Issue 1
2.10.78

DESIGNS DEPARTMENT TECHNICAL MEMORANDUM

NO. 2.439 (78)

Improvements to Pye UHF/77 Transmitter Drive

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(I. J. Shelley)
for Head of Designs Department

Written by: M. T. Ellen

D.D. Tech. Mem.
No. 2.439 (78)
Title Sheet

JP

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DESIGNS DEPARTMENT TECHNICAL MEMORANDUM

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C O N T E N T S

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Improvements to Pye UHF/77 Transmitter Drive

1. Summary

Several of the video amplifiers in this drive have poor power supply regulation, which causes a slight increase in gain at low frequencies, and the video clamps are unable to correct the resultant variation in black level, in less than about 20 lines. Further work is required to determine the practicability of improving the power supply regulation but a significant improvement is unlikely, so individual amplifier compensation networks are recommended to improve the overall performance. Measurements show that by adding compensation networks the distortion may be reduced to 30% of its original value, which is a significant improvement. However further improvements may be obtained by optimising the component values of the compensating networks.

2. Introduction

Pye UHF/77 Transmitters produce a variation in picture level of approximately 10% over 20 lines following a change from black to white (or vice versa). This Technical Memorandum describes the cause of the impairment and shows the effect of a practicable solution.

3. Cause of Impairment

The transmitter drive consists of several video amplifiers cascaded with pre-correction circuits. Three types of amplifier module are used and they are referred to as A, B and C. The A amplifier module has a low gain and no clamp. The B amplifier module has a clamp followed by a 20dB amplifier. The C amplifier module is electrically similar to two B amplifier modules; one is used to amplitude modulate the output from a UHF oscillator and the other is used to provide phase correction.

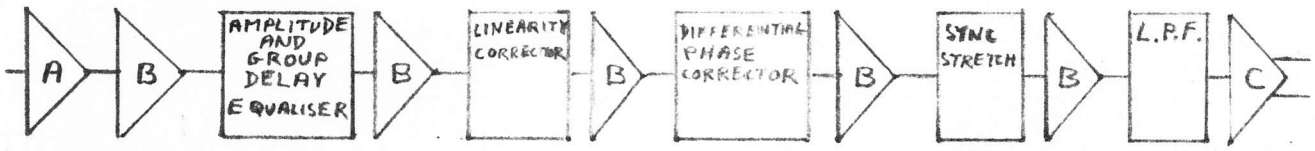


Fig.1
Simplified block diagram of video signal chain in drive

The A and B amplifiers have poor power supply regulation, which results in a gain increase at low frequencies. Therefore a 50Hz TV waveform is distorted as follows by each amplifier:

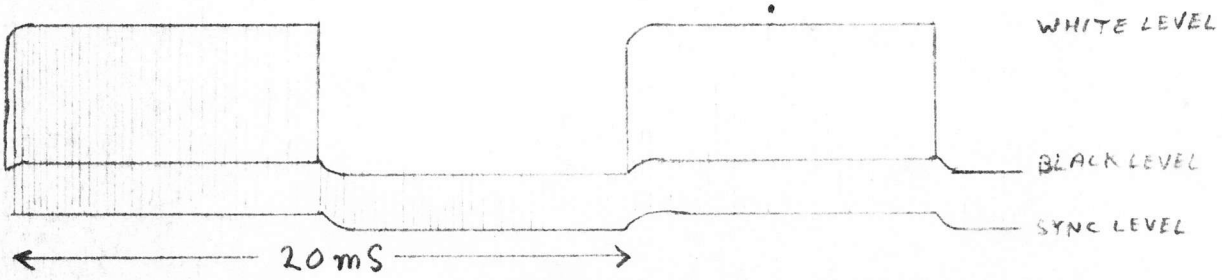


Fig.2

Distortion produced by each video amplifier

All the clamps have a slow response time and are unable to compensate for the change in black level in less than about 20 lines. Also, due to the combined effect of 6 clamps, a significant overshoot is produced (see fig.7).

4. Modification to Reduce Impairment

It would be desirable to improve the power supply regulation and it may be possible to achieve this by replacing the existing 22μH chokes L1 and L2 with lower resistance types. These chokes, which feed power to the output stages of each B amplifier, have a resistance of 2.8Ω and further work is required to determine whether this resistance is necessary to prevent coupling between each amplifier. If the choke resistance is not necessary, replacement of the chokes may be the best solution, however an alternative practicable solution is to add frequency response compensation networks to the output of the five B amplifiers. This is a convenient modification because the B amplifier modules are fitted with plug-in sub-boards containing the following circuit:-

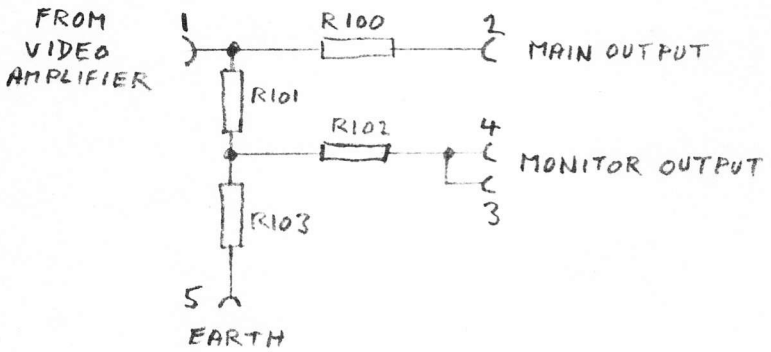


Fig.3

B Amplifier Module Sub-Board

The resistor values vary according to the position of the B amplifier module in the video signal chain, but their purpose is to define the main video output impedence and to attenuate the monitor output level to 1 volt. These sub-boards are about 3cm sq. and therefore reasonably cheap to replace.

