TONE SOURCES TS/10 AND TS/10P

Introduction

Tone Source TS/10 is a variable-frequency RC oscillator of the Wien-bridge type intended for use in test rooms and control rooms. It has three frequency ranges covering 20 c/s to 20 kc/s and a normal maximum output of + 18 dB into 600 ohms which may be increased when required to + 20 dB over most of the frequency range. An output attenuator controlled by a three-position switch gives 40 dB, 0 dB, and 20 dB reduction in output level, and 18 dB variation in 2-dB steps is provided by a stud-type variable attenuator. The output level with no attenuation in circuit can be accurately adjusted to + 18 dB by means of a continuously-variable control in conjunction with a calibrated red mark on the feed meter used as an output meter.

The unit is mains-operated and is mounted on a 5¼ in. × 19 in. panel. For portable use it is fitted in a case and is then coded TS/10P.

TS/10 weighs 19 lb and the TS/10P weighs 22½ lb.

General Arrangement

The layout of the front panel is shown in Fig. 8.6. The general construction is similar to that of the TS/9. The components used in the frequency-determining network are mounted in a screened compartment behind the dial of the two ganged variable capacitors which is calibrated 200 to 2000. Multiplying factors are introduced by the frequency range switch on the left of the dial to give the three frequency ranges of 20 c/s to 200 c/s, 200 c/s to 2 kc/s, and 2 kc/s to 20 kc/s.

The mains unit is mounted behind the right-hand end portion of the panel, to the right of the output attenuators, and the fuses and indicating lamp are accessible from the front of the panel.

Circuit Description (Fig. 28)

Oscillator Stages

The RC oscillator is basically of the Wien-bridge type described in Appendix A and used in other BBC tone sources. Valves V1a (½ CV455) and V2 (CV2127) are used for this purpose and the output of the oscillator is fed via an amplifying stage V1b (½ CV455) to the phase-splitting push-pull output stage V3 (CV455).

Positive feedback is applied from the anode of V2 to the grid of V1a via the series-reactance arm of the bridge as in other tone sources and as described in Appendix A. Negative feedback to limit the amplitude of the oscillations is applied via a thermistor TH1 instead of using a lamp as the non-linear resistor; the fixed resistance arm of the bridge is provided by the resistor R19 connected in the cathode circuit of V1a. This is the arrangement used in the PTS/16, and reversal of the linear and non-linear resistance arms from the arrangement shown in Appendix A is necessary because a thermistor has a negative resistance/temperature coefficient whereas that of a lamp is positive.

The output from the bridge is fed to the amplifying valve V1b via a second thermistor TH2 and a resistance network. This thermistor helps to correct variations in output level caused by the effect of ambient temperature changes on TH1, and the two thermistors are therefore mounted close

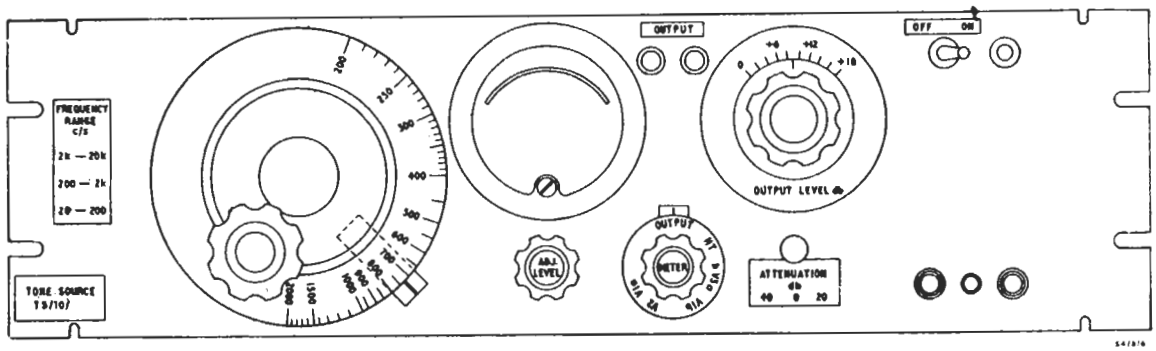


Fig. 8.6. Tone Sources TS/10 and TS/10P: Face Panel

together so that they have the same ambient temperature.

