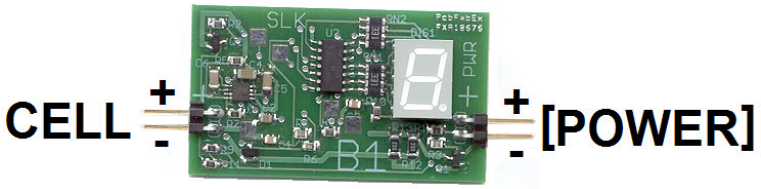
B1 Instructions
(cell tester/balancer)



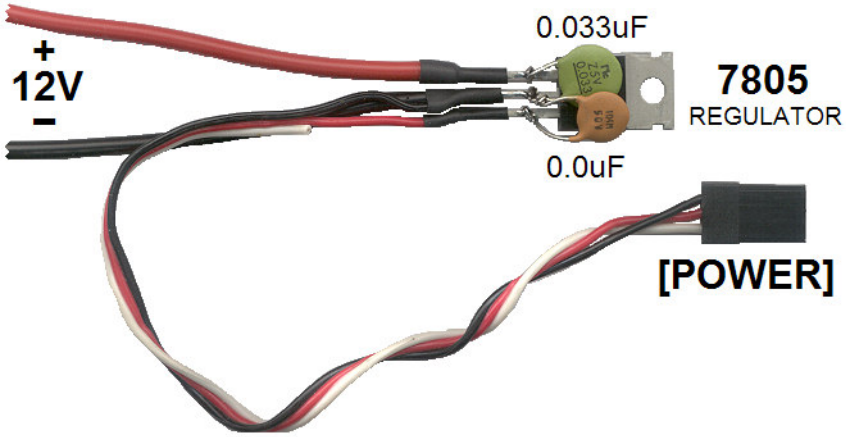
Overview
The ***B1*** was conceived as an economical cell balancer for M1 cells (A123 Systems, DeWalt 36V). Our field experience has shown that these cells stay in balance pretty well. It is normally only necessary to check them periodically. The problem is that the cell voltage differences are very small during charge until almost full. If M1 cells are checked at end of charge, they can frequently appear to be unbalanced when they are not. Conversely, if checked when not fully charged, they can appear to be balanced when they are not. ***B1*** allows you to measure each cell voltage (one at a time), and to either charge or discharge each cell.

B1 Uses
B1 can be used as a voltmeter to check your M1 or LiPo cells. ***B1*** gets its power from the cell and does not need to be connected to anything else. You can quickly check your pack capacity at the field without a cumbersome voltmeter and adapters. You can also use ***B1*** to check your [4-cell] receiver packs. ***B1*** measures voltages from 2.800V to 5.800V with 5-millivolt resolution. ***B1*** allows balancing of LiPo packs as well as M1 packs.

Connectors
Your ***B1*** comes with a 0.1-inch pin-spacing cell connector. That's the one on the left side of the picture above. The [power] connector connects to the other end, as indicated. This connection is only used when charging a cell. Please get the polarity correct and the right connector on the right end. You probably won't hurt the ***B1*** if you get ends or polarity swapped, but it won't work. **You might cause damage if you plug the cell end into a source of greater than six volts, e.g. two cells in series or a five-cell receiver pack.**

[POWER]
B1 is powered by the cell under test. You don't need [POWER] to measure voltages or discharge cells. You can balance without a charger if all cells are above 3.45V (4.05V for LiPo). You can also balance without a charger by discharging the high cells to 3.45 volts, charging again briefly, and repeating.

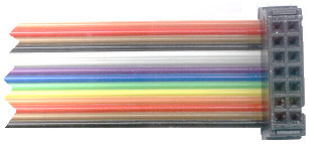
Power Sources
A receiver pack is the simplest power source but has limited capacity. The receiver pack connector plugs directly into ***B1***. Other 5V sources can be substituted. If you have an old ESC with BEC, you can plug it in to a large pack and plug the throttle cable into ***B1***. You could also add clip leads and connect the pack leads to your 12V charger battery or power supply instead of using a flight pack. Similarly, you can hook up an *Ultimate BEC* to a 12V supply. The photo below shows a simple power source to run from your 12V supply - less than $5 using Radio Shack parts. It is simply a 5-volt regulator, a couple of capacitors, a servo cable, and wires to connect to the supply. Cover the regulator with shrink wrap or tape.



