DESIGNS DEPARTMENT HANDBOOK

No. 3.235(79)

AM9/21 Intercom Microphone Amplifier

C O N T E N T S

D R A W I N G S

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AM9/21 Intercom Microphone Amplifier

1. INTRODUCTION

The AM9/21 is intended for use as a microphone amplifier in intercom and talkback systems. The amplifier has balanced input and balanced output and provides -10dB nominal volume output. The gain may be preset in the range +40dB to +70dB by means of a dual switch on the p.c.b. The amplifier also features a limiter operating at approximately +11dB output level to prevent serious distortion due to output clipping.

2. SPECIFICATION

2.1 Performance Data

Input impedance	: Greater than 1.8kΩ balanced.
Gain	: +40dB to +70dB preset by a dual switch, in 10dB steps, with ±5dB fine gain control.
Frequency Response	: 100Hz to 10kHz +0dB, -3dB w.r.t. 1kHz.
Total Harmonic Distortion	: Less than 0.3% at 100Hz (0dB into 1kΩ load).
Noise Factor	: Better than 8dB with 300Ω input termination.
Normal operating output level	: -10dB to 0dB.
Maximum output level (clipping)	: +12.5dB (24V supply, 1kΩ load). Clipping is prevented in normal use by the action of the limiter.
Limiter Range	: Better than 18dB operating at +11dB ±1dB output level.

2.2 Mechanical Data

P.C.B. Dimensions:		127 mm x 75 mm
Fixing Bracket	:	30 mm high with 3 x M4 anchor nuts

2.3 Installation Data

Power Requirements:		-50V or ±24V at 35mA approximately or ±12V or +24V or -24V at 20mA approximately.
		The connections are shown in D48053 A3.
Connector	:	11-way ISEP plug. (PLA).
Input	:	PLA2, 3.
Output	:	PLA9, 10.

3. OPERATION

The gain of the AM9/21 microphone amplifier may be preset in the range +40dB to +70dB. This adjustment is provided in increments of +10dB and +20dB by a dual switch on the p.c.b. A fine adjustment is also provided by means of a preset potentiometer which gives a variation of ±5dB on the nominal gain. To give the nominal gain, ±2dB the preset should be turned to its mid-position The overall gain is the sum of 40dB plus the switch settings, ± the setting of the fine gain control.

4. MAINTENANCE

4.1 Circuit Description

The AM9/21 microphone amplifier input stage uses a transformer (T1), with approximately 11dB voltage gain, to give a balanced input and an operational amplifier (IC2) working as a non-inverting amplifier with a gain of 33.3dB.

C7 gives high frequency roll off and R5, R7, C4 and C5 decouple IC2 from the supply rails. C8 gives low frequency roll-off and a.c. couples the signal to IC3 operating as an inverting amplifier.

The gain of IC3 may be varied by ±10dB by switching R15 in or out of the feedback loops using SA and by ±20dB by switching R16 using SB. R11 gives ±5dB variation on the nominal gain. The step-down transformer (T2) on the output of IC3 gives 6dB loss to produce the required overall gains and provides a balanced output.

The circuit is designed to operate at -10dB output level, but will also work at zero level with +10dB headroom before

the limiter acts. Serious distortion due to clipping is reduced by the limiter circuit which operates when the output level is in the range +10dB to +12dB. The output of IC3 is fed via R18 and C9 to a d.c. restoring circuit consisting of D3, D5 and C10 to produce a negative d.c. control voltage.

A threshold of approximately -13V is achieved by D4 and Vgs (off) of TR1 and when it is exceeded the control voltage increases the resistance of the F.E.T. and reduces the gain of IC2. Normally the gate-to-source voltage of the F.E.T. is 0V and it is turned on with a maximum resistance of 60Ω.

When the F.E.T. is turned completely off R12 is switched in series with R9 reducing the gain of IC2 to 13.6dB i.e., the limiter has a 20dB maximum gain control range. R8 provides a discharge time constant for C10 to give a time delay and C6 decouples zener noise to ground to prevent a noisy output signal.

Split-mode or single-sided supplies can be used to power the AM9/21 as an internal '0V' is generated by IC1 to facilitate biassing of IC2 and IC3. C1 and IC1 couple the 'clean' reference 0V from the supply to the generated '0V' and R4 maintains the stability of IC1. D1 and R1 act as a zener regulator for operating the amplifier from supplies in the range 45V to 55V.

