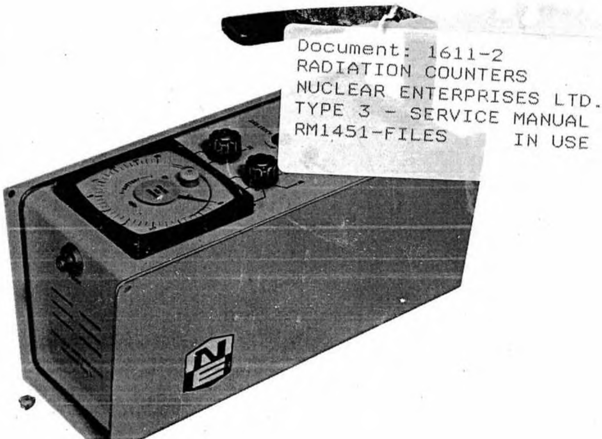
PORTABLE CONTAMINATION MONITOR TYPE PCM3



INSTRUCTION MANUAL

NUCLEAR ENTERPRISES LIMITED

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1 INTRODUCTION

The Portable Contamination Monitor type PCM3 is a small, lightweight instrument, which can be used with many types of probe for the detection of radioactive contamination. It is particularly suitable for use with dual phosphor probes (such as Nuclear Enterprises Type DP2) which respond to both alpha and beta radiation. The alpha pulse amplitude from this type of probe is about twelve times that for beta.

The probe e.h.t. supply is adjustable (on the front panel) from 350V to 1300V.

The function switch on the front panel enables the operator to select alpha, beta, or alpha-plus-beta modes.

The monitor has four ranges covering a total of 10000 counts/second. Counts are indicated on a meter, and a loudspeaker can be switched into circuit to give an audible indication of count rate if required.

A 'fail safe' circuit gives audible warning (regardless of whether the speaker is switched in or not) if the probe is encountering intensive radiation and is overloaded or, in the case of scintillation probes, if the probe window is punctured.

An alarm trip circuit, with a two-pin outlet is provided to enable an external alarm relay to be actuated if the meter indication exceeds a preset level. (For suitable type of relay see SECTION 3, "Set Alarm Trip Circuit").

The circuit components are mainly contained on two plug-in printed boards and one fixed board assembly.

The unit is constructed of aluminium and finished in light cream.

The monitor is normally powered from an internally-fitted 9V battery, (type PP9) but, if required, a mains unit can be supplied to fit into the space normally occupied by the battery. Provision is made for the battery voltage (on load) to be indicated on a sector of the count meter.

2 SPECIFICATION

PHYSICAL

HEIGHT (including handle) 9in (23cm).

WIDTH 4·75in (12cm).

LENGTH 11in (28cm).

WEIGHT 6lb (2·7kg).

FINISH Light cream (A.E.R.E. 61).

ELECTRICAL

RANGE OF MEASUREMENTS 1-10000 counts per second in four ranges.

DISPLAY 3-inch meter with linear scale.

AUDIO INDICATION A high-pitched note for every alpha particle and a click for every beta particle.

INPUT SENSITIVITIES Approx. 80mV for beta. Approx. 1V for alpha.

ALARM TRIP CIRCUIT Operates an external relay at any pre-set count rate.

FAIL SAFE CIRCUIT Produces a continuous tone from the loudspeaker if the probe becomes overloaded.

E.H.T. SUPPLY Adjustable, 350V - 1300V.

TEMPERATURE RANGE $0^{\circ}C$ to $+45^{\circ}C$.

BATTERY 9V, type PP9.

BATTERY LIFE 60 hours continuous use.

REQUIREMENT FOR MAINS OPERATION Mains Unit type PM9 (Modified).

3 INSTALLATION

On receiving the instrument, check that no damage has been sustained in transit.

Ensure that the function switch is set to the OFF position.

Check that the ADJUST EHT pre-set control, on the front panel is in the OFF position (Fully anticlockwise).

> WARNING: On no account must the ADJUST EHT control be moved away from the OFF position until a probe is connected.

Remove the bottom of the case by unscrewing the four retaining screws.

Fit the 9V battery or, if a mains unit is to be used, fit this. Replace the cover.

Set the function switch to the BATT position and ensure that the meter needle lies within the sector marked BATTERY.

Connect a suitable probe to the PROBE socket. (Plug, P.E.T. Type 101, manufactured by Precision Electronic Terminations Ltd., St. Johns Hill, Sevenoaks, Kent, England).

Set the SPEAKER switch to ON.

E.H.T. ADJUSTMENTS

Set the ADJUST EHT control to give an e.h.t. output voltage suitable for the type of probe in use; this can be done in one of three ways:

NOTE: When the function switch is set to the EHT position, an arbitrary indication of e.h.t. voltage is given on the Counts/Second scale. This enables the curve required in setting-up procedures (ii) and (iii), to be drawn.

(i) APPROXIMATE SETTING FOR BETA OR GAMMA TYPE PROBES (applicable to BP4,

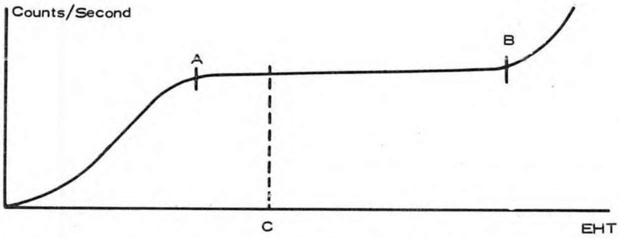

FIG. 1 SETTING UP CURVE METHOD (ii)

BP5, DP2, GP2 and GP3 probes only).

In conditions of normal background gamma radiation, set the range switch to X1, and the function switch to the beta position.

Turn the ADJUST EHT control until the meter indicates between 3 and 7 counts per second.

(ii) ACCURATE SETTING (all types of probe).

Place the probe face in contact with a suitable radioactive source; e.g. Am^{241} alpha source, in the case of an alpha probe.

Set the function switch to EHT and turn the ADJUST EHT control until the meter pointer reaches the first division on the scale. Now set the range switch to a suitable count range and the function switch to the appropriate position. Note the meter reading. Repeat these operations at successive meter divisions and plot a graph of count rate against e.h.t. indication. The graph produced from an alpha probe or a G.M. counter should resemble the one shown in Fig. 1. Several count ranges may have to be covered before point A is reached.

Set the ADJUST EHT control until the meter indicates the value shown at C (one quarter of the distance along the plateau A B). The e.h.t. voltage is now correctly set.

If a beta scintillation counter is used, the plateau will be much less distinct and the centre of the plateau should be taken as the operating point.

(iii) FOR USE WITH DUAL PHOSPHOR PROBES

Plot a graph of counts against e.h.t. voltage as in (ii) but use an alpha source with the function switch set to the beta position. The graph should resemble curve (A) overleaf.

Set the ADJUST EHT control to obtain the value at point C on curve (A) as indicated by the dip in count rate. The equivalent curves for counts from an alpha source, with the function switch set to the alpha position, and for counts from a beta source, with the function switch set to the beta position, will then be approximately as shown by curves (B) and (C). The curve for counts from beta source, with the function switch in the alpha position would be as shown by curve (D).

SET THE ALARM TRIP CIRCUIT

A relay (12V two-pole changeover, resis-

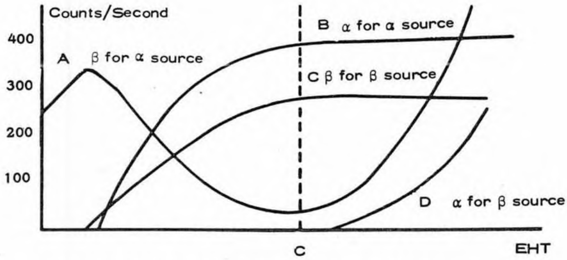

FIG. 2 SETTING UP CURVE METHOD (iii)

tance not less than 160Ω) can be connected to the two-pin sockets adjacent to the Set Trip control. (A plug to fit this socket is supplied with the instrument).

It should be noted that the alarm trip circuit operates at a meter deflection pre-set by the SET TRIP control and, therefore, will operate at a count rate dependent upon the range selected.

Clockwise rotation of the control decreases the count rate at which operation occurs.

TO SET THE FAIL SAFE CIRCUIT

When the probe current exceeds its normal value as would happen for example, if the probe window were punctured, the circuit causes a continuous tone to be heard at the loudspeaker, regardless of whether or not the speaker is switched on.

To adjust, subject the probe to maximum count-rate conditions applicable to the probe in use, then turn the control slowly clockwise until the loudspeaker emits a continuous tone.

CONTROLS

CONTROL	FUNCTION
Function switch	This switch has six positions: OFF, BATT., EHT,* β, α, and α+β.
Range switch	Multiplies the 0-10 counts per second indicated on the meter by:- X1, X10, X100 and X1000.
SPEAKER	Switches the speaker ON or OFF.
ADJUST EHT	This is a pre-set control operated by a screwdriver with an OFF position at its extreme anti-clockwise position.
SET FAIL SAFE	This is a pre-set control which is initially set up as described in Section 3 (INSTALLATION).
SET TRIP Pre-set control and socket	This is a socket to which a relay may be connected to give external indication if a pre-set count level is exceeded. See Section 3 (INSTALLATION).

* When the function switch is set to the EHT position an arbitrary indication of e.h.t. voltage is given in the Counts/Second Scale. This enables the curves required in setting-up procedures (ii) and (iii) of Section 3, to be drawn.

