SOUNDCRAFT CPS2000

Console Power Supply

User and Technical Manual

For your own safety and to avoid invalidation of the warranty all text marked with these Warning Symbols should be read carefully.



IMPORTANT: please read this manual carefully before connecting your Soundcraft console power supply to the mains for the first time.

Part No. ZM0198 Issue 4

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It is recommended that all maintenance and service on the product should be carried out by Soundcraft or its authorised agents. Soundcraft cannot accept any liability whatsoever for any loss or damage caused by service, maintenance or repair by unauthorised personnel.

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Introduction

Introduction

WARNING: THIS APPARATUS MUST BE EARTHED

The CPS2000 is a linear power supply which, like other linear supplies, produces DC voltages by rectifying, smoothing and regulating AC voltages from the secondary windings of a mains transformer. Soundcraft mixing consoles employ a number of dc voltage supply levels in their operation and these are all provided at the output of each supply unit.

In regulating these voltages there is considerable heat generated, the dissipation of which is achieved through a substantial heat sink on each side of the unit. Two fans are incorporated which draw air over the heatsinks to provide adequate heat dissipation for the regulators and reduce the outer case temperature.

The CPS2000 is designed for installation in a 19" rack unit, occupying 4U of rack height. Refer to the section "RECOMMENDATIONS FOR INSTALLATION" on Page 7.

LEDs are provided on the front panel to show the operation of the regulating circuits, and a digital voltmeter monitors the mains supply voltage.

The CPS2000 may be linked to a second CPS2000 to provide automatic power backup in the event of one of the units failing.

MAINS VOLTAGE SELECTION.

Special attention should be paid to the following information:

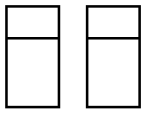
Do not change the voltage setting without first turning the unit off and unplugging the mains lead. Ensure that the cover plate over the mains voltage selection switches is replaced after correct voltage selection has been made and that the cover plate is positioned to show the correct mains voltage.

This unit is capable of operating over a wide range of mains voltages by means of a comprehensive set of selectable voltage settings. It is important to ensure that the correct voltage setting has been selected for the level of local mains voltage supply, for safe, uninterrupted operation of the unit.

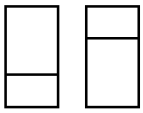
There are two mains voltage selection switches behind a cover plate on the front of the unit. Voltage selection is achieved by moving the switches using a screwdriver blade, into the correct positions, as shown by the symbols marked on the front panel. In this way the unit is set up for operation at one of the following ranges of mains supply:

NOMINAL VOLTAGE	OPERATING VOLTAGE RANGE
Vrms AC	*Vrms AC*
230	182-253
200	158-220
115	91-126
100	79-110

Mains Voltage Selector Positions

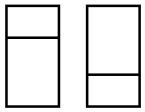


230V

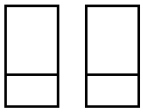


115V

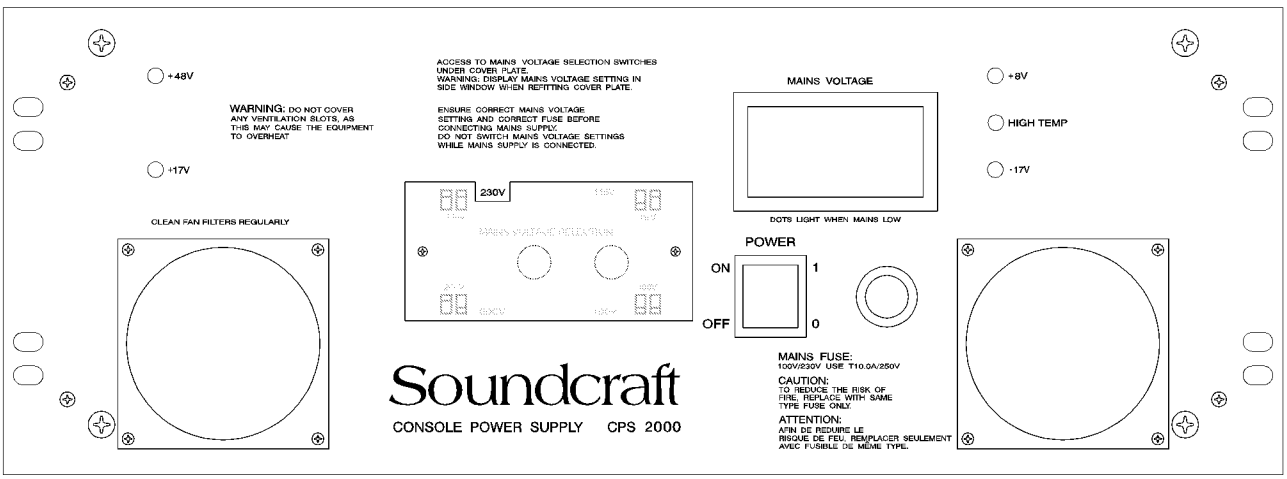
200V

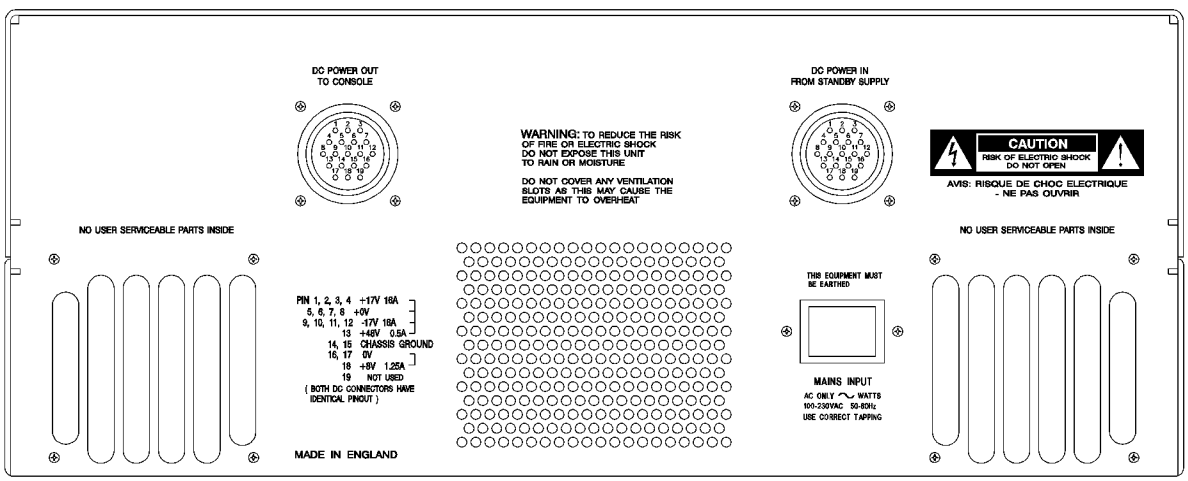


100V



Front and Rear Panel Views





OPERATING VOLTAGE RANGE

It is very important to use the correct mains voltage selection. A wide operating range of mains voltages is provided to enable the unit to function down to only 85Vrms on the mains supply. This facility is incorporated to overcome the problems that some power supplies have with internal regulation when operating from a poorly regulated mains supply.

Do not operate the PSU with a consistently high (above nominal) reading on the mains meter. Operation with the mains higher than +10% may cause serious damage

The mains meter is essentially a peak-reading device, as it is the peak value of the mains waveform which is the most important factor in providing the correct mains voltage to the power supply. For this reason, and because with long power cables it is common for the mains waveform to become distorted, the indication of the meter may not agree with readings taken with the usual types of quasi-RMS reading testmeter.

Note that the meter measures the voltage actually available at the PSU, and therefore will indicate any voltage drop on mains supply wiring.

REPLACING MAINS FUSE.

In the event of incorrect switching of the mains voltage selectors, a mains power surge or underrated fuse value, the mains fuse in the front panel will blow and the CPS2000 will not function. Switch the ON/OFF switch to the OFF position. Check the fuse and replace if necessary; also check that the voltage selection is correct for the mains supply level before switching the unit ON again.

To avoid risk of fire replace only with the correct value fuse, as indicated on the unit.

In the event of repeated failure of the mains fuse consult the Soundcraft dealer from where the unit was purchased.

This unit contains no user serviceable parts. Refer all servicing to a qualified service engineer, through the appropriate Soundcraft dealer.

Warranty

1 **Soundcraft** is a trading division of Harman International Industries Ltd.

End User means the person who first puts the equipment into regular operation.

Dealer means the person other than Soundcraft (if any) from whom the End User purchased the Equipment, provided such a person is authorised for this purpose by Soundcraft or its accredited Distributor.

Equipment means the equipment supplied with this manual.

2 If within the period of three years from the date of delivery of the Equipment to the End User it shall prove defective by reason only of faulty materials and/or workmanship to such an extent that the effectiveness and/or usability thereof is materially affected the Equipment or the defective component should be returned to the Dealer or to Soundcraft and subject to the following conditions the Dealer or Soundcraft will repair or replace the defective components. Any components replaced will become the property of Soundcraft.

3 Any Equipment or component returned will be at the risk of the End User whilst in transit (both to and from the Dealer or Soundcraft) and postage must be prepaid.

4 This warranty shall only be available if:

a) the Equipment has been properly installed in accordance with instructions contained in Soundcraft's manual; and

b) the End User has notified Soundcraft or the Dealer within 14 days of the defect appearing; and

c) no persons other than authorised representatives of Soundcraft or the Dealer have effected any replacement of parts maintenance adjustments or repairs to the Equipment; and

d) the End User has used the Equipment only for such purposes as Soundcraft recommends, with only such operating supplies as meet Soundcraft's specifications and otherwise in all respects in accordance Soundcraft's recommendations.

5 Defects arising as a result of the following are not covered by this Warranty: faulty or negligent handling, chemical or electro-chemical or electrical influences, accidental damage, Acts of God, neglect, deficiency in electrical power, air-conditioning or humidity control.

6. The benefit of this Warranty may not be assigned by the End User.

7. End Users who are consumers should note their rights under this Warranty are in addition to and do not affect any other rights to which they may be entitled against the seller of the Equipment.

Recommendations for Installation of the CPS 2000

FOR UK USERS ONLY

IMPORTANT WARNING
THIS APPLIANCE MUST BE EARTHED

The wires in the mains lead are coloured in accordance with the following code:

Green and Yellow:	Earth
Blue:	Neutral
Brown:	Live

As the colours of the wires in the mains lead may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- The wire which is coloured Green and Yellow must be connected to the terminal in the plug which is marked with the letter E or by the earth symbol.
- The wire which is coloured Blue must be connected to the terminal in the plug which is marked with the letter N or coloured Black.
- The wire which is coloured Brown must be connected to the terminal in the plug which is marked with the letter L or coloured Red.

Recommendations for Installation

The CPS2000 power supply is provided with front panel fixing holes for 19" rack-mounting and will occupy 4U of rack space. Rear support should be provided when fitted in a 19" rack.

The CPS2000 is a heavy unit (30kg,) and should be regarded as a two-man lift. Take suitable precautions when lifting

As with any power supply that contains a large mains-voltage transformer, it is preferable to provide a degree of physical isolation of the unit from other electronic equipment, particularly that which carries low level audio signals, to avoid any possible hum pick-up. For this reason the unit is used with a long (6.5 metres) output cable to enable it to be positioned away from the mixing console.

For the same reason, when rack-mounting it is preferable to avoid locating the unit adjacent to signal processing equipment.

It should be noted that if a complete rack containing a CPS2000 unit is to be operated from a different mains supply level, then the unit should be withdrawn from the rack in order to reselect the mains voltage setting, at the same time as resetting any other equipment.

The other important consideration when rack-mounting the unit is the need for natural convection of air over the case and an unrestricted air flow through the unit. Note that air is drawn in at the front of the unit and expelled through the rear panel.

Good ventilation BELOW the unit, in the floor or back of the rack, and similarly ABOVE the unit, at the top of the rack, will ensure a path for continuous air flow.

Other equipment in the rack which is known NOT to produce a significant amount of heat should be mounted BELOW the unit. Equipment that also relies on good air flow within the rack (ie. most power amplifiers and other power supplies) should be given due consideration and some space should be provided between such units and between these and the CPS2000 unit. Forced convection, by means of a fan-tray, may be desirable in this situation.

The CPS2000 will operate as a free-standing unit without requiring any special cooling arrangement, but should not be allowed to be accidentally or deliberately covered over in any way.

Do not operate the unit with the top cover removed as this exposes hazardous voltages.

The filters on the cooling fans must be inspected regularly and cleaned if necessary to maintain good airflow through the unit. This will be particularly important if the unit is used in a dusty environment.

Finally, some consideration should be given to the earthing arrangement of the system at the centre of which are the console and the CPS2000 (and any other Soundcraft power supply units). The console chassis is earthed, through the mains earth, via the power supply. When rack-mounting the CPS2000(and any other Soundcraft power supply units) care should be taken to avoid any possible 'ground loops' in the system which would introduce audible hum to otherwise clean audio signals. Ground loops may occur where signal processing equipment, patched to the console, has its signal earth commoned to the equipment chassis. The ground loop is formed if this chassis and the power supply chassis are in electrical contact through the fixing rails they share in the rack. To avoid this situation, standard isolating washers may be employed when fixing the power supply (or supplies) or any other unit into the rack.

W A R N I N G : THIS APPARATUS MUST BE EARTHED. Under no circumstances should the mains earth be disconnected from the CPS2000 power supply unit.

GENERAL

As with all electrical/electronic equipment care should be taken when handling this unit. Avoid general mishandling and do not drop. Avoid storage and operation in dusty locations and do not expose to corrosive atmospheres.

To avoid risk of fire do not expose this unit to rain or moisture.

Retain all packaging for transportation in the event of the unit requiring servicing. Retain this manual safely, along with all other relevant documents.

For touring/mobile transportation it is advisable to install the CPS2000 in a flight case to provide mechanical protection. Refer to your Soundcraft dealer for a suitable case.

Where the CPS2000 is enclosed in a touring case, provision must be made for adequate ventilation to the rear of the unit to ensure unrestricted supply of air for the cooling fan.

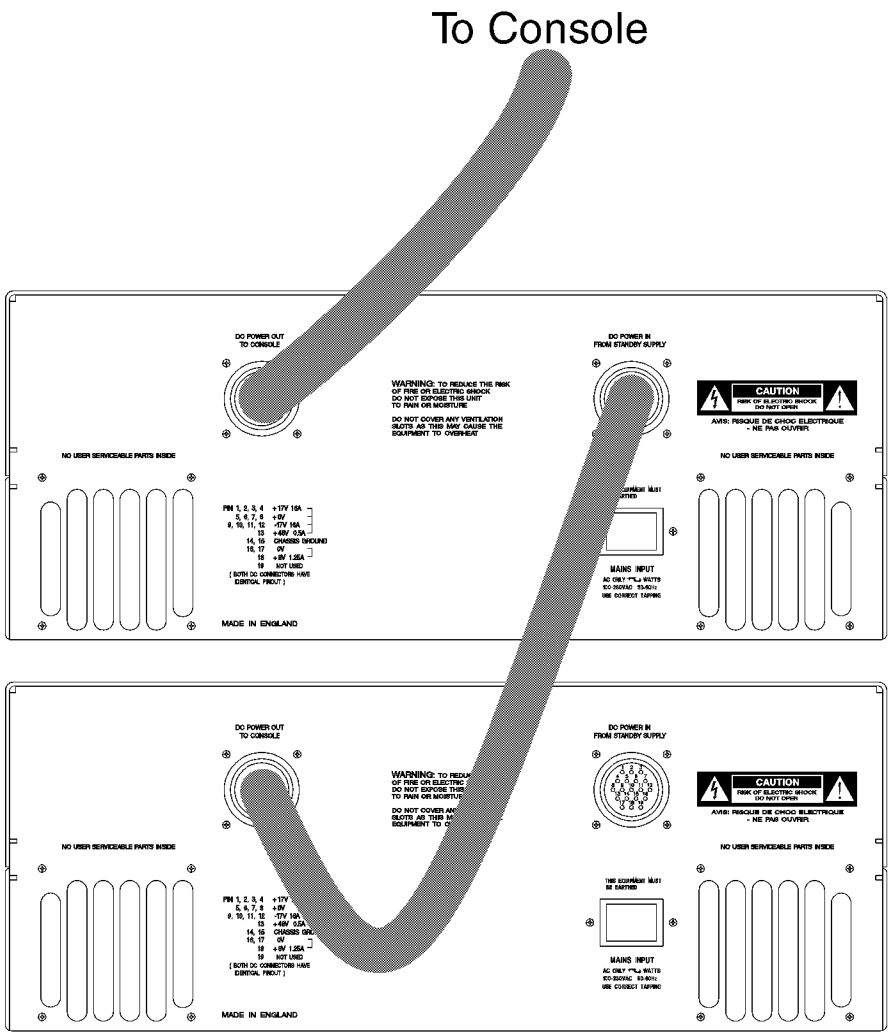
Use only the 16 Amp mains lead supplied, no other type is to be used.