The circuit of the first four modified sub-boards will be as follows:

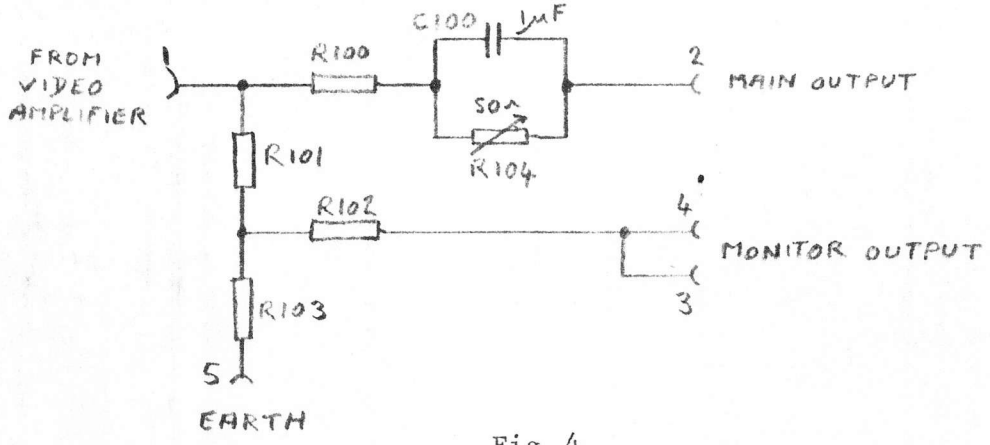


Fig. 4
Sub-board including main low frequency compensation network

The frequency response of the compensating network is shown for various resistor values in Appendix 2. Ideally this response should exactly compensate the amplifier response, however during initial investigation at Rowridge (5-9-78) it was found necessary to add another network to the last B amplifier module only, to correct the bar-k. This resulted in the following circuit,

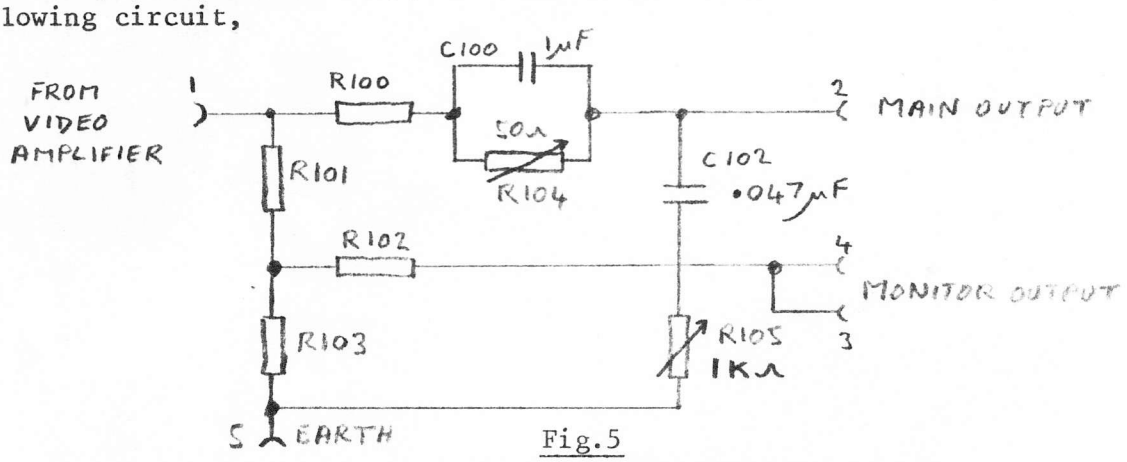


Fig.5
Sub-board including both compensation networks

The frequency response of the additional network is shown for various resistor values in Appendix 2. However the exact reason for it being needed is not clear, the possibilities are as follows:

1. The time constant of the main compensation network may be too short.

2. The gain of the basic amplifiers may rise at low frequencies in a complex manner which cannot be precisely compensated for by the simple network used. If so the gain would not be constant at low frequencies and a compromise setting of the main low frequency compensation network would be required. This could result in a poor bar-k rating.

3. Poor frequency response in another part of the drive may necessitate pre-correction in order to obtain a good overall bar-k rating. The A amplifier module is fitted (in the original design) with a low frequency compensation network similar to that shown in fig.4 and it has been used in the past to adjust the bar-k rating of the entire transmitter. However at Rowridge, when adjusted for optimum bar-k rating the network produced significant distortion of a 50Hz waveform which suggests that it should not be adjusted for optimum bar-k from the transmitter. The Pye Handbook gives the following information on the A amplifier module compensation network: "This network is provided to introduce low frequency compensation of the waveform should this be found necessary". The fact that the A amplifier compensation network was used to adjust the bar-k rating, suggests that some overall bar-k correction is necessary. But the extra network shown in fig.5 provides a better means of achieving the correction.

As a result of these considerations it has been decided to produce a small batch of sub-boards with the circuit shown in fig.6. The 0.047μF capacitor and 1KΩ potentiometer will be omitted except on the boards fitted to the fifth B amplifier module. The 1μF capacitor will be mounted so that it may be easily replaced with other values during initial field trials. Links will be provided to remove the new network, so that the modified and unmodified performance may be easily compared.

