



AUDIO OSCILLATOR G231
TYPE 1A94771

HANDBOOK 94771R

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
Engineering Products Division

422 LANE COVE ROAD, NORTH RYDE, N.S.W.

**SUPERVISING TECHNICIAN
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RICHMOND, E.1. VIC.**

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REVISION RECORD

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PART 1

GENERAL INFORMATION

1. GENERAL DESCRIPTION

The G231 is a portable, low-distortion R.C. oscillator providing calibrated sinusoidal test signals from 10 Hz to 30 kHz in four ranges incorporating band-spread in the three lower ranges. The upper range (10 kHz to 30 kHz) has an approximately linear scale for easy reading and accurate resettability.

The solid-state circuitry used throughout is complemented by robust mechanical construction which permits open access to all components for easy serviceability.

A balanced, floating output is obtained by using a specially designed shielded output transformer of high quality, having a mu-metal core to ensure low distortion at ALL levels. The strictly controlled balance of the secondary winding produces a minimum of longitudinal signal, even at 30 kHz, without the need for "forced balancing" by employing a grounded centre-tap in the secondary winding. The output may be unbalanced, when required, by connecting one terminal to the chassis of the equipment under test.

2. APPLICATION

When used with a companion instrument such as the A.W.A. Distortion and Noise Meter F240, rapid checks of all performance parameters in high-quality audio amplifiers, limiting and a.g.c. amplifiers, audio filters, lines and line equalisers may be made.

In conjunction with the A.W.A. Modulation Monitor, complete checks of the modulation characteristics of AM transmitters may be made with great accuracy.

3. TECHNICAL SPECIFICATION

Frequency

Range:

10 Hz to 30 kHz in four overlapped ranges:-
10 Hz to 110 Hz *
100 Hz to 1.1 kHz *
1 kHz to 11 kHz *
10 kHz to 30 kHz

* When any of these ranges is selected in conjunction with the SPREAD button, the upper 50% of that range is obtained in the dial sweep.

Resettability:

Maximum departure of frequency from scale indication: -

10 Hz to 100 Hz $\pm 4\%$

100 Hz to 30 kHz $\pm 3\%$

A two-speed drive is incorporated, with direct and 6 : 1 ratios, for easy setting.

Output

Level:

Into 600 ohm: +22 dBm or 160 mW or 10 V maximum.

Control: step attenuator -60 dBm to +20 dBm in 10 dB steps plus fine level control having a 30 dB range. Each step is within ± 0.25 dB of stated value when referred to the 0 dB step at 1 kHz.

Uniformity: ± 0.3 dB from 10 Hz to 30 kHz when referred to 1 kHz.

Meter:

- (a) Frequency response: ± 0.1 dB from 10 Hz to 30 kHz.
- (b) Absolute level inaccuracy at 0 dBm: the actual output into a 600 ohm load resistor is within ± 0.1 dB of 0 dBm at 1 kHz for a temperature of 25°C.

Source Impedances:

Nominally 40 ohm * and 600 ohms, balanced or unbalanced. Either is designed to feed 600 ohm lines.

* Equivalent circuit approximately 40 ohms in series with 180 microhenries.

Return Loss of
600 ohm Output:

At least 25 dB from 10 Hz to 30 Hz.

At least 30 dB from 30 Hz to 15 kHz.

At least 25 dB from 15 kHz to 30 kHz.

Distortion:	Less than 0.1% from 30 Hz to 20 kHz. Less than 0.2% from 20 kHz to 30 kHz. With load Z 600 ohm or greater. Refer table in Part 5, section 3.5.
Hum and Noise:	Below -60 dB relative to output signal, or below -105 dBm, whichever is the greater level.
Longitudinal Output:	When the balanced output is terminated with a centre-tapped 600-ohm resistor, the two halves of which are matched to within 0.1%, the voltage produced across a 300 ohm resistor connected from the centre-tap to chassis is at least 35 dB below the transverse output voltage.

Controls

Frequency, Tuning:	Two-speed dial drive.
Frequency, Range:	Push-button switches.
Level:	8-position step attenuator calibrated in terms of output level plus fine control.
Z Source:	Two position switch: 40 ohm and 600 ohm.
Power:	Four position switch. 1. OFF. 2. AC/DC. (a.c. mains or external battery operation. Internal battery, when fitted, is trickle charged.) 3. BATT. Internal rechargeable battery operation. 4. CHARGE. To recharge internal battery when fitted. This position switches the meter to indicate the state of discharge of internal battery.

Power Supply

A.C. Mains: 115 V, 220 V, 230 V, 240 V
and 260 V, 50 Hz or 60 Hz at 7 VA. Mains
voltage may be within -15% to +10% of con-
nected tap voltage.

D.C. Supply: Internal batteries: two Eveready
nickel-cadmium batteries type Y614 with
battery protection unit.

Operating time 10 hours, recharge time approximately 14 hours (Option 318).

D.C. Supply: External batteries:
-21.2 V to -26.4 V) 80 mA to 120 mA
-43.5 V to -52.8 V)

Output Connectors

Front: 3-way Siemens Halske type 9 Rel
kli 6a

Rear: 5-way Preh type 8-7505.

Wiring details on Drg 94771H1.

Both connectors wired in parallel.

Dimensions and Weight

Height: 5-7/8 in (149 mm) including feet.
5-1/4 in (133 mm) rack mounting.
Width: 18½ in (470 mm) including handles.
Depth: 14 in (355 mm).
Weight: 16 lb (7.26 kg) less battery.

Accessories Provided

Two-terminal connector for alternative input -
Belling Lee type L1568/61S (to suit banana
plugs) with adaptor plate.

Adaptor plate for fitting tip, ring and sleeve
or carrier jacks.

Instruction manual.

Detachable power cable (wound on clamps at
rear of unit when not in use).

Spare fuses for a.c. mains and external
battery use.

Allen key for knobs (stored inside case).

Mating connector for Siemens Halske output
connector on front.

Mating connector for Preh output connector at
rear.

Mating connector for external battery input at
rear.

Options

Item 302: Jacks fitted in place of Siemens Halske connector on front panel.

Item 312: Rack mounting kit.

Item 318: Rechargeable battery kit comprising two Eveready type Y614 batteries, battery protection unit and mounting parts.

Model Variations

Units bearing serial numbers 57 and above have a voltage scale in addition to the dBm scale on the step attenuator and level meter.

PART 2

INSTALLATION

1. RACK MOUNTING (Option item 312)

WARNING: Do not locate the G231 oscillator where strong magnetic fields are liable to be present (e. g. adjacent to power supplies).

If the G231 Audio Oscillator is to be mounted in a standard 19-inch wide rack, proceed as follows:

1. Remove the two trim strips (2 screws each) at either side of the instrument. This exposes a total of eight screws which hold the side panel handles.
2. Remove these screws with due care as they also hold the front panel assembly to the chassis.
3. Fit the rack mounting adaptors in place of the side panel handles using the same eight screws. Store the handles, trim strips and their screws for future use if required. Remove rubber feet and foot wire on bottom cover.
4. The instrument may now be fitted into a standard 19-inch rack.

Note that an output connector is available at rear of instrument for rack-mounted operation.

2. OUTPUT CONNECTIONS

Three-way Front Panel Connector

The uppermost pin in the connector is earthed. The other two pins are the 'floating' or balanced output circuit. To feed into an unbalanced circuit, connect the active of the circuit to the centre pin of the mating plug (Siemens Halske type 9 Rel stp 6ac). Link the other two pins and connect to the earthy side.

A separate chassis earth terminal is provided adjacent to the three-way connectors.

A different output connector may be substituted if required. A two-terminal Belling Lee connector type L1568/61S with adaptor plate is supplied as a standard accessory. An adaptor plate for substituting jacks (Transmission Products type TP1120) is also provided.

Select the preferred output connector and the appropriate adaptor plate and proceed as follows:

1. Remove the G231 top and bottom access panels (4 screws each).
2. Remove the two screws securing the Siemens Halske output connector, taking care not to lose the two nuts. Swing the connector clear of the components.
3. Identify the wire connections, then unsolder from the connector.
4. If using jack sockets, prepare them as shown in Drg 94771H1.
5. Substitute the preferred connector and adaptor plate and re-solder the wires to the appropriate contacts.

NOTE: If the earth wire (formerly connected to the top contact) is no longer required, either remove it completely or carefully insulate it and tape it back for possible future use.

6. Use the two original screws and nuts to secure the new connector.

3. A.C. MAINS OPERATION

The G231 is supplied wired for operation from 50 to 60 Hz a.c. mains having a nominal voltage of 240 V. The instrument will then operate correctly for short-term variations of +10%, -15% from the nominal voltage (216 V to 276 V).

The power transformer has tapings for 115 V, 220 V, 230 V, 240 V, 260 V. The +10%, -15%, short-term variations can be tolerated on any selected one of the above mains voltages.

Before connecting the instrument to the mains, it is advisable to check that the selected tap on the power transformer corresponds to the nominal voltage of the a.c. source available. Procedure for tap checking or changing is as follows:

1. Remove the G231 top access panel (4 screws).

2. Remove the power supply box cover (2 screws at rear and 1 screw on side). If internal batteries are fitted, remove the battery assembly first (4 screws).
3. For 240V (nominal) operation, the mains leads (black and red) should conform with Drg 94771H1 and on power supply box cover.
4. For operation from any other nominal voltage within the above specified range, connect the mains leads to the appropriate taps as shown on Drg 94771H1 and on power supply box cover.
5. Check that the fuse is correct for mains voltage operation (250 mA).
6. Replace battery assembly (if fitted) and covers.

4. EXTERNAL D.C. SOURCE OPERATION

The G231 can also be operated from an external d.c. source of -21.2 V to -26.4 V and -43.5 V to -52.8 V. The positive terminal is earthed to the instrument case.

A 5-way remote connector, wired as shown on Drg 94771H1, is supplied for connection to the external d.c. source.

Check that the fuse is correct for external d.c. operation (1 A).

5. INTERNAL BATTERY OPERATION (OPTIONAL)

Two Eveready type Y614 nickel-cadmium batteries, together with mounting plates can be fitted inside the instrument. They permit operation independently of a.c. or external d.c. sources and can be recharged when either of these sources is connected. A separate Battery Protection Unit type 2A94758 is included in the battery kit and is also accommodated with the instrument. It disconnects the batteries from their load if a minimum voltage of 21.5 V is reached. The procedure for fitting both items is as follows:

1. Remove the G231 top and bottom access panels (4 screws each).
2. Take the battery assembly and solder the red lead to the positive lug and the green lead to the negative lug of battery 1. Solder the yellow lead to the positive lug and the blue lead to the negative lug of battery 2.

3. Place the battery assembly in position inside the G231 and secure with the four screws, entering from the rear panel. Take care that the battery leads do not short-circuit during this operation.
4. Connect the four battery leads to the terminal strip located between the batteries and power switch, joining them in the order stencilled on the plate.
5. Place the battery protection unit in position below the terminal strip and secure, with three screws and washers supplied, to the three pillars on the partition.
6. Connect the three leads of the battery protection unit to the terminal block. Corresponding leads are identified by colours.
7. Refit the top and bottom access panels.

End of Part

PART 3

OPERATION

1. PRELIMINARY

Check that mains voltage is within specified limits. Switch on.

2. SELECTING FREQUENCY

1. Press push-button for range containing the required frequency.
2. Set the tuning dial as closely as possible to the required frequency.
3. If higher resolution is required at frequencies above 5 on the scale, press the SPREAD button whilst holding down the frequency range button previously operated.

NOTE: The linearity of the 10 kHz to 30 kHz range scale obviates the need for band-spread on this range; however, inadvertant operation of the SPREAD button will cause no damage.

3. SELECTING OUTPUT IMPEDANCE

Set the Z source switch to 40 OHM or 600 OHM as required.

4. ADJUSTING OUTPUT LEVEL

1. For best accuracy of output level metering, set the OUTPUT LEVEL selector to a position such that the desired output level is obtained with the meter reading between -8 and +2 on the scale.
2. Set the output to the required level by means of the fine control.

NOTE: 0 dBm is 1 mW in 600 ohms for Z source: 400 ohm or 600 ohm.

