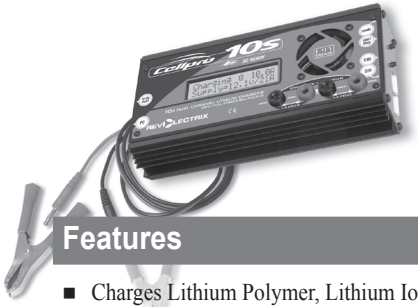


Cellpro 10s Charger

Model LC10S10ADC, for use with LiPo, Li-Ion and A123 battery packs with node connectors

10 Amp model for automatic and manual charging with cell balancing and overcharge protection

Features

- Charges Lithium Polymer, Lithium Ion and A123 packs. Charges any brand of pack. Accepts Cellpro Adapters for plug-and-play compatibility.
- Accepts Cellpro node connectors, which enable the charger to monitor each cell during charging and independently charge each cell to its optimum level. Charger includes two adapters for charging 2s to 4s Cellpro packs having 5-pin node connectors.
- Charges one 1s to 10s pack, or two 1s to 5s packs simultaneously. When two packs are connected to the charger, internal electronic switches connect the packs in series.
- Up to 10A charge current (318W continuous input and 260W continuous output at 15.7V input).
- Up to 3.0C charge rate, the fastest in the industry.
- Charges packs through node connectors with or without connecting main discharge wires to charger. Compensates for discharge wire lengths up to six feet with 1mV accuracy.
- Displays individual cell internal resistance to 0.1milliohm, an exclusive feature for estimating pack quality and finding bad cells.
- Backlit LCD display provides easy readability.
- Bidirectional PC interface enables extensive charger setup using free Charge Control Software. Configure custom presets, adjust speaker volume, set LCD contrast and control many other settings.
- Charge Optimization can be set for an accurate 1mV cell balance or for Faster Charging (with less balance) using the Charge Control Software.
- Charge Control Software automatically checks for software and charger firmware updates. Update charger firmware without sending the charger back to the factory.
- Works with a wide range of power supplies, even those not rated for high power. Easily changes from moderate current bench supply at home to car battery at the field.
- Intelligent controller performs extensive checks to prevent damage to packs and power supply.

Precautions

- Follow all instructions in this manual to assure safe operation.
- **IMPORTANT:** Do not disconnect or connect packs while the charger is charging.
- Always watch LiPo packs while they are charging. Never leave LiPo packs unsupervised during charging.
- See additional warning sheets provided with FMA LiPo packs.
- Follow all guidelines for charging, discharging, handling and storing LiPo cells.
- Minor arcing may occur when discharge wires are connected to the charger before charging. This is normal.

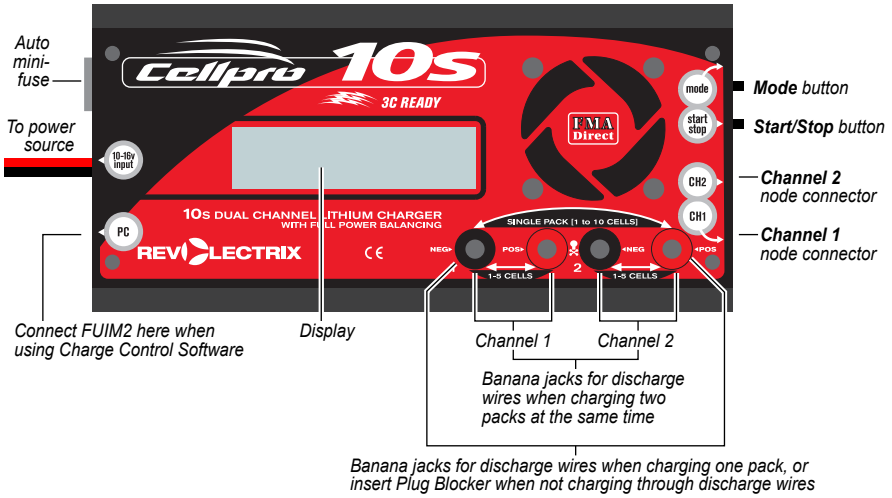
FMA, Inc. ● 5713 Industry Lane, Suite 50 ● Frederick, MD 21704

Sales: (800) 343-2934 ● Technical: (301) 668-4280 ● www.fmadirect.com

Parts

- ☐ Cellpro 10s Charger
- ☐ 2 6-pin to 5-pin node connector adapters (to enable Cellpro packs equipped with 5-pin connectors to be charged using the Cellpro 10s Charger)
- ☐ Plug Blocker (to enable charging packs without connecting discharge wires)
- ☐ Optional: FUIM2 PC connectivity set (required for using the Charge Control Software)

