SMART KIT No. 1027

Ni-Cad BATTERY CHARGER

GENERAL DESCRIPTION

A sophisticated universal battery charger that will charge your batteries safely. It has indicators to show that it is working and that the batteries to be charged are connected to the circuit. It can be adjusted to four different charging currents to cater for different battery types and also has two different voltage outputs to accommodate more batteries in series.

HOW IT WORKS

The circuit is basically a constant current source whose output current can be selected by means of the selector switch S2. The op-amp 741 is there to monitor the output of the circuit and disconnect the circuit if there are no batteries connected to it, or if they have been connected the wrong way round. If the batteries are connected correctly and have a minimum remaining voltage of 1 V each (typical condition for discharged 1.2 V Ni-Cad cells which should never be left to discharge below that level) then the circuit will detect them and will start charging. In this case, to indicate that all is well the LED D10 will illuminate and will stay on as long as the batteries are in the circuit and they are charging. At the same time the other LED D9 will also glow if the current flowing through the circuit is correct. The use of the two LED's to give an indication of the operating conditions of the charger makes its use safer for the batteries.

If more than one batteries of the same type are going to be charged at the same time, they should be connected in series and the output current selected should be the recommended by the manufacturer for this type of cell. (Usually the charging current of a Ni-Cad in mA is 1/10 its capacity in mAh.) The usual charging time is 14 hours and if the current is correct no harm will be caused if the cells are left on the circuit a bit longer.

As you see from the diagram the circuit also has a voltage selector switch to change the input voltage. When you are charging few batteries and the output voltage required is low then you should choose the lower voltage input in order to avoid putting too much strain on the output transistor TR3, which would otherwise have to reduce the output voltage dissipating a lot of heat in the process. You don't have to measure the output voltage to know if you must change the position of S1. If you choose the lower voltage input and both LED's glow steadily then you can leave it as it is. If the LED D9, which is used to indicate that the output voltage is correct for the number of cells that you are charging, fails to light then you have a clear indication that the higher voltage input must be selected.

The resistor marked Rx has not been include on purpose to let you include a «custom selected» charging current for your particular needs. The value of Rx is calculated if we divide 0.7 by the charging current required in Amperes. The

circuit with the other three resistors can supply 50, 200 and 400 mA by selecting R11, 12 and 13 respectively.

As you see the circuit has almost everything on the p.c. board (even the selector switch is included) and the only external components required are the mains transformer and the output connectors.

CONSTRUCTION

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up considerably and reduces the possibility of making errors. Smart Kit boards also come pre-drilled and with the outline of the components and their identification printed on the component side to make construction easier. To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and makes soldering easier.

Soldering the components to the board is the only way to built your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it. DO NOT file or sandpaper a dirty or worn out tip. If the tip cannot be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time. DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work.

In order to solder a component correctly you should do the following:

- Clean the component leads with a small piece of emery paper.
- Bent them at the correct distance from the component body and insert the component in its place on the board.
- You may find sometimes a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board. In this case use a mini drill to enlarge the holes slightly. Do not make the holes too large as this is going to make soldering difficult afterwards.
- Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead emerges from the board. The iron tip must touch the lead slightly above the p.c. board.
- When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and allow the

solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked, or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it.

Take care not to overheat the tracks as it is very easy to lift them from the board and break them.

When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component.

Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together.

When you finish your work cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that still remain on it.

Building the battery charger is very straightforward and you should have no difficulty if you follow our directions. The least sensitive components should be soldered on the board first and the project should be gradually completed following a logical sequence in order to avoid making mistakes. So as a guide we recommend that you start with the pins and the IC socket, continue with the resistors and the capacitors and conclude your work with the diodes and the transistors. You must be careful with the electrolytic capacitors and the semiconductors as they are polarised and should be inserted the right way round.

The output transistor must be fitted with the heatsink sup plied with the kit as it gets quite hot in operation especially when the circuit is used to charge high capacity batteries of low voltage.

When everything is in its place, connect the switches with the board, the mains transformer in the input as it is shown in the circuit and a discharged battery in the output of the circuit with the positive pole at point 8 and the negative at point 7.

Select by means of S2 the right charging current for the battery you have connected and connect the circuit to the mains. Both LED’s should glow and the battery should start charging. If you disconnect the battery from the circuit the LED’s should go OFF.

IF IT DOESN’T WORK

- Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems.
- Check again all the external connections to and from the circuit to see if there is a mistake there.
- See that there are no components missing or inserted in the wrong places.
- Make sure that all the polarised components have been soldered the right way round and the IC is also inserted the right way round.
- Check your project for faulty or damaged components.

