

ARCAM

ALPHA AMPLIFIER SERVICE MANUAL

(ALL MODELS)

ARCAM ALPHA AMPLIFIER SERVICE MANUAL

Issue 2 16/10/91 Arcam Drawing No. H04/0001

Alpha amplifier	s/n 0001 - 5580	Alpha Plus	s/n 5581 - 18799
Alpha II	s/n 18800 - 39649	Alpha III	s/n 39650 -

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Unless otherwise stated the circuit description for the various versions of the amplifier are identical but please refer to the appropriate circuit diagrams for the model in question.

Circuit description

[Component numbers for the right hand channel are prefixed by 100; e.g. R103 is equivalent to R3 in the left hand channel. Components common to both channels (e.g. power supply) have the prefix 200.]

Disc input

Alpha and Alpha Plus

The disc input amplifier consists of a dual op-amp selected for low noise (IC201, NE5532), one op-amp for each channel. The RIAA equalization is achieved by feedback round the op-amp, with R3, C4, R4, C5 determining the mid-band frequency response, R2 the gain and C3 the low frequency roll off. The cartridge is loaded by R1 in parallel with C1 and there is an option for a cartridge loading module for additional loading if required (ULM/M). C2 provides R.F. suppression. The output is coupled via C6 to the input selector switch.

Alpha II

The Alpha II has an optional moving coil facility added and the loading module option was removed. The moving coil board, (MCA board available from Arcam), plugs in place of the 8 way plug in the disc stage. The MCA board is based on the moving coil stage of the D60 and D90.2 amplifiers and provides a 21 dB flat response amplifier. It has its own on board +8V regulated supply, provided by Z1, R202, R203, derived from the Alpha's own +15V supply. The required audio signals and supply pass to from the board via the 8 way connector. (See separate MCA circuit diagram).

Alpha III

The moving coil option is not available on the Alpha III and the low frequency roll off was changed by increasing the value of C3 from 10uF to 22uF.

Selector switch

Alpha

The selector switch is a five position switch with an output via R8 to the tape output sockets and an output via R9 to the volume control, RV201. R6 and R7 form a 6dB attenuator for the CD input.

Alpha Plus onwards

The cd input attenuator was reduced to 4dB to provide a better level match when switching between inputs.

Alpha II and III

The Alpha II was the first Alpha model to have a separate tape switch which enables monitoring of 3 head machines. This was included to prevent the feedback howl which occurred with certain tape decks on the original Alpha models. The cd attenuator was removed on the Alpha III and the input sensitivity reduced to that of the other line inputs.

Line preamp

Alpha, Alpha Plus and Alpha II

The line preamp is a dual op-amp selected for low noise (IC202, NE5532), one op-amp per channel. The gain is fixed by R11 and R12.

Alpha III

On the Alpha III the gain previously provided by the line stage ic is provided by IC1 after the tone control stage.

Tone controls

Alpha, Alpha Plus and Alpha II

The tone control stage consists of one op-amp per channel (IC1, TL071 - NE5534 from Alpha Plus onwards) with frequency sensitive feedback around it. The bass control is RV202. The range of the control is set by the end stop resistors R13, R16 and the frequency at which it operates by C9. The treble control is RV203. The range of the control is set by the end stop resistors R14, R17 and the frequency at which it operates by C10. R15 is an isolation resistor to reduce interaction between the bass and treble controls.

Alpha III

The Alpha III has a direct switch which bypasses both the tone controls and balance pot. The tone control stage has no gain with the controls set flat and has a cut and boost of approximately 5dB's at 50Hz and 10KHz. The tone controls are based around a dual op-amp IC202 with half of the op-amp used for each channel.

Mute circuit and balance control

Alpha

The balance control is RV204 and R18 which feeds via R19 to the power amp. Q1 is the mute FET which provides a turn on mute. This device is normally "on" i.e. R_{ds} is low with no gate voltage. When power is applied it becomes high resistance via a time constant which is determined by R201 and C201. D201 discharges C201 rapidly after the amplifier has been turned off. This ensures that the mute circuit still operates if the amplifier is turned off and turned on again soon after. The effectiveness of the mute is determined by the ratio of the "QN" resistance of Q1 to the resistance of R18, R19 and is typically better than 40dB.

Alpha Plus, Alpha II and III

The mute circuit was modified with the addition of 3 components, R204,205 and Q201, and the change of D201 from a diode to a 5V6 zener diode. The circuit works in a similar way to the original mute circuit but the extra components are used to monitor the $\pm 15V$ rails and as they drop below a certain value Q201 is turned on, pulling the gates of fet's Q1,101 down to ground and so muting the output. (On the Alpha III Q203 provides the same function as Q201 on the earlier units).

Preamp power supply

All models

The pre amp is powered by a regulated ± 15 volt supply. IC203 and IC204 are the 15 volt regulators and C202-205 are de-coupling capacitors.

Alpha III units with issue 8 pcb's (s/n > 41756), have dropper resistors, R207, R208, in line with the regulators to reduce the input level to a safe level for the regulators.

