



Cellpro 4s Charger

Model LIPOCH4S03, for use with Cellpro and other LiPo battery packs with node connectors

Automatic and manual charging at up to 3A with cell balancing and overcharge protection

Features

- Simple to operate: just connect the Cellpro 4s charger between a power source and a Cellpro Pack. No jumpers, plugs or dials to set! Charger automatically determines pack capacity and sets optimal current, then dynamically adjusts charge rate as needed. Manual charge rates of 0.25A to 3A (in 0.25A increments) allow for special situations.
- Each cell is charged independently, providing exceptional charging safety and elevating RC packs to the safety level of cellphones.
- Charges LiPo packs having one to four cells and any capacity up to 24Ah. Typical packs of up to 3Ah capacity charge in 50 minutes or less using charger's 1.0C Auto Current Mode.
- Multifunction display shows operating mode, individual cell voltages, charge current, supply voltage, and amount of charge (mAh) put into pack. Plus, the unique Fuel display shows percent capacity remaining in a pack.
- Viewer software (a free download) displays real-time data and graphs.
- Latest technology provides the ultimate in safety. Even charges packs having hidden physical damage without danger of fire. A pack will not charge if individual cell voltages don't equal total pack voltage.
- Cell balancing to 10mV and automatic overcharge protection assure longest pack life. Automatic temperature monitoring prevents pack overcharging at low ambient temperatures and charger damage at high ambient temperatures.
- Low Voltage Restore feature automatically attempts to repair overdischarged packs. Cells discharged as low as 0.5V may be repaired to as much as 98% of capacity.
- Cold Weather Charge stops charging at 4.10V when temperature is below 55°F to prevent cell damage.
- Charges certain non-Cellpro LiPo packs equipped with node connector cables. Adapters are available from FMA Direct.
- Operates from any 10–16V DC power source. Inputs and outputs are protected against reverse polarity.

Precautions

- Follow all instructions in this manual to assure safe operation.
- Always watch LiPo packs while they are charging. Never leave LiPo packs unsupervised during charging.
- See additional warning sheets provided with this charger and FMA LiPo packs.
- Follow all guidelines for charging, discharging, handling and storing LiPo cells.

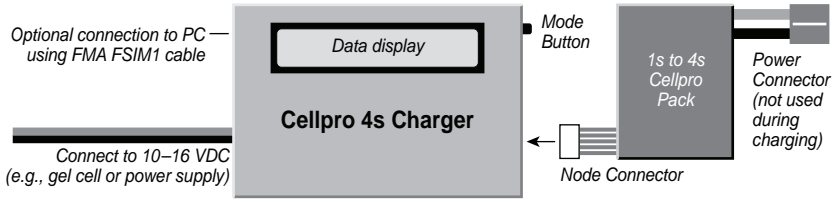
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Connecting the charger

Connecting Cellpro Packs

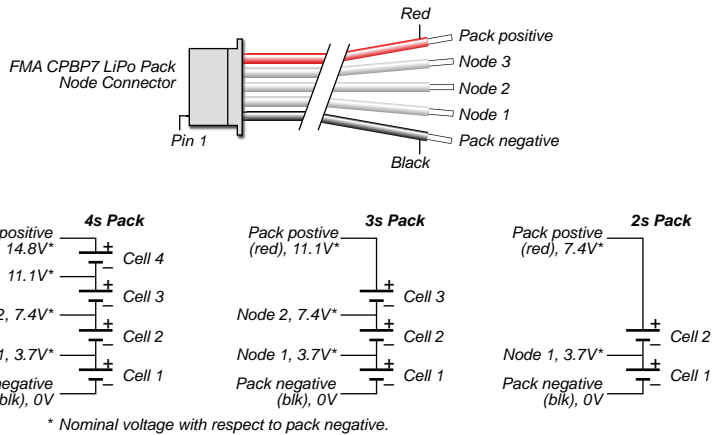
Connect Cellpro Packs as shown in this diagram:



Connecting non-Cellpro packs

FMA Direct offers plug-and-play adapters for charging LiPo packs equipped with node connectors made by other vendors. Check the Cellpro section at www.fmadirect.com for the latest adapters.

