Web Site: www.parallax.com
Forums: forums.parallax.com
Sales: sales@parallax.com
Technical: support@parallax.com

Office: (916) 624-8333
Fax: (916) 624-8003
Sales: (888) 512-1024
Tech Support: (888) 997-8267

Li-ion Power Pack / Charger – 2 Cell (#28986)

The Li-Ion Power Pack-Charger – 2 Cell is an integrated storage cell and charging system on a single 3" x 4" printed circuit board. Compatible with most 18650-size Li-ion cells, the total power output capability of the system is approximately 14–20 watt/hours, depending on the capacity of cells you choose. Although this Power-Pack/Charger is compatible with both protected and unprotected Li-ion 18650 cells, Parallax highly recommends using the protected types, such as Parallax part #28987.

Features

- PCB-mounted cell holders with on-board charging circuitry
- Multiple power input/output options
- On-board output fuse protection
- Nominal 7.4 VDC output; 8.2 VDC maximum
- Standard 3" x 4" PCB footprint integrates well with the Board of Education® (#28150), Propeller™ Proto Board (#32212), or any application needing a reliable power supply with an integrated charging system
- Automatic charge/discharge switching circuitry
- Holds two rechargeable 3.7 volt Li-ion 18650-size cells
- Multiple LED indicators provide charge readiness information for each individual cell; a status key for the LED indicators is printed on the board.
- Aggressive holders retain cells in any board orientation and in moderate shock environments, such as mobile robotic applications. Cells are not permanent, and can be replaced.
- Dedicated circuitry continuously monitors the charging process to ensure safety, efficiency, and to maximize the number of charge/discharge cycles of each cell.

Key Specifications

- Charging Power Requirements: +5–12 VDC @ 1amp (min.); 2.1 mm barrel jack, center positive supply (#750-00009 works well)
- Power Output: Unregulated nominal 7.4 VDC @ 1800—2600 mAh (depending on cells used)
- Dimensions: 3.0 x 4.0 x 1.0 in; 7.6 x 10.2 x 2.54 cm
- Charging Time: 1 – 6 hrs or more, depending upon the discharge level and capacity of the cells

Application Ideas

- Portable power for data-logging applications
- Mobile robots
- Standby power / automatic power-switching
- Automatic charging circuits
- Stackable auxiliary power solutions
- Boe-Bot® / Board of Education / Propeller Proto Board Auxiliary Power Supplies
- Stingray™ Robot (#28980) battery pack upgrade

Packing List

- (1) Li-ion Power-Pack / Charger – 2 Cell PCB, 3” x 4”
- (1) Li-ion Battery Cable (#802-00020)
- (2) 2-amp fuses; 1 pre-installed, 1 spare (#452-00065)
- (4) Black dome rubber feet (#700-00087)
- (4) Clear square rubber feet (#700-00037)

Additional Items Required

- (2) Li-ion 18650-size cells (#28987 or equivalent)
- +5 to +12 VDC power supply, center positive, 2.1 mm barrel jack (#750-00009 or equiv.)
- Safety glasses
- Multi-meter (VOM)