4.2 Fault Location

N.B. In no instance should the '0V' line be earthed, connected to chassis or 0V reference. Faults can be located by a simple fault finding procedure:-

4.2.1 DC Checks

1. Connect supply available as in D 48053 A3 with no input or output load.

a) If supply is +24V, -24V or ±12V, check the voltage on PLA1 w.r.t. PLA6 and 7 is +24V and current drawn from supply is <25mA, typically 18mA.

or b) If supply is ±24V or -50V, check the voltage on PLA1 w.r.t. PLA6 and 7 is in the range +25V to +30Vand current drawn from supply is <45mA, typically 35mA.

Check PLA5 is linked to incoming 0V reference as in D 48053 A3

Check voltage across C2 = voltage across C3 within 0.5V.

Check voltages on pins 7 and 4 of IC3 are the same

as on PLA1 and PLA 6 and 7 w.r.t. '0V' line.

Check voltage drops across R7 and R5 are in the range 2V to 5V.

4.2.2 A.C. Gain Checks

N.B. Measure all a.c. levels with a high input impedance voltmeter. Output unloaded. Set gain of amplifier to 70dB by moving SA (brown switch) to +10dB and SB (red switch) to +20dB as indicated on p.c.b. Set R11 to mid-position.

Apply -70dB input level @ 1kHz and check output is 0dB ±2dB. Changeover SA, check output = -10dB ±2dB. Change over SB check output = -30dB ±2dB.

The output of T1 should be -59.1dB ±1dB.

The output of IC2 (pin 6) should be -25.8dB ±1dB.

The output level of T2 should be 6dB ±.5dB less than its input level.

If the output of IC2 is too low, short TR1 from drain to source to check it is not open circuited, or has a high resistance. The voltage on the gate of TR1 should be in the range 0V to -1V w.r.t. '0V' line.

4.2.3 Limiter Check

Reset the gain to 70dB by moving SA (brown switch) to +10dB and SB (red switch) to +20dB, as indicated on p.c.b. Set R11 to its mid-position.

Apply -42dB @ 1kHz input level and check output is in the range +10dB to +12dB.

Check voltage on the gate of the F.E.T. is in the range -3.5V to -7V w.r.t. '0V'.

Check voltage across C10 is in the range 12V to 16V.

Check level at output of IC2 (pin 6) is in the range -20dB to -10dB.

For operation of limiter see Section 4.1.

4.2.4 Noise Check

Short the input (PLA2, 3) and peak the noise to 5 on an unweighted T.P.M. with the gain set to 70dB. (see 4.2.2) The output noise should be less than -55dB. If this is not the case check output for hum, using a CRO, which should be less than 8mV peak-to-peak. (Note, if the bracket is not connected to the chassis for this test then PLA4 must be used to make this connection (see

D 48053 A3)).

5. INSTALLATION

5.1 Power Supplies

The AM9/21 is designed to operate from the following supply voltages:-

+24V, -24V, ±12V, ±24V, -50V.

No internal modifications are required for any of the above supplies, the changes are made externally.

The connections to AM9/21 are shown in D 48053 A3 and note that PLA5, the reference input, must always be connected to the clean incoming 0V line from the power supply.

The above supply voltages are recommended, however, the amplifier may be powered from lower voltages in the range 12V to 24V, with the 0V reference connected to PLA5. However, clipping will occur at a lower output level and will not be prevented by the limiter which operates at +11dB approximately. Note, the maximum voltage applied between PLA1 and PLA6 and 7 must not exceed 24.5V, or D1 may turn on, taking excessive current.

As the circuit incorporates a supply rail splitter, the input voltage need not be split symmetrically, therefore +15V, 0V, - 9V is acceptable.

The higher supply voltages, (±24V and -50V) are applied between PLA11 and PLA1 and the range over which these will work is 40V to 55V. 0V is connected to PLA5 as before and the supply voltage need not be split symmetrically for correct operation.

5.2 Output Loads

The minimum recommended load impedance is 1kΩ which gives a reduction in gain of approximately 0.5dB. However, the output level is sufficient, when the gain is set to 70dB, to drive headphones (600Ω and 8Ω) directly and give a reasonable output level. The circuit is designed however, to feed the complementary power amp (AM5/20 D.D. Handbook No. 3.193(77)) rather than drive a load directly.

