AUDIO AND VIDEO EQUIPMENT

Page

1. INTRODUCTION.

1.1 A number of different types of amplifiers are used at N.B.S. sound and T.V. broadcasting stations for amplification of the audio and video programmes, prior to their application to the sound and vision transmitters.

This publication, which has been prepared from relevant manufacturers' handbooks, summarises the electrical performance of some of these types.

Brief descriptions of a typical "flying spot" slide scanner and a T.V. Programme Link Modulator are also included.

Issue 1, 1970.

2. AUDIO AMPLIFIER, TYPE 1.

2.1 General. Fig. 1 shows the circuit of a typical Type 1 Amplifier. This is a fixed gain audio amplifier with an output power of approximately 120mW (+21dBm), suitable for microphone level work. Two alternative inputs are provided, one of 150 ohms suitable for operation from a 50 ohm microphone, the other of 600 ohms.

A multi-shielded input transformer, tapped on the primary side, feeds a two-stage amplifier with heavy negative feedback, giving high gain stability, wide frequency range and low noise and distortion. The first stage uses a low noise pentode; the second stage, a double triode used in parallel.

Two polarised metering sockets are provided for measurement of V1 and V2 cathode currents. These give a half-scale reading on a 1mA/1,000 ohm (1V F.S.D.) meter. Valves should be replaced when the current drops below 40% F.S.D.

2.2 Electrical Performance.

Input Impedance: 600 ohms ±15% over frequency range 30Hz to 15kHz. (Source impedance, 600 ohms).

150 ohms ±15% over frequency range 30Hz to 15kHz. (Source impedance, 50 ohms).

Output Impedance: 600 ohms ±15% over frequency range 30Hz to 15kHz.

Load Impedance: 600 ohms.

Gain: For 600 ohm input impedance:-
40dB ±1dB measured at +8dBm as ratio of output to input powers.

For 150 ohm input impedance:-
46dB ±1dB measured as voltage ratio.

Frequency Response: ±1dB from 30Hz to 15kHz, relative to 1kHz at +8dBm.

Distortion: Not greater than 0.5% at +21dBm from 60Hz to 7.5kHz.

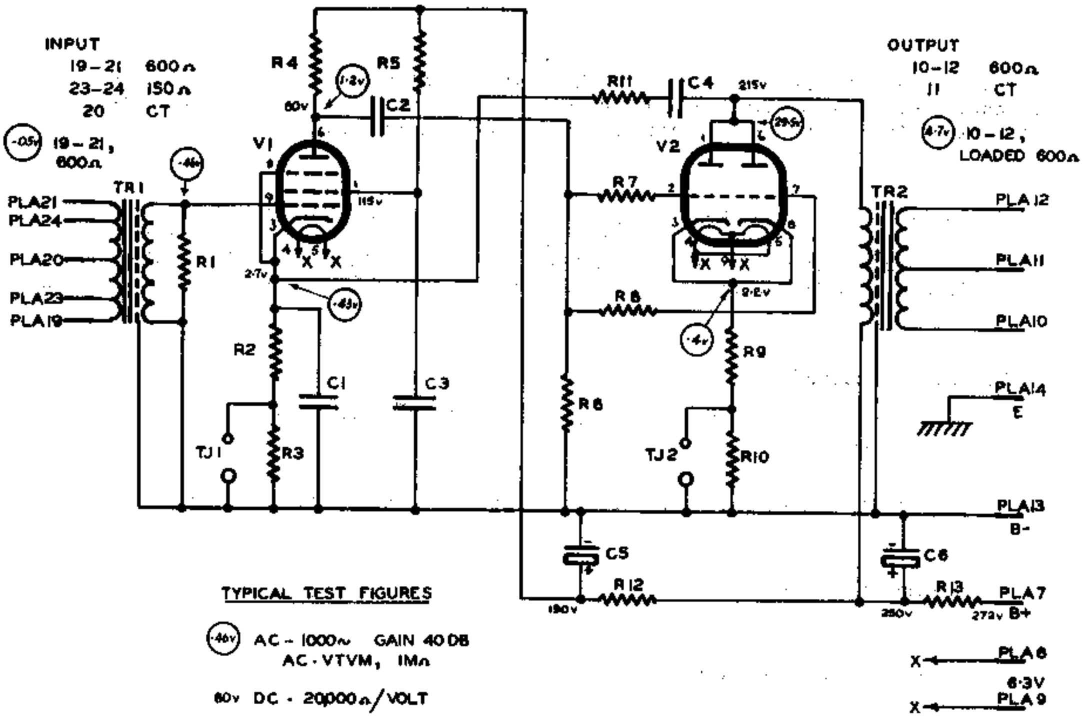
Not greater than 1.0% at +21dBm from 30Hz to 15kHz.

Noise: The noise at the output does not exceed -82dBm with the input terminated in its appropriate source impedance.

Crosstalk: The amplifier output does not exceed -67dBm with the disturbing amplifier delivering +8dBm at the output.

Stability: The amplifier remains stable when the termination is changed from 600 ohms to 600 ohms in parallel with 0.1µF.

Power Requirement: A.C., 6.3V, 0.5A.
D.C., 240V-300V, 16mA.



R1	68K 5% Hi Stab.
R2	1.6K 5% " "
R3	510Ω 5% " "
R4	100K 5% " "
R5	330K 5% " "
R6	1 Meg 10% Carbon
R7, R8	27K 10% "
R9	120Ω 5% Hi Stab.
R10	39Ω 5% ½W Crack.Carb.
R11	150K 5% Hi Stab.
R12	47K 10% Carbon
R13	1.5K 10% "

C1	.0033uF 5% Mica
C2	0.22uF Paper 400V
C3, C4	0.1uF Paper 400V
C5	8uF / 300VW
C6	24uF / 300VW
V1	EF86
V2	12AT7
PLA	Connector, 24 pin Painton or equivalent
TJ1 TJ2	Socket, Cinch Type

FIG. 1. AUDIO AMPLIFIER, TYPE 1 - SCHEMATIC CIRCUIT AND PARTS LIST.

3. AUDIO AMPLIFIER, TYPE 2.

3.1 General. Fig. 2 shows the circuit of a typical Type 2 Amplifier. This is a low gain audio amplifier used mainly as an isolating amplifier and for compensation of switching losses. The nominal power output of 250mW (+24dBm) is sufficient for all line work, and the gain is variable in 0.5dB steps. The input impedance is suitable for bridging a terminated 600 ohm line, and the output is designed to feed a 600 ohm load.

A multi-shielded input transformer with a balanced stepped gain control on its secondary side, feeds two low power output pentodes in push-pull. Negative feedback is applied from tertiary windings on the output transformer.

Two polarised metering sockets are provided for measurement of V1 and V2 cathode currents. These give a half-scale reading on a 1mA/1,000 ohm (1V F.S.D.) meter. Valves should be replaced when the current drops below 40% F.S.D. For minimum distortion at low frequencies, the valve currents should be within 10% of each other.

3.2 Electrical Performance.

Input Impedance: Greater than 25,000 ohms over the frequency range 30Hz to 15kHz.

Output Impedance: 600 ohms ±15% over the frequency range 30Hz to 15kHz.

Load Impedance: 600 ohms.

Gain: 0dB to 6.5dB, variable in 0.5dB steps.