Power amplifier

Alpha, Alpha Plus and Alpha II

The input to the power amp is fed to the differential pair Q2 and Q3. Q4 and Q5 provide a constant current for the differential pair. The output from the collector of Q2 is fed to the class A stage, Q8, Q6 and Q7 form a constant current source for Q8. The output from this stage is fed to the driver transistors Q11, Q12 which drive the complementary power transistors Q13 and Q14. Feedback is taken from the output of the power amp via R25 and R26 (part of the feedback is around the fuse) and is fed back to the second input of the differential pair, the base of Q3. The overall gain of the amplifier is set by the ratio of R25 and R28 (in parallel) to R23, with C13 providing a low frequency roll off. C14 is the high frequency compensation capacitor, necessary to ensure stability of the power amp. The quiescent current in the power amp is set by RV1 and should be adjusted so that the

current through Q13 and Q14 is approx. 30mA (7mV across R41). The output transistors are constrained to operate within their safe operating area by the protection circuitry: R31,32,33,34,35,36,37,38; C15,16; D1,2; Q9,10. The speaker fuse (2A , fast blow) should only ever be replaced with a fuse of the same type. The inductor L1 ensures stability if a capacitive load is put on the output of the amplifier. The headphone socket is fed from R45 and the "switched" speaker outputs are controlled by the headphone socket. D3 and D4 protect against transients from inductive loads. Protection against major power amplifier faults is provided by the mains fuse.

Alpha III

The power amp signal comes from the first gain stage formed by IC1a before going to the input of the differential input. The power amplifier also has a d.c. servo, IC1b, in the feedback loop to keep the dc voltage at the speaker outputs at 0V. This works by having very little gain at audio frequencies but an extremely high d.c. gain. Q7 is a higher power rating device, BD139, on the Alpha III. New speaker terminal binding posts were fitted on the Alpha III and the inductor were replaced with air cored types.

Power supply

All models

The power supply comprises a transformer, bridge rectifier and reservoir capacitors. The transformer is a toroidal transformer, (except on original Alpha where it is a frame type), which can be wired for either 240V or 120V operation. (220V/110V option is available). The mains switch is a two pole type which meets international standards for safety. The mains fuse is a 800mA slow blow (1.25A slow blow for 120v operation) fuse and should only be replaced with a fuse of the same type.

NOTE: THE MAINS FUSE IS ALWAYS LIVE EVEN WITH THE AMPLIFIER'S MAINS SWITCH OFF!

D203-D206 form the bridge rectifier and C210,C211 are the power supply reservoir capacitors. C208, C209 are high frequency supply de-coupling capacitors. C212 suppresses switching transients. D202 is the power LED and R202 is the current through D202. From Alpha II onwards the current limit resistor for the led was changed by adding a second series resistor, R203, and the power led was changed from red to green.

Alpha III

The Alpha III has a higher voltage power supply, 38V dc, compared to the older models with 33V rails, and 10000uF smoothing capacitors per rail instead of 6800uF, to give the unit a higher power rating. The transformer is a multi voltage unit and can be wired for 240V,220V or 120V by moving 1 wire on the primary winding and uprating the fuse as necessary. An third led current limit resistor was added to reduce the dissipation in the other two, due to the increased supply voltage.

CHANGE OF MAINS VOLTAGE (ALPHA)

WARNING - The unit must be unplugged from the mains supply when changing the wiring or the mains fuses since the fuse is at mains potential even with the unit switched off.

The frame transformer of the Alpha amplifier can be converted to be used at 240/120V or 220/110V. Other voltage changes require a new transformer.

240V to 120V (220V to 110V) conversion.

1. Disconnect from the mains supply.
2. Remove top and bottom covers of amplifier
3. Fold back or remove the mains insulating cover.
4. Cut through the track (marked with an "X" on the solder resist) that links the two primary windings of the transformer. Leave a clear gap of at least 2mm between the remaining conductors.
5. Using 22swg tinned copper wire solder two links in the positions shown on the diagram below.
6. Replace the the mains insulator and bottom cover plate.
7. Replace the mains fuse with an 1.25A anti-surge fuse and replace the top cover.

120V to 240V (110V to 220V) is a reversal of the above procedure.

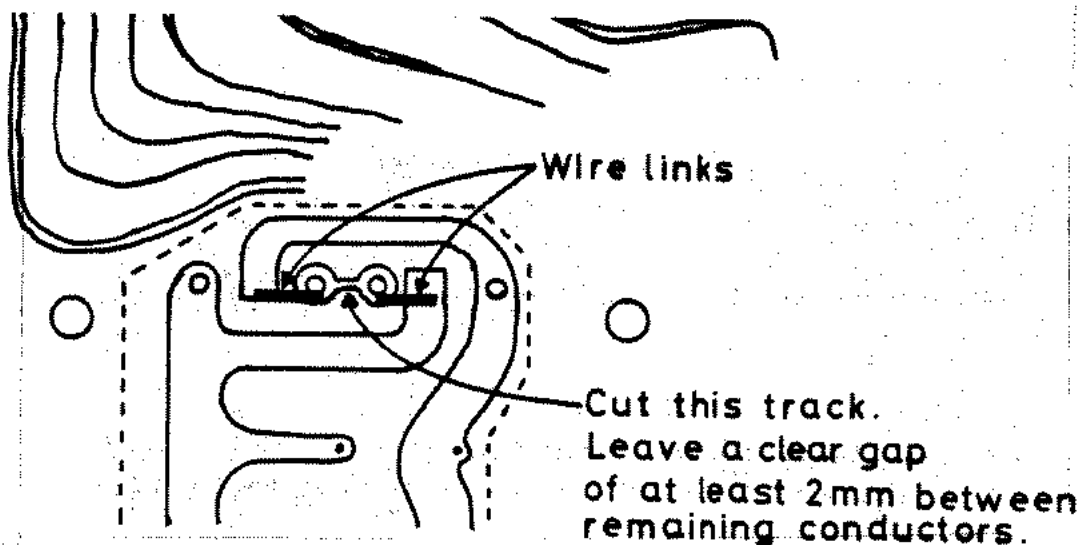


Diagram showing 240/120V conversion

CHANGE OF MAINS VOLTAGE (ALPHA PLUS, ALPHA II)

WARNING - The unit must be unplugged from the mains supply when changing the wiring or the mains fuses since the fuse is at mains potential even with the unit switched off.