The balanced output from T2 (AL/99APC) will also drive a line up to 100 m long without adversely affecting the frequency response of the amplifier.

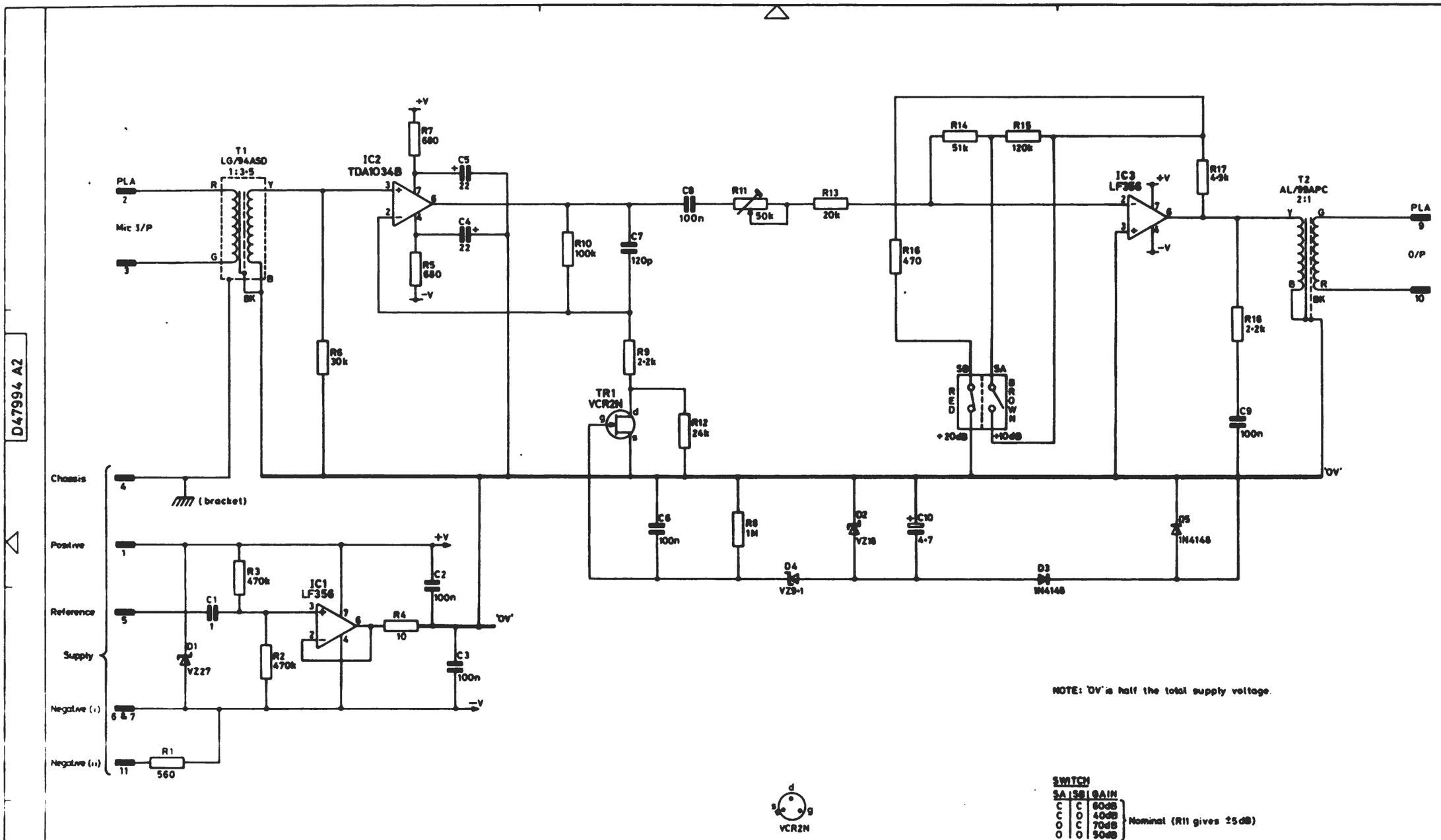
5.3 Connections

The circuit has balanced input on PLA2 and PLA3 and balanced output on PLA9 and PLA10. The power supply connections are

described in 5.1. Connection is made via an 11-way ISEP plug and socket. The input is designed to be fed from a 300Ω microphone.

