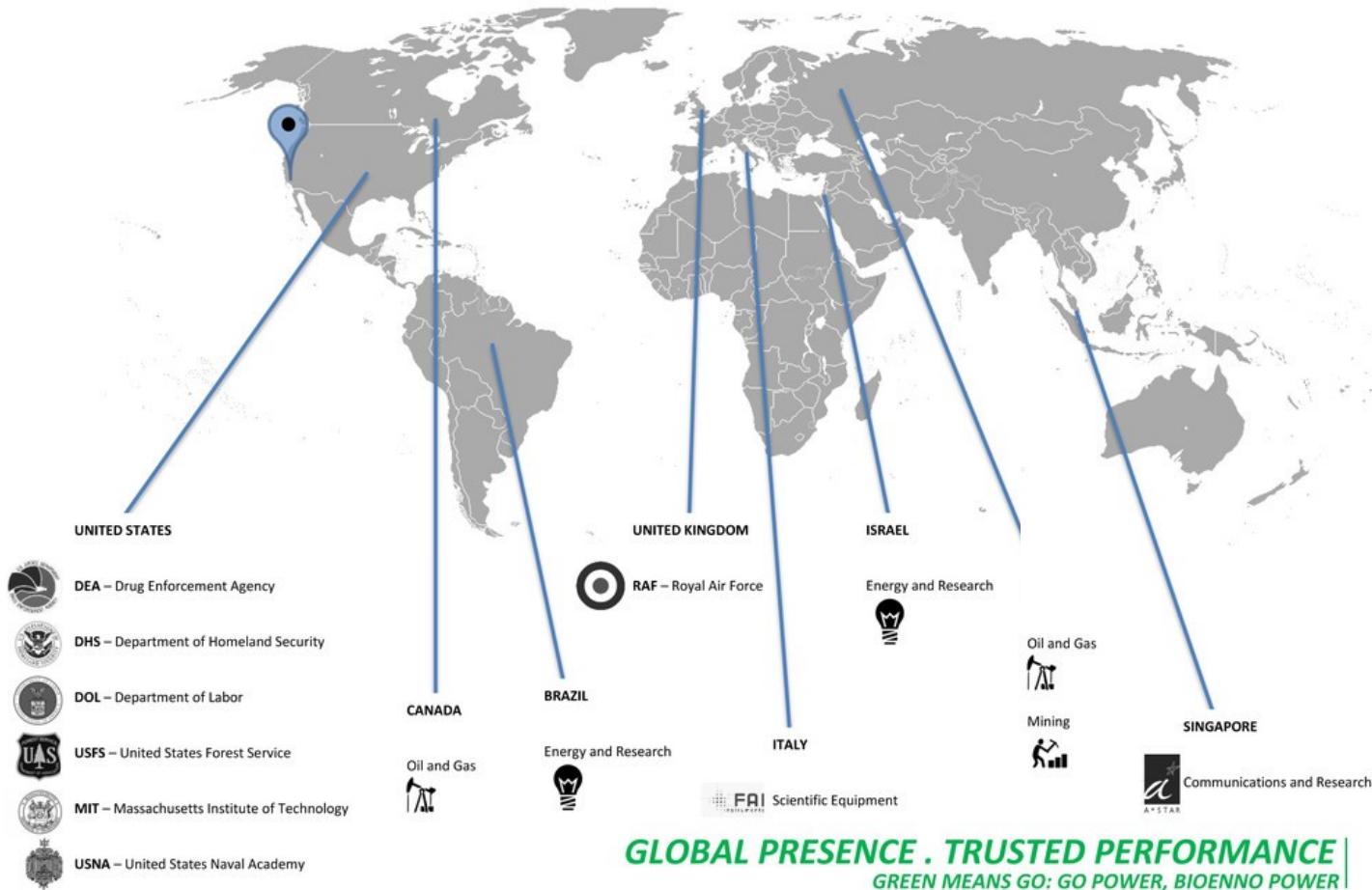
Bioenno Power®
3657 W. MCFADDEN AVE.
SANTA ANA, CALIFORNIA 92704

www.bioennopower.com
sale@bioennopower.com
Phone: (888) 336-7864

About Bioenno Power

- Founded in 2010

- OEM of various products
  - Lithium Iron Phosphate (LiFePO4) Batteries
  - Solar products

- Facilities located in Santa Ana, California

- Company/contract manufacturers have implemented ISO 9001:2008 and ISO 14001 quality and environmental standards

- World class-technology

- Best in class, after-sales service and outstanding warranty

- Customers world-wide!

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World-Wide Customers

UNITED STATES

DEA – Drug Enforcement Agency

DHS – Department of Homeland Security

DOL – Department of Labor

USFS – United States Forest Service

MIT – Massachusetts Institute of Technology

USNA – United States Naval Academy

CANADA

Oil and Gas

BRAZIL

Energy and Research

UNITED KINGDOM

RAF – Royal Air Force

ITALY

FAI Scientific Equipment

ISRAEL

Energy and Research

Oil and Gas

Mining

SINGAPORE

Communications and Research

GLOBAL PRESENCE . TRUSTED PERFORMANCE
GREEN MEANS GO: GO POWER, BIOENNO POWER

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What is LiFePO4?

- Also known as "LFP", "Lithium Iron Phosphate", "Lithium Ferrous Phosphate", "LIFE-PO", "LiFE"
- State-of-the-art battery chemistry
- Tremendous thermal and chemical stability
- Intrinsically safer because of the ultra-stable Fe-P-O bond
- Enhanced charge cycles; over 2000+ charge cycles! 5+ years of service life!
- Totally different than LiCoO2 and Li-Ion Polymer or LiPo! Don't confuse them!