3. Below 30 Hz, the full output capability of +22 dBm is not available because of transformer saturation.

THE LEVEL SHOULD THEREFORE BE RESTRICTED TO LESS THAN 14 dBm AT FREQUENCIES BELOW 30 Hz IF LOW DISTORTION SIGNALS ARE REQUIRED.

5. RECHARGING INTERNAL BATTERIES

5.1 Initial Recharging

Batteries which have been unused for a period of six months should be treated as follows:

1. Disconnect G231 from a.c. mains or external d.c. supply.
2. Turn POWER switch to CHARGE position and note whether batteries have reached the Batt. Min. position as indicated on the LEVEL meter. If reading is above the Batt. Min. mark, the batteries should be discharged by operating the unit normally on its internal batteries.
3. When the battery voltage falls to the Batt. Min. mark (representing -21.5 V) the Battery Protection Unit will disconnect them.
4. Turn the POWER switch to the OFF position, connect the unit to a.c. mains or external d.c. supply and then turn the POWER switch to the A.C./D.C. position (NOT CHARGE).

This procedure trickle-charges the batteries thereby ensuring that the initial charging rate, as recommended by the manufacturer, is not exceeded. The internal batteries should be kept on trickle charge for six hours. Subsequent charging may be done at the full 100 mA rate with the POWER switch in the CHARGE position.

5.2 Routine Recharging

1. Connect the G231 to a.c. mains or external d.c. supply.
2. Turn POWER switch to CHARGE position. Recharging takes approximately 14 hours if the batteries are completely discharged. Do not charge for more than 16 hours maximum at the 100 mA rate.

5.3 Trickle-Charging

The internal batteries are trickle-charged at a 20 mA rate when the G231 is being used on a.c. mains or external d.c. supply (A.C./D.C.). Continuous charging at this rate, even for several months, will not damage the batteries.

5.4 Temperature Ranges

The ranges of temperature applicable to operation and storage of Y614 batteries, in or out of the unit, are:

Charge: 0°C to +45°C (+32°F to +113°F)
Discharge: -20°C to +50°C (-4°F to +122°F)
Storage: -40°C to +60°C (-40°F to +140°F)

IMPORTANT NOTE

Do not recharge the batteries at a temperature above 45°C (113°F).

5.5 Disposal of Batteries

WARNING: Nickel-cadmium batteries should not be disposed of by fire; such an action can result in an EXPLOSION.

PART 4

TECHNICAL DESCRIPTION

Refer to drawings 94771H1 and 94771C1.

1. OSCILLATOR CIRCUIT

The oscillator is of the Wien Bridge type and consists essentially of a high-gain direct-coupled amplifier (1VT1, 1VT2, 1VT3) with overall a.c. feedback over two paths between the output and the input.

One path determines the oscillation frequency by providing positive feedback. The capacitors are selected by the frequency range push-button switch SWA. The resistive part is determined by a ganged potentiometer RV1a, RV1b and by switched resistors, (1R16, 1R15, 1R12a, 1R12b, 1R11, 1RV1, 1RV2, R11, R12). Potentiometers 1RV1 and 1RV2 allow adjustment to the calibration of the frequency scale at the high frequency end.

The second path provides negative feedback and comprises 1RT1, 1R6, 1R4, 1R7. Thermistor 1RT1 regulates the oscillation amplitude.

2. METER AMPLIFIER

A buffer stage 2VT1 is connected as an emitter follower to drive the output stage 2VT2, 2VT3. Voltage feedback resistor 2R5 defines the d.c. voltage at the connection of the two collectors. The output stage provides a current source in order to minimise non-linearity effects of rectifiers 2MR1 and 2MR2. The meter is calibrated by 2RV1.

3. OUTPUT STEP ATTENUATOR

The step attenuator is divided into two parts. This helps maintain a good signal-to-noise ratio. One part precedes the output amplifier and consists of close-tolerance high-stability resistors R13 to R17. It provides up to 40 dB attenuation selected in 10 dB steps by wafer switch SWB/2R.

The other part follows the output amplifier and consists of R18 and R19. This part provides 40 dB or zero attenuation selected by SWB/1.

Attenuations of switch sections are related to output level settings as follows:

OUTPUT LEVEL dBm	ATTENUATION INTRODUCED BY		
	SWB/2R	dB	SWB/1
+20	0		0
+10	10		0
0	20		0
-10	30		0
-20	40		0
-30	10		40
-40	20		40
-50	30		40
-60	40		40

4. OUTPUT AMPLIFIER

The output amplifier is wide-band and consists of three direct-coupled stages. The first stage 3VT1 has a high input impedance so as to avoid any significant loading of the preceding step attenuator. The voltage gain of the amplifier comes from the driving stage 3VT2 which has the capacitor 3C4 in a bootstrap arrangement in its collector branch to give high gain. It drives the quasi-complementary symmetry output stage whose output impedance is kept low by overall negative feedback. This helps to minimise distortion in the output transformer at low frequencies.

5. REGULATOR

The regulator is of the series type. An error signal is derived from the bridge (4MR2, 4R7 - 4R5, 4R6, 4RV1) amplified by 4VT3, 4VT2 and fed back to the base of 4VT1.

6. POWER SUPPLY

6.1 A.C. Mains and External D.C.

The a.c. input voltages are stepped-down by TR2 and full-wave rectified by 4MR1. Capacitor C1 provides smoothing. Diodes MR1 and MR2 give protection from inadvertant connection of a d.c. input of the wrong polarity, or simultaneous connection of a.c. mains and d.c. voltage. In the latter case, the unit operates from whichever supply is dominant.

6.2 Rechargeable Internal Batteries (Optional)

Both batteries are connected in series when operating the instrument. Charging is done with the two batteries in parallel - each battery having separate series resistors to limit the charging current.

Recharging can be done by either a.c. supply or external d.c. supply. The average voltage is monitored on the meter. To keep the internal batteries in a fully charged condition, they are trickle charged at the 20 mA rate when using the instrument on a.c. or external d.c. supply.

The batteries have a relatively constant discharge voltage which is approximately 12 V for the Eveready type Y614 used in this instrument.

The capacity is 1000 milliampere-hours referred to a 10-hour discharge rate and an end-point voltage of 11 V. The batteries in the G231 are used at the 10-hour discharge rate. As an approximate guide, every 10 hours of discharge requires 14 hours of charging.

6.3 Battery Protection Unit

Refer to Drg 94758C2.

The function of this unit is to disconnect the load from the batteries if their total voltage drops below 21.5 V. Transistors VT3, VT4 and VT2 are arranged in a positive feedback loop. Preset RV1 determines the switching point between the 'on' and 'off' state. A step function of sufficient magnitude applied to R1, C1 will switch the loop 'on' which, in turn, brings VT1 into saturation.

PART 5

MAINTENANCE

1. GENERAL

1.1 Mains Cable

Check the mains cable periodically for wear, paying particular attention to the condition of the insulation and continuity of the earth lead.

1.2 Fitting New Lamps

1. Switch the unit off and disconnect the mains cable.
2. Remove the small knob on the frequency scale.
3. Remove the large knob and frequency scale (2 screws).
4. Remove top and bottom access panels.
5. Remove three unsealed screws on face of cursor and loosen two grub screws securing drive coupling to potentiometer shaft.
6. Remove the cursor and drive assembly.
7. Unsolder the damaged lamp and fit a new one. Switch unit on and check operation of lamp.
8. Connect a frequency counter such as described in Section 2, Item 1 of Part 5.
9. Press X1000 button and rotate potentiometer shaft by hand until the counter indicates a frequency of 1 kHz $\pm$ 5 Hz.
10. Refit cursor and drive assembly. Replace three screws. Fit scale and large knob in position. Lightly tighten two 8BA screws.
11. Rotate dial until it indicates 1 kHz. Check that oscillator frequency is still 1 kHz $\pm$ 5 Hz.
12. Tighten the two grub screws (see Note), taking extreme care not to short-circuit the dial lamp wiring.

13. The oscillator frequency should now be correct within the prescribed tolerance but greater accuracy may be obtained by loosening the two screws on the large knob and rotating the scale itself. Tighten the two screws firmly and replace the small knob.
14. Check resettability at other frequencies.

NOTE: If at least one grub screw is not accessible in the 1 kHz position, choose a more convenient frequency and set with a tolerance of $\pm 0.5\%$.

15. Replace top and bottom access panels.

1.3 Lubrication and Cleaning

Use a suitable solvent to clean switches and variable resistors when necessary.

To prevent electrical troubles due to adherence of dust to lubricated surfaces, re-lubricate using the smallest possible amount of lubricant. Ensure that all surplus lubricant is removed.

A pressure-packed 12 ounce can of suitable cleaner-lubricant is available as AWA Electrical Contact Cleaning Lubricant.

1.4 Re-Calibration

Depending on the severity of the environment, periodically check the basic calibration of the instrument by re-calibrating as described in Part 5, Section 3.2, steps 1 to 4.

2. TEST EQUIPMENT REQUIRED FOR CHECKING PERFORMANCE OF G231 AUDIO OSCILLATOR

Item	Description	Suitable Type
1.	Frequency counter to read frequencies of 10 Hz to 30 kHz, accuracy 1 part in 10^4 (must have 10 sec. count).	Racal SA535
2.	Multimeter to read 0-60 V $\pm 3\%$, 0-50 mA, input impedance 20000 ohm/volt	Avo, Model 8

- | | | |
|-----|--|--|
| 3. | Distortion and Noise Meter to read distortion down to 0.05% and noise down to -110 dBm | AWA Distortion and Noise Meter F240 Type 1A94766 |
| 4. | Audio frequency level meter with high input impedance to read levels from -60 dBm to +30 dBm. An error of 0.05 dB between attenuator steps is satisfactory. For terminated or return loss measurements, reduce the high input impedance to 600 ohm $\pm 1\%$ by means of a suitable parallel resistor. | Hewlett-Packard Model 400E |
| 5. | D.C. Power Supply, adjustable from 21 V to 53 V (positive earth). Output current capability of 100 mA. | |
| 6. | Test Oscillator with flat response from 10 Hz to 30 kHz and capable of supplying up to +12 dBm into 600 ohms from 600 ohms. | AWA Test Oscillator G230 or Audio Oscillator G231. |
| 7. | Longitudinal suppression pad as shown on Drg 94771D3. | |
| 8. | Return Loss bridge as shown on Drg 94771D3 | |
| 9. | Oscilloscope with characteristics suitable for general audio use. | |
| 10. | Resistor 150 ohm $\pm 5\%$, 2W. | |
| 11. | Resistor 600 ohm, $\pm 0.5\%$, 1/2W. | |
| 12. | Sealing Cement - Glipolin or Sevac. | |

3. PROCEDURE FOR CALIBRATING AND TESTING G231 AUDIO OSCILLATOR

3.1 Power Supply Checks and Settings

1. Connect power cable from G231 to mains.
2. Set power switch to A.C./D.C.
3. Set frequency to 1 kHz.

4. Check the voltage at pin 29 (Refer to Drg 94771H1 at output of Regulator). This should be -18.0 V. Adjust 4RV1 if needed.
5. Disconnect mains cable.
6. Set the d.c. power supply (item 5) to -24 V. Connect the negative lead to PLD pin 2 and the positive lead to PLD pins 1 and 6.
7. Check that the voltage at pin 29 is still -18.0 V.
8. Gradually decrease the d.c. power supply voltage and note the voltage at which the -18.0 V at pin 29 starts to fall. Check that the d.c. power supply voltage is below -21 V.
9. Connect the negative lead of the d.c. power supply to PLD pin 3. Leave the positive lead connected as in step 6.
10. Set the d.c. power supply output to -48V.
11. Gradually increase the voltage to -53V and check that the voltage at pin 29 remains constant at -18.0 V.

3.2 Frequency Calibration

1. Make the following initial settings:

Power: A.C./D.C.