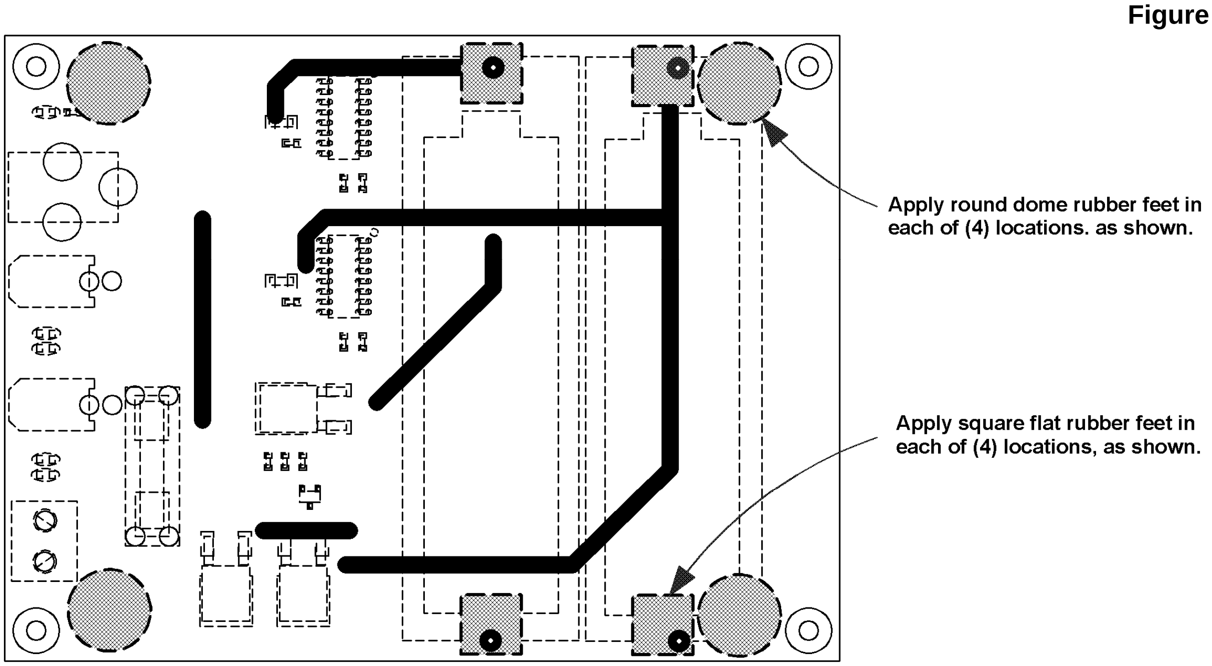
Assembly Instructions

CAUTION: Before inserting the cells into the holder, two sets of rubber feet must be applied to the correct places on the bottom of the PCB, following the steps below. Aside from applying the rubber feet and installing the cells into the holders, the PCB itself comes fully assembled and tested.

Lithium cells come pre-charged (to some extent), so treat them carefully—they already contain a significant amount of energy. Handle with care and do not short the terminals!

Step 1: Turn the PCB over so that it’s oriented as shown in Figure 1 below.

Figure 1



(Li-ion Power-Pack / Charger PCB) - Bottom View

Step 2: Place a clear flat rubber foot over each of the (4) soldered cell terminals as shown in Figure 1. These feet protect the cell holder terminals from being accidentally shorted. Remember: Li-ion cells have a lot of stored energy and rapid discharge can result in an unsafe condition. Even though the output of the board is fuse protected, direct shorting of these solder points is not within the fused portion of the circuit.

Step 3: Place a black domed rubber foot in each of the four locations designated by the dashed circles on the silk screen. These provide stability for the board if you set it on a flat surface. If you will be mounting this device on standoffs where the board traces cannot be shorted, then you can skip this step.

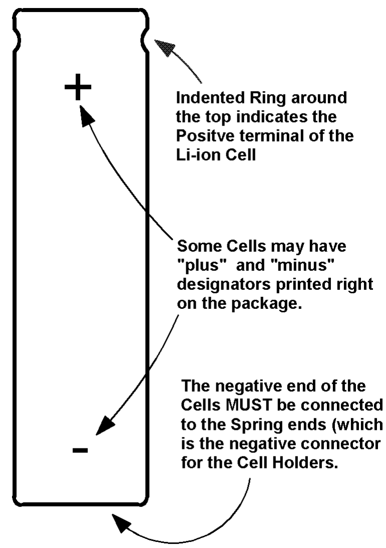
Step 4: Carefully remove the cells from their packaging. Note the positive cell polarity. Various brands of cells are marked differently. The positive terminal may be indicated by a ringed indentation near one end of the cell, or the packaging may be printed with "+" and/or "-" designators (as shown in Figure 2).

Step 5: Using a multi-meter (VOM), measure the voltage of each cell. Write down the sum total of the two voltages. If either cell measures less than 3 volts, it may be defective.

Step 6: Turn the board right-side up as shown in Figure 3.

Step 7: Carefully place the bottom (negative) end of a cell against the spring in Cell Holder "A", and then gently slide it down and in at a slight angle into the holder until it snaps into place. Repeat for Cell Holder "B."

Figure 2



Individual Li-ion #18650 Cell

Note: Cells without internal PCB's will snap into the holders easily.

Higher quality cells (those that have internal PCB protection such as Parallax #28987), are slightly longer. They will fit into the holder, but they are a very tight fit. The holder's ends will flex a bit as you insert the cell. Sight along the sides of the cells to make sure that they are completely seated into the cell holders.

