AF Signal Generator J2C

Contents

Illustrations

Introd

The Ad
meet th
and incl
and hi-fi

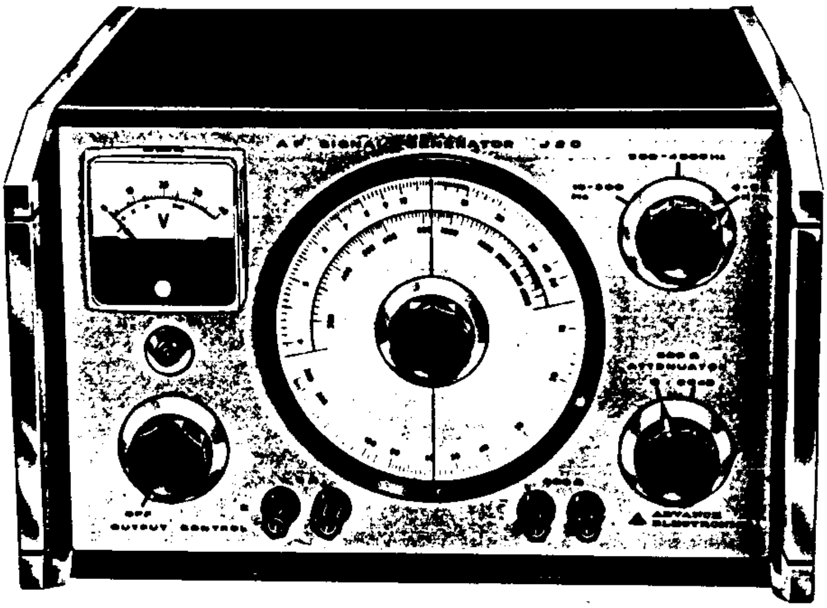
The ins
a maxin
The out
and a
attenua
provide

Overall
on fun
of a th
control

The Advance AF Signal Generator J2C has been designed primarily to meet the special requirements of telephone and radio service engineers, and includes facilities which are most frequently needed for testing audio and hi-fi equipment.

The instrument has a frequency range of 15Hz to 50kHz and provides a maximum output of one watt with an exceptionally low distortion level. The output impedance is maintained at about 600Ω over the entire range, and a 20dB attenuator can be switched in to provide a higher order of attenuation when required. An alternative 5Ω impedance output is also provided.

Overall distortion at full output above 100Hz is less than 2% (34dB down on fundamental). Any signal within the range is obtained by operation of a three position range switch used in conjunction with a slow motion control and calibrated dial.



Specification

Frequency Ranges

A—4kHz to 50kHz
B—300 Hz to 4kHz
C—15Hz to 300Hz
Accuracy ± (2% + 1Hz).

Output

Output into 600Ω 0.1mW to 1W (0.25V to 25V), continuously variable.
Accuracy: ±(1dB + 1.5% f.s.d.).
Maximum output into 5Ω greater than 500mW, continuously variable.

Output Impedance

The output impedance approximates to 600Ω over the whole range. Where closer accuracy is required the 20dB attenuator should be used.

Attenuator

A 20dB 600Ω attenuator is incorporated. This is a π pad built of close tolerance resistors.
When switched in circuit it provides a more accurate output impedance with a maximum output of 10mW (2.5V).

Distortion

Total harmonic and hum content as compared with fundamental, above 100Hz:
better than 34dB down (2%) at full output
better than 40dB down (1%) at 100mW.
There is a slight increase in distortion below 100Hz, but it is still low, down to 15 Hz.

Power Supplies

105 to 125V, 210 to 250V, a.c. only, 45 to 100Hz.

Consumption

Approximately 40W.

Dimensions (overall)

11" wide, 7⅝" high, 10¾" deep (28 × 19.4 × 27.3 cm).

Weight

19 lb (8.6kg).

Finish

Light blue case and side panels with medium grey frame and light grey front panel.

on 2

Where

close

dance

above

low,

ght grey

Operation

3.1 POWER SUPPLY

The instrument is despatched with the supply transformer set to operate at 210 to 250V.
For operation at 105 to 125V the supply transformer tappings must be changed as follows:

(1) Remove the wrap-round case by releasing two clips at the rear of the instrument. The supply transformer is located on the left hand side of the chassis behind the OUTPUT CONTROL.

