TC Charger
Serial Controlled
Lithium Battery Charger
DESCRIPTION:

For budget minded EV builders, the Hangzhou TieCheng charger (TC Charger), also known as the Chennic or Elcon charger (two trading companies that sell it), has emerged as the low cost charger option for do-it-yourself electric vehicle builders. This charger has proven reliable and accurate over time at a very reasonable cost.

The drawback is that it has not been very configurable. To purchase, you must select a charge profile when you order it, and it is permanently configured at the factory. It cannot be changed by the end user.

If you make changes to your battery pack and need it to charge to a different voltage, you must send it off for months at an expense of a hundred dollars or so to have it "reprogrammed." As most EV builders make changes to their battery packs, move chargers between vehicles and builds, this can turn a very inexpensive charger into a very expensive lesson in how NOT to save money.

But the power electronics are reasonably good and the charger has been mostly reliable and accurate. EVTV has developed a controller that operates the charger through the CANbus port and allows the end user to easily configure the charger for voltage and current.

The result is a reasonably priced charger you CAN easily control to change the charge voltage, current, and termination at any time and without special software programs. And we've made it ridiculously simple. The controller puts out a serial ASCII text one line message that shows your target voltage, charge current, termination setting, ampere-hours, and kilowatt hours. You can plug in ANY laptop with ANY serial terminal program to this device and watch it for hours on end - the fun never ends. But better, you can alter the target charge voltage, the current level, and the END point of the charge process, with just three abbreviated commands.

The laptop is NOT required to run the charger in normal operation – only when you reconfigure it. Thereafter it operates quite automatically, communicating with the TC charger as necessary to maintain the values you specified.
SPECIFICATIONS

MAX OUTPUT POWER: 4 kW
AC INPUT RANGE - 85-265vac
AC INPUT FREQUENCY: 45-65 Hz
AC POWER FACTOR: >0.98
FULL LOAD EFFICIENCY: >93%
ENVIRONMENTAL ENCLOSURE: IP46
OPERATING TEMPERATURE: -40C to +55C
DIMENSIONS: 352 x 366.5 x 138.8 mm
INTERNAL CURRENT LIMIT TEMPERATURE: 75C
INTERNAL SHUTDOWN TEMPERATURE: 85C charger automatically restarts if temperature falls.
REVERSE POLARITY PROTECTION: Charger will not charge if battery terminals are reversed.
SHORT CIRCUIT PROTECTION: Charger terminates during short circuit on output. If this is removed, it will automatically restart within 10 seconds.
OVER/UNDER VOLTAGE PROTECTION: If input out of range, charger terminates. It will restart automatically when power is restored.

LED NORMAL OPERATING INDICATIONS

The TC Charger features a Red/Green LED to indicate various operations and faults.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED FLASH</td>
<td>one second interval - Constant Current Phase</td>
</tr>
<tr>
<td>YELLOW FLASH</td>
<td>- one second interval - Constant Voltage Phase</td>
</tr>
<tr>
<td>GREEN FLASH</td>
<td>- one second interval Charge complete</td>
</tr>
</tbody>
</table>

LED FAULT INDICATIONS

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED/GREEN/6 sec pause</td>
<td>Wrong battery</td>
</tr>
<tr>
<td>RED/GREEN/RED/ 5 sec pause</td>
<td>Overcharged</td>
</tr>
<tr>
<td>RED/GREEN/RED/GREEN/RED/3 sec pause</td>
<td>AC input out of range</td>
</tr>
<tr>
<td>RED/GREEN/RED/GREEN/RED/GREEN/RED/1 sec pause - GREEN/RED/6 sec pause</td>
<td>CANbus communications error</td>
</tr>
<tr>
<td>GREEN/RED/GREEN/RED/4 sec pause</td>
<td>Charger Overtemp</td>
</tr>
<tr>
<td>RED/GREEN flash on 1 second interval</td>
<td>Battery Disconnected</td>
</tr>
</tbody>
</table>
APPLICATION:

The TC Charger features a very simple charge curve operation. It charges at a specified current continuously until the Lithium battery pack reaches a specific voltage. This is termed the CONSTANT CURRENT phase or CC. This is typically the maximum current the charger can make. However, you can adjust this current level with the “a” command by sending “a24.7” for example to specify a charging current of 24.7 amperes. You may want to set a lower current level depending on the capabilities of the circuit you are charging from.

The battery pack will exhibit a voltage measured at the end terminals that is the result of the battle between the applied current and the energy level of the cells. We term this the CHARGE voltage and it really isn’t the “voltage” of the battery pack at all. But as the battery state of charge increases, this measured voltage will as well – giving us an indication of charge level.

We can target any voltage we like as part of the charge process. Normally we charge LiFePo4 cells to 3.5volts times the number of cells in the pack. A 20 cell pack would be charged to a target voltage of 70 volts, for example. Your specific lithium batteries may specify a different charge voltage. You can set this target voltage at any time by entering the “v” command. “v193”, for example, would set a target voltage of 193v.

Once the TC Charger detects that the measured voltage equals the specified target voltage, it enters the CONSTANT VOLTAGE or CV phase. That is, it will adjust the current level so the applied energy “holds” the terminals at that voltage while continuing to charge the cells. If the voltage increases, it will lower the current. If the voltage decreases, it will raise the current in an effort to hold the target voltage exactly. It is accurate in doing this to perhaps +/- 0.8v

As the charge level increases in the battery pack, the current applied to hold this voltage will gradually diminish. For most LiFePo4 cells, the charge process is to END the charge when the current reaches 0.05C or 5% of the rated capacity of the cell. For a 100AH cell, this would be 5 amps. You can set this value with the “e” command to “end” the charge at that current level. “e4.5”, for example would terminate the charging process once the current level has diminished to below 4.5 amps.

