

DESIGNS DEPARTMENT HANDBOOK

NO. 3.186(76)

Peak Programme Meter Tester TE1/25

.....
(I.D.B. Millar)
for Head of Designs Department

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D.D. Handbook No. 3.186(76)
Title Sheet

Peak Programme Meter Tester TE1/25C O N T E N T S

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Peak Programme Meter Tester TE1/25

1. INTRODUCTION

The TE1/25 is a compact battery operated unit providing all the tests necessary to check and align a standard peak programme meter complete with its associated drive amplifier.

The tester will allow the following tests to be carried out.

1. Static Scale Law.
2. Frequency Response.
3. Reverse Polarity (Reversibility).
4. Dynamic Response and Integration Time.
5. Return Time (Fallback).

The output of the tester is balanced and floating and can be connected to both bridging and 600 ohm inputs. A small meter is provided to enable the tester output to be monitored and the battery state checked. The power consumption is low and batteries should not need changing very often with normal use.

2. OPERATION

Basic operating instructions are contained in the lid of the case however amplified instructions are given below with explanatory notes.

2.1 Power Supply

Power is applied to the unit when a standard P.O. type 316 plug is inserted in the output jack. When the unit has been switched 'on' in this way the battery state may be ascertained by depressing the battery check buttons and noting the reading on the meter. The current drain is heavier on the positive battery so this will require replacing first. Batteries should be changed whenever the pointer reaches the lower edge of the green band. The batteries consist of two type PP9's located under the P.V.C. cover at the rear of the panel.

2.2 Scale Law and Frequency Response

Having switched the unit 'on' the 'Cont' and 1kHz buttons should be pressed. The output attenuators set to 0dB and the scale level to Mk '4'. The meter should read on the 0dB red line. If the reading is incorrect check that the output has not been short circuited or that the load is less than the 600 ohm minimum.

The coarse output attenuator should now be set for the basic sensitivity of the circuit under test viz -20dB, -10dB or 0dB. The scale Law checks may now be carried out. The following are the permissible deviations at the various scale marks.

<u>Scale Mark</u>	<u>Permissible Deviation</u>
1	$\pm 0.5\text{dB}$
2	$\pm 0.2\text{dB}$
3	$\pm 0.3\text{dB}$
4	$\pm 0.2\text{dB}$
5	$\pm 0.3\text{dB}$
6	$\pm 0.2\text{dB}$
7	$\pm 0.5\text{dB}$

The zero setting may also be checked by setting the Scale attenuator to '0'.

It should be noted that the spacing between the scale marks on all modern transistor P.P.M. amplifiers is 4dB. On older designs such as the MNA/3, ATM/1, TPM/3 & PPM/6 the 1-2 spacing is 6dB. In order to check these earlier instruments the level for Mark 1 is -14dB relative to Mark 4. This level can be achieved by setting the coarse output attenuator to -10dB and the scale control to '3'.

The frequency response at any scale mark can be ascertained by pressing the appropriate frequency button. The maximum deviation over the frequency range 30Hz to 15kHz is $\pm 0.3\text{dB}$.

2.3 Dynamic Response

The dynamic response of a P.P.M. is assessed by noting the deflection obtained when 5kHz bursts of tone of constant amplitude are applied to the instrument.

Normally the steady state value of the tone is adjusted to give a reading of '6' on the P.P.M. The 'burst' button is now depressed and the deflection noted. If it is required to measure the deflection accurately, then having marked the pointer position, with for example a chinagraph pencil, the 'Cont' button should be pressed again and the output level adjusted to the pencil mark. The level can now be read off the control settings.

When the 'burst' button is pressed this automatically sets the oscillator to the correct frequency of 5kHz. The burst will be automatically re-triggered with approximately a 6 second period. This is to allow sufficient time for the P.P.M. circuits to decay properly. The following is the performance of a standard P.P.M. to bursts of 5kHz tone whose steady state amplitude gives a reading of '6'.

<u>Burst Width</u>	<u>Reading</u>	<u>Tolerance</u>
100 ms	6	$\pm 0.5\text{dB}$
10 ms	$5\frac{1}{2}$	$\pm 0.5\text{dB}$
5 ms	5	$\pm 0.75\text{dB}$
2 ms	4	$\pm 1.0\text{dB}$

The width of burst which gives a deflection which is 2dB below the steady state reading is known as the Integration Time of the instrument. All BBC Peak Programme Meters have an integration time of 10 ms.

2.4 Decay Time (Fallback)

Traditionally the decay time of a P.P.M. has been measured with a stopwatch. The time is defined as the time taken for the pointer to fall from Mk 7 to Mk 1 when a tone giving a deflection to Mk 7 is suddenly removed.

The TE1/25 enables this test to be carried out without the use of a stopwatch. The procedure is as follows. With the 'cont' button pressed the steady level is adjusted for a reading to Mk 7. The 'decay' button and a 'decay time' button are pressed. The tester will now produce a long tone burst (200 ms) which is repeated at intervals as selected by the decay time buttons.

The correct decay time is given when the pointer just reaches Mk 1 before the pointer is re-started. The decay times available give the permissible spread on a P.P.M. A standard P.P.M. falls 24dB in 2.8 seconds. Early P.P.M.'s with the 26dB scale have a 3 second decay time.

2.5 Reversibility Test

The Reversibility Test primarily checks that the P.P.M. will register correctly both positive and negative-going signals.

The following is the procedure for carrying out the test. The 'cont' and 1kHz buttons are pressed. Next the + Rev button is pressed and the level adjusted to a convenient scale mark. The - Rev button is then pressed and the change in reading on the P.P.M. noted. The permissible difference is $\pm 0.5\text{dB}$.

Pressing the + Rev button gives a positive-going half-wave rectified signal at the output. The - Rev button gives a negative-going signal at the output.

3. PERFORMANCE SPECIFICATION

3.1 Electrical Data

Output Level (switched)	-20dB -10dB and 0dB
(coarse)	-12dB to +12dB in 2dB steps, calibrated in P.P.M. Scale Numbers. Step accuracy $\pm 0.1\text{dB}$.
(fine)	-1dB to +1dB in 0.2dB, 0.3dB and 0.5dB steps. Step accuracy $\pm 0.05\text{dB}$.

Output Impedance	: 7 Ω balanced
Output Frequencies	: 4 fixed frequencies of 30Hz, 1kHz, 5kHz and 15kHz \pm 4% with a level accuracy of \pm 0.1dB w.r.t. 1kHz.
Tone Burst Widths	: 4 fixed widths of 2 ms, 5 ms, 10 ms and 100 ms \pm 2%; repeat interval 6 seconds.
Decay Times	: 4 fixed times of 2.5s, 2.8s, 3.0s and 3.2s \pm 2%. Burst width 200 ms.
Reversibility	: Half-wave rectified output. Polarity selected by appropriate button.

3.2 Mechanical Data

Size	: 220 mm x 200 mm x 105 mm Black 'Topper' carrying case.
Weight	: 2.25 kg.

3.3 Installation Data

Power	: \pm 9v @ 50mA (2 x PP9 Batteries)
Output Connector	: 3-pole, B Gauge, Jack.

4. CIRCUIT DESCRIPTION

The basic oscillator is of the Wien Bridge type. The maintaining amplifier is 1 IC1. The amplifier output is rectified by 1D1 and the resultant DC smoothed by 1C4. This DC is applied to the gate of 1 TR1 causing the drain/source resistance to vary with the output level. This in turn controls the gain of 1 IC1 and hence stabilises the oscillator output level. The oscillator level is adjusted by 1R6 which varies the DC applied to 1 TR1. The bridge components are switched by 2S1 - 2S4. Phase shift in the maintaining amplifier at 15kHz can upset the bridge so 2C1 has been added to compensate for this.

1 IC2 is a balanced modulator which has been connected as a tone gate. The oscillator is fed to the gate via 1 R8 which enables the signal input to be set. 1 R16 balances the tone gate to reduce the signal breakthrough to a minimum when the gate is off. The signal from the tone gate is then fed via 1 C6 to S1 which forms the coarse output level control. This has three positions 0dB, -10dB and -20dB. The attenuation is provided by 1 R18 - 1 R20. The signal now passes to 1 IC3 which normally forms a buffer amplifier with 6dB of gain. For the reversibility test this amplifier becomes a half wave rectifier. This is achieved when either diodes 5D3 or 5D4 are inserted into the feedback path of 1 IC3 by pressing 5S3 or 5S4.

The output of 1 IC3 feeds the Scale Mark attenuator 1S1. The signal then feeds the fine output attenuator 1S2 via the buffer stage 1 IC4. The fine output attenuator feeds the output amplifier comprising 1 IC5, 1 TR2, 1 TR3 and the output transformer 1T1. Normally the amplifier is connected directly to the transformer. However to avoid D.C. appearing on the transformer during the reversibility test capacitors 1 C18 - 1 C19 are interposed between the amplifier and the transformer by 5S3/5S4. The output transformer 1T1 has a step up ratio of 1:2. The transformer feeds the metering board (No. 5) and the output jack JKA.

The output signal is metered by ME1, the signal having been rectified and smoothed by 5D2 and 5C1. Resistor 5R4 enables the meter reading to be adjusted. The diode 5D1 prevents the meter from being overdriven.

The battery check buttons 5S1 and 5S2 switch the meter via resistors 5R1 - 5R3 to the batteries BY1 and BY2. The power from BY1 is switched by contacts on JKA. The power from BY2 is switched by 1 TR4. 1 TR4 is made conducting by the appearance of the positive potential on 1 R63 when a plug is inserted in JKA.

The timing of the tone bursts and the decay time periods are controlled by 1 IC6. 1 IC6 is a dual timer integrated circuit type NE 556. 1 IC6b forms an astable multivibrator circuit. The main timing capacitor is 1C12 which with the resistors on board 3 form the decay time periods as selected by 3S1 - 3S4. 3R5 - 3R6 give a time period of six seconds for the automatic resetting of the tone bursts. The output of 1 IC6b is used to trigger 1 IC6a which is connected as a monostable. 1 IC6a generates the tone gating waveform for driving the tone gate 1 IC2. When 1 IC6a has been triggered it generates a pulse whose width is determined by the capacitor 1C15 and the timing resistors on board 4. 4R5 gives a 200 ms gate time which is used when measuring fall back times.

The 'cont' button S2 performs two functions. When released it sets the oscillator to 5kHz for use with the burst signals. When depressed it prevents 1 IC6a from being triggered by 1 IC6b by returning pin 6 of 1 IC6a to 0v. The output of 1 IC6a is thus held near to the positive rail keeping the tone gate 'on'.

