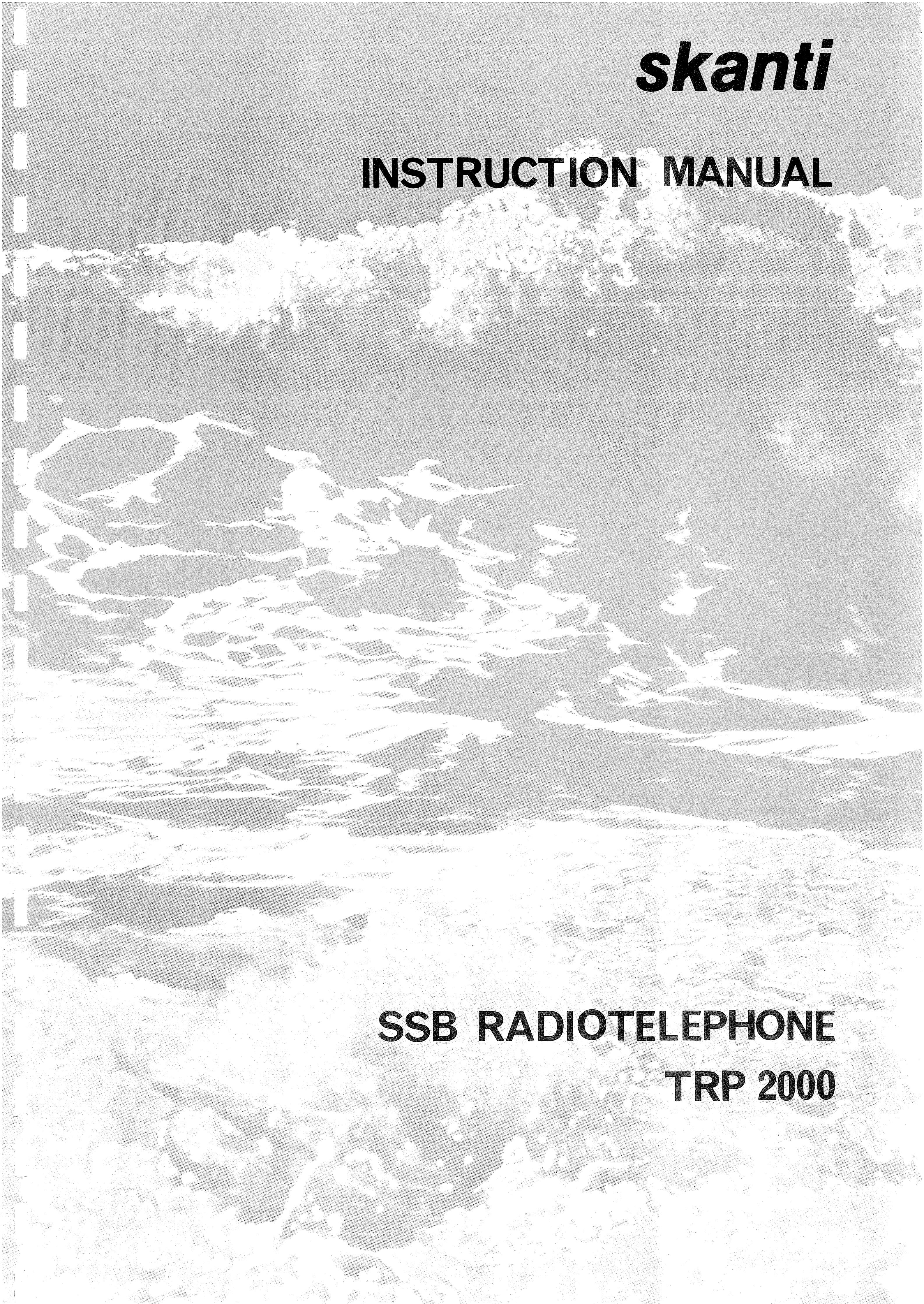


skanti

INSTRUCTION MANUAL

SSB RADIOTELEPHONE
TRP 2000

Fig. 3-4

T2000 TUNING CHART

Ship: ______________________ Harbour: ______________________

Technician: ____________ Date:_____ 19___ TRP2000 serial no:______________

Supply voltage ____V DC/AC - 50/60 Hz Antenna: ______________________

Meter readings are taken with "POWER"-switch in position "FULL POWER SIMPLEX" and "MODE"-switch in position "A3H (TUNE)".
ANTENNA CURRENT is measured with meter switch /122\ S1 in position "ANTENNA CURRENT" (upwards) and LEVEL is measured with /122\ S1 in position "LEVEL" (downwards).

Mark in plan below positions on drum switch in which programming tabs have been inserted.

2182 kHz ANTENNA COIL A/B

CHAN-NEL	FREQ. kHz	LEVEL	ANTEN-NA CUR-RENT	DRUM WAFER NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2182																	
16																		
2																		
17																		
3																		
18																		
4																		
19																		
5																		
20																		
6																		
21																		
7																		
22																		
8																		
23																		
9																		
24																		
10																		
25																		
11																		
26																		
12																		
27																		
13																		
28																		
14																		
29																		
15																		
30																		

NOTE: When the plan has been filled out be sure to set the meter switch /122\ S1 to the "ANTENNA CURRENT" position (upwards).

