TELEVISION AMPLIFIERS

SECTION 1

DISTRIBUTION AMPLIFIERS: TV/DA/1 SERIES

Introduction

The distribution amplifiers in the TV/DA/1 series are buffer amplifiers designed for general use and each provides four independent outputs from a common input. The parent TV/DA/1 equipment is described in detail below, following which is information about distinguishing features of other versions identifiable by letters added to the common type-code. An important note concerning application of these equipments to pulse distribution is on page 1.8.

TV/DA/1

The amplifier provides four identical 75-ohm outputs from a single 75-ohm input. The gain from the common input to any of the outputs is nominally 0 db ; this can be varied by $\pm$ 2·5 db by means of a gain control at the input. The amplifier is mounted on a 19 $\times$ 7 inch panel, suitable for single-sided bay mounting. Input and output connections are made via ‘Musa’ plugs at the rear of the unit ; input and output monitoring plugs are mounted on the front panel of the unit. Power supplies are normally obtained from a stabilised power-supply unit SPS/4, connections at the amplifier being made by a four-pin plug situated at the rear of the unit.

As several of these amplifiers may be included in the transmission chain, the amplitude and phase characteristics must be nearly as possible ideal. The frequency response is held level within 0·1 db from 50 c/s to 3 Mc/s ; it is thus possible to cascade 10 such amplifiers before the overall frequency response varies by 1 db. In practice the frequency response is maintained substantially flat well beyond the nominal pass-band. It is not normal practice to quote the phase shift-frequency characteristic of an amplifier; but rather, as explained in Television Engineering, Volume 2, to quote the group delay at medium and high frequencies and the degree of ‘sag’ for a square-wave input at low frequencies. The group delay in the region 100 kc/s to 4 Mc/s varies by less than 0.005 microsecond, and the amplitude of a 50 c/s square wave does not vary by more than 5 per cent. The latter is in part dependent upon the frequency response at low frequencies.

Circuit Description

A complete circuit diagram of the amplifier is shown in Fig. 1. The amplifier comprises four stages of amplification, negative feedback being applied over the last three.

The input signal is fed from the *INPUT* plug to the network comprising R1, R2 and R3. R1 and R3 are close-tolerance resistors whilst R2 is a non-inductive input control, and the terminating resistance presented to the input is 75 ohms. The values of R2 and R3 are proportioned so that at the minimum setting of R2 a loss of 5 db is introduced.

From the slider of R2, the input signal is applied via C1 to the grid of V1 ; R38 is a low value resistor (47 ohms) introduced to prevent parasitic oscillations. V1 has a relatively low value of anode load (R6, 1·8 kilohms) and has negative current feedback applied by R8 and R9, so that the stage has a level frequency response with little phase shift over a wide band ; the overall gain from the grid of V1 to the grid of V2 is approximately 6 db. The negative current feedback also serves to ensure that the time constant of the coupling network to the grid of V1 is sufficiently large to prevent low-frequency distortion. The apparent value of the resistor R4 is increased by a factor $(1 + g_m R9)$ where g_m = the mutual conductance of V1, about 7·5 mA per volt. The apparent value is therefore approximately 5·2 $\times$ 1·5 megohms = 7·8 megohms. The time constant, given by the magnitude of this resistance multiplied by the capacitance of C1, is thus about 2 seconds. The input capacitance of V1 is reduced in the ratio $1/[1 + g_m (R8 + R9)]$; the resistance of the input circuit is, however, so low that its shunting effect at high frequencies is negligible. For a discussion of these techniques of extending the frequency response by means of negative current feedback, reference should be made to Television Engineering, Volume 2.

Due to the relatively small time-constant of the coupling network to the grid of V2 (C3, R11), the input to V2 tends to have appreciable attenuation and phase shift at low frequencies, but this is offset by the action of the V1 anode-decoupling network R5, C4. At low frequencies, C4 has appreciable reactance, and the effective anode load of V1 therefore rises, increasing the gain of the stage, whilst the reactive component of the load introduces a phase shift of opposite sign to that introduced by C3, R11. This method of extending the low frequency response of an amplifier is discussed in detail in Television Engineering, Volume 2.

Inductor L1 is included in series with the cathode circuit of V1 to preserve a level frequency response at high frequencies. The feedback resistors R8 and R9 are shunted appreciably at these frequencies by the cathode/earth capacitance of the valve, and the amount of feedback tends to fall, introducing a rising frequency response. L1 offsets this effect by increasing the feedback at high frequencies, so that the overall effect is to preserve the frequency response substantially flat in the region where it would otherwise rise. The arrangement also has the effect of reducing phase shift arising from the action of the cathode/earth capacitance.

V2 and V3 are conventional amplifying stages driving the output stage V4. Because of the cathode-follower action of V4, the signal at the feedback take-off point is similar to that at the grid of V4, although of smaller amplitude. Neglecting the effect of L2 (discussed later) the frequency response measured at the two points is identical, since the shunting effect of the cathode/earth capacitance of V4 is negligible as the resistance of R24 and R25 is very low. Thus in respect of the action of the feedback in correcting the frequency response, the feedback signal could as well be taken from the grid of V4. The feedback is taken from the cathode of V4 since it provides two additional advantages. Firstly, the feedback is taken from a low-impedance point thus minimising the effect of stray capacitance across the feedback path. Secondly, the feedback signal is dependent upon the current in V4, and the overall input voltage/output current characteristic of the three stages of V2-V4 is therefore made more linear. The feedback lead to the cathode of V2 is a length of co-axial cable which is terminated by the cathode circuit impedance of V2 ($\frac{1}{g_m}$ in parallel with R15), about 85 ohms. Thus, the cable is terminated by an impedance approximately equal to its characteristic impedance. The purpose of this arrangement is to prevent frequency discrimination in the feedback chain due to reactance which would be present if an unscreened length of wire were used.