CAUTION: Removing the cells once they have been inserted into the holders is NOT recommended. The holders are tight by design, and so the cells do not come out easily. Be aware that the body of a Li-ion cell is usually covered by a thin plastic wrapper that can be easily pierced. Furthermore, the negative terminal of a Li-Ion cell actually encompasses the entire body of the cell, to right up near the top of the Positive terminal of the cell itself. Attempting to pry a cell out of a holder with a sharp-edged screwdriver blade could pierce the cell's wrapper and short out the cell, damaging it.

However, if you ever do need to remove the cell, (i.e. when the cells wear out), a dull-edged, non-conducting prying tool, such as a chip-puller, is recommended. If such a tool isn't available, you can use a small, flat-bladed screwdriver covered in heat-shrink tubing or electrical tape. A small pair of needle-nose pliers (also covered in insulated material) works well too.

Initial Testing

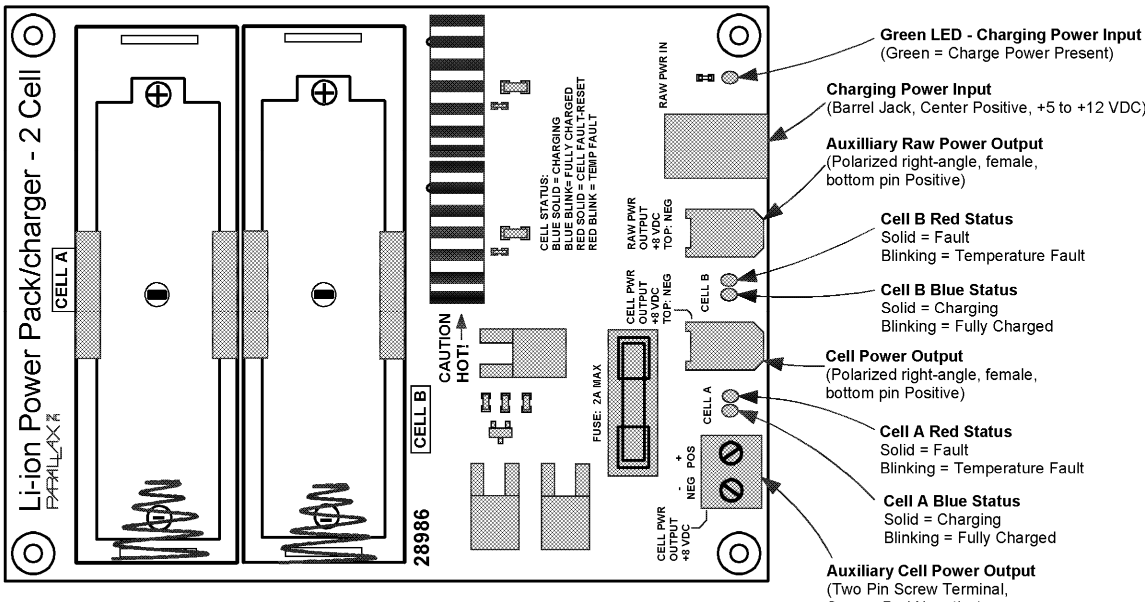
Step 8: Measure the voltage by placing your VOM's probes on the top two screw terminals on the green Cell Power Output terminal block. You should measure the same voltage as the sum of the two cells you measured in Step 5 (above).

Step 9: Plug the Battery Cable into the Cell Power Output jack (See Figure 3). Now measure the output voltage by inserting the positive VOM probe into the inside of the barrel plug on the end of the adapter cable, and touching the negative VOM probe to the outside ring of the barrel plug. Again, you should measure very close to the same voltage as the sum of the two cells you measured in Step 5 (above).

Step 10: Connect a "center positive" 2.1mm wall transformer (such as Parallax #750-00009) to the Charging Power Input jack as noted in Figure 3. The power supply should have a voltage output between +5 VDC and +12 VDC. The amount of current necessary to charge the cells is controlled automatically by the circuitry; however your wall transformer should be rated at 1 amp or more to minimize charging time. If the charging current supply is too low, the charging circuits may not operate. In addition, a lower current will not harm the cells; they'll just take longer to charge.

Step 11: Upon application of charging power, the green LED (next to the barrel jack) will turn on. After a few moments, the blue status indicator LEDs should come on. Solid blue means that the cells are being charged.