Z Source: 600 ohm

Output Level: +10 dBm

2. Set 1RV1 and 1RV2 to approximately mid-position.
3. Depress X1000 push-button.
4. Connect counter (item 1) and set the frequency of the G231 so that the counter reads 1 kHz $\pm$ 5 Hz.
5. Loosen the two grub screws which hold the potentiometer shaft to the drive coupling without changing the potentiometer position. Be careful not to short-circuit the lamp voltage supply. If access to the grub screws is obstructed, set the G231 to the lowest frequency at which access is possible and repeat steps 3 to 5 at this frequency.
See Note.

6. Set the scale of the G231 to 1 kHz (or whatever frequency is being used for calibration).
7. Compare the frequency again with the counter and tighten one grub screw only.
8. Set the frequency to 11 kHz on the same range and adjust 1RV1 until the counter indication is also 11 kHz. Recheck 1 kHz point.
9. Check the following points by switching the range and setting cursor according to table below.

<u>Range</u>	<u>Scale</u>	<u>F. Hz.</u>	<u>Tol. Hz.</u>	<u>Action necessary</u>
X10	1	10	± 0.4	A compromise must be reached where all points listed are within tolerance. Slight repositioning of scale and/or readjustment of 1RV1 may be necessary.
X100	1	100	± 3	
X1000	1	1 k	± 30	
X1000 + SPREAD	5	5 k	± 150	
X100 + SPREAD	5	500	± 15	
X10 + SPREAD	5	50	± 2	
X1000	11	11 k	± 330	
X1000	3	3 k	± 90	
X100	3	300	± 9	
X10	11	110	± 3.3	
X10	3	30	± 0.9	
10 k - 30 kHz	10	10 k	± 300	Adjust 1RV2
10 k - 30 kHz	30	30 k	± 30	
10 k - 30 kHz	20	20 k	± 600	

NOTE: In some cases, minor adjustment of the drive coupling on the potentiometer shaft is not possible since the grub screws tend to re-locate in their original position.

In most cases, sufficient calibration adjustment may be made by adjusting the scale itself. Remove the small knob and loosen the two screws securing the large knob and scale. Rotate the scale until calibration is correct. Tighten the screws and replace the small knob.

10. Seal 1RV1 and 1RV2 with Sealing Cement.

3.3 Meter Calibration and Attenuator Accuracy

NOTE: If a distortion check is needed carry this out prior to meter calibration. See Part 5, Section 3.5.

1. Make the following initial settings:

Power: A.C./D.C.

Z Source: 600 ohm

Frequency: 1 kHz

2. Connect the level meter (item 4) to the G231 and connect a 600 ohm $\pm 0.05\%$ resistor (item 11) in parallel.
3. Adjust output level of G231 for 0 dB on level meter (1 V scale).
4. Adjust 2RV1 so that G231 meter reads 0 dBm.
5. Set G231 to 40 ohms source impedance and check that reading on level meter is 0 dB ± 0.1 dB.
6. Seal 2RV1.
7. Check the attenuator steps of the G231 against the level meter according to the following table:

G231 step dB	0	-10	-20	-30*	-40*	-50*	-60*	+10	+20
Level Meter Range dB	0	-10	-20	-30	-40	-50	-60	+10	+20
Tolerance dB	Cal. 0	0 ± 0.25	0 ± 0.25	0 ± 0.25	0 ± 0.25	0 ± 0.25	0 ± 0.25	0 ± 0.25	0 ± 0.25

8. * If these steps are all giving a higher reading, such as 0.2 dB high, connect a 27 ohm resistor in parallel with R19 on 94771H1. If the reading is 0.2 dB low, connect a 2.4 k resistor in parallel with R18.

3.4 Meter Linearity

1. Set output of G231 to 0 dBm and connect level meter. Connect 600 ohm $\pm 0.5\%$ resistor in parallel. Check that level meter reads 0 dB.
2. Turn the output level fine control anti-clockwise until the G231 meter reads -10 dBm.

3. Set attenuator at -10 dB.
4. Check that level meter now reads -10 dB ± 0.5 dB.

3.5 Distortion

1. Make the following initial settings on the G231:

Power: A.C./D.C.

Z Source: 600 ohm

Output level: +22 dBm

Frequency: 30 Hz.

2. Connect a 150 ohm resistor (item 10) to the output and display the waveform on the oscilloscope (item 6).
 3. Adjust 3RV1 so that equal clipping of the waveform occurs when the output is increased above +22 dBm.
 4. Remove the output connector and turn the fine control fully anti-clockwise.
 5. Connect the multimeter (item 2) to test pins 33 (-) and 37 (+).
 6. Set multimeter to 2.5 V range and adjust 3RV2 until the reading is 0.6 V.
 7. Disconnect multimeter and connect G231 to the distortion meter (item 3).
- 2). Make the distortion checks as given in the table below:

Frequency	10 Hz				30 Hz				20 kHz				30 kHz			
Source Z	600		40		600		40		600		40		600		40	
Load Z	600		150		600		150		600		150		600		150	
Level dBm	-10	+12	-10	+12	-10	+22	-10	+20	-10	+22	-10	+20	-10	+22	-10	+20
Distortion not exceeding *	0.3%		0.3%		0.1%		0.2%		0.1%		0.2%		0.2%		0.2%	
	(-50 dB)		(-50 dB)		(-60 dB)		(-54 dB)		(-60 dB)		(-54 dB)		(-54 dB)		(-54 dB)	

- * A compromise must be reached where no distortion figure is higher than these given in the table.
 Slight readjustment of 3RV1 (when using higher output levels) and 3RV2 (when applying 150 ohm load) may be necessary.
 A curve showing the total harmonic distortion of the G231 is given on Drg 94771D4.

8. Seal 3RV1 and 3RV2.
9. Recalibrate instrument according to section 3.3 if 3RV1 or 3RV2 have been adjusted.

3.6 Output Level Constancy

1. Make the following initial settings:

Power: A.C. /D.C.

Z Source: 600 ohm

Output Level: 0 dBm

Frequency: 1 kHz

2. Connect level meter and set it to 600 ohms, 0 dBm.
3. Adjust G231 for exactly 0 dBm on level meter.
4. Check at the following frequencies against the level meter according to the table below. Do not readjust the fine output control after the setting made in step 3.

Frequency Range	Cursor	Frequency Hz	Level Meter
X1 k (bk)	1	1 k	Cal. 0 dB
X1 k (bk)	11	11 k	0 $\pm$ 0.3 dB
X100	1	100	0 $\pm$ 0.3 dB
X100	11	1.1 k	0 $\pm$ 0.3 dB
X10	1	10	0 $\pm$ 0.3 dB
X10	11	110	0 $\pm$ 0.3 dB
X1 k (red)	10	10 k	0 $\pm$ 0.3 dB
X1 k (red)	30	30 k	0 $\pm$ 0.3 dB

5. Repeat step 4 with the G231 set to 40 ohms Z source.

3.7 Longitudinal Suppression

1. Make the following initial settings:

Z Source: 600 ohm

Frequency: 30 kHz

Output Level: 0 dBm

2. Insert the longitudinal suppression pad (item 7) between the G231 and level meter (item 4) as shown on Drg 94771D3.
3. Read the voltage on the level meter. The negative of this reading in dB is the longitudinal suppression. Check that it is equal to or greater than 35 dB.
4. Repeat the measurement with the G231 set to 40 ohm Z source.

3.8 Return Loss

1. Connect the test oscillator (item 6) and the level meter (item 4) to the return loss bridge (item 8) as shown on Drg 94771D3. DO NOT CONNECT THE G231 UNDER TEST.
2. Set the test oscillator output to 600 ohms and the frequency to 30 kHz. Adjust the output level of the test oscillator until the level meter indicates 0 dBm.
3. Set the G231 oscillator as follows:

Power:	A. C. /D. C.
Z Source:	600 ohm
Output level range:	0 dBm
Output fine control:	Fully anti-clockwise
Frequency range switch:	No push-button depressed.
4. Connect the output terminals of the G231 to the return loss bridge as shown on Drg 94771D3. Note the new reading on the level meter. The negative of this reading is the return loss. Check that it is equal to or greater than 25 dB.
5. Repeat the measurement with the test oscillator set to 10 Hz. Check that the return loss reading is equal to or greater than 25 dB.

6. Repeat the measurement with the test oscillator set to 30 Hz and 20 kHz. Check that the return loss reading is equal to or greater than 30 dB.

3.9 Noise

1. Set the G231 oscillator as follows:
Output level: -50 dBm
Z Source: 600 ohm
Frequency: 1 kHz
2. Release the frequency range button so that the G231 no longer oscillates. This may be done by partly depressing another push-button.
3. Connect the distortion and noise meter (item 3), in the 600 ohm condition, to the output of the G231 oscillator. Read the noise level and check that it does not exceed -105 dBm.

End of Part

PART 6COMPONENT SCHEDULE

1. EXPLANATORY NOTES

The component schedule is laid out as follows:

Column 1	Circuit Reference Number
Column 2	Description
Column 3	Manufacturer's Reference
Column 4	AWA Stock Code Number

When ordering replacement parts, please quote ALL details for a particular component, TOGETHER WITH the type number of the unit and the circuit reference of the component. The component supplied against the order may not be identical with the original equipment but will be a recommended replacement differing only in minor mechanical or electrical details; such differences will not impair operation of the equipment.

2. COMPONENTS MOUNTED ON CIRCUIT BOARDS

1C1	100 μ F -10+50%, 6.4 VDCW, electrolytic	Sprague	229723
1C2	640 μ F -10+50%, 25 VDCW, electrolytic	Philips C437AR/F640	
1C3	0.01 μ F $\pm$ 1%, 125 VDCW, polystyrene, metal case	Allied Cap. TCS/C148	
1C4	0.1 μ F $\pm$ 1%, 63 VDCW, polystyrene, metal case	Allied Cap. TCS/C0660	
1C5	Not used		
1C6	1 μ F $\pm$ 2%, 160 VDCW, stabilised polyester	Anocap TFA E105	
1C7	0.01 μ F $\pm$ 1%, 125 VDCW, polystyrene, metal case	Allied Cap. TCS/C148	
1C8	0.1 μ F $\pm$ 1%, 63 VDCW, polystyrene, metal case	Allied Cap. TCS/C0660	
1C9	1 μ F $\pm$ 2%, 160 VDCW, stabilised polyester	Anocap TFA E105	
1C10	Not used		

Components Mounted on Circuit Board (Continued)

1C11	4 μ F -20+50%, 35 VDCW, tantalum	STC TAG	228194
1C12	750 pF $\pm$ 1%, 630 VDCW, polystyrene, metal case	Allied Cap. TCS/C661	
1C13	750 pF $\pm$ 1%, 630 VDCW, polystyrene, metal case	Allied Cap. TCS/C661	
1C14	47 μ F $\pm$ 10%, 6 VDCW, tantalum, style CS13		229556
1R1	100 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	616043
1R2	15 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	612948
1R3	4.7 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	610974
1R4	1.8 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	609094
1R5	Not used		
1R6	220 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	605275
1R7	15 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	612948
1R8	18 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	613321
1R9	1 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	608060
1R10	Not used		
1R11	1.2 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	608337
1R12a	6.8 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	611550
1R12b	240 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	616821
1R13	100 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	604065
1R14	Not used		
1R15	6.8 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	611550
1R16	1.3 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	608453
1RT1	5 k Ω $\pm$ 20%, thermistor	STC R53	893723
1RV1	220 Ω $\pm$ 20%, 1/4W, linear law	Plessey MP Dealer PC	
1RV2	470 Ω $\pm$ 20%, 1/4W, linear law	Plessey MP Dealer PC	
1VT1	Transistor, silicon, PNP	STC TT4121 or Fairchild 2N4121	906718
1VT2	Transistor, silicon, NPN	STC TT3565 or Fairchild 2N3565	906672
1VT3	Transistor, silicon, PNP	STC TT3638A or Fairchild 2N3638A	906679
2C1	10 μ F -20+50%, 15 VDCW, tantalum	STC TAG	228776
2C2	4 μ F -20+50%, 35 VDCW, tantalum	STC TAG	228194
2C3	10 μ F -20+50%, 15 VDCW, tantalum	STC TAG	228776

Components Mounted on Circuit Board (Continued)