If an adapter isn't available for the pack you want to charge, or if the pack doesn't have a node connector, the FMA CPBP7 LiPo Pack Node Connector cable assembly will make the pack compatible with the Cellpro 4s Charger. The diagrams below show how the Node Connector attaches to packs of various configurations. Additional assembly information is provided with the Node Connector.



Charger specifications

For battery type	1s to 4s Lithium Polymer packs; FMA Cellpro Packs recommended; charger can be used with another manufacturer's 1s to 4s LiPo packs having node connectors and connected to charger with an appropriate FMA adapter cable
Input voltage	10 to 16VDC, reverse polarity protected
Input current	Up to 6A at 10VDC, up to 4.5A at 13.6V
Power conversion	62.5kHz switcher operating at 90% efficiency
Nominal output voltage	4.2 volts per cell
Output current	Up to 3A, reverse polarity protected
Cell balancing	To within 10mV
Voltage calibration	Cell voltage measurements are factory calibrated to a standard traceable to NIST; calibration is to $\pm 6\text{mV}$
Current calibration	Charge current is factory calibrated on a 4A standard; calibration is to $\pm 6\text{mA}$
Measurement accuracy	Voltage: $\pm 10\text{mV}$ Charge current: $\pm 1\%$ Capacity added to pack: $\pm 1\%$ Percent capacity ("Fuel"): $\pm 5\%$
Serial data output	19.2kbps, 8 bits, 1 start bit, 1 stop bit, no parity

FMA limited warranty

FMA, Inc. warrants this product to be free of manufacturing defects for the term of one year from the date of purchase. Should any defects covered by this warranty occur, the product shall be repaired or replaced with a unit of equal performance by FMA or an authorized FMA service station.

Limits and exclusions

This warranty may be enforced only by the original purchaser, who uses this product in its original condition as purchased, in strict accordance with the product's instructions. Units returned for warranty service to an FMA service center will be accepted for service when shipped postpaid, with a copy of the original sales receipt or warranty registration form, to the service station designated by FMA.

This warranty does not apply to:

- Consequential or incidental losses resulting from the use of this product.
- Damage resulting from accident, misuse, abuse, neglect, electrical surges, reversed polarity on connectors, lightning or other acts of God.
- Damage from failure to follow instructions supplied with the product.
- Damage occurring during shipment of the product either to the customer or from the customer for service (claims must be presented to the carrier).
- Damage resulting from repair, adjustment, or any alteration of the product by anyone other than an authorized FMA technician.
- Installation or removal charges, or damage caused by improper installation or removal.

Call (301) 668-7614 for more information about service and warranty repairs.

Charging a pack

About charge current

The Cellpro 4s Charger provides both automatically controlled and fixed charging current modes:

- In **Auto Current Mode**, the charger measures pack parameters and sets an optimal charge current. Two auto current settings are available: 1.0C and 1.4C.
- In **Fixed Current Mode**, the charger applies the current you select. Fixed currents from 0.25A to 3.0A in 0.25A increments are available.

When first connected to a power source, the charger is set for 1.0C Auto Current Mode (the factory default). You can change to another current setting at any time (as described below). The charger remembers the charging mode and current setting when disconnected from the power source, and will start in that configuration the next time it is used.

The 1.4C Auto Current rate is a breakthrough for LiPo charging. FMA has conducted extensive testing at 1.4C with its cell-balancing chargers and compatible LiPo packs. No evidence of safety issues or cycle life degradation has been found.