5.4 Mounting

The unit can be mounted either by connecting the bracket, containing 3 x M4 anchor nuts, to a chassis or by using the 4 x M2.5 mounting holes in the p.c.b. In the latter case the bracket must be connected to chassis, to shield the input transformer, by connecting a line from chassis to PLA4.



NOTE: '0V' is half the total supply voltage.

SWITCH

SA	SB	GAIN	
C	C	60dB	Nominal (R11 gives ±5dB)
C	O	40dB	
O	C	70dB	
O	O	50dB	

NOTE: The signal on PLA 9 is in phase with the signal on PLA 2.

SCALE - 0

THIRD ANGLE PROJECTION

ORIGINAL FRAME SIZE 400mm x 574mm

CHANGE 28/12/79

AM9/21

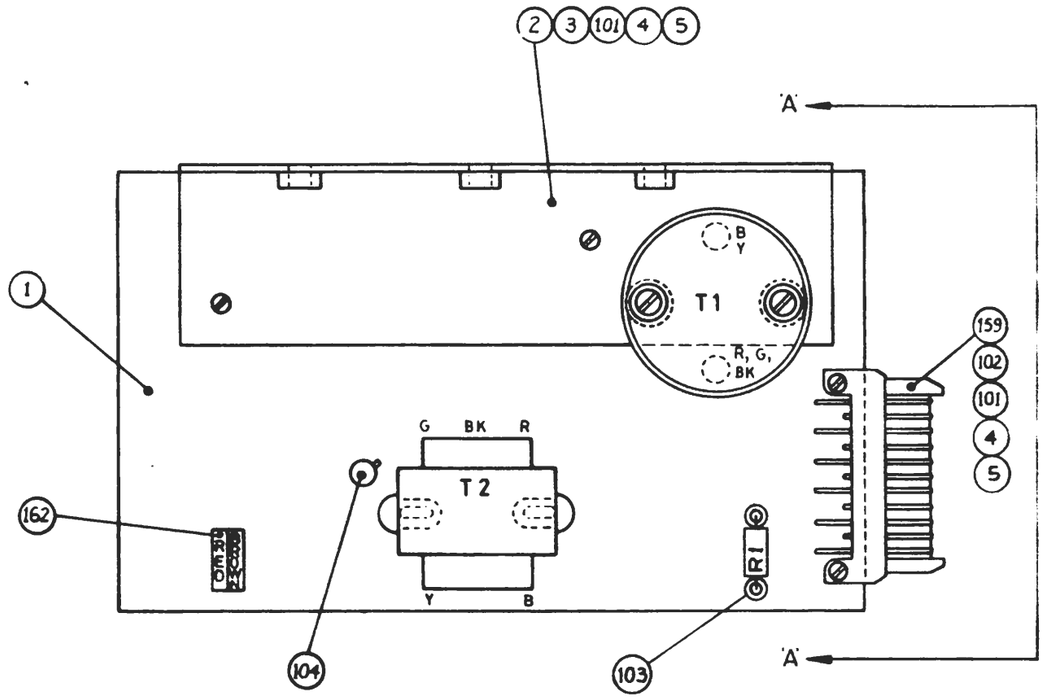
INTERCOM MICROPHONE AMPLIFIER CIRCUIT

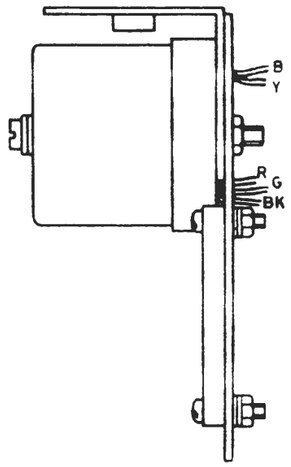
All dimensions in millimetres unless otherwise stated
Normal tolerances
no decimal place — ± 1 mm unless
one decimal place — ± 0·3 mm otherwise
two decimal places — ± 0·1 mm stated

DRN.		DESIGNS DEPARTMENT
TCD	P.D.G.	D47994 A2
CKD		
APPD	P. C.	

D47996A3

FIGURE 1. Assembly



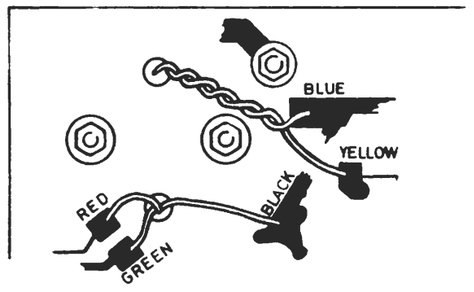


VIEW ON 'A-A

The clamp on transformer T2 should pass through the 2 x 6mm Ø holes, be bent inwards as shown and soldered.