TRP 2000

INSTRUCTION MANUAL

CONTENTS

Gorm Helt-Hansen

LIST OF FIGURES

LIST OF DIAGRAMS

1. INTRODUCTION

1.1. The TRP 2000 is a single sideband radiotelephone transmitter-receiver for simplex, semi-duplex or duplex telephone traffic in the 1605-4000 kHz coastal telephone band and in the maritime 4 MHz shortwave telephone band.

The transmitter T 2000 is crystal controlled and has a total of 30 channels. Provision is made for emission of A3H, A3J and A3A signals, the upper sideband being used in all cases.

The receiver R 2000 is composed of a crystal controlled section which has a total of 30 channels and a tunable section covering the LW, the MW and the 1605-4450 kHz shortwave bands. The receiver is designed for reception of signals of type A2, A2H, A3, A3H and upper-sideband A3J and A3A. By means of a loop of a ferrite antenna direction finding is possible in the three bands covered by the tunable section. A loudspeaker is incorporated in the cabinet and an external loudspeaker may be connected if desired.

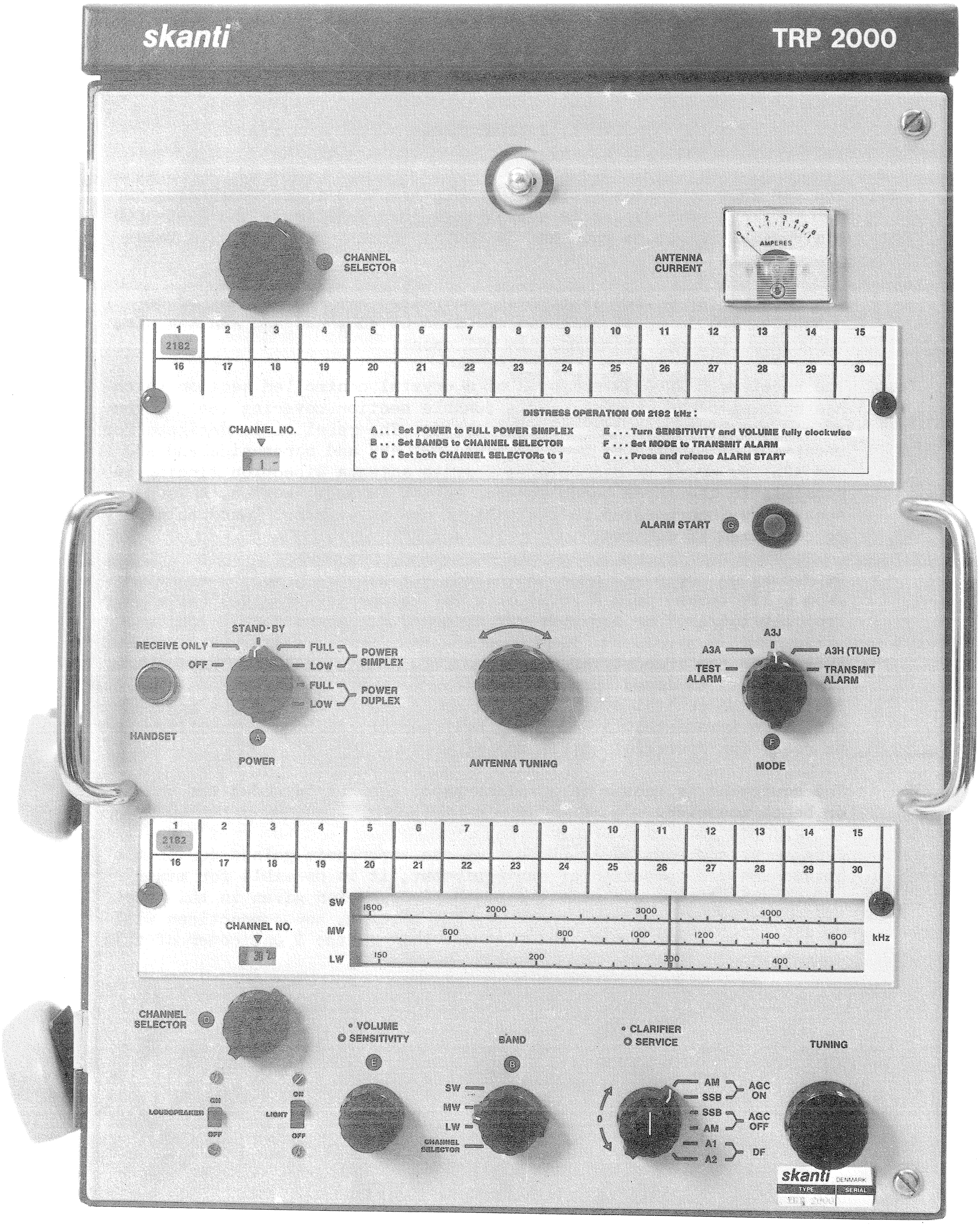
Depending on the power pack installed, the equipment can be operated from a 12V (power pack P 2002) or a 24V (power pack P 2000) battery or from 110/115/120V or 220/230/240V AC 50-60 Hz (power pack P 2001).

Except for the transmitter power amplifier stage, silicon solid-state circuitry is employed throughout. These features in connection with the fact that no crystal ovens are used cause the receiver to be ready for operation immediately after being switched on, and the transmitter to be ready for operation within one minute.

The equipment is housed in a splash-proof cabinet intended for bulkhead or bench mounting.

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.

