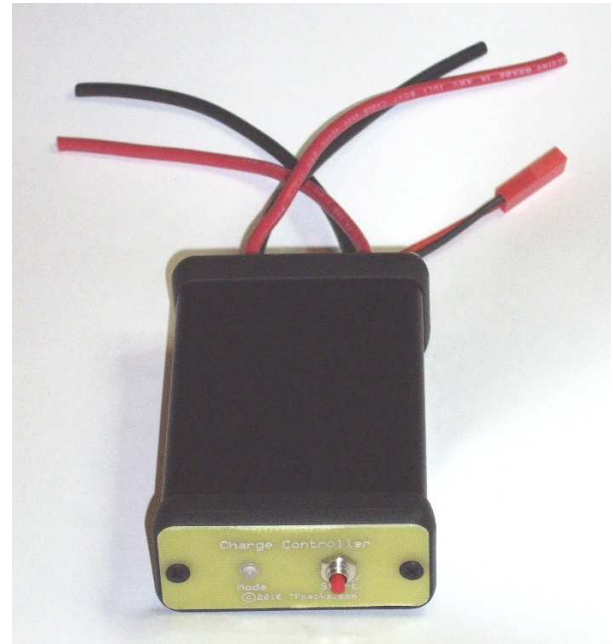


Charge Controller

Assembly and Test Instructions

Parts List Changes

- R1: 15K 1/2W
- R2, R3, R4: 1K 1/8W
- R6, R7: 10 ohm 1/8W
- R5, R9, R10, R11-R16: 10K 1/8W
- R17, R18: 4.7K 1/8W
- R8: .005 ohm 5W 1% current sensing resistor
- C3: 100uF 50V electrolytic
- C4, C7: 10uF MLCC
- C1, C2, C5, C3, C9: .1uF ceramic
- C8: .01uF ceramic
- D1 15V 1W Zener
- D2: 1N4007 1A
- D3: 1N914
- LED1: Red/Green LED
- Q1: FJP9100TU NPN
- Q2, Q3: N-Channel FET (IPP04CNE8NG)
- SCR1, SCR2: 2N5064
- U1: LM78L12
- U2, U3: Dual TLC2272 op-amp
- U4: IXDF404 gate driver
- 2-pin header
- Shunt
- 2-position Phoenix 3.5mm mini-terminal block (2 required)
- VR1: 100 ohm trim pot
- Extruded aluminum case
- RY1: Miniature 12V SPDT relay
- SW1: SPST miniature pushbutton switch
- 2-pin JST/BEC Male/Female Pigtails



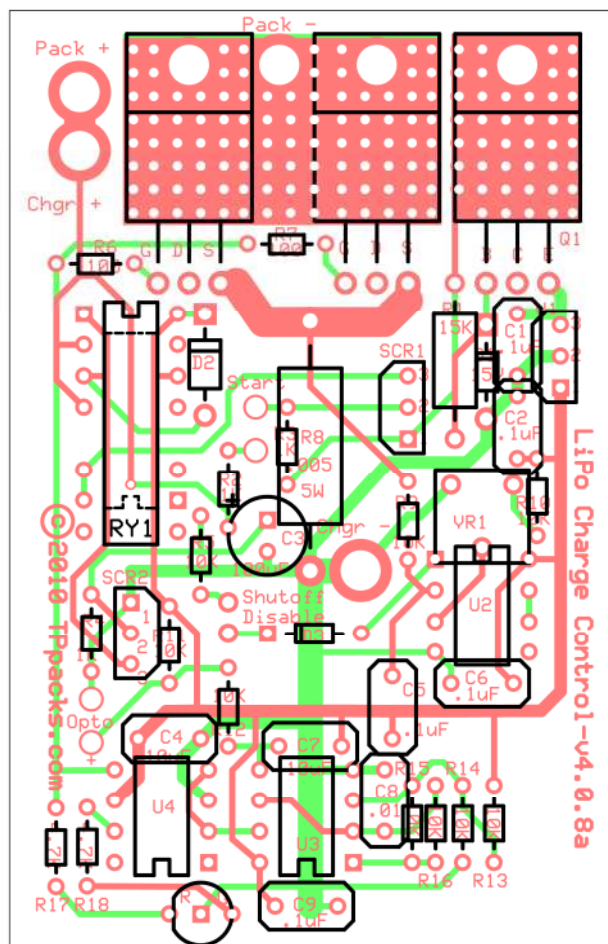
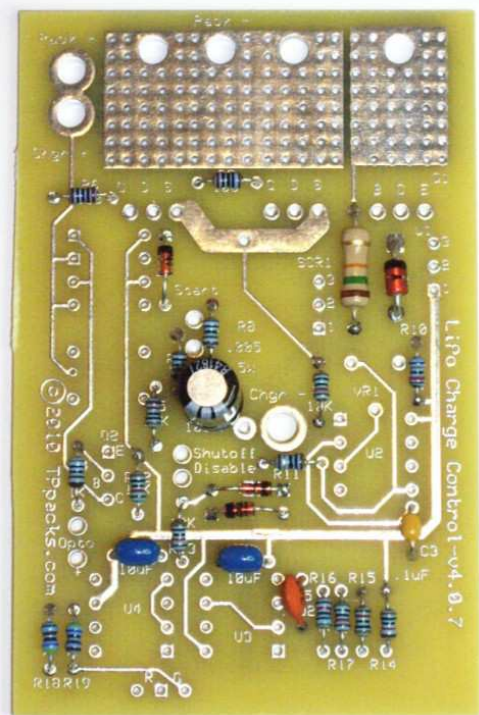
A complete schematic is provided as an attached addendum, to this document. Please refer to this schematic for parts reference.