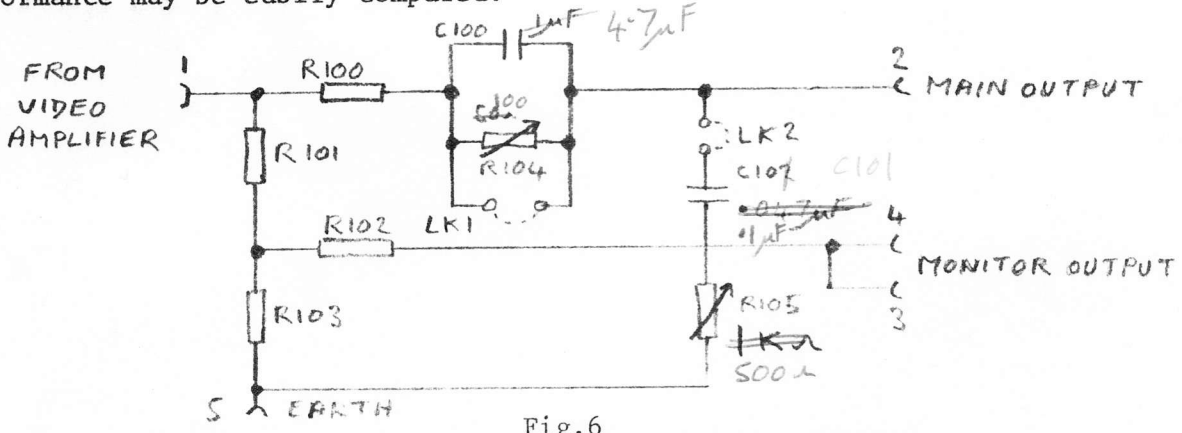


Fig.6
Circuit of Replacement B Amplifier Module Sub-board

The C amplifier module does not contain sub-boards, so it cannot be easily modified. However it has more complex and better power supply arrangements, which give the amplifier a low frequency performance that is much better than the B amplifiers.

By adjusting the existing A amplifier module compensation network and the five new B amplifier module compensation networks for minimum 50Hz waveform distortion, none of the clamps in the signal chain (including the one in the C amplifier module) are fed with a signal that changes black level quickly.

5. Effect of Modification

The photographs in Appendix 1 show the distortion produced by the transmitter

and DM1M, with and without the modifications described above. The variation in black level on a 50Hz TV waveform is reduced from 90mV to 25mV on a standard 1V signal and the duration of the disturbance is reduced from 20 lines to about 5 lines. Refinement of the component values may further reduce the distortion. See fig 6.

6. Adjustment of Modified Circuits

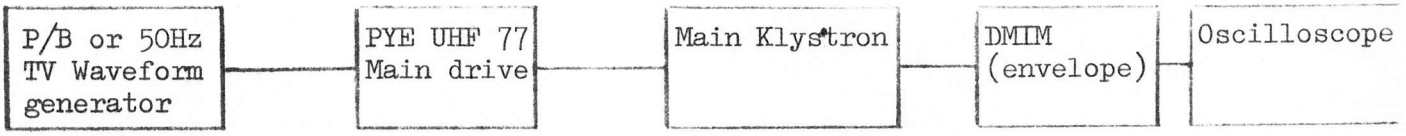
1. Apply a 50Hz waveform to the drive input.
2. Adjust R81 in the A amplifier module for constant black level at the input to the following amplifier.
3. Adjust R104 on the new compensation network fitted to the first B amplifier, for constant black level at the input to the following amplifier.
4. Repeat 3 for each compensation network and amplifier in turn.
5. Apply a pulse and bar waveform to the drive input.
6. Adjust R105 on the fifth compensation network for optimum bar-k rating at the input to the C amplifier module.
7. Apply a 50Hz TV waveform to the drive input.
8. Adjust R104 on the fifth compensation network for constant black level at the input to the C amplifier module.
9. Repeat 6, 7 and 8.
10. Observe the waveform at the output of the DM1M and trim (if necessary) all the compensation networks to obtain the optimum 50Hz and bar waveform.

7. Conclusion and Recommendation

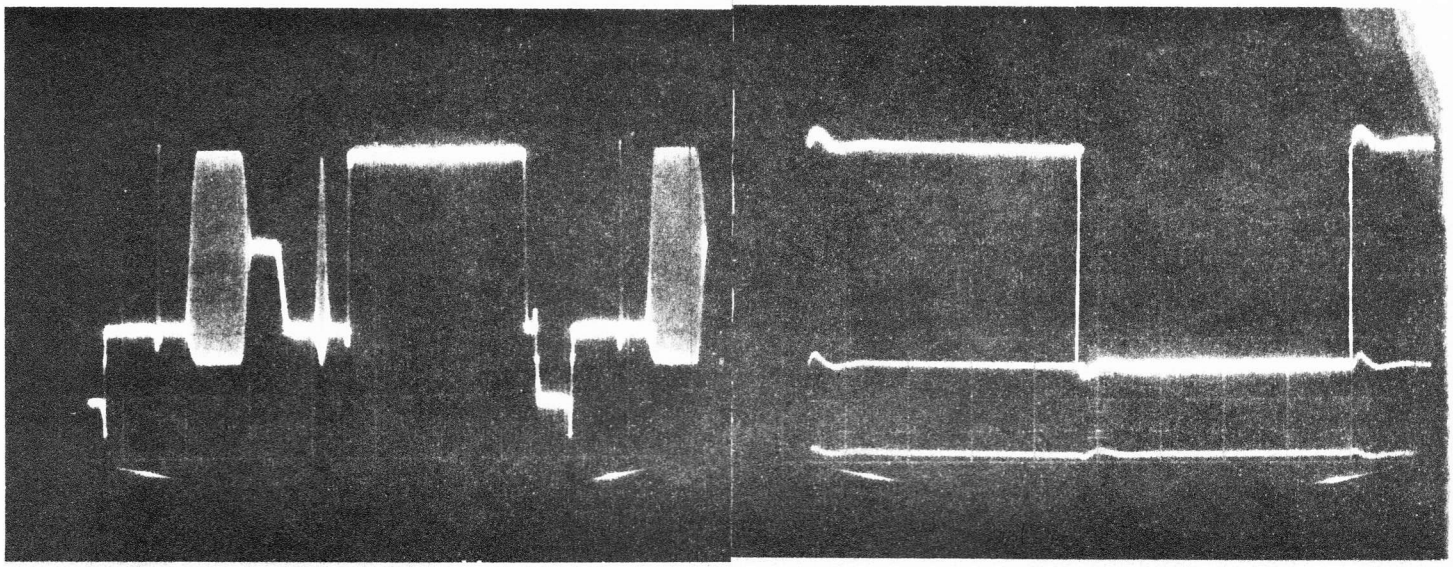
The low frequency performance of Pye UHF/77 transmitters may be significantly improved by replacing five small printed boards with new boards containing simple compensation networks and a small batch of replacement boards should be manufactured. However, before installing these replacement boards, power supply chokes L1 and L2 on each B amplifier module in a drive should be replaced with lower resistance types and the effect should be measured. If there is a significant improvement in the LF response, without any side effects, this may be a better solution than adding compensation networks. However, **it is likely that some bar-k compensation would still be required and this could be provided by the replacement sub-module for the fifth B amplifier.** Adjustment of the existing compensation network on the A amplifier **module for optimum** bar-k degrades the LF performance and is therefore not **recommended.**
If the power supply regulation cannot be significantly improved by replacing the chokes in each amplifier, then compensation networks should be installed at Rowridge and Hannington to confirm initial experiments.