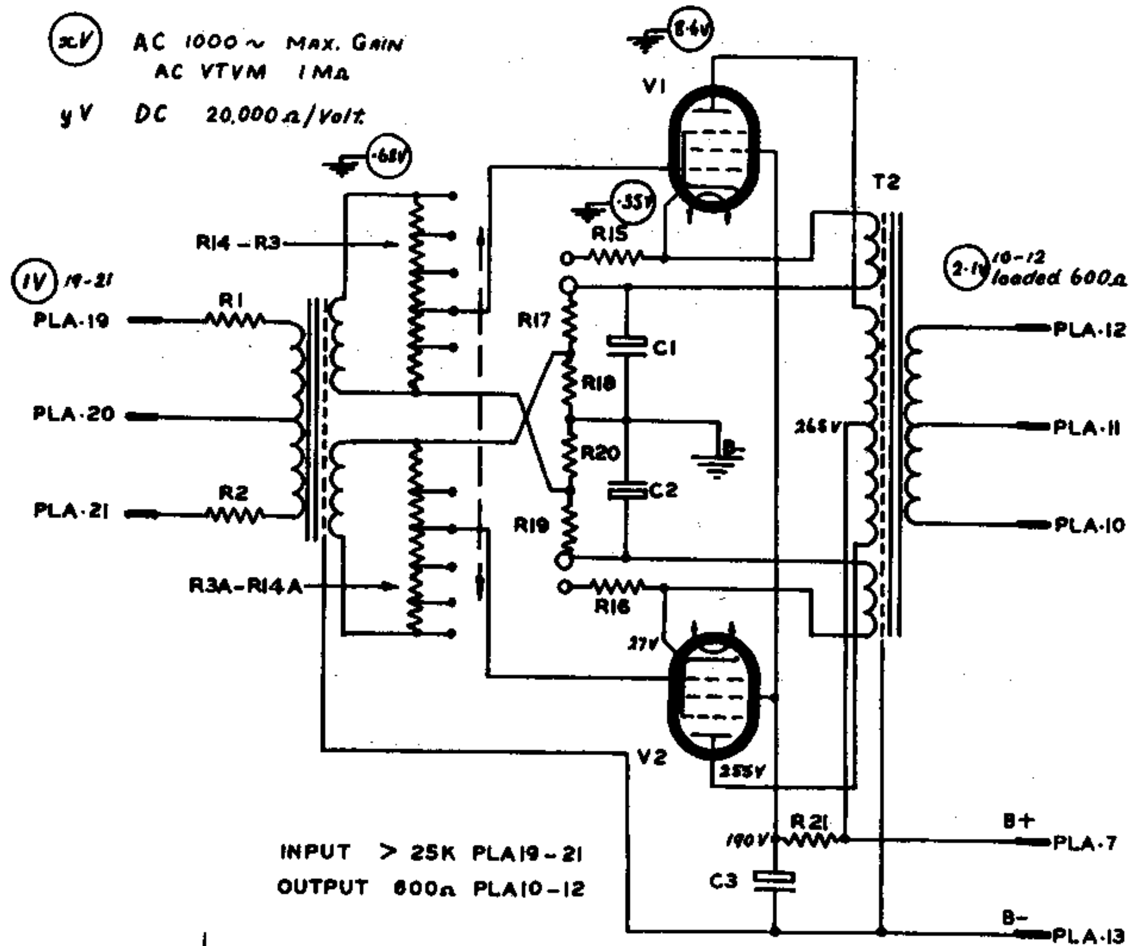
Frequency Response: ±1.0dB from 30Hz to 15kHz, relative to 1kHz.

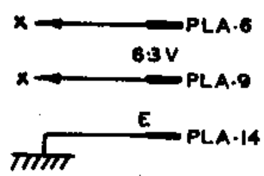
Distortion: The distortion does not exceed 0.5% at +24dBm from 60Hz to 7.5kHz.
The distortion does not exceed 1.0% at +24dBm from 30Hz to 15kHz.
The amplifier will deliver +30dBm (1watt) before serious distortion occurs.

Noise: The equivalent noise input is less than -80dBm. (Crosstalk due to an adjacent amplifier delivering an output of +11dBm, does not cause appreciable alteration of this figure).

Stability: The amplifier remains stable when the termination is changed from 600 ohms to 600 ohms in parallel with 0.1μF.

Power Requirement: A.C., 6.3V, 0.4A
D.C., 240V-300V, 20mA.





R1, R2	4.3K	½	Watt 5% D.C.C. Hi-Stab.
R3, R4, R5) R3a, R4a,) R5a)	2.7K	½	" " Cracked Carbon
R6, R7) R6a, R7a)	2.2K	½	" " " "
R8, R8a	3.9K	½	" " " "
R9, R10) R9a, R10a)	1.8K	½	" " " "
R11, R11a	3.3K	½	" " " "
R12, R13) R12a, R13a)	1.5K	½	" " " "
R14, R14a	27K	½	" " " "
R14, R14a	180K	½	" " " "
R15, R16	180 Ohm	½	Watt 5% Cracked Carbon
R17, R19	1K	½	" " " "
R18, R20	1.8K	½	" " " "
R21	39K	1	" 10% Comp. RMC

C1, C2	50 uF 25VW
C3,	8 uF 450VW
V1, V2	EL91/6AM5
J1, J2	Sockets, 2 pin Cinch Type
SW1	Switch, OAK type, 1 pole, 12 position 2 section
PLA	Connector, 24 pin male Painton
T1	Transformer, Input
T2	Transformer, Output

FIG. 2. AUDIO AMPLIFIER, TYPE 2 - SCHEMATIC CIRCUIT AND PARTS LIST.

4. AUDIO AMPLIFIER, TYPE 3.

4.1 General. Fig. 3 shows the circuit of a typical Type 3 Amplifier. This is a high impedance input, monitoring amplifier designed:-

(i) for bridging a terminated 600 ohm line and to provide high quality audio output to a wide-range monitor loudspeaker; or

(ii) to act as a distribution amplifier to a large number of lines.

Sockets are provided to allow metering of the cathode current of each valve. Using a 1,000 ohms per volt, 1mA meter, a deflection of approximately half-scale is obtained with valve in normal operation condition. A potentiometer R21 is provided to balance the direct current of the output valves.

4.2 Electrical Performance.

Source Impedance: 300 ohms.

Input Impedance: Greater than 25,000 ohms.

Load Impedance: 3 ohms or 12 ohms, adjustable by output plug wiring.

Output Impedance: Less than 0.4 ohm and 1.5 ohms, respectively.

Gain: 42dB, continuously variable by means of a potentiometer.

Frequency Response: ±0.5dB from 30Hz to 15kHz.
±1dB from 15Hz to 30kHz.

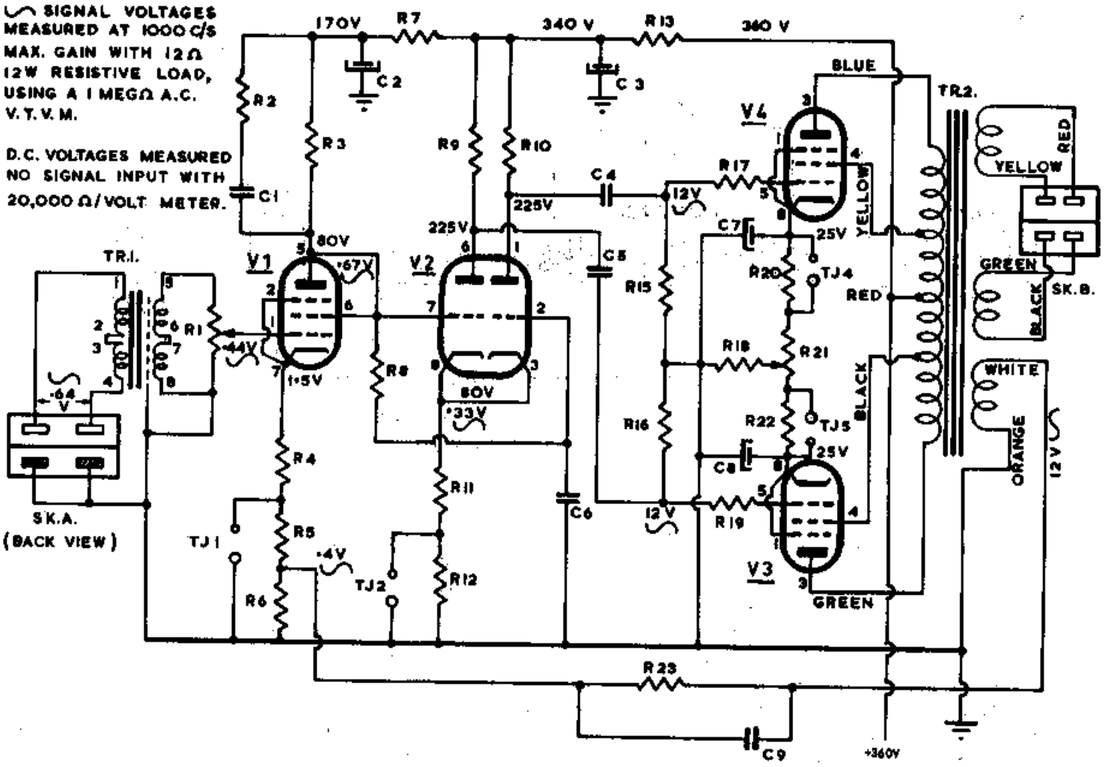
Power Output and Distortion: At 12 watts output, the distortion does not exceed 0.25% over the range 60Hz to 7.5kHz, and does not exceed 0.6% over the range 30Hz to 15kHz.

At 18 watts output, the distortion does not exceed 1% over the range 60Hz to 7.5kHz, and does not exceed 2% over the range 30Hz to 15kHz.

Noise: Equivalent noise input is -83dBm at maximum gain, and with input terminated in 300 ohms non-reactive resistance.

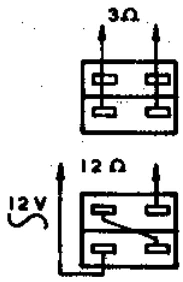
Stability: The amplifier is free from oscillation when the output termination is varied from open circuit to 25 ohms non-reactive resistance, to 25 ohms in parallel with 0.2µF capacitance. The frequency response is within 1dB of the above response under these conditions.

A.C. Power Input: 200V to 250V, adjustable by selecting fuse positions. Primary current is 0.5A (approx.).