If T2 is supplied with 6 fixing pins, the pin between YELLOW and BLUE should be cut off before assembly.

FIGURE 2. Rear detail around Item (2)



SCALE 0

THIRD ANGLE PROJECTION

ORIGINAL FRAME SIZE
277mm x 400mm

ISS 1 CHANGE 28/12/79

AM9/21

ASSEMBLY AND WIRING DIAGRAM

All dimensions in millimetres unless otherwise stated. Normal tolerances:
no decimal place — ± 1 mm unless
one decimal place — ± 0·3 mm otherwise
two decimal places — ± 0·1 mm stated

DRN		DESIGNS DEPARTMENT
TCD.	PDG	D47996 A3
CKD.		
APPD		

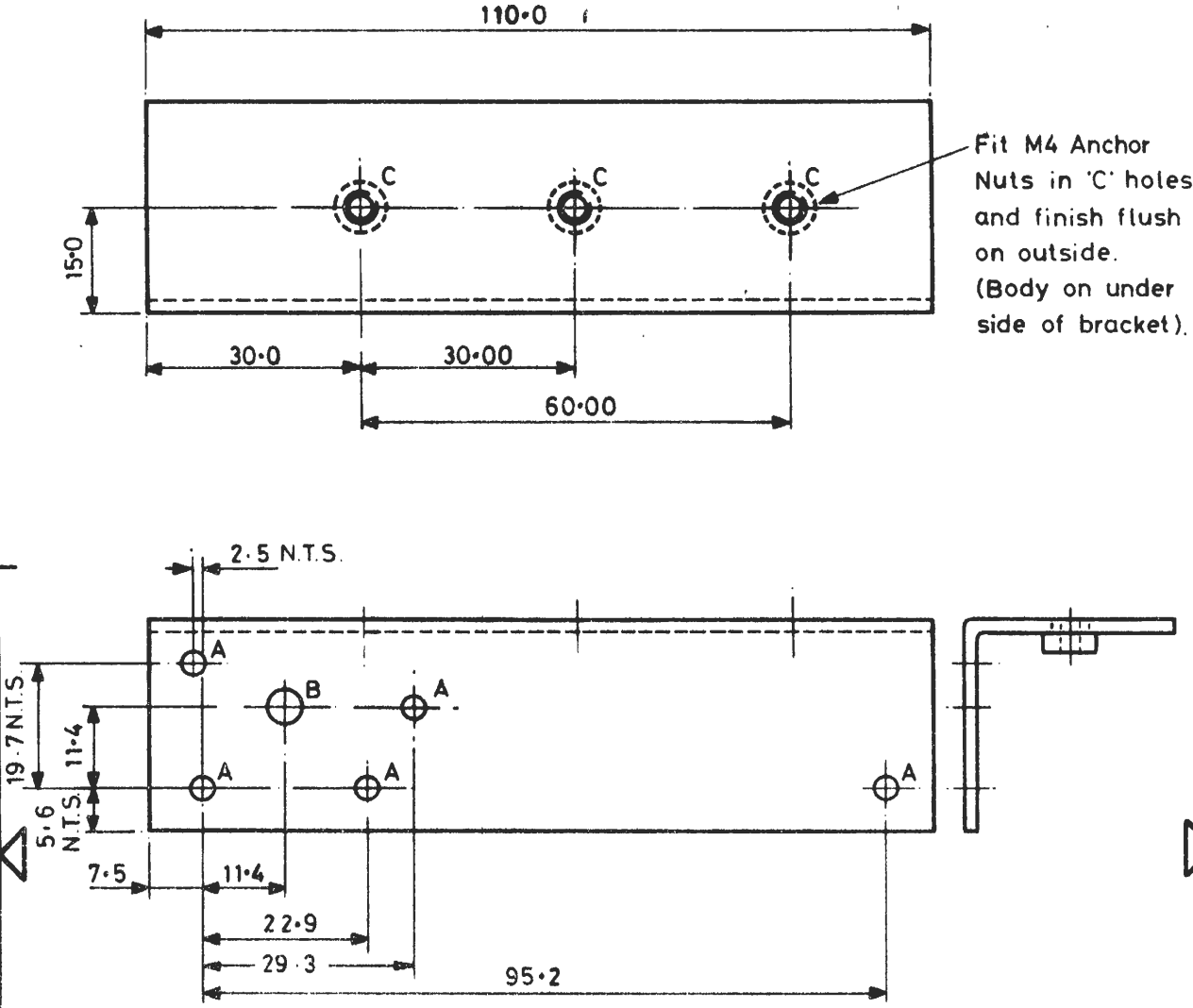
S&H LTD L 5063

D47997A4

ORIGINAL FRAME SIZE 190mm x 277mm

THIRD ANGLE PROJECTION

All dimensions in millimetres unless otherwise stated :
Normal tolerances :
no decimal place ± 1 mm unless otherwise stated
one decimal place ± 0·3 mm
two decimal places ± 0·1 mm



BRACKET

MATERIAL : 30 x 30 x 1·6 Al. Alloy angle, HE15TF to BS1474

FINISH : Clean.

NOTE : Remove all sharp edges and corners.

