3

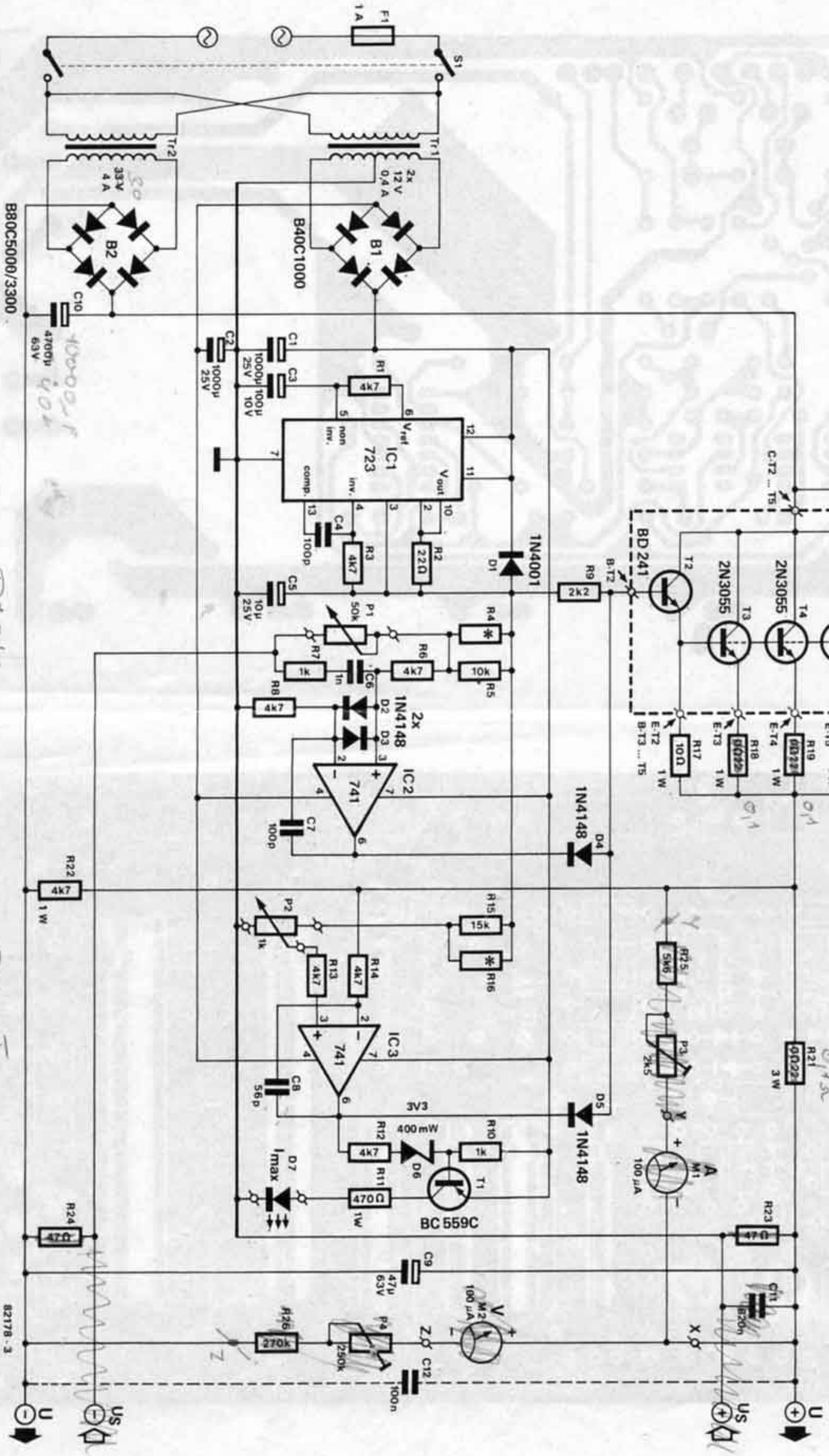