R.1	Pot. 20K Log.
R.2	6.8 K 10%
R.3	68 K 5%
R.4, 5	500 Ω 5%
R.6	150 Ω 5%
R.7	150 K 10%
R.8	1 M 10%
R.9, 10	100 K 2%
R.11	39 K 10%
R.12	390 Ω 5%
R.13.	10 K 10%
R.15, 16	330 K 10%
R.17, 19	2.2 K 10%
R.18	180 Ω 5%
R.20, 22	22 Ω 10%
R.21	Pot. 100 Ω W.W. 2W
R.23	4.7 K 5%
R.26	27 K 10%

C.1	100 pf. 10% M.S.
C.2, 3	8 uf Elect. 450 v DCW
C.4, 5	.33 uf 400 v Polyester
C.6	.47 uf 400 v Polyester
C.7, 8	100 uf 25 v.w. Elect.
C.9	220 pf. 10% M.S.
C.10, 11	4 uf 400 v DC Paper
C.12	.01 uf 1000 v Styro.
V.1	6AU6
V.2	12AT7
V.3, 4	EL34/6CA7



OUTPUT PLUG WIRING (BACK) VIEW

FIG. 3. AUDIO AMPLIFIER, TYPE 3 - SCHEMATIC CIRCUIT AND PARTS LIST.

5. AUDIO (LIMITER) AMPLIFIER, TYPE 4.

5.1 General. The Type 4 Amplifier is a limiting amplifier designed for use in the audio input of transmitters as a protection against over-modulation. Fig. 4 shows the main elements of the amplifier, which is essentially an audio frequency amplifier with automatic gain control.

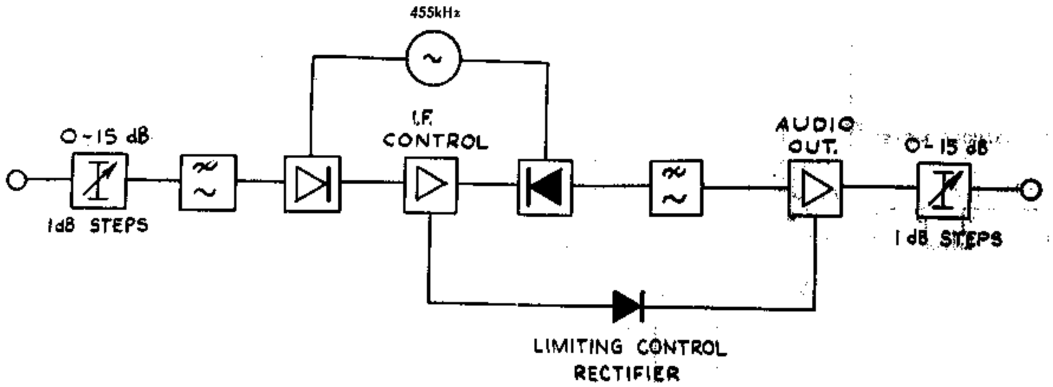


FIG. 4. LIMITER AMPLIFIER, TYPE 4 - BLOCK SCHEMATIC.

In operation, the input signal passes through the audio input filter to the modulator where it modulates a 455kHz carrier. This modulated signal, after amplification in a variable gain I.F. amplifier, is passed to the demodulator and the recovered audio signal is then filtered and amplified to output level. For control of the amplifier gain, a sample of the output signal is peak rectified and the D.C. voltage so obtained is fed back to the control grid of the variable gain I.F. amplifier. In order to minimise the distortion contributed by the modulation process, a low modulation index in both the modulator and demodulator is obtained by the use of a common carrier oscillator input of high relative amplitude.

5.2 Definition of Terms. Special terms used to specify the particular properties of limiting amplifiers, are listed below:-

Threshold. The input signal level above which limiting commences. The level is expressed in dBm for a sinusoidal tone.

Amount of Limiting. When using a sinusoidal input signal whose level exceeds the threshold level, the ratio of these levels expressed in dB is called the amount of limiting.

Attack Time. The time taken for the limiting amplifier to response to a signal peak above threshold. The attack time quoted in the performance figures (see para. 5.3) is the time taken for the amplifier gain to reduce to a value 1dB from its final value after the level of a steady input tone has been changed from below threshold to 20dB above threshold.

Recovery Time. The time taken for the limiting amplifier to recover following a signal peak above threshold. The recovery time quoted in the performance figures (see para. 5.3) is the time taken for the amplifier gain to increase to a value 1dB from its original value after a steady tone of 20dB above threshold has been removed.

Thump. The surges that may be generated within the limiting amplifier when the programme level is varying above threshold. The signal-to-thump ratio given in the performance figures (see para. 5.3) is measured using a pulsed tone input with a rectangular envelope displayed on a suitable C.R.O.

5.3 Electrical Performance.

Input Impedance: Balanced 600 ohms ±10% over the frequency range 30Hz to 15kHz.

Output Impedance: Balanced 600 ohms ±10% over the frequency range 30Hz to 15kHz.

Gain: Below threshold, 40dB ±1dB at 1,000Hz.

Frequency Response: Variation of gain from that obtained at 1,000Hz, is ±1dB from 30Hz to 15kHz.

Threshold: Input threshold level is -21dBm ±1dB at 1,000Hz.

Output Level: With a threshold level input signal of 1,000Hz, output level is +19dBm.

Limiting Characteristic:

(i) Input signal of 1,000Hz and output threshold level corrected to +19dBm. For input levels from threshold to 20dB above threshold the limiting characteristic, when plotted dBm input/dBm output, should not rise by greater than 1.5dB and should lie within the hatched area of the characteristics plotted in Fig. 5.

(ii) Input signal 30Hz to 15kHz. The limiting characteristic does not depart from the 1,000Hz characteristic by greater than 1dB.

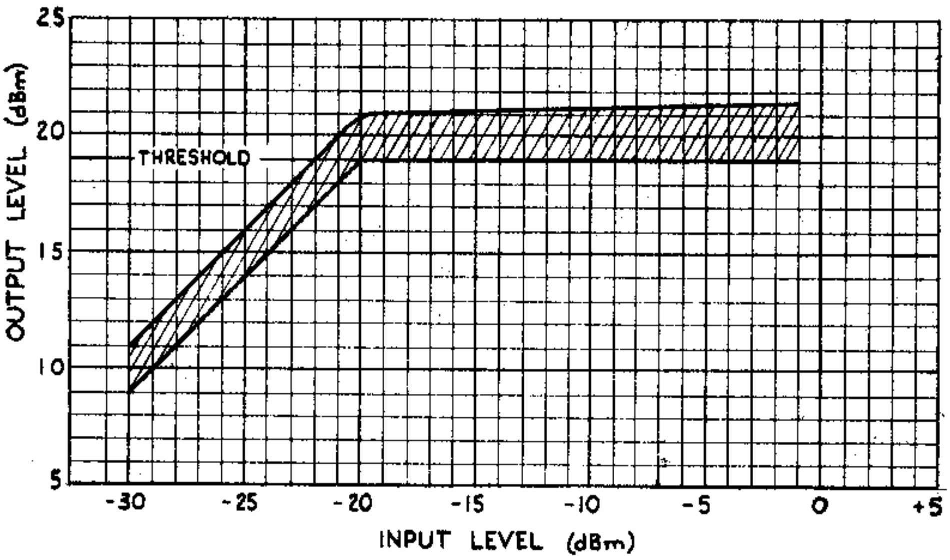


FIG. 5. LIMITER AMPLIFIER, TYPE 4 - INPUT/OUTPUT CHARACTERISTICS AT 1,000Hz.

Distortion: With an input signal of 30Hz to 15kHz, at a level equivalent to:

(i) threshold level, distortion is less than 1%;

(ii) 20dB of limiting, distortion is less than 2%.

Noise: Less than -50dBm, output.

Attack Time: Less than 1mS.

Recovery Time: 0.5, 1 or 2 seconds nominal. Extended recovery time for peaks of long duration.

Thump: Signal-to-thump ratio is greater than 40dB for all input levels up to that which will produce 20dB of limiting.

Power Supply: A power supply providing 250 volts D.C. at 50mA, and 6.3 volts A.C. at 1.6A, where the D.C. supply noise is less than 10mV, is required.

5.4 Circuit Description. Fig. 14 (attached) shows the schematic circuit of a typical Type 4 Amplifier.

Input Audio Circuit. The input attenuator (with screwdriver adjustment on the front panel) enables the threshold level to be adjusted. It consists of a balanced attenuator of 15dB variable in 1dB steps to give a threshold level from -6dBm to -21dBm.

The input attenuator is connected to the primary of the balanced input transformer (TR1) via a fixed 14dB attenuator and a low pass filter L1 which attenuates any R.F. interference on the incoming line.