The feedback resistor R25 also serves to provide bias for V2, the magnitude of the bias being almost entirely determined by the current of V4, which greatly exceeds that of V2. Under normal working conditions, therefore, R15 is practically ineffective. The resistor is included, however, so that the feedback path may be broken without appreciable change in the bias applied to V2. With this arrangement, V4 must not be removed from circuit unless V2 is also removed.

Negative current feedback is applied to V4 by R24 and R25; the purpose of this feedback is to improve the linearity of the stage and to reduce the effective input capacitance of the valve. The capacitance from grid to cathode and grid to screen (effectively in parallel) is about 35 picofarads; this input capacitance is reduced in the same ratio as the stage gain by the action of R24 and R25. The gain reduction factor is about 1·7, given by $1/(1 + g_m R_k)$, where R_k is $R24 + R25$, (= 61 ohms) and g_m is about 12 mA per volt, so that the effective input capacitance is about 20 picofarads.

The stage gains of V2 and V3 are unequal in order to satisfy as nearly as possible the conditions for maximal flatness with the degree of feedback employed (27 db at medium frequencies)*. At high frequencies, the gain of V3 commences to fall before that of V2 due to the effect of shunt capacitance; at low frequencies, the gain of V2 (measured to the grid of V3) commences to fall before that of V3 due to the small coupling capacitor employed (C7).

The values of circuit elements necessary to achieve maximal flatness are somewhat critical, and in order to provide for variations between production models, inductor L2 is included in the feedback circuit. The amplifier has been designed to have a frequency response tending to rise slightly at high frequencies when L2 is not in circuit; this tendency is offset by the increase in feedback at these frequencies provided by L2, which comprises a coil of 2½ turns. By alteration of the spacing of the turns, the frequency response can be adjusted within fine limits on test.

The four outputs are fed in parallel from the anode of V4, and are fed through relatively high

* For a discussion of this technique, reference should be made to Television Engineering, Volume 2, and an article by C. F. Brocklesby, " Negative Feedback Amplifiers," *Wireless Engineer*, February, 1949.

value resistors (R28-R34, 1·5 kilohms) to ensure that crosstalk between the outputs is held to a low figure. The load presented by these four circuits in parallel at the anode of V4 is 380 ohms approximately, and in combination with the anode feed resistor R23, presents V4 with an anode load of about 270 ohms. Since the attenuation between the anode of V4 and each individual output (loaded by a 75-ohm external circuit) is about 32 db, V4 is required to produce an output 40 volts d.a.p. at its anode in order to supply the maximum required output voltage of 1 volt d.a.p. In order to secure this amplitude of anode voltage swing, the double-amplitude peak current into the load must be in the region of 150 mA.

The provision of such a large current swing requires a high standing anode current in the output stage, and for this reason the valve V4 is a Type 12 E1. The valve anode current is of the order of 160 mA, and this is fed through the 1-kilohm resistor R23; the quiescent anode potential is thus about 140 volts. By virtue of the low magnitude anode load the effect of shunt capacitance is negligible at all frequencies within the working range. R23 is a wire-wound resistor of the Ayrton-Perry winding type (i.e., non-inductive) to ensure that its impedance is substantially resistive in this range. For this reason, no high-frequency correction is necessary in the anode circuit, so that the feedback from V4 to V2 can be taken from the cathode circuit.

The screen of V4 is fed from the potential divider R27, R39, the values of which are chosen so that the screen potential is about 130 volts. The potential divider is employed to ensure that the screen potential does not vary appreciably with individual valves. The reason for this is that with some valves pronounced secondary emission from the anode occurs on negative-going anode potential swings, producing severe output waveform distortion. This can only be eliminated if the screen potential is made sufficiently low, and substantially constant irrespective of the particular valve used.

The overall gain from the grid of V2 to the anode of V4 is 28·5 db, which together with the gain of V1 gives an overall gain from the grid of V1 to the anode of V4 of 34·5 db. A loss of 2·5 db is introduced by the gain control at its zero setting, and the loss from the anode of V4, to each of the individual outputs (loaded by a 75 ohm external load) is 32 db. The overall gain of the amplifier is thus 0 db, as required.

Resistors R23 and R24 are of high wattage rating non-inductive wire-wound types. R23 is rated at 40 watts, and R24 at 5 watts. The resistors R28-R35 are all of high stability close tolerance type, to ensure constancy of output level and output impedance.

Monitoring Facilities

Two outputs are provided for monitoring purposes. These outputs are taken in parallel with the input to the amplifier, and with output No. 1 respectively. To avoid mismatching effects, any monitoring equipment connected at these points should have a high input impedance. The monitor plugs, designated *MON. INPUT* and *MON. OUTPUT*, respectively, project through the front panel of the unit.

Metering

The total current feeds for each of the four stages can be checked by means of the meter M1, mounted on the front panel. The meter reads full scale for a current of 1 mA, and is scaled 0-20; by means of its selector switch, the meter can be connected in parallel with any of the metering resistors R7, R14, R19 and R26. Additionally, the meter, in combination with R37, can be used to measure the h.t. supply voltage. The values of the metering resistors R7, R14 and R19 have been chosen so that when metering the currents in V1, V2 and V3, the meter indicates directly the current in milli-amps. The value of R26 is such that the meter reads full scale for a current of 400 mA, so that the scale reading multiplication factor is 20. When metering the h.t. supply voltage the meter full-scale deflection corresponds to 500 volts.