4 OPERATING INSTRUCTIONS

It is assumed that the adjustments and connections detailed in Section 3 (INSTALLATION) have been made.

Set the function switch to BATT and ensure that the meter pointer lies within the zone marked BATTERY. If the required indication is not obtained, remove the bottom cover and renew the battery.

Set the function switch to the required position, i.e. β, α, or $\alpha+\beta$.

Set the range switch to cover the largest count rate likely to be encountered.

Apply the probe to the area to be monitored. For monitoring alpha radiation the probe must be held very close to the surface under examination since alpha particles travel only a few centimeters in air However, if a scintillation counter probe is being used, particular care must be taken to see that the light-tight window noes not touch the surface being examined as it may itself become damaged or contaminated.

WARNING: E.H.T. potentials are generated within the monitor. The instrument should ON NO ACCOUNT be switched on unless a probe is attached, nor should a probe be detached until the instrument is switched OFF. Take care not to touch the e.h.t. circuits if these are exposed for servicing while the instrument is switched on.

5 TECHNICAL INFORMATION

[A] CIRCUIT DESCRIPTION

The complete circuit is shown in block schematic form in Fig. 3.

The components are contained mainly on three printed cards; each printed card has been given an identity number, shown below:

Comp. PCM3 card (Stabilised Power Supply, Input Amplifier, Range Multiplier and Audio Stages) Identity No. 1

Disc. PCM3 card (Discriminators, Anti-coincidence and Alarm Circuits) Identity No. 2

E.H.T. Sub-assembly Identity No. 3

Throughout this chapter, for clarity, all components mounted on a card will be identified by the card identity number (as above) followed by the circuit reference; e.g. 3VT1 refers to VT1 on card 3. Components with no identity number are to be found on the main assembly.

RATEMETER CIRCUIT (See Figs. 6, 8 and 10)

Radioactive particles acting on the probe produce changes in probe current; these changes are transmitted as negative pulses, via 3C11 to the compound emitter follower, 3VT3 and 3VT4. The output from this stage is applied to card 1, pin 6, where it is fed to an amplifier 1VT4, 1VT5 and 1VT6. This amplifier has two outputs; one giving a gain of unity at pin 7 and the other a gain of X6 at pin 4. Negative feedback is provided via 1R13.

The X1 output feeds the alpha discriminator and the X6 the alpha-plus-beta discriminator. Both discriminators are on card 2.

The approximate overall sensitivity of the alpha circuit, up to and including the discriminator, is 1V and that of the alpha-plus-beta circuit, 80mV; this being slightly less than the ratio between the amplitudes of the alpha and beta pulses from a type DP2 probe.

DISCRIMINATOR CIRCUIT

The discriminators (see Fig. 10) are similar and, considering the alpha circuit, consist of a 1mA tunnel diode 2D1, fed via a series resistor, 2R1, followed by the discriminator stages 2VT1 and 2VT3. The output is amplified by 2VT5 to provide the alpha output at pin 9. In the quiescent state 2VT3 is switched on. When the input pulse amplitude is sufficient to cause 1mA to flow through the series resistor, the tunnel diode changes state and produces a negative-going voltage step of approximately 500mV which triggers the discriminator.

The alpha-plus-beta discriminator output is differentiated by 2C10 and applied to the base of 2VT7 which is then switched off by the rear edge of the pulse for a time governed by 2C10 and 2R17, thus producing the negative beta pulse at pin 5.

ANTI-COINCIDENCE CIRCUIT

The transistor 2VT7 is normally bottomed by current in 2R17, but it obtains its supply from the collector of 2VT1 in the alpha discriminator and is, therefore, only operative if 2VT1 is not conducting, i.e. is in its quiescent state.

If the alpha discriminator is triggered, 2VT1 conducts and removes the supply from 2VT7, thus preventing the production of a pulse at pin 5.

In this way, coincident alpha pulses are removed from the alpha-plus-beta discriminator and beta counts are only produced when the input pulse height corresponds to a beta particle.

Three separate negative pulse trains are thus available: alpha at pin 9 (card 2) beta at pin 5 (card 2) and alpha + beta at pin 4 (card 2).

These pulses are selected by SB-2 and applied to the emitter follower VT2 (chassis component). The output of VT2 is fed to the audio and ratemeter stages via SD and SB.

RANGE MONOSTABLE (See Fig. 8)

1VT7 and 1VT8 are connected as a monostable multivibrator with time constants (1C3 to 1C6 and their associated resistors) selected by SA1. In the quiescent state, 1VT8 is bottomed by the current through the particular timing resistance in use. 1VT7 is cut off by the positive voltage at its base.

The ratemeter output current in 1VT7 is integrated by 1R16 and 3C12. The d.c. voltage built up across 3C12 is monitored by the display meter M1 via switch SB. The meter indication is, therefore, directly proportional to pulse rate.

The multivibrator pulse width can be adjusted by the variable resistors 1RV1 to 1RV4, inclusive.

The emitter of 1VT7 is returned to earth via the alarm circuit 2VT12, 2VT13 and 2VT14.

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AUDIO CIRCUITS (See Figs. 8 and 10)

1VT9 and 1VT10 are connected as an emitter-timed multivibrator; this is prevented from free-running, in the absence of probe pulses, by the collector potentials of either of the transistors connected to the base of 1VT9.

Each time the base of 1VT9 is driven negative, a negative pulse appears at its emitter; this drives the output amplifier stage, 1VT11 and 1VT12, and allows the capacitor 3C9 to discharge through the loudspeaker with a corresponding click. To maintain a reasonably constant loudspeaker output over the ranges, 3C9 is charged through a resistor, 3R4. At high count rates, this prevents the capacitor from being fully re-charged during the interval between pulses and so restricts the loudspeaker pulse current.

If the base of 1VT9 is negative for a time longer than the basic period of the multivibrator, then the device free runs and a series of pulses are passed to the speaker and a different note is produced; this occurs when the monostable 2VT6, 2VT8 is triggered by the output from the alpha discriminator. This monostable produces a pulse of approximately 20ms which, in turn, causes 1VT9, 1VT10 to produce approximately 30 pulses. If the base of 1VT9 is held negative a continuous tone is produced as is the case on operation of the overload circuit.

DETECTOR OVERLOAD AND FAIL SAFE CIRCUIT (See Figs. 5 and 10)

The e.h.t. oscillator 3VT1 collector voltage is rectified by 3C13, 3D3 with respect to the base voltage of 2VT11 (-2V). 2VT10 and 2VT11 form a long tailed pair, the base of 2VT10 being fed with the difference between the probe current and a current derived from the rectified oscillator collector voltage. 2VT9 provides further amplification. This stage is normally bottomed, but when an overload occurs it is switched off, which causes the audio oscillator to free run.

The speaker switch does not switch off this alarm.

ALARM CIRCUIT (See Figs. 10 and 6)

The ratemeter current is also fed to the current amplifier 2VT12, 2VT13 and 2VT14. The output of this amplifier (a voltage swing equivalent to the input multiplied by the resistance of 2R43) is compared with a variable voltage derived from the SET TRIP control RV1 (Fig. 6).

When the ratemeter output exceeds this voltage 2VT15 and 2VT16 conduct and thus enable an external relay to be energised. 2R38 provides a small amount of feedback to give the circuit hysteresis.

E.H.T. CIRCUIT (See Fig. 6)

The e.h.t. voltage required for the probe is supplied by a 'ringing choke' converter. This consists of a transformer-coupled oscillator, 3VT1, and a voltage quadrupler formed by the rectifiers 3D6 to 3D9, with the associated RC network.

The output voltage can be adjusted by RV2 and switched off for test purposes by the switch SC ganged to it. 3D2, 3C4 and 3R3 form a peak rectifier circuit. When the function switch is set to the EHT position the rectified voltage is connected to the display meter, to give an arbitrary indication of e.h.t. voltage.

Changes in output voltage, due to changes of temperature are minimised by means of a compensating diode 3D1.

The stability of the output voltage is largely dependent on the stability of the -5V supply. This is so controlled that a 10% change in battery voltage gives less than 1% change in e.h.t. voltage.

STABILISED POWER SUPPLY (See Figs. 6 and 8)

This provides a stabilised, low impedance output of approximately -5V with respect to earth and a bias voltage of approximately +0·7V.

The input voltage (from battery BY1, Fig. 6) is applied to the stabiliser card 1, pin 8.

In this circuit, changes in output voltage are compared with a voltage derived from the zener diode 1D2. The difference voltage is amplified by 1VT3 and 1VT2 and applied to the base of 1VT1. The resulting change in current through this transistor is sufficient to restore the output voltage to its original value.

1R1 and 1D1 shunt 1VT1 to produce the +0·7V bias voltage.

With the control switch SB set to BATT, the display meter is connected to monitor the battery voltage.

[B] MAINTENANCE

NOTE: In view of the E.H.T. potentials, care should be taken when carrying out maintenance and adjustments to the exposed chassis.

The following equipment is required for setting up and checking the instrument.

(i) Multirange Testmeter 20kΩ/V.
(ii) Pulse Generator giving negative pulses; amplitude 50mV to 2V p.r.f. 10c/s to 10kc/s, pulse width 10μs.
(iii) Relay 12V (180Ω), connected to a plug for mating to the socket SKTC.
(iv) Beta Scintillation Probe (e.g. Nuclear Enterprises Dual Probe type DP).
(v) Radiation source e.g. 5-25mCi Cobalt 60.

To remove the instrument from its case, unscrew the four captive screws in the base.

Set the meter mechanical zero with the monitor in a horizontal position.

