PA250

POWER AMPLIFIER

TECHNICAL MANUAL

CONTENTS

1 Introduction

The PA 250 uses a very efficient power supply design, combining a toroidal transformer and switch mode regulator which are ideally suited to transmitter applications where the rejection of supply borne voltage spikes and surges is of prime importance. Woven mat PTFE circuit boards bonded to the massive heat sink/ground plane are used to achieve remarkable thermal stability at the surface mounted component level, leading to excellent reliability.

Installation is very straight forward thanks to the PA 250's fully featured metering and control. The meter shows PA forward and reflected power, voltage, current and temperature allowing setup and long term monitoring to be a simple repeatable process. Output power is set from the front panel and forward and reflected power alarm thresholds are easily set and previewed on the meter. A remote control/monitoring socket allows status information to be connected to a telemetry system and for external muting of the RF output.

The PA 250 design uses high reliability components specified to deliver full output power, continuously over many years with no routine maintenance requirement. It is built to exceed the requirements of ETS 300 384: January 1995, Radio broadcasting systems standard for VHF FM sound broadcasting transmitters, specifying equipment for radio transmission.

2 Safety, Electrical hazard

This unit contains high voltages which could be fatal. YOU MUST ALWAYS ISOLATE THE UNIT FROM THE ELECTRICAL SUPPLY BY COMPLETELY DISCONNECTING IT BEFORE ATTEMPTING TO OPEN THE CASE.

THIS EQUIPMENT MUST BE EARTHED.

Do not expose this equipment to rain or any other source of water.

In common with all electrically operated equipment, only suitably trained competent personnel should attempt to adjust, modify or repair this equipment or operate it with the cover removed. In case of query please contact your local agent or sbs.

Any unauthorised adjustment, modification or repair of this equipment may invalidate any warranty and/or safety approvals that apply.

Please read all of this manual and familiarise yourself with the controls before attempting to use this equipment.

To ensure safety, it is the responsibility of the user to install and operate this equipment in a manner that is within the manufacturers specifications.

3 Safety, Toxic hazard

This equipment includes devices which contain Beryllium Oxide which is a highly toxic substance. Inhalation or ingestion of even tiny particles could be injurious to health or even FATAL!

Extreme care must be exercised when replacing and discarding components which may contain Beryllium Oxide. If any such device is physically damaged, you should seek expert advice, e.g. by contacting the device's manufacturers.

All such devices must be disposed of in accordance with local regulations. In the UK your local council will have a toxic waste disposal department who will be able to advise you. Elsewhere you should contact the responsible authorities.

NEVER DISPOSE OF A DEVICE CONTAINING BERYLLIUM OXIDE WITH GENERAL WASTE.

4 Safety, RF hazard

RF BURN HAZARD:

Removing the top cover of the unit will expose components operating at high RF voltages. The power MOSFET transistor and components in the RF output and filtering networks pose a very high risk. YOU MUST ALWAYS ISOLATE THE UNIT FROM THE ELECTRICAL SUPPLY BY COMPLETELY DISCONNECTING IT BEFORE ATTEMPTING TO OPEN THE CASE.

Antenna systems connected to any radio transmitter/amplifier will also cause RF burns. Expert advice should be sought about the safe installation of such systems.

RF EXPOSURE HAZARD:

Antenna systems should be installed such that exposure by any person to RF fields cannot exceed safe limits. The permitted limits vary from country to country. Expert advice should be sought about the safe installation of any antenna system.

5 Unpacking

This package should contain:-

1x PA250 Power Amplifier
1x IEC Power lead
1x PA250 manual

If any items are missing or damaged please inform your supplier immediately.

Initial Checks

Ensure that the PA250 has been set to the correct line voltage for your country. The standard version is set to 230V.

6 Controls and Connectors

Front Panel:

POWER LED	Green indicates power is applied and that the power supply is operating correctly, red indicates failure of the switch mode power supply.
P.FWD LED	Green indicates that output power is above preset alarm level. Red indicates that the output power is below that level. Orange indicates that the external mute (via rear panel control connector) is active.
P.REF LED	Green indicates that the reflected power is below the preset alarm level. Orange indicates that reflected power is above the preset alarm level. Red indicates that the VSWR cutback has come into operation which occurs at above 25W reflected power.
TEMP LED	Green indicates that the RF MOSFET case temperature is below 100 Celsius and red indicates that it is above 100 Celsius causing the temperature cutback to operate.
METER	Through the range selector switch, the meter may provide an indication of temperature, forward power (300W FSD), reflected power (30W FSD), power supply voltage and power supply current.
POWER O/P ADJUST	Adjusts the output power between minimum and maximum. A small flat bladed trimmer tool is required to make this adjustment.
PUSH TO DISPLAY	Pushing this button displays the forward or reflected power alarm preset levels on the meter. Use the selector to switch the meter to read forward or reflected power. Hold in the button and the meter indicates the level at which the associated alarm will operate.
P.FWD ADJUST	Use this control in conjunction with the above button to preset the forward power alarm level. A small flat bladed trimmer tool is required to make this adjustment. The amplifier output power is not affected by this adjustment.

P.REF ADJUST — Use this control in conjunction with the above button to preset the reflected power alarm level. A small flat bladed trimmer tool is required to make this adjustment. The amplifier output power is not affected by this adjustment.

Rear Panel:

AC POWER — Filtered IEC female connector with T6.3A fuse in pull out drawer.

Earth point — M4 threaded insert for earth bonding if required.

OUTPUT 50 OHM — N-type female connector.

INPUT 50 OHM — TNC female connector.

CONTROL/MONITOR — 25 way D-type female connector.

Pin 1	Power supply OK
Pin 2	Forward power OK
Pin 3	Temperature OK
Pin 4	VSWR cutback active
Pin 5	Reflected power OK
Pin 14	Interlock
Pin 15	Interlock
Pin 19	External mute (ground to activate)
Pin 20	External power indication (unbuffered)
Pin 21	External power control
Pin 24,25	Ground

All outputs are open collector and low in their normal state. The output transistors are BC184L's, which can sink up to 100mA max. with an absolute maximum switched voltage of 30V.

The interlock pins must be connected together for the PA250 power supply to operate. They should not be connected to any other point.