Use only the DC output lead supplied, no other type is to be used.

PSU Linking

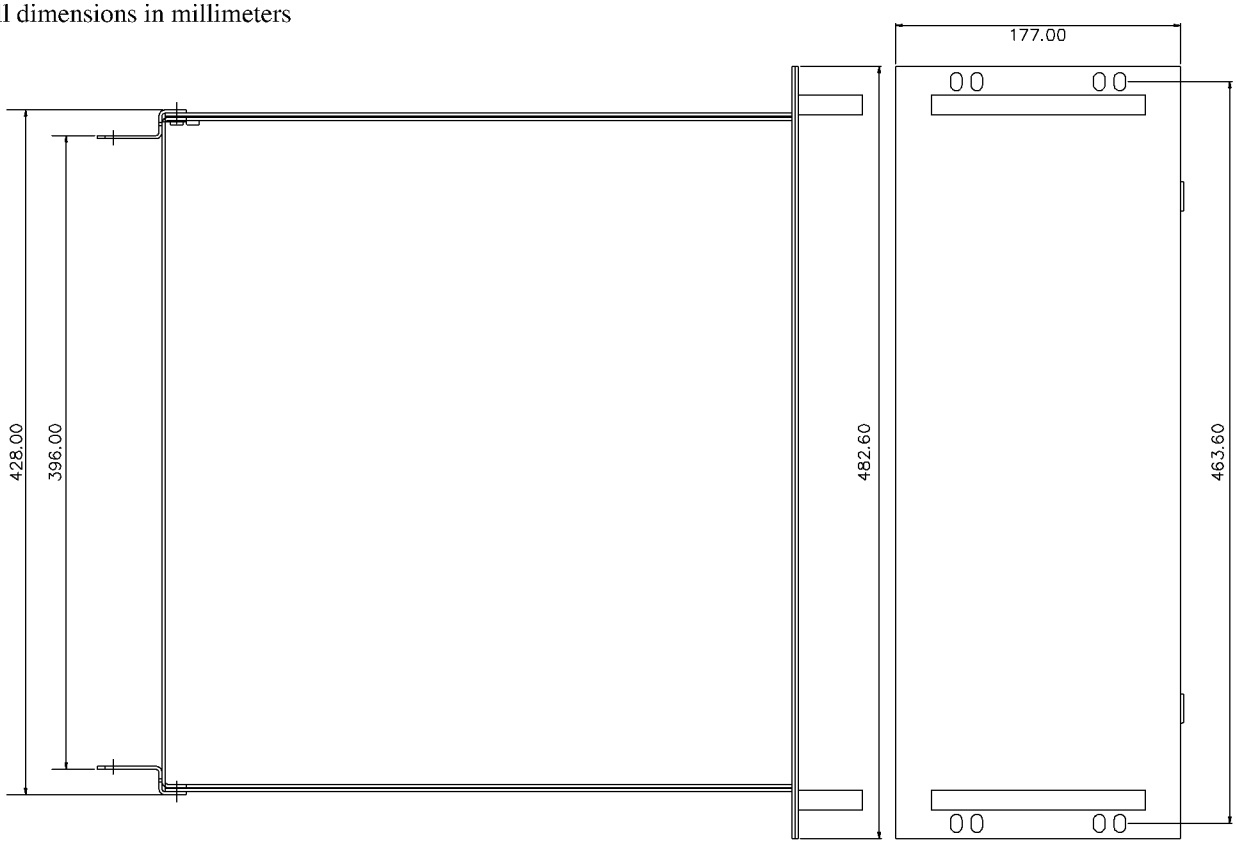
Link the second PSU to the first as shown in the following diagram.

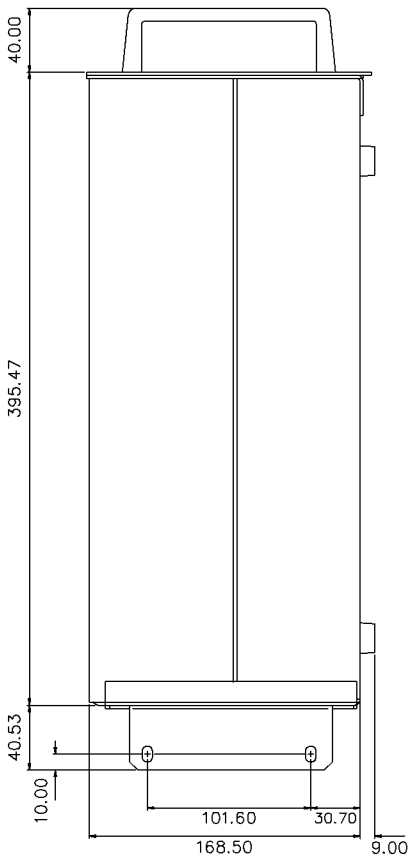
Note that the linking cable is included when a spare CPS2000 is ordered.



Dimensions

All dimensions in millimeters





Technical Specification

Technical Specification

MAINS INPUT VOLTAGE RANGE:

230/200/115/100 V AC +10% / -15% @ 50/60Hz

RATED INPUT POWER (Max):

980 WATTS

MAINS FUSE RATING:

Use T10A/250V (slow-blow).

OUTPUTS

DC. VOLTAGE RAIL	MAX. OUTPUT CURRENT
+17V	16.00 AMPS
-17V	16.00 AMPS
+48V	0.50 AMPS
+8V	1.25 AMPS

All voltage and current measurements are to be taken at the console-end of the power supply cable.

OPERATING TEMPERATURE RANGE (Ambient):

-10 TO +40°C.

HUMIDITY:

Similar unit tested at 0-90% RH non-condensing +/-5% Relative Humidity at 40 °C for 16 hours. Load switched between 20% and 100% at regular 30 minute intervals.

OVERALL DIMENSIONS:

HEIGHT:		177.00mm. (4U)
WIDTH:	Chassis	440.00mm.
	Front panel	482.60mm.
DEPTH: (excl. handles)		436.00mm.

WEIGHT:

(Excl. packing): 30Kg

Circuit Description

THIS UNIT CONTAINS NO USER SERVICEABLE PARTS. REFER ALL SERVICING TO A QUALIFIED SERVICE ENGINEER, THROUGH THE APPROPRIATE SOUNDCRAFT DEALER.

Circuit Description

NOTE: This version Description deals with supplies fitted with PCBS of Issue 7; compared with Issue 4 these have:

1) Improved overload protection that shuts down the supply instead of foldback current limiting. At Issue 7 protection further enhanced for better current control if shorts exist in PSU end of DC cable.

2) Improved mains voltage meter with full-wave rectification to avoid live/neutral asymmetry.

3) Thermostatic control of cooling fans for lower noise.

INTRODUCTION.

The CPS2000 power supply provides +/-17V at 16 Amps, +8V at 1 Amp, and +48V at 0.5 Amp. The main PCB (SC3804) is in LH and RH halves. The LH PCB carries the +17V and +48V supplies. The RH PCB carries the -17V and +8V supplies. A separate PCB (SC3817) carries the mains voltage selector switches at the front of the unit.

THE +/- 17V RAILS. SC3804

This consists of two identical +17V supplies connected together to give +/-17V.

Each 17V supply is a linear regulator with conventional fullwave rectification and a large (100,000uF) reservoir capacitor. This is combined with a second power supply that powers the driver transistors, the cooling fan, and the digital mains meter. The main series pass elements are 250W discrete bipolar transistors connected in parallel with suitable current-sharing precautions and mounted on a fan-cooled heatsink. The voltage reference and servo control amplifier is provided by a 723 regulator IC. The circuitry of the +17V regulator is described in detail below:

The +17V Supply. (LH PCB)

The transformer secondary is fused by means of 32 Amp Safeclip (BS88) fuses mounted in holders on the floor of the chassis. They are NOT intended for customer replacement. A spare fuse will be provided, but it is stressed that these fuses will only blow in the event of catastrophic failure, such as a major short in the wiring or a failed bridge rectifier.

The fullwave bridge rectifier is mounted on the heatsink, at the hottest end as it is the most heat-tolerant of the semiconductors. The reservoir capacitors are mounted by clips on the floor of the chassis. For safety reasons, the reservoir capacitor is discharged by bleeder resistor R9 at switchoff; this takes about 30 seconds. A red warning LED on the PCB is on whenever the capacitor is charged. The unregulated DC is approx +26 to +29V.

The 723 IC contains a 7.15V nominal Zener diode, defining the voltage that appears at Pin 6. Zener references generate appreciable noise, and this, plus any ripple, is filtered out by R10,C10. R10 is in series with the positive input of the servo opamp (Pin 5) and is made roughly equal in resistance to the feedback divider R16,17 etc to minimise bias-current offsets.

The feedback divider R16,17,18 & PR1 derives a fraction of the output voltage and delivers it to the negative input of the servo opamp. (Pin 4) The negative feedback keeps this point also at 17.15V, so the actual output voltage is determined by the feedback divider ratio, which is trimmed over a narrow range by PR3.

The output of the servo opamp controls the output through TR8, which is an emitter follower driving the parallel pass devices TR4,5,6. R41 is included for diagnostic purposes, so that the current being supplied by the 723 (only a few mA) can be measured. The power supply to TR8 is taken from the +12V supply. This has its 0V side connected to the positive unregulated DC supply of 26 - 29V, (at nominal mains) giving a total voltage of approx 38 - 41V for the driver; this also powers the 723 IC. This subrail markedly reduces the minimum drop across the pass elements and therefore increases the efficiency.

The 723 IC is powered through R11, which allows ripple filtering by C9, and voltage protection by DZ1,2. These Zeners are not required to reduce ripple; their function is purely protective, preventing the 40V Vmax spec of the 723 being exceeded should the mains voltage rise above nominal.

The current through the pass devices TR4-7 is shared equally due to the current-sharing resistors R35-45. The drop across these at full load is approx 200mV which is more than enough to swamp Vbe differences in the main transistors.

50 Amp Schottky diode D7 on the output allows supplies to be paralleled for redundancy.

The Mains Voltage Meter.

The incoming mains voltage is continuously indicated on the front panel by a 3.5 Digit Panel Meter. (DPM) This is powered from a +5V supply derived from the +12V subrail by 7805 regulator REG2.

The +5V supply is reduced to +2.5V by R30,31, and buffered by IC2-A to generate a half-rail for the DPM input.

The incoming mains is monitored by differential amplifier IC1-A, which looks at the voltage between Live and Neutral; this avoids problems with having one side of the meter connected to Earth, which is often not at quite the same potential as Neutral. The Voltage is picked off via two special BSI safety-approved 680K resistors on the voltage select PCB (SC3817) which connect to CN3. The circuitry around IC1-A (R21-24) gives unity gain, but the presence of the 680K resistors on the input gives suitable scaling of the 50Hz signal.

The signal is applied to precision full-wave rectifier IC1-B, IC2-B via DC-blocking cap C5; this circuit is biased by the +2.5V halfrail. The rectified output is smoothed by C6 and scaled by R39 and PR1 before applying it to the DPM input on CN1 Pin 8. (IN HI)

Note the DPM has a differential input, so the cold side (IN LO, Pin 7) is connected to the +2.5V halfrail.

The Mutual Shutdown System.

Equipment containing some kinds of op-amp is vulnerable to damage when only one of the +/-17V rails fails, as in this case excessive supply currents can be drawn, damaging fuse resistors on the modules.

When both 17V supplies are working normally, current flows through DZ8, OPTO1, and across to the RH PCB. OPTO1 is on so the base drive to TR22 is shunted away and the 723 works normally. Likewise, TR24 is kept on via R100, and ensures TR28 stays off.

If either supply fails there is insufficent voltage to keep DZ8 conducting, and current flow ceases in the mutual shutdown line. TR22 is turned via the special supply generated by D13, C26, and the internal node of the 723 IC3 is pulled down to ground, turning it off. Likewise, in the -17V supply, TR28 is turned via the special supply generated by D14, C25, and the internal node of IC4 is pulled down to ground, turning it off.

C27,30 delay the action of mutual shutdown sufficiently to allow the supplies to start, as they may not rise to working voltage at exactly the same rate.

When shutdown has ocurred, the supply is reset by turning the mains briefly off and on. R100 discharges C25 so that the circuit is ready for use at the next switch-on. The special supplies generated by D13, C26, and D14, C25, are designed to discharge very quickly at power-off, and it should not be necessary to turn the PSU off for more than a second to reset it.

Overcurrent Protection.

The simplest form of overcurrent protection is the constant-current system; when an attempt is made to draw excessive current, the output voltage is reduced so that no more than a fixed maximum can be drawn. The high current capability of this PSU means that constant current protection alone is not practical as the dissipation in the pass devices is too high for the cooling system to deal with, and in the long term they will overheat.

The standard answer to this problem is foldback current-limiting. Once again the output voltage is reduced to prevent excessive current flow, but it is more severely reduced so that the current flowing is not limited to a fixed maximum, but to a value lower than that which triggered the protection originally. This greatly reduces the dissipation in the supply in protection mode.

This system accomplishes its task, but can give trouble as the supply may work perfectly into a resistive test load but not start into a real console load. The problem is that a mixing console is essentially a constant-current load; as the supply voltage is increased, almost the full current is drawn when only 2 or 3 volts are applied. There are thus two stable states, with rails normal and the full current drawn, or with the supply shut down to the few volts that will cause the foldback current to flow. When the supply is switched on, it tends to stick in the second of these two states.

The CPS2000 avoids this problem by implementing constant-current protection that causes complete shutdown (rather than foldback) after a fixed time delay. This is described for the +17V supply; the -17V supply operates identically.

The first part of the problem is to measure the output current without dropping 0.6V across a resistor to turn on a protection transistor. At 16 Amps the losses in this drop would be unacceptable. Therefore supply current is measured by the voltage drop across 0.05R resistors (R35,36 in parallel) which carry a quarter of the output current and so drop 200 mV at full load. This is compared with a 200mV reference voltage across R86, derived from bands-gap reference IC8 which sits on the output rail, by differential amplifier TR18,19. When the input to TR19 exceeds the 200mV applied to TR18, TR19 conducts and pulls down the internal 723 node at pin 13, reducing the output voltage.

This causes current to cease in the mutual shutdown line, as described above, and after a brief delay caused by C27,30, both 17V supplies are shut down.

ISSUE 7 operates exactly as above. The only difference is that the differential amplifier TR18,19 has its tail fed from a negative subrail at approx -26V. This subrail is generated from the AC input to the PCB by charge-pump C41,42,D22,23. The resulting negative voltage is stabilised by 8V2 Zener DZ10, and applied to R73. This keeps the tail current of TR18,19 more constant, and so maintains the transconductance (current out for voltage in) at a higher level, giving closer feedback control of current-limiting under extreme conditions. The RH PCB operates identically.

Undervoltage warning.

The supply gives a warning indication when the mains voltage has fallen so low that regulation is about to be lost. The Headroom Indicator subsystem illuminates all the decimal points on the DPM, giving a clear signal that something is amiss.

The voltage across the pass transistors is monitored by TR3; when this voltage falls too low, TR3 turns off, turning off TR1. TR1 collector is then pulled up to +40V by R26, charging C7 through D5, and so turning on TR2. This connects the DPM decimal point connections to the local 0V (actually +26 TO +29V above supply 0V) via current-limiting resistors R32-34. The peak-hold action of D5/C7 is required as the voltage across the pass transistors includes a large ripple content that would leave the decimal points rather dim if they were being strobed at 100 Hz.