When switched to BATT (the EHT must be off) ensure that the meter indicates within the battery region.

With the E.H.T. still switched off, switch the loudspeaker on, select α+β and X100, and measure the d.c. supply between pins 11 (M) +VE and 23 (AA) of SKTA the socket holding Card 1. This should be between 4·9 and 5·4V. The voltage between pins 13 (P) +VE (M) should be 0·5 to 0·8V.

Remove the Testmeter and connect the Pulse Generator set to 10c/s, 50mV negative pulses in its place, turn the SET TRIP control fully anti-clockwise connect the plug with the relay attached to socket SKTC and switch to α+β X1.

Gradually raise the pulse amplitude until a high ratemeter reading and an audible response are obtained. Approximately half-scale deflection should occur with an input between 70-95mV.

With the input at 150mV switching to α should

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cause both meter and loudspeaker response to disappear, returning when the switch is set to β. Adjust RV1 on the component card (Card 1) to give a reading of 10 counts/second on the ratemeter.

With the switch at β, raise the input amplitude until the meter deflection falls again to half-scale which should occur with an input of between 0·7V and 1·1V. With the input raised to 2V there should be no response.

Switch to α+β and ensure that there is a positive meter reading and loudspeaker response (Alpha tones) in each case.

Set the input amplitude to 150mV and calibrate the other ratemeter ranges to full-scale deflection in the following manner:-

Switch to X10, feed in a pulse rate of 100c/s and adjust RV2.

Switch to X100, feed in a pulse rate of 1kc/s and adjust RV3.

Switch to X1000, feed in a pulse rate of 10kc/s and adjust RV4.

Ensure that the loudspeaker output consists of Beta tones on all ranges.

Maintaining an input 150mV pulses at 10kc/s adjust the SET TRIP control slowly clockwise from the maximum anti-clockwise until the relay energises. Next lower the p.r.f. until the relay de-energises. The pulse rate at which this occurs should be between 6-8kc/s. Remove the relay, switch off and remove the Pulse Generator.

Turn the SET FAIL SAFE control slowly clockwise from the anti-clockwise position until a continuous audio tone is emitted by the loudspeaker. Turn the control back approximately 10 degrees from this point.

Switch to X1000 range and expose the probe to the radiation source so as to cause a meter deflection over full-scale. The meter reading may fall to zero and the continuous audio tone should occur. Removing the radiation source some distance should restore the positive meter reading and normal pulse tones.

On completion, return the instrument to its case.

[C] COMPONENTS LIST

(i) COMP. PCM3 CARD (STABILISED POWER SUPPLY, INPUT AMPLIFIER, RANGE MULTIPLIER AND AUDIO STAGE).

CAPACITOR	1C1	Not used
	1C2	0·1μF, 20%, 30V
	1C3	0·22μF, 20%, 30V
	1C4	0·022μF, 20%, 30V
	1C5	0·0022μF, 5%, 125V
	1C6	220pF, 5%, 125V
	1C7	390pF, 10%, 500V
	1C8	100pF, 5%, 125V
	1C9	0·1μF, 20%, 30V
	1C10	200μF, +50-10%, 6·4V

	1C11	33pF, 5%, 750V
	1C12	1000µF, +20-10%, 2·5V
DIODE	1D1	IS920
	1D2	OAZ240
	1D3, 4	OA47
POTENTIOMETER	1RV1-4	47kΩ, 20%, 0·25W
RESISTOR	1R1	180Ω, 5%, 0·125W.
	1R2	1kΩ, 10%, 0·5W. RMA16
	1R3	2·2kΩ, 10%, 0·5W. RMA16
	1R4	68Ω, 10%, 0·5W. RMA16
	1R5	36kΩ, 5%, 0·25W. Welwyn C21
	1R6	10kΩ, 5%, 0·125W
	1R7	12kΩ, 5%, 0·25W. Erie 109
	1R8	750Ω, 5%, 0·25W. Erie 109
	1R9	Not used
	1R10	560Ω, 5%, 0·5W
	1R11	1kΩ, 5%, 0·25W. NJ60
	1R12	1kΩ, 5%, 0·25W. Welwyn C21
	1R13	3·3kΩ, 5%, 0·25W. Welwyn C21
	1R14	2·7kΩ, 10%, 0·5W. RMA16
	1R15	100Ω, 5%, 0·25W. Erie 109
	1R16	270Ω, 5%, 0·25W. Erie 109
	1R17	2·7kΩ, 5%, 0·25W. Erie 109
	1R18-21	27kΩ, 5%, 0·25W. Welwyn C21
	1R22	Not used
	1R23	1·5kΩ, 5%, 0·25W. Welwyn C21
	1R24	2·2kΩ, 5%, 0·25W. Erie 109
	1R25	68Ω, 10%, 0·5W. RMA16
	1R26	100kΩ, 5%, 0·25W. Erie 109
	1R27	2·2kΩ, 10%, 0·5W. RMA16
	1R28	3·9kΩ, 10%, 0·5W. RMA16
	1R29	1·8kΩ, 10%, 0·5W. RMA16
	1R30	680Ω, 10%, 0·5W. RMA16
	1R31	3·3kΩ, 10%, 0·5W
	1R32	Not used
	1R33	22Ω, 10%, 0·5W. RMA16
	1R34-36	33kΩ, 5%, 0·125W
TRANSISTOR	1VT1	ACY20
	1VT2, 3	2N1302
	1VT4-6	BCY07

	1VT7		ASZ21
	1VT8-11		BCY70
	1VT12		ACY20

(ii) DISC. PCM3 CARD (Discriminators, Anti-coincidence and Alarm Circuits)

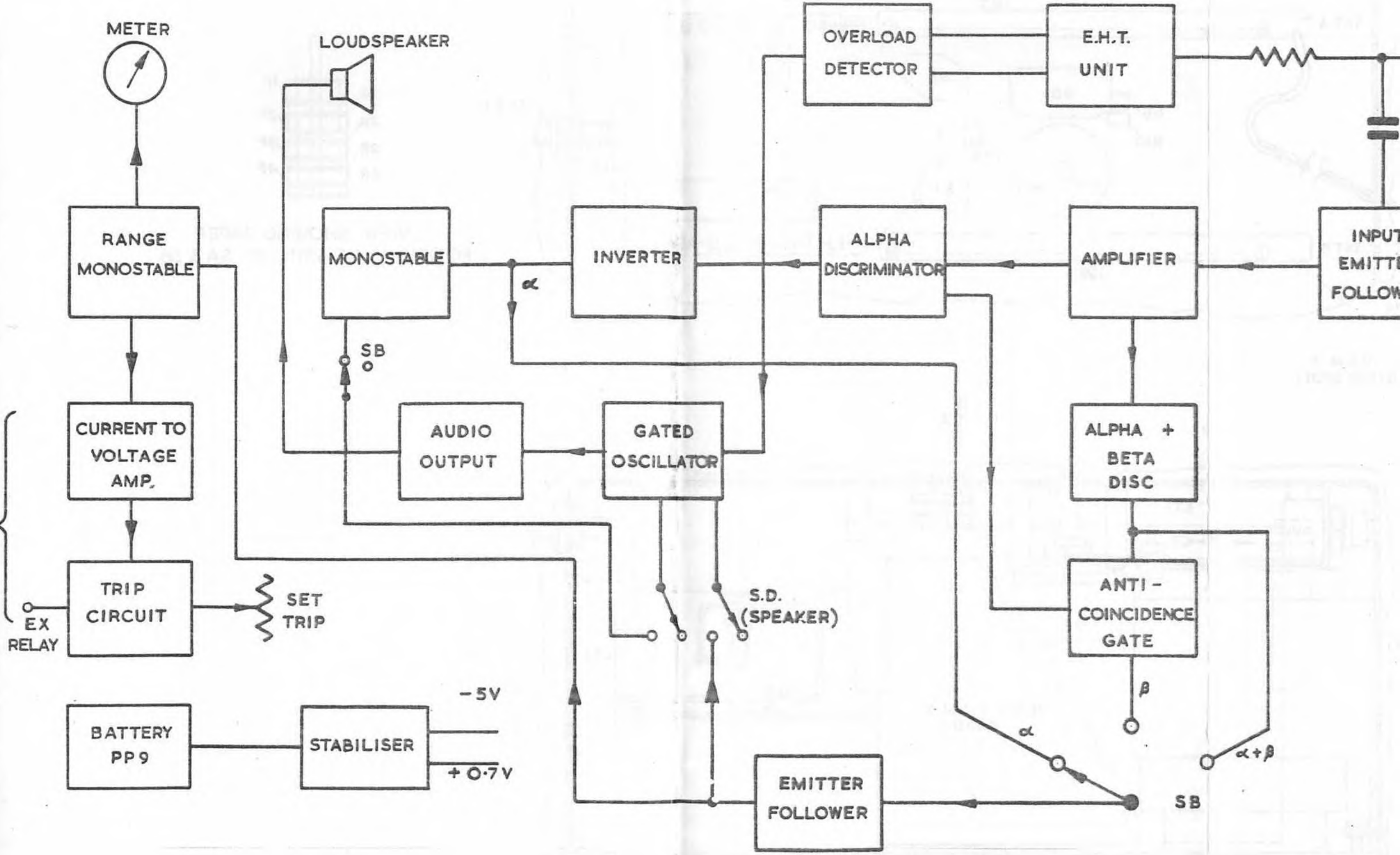
CAPACITOR	2C1	0·1μF, 20%, 30V
	2C2	1000pF, 5%, 125V
	2C3	200μF, +50-10%, 6·4V
	2C4	100pF, 10%, 500V
	2C5-7	Not used
	2C8	0·22μF, 20%, 30V
	2C9	25μF, +50-10%, 6·4V
	2C10	82pF, 2pF, 125V
DIODE	2D1, 2	1N3712
	2D3, 4	Not used
	2D5	OA91
	2D6	1N914
	2D7	OA91
RESISTOR	2R1	820Ω, 5%, 0·25W. Welwyn C21
	2R2	470Ω, 5%, 0·25W. Welwyn C21
	2R3, 4	3·9kΩ, 5%, 0·25W. Welwyn C21
	2R5, 6	680Ω, 5%, 0·25W. Welwyn C21
	2R7, 8	3·9kΩ, 5%, 0·25W. Welwyn C21
	2R9, 10	10kΩ, 10%, 0·5W. RMA16
	2R11	6·8kΩ, 5%, 0·25W. Welwyn C21
	2R12, 13	390Ω, 10%, 0·5W. RMA16
	2R14	12kΩ, 5%, 0·25W. Welwyn C21
	2R15	2·2kΩ, 10%, 0·5W. RMA16
	2R16	Not used
	2R17	33kΩ, 5%, 0·5W. NJ60
	2R18	27kΩ, 10%, 0·5W. RMA16
	2R19	10kΩ, 5%, 0·25W. Welwyn C21
	2R20	2·2kΩ, 10%, 0·5W. RMA16
	2R21	4·7kΩ, 10%, 0·5W. RMA16
	2R22	10kΩ, 5%, 0·125W.
	2R23	150kΩ, 5%, 0·25W. Welwyn C21
	2R24	4·7kΩ, 10%, 0·5W. RMA16
	2R25	4·7kΩ, 5%, 0·25W. Welwyn C21
	2R26	18kΩ, 5%, 0·25W. Welwyn C21
	2R27	39kΩ, 5%, 0·25W. Welwyn C21
	2R28	18kΩ, 5%, 0·125W