Modulator and Oscillator. The suppressed carrier ring type modulator comprises a resistive (RV2) and capacitive (C5) balancing network, and a tuned balanced to unbalanced H.F. output transformer. When the modulator is balanced, its output consists of a double sideband suppressed carrier product, together with higher order products.

The 455kHz carrier oscillator comprises a crystal controlled, output tuned anode circuit. The modulator's carrier is derived through dropping resistor R12. The oscillator output at the junction of C17 and R12 is adjusted to 20 volts peak to peak with the iron dust core slug L3.

Intermediate Frequency Amplifier. The I.F. amplifier control valve V1 is a variable-mu valve whose gain is varied by the application of a D.C. voltage to its grid. The anode and screen potentials of this valve are stabilised by the voltage regulator tube V7.

The overall gain of the amplifier is 40dB and is set by adjusting potentiometer RV7. This control should be adjusted only when valve V1 is replaced.

Demodulator. The demodulator is driven from the anode of V1 and is similar to the modulator. The carrier signal is obtained from the 455kHz crystal oscillator. The demodulated signal is applied to a "demod" filter L2, which passes the audio frequency components and attenuates the higher frequency components.

Output Audio Amplifier. The output audio amplifier is a balanced two stage amplifier (V2, V3, V4) which has a voltage gain of 32dB from V2, V3 control grids to the output load. The first stage (V2, V3) is a pair of pentodes in push-pull, resistance-capacitance coupled to the output pair which is a double triode (V4). This is transformer coupled to the balanced output attenuator which adjusts the output level of the amplifier. The output attenuator can be adjusted from 0dB to 15dB in 1dB steps with a screwdriver adjustment on the front panel. The current and voltage feedback circuits of this amplifier are adjusted to give an output impedance of 600 ohms.

Control Circuit. The cathodes of the double diode control rectifier V6 are driven in push-pull from the primary of the output transformer TR5 via the D.C. blocking capacitors C28 & C29. The anodes are connected together and the negative voltage obtained from this rectification is applied via the control line to the grid of the control valve V1 and so changes the overall gain of the I.F. amplifier. The output level at which limiting commences is determined by a positive bias applied to the cathodes of these diodes. This bias is obtained from a voltage regulator valve V7 and a divider network comprising R47, potentiometer RV6, and R42. The "Limiting Level" potentiometer RV6 is adjusted so that the output is +19dBm when the threshold of limiting is reached.

The attack time depends on the charging time constant of C25 and C6 and the total source impedance. During recovery, however, the rectifier is non-conducting so that the recovery time depends upon the discharge time constant in the grid of the control valve V1. Three values of recovery time are obtained by switching the shunt resistance to R37, R38 or R39. The "Recovery Time" switch SWB is mounted on the front panel and should be set as instructed to suit the particular station and programme. When the limiting peaks are of short duration and occur only occasionally, the recovery time is governed by the time constant of C25, C6 and R37, R38 or R39. When these peaks occur more frequently, C24 also receives a charge via R40 so that the recovery time is extended.

A 100µA meter M1, mounted on the front panel and calibrated in dB of limiting, can be connected (via switch SWA) in the anode circuit of the control valve V1 to indicate the amount of limiting. When the meter is switched to this condition, the anode current in the meter circuit is initially adjusted by the meter "CAL" potentiometer RV4 until the meter reads full scale with no signal applied to the amplifier. This deflection indicates 0dB of limiting. An external meter may be connected in series with the main meter to monitor the amount of limiting at a remote point. This external monitoring meter will register only when switch SWA is set at "LIMIT".

Routine Balance Test. As a routine check, a thump balance test is provided. To perform this test, disconnect any audio input, set switch SWA to "BAL" position and press the red non-locking "BAL" button SWC. This applies a 50Hz voltage from the filament heater supply to the grid of the control valve, to simulate a limiting signal of varying level. If the amplifier is unbalanced to such an extent that thump would occur, a 50Hz signal will appear at the output and can be measured on meter M1. Check that the meter does not pass the 22dB mark. If it does, adjust the mod. carrier balance control RV2, for minimum reading (zero) on M1.

After a period in service, the range of RV2 may not be sufficient to obtain a 50Hz minimum, and a more comprehensive balancing procedure must then be used, as outlined in the manufacturer's handbook.

All balancing should be performed only after the amplifier has been in operation for at least one hour in order to reduce the effects of temperature drift in the modulator and demodulator.

<u>It should be noted that when the red "BAL" button is pressed, this test injects a 50Hz signal into the amplifier and, therefore, must not be applied when the amplifier is carrying programme.</u>

Valve Currents. The anode currents of all valves other than the regulator V7 and double diode V6, may be checked periodically by means of switch SWA and meter M1 on the front panel.

6. UTILITY AMPLIFIER.

6.1 General. Fig. 6 shows the circuit of a general purpose transistorised amplifier designed for audio programme applications. It may be used as a pre-amplifier, booster amplifier, line or isolating amplifier. A pair may be used as a splitting amplifier. The nominal power output is 250mW (+24dBm) and the gain may be adjusted between limits of 36dB and 56dB in 5dB steps. Tappings on the input and output transformers provide a choice of input and output impedances. An auxiliary output on the amplifier provides up to 1 watt power output for direct feeding to a 15 ohm speaker.

The input transformer provides a balanced input circuit and optimum source impedance for low noise operation of VT1. After amplification by transistors VT1 and VT2, the input signal is applied to the complementary symmetry phase inverter section (VT3 and VT4) which in turn drives the class B output stage (VT5 and VT6). The stages are directly coupled, stabilised with A.C. and D.C. feedback and temperature compensated.

A series regulator VT7 is incorporated in each amplifier to reduce the ripple and the possibility of crosstalk when a number of amplifiers are connected to a common power supply.

Correct base bias for VT1 is obtained by adjusting RV1 so that the voltage at board terminal 13 is HALF the voltage at board terminal 17.

Gain control is accomplished by varying the D.C. feedback level to VT1 by sectional strapping of a resistance chain in the emitter circuit of that transistor.

6.2 Electrical Performance. (The following performance figures are for a load termination of 600 ohms).

Input Impedance: Suitable for connection across 50 ohm, 150 ohm or 600 ohm sources. (Unterminated input transformer with centre tapped primary winding).

Output Load Impedance: 150 ohms or 600 ohms (balanced or unbalanced).

Gain: 36, 41, 46, 51 or 56dB as selected by external strapping of slide connected contacts.

Frequency Response: ±0.5dB from 30Hz to 15kHz.

Maximum Output: 250mW (+24dBm).

Harmonic Distortion: Not greater than 0.5% from 30Hz to 15kHz at full output.

Noise: -120dBm within the range 30Hz to 15kHz referred to input terminated in 600 ohms.

Auxiliary Output: 1 watt into 15 ohms.

Power Requirement: 24V D.C. external supply. The current drain varies from 10mA at zero output to 110mA at full output.

