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G & E BRADLEY A.C. CALIBRATOR TYPES 125B & C

GENERAL AND TECHNICAL INFORMATION

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PREFACE

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THE 125B CALIBRATOR

THE 125C CALIBRATOR

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SECTION 1

INTRODUCTION

1.1 BRIEF DESCRIPTION

The AC Calibrator 125 is a versatile AC voltage source providing an output with a sinusoidal waveform calibrated in r.m.s. or average values. The output frequency is determined by tuned circuits contained within plug-in units which fit into an aperture in the front panel.

The output voltage range is 0 to 511V at 5VA.

The original version in quantity production was the 125B mainframe into which was fitted a plug-in at 50Hz, 60Hz, 400Hz and 1kHz. Variations of this plug-in were available as options.

Model	Discrete Output Frequencies
1254B	50Hz, 60Hz, 400Hz, 1kHz
1256B	40Hz, 50Hz, 60Hz, 400Hz
1257B	50Hz, 400Hz, 1kHz, 2.4kHz

All these plug-ins have now been superceded by a new version designated 1258. This is an active tunable bandpass filter having a push-pull output in two frequency ranges covering the spectrum from 39Hz (nominal) to 3.2kHz.

This new plug-in has required minor modification to the 125 mainframe, mainly to provide the +15 volt and -15 volt regulated power supplies required for the 1258. The new combination becomes the 125C.

The overall performance of the 125C provides a voltage accuracy better than ±0.2% and second and third harmonic distortion of less than 0.15% at 40Hz to 2.4kHz q.v.

The 125 output is continuously referenced to a Weston Standard cell. Any error is indicated directly on a front panel centre zero meter. The error can be eliminated using a variable set level control.

This feature provides a means of varying the selected output over two separate switchable ranges of ±0.5% and +5% of the dialled output. The meter thus allows percentage deviation to be read directly from the front panel meter to provide a simple method of calibrating a.c. meters.

1.2 OUTPUT RANGES

The output is selected in 100mV steps using four front panel rotary switches with clearly read digits to show the selected value. The output range can be extended by using a ratio transformer. These were originally manufactured and supplied as an optional accessary, designated the 1255. Production of this item has now ceased. Customers requiring this facility can obtain a suitable alternative from F. Sullivan and Company of Dover. The part number is ratio transformer F9100.

Using the ratio transformer the additional ranges are -

0 to 1.1 volts in 10mV steps
0 to 110mV in 1mV steps

1.3 APPLICATIONS FOR THE 125C

The 125C provides an economical and convenient means of calibrating a.c. voltage and current measuring instruments, including oscilloscopes and similar equipment.

It is also useful as a source for checking the attenuation of a.c. transmission lines or in any other application requiring accurate a.c. voltage at 5VA up to 500 volts.

SECTION 2.

SPECIFICATION

2.1	AC Calibrator 125B with 1254B Plug-in and 125C with 1258 Plug-in.	
2.1.1	Output Voltage	0 - 511V in 100mV steps
2.1.2	Output Waveform	Sinusoidal
2.1.3	Frequency	1254B spot frequencies of 50Hz, 60Hz, 400Hz and 1kHz 1258 continuously variable from 40Hz* to 3.2kHz in two ranges. X1 40Hz* - 320Hz X10 300Hz - 3.2kHz Accuracy 40Hz* - 3.2kHz ±2% * 30Hz nominal
2.1.4	Harmonic Content	For loads up to 2.5VA 125B with 1254B Plug-in 2nd and 3rd harmonic - less than 0.15% 4th and 5th harmonic - less than 0.05% Other harmonics - negligible 125C with 1258 Plug-in 2nd and 3rd harmonic 30Hz - 40Hz - 0.1% 40Hz - 2.4kHz - 0.15% 2.4kHz - 3.2kHz - 0.3% 3rd and 4th harmonic 30Hz - 40Hz - 0.1% 40Hz - 2.4kHz - 0.05% 2.4kHz - 3.2kHz - 0.1%
2.1.5	Output Calibration	Average and r.m.s. values
2.1.6	Voltage Accuracy	125B with 1254B Plug-in. Better than ±0.20% of indicated output. 125C with 1258 Plug-in 30Hz - 40Hz ±0.4% of indicated output 40Hz - 2.4kHz ±0.2% of indicated output ◀ 2.4kHz - 3.2kHz ±0.7% of indicated output ▶
2.1.7	Regulation	For any power factor. Better than 0.15% of indicated outputs plus 0.1V Terminal Not more than 1.5mV for 50mA load (equivalent to 50mΩ).

		Main Output Terminal. Not more than 3mV for 25mA load (equivalent to 120mΩ).
2.1.8	Maximum Output for Stated Regulation	5mA on hundreds selector 25mA on tens selector 50mA on units and tenths selector
2.1.9	Absolute Maximum Output	Not exceeding 5VA above 1.0 volt Not exceeding 5A below 1.0 volt
	Frequency Stability	Typically ±0.01% per $^{\circ}$C
	Selectivity (Q)	50±10% for the tuning range 30Hz - 3.2kHz
	Voltage Gain at Resonance	3.0 ±5% into 100kΩ load for both outputs at 1kHz
	Voltage Gain - Flatness	±0.5dB, 50Hz - 1.5kHz ±1.0dB, 30Hz - 3.2kHz
	Maximum Output Voltage	200mV r.m.s.
	Distortion	Total harmonic distortion 100mV output - 0.02% maximum
	Output Offset Voltage	1mV maximum
	Output Noise Level	100µV p-p maximum
	Temperature Range	+10°C - 45°C operating -10°C - 55°C for storage
2.1.10	Voltage Amplitude Reference	Reference cell internal or external, 1.093 absolute volts nominal
2.1.11	Output Voltage Variation	Up to ±5% of selected voltage by means of continuously variable control
2.1.12	Power Supply	Input Voltages: 100-125V or 200-250V, 50/60Hz single phase Permissible variation for stated accuracy: +7) per cent of -10) normal rating Consumption: 55 watts maximum
2.1.13	Overall Dimensions	Full rack case. Height 23cm (9.25") Width 50cm (19.75") Depth 34cm (13.375")
2.1.14	Weight	21.5kg (47 lb) Net.

2.2 RATIO TRANSFORMER TYPE 1255

2.2.1	Ratios	1 : 10 (x0.1) and 1 : 100 (x0.01)
2.2.2	Maximum Input Voltage	11V, 50Hz to 1kHz, r.m.s. or average value
2.2.3	Output Voltage	1 : 100 range 0 - 110mV r.m.s. or average value in 1mV steps. 1 : 10 range 0 - 1V r.m.s. or average value in 10mV steps Output Voltage and Calibration Value are selected by controls on AC Calibrator Type 125B/C
2.2.4	Accuracy	Better than 0.1% of OUTPUT with respect to INPUT on NO LOAD but including errors due to slight loading by transformed losses.
2.2.5	Output Impedance	1 : 100 range 6mΩ maximum ◀ 1 : 10 range 30Ω maximum ▶
2.2.6	Absolute Maximum Load	5Amps

SPECIFICATION

<u>Variable Frequency Plug-in Unit 1258</u>

Frequency Range	Dial reading x1 *30/40Hz - 320Hz x10 300Hz - 3.2kHz (*30Hz nominal)
Frequency Accuracy	±2% of indication
Frequency Vernier	+2% maximum shift at any dial setting.

SECTION 3

OPERATING INSTRUCTIONS

3.1 INSTALLATION

3.1.1 Supply Voltage Adjustment and Fuse Rating

The instrument can be operated from any single-phase alternating supply within the voltage ranges 100-125V or 200-250V, 50-60Hz. Before connecting the supply, the Voltage Selector plug on the rear panel must be set in accordance with the supply voltage to be used.

The instrument is despatched from the factory with a 2-ampere fuse fitted and the Voltage Selector set for operation from a 240V, 50-60Hz supply. To adjust for other voltages withdraw the selector plug and insert it so that the engraved arrow points towards the appropriate voltage marking on the panel.

NOTE: A 5-ampere fuse must be fitted for operation from 100-125V supplies. (see para. 5.1.1)

3.1.2 Mains Connection

A 3-pin plug must be fitted to the mains lead in accordance with the following code:

BROWN lead to LINE
BLUE lead to NEUTRAL
GREEN & YELLOW lead to EARTH

3.1.3 Operating and Storage Position

The instrument must be operated and stored in an upright position on a level surface.

3.2 CONTROLS

The function of the controls on the front panels of the AC Calibrator 125 and the Plug-in Unit are as follows -

Plug-in Unit 1254B, 1256B, 1257B

FREQUENCY switch	Selects frequency of output voltage.

Plug-in Unit 1258

FREQUENCY Hz	
X1 40-320Hz (Dial reading x1)	Selects lower frequency range 300Hz - 3.2kHz
X10 300-2.4kHz (Dial reading x10)	Selects higher frequency range 300Hz - 3.2kHz
Vernier	Provides a frequency shift of a +2% maximum at any dial setting.

Cal.	Position used for vernier when calibrating the dial setting during setting up, or when using the instrument without an output frequency monitor meter. In the CAL position output is the calibrated dialled setting.
FREQUENCY Dial	Provides continuously variable frequency output in two ranges X1 or X10 depending upon the setting of the range switch.

AC Calibrator

OUTPUT switch	Controls output from OUTPUT terminals only. Connects OUTPUT terminals to chassis in the OFF position.
HUNDREDS) Output TENS) Voltage UNITS) Selector TENTHS) Switches	Select output voltage
SET LEVEL control	Varies output voltage continuously by up to 5% above or below calibrated level.
PERCENTAGE DEVIATION METER switch	Selects range of operation of Percentage Deviation Meter either 0.5% or 5% full scale. Set zero provides setting up position for balancing the monitoring amplifier using the SET ZERO control q.v.
REFERENCE CELL VOLTAGE	Compensates monitoring amplifier for differences in absolute voltage of the reference cell.
SET ZERO control	Balances monitoring amplifier, so setting Percentage Deviation Meter to Zero.
MAINS EARTH switch	Connects COMMON output terminal and chassis direct to mains earth or via 47 ohm isolating resistor.

3.3 OUTPUT TERMINALS

The functions and use of the four output terminals are as follows -

OUTPUT	Provides switched output up to 100V at 25mA maximum current and up to 511V at 5mA maximum current, controlled by OUTPUT switch.
0 - 11V DIRECT	Provides unswitched output to 11V at 50mA maximum current.
0 - 1V DIRECT	Provides unswitched output to 1V at 50mA maximum current.

COMMON	Output NEUTRAL terminal is connected permanently to chassis. The MAINS EARTH switch connects chassis to mains earth direct, or via a 47Ω resistor.

3.4 REFERENCE CELLS

3.4.1 <u>Internal Cell</u>

A Muirhead Type D-845-A Reference Cell, with a nominal voltage of 1.0193 volts, provides the reference voltage.

The REFERENCE CELL VOLTAGE control on the rear of the instrument is preset during manufacture to the nominal terminal voltage of the cell. For maximum accuracy this control must be reset to the position corresponding to the absolute terminal voltage. To reset the control -

(a) Slacken the locking screw adjacent to the control.
(b) Set the control to the required position and
(c) Tighten the locking screw.

The terminal voltage of the cell can be checked across the REFERENCE CELL terminals adjacent to the REFERENCE CELL VOLTAGE Control.

NOTE: The Reference Cell must be operated and stored in an UPRIGHT position, i.e. with the terminals at the bottom of the cell. The cell may be permanently damaged if it is in other position for a prolonged period, particularly if it is subjected to vibration or changes in ambient temperature whilst in this condition. Refer to the data sheets published by Muirhead & Co. for information on the restoration of cells that have been misused in this manner.

3.4.2 <u>Use of External Reference Cell</u>

An external reference cell having an absolute terminal voltage within the range 1.018 to 1.020 volts can be connected to the instrument, in place of the internal cell, in the following manner -

(a) Disconnect leads to internal reference cell from REFERENCE CELL terminals.
(b) Connect external reference cell to REFERENCE CELL terminals observing correct polarity.
(c) Slacken the locking screw, set the REFERENCE CELL VOLTAGE control to the absolute terminal voltage of the external cell, and tighten the locking screw.

3.5 OPERATION

3.5.1 <u>General</u>

To allow the circuits to attain stable operating conditions, the instrument should be switched on for at least 15 minutes before use. If maximum stability is required, allow a warm up period of at least one hour.

<u>WARNING - HIGH VOLTAGE</u>
THE OUTPUT SWITCH SHOULD ALWAYS BE SET TO THE OFF POSITION BEFORE MAKING CONNECTIONS TO THE OUTPUT TERMINAL.

3.5.2 Operating Instructions

(a) Set MAINS and OUTPUT switches to the OFF position. Set PERCENTAGE DEVIATION METER switch to SET ZERO. Check that REFERENCE CELL VOLTAGE control is set to correspond to the absolute terminal voltage of the internal or external reference cell in use.

(b) Set FREQUENCY on Plug-in Unit to the required output frequency.

(c) Set MAINS switch to ON and check that the neon indicator glows.

(d) Set OUTPUT CALIBRATION switch to RMS or AVERAGE as required.

(e) Check PERCENTAGE DEVIATION METER for zero indication.

(f) Set OUTPUT VOLTAGE Selector switch to the required output voltage.
Set PERCENTAGE DEVIATION METER switch to 0.5 per cent range and check that meter indicates zero error.
Adjust SET LEVEL Control as necessary to obtain this condition.

NOTE: The 0.5 per cent range of the PERCENTAGE DEVIATION METER gives maximum accuracy when setting the output level.

(g) Connect load to output terminals as appropriate and set MAINS EARTH switch as required. Set OUTPUT switch to ON when using OUTPUT terminal.

3.5.3 Calibrating AC Meters Using Percentage Deviation Facility

(a) Set controls as described in para 3.5.2.

(b) Set PERCENTAGE DEVIATION METER switch to 5 PER CENT RANGE.

(c) Vary SET LEVEL control until the indication on the meter under test corresponds to the voltage set up on the OUTPUT VOLTAGE switches.

(d) Read percentage error of meter indication directly from the scale of the PERCENTAGE DEVIATION METER.

NOTE: The polarity of the deviation indicated on the PERCENTAGE DEVIATION METER is referenced to the output from the AC Calibrator and is in the opposite sense of the error present in the indication given by the meter under test.

e.g. A meter under test indicates 10V when the OUTPUT VOLTAGE switches are set to 10V and the SET LEVEL control is set for a PERCENTAGE DEVIATION METER indication of +5 per cent, which corresponds to an output voltage of 10.5V from the AC Calibrator. The indication given by the meter undet test is, therefore, 5 per cent LOW, i.e. -5 per cent error.

3.5.4 Connection of Ratio Transformer Type 1255 (Now obsolescent)

(a) Connect BLACK spade terminal of Ratio Transformer to black COMMON terminal AC Calibrator.

(b) Connect RED spade terminal to 0 - 11V DIRECT output terminal of AC Calibrator.

(c) Connect the load between the BLACK (earth) and the RED X0.01 RED X0.1 output terminals of the Ratio Transformer.

(d) Set the controls of AC Calibrator Type 125B as described in para 3.5.2.

NOTE: The TENTHS and UNITS output voltage selector switches of AC Calibrator Type 125 set the output voltage at the terminals of the Ratio Transformer. These switches provide incremental steps of 10mV and 1mV respectively at the X0.01 terminal and 100mV and 10mV respectively at the X0.1 terminal. The maximum output voltage loading for each terminal is as follows -

Terminal	Output Voltage	Max Load (absolute)
X0.1	0 to 1.1V	2VA (0.4 to 1.1V) 5 amps (Below 0.4)
X0.01	0 to 110mV	5 amps

SECTION 4

TECHNICAL DESCRIPTION

4.1 CONSTRUCTION

4.1.1 AC Calibrator Type 125

The AC Calibrator Type 125 consists of a main chassis assembly with integral front and rear panels. All the main operating controls are mounted on the front panel. The Reference Cell Voltage Control, Reference Cell Terminals, Voltage Selector Panel and Mains Fuse are mounted on the rear panel. Detachable top, bottom and side panels provide access to the main chassis. The chassis assembly is a framework on which the major components such as the toroidal output transformers, mains transformers, valves and sundry miscellaneous components are mounted directly. The major circuits are mounted on six component board sub-assemblies which are wired directly to the appropriate main chassis components. These component board sub-assemblies contain the following circuits -

Board 1	Preamplifier circuit
Board 2	Amplifier circuit and miscellaneous components
Board 3	Precision Rectifier and Reference Cell Interlock circuits
Board 4	Differential Amplifier circuit
Board 5	+500V Stabiliser circuit
Board 6	Miscellaneous Power circuits

Fig. 2 shows the location of the component boards on the main chassis assembly and the location of all chassis mounted components. The location of components on the individual boards is shown in Fig. 3 to 8. The designation and location of all the front panel controls are shown in the Frontispiece. The components on the rear panel are shown in Fig. 9.

4.1.2 Plug-in Units

The plug-in unit consists of a sub-assembly chassis which is inserted into an aperture in the upper left hand side of the front panel. The unit is located by two steel pins which engage with bushes in the 125 calibrator chassis assembly. A captive threaded rod secures the plug-in unit by engaging with a tapped bush on the calibrator chassis. A milled knob allows the rod to be secured into the tapped bush.

Electrical connections are made automatically through a socket on the plug-in and a fixed plug on the calibrator, when the steel pins locate in the calibrator chassis.

The 1258 Variable Frequency unit is the only one now in production.

4.1.3 Ratio Transformer Type 1255

The Ratio Transformer Type 1255 consists of a precision wound toroidal transformer contained in a metal case. The input connections to the transformer are made via a cable fitted with spade terminals. The output connections are made via three insulated terminals on the top panel of the case. The Ratio Transformer is not now made by G. E. Bradley - see para. 1.2.