2C4 15 μ F $\pm 10\%$, 20 VDCW, tantalum,
style CS13

2C5 15 μ F $\pm 10\%$, 20 VDCW, tantalum,
style CS13

2MR1 Diode, germanium

Philips OA47

597212

2MR2 Diode, germanium

Philips OA47

597212

2R1 47 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

614993

2R2 220 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

616741

2R3 2.7 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

609890

2R4 82 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

615812

2R5 220 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

616741

2R6 2.7 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

609890

2R7 2.7 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

609890

2R8 10 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

612068

2R9 56 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

615183

2R10 4.7 k Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

610974

2R11 100 Ω $\pm 2\%$, 1/2W, metal oxide

Electrosil TRH5

604065

2RV1 22 k Ω $\pm 20\%$, 1/4W, linear law

Plessey MP Dealer PC

2VT1 Transistor, silicon, PNP

STC TT3638A or
Fairchild 2N3638A

906679

2VT2 Transistor, silicon, PNP

Fairchild 2N4249

906789

2VT3 Transistor, silicon, NPN

STC TT3565 or
Fairchild 2N3565

906672

3C1 10 μ F -20+50%, 15 VDCW, tantalum

STC TAG

228776

3C2 10 μ F -20+50%, 15 VDCW, tantalum

STC TAG

228776

3C3 Not used

3C4 80 μ F -10+50%, 25 VDCW, electrolytic

Philips C426AR/F80

3C5 4 μ F -20+50%, 35 VDCW, tantalum

STC TAG

228194

3C6 22 pF $\pm 5\%$, 500 VDCW, N750,
ceramic disc

Ducon CDS

220884

3C7 390 pF $\pm 5\%$, 630 VDCW, polystyrene

Allied Cap. TCS607

3MR1 Diode, silicon

Fairchild AN1102

3MR2 Diode, silicon

Fairchild AN1102

Components Mounted on Circuit Boards (Continued)

3R1	18 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	613321
3R2	150 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	616441
3R3	47 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	614993
3R4	6.8 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	611550
3R5	Not used		
3R6	220 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	605275
3R7	Not used		
3R8	820 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	607685
3R9	270 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	605654
3R10	470 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	606613
3R11	1 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	608060
3R12	470 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	606613
3R13	10 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	601112
3R14	10 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	601112
3RV1	100 k Ω $\pm$ 20%, 1/4W, linear law	Plessey MP Dealer PC	
3RV2	2.2 k Ω $\pm$ 20%, 1/4W, linear law	Plessey MP Dealer PC	
3VT1	Transistor, silicon, NPN	STC TT3565 or Fairchild 2N3565	906672
3VT2	Transistor, silicon, PNP	STC TT4121 or Fairchild 2N4121	906718
3VT3	Transistor, silicon, NPN	Fairchild 2N3643	906682
3VT4	Transistor, silicon, PNP	STC TT3638A or Fairchild 2N3638A	906679
3VT5	Transistor, silicon, NPN	STC TT8105	906805
3VT6	Transistor, silicon, NPN	STC TT8105	906805
	Heatsink, multifinned TO-5, for 3VT5, 3VT6	AWA	397717
4C1	220 pF $\pm$ 5%, 500 VDCW, N750, ceramic disc	Ducon CDS	
4C2	80 μ F -10+50%, 25 VDCW, electrolytic	Philips C426AR/F80	
4C3	4 μ F -20+50%, 35 VDCW, tantalum	STC TAG	228194
4MR1	Bridge rectifier, silicon	Siemens Halske B40C2200	597299
4MR2	Zener diode	Philips BZY88/C6V8	596891

Components Mounted on Circuit Board (Continued)

4R1	22 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	613679
4R2	47 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	614993
4R3	6.8 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	611550
4R4	15 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	612948
4R5	3.3 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	610325
4R6	4.7 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	610974
4R7	4.7 k Ω $\pm 2\%$, 1/2W, metal oxide	Electrosil TRH5	610974
4RV1	2.2 k Ω $\pm 20\%$, 1/4W, linear law	Plessey MP Dealer PC	
4VT1	Transistor, silicon, PNP	RCA 2N4036	906712
4VT2	Transistor, silicon, NPN	STC TT3694 or Fairchild 2N3694	906687
4VT3	Transistor, silicon, PNP	Fairchild 2N4249	906789
	Heatsink, multifinned, TO-5, for 4VT1	AWA	397717

3. COMPONENTS MOUNTED ON FRONT PANEL AND MAIN CHASSIS

C1	1400 μ F -10+50%, 64 VDCW, electrolytic	Philips C432MR/H1400	
C2	8000 μ F -10+50%, 25 VDCW, electrolytic	Philips C432MR/F8000	
C3	3300 pF $\pm 5\%$, 400 VDCW, polyester	Anocap TFAH332	
C4	3300 pF $\pm 5\%$, 400 VDCW, polyester	Anocap TFAH332	
FS1	Fuse link, miniature, glass cartridge, 250 mA		370058
FS2	Fuse link, miniature, glass cartridge, 1 A		370046
LP1	Lamp, lilliput telephone, 30 V, 20 mA	E.S. Rubin	
LP2	Lamp, lilliput telephone, 30 V, 20 mA	E.S. Rubin	
LP3	Lamp, lilliput telephone, 30 V, 20 mA	E.S. Rubin	
M1	Voltmeter (up to Serial No. 56 inclusive) Voltmeter (from Serial No. 57)	Master Instruments AWA 94771W51 Master Instruments AWA 94771W52	
MR1	Diode, silicon	RCA 1N3254	597309
MR2	Diode, silicon	RCA 1N3254	597309
MR3	Diode, silicon	RCA 1N3254	597309

Components Mounted on Front Panel and Main Chassis (Continued)

PLA	Connector, 3-contact, male, audio	Amal. Comm. & Eng. PCC-3S	
PLB	Connector, 5-contact, male, audio		234826
PLC	Not used		
PLD	Connector, 6-contact, female, cord- grip	Bulgin P428	233982
PLE	Moulded cord and plug assembly	AWA	250409
R1	180 Ω $\pm$ 5%, 3.25 W, metal oxide	IRC PF4	
R2	330 Ω $\pm$ 5%, 3.25 W, metal oxide	IRC PF4	
R3	150 Ω $\pm$ 5%, 3.25 W, metal oxide	Welwyn F32	604692
R4	150 Ω $\pm$ 5%, 3.25 W, metal oxide	Welwyn F32	604692
R5	Not used		
R6	820 Ω $\pm$ 2%, 1W, metal oxide	Electrosil TR6	
R7	680 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	607305
R8	300 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	616994
R9	330 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	617118
R10	Not used		
R11	3.97 k Ω $\pm$ 0.5%, 1/4W, metal oxide	Corning NA60	610640
R12	3.97 k Ω $\pm$ 0.5%, 1/4W, metal oxide	Corning NA60	610640
R13	4.64 k Ω $\pm$ 1%, 1/4W, metal oxide	Corning NA60	610908
R14	1.47 k Ω $\pm$ 1%, 1/8W, metal film, RFG7	Painton PMF60	608674
R15	464 Ω $\pm$ 1%, 1/8W, metal film, RFG7	Painton PMF60	606526
R16	147 Ω $\pm$ 1%, 1/8W, metal film, RFG7	Painton PMF60	604620
R17	68.1 Ω $\pm$ 1%, 1/8W, metal film, RFG7	Painton PMF60	603606
R18	51.1 Ω $\pm$ 1%, 1/4W, metal oxide	Corning NA60	603291
R19	0.523 Ω $\pm$ 1%, 2W, wirewound	IRC ASW2	
R20	Not used		
R21	330 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	605977
R21a	2.2 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	609471
R22	330 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	605977
R22a	2.2 k Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	609471
R23	10 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	601112
R24	10 Ω $\pm$ 2%, 1/2W, metal oxide	Electrosil TRH5	601112
R25	9.31 k Ω $\pm$ 1%, 1/4W, metal oxide	Corning NA60	611973
RV1a)	16 k Ω $\pm$ 2%, potentiometer, 2-gang,	Colvern CLR50/136/11	621626
RV1b)	wirewound, semi-log. curve 'A'		
RV2	10 k Ω resistor, variable, $\pm$ 20%, composition, linear	Plessey type E AWA 94771V59	

Components Mounted on Front Panel and Main Chassis (Continued)

SKA	Connector, 3 contacts, female, audio	Siemens Halske 9 Rel kli 6a	233970
SKB	Connector, 5 contacts, female, audio	Preh 8-7505	234828
SKC	Terminal, black	Belling Lee L1568/15C	
SKD	Connector, 6 contact, male	Bulgin P427	233983
SKE	Connector, 3 contact, male	Bulgin P429	233972
SWA	Switch, push-button	MSP 700	
		AWA 94771V102	
SWB	Switch, rotary, 9 positions, Oak F	AWA 94771V103	
SWC	Switch, rotary, 2 positions, Oak F	AWA 94771V104	
SWD	Switch, rotary, 4 positions, Oak F	AWA 94771V105	
TR1	Transformer, audio	Trimax TA2411	
TR2	Transformer, power	AWA 54487-001	

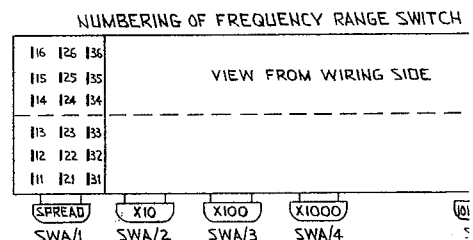
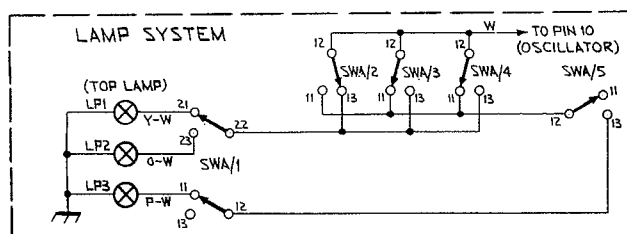
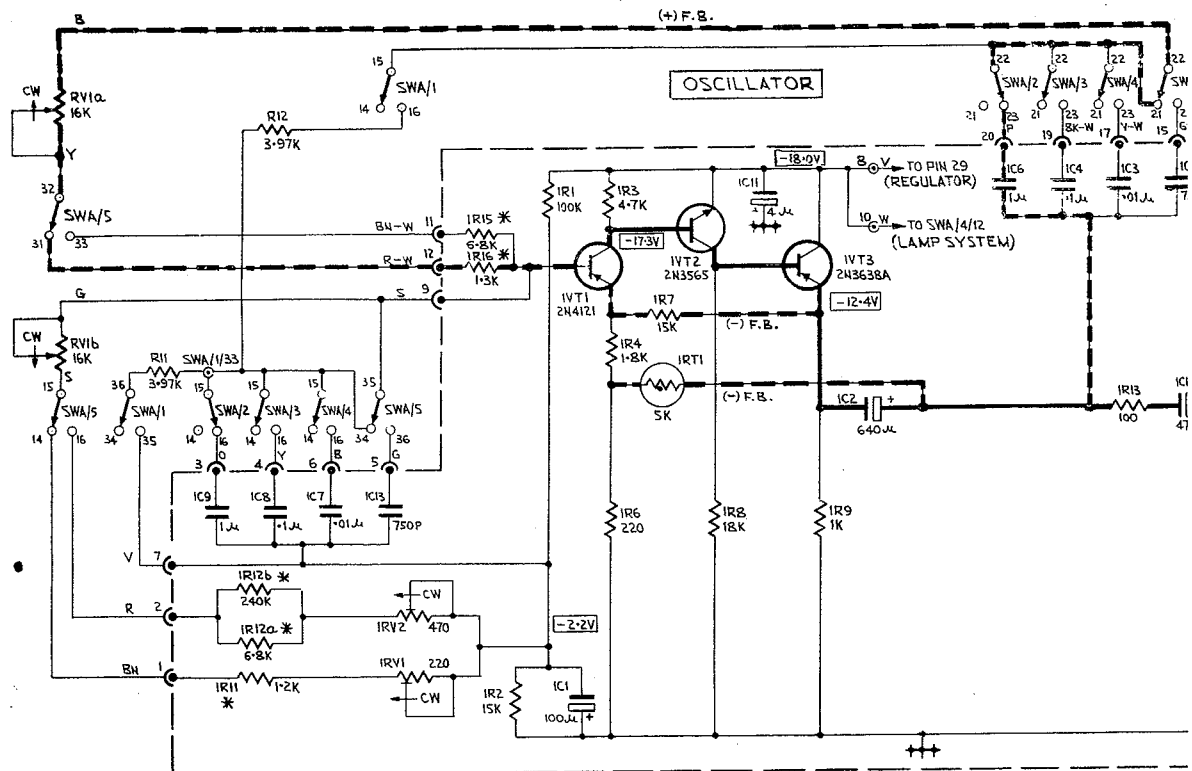
4. MISCELLANEOUS ITEMS

