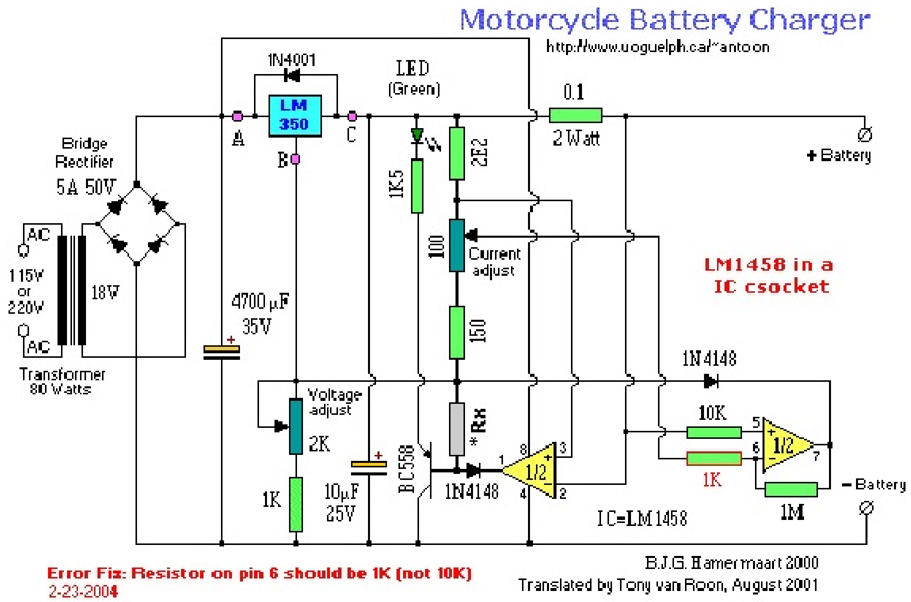

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This 3A charger was srcinally designed to work with small batteries like those used in motorcycles. In principle it can be used to charge car batteries also but will take a lot longer.
The charger below charges a battery with a constant current to 14.1 volt. When this level is reached, the current charge drops automatically to a safer level (13.6V) and keeps charging at this slower rate untill the LED lights up indicating a fully charged battery. This project looks very much alike with the Gel cell II charger elsewhere posted in the 'Circuits' section. The difference is the IC, namely a LM1458 instead of a LM301A. Nice job Jan!

Description:

The LM350 is an adjustable voltage regulator and keeps the voltage between points C and B at 1.25 Volt. By adding a 1K resistor between point B and gnd (-) you can, as it were, lift up the output voltage. To accurately control the output voltage we add to this resistor, in series, a 2K adjustable 10-turn potentiometer. As soon as a battery is connected a current flow occurs, controlled by the right halve of the LM1458. The current through the 0.1 ohm resistor causes a voltage drop. This drop is compared with the voltage on the walker of 100-ohm pot. The moment this drop is greater than the one adjusted with the potmeter will cause the output of the LM1458 IC to go low and a small current starts to flow thru the diode and this in effect will reduce the current through the series resistors 1K + 2Kpot. The current is hereby stabilized.

The point between C and B is devided by three resistors; 2.2 ohm, 100 ohm pot, and the 150 ohm. 2.2 ohm and the 100 ohm potmeter are connected to the non-inverting input (+) of the LM1458 IC. The inverting input (-) is connected to the 0.1 ohm wire-wound resistor in series with the output. As long as the voltage drop, caused by the current-flow over this resistor is greater than the voltage drop over the 2.2 ohm resistor the output of the LM1458 will stay high and in turn block the BC558 transistor. But as soon as the charge current falls below a specific value the 1458 will go low and turn on this transistor which wich activate the LED. At the same time a small current will flow thru the 'Rx' resistor, which will cause that the output voltage of the charger switches to 13.6 Volt. This is a very safe output voltage, and does not cause overcharging to the battery and remains fully charged (trickle).
Rx should be an experimental value determined below; a mathematically calculation is possible but the exact

The LM350 can be substituted with a NTE970, and the BC558B with a NTE159 if you wish.
The adjustments for this charger are really simple and the only thing needed is digital multimeter. The LM1458 should **NOT** be in the socket while doing the first adjustment. When no battery is connected there is no current flow thru the 0.1 ohm resistor and therefore pulling the output low. So no IC yet in the socket. Do **NOT** connect a battery also. I know that is obvious to most of us, but some people... :-)
Okay, here we go:
1. Connect the multimeter (set for Volt DC) to the '+' and '-' battery output and adjust with the 2k trimpot the output voltage to 14.1 Volt.

2. Switch the power off. Discharge the capacitors (short them out with a piece of wire).

3. Now insert the LM1458 IC carefully (check no pins are bend underneath the chip).

4. Switch the power back on and make the resistor marked **Rx** such a value that the output voltage reads 13.6 volt exactly.