7 Installation

Installation should be straight forward. It is strongly recommended that the unit is mounted on support rails within the rack. The case will get warm in normal operation. A space of 1U (44mm) above and below the unit should provide adequate ventilation to the case. To cool the PA, two fans take in air at the front panel and blow the heated exhaust air out the back directly into the rack. If this air flow is restricted in any way the PA250 will have to operate at a higher internal temperature which may have a detrimental effect on its service life. In extreme cases the thermal cutback may operate to keep the internal unit temperature at a sustainable level by reducing the RF output power.

All cables, particularly RF should be of a high quality low loss type. Terminations should be secure and follow the instructions supplied with the individual connector. Control cables should be screened.

Due consideration should be given to the safety of the installation, in particular to the AC power wiring. Attention is drawn to the section of this manual relating to electrical safety. Where necessary, the antenna down lead should be grounded to a safety earth via an adequately rated grounding plate.

A drive of minimum 5W is required at the RF input. Maximum permissible input is 8W. No internal adjustment of the unit is required during installation. A green Power LED indicates that the unit has an electricity supply input and that the switch mode regulator, responsible for supplying power to the RF amplifier, is operating correctly. Output power is adjusted by the use of a small flat bladed screwdriver or trimming tool. Turn the Power O/P Adjust control with the meter set to read P. FWD on the selector. Set the required power level. If the P.REF LED turns red the reflected power cutback has come into operation so the power adjust may have limited effect. Turn off the unit and correct the fault with the antenna or down leads.

Once the required power is being displayed on the meter, push in the small Push To Display switch and the meter will indicate the forward power alarm level. If the power should drop to this level during operation, a forward power fault will be flagged by the front panel LED turning red and at the control/monitor socket. While holding in the push switch, turn the P. FWD Alarm Level Adjust control until the meter shows the level at which this alarm is required to operate. Similarly the reflected power alarm level can be set by turning the P. REF Alarm Level Adjust with the push switch held in and the meter set to display P. REF on the selector. If the reflected power should rise to this level a fault will be flagged by the P. REF LED turning orange and through a signal output from the control/monitor socket. This alarm is designed to give an early indication of an antenna fault. The reflected power cut back will operate above 25W reflected. The P. REF LED will turn red in this condition and a separate failure signal will be output. Adjustment of the P.REF Alarm Level will not effect the cutback circuit.

An indication of the efficiency of the amplifier can be gained from the PA.V and PA.A ranges on the meter.

8 Specifications

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RF Input:	5-7W
RF Output:	20 - 250 W (front panel pre-set)
Input / Output Impedance:	50 Ω
Spurious outputs:	< -90 dBc (87.5 MHZ to 137 MHZ @ f_c > ± 0.5 MHZ)
Harmonic & spurious output:	< -72 dBc (30 MHZ to 1 GHz)
AM Noise:	< 0.5% @ ± 40 kHz deviation
Minimum return loss:	12 dB at full power (foldback above this level)
Power Supply:	230 V ± 10%, 50/60 Hz

Environmental conditions:	Temperature :	-20°C to 45°C
	Humidity:	≤ 90% RH, non condensing

Dimensions: 88 mm high (2U) x 443 mm wide x 420 mm deep, including handles and connectors, 12.5 kg weight

9 How to contact sbs

For all enquiries write to:-

sbs
PO Box 100
Hastings
East Sussex
TN35 4NR

Or telephone 01424 445588 within the UK, +44 1424 445588 from outside the UK.

Or fax 01424 443388 within the UK, +44 1424 443388 from outside the UK.

Or email sales@sbs.uk.com for sales enquiries or support@sbsfm.com for technical support.

Alternatively visit our web site: http://www.sbsfm.com/

10 Technical Section Contents

10.1 Introduction

The PA250 is internally divided into two sections. All RF circuitry is housed in a screened enclosure and is contained on two PTFE based PCBs, PAIN and PAOUT. The PAMASTER PCB is mounted outside of the RF section. It provides the power supply and all control and monitoring for the RF amplifier section. Power is fed into the RF enclosure through two 'feedthru' capacitors. A filtered D type connector takes all other signals between the two sections. The D type connector is mounted on the PATERM PCB within the RF box. This routes the power and temperature sensor signals back to the PAMASTER PCB and distributes power to the fans.