Battery, 12.5 V, 1000 mAH, nickel-cadmium, rechargeable, welded stack, polythene tube, optional	Eveready Y614	
Battery unit	AWA 94771W321	
Battery Protection Unit	AWA 2A94758	
Bracket, rack mounting (2)	AWA 94764V13	
Cursor, V.F.O. control, white	AWA 94771V284	
Drive Assembly, V.F.O. control	AWA 94771V287	
Foot, rubber (for bottom cover), 2	AWA	345085
Foot, wire (tilting stand)	AWA 94766V18A	
Clamp	AWA 94766V20A	
Knob, V.F.O. control, small (silver)	AWA	422704
Knob, V.F.O. control, small (gold) (replace with same type only)	Sato 8040 gold	
Knob, V.F.O. control, large	AWA 94771V294	
Knob, step attenuator (up to Serial No. 56 inclusive)	AWA	422939
Knob, step attenuator (from Serial No. 57)	AWA 94771V15	

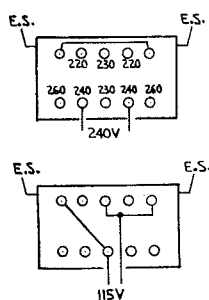
Miscellaneous Items (Continued)

Knob, level fine control	AWA	422943
Knob, power, Z source	AWA	422939
Plate, jack mounting	AWA 94768V354	
Plate, terminal mounting	AWA 94768V353	
Scale, V.F.O., control, clear	AWA 94771V286	

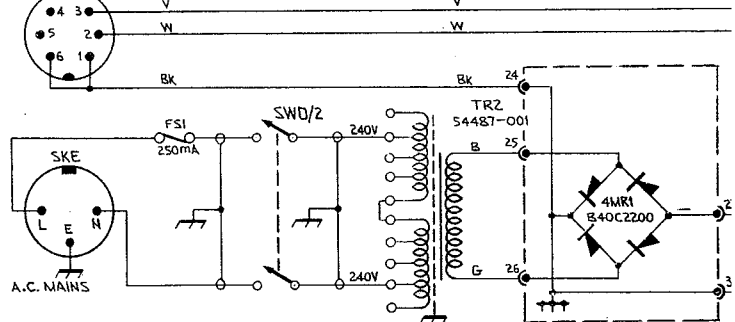
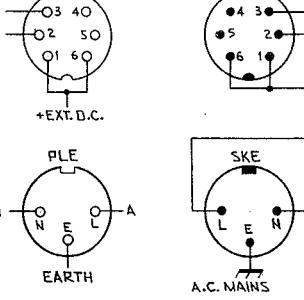
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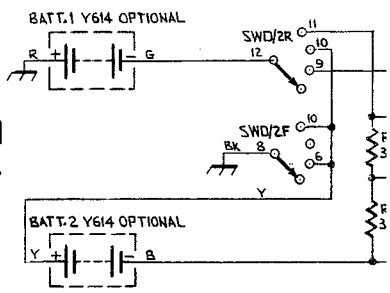
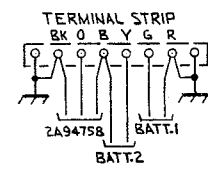
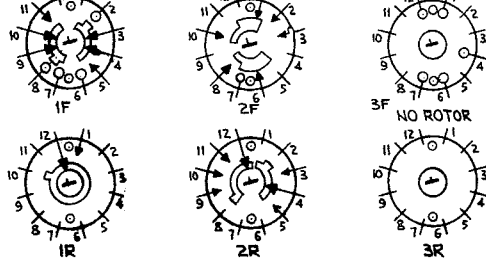
MAINS TRANSFORMER WIRING VIEW

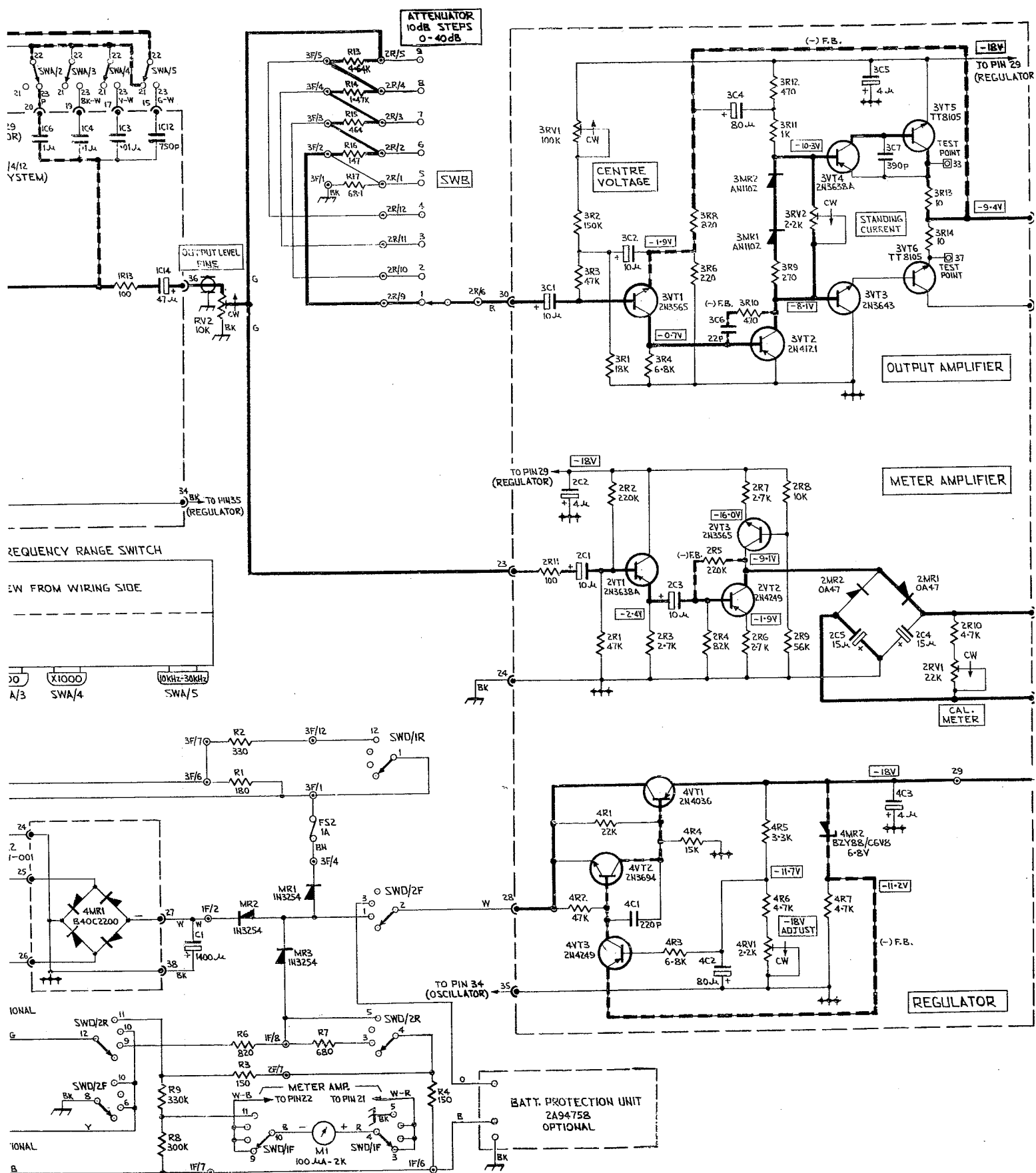


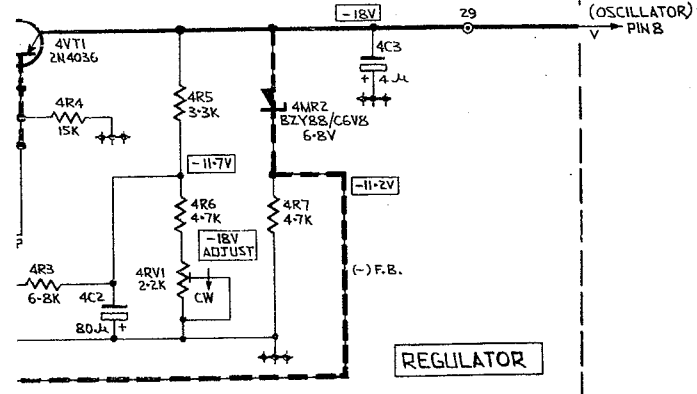
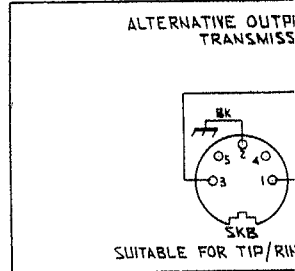
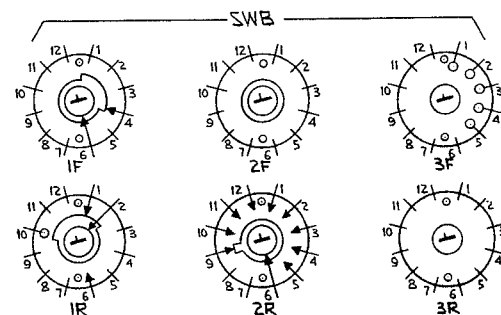
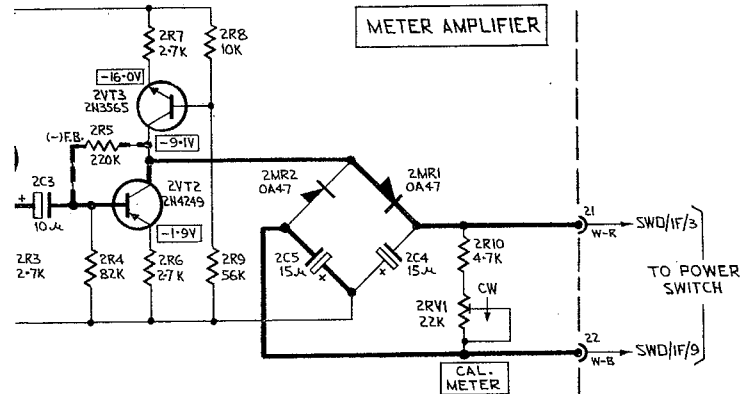
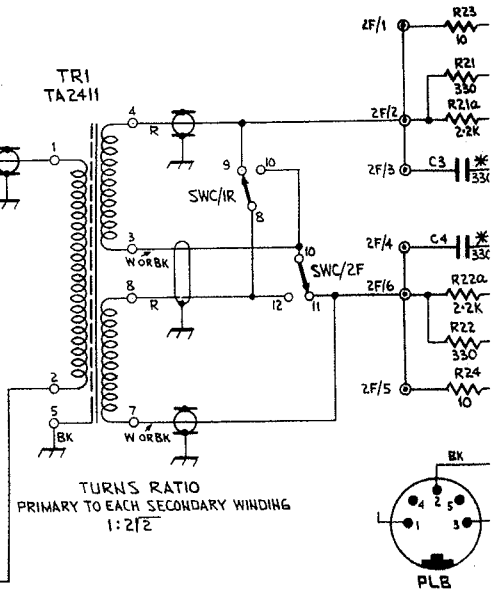
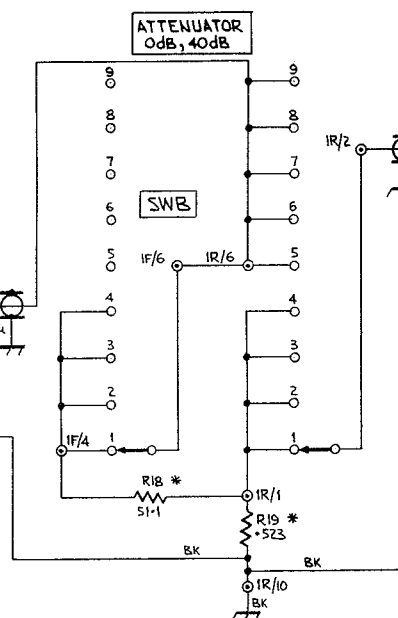
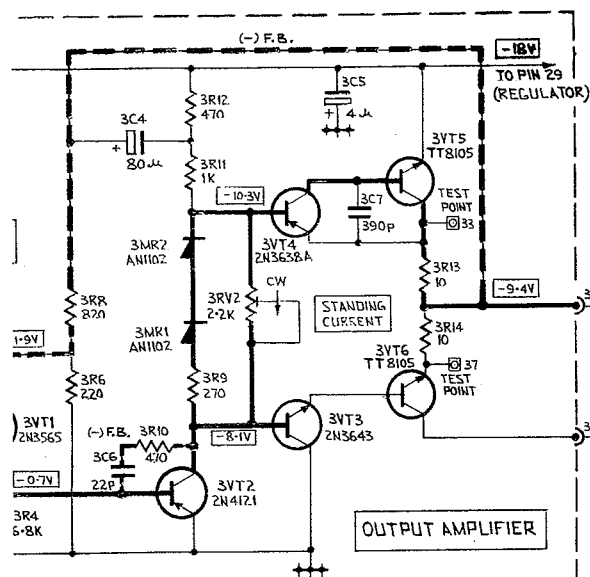
WIRING SIDE OF CONNECTORS



