100 W DISCO MIXER AMPLIFIER

Designed by Richard Becker of Powertran this unit can deliver any way you want, and for less than £50!
Build it as a disco amp — it provides four inputs and three tone controls as well as 100W RMS.
Build the power amps for home use — check the spec — for low cost high quality sound.

NOT LONG AGO we published a super-fi 200W amplifier for the most demanding professional and domestic applications and this circuit is being highly acclaimed (by those who know about amplifiers!)

See for example the review in 'Sound International' December 1978 issue. However, exotic circuitry does not come at a low price.

This project does!

For less than £50 you can build a rugged general purpose high power amplifier complete with built in adaptable mixer. Using the newest of Motorola's extra strong power transistors this design pushes out 100 watts (genuine RMS type) and a bit to spare into 8 ohms. Overload protection is built-in and distortion is less than 0.1% right up to clipping level.

Mixing It

The mixer takes a wide range of inputs such as disc, microphone, guitar or just about anything you fancy as the sensitivities of the buffered input stages can be simply changed. There are three tone controls — bass, middle and treble each having a range of 15dB boost and 15dB cut and also a master volume control.

Mechanically the design is simplicity in the extreme with the absolute minimum of wiring. The power transistors fit onto the power amplifier board so there are no wires to give stability problems and all the controls mount directly onto the mixer board. Even the input jacks are soldered to the board! All the components are cheap and with the possible exception of the power transistors and transformer readily available.

These can all be obtained from Powertran who are supplying this project as a complete kit which incudes fully finished metalwork to give the professional finishing touches.

Construction

Assemble the printed circuit boards following the overlays. On the power amplifier board sandwich the cooling bracket between the power transistors and the circuit board as shown in the drawing not forgetting to smear silicon grease onto the mica washers. Fitting Q104 is easier accomplished after the bracket is in position. Smear some grease on this too before sitting it in the hole in the bracket

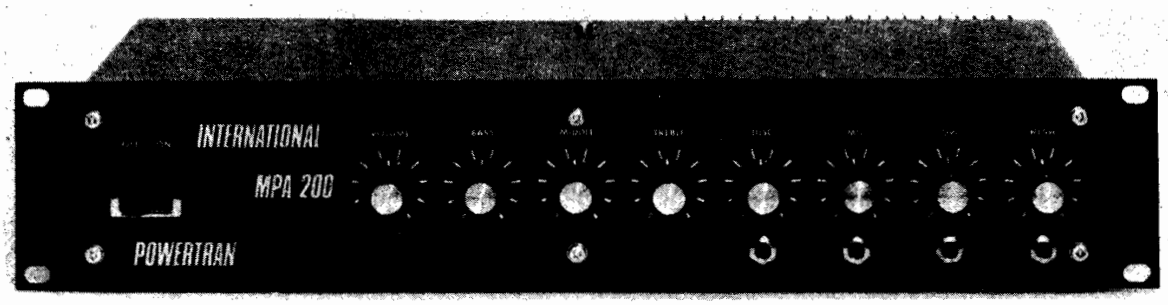
Even when there is no signal, Q105 is dissipating over 500 mW so get rid of the heat from this with a cooling clip pressed onto it. Wind L1 onto R128 with 10 turns of 25g wire before fitting to the board. The wire supplied in the kits is self fluxing polyurethane covered and can be soldered directly to the board. Before fitting any components to the mixer board press in pins, from the component side of the board at the 16 points marked x. These are for connecting to the jack sockets but do not fit them yet. Now fit all the components taking particular care to solder the potentiometers squarely on the board and when complete secure to the front panel with the potentiometer nuts. Remove all but three spacer washers from the jack sockets and bending their tags to fit over the pins on the board screw to the panel and solder in position.

Press capacitors C115, 116 into their mounting clips and connect the rectifier diodes and C113, 114 across them as shown in the diagram then complete the mechanical assembly and wiring noting that ALL ground (OV) connections are made to a stack of solder tags fitted to the chassis near the power supply capacitors.