Mechanical Construction

The unit is mounted on a 19-inch panel for bay mounting. Behind the front panel, and at a distance of 6½ inches from it, is a sub panel secured to side panels attached to the front panel. On this sub panel are mounted the amplifier valves and components. The amplifier is enclosed by a cover, which is detached from the rear, and located when in place by the side panels. The cover is cut out at the rear, to give access to the input plug, output plug and power supply plug respectively.

Access to the valves from the front of the unit is through a detachable plate secured to the front panel. The plate is fitted with a handle, and is held in place by the pressure of spring mountings on two fasteners at the top and bottom centre of the plate. Additionally, handles are attached to the front panel, to assist removal and replacement of the amplifier.

Valve Data

Valve	*Feed Current Panel Meter Reading*	**Anode Voltage Reading*	*Meter Range*	**Screen Voltage Reading*	*Meter Range*	**Cathode Voltage Reading*	*Meter Range*
V1 (6F12)	9	192	400V	197	400V	7·7	10V
V2 (6F12)	10	180	400V	170	400V	2·1	10V
V3 (6F12)	9	228	400V	194	400V	2·25	10V
V4 (12E1)	8·5	150	400V	130	400V	10·0	100V

* Measured with AVO Model 7

Tolerance on all readings ± 10%

General Data

Gain Control

Reliance type TW/1, 100 ohms non-inductive wirewound.

Feed meter

Weston type S33, 1 mA F.S.D. scaled 0-20.

Meter Switch

Oak type H. 1 bank, 1 pole 5 way. Non-shorting. Spindle ¼ in. × ½ in. without flat. ⅜ in. spacer.

Input, Ouput and Monitor Plugs

P.O. Co-axial Plug No. 1.

Impedances

Input : $Z = 75$ ohms resistive.
Output : $Z = 75$ ohms resistive.

Normal Working Levels

Input : 1 volt d.a.p.
Output : 1 volt d.a.p.
Maximum Output : 1·2 volt d.a.p.

Power Consumption

H.T. 220 mA at 300 volts.
L.T. 2·6 A at 6·3 volts.

Power supply normally obtain from stabilised power-supply unit SPS/4.

Test Data (TV/DA/1)

Input and Output Impedances

The input and output resistances measured at d.c. should be 75 ohms ± 2 per cent and 78·2 ± 2 per cent respectively.

Gain

Test conditions :

The gain should be measured between 75-ohm terminations at 100 kc/s with the gain control set to maximum.

The gain should be between 2 and 3·5 db ; the other three outputs should be within ± 0·2 db of the first output. With the gain adjusted to 0 db the gain control should indicate 0 db. If this condition is not met, the knob should be moved round on its spindle to give this indication.

Frequency Response

Apparatus required :

(1) Oscillator covering range 10 kc/s-4 Mc/s.
(2) Moullin valve voltmeter with 75 ohm input attachment, or other suitable wide-range instrument.
(3) Double-pole change-over switch (Musa type).
(4) TV/TG/1 with power supply.
(5) Waveform monitor TV/WM/1.

Medium and High Frequencies

Test conditions :

The apparatus in (1) to (3) above should be set up as shown in Fig. 1.1.

The response should be taken as follows :

(*a*) Set changeover switch so that the valve voltmeter is connected to the output of the oscillator. Set oscillator frequency to 100 kc/s, and adjust output until the valve voltmeter indicates 0·35 volt r.m.s.

(*b*) Throw changeover switch and adjust TV/DA/1 gain control until valve voltmeter again reads 0.35 volt r.m.s.

(*c*) Adjust oscillator frequency to 3 Mc/s, set changeover switch so that the valve voltmeter is connected to the oscillator output; adjust oscillator output to 0·35 volts r.m.s.

(*d*) Throw changeover switch and observe valve voltmeter reading; it should not change by more than ± 1 per cent (0·1 db). In the event of failure to satisfy this test proceed as in (*f*)-(*k*) below.

(*e*) Repeat procedure indicated in (*c*) and (*d*) above at frequencies of 10 kc/s, 20 kc/s, 50 kc/s, 200 kc/s, 500 kc/s, 700 kc/s, 1 Mc/s, 1·5 Mc/s, 2·0 Mc/s, 2·5 Mc/s, 3·5 Mc/s and 4 Mc/s. The valve voltmeter reading should not differ by more than 1 per cent in either position of the changeover switch from 10 kc/s to 2·5 Mc/s, and by not more than 6 per cent (0·5 db) at 3·5 Mc/s and 4 Mc/s.

If the gain at 100 kc/s and 3 Mc/s differs by more than 1 per cent proceed as follows:

(*f*) Terminate oscillator output from the changeover switch to the amplifier in 75 ohms, and connect to the grid of V2.

(*g*) With oscillator set at 100 kc/s, and connected to the valve voltmeter, adjust oscillator output to 0·7 volt r.m.s.

(*h*) Throw changeover switch, and note valve voltmeter reading, which should be about 0·35 volt r.m.s.

(*i*) Repeat (*g*) and (*h*) with oscillator frequency at 3 Mc/s.

(*j*) The readings obtained in (*h*) and (*i*) should be equal; if they are not, adjust the spacing of the turns of L2 and repeat (*g*) to (*i*) until equality is obtained.

(*k*) Repeat (*a*)-(*d*). If readings still differ by more than 1 per cent, adjust core of L1 until this requirement is met.

Low Frequencies

Test conditions:

Connect TV/TG/1 to input of TV/DA/1, and Waveform Monitor *DC* input to any output. Set TV/TG/1 to *COMPLETE WAVEFORM*, *PULSE SIGNALS*, *FRAME* 1 and zero lift, and observe frame waveform.