Preparation

As with all CMOS-based electronic parts, care must be given to work in a static-free environment. These semiconductor parts are susceptible to damage, from static electricity. Start with the side of the board with the printed nomenclature facing up. Use the placement guide shown here to orient the parts to be installed. Be sure to place the semiconductor parts in the proper orientation. Pin 1 of the TO-92 part is installed in the hole with the square pad. Pin 1 of the 8-pin DIPs are marked with a square pad as well. The cathodes of the diodes have square pads, as does the positive side of C1, a polarized electrolytic. The red side of the 3-wire LED has a flat spot, and the green side has the shortest leg.

Parts Installation

It is easiest to start with the vertically oriented resistors. Bend the leads on each 90 degrees, right at the ends of the resistor, and place them on the board in the positions indicated. It doesn't matter which end goes where, as resistors are not polarized. Once installed, bend the wires slightly, in order to hold the resistors in place.



Solder all of these in place, and then trim the leads. Next, install, solder and trim the rest of the "flat parts", including the capacitors and the diodes. The striped end of the diodes is the cathode, and goes in the hole with the square pad. Only C1 is polarized, and the positive lead goes in the square-padded hole.

Continue on to install the 8-pin DIPs, which have a notch to indicate pin 1. Again, pin1 goes in the hole with a square pad.

Next comes the TO-92 parts. With the nomenclature and flat face towards you, and the three legs exiting towards the bottom, pin 1 is the first one, on the left. The larger TO-220 parts, the two FETs (Q2 and Q3), and the power transistor (Q1), mount with the metal tab against the PCB.