Testing and Setting Up

Without F2, 3 fitted check the power supply. Being off-load the voltage on each rail will be nearer 54 volts than 50 volts. Switch off and discharge the capacitors. No fireworks by using screwdrivers please! Use a resistor of about 100R. Fit the fuses, turn down the master volume control, turn RV101 to its midway position and turn RV102 fully clockwise.

Turn on and set the voltage between the can of Q111 and the amplifier output terminal to 33mV with RV 102. This corresponds to a



SPECIFICATION

SPECIFICATION (power amplifier)
Power output: 112 into 8 ohms
Harmonic distortion: 0.07% at 1KHz, 8R at clipping level.
Frequency response: (3dB) 10Hz — 30KHz
Damping factor: 100
Sensitivity: 0.775V (0dBm) for 100W into 8Ω
Hum & Noise: —99 dB
Input impedance: 22k

SPECIFICATION (mixer)
input DISC disc equalization sensitivity 3mV input impedance 47K
input MIC flat response sensitivity 1mV input impedance 1K
input LOW flat response sensitivity 10mV input impedance 10K
input HIGH flat response sensitivity 100mV input impedance 100K

Bass control +15dB —15dB at 30Hz
Middle control +15dB —15dB at 1KHz
Treble Control +15dB —15dB at 15KHz

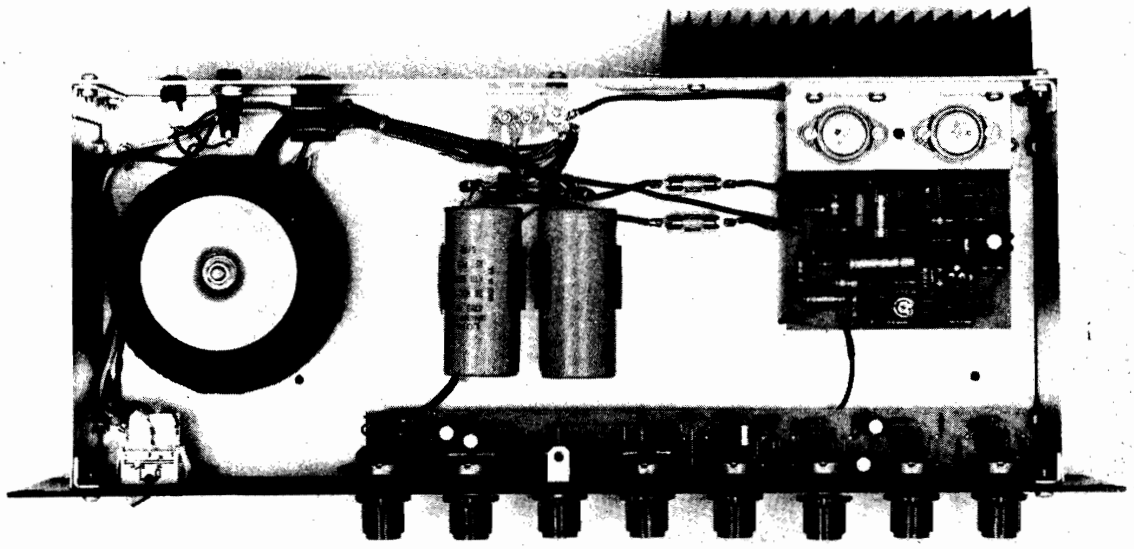
By simple component changes all four inputs can have flat response for any sensitivity between 1mV and 100mV