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Advantages of LiFePO4 Batteries

|	Bioenno Power LiFePO4	Sealed Lead Acid
Safety	Inherently Safe as a result of strong chemical bonds and non-toxic	Sulfating, Venting, Leaking, Lead is toxic
Weight	50% to 60% lighter compared to SLA batteries	Heavy!
Life Cycles	>2000+ Cycles	< 200 to 300
Protection Circuitry	Built-in and advanced protection circuit module (PCM) and battery management system (BMS) Prevents overcurrent, overdischarge, undervoltage/ overvoltage, thermal	No protection – Can easily overdischarge SLA batteries, or overcharge them
Capacity	Get nearly 100% of the full capacity out of the battery	Can only discharge 50% of the written capacity!

Performance/Longevity

	Bioenno Power LiFePO4
Memory Effect	None. LiFePO4 battery chemistry does not have any memory effect, and can be charged at any SOC (state of charge) – 25%, 50%, 75%, etc. Suitable for both cyclic and standby applications.
Effects of Partial Cycling	LiFePo4 batteries can be partially cycled. Because there is no memory effect, the battery can be partially cycled without degradation. A partial cycle, does not count as a full cycle. Example: Charge and discharge to 50% State of Charge is considered a half cycle.
Self-Discharge Rate	~2 to 3% Per Year – Considered to be extremely low

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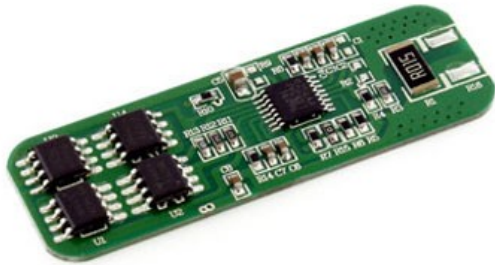# LiFePO4 Full Capacity Advantage!

12V, 12Ah Lead Acid
Only can be discharged
50%. So in reality you get
Only 6Ah out of the battery!
12V, 12Ah Lead Acid
is basically a 6Ah
battery
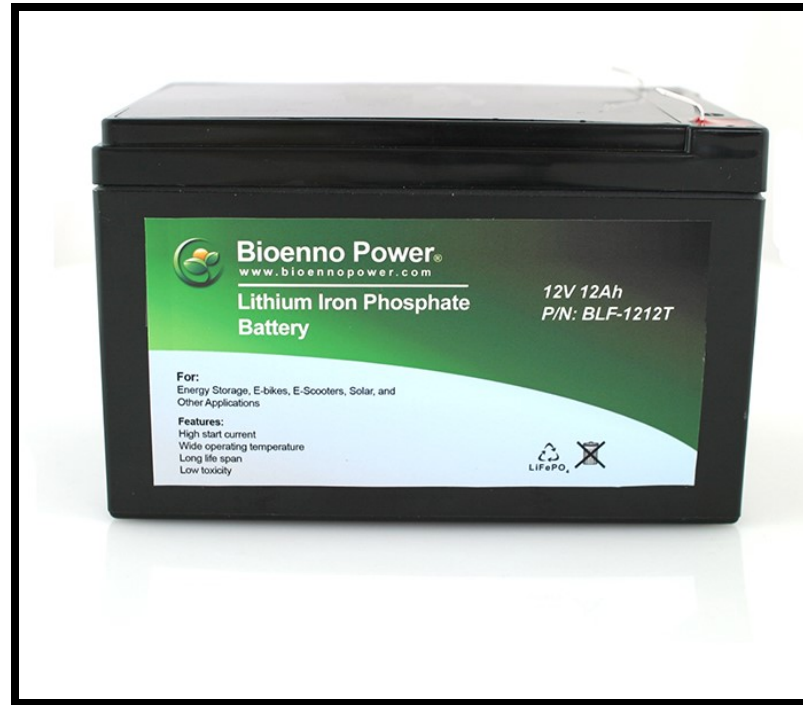
12V, 12Ah LiFePO4
You get nearly 100% capacity!
12Ah LiFePO4 = 12Ah of True Capacity
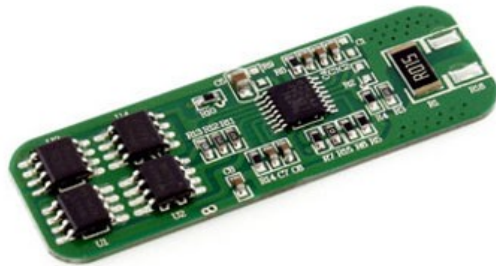
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FAQ for PCM

Common Question:
What functions do the Protection Circuit Module (PCM) perform?