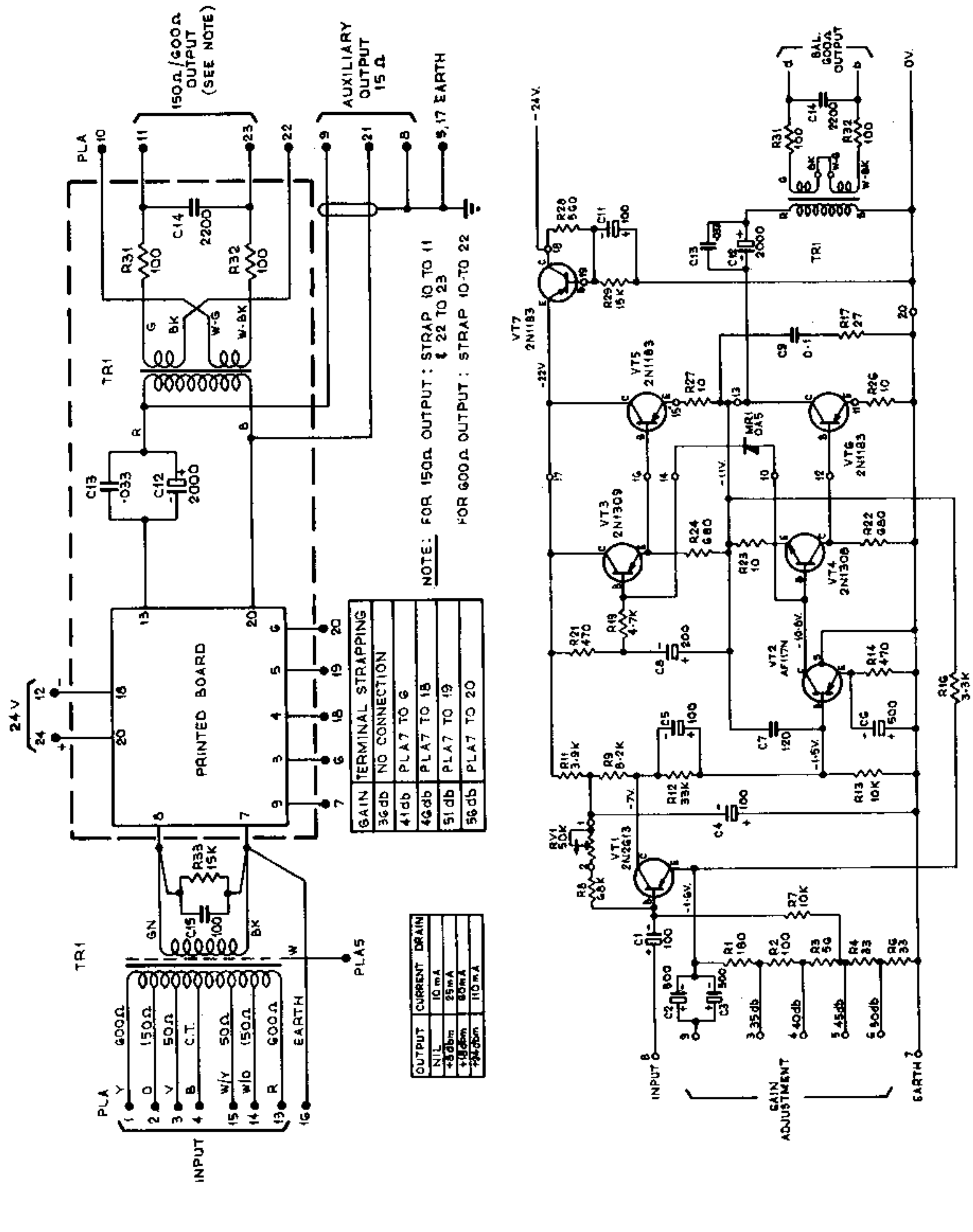


FIG. 6. TRANSISTOR TYPE UTILITY AMPLIFIER - SCHEMATIC CIRCUIT.

7. MONITOR AMPLIFIER.

7.1 General. Fig. 7 shows the circuit of a typical transistor-type 10 watt monitor amplifier designed for use in studio or other high quality audio applications. It is suitable for bridging across a 600 ohm line or other low impedance source, or for feeding from a pre-amplifier. The amplifier is designed to operate from a 48V, 0.5A D.C. power supply.

The input signal is amplified by VT1 and VT2 and then applied to the complementary symmetry phase inverter section (VT3 and VT4) which, in turn, drives the class B transistors (VT5 and VT6). The stages are directly coupled, stabilised with A.C. and D.C. feedback and temperature compensated.

Correct base bias for VT1 is obtained by adjusting potentiometer RV1 so that the voltage at board terminal 13 is HALF the voltage at board terminal 17

Referring to Fig. 7, internal gain control is achieved by strapping PLA1 to PLA2 and PLA9 to PLA10, and feeding the input signal to pins PLA3 and PLA11 For operation with an external gain control, the signal is applied to PLA1 and PLA9.

7.2 Electrical Performance.

Input Impedance: 10 kilohms balanced when used with recommended gain control (bridging loss 0.5dB).

Gain: When connected to a 600 ohm line delivering +18dBm to a 600 ohm load the amplifier will deliver 10 watts, that is, an apparent gain of 32dB

Frequency Response: ±1dB from 30Hz to 15kHz.

Power Output: 10 watts into 15 ohms.

Harmonic Distortion: 0.5% at 10 watts output into 15 ohms within the range 30Hz to 15kHz.

Noise: Better than 80dB below rated output.

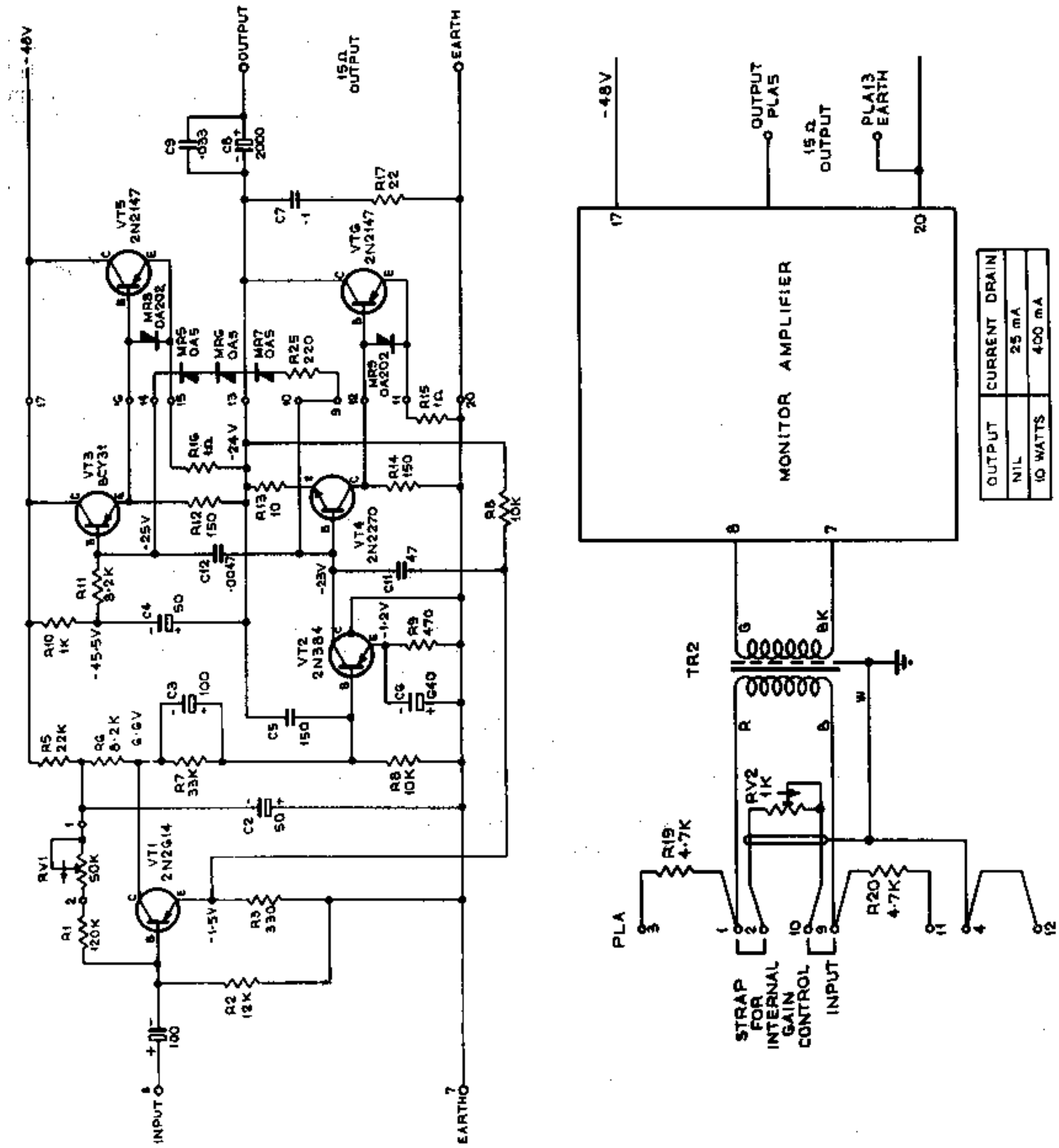


FIG. 7. TRANSISTOR TYPE MONITOR AMPLIFIER - SCHEMATIC CIRCUIT.

8. VIDEO DISTRIBUTION AMPLIFIER.

8.1 General. A Video Distribution Amplifier (V.D.A.) is an isolation amplifier designed for use at any point in a T.V. system to provide a number of independent low impedance (75 ohm) outputs from a single video input.

Fig. 8 shows the block diagram of a typical V.D.A. which provides three outputs from one bridging input. This is a transistorised version which is physically divided into three circuit cards:-

Video Gain Control, Video Output Amplifier and Power Supply.

The diagram also shows a Sync Pulse Adder which may be provided to allow the addition of sync pulses to the video output signals.

The V.D.A. is designed as a plug-in unit and eight separate amplifiers can be housed in a frame which mounts on a standard 19" rack and occupies 5¼" of vertical space. Each amplifier has its own self-contained power supply and all inputs and outputs are brought out through a multi-pin plug PLA to soldering points for direct connection to coaxial cabling.

Test jacks TJA and TJB on the front panel enable a C.R.O. to be connected to either input or output via 1,000 ohm isolating resistors.

8.2 Electrical Performance. Video Input: Composite or non-composite, at a level of 0.5V to 2V peak-to-peak. Bridging input has a return loss greater than 40dB when connected to a terminated 75 ohm line.

Sync Input: 2V to 4V peak-to-peak negative going.

Video Output: Three outputs of standard level composite signal derived from a low impedance source via isolating networks. Nominal output impedance is 75 ohms with return loss greater than 30dB.

