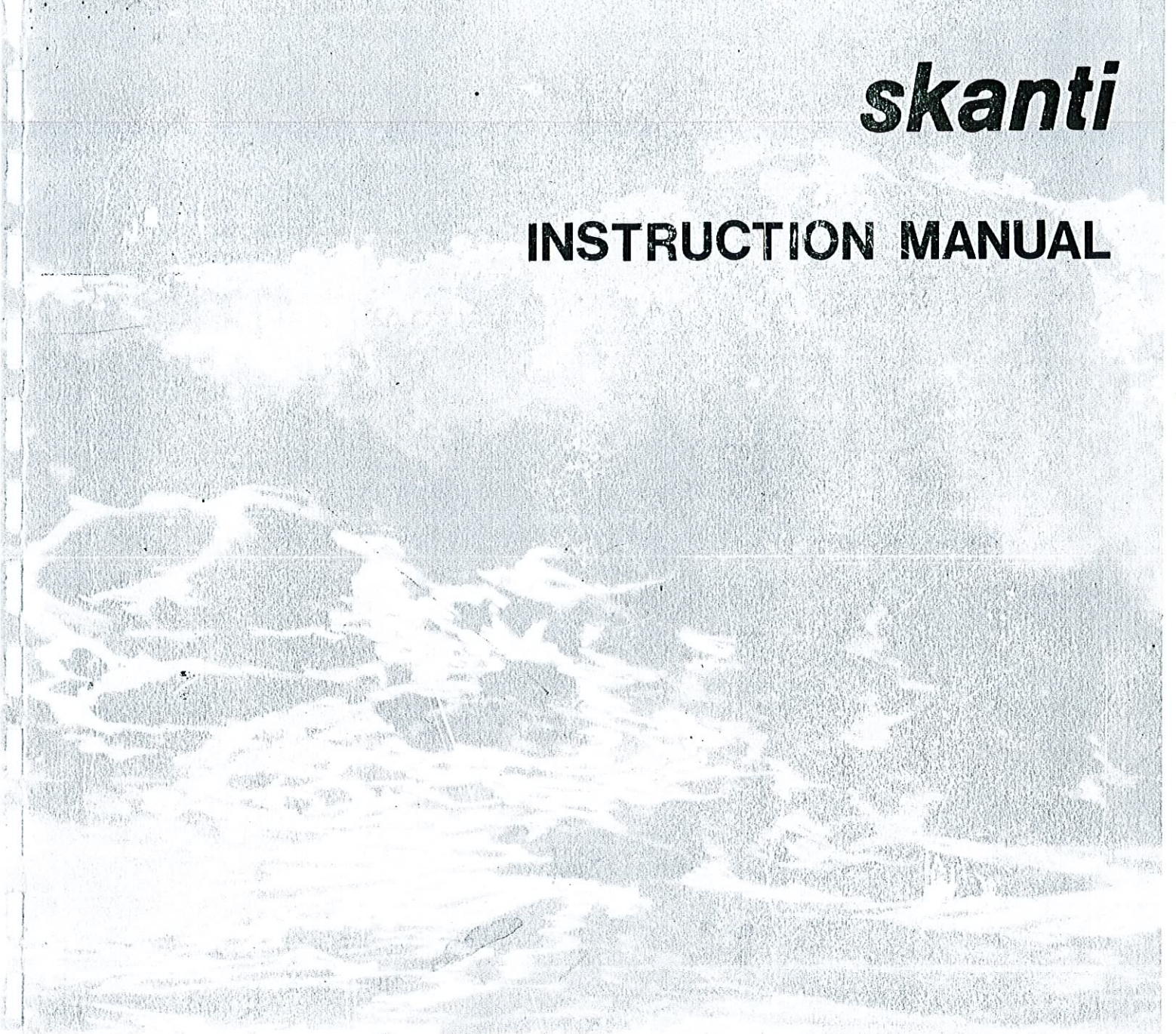
skanti

INSTRUCTION MANUAL



SSB RADIOTELEPHONE
Type TRP5000

TRANSMITTER AND POWER PACKS
T5000, E5000, E5001, P5000 AND P5001

T 5000 TUNING CHART

Ship:_____ Harbour:_____

Technician:_____ Date:_____ T5000 serial no.:_____

Supply voltage:_____V DC/AC-50/60 Hz Antenna:_____

CHECK SWITCH readings are taken with POWER switch in position FULL POWER DUPLEX and MODE switch in position A3J.

CHECK SWITCH	TUNE button not pressed	TUNE button pressed
V_A		
V_{S1}		
V_{S2}		
V_G		
I_1		
I_2		
V_D		
Freq. kHz (not 2182):		

LEVEL readings are taken with POWER switch in position MEDIUM POWER SIMPLEX and TUNE button pressed. ANTENNA CURRENT readings are taken with POWER switch in position FULL POWER SIMPLEX and TUNE button pressed. Readings are taken on that frequency in each band which gives the highest Level reading.
Mark in plan below positions on drum switch in which programming tabs have been inserted.

BAND	FREQ. kHz	LEVEL	ANT. CUR-RENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2182	—																													
A																														
B																														
C																														
D																														
E																														
F																														
G																														
H																														
4MHz																														
6MHz																														
8MHz																														
12MHz																														
16MHz																														
22MHz																														
25MHz																														

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TRP 5000 INSTRUCTION MANUAL

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NOTICE

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TRP 5000
INSTRUCTION MANUAL

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF DIAGRAMS

1. Introduction

1.1 The TRP 5000 is a single sideband radiotelephone transmitter receiver combination for duplex, semiduplex and simplex telephone traffic in the 1.6–4 MHz coastal telephone band and in the maritime mobile shortwave bands between 4 and 27.5 MHz. In addition the TRP 5000 provides facilities for radiotelegraph and telex transmission and reception

The TRP 5000 is composed of the T 5000 transmitter power amplifier, the P 5000 (24 V DC) or the P 5001 (AC) power pack, the E 5000 exciter and the R 5000 receiver. This instruction manual describes the Transmitter Power Amplifier, the Exciter and the Power Packs, while the Receiver is covered in a separate manual.

The transmitter is fully synthesized and provides keyboard selection of up to 256 pre-programmed frequencies, which can be freely distributed in the maritime frequency bands.

Silicon transistors and integrated circuits are used throughout except for the transmitter power amplifier stage. These features in conjunction with the fact that no crystal ovens are used enable the transmitter to be ready for operation within 30 seconds after being switched on.

The cabinet is a sturdy 19-inch rack construction containing all necessary interconnections.

Because we are constantly processing the experience gained during the production and operation of our equipment, it is possible for minor modifications to occur relative to the information given in this instruction manual. Wherever practicable, however, any corrections will be listed on a correction sheet at the back of the front cover of this manual.

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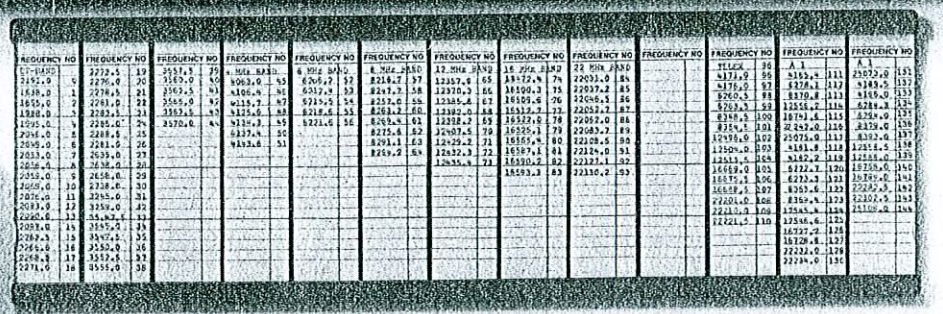
TRP 5000

T 5000



FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO	FREQUENCY NO
1.5 BAND	3273.5 19	3557.5 79	4 MHz BAND	6 MHz BAND	6 MHz BAND	8 MHz BAND	12 MHz BAND	16 MHz BAND	22 MHz BAND		FLEX 96	A 1	A 1
3192.0 9	3276.0 20	3569.0 80	4063.0 45	6206.2 52	8218.7 57	12357.6 65	16772.4 74	22031.0 84			4171.0 97	8165.4 111	21652.0 131
1638.0 1	3278.5 21	3563.5 81	4106.4 46	6312.4 53	8247.7 58	12370.3 66	16790.3 75	22037.2 85			4176.0 98	8218.1 112	21683.5 132
1659.0 2	3283.0 22	3565.0 82	4115.7 47	6315.5 54	8257.0 59	12385.6 67	16809.6 76	22046.5 86			8240.5 99	8270.8 113	21849.0 133
1888.0 3	3283.5 23	3582.5 83	4125.0 48	6218.6 55	8263.2 60	12390.0 68	16819.9 77	22052.7 87			8263.5 99	12555.2 114	21884.8 134
1895.0 4	3285.0 24	3570.0 84	4134.3 49	6221.6 56	8269.4 61	12398.2 69	16832.0 78	22062.0 88			8268.5 100	16791.6 115	21934.0 135
2046.0 5	3288.5 25		4237.4 50		8275.6 62	12407.5 70	16835.1 79	22083.7 89			8284.5 101	16792.0 116	21938.0 136
2045.0 6	3281.0 26		4243.6 51		8291.1 63	12429.2 71	16865.4 80	22108.5 90			12504.0 103	25075.0 117	21992.0 137
2033.0 7	2639.0 27				8259.2 64	12432.3 72	16587.1 81	22124.0 91			12513.5 104	4181.8 118	22016.5 138
2036.4 8	2638.0 28					12435.4 73	16590.2 82	22127.1 92			16669.0 105	8182.9 119	22155.0 139
2059.0 9	2658.0 29						16593.3 83	22130.2 93			16675.1 106	16792.0 120	22255.0 140
2060.0 10	2338.0 30										16658.1 107	6273.3 121	21849.0 141
2036.0 11	3285.0 31										22201.0 108	8363.6 122	22242.5 142
2083.0 12	3259.0 32										22210.3 109	8354.4 123	22302.5 143
2060.0 13	3542.5 33										22221.5 110	12546.4 124	22100.0 144
2083.0 14	3565.0 34											12546.6 125	
2089.5 15	3547.5 35											16727.2 126	
2065.0 16	3550.0 36											16728.8 127	
2068.5 17	3552.5 37											22232.0 129	
2071.0 18	3555.0 38											22234.0 130	

ANTENNA CURRENT
AMPERES

PUSH AND TUNE TO MAX. ANTENNA CURRENT

TUNING

LEVEL (MEDIUM POWER)

V_{S1} V_{S2} V_G I_1 I_2 V_A V_O

CHECK SWITCH (PULL)

25 MHz 2182 kHz A B C D E F G H 4 MHz 6 MHz 8 MHz 12 MHz 16 MHz 22 MHz

(B) BAND

SERIAL NO.

AIR FILTER
(CLEAN PERIODICALLY)

P 5000 NL

RECEIVE ONLY OFF TRANSMIT

(A) SUPPLY

FOR DISTRESS OPERATION ON 2182 kHz
SET CONTROLS AS FOLLOWS
A.. SUPPLY to TRANSMIT
BC. BANDs to 2182 kHz
D.. VOLUME fully clockwise
E.. SENSITIVITY fully clockwise
F.. MODE to TRANSMIT ALARM
G.. Press and release ALARM START
When alarm signal after 45 secs cease depress handset key and transmit distress message in accordance with instruction card

SERIAL NO.

1.6A 1.6A 3.15A 40A 8A 1.6A 0.1A

E 5000

FREQUENCY NO.

SIMPLEX MEDIUM LOW FULL FULL DUPLEX MEDIUM LOW

POWER

KEY

HANDSET

SERIAL NO.

TEST ALARM F1 A1 A2H A3A A3J A3H TRANSMIT ALARM

(F) MODE

(G) ALARM START

DIMMER

R 5000 NL

AGC OFF A3J A3A A3·A3H F1·A1 AGC ON A3J-A3A A3·A3H F1·A1

MODE

FREQUENCY

MHz kHz

(E) SENSITIVITY

(D) VOLUME

OFF ON

DUPLEX RANGES MHz 25 22 16 12 8 6 4

500 kHz 2182 kHz .01-1.6 .06-.18 .18-.53 .53-1.6 1.6-4 4-12 12-30

(C) BAND

PRESELECTOR RANGES MHz

PRESELECTOR TUNING

CLARIFIER

TUNING

DIMMER

SERIAL NO.

PHONES

2. Operating Instructions

2.1 Distress Operation on 2182 kHz

Set controls as follows:

A SUPPLY to TRANSMIT

B C BANDs to 2182 kHz

D VOLUME clockwise

E SENSITIVITY fully clockwise

F MODE to TRANSMIT ALARM

G Press and release ALARM START

The alarm signal is now transmitted for approx. 45 seconds and may be monitored in the handset earpiece. When the alarm signal ceases depress handset key and, speaking clearly into microphone, transmit distress message.

If it is required to repeat the alarm signal transmission, it is only necessary to press and release the ALARM START push button again.

An alarm signal transmission may be interrupted at any time by turning the MODE switch to A3H.

NOTE: In the TRANSMIT ALARM mode on 2182 kHz the power output of the transmitter is automatically set to FULL POWER SIMPLEX independent of the setting of the POWER switch.

2.2 Tuning to 2182 kHz

1. Set SUPPLY switch to TRANSMIT.
   30 seconds after switching on the transmitter is ready for operation.
2. Set BAND switch to 2182 kHz.
   The band-indicator lamp will show constant light indicating that 2182 kHz is selected. The FREQUENCY NO display will extinguish.
3. Press TUNE button and adjust TUNING control for maximum deflection on ANTENNA CURRENT meter.
   The tuning range on 2182 kHz is reduced so that power is transmitted even when the TUNING control is not adjusted.

The transmitter is now ready for operation.

NOTE: The type of service used on 2182 kHz is A3H, simplex. This mode is automatically selected when the BAND switch is set to 2182 kHz, and the MODE switch can therefore be set to any position except TEST ALARM. The equipment will also work in the simplex mode even if the POWER switch is in a DUPLEX position.

2.3 Tuning to a Frequency Other than 2182 kHz

1. Set SUPPLY switch to TRANSMIT.
   30 seconds after switching on the transmitter is ready for operation.
2. Set BAND switch to any band except 2182 kHz.
3. Turn DIMMER control fully clockwise
4. If FREQUENCY NO display does not show zero, clear display using C key of keyboard.
5. Look up desired frequency in frequency chart and read Frequency No.
6. Key Frequency No. into keyboard. The selected Frequency No. will be displayed.
7. Set BAND switch to position indicated by flashing band indicator lamp. If no flashing occurs the BAND switch is already correctly set.
8. Press TUNE button and adjust TUNING control for maximum deflection on ANTENNA CURRENT meter.
9. Select desired type of service with MODE and POWER switches.

Transmitter is now ready for operation.

NOTE: Transmission is inhibited if the mode setting does not correspond with the frequency selected. On radiotelephone frequencies the transmitter can be keyed only in the modes A3A, A3J, A3H, and TRANSMIT ALARM. On wireless telegraph frequencies the transmitter can be keyed only in the modes A1, A2H, and F1.

2.4 Operating Controls and their Functions

2.4.1 The SUPPLY switch has four positions:

OFF	Receiver and transmitter are switched off.
RECEIVE ONLY	Power Pack is started up and supplies power to Receiver (and grid bias to transmitter output valves). Remote speaker of receiver is connected to receiver output.
STAND BY	Power Pack supplies power to Receiver, Exciter, band indicator, and filaments of transmitter output valves. Remote speaker of receiver is connected to receiver output.
TRANSMIT	Transmitter can be keyed. Remote speaker of receiver is disconnected.

NOTE: A built-in delay circuit protects the output valves of the transmitter from being keyed for the first 30 sec. after switching to STAND BY or TRANSMIT.

2.4.2 The POWER switch has six positions:

LOW POWER SIMPLEX	Transmitter is keyed from handset key, morse key, or telex equipment dependent on mode of operation. Receiver is muted while transmitting. Transmitter can be driven to approx. 1/20 of full output power.
MEDIUM POWER SIMPLEX	As above, but transmitter can be driven to approx. ¼ of full output power.
FULL POWER SIMPLEX	As above, but transmitter can be driven to full power.
FULL POWER DUPLEX	Transmitter is keyed constantly in the F1, A3A, A3J, A3H and TRANSMIT ALARM modes (provided the selected frequency is in accordance with the mode setting). Receiver is on but built-in speaker is disconnected. In the A2H and A1 modes the operation is simplex independent of the setting of the POWER switch. Transmitter can be driven to full output power.
MEDIUM POWER DUPLEX	As above, but transmitter can be driven to approx. ¼ of full output power.
LOW POWER DUPLEX	As above, but transmitter can be driven to approx. 1/20 of full output power.

NOTE: With the BAND switch set to 2182 kHz, simplex is automaticlly selected, independent of the POWER switch setting, and if at the same time the MODE switch is set to TRANSMIT ALARM, the transmitter is automatically set to full power.

2.4.3 The MODE switch has eight positions:

A2H	Transmission of modulated radiotelegraphy. Only the morse key input is open. The transmitter can only be keyed if a telegraphy frequency is selected.
A1	Transmission of unmodulated radiotelegraphy. Only the morse key input is open. The transmitter can only be keyed if a telegraphy frequency is selected.
F1	Transmission of telex. Only the telex inputs are open. Transmission is only possible if a telegraphy frequency is selected.
TEST ALARM	The built-in two tone alarm generator is connected to the receiver AF amplifier. Transmitter cannot be keyed.
A3A	Transmission of single-sideband signal with reduced carrier. Transmission is only possible if a radiotelephony frequency is selected. The transmitter can be keyed from the handset key or by setting the POWER switch to DUPLEX.
A3J	As above, but carrier suppressed.
A3H	As above, but full carrier.
TRANSMIT ALARM	The two-tone alarm generator is connected to the receiver AF amplifier and the alarm generator is ready for transmission of an alarm signal. The mode is A3H as above.

2.4.4 The ALARM START push-button is used to start the alarm generator after the MODE switch has been turned to the TRANSMIT ALARM position. The push-button is depressed and released and the alarm signal will be transmitted for approx. 45 seconds.

The push-button is also used for starting the alarm generator in the TEST ALARM position.

2.4.5 The KEYBOARD is used for frequency selection. It controls the frequency memory. The programmed frequencies are listed in the frequency chart. Each frequency is supplied with a number and this number is keyed into the keyboard. The frequency number selected is displayed on the FREQUENCY NO display.

The display is cleared by using the C-key, which resets the display to zero.

The display extinguishes when the BAND switch is set to 2182 kHz, but keyboard entry is still possible and the display will show the selected Frequency No. when the BAND switch is turned away from 2182 kHz.

If an unprogrammed Frequency No is selected, the display will start to flash, indicating that transmission is not possible.

2.4.6 The DIMMER controls the intensity of the FREQUENCY NO display.

2.4.7 The TUNING control is used for tuning the antenna circuit to maximum antenna current indicated on the ANTENNA CURRENT meter.

2.4.8 The BAND switch has 16 positions:

2182 kHz	The FREQUENCY NO display is extinguished and the band-indicator lamp shows constant light indicating that 2182 kHz is selected. The range of the TUNING control is reduced. The A3H, simplex mode is automatically selected.

Bands A to H cover the coastal telephone band 1.6 to 4 MHz.

The 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz, 22 MHz, and 25 MHz positions cover the maritime short-wave bands.

A band indicator lamp at each position shows by flashing light where to set the BAND switch in accordance with the Frequency No selected. The light will extinguish when the BAND switch is set at the correct position.

2.4.9. The TUNE push-button is used when tuning the antenna circuit. The transmitter is keyed and a tune signal is generated. During tuning, the receiver is muted.

2.4.10 The CHECK SWITCH is not normally operative. Pulling the switch knob out will switch the ANTENNA CURRENT meter to read the voltage or current selected with the switch. When released, the knob will return to its original position.

The switch has eight positions:

LEVEL	Check of anode AC voltage swing
V_A	Check of anode DC voltage
V_{S1}	Check of screen grid voltage of valve no. 1
V_{S2}	Check of screen grid voltage of valve no. 2
V_G	Check of grid bias
I_1	Check of cathode current of valve no. 1
I_2	Check of cathode current of valve no. 2
V_D	Check of supply voltage to driver amplifier.

2.5 Filter Cleaning

The air filter on the transmitter power amplifier front panel should be cleaned periodically. The filter element is easily removed without the use of tools. Wash in warm water and dry thoroughly.

3. Installation

Correct installation of the equipment is important for maximum performance and reliability. Antennas and earth connections must be installed with the greatest care, especially where duplex telephony is desired.

3.1 Types of Installation

The TRP 5000 radiotelephone may be powered from either a 24 V battery or from 110/115/120/220/230/240V AC mains.

The TRP 5000 is composed of the following units

For 24V battery operation:

Type T 5000 transmitter power amplifier
Type P 5000 power pack
Type E 5000 exciter
Type R 5000 receiver

For AC mains operation (single-phase or two-phase):

Type T 5000 transmitter power amplifier
Type P 5001 power pack
Type E 5000 exciter
Type R 5000 receiver

The units are connected together in the TRP 5000 cabinet in which also the connections to the permanent installation are made.

3.2 Removal of units

After removal of the front-panel screws, the units may be pulled out as far as the built-in stops permit. The cables may be unplugged and the individual units removed entirely from the cabinet after having released the stop latches. This is done by pushing the unit slightly back into the cabinet (approx. 10 mm) and pressing the two nylon knobs of the latches at the sides of the unit while pulling the unit out.

For ease of removal of the units start with the lowest and proceed upwards. The reverse order is used when refitting the units.

3.3 Mounting the Cabinet

The cabinet is supplied with shock absorbers. The drawing on page 3-20shows the drilling plan for the necessary holes.

3.4 Connection to the Permanent Installation

Check that the correct power pack is installed in the equipment and, in case of AC operation, set for the correct mains voltage. The drawing of Terminal strip A on page 3-23 shows the marking of the terminals to be used for the installation. Necessary cable cross sections are also indicated. All cables except the transmitter antenna and earth leads are brought through the cutout in the cabinet rear wall in a loop that is large enough to take up any play between the equipment and the bulkhead.

A mains switch and fuses are to be provided in the supply leads. External fuse ratings are listed in Table 3.1.

Power Pack	Supply Voltage	External Fuses
P 5000	24V DC	50A
P 5001	110V, 115V, 120V } 50-60 Hz	20 A
P 5001	220V, 230V, 240V } 50-60 Hz	15A

Table 3.1

3.4.1 Supply Voltage Changing in P 5001 (AC operation) :

Voltage Changing in the P 5001 power pack is carried out by unsoldering the connections to and between the terminals of the two transformers 265 T1 and 265 T2.

The necessary connections are shown on the diagram of P 5001.

When changing voltage it is also necessary to replace the fuse in the power pack input lead. Fuse rating is given on the P 5001 diagram.

3.5 Earth Connections

As the transmitter earth connection is always a part of the total antenna system, it is of the utmost importance that the earth connection is constructed to have the smallest possible RF-impedance. Losses in the earth connection will result in a decrease in radiated power which means that the range of the transmitter will be reduced. A poor earth connection will further impede or even make duplex communication impossible.

3.5.1 Transmitter Earth Terminal:

The transmitter earth terminal is located on the top of the cabinet.

3.5.1.1 Steel Ships:

From the transmitter earth terminal a 100x0.5 mm copper strap is run uninterrupted to two ½" bolts welded to the hull as close to the equipment as possible

3.5.1.2 Wooden Ships:

From the transmitter earth terminal a 100x0.5 mm copper strap is run, preferably uninterrupted, to an earth bolt welded to an earth plate having a minimum area of 1 m^2 mounted under the water line. Should it, however, be necessary to break the copper strap, for example to pass through a deck, two ½" bolts should be used for this feed through. The copper strap should then be continued below deck, after connection to the same two bolts.

The copper strap must not be passed through iron pipes and should be kept a minimum distance of 0.5 m from iron parts of some extent. If this minimum distance cannot be kept the copper strap must be effectively connected to these parts using a strap having the same dimensions.

On wooden ships having a superstructure of metal, this superstructure should also be effectively connected to the copper strap.

3.5.2 Receiver Earth Terminal:

The receiver earth terminal is located on terminal strip A at the cabinet rear wall.

3.5.2.1 Steel Ships:

A flexible 2.5 mm^2 earth wire is run from the receiver earth terminal to a separate ½" earth bolt welded to the hull as close to the equipment as possible. This earth bolt must not be used for earthing other equipments, and the receiver earth wire shall be as far as possible from the transmitter copper strap.

3.5.2.2 Wooden Ships:

A flexible 2.5 mm^2 earth wire is run from the receiver earth terminal directly to the transmitter earth bolt on the earth plate. The earth wire should be run a minimum distance of 0.5 m from the transmitter copper strap.

3.5.3 Other Cables:

Other cables should be placed as far away as possible from the transmitter and receiver earth leads and under no circumstances parallel with the transmitter copper strap closer than 0.7 m and, for the receiver earth lead, closer than 0.2 m.

3.5.4 Earthing the Battery:

RF earth connections will cause neither battery nor mains leads to be connected to the hull. If it is desired to connect the battery to the hull, it is important to make the connection right at the battery, never in the transmitter. In cases where the installation is carried out so as to include the facility for charging during operation through a dropping resistor from a balanced ship's mains (110/220V DC), the battery must not be earthed.

3.6 Antennas

In order to minimize duplex noise, the transmitting and receiving antennas should be kept as far away from each other as possible. Stays, wires, steel masts etc. should either be earthed effectively or insulated.

Likewise in order to minimize duplex noise, every other electric installation such as cable braiding (screens) and instruments should be earthed effectively, and the instruments in question should be fitted with noise-interference suppression devices.

The Antennas should be suspended well in the clear, away from objects whose influence on the antennas may vary, such as derricks etc. Insulators should be of the best type having low leakage even when wet.

3.6.1 Transmitter Antenna Terminal:

The transmitter antenna terminal is located on the top of the cabinet.

3.6.2 Transmitter Antenna:

The transmitter antenna tuning system will tune a minimum impedance of 150 pF in series with 6 ohms at 1.6 MHz which normally corresponds to a wire length of approx. 14 m.

To ensure the greatest possible radiated power the transmitter antenna should be as long as possible and although a length of 14 m can be tuned it is strongly recommended never to use lengths less than 20 m as the radiated power from short antennas will result in unsatisfactory communication. There are no limitations regarding the maximum length of the antenna. The antenna should be terminated in a feed-through insulator in the roof or side wall of the radio room. The feed-through insulator should be located in such a way that the distance between the insulator and the transmitter antenna terminal is as short as possible to avoid losses and radiated RF-power inside the radio-room which might disturb other equipment.

A short length of coaxial cable type RG8-U, of which only the braid and the outer insulation is used, is inserted between the feed-through insulator and the transmitter antenna terminal. Both ends of the coaxial screen are soldered to cableshoes of suitable dimensions for the feed-through insulator and the transmitter antenna terminal.

If, for practical reasons, it should be necessary to mount the feed-through insulator some distance from the transmitter, the connection from the insulator to the vicinity of the transmitter should be done with a length of copper tubing mounted on stand-off insulators. A length of coaxial cable, as described above, should then be inserted between the last stand-off and the transmitter antenna terminal; any play between the transmitter and bulkhead will then be taken up by the cable.

3.6.3 Receiver Antenna Terminal:

The receiver antenna terminal is located on terminal strip A at the cabinet rear wall.

3.6.4 Receiver Antenna:
Length: 7-50 m. The receiving antenna should be brought in by a length of coaxial cable, which should be as short as possible, especially in the case of a short antenna.

If a long coaxial cable is used in order to separate receiver and transmitter antennas it will often be advantageous to insert an impedance matching transformer at the antenna end of the coaxial cable.

While the receiver input impedance is always 50 ohm at frequencies above 4 MHz, the receiver is normally supplied with a high impedance input at frequencies below 4 MHz. It is however possible to change the receiver input impedance to 50 ohms also at frequencies below 4 MHz. Reference is made to the receiver instruction manual.

3.6.5 Antenna Relay:

As shown on the drawing on page 3-27, an antenna relay may be installed in the antenna circuit. The relay may be installed if the transmitting antenna is to be used for other purposes, for instance for an extra receiver, or if it is desired to perform the installation as a simplex installation with only one antenna. The relay coil should be rated for 24V DC. It should be connected to terminals 3 (+) and 4 (–) on terminal strip A and protected with a suitable diode.

3.7 Remote Speaker

If a remote speaker is to be installed it should be connected to terminals 1 and 2 of terminal strip A

Note that the remote speaker will be connected to the receiver only when the SUPPLY switch is at RECEIVE ONLY and STAND-BY.

An audio power of 5 watts is available into a 4 ohms load. This power can be shared between several loudspeakers if so desired. The built-in speaker in the power pack has an impedance of 8 ohms. When connecting the remote speaker(s) the minimum value of the total impedance should be 4 ohms including the built-in speaker. If 5 watts is required in the remote speaker(s), the built-in speaker must be switched off.

3.8 Transmitter-On Indication

Indication of the transmitter-on condition can be obtained by means of a voltage (24V at max. 0.2A) which is controlled by the transmit relay and can be taken off between terminals 3 (+) and 4 (–) of terminal strip A.

3.9 Replacement of Power Pack

Two different power packs are available for operation of the equipment.

The P 5000 is used for 24V battery operation. If the equipment is to be operated from AC-mains the P 5001 power pack must be used. Replacing a power pack involves no modifications of transmitter or receiver.

3.10 Optional Terminal Strips

Three optional terminal strips are available. The terminal strips are supplied with cables and plugs and are to be mounted on the cabinet back wall as shown on page 3-22.

Output Terminal Strip B gives a number of extra output facilities as shown on page 3-24 and is to be connected to the Power Pack.

Input Terminal strip C, shown on page 3-25, is to be connected to the Exciter.

Output Terminal Strip D, shown on page 3-26, is intended to be connected to the Transmitter Power Amplifier and can be used for example where it is desired to control an ATU. The corresponding socket in the T5000 is only mounted and wired on special order, but a BAND switch wafer which can be wired to give the BAND position is always supplied as an integral part of the Transmitter Power Amplifier.

PROM-types which can be installed in the MEMORY of /238\ :

Manufacturer	Types	
INTERSIL	IM 5600	
INTERSIL	IM 5610	
TI	SN 54188	**Only** these PROM-types can be programmed by means of the optional PROGRAMMING UNIT /241\ .
TI	SN 54188 A	
TI	SN 54S188	
TI	SN 74188	
TI	SN 74188 A	
TI	SN 74S188	

Table 3.11.1

3.11 Programming of MEMORY 238, General

3.11.1 The building block of the memory, located on printed circuit board 238, is the Programmable Read Only Memory, in short PROM.

A PROM is not reprogrammable, because programming a bit position is like blowing a fuse.

3.11.2 On printed circuit board 238 24 PROMs can be mounted in separate sockets. The 24 sockets are formed into eight columns (No. 1 to No. 8), each containing three sockets (A, B, and C). The necessary information associated to a Frequency No. is stored in three PROMs in a column. Each column can contain information of 32 different Frequency Nos. The association between the Frequency Nos and the column Nos is shown in table 3.12.9.

3.11.3 The programming of the PROMs can be done in two ways.

The optional PROGRAMMING UNIT 241 can be used for this job as described in paragraph 3.13. But only the eight TI- types shown in the table 3.11.1 can be programmed by means of printed circuit board 241

The other way is to let the local PROM-distributor do the programming. In this case *all* the PROM-types shown in table 3.11.1 can be used in the MEMORY 238.

3.11.4 The MEMORY 238 controls the Band Indicator of Transmitter Power Amplifier. This implies that the distribution of the coastal telephone frequencies in the bands A to H have to be decided in advance when programming the memory.

Each position of the Transmitter Power Amplifier BAND switch can, in principle, be adjusted to any frequency, but once adjusted (during installation on board a ship) the frequency coverage of each band is limited. In order to obtain a reasonable output power, the difference between the highest and the lowest frequency within a band should not exceed approx. 200 kHz.

Table 3.11.2 suggests a subdivision of the coastal telephone band based on article 7, section 4 (1976) of the Radio Regulations. If, however, special frequencies are to be covered, another subdivision may be necssary. Further, table 3.11.2 shows the frequency ranges of the HF bands covered by the Exciter.

Transmitting frequency (kHz)	BAND	Transmitting frequency (kHz)	BAND
1605–1670	A	4063 - 4219.4	4 MHz
1950–2150	B	6200 - 6325.4	6 MHz
2150–2350	C	8195 - 8435.4	8 MHz
2350–2550	D	12330 - 12652.3	12 MHz
2550–2750	E	16460 - 16859.4	16 MHz
3000–3200	F	22000 - 22310.5	22 MHz
3200–3400	G	25010 - 25600	25 MHz
3400–3600	H		

Table 3.11.2

3.11.5 Information about the transmitting mode of every Frequency No. in use must be stored in the memory, whether it is a radiotelephone frequency (A3A, A3J, or A3H) or a wireless telegraph frequency (A1, A2H, or F1).

3.11.6 Programming Frequency No. zero can be done in two ways.

If it is convenient that this Frequency No. contains the information associated with an often used transmitting frequency, the programming instructions do not differ from the instructions concerning any other Frequency No.

On the other hand, if it is not desired to store any transmitting frequency information associated with Frequency No. zero, this can either be done as described in paragraph 3.12.14, if it is convenient to let the local PROM-distributor do the programming, or in paragraph 3.13.22, if the programming is performed by means of the optional PROGRAMMING UNIT /241\

3.11.7 The easiest method of checking the programmed frequencies when the PROM's have been mounted in the MEMORY /238\ is by connecting a frequency counter to the output BNC socket, 231SK7, of the Exciter. The output socket is the one carrying no colour code. It is normally connected to the Transmitter Power Amplifier via a coaxial cable. Unplug the cable and connect the counter to this socket.

The check is made with the SUPPLY switch in STAND BY. The frequency measured is the transmitting frequency, f_t. Radiotelephone frequencies are measured in the A3H mode, DUPLEX. Wireless telegraph frequencies are measured in the A1 mode, morse key down.

3.12 Ordering programmed PROMs

3.12.1 To make it possible for the local PROM-distributor to do the programming the customer must fill in a Word Pattern Sheet, supplied by the distributor, for each PROM which is to be programmed.

3.12.2 First of all one must find out which of the 32 input addresses of the PROM corresponds to the wanted Frequency No. It is done in accordance with table 3.12.1.

Frequency No. (both incl.)	Input Address equal to:
0– 31	(Frequency No.)
32– 63	(Frequency No.) – 32
64– 95	(Frequency No.) – 64
96–127	(Frequency No.) – 96
128–159	(Frequency No.) –128
160–191	(Frequency No.) –160
192–223	(Frequency No.) –192
224–255	(Frequency No.) –224

Table 3.12.1

3.12.3 Now the proper BAND corresponding to the transmitting frequency is to be found. If it is a coastal telephone frequency paragraph 3.11.4 describes what to do.

The encoding of the different BANDs is shown in table 3.12.2.

BAND	Code
A	0000
B	0001
C	0010
D	0011
E	0100
F	0101
G	0110
H	0111
4 MHz	1000
6 MHz	1001
8 MHz	1010
12 MHz	1011
16 MHz	1100
22 MHz	1101
25 MHz	1110
MF	1111

Table 3.12.2

3.12.4 The transmitting mode is encoded as follows:

MODE	CODE
A3H, A3A, or A3J	0
A1, A2H, or F1	1

Table 3.12.3

3.12.5. Calculate the synthesizer frequency f_s from the transmitting frequency f_t as shown in table 3.12.4. Observe that the transmitting frequency f_t is the carrier frequency in the modes A2H, A1, A3A, A3J and A3H. In the F1-mode f_t is the assigned frequency, provided that the center frequency of the AF output from the telex equipment is 1500 Hz. If the AF center frequency is 1700 Hz, subtract 200 Hz from the assigned frequency to obtain f_t.

BAND	f_s Synthesizer frequency
1605–4000 kHz	f_t + 1400 kHz
4 MHz	f_t + 1400 KHz
6 MHz	f_t – 2800 KHz
8 MHz	f_t – 4200 KHz
12 MHz	f_t – 8400 KHz
16 MHz	f_t – 12600 KHz
22 MHz	f_t – 18200 KHz
25 MHz	f_t – 21000 KHz

Table 3.12.4

3.12.6 Each of the four least significant digits of the synthesizer frequency ("100 kHz", "10 kHz", "1 kHz", and "100 Hz") are encoded as follows:

Number	Code
0	1001
1	1000
2	0111
3	0110
4	0101
5	0100
6	0011
7	0010
8	0001
9	0000

Table 3.12.5

3.12.7 The most significant digit of the synthesizer frequency ("1 MHz") is encoded as follows.

Number	Code
3	10
4	01
5	00

Table 3.12.6

3.12.8 In order to store this information 3 PROMs must be programmed at the same input address. These 3 PROMs are labelled A, B, and C. The total amount of information should now be arranged as follows:

Input Address	Control bit	Band	Mode	Synthesizer frequency				
				1 MHz	100 kHz	10 kHz	1 kHz	100 Hz
I	O_7	$O_6O_5O_4O_3$	O_2	O_1O_0	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$
	PROM-C				PROM-B		PROM-A	

(O_0 to O_7 indicates outputs to be programmed).

Table 3.12.7

3.12.9 NB. The code of the »Control bit« is always to be 1 for each Frequency No. to be programmed.

3.12.10 Example 1:

Assume that the telex frequency 4170.0 KHz is to be programmed at Frequency No. 83.

The input address can be found from table 3.12.1:
Input address = 83–64 = **19** (1)

According to paragraph 3.12.9 the Control bit is set to **1** (2)

According to table 3.12.2:

BAND = 4 MHz Code = **1000** (3)

The code for the F1 mode is, according to table 3.12.3 : **1** (4)

The synthesizer frequency can be calculated from table 3.12.4.

f_S = 4170.0 KHz + 1400.0 KHz = 5570.0 KHz

By use of table 3.12.5 and table 3.12.6 the associated codes can be found:

Digit	Number	Code	
"1 MHz"	5	**00**	(5)
"100 KHz"	5	**0100**	(6)
"10 KHz"	7	**0010**	(7)
"1 KHz"	0	**1001**	(8)
"100 Hz"	0	**1001**	(9)

The total amount of information is now to be arranged:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Input Address	Control bit	Band	Mode	Synthesizer frequency				
				1 MHz	100 kHz	10 kHz	1 kHz	100 Hz
19	1	1000	1	00	0100	0010	1001	1001
I	O_7	$O_6O_5O_4O_3$	O_2	O_1O_0	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$
	PROM-C				PROM-B		PROM-A	

Table 3.12.8 a

Example 2:

Assume that a radiotelephone frequency 3550.0 KHz is to be programmed at Frequency No. 228.

The input address can be found from table 3.12.1:

Input address = 228–224 = **4** (1)

According to paragraph 3.12.9 the Control bit is set to **1** (2)

According to table 3.11.2 and table 3.12.2:

BAND = H, Code = **0111** (3)

The code for the radiotelephony mode is, according to table 3.12.3: **0** (4)

The synthesizer frequency can be calculated from table 3.12.4:

f_S = 3550.0 KHz + 1400.0 KHz = 4950.0 KHz

By use of table 3.12.5 and table 3.12.6 the associated codes can be found:

Digit	Number	Code	
1 MHz	4	**0 1**	(5)
100 KHz	9	**0 0 0 0**	(6)
10 KHz	5	**0 1 0 0**	(7)
1 KHz	0	**1 0 0 1**	(8)
100 Hz	0	**1 0 0 1**	(9)

The total amount of information is now to be arranged:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Input Address	Control bit	Band	Mode	Synthesizer frequency				
				1MHz	100 kHz	10 kHz	1 kHz	100 Hz
4	1	0 1 1 1	0	0 1	0 0 0 0	0 1 0 0	1 0 0 1	1 0 0 1
I	O_7	$O_6O_5O_4O_3$	O_2	O_1O_0	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$
	PROM-C				PROM-B		PROM-A	

Table 3.12.8 b

3.12.11 When the three PROMs are to be installed in the MEMORY /238\ make sure that they are mounted in the correct column:

Column No.	Frequency No. both inclusive
1	0– 31
2	32– 63
3	64– 95
4	96–127
5	128–159
6	160–191
7	192–223
8	224–255

Table 3.12.9

3.12.12 Also take care that PROM-A is mounted in the socket marked with an A, PROM-B in socket B, and PROM-C in socket C.

The top mark of the PROM-package is to be directed as shown on printed circuit board /238\ .

3.12.13 A selfadhesive sticker should be placed on the package of each PROM, indicating in which column and socket (A, B, or C) it is to be mounted.

3.12.14 Concerning the programming of Frequency No. zero some considerations are to be made; refer to paragraph 3.11.6.

If no transmitting frequency information is to be stored at Frequency No. zero, the following information must be programmed at this Frequency No.:

Input address = 0
Control bit = 1
BAND = 1 1 1 1 (Keying the transmitter will be inhibited)
MODE = 0
Synthesizer frequency = 5999.9 KHz

Or in the arranged form:

Input Address	Control bit	Band	Mode		Synthesizer frequency			
				1 MHz	100 kHz	10 kHz	1 kHz	100 Hz
0	1	1 1 1 1	0	0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1	O_7	$O_6O_5O_4O_3$	O_2	O_1O_0	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$	$O_7O_6O_5O_4$	$O_3O_2O_1O_0$
	PROM-C				PROM-B		PROM-A	

Table 3.12.10

3.13 Instruction for use of PROGRAMMING UNIT /241\

3.13.1 Three sockets are located in the PROGRAMMING UNIT. From MEMORY /238\ the three PROMs in the column No. found from table 3.12.9 are moved to board /241\ and mounted in these three sockets.

Take care that the one placed in socket A on /238\ is mounted in the socket marked with an A, socket B in socket B, and socket C in socket C. Also take care that the topmark of the PROM package is directed as shown on /241\ .

3.13.2 A minor disadvantage associated with the use of the PROM as the memory building block is that a few per cent of the PROMs cannot be programmed in one or more bit positions due to tolerance problems in the manufacturing process. In this case section 3.13.17 describes what to do.

3.13.3 Because a PROM is not reprogrammable the greatest care should be taken concerning the programming procedure.

3.13.4 For each Frequency No. the following information must be stored in the PROMs. This information should be written on a Programming Work Sheet as shown on page 3-34.

3.13.5 The proper BAND corresponding to the transmitting frequency is to be found from table 3.11.2 if it is a coastal telephone frequency, otherwise it is selfexplanatory.

3.13.6 It must be decided whether it is to be a radiotelephone frequency (RT = A3H, A3A, or A3J) or a wireless telegraph frequency (WT = A1, A2H, or F1).

3.13.7 Furthermore the synthesizer frequency must be calculated from the transmitting frequency as shown on the screening lid to the right of the PROGRAMMING UNIT or in table 3.12.4.

3.13.8 By means of the ON-OFF switch on /241\ this unit is turned on.

3.13.9 All the sliders of the programming tool are now adjusted according to this information. In the other window some holes will appear and these are the positions which must be programmed.

3.13.10 By means of the Keyboard on the front panel the Frequency No., which is to be programmed, is selected. (The displays may flash during the programming procedure, but this is unimportant).

3.13.11 If the lamp of the grey pushbutton is now lit, it means that the Frequency No. chosen has already been programmed once, and further programming is automatically inhibited.

3.13.12 On the other hand if the above mentioned lamp is unlit, it means that programming can now be done.

3.13.13 The Programming Pin is now placed in the extreme right hole in the window. The lamp of the red pushbutton will light as long as the Programming Pin does not have proper contact with the underlying socket-terminal or if this hole position has already been programmed.

3.13.14 Now activate the red pushbutton.

3.13.15 If the programming was done successfully the lamp of the red pushbutton will now light and the Pin is moved to the next hole.

3.13.16 If the programming was not done succesfully, the red pushbutton must be activated repeatedly until the lamp is lit.

3.13.17 If it turns out that it is impossible to program this hole position, the only thing to do is to choose another Frequency No. and start to program all over again. Later on, when the PROMs are installed on /238\ , the transmitter is automatically prevented from being keyed, if this unsuccessfully programmed Frequency No. is chosen; this will also be indicated by the displays, which will begin to flash.

3.13.18 If all the hole positions in the window have been successfully programmed, the Programming Pin must be placed in the hole in the middle of the tool, and this position is then to be programmed.

3.13.19 This will make the lamp of the grey pushbutton light, thus indicating that this Frequency No. is correctly programmed; any attempt to program further information at this Frequency No. is now automatically prevented.

3.13.20 If, later on, it turns out that nevertheless a mistake was made, when the sliders were adjusted, and the »Enable« hole position had been programmed, it is still possible to »Disable« the Frequency No.
This is done as follows.

3.13.21 Adjust the »MHz«-slider so that a black field appears in the window; two holes will now appear in the other window; now push and keep down the grey pushbutton until both of these two hole positions are programmed, as normal by means of the Programming Pin and the red pushbutton. When this has been accomplished, it will prevent the transmitter from being keyed when the PROMs are mounted on /238\ . If this Frequency No. is chosen; this will also be indicated by means of the flashing displays.

3.13.22 Concerning the programming of Frequency No. zero some considerations are to be made, refer to paragraph 3.11.6.

3.13.23 If no transmitting frequency information is to be stored at Frequency No. zero, the following procedure must be followed.

Adjust the Band-slider so that an "MF" appears in the window; only the associated four hole positions and afterwards the Enable position in the middle of the tool must be programmed.

This will, when the three PROMs are mounted on /238\ , prevent the displays and the Band Indicator from flashing and also prevent the transmitter from being keyed when Frequency No. zero is chosen.

3.13.24 When the programming of the Frequency Nos has been accomplished the PROGRAMMING UNIT is turned off, the Programming Pin is placed in its holding clips, and the three PROMs are moved back to the MEMORY /238\ .

Take care that the PROMs are mounted in the correct way and in the correct sockets.

3.13.25 A selfadhesive sticker should be placed on the package of each PROM indicating in which column and socket (A, B, or C) it is to be mounted.

3.13.26 Programming procedure step by step

1. Calculate for each Frequency No. the synthesizer frequency from the transmitting frequency as shown in table 13.12.4, find the correct BAND (for a coastal telephone frequency table 3.11.2 is used), and decide whether it is to be a radiotelephone frequency (RT) or a radiotelegraph frequency (WT)
2. Mount the three PROMS in their respective sockets on /241\ .
   (Take care that they are correctly positioned).
3. Turn on the PROGRAMMING UNIT
4. Adjust the seven sliders according to step 1.
5. Select by means of the Keyboard the Frequency No. to be programmed.
   (The displays may now flash, but this is unimportant).

   If the lamp of the grey pushbutton lights, the Frequency No. chosen has already been programmed and a new Frequency No. must be selected.
6. Place the Programming Pin in one of the holes in the window of the tool; beginning from the right.

   If this hole position is unprogrammed the lamp of the red pushbutton will extinguish.
7. Activate the red pushbutton

   The lamp of the red pushbutton will now light if the programming was successful.

   As long as there are unprogrammed hole positions the steps 6 and 7 are repeated.

   If the lamp of the red pushbutton does not light, step 7 is repeated until it lights.
   (If this turns out to be impossible then proceed to step 9).
8. Program "Enable" hole position in the middle of the Programming Tool, thus enabling this Frequency No.

   If there are more Frequency Nos to program then go back to step 4, otherwise to step 16.

   If there is a hole position, which cannot be programmed:
9. Select a new unprogrammed Frequency No. and start from step 6.

   If it turns out, after having performed step 8, that a mistake was made concerning the information already programmed:
10. Adjust the "MHz"-slider, so that a black field appears in the window.
11. Place the Programming Pin in one of the two associated holes.

12. Push and keep down during step 13 the grey pushbutton.
13. Activate the red pushbutton.
14. Move the Programming Pin to the other hole and repeat the steps 12 and 13.
15. Go back to step 4 and repeat through to step 8.
16. Turn off the Programming Unit.
17. Place the Programming Pin in its holding clips.
18. Place a selfadhesive sticker on the package of each PROM, indicating in which column and socket (A, B, or C) it is to be mounted on MEMORY /238\ .
19. Move the three PROMs to /238\ . (Take care that they are mounted in the correct way and in the correct sockets).

3.14 Adjustment of Antenna Tuning

3.14.1 The drum switch of the antenna tuning circuit becomes accessible by pulling the Transmitter Power Amplifier unit partly out of the cabinet. As connections to earth and antenna are maintained, it is possible to perform the adjustments with the Transmitter Power Amplifier in this position. When adjustment has been completed it ought to be checked with the unit in place. Minor corrections may be necessary.

The safety switch, that normally prevents keying when the transmitter power amplifier unit is pulled out, has to be disabled. The piston of the switch has to be pulled outwards to the locked position.

Note: Extreme care has to be taken as high tension is now accessible when the SUPPLY switch is in position TRANSMIT.

The various components of the antenna tuning circuit are selected by means of the drum switch which can be programmed individually for each band by inserting programming tabs into the appropriate wafers. The distribution of frequencies into the bands has been determined when programming the MEMORY /238\ as described in section 13.11.

It is important that the adjustments are made with the antenna in its normal working position and that no cranes, derriks, etc. are near, as these will influence the tuning.

The meter on the front panel indicates the actual antenna current. Since the antenna impedance varies considerably over the frequency range, the antenna current will vary correspondingly, even though the output power is the same. If the antenna length is approximately half a wavelength or a multiple thereof, the meter reading will be very low. If this is undesirable, a higher reading can only be obtained by shortening or lengthening the antenna.

Due to the wide adjustment range when programming the drum switch, attention must be drawn to the possibility of erroneously adjusting to the second harmonic frequency. The only sure method of checking this is by means of a frequency counter or an oscilloscope connected to a loop around the antenna insulator of the transmitter. Check one frequency in each band. (A3H or A3A DUPLEX, TUNE button not pressed).

3.14.2 Bands A to H:

The configuration is basically an L-network, the series inductance of which consists of variometer »A«. The rotor and stator of the variometer can be connected either in series or in parallel. The series connection is to be used on the lower frequencies, giving a high value of inductance. The parallel connection is to be used on the higher frequencies, giving a lower value of inductance. The transition frequency depends on the antenna.

The shunt capacitance, in parallel to the P.A. valves, can be selected between 6 and 1600 pF in steps of 6 pF by means of wafers 1 to 9. Increasing the shunt capacitance while still having resonance (by adjusting the variometer by means of the TUNING knob) decreases the voltage swing on the P.A. valves (the load presented to the valves becomes lower) and vice versa.

If the antenna is long, it may be necessary to use the shortening capacitors or the output capacitor (wafers 22, 23, and 24 or any combination of these) in order to obtain resonance. If the antenna is short, it may be necessary to use the output capacitor (wafer 24) on the lowest frequencies.

3.14.3. Bands 4 to 25 MHz:

The configuration is basically a π-network. The series inductance may consist of either variometer »A« or variometer »B«. The rotor and stator of variometer »B« may be connected either in series or in parallel. The parallel-connection is to be used only in the higher frequency bands. The transition frequency depends on the antenna.

The shunt capacitance, in parallel to the P. A. valves, is preset on each band by means of wafers 13, 14, and 15.

The output capacitance can be selected between 6 and 1600 pF by means of wafers 1 to 9. Increasing the output capacitance, while still having resonance, increases the voltage swing on the P. A. valves and vise versa.

On frequencies above 8 MHz the output capacitance can be reduced, if necessary, by means of the coils at wafers 24 and 25. The coil at wafer 24 is to be used only on the 22 MHz and 25 MHz bands, where the impedance of the series connected capacitor is negligible.

Due to unavoidable stray capacitances, resonance in variometer »A« can occur on one or more of the short wave bands. It shows up as a sudden dip in the ANTENNA CURRENT meter-reading when the TUNING control is rotated slowly over its range. Such resonances within a band must be avoided as they can cause flash-over. This is avoided by shorting variometer »A« of the band in question by inserting tabs in wafers 27 or 17 and 19 or all three.

3.14.4 Adjustment Procedure:

3.14.4.1 1. Set SUPPLY switch to STAND BY and POWER switch to MEDIUM POWER SIMPLEX.

2. Insert tabs for the band in question as shown on Pages 3-28 to 3-32.

3. Set SUPPLY switch to TRANSMIT and press TUNE button while rotating the TUNING control until resonance is obtained, i.e. maximum deflection on ANTENNA CURRENT meter without being at the extreme of the tuning range (inspect rotorposition of the variometer used).

4. Set CHECK SWITCH to LEVEL and pull the knob while pressing the TUNE button. Observe Level-reading on meter. Reading should be as near 3 as possible but never above.

5. Set SUPPLY switch to STAND BY and adjust Level by selecting appropriate tab settings on wafers 1 to 9 (refer to sections 3.14.2 and 3.14.3). Revert to point 3.

3.14.4.2 If resonance is obtained at, or is outside, one of the extreme positions of the TUNING knob, select another variometer configuration.

3.14.4.3 If resonance cannot be obtained, remove tab on wafer 21 and insert one or both of the shortening capacitors (wafers 22 and 23), always use the largest possible capacitance.

3.14.4.4 If on bands A to H resonance still cannot be obtained, insert the output capacitor (wafer 24), if neoessary in combination with one or both of the shortening capacitors.

3.14.4.5 If Level-reading is too high, even with none of the capacitors 1 to 9 connected, insert the coil at wafer 25 on the 8, 12 or 16 MHz bands, or the coil at wafer 24 on the 22 or 25 MHz bands.

3.14.4.6 If flash-over occurs on 22 MHz at contact 25, insert tab in wafer 25.

3.14.5 2182 KHz:

The adjustment is performed as described above for a frequency in the lower CT band. In order to reduce the range of the TUNING control proceed as follows:

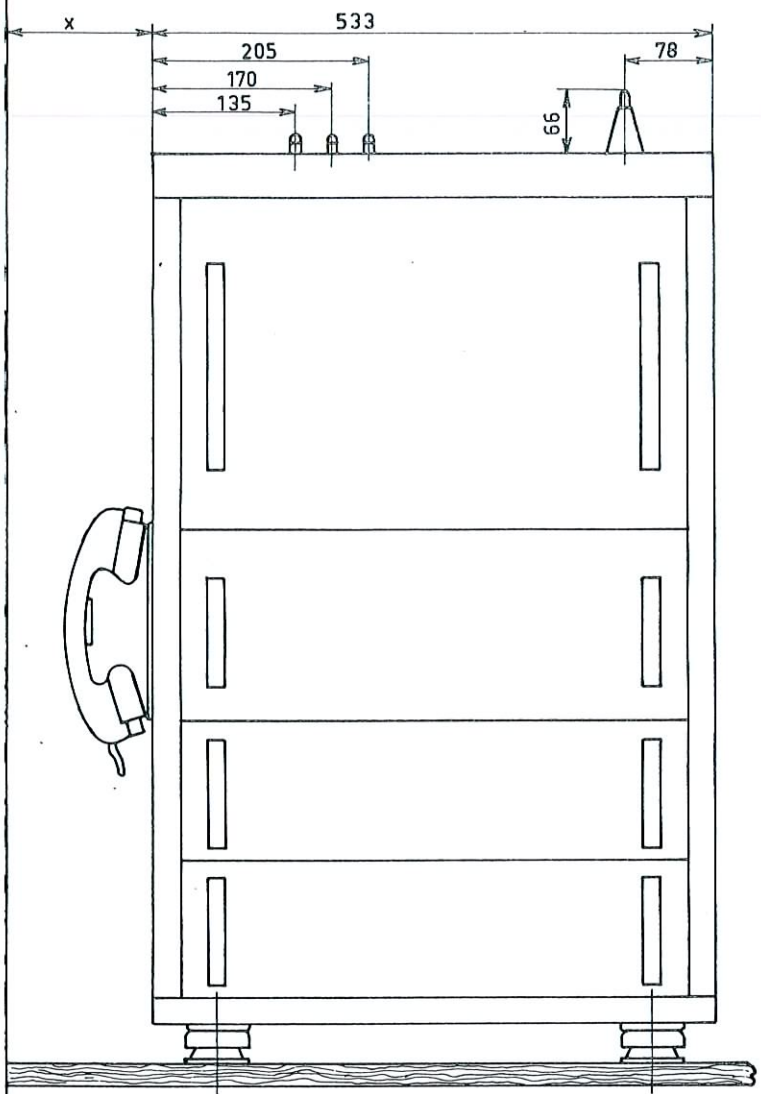
1. Move tab on wafer 19 to wafer 18.

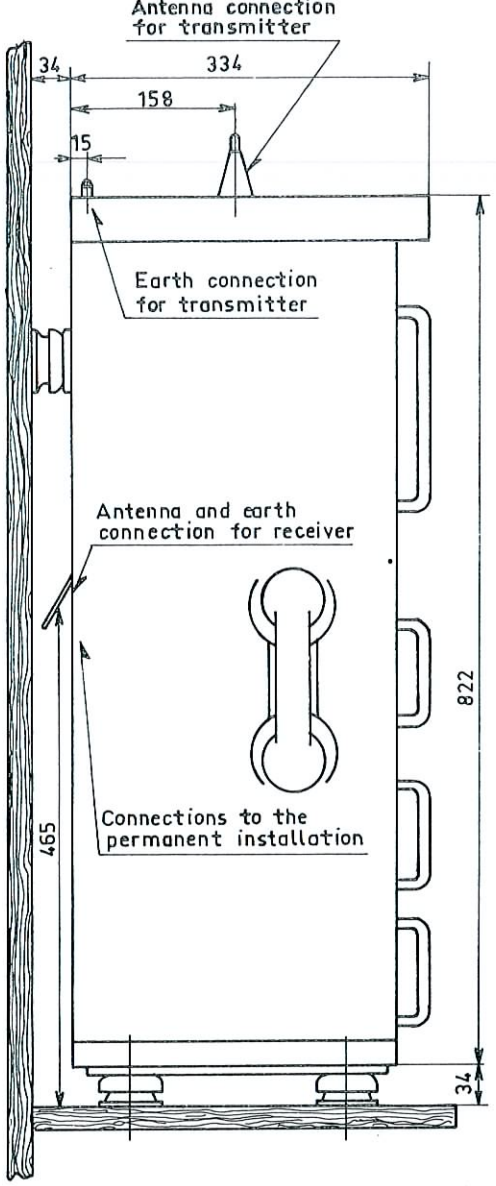
2. Place one end of the clip-on lead on the middle of »2182 KHz Fine Tuning Coil«.

3. With the other end of the clip-on lead, select that winding on the stator of Variometer »A« or the »2182 kHz Coil« below, which gives the highest level reading.

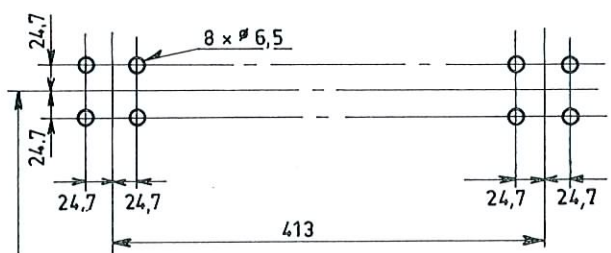
4. Rotate TUNING control to its center position and select that winding on the "2182 kHz Fine Tuning Coil" which gives maximum Level-reading.

x = Min 140 with handset
x = Min 50 without handset

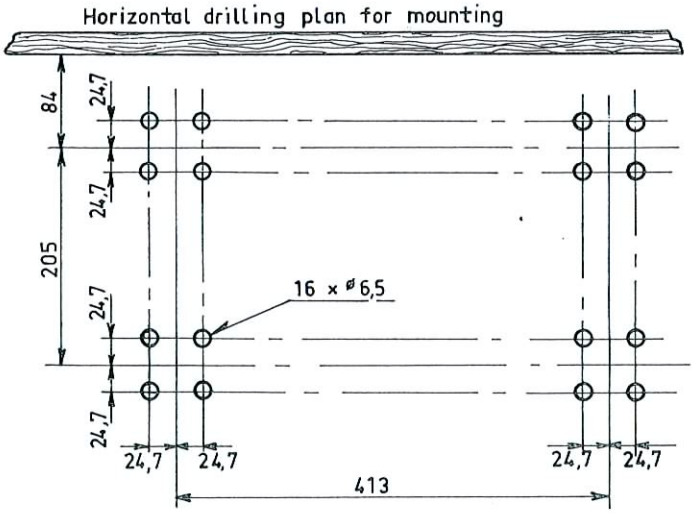


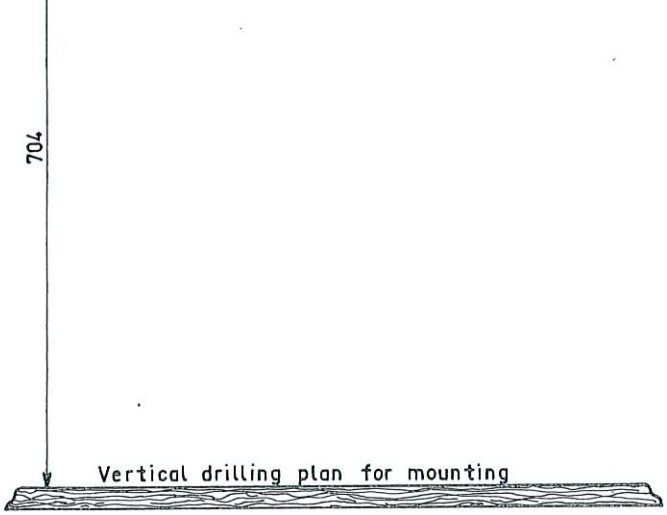


Note: For easé of mounting the six shock absorbers can be reversed and thereafter only one hole per shock absorber need be drilled.