APPENDIX 1

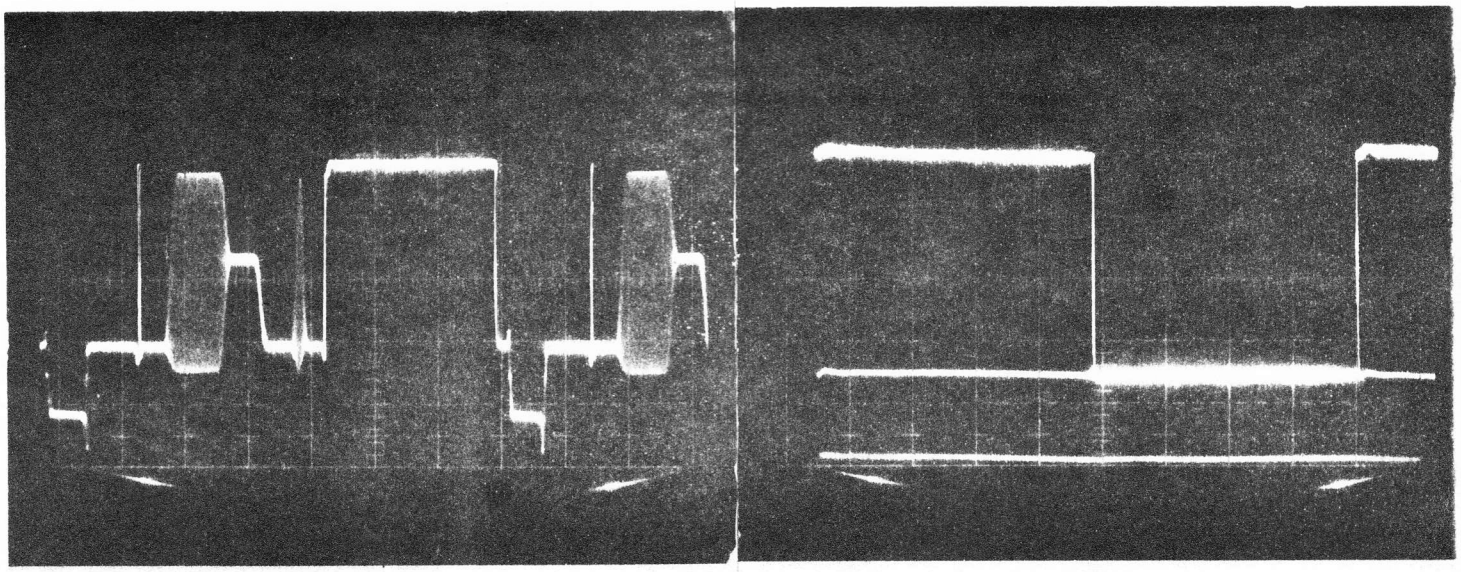
Photographs of waveforms taken before and after modifying the BBC2 transmitter at Rowridge.



