

Technical manual

MA. 949 Power Unit and Loudspeaker Amplifier



1976
THE QUEEN'S AWARD
FOR EXPORT ACHIEVEMENT
TO RACAL-MORSECA LTD.



1977
THE QUEEN'S AWARD
FOR EXPORT ACHIEVEMENT
TO RACAL-TACTICOM LTD.

RACAL
The Electronics Group

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LETHAL WARNING

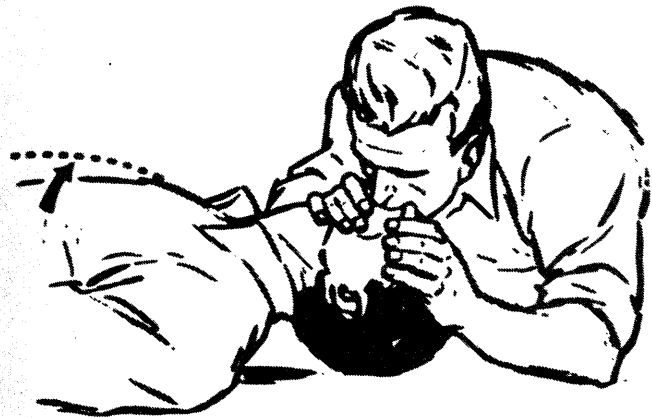
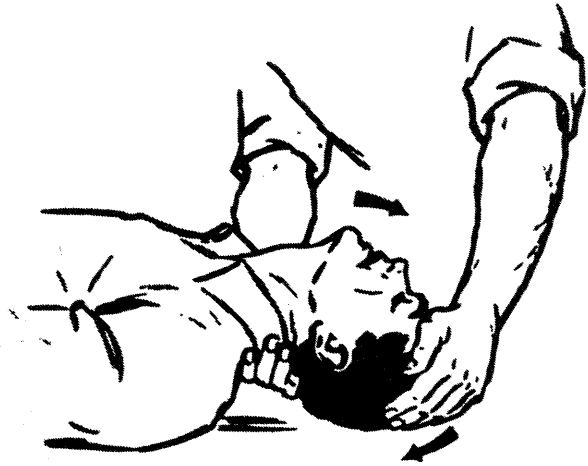
Voltages within this equipment are sufficiently high to endanger life.

Care should be taken when covers are removed.

Resuscitation instructions are given overleaf.

FIRST AID

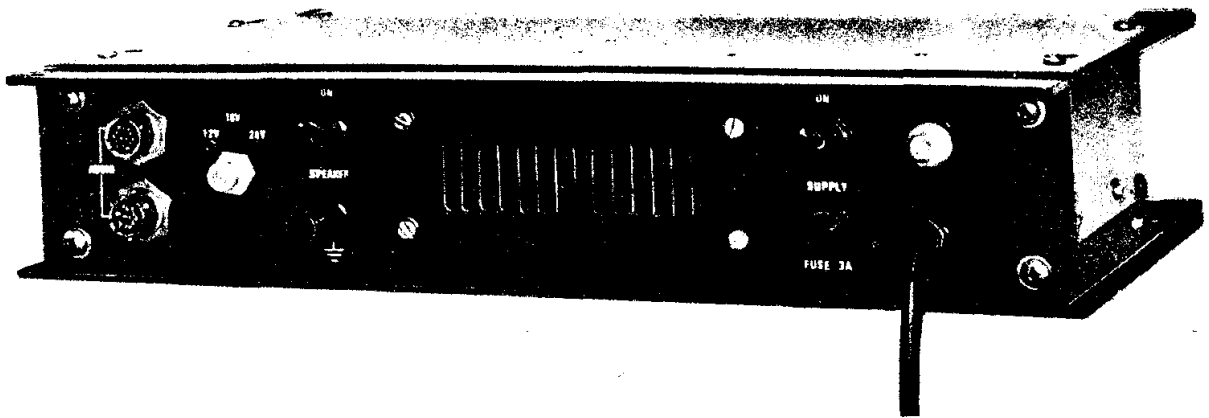
in case of Electric Shock



1. Lay victim on his back.
2. Clear victim's mouth and throat.
3. Tilt victim's head back as far as possible and raise his head.
4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise. Note: Blow forcefully into adults, but gently into children.
7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at a rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible all the time.

Have someone else send for a Doctor
Keep patient warm and loosen his clothing

DO NOT Give liquids
until patient is conscious



Power Unit and Loudspeaker Amplifier
Type M A. 949

**THIS HANDBOOK REFERS TO EQUIPMENT
SERIAL NUMBER AND SUBSEQUENT**

HANDBOOK AMENDMENTS

**See Yellow Amendment Sheet Numbers
which follow this page. The action called for by the amendments should
be carried out by hand as soon as possible.**

POWER UNIT AND LOUDSPEAKER AMPLIFIER TYPE MA 949

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ILLUSTRATIONS

Power Unit and Loudspeaker Amplifier type MA.949

Component Layout: Main Chassis

Component Layout: Regulator Board

Component Layout: Amplifier Board

Circuit Diagram: Power Unit

Circuit Diagram: Audio Amplifier

Frontispiece

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

TECHNICAL SPECIFICATION

D.C. Power Supply

Outputs; regulated

24V nominal at 5.5A maximum

or

18V nominal at 5.5A maximum

or

12V nominal at 1A maximum

1:2

Duty Cycle

Loudspeaker Amplifier

Power Output:

1.0W from 18V or 24V supply.
0.5W from 12V supply.

Input Sensitivity:

550mV r.m.s. for 1W output.

Harmonic Distortion:

Less than 5%.

A.C. Supply Input

Supply Voltages:

100 to 125V or 200 to 250V a.c.

Supply Frequency:

47 to 60Hz, single phase

Power Consumption:

150VA, nominal

Dimensions.

Height:

88mm.

Width:

395mm.

Depth:

215mm.

Weight:

5.5kg

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The Power Unit and Loudspeaker Amplifier type MA 949 enables the Racal range of manpacks to be operated from 100 to 125 or 200 to 250 volt a.c. mains supply.

RANGE OF EQUIPMENTS

2. The Power Unit provides a stabilized output at 12V, 18V or 24V d.c. This d.c. output voltage is selected by a front panel control. The MA 949 may be used with any manpack which operates from these voltages. A representative list of equipments with their supply requirements is given in the Table below.

<u>Equipment</u>	<u>D.C. Voltage</u>
TRA.906	18V
TRA.921	18V
TRA.922	18V
TRA.931	24V
TRA.932	24V
TRA.6929	18V
TRA.965	12V
TRA.971	12V

AUDIO AMPLIFIER

3. The audio output from the manpack receiver is amplified to 1 Watt level and fed to a loudspeaker mounted on the front panel. The output level may be adjusted at the manpack. On/off switching is provided.

CONSTRUCTION

4. The MA 949 is housed in a robust metal case with a flat top, upon which the manpack may be mounted. The top cover plate is detachable, for maintenance purposes.