The amplitude of a frame bar should not vary by more than 5 per cent. The values of C3, C4, R6 and R11 control this wave shape; if response is outside limits, adjust C3 or R11. Turn the gain control from minimum to maximum, and check that the output varies smoothly and that the amplifier remains stable.

Transient Response

Test Conditions:

As for *Low Frequencies* above.

Connect 75-ohm resistor to Waveform Monitor *MON* plug.

Set TV/TG/1 to *LINE WAVEFORM*, *SPIKE* 1, and zero lift.

Set Waveform Monitor to observe line pulse at maximum expansion.

Check that any overshoot is not measurably greater than that of the generator.

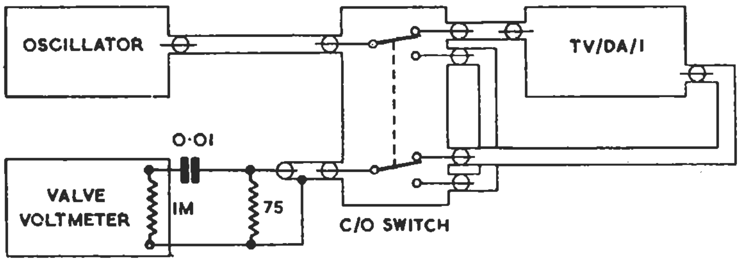

Fig. 1.1 TV/DA/1: Arrangement of Apparatus for Medium- and High-frequency Response Test

Noise

Test conditions :

No input to TV/DA/1.

Output connected to Amplifier Detector high-impedance input.

Noise level should be better than —60 db.

TV/DA/1A

This amplifier is almost identical electrically with the TV/DA/1. The changes comprise the addition of anti-parasitic oscillation resistors in the grid circuits of the V2, V3, V4 (' grid stoppers '). The introduction of these resistors has led to renumbering of certain resistors in the unit as shown in the table facing Fig. 1. The electrolytic capacitors employed are of a different type although of the same capacitance ; the new types are indicated in the table. A six-way power input plug is used instead of the 4-way type employed in the TV/DA/1. Connections to this plug are as follows :

7.	+ 300 V	H.T. supply
8.	Earth	
9.	6·3 V a.c.	L.T. supply
10.	Earth	
11.	—	
12.	Earth.	

Pins 8, 10 and 12 are wired together at the plug.

The mechanical construction is somewhat different. The panel depth is 5¼ inches instead of 7 inches in the TV/DA/1 and the monitor plugs are brought out at the rear of the unit and not through the front panel.

TV/DA/1B

This amplifier is similar to the TV/DA/1 in mechanical construction, and differs only in respect of provision of a facility for altering the gain to 6 db ± 2·5 db. This facility may be used when the input signal is in the region of 0·5 volt d.a.p., as, for example, at the output of a line equaliser. The amplifier is then capable of supplying an output of 1 volt d.a.p. The increased gain is achieved by the incorporation of an additional resistor R40 and inductor L3 in the cathode circuit of valve V1, as shown in Fig. 1.2, and the provision of two tags, so that the resistor R9 (reduced to 470 ohms) and inductor L1 can be strapped out of circuit ; when this is done, the gain is increased by 6 db. When R9 and L1 are in circuit, the circuit is similar to that of the TV/DA/1.

When R9 and L1 are strapped out of circuit, feedback is provided by R8, R40 and L3. The feedback at medium frequencies is reduced by about 6 db so that the overall gain is increased by this amount. L3 now serves to maintain the feedback fraction constant at high frequencies by offsetting the reduction which would otherwise be introduced by the cathode-earth capacitance of V1.

In order to provide for the two conditions of operation, the *GAIN db* plate is engraved on both sides. On one side the plate is engraved from —2·5 db to + 2·5 db in 0·5 db steps, and on the other from + 3·5 db to + 8·5 db in 0·5 steps. The plate is set to correspond to the working condition selected.

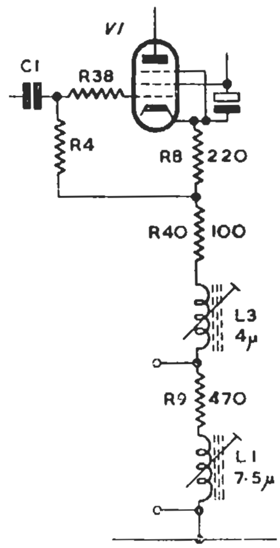

Fig. 1.2 TV/DA/1B: Cathode Circuit of Valve V1

The test data for the TV/DA/1B differs slightly from that of the TV/DA/1, and is set out below. For brevity, the condition where R9 and L1 are in circuit will be referred to as the zero gain condition, and the condition when R9 and L1 are strapped out of circuit as the 6 db gain condition.

Test Data (TV/DA/1B)

Input and Output Impedances

The input and output resistances measured at d.c. should be 75 ohms ± 2 per cent and 78·2 ohms ± 2 per cent respectively.

Gain

Test conditions :

The gain should be measured between 75 ohm terminations at 100 kc/s with the gain control set to maximum. In either gain condition the input signal should be set so that the output signal is 1 volt d.a.p.

In the zero gain condition, the gain should be between 2 and 3·5 db.

In the 6-db gain condition, the gain should be between 8 and 9·5 db.

With the working condition selected, the gain control knob should be set on the spindle so that with the gain of the amplifier adjusted to 0 or 6 db according to the condition selected, the knob pointer indicates this value.

In either condition of working, the level at the other three outputs should be within ± 0·2 db of that at the first output.

Frequency Response

The apparatus required is the same as that required for the TV/DA/1 and should be set up as shown in Fig. 1.1.

Medium and High Frequencies

Set amplifier to 6-db gain condition.