10.2 Circuit diagrams

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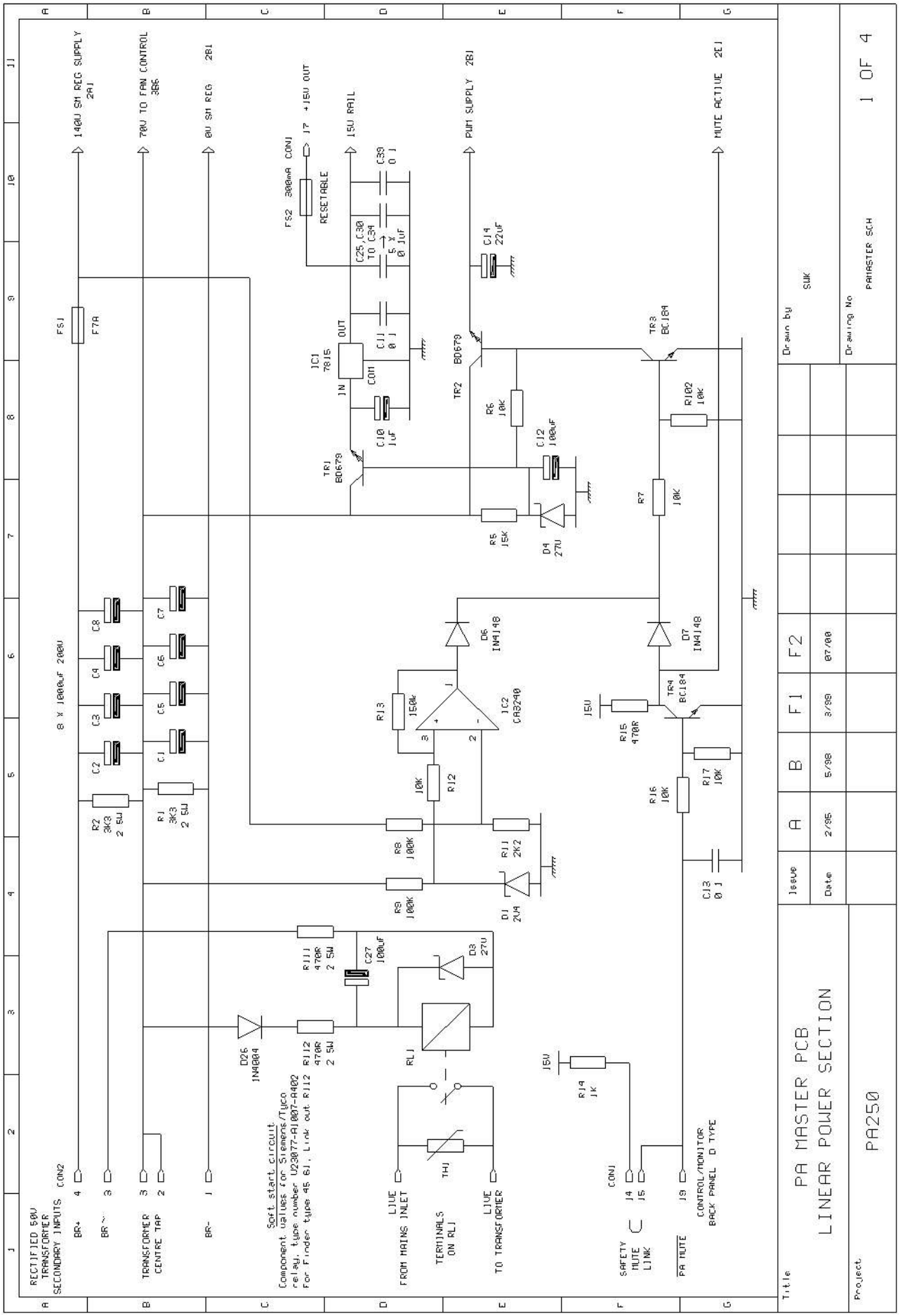