	2R29	10kΩ, 5%, 0·25W. Welwyn C21
	2R30	2·2kΩ, 10%, 0·5W. RMA16
	2R31	3·3kΩ, 5%, 0·25W. Welwyn C21
	2R32	1·2kΩ, 5%, 0·25W. Welwyn C21
	2R33	1·5kΩ, 10%, 0·5W. RMA16
	2R34	2·2kΩ, 5%, 0·25W. Welwyn C21
	2R35	2·7kΩ, 5%, 0·25W. Welwyn C21
	2R36	330Ω, 5%, 0·25W. Welwyn C21
	2R37	2·7kΩ, 5%, 0·25W. Welwyn C21
	2R38	56kΩ, 5%, 0·25W. Welwyn C21
	2R39	3·9kΩ, 10%, 0·5W. RMA16
	2R40	1kΩ, 5%, 0·25W. Welwyn C21
	2R41	5·6kΩ, 5%, 0·25W. Welwyn C21
	2R42	3·3kΩ, 5%, 0·25W. Welwyn C21
	2R43	4·7Ω, 5%, 0·25W. Welwyn C21
TRANSISTOR	2VT1-4	ASY27
	2VT5	BCY70
	2VT6	2N3703
	2VT7	ASZ21
	2VT8	2N3703
	2VT9	ACY21
	2VT10, 11	2S323
	2VT12-14	2N3703
	2VT15	2N1302
	2VT16	ACY20
	2VT17	2N1302

(iii) MAIN ASSEMBLY AND E.H.T. CARD

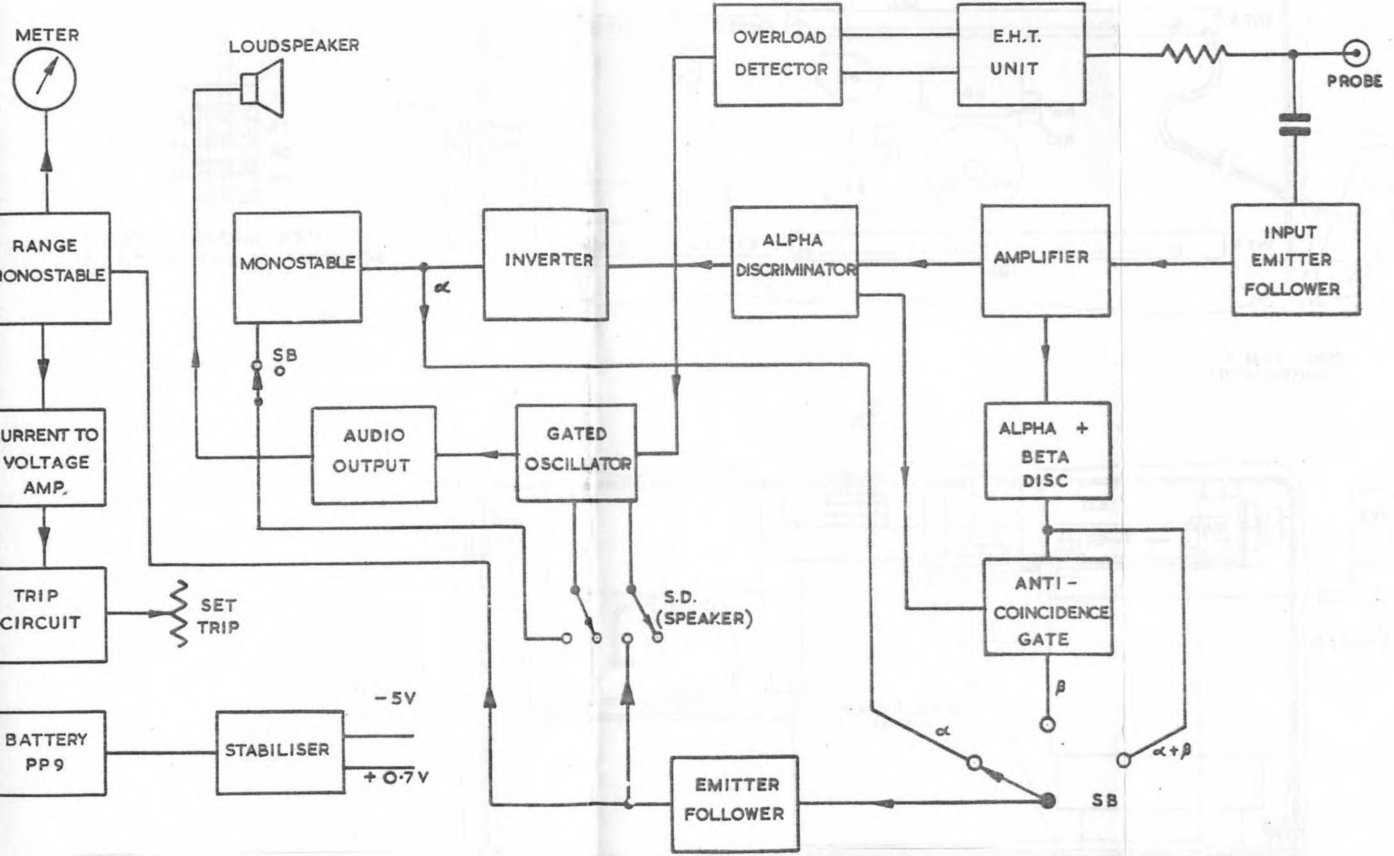
CAPACITOR	C1	Not used
	3C2	500μF, +50-10%, 2·5V
	3C3	200μF, +50-10%, 6·4V
	3C4	0·1μF, 20%, 30V
	3C5, 6	100pF, 20%, 3·5kV
	3C7, 8	0·01μF, G.M.V., 2kV
	3C9	320μF, +50-10%, 6·4V
	3C10	0·01μF, G.M.V., 2kV
	3C11	330pF, 20%, 4kV
	3C12	320μF, +50-10%, 2·5V
	3C13	0·01μF, 20%, 30V
	3C14	0·1μF, 20%, 30V
	3C15, 16	0·01μF, 20%, 30V
DIODE	3D1	OA10

	3D2, 3	1S130
	D4	Not used
	D5	1S130
	3D6-9	BYX10
LOUDSPEAKER	LS1	3Ω
METER	M1	0-250µA. Duplex 4E/B9206
POTENTIOMETER	RV1	2·5kΩ, 20%, 0·25W
	RV2	1kΩ, 20%, 1W. (with SC)
	RV3	500kΩ, 20%, 0·25W
RESISTOR	3R1	5·6kΩ, 10%, 0·5W. RMA16
	3R2	270Ω, 10%, 0·5W. RMA16
	3R3	33kΩ, 5%, 0·5W
	3R4	82Ω, 10%, 0·5W. RMA16
	3R5	470kΩ, 10%, 0·5W. RMA16
	3R6	1MΩ, 10%, 0·5W. RMA16
	3R7	1·8kΩ, 5%, 0·25W.
	3R8	33kΩ, 5%, 0·125W.
	3R9	1kΩ, 5%, 0·25W. Erie 109
	3R10	4·7kΩ, 10%, 0·5W. RMA16
	3R11	2·7kΩ, 10%, 0·5W. RMA16
	3R12	47kΩ, 10%, 0·5W. RMA16
	3R13, 14	100kΩ, 10%, 0·5W. RMA16
	3R15	68kΩ, 10%, 0·5W. RMA16
SOCKET	SKTA	24 way. 1E/A19718
	SKTB	24 way. 1E/A19718
	SKTC	2 way (EXT RELAY). 7A/A2507A
	SKTD	coaxial 1E/A19586
SWITCH	SA	1E/A38884/4
	SB	1E/A38884/5
	SC	with RV2. 1E/38884/5
	SD	Slider. 1E/A38731/D
TRANSFORMER	3T1	1E/A/A35538
TRANSISTOR	3VT1	ACY21
	VT2	2N3703
	3VT3, 4	BCY70