CAUTION: The 1.4C Auto Current rate applies only to FMA cell-balancing chargers and FMA LiPo packs equipped with node connectors. Other chargers don't charge individual cells, and are limited to a 1.0C rate. Charging at greater than 1.0C with those chargers increases the risk of fire. Always follow charger and pack manufacturers' recommendations for maximum charge rate.

How to charge a pack

Tip: Because FMA's cell balancing technology monitors individual cells, you don't need to cool a pack before charging it. Go from flying to charging to flying again without waiting. FMA cell-balancing chargers are the only ones that can charge a pack immediately after discharge without damaging the pack.

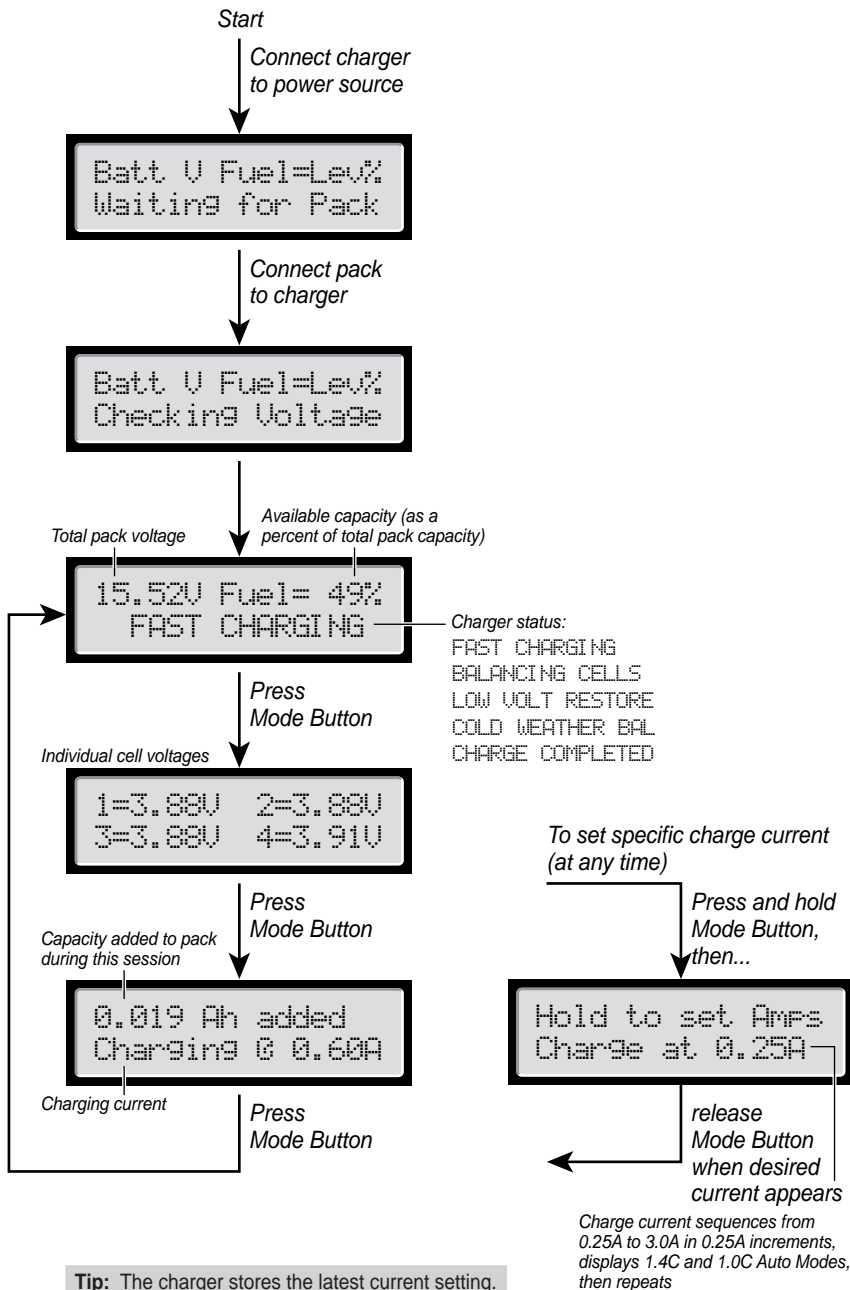
1. Connect the charger to a power source and a pack as shown on the previous page.
2. If you want a different charging mode or current:
 - a. Press and hold the Mode Button. The display will cycle through available charging modes and currents.
 - b. Release the Mode Button when the desired charging mode or current is displayed.

