INSTRUCTION BOOK No. 51932R

DISTORTION AND NOISE METER A51932

Issue 2

SERIAL No. 171 AND ABOVE

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
47 YORK STREET, SYDNEY

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I N D E X

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1. BRIEF SPECIFICATION

1.1 Application

The A.W.A. Distortion and Noise Meter type A51932 is suitable for the measurement of total waveform distortion, noise, and/or hum voltages in all audio-frequency circuits. It is also useful as a level indicator.

When used with the A.W.A. Amplitude Modulation Monitor (Series A51926) overall performance tests can be made on the audio-frequency characteristics of a.m. type transmitters.

The A51932 instrument may be obtained either for mounting in a standard 19 inch equipment rack, or in a cabinet for portable use.

The frequency range is variable from 25 cycles to 25 kc. in six steps, and the illuminated meter scale is calibrated for volume levels (dbm), noise levels (db), and % distortion.

1.2 Design Summary

The instrument consists essentially of a frequency selective amplifier, a calibrated attenuator, and a valve voltmeter.

An audio-frequency signal to be measured is applied to the valve voltmeter via the calibrated attenuator, and the reference level is set. The signal is then switched to the frequency selective amplifier which, when balanced, completely eliminates the fundamental frequency, and passes without attenuation all frequencies differing one octave or more from the fundamental. The residual voltage is again applied to the voltmeter and compared to the initial reference voltage as a percentage figure.

Volume levels and noise voltages are measured directly, using the valve voltmeter and calibrated attenuator.

A voltage-regulated h.t. supply is incorporated to ensure stable operation of the instrument.

1.3 Performance Data

DISTORTION:

Meter Range:-	0 to 0.3%, 0 to 1.0%, 0 to 10% and 0 to 30%. Fifth position is CAL. (0-100%)
Accuracy:-	±5% of the full-scale readings for each range, ± the residual distortion.

Audio Frequency Range:-	30 to 25,000 cycles fundamental frequency, covered in six steps, each continuously variable over a range of approximately 3.3:1.
Input Impedance:-	0.1 Megohm unbalanced. Bridging 600 ohms, unbalanced Bridging 600 ohms, balanced (In the two latter positions, the bridging loss is less than 0.2 db).
Input Voltages:-	1.2 to 25 volts for the 0.1 Megohm input; 0.8 to 8.0 volts for the bridging input.
Residual Distortion:-	0.1 Megohm input -- .05% maximum Bridging 600 ohm inputs -- 0.1% max. between 50 and 25,000 cycles, but generally less than .05%. Below 50 cycles rises sharply with input level; at 25 cycles is 0.3% with 1 volt input.

NOISE & VOLUME LEVEL (note:- 0 dbm = 1mW in 600Ω)

Meter Ranges:-	Noise	--	0 to -80 db.
	Volume Levels	--	+20 to -60 dbm.
Frequency Response:-	0.1MΩ input	--	25 to 100,000 cycles ±2 db.
	Bridging 600Ω inputs	--	30 to 20,000 cycles, ±1.0 db.
			25 to 50,000 cycles, ±2.5 db.
Residual Noise:-	below -80 dbm.		

POWER SUPPLY

The instrument operates from a supply of 210-270 volts, 40-60 cycles, and the power consumption is approximately 65 watts.

1.4 Connections

Twin jacks are provided at the front panel for input connection. The jack-springs are normalled to terminals also on the front panel, and these in turn are permanently wired in parallel with a 12-pin connector block at the rear of the chassis. A twin-plug patchcord inserted in the jacks therefore breaks off the two sets of auxiliary connections. The 12-pin block is intended for use with a Modulation Monitor, or for some other more-or-less permanent connection.

Also at the rear is a single-circuit jack, from which the audio signal as applied to the voltmeter diodes can be obtained. This is for connection to a C.R.O. or similar device.

1.5 Valve Complement

Radiotron Type	No. Off	Function
6AU6	3	Post Amplifier input (V1) Pre-amplifier input (V5) Pre-amplifier output (V7)
6SN7-GT	3	Post amplifier, stages 1 and 2 (V2) Post amplifier, stages 3 and 4 (V3) Pre-amplifier, stage 2 (V6)
6H6-GT	1	Voltmeter diodes (V4)
6SQ7-GT	2	Voltage control (V11, V12)
6V6-GT	2	Voltage regulators (V9, V10)
OD3/VR150	1	Voltage regulator (V13)
6X5-GT	1	H.T. rectifier (V8)

1.6 Dimensions, etc.

Portable type	--	19" wide x 12" deep x 8.3/4" high
Rack-mounting type	--	19" wide x 12" deep x 10.1/4" high

The weight of the portable type unit is approximately 60 lbs.

The front panel is polished grey with red and while lettering, the portable unit case being grey wrinkle finish.

2. INSTALLATION

2.1 Valves and Fuses

When the unit is first received, it should be inspected to check that the valves are firmly in place, and that the fuses are in the correct clips to suit the mains voltage being used (refer 2.3 below). The position of the valves may be checked by the stencilling on the chassis, and the valve complement table give previously.

2.2 Removal from Case

(a) Portable Unit:-

(i) Remove the two 1/4 Whit. screws at each side of the front panel.

(ii) Place the instrument with the front panel face downwards (all leads being disconnected from the panel).