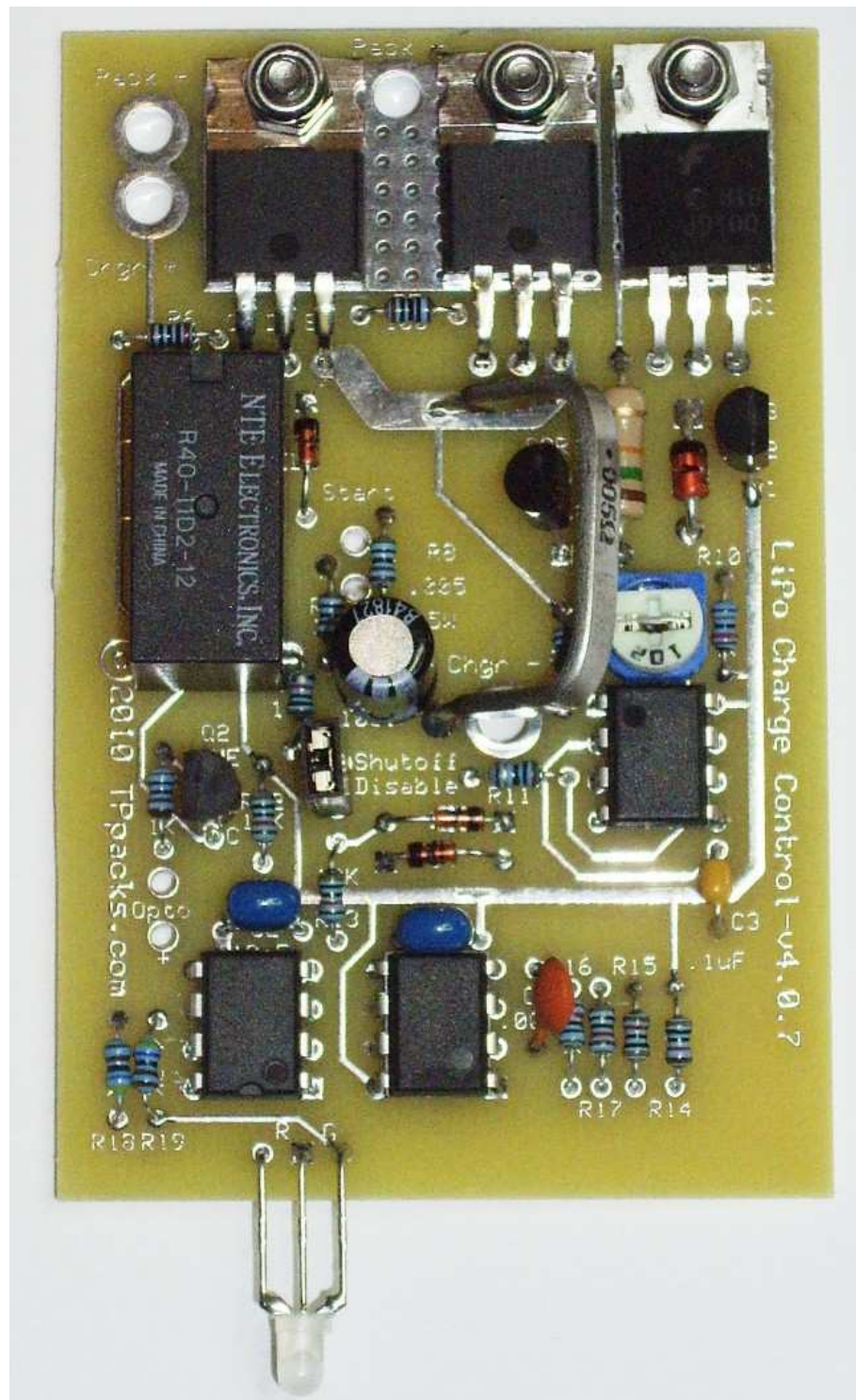
The 1K trimmer pot and the .005 ohm 5W current measuring shunt can be installed next. The shunt legs will have to be bent over to the right slightly, to fit inside the case.

The three TO-220 parts should be bolted to the PCB using M3x6 mm, or M3x8 mm button-head screws and locknuts.

The relay is sized to fit in the space of a standard DIP, either a 16-pin format, if a DPDT-type is used, or a 10/12-pin layout, if a SPDT relay is used. For the latter, the 2nd set of holes down are the 1st ones used (see dashed lines on layout picture on page 2), and is oriented 180 degrees from the 16-pin DPDT format. Pin 1 of the 12-pin is in the same location as pin 10, for the DIP-16 pinout. Note that pin 1, in both cases, has a square pad.

The two-pin header is installed next, along with the matching jumper/shunt.

Finally, the two 2-position 3.5mm mini-terminal blocks can be installed in the holes marked for the "Start" button and for the "Opto" connection, or these can be hard-wired with small-gauge hookup wire.



The LED leads should be left about .375" long, and bent over 90 degrees, so they will fit into the hole in the custom end-plate.



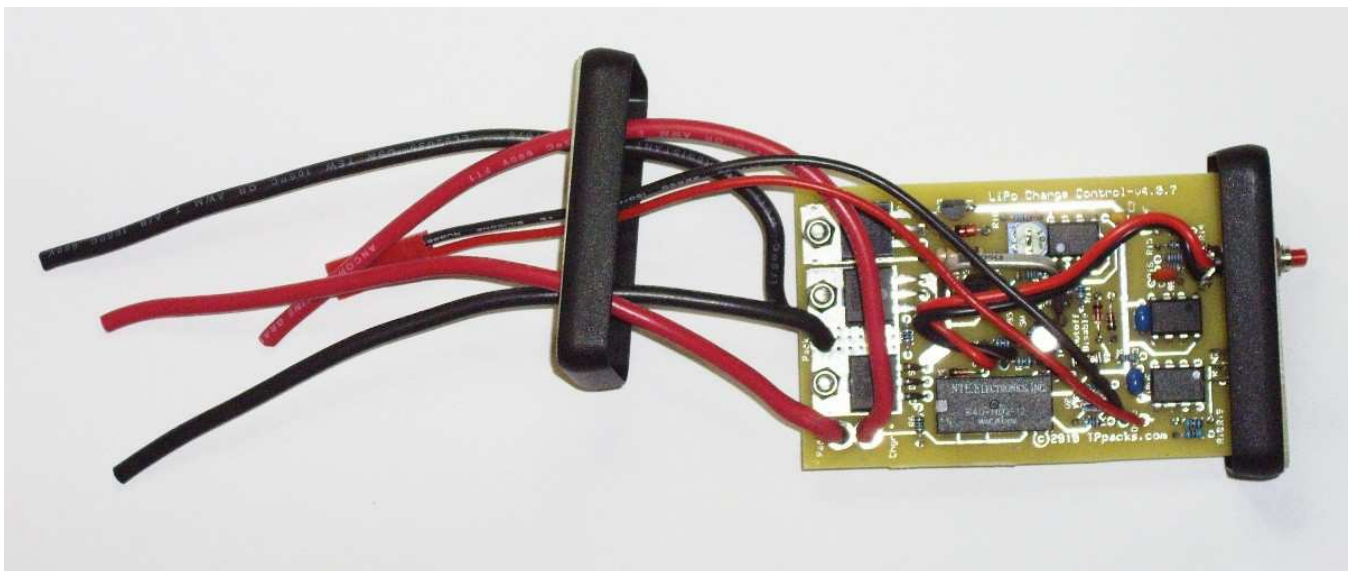
There are two custom end plates that are used as replacements for the ones that come with the small enclosure. They might need some slight trimming, but should fit snugly into the frames, as shown.