Tip: More information about the display—and how to navigate it—is provided on the next page.

3. Under normal conditions, the charger will beep at the following times:
 - When pack has been charged to 90% of capacity.
 - When pack has been charged to 100% of capacity.

About the data display

The diagram below explains the data display, how to view data about the pack being charged, and how to manually set the charge current.



Troubleshooting

Operating errors appear as codes in the display. To determine the problem, look up the code in the table below. Correct the error. If errors continue, contact FMA Customer Service.

ERROR 23
Push to Reset

Typical error message

Code	Cause	Resolution
1	Low-cell-voltage timeout on startup	Try charging again no more than 2 times. Cell may have internal short.
2	Input voltage below 10 volts	Lower charge amps, get a bigger power source (power source must output at least 5A).
3	Input voltage above 16 volts	Power source voltage is too high. Lower voltage.
4	Input voltage unstable	Power source is too small. Lower charge current. Check for loose connections or thin wires.
5	Cell voltage above 4.30 volts	Discharge pack.
6	Cell removed too many times (charger attempted to charge, but failed)	If error continues, pack or charger may have a problem.
7	Bad mode number	Factory error. If error persists, send charger for repair.
8	Checksum error	Factory error. Send charger for repair.
9	Overcurrent	Power source may be unstable. If power source voltage is stable, send charger for repair.
13	Overvoltage shutdown	Factory error. If error persists, send charger for repair.
14	Bad EEPROM write	Factory error. If error persists, send charger for repair.
15	System soft start	Check for bad power connection or low source voltage.
16	Firmware corruption	Factory error. If error persists, send charger for repair.
17	Cell voltages don't total correctly	Cycle charger power. Pack may have a bad cell.
18	Cell balancing stopped after 8 hours	Raise charge current. Pack may be bad, or too big.
20	Fast charge stopped after 8 hours	Raise charge current. Pack may be bad, or too big.
21	Bad cell count	Check individual cell voltages (each cell must be above 0.5V).
22	Charge current too low	If pack is not full, try raising current above 1A.
23	Pack detect ran 8 times without finishing a single charge	Pack may have bad cell.
24	Cell dropped below 3 volts during charge	Pack may have bad cell.
28	Pack detect failed	Check individual cell voltages (each cell must be above 0.5V).

Charger Viewer Software

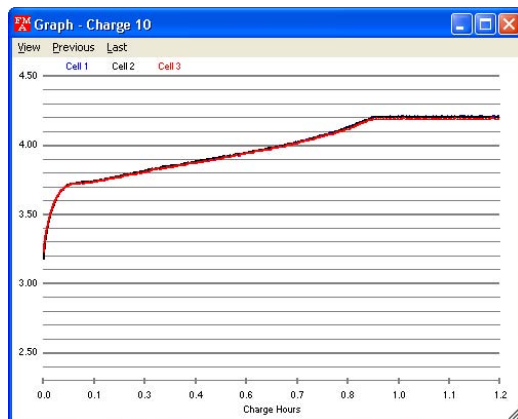
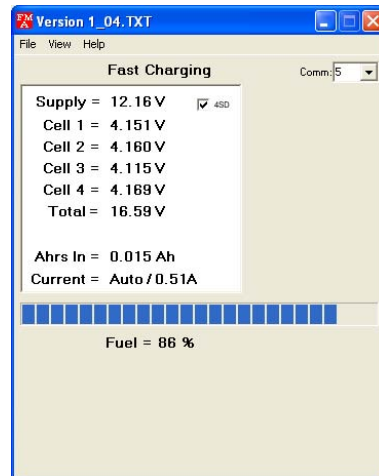
Use the Charger Viewer Software to monitor pack voltage, cell voltages, charge current and error codes on your PC.