Fig. 1-1


skanti
TRP 2000
CHANNEL SELECTOR
ANTENNA CURRENT
AMPERES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
2182
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
CHANNEL NO.
DISTRESS OPERATION ON 2182 kHz :
A . . . Set POWER to FULL POWER SIMPLEX
B . . . Set BANDS to CHANNEL SELECTOR
C D . Set both CHANNEL SELECTORs to 1
E . . . Turn SENSITIVITY and VOLUME fully clockwise
F . . . Set MODE to TRANSMIT ALARM
G . . . Press and release ALARM START
ALARM START
STAND-BY
RECEIVE ONLY
OFF
FULL
LOW
POWER SIMPLEX
FULL
LOW
POWER DUPLEX
HANDSET
POWER
ANTENNA TUNING
A3J
A3A
A3H (TUNE)
TEST ALARM
TRANSMIT ALARM
MODE
SW
MW
LW
kHz
CHANNEL SELECTOR
VOLUME
SENSITIVITY
BAND
CLARIFIER
SERVICE
TUNING
LOUDSPEAKER
ON
OFF
LIGHT
CHANNEL SELECTOR
AM
SSB
AGC ON
SSB
AM
AGC OFF
A1
A2
DF
skanti DENMARK
TYPE
SERIAL

2. OPERATING INSTRUCTIONS

2.1. DISTRESS OPERATION on 2182 kHz.

A Set POWER to FULL POWER SIMPLEX

B Set BAND to CHANNEL SELECTOR

C-D Set both CHANNEL SELECTORs to 1

E Turn SENSITIVITY and VOLUME fully clockwise

F Set 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(TUNE)".

2.2. Tuning to 2182 kHz.

(1) Set "POWER"-switch to "FULL POWER SIMPLEX"

(2) Set "BAND"-switch to "CHANNEL SELECTOR"

(3) Set both "CHANNEL SELECTOR"s to 1

(4) Turn "SENSITIVITY" fully clockwise

(5) Adjust "VOLUME" for a convenient volume

(6) Set "MODE"-switch to "A3H(TUNE)"

(7) Press handset key

(8) Adjust "ANTENNA TUNING" for maximum reading on "ANTENNA CURRENT" meter.

(9) Release handset key.

The equipment is now ready for operation.

NOTE: The type of service used on 2182 kHz is A3H, simplex. When the equipment is tuned to 2182 kHz the A3H mode is automatically selected and the "MODE"-switch can therefore be set to any position except "TEST ALARM".

2.3. Tuning to an SSB Station

(1) Set "POWER"-switch to "STAND-BY"

(2) Look up desired frequencies in frequency charts

(3) Read channel numbers on frequency charts and set "CHANNEL SELECTOR"s to these numbers

(4) Set "SERVICE"-switch to "SSB AGC ON"

(5) Set "BAND"-switch to "CHANNEL SELECTOR"

(6) Turn "SENSITIVITY" fully clockwise

(7) Adjust "VOLUME" for a convenient volume

(8) Adjust "CLARIFIER" control for natural-sounding speech when the desired station is modulated

(9) Set "MODE"-switch to "A3H(TUNE)"

(10) Set "POWER"-switch to "FULL POWER SIMPLEX"

(11) Press handset key

(12) Turn "ANTENNA TUNING" for maximum "ANTENNA CURRENT" meter reading

(13) Select desired type of service with "MODE"- and "POWER"-switches.

The equipment is now ready for operation.

NOTE: Under certain circumstances it can be advantageous to use manual gain control of the receiver either in addition to the automatic gain control (SSB AGC ON) or with the automatic gain control switched off (SSB AGC OFF). This is done by turning the SENSITIVITY control anti-clockwise until best reception is obtained and has the effect of reducing background noise coming up in speech pauses.

2.4. Tunable receiver

(1) Set "POWER"-switch to "RECEIVE ONLY"

(2) Set "BAND"-switch to desired band

(3) Set "SERVICE"-switch to "AM AGC ON"

(4) Turn "SENSITIVITY" fully clockwise

(5) Adjust "VOLUME" for a convenient volume

(6) Set the "CLARIFIER" to the "O"-position

(7) Turn the "TUNING" control until the dial pointer is at the desired frequency on the tuning scale.

NOTE: In the shortwave band 1605-4450 kHz the coverage of the "CLARIFIER" is extended. The "CLARIFIER" can therefore be used as a fine tuning control in this band.

2.5. Direction Finding (Optional)

Operating instructions are given in the documentation supplied with the direction finding equipment.

2.6. Operating Controls and Their Functions.

The "POWER" switch has seven positions:

"OFF"	Receiver and transmitter are switched off.
"RECEIVE ONLY"	Power pack is started up and supplies power to receiver only. External speaker of receiver is connected to to receiver output.
"STAND BY"	Power pack supplies power to receiver and filaments of transmitter output valves. External speaker of receiver is connected to receiver output.
"FULL POWER SIMPLEX"	Transmitter can be keyed by pressing handset key and PA valves can be driven to full output. Receiver is muted when transmitting. External speaker of receiver is disconnected.
"LOW POWER SIMPLEX"	Transmitter can be keyed by pressing handset key and PA valves can be driven to approx. 1/4 of full output. Receiver is muted when transmitting. External speaker of receiver is disconnected.
"FULL POWER DUPLEX"	Transmitter is keyed constantly but microphone circuit is not closed until handset key is pressed. PA valves can be driven to full output. Receiver is on but built-in speaker is disconnected and only the earpiece is connected to receiver output. External speaker of receiver is disconnected.
"LOW POWER DUPLEX"	Transmitter is keyed constantly, but microphone circuit is not closed until handset key is pressed. PA valves can be driven to approx. 1/4 of full output. Receiver is on, but built-in speaker is disconnected and only the earpiece is connected to receiver output. External speaker of receiver is disconnected.
"ANTENNA TUNING"	is used for fine adjustment of antenna tuning.