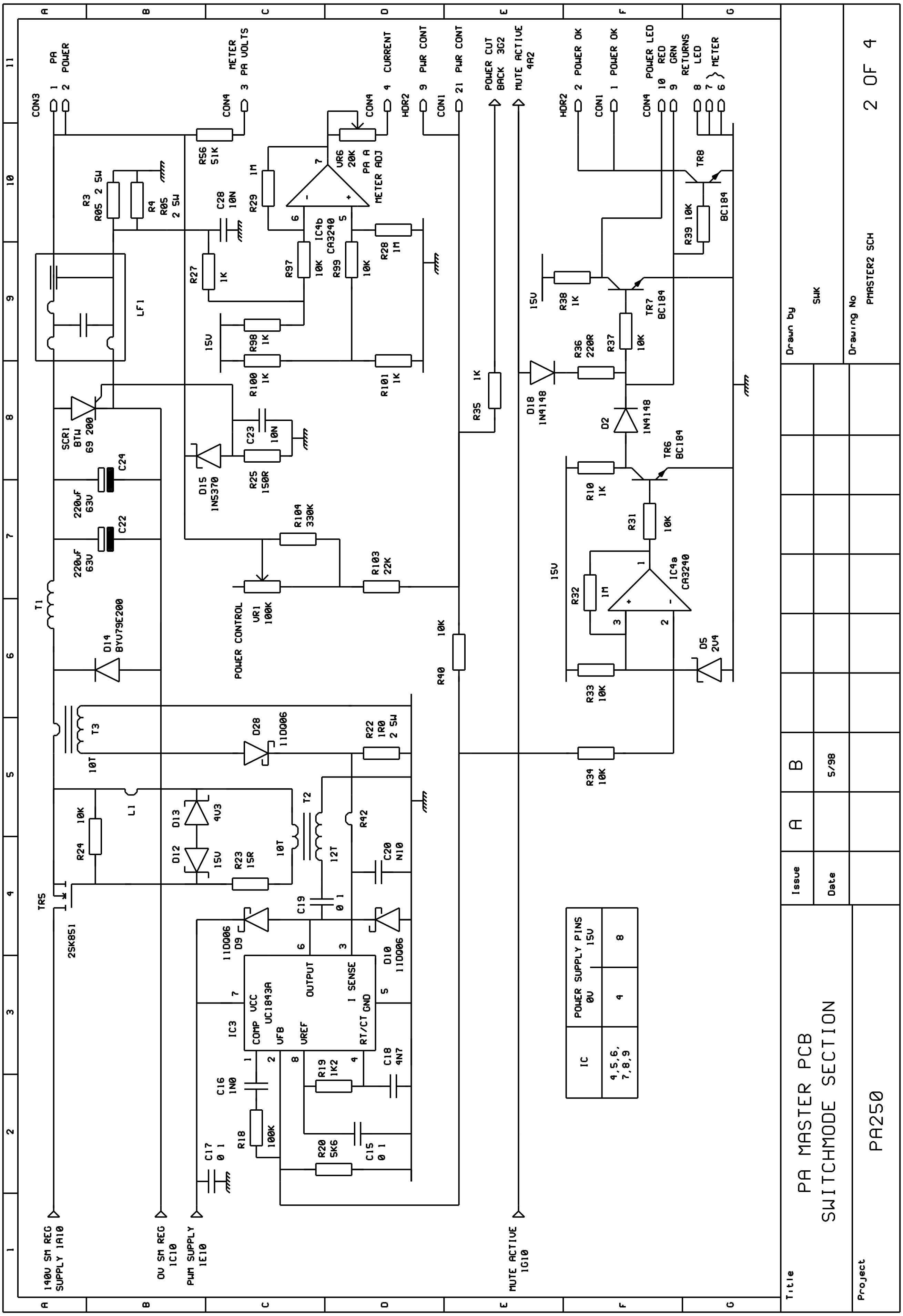
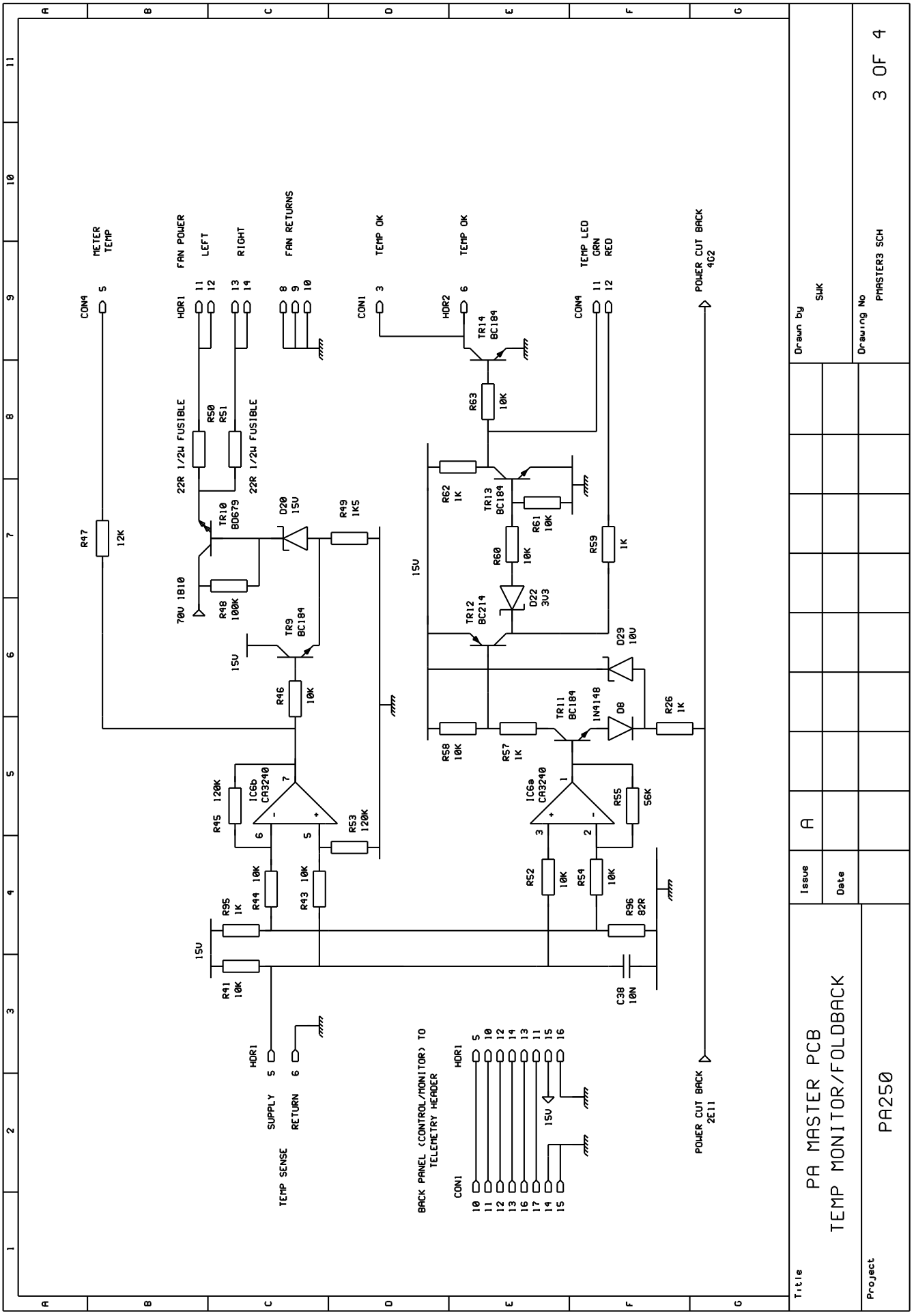