(2) Remove the connection between tag 2 and tag 3. Connect tag 1 to tag 2, and tag 3 to tag 4.

The instrument is provided with a 3-core cable so that the case may be earthed to the supply earth if desired.
The on-off switch is incorporated in the OUTPUT CONTROL.

3.2 FREQUENCY

A signal of any frequency between 15Hz and 50Hz is set by using the range switch in conjunction with the calibrated dial.
Continuous adjustment is by means of the slow motion control situated centrally on the dial.

3.3 OUTPUT IMPEDANCES

Two alternative output impedances are available as follows:

(a) A 600Ω output from the right hand pair of red terminals, labelled 600Ω. The accuracy of the output impedance is greatly improved when the 20dB attenuator is in use. These terminals are not earthed, but an earth connection to either terminal can be made if desired.

(b) A 5Ω output from the black E terminal (an earthing terminal) and the adjacent red terminal. The earthing terminal can be used for general earth connections as required.

3.4 OUTPUT LEVEL CONTROLS

Variation of the output level is accomplished by means of a front panel potentiometer control and a 20dB attenuator which can be switched into circuit.

The output without the 20dB attenuator is that indicated by the meter, there being no increase in distortion if the output is not terminated. When the 20dB attenuator is in circuit and the output is loaded with 600Ω, the output voltage is one-tenth of that indicated. When the load is of high impedance the output voltage is one-fifth of that indicated.

The output level at the 5Ω sockets is controlled by the OUTPUT CONTROL alone, and a maximum output of 500mW is available.

4.1 GENERAL

A functional diagram of signal generator is shown in Fig. 1, and a circuit diagram for the instrument is shown in Fig. 4. Basically the circuit consists of a Wein bridge type oscillator switched in three ranges, followed by a triode driver stage and tetrode output stage working into the output transformers T1 and T2. Output transformer T2 is used only for the high frequency range A, and is selected by S1. The power supplies are derived from a full-wave rectifier using resistance/capacitance smoothing, and from a low voltage winding supplying the valve heaters.

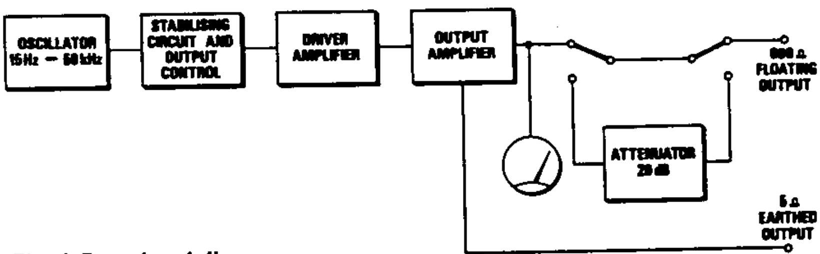


Fig. 1 Functional diagram

4.2 WEIN BRIDGE OSCILLATOR

The series RC elements of the bridge are formed by R4, R5 or R6 and part of the ganged capacitor designated C5, together with the parallel capacitor C4. Parallel RC elements are formed by the other part of the ganged capacitor designated C6 and either R1, R2 or R3. Capacitors C1, C2 and C3 are trimmers across these resistors, required for calibration purposes. R15 is selected during manufacture to provide, in conjunction with R7, a means of frequency calibration at the low frequency end of the range (15Hz).

The common junction of the bridge elements are connected to the V1a/V1b amplifier at the V1b grid. Other bridge connections are made via C8 to V1a anode and via C7 to the V1a cathode circuit. The two sections of V1 are RC coupled from V1b anode to V1a grid. The connection of R11 to the junction of R9 and R10 provides negative feedback to V1a, and automatic bias is produced by the cathode resistors R9 and R10. The oscillator is connected to the thermistor stabilising circuit from the bridge side of C8.

4.3 STABILISATION CIRCUIT TH1 AND TH2

The operation of the thermistors TH1 and TH2 are to some extent interdependent, but TH1 can be considered as the principal means of stabilising the output frequency and TH2 the output amplitude, with change in temperature. R14 is a means of setting the thermistor current and is the preset output level control. RV1 is the front panel OUTPUT CONTROL. C10, connected across part of RV1, provides some compensation at the high frequency end of the working range. Connection to the driver stage is made via R16.