The "MODE" switch has five positions:

"TEST ALARM"	The alarm generator is connected to the receiver AF-amplifier. Transmitter cannot be keyed.
"A3A"	Transmission of single-sideband signal with reduced carrier. Transmitter can be keyed.
"A3J"	Transmission of single-sideband signal with suppressed carrier. Transmitter can be keyed.
"A3H(TUNE)"	Transmission of single-sideband signal with full carrier. Transmitter can be keyed.
"TRANSMIT ALARM"	The alarm generator is connected to the receiver AF-amplifier. The mode A3H is selected and the alarm generator is ready for transmission of alarm signal. Transmitter can be keyed.

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

The pushbutton is also used for starting the alarm generator after the "MODE" switch has been turned to the "TEST ALARM" position.

The upper "CHANNEL SELECTOR" switch has 30 positions and selects the transmitting frequency.

The "ANTENNA CURRENT" meter reads the antenna current. The scale is logarithmic.

The lower "CHANNEL SELECTOR" switch has 30 positions and selects the receiving channel.

The "LOUDSPEAKER" switch disconnects the built-in loudspeaker.

The "LIGHT" switch reduces or switches off the illumination of both transmitter and receiver.

"SENSITIVITY": Manual adjustment of receiver RF gain.

"VOLUME": Manual adjustment of receiver AF gain.

The "BAND" switch has four positions:

"LW"	Long Wave band (150-450 kHz) in tunable receiver.
"MW"	Medium Wave band (525-1605 kHz) in tunable receiver.
"SW"	Short Wave band (1605-4450 kHz) in tunable receiver.
"CHANNEL SELECTOR"	Short Wave band (1605-4450 kHz) in spot frequency receiver.

The "SERVICE" switch has six positions:

"AM AGC ON"	Reception of double and single-sideband modulation with full carrier (A3 and A3H). Automatic gain control in operation.
"SSB AGC ON"	Reception of single-sideband modulation with suppressed or reduced carrier. (A3J and A3A). Automatic gain control in operation.
SSB AGC OFF"	Reception of single-sideband modulation with suppressed or reduced carrier (A3J and A3A). Automatic gain control inoperative.
"AM AGC OFF"	Reception of double and single-sideband modulation with full carrier (A3 and A3H). Automatic gain control inoperative.
"A1 DF"	(Optional) Direction finding of unmodulated signals.
"A2 DF"	(Optional) Direction finding of modulated signals.

The "CLARIFIER" is used for accurate tuning to frequency. Adjust for natural-sounding speech.

The "TUNING" is used for frequency adjustment of tunable receiver.

3. INSTALLATION

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

3.1. Types of Installation

The TRP 2000 radiotelephone may be powered from either a 12V or a 24V battery or from 110/115/120/220/230/240V AC mains.

The TRP 2000 is composed of the following units:

For 12V battery operation:
Type T 2000 transmitter
Type R 2000 receiver
Type P 2002 power pack

For 24V battery operation:
Type T 2000 transmitter
Type R 2000 receiver
Type P 2000 power pack

For AC mains operation (single-phase or two-phase):
Type T 2000 transmitter
Type R 2000 receiver
Type P 2001 power pack.

The units are connected together in the TRP 2000 cabinet in which also the connection to the permanent installation is made.

3.2. Removal of Units

Transmitter and receiver are mounted on the cabinet door and after loosening of two front panel screws the door can be opened.
The cables may be unplugged and the door removed entirely from the cabinet.
The power pack is mounted on the cabinet back wall and may be lifted out when the cables to the permanent installation have been removed and four screws have been loosened.

3.3. Mounting the Cabinet.

The equipment is intended for bulkhead or bench mounting. The drawings on pages 3-10 and 3-11 show the drilling plans 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 actual power pack diagram shows the marking of the terminals to be used for the installation. Necessary cable cross sections are also indicated.
All cables except the transmitter and receiver antennas and earth leads should be separated below the transmitter and the individual conductors brought through the cutout in the bottom of the cabinet 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 2002	12V DC	50A
P 2000	24V DC	30A
P 2001	110V)) 115V) 50-60 Hz) 120V)	10A
P 2001	220V)) 230V) 50-60 Hz) 240V)	6A

Table 3.1.

3.4.1. Supply Voltage Changing in P 2001 (AC operation).

Voltage changing in the P 2001 power pack is carried out by unsoldering the connections to and between the terminals of the three transformers 146 T1, 146 T2 and 146 T3.

The necessary connections are shown on the diagram of P 2001.

When changing voltages it is also necessary to replace the two fuses in the power pack input leads. Fuse ratings are given on the P 2001 diagram.

3.5. Earth Connections.

The transmitter earth terminal is located on the top of the cabinet below the bonnet. To get access to the earth terminal remove the bonnet by opening the cabinet door and unscrewing the four screws carrying the bonnet. From this earth terminal a 50-100x0.5 mm copper strap should be connected to the hull on a steel ship, the ships keel or an earth plate with minimum dimensions of 1x1 metre mounted under the water line.

The receiver earth terminal is located on the top of the receiver and should be connected to earth using a length of 2.5 sq.mm wire. This wire should be connected to a separate earth screw, which must not be shared by other equipments. The earth lead should be run as far from the transmitter copper strap as is practicable.

