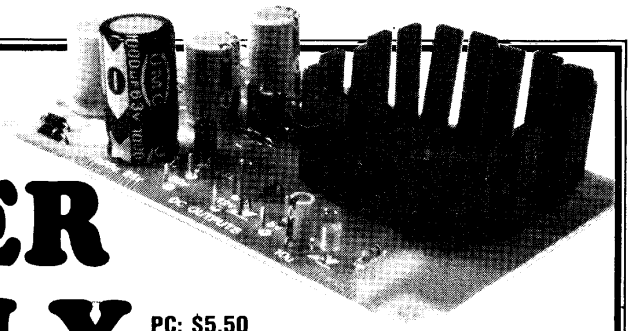
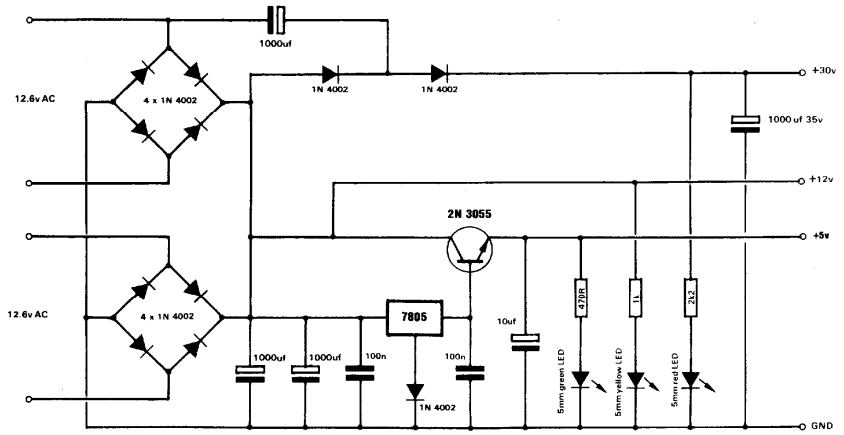
TEC POWER SUPPLY



PC: $5.50
Parts: $13.90
Complete Kit incl. Transformer, PC & case: $44.25



With the gradual expansion of the TEC, we have come to the stage where we have run out of voltage and current from a plug pack.

A 12 volt 500mA plug pack may sound ideal in theory but when you connect it to a project requiring about 300mA, a cruel thing happens. The output voltage falls from 12v to 10v!

This may be ok if you are dropping it down to 5v via a regulator, but when you want the full 12v for say a voltage doubling operation, 10 volts is not enough!

For too long we have been gulled into believing the ratings of transformers and plug packs. It's only when we require the full rated output that we realize it will not produce.

We learnt our first lesson with the 2155 in a power supply some years ago. Its stated output is 15v AC at 1 amp and this really means 1 amp AC. It also has an AC rating of 15VA and this is very similar to saying 15 watts.

But as soon as we place a 2155 in a power supply we convert the AC to DC via a bridge and gladly accept the output rise to about 21v DC, which is about 40% higher than the AC voltage.

Since the volt-amp rating of the transformer is a CONSTANT (a **constant** is a value in a formula which does not alter) and is 15VA, we must derate the output current to 700mA to maintain the rating of 15VA (or 15 watts).

Thus we can safely draw only about 700mA from a 2155.

There are further projects being designed for the TEC and they include a VDU, possibly for the next issue. The VDU board takes about 350mA, making a total very near the maximum for a 2155 and above the capability of a 500mA plug pack.

We also have a Relay Driver board requiring 12v-15v for the relays and an EPROM BURNER, in this issue, requiring 30v.

All this has led us to design a power supply capable of delivering these 3 voltages. At a later date it can be expanded to deliver about 1.4 amps to the 5v line, to cater for fully expanded TEC's.

The TEC Power Supply is not only for the TEC, but will also power any other project requiring one or more of these voltage.

The project is mounted in a neat plastic case as supplied by Altronics and Dick Smith and is the LARGER of the two (in the range).

These cases make the project look very professional and can accommodate both 2155's and the PC board. The floor of the case has a number of spigots for mounting the board and transformer(s) so that everything fits firmly and neatly in position.

As with all projects which involve connection to the mains, this project must not be connected until it is checked by someone with experience.

The first question you will ask is "Why use two 2155's and two bridges."

The answer is simple. Working with currents up to 1 amp produce very few problems. Components such as diodes, regulators and transformers are designed for a maximum of 1 amp. When you go over 1 amp, the problems start.