Charger and pack terminology



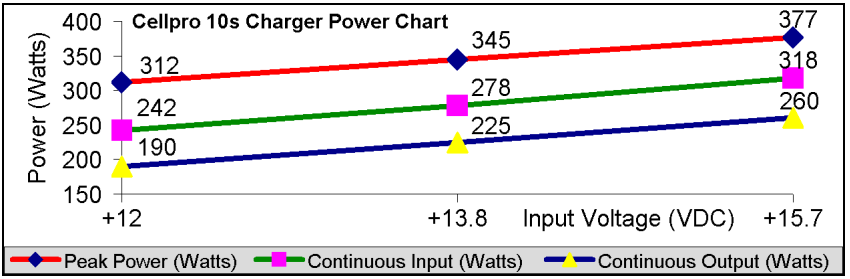


Understanding the Cellpro 10s Charger

You can set the Cellpro 10s Charger's charge rate to one of three Auto modes—1C, 2C or 3C—as appropriate for the pack(s) being charged. When one of these rates is selected, the charger determines the pack's capacity and automatically sets the correct output current using FMA's advanced Fuel Gauging technology. You can also manually set charge current to any value between 0.1A and 10A in 0.1A increments. Finally, you can select Storage Charge mode which charges to 50% rated capacity using Fuel Gauging technology. The charger handles multiple chemistries and charge parameter presets.

When one pack is connected to the charger, the pack is intially charged at the selected charge rate (or the maximum charge rate possible). Using Ohm's law, the maximum charge rate (Amps) is derived from the maximum power (Watts) the charger can produce without overheating.

Maximum power is approximately 300W measured at the charger input (FMA rates maximum power using a 15V DC input source). Maximum power depends on many factors including pack imbalance during charge, input (supply) voltage, output (charge) voltage, DC/DC converter efficiency (which varies between 80% and 90% depending on the relationship of supply voltage-to-charge voltage), ambient temperature, and internal operating temperature.



Peak Power = Maximum input power charger draws for first 3-5 minutes of charge.

When the pack reaches about 90% capacity, the charger enters balance charge mode. Charge current tapers off, but will remain at 1A or higher until the pack voltage slows the current to 1/20th C (Constant Voltage Mode). When the pack reaches 99% capacity, the charger beeps three times. The pack can be removed to use, or allowed to continue charging until the pack is 100% full and the charger displays "Charge Complete."

During the entire charge process, the charger power balances the pack using 1A current until all cell voltages are within 1mV of each other. Power balancing is the process of beginning the balancing process early in the charge cycle using high current to shunt excess cell voltage while other cells in the pack have a chance to catch up. Power balancing means the pack tops off faster and the total charge time is greatly reduced. This is possible because the balance circuitry is internal to the charger. Automatic temperature control and an integral fan ensure the charger never exceeds maximum safe operating temperature under any conditions. The result is faster, safer charge times.

When charging two packs, the packs are connected in series using four electronic switches inside the charger. In effect, the charger treats the two packs as a single pack. (For example, if you connect a 3s pack and a 4s pack, the charger operates on them as one 7s pack.) If the pack capacities are different for the two packs connected, the charge rate should be selected based on the lower capacity pack. Initially, the packs are charged at the selected charge rate (or the maximum charge rate possible) until one pack becomes fully charged—however, the charger handles cell balancing of the two packs completely independently. The second pack continues to be charged at a minimum of 1A charge rate until it is full and balanced.

Notice that one of the packs in a simultaneously charged pair is always topped off at a minimum rate of 1A (dictated by the maximum balance current available). If the packs have the same capacity, and were discharged to about the same level, both packs will charge in less than 30 min-

utes at 3C. However, if the packs have different capacities, or were discharged to different levels, charging for the pair could take longer than expected. Since the charger supports fast balance current of 1A, all other things being equal, the charger still outperforms competing brands. In most instances, by the time the first pack is fully charged, the second pack is already approaching constant voltage charge mode; the battery pack itself is the limiting factor in charge time, not the charger.

> **Example 1:** You are powering an aircraft with two 4s 2100mAh packs connected in series. Because those packs have the same capacity, and were discharged to about the same level, you can expect them to charge in about the same time. It would be appropriate to charge them simultaneously using the Cellpro 10s Charger.
>
> **Example 2:** You are powering one aircraft with a 3s 500mAh pack, and other aircraft with a 5s 5000mAh pack. If you charge these packs simultaneously using the Cellpro 10s Charger, it would probably take a long time (the 500mAh pack would become full first, then the charger would switch to its 1A balancing rate to fill up 5000mAh pack, which could take several hours). In this case, it would be faster to charge these packs separately because the charger can then apply optimum (and substantially different) charge currents to each pack.

In some cases, such as Example 2, it will be faster to charge two packs separately rather than simultaneously. It's up to you to decide whether to charge two packs individually or as a pair, based on what you know about their respective capacities and discharge states.

The Cellpro 10s is equipped with FMA Fuel Gauging technology. During all phases of the charge process, the charger will report the fuel level of two packs being charged independently. In Example 2 above, when the 500 mAh pack reaches 99% capacity (the charger beeps three times), it is a simple matter to remove the pack from the charger and continue charging the 5000 mAh pack at a higher charge rate. Here's the full procedure:

1. Connect both packs and start charging them at an Auto rate.
2. Watch the fuel level display. When one pack reaches 99% fuel level (the charger beeps three times), stop charging.
3. Disconnect the full pack.
4. If the partially charged pack is connected to Channel 2, move it to Channel 1.
5. Continue charging the partially-charged pack.