Unmodified:-

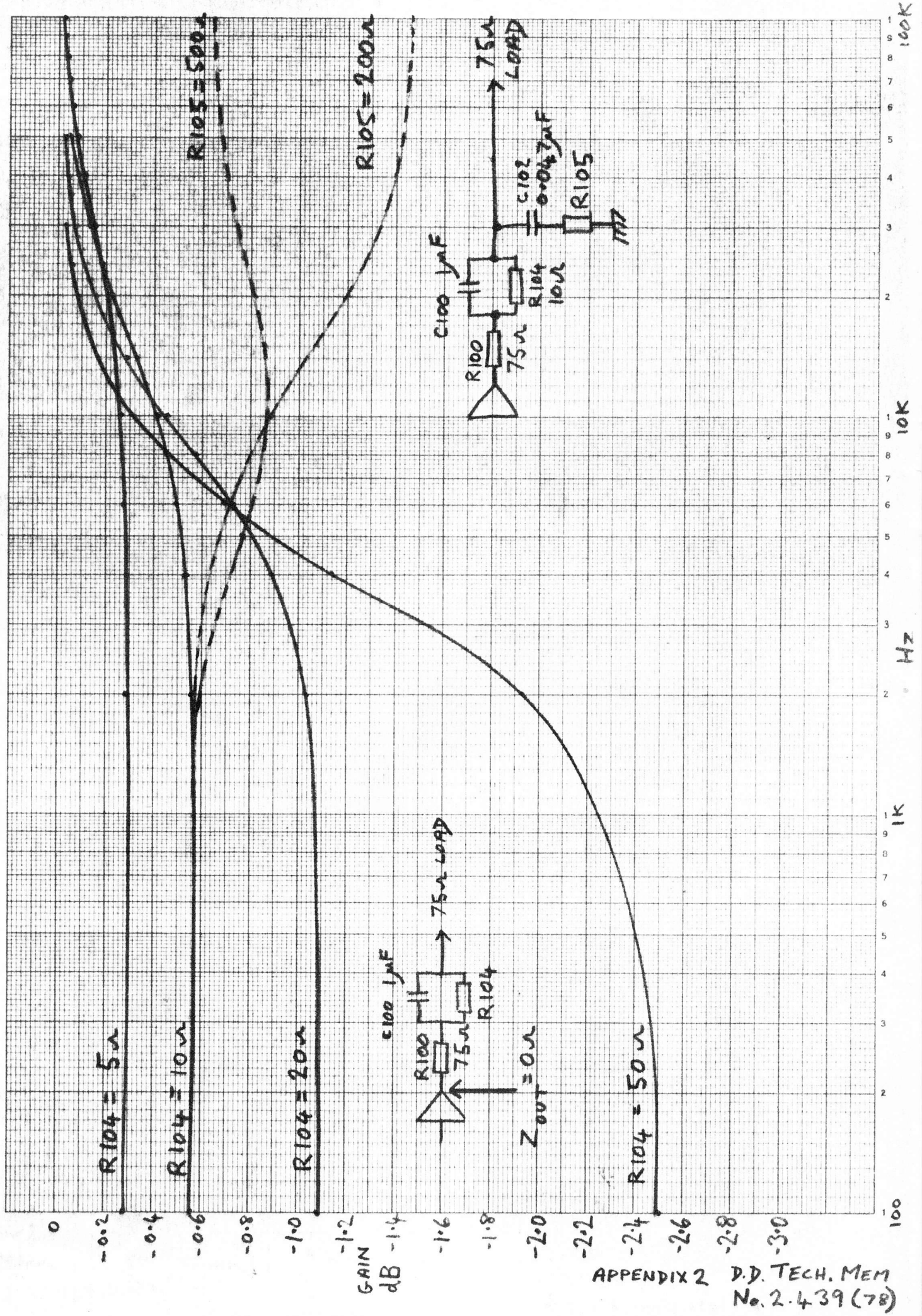


Modified:-



D.D. TECH. MEM. No. 2.439 (78) APPENDIX 1

APPENDIX 2



APPENDIX 2 D.D. TECH. MEM No. 2.439 (78)

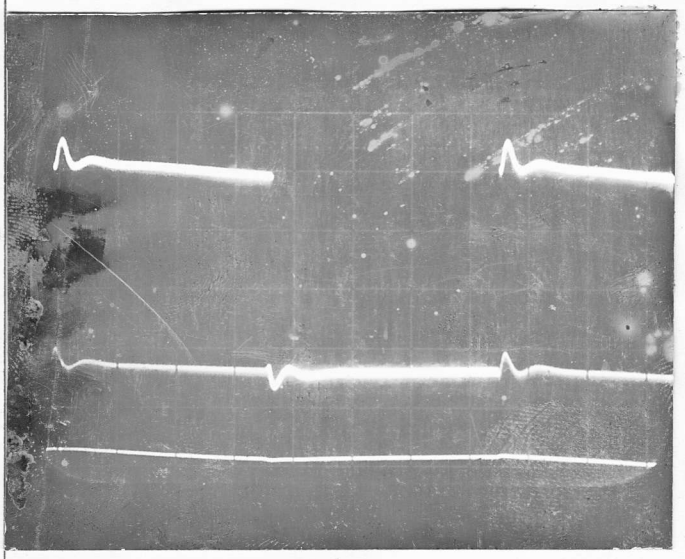
From: M. T. Ellen, Designs Department

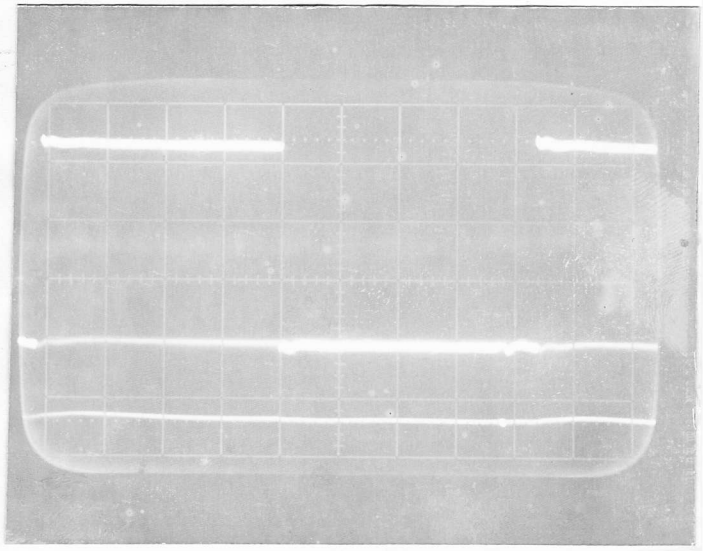
Room No. & Building: 504, Western House Tel. Ext.: 4416 date: 25th January, 1979