4.2 FUNCTIONAL DESCRIPTION

The AC Calibrator Type 125 is a low frequency push-pull oscillator comprising a tuned circuit followed by a transistor preamplifier, a valve amplifier and a cathode follower output stage. The output is taken from two precision-wound multiple-tapped toroidal output transformers which also provide an overall feedback signal and a monitoring signal. The feedback signal is coupled to the tuned circuit via a lamp bridge circuit to provide amplitude stabilisation. The monitoring signal is applied to a circuit consisting of a precision rectifier and a differential amplifier, which drives a centre-zero meter indicator (PERCENTAGE DEVIATION METER). The circuit rectifies the monitoring signal and compares it with the output from a standard cell. Error is indicated on the meter as a percentage deviation of the oscillator output voltage. The error can be corrected by adjusting the level of the feedback signal using the manual SET LEVEL control to restore the oscillator output to the calibrated amplitude. A block diagram of the circuit is given in Fig. 1.

The 1258 plug-in contains the active tunable band-pass filter with push-pull outputs in two ranges covering the spectrum from 39Hz (nominal) to 3.2kHz.

The feedback signal from the output transformer is coupled into the tuned circuit via the lamp bridge circuit and the primary winding of the operative transformer. The lamp bridge circuit operates by virtue of the non-linear variation of lamp resistance with input power. The range of the instrument, is set to balance when the output from the instrument is at the calibrated amplitude level. Any change in the output level results in an anti-phase output from the bridge circuit as feedback to vary the gain of the oscillator in opposition and so restore the output to the calibrated level.

The lamp bridge circuit includes the SET LEVEL control to allow adjustment of the oscillator output level by varying the balance conditions of the bridge circuit in the feedback path. The OUTPUT CALIBRATION switch enables the level of the sinusoidal output to be set to provide either the average or r.m.s. value of the selected voltage. The bridge circuit also has controls to enable the output calibration circuit to be set up.

Four rotary switches each with 10 discrete positions and with easily read digits from 0-10 allow the selection of tenths, units, tens and hundreds of volts by connecting the appropriate tappings on the output transformer to the output terminals. The selected voltage from each decade is series connected to provide the final voltage applied to the output terminals. The tenths outputs are supplied by an auxiliary transformer fed from the main output transformer.

A second output winding on the auxiliary transformer provides a monitoring signal, which is a constant pecentage of the oscillator output voltage irrespective of the setting of the output voltage selector switches. This signal is rectified and applied to one input of the differential amplifier where it is compared with the output from the reference cell, which is applied to the opposite input of the amplifier. Because the monitoring signal level is directly proportional to the oscillator output level, any deviation of the monitor signal level relative to its normal level is proportional to the deviation of the output relative to its normal level. The ratios are thus similar and are constant for any selected output voltage. By balancing the differential amplifier under normal output level conditions against the constant output from the reference cell, any deviation in the output level appears as a positive or negative error signal at the amplifier input. After amplification this error signal is applied to the centre zero meter, which is calibrated in units of percentage deviation. Indicated deviation is offset by adjusting the oscillator circuit feedback using the SET LEVEL control until a zero error meter reading shows that the monitoring circuit inputs are balanced.

The power circuits provide outputs of +500V d.c. stabilised for the oscillator amplifier, +15V and -15V for the oscillator preamplifier and floating outputs of 15V and -15V for the differential amplifier. In addition, outputs of +250V d.c. two floating outputs of +110V and a -45V output are provided for the oscillator output cathode follower stage. Three 6.3V a.c. outputs provide the heater supplies for the oscillator and +500V power supply stablisier valves.

4.3 CIRCUIT DESCRIPTION

4.3.1 Circuit Diagrams

The circuit diagram for the 1258 is given in Fig. 11. The circuit for the 1254B plug-in is given in Fig. 12. Circuit diagrams for the 125B and 125C are given in Figs. 13 and 14 and in Fig. 10.

4.3.2 The Oscillator Circuit

The oscillator circuit comprises the tuned circuit contained in the Plug-in Unit, the preamplifier VT1 to VT8, the amplifier V4/V5/VT22/VT23, the output cathode follower V6/V7, the output transformer T2 and the lamp bridge circuit.

4.3.3 The Tuned Circuit 1254B Plug-in

The tuned circuit comprises the a.f. transformers T1 and T2, the tuning capacitors C1 to C11, the FREQUENCY switch SA and the setting up controls RV1/RV2/RV3/RV4. The FREQUENCY switch SA connects the transformer secondary windings and the tuning capacitors as parallel circuit combinations to provide the selected output frequency. Thus -

50Hz - C4, C5, C11, C3 and C10 with T1
60Hz - C4, C5, C11, C9 with T1
400Hz - C2, C8, R2 with T2

The primary winding of the a.f. transformer selected by wafer SA1 of the FREQUENCY switch SA couples the feedback voltage from the lamp circuit into the tuned circuit. The setting up controls RV1, RV2, RV3 and RV4 allow the amplitude of the feedback signal to be preset for each output frequency. The control appropriate to the selected frequency is switched into circuit by wafer SA1 of the FREQUENCY switch SA.

The tuned circuit is connected to the preamplifier circuit in AC Calibrator Type 125 via pins 3, 4 and 7 of socket SKTA, and the feedback voltage is applied to the circuit via pins 7 and 2 of the same socket.

4.3.4 The Tuned Circuit 1258 Plug-in

The bandpass filter uses two feedback integrators and a variable gain amplifier in a main loop with auxiliary damping loops.

The first integrator comprises amplifier A2, R11 and either C6 for the X1 range or C7 for the X10 range. The second integrator comprises amplifier A4, R29 and either C14 for the X1 range or C15 for the X10 range. The gain of the inverting amplifier A1 is set by adjustment of the tuning potentiometer RV2. The circuit is resonant at that frequency for which the voltage gain around the main loop is unity.

The bandpass output from A2 is phase inverted by A3 and applied to A1 via RV5 (X1 range) or RV6 (X10 range) to control the Q in the centre of the tuning range. The feedback loop R15, R16 and R17 limits the maximum Q at the ends of the tuning ranges. Independent adjustments of the Q at high and low frequency ends of both ranges are provided by RV3, RV7 and RV8. C11 provides phase compensation at 3kHz.

The input is coupled to the circuit by R3, R4 and R5 to maintain a constant output from A2 as RV2 is tuned across each range. C1 provides compensation at 2kHz.

MR1, MR2 and R36 form a limiter to prevent self oscillation when the unit is switched on.

4.3.5 The Preamplifier

The tuned circuit is coupled via emitter followers VT1 and VT8 to the base circuits of VT2 and VT7, which form the first stage of a direct-coupled push-pull pre-amplifier. The outputs from the collectors of VT3 and VT6 in the second stage are applied via emitter followers VT4 and VT5 to the grid circuits of V4a and V4b in the power amplifier.

The emitter circuits of VT2, VT4, VT5 and VT7 are returned to the +15V supply via a common balancing circuit RV2 and R27. Adjustment of the potentiometer RV2 varies the bias potentials applied to both sections of the amplifier. C15 and C16 bypass the balancing circuit at signal frequencies.

4.3.6 The Power Amplifier

The outputs from the preamplifier emitter followers are coupled via R34 and R44 respectively to the grids of triodes V4a and V4b, which operate as input cathode followers. Negative feedback from the output cathode followers V6 and V7 is applied to these grids also, via R51 and R52. The cathodes of V4a and V4b are direct-coupled to the bases of transistors VT22 and VT23, which drive the cathodes of earthed grid amplifier triodes V5a and V5b. RV3 and RV4 preset the emitter potentials of VT22 and VT23 to compensate for transistor and valve tolerances and to equalise the gain of both stages. The anodes of V5a and V5b are resistance-capacitor coupled, via C19 and C20 and the respective bias networks, to the grids of beam tetrode output cathode followers V6 and V7. These stages provide a low impedance drive to the output transformer T2 to maintain a constant output voltage for any of the wide variations of external load impedance which may be connected across the output terminals. The screen grid potentials of V6 and V7 are provided from independent floating supplies of +110V d.c., which are referenced to the output potentials of the respective valves. The grid bias voltage for these valves is obtained from a -45V supply and is preset by RV16 and RV15 to equalise the quiescent cathode currents of the two valves.

4.3.7 The Output Transformer T2

The Output Transformer T2 has three multiple-tapped secondary windings, which provide outputs of 0-400V, tapped at intervals of 100V; 0-100V, tapped at intervals of 10V; and 0-10V, tapped at intervals of 1V. An auxiliary transformer T3, connected across the 10V secondary winding of T2, provides further outputs of 0-10V, tapped at intervals of 100mV.

The outputs from the secondary windings are connected to the output terminals TL1 (OUTPUT) TL2 (0-11V DIRECT) and TL3 (0-1V DIRECT) via SB, SC, SD and SE which provide the voltage selection facilities. SD and SE incorporate intermediate make-before-break contacts between each switch position. These contacts are earthed via resistors R101 and R102 to minimise the transient surges across the output terminals during switching.

Unswitched outputs are provided at the low voltage terminals TL2 and TL3. The high voltage output at terminal TL1 is controlled by the OUTPUT switch SJ.

An additional centre-tapped winding on output transformer T2 provides the overall feed-back signal applied to the Lamp Bridge circuit. The monitoring signal is obtained from a second output winding of the auxiliary transformer T3.

4.3.8 The Lamp Bridge Circuit

The basic bridge circuit consists of the windings of transformer T2 in parallel with the series network R55 and the lamp ILP2. The non-linear law of the lamp gives the bridge its voltage sensitive characteristic.

The complete circuit comprises the feedback winding (terminals 23-22-21) of the output transformer T2, the SET LEVEL control RV7, the switch SF2 with the correction resistors R56 and R57 and the calibration correction network RV6, RV54 and switch SG2.

The bridge is operated in a near balance condition giving an effective loop gain of approximately 15. The loop gain is defined as the ratio of the percentage change of output of the lamp bridge to the percentage change of input.

The operating level for the bridge circuit is preset by RV5. Any increase in the level of the input to the bridge resulting from an increase in oscillator output causes a decrease in the output from the lamp bridge and tends to restore the correct level of oscillation. Resistors R60, R61, R54 and RV6, controlled by wafer SG2 of the OUTPUT CALIBRATION switch, ensure identical operating conditions for the lamp on RMS and AVERAGE calibration ranges. Resistors R56 and R57, controlled by wafer SF2 of PERCENTAGE DEVIATION METER switch, limit the range of the SET LEVEL control RV7 to give a total amplitude deviation of ±0.5 or ±5 per cent respectively. Socket SKTB and plug PLB are included in the circuit to simplify the setting up procedure.

4.3.9 The Monitoring Circuit

The Monitoring Circuit comprises the precision rectifier VT11 and VT12, the differential amplifier VT13 to VT21, the centre zero meter M1 and their associated circuits.

4.3.10 The Precision Rectifier

Transistors VT11 and VT12 operate as two symmetrical switching circuits to give full-wave rectification of the monitoring voltage applied from terminals 13 to 17 of the auxiliary transformer T3.

During the positive half cycle of the input waveform, when terminals 13, 18 and 20 are positive-going and terminals 17, 19 and 21 are negative-going, the base of VT11 is driven positive. Base collector current flows and VT11 conducts allowing current to pass via the rectifier load resistor R64 to the centre tap terminal 15 of T3. The base of VT12 is driven negative, due to the current through R59 and MR27, so that no base current flows and VT12 is cut off. During the negative half cycle of the input waveform the opposite condition occurs with VT12 conducting VT11 cut off.

The output from the circuit is a train of rectified half sine waves, which have a d.c. component equal to the average value of the input voltage, superimposed on offset voltages, which are generated in VT11 and VT12. The offset voltages are cancelled by applying a correction voltage in series with the reference cell output to the opposite input of the differential amplifier. The correction voltage is derived from the +15V supply via RV17 (OFFSET VOLTAGE CORRECTION) and developed across R100. R99 limits the effective range of adjustment of RV17. The correction voltage is set up using the NORMAL/CALIBRATE Switch SK. Wafer SK1 disconnects the monitoring signal from the rectifier circuit; wafer SK2 connects the collectors of the switching transistors VT11 and VT12 to chassis and disconnects the reference cell from the differential amplifier. As a result the offset voltages and the correction voltage only are applied to the differential amplifier and RV17 is adjusted under these conditions for a balance (zero) indication on meter M1.

Wafer SG1 of the OUTPUT CALIBRATION switch SG reduces the level of the input monitoring signal applied to the rectifier circuit in the AVERAGE position of the switch by connecting the precision rectifier across terminals 14 and 16 of transformer T3, to compensate for an increased output from the oscillator at this setting. (e.g. 100V RMS corresponds to 141.4V peak, 100V AVERAGE corresponds to 157V peak.) A further contact set on wafer SG1 connects either R66 and RV8 or R67 and RV9 in series with R65 across the +15V supply. Adjustment of RV8 and RV9 at the corresponding positions of the switch varies the voltage across R65. This voltage, which is applied to the differential amplifier as a correction voltage in series with the rectified signal, allows the circuit to be set up independently at each position of the OUTPUT CALIBRATION switch SG to match the monitoring signal as closely as possible to the terminal voltage of the reference cell.

The correction voltage developed across R65 is also influenced by REFERENCE CELL VOLTAGE control RV14 connected between the +15V and -15V supplies. This control further adjusts the voltage across R65 to compensate for differences in reference cell terminal voltage. R98 limits the effective range of adjustment of RV14.

The rectified signal developed across R64 in series with the correction voltage developed across R65 is applied via R68 and PERCENTAGE DEVIATION METER switch SF1 to the base of VT13 in the differential amplifier.

4.3.11 The Differential Amplifier

VT13/VT14 and VT15/VT16 are dual transistors operating as emitter followers and amplifier stages respectively. VT17/VT18 and VT21/VT20 form a two-stage emitter follower output stage for each section of the amplifier. VT19 operates in a constant current mode to give an effective long tail characteristic to the differential amplifier.

The output from the precision rectifier circuit is applied via VT13 to the base of VT15 and a positive voltage from the internal reference cell BY1 (or an external reference cell connected between terminals TL5 and TL6) in series with the offset voltage correction developed across R100 (see para 4.3.10) is applied via relay contact RLA1 and VT14 to the base of VT16.

Coupling between the two sections of the amplifier is provided via the common emitter load comprising VT19 and R85. RV13 operates as a short circuit SET ZERO control for the amplifier; RV10 operates as an open circuit SET ZERO control. The total emitter current of VT15 and VT16 is maintained constant by VT19, whose base is held at a constant potential by the network R81 and TH1 connected across zener diode MR28. TH1 provides thermal compensation by varying the base potential of VT19 inversely with temperature to offset variations on the base emitter current due to ambient temperature changes.

Capacitors C24 and C25, connected between the collectors of VT15 and VT16, reject all A.C. components and prevent overloading in the amplifier.

RV11, with R70 and RV12 are scaling resistors switched by wafer SF2 of the PERCENTAGE DEVIATION METER switch. These resistors act as gain controls to give the correct sensitivities on the 0.5 and 5 per cent ranges respectively.

The circuit is set up under static conditions with the bases of VT13/14 connected via R69, R87 and wafer SF of the PERCENTAGE DEVIATION METER switch. Socket SKTE and Plug PLE are included to facilitate setting up the circuit.

Relay RLA is controlled by the output from the oscillator circuit. MR29 and MR30, which are connected across the primary winding of the output transformer T2, rectify the negative half cycles of the oscillator output to provide a negative a negative voltage that is applied via the filter circuit R62, R63, C27 to the base of VT9. This voltage holds the base of VT9 negative and allows the transistor to conduct and energise RL4 from the -45V supply. In the event of a failure in the oscillator circuit the drive to VT9 ceases and the transistor cuts off de-energising RLA to disconnect the reference cell from the differential amplifier. The circuit also disconnects the reference cell when the instrument is switched off. MR31 is connected across the relay coil to prevent transient surges developing across the coil during switching.

4.3.12 Power Supplies

The single phase mains input of 100-125V or 200-250V, 50/60Hz is applied to mains transformer T1 via the double pole MAINS switch SA and the Voltage Selector panel X1, which connects the split primary winding of T1 in series or parallel configuration in accordance with the input voltage. The input is fused in the 'Line' feed by FS1. Neon lamp ILP1 connected in series with R1 across the 125V winding (terminals 1 and 5), operates as a MAINS ON indicator.

4.3.13 500V Stabilised Supply

The 500V d.c. stabilised supply provides the anode voltages for the amplifier valves V4 and V5 in the oscillator circuit. The supply obtained from the voltage doubler C1/MR1, C2/MR2 connected across secondary winding (terminals 11 and 12) of transformer T1, is applied to the anode of series regulator valve V1.

The output from V1 is controlled by the shunt valve V2. The cathode and screen voltages of V2 are stabilised at approximately +90V and +200V respectively by the potentiometer chain comprising neon stabiliser V3 and resistors R4 and R5. The grid potential of V2 is obtained from the resistor chain R7, R8, RV1 and R9. This potential is preset by adjustment of RV1 under normal load conditions to set the anode potential of V2 and hence the grid potential of V1 to the level required to maintain the output potential at +500V. Any tendency for the output voltage to change due to variations in load current etc., results in a proportional change in potential at the grid of V2. The resultant change in potential at the anode of V2, which is in antiphase with the output voltage change, is coupled direct to the grid of V1 to vary the impedance presented by the valve to the input supply and so restore the output voltage to the correct level. The screen grid voltage for V1 and the anode supply for V2 are stabilised at 36 volts above the cathode potential of V1 by the zener diodes MR3 and MR4.

4.3.14 +15V Supplies 125B

The +15V and -15V supplies for the transistor circuits of the oscillator preamplifie: are obtained from terminals 21-22-23 of transformer T1 and rectified by the bridge circuit MR17 to MR20. The outputs are smoothed by C12 and C13 and stabilised by zener diodes MR21 and MR22 in combination with current limiter resistors R16 and R17.

The unsmoothed negative output from the bridge rectifier, of approximately -45V, is used to provide the grid bias supplies for the amplifier drive cathode followers V6 and V7. The output is applied to the identical bias network RV16 and R11, R12 (V6) and RV15, R37, R15 (V7). RV16 and RV15 preset the quiescent cathode currents of V6 and V7 respectively. R12 and R15 limit the effective range of these controls.

The 15V supplies for the transistor circuits of the differential amplifier are obtained from the voltage doubler circuit MR23/C14, MR32/C28 connected across terminals 24 and 25 of transformer T1. The outputs are stabilised by zener diodes MR24 and MR25 at +15V and -15V relative to a floating zero reference.