An identical circuit (TR9, TR10) monitors headroom in the -17V supply. If the voltage across the pass transistors falls too low then TR9 turns off, allowing R78 to pull up the anode of D12 and charge C7 as before.

The -17V Supply. (RH PCB)

The actual 17V section of this is identical to that in the +17V section.

The +12V subrail circuitry is much simpler as it only provides power for the driver TR11, the 723, and the fan. There is no mains meter circuitry here.

The Headroom Indicator subsystem monitors the voltage across the pass transistors by TR10. When this voltage falls too low, TR10 turns off, turning off TR9 and allowing its collector to be pulled up by R71. (To Be Completed)

The Temperature Protection System.

This is designed to protect the +/-17V rails only. The +48V and +8V regulators incorporate internal thermal protection, and in any case, their heat dissipation is very small compared with the heatsink size. The +/-17V rails, however are vulnerable to blocked cooling vents or fan failure, so protection is provided that shuts down the 17V rails if the TO3 device cans exceed 100 degC.

The thermal sensor on the RH heatsink is LM35DZ TR31. It outputs 10mV per degreeC above freezing point (0 degC) and applies it to IC5-B non-inverting input. IC5-B is used as a comparator, with R114,106 giving a small amount of hysteresis to prevent dither or oscillation.

IC reference TR29 produces a stable 1.237V which is reduced to 1.00V by R104,112. This is applied to the inverting inputs of IC5-A,B as the shutdown temperature reference, and represents 100 degC at the TO3 can top. TR27 senses the temperature of the LH heatsink.

If either heat sensor exceeds 100 degC the output of the associated op-amp goes high, applying voltage to the top of R109, and enabling the relaxation LED-flashing oscillator IC6-B. LED7 flashes at approx 2 Hz.

If JMP2 is fitted in the "ON" position, shutdown of the +/-17V rails is also implemented. TR30 is turned on via R117, which turns on TR28, and shuts down the -17V supply. The mutual shutdown system then also shuts down +17V. If JMP2 is in the "OFF" position, only the LED flashing occurs.

The +48V Supply.

Max current rating is 0.5 Amps. The +48V phantom supply is based on the high-voltage regulator TL783C. (REG1) The AC input is fused by F4 and fullwave rectified by BR4; C1,24 are the reservoir capacitors. The unregulated DC may rise as high as +85V on high mains.

The TL783C maintains a fixed 1.27 V between its ADJ and OUT pins, so the adjustable voltage-divider R1-PR2-R2 gives an output of approx 48V. This can be finely adjusted by PR2. The divider current is also used to power the rail indicator LED3, minimising the current wasted inside the regulator circuit.

An output current of 0.5A and a wide (+10/-20%) mains range means that a TL783C alone is only marginally capable of handling the power dissipation. Therefore preregulator TR16,17, working as an emitter-follower biased from the +48V output by zener DZ5, absorbs some of the voltage drop, so that only approx 62V appears on the TL783C input. C28 ensures HF stability of REG1.

Two protection diodes are included. D1 protects the regulator from reverse voltage if there is a charged capacitor across the output but the voltage on C1,24 has collapsed. D2 prevents the ADJ pin from rising above the OUT pin (due to the charge on C2) if the output is shorted.

Conventional diode D6 on the output allows supplies to be paralleled for redundancy.

The +8V Supply.

Max current rating 1.0 Amps. This supply is primarily intended for powering console internal computers; it will be regulated down to +5V inside the console.

The AC input is fused by F4 and fullwave rectified by BR4. The unregulated DC is about +15V on nominal mains. The LM317T regulator maintains a fixed 1.25V between its ADJ and OUT pins, so fixed voltage-divider R68,69 gives an output of approx 8.1 V. C23 reduces output ripple from 1 mV to approx 180 uV at full load.

Two protection diodes are included. D9 protects the regulator from reverse voltage if there is a charged capacitor across the output but the voltage on C20,21 has collapsed. D10 prevents the ADJ pin from rising above the OUT pin (due to the charge on C23) if the output is shorted.

Conventional diode D11 on the output allows supplies to be paralleled for redundancy.

Mains Voltage Select PCB. SC3817

This PCB (SC3817) carries the inrush suppressor and two DPCO switches that select the transformer primary connections to suit the incoming mains voltage.

The first switch A selects between EUROPE and USA/JAPAN settings. The second switch B selects high and low variations on this:

Mains Switch A Setting	Mains Switch B Setting	Nominal Mains Voltage	Dropout Voltage Spec'd	Dropout Voltage Measured
EUROPE	230/115	230	195	182
EUROPE	200/100	200	170	158
USA/JAPN	230/115	115	98	91
USA/JAPN	200/100	100	85	79

Note that the dropout voltages in the rightmost column were measured on a CPS2000, and are significantly lower than the guaranteed dropout specification of -15%.

Fan Control PCB. SC4032.

Thermostatic fan control was fitted to the CPS2000 from February 1999. The controller is a separate PCB (SC4032) mounted on the front heatsink bracket, with a thermal sensor pressed against the top surface of the heatsink.

The CPS2000 fan control system adapts the fan speed to the power drawn. This gives a substantial reduction in fan noise under almost all circumstances; the exception being 10% high mains and maximum current drawn, which naturally sets the fan to full speed. The PCB (with associated mounting bracket) may be retrofitted to existing CPS2000 units.

The servo circuit consists of opamp IC1-A, temperature sensor IC5, shunt regulator IC4, and fan control devices TR7,TR10.

IC4 maintains 2.50V between its "anode" and "cathode"; this is the precise voltage that drives the reference chain R53,55. TR8 also uses this voltage to set its emitter at 4.4V above ground; this keeps IC1's inputs within their common-mode range. Thus both ends of the voltage divider R53-R55 are fixed at defined voltages.

LM35DZ temperature sensor IC5 outputs 10mV per degreeC above freezing point (0 degC) and applies it to IC1-A non-inverting input. The desired heatsink temperature is set at the junction of R53,55, which sits at +5.0V approx. This is 600mV above the +4.4V rail, and so represents 60 degC.

R52,57 set the servo loop gain. This is designed to be safely below the level at which slow thermal oscillations would occur. R56,D19 increase the loop gain when IC1-A output is below 4V. This prevents the fan sitting for long periods in a not-quite-running state where it consumes current but does not rotate. The voltage range 1-4V where this occurs is thus skipped over quickly.

The fan is driven through feedback amplifier TR7,10, which has a voltage gain of 1.3 times. This allows the fan to be driven over its full operating voltage range despite the output saturation limits of IC1-A. This gives improved cooling at high temperatures and mains voltages.

The CPS2000 thermal shutdown system is quite separate and has no connection with this PCB.

FAULTFINDING NOTES.

SAFETY: These safety notes are directed to those testing and repairing this power supply. Legal requirements mean that we must not encourage untrained personnel to take the lid off.

+/- 17V RAILS.

1) A convenient position for attaching a test meter to 0V is the top leg of bleeder resistor R9 (top leg of R47 on RH PCB) Remember these resistors run hot.

2) If one side of the +/-17V supply is not working, the mutual shutdown system will close down both sides of the supply. This makes faultfinding difficult as it is often not obvious which side has failed. The mutual shutdown can be disabled by putting on jumpers JMP1 & JMP3 on PCBs at Issue 6 and above.

IT IS ESSENTIAL THAT THESE JUMPERS ARE REMOVED AFTER SERVICING IS COMPLETED! FAILURE TO DO THIS MAY CAUSE SEVERE CONSOLE DAMAGE IF ONLY ONE 17V RAIL SHUTS DOWN.

3) If the wireform connecting the two PCBs is disconnected, the mutual shutdown will close down both sides of the supply. The Headroom Alarm dots will also show on the DPM as an active low from the RH PCB is required to suppress them, and this is now missing.

4) If there is no power to the 723 IC (eg if R11 or R48 is open-circuit) the output will remain low, but no damage occurs.

5) It is possible to swop over the two 2-pin connections on the LH PCB in error. The fan will not run, but no circuit damage occurs.

+48V SUPPLY.

1) If TR17 fails short-circuit, the regulator will appear to work, but since all voltage is dropped across the TL783 regulator, this will overheat and shut down at high currents. The TL783 should not be damaged if this is the only fault present.

2) If zener DZ5 fails short-circuit, the regulator will not turn on, and there will be only 300 mV approx at the output.

3) As usual, the unregulated supply to the +48V regulator can reach +90V, and should be treated with some respect.

+8V SUPPLY.

1) This is a completely standard IC regulator circuit. The regulator REG3 is the only part that is likely to fail.

2) This supply contains mains voltages on the voltage select PCB, the mains switch, etc, and the usual precautions must be taken.

3) The main reservoir capacitors have a capacity of one tenth of a Farad, and are charged to +26V.

THIS IS DANGEROUS.

The danger lies not in the voltage, but in the enormous currents that will flow if the capacitor terminals are shorted. A small screwdriver will simply disappear in a violent explosion. The main bodily danger is from metal watchstraps, etc. Serious burns are very likely if these contact the capacitor.

For safety reasons, the reservoir capacitors are discharged at switchoff by bleeder resistors R9 and R47; this takes about 30 seconds. Red warning LEDs on the PCB are ON when the capacitors are charged.

Parts List

Spare Parts

Notes:

1) The 'Module/PCB Assemblies' section is indented to show those items which are part of another, higher level, item.

2) Some of the descriptions are followed by one of the following 3 symbols:

- STATIC SENSITIVE. Anti-static precautions must be taken whilst handling this part.

! - SAFETY CRITICAL PART. A part of a different type may not be substituted.

@ - A part from a specific Manufacturer. Using an equivalent from another manufacturer may lead to loss of performance.

CPS2000 POWER SUPPLY UNIT — RW8009

---	!CPS2000 WIRED TESTED PSU CHAS	!	RY8009
---	SLF SEAL BAGS+PNLS 6X9"		TZ2298
---	!5X20MM T2A/250V AS FUSE	!	ZD8102
---	!5X20MM T10A/250V AS FUSE	!	ZD8110
---	!5X20MM T12.5A/250V AS FUSE	!	ZD8112
---	!CPS2000 FUSE 32A BS88	!	ZD8900
---	CPS2000 USER&TECH GUIDE		ZM0198

---	!CPS2000 WIRED TESTED PSU CHAS	RY8009
---	80MM FAN FILTER ASSY	HZ2211
---	NO.6X1/2"TYPE B CSK POZI BLACK	NA0073
---	M5X12MM CSK POZI BLK SCREW	NA0091
---	M3 X 8MM PAN POZI BLCK SCRW	NA0130
---	M4X10MM PAN POZI STL SCR BLACK	NA0146
---	M4 NYLON INSERT NUT TYPE T	NB0127
---	M4 CRINKLE WASHER	NC0278
---	CPS2000 HANDLE	NZ2362
---	CPS2000 PSU CVR PLATE	PB0720-02
---	CPS2000 PSU LID	PH1402-02
---	CPS2000 FRONT PNL	PJ1508-02
---	CPS2000 WIRED CHASSIS ASSY	RS5978

---	**CPS2000 WIRED CHASSIS ASSY**		**RS5978**
---	**M5X12MM CSK POZI BLK SCREW**		**NA0091**
---	**M4X10MM PAN POZI STL SCR BLACK**		**NA0146**
---	**M3X12MM PAN POZI SCREW BLACK**		**NA0237**
---	**M6X20MM PAN POZI CLR SCR**		**NA0317**
---	**NO8X3/8 PAN POZI B BLACK SCR**		**NA0372**
---	**M3 NYLON INSERT NUT**		**NB0113**
---	**M4 NYLON INSERT NUT TYPE T**		**NB0127**
---	**M6 NYLON HEX DOME NUT**		**NB0165**
---	**M4 PLAIN STEEL WASHER ZNC CLR**		**NC0249**
---	**CPS2000 PSU TRANS CLAMP PLATE**		**PF0646-01**
---	**CPS2000 LH MODULE ASSY**		**RS5974**
D7	MBR5025L 50A 25V SCK DIODE		BA0023
TR4, TR5, TR6, TR7	MJ15024 NPN POWER TRANS TO3	@	BD0373
TR8, TR17	MJL3281A DRIVER TRANSISTOR		BD0399
REG2,	V.REG LM7805 +5V 1A		BE0424
REG1,	VOLTAGE REG TL783CKC		BE0455
---	MTHD 2WY .1" FML		FF0585
---	PAPST 12V 2.4W 80MM FAN		HD0005
---	M5X30MM PAN POZI SCREW		NA0094
---	M4 X 16MM PAN POZI SCREW		NA0125
---	M4 X 12MM PAN POZI SCREW		NA0165
---	NO6 X 5/8" TYPE B PAN POZI BLK		NA0258
---	M5 NYLON INSERT NUT		NB0116
---	M4 NYLON INSERT NUT TYPE T		NB0127
---	NYLOCK NUT ZINC 6-32 UNIFIED		NB0173
---	M4X9 1MM THICK RUBBER WASHER		NC0293
---	NO6 PLASTIC WASHER 1.58MM		NC0295
---	CPS2000 TO3P MOUNTING CLIP		NZ2354
---	FAN GASKET 80.00MM		NZ2357-02
---	CPS2000 FAN FRONT BRKT		PF0649-01
---	CPS2000 EXTRU HEATSINK		PN1260-01
---	LH HALF OF CPS2000 PSU PCB ASSY		RF3804
This list covers both LH & RH PCB's			
ISSUE 0	***PROCESS SHEET ISSUE***		AA
R41, R50	MF 0.25W RES 2% 10R		AD0401
R3, R19, R55	MF 0.25W RES 2% 100R		AD0425
R1	MF 0.25W RES 2% 120R		AD0427
R68	MF 0.25W RES 2% 180R		AD0431
R94	MF 0.25W RES 2% 200R		AD0432
R11, R32, R33, R34, R48	MF 0.25W RES 2% 330R		AD0437
R77	MF 0.25W RES 2% 620R		AD0441
R70	MF 0.25W RES 2% 680R		AD0445
R102	MF 0.25W RES 2% 1K		AD0449
R69	MF 0.25W RES 2% 1K6		AD0451
R20, R67	MF 0.25W RES 2% 1K6		AD0454
R87	MF 0.25W RES 2% 1K8		AD0455
R10, R49, R76, R81, R83, R84, R86, R90, R91, R92, R98	MF 0.25W RES 2% 2K2		AD0457
R85, R93	MF 0.25W RES 2% 2K4		AD0458
R46, R95	MF 0.25W RES 2% 3K3		AD0461
R2, R93	MF 0.25W RES 2% 3K9		AD0463
R16, R17, R64, R65, R107, R108	MF 0.25W RES 2% 4K7		AD0465
R122	MF 0.25W RES 2% 5K1		AD0466
R80, R82, R97, R116	MF 0.25W RES 2% 6K8		AD0469