Charger input current limiting

The charger will draw up to 25A to deliver its 10A maximum output current. The high input current is required when the input voltage must be boosted to drive packs having larger numbers of cells in series. The charger's algorithms are based on power, not current. The charger initially draws 300W, but will automatically reduce power consumption based on its internal temperature. Output power is determined by several factors, including battery pack imbalance during charge, input voltage, input current, output voltage, ambient temperature, and the charger's internal temperature.

The charger's DC-to-DC converter is typically 80% to 90% efficient. Highest efficiency occurs when the input voltage is higher than the output voltage needed to charge the connected pack(s). However, the charger cannot tolerate input higher than 16V. Setting the input voltage to 15V provides the highest efficiency, coolest operating temperature and fastest charging times, especially when charging packs containing more than five cells in series.

You can also manually limit the charger's input current so the charger will not draw more power than the supply can provide. If you know your power supply is rated for 3A output, for example, you can limit the charger's input current to 3A. (Be aware that limiting charger input current may increase pack charge times.) When the charger is powered from a high current source (such as a car battery), you can override manual current limiting to provide maximum pack charging current. Details are provided in "Limiting charger input current" in the "Using the Charge Control Software" section of this manual.

Connecting packs to the charger

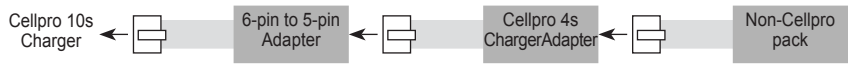
General information

- If a pack has both a node connector and discharge wires, you can charge using the node connector only, or both node connector and discharge wires. When charging two packs simultaneously, both packs must be connected the same way: either node connectors only, or both node connectors and discharge wires.
  - When charging only through a node connector, the charger balances individual cells. However, charge current is limited to 4A to protect the small node connector wires.
  - When charging through both node connector and discharge wires, the charger balances individual cells and measures individual cell internal resistances. Charge current is not limited to 4A.
- When charging only one pack, always plug that pack into the charger's Ch1 jack.
- When charging only one pack using its discharge wires and node connector, always connect the discharge wires to the charger's outermost banana jacks.
- When charging one or two packs without using discharge wires, you must plug the Plug Blocker into the charger's banana jacks.
- When charging two packs, both packs must have the same chemistry. For example, you can't charge one A123 pack and one LiPo pack at the same time.
- Pack discharge wires are usually not terminated in banana plugs (e.g., they might be terminated in a Deans connector). For convenience in connecting to the charger, prepare an adapter cable with banana plugs on one end and a connector that mates with the pack's discharge connector on the other end. FMA sells banana plugs suitable for this purpose as FMA Part Numbers BPNS-BLK (Black –) and BPNS-RED (Red +).

CAUTION: When using the banana plug adapter cables described above, ALWAYS insert the banana plugs into the charger BEFORE connecting the adapter cable to the pack. Reverse the sequence when disconnecting the pack. This will prevent the live banana plugs from touching each other, which would create a dangerous condition and could seriously damage the pack.

Connecting non-Cellpro packs

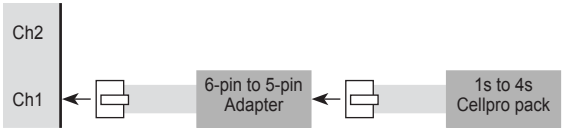
Generally follow the instructions in "Connecting one 1s to 10s Cellpro pack" and "Connecting two 1s to 5s Cellpro packs," but your packs may not be equipped with compatible node connectors. FMA Direct offers plug-and-play adapters for charging LiPo packs equipped with node connectors made by other vendors. Check *www.fmadirect.com/cellpro_adapters.html* for adapter compatibility. The Cellpro 10s charger works with all existing Cellpro 4s charger adapters. You must connect a 6 pin-to-5 pin Adapter (provided with the Cellpro 10s Charger) between the charger and the Cellpro 4s charger adapter, as shown here:

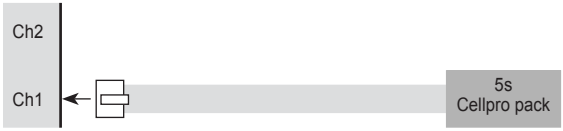


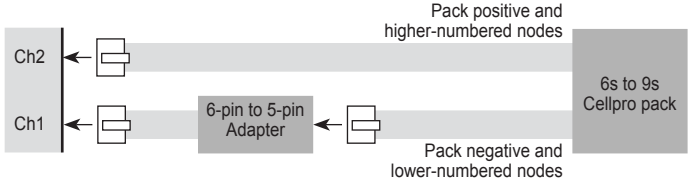
If an adapter isn't available for the pack you want to charge, or if the pack doesn't have a node connector, the FMA Part Number CPBP7 (Cellpro battery pigtail 10", 5 position) and/or FMA Part Number CPBP6P-10 (Cellpro battery pigtail 10", 6 position) cable assemblies can be used to make the pack compatible with the Cellpro 10s Charger. Instructions for connecting these cable assemblies to your packs are provided in the "Cellpro Pin Lead Connection" document at *www.fmadirect/support_docs/item_1254.pdf*. See also "Node connector wiring," later in this manual.