The response should be taken as follows:

(*a*) Set changeover switch so that the valve voltmeter is connected to the output of the oscillator. Set the oscillator frequency to 100 kc/s and adjust output until the valve voltmeter indicates 0·175 volt r.m.s.

(*b*) Throw changeover switch and adjust TV/DA/1B gain control until the valve voltmeter reads 0·35 volt r.m.s.

(*c*) Adjust oscillator frequency to 3 Mc/s. set changeover switch so that the valve voltmeter is connected to the oscillator output; adjust output to 0·175 volt r.m.s.

(*d*) Throw changeover switch and observe valve voltmeter reading; it should be 0·35 volt ± 1 per cent (0·1 db). In the event of failure to satisfy this test proceed as in (*f*)-(*k*) below.

(*e*) Repeat procedure indicated in (*c*) and (*d*) above, at frequencies of 10 kc/s, 20 kc/s, 50 kc/s, 200 kc/s, 500 kc/s, 700 kc/s, 1 Mc/s, 1·5 Mc/s, 2·0 Mc/s, 2·5 Mc/s, 3·5 Mc/s and 4 Mc/s. The valve voltmeter reading should not differ by more than 1 per cent from 0·35 volt when indicating the output from the TV/DA/1B from 10 kc/s to 2·5 Mc/s, and by not more than 6 per cent (0·5 db) at 3·5 Mc/s and 4 Mc/s.

If the gain at 100 kc/s and 3 Mc/s differs by more than 1 per cent proceed as follows:

(*f*) Terminate oscillator output from the changeover switch to the amplifier in 75 ohms, and connect to the grid of V2.

(*g*) With the oscillator set at 100 kc/s, and connected to the valve voltmeter, adjust output to 0·7 volt r.m.s.

(*h*) Throw changeover switch and note valve voltmeter reading, which should be about 0·35 volt r.m.s.

(*i*) Repeat (*g*) and (*h*) with oscillator frequency at 3 Mc/s.

(*j*) The readings obtained in (*h*) and (*i*) should be equal; if they are not adjust the spacing of the turns of L2 and repeat (*g*) to (*i*) until equality is obtained.

(*k*) Repeat (*a*)-(*d*). If the reading obtained in (*d*) still differs by more than 1 per cent from 0·35 volt adjust the core of L3 until this requirement is met.

Set amplifier to 0 db gain condition.

Repeat (*a*) to (*d*) above; the output from the oscillator should now be set to 0·35 volt r.m.s. If the valve voltmeter readings obtained in (*d*) differs by more than 1 per cent from 0·35 volt adjust the core of L1 until this requirement is met.

Low Frequencies

As for TV/DA/1, amplifier set to 0-db gain condition.

Transient Response

As for TV/DA/1, amplifier set to 0-db gain condition.

Noise

As for TV/DA/1.

TV/DA/1D

A complete circuit diagram of the amplifier is given in Fig. 11; it is similar to that of the

TV/DA/1B. The modifications improve the response of the amplifier to abrupt changes of the mean value of the input signal, such as those which occur when the signal changes from black level with syncs to peak white with syncs. The modifications improve the low-frequency response of the amplifier and increase the signal-handling capacity of the output stage.

There are three modifications:

(*a*) The value of R5 is reduced from 10 kilohms to 2·7 kilohms; this reduces the gain of V1 at low frequencies where the decoupling capacitor C4 is not fully effective. Additionally the nominal values of R11 and C3 are altered; the final values of these components are selected on test.

(*b*) The values of components C7, C10, R17 and R22 within the feedback loop embracing V2 to V4 are altered, and components C18, R41, C17 and R42 are added. These increase the stability margin at very low frequencies.

(*c*) The output circuit at the anode of V4 is altered so that, for a given current swing in each of the output circuits, the anode voltage swing is appreciably lower than its former value. Advantage is taken of this lower voltage swing to raise the screen-grid potential, by increasing the value of R39. This in turn means that the grid base of the valve is increased, eliminating grid-current flow on the peaks of the overshoot following certain switching transients.

To maintain the anode current of V4 at 150 mA, the cathode bias resistor R24 is increased to 82 ohms. The increased screen potential also increases the gain of V4, and the value of R25, the feedback resistor, is increased to 12 ohms to maintain the gain from V2 to V4 at its former value. The grid resistor R22 is returned to earth and the cathode bias is developed across R24 and R25 in series.

Test Data

As for the TV/DA/1B (page 1.6).

Valve Data

As for the TV/DA/1 (page 1.4) with the following exceptions:

Anode voltage of V1 is 260
Anode voltage of V4 is 180
Screen voltage of V4 is 157
Cathode voltage of V4 is 14·0

Pulse Distribution Applications

If a TV/DA/1, 1A, or 1B is used for the distribution of negative-going pulse signals only, the signal at the grid of V4 will be positive going, and due to its assymetrical nature, the bias applied to V4 will increase. If the pulses are of sufficient amplitude, V4 will be cut off between successive pulses and instability due to the action of the feedback over the stages V2 to V4 will occur. In order to eliminate this, R39 is removed from circuit when amplifiers are to be used for this application. As a result, the screen potential of V4 tends to rise, increasing the signal-handling capacity of V4. Where this modification is made, the gain control in fitted with a white knob indicating this fact. If it is desired to carry out the performance tests detailed earlier on such a model, the resistor R39 must first be replaced in circuit.

The removal of R39 will alter the quiescent anode and screen potentials of V4 to values other than those shown in the valve data section. The revised figures are (a) anode voltage 115, (b) screen voltage 160.