Answer:
- Balancing and Equalization of Cells in LiFePO4 battery pack
- Overvoltage Protection
- Overcurrent Protection
- Overdischarge Protection
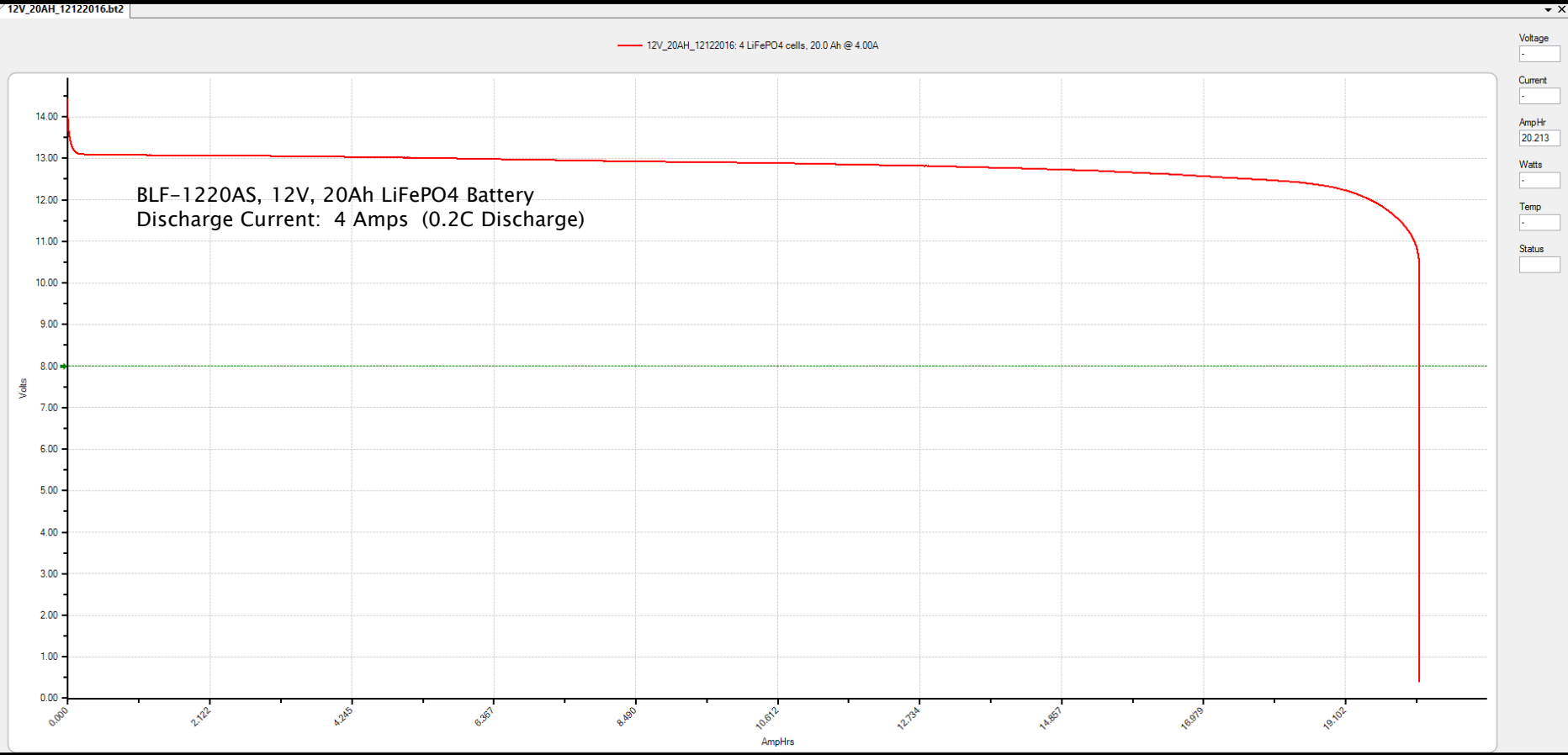- Short Circuit Protection
- Temperature protection

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Battery Spec

Bioenno Power®
BLF-1220AS
ABS Sealed Version
40A Max Continuous Discharge Current
12V, 20Ah LiFePO4 (Lithium Iron Phosphate) Battery