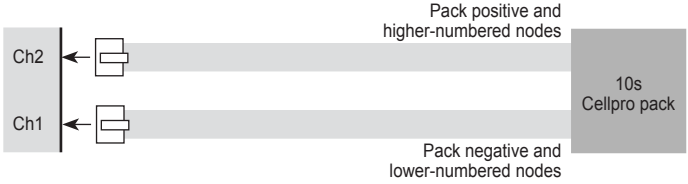
Connecting <u>one</u> 1s to 10s Cellpro pack

1. How you connect the Cellpro pack's node connector(s) to the charger depends on the pack's configuration. Find the pack's configuration in the diagrams below, then connect as shown in that diagram.

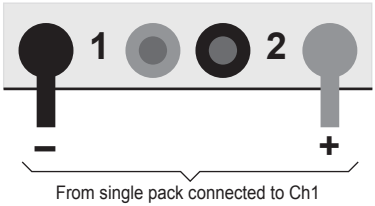








2. If you are using the discharge wires during charging the single pack, plug the discharge wires into the outermost banana jacks.

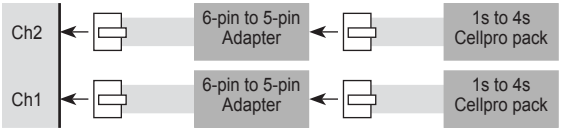


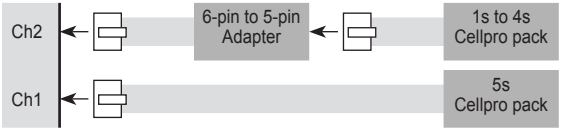
or

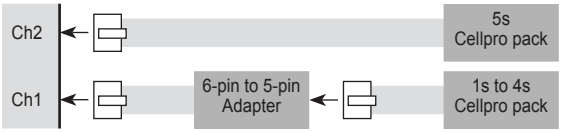
If you are not using the discharge wires during charging, insert the Plug Blocker into the outermost banana jacks.

Connecting <u>two</u> 1s to 5s Cellpro packs

1. How you connect the Cellpro packs' node connectors to the charger depends on the packs' configurations. Find the configurations in the diagrams below, then connect as shown in that diagram.

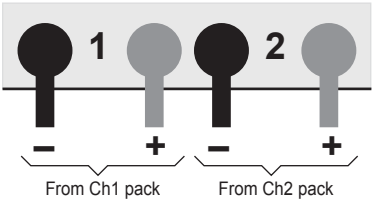








2. If you are using the discharge wires during charging, connect the discharge wires into the banana jacks as shown below.



or

If you are not using the discharge wires during charging, insert the Plug Blocker into the outermost banana jacks.

Applying power to the charger

- *To apply power to the charger:* Connect the charger to a 12V to 15V bench power supply, field battery or car battery. If your bench power supply is equipped with banana jacks for output, you can remove the plier clamps from the charger's input cables and plug the cables directly into the power supply jacks.

When the charger is powered up, it displays the following screens in sequence:

FMA Cellpro 10s [firmware version]*	Welcome screen
2 Packs Charge [chem]* **Set @** [charge current]*	Last-used preset
SAFE TO CONNECT **Press START**	Home screen

*Information in square brackets varies.

Introduction to presets

As shipped from the factory, the charger has two presets:

- **2 Packs Charge, LiPo Set @ 1.0C**
- **1 Pack Charge, LiPo Set @ 1.0C**

When power is applied, the charger always initializes to the last preset used for charging. Instructions in "Selecting a preset," later in this manual, show how to switch between these presets.

If you altered the charge settings for a preset at the charger (as described in "Changing a preset," later in this manual), those changes are retained when the charger is disconnected from power, and will be reapplied when the charger is powered up again.

"Selecting a preset" and "Changing a preset," in the next section, provide additional information.

Note: If you programmed the charger using the Charge Control Software, additional presets may be available. Also, if you have been using the software, you may have given the factory presets different names. Bottom line: if you change settings at the charger, or redefine presets, you probably won't see the factory presets shown above.

Operating the charger

You operate the charger using the **Mode** button and **Start/Stop** button on the right side of the charger:

- **Mode** button: enables you to select a preset, change preset values and display charging data during charging.
- **Start/Stop** button: enables you to start charging after you have selected a preset, and to stop charging at any time.

Using these buttons you can:

- Select a preset (see "Selecting a preset").
- Change charge settings for any preset (see "Changing a preset").
- Charge the attached pack(s) and view real-time operating information (see "Charging a pack or packs").

Selecting a preset

- *To determine the currently selected preset and review its settings:* Press the **Mode** button on the charger's right side.
- *To select a different preset:* Press the **Mode** button until you see the desired preset's name and settings in the display, then wait until you see the **`Safe to Connect`** screen.

The preset displayed when you stop pressing the **Mode** button is the "selected" preset. Once the preset is selected, you can change the charge settings for this preset (see "Changing a preset") or begin charging by pressing the **Start/Stop** button.