R18, R66	MF 0.25W RES 2% 7K5	AD0470
R79, R99 ---	MF 0.25W RES 2% 8K2	AD0471
R13, R14, R15, R21, R22, R25, R26, R27, R51, R52, R54, R71, R78, R73, R94, R120, R121 ---	MF 0.25W RES 2% 10K	AD0473
R101 ---	MF 0.25W RES 2% 15K	AD0477
R12, R53, R72, R104	MF 0.25W RES 2% 22K	AD0481
R28, R29, R30, R31, R115	MF 0.25W RES 2% 47K	AD0489
R23, R24, R75, R100, R110, R112, R113, R114, R117	MF 0.25W RES 2% 100K	AD0497
R103, R109	MF 0.25W RES 2% 220K	AD0505
R39, R111	MF 0.25W RES 2% 680K	AD0517
R105, R106, Not Ais	000 !Res MF 10M 2% 0.25W VR37	AD8107
R35, R36, R37, R38, R42, R43 R44, R45, R56, R57, R58, R59 R60, R61, R62, R63	W/W RES 2W 10% OR1	AG0654
R9, R47	W/W RES 4W 470R VTM	AH0744
D3, D4, D5, D12, D16, D17, D19, D20, D21	DIODE 1N4148	BA0001
D1, D2, D6, D9, D10	DIODE 1N4001	BA0005
D11	DIODE RL/MR752 200V 6A PRFM.6"	BA0007
DZ8	ZENER DIODE 400MW 3.3V	BB0101
DZ5	ZENER DIODE 400MW 11V	BB0106
DZ7Not Ais Note: Fit opposite way round to board nutation	ZENER DIODE 400MW 4.7V	BB0111
DZ1, DZ3	ZENER DIODE 500MW 18V	BB0120
DZ2, DZ4	ZENER DIODE 22V 400MW	BB0125
BR,2,4	BDG RECT 6A 200V	BC0209
BR1, 3	BDG RECT BR22 2A	BC0212
TR3, TR10, TR20, TR23, TR26, TR30	PNP TRANS 2SA970GR (TAPED)	BD0301
TR2, TR9, TR18, TR19, TR21, TR22 TR24, TR25, TR28	NPN TRANS 2SC2240BL(TAPED)	BD0302
OPTO1	CNY17-1	BD0348
TR16	MPSA42 NPN TRANS	BD0369
IC1, IC2, IC5, IC6	JRC DUAL OP AMP 072BDE	BE0413
IC3, IC4	723C VOLTAGE REGULATOR	BE0526
TR29, IC7, IC8	LM385 VOLTAGE REFERENCE	BE0531
C8, C18	C/C0.2"TAPED 100V 470PF(N47)	CA0008
C28	MICRO-BOX 5MM 5% 100V 220N	CC0251
C4, C5, C11, C19	VERT ELEC 0.2" TPD 47MF 25V	CE0401
C2, C3, C22, C23, ---	VERT ELEC 0.2" 47UF 63V	CE0402
C6, C7, C29	VERT ELEC 0.2"TPD 2.2MF 50V	CE0416
C10, C17, C25	VERT ELEC 220 MF 25V	CE0422
C27, C30	220 / 6V3	CE0423
C9, C16	VERT ELEC 5MM 100MF/63V	CE0430
C1, C24	VERT ELEC 470MF/100V 16MM O/D	CE0436
C12, C13, C14, C15, C20, C21	ELECT RADIAL 2200UF/35V	CE0443
C26	VERT ELEC 330MF/6.3V 6.3D 11L	CE0455
PR3, PR4	CERMET TRIMMER HORIZ 9OH 2K2	DE0401
PR2	CERMET TRIMMER HORIZ 1K	DE0425
CN1	G80 IDC 16WY VERT ML LTCH HDR	FA0092
REG1, 2, 3	MTHD 0.1" 3WY R/A ML	FD0309
CN2, CN3, CN6	MTHD .1" 2WY VERT LCKNG ML HDR	FF0641
CN7, CN8	MTHD .1" 6WY VERT LCKG ML HDR	FF0649
CN4, CN5	MLX 4WY ML HDR	FF0862
LED2,3,	T1 3/4 5MM LED GREEN	JA0034
LED1,4,	LED RED 3MM S/B SHORT-MD5543	JA0103
---	SELF CLINCHING FASTENER	NZ2317
---	CPS2000 PSU PCB	SC3804-03
F1, F2, F3, F4	!SCHURTER FUSE CLIP !	ZD0317

	---	!FUSE COVER SCHURTER 853-9561	!	ZD8013
	---	!5X20MM T2A/250V AS FUSE	!	ZD8102
---		KOOL PAD LM317T/337T		ZC0217
---		30CMX30CM THERMALLY CNDCTV SHT		ZC0223
---		KOOL PAD TO3P (HI-EFFICIENCY)		ZC0227
---		KERATHERM 86/10 PAD		ZC0230
---		**CPS2000 RH MODULE ASSY**		**RS5975**
	D8	MBR5025L 50A 25V SCK DIODE		BA0023
	TR12, TR13, TR14, TR15	MJ15024 NPN POWER TRANS TO3	@	BD0373
	TR11	MJL3281A DRIVER TRANSISTOR		BD0399
	REG3,	V.REG +1.2/37V 1.5A (LM317T)		BE0430
---		MTHD 2WY .1" FML		FF0585
---		PAPST 12V 2.4W 80MM FAN		HD0005
---		M5X30MM PAN POZI SCREW		NA0094
---		M4 X 16MM PAN POZI SCREW		NA0125
---		M4 X 12MM PAN POZI SCREW		NA0165
---		NO6 X 5/8" TYPE B PAN POZI BLK		NA0258
---		M5 NYLON INSERT NUT		NB0116
---		M4 NYLON INSERT NUT TYPE T		NB0127
---		NYLOCK NUT ZINC 6-32 UNIFIED		NB0173
---		M4X9 1MM THICK RUBBER WASHER		NC0293
---		NO6 PLASTIC WASHER 1.58MM		NC0295
---		CPS2000 TO3P MOUNTING CLIP		NZ2354
---		FAN GASKET 80.00MM		NZ2357-02
---		CPS2000 FAN FRONT BRKT		PF0649-01
---		CPS2000 EXTRU HEATSINK		PN1260-01
---		RH HALF OF CPS2000 PSU PCB ASSY		RF3804
---		**CPS2000 FRONT SUB PNL ASSY**		**RS5976**
---		!ILLUM RCKR SWT DPST	!	DL8005
---		LED 3.5 DIGIT PANER METER		JE0414
---		CPS2000 FRONT SUB PNL		PF0648-01
---		!SCHRTR FUSEHOLDER	!	ZD8014
---		!SCHRTR FUSE CARRIER	!	ZD8015
---		!SCHRTR FUSEHOLDER INSULATOR	!	ZD8016
---		!5X20MM T10A/250V AS FUSE	!	ZD8110
---		**CPS2000 CHASSIS ASSY**		**RS5977**
---		VERT ELEC 100.000UF 40V		CE0492
---		!IEC INLET SKT 16A PNL MNT	!	FJ8010
---		M3X10MM CSK POZI SCREW BLACK		NA0115
---		M4X10MM PAN POZI STL SCR BLACK		NA0146
---		M5 X 15MM PAN/POZI SELF COL		NA0156
---		M3 NYLON INSERT NUT		NB0113
---		M4 NYLON INSERT NUT TYPE T		NB0127
---		M4 CRINKLE WASHER		NC0278
---		CAPACITOR MOUNTONG BRKT VERT		NZ2356
---		CPS2000 REAR LH BRACKET		PG1301-01
---		CPS2000 REAR RH BRACKET		PG1302-01
---		CPS2000 BASE PNL		PJ1507-02
---		PSU EARTH SYMBOL SLF-ADH		ZA0078
---		RICHO SCREW ON PLASTIC FEET		ZZ2541
---		**CPS2000 TX WFM ASSY**		**RV3656**
---		CPS2000 BRIDGE RECTIFIER		BC0220
---		4WY FML HOUSING 42021 SERIES		FF0878
---		**!CPS2000 MAINS TRANSFORMER**	!	**HB8025**
---		**CPS2000 VOLTAGE SEL PCB ASSY**		**RA3817**
	R1, R2	!RES MF 10M 2% 0.25W VR37	!	AD8107
	TH1,	INRUSH SUPPRESSOR 20SP0R7	@	AZ2265
	SW1, SW2	!TW VOLTAGE SELECTOR SWT	!	DJ8000
	CN1	MTHD.1"2WY R/A LCKG ML HDR S12		FF0648

	---	CPS2000 PSU VOLTAGE SEL PCB AS	SC3817-01
	F1-FITU	!SCHURTER FUSE CLIP !	ZD0317
	---	!FUSE COVER SCHURTER 853-9561 !	ZD8013
	---	!5X20MM T12.5A/250V AS FUSE !	ZD8112
	---	CPS2000 MNS SWT TO VOLT SEL WM	RV3658
	---	1/4"CRIMP RCPTCLE CCT(CHAINED)	FG0629
	---	32/0.2 BLUE WIRE	LA0013
	---	32/0.2 BROWN WIRE	LA0014
	---	!CPS2000 FUSE 32A BS88 !	ZD8900
	---	!CPS2000 BS88 FUSEHOLDER !	ZD8901
---		**CPS2000 MNS INLT TO MNS SWT WM**	**RV3657**
	---	1/4"CRIMP RCPTCLE CCT(CHAINED)	FG0629
	---	1/4" PRE-INSLTD RCPTCLE (BLUE)	FG0646
	---	32/0.2 BLUE WIRE	LA0013
	---	32/0.2 BROWN WIRE	LA0014
	---	32/0.2 YELLOW/GREEN WIRE	LA0023
	---	H20X20MM HELSYN SLEEVE BLUE	LF0512
	---	2BA VIBRATION RESIST.SOLDR TAG	NE0409
---		**CPS2000 MNS TO VOL SEL PCB WFM**	**RV3659**
	---	MTHD 2WY .1" FML	FF0585
	---	7/0.2 TWISTED PAIR BLACK/WHITE	LA0047
---		**CPS2000 MAINS METER WFM**	**RV3660**
	---	VARELCO IDC 16WY FML CBL MNT	FA0110
	---	R/CBL GREY 16WY	LC0225
---		**CPS2000 LH/RH PCB LINKING WFM**	**RV3661**
	---	MTHD .1" 6WY FML	FF0650
	---	7/0.2 TWISTED PAIR BLUE/YELLOW	LA0050
---		**CPS2000 DC OUTPUT WFM LH**	**RV3662A**
	---	SOCAPEX 19WY PNL MNT FML	FJ0868
	4 X 500	32/0.2 BLACK WIRE	LA0012
	4 X 250	32/0.2 BLUE WIRE	LA0013
	2 X 740	32/0.2 GREY WIRE	LA0016
	---	32/0.2 ORANGE WIRE	LA0017
	---	32/0.2 PINK WIRE	LA0018
	4 X 400	32/0.2 RED WIRE	LA0019
	2 X 250	32/0.2 YELLOW/GREEN WIRE	LA0023
	---	H20X20MM HELSYN SLEEVE BLUE	LF0512
	---	2BA VIBRATION RESIST.SOLDR TAG	NE0409
---		**CPS2000 DC OUTPUT WFM RH**	**RV3662B**
	---	SOCAPEX 19WY PNL MNT FML	FJ0868
	4 X 300	32/0.2 BLACK WIRE	LA0012
	4 X 200	32/0.2 BLUE WIRE	LA0013
	2 X 560	32/0.2 GREY WIRE	LA0016
	---	32/0.2 ORANGE WIRE	LA0017
	---	32/0.2 PINK WIRE	LA0018
	4 X 600	32/0.2 RED WIRE	LA0019
	2 X 250	32/0.2 YELLOW/GREEN WIRE	LA0023
	---	H20X20MM HELSYN SLEEVE BLUE	LF0512
	---	2BA VIBRATION RESIST.SOLDR TAG	NE0409
---		**CPS2000 OV LINK WFM**	**RV3663**
	---	!16 AWG WIRE BLUE UL1007 !	LA8012
	---	H20X20MM HELSYN SLEEVE BLUE	LF0512
	---	2BA VIBRATION RESIST.SOLDR TAG	NE0409
---		**CPS2000 RESERVR CAP TO PCB WFM**	**RV3664**
	---	!16AWG WIRE BROWN UL1015 !	LA8024
	---	H20X20MM HELSYN SLEEVE BLUE	LF0512
	---	2BA VIBRATION RESIST.SOLDR TAG	NE0409
---		**CPS2000 RECT TO RESERVR CAP WM**	**RV3665**
	---	14AWG TRI-RATED WIRE RED	LA0079

---	14AWG TRI-RATED WIRE BLACK	LA0080
---	H20X20MM HELSYN SLEEVE BLUE	LF0512
---	2BA VIBRATION RESIST.SOLDR TAG	NE0409

Fan Control

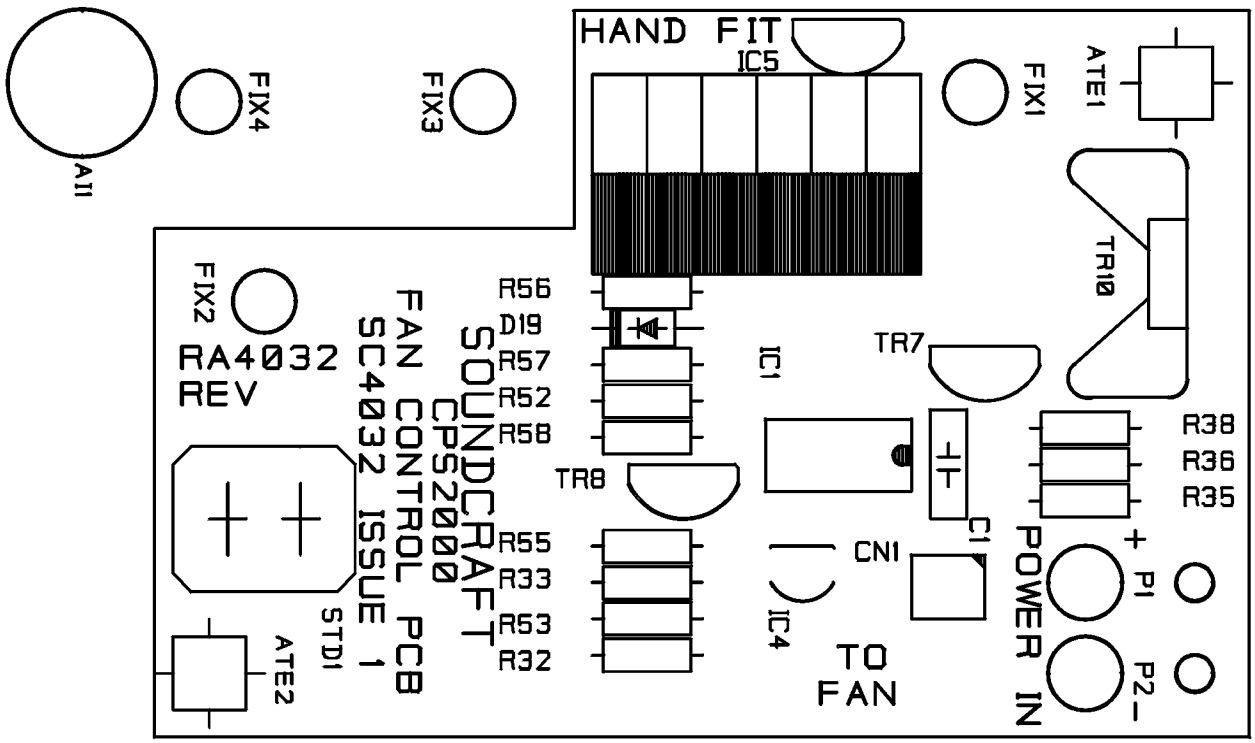
CPS2000 Fan Control & PCB SC4032

Technical Description.