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. 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 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. Receiving Antenna.

Length: 7-30 metres. 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 short antennas.

3.6.2. Transmitting Antenna.

Length: 7-30 metres inclusive of lead-in. The antenna should be terminated in a feed-through insulator in the roof or side wall of the radio room. The antenna is to be brought in to the transmitter through a length of copper tubing mounted on stand-off insulators. A length of carbon brush cable or some similar flexible bare conductor should be inserted between the last stand-off and the transmitter antenna insulator; any play between the transmitter and bulkhead will then be taken up by the cable.

3.6.3. Antenna Relay.

As shown in the drawing on page 3-12, 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 12V DC when using power pack P 2002 and for 24V DC when using P 2000 or P 2001. It should be connected to terminals C (-) and D (+).

3.7. Extension Speaker.

If an extension speaker is to be installed it should have 4 ohms impedance and a power handling capacity of 4W or more. It should be connected to terminals E and F.

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

In the other positions of the "POWER" switch the extension speaker is disconnected from the receiver output.

3.8. Transmitter-On Indication.

Indication of the transmitter-on condition can be obtained by means of a voltage (12 or 24V at max. 0.2A) which is controlled by the transmit relay and can be taken off between terminals C (-) and D (+).

3.9. Replacement of Power Packs.

Three different power packs are available for operation of the equipment. Either power pack can be mounted on the cabinet back wall.

The P 2000 is used for 24 V battery operation whilst the P 2002 is used for 12V battery operation. If the equipment is to be operated from AC-mains the P 2001 power pack must be used. Replacing a power pack involves no modifications of transmitter or receiver.

3.10. Channel Crystal Calculation.

Channel crystal frequencies fx are calculated as follows:

$f_x = f_c + 1400$ kHz

where f_c is the carrier frequency of the transmitted or received signal, and all frequencies are in kHz.

Channel crystals should meet the specification given in 3.11 and will then be marked with f_c on the case top and with f_x on the case side.

3.11. Channel Crystal Specification

Holder:	HC-6/U
Frequency:	3005-5850 kHz
Tolerance:	a) ± 0,002% at 25°C.
	b) ± 0,001% variation from 25°C over temperature range.
Temperature range:	-20°C to +70°C
Circuit:	Parallel resonance, 30pF
Drive Level:	1mW
Activity:	DEF 5271
Operating mode:	Fundamental
Marking:	Case top: (nominal frequency -1400) kHz
	Case side: T-1002 and nominal crystal frequency.

3.12. Installing Channel Crystals in Transmitter.

When installing crystals in the transmitter proceed as follows:

Remove the lid of the screening can at the back of the transmitter chassis. Locate the crystal socket corresponding to the desired channel number and insert the crystal. Note that channel 1 must always be used for 2182 kHz as the A3H mode is automatically selected on this channel.

If less than 15 channels are to be installed crystal sockets with numbers between 1 and 15 shall be used.

If more than a total of 15 channels are to be installed the channels with numbers between 16 and 30 must be paired with the channels between 1 and 15 (1 and 16, 2 and 17 ....) as shown in the frequency chart on the transmitter front panel, as the antenna coarse tuning system is designed in such a way that each setting is used twice. This means that two channels sharing the same coarse tuning setting must have frequencies of within 5-10% of each other.
(Example: Channel 3 corresponds to a radiated frequency of 2738 kHz. Channel 18 must then be selected to have a frequency in the range from 2500 kHz to 3000 kHz).

As the fine tuning range on the distress frequency 2182 kHz is reduced to ensure adequate radiated power regardless of the setting of the "ANTENNA TUNING" knob, it is necessary to select the radiated frequency of channel 16 within ±1% of 2182 kHz (2160 kHz - 2200 kHz) or if no channels in this range are to be installed then to omit the use of channel 16.

Connect a frequency counter (resolution 1 Hz, accuracy 10^{-7}) to the counter terminals 123 -1 and 123 -2 (common). Set the "CHANNEL SELECTOR" switch to the channel number in question and adjust the trimmer capacitor associated with the crystal so that the frequency will be that specified on the side of the crystal can (-0/+5 Hz).

Remove the transparent cover from the channel frequency chart and mark the chart with the appropriate station or channel frequency.

3.13. Adjustment of Transmitter Antenna Tuning.

3.13.1. Network.

As shown on the transmitter wiring diagram, the antenna tuning is basically performed by means of an L-network; in addition to this there is a possibility of selecting an output capacitor and an antenna shortening capacitor.

The L-network acts in such a way that increasing the shunt capacitor, while still having resonance, decreases the voltage swing on the anodes of the output valves (the load impedance presented to the output valves becomes lower) and vice versa.

The various components in the L-network are selected by means of a drum switch which can be programmed individually for each of the channels 1 to 15. The programming is performed by inserting programming tabs into the appropriate wafers on the drum switch.

Wafers 9 to 15 select the shunt capacitors. The value of these has been selected in such a way that it is possible to obtain any value between 27pF and approx. 3200 pF in steps of 27pF.

Wafers 5, 6 and 8 select the inductance range of the variometer. In order to increase this range the rotor and stator sections of the variometer may be connected either in series or in parallel. When wafer 8 is used, the sections are in series, giving a high value of inductance while the use of wafers 5 and 6 brings the sections in parallel, giving a low value of inductance.