To convert the Alpha Plus or Alpha II to work at a different mains voltage requires changing the position of 2 wires from the primary winding of the transformer for 240V to 120V or 220V to 110V conversion and a change of fuse rating.

To convert to other variations, i.e 240V to 220v, requires a change of transformer. The pcb legend is shown below.

240/220V WIRING (800mA ANTI-SURGE FUSE)

☒	☒	☒
ORANGE	BROWN & RED	BLACK
	☒	

120/110V WIRING (1.25A ANTI-SURGE FUSE)

☒		☒
ORANGE & BROWN		BLACK & RED
☒		☒

CHANGE OF MAINS VOLTAGE (ALPHA III)

WARNING - The unit must be unplugged from the mains supply when changing the wiring or the mains fuses since the fuse is at mains potential even with the unit switched off.

The Alpha III has a multi voltage transformer* so the same transformer can be used for 240V, 220V and 120V by moving two of the three wires, (orange, yellow or brown) and changing the fuse rating as necessary. The wire in the bottom left hand corner determines the mains voltage, i.e. orange for 240V, and the other two wires go into the holes marked "Spare Wires". The black wire does not move. The pcb legend is shown below.

240V WIRING (800mA ANTI-SURGE FUSE)

<input checked="" type="checkbox"/> BROWN SPARE WIRES <input checked="" type="checkbox"/> YELLOW	<input checked="" type="checkbox"/> BLACK
<input checked="" type="checkbox"/> ORANGE (This wire determines the voltage)	240V ORANGE 220V YELLOW 120V BROWN

220V WIRING (800mA ANTI-SURGE FUSE)

<input checked="" type="checkbox"/> BROWN SPARE WIRES <input checked="" type="checkbox"/> ORANGE	<input checked="" type="checkbox"/> BLACK
<input checked="" type="checkbox"/> YELLOW (This wire determines the voltage)	240V ORANGE 220V YELLOW 120V BROWN

120V WIRING (1.25A ANTI-SURGE FUSE)

<input checked="" type="checkbox"/> YELLOW SPARE WIRES <input checked="" type="checkbox"/> ORANGE	<input checked="" type="checkbox"/> BLACK
<input checked="" type="checkbox"/> BROWN (This wire determines the voltage)	240V ORANGE 220V YELLOW 120V BROWN

* The first 100 Alpha III's have a 240/120V transformer and do not have the extra yellow wire. To convert these to 220V requires a new transformer.

RESETTING THE QUIESCENT CURRENT

After replacement of components in the power amplifier stages of the Alpha amplifier the quiescent current setting should be checked and adjusted if necessary. The adjustment should be made with no load connected to the amplifier and no signal applied and after the unit has been switched on for about 30 minutes. The voltage should be measured across **one** of the 0.22 ohm emitter resistors and should be set to 8mV for Alpha, Alpha Plus and Alpha II but only to 4.5mV on the Alpha III.

CIRCUIT DIAGRAMS

No.	Title of Circuit
1	Alpha & Alpha Plus Power Amp & Power Supplies
2	Alpha & Alpha Plus Disc, Line & Tone Control Stages
3	Alpha II Power Amp & Power Supplies
4	Alpha II Disc, Line & Tone Control Stages
5	Alpha II Moving Coil Preamp Option Board (MCA)
6	Alpha III Power Supplies
7	Alpha III Disc & Tone Control Stages
8	Alpha III Power Amp

BOARD MODIFICATIONS

ALPHA 3

Issue 6 PCB - THIS IS THE FIRST ISSUE BOARD FOR ALPHA 3 - Q6 MUST be fitted wrong way round to screening on pcb due to collector/emitter legs being swapped when laid out.

Issue 7 PCB - Headphone jumper link re-routed. Q6 still incorrect screening.

Issue 8 PCB - R207,208 and 206 added to provide higher overvoltage safety margin. C213, 214 changed from 2n2 to 4n7.

Nov 91 - Issue 8 boards only - R19,119 changed from 820R to 56R, R50,150 changed from 820R to 1K8, R20,120 changed from 1K8 to 2K2, R49,149 changed from 100K to 47K, 5V6 zener diode and 10uF capacitor added in series with R24,124 and power led now connected to + 38V rail to reduce switch off thump. (See separate modification sheet).

Issue 9 PCB - Incorporating all the modifications of Nov 91.

ALPHA III SWITCH-OFF THUMP CURE 03/12/91

Issue 8 boards only (serial numbers 41757 - 43694 approx.)

1. Change R20,120 from 1K8 to 2K2
2. Change R49,149 from 100K to 47K (metal film)
3. Change R50,150 from 820R to 1K8 (metal film)
4. Change R19,119 from 820R to 56R
5. Connect the power led to the positive rail as described below.

Reverse the black and red wires to the power led.

Unsolder the leg of R206 nearest to link LK20. Solder this leg to the nearest leg of R127.