PORTABLE CONTAMINATION MONITOR TYPE 3

F



PORTABLE CONTAMINATION MONITOR TYPE 3

FIG. 3

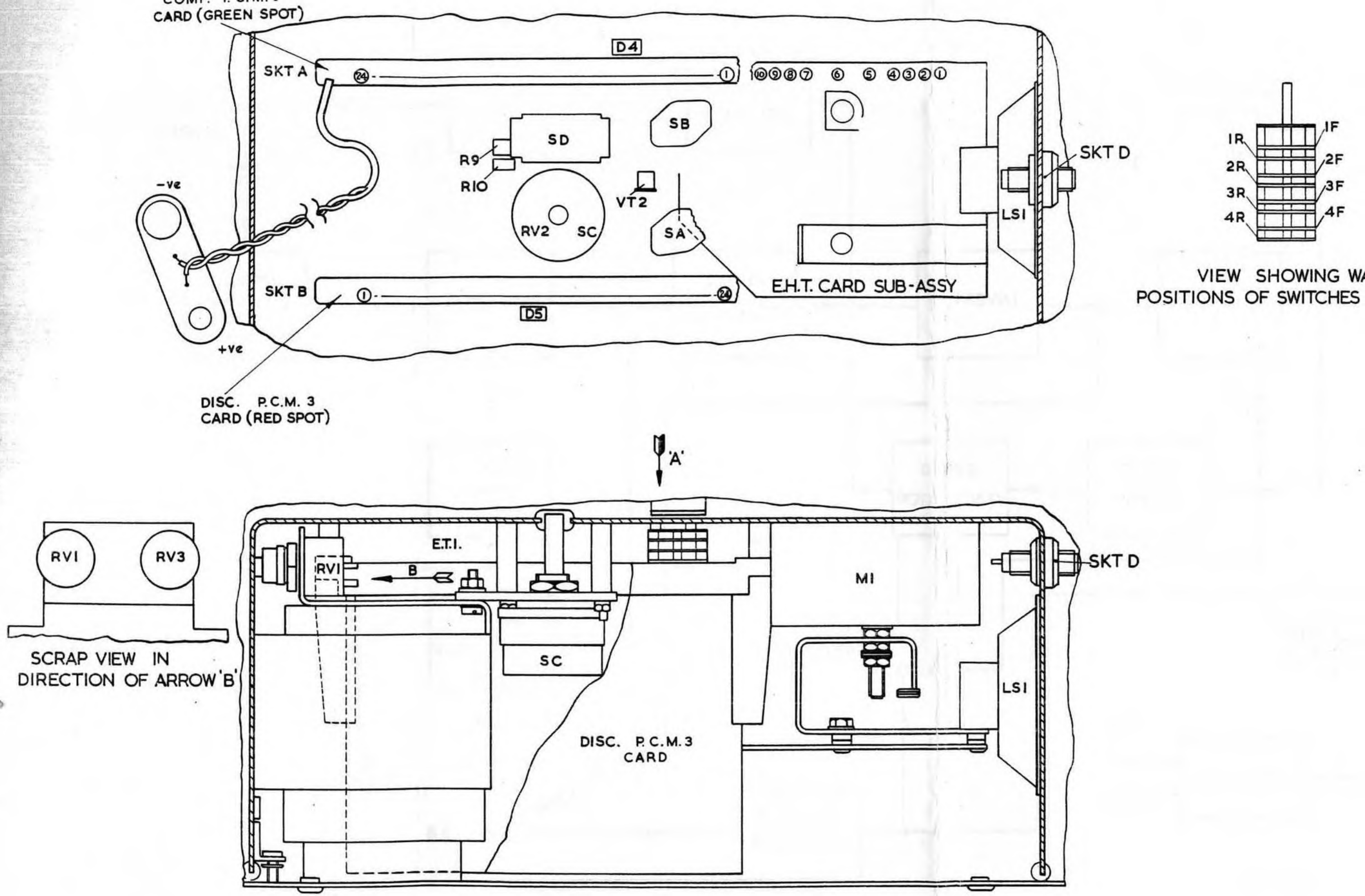
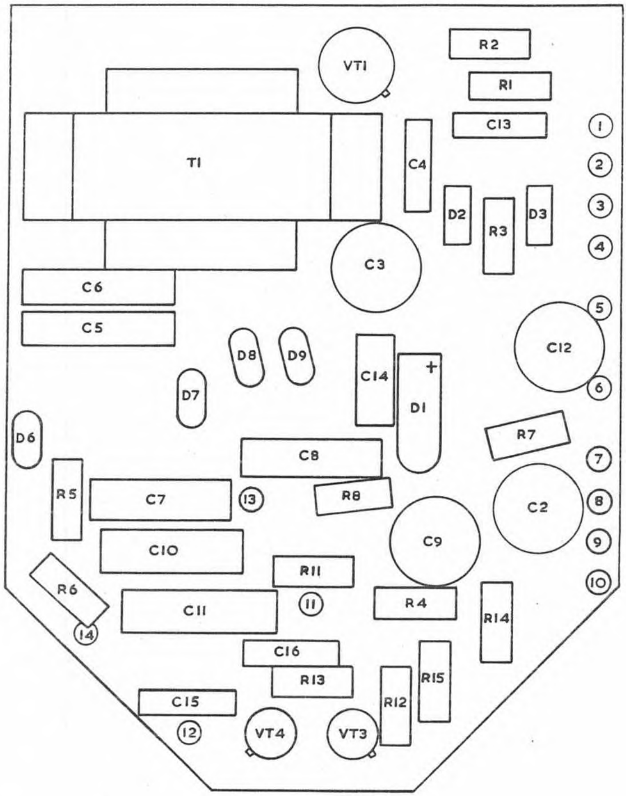