Subject: IMPROVEMENTS TO PYE UHF77 TRANSMITTER DRIVE

To:
Mr. D. M. Kitson
Mr. I. J. Shelley
Mr. G. G. Johnstone
Mr. J. E. Holder
Mr. A. L. Hands, TCPD
Mr. I. Tupper, Transmitter Group
Mr. T. M. Cook, Transmitter Group
Mr. P. Lamb, TCPD
Mr. D. Feek, Rowridge
Mr. F. Bowles, Hannington

The BBC1 main drives at Rowridge and Hannington were modified to reduce LF distortion on 16th/17th January, 1979. The work, which was done by Tim Cook, Peter Lamb and Martin Ellen, consisted of fitting and adjusting five small equaliser modules in each drive. The effect of the modification is shown in the photographs below. The left-hand photograph was taken in July 1978 and shows the output from Hannington with a 50Hz waveform generated at Rowridge. The right-hand photograph was taken on 17th January, 1979 after modifying the drives and shows the output of Hannington with a 50Hz waveform generated at LBH Switching Centre.





The LF distortion caused by each transmitter is now less than 1% (it was 9%) and some of the residual distortion seen on the right hand photograph is caused by the vision link to Rowridge.

Designs Department Technical Memorandum 2.439(78) gives the background to this work and the final modification is substantially as recommended in the D.D.T.M. However during the recent visit to Rowridge it was found that better performance could be obtained by increasing the time constant of the compensation networks. Also, replacing the power supply chokes with lower resistance types, which could have been a simpler solution, made the waveform worse.

The equaliser modules have now been coded: LF Equaliser EQ5/556 A-E and Designs Department are producing a PCB layout suitable for the manufacture of a large number of equalisers.

M. T. Ellen

M. T. Ellen

AS/20

From: M.T.ELLEN Department: DESIGNS

Room No. & Building: 504 Tel. Ext: 4416 Date: 22/1/79

Subject: **APPLICATION FOR EQUIPMENT CODE AND DESIGNATION**

To: 1) Drawing Office Manager, Designs Department, Western House
2) Return to: Originating Engineer (above address)

Please allocate a code and designation for the following equipment in accordance with Designs Department Technical Memorandum No.4.32(76) "Guide to Coding of Equipment".

Note: All the following information is required for insertion into "Registered Designs and Coded Equipment" and to determine the correct code.

Suggested Code	Suggested Designation
EQ5/556A-E	LF EQUALISER

Main function and brief technical details, sufficient to unambiguously describe the equipment and any options, if available.

This unit has been designed to replace the output attenuator modules in the 'B' amplifiers of PYE UHF77 transmitter drives. Versions A to E are suitable for the five 'B' amplifiers in a PYE UHF77 drive. The suffix letter indicates the main output impedance and the monitor output attenuation. They all provide correction for 50Hz waveform distortion produced by the amplifiers and the E version provides correction for bar tilt produced by the transmitter.

Power Requirements:	Does this equipment use television waveforms: YES/~~NO~~
NONE	

BBC chassis code, or dimensions of printed circuit board or chassis: 38mm x 41mm

Codes of equipment superseded, if applicable	Codes of parent equipment, if any	Codes of sub-units, if any

TO BE COMPLETED BY DESIGNS DEPARTMENT

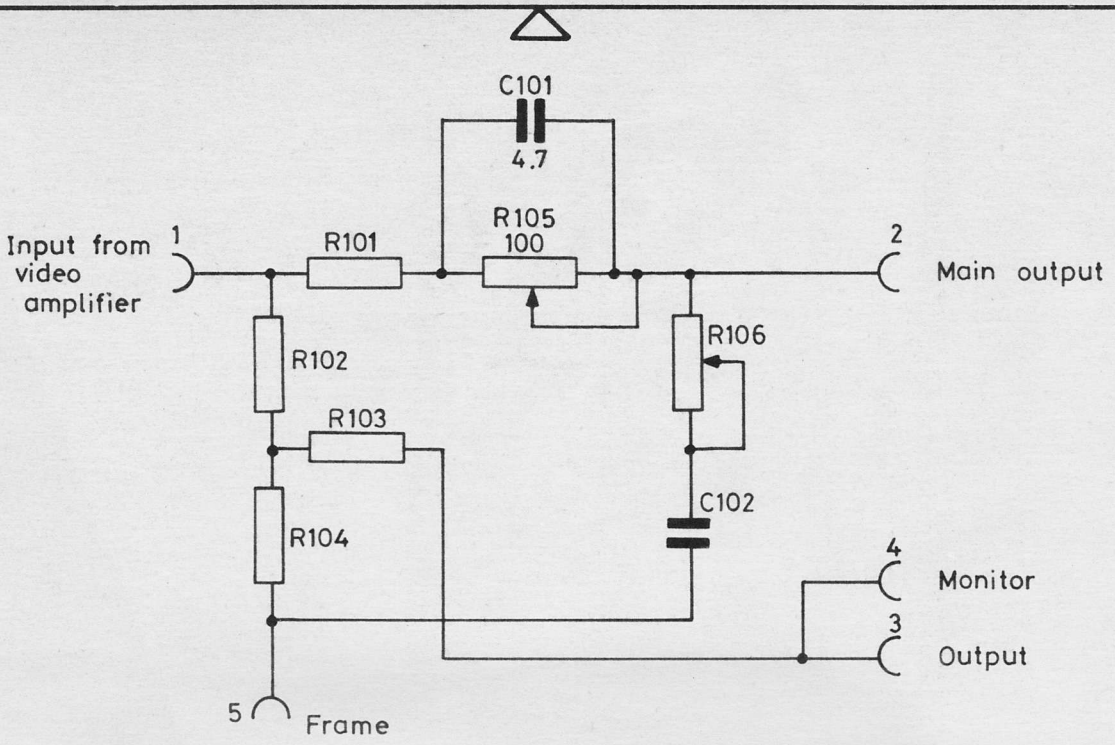
Allocated Code:	Allocated Designation:	
Signature:	Date:	C.A. No.

