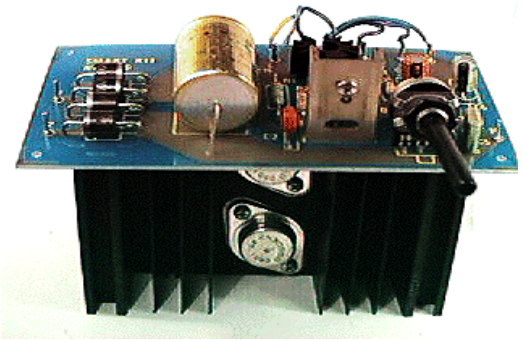
QUASAR ELECTRONICS
PROJECT No. 1096

2-30 V/5 A STABILIZED POWER SUPPLY

General Description

This project is an easy to build, powerful, stabilised power supply with variable output voltage from 2 to 30 Volts and a maxi mum power rating of 5 A. It is very easy to build and it has been designed to cover almost all the voltages needed in the electronics laboratory. The power rating is require probably much higher than what any project will ever but it is there just in case !



Technical Specifications - Characteristics

Input voltage: ..... 24 VAC
Maximum I/O current: ..... 5 A
Output Voltage: ..... 2 - 30 VDC
Output fluctuation: ..... 0.2 % max

- Electronic voltage stabilisation.
- Simple and continuous voltage adjustment.
- High output current.
- High reliability for long, trouble free service.

How it Works

The circuit has a rectifier bridge in its input (D1-D4) which is connected across the secondary of the mains transformer (pins 1 and 2). The capacitor C1 smoothes the output of the rectifier and C2 blocks any stray high frequencies that may cause instability in the operation of the LM317. The DC output is applied through R1 to the input of U1 (LM317) which is a variable output voltage regulator. The output voltage is adjusted by means of the potentiometer P1 and the IC will maintain the output voltage at the preset value regardless of the current drawn by the load, provided it is within the circuit's power handling capabilities.
The diode D5 protects the regulator from any discharges of C4 through U1 that could be catastrophic. Similarly the other diode D6 protects U1 from any spurious discharges of C3. The resistor R5 is there to load the IC's output so that there is always some current flowing to keep the circuit working, even if there is no load present in the output. The capacitor C3 takes care of any voltage fluctuation present, improving the quality of the DC output considerably.
The regulator itself has not been designed to control heavy currents and in order to make a power supply that can deliver up to 5 A in its output it is necessary to use transistors which can take the extra load. In this circuit we use three transistors Q1,2 and 3. Q2 and Q3 are connected in parallel to increase their power handling capability and Q1 is used as a driver for the other two. The two resistors R3 and R4 are connected in parallel and are there to provide the necessary bias to the bases of Q2 and Q3.
The two capacitors C4 and C5 across the output of the circuit block high frequencies which could possibly cause instability to the output of the power supply.

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. QUASAR ELECTRONICS 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 also makes soldering easier.
Soldering the components to the board is the only way to build 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.
- Bend them at the correct distance from the component's 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 leave 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 may still remain on it.

The project has very few components and apart from the two power transistors and the potentiometer everything else is soldered directly on the printed circuit board. The outlines of all the components have been clearly stencilled on the PCB and you should have no difficulty in locating and soldering them in their places. As the circuit is going to be used with quite heavy cur rents flowing through some of its parts it is necessary to make as good joins as you possibly can, and to make everything as neat and orderly as possible.
Follow the general advises given above as close as you can and plan your work so that you solder