ELECTRICAL SAFETY

This circuit is powered by a mains transformer (not included) so 230 VAC is present in some of its parts.

Voltages above 50 V are DANGEROUS and could even be LETHAL.

In order to avoid accidents that could be fatal to you or others please observe the following rules:

- DO NOT work if you are tired or in a hurry, double check everything before connecting your circuit to the mains and be ready to disconnect it if something looks wrong.
- DO NOT touch any part of the circuit when it is under power.
- DO NOT leave mains leads exposed. All mains leads should be well insulated.
- DO NOT change the fuses with others of higher rating or replace them with wire or aluminium foil.
- DO NOT work with wet hands.

If you are wearing a chain, necklace or anything that may be hanging and touch an exposed part of the circuit BE CAREFUL.

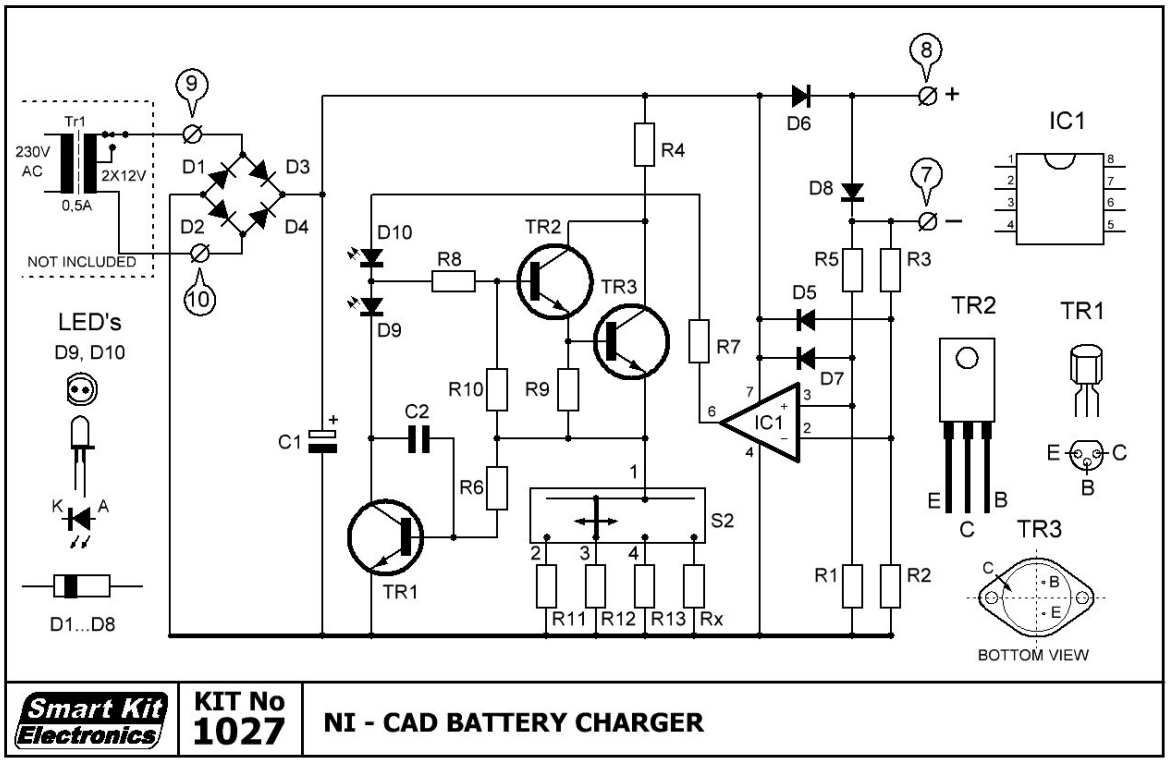
- ALWAYS USE correct mains lead with the correct plug and earth your circuit correctly.
- If the case of your project is made of metal make sure it is properly earthen.
- If it is possible use a mains transformer with a 1:1 ratio to isolate your circuit from the mains.
- When you are testing a circuit that works off the mains wear shoes with rubber soles, stand on dry non-conductive floor and keep one hand in your pocket or behind your back.

If you take all the above precautions you are reducing the risks you are taking to a minimum and this way you are protecting yourself and those around you.

A carefully built and well insulated device does not constitute any danger for its user.

BEWARE: ELECTRICITY CAN KILL IF YOU ARE NOT CAREFUL.

Schematic Diagram



Parts List

All components including printed circuit board, assembly instructions including schematics and detailed parts list are supplied when you purchase the kit.

Ordering

For pricing info and online ordering please visit:

http://www.quasarelectronics.com/1027.htm

For further info please contact us by e-mail:

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