(iii) Lift off the back case, threading the power cord through the rear hole as necessary.

(iv) When replacing the case, check that the power cord does not become tangled inside, and that the front panel screws are tightened securely.

(b) Rack-mounted Unit

(i) The detachable top and bottom covers may be removed when the unit is either in or out of the rack.

(ii) Loosen the two knurled screws at the rear of the lower cover plate, and withdraw it from the two front pegs.

(iii) On the top cover, release the large coin-slotted fasteners, and withdraw the cover until the bollards under the front edge are clear of the end supporting brackets.

(iv) Note that this type of unit is held in the rack by two 1/4 Whit. screws at each end of the front panel.

2.3 Adjustment for Mains Supply Voltage

When checking the fuses under the fibre cover inside the rear of the chassis, note that they are fitted in the correct

2.3 Adjustment for Mains Supply Voltage (Cont'd)

clips to suit the mains voltage being used, within the range 210 to 270 volts. hen the unit is dispatched from the factory, they are normally fitted for 240 volt operation. One 3 amp. fuse is fitted in the clips marked COM. and the other should be fitted in the clips marked 220, 240 or 260, whichever is closest to the mains supply voltage.

2.4 12-pin Connector Block

As described in 1.4 previously, this is for a more-or-less permanent connection, such as rack wiring, etc. The A.W.A. Modulation Monitor type A51926 is normally provided with a shielded cable and 12-pin plug to match this socket, connection being to pins 1 and 2.

2.5 Earth Connection

hen the rack-mounting type instrument is used, care should be taken that good earthing is achieved on installing the unit in the rack. The front panel should make secure metallic contact to the frame of the rack, which should not be sprayed or painted at these points.

Note that an earth connection is also available at pins 3 and 4 of the rear 12-pin block, but as this will normally be used to earth the shielding of the associated plug and cable, it should not be relied upon as a permanent earth.

On the table-mounting portable type, the earth terminal provided at the left of the front panel should be used for an earth lead.

3. OPERATION

3.1 Setting Up

Set the mechanical zero of the meter. Connect the instrument to the mains, switch on and note that the meter is illuminated. Allow about 5 minutes warming-up period if accurate results are expected.

Under very humid conditions the length of warming-up period required to bring the balance of the frequency-selective amplifier back within the range of the "R" control may be considerably longer particularly on the lowest frequency range.

3.2 Audio-frequency Source

When making distortion and noise measurements of an amplifier, etc., an audio-frequency source is required for feeding the unit under test. This source must be substantially free from distortion, noise, and hum (particularly when low values are being measured), otherwise due allowance must be made. Suggested instruments suitable for the purpose are the A.W.A. Low Distortion Audio Oscillator Series A51042, which provides more than 30 fixed frequencies between 15 and 25,000 cycles; and the A.W.A. Beat Frequency Oscillator Series A96060, which has an output continuously variable between 0 and 20,000 cycles.

3.3 WARNING: Front-panel Terminals and 12-pin Block

The rear 12-pin block and the front-panel terminals are wired in parallel. When using either set of connections, TAKE CARE that undesired inputs are not attached to the alternative set.

3.4 Distortion Measurements

(i) Connect the oscillator to the input terminals of the unit under test, and set to the required frequency. Connect the output of the unit to whichever input terminals are convenient on the Distortion Meter. Adjust the signal from the external oscillator to give the desired output from the unit under test. It will generally be necessary to terminate this output with a suitable load resistor, which is then bridged by the Distortion Meter.

(ii) Select one of the three input-impedance arrangements to suit the output circuit of the unit being tested, i.e.:-

BRIDGING 600Ω BALANCED
BRIDGING 600Ω UNBALANCED
0.1 MΩ UNBALANCED

(iii) Set the METER READING switch on the Distortion Meter to CAL., and adjust the CAL. control until the meter in the

3.4 Distortion Measurements (Cont'd)

(iii) instrument reads full scale.

(iv) Set the FREQUENCY RANGE switch and turn the FREQUENCY dial to give the same nominal frequency as the external oscillator, and set the METER READING switch to DIST.

(v) Now vary the FREQUENCY dial about the nominal setting, at the same time adjusting the "R" control, until the meter shows an absolute minimum reading. The meter-scale range may be changed as required to obtain a conveniently readable deflection.

(vi) When measuring low values of distortion, and particularly when the signal is unstable, care should be exercised in carrying out step (v) to obtain accurate balance (minimum reading).

(vii) The meter reading finally obtained is the average distortion registered directly as a percentage figure on the scale.

3.5 Noise Level Measurement

(i) The procedure for calibrating the instrument is a repetition of steps (i) to (iii) in 3.4 above.

(ii) Leaving the METER READING switch in the CAL./NOISE position, remove the signal input from the unit under test. It is usual to then terminate the input of the unit by a resistance equivalent to the normal sending circuit impedance.

(iii) Increase the meter sensitivity by turning the Meter Range switch clockwise, until a convenient deflection is obtained. The arithmetic sum of the meter reading in db. and the switch position in db is the average voltage ratio between the noise and the initial signal applied to the Distortion Meter input when calibrating (i.e., normally the desired output of the unit under test).

3.6 Dbm Level Measurements

(i) NOTE: 0 dbm = 1mW in 600 ohms = 0.775V across 600 ohms.

(ii) Turn the METER READING switch to the "dbm" position.