DRILLING TABLE	
HOLE	SIZE
A	Ø 3·0
B	Ø 4·5
C	Ø 5·5

SCALE 1:1

Parts List No. D47995A4

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BBC

DS/A4

ISS	CHANGE
1	28/12/79

AM9/21

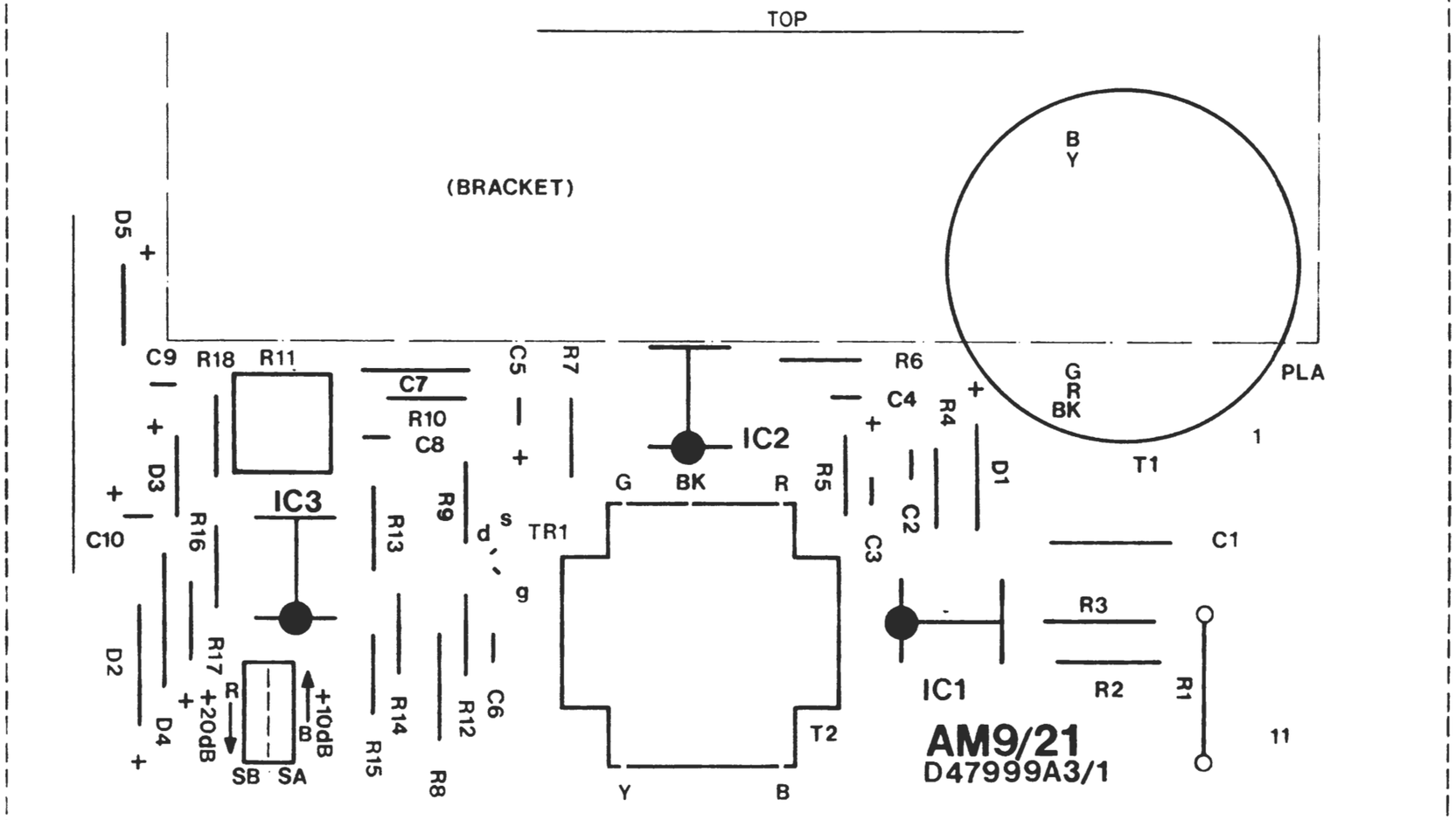
DETAIL

DRN.		DESIGNS DEPARTMENT
TCD.	PDG	D47997A4
CKD.		
APPD	P.F.	

S & H LTD L4518A

D47991 A3

MINIMUM SIZE TO CUT NEGATIVE



CHARACTERS AND LINES TO BE PRINTED IN WHITE SCALE 2 : 1