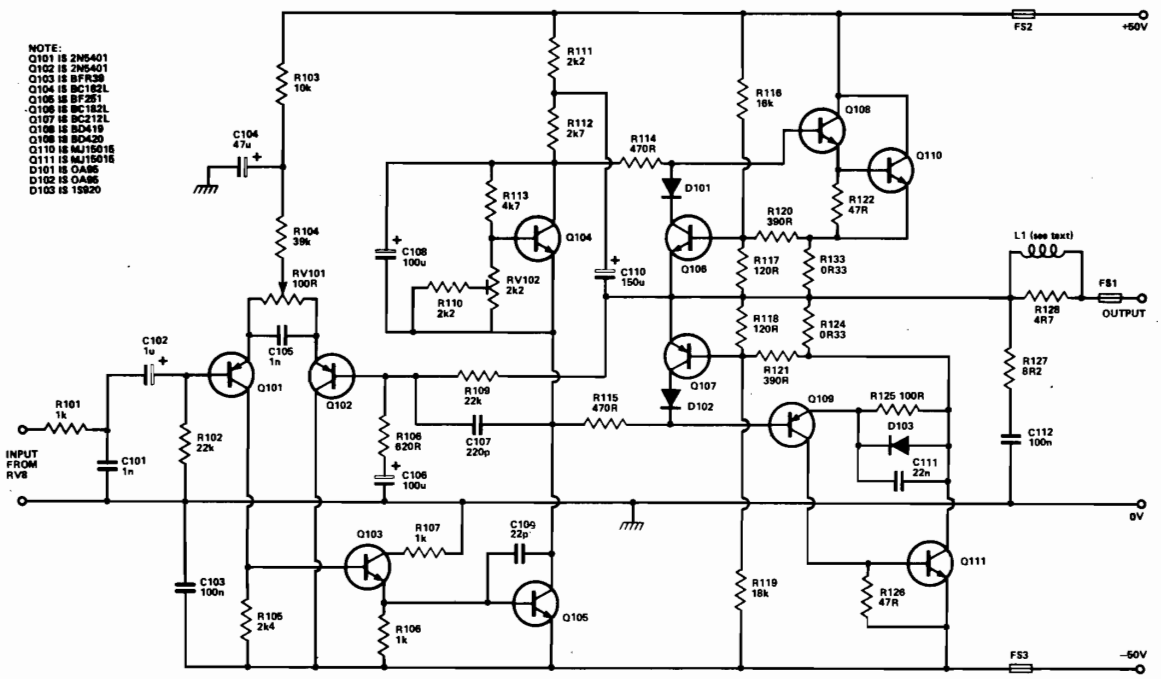
current of 100mA in the output stage. Adjust RV101 for zero off-set voltage at the output terminal. Make re-measurements of these voltages for about 10 minutes or until they stop changing whilst the amplifier is becoming thermally stabilized.

Switch off, fit the cover and your amplifier is now ready for use. ETI ▶

BUYLINES

A complete kit of parts for this project, including all metalwork, nuts, bolts, PCBs and components will be available from Powertran Electronics, Portway Industrial Estate, Andover, Hants SP10 3NM for £49.90+VAT. The PCBs will be available only from them as they are their design.
In addition the parts for both the mixer and power amp boards are available separately at a cost of £10.40 and £10.60 all inc. respectively.