Horizontal drilling plan for mounting

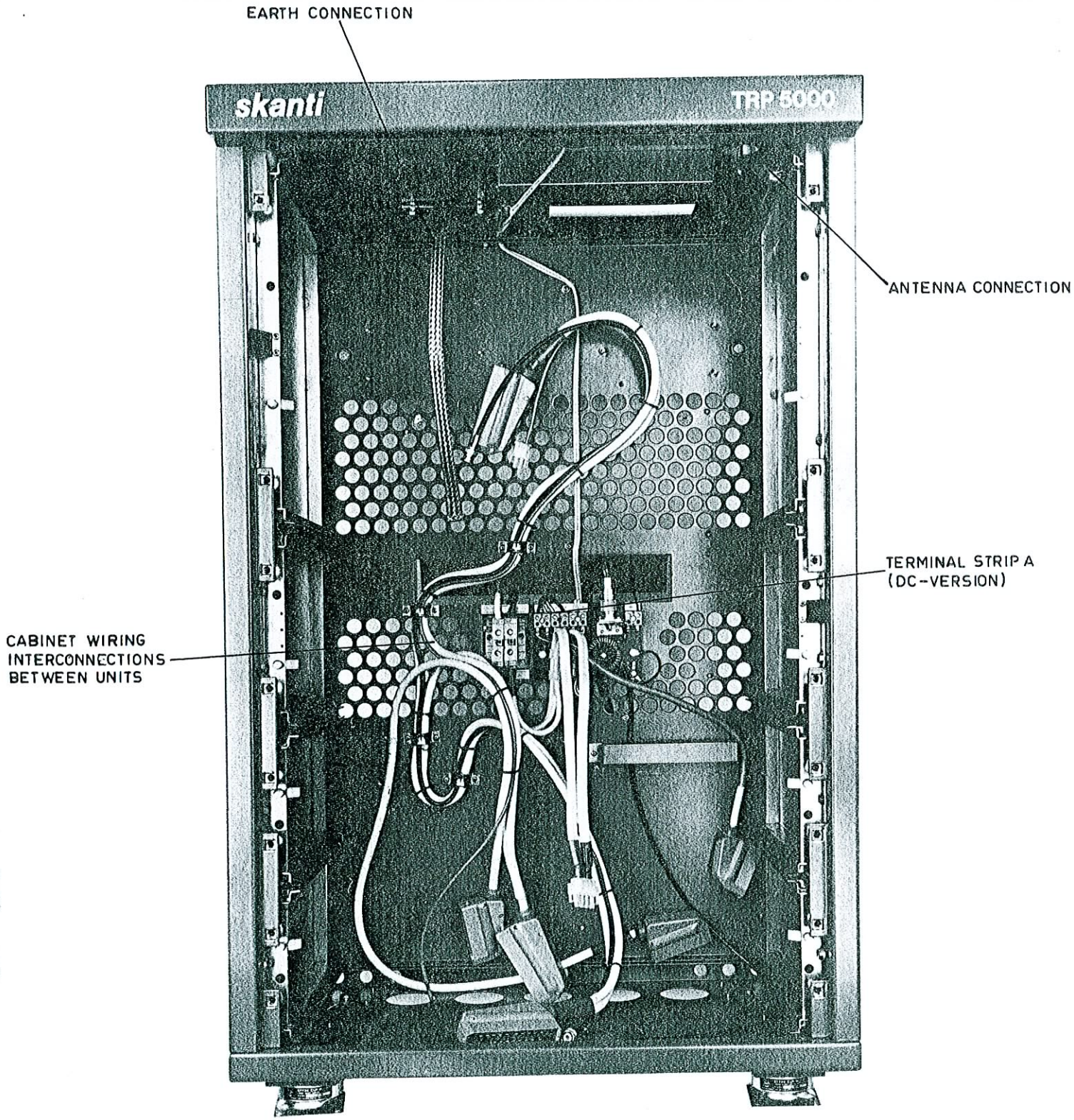




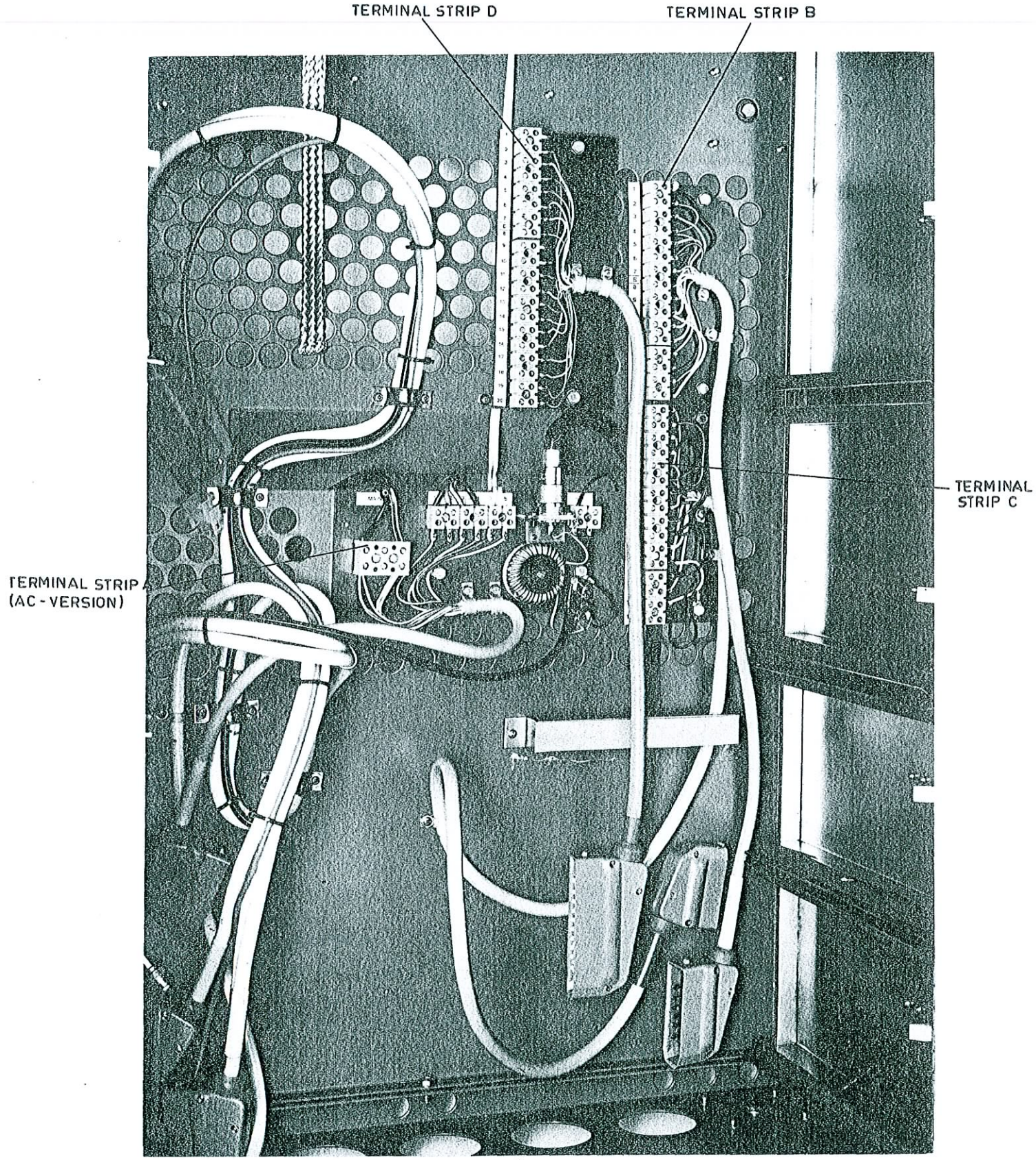
Dimensions are in mm
Tolerances : ± 1mm

Unit :	Appr. weight :
TRP5000 DC	83.5kg
TRP5000AC	89.5kg

MOUNTING OF TRP5000



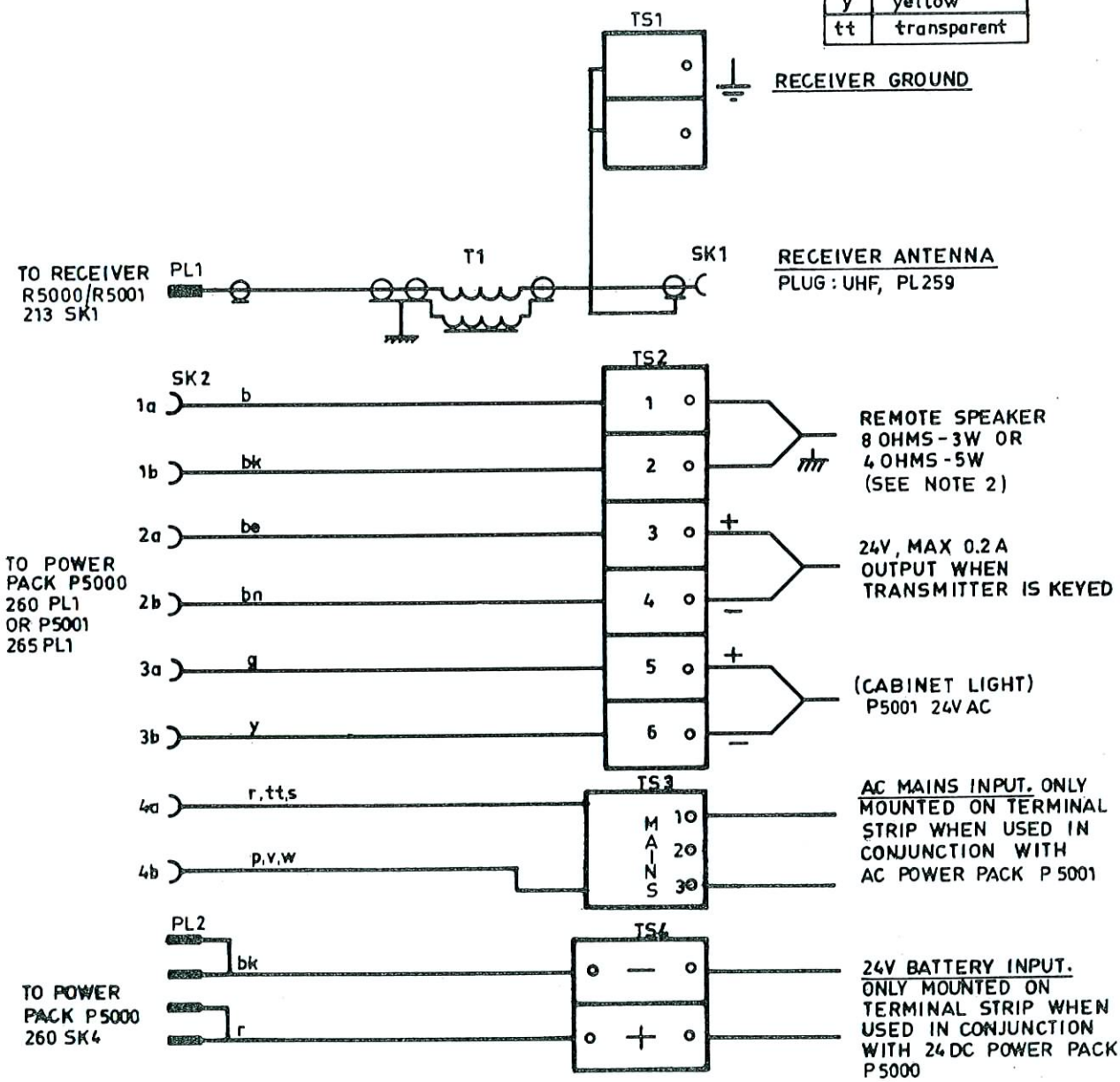
TRP 5000 CABINET, STANDARD VERSION



TRP5000 CABINET, ALL OPTIONAL TERMINAL STRIPS INSTALLED

CABINET WIRING
TERMINAL STRIP A
(mounted on cabinet back wall)

b	blue
be	beige
bk	black
bn	brown
g	green
or	orange
p	pink
r	red
s	slate (grey)
v	violet
w	white
y	yellow
tt	transparent



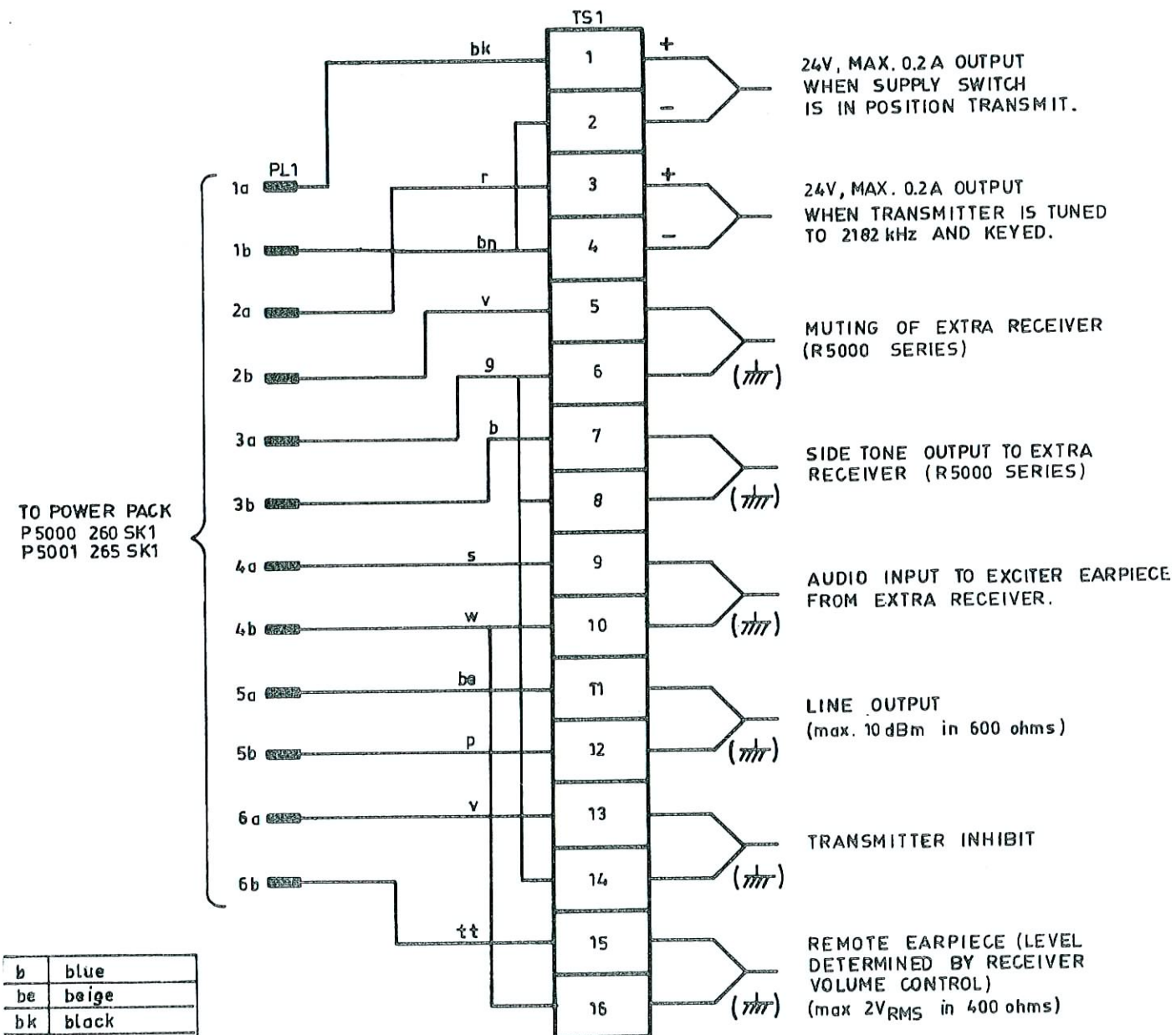
NOTE 1 :

MAX CABLE LENGTH TO BATTERY	MIN. CONDUCTOR AERA
5 m	2x10 mm^2
9 m	2x16 mm^2
13 m	2x25 mm^2

NOTE 2 : AN AUDIO POWER OF 5 WATTS IS AVAILABLE INTO A 4 OHMS LOAD. THIS POWER CAN BE SHARED BETWEEN SEVERAL LOUDSPEAKERS IF SO DESIRED. THE BUILT-IN SPEAKER IN THE POWER PACK HAS AN IMPEDANCE OF 8 OHMS. WHEN CONNECTING REMOTE SPEAKERS THE MINIMUM VALUE OF THE TOTAL IMPEDANCE SHOULD BE MORE THAN 4 OHMS INCLUDING THE BUILT-IN SPEAKER IN ORDER TO OBTAIN MAXIMUM POWER OUTPUT. IF 5 WATTS IS REQUIRED IN REMOTE SPEAKER(S) THE BUILT-IN SPEAKER MUST BE DISCONNECTED.

OUTPUT TERMINAL STRIP B
OPTIONAL

(terminal strip to be mounted on cabinet back wall)



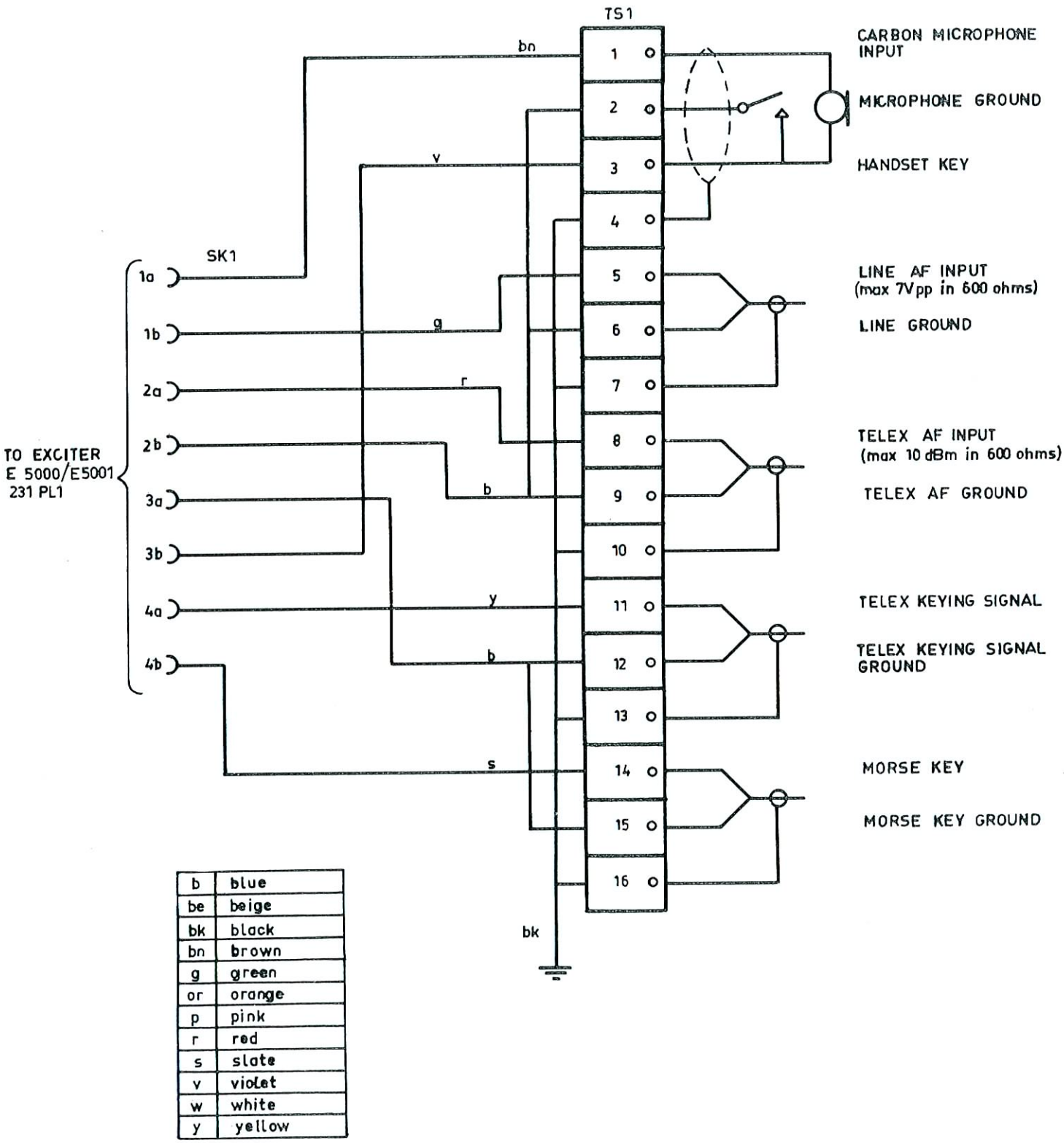
b	blue
be	beige
bk	black
br	brown
g	green
or	orange
p	pink
r	red
s	slate (grey)
v	violet
w	white
y	yellow
tt	transparent

E 5000 / E5001

INPUT TERMINAL STRIP C.

OPTIONAL

(terminal strip to be mounted on cabinet back wall)



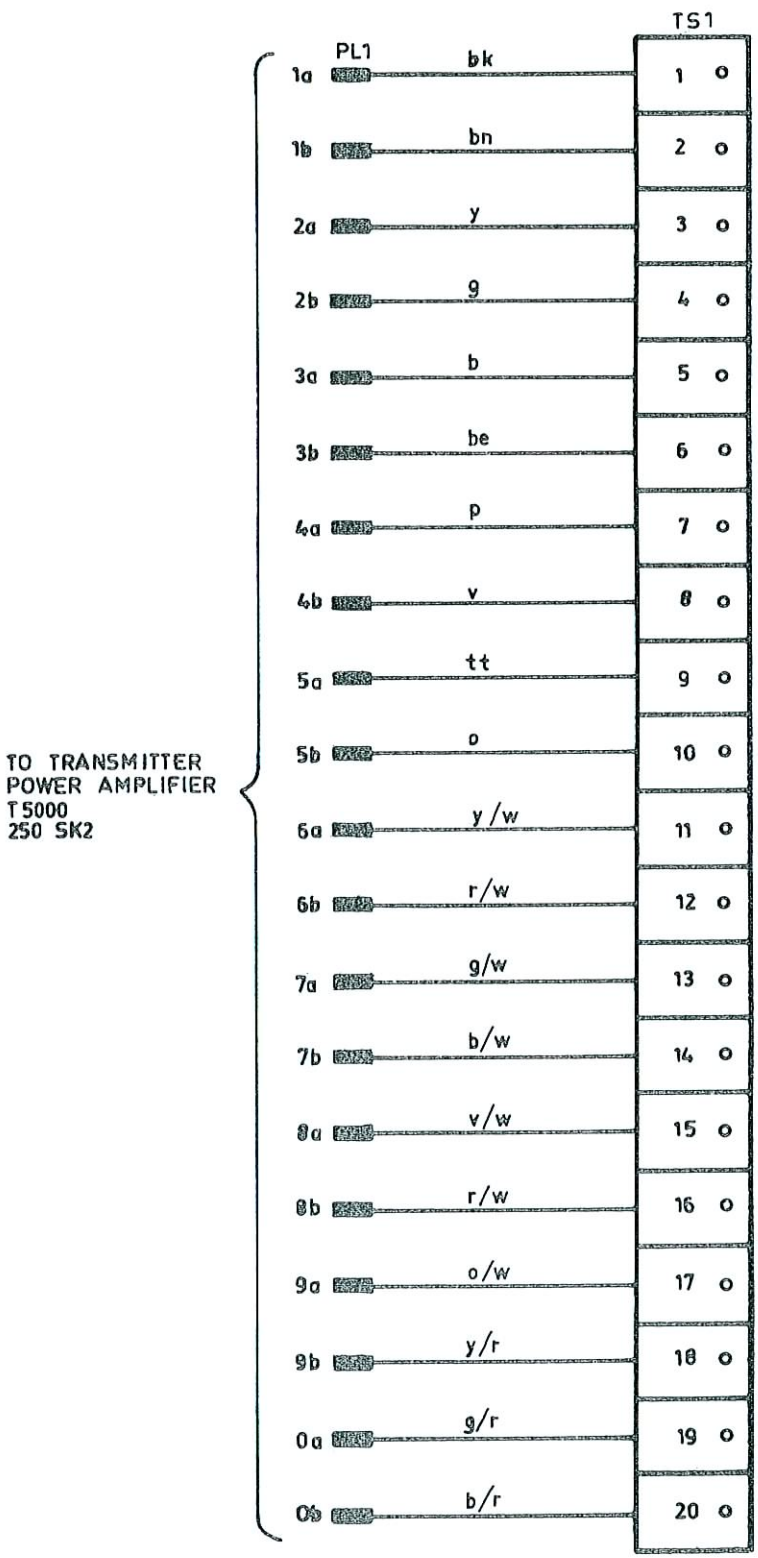
b	blue
be	beige
bk	black
bn	brown
g	green
or	orange
p	pink
r	red
s	slate
v	violet
w	white
y	yellow

T5000

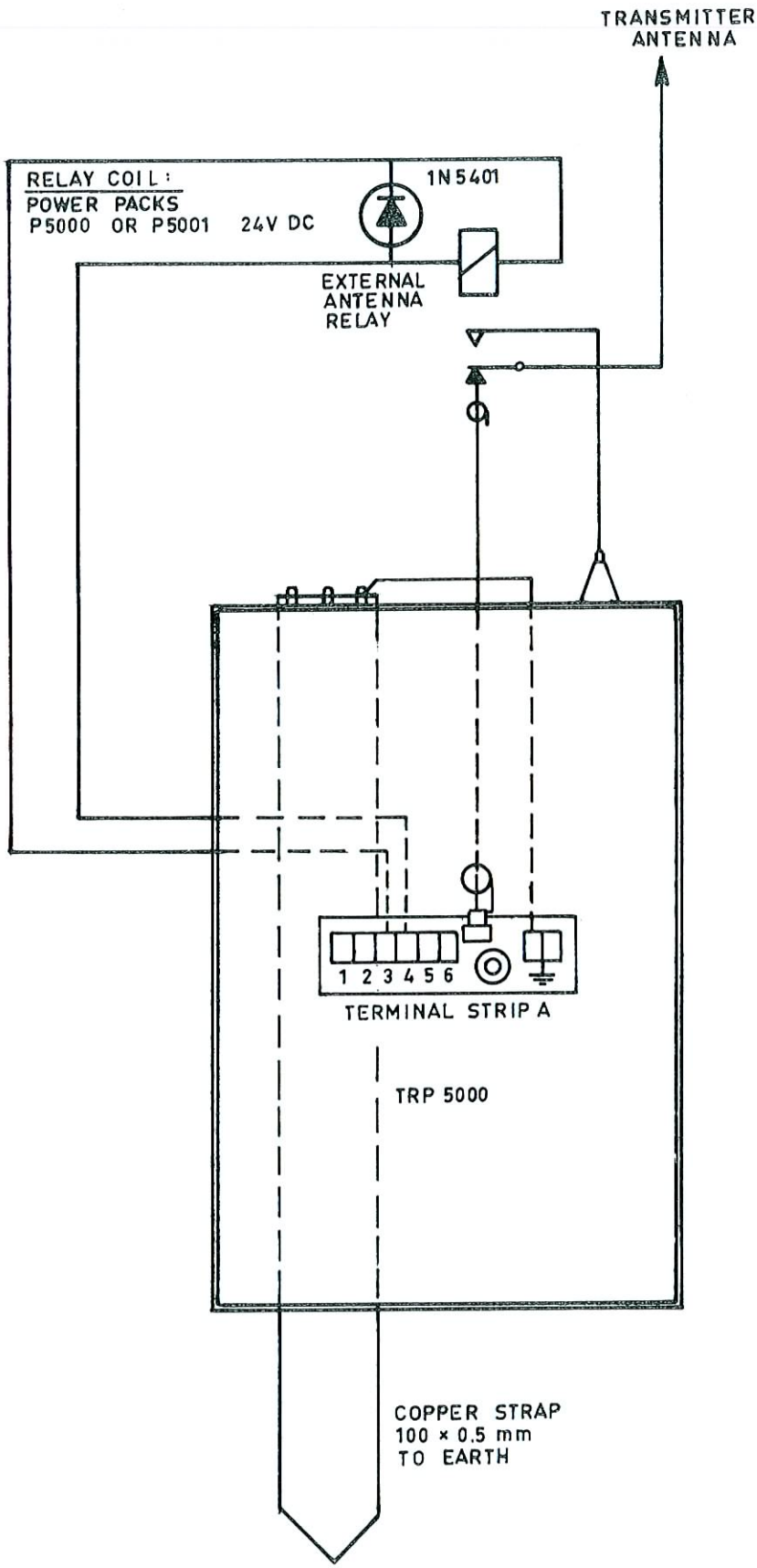
OUTPUT TERMINAL STRIP D
OPTIONAL

(terminal strip to be mounted on cabinet back wall)

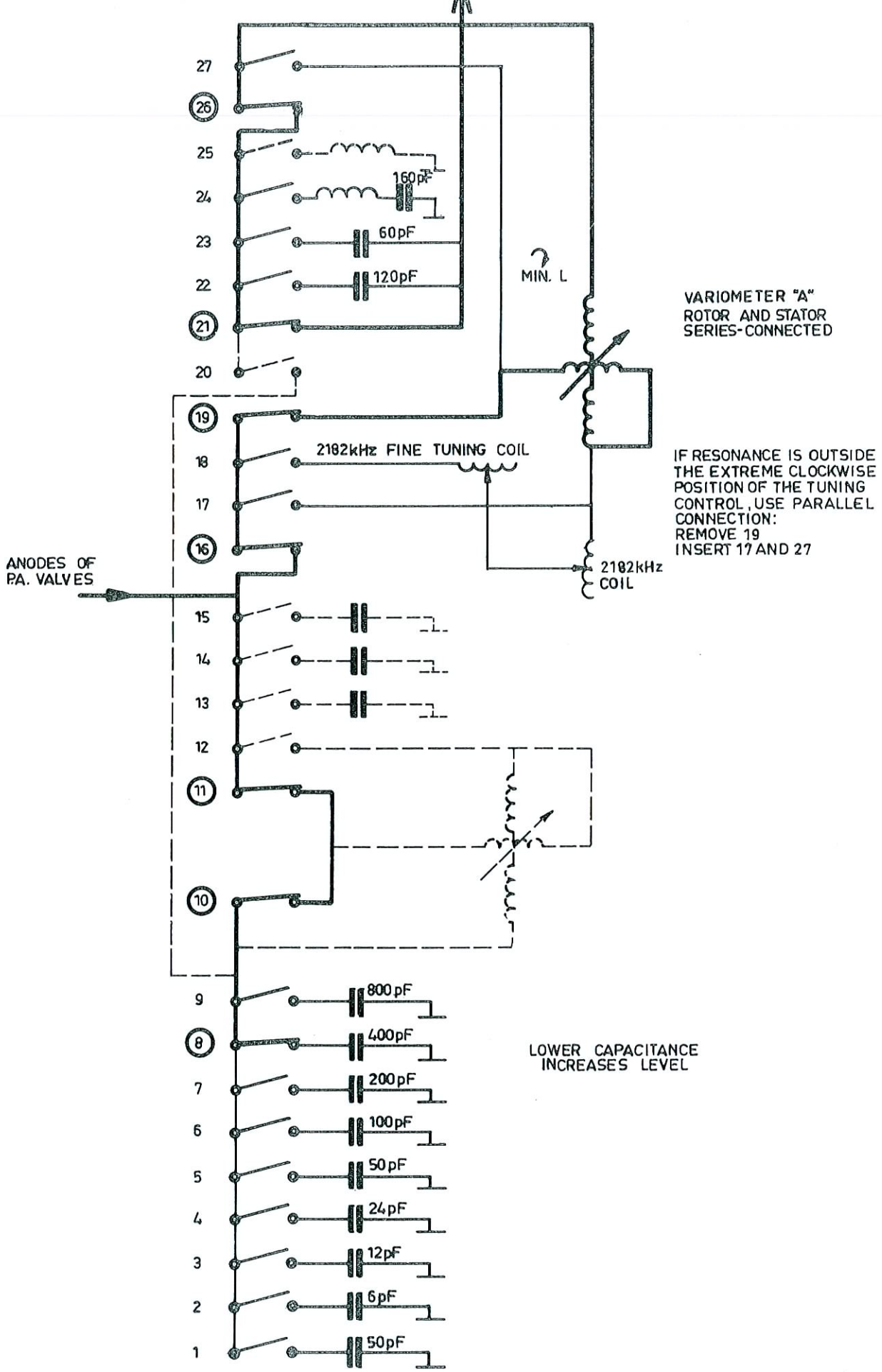
To be used for example to control an ATU.
Note that the corresponding socket SK2 in T5000 only is mounted and wired on special order.



b	blue
be	beige
bk	black
bn	brown
g	green
or	orange
p	pink
r	red
s	slate (grey)
v	violet
w	white
y	yellow
tt	transparent

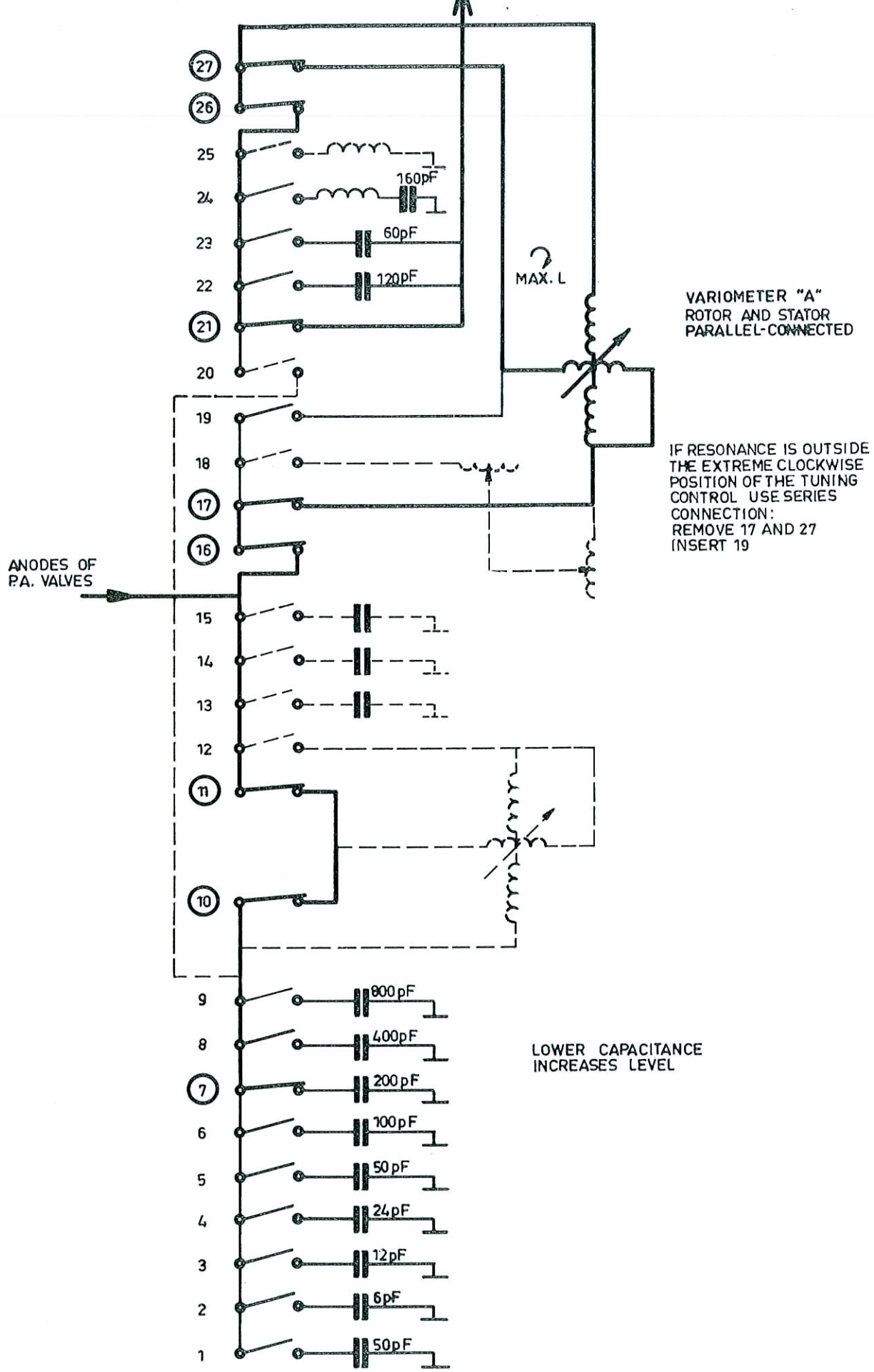


Installation of external antenna relay for integral receiver (simplex one antenna installation) or extra receiver.



INITIAL TAB-SETTINGS ON BAND-SWITCH DRUM
LOWER CT-BAND (below approx. 3MHz)

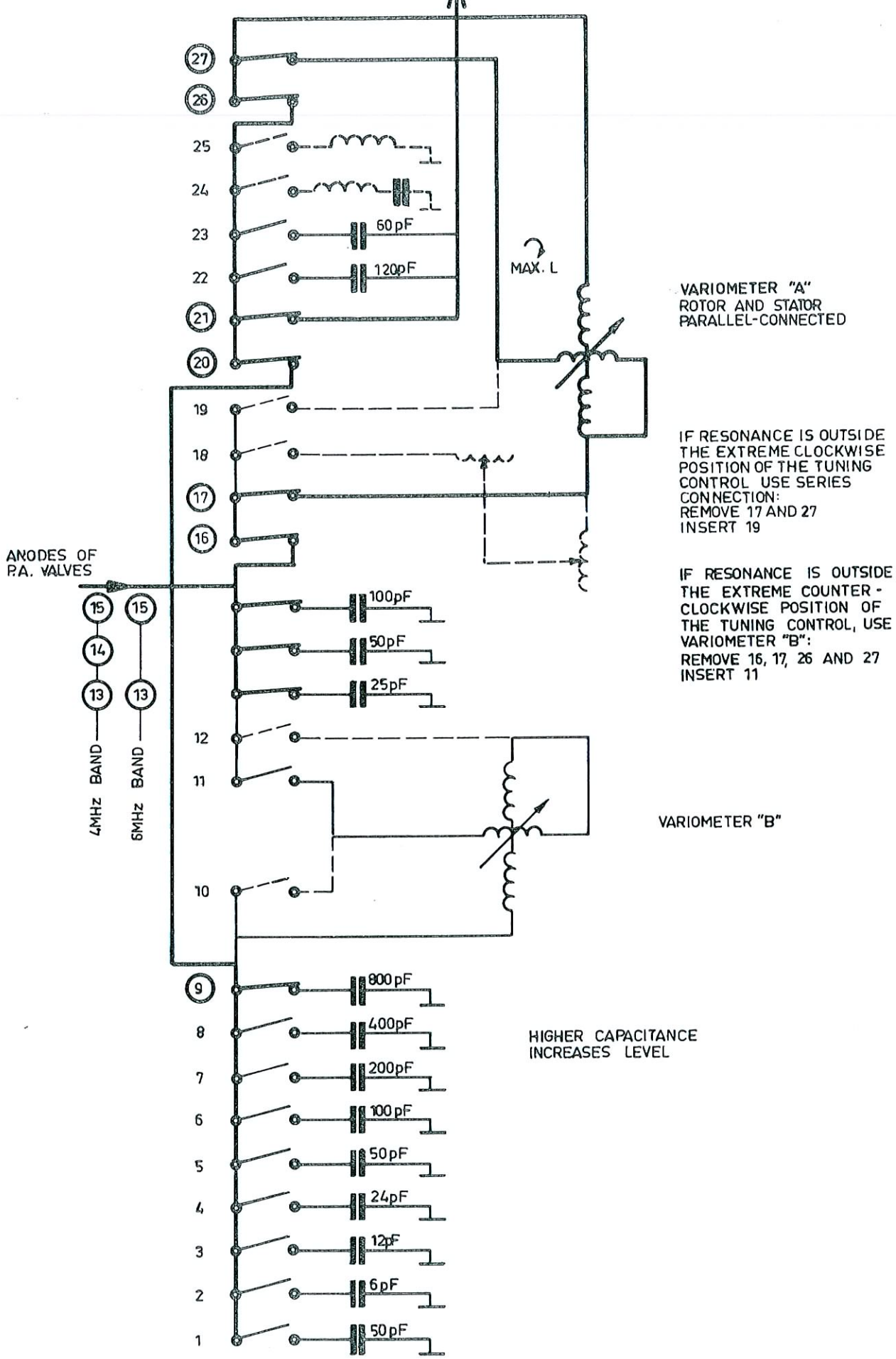
? 227 13



992 227 13

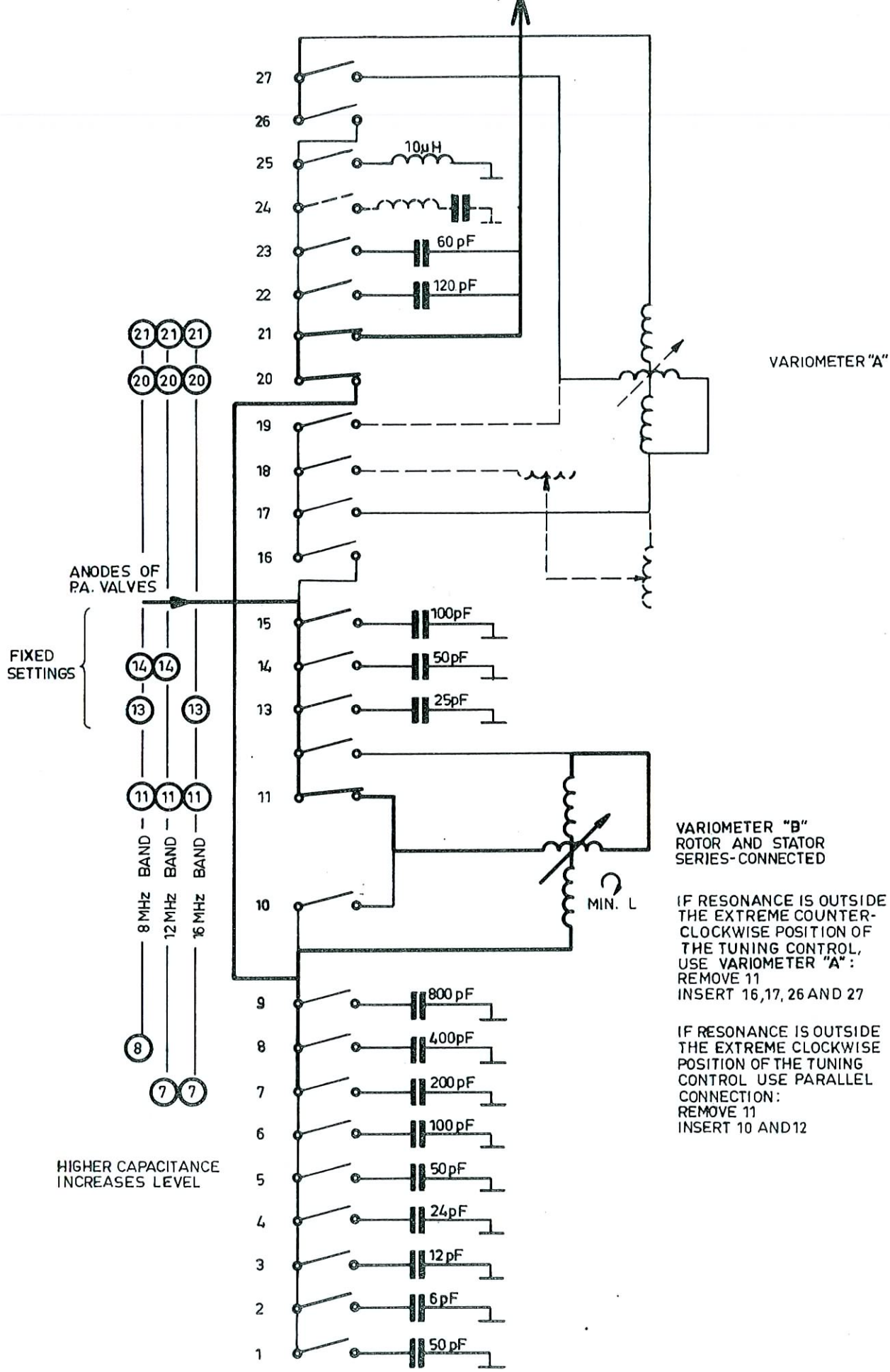
INITIAL TAB-SETTINGS ON BAND-SWITCH DRUM
UPPER CT-BAND (above approx. 3MHz)

992 227 23



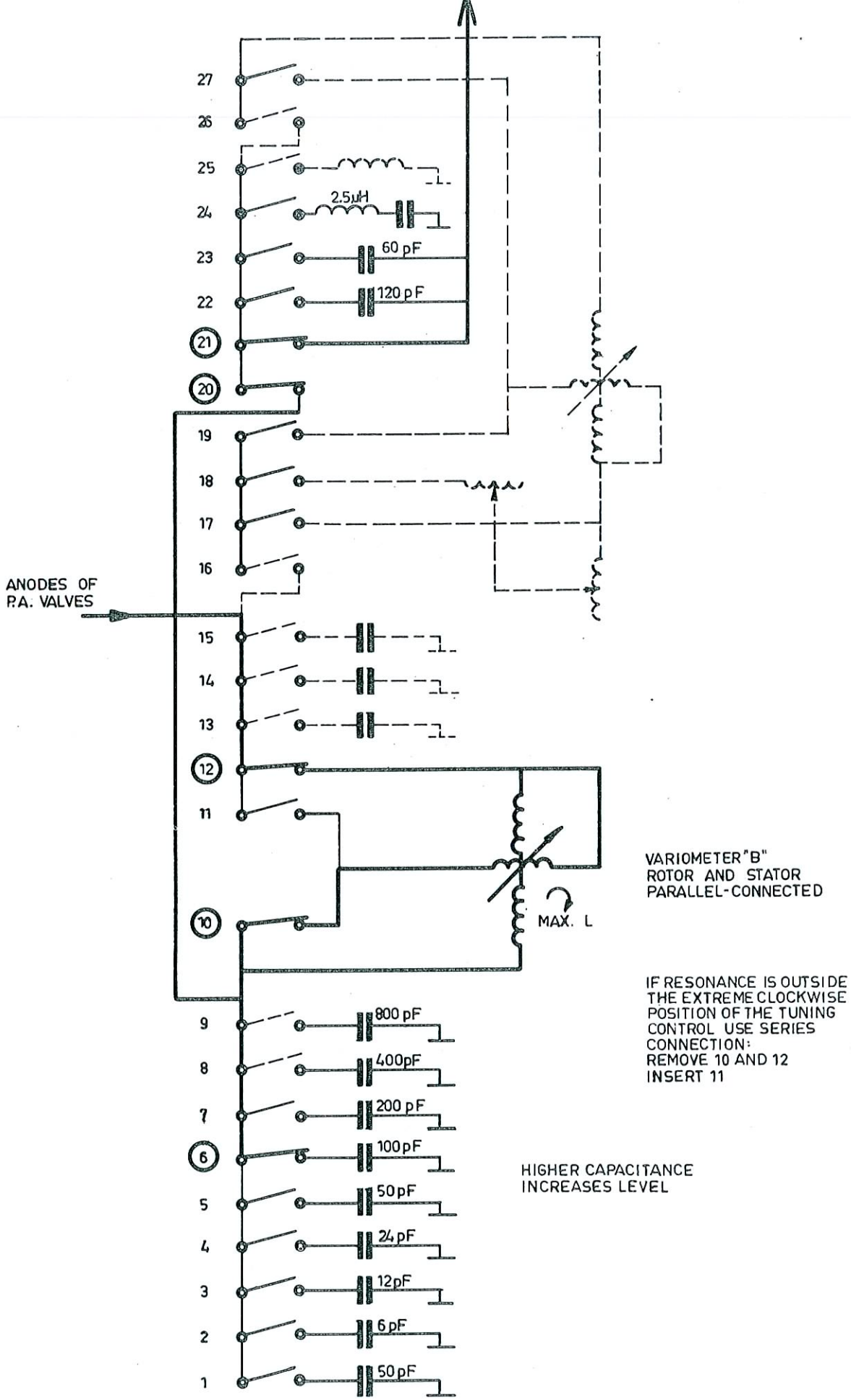
INITIAL TAB-SETTINGS ON BAND-SWITCH DRUM
4-6MHz BANDS

? 227 33



992 227 43

INITIAL TAB-SETTINGS ON BAND-SWITCH DRUM
8 - 16 MHz BANDS



INITIAL TAB-SETTINGS ON BAND-SWITCH DRUM
22 - 25MHz BANDS

9922 227 53

T 5000 TUNING CHART

Ship:_____ Harbour:_____

Technician:_____ Date:_____ T5000 serial no.:_____

Supply voltage:_____V DC/AC-50/60 Hz Antenna:_____

CHECK SWITCH readings are taken with POWER switch in position FULL POWER DUPLEX and MODE switch in position A3J.

CHECK SWITCH	TUNE button not pressed	TUNE button pressed
V_A		
V_{S1}		
V_{S2}		
V_G		
I_1		
I_2		
V_D		
Freq. kHz (not 2182):		

LEVEL readings are taken with POWER switch in position MEDIUM POWER SIMPLEX and TUNE button pressed. ANTENNA CURRENT readings are taken with POWER switch in position FULL POWER SIMPLEX and TUNE button pressed. Readings are taken on that frequency in each band which gives the highest Level reading.
Mark in plan below positions on drum switch in which programming tabs have been inserted.

BAND	FREQ. kHz	LEVEL	ANT. CUR-RENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2182	—																													
A																														
B																														
C																														
D																														
E																														
F																														
G																														
H																														
4MHz																														
6MHz																														
8MHz																														
12MHz																														
16MHz																														
22MHz																														
25MHz																														

PROGRAMMING WORK SHEET.

Transmitting Frequency (kHz)	Frequency Correction (kHz)	Freq. No.	Band	Mode	Synthesizer Frequency (kHz)

4. Technical Data

Modes of operation
Duplex, semiduplex and simplex A3A, A3H, A3J, and F1.
Semiduplex and simplex A1 and A2H.
At 2182 kHz A3H simplex only

Power Output
A1, A2H, A3A, and A3J: 400 watts Peak Envelope Power
F1: 250 watts
with reduction to less than 20 watts.

Operating frequencies
2182 kHz plus up to 256 synthesized frequencies. The frequencies can be freely distributed in the maritime mobile bands up to 27.5 MHz.

Frequency Accuracy
Better than ± 40 Hz

Frequency Stability
Better than ± 20 Hz in any 15 minute period.

Modulation characteristic.
Within 6 dB from 350 Hz to 2700 Hz

Alarm Generator
A two-tone alarm generator is incorporated.

Supply Voltage
24 V battery with P5000 Power Pack or 110/115/120 or 220/230/240 V single – or two phase AC, 50-60 Hz with P5001 Power Pack.

Supply Voltage Variations
DC: – 10 to + 30%
AC: ± 10%

Consumption

	24 V battery	AC mains
RECEIVE ONLY	2.5 A	85 VA
STAND BY	6.5 A	235 VA
TRANSMIT (unkeyed)	9 A	270 VA
A3J (unmodulated)	27 A	800 VA
A3H (unmodulated)	34.5 A	1000 VA
TRANSMIT ALARM	39.5 A	1200 VA
F1	36.5 A	1150 VA
A1 (50% duty cycle)	35 A	1150 VA

Dimensions and weight

Height (cabinet only):	822 mm
With (cabinet only):	533 mm
Depth (cabinet only):	334 mm
Weight (DC):	83.5 kgs
Weight (AC):	89.5 kgs

5. Technical Description

5.1 Mechanical

5.1.1 The equipment consists of four main units: Transmitter Power Amplifier, Power Pack, Exciter and Receiver. The Transmitter Power Amplifier is built on an alodine treated aluminium chassis. The other units are built on zinc plated and passivated iron chassis.

5.1.2 The cooling of the two P.A. valves is by forced air, provided by a blower installed at the back of the Transmitter Power Amplifier chassis. The air-intake is on the front panel where an airfilter is mounted. The filter element can be removed for cleaning.

5.1.3 The transmitter power amplifier T5000 contains four printed circuit boards. The boards /251\ and /254\ become accessible after removal of the lid of the tube compartment at the back of the chassis. /252\ is mounted on the CHECK SWITCH and /253\ becomes accessible after removal of the front plate.

5.1.4 The exciter E5000 contains five plug-in boards /234\ to /238\ and two boards in separate screened cans /232\ and /233\ that become accessible after removal of the respective lids. Board /239\ is mounted behind the front panel. This board and the motherboard /231\ become accessible when the front panel is tilted forward, this is possible after removal of the two upper screws in each side fixing the front panel.

5.1.5 The 24V DC power pack P5000 contains four printed circuit boards /261\ to /264\ . The boards /261\ and /262\ are mounted below the chassis, while board /263\ and /264\ are mounted on the back of the chassis front plate.

5.1.6 The AC power pack P5001 contains three printed circuit boards /266\ to /268\ . The boards /266\ and /267\ are mounted below the chassis, while board /268\ is mounted on the back of the chassis front plate.

5.2 Circuit Description, General

Each printed circuit board and also the chassis-mounted components, have been allocated an identification number:

Exciter, E5000, /230\ to /241\
Transmitter Power Amplifier, T5000, /250\ to /254\
Power Pack, P5000, /260\ to /264\
Power Pack, P5001, /265\ to /268\

The designation of a component or terminal includes this number as a prefix, e.g. 232R3 (resistor R 3 on board /232\ ), or 232-12 (terminal No. 12 on board /232\ .

For convenience in this section and on the circuit diagrams, the prefix is omitted except where there is a risk of ambiguity.

5.3 Circuit Summary, Exciter E 5000

5.3.1 The circuit diagram is divided into a wiring diagram on page 8-67 showing the Motherboard /231\ and the interconnections between the printed circuit boards, of which the Exciter is composed, and circuit diagrams of the individual circuit boards. The block diagram on page 8-60 illustrates the operation of the Exciter.

5.3.2 The signal path is contained on boards /232\ and /233\ . The AF input signal, after having passed an input selecter and a compressor, is converted to a 1,4 MHz double sideband signal by mixing with a 1.4 MHz signal derived from the master oscillator. The upper sideband is removed in a crystal filter and the lower sideband is applied to an amplifier, the gain of which is set in accordance with the mode selected. At the output a 1.4 MHz signal of appropriate level for carrier re-insertion is applied in the modes A3A and A3H.

5.3.3 The 1.4 MHz single sideband signal is fed to the RF Translator /233\ that converts it to the desired transmission frequency. The 1st. mixer converts the signal to an upper sideband signal in the range 1.6 to 4.3 MHz, a low-pass filter removes the image frequency. The gain of the amplifier following the filter can be controlled in steps from the POWER-switch. The level setting circuitry at the output of the amplifier allows the level to be set independently at each band.

The 2nd. mixer converts the signal to the different bands by mixing it with fixed injection frequencies. The mixer is followed by switchable band pass filters and an amplifier.

5.3.4 In the A1, A2H and TRANSMIT ALARM modes the AF signal is supplied from the tone generators on board /234\ . The 1.5 kHz oscillator is used for generating the carrier frequencies in the modes A1 and A2H. A 1.5 kHz shift command from the mode control circuit makes the synthesizer decrease its output frequency by 1.5 kHz in these modes which means that the output frequency of the exciter becomes the correct transmission frequency. The 2.2 kHz oscillator in addition is used for generating the sideband in the A2H mode giving a modulation frequency of 700 Hz.

The Keyline output from the keying circuit to the Power Pack tells the HT converter to start when the line goes high. However, this is inhibited until the phase locked loops of the synthesizer and the Harmonic Generator have locked or if an invalid frequency No. has been selected. If the 1.4 MHz Reference Signal is missing, the keyline is also inhibited, as the synthesizer cannot lock.

5.3.5 The Frequency Synthesizer, contained on boards /236\ and /237\ , consists of a single loop using the so-called Sidestep-technique. The loop is able to generate any frequency from 3,000.0 KHz to 5,999.9 KHz in steps of 100 Hz. In the F1, A1, A2H modes the output frequency is automatically decreased by 1.5 KHz.

The Frequency Synthesizer ioop is locked to a 1KHz reference signal derived from the 1.4 MHz reference frequency, so that the output frequency will exhibit exactly the same stability as the master oscillator . The output frequency of the loop is controlled from the Memory /238\ .

The Sidestep principle is performed as follows. Assume that the output frequency of the Frequency Synthesizer is (a, b.c.d., e) KHz. This frequency is divided by (a b c d + 1)e times and (a b c d) x (10-e) times, so that the division ratio on the average is: ((abcd+1)xe + (abcd)x(10-e)) = abcd.e. Thus the average output frequency of the variable counter chain will become equal to the 1 KHz reference frequency of the loop, as it should, if the loop is properly locked.

5.3.6 The injection frequency to the 2nd. mixer of the RF Translator is supplied by the Harmonic Generator /235\ . The frequencies are all harmonics of the 1.4 MHz reference frequency. The desired harmonic is selected by a Band Selector controlled from the Memory. The Band Selector also selects the correct band-pass filter and level setting potentiometer of the RF Translator.

5.3.7 The Memory /238\ in which the necessary information associated to each Frequency No. is stored controls the synthesizer and the Harmonic Generator, and supplies information to the Band Indicator of the Transmitter Power Amplifier. The memory address is selected from board /239\ which contains the keyboard and a display showing the selected Frequency No.

5.3.8 The 1.4 MHz reference frequency is normally supplied from the master oscillator of the receiver. However, if the receiver is not installed in the cabinet, Master Oscillator /240\ is available for mounting in the Exciter.

5.4 Circuit Description, Exciter E 5000

5.4.1 /232\ 1.4 MHz EXCITER

The AF input signals are connected to the compressor through an input selector. The microphone and line inputs are open only if the terminals 4 and 8 are both HIGH. The telex AF input is open only if terminal 8 is LOW. The tone input is always open.

The gain of the compressor is controlled by means of the field effect transistor TR2, which functions as a variable emitter resistor for the left hand transistor in IC1. The control voltage is provided by a rectifier consisting of the pair of IC1 transistors to the right, which detect the sideband level at the output of the crystal filter X1. When terminal 4 is LOW the compressor is off, as the resistance of TR2 is kept at its maximum value.

The compressed audio signal and a 1.4 MHz signal from the carrier level regulator IC2 are fed to the balanced mixer IC3. The output is a 1.4 MHz double sideband suppressed carrier signal, which is amplified in TR4 and fed through crystal filter X1 that removes the upper sideband and suppresses the carrier still further.

The gain of the amplifier stage following the filter is controlled from terminals 13, 14, and 15 by inserting different emitter resistors. In the A3H-mode all terminals are HIGH and the gain is determined by R70. Carrier re-insertion is performed by applying the 1.4 MHz signal from the carrier level regulator to TR6 via an attenuator controlled from the same terminals.

5.4.2 /233\ RF TRANSLATOR

The 1st. mixer converts the 1.4 MHz LSB-signal to an USB-signal in the frequency range 1.6 to 4.3 MHz, by mixing it with the injection frequency from the VCO of the synthesizer. The image signal is removed in the 4.3 MHz low-pass filter and the wanted signal is applied to TR1. The gain of this stage is controlled from the POWER switch via terminals 1 and 2. The load-resistance at the collector is adjustable and can be set individually at each band by means of variable resistors.

The 2nd. mixer converts the signal to the transmission frequency. The injection frequency is fixed for each band. In the bands 1.6 to 4 MHz and the 4 MHz HF band the injection frequency is zero, which means that the output frequency is the same as the input frequency. The mixer works as an amplifier since the one pair of transistors are cut off by means of D11 or D12.

The mixer is followed by a number of band pass-filters and an amplifier. A filter is selected by taking one of the terminals 12 to 21 LOW, while keeping the others HIGH. At the same time the corresponding level setting potentiometer is selected.

5.4.3 /234\ CONTROL CIRCUIT AND TONE GENERATORS

The mode control signals from the MODE-switch, and the 2182 kHz and MF information from the transmitter power amplifier, are the input signals to the programmable read only memory (PROM), IC5, of the Mode Selector. The PROM has been programmed to give at the output the desired control signals corresponding with the wanted mode.

The Mode Selector controls the input selector and the mode setting of the 1.4 MHz Exciter /232\ via the respective control leads. The 1.5 kHz SHIFT output tells, when HIGH, the synthesizer to decrease its frequency by 1.5 kHz. In the F1-mode, the anode voltage of the P.A. valves is lowered by means of a relay in the Power Pack controlled from transistor TR5. Automatic selection of FULL POWER is carried out by means of transistor TR4, when 2182 kHz (terminal 14a LOW) and TRANSMIT ALARM (output O_6 of IC5 LOW) are selected. The mode selector further controls the Key Selector.

Keying of the transmitter is only possible from the MORSE KEY input in the A2H and A1 modes, from the TELEX KEY input in the F1 mode, from the HANDSET KEY input in the A3A, A3J, A3H and TRANSMIT ALARM modes, and from the DUPLEX input in the F1, A3A, A3J, A3H or TRANSMIT ALARM modes, provided 2182 kHz is not selected, as the DUPLEX input is then inhibited. Furthermore the information on terminal 24a (WT) from MEMORY /238\ has to be in accordance with the mode selected (except on 2182 kHz): HIGH at A2H, A1, and F1, LOW at A3A, A3J, A3H, or TRANSMIT ALARM. The keying signal at IC2, pin 8 controls, via an inverter, transistor TR9, supplying +12 V to RF TRANSLATOR /233\ when keyed, and activating the keyline to the power pack. In SIMPLEX it supplies base current to TR8, controlling the muting of the receiver.

The Two-tone Alarm Signal Generator incorporates the 45 sec. Timer, the 2Hz Astable Multivibrator, and the 2.2 kHz and 1.3 kHz Oscillators. The 45 sec. Timer is enabled from the Mode Selector in TEST ALARM and TRANSMIT ALARM, and can be started by pushing the ALARM START push-button that applies +12 V to

terminal 2c. Via the voltage divider R32 and R33, a keying signal is applied to the Key Selector. The 2Hz Astable Multivibrator starts and supplies base current to TR6 and TR 11 alternatively. The audio signal from the oscillators is, via the Tone Keyer, applied to the 1.4 MHz EXCITER /232\ and, via the Sidetone Keyer, applied to the receiver audio amplifier.

In the A1-mode the 1.5 kHz oscillator is started. The audio signal is keyed in the Sidetone Keyer and the Tone Keyer which are both controlled from the morse key. Capacitor C8 and adjoining components at the gain control input of IC7 serve to shape the tone pulses correctly.

In the A2H-mode, the 2.2 kHz oscillator as well as the 1.5 kHz oscillator are on. R54 is connected to ground in IC4, thereby reducing the peak level of the audio signal at the Tone Keyer input to the same level as when only one tone is present. The Sidetone Keyer is connected to the 1.5 kHz oscillator only, as TR12 is turned off by means of D24.

When the TUNE-button of the Transmitter Power Amplifier is activated, terminal 18c is LOW. A2H is selected by means of D1 and D3, the transmitter is keyed via IC2 pin 9, and the Sidetone Keyer is turned off by means of IC? pin 1.

5.4.4 /235\ HARMONIC GENERATOR

There is one phase locked loop and its associated lock detector located on this printed circuit board.

The reference frequency of 1.4 MHz for this loop is derived from the TCXO, in order to accomplish the necessary degree of frequency stability of the output signal from the Voltage Controlled Oscillator.

The fixed reference frequency of 1.4 MHz is fed to one of the two input ports of the Phase/Frequency Detector. The output from the Loop Divider is fed, via IC2, to the other input port of the Phase/Frequency Detector, which in the case of a frequency difference between the two signals will produce a DC-error voltage.

The purpose of the Low Pass Filter is to remove the pulses from the output of the Phase/Frequency Detector, thus allowing only the DC-error voltage to pass on to the vari-cap diodes of the Voltage Controlled Oscillator.

The outputs of the VCO are amplitude regulated and fed to the RF-TRANSLATOR /233\ and Pre-scaler respectively.

The division ratio of the Pre-scaler and the Loop Divider is controlled by four outputs of the Band Decoder, IC4, which is again controlled by the BAND-information stored in the MEMORY /238\ .

Four other outputs of the Band Decoder select, via the Band Selector IC1, the proper band of the VCO and the proper band pass filter of the RF TRANSLATOR /233\ .

The Lock Detector detects any frequency difference between the two signals fed to the input ports of the Phase/Frequency Detector. When a frequency difference is observed, the Lock Detector turns on TR9, thus pulling down the KEYLINE to a low level voltage, as long as frequency equality is not accomplished.

5.4.5 /236\ VCO

The Loop Filter and Voltage Controlled Oscillator are located on this printed circuit board.

The Loop Filter consists of an active 4th order low pass filter and an integrator. The purpose of the Loop Filter is to remove the pulses from the output of the Phase/Frequency Detector on board /237\ and allow only the DC-information to pass on to the vari-cap diodes of the VCO. The VCO is amplitude stabilized.

The selection of one of the three bands of the VCO is carried out by means of a decoding circuit on /237\ .

5.4.6 /237\ FREQUENCY DIVIDERS

There are two divider chains, their associated buffer amplifiers, a 2182 KHz preselection circuit, a lock detector, and a phase/freq.detector located on this printed circuit board.

The Reference Divider divides the 1.4 MHz from the TCXO by 1400, thus providing the 1 KHz reference frequency for the Phase/Frequency Detector.

The Loop Divider chain consists of four programmable, decimal counters, IC16, IC20, IC23, and IC26, which are loaded at the end of each counting cycle with the data blocks supplied by the Memory /238\ or the 2182 kHz Preselection circuit. The Sidestep Control consists of a decimal counter, IC6, a four bit comparator, IC10, and gating circuitry. A data block, containing the information about the 100 Hz setting is fed to the comparator. At the end of each counting cycle IC6 is incremented by one and its outputs (B) are compared with the content of the data block (A). As long as B is less than A the division ratio of the four programmable counters are equal to the BCD 9's complement of their four associated datablocks. When B becomes equal to or greater than A the division ratio is incremented by one. This change of the division ratio is controlled by output pin 5 of IC10, which selects one of the two decoding branches, branch 1 and branch 2, consisting of parts of IC3, IC4, IC5, and IC8, and one half of IC1.

When the mode F1, A1, or A2H is chosen, the division ratio is decreased by one and two alternately, independent of the above mentioned sidestepping procedure. This is controlled by the "1.5 kHz SHIFT" line and performed by the other half of IC1, where output pin 9 is changed at the conclusion of each counting cycle, thus shifting between the two decoding branches, branch 3 and branch 4, alternately. This means that the division ratio is decreased by 1.5 on the average. Because the reference frequency of the loop is 1 kHz, this means that the output frequency of the loop is decreased by 1.5 kHz.

The output from the Loop Divider chain is fed to the Phase/Frequency Detector and is here compared to the fixed 1KHz reference frequency. In case of a frequency difference the detector will produce a DC-error voltage which will correct the VCO on board /236\ to establish the wanted frequency equality.

The two inputs /238\ -9a and /238\ -10a containing information about the MHz setting is decoded in order to select the proper band of the VCO on board /236\ . If both of the two inputs are HIGH, the Disable output line is activated.

The Lock Detector consists of IC15 and IC17. If the loop is in lock, output pin 9 of IC19 will always be LOW when the output pulse from the Loop Divider is generated, so output pin 9 of IC15 stays LOW.

In an unlocked condition of the loop, output pin 9 of IC19 will be at a LOW or HIGH logic level at random when the output pulse from the Loop Divider is generated. The first monostable multivibrator of IC17 is triggered by the corresponding output changes of IC15, thus, via the last half of IC17, inhibiting the Keyline.

If the reference signal of the loop is missing, this is detected by the last half of IC17, again inhibiting the Keyline.

5.4.7 /238\ MEMORY

This printed circuit board contains 24 sockets, organized as eight columns (No. one to No. eight) by three rows (A, B, and C). Thus up to 24 Programmable Read Only Memories (PROMs) corresponding to 256 different Frequency Nos. can be mounted in the MEMORY.

The PROM used here is organized as 32 words by 8 bits. Because 24 bits are needed as control information for each Frequency No. three PROMs must be driven in parallel, corresponding to an extended memory block organized as 32 words by 24 bits.

A memory block consisting of three PROMs is mounted in one of the eight columns. The PROMs in column No. one contain the necessary 24 bits associated with the Frequency Nos. from 0 to 31, column No. two contains the 24 bits associated with the Frequency Nos from 32-63 and so on (see table 3.12.1).

From board /239\ the binary encoded Frequency No. selects, via 5/6 IC1, one of 32 words and, via IC2, one of eight columns.

5.4.8 /239\ DISPLAY AND KEYBOARD

When a key is depressed the associated keynumber is encoded to the BCD code by means of IC2 and IC4. This BCD coded data block is fed to the input ports of the first register IC8 of the Digit Register Stack.

When a key is depressed or released some sort of bouncing effect will always appear before the key has settled. This bouncing is removed by means of the Key Bounce Eliminator, consisting of IC5 and the associated external components. A clock pulse is produced when the key has settled, after being acivated, and then the data block mentioned above is read into the first register of the Digit Register Stack, and the data blocks already stored in this Stack are shifted to the next register. The outputs of the Digit Register Stack are the BCD code of the Frequency No. chosen. Via the three BCD to 7-segment decoder/drivers, IC12, IC14, and IC19, the Frequency No. is displayed. The BCD encoded Frequency No. is converted to its associated binary code before it leaves this board, by means of IC15, IC16, IC20, and IC21, in order to select the proper information stored in the Memory /238\ . It is not possible to choose a Frequency No. greater than 255, if such an attempt is done a decoding circuitry of 3/4 IC7 automatically clears the Digit Register Stack.

By means of the variable voltage regulator consisting of TR1, TR2, and associated components the three l.e.d.-displays can be dimmed continously.

When the BAND switch is turned to the 2182 kHz position, terminal 11 receives a LOW level signal which, via ¾ IC6, activates the ripple blanking outputs of IC12, and IC19. The displays are then blanked, but the original Frequency No. is stored.

If a HIGH level is applied to terminal 13 (Disable) or a LOW level to terminal 14 (Programmed Frequency No.), the Blanking Oscillator consisting of IC3 and associated components starts a 1Hz oscillation and the Keyline is inhibited. Thus the displays, via ¾ IC6 and IC12, IC14, and IC19, will start to flash with a frequency of 1 Hz. However, if the BAND switch is turned to its 2182 kHz position, the levels of terminals 13 and 14 do not affect the Keyline.

5.4.9 ⚠240⚠ MASTER OSCILLATOR

The oscillator itself is a sealed unit containing a highly stable temperature compensated crystal oscillator, TCXO, at 11.2 MHz. The output signal of the TCXO is amplified in the transistors TR1 to TR3 and fed to the binary counter IC1 that divides the input frequency by 8. The 1.4 MHz square wave signal is filtered in a tuned circuit C6, T1, and the resulting sine wave signal is fed to the output terminals.