Requirements for using the Charger Viewer Software:

- Windows 98 or later computer.
- Microsoft .NET Framework, which must be installed before installing the Charger Viewer Software. The .NET Framework is a free download from Microsoft at www.microsoft.com/downloads.

1. Download “Charger 4s Viewer” from the **Support** page at www.fmadirect.com. Double-click the downloaded file and follow the installation instructions.
2. Connect Charger to pack and to power supply.
3. Connect Charger to PC using an RS232C cable and FMA P/N FSIM1. If PC doesn't have an RS232C port, use an RS232C-to-USB adapter to connect cable to USB port.
4. Launch Charger Viewer. Program checks ports until it finds charger data, or open **Comm** list and select a port.

- *To add notes:* **View > Battery Notes**.
- *To see voltage versus time:* **View > Graphs**. Then in **Graph** window, **View > Charge Voltage** or **View > Discharge Voltage** as needed.



Tip: Resize the **Graph** window to see more detail.

Practical information about the Cellpro Charger and Packs

General information

- Cells in a pack have different voltages when they are discharged. The Cellpro 4s Charger balances (equalizes) cell voltages while it is charging the pack.
- During charging, cells that charge the fastest are the weakest cells in the pack. At the end of charging, cells with the highest voltage are weakest. This happens because weaker cells have lower capacity, and they charge faster than stronger cells.
- If the Cellpro Charger displays **LOW VOLT RESTORE**, the pack was overdischarged during its last use. The charger will attempt to repair cells measuring between 0.5V and 2.7V. Cells measuring below 0.5V cannot be restored, and any pack containing such cells should be removed from service. To avoid additional damage to restored cells, do not overdischarge a repaired pack.
- By definition, end of life for a LiPo cell is when the cell can only be charged to 80% of its original capacity rating. The number of charge/discharge cycles a cell undergoes before reaching end of life depends on several factors, including cell quality, discharge rate, internal heat generated during use, and other parameters. Cells in an older pack may be more out of balance, but the Cellpro 4s Charger will still balance them to within 10mV by the end of charge. For this reason, it may take longer to balance older packs. The charger may show **FUEL=99%** for several hours while it is balancing a high capacity (3Ah and up) “veteran” pack that is severely out of balance.

Charging packs

- You can top off packs, or remove them when they are partially charged. There is no way to damage a pack when using the Cellpro 4s Charger.
- If a pack is at 80% or less of its capacity when connected to an auto-detect speed controller, the controller may lower its cut-off voltage. This could overdischarge the pack during the flight. Auto-detect speed controllers should properly set cut-off voltage if packs are charged to at least 90%.
- To save time, stop charging when the pack reaches about 95% of capacity. That last 5% takes the longest.
- Some cells may sag to 4.10V within an hour after charging. This is normal as packs age.

Storing packs

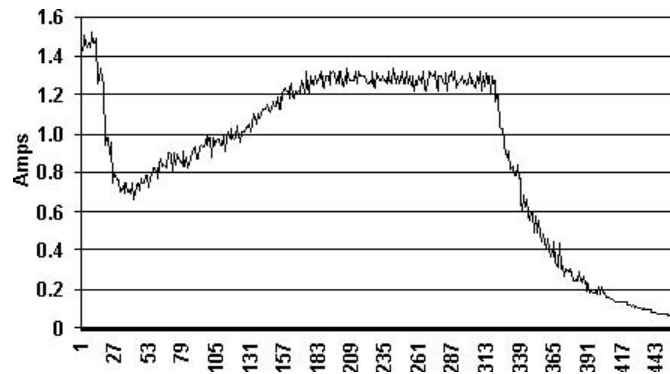
- For best results, packs should be stored at 50% to 90% capacity.
- Packs charged to 100% should not be cooled below room temperature. Cells at 90% or less capacity can be cooled below 32°F (0°C).

