SECTION 5

PULSE DISTRIBUTION AMPLIFIER TV/PDA 1

Introduction

The pulse distribution amplifier TV/PDA/1 is intended for use at Studio centres for the distribution of the four types of standard pulse waveforms, viz., Line Trigger, Field Trigger, Mixed Blanking and Mixed Synchronising. The amplifier will only handle negative-going pulses, and provides five negative-going outputs at 2 volts d.a.p., each from an impedance of 75 ohms; the isolation between outputs is greater than 41 db. The input impedance is high, nominally 20 kilohms. The gain is continuously variable over the range 0-10 db and this permits a range of variation of input pulse amplitude to be handled. The time of rise and fall of the output pulses should be less than 0·18 microseconds. The amplifier may also be used for the distribution of pulse waveforms other than those listed above, provided that the mark/space ratio exceeds four to one. If the mark/space ratio is less than this figure, the rated output amplitude may not be obtained.

The amplifier is mounted on a standard CH 39 chassis, having a front panel of 19 × 5¼ inches. It is suitable for bay mounting; when so mounted the unit projects through the bay. 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. The unit incorporates its own power supply unit and its power consumption is approximately 70 watts.

Circuit Description

A circuit diagram of the unit is shown in Fig. 9, from which it will be seen that the unit comprises a three stage amplifier and a power supply unit.

The input signal is fed via a Musa plug to the resistive termination provided by R50. This resistor is 22 kilohms, so that the input impedance is high, and suitable for bridging 75 ohm circuits. The signal is then fed to the grid of the first stage V1, which has a variable resistor R7 in its cathode circuit which provides negative current feedback to control the gain of the stage. The range of the gain control is approximately 10 db.

The signal from the anode of V1 is fed to the cathode-follower stage comprising the two triodes of valve V2 connected in parallel. This cathode-follower stage serves to prevent the input capacitance of the parallel-connected output valves V3 and V4 from shunting the anode load of V1, and to provide a low impedance source for driving this relatively high-capacitance load. The two parallel-connected output valves feed five separate outputs, each giving an output at an impedance of 75 ohms. A network of resistors R31-R44 is used to provide the load for the output valves. These resistors are grouped in pairs, e.g., R31 and R32, connected between the anodes of the output valves and the h.t. supply. Each of these pairs of resistors is associated with an output socket, which is fed from the junction of the two resistors. The h.t. supply is held off by means of a capacitor, and the correct output impedance is achieved by the employment of a resistor of 82 ohms connected in parallel with the output socket. This resistor, in conjunction with the impedance presented by the network of feed resistors, provides an output impedance in the region of 75 ohms. The output circuit arrangement adopted ensures that there is isolation between the individual outputs of the order of 41 db.

The mean anode currents of the output valves are stabilised against changes under operational conditions by current feedback provided by the large-value cathode bias resistors R24 and R28. In order to provide the correct grid-cathode bias voltage the grids are held at a positive potential with respect to earth by means of the bleeder chain R20, R21 across the h.t. supply. The cathode bias resistors are decoupled, and thus do not produce any signal feedback.

Because of the non-linearity of the i_a–v_g characteristics of V3 and V4, the mean anode current tends to increase under driven conditions. The effect of the cathode feedback resistors is to oppose this change by increasing the working grid-cathode bias. This has the effect of reducing the stage gain. Thus the overall gain tends to fall with increasing input signal amplitude. The gain also varies with the mark/space ratio of the input signal; the gain decreases as the mark/space ratio decreases. With a mark/space ratio of less than 4 : 1, it may not be possible to obtain the rated output of 2 volts d.a.p. with an input signal amplitude of 2 volts d.a.p.

The rising impedance of the inter-stage and output coupling capacitors at low frequencies tends to reduce the gain of the amplifier at low frequencies. The effect is partially offset by the action of capacitors C4 and C6. The value of C4 is such that at low frequencies only partial decoupling of the anode circuit of V1 is achieved, and the anode load impedance of V1 rises, with a consequent rise of gain. At low frequencies also, the value of C6 is such that the cathode load impedance of V2 increases. The gain of the stage thus approaches more nearly to the value of unity as the input signal frequency decreases.

Monitoring Facilities

Two monitoring outputs are provided at the front panel. These outputs are fed in parallel with the input to the amplifier, and with Output No. 1 respectively. These are designated *In Mon.* and *Out Mon.* respectively. Additionally, a test-point is provided in parallel with each of the five output circuits; these are situated at the rear of the unit, each test point adjacent to the output socket with which it is associated.