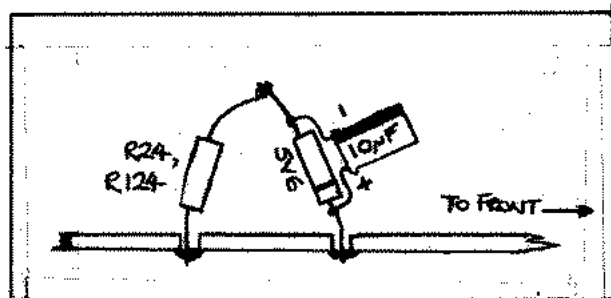
6. Desolder the end of resistors R24,124 nearest to the front panel and pull these ends of the resistors up out of the pcb.

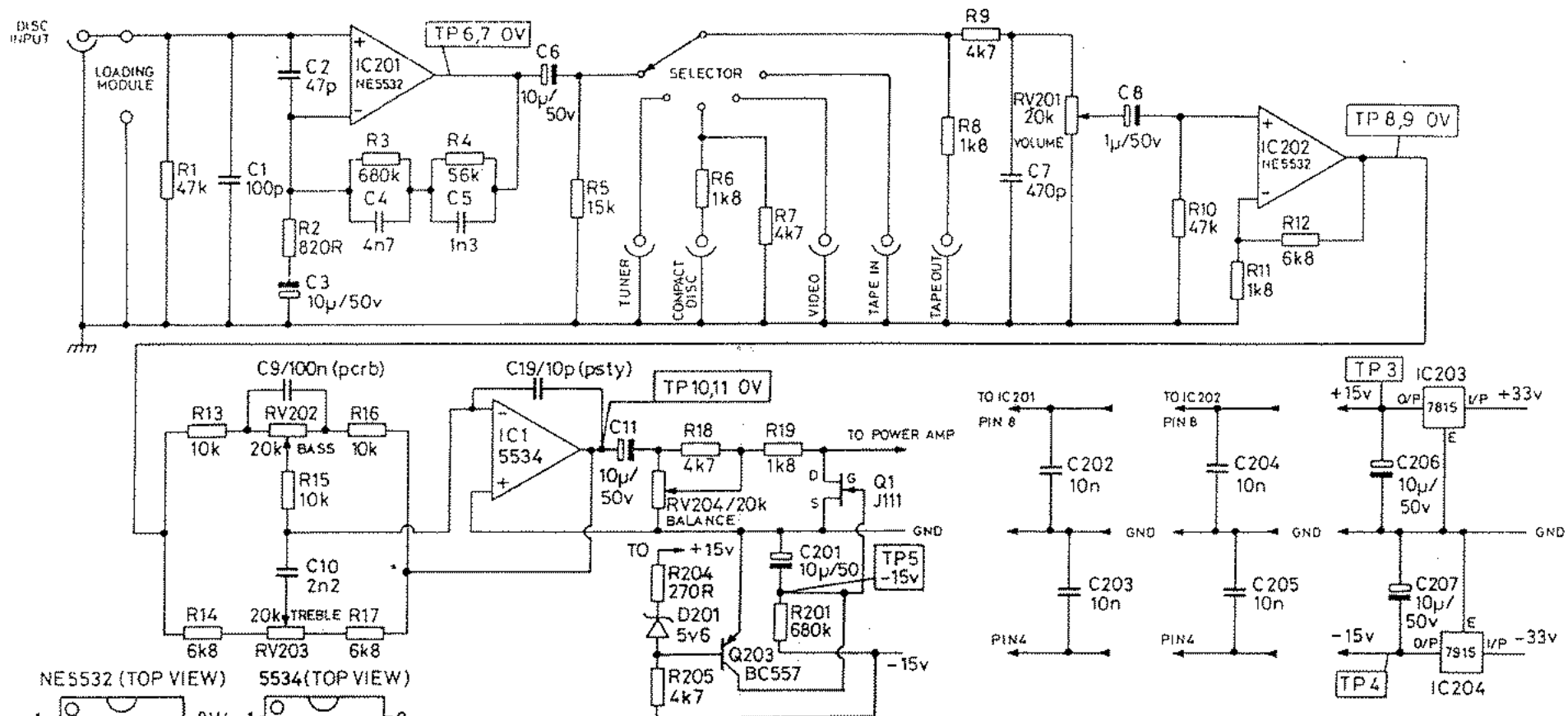
Solder a 5V6 zener diode in series with the resistor and a 10uF capacitor in parallel with the zener diode as shown below.

N.B. It may be easier to solder the zener/capacitor assembly together before fitting into the board.

These modifications should virtually eliminate all switch off noise on the Alpha III.

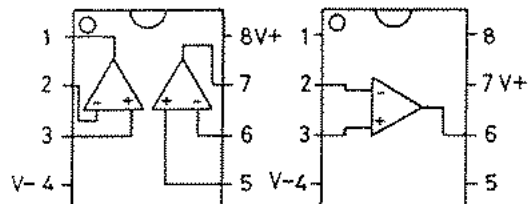
This modification can be retrofitted to any issue of board less than issue 8 except there is no R206 on earlier issues. When modifying early boards read R202 for R206.