TCXO's of two different manufactures may be used. In both cases crystal oscillator ageing is very small (less than 10^{-6} per anum) and will be greatest during the first few years. Ageing will normally cause an increase in frequency, which in the one case can be compensated for by introducing the connection indicated by the dotted line in the circuit diagram (this will reduce the frequency by appox. $2x10^{-6}$) and in the other case by changing the factory selected resistor. The resistor should be selected at 25°C ambient temperature to give a TCXO output frequency offset from the nominal frequency (11.2 MHz) by the amount marked on the can.

Frequency adjustment should be carried out only if a high quality counter is available for control of the frequency. It must be ensured that the accuracy of the counter at the time of use is better than 10^{-7}.

5.4.10 ⚠241⚠ PROGRAMMING UNIT (Optional)

The purpose of this printed circuit board is to make it possible to program manually the PROMs used as building blocks in the MEMORY ⚠238⚠

The only types of PROMs, which can be programmed by means of the PROGRAMMING UNIT are the TI-types shown in table 3.11.1.
Three PROMs together can contain the information of 32 different Frequency Nos. The three PROMs are placed in SK1, SK2 and SK3. Their input wordaddress is chosen by means of the keyboard on the front panel, thus selecting one of the 32 possible words in each of the three PROMs.

A programmed output will be greater than 2V (HIGH), an unprogrammed output will be less than 0.8V (LOW). To prevent an attempt being made, by mistake, to program new information into a word which has already been programmed once, one bit location, pin 9 of the PROM placed in SK1, must always be programmed if the rest of the bit locations of a Frequency No. have been correctly programmed.

Half of IC4 is always sensing the voltage level on pin 9 of SK1. If this voltage level is HIGH, pin 5 of IC4 will also become HIGH after the first positive transition of the clock pulse at pin 3, thus disabling IC2 and thereby IC6 and IC8 from being activated by the key S1.

By activating the key S2, the output of pin 9 of SK1 will be forced LOW, as for an unprogrammed Frequency No., thus permitting the user via the key S1 to activate IC and thereby IC6 and IC8.

Their outputs are combined by means of 4/6 IC5, 2/4 IC7 and 1/4 IC3 into three pulse-trains, one for the V_{cc}-pins and one for the Enable pins of the three PROMs and lastly one for the transistor TR1. This transistor sinks the programming current from the PROM-output to which the Programming Pin is connected.

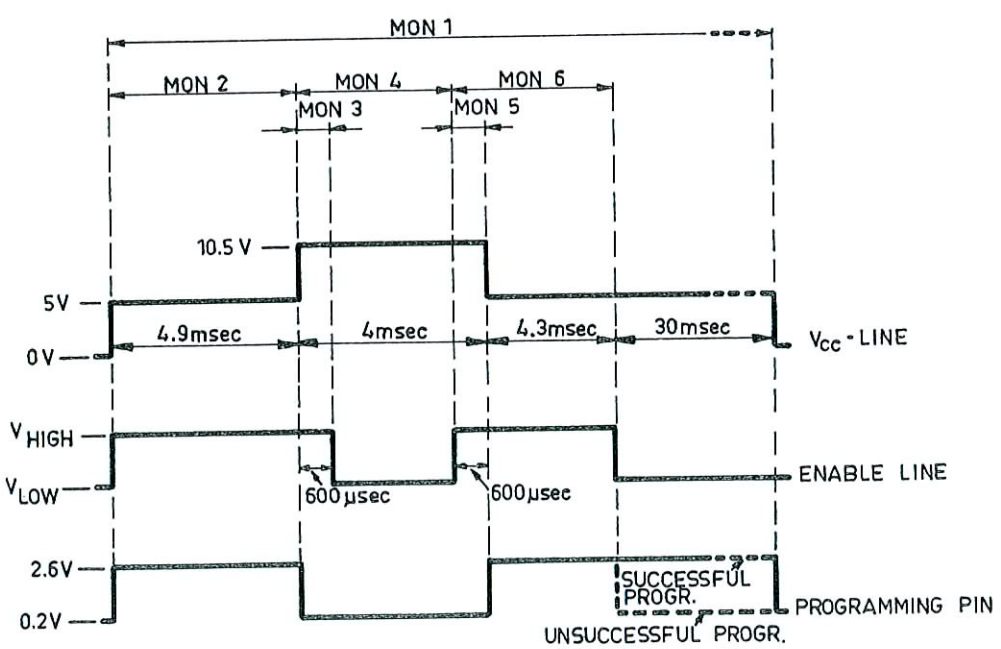
The three pulse-trains are shown below.

The two voltage levels of the V_{cc}-pins of the PROMs are stabilized by means of D3 and IC9.

In order to keep the PROMs as cool as possible, which is very essential to obtain good programming results, their V_{cc} supply line only receives a 5V pulse in 5 msec out of 100 msec during the period of time where no programming takes place. This pulsed operation is controlled by a clock-pulse generated by IC1 opening and closing, via 2/4 IC3 and 2/6 IC5, the transistor TR2. At the end of each 5 msec period the logic levels of pin 9 of SK1 and the Programming Pin are read into the two D-flipflops of IC4; a HIGH level, corresponding to a programmed bit location will make the associated lamp light.

When the key SK1 is activated and MON1 of IC2 is triggered, the clock generator IC1 is stopped. Once the programming pulse-trains have been accomplished the clockgenerator is allowed to start again after a delay of approximately 30 msec.

A delay circuit consisting of R71, R72, C12 and D4 prevents the V_{cc}-programming pulse from being generated when the PROGRAMMING UNIT is first switched on. This prevents false generated signals to IC2. This is accomplished by turning off TR2 via 1/4 IC3 and 2/6 IC5 until all the voltage levels have stabilized.



5.5 Circuit Summary, Transmitter Power Amplifier T 5000

5.5.1 The circuit diagram is divided into a wiring diagram on page 8-89 showing the interconnections between the printed circuit boards of which the Transmitter Power Amplifier is composed, and circuit diagrams of the individual circuit boards. The block diagram on page 8-61 illustrates the operation of the Transmitter Power Amplifier.

5.5.2 The RF signal from the Exciter is amplified in the DRIVER /251\ and applied to the P.A. output valves. Antenna tuning is preselected with the BAND switch, and fine tuning is performed with the TUNING control.

5.5.3 Antenna current measuring and CHECK SWITCH circuits are contained on printed circuit board /252\ .

5.5.4 Visual indication of where to set the BAND-switch in accordance with the frequency selected is performed by the BAND INDICATOR /253\ . When 2182 kHz is selected, information is supplied to the Exciter. If the BAND switch is incorrectly set, the Keyline Inhibit output prevents keying of the transmitter.

5.5.5 Regulation of grid and screen grid voltages, as well as filament voltages for the P. A. output valves, is carried out on printed circuit board /254\ .

5.6 Circuit Description, Transmitter Power Amplifier T 5000

5.6.1 /251\ DRIVER

A preamplifier consisting of TR1 and TR2 in parallel amplifies the signal which is then applied to a class A push-pull stage consisting of the transistors TR3 and TR4. The DC current of these transistors is set by means of the variable resistor R7. Coarse setting is by means of the resistors R13-R15. The compensation network at the output provides a flat response over the frequency range.

5.6.2 /252\ METER CIRCUIT

The printed circuit board is an integral part of the CHECK SWITCH and contains voltage dividers for metering different voltages of the Transmitter Power Amplifier. D1 rectifies the current of the antenna current transformer. D2, R11, and R13 provide compression of the meter scale. TR1 inverts the negative grid voltage to a positive current in the meter when checking V_G.

5.6.3 /253\ BAND INDICATOR

The purpose of the Band Indicator is to show where to set the BAND switch in accordance with the frequency selected. This is done by means of 16 light emitting diodes, 15 of which are controlled from two 1 of 10 decoders IC3 and IC5. These decode the binary band information from the Exciter and make one of the lamps flash if the BAND switch is incorrectly set. The BAND switch information and the information from the Exciter are compared in the Comparator, IC4. If they are not equal the output will be LOW and will via IC6 and IC7, start the 1 Hz Multivibrator (FLASH ENABLE: HIGH) that controls the decoders via $^2/_4$ IC1. At the same time the Keyline output is LOW thus inhibiting transmission.

When "2182 kHz" is selected by means of the BAND switch the information is HIGH on all four input leads from the BAND switch. In that case the output from ½ IC2, pin 8, is HIGH and as terminal 7 is open and thus HIGH too, the output of ¼ IC 1, pin 11, is LOW, telling the Exciter to select 2182 kHz. The light emitting diode D1 will show constant light.

5.6.4 254 VOLTAGE REGULATORS

The Grid Voltage Regulator consists of two integrated circuits IC1 and IC2 that operate as zener diodes having a very low temperature coefficient. The actual grid voltage is set by means of the variable resistor R1.

The screen grid voltage of the power amplifier tube V1 is fixed and determined by two 150 V zener diodes 250 D1 and 250 D3. In order to be able to equalize the currents of the two tubes, the screen grid voltage of V_2 is made adjustable. The zener diodes 250 D5 and 250 D6 are connected to a voltage regulator containing transistor 250 TR1, the collector voltage of which can be set by means of variable resistor R3.

The 6V filament voltages of the power amplifier tubes has to be controlled within very narrow limits to obtain maximum tube life. This is done in the Filament Voltage Regulator. In order to reduce current consumption the filaments of the two tubes are series connected, which means that the voltage of each tube has to be controlled. The regulator of V_2 consists of the NPN darlington transistor 250 TR3 in connection with the zener diode D4 and resistor R15. When the voltage of the filament reaches 6V, the transistor starts to conduct and shunts the filament by which the voltage is kept constant. The regulator of V_1 is identical except the transistor is a PNP darlington. The collector currents of the two transistors pass the diodes D5 and D6, and the voltage across these diodes is applied to a current regulator consisting of TR1 and 250 TR2. TR3 serves to limit the peak current.

5.7 Circuit Summary, 24V DC Power Pack P5000

5.7.1 The circuit diagram is divided into a wiring diagram on page 8-99 showing the interconnections between the printed circuit boards of which the Power Pack is composed, and circuit diagrams of the individual circuit boards. The block diagram on page 8-62 illustrates the operation of the Power Pack.

5.7.2 Filament supply for the transmitter power amplifier output valves is obtained directly from the battery, while the remaining necessary supply voltages for Transmitter Power Amplifier, Exciter and Receiver are generated in converters. Converter transformers give full isolation between the battery voltage and the chassis, permitting these to be earthed without causing the supply leads to be earthed.

5.7.3 Low tension voltages for Exciter and Receiver and negative grid voltage for the Transmitter Power Amplifier are generated by the LT-converter followed by rectifiers and stabilizers.

The LT-converter frequency is determined by an RC-coupled oscillator followed by a bistable multivibrator.

5.7.4 High tensions for the P.A. valves are generated by the HT-converter followed by rectifiers. To avoid excessive anode voltage to the P.A.-valves at high battery voltages an input voltage sensor is incorporated in the power pack. When the input voltage exceeds a certain voltage a relay in the input voltage sensor circuit will operate and decrease the anode voltage.

Supply voltage for the driver stage in the transmitter power amplifier is also generated in the HT-converter followed by rectifiers and a voltage stabilizer.

The HT-converter is driven from two secondary windings on the LT-converter transformer.

5.7.5 To fulfil the input voltage requirements of the blower in the transmitter power amplifier, a seperate blower converter is incorporated.

5.8 Circuit Description, 24V DC Power Pack P5000

5.8.1 

LT-, HT-, AND BLOWER-CONVERTER

Relay RL1 serves as a mains switch. The current which energizes RL1 is controlled by the POWER switch. Turning the switch from OFF to RECEIVE ONLY connects the relay coil to the battery voltage. Diode 261D1 ensures that the relay cannot operate if the battery voltage does not have the correct polarity. The contacts of RL1 are protected against excessive capacitor chargeing current by resistor R2. The resistor ensures that the capacitors after the relay are always charged before the contacts are closed.

The LT- converter is composed of transistors TR10 and TR12, and the square wave output signal is coupled through transformer T3 to the LT- and grid voltage-rectifiers and as a drive signal to the HT-converter.

The HT-converter contains transistors TR4, TR6, TR8 and TR11 and the output signal is coupled through transformer T2 to the HT-rectifiers.

The Blower-converter contains transistors TR1 and TR2 and the output transformer T1 transforms the square wave output voltage to the correct level.

Included in the Power Pack is also a loudspeaker connected to the associated receiver AF-output.

5.8.2 

CONVERTER DRIVER LT- RECTIFIERS AND -STABILIZERS.

A bistable multivibrator composed of transistors TR2 and TR4 is driven by oscillator IC1 with a nominal frequency of 440 Hz. The output signals from the multivibrator are therefore square waves with a repetition frequency of 220 Hz, and these signals having a phase difference of 180° are, after current amplification in transistors TR1 and TR3, used as driving signals for the LT-converter.

One output signal from the LT-converter is rectified in diodes D11 and D12 which are followed by two voltage stabilizers both having a nominal voltage of 7.5 V.

Another output signal from the LT-converter is rectified in diodes D16 and D17 followed by a voltage stabilizer having a nominal output voltage of 15.7V.

The board contains also the keying relay RL1 for the complete TRP5000 equipment. The contacts of the relay are used to disconnect the speaker built into the Power Pack, and to key the grid bias of the P.A. valves.

5.8.3 262 HT-RECTIFIERS AND BASE KEYING CIRCUIT.

The current which energizes relays RL1 and RL2 passes Transmitter Power Amplifier safety switch 250 S 1 and Power Pack safety switch 260 S 2 and is controlled by keying relay 261RL1. Via the contacts of RL1 and RL2, base drive is applied to the HT-converter transistors and the square wave output is rectified in six bridge circuits. The DC-outputs of each bridge are series connected to obtain the anode supply voltage for the Transmitter Power Amplifier, while the DC-output from the second bridge above ground is used as screen grid supply voltage.

When the MODE switch of the associated Exciter is set to F1, the anode voltage is lowered by opening the contacts of relay RL3 and thereby the anode dissipation in the Transmitter Power Amplifier is decreased.

The anode voltage is further controlled by relay 264RL1 which in the case of high battery voltage will decrease the available anode voltage by disconnecting the input voltage to one of the six bridge rectifier circuits.

5.8.4 263 DRIVER- AND GRID-VOLTAGE STABILIZERS, BLOWER CONVERTER DRIVER AND TIMER

An output voltage from the HT-converter transformer 260T2 is fed to rectifiers D1 and D2 followed by a voltage stabilizer having a nominal output voltage of 28 V.

An output voltage from the LT-converter transformer 260 T3 is fed to bridge rectifier D3, D4, D5 and D6 followed by a zener diode stabilizer. The stabilized voltage is negative with respect to chassis and is further stabilized in the Transmitter Power Amplifier to be used as grid voltage.

To avoid the transmitter being keyed before the filaments of the P.A. valves have reached their operating temperature, a 30 seconds timer is included. The timer is composed of integrated circuit IC1 and will commence the timing period when the POWER switch 260 S1 is turned from RECEIVE only to STAND BY. Until the 30 seconds period has elapsed the keying relay 261RL1 connot be operated.

The blower in the Transmitter Power Amplifier requires a 50 Hz input voltage. A bistable multivibrator composed of transistors TR2 and TR4 is driven by oscillator TR1 with the nominal frequency 100 Hz. The output signals from the multivibrator are therefore square waves with a repetition frequency of 50 Hz, and these signals which have a phase difference of 180° are used as driving signals for the Blower-converter.

5.8.5 264 INPUT VOTAGE SENSOR

A Schmitt trigger having a hysterisis of approx. 2 volts is used as an input voltage sensor. If the battery input voltage exceeds a certain value relay RL1 will open and decrease the anode voltage by opening one of the secondary windings on the HT-transformer 260 T2. When the battery voltage is approx. 2 volts below the trigger point relay RL1 will close, increase the anode voltage and thereby ensure that the anode dissipation of the P.A. valves are within safe limits.

The board also carries a noise suppression filter for the Blower-converter.

5.9 Circuit Summary, AC Power Pack P5001

5.9.1 The circuit diagram is divided into a wiring diagram on page 8-109 showing the interconnections between the printed circuit boards of which the Power Pack is composed, and circuit diagrams of the individual circuit boards. The block diagram on page 8-63 illustrates the operation of the Power Pack.

5.9.2 All necessary supply voltages for Transmitter Power Amplifier, Exciter and Receiver are obtained through transformers T1 and T2. The transformers give full isolation between the mains input voltage and chassis, permitting these to be earthed without causing the mains leads to be earthed.

5.9.3 Low tension voltages for Exciter and Receiver and negative grid voltage for the Transmitter Power Amplifier are obtained through transformer T1 followed by rectifiers and stabilizers.

Transformer T1 also carries secondary windings for filament supply to the P.A. valves and for the blower in the Transmitter Power Amplifier.

5.9.4 High tension for the Transmitter Power Amplifier is obtained through transformer T2 followed by rectifiers.

Supply voltage for the driver stage in the Transmitter Power Amplifier is also obtained from transformer T2 followed by rectifiers and a voltage stabilizer. Included in the Power Pack is also a loudspeaker connected to the associated receiver AF-output.

5.10 Circuit Description, AC Power Pack P5001

5.10.1 

TRANSFORMERS

A double mechanically operated safety switch is inserted in the mains input leads. The primary current of transformer T1 is controlled by the POWER switch. Turning the switch from OFF to RECEIVE ONLY connects the transformer to the mains and low tension is supplied to the Receiver. Relay RL1 connects the primary windings of transformer T2 to the mains.

5.10.2 

LT-STABILIZERS

One output voltage from transformer 265T1 is rectified in the chassis mounted diodes 265D1 and 265D2. Two voltage stabilizers, one supplying the Receiver and one the Exciter, have a nominal voltage of 7.5 V.

Another output voltage from transformer 265T1 is rectified in diodes D8 and D9 followed by a voltage stabilizer having a nominal output voltage of 15.7 V. This voltage is supplied to both Receiver and Exciter.

The board also contains the keying relay RL2 for the complete TRP5000 equipment. The contacts of the relay are used to disconnect the speaker built into the Power Pack and to key the grid bias of the P.A. valves.

5.10.3  HT-RECTIFIERS

HT-transformer 267 T2 has six secondary HT-windings. Each winding is connected to a bridge rectifier and the DC-outputs are series connected to obtain the anode supply voltage for the Transmitter Power Amplifier, while the DC-output from the second bridge above ground is used as screen grid supply voltage.

When the MODE switch of the associated Exciter is set to F1, the anode voltage is lowered by Opening the contacts of relay RL1 and thereby the anode dissipation in the Transmitter Power Amplifier is decreased.

5.10.4  DRIVER AND GRID VOLTAGE STABILIZERS

An output voltage from the HT-transformer 265T2 is fed to rectifiers D1 and D2 followed by a voltage stabilizer having a nominal output voltage of 28 V.

An output voltage from the transformer 265T1 is fed to bridge rectifier D3, D4, D7 and D8 followed by a zener diode stabilizer. The stabilized voltage is negative with respect to chassis and is further stabilized in the Transmitter Power Amplifier to be used as grid voltage.

To avoid the transmitter being keyed before the filaments of the P.A. valves have reached their operating temperature, a 30 seconds timer is included. The timer is composed of integrated circuit IC1 and will commence the timing period when the POWER switch 265S2 is turned from RECEIVE ONLY to STANDBY. Until the 30 seconds period has elapsed the keying relay cannot be operated.

The board contains also a filament-voltage rectifier D5 and D6, and relay RL1 is used to apply power to the blower in the Transmitter Power Amplifier.

6. Simple Service

6.1 Incorrect Operation

If the equipment is not functioning correctly, a check should be made that it is being operated properly. Go through adjustment procedures 2.2 and 2.3 if necessary.

6.2 Battery

The condition of the battery should be checked at frequent intervals. The battery must always be fully charged and should be topped up frequently with distilled water (liquid should rise 5 to 10 mm above the plates).

6.3 Checking the Antenna Tuning

The antenna tuning may be checked by adjusting the transmitter as described in section 2.3, preferably on one of the frequencies that was listed in the TUNING CHART when the equipment was installed.

Then set POWER switch to SIMPLEX, MEDIUM and CHECK SWITCH to LEVEL. Pull the CHECK SWITCH knob out and press TUNE button. Note the meter reading.

Set POWER switch to SIMPLEX, FULL and press TUNE button. Note ANTENNA CURRENT reading.

Compare the readings with the readings listed in the TUNING CHART. If the two readings differ appreciably from the listed values, and the transmitter is otherwise functioning normally, the fault can be expected to be in the antenna system or in the transmitter earth connection.

Accordingly, the following checks should be made:

Have any changes been made in antenna or earth connections since the installation was made?

Have any changes been made in the rigging of the vessel, or in the placement of derricks etc.?

Is leakage present on the antenna, possibly caused by moisture or dirt on the antenna insulators?

6.4 Using the CHECK SWITCH

The CHECK SWITCH is not normally operative. Pulling the switch knob out will switch the ANTENNA CURRENT meter to read the voltage or current selected with the switch. When released, the knob will return to its original position.

The meter reading in all positions except LEVEL is approx. 3 under normal conditions, i.e. transmitter adjusted as described in section 2.3, POWER switch set to FULL and TUNE button pressed.

Position of CHECK SWITCH	Check of	Deflection to 3 corresponds to approx	Actual deflection
V_A	anode DC voltage	1700 V	2.4 to 3.5 dependent on supply voltage
V_{S1}	screen grid voltage of valve no. 1	300 V	
V_{S2}	screen grid voltage of valve no. 2	300 v	2.4 to 3.6 dependent on valve characteristics
V_G	control grid bias	– 49 V	2.3 to 3.7 dependent on valve characteristics
I_1	cathode current of valve no. 1	165 mA	
I_2	cathode current of valve no. 2	165 mA	
V_D	supply voltage to driver amplifier	28 V	

Table 6.4.1

If the meter shows no reading in these positions, reference should be made to section 6.5.

With POWER switch set to DUPLEX, FULL and TUNE button not pressed, valve current readings, I_1 and I_2, in the A3J mode, unmodulated will be approx. 1.4, and in the A3H mode, unmodulated approx.2.3.

6.5 Replacement of Fuses

All fuses, except the high tension fuse, are accessible on the front panel of the Power Pack. The high tension fuse becomes accessible when the Power Pack is pulled out.

Note: Set SUPPLY switch to OFF and open external supply voltage switch before opening the equipment and replacing fuses. Short circuit both ends of high tension fuse to chassis using an insulated tool before touching it.

Fuse ratings are given in table 6.5.1 and table 6.5.2 below. Fuses with marked ratings within 5 per cent of the ratings given must be used. Note that slow or fast blowing fuses must be used where specified.

Fuse Rating	Designation	Front Panel Fuses (from left to right)	Symptom if fuse is blown
1.6A fast	260FS 5	7.5V to Receiver	no light in display
1.6A fast	260FS 6	15.7Vto Receiver and Exciter	no light in displays, negative deflection in CHECK SWITCH position V_G
3.15A fast	260FS 3	7.5V to Exciter	no light in displays
40A fast	260FS 2	24V battery input (LT-and HT-converters)	no light in display
8A fast	260FS 1	24V battery input (RL 1, filament supply, blower)	no light in displays, no cabinet light
1.6A fast	260FS 4	28V to Driver in T5000	no reading in CHECK SWITCH position V_D
0.5A fast	260FS 8	600V screen grid supply	no reading in CHECK SWITCH positions V_{S1} and V_S
		High Tension Fuse	
0.5A HT	260FS 7	1700V to anodes	no reading in CHECK SWITCH position V_A

Fuse Rating, 24V DC Power Pack P5000
Table 6.5.1.

Fuse Rating	Designation	Front Panel Fuses (from left to right)	Symptom if fuse is blown
1.6A fast	265FS 3	7.5V to Receiver	no light in display
1.6A fast	265FS 7	15.7V to Receiver and Exciter	no light in displays, negative deflection in CHECK SWITCH position V_G
3.15A fast	265FS 2	7.5V to Exciter	no light in display
8/16A slow	265FS 1	mains input	no light in displays, no cabinet light
8A fast	265FS 8	filament supply	no reading in CHECK SWITCH positions I_1 and I_2
1.6A fast	265FS 6	28V to Driver in T5000	no reading in CHECK SWITCH position V_D
0.5A fast	265FS 5	600V screen grid supply	no reading in CHECK SWITCH positions V_{S1} and V_{S2}
		High Tension Fuse	
0.5A HT	265FS 4	1700V to anodes	no reading in CHECK SWITCH position V_A

Fuse Ratings, AC Power Pack P5001
Table 6.5.2.

7. REPAIR AND ALIGNMENT

7.1 Introduction

Repairs and adjustments on the equipment should be performed only by qualified technicians, to whom this chapter is addressed. Before attempting any repairs or adjustments, a study of Chapter 5, Technical Description, is recommended.

7.2 Cross-Slot Screws

The cross-slot screws used to secure the printed circuit boards are Pozidriv screws. A Pozidriv screwdriver No. 1 should be used in order to avoid damaging such screws.

7.3 Locating Subunits and Components

Locations of circuit boards in the equipment appear from the photographs on pages 8-56 to 8-59. Locations of components on each circuit board appear on the component location drawings against the respective circuit diagrams.

7.4 Locating Faults

Fault finding, as described in section 7.5 below, is aided by test points provided for the purpose of permitting rapid localization of faulty circuit boards on the basis of DC measurements. Since not all types of faults can be traced by means of DC measurements, supplementary AC measurements with an oscilloscope may be required; see section 7.6. To facilitate fault finding on each individual circuit board, typical voltages are listed on the circuit diagrams.

7.5 Test Points

Several circuit boards contain one or more test points. They are small pin-type terminals, colour coded following the standard colour code in addition to being numbered. In the circuit diagrams, test points are marked TP 1, TP 2 etc., and typical voltages at the test points are listed there.

The terminals of the circuit boards may to a great extent also be regarded as tet points. Typical voltages are therefore also listed against relevant terminals on the circuit diagrams.

If a voltage measured at a test point differs markedly from the listed value it is a fairly certain indication that the circuit board in question is faulty, assuming that the voltages applied to the circuit board are th correct ones. This should likewise be checked.

7.6 AC Voltages

AC voltages listed in the circuit diagrams are typical voltages. Voltages specified are based on measurement with an oscilloscope having an input impedance of 10 Mohms in parallel with 7 pF, a sensitivity of the order of 50 mV/div and a frequency range of not less than DC -50 MHz.

AC voltage values measured in the signal path of the transmitter can be measured only if the transmitter is modulated with a two-tone signal. This can be done by pressing the TUNE button of the transmitter.

7.7 DC Voltages

DC voltages listed in the circuit diagrams are based on measurement with a 25 kohms/volt multimeter. If a stated voltage is dependent on the setting of a control, this is also stated on the circuit diagrams. Typical logic levels (LOW/HIGH) are indicated in brackets.

7.8 Replacement of Valves

7.8.1 Replacement of one or both of the valves in the transmitter Power Amplifier normally requires readjustment of the quiescent current and RF drive voltage to the valves.

Note: Set SUPPLY switch to OFF before opening the equipment. Short anodes of valves to chassis, using an insulated tool, before touching the valves.

The adjustment procedure following a valve replacemnet must be performed as follows.

7.8.2 Adjustment of Quiescent Current:

The quiescent current of each valve must be 75 mA and may be measured by means of the built-in meter. Readings in position I_1 and I_2 of the CHECK SWITCH (pulled) should be 1.4 in the A3J-mode, unmodulated. The adjustment is made by means of the trimming potentiometers 254R1 and 254R3 located behind the two membane grommets in the upper left corner of the valve chassis. The left hand potentiometer controls the screen grid voltage of valve no. 2. The right hand potentiometer controls the grid bias of both valves. Use a 2mm wide screw driver for the adjustments.

1. Pull the Transmitter Power Amplifier unit out as far as the built-in stops permit, and pull the piston of the safety switch outwards to the locked position.
2. Set SUPPLY switch to TRANSMIT, POWER switch to SIMPLEX and MODE switch to A3J.
3. Key a Frequency No. programmed to a radiotelephone frequency into the keyboard and set BAND switch accordingly.

30 seconds after switching to TRANSMIT the transmitter can be keyed. Keying is performed by setting the POWER switch to DUPLEX or by pressing the handset key. If the handset key is used, remove the microphone capsule in order to avoid unwanted modulation of the transmitter.

Note: Extreme care must be taken as high tension is now accessible.

4. Key the transmitter and adjust I_1 by means of 254R1 (right) to 1.4 on the meter scale.
5. Key the transmitter and adjust I_2 by means of 254R3 (left) to the same value.
6. Keep the transmitter keyed for a period of 5-10 minutes and repeat points 4. and 5. if necessary.

7.8.3 Adjustment of RF drive voltage:

Due to the spread in valve characteristics it may also be necessary to re-adjust the grid drive to the valves.

Adjustments are made separately for the CT-band (1.6 to 4 MHz) and each HF-band by means of the Level Setting potentiometers on printed circuit board /233\ in the Exciter. These become accessible by removing the lid of the screened can below the chassis.

The potentiometers are adjusted so that a maximum valve current of between 165 mA and 175 mA is obtained per valve with POWER switch set to FULL and TUNE button pressed. This corresponds to a deflection of between 3.0 and 3.2 on the built-in meter with the CHECK SWITCH (pulled) in position I_1 and I_2. Note that maximum current is obtained when the ANTENNA TUNING is detuned. If the two currents vary slightly, the highest reading must not exceed 3.2.

7.9 Adjustments

The following sections describe alignment procedures for printed circuit boards that contain adjustable components. Bear in mind that no adjustments should be carried out unless there is a clear indication that it is really necessary. Moreover, adjustments should be carried out only by a qualified technician with the necessary equipment at his disposal.

When a unit or printed circuit board is replaced, adjustments are in some cases necessary. These cases are listed in the table blow.

Replacement of unit or board	Adjustment required of	Procedure given in section
E 5000/E 5001	Level Setting	7.8.3.
/232\	232R15 Level Setting	7.10.2 7.8.3
/233\	Level Setting	7.8.3
/234\	232R15	7.10.2.
T 5000	Level Setting Antenna Tuning	7.8.3 3.14
/254\	Quiescent current	7.8.2

7.10 232 Realignment of 1.4 MHz EXCITER

Measuring equipment:

Oscilloscope having a sensitivity better than 50mV/div. Input impedance 10 Mohm in parallel with 20 pF or less.

7.10.1 Realignment of 232R6, Microphone Sensitivity:

The microphone sensitivity potentiometer is normally fully clockwise, corresponding to full sensitivity. When the transmitter is installed where there is a high acousic noise level it can be advantageous to reduce the sensitivity by turning the potentiometer half or fully anticlockwise. This has the effect of reducing the background noise coming up in speech pauses. The compressor ensures that the transmitter is still fully modulated by the speech signal.

7.10.2 Realignment of 232R15:

Control settings: SUPPLY switch: STAND BY

1. Connect oscilloscope to test point 232TP7.
2. Unsolder brown lead to terminal 232-4.
3. Set potentiometer 232R15 to the middle of its range.
4. Press TUNE button and adjust sensitivity of oscilloscope to give a full screen peak to peak deflection.
5. Resolder brown lead to terminal 232-4.
6. Press TUNE button and adjust 232R15 to give exactly the same deflection on oscilloscope as before.

7.10.3 Realignment of 232R42, Balance:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3J
BAND switch: not 2182 kHz

1. Connect oscilloscope to test point 232TP6.
2. Adjust potentiometer 232R42 for minimum deflection on oscilloscope.

7.10.4 Realignment of 232R46, Carrier Level:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3H

1. Connect oscilloscope to 232C42/232L6.
2. Press TUNE button and adjust sensitivity of oscilloscope to give a full screen peak to peak deflection.
3. Unsolder grey lead to terminal 232-13.

4. Press TUNE button and adjust 232 R46 to give exactly the same peak deflection as before.
5. Resolder grey lead to terminal 232-13.

Above procedure implies that 232R15 is correctly adjusted (point 7.10.2.).

7.10.5 Realignment of 232T1:

Control settings: SUPPLY switch: STAND BY

1. Connect oscilloscope to test point 232TP7.
2. Press TUNE button and adjust 232T1 for maximum deflection on oscilloscope.

7.10.6 Realignment of 232L6:

Control settings: SUPPLY switch: STAND BY

1. Connect oscilloscope to 232C42/232L6.
2. Connect a shorting strap across capacitor 233C1.
3. Press TUNE button and adjust 232L6 for maximum deflection on oscilloscope.
4. Remove shorting strap.

7.11 ⚠233 Realignment of RF TRANSLATOR

Measuring equipment:

Oscilloscope having a sensitivity better than 50mV/div. Input impedance 10 Mohms in parallel with 20 pF or less. Frequency range up to 50 MHz.

Standard Signal Generator covering the range 2-11 MHz and having a frequency accuracy better than 10^{-3}.

Receiver, heterodyne voltmeter or spectrum analyzer covering the range 2-11 MHz.

7.11.1 Realignment of Level Setting potentiometers:

The Level Setting potentiometers control the RF drive voltage to the power output valves. Alignment procedure is given in section 7.8.3.

7.11.2 Realignment of 233R4:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3H
POWER switch: DUPLEX
FREQUENCY NO: A radiotelephone frequency below 2800 kHz

1. Connect oscilloscope to output BNC socket 231SK7.
2. Adjust 233R4 for minimum interference signal.

7.11.3 Realignment of 233R57:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3H
POWER switch: DUPLEX
BAND switch: Not 2182 kHz
FREQUENCY NO: A radiotelephone frequency in the 6 MHz band.

1. Connect oscilloscope to output BNC socket 231SK7.
2. Adjust 233R4 for minimum interference signal.

7.11.4 Realignment of 233T1:

Control settings: SUPPLY switch: STAND BY

1. Connect oscilloscope to 232C42/232L6.
2. Press TUNE button and adjust 233T1 for minimum deflection on oscilloscope.

7.11.5 Realignment of 4.3 MHz Low Pass Filter:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3J
POWER switch: DUPLEX
BAND switch: Not 2182 kHz
FREQUENCY NO: Any radiotelephone frequency

1. Remove strap between terminals 233-6 and 233-7 and connect signal generator between same two terminals (233-7 is ground).
2. Connect receiver input via a coaxial cable to test point 233TP3 through a 10 nF capacitor, and to ground at 233R16.
3. Set signal generator to 4.6 MHz, 100mV.
4. Set receiver to same frequency and adjust for a beat note.
5. Adjust 233L4 for minimum signal (adjust receiver sensitivity to obtain a clear minimum).
6. Set signal generator and receiver to 4.7 MHz.
7. Adjust 233L5 for minimum signal.
8. Set signal generator and receiver to 5.0 MHz.
9. Adjust 233L3 for minimum signal.
10. Set signal generator and receiver to 6.14 MHz.
11. Adjust 233L6 for minimum signal.
12. Set signal generator and receiver to 10.35 MHz.
13. Adjust 233L2 for minimum signal.
14. Remove signal generator and receiver and strap terminals 233-6 and 233-7 together.

7.11.6 Realignment of 1.6-4 MHz filter:

Control settings: SUPPLY switch: STAND BY
MODE switch: A3J
POWER switch: DUPLEX
BAND switch: Not 2182 kHz
FREQUENCY NO: A radiotelephone frequency between 1.6 and 4 MHz

1. Connect signal generator to test point 233TP3 through a 10 nF capacitor and to ground at 233R16.
2. Connect receiver input to BNC socket 231SK7.
3. Set signal generator to 4.43 MHz, 100 mV.
4. Set receiver to same frequency and adjust for a beat note.
5. Adjust 233L22 for minimum signal (adjust receiver sensitivity to obtain a clear minimum).
6. Set signal generator and receiver to 4.83 MHz.
7. Adjust 233L24 for minimum signal.
8. Set signal generator and receiver to 7.13 MHz.
9. Adjust 233L20 for minimum signal.

7.11.7 Realignment of Band Pass Filters 4-25 MHz:

Control Settings: SUPPLY switch: STAND BY
MODE switch: A3J
POWER switch: DUPLEX
BAND switch: Not 2182 kHz

1. Connect signal generator to test point 233TP3 through a 10nF capacitor and to ground at 233R16.
2. Connect oscilloscope to BNC socket 231SK7 through a coaxial cable terminated into 50 ohms at the oscilloscope.
3. Select by means of the keyboard a radiotelephone frequency in the band to be realigned.
4. Set signal generator to alignment frequency given in table below.
5. Connect a 1 kohm resistor between the alignment terminals across 233L32.
6. Adjust the input coil of the filter in question for maximum deflection on oscilloscope.
7. Move the 1 kohm resistor to the alignment terminals across 233R56.
8. Adjust the output coil of the filter for maximum deflection on the oscilloscope.
9. Remove 1 kohm resistor.

Band	Alignment frequency applied to 233TP3	Input Coil	Output Coil
4 MHz	4140 kHz	233L13	233L25
6 MHz	2062 kHz	233L14	233L26
8 MHz	2715 kHz	233L15	233L27
12 MHz	2690 kHz	233L16	233L28
16 MHz	2660 kHz	233L17	233L29
22 MHz	2560 kHz	233L18	233L30
25 MHz	2900 kHz	233L19	233L31

7.12 (234) Realignment of CONTROL CIRCUIT AND TONE GENERATORS

Measuring equipment:

Frequency Counter having an accuracy better than 10^{-4} and a sensitivity of at least 0.5 V.

Extender Board (259).

7.12.1 Realignment of 234T1 and 234T2:

Control settings: SUPPLY switch: STAND BY
MODE switch: TEST ALARM

1. Insert extender board.
2. Connect frequency counter between terminals 234-32c and 234-4c (ground).
3. Connect the adjustment terminals marked 1 and 2 together.
4. Depress and release ALARM START pushbutton.
5. Adjust 234T1 until counter reads 2200 Hz ± 1 Hz.
6. Remove connection referred to in point 3 above.
7. Connect the terminals marked 2 and 3.
8. Depress and release ALARM START button.
9. Adjust 234T2 until counter reads 1300 Hz ± 1 Hz.
10. Remove connection referred to in point 7 above.

7.12.2 Realignment of 234T3:

Control settings: SUPPLY switch: STAND BY
MODE switch: A1

1. Insert extender board.
2. Connect frequency counter between terminals 234-32c and 234-4c (ground).
3. Depress morse key or alternatively short circuit the terminals of the jack socket 230SK2.
4. Adjust 234T3 until counter reads 1500 Hz ± 1 Hz.

7.13 /235\ Realignment of HARMONIC GENERATOR

Measuring equipment:

DC Voltmeter having an internal resistance of 25 kohms or more.

Extender Board /259\.

Control settings: SUPPLY switch: STAND BY
BAND switch: Not 2182 kHz

Board /235\ exists in two versions. The diagram nos. are 992 203 3 ② and 992 203 3 ④. The printed circuit board of the latter version is labelled ④. Two different alignment procedures are applicable.

Version ②:

1. Insert extender board.
2. Connect voltmeter to test point 235TP1.
3. Connect pin no. 11 of 235IC7 (74LS03) to ground.
4. Note voltmeter delfection and remove connection referred to in point 3.
5. Select a Frequency No. where no PROMs are installed on MEMORY board /238\.
6. Adjust 235L2 for exactly the same delfection as in point 4 above.
7. Select by means of the Keyboard a frequency in the 25 MHz band and adjust 235L4 for the same deflection.
8. Select a frequency in the 22 MHz band and adjust 235L5 for the same deflection.
9. Select a frequency in the 16 MHz band and adjust 235L6 for the same deflection.
10. Select a frequency in the 12 MHz band and adjust 235L7 for the same deflection.
11. Select a frequency in the 8 MHz band and adjust 235L8 for the same deflection.
12. Select a frequency in the 6 MHz band and adjust 235L9 for the same deflection.

Version ④:

1. Insert extender board.
2. Connect voltmeter to test point 235TP4.
3. Select a Frequency No. where no PROMs are installed on the MEMORY board /238\ and adjust 235L2 for 3.8 volts on the voltmeter.
4. Select by means of the Keyboard a frequency in the 25 MHz band and adjust 235L4 for 3.8 volts.
5. Select a frequency in the 22 MHz band and adjust 235L5 for 3.8 volts.
6. Selett a frequency in the 16 MHz band and adjust 235L6 for 3.8 volts.
7. Select a frequency in the 12 MHz band and adjust 235L7 for 3.8 volts.
8. Select a frequency in the 8 MHz band and adjust 235L8 for 3.8 volts.
9. Select a frequency in the 6 MHz band and adjust 235L9 for 3.8 volts.

7.14 236 Realignment of VCO

Measuring equipment:

Frequency Counter having an accuracy better than 10^{-3} and a sensitivity of at least 0.5 V.

Extender Board 259.

Control settings: SUPPLY switch: STAND BY
BAND switch: Not 2182 kHz

1. Insert extender board.
2. Connect terminal 236-2a to terminal 236-4a (ground).
3. Connect frequency counter between terminal 236-30c and terminal 236-26c (ground).
4. Select by means of the Keyboard a frequency in the range 1600 to 2599.9 kHz.
5. Adjust 236T1 until the counter reads 4.30 MHz.
6. Select a frequency in the range 2600 to 3599.9 kHz.
7. Adjust 236L2 until the counter reads 5.35 MHz.
8. Select a frequency in the 4 MHz band.
9. Adjust 236L3 until the counter reads 6.45 MHz.
10. Remove connection referred to under point 2 above.

7.15 240 Realignment of MASTER OSCILLATOR

Measuring equipment:

Oscilloscope having an input impedance of 10 Mohms in parallel with 20 pF or less.

Control settings: SUPPLY switch: STAND BY

1. Connect oscilloscope to terminals 240-2 and 240-3 (ground).
2. Adjust 240T1 for maximum deflection on oscilloscope.

7.16 251 Realignment of DRIVER

Measuring equipment:

DC Voltmeter.

1. Disconnect HT-supply to Transmitter Power Amplifier by removing the plug to 250SK1.
2. Connect voltmeter to emitter of 251TR3 or 251TR4.
3. Set SUPPLY switch to TRANSMIT, select a Frequency No. and set BAND and MODE switches accordingly.
4. Key the transmitter and adjust 251R7 for 1.1 volts on the voltmeter (if maximum voltage is below 1.1 volts strap terminals 251-2 and 251-3 together etc.)

7.17 254 Realignment of VOLTAGE REGULATORS

Potentiometers 254R1 and 254R3 control the quiescent current of the power output valves. Alignment procedure is given in section 7.8.2.

	INPUT						OUTPUT								
	$\overline{(MF)}$	(2182 kHz)	MODE switch												
	A_4	A_3	A_2	A_1	A_0		O_7	O_6	O_5	O_4	O_3	O_2	O_1	O_0	Mode of operation
0	0	0	0	0	0	A2H	1	1	1	1	1	0	1	1	A2H
1	0	0	0	0	1	A1	1	1	1	1	1	0	1	1	A2H
2	0	0	0	1	0	F1	1	1	1	1	1	0	1	1	A2H
3	0	0	0	1	1	TEST ALARM	1	1	1	1	1	0	1	1	A2H
4	0	0	1	0	0	A3A	1	1	1	1	1	0	1	1	A2H
5	0	0	1	0	1	A3J	1	1	1	1	1	0	1	1	A2H
6	0	0	1	1	0	A3H	1	1	1	1	1	0	1	1	A2H
7	0	0	1	1	1	TRANSMIT ALARM	1	1	1	1	1	0	1	1	A2H
8	0	1	0	0	0	A2H	1	1	1	1	1	0	1	1	A2H
9	0	1	0	0	1	A1	0	1	1	1	1	0	1	1	A1
10	0	1	0	1	0	F1	1	1	1	1	1	0	1	1	A2H
11	0	1	0	1	1	TEST ALARM	0	0	1	0	1	1	1	1	TEST ALARM
12	0	1	1	0	0	A3A	1	1	1	1	1	0	1	1	A2H
13	0	1	1	0	1	A3J	1	1	1	1	1	0	1	1	A2H
14	0	1	1	1	0	A3H	1	1	1	1	1	0	1	1	A2H
15	0	1	1	1	1	TRANSMIT ALARM	1	1	1	1	1	0	1	1	A2H
16	1	0	0	0	0	A2H	0	1	0	0	1	1	1	1	A3H
17	1	0	0	0	1	A1	0	1	0	0	1	1	1	1	A3H
18	1	0	0	1	0	F1	0	1	0	0	1	1	1	1	A3H
19	1	0	0	1	1	TEST ALARM	0	0	1	0	1	1	1	1	TEST ALARM
20	1	0	1	0	0	A3A	0	1	0	0	1	1	1	1	A3H
21	1	0	1	0	1	A3J	0	1	0	0	1	1	1	1	A3H
22	1	0	1	1	0	A3H	0	1	0	0	1	1	1	1	A3H
23	1	0	1	1	1	TRANSMIT ALARM	0	0	0	0	1	1	1	1	TRANSMIT ALARM
24	1	1	0	0	0	A2H	1	1	1	1	1	0	1	1	A2H
25	1	1	0	0	1	A1	0	1	1	1	1	0	1	1	A1
26	1	1	0	1	0	F1	0	1	1	0	0	1	0	1	F1
27	1	1	0	1	1	TEST ALARM	0	0	1	0	1	1	1	1	TEST ALARM
28	1	1	1	0	0	A3A	0	1	0	0	1	1	1	0	A3A
29	1	1	1	0	1	A3J	0	1	0	0	1	0	1	1	A3J
30	1	1	1	1	0	A3H	0	1	0	0	1	1	1	1	A3H
31	1	1	1	1	1	TRANSMIT ALARM	0	0	0	0	1	1	1	1	TRANSMIT ALARM

Function Table for 234IC5
32 x 8 bit PROM of CONTROL CIRCUIT AND TONE GENERATORS 

	INPUT						OUTPUT							
	$\overline{(2182\ kHz)}$	Band, 8	Band, 4	Band, 2	Band, 1									
	A_4	A_3	A_2	A_1	A_0		O_7	O_6	O_5	O_4	O_3	O_2	O_1	O_0
0	0	0	0	0	0	2182 kHz	1	1	1	1	0	0	0	1
1	0	0	0	0	1		1	1	1	1	0	0	0	1
2	0	0	0	1	0		1	1	1	1	0	0	0	1
3	0	0	0	1	1		1	1	1	1	0	0	0	1
4	0	0	1	0	0		1	1	1	1	0	0	0	1
5	0	0	1	0	1		1	1	1	1	0	0	0	1
6	0	0	1	1	0		1	1	1	1	0	0	0	1
7	0	0	1	1	1		1	1	1	1	0	0	0	1
8	0	1	0	0	0		1	1	1	1	0	0	0	1
9	0	1	0	0	1		1	1	1	1	0	0	0	1
10	0	1	0	1	0		1	1	1	1	0	0	0	1
11	0	1	0	1	1		1	1	1	1	0	0	0	1
12	0	1	1	0	0		1	1	1	1	0	0	0	1
13	0	1	1	0	1		1	1	1	1	0	0	0	1
14	0	1	1	1	0		1	1	1	1	0	0	0	1
15	0	1	1	1	1		1	1	1	1	0	0	0	1
16	1	0	0	0	0	A	1	1	1	1	0	0	0	1
17	1	0	0	0	1	B	1	1	1	1	0	0	0	1
18	1	0	0	1	0	C	1	1	1	1	0	0	0	1
19	1	0	0	1	1	D	1	1	1	1	0	0	0	1
20	1	0	1	0	0	E	1	1	1	1	0	0	0	1
21	1	0	1	0	1	F	1	1	1	1	0	0	0	1
22	1	0	1	1	0	G	1	1	1	1	0	0	0	1
23	1	0	1	1	1	H	1	1	1	1	0	0	0	1
24	1	1	0	0	0	4 MHz	1	1	1	1	0	0	1	0
25	1	1	0	0	1	6 MHz	1	1	0	1	0	1	0	0
26	1	1	0	1	0	8 MHz	1	1	0	0	0	1	0	1
27	1	1	0	1	1	12 MHz	1	0	0	1	0	1	1	0
28	1	1	1	0	0	16 MHz	0	0	1	1	0	1	1	1
29	1	1	1	0	1	22 MHz	0	0	0	1	1	0	0	0
30	1	1	1	1	0	25 MHz	0	0	0	0	1	0	0	1
31	1	1	1	1	1	MF	1	1	1	1	0	0	0	0

Function Table for 235IC4
32 x 8 bit PROM of HARMONIC GENERATOR 235

8. PARTS LIST AND CIRCUIT DIAGRAMS

8.1 Numbering

An identification number between /230\ and /279\ is assigned to each module. The designation of a component or terminal includes this number as a prefix – example: 232R3 (resistor R3 on module /232\ ), or 232-12 (terminal No. 12 on module /232\ ).

8.2 Switches

Switches with stops are shown in the extreme anticlockwise position. The BAND switch is shown in the BAND A position.

Switch wafer No. 1 is the wafer nearest to the front panel, and the front side of a wafer is the side facing the front panel.

8.3 Terminals

Locations of terminals appear from the component location drawings. On the circuit diagrams, each terminal is identified by a number and in most cases by an explanatory text. In addition to this, the number of the module and terminal to which the lead is connected is indicated (example: /232\ -12). Where interconnections consist of coaxial cables, only the number of the terminal is given to which the inner conductor of the cable is connected.

8.4 Voltages

Typical DC voltages are indicated on the circuit diagrams next to the points to which they refer and are marked with a »*V*«.

Typical logic levels are indicated in a bracket (LOW/HIGH) on the circuit diagrams next to the point to which they refer and are marked with a »*V*«.

Typical AC voltages are likewise indicated on the circuit diagrams. They are marked with »*Vpp*« or »*mVpp*«.

For measuring conditions see Chapter 7.

8.5 Test Points

Location of test points are shown on the component location drawings. Typical voltage at each test point is indicated on the circuit diagram.

8.6 Symbol Explanation

8.6.1 Logic circuits:

A small circle at an external input means that the specific input is active LOW, i.e. it produces the desired function, in conjunction with other inputs if its voltage is the lower of the two logic levels in the system, otherwise the specific input is HIGH.

A small circle at a clock input means that the outputs change on the HIGH to LOW clock transition.

A small circle at an output indicates that when the function designated is true, the output is LOW.

Inputs and outputs are labelled with mnemonic letters as described in table 8.6.1.

8.6.2 Logic Functions:

Logic functions are labelled with mnemonic letters in a bracket. An active LOW function is given a bar over the label.

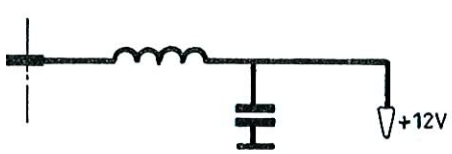
More logic functions may be connected by means of the principles of Boolean Algebra.

8.6.3 Arrows:

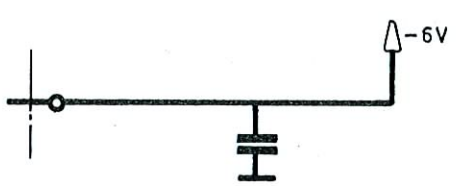
A black arrow on a line indicates in which direction an AC-signal flows.

A white arrow on a line indicates in which direction the information of a DC signal flows. An exception from this rule is the supply lines and their connections, which are always indicated by a supply voltage level or its associated label.

Positive supply line: Example



Negative supply line: Example



Connections to supply line: Example

Label	Short for	Meaning
I_x	Input	Inputs to combinatorial circuits
J,K		Inputs to JK flip flops
D_x	Data	Inputs to D flip flops and latches
S,R	Set, Reset	Inputs to JK and D flip flops, latches, registers, and counters; R resets output to LOW; S sets output to HIGH
P_x		Inputs to registers and counters
A_x	Address	Inputs used for selection of an input, output, data route, or memory location
E	Enable	
PE	Parallel Enable	Control input used to synchronously load information in parallel into a circuit
MR	Master Reset	Input which resets asynchronously all outputs to LOW, overriding all other inputs
CL	Clear	Input which resets outputs to LOW, but does not override all other inputs
CP	Clock Pulse	
CE, CEP, CET	Count Enable	Control inputs to counters
O_x	Output	Outputs of combinatorial circuits
Q_x		Outputs of sequential circuits
TC	Terminal Count	(Output of a counter indicating 1111 for up binary counters, 1001 for up decimal counters, or 0000 for down counters).

Table 8.6.1

8.7. Abbreviations

A	=	ampere, amperes
C	=	capacitor
Car.	=	carbon
Cer.	=	ceramic
D	=	diode
F	=	farad
FS	=	fuse
H	=	henry
IC	=	integrated circuit
k	=	kilo or 10^3
L	=	inductor
LS	=	loudspeaker
lin.	=	linear
log.	=	logarithmic
m	=	milli or 10^{-3}
M	=	mega or 10^6
ME	=	instrument
MF	=	metal film
Mi	=	mica
MP	=	metallized paper
μ	=	micro or 10^{-6}
n	=	nano or 10^{-9}
NPO	=	temp. coefficient 0
N150	=	temp. coefficient –150
NTC	=	neg. temp. coefficient
P	=	pico or 10^{-12}
PL	=	connector (plug)
Polyes.	=	polyester
Polyst.	=	polystyrene
PTC	=	pos. temp. coefficient
R	=	resistor
RL	=	relay
S	=	switch
SK	=	connector (socket)
SL	=	lamp
T	=	transformer
Tan	=	tantalum electrolytic capacitor
TR	=	transistor
V	=	working voltage DC or volts
V1...	=	valve
Vac.	=	working voltage AC
Var.	=	variable
Vpp	=	peak to peak voltage
Varicap	=	variable capacitance diode
ww	=	wire wound
W	=	watt, watts
W.alum.	=	wet aluminium electrolytic
X	=	crystal, crystal osc. or crystal filter

PARTS LIST

FOR

230S 1					372 200 13
S 2					372 200 23
S 3					763 000 13 449 000 25
230SK1	5 Way				751 000 03
SK2					750 000 12
230C 1	47 nF	-20/+80%	12V	Cer.	601 447 00
C 2-5	10 nF	-20/+80%		Cer.	601 410 00

PARTS LIST

FOR

231C 1- 3	0.1 nF	10%	250V	Polyes.	624 510 00
C 4- 6	10 nF	10%	250V	Polyes.	624 410 00
C 7- 8	1 uF	10%	100V	Polyes.	623 610 00
C 9-23	0.1 uF	10%	250V	Polyes.	624 510 00
231IC1	uA 7812				850 781 20
IC2	uA 7805				850 780 50
231L 1- 8	47 uH	10%	RF Choke		740 147 00
L 9-10	25 uH		RF Choke		740 125 00
L11-18	47 uH	10%	RF Choke		740 147 00
L19	25 uH		RF Choke		740 125 00
L20	47 uH	10%	RF Choke		740 147 00
L21	25 uH		RF Choke		740 125 00
L22-24	47 uH	10%	RF Choke		740 147 00
231PL1	8 Way				751 000 26
PL2	20 Way				751 000 28
231R 1	470 ohms	5%	1/3W	Car.	501 247 00
231SK1	32 Way				751 000 21
SK2	BNC				750 000 10
SK3- 6	32 Way				751 000 21
SK7	BNC				750 000 10
SK8	64 Way				751 000 42

PARTS LIST

FOR

232C 1- 4	0.1 uF	10%	250V	Polyes.	624 510 01
C 5- 6	10 nF	10%	250V	Polyes.	624 410 00
C 7- 8	0.1 uF	10%	250V	Polyes.	624 510 01
C 9	22 uF		16V	Tan	651 722 00
C10-11	0.1 uF	10%	250V	Polyes.	624 510 01
C12	22 uF		16V	Tan	651 722 00
C13	10 nF	10%	250V	Polyes.	624 410 00
C14	0.1 uF	10%	250V	Polyes.	624 510 01
C15	1 uF	10%	100V	Polyes.	623 610 00
C16	22 uF		16V	Tan	651 722 00
C17	1 nF	1%	500V	Polyst.	615 310 01
C18	10 nF	10%	250V	Polyes.	624 410 00
C19	6.8 uF	10%	100V	Polyes.	623 668 00
C20-21	10 nF	10%	250V	Polyes.	624 410 00
C22	2.2 uF	10%	100V	Polyes.	623 622 00
C23-25	0.1 uF	10%	250V	Polyes.	624 510 01
C26	10 nF	10%	250V	Polyes	624 410 00
C27	2.7 nF	1%	125V	Polyst.	613 327 00
C28	0.1 uF	10%	250V	Polyes.	624 510 01
C29	680 pF	1%	500V	Polyst.	615 268 00
C30-32	10 nF	10%	250V	Polyes	624 410 00
C33-41	0.1 uF	10%	250V	Polyes.	624 510 01
C42	1.8 nF	1%	250V	Polyst.	614 318 00

232D 1- 5	1S920	830 192 00
D 6- 7	AAZ17	830 001 70
D 8-12	1S920	830 192 00

232IC1	CA3046	850 304 60
IC2	LM1496	850 149 60
IC3	CA3046	850 304 60

232L 1	100 uH	10%	RF Choke	740 210 00
L 2	4.7 uH	10%	RF Choke	740 047 00
L 3- 5	100 uH	10%	RF Choke	740 210 00
L 6			Coil	102 210 02

PARTS LIST

FOR

232

232R 1- 2	680 ohms	5%	1/3W	Car.	501 268 00
R 3	180 ohms	5%	1/2W	Car.	502 218 00
R 4	1.5 kohms	5%	1/3W	Car.	501 315 00
R 5	10 kohms	5%	1/3W	Car.	501 410 00
R 6	47 kohms		Var.		582 447 00
R 7- 8	10 kohms	5%	1/3W	Car.	501 410 00
R 9	10 kohms	5%	1/3W	Car.	501 410 00
R10	15 kohms	5%	1/3W	Car.	501 415 00
R11-12	10 kohms	5%	1/3W	Car.	501 410 00
R13	390 ohms	5%	1/3W	Car.	501 239 00
R14	2.7 kohms	5%	1/3W	Car.	501 327 00
R15	1 kohm		Var.		582 310 00
R16	390 ohms	5%	1/3W	Car.	501 239 00
R17	470 ohms	5%	1/3W	Car.	501 247 00
R18	22 kohms	5%	1/3W	Car.	501 422 00
R19	100 kohms	5%	1/3W	Car.	501 510 00
R20	220 kohms	5%	1/3W	Car.	501 522 00
R21	47 kohms	5%	1/3W	Car.	501 447 00
R22	22 kohms	5%	1/3W	Car.	501 422 00
R23	680 ohms	5%	1/3W	Car.	501 268 00
R24	100 kohms	5%	1/3W	Car.	501 510 00
R25	220 ohms	5%	1/3W	Car.	501 222 00
R26	470 kohms	5%	1/3W	Car.	501 547 00
R27	2.2 kohms	5%	1/3W	Car.	501 322 00
R28	4.7 kohms	5%	1/3W	Car.	501 347 00
R29	470 kohms	5%	1/3W	Car.	501 547 00
R30	10 kohms	5%	1/3W	Car.	501 410 00
R31	470 kohms	5%	1/3W	Car.	501 547 00
R32	47 ohms	5%	1/3W	Car.	501 147 00
R33-34	10 kohms	5%	1/3W	Car.	501 410 00
R35	1 kohm	5%	1/3W	Car.	501 310 00
R36	560 ohms	5%	1/3W	Car.	501 256 00
R37	1 kohm	5%	1/3W	Car.	501 310 00
R38	470 ohms	5%	1/3W	Car.	501 247 00
R39	1.2 kohms	5%	1/3W	Car.	501 312 00
R40	1.8 kohms	5%	1/3W	Car.	501 318 00
R41	4.7 kohms	5%	1/3W	Car.	501 347 00
R42	47 kohms		Var.		582 447 00
R43	1 kohm	5%	1/3W	Car.	501 310 00
R44	4.7 kohms	5%	1/3W	Car.	501 347 00

232R45	10 kohms	5%	1/3W	Car.	501 410 00
R46	1 kohm		Var.		582 310 00
R47	820 ohms	5%	1/3W	Car.	501 282 00
R48-49	470 ohms	5%	1/3W	Car.	501 247 00
R50	100 ohms	5%	1/3W	Car.	501 210 00
R51	22 kohms	5%	1/3W	Car.	501 422 00
R52	10 kohms	5%	1/3W	Car.	501 410 00
R53	22 kohms	5%	1/3W	Car.	501 422 00
R54	220 ohms	5%	1/3W	Car.	501 222 00
R55-56	1 kohm	5%	1/3W	Car.	501 310 00
R57	10 kohms	5%	1/3W	Car.	501 410 00
R58	2.2 kohms	5%	1/3W	Car.	501 422 00
R59	1 kohm	5%	1/3W	Car.	501 310 00
R60	1.5 kohms	5%	1/3W	Car.	501 315 00
R61	2.2 kohms	5%	1/3W	Car.	501 322 00
R62	8.2 kohms	5%	1/3W	Car.	501 382 00
R63	150 ohms	5%	1/3W	Car.	501 215 00
R64	47 ohms	5%	1/3W	Car.	501 147 00
R65	68 ohms	5%	1/3W	Car.	501 168 00
R66-67	100 ohms	5%	1/3W	Car.	501 210 00
R68	220 ohms	5%	1/3W	Car.	501 222 00
R69	470 ohms	5%	1/3W	Car.	501 247 00
R70	332 ohms	1%	0.4W	MF	511 233 20
R71	220 ohms	5%	1/3W	Car.	501 222 00
R72	301 ohms	1%	0.4W	MF	511 230 10
R73	100 ohms	5%	1/3W	Car.	501 210 00
R74	2.2 kohms	5%	1/3W	Car.	501 322 00
R75	2.7 kohms	5%	1/3W	Car.	501 327 00
R76	422 ohms	1%	0.4W	MF	511 242 20
R77	47 ohms	5%	1/3W	Car.	501 147 00
R78	270 ohms	5%	1/3W	Car.	501 227 00
R79-80	100 ohms	5%	1/3W	Car.	501 210 00
R81	422 ohms	1%	0.4W	MF	511 242 20
R82	100 ohms	5%	1/3W	Car.	501 210 00

PARTS LIST

FOR

232T 1	Transformer	102 104 82
232TR1	BC547B	840 054 70
TR2	BF245B	843 024 50
TR3	BC558B	840 055 80
TR4- 5	BC337-25	840 033 70
TR6	BC547B	840 054 70
232X 1	1.4 MHz	382 037 61

FOR

233C 1	1.8 nF	1%	250V	Polyst.	614 318 00
C 2	47 nF	10%	250V	Polyes.	624 447 00
C 3- 5	0.1 uF	10%	250V	Polyes.	624 510 00
C 6	56 pF	1%	500V	Polyes..	615 156 00
C 7	6.8 pF	±0.25 pF	400V	Cer.N150	605 068 00
C 8	91 pF	1%	500V	Polyes.	615 191 00
C 9-10	56 pF	1%	500V	Polyes.	615 156 00
C11	110 pF	1%	500V	Polyes.	615 211 00
C12	47 pF	5%	400V	Cer.N150	605 147 00
C13	91 pF	1%	500V	Polyes.	615 191 00
C14	68 pF	1%	500V	Polyes.	615 168 00
C15	33 pF	5%	400V	Cer.N150	605 133 00
C16	51 pF	5%	400V	Cer.N150	605 151 00
C17-19	0.1 uF	10%	250V	Polyes.	624 510 00
C20	47 pF	5%	400V	Cer.N150	605 147 00
C21-28	0.1 uF	10%	250V	Polyes.	624 510 00
C29	10 nF	10%	250V	Polyes.	624 410 00
C30	0.1 uF	10%	250V	Polyes.	624 510 00
C31	10 nF	10%	250V	Polyes.	624 410 00
C32-44	0.1 uF	10%	250V	Polyes.	624 510 00
C45	470 pF	1%	500V	Polyst.	615 247 00
C46	0.1 uF	10%	250V	Polyes.	624 510 00
C47	7.5 pF	±0.25 pF	400V	Cer.N150	605 075 00
C48	0.1 uF	10%	250V	Polyes.	624 510 00
C49	510 pF	1%	500V	Polyst.	615 251 00
C50	470 pF	1%	500V	Polyst.	615 247 00
C51	240 pF	1%	500V	Polyst.	615 224 00
C52	180 pF	1%	500V	Polyst.	615 218 00
C53-54	140 pF	1%	500V	Polyst.	615 214 00
C55	82 pF	5%	400V	Cer.N150	605 182 00
C56	27 pF	5%	400V	Cer.N150	605 127 02
C57	270 pF	1%	500V	Polyst.	615 227 00
C58	47 pF	5%	400V	Cer.N150	605 147 00
C59	36 pF	5%	400V	Cer.N150	605 136 01
C60	18 pF	5%	400V	Cer.N150	605 118 03
C61	13 pF	5%	400V	Cer.N150	605 113 00
C62	10 pF	±0.25 pF	400V	Cer.N150	605 110 00
C63	7.5 pF	±0.25 pF	400V	Cer.N150	605 075 00
C64	5.6 pF	±0.25 pF	400V	Cer.N150	605 056 00
C65	5.1 pF	±0.25 pF	400V	Cer.N150	605 051 00

FOR

233C66	22 pF	5%	400V	Cer.N150	605 122 02
C67	510 pF	1%	500V	Polyst.	615 251 00
C68	470 pF	1%	500V	Polyst.	615 247 00
C69	240 pF	1%	500V	Polyst.	615 224 00
C70	180 pF	1%	500V	Polyst.	615 218 00
C71	140 pF	1%	500V	Polyst.	615 214 00
C72	150 pF	1%	500V	Polyst.	615 215 00
C73	91 pF	5%	400V	Cer.N150	605 191 00
C74	180 pF	1%	500V	Polyst.	615 218 00
C75	33 pF	5%	400V	Cer.N150	605 133 00
C76-82	0.1 uF	10%	250V	Polyes.	624 510 00
C83-85	10 nF	10%	250V	Polyes.	624 410 00
C86-88	0.1 uF	10%	250V	Polyes.	624 510 00
233D 1-31	1S920				830 192 00
233IC1- 2	CA3046				850 304 60
233L 1	100 uH	10%	RF Choke		740 210 00
L 2			Coil		102 111 22
L 3			Coil		102 111 32
L 4			Coil		102 111 42
L 5			Coil		102 111 52
L 6			Coil		102 111 62
L 7-10	100 uH	10%	RF Choke		740 210 00
L11	1 mH	10%	RF Choke		740 310 01
L12	220 uH	10%	RF Choke		740 222 00
L13			RF Choke		102 211 91
L14			Coil		102 212 01
L15			Coil		102 212 01
L16			Coil		102 212 11
L17			Coil		102 212 21
L18			Coil		102 212 31
L19			Coil		102 212 41
L20			Coil		102 211 61
L21	680 uH	10%	RF Choke		740 268 00
L22			Coil		102 211 71
L23	680 uH	10%	RF Choke		740 268 00
L24			Coil		102 211 81
L25			Coil		102 211 91
L26			Coil		102 212 01
L27			Coil		102 212 01