Nothing is designed for 1.5 amp or 2 amp and in fact high power components start at 3 amp.

This means a 1.5 amp or 2 amp power supply falls into the middle of component availability.

The cheapest and best solution is to produce two 1 amp supplies and parallel them up. This is what we have done. Two 2155 transformers are taken to two bridges and from there the current gets divided between the three outputs. Most of the current will be required by the 5v line while the 15v and 30v lines will not require heavy currents.

In practice, only about 30-50mA will be required on the 30v line for the EPROM BURNER and only about 100mA for the Relay Driver board.

HOW THE CIRCUIT WORKS

The circuit is basically a 7805 regulated power supply with a series pass 2N 3055 transistor to supply the current for the 5v rail.

The 15v rail is taken from the input to the regulator and is filtered and smoothed DC, but not regulated.

Referring to the circuit diagram, the 30v rail is obtained by voltage doubling the 15v line. The top bridge is responsible for this and means it is the bridge which operates when only ONE transformer is used. The lower bridge provides the back-up when more than about 700mA total is required.

The 5v line has some interesting points.

The output transistor is an emitter follower in which the base voltage is determined by the output voltage of the 7805 regulator. As we know, the emitter of a transistor in an emitter follower arrangement is .6v lower than the base. Thus, to obtain a 5v output, we must supply the base with 5.6v. This is achieved by placing a diode in the 'common' line of the 7805 and increases the output by .6v. Thus it emerges from the 2N 3055 at exactly 5v.

In this arrangement we have lost the shut-down facility of the 7805. But since we have found this to be very unreliable with a 2155 transformer, nothing has really been lost.

PARTS LIST

1 - 470R ¼watt
1 - 1k
1 - 2k2

2 - 100n greencap
1 - 10mfd electro
3 - 1000mfd 16v or 25v
1 - 1000mfd 35v or 63v

11 - 1N 4002 diodes

1 - 5mm red LED
1 - 5mm green LED
1 - 5mm yellow LED

1 - 7805 regulator
1 - 2N 3055 transistor

1 - T0-3 heatsink

2 - 4BA nuts and bolts
3 - 6BA nuts and bolts

10 x 20cm hook-up flex
1 - 2 pin DIN socket
1 - 3.5mm socket
1 - RCA socket

1 - 2155 transformer
4cm heat-shrink tubing
1 - cord clamp
1 - power cord and plug-top
1 - solder tag for earth lead
1 - H 0482 case
1 - SPDT switch for mains
heatsink compound

1 - TEC POWER SUPPLY PC

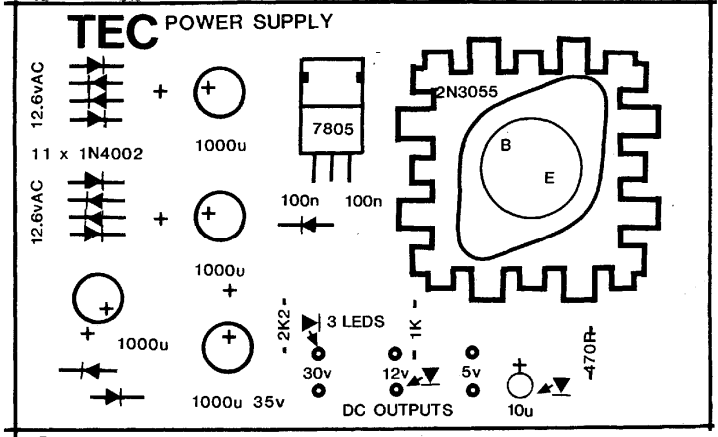
Extra parts: 1 - 2 pin DIN plug, 1 - 3.5mm plug & 1 - RCA plug: $1.30

The 7805 requires about 1.5 amps to be flowing before it will shut down and this current is not available from a 2155.

When looking at the photo of the completed project you will notice the regulator does not have a heat fin. This is because the regulator does not supply the current to the 5v line. The transistor does all the work. The regulator supplies a voltage and about 50-80mA to the 2N 3055, to drive it. The transistor has a current gain of about 10 to 20 and thus it is capable of supplying about 700-1400mA. This is why the 2N 3055 must be properly heat sinked.

CONSTRUCTION

All the comonents are mounted on a single PC board with flying leads to each of the output jacks and the indicator LEDs. If using one transformer, a twisted pair goes from the 12.6v AC holes on the middle of the edge of the PC to the 0v and 12.6v tapping on the transformer.