The 'decay' button S3, when pressed, sets 1 IC6a to give a burst duration of 200 ms. The timing resistor is 4R5. The long burst being used for the 'decay' time tests as described earlier.

The burst button S4, when pressed, sets 1 IC6b to give a repetition time of six seconds between bursts. The timing resistors are 3R5 - 3R6.

5. MAINTENANCE

The unit is easily removed from its carrying case. Firstly the battery cover and batteries should be removed. If now the five screws in the bottom of the case are removed the chassis should be able to be withdrawn from the case. Should it be necessary to remove the front panel then the rotary knobs and the coarse attenuator switch knob should be removed first. The escutcheon can then be removed which will allow access to the front panel securing screws.

5.1 System Check

The circuit, D 41357 A1, gives the levels and voltages that will be found throughout the unit. The DC voltages were measured with BY1 and BY2 at 9v. The AC levels were measured with the following switch settings.

- 1) Scale switch 1S1 set to '4'.
- 2) Coarse O/P switch S1 set to '0' dB.
- 3) Fine O/P switch 1S2 set to '0' dB.

5.2 Adjustments and A.O.T. Components

Normally the adjustable pre-sets should not need re-setting during the life of the unit, however, if they are inadvertently moved the procedure for re-setting them is given below. It is not advisable to alter any of the A.O.T. components unless some component has failed so requiring them to be changed.

The following equipment is required for carrying out re-alignment and re-setting of A.O.T. components.

- | | | |
|----|--|-------------------|
| 1. | AC Test Equipment or equivalent | e.g EP 14/1 |
| 2. | Frequency Meter | e.g. H.P. 5304A |
| 3. | Electronic timer/counter | e.g. H.P. 5304A |
| 4. | Oscilloscope preferably with storage | |
| 5. | High Z DC multimeter | e.g. Advance DDM7 |
| 6. | Bench Power Supply $\pm 6v$ to $\pm 9v$ at 50mA DC | |

Re-alignment should not be attempted if this equipment is not to hand. It should be realised that this is a piece of test equipment used for checking and aligning other equipment and therefore maintenance should not be undertaken lightly. If the calibration is felt to be out of specification and the requisite test equipment is not to hand then the unit should be returned to E.D. Test Lab for repair.

5.2.1 Oscillator Level (1R6) and Frequency Response (2C1)

If any of the Wien Bridge components or those in the control chain are changed viz 1 TR1, 1C4, 1C1 etc. then the oscillator level control 1R6 may need re-setting. The oscillator output level as measured at 1C5 negative should be $+8dB \pm 0.5dB$. If this is not correct the value of 1R6 should be adjusted. The frequency response of the oscillator should be checked at 15kHz. If the level change between 1kHz and 15kHz is greater than 0.1dB than it may be necessary to adjust 2C1. If 2C1 is altered the generated frequency should be checked for accuracy.

5.2.2 Tone Gate Adjustments (1R16 and 1R17)

The tone gate balance control 1 R16 adjusts for minimum tone breakthrough when the tone gate is off. 1R16 should only be adjusted when pin 7 of 1 IC2 is at 0v which can be achieved by turning 1 R17 fully clockwise. All adjustments to the tone gate should be carried out with the supply rail at $\pm 6v$ and the 'cont' and 1kHz buttons pressed.

Having set 1R16 the tone gate drive, 1 R17, should be re-set. Monitor the output tone with an EP14/1 set to mean, flat and turn 1 R17 fully anticlockwise. Now turn 1 R17 clockwise until the output just starts to fall.

5.2.3 Fine Output Level Adjustment (1R8)

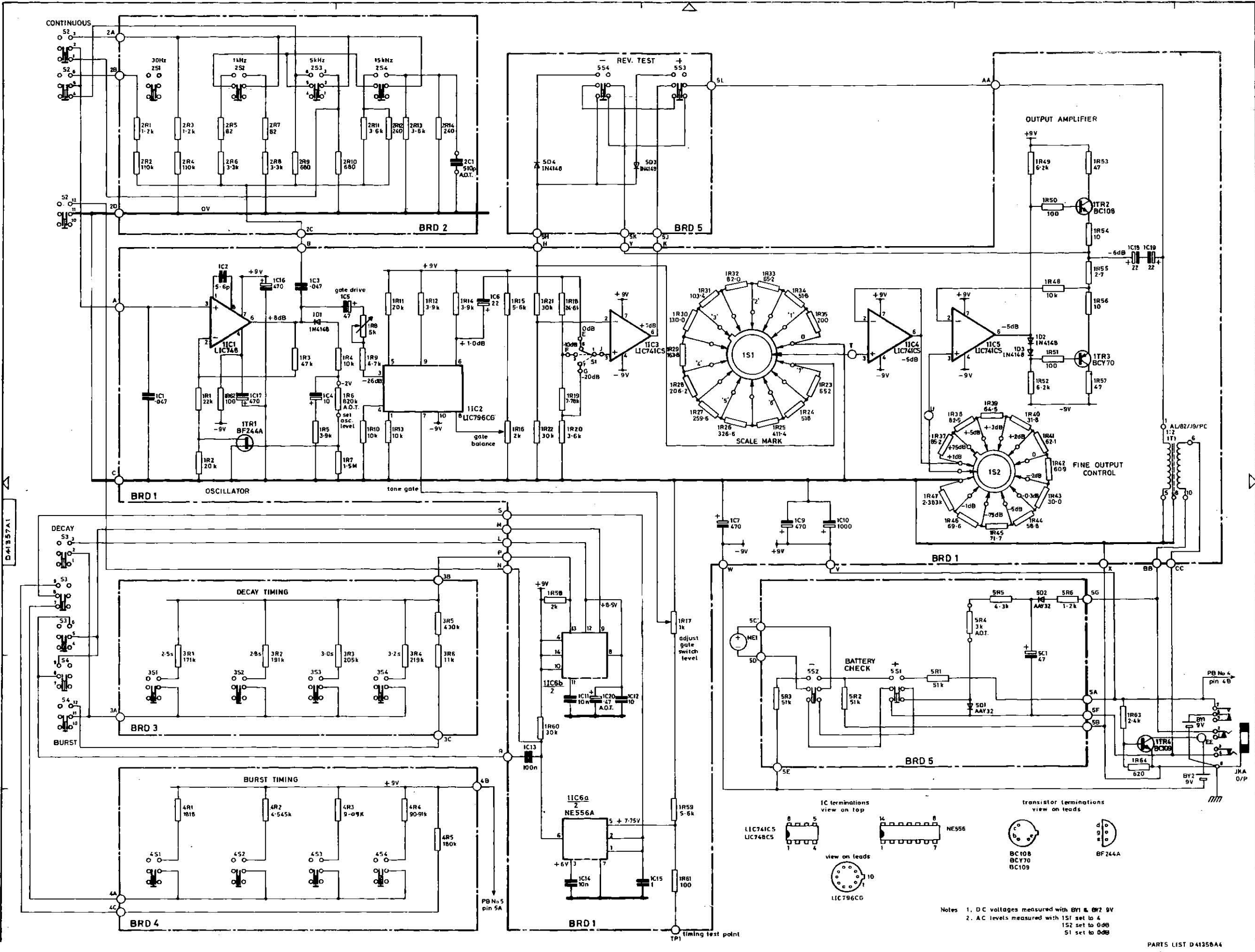
1R8 permits the output level to be set accurately. The correct output level at 1kHz with the attenuators set to 0dB and scale mark '4' is +0.05dB into high impedance.

5.2.4 Meter Calibration (5R4)

If the meter ME1 has been changed then it may be necessary to alter 5R4 to correct the 0dB mark. 5R4 should be adjusted to give a reading on the red line when the output level is 0dB.

5.2.5 Decay Time Period Adjustment (1C20)

If the timing integrated circuit 1 IC6 or 1C12 is changed then the decay time periods should be checked and 1C20 adjusted if necessary. The times should be checked by connecting a counter/timer to TP1.



4-2-77	1
1-9-77	2
23-3-77	3
31-3-77	4

THIRD ANGLE PROJECTION
 All dimensions in millimetres unless otherwise stated
 Normal tolerances
 no decimal place - ±1 mm
 one decimal place - ±0.3 mm
 two decimal places - ±0.1 mm
 unless otherwise stated
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TE1/25 (PPM TESTER) CIRCUIT

DRN	TCD	CKD	APPD
BM B	EKL	PCL	
DESIGNS DEPARTMENT			

D41357A1

Notes 1. D.C. voltages measured with BY1 & BY2 9V
 2. A.C. levels measured with IS1 set to 4
 IS2 set to 0dB
 S1 set to 0dB

PARTS LIST D41358A4

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IS	CHANGE
1	4-2-77
2	16-2-77

ITEM No.	No. OFF	DESCRIPTION	CCT REF.	BBC REF. OR DRG. No.
DRAWING NUMBERS				
		CIRCUIT	D41357A1	
		PARTS LIST	D41358A4	
		ASSEMBLY	D41359A1	
		DETAILS 1-8	D41360A1	
		DETAILS 9-14	D41361A1	
		P.B. No.1 WIRING	D41362A1	
		P.B. No.1 COMP SIDE WIRING	D41363A1	
		P.B. No.1 COMP. LOC.	D41364A1	
		P.B. No.1 DRILLING	D41365A3	
		P.B. No.2 WIRING	D41366A4	
		P.B. No.2 COMP. LOC.	D41367A4	
		P.B. No.2 DRILLING	D41368A4	
		P.B. No.3 WIRING	D41369A4	
		P.B. No.3 COMP. LOC.	D41370A4	
		P.B. No.3 DRILLING	D41371A4	
		P.B. No.4 WIRING	D41372A4	
		P.B. No.4 COMP. LOC.	D41373A4	
		P.B. No.4 DRILLING	D41374A4	
		P.B. No.5 WIRING	D41375A4	
		P.B. No.5 COMP. LOC.	D41376A4	
		P.B. No.5 DRILLING	D41377A4	
		DETAIL 15	D41378A4	
		ESCUTCHEON LEGEND	D41379A2	
		WIRING	D41380A1	
		OPERATING INSTRUCTIONS LABEL	D41836A3	
FURTHER INFORMATION REQUIRED FOR MANUFACTURE				
		UNIT ASSEMBLY INFORMATION	EA10484	
		UNIT WIRING INFORMATION	EA10137	
			EA10139	
			EA10140	
		TRANSFORMER INFORMATION	AL/82/J9/PC	
		LABEL	D39107A4-CP	
1	1	CASE - TOPPER CASES (HUNTINGDON) LTD		
		TYPE BBC 7 INSTRUMENT CASE, EXTERNAL		
		REF. DIMS. 7 ³ / ₄ " X 7 ³ / ₄ " X 4"		
		MODIFIED TO		D41361A1 DET. II
2	1	MOUNTING PANEL		D41360A1 DET. I