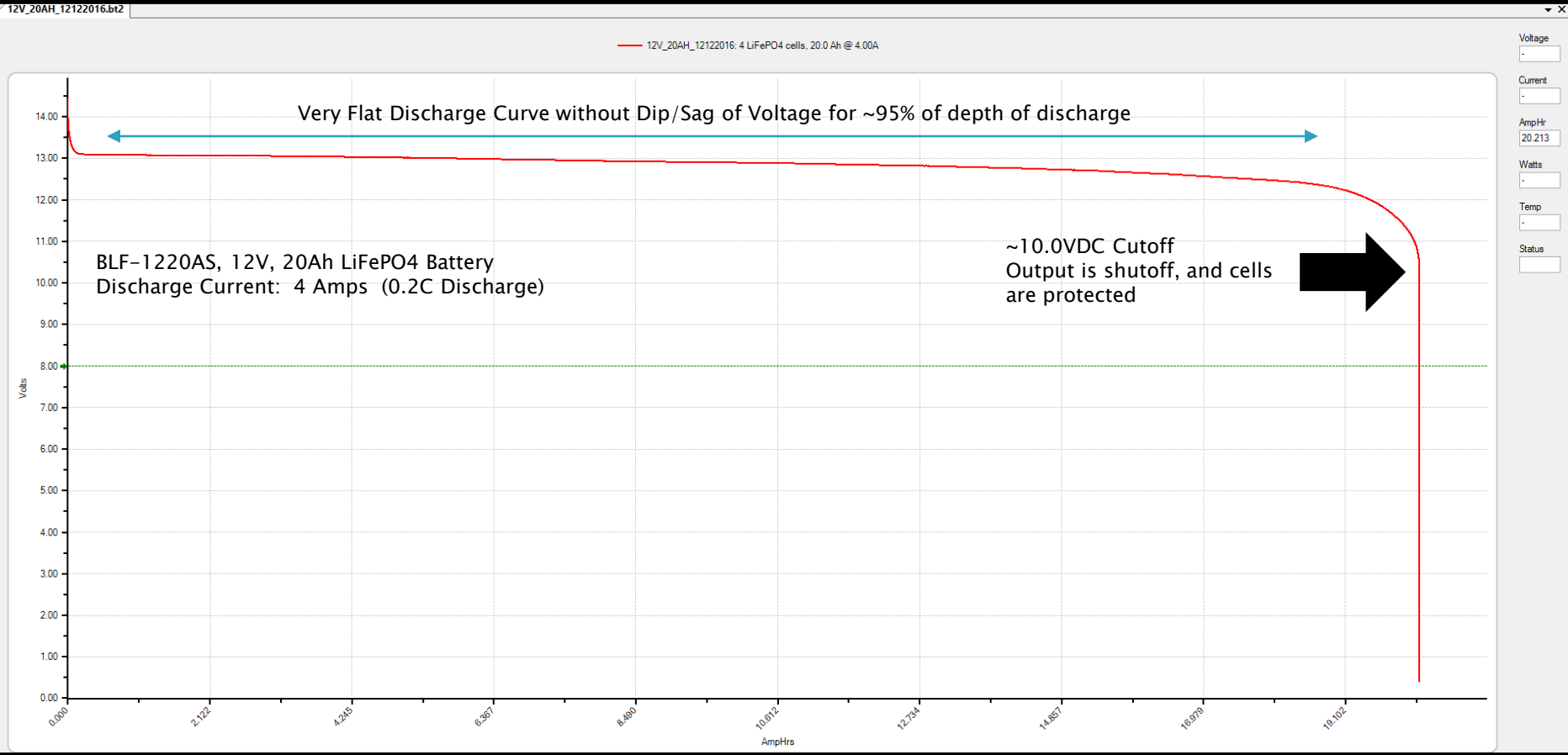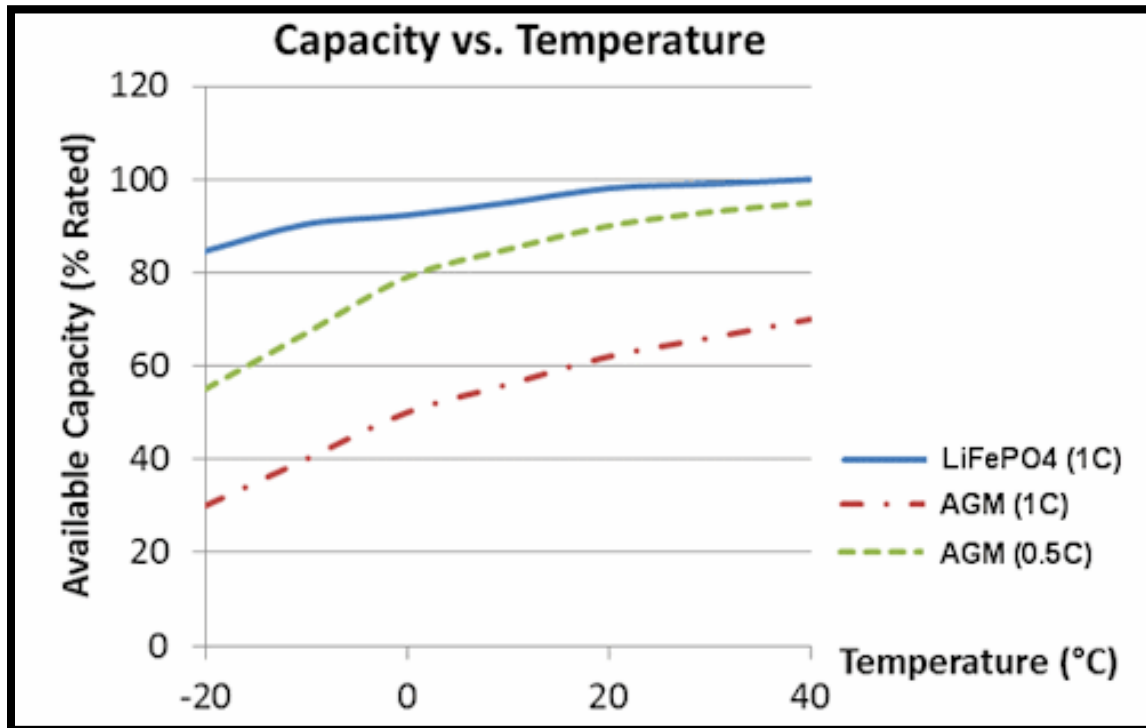|	
Nominal Voltage	12.8V
Nominal Capacity	20 Ah
Case Type	ABS Sealed
Internal Impedance	< 100 milli-ohms
Nominal Charge Voltage	14.6 VDC (+/- 0.05V)
Discharge Cutoff Voltage	10VDC (+/- 0.5V)
Max Continuous Discharge Current	**40A** *(Electrical Load should not exceed 40A continuous)*
Max Peak Pulse Discharge Current	60A (30 Seconds)
Charge Method *LiFePO4 Batteries must be charged using CC/CV Method. Bioenno Power advises use of LiFePO4 chargers that are compatible with Bioenno Power batteries.*	Constant Current (CC) / Constant Voltage (CV) CC Charging Current: 8A (or less) Constant Voltage: 14.6 VDC Charging Cut-Off Condition: < 200 mA
Cycle Life	2000 Charge Cycles (at 0.2C discharge rate)
PCM (Protection Circuit Module) Parameters Built in Protection Circuit Module	Overcharge Protection for Each Cell: Min: 3.775 V; Typical: 3.8V; Max: 3.825 V Overcharge Recovery Protection for Each Cell: Min: 3.55V; Typical: 3.6V; Max: 3.65V Undercharge Protection for Each Cell: Min: 1.92V; Typical: 2.0V; Max: 2.08V Undercharge Recovery Protection for Each Cell: Min: 2.2V; Typical: 2.3V; Max: 2.4V Discharge Overcurrent Protection: Min: 70A; Typical: 80A; Max: 90A Over Temperature Protection: Min: 60 deg C; Typical: 65 deg C; Max: 70 deg C Over Temperature Recovery Protection: Min: 50 deg; Typical: 55 deg C; Max: 60 deg C
Dimensions	7.19 in. x 3.13 in. x 6.69 in. (182 mm x 77 mm x 171 mm)
Weight	5.8 lbs. (2.6 kg.)
Operating Temperature	Charging: 32F to 113F (0 deg C to 45 deg C) Discharging: 14F to 140F (-10 deg C to 60 deg C)

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Discharge Curve

BLF-1220AS, 12V, 20Ah LiFePO4 Battery
Discharge Current: 4 Amps (0.2C Discharge)

Discharge Curve

12V_20AH_12122016.bt2   ▼ × ×

12V_20AH_12122016: 4 LiFePO4 cells, 20.0 Ah @ 4.00A

Very Flat Discharge Curve without Dip/Sag of Voltage for ~95% of depth of discharge