The resistance network includes two variable resistors R22 and R23 which are used to adjust the maximum output of the tone source to exactly + 18 dB. With the ADJUST LEVEL control resistor R23 set at maximum, R22 is pre-set to give a maximum output of + 21 dB into 600 ohms; a maximum output of + 18 dB is then obtained by adjusting R23 so that the pointer of the output meter coincides with the calibrated red line on the meter scale.

Frequency-determining Network

The theory of the frequency-determining network is described in Appendix A. The resistors in the two arms are adjusted on test to give values of 7·15 MΩ, 715 kΩ, and 71·5 kΩ for the three positions of the range switch.

The trimmers of the two ganged variable capacitors C1 and C2 are adjusted on test, with the range switch in its mid position, to give constant output level over the required frequency range of 200 to 2000 c/s, and the frequency dial is then calibrated to read 200 to 2000.

Multiplying factors of 1:10 and 10:1 are introduced by the other two positions of the range switch.

Amplifier and Output Stages

The amplifier and output stages incorporating valves V1b and V3 are virtually identical with those employed in Amplifier C/9 and described in Technical Instruction S3 Section 21.

Valve-Feed and Output Meter

The meter circuit is arranged to give readings at the red index line on the meter scale of the following valve anode currents ± 20% for an H.T. voltage of 300 ± 15 V and an L.T. voltage of 6·3 ± 0·15 V:

Valve	*Anode Current* (mA)
V1a	1·0
V2	21·0
V1b	0·85
V3a	8·0
V3b	8·0

When the meter is switched to read *H.T. Volts* the red index line indicates 300 ± 15 V.

With the meter switch in the *Output* position the meter is connected across a bridge rectifier which is fed from the output stage and connected in front of the output attenuator. The resistor R57 in series with the bridge rectifier is adjusted on test so that the red index line on the meter scale corresponds to an output level of + 18 dB when the tone source is terminated by 600 ohms and the attenuator switch and the variable attenuator dial are set to read zero and + 18 dB respectively i.e. the attenuation is zero.

Output Impedance Arrangements

A purely resistive output impedance of 600 ohms is obtained from the two resistors R58 and R59, and the meter circuit indicates the e.m.f. in series with it. Because of the impedance of the amplifier output stage this e.m.f., and therefore the meter reading, will depend on the impedance presented by the attenuator and the external load.

At sending levels of zero dB and below this impedance is almost constant at 600 ohms irrespective of external load variations. At higher sending levels, however, when sending to a load impedance which varies with frequency, as for example, a line, care should be taken to re-adjust the level control when necessary to keep the meter indication at the red mark to maintain the correct level and output impedance conditions.

General Data

Frequency Ranges

1. 20 c/s — 200 c/s
2. 200 c/s — 2 kc/s
3. 2 kc/s — 20 kc/s

Frequency Accuracy

Over the middle range the frequency should be accurate to within ± 1%.

At any frequency between 40 c/s and 10 kc/s the range-change switch should give frequency changes in the ratios 10:1 and 1:10 relative to the middle range to an accuracy of ± 1%.

Between 20 c/s and 20 kc/s the error should not exceed ± 2%.

Harmonic Content

At a maximum output level of + 18 dB into 600 ohms (meter reading to red index mark) the total harmonic content should not exceed:

0·1% at 1 kc/s
0·25% at 60 c/s

At 20 c/s appreciable distortion will occur at maximum output levels exceeding about + 17 dB (Meter reading about 5·5 volts).

Output Level

Without readjustment of level the output level should remain constant with frequency over the range 40 c/s to 15 kc/s to within ± 0·15 dB.

With readjustment of level to the red mark on the meter scale the output level should similarly be constant to within ± 0·05 dB.

Noise

With oscillation stopped by disconnecting the positive feedback circuit at C10 the noise output with no output circuit attenuation, measured on an amplifier detector should not exceed:

At any frequency setting in the middle or upper ranges:

— 60 dB (a signal/noise ratio of 78 dB).