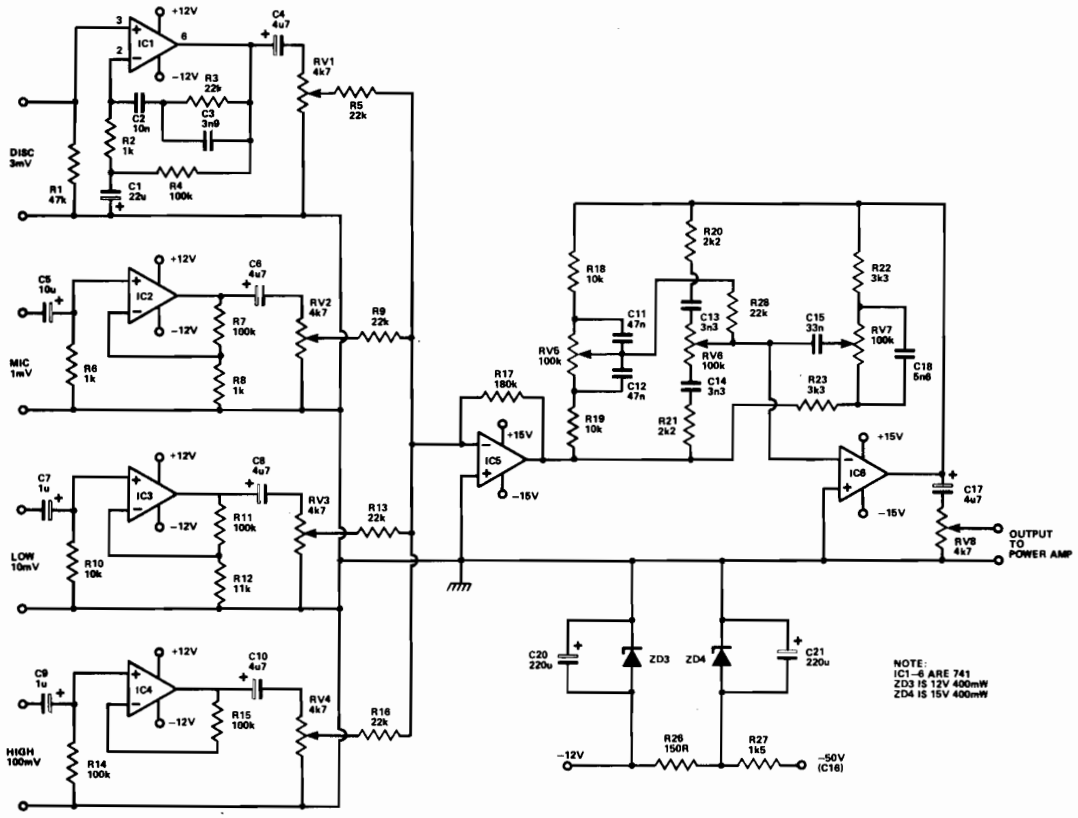
HOW IT WORKS

Power amplifier.
To achieve reliable high power delivery at low cost 'Power Base Technology' type power transistors are the obvious choice, offering an excellent safe operating area at a very favourable price. One such device is the well known and readily available 2N3773 which can be used in this design, however Motorola have recently introduced the MJ15015 which will not only handle more power (180 watts) but is cheaper too (only about £1.50). These are driven by Q108, 109 which supply the base current for the output transistors without loading heavily the voltage amplifying stage of Q105. The combination of R125, D103, C111 is used to simulate the input impedance of a power transistor to make similar the impedances at the bases of Q108, 109 so as to increase the symmetry of the output stage which is necessary to achieve low distortion. R122, 126 improve the switching times of the output transistors by removing charge carriers from their bases. This is necessary for smooth transfer in the cross-over region i.e. when the signal changes from positive (delivered by Q110) to negative (accepted by Q111). Bias for the output stage is provided by Q104, the voltage across which is adjusted by RV 102. For thermal stability of quiescent current this transistor is in thermal contact with the cooling bracket. C108 is an AC bypass. R123, 124 are the resistors which sense the current in the output stage, the voltage across these will be the voltage across TR104 less the voltage of the three base-emitter junctions of TR108, 110, 111 and the junction of D103.