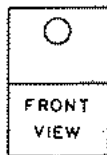


NE5532 (TOP VIEW)

5534 (TOP VIEW)



7815



I/P E O/P

7915



E I/P O/P

J111



G S D

		TITLE	
		ARCAM ALPHA	
DRAWN WITH REFERENCE TO BS 306		DISC AND LINE INPUTS, TONE CONTROLS, MUTE & PREAMP POWER SUPPLIES	
PROJECTION THIRD ANGLE		DRG TYPE	
ALL DIMENSIONS MILLIMETRES UNLESS OTHERWISE STATED		PART NO.	
TOLERANCES UNLESS OTHERWISE STATED		ORIGINAL SCALE	
MATERIAL		ISSUE	DATE
FINISH		INITIALS	CHANGE
		DRAWN BY	CHECKED BY
		DATE	DATE
		APPROVED BY	
		DATE	
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		SHEET	OF
		DRAWING NUMBER	
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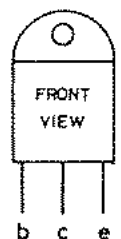
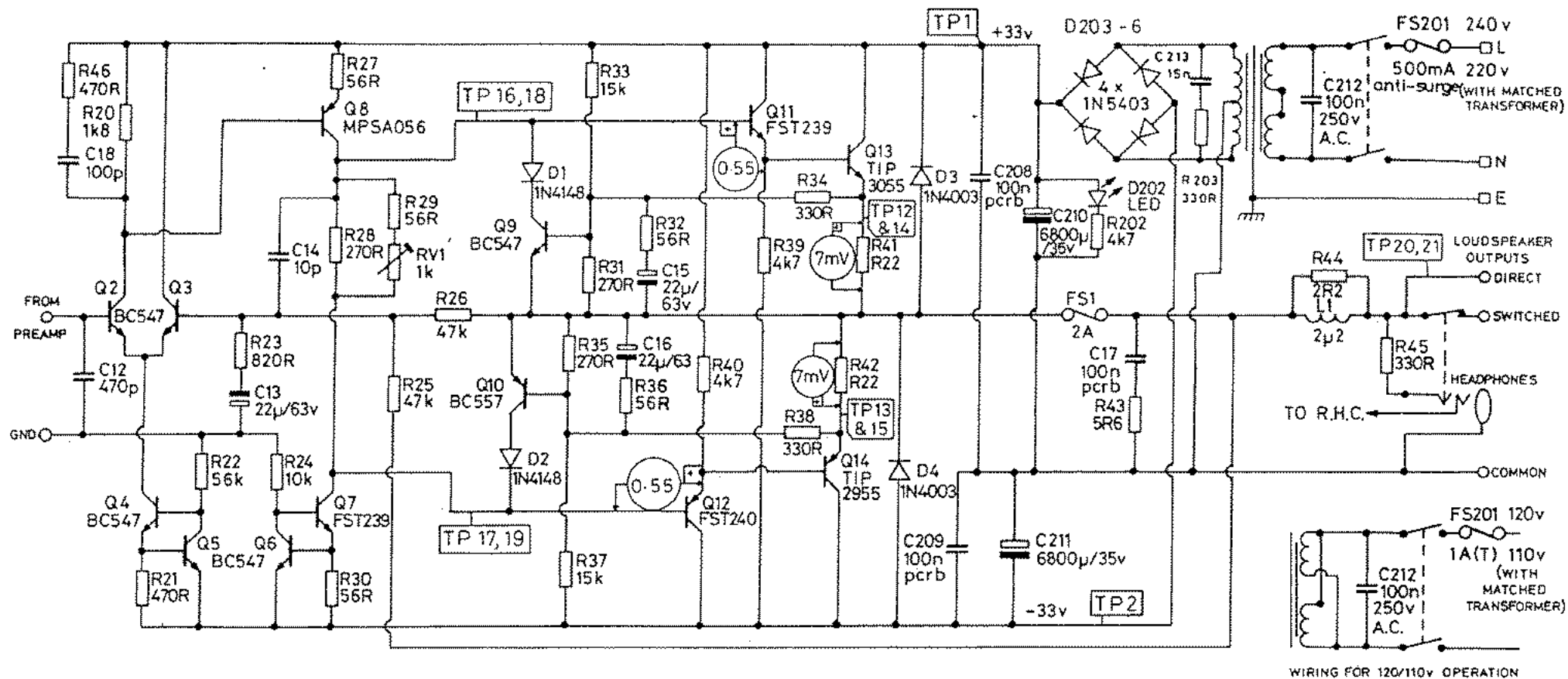
Serial numbers 5581 →

R6 - 1k8
C9 - 100n polycarbonate
C19 - 10p polystyrene added
IC1 - NE5534

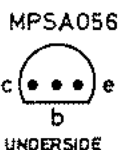
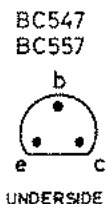
ALPHA +
UPGRADE

Revised Mute Circuit (additional)

R204 - 270R
R205 - 4k7
D201 - 5v6 Zener
Q203 - BC557



TIP3055
TIP2955



		TITLE	
		ARCAM ALPHA POWER AMPLIFIER CIRCUIT AND POWER SUPPLIES	
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PROJECTION THIRD ANGLE		PART NO.	
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TOLERANCES UNLESS OTHERWISE STATED			
MATERIAL			
FINISH			

SERIAL NUMBERS 5581 →
C208, 209, 17 - 100n polycarbonate
FS201 - 500mA anti-surge - ALPHA+upgrade
R46 - 470R } additional
C18 - 100p

C213 & R203 added. Serial no. 490 onwards.