At a setting of 200 c/s on the lowest range (the worst case):

— 50 dB (a signal/noise ratio of 68 dB)

Output Balance

The output circuit balance, with no attenuation, should not be worse than:

— 80 dB at 1 kc/s

— 60 dB at 10 kc/s

Stability with Temperature and Mains-Voltage Change

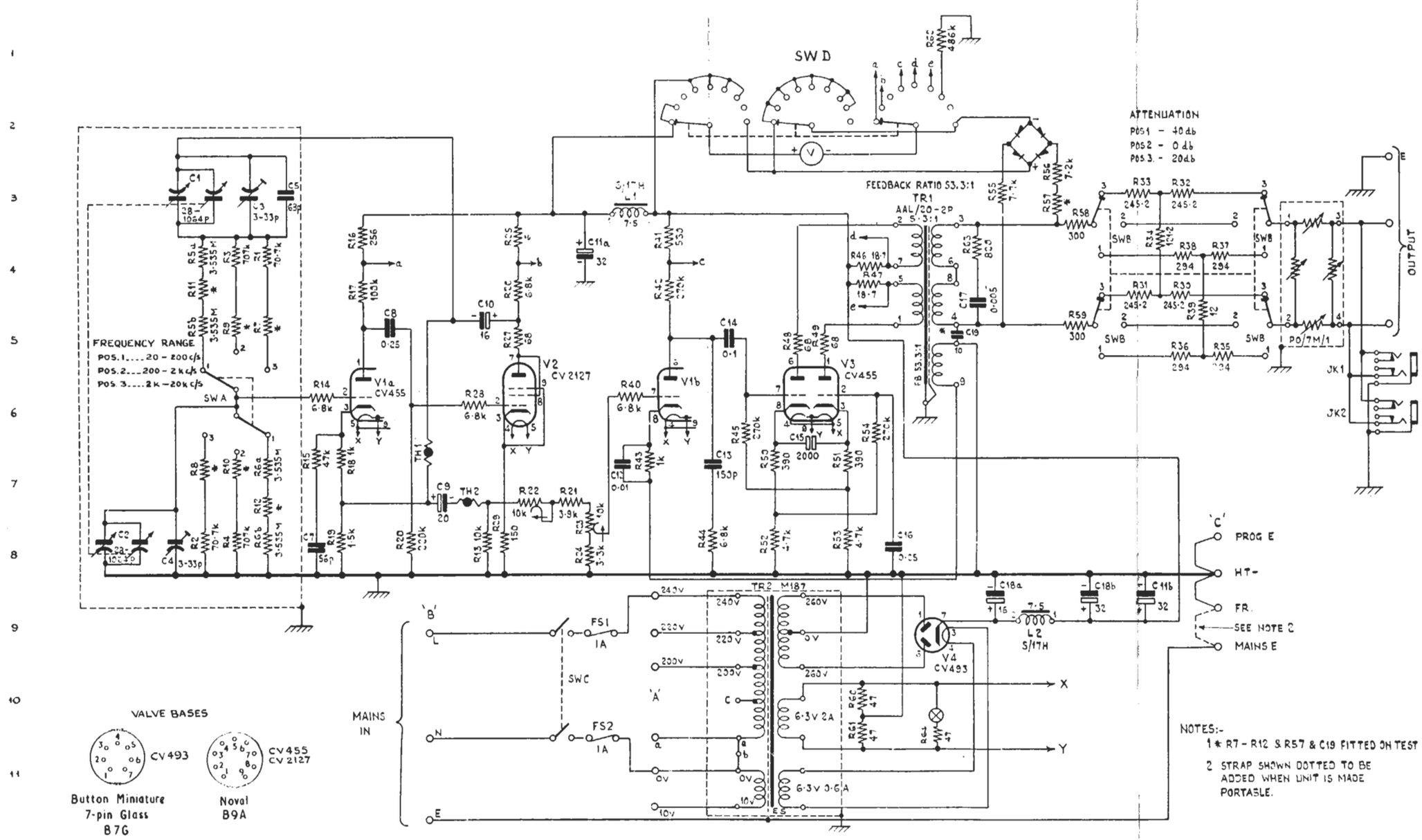
Over a period of one hour five minutes after switching on from cold, the output level should change by not more than 0·1 dB and the frequency by not more than 0·1 %.