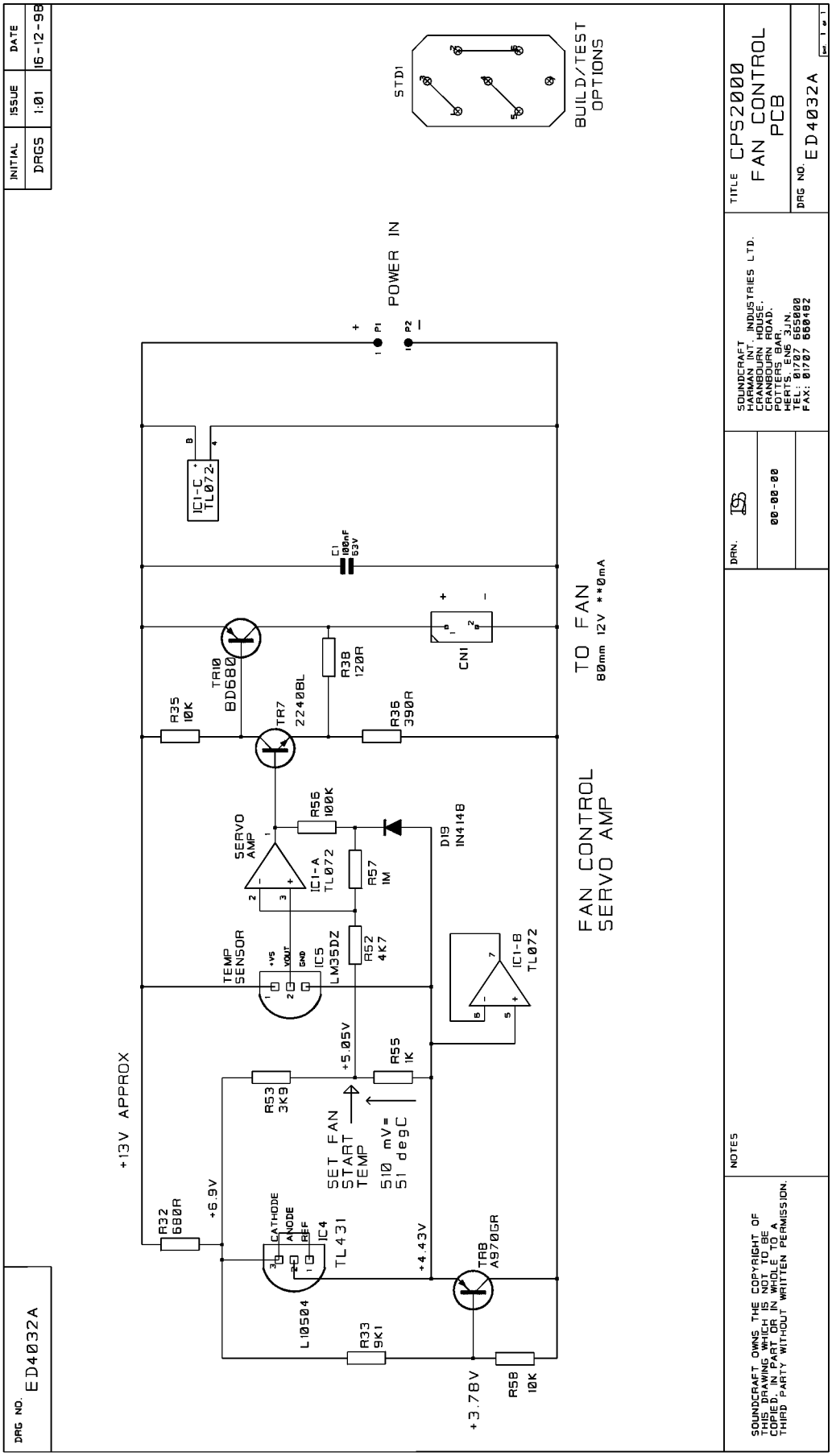
The later models of the CPS2000 are fitted with a fan control servo system that adapts the fan speed to the power drawn. This gives a substantial reduction in fan noise under almost all circumstances; the exception being 10% high mains and maximum current drawn, which naturally sets the fan to full speed. The PCB (with associated mounting bracket) may be retrofitted to existing CPS2000 units.

The servo circuit consists of opamp IC1-A, temperature sensor IC5, shunt regulator IC4, and fan control devices TR7,TR10. IC4 maintains 2.50V between its "anode" and "cathode"; this is the precise voltage that drives the reference chain R53,55. TR8 also uses this voltage to set its emitter at 4.4V above ground; this keeps IC1's inputs within their common-mode range. Thus both ends of the voltage divider R53-R55 are fixed at defined voltages. LM35DZ temperature sensor IC5 outputs 10mV per degreeC above freezing point (0 degC) and applies it to IC1-A non-inverting input. The desired heatsink temperature is set at the junction of R53,55, which sits at +5.0V approx. This is 600mV above the +4.4V rail, and so represents 60 degC. R52,57 set the servo loop gain. This is designed to be safely below the level at which slow thermal oscillations would occur. R56,D19 increase the loop gain when IC1-A output is below 4V. This prevents the fan sitting for long periods in a not-quite-running state where it consumes current but does not rotate.

The voltage range 1-4V where this occurs is thus skipped over quickly. The fan is driven through feedback amplifier TR7,10, which has a voltage gain of 1.3 times. This allows the fan to be driven over its full operating voltage range despite the output saturation limits of IC1-A. This gives improved cooling at high temperatures and mains voltages. The CPS2000 thermal shutdown system is quite separate and has no connection with this PCB.



CPS2000 Fan Controller Circuit Diagram



CPS2000 Fan Controller Parts List

Reference	Description	Component	
	FAN CONTROL PCB	**GA4032**	
C1	POLY-CAP 5MM 5% 63V 100N	CC0252	
CN1	"MTHD.1""2WY R/A LCKG ML HDR S12"	FF0648	1
D19	DIODE 1N4148	BA0001	1
IC1	JRC DUAL OP AMP 072BDE	BE0413	1
IC4	TL431 SHUNT REGULATOR	BE0503	1
IC5-FIT	LM35DZ THERMAL SENSOR	BE0477	1
ISSUE 1	*****PROCESS SHEET ISSUE*****	**RA4032AA**	
P1	CPS2000 FAN CONTROL WFM	RV4016-140	
P2	CPS2000 FAN CONTROL WFM	RV4016-140	
R32	MF 0.25W RES 2% 680R	AD0445	
R33	MF 0.25W RES 2% 9K1	AD0472	
R35	MF 0.25W RES 2% 10K	AD0473	
R36	MF 0.25W RES 2% 390R	AD0439	
R38	MF 0.25W RES 2% 120R	AD0427	
R52	MF 0.25W RES 2% 4K7	AD0465	
R53	MF 0.25W RES 2% 3K9	AD0463	
R55	MF 0.25W RES 2% 1K	AD0449	
R56	MF 0.25W RES 2% 100K	AD0497	
R57	MF 0.25W RES 2% 1M	AD0521	
R58	MF 0.25W RES 2% 10K	AD0473	
TR10	BD680 TRANS	BD0368	
TR10	TO126 CLIP-ON H/SNK RDPT PF730	PN1235	
TR7	NPN TRANS 2SC2240BL(TAPED)	BD0302	
TR8	PNP TRANS 2SA970GR (TAPED)TOSH	BD0301	

Technical Drawings

Circuit Diagrams

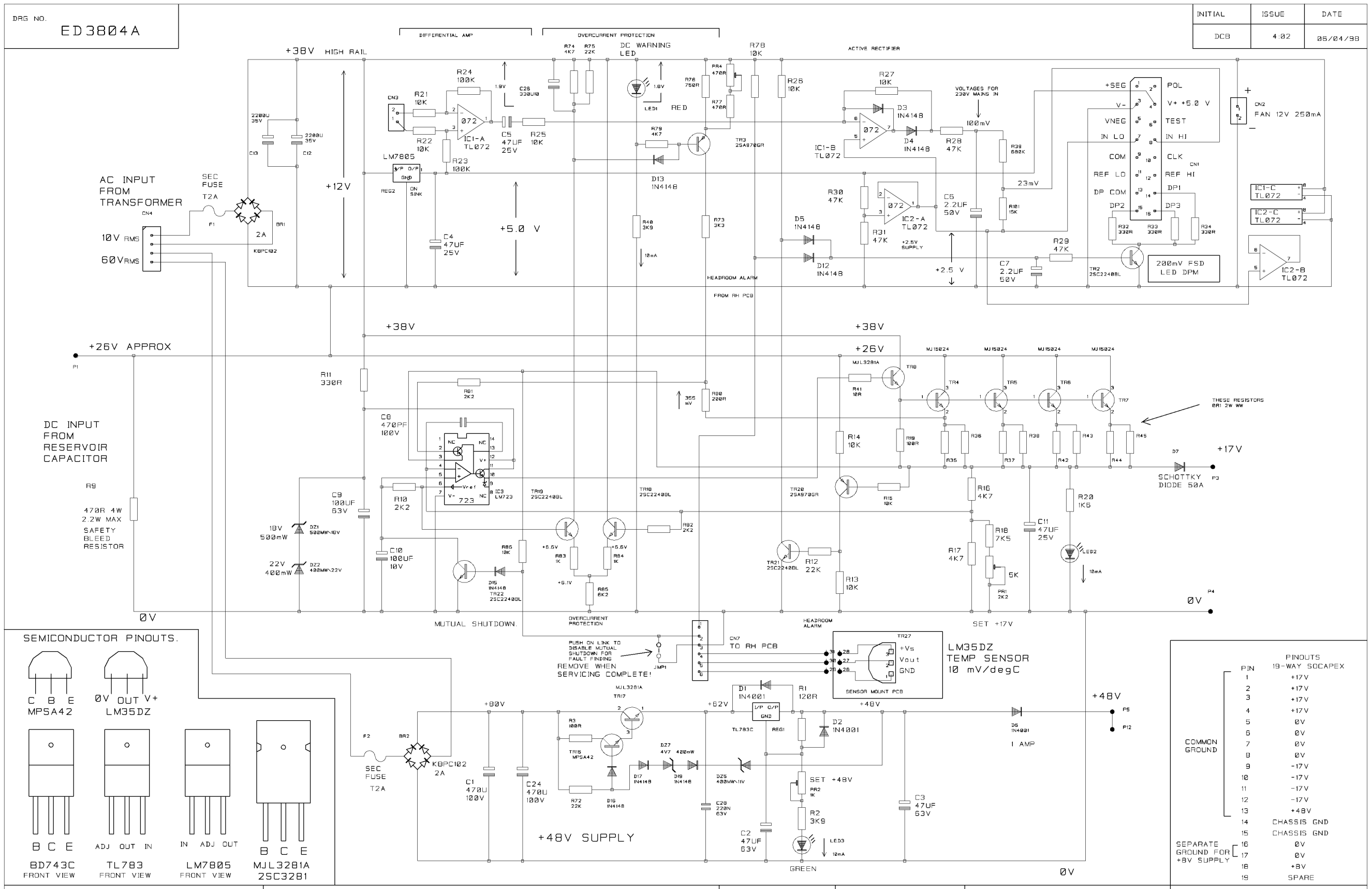
ED3804A	Iss 4.02
ED3804B	Iss 4.02
ED3804A	Iss 5.03
ED3804B	Iss 5.03
ED3804A	Iss 6.04
ED3804B	Iss 6.04
ED3804A	Iss 8.02
ED3804B	Iss 8.02
ED3817	Iss 4.01

PCB Layouts

ED3804	Iss 4.02
ED3804	Iss 5.03
ED3804	Iss 6.04
ED3804	Iss 8.02
ED3817	Iss 4.01

DRG NO.
ED3804A

INITIAL	ISSUE	DATE
DCB	4:02	06/04/98



NOTES

LAST USED: R117 D21 IC6
CN8 BR4 P20
C29 DZ6 LED7
PR3 TR29 JMP2

REMOVED:

DRN. DS

TITLE
CPS2000
LH PCB. +17V +48V

DRG NO.
ED3804A

DRG NO.	INITIAL	ISSUE	DATE
ED3804B	DCB	4:02	06/04/98

TO DO

TEMP SENSOR PCB & PADS
LM385 LIB SHAPE

MUTUAL SHUTDOWN.
TO LH PCB

HEADROOM ALARM

CN8
TO LH PCB

AC INPUT
FROM
TRANSFORMER

10V RMS
12V RMS

CN5

SEC
FUSE
T2A

F3

BR3
KBPC102
2A

HIGH RAIL +38V APPROX

2200/35
C14

C15
2200/35

CN6
FAN 12V 250mA

C25
220UF
25V

R100
10K

DZ6
400MW\7V5

R97
750R

R95
4K7

R96
22K

1.90V

C27
330U10

INTERNAL
WARNING
LED

+38V

RED

1.80V

LED4

R85
4K7

PR5
470R

R98
470R

TR23
2SA970GR

D14
IN4148

+26V APPROX

P6

R48
330R

R92
2K2

C18
470PF
100V

R46
3K3

355
mV

R94
200R

R93
3K9

DC INPUT
FROM RESERVOIR
CAPACITOR

R47
470R 4W
2.2W MAX
SAFETY
BLEED
RESISTOR

C16
100UF
63V

R49
2K2

IC4
LM723

18V
500mW
DZ3
500MW\18V

22V
400mW
DZ4
400MW\22V

C17
100UF
10V

TR25
2SC2240BL

R89
1K

R90
1K

+5.6V

+6.1V

TR24
2SC2240BL

R91
2K2

R88
6K2

R116
10K

R115
47K

R87
5K6

TR28
2SC2240BL

HI-TEMP.
SHUTDOWN.

MUTUAL
SHUTDOWN.
TR26
2SA970GR

OVERCURRENT
PROTECTION

HEADROOM
ALARM

P7

R71
10K

R107
4K7

R113
100K

R118
47K

IC5-A
TL072

R105
10M

R104
22K

LM385
TR29

FB

R108
4K7

R112
100K

TR31
LM35DZ TEMP
SENSOR
10mV/degC
SENSOR MOUNT PCB

+Vs
Vout
GND

Z22
Z23
Z24
Z25

IC5-B
TL072

R114
100K

R106
10M

IC6-A
TL072
NOT USED

D20
IN4148

D21
IN4148

IC5-C
TL072

IC6-C
TL072

R109
220K

R111
680K

R117
100K

IC6-B
TL072

R102
1K

R103
220K

C29
2.2UF
50V

LED7
RED

JMP2
OFF ON

THERMAL
SHUTDOWN
ON/OFF

R110
100K

TR30
2SA970GR

LED FLASH OSCILLATOR 2Hz

+26V

TR11

TR12

TR13

TR14

TR15

RESISTORS
ALL 0R1 2W WW

R50
10R

R51
10K

R55
100R

R56

R57

R58

R59

R60

R61

R62

R63

0V

P8

D8
SCHOTTKY
OUTPUT
DIODE

R52
10K

TR10
2SA970GR

R53
22K

TR9
2SC2240BL

R54
10K

R64
4K7

R65
4K7

R66
7K5

PR3
2K2

R67
1K5

C19
47UF
25V

10mA
GREEN

LED5

P9

-17V

SET -17V

HEADROOM
ALARM

THERMAL SHUTDOWN

P7

LM385 1.2V
REFERENCE

0V V+ FB

LM35DZ
TEMP
SENSOR

0V OUT V+

B C E
2SA970GR
2SC2240BL
LOOKING AT PINS

ADJ IN
OUT
LM317T
FRONT VIEW

D9
IN4001

LM317T
I/P O/P
GND

REG3
VREF=1.25

+13V

R68
180R

D10
IN4001

D11
RL\MR752

3 A

+8V

P10

P13

+8V
SUPPLY

BR4

F4

SEC
FUSE
T2A

KBPC102

2A

C20
2200/35

C21
2200/35

C23
47UF
63V

R69
1K1

C22
47UF
63V

R70
680R

LED6

10mA
GREEN

P14 P15

P15 P17

PINOUTS
19-WAY SOCAPEX

PIN	
1	+17V
2	+17V
3	+17V
4	+17V
5	0V
6	0V
7	0V
8	0V
9	-17V
10	-17V
11	-17V
12	-17V
13	+48V
14	CHASSIS GND
15	CHASSIS GND
16	0V
17	0V
18	+8V
19	SPARE

COMMON GROUND

SEPARATE GROUND FOR +8V SUPPLY

NOTES LAST USED:

R117	D21	IC6
CN8	BR4	P20
C29	DZ6	JMP2
PR3	TR29	

DRN. DS

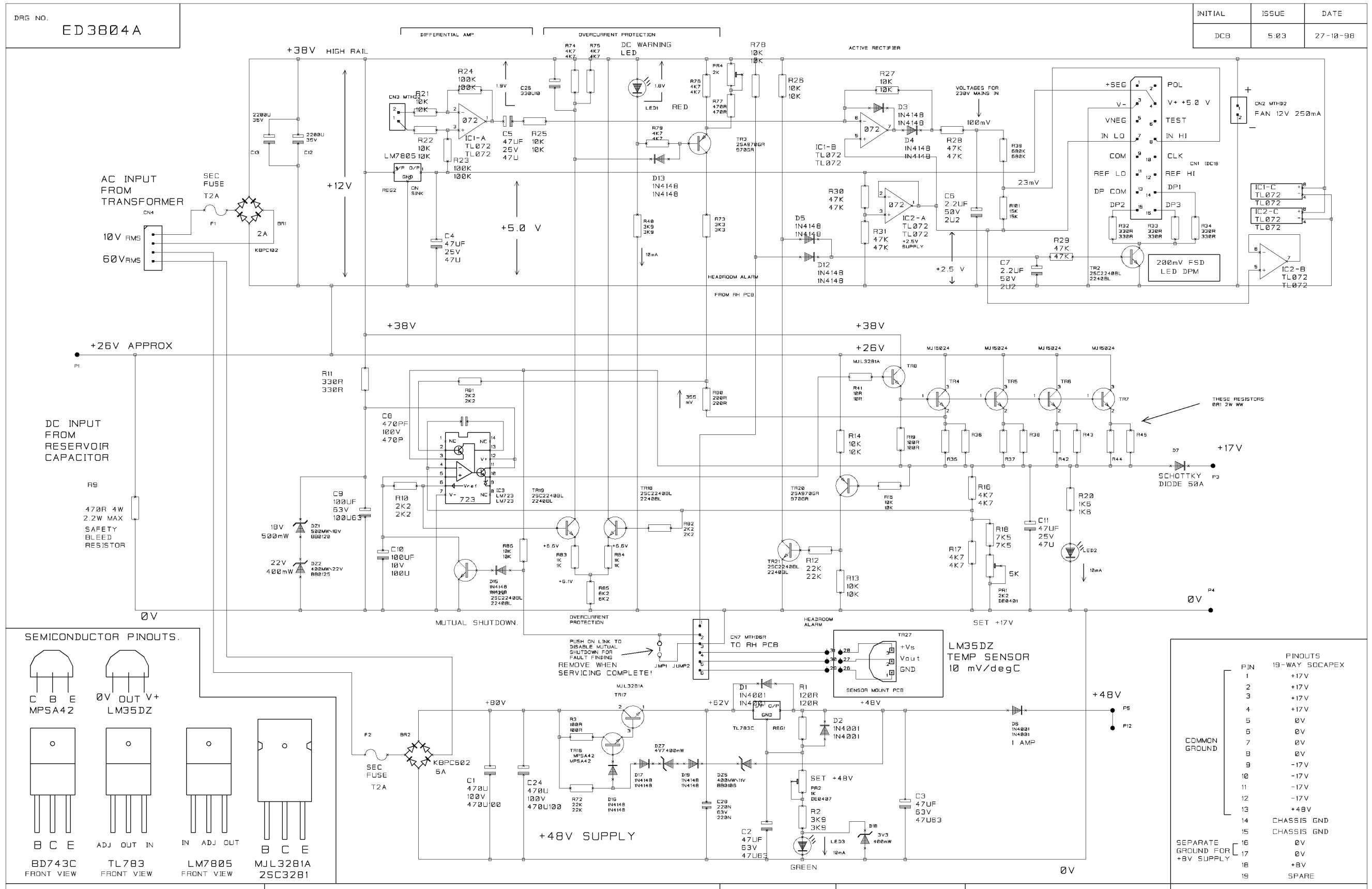
TITLE CPS2000

RH PCB. -17V +8V

DRG NO. ED3804B

SHT. 2 OF 2

DRG NO.	INITIAL	ISSUE	DATE
ED3804A	DCB	5.03	27-10-98



NOTES

LAST USED: R117 D21 IC6 CN8 BR4 P20 C29 DZ6 LED7 PR3 TR29 JMP2

REMOVED:

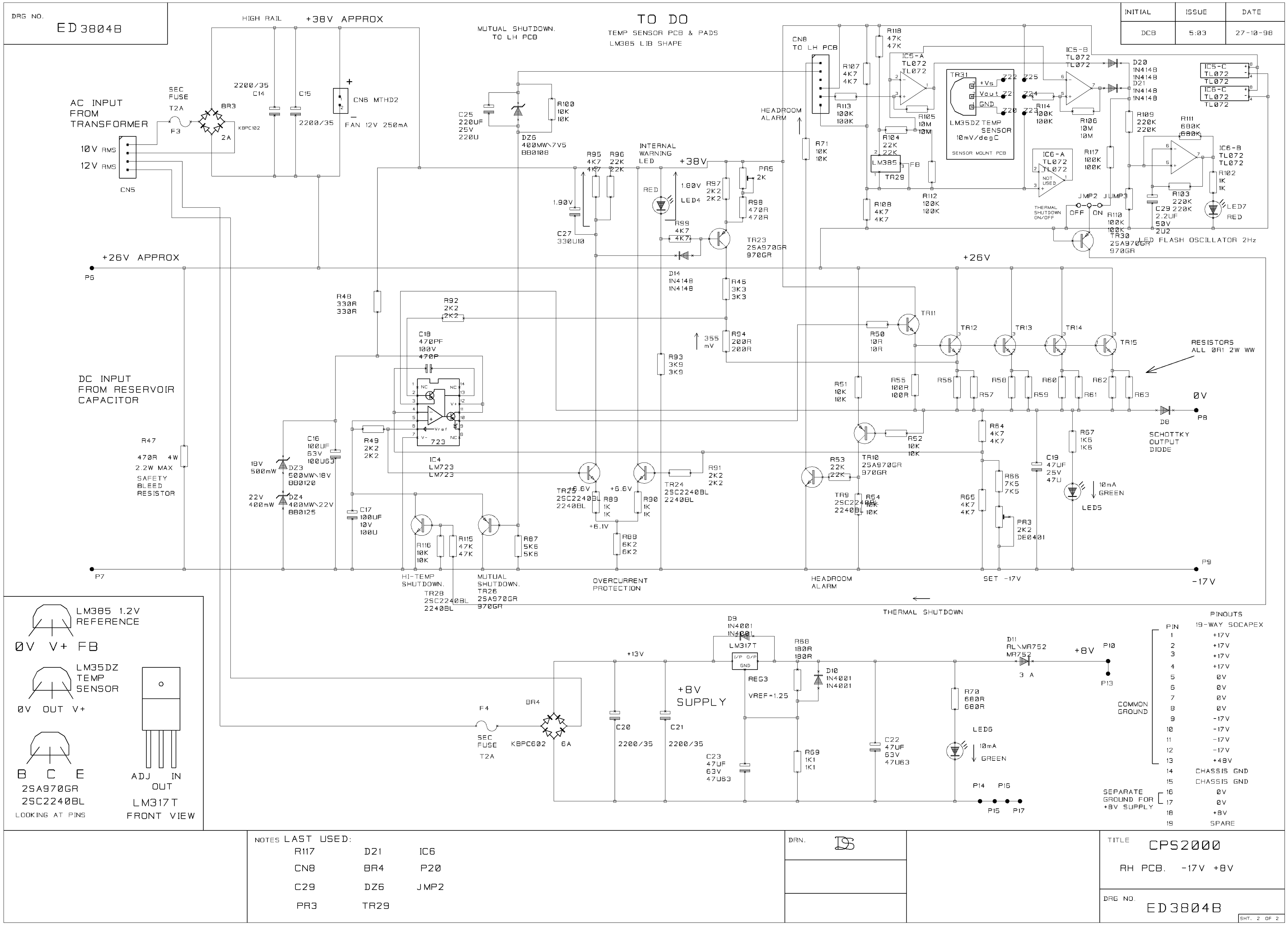
DRN. DS

TITLE CPS2000

LH PCB. +17V +48V

DRG NO. ED3804A

SHT. 1 OF 2



DRG NO. ED3804B
HIGH RAIL
+38V APPROX
MUTUAL SHUTDOWN. TO LH PCB
TO DO
TEMP SENSOR PCB & PADS
LM385 LIB SHAPE
AC INPUT FROM TRANSFORMER
10V RMS
12V RMS
CN5
SEC FUSE T2A F3
BR3 2A KBPC102
C14 2200/35
C15 2200/35
CN6 MTHD2
FAN 12V 250mA
C25 220UF 25V 220U
DZ6 400MW\7V5 BB0108
R100 10K
INTERNAL WARNING LED
RED LED4
CN8 TO LH PCB
HEADROOM ALARM
+26V APPROX
DC INPUT FROM RESERVOIR CAPACITOR
R47 470R 4W 2.2W MAX SAFETY BLEED RESISTOR
IC4 LM723
HI-TEMP SHUTDOWN.
MUTUAL SHUTDOWN.
OVERCURRENT PROTECTION
HEADROOM ALARM
SET -17V
THERMAL SHUTDOWN
RESISTORS ALL 0R1 2W WW
0V
SCHOTTKY OUTPUT DIODE
-17V
LM35DZ TEMP SENSOR 10mV/degC
SENSOR MOUNT PCB
LED FLASH OSCILLATOR 2Hz
THERMAL SHUTDOWN ON/OFF
+8V SUPPLY
LM317T REG3 VREF=1.25
SEC FUSE T2A
KBPC602 6A
+13V
+8V
LED5 10mA GREEN
LED6 10mA GREEN
LM385 1.2V REFERENCE
0V V+ FB
LM35DZ TEMP SENSOR
0V OUT V+
B C E
2SA970GR
2SC2240BL
LOOKING AT PINS
ADJ IN OUT
LM317T FRONT VIEW
PINOUTS
PIN 19-WAY SOCAPEX
1 +17V
2 +17V
3 +17V
4 +17V
5 0V
6 0V
7 0V
8 0V
9 -17V
10 -17V
11 -17V
12 -17V
13 +48V
14 CHASSIS GND
15 CHASSIS GND
16 0V
17 0V
18 +8V
19 SPARE
COMMON GROUND
SEPARATE GROUND FOR +8V SUPPLY
NOTES LAST USED:
R117 D21 IC6
CN8 BR4 P20
C29 DZ6 JMP2
PR3 TR29
INITIAL ISSUE DATE
DCB 5:03 27-10-98
DRN.
TITLE CPS2000
RH PCB. -17V +8V
DRG NO. ED3804B
SHT. 2 OF 2

DRG NO.
ED3804A

INITIAL	ISSUE	DATE
DCB	6.04	03-11-99

OVERCURRENT PROTECTION

DIFFERENTIAL AMP

+38V HIGH RAIL

AC INPUT FROM TRANSFORMER

SEC FUSE T3.15A

10V RMS

60V RMS

2A KBPC102

+12V

+5.0 V

LM7805

REG2

R21 10K

R22 10K

R24 47K

R23 47K

C4 47UF 25V

C5 2U2 50V

R25 33K

IC1-A TL072

2200U 35V

C13

C12

FULL-WAVE ACTIVE RECTIFIER

R78 10K

R26 10K

D3 IN4148

D4 IN4148

R27 10K

R120 10K

R121 10K

R122 5K1

IC1-B TL072

IC2-B TL072

VOLTAGES FOR 230V MAINS IN

100mV

R28 47K

R30 680K

23mV

R101 47K

C6 2.2UF 50V

R30 47K

R31 82K

IC2-A TL072

+2.5V SUPPLY

+2.5 V

HEADROOM ALARM FROM RH PCB

D5 1N4148

D12 1N4148

C7 2.2UF 50V

R29 47K

TR2 2SC2240BL

200mV FSD LED DPM

+SEG

V-

VNEG

IN LO

COM

REF LO

DP COM

DP2

POL

V+ +5.0 V

TEST

IN HI

CLK

REF HI

DP1

DP3

CN1

R32 330R

R33 330R

R34 330R

IC1-C TL072

IC2-C TL072

CN2

FAN 12V 250mA

AC IN

P21

D13 1N4001

C26 2.2UF 50V

+26V APPROX

P1

DC INPUT FROM RESERVOIR CAPACITOR

+38V

R11 330R

OVERCURRENT PROTECTION

+38V

+26V

MJL3281A

TR8

MJ15024

TR4

TR5

TR6

TR7

R41 10R

THESE RESISTORS 0R1 2W WW

LED1

R80 6K8

TR18 2SC2240BL

R64 2K2

R79 8K2

LM385

R86 3K6

IC8

TR19 2SC2240BL

R81 2K2

R14 10K

R9 100R

R36

R35

R38

R37

R43

R42

R45

R44

D7

+17V

SCHOTTKY DIODE 5A

P3

C8 470PF 100V

IC3 LM723

COMP

OUTPUT

NFB

R10 2K2

C9 100UF 63V

C10 220UF 25V

DZ1 500MW-18V

18V 500mW

DZ2 400MW-22V

22V 400mW

R83 2K2

R82 6K8

R75 100K

R74 47K

27V 500mW DZ8

R85 2K4

10 mA

R73 7K5

C38 330UF 6.3V

JMP1

TR22 2SC2240BL

PUSH ON LINK TO DISABLE MUTUAL SHUTDOWN FOR FAULT FINDING

OPTO1 CNY17-1

TR20 2SA970GR

TR21 2SC2240BL

R12 22K

R13 10K

R15 10K

R16 4K7

R17 4K7

R18 7K5

5K

PR1 2K2

C11 47UF 25V

R20 1K5

LED2

10mA

R5

470R 4W 2.2W MAX SAFETY BLEED RESISTOR

0V

P4

0V

REMOVE WHEN SERVICING COMPLETE!

MUTUAL SHUTDOWN LINE.

CN7

TO RH PCB

HEADROOM ALARM

TR27

+Vs

Vout

GND

SENSOR MOUNT PCB

LM35DZ TEMP SENSOR 10 mV/degC

SET +17V

SEMICONDUCTOR PINOUTS.

C B E MPSA42

0V OUT V+ LM35DZ

B C E BD743C FRONT VIEW

ADJ OUT IN TL783 FRONT VIEW

IN ADJ OUT LM7805 FRONT VIEW

B C E MJL3281A 2SC3281

MJL3281A TR17

+80V

+62V

+48V

D1 1N4001

R1 120R

TL783C REG1

D2 1N4001

D6 1N4001 1 AMP

+48V

P5

P12

F2

BR2

SEC FUSE T2A

KBPC502 5A

C1 470U 100V

C24 470U 100V

R3 100R

C31 10N 100V

TR15 MPSA42

R72 22K

D17 1N4148

D16 1N4148

DZ7 4V7 400mW

D19 1N4148

DZ5 400MW-11V

C28 220N 63V

SET +48V

PR2 1K

R2 3K9

C2 47UF 63V

LED3

12mA

D18 3V3 400mW

C3 47UF 63V

GREEN

+48V SUPPLY

0V

PINOUTS 19-WAY SOCAPEX	PIN	
COMMON GROUND	1	+17V
	2	+17V
	3	+17V
	4	+17V
	5	0V
	6	0V
	7	0V
	8	0V
	9	-17V
	10	-17V
	11	-17V
	12	-17V
	13	+48V
	14	CHASSIS GND
	15	CHASSIS GND
SEPARATE GROUND FOR +8V SUPPLY	16	0V
	17	0V
	18	+8V
	19	SPARE