D46045A4

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



COMPONENT	EQUALISER EQ5/556				
	A	B	C	D	E
R101	75	75	strap	strap	75
R102	180	300	180	300	240
R103	22	15	22	15	12
R104	75	75	75	75	68
R106	N/C	N/C	N/C	N/C	500
C102	N/C	N/C	N/C	N/C	100n

PARTS LIST DRG. No. D46046A4

SCALE 0

BBC

DS/A4

CHANGE

ISS

UNAPPROVED

EQ5/556 A-E
L.F. EQUALISER CIRCUIT

DRN.		DESIGNS DEPARTMENT
TCD.	PDG	D46045A4
CKD.		
APPD		

S & H LTD L4518A

D46046 A4

ISS.

CHANGE

EQ5/556A-E L.F. EQUALISER PARTS LIST

ITEM No.	No. OFF A	B	C	D	E	DESCRIPTION	C'CT REF.	BBC REF. OR DRG. No.
						Drawing Numbers		
						Circuit D46045A4		
						Parts List D46046A4		
						Printed Brd. Wiring Master D46047A4		
						Printed Brd. Wiring Comp. Loc. D46048A4		
						Printed Brd. Wiring Drilling D46049A4		
						Printed Brd. Wiring Master (Multiple) D46050A2		
						Printed Brd. Wiring Comp. Loc. (Multiple) D46051A2		
						Printed Brd. Wiring Assembly D46052A4		
						Further information required for manufacture		
						Unit Assembly information		
						Unit Wiring information EA10137 Note 1		
						EA10140 Notes 1 & 11		
1	1	1	1	1	1	Printed Board manufactured to:		D46047A4 OR D46050A2
								D46048A4 OR D46051A2
2	5	5	5	5	5	Cage Jack, Cambion 450-3392-01-03-00		
						Resistors, Metal Oxide, 0.4W,		
3	-	-	-	-	1	12Ω ±2%	R103	S26877 - 0227744
4	-	1	-	1	-	15Ω ±2%	R103	S26877 - 0227760
5	1	-	1	-	-	22Ω ±2%	R103	S26877 - 0098976
6	-	-	-	-	1	68Ω ±2%	R104	S26877 - 0227882
7	1	1	-	-	1	75Ω ±1%	R101	S26877 - 0098992
8	1	1	1	1	-	75Ω ±1%	R104	S26877 - 0098992
9	1	-	1	-	-	180Ω ±2%	R102	S26877 - 0227910
10	-	-	-	-	1	240Ω ±2%	R102	S26877 - 009932X
11	-	1	-	1	-	300Ω ±2%	R102	S26877 - 0099338
						Resistors, Variable Cermet, 0.5W		
12	1	1	1	1	1	100Ω Multi-turn 0.5W Linear	R105	S27243 - 0306011
13	-	-	-	-	1	500Ω Multi-turn 0.5W Linear	R106	S27243 - 0305999
						Capacitors		
14	-	-	-	-	1	100nF ±10% 100V	C102	S21030 - 0208951
15	1	1	1	1	1	4·7μF ±10% 100V	C101	S21034 - 0209198
16	1	1	1	1	1	Label, Warning re: Beryllium Compounds. To:-		D40615 A4

BBC

DS/PLA4

EQ5/566A-E

L.F. EQUALISER PARTS LIST

DRN.	
TPD.	PDG
CKD.	
APPD	

DESIGNS DEPARTMENT

D46046 A4

VM161A4

BBC

All dimensions in millimetres unless otherwise stated.
Normal tolerences:
no decimal place:– ±1 mm
one decimal place:– ±0.3mm
two decimal places:– ±0.1mm
unless otherwise stated