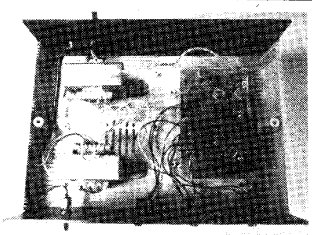
The overlay for the TEC POWER SUPPLY. The 7805 voltage regulator does not require a heatsink but the 2N 3055 must be suitably heatsinked as it is the current regulating component.

Start by fitting the 11 power diodes. The cathode end is identified via a white band around one end and this corresponds to the line on the symbol on the overlay.

The diodes must be pushed home BEFORE soldering and must touch the board AFTER soldering. This is necessary as the copper tracks are designed to act as a heatsink to prevent the diodes getting too hot.

Next fit the three resistors. These are current-limiting resistors for the indicator LEDs.

Fit the two 100n greencaps and the 4 electrolytics. Note the marking on the electro's indicates the negative lead whereas the board identifies the positive lead. Don't get mixed up.



Layout of 2- 2155 transformers and PC board inside case.

compound squeezes from around the edges of the transistor. If you have done this correctly, it will be even all round. Solder the base and emitter leads. The collector is the case of the transistor and gets its voltage via the bolts. That's why they must be screwed up tightly and don't get the thermal compound on the bolts.

The next stage is to attach the flying leads to the board for the input and output.

It is suggested that a colour code is used so that each output can be recognised by a colour. This will prevent a major mistake.

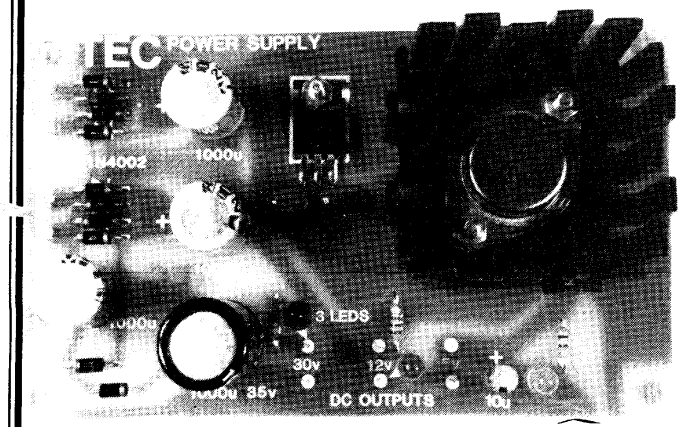
The 3 output sockets are different to each other so that the plugs must also be different. Each project you connect to the supply must be fitted with the correct type of plug and this will prevent the wrong voltage being selected.

The sockets we have chosen are RCA for the 5v line, 3.5mm for the 15v and 2 pin DIN for the 30v. The RCA socket is used for the 5v because it provides the greatest amount of contact between plug and socket for the higher current flow.

These sockets are mounted on the front panel along with the indicator LEDs.

The exact position for these sockets is not critical except you have to make allowance for the heat fin and transformer. This restricts the layout somewhat and the photo shows a suitable positioning.

The only other component on the front panel is a 240v power switch.



Next push the leads of the 7805 through the hoes in the board and bend the regulator over. Attach it to the board with a nut and bolt and then solder the leads.

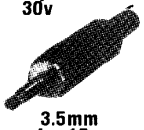
The final component to mount is the power transistor.

Place the heat-fin on the board and before the transistor is fitted into place, smear a little thermal compound on the underside of the transistor.

Take care not to short the base or emitter leads against the heatsink.

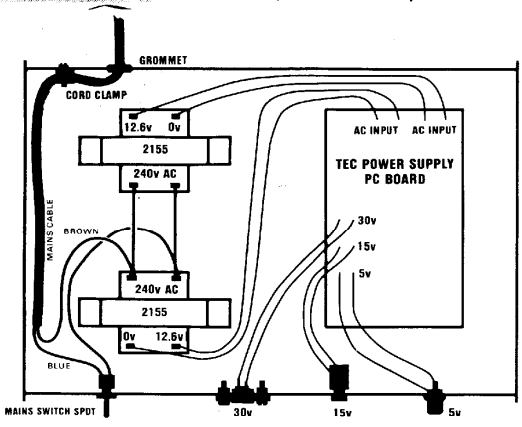
Place the transistor onto the heatsink and attach to the board with two nuts and bolts. As you tighten the bolts, you will notice the

2 pin DIN for 30v



3.5mm for 15v

RCA for 5v.