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D47998A3

SCALE 0

THIRD ANGLE PROJECTION

ORIGINAL FRAME SIZE
277mm x 400mm

DS. A3. 1

ISS	CHANGE
15	11 79
1	

AM9/21

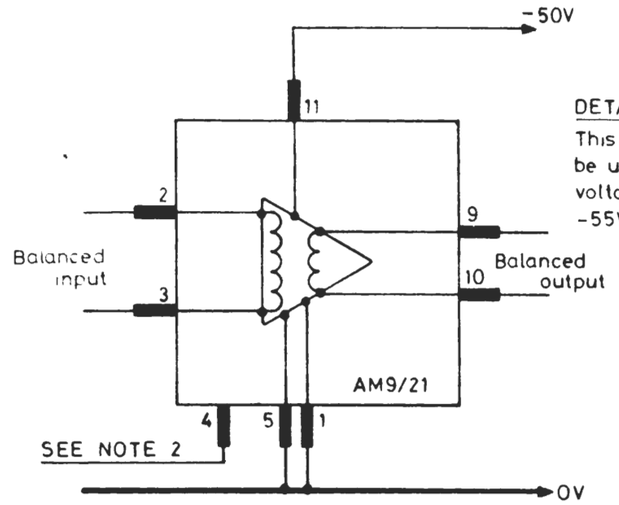
PRINTED BOARD COMPONENT LOCATION

All dimensions in millimetres unless otherwise stated : Normal tolerances :
no decimal place — ± 1 mm unless
one decimal place — ± 0·3 mm otherwise
two decimal places — ± 0·1 mm stated