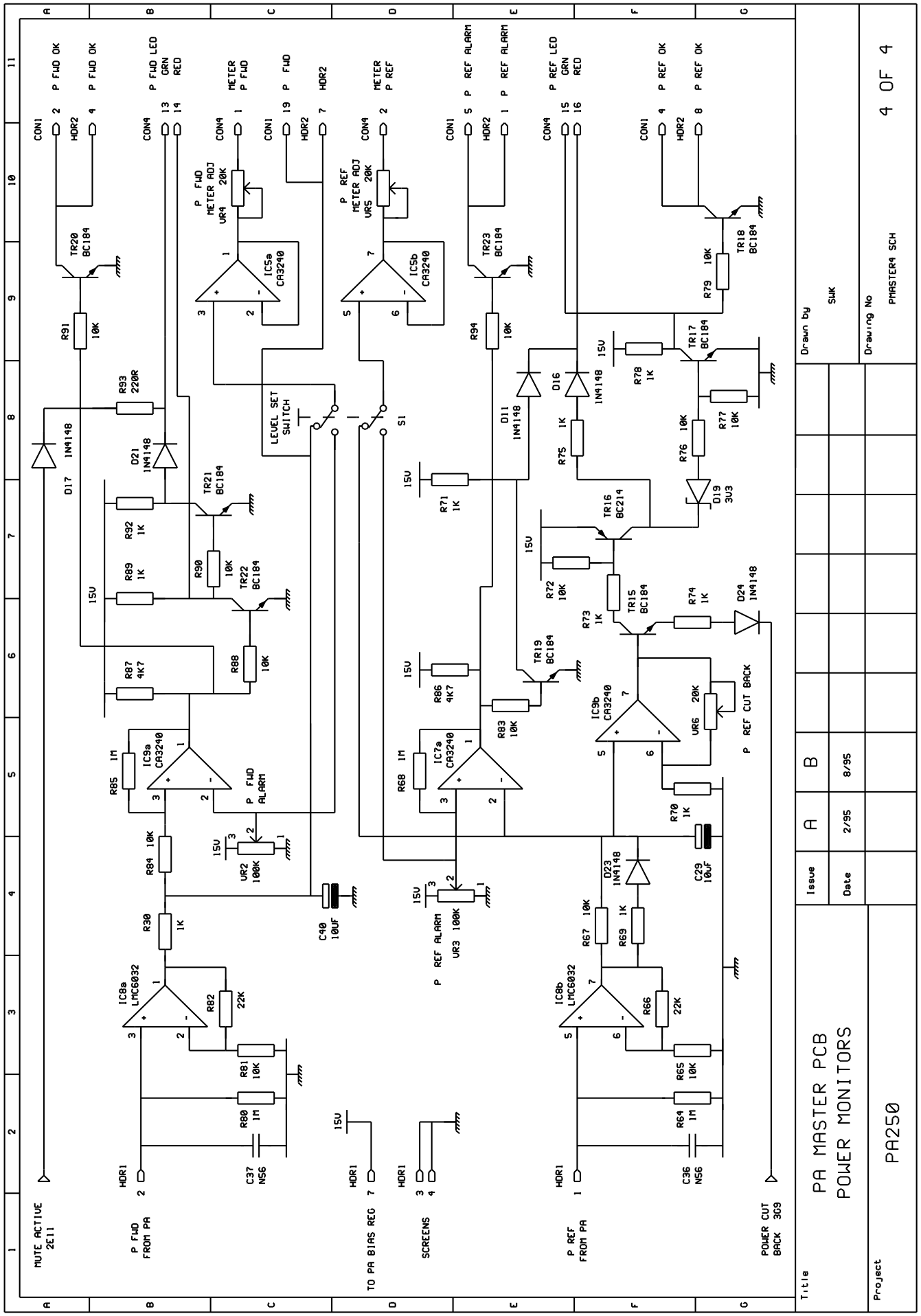
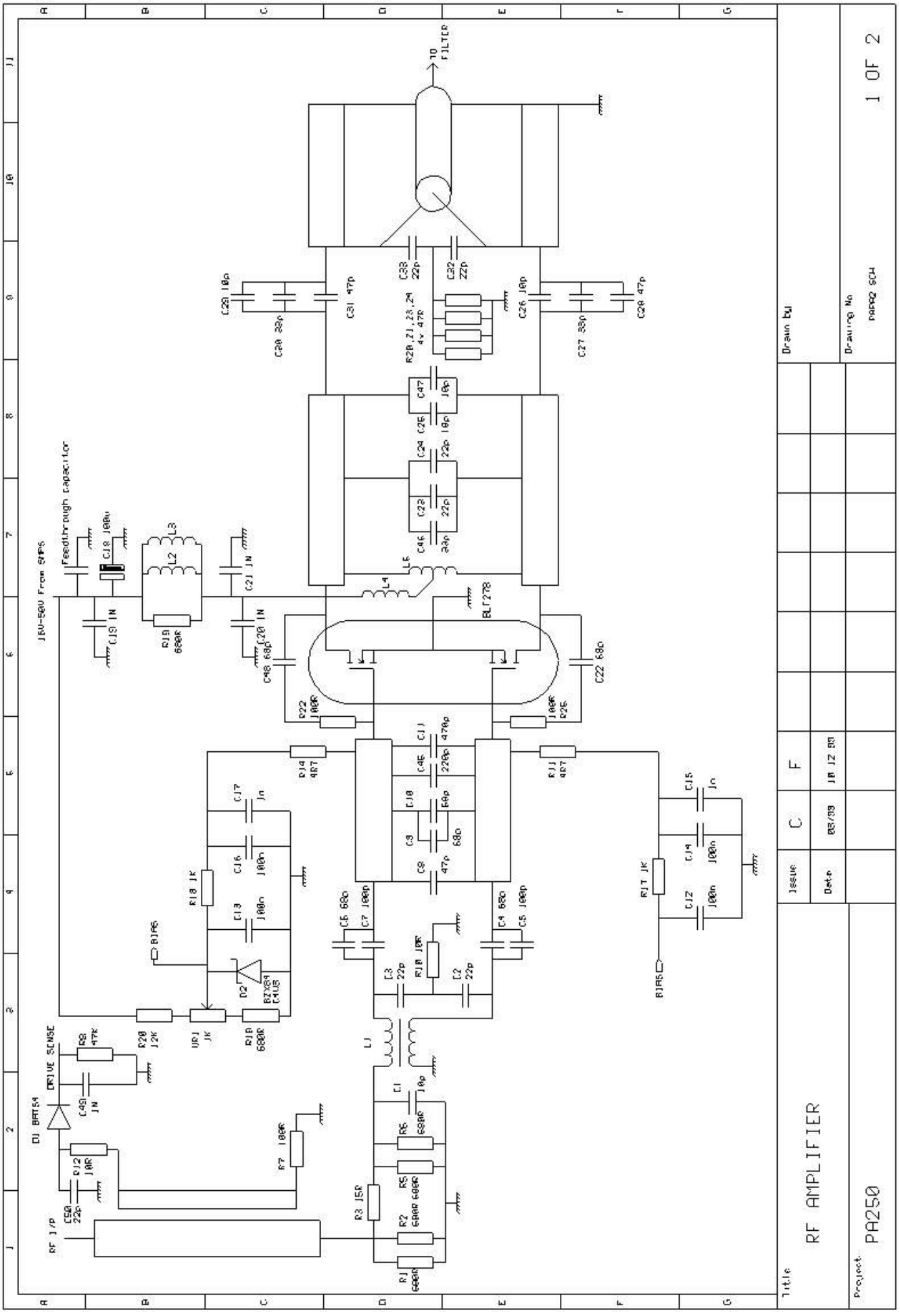
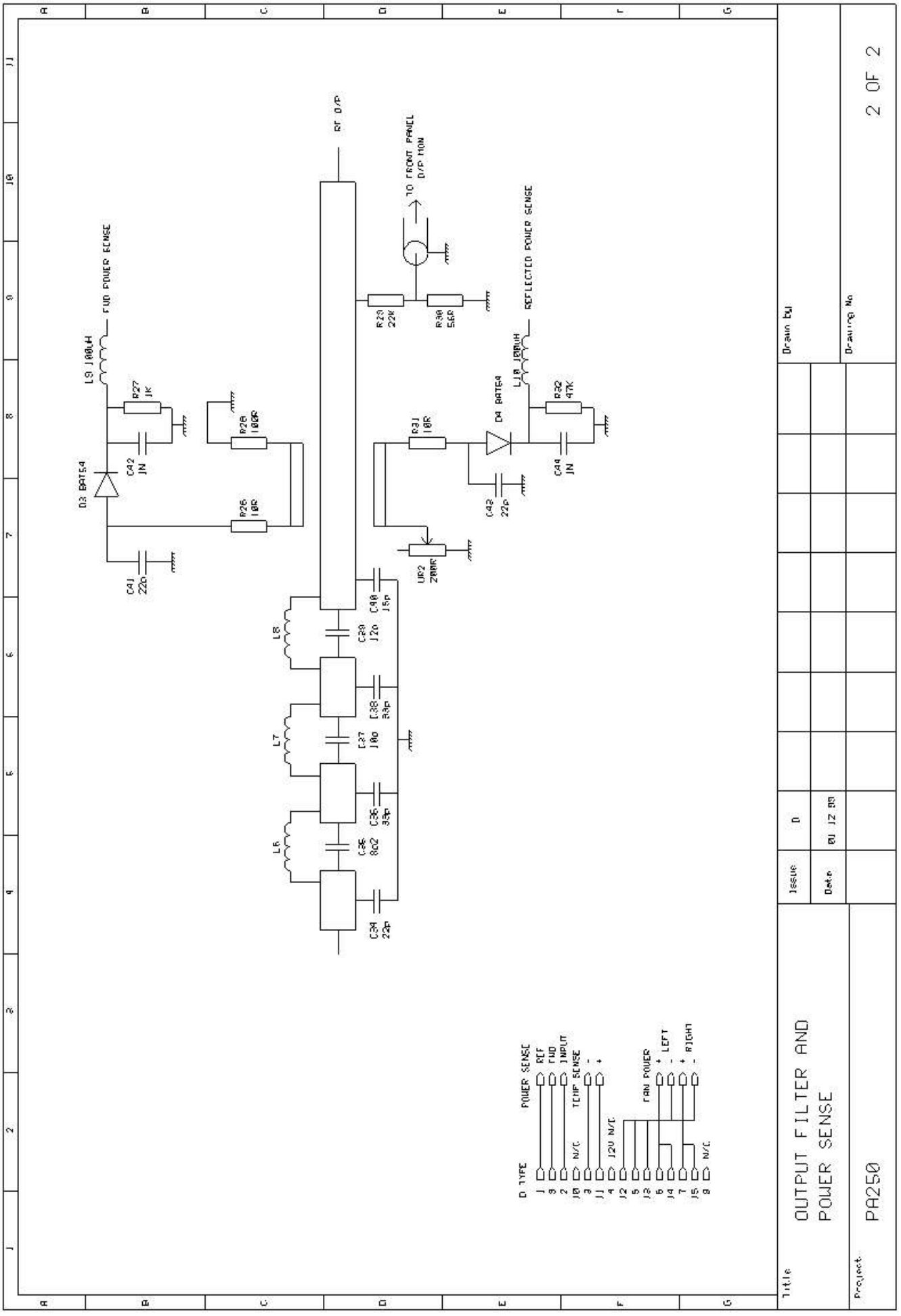