Metering

The total feed current for each of the valves in the unit can be checked by means of the meter mounted on the front panel. The meter reads full scale for a current of 100 microamps, and is scaled 0–15; by means of its selector switch, the meter can be connected in parallel with any of the metering resistors R10, R19, R25 and R29. Additionally, the meter, in combination with resistors R48 and R49 can be used to measure the h.t. supply voltage. A table of meter readings for correct operation is given in the valve data section.

Mechanical Construction

The unit is mounted on a standard CH/39 chassis, the front panel dimensions being 19 × 5¼ inches. Input and output connections are made at the rear of the unit, the cover being cut out to give access to the plugs and sockets.

Input and Output Connections

Input and output connections are made via Musa plugs. The mains supply is fed via a F. and E. four way socket type EP-CG-4-11, wired in accordance with standard practice.

Valve Data

Meter Switch Position	*Valve*	*Reading*	*Scale Reading Multiplication Factor*
V1	V1	8	× 2 mA
V2	V2	10	× 1 mA
V3	V3	10·2	× 4 mA
V4	V4	10·2	× 4 mA
HT+	-	12·5	× 20 V

Readings taken with the input terminated in 75 ohms, and the *Gain* control set to maximum. Tolerance on all valve current readings ±20 per cent. Tolerance on h.t. voltage ±10 per cent.

General Data

Impedances

Input: 22 kilohms nominal
Output: 75 ohms resistive

Normal working levels

Input: 2 volt d.a.p. negative-going nominal (range of acceptable input 0·45 volt—3 volt).
Output: 2 volt d.a.p. negative-going.
Maximum output: 3 volt d.a.p. negative-going.
Power consumption: 70 W approximately.

Test Data

Apparatus required:

Pulse generator, giving 2 volt d.a.p. negative-going output
Waveform Monitor TV/WM/1 or EMI 3794 Y with Gain and Delay unit
Variable attenuator, having range 0–20 db, working between 75 ohms terminations
Avo Model 7.

(1) Set the tap on the primary winding of the mains transformer to the correct value. Switch on, and allow ten minutes to elapse for the unit to warm up. Check h.t. and l.t. voltages and valve current feeds. The h.t. voltage should be 250 ± 25; the l.t. voltage 6·3 ± 0·4 r.m.s. The valve current feeds should be as given in the table in the Valve Data section. During initial adjustment the h.t. voltage should be set to 250 ± 5 volts by selection of the value of R46.

Measure the ripple voltage on the h.t. line; this should not exceed 100 mV. If the valve currents or the h.t. voltage are not within the limits prescribed, the following table of data may assist in locating the source of the fault.

Measurement	*Avo Range*	*Nominal Value (tolerance ± 20 per cent)*
Rectifier anodes to transformer centre tap	400V	250V r.m.s.
Rectifier cathode to chassis	400V	250V
V1 anode to chassis	400V	175V
V1 cathode to chassis	100V	31V
V2 cathode to chassis	100V	80V
V3 anode to chassis	400V	215V
V3 cathode to chassis	100V	44V
V4 anode to chassis	400V	215V
V4 cathode to chassis	100V	44V
V1 anode current	100mA	12mA
V1 screen current	100mA	10mA
V3 anode current	100mA	35mA
V3 screen current	10mA	6mA
V4 anode current	100mA	35mA
V4 screen current	10mA	6mA
Mains supply current	1000mA	270mA r.m.s.

(2) Terminate the input and one of the outputs of the amplifier in 75 ohms. Connect the waveform monitor to the terminated output. Connect the pulse generator to the attenuator, and the output of the attenuator to the input of the amplifier. Set the pulse generator to give a mixed blanking waveform. If a Cintel square wave generator type CT 1 is used, the repetition frequency should be set to 10 kc/s and the mark/space ratio should be adjusted to give negative-going pulses of 18 microseconds duration.

Set the output from the pulse generator to 2 volts d.a.p., set the *Gain* control of the amplifier to maximum, and adjust the attenuator setting so that the output pulse amplitude is 2 volts d.a.p. The attenuator setting should be 13 ± 2 db.

Set the *Gain* control to minimum, and the attenuator setting to zero loss. The amplitude of the output pulse should then be between 1 and 1·2 volts d.a.p. Remove the 75 output termination, and check that the output pulse amplitude rises by 6 ± 0·75 db

The gain of the amplifier measured as above, with the other three types of standard waveform, is given in the table below.

Signal	*Gain setting control*	*Gain, db*
Line trigger	Maximum	14·5±2
	Minimum	−3±2
Field trigger	Maximum	14·5±2
	Minimum	—3·0±2
Mixed sync	Maximum	14±2
	Minimum	−4±2

The table below gives the signal amplitudes at various points in the amplifier, when set to give zero gain, with a mixed blanking input signal of 2 volts d.a.p.