SWD



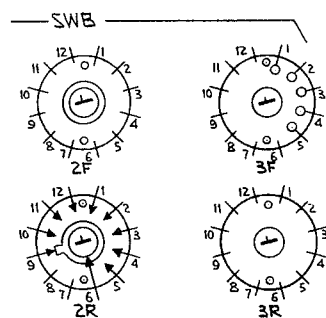
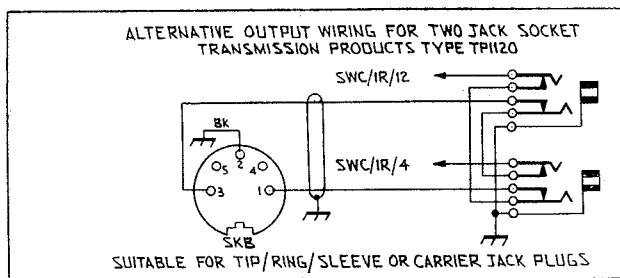
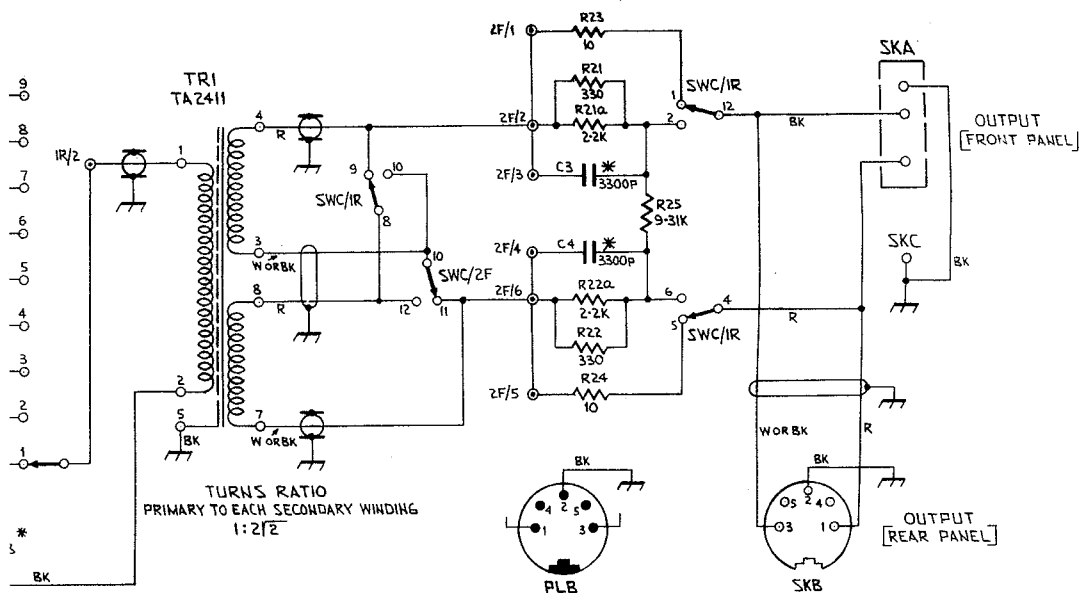




SWITCH POSITION TABLE

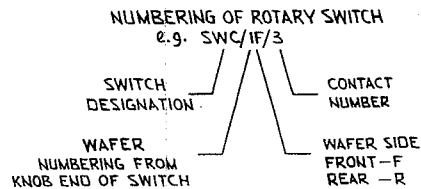
SWA FREQUENCY RANGE			SWB OUTPUT LEVEL		SWC Z SOURCE		SWD POWER	
LAMP	PUSH BUTTON	POSN. DRN.	POSITION	POSN. DRN.	POSITION	POSN. DRN.	POSITION	POSN. DRN.
1	2	10Hz-110Hz	•	1	-60dB	•	1	OFF
1	3	100Hz-1.1kHz	2	-50dB	2	600Ω	2	A.C./D.C.
1	4	1kHz-11kHz	3	-40dB			3	BATT.
3	5	10kHz-30kHz	4	-30dB			4	CHARGE
2	1+2	50Hz-110Hz	5	-20dB				
2	1+3	500Hz-1.1kHz	6	-10dB				
2	1+4	5kHz-11kHz	7	0 dB				
			8	+10 dB				
			9	+20dB				

NUM1
SWTC
DESIGNA
WAFER
NUMBERING FR
KNOB END OF SWI
1. A SINGLE WAFER
SWC/1 AND IND1
SIMILARLY ONE
IN THE FORM 1
2. FRONT AND RI
END OF SWITCH



ITCH POSITION TABLE

SWB		SWC		SWD	
OUTPUT LEVEL	POSN. DRN.	Z SOURCE	POSN. DRN.	POWER	POSN. DRN.
1 -60dB	•	1 40Ω	•	1 OFF	•
2 -50dB		2 600Ω		2 A.C./D.C.	
3 -40dB				3 BATT.	
4 -30dB				4 CHARGE	
5 -20dB					
6 -10dB					
7 0 dB					
8 +10 dB					
9 +20dB					

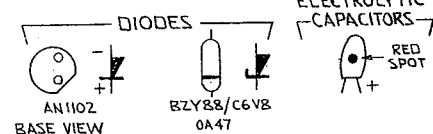
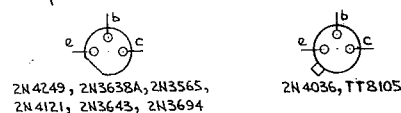


- NOTES:
1. A SINGLE WAFER MAY BE DESIGNATED IN THE FORM SWC/1 AND INDIVIDUAL CONTACTS IN THE FORM F/3 ETC. SIMILARLY ONE SIDE OF ANY WAFER MAY BE DESIGNATED IN THE FORM IF, ETC.
 2. FRONT AND REAR OF WAFERS VIEWED FROM KNOB END OF SWITCH IN EXTREME COUNTER-CLOCKWISE POSITION.

NOTES:

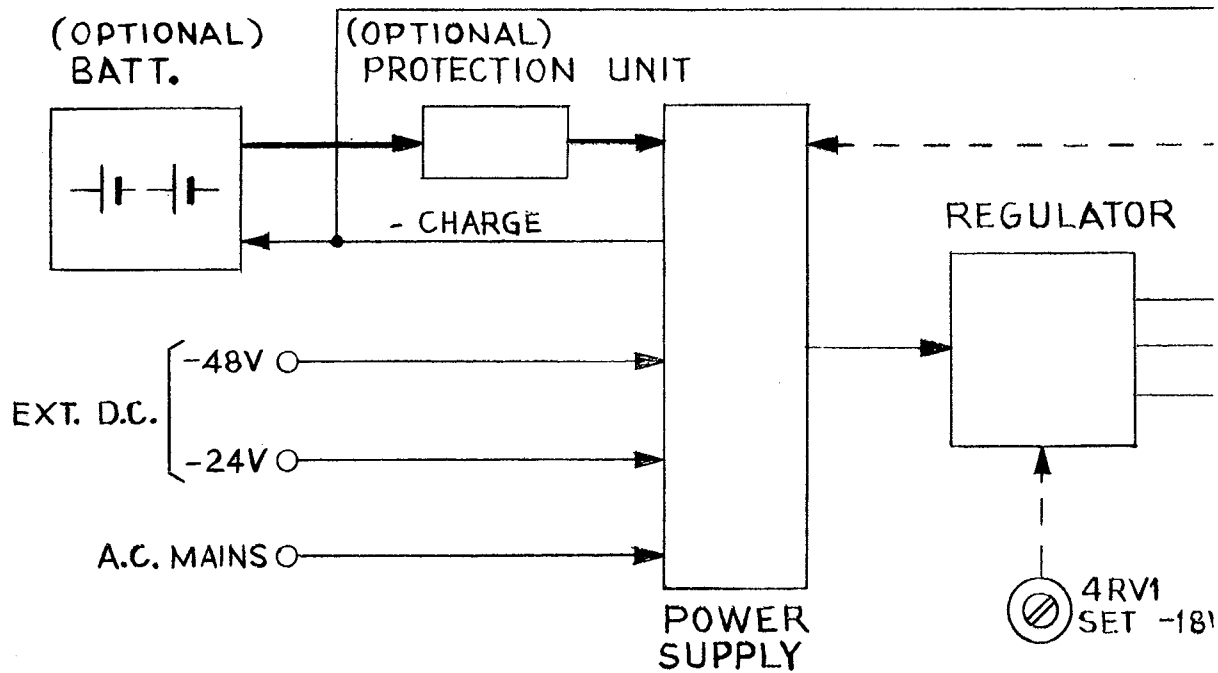
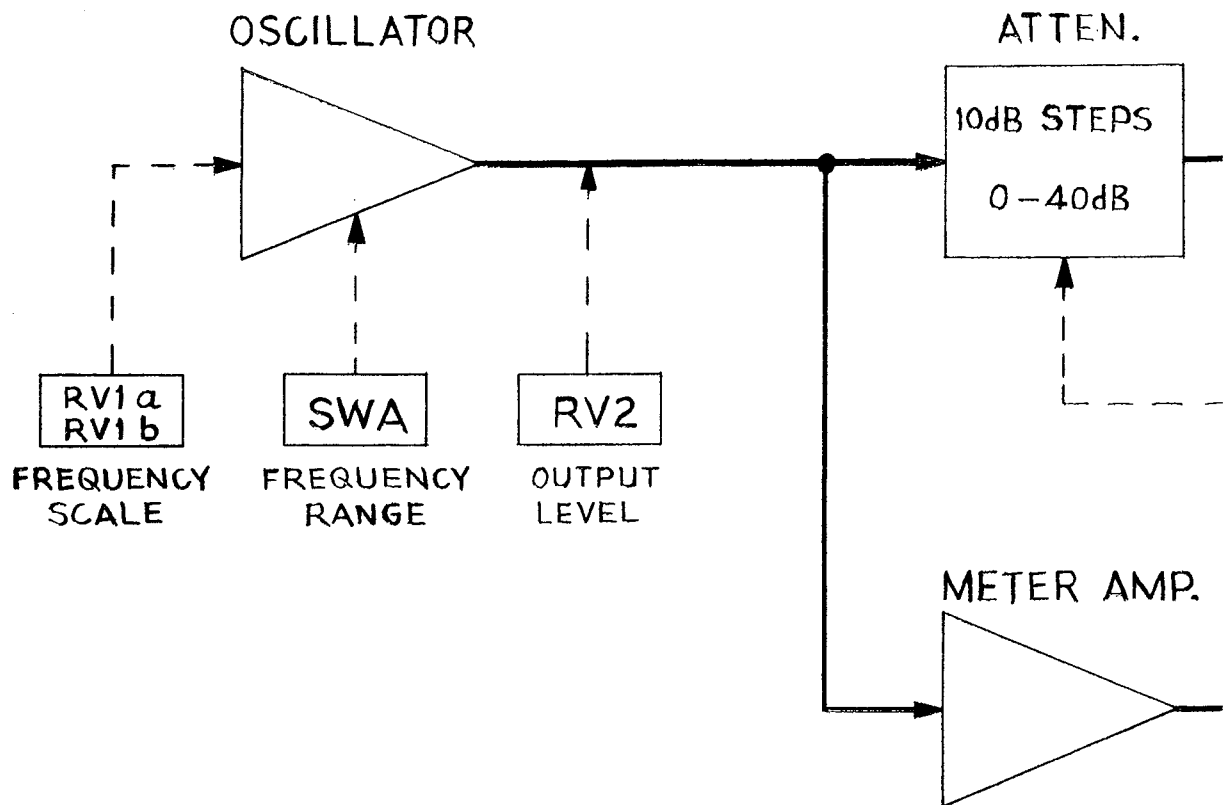
- 1. HEAVY LINES SIGNIFY MAIN CIRCUIT PATHS.
- 2. DASHED LINES SHOW FEEDBACK PATHS.
- 3. ALL D.C. VOLTAGES SHOWN ON THIS CIRCUIT MAY BE CHECKED WITH AN AVO MODEL 8 MULTIMETER, SET TO 10V OR 25V F.S.D.
- 4. RESISTORS IN OHMS K=1,000 M=1,000,000
- 5. * NOMINAL VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.