Layout for 2 transformers. If only one transformer is required, the smaller case can be used.

WIRING THE MAINS SECTION

Wiring the mains lead to the power supply is simple enough except that it must be done according to RULE. This states that the lead must be attached or 'gripped' to the cabinet so that it will not pull out or pull on the wires inside the box.

Make a hole in the rear panel which is just large enough and push 20cm of the lead through. Place a cord anchor about 2cm from this hole and fasten the lead to the cord grip with a nut and bolt.

Remove 9cm of the outside sheath and separate the three inner wires. The ACTIVE lead is RED or BROWN and must be taken to the switch on the front panel. Bare ½cm of the lead and slip a 2cm length of heat-shrink tubing over this lead. Solder to either terminal of the switch.

Cut the **BLUE** or **BLACK** neutral wire slightly shorter and repeat the same procedure, this time connecting to either of the primary terminals on the transformer. Don't forget the short length of heat-shrink.

Finally the earth lead must be connected. Surprisingly, this lead must be the longest so that it is the last lead to be broken, should the cord be pulled. Solder this to a solder tag and screw it onto one leg of the transformer.

A short jumper is required between the switch and the other input of the transformer. Add this and include the heat-shrink.

The heat-shrink must now be pushed over the exposed parts of each of the connections and shrunk into place by heating with a match or candle. The object of the exercise is to cover all the mains wiring so that nothing can touch a live wire.

If you have bought a MOULDED PLUG, the power cord will now be complete. If the plug-top requires attaching, use the colour code given above for the correct connection of the wires. You may think the choice of colours is rather poor. Don't blame me. It's an international code, to assist colour-blind people.

TESTING THE POWER SUPPLY

Testing the power supply is done in two stages.

Connect the plug to the mains and turn the switch on the case ON and OFF very quickly. The three indicator LEDs should come on. If they do, you can be sure the three voltages are present.

Next you must test the supply to see if any of the components are going to overheat. This is always an important stage in testing a project which has the potential for supplying a lot of power.

Turn the supply ON for 10 seconds, then pull the plug from the wall. Feel the temperature of each component. If everything is cool, repeat for 30 seconds. Again remove the plug and feel each item.

If everything is ok, switch on for 5 minutes and try again.

Parts can be damaged very quickly when in a high current situation like this and if an electrolytic is around the wrong way, it will very quickly heat up and may even explode.

The next stage is to measure the output voltages with a multimeter. The most important voltage is the 5v rail. It must be exactly 5v. TTL projects such as the TEC computer will be connected to this rail and it must be spot on 5v.

The other rails are not quite so critical as they are used to operate relays; and the 30v rail will be taken to a 24v regulator for feeding into a 25v line as shown in the EPROM BURNER project.

Even so, you should make sure they are delivering the required voltage. If the 30v rail, for instance, is only 15v or 20v, something is wrong. And if it is 25v, it will not be sufficient for the EPROM project.

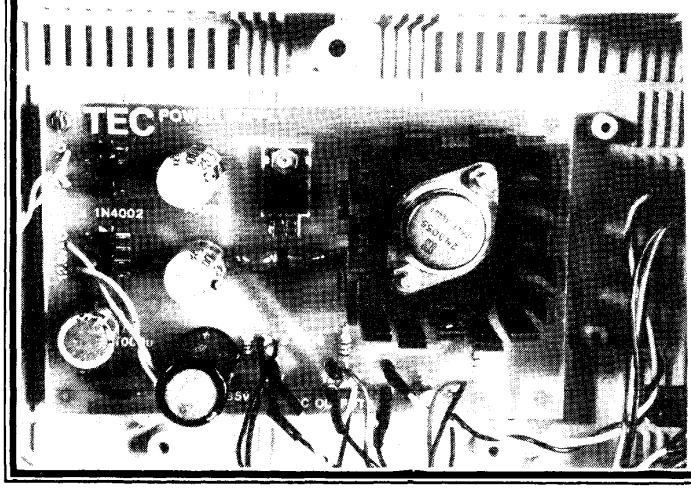
A low voltage, like this, may be due to low mains or a diode missing (not working) in the bridge.

One way to test the diodes is to fully load the supply, via say the 15v rail, and feel the temperature rise of each diode. They should all get equally warm.

If your area suffers from low mains voltage, you can increase the voltage of the supply by connecting between the 0v and 15v tapping on the transformer.

FINAL ASSEMBLY

After testing the power supply for temperature rise, fit the front and back panels and close the case using the two long screws provided. Use white lettra-set or other form of identification to show the three output voltages and the ON position for the mains switch.



