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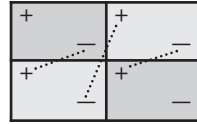


SmartSpark[®]
BatteQ[™]

Questions and Answers I.

Explain again what BatteQ does...

Imagine four (6 volt nominal) batteries in series, like this:



You may have 28.0 volts from one end to the other, but that doesn't guarantee 7.0 volts on each segment. Without intervention, a battery string like this is almost never in balance. An unbalanced pack is like an unmatched team of horses: some are stronger than others, but they can't pull well together. The 6V-4 **BatteQ** draws energy from the stronger segments and adds this energy to the weaker ones. The result is better battery health & performance.

Why is Batt EQ so much cheaper than other "big battery" balancers?

Other balancers for big batteries use a microprocessor to decide which segments of the battery are too high and which are too low; then they use complicated circuits to move the energy. The **SmartSpark** approach is simpler and less costly to build, yet it still balances the voltage accurately.

BatteQ is covered by patents in the US and in other countries. Additional patents are pending. **SmartSpark Energy Systems, Inc.** is determined to protect its technology against all and all encroachments.

How energy efficient is the device?

Consider four (6 volt nominal) batteries in series as drawn above. Suppose two of the units are already perfectly balanced, one is too high, and one is too low. If **BatteQ** must remove 100 watt-hours from the highest unit, it will deliver about 99 of those watt-hours to the lowest one. The "throughput efficiency" is therefore around 99%. Because the efficiency is so high, the **BatteQ** circuit runs cool and has a long life.

Model LA-500-6V-4 also consumes about 28 watt-hours of energy from the battery string every 24 hours. (This energy drain could be offset with a small 10 watt solar module.) If the battery stands idle for one week, **BatteQ** will enter a "sleep mode" with ultra low power consumption (because balancing is not required on an inoperative battery). Once battery charging resumes, **BatteQ** will automatically go back to work. A small LED blinks slowly when **BatteQ** is awake, and it stops blinking when **BatteQ** is asleep.

The power draw of **BatteQ** is less than the energy (that otherwise should be) spent on EQ charging. **BatteQ** is more than just a replacement for the EQ charge, however, because it also balances the battery *during discharge*. The weakest segments receive voltage support so low voltage trigger points (for the string) are not reached until the strong segments are as wrung out as the weak ones. Testing on older batteries indicates measurably higher energy delivery when **BatteQ** is deployed. That's the best kind of efficiency: the cost efficiency of longer battery lifetime!

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Questions and Answers II.

How do I know the product is reliable? How do I know it's working?

The production models represent the fourth generation design from **SmartSpark**. They are current limited at a level well below the failure point of the components, and your purchase is backed by a 2-year limited warranty.

To confirm proper **BatteQ** operation, first make sure your “end-to-end” battery voltage is stable, then read the voltage of each rubber case with a digital voltmeter. With **BatteQ** on the job, the voltages should all match. A fast blinking LED indicates severe imbalance; **BatteQ** will stay asleep until you achieve rough balance by other means.

Does BatteQ integrate with other system components?

BatteQ simply bolts to your battery to keep it in balance; it doesn't need to “talk” with other parts of the system.

What's the battery size limit? Can I move it from one string to another?

Don't “rotate” a single **BatteQ** from one string to the next—it's easier to just “cross-tie” (or massively parallel) the battery bank. The size limit depends on several factors. Since **BatteQ** is internally protected from overload, it's OK to install just one balancer even on big battery banks. Jumbo battery systems, however, may indicate a need for two or more **BatteQ** units.

To decide if you need another device, voltage readings as described above are helpful. Even better: measure the amperage on every **BatteQ** cable during extreme charge/discharge conditions. For model #LA-500-6v-4, a reading of 15 amps on the outside channels (or 30 amps on the inside channels) would indicate that the device is near its self protection limit and should be given a helper. “LA-250 type” balancers “self protect” at a level 50% lower.

Can I add or remove energy on just one segment of my battery string?

This is not recommended, even with **BatteQ**. To run low voltage loads from a high voltage battery, a DC converter in series with the load is the most reliable way to avoid throwing your battery out of balance.

Why are the cables so heavy?

#LA-500-6v-4 can transfer 16 amps continuously from one channel to its neighbor, if that's what it takes to keep the battery in balance. Inside channels could receive 16 amps from two directions, for a total of 32 amps. Good performance therefore calls for #6 stranded copper cable, tinned lugs, and quality terminations. Smaller **BatteQ** devices can use smaller cables, of course, but the need for relatively low cable resistance still applies.

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Questions and Answers III.

Are other BatteQ models available?

#LA-500-6V-6 (for 6 volt batteries in multiples of six) should be available by 2007. Pre-order now.
6V-8 units (for 6 volt batteries in multiples of eight) are unlikely in 2007. See below diagram for a workaround.