BBC
DS:PLA4

TEI/25
TESTER, P.P.M
PARTS LIST

DRN.	GRB	DESIGNS DEPARTMENT
TPD.		
CKD.	R.K.L.	D41358A4
APPD.		SHEET 1 OF 15 SHEETS

CHANGE
4-2-77

ITEM No.	No. OFF	DESCRIPTION	C/C'T REF.	BBC REF. OR DRG. No.
3	1	ESCUTCHEON		D41360A1 DET. 2
4	1	MOUNTING BAR		D41360A1 DET. 3
5	1	MOUNTING BAR		D41360A1 DET. 4
6	1	L.H. SIDE PANEL INCLUDING:- 4 OFF M4 HANK BUSH. 2 OFF M2.5 HANK BUSH		D41361A1 DET. 9
7	1	R.H. SIDE PANEL INCLUDING:- 4 OFF M4 HANK BUSH 2 OFF M2.5 HANK BUSH		D41361A1 DET. 10
8	1	SWITCH SUPPORT BRACKET		D41361A1 DET. 14
9	1	LABEL ENGRAVED TO:-		D39107A4 - CP D41360A1 DET. 5
10	2	SPACER		D41360A1 DET. 6
11	1	THUMBSCREW		D41360A1 DET. 7
12	1	PILLAR		D41360A1 DET. 8
13	1	SPACER, M3 TAPPED, 5LG		1-58285-0211352
14	1	LABEL, OPERATING INSTRUCTIONS		D41836A3
15				
16	1	PRINTED BOARD No.1		D41362A1, D41363A1 D41364A1, D41365A3
17	1	PRINTED BOARD No.2		D41366A4, D41367A4 D41368A4
18	1	PRINTED BOARD No.3		D41369A4, D41370A4 D41371A4
19	1	PRINTED BOARD No.4		D41372A4, D41373A4 D41374A4
20	1	PRINTED BOARD No.5		D41375A4, D41376A4 D41377A4
21				
22	1	BATTERY COVER		D41361A1 DET. 13
23	2	RUBBER PAD - 60mm X 50mm X 4.8mm (3/16) THICK "RUBAZOTE"		
24				

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BBC

DS/PLA4

TEI/25
PARTS LIST

DRN.	GRB	DESIGNS DEPARTMENT
TPD.		
CKD.	KKZ	D41358A4
APPD.		SHEET 2 OF 15 SHEETS

TEI/25 PARTS LIST

CHANGE
4-2-77
3-2-77

ITEM No.	No. OFF	DESCRIPTION	C/C'T REF.	BBC REF. OR DRG. No.
25	A/R	WIRE PUF 1/3M BLUE		
26	A/R	WIRE PUF 1/3M ORANGE		
27	A/R	WIRE PUF 1/3M GREEN		
28	A/R	WIRE PUF 1/3M SLATE		
29	A/R	WIRE PUF 1/3M BROWN		
30	A/R	WIRE PUF 1/3M WHITE		
31	A/R	WIRE PUF 1/3M RED		
32	A/R	WIRE PUF 1/3M BLACK		
33	A/R	WIRE PUF 1/3M YELLOW		
34	A/R	WIRE PUF 1/3M VIOLET		
35				
36	A/R	22 SWG B.T.C.		
37				
38	A/R	CABLE PSN 1/1M		
39				
40	A/R	LACING CORD		
41				
42				
		<u>SCREWS</u>	<u>FOR FIXING ITEMS</u>	
43	B	M4X6 LG PAN HD M.S. Zn.P	6, 7, 16	
44				
45	1	M3X16 LG PAN HD M.S. Zn.P	13	
46	5	M3X10 LG PAN HD M.S. Zn.P	104, 221	
47				
48	1	M3X6 LG CSK HD M.S. Zn.P	12	
49				
50	2	M2.5 X 10 LG CSK HD M.S. Zn.P	249	
51	2	M2.5 X 8 LG CSK HD M.S. Zn.P	8	
52	14	M2.5 X 6 LG CSK HD M.S. Zn.P	2, 4, 5, 10, 257	
53	10	M2.5 X 6 LG PAN HD M.S. Zn.P	252, 253, 254	
54				
55	6	M2X6 LG PAN HD M.S. Zn.P	3, 9	
56				
57				
58				
		<u>NUTS</u>		
59	6	M3 HEX FULL M.S. Zn.P	13, 104, 221	
60	2	M2 HEX FULL M.S. Zn.P	9	
61	4	M2.5 HEX FULL M.S. Zn.P	8, 249	
62				
		<u>WASHERS</u>		
63	8	M4 PLAIN M.S. Zn.P	6, 7, 16	
64				
65	6	M3 PLAIN M.S. Zn.P	13, 104, 221	
66	2	M2.5 PLAIN M.S. Zn.P	8	
67	2	M2 PLAIN M.S. Zn.P	9	
68				
69	1	M6 NORMAL, BEVELLED EDGE M.S. Cr. P. (POL)	11	1-38511-806
70				
71				
72				

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BBC
DS/PLA4

TEI/25
PARTS LIST

DRN.	GRB	DESIGNS DEPARTMENT D41358A4 SHEET 3 OF 15 SHEETS
TPD.		
CKD.	RKL	
APPD.		

ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
101	3	Button,Switch,Grey:Isostat 4716(grey)	
102	2	Button,Switch,Red:Isostat 4716(red)	
103	14	Button,Switch,Black:Isostat 4716(black)	
104	4	* Foot,Plastic,Grey:Engineering Enterprises 497	0350096
105	2	Battery Connector(Pair):RS Comp. 488-012	
106	1	Knob,K5,Black,Modified To:-	D19211A4CP DET3
107	1	Knob,K6,Black,Modified To:-	D19445A4 DET3
108	7	* Pin,Terminal:Sealectro A0013620G/T	0239341
109	54	* Tag:Vero TP11034	0277818
110			
111			
112			
113			
114			
115			
116			
117			
CAPACITORS			
118	2	47nF,1%,160V dc,Capacitor,Rectang,Polycarbonate Advance Filmcap CMRO 10A(Selected By Manufacturer) (2) 1C1, 1C3	
119	1	1.0uF,1%,160V dc,Capacitor,Rectang,Polycarbonate Advance Filmcap CMR 20A(Selected By Manufacturer) (1) 1C15	

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ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
120	1	10uF, 10%, 20V dc, Capacitor: ITT TAA B10325 (1) 1C12	
121	1	* 100nF, -25+50%, 30V dc, Capacitor, Ceramic, Disc (1) 1C13	S20614-0085109
122	1	* 47uF, -10+50%, 10V dc, Capacitor, Min. Elect. (1) 1C5	S20713-0204849
123	1	* 10uF, -10+50%, 25V dc, Capacitor, Min. Elect. (1) 1C4	S20714-0204901
124	3	* 22uF, -10+50%, 25V dc, Capacitor, Min. Elect. (3) 1C6, 1C18, 1C19	S20714-020491X
125	1	* 1.0mF, -10+50%, 10V dc, Capacitor, Min. Elect. (1) 1C10	S20723-0207946
126	4	* 470uF, -20+100%, 10V dc, Capacitor, Plug-in Elect. (4) 1C7, 1C9, 1C16, 1C17	S20811-0211257
127	1	* 47uF, -20+100%, 35V dc, Capacitor, Plug-in Elect. (1) 5C1	S20814-0211281
128	1	* 5.6pF, -+1p, 125V dc, Capacitor, Polystyrene Foil (1) 1C2	S21004-0208182
129	1	* 510pF, 2%, 125V dc, Capacitor, Polystyrene Foil, AOT (1) 2C1	S21004-0084692
130	2	* 10nF, 10%, 250V dc, Capacitor, Metallised Polyester (2) 1C11, 1C14	S21034-0209041
131	1	* 470nF, 10%, 100V dc, Capacitor, Metallised, Poly, AOT (1) 1C20	S21034-0209139
132			
133			
134			
135			
136			

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ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
RESISTORS			
137	1	30.0 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R43	
138	1	31.8 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R40	
139	1	51.8 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R34	
140	1	58.8 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R44	
141	1	60.9 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R42	
142	1	62.1 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R41	
143	1	64.5 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R39	
144	1	65.2 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R33	
145	1	69.6 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R46	
146	1	71.7 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R45	
147	1	82.0 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R32	
148	1	82.5 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R38	
149	1	85.2 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R37	
150	1	103.4 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R31	
151	1	130.0 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R30	
152	1	163.8 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R29	
153	1	200.0 ohm, 0.25%, Resistor, Metal Film: Holco H8 (1) 1R35	

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ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
154	1	206.2 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R28	
155	1	259.6 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R27	
156	1	326.6 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R26	
157	1	411.4 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R25	
158	1	518.0 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R24	
159	1	652.0 ohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R23	
160	1	1.818kohm,1%,Resistor,Metal Film:Holco H8 (1) 4R1	
161	1	2.383kohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R47	
162	1	3.60kohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R20	
163	1	4.545kohm,1%,Resistor,Metal Film:Holco H8 (1) 4R2	
164	1	7.78kohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R19	
165	1	24.6kohm,0.25%,Resistor,Metal Film:Holco H8 (1) 1R18	
166	1	90.91kohm,1%,Resistor,Metal Film:Holco H8 (1) 4R4	
167	1	171.0kohm,1%,Resistor,Metal Film:Holco H8 (1) 3R1	
168	1	191.0kohm,1%,Resistor,Metal Film:Holco H8 (1) 3R2	
169	1	205.0kohm,1%,Resistor,Metal Film:Holco H8 (1) 3R3	
170	1	219.0kohm,1%,Resistor,Metal Film:Holco H8 (1) 3R4	
171	1	* 2.7 ohm,5%,Resistor,Carbon Film,0.33W. (1) 1R55	S26833-0210347