4.4 DRIVER AMPLIFIER V2

V2 is a triode amplifier with a resistive anode load that is coupled to the output amplifier via C14. Part of the hum voltage existing across R21 in the HT line is applied as negative feedback at the V2 grid, thus reducing the hum level in the output signal. Normal negative feedback is connected from the output amplifier to the V2 cathode circuit via R20 and C13. Coupling to the output stage is made via capacitor C14.

4.5 OUTPUT CIRCUIT

The output amplifier V3 is a tetrode amplifier with an anode load that is selected by S1c. For the 600Ω output on the high frequency range A, T2 is connected in circuit and the primary and secondaries of T1 are short circuited. For the middle and low frequency ranges B and C, the transformer T1 is connected in circuit and T2 primary and secondary windings are short circuited. For the 5Ω output, on the other hand, the low impedance output from T2 is used on the high frequency range and low impedance outputs from both T1 and T2 are used in series for the middle and low frequency ranges.

Some automatic negative bias is produced by R23 in the cathode circuit of V3 which is partially by-passed by C15, thus providing increased amplification at the top end of the range. Preset potentiometer R24 is used to set the standing d.c. current in V3 and hence the output impedance of the signal generator. The 20dB output attentuator is a conventional unbalanced π type, formed by resistors R25, R26 and R27 and is switched into circuit by S2.

4.6 METER CIRCUIT

The meter circuit, consisting of the full-wave bridge rectifiers MR1-MR4 and meter M1, is connected directly across the 600Ω input to the 20dB attenuator. When the 20dB attenuator is in use and the 600Ω output is properly terminated, the meter reading must be divided by ten to obtain the true output level.

4.7 POWER SUPPLY CIRCUIT

The a.c. supply is connected to T3 via the fuse FS1 across either the whole of the primary winding in series, for 210 to 250V working, or across the two halves of the primary winding in parallel, for 105 to 125V working. Alteration from one voltage to the other can be made by altering soldered connections as indicated on the transformer tag panel and with reference to the circuit diagram. The indicator neon lamp N1 is connected across one half of the primary winding.

The T3 secondary winding is connected to the full wave rectifier valve V4. Capacitors C18 and C19 form a simple decoupling circuit to earth for HF frequencies that may be picked up internally or from adjacent equipment. The 6.3V winding supplies the heater chain and has a straightforward hum bucking network formed by R29 and R30 that decouples the hum frequencies to earth.

Maintenance — *Section 5*

5.1 GENERAL

The instrument has excellent component accessibility and any maintenance can easily be carried out after the removal of a side-panel or the wrap-round case. The general component layout of the instrument is illustrated in Fig. 2 and 3.

5.2 FUSE REPLACEMENT

After removing the top half of the wrap-round case, the fuse FS1 will be immediately accessible to the rear of the supply transformer T3. The correct replacement fuse is a 500mA Belling Lee type L1055 or equivalent, Advance Part No. 352.

5.3 VALVE REPLACEMENT

All the valves are mounted on the upper half of the instrument chassis and are accessible when the case is removed. Instrument calibration will not normally be affected by valve replacement, but changing V1 will require a check of the current through TH1 as outlined in para. 5.5 (5).

5.4 INTRODUCTION TO RECALIBRATION

After a long period in service the instrument may need some small internal adjustments to regain maximum frequency or voltage calibration accuracy. The entire recalibration procedure is listed below but unnecessary tampering of preset controls is not recommended.

5.5 VOLTAGE CALIBRATION

(1) Switch on the instrument and terminate the 600Ω output terminals via a switch in a 600Ω, 1% resistor having a minimum rating of 1.5W.

(2) Connect the 600Ω terminals to a valve voltmeter VM77C or similar instrument. With the frequency set for 1Hz, turn the OUTPUT CONTROL to a maximum, fully clockwise.

(3) Unlock R33 by turning the central screw counter-clockwise. Adjust R33 by rotating the 6BA nut surrounding the locking screw, until a meter reading of 27V is obtained. Lock R33 in this position by rotating the central screw clockwise, while keeping the nut steady.