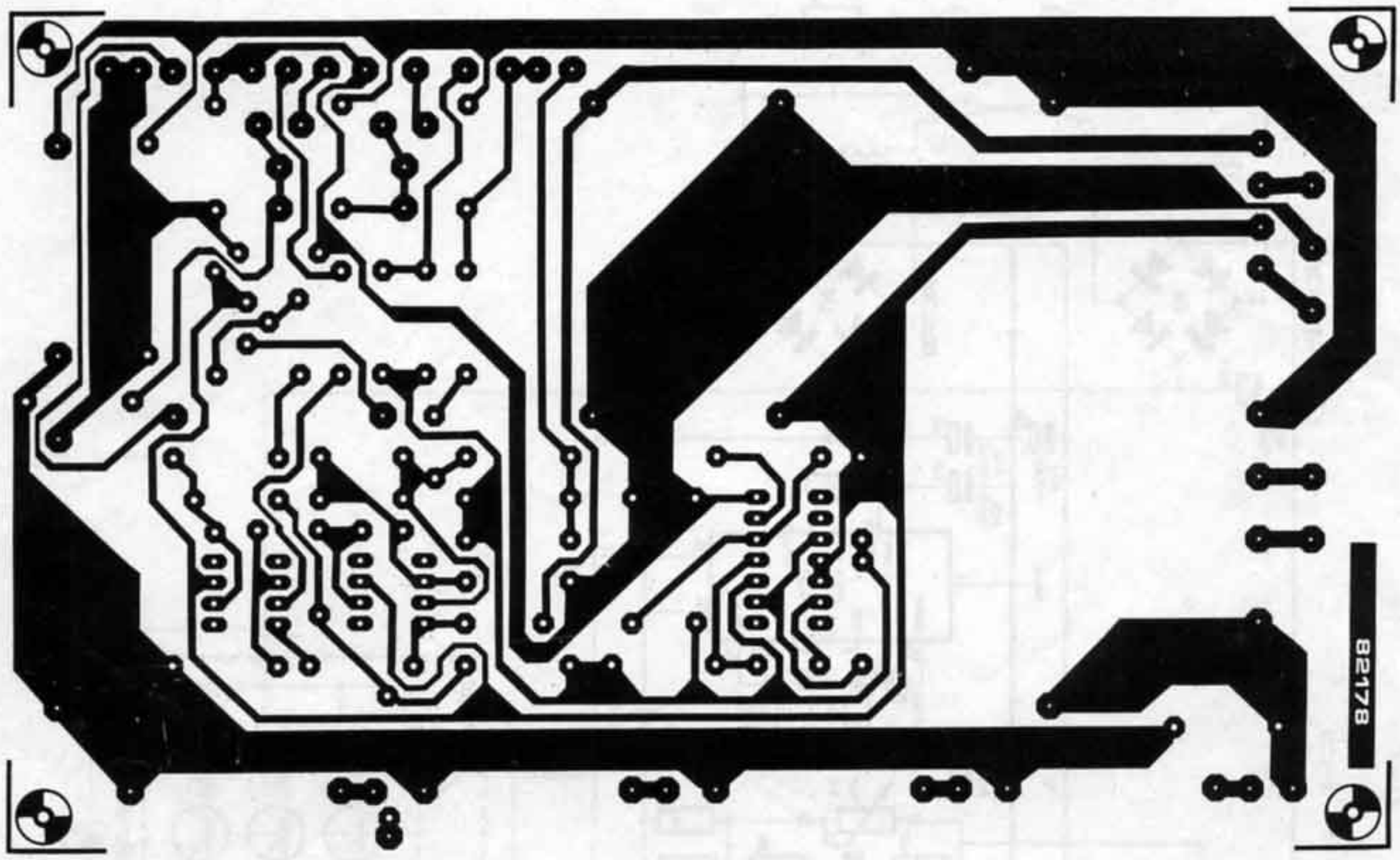