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ITEM No.	Qty		DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
172	1	*	1.5Mohm,5%,Resistor,Carbon Film,0.33W. (1) 1R7	S26833-0211064
173	2	*	10 ohm,2%,Resistor,Metal Film,0.4W. (2) 1R54, 1R56	S26877-0099433
174	2	*	47 ohm,2%,Resistor,Metal Film,0.4W. (2) 1R53, 1R57	S26877-0099291
175	2	*	82 ohm,2%,Resistor,Metal Film,0.4W. (2) 2R5, 2R7	S26877-0099303
176	4	*	100 ohm,2%,Resistor,Metal Film,0.4W. (4) 1R50, 1R51, 1R61, 1R62	S26877-0099007
177	2	*	240 ohm,2%,Resistor,Metal Film,0.4W. (2) 2R12, 2R14	S26877-009932X
178	1	*	620 ohm,2%,Resistor,Metal Film,0.4W. (1) 1R64	S26877-0099058
179	2	*	680 ohm,2%,Resistor,Metal Film,0.4W. (2) 2R9, 2R10	S26877-0099066
180	1	*	820kohm,2%,Resistor,Metal Film,0.4W,AOT (1) 1R6	S26877-0228283
181	3	*	1.2kohm,2%,Resistor,Metal Film,0.4W. (2) 2R1, 2R3 (1) 5R6	S26877-0099102
182	1	*	2.0kohm,2%,Resistor,Metal Film,0.4W. (1) 1R58	S26877-0099137
183	1	*	2.4kohm,2%,Resistor,Metal Film,0.4W. (1) 1R63	S26877-0099153
184	1	*	3.0kohm,2%,Resistor,Metal Film,0.4W,AOT (1) 5R4	S26877-0099362
185	2	*	3.3kohm,2%,Resistor,Metal Film,0.4W. (2) 2R6, 2R8	S26877-0099161
186	2	*	3.6kohm,2%,Resistor,Metal Film,0.4W. (2) 2R11, 2R13	S26877-0227996
187	3	*	3.9kohm,2%,Resistor,Metal Film,0.4W. (3) 1R5, 1R12, 1R14	S26877-009917X
188	1	*	4.3kohm,2%,Resistor,Metal Film,0.4W. (1) 5R5	S26877-0099188
189	1	*	4.7kohm,2%,Resistor,Metal Film,0.4W. (1) 1R9	S26877-0099425

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ITEM No.	Qty		DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
190	2	*	5.6kohm, 2%, Resistor, Metal Film, 0.4W. (2) 1R15, 1R59	S26877-0228019
191	2	*	6.2kohm, 2%, Resistor, Metal Film, 0.4W. (2) 1R49, 1R52	S26877-0099196
192	4	*	10kohm, 2%, Resistor, Metal Film, 0.4W. (4) 1R4, 1R10, 1R13, 1R48	S26877-0099224
193	1	*	11kohm, 2%, Resistor, Metal Film, 0.4W. (1) 3R6	S26877-0099504
194	2	*	20kohm, 2%, Resistor, Metal Film, 0.4W. (2) 1R2, 1R11	S26877-022806X
195	1	*	22kohm, 2%, Resistor, Metal Film, 0.4W. (1) 1R1	S26877-0228078
196	3	*	30kohm, 2%, Resistor, Metal Film, 0.4W. (3) 1R21, 1R22, 1R60	S26877-0228094
197	1	*	47kohm, 2%, Resistor, Metal Film, 0.4W. (1) 1R3	S26877-0099267
198	3	*	51kohm, 2%, Resistor, Metal Film, 0.4W. (3) 5R1, 5R2, 5R3	S26877-0228122
199	2	*	110kohm, 2%, Resistor, Metal Film, 0.4W. (2) 2R2, 2R4	S26877-022819X
200	1	*	180kohm, 2%, Resistor, Metal Film, 0.4W. (1) 4R5	S26877-0099409
201	1	*	430kohm, 2%, Resistor, Metal Film, 0.4W. (1) 3R5	S26877-0228307
202	1	*	1.0kohm, 10%, Var. Resistor, Cermet, Multiturn, 0.33W (1) 1R17	S27241-0211423
203	1	*	2.0kohm, 10%, Var. Resistor, Cermet, Multiturn, 0.33W (1) 1R16	S27241-0211431
204	1	*	5.0kohm, 10%, Var. Resistor, Cermet, Multiturn, 0.33W (1) 1R8	S27241-021144X
205	1		9.09K ohm, 10% RESISTOR, METAL FILM, HOLCO HB (1) 4R3	
206				
207				

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BBC
 VM423A4

ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
208			
209			
210			
211			
212			
213			
214			
215			
216			
217			
218			
219			
220			
		TRANSFORMERS	
221	1	AL/82J9PC Modified To:- (1) 1T1	D41361A1 DET12
222			
223			

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ITEM No.	Qty		DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
DIODES				
224	5	*	1N4148 (3) 1D1, 1D2, 1D3 (2) 5D3, 5D4	0102612
225	2	*	AAY32 (2) 5D1, 5D2	0110935
226				
227				
228				
TRANSISTORS				
229	1	*	BC108 (1) 1TR2	014975X
230	1	*	BC109 (1) 1TR4	0112282
231	1	*	BF244A (1) 1TR1	0171869
232	1	*	BCY70 (1) 1TR3	011278X
233				
234				
235				
INTEGRATED CIRCUITS				
236	1	*	NE556A (1) 1IC6	017726X
237	3	*	LIC741CS (3) 1IC3, 1IC4, 1IC5	0151232
238	1	*	LIC748CS (1) 1IC1	0153742

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ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
239	1	LIC796CG (1) 11C2	015894X
240			
241			
242			
BATTERIES			
243	2	Battery,9V dc:Ever Ready PP9 (2) B1, B2	
244			
245			
JACKS			
246	1	Jack,Fixed,Short,8 Point,90 deg. Terminals (1) JK.A	S23185-0375426
247			
248			
METERS			
249	1	Meter,Moving Coil,Edgewise(100uA FSD):Turner 125 Scale Modified BY MANUFACTURER TO D41370A4 DET.15 (1) ME1	
250			
251			

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ITEM No.	Qty	DESCRIPTION AND CIRCUIT REFERENCE	BBC REF. or DRG.No.
SWITCHES			
252	3	Switch, 4 Module, Interlocking, 6 Contacts Bracket Length 80.1mm: Isostat(Professional)CD-17.5 (1) 2S1, 2S2, 2S3, 2S4 (1) 3S1, 3S2, 3S3, 3S4 (1) 4S1, 4S2, 4S3, 4S4	
253	1	Switch, 4 Module, Momentary, 6 Contacts Bracket Length 80.1mm: Isostat(Professional)CD-17.5 (1) 5S1, 5S2, 5S3, 5S4	
254	1	Switch, 3 Module(Alternate Positions)12 Contacts Bracket Length 97.6mm(5 Module Lengths): Isostat(Professional)CD 17.5 (1) S2, S3, S4	
255	1	Switch, Rotary: Diamond H Controls 02-6216-AMD1 DQ8208 (1) 1S1	
256	1	Switch, Rotary: Diamond H Controls 02-6215-E01 DQ8208 (1) 1S2	
257	1	Switch, Wafer, Lever Operated, 1 Pole, 3 Way, MBB (1) S1	0344800

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CIRCUIT REFERENCE INDEX

1C1 118	1R13 192	1R50 176		B1 243
1C2 128	1R14 187	1R51 176	4R1 160	B2 243
1C3 118	1R15 190	1R52 191	4R2 163	
1C4 123	1R16 203	1R53 174	4R3 205	JK.A 246
1C5 122	1R17 202	1R54 173	4R4 166	
1C6 124	1R18 165	1R55 171	4R5 200	ME1 249
1C7 126	1R19 164	1R56 173		
	1R20 162	1R57 174	5R1 198	S1 257
1C9 126	1R21 196	1R58 182	5R2 198	S2 254
1C10 125	1R22 196	1R59 190	5R3 198	S3 254
1C11 130	1R23 159	1R60 196	5R4 184	S4 254
1C12 120	1R24 158	1R61 176	5R5 188	
1C13 121	1R25 157	1R62 176	5R6 181	1S1 255
1C14 130	1R26 156	1R63 183		1S2 256
1C15 119	1R27 155	1R64 178	1T1 221	
1C16 126	1R28 154			2S1 252
1C17 126	1R29 152	2R1 181	1D1 224	2S2 252
1C18 124	1R30 151	2R2 199	1D2 224	2S3 252
1C19 124	1R31 150	2R3 181	1D3 224	2S4 252
1C20 131	1R32 147	2R4 199		
	1R33 144	2R5 175	5D1 225	3S1 252
2C1 129	1R34 139	2R6 185	5D2 225	3S2 252
	1R35 153	2R7 175	5D3 224	3S3 252
5C1 127		2R8 185	5D4 224	3S4 252
	1R37 149	2R9 179		
1R1 195	1R38 148	2R10 179	1TR1 231	4S1 252
1R2 194	1R39 143	2R11 186	1TR2 229	4S2 252
1R3 197	1R40 138	2R12 177	1TR3 232	4S3 252
1R4 192	1R41 142	2R13 186	1TR4 230	4S4 252
1R5 187	1R42 141	2R14 177		
1R6 180	1R43 137		1IC1 238	5S1 253
1R7 172	1R44 140	3R1 167	1IC2 239	5S2 253
1R8 204	1R45 146	3R2 168	1IC3 237	5S3 253
1R9 189	1R46 145	3R3 169	1IC4 237	5S4 253
1R10 192	1R47 161	3R4 170	1IC5 237	
1R11 194	1R48 192	3R5 201	1IC6 236	
1R12 187	1R49 191	3R6 193		

END OF CIRCUIT REFERENCE INDEX.