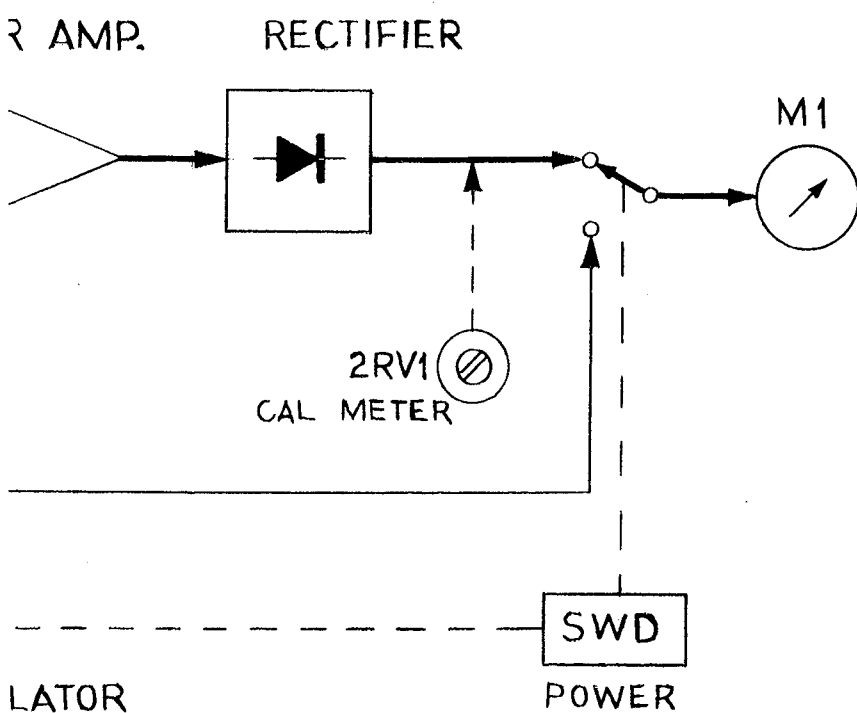
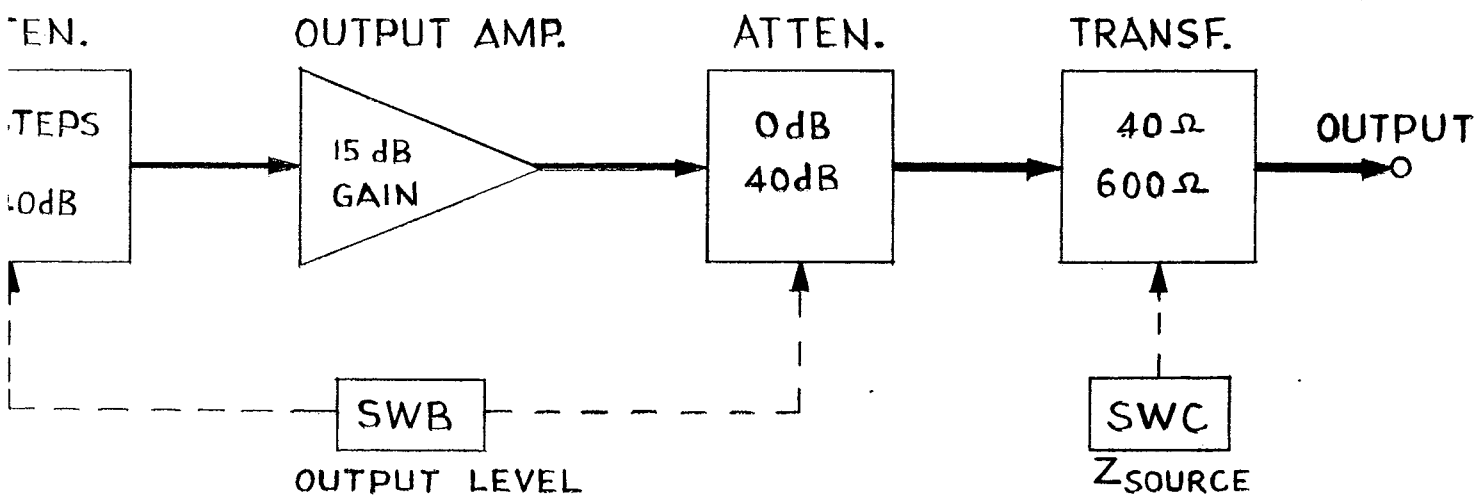
BASE VIEWS OF TRANSISTORS



AUDIO OSCILLATOR G231
TYPE 1A94771
ORG.94771 H1

PL-83952-0



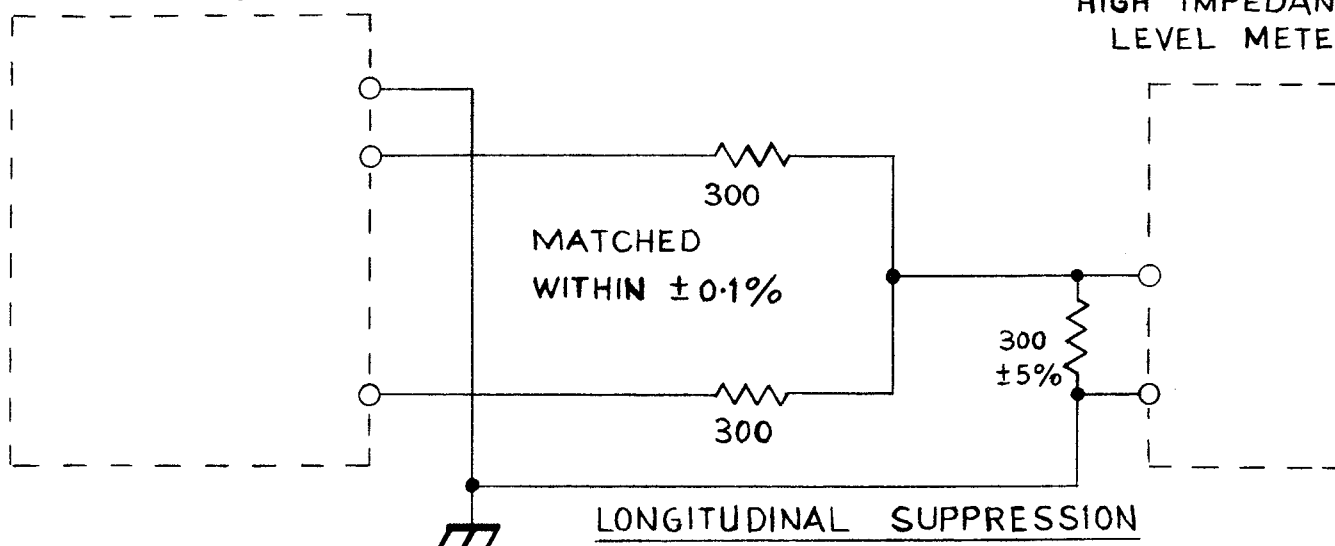


BLOCK DIAGRAM
 AUDIO OSCILLATOR - G231
 TYPE 1A94771
 DRG. 94771C1

PV-B3954-0

G231 UNDER TEST

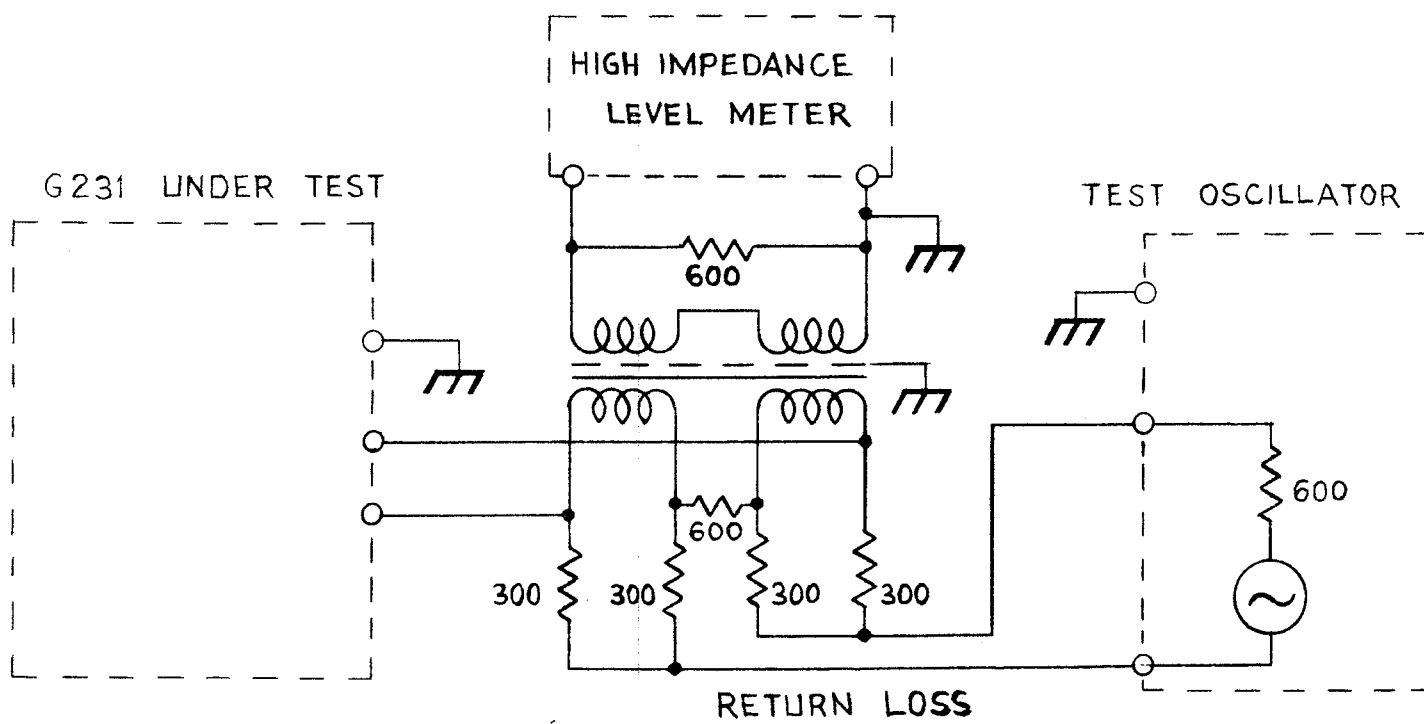
HIGH IMPEDANCE
LEVEL METER



G231 UNDER TEST

HIGH IMPEDANCE
LEVEL METER

TEST OSCILLATOR



NOTES:

RESISTORS: — TOLERANCE $\pm 1\%$.