NOTE

The TC Charger can operate from any AC voltage from 85 to 265 vac. But it will typically charge at much lower current levels at 120vac than at 240vac. This is because the typical 120vac circuit is limited to 15 amperes and there may be other devices on the circuit such as refrigerators or lighting. 240vac circuits tend to be dedicated to charging and capable of much higher currents. If you do want the option to charge at 120vac, MAKE SURE your ending or terminating current level is less than the default current level for the charger at 120vac. Otherwise, it will begin the charge process, but terminate the charge after two minutes.
ALL chargers actually have three primary limitations and these limitations are quite interactive. These limits are:

- **POWER**
- **VOLTAGE**
- **CURRENT**

These limitations will be listed on a label on the side of your TC Charger depending on the specific charger model purchased. It will also normally indicate a different current limitation for 120vac operation.

The important thing to understand is that **ALL THREE** limitations apply **ALL THE TIME**. And they are of course related.

For example, the 258v charger is limited to 18 amps in the 4000 watt model. But power is a function of voltage and current. So at 258 volts and 18 amps would be 4544 watts (258x18) which is beyond the ability of the charger. You can charge up to 258 volts, but your maximum current at that voltage level will be determined by 4000/258 or about 15.5 amps.

Similarly, using the same charger at 144 volts and 4000 watts would indicate a current level of 27.77 amperes. But this is quite beyond the 18 ampere current limitation and so you would be limited to 144v and 18 amps for 2592 watts.

The chargers are further limited to a minimum voltage of about 35 volts. And for voltage levels less than half of the maximum voltage, it will cut the current level in half as well, even though it continues to report the higher current level. We have no idea why this “feature” is included but we think it may be for charging packs that have been overdischarged to below 50% of normal voltage levels. It will charge at half current until the cells reach at least half of the maximum voltage of the charger.
Connections for the TC Charger are quite simple.

The charger controller has two wires and a cable.

1. Connect the red wire to the vehicle 12vdc supply. This supply must always be available when charging – a 12v battery or a DC-DC converter that is always on. This can be 7-18vdc but must always be available to power this controller.

2. Connect the black wire to frame ground. This is the return for the automotive 12vdc.

3. Connect the controller cable to the CANbus port on the TC Charger as shown. This is a weatherproof but rather delicate SP13 connector. Insert it gently and spin on the threaded collar to the mating receptacle. Do not overtighten.
**AC CONNECTIONS**

The TC Charger has a three wire AC input cable.

- **GREEN** – earth ground
- **WHITE** – neutral on 120vac or L2 on 240vac
- **BLACK** – hot on 120vac or L1 on 240vac

You would normally have this wired to your J1772 input circuit.

**DC CONNECTIONS**

The two wire DC cable:

- **RED** – Positive terminal of the pack
- **BLACK** – Negative terminal of pack or current measurement shunt on negative pack terminal.
SETTING THE CANBUS CONTROLLER

Before using your TC Charger, you must set the target voltage, current, and end point for the charger. This can be done using a USB miniB printer cable (included) and any laptop with an ASCII terminal program.

1. Connect USB cable between device (laptop) and the CAN controller module.

2. Launch your terminal program with the follow serial port settings:
   - Data rate: 19200
   - Data bits: 8
   - Parity: N
   - Stop bits: 1

The screen should appear as follows:
**TargetV** shows the entered target voltage.

**Actual**: shows the actual current pack voltage measured by the charger.

**ReqAMP** shows the requested current level

**Charging** shows the actual current level

**End** indicates the specified current level at which the charge process will terminate

**Ah** indicates the number of ampere-hours that have been charged since the program was launched.

**kWh** indicates the total number of kilowatt–hours that have been charged since the program was launched.

This display will show a continuously updated string as they are received – about two strings per second. There is also a time mark showing how long the charger has been charging.
**TO SET THE TARGET VOLTAGE**

Type `vXXX.x` or `Vxxx.x` and press ENTER where `xxx.x` indicates the target voltage. Good to 1/10th but you may omit the decimal fraction if desired.

Example: `v192`

Example: `V156.3`

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**TO SET THE TARGET CURRENT**

Type `axx.x` or `Axx.x` and press ENTER where `xx.x` indicates the desired charging current and press ENTER. Good to 1/10th but you may omit the decimal fraction if desired.

Example: `a15`

Example: `A16.7`

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**TO SET THE TERMINATING CURRENT**

Type `exx.x` or `Exx.x` and press ENTER where `xx.x` indicates the desired charging current and press ENTER. Good to 1/10th but you may omit the decimal fraction if desired.

Example: `e5.2`

Example: `E7`

*After setting these values and observing the effects, you may unplug the USB cable. These values will be retained in an EEPROM memory and used whenever your charger receives 240vac. You do NOT need to have a laptop connected thereafter to charge your vehicle. It will charge to the specified voltage at the specified current. Once it reaches that voltage, it will hold it until the current diminishes to the specified END level. And at that point it will terminate.*

You can reconnect your serial terminal program at any time to observe operation or alter these three variables.*