Wafer 7 is always used on channel 1, the distress frequency. In order to reduce the fine tuning range on this frequency to ensure adequate radiated power regardless of the setting of the "ANTENNA TUNING" knob, the rotor section of the variometer is disconnected. The resonance on this frequency is obtained by connecting the "2182 kHz fine tuning coil" to a suitable tap on the stator section of the variometer. In order to increase the inductance range it is also possible to connect the "2182 kHz antenna coil" in series with the "2182 kHz fine tuning coil".

Wafer 4 selects the output capacitor, while wafers 3 and 2 select the shortening capacitors. Wafers 1 connects the antenna directly to the variometer.

3.13.2. Tuning procedure.

In order to obtain the highest degree of accuracy the adjustment procedure stated below is carried out with the "POWER" switch set to "FULL POWER SIMPLEX".

To avoid excessive voltages in the antenna tuning section it is, however, recommended that initial setting up is made with the "POWER" switch set to "LOW POWER SIMPLEX" which means that the level reading should be approx. 1 at resonance.

Final adjustment should then be made with the "POWER" switch set to "FULL POWER SIMPLEX" and the level reading should be adjusted to be as near as possible to 2.0 but never above this value.

3.13.3. Tuning Channel 2 to 15 (or 17 to 30).

If less than 15 channels are installed, the tuning is carried out on channels 2 to 15. If more than a total of 15 channels are installed, the channels must be paired as described in section 3.12., and the tuning must be carried out on the channel with the lowest frequency.

3.13.3.1. Set the "MODE" switch to position "A3H (TUNE)".

3.13.3.2. Set the meter switch 122 S1 to the level detector position (downwards); in this position the antenna current meter on the front panel indicates the level on the anodes of the output tubes.

3.13.3.3. If the frequency is below approx. 2.5 MHz, insert tabs in wafer 10 (shunt capacitor 800pF), wafer 8 (variometer series connected) and in wafer 1 (direct connection to the antenna). If the frequency is above approx. 2.5 MHz, insert tabs in wafer 11 (shunt capacitor 400pF), wafers 6 and 5 (variometer parallel connected) and in wafer 1.

3.13.3.4. Depress the key on the handset and turn the "ANTENNA TUNING" knob until resonance is obtained, (maximum reading on the meter without having the "ANTENNA TUNING" knob to one of its extreme positions).

3.13.3.5. Observe the level reading on the meter. The reading should be as near as possible to 2.0, but never above this value. If the level is too high, the shunt capacitor must be increased by using a different tab setting and vice versa.

3.13.3.6. Use of output and shortening capacitors.

Depending on the type of antenna used it may be impossible to obtain resonance as described above. In these cases it is necessary to use either the output capacitor or the shortening capacitors or a combination of both.

3.13.3.7. If the antenna is very short it may on low frequencies be necessary to use the output capacitor (wafer 4).

3.13.3.8. If the antenna is very long it may on low frequencies be necessary to use shortening capacitors (wafers 2, 3 or both). When doing this, always use the largest possible capacitor. If the length of the antenna becomes more than 1/4 wavelength on high frequencies, it may be necessary to use both the output capacitor and a shortening capacitor.

3.13.3.9. In the neighbourhood of 2.5 MHz, where the variometer connection shifts from series to parallel it may be necessary to insert a shortening capacitor (use tabs in both wafers 2 and 3 if possible) to obtain resonance.

3.13.4. Tuning Channel 1. (2182 kHz)

In order to find the correct value of the shunt capacitor, channel 1 is first tuned as described in 3.13.3.

Then proceed as follows:

3.13.4.1. Move the tab in wafer 8 to wafer 7.

3.13.4.2. Place the plug from the "2182 kHz fine tuning coil" in position B on the "2182 kHz antenna coil".

3.13.4.3. Place one end of the clip-on lead on the middle of the "2182 kHz fine tuning coil" and, with the other end select that winding on the lower half of the variometer stator which gives highest level reading.
If resonance cannot be obtained, the plug from the "2182 kHz fine tuning coil" must be moved to position A on the "2182 kHz antenna coil".

3.13.4.4. If the antenna is very short it may be necessary to use the output capacitor (wafer 4).

3.13.4.5. Place the "ANTENNA TUNING" knob in its center position and select that winding on the "2182 kHz fine tuning coil" which gives maximum level reading.

3.13.5. Antenna Current Metering.

When the adjustment of all installed channels is completed be sure to set the meter switch /122\ S1 to the antenna current position (upwards). In this position the meter on the front panel indicates the actual antenna current.

3.14. Installing Channel Crystals in Receiver.

When installing crystals in the receiver proceed as follows:

Remove the lids of the screening cans at the back of the receiver chassis. Locate the crystal socket corresponding to the desired channel number and insert the crystal. Note that channel 1 must always be used for 2182 kHz as the AM mode is automatically selected on this channel.

Connect a frequency counter (resolution 1 Hz, accuracy 10^{-7}) to the counter terminals on board 134 . Set the "CHANNEL SELECTOR" switch to the channel number in question and adjust the trimmer capacitor associated with the crystal so that the frequency will be that specified on the side of the crystal can (-0/+5 Hz).

Align the antenna input filter as described in section 3.15.
Remove the transparent cover from the channel frequency chart and mark the chart with the appropriate station or channel frequency.

3.15. Alignment of Receiver Antenna Input Filters.

When a new channel crystal is installed the antenna input filter of the channel-number in question has to be aligned. The two filter boards 131 and 132 are located in the same screen can as the channel oscillator and adjustment of the coils is possible through the holes in the channel oscillator board.