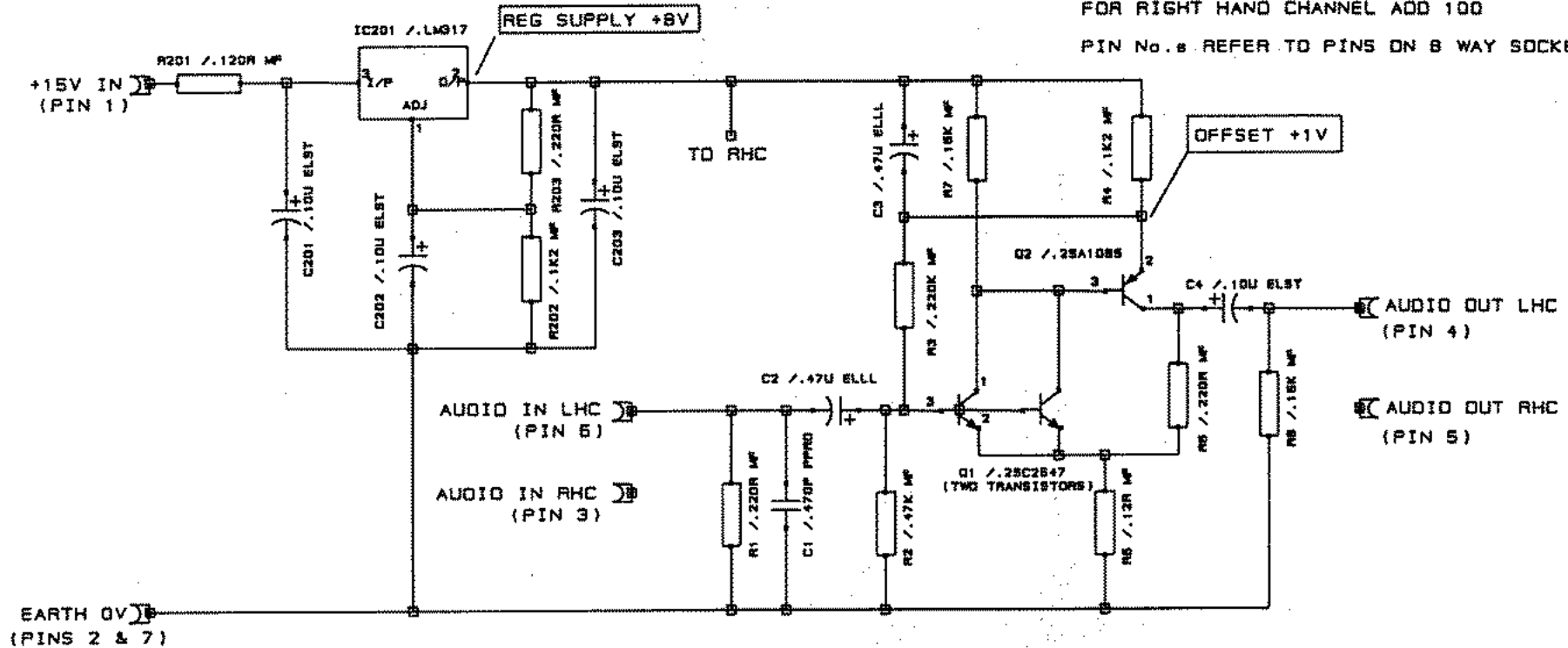
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MCA MOVING COIL BOARD

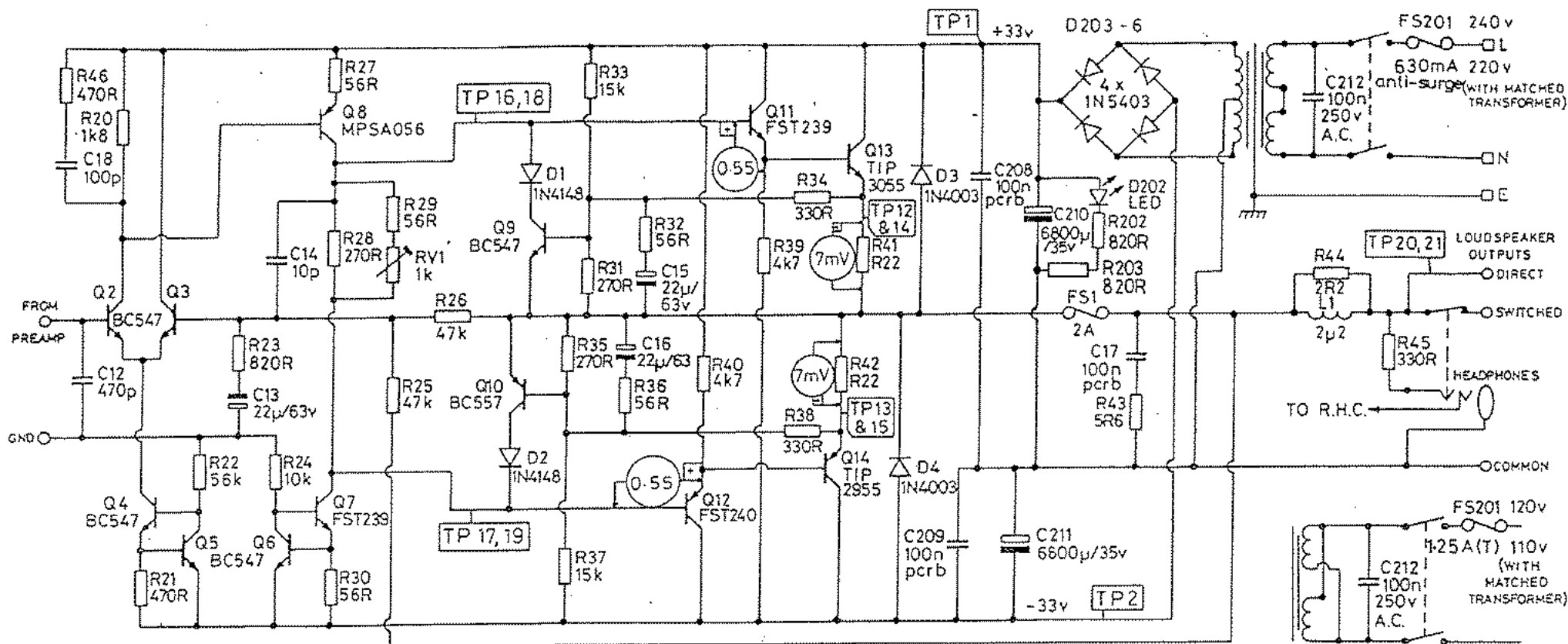
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FOR RIGHT HAND CHANNEL ADD 100