Figure 3



(Li-ion Power/Pack - Chager 2-cell PCB - TOP View)

Circuit Description and Operation

CAUTION: Due to the nature of the charging circuitry and the size and very high capacity of the cells, the heat-sinks near the cell holders may get hot! The amount of heat generated depends on the length of charging time, the amount of charge on each of the cells, and the voltage input of the charging power source. For example, a 12 VDC transformer and/or completely drained cells will generate more heat than a 7.5 VDC charge input or near-fully charged cells.

With cells installed in their respective holders, and with no external connections to the input/output jacks, the circuitry is inactive and there is no current flow (other than some very, very small leakage current through the inactive charging circuits).

Upon application of +5 to +12 VDC to the Charging Power Input jack (J1), the following happens:

a) The Charging Power Input (Green LED) is activated.
b) The Auxiliary Raw Power Output has power that is directly from the charging source (wall transformer, solar panel, car battery, etc.). This power can be used to operate another circuit or application using the (included) Battery Cable.
c) Each cell is electrically disconnected and isolated from the other.
d) The Cell Power Output jacks are disconnected from the cells, and disabled.
e) The dual charging circuits begin a qualification mode to determine each cell's characteristics.
f) After checking the cells, LED status indicators are activated. If required, each cell begins charging their respective cells.

When Charging Power is removed, it results in the following:

a) The Auxiliary Raw Power Output jack is disabled.
b) Cell charging circuits are disabled and Status indicator LEDs are disabled.
c) The cells are electrically connected into a series configuration.
d) Cell Power Output jacks connect to the cells, resulting in a 7.4 to 8.2 VDC output.

Jack/Plug/Indicators Functional Descriptions

Green LED: Charge Power Indicator—whenever charging power is applied to the Charging Power Input barrel jack, the board is receiving power.

Charge Power Input: 2.1mm barrel jack, center positive. +5 to +12 VDC input. Do not reverse the input voltage as this may damage the charging circuitry. Charging time is dependent on the amperage available from the power supply you choose, as well as the capacity of the cells you choose.

Aux. Raw Power Output: Polarized, right angle, female, bottom pin positive. This connection can be used to power another device. For example, you can charge the Li-ion cells and operate another device from the same power supply. When you plug in wall-transformer (to charge the Li-ion cells), you can use the Molex/barrel jack cable to provide power to another device (such as a Board of Education, Propeller Proto Board, etc.) This is not power from the cells. This is the same power that is charging the cells, via your charging supply input on the Charge Power Input barrel jack.

Cell B Red Status: This LED indicates a fault condition in Cell B.

- Solid = There is/was a fault in the cell, or there was a glitch during the charging process. Remove and then re-apply power to the board, to see if the condition persists.
- Blinking = The temperature of the cell is outside the safe charging zone. The safe charging zone is typically set for between 32 and 113 °F (0 to 45 °C).
- Off = There is no fault condition detected with Cell B, or there is no cell in the holder.

Cell B Blue Status: This LED indicates the charging status of Cell B.

- Solid = The cell is charging.
- Blinking = The cell is fully charged.
- Off = The cell was already fully charged and no charging was needed, there is no cell in the holder, or the cell is not fully-seated into the holder.

Cell Power Output: Polarized, right angle, female, bottom pin positive.
This Power Output jack is the output from the cells.

When there is no Charge Power Input (i.e. When the wall charger is disconnected from the PCB), the two 3.7 volt cells are electrically connected together in a series configuration, and the resulting power (3.7 VDC x 2 cells = 7.4 VDC) is available at this jack.

Upon application of Charge Power, Cell Power Output is disconnected from the on-board cells, and this jack is disabled.

Cell A Red Status: This LED indicates a fault condition in Cell A.

- Solid = There is/was a fault in the cell, or there was a glitch during the charging process. Remove and then re-apply power to the board, to see if the condition persists.
- Blinking = The temperature of the cell is outside the safe charging zone. The safe charging zone is typically set for between 32 and 113 °F (0 to 45 °C).
- Off = There is no fault condition detected with Cell A, or there is no cell in the holder.

Cell A Blue Status: This LED indicates the charging status of Cell A.

- Solid = The cell is charging.
- Blinking = The cell is fully charged.
- Off = The cell was already fully charged and no charging was needed, there is no cell in the holder, or the cell is not fully-seated into the holder.

Auxiliary Cell Power Output: Two-pin Screw Terminal Block, Square Pad Negative. This connection simply provides an alternative way to connect your application to the Cell Power Output. (No need to use the polarized cable). Be careful to check the polarity of your circuit, as this is not a polarized connector.