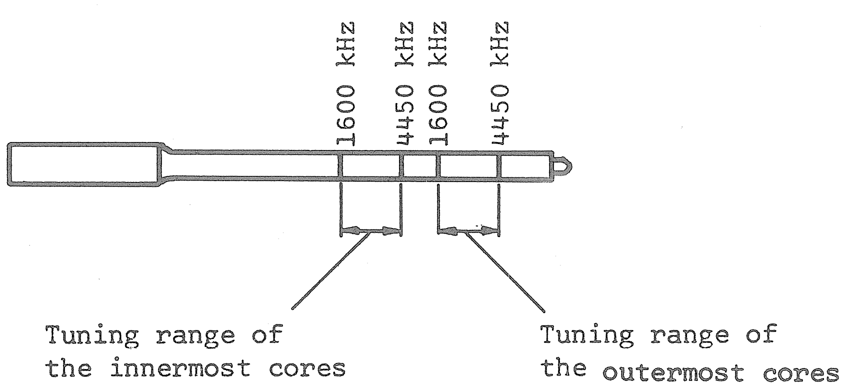
Use the trimming tool delivered with the equipment. This trimming tool is marked in a way that gives a rough indication of the tuning range of each coil-core (see drawing below).

Connect a signal generator to the antenna input socket and set the frequency to the required channel frequency. Adjust the appropriate coils for maximum output from the loudspeaker.

If a signal generator is not available it is also possible to make the alignment by connecting an antenna to the receiver and adjust for maximum atmospheric noise, or if there is traffic on the channel for maximum signal level.

Start the alignment by turning the innermost core to an approximate position using the marks on the trimming tool. Then carefully adjust the outermost core for maximum output and finally the innermost core. Set "SERVICE" switch to AGC OFF and use the "SENSITIVITY" control to obtain a convenient level.

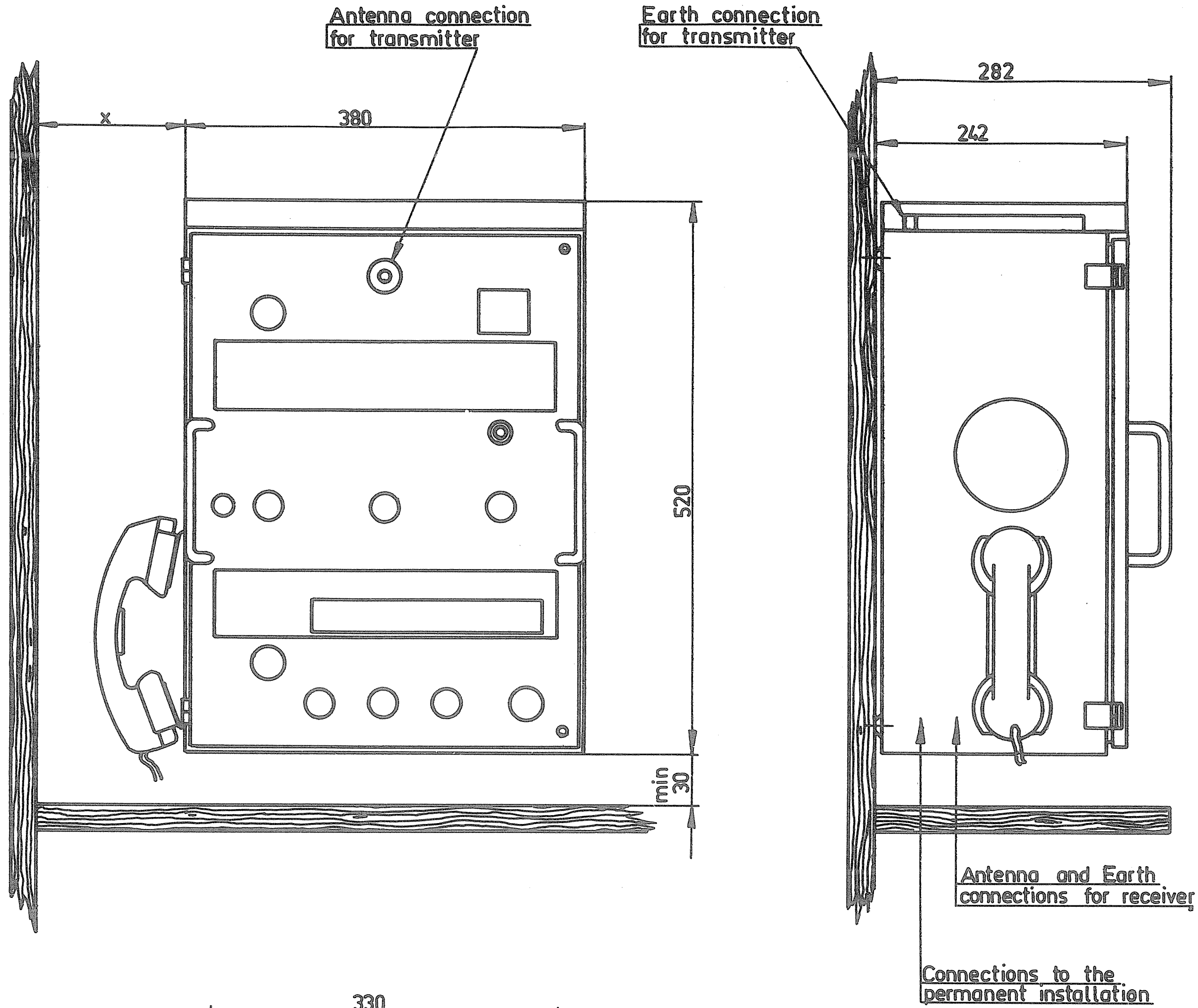
Readjustment of the cores of the innermost coils is advantageous after the receiver is connected to the antenna of the ship.