A mains voltage change of ± 10 % should change the output by not more than 0·1 dB. The effect on frequency should be negligibly small.

W.G. 0958

COMPONENT TABLE: FIG. 28

Comp.	Loc.	Type	Tolerance per cent
C1	A3	Wingrove and Rogers C60-54/1	
C2	A8		
C3	B3	Wingrove and Rogers C31-11/1 8/·0075 in.	
C4	A8	Wingrove and Rogers C31-11/1 8/·0075 in.	
C5	C3	T.C.C. CSM20N	± 5
C7	C8	T.C.C. CSM20N	± 5
C8	D5	T.C.C. CP47S/PVC	± 20
C9	E7	T.C.C. SCE70B/PVC	+ 50 − 20
C10	E5	Plessey CE809/1	+ 50 − 20
C11a	G4	Plessey CE818/1	+ 50
C11b	Q8		− 20
C12	H7	Hunt B810	± 20
C13	J7	T.C.C. CSM20N	± 5
C14	J5	T.C.C. CP37N/PVC	± 20
C15	K6	T.C.C. CE25AAR	
C16	L8	Hunt B501/P	± 25
C17	M5	Hunt B815	± 25
C18a	N8	Plessey CE911/1	+ 50
C18b	P8		− 20
C19	M5	T.C.C. CSM20N (Fitted on test)	
L1	H3	BBC S/17H	
L2	N9	BBC S/17H	
MR1	N2	Westinghouse 1 mA	
R1	C4	Painton 74	± 1
R2	B8	Painton 74	± 1
R3	B4	Painton 75	± 1
R4	B8	Painton 75	± 1
R5a	B4	Painton 76	± 1
R5b	B5	Painton 76	± 1
R6a	C7	Painton 76	± 1
R6b	C8	Painton 76	± 1
R7	C5	Erie 109 (Fitted on test)	
R8	B7	Erie 109 (Fitted on test)	
R9	B5	Erie 109 (Fitted on test)	
R10	B7	Erie 109 (Fitted on test)	
R11	B4	Erie 109 (Fitted on test)	
R12	C7	Erie 109 (Fitted on test)	
R13	F8	Erie 9	± 10
R14	C6	Erie 16	± 10
R15	C7	Erie 9	± 10
R16	D4	Painton 73	± 1
R17	D4	Erie 9	± 10
R18	D7	Erie 9	± 10
R19	D8	Erie 109	2
R20	E8	Erie 9	10
R21	G7	Erie 9	± 10
R22	F7	Morganite LH, linear, 1 in. Sp. slotted, with washer and locating lug	± 20
R23	G8	Morganite spindle reduced to 13/16 in.	± 20
R24	G8	Erie 9	± 10
R25	F4	Painton P406	± 1
R26	F4	Painton P301	± 5
R27	F5	Erie 16	± 10
R28	F6	Erie 16	± 10
R29	F8	Erie 9	± 10
R30	Q5	Painton 73	± 1
R31	Q5	Painton 73	± 1
R32	Q3	Painton 73	± 1
R33	Q3	Painton 73	± 1
R34	Q4	Painton 73	± 1
R35	R5	Painton 73	± 1
R36	Q5	Painton 73	± 1
R37	R4	Painton 73	± 1
R38	Q4	Painton 73	± 1
R39	R5	Painton P406	± 1
R40	H6	Erie 16	± 10
R41	H4	Painton 73	± 1
R42	H4	Erie 9	± 10
R43	H7	Erie 9	± 10
R44	J8	Erie 9	± 10
R45	J6	Erie 9	± 10
R46	L4	Painton P406	± 1
R47	L4	Painton P406	± 1
R48	K5	Erie 16	± 10
R49	K5	Erie 16	± 10
R50	K7	Erie 109	2
R51	L7	Erie 109	2
R52	K8	Painton 73	± 1
R53	L8	Painton 73	± 1
R54	L6	Erie 9	± 10
R55	N3	Painton 73	± 1
R56	P3	Painton 73	± 1
R57	P3	Erie 109 (Fitted on test)	
R58	P3	Painton 73	± 1
R59	P5	Painton 73	± 1
R60	L10	Erie 8	± 10
R61	L10	Erie 8	± 10
R62	M1	Painton 73	± 1
R63	M4	Erie 9	± 10
R64	M10	Painton MV1	± 5
TR1	M5	BBC AAL/20-2P Ass.E, Class Z	
TR2	K10	BBC M187, mumetal can (modified)	