CONTROLS AND CONNECTORS

5. All control functions and external connections are made at the front of the unit. The front panel carries the following items:-

- Loudspeaker
- Loudspeaker switch
- D.C. Voltage Selector
- Audio connectors (2)
- A.C. supply switch
- A.C. supply indicator and fuse
- A.C. supply input lead
- Earth terminal

CHAPTER 2
SETTING-TO-WORK

INSPECTION

1. The MA 949 Unit should be examined for signs of damage in transit. Any dust or loose packing material should be removed.

MAINS VOLTAGES

2. Before making connections to the a.c. supply, ensure that the Unit is wired for operation from the local supply voltage, by referring to Fig. 4. Mains voltage adjustment is by soldered connections to transformer T1.
3. The SUPPLY connections are made via a flying lead, as follows:-
 - Brown core to Live
 - Blue core to Neutral
 - Green/Yellow core to Earth.
4. Ensure that the fuse link FS1 is intact. A 3 amp rating is suitable for 200 to 250V a.c. operation and a 5 amp rating for 100 to 125V a.c. operation.

SWITCH-ON PROCEDURE

5. The recommended procedure is as follows:
 - (1) Ensure that the SUPPLY switch is OFF then set the SET DC. VOLTS Switch to 12V, 18V or 24V as required.

CAUTION.

The d.c. supplies for the manpack are fed via the AUDIO connectors at the front of the MA 949. The correct d.c. voltage must be selected before these connections are made. Failure to observe this precaution could cause permanent damage to the manpack. Refer to Chapter 1 for the voltage setting required, or consult the technical manual for the manpack.

- (2) Disconnect any existing power source, such as a battery box, from the manpack.
- (3) Connect one of the AUDIO Sockets on the MA 949 to one of the AUDIO connectors on the manpack, using a multi-way cable.
- (4) Connect the handset to the second AUDIO socket on the manpack. Set the audio gain control to mid-travel initially.
- (5) Set the SUPPLY switch to ON and ensure that the power indicator is lit.
- (6) Select SPEAKER-ON or OFF as required.

The manpack may now be operated in the usual manner. The loudspeaker level is controlled by the manpack's audio control.

NOTE. The second AUDIO Socket on the MA 949 may be used for a key or telephone connection. No provision is made for microphone input.

CHAPTER 3

CIRCUIT DESCRIPTION

REGULATED POWER SUPPLY (Fig. 4)

1. The power supply provides a stabilized d.c. power source for the manpack and the loudspeaker amplifier.
2. The main a.c. supply is fed via the POWER switch S1 and fuse FS1 to the primary of transformer T1. The primary windings on T1 are connected in series for 200 to 250 volts a.c. input, or in parallel for 100 to 125 volts a.c. input. For 24 volt d.c. output, switch S2 selects the whole of the secondary voltage as input to the bridge rectifier D1. A lower voltage is used for the 18 volt and 12 volt output settings.
3. The d.c. output from D1 is developed across reservoir capacitor C1 and is fed to the input of the voltage regulator circuit. Capacitor C3 provides smoothing for the regulated output. The d.c. supply for the manpack appears at pins B (positive) and D of the AUDIO connectors SKT1 and SKT2.
4. Transistor 1TR4 forms part of a voltage-sensitive bridge 1R13 to 1R16 and 1D4. The voltage sensitive bridge detects any changes in output loading and applies an appropriate correction to TR1 base current. The signal from 1TR4 is amplified by 1TR1 and TR2 to drive TR1, the series regulating element. The zener diode provides a reference voltage at 1TR4 emitter. 1TR3 with 1D3 forms a high impedance collector load for 1TR4. The preset adjustment for 24 volts d.c. output is 1R15. Separate controls 1R17 and 1R18 are switched into circuit for the 18 volt and 12 volt settings respectively.

Overload Protection

5. Overload protection is given by 1TR2, which is normally non-conducting. When the output current exceeds a predetermined level, the voltage developed across 1R3 causes 1TR2 to conduct. This reduces the drive to 1TR1, causing the output voltage to fall. The overload trip-level is preset by potentiometer 1R4.

LOUDSPEAKER AMPLIFIER (FIG. 5)

6. Audio output from the receiver is applied via switch S3 and pin 5 to the input of a two-stage amplifier 4TR1, 4TR2. The output from 4TR2 feeds the driver stages 4TR5, 4TR6. Transistors 4TR5 and 4TR6 function as a complementary pair, to provide push-pull audio drive to the bases of the output transistors 4TR7 and 4TR8.
7. The audio output appearing at pins 1 and 2 is fed to the loudspeaker. Negative feedback is applied from the output stage via 4R6 to 4TR1 emitter. Diodes 4D1 and 4D2 provide d.c. bias and thermal stabilization.

CHAPTER 4
MAINTENANCE

INTRODUCTION

1. The internal controls of the MA 949 are preset during manufacture. The equipment will normally require readjustment only at infrequent intervals.

TEST EQUIPMENT

2. The following items of test equipment will be required:-

- (1) Multimeter (2 off)
(Example: Avo Model 8)
- (2) Rheostat
Resistance Range: 0 to 168 ohms
Current Rating: 5A
(Example: B. E. R. C. O. Type DL5M)
- (3) Electronic Voltmeter
Sensitivity 50mV to 10V r.m.s.
Frequency Range: 100Hz to 20kHz.
(Example: Advance 77)
- (4) A.F. Signal Generator
Frequency Range: 100Hz to 20kHz.
Impedance: 600 ohms
(Example: Advance J2)
- (5) Oscilloscope
Frequency Range: 100Hz to 20kHz
Sensitivity: 2V/cm
(Example: Advance OS. 2000)
- (6) A.F. Power Meter
Frequency Range: 100Hz to 20kHz.
Power Ranges: 0.1W to 10W
Impedance: 8 ohms
(Example: Marconi TF. 893A)

DISMANTLING

3. To obtain access for test and fault location purposes, remove the 4 Pozidriv screws securing the top cover and lift it clear. The method of reassembly will be self-evident.

NOTE: The metric thread 'cross head' screws fitted to Racal equipment are of Pozidriv type. Phillips type and Pozidriv type screwdrivers are not interchangeable and the use of the wrong screwdriver will cause damage. Pozidriv screwdrivers have blue handles and are manufactured by Messrs. Stanley.

CAUTION: With the cover removed, high voltages will be present at unguarded points on the mains transformer T1 and the POWER switch S1. Before making any adjustments, note the positions of these items.

POWER SUPPLY TESTS

4. This procedure sets the d.c. output voltages and the overload protection circuit. These adjustments must be made in the order shown.

D.C. Voltage Adjustment

5. (1) Set the SUPPLY switch to OFF and the SET DC VOLTS switch to 24V.
- (2) Set controls 1R15, 1R17 and 1R18 to their mid-travel positions and 1R4 fully anticlockwise.
- (3) Connect the multimeter No. 1, set to the 25 volts d.c. range, across the regulated d.c. output. This voltage appears at pins B (positive) and D of the AUDIO sockets and at pins 4 and 6 on the Regulator board.
- (4) Connect the MA 949 to the a.c. supply. Switch the SUPPLY on and check that the power indicator is lit.
- (5) Adjust 1R15 to give exactly 24 volts d.c. output.
- (6) Switch the SUPPLY off and SET DC VOLTS to 18V.
- (7) Switch on again and adjust 1R17 to give 18 volts output.
- (8) Switch the supply off and reset SET DC VOLTS to 12V.
- (9) Switch on again and adjust 1R18 for 12 volts output.
- (10) Switch off.