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ORIGINAL
FRAME SIZE
190mm x 277mm

ALL DIMENSIONS IN MILLIMETRES UNLESS
OTHERWISE STATED

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BBC

VM418/A4

SHT.	ISS.	DETAILS OF CHANGE	SHT.	ISS.	DETAILS OF CHANGE
4	2	EXTENSIVE CHANGES TO RESISTOR & CAPACITOR ITEMS G.R.B. 2-3-77			
5	2				
6	2				
7	2				
8	2				
9	2				
10	2				
11	2				
12	2				
13	2				
14	2				
15	2				
3	2				
12	3	ITEM 249 INFORMATION ALTERED 21-3-77 G.R.B.			
7	3	RESISTOR VALUE CHANGES 31-3-77 G.R.B.			
8	3				
9	3				
14	3				
15	4				

DESIGNS DEPARTMENT

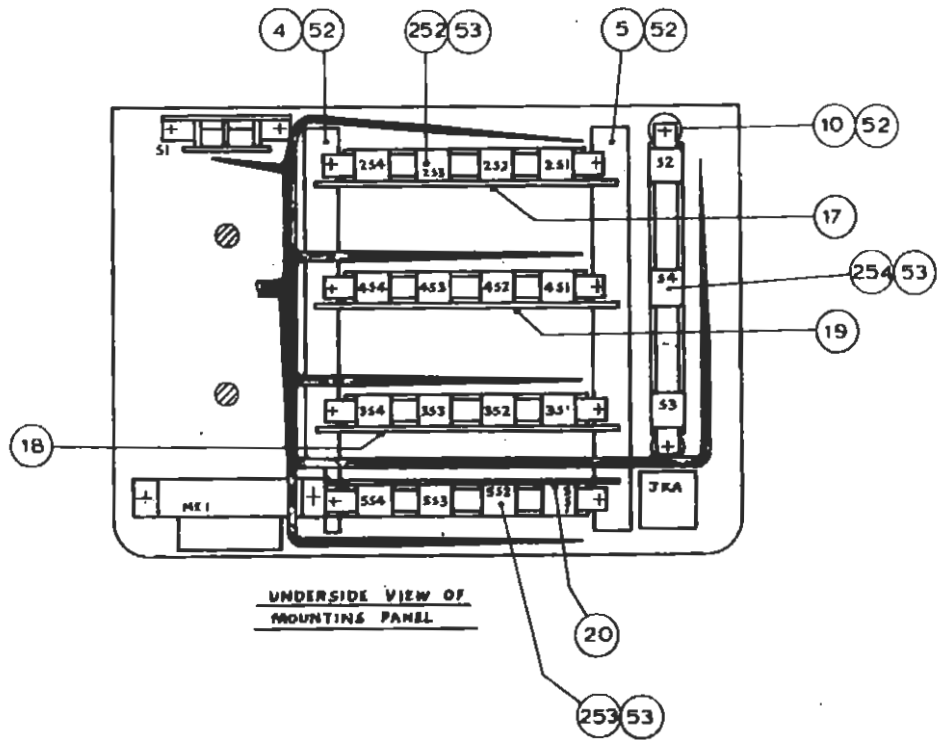
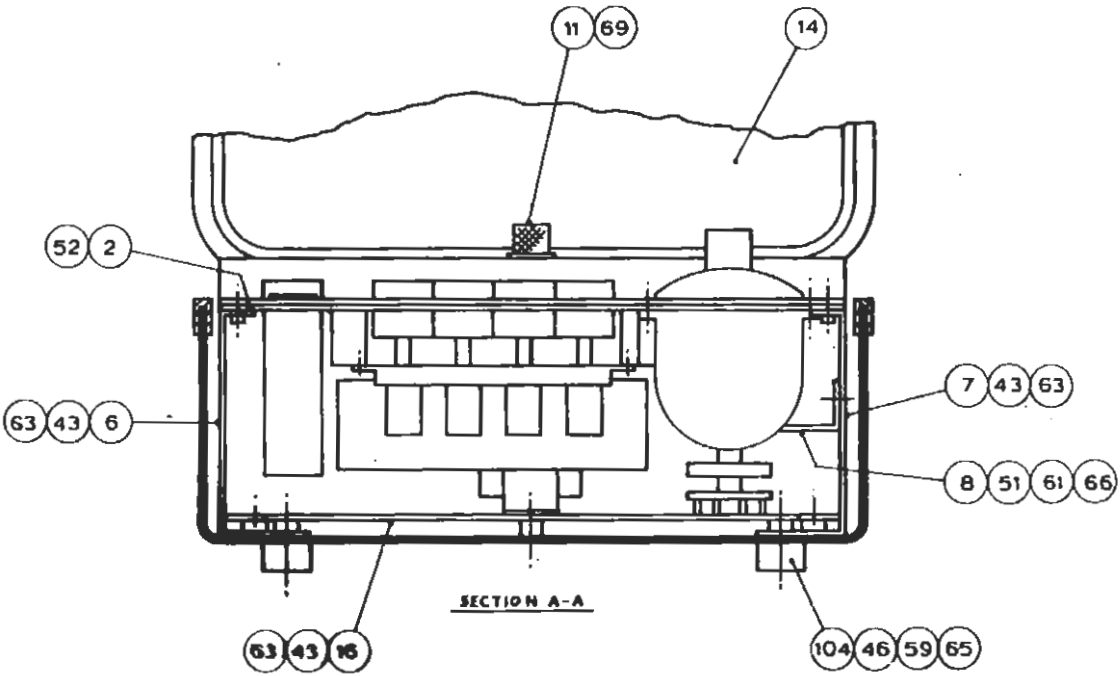
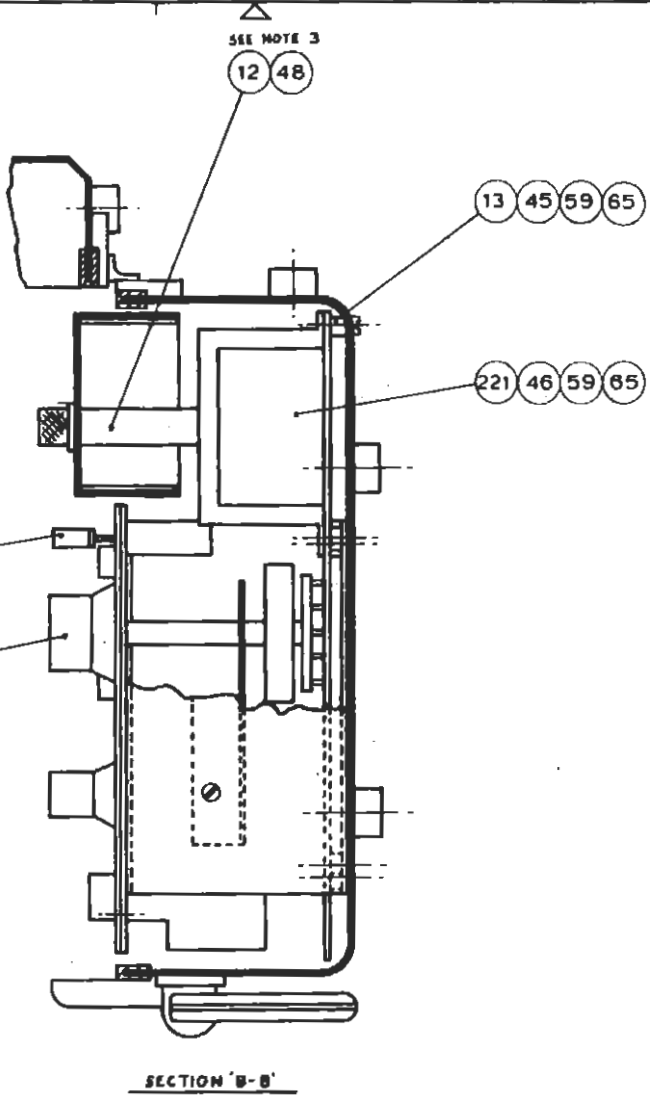
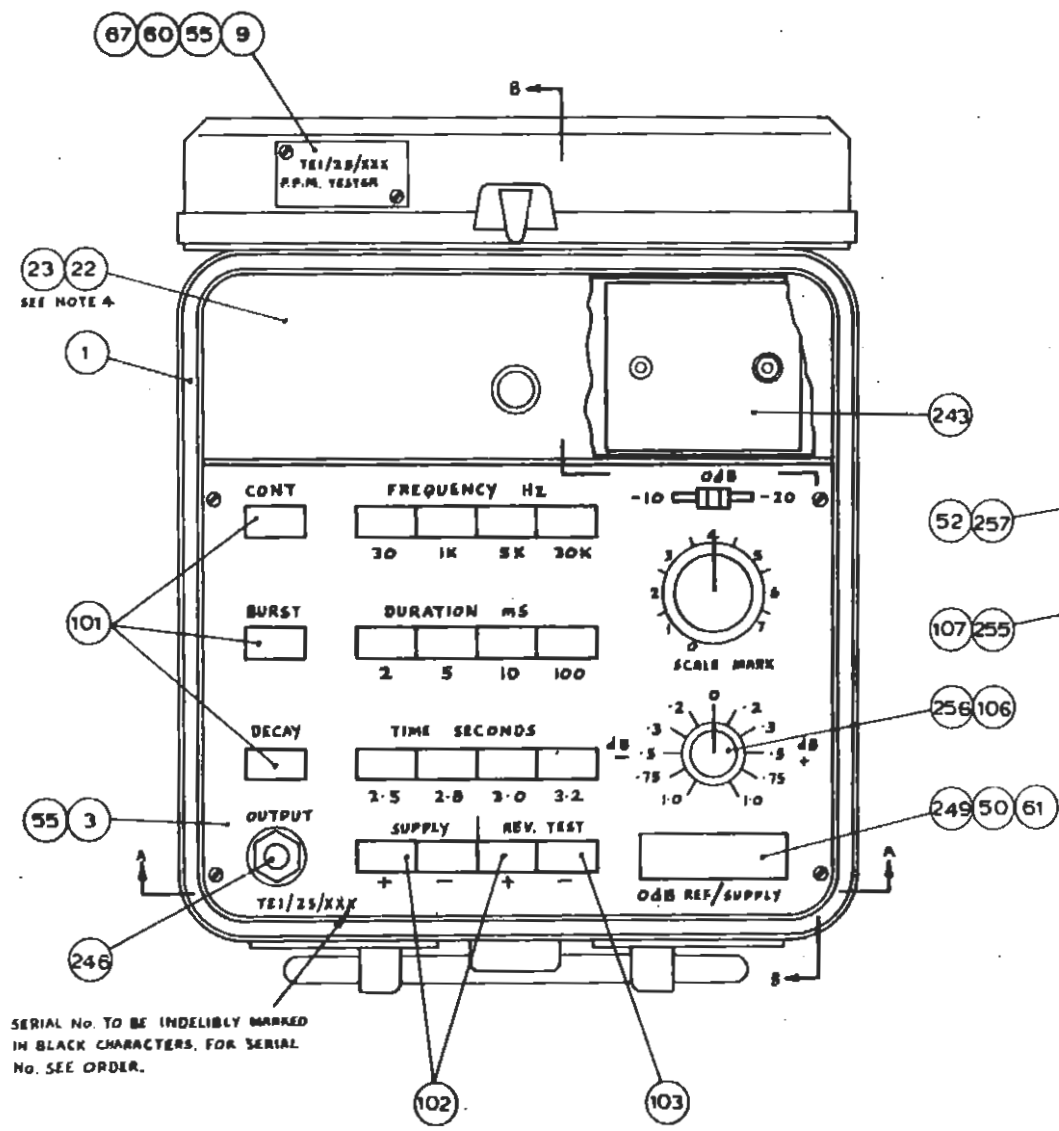
CODE:- TR1/25

PARTS LIST CHANGE RECORD, ISSUE:- 4 31/3/77

D41358 A4

SHEET 15

- NOTES**
1. UNIT TO BE ASSEMBLED IN ACCORDANCE WITH DRG. EA10484 NOTES 1,4,6,7,17.
 2. COMPONENTS TO BE FITTED TO PRINTED BOARDS IN ACCORDANCE WITH DRG. EA10140 NOTES 1,4,9,18.
 3. APPLY LOCTITE TO SCREW SECURING PILLAR TO TRANSFORMER BEFORE ASSEMBLY.
 4. STICK RUBBER PADS INSIDE TOP OF BATTERY COVER USING "EVOSTICK" OR SIMILAR.