> **Note:** The Charge Control Software enables you define up to six custom presets. If you have defined custom presets, you can—at the charger—select any preset. (If you have not defined custom presets, the two factory presets are available.)

Changing a preset

You can change the charge settings for the currently selected preset to match the characteristics of the pack(s) you are charging.

> **Note:** Changes you make to presets are saved in the charger when the charger is disconnected from power.

1. Select the preset you want to change (see "Selecting a preset," above).
2. At this point, there are several things you can do:
   - *To change the chemistry:*
     a. Press and hold the **Mode** button, then release it when the display changes to this:

```
Choose Chemistry
  Hold for More
```

> **Note:** If you hold the **Mode** button down longer, you'll see **`Choose Chg. Amps`** or **`Exit`** (both described below).

When you release the **Mode** button, you'll see the chemistry setting:

```
Choose Chemistry
[chemistry] @[voltage]
```

b. Press and release the **Mode** button until you see the chemistry you want. Choices are:
   - **`Lithium Poly 4.20V`**
   - **`Lithium Ion 4.20V`**
   - **`Lithium Ion 4.10V`**
   - **`A123 3.65V`**

■ *To change the charge current:*

a. Press and hold the **Mode** button, then release it when the display changes to this:

```
Choose Chg. Amps
  Hold for More
```

Note: If you hold the **Mode** button down longer, you'll see **`Exit`** (described below) or **`Choose Chemistry`** (described above).

When you release the **Mode** button, you'll see the charge current setting:

```
Choose Chg. Amps
Charge @ [current]
```

b. Then:

- Press the **Mode** button about once per second to increase current in 0.1A steps.
- Press the **Mode** button quickly twice to increase current to the next Amp.
- When the maximum current is reached, press the **Mode** button once for each of the following three Auto charge modes or Storage charge mode:
  - **`1.0C`** (where C = pack's capacity)
  - **`2.0C`**
  - **`3.0C`**
  - **`Store`** (to charge pack to about 50% capacity; optimum for long-term storage)
  - (Return to charge current settings at 0.1A)

Note: The charger's Auto charge fuel gauge tables are optimized for Lithium Cobalt batteries. If you are charging Lithium Manganese batteries, Auto charge modes may take twice as long as expected. Manual current settings are recommended when charging Lithium Manganese batteries.

■ *To save the settings and return to the Home screen:* Press and hold the **Mode** button, then release it when the display changes to this:

```
      Exit
Hold for More
```

Note: If you hold the **Mode** button down longer, you'll see **`Choose Chemistry`** or **`Choose Chg. Amps`** (both described above).

or

*To save the settings and begin charging **if a pack is connected to the charger**:* Press the **Start/Stop** button on the charger's right side. Details are provided in the next section.

Charging a pack or packs

1. Before charging, pack(s) must be properly connected to the charger. See "Connecting packs to the charger," earlier in this manual, for details.
2. Press the **Start/Stop** button for one second to enter Charging Mode.
3. You will see the following screens in sequence:

```
Checking Pack(s)
```

```
CHARGING   Press
 MODE for info.
```

4. While in Charge Mode, you can take the following actions:
   - *To view pack and operating data:* Press the **Mode** button repeatedly to cycle through the following screens. (These examples assume two packs are being charged; if one pack is being charged, only the top line may appear in some screens.)

```
C 0.5A 00:00:59
Supply=13.8V/ 1A
```
Charge current and charge time.
Supply voltage and input current.

```
[preset name]
[chem] Set @ [charge current]
```
Selected preset.
Preset's charging settings.

```
Ch1 [chemistry] [charge process]
Ch2 [chemistry] [charge process]
```
Chemistry and charge process (Fast Charging, Balance Charging, etc.) in effect for each channel.

```
Ch1 Fuel = 47%
Ch2 Fuel = 55%
```
Results of unique FMA algorithm that determines pack "fuel level." Data is also used to calculate correct C rate during 1/2/3C charging.

```
Ch1 Pack = 11.754V
Ch2 Pack = 11.821V
```
Total pack voltage(s).

```
Ch1    42mAh In
Ch2    40mAh In
```
mAh put back into pack(s) during charging.

```
1:3.835V 2:3.955V
3=3.959V 4=3.873V
```
Individual cell voltages.* ":" indicates Ch1, "=" indicates Ch2. Similar screens may appear, depending on the number of cells being charged.

```
1:23.3mΩ  2:17.1
3=12.1mΩ  4=25.7
```
Individual cell internal resistances in milliohms.*† ":" indicates Ch1, "=" indicates Ch2. Similar screens may appear, depending on the number of cells being charged.

*Cells are numbered from 1 through n, where 1 is the first cell in the pack connected to Ch1, and n is the last cell in the pack (if only one pack is being charged) or the last cell in the pack connected to Ch2 (if two packs are being charged).

†For the charger to calculate internal resistances, a) pack discharge wires must be connected during charging and b) pack must be at less than 80% fuel level. Internal resistances will be available for display after about 12 minutes of charging, and will be periodically updated after that.