Load Current

6. (1) Connect the multimeter No. 2 in series with the rheostat across the regulated d.c. output. Use maximum load resistance initially. Set multimeter No. 2 to the 10A d.c. range.
- (2) Set the SET DC VOLTS switch to 24V.
- (3) Switch the SUPPLY on and adjust the rheostat for 5.5A load current initially.
- (4) Note the output voltage then increase the load current to 6.0A.
- (5) Adjust 1R4 until the output voltage starts to fall.
- (6) Vary the load current either side of the 6.0A setting and note the output voltage variation. Re-adjust 1R4 to ensure that the maximum current available is 6.0A.
- (7) Connect a temporary short circuit across the rheostat. Check that the load current does not exceed 2A.
- (8) Remove the short circuit and check that the output voltage returns to its previous value.
- (9) Switch off and reset SET DC VOLTS to 18V.
- (10) Repeat steps (6) to (8) to check the overload protection but do not readjust 1R4.
- (11) Switch off. Disconnect the rheostat and the multimeters.

AUDIO AMPLIFIER TESTS

Power Output

7. (1) Carefully unsolder the lead from pin D2 of the Amplifier board.
- (2) Connect the audio power meter, set to the 10 watt range, between pins D1 and D2. Set the load impedance to 8 ohms.
- (3) Connect the Y-amp input of the oscilloscope to pins D2 (live) and D1. Set the oscilloscope to the 5V/cm range.
- (4) Connect the output of the audio generator between pins F (live) and D of AUDIO socket SKT1.
- (5) Set the generator frequency to 1000Hz and the a.f. output level to 100mV r.m.s.
- (6) Connect the electronic voltmeter, set to the 1 volt a.c. range, across the output of the audio generator.
- (7) Set the SET DC VOLTS switch to 18V and the SPEAKER switch to ON. Switch the SUPPLY on.

- (8) Adjust the oscilloscope to display the 1000Hz output waveform.
- (9) Increase the a.f. signal input until the peaks of the waveform start to flatten. The audio power output should be at least 1 watt.
- (10) Reduce the signal input to give 1 watt output. The signal input level should be 550mV \pm 10%.

Frequency Response

8. (1) Tune the audio generator to 200Hz, maintaining the same input level as above. The audio power output should be approx. 0.4 watts.
- (2) Tune the generator to 5000Hz and check that the power output is at least 0.7 watts.
- (3) Retune the generator to 1000Hz.

Muting

9. (1) Using a suitable wire link, connect pin C to pin D on AUDIO socket SKT2. Check that the amplifier output falls to zero.
- (2) Remove the wire link. The output should re-appear.
- (3) Repeat steps (1) and (2) using socket SKT1.
- (4) Switch the SUPPLY off. Disconnect the test equipment as appropriate.
- (5) Reconnect the wiring to pin D2 of the Amplifier board.

D.C. VOLTAGES

10. The d.c. voltages given in the following Table are typical values, measured with an Avometer model 8 multimeter (20,000 ohms per volt). The test conditions were:-

SET DC VOLTS switch set to 18V.

No external load current.

No signal input to the Loudspeaker Amplifier.

The negative terminal of the multimeter was connected to the negative terminal of capacitor C1.

Typical D.C. Voltages

	<u>Emitter</u>	<u>Base</u>	<u>Collector</u>
TR1	18.0	18.5	35.0
TR2	18.5	19.0	35.0
<u>Regulator Board</u>			
1TR1	19.0	19.6	31.0
1TR2	18.1	18.3	19.6
1TR3	34.0	33.7	20.0
1TR4	6.2	6.8	20.0
<u>Amplifier Board</u>			
4TR1	9.0	8.4	0.7
4TR2	0	0.7	6.0
4TR3	9.2	9.2	10.0
4TR4	9.2	9.2	8.6
4TR5	9.2	8.6	0.1
4TR6	9.4	10.0	18.0
4TR7	9.2	9.4	18.0
4TR8	0	0.1	9.2

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number
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MAIN ASSEMBLY

Miscellaneous

LS1		Loudspeaker			912551
T1		Transformer			710156
FS1		Fuselink, 3A			922451
		Fuselink 5A			921724
		Fuseholder			924259
FS2		Fuselink 5A			922453
		Fuseholder			924259
LP1		Lampholder, Amber			917718
		Terminal Insulation Kit			925961

REGULATOR BOARD

Resistors

	<u>Ohms</u>		<u>W</u>		
1R1	1k	Carbon Film	1/3	5	924680
1R2	4.7k	Carbon Film	1/3	5	924689
1R3	0.1	Wirewound	2½	10	921359
1R4	4.7k	Variable	-	20	919511
1R5	47k	Carbon Film	1/3	5	924700
1R6	18k	Carbon Film	1/3	5	924696
1R7	4.7k	Carbon Film	1/3	5	924689
1R8	15	Carbon Film	1/3	5	924662
1R9	470	Carbon Film	1/3	5	924677
1R10	27k	Carbon Film	1/3	5	924689
1R11	220	Carbon Film	1/3	5	924673
1R12	1k	Carbon Film	1/3	5	924680
1R13	2.2k	Carbon Film	1/3	5	924684
1R14	2.2k	Carbon Film	1/3	5	924684
1R15	470	Variable	-	20	919514
1R16	680	Carbon Film	1/3	5	924678
1R17	1k	Variable		20	919516
1R18	2.2k	Variable		20	919974
1R19	1k	Carbon Film	1/3	5	924680
1R20	10k	Carbon Film	1/3	5	924693
1R21	2.2k	Carbon Film	1/3	5	924684

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number
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REGULATOR BOARD

Capacitors μF

			<u>V</u>		
1C1	.01	Disc ceramic	250	-20+40	916187
1C2	.01	Disc ceramic	250	-20+40	916187
1C3	.01	Disc ceramic	250	-20+40	916187
1C4	4.7	Fixed	35	20	914026
1C5	.001	Disc ceramic	40	-20+100	924242
1C6/7	.01	Disc ceramic	250	-20+40	916187

Diodes

1D1		BAV10			918130
1D2		1N4149			914898
1D3		1N4149			914898
1D4		BZY88-C6V2			911682
1D5		BZY88C27V			919300
1D6		BZY88C27V			919300
1D7		BZY88C27V			919300