Figure 3. The circuit diagram of the precision power supply. Resistors R4/R5 correspond to R in figure 2, IC2 to A1, IC3 to A2 and R21 to R_S. Of the two transformers, Tr1 provides the supply for the reference current source while Tr2 supplies the power for the output stage.

5



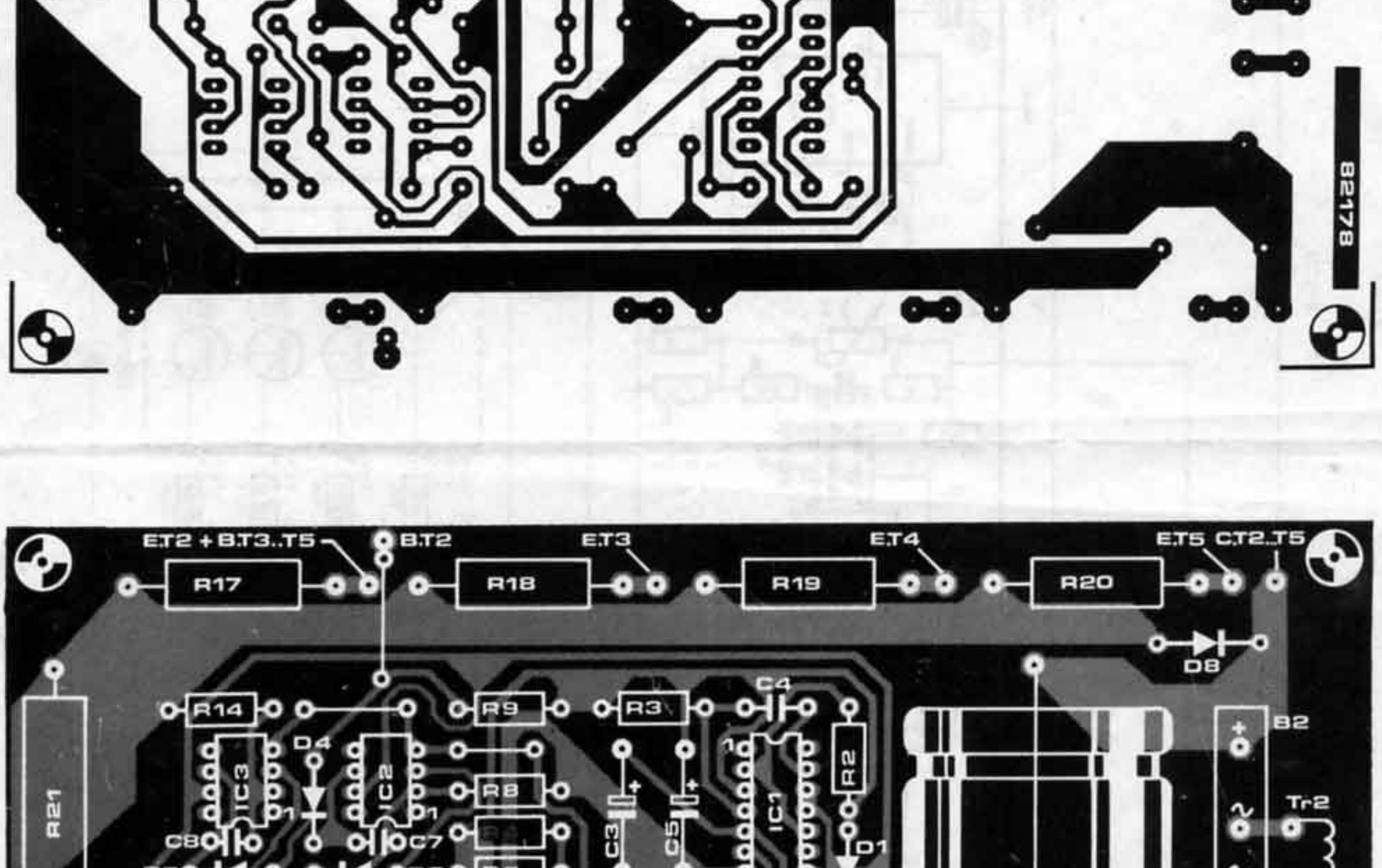


Figure 5. The track pattern and component layout for the printed circuit board used for the precision power supply.