4.3.15 +15V Regulated Supplies 125C

The 125C mainframe has been modified to provide series regulation using VT24 and VT25. See Fig. 1.

4.3.16 The 250V Supply

The 250V d.c. supply for the oscillator circuit cathode follower stages is obtained from terminals 13 and 14 of transformer T1, rectified by the bridge circuit MR5 to MR8 and smoothed by capacitor C5.

4.3.17 The +110V Supplies

The +110V d.c. supplies for the screen grid voltages of the oscillator circuit output cathode followers are obtained from two similar but independent circuits.

The supply for V6 is obtained from full wave rectifier MR10 and MR12 connected across terminals 15 and 17 of transformer T1. The supply is smoothed by C6.

The supply for V7 is obtained in a similar manner from terminals 18 to 20 of transformer T1. This supply is rectified by MR14 and MR16 and smoothed by C9.

4.3.18 6.3V AC Supplies

Three independent 6.3V AC supplies are provided from terminals 26 to 28, 29 to 31 and 32 to 33 of transformer T1. These supplies provide the heater voltages for the valves in the power amplifier and cathode follwer stages of the oscillator circuit and the 500V Stabiliser circuit.

4.4 RATIO TRANSFORMER TYPE 1255

The output voltage from the 0-11V DIRECT terminal of the AC Calibrator is applied across the primary winding of a toroidal transformer. The output across the secondary winding of the transformer is applied to the X0.1 terminal. The output for the X0.01 terminal is taken from a precision tapping on the secondary winding.

SECTION 5

MAINTENANCE

5.1 GENERAL

Before attempting to trace a fault or effect a repair the technical description given to Section 4 should be read as a guide to the functions and operation of the individual circuits and components.

5.1.1 Fuse Replacement

The mains fuse FS1 is located on the rear panel of the instrument. To replace the fuse -

(a) Unscrew the fuse carrier from the fuseholder and remove with the fuse cartridge attached.

(b) Remove the fuse cartridge from the carrier and replace with one of the same type and rating, i.e. Bulgin Type F128, 2 Amp for 200-250 volt operation; 5 Amp for 100-125V operation.

(c) Replace carrier in fuseholder.

5.1.2 Removal of Plug-in Unit

(a) Unscrew the captive milled securing screw protruding from the front panel of the unit and pull forward to the full extent of its travel.

(b) Withdraw the unit from the front of the AC Calibrator

5.1.3 Access to Chassis Assembly

To gain access to the chassis assembly; the top, bottom and side panels must be removed as follows -

(a) Top and bottom panels.

Unscrew the eight screws securing each panel to the chassis frame and remove the panels.

(b) Side panels.

Unscrew the two screws securing each lifting handle to the chassis frame and remove handles. Unscrew the eight screws securing each side panel and remove the panels.

5.1.4 Transistor Replacement

Before replacing a transistor the associated circuit should be checked to ascertain the cause of failure and eliminate any other fault that may exist. Soldering operations involving transistors should be effected rapidly using a heat shunt.

5.1.4 Bridge Lamp Replacement

A replacement for Lamp ILP2 in the bridge circuit is mounted beside the operative lamp under a common securing clip on Board 3.

5.2 SERVICING

5.2.1 Test Voltages

Test Voltages should be measured using a multi-range test meter having a resistance of not less than 20,000 ohms per volt and set to the most convenient range. The AC signal levels given in paragraph 5.2.1 (e) should be measured on an oscilloscope or on a test meter having a sensitivity of at least 1 Megohm per volt.

The voltages shown in the following tables are measured with respect to chassis unless otherwise stated and are typical of those to be expected at the circuit positions indicated. All voltage measurements should be made with the Plug-in Unit fitted and with the front panel controls of the AC Calibrator set as follows -

MAINS SWITCH	ON
OUTPUT CALIBRATION SWITCH	RMS
PERCENTAGE DEVIATION METER SWITCH	SET ZERO
OUTPUT VOLTAGE SWITCHES	
HUNDREDS	0
TENS	0
UNITS	0
TENTHS	0
MAINS EARTH SWITCH	DIRECT
OUTPUT SWITCH	OFF

(a) Internal Test Points

The majority of internal voltages are measured between test points provided on two terminal strips located on top of the chassis. The terminal strip carrying test points TP1 to TP9 is mounted on top of transformer T1 at the left hand rear of the chassis. The strip carrying test points TP10 to TP15 is mounted on the right hand chassis support. These test points are shown on the circuit diagram Fig. 13 as balloons referenced with the test point (TP) number. Test points TP9, TP13 and TP14 are connected to chassis earth.

Test Points	DC Voltage
TP1 to TP9	500
TP2 to TP9	270
TP3 to TP9	2V a.c. -6.1V d.c.
TP4 to TP9	2V a.c. -6.1V d.c.
TP5 to TP9	250
TP6 to TP9	250
TP7 to TP2	1.0 Disconnect PLC
TP8 to TP2	1.0 before measuring
TP9	EARTH
TP10	NOT USED

TP11 to TP14	35mV a.c.
TP12 to TP14	1.0
TP13	EARTH
TP14	EARTH
TP15 to TP14	0.03

(b) Power Supplies

Test Point	DC Voltage
TP1 to TP9	500
TP2 to TP9	270
Across C7	110
Across C10	110
Across MR21	+16
Across MR22	-16
Across MR24	+15
Across MR25	-15
T1 26-28	6.3V a.c.
T1 29-31	6.3V a.c.
T1 32-33	6.3V a.c.

(c) Transistor Electrode Potentials

Circuit Reference	Collector	Base	Emitter
VT1	-3	0	+0.08
VT2	-0.5	+0.1	+0.16
VT3	-6.3	-0.5	0
VT4	-15	-6.3	-6.1
VT5	-15	-6.3	-6.1
VT6	-6.3	-0.5	0
VT7	-0.5	+0.1	+0.16
VT8	-3	0	+0.08
VT9	-0.08	-0.64	0
VT10	-	-	-
VT11	-	-	-
VT12	-	-	-
VT13 *	-6.8	-	-8.15
VT14 *	-6.8	-	-8.15
VT15 *	-5.1	-8.15	-9.15
VT16 *	-5.1	-8.15	-9.15
VT17 *	0	-4.4	-5.4
VT18 *	-9.2	-5.4	-5.2
VT19 *	-10	-11.8	-12.0
VT20 *	-9.2	-6.4	-5.2
VT21 *	0	-4.4	-5.4
VT22	+5.7	-1.5	-2.15
VT23	+5.7	-1.6	-2.2

Electrode Voltages marked * should be measured with respect to circuit diagram reference point G.

(d) Valve Electrode Potentials

Circuit Reference	Anode	Cathode	Screen Grid
V1	700	500	535
V2	500	84	84
V3	84	-	-
V4a	160	-1.5	-
V4b	160	-1.5	-
V5a	250	5.7	-
V5b	250	5.7	-
V6	250	-	110
V7	270	-	110

(e) AC Signal Levels

Circuit Reference	Signal Voltage (AC) RMS
T2 pins 5 and 7	80
VT4 emitter	2
VT5 emitter	2
TP11	35mV
T1 (Red and Black)	

5.3 SETTING UP

5.3.1 Test Equipment

The following test equipment is required for setting up the AC Calibrator Type 125B with Plug-in Unit Type 1254B and the 125C with Plug-in Unit 1258. If the equipment listed is not available the instrument may be returned for repair or recalibration to G. & E. Bradley Ltd., Technical Services Department, Electral House, Neasden Lane, London NW10 1RR.

(a) Multi-range Test Meter having an input resistance of not less than 1MΩ per volt and capable of measuring to an accuracy of ±3% of f.s.d.. AC voltages between 35mV and 550V. DC voltages between 10mV and 550V with a discrimination of 0.1mV on the lowest range, e.g. Multimeter CT471, (G. & E. Bradley Ltd.).

(b) A precision d.c. voltage source capable of providing d.c. voltages of 510mV, 1.8V, 1.9V, 2.0V and 5.1V to an accuracy of ±0.5% of indicated output.

(c) A frequency counter capable of measuring frequencies from 30-300Hz with an accuracy of ±1Hz and having a gate time of 10 seconds, e.g. Counter Timer 234 (G. & E. Bradley Ltd.).

(d) Four precision resistors as follows -

1 Megohm ±2% 0.25W
10 Kilohm ±0.1% 0.25W
100 Ohms ±0.1% 0.25W
1 Kilohm ±10% 0.25W

Connected as shown in Fig. 15.

5.3.2 Test Conditions

Before starting the test procedures fit the plug-in unit and switch on the calibrator for one hour to allow the instrument to attain thermal stability.

Test procedures should always be done in sequence and in their entirety.

5.3.3 Adjustment of Control Knob Position

To adjust the position of the control knobs with relation to their corresponding control shafts proceed as follows -

(a) Remove centre insert from control knob.

(b) Slacken screw exposed.

(c) Turn knob to desired position taking care not to rotate the shaft.

(d) Tighten screw to lock knob on shaft.

(e) Replace centre insert.

5.3.4 500V Stabilised H.T. Supply

(a) Set the front panel controls of the AC Calibrator to the following positions.

OUTPUT CALIBRATION SWITCH SG	RMS
PERCENTAGE DEVIATION METER SWITCH SF	SET ZERO
OUTPUT VOLTAGE SWITCHES	0
HUNDREDS SB	0
TENS SC	0
UNITS SD	0
TENTHS SE	0
MAINS EARTH SWITCH	DIRECT
OUTPUT SWITCH	OFF

(b) Set multi-range test meter to 1200V DC range and connect between test points TP1 (+) and TP9 (-).

(c) Set RV3 and RV4 to approximately mid-position.

Adjust RV1 for an indication of +500V on the test meter.

(d) Disconnect the test meter.

5.3.5 Preamplifier

(a) REMOVE plug PLC from socket SKTC and set NORMAL/CAL switch SK to NORMAL.

(b) Set Multi-range test meter to 4V DC range and connect between test points TP3 (+) and TP4 (-).

(c) Adjust RV2 (PREAMPLIFIER SET ZERO) for zero indication on test meter.

(d) Set test meter to 400mV DC range and re-adjust RV2 for zero indication on test meter.

(e) Disconnect test meter. Do NOT replace plug PLC.

5.3.6 Amplifier

(a) Set multi-range test meter to 400V DC range and connect between TP5 (+) and TP9 (-).

(b) Adjust RV3 for an indication of 250V on test meter.

(c) Transfer positive lead of test meter to TP6 (+).

(d) Adjust RV4 for an indication of 250V on test meter.

(e) Replace positive lead of test meter on TP5 (+).

(f) Repeat operations (b) and (e) inclusive until the voltages at both test points TP5 and TP6 are 250V simultaneously.

(g) Disconnect test meter, set to 1.2V DC range and connect between test points TP2 (+) and TP7 (-).

(h) Adjust RV16 for an indication of 1V on test meter.

(j) Transfer negative lead of test meter to TP8 (-).

(k) Adjust RV15 for an indication of 1V on test meter.

(l) Disconnect test meter.

5.3.7 Differential Amplifier

(a) Remove plug PLE from socket SKTE. Check that PERCENTAGE DEVIATION METER switch is set to SET ZERO.

(b) Adjust RV10 for zero indication on the PERCENTAGE DEVIATION METER.

(c) Replace plug PLE in socket SKTE.

(d) Adjust PERCENTAGE DEVIATION METER SET ZERO control RV13 for zero indication on the PERCENTAGE DEVIATION METER.

(e) Repeat operations (a) to (d) inclusive until a zero indication is obtained on the PERCENTAGE DEVIATION METER with plug PLE both connected and disconnected from socket SKTE. Ensure that plug PLE is replaced in socket SKTE on completion of this operation.

(f) Set PERCENTAGE DEVIATION METER switch to 5 PER CENT RANGE.

(g) Link test point TP16 to TP13.

(h) Connect the output from the DC Calibrator via the divider network Fig. 15 across test points TP12 (+) and TP14 (-).

(j) Set output of DC Calibrator to 5.1V.

(k) Adjust RV12 for full scale deflection of PERCENTAGE DEVIATION METER.

(l) Set output of DC Calibrator to 510mV.

(m) Set PERCENTAGE DEVIATION METER switch to 0.5 PER CENT RANGE.

(n) Adjust RV11 for full scale deflection of PERCENTAGE DEVIATION METER.

(o) Disconnect the DC Calibrator and divider and remove the link between test points TP16 and TP13.

(p) Set PERCENTAGE DEVIATION METER switch to SET ZERO.

5.3.8 Reference Cell Correction

(a) Remove plug PLD from socket SKTD.

(b) Set multi-range test meter to 12mV range and connect between test points TP15 (+) and TP13 (-).

(c) Slacken locking screw and adjust REFERENCE CELL VOLTAGE control for zero indication on test meter.

(d) Verify that control knob indicates 1.019V exactly on calibration scale. Reposition knob if necessary, to obtain this condition.

(e) Disconnect test meter and replace plug PLD in socket SKTD.

(f) Connect the positive output from the DC Calibrator via the divider network of Fig. 15 to the positive terminal of the multi-range test meter. Connect the negative terminal of the test meter to TP15 and the negative output of the DC Calibrator to TP14.

(g) Set test meter to 12mV DC range and output of DC Calibrator to 2.9V.

(h) Adjust RV9 for zero indication on test meter.

(j) Set OUTPUT CALIBRATION switch to AVERAGE and set output of DC Calibrator to 1.9V.

(k) Adjust RV8 for zero indication on the test meter.

(l) Set REFERENCE CELL VOLTAGE control to 1.018V and the output from DC Calibrator to 1.8V. Verify that the inidcation on the test meter is not greater than ±0.1mV.

(m) Set REFERENCE CELL VOLTAGE control to 1.020V and the output from the DC Calibrator to 2V. Verify that the indication on the test meter is not greater than ±0.1mV.

(n) Disconnect the test equipment. Replace plug PLC in socket SKTC.

(o) Set REFERENCE CELL VOLTAGE control to 1.0193V and tighten the locking screw.

5.3.9 Precision Rectifier Circuit

(a) Set OUTPUT CALIBRATION switch to RMS.

(b) Set NORMAL/CAL switch SK to CAL. Verify that PERCENTAGE DEVIATION METER switch is set to SET ZERO.

(c) Verify that PERCENTAGE DEVIATION METER indicates zero. Adjust PERCENTAGE DEVIATION METER SET ZERO control if necessary to obtain this condition.

(d) Set PERCENTAGE DEVIATION METER switch to 0.5 PER CENT RANGE.

(e) Adjust RV17 (OFFSET VOLTAGE CORRECTION) for zero indication on PERCENTAGE DEVIATION METER.

(f) Set NORMAL/CAL switch to NORMAL.

5.3.10 Lamp Bridge and Loop Gain with 125B and 1254 Plug-in

(a) Set PERCENTAGE DEVIATION METER switch to 5 PER CENT RANGE.

(b) Set FREQUENCY switch on the Plug-in Unit to 50Hz.

(c) Remove plug PLB from socket SLTB.

(d) Set test meter to 40mV AC range and connect between test points TP11 (+) and TP13 (-).

(e) Adjust RV1 in Plug-in Unit for zero indication on PERCENTAGE DEVIATION METER and RV5 in AC Calibrator for an indication of 35mV on the test meter. Repeat both adjustments alternately until the required indications on both meters are obtained simultaneously.

(f) Set PERCENTAGE DEVIATION METER switch to SET ZERO. Verify that PERCENTAGE DEVIATION METER indicates zero.

(g) Set PERCENTAGE DEVIATION METER switch to 0.5 PER CENT RANGE and repeat operation (e).

(h) Set FREQUENCY switch on the Plug-in Unit to 60Hz, 400Hz and 1kHz and adjust RV2 (60Hz), RV3 (400Hz) and RV4 (1kHz) at the corresponding position of the FREQUENCY switch for zero indication on the PERCENTAGE DEVIATION METER.

(j) Set OUTPUT CALIBRATION switch to AVERAGE.

(k) Adjust RV6 on AC Calibrator for zero indication on PERCENTAGE DEVIATION METER.

(l) Set OUTPUT CALIBRATION switch to RMS.

(m) Replace plug PLB in socket SKTB.

(n) Adjust SET LEVEL control for zero indication on PERCENTAGE DEVIATION METER. Verify that control knob indicates against the calibration spot on the instrument front panel. Re-position the knob on ths spindle if necessary to obtain this condition.

5.3.11 Lamp Bridge Loop Gain with 125C and 1258 Variable Frequency Plug-in

(a) Set the PERCENTAGE DEVIATION METER of the AC Calibrator to 5 PER CENT RANGE.

(b) Set the Frequency dial of the 1258 Plug-in Unit to 100 and the Multiplier switch to X1.

(c) Remove the plug PLB from socket SKTB.

(d) Set the test meter to 40mV AC range, and connect between test points TP11 (positive) and TP13 (negative).

(e) Adjust RV5 of the 1258 for zero indication on the PERCENTAGE DEVIATION METER and RV5 of the AC Calibrator until the test meter reads 35mV. Repeat the adjustments alternately until the required indications on both meters are obtained simultaneously.

(f) Set PERCENTAGE DEVIATION METER switch to SET ZERO. Verify that PERCENTAGE DEVIATION METER indicates zero.

(g) Set PERCENTAGE DEVIATION METER switch to 0.5 PER CENT RANGE and repeat operation (e).

(h) Set the Frequency dial of the 1258 Plug-in in turn to 40, 100 and 300Hz and adjust RV3 (40Hz), RV5 (100Hz) and RV7 (300Hz) for zero indication on the PERCENTAGE DEVIATION METER. Repeat the adjustments until no further improvement is obtained as the dial is rotated slowly from 40Hz to 300Hz.

Set the Frequency switch to X10 and adjust RV4 (400Hz), RV6 (1kHz) and RV8 (3kHz) in turn for zero indication on the PERCENTAGE DEVIATION METER. Repeat the adjustments until no further improvement is obtained as the dial is rotated slowly from 400Hz to 3kHz.