If the charger detects a problem, it will stop charging and display a safety code. If this happens:
1. Press the **Mode** button to reset the charger.
2. Reconnect the battery properly.
3. Press the **Start/Stop** button to continue charging.

- *To stop charging:* Press the **Start/Stop** button for one second. The charger displays the Home screen.

  Note: Pack data is lost when you leave Charging Mode, so if you want to see it, do so before pressing the **Start/Stop** button.

  Note: If you restart the charge, you might see a **`Please wait...`** screen. The charger is discharging capacitors, which may take up to one minute. When reinitialization is complete, charging will begin again.

5. When charging is complete, the display below will appear, and the charger will beep for about 30 seconds to alert you.

```
Ch1 [chemistry] DONE
Ch2 [chemistry] DONE
```

- *To review final data for the pack(s):* Press the **Mode** button to cycle through the data screens.

  Note: Pack data is lost when you leave Charging Mode, so if you want to see it, do so before pressing the **Start/Stop** button.

- *To leave Charging Mode:* Press the **Start/Stop** button.

Alternate charging modes

Based on what the charger determines about charging conditions, it may enter one of these charging modes (as indicated in the display):

- In **Low Voltage Restore Mode**, the charger automatically attempts to repair an overdischarged pack. Cells discharged as low as 0.5V may be repaired to as much as 98% of capacity.
- In **Safety Charging Mode**, the charger detects that at least one cell is seriously out of balance, and automatically lowers charge current to 0.5A.

  CAUTION: If the charger's display shows **`SAFETY CHARGING`** during several attempts at charging, the pack is damaged. Treat damaged packs with caution. Do not charge them on a flammable surface, and do not charge them unattended.

- In **Cold Weather Balancing Mode**, charging automatically stops at 4.10V/cell when temperature is below 55°F to prevent cell damage.

Using the Charge Control Software

The Cellpro 10s Charge Control Software enables you to define presets, save and load groups of presets, update the charger's firmware, and control various aspects of the charger's options.

Installing the Charge Control Software

1. On your Windows-based computer, launch Internet Explorer and navigate to *http://www.fmadirect.com/new_applications/CellPro10S_Software/setup.exe*
2. Follow the instructions displayed onscreen. The software will download, install and launch.

*If you encounter a problem because your default browser is not Internet Explorer, temporarily designate Internet Explorer as your default browser:

1. **Start > Control Panel**.
2. In the **Control Panel**, double-click **Add or Remove Programs**.
3. In the **Add or Remove Programs** dialog, click **Set Program Access and Defaults** in the left panel.
4. Open the **Custom** panel.
5. Under **Choose a default Web browser**, click **Internet Explorer**.
6. Click **OK**.
7. Close the **Add or Remove Programs** dialog and the **Control Panel** dialog.

After installing the Charge Control Software, you can revert back to your preferred browser.

Launching the Charge Control Software

1. **Start > All Programs > FMA Direct > Cellpro 10s**.
2. If your computer is connected to the Internet at this time, the program will check to see whether a new version is available. If a new version is available, you will have the option to install the new version or launch the version you already have.
3. After the program launches, and if your computer is connected to the Internet, the program will check to see whether a new version of the charger firmware is available. If new firmware is available, a message will appear; click **OK** to close the message window. See "Updating charger firmware," later in this manual, for instructions.

Connecting the charger to your computer

1. Plug the FUIM2's 3-pin connector into the jack on the charger's left side. The black wire should be toward the bottom of the charger's panel.
2. Plug the FUIM2's USB connector into your computer.
3. If the Charge Control Software isn't running, launch it now.
4. Watch the message line just below the program's menu bar.
   - If "Waiting to Start" appears, everything is working properly and you are ready to use the program.
   - If "Checking Com COMx for data" doesn't go away, the program can't communicate with the charger. To correct this:
     a. Click **Download USB Driver** at the bottom the Charge Control Software window.
     b. Run the installer.
     c. Restart your computer.

Monitoring charging operations

- *To monitor cell voltages, total pack voltage and related charging parameters **during charging**:* Click the **Cells** tab.
- *To monitor cell internal resistances **during charging**:* Click the **Int. Res.** tab.

> **Note:** For the charger to calculate internal resistances, a) pack discharge wires must be connected during charging and b) pack must be at less than 80% fuel level. Internal resistances will be available for display after about 12 minutes of charging, and will be periodically updated after that.

- *To view cell parameter graphs:* **View > Graphs**. In the **Graphs** window:
  - *To view volts:* **View > Volts**.
  - *To view current:* **View > Amps**.
  - *To view internal resistance:* **View > Internal Resistance**.
  - *To view fuel level:* **View > Fuel**.
  - *To print a graph:* **File > Print**.

Limiting charger input current

The charger will draw up to 25A to deliver its 10A maximum output current. The high input current is required when the input voltage must be boosted to drive packs having larger numbers of cells in series. The charger monitors input current from the power supply, and automatically reduces pack charge current if it determines that the power supply can't keep up.