L.F. Response: Less than 2% tilt on 50Hz square wave.

H.F. Response: Within 0.5dB to 10MHz at any setting of gain control.

Linearity: Measured with an output of 2V peak-to-peak sawtooth plus 0.2V of 1MHz sine wave, the variation in the 1MHz components of the output (when received via a H.P. filter) is less than 2%.

Gain Control: A preset control is adjustable over the range ±6dB.

Sync Control: A preset control is adjustable over the range 0.2V to 0.4V.

Noise: With inputs and outputs terminated, the peak-to-peak value of noise and hum at the output is at least 56dB below one volt.

Transient Response: Less than 2% overshoot on a pulse having 0.1μS rise time. The "K" factor is 0.5% for a "T" pulse.

Isolation between Outputs: Greater than 40dB at 1MHz.

8.3 Video Gain Control Card. (Fig. 9). This card incorporates a 2N706 transistor connected as an emitter follower. A potentiometer RV1 in the emitter circuit enables the gain to be varied from unity to -12dB. The two 10V tantalum electrolytic capacitors C1 and C2 at the input enable the amplifier to be fed from signal lines having a D.C. offset of up to ±10V. MR1 and MR2 protect the transistor by preventing the application to its base of excessive voltage due to surges or failure of C1 or C2

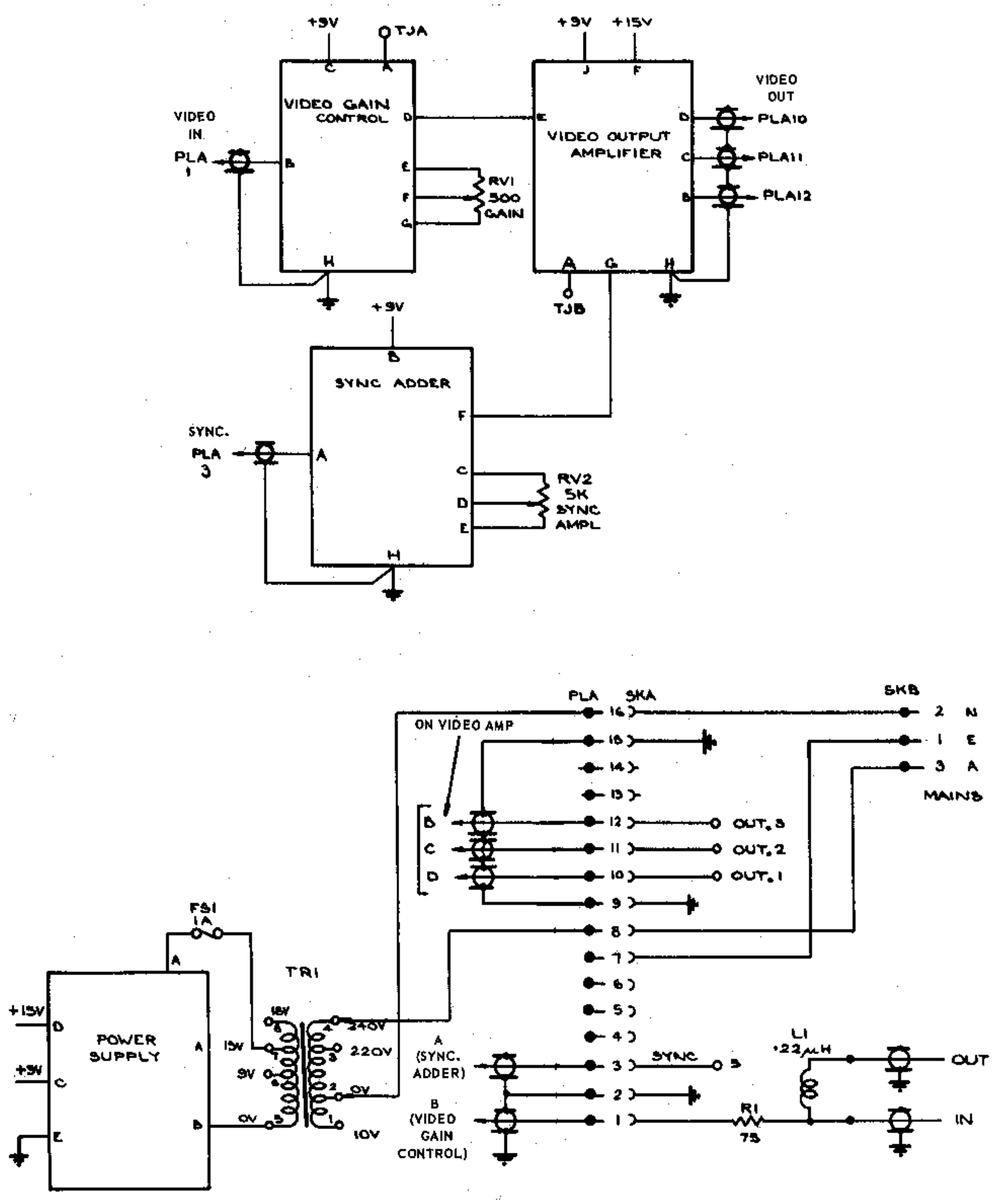


FIG. 8. BLOCK DIAGRAM OF TYPICAL V.D.A. (TRANSISTOR TYPE).

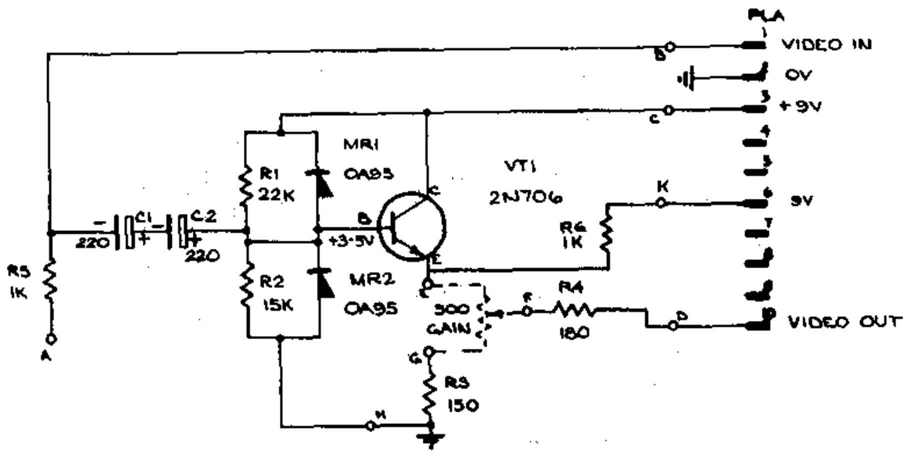


FIG. 9. SCHEMATIC CIRCUIT OF TYPICAL V.D.A. GAIN CONTROL CARD.

8.4 Video Output Amplifier Card (Fig. 10). The video output from the gain control card is amplified by VT1 and VT2 on the video output amplifier card and then fed to the output emitter follower VT3. Negative feedback is applied from VT3 emitter to VT1 emitter via R9, R6 and R4. The gain of the amplifier is determined by the potential divider formed by R9 and the parallel combination R6 and R4. Due to the negative feedback, the impedance at VT3 emitter is of the order of 1 ohm; this is padded out by R11, R12 and R13 to provide three outputs of 75 ohm source impedance. When required, sync pulses from the sync adder card, are inserted via R7.

The preset control RV1 (Set VT3 Current) is adjusted so that the voltage at test jack TJB is +1.5V as measured with a 20,000 ohm per volt (or better) meter. This is an important adjustment and must be done accurately. If the voltage is set more positive, VT3 will overheat; if set less positive, the linearity will be degraded.

Capacitor C2 adjusts the frequency response. With the amplifier set for overall unity gain, C2 is normally set to give a frequency response flat to ±0.1dB up to 10MHz. If it is desired to obtain a boosted frequency response for compensation, C2 can be set at minimum capacitance. In this case, the frequency response will be boosted by approximately 6dB at 10MHz.

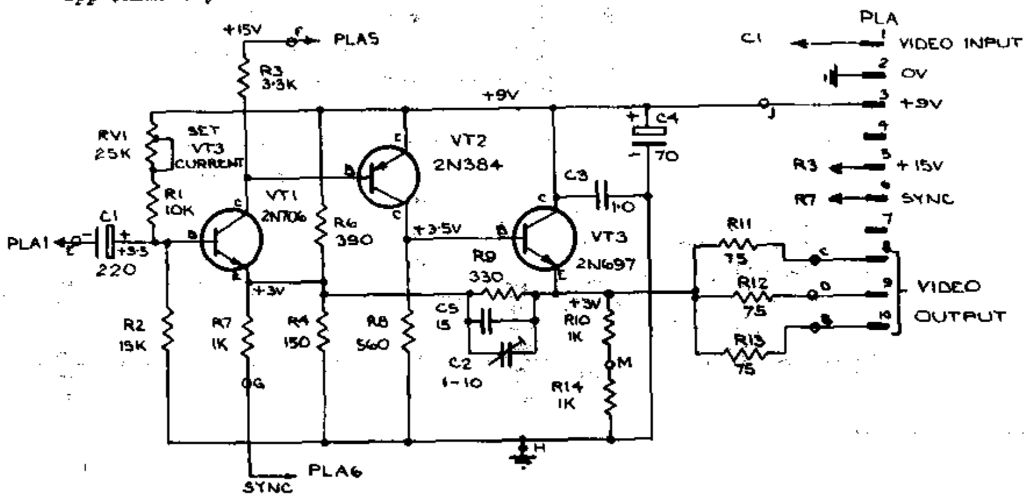


FIG. 10. SCHEMATIC CIRCUIT OF TYPICAL V.D.A. OUTPUT AMPLIFIER CARD.