5.3.12 Output Check

(a) Set AC Calibrator and Plug-in Unit controls as follows -

AC Calibrator

OUTPUT CALIBRATION SWITCH	RMS
PERCENTAGE DEVIATION METER SWITCH	SET ZERO
OUTPUT VOLTAGE SWITCHES	0 0 0 0
MAINS EARTH SWITCH	DIRECT
OUTPUT SWITCH	OFF

Plug-in Unit

FREQUENCY SWITCH - 1254 Plug-in	50Hz or Frequency
1258 Plug-in	Dial 50 on X1 Range

(b) Adjsut SET LEVEL control for zero indication on PERCENTAGE DEVIATION METER.

(c) Set multi-range test meter to 1.2V AC range and connect between the OUTPUT and COMMON terminals.

(d) Set OUTPUT switch ON.

(e) Set the TENTHS Voltage Selector switch to each position in turn. Verify that the test meter indication corrsponds to the switch calibration at each position. Leave the TENTHS Voltage Selector switch set to 10.

(f) Set test meter to 12V AC range.

(g) Set UNITS Voltage Selector switch to 1 and check that test meter indicates 2V.

(h) Set TENTHS Voltage Selector switch to 0.

(j) Set UNITS Voltage Selector switch to each position in turn and verify that the test meter indication corresponds to the switch calibration at each position. Leave UNITS Voltage Selector switch set to 10.

(k) Set test meter to 120V AC range.

(l) Set TENTHS Voltage Selector switch to 1 and verify that test meter indicates 20V.

(m) Set UNITS Voltage Selector switch to 0.

(n) Set TENS Voltage Selector switch to each position in turn and verify that the test meter indication corresponds to the switch calibration at each position. Leave the TENS Voltage Selector switch set to 10.

(o) Set test meter to 1200V AC range.

(p) Set HUNDREDS Voltage Selector switch to 1 and check that test meter indicates 200V.

(q) Set TENS Voltage Selector switch to 0.

(r) Set HUNDREDS Voltage Selector switch to each position in turn and check that the test meter indication corresponds to the calibration at each position.

(s) Set HUNDREDS Voltage Selector switch to 0 and OUTPUT switch to OFF. Disconnect test meter.

SECTION 6

PARTS LIST

125C. Circuit Components

The main parts list is for the 125B.

Some components have been changed and some added in the 125C Circuits. These changes are as follows.

CIRCUIT REF.	VALUE	TOL %	RATING	STYLE	REF
R16	6.8k	±10	1.0	Morganite Type W	GR60596
R17	6.8k	±10	1.0		
VT13) VT14)	now dual transistor			2N 2916	
VT15) VT16)	now dual transistor			2N 2916	
VT18	NTG 890				
VT20	NTG 890				
VT24	Added in Power Supply			2N 4922	
VT25	Added in Power Supply			2N 4919	

SECTION 6

PARTS LIST

When ordering spare parts please quote the Instrument Type and Serial Number and the circuit reference and value of the components required.

AC CALIBRATOR TYPE 125B

RESISTORS, FIXED

CIRCUIT REF.	VALUE	TOL %	RATING W	MANUFACTURER OR STYLE	REFERENCE NO.
R1	82k	±10	0.25	RC7-K	Z223029
R2	33k	±5	6	RWV-4L	Z113433
R3	150k	±2	0.25	RC2-E	Z216490
R4	270k	±2	0.5	Welwyn C22	GR20169
R5	100k	±2	0.25	RC2-E	Z216450
R6	4.7	±10	0.25	Erie Type 16	GR05342
R7	820k	±2	0.5	Welwyn C22	GR20168
R8	820k	±2	0.5	Welwyn C22	GR20168
R9	240k	±2	0.25	RC2-E	Z216877
R10	100	±2	0.25	RC2-E	Z215400
R11	100k	±2	0.25	RC2-E	Z216450
R12	330	±2	0.25	RC2-E	Z216928
R13	4.3k	±2	0.25	RC2-E	Z215790
R14	4.3k	±2	0.25	RC2-E	Z215790
R15	330k	±2	0.25	RC2-E	Z216928
*R16	3k	±2	0.5	RC2-D	Z215751
*R17	1.2k	±5	3	RWV-4J	Z113322
R18	6.2k	±2	0.5	RC2-D	Z215831
R19	4.7k	±2	0.25	RC2-E	Z215800
R20	11k	±2	0.25	RC2-E	Z216221
R21	18k	±2	0.25	RC2-E	Z216271
R22	220k	±2	0.25	RC2-E	Z216529
R23	47k	±2	0.25	RC2-E	Z216370
R24	27k	±2	0.25	RC2-E	Z216311
R25	10k	±0.5	0.25	Plessey Metalux 'AT'	GR09442
R26	500	±0.5	0.5	Plessey Metalux 'AT'	GR09441
R27	9.1k	±2	0.25	RC2-E	Z215870
R28	500	±0.5	0.25	Plessey Metalux 'AT'	GR09441
R29	10k	±0.5	0.25	Plessey Metalux 'AT'	GR09442
R30	27k	±2	0.25	RC2-E	Z216311

* See page 33.

RESISTORS, FIXED Cont'd

CIRCUIT REF.	VALUE	TOL %	RATING W	MANUFACTURER OR STYLE	REFERENCE NO.
R31	47k	±2	0.25	RC2-E	Z216370
R32	18k	±2	0.25	RC2-E	Z216271
R33	220k	±2	0.25	RC2-E	Z216370
R34	25k	±0.5	0.25	Plessey Metalux 'AT'	GR09443
R35	27k	±2	0.5	RC2-D	Z216312
R36	6.2k	±2	0.25	RC2-E	Z215830
R37	100k	±2	0.25	RC2-E	Z216450
R38	NOT USED				
R39	100k	±2	1	RC4-P	Z122294
R40	100	±10	0.25	RC7-K	Z221109
R41	27	±10	0.25	RC7-K	Z221037
R42 *	100	±2	0.25	RC2-E	Z215400
R42	100	±1	0.25	RFG5-D	Z128467
R43	NOT USED				
R44	25k	±0.5	0.25	Plessey Metalux 'AT'	GR09443
R45	NOT USED				
R46	6.2k	±2	0.25	RC2-E	Z215830
R47	100k	±2	1	RC4-P	Z122294
R48	100	±10	0.25	RC7-K	Z221109
R49	27	±10	0.25	RC7-K	Z221037
R50 *	100	±2	0.25	RC2-E	Z215400
R50	100	±1	0.25	RFG5-D	Z128467
R51	1M	±0.5	0.25	Plessey Metalux 'AT'	GR09446
R52	1M	±0.5	0.25	Plessey Metalux 'AT'	GR09446
R53	270	±2	0.25	Plessey Metalux 'AT'	GR09450
R54	2.2k	±2	0.25	Plessey Metalux 'AT'	GR09479
R55	25	±2	0.25	Plessey Metalux 'AT'	GR09480
R56	2k	±2	0.25	RC2-E	Z215710
R57	620	±2	0.25	RC2-E	Z215590
R58	6.8k	±10	0.25	RC7-K	Z222109
R59	6.8k	±10	0.25	RC7-K	Z222109
R60	1.73	±1	1.5	Painton 406A	GR07620
R61	1.73	±1	1.5	Painton 406A	GR07620
R62	68k	±10	0.25	RC7-K	Z222016
R63	68k	±10	0.25	RC7-K	Z222016
R64	10k	±10	0.25	RC7-K	Z222130
R65	33	±2	0.25	Welwyn C21	GR09193
R66	22k	±2	0.25	RC2-E	Z216291
R67	15k	±2	0.25	RC2-E	Z216251

* Early models only.

RESISTORS, FIXED Cont'd

CIRCUIT REF.	VALUE	TOL %	RATING W	MANUFACTURER OR STYLE	REFERENCE NO.
R68	1k	±10	0.25	RC7-K	Z222004
R69	1k	±10	0.25	RC7-K	Z222004
R70	220	±2	0.25	RC2-E	Z215480
R71	1k	±2	0.25	RC2-E	Z215640
R72	1M	±2	0.5	RC2-D	Z216658
R73	5.6k	±2	0.25	RC2-E	Z215820
R74	56k	±2	0.25	RC2-E	Z216390
R75	1k	±2	0.25	RC2-E	Z215640
R76	2.2M	±2	0.25	RC2-D	Z216915
R77	82k	±0.5	0.25	Welwyn M4	GR05132
R78	68k	±10	0.25	RC7-K	Z223016
R79	6.2k	±5	0.25	RC7-K	Z222103
R80	3.3k	±0.5	0.25	Plessey Metalux 'AT'	GR09438
R81	3.9k	±2	0.25	RC2-E	Z215780
R82	2.7k	±2	0.25	RC2-E	Z215740
R83	39k	±2	0.25	RC2-E	Z216350
R84	15k	±2	0.25	RC2-E	Z216251
R85	4.7k	±2	0.25	RC2-E	Z215800
R86	18k	±2	0.25	RC2-E	Z216271
R87	1k	±10	0.25	RC7-K	Z222004
R88	9.1k	±2	0.25	RC2-E	Z215870
R89	3.3k	±0.5	0.25	Plessey Metalux 'AT'	GR09438
R90	6.2k	±5	0.25	RC7-K	Z222103
R91	68k	±10	0.25	RC7-K	Z223016
R92	82k	±0.5	0.25	Welwyn M4	GR05132
R93	2.2M	±2	0.5	RC2-D	Z216915
R94	56k	±2	0.25	RC2-E	Z216390
R95	1M	±2	0.5	RC2-D	Z216658
R96	1k	±2	0.25	RC2-E	Z215640
R97	47	±10	0.5	RC7-H	Z221069
R98	430k	±2	0.5	RC2-D	Z216586
R99	100k	±2	0.25	RC2-E	Z216450
R100	33	±5	0.25	RC2-E	Z215061
R101	33	±5	9	RWV4-K	Z113451
R102	330	±5	9	RWV4-K	Z113475

RESISTORS, VARIABLE

CIRCUIT REF.	VALUE	TOL %	RATING W	MANUFACTURER OR STYLE	REFERENCE NO.
RV1	250k	±20	±0.25	RVC-15A	Z119469
RV2	50	±10	0.5	RVW-13	Z119485
RV3	1k	±10	0.5	RVW-13	Z119489
RV4	1k	±10	0.5	RVW-13	Z119489
RV5	100	±5	2	Reliance HEL 07-10	GR09238
RV6	500	±10	0.5	RVW-13	Z119488
RV7	500	±10	3	A.B. Metals Claostat 58	GR30075
RV8	10k	±10	0.5	Colvern CLR 1106/9S	GR30211
RV9	5k	±10	0.5	RVW-13	Z119491
RV10	10k	±20	0.25	RVC-15A	Z119465
RV11	250	±10	0.5	RVW-13	Z119487
RV12	2.5k	±10	0.5	RVW-13	Z119490
RV13	100	±5	2	Reliance HEL 07-10	GR09238
RV14	25k	±10	2	Clarostat 43	GR30077
RV15	100k	±20	0.25	RVC-15A	Z119468
RV16	100k	±20	0.25	RVC-15A	Z119468
RV17	250k	±20	0.25	RVC-15A	Z119469

CAPACITORS, FIXED

CIRCUIT REF.	VALUE	TOL %	RATING V	MANUFACTURER OR STYLE	REFERENCE NO.
C1	16μF	+50 -20	450	Hunts JFQ554AT	GC10142
C2	16μF	+50 -20	450	Hunts JFQ554AT	GC10142
C3	0.1μF	±10	400	Mullard C296AC/A100K	GC34158
C4	0.47μF	±20	600	Hunts AF230	GC04121
C5	64μF	+50 -20	350	Hunts JFQ410T	GC10141
C6	50μF	+50 -20	150	Hunts MEF 115T	GC10096
C7	4μF	+50 -20	350	Hunts MEW 111T	GC10146
C8	NOT USED				
C9	50μF	+50 -20	150	Hunts MEF 115T	GC10096
C10	NOT USED				
C11	NOT USED				

CAPACITORS, FIXED Cont'd

CIRCUIT REF.	VALUE	TOL %	RATING V	MANUFACTURER OR STYLE	REFERENCE NO.
C12	25μF	+100 -20	50	Hunts MEW 39T	GC10143
C13	25μF	+100 -20	50	Hunts MEF 41T	GC10143
C14	50μF	+100 -20	50	Hunts MEF 41T	GC10144
C15	200μF	+100 -20	12	Plessey CE2018	GC10183
C16	200μF	+100 -20	12	Plessey CE2018	GC10183
C17	50μF	+100 -20	12	Plessey CE286	GC10182
C18	NOT USED				
C19	0.47μF	±10	400	Mullard C296AC/A470K	GC4157
C20	0.47μF	±10	400	Mullard C296AC/A470K	GC04157
C21	NOT USED				
C22	NOT USED				
C23	NOT USED				
C24	2.2μF	±20	250	T.M.C. S128231	GC12137
C25	2.2μF	±20	250	T.M.C. S128231	GC12137
C26	1μF	±10	250	T.M.C. S128229	GC12136
C27	0.22μF	±10	125	Wima Tropyfol M	GC24102
C28	50μF	+100 -20		Hunts MEF41T	GC10144

DIODES

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
MR1 MR2	Lucas DD058	-
MR3 MR4	Lucas ZC018	-
MR5 MR6 MR7 MR8	Lucas DD006	-
MR9	NOT USED	
MR10	Lucas DD006	-

DIODES Cont'd

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
MR11	NOT USED	
MR12	Lucas DD006	-
MR13	NOT USED	
MR14	Lucas DD006	-
MR15	NOT USED	
MR16	Lucas DD006	-
MR17	Lucas DD003	
MR18		
MR19		
MR20		
MR21	Lucas ZC015	-
MR22		
MR23	Lucas DD003	-
MR24	Lucas ZC015	-
MR25		
MR26	Mullard OA81	GV00505
MR27		
MR28	Mullard)AZ243	GV25223
MR29	Lucas DD006	-
MR30		
MR31	Mullard OA81	GV00505
MR32	Lucas DD003	-

TRANSISTORS

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
VT1	CV7003	-
VT2		
VT3	Mullard OC202	GV28063
VT4	Mullard BCY70	GV00490
VT5		
VT6	Mullard OC202	GV28063
VT7	CV 7003	-
VT8		
VT9	Mullard OC203	CV7152
VT10	NOT USED	
VT11	Mullard OC139	GV28038
VT12		

TRANSISTORS Cont'd

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
*VT13 *VT14	Texas 2S 502 (Matched pair)	B 4885
*VT15 *VT16	Texas 2S 502 (Matched pair)	B 4885
VT17	Texas 2S 502	GV01322
*VT18	Mullard GET888	GV28102
VT19	Mullard OC139	GV28038
*VT20	Mullard GET888	GV01332
VT21 VT22 VT23	Texas 2S 502 Texas 2S 502 Texas 2S 502	GV01332
VT24 - VT25	See page 31	

VALVES

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
V1	Mullard EL86	GV25094
V2	Mullard EF86	CV2901
V3	Mullard 90C1	GV26608
V4 V5	Mullard E180CC	GV25802
V6 V7	CV 4060	

TRANSFORMERS

CIRCUIT REFERENCE	MANUFACTURER AND TYPE	REFERENCE NO.
T1	-	C4719
T2	-	C4873
T3	-	C4874

SWITCHES

CIRCUIT REF.	DESCRIPTION	MANUFACTURER	REFERENCE NO.
SA	Toggle switch	81055/BT/13/CHR. Arrow	GS01096
SB	Rotary switch		SKA1994/61/A

* See page 33.

SWITCHES Cont'd

CIRCUIT REF.	DESCRIPTION	MANUFACTURER	REFERENCE NO.
SC SD	Rotary switch		SKA1994/61/B
SE	Rotary switch		SKA1994/61/C
SF	Rotary switch		SKB1994/59
SG	Rotary switch		SKB1994/57
SH	Toggle switch	81055/BT/13/CHR. Arrow	GS01096
SJ	Toggle switch	Arrow 102PX	GS00032
SK	Minature rotary switch		A 4917

PLUGS, SOCKETS AND TERMINALS

CIRCUIT REF.	DESCRIPTION	MANUFACTURER	REFERENCE NO.
SKTB	Socket, fixed	Belling-Lee L1529/AU/Green	GP60769
SKTC	Socket, fixed	Belling-Lee L1529/AU/Blue	Z491263
SKTD	Socket, fixed	Belling-Lee L1529/AU/Yellow	GP60770
SKTE	Socket, fixed	Belling-Lee L1529/AU/Natural	GP60771
PLA	Plug, fixed	McMurdo RP8	GP12121
PLB	Plug, free	Belling-Lee L1528/AU/Green	GP60772
PLC	Plug, free	Belling-Lee L1528/AU/Blue	GP60773
PLD	Plug, free	Belling-Lee L1528/AU/Yellow	GP60774
PLE	Plug, free	Belling-Lee L1528/AU/Natural	GP60775
TL1, TL2 TL3	Terminal	Belling-Lee L1499/ISL/Red	GB10151
TL4	Terminal	Belling-Lee L1499/ISL/Black	GB10153
TL5	Terminal	Painton shrouded non spring-loaded Red 313185	GB10197
TL6	Terminal	Painton shrouded non spring-loaded Black 312038	GB10202
TP1 to TP15	Socket (Press fit)	Sealectro SKT-2BC	GP01616

MISCELLANEOUS

CIRCUIT REF.	DESCRIPTION	MANUFACTURER OR I. S. SYTLE	REFERENCE NO.
TH1	Thermostor	Mullard VA1055	GR70200
RLA	Relay	Besson and Robinson Tris 154C	GS01142
BY1	Reference cell	Muirhead D845-A	GA00100
ILP1	Lamp	HIVAC 29L	GV33094
ILP2	Lamp	HIVAC X B3	GV33085
M1	Meter		SKB/1994/60
X1	Voltage selector panel	McMurdo B279002/A	G001135
FS1	Fuse link 2A, 5A	Bulgin F128	GV17070

PLUG-IN UNIT TYPE 1254B

RESISTORS

CIRCUIT REF.	VALUE	TOL %	RATING W	MANUFACTURER OR I.S. STYLE	REFERENCE NO.
R1	220k	±10	0.25	RC7-K	5905-99-022 3079
R2	150k	±10	0.25	RC7-K	5905-99-022 3070
RV1	250	±5	0.5	Reliance WL35 (Std)	GR30057
RV2 RV3	500	±5	0.5	Reliance WL35 (Std)	GR30058
RV4	1k	±5	0.5	Reliance WL35 (Std)	GR30059