first of all the pins and the resistors, then the capacitors and finally the diodes, the transistors and the IC, to avoid overheating and possibly damaging the most sensitive components. The large resistor R1 should be kept 2 - 3 mm above the board, to allow air circulation, because it can get quite hot at times. Be careful with the electrolytic capacitors which are polarised and should be placed the right way round. The IC should be fitted with a small heatsink (supplied) and it must also be inserted the right way round. The heavy white line in the outline of the IC, on the side of the heatsink, is the metal base of its case and the device must be soldered in place with the same orientation. Do not hold the soldering iron on the pins of the IC (and for that matter all the other semiconductors) as excess heat can destroy them.
The two power transistors must be mounted on the large heat sink supplied with the kit. Use the insulating washers and the mica insulators that you will find in your kit to insulate the transistors from the heatsink and make sure that there is no electric contact between the transistors and the aluminium heatsink. Do not forget to smear some heat transfer compound on the touching surfaces and to tighten the screws as much as possible to ensure that heat is dissipated as much as possible through the touching surfaces. Use heavy gauge cable to connect the transistors with the P.C. board according to the practical diagram.
BE VERY CAREFUL BECAUSE ANY MISTAKE IN THESE CONNECTIONS CAN DESTROY THE OUTPUT TRANSISTORS !!!
The potentiometer can be mounted directly on the PCB or fitted in the front panel of the case and connected to the board with a length of cable. Be careful to wire it so that the output voltage increases when the potentiometer is turned to the right.
Fit the small round heatsink to Q1 and inspect your work for any mistakes, components left out or leads left unsoldered. It is much better to invest in some time to make a careful inspection of everything than having to spend a lot of money in expensive repairs which can be avoided.
Using heavy gauge cable (having at least 1.5 mm cross section), connect the secondary winding of a 24 V/5 A mains transformer across the AC input of the circuit (pins 1 and 2). Place a fuse in series with the primary winding of the transformer rated at 800 mA and using a properly insulated mains lead, connect the transformer's primary winding to the mains. If you connect a voltmeter across the circuit's output at pins 9 (+) and 11 (-), it must give you an indication of the output voltage and turning the potentiometer in either direction the voltage should change accordingly.
The output voltage should change continuously and smoothly between 2 and 30 Volts and it should not change from the preset value when a load is connected in the circuit's output.

Adjustments

This kit does not need any adjustments, if you follow the building instructions.

Warning

QUASAR ELECTRONICS kits are sold as stand alone training kits.
If they are used as part of a larger assembly and any damage is caused, our company bears no responsibility.

While using electrical parts, handle power supply and equipment with great care, following safety standards as described by international specs and regulations.

CAUTION
This circuit works from the mains and there are 220 VAC pre sent 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
members of your family 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.

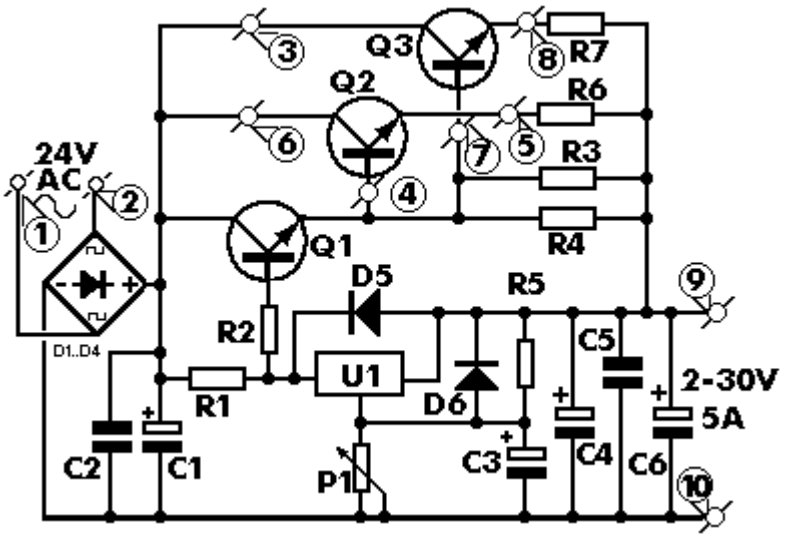
- DO NOT leave mains leads exposed. All mains leads should be well insulated.
- DO NOT change the fuses with others of higher rating or replace them with wire or aluminium foil.
- DO NOT work with wet hands.
- If you are wearing a chain, necklace or anything that may be hanging and touch an exposed part of the circuit, BE CAREFUL.
- ALWAYS USE a proper mains lead with the correct plug and earth your circuit properly.
- If the case of your project is made of metal make sure that 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.

If it does not 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. - Make sure the supply has the correct voltage and is connected the right way round to your circuit.
- Check your project for faulty or damaged components.
If everything checks out and your project still fails to work, please contact us for information on our Get-You-Going service.

Electronic 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/1096.htm

For further info please contact us by e-mail:

mailto: sales@QuasarElectronics.com