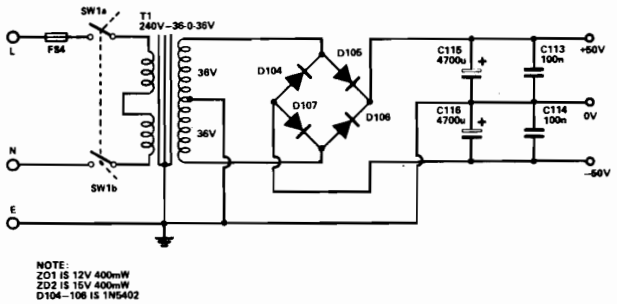
Protection against overload is provided by Q106, 107 with current sensing by R117, 120, 123 and R118, 121, 124 and voltage sensing by R116, 117 and R118, 119. R115 limits the current drawn from the load through Q107, 105 during overload. R114 restores symmetry for positive going signals. However, the presence of R114, 115 can, under heavy load conditions, lead to voltages which can turn on the base — collector junctions of the protection transistors introducing a discontinuity into the transfer characteristic of the amplifier (that's a posh way of saying distortion!) This is prevented by germanium diodes D101, 102. C110 is a bootstrap capacitor which increases the effective impedance seen at the collector of Q105, thereby increasing the gain of that stage which takes the signal from differential pair Q101, 102, via the emmiter follower buffer Q103. RV101 is used to adjust the output off-set voltage to zero. The overall voltage gain of the amplifier is determined by R106, 109 and is about 36 corresponding to 0dBm (0.775V) for full power. R101, C101 are an input filter to remove RF interference and prevent overload by transients. Frequency compensation and stabilization is performed by C105, 107, 109, 112, R127, 128, and L1.

Power supply
For economy the supply to the amplifier is unregulated. D104-107 form a full wave rectifier filtered by C115, 116. C113, 114 remove high frequency transients from the power rails. A toroidal transformer is used because the stray magnetic field is very low thereby reducing the hum introduced into the system. The mixer is supplied by zener diode regulators fed from the 50V power rails. Two stages of regulation are used to prevent low frequency feedback to the input stages. Because of the bass boost of the disc equalization characteristic this is important otherwise low frequency instability of the system could result.

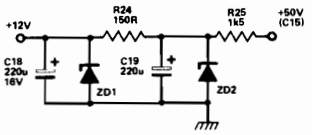
Mixer
The actual mixing is carried out by RV1-4, R5, 9, 13, 16, 16 and IC5 but before that the inputs are buffered by IC1-4 stages. IC1 stage is RIAA equalized for use with a magnetic pick-up but if this facility is not required it can be built with flat equalization for another purpose such as a guitar pick-up (10 or 15 mV sensitivity being suit-



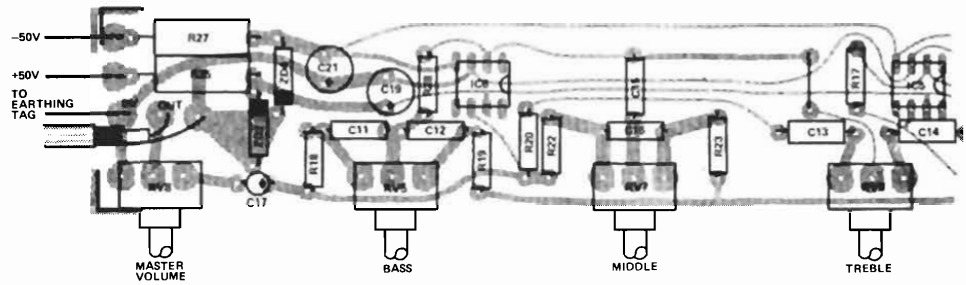
Above left: the full circuit for the power amplifier section of the mixer amp. This builds onto its own PCB and can be employed to good advantage in other systems. Above right: the mixer circuit itself. Note the provision of a third-mid-tone control circuit which will be found to be useful in disco applications. Below right: power supply circuit for the whole unit.