CAPACITORS

CIRCUIT REF.	VALUE	TOL %	RATING V	MANUFACTURER OR I.S. STYLE	REFERENCE NO.
C1	0.033μF	±10	250	Mullard C281AB/A33K	GC00021
C2	0.33μF	±10	250	Mullard C281AB/A330K	GC00025
C3	0.68μF	±10	250	Mullard C281AB/A680K	GC00023
C4 C5	1μF	±10	250	Mullard C281AB/AIM	GC00024
C6	0.022μF	±10	250	Mullard C281AB/A22K	GC00022
C7 to C11	A.O.T.			-	A 4997

MISCELLANEOUS

CIRCUIT REF.	DESCRIPTION	MANUFACTURER OR I.S. STYLE	REFERENCE NO.
T1	Transformer, tuned	-	B10477
T2	Transformer, tuned	-	B10478
SA	Rotary switch	-	B4996
SKTA	Socket, fixed	McMurdo RS8	GP12021

PLUG-IN UNIT TYPE 1258

RESISTORS, FIXED

CIRCUIT REF.	VALUE Ω	TOL %	RATING W	MANUFACTURER	REFERENCE NO.
R1	150	±2	0.25	Dubilier RG-07	GR01136
R2	300	±2	0.25	Dubilier RG-07	GR00391
R3	15k	±2	0.25	Dubilier RG-07	GR07961
R4	33k	±2	0.25	Dubilier RG-07	GR00659
R5	6.8k	±2	0.25	Dubilier RG-07	GR07957
R6	68k	±2	0.25	Dubilier RG-07	GR006600
R7	2.2k	±1	50ppm	Morganite FG55	GR00663
R8	1k	±1	50ppm	Morganite FG55	GR00664
R9	1.5k	±2	0.25	Dubilier RG-07	GR07948
R10	56	±2	0.25	Dubilier RG-07	GR00513
R11	16k	0.5	50ppm	Morganite FC55	GR00665
R12	15k	±2	0.25	Dubilier RG-07	GR07961
R13	1.5k	±2	0.25	Dubilier RG-07	GR07948
R14	390	±2	0.25	Dubilier RG-07	GR00391
R15	15k	±2	0.25	Dubilier RG-07	GR07961
R16	33k	±2	0.25	Dubilier RG-07	GR00659
R17	56	±2	0.25	Dubilier RG-07	GR00513
R18	10k	±2	0.25	Dubilier RG-07	GR07959
R19	33k	±2	0.25	Dubilier RG-07	GR00659
R20	33k	±2	0.25	Dubilier RG-07	GR00659
R21	15k	±2	0.25	Dubilier RG-07	GR07961
R22	1.5k	±2	0.25	Dubilier RG-07	GR07948
R23	1.8k	±2	0.25	Dubilier RG-07	GR07949
R24	56	±2	0.25	Dubilier RG-07	GR00513
R25	10k	±2	0.25	Dubilier RG-07	GR07959
R26	47k	±2	0.25	Dubilier RG-07	GR07964
R27	3.9k	±2	0.25	Dubilier RG-07	GR07953
R28	680	±2	0.25	Dubilier RG-07	GR00392
R29	16k	0.5	50ppm	Morganite FC55	GR00665
R30	15k	±2	0.25	Dubilier RG-07	GR07961
R31	1.5k	±2	0.25	Dubilier RG-07	GR07948
R32	56	±2	0.25	Dubilier RG-07	GR00513
R33	120k	±2	0.25	Dubilier RG-07	GR00531
R34	150k	±2	0.25	Dubilier RG-07	GR00661
R35	150k	±2	0.25	Dubilier RG-07	GR00661
R36	100	±2	0.25	Dubilier RG-07	GR00533
R37	1.1k	±2	0.25	Dubilier RG-07	GR00662
R38	1.1k	±2	0.25	Dubilier RG-07	GR00662
R39	27	±5	0.25	Electrosil TR4	GR01140

RESISTORS, FIXED

CIRCUIT REF.	VALUE Ω	TOL %	RATING W	MANUFACTURER	REFERENCE NO.
R40	27	±5	0.25	Electrosil TR5	GR01140
R41	390	±5	0.25	Electrosil TR5	GR07127

RESISTORS, VARIABLE

CIRCUIT REF.	VALUE Ω	TOL %	RATING W	MANUFACTURER	REFERENCE NO.
RV1	1k	±10	1	Plessey WMP-PC	GR00461
RV2	30k	3	Lin 0.25	Beckman 5311	BL33051
RV3	4.7k	±10	1	Plessey WMP-PC	GR00672
RV4	4.7k	±10	1	Plessey WMP-PC	GR00672
RV5	4.7k	±10	1	Plessey WMP-PC	GR00672
RV6	4.7k	±10	1	Plessey WMP-PC	GR00672
RV7	47	±10	1	Plessey WMP-PC	GR00671
RV8	47	±10	1	Plessey WMP-PC	GR00671
RV9	10k	±20	0.2	Part of B142753	

INTEGRATED CIRCUIT AND DIODES

CIRCUIT REF.	MANUFACTURER	REFERENCE NO.
A1/A3	Dual Operational Amp Texas SN727907 DN	GV01440
A2/A4	Dual Operational Amp Texas SN72709DN	GV01440
MR1	Diode IN4448	IN4448
MR2	Diode IN4448	IN4448

CAPACITORS

CIRCUIT REF.	VALUE Ω	TOL %	RATING V	MANUFACTURER	REFERENCE NO.
C1	150pF	2	350	Johnson Mathey C14F	GC20218
C2	470pF	10		Erie H1K/AD	GC20211
C3	39pF	5		Erie N560/AD	GC20213

CAPACITORS

CIRCUIT REF.	VALUE Ω	TOL %	RATING V	MANUFACTURER	REFERENCE NO.
C4	270pF	10		Erie H1K/AD	GC20212
C5	270pF	10		Erie H1K/AD	GC20212
C6	83nF	0.5	200	Johnson Mathey C55F	GC20216
C7	8.2nF	0.5	200	Johnson Mathey C33F	GC20215
C8	1nF	10		Erie H1K/AD	GC20214
C9	1nF	10		Erie H1K/AD	GC20214
C10	39pF	5		Erie N560/AD	GC20213
C11	68pF	2	350	Johnson Mathey C14F	GC20217
C12	470pF	10		Erie H1K/AD	GC20211
C13	39pF	5		Erie N560/AD	GC20213
C14	82nF	0.5	200	Johnson Mathey C55F	GC20216
C15	8.2nF	0.5	200	Johnson Mathey C33F	GC20215
C16	100nF	20	250	Mullard C280AE	GC18082
C17	100nF	20	250	Mullard C280AE	GC18082

MISCELLANEOUS

CIRCUIT REF.	MANUFACTURER	REFERENCE NO.
Switch Assy.		B141227
Dial		A140832
Reduction Ball Drive	Jackson 4511/DAF	GO03133
Knob, 9m/m	Elma Type 71-9, 1/8 Red	GK00176
Knob (wing) 14.5m/m	Elma Type 73-14. 1/4 Black	GK00182
Knob 21m/m	Elma Type 72-21. 1/4 Black	
Socket Fixed	McMurdo	GP12020
Dual In-line Socket (for I.C. SN72-709PN)	Varicon B358-014-297-001	

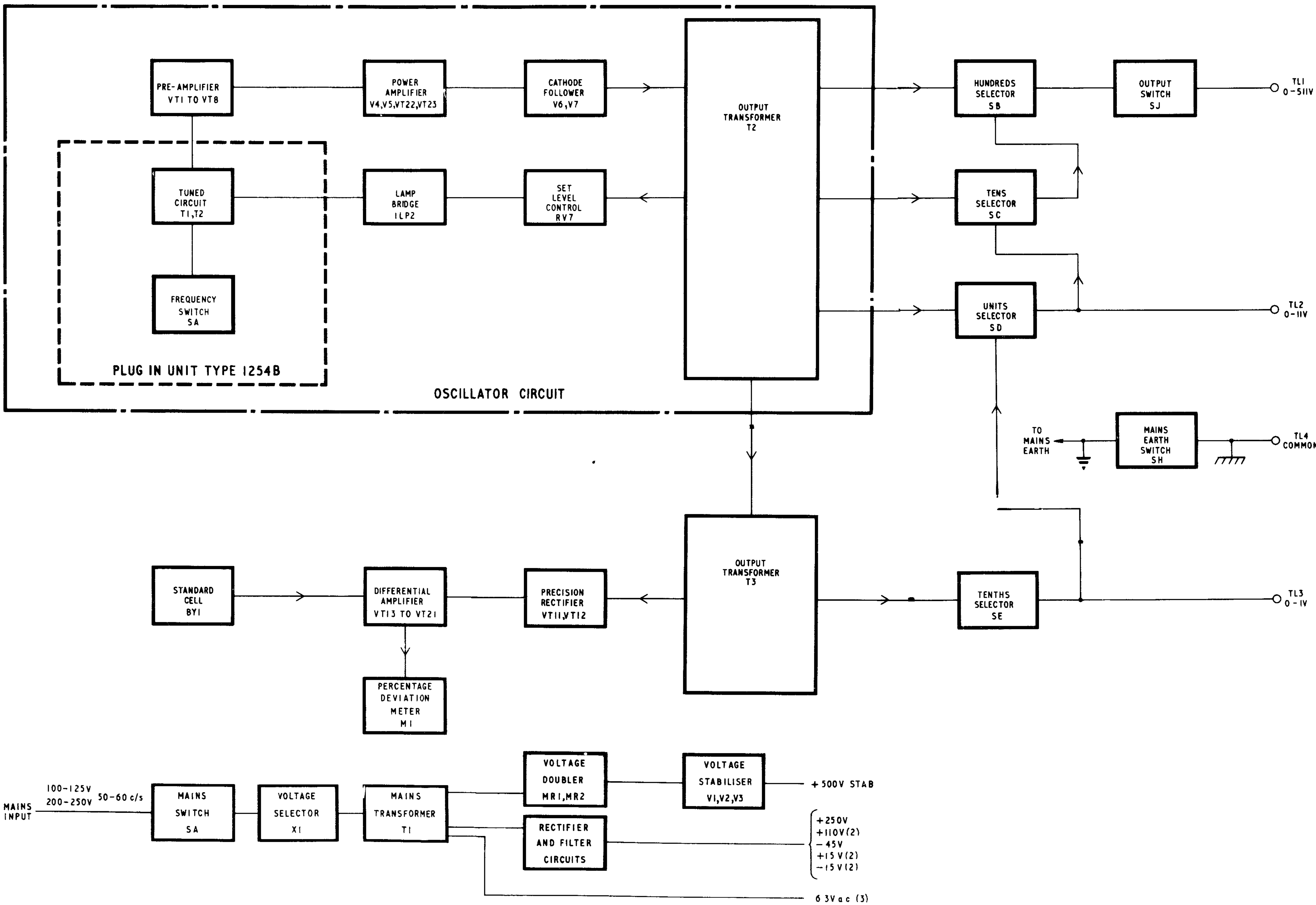
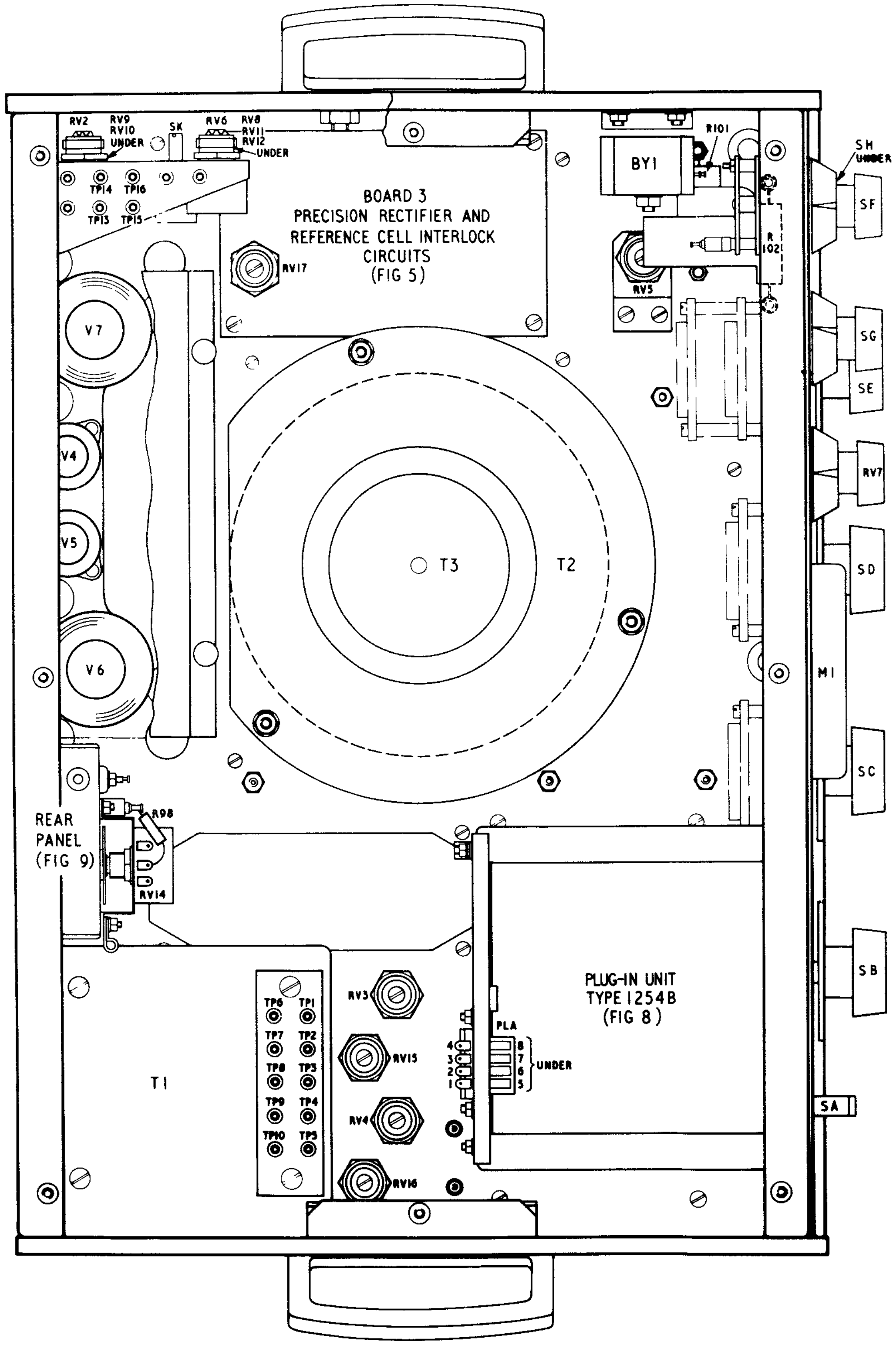
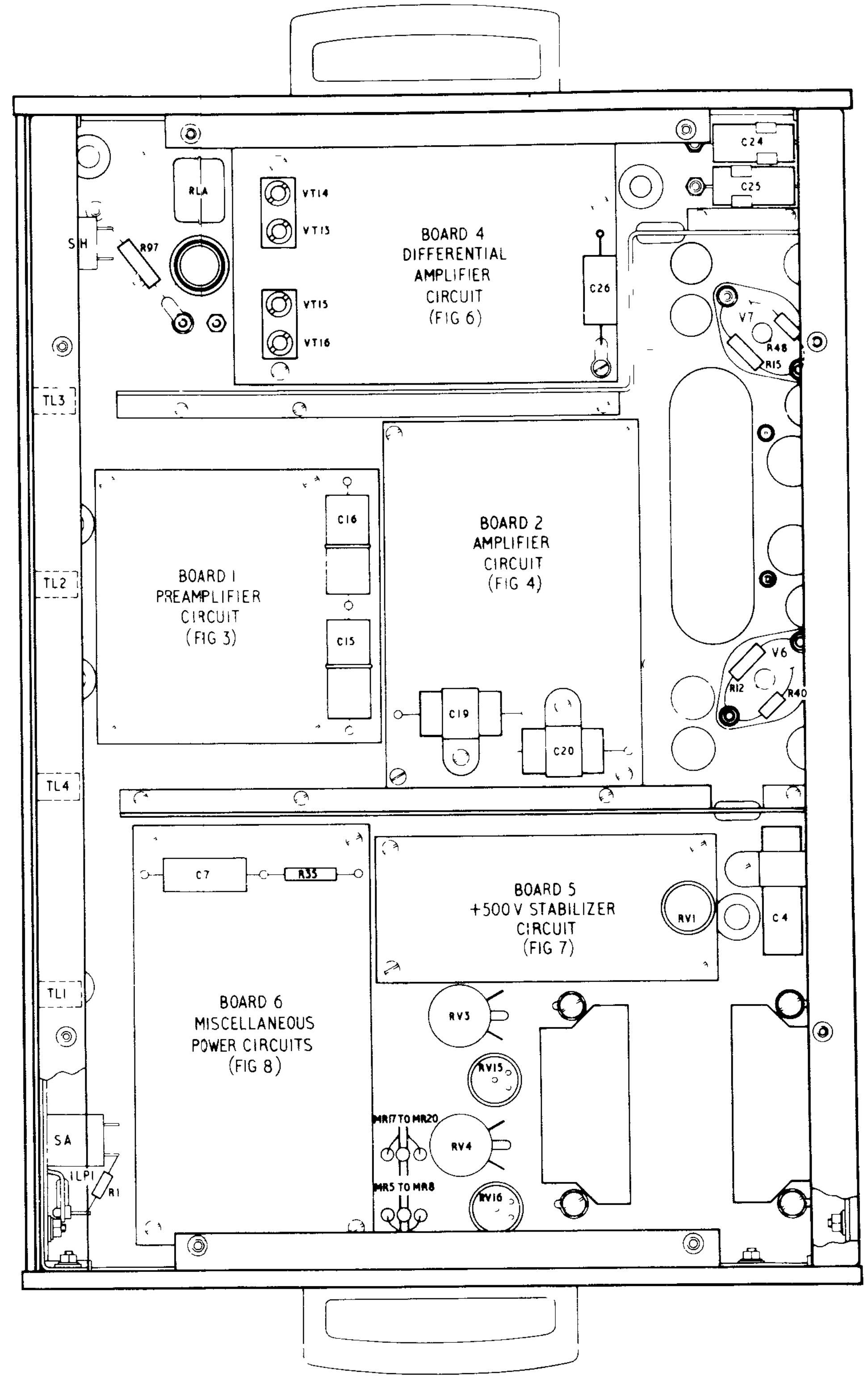