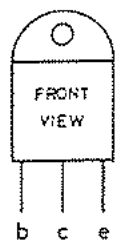
PIN No.s REFER TO PINS ON 8 WAY SOCKET



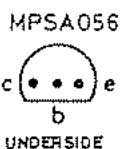
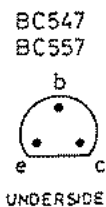
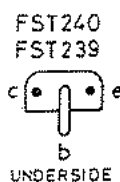
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SHT. 1	OF. 1	ORG NO. C02/0058		
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ARCAM. A & R CAMBRIDGE LTO, CB5 9PB				



WIRING FOR 120/110V OPERATION

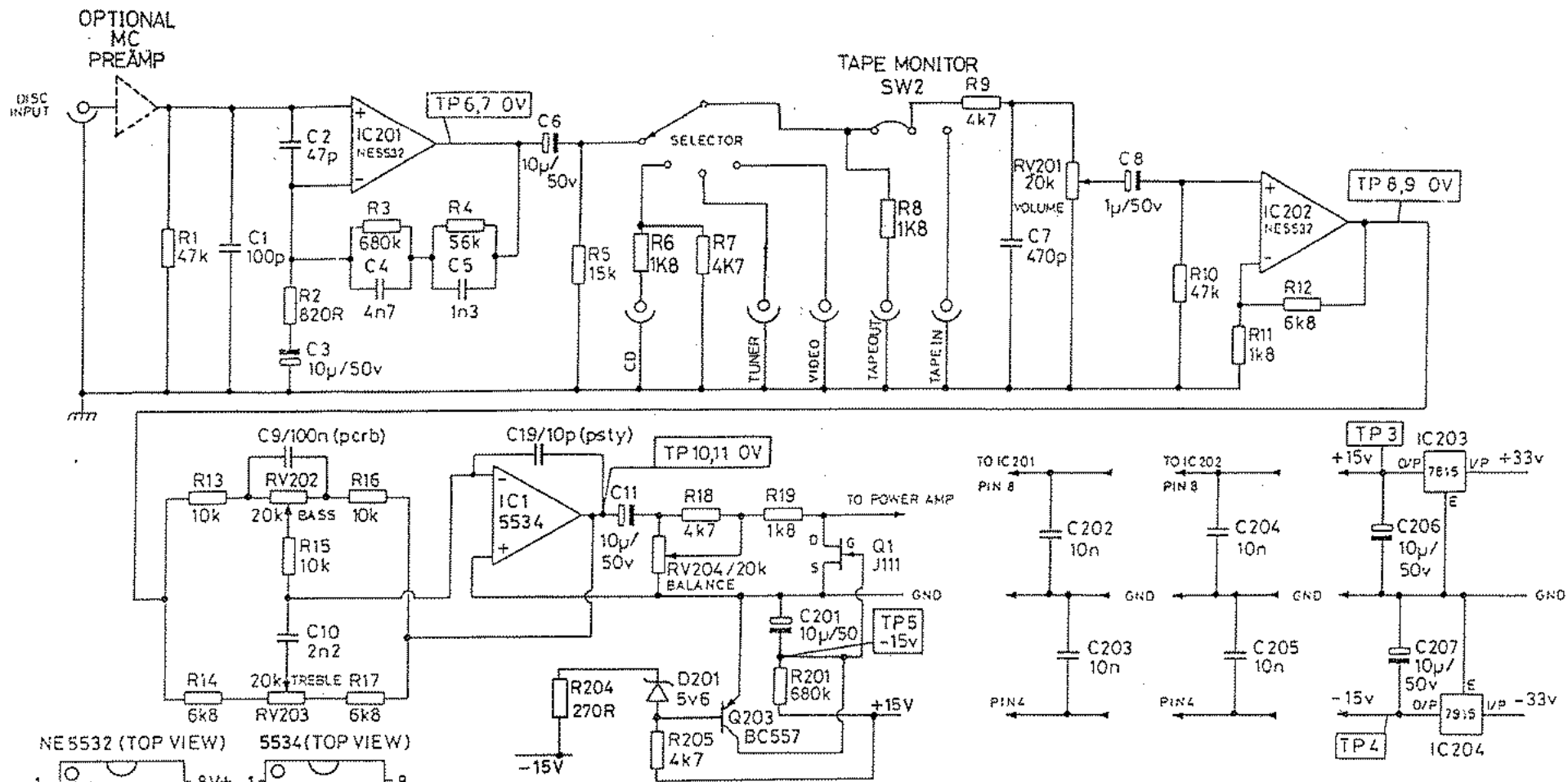


TIP3055
TIP2955



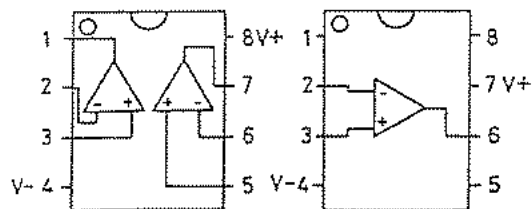
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PROJECTION THIRD ANGLE		PART NO. ORIGINAL SCALE	
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MATERIAL		FINISH	

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ISSUE	DATE	INITIALS	CHANGE	ECN NO
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DATE 11-10-84		DATE		DATE
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SHEET 1 OF 2		DRAWING NUMBER C02/0018		