8.5 Sync Adder Card (Fig. 11). Sync pulses fed to the sync card are amplified and partially clipped in VT1 and then fed to the emitter follower VT2. The diodes MR1 and MR2 take a slice from the sync pulse at V2 emitter and feed it to the output amplifier card. The size of the slice and, therefore, the size of the sync pulse from the output amplifier is controlled by the VT3 current which is set by RV2 (Sync Amplitude), mounted on the front panel of the V.D.A.

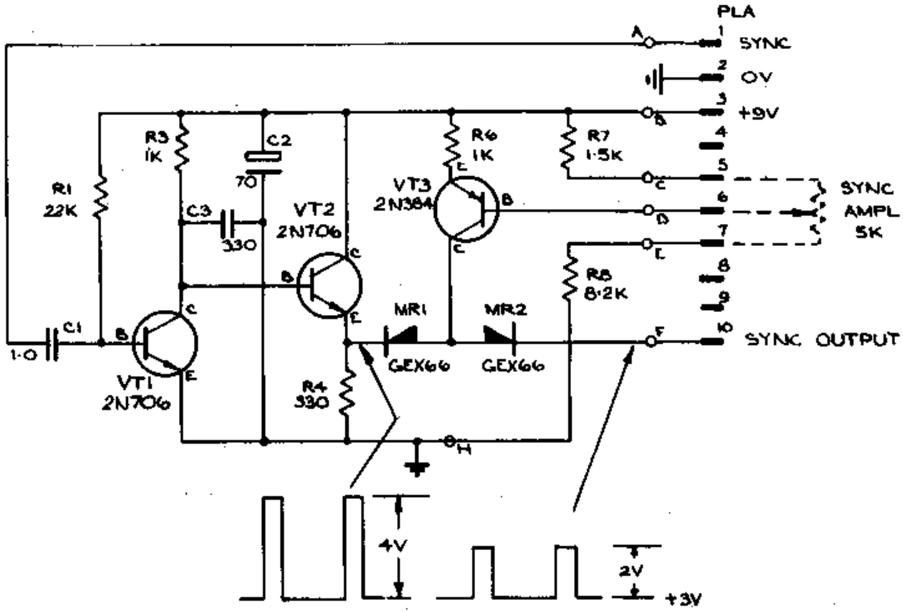


FIG. 11. SCHEMATIC CIRCUIT OF TYPICAL V.D.A. SYNC ADDER CARD.

8.6 Power Supply Card (Fig. 12). This card provides stabilised voltages for the V.D.A. The A.C. mains input voltage is stepped down by a power transformer which has primary tappings to suit nominal mains voltages from 220V to 250V, and applied to the bridge rectifier MR1 to MR4. Transistor VT1 is a series regulator controlled by transistor VT2. The +15V rail is regulated by a zener diode.

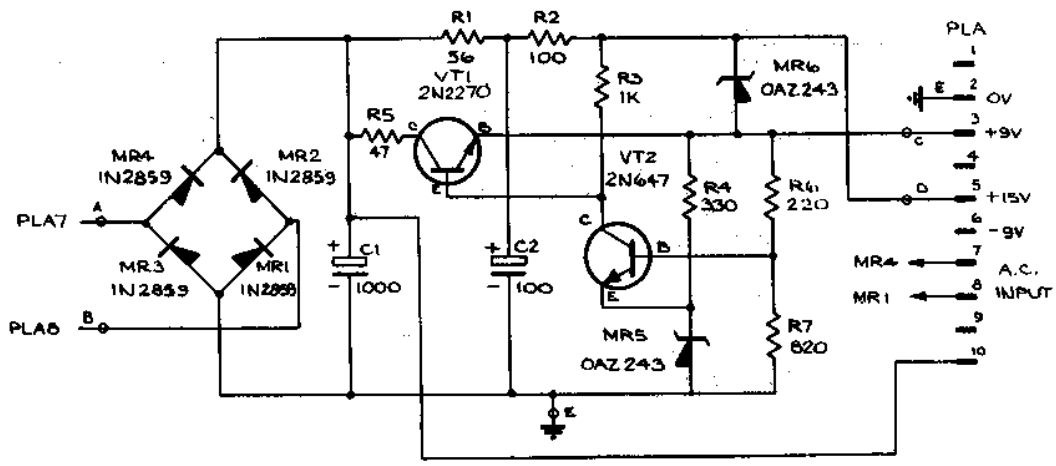


FIG. 12. SCHEMATIC CIRCUIT OF TYPICAL V.D.A. POWER SUPPLY CARD.

9. "FLYING SPOT" SLIDE SCANNER.

9.1 General. Slide Scanners are used for the transmission of slides and internal signals of every kind, and also for the provision of test patterns for the setting up and testing of T.V. transmitters and microwave links.

Special features of a typical slide scanner are:-

(i) Good picture quality and high signal-to-noise ratio due to the use of a high-quality scanner tube and a multiplier photocell.

(ii) Remotely operated slide changer permitting slides to be selected in any arbitrary sequence.

(iii) Remote control of all essential electrical adjustments.

(iv) Press-button change-over from positive to negative operation with extensive gamma correction.

(v) Automatic gain control which may be switched off.

(vi) Automatic black level control may be switched to "gated" or for darkest point in picture.

(vii) Continuous picture and signal level monitoring by picture and waveform monitor.

9.2 Construction and Operation. In a typical slide scanner, the E.H.T. unit for generating the anode voltage for the scanner tube, and the picture and waveform monitors for continuous supervision of the outgoing picture are fitted in the upper part of the sheet-steel cubicle. The middle portion of the cubicle contains the scan generators and the image scanning system with the slide changer device. The lower part of the cubicle contains the preamplifier and main amplifier, the pulse shaper and the mains voltage units, as well as all the associated auxiliary units. The control desk on the front door can be hinged up and allows convenient operation of the apparatus.

All the units are arranged on individual chassis for ease of access. The whole of the wiring is visible. Quick release plug connectors enable the individual chassis to be readily interchanged.

Internal illumination is switched on when the cubicle door is opened.

9.3 Technical Data.

Scanning System:	Light-spot scanner (flying spot)		
Inputs:	Horizontal pulses	(H)	-4Vpp ±40% at 75 ohm into loop-in filters
	Vertical pulses	(V)	
	Blanking signal	(A)	return loss> 24dB up to 7MHz
	Synchronizing signal	(S)	
Outputs:	1 × composite signal	(BAS)	+1Vpp or +1.4Vpp at 75 ohm
	2 × blanked video signal	(BA)	+0.7Vpp or +1Vpp at 75 ohm
Amplifier Characteristics:	Frequency response:		±0.5dB from 1MHz to 5MHz.
			-1dB at 7MHz
	Overshoot (100nS)		<1.5%
	Differential gain (at $\gamma = 1$)		>0.9
Overall Characteristic:	Depth of modulation when transmitting a 5MHz bar pattern, in centre of picture:		≥70%
Slide Dimensions:	Standard external dimensions:		50mm × 50mm
	Picture size (size of raster in plane of slide):		21mm × 28mm
	Either positive or negative slides with densities between 0.2 and 2.2 can be used.		
	Colour slides likewise provide good television pictures.		
Changing time:	From one slide to an adjacent slide:		1.5 secs. approx.
	For a complete rotation of the slide changer:		3 secs. approx.
Apparent difference in position between any two slides:			
	Vertical:		2% of picture height max.
	Horizontal:		2.5% of picture height max.
Power Supply:	220V, 50Hz, 7A approx.		
	Can be adjusted for 210/220/230/240V A.C. mains supply.		

10. T.V. PROGRAMME LINK MODULATOR.

10.1 General. This equipment is used for the modulation of T.V. vision and sound signals for application to associated broadband radio link equipment.

The basic functions of the modulator equipment are:-

(i) To apply pre-emphasis to the T.V. signal (to reduce its characteristic asymmetry during periods of low frequency modulation),

(ii) to combine the vision and sound signals; and

(iii) to convert them into a composite frequency modulated signal of 70MHz centre frequency for application to the associated transmitter.