BLF–1220AS, 12V, 20Ah LiFePO4 Battery
Discharge Current: 4 Amps (0.2C Discharge)

~10.0VDC Cutoff
Output is shutoff, and cells
are protected

Voltage

Current

AmpHr
20.213

Watts

Temp

Status

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Available Capacity vs Temperature

Capacity vs. Temperature

- No significant reduction in capacity for LiFePO4 at low temperatures

- AGM batteries have significant reduction at lower temperatures

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Run-Time Calculations

- How to calculate run-time based on power for LiFePO4
- Simple:
  - Find out the average continuous power of your equipment
  - Power (Watts) = Voltage (Volts) x Current (Amps)
  - Example:
    - 10 Watts (continuous)
    - Voltage x Capacity of battery: 12V x 12Ah = 144 Watt-Hours (unit of energy capacity)
    - Watt-Hours / Watts = 144 Watt-hours / 10 Watts = 14 hours

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Weighted Average Calculations

▶ Weighted Average:
  ◦ $(x)*(Power_1) + (1-x)(Power_2) =$ Weighted Average Power
  ◦ Example 1:
    • 20% of the time: Transmit at 10 Watts[*]
    • 80% of the time: Receive at 2 Watts[*]
    • Weighted Average Power = 0.20*10 + 0.80*2 = 3.6 Watts
    • 12V, 12Ah LiFePO4 → ~40 hours of run-time ([12Vx12Ah]/3.6)
  ◦ Example 2:
    • 20% of the time: Transmit at 100 Watts[*]
    • 80% of the time: Receive at 2 Watts[*]
    • Weighted Average Power = 0.20*100 + 0.80*2 = 21.6 Watts
    • 12V, 20Ah LiFePO4 → ~11 hours of run-time ([12Vx20Ah]/21.6)

    • *Note: Power consumption is the electrical consumption of the power amplifier

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Growing Ham Radio Base…

W6GYC (DM04rl)

Mike's Amateur Radio Page – Working the World QRP

HOME   ABOUT W6GYC   **GEAR**   HOW TO BECOME A HAM   LINKS   MEDIA   MODS   OLD STUFF

THE RADIO AMATEUR'S CODE   FCC DATABASE

Michael Jones
W6GYC
Santa Clarita, CA

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Growing Ham Radio Base...

K. Greg Lane
N4KGL
Panama City, Florida

Growing Ham Radio Base...

N4KGL
Greg Lane
730 Brandeis Ave
Panama City, FL 32405
Bay County, USA
Loc: EM70de

Slim Jim Antenna.

Bioenno Power
12V 15Ah
180 Watt-Hours
P/N: BLF-1215T
Lithium Iron Phosphate Battery
12A Max Continuous Discharge Current

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Growing Ham Radio Base…

Norwegian Amateur Radio Station LA9XGA

Lisenced since 1989

Tor-Atle Sandal
LA9XGA
www.la9xga.com
Norway

This SOTA hike started from my home (Eikesaas Ranch) at 06:00 UTC, and it took me around 3 hours to get to the summit. The weather today was almost unbelievable with minus 10 degrees and a clear blue sky, and the view from the summit almost indescribable. On this activation I was using my Elecraft KX3 with 5-10W output, 2 x Bioenno Power LiFePo4 12V 8Ah battery and a Buddistick multi-band vertical antenna. I made a total of 153 QSO's on this remote summit activation.

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Growing Ham Radio Base...

Norwegian Amateur Radio Station LA9XGA

Lisenced since 1989

Growing Ham Radio Base...

Building a Solar System Setup

FAQ for Solar Panels

Common Question:
How many Watts for the Solar Panel?

Answer:
Depends on Size of the Battery!
12V 12Ah LiFePO4 Battery = 144 Watt-Hours

Need a 60 Watt Panel to Charge the battery in ~2 hours
(144 Watt-Hours/ 60 Watts = 2.4 hours)

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FAQ For Solar Charge Controller

Common Question:
Do I really need a solar charge controller? I want to just hook up the panel directly to the battery

Answer:
Solar charge controller is a must to regulate the solar panel voltage (which can range anywhere from 15VDC to 22VDC for a "12V solar panel"). The solar charge controller steps down the voltage from the solar panel so that the battery can accept it for properly charging the battery.

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FAQ For LiFePO4 Battery

Common Question:
Do I need a special charger for these batteries?

Answer:
The battery wants to see a "constant-voltage, current limited" power supply (can be linear or switch-mode). Overcharge/overvoltage protection and balancing is all built-in into the battery itself. No need for any fancy balancing charger. You simply apply a charge voltage anywhere between 13.8V~15 VDC, and current limit the supply to the maximum charge current for the battery (2A, 4A, 10A, etc.) depending on the model of the battery. Bioenno also pairs up the batteries with these supplies.

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FAQ For LiFePO4 Battery

Common Question:
What's the charge voltage for these batteries? What's the open circuit voltage?

Answer:
The battery charges anywhere between 13.8VDC~15VDC. After charging, the battery's open circuit voltage rests at 13.2 ~ 13.5VDC. This voltage matches up with all types of mobile radio communications equipment very well (13.8VDC +/- 15%)

FAQ For LiFePO4 Battery

Common Question:
What size of battery do I need?
How do I know ?

Answer:
First, you need to know the total power consumption.   Second, what's the desired run-time.