FOR

233L28			Coil		102 212 11
L29			Coil		102 212 21
L30			Coil		102 212 31
L31			Coil		102 212 41
L32	1 mH	10%	RF Choke		740 310 01
L33	100 uH	10%	RF Choke		740 210 00
L34	100 uH	10%	RF Choke		740 210 00
233R 1- 2	121 ohms	1%	0.4W	MF	511 212 10
R 3	1.8 kohms	5%	1/3W	Car.	501 318 00
R 4	1 kohm	Var.			582 310 00
R 5	1.8 kohms	5%	1/3W	Car.	501 318 00
R 6- 7	220 ohms	5%	1/3W	Car.	501 222 00
R 8	270 ohms	5%	1/3W	Car.	501 227 00
R 9	68 ohms	5%	1/3W	Car.	501 168 00
R10	1.8 kohms	5%	1/3W	Car.	501 318 00
R11	560 ohms	5%	1/3W	Car.	501 256 00
R12	1.2 kohm	5%	1/3W	Car.	501 312 00
R13	1.8 kohms	5%	1/3W	Car.	501 318 00
R14	22 kohms	5%	1/3W	Car.	501 422 00
R15	820 ohms	5%	1/3W	Car.	501 282 00
R16	560 ohms	5%	1/3W	Car.	501 256 00
R17	180 ohms	5%	1/3W	Car.	501 218 00
R18	390 ohms	5%	1/3W	Car.	501 239 00
R19	1.8 kohms	5%	1/3W	Car.	501 318 00
R20	22 kohms	5%	1/3W	Car.	501 422 00
R21	270 ohms	5%	1/3W	Car.	501 227 00
R22	220 ohms	5%	1/3W	Car.	501 222 00
R23	1 kohm	Var.			582 310 00
R24	220 ohms	5%	1/3W	Car.	501 222 00
R25	4.7 kohms	5%	1/3W	Car.	501 347 00
R26	220 ohms	5%	1/3W	Car.	501 222 00
R27	1 kohm	Var.			582 310 00
R28-29	220 ohms	5%	1/3W	Car.	501 222 00
R30	1 kohm	Var.			582 310 00
R31-32	121 ohms	1%	0.4W	MF	511 212 10
R33-34	220 ohms	5%	1/3W	Car.	501 222 00
R35	1 kohm	Var.			582 310 00
R36-37	220 ohms	5%	1/3W	Car.	501 222 00
R38	1 kohm	Var.			582 310 00
R39-41	220 ohms	5%	1/3W	Car.	501 222 00
R42	1 kohm	Var.			582 310 00
R43-45	220 ohms	5%	1/3W	Car.	501 222 00

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233R46	1 kohm	Var.			582 310 00
R47	220 ohms	5%	1/3W	Car.	501 222 00
R48	68 ohms	5%	1/3W	Car.	501 168 00
R49	220 ohms	5%	1/3W	Car.	501 222 00
R50	1 kohm	Var.			582 310 00
R51-52	1 kohm	5%	1/3W	Car.	501 310 00
R53-54	220 ohms	5%	1/3W	Car.	501 222 00
R55	1 kohm	Var.			582 310 00
R56	4.7 kohms	5%	1/3W	Car.	501 347 00
R57	1 kohm	Var.			582 310 00
R58	220 ohms	5%	1/3W	Car.	501 222 00
R59	1.8 kohms	5%	1/3W	Car.	501 318 00
R60	1.5 kohms	5%	1/3W	Car.	501 315 00
R61	330 ohms	5%	1/3W	Car.	501 233 00
R62-63	47 ohms	5%	1/3W	Car.	501 147 00
R64-70	100 ohms	5%	1/3W	Car.	501 210 00
R71	3.9 kohms	5%	1/3W	Car.	501 339 00
R72	1.8 kohms	5%	1/3W	Car.	501 318 00
R73	2.7 kohms	5%	1/3W	Car.	501 327 00
R74	10 kohms	5%	1/3W	Car.	501 410 00
R75	12 kohms	5%	1/3W	Car.	501 412 00
R76	15 kohms	5%	1/3W	Car.	501 415 00
R77	18 kohms	5%	1/3W	Car.	501 418 00
R78-84	100 ohms	5%	1/3W	Car.	501 210 00
R85	2.7 kohms	5%	1/3W	Car.	501 327 00
R86	10 kohms	5%	1/3W	Car.	501 410 00
R87	12 kohms	5%	1/3W	Car.	501 412 00
R88	15 kohms	5%	1/3W	Car.	501 415 00
R89	18 kohms	5%	1/3W	Car.	501 418 00
R90	3.9 kohms	5%	1/3W	Car.	501 339 00
R91	1.8 kohms	5%	1/3W	Car.	501 318 00
R92	2.2 kohms	5%	1/3W	Car.	501 322 00
R93-94	8.2 kohms	5%	1/3W	Car.	501 382 00
R95	470 ohms	5%	1/3W	Car.	501 247 00
R96	1 kohm	5%	1/3W	Car.	501 310 00
R97-98	47 ohms	5%	1/3W	Car.	501 147 00

233T 1	Transformer	102 211 51
T 2	Transformer	102 102 32
T 3	Transformer	102 102 22
T 4	Transformer	102 211 31
T 5	Transformer	102 211 42
T 6	Transformer	102 211 21

PARTS LIST

FOR

233TR1	BC547B	840 054 70
TR2	BF240	840 024 00
TR3	BFW17A	840 001 70

PARTS LIST

FOR

234C 1	0.1 uF	10%	250V	Polyes.	624 510 00
C 2	6.8 uF	10%	100V	Polyes.	623 668 00
C 3	0.1 uF	10%	250V	Polyes.	624 510 00
C 4	0.15 uF	1%	63V	Polyst.	612 515 00
C 5	3.3 uF	10%	100V	Polyes.	623 633 00
C 6- 8	6.8 uF	10%	100V	Polyes.	623 668 00
C 9	0.1 uF	10%	250V	Polyes.	624 510 00
C10-11	0.15 uF	1%	63V	Polyst.	612 515 00
C12-13	0.1 uF	10%	250V	Polyes.	624 510 00

234D 1- 3	AAZ17		830 001 70
D 4- 5	BZX79C4V7	Zener	832 794 70
D 6- 7	1S920		830 192 00
D 8	AAZ17		830 001 70
D 9-13	1S920		830 192 00
D14	AAZ17		830 001 70
D15-27	1S920		830 192 00
D28	BZX79C4V7	Zener	832 794 70

234IC1	7416		850 741 60
IC2	74LS10		850 741 01
IC3	74LS00		850 740 02
IC4	7416		850 741 60
IC5	74188A	(programmed)	382 215 91
IC6	74LS32		850 743 20
IC7	LM1496		850 149 60
PL	32 Way		751 000 20

234R 1- 7	1 kohm	5%	1/3W	Car.	501 310 00
R 8	2.2 kohms	5%	1/3W	Car.	501 322 00
R 9	1 kohm	5%	1/3W	Car.	501 310 00
R10	1.82 kohms	1%	0.4W	MF	511 318 20
R11	6.81 kohms	1%	0.4W	MF	511 368 10
R12	1 kohm	5%	1/3W	Car.	501 310 00
R13	787 kohms	1%	0.5W	MF	512 578 70
R14	100 ohms	5%	1/3W	Car.	501 210 00
R15	787 kohms	1%	0.5W	MF	512 578 70
R16-18	2.2 kohms	5%	1/3W	Car.	501 322 00
R19	1 kohm	5%	1/3W	Car.	501 310 00
R20	10 kohms	5%	1/3W	Car.	501 410 00
R21	2.2 kohms	5%	1/3W	Car.	501 322 00
R22	10 kohms	5%	1/3W	Car.	501 410 00
R23	470 ohms	5%	1/3W	Car.	501 247 00

234R24	4.7 kohms	5%	1/3W	Car.	501 347 0
R25	1 kohm	5%	1/3W	Car.	501 310 0
R26-29	2.2 kohms	5%	1/3W	Car.	501 322 0
R30	10 kohms	5%	1/3W	Car.	501 410 0
R31	2.2 kohms	5%	1/3W	Car.	501 322 0
R32	680 ohms	5%	1/3W	Car.	501 268 0
R33	220 ohms	5%	1/3W	Car.	501 222 0
R34-35	2.2 kohms	5%	1/3W	Car.	501 322 0
R36	4.7 kohms	5%	1/3W	Car.	501 347 0
R37	22 kohms	5%	1/3W	Car.	501 422 0
R38	47 kohms	5%	1/3W	Car.	501 447 0
R39	3.3 kohms	5%	1/3W	Car.	501 333 0
R40	820 ohms	5%	1/3W	Car.	501 282 0
R41	1.8 kohms	5%	1/3W	Car.	501 318 0
R42	6.8 kohms	5%	1/3W	Car.	501 368 0
R43-44	10 kohms	5%	1/3W	Car.	501 410 0
R45	6.8 kohms	5%	1/3W	Car.	501 368 0
R46	10 kohms	5%	1/3W	Car.	501 410 0
R47	2.2 kohms	5%	1/3W	Car.	501 322 0
R48	1 kohm	5%	1/3W	Car.	501 310 0
R49-50	56 kohms	5%	1/3W	Car.	501 456 0
R51	3.3 kohms	5%	1/3W	Car.	501 333 0
R53	10 kohms	5%	1/3W	Car.	501 410 0
R54	1.8 kohms	5%	1/3W	Car.	501 318 0
R55	6.8 kohms	5%	1/3W	Car.	501 368 0
R56	1 kohm	5%	1/3W	Car.	501 310 0
R57	3.3 kohms	5%	1/3W	Car.	501 333 0
R58	1.8 kohms	5%	1/3W	Car.	501 318 0
R59	3.3 kohms	5%	1/3W	Car.	501 333 0
R60	820 ohms	5%	1/3W	Car.	501 282 0
R61	2.2 kohms	5%	1/3W	Car.	501 322 0
R62	1.8 kohms	5%	1/3W	Car.	501 318 0
R63	22 kohms	5%	1/3W	Car.	501 422 0
R64	180 ohms	5%	1/3W	Car.	501 218 0
R65	330 ohms	5%	1/3W	Car.	501 233 0
R66	47 kohms	5%	1/3W	Car.	501 447 0
R67-68	6.8 kohms	5%	1/3W	Car.	501 368 0
R69	2.2 kohms	5%	1/3W	Car.	501 322 0
R70	680 ohms	5%	1/3W	Car.	501 268 0

PARTS LIST

FOR

234R71	220 ohms	5%	1/3W	Car.	501 222 00
R72	6.8 kohms	5%	1/3W	Car.	501 368 00
R73	47 kohms	5%	1/3W	Car.	501 447 00
R74	6.8 kohms	5%	1/3W	Car.	501 368 00
R75	220 ohms	5%	1/3W	Car.	501 222 00
R76	560 ohms	5%	1/3W	Car.	501 256 00
R77	1.8 kohms	5%	1/3W	Car.	501 318 00
R78	4.7 kohms	5%	1/3W	Car.	501 347 00
R79-80	680 ohms	5%	1/3W	Car.	501 268 00
R81	820 ohms	5%	1/3W	Car.	501 282 00
R82	47 kohms	5%	1/3W	Car.	501 447 00
R83	22 kohms	5%	1/3W	Car.	501 422 00
R84	4.7 kohms	5%	1/3W	Car.	501 347 00
R85	1.8 kohms	5%	1/3W	Car.	501 318 00
R86	47 kohms	5%	1/3W	Car.	501 447 00
R87	1 kohm	5%	1/3W	Car.	501 310 00

234T 1	Transformer	102 007 22
T 2	Transformer	102 007 12
T 3	Transformer	102 211 11

234TR1- 3	BC558B	840 055 80
TR4- 6	BC547B	840 054 70
TR7	BC558B	840 055 80
TR8	BC547B	840 054 70
TR9-10	BC558B	840 055 80
TR11-14	BC547B	840 054 70
TR15	BF245B	843 024 50

235C 1-7	0.1 uF	10%	250V	Polyes.	624 510 00
C 8	1000 uF		6.3V	W.alum.	652 910 02
C 9	470 uF		16V	W. alum	651 847 00
C10	47 nF	-20/+80%C	16V	Cer.	601 447 00
C11	0.1 uF	10%	250V	Polyes.	624 510 00
C12	27 pF	5%	400V	Cer.N150	605 127 02
C13	100 pF	1%	500V	Polyst.	615 210 00
C14-15	0.1 uF	10%	250V	Polyes.	624 510 00
C16-19	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C20-21	0.1 uF	10%	250V	Polyes.	624 510 00
C22	47 pF	5%	400V	Cer.N150	605 147 00
C23-28	0.1 uF	10%	250V	Polyes.	624 510 00
C29	47 nF	-20/+80%	16V	Cer.	601 447 00
C30	56 pF	5%	400V	Cer.N150	605 156 00
C31	68 pF	5%	400V	Cer.N150	605 168 00
C32	39 pF	5%	400V	Cer.N150	605 139 00
C33	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C34	180 pF	1%	500V	Polyst.	615 218 00
C35	5.6 nF	1%	63V	Polyes.	612 356 00
C36	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C37	0.22 uF	10%	100V	Polyes.	623 522 00
C38	33 pF	5%	400V	Cer.N150	605 147 00
C39	0.1 uF	10%	250V	Polyst.	615 227 00
C40-49	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C50	0.1 uF	10%	250V	Polyes.	624 510 00
235D 1	BB104				833 010 40
D 2-7	1S920				830 192 00
D 8-9	AAZ17				830 001 70
235IC1	74LS145				857 414 50
IC2	74LS00				850 740 02
IC3	74LS74				850 747 40
IC4	74S188 (programmed)				382 215 81
IC5	74LS163				851 416 31
IC6	74LS00				850 740 02
IC7	74LS03				850 740 31
IC8	301A				850 030 10
235L 1	22 uH	10%	RF Choke		740 122 01
L 2			Coil		102 211 01
L 3	1 mH	10%	RF Choke		740 310 01
L 4			Coil		102 210 42
L 5			Coil		102 210 52
L 6			Coil		102 210 62
L 7			Coil		102 210 72
L 8			Coil		102 210 82
L 9			Coil		102 210 92
L10	100 uH	10%	RF Choke		740 210 00

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235PL1	32 Way				751 000 20
235R 1	33 ohms	5%	1/2W	Car.	502 133 00
R 2	100 kohms	5%	1/3W	Car.	501 510 00
R 3	100 ohms	5%	1/3W	Car.	501 210 00
R 4	10 kohms	5%	1/3W	Car.	501 410 00
R 5	100 ohms	5%	1/3W	Car.	501 210 00
R 6	220 ohms	5%	1/3W	Car.	501 222 00
R 7	4.7 kohms	5%	1/3W	Car.	501 347 00
R 8	1 kohm	5%	1/3W	Car.	501 310 00
R 9	56 ohms	5%	1/3W	Car.	501 156 00
R 10-11	2.7 kohms	5%	1/3W	Car.	501 327 00
R12	6.8 kohms	5%	1/3W	Car.	501 368 00
R13	3.9 kohms	5%	1/3W	Car.	501 339 00
R14	1.8 kohms	5%	1/3W	Car.	501 318 00
R16	33 kohms	5%	1/3W	Car.	501 433 00
R17	1.5 kohms	5%	1/3W	Car.	501 315 00
R19	2.2 kohms	5%	1/3W	Car.	501 322 00
R20	82 ohms	5%	1/3W	Car.	501 182 00
R22	220 ohms	5%	1/3W	Car.	501 222 00
R23	27 ohms	5%	1/3W	Car.	501 127 00
R24	10 kohms	5%	1/3W	Car.	501 410 00
R25	8.2 kohms	5%	1/3W	Car.	501 382 00
R26	330 ohms	5%	1/3W	Car.	501 233 00
R27-32	100 ohms	5%	1/3W	Car.	501 210 00
R33	8.2 kohms	5%	1/3W	Car.	501 382 00
R34	470	5%	1/3W	Car.	501 247 00
R35-52	4.7 kohms	5%	1/3W	Car.	501 347 00
R53-57	1 kohm	5%	1/3W	Car.	501 310 00
R58	10 ohms	5%	1/3W	Car.	501 110 00
R59	1 kohm	5%	1/3W	Car.	501 310 00
R60	820 ohms	5%	1/3W	Car.	501 282 00
R61	4.7 kohms	5%	1/3W	Car.	501 347 00
R62-64	1 kohm	5%	1/3W	Car.	501 310 00
R65	4.7 kohms	5%	1/3W	Car.	501 347 00
R66	10 kohms	5%	1/3W	Car.	501 410 00
R68-70	1 kohm	5%	1/3W	Car.	501 310 00
R71	22 kohms	5%	1/3W	Car.	501 422 00

PARTS LIST

FOR

235R73	22 ohms	5%	1/3W	Car.	501 122 00
R74	1.8 kohm	5%	1/3W	Car.	501 318 00
R75	1.0 kohms	5%	1/3W	Car.	501 310 00
R76	1.8 kohms	5%	1/3W	Car	501 318 00
R77-78	2.7 kohms	5%	1/3W	Car.	501 327 00
R79	8.2 kohms	5%	1/3W	Car.	501 382 00
R80	22 kohms	5%	1/3W	Car.	501 422 00
R81	10 kohms	5%	1/3W	Car.	501 410 00
R82	22 kohms	5%	1/3W	Car.	501 422 00
R83	12 kohms	5%	1/3W	Car.	501 412 00

235TR1-3	BF240	840 024 00
TR4-5	BSX20	840 002 00
TR6	BF240	840 024 00
TR7	BSX20	840 002 00
TR8-9	BC547B	840 054 70
TR10	BSX20	840 002 00

PARTS LIST

FOR

236C 1	0.47 uF	10%	100V	Polyes.	623 547 00
C 2	68 nF	10%	100V	Polyes.	623 468 00
C 3	0.1 uF	10%	250V	Polyes.	624 510 00
C 4	33 pF	5%	400V	Cer.	605 133 00
C 5	100 uF		25V	W.alum.	652 810 00
C 6- 7	1000 uF		16V	W.alum.	651 910 00
C 8-11	0.1 uF	10%	250V	Polyes.	624 510 00
C12	33 pF	5%	400V	Cer.	605 133 00
C13	0.1 uF	10%	250V	Polyes.	624 510 00
C14	33 pF	5%	400V	Cer.	605 133 00
C15	0.1 uF	10%	250V	Polyes.	624 510 00
C16-17	2.2 uF	10%	100V	Polyes.	623 622 00
C18	47 nF	10%	250V	Polyes.	624 447 00
C19	10 nF	10%	250V	Polyes.	624 410 00
C20	47 nF	10%	250V	Polyes.	624 447 00
C21	10 nF	10%	250V	Polyes.	624 410 00
C22	470 pF	1%	500V	Polyst.	615 247 00
C23	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C24	0.1 uF	10%	250V	Polyes.	624 510 00
C25	1 uF	10%	100V	Polyes.	623 610 00
C26-27	47 nF	10%	250V	Polyes.	624 447 00
C28-30	0.1 uF	10%	250V	Polyes.	624 510 00
C31	68 nF	10%	100V	Polyes.	623 468 00
236D 1	BZX79C6V8	Zener			832 796 80
D 2	BB113				833 011 30
D 3-4	1S920				830 192 00
236IC1- 3	301A				850 030 10
236L 1	220 uH	10%	RF Choke		740 222 00
L 2			Coil		102 210 32
L 3			Coil		102 210 23
236PL1	32 Way				751 000 20
236R 1- 2	33 kohms	5%	1/3W	Car.	501 433 00
R 3	330 ohms	5%	1/3W	Car.	501 233 00
R 4	6.8 kohms	5%	1/3W	Car.	501 368 00
R 5	22 ohms	5%	1/3W	Car.	501 122 00
R 6	39 ohms	5%	1/3W	Car.	501 139 00

FOR

236R 7- 8	33 kohms	5%	1/3W	Car.	501 433 00
R10	6.8 kohms	5%	1/3W	Car.	501 368 00
R11	220 ohms	5%	1/3W	Car.	501 222 00
R12	100 kohms	5%	1/3W	Car.	501 482 00
R13	560 ohms	5%	1/3W	Car.	501 256 00
R14	27 kohms	5%	1/3W	Car.	501 427 00
R15	56 kohms	5%	1/3W	Car.	501 456 00
R16	4.7 kohms	5%	1/3W	Car.	501 347 00
R17	56 kohms	5%	1/3W	Car.	501 456 00
R18	4.7 kohms	5%	1/3W	Car.	501 347 00
R19	100 kohms	5%	1/3W	Car.	501 510 00
R20	3.9 kohms	5%	1/3W	Car.	501 339 00
R21	2.2 kohms	5%	1/3W	Car.	501 322 00
R22	4.7 kohms	5%	1/3W	Car.	501 347 00
R23	22 kohms	5%	1/3W	Car.	501 422 00
R24	15 kohms	5%	1/3W	Car.	501 415 00
R25	2.7 kohms	5%	1/3W	Car.	501 327 00
R26	100 ohms	5%	1/3W	Car.	501 210 00
R27	1 kohm	5%	1/3W	Car.	501 310 00
R28	180 ohms	5%	1/3W	Car.	501 218 00
R29	100 kohms	5%	1/3W	Car.	501 510 00
R30	120 ohms	5%	1/3W	Car.	501 212 00
R31	3.3 kohms	5%	1/3W	Car.	501 333 00
R32	2.7 kohms	5%	1/3W	Car.	501 327 00
R33	10 kohms	5%	1/3W	Car.	501 410 00
R34	39 ohms	5%	1/3W	Car.	501 139 00
R35	56 ohms	5%	1/3W	Car.	501 156 00
R36	180 ohms	5%	1/3W	Car.	501 218 00
R37	220 ohms	5%	1/3W	Car.	501 222 00
R38	22 ohms	5%	1/3W	Car.	501 122 00
236T 1					102 210 11
236TR1- 2	BF240				840 024 00
TR3	BC547B				840 054 70
TR4	BSX20				840 002 00

FOR

237C 1	4.7 nF	-20/+80%	32V	Cer.	602 347 00
C 2	47 nF	-20/+80%	16V	Cer.	601 447 00
C 3- 8	47 nF	-20/+80%	16V	Cer.	601 447 00
C 9	10 nF	-20/+80%	32V	Cer.	602 410 00
C10	47 nF	-20/+80%	16V	Cer.	601 447 00
C11	1.2 nF	1%	500V	Polyst.	615 312 00
C12	10 nF	-20/+80%	32V	Cer.	602 410 00
C13	100 uF		25V	W.alum.	652 810 00
C14	22 uF		16V	W.alum.	651 722 00
C15	180 pF	1%	500V	Polyst.	615 218 00
C16	270 pF	1%	500V	Polyst.	615 227 00
C17	220 pF	1%	500V	Polyst.	615 222 00
C18	680 pF	1%	500V	Polyst.	615 268 00
C19	0.1 uF	10%	250V	Polyes.	624 510 00
C20	1.8 nF	1%	125V	Polyst.	613 318 00
C21	47 nF	-20/+80%	16V	Cer.	601 447 00

237IC 1	74LS74	850 747 40
IC 2	7416	850 741 60
IC 3	74LS11	850 741 11
IC 4	74LS32	850 743 20
IC 5	74LS08	850 740 80
IC 6	74LS90	850 749 01
IC 7	74LS93	850 749 32
IC 8	74S32	850 743 21
IC 9	74LS00	850 740 02
IC10	74LS85	850 748 50
IC11	74LS32	850 743 20
IC12	74LS08	850 740 80
IC13	74LS21	850 742 10
IC14	74LS90	850 749 01
IC15	74LS74	850 747 40
IC16	74LS160	857 416 00
IC17	74LS123	857 412 30
IC18	74LS32	850 743 20
IC19	74LS90	850 749 01
IC20	74LS160	857 416 00
IC21	74LS08	850 740 80
IC22	74LS08	850 740 80
IC23	74LS160	857 416 00
IC24	74LS00	850 740 02
IC25	7426	850 742 60
IC26	74LS160	857 416 00

FOR

237L 1	10 uH	10%	RF Choke		740 110 00
L 2	100 uH	10%	RF Choke		740 210 00
237PL1	32 Way				751 000 20
237R 1	3.3 kohms	5%	1/3W	Car.	501 333 00
R 2	10 kohms	5%	1/3W	Car.	501 410 00
R 3	68 ohms	5%	1/3W	Car.	501 168 00
R 4	220 ohms	5%	1/3W	Car.	501 222 00
R 5	82 ohms	5%	1/3W	Car.	501 182 00
R 6	390 ohms	5%	1/3W	Car.	501 239 00
R 7	1.2 kohms	5%	1/3W	Car.	501 312 00
R 8	2.2 kohms	5%	1/3W	Car.	501 322 00
R 9	47 ohms	5%	1/3W	Car.	501 147 00
R10	3.3 kohms	5%	1/3W	Car.	501 333 00
R11	390 ohms	5%	1/3W	Car.	501 239 00
R12	470 ohms	5%	1/3W	Car.	501 247 00
R13	1 kohm	5%	1/3W	Car.	501 310 00
R14	22 kohms	5%	1/3W	Car.	501 422 00
R15	1 kohm	5%	1/3W	Car.	501 310 00
R16-20	1 kohm	5%	1/3W	Car.	501 310 00
R22	12 kohms	5%	1/3W	Car.	501 412 00
R23	18 kohms	5%	1/3W	Car.	501 418 00
R24	1.5 kohms	5%	1/3W	Car.	501 315 00
R25	820 ohms	5%	1/3W	Car.	501 282 00
R26	1.5 kohms	5%	1/3W	Car.	501 315 00
R27	1 kohm	5%	1/3W	Car.	501 310 00
R28-29	4.7 kohms	5%	1/3W	Car.	501 347 00
R30	2.2 kohms	5%	1/3W	Car.	501 322 00
R31-33	1 kohm	5%	1/3W	Car.	501 310 00
R34	1.8 kohms	5%	1/3W	Car.	501 318 00
R35	10 ohms	5%	1/3W	Car.	501 110 00
R36	100 ohms	5%	1/3W	Car.	501 210 00
TR1-4	BC 547 B				840 054 70

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238C 1	0.68 uF	10%	100V		623 568 00
238IC1	7417				850 741 70
IC2- 3	7805				850 780 50
IC4	7442A				850 744 20
238R 1- 5	680 ohms	5%	1/3W	Car.	501 268 00
R 6-29	1 kohm	5%	1/3W	Car.	501 310 00
238PL	64 Way				751 000 22
238SK1-24	16 Way				751 000 24

FOR

239C 1	47 nF	-20/+80%	16V	Cer.	601 447 00
C 2	100 uF		16V	W.alum.	651 810 00
C 3	22 uF		16V	W.alum.	651 722 00
C 4	10 nF	10%	250V	Polyes.	624 410 00
C 5	22 uF		16V	W.alum.	651 722 00
C 6	10 nF	10%	250V	Polyes.	624 410 00
C 7	100 pF	1%	500V	Polyst.	615 210 00
C 8	220 pF	1%	125V	Polyst.	613 222 00
C 9-10	47 nF	-20/+80%	16V	Cer.	601 447 00
C11	0.22 uF	10%	100V	Polyes.	623 522 00
C12	0.1 uF	10%	250V	Polyes.	624 410 00
C13	22 uF		16V	W.alum.	651 722 00

239D 1	AAZ17	830 001 70
D 2- 4	1S920	830 192 00
D 5	AAZ17	830 001 70
239IC 1	74LS03	850 740 31
IC 2	74LS00	850 740 02
IC 3	555	850 055 50
IC 4	74148	857 414 80
IC 5	74LS123	857 412 30
IC 6	74LS09	850 740 90
IC 7	74LSo3	850 740 31
IC 8- 9	74LS195A	857 419 50
IC10	74LS74	850 747 40
IC11	MAN82	824 008 20
IC12	74LS47	850 744 70
IC13	MAN82	824 008 20
IC14	74LS47	850 744 70
IC15-16	74184	857 418 40
IC17	7805	850 780 50
IC18	MAN82	824 008 20
IC19	74LS47	850 744 70
IC20-21	74184	857 418 40

239R 1- 2	4.7 kohms	5%	1/3W	Car.	501 347 00
R 3- 9	4.7 kohms	5%	1/3W	Car.	501 347 00
R10	4.7 kohms	5%	1/3W	Car.	501 347 00
R11-13	4.7 kohms	5%	1/3W	Car.	501 347 00
R14	33 ohms	5%	1/3W	Car.	501 133 00

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239R15	2.2 kohms	5%	1/3W	Car.	501 322 00
R16	33 kohms	5%	1/3W	Car.	501 433 00
R17	1.8 kohms	5%	1/3W	Car.	501 318 00
R18	100 ohms	5%	1/3W	Car.	501 210 00
R19	10 kohms	5%	1/3W	Car	501 410 00
R20-21	4.7 ohms	5%	1/3W	Car.	501 347 00
R22	10 kohms	5%	1/3W	Car.	501 410 00
R23	4.7 kohms	5%	1/3W	Car.	501 347 00
R24-28	100 ohms	5%	1/3W	Car.	501 210 00
R29	4.7 kohms	5%	1/3W	Car.	501 347 00
R30-35	100 ohms	5%	1/3W	Car.	501 210 00
R36	4.7 kohms	5%	1/3W	Car.	501 347 00
R37-38	100 ohms	5%	1/3W	Car.	501 210 00
R39-43	4.7 kohms	5%	1/3W	Car.	501 347 00
R44-45	100 ohms	5%	1/3W	Car.	501 210 00
R46-47	4.7 kohms	5%	1/3W	Car.	501 347 00
R48	100 ohms	5%	1/3W	Car.	501 210 00
R49-50	4.7 kohms	5%	1/3W	Car.	501 347 00
R51	100 ohms	5%	1/3W	Car.	501 210 00
R52	4.7 kohms	5%	1/3W	Car.	501 347 00
R53	100 ohms	5%	1/3W	Car.	501 210 00
R54-56	4.7 kohms	5%	1/3W	Car.	501 347 00
R57	100 ohms	5%	1/3W	Car.	501 210 00
R58	4.7 kohms	5%	1/3W	Car.	501 347 00
R59	100 ohms	5%	1/3W	Car.	501 210 00
R60-61	4.7 kohms	5%	1/3W	Car.	501 347 00
R62	1 kohm		Lin.		352 213 02
R63	150 ohms	5%	1/3W	Car.	501 215 00
R64-69	4.7 komhs	5%	1/3W	Car.	501 347 00
R70	1.5 kohms	5%	1/3W	Car.	501 315 00
R71	4.7 kohms	5%	1/3W	Car.	501 347 00
239S1-12	M61-0110				763 000 07
239SK1-3				WW	751 000 25

PARTS LIST

FOR

240C 1	47 nF	-20/+80%	16V	Cer.	601 447 00
C 2	0.1 uF	10%	250V	Polyes.	624 510 00
C 3	47 pF	5%	400V	Cer.N150	605 147 00
C 4	10 nF	-20/+80%	32V	Cer.	602 410 00
C 5	0.1 uF	10%	250V	Polyes.	624 510 00
C 6	3.3 nF	1%	125V	Polyst.	613 333 00
240IC 1	7493				850 749 31
240L 1	100 uH	10%	RF Choke		740 210 00
240R 1	470 ohms	5%	1/3W	Car.	501 247 00
R 2	820 ohms	5%	1/3W	Car.	501 282 00
R 3	15 kohms	5%	1/3W	Car.	501 415 00
R 4	2.7 kohms	5%	1/3W	Car.	501 327 00
R 5	1.2 kohms	5%	1/3W	Car.	501 312 00
R 6	270 ohms	5%	1/3W	Car.	501 227 00
R 7	27 kohms	5%	1/3W	Car.	501 427 00
R 8	8.2 kohms	5%	1/3W	Car.	501 382 00
R 9	2.2 kohms	5%	1/3W	Car.	501 322 00
R10	680 ohms	5%	1/3W	Car.	501 268 00
R11	8.2 kohms	5%	1/3W	Car.	501 382 00
R12	15 kohms	5%	1/3W	Car.	501 415 00
R13-14	470 ohms	5%	1/3W	Car.	501 247 00
R15	820 ohms	5%	1/3W	Car.	501 282 00
R16	180 ohms	5%	1/2W	Car.	502 218 00
240T 1					105 215 71
240TR1- 2	BF240				840 024 00
TR3	BSX20				840 002 00
240X 1	OSCILLATOR	TCXO	11.2MHz		811 000 01

PARTS LIST

FOR

241C1	22 uF		16V	W.alum.	651 722 00
C2	10 nF	10%	250V	Polyes.	624 410 00
C3	22 uF		16V	Tan	651 722 00
C4	0.68 uF	10%	100V	Polyes.	623 568 00
C5	220 pF	1%	500V	Polyst.	615 222 00
C6	0.22 uF	10%	100V	Polyes.	623 522 00
C7	0.47 uF	10%	100V	Polyes.	623 547 00
C8	680 pF	1%	500V	Polyst.	615 268 00
C9	0.22 uF	10%	100V	Polyes.	623 522 00
C10	0.68 uF	10%	100V	Polyes.	623 568 00
C11	0.22 uF	10%	100V	Polyes.	623 522 00
C12	470 uF		6.3V	W.alum.	650 847 00
C13-15	47 nF	-20/+80%	16V	Cer.	601 447 00
241D1-2	TIL209A	Zener			823 000 00
D3	BZX79C5V1				832 795 10
D4	AAZ17				830 001 70
241IC1	555				850 055 50
IC2	74LS123				857 412 30
IC3	74LS00				850 740 02
IC4	74LS74				850 747 40
IC5	7406				850 740 60
IC6	74LS123				857 412 30
IC7	7426				850 742 60
IC8	74LS123				857 412 30
IC9	7805				850 780 50
PL1	32Way				751 000 20
241R1	5.6 kohms	5%	1/3W	Car.	501 356 00
R2	270 ohms	5%	1/3W	Car.	501 227 00
R3	27 kohms	5%	1/3W	Car.	501 427 00
R4-13	3.9 kohms	5%	1/3W	Car.	501 339 00
R14	4.7 kohms	5%	1/3W	Car.	501 347 00
R15-20	3.9 kohms	5%	1/3W	Car.	501 339 00
R21	330 ohms	5%	1/3W	Car.	501 233 00
R22	18 kohms	5%	1/3W	Car.	501 418 00
R23	4.7 kohms	5%	1/3W	Car.	501 347 00
R24-31	3.9 kohms	5%	1/3W	Car.	501 339 00

PARTS LIST

FOR

241R32	6.8 kohms	5%	1/3W	Car.	501 368 00
R33-36	3.9 kohms	5%	1/3W	Car.	501 339 00
R37	18 kohms	5%	1/3W	Car.	501 418 00
R38-39	3.9 kohms	5%	1/3W	Car.	501 339 00
R40	470 ohms	5%	1/3W	Car.	501 247 00
R41-42	3.9 kohms	5%	1/3W	Car.	501 339 00
R43	4.7 kohms	5%	1/3W	Car.	501 347 00
R44	6.8 kohms	5%	1/3W	Car.	501 368 00
R45-56	3.9 kohms	5%	1/3W	Car.	501 339 00
R57	330 ohms	5%	1/3W	Car.	501 133 00
R58	18 kohms	5%	1/3W	Car.	501 418 00
R59-62	3.9 kohms	5%	1/3W	Car.	501 339 00
R63	820 ohms	5%	1/3W	Car.	501 282 00
R64	560 ohms	5%	1/3W	Car.	501 256 00
R65-68	1 kohm	5%	1/3W	Car.	501 310 00
R69	1.8 kohms	5%	1/3W	Car.	501 318 00
R70	4.7 kohms	5%	1/3W	Car.	501 347 00
R71	10 kohms	5%	1/3W	Car.	501 410 00
R72	33 ohms	5%	1/3W	Car.	501 133 00
241S1					763 000 12
S2					763 000 11
S3					761 000 01
241SK1					751 000 43
SK2-3					751 000 46
SK4-5					751 000 43
241TR1	BC337-25				840 033 70
TR2	BD234-10				842 023 40

992 206 31

PARTS LIST

FOR

250

250B 1	BLOWER AIR FILTER				382 214 73 342 224 81
250C 1	16 uF	10%	250V	MP	634 716 00
C 2	0.1 uF	10%	12V	Cer.	601 510 00
C 3	0.22 uF	10%	400V	Polyes.	625 522 00
C 4- 6	0.1 uF	10%	250V	Polyes.	624 510 01
C 7	0.22 uF	10%	400V	Polyes.	625 522 00
C 8	4.7 nF	10%	5kV	Cer.	608 347 00
C 9	0.1 uF	10%	250V	Polyes.	624 510 01
C10	10 nF	10%	400V	Polyes.	625 410 00
C11	0.1 uF	10%	250V	Polyes.	624 510 01
C12	1 nF	10%	3kV	Mi	698 310 00
C13	100 pF	5%	400V	Cer.	605 210 00
C14-15	5.6 pF	±0.25pF	1.6kV	Cer.	607 056 00
C17	160 pF	-20/+20%	10kV		608 216 03
C18	60 pF	-20/+20%	4kV		608 160 02
C19	120 pF	-20/+20%	3kV		608 212 01
C20	100 pF	-20/+20%	3kV		608 210 04
C21	50 pF	-20/+20%	3kV		608 150 01
C22	25 pF	-20/+20%	3kV		608 125 01
C23	400 pF	-20/+20%	3kV		608 240 01
C24	100 pF	-20/+20%	3kV		608 210 04
C25	50 pF	-20/+20%	3kV		608 150 01
C26-27	25 pF	-20/+20%	3kV		608 125 01
C28-30	6 pF	-1pF/+1pF	9kV		608 060 00
C31	25 pF	-20/+20%	3kV		608 125 01
C32	400 pF	-20/+20%	3kV		608 240 01
C33	100 pF	-20/+20%	3kV		608 210 04
C34	50 pF	-20/+20%	3kV		608 150 01
R35-36	25 pF	-20/+20%	3kV		608 125 01
C37-38	6 pF	-1pF/+1pF	9kV		608 060 00
C39	25 pF	-20/+20%	3kV		608 125 01
C40	100 pF	-20/+20%	3kV		608 210 04
C41	50 pF	-20/+20%	3kV		608 150 01
C42	25 pF	-20/+20%	3kV		608 125 01
C43	6 pF	-1pF/+1pF	9kV		608 060 00
C44	100 pF	-20/+20%	3kV		608 210 04
C45	50 pF	-20/+20%	3kV		608 150 01
C46	25 pF	-20/+20%	3kV		608 125 01
C47	6 pF	-1pF/+1pF	9kV		608 060 00

PARTS LIST

FOR

250D 1	1N3011	Zener			832 301 10
D 2	1S923				830 192 30
D 3	1N3011	Zener			832 301 10
D 4	1S923				830 192 30
D 5	BZY93C75R	Zener			832 937 51
D 6	1N3011	Zener			832 301 10
D 7	1N4148				830 414 80
250L 1	22uH	10%			740 122 01
L 2					102 222 11
L 3					102 228 11
L 4	2182 kHz	Fine tuning			102 107 63
L 5	VARIOMETER "B"				107 185 00
L 6	VARIOMETER "A"				107 184 00
250ME1	1 mA				342 221 92
250PL1	26 Way				751 000 75
250R 1- 2	15 kohms	5%	30W	WW	528 415 01
R 3	390 ohms	5%	2/3W	Car.	502 239 00
R 4	12 ohms	5%	2/3W	Car.	502 112 00
R 5	47 ohms	5%	1/3W	Car.	501 147 00
R 6	12 ohms	5%	2/3W	Car.	502 112 00
R 7	3.9 ohms	5%	15W	WW	528 039 00
R 8- 9	15 ohms	5%	36W	WW	528 115 00
R10-11	12 ohms	5%	2/3W	Car.	502 112 00
R12	390 ohms	5%	2/3W	Car.	502 239 00
R13	12 ohms	5%	2/3W	Car.	502 112 00
R14	47 ohms	5%	1/3W	Car.	501 147 00
R15	12 ohms	5%	2/3W	Car.	502 112 00
R16	4.7 kohms	5%	1/2W	Car.	501 347 00
R17-18	12 ohms	5%	2/3W	Car.	502 112 00
R19	47 ohms	5%	2W	Car.	505 147 00
R20-24	3.3 Mohms	5%	1W	Car.	523 633 00
R25	15 ohms	5%	15W	WW	528 115 01
R26-27	MOV				599 530 00

PARTS LIST

FOR

250SK 1	1 Way	751 000 35 751 000 38
SK 2	20 Way (Optional)	751 000 31
SK 3	BNC	750 000 02
250T 1		102 222 01
250TR 1	BD157	842 157 00
TR 2	BD644	842 644 00
TR 3-4	BD645	842 645 00
250V 1-2	4CX250B	820 425 00

PARTS LIST

FOR

251C 1- 2	0.1 uF	10%	250V	Polyes.	624 510 00
C 3	10 nF	10%	250V	Polyes.	624 410 00
C 4- 6	18 pF	5%	400V	Cer.NPO	605 118 00
C 7	10 nF	10%	250V	Polyes.	624 410 00
C 8	0.1 uF	10%	250V	Polyes.	624 510 00
C 9	10 nF	10%	250V	Polyes.	624 410 00
C10	0.1 uF	10%	250V	Polyes.	624 510 00
251D 1	10D05				831 100 51
D 2	BYX38-300				831 003 80
251L 1	100 uH	10%	RF Choke		740 210 00
L 2	2.2 uF	10%	RF Choke		740 022 00
L 3- 4			Coil		102 213 21
251R 1	220 ohms	5%	1/3W	Car.	501 222 00
R 2	150 ohms	5%	1/3W	Car.	501 215 00
R 3	470 ohms	5%	1/3W	Car.	501 247 00
R 4	47 ohms	5%	1/3W	Car.	501 147 00
R 5	120 ohms	5%	2W	Car.	505 212 00
R 6	47 ohms	5%	1/3W	Car.	501 147 00
R 7	100 ohms	Var.	3/4W	Car.	582 222 00
R 8	10 ohms	5%	1/2W	Car.	502 110 00
R 9	12 ohms	5%	1/2W	Car.	502 112 00
R10-11	1 kohm	5%	1W	Car.	504 310 00
R12	220 ohms	5%	1/3W	Car.	501 222 00
R13-15	470 ohms	5%	2W	Car.	505 247 00
R16-17	1 kohm	5%	1W	Car.	504 310 00
R18-19	100 ohms	5%	1/3W	Car.	501 210 00
R20-29	10 ohms	5%	1/2W	Car.	502 110 00
R30	15 ohms	5%	1/2W	Car.	502 115 00
R31-35	1 kohm	5%	1W	Car.	504 310 00
R36	22 kohms	5%	1/2W	Car.	502 422 00
251T 1	Transformer				102 213 41
T 2	Transformer				102 213 32
251TR1- 2	BFW17A				840 001 70
TR3- 4	BLX13				842 001 30

PARTS LIST

FOR

252

252C 1	1 uF	10%	100V	Polyes.	623 610 00
C 2	10 nF	10%	250V	Polyes.	624 410 00
C 3	0.1 uF	10%	250V	Polyes.	624 510 00
C 4	10 nF	10%	250V	Polyes.	624 410 00
252D 1	AAZ17				830 001 70
D 2	1S920				830 192 00
252L 1	100 uH	10%	RF Choke		740 210 00
252R 1	1.5 Mohms	5%	1W	Car.	513 615 00
R 2	9.09 kohms	1%	1/3W	MF	511 390 90
R 3- 4	562 kohms	1%	1/2W	MF	512 556 20
R 5	1.5 Mohms	5%	1W	Car.	513 615 00
R 6	8.2 kohms	5%	1/3W	Car.	501 382 00
R 7- 8	22 kohms	5%	1/3W	Car.	501 422 00
R 9	10 kohms	5%	1/3W	Car.	501 410 00
R10	3.9 kohms	5%	1/3W	Car.	501 339 00
R11	680 ohms	5%	1/3W	Car.	501 268 00
R13	820 ohms	5%	1/3W	Car.	501 282 00
R14	6.8 kohms	5%	1/3W	Car.	501 368 00
R15	560 kohms	5%	1/3W	Car.	501 556 00
R16	47 kohms	5%	1/3W	Car.	501 447 00
R17	33 kohms	5%	1/3W	Car.	501 433 00
252S 1					372 200 43
252TR1	BC557B				840 055 70

PARTS LIST

FOR

253C 1	0.1 uF	10%	250V	Polyes.	624 510 01
C 2	22 uF		16V	W.alum.	651 722 00
C 3- 4	10 nF	10%	400V	Polyes.	625 410 00
C 5-10	10 nF	-20/+80%	32V	Cer.	602 410 00
253D 1-16	MV5353				823 000 01
253IC1	74LS37				850 743 70
IC2	74LS21				850 742 10
IC3	74LS145				857 414 50
IC4	74LS266				857 426 60
IC5	74LS145				857 414 50
IC6	74LS00				850 740 o2
IC7	74LS03				850 740 31
IC8					850 055 50
253R 1- 5	2.2 kohms	5%	1/3W	Car.	501 322 00
R 6	150 ohms	5%	1/3W	Car.	501 215 00
R 7	2.2 kohms	5%	1/3W	Car.	501 322 00
R 8	1 kchm	5%	1/3W	Car.	501 310 00
R 9	33 kohms	5%	1/3W	Car.	501 433 00
R10	150 ohms	5%	1/3W	Car.	501 215 00
R11	1.8 kohms	5%	1/3W	Car.	501 318 00
253TR1	BC 547 B				840 054 70

PARTS LIST

FOR

254C 1	10 nF	10%	250V	Polyes.	624 410 00
C 2	0.22 uF	10%	250V	Polyes.	624 522 01
C 3	10 nF	10%	250V	Polyes.	624 410 00
C 4- 5	0.1 uF	10%	250V	Polyes.	624 510 00
C 7-12	22 nF	10%	250V	Polyes.	624 422 00
C 13	10 nF	10%	250V	Polyes.	624 410 00
254D 1	BZX79 C6V8	Zener			832 796 80
D 2	1S920				830 192 00
D 3- 4	BZX79 B4V7	Zener			832 794 71
D 5- 6	1N5401				831 540 10
254IC1- 2	550				850 055 00
254R 1	4.7 kohms		Var.		582 347 00
R 2	6.8 kohms	5%	1/3W	Car.	501 368 00
R 3	47 kohms		Var.		582 447 00
R 4	3.3 kohms	5%	1/3W	Car.	501 333 00
R 5	1.2 kohms	5%	1/2W	Car.	502 312 00
R 6	330 ohms	5%	1/3W	Car.	501 233 00
R 7	5.6 kohms	5%	1/3W	Car.	501 356 00
R 8	330 ohms	5%	1/3W	Car.	501 233 00
R 9	0.47ohm	5%	5W	WW	527 004 70
R12	330 ohms	5%	1/3W	Car.	501 233 00
R13	390 ohms	5%	1/3W	Car.	501 239 00
R14-15	100 ohms	5%	1/3W	Car.	501 210 00
R16	10 ohms	5%	1/3W	Car.	501 110 00
R17	4.7 kohms	5%	1/3W	Car.	501 347 00
R18	180 ohms	5%	1/2W	Car.	502 218 00
254TR1 -2	BC547B				840 054 70

PARTS LIST

FOR

260C 1- 2	0.1 uF	-10/+10%	250V	Polyes.	624 510 00
C 3	2.2 uF	-10/+10%	250V	Polyes.	624 622 00
C 4	1000 uF		40V	W.alum.	652 910 01
C 5	1 uF	-10/+10%	250V	Polyes.	624 610 00
C 6- 7	0.1 uF	-10/+10%	100V	Polyes.	623 510 00
C 8	1 uF	-10/+10%	250V	Polyes.	624 610 00
C 9	4700 uF		40V	W.alum.	652 947 02
C10	2.2 uF	-10/+10%	250V	Polyes.	624 622 00
C11	1 uF	-10/+10%	250V	Polyes.	624 610 00
C12	4.7 nF	-20/+50%	5kV	Cer.	608 347 01
C13	10 nF	-10/+10%	1600V	Polyes.	627 410 00
260D 1	BZX93C33R	Zener			832 933 30
260FS1	8 A	FAST	6.3x32mm		720 380 00
FS2	40 A	FAST	7x32mm		720 440 00
FS3	3.15 A	FAST	6.3x32mm		720 331 51
FS4- 6	1.6 A	FAST	6.3x32mm		720 316 01
FS7	0.5 A	HT-FUSE	6.3x80mm		720 250 00
FS8	0.1 A	FAST	6.3x32mm		720 210 00
260L 1					374 200 74
260LS1	8 ohms				860 000 02
260PL1	8 Way				751 000 26
PL3	12 Way				751 000 27
260R 1	220 kohms	5%	1W	Car.	504 522 00
R 2	1 kohm	5%	1W	Car.	504 310 00
R 3	27 ohms	5%	5W	WW	527 127 00
R 4- 5	6.8 ohms	5%	14W	WW	528 068 01
R 6- 7	27 ohms	5%	5W	WW	527 127 00
R 8	15 kohms	5%	11W	WW	528 415 00
R 9-10	0,5 ohm	5%	11W	WW	528 005 00
R11-14	1 kohm	5%	1/3W	Car.	501 318 00
R15-16	100 ohms	5%	1/2W	Car.	502 210 00
260RL1		2 MAKE, 24V COIL			780 000 05
260S 1					374 200 21
S 2					764 000 02

PARTS LIST

FOR

260SK 1	12 Way		751 000 30
SK 2	26 Way		751 000 32
SK 3	1 Way		751 000 38 751 000 35
SK 4	4 Way		751 000 37 751 000 35
260T 1			384 200 81
T 2		HT	384 200 14
T 3		LT	384 200 64
260TR 1-2	2N6258		842 625 80
TR 3	2N3771		842 377 10
TR 4	2N6258		842 625 80
TR 5	2N3055		842 305 50
TR 6	2N6258		842 625 80
TR 7	BD234-10		842 023 40
TR 8	2N6258		842 625 80
TR 9	2N3055		842 305 50
TR 10-12	2N6258		842 625 80
TR 13	BD234-10		842 023 40
TR 14	2N3055		842 305 50

PARTS LIST

FOR

261C 1	47 nF	10%	250V	Polyes.	624 447 00
C 2	0.1 uF	10%	250V	Polyes.	624 510 00
C 3	47 nF	10%	250V	Polyes.	624 447 00
C 4	0.1 uF	10%	250V	Polyes.	624 510 00
C 5- 6	47 nF	10%	250V	Polyes.	624 447 00
C 7- 8	0.1 uF	10%	250V	Polyes.	624 510 00
C 9-10	4700 uF		25V	W.alum.	652 947 01
C11	0.47 uF	10%	100V	Polyes.	623 547 00
C12-13	100 uF		25V	W.alum.	652 810 00
C14	10 nF	-20/+80%	32V	Cer.	602 410 00
C15-16	0.1 uF	10%	250V	Polyes.	624 510 00
C17	2200 uF		40V	W.alum.	652 922 00
C18	100 uF		25V	W.alum.	652 810 00

261D 1	10D05		831 100 51
D 2	1S920		830 192 00
D 3	10D2		831 102 00
D 4- 7	1S920		830 192 00
D 8	10D2		831 102 00
D 9-10	1S920		830 192 00
D11-12	21PT5		831 021 50
D13-14	BZX79B6V8	Zener	832 796 81
D15	1S920		830 192 00
D16-17	1N5401		831 540 10
D18-19	1S920		830 192 00
D20	BZX79B7V5	Zener	832 797 50
D21	1S920		830 192 00
D22	BZX79B7V5	Zener	832 797 50

261IC1	555	850 055 50

261R 1	56 kohms	5%	1/3W	Car.	501 456 00
R 2	10 kohms	5%	1/3W	Car.	501 410 00
R 3	12 ohms	5%	3/4W	Car.	503 112 00
R 4	2.7 kohms	5%	1/3W	Car.	501 327 00
R 5	330 ohms	5%	1/2W	Car.	502 233 00
R 6	470 ohms	5%	1/3W	Car.	501 247 00
R 7	100 ohms	5%	1/3W	Car.	501 210 00
R 8	680 ohms	5%	3W	WW	526 268 00
R 9	10 kohms	5%	1/3W	Car.	501 410 00
R10	100 ohms	5%	1/3W	Car.	501 210 00

PARTS LIST

FOR

261R11	470 ohms	5%	1/3W	Car.	501 247 00
R12	4.7 kohms	5%	1/3W	Car.	501 347 00
R13	1 kohm	5%	1/3W	Car.	501 310 00
R14	2.2 kohms	5%	1/3W	Car.	501 322 00
R15	4.7 kohms	5%	1/3W	Car.	501 347 00
R16	680 ohms	5%	3W	WW	526 268 00
R17	10 kohms	5%	1/3W	Car.	501 410 00
R18	330 ohms	5%	1/2W	Car.	502 233 00
R19	82 ohms	5%	3W	WW	526 182 00
R20	68 ohms	5%	1/2W	Car.	502 168 00
R21-22	33 ohms	5%	1/3W	Car.	501 133 00
R23	68 ohms	5%	1/3W	Car.	501 168 00
R24	120 ohms	5%	1/2W	Car.	502 212 00
R25	68 ohms	5%	1/3W	Car.	501 168 00
R26	47 kohms	5%	1/3W	Car.	501 447 00
R27	4.7 kohms	5%	1/3W	Car.	501 347 00
R28	39 ohms	5%	1/3W	Car.	501 139 00
R29	100 ohms	5%	1W	Car.	504 210 00
R30	10 ohms	5%	1/2W	Car.	502 110 00

261RL1		3 Change over, 16V Coil	780 000 24

261TR1	D44C10	842 441 00
TR2	BC547B	840 054 70
TR3	D44C10	842 441 00
TR4	BC547B	840 054 70
TR5	BC337-25	840 033 70
TR6	BD135-10	842 013 50
TR7	BC337-25	840 033 70
TR8	BC547B	840 054 70
TR9	BD135-25	842 013 50

FOR

262C 1	470 uF		40V	W.alum.	652 847 00
C 2- 7	22 uF		450V	W.alum.	655 722 00
262D 1- 4	21PT5				831 021 50
D 5-28	1N5408				831 101 00
D29	IS920				830 192 00
D30	10D05				831 100 51
262R 1- 4	100 ohms	5%	1/2W	Car.	502 210 00
R 5-10	100 kohms	5%	2W	Car.	505 510 00
R11	150 ohms	5%	1/3W	Car.	501 215 00
R12	150 ohms	5%	2W	Car.	505 215 00
R13	68 ohms	5%	1W	Car.	504 168 00
262RL1-3		1 Make, 12V Coil			780 000 19

PARTS LIST

FOR

263

263C 1	22 uF		16V	Tan.	651 722 00
C 2- 3	0.1 uF	10%	250V	Polyes.	624 510 00
C 4	1.0 uF	10%	100V	Polyes.	623 610 00
C 5	10 nF	10%	250V	Polyes.	624 410 00
C 6	2200 uF		63V	W.alum.	652 922 01
C 7	1.0 uF	10%	250V	Polyes.	624 610 01
C 8	0.1 uF	10%	250V	Polyes.	624 510 00
C 9-10	47 nF	10%	250V	Polyes.	624 447 00
C11	470 uF		40V	W.alum.	652 847 00
263D 1- 2	1N5402				831 540 20
D 3- 6	10D10				831 101 00
D 7- 9	1S920				830 192 00
D10-12	BZX87C47	Zener			832 874 70
D13-14	1S920				830 192 00
D15-17	BZX79B9V1	Zener			832 799 10
D18	BZX79B8V2	"			832 798 20
263IC1	555				850 055 50
263R 1	1.5 Mohms	5%	1/2W	Car.	502 615 00
R 2	12 ohms	5%	3/4W	Car.	503 112 00
R 3	4.7 kohms	5%	1/3W	Car.	501 347 00
R 4	2.7 kohms	5%	1/3W	Car.	501 327 00
R 5	270 kohms	5%	1/3W	Car.	501 527 00
R 6	27 ohms	5%	1/3W	Car.	501 127 00
R 7	10 ohms	5%	1/2W	Car.	502 110 00
R 8	4.7 kohms	5%	1/3W	Car.	501 347 00
R 9	150 ohms	5%	5W	WW	527 215 00
R10	100 ohms	5%	1/2W	Car.	502 210 00
R11	10 kohms	5%	2W	Car.	505 410 00
R12	4.7 kohms	5%	1/3W	Car.	501 347 00
R13	150 ohms	5%	1W	Car.	504 215 00
R14	68 ohms	5%	1/3W	Car.	501 168 00
R15	4.7 kohms	5%	1/3W	Car.	501 347 00
R16	150 ohms	5%	5W	WW	527 215 00
R17	100 ohms	5%	1/2W	Car.	502 210 00
R18	10 kohms	5%	1/3W	Car.	501 410 00
R19	100 ohms	5%	1/3W	Car.	501 210 00
R20	10 kohms	5%	1/3W	Car.	501 410 00
R21	1 kohms	5%	1/3W	Car.	501 310 00
263TR1	2N6027	PUT			844 602 70
TR2	BC337-25				840 033 70
TR3	BD135-10				842 013 50
TR4	BC337-25				840 033 70

FOR

264C 1- 2	470 uF		40V	W.alum.	652 847 00
C 3	22 uF		16V	Tan.	651 722 00
C 4	100 uF		16V	W.alum.	651 810 00
264D 1	IN5401				831 540 10
D 2	BZX79B12	Zener			832 791 20
D 3	IS920				830 192 00
264L 1- 2	25 uH	RF Choke			740 125 00
264R 1	23.2 kohms	1%	0.4W	MF	511 423 72
R 2	6.81 kohms	1%	0.4W	MF	511 368 10
R 3	1.2 kohms	5%	1/2W	Car.	501 312 00
R 4	220 ohms	5%	1/3W	Car.	501 222 00
R 5	1 kohm	5%	1/3W	Car.	501 310 00
R 6	5.76 kohms	1%	0.4W	MF	511 357 60
R 7	6.81 kohms	1%	0.4W	MF	511 368 10
R 8	5.6 kohms	5%	1/3W	Car.	501 356 00
R 9	270 ohms	5%	1W	Car.	504 227 00
R10	10 kohms	5%	1/3W	Car.	501 410 00
264RL1		1 Make, 12V Coil			780 000 19
264TR1- 2	BC547B				840 054 70
TR3	BC557B				840 055 70

PARTS LIST

FOR

265C1-2	47 nF	10%	630V	Polyes.	626 547 01
C3-4	0.47 uF	10%	630V	Polyes.	626 447 01
C5	4.7 nF	-20/+50%	5kV	Cer.	608 347 01
C6	10 nF	-10/+10%	1600V	Polyes.	627 410 00
C7-12	330 uF		350V	W-alum.	654 833 00
C13	47 uF		450V	W.alum.	655 747 00
265D1-2	BYX42-300				831 423 00
265FS1	8A	Slow	6.3 x 32 mm	(220V AC)	720 380 01
FS1	16A	Slow	6.3 x 32 mm	(110V AC)	720 416 00
FS2	3.15A	Fast	6.3 x 32 mm		720 331 51
FS3	1.6A	Fast	6.3 x 32 mm		720 316 01
FS4	0.5A	HT-FUSE	6.3 x 80 mm		720 250 00
FS5	0.5A	Fast	6.3 x 32 mm		720 250 01
FS6-7	1.6A	Fast	6.3 x 32 mm		720 316 01
FS8	8A	Fast	6.3 x 32 mm		720 380 00
265L1					374 212 31
265LS1	8 ohms				860 000 02
265PL1	8 Way				751 000 41
PL2	Not used				
PL3	12 Way				751 000 33
265R1	25 kohms	5%	40W	WW	528 510 00
R2	220 kohms	5%	1W	Car.	504 522 00
R3	6.8 ohms	5%	14W	WW	528 068 01
R4	15 kohms	5%	11W	WW	528 415 00
R5-8	1 kohm	5%	1/3W	Car.	501 310 00

994 210 03

PARTS LIST

FOR

265RL1	Contactor	782 000 01
265S1	Safety	764 000 02
S2	Power	374 200 32
265SK1	12 Way	751 000 30
SK2	26 Way	751 000 32
SK3	1 Way	751 000 35
265T1	LT	384 200 53
T2	HT	384 200 45
265TR1	2N3771	842 377 10
TR2	2N3055	842 305 50
TR3-4	BD234-10	842 023 40
TR5-6	2N3055	842 305 50

994 210 03

PARTS LIST

FOR

266C 2	10 nF	10%	250V	Polyes.	624 410 00
C 3- 4	4700 uF		25V	W.alum.	652 947 00
C 5	0.47 uF	10%	100V	Polyes.	623 547 00
C 6	100 uF		25V	W.alum.	652 810 00
C 7	100 uF		25V	W.alum.	652 810 00
C 8- 9	0.1 uF	10%	250V	Polyes.	624 510 00
C10	100 uF		25V	W.alum.	652 810 00
C11	2200 uF		40V	W.alum.	652 922 00
266D 1- 3	1S920				830 192 00
D 4- 5	BZX79B6V8	Zener			832 796 81
D 6- 7	1S920				830 192 00
D 8- 9	1N5401				831 540 10
D10-11	BZX79B7V5	Zener			832 797 50
266R 1	180 ohms	5%	1W	Car.	504 218 00
R 2	47 kohms	5%	1/3W	Car.	501 447 00
R 3	82 ohms	5%	3W	WW	526 182 00
R 4	120 ohms	5%	1/2W	Car.	502 212 00
R 5	68 ohms	5%	1/2W	Car.	502 168 00
R 6- 7	33 ohms	5%	1/3W	Car.	501 133 00
R 8- 9	68 ohms	5%	1/3W	Car.	501 168 00
R10	4.7 kohms	5%	1/3W	Car.	501 347 00
R11	39 ohms	5%	1/3W	Car.	501 139 00
R12	100 ohms	5%	1W	Car.	504 210 00
R13	10 ohms	5%	1/2W	Car.	502 110 00
R14	330 ohms	5%	1/2W	Car.	502 233 00
266RL1	1 Make 12V Coil				780 000 02
RL2	3 Change over 16V Coil				780 000 24
266TR1	BC547B				840 054 70
TR2	BC337-25				840 033 70
TR3	BD135-10				842 013 50
TR4	BC337-25				840 033 70
TR5	BD135-10				842 013 50

PARTS LIST

FOR

267C1-6	0.1 uF	10%	400V	Polyes.	625 510 00
267D1-24	MR510				831 051 00
D25	1S920				830 192 00
267R1-6	27 ohms	5%	3/4W	Car.	503 127 00
R13	150 ohms	5%	1/3W	Car.	501 215 00
267RL1			1 Make 12V Coil		780 000 19

994 202 83

PARTS LIST

FOR

268C 1- 4	0.1 uF	10%	250V	Polyes.	624 510 00
C 5	22 uF		16V	Tan.	651 722 00
C 6	2200 uF		63V	W.alum.	652 922 01
C 7	2200 uF		40V	W.alum.	652 922 00
C 8	1 uF	10%	250V	Polyes.	624 610 00
C 9	10 nF	10%	250V	Polyes.	624 410 00
C10	470 uF		40V	W.alum.	652 847 00
268D 1- 2	1N5402				831 540 20
D 3- 4	10D10				831 101 00
D 5- 6	21PT5				831 021 50
D 7- 8	10D10				831 101 00
D 9-11	1S920				830 192 00
D12-14	BZX87C47	Zener			832 874 70
D15	1S920				830 192 00
D16-18	BZX79B9V1	Z ener			832 799 10
268IC1	555				850 055 50
268R 1	1.5 Mohms	5%	1/2W	Car.	502 615 00
R 2	10 ohms	5%	1/2W	Car.	502 110 00
R 3	4.7 kohms	5%	1/3W	Car.	501 347 00
R 4	10 kohms	5%	2W	Car.	505 410 00
R 5	150 ohms	5%	1W	Car.	504 215 00
R 6	68 ohms	5%	1/3W	Car.	501 168 00
268RL1			1 Make 24V Coil		780 000 22
268TR1	BD135-10				842 013 50

PARTS LIST

FOR

TRP 5000 Cabinet Wiring

Interconnections between units

PL1	1 Way				751 000 40 751 000 36
PL2	26 Ways				751 000 32
PL3	BNC				371 000 24
PL4	1 Way				751 000 40 751 000 36
PL5	BNC				371 200 24
PL6-7	BNC				371 200 13
R1	10 ohms	10%	1W	WW	523 110 00
R2	27 ohms	5%	5W	WW	527 127 00
S1	Toggle switch with plastic cap				762 000 13 762 000 12
SK1	12 Ways				751 000 30
SK2	26 Ways				751 000 75
SK3	20 Ways				751 000 31
SK4	12 Ways				751 000 30
SL1-4		24-30V	2W	E10	821 000 08

PARTS

FOR

TRP 5000 Cabinet Wiring
Terminal Strip A

PL 1	BNC	371 200 31
PL 2	4 Ways	751 000 39 751 000 36
SK1	UHF	750 000 01
SK2	8 Ways	751 000 29
TS1	2 Ways	770 000 04
TS2	6 Ways	770 000 04
TS3	3 Ways	770 000 14
TS4	2 Ways	770 000 09