Test point	*Signal amplitude, volts d.a.p.*
V1 grid	2·0
V1 cathode	1·4
V1 anode	20·0
V2 cathode	18·0
V3, V4 anode	60·0
Output	2·0

(3) With the input and output terminated in 75 ohms, measure the hum level at the terminated output. This should not exceed 6 mV d.a.p.

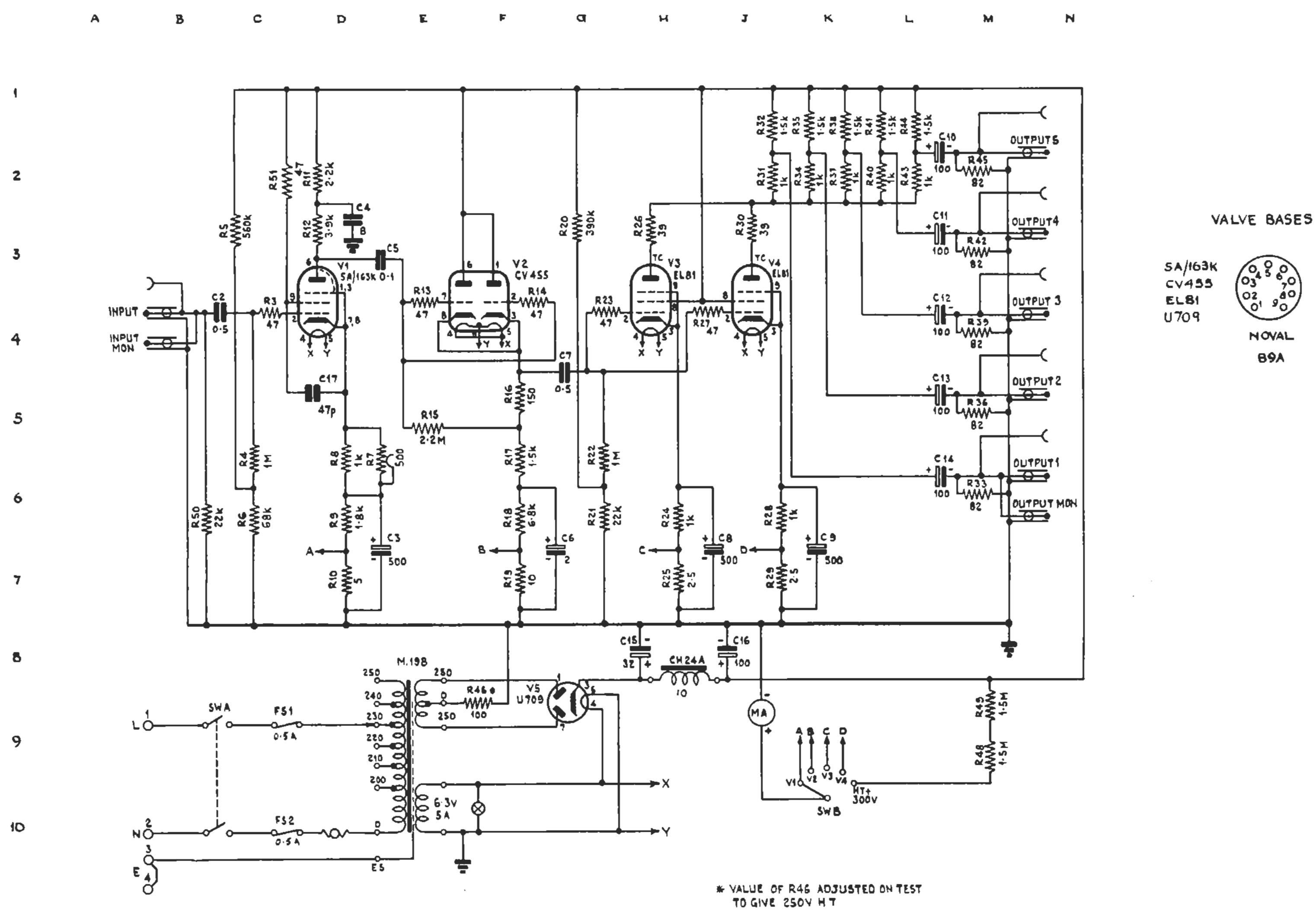
(4) Terminate the input and one output in 75 ohms. Connect the waveform monitor to the terminated output, and apply the signal from the pulse generator to the input. Set the input signal amplitude to 2 volts d.a.p., and with a line trigger signal adjust the gain control until the output is 2 volts d.a.p. With an input signal rise time of less than 0·15 microseconds, the output rise time should be less than 0·18 microseconds.