Example: 50 Watts total power
12V 12Ah -> ~3 hours run-time
12V 20Ah → ~ 5 hours run-time
12V, 40Ah -> ~10 hours run-time
12V, 100Ah -> 24 hours run-time

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FAQ For LiFePO4 Batteries for Ham Radio QRP / QRO

Transmit Power	Receive Power	Weighted Average (20% Tx + 80% Rx)	Battery Run-Times
10 Watts	5 Watts* *Modern radios have a receive power < 5 Watts	6 Watts	6 Ah -> 12 hours 8 Ah -> 16 hours 12Ah → 24 hours 15Ah -> 30 hours 20Ah -> 40 hours
20 Watts		8 Watts	6 Ah -> 9 hours 8 Ah -> 12 hours 12Ah → 18 hours 15Ah -> 22 hours 20Ah -> 30 hours
50 Watts		14 Watts	6 Ah -> 5 hours 8 Ah -> 7 hours 12Ah → 10 hours 15Ah -> 13 hours 20Ah -> 17 hours

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FAQ For LiFePO4 Batteries for Ham Radio QRP / QRO

Transmit Power	Receive Power	Weighted Average (20% Tx + 80% Rx)	Battery Run-Times
100 Watts	5 Watts*	24 Watts	12Ah → 6 hours 15Ah -> 7.5 hours 20Ah -> 10 hours
150 Watts		34 Watts	15 Ah -> 5 hours 20 Ah -> 7 hours 40 Ah -> 14 hours
200 Watts	*Modern radios have a receive power < 5 Watts	44 Watts	20 Ah-> 5 hours 40 Ah -> 10 hours 60 Ah -> 16 hours

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Southern California Gas Company / Sempra (Los Angeles and San Diego)

Natural gas is stored in massive underground reservoirs (for large cities) in order to buffer for demand

California state law requires all gas companies to monitor for any leaks in these massive reservoirs before any issues

Bioenno Power model BLF-1220AS Battery As Installed

P-Box Enclosure

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Southern California Gas Company / Sempra
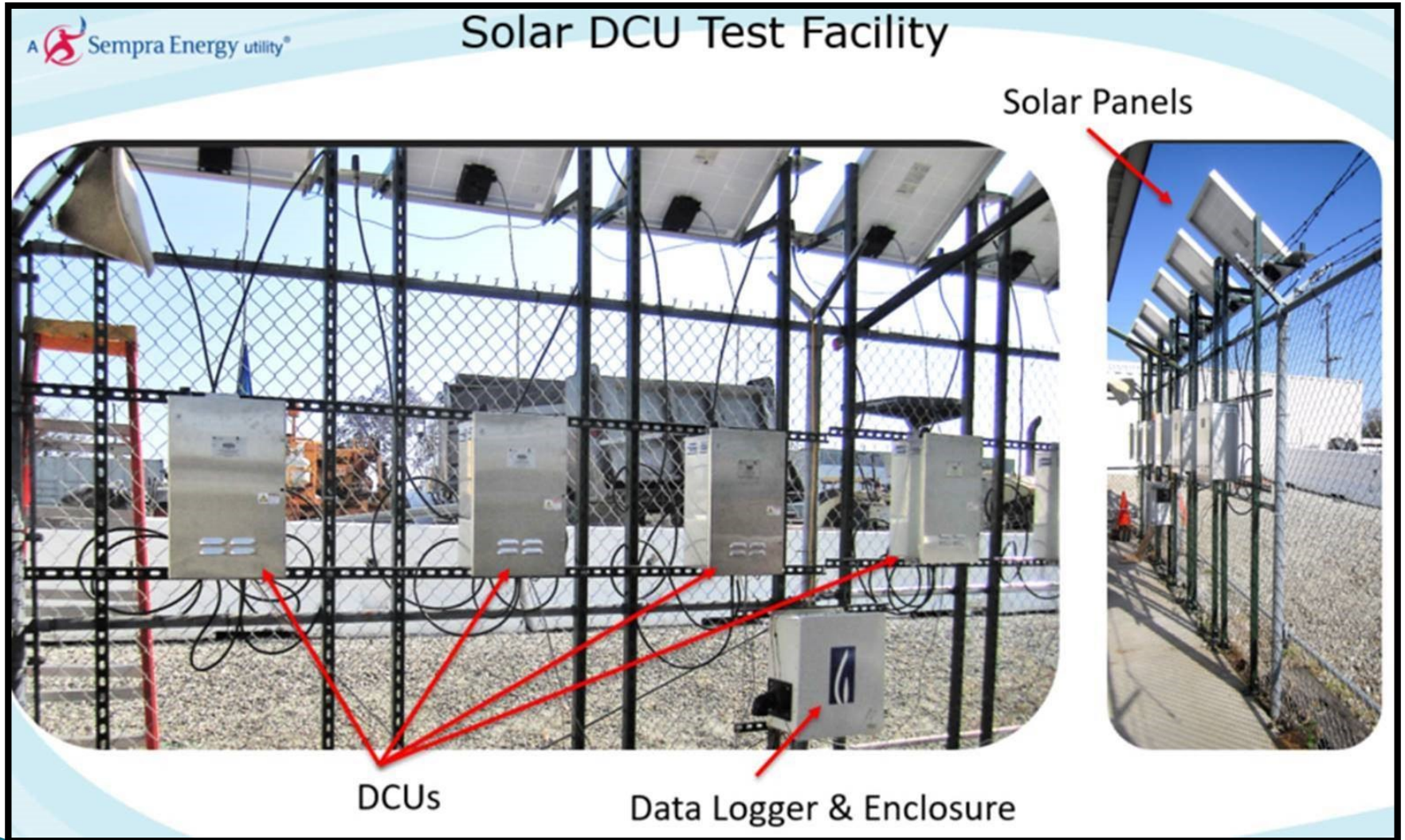
Nanometrics (Ottawa, Canada)

Satellite-based (Ku-band) telemetry system
for oil/gas exploration
in Alberta/Manitoba

Temperature performance down to -30 deg C
(through Bioenno Power proprietary low temp. enhancement in electrolyte)

Incorporates
BLF-1220A batteries,
solar controller system,
and panels

# Fleaux Services (Shreveport, LA / Laredo, TX)

- Solar-based telemetry oil/gas flow monitoring system
- Operates on LTE cellular and radio packet (VHF/UHF/Microwave)
- Incorporates BLF-1220AS/1230AS batteries, solar controllers, and panels
- Replaced entire SLA/AGM legacy batteries with LiFePO4