FIG 4 LAYOUT OF MAIN ASSEMBLY COMPONENTS

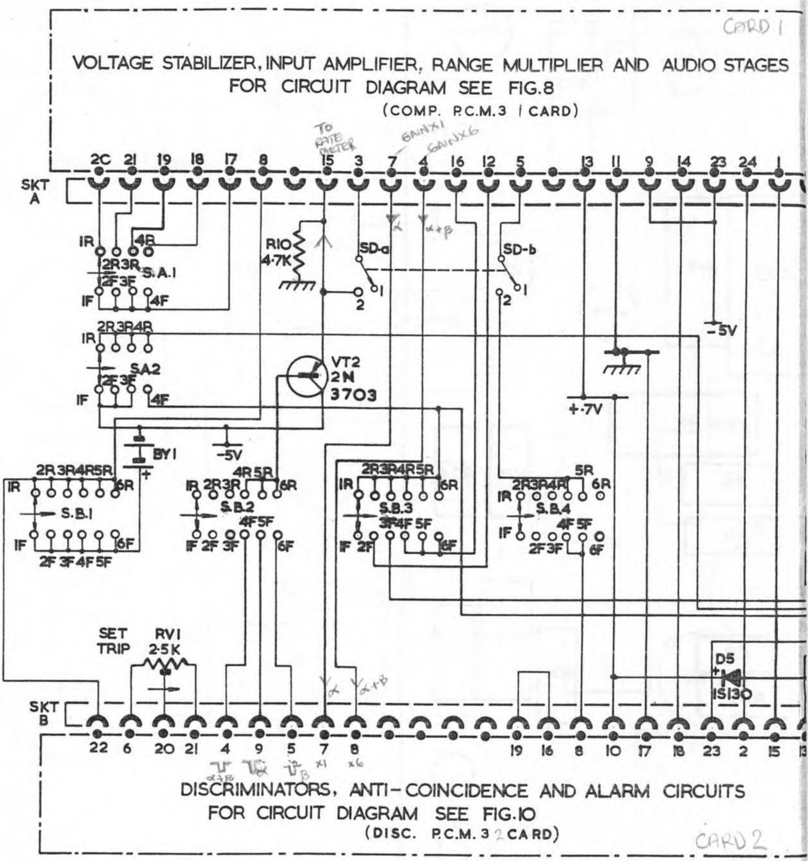


CARD 3

E.H.T. SUB - ASSEMBLY

FIG. 5

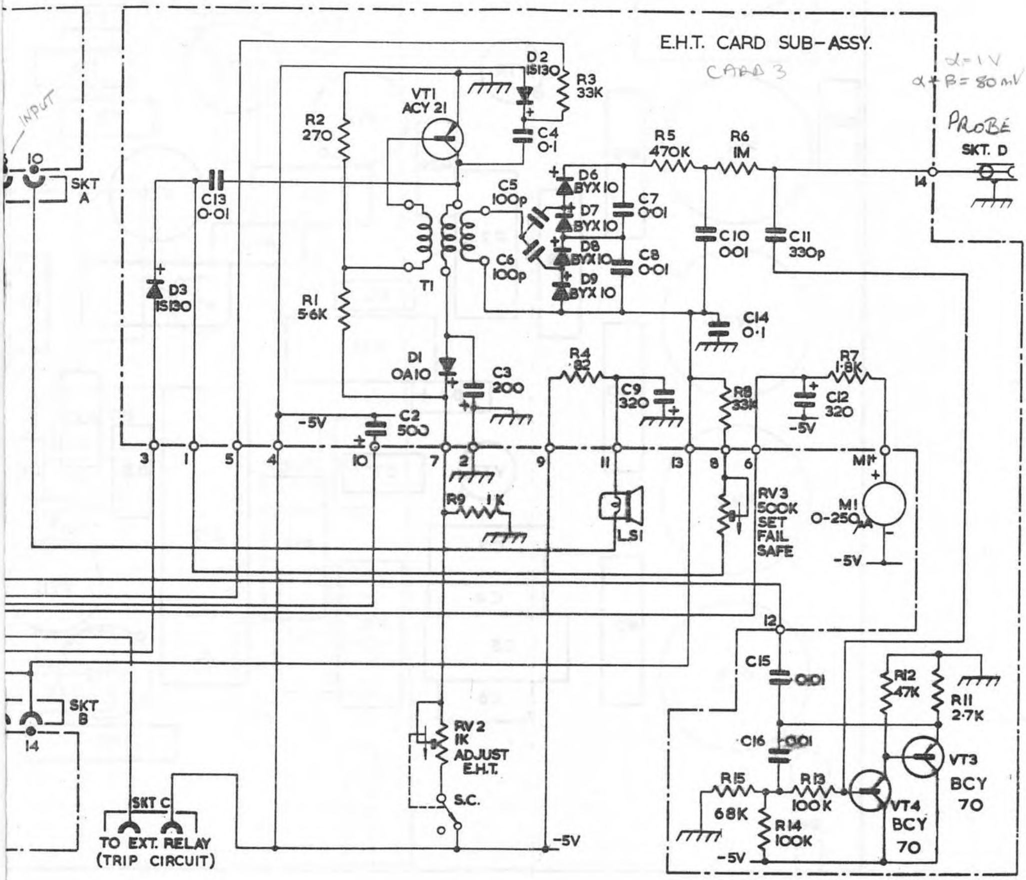
TL1429



SWITCH A	
POS.	FUNCTION
1	X1000
2	X100
3	X10
4	X1

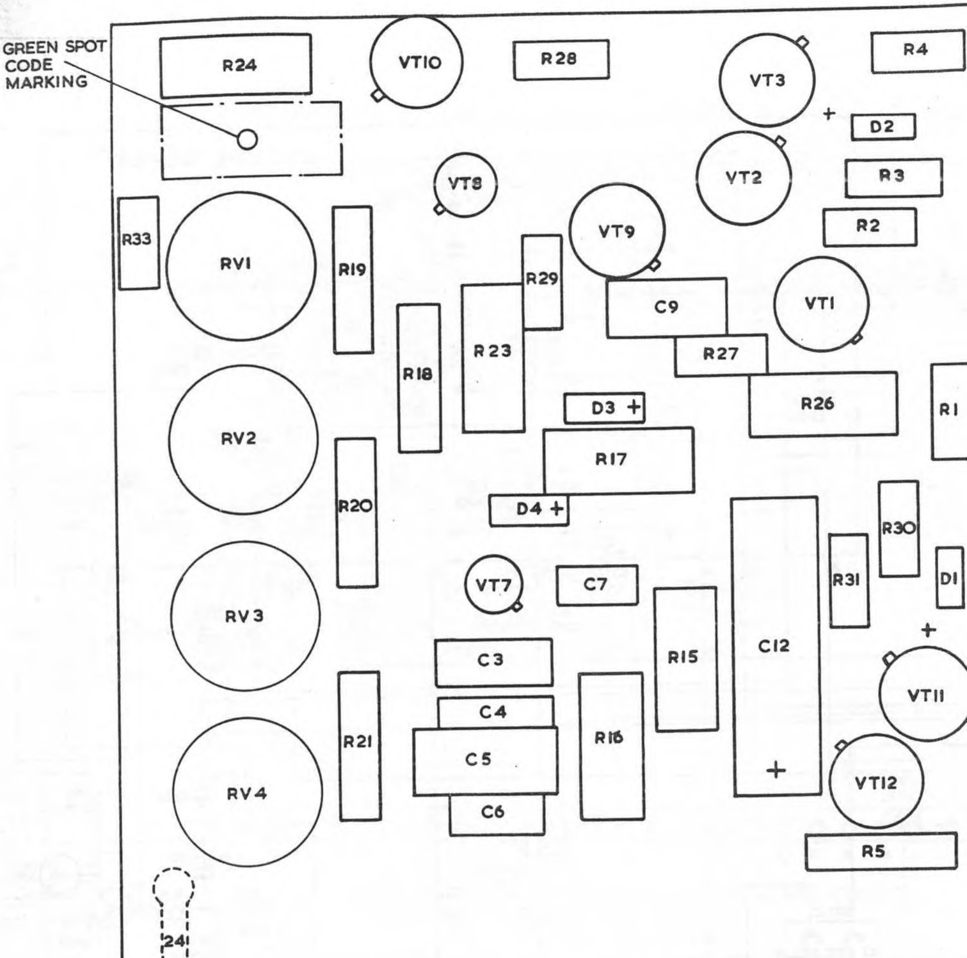
SWITCH B	
POS.	FUNCTION
1	OFF
2	BATT.
3	E.H.T.
4	$\alpha + \beta$
5	α
6	β