#LA-250-6V-4 (50% less powerful than #LA-500-6v-4) is available now. List is \$249. (Dealers: 14 per carton)
#LA-250-6V-6 should be available by 2007, and will be great for 36 volt golf carts. Pre-order now.

#LA-50-12V-2 (24 volt string of smaller 12 volt batteries) is available now on special order. Quoted upon request.
#LA-50-12V-4 (48 volt string of smaller 12 volt batteries) is available soon on special order. Quoted upon request.

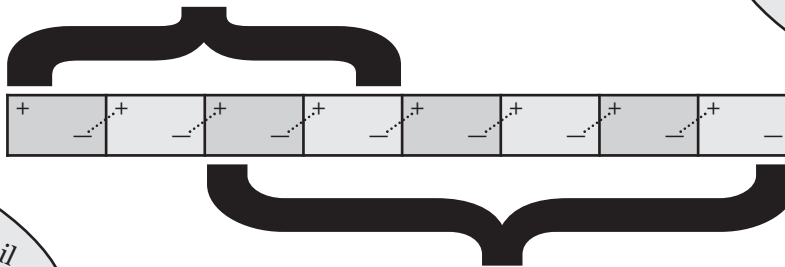
#LA-250-12V-4 (48 volt string of 8D batteries) should be available by 2007. Pre-order now.

If you need to balance bigger batteries (or Ni-Cads, Lithiums, etc.), send email or call for more information.

What if there's not a BatteQ unit to match my higher voltage battery string?

We still have options. Here's one way to balance a 48 volt string of L-16's without a 48 volt device:

Devote one #LA-500-6v-4 to
this 24 volt segment of the string...



...and devote one #LA-500-6V-6 to
this 36 volt segment of the string...

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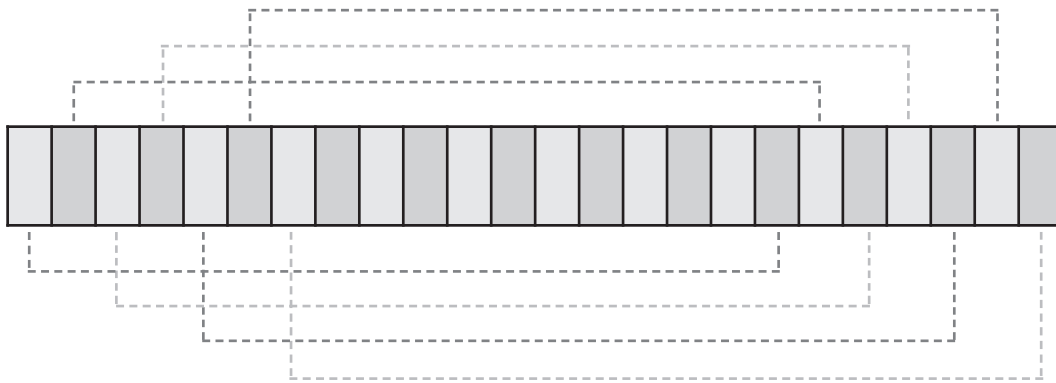


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Questions and Answers IV.

Isn't there any way for BatteQ to balance individual cell levels?

You really *can* approach “battery nirvana” with **BatteQ**, but it takes motivation and money. The rectangles below represent individual 2 volt lead-acid cells—24 of them, for a 48 volt string. A perfectly balanced string of 2 volt cells in AGM technology: that's the ultimate lead acid battery.



Each dotted line bracket represents the “end cables” for a model LA-500-6V-6 **BatteQ** device. Seven units (or 14, 21, etc.) are needed for a setup like this, but the balancers are still often cheaper than the cells. With 49 balancing cables in all, every cell will receive at least one EQ cable. Eighteen of the cells will be balanced in two directions; six of them will be balanced in one direction. Maximum voltage balance means maximum performance.

For 3.6 volt lithium cells instead of 2 volt lead acid cells, individual cell balancing makes even more sense.

The above exercise will lead most of us to stick with the venerable L-16 battery architecture.

The three cells within a single L-16 case tend to be more consistent compared with cells inside another case. That's because all the cells within one case were built at the same time, using the same batches of material. The cells within a single case also were subjected to identical “forming charge/discharge” routines at the time of manufacture. Disregarding the “cell-to-cell” variations within a single battery case is a compromise that most people can accept, since **BatteQ** so effectively addresses “case-to-case” imbalance problems.

BatteQ deployment on a string of eight L-16's reduces 24 (possibly great) cell variations down to a few smaller variations. The L-16/**BatteQ** combination isn't the ultimate battery shown above, but it's a big improvement over any unbalanced pack. What's more, this combo can be built at moderate cost using familiar battery building blocks.

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