PARTS LIST

FOR

P5000 / P5001

OUTPUT TERMINAL STRIP B

PL 1	12 Ways	751 000 33
TS 1	16 Ways	770 000 04

PARTS LIST

FOR

E 5000 / E 5001

Input terminal Strip C

Optional

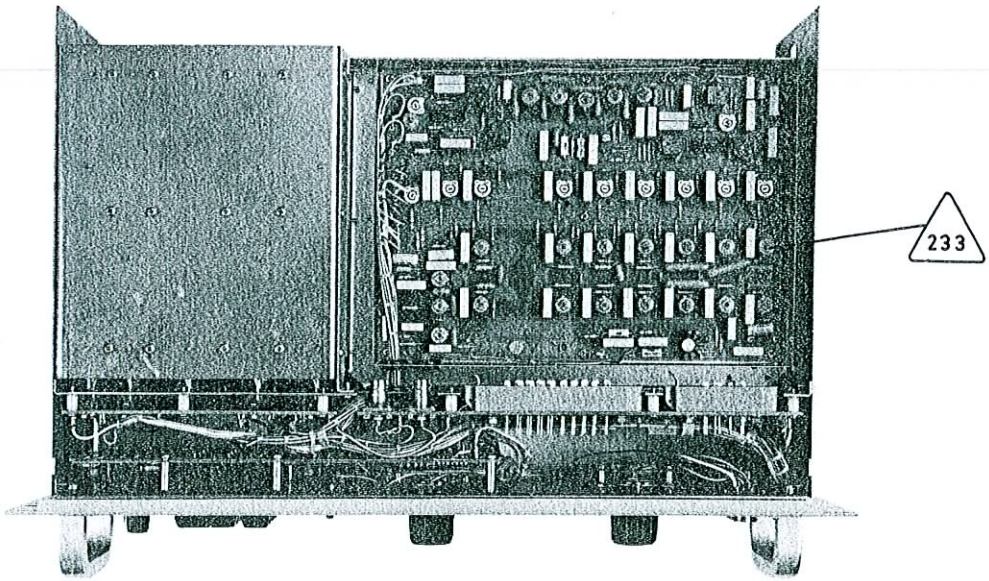
SK1	8 Ways	751 000 29
TS1	16 Ways	770 000 04

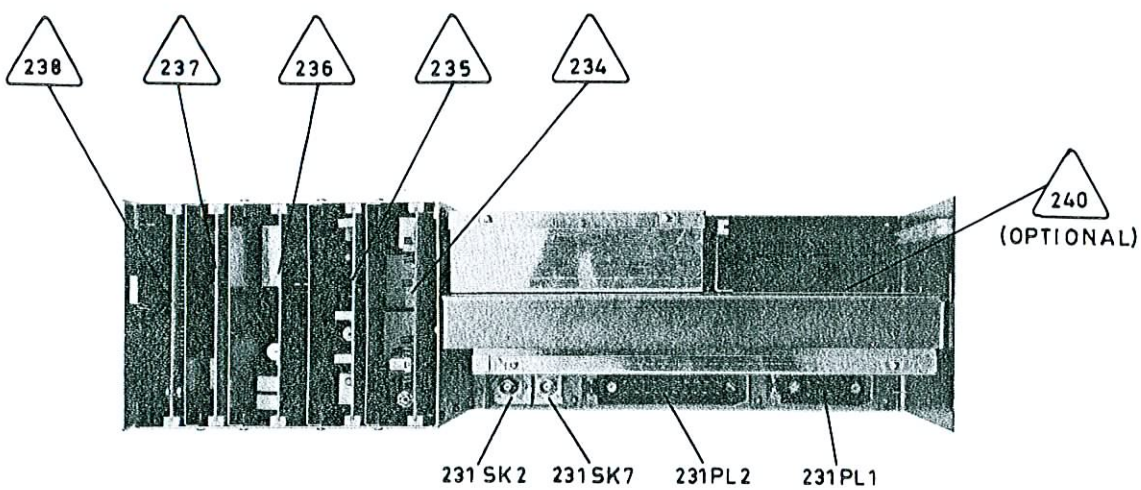
PARTS LIST

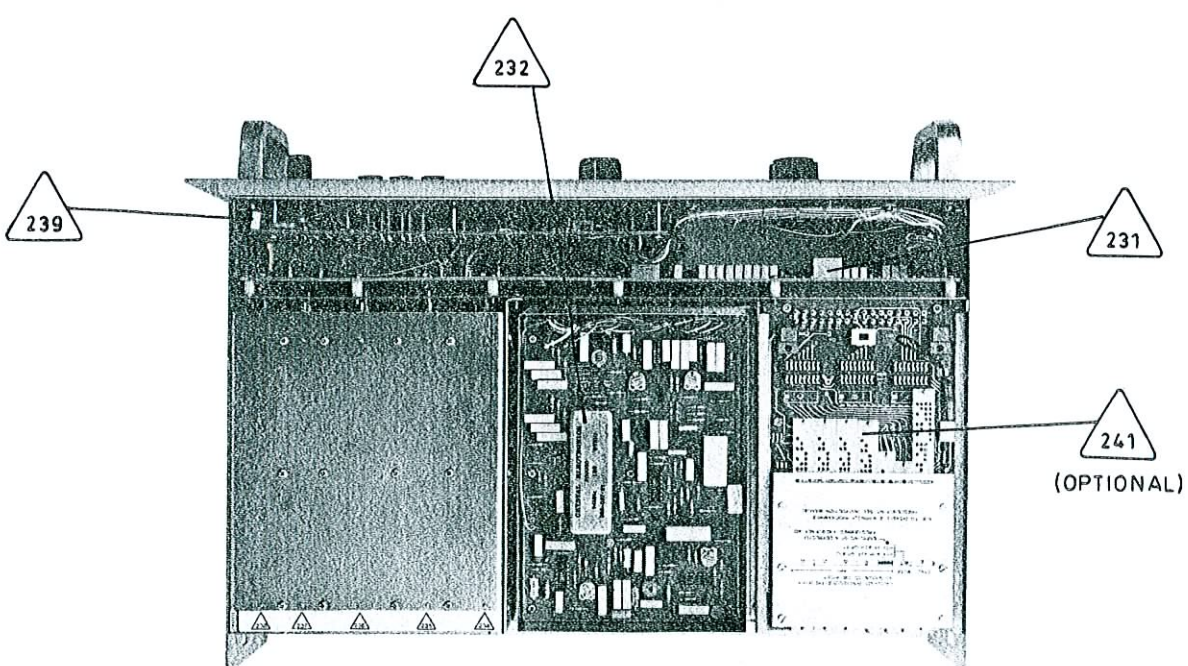
FOR

T 5000
Output terminal Strip D
Optional

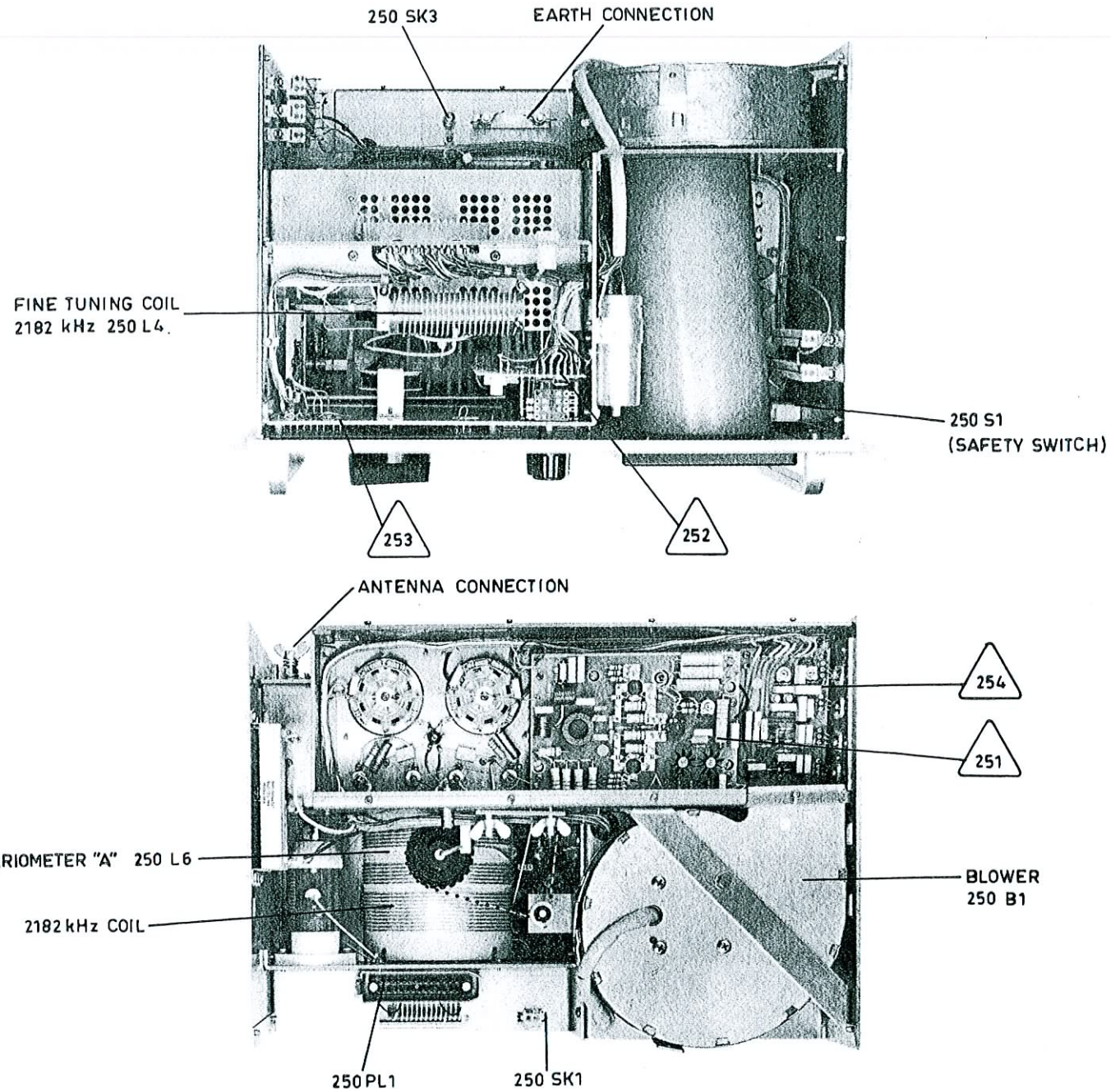
PL 1	20 Ways	751 000 34
TS 1	20 Ways	770 000 04



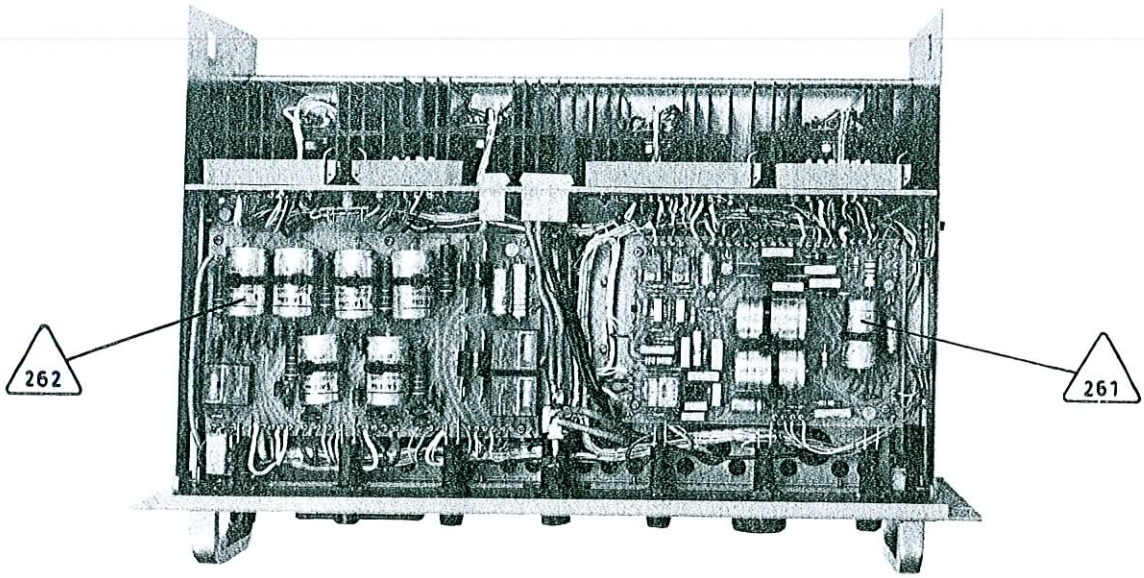


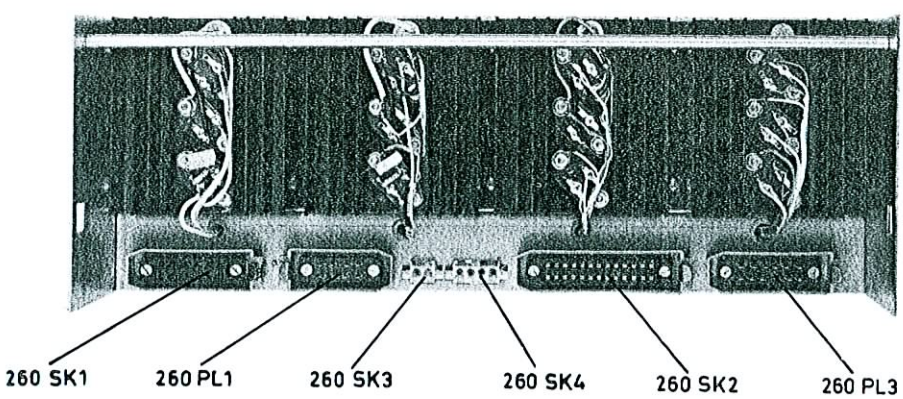


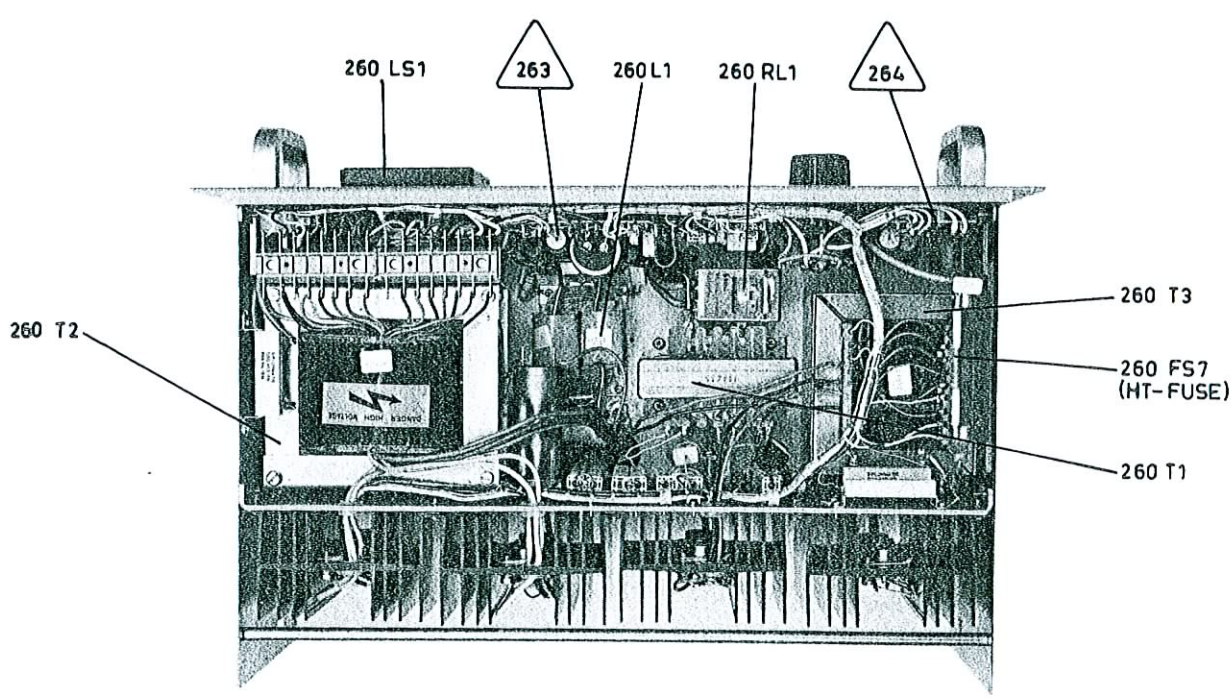
LOCATION OF CIRCUIT BOARDS
EXCITER E5000



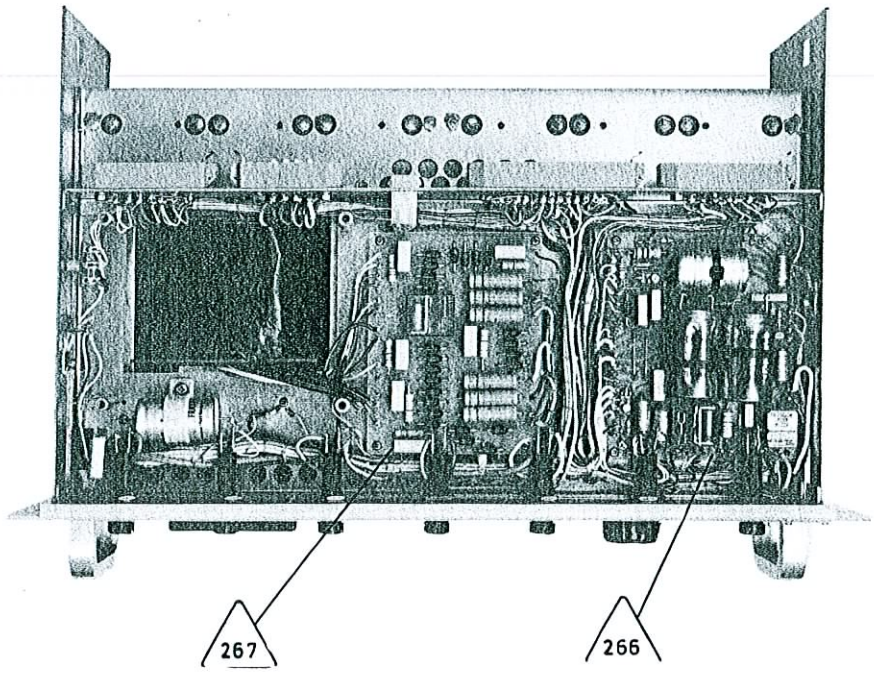
LOCATION OF CIRCUIT BOARDS
TRANSMITTER POWER AMPLIFIER T5000

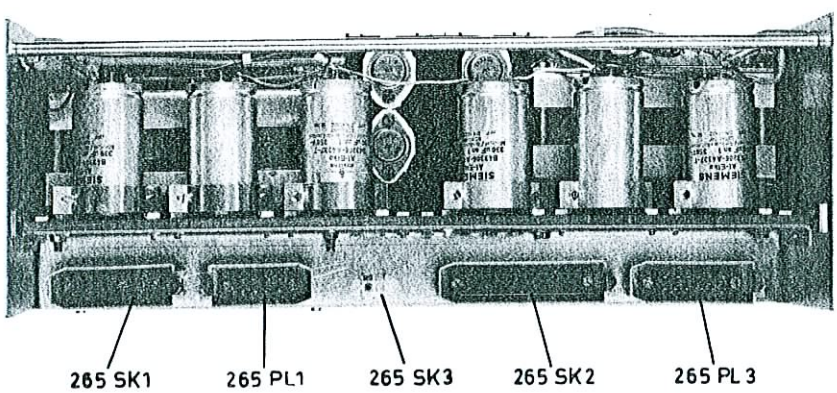


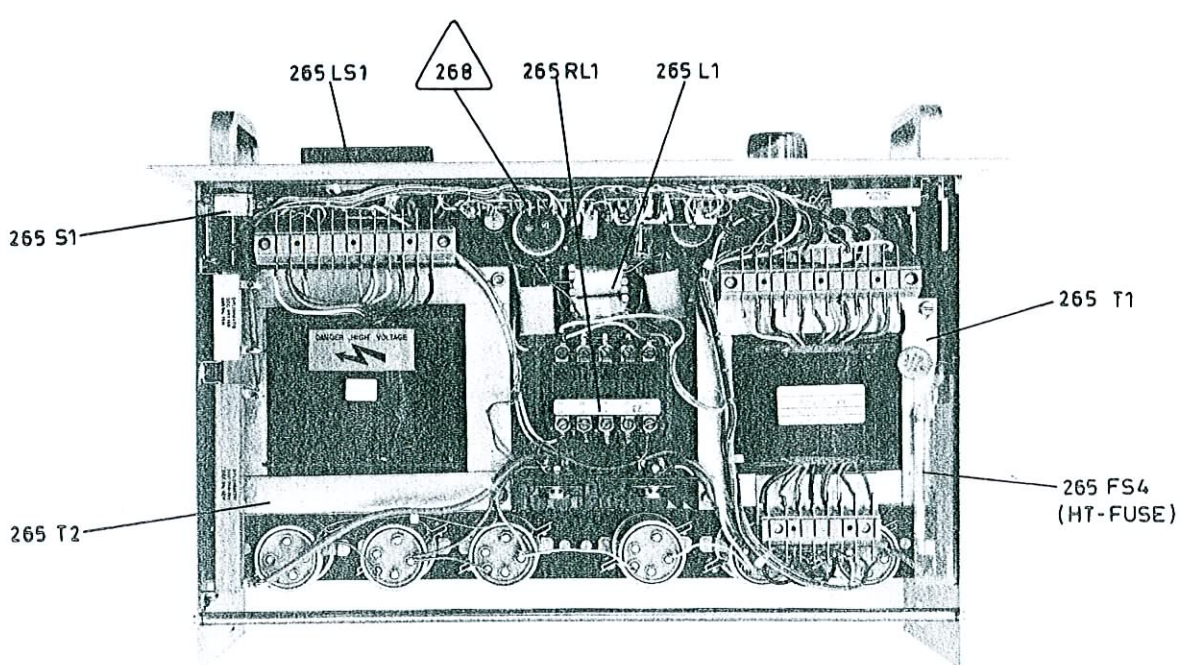




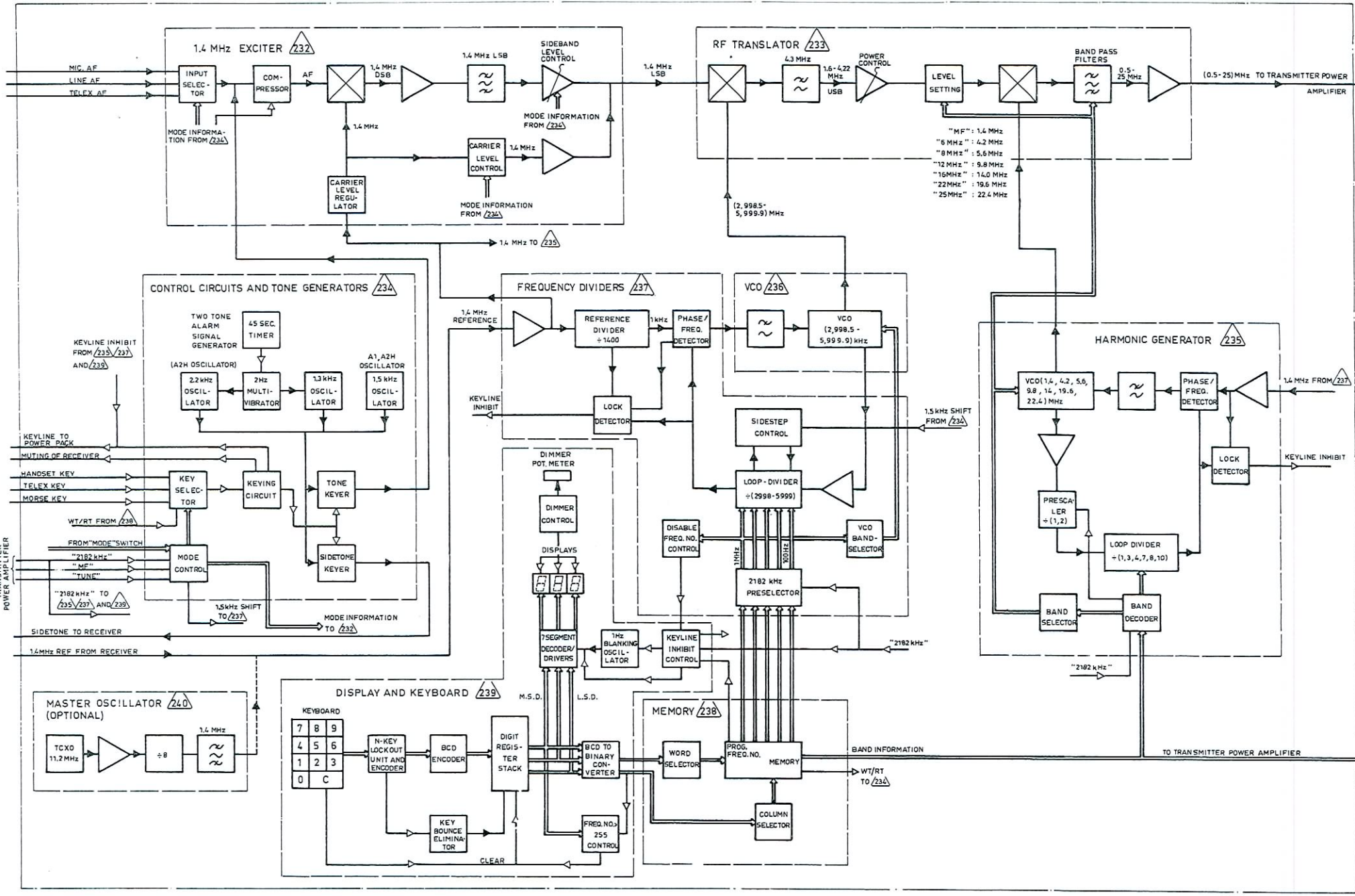
LOCATION OF CIRCUIT BOARDS
24V DC POWER PACK P5000





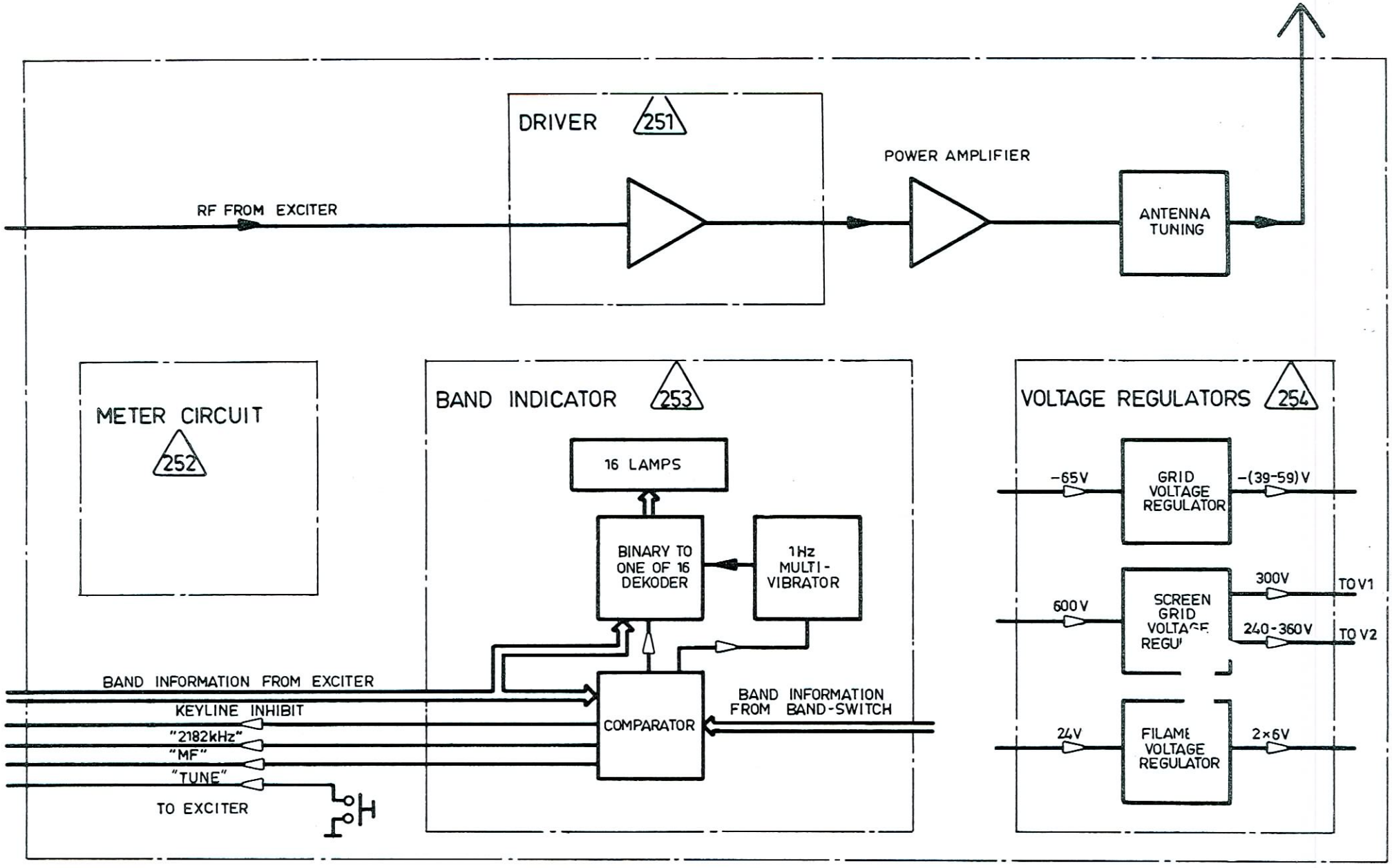


LOCATION OF CIRCUIT BOARDS
AC POWER PACK P5001

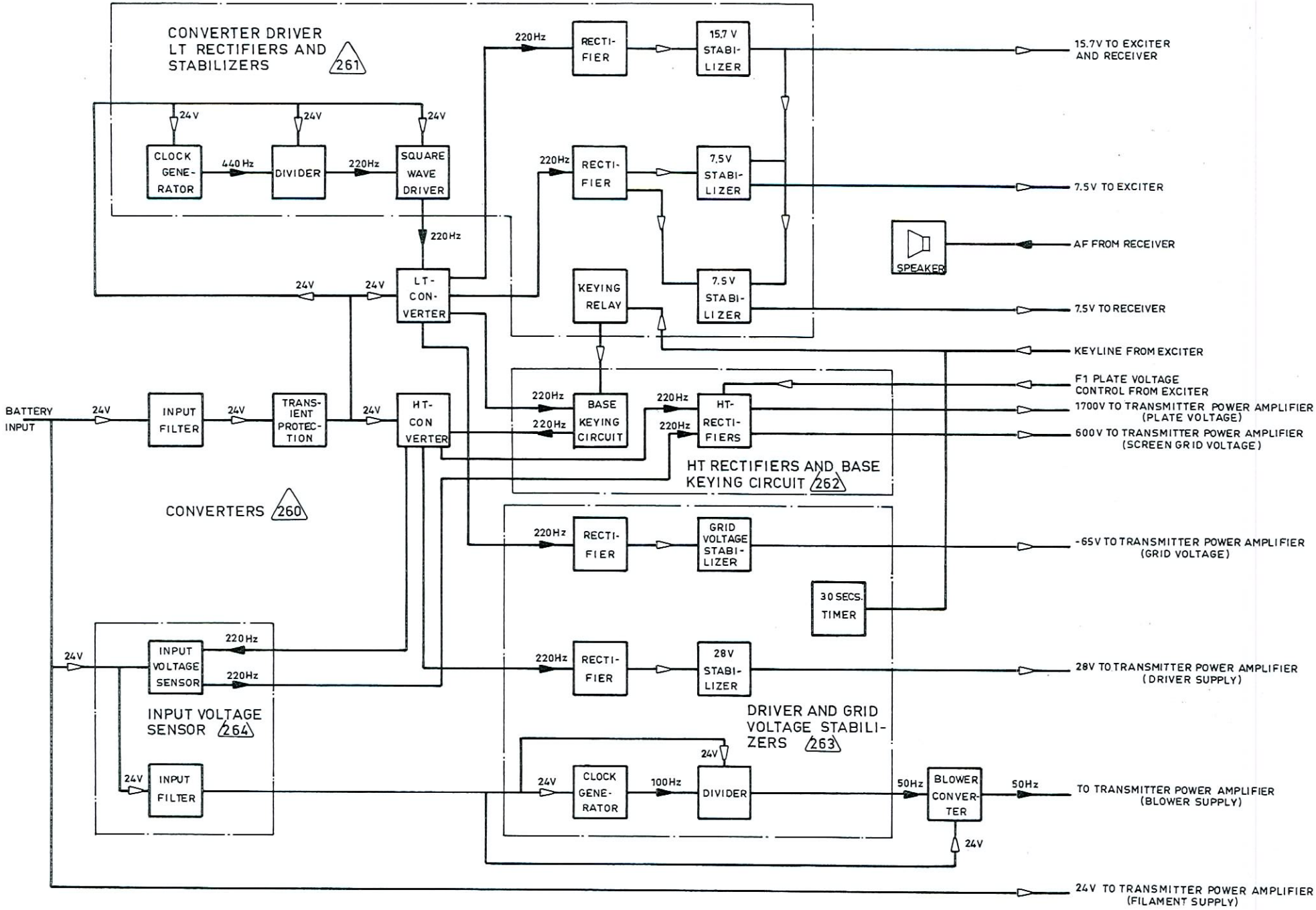


992 224 92

BLOCK DIAGRAM, EXCITER E5000

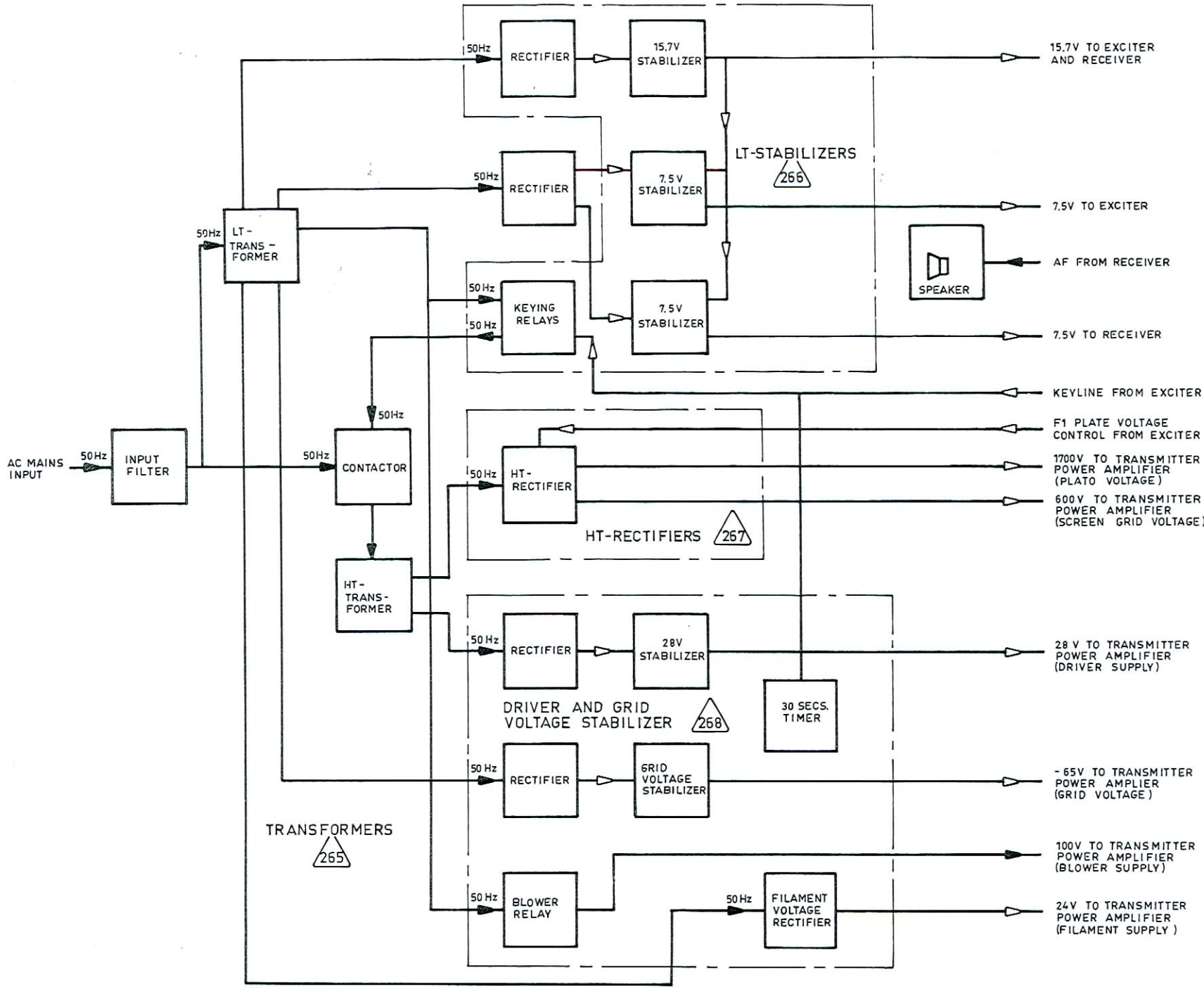


BLOCK DIAGRAM T5000 TRANSMITTER POWER AMPLIFIER

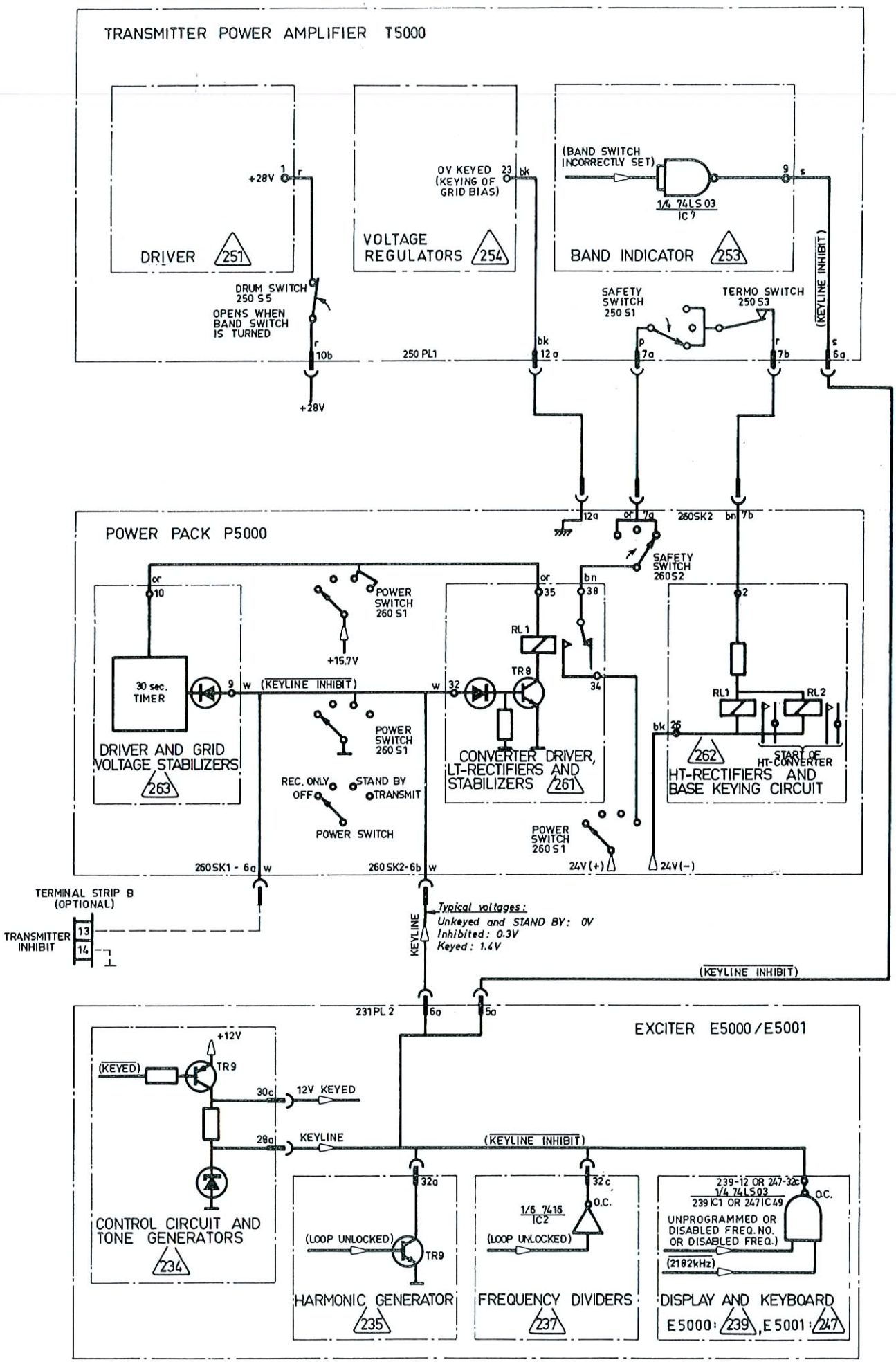


994 210 11

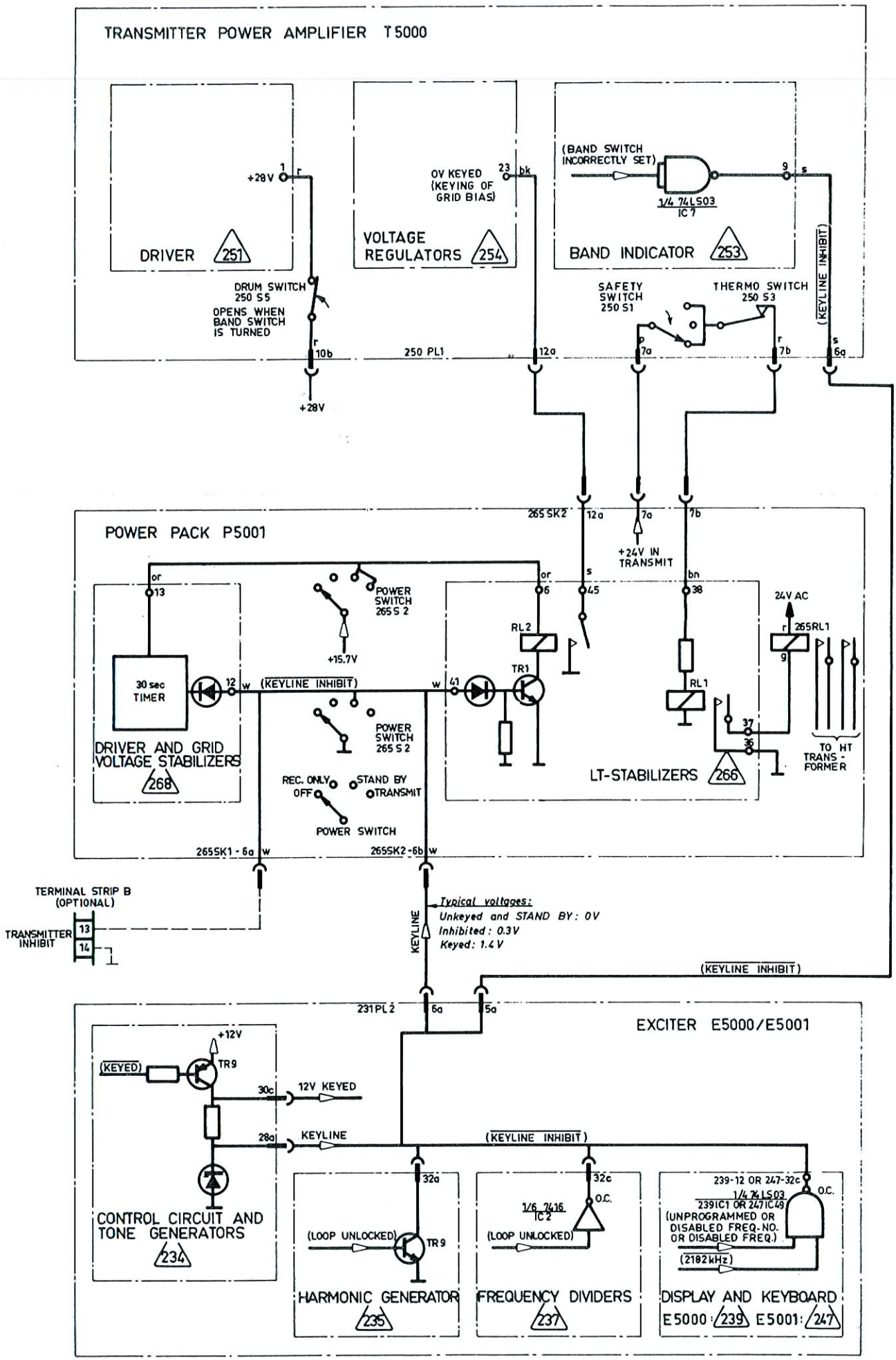
BLOCK DIAGRAM P5000, 24 V DC POWERPACK



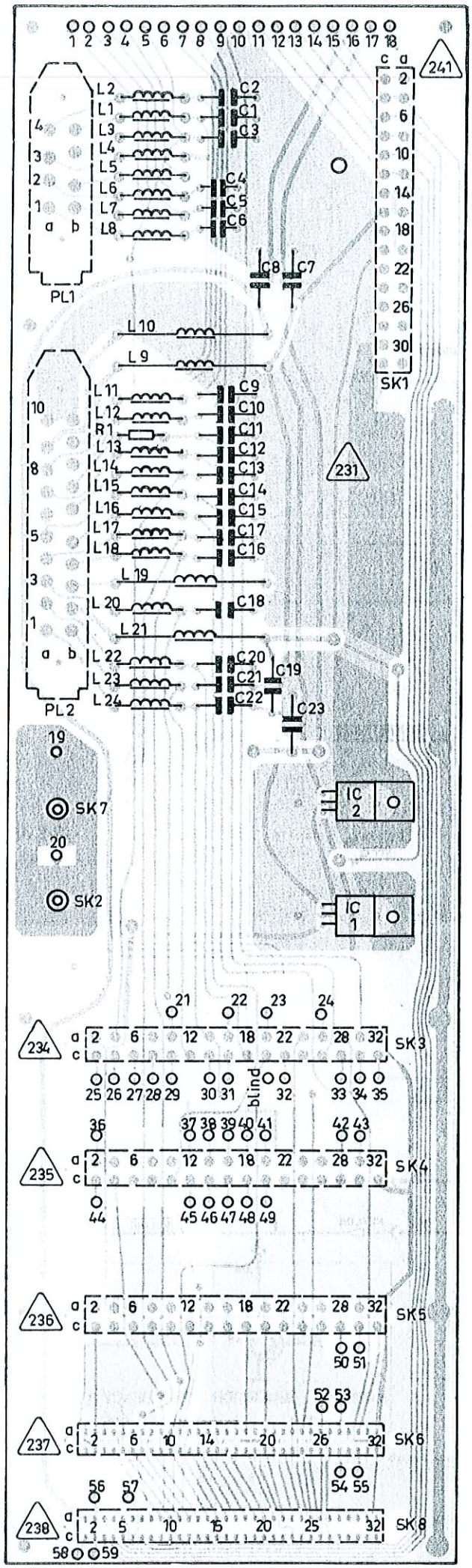
BLOCK DIAGRAM P5001, AC MAINS POWER PACK



KEYING CIRCUIT, SIMPLIFIED DIAGRAM
TRP 5000 INCORPORATING DC POWER PACK P 5000

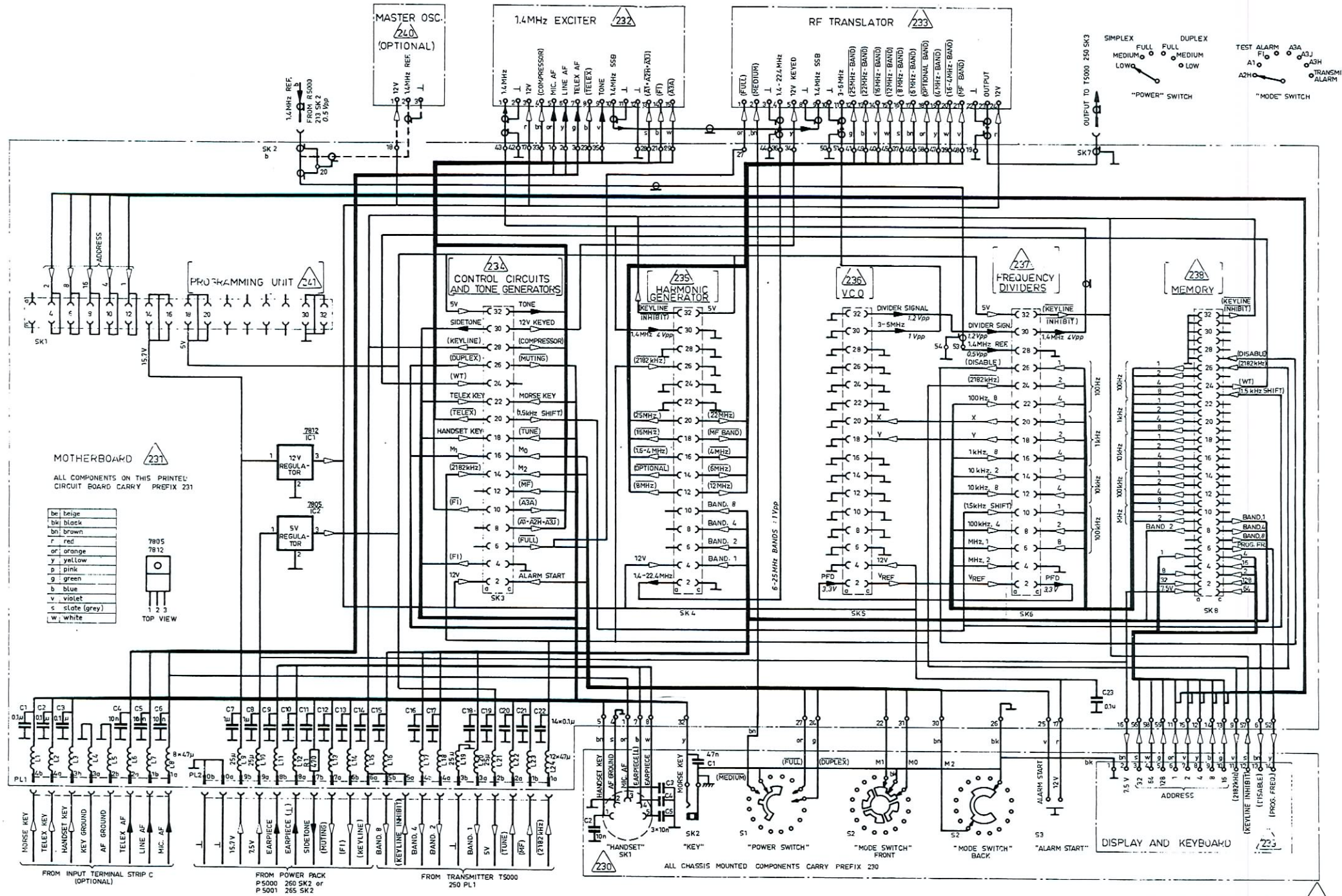


KEYING CIRCUIT, SIMPLIFIED DIAGRAM
TRP 5000 INCORPORATING AC POWER PACK P5001



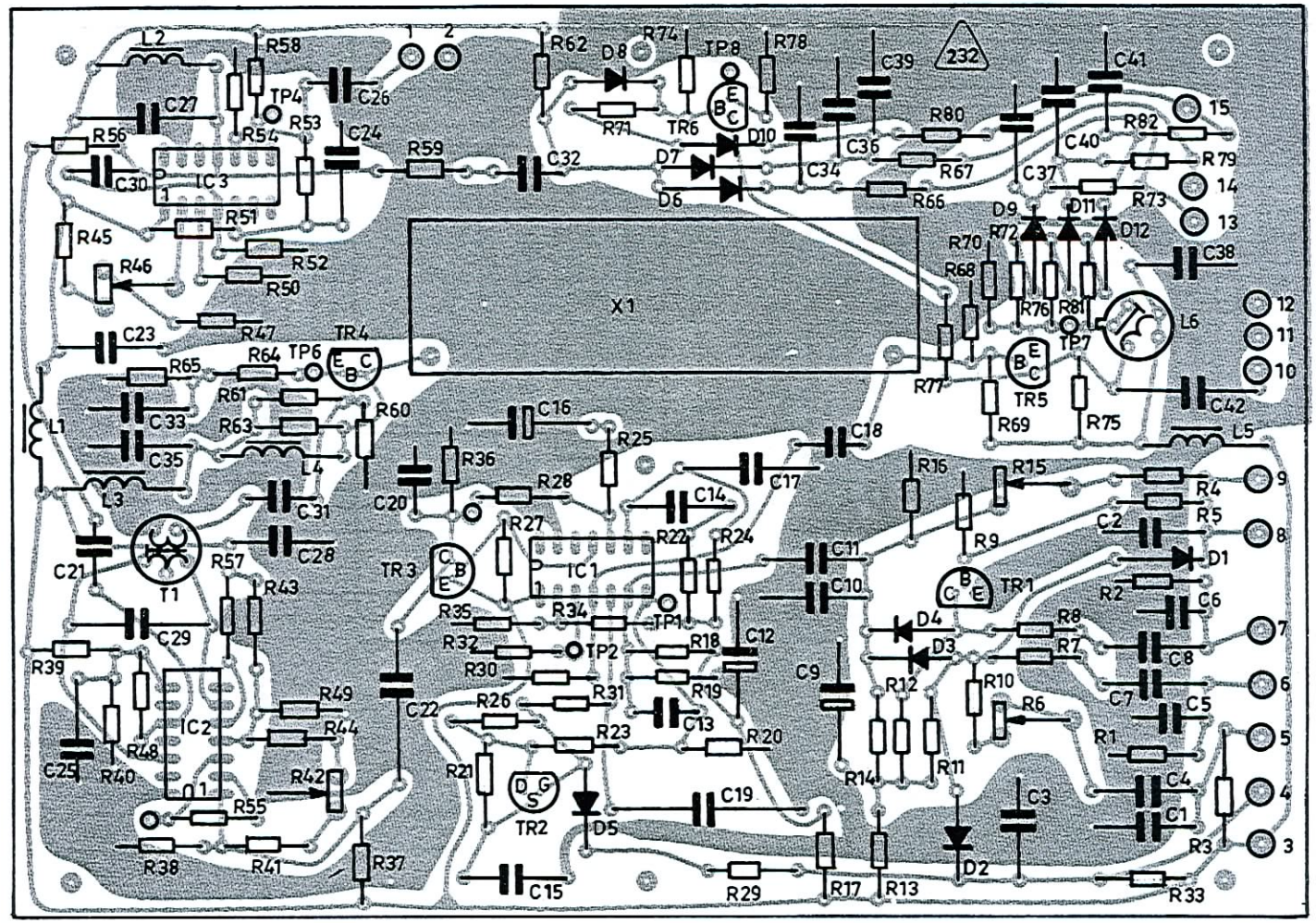
PRINTED CIRCUIT BOARD 231
VIEWED FROM COMPONENT SI

992 207 41

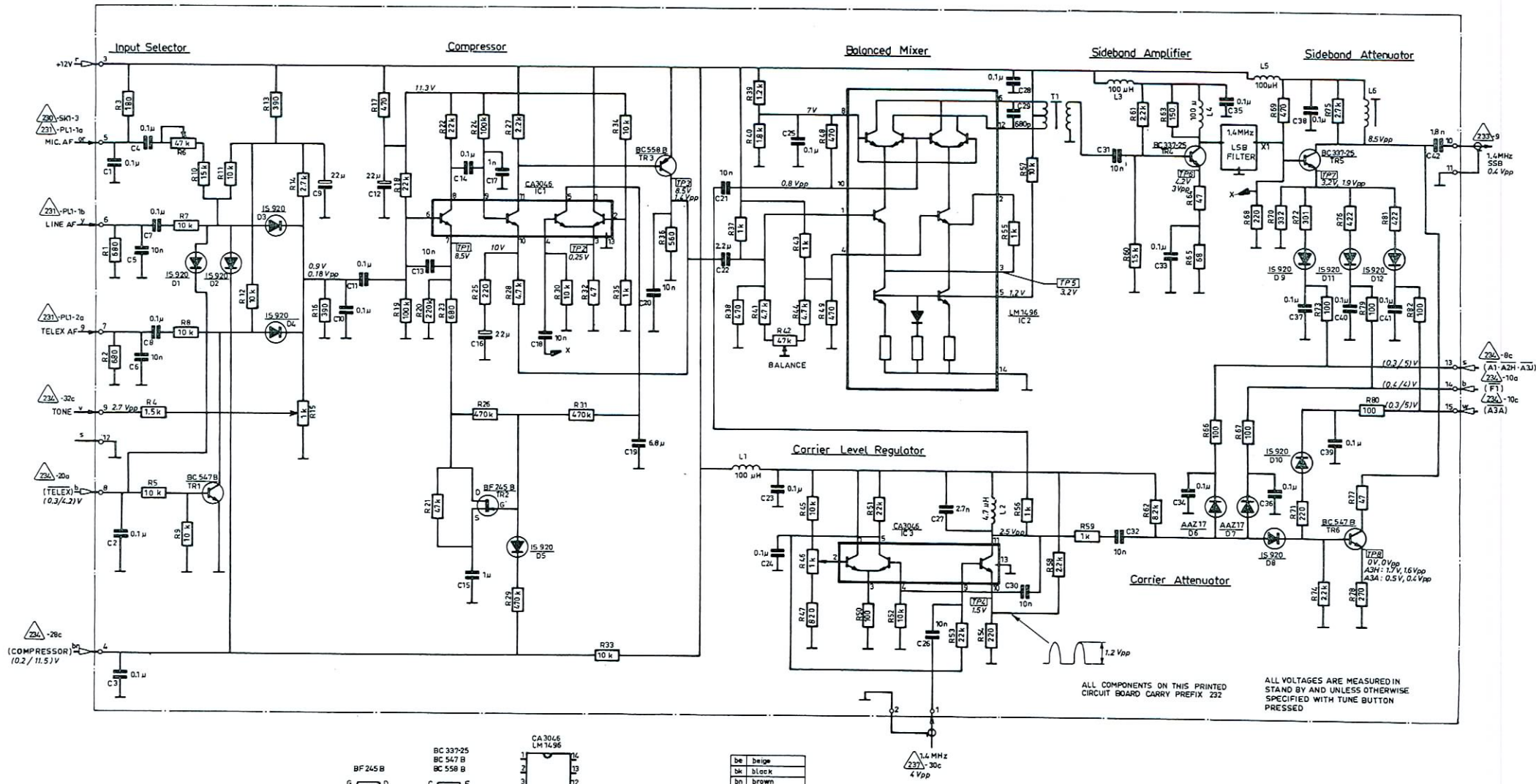


MOTHERBOARD 231

E5000 WIRING DIAGRAM 230

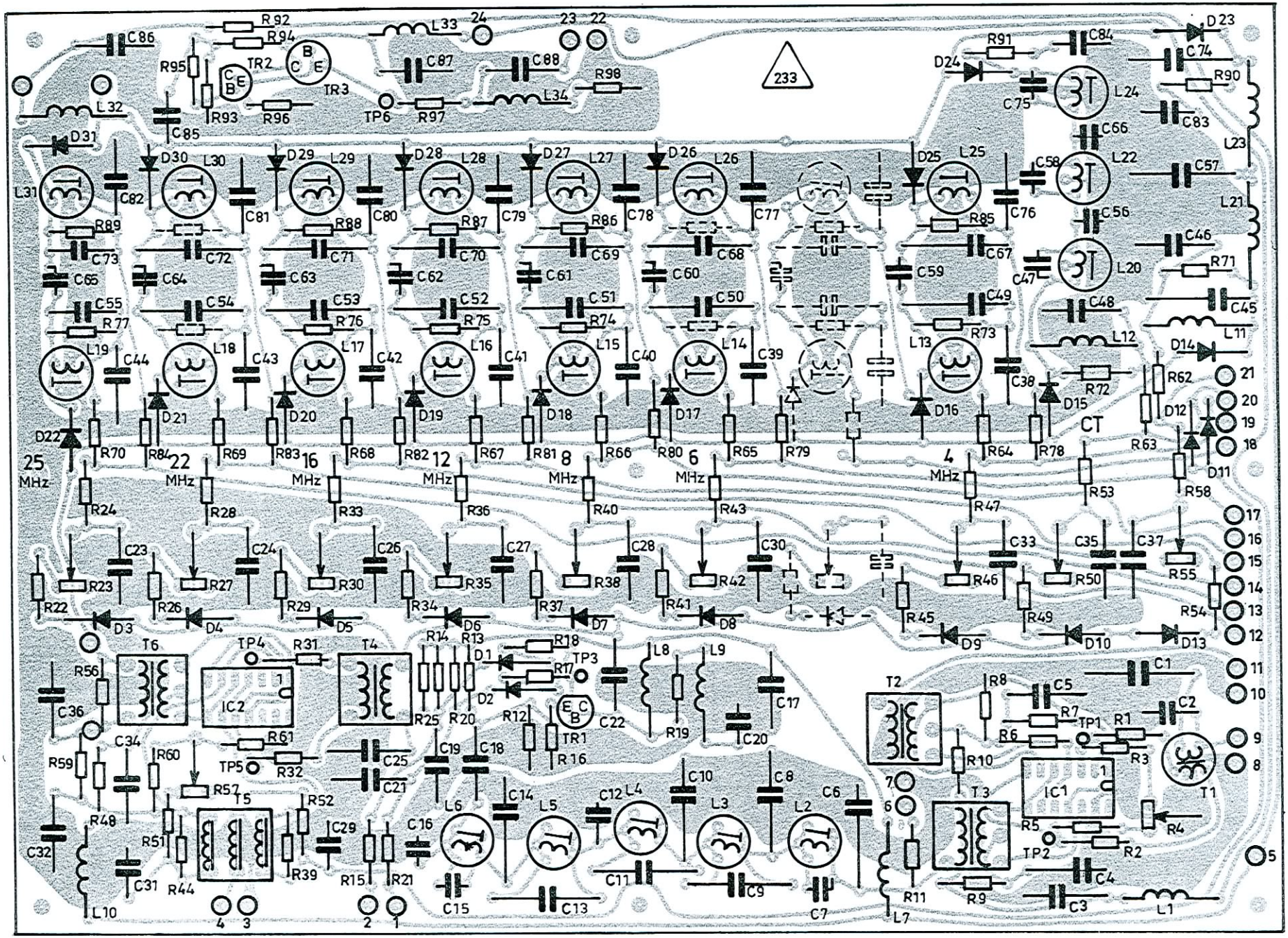


PRINTED CIRCUIT BOARD 232
VIEWED FROM COMPONENT SIDE

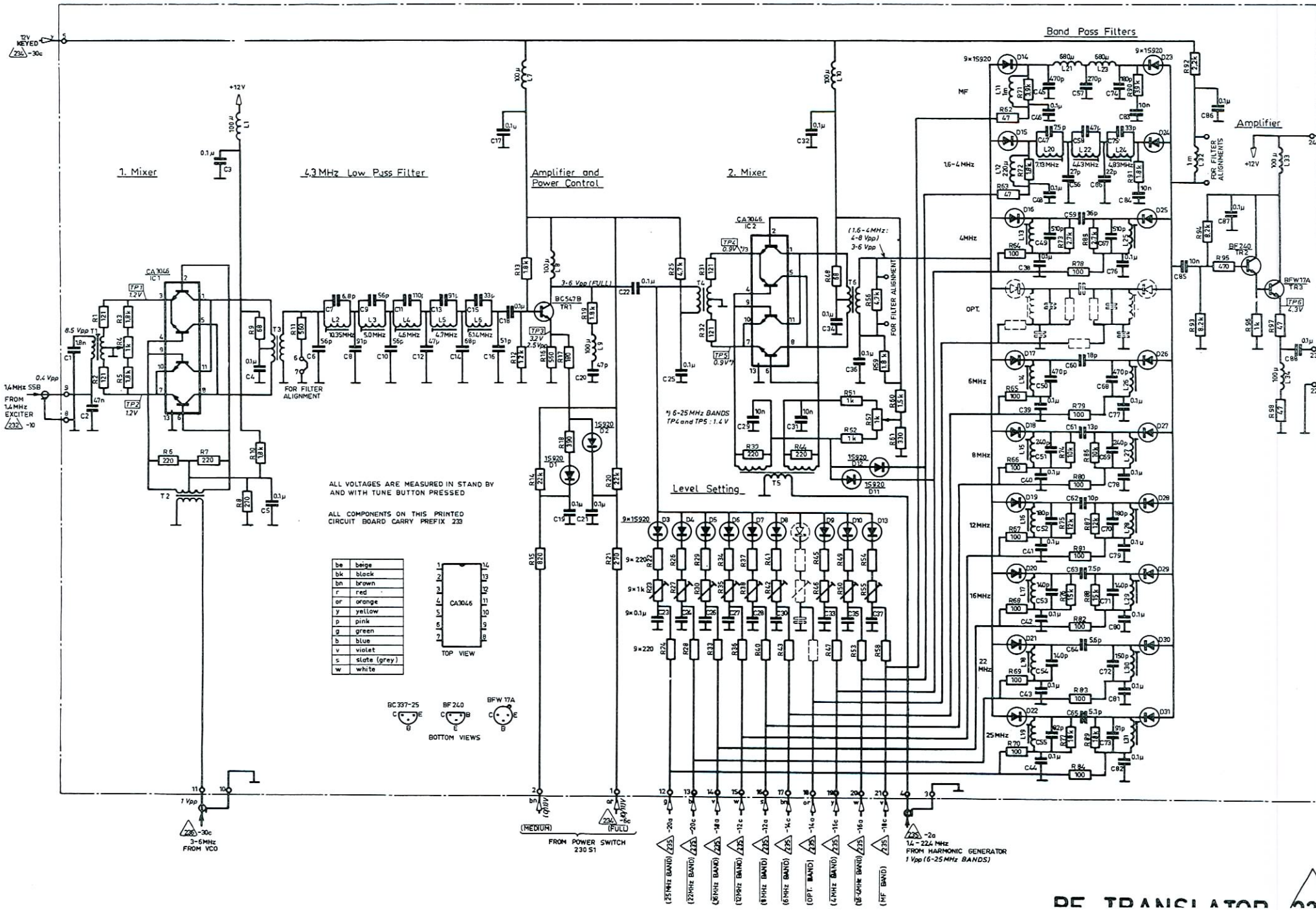


992 201 8③

1.4 MHz EXCITER 232

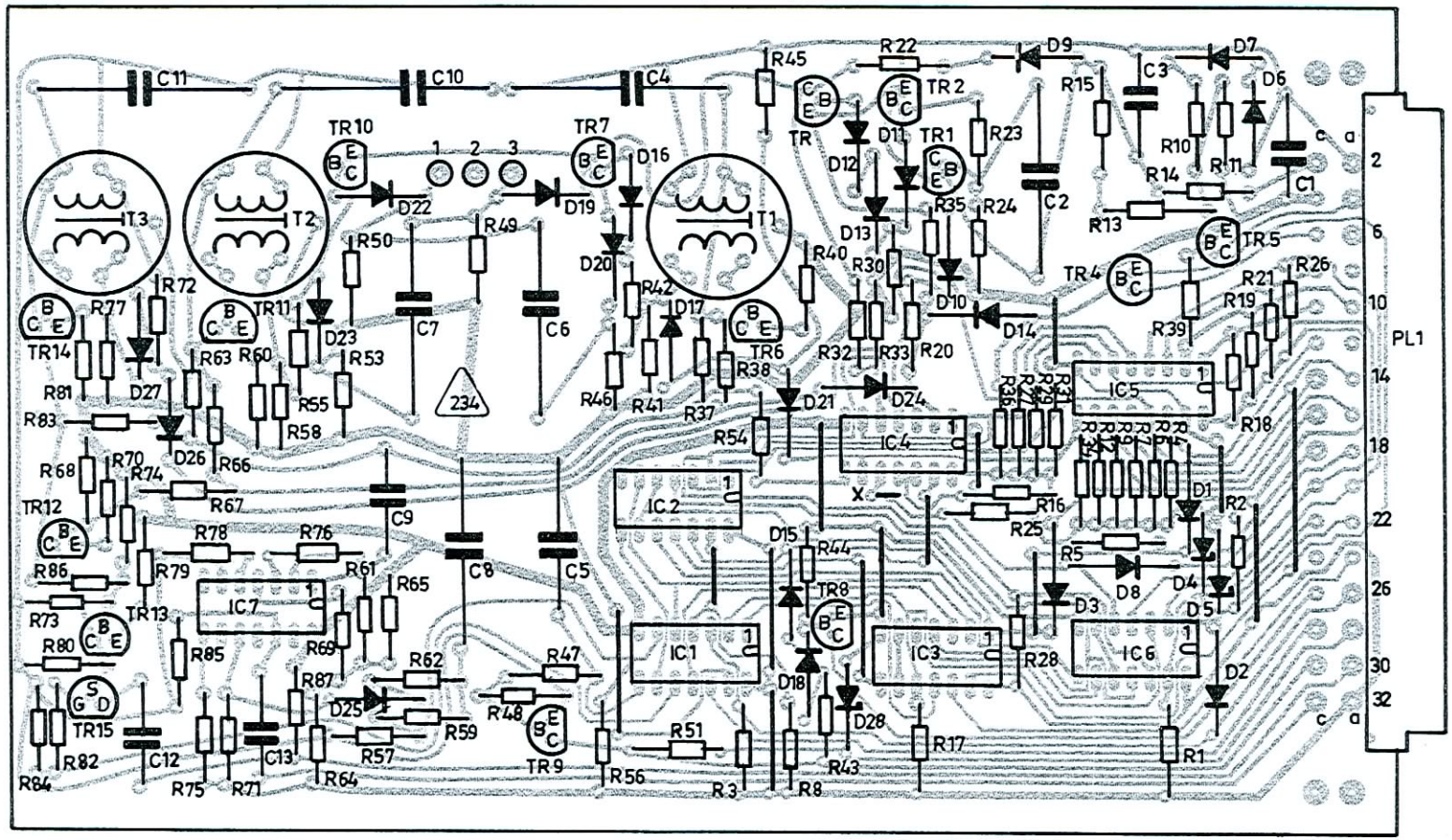


PRINTED CIRCUIT BOARD 233



be	beige
bk	black
bn	brown
r	red
or	orange
y	yellow
p	pink
g	green
b	blue
v	violet
s	slate (grey)
w	white