5. Swith the multimeter to 'Amp-dc'. Turn the 100-ohm trimpot all the way CCW. Connect the 'to-be-charged-battery' (e.i. NOT a fully charged battery) and turn back the trimpot untill the current load is 0.1 X the battery capacity (max 3A). Example: A 16Amp battery adjusting to 1.6A. If you don't have an Amp meter on your multimeter you can use the 2-volt setting on your meter and connect it over the 0.1 ohm resistor. The current is volt devided by 0.1, so for 3A the meter should read 0.3 volt.

That's it. To get the Rx value you could also use a trimpot until you get the 13.6volt and then read the ohm's value of the trimpot and replace with a resistor. In my opinion this resistor should be a metalfilm type at 1 or 2% tolerance.

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The Technical bits:

For those of you interested in how the value of essential components was calculated, read on. You may be able to design your own charger for use with a different current or voltage (like 6-volt).
Calculations srcin from the voltage between points C and B of the LM350 regulator. When a resistor is connected between these two points, enough current starts to flow that the voltage over this resistor measures 1.25 volt. In our case, the resistor total is 2.2 + 100 + 150 =252.2 ohm. Because we deal with very small currents the calculations are performed in milliamps and the calculations of resistance in Kilo-Ohms. Thus, the current thru this resistor is 1.25 / 0.2522 = 4.9564 mA. The same current also flows thru the 1K & 2K series resistors. We want the output voltage to be 14.1 volt, meaning the voltage drop over these series resistors must be 14.1 - 1.25 = 12.85 Volt.
The total resistance value thus must be 12.85 / 4.9564 = 2.5926 Ohms. To enable us to adjust it to this value, one of the resistors is chosen as a 10-turn trimpot (trimmer potentiometer). Together with the 1K in series (making it a total of 3K)we can adjust it to this correct value.
The **Rx** value is calculated this way; In this scenario we like to have a output voltage of 13.6 volt, in other words, the voltage on the connection point between the 1K/2Kpot should be 13.6 - 1.25 = 12.35 volt. This means that the current thru the 'voltage-divider' will be 12.35 / 2.5926 = 4.7635 mA and the leftover current should be 4.9564 - 4.7635 = 0.1929 mA thru Rx and also cause a voltage drop of 12.35 - 2.78 = 9.57 volt. Measuring this calculated value at the base of the BC558 transistor was 2.78 volt after the output of the LM1458 had become low. With the current of 0.1929 mA the result has become9.47 / 0.1929 = 49.611 Kilo-Ohm. A resistor of 47K would come close enough. Ofcourse you could also use a 50K trimpot to adjust the value even more accurately.
The 1K5 (1500 Ohm) resistor in series with the LED is to limit the current thru the LED below 20 mA.

The adjustment with the 100-ohm trimpot determines the maximum charge current. The voltage on the walker of this trimpot varies between 10.9 mV - 506.54 mV. The current is this way made adjustable between 0.1A - 5A, but we should not go that far because the LM350K can not handle anything over 3Amp. If we chose a trimpot with a value of 50 ohm, then on the other hand the 3A can not be obtained. So, careful adjustment is the remedy. Take your time!

With this information it is a simple task to calculate the dissipation values of the resistors. In other words, the product of the resistance multiplied with the current in square (I2xR).
The only resistor which gets it difficult is the 0.1 ohm, but then again, not by much 3 x 3 x 0.1 = 0.9 Watt.
Rest us to calculate the power. For that we have add a couple of voltages. We have the input voltage of 14.1, the voltage drop over the resistor, 0.1 x 3 = 0.33 volt, and 3 volt minimum over the LM1458 for proper function, total 17.43 volt. The transformer provides 18V (effective). With ideal rectifying this should total 18 x 1.41 = 25.38 volt. There are however losses via the diodes and bridge rectifier so there is about 23.88 volt remaining. Not much tolerance to play with, on the other hand, too much causes energy loss in the form of heat anyway.
The voltage drop over the buffer capacitor may not be lower than 17.43 volt, meaning, the ripple voltage may reach about 23.88 - 17.43 = 6.45 volt. By double-fase rectifying is the ripple voltage equal to I/(2xfxC) whereby I is the discharge current, f is the supply frequentie and C is capacity of the buffer capacitor in Farad.
Exchanging places this would give C = 3/(2x50x6.45) = 0.004651 Farad, or 4651 uF. A standard value of 4700 uF with a minimum voltage value of about 35-40 Volt. The other capacitor is not very critical and is only there to kill small voltage spikes which could influence the operation of this charger otherwise.

The bridge rectifier gets a good workout also and it is therefore recommended to chose NOT a too light a unit. A 5A rectifier is often too small, better to take a 8 or 10A type. These are readily available everywhere.

Last but not least, the transformer. The buffer capacitor has approximately 25 volt accros. The current is 3A. This calculates to a power of 25 x 3 = 75 watt. This transformer has its own problems with powerloss (naturely occuring) and so a unit of about 80 watt is acceptable.
Never attempt to charge a 6 volt battery with a 12 volt charger; you are asking for trouble. Good luck all!

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