Parts list

Resistors:
R1,R3,R6,R8,R12,R13,R14 = 4k7
R2 = 22 Ω
R4,R16 = see text
R5 = 10 k
R7,R10 = 1 k
R9 = 2k2
R11 = 470 Ω/1 W
R15 = 15 k
R17 = 10 Ω/1 W
R18,R19,R20 = 0,22 Ω/3 W
R22 = 4k7/1 W
R23,R24 = 47 Ω
R25 = 5k6
R26 = 270 k
P1 = 50 k potentiometer
P2 = 1 k potentiometer
P3 = 2k5 preset
P4 = 250 k preset

Capacitors:
C1,C2 = 100 µ/25 V
C3 = 100 µ/10 V
C4 = 100 p
C5 = 10 µ/25 V
C6 = 1 n
C7 = 100 p
C8 = 56 p
C9 = 47 µ/63 V
C10 = 4700 µ/63 V
C11 = 820 n
C12 = 100 n

Semiconductors:
B1 = bridge rectifier B40C1000
B2 = bridge rectifier B80C5000/3300
D1,D8 = 1N4001
D2 . . . D5 = 1N4148
D6 = 3V3 400 mW zener
D7 = LED red
T1 = BC 559C
T2 = BD 241
T3,T4,T5 = 2N3055
IC1 = 723
IC2,IC3 = 741

Miscellaneous:
S1 = double pole mains switch
M1,M2 = 100 µA meter
Tr1 = 2 x 12 V/400 mA mains transformer
Tr2 = 33 V/4 A mains transformer
F = 1 A fuse

output load resistance is necessary. This is taken care of by R22.
It will be noted that there appear to be more output terminals than the usual power supply needs. The two extra outputs, $+U_S$ and $-U_S$, are in fact inputs. These so-called 'sense' inputs are used to allow for voltage drop compensation when working with long connecting cables between the power supply and its load. Figure 4 illustrates how the inputs are used. Two extra wires are connected as shown between the load and the sense inputs. The result of this is that the supply voltage level is now effectively measured at the load and not at the output terminals of the power supply. This enables the circuit to compensate for any voltage drop resulting from the resistance in the main supply cables. It should be noted that if the total resistance of the two main supply cables is 1 Ω, at the current level of 1 A the voltage drop will be 1 V. In normal use,