SERIAL No. TO BE INDELIBLY MARKED IN BLACK CHARACTERS. FOR SERIAL No. SEE ORDER.

FOR WIRING INFORMATION
SEE WIRING DIAGRAM D41350A1

THIRD ANGLE PROJECTION

All dimensions in millimeters unless otherwise stated.

Normal tolerances
No decimal place ± 0.5 mm
One decimal place ± 0.3 mm
Two decimal places ± 0.2 mm
Unless otherwise stated

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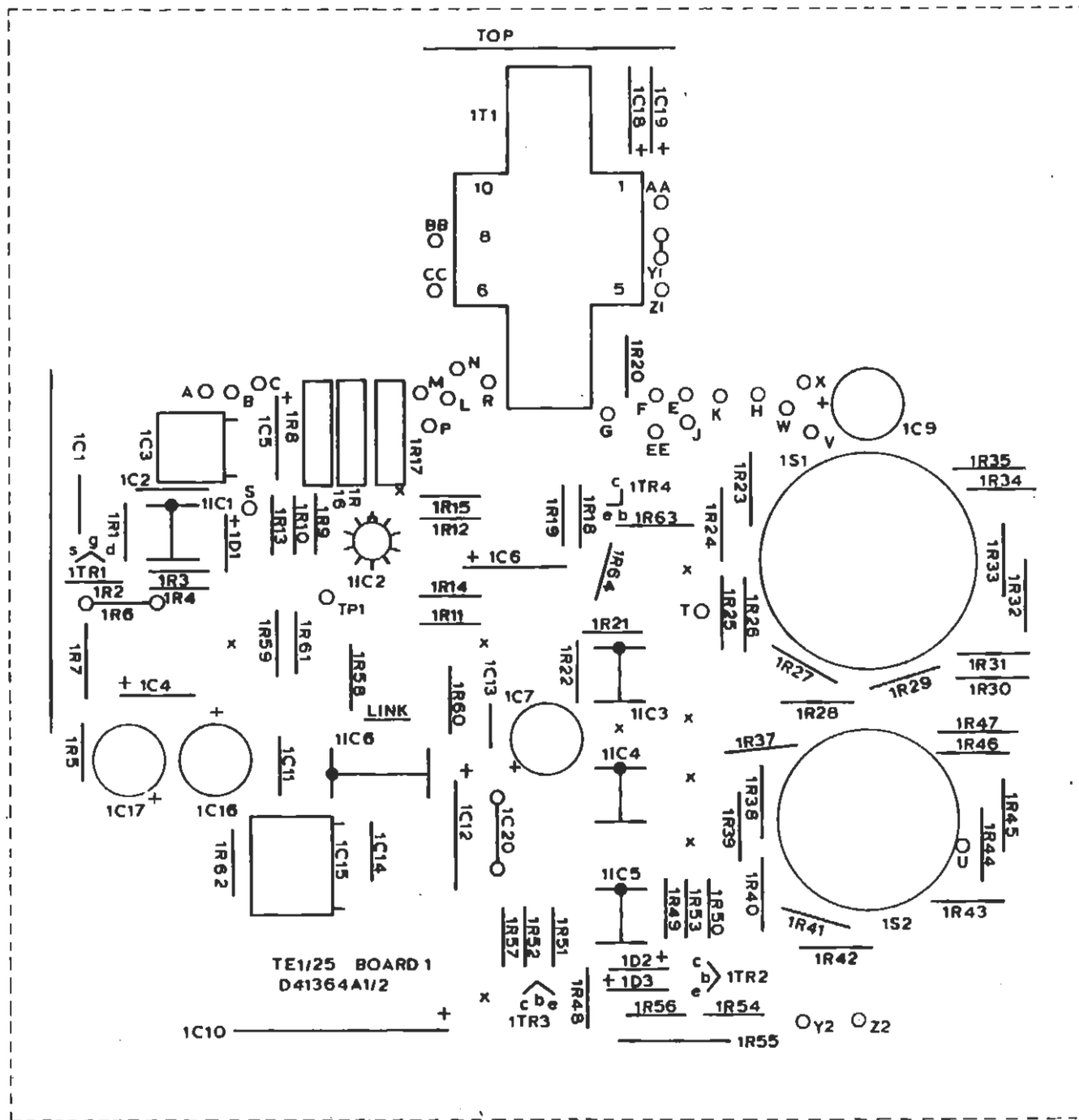
TE1/25
ASSEMBLY

DRN	TCD	CKD	APPD.
GER			
DESIGNS DEPARTMENT			
D41359A1			

PARTS LIST: D41358A4

D41359A1

D41364A1



CHARACTERS & LINES TO BE PRINTED IN BLACK.
 PRINTED WIRING ON REVERSE SIDE OF BOARD IS D41362A1
 PRINTED WIRING ON COMPONENT SIDE OF BOARD IS D41363A1

SCALE 2:1

Original Form No. 61			
CHANGE			
4-2-77	1		
24-2-77	2		
THIRD ANGLE PROJECTION			
All dimensions in millimeters unless otherwise stated			
Revised tolerances			
no decimal place	+1 mm		
one decimal place	+0.2mm		
two decimal places	+0.1mm		
unless otherwise stated			
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TE1/25			
F.B. BOARD 1 COMPONENT LOCATION			
DRN	TCD	CKD	APPD.
GR		PK	
ORIGINS DEPARTMENT			
D41364A1			

D41367 A4

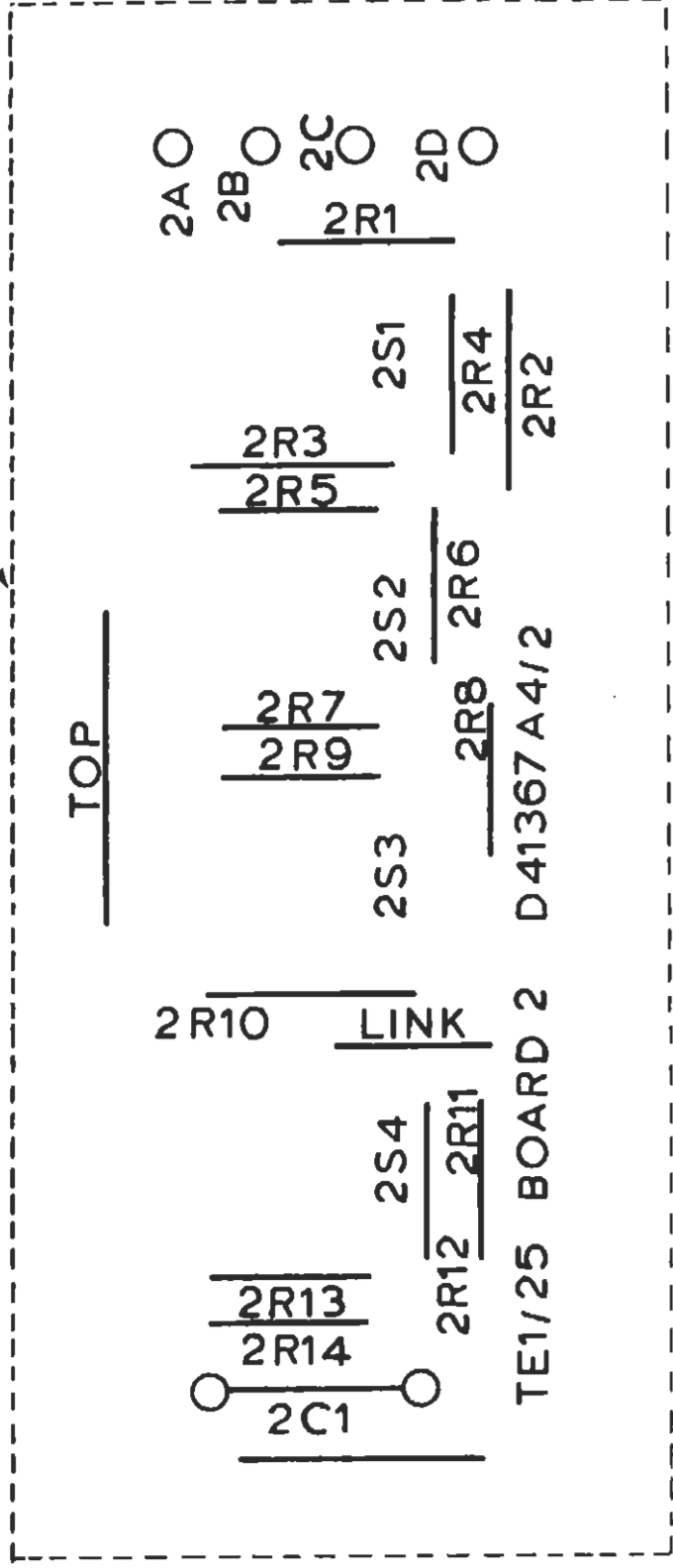
TE1/25 PRINTED BOARD COMPONENT LOCATION No.2