PA MASTER PCB
SWITCHMODE SECTION
PA250
2 OF 4
Drawn by SWK
Drawing No PMASTER2 SCH
Issue A B
Date 5/98
Title
Project
POWER SUPPLY PINS
IC 4,5,6,7,8,9
0V 4
15V 8
140V SM REG SUPPLY 1A10
0V SM REG 1C10
PWM SUPPLY 1E10
MUTE ACTIVE 1G10
PA POWER
METER PA VOLTS
CURRENT
PWR CONT
POWER CUT BACK 3G2
MUTE ACTIVE 4A2
POWER OK
POWER LED RED GRN
RETURNS LED
METER
POWER CONTROL
PA A METER ADJ


METER TEMP
FAN POWER
LEFT
RIGHT
FAN RETURNS
TEMP OK
TEMP OK
TEMP LED
GRN
RED
POWER CUT BACK 4Q2
CON4
HDR1
CON1
HDR2
22R 1/2W FUSIBLE
22R 1/2W FUSIBLE
TR10 BD679
TR9 BC184
TR14 BC184
TR13 BC184
TR12 BC214
TR11 BC184
D20 15V
D22 3V3
D29 10V
D8 1N4148
IC6b CA3240
IC6a CA3240
R47 12K
R48 100K
R49 1K5
R46 10K
R50
R51
R63 10K
R62 1K
R61 10K
R60 10K
R59 1K
R58 10K
R57 1K
R26 1K
R45 120K
R53 120K
R44 10K
R43 10K
R95 1K
R41 10K
R52 10K
R54 10K
R55 56K
R96 82R
C38 10N
70V 1B10
15V
SUPPLY
RETURN
TEMP SENSE
BACK PANEL (CONTROL/MONITOR) TO TELEMETRY HEADER
POWER CUT BACK 2E11
Drawn by SWK
Drawing No PMASTER3 SCH
3 OF 4
Issue A
Date
Title PA MASTER PCB TEMP MONITOR/FOLDBACK
Project PA250


P FWD OK
P FWD LED GRN RED
METER P FWD
P FWD
P REF ALARM
P REF LED GRN RED
P REF OK
P FWD METER ADJ 20K VR4
P REF METER ADJ VR5 20K
IC5a CA3240
IC5b CA3240
LEVEL SET SWITCH
S1
TR20 BC184
TR21 BC184
TR22 BC184
TR23 BC184
TR15 BC214
TR16 BC214
TR17 BC184
TR18 BC184
TR19 BC184
D17 1N4148
D21 1N4148
D11 1N4148
D16 1N4148
D19 3V3
D24 1N4148
D23 1N4148
R91 10K
R93 220R
R92 1K
R89 1K
R90 10K
R88 10K
R87 4K7
R85 1M
R84 10K
R30 1K
R82 22K
R81 10K
R80 1M
R71 1K
R86 4K7
R83 10K
R68 1M
R94 10K
R75 1K
R76 10K
R77 10K
R79 10K
R78 1K
R72 10K
R73 1K
R74 1K
R70 1K
R67 10K
R69 1K
R66 22K
R65 10K
R64 1M
VR2 100K
VR3 100K
VR6 20K
C40 10UF
C29 10UF
C37 N56
C36 N56
IC8a LMC6032
IC8b LMC6032
IC9a CA3240
IC9b CA3240
IC7a CA3240
MUTE ACTIVE 2E11
P FWD FROM PA
TO PA BIAS REG
SCREENS
P REF FROM PA
POWER CUT BACK 309
P REF CUT BACK
Issue A B
Date 2/95 8/95
Drawn by SWK
Drawing No MASTER4 SCH
4 OF 4
Title PA MASTER PCB POWER MONITORS
Project PA250