(5) With the amplifier set up as in (4) above, apply a mixed blanking signal, and measure the tilt of the waveform; this should be less than 5 per cent. If the Cintel pulse generator is employed, the pulse repetition rate should set to 50 c/s, and the mark/space ratio to 4 : 1. In this condition the tilt should be less than 5 per cent.

(6) Repeat (5) above, using each of the other sockets in turn, and at each output socket check also the output at the associated test point. Check also the output at the monitoring socket when *Output 1* is under test. The outputs should be equal within 0·5 db, and the field tilt should be less than 5 per cent.

COMPONENT TABLE: FIG. 9

Comp.	Loc.	Type	Tolerance Per cent
C2	B4	Hunts B502P 150V	± 25
C3	D7	Plessey CE17027/1 50V	− 20, + 100
C4	D2	Hunts WP202	
C5	D3	TCC C.P.37N/PVC 350V	± 20
C6	F7	TCC SCE 76PE/PVC 450V	− 20, + 50
C7	G4	Hunts B502P	
C8	H7	Plessey CE17027/1 50V	− 20, + 100
C9	K7	Plessey CE17027/1 50V	− 20, + 100
C10	L2	Plessey CE874/1 450V	− 20, + 100
C11	L3	Plessey CE874/1 450V	− 20, + 100
C12	L4	Plessey CE874/1 450V	− 20, + 100
C13	L5	Plessey CE874/1 450V	− 20, + 100
C14	L6	Plessey CE874/1 450V	− 20, + 100
C15	G8	Plessey CE811/1 450V	− 20, + 100
C16	H8	Plessey CE874/1 450V	− 20, + 100
C17	C5	Erie N750K 500V	± 10
L1	H8	BBC CH24A	
R3	C4	Erie 9 0·25W	± 10
R4	C6	Erie 9 0·25W	± 10
R5	C3	Erie 108 0·5W	± 2
R6	C6	Erie 108 0·5W	± 2
R7	D6	Colvern CLR3001/95	—
R8	D6	Erie 109 0·25W	± 2
R9	D6	Painton MV1 1·5W	± 5
R10	D7	Painton MV1 1·5W	± 5
R11	D2	Painton MV1 1·5W	± 5
R12	D3	Painton P301 4·5W	± 5
R13	E4	Erie 9 0·25W	± 10
R14	F4	Erie 9 0·25W	± 10
R15	E5	Erie 8 0·5W	± 10
R16	F5	Erie 9 0·25W	± 10
R17	F6	Erie 8 0·5W	± 10
R18	F6	Painton P306 3W	± 5
R19	F7	Painton MV1 1·5W	± 5
R20	G3	Erie 108 0·5W	± 5
R21	G6	Erie 109 0·25W	± 2
R22	G6	Erie 9 0·25W	± 10
R23	G4	Erie 9 0·25W	± 10
R24	H6	Painton MV1 1·5W	± 5
R25	H7	Painton MV1 1·5W	± 5
R26	H3	Erie 9 0·25W	± 10
R27	H4	Erie 9 0·25W	± 10
R28	J6	Painton MV1 1·5W	± 5
R29	J7	Painton MV1 1·5W	± 5
R30	J3	Erie 9 0·25W	± 10
R31	J2	Painton MV1 1·5W	± 5
R32	J1	Painton MV1 1·5W	± 5
R33	M6	Erie 108 0·5W	± 2
R34	K2	Painton MV1 1·5W	± 5
R35	K1	Painton MV1 1·5W	± 5
R36	M5	Erie 108 0·5W	± 2
R37	K2	Painton MV1 1·5W	± 5
R38	K1	Painton MV1 1·5W	± 5
R39	M4	Erie 108 0·5W	± 2
R40	L2	Painton MV1 1·5W	± 5
R41	L1	Painton MV1 1·5W	± 5
R42	M3	Erie 108 0·5W	± 2
R43	L2	Painton MV1 1·5W	± 5
R44	L1	Painton MV1 1·5W	± 5
R45	M2	Erie 108 0·5W	± 2
R46	E8	Painton P301 4·5W	± 5
R48	M9	Erie 9 0·25W	± 10
R49	M9	Erie 9 0·25W	± 10
R50	B6	Erie 9 0·25W	± 10
R51	C2	Erie 9 0·25W	± 10
TR1	D10	BBC M198	



PULSE DISTRIBUTION AMPLIFIER TV/PDA/1.

FIG 9

V2