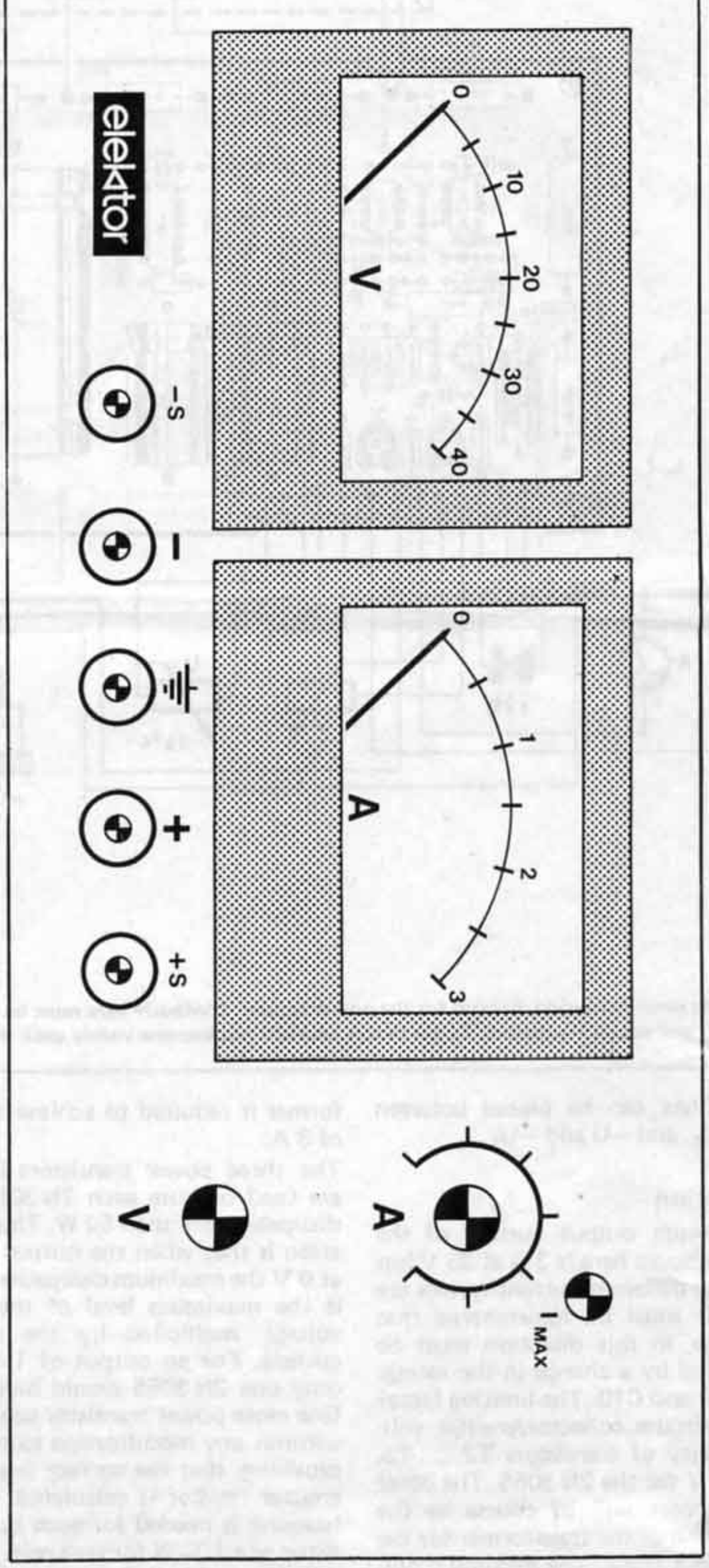


Figure 7. The design of the front panel that is available from Elektor. It is manufactured from scratch resistant polycarbonate material and is self-adhesive. The illustration is at a reduced scale, the actual size is 11 cm by 30 cm.