TONE SOURCE TS/10 & TS/10P : CIRCUIT

COMPONENT TABLE: FIG. 28

Comp.	Loc.	Type	Tolerance per cent
C1	A3	Wingrove and Rogers C60-54/1	
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C7	C8	T.C.C. CSM20N	± 5
C8	D5	T.C.C. CP47S/PVC	± 20
C9	E7	T.C.C. SCE70B/PVC	+ 50 − 20
C10	E5	Plessey CE809/1	+ 50 − 20
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C11b	Q8		
C12	H7	Hunt B810	± 20
C13	J7	T.C.C. CSM20N	± 5
C14	J5	T.C.C. CP37N/PVC	± 20
C15	K6	T.C.C. CE25AAR	
C16	L8	Hunt B501/P	± 25
C17	M5	Hunt B815	± 25
C18a	N8	Plessey CE911/1	+ 50 − 20
C18b	P8		
C19	M5	T.C.C. CSM20N (Fitted on test)	
L1	H3	BBC S/17H	
L2	N9	BBC S/17H	
MR1	N2	Westinghouse 1 mA	
R1	C4	Painton 74	± 1
R2	B8	Painton 74	± 1
R3	B4	Painton 75	± 1
R4	B8	Painton 75	± 1
R5a	B4	Painton 76	± 1
R5b	B5	Painton 76	± 1
R6a	C7	Painton 76	± 1
R6b	C8	Painton 76	± 1
R7	C5	Erie 109 (Fitted on test)	
R8	B7	Erie 109 (Fitted on test)	
R9	B5	Erie 109 (Fitted on test)	
R10	B7	Erie 109 (Fitted on test)	
R11	B4	Erie 109 (Fitted on test)	
R12	C7	Erie 109 (Fitted on test)	
R13	F8	Erie 9	± 10
R14	C6	Erie 16	± 10
R15	C7	Erie 9	± 10
R16	D4	Painton 73	± 1
R17	D4	Erie 9	± 10
R18	D7	Erie 9	± 10
R19	D8	Erie 109	± 2