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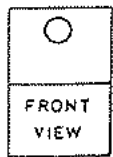


NE 5532 (TOP VIEW)

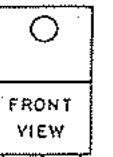
5534 (TOP VIEW)



7815



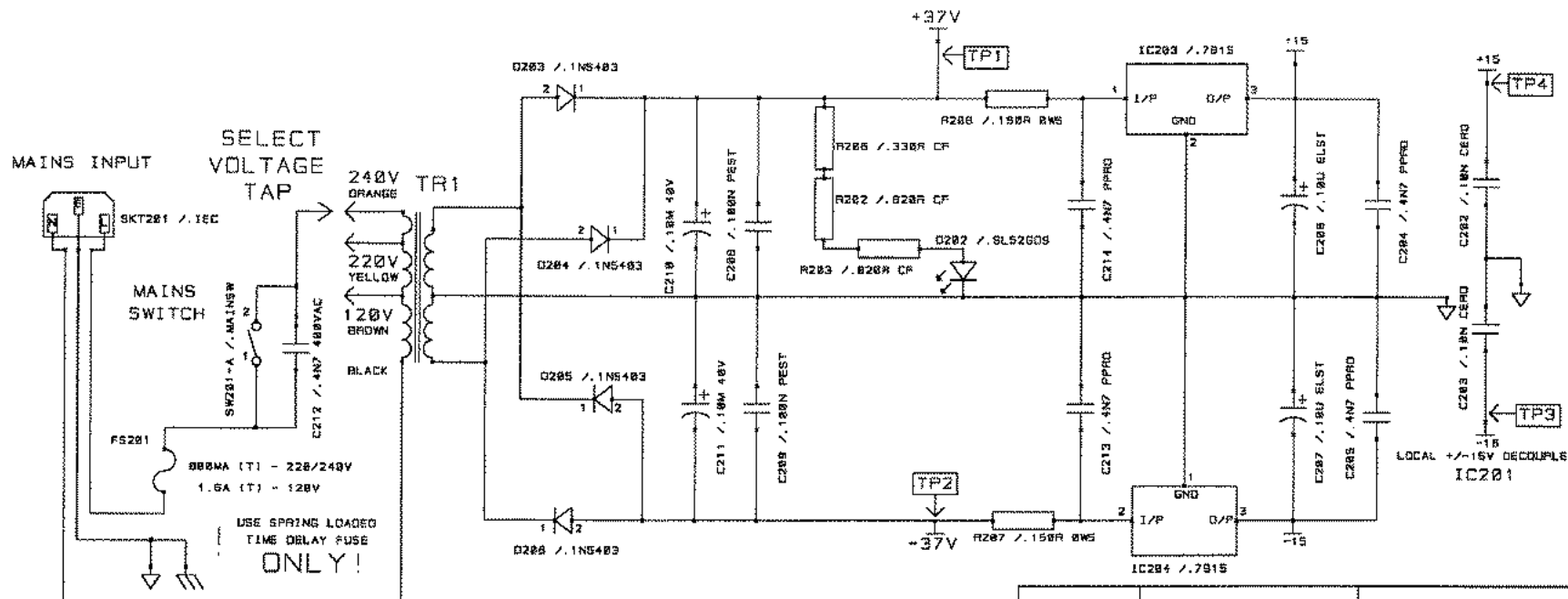
7915



UNDERSIDE

<h1>ARCAM</h1> <p>A&R Cambridge Limited</p>		TITLE	
		ALPHA II AMPLIFIER	
DRAWN WITH REFERENCE TO BS 308		DISC & LINE INPUTS, TONE CONTROLS, MUTE & PRE-AMP P.S.U.'s	
PROJECTION THIRD ANGLE		DRG. TYPE	CCT DIA'
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED		PART NO.	
TOLERANCES UNLESS OTHERWISE STATED		ORIGINAL SCALE	
MATERIAL		FINISH	

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DATE 11-10-84		DATE	DATE
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LED WAS POWERED FROM -VE SUPPLY

DRAWN BY	S. BLANDFORD	ISS	DATE	ECN NO.
DATE DRAWN	3-SEPT-1991	TITLE ALPHA AMP 3 POWER SUPPLY		
SHT. 1	OF 3	DRG NO. H04/0001		
ARCAM. A & R CAMBRIDGE LTD, CB5 9PB				