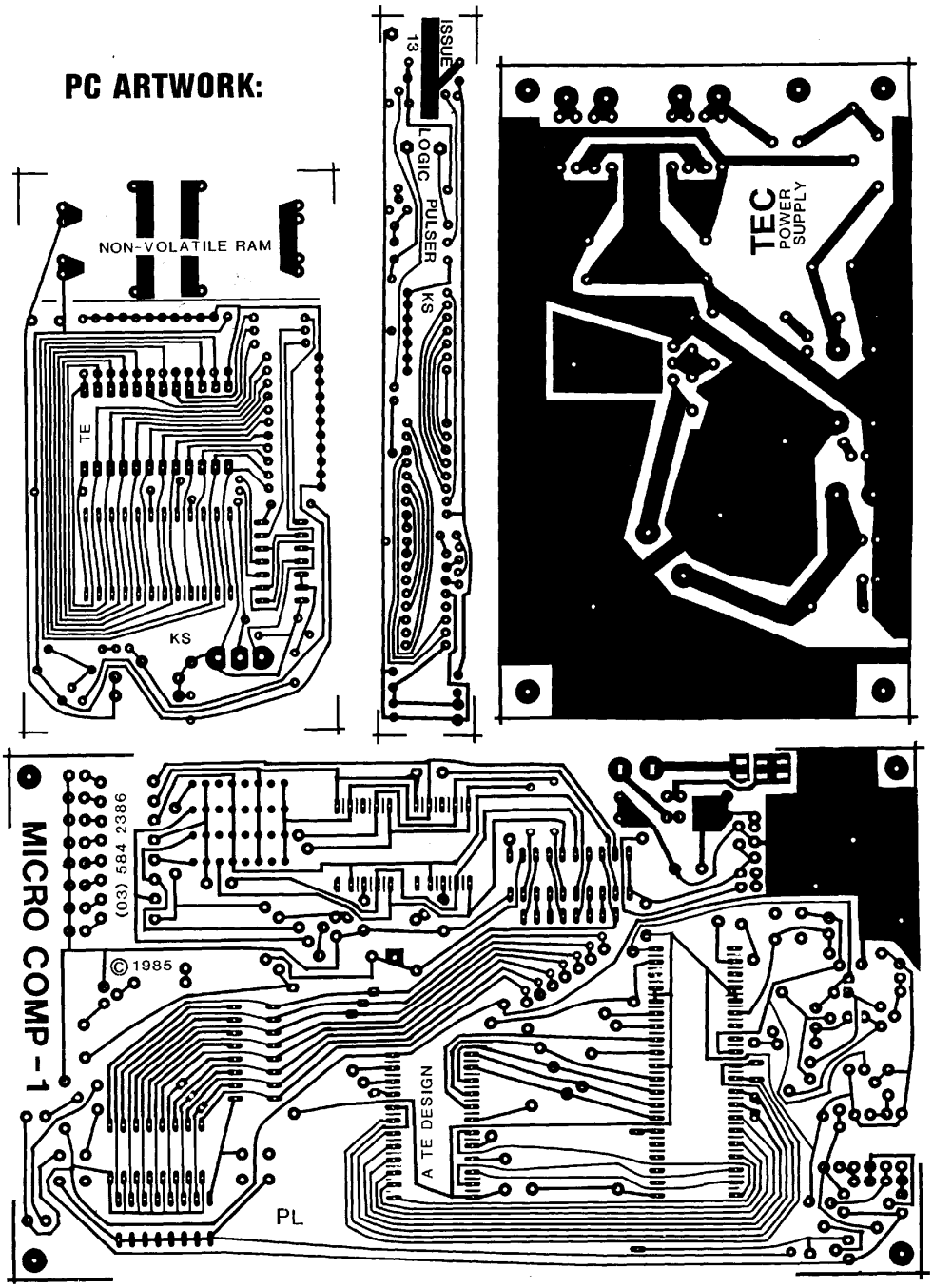
POWERING THE TEC

The TEC can be powered from either the 15v line or the 5v line.

If powering from the 15v line, a lead can be taken from the AC terminals on the TEC to the 15v output. The 7805 regulator on the TEC will provide the regulation. It is interesting to note the input lines can be either way around as the TEC has a full wave rectifier and this means the input voltage can be of any polarity.

If supplying from the 5v output, things are different. You must connect to the 5v rail of the TEC. This is done by connecting one lead to the earth line and the other to the output pin of the 7805.