FIG. 1 FUNCTIONAL BLOCK DIAGRAM



TOP VIEW



UNDERSIDE VIEW

FIG. 2 COMPONENT BOARD AND MISCELLANEOUS COMPONENT LOCATION

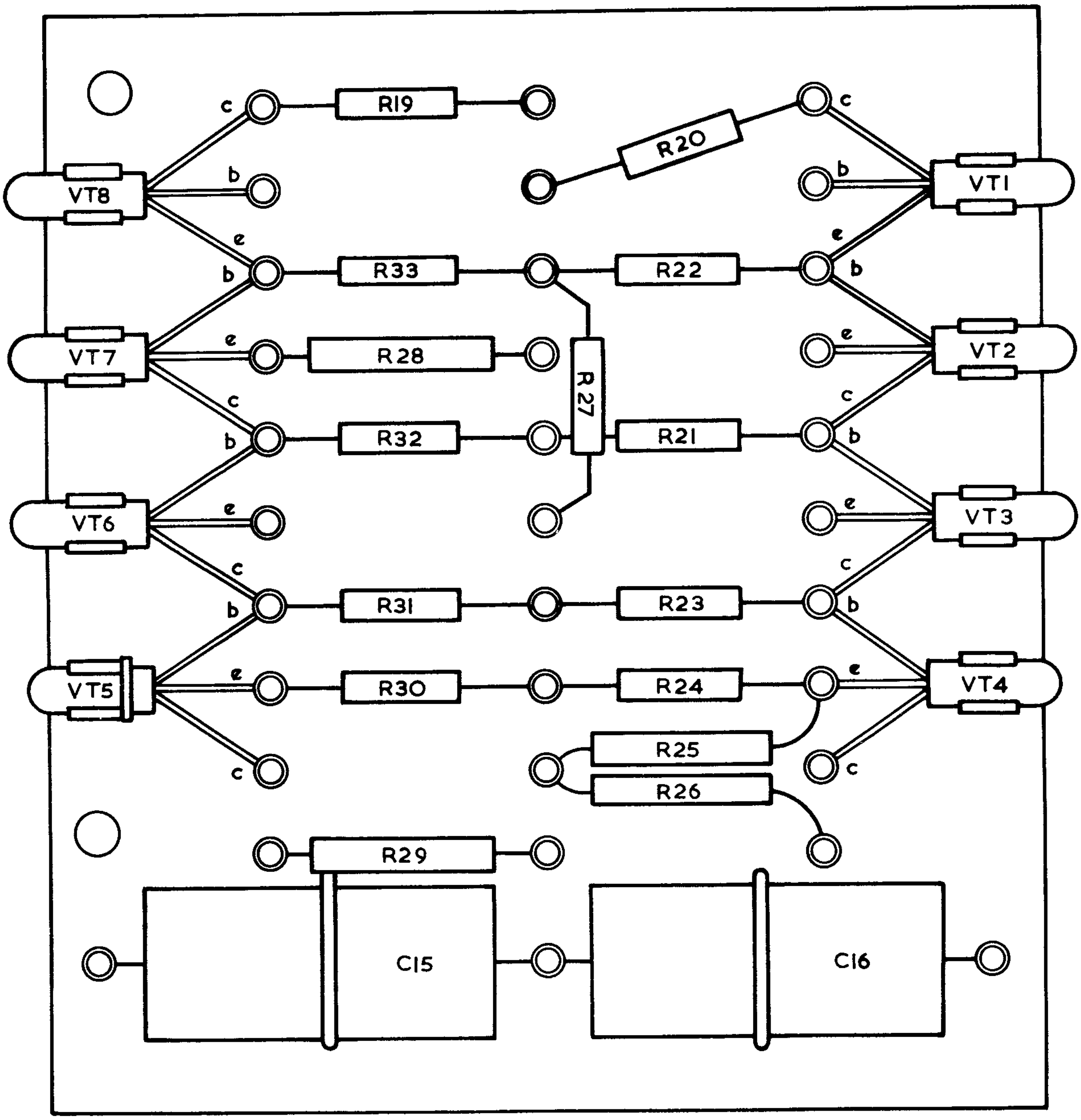


FIG. 3 BOARD 1 -PREAMPLIFIER CIRCUIT - COMPONENT LOCATION

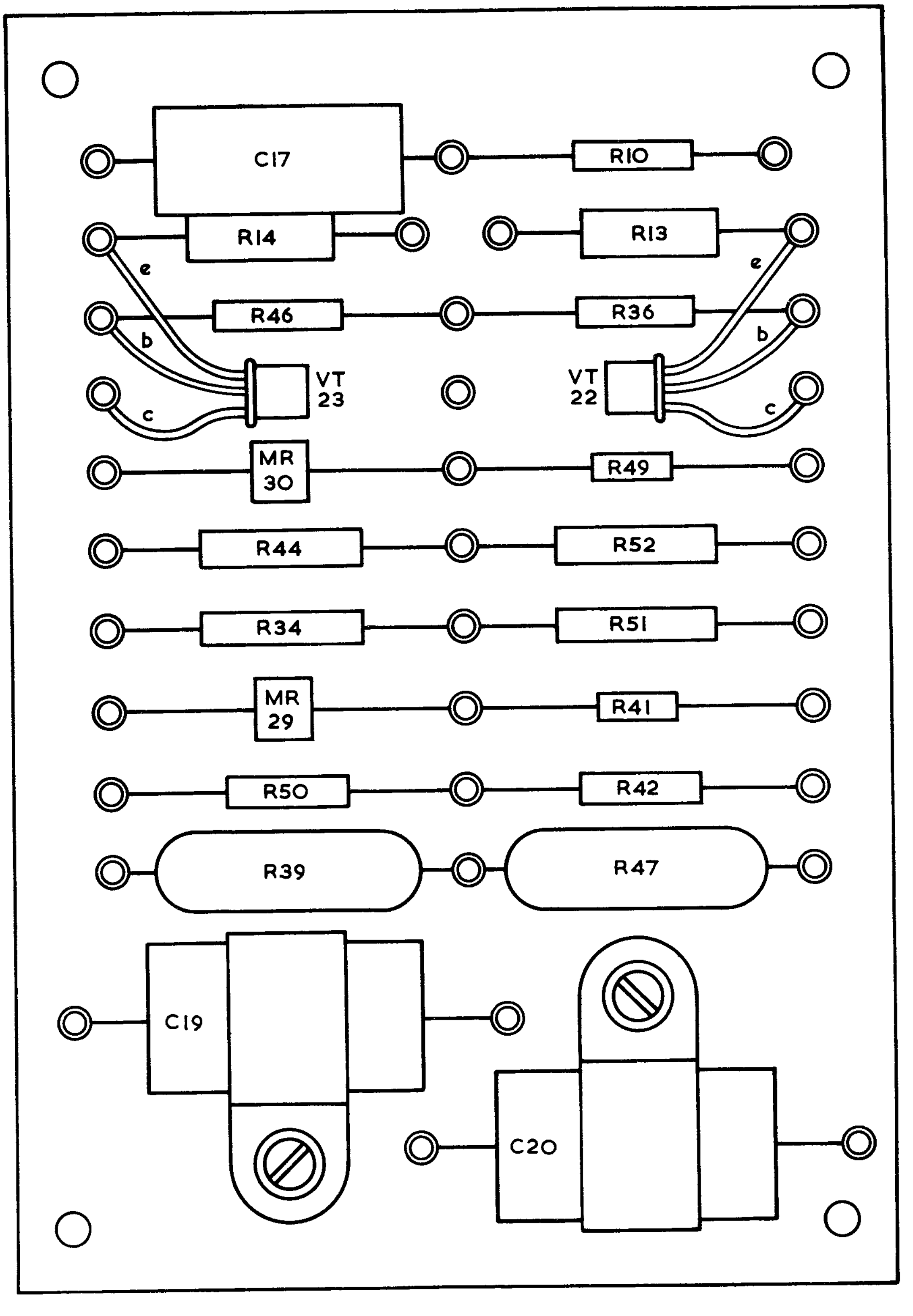


FIG. 4 BOARD 2 - AMPLIFIER CIRCUIT - COMPONENT LOCATION

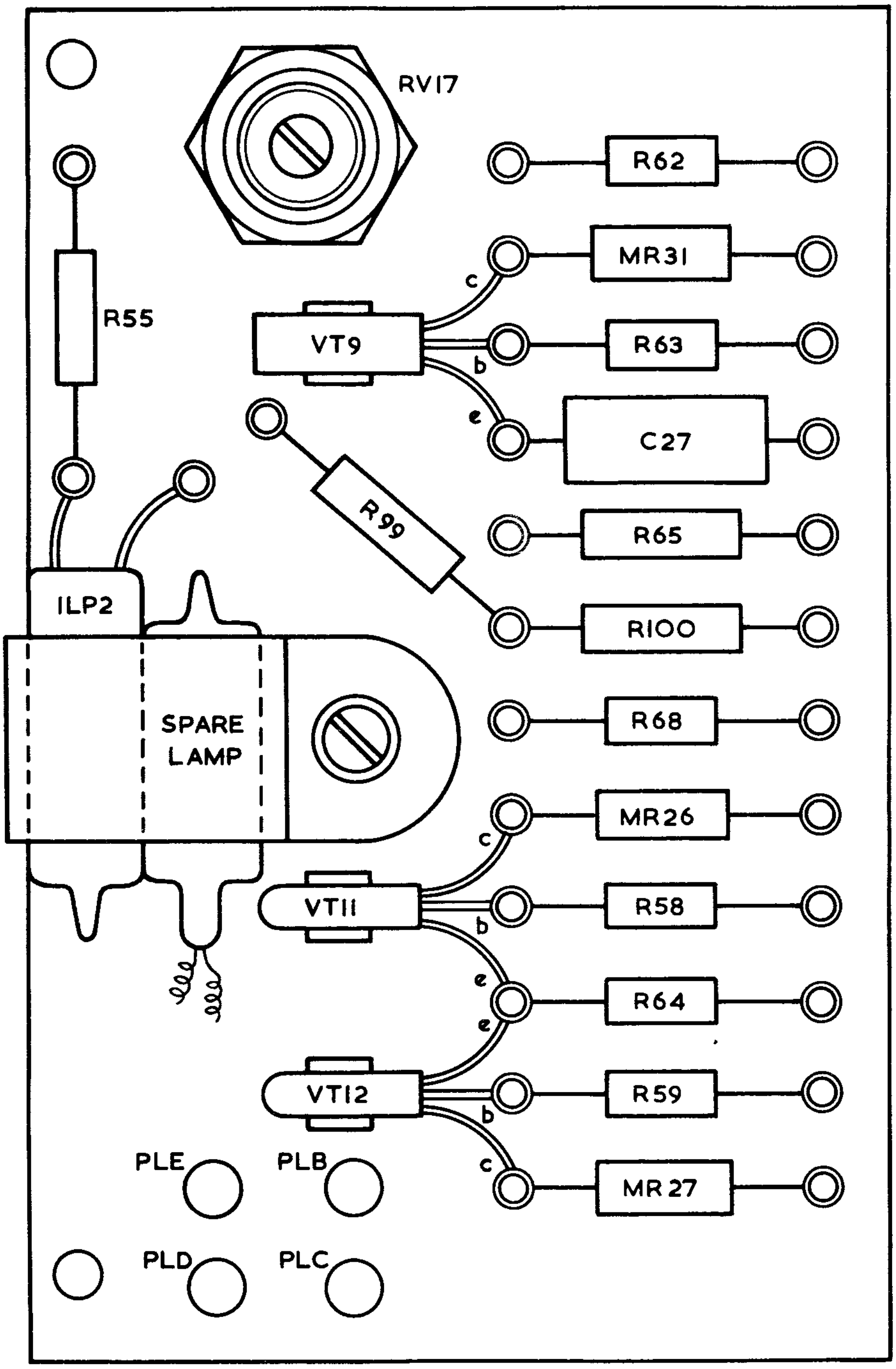


FIG. 5 BOARD 3 - PRECISION RECTIFIER AND REFERENCE CELL INTERLOCK CIRCUITS - COMPONENT LOCATION

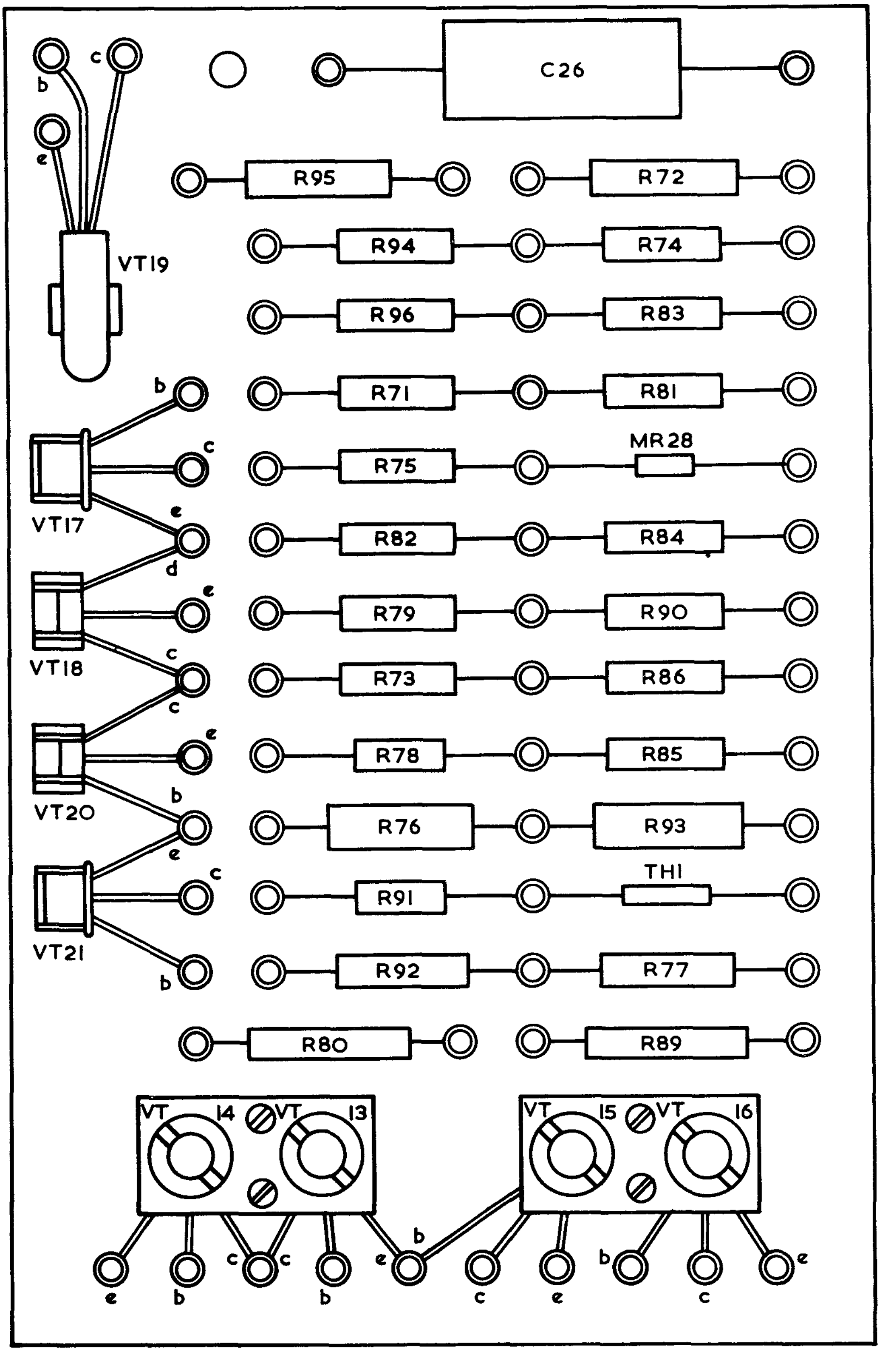