Transistors

1TR1		BUY80			926062
1TR2		ZTX304			921558
1TR3		ZTX504			928026
1TR4		ZTX304			921558

AMPLIFIER BOARD

Resistors ohms

			<u>W</u>		
4R1	56	Carbon Film	1/3	5	924666
4R2	5.6k	Carbon Film	1/3	5	924690
4R3	2.2k	Carbon Film	1/3	5	924684
4R4	6.8k	Carbon Film	1/3	5	924691
4R5	220	Carbon Film	1/3	5	924673
4R6	1.5k	Carbon Film	1/3	5	924682
4R7	6.8k	Carbon Film	1/3	5	924691
4R8	68	Carbon Film	1/3	5	924667
4R9	1k	Carbon Film	1/3	5	924680
4R10	1k	Carbon Film	1/3	5	924680
4R11	1k	Carbon Film	1/3	5	924680
4R12	0.75	Wirewound	1 1/2	10	916158
4R13	0.75	Wirewound	1 1/2	10	916158
4R14	Not used				
4R15	1k	Carbon Film	1/3	5	924680
4R16	1k	Carbon Film	1/3	5	924680
4R17	1k	Carbon Film	1/3	5	924680

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number
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AMPLIFIER BOARD

Capacitors

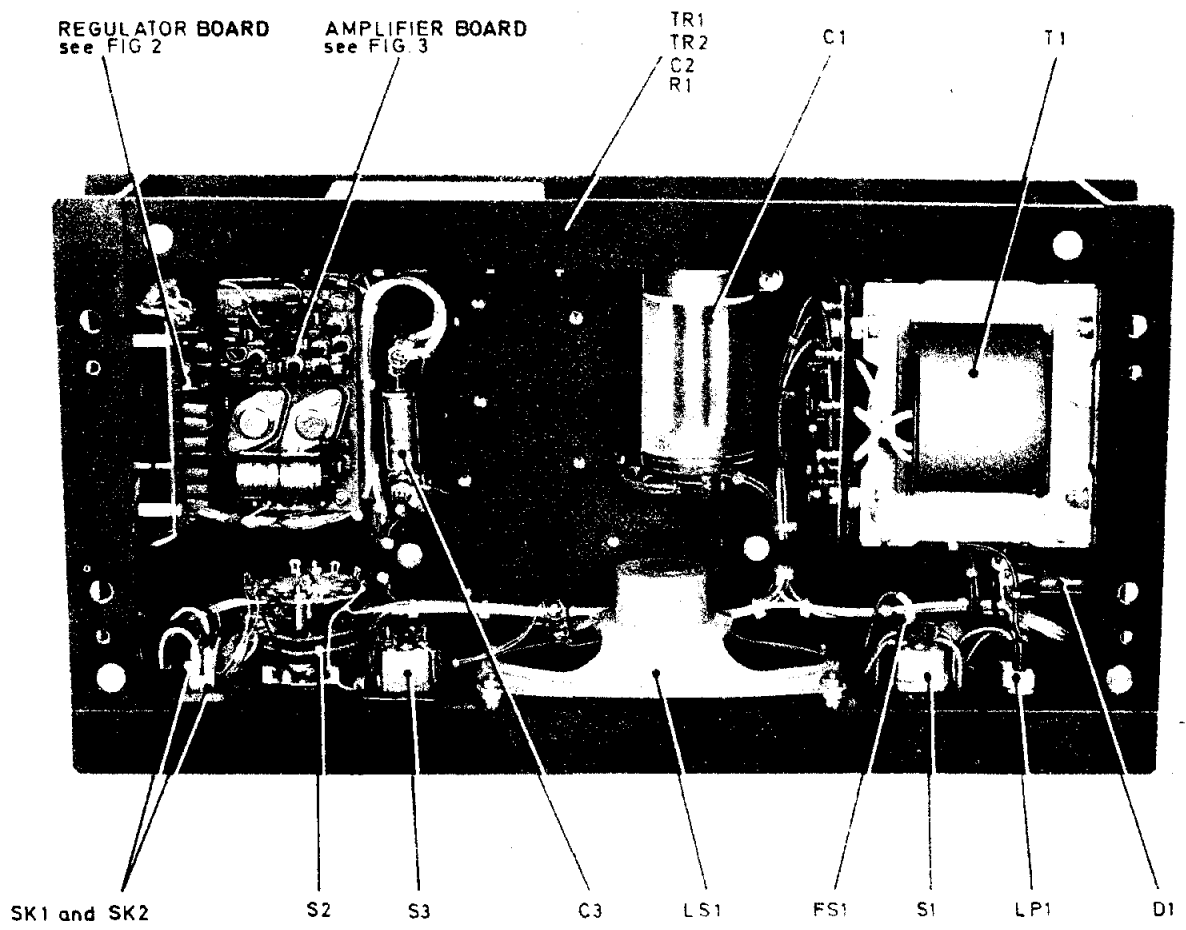
	<u>μF</u>		<u>V</u>		
4C1	.01	Disc Ceramic	250	-20 + 40	916187
4C2	4.7	Tantalum	35	20	914026
4C3	.47	Tantalum	35	20	915168
4C4	.01	Disc Ceramic	250	-20 + 40	916187
4C5	4.7	Tantalum	35	20	914026
4C6	.01	Ceramic	63	20	915173
4C7	4.7	Tantalum	35	20	914026
4C8	Not Used				
4C9	.470	Electrolytic	25	-10 + 50	922307

Diodes

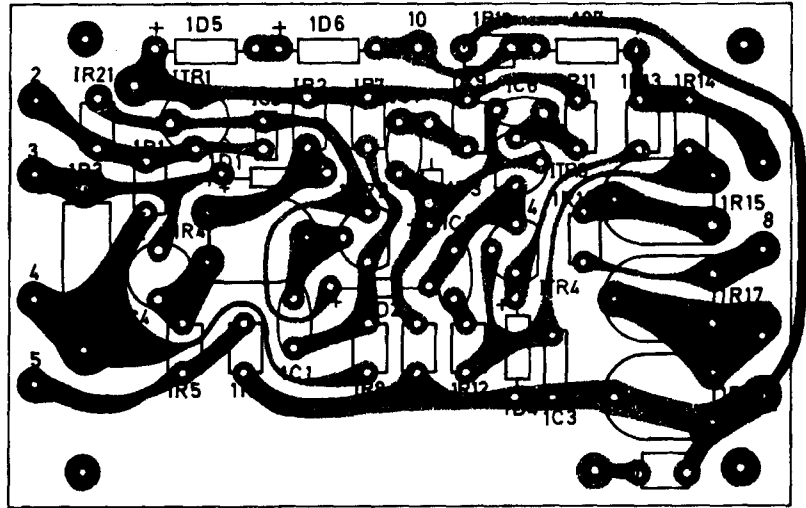
4D1	1N4149	914898
4D2	1N4149	914898
4D3	1N4149	914898

Transistors

4TR1	ZTX212	923172
4TR2	ZTX237	923171
4TR3	ZTX237	923171
4TR4	ZTX212	923172
4TR5	ZTX212	923172
4TR6	ZTX237	923171
4TR7	2N3054	911951
4TR8	2N3054	911951