TO FILTER
Feedthrough capacitor
1KW-50W From SMPS
DRIVE SENSE
RF I/P
RF AMPLIFIER
PA250
1 OF 2


RF O/P
TO FRONT PANEL
O/P MON
R29
22K
R30
56R
FWD POWER SENSE
L9 100uH
R27
1K
C42
1N
D3 BAT54
C41
220p
R28
100R
R26
10R
REFLECTED POWER SENSE
L10 100uH
D4 BAT54
R32
47K
C44
1N
R31
10R
C43
22p
VR2
200R
C40
15p
C39
12p
C38
33p
C37
10p
C36
33p
C35
8p2
C34
22p
L8
L7
L6
D TYPE
POWER SENSE
REF
FWD
INPUT
TEMP SENSE
-
+
12V N/C
FAN POWER
+ LEFT
- LEFT
+ RIGHT
- RIGHT
N/C
Issue
D
Date
01 12 00
Drawn By
Drawing No
2 OF 2
Title
OUTPUT FILTER AND
POWER SENSE
Project
PA250

10.3 Circuit description

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POWER SUPPLIES

The electricity supply passes through a filtered and fused IEC inlet and is fed through a series inrush limiting circuit to the primary winding of the transformer. Initially TH1, a negative temperature coefficient thermistor, provides a high resistance path to the primary current. The heating effect of the current rapidly reduces the resistance of the thermistor increasing the primary current in a controlled manner. Finally RL1 removes the thermistor from the circuit, once the voltage across the 70V line is established. If the electricity supply is disconnected, RL1 will quickly disconnect because of the loss of the AC feed via R112, enabling the inrush limiting circuit to operate as soon as power is restored. This arrangement prevents fuse failure during power brown outs.

The secondary of the transformer is bridge rectified producing an unregulated 140V DC rail. A centre tap delivered direct from the transformer gives a 70V DC half rail. Capacitors C1,C5,C6 and C7 smooth the lower half rail and C2,C3,C4 and C8 smooth the upper half. R1 and R2 are bleed resistors for these capacitors. Only the switch mode regulator is supplied by the 140V line, being delivered to the switching FET through FS1.

All control and monitor circuitry is powered from 15V output from the three terminal regulator IC1. Its input is derived from the 70V line, being reduced to around 27V by TR1 acting as a pre regulator. Like TR1, TR2 uses the voltage across D4, a 27V Zener, as a reference to produce a supply for the switch mode PWM controller. This supply is enabled by TR3 on the base of TR2. The PWM supply can be turned off from two sources driving TR3 through two diodes. A circuit based on IC2 will not allow the PWM circuit to be energised until the 140V becomes available on power up or if FS1 is open circuit. Externally pulling the PA Mute signal to 0V or disconnecting the Safety Mute Link will turn off TR4, having the effect of turning off the PWM supply and pulling the Mute Active line high through R15. Mute Active stops a power supply fault from being flagged during a mute and signals the mute state on the front panel by turning the P. FWD LED orange. A loss of forward power will be signalled on the rear panel control/monitor socket.

SWITCH MODE REGULATOR

A variable supply of 16 to 50V DC at up to 10A is generated by a buck or forward type converter. The RF output power of the PA250 is controlled through the adjustment of this supply to the RF amplifier. FET TR5 is the switching device. When it is turned on, current flows through T1 producing the output voltage across C22 and C24. When TR5 is turned off, the magnetic field of T1 changes polarity, forward biasing D14 and producing a current through C22 and C24, maintaining the output voltage. Drive for TR5 is transformer coupled by T2 to the output of the controller IC. Current taken through TR5 is sampled by T3. This is rectified and produces a voltage across R22 which is

filtered and fed to the Pulse Width Modulator device IC2. The oscillator frequency of 200KHz is set by R19 and C18. A feed back of the power supply output voltage is derived through the front panel Power O/P Adjust potentiometer VR1. The P.M. controller varies the supply output such that the fed back portion of the output is kept at a constant 2.5V across R20. The power supply failure detection circuit monitors this voltage and flags a fault if it drops below 2.4V. Half of dual op' amp IC4 compares the feedback voltage with a reference from Zener D5 and passes its output through a chain of transistors TR6, TR7 and TR8 to control the front panel LEDs and Power OK monitor signal. Temperature and reflected power cutback circuits resistively sum their outputs with the feed back voltage through R35 and similarly an external input can be summed into the feed back loop to provide RF power control from other sources.

On the output of the supply SCR1 is employed as an over voltage crow bar to save the RF power device in the case of a serious power supply failure. LF1 filters high frequency switching noise created by TR5 before the output of the supply becomes referenced to the chassis through R3 and R4. These resistors in the return line sense the current taken by the amplifier. IC4 amplifies the voltage drop across them to drive the meter. For the PA. Volts range on the meter, R56 supplies the meter coil directly from the power rail.

TEMPERATURE CONTROL

Embedded in the heatsink next to the RF power device is a two terminal temperature sensor. It has a positive temperature coefficient with a linear relationship between resistance and temperature rise. A differential amplifier based around half of IC9 produces a 0 to 12V signal relating to a temperature range of 0 to 100 Celsius. This is used to drive the meter through R47 and to vary the speed of the fans. The other half of IC9 drives TR11 to introduce a positive current into the power supply feed back loop as the temperature rises over 100 Celsius. The effect is a progressive reduction in power supplied to the RF amplifier in order to keep the RF power device within its temperature rating. Operation of the temperature cut back is signalled through TR12 and TR13 driving the front panel LEDs, and TR14 provides the collector output at the Control/Monitor socket.