SWITCH D	
SPEAKER	
POS.	FUNCTION
1	OFF
2	ON



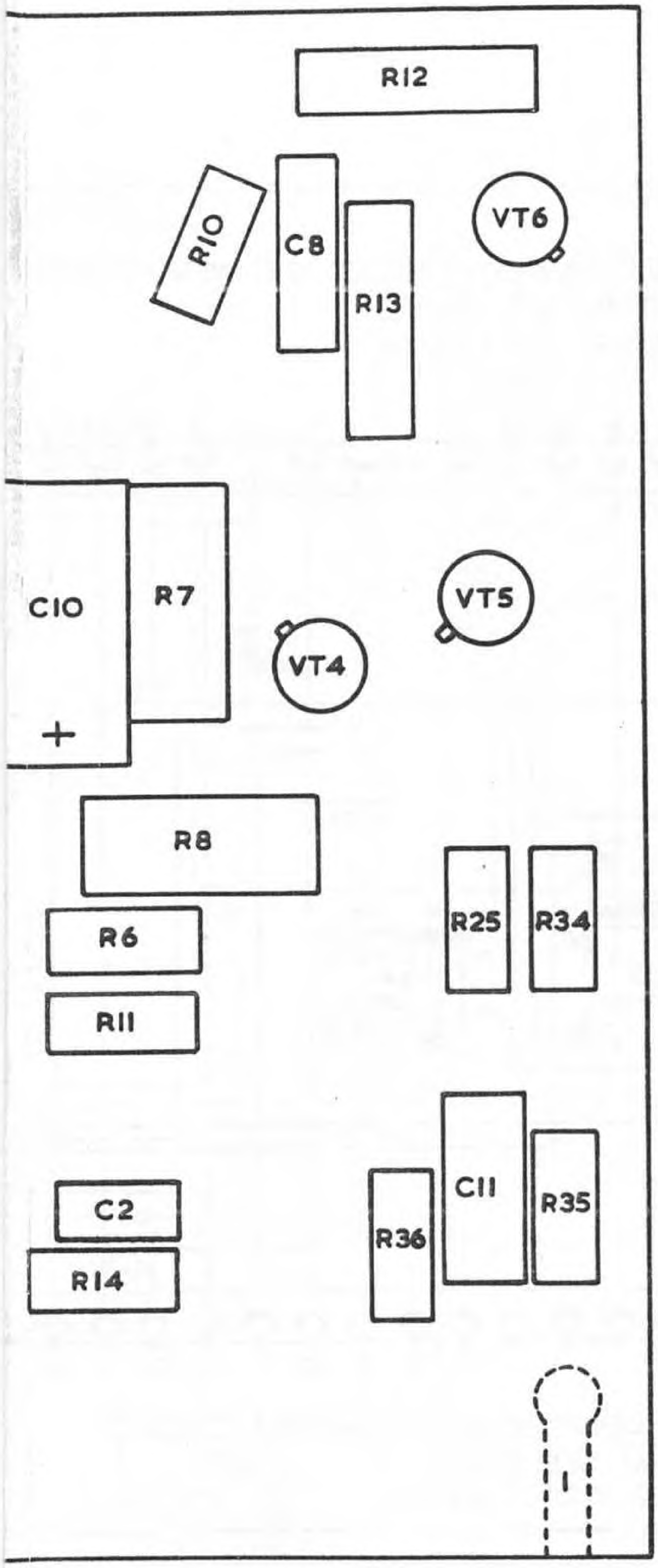
H.T. CIRCUIT AND MAIN ASSEMBLY

FIG. 6

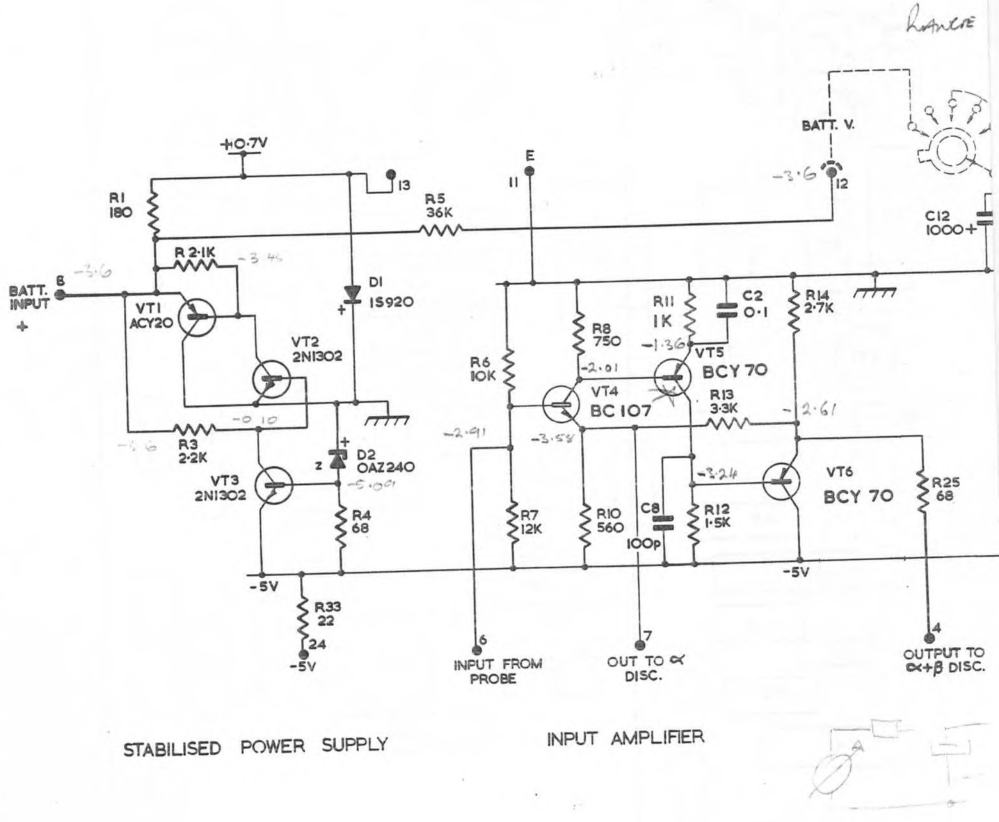


CARD 1, COMP. PCM 3

VOLTAGE STABILIZER, INPUT AMPLIFIER, RANGE MULTIPL



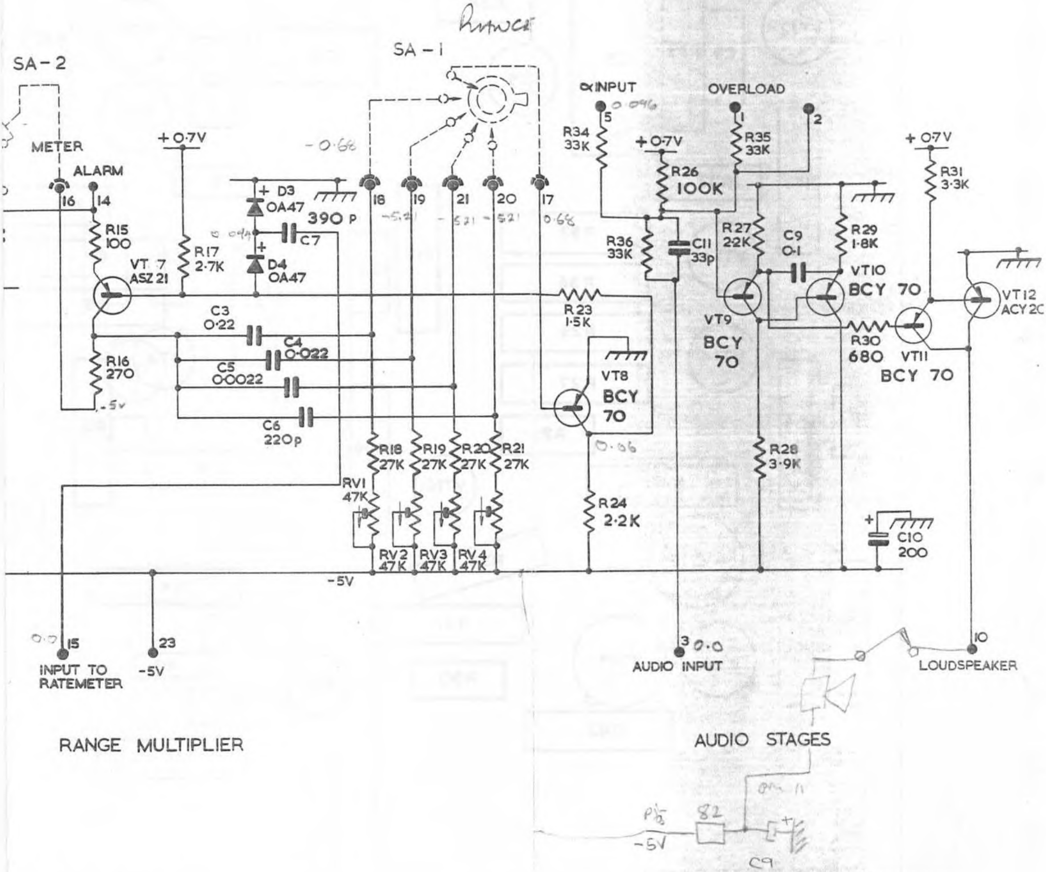
ER AND AUDIO STAGES



CARD I

VOLTAGE STABILIZER, INPUT AMPLIFIER, RA

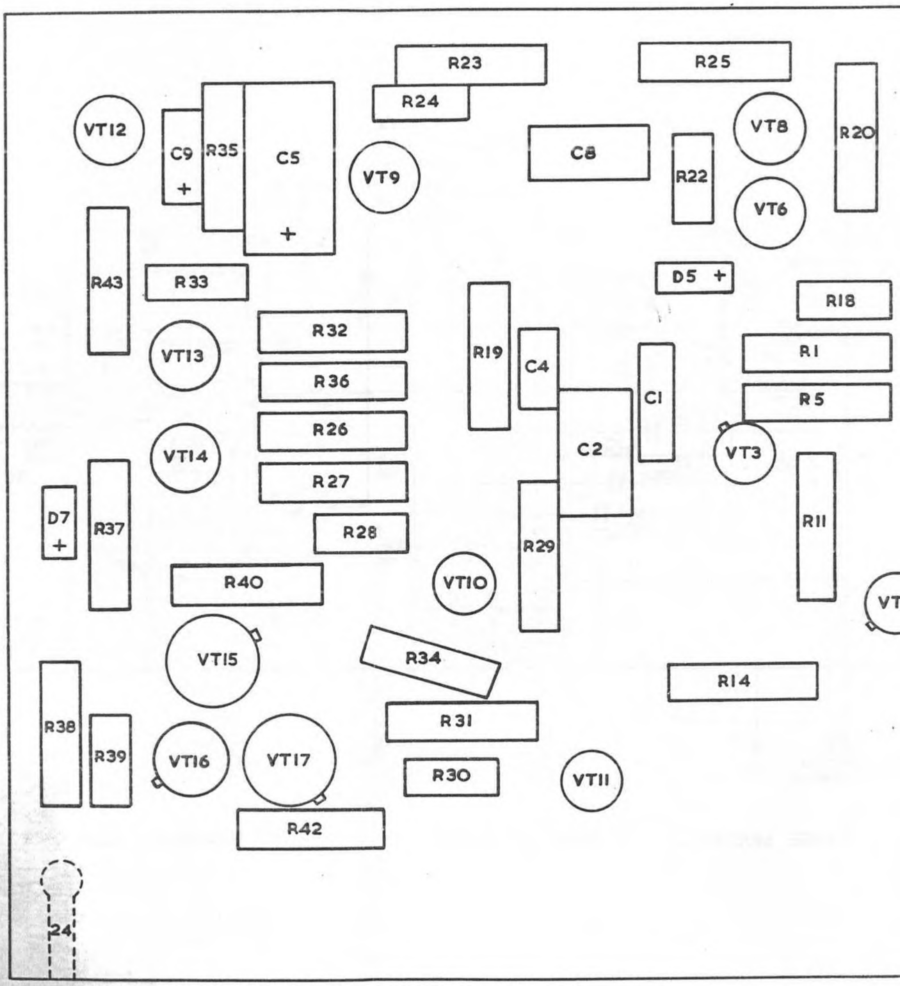
TL 1429



COMP. PCM 3