NOTES

LAST USED: R117 D21 IC6
CN8 BR4 P20
C29 DZ6 LED7
PR3 TR29 JMP2

REMOVED:
R77

DRN. DS

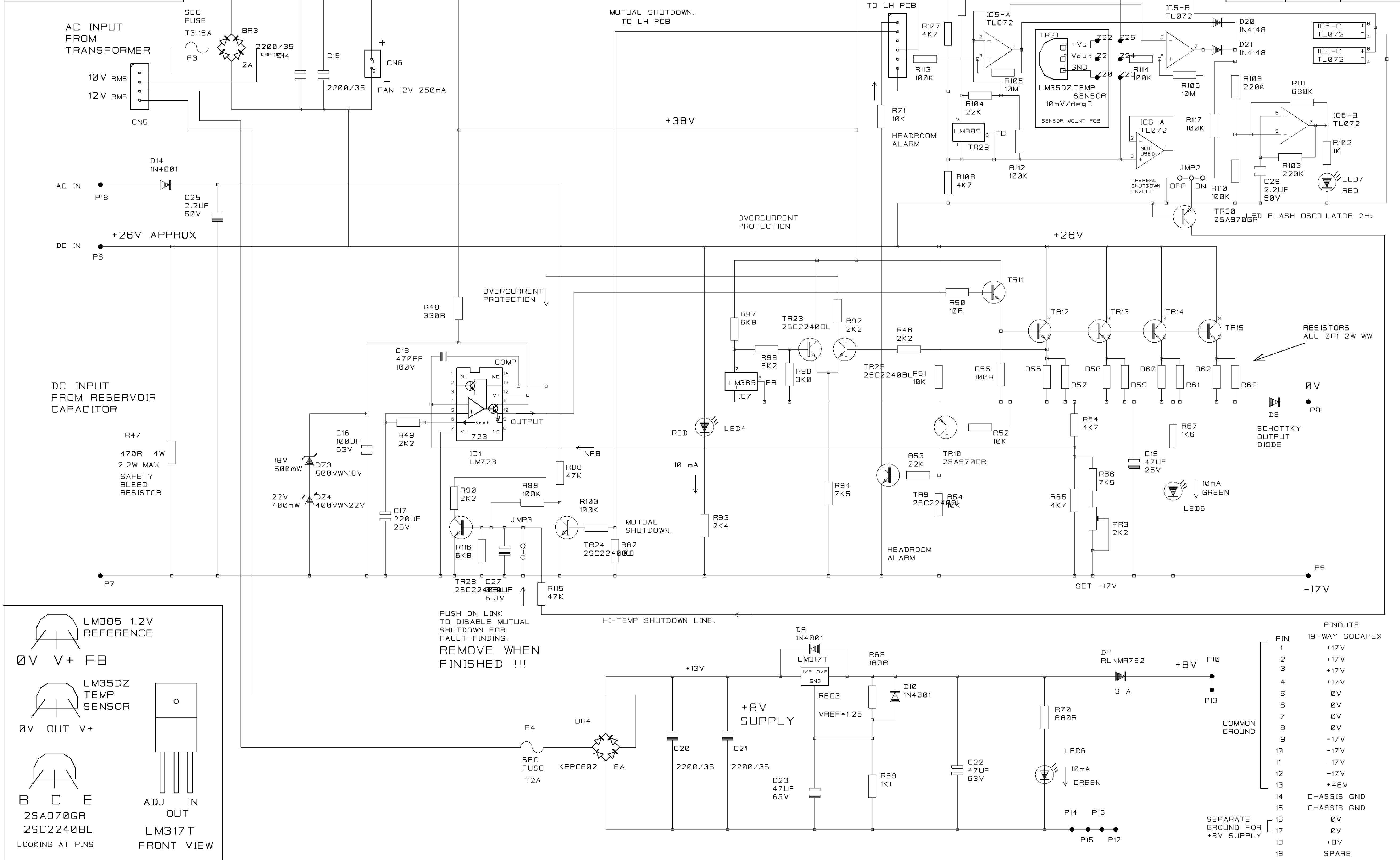
TITLE
CPS2000
LH PCB. +17V +48V

DRG NO.
ED3804A

SHT. 1 OF 2

DRG NO. ED3804B

INITIAL	ISSUE	DATE
DCB	6:04	03-11-99



NOTES LAST USED:

R117	D21	IC6
CN8	BR4	P20
C29	DZ6	JMP2
PR3	TR29	

DRN. DS

TITLE CPS2000

RH PCB. -17V +8V

DRG NO. ED3804B

SHT. 2 OF 2

DRG NO.	INITIAL	ISSUE	DATE
ED3804A	TW	8.02	15-6-00

OVERCURRENT PROTECTION

DIFFERENTIAL AMP

+38V HIGH RAIL

FULL-WAVE ACTIVE RECTIFIER

AC INPUT FROM TRANSFORMER

SEC FUSE T3.15A

10V RMS

60V RMS

2A

KBPC102

+12V

+5.0 V

IC1-A LF412

IC1-B LF412

IC2-A LF412

IC2-B LF412

LM7805

VOLTAGES FOR 230V MAINS IN

100mV

2.3mV

+2.5 V

+2.5V SUPPLY

HEADROOM ALARM FROM RH PCB

200mV FSD LED DPM

+SEG POL

V+ +5.0 V

VNEG TEST

IN LO IN HI

COM CLK

REF LO REF HI

DP COM DP1

DP2 DP3

CN1 IDC16

CN2 MTHD2 FAN 12V 250mA

AC IN YLO

+26V APPROX

DC INPUT FROM RESERVOIR CAPACITOR

470R 4W 2.2W MAX SAFETY BLEED RESISTOR

OVERCURRENT PROTECTION

+38V

+26V

MJL3281A

MJ15024

THESE RESISTORS 0R1 2W WW

+17V

SCHOTTKY DIODE 5A

LM385

LM723

TR20 2SA970GR 970GR

TR21 2SC2240BL 2240BL

18V 500mW DZ1

22V 400mW DZ2

8V2 DZ10

27V 500mW DZ8

-26V

0V

SET +17V

REMOVE WHEN SERVICING COMPLETE!

MUTUAL SHUTDOWN LINE.

PUSH ON LINK TO DISABLE MUTUAL SHUTDOWN FOR FAULT FINDING

JMP1 JUMP2

OPTO1 CNY17-1

LED1 LED2 LED3

12mA

10 mA

SET +48V

+48V SUPPLY

+80V

+62V

+48V

TL783C

TRIS MPSA42

KBPC602 5A

SEC FUSE T2A

1 AMP

GREEN

C B E MPSA42 SEMICONDUCTOR PINOUTS.

0V OUT V+ LM35DZ

LM35DZ TEMP SENSOR 10 mV/degC

SENSOR MOUNT PCB

HEADROOM ALARM

TO RH PCB

PINOUTS 19-WAY SOCAPEX	PIN	
COMMON GROUND	1	+17V
	2	+17V
	3	+17V
	4	+17V
	5	0V
	6	0V
	7	0V
	8	0V
	9	-17V
	10	-17V
	11	-17V
	12	-17V
	13	+48V
	14	CHASSIS GND
	15	CHASSIS GND
SEPARATE GROUND FOR +8V SUPPLY	16	0V
	17	0V
	18	+8V
	19	SPARE

BD743C FRONT VIEW

TL783 FRONT VIEW

LM7805 FRONT VIEW

MJL3281A 2SC3281

NOTES

LAST USED: R117 D21 IC6 CN8 BR4 P20 C29 DZ6 LED7 PR3 TR29 JMP2

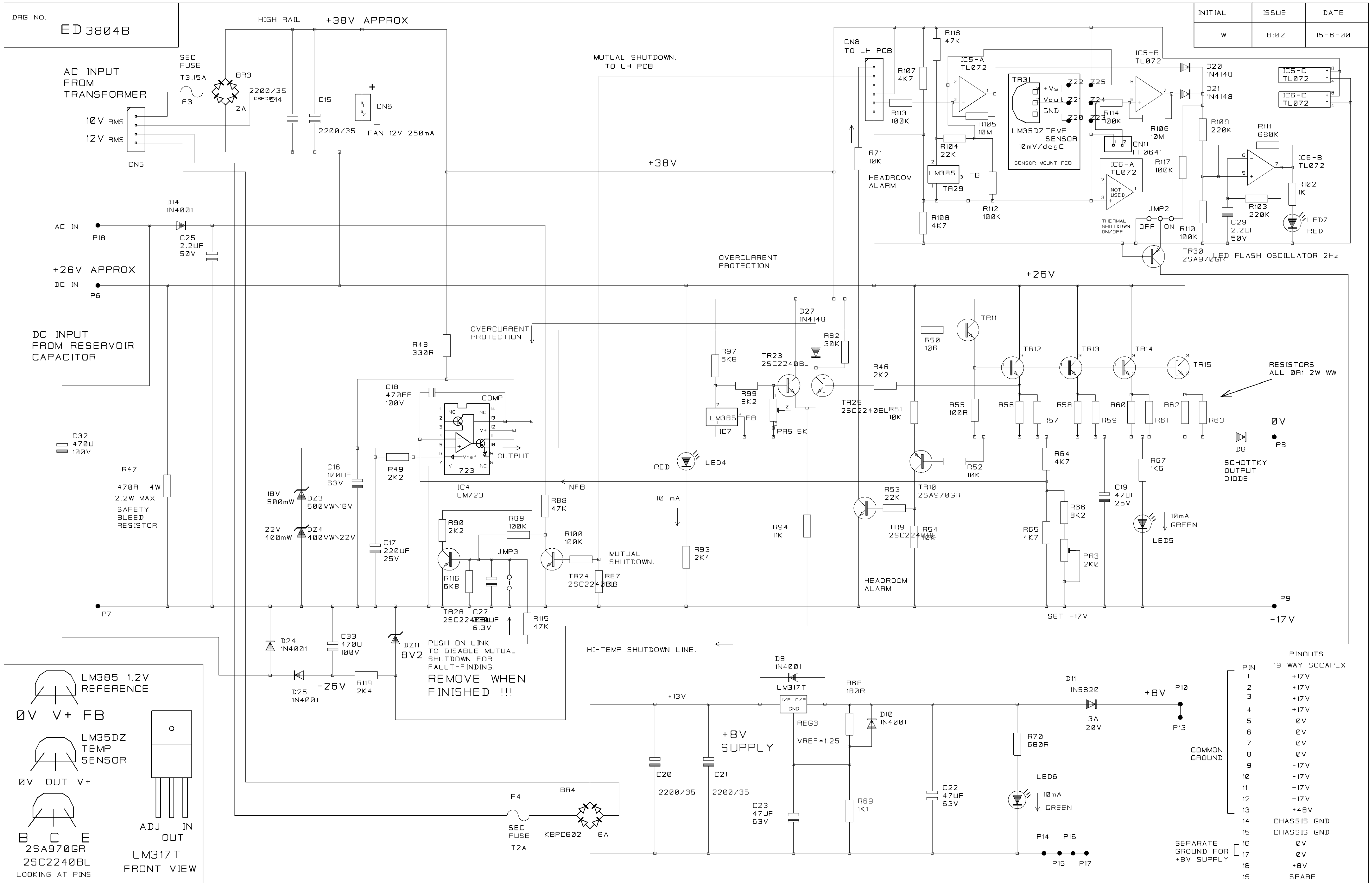
REMOVED: R77

DRN. DS

TITLE CPS2000

LH PCB. +17V +48V

DRG NO. ED3804A



INITIAL	ISSUE	DATE
TW	8:02	15-6-00

NOTES LAST USED:

R117	D21	IC6
CN8	BR4	P20
C29	DZ6	JMP2
PR3	TR29	

DRN. DS

TITLE CPS2000

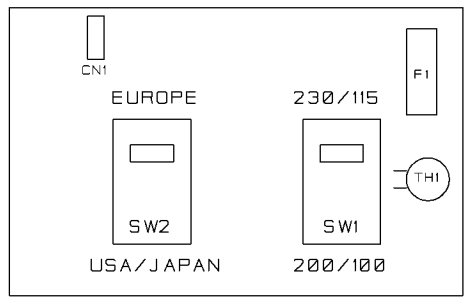
RH PCB. -17V +8V

DRG NO. ED3804B

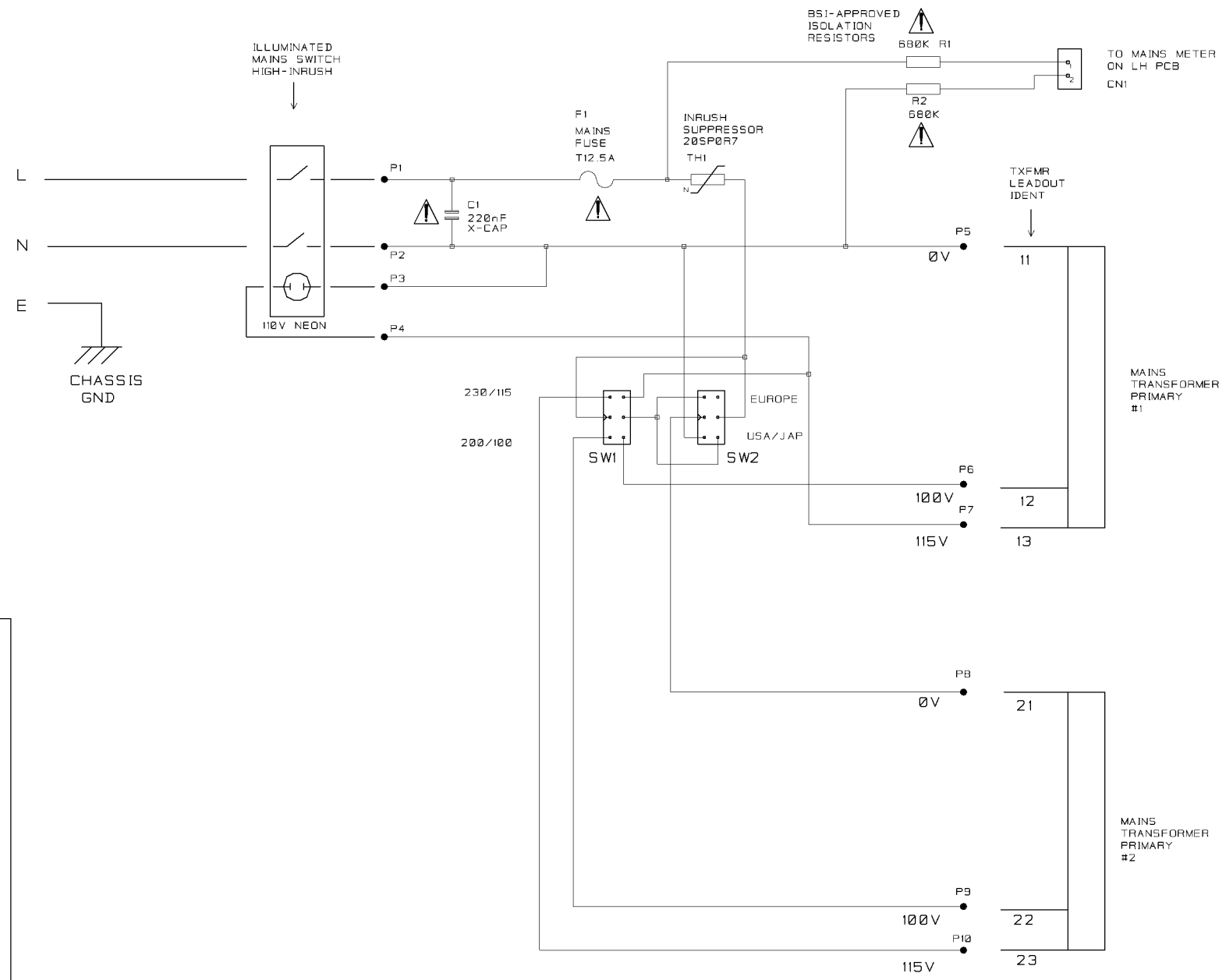
SHT. 2 OF 2

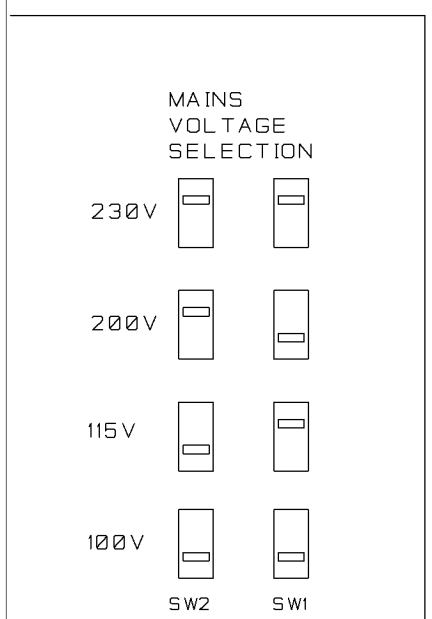
DRG NO.
ED 3817

INITIAL	ISSUE	DATE
RNJS	4:01	11/10/99



PCB MECHANICAL ORIENTATION FROM FRONT.





NOTES

PCB MUST BE 2-OZ COPPER.