WOH 3077 Component Layout: Main Chassis Fig.1

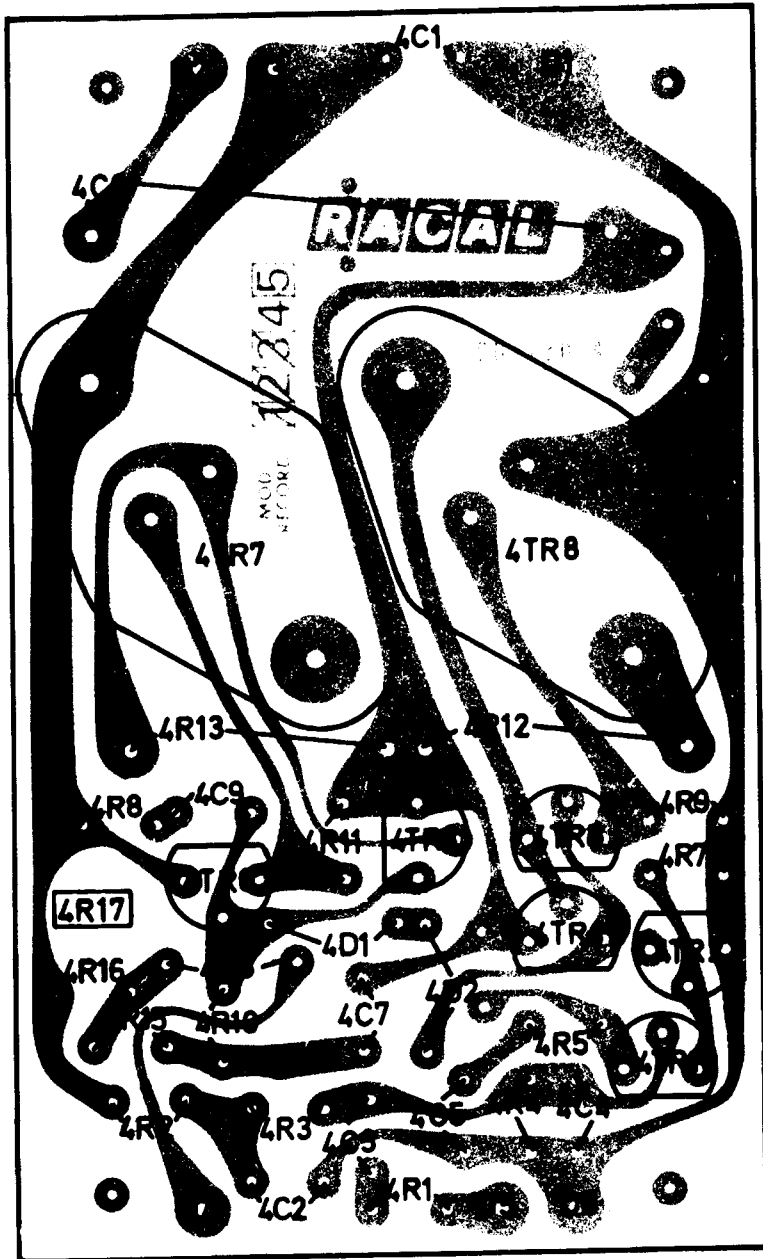


WOH3077 CD713043 SHT. 2
1 4

WOH3077 CD713043 SHT. 3
1 3 4

Component Layout : Regulator PCB

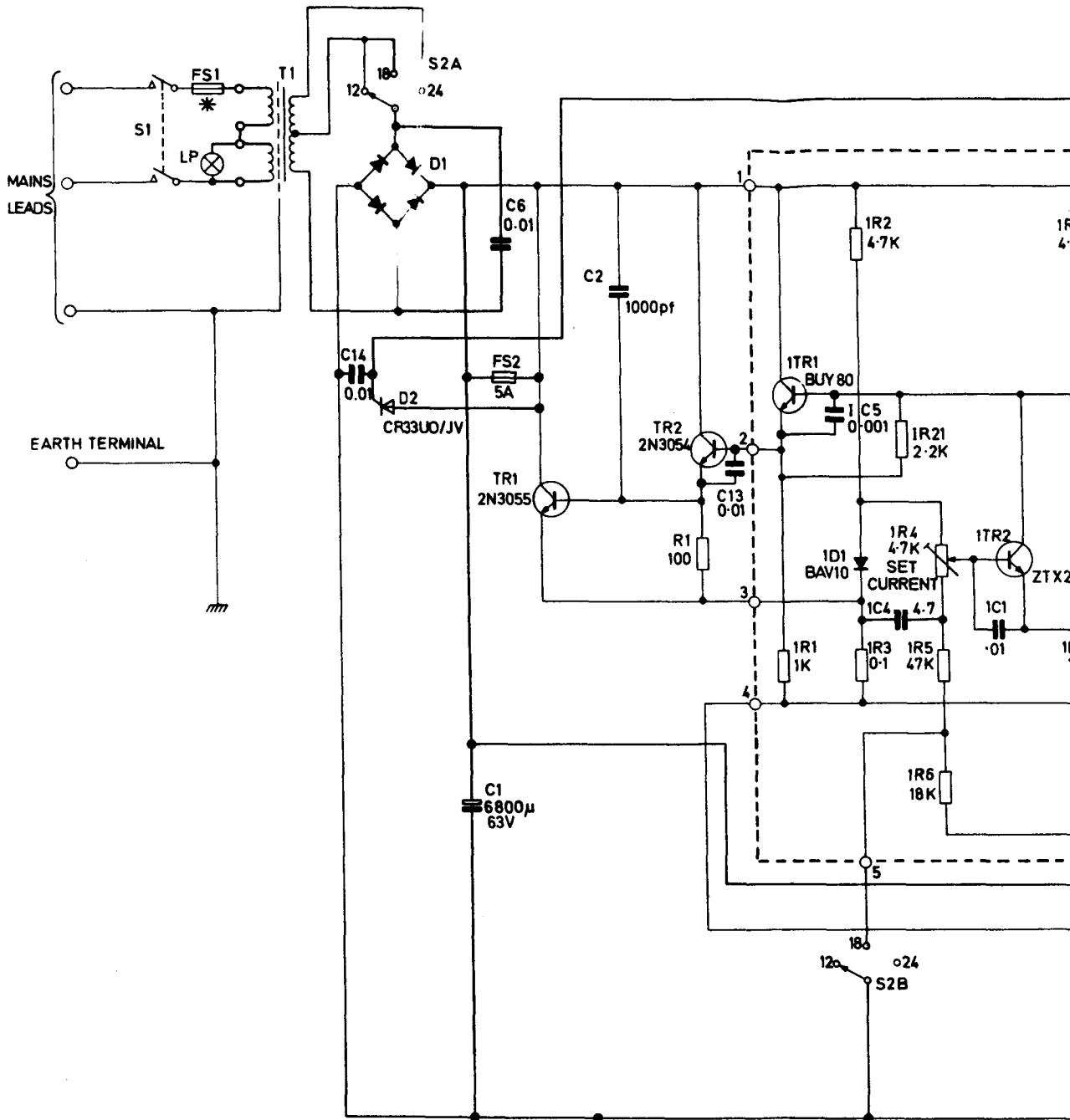
Fig.2



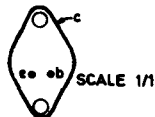
WOH3077	CD713034	SHT. 2
2	4	
WOH3077	CD713034	SHT. 3
3	4	