DRN.		DESIGNS DEPARTMENT
TCD.	PDG	D47999 A3
CKD.		
APPD	P L	

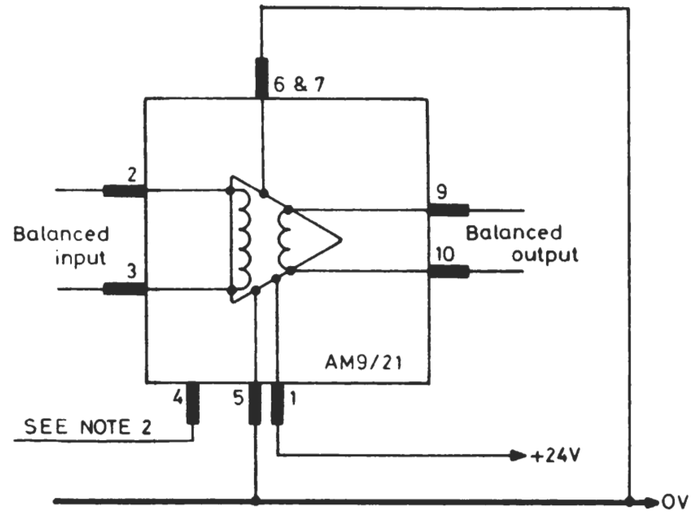
S&H LTD L5063

D480 , A3



DETAIL 1. -50V SUPPLY

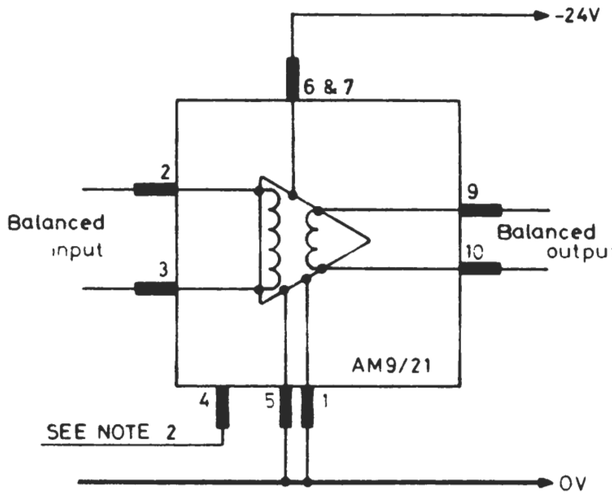
This configuration may be used with any voltage from -40V to -55V.



DETAIL 3. +24V SUPPLY

This configuration may be used with any voltage from +12V to +24V.

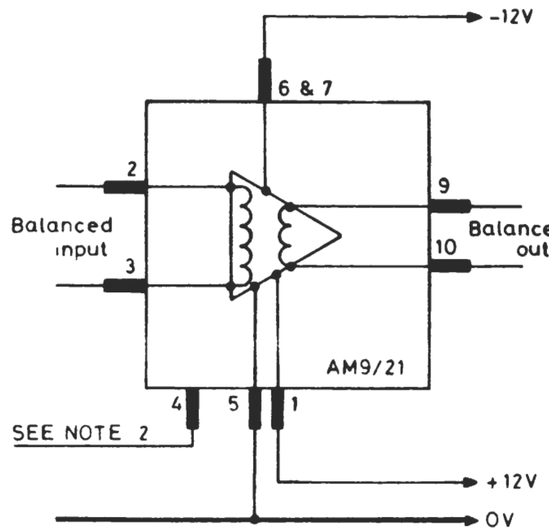
SEE NOTE 1.



DETAIL 2 -24V SUPPLY

This configuration may be used with any voltage from -12V to -24V.

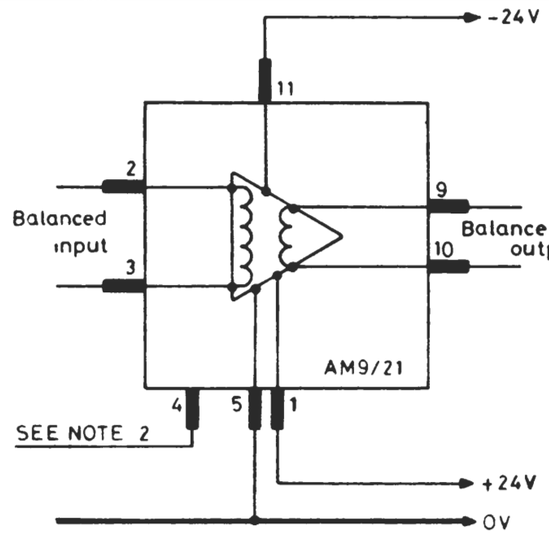
SEE NOTE 1.



DETAIL 4 ±12V SUPPLY

This configuration will accept a split supply voltage from ±6V to ±12V.

SEE NOTE 1.



DETAIL 5. ±24V SUPPLY

This configuration will accept a split supply voltage from ±20V to ±27·5V.

NOTE 1. FOR LIMITER TO OPERATE THE SUPPLY VOLTAGE MUST BE GREATER THAN 23V.

NOTE 2. CONNECT PLA 4 TO THE SIGNAL EARTH IF THE BRACKET IS NOT USED TO MOUNT THE AM9/21

SCALE:-

THIRD ANGLE PROJECTION

ORIGINAL FRAME SIZE
277mm x 400mm

CHANGE 28/12/79

AM9/21

INSTALLATION AND CONNECTION DIAGRAM

All dimensions in millimetres unless otherwise stated. Normal tolerances:
no decimal place — ±1 mm unless
one decimal place — ±0·3 mm otherwise
two decimal places — ±0·1 mm stated

DRN.		DESIGNS DEPARTMENT
TCD.	PDG	D48053 A3
CKD.		
APPD	PE	