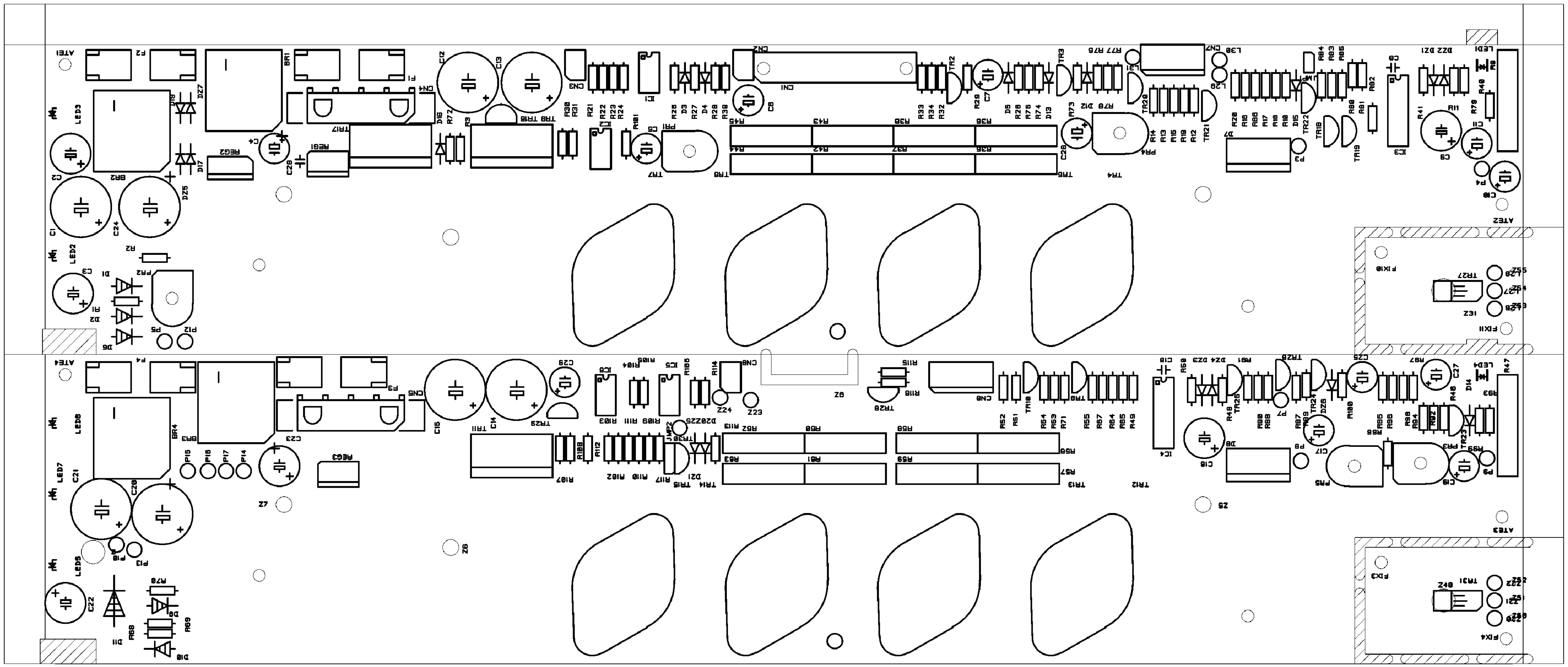
DRN. TS

TITLE

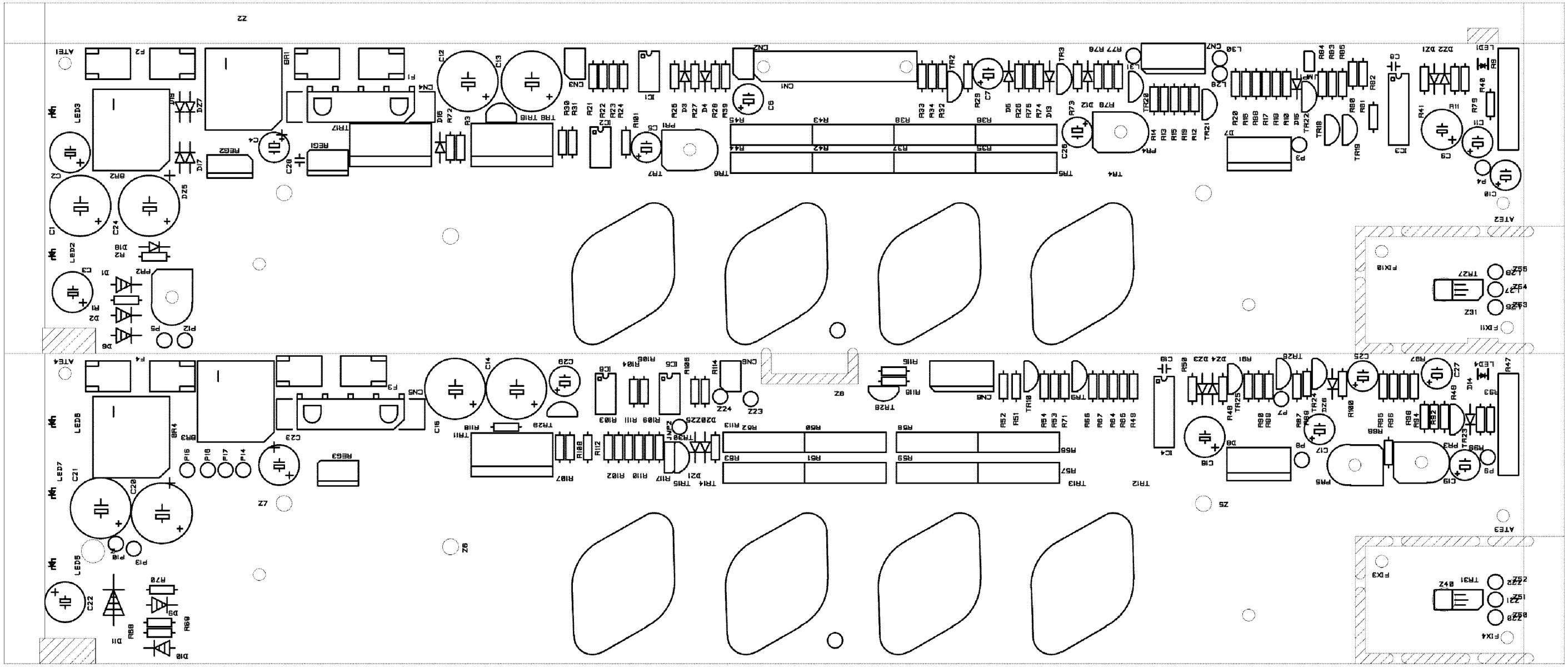
CPS2000
MAINS VOLTAGE SELECT PCB

DRG NO.
ED3817

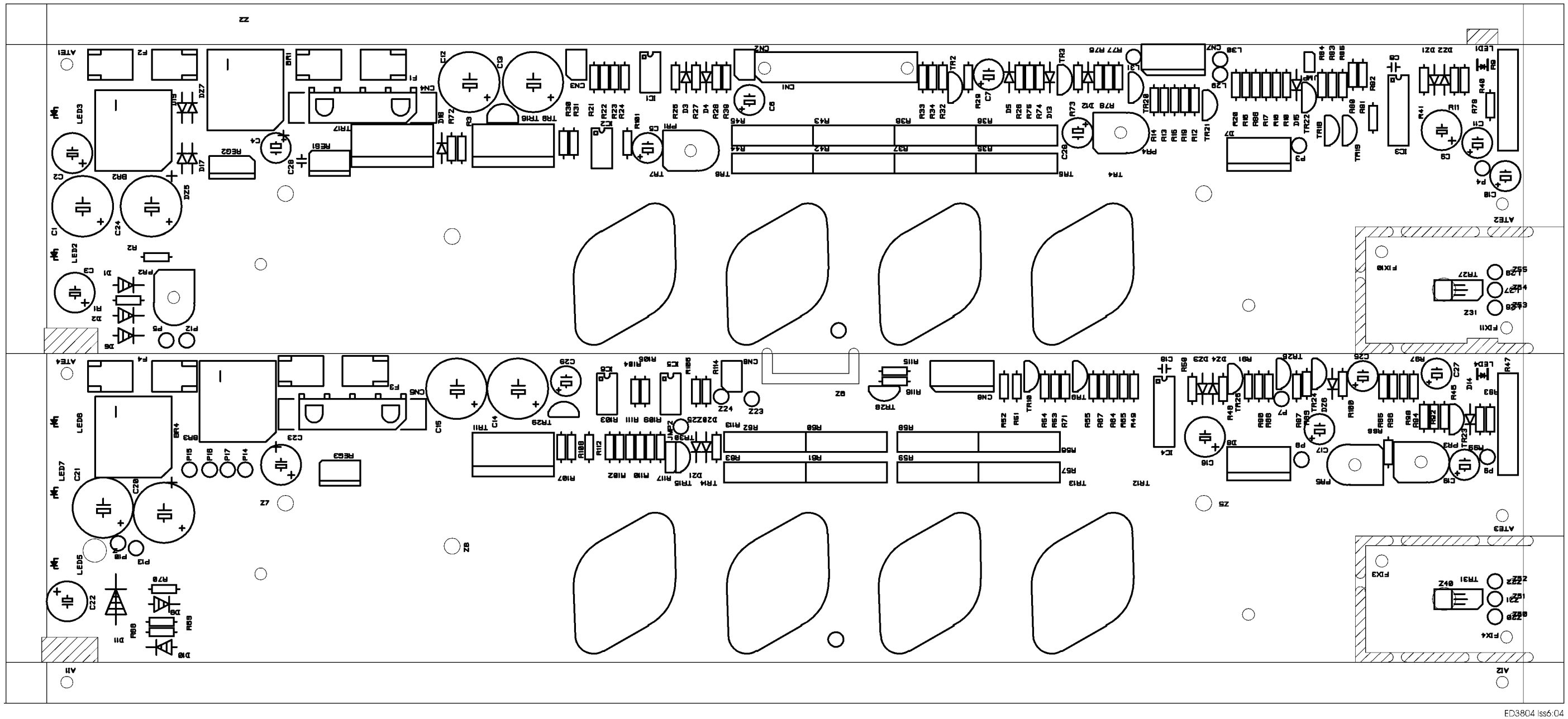
SHT. 1 OF 1



ED3804 Iss4:02



ED3804 Iss5:03



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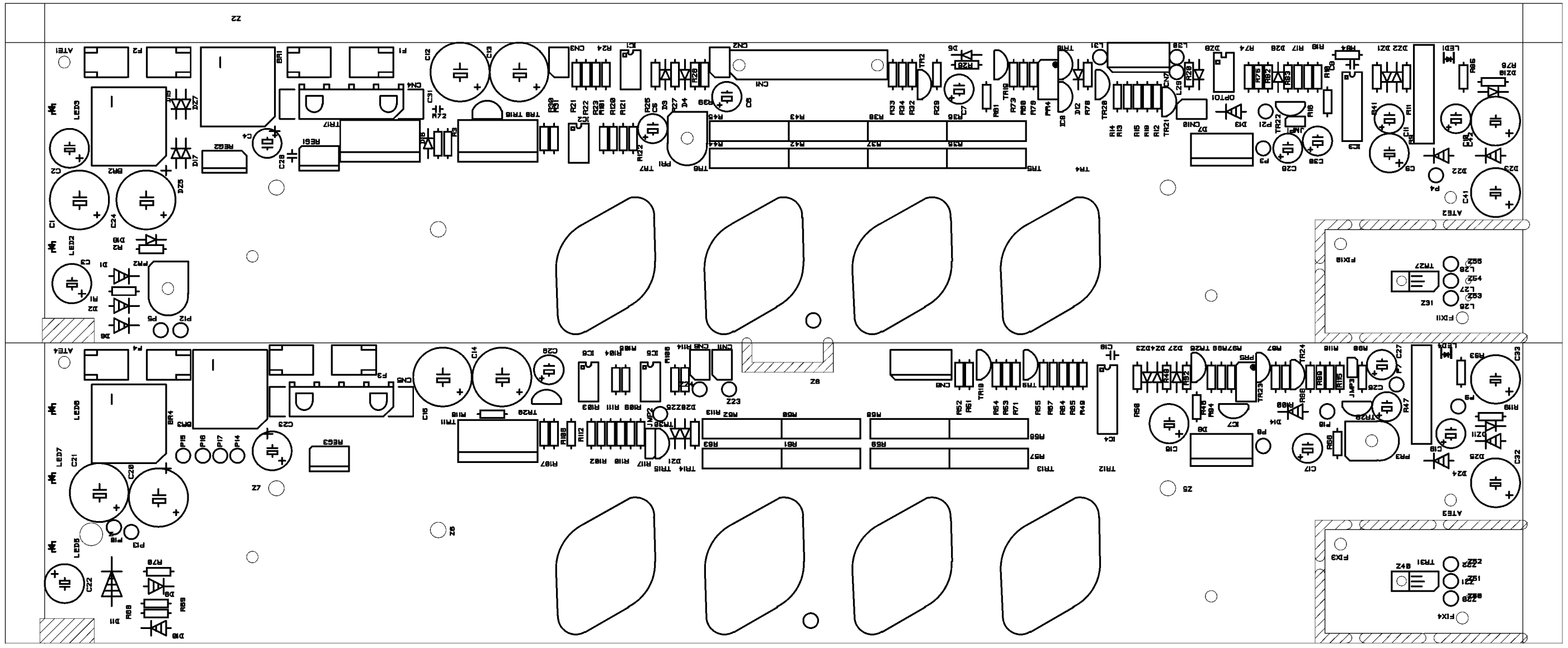
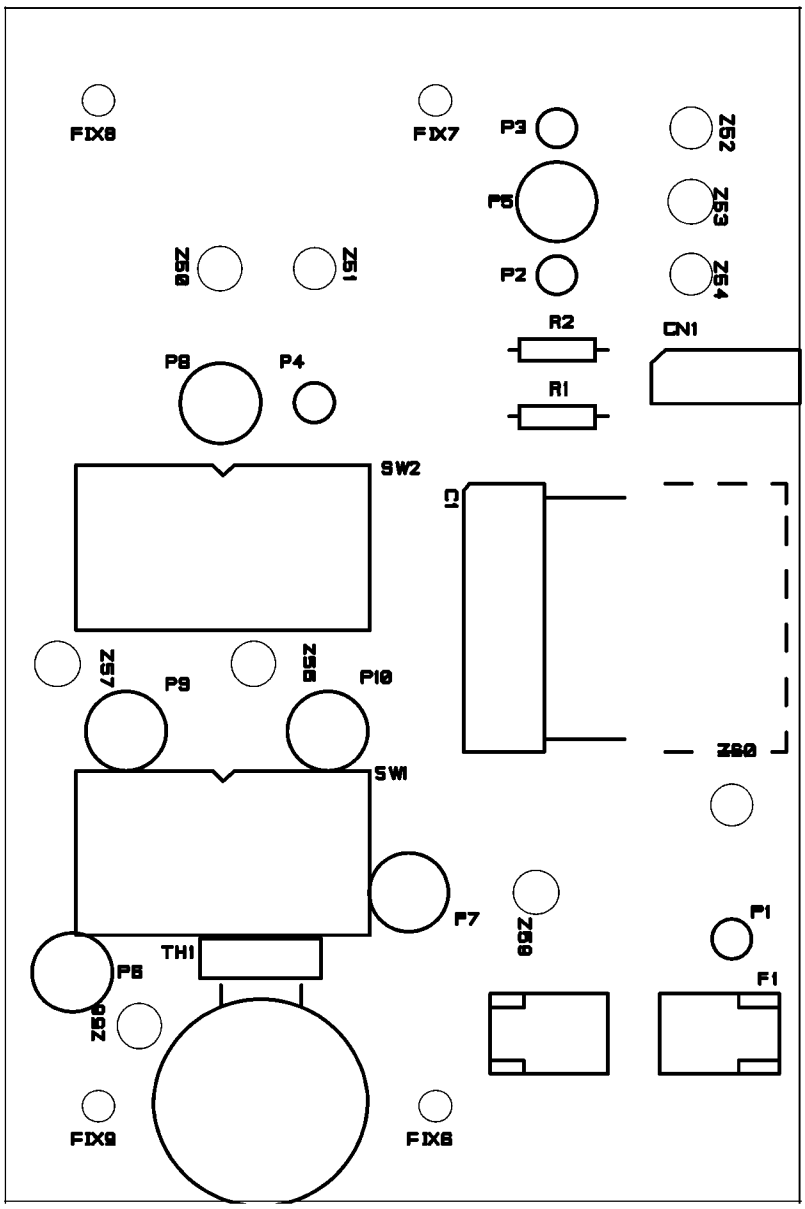


ED3804 Iss 8:02


FIX8
FIX7
P3
ZS2
P5
ZS3
ZS5
ZS1
P2
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R2
CN1
P8
P4
R1
SW2
C1
ZS7
ZS6
P9
P10
ZS0
SW1
F7
ZS8
P1
TH1
P6
F1
ZS9
FIX9
FIX6

ED3817 Iss4