Component Layout:
Amplifier P.C.B

Fig. 3



2N3054
2N3055



ZTX 237
ZTX 212

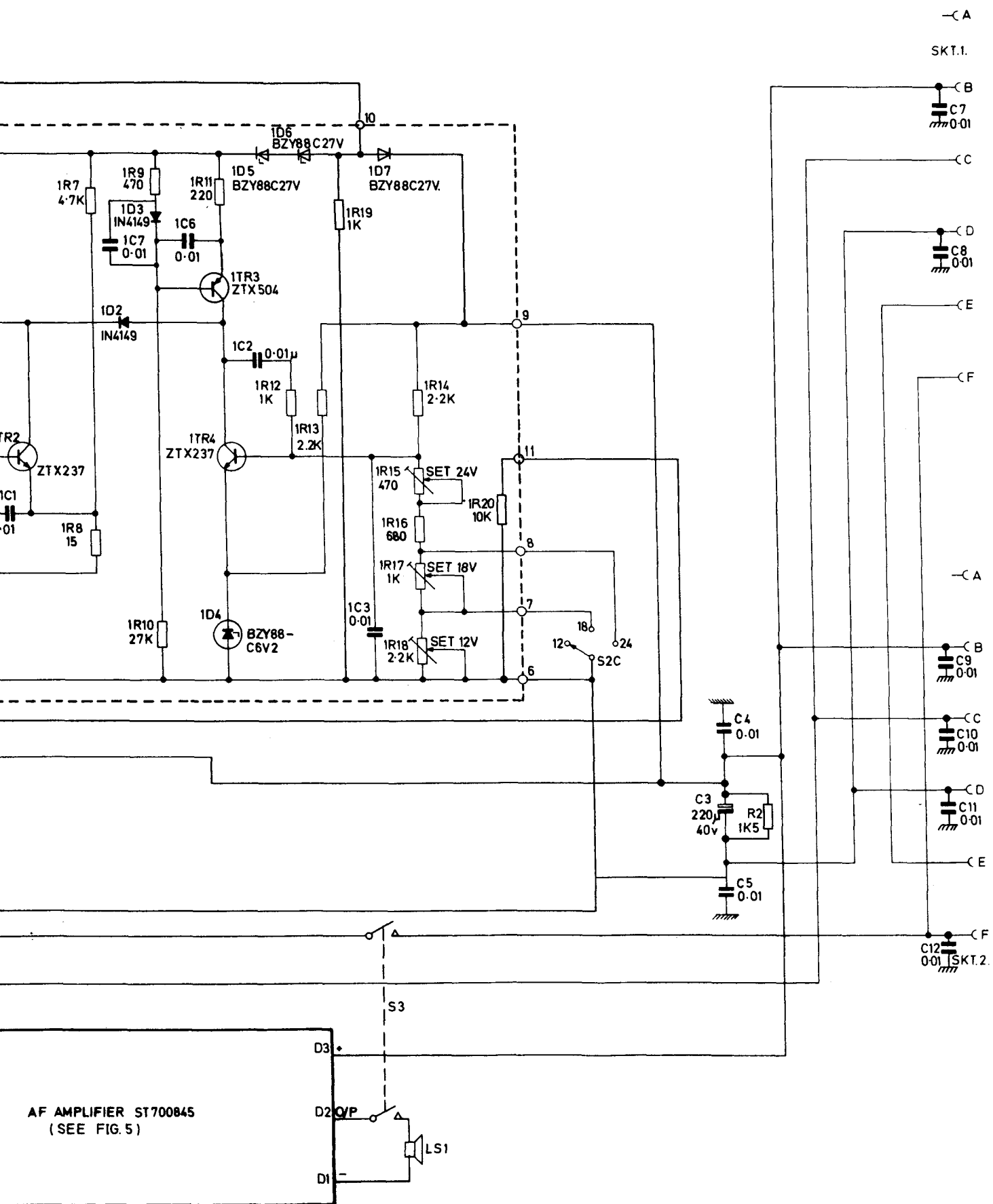


TRANSISTOR LEAD CONFIGURATION
(AS VIEWED FROM LEAD SIDE)

* FUSE RATING 3A 200/250V INPUT
* FUSE RATING 5A 100/125V INPUT

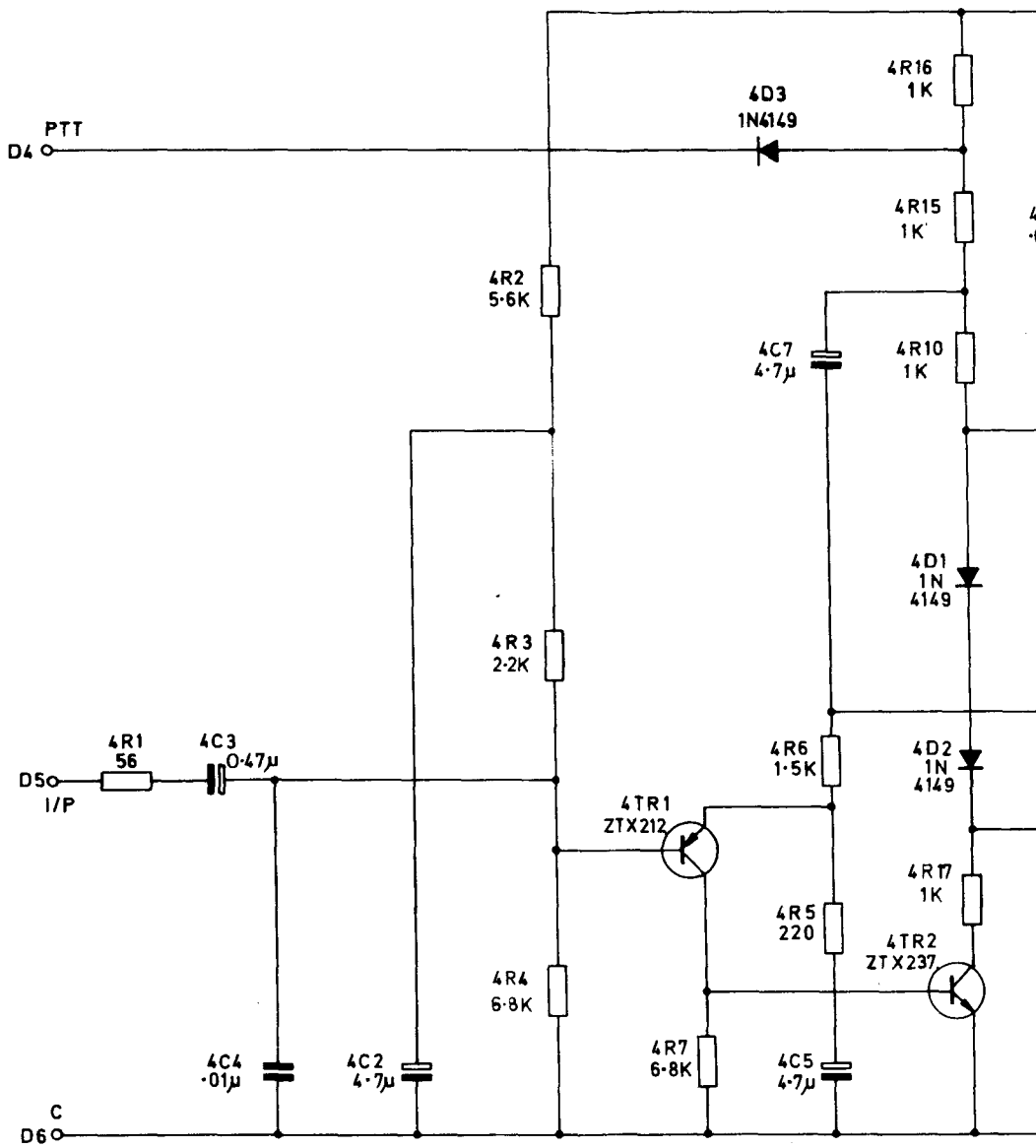
WOH3077 DC700883
B 1 2 3 4 5 6

Circuit:



Circuit: Power Unit

Fig. 4



2N3054



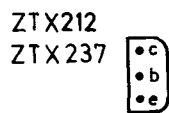
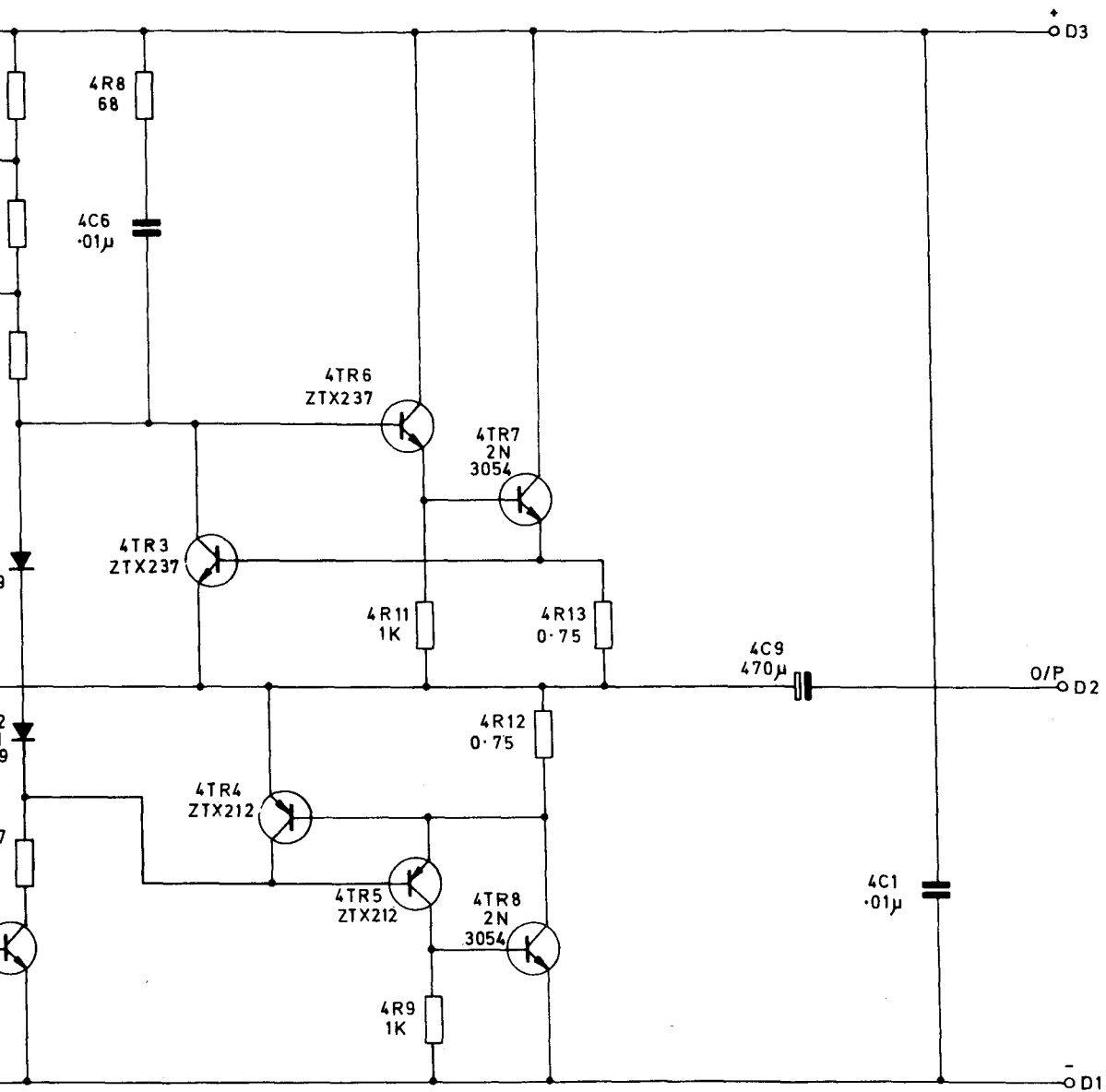
SCALE 1/1

TRANSISTOR LEAD CONNECTIONS
(AS VIEWED FROM LEFT)