FIG. 6 BOARD 4 -AMPLIFIER CIRCUIT - COMPONENT LOCATION

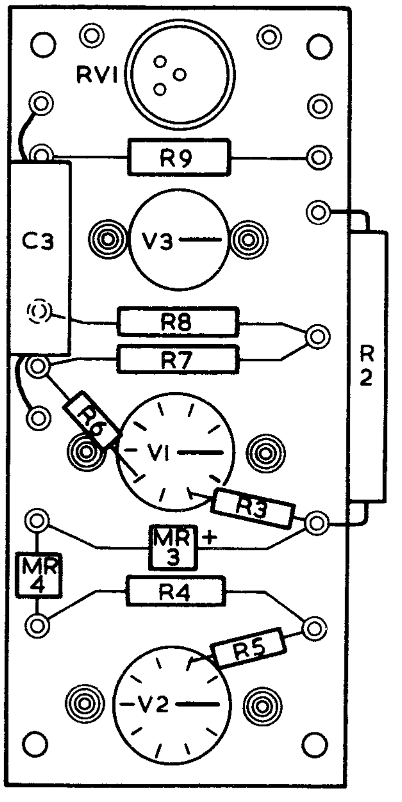


FIG. 7 BOARD 5 -+500V STABILISER CIRCUIT - COMPONENT LOCATION

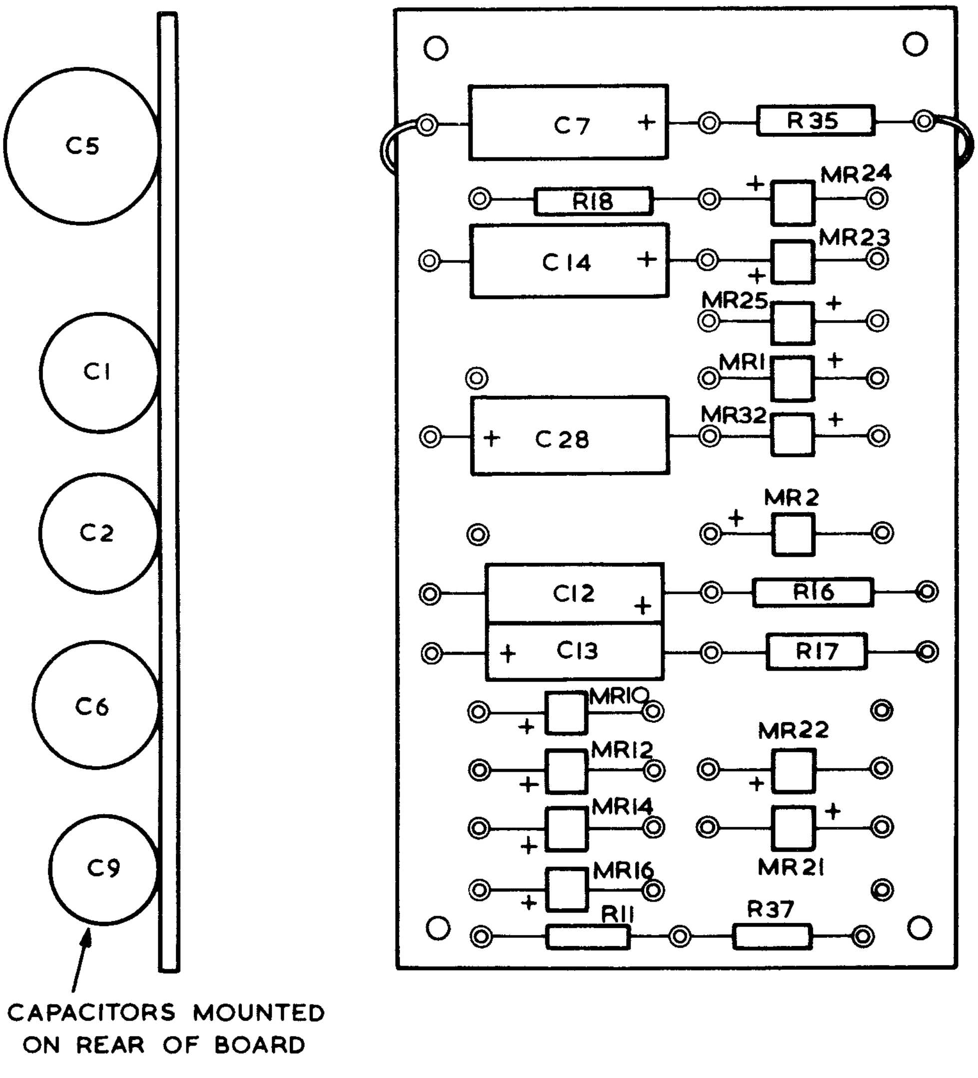


FIG. 8 BOARD 6 -MISCELLANEOUS POWER CIRCUIT - COMPONENT LOCATION

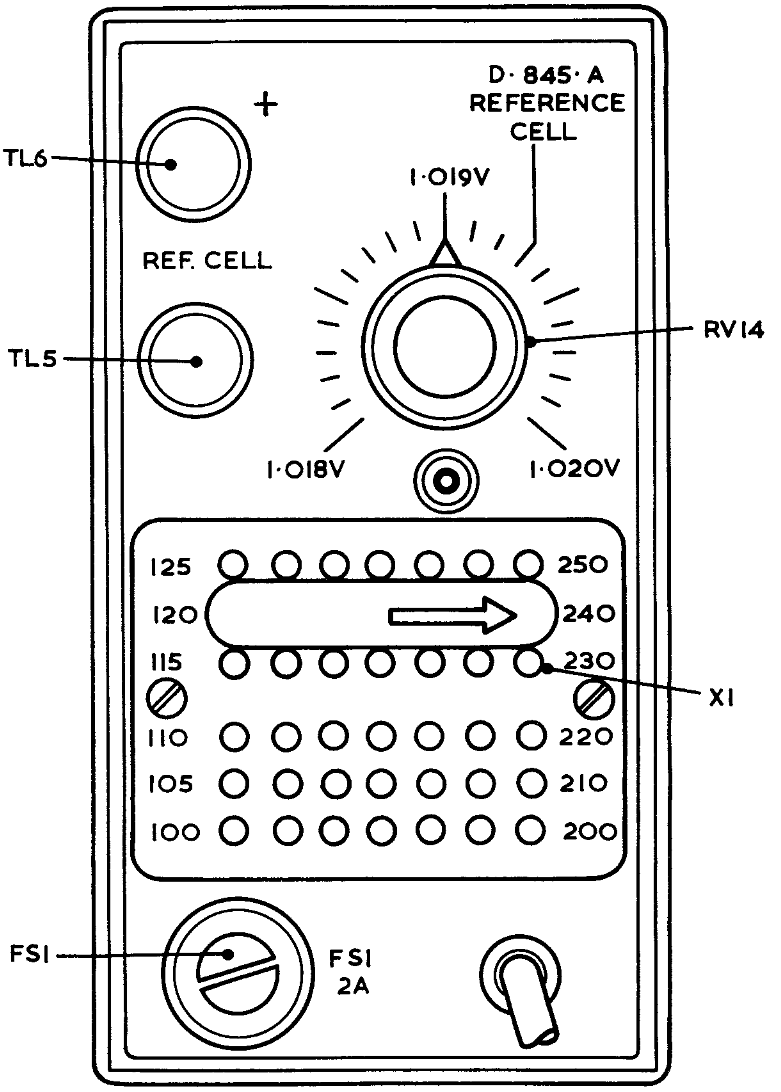


FIG. 9 REAR PANEL COMPONENTS

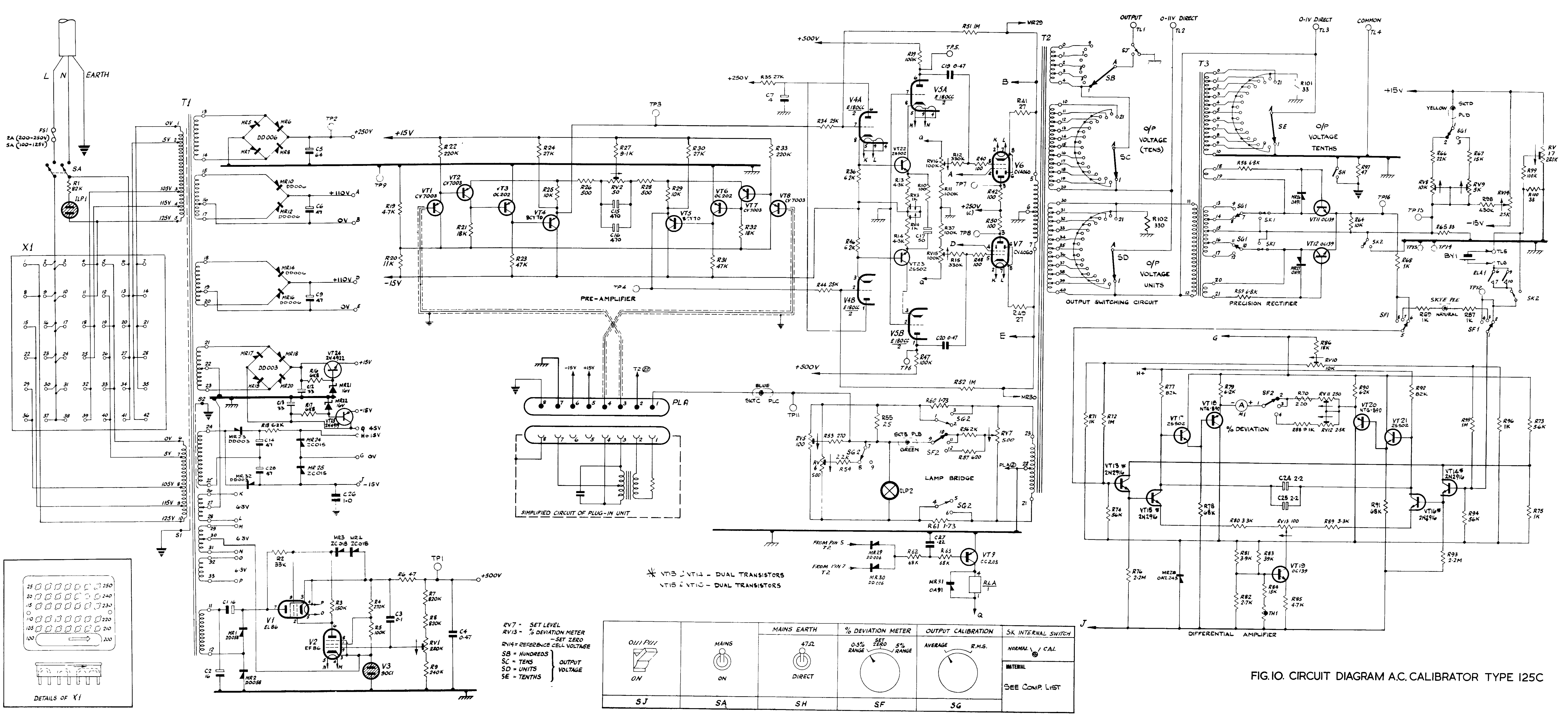


FIG. 10. CIRCUIT DIAGRAM A.C. CALIBRATOR TYPE 125C

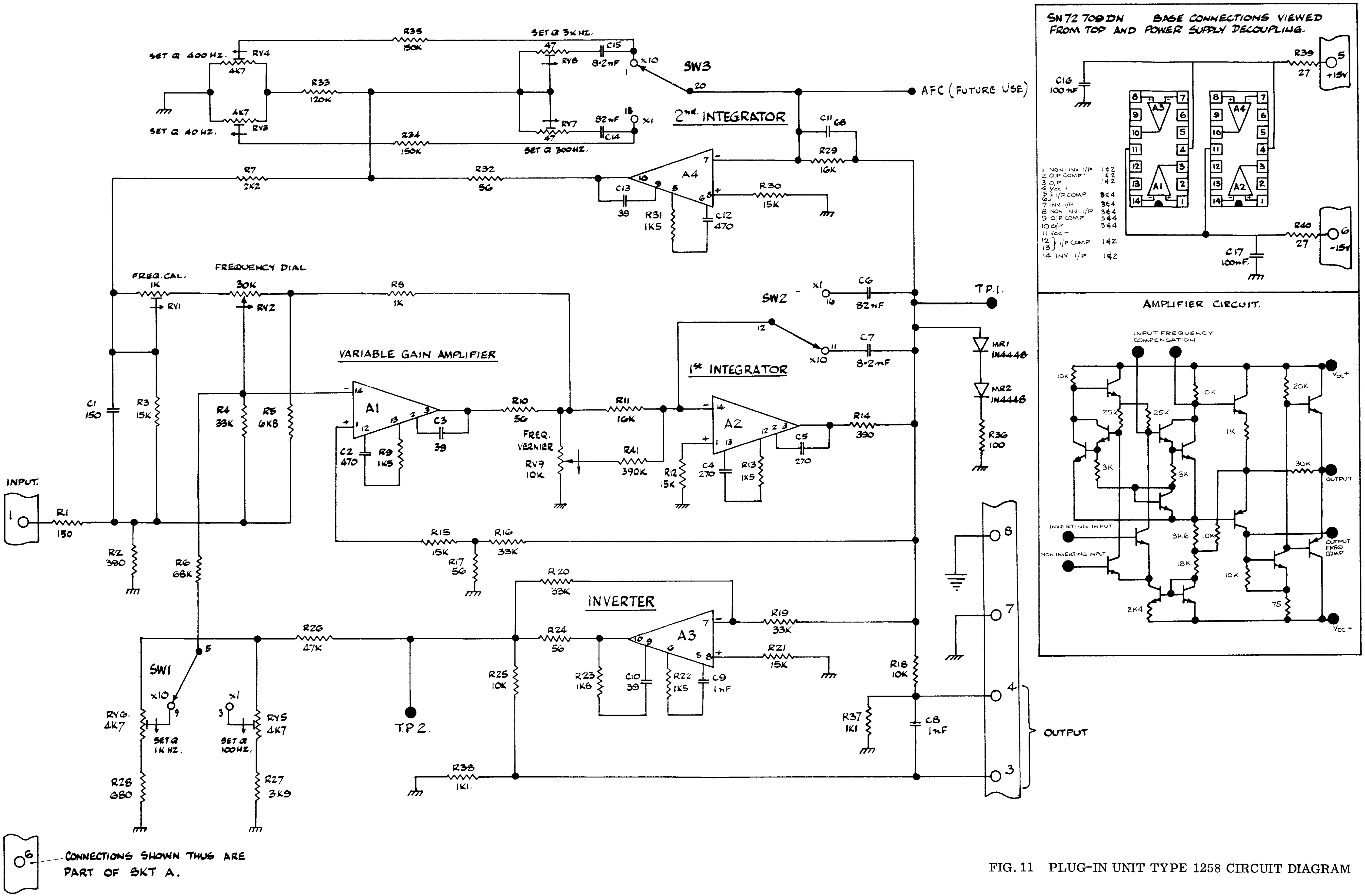
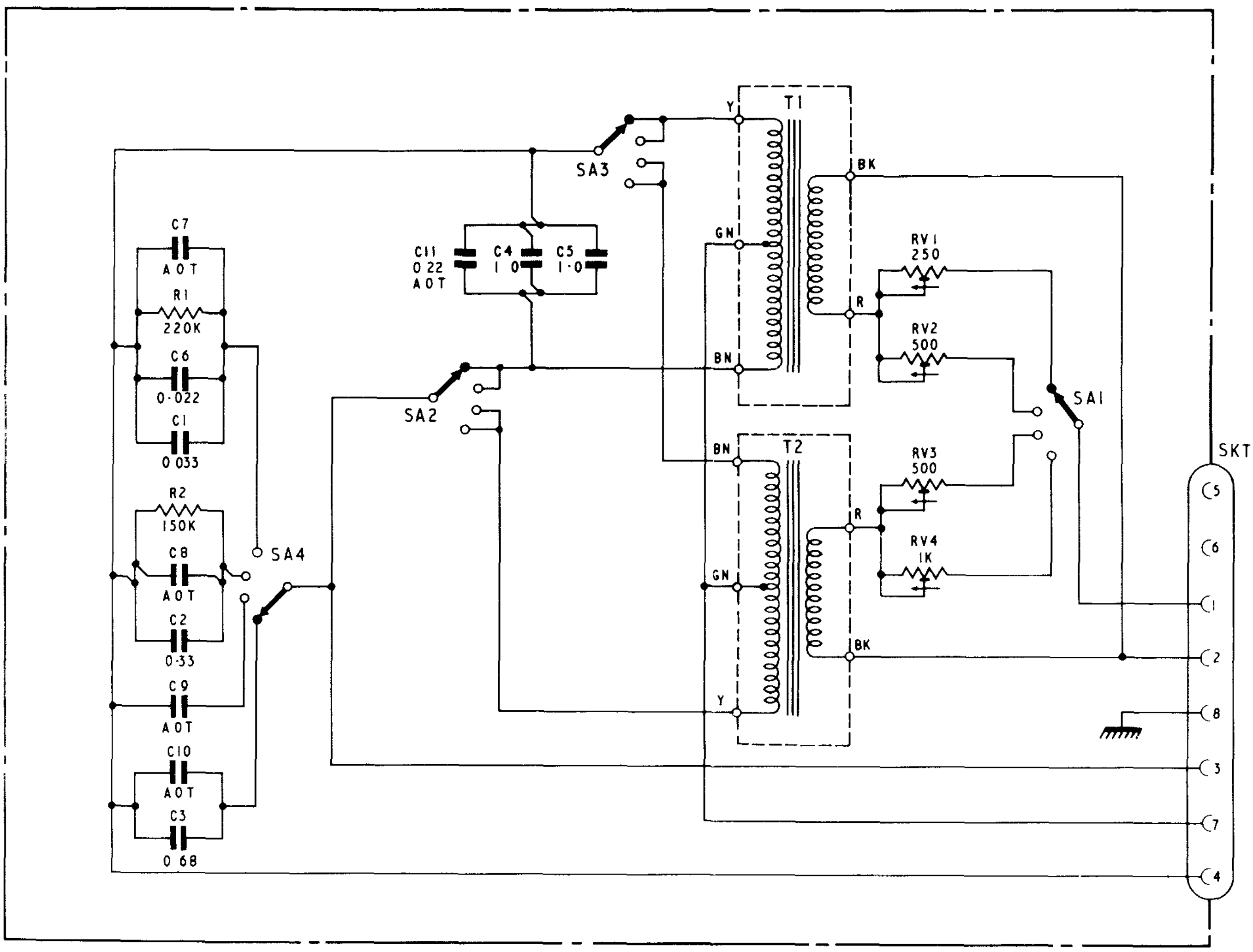