Connecting Everything

Tap connectors are anything but standardized. Compatibility is almost non-existent. Not only is the wiring different, but there are numerous connectors. We used to worry about being universal but have gotten over it. B1 comes with a 2-pin 0.1" "plug". Connecting to some taps requires a 2-mm.-spacing "plug". We chose to use the more robust 0.1" configuration to also allow use as an ESV for 4-cell receiver packs. We can provide a 2-mm. adapter. Hopefully you've already standardized on one spacing or the other. The next hurdle is the wiring. If you use Thunderpower and have the 2-mm. adapter, you're good to go. If you have 2S or 3S FMA packs, you will notice that the most positive pin is not adjacent to the others. That's a problem. In order to use ***B1*** with these connectors, you need to move the wayward wire next to the others. This can be done by carefully lifting the little tab with the tip of a #11 knife blade and slipping out the pin. Just slip it into the right hole until it "clicks" and can't be pulled out. PowerQuest has a similar arrangement except with the most negative wire. These pins can be moved by pressing your blade on the metal tab next to the base of the housing slot and slipping the pin out.

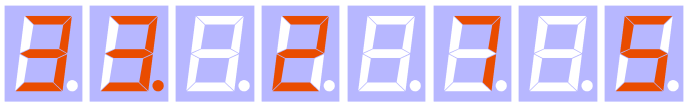
We use a 14-pin "header" with multi-colored ribbon cable for our large pack construction (good for up to 12S). Negative goes on pin 1, followed by cells 1-6. The positive of cell 6 also goes on the first wire of the next row, followed by cells 7-12. This allows up to 12S packs to be easily checked with ***B1***.



1-	1+	2+	3+	4+	5+	6+
6+	7+	8+	9+	10+	11+	12+

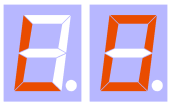
Reading the Display

The single-digit display might taking some getting used to, but it does the job. When you plug ***B1*** into a cell, the voltage is displayed twice. The example below shows what 3.275 volts looks like:

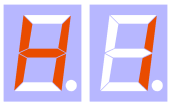


THREE POINT TWO SEVEN FIVE time →

If the voltage is below 2.80 volts, the display will indicate

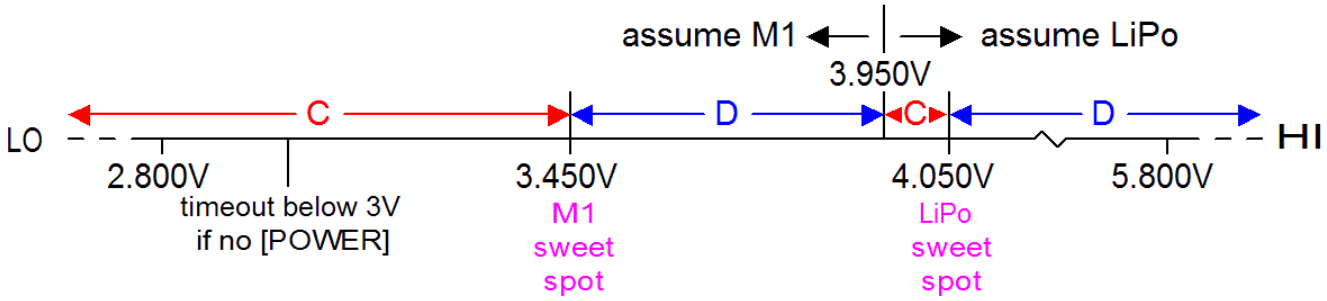


If the voltage is above 5.80 volts, the display will indicate



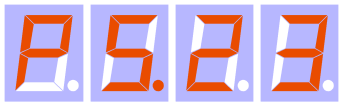
Using the *B1*

When you plug B1 into a cell tap, The voltage is read twice. The two readings could differ slightly since the B1 is placing a small load on the cell. B1 then decides if the cell needs to be charged or discharged. This will be discussed in more detail in the balancing section. You do not need to plug a pack into the ***B1*** to measure cell voltages or discharge cells. Using a pack can often be avoided as previously discussed. If the cell needs charging, the display will show ***C*** followed by a blinking decimal point. Every 15 seconds the cell voltage will be displayed. If ***B1*** is not connected to [POWER] within about five minutes. ***B1*** shuts off. If the cell voltage is very low and remains below 3.0 volts for a minute of charging, ***B1*** will shut off to reduce drain on the cell. If the cell needs discharging, the display will show ***8*** with a blinking decimal point. The cell voltage will be displayed every 15 seconds. The chart below shows charge and discharge ranges.



As the "sweet spot" (3.45V for M1, 4.05V for LiPo) is approached from either direction, the following displays are used:

At this time, voltage readings will no longer be displayed. Voltage is 3.44-3.46V or 4.04-4.06V, depending on your starting point. It will take some time to hit the "sweet spot" and the display will jump back and forth for awhile. Once ***B1*** has been in the sweet spot for several seconds, it shuts itself off. B1 also shuts itself off in a few minutes if charging is indicated and no power source is connected. When [POWER] is first connected, ***B1*** will indicate its voltage,



Although ***B1*** does not draw much power when it shuts off, it does draw a little and it's a good idea not to leave it connected for several hours or days.

Balancing

You do not need to balance your packs often. ***B1*** is a convenient tool for quickly checking them for balance and for remaining capacity. When balancing is desired, understand that the process takes time. Best to be doing something else while keeping an occasional eye on the display. It is easier to discharge cells than to charge, since it does not require a power source.

The trick for balancing M1 cells is to first charge the pack using the ***Dapter*** or other M1-compatible charger. Then each cell is either charged or discharged to 3.45 volts. At this voltage, there is much more voltage change for a small current change than during most of the charge. Matching the cells to +/- 10 millivolts at this voltage results in much better balance. ***B1*** is powered by the cell under test, but the energy for charging comes from a 5-volt source, as discussed previously. If none of the cells are above the sweet spot to start with, you can avoid ***B1*** charging charge the pack again at 1C or less. Always allow 5-10 minutes for voltages to settle. Now discharge the cells that are high and charge again. If none of the cells are above the sweet spot, charge the pack again at 1C or less. Always allow 5-10 minutes for voltages to settle. Now discharge the cells that are high and charge again.

If you have some cells that are way out of balance, or if you don't like the multiple charge strategy, it is recommended that you use one of the alternate power sources described above rather than a receiver pack.

Balancing cells is a good place to use common sense. For example, suppose you have a 6-cell pack with 5 cells measuring 3.35V and 1 cell measuring 3.70V. Take the high cell to 3.45V and don't worry about bringing the others up. If your Dapter is usually leaving all the cells below 3.45V, try finishing the charge at a lower current. ***B1*** uses relatively small currents. Charging is around 100-200 milliamps, and discharge is about 100 milliamps. ***B1*** uses the display for discharge. Clearly, it will take some time to get cells to the sweet spot. For example, a 2100 mah LiPo pack will take over an hour to raise a cell voltage 100 millivolts. Don't use B1 to charge an empty cell unless you have plenty of time.

When balancing packs, there is no need to be obsessive. Having all the cells in your M1 pack within 50 millivolts is fine. With LiPo, 20 millivolts is not worth losing sleep over.

Other Uses

You can use ***B1*** to check your 4-cell receiver pack.

B1 can be used to find a weak cell by re-checking the cells with the motor running. A weak cell will generally have a significantly lower voltage than the others.

Warranty

- If your ***B1*** does not work properly or you're otherwise not satisfied during the first 30 days, return it undamaged and we will refund your money.
- If your ***B1*** fails during the first year (not due to obvious abuse) we will repair or replace it at our option at no cost.
- After the first year, repair or replacement will be at a flat fee of $15.00 including return shipping.
- We cannot be responsible for damaged packs.

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