Application Ideas and Sample Circuits

The following circuits represent some different combinations of charging and power delivery options. Figure 4 is an application that will simultaneously charge the cells, as well as provide Raw (wall-transformer) power to a separate application, such as a Board of Education, Propeller Proto Board, etc.

Figure 4

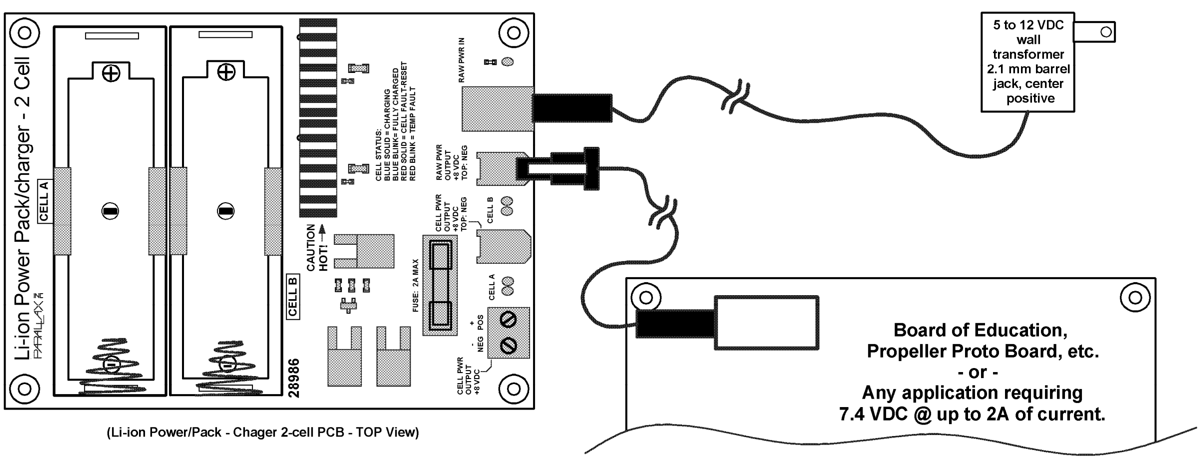


Figure 5 is delivering cell power to an application and the cells are not being charged. This would be a common circuit in the case of a mobile robotics application.

Figure 5

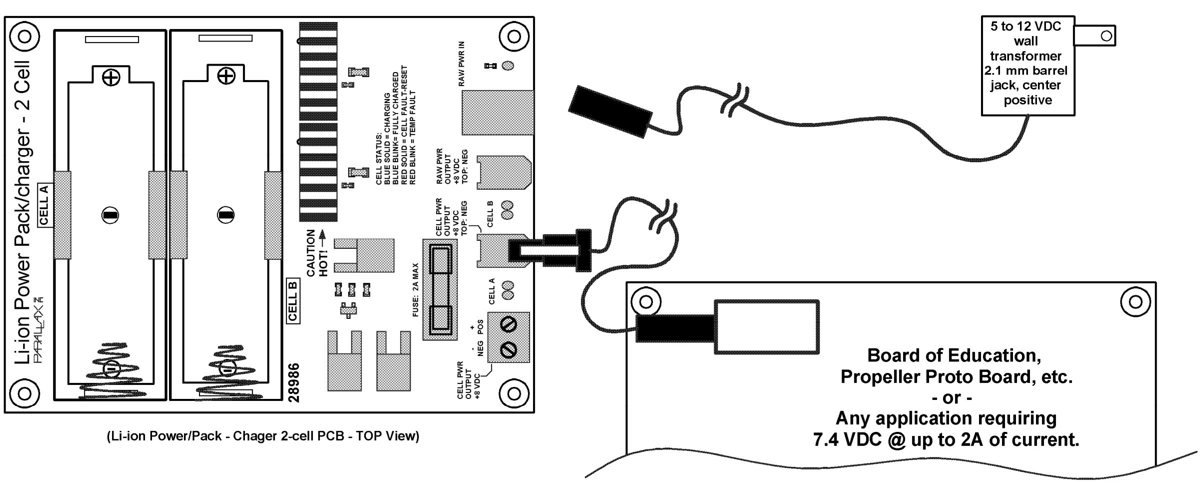
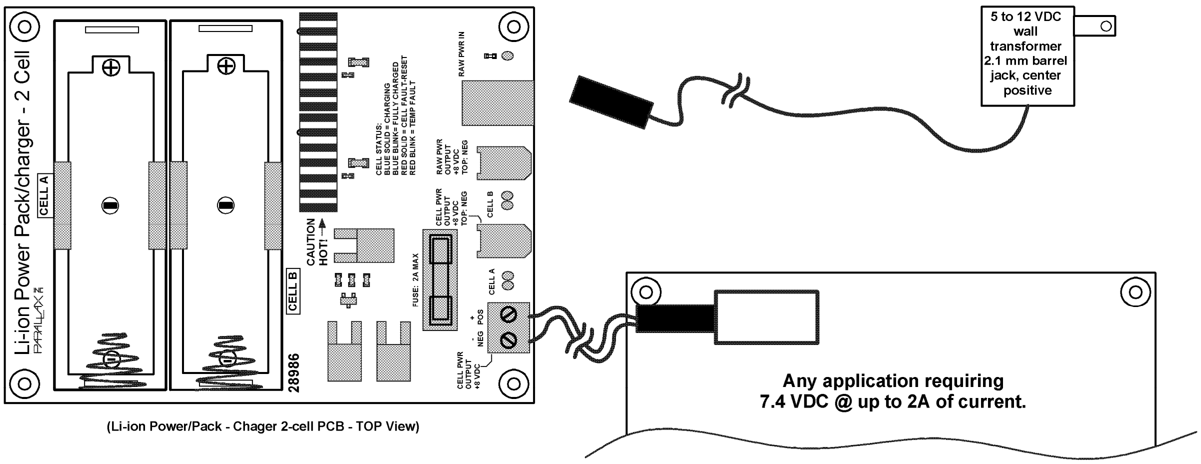