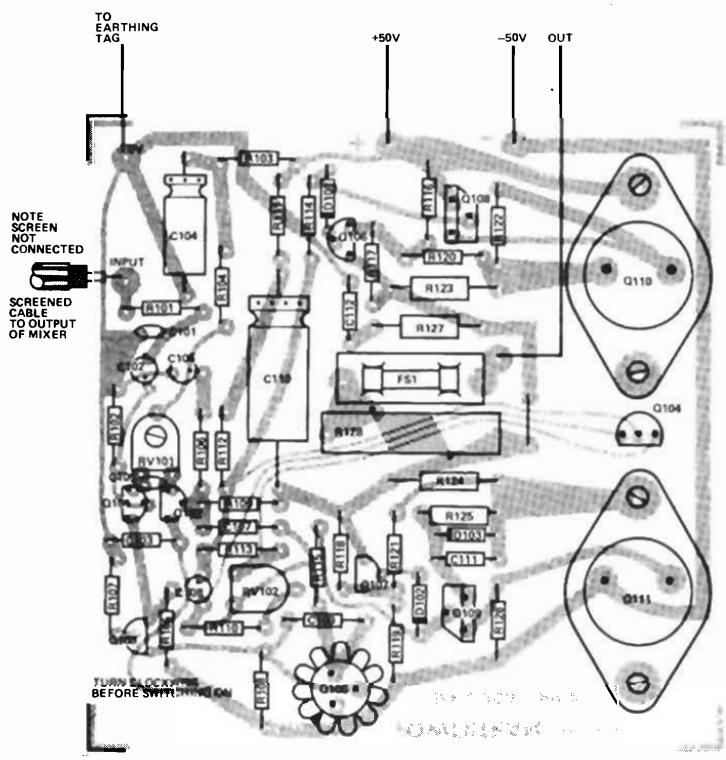
NOTE:
ZD1 IS 12V 400mW
ZD2 IS 15V 400mW
D104–108 IS 1N5402



able for most pick-ups). For 15 mV sensitivity omit C3, R4, use wire links in place of C1, 2, use 15K, 18K, 100K for R1, 2, 3 respectively and replace link A with a lu tantalum capacitor. All the buffer stages produce an output of 100mV for their rated input. Changing the resistor values alters the sensitivity for example IC3 stage could also be built for 15mV sensitivity, 15K, 18K, 100K then being used for R10, 12, 11 respectively, provision is also made for disc equalisation components on the IC2 stage.

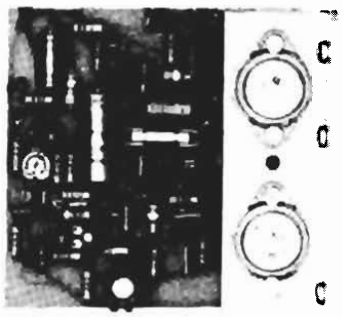


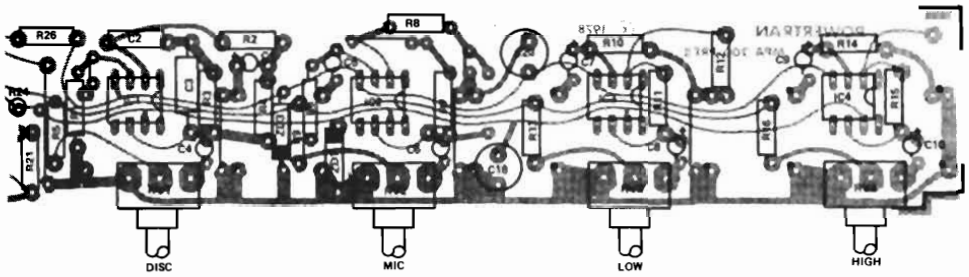
Above: the somewhat protracted overlay for the mixer board of the amplifier unit. This fixes onto the back of the controls to make construction easier. Below: the main power amplifier overlay. Read the setting-up procedures carefully before turning this on!