You can also manually limit the charger's input current so the charger will not draw more power than the supply can provide. If you know your power supply is rated for 3A output, for example, you can limit the charger's input current to 3A. This feature prevents damage to power supplies, such as bench supplies, having low to moderate output currents. (Be aware that limiting charger input current may increase pack charge times.) When the charger is powered from a high current source (such as a car battery), you can override manual current limiting to provide maximum pack charging current.

- *To monitor supply voltage:* Click the **Supply** tab.
- *To manually set input current limiting:*
  1. In the **Supply** tab, select the desired maximum current in the **Current Limit** dropdown list.
  2. Click the **Update Charger** button.
- *To override manual input current limiting at the field without using the Charge Control Software:*
  1. Press and hold the charger's **Mode** button.
  2. Connect the charger's input cables to the power source.
  3. When you see characters in the charger's LCD display, release the **Mode** button.

> **Note:** If manual input current limiting is in effect, you must repeat this procedure each time you apply power to the charger if you want the charger to operate at full input current.

Defining presets

You can define up to six preset charging configurations. Each preset consists of a name, a chemistry and a charge current. See "Selecting a preset," earlier in this manual, for instructions on selecting a preset for charging.

> **Note:** Remember that presets can be overridden at the charger. Preset changes made at the charger are retained in the charger until manually changed again, or until a new group of presets is downloaded to the charger. When you connect the charger to the computer and launch the Charge Control Software, the program uploads and displays the presets stored in the charger.

Perform all preset operations in the **Presets** tab.

- *To define a preset:*
  1. In the **Name** field, enter a name for the preset.
  2. In the **Chem** field, select the chemistry.
  3. In the **Amps** field, select the charge current.
  4. If this preset will be used to charge a 6s to 10s pack, activate the **Single Pack** option (this enables the charger to treat Ch1 and Ch2 as a single channel).
- *To download presets to the charger:* Click **Update Charger**. The charger will beep when downloading is complete.
  or
  To ignore changes and restore the previous presets: Click **Cancel**.
- *To restore the factory settings:* Click **Factory Default**, then click **Update Charger**.

> **Note:** This restores the factory default presets, and also resets the LCD contrast, speaker settings and auto scroll settings.

Setting charger options

1. Click the **Options** tab.
2. Set options as desired:
   - **LCD Contrast** sets the contrast of the charger's LCD display. The display will be easier to read in bright conditions when the contrast is high.
   - **Auto Scroll Cells ON** option, when activated, directs the charger to scroll through screens during charging. **Auto Scroll Seconds** controls how long each screen is displayed.
   - **Speaker Volume** controls the loudness of the charger's speaker. If you want the charger to confirm when you press the **Mode** button and **Start/Stop** button, activate the **Button Clicks ON** option. Deactivate the **Speaker ON** option to mute the charger.
   - **Optimize for Accuracy** balances cells to 1mV. The charger can take an additional two to five minutes to balance the cells. **Optimize for Fast Charge** ends the charge at 0.1C.
3. Click **Update Charger**.
   or
   If you don't want to apply the changes, click **Cancel**.

Recording charge data

The Charge Control Software can record charge data for each charging session.

1. Press the **Start/Stop** button on the charger to start a session.
2. When prompted, enter a file name. You can enter a file name you previously used, but you must confirm that you want to overwrite older data.

Charge data is stored in a semicolon-delimited format, which can be imported into a spreadsheet for analysis.

Updating charger firmware

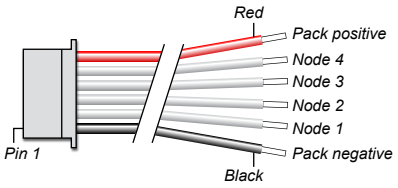
The Charge Control Software automatically checks for new firmware each time it is launched (assuming the computer is connected to the Internet). If new firmware is available, it is downloaded to your computer. When you are ready to update the charger:

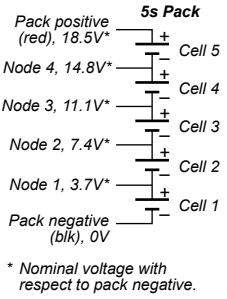
1. Be sure the charger is connected to the computer, and is powered up.
2. Disconnect all packs from the charger.
3. In the Charge Control Software window, switch to the **Firmware** tab.
4. Select the firmware you want to download.
5. If the previous firmware download was interrupted, activate the **My Charger is Dead** option.
6. Click Update Firmware.
7. Wait—and do nothing—until updating is complete.

> **IMPORTANT:** During firmware downloading, do not disconnect the charger from power, do not disconnect the charger from the computer, and do not exit the Charge Control Software.

Node connector wiring

This diagram shows how a 6 pin node connector is wired to a 5s pack.





Estimating performance factors

If you don't have a way to directly measure your propulsion system's electrical parameters, the Cellpro 10s 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

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

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

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

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

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

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)

Troubleshooting

There are 26 ways to improperly connect two packs to a charger! After the **Start/Stop** button is pressed, a special battery checking sequence automatically checks every wire before closing the internal switches (if discharge wires are not used during charging). It is possible to get an unrelated safety code from a simple wiring issue.