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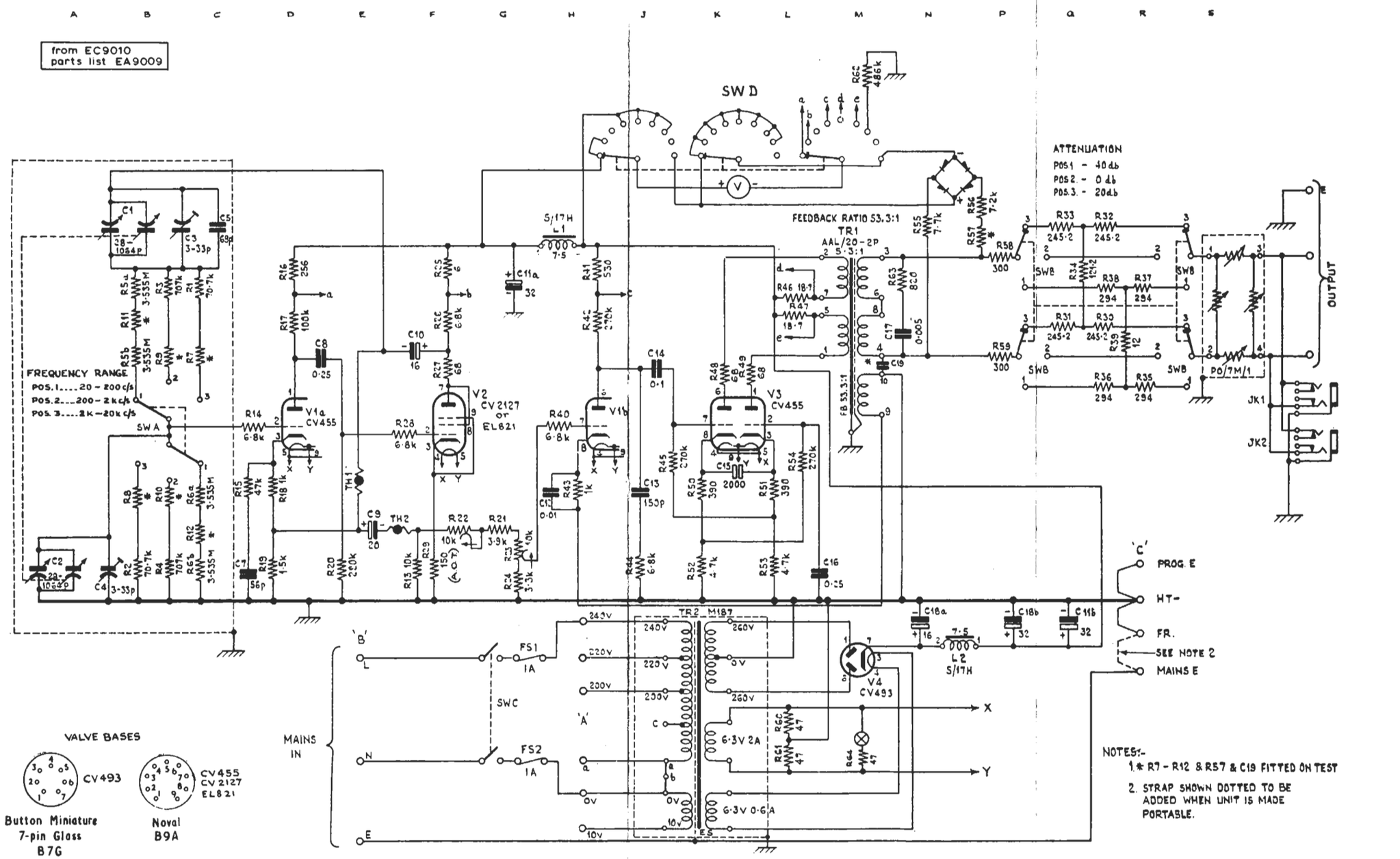
R27	F5	Erie 16	± 10
R28	F6	Erie 16	± 10
R29	F8	Erie 9	± 10
R30	Q5	Painton 73	± 1
R31	Q5	Painton 73	± 1
R32	Q3	Painton 73	± 1
R33	Q3	Painton 73	± 1
R34	Q4	Painton 73	± 1
R35	R5	Painton 73	± 1
R36	Q5	Painton 73	± 1
R37	R4	Painton 73	± 1
R38	Q4	Painton 73	± 1
R39	R5	Painton P406	± 1
R40	H6	Erie 16	± 10
R41	H4	Painton 73	± 1
R42	H4	Erie 9	± 10
R43	H7	Erie 9	± 10
R44	J8	Erie 9	± 10
R45	J6	Erie 9	± 10
R46	L4	Painton P406	± 1
R47	L4	Painton P406	± 1
R48	K5	Erie 16	± 10
R49	K5	Erie 16	± 10
R50	K7	Erie 109	± 2
R51	L7	Erie 109	± 2
R52	K8	Painton 73	± 1
R53	L8	Painton 73	± 1
R54	L6	Erie 9	± 10
R55	N3	Painton 73	± 1
R56	P3	Painton 73	± 1
R57	P3	Erie 109 (Fitted on test)	
R58	P3	Painton 73	± 1
R59	P5	Painton 73	± 1
R60	L10	Erie 8	± 10
R61	L10	Erie 8	± 10
R62	M1	Painton 73	± 1
R63	M4	Erie 9	± 10
R64	M10	Painton MV1	± 5
TR1	M5	BBC AAL/20-2P Ass.E, Class Z	
TR2	K10	BBC M187, mumetal can (modified)	



NOTES:-

1. * R7 - R12 & R57 & C19 FITTED ON TEST
2. STRAP SHOWN DOTTED TO BE ADDED WHEN UNIT IS MADE PORTABLE.

TS/10/1T

Fig. 28. Circuit of TS/10 & TS/10P