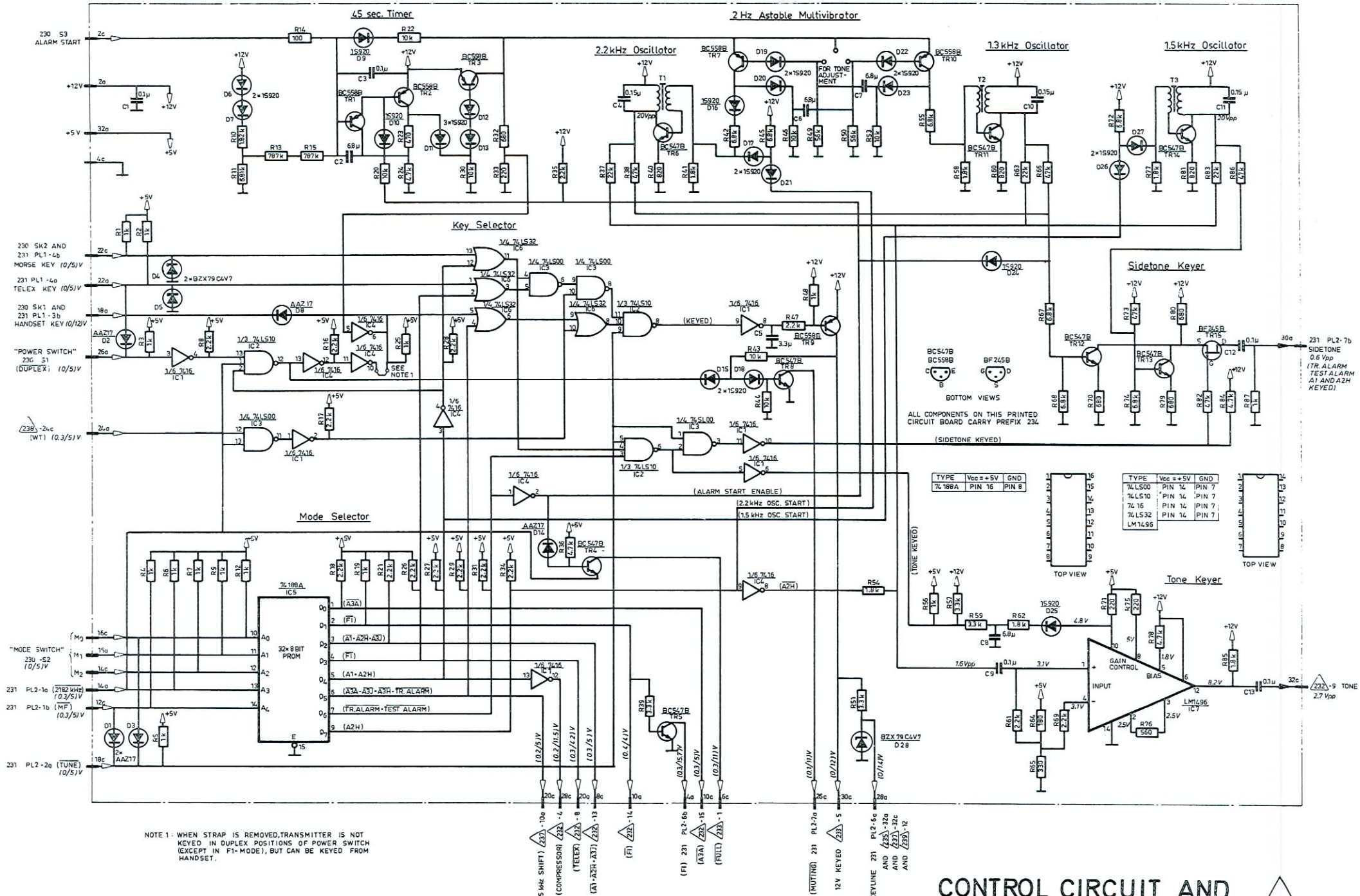
RF TRANSLATOR

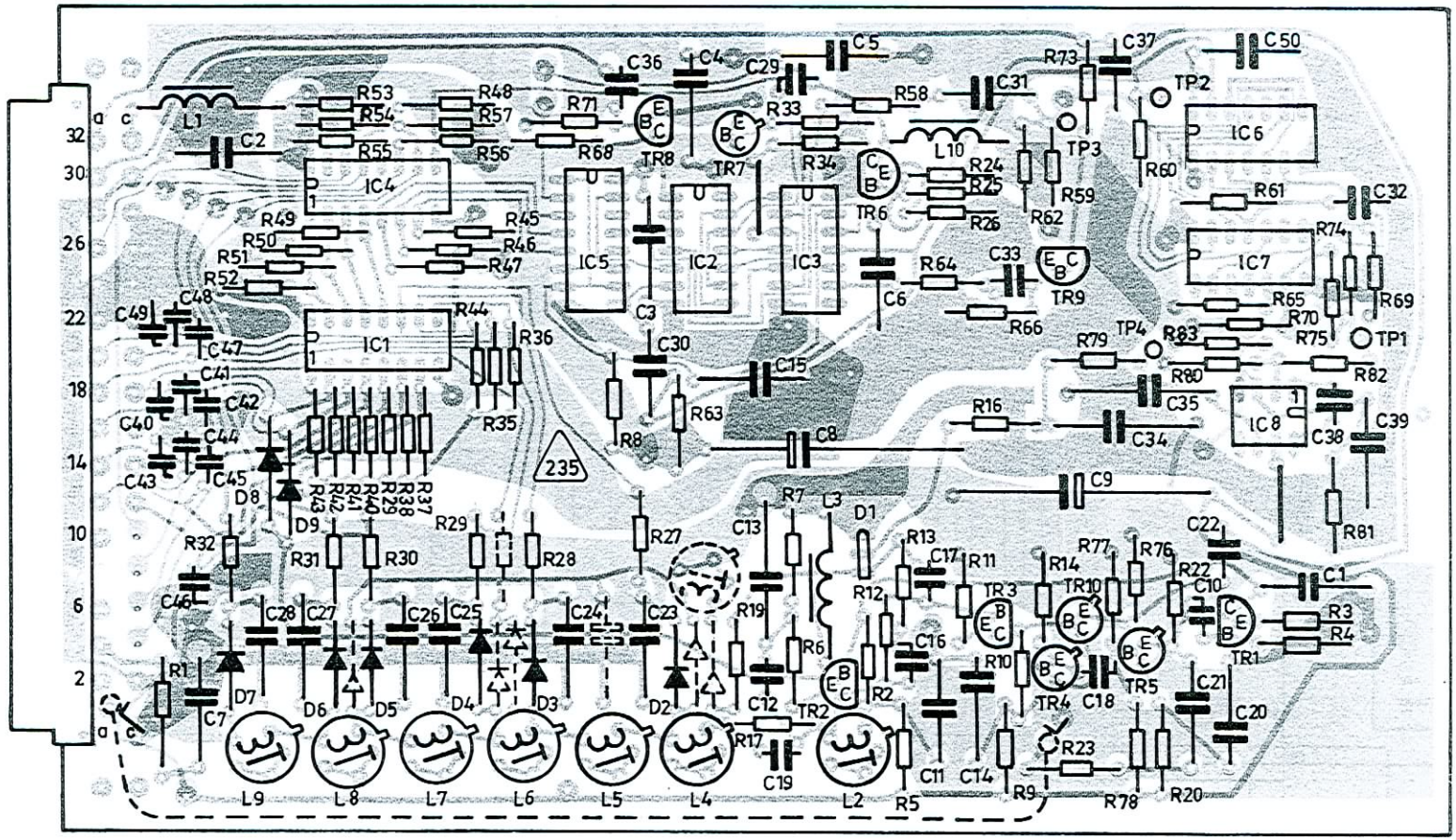


X = NOTE 1

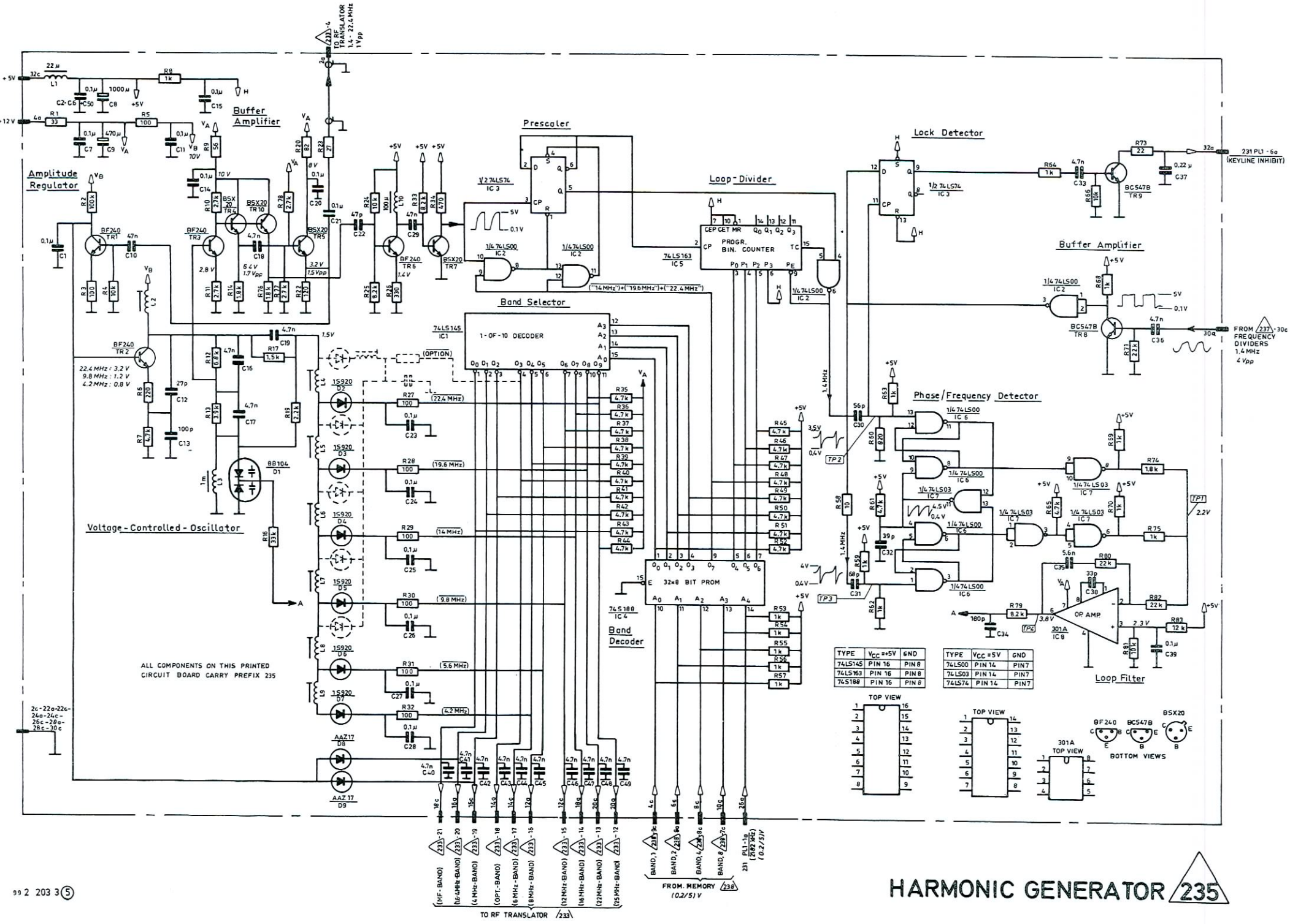
PRINTED CIRCUIT BOARD 234

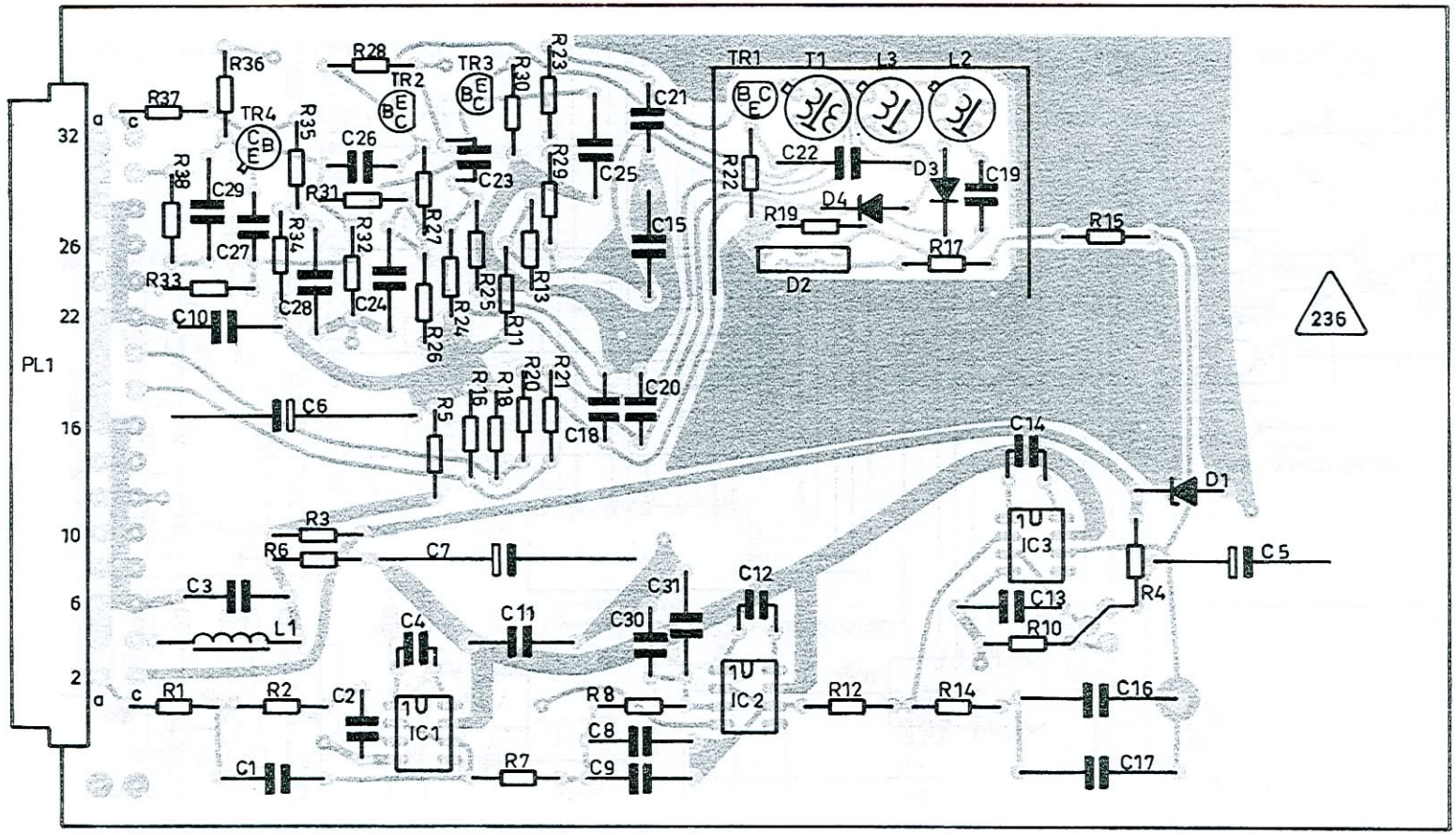
VIEWED FROM COMPONENT SIDE


45 sec. Timer
2 Hz Astable Multivibrator
2.2kHz Oscillator
1.3kHz Oscillator
1.5kHz Oscillator
Key Selector
Mode Selector
Sidetone Keyer
Tone Keyer
230 S3 ALARM START
230 SK2 AND 231 PL1-4b MORSE KEY (0/5)V
231 PL1-4a TELEX KEY (0/5)V
230 SK1 AND 231 PL1-3b HANDSET KEY (0/12)V
"POWER SWITCH" 230 S1 (DUPLEX) (0/5)V
"MODE SWITCH" 230 S2 (0/5)V
231 PL2-1a (2182 kHz) (0.3/5)V
231 PL2-1b (MF) (0.3/5)V
231 PL2-2a (TUNE) (0/5)V
(KEYED)
(SIDETONE KEYED)
(ALARM START ENABLE)
(2.2kHz OSC. START)
(1.5 kHz OSC START)
(TONE KEYED)
(A2H)
SEE NOTE 1
74188A IC5
32×8 BIT PROM
BC547B BC558B
BF245B
BOTTOM VIEWS
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 234
TOP VIEW
GAIN CONTROL
INPUT
BIAS
LM1496 IC7
231 PL2-7b SIDETONE 0.6 Vpp (TR.ALARM TEST ALARM A1 AND A2H KEYED)
232-9 TONE 2.7 Vpp
(1.5 kHz SHIFT) 237-10a
(COMPRESSOR) 232-4
(TELEX) 232-8
(A1·A2H·A3J) 232-13
(F1) 232-14
(F1) 231 PL2-6b 232-15
(A3A) 232-10
(FULL) 233-1
(MUTING) 231 PL2-7a 231-5
12V KEYED
KEYLINE 231 PL2-6a AND 235-32a AND 237-32c AND 239-12
NOTE 1: WHEN STRAP IS REMOVED, TRANSMITTER IS NOT KEYED IN DUPLEX POSITIONS OF POWER SWITCH (EXCEPT IN F1-MODE), BUT CAN BE KEYED FROM HANDSET.
CONTROL CIRCUIT AND



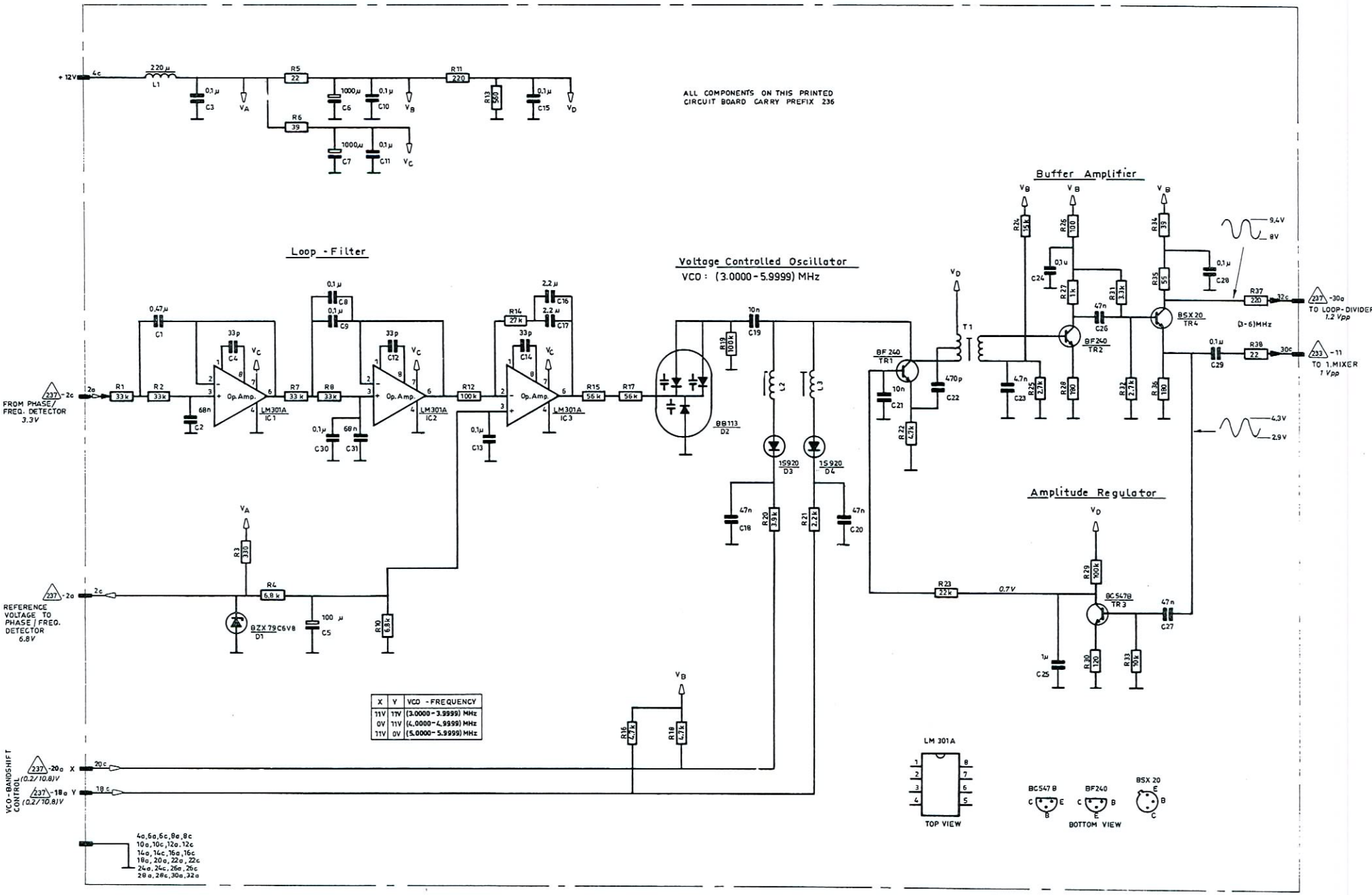
PRINTED CIRCUIT BOARD 235
VIEWED FROM COMPONENT SIDE


HARMONIC GENERATOR 235
Buffer Amplifier
Amplitude Regulator
Voltage-Controlled-Oscillator
Prescaler
Loop-Divider
Band Selector
Band Decoder
Lock Detector
Buffer Amplifier
Phase/Frequency Detector
Loop Filter
1-OF-10 DECODER
32x8 BIT PROM
PROGR. BIN. COUNTER
OP AMP
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 235
TO RF TRANSLATOR 233
FROM MEMORY 238
231 PL1 - 6a (KEYLINE INHIBIT)
FROM 237 - 30c FREQUENCY DIVIDERS 1.4 MHz 4 Vpp
TOP VIEW
BOTTOM VIEWS
99 2 203 3 (5)
8 - 75

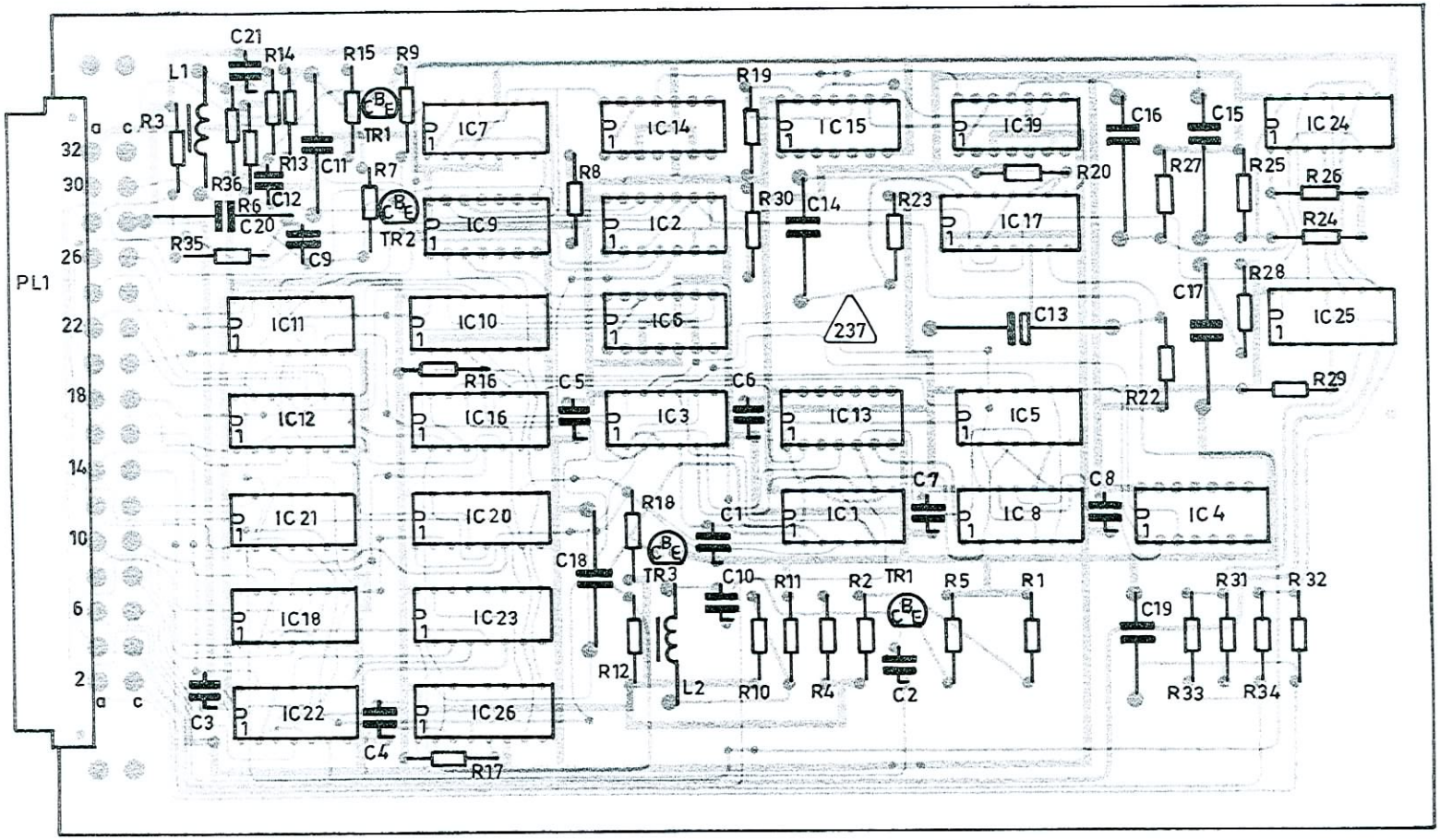


PRINTED CIRCUIT BOARD 236

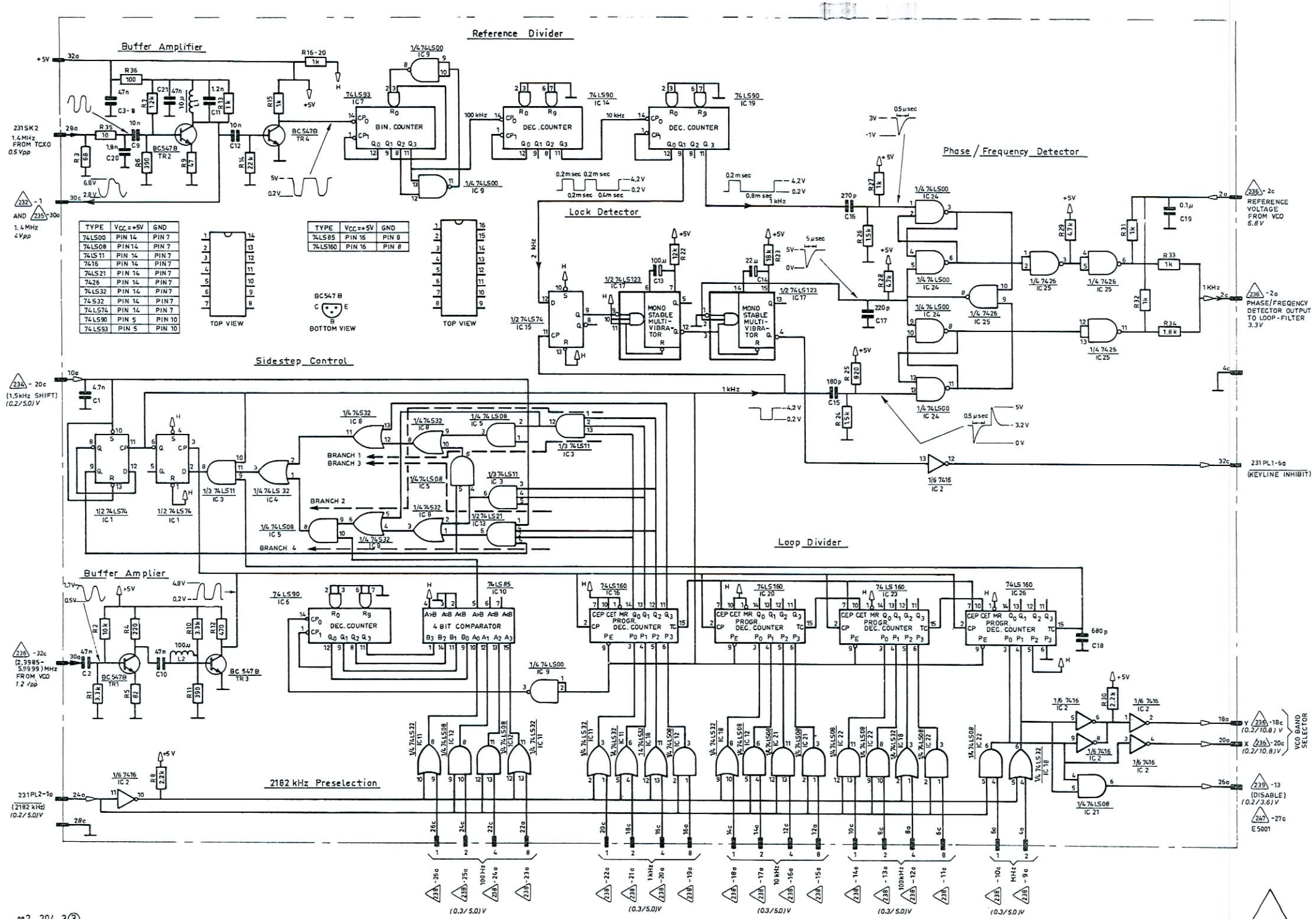
VIEWED FROM COMPONENT SIDE



X	Y	VCO - FREQUENCY
11V	11V	(3.0000 - 3.9999) MHz
0V	11V	(4.0000 - 4.9999) MHz
11V	0V	(5.0000 - 5.9999) MHz

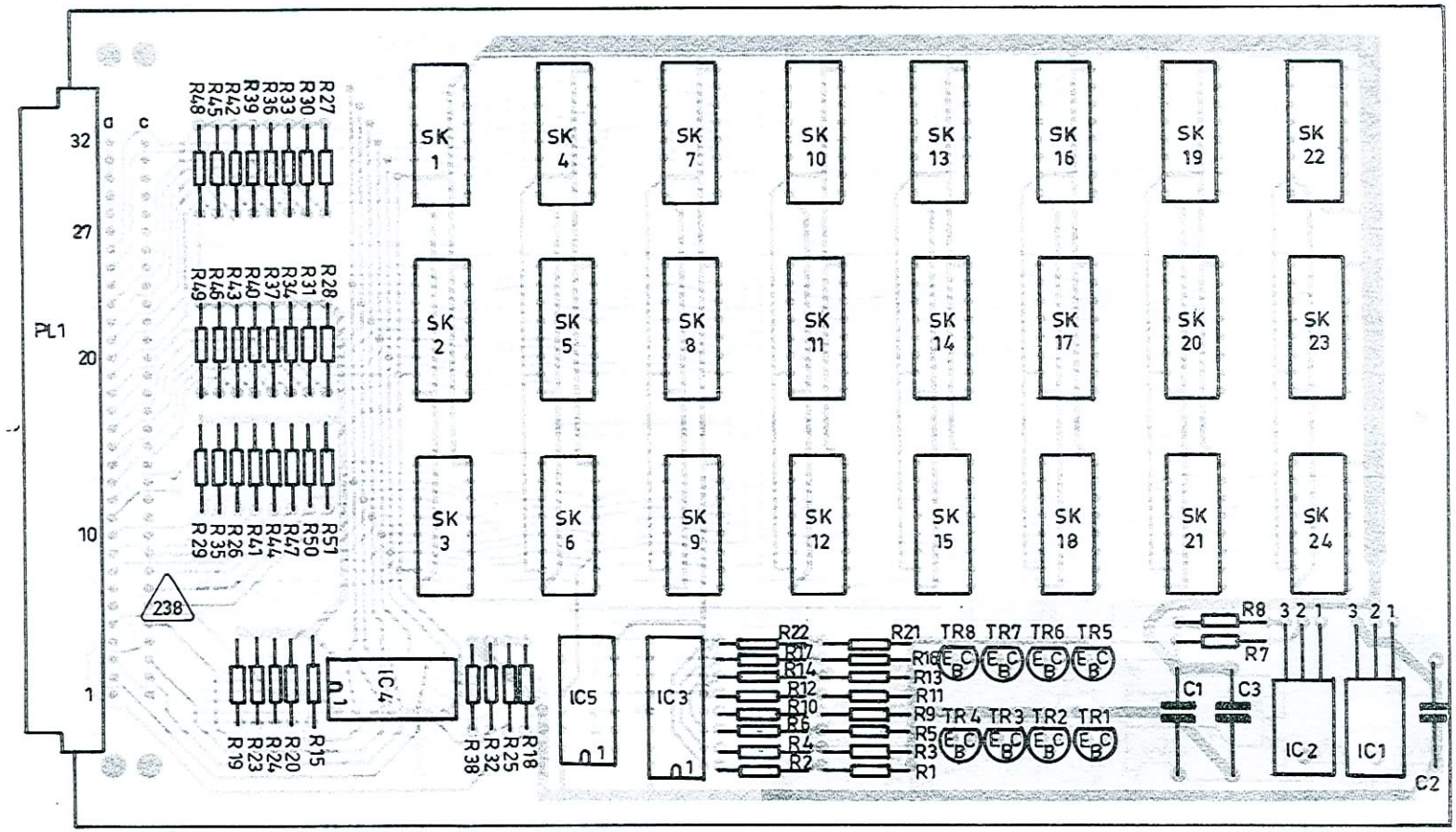


PRINTED CIRCUIT BOARD 237
VIEWED FROM COMPONENT SIDE



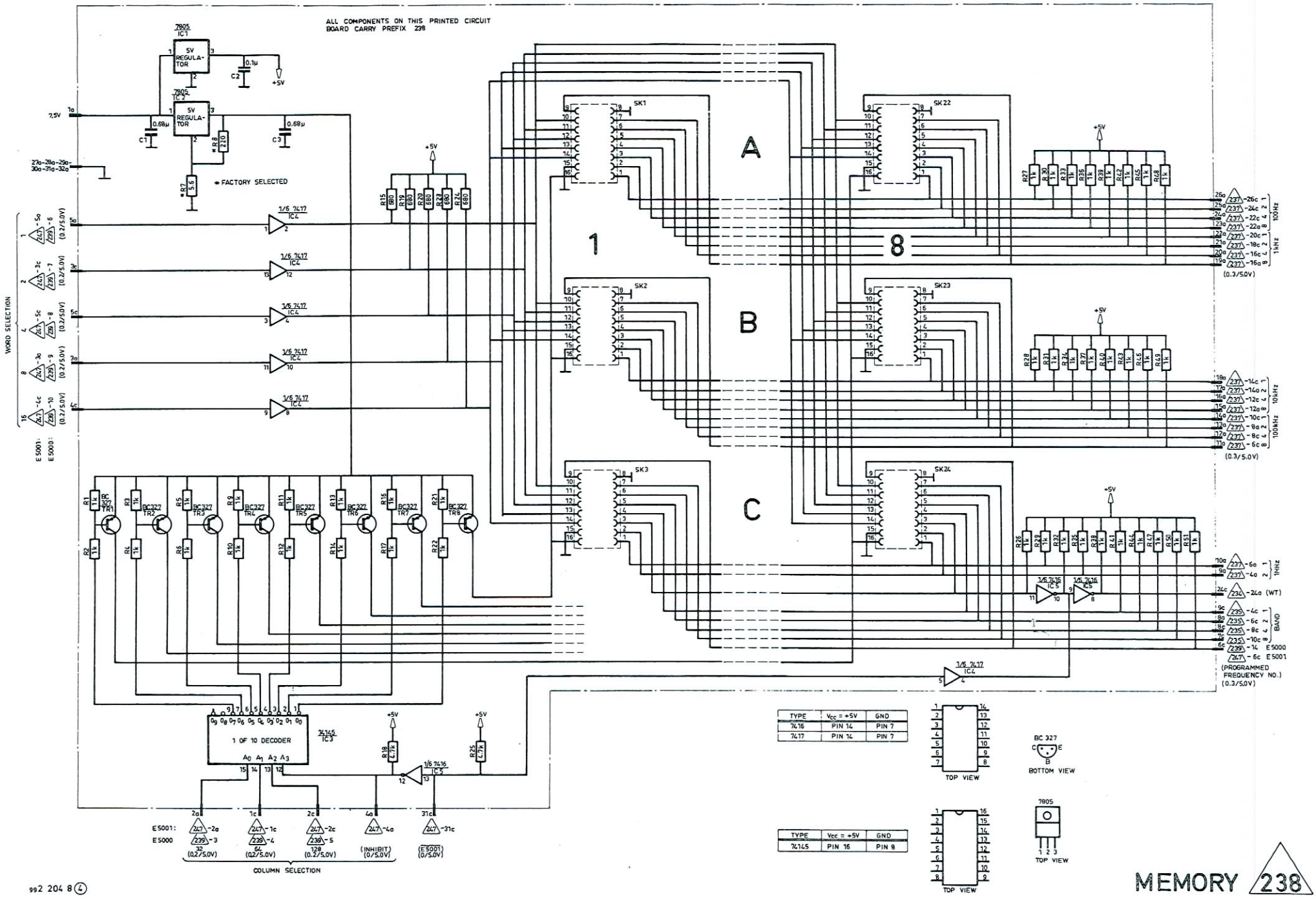
TYPE	V_{CC} = +5V	GND
74LS00	PIN 14	PIN 7
74LS08	PIN 14	PIN 7
74LS11	PIN 14	PIN 7
7416	PIN 14	PIN 7
74LS21	PIN 14	PIN 7
7426	PIN 14	PIN 7
74LS32	PIN 14	PIN 7
74S32	PIN 14	PIN 7
74LS74	PIN 14	PIN 7
74LS90	PIN 5	PIN 10
74LS93	PIN 5	PIN 10

TYPE	V_{CC} = +5V	GND
74LS85	PIN 16	PIN 8
74LS160	PIN 16	PIN 8



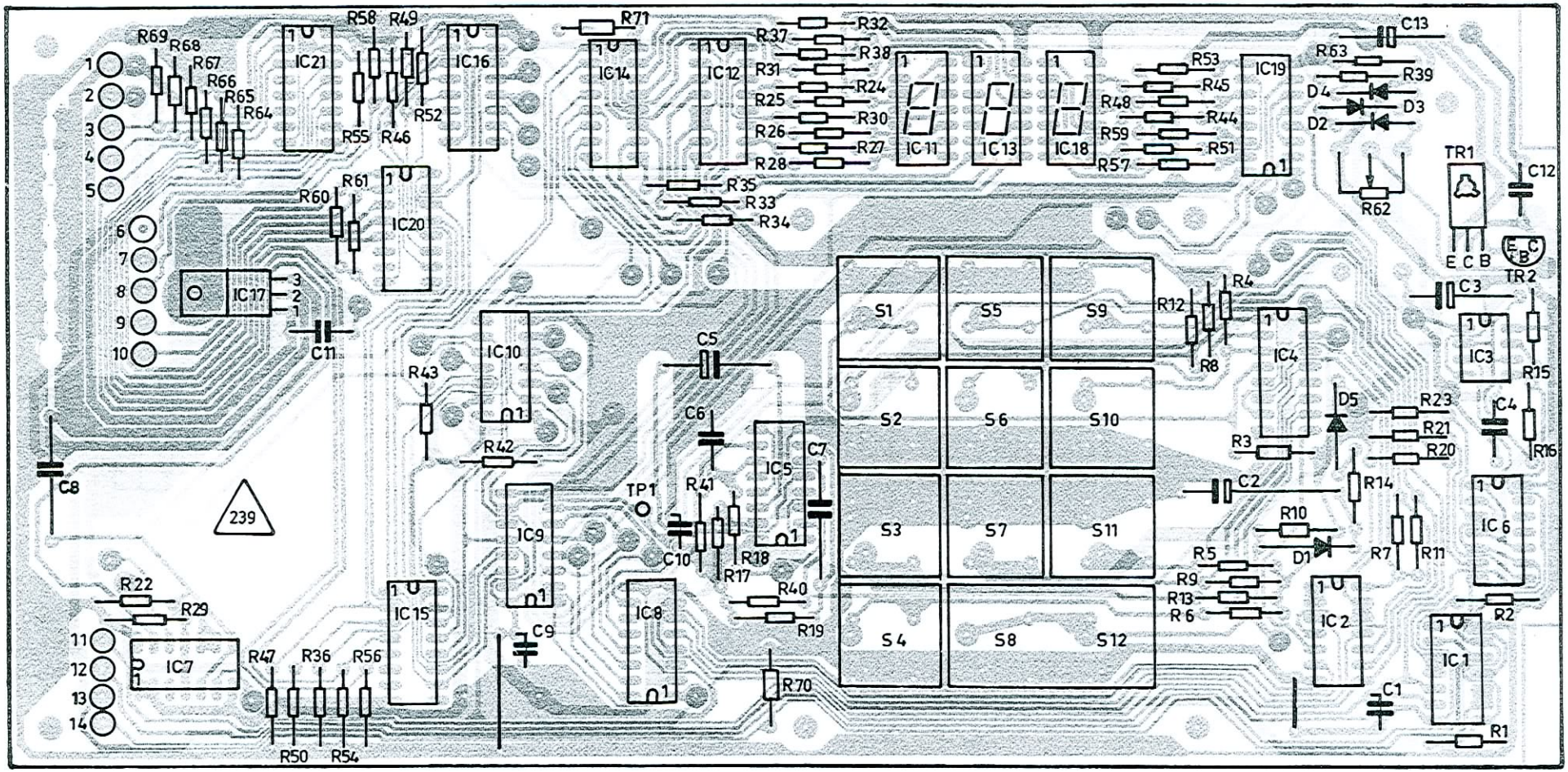
PRINTED CIRCUIT BOARD 238

VIEWED FROM COMPONENT SIDE



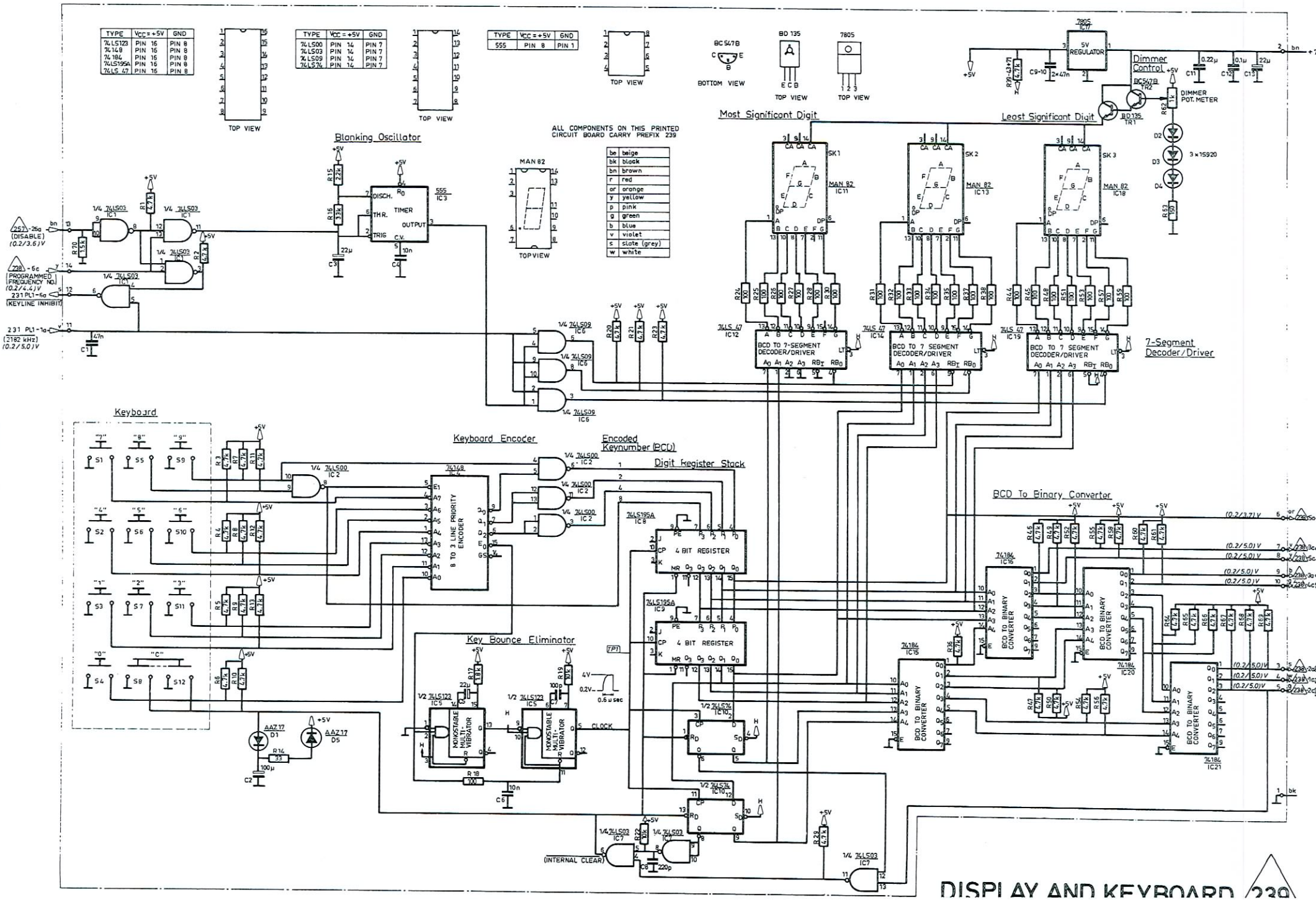
MEMORY 238

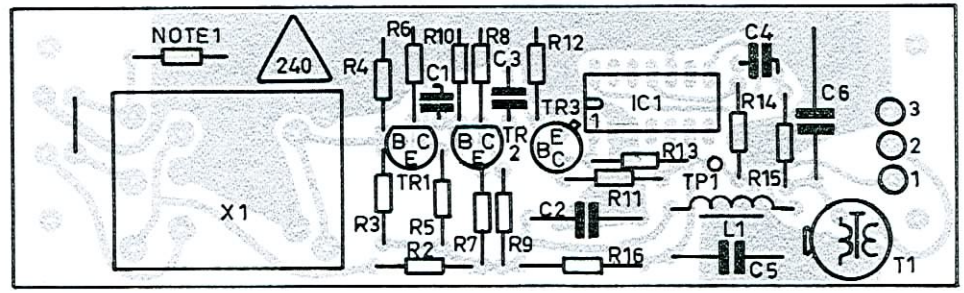
992 204 8 (4)



9922 205 21

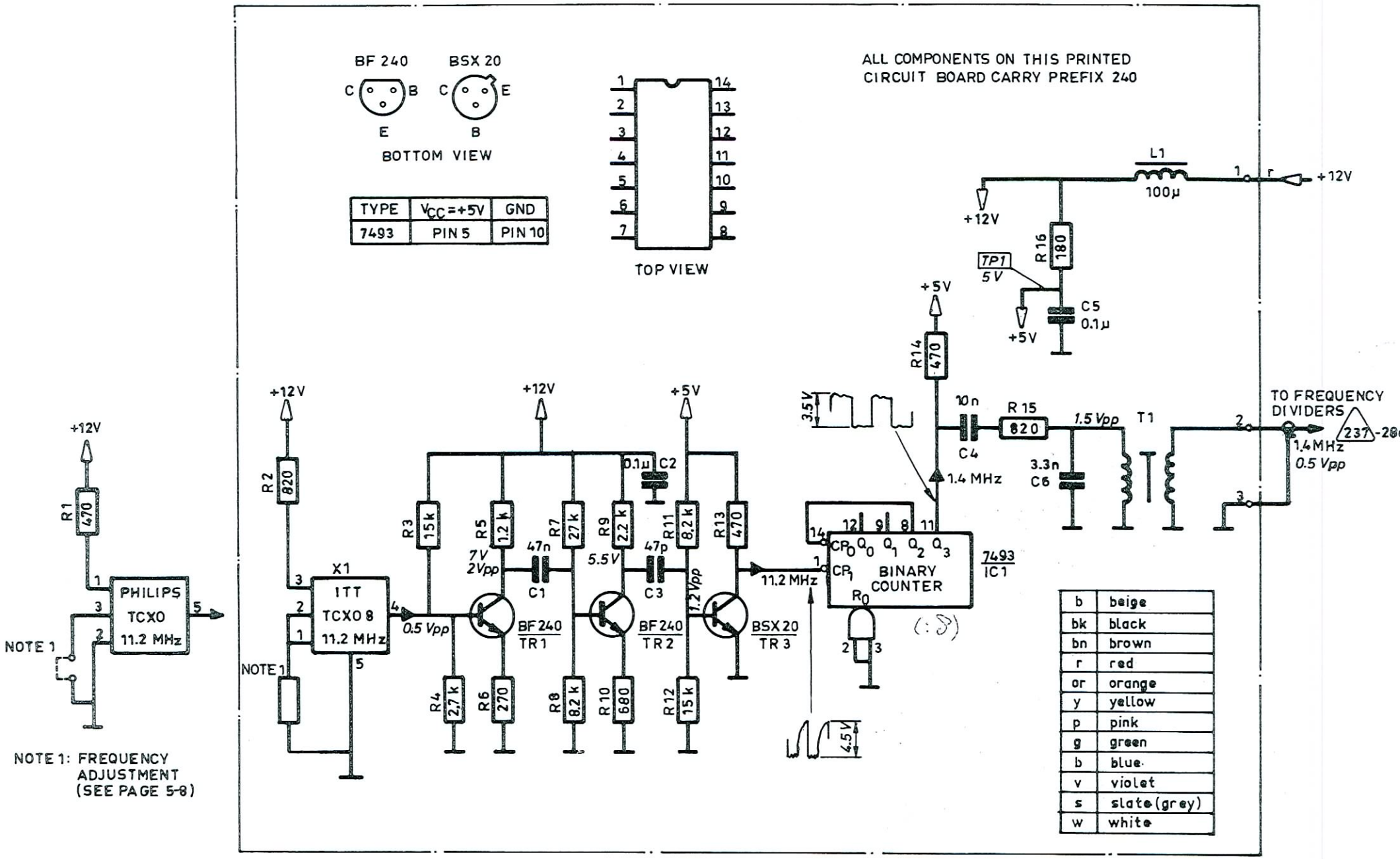
PRINTED CIRCUIT BOARD 239
VIEWED FROM COMPONENT SIDE


TYPE | VCC = +5V | GND
74LS123 | PIN 16 | PIN 8
74148 | PIN 16 | PIN 8
74184 | PIN 16 | PIN 8
74LS195A | PIN 16 | PIN 8
74LS 47 | PIN 16 | PIN 8
TYPE | VCC = +5V | GND
74LS00 | PIN 14 | PIN 7
74LS03 | PIN 14 | PIN 7
74LS09 | PIN 14 | PIN 7
74LS74 | PIN 14 | PIN 7
TYPE | VCC = +5V | GND
555 | PIN 8 | PIN 1
TOP VIEW
BC 547B
BOTTOM VIEW
BD 135
TOP VIEW
7805
TOP VIEW
Blanking Oscillator
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 239
be beige
bk black
bn brown
r red
or orange
y yellow
p pink
g green
b blue
v violet
s slate (grey)
w white
Most Significant Digit
Least Significant Digit
Dimmer Control
DIMMER POT. METER
3 x 1S920
7-Segment Decoder/Driver
BCD TO 7-SEGMENT DECODER/DRIVER
Keyboard
Keyboard Encoder
8 TO 3 LINE PRIORITY ENCODER
Encoded Keynumber (BCD)
Digit Register Stack
4 BIT REGISTER
Key Bounce Eliminator
MONOSTABLE MULTI-VIBRATOR
BCD To Binary Converter
BCD TO BINARY CONVERTER
WORD SELECTION
COLUMN SELECTION
(INTERNAL CLEAR)
CLOCK
DISPLAY AND KEYBOARD 239

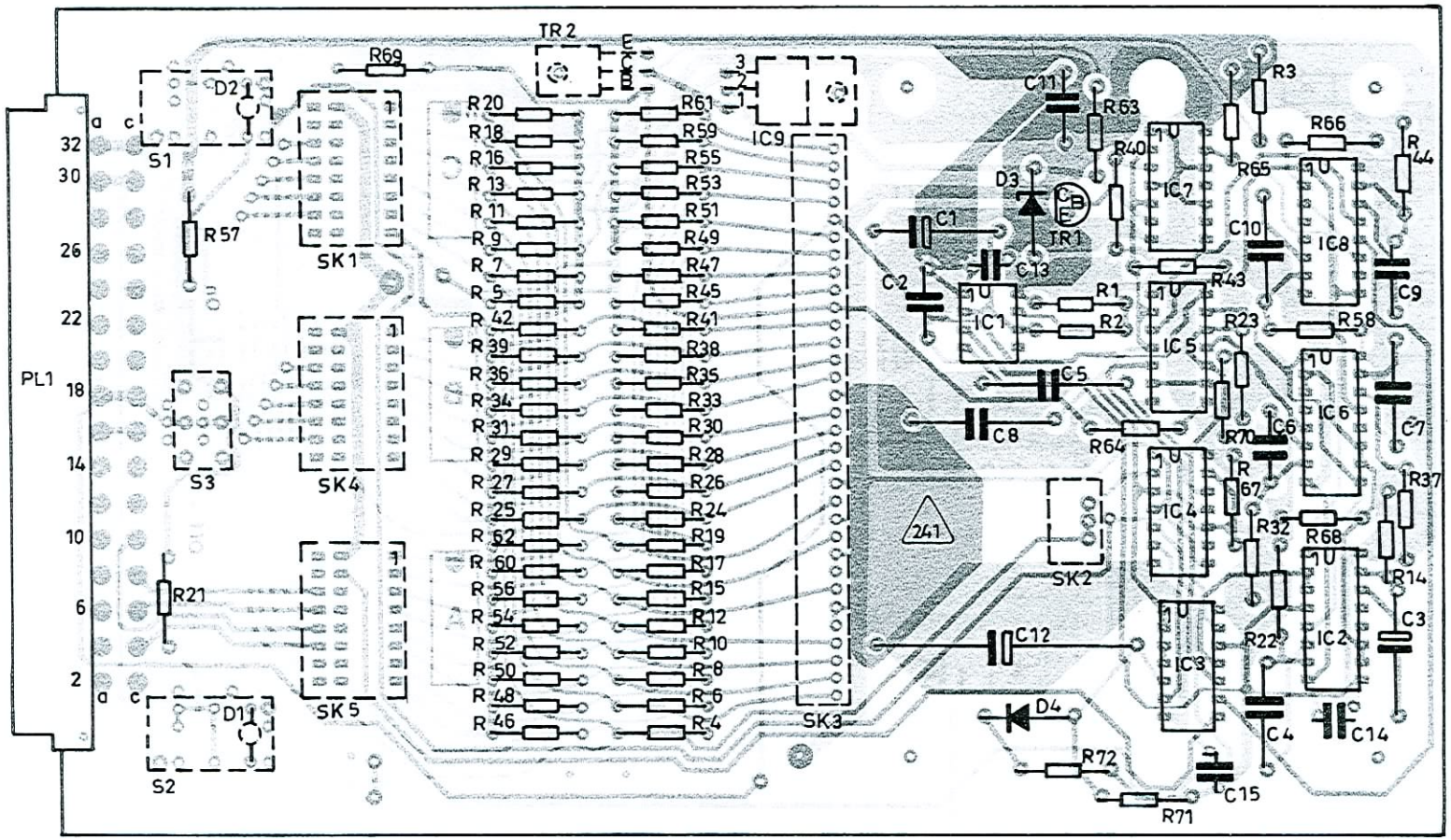


PRINTED CIRCUIT BOARD (240)

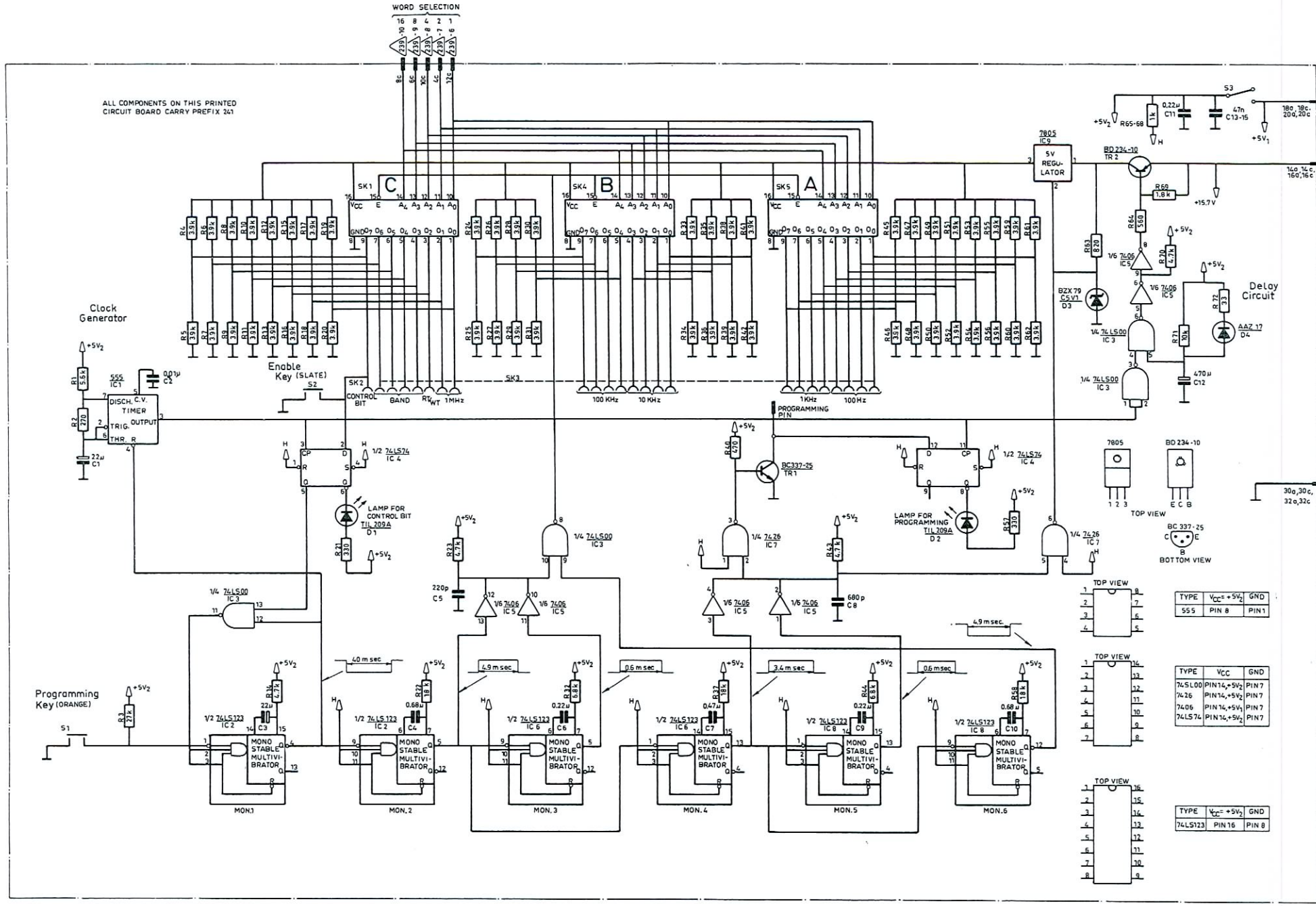
VIEWED FROM COMPONENT SIDE



MASTER OSCILLATOR 240



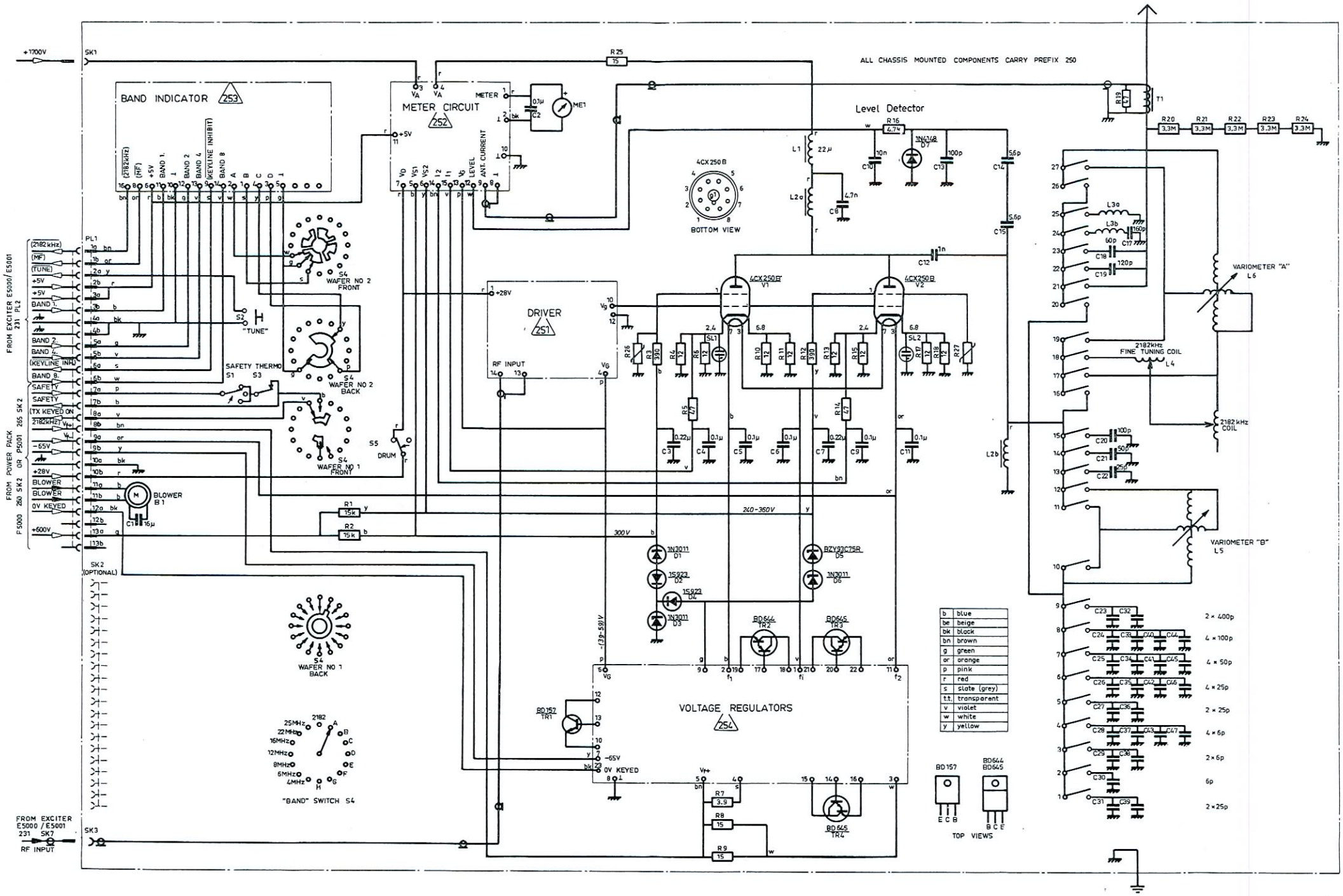
PRINTED CIRCUIT BOARD 241
VIEWED FROM COMPONENT SIDE