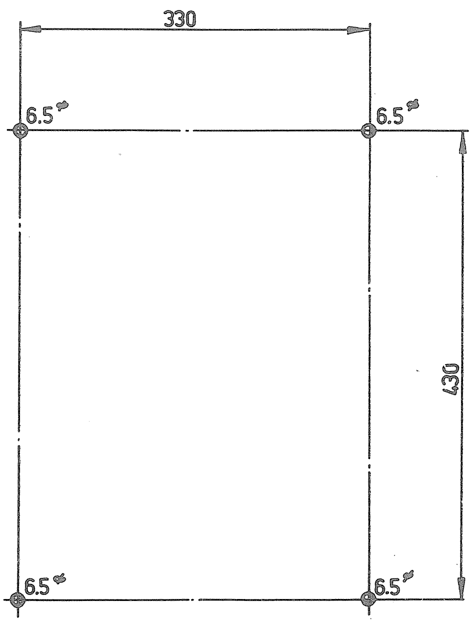


The marks on the trimming tool refer to the front of the channel oscillator printed circuit board and the edge of the coil former respectively.

BULKHEAD MOUNTING OF TRP2000

x = Min 140 with handset
x = Min 70 without handset





Vertical drilling plan for bulkhead mounting

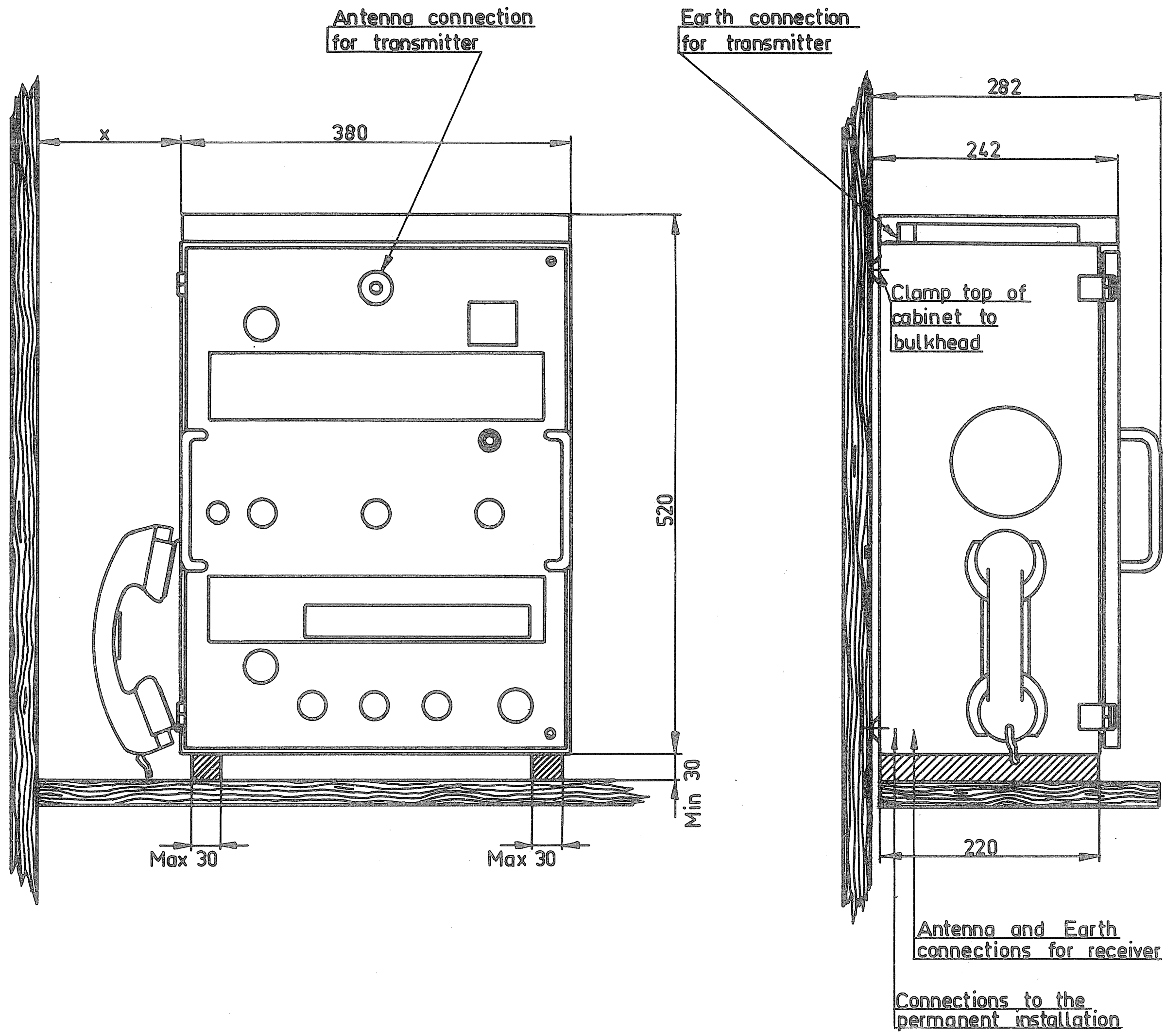
UNIT:	Appr. weight:
TRP2000 DC	25.5 