THIRD ANGLE PROJECTION

Original Frame Size
190mm × 277mm

D46048A4

CHANGE	ISS

UNAPPROVED

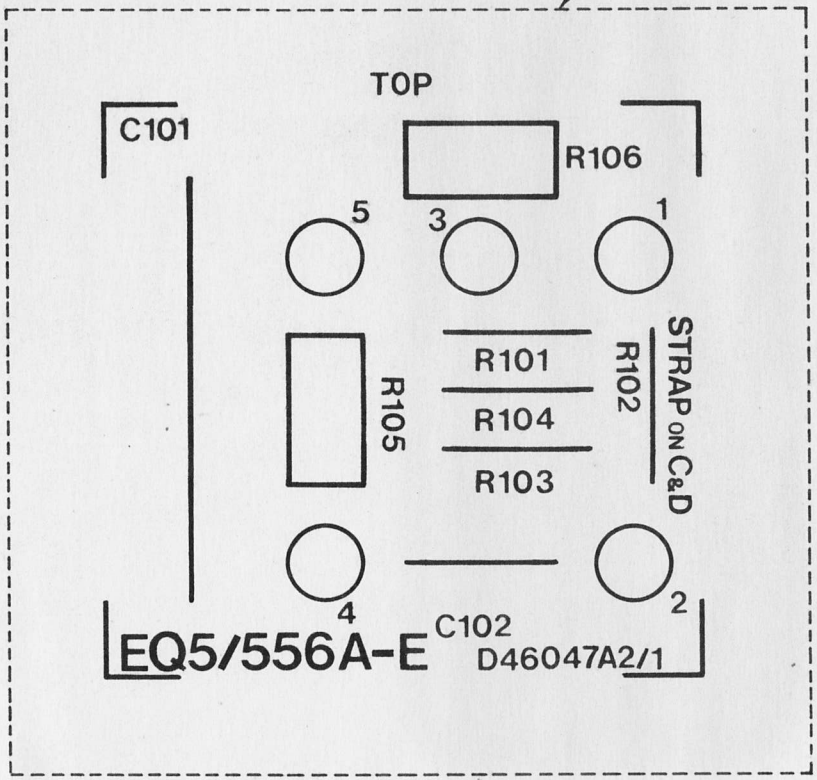
	DRN	
APPD	CKD.	
	TCD.	PDR

EQ5/556 A-E
PRINTED BOARD
COMPONENT LOCATION

DESIGNS DEPARTMENT

D46048A4

MINIMUM SIZE TO CUT NEGATIVE



CHARACTERS AND LINES TO BE PRINTED IN WHITE
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D46047A2

SCALE : 2 : 1

S & H LTD L 3932

VM246A4

BBC

EQ5/566A-E PRINTED BOARD DRILLING

D46049A4

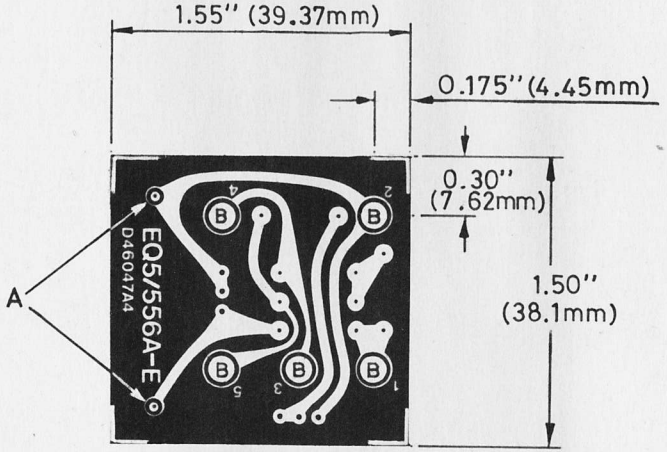
CHANGE	ISS
/ /	

UNAPPROVED

PRINTED BOARD DRILLING EQ5/556A-E D46049A4

APPD		DRN
CKD		TCD
		PDG

DESIGNS DEPARTMENT



CUT BOARD TO DIMENSIONS SHOWN

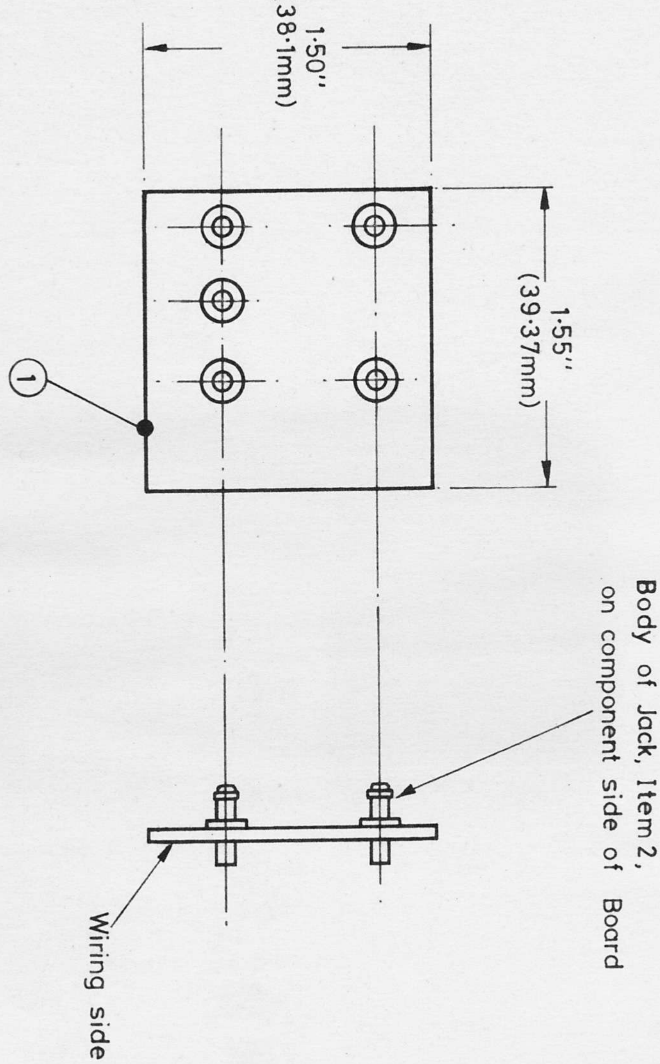
SCALE 1:1

HOLE REF.	DRILL NO. OR SIZE	DIAMETER DEC.	DIAMETER MM
B	—	·13	3·3
A	60	·040	1·0
UN-LETTERED	66	·033	·85

MATERIAL : 1·6 THK. TO BS4584, +CL 5·2, EP-GC-Cu-3, 35/—, 1·6±0·20 (EPOXIDE WOVEN GLASS FABRIC, CLAD ON ONE SIDE WITH 35μm COPPER)

FINISH : TINNED.

MANUFACTURED TO D46047A4 & D46045A4



D46052 A4

ORIGINAL FRAME SIZE
190mm x 277mm

THIRD ANGLE PROJECTION

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

BBC

DS/A4

SCALE 1/1

CHANGE

ISS

UNAPPROVED

EQ5/556 A - E
L.F. EQUALISER ASSEMBLY

DRN.	PDG	DESIGNS DEPARTMENT
TCD.		D46052 A4
CKD.		
APPD		

S & H LTD L4518A