Figure 6 is also delivering cell power, but through the two screw terminals instead of the polarized connector. Cell power is simultaneously available on the polarized connector as well.

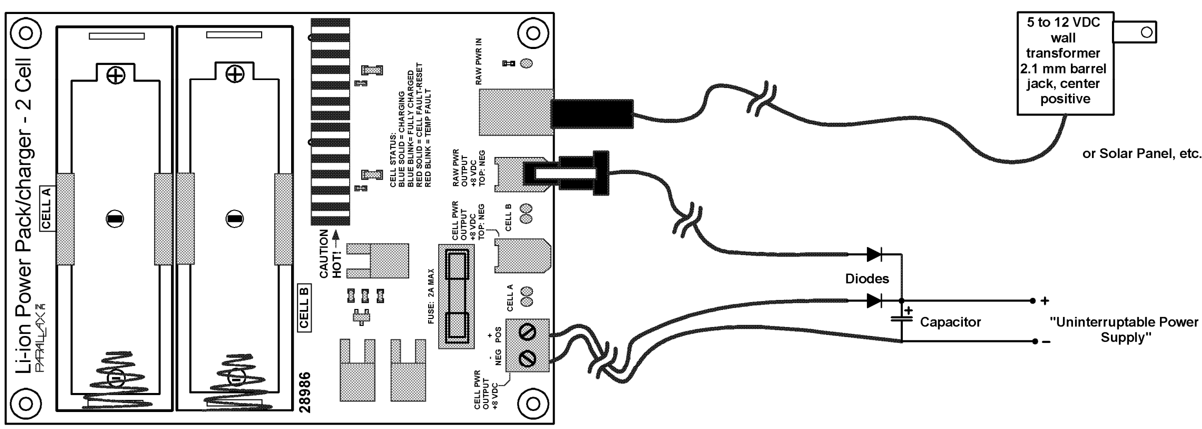
Figure 6



(Li-ion Power/Pack - Chager 2-cell PCB - TOP View)

The circuit in Figure 7 operates as an uninterruptable power supply. All that is needed is the addition of a couple of diodes and an appropriately sized capacitor. When charging power is available, the cells are taken out of the circuit and they are being charged. That same charging input power is available through the Raw Power Output jack to power an application.

Figure 7



(Li-ion Power/Pack - Chager 2-cell PCB - TOP View)

When the Charging Input Power is no longer available (for example, a solar panel at night), the Cell Power Output jack is activated. There will be a switch-over period, so be sure to use a capacitor large enough to span that time.

To minimize the diode's voltage drop, you could use a device like the STPS40L15CT which is designed especially for applications like this.