FIG. 11 PLUG-IN UNIT TYPE 1258 CIRCUIT DIAGRAM



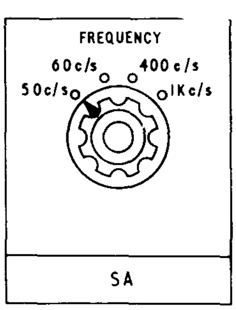


FIG. 12 PLUG-IN UNIT TYPE 1254B - CIRCUIT DIAGRAM

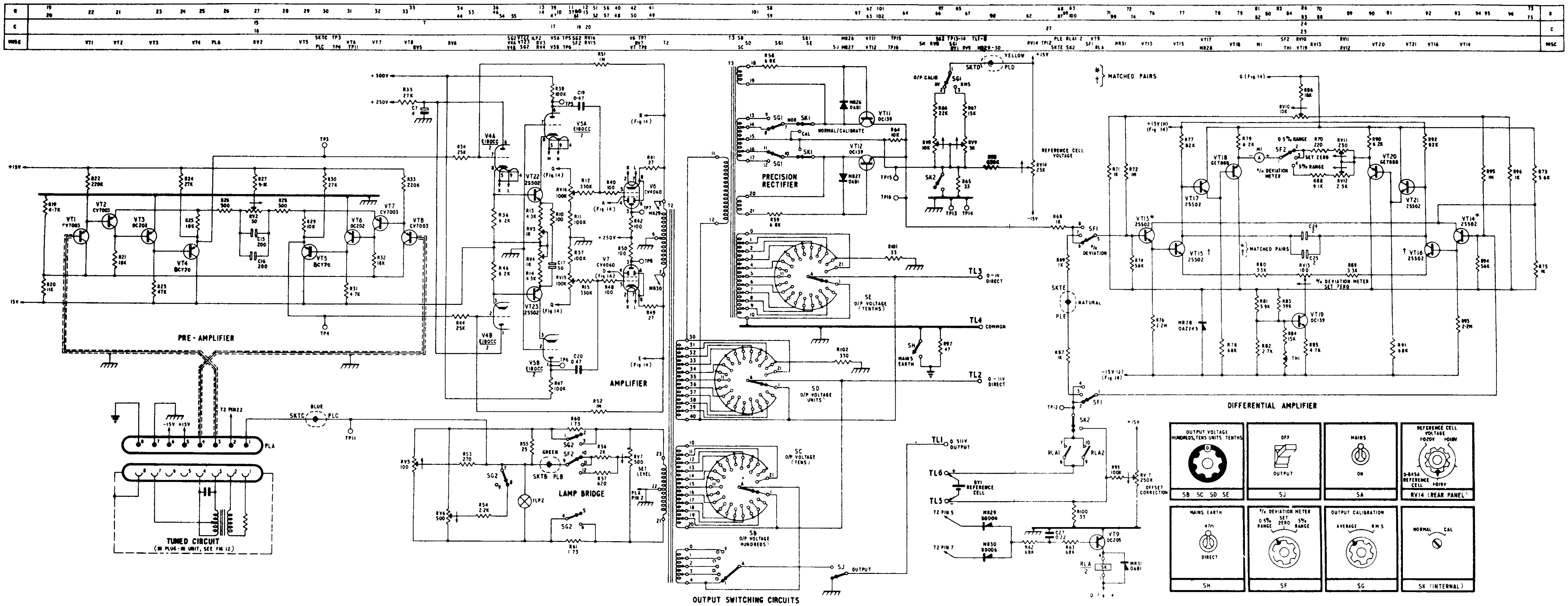


FIG. 13   AC CALIBRATOR TYPE 125B - SIGNAL CIRCUITS

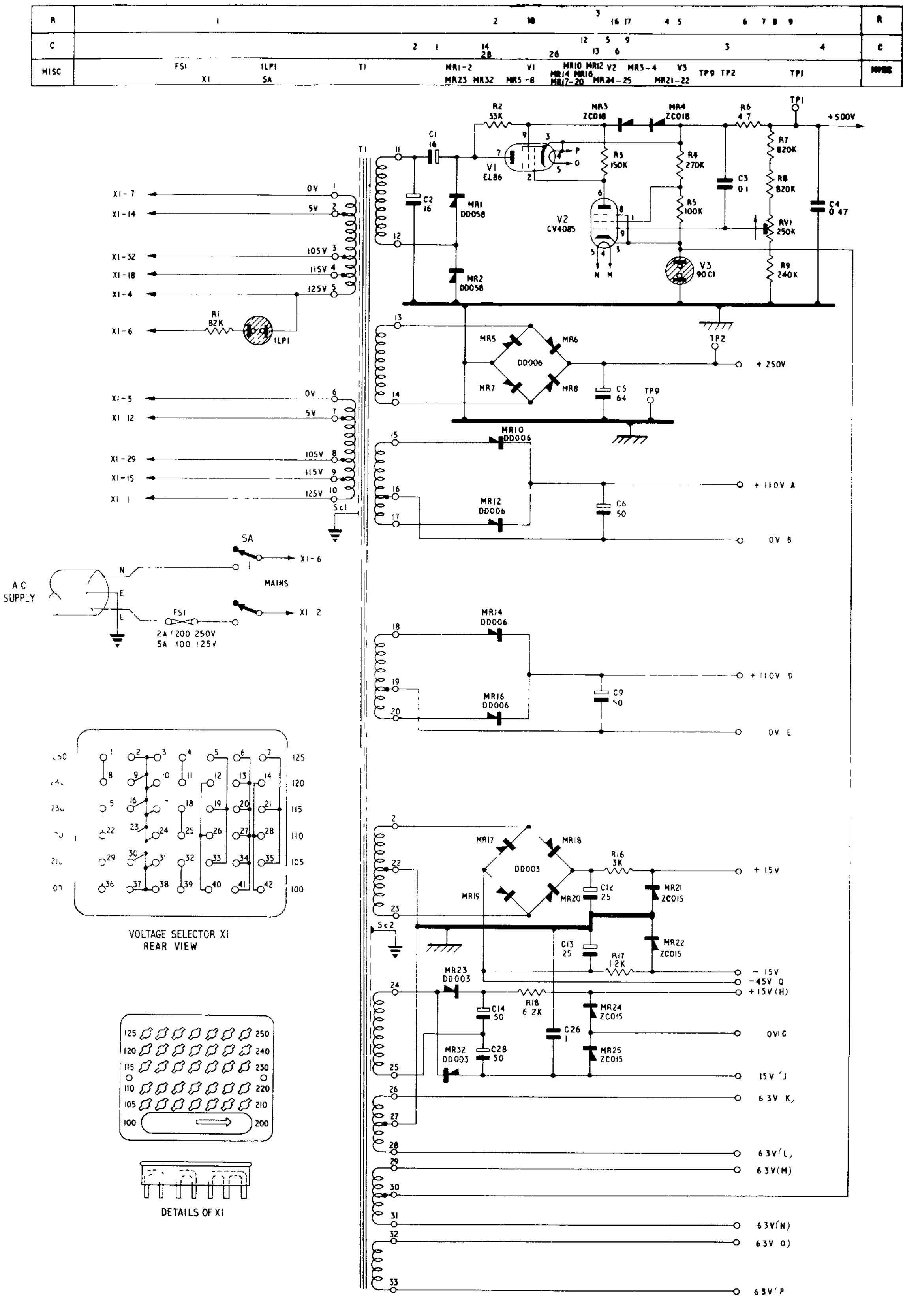


FIG. 14 AC CALIBRATOR TYPE 125B - POWER CIRCUITS

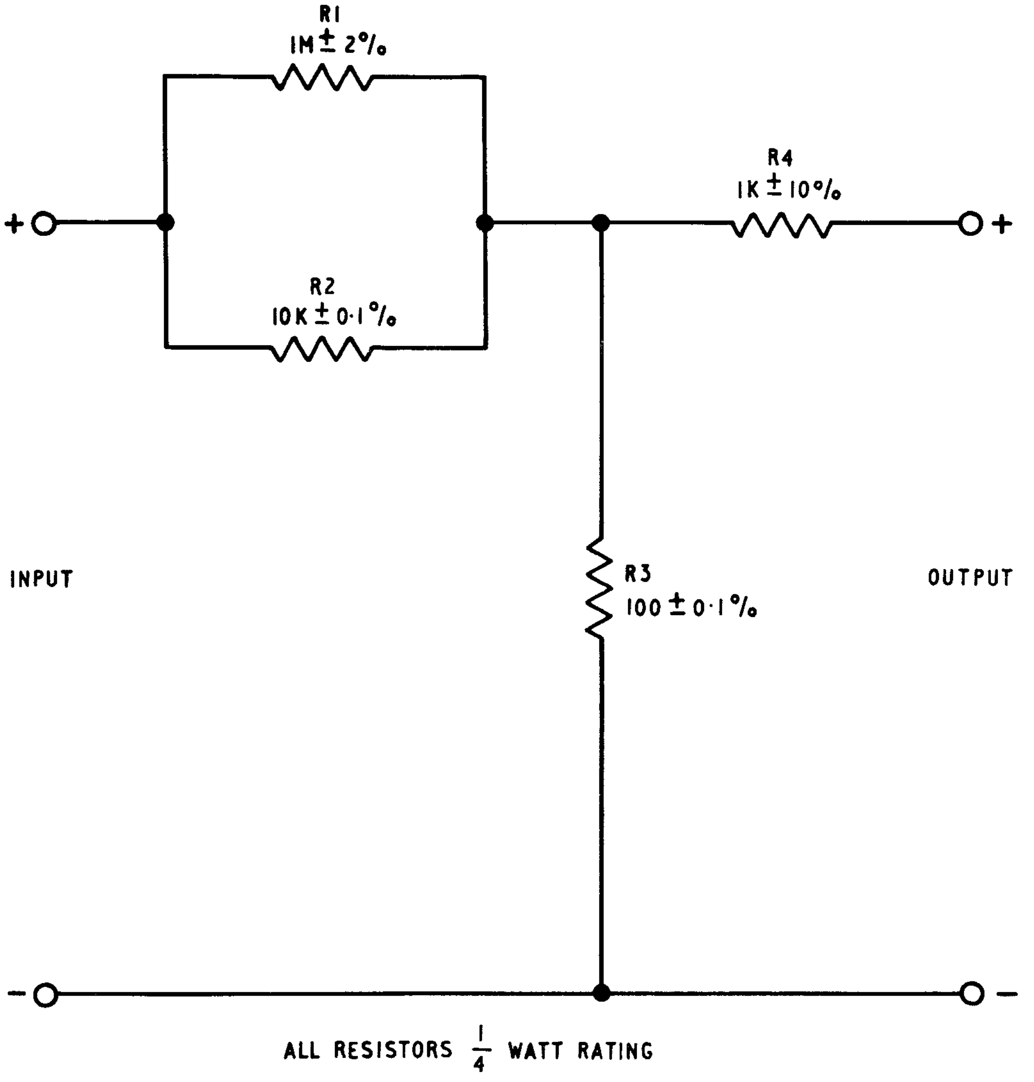
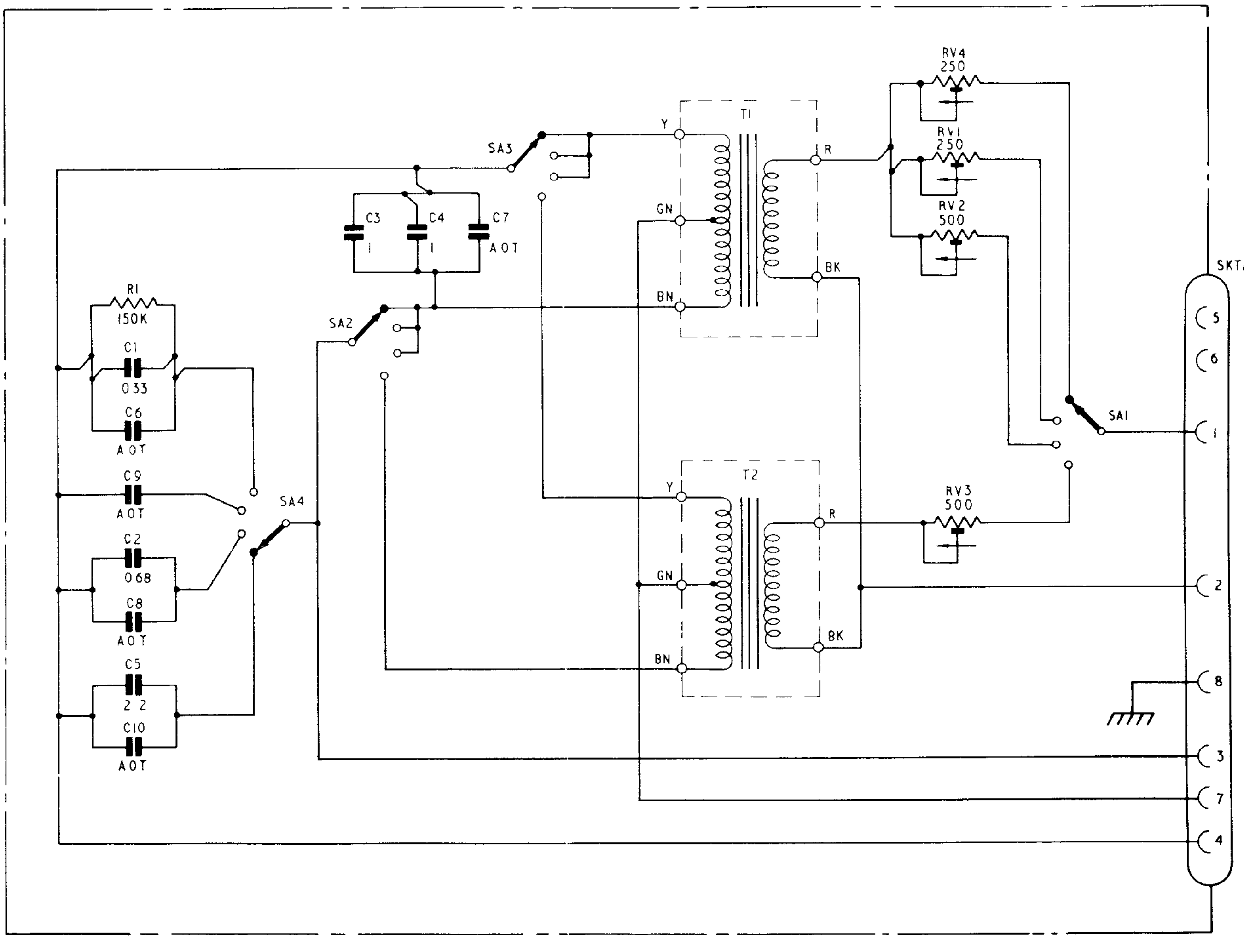


FIG. 15 DIFFERENTIAL AMPLIFIER TEST EQUIPMENT - DIVIDER NETWORK



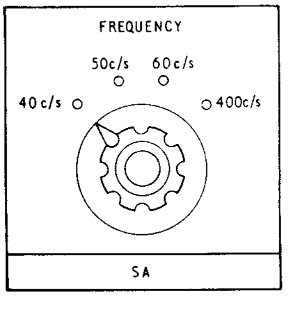
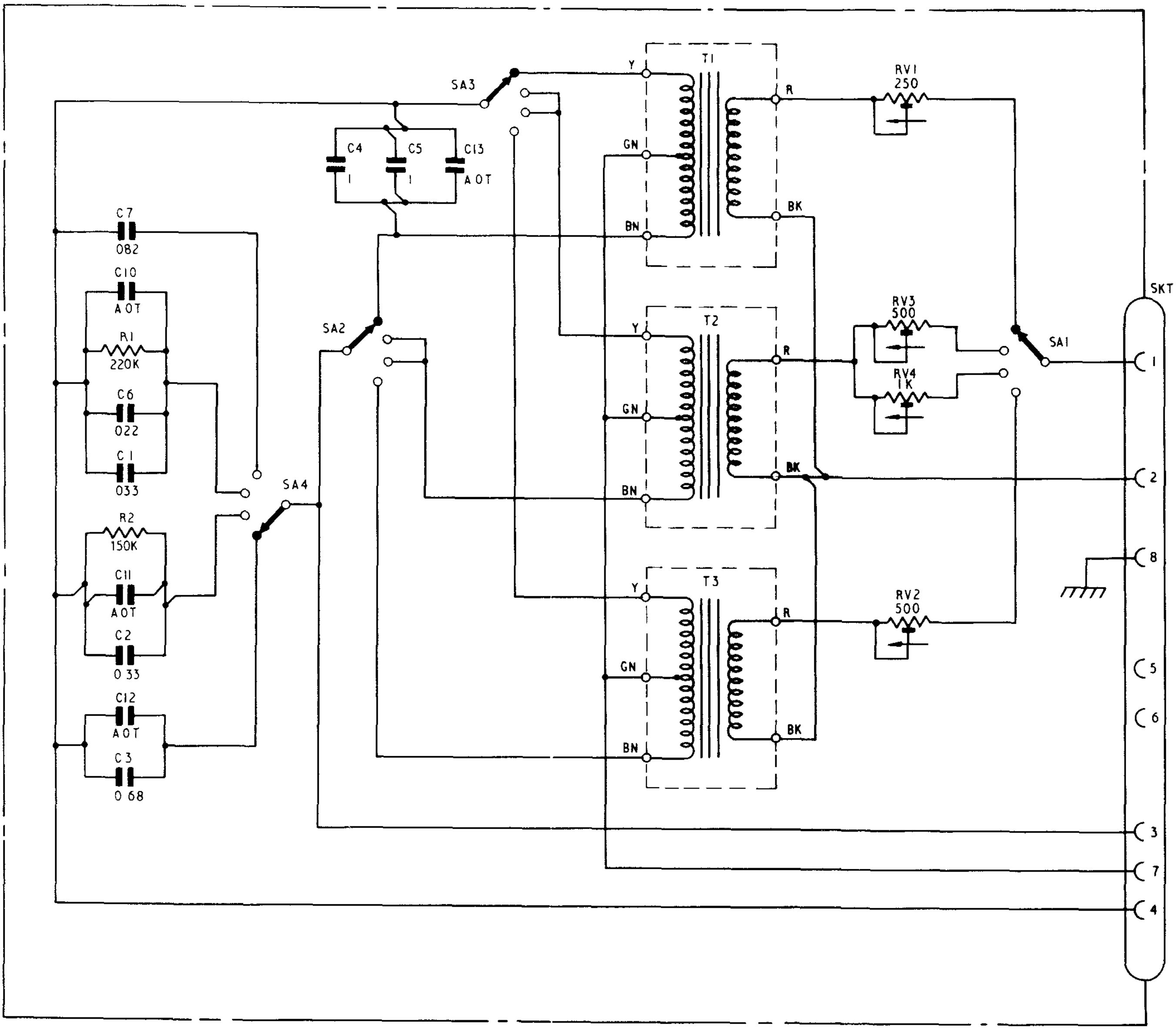


FIG. 16 PLUG-IN UNIT TYPE 1256B - CIRCUIT DIAGRAM



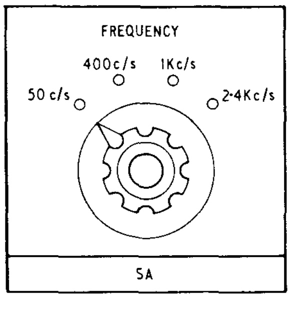


FIG. 17 PLUG-IN UNIT TYPE 1257B - CIRCUIT DIAGRAM