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

Message	Problem
2 Pack Con. Err	Check pack wiring
Amps too low	Reset the charger
Bad EEPROM Write	Internal error
Bad FET supply voltage	Check the input voltage
Bad Mode Number	Internal error
Bypass Overvolt	Check the pack wiring
C2 Pack Detected	Pack was added to Ch2 while charging
Cell < 0.1V	Low cell voltage
Ch1 Bad S. Count	Cell count cannot be determined; check for a cell < 0.5V
Ch1 has no Pack	Pack must be installed on Ch1
Ch1 No Add Up	Cell verification failed
Ch1 Pos < 0.5V	Check node wiring
Ch2 Bad S. Count	Cell count cannot be determined; check for a cell < 0.5V
Ch2 No Add Up	Cell verification failed
Charger Overcurrent	Make sure the charger current is steady
Check Pos. Term	Positive terminal not connected
Chg. Overvoltage	Cell is over voltage
Chgr Temp. >160F	Make sure the fan is working
Low Voltage Cell	Cell did not recover after 5 minutes of charge
Neg. Term. < 0V	Black banana jack is reading below 0 volts
No Plug Blocker	Plug Blocker required, but not installed
Node 10 < 0V	Last node wire is reading negative voltage
Reverse Polarity	Check wiring
Series Chrgrs?	Check that two chargers aren't charging a series pack
Supply <10 Volts	Low input supply voltage
Supply >16 Volts	High input supply voltage
Supply Unstable	Possible thin supply wires; set input current limiting with Charge Control Software
System Softstart	Check for good power supply leads
Temp out of Rnge	Make sure the fan is working

Pack wiring issues can cause nuisance safety codes. If any of the safety codes below appear, try connecting the pack to the banana jacks and node connectors without using the plug blocker.

Safety code	Problem
60-65	Positive switch close failure
66-71	Series switch close failure
72-77	Negative switch close failure
78	Greater than 42V detected
79-80	Cell count out of range (internal software check)
81-86	Charge switch close failure
87	Voltage steady timeout
88	Check Pack 1 voltage out of range
89	Check Pack 2 voltage out of range
90-92	Internal software check
93	Calibration checksum error. Charger must be returned to factory for calibration.

Specifications

For battery type	Lithium Polymer, Lithium Ion, Lithium Manganese and A123 packs; charger can be used with 1s to 10s packs having node connectors and connected to charger with an appropriate FMA adapter cable
Pack capacity	100mAh to 65Ah (charge time limited to maximum of 12 hours)
Input voltage	10 to 16VDC, reverse polarity protected
Input current	Up to 25A; can be limited to 1A to 25A in 0.25A increments
Power conversion	62.5kHz switcher operating at 90% efficiency
Nominal output voltage	3.60, 4.10 and 4.20 volts per cell; 42V maximum
Output current	Up to 3A, reverse polarity protected
Cell balancing	To within 1mV with 0.1mV resolution
Voltage calibration	Cell voltage measurements are factory calibrated to 1ppm (50µV) traceable to NIST
Internal switches	Four internal FET switches series-connect packs to enable charge through node connectors only; switches close only after proper pack connection is verified; maximum switch current limited to 4A
Plug blocker	Prevents reverse polarity connection to banana jacks after internal switches are closed; charger looks for 4.7kohm resistor when using internal switches
Current calibration	Charge current is factory calibrated on a 4A standard; calibration is to ±5mA
Measurement accuracy	Absolute voltage accuracy: ±2mV from 0 to 50V Charge current: ±1% Capacity added to pack: ±1% Percent capacity (“Fuel”): ±5%
Internal resistance	0.1mV voltage resolution allows accurate four point internal resistance measurement of each cell
Serial data output	19.2kbps, 8 bits, 1 start bit, 1 stop bit, no parity; CRC16 checksum
Firmware updates	Encrypted at factory, decrypted in charger

Quick start for the Cellpro 10s Charger

Refer to manual for complete operating details.

A. Connect charger to a 12V to 16V (maximum) power source.

B. Connect pack(s) to charger.

- Plug pack's node connector(s) into channel jack(s) on right side of the charger (use node connector adapters as needed).
- When charging only one pack, plug pack's node connector into Ch1. Plug pack's discharge wires into outermost banana jacks on charger's panel.
- When charging two packs: Plug discharge wires from Ch1 pack into banana jack pair #1, and plug discharge wires from Ch2 pack into banana jack pair #2.
- If you choose not to charge through pack's discharge wires, insert Plug Blocker into outermost banana jacks.

C. Configure charger:

- *To review selected preset's settings:* Press **Mode** button.
- *To select a different preset:* Press **Mode** button until you see the desired preset's name and settings in display.
- *To change selected preset's settings:* Press and hold **Mode** button to set chemistry and/or charge current. Press and hold to exit.

D. Press **Start/Stop** button for one second to begin charging.

E. During charging:

- *To view charge data:* Press **Mode** button repeatedly.
- *To stop charging:* Press **Start/Stop** button for one second.

F. The charger will automatically stop charging, and beep for 30 seconds, when charging is complete.

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) 668-4280 for more information about service and warranty repairs.