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BBC VM161A4

CHANGE
4-2-77
24-2-77

MINIMUM SIZE TO CUT NEGATIVE



TE1/25 PRINTED BOARD No.2 COMPONENT LOCATION

DRN	GRB
TCD	
CKD	RKL
APPD	

DESIGNS DEPT

D41367A4

CHARACTERS AND LINES TO BE PRINTED IN WHITE/BLACK.
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D41366A4

SCALE 2:1

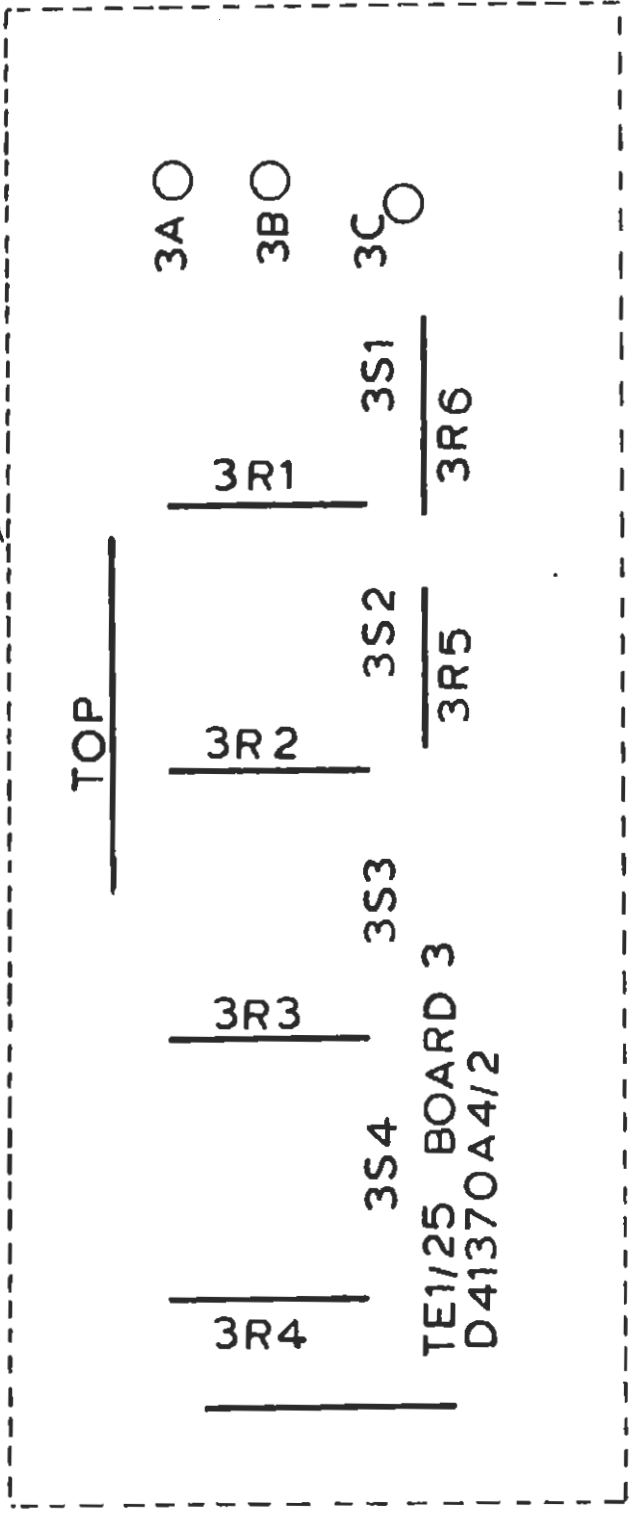
D 41370 A 4

TE1/25 PRINTED BOARD COMPONENT LOCATION No. 3

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CHANGE	IS
4-2-77	1
24-2-77	2

MINIMUM SIZE TO CUT NEGATIVE



CHARACTERS AND LINES TO BE PRINTED IN WHITE/ ~~BLACK~~.
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D41369A4

SCALE 2:1

BBC
VM161A4

TE1/25 PRINTED BOARD No. 3
COMPONENT LOCATION

DRN	GRB
TCD	
CKD	R.K.L.
APPD	

DESIGNS DEPT

D41370A4

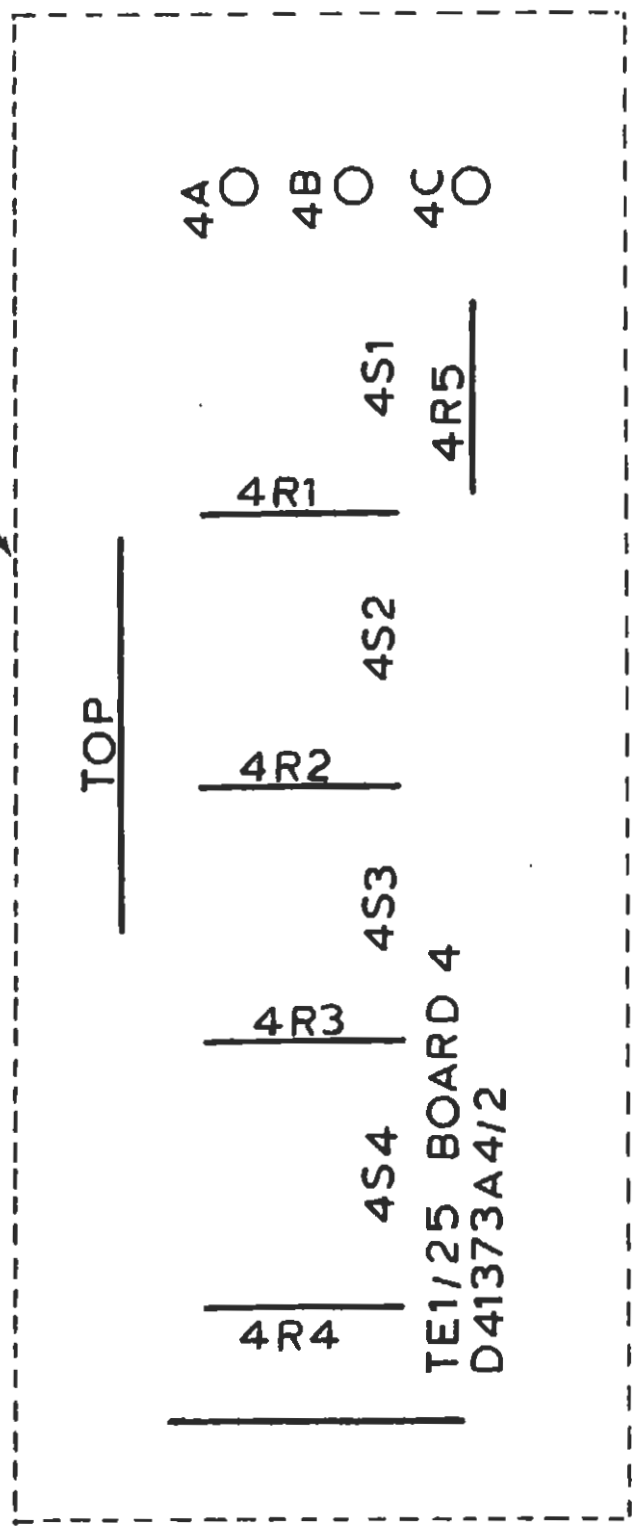
D41373A4

TE1/25 PRINTED BOARD COMPONENT LOCATION No. 4

CHANGE
4-2-77
24-2-77

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MINIMUM SIZE TO CUT NEGATIVE



CHARACTERS AND LINES TO BE PRINTED IN WHITE / ~~BLACK~~.
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D4-1372A4

SCALE 2:1

BBC

VM181A4

TE1/25 PRINTED BOARD No. 4
COMPONENT LOCATION

DRN	6RB
TCD	
CKD	R.K.L.
APPD	R.K.L.

DESIGNS DEPT

D41373A4

D41376A4

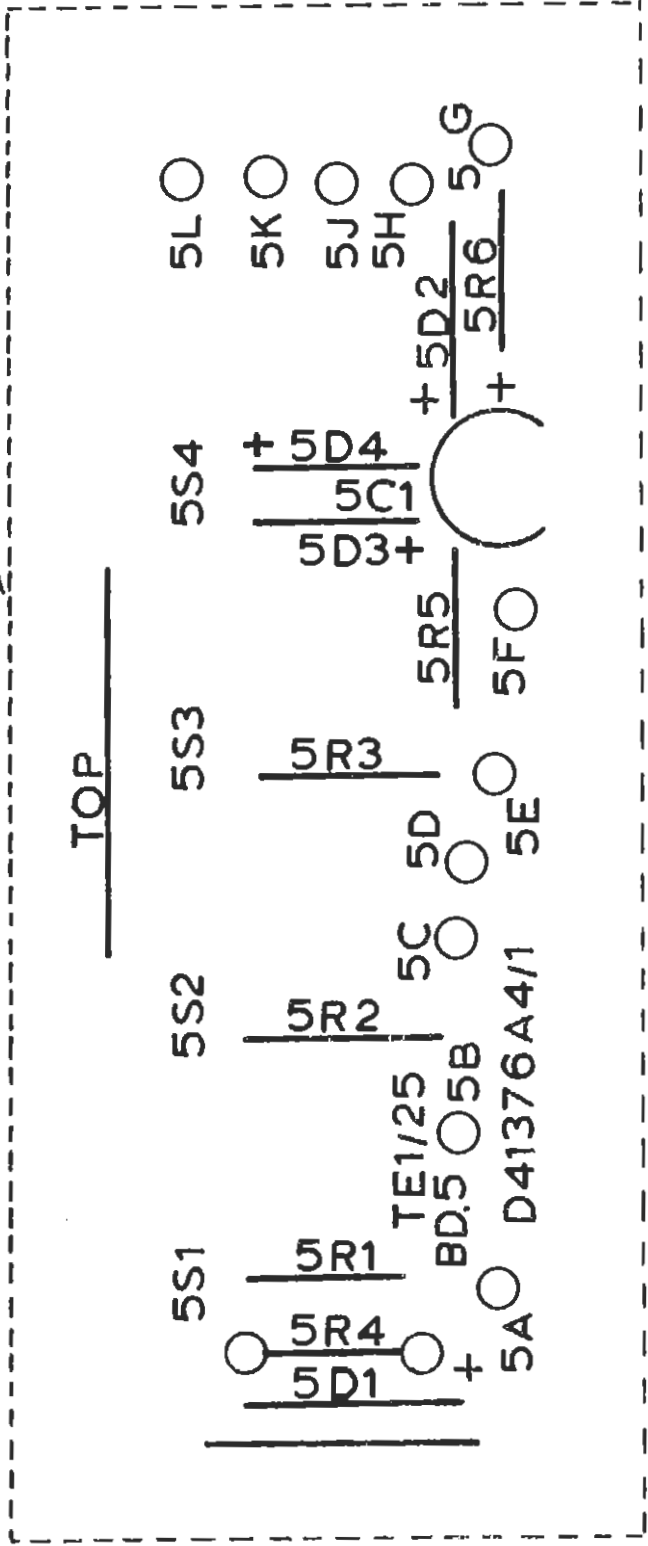
TE1/25 PRINTED BOARD COMPONENT LOCATION No.5