ZTX212
ZTX237

WOH3077	CC700845					
3	5	6	7	8	10	11

Circuit: Au

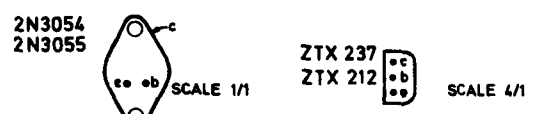
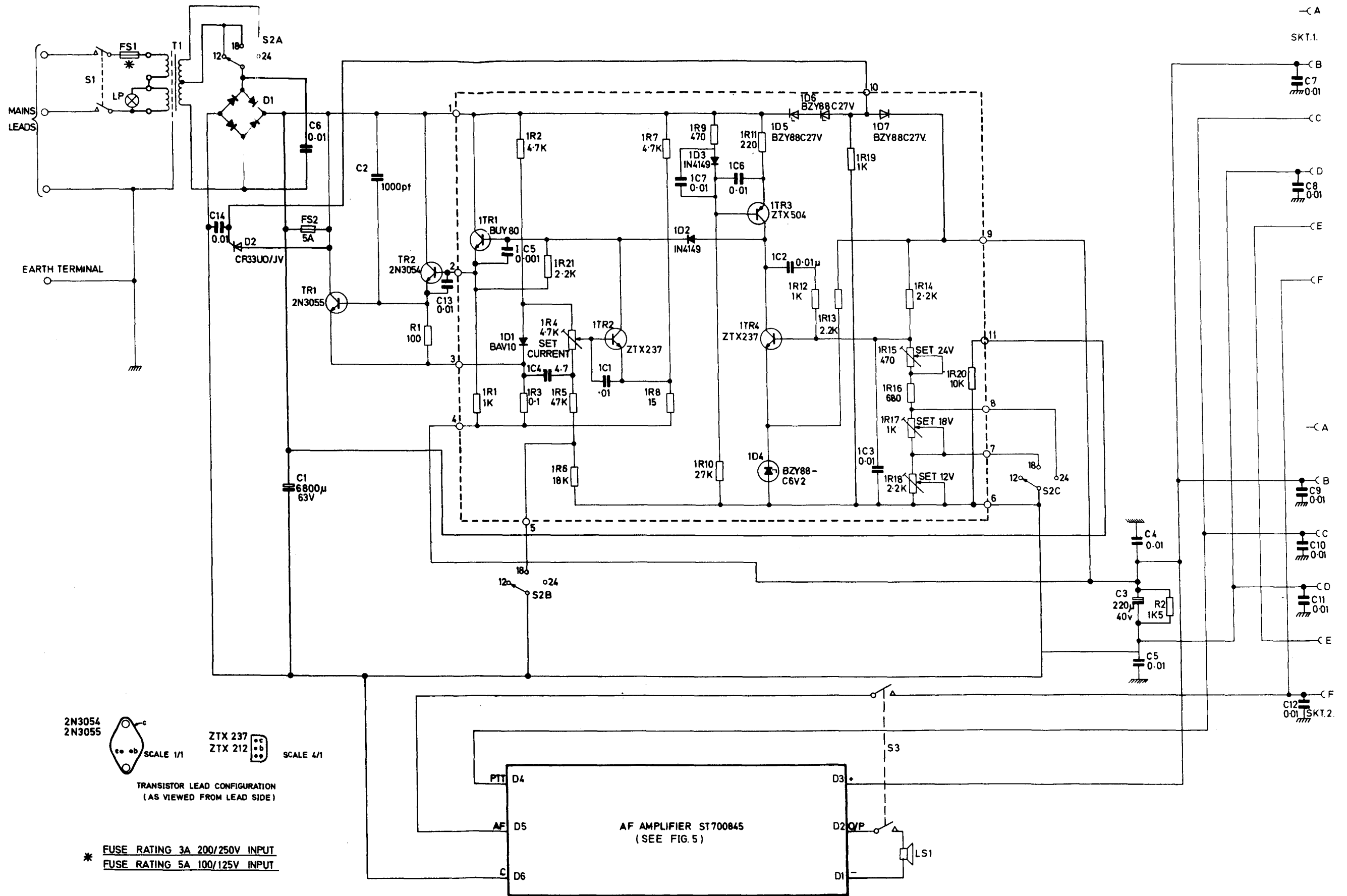


SCALE 4/1

LEAD CONFIGURATION
(FROM LEAD SIDE)

Audio Amplifier

Fig. 5



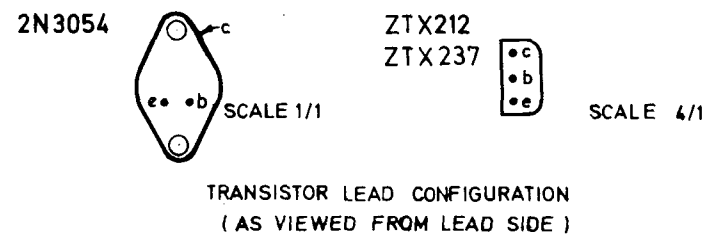
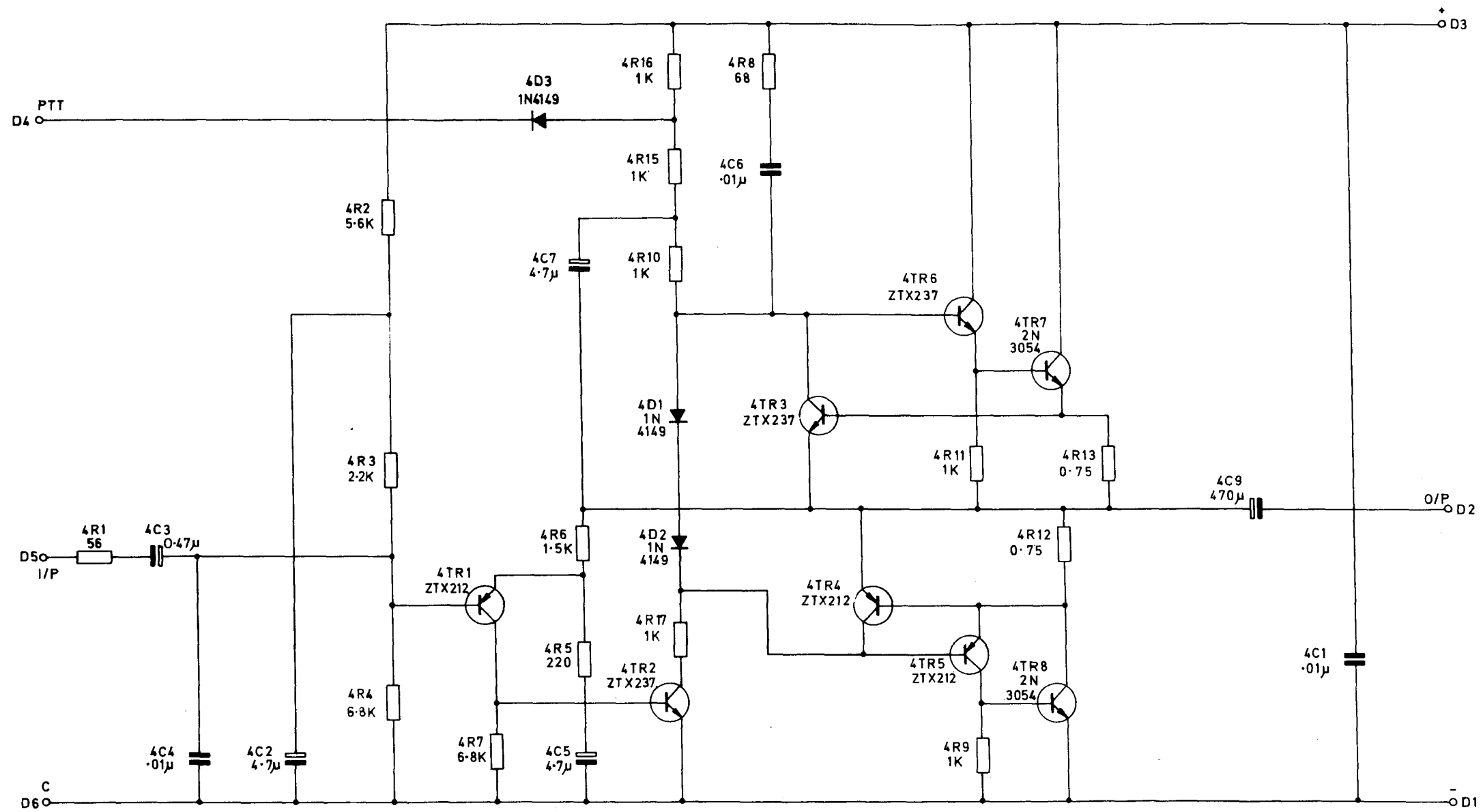
TRANSISTOR LEAD CONFIGURATION
(AS VIEWED FROM LEAD SIDE)

* FUSE RATING 3A 200/250V INPUT
* FUSE RATING 5A 100/125V INPUT

WOH3077 DC700863
B123456

Circuit: Power Unit

Fig. 4



WOH3077	CC700845
3	5 6 7 8 10 11

Circuit: Audio Amplifier

Fig. 5