(4) Set the frequency to 50Hz and readjust R14 until an output level of 27V is obtained with the OUTPUT CONTROL set to a maximum.

(5) Connect the valve voltmeter VM77C across R34 and adjust the output frequency to 50Hz. A minimum voltage of 13mV should be measured across R34. If the voltage is less than 13mV, replace valve V1. If the voltage is still less than 13mV, replace TH1.

5.6 OUTPUT IMPEDANCE ADJUSTMENT

(1) Reduce the output level to an indicated 15V and switch out the 600Ω termination. Adjust the output level to give exactly full scale deflection (f.s.d).

(2) Switch in the 600Ω termination and adjust preset potentiometer R24 at the rear, until the output is exactly half f.s.d. Repeat this procedure until the output reading with the 600Ω load is exactly half the reading with no load. The 600Ω output impedance will now be correct.

5.7 FREQUENCY CALIBRATION

(1) Adjust the 600Ω terminated output level to 6V and, with the aid of an oscilloscope, use Lissajous displays to check the generator frequency against . ference frequency having an accuracy of at least ±0.2%.

(2) Set the uency to 50Hz and adjust C3 to obtain a stationary Lissajo . ay. Access to C3 is obtained after removing the screening can i in para. 5.7 (3).

(3) To adjust ency towards the 4Hz end of the range A, release the it covers the ganged capacitors by removing three 4BA erside of the chassis. Adjust the outer plates only of the ran tors C5 and C6, to align the scale figures to the input quen

NOTE Th alibration of range A affects the calibration of both B and C ra s, and must therefore be carried out with great care.

(4) Switch range C and set the scale to 25Hz. Adjust the output to exact Hz by using a 50Ω potentiometer substituted temporarily in place of R1 .

(5) Switch Hz and make any necessary adjustments to C3. Repeat the ad ts at 25Hz and 50Hz until both frequencies are correct, by ref the scale. Measure the resistance of the 50kΩ potentiometer it and replace with the nearest preferred value resistor, ¼W rati). Solder the resistor between R7 and the earth tag at the rear of the range switch S1a.

(6) Switch to range C and adjust C1 for correct scale calibration at 300Hz. Check that calibration at 25Hz and 300Hz is not affected. Check calibration accuracy at 200Hz, 100Hz, 50Hz, 25Hz and 20Hz. If an error greater than 1% exists at 100Hz first re-check that the A range calibration is correct. Next check that R1 and R4 are within ½% of 13MΩ.

(7) Switch to range B and adjust C2 for correct scale calibration at 4Hz. Check the scale accuracy at the main points throughout the range. If frequencies are low, a resistor of 750Ω to 2.2kΩ must be wired in series with R3 (70kΩ on range A), and range A will need recalibration. Further adjustment of R15 at 25Hz may be necessary. If frequencies are high, a resistor of 5.6kΩ to 22kΩ must be wired in series with R1 (1MΩ on B range) in order to spread out the range.

(8) When the calibration is complete replace the screening can but do not secure to the ch is.

(9) Adjustment to C3 may be necessary through the appropriate holes in the scr Replace the screening can and secure it firmly to the ch 4BA nuts.

(10) Check that c ver the frequency range is within ±1%.

(11) With the OUTPU imum check that the frequency does not vary the from all ranges by more than 0.5%.

5.8 FINAL ADJUSTMENTS

(1) Check output impedance at 1kHz as in para. 5.7 and adjust R24 as necessary.
(2) Set OUTPUT CONTROL to a maximum and adjust output to exactly 27V using R14 at 4kHz, B range or 50kHz, A range. Make adjustments at the frequency which produces the lower output level.
(3) With the output at 27V, 50kHz check the voltage across R34 using the valve voltmeter. The voltage should not be less than 13mV.
(4) Set output to 25V, 1kHz and check distortion at the +20dB mark on the front panel meter, the distortion should not exceed 0.7%. Excessive distortion figures in either case could be due to hum i.e. insufficient smoothing of HT or of ripple injection at V2 grid. Check components R17, C12, R21.
(5) Check the distortion on range A at 4kHz, 25V. Distortion should be no greater than 2%.
(6) Connect a valve voltmeter (e.g. Advance VM77C) to the 5Ω output terminals. Switch in the 20dB attenuator. The output level should be between 2.2V and 2.6V.
(7) Replace the cover and side panels and recheck the frequency and output levels at both ends and mid-scale of each range.
(8) Recalibration is now complete.

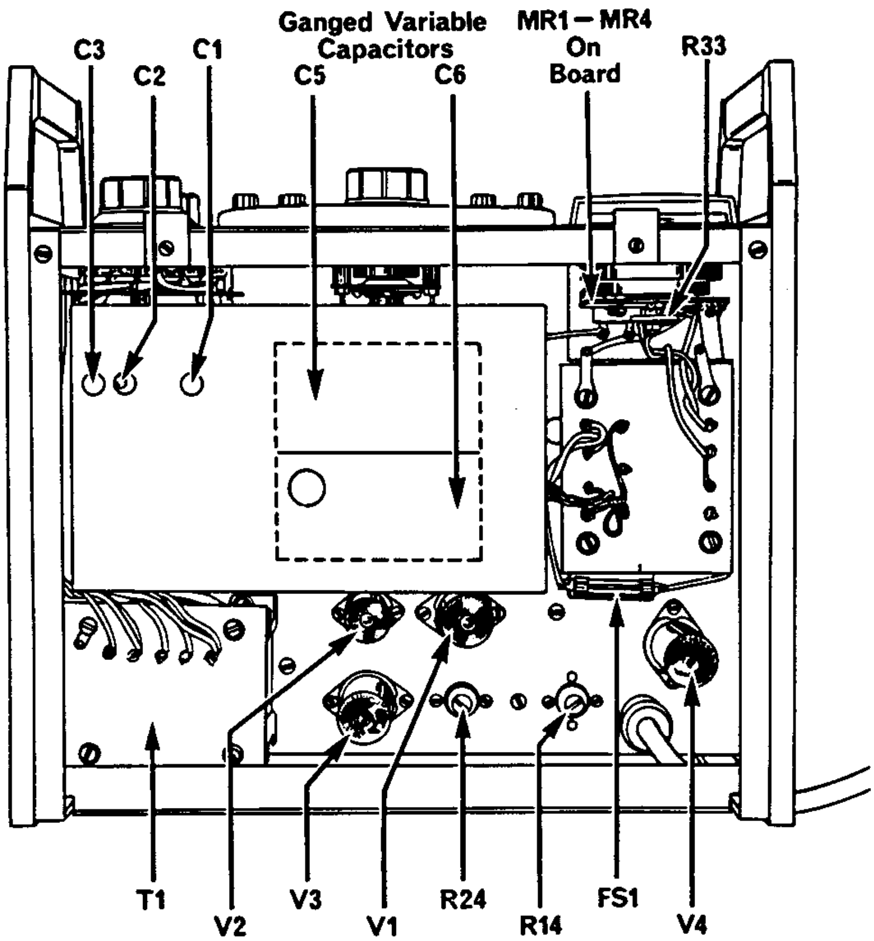


Fig. 2 Component layout—top view

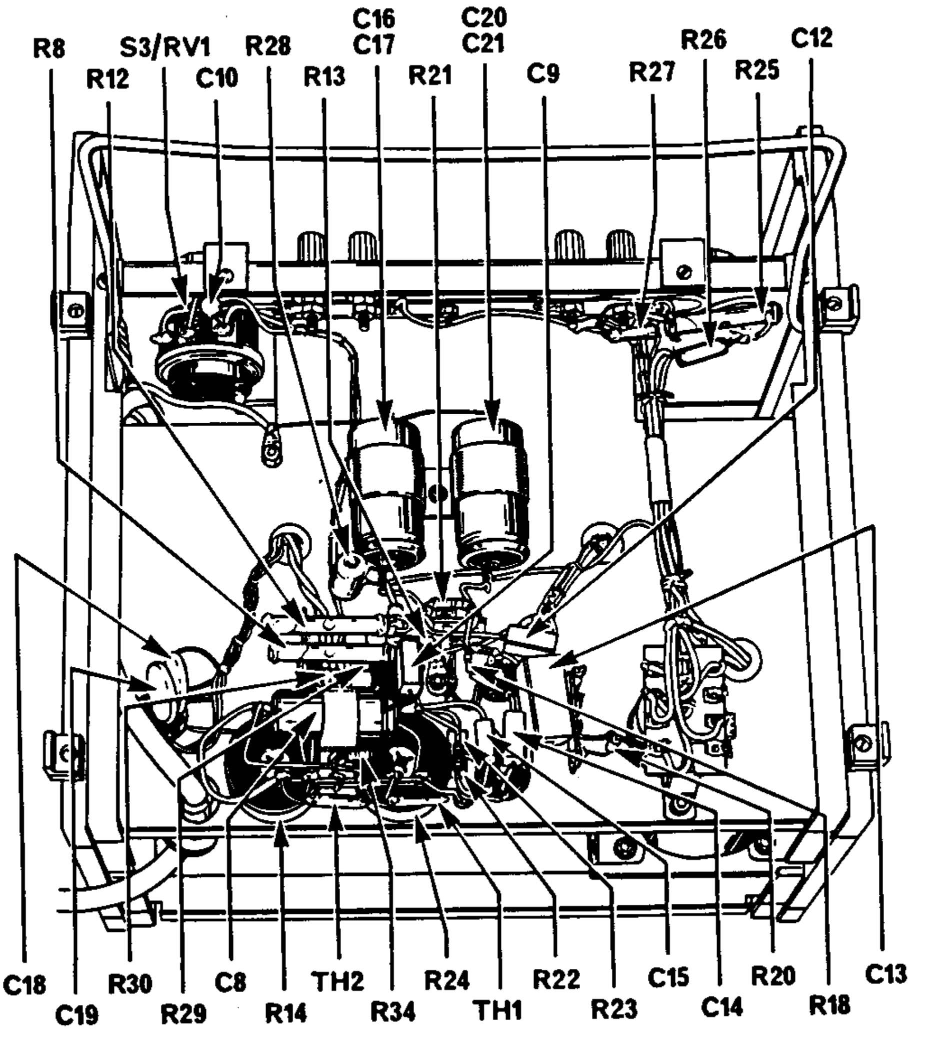


Fig. 3 Component layout—underside view

Componen

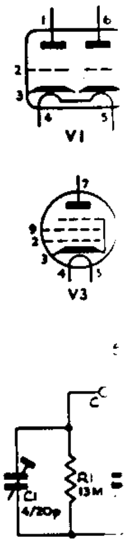


Fig. 4 Circu

NOTES All
All
J2C

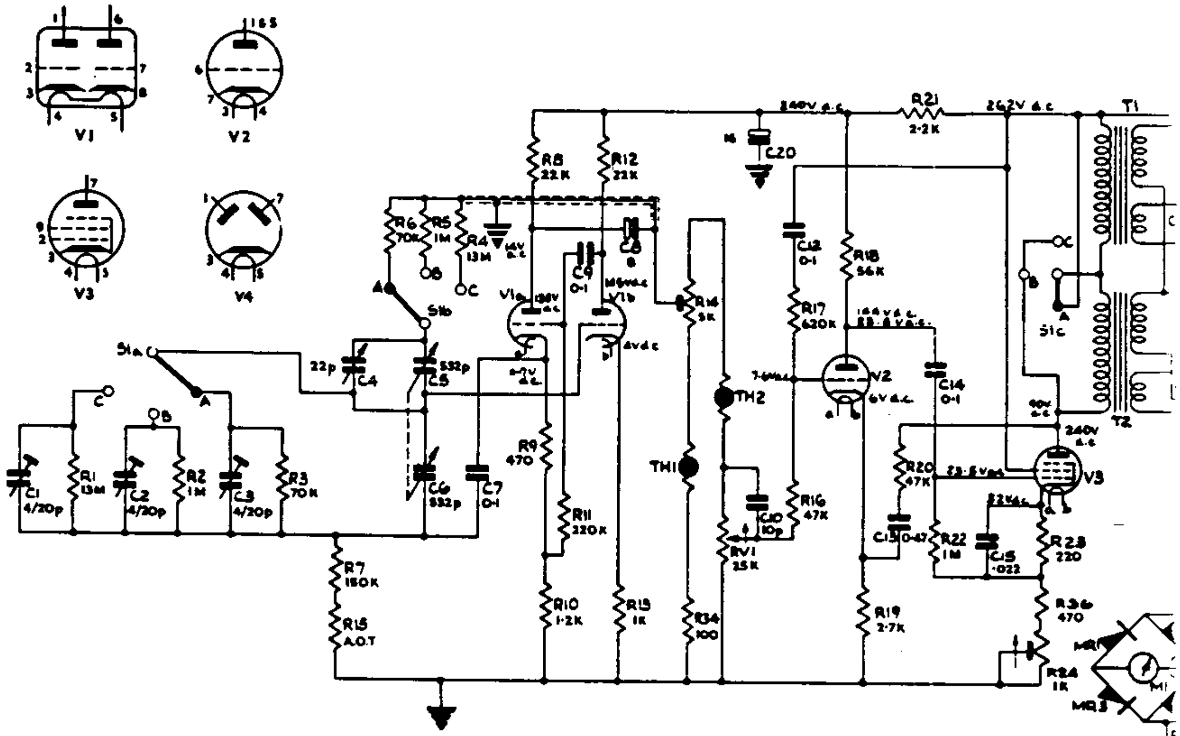
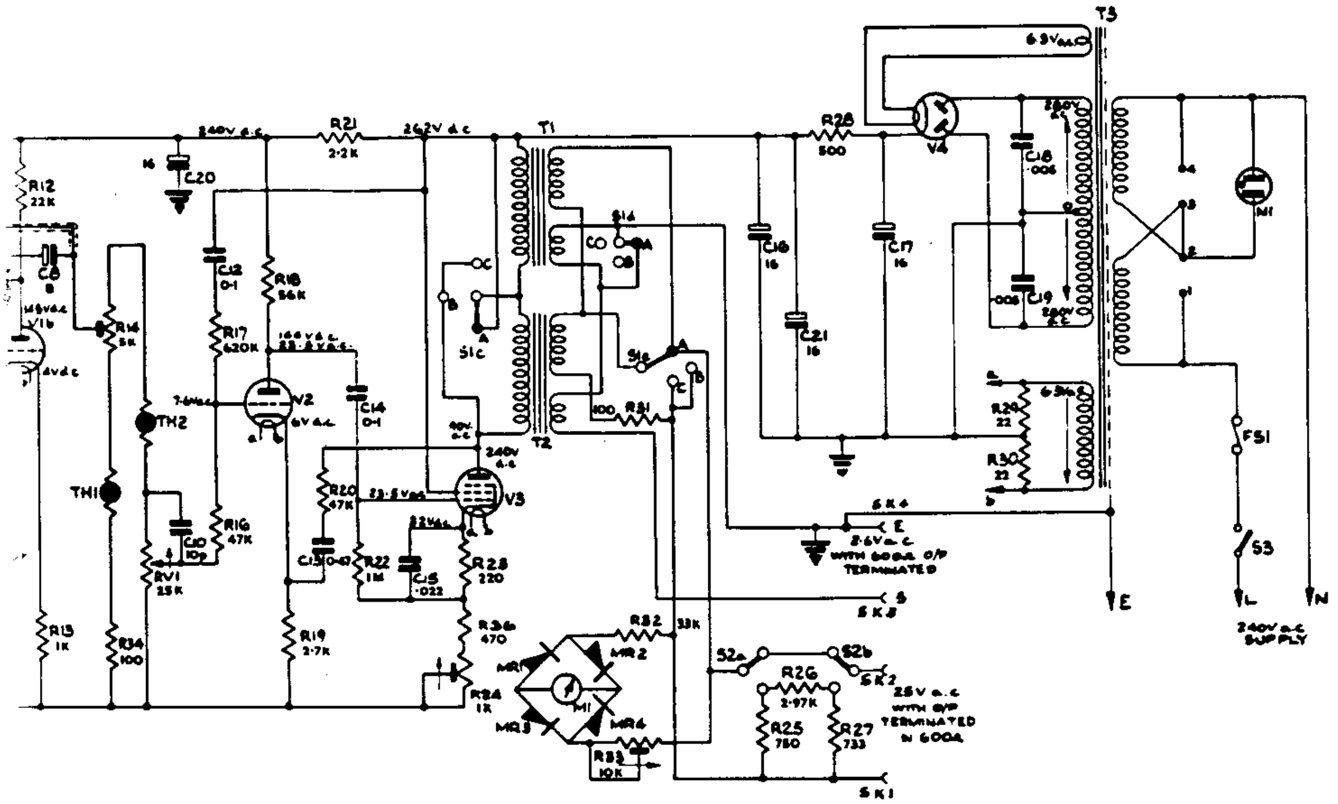


Fig. 4 Circuit Diagram

NOTES All D.C. measurements with 20kΩ per Volt Meter.
All A.C. measurements with A.C. Millivolt Meter VM77C with J2C set to 1kHz sinewave 25V output.



·leter VM77C with

Ref.	*Value*	*Description*	*Part No.*
RESISTORS (Erie 16 unless specified)			
R1	13M	±1% Welwyn C23	6700
R2	1M	±1% Welwyn C22	6701
R3	70K	±1% Welwyn C22	6702
R4	13M	±1% Welwyn C23	6700
R5	1M	±1% Welwyn C22	6701
R6	70K	±1% Welwyn C22	6702
R7	150K	±5% Welwyn C21	10253
R8	22K	±10% Erie 8	6706
R9	470Ω	±10%	3419
R10	1.2K	±5%	1172
R11	220K	±5%	6703
R12	22K	±10% Erie 12	3248
R13	1K	±5%	3424
R14	5K	Preset Pot. Colvern CLR901	7700
R15		Adjusted during manufacture	
R16	47K	±5%	2933
R17	620K	±5%	5092
R18	56K	±5%	3435
R19	2.7K	±5%	3247
R20	47K	±10%	2933
R21	2.2K	±5%	21553
R22	1M	±10%	1171
R23	220Ω	±10%	21554
R24	1K	Preset Pot. Colvern CLR 901	7699
R25	750Ω	±5% Erie 2	7780
R26	2.97K	±1% Welwyn C22	3614
R27	733Ω	±1% Welwyn C22	3615
R28	500Ω	±10% W/W Dubilier A1	11248
R29	22Ω	±10% Erie 8	6850
R30	22Ω	±10% Erie 8	6850
R31	100Ω	±10%	3416
R32	33K	±5%	317
R33	10K	Preset Pot. Egen 123	1064
R34	100Ω	±10%	3416
R35		Not used	
R36	470Ω	±10% Erie 2	21555
RV1	25K	Linear Pot. Colvern CLR 4983/12	7701

Ref.	*Value*	*Description*	*Part No.*
CAPACITORS (Wima Tropyfol M unless specified)			
C1, C2, C3	4/20pF	Trimmer Triko 004a/10BMD.20	4910
C4	22pF	Lemco 1106/R	18330
C5, C6	532+532pF	2 gang Polar E24 Type C1602	10555
C7	0.1uF	400V	2385
C8	8uF	450V DC electrolytic Hunts JE553T	10760
C9	0.1uF	400V	2385
C10	10pF	10% Hunts Hi-Q N750	7703
C11		NOT USED	
C12	0.1uF	400V	2385
C13	0.47uF	400V	2365
C14	0.1uF	400V	2385
C15	.022uF	400V	4243
C16, C17	16+16uF	350V DC electrolytic Hunts JE413	7014
C18, C19	0.005uF	2kV AC Erie K3500/CD8	1514
C20, C21	16+16uF	350V DC electrolytic Hunts JE413	7014
VALVES			
V1	ECC88		4548
V2	6C4 (EC90)		4549
V3	EL84		12785
V4	EZ81		12070
MISCELLANEOUS			
FS1		Fuse 500mA B/Lee L1055	352
MR1, MR2, MR3, MR4		Rectifier Mullard OA70	342
M1		Meter 0-40V AC 0-0.89mA DC	A15132
N1		Neon pilot lamp 100-125V	1165
S1		Range switch D No. A4876	17267
S2		Attenuator switch	7702
S3		Mains switch	
T1		Output transformer low	MT315
T2		Output transformer high	MT316
T3		Mains transformer Input 105-125V / 210-250V 50-100Hz	MT314B
TH1		ST & C Thermister 1522/100	6719
TH2		Thermister A14	7811