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COMPONENT TABLE: FIG. 1

PAGE 1

TELEVISION DISTRIBUTION AMPLIFIER TV/DA/1

Comp.	Loc.	Type	Tolerance per cent
C1	B4	T.C.C. CP47S/PVC	
C2	D5	T.C.C. SCE79PE/PVC 450V	
C3	E4	T.C.C. CP33N/PVC	
C4	E7	Dubilier B215	
C5	F5	T.C.C. SCE 79PE/PVC 450V	
C6	G7	T.C.C. CE61PE/PVC 350V	
C7	G4	T C C. CP32N/PVC	
C8	G7	T.C.C. CE18B/PVC	
C9	G7	T.C.C. SCE79PE/PVC 450V	
C10	U4	T.C.C. CP37N/PVC	
C11	K5	T.C.C. CE61PE/PVC 350V	
C12	L5	T.C.C. CE13PE/PVC 350V	
C13	M5	T.C.C. CE13PE/PVC 350V	
C14	N5	T.C.C. CE13PE/PVC 350V	
C15	O5	T.C.C. CE13PE/PVC 350V	
C16	P5	T.C.C. CE61PE/PVC 350V	
L1	C7	BBC D1/24	
L2	J6	2·5 Turns 5/16" ID 20 SWG	
R1	A6	Erie 108 0·5W	1
R2	B6	Reliance TW/1/8S/W Non-inductive	
R3	B7	Erie 108 0·5W	1
R4	B6	Erie 109 0·25W	10

Comp.	Loc.	Type	Tolerance per cent
R5	C2	Dubilier BTB 1W	10
R6	C3	Erie 109 0·25W	2
R7	D2	Erie 109 0·25W (±0·5Ω)	5
R8	D6	Erie 109 0·25W	2
R9	D6	Erie 109 0·25W	2
R10	D3	Erie 9 0·25W	10
R11	E6	Erie 109 0·25W	10
R12	E3	Dubilier BTB 1W	10
R13	E3	Erie 109 0·25W	2
R14	F2	Erie 109 0·25W (±0·5Ω)	5
R15	F6	Erie 109 0·25W	2
R16	F3	Erie 9 0·25W	10
R17	G6	Erie 9 0·25W	10
R18	G3	Erie 100 1W	2
R19	H2	Erie 109 0·25W (±0·5Ω)	5
R20	H7	Erie 109 0·25W	2
R21	J3	Erie 9 0·25W	10
R22	J6	Erie 9 0·25W	2
R23	J3	Painton B1 PX2005	5
R24	K6	Welwyn AWL 3111 4·5W	5
R25	U7	Constanta Cat. No. 1022	1
R26	K2	See note on Fig. 1	5
R27	K3	Painton P301 4·5W	5
R28	L4	Erie 100 1W	2
R29	L7	Erie 108 0·5W	2
R30	M4	Erie 100 1W	2
R31	M7	Erie 108 0·5W	2
R32	N4	Erie 100 1W	2
R33	N7	Erie 108 0·5W	2
R34	04	Erie 100 1W	2
R35	O7	Erie 108 0·5W	2
R36	Q6	Erie 108 0·5W	2
R37	S5	Erie 108 0·5W	2
R38	C5	Erie 9 0·25W	10
R39	K7	Painton P301 4·5W	5

COMPONENT TABLE: FIG. 1

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TELEVISION DISTRIBUTION AMPLIFIER TV/DA/1A

As for TV/DA/1, with the following exceptions:

Comp.	Loc.	Type	Tolerance per cent
C1	B4	Hunt W48 A301	
C2	D5	B.E.C. CE807/1	
C3	E4	T.C.C. CP345	
C4	E7	Hunt W54 P202	
C5	F5	B.E.C. CE807/1	
C6	G7	B.E.C. CE809	
C7	G4	T.C.C. CP335	
C8	G7	T.C.C. CE26D	
C9	G7	B.E.C. CE807	
C10	U4	T.C.C. CP45N	
C11	K5	B.E.C. CE809/1	
C12	L5	B.E.C. CE811/1	
C13	M5	B.E.C. CE811/1	
C14	N5	B.E.C. CE811/1	
C15	O5	B.E.C. CE811/1	
C16	P5	B.E.C. CE809	
R24	K6	Welwyn AWL 3111	5
R38	A10	Erie 9 0·25W	10
R39	B10	Erie 9 0·25W	10
R40	C10	Erie 9 0·25W	10
R41	E10	Erie 9 0·25W	10
R42	F10	Painton P301 4·5W	5

TELEVISION DISTRIBUTION AMPLIFIER TV/DA/1B

As for TV/DA/1, with the following exceptions:

Comp.	Loc.	Type	Tolerance per cent
L3	L11	BBC D1/25	
R9	L11	Erie 109 0·25W	2
R40	L10	Erie 109 0·25W	2