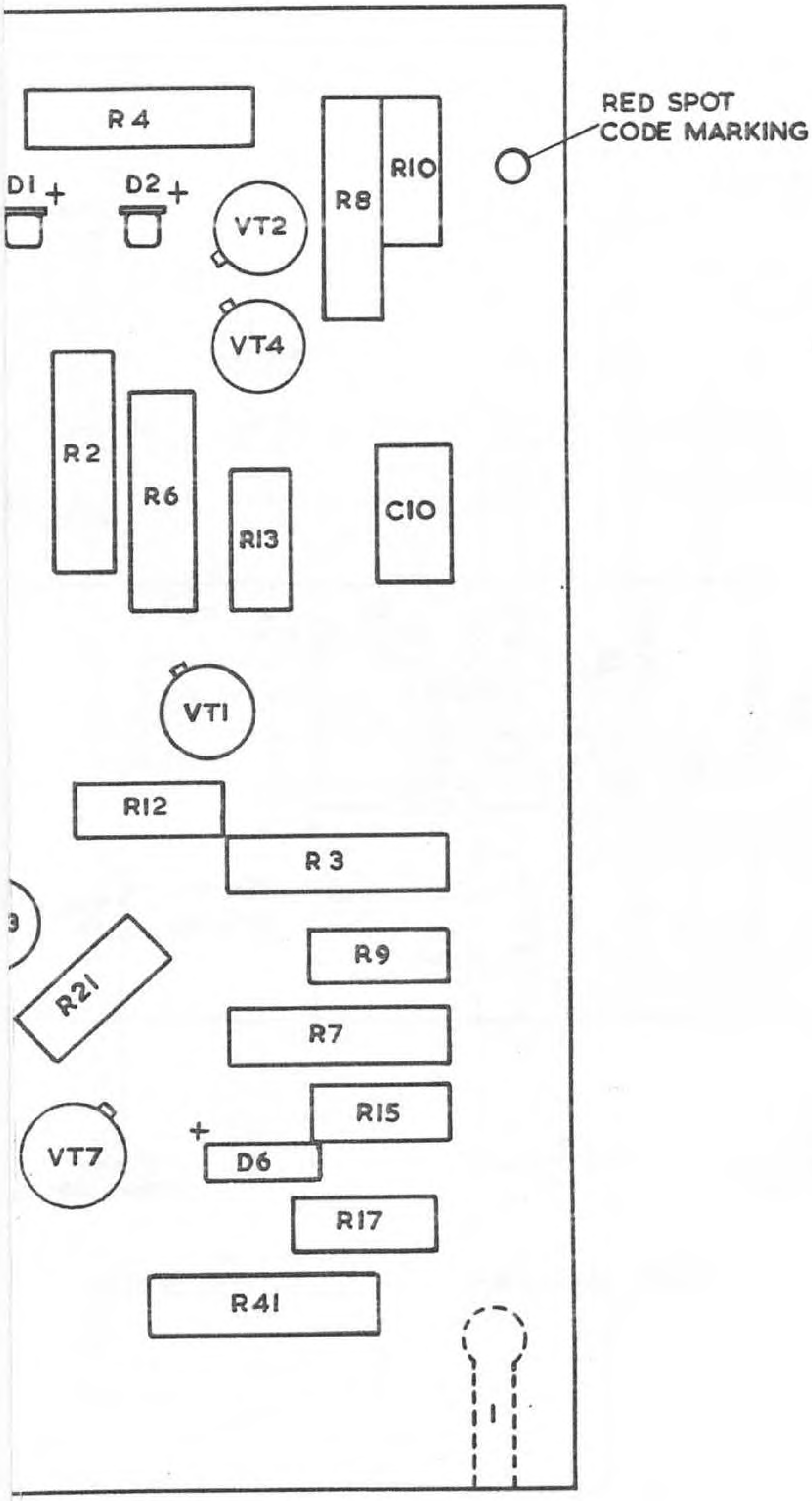
GE MULTIPLIER AND AUDIO STAGES

FIG. 8

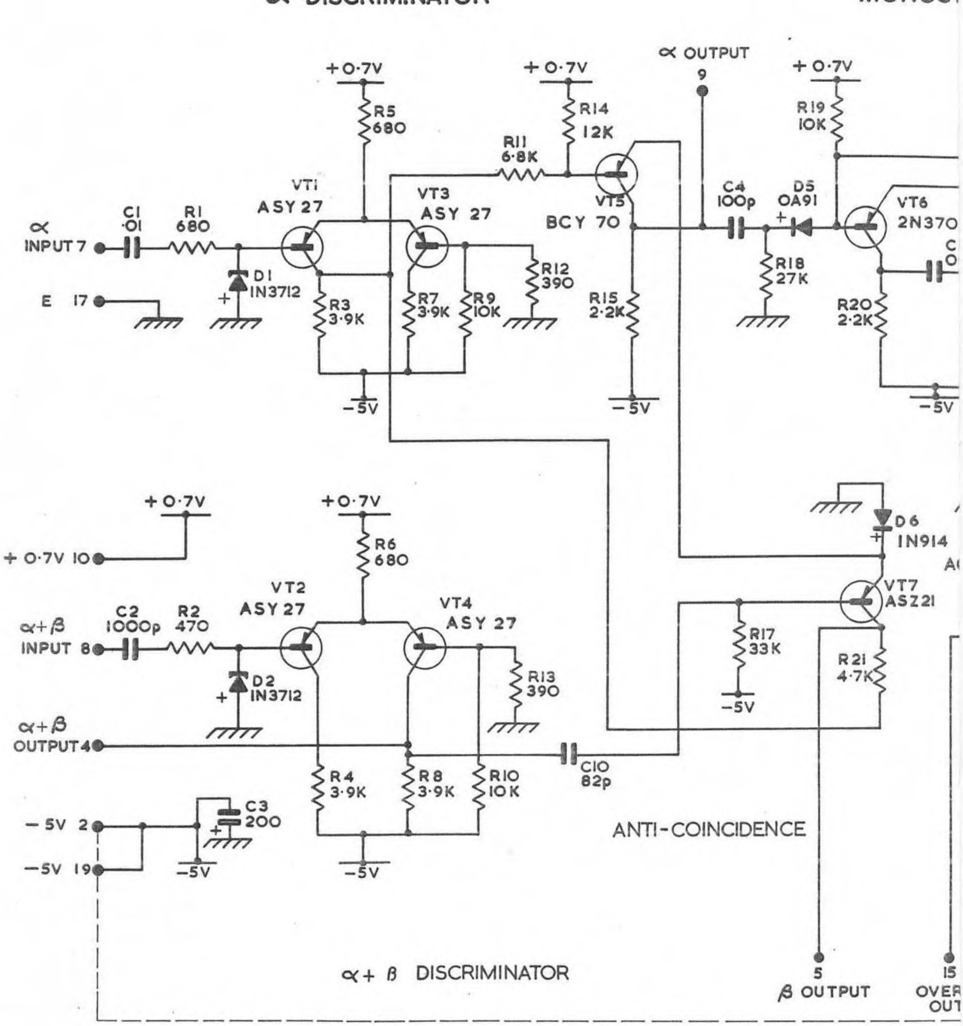


CARD 2, DISC. PCM3

DISCRIMINATORS, ANTI-COINCIDENCE, AND ALARM CI


RED SPOT
CODE MARKING
R4
R10
R8
D1 +
D2 +
VT2
VT4
R2
R6
R13
C10
VT1
R12
R3
R9
R21
R7
R15
VT7
D6
R17
R41

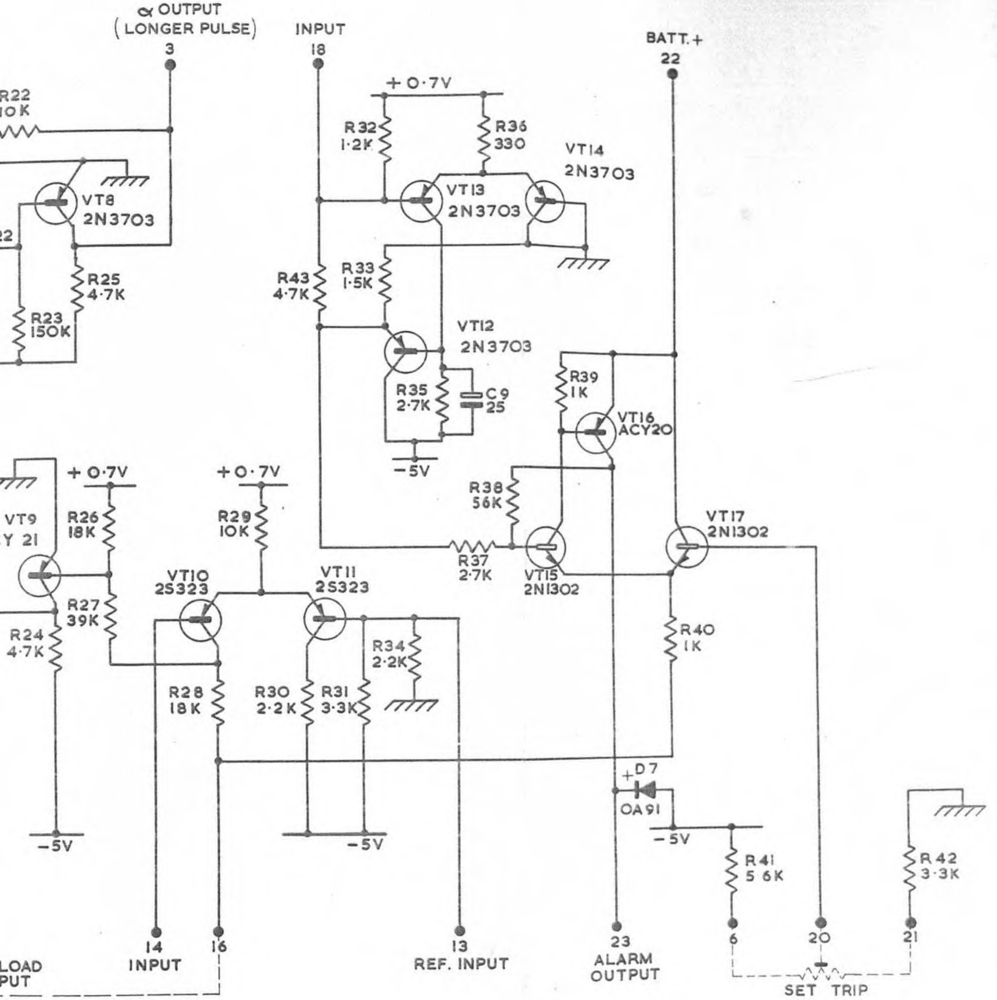
RCUITS



CARD 2,

DISCRIMINATORS, ANTI-COINCIDENCE

TL 1429



DISC. PCM 3

AND ALARM CIRCUIT

FIG 10