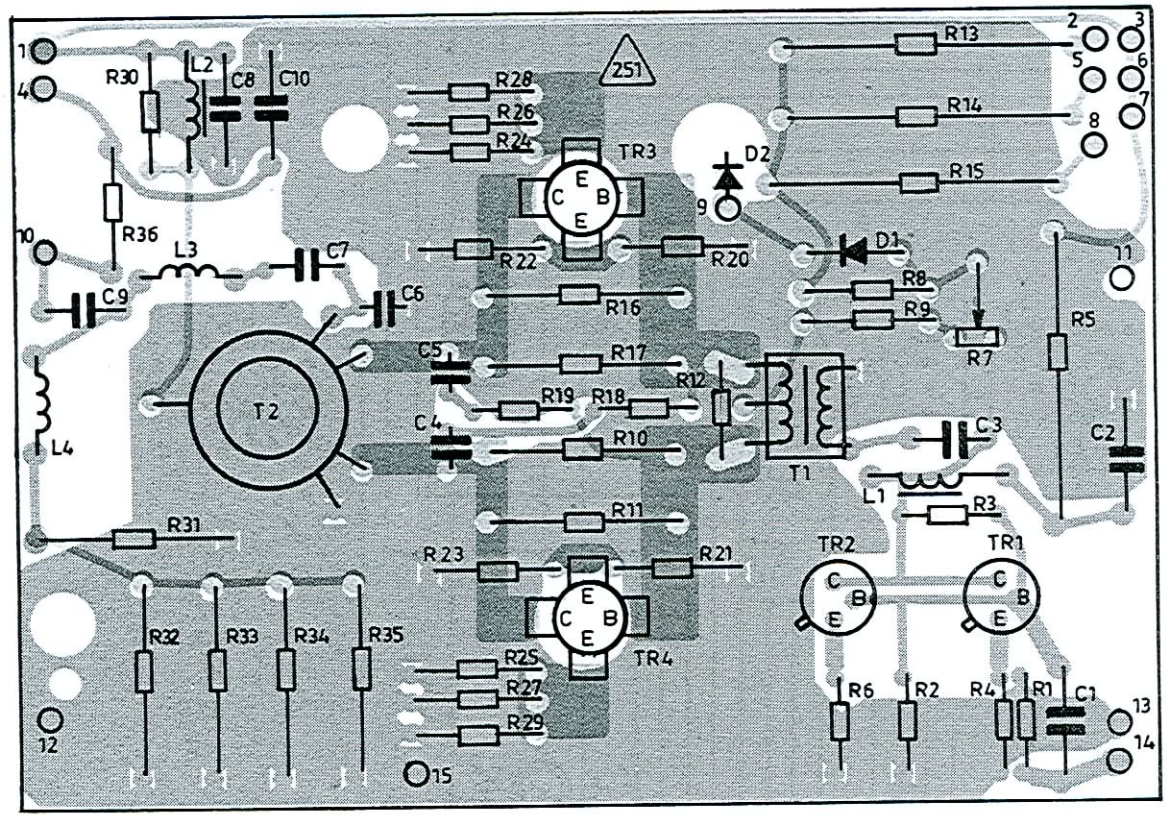
992 206 3①

PROGRAMMING UNIT

241

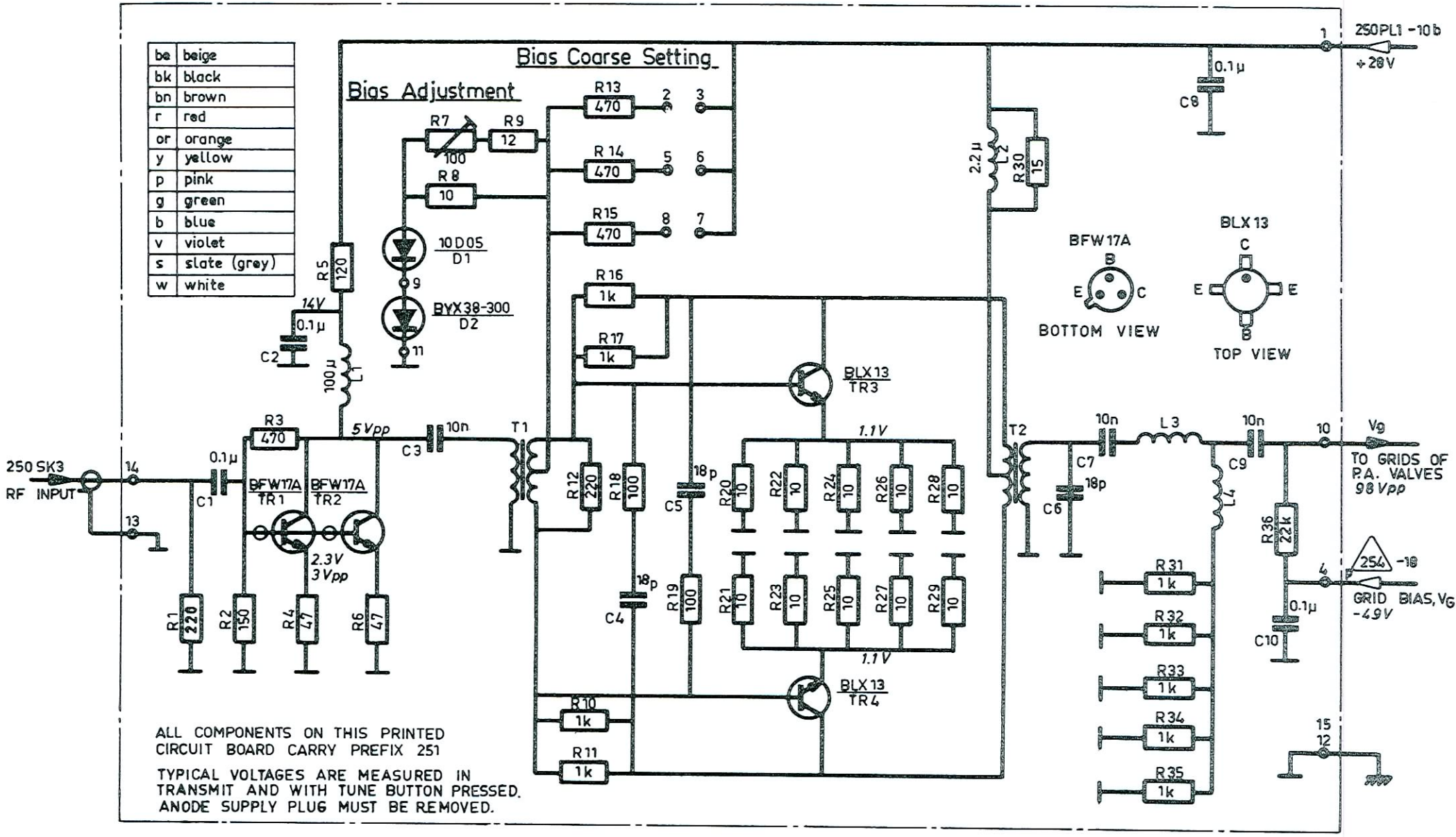


T5000 WIRING DIAGRAM 250

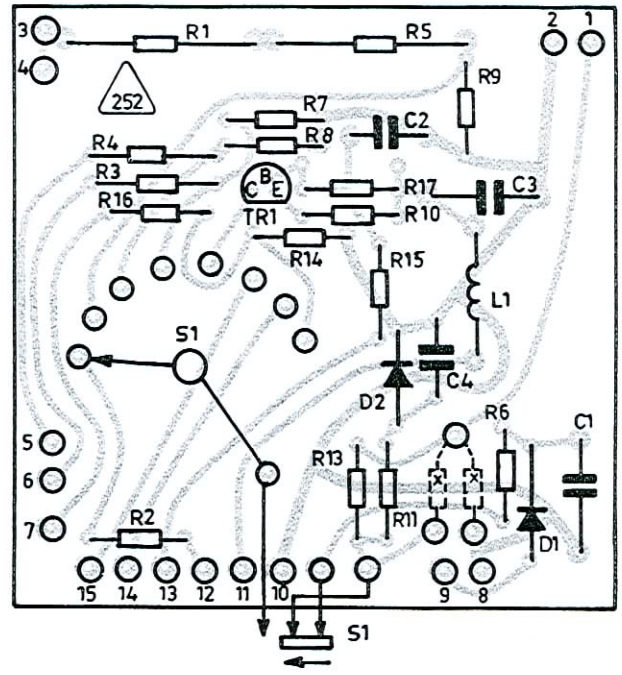


PRINTED CIRCUIT BOARD 251

VIEWED FROM COMPONENT SIDE


be beige
bk black
bn brown
r red
or orange
y yellow
p pink
g green
b blue
v violet
s slate (grey)
w white
Bias Coarse Setting
Bias Adjustment
R13 470
R14 470
R15 470
R7 100
R9 12
R8 10
10D05 D1
BYX38-300 D2
R5 120
14V
0.1µ C2
100µ L1
R3 470
5Vpp
10n C3
T1
250 SK3 RF INPUT
14
13
0.1µ C1
BFW17A TR1
BFW17A TR2
2.3V 3Vpp
R1 220
R2 150
R4 47
R6 47
R16 1k
R17 1k
BLX13 TR3
1.1V
R12 220
R18 100
18p C5
18p C4
R19 100
R20 10
R22 10
R24 10
R26 10
R28 10
R21 10
R23 10
R25 10
R27 10
R29 10
1.1V
BLX13 TR4
R10 1k
R11 1k
2.2µ L2
R30 15
0.1µ C8
1 250PL1 -10b +28V
BFW17A
B E C
BOTTOM VIEW
BLX13
C E E B
TOP VIEW
T2
10n C7
18p C6
10n L3
10n C9
L4
10 Vg
TO GRIDS OF P.A. VALVES 98Vpp
R36 22k
4 254 -18
GRID BIAS, VG -4.9V
0.1µ C10
R31 1k
R32 1k
R33 1k
R34 1k
R35 1k
15
12
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 251
TYPICAL VOLTAGES ARE MEASURED IN TRANSMIT AND WITH TUNE BUTTON PRESSED. ANODE SUPPLY PLUG MUST BE REMOVED.

DRIVER 251

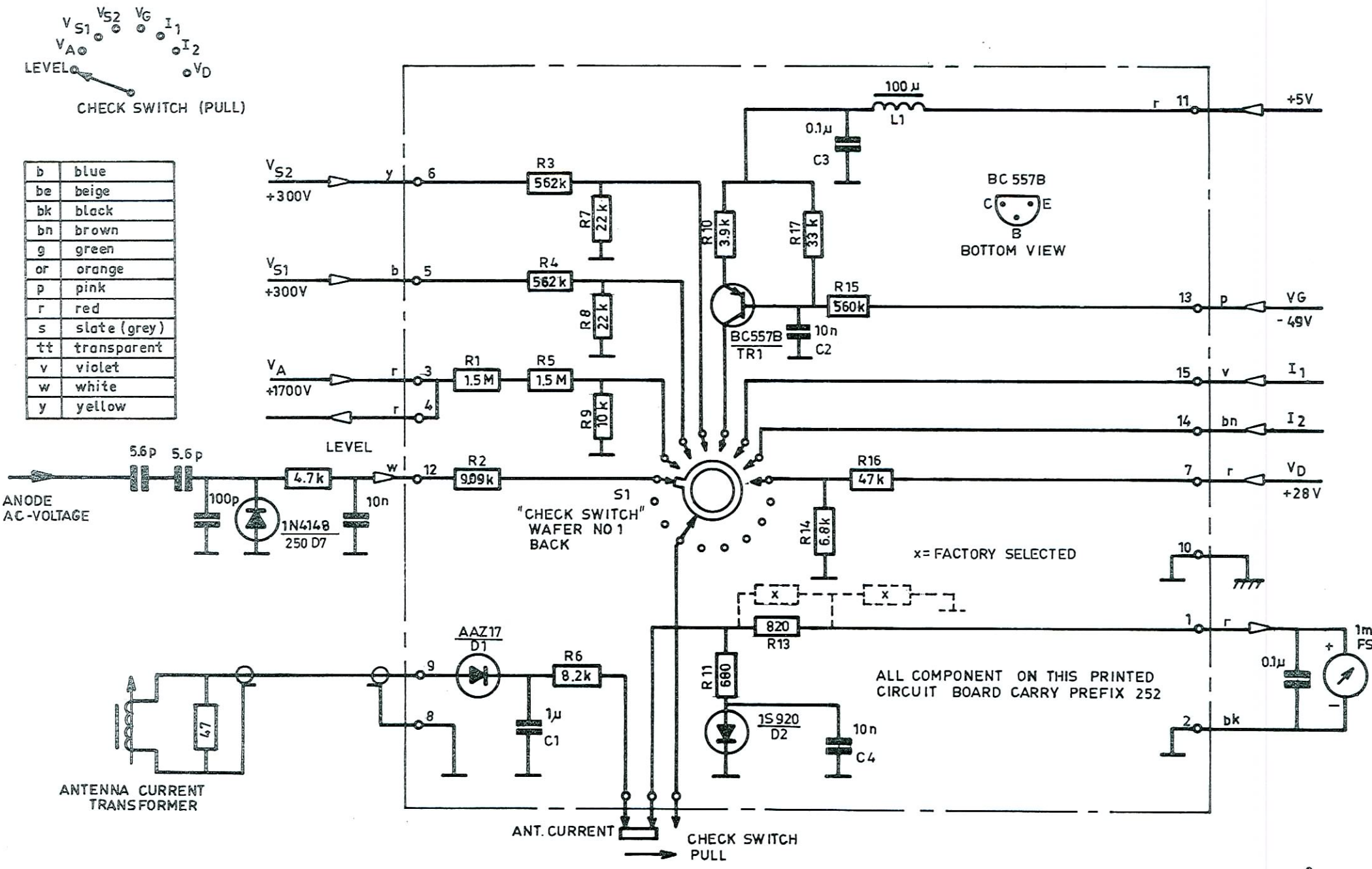


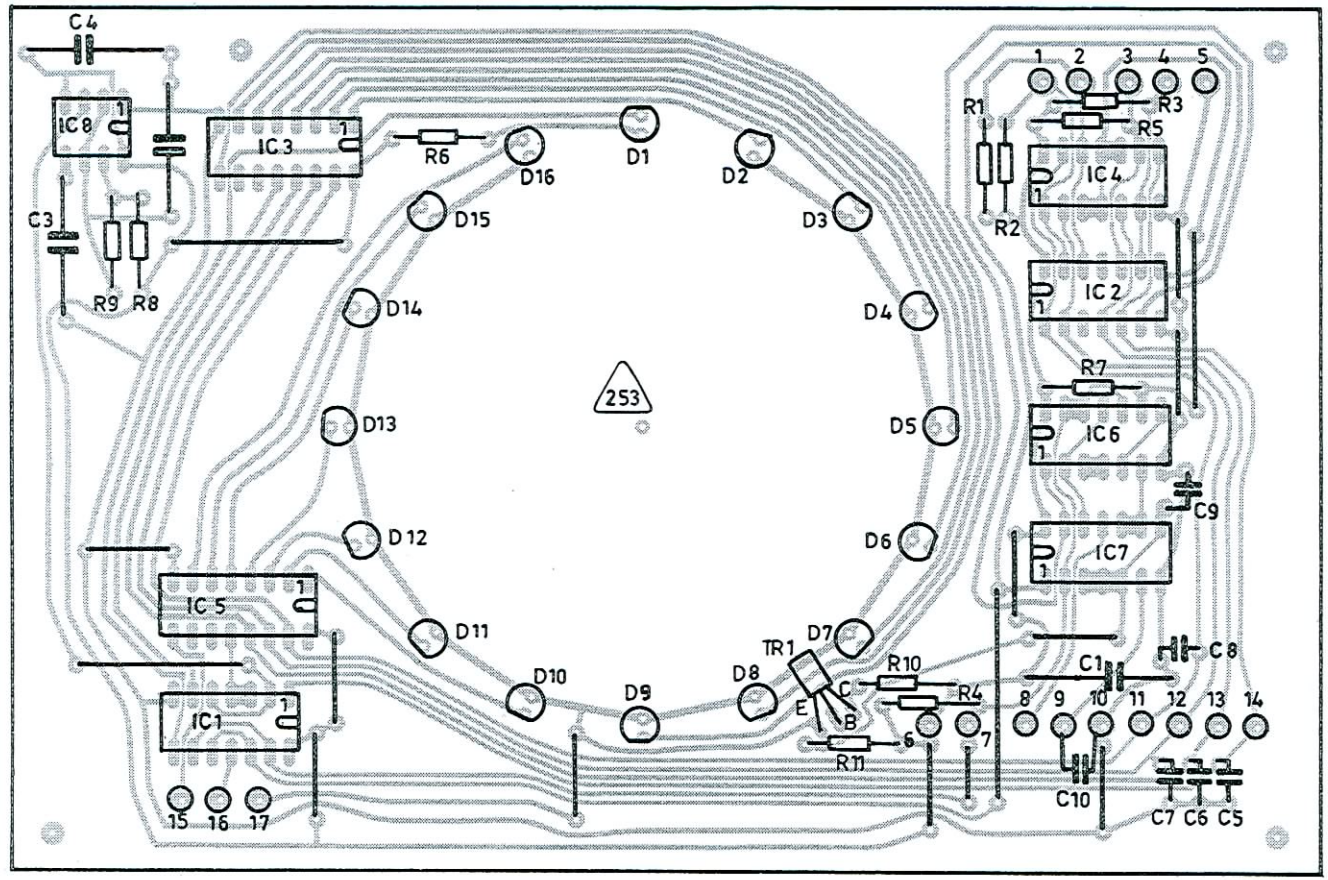
8-92

PRINTED CIRCUIT BOARD 252

VIEWED FROM COMPONENT SIDE

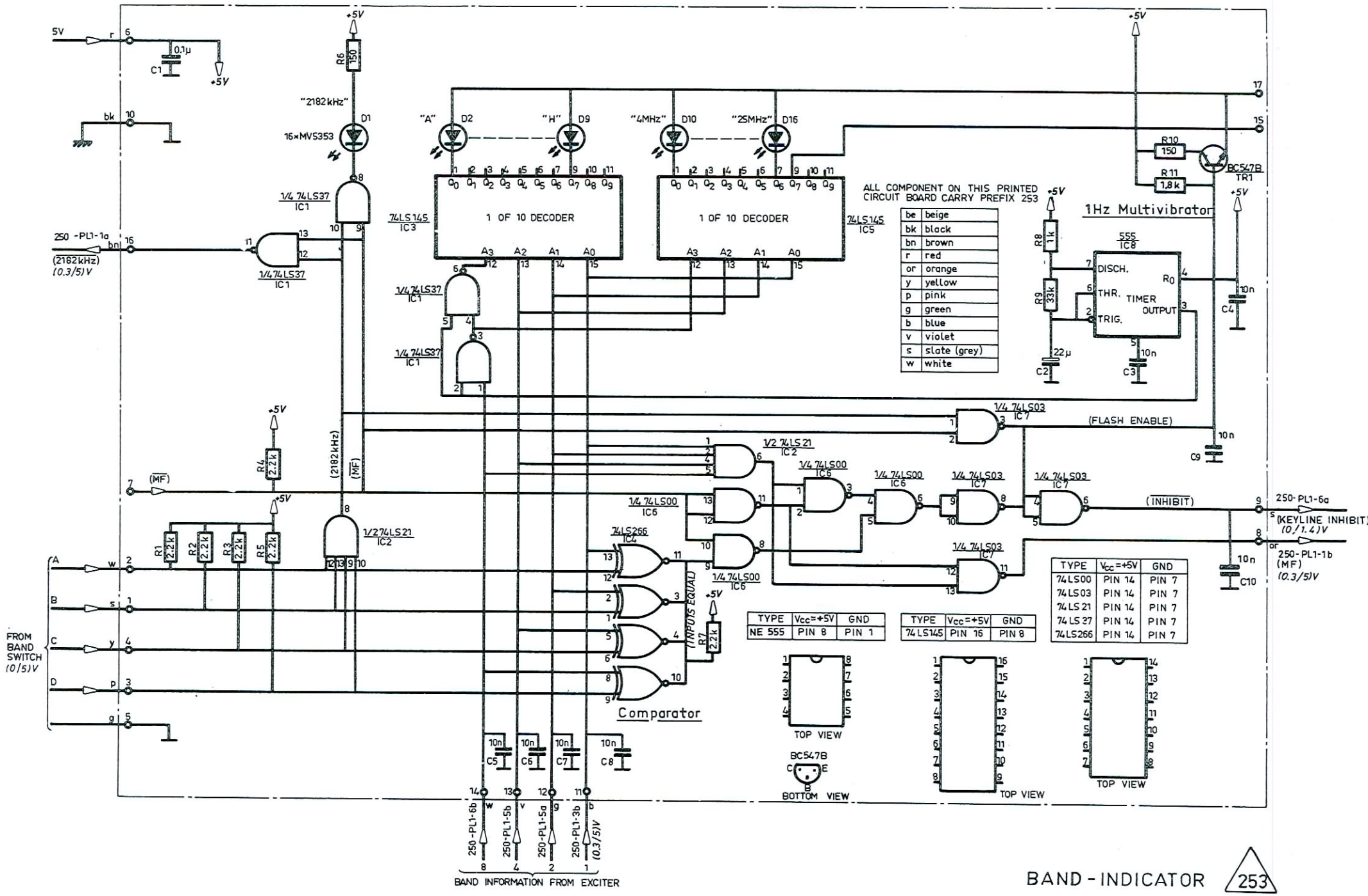
9922 209 72


V S1
V S2
V G
I 1
V A
I 2
V D
LEVEL
CHECK SWITCH (PULL)
b blue
be beige
bk black
bn brown
g green
or orange
p pink
r red
s slate (grey)
tt transparent
v violet
w white
y yellow
V S2 +300V
V S1 +300V
V A +1700V
LEVEL
ANODE AC-VOLTAGE
5.6p
5.6p
100p
1N4148 250 D7
10n
4.7k
R1 1.5 M
R2 9.09k
R3 562k
R4 562k
R5 1.5 M
R7 22k
R8 22k
R9 10k
R10 3.9k
R14 6.8k
R15 560k
R16 47k
R17 33k
S1 "CHECK SWITCH" WAFER NO 1 BACK
BC557B TR1
10n C2
100 µ L1
0.1µ C3
BC 557B
C E B
BOTTOM VIEW
+5V
VG -49V
I 1
I 2
V D +28V
x= FACTORY SELECTED
820 R13
AAZ17 D1
R6 8.2k
1µ C1
R11 680
1S 920 D2
10n C4
47
ANTENNA CURRENT TRANSFORMER
ALL COMPONENT ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 252
0.1µ
1m FS
ANT. CURRENT
CHECK SWITCH PULL



PRINTED CIRCUIT BOARD 253

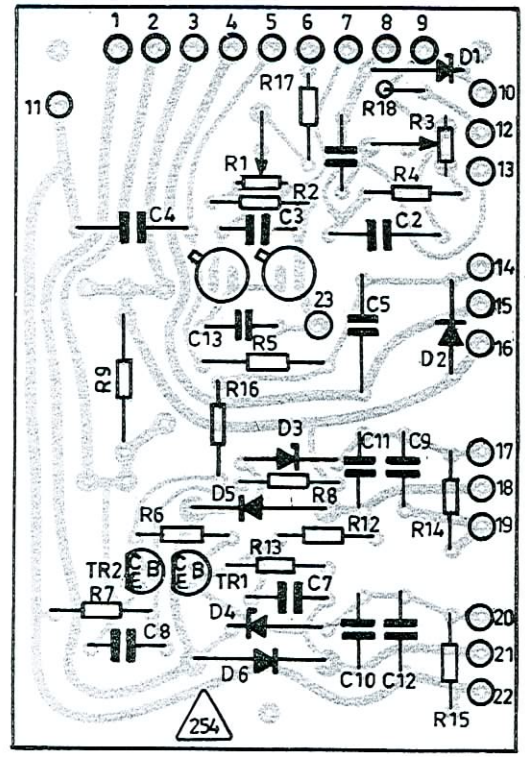
VIEWED FROM COMPONENT SIDE



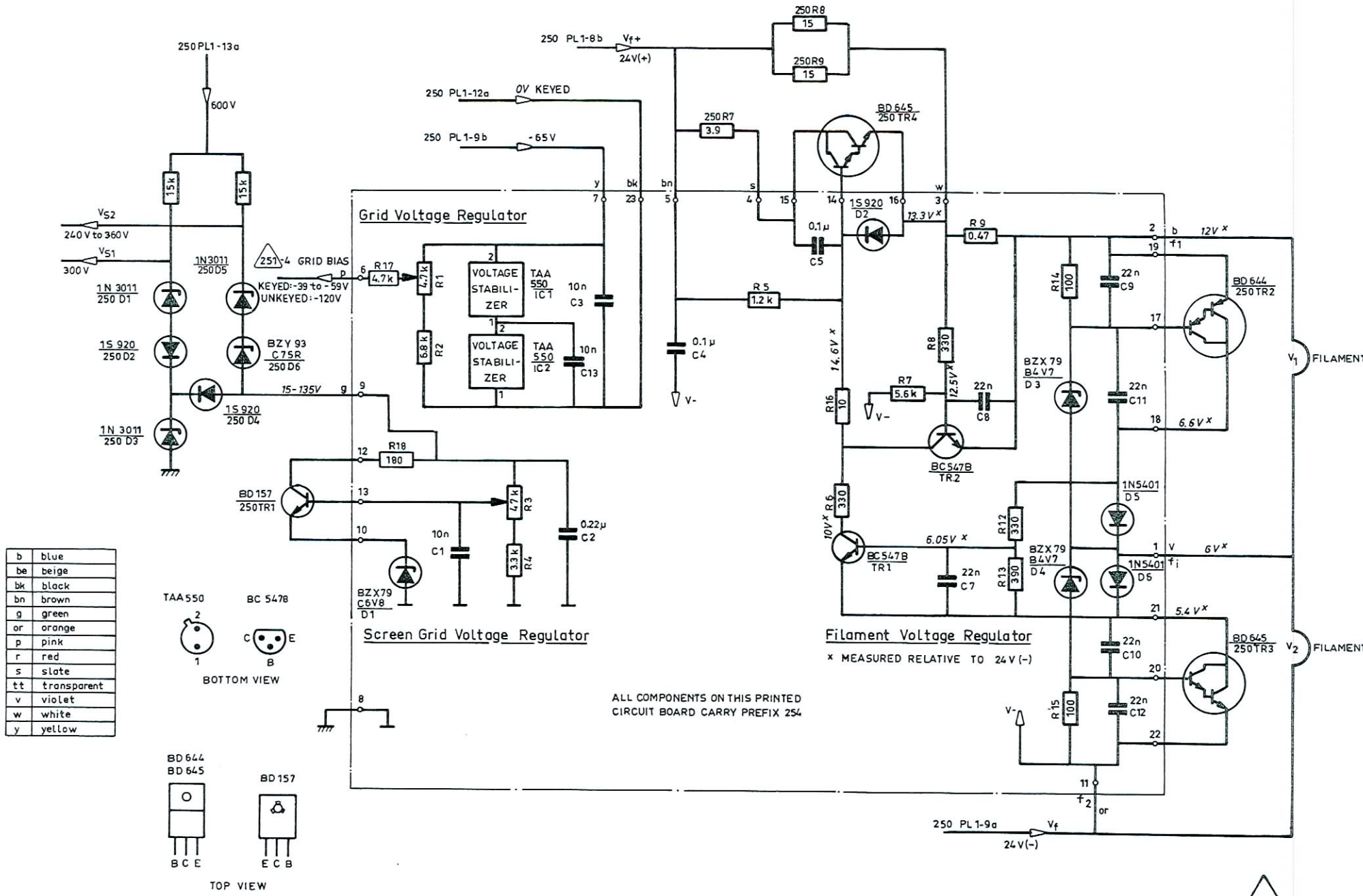
BAND - INDICATOR 253

8-95

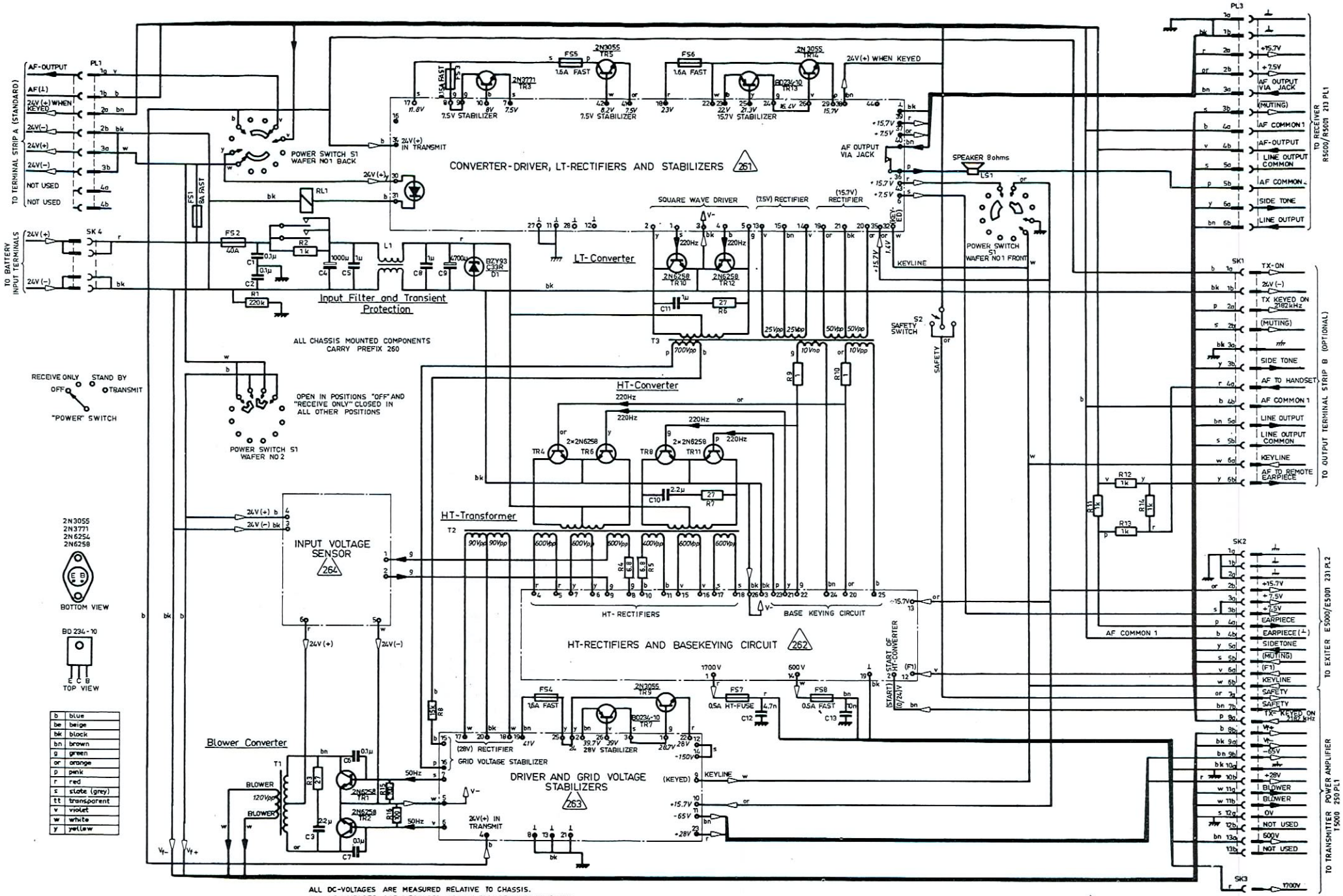
992 209 3⑤



PRINTED CIRCUIT BOARD 254
VIEWED FROM COMPONENT SIDE

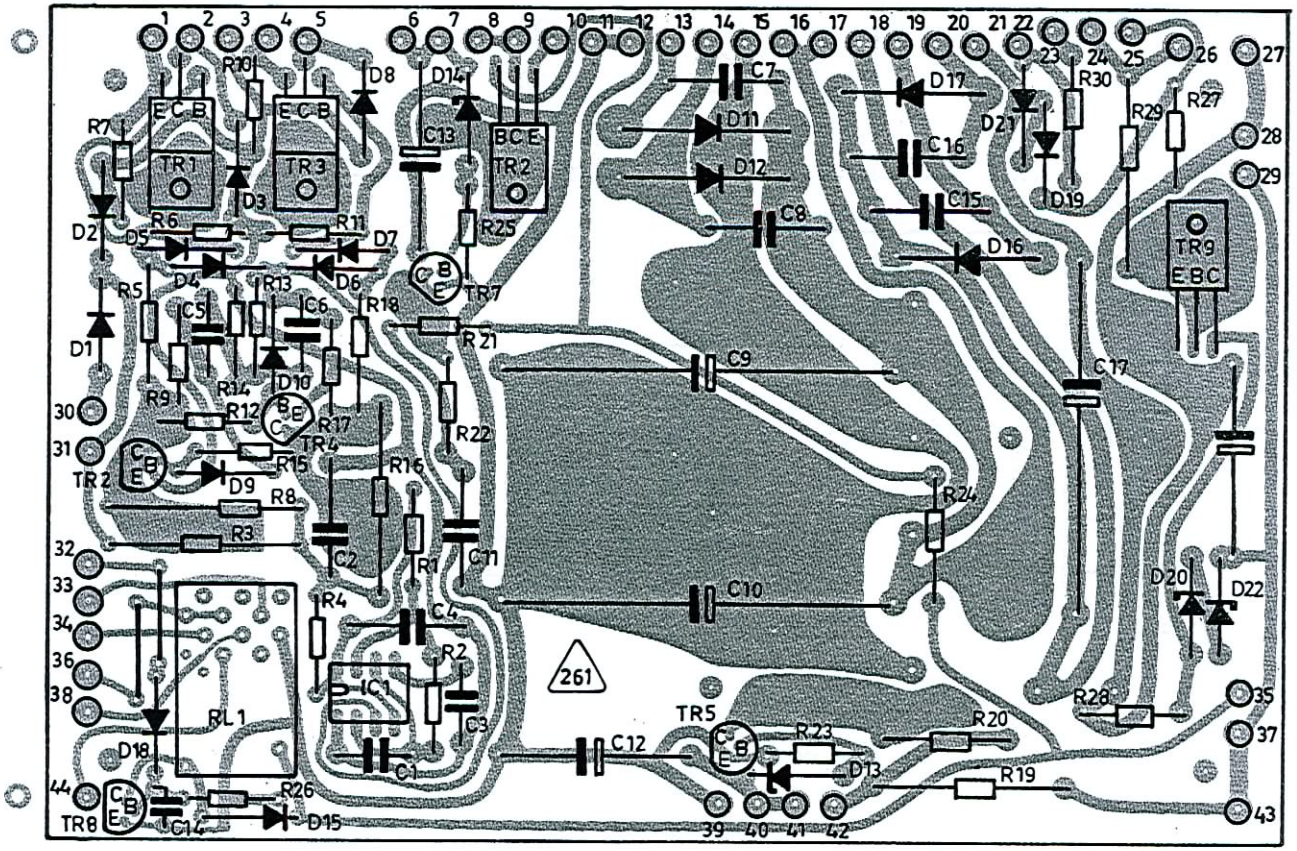


VOLTAGE REGULATORS 254

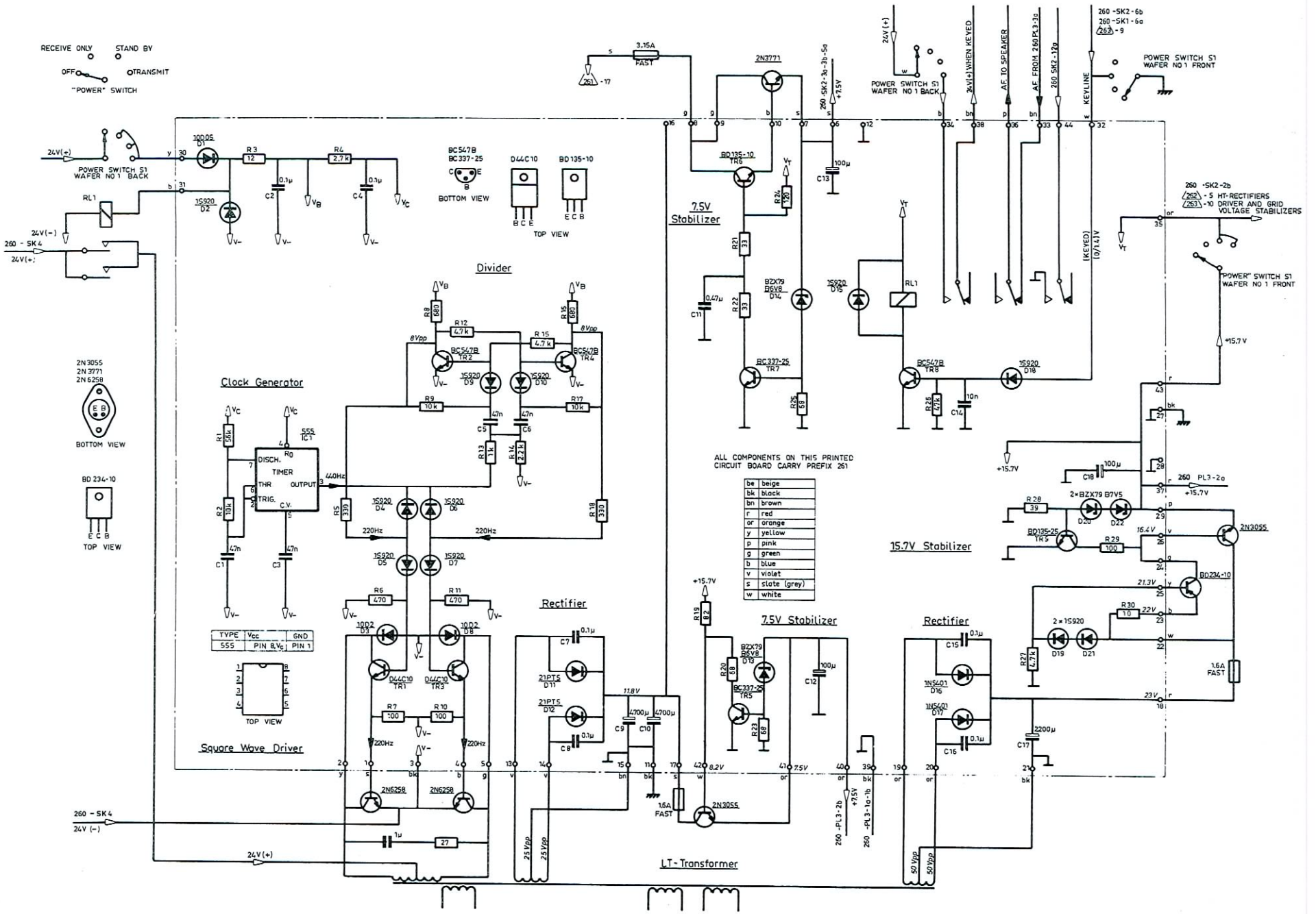


P5000 24DC POWER PACK

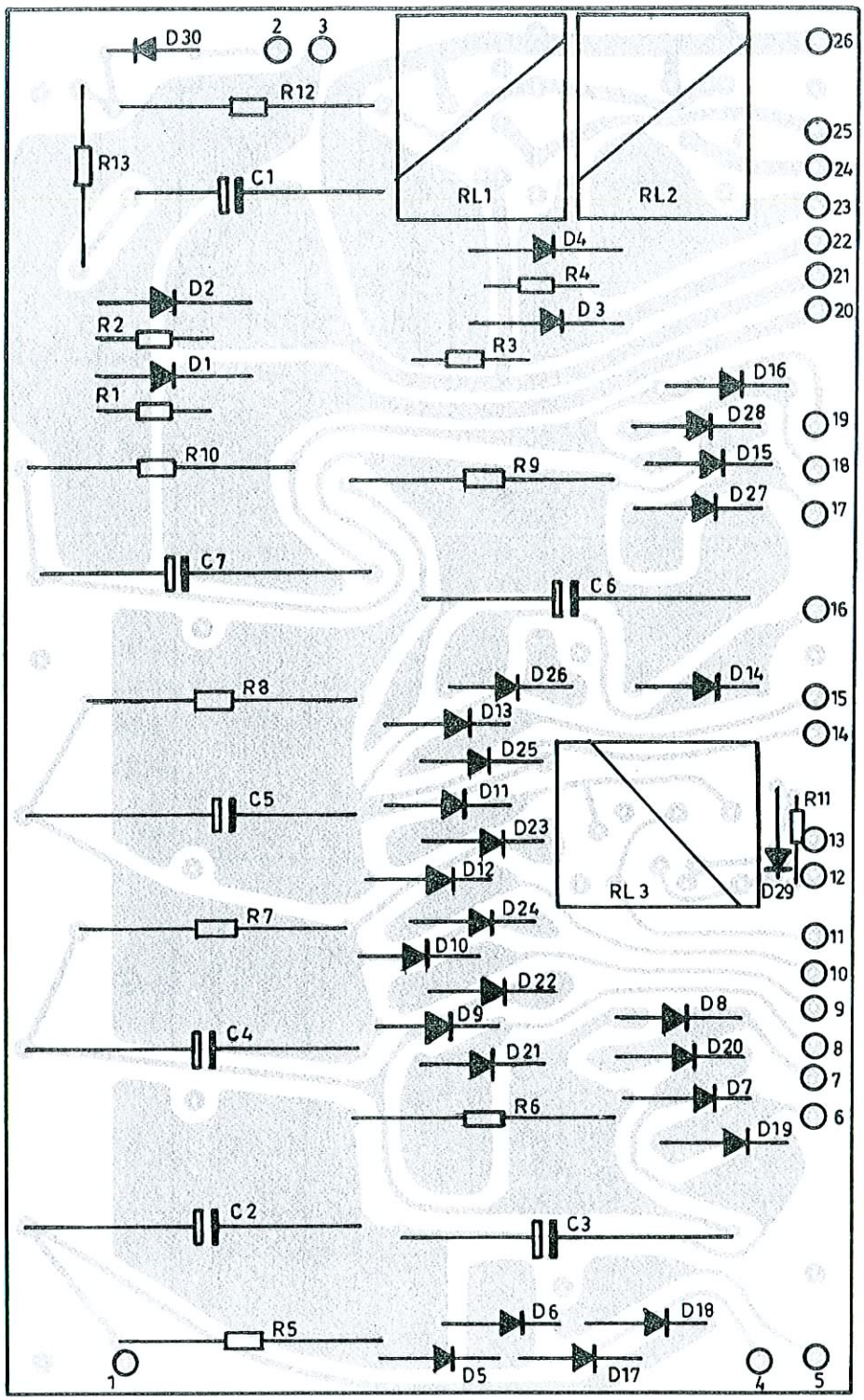
WIRING DIAGRAM 260



PRINTED CIRCUIT BOARD 261
VIEWED FROM COMPONENT SIDE



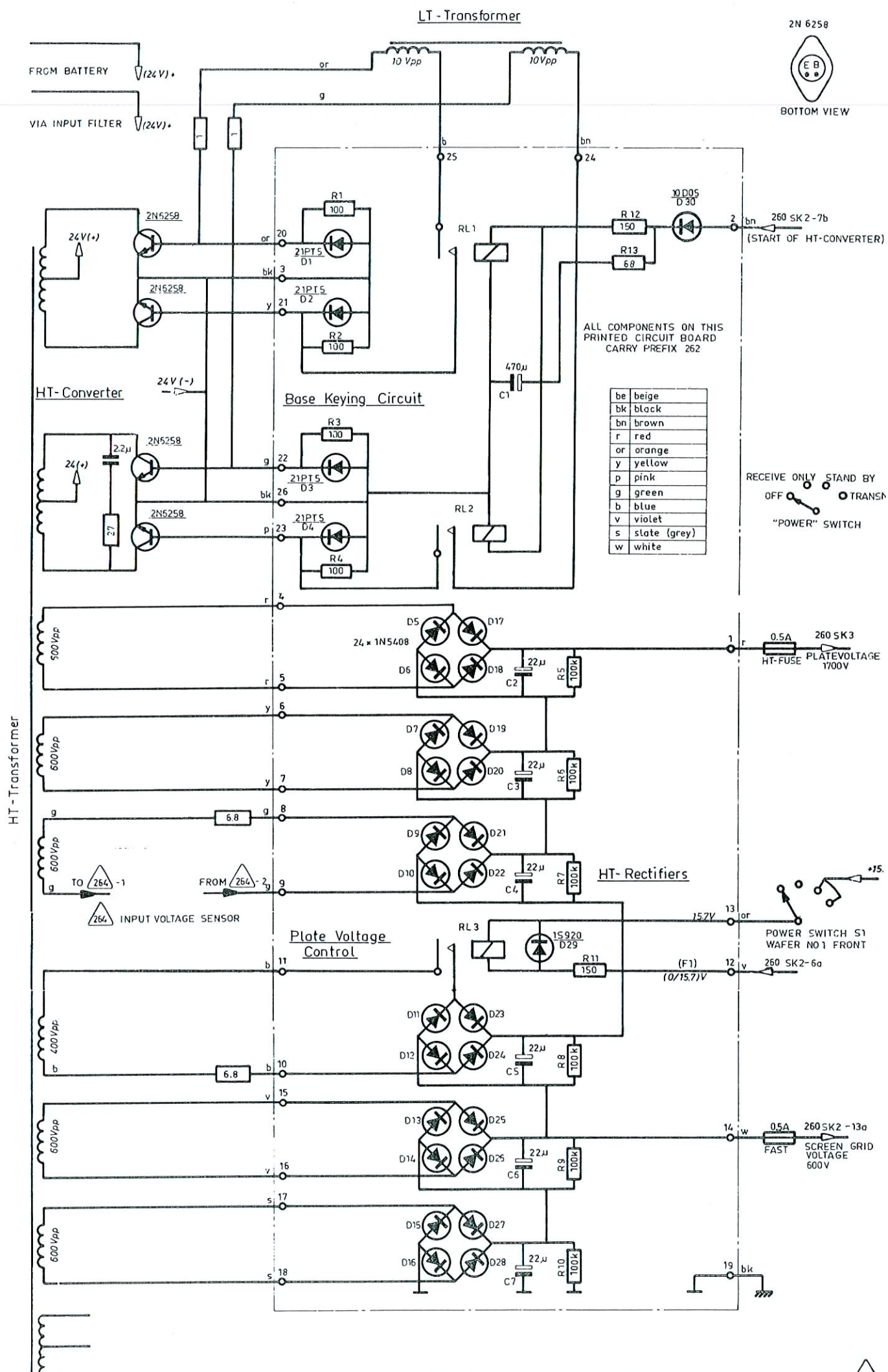
CONVERTER-DRIVER, LT-RECTIFIERS AND STABILIZERS 261



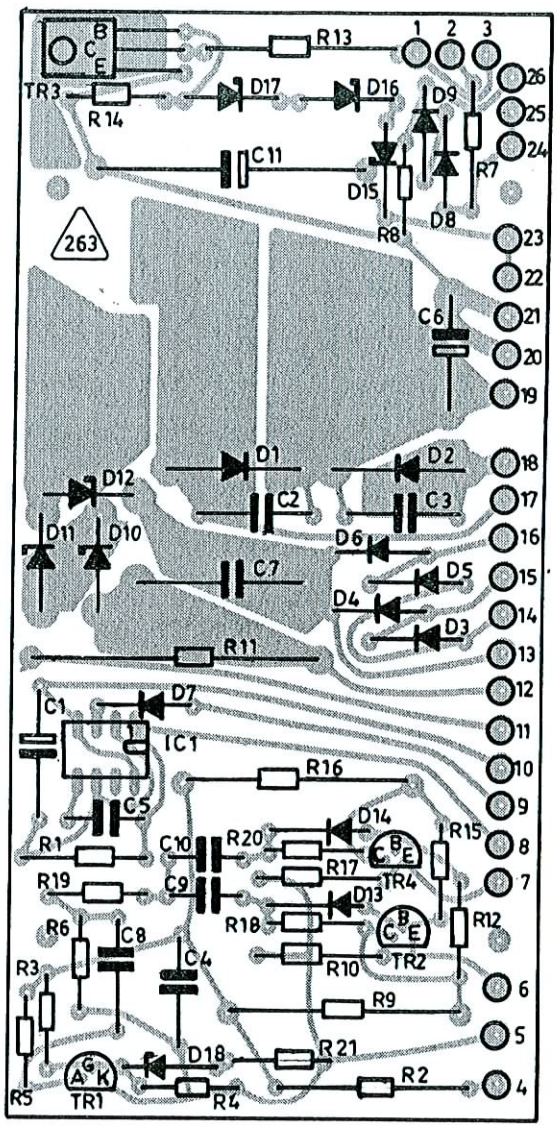
PRINTED CIRCUIT BOARD 262

994 201 72

VIEWED FROM COMPONENT SIDE



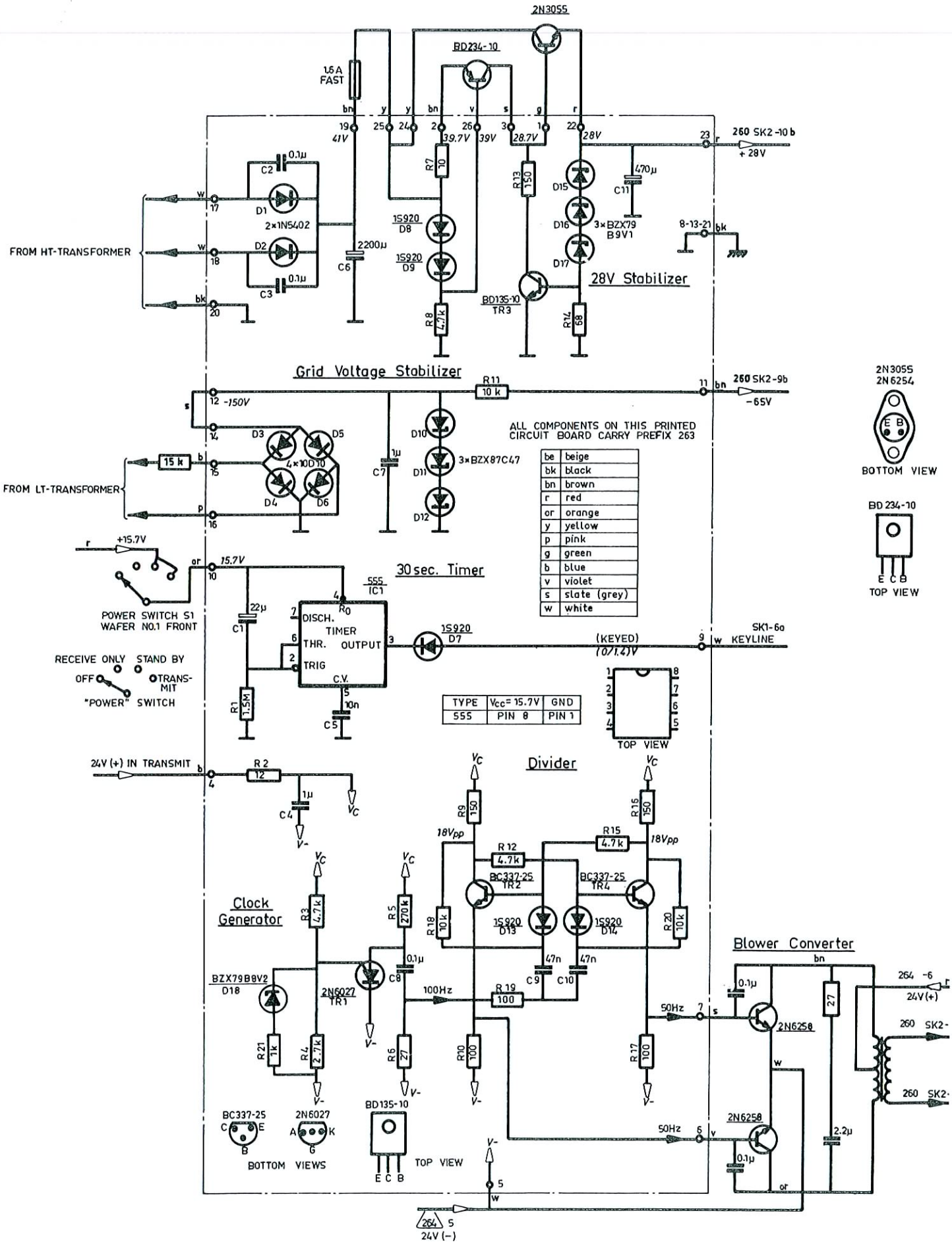
HT RECTIFIERS AND BASE KEYING CIRCUIT 262



PRINTED CIRCUIT BOARD 263

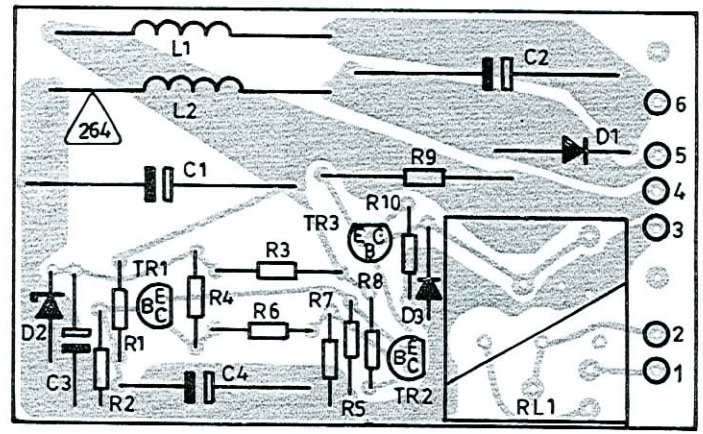
VIEWED FROM COMPONENT SIDE

-994 204 72



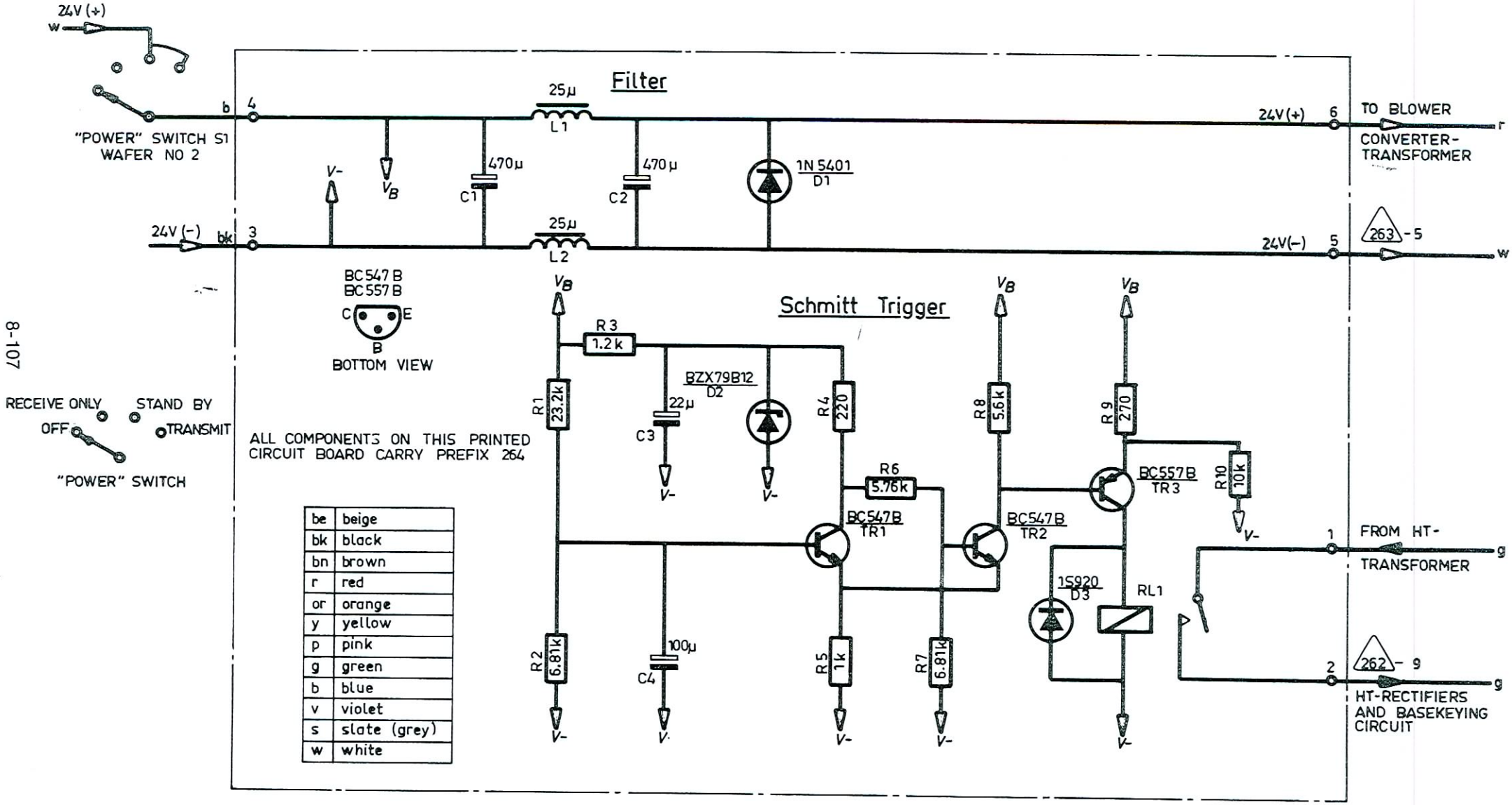
994 204 8 ②

DRIVER AND GRID VOLTAGE STABILIZERS

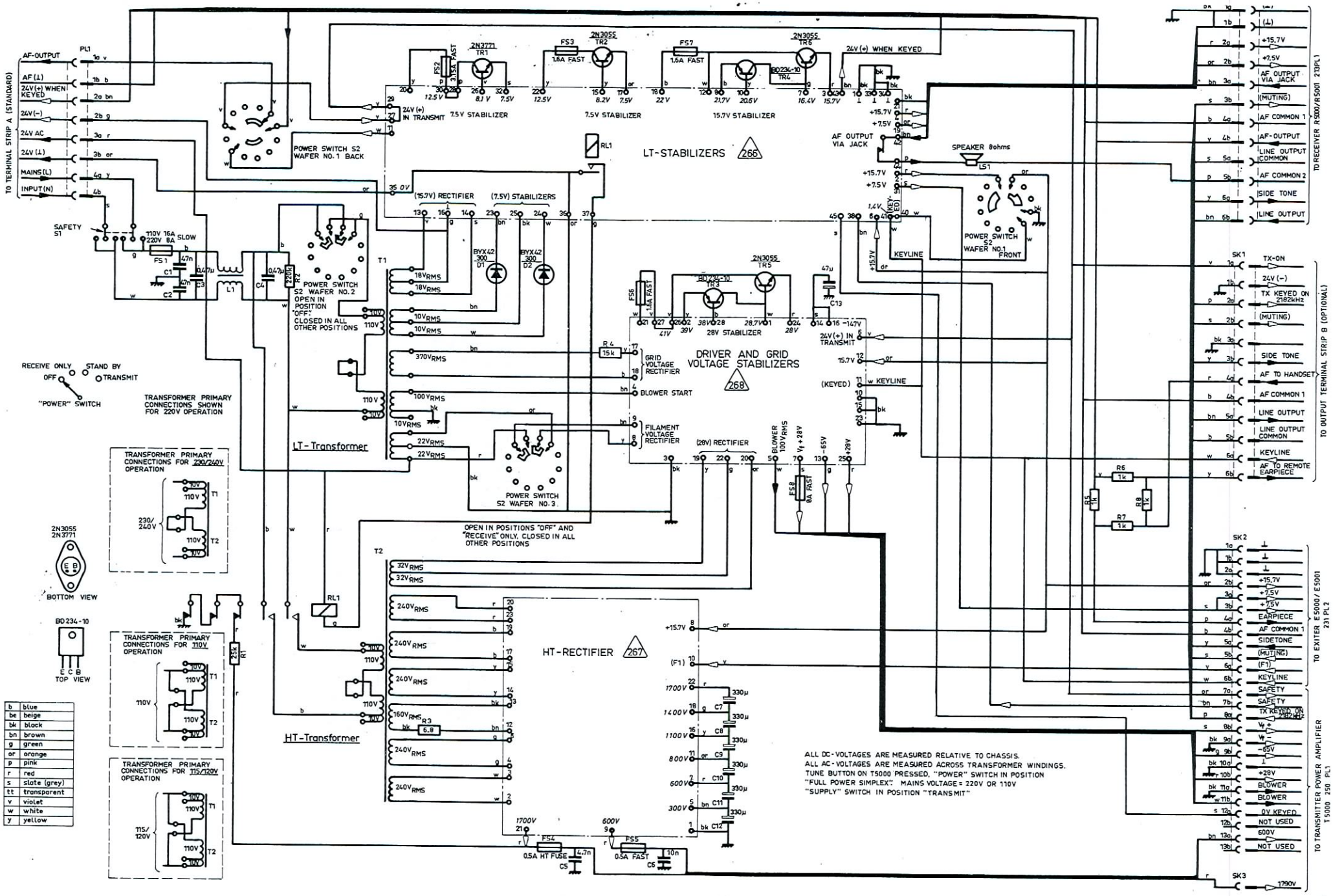


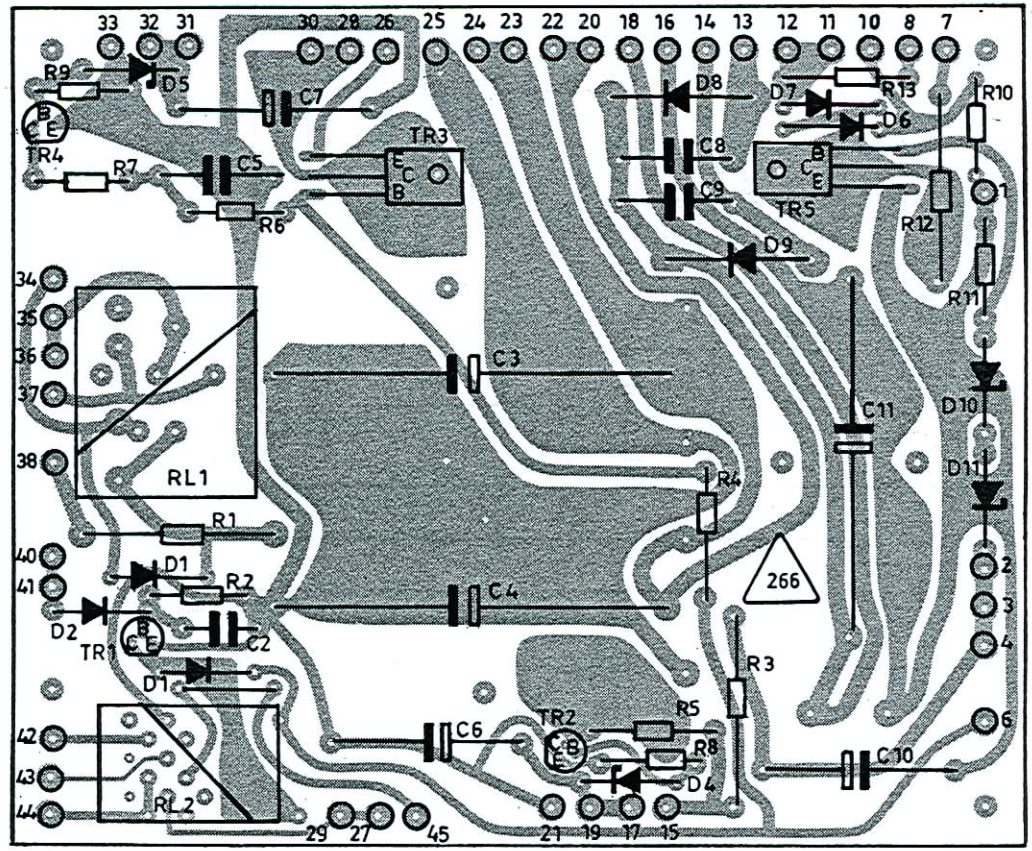
PRINTED CIRCUIT BOARD 264

VIEWED FROM COMPONENT SIDE



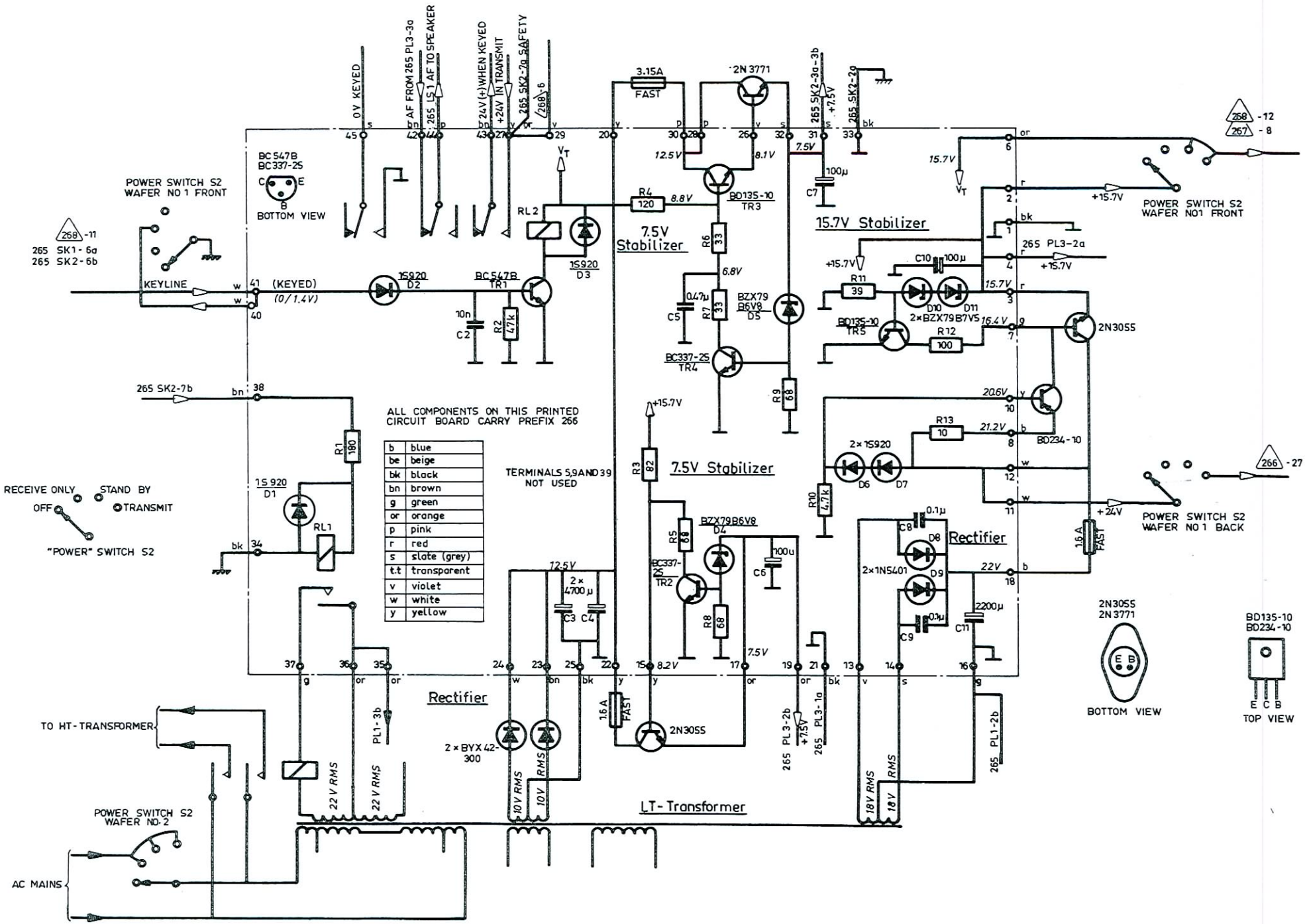
INPUT VOLTAGE SENSOR 264


P 5001 AC POWER PACK
WIRING DIAGRAM 265
LT-STABILIZERS 266
DRIVER AND GRID VOLTAGE STABILIZERS 268
HT-RECTIFIER 267
LT-Transformer
HT-Transformer
TO TERMINAL STRIP A (STANDARD)
TO RECEIVER R5000/R5001 213PL1
TO OUTPUT TERMINAL STRIP B (OPTIONAL)
TO EXITER E5000/E5001 231 PL2
TO TRANSMITTER POWER AMPLIFIER T5000 250 PL1
ALL DC-VOLTAGES ARE MEASURED RELATIVE TO CHASSIS.
ALL AC-VOLTAGES ARE MEASURED ACROSS TRANSFORMER WINDINGS.
TUNE BUTTON ON T5000 PRESSED, "POWER" SWITCH IN POSITION "FULL POWER SIMPLEX", MAINS VOLTAGE = 220V OR 110V
"SUPPLY" SWITCH IN POSITION "TRANSMIT"
994 210 0③