CHANGE
4-2-77

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MINIMUM SIZE TO CUT NEGATIVE

TOP



CHARACTERS AND LINES TO BE PRINTED IN WHITE/~~BLACK~~.
PRINTED WIRING ON REVERSE SIDE OF BOARD IS D41375A4

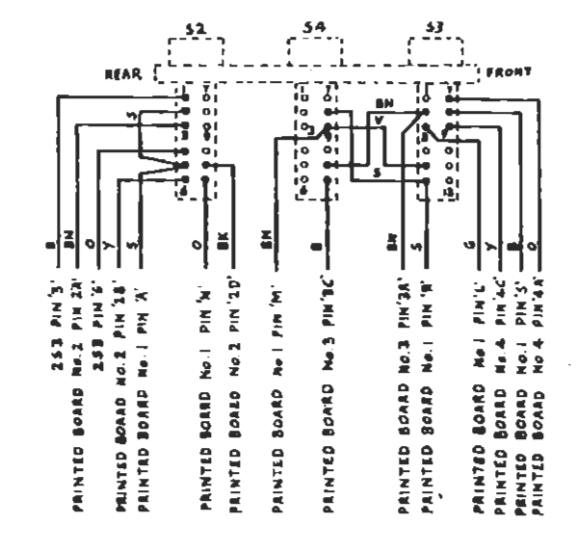
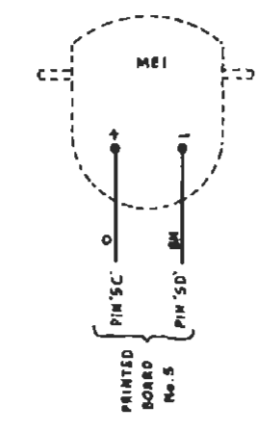
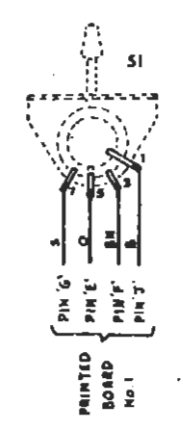
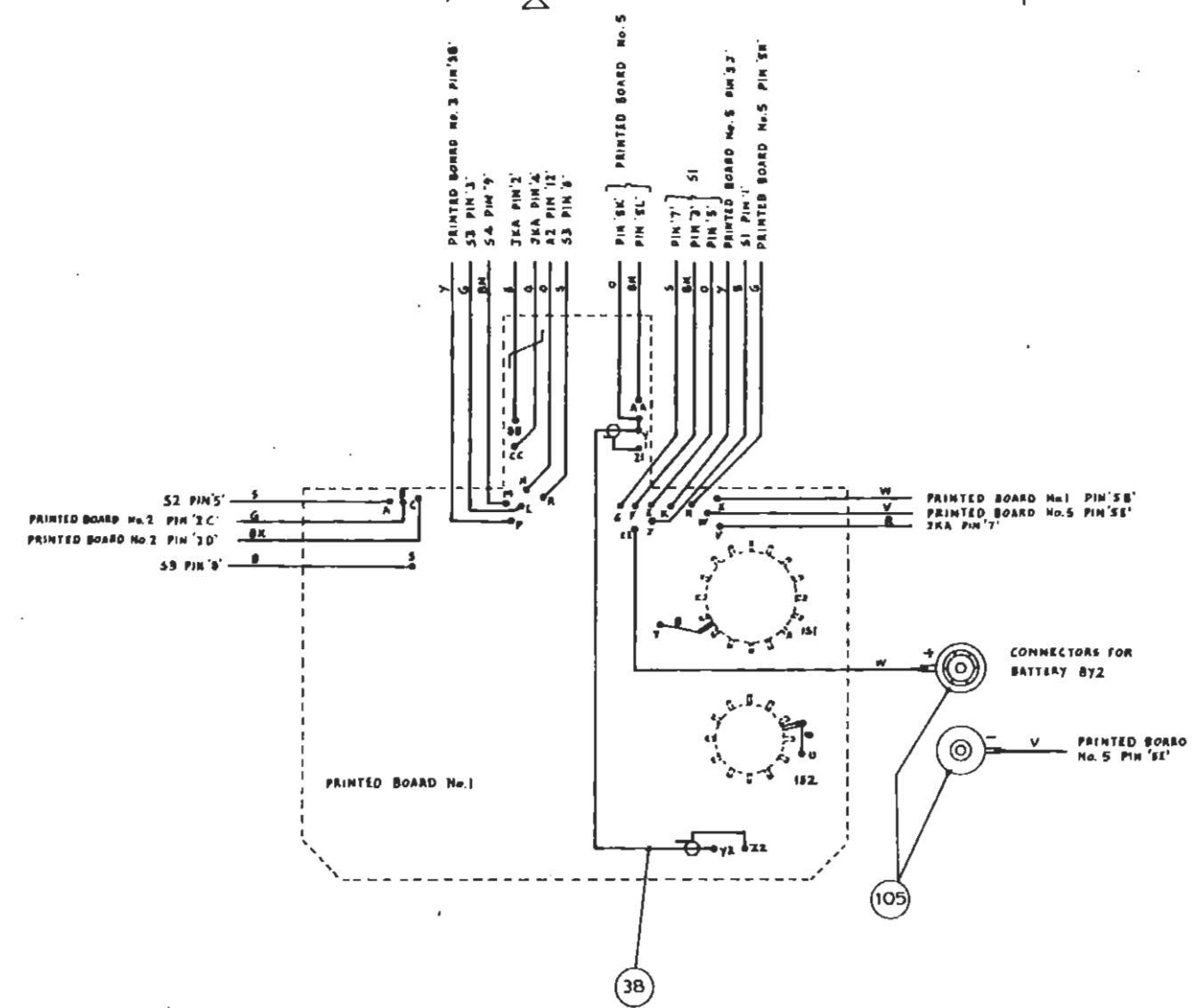
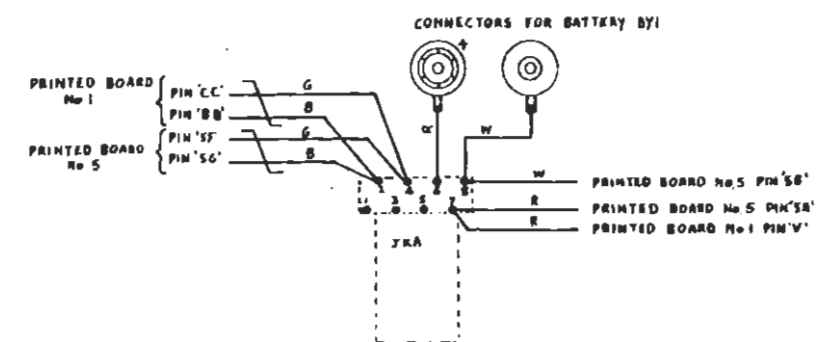
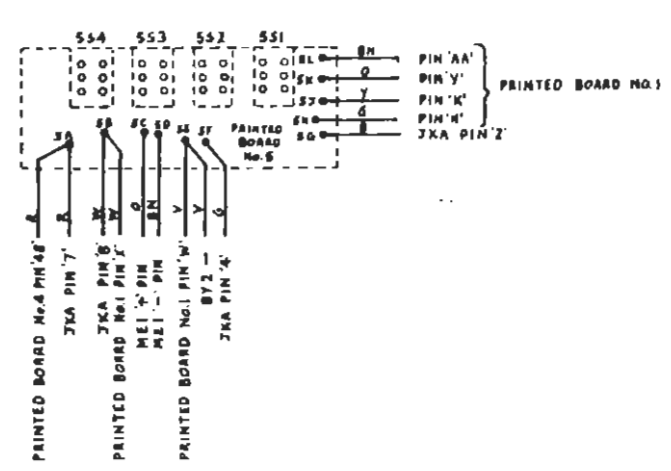
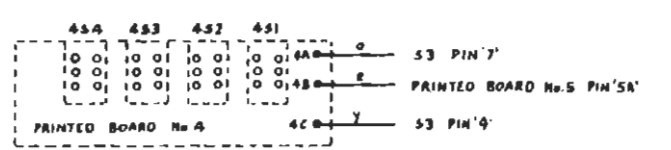
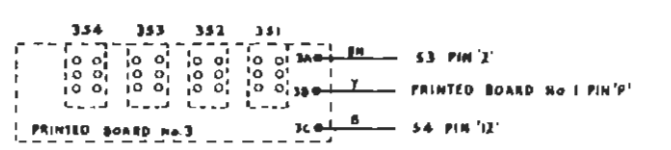
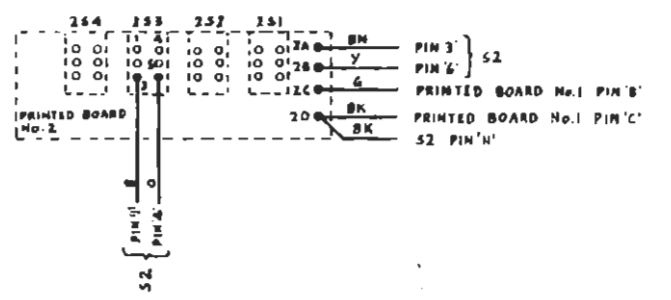
SCALE 2:1

BBC
VM161A4

TE1/25 PRINTED BOARD No.5
COMPONENT LOCATION

DRN	GRB
TCD	
CKD	RKL
APPD	

DESIGNS DEPT
D41376A4



- NOTES**
1. WIRING TO BE IN ACCORDANCE WITH DA6. EA10137 NOTES 2, 3, 5 & EA10139 NOTE 16.
 2. ALL WIRING TO BE IN PUF13M, COLOURS AS SHOWN, UNLESS OTHERWISE STATED.
 3. WIRING TO BE LACED USING CORD ITEM .
 4. FOR CABLE ROUTING SEE ASSEMBLY DRG. D41359A1.

THIRD ANGLE PROJECTION

All dimensions in millimeters unless otherwise stated

Normal tolerances

no decimal places	±1 mm
one decimal place	±0.2mm
two decimal places	±0.1mm

Unless otherwise stated

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TEI/25

WIRING

DRN	TCD	CKO	APPD.
GRB		R.M.L.	
DESIGNS DEPARTMENT			

D41380A1

PARTS LIST: D41359A4

D41380A1