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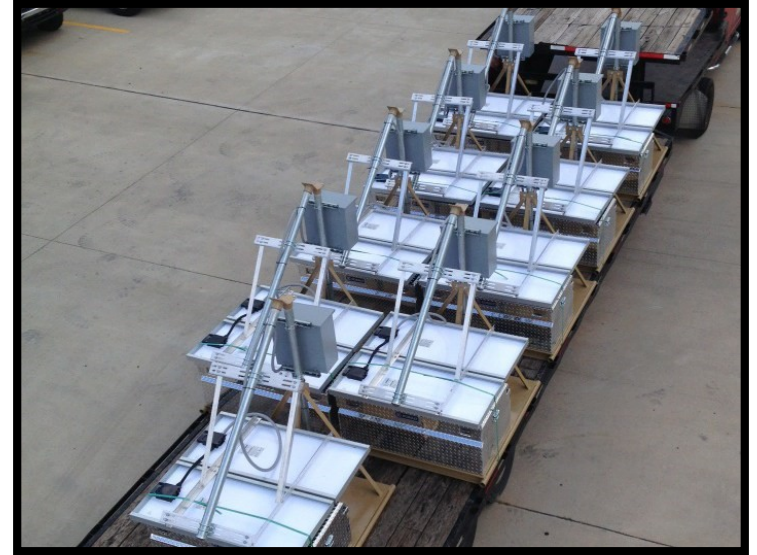
Events/News

- OCARC, OCRACES, SOARA, MTARA, PAPA, Pasadena ARC/ARES
- Palm Springs Hamfest
- HamNation – Episode 241
- Visalia DX Convention (April 2019)
- Nevada State Convention (Reno, NV – July 19–20, 2019)
- Dayton/Xenia Hamvention (Xenia, OH – May 17 – 19, 2019)
- Seaside Seapac (Seaside, OR) – June 1 – 2, 2019
- Texas HamComm (Dallas, TX) – June 7 – 8th 2019
- Ham Radio Outlet Ham Jam (Anaheim / San Diego / Portland)
- HRO Superfest (September 2019)
- PacificCon (San Ramon, CA) – October 18 – 20, 2019)
- Orlando Hamcation (February 2019)

Gordon WEST   WB6NOA
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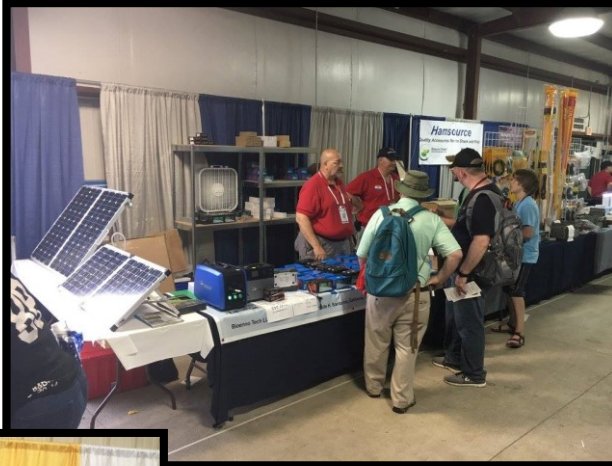
Reviews

CQ Magazine Article

Ultra-Lightweight, Long Runtime, Batteries

While Lithium Iron Phosphate (LiFePO4) battery technology for motor starting applications has been around for a few years, a Southern California company called Bioenno Power now uses it to manufacture portable light-weight battery packs specifically for amateur radio applications (Photo A).

Kevin Zanjani, KI6DHQ, with Bioenno Power, has been making the ham radio club rounds, as well as conventions, demonstrating the advantages of Lithium Iron Phosphate battery systems, specifically for ham radio ham portable and/or emergency portable or emergency backup battery operations.

"Our Lithium Iron Phosphate batteries are inherently safer than Lithium Ion. Lithium Iron Phosphate batteries will not explode, will not give off gas, and offer 2,000 charge cycles versus 300 charge cycles for the sealed lead acid batteries," states Zanjani.

The Bioenno Power deep cycle LiFePO4 batteries are rated at true capacity, allowing the user to extract more than 90% of the actual rating listed on battery.

Other manufacturers may rate their battery capacity as "lead-acid equivalent," intended solely for short bursts of current to start a motorcycle engine. The deep cycle Bioenno Power batteries provide a much larger number of cells to achieve the capacity required to power ham radio equipment and other electronics.

We tested this extraordinary lightweight battery, rated at 12 volts at 15 amp hours. It easily ran a 100-watt HF transceiver for many hours. For the Elecraft KX3, either a 6 amp-hour or 9 amp-hour Bioenno Power battery will work very well.

"I did some testing using my 100-watt Elecraft and the 12 volt/12 amp-hour battery, and did a fair amount of transmitting for over four hours," comments Tracy Lenocker, WA6ERA.

"The voltage held up fine on transmit. I also tested the deep-cycle Bioenno batteries with an MFJ voltage conditioner but the conditioner was not needed. I plan to purchase some of Bioenno's super-ultra capacitors to build something like the MFJ unit. Ultra-lightweight, these batteries weigh only a quarter as much as the lead-acid type of battery. Best of all, this new technology is perfect for hiking and operating portable in the national parks and everywhere else," comments Tracy.

*CQ Contributing Editor,
2414 College Dr., Costa Mesa, CA 92626
e-mail: <wb6noa@cq-amaeur-radio.com>

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Reviews

- QST Magazine Article (September 2017)

Considering Which One to Get

Bioenno offers a wide selection of BLF-series LiFePO$_4$ batteries ranging in capacity from 3 Ah (amp-hours) to a whopping 300 Ah. When considering which battery to get, take a look at how much current your radio requires on transmit and receive, what mode(s) you will use, whether you will be operating casually (listening) or transmitting a lot, and how long you want to operate before recharging the battery. Keep in mind that high duty-cycle modes, such as FM or digital, will use battery capacity more quickly than SSB or CW. Online calculators, such as the one at **www.4sqrp.com/Battery_Capacity/index.php**, can help with planning.