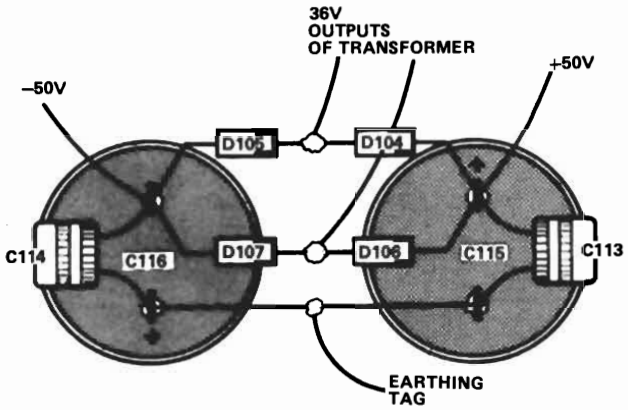


Component overlays for the boards within the unit. The mixer board is shown above — unfortunately in two pieces—(we're not fond of that kind of centre fold-out!) to make the components clear.

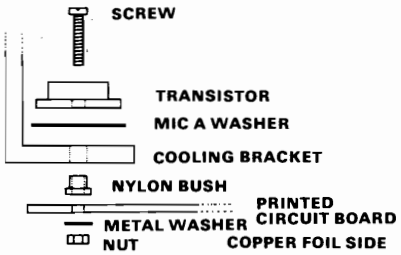
Below left is the 100W amplifier board. Take care when fitting the power transistors to their heatsinks, follow the diagram opposite. Note that RV102 should be set fully clockwise before switch on.







Left: the method of mounting the PSU components around the large reservoir capacitors C116 and C117.
Below: fitting the power transistors to the heatsink.



PARTS LIST

RESISTORS ¼W 5% Carbon Film

R1	47k
R2,6,8,	1k
R3,5,9,13, 16,28	22k
R4,7,11,14,15	100k
R10,18,19,	10k
R12	11k
R17	180k
R20,21	2k2
R22,23	3k3
R24,26	150R
R25,27	1k5(1W)

RESISTORS ¼W 5% Carbon Film

R101,107,108	1k
R102,109	22k
R103	10k
R104	39k
R105	2k4
R106	620R
R110,111	2k2
R112	2k7
R113	4k7
R114,115	470R
R116,119	18k
R117,118	120R
R120,121	390R
R122,126	47R
R123,124	OR33 (2½W)
R125	100R
R127	8R2 1W
R128	4R7 2W

CAPACITORS

C1	22u 16V tantalum
C2	10n polyester
C3	3n9 polystyrene
C4,6,8,10,17	4µ7 16V tantalum
C5	10µ 16V tantalum
C7,9	1µ 16V tantalum
C11,12	47n polyester
C13,14	3n3 polystyrene
C15	33n polyester
C16	5n6 polystyrene
C18,19,20,21	220µ 16V electrolytic
C101, 105	1n ceramic
C102	1µ 16V tantalum
C103,112, 114	100n polyester
C104	47µ 63V electrolytic
C106, 108	100µ 3V tantalum
C107	220p polystyrene
C109	22p 100V polystyrene
C110	150µ 63V electrolytic
C111	22n polyester
C115,116,	4700µ 63V electrolytic

SEMICONDUCTORS

IC1—6	741
ZD1,3	12V 400mW
ZD2,4	15V 400mW
101,102	2N5401
103	BFR39
104,106	BC182L
105	BF257
107	BC212L
108	BD419
109	BD420
110,111	MJ15015 or 2N3773
D101,102	0A95
D103	1S920
D104-107	1N5402 or BY254

FUSES

F1	4A fast
F2,3	3A fast
F4	1A5 anti surge

POTENTIOMETERS

RV1-4,8	4k7 log
RV5-7	100k lin
RV101	100R pre-set
RV102	2k2 pre-set

TRANSFORMER
T1 0-117V — 234V to 36V-0-36V with electrostatic screen

MISCELLANEOUS
Power transistor mounting bracket, two heat sinks 3in x 3in x 1in, TO5 cooling clip, six IC sockets, five ¼in mono jack sockets, two chassis mounting fuse holders, PCB mounting fuse holder, panel mounting mains fuse holder, illuminated mains switch DPDT, eight knobs, fibre glass ready drilled PCB's, metalwork and cabinet to suit, two capacitor clips, cable clamp, nuts, bolts, brackets, cable etc.