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EC 8368
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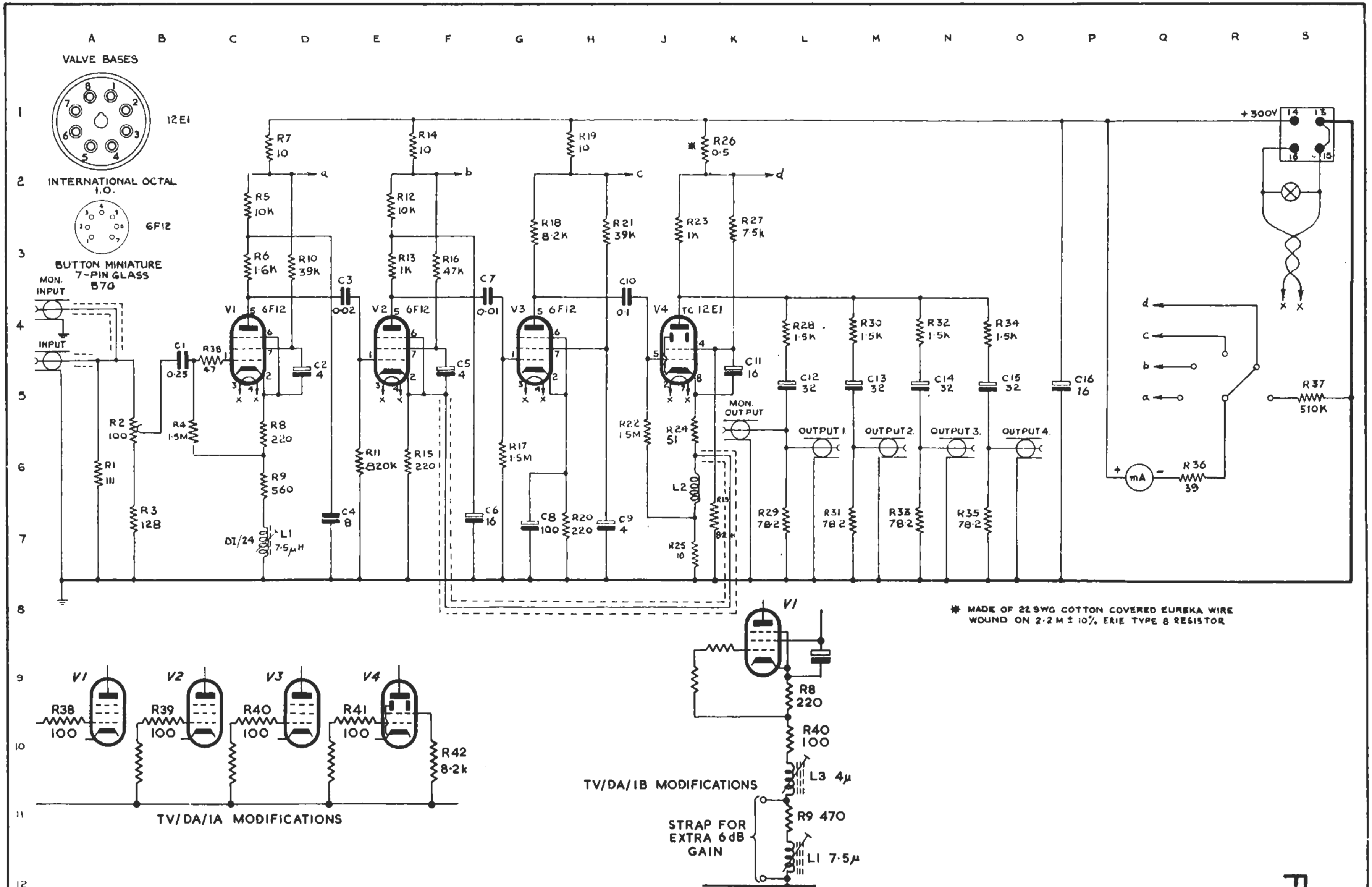