Another point to consider is the maximum current the battery will need to supply. Some of the Bioenno batteries are rated for maximum continuous discharge current of 60 A or more, while others are rated for 10 A or less. A typical 100 W HF transceiver requires around 20 A for full transmit power.

For this review, we ordered two batteries. The BLF-1220A (see Figure 9) is a 12 V, 20 Ah battery rated for 40 A continuous discharge. It measures 6.5 × 4.3 × 3.3 inches and weighs 5.4 pounds. For comparison, a Duracell Ultra 20 Ah SLA deep-cycle battery measures 7 × 6.5 × 3 inches and weighs 13.3 pounds. Like all of the BLF series batteries, the BLF-1220A has red and black wires with Anderson Powerpole connectors for the load (in this case, the radio) and a coaxial power jack for charging.

The second battery is the BLF-1209A, a 12 V, 9 Ah unit rated for maximum continuous discharge current of 12 A. This one measures 4.3 × 3.2 × 3 inches and weigh 2.6 pounds. Again, it's smaller and less than half the weight of a comparable SLA battery.

We also ordered the companion 14.6 V, 4 A charger, which can be used with either Bioenno battery. There's no metering, just an LED that indicates red for constant current charging and green for constant voltage charging. The manual cautions that the green light doesn't necessarily mean that the battery is charged, and recommends always charging for at least 5 hours to ensure a full charge.

In the Field

I used the BLF-1220A on a number of NPOTA activations with my Kenwood TS-590S 100 W HF transceiver. To make life easier, I bought several Powerwerx adapters. One goes from the four-pin power connector on my radio to Powerpoles, and another adds automotive-style fuses. I also added a Powerwerx inline meter that measures voltage and current and keeps track of amp hours used and other parameters. These are shown with the BLF-1209A in Figure 10.

I found that my transceiver draws 17.7 A on transmit (100 W output) and about 1.25 A on receive. During a typical NPOTA activation, I operated the radio between 80 and 100 W RF output, about 70% SSB and 30% CW, and usually running stations at a good pace until the pileup stalled and then changing bands or modes. Generally, my activations lasted a couple of hours, and I had plenty of battery power available. One time, I did run out of battery after about 3 1/2 hours and 332 contacts. Of course, it would last longer if I operated more SSB, operated at a slower pace (less transmitting), or turned the output power down a bit.

I was curious to see how the battery would do under really difficult conditions, so I used it at home to power my radio at 100 W during a CW contest. I called CQ and ran stations continuously while keeping an eye on the power monitor (that's a lot of transmit-

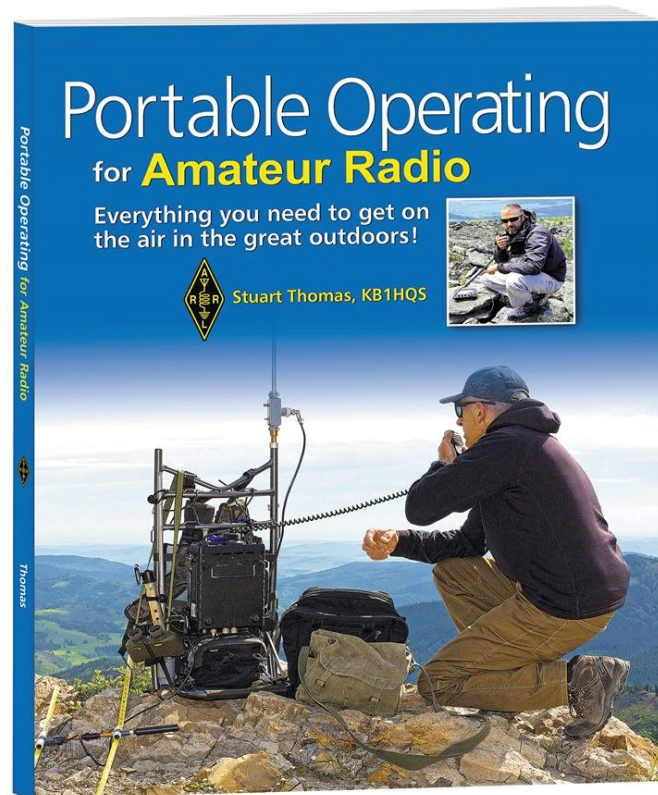**Figure 9** — The Bioenno BLF-1220A battery and 14.6 V, 4 A charger.

Figure 10 — The Bioenno BLF-1209A with Powerwerx inline meter and Powerpole adapters. Using these adapter cables, it's a breeze to switch among different radios and batteries.

Bioenno Power®

Reviews

- ARRL Portable Operating for Amateur Radio – Everything you need to get on the air in the great outdoors!

Variety of Power Solutions....

▶ Bioenno Power provides a variety of advanced power solutions:

- ◦ Audio/Visual/Film
- ◦ E-Bikes / E-Scooters
- ◦ Electric Golf Caddy
- ◦ Energy Storage
- ◦ Gardening Tools
- ◦ Green Energy (Solar and Wind)
- ◦ Marine
- ◦ Photography
- ◦ Radio Communications (including Amateur Radio)
- ◦ Replacement for SLA (sealed lead acid) batteries
- ◦ Robotics
- ◦ RVs / Campers
- ◦ UPS (uninterruptible power supply)
- ◦ Wheelchairs

Bioenno Power®

New Products for 2020....

DOOR PRIZE!

(BLF–1212A+CHARGER)
(Will ship to lucky winner)

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Thank You!

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