7

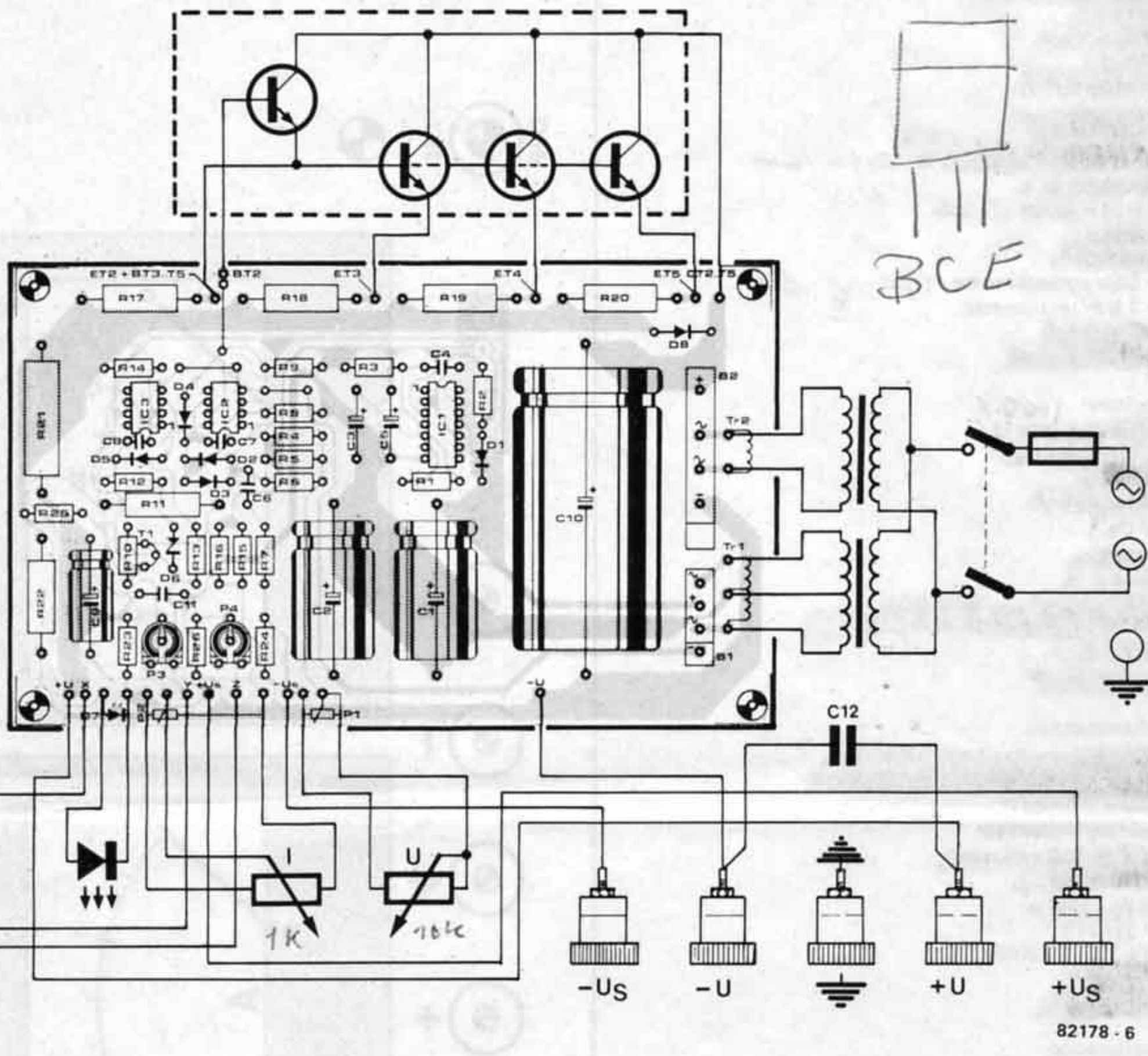


Figure 6. The practical wiring diagram for the power supply. Obviously care must be taken with connections, especially with respect to the transformers and power transistors. Errors in this area will not become visible until the smoke clears!

shorting links can be placed between +U and $+U_S$, and −U and $-U_S$.

Construction

The maximum output current of the circuits as shown here is 3 A at 35 V but in principle different current ratings are possible. It must be remembered that any change in this direction must be accompanied by a change in the ratings of both C9 and C10. The limiting factor is the maximum collector/emitter voltage capability of transistors T2 . . . T5. This is 60 V for the 2N 3055. The other deciding factor will of course be the current rating of the transformer for the power output stage. The maximum output of the power supply is a factor $\frac{1}{\sqrt{2}}$ of the current supplied by the transformer which explains why a 4 A transformer is required to achieve an output of 3 A.

The three power transistors in parallel are used because each 2N 3055 cannot dissipate more than 50 W. The consideration is that when the output voltage is at 0 V the maximum dissipation required is the maximum level of the rectified voltage multiplied by the maximum current. For an output of 1 A at 35 V only one 2N 3055 would be sufficient. One more power transistor can be added without any modification to the circuit providing that the correct value for the emitter resistor is calculated. A 2 °C/W heatsink is needed for each power transistor or a 1 °C/W for each pair. Capacitor C12 is mounted directly onto the output terminals as shown in figure 6.

Do not mount the resistors R4 and R16 initially as their value will depend on the maximum output voltage and current. For this reason it will not be possible to mount the printed circuit board into the case until test and calibration is completed. Set P1 to maximum, switch on and connect a multimeter to the output of the circuit. By trial and error find the actual value of R4 which gives the maximum required output voltage. This can be done by connecting different resistors in parallel to R5. When the correct value has been found it can be soldered in place on the board. Repeat the exercise with P2 and R16 (in parallel with R15) until the maximum current level is found.

The remaining calibration is that of the meters by adjustment of P3 and P4. It is possible to build the power supply using only one meter. In this case a 2 pole 2 way switch connected to points x, y and z is required to switch between volts and amps.