TELEVISION DISTRIBUTION AMPLIFIERS TV/DA/1, 1A, 1B: CIRCUIT

FIG 1
ISSUE 3

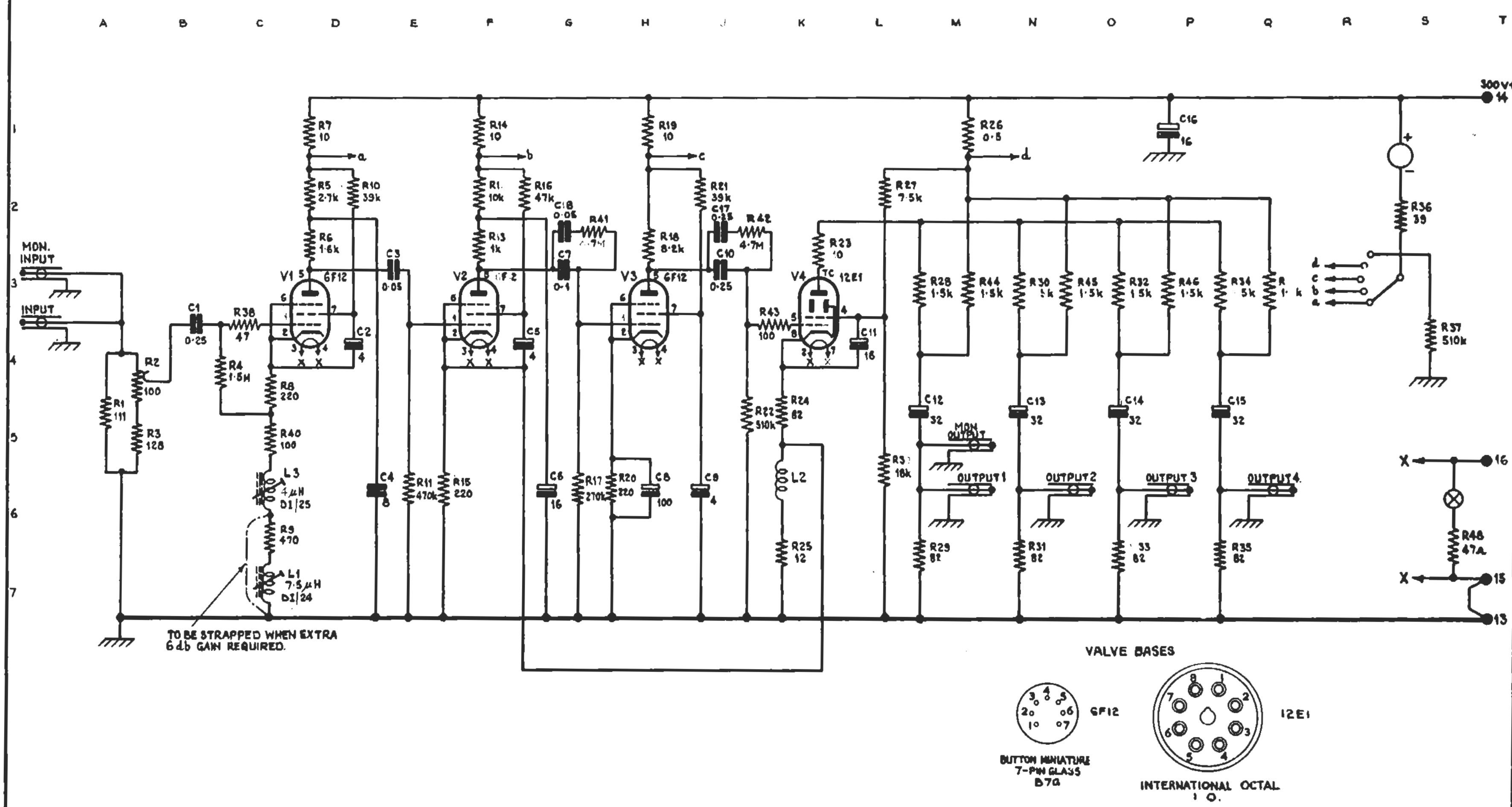
V2

COMPONENT TABLE: FIG. 11

Comp.	Loc.	Type	Tolerance Per cent	Comp.	Loc.	Type	Tolerance Per cent
C1	B4	TCC CP47S/PVC 500V	± 20	R13	F3	Erie 109 0·25W	± 2
C2	D4	TCC SCE 79PE/PVC 450V	− 20, + 50	R14	F1	Erie 109 0·25W	± 0·5Ω
C3	E3	TCC CP27S/PVC 500V	+ 20	R15	F6	Erie 109 0·25W	± 2
C4	E6	Dubilier B215 600V	± 20	R16	G2	Erie 9 0·25W	± 10
C5	G4	TCC SEC 79PE/PVC 450V	− 20, + 50	R17	G6	Erie 9 0·25W	± 10
C6	G6	TCC CE61PE/PVC 450V	− 20, + 50	R18	H3	Erie 100 1W	± 2
C7	G3	TCC CP46S/PVC 500V	±20	R19	H1	Erie 109 0·25W	± 0·5Ω
C8	H6	TCC CE18B/PVC 12V	− 20, + 50	R20	H6	Erie 109 0·25W	± 2
C9	J6	TCC SEC 79PE/PVC 450V	− 20, + 50	R21	J2	Erie 9 0·25W	± 10
C10	J3	TCC CP47S/PVC	± 20	R22	J5	Erie 109 0·25W	± 2
C11	L4	TCC CE61PE/PVC 450V	− 20, + 50	R23	K3	Erie 8 0·5 W	± 10
C12	M5	TCC CE13PE/PVC 450V	− 20, + 50	R24	K5	Welwyn AWL 3111 2W	± 5
C13	N5	TCC CE13PE/PVC 450V	− 20, + 50	R25	K7	Erie 100 1W	± 25Ω
C14	O5	TCC CE13PE/PVC 450V	− 20, + 50	R26	M1	BBC EK9661 Det.24	
C15	Q5	TCC CE13PE/PVC 950V	− 20, + 50	R27	L2	Painton P301 4·5W	± 5
C16	P1	TCC CE61PE/PVC 450V	− 20, + 50	R28	M3	Welwyn AWL 3112 6W	± 2
C17	J2	TCC CP47S/PVC 500V	± 20	R29	M7	Erie 108 0·5W	± 2
C18	G2	TCC CP37S/PVC 500V	± 20	R30	N3	Welwyn AWL 3112 6W	± 2
				R31	N7	Erie 108 0·5W	± 2
L1	D7	BBC SPEC ED TC/D1/24		R32	O3	Welwyn AWL 3112 6W	± 2
L2	K6	BBC EK9661 DET.31		R33	O7	Erie 108 0·5W	± 2
L3	C6	BBC SPEC ED TC/D1/25		R34	Q3	Welwyn AWL 3112 6W	± 2
				R35	Q7	Erie 108 0·5W	± 2
R1	A5	Erie 108 0.5W	± 1	R36	S2	Erie 108 0·5W	± 2
R2	A4	Reliance TW/1/8S/W 5W	± 5	R37	S4	Erie 108 0·5W	± 2
				R38	C4	Erie 9 0·25W	± 10
R3	A5	Erie 108 0.5W	± 1	R39	L6	Painton P301 4·5W	± 5
R4	C4	Erie 9 0·25W	± 10	R40	C5	Erie 109 0·25W	± 2
R5	D2	Erie 8 0·5W	± 10	R41	G2	Erie 9 0·25W	± 10
R6	D3	Erie 109 0·25W	± 2	R42	J2	Erie 9 0·25W	± 10
R7	D7	Erie 109 0·25W	± 0·5Ω	R43	K4	Erie 9 0·25W	± 10
R8	C4	Erie 109 0·25W	± 2	R44	M3	Welwyn AWL 3112 6W	± 5
R9	C6	Erie 109 0·25W	± 2	R45	O3	Welwyn AWL 3112 6W	± 5
R10	D2	Erie 9 0·25W	± 10	R46	P3	Welwyn AWL 3112 6W	± 5
R11	E6	Erie 9 0·25W	± 10	R47	Q3	Welwyn AWL 3112 6W	± 5
R12	F2	Dubilier BTB 1W	± 10	R48	T6	Painton MV1 1·5W	± 5

Facing Fig. 11

58/GGJ/002/DJE
EC 9654
ISS 2



TELEVISION DISTRIBUTION AMPLIFIER TV/DA/1D : CIRCUIT

FIG 11

V2