A simplified block diagram of the modulator equipment is shown in Fig. 13.

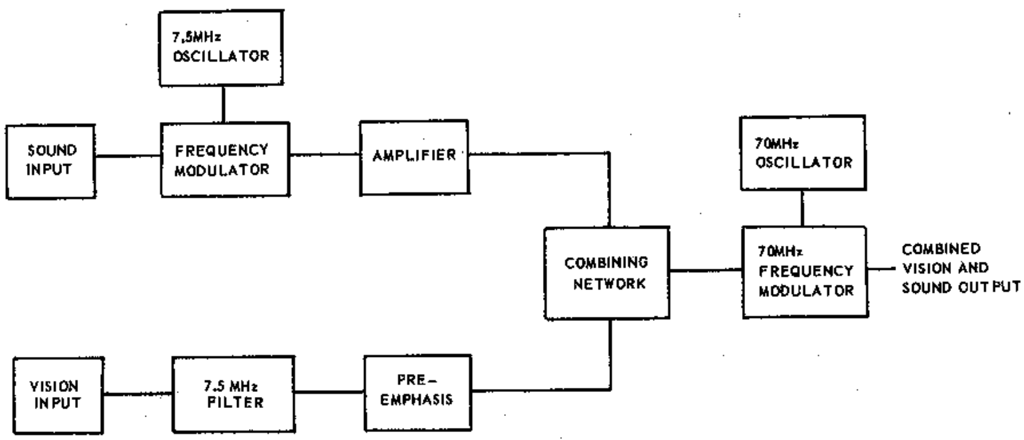


FIG. 13. BLOCK DIAGRAM OF MODULATOR EQUIPMENT.

The baseband vision signal of 25Hz to 5MHz is applied via a 75 ohm coaxial cable to a phase equalised 7.5MHz band-stop filter which suppresses any sound channel frequencies (7.5MHz component plus sidebands) that may exist in the vision signal. The signal then passes through an attenuation equaliser circuit (pre-emphasis) to the combining network.

The sound signal of 30Hz to 15kHz is applied via a 600 ohm switched attenuator, transformer and 15kHz L.P. filter to a frequency modulator. Here, it is converted to a 7.5MHz frequency modulated sub-carrier, the centre frequency of which is stabilised by an A.F.C. system. The F.M. sound signal is amplified and combined with the vision signal in the combining network.

The combined vision (25Hz to 5MHz) and sub-carrier sound (7.5MHz) in the band 25Hz to 8MHz is then converted to a 70MHz frequency modulated carrier, the centre frequency of which is automatically controlled to within close limits. The 70MHz frequency modulated output at a level of 500mV is applied via a 75 ohm coaxial cable to the mixer unit of the transmitter.

10.2 Typical Performance. The following performance figures are typical values obtained on the combined performance of the modulation and associated demodulation equipment.

(i) Vision Channel.

Frequency Response: Within ±0.4dB from 200kHz to 3.5MHz.
Within ±2dB from 3.5MHz to 5MHz.

Low Frequency Response: Slope on 50Hz square wave, less than ±2% (with sync pulses).

Middle Frequency Response: Slope on 25μS peak white pulse at line frequency (excluding first and last 5%), less than ±1%.

Linearity: Sync pulse, less than ±7.5% of normal amplitude.
Black to white, less than ±7.5% of ideal waveform.

Transient Response: Rise time not greater than 85nS.

Input Level: -3dB to +5dB, reference 1V (double amplitude peak).

Output Level: -5dB to +5dB, reference 1V (double amplitude peak).

Input and Output Impedances: 75 ohms unbalanced, with return loss greater than 20dB up to 5MHz.

Deviation: ±4MHz peak with respect to intermediate frequency of 70MHz (sound 200kHz R.M.S. on 70MHz).

Signal to Noise Ratio: $\frac{\text{D.A.P. Signal}}{\text{R.M.S. Noise}}$ = 60dB or more.

Hum Level: $\frac{\text{D.A.P. Signal}}{\text{D.A.P. Hum}}$ = 43dB or more.

(ii) Sound Channel.

Frequency Response: Within ±0.75dB from 50Hz to 10kHz. Slope of characteristic, not greater than 6dB per octave in the ranges 30-50Hz and 10-15kHz.

Distortion: Audio frequency distortion at ±100kHz deviation. Harmonic test at 30Hz.
Ratio of second harmonic to fundamental = -40dB.
Ratio of third harmonic to fundamental = -45dB.

Two tone test, each tone at ±50kHz deviation, 1kHz to 15kHz.
Ratio of second harmonic to fundamental = -50dB.

Deviation: ±100kHz for 7.5MHz carrier.

Input Level: 0dBm to +10dBm.

Input Impedance: 600 ohms balanced, with return loss greater than 20dB at +10dBm.

Signal to Noise Ratio: With vision, 55dB or greater.
Without vision, 60dB or greater.

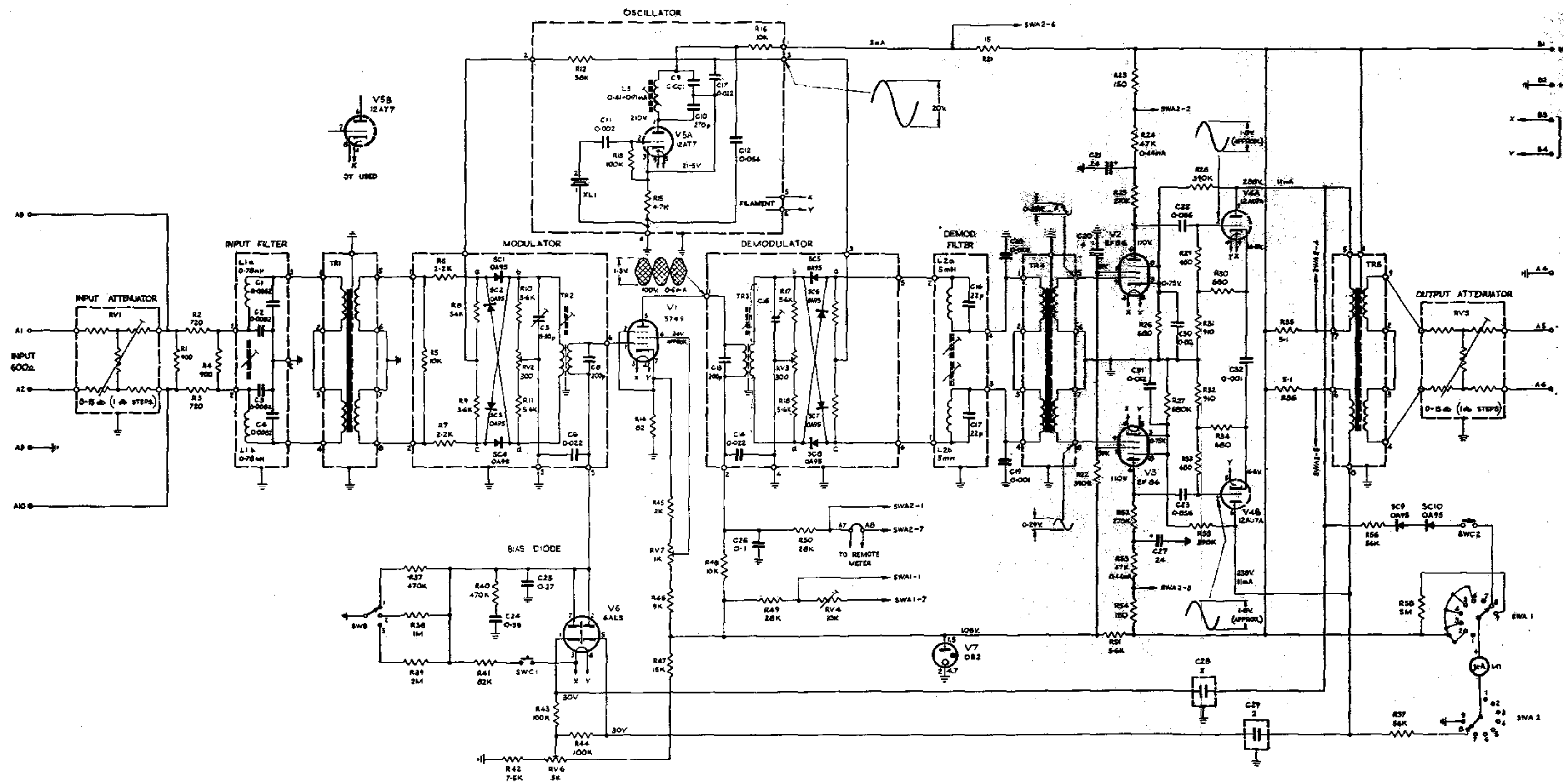


FIG. 14. AUDIO (LIMITER) AMPLIFIER, TY
SCHEMATIC CIRCUIT.