How Auto Current Mode works

The Cellpro 4s Charger's Auto Current Mode precisely monitors individual cell fuel levels (cell voltages) in a pack. If the charger determines it is charging too fast, it slows down. Likewise, if it is charging too slow, it speeds up. The charger adjusts charge current at one minute intervals throughout the charge cycle.

When charging starts, it takes a short time for the charger to determine the correct parameters, so it may "hunt" for up to five minutes before it settles on the optimum current. This is normal, and doesn't harm the pack. The longer the charge, the more accurate the calculation.

The plot below shows how Auto Current Mode adjusts the charger's current when charging a 1.25Ah pack at 1.0C. Initially, the charge current is higher than 1.0C. Within a few minutes the charger adjusts the current downward, and it eventually reaches 1.0C (1.25A in this case). Current drops as the pack reaches full charge. When charge current drops to about 0.1C, the pack is fully charged.



Since Auto Current Mode always starts at the last current calculated during the previous charge cycle, the charger detects and adjusts for an overcurrent condition: if any cell's voltage increases more than 10% during the first two minutes of charging, Auto Current Mode defaults to 0.5A. This prevents overcurrent if the previously charged pack had a substantially larger capacity.

With the 1.0C Auto Current Mode, a fully discharged pack is charged to its nominal capacity in about one hour. Auto Current Mode takes into account a pack's starting charge level, so topping off a 50% discharged pack takes only about one-half hour.

Estimating performance factors

If you don't have a way to directly measure your propulsion system's electrical parameters, the Cellpro 4s Charger enables you to estimate them using before- and after-flight measurements.

Collect data

Charge pack.



When charging is finished, record **Fuel %** and **total pack voltage** (i.e. sum of cell voltages).



Fly plane (or test on the ground). Record **flight time in minutes**.



Connect pack to charger. Record **Fuel %** and **total pack voltage**.

Calculate performance factors

$$\frac{(\text{Fuel \% before flight}) - (\text{Fuel \% after flight})}{100} \times (\text{Pack capacity, Ah}) = \text{Capacity consumed during flight, Ah}$$

$$\frac{(\text{Capacity consumed during flight, Ah}) \times 60}{(\text{Flight time, minutes})} = \text{Average current during flight, A}$$

$$\frac{(\text{Pack voltage before flight, V}) + (\text{Pack voltage after flight, V})}{2} = \text{Average voltage during flight, V}$$

$$(\text{Average voltage during flight, A}) \times (\text{Average current during flight, V}) = \text{Average power during flight, Watts}$$

$$\frac{(\text{Average power during flight, Watts})}{(\text{Model weight, pounds})} = \text{Watts per pound}$$

Evaluate results

- **Average current during flight** gives you a rough idea whether system components—ESC, motor, connectors and wiring—are operating within their current ratings. Keep in mind that peak current during flight may greatly exceed the average current you calculated.
- **Watts per pound** is an approximate indicator of aircraft performance (other factors influencing performance include lift, drag and motor type). Here are some guidelines:
 - 25 to 30 watts per pound: level flight.
 - 40 to 50 watts per pound: take off from smooth surface, climb.
 - 50 to 75 watts per pound: take off from grass, sport aerobatics.
 - 75 to 125 watts per pound: pattern aerobatics.
 - Over 125 watts per pound: 3D.

Tip: For more direct electrical measurements, consider these FMA products:

- 60A Current Shunt (Model DVM-SHUNT-60)
- Digital Multimeter (Model DVM-VC890D)
- Flight System Whatt Meter (Model FSWM1) for use with the FS8 Co-Pilot