Both fans are driven by TR10 through two fusible resistors. The fans have built in current limiting and blocking protection, but should a serious fan failure occur the fusible resistor is sacrificed to protect the drive to the other fan. The level of drive voltage applied is the 0 to 12V temperature related signal added by TR9 to the 15V across Zener D20 on the base of TR10.

POWER MONITORS

The forward power sensed voltage is buffered by IC8 and routed to IC9 and the front panel display push switch. IC9 compares the level with that supplied from the front panel P. FWD Alarm preset. Should the forward power sense voltage drop lower than the alarm level the drop in output from IC9 will command the P.FWD LED to turn red, driving through TR22 and TR23, and remove the P.FWD

OK output signal via TR20. From the front panel display push switch, the forward power sense level is buffered by IC5 to drive the meter. When the switch is pressed the alarm level replaces the sensed voltage to drive the meter. Meter calibration on the forward power range is through preset VR4.

The reflected power sensed voltage is buffered by IC8 and delivered across C29. R69 and D23 provide a fast charge path while R67 gives a slow discharge. From C29 the reflected level is routed to the front panel display push switch and to IC7 and IC9. IC7 makes a comparison with the level set on the P. REF Alarm preset. A rise of reflected power above the alarm level will cause a fault output on the P. REF Alarm line driven by TR23. The P. REF LED will be driven orange by TR19 applying current through R71 to the red anode of the LED while the green anode is also being supplied. IC9 is responsible for controlling the amount of cutback applied as the reflected power reaches 25W. Current is added into the feedback loop of the switch mode regulator which reduces the supply to the RF amplifier. The reflected power is kept at a sustainable level by progressively reducing the delivered RF power. The operation of the cutback is signalled by TR16 and TR17 driving the P. REF LED red and through TR18 flagging the failure on the P. REF OK line.

10.4 Alignment

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PSU Test Procedure

No.	Test	Description
1.	Visual inspection	Check all connections are secure.
2.	Apply power	Install mains fuse, remove FS1 (PSU PCB), disconnect ribbon cable to PA unit and disconnect fans (orange headers). Connect mains power. Power LED should be green, P.Fwd LED Orange, P.Ref LED green and TEMP LED red. Meter should indicate zero on all ranges except temperature which should be at full scale.
3.	Connect interlock	Link together pins 14 and 15 of the Control/Monitor connector.
4.	Check voltages	Check for approximately +140V DC at the end of FS1 nearest the rear of the case. Check for +15V on pin 15 of HDR2 .
5.	Check soft start	Connect and remove the IEC mains cable. Check that the soft start relay changes over instantaneously.
6.	Test switch mode	Remove the mains input. Install FS1, turn front panel power control fully CCW, reconnect ribbon cable to PA unit, reconnect fans connect 8 Ohm test load to PSU output. Connect mains input. Check that PSU output is about +16V.
7.	Turn up power	Whilst turning up power control, listen for any squeals or noise from the switch mode supply. If anything is heard, investigate before increasing power control setting further.
8.	Check meter	Check that P.Fwd and P.Ref readings are zero. Check voltage reading. Check operation of push button for alarm level setting.
9.	Current calibration	Disconnect mains power. Connect an ammeter into the feed to the test load. Reconnect the mains power and adjust the power control to give a meter reading of 6 amps. Use VR6 to calibrate the PA A range of the PA250'2 meter.
10.	Check temp sense	Disconnect the temperature sensor from the sub PCB in the PA section. The fan speed should increase to

		maximum. The power supply output voltage should drop to zero, the temperature reading on the meter should go to full scale and the TEMP LED should turn red.
11.	Temp cutback	Connect a 100kOhm potentiometer in place of the temperature sensor. Adjust it while watching the front panel meter. The fan speed should increase as the indicated temperature increases. At 95 Celsius the power supply output voltage should start to drop.
12.	Check controls	Verify that the external mute operates (link pin 19 to ground) and that the alarm signals are correct.

10.5 Fan replacement

The PA 250 uses PAPST 614 DC brush less fans with electronic blocking protection to ensure a long service life. Any replacement should be of the same type to ensure continued reliability.

Replacing the fan is a simple process. If the equipment rack where the PA250 is installed has chassis supports (recommended) then it can be done without removing the amplifier from the rack. Slide the amplifier out of the rack by approximately 50mm.

Fan replacement procedure:

1. Disconnect the power from the amplifier.

2. Remove the four screws holding the front cover of each fan.

3. Remove the three screws from the top and bottom of the PA250 adjacent to the front panel.

4. Remove the three screws from each side of the PA250 adjacent to the front panel.

5. Carefully pull the front panel away from the amplifier. The meter and RF monitor wiring will still be attached to the front panel. The meter ribbon cable can be unfastened from the main PCB and the RF monitor cable disconnected (BNC connector). The front panel can now be put aside.

6 The fans will now be loose. Remove the faulty fan and pull the orange connector from the small PCB on the left.

7. Fitting the new fan is the reverse of the removal procedure. If the fan was not supplied with the orange connector then remove it from the old fan and fit it to the new one, taking care to get the polarity correct.

8. When fitting the new fan, take care to route its supply wires above the fans so that they are not trapped by the front panel.

If the new fan fails to operate, it is likely that a fusible resistor on the main PCB has failed (R50 or R51). These are Philips NFR25 series 22Ω and must be replaced with the same type.

11 Declaration of conformity

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Name of Manufacturer: sbs
Address of Manufacturer: PO Box 100
HASTINGS
East Sussex
TN35 4NR

Product: PA250 FM Power Amplifier

Declaration:

The product described above compiles with the requirements of the Low Voltage Directive (73/23/EEC) and the protection requirements of the EMC Directive (89/336/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Standards:

EN 60065:1998	Safety requirements for mains operated electronic and related apparatus for household and similar general use
EN 50081-2:1994	Electromagnetic compatibility. Generic emission standard. Industrial environment
EN 50082-2:1995	Electromagnetic compatibility. Generic immunity standard. Industrial environment

Additionally, the product described above complies with all relevant parts of the following standards:

ETS 300 384:1995	Radio broadcasting systems; Very High Frequency (VHF), frequency modulated, sound broadcasting transmitters

Signed: On file

for and on behalf of sbs, UK: Pyers Easton, CEO

Date of Issue: 16 . 05. 2001