PRINTED CIRCUIT BOARD 266

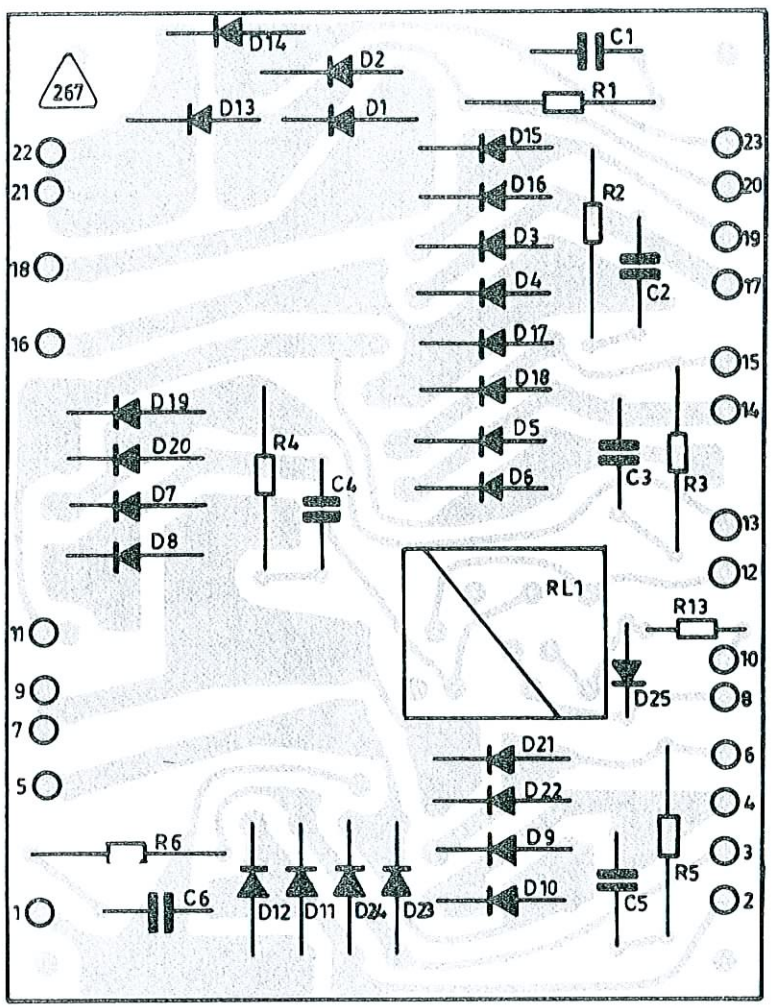
VIEWED FROM COMPONENT SIDE



8-111

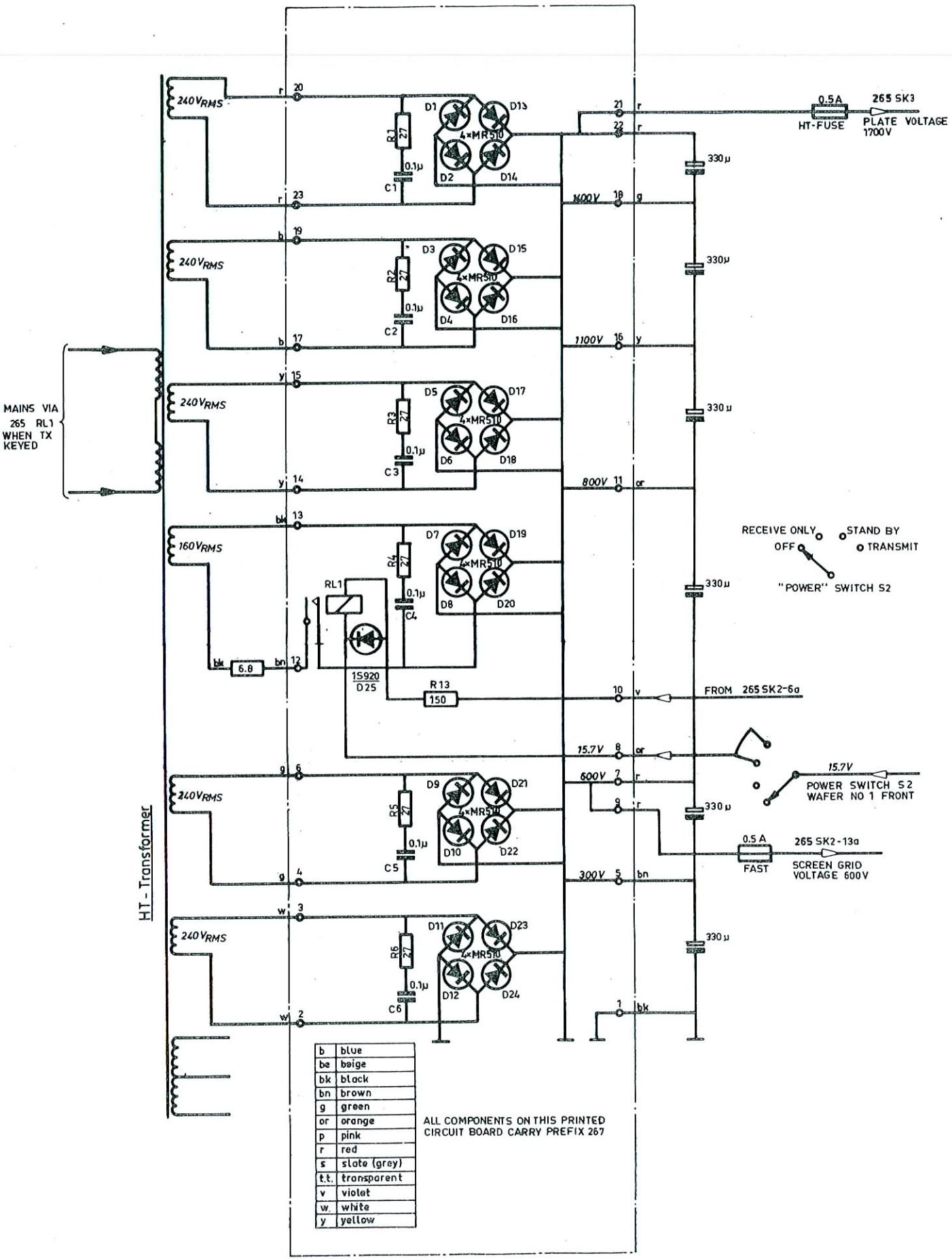
994 202 3(4)

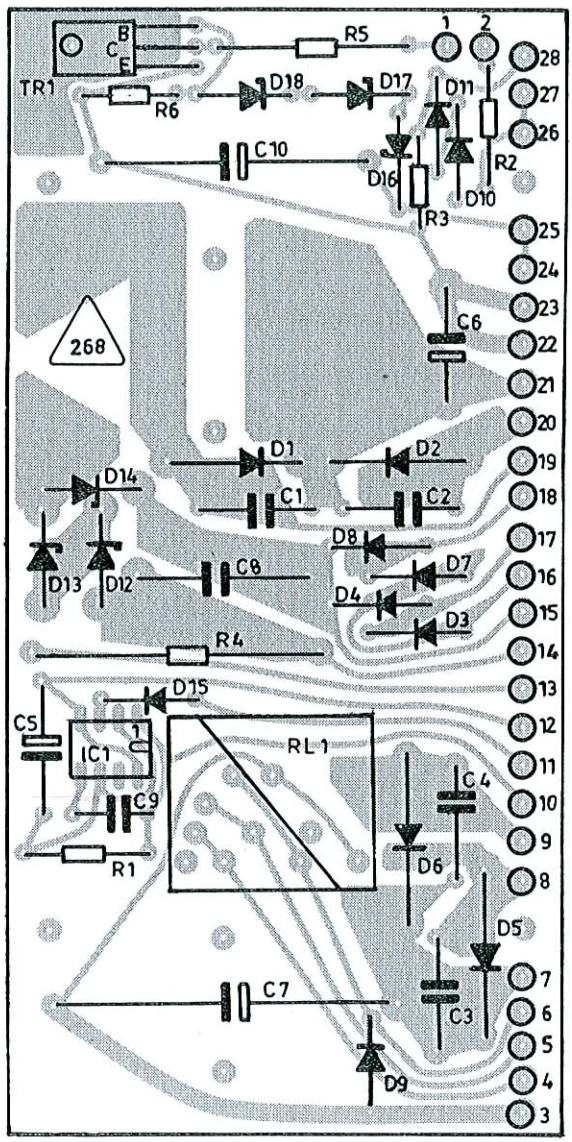
LT-STABILIZERS 266



994 202 72

PRINTED CIRCUIT BOARD 267
VIEWED FROM COMPONENT SIDE

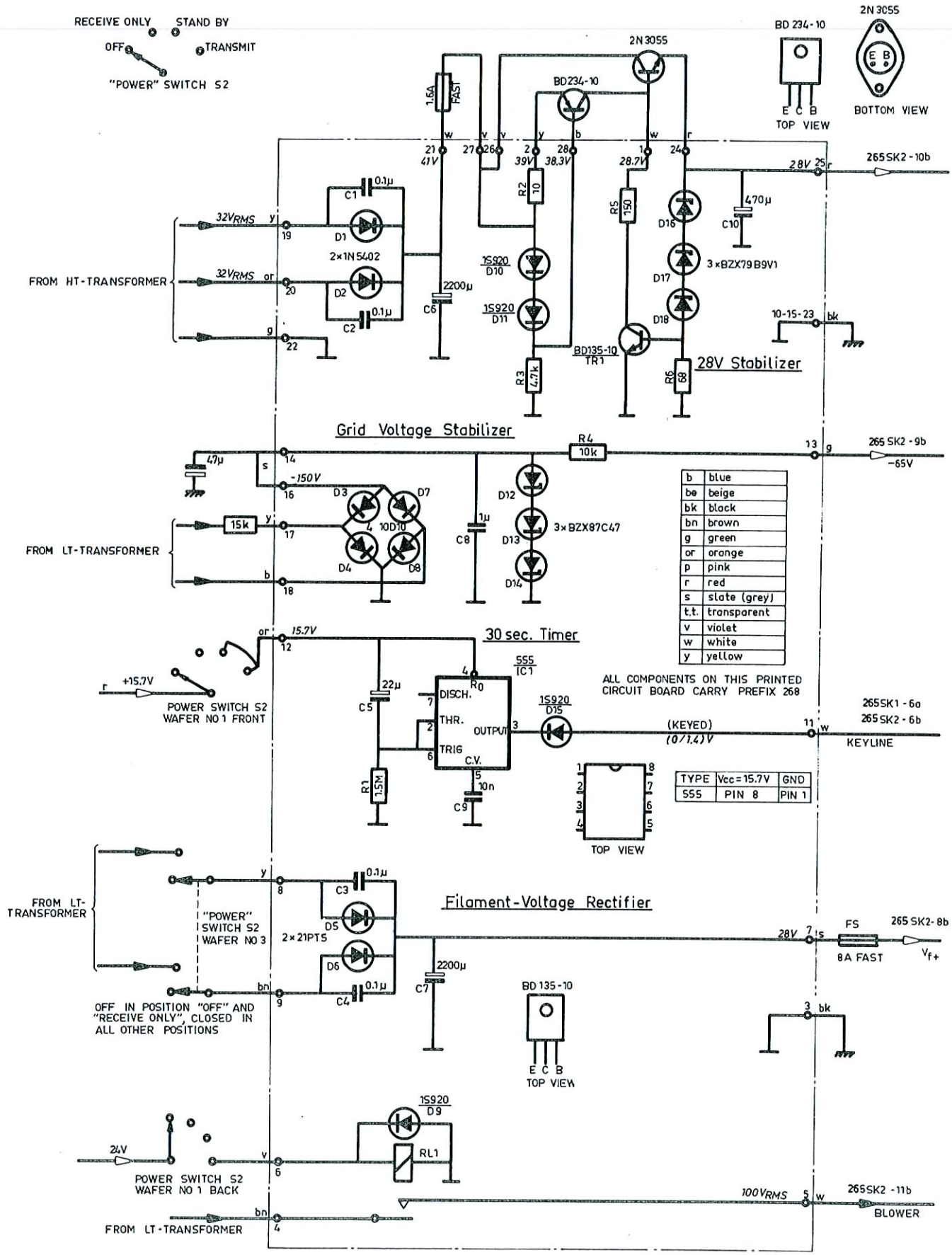

240VRMS
160VRMS
HT-Transformer
MAINS VIA 265 RL1 WHEN TX KEYED
4×MR510
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
R1 27
R2 27
R3 27
R4 27
R5 27
R6 27
0.1µ
C1
C2
C3
C4
C5
C6
RL1
6.8
1S920
D25
R13
150
330µ
1400V
1100V
800V
600V
300V
15.7V
0.5A
HT-FUSE
265 SK3
PLATE VOLTAGE 1700V
RECEIVE ONLY
STAND BY
OFF
TRANSMIT
"POWER" SWITCH S2
FROM 265 SK2-6a
15.7V
POWER SWITCH S2 WAFER NO 1 FRONT
0.5 A
FAST
265 SK2-13a
SCREEN GRID VOLTAGE 600V
b blue
be beige
bk black
bn brown
g green
or orange
p pink
r red
s slate (grey)
tt. transparent
v violet
w. white
y yellow
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 267

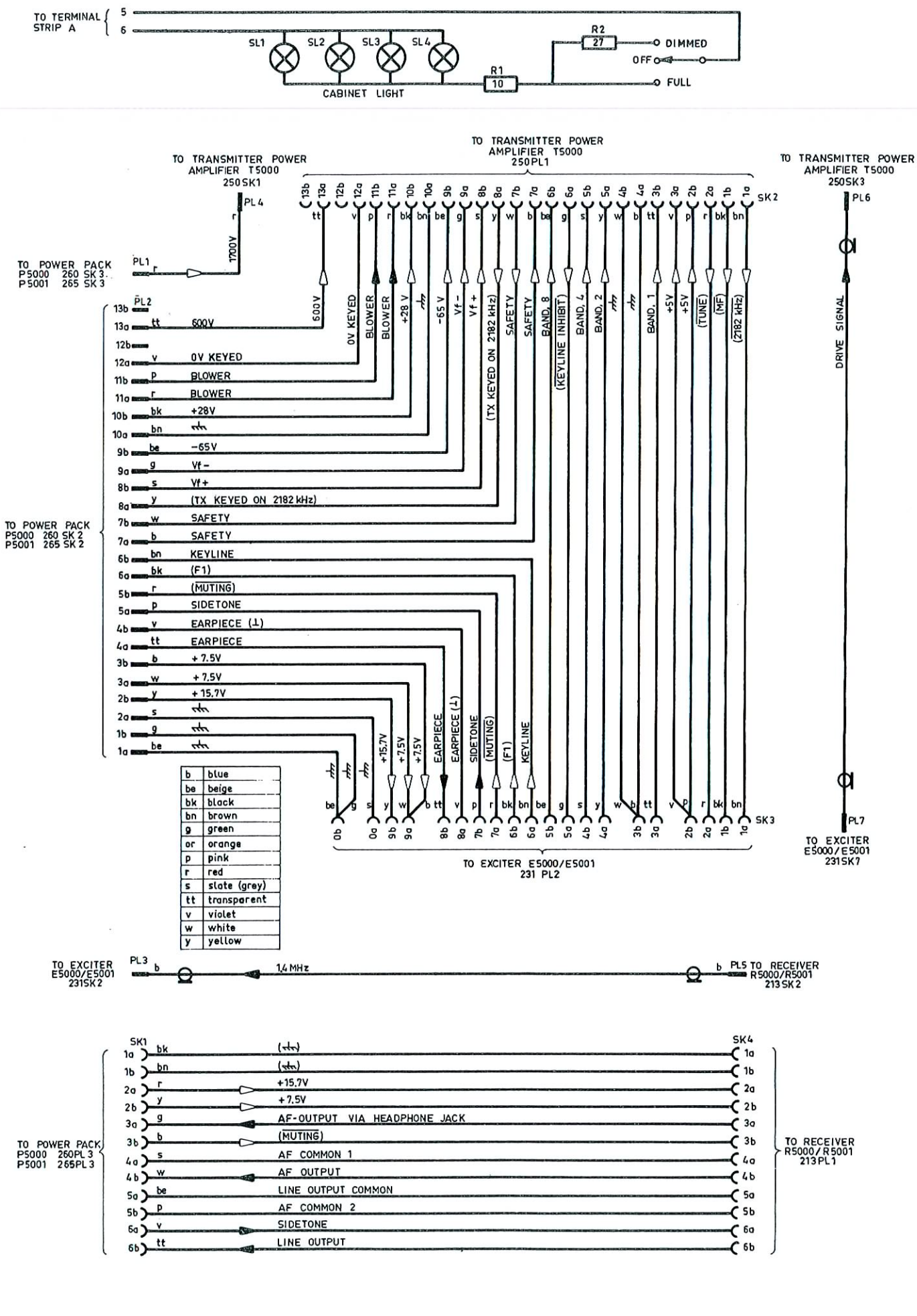


PRINTED CIRCUIT BOARD 268

994 205 21

VIEWED FROM COMPONENT SIDE


RECEIVE ONLY
STAND BY
OFF
TRANSMIT
"POWER" SWITCH S2
2N3055
BD234-10
BD 234-10
2N 3055
E C B
TOP VIEW
BOTTOM VIEW
1.6A FAST
21 41V
27
26
2 39V
28 38,3V
1 28.7V
24
28V 25
265SK2 - 10b
R2 10
R5 150
C1 0.1µ
C10 470µ
D16
D17
D18
3×BZX79B9V1
32VRMS
FROM HT-TRANSFORMER
D1
2×1N5402
D2
C2 0.1µ
C6 2200µ
1S920 D10
1S920 D11
BD135-10 TR1
R3 4.7k
R6 68
10-15-23 bk
28V Stabilizer
Grid Voltage Stabilizer
R4 10k
13
265 SK2 - 9b
-65V
47µ
14
-150V
16
15k
17
18
FROM LT-TRANSFORMER
D3
D4
4 10D10
D7
D8
C8 1µ
D12
D13
D14
3×BZX87C47
b blue
be beige
bk black
bn brown
g green
or orange
p pink
r red
s slate (grey)
t.t. transparent
v violet
w white
y yellow
ALL COMPONENTS ON THIS PRINTED CIRCUIT BOARD CARRY PREFIX 268
30 sec. Timer
15.7V
12
+15.7V
POWER SWITCH S2 WAFER NO 1 FRONT
555 IC1
R0
DISCH.
THR.
TRIG
OUTPUT
C.V.
22µ C5
R1 1.5M
10n C9
1S920 D15
(KEYED) (0/1.4)V
11
265SK1 - 6a
265SK2 - 6b
KEYLINE
TYPE Vcc=15.7V GND
555 PIN 8 PIN 1
TOP VIEW
FROM LT-TRANSFORMER
"POWER" SWITCH S2 WAFER NO 3
OFF IN POSITION "OFF" AND "RECEIVE ONLY", CLOSED IN ALL OTHER POSITIONS
8
9
C3 0.1µ
D5
2×21PT5
D6
C4 0.1µ
C7 2200µ
Filament-Voltage Rectifier
28V 7
FS
8A FAST
265 SK2- 8b
Vf+
BD 135-10
E C B
TOP VIEW
3 bk
1S920 D9
RL1
24V
POWER SWITCH S2 WAFER NO 1 BACK
6
4
FROM LT-TRANSFORMER
100VRMS 5
265SK2 -11b
BLOWER



TRP5000 CABINET WIRING
INTERCONNECTIONS BETWEEN UNITS

991 202 64

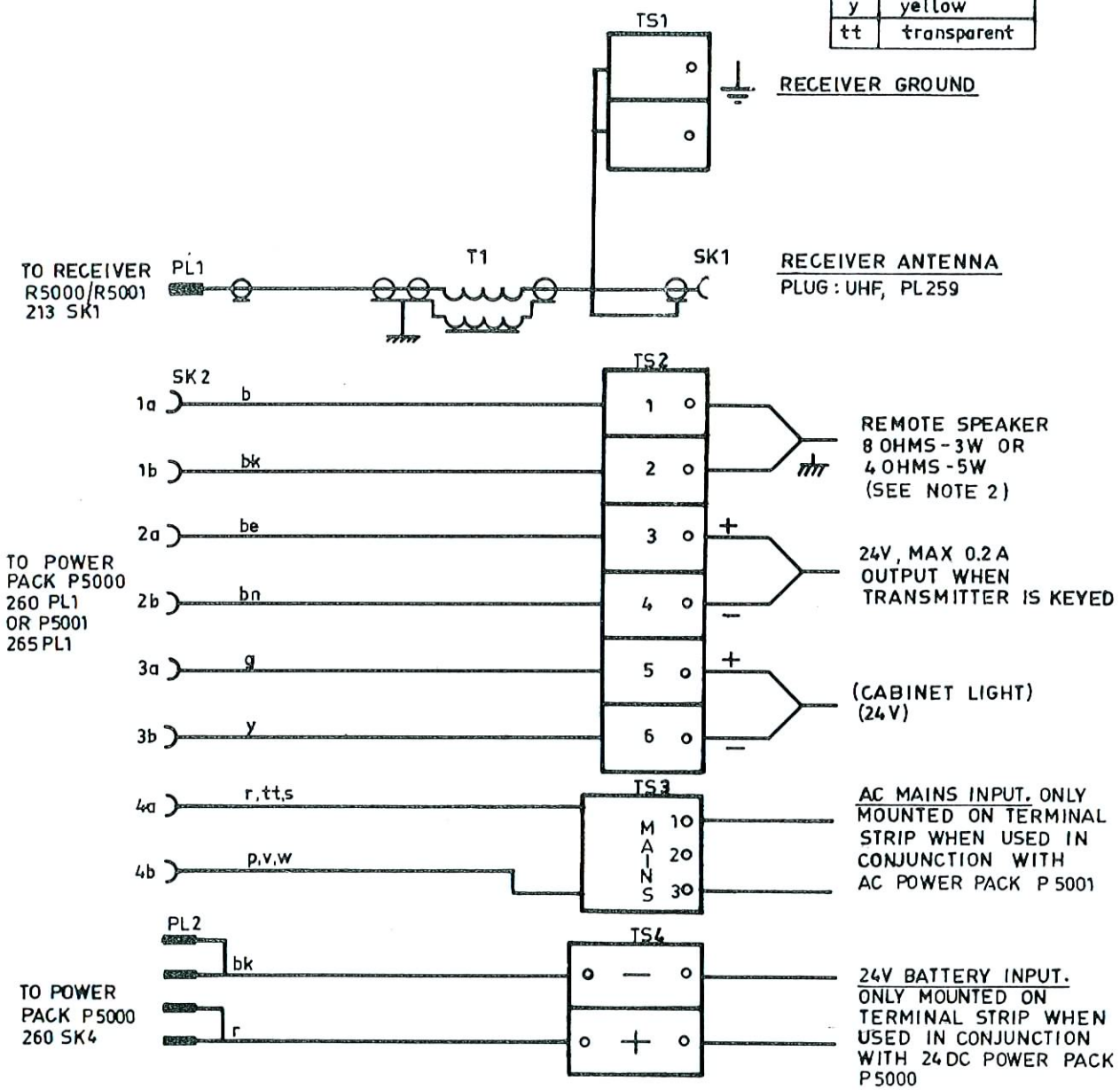
TRP 5000

CABINET WIRING

TERMINAL STRIP A

(mounted on cabinet back wall)

b	blue
be	beige
bk	black
bn	brown
g	green
or	orange
p	pink
r	red
s	slate (grey)
v	violet
w	white
y	yellow
tt	transparent



NOTE 1 :

MAX CABLE LENGTH TO BATTERY	MIN. CONDUCTOR AERA
5 m	2x10 mm^2
9 m	2x16 mm^2
13 m	2x25 mm^2

NOTE 2 : AN AUDIO POWER OF 5 WATTS IS AVAILABLE IN A 4 OHMS LOAD. THIS POWER CAN BE SHARED BETWEEN SEVERAL LOUDSPEAKERS IF SO DESIRED. THE BUILT-IN SPEAKER IN THE POWER PACK HAS AN IMPEDANCE OF 8 OHMS. WHEN CONNECTING REMOTE SPEAKERS THE MINIMUM VALUE OF THE TOTAL IMPEDANCE SHOULD BE MORE THAN 4 OHMS INCLUDING THE BUILT-IN SPEAKER IN ORDER TO OBTAIN MAXIMUM POWER OUTPUT. IF 5 WATTS IS REQUIRED IN REMOTE SPEAKER(S) THE BUILT-IN SPEAKER MUST BE DISCONNECTED.

EXCITER

Type E5001

ADDENDUM TO
INSTRUCTION MANUAL FOR
SSB RADIOTELEPHONE TYPE TRP5000

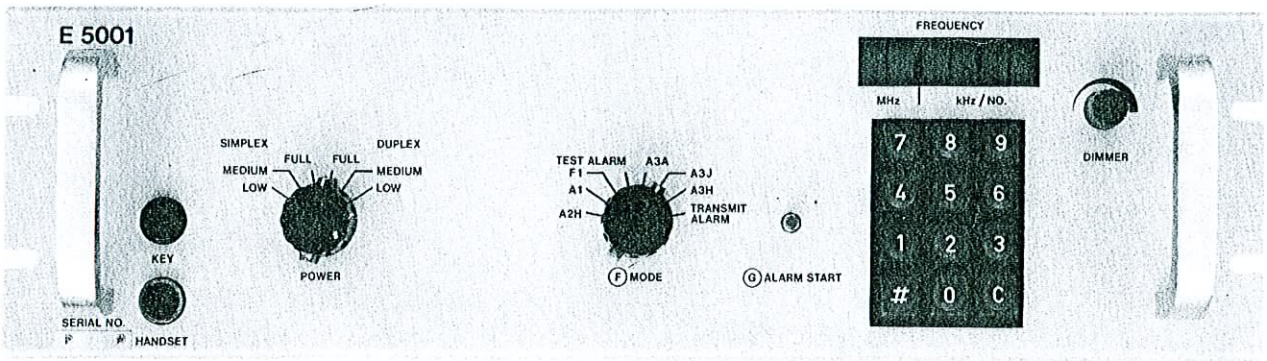
CONTENTS

1. INTRODUCTION

1.1. The E 5001 exciter is intended to be used as a part of the TRP 5000 single sideband radiotelephone transmitter receiver combination where it can directly replace the E 5000 exciter.

The E 5001 features direct keyboard selection of any frequency in the maritime mobile bands and, in addition, 128 programmable frequencies.

Apart from the method of frequency selection the E 5001 and the E 5000 are identical. For this reason reference should be made to the description in the TRP 5000 manual. This addendum covers only the part of the E 5001 that differs from the E 5000.



2. OPERATING INSTRUCTIONS

The operating controls of the E 5001 are identical to the operating controls of the E 5000 except that the KEYBOARD has one additional key marked [#]. This key is used for selecting between free frequency and programmed frequency selection.

In the programmed frequency position the »no.« sign is shown in the display. The keyboard is used for selection of the No. of a preprogrammed frequency listed in the frequency chart. The keyed-in No. is shown in the display.

In the free frequency position the decimal point is shown in the display. The keyboard is used for direct selection of the desired transmitting frequency in the maritime mobile bands. The transmitting frequency is shown in the display.

Note that the displayed frequency is the carrier frequency in the modes A2H, A1, A3A, A3J and A3H. In the F1 mode the displayed frequency is the assigned frequency, provided that the center frequency of the AF output from the telex equipment is 1500 Hz.

3. INSTALLATION

The E 5001 as in the case of the E 5000 covers the maritime mobile frequency bands only. The band-pass filters in the exciter limit the usable frequencies to the marine bands, even through any frequency can be keyed into the keyboard. Table 3.1 below shows the frequency ranges covered by the exciter.

1605 - 4000.0 kHz
4063 - 4219.4 kHz
6200 - 6325.4 kHz
8195 - 8435.4 kHz
12330 - 12652.3 kHz
16460 - 16859.4 kHz
22000 - 22310.5 kHz
25010 - 25600.0 kHz

Table 3.1

The exciter supplies control signals to the Band Indicator of the Transmitter Power Amplifier T 5000 showing where to set the BAND switch in accordance with the frequency selected. The frequency range 1605-4000 kHz is divided into 8 bands (positions A to H on the BAND switch) as shown in table 3.2 below. The subdivision is based on article 7, section 4 (1976) of the Radio Regulations.

Transmitting frequency (kHz)	BAND
1605-1750	A
1950-2150	B
2150-2350	C
2350-2550	D
2550-2750	E
3000-3200	F
3200-3400	G
3400-3600	H

Table 3.2

If special frequencies in the range 1605-4000 kHz are to be covered another subdivision may be necessary. In this case the PROM 247IC17 which determines the control signals to the Band Indicator has to be replaced with one that has been programmed to give the desired subdivision. When programming the Memory /238\ this new subdivision must also be respected. Note that when a special subdivision is made the difference between the highest and lowest frequency within a band should not exceed approx. 200 kHz.

After installation the antenna tuning circuit of the Transmitter Power Amplifier should be adjusted, in each band, at one of the band limits (see tables 3.1 and 3.2). It must be checked at the opposite band limit that the »Level« does not exceed 3.

Note: /238\ MEMORY board has been modified to adapt it to the E 5001. The diagram No. of the new version is 992 204 8 (4) and the printed circuit board is labeled (4) . This version can be used in the E 5001 as well as in the E 5000.

Older versions are modified as follows. The connection from 238IC2 pin 12 to ground is opened and 238IC2 pin 12 is connected to terminal 238-4a. The connection from 238R14 to terminal 238-24c is opened. The printed circuit board can then be used only in the E 5001.

4. TECHNICAL DATA

Frequency coverage

1.6 to 4 MHz and 4-6-8-12-16-22 and 25 MHz maritime mobile telephony-, telegraphy- and telex frequencies.

Frequency Selection

1. Free frequencies:
   Keyboard selection in 100 Hz increments (6 digits).
   Frequency shown in display.
2. Programmed frequencies:
   Keyboard selection of up to 128 preprogrammed frequencies.
   Frequency No. shown in display.
3. 2182 kHz:
   Separately selected by Transmitter Power Amplifier BAND switch.

Replacement of Exciter

Replacing an E 5001 with an E 5000 and vice versa involves no modification of Transmitter Power Amplifier, Power Pack or Receiver.

5. TECHNICAL DESCRIPTION

The E 5001 contains the same printed circuit boards as the E 5000 except that board /239\ is replaced by board /247\. This board is mounted behind the front panel and connected to the motherboard /231\ by means of a ribbon cable /246\. The back of 231SK8 serves as a plug for the ribbon cable socket.

In the E 5001 the (WT) output, terminal 238-24c, from MEMORY /238\ is disabled and terminal 238-24c is via the ribbon cable and /247\ connected to terminal 231SK8-23c (1.5 kHz SHIFT). This means that in the E 5001 transmission is *not* inhibited if the mode setting does not correspond with the frequency selected.

/247\ DISPLAY AND KEYBOARD, Circuit Description

When a key is depressed or released some sort of bouncing effect will always appear before the key has settled. This bouncing is removed by means of the Key Bounce Eliminator, consisting of IC41 and associated external components. When a key has settled after being depressed, a read-pulse is produced at pin 5 of IC41 and the BCD code of the key number in question, produced by IC42 and IC44, is read into the first register IC40 of the Digit Register Stack. The data blocks already stored in this Stack are simultaneously shifted to the next register.

The content of the Digit Register Stack is decoded by means of the six BCD to 7-segment decoder/drivers IC3, IC12, IC20, IC25, IC29, and IC33, which will turn on the proper segments of the six displays IC4, IC13, IC21, IC26, IC30, and IC35.

By means of the variable voltage regulator consisting of TR2, TR3, dimmer potentiometer R 108 and associated components the six displays can be dimmed continuously.

Two display modes are possible.

If the key S4 is open, any Exciter output frequency less than 30,000.0 kHz can be keyed into the displays. By means of TR1, which is now turned on, the decimal point of the display IC35 is lit.

If the key S4 is closed any Frequency No. less than 256 can be keyed into the three displays IC26, IC30, and IC35. In this case the three displays IC4, IC13 and IC21 will be turned off due to a LOW at the RBO input of IC3, IC12, and IC20. TR4 will be turned on, now sinking the currents through the diodes D1, D2, D3, D4, D5, D6, and D7. Thereby some segments of the two displays IC4 and IC13 are lit, forming two letters: no (short for Frequency No.). TR1 is turned off, extinguishing the decimal point of IC35.

If the 2182 kHz position of the BAND switch is chosen, a LOW enters at terminal 247-26c and produces via a few gates a steady low at the RBO-input of the six BCD to 7-segment decoder/drivers. This turns off all the segment drivers thereby extinguishing all the displays. TR1 and TR4 are also turned off so that no current can pass through the diodes D1, D2, D3, D4, D5, D6, D7, and the decimal point of IC35.

When the Exciter output frequency is displayed some circuitry is necessary to provide proper control of the Frequency Synthesizer. Each of the three least significant data blocks of the Digit Register Stack is fed to a BCD to 9's complement converter IC28, IC31, and IC45 before it is fed to /237\, controlling the 100 Hz, 1 kHz, and 10 kHz digits of the Synthesizer frequency.

The 100 kHz data block and correction data, stored in PROM IC10, are added together in the Full adder IC11. The result controls the PROM IC9 which provides the information of the 100 kHz and 1 MHz digits of the synthesizer frequency.

The Band information is derived from PROM IC17. If the Exciter output frequency is between 1.60 MHz and 3.99 MHz, then IC17 is controlled by the 10 kHz, 100 kHz and 1 MHz data blocks of the Digit Register Stack via IC19, IC24 and IC16. The programming of PROM IC17 will provide a Band selection in accordance with table 3.2.

If the Exciter output frequency is outside the 1.60 MHz to 3.99 MHz frequency range PROM IC17 is controlled by the 1 MHz and 10 MHz data blocks via IC8 and IC16.

If one tries to key into the displays an Exciter output frequency greater than 29,999.9 kHz pin 3 of IC2 will produce a clear command for the whole Digit Register Stack.

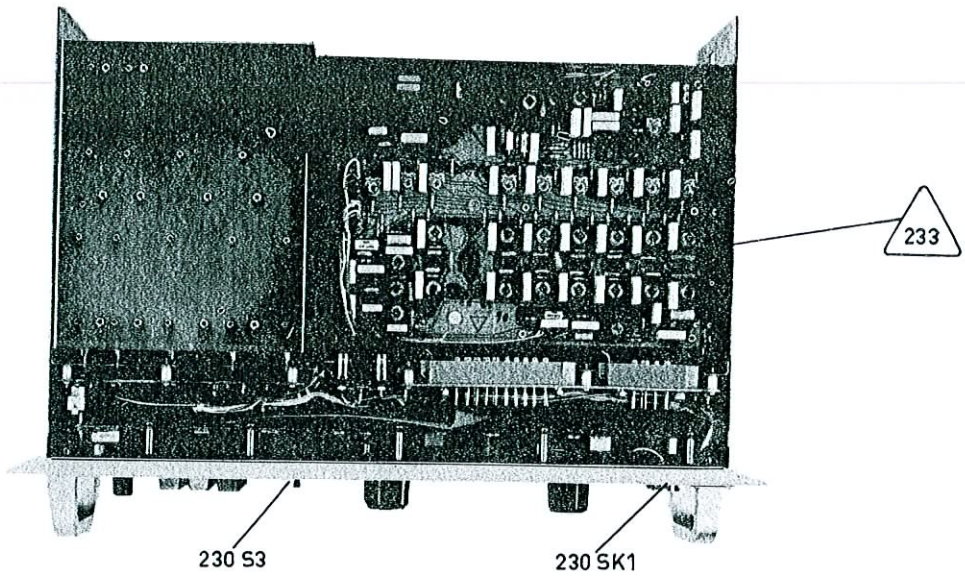
When the Frequency No. is displayed IC8, IC9, IC10, IC16, IC17, IC18, IC28, IC31, and IC45 are all disabled, and simultaneously the Memory /238\ is enabled via terminal 247-4a. The four now enabled BCD to binary converters IC34, IC36, IC38, and IC39 convert the BCD code of the three least significant data blocks to the associated binary code, thus providing necessary control for the Memory /238\.

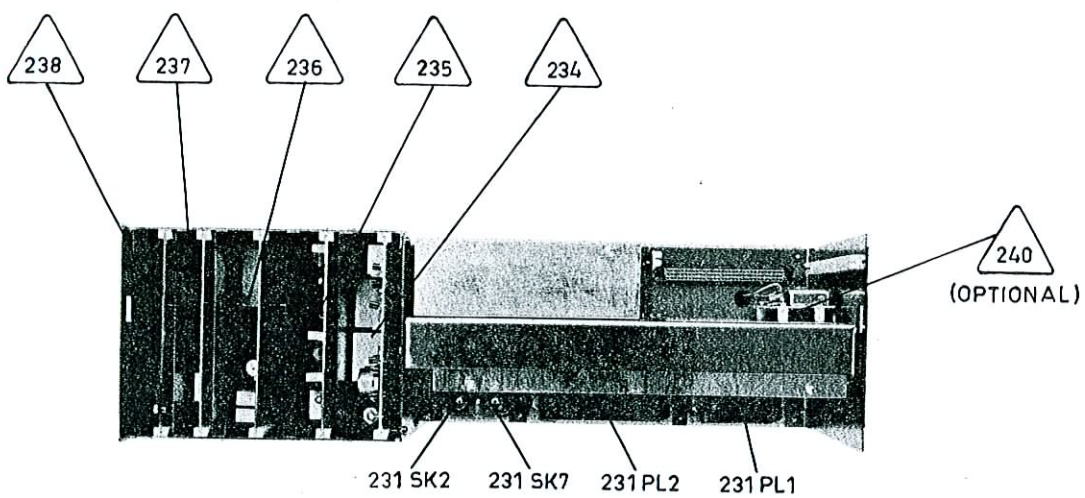
If one tries to key into the displays a Frequency No. greater than 255, 3/6 of IC37 will via 1/4 IC1 produce a clear command on the clear-line of the Digit Register Stack.

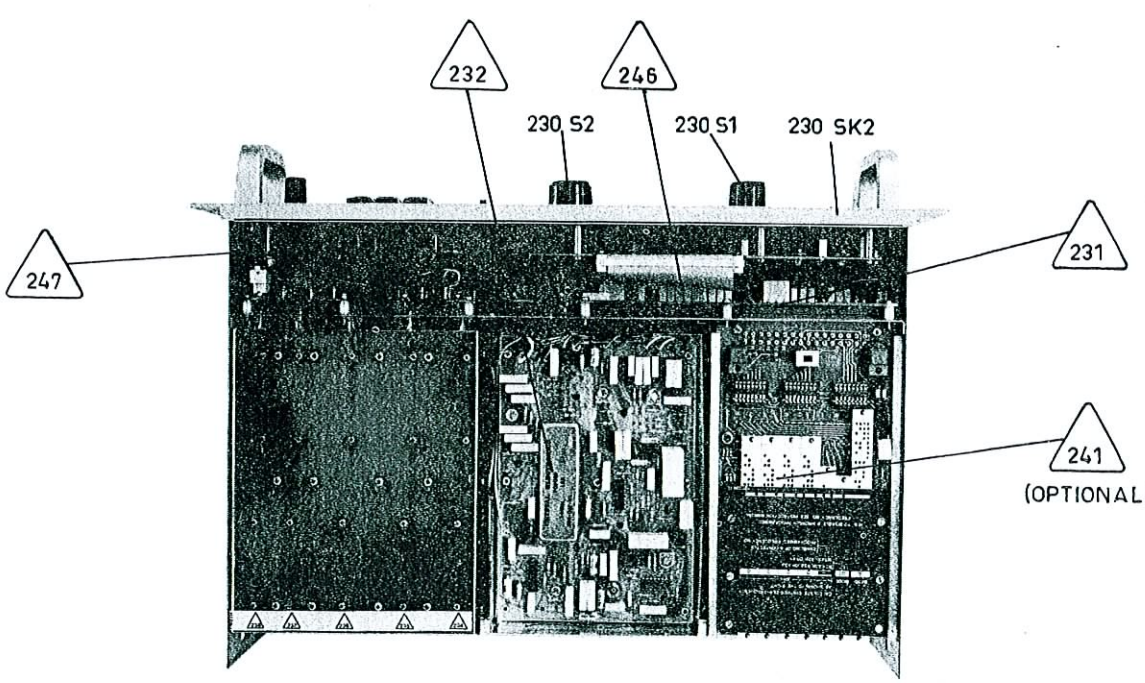
The »C«-key S12 is attached to the same clear line thus providing the facility of manual clear.

Each time the Display mode-key S4 is activated one of the two monostables of IC50 will be triggered and will thereby produce a clear command on the above mentioned clear-line.

If a HIGH appears on terminals 247-6a (Disable) or LOW on terminal 247-6c (Programmed Frequency No.) the Blanking Oscillator consisting of IC48 and associated components start a 1 Hz oscillation and the Keyline is inhibited. The output from pin 3 IC48 will via a few gates make the displays flash with a frequency of 1 Hz, but these gates control that this flashing only takes place in the Frequency No. display mode.







LOCATION OF CIRCUIT BOARDS
EXCITER E5001

PARTS LIST

FOR

245S 1					372 200 13
S 2					372 200 23
S 3					763 000 09
245SK1	5 Way				751 000 03
SK2					750 000 12
245C 1	47 nF	-20/+80%	12V	Cer.	601 447 00
C 2-5	10 nf	-20/+80%	30V	Cer.	602 410 00

PARTS LIST

FOR

Ribbon Cable complete	107 024 61

PARTS LIST

FOR

247C1	100 pF	1%	500V	Polyst.	615 210 00
C2	10 nF	10%	250V	Polyes.	624 410 00
C3-5	0,1 uF	10%	100V	Polyes.	623 510 00
C6-7	0,1 uF	10%	100V	Polyes.	623 510 00
C8	22 uF		16V	Tan	651 722 00
C9	0,22 uF	10%	100V	Polyes.	623 522 00
C10	0,22 uF	10%	100V	Polyes.	623 522 00
C11	10 nF	10%	250V	Polyes.	624 410 00
C12	100 uF		25V	W.Alum.	652 810 00
C13	22 uF		16V	Tan	651 722 00
C14	1 uF	10%	100V	Polyes.	623 610 00
C15-16	10 nF	10%	250V	Polyes.	624 410 00
C17	220 pF	1%	500V	Polyst.	615 222 00
C18	0.22 uF	10%	100V	Polyes.	623 522 00

247D1-7	AAZ17	830 001 70
D8-10	IS920	830 192 00
D11-12	AAZ17	830 001 70
247IC1	74LS125	857 412 50
IC2	74LS03	850 740 31
IC3	74LS47	850 744 70
IC4	MAN82	824 008 20
IC5	74LS74	850 747 40
IC6	74LS05	850 740 51
IC7	74LS266	857 426 60
IC8	74184	857 418 40
IC9	74S188 (programmed)	382 212 51
IC10	74S188 (programmed)	382 212 61
IC11	74LS283	857 428 30
IC12	74LS47	850 744 70
IC13	MAN82	824 008 20
IC14	74LS03	850 740 31
IC15	74LS195 A	857 419 50
IC16	74LS257 A	857 425 70
IC17	74S188 (programmed)	382 212 71
IC18	74LS257 A	857 425 70

1 - 5

PARTS LIST

FOR

247IC19	74184	857 418 40
IC20	74LS47	850 744 70
IC21	MAN82	824 008 20
IC22	7416	850 741 60
IC23	74LS195 A	857 419 50
IC24	74LS85	850 748 50
IC25	74LS47	850 744 70
IC26	MAN82	824 008 20
IC27	74LS195 A	857 419 50
IC28	74184	857 418 40
IC29	74LS47	850 744 70
IC30	MAN 82	824 008 20
IC31	74184	857 418 40
IC32	74LS195 A	857 419 50
IC33	74LS47	850 744 70
IC34	74184	857 418 40
IC35	MAN82	824 008 20
IC36	74184	857 418 40
IC37	74LS05	850 740 51
IC38-39	74184	857 418 40
IC40	74LS195 A	857 419 50
IC41	74LS123	857 412 30
IC42	74LS00	850 740 02
IC43	74LS09	850 740 90
IC44	74148	857 414 80
IC45	74184	857 418 40
IC46-47	7805	850 780 50
IC48	555	850 055 50
IC49	74LS03	850 740 31
IC50	74LS123	857 412 30
247PL1	64 Way	751 000 22

PARTS LIST

FOR

247R1	4,7 kohms	5%	1/3W	Car.	501 347 00
R2-4	100 ohms	5%	1/3W	Car.	501 210 00
R5-6	4,7 kohms	5%	1/3W	Car.	501 347 00
R7	100 ohms	5%	1/3W	Car.	501 210 00
R 8-10	4,7 kohms	5%	1/3W	Car.	501 347 00
R11	100 ohms	5%	1/3W	Car.	501 210 00
R12-14	4.7 kohms	5%	1/3W	Car.	501 347 00
R15	100 ohms	5%	1/3W	Car.	501 210 00
R16-19	4,7 kohms	5%	1/3W	Car.	501 347 00
R20	100 ohms	5%	1/3W	Car.	501 210 00
R21-23	4,7 kohms	5%	1/3W	Car.	501 347 00
R24	100 ohms	5%	1/3W	Car.	501 210 00
R25-26	4,7 kohms	5%	1/3W	Car.	501 347 00
R27	100 ohms	5%	1/3W	Car.	501 210 00
R28	4,7 kohms	5%	1/3W	Car.	501 347 00
R29-44	100 ohms	5%	1/3W	Car.	501 210 00
R45	4,7 kohms	5%	1/3W	Car.	501 347 00
R46	100 ohms	5%	1/3W	Car.	501 210 00
R47-48	4,7 kohms	5%	1/3W	Car.	501 347 00
R49	100 ohms	5%	1/3W	Car.	501 210 00
R50-52	4,7 kohms	5%	1/3W	Car.	501 347 00
R53	100 ohms	5%	1/3W	Car.	501 210 00
R54-56	4,7 kohms	5%	1/3W	Car.	501 347 00
R57	100 ohms	5%	1/3W	Car.	501 210 00
R58-61	4,7 kohms	5%	1/3W	Car.	501 347 00
R62	100 ohms	5%	1/3W	Car.	501 210 00
R63	4,7 kohms	5%	1/3W	Car.	501 347 00
R64	100 ohms	5%	1/3W	Car.	501 210 00
R65	4,7 kohms	5%	1/3W	Car.	501 347 00
R66	100 ohms	5%	1/3W	Car.	501 210 00
R67	4,7 kohms	5%	1/3W	Car.	501 347 00
R68-71	100 ohms	5%	1/3W	Car.	501 210 00
R72-73	4,7 kohms	5%	1/3W	Car.	501 347 00
R74	100 ohms	5%	1/3W	Car.	501 210 00
R75	4,7 kohms	5%	1/3W	Car.	501 347 00
R76-81	100 ohms	5%	1/3W	Car.	501 210 00
R82-84	4,7 kohms	5%	1/3W	Car.	501 347 00
R85-86	100 ohms	5%	1/3W	Car.	501 210 00
R87	4,7 kohms	5%	1/3W	Car.	501 347 00

PARTS LIST

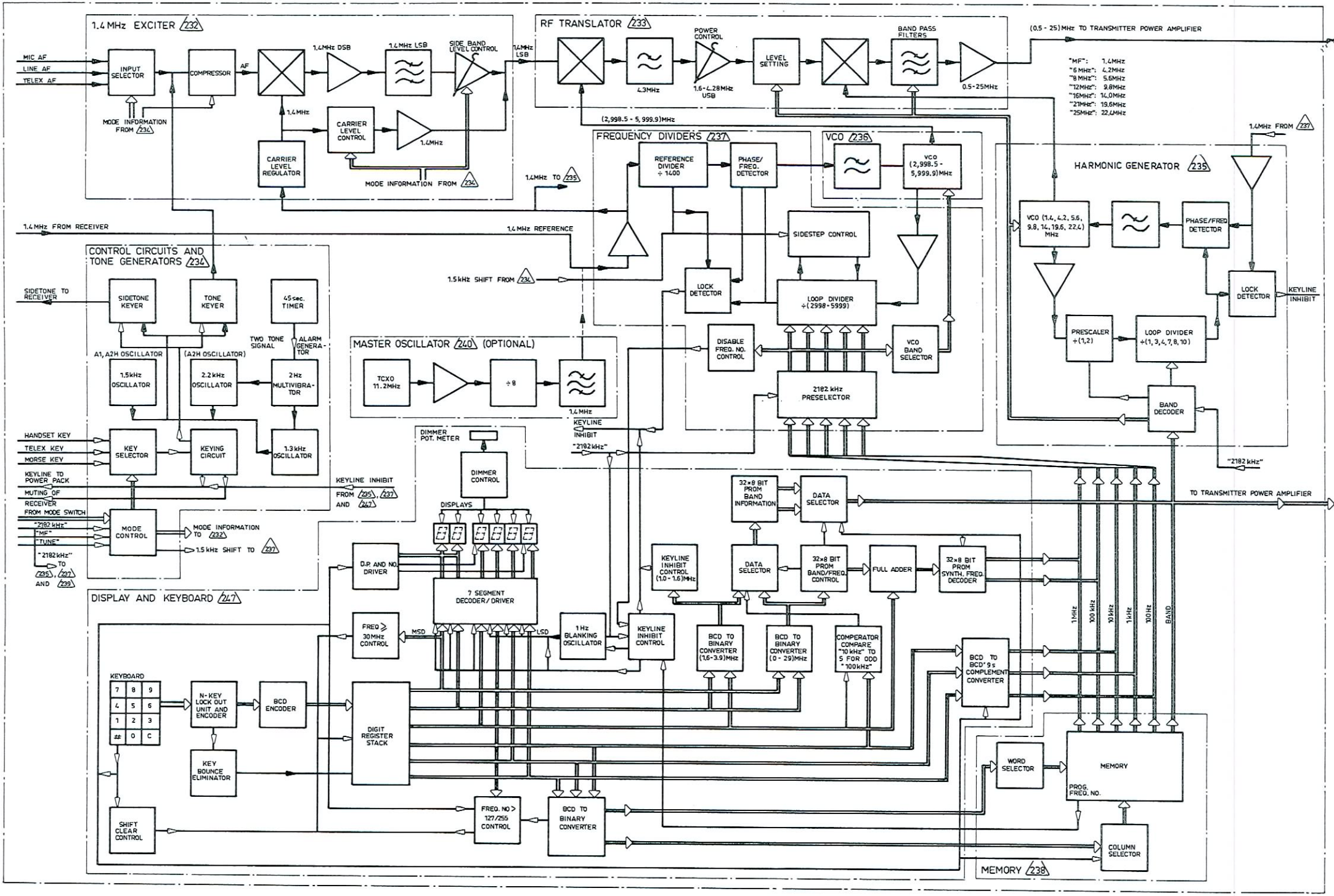
FOR

247R88	100 ohms	5%	1/3W	Car.	501 210 00
R89-90	4,7 kohms	5%	1/3W	Car.	501 347 00
R91	100 ohms	5%	1/3W	Car.	501 210 00
R92	4,7 kohms	5%	1/3W	Car.	501 347 00
R93	100 ohms	5%	1/3W	Car.	501 210 00
R94	4,7 kohms	5%	1/3W	Car.	501 347 00
R95	100 ohms	5%	1/3W	Car.	501 210 00
R96-97	4,7 kohms	5%	1/3W	Car.	501 347 00
R98	100 ohms	5%	1/3W	Car.	501 210 00
R99-103	4,7 kohms	5%	1/3W	Car.	501 347 00
R104	100 ohms	5%	1/3W	Car.	501 210 00
R105-106	4,7 kohms	5%	1/3W	Car.	501 347 00
R107	1,5 kohms	5%	1/3W	Car.	501 315 00
R108	1 kohm	LIN.			352 213 02
R109	150 ohms	5%	1/3W	Car.	501 215 00
R110-113	4,7 kohms	5%	1/3W	Car.	501 347 00
R114	10 kohms	5%	1/3W	Car.	501 410 00
R115-117	4,7 kohms	5%	1/3W	Car.	501 347 00
R118	1,8 kohms	5%	1/3W	Car.	501 318 00
R119	100 ohms	5%	1/3W	Car.	501 210 00
R120	1 kohm	5%	1/3W	Car.	501 310 00
R121	NOT USED				
R122-123	1 kohm	5%	1/3W	Car.	501 310 00
R124-125	4,7 kohms	5%	1/3W	Car.	501 347 00
R126	1.8 kohms	5%	1/3W	Car.	501 318 00
R127	2.2 kohms	5%	1/3W	Car.	501 322 00
R128-133	4,7 kohms	5%	1/3W	Car.	501 347 00
R134	1,8 kohms	5%	1/3W	Car.	501 318 00
R135	33 ohms	5%	1/3W	Car.	501 133 00
R136-138	4,7 kohms	5%	1/3W	Car.	501 347 00
R139	2,7 kohms	5%	1/3W	Car.	501 327 00
R140	2,2 kohms	5%	1/3W	Car.	501 322 00
R141	33 kohms	5%	1/3W	Car.	501 433 00
R142-145	4,7 kohms	5%	1/3W	Car.	501 347 00
R146-149	10 kohms	5%	1/3W	Car.	501 410 00
R150	1,5 kohms	5%	1/3W	Car.	501 315 00
247S1-3	M61-0110				763 000 07
S4	M51-0136				763 000 08
S5-12	M61-0110				763 000 07
247SK1-2	16 Way				751 000 24
SK3-8	14 Way				751 000 25

PARTS LIST

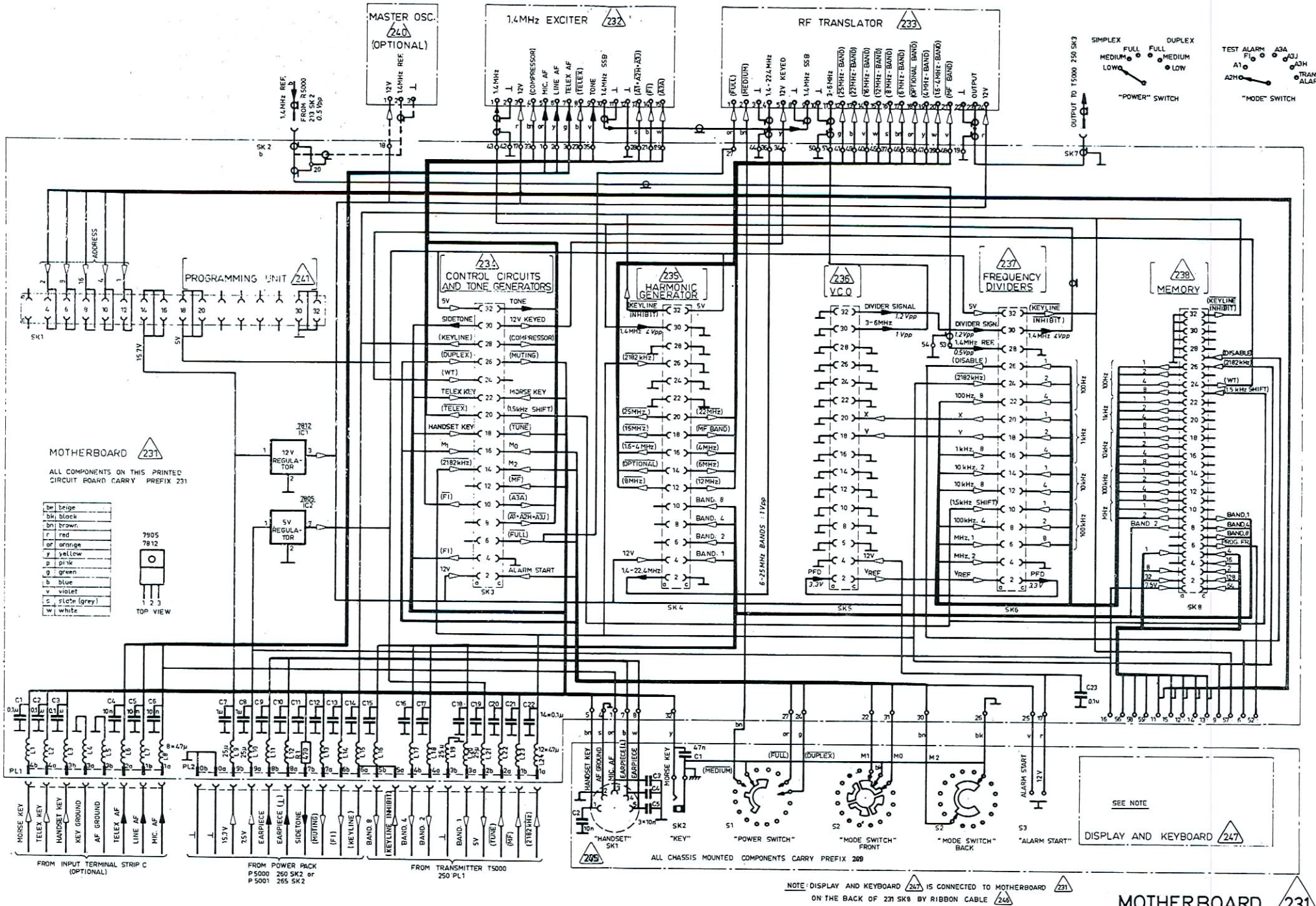
FOR

247TR1	BC337	840 033 70
TR2	BD135-10	842 013 50
TR3	BC547	840 054 70
TR4	BC337	840 033 70



BLOCK DIAGRAM EXCITER E5001

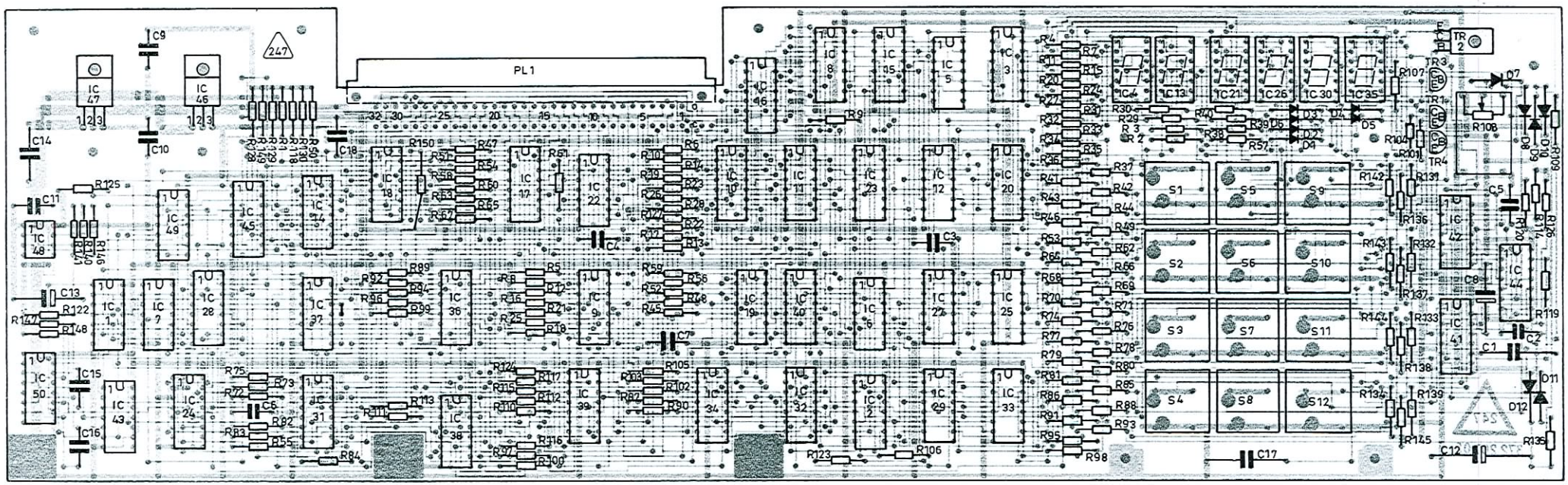
992 207 71



MOTHERBOARD 231

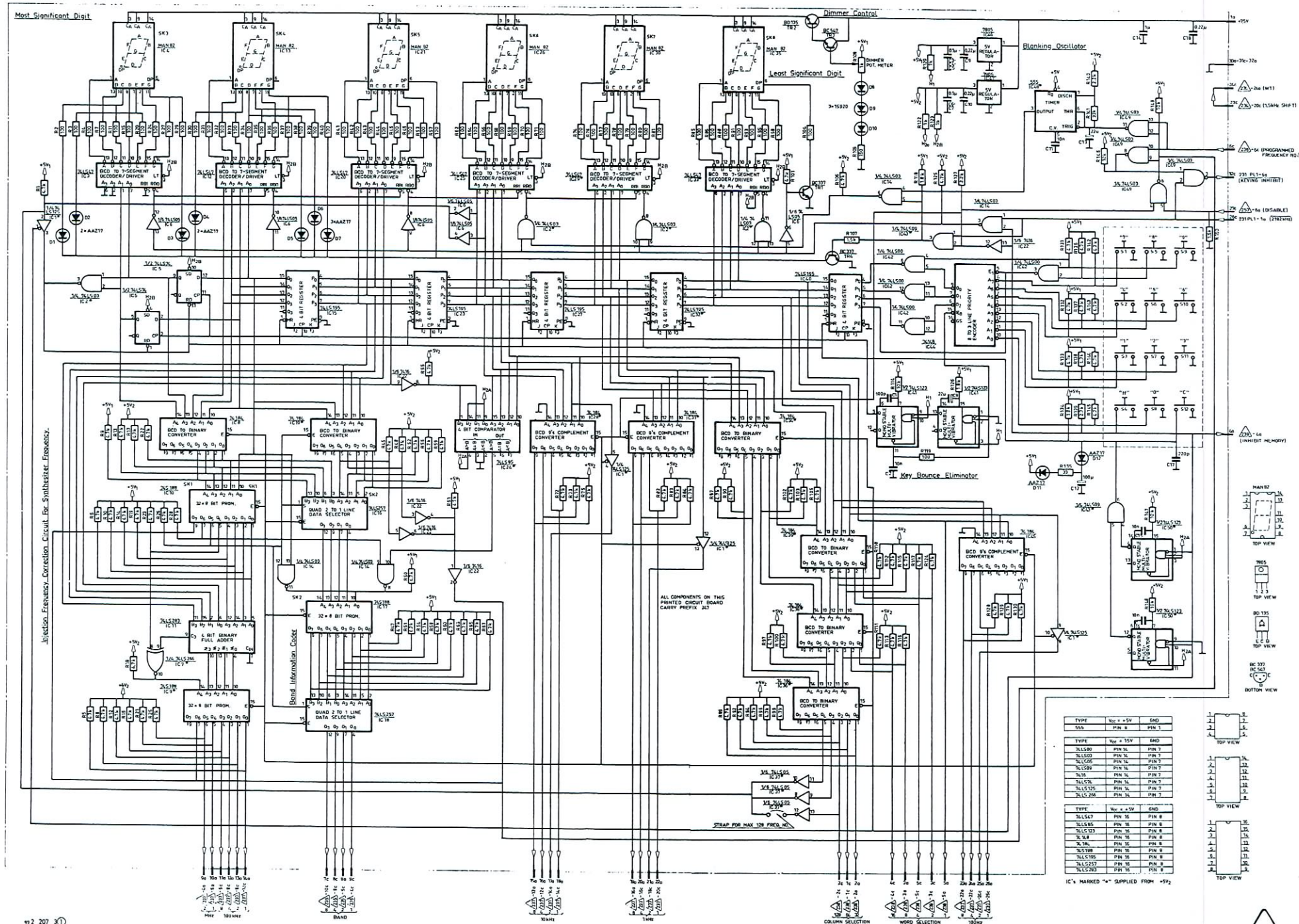
E5001 WIRING DIAGRAM 245

992 207 6(1)



PRINTED CIRCUIT BOARD 247

VIEWED FROM COMPONENT SIDE



DISPLAY AND KEYBOARD 247