TRANSFORMER: — $150\Omega + 150\Omega$ PRIMARY.

$150\Omega + 150\Omega$ SECONDARY.

10Hz — 30kHz .

TRIMAX: — TA37A IS SUITABLE.



MEASUREMENT OF RETURN LOSS AND
LONGITUDINAL SUPPRESSION

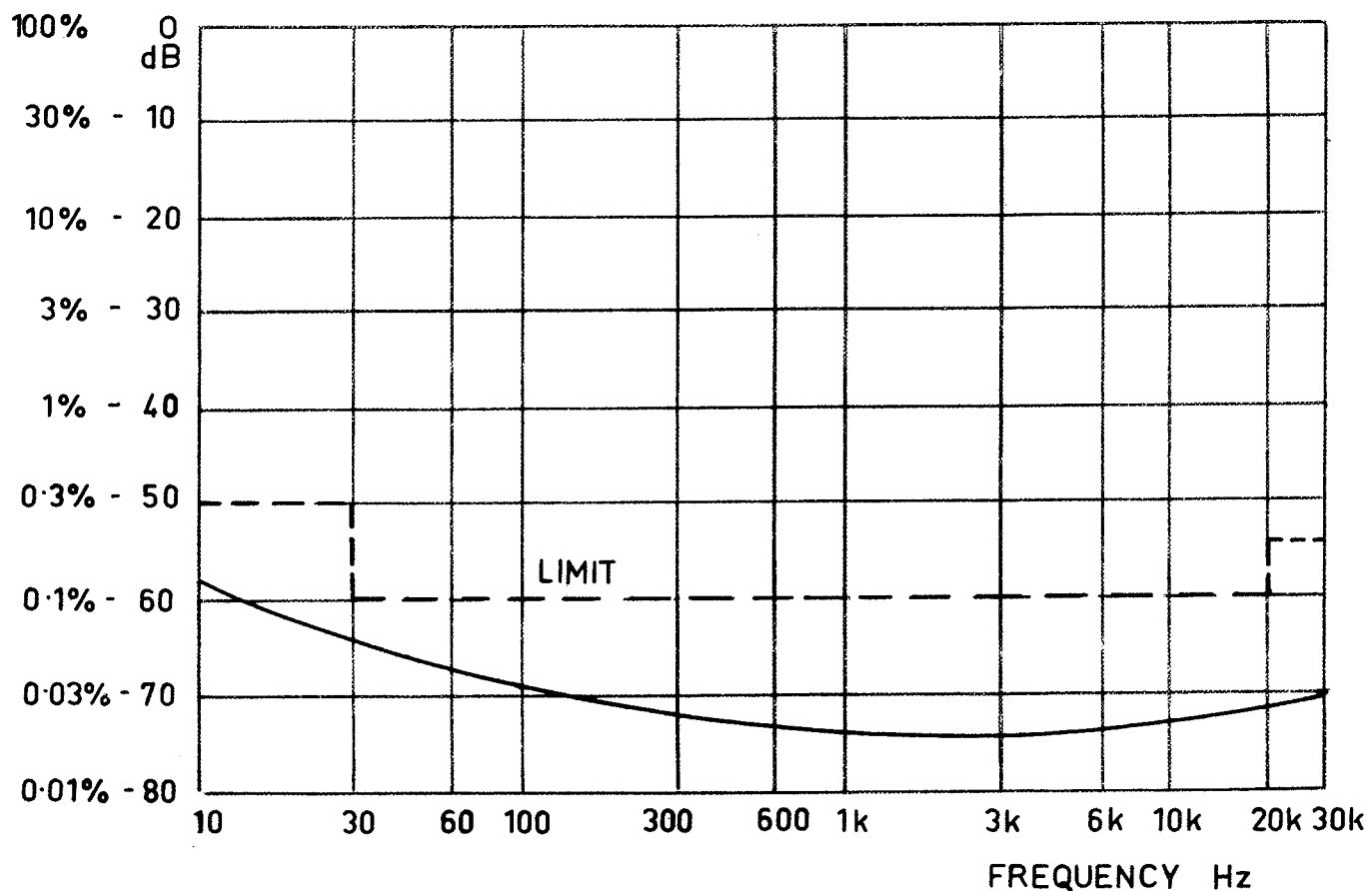
AUDIO OSCILLATOR-G231

TYPE 1A94771

DRG. 94771D3

PV-B3956-0

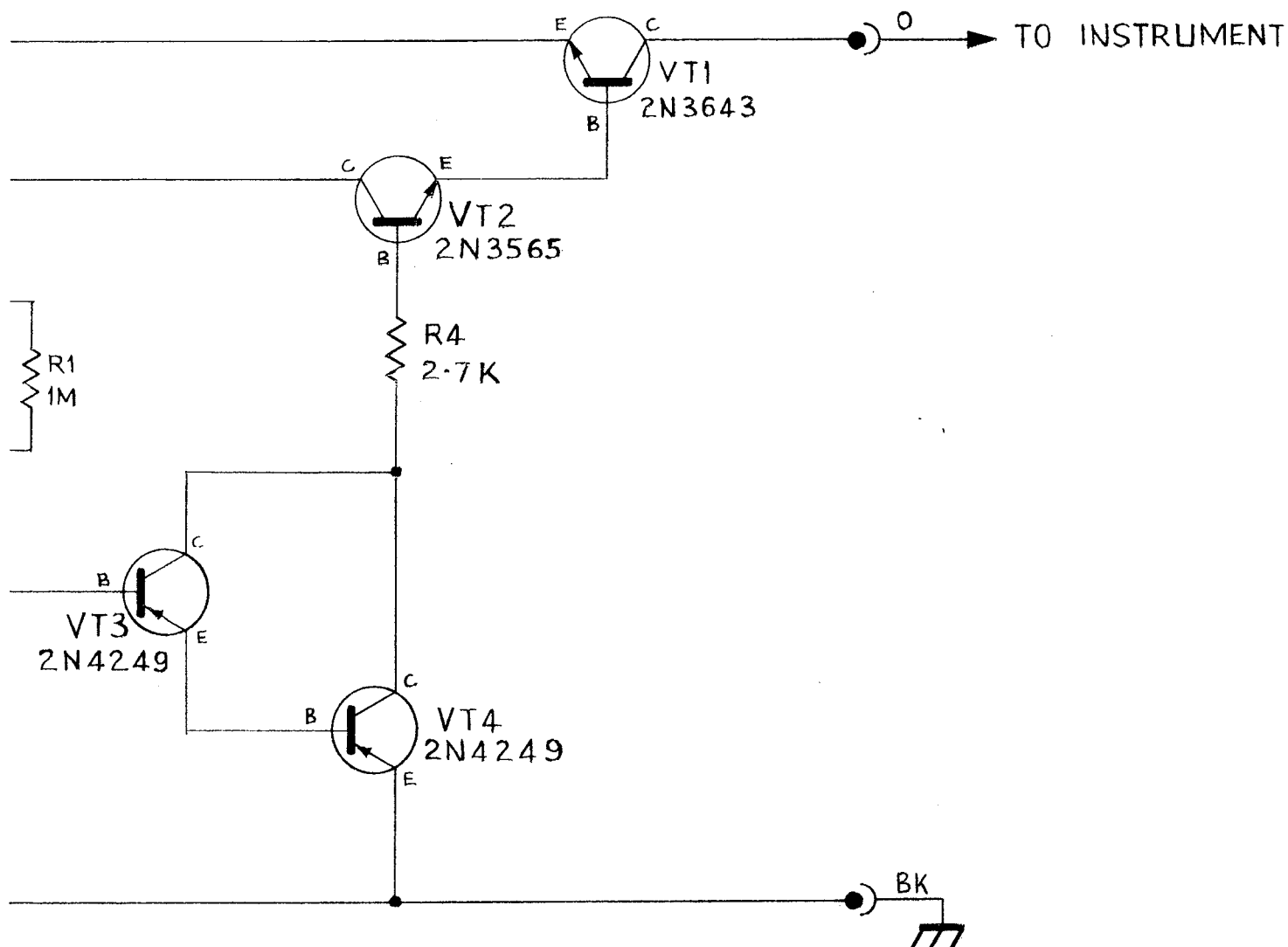
DISTORTION



OUTPUT LEVEL 0 dBm
INTO 600 Ω



TOTAL HARMONIC DISTORTION
TYPICAL CURVE
AUDIO OSCILLATOR G231
DRG.94771D4 PV-83957-0



2 CUT-OUT AT POINT O
DROPS BELOW 21.5 V.

INDUCTING CURRENT

RATED OR APPROACHING

0.1V)



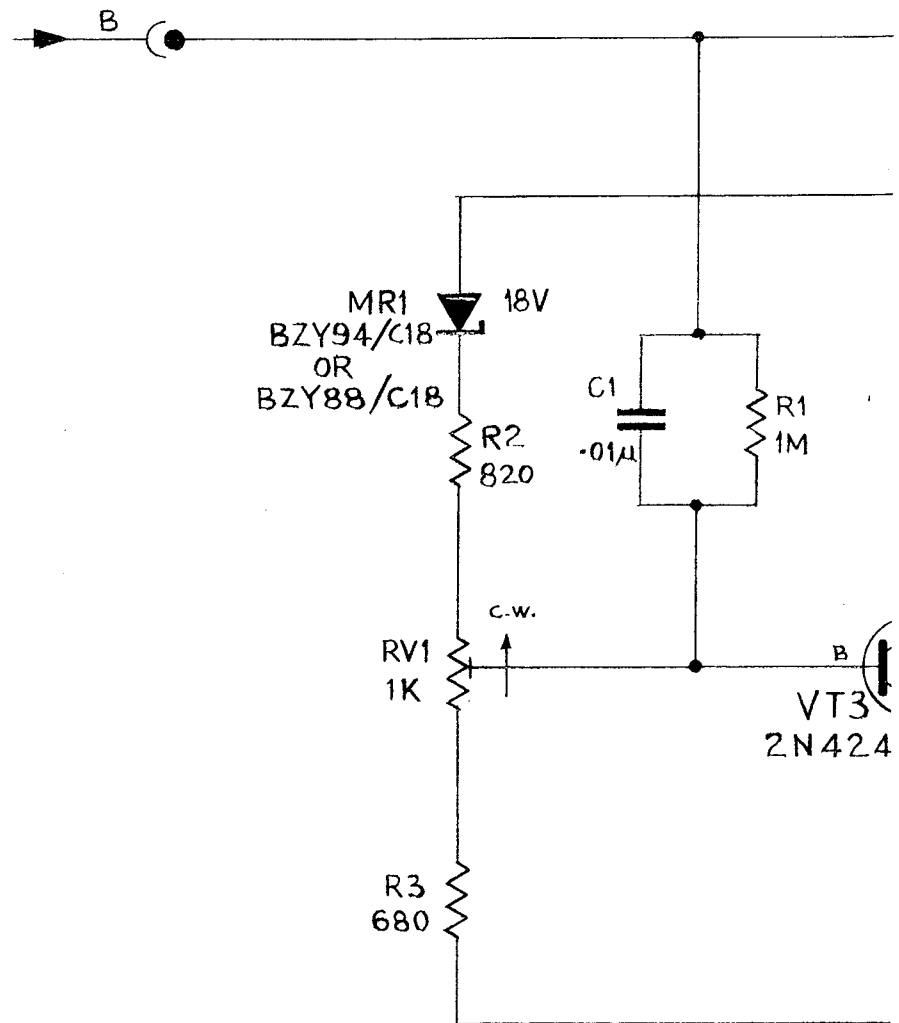
BATTERY PROTECTION UNIT

TYPE 2A-4A94758

DRG. 94758C2

PV-B3955.0

FROM
BATTERY



NOTES: 1. ADJUST RV1 FOR CUT-OFF
AS VOLTAGE AT B DROPS BY

2. WHILE UNIT IS CONDUCTING
BETWEEN B AND O,
VT1,3,4 ARE SATURATED (

SATURATION.
(VT1 V_{CE} APPROX. 0.1V)