PC ARTWORK:


NON-VOLATILE RAM
TE
KS
ISSUE 1
LOGIC PULSER
KS
TEC
POWER SUPPLY
MICRO COMP-1
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A TE DESIGN
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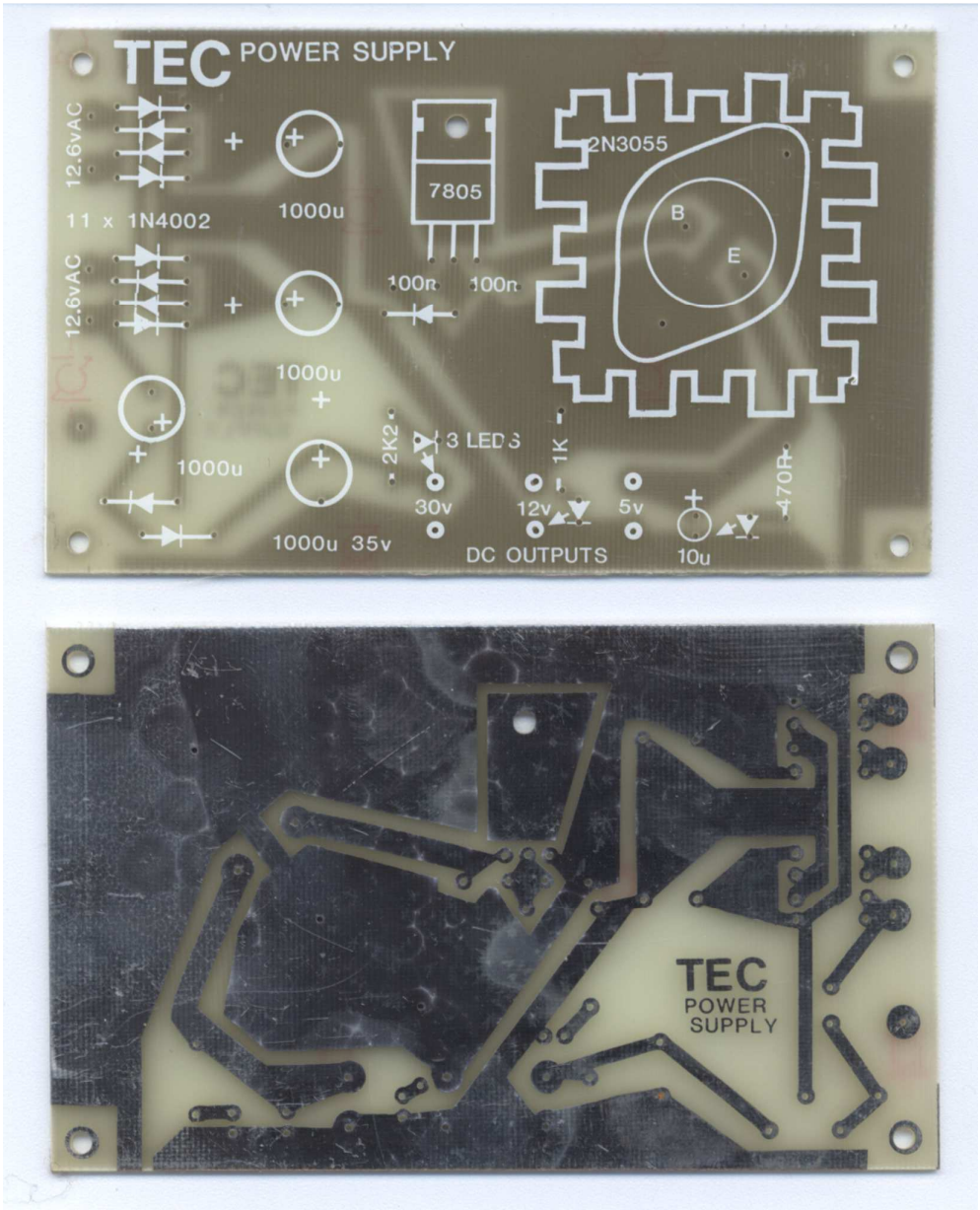
TEC POWER SUPPLY
12.6vAC
11 x 1N4002
12.6vAC
1000u
1000u
1000u
1000u 35v
7805
100n
100n
2N3055
B
E
2K2
3 LED3
1K
30v
12v
5v
470R
10u
DC OUTPUTS
TEC
POWER
SUPPLY