(iii) The level in a 600 ohm circuit carrying steady-tone a.c. sine-wave may be measured directly in "dbm" by turning the Meter Range switch to the appropriate position, and is the arithmetical sum of the meter scale reading and the meter switch position.

3.7 Use With Modulation Monitor

(i) Connect the output of the Modulation Monitor to the input

3.7 Use With Modulation Monitor (Cont'd)

of the instrument. A special cable is provided with the A.W.A. Modulation Monitor Series A51926 to match the 12-pin socket at the rear of the A51932 instrument.

(ii) Turn the INPUT switch to the 0.1 MΩ UNBALANCED position.

(iii) When the transmitter is modulated by a suitable audio oscillator (see 3.2 above) the audio characteristic of the transmitted signal may be checked for noise and distortion as previously described.

4. TECHNICAL DESCRIPTION

4.1 Post Amplifier Section.

This section consists of valves V1 to V4, and includes the calibrated attenuator S3 and the diode-rectifier voltmeter V4/M1. The attenuator is calibrated in six 10 db steps.

The two diodes in V4 are used in a balanced circuit arrangement so that the no-signal current through the meter is essentially zero; this is achieved by selecting R33 on test at the factory. R25 is a pre-set potentiometer which enables the full-scale-deflection of M1 to be adjusted.

The CAL. control R6 at the front panel is a potentiometer used to set the input level to the Post Amplifier when required.

4.2 Pre-amplifier Section

The three valves V5, V6, and V7 form a frequency-selective amplifier in conjunction with the R-C filter network, which is a Wein type bridge having two resistive arms and two reactive arms. The reactive arms are coupled to the FREQUENCY RANGE switch S4 as well as to the FREQUENCY dial on the front panel, while the "R" control on the front panel varies one resistive arm.

Manipulation of these controls enables the fundamental frequency of the applied signal to be completely balanced out, leaving only the distortion products, etc., to be measured.

Due to the use of extensive degeneration, the amplifier behaves as a unity gain circuit for all frequencies differing one octave or more from the fundamental, the gain being adjusted accurately to unity by the potentiometer R68, which is the pre-set output control in the anode circuit of V7.

4.3 Input Switching Arrangements

Initial input is applied to the switch S1, which connects it to the bridging transformer T1 for 600 ohm inputs or direct to the coupling capacitor C1 for the high-impedance (0.1 MΩ) input. In the 600Ω BALANCED position, the primary of T1 is floating, while in the 600Ω UNBALANCED position the lower end of the primary (pin 2) is earthed. In these two positions the output from the secondary is fed via C1 to the switch S2. In the 0.1MΩ UNBALANCED position, both sides of the T1 primary are earthed.

The METER READING switch S2 passes the input signal to the required section of the instrument, in conjunction with S1. As will be seen from the circuit diagram, the 0.1MΩ input cannot be used when reading "dbm" levels; these apply only to the 600 Ω inputs. In the two 600Ω positions of S1, the signal is tapped down the secondary of T1, and fed by S2 direct to V1 in the Post Amplifier for "dbm" measurements.

For the CAL./NOISE position of S2, the signal on the moving arm of the CAL. control R6 is fed to V1, while in the DIST. position, this signal is applied to V5 of the Pre-amplifier, the output of the Pre-amplifier then being connected via R68 to V1 of the Post Amplifier.

4.4 Regulated Power Supply

Valves V8 to V13 are used to provide a regulated h.t. output of 280 volts d.c. The circuit guards against the affect of variations in mains voltage, using a normal arrangement of V9 and V10 as series regulators with V11 as the control valve. V12 is arranged in a feedback circuit which reduces ripple and provides a low-impedance output from the supply.

A pre-set potentiometer R69 across the heater circuit is used for hum control, and it is important that the relative connections to the heater of each valve be as shown on the circuit diagram. A separate winding is provided for the heaters of V9 and V10, as these are at a high potential to earth.

The primary connections of the power transformer have been described in 2.3 previously.

5. MAINTENANCE

CAUTION: UNDER NO CIRCUMSTANCES SHOULD ANY PRE-SET CONTROLS BE CHANGED EXCEPT AS ADVISED IN THE FOLLOWING NOTES.

5.1 Valves

No periodic maintenance other than occasional replacement of valves is required. The design of the circuit is such that changing valves can produce only slight changes in operating efficiency and calibration. However, valves that differ widely in operating characteristics can upset the overall efficiency of the instrument; this is especially so for valves V4, V5 and V6.

V1, V2 and V3 can be changed without special precautions, but care should be taken to see that all replacement valves, particularly V1, V2, V5, V6, V7, V11, and V12 have a low heater/cathode leakage current.

V4 should be selected for matching of the twin diodes, which is indicated by zero reading on the meter with no signal input. V5 and V6 should also be selected, as they may introduce a residual distortion in the order of 0.1%.

5.2 Servicing Data

(a) Some general information is given below for use in dealing with simple faults, which may occur after a considerable period of normal operation. In the case of troubles of an obscure or complicated nature the unit should be returned to the factory for servicing. If this is impracticable details of the trouble should be referred to the factory for advice regarding its correction and the supply of replacement parts. Details of the type and serial number of the instrument, together with the particular conditions of use, should be quoted. A full description of any replacement components required should also be given when ordering.

(b) The cause of common faults will normally be revealed by a check on the condition of valves, and on the electrode voltages (given in a table below). These tests should therefore be made as a first step in investigation.

Details of the components are listed in the Component Schedule (Section 6), while values and circuit reference numbers are on the circuit diagram, Drg. No.51932G1.

5.3 Table of Typical Socket Voltages

Measured on a 1,000 ohms-per-volt d.c. meter between valve pin and earth; tolerance ±10% (except 280V h.t., which is ±5V). All heaters are 6.3V a.c.

Valve	Pin No.	Voltage	Meter Range
V1	2,7	2.0	10V
	5,6	125	1000V
V2	2	280	500V
	3	150	1000V
	5	100	1000V
	6	2.2	10V
V3	2	100	1000V
	3	.9	10V
	5	100	1000V
	6	2.0	10V
V5	2,7	6.0	10V
	5,6	200	1000V
V6	5	250	1000V
	6	8	10V
		(Pointer may oscillate between 7 and 9 volts)	
V7	2,7	2.0	10V
	5,6	120	1000V
V9	2,7,8	280	500V
	3,4	400	1000V
	5	75	1000V
V8	3,5	360	1000V a.c.
	8	430	1000V
V10	2,7,8	280	500V
	3,4	400	1000V
	5	75	1000V
V12	3,4,5	2.0 (Depends on setting of R80)	10V
	6	150	1000V

V11	2	150	1000V
	3,4,5	160	1000V
	6	75	1000V
V13	2	1.5	10V
	5	160	1000V

5.4 Frequency-selective Amplifier Calibration

Set the FREQUENCY RANGE switch to the 250-800 cycles position, and the main FREQUENCY dial to 250 cycles. Apply a signal source of 1,000 cycles sine wave to the input of the instrument. The meter indication obtained for both the CAL./NOISE and the DIST. positions of the METER READING switch should be identical.

If this is not the case, re-set the potentiometer R68 to achieve identical readings. However, caution should be observed in altering the original adjustment, as any change in calibration will invariably be due to a faulty valve or component.

5.5 "Dbm" Level Calibration

Apply a signal of 400 cycles sine wave to the 600Ω BRIDGING input terminals, and adjust the level to 0.775 volts. Set the METER READING Switch to "dbm" and turn the Meter Range switch to "0 dbm". The meter should read full scale.

If it is found to require correction, re-set the potentiometer R25. However, the remarks in 5.4 above also apply here re altering the control from its original setting.

5.6 Hum Control R69

Set the FREQUENCY RANGE switch to the 25-80 cycles position, the main FREQUENCY dial to 50 cycles, and the METER READING switch to DIST. Then with the CAL. control in the minimum position (anti-clockwise) and the Meter Range switch set to the -60 db position (clockwise) the residual noise reading shown on the meter should be less than 70 db.

If this is not so, adjust R69 for minimum deflection of the meter.

NOTE: Care should be taken that there is no possibility of external fields being picked up when making this check, and the input terminals of the unit should be shorted.

5.7 H.T. Voltage Control

If necessary, the h.t. voltage at the output of the filter (pin 8 of V9 or V10) may be adjusted to give 280 volts ±5 volts by adjusting the pre-set control R80.

5.8 Meter Zero

Small discrepancies in the zero setting of the meter with no signal input may be corrected by using the mechanical zero adjustment on the face of the meter.

6. COMPONENT SCHEDULE Revised 040958

When ordering replacement parts please quote ALL details given below for a particular component.

The component supplied against the order may not be identical with the original item in the equipment, but will be a satisfactory replacement differing in only minor mechanical or electrical details; such differences will not impair the operation of the equipment.

6.1 Distortion and Noise Meter A51932 (Serial No.171 and above)

Circ. Ref. No.	Description	A.W.A. Type Number (unless otherwise stated)
(a) Capacitors		
C1	0.47 µF, ±20%, 400VW, paper, tubular	Ducon TPB85
C2	0.01 µF, ±20%, 500VW, paper, tubular metal case	U.C.C. type PMM
C3	1 µF, -10+20%, 400VW, paper, rectangular metal case	Ducon 2S10
C4	0.05 µF, ±25%, 350VW, paper, tubular metal case	U.C.C. type PMM
C5	0.02 µF, ±25%, 350VW, paper, tubular metal case	U.C.C. type PMM
C6	0.02 µF, ±25%, 350VW, paper, tubular metal case	U.C.C. type PMM
C7	4 µF, -10+20%, 400VW, paper, tubular	Ducon 2S40
C8	25 µF, -20+100%, 25VPW, electrolytic, tubular metal case	Ducon ET
C9	0.047 µF, ±20%, 400VW, paper, tubular	Ducon TPB85
C10	1 µF, -10+20%, 400VW, paper, rectangular metal case	Ducon 2S10
C11	2 µF, -10+20%, 400VW, paper, rectangular metal case	Ducon 2S20
C12 – C25	Refer to 6.2 below.	

C26	0.1 μF, ±20%, 400VW, paper, tubular	Ducon TPB85
C27	25 μF, -20+100%, 25VPW, electrolytic, tubular metal case	Ducon EE
C28	10 μF, -10+20%, 600VW, paper, rectangular metal case	Ducon 3S100
C29	10 μF, -10+20%, 600VW, paper, rectangular metal case	Ducon 3S100
C30	0.01 μF, ±25%, 500VW, paper, tubular metal case	U.C.C. type PMM
C31	16 μF, -20+50%, 450VPW, electrolytic, tubular metal case	Ducon ET
C32	16 μF, -20+50%, 450VPW, electrolytic, tubular metal case	Ducon EE
C33	500 μμF, ±5%, 500VW, silver mica, nominal, to be selected on test	Simplex SM
C34	50 μμF, ±10%, 500VW, mica	Simplex MS
C35	0.01 μF, ±10%, 500VW, mica	Simplex SM
C36	0.01 μF, ±10%, 500VW, mica	Simplex SM
C37	0.01 μF, ±10%, 500VW, mica	Simplex SM
C38	Refer to 6.2 below	
C39	Selected on test	
C40	Selected on test	

(b) Resistors

NOTE: Resistors described as "Composition Grade 1" and "Composition Grade 2" are made by various manufacturers to RCS standards. "Vitreous enamelled" resistors are completely identified by the "RWV" type number given, and are also produced by several manufacturers to a common specification. Acceptable manufacturers of these resistors are listed below.

Wattage ratings are quoted at 71°C.

Composition Grade 1	Manufacturer and Type
1/8W insulated	Erie 109
1/4W insulated	Erie 108
1/4W non-insulated	(I.R.C. type DCC (Welwyn C21 (Painton 72
1/2W insulated	Erie 100
3/4W non-insulated	(I.R.C. type DCE (Welwyn C23 (Painton 74
1W non-insulated	(I.R.C. type DCG (Welwyn C24 (Painton 75

Composition Grade 2

1/4W. insulated	I.R.C. type BTS
1/2W insulated	I.R.C. type BTA
1/2W non-insulated	Morganite T
1W insulated	I.R.C. type BTB
1W non-insulated	Morganite R

Vitreous Enamelled

Description according to type number	(I.R.C. (Reco (Ducon

R1	39 kΩ, ±5%, 1/2W, composition, grade 1, insulated	
R2	22 kΩ, ±1%, 1/2W, composition, grade 1, insulated	
R3	6.8 kΩ, ±2%, 1/2W, composition, grade 1, insulated	
R4	Not used	
R5	3.3 kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R6	100 kΩ, variable, potentiometer, composition, Morganite	51932T63-1
R7	40 kΩ, ±10%, 2W, composition, non-insul.	I.R.C. type DCH
R8	560 Ω, ±10%, 1/2W, composition, grade 2, insulated	
R9	220 Ω, ±10%, 1W, composition, grade 2, insulated	
R10	1 MΩ, ±10%, 1W, composition, insulated	
R11	560Ω, ±10%, 1/2W, composition, grade 2, insulated	
R12	20kΩ, ±10%, 2W, composition, non-insulated	
R13	12.8kΩ, ±2%, 1/4W, composition, grade 1, insulated	
R14	4.050Ω, ±2%, 1/4W, composition, grade 1, insulated	
R15	1280Ω, ±2%, 1/4W, composition, grade 1, insulated	
R16	405Ω, ±2%, 1/4W, composition, grade 1, insulated	
R17	128Ω, ±2%, 1/4W, composition, grade 1, insulated	
R18	40.5Ω, ±2%, 1/4W, composition, grade 1, insulated	
R19	17.2Ω, ±2%, 1/2W, wire-wound	51932T173
R20	1MΩ, ±10%, 1W, composition, insulated	

R21	40kΩ, ±10%, 2W, composition, non-insulated	I.R.C. type DCH
R22	560Ω, ±10%, 1/2W, composition, grade 2, insulated	
R23	1MΩ, ±10%, 1W, composition, insulated	
R24	40kΩ, ±10%, 2W, composition, non-insulated	I.R.C. type DCH
R25	500Ω, variable, wire-wound	I.R.C. type W
R26	1MΩ, ±10%, 1W, composition, insulated	
R27	10kΩ, ±5%, 6W, wire-wound, vitreous enamelled, wire terminations	RWV4-L
R28	10kΩ, ±5%, 6W, wire-wound, vitreous enamelled, wire terminations	RWV4-L
R29	100Ω, ±5%, 1/2W, composition, grade 1, insulated	
R30	2.7kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R31	22kΩ, ±5%, 1/2W, composition, grade 1, insulated	
R32	1.2kΩ, ±2%, 1W, composition, (not used after serial 264)	
R33	6.8kΩ, ±10%, 1/2W, composition (not used after serial 264)	
R34	3.75Ω, ±2%, 3W, wire-wound, coating C.	I.R.C. type AA
R35	Not used.	
R36	40kΩ, ±10%, 2W, composition, non-insulated	I.R.C. type DCH
R37	8.2kΩ, ±2%, 1/2W, composition, grade 1, insulated	
R38	10kΩ, ±1%, 1/2W, composition, grade 1, insulated	
R39	7.5kΩ, ±2%, 1/2W, composition, grade 1, insulated	
R40	630Ω, variable, wire-wound, I.R.C. type W, modified.	51932T63
R41	8250Ω, ±1%, 1/2W, composition, grade 1, insulated	
R42	1MΩ, ±10%, 1W, composition, insulated	
R43	2.5kΩ, ±2%, 1/2W, composition, grade 1, insulated	
R44) R45)	Refer to 6.2 below.	
R46) R47) R48) R49) R50)	Refer to 6.2 below.	
R51) R52) R53) R54) R55)	Refer to 6.2 below.	
R56) R57) R58) R59) R60)	Refer to 6.2 below.	

R61) R62) R63) R64) R65)	Refer to 6.2 below.	
R66	40kΩ, ±10%, 2W, composition, non-insulated	I.R.C. type DCH
R67	560Ω, ±10%, 1/2W, composition, grade 2, insulated	
R68	100kΩ, variable, potentiometer, composition	Morganite LHNAR1041
R69	100Ω, variable, wire-wound	I.R.C. type W
R70	470Ω, ±5%, 4.5W, wire-wound, vitreous enamelled, wire terminations	RWV4-K
R71	10kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R72	10kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R73	5kΩ, ±5%, 5W, wire-wound, coating C	I.R.C. type AB
R74	10kΩ, ±5%, 6W, wire-wound, vitreous enamelled, wire terminations	
R75	470kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R76	10kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R77	10kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R78	470kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R79	2.2kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R80	500Ω variable, wire-wound	I.R.C. type W
R81	820kΩ, ±10%, 1/2W, composition, grade 2, insulated	
R82	Determined on test (may or may not be used)	
R83	Determined on test (not used after serial 264)	
R84	To be selected on test (Parallel with R19)	

(c) <u>Sockets</u>

V1	7-pin, miniature P.T.F.E.	Clix VH337/702 CPS
V2	Octal, mica filled phenolic	Teletron ST38L
V3	Octal, mica filled phenolic	Teletron ST38L
* V4	Octal, mica filled phenolic	Teletron ST38L

* V4 not used on units after Serial No.264.

V5	7-pin, miniature, P.T.F.E.	Clix VH337/702/CPS
V6	Octal, steatite	1S3331
V7	7-pin, miniature, P.T.F.E.	Clix VH337/702/CPS
V8	Octal, mica filled phenolic	Teletron ST38L
V9	Octal, mica filled peenolic	Teletron ST38L
V10	Octal, mica filled phenolic	Teletron ST38L
V11	Octal, mica filled phenolic	Teletron ST38L
V12	Octal, mica filled phenolic	Teletron ST38L
V13	Octal, mica filled phenolic	Teletron ST38L

(d) Miscellaneous

F1	Glass cartridge type fuse, loaded 1A.	Belling Lee L1055
F2	Glass cartridge type fuse, loaded 1A.	Belline Lee L1055
M1	Moving coil, multimeter, 215μA. 750Ω resistance, calibrated in air; scale to Drg.51932V7, Master S34	Code No.464962
W1	Germanium crystal diode rectifier	GEX34
S1	Oak "H" type switch	51932V115
S2	Oak "H" type switch	51932V115
S3	Oak "H" type switch	51932V116
S4	Refer to 6.2 below PAGE 23	
S5	Toggle switch "Alpha"	S3510
T1	Transformer	5TW8206
T2	Transformer	1TK57472

6.2 Filter Network 2R51934

(a) Capacitors

C12	0.1 μF, ±20%, 400VW, paper, tubular	Ducon TPB85
C13	0.5 μF, -10+20%, 400VW, paper, rectangular metal case	Ducon 2S05
C14	To be selected on test	
C15	6-102 μμF, variable, miniature, air dielectric	3U52834
C16	6-102 μμF, variable, miniature, air dielectric	3U52834
C17	6-102 μμF, variable, miniature, air dielectric	3U52834
C18	Not used	
C19	Not used	

C20 11-430 μμF)
C21 11-430 μμF)
C22 11-430 μμF) 4-gang, variable, air dielectric 51934V17
C23 11-430 μμF)

C24 280 μμF, ±5%, 500VW, silver mica Simplex SS
C25 280 μμF, ±5%, 500VW, silver mica Simplex SS
C38 To be selected on test

(b) Resistors

R44 500kΩ, nominal, to be selected on test
R45 500kΩ, ±10%, 1W, composition, grade 2, insulated.

R46 16.9kΩ, ±1%, 1/4W, composition, grade 1, insulated
R47 16.9kΩ, ±1%, 1/4W, composition, grade 1, insulated
R48 36.5kΩ, ±1%, 1/4W, composition, grade 1, insulated
R49 36.5kΩ, ±1%, 1/4W, composition, grade 1, insulated
R50 115.6kΩ, ±1%, 1/4W, composition, grade 1, insulated

R51 115.6kΩ, ±1%, 1/4W, composition, grade 1, insulated
R52 365kΩ, ±1%, 1/4W, composition, grade 1, insulated
R53 365kΩ, ±1%, 1/4W, composition, grade 1, insulated
R54 506kΩ, ±1%, 1/4W, composition, grade 1, insulated
R55 506kΩ, ±1%, 1/4W, composition, grade 1, insulated

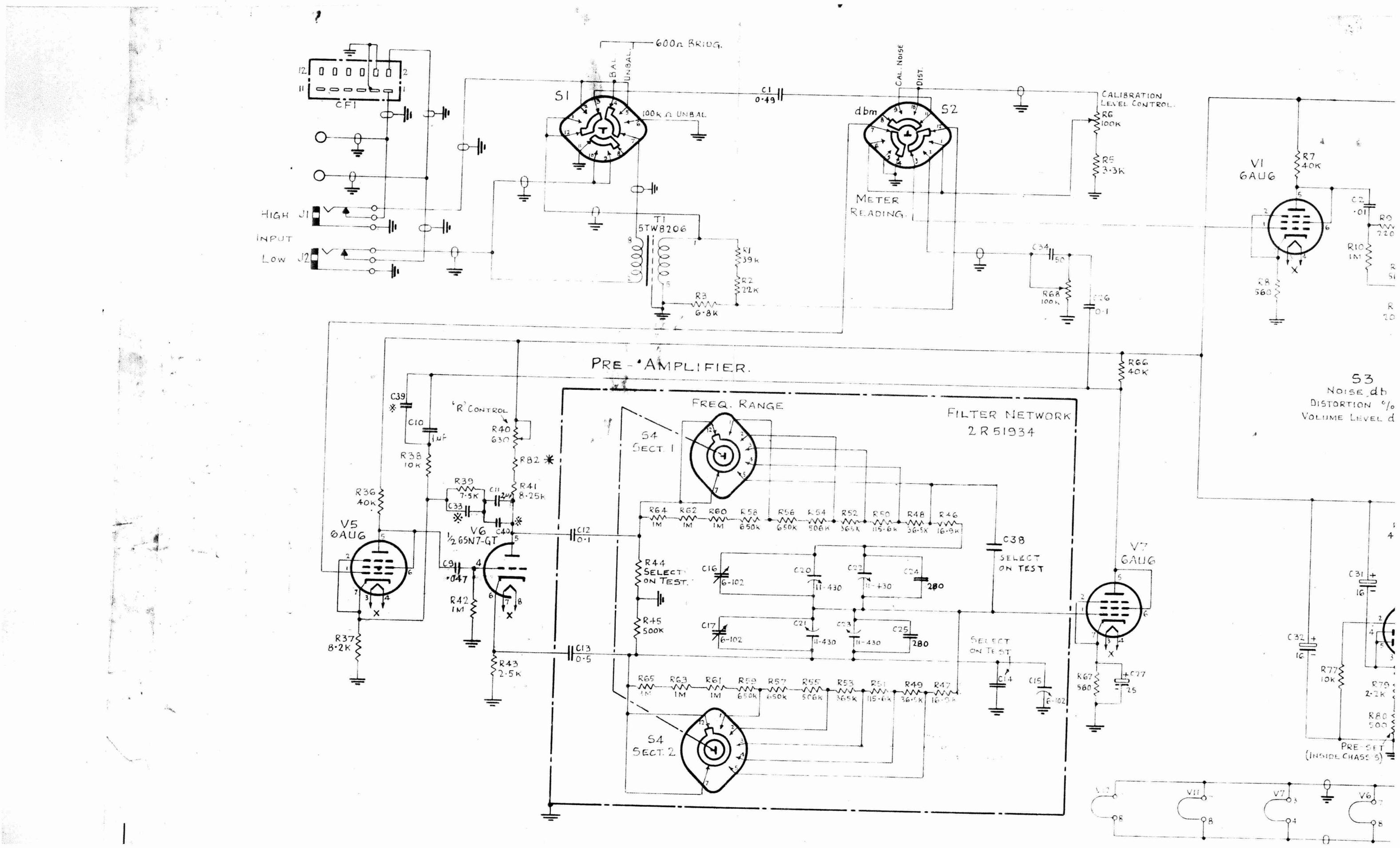
R56 650kΩ, ±1%, 1/4W, composition, grade 1, insulated
R57 650kΩ, ±1%, 1/4W, composition, grade 1, insulated
R58 650kΩ, ±1%, 1/4W, composition, grade 1, insulated
R59 650kΩ, ±1%, 1/4W, composition, grade 1, insulated
R60 1MΩ, ±1%, 1/4W, composition, grade 1, insulated

R61 1MΩ, ±1%, 1/4W, composition, grade 1, insulated
R62 1MΩ, ±1%, 1/4W, composition, grade 1, insulated

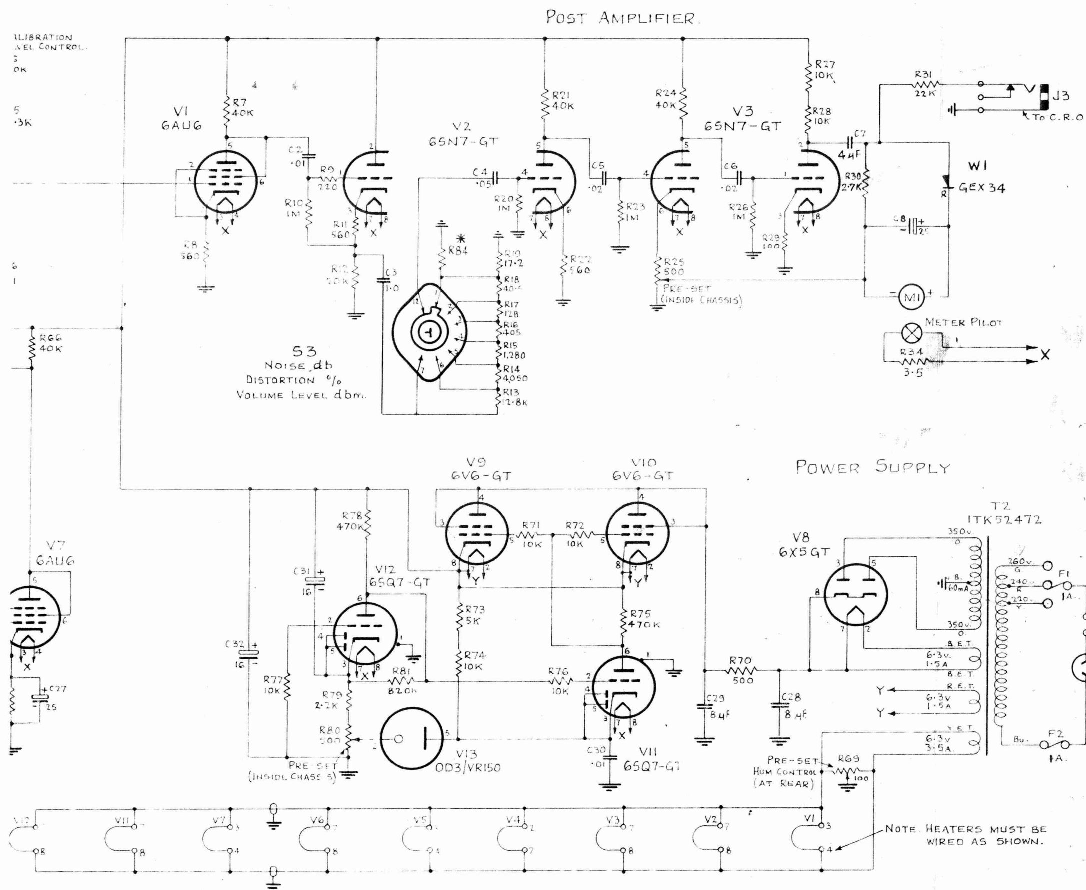
R63	1MΩ, ±1%, 1/4W, composition, grade 1, insulated
R64	1MΩ, ±1%, 1/4W, composition, grade 1, insulated
R65	1MΩ, ±1%, 1/4W, composition, grade 1, insulated

(c) <u>Switches</u>

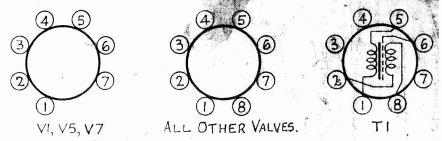
S4 Oak "H" type 51934V19



600Ω BRIDG.
BAL.
UNBAL.
S1
100k Ω UNBAL.
C1 0·49
CAL NOISE
DIST.
dbm
S2
CALIBRATION LEVEL CONTROL.
R6 100K
R5 3·3K
V1 6AUG
R7 40K
CFT
HIGH J1
INPUT
LOW J2
T1 STW8206
R1 39K
R2 22K
R3 6·8K
METER READING.
C34 50
R68 100K
C26 0·1
R8 560
R10 1M
PRE-AMPLIFIER.
R66 40K
S3
NOISE db
DISTORTION %
VOLUME LEVEL
C39
C10 1μF
'R' CONTROL
R40 630
R82
R41 8·25K
R38 10K
R39 7·5K
C11
C33
C40
R36 40K
V5 6AUG
V6 ½ 6SN7-GT
C9 ·047
R42 1M
R37 8·2K
R43 2·5K
C12 0·1
C13 0·5
FREQ. RANGE
S4 SECT. 1
FILTER NETWORK 2R51934
R64 1M
R62 1M
R60 1M
R58 650K
R56 650K
R54 500K
R52 365K
R50 115·6K
R48 36·5K
R46 16·9K
C38 SELECT ON TEST
R44 SELECT ON TEST.
C16 6-102
C20 11-430
C22 11-430
C24 280
R45 500K
C17 6-102
C21 11-430
C23 11-430
C25 280
SELECT ON TEST
C14
C15 6-102
R65 1M
R63 1M
R61 1M
R59 650K
R57 650K
R55 500K
R53 365K
R51 115·6K
R49 36·5K
R47 16·9K
S4 SECT. 2
V7 6AUG
R67 560
C27 25
C31 16
C32 16
R77 10K
R79 2·2K
R80 500
PRE-SET (INSIDE CHASSIS)
V12
V11
V7
V6

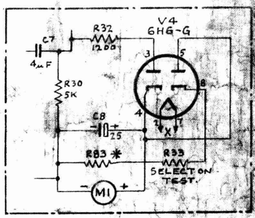


BOTTOM VIEW OF SOCKET CONNECTIONS.



NOTES.

1. COMPONENT VALUES.
   RESISTORS IN OHMS.
   K = 1,000 Ω M = 1,000,000 Ω
   ELECTROLYTIC CAPACITORS IN μF
   OTHER CAPACITORS IN μF (e.g. ·01) OR μμF (e.g. 40)
   UNLESS OTHERWISE NOTED.
   ✱ MAY OR MAY NOT BE USED.
2. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTI-CLOCKWISE POSITION.
3. CF1 SHOWN REAR (WIRING SIDE) VIEW, LOOKING FROM FRONT PANEL WITH CHASSIS INVERTED.
4. ✱C33, C39 & C40 TO BE SELECTED ON TEST.



THIS CIRCUIT APPLIED FOR SERIAL Nos 171-264.

FOR UNITS 171 & OVER.

AWA

DISTORTION & NOISE METER.
TYPE A51932.
DRG. 51932G2.