The PCB slides into the side rails. Use the slots just below the screw holes for the end plates. Make sure the shunt resistor is bent over far enough to clear the inside top of the case.



Final Assembly

Two sets of 12-14-gauge wires are used to connect to the charger/supply, and then to the pack. These need to be fed through the marked holes on the end plate, and soldered onto the board in the marked locations. The two-wire JST-BEC pigtail needs to be fed through the smaller holes in the middle of the end plate, and soldered to the appropriate pads, or screwed into the mini-terminal block, if those are being used. The small pushbutton switch should be installed in the other end plate, and wired to the "Start" button pads, or screwed into the mini-terminal blocks, if used. Leave the "Start" button wires long enough that the end plate can be pulled approximately 1" away from the end of the PCB



Once testing and current adjustment tasks are completed (see the next section), the completed assembly can be installed in the case, which is basically a square-shaped extruded aluminum tube, with slots in it. Use the screws that come with the case to attach the end cap/plate.

Test Procedures

There are three main functional areas within the Charge Controller logic, the 12V regulator/auto-shutoff section, the current measurement section and the PWM/FET control section. For testing purposes, prior to hooking up the Charge Controller to the actual pack, the auto-shutoff disable jumper/shunt needs to be temporarily removed.

To initially test that the 12V regulator is working properly either the actual supply/charger that will be used for charging can be used, or a variable lab supply, set to about 20-25V. Connect the supply to the Charger + and – input leads, and then press the “Start” button. The LED should light up red, or red. If it doesn't, the first thing to check is to see if there is a voltage at pin 3 of SCR1. It should be equal to the supply voltage. This is the other side of the relay's normally closed (NC) connection. If there is a voltage present, check the output of the 12V regulator, which is pin 1 of U1. If there is nothing, work backwards, and check the input to the regulator, which is U1pin3. You should see about 15V. If the +15V is present, the 12V regulator is either bad, or maybe installed backwards.

Assuming the LED comes on, that says the 12V regulator is working properly. The next test is to see if the auto-shutoff logic works. To test this, simply short out the two jumper pins. Since no current is flowing through the FETs, shorting the pins will briefly connect the output of the current control section to the auto-shutoff section. With no current flowing, this output should be high, which will turn on SCR2, if the jumper is in place. When SCR2 comes on, it energizes the relay coil, which breaks the normally closed connection, cutting the input power to the 12V regulator. The LED should go off, and stay off.

Next, the HVC/opto “throttling” logic can be tested. All that is required is to use a resistor to short out the opto input pads. The value is not critical; anything from 1k to 10k would work fine. Press the “Start” button, to verify that the LED comes on red again. Briefly short out the “Opto” pads with the resistor. Each time this is done, the LED should switch from red to green..

At this point the major sections have been successfully tested. The final task is to check out and adjust the low-current shutoff logic. For this a load is required, or the pack needs to be connected, and something utilized to measure current, such as a WattMeter. The auto shutoff jumper/shunt should also be re-installed. The HVC/opto plug can be left disconnected, for now. The “Start” button should be pressed, and the LED should come on and stay on. If it doesn't stay on, try adjusting the trim pot to somewhere in the middle, and press the “Start” button again.

Adjusting the trim pot will vary the point where the relay engages, cutting power to the board. The adjustment range is from 0 to about 3A. The easiest way to test/adjust this point is during an actual charge, with the pack connected..

After the current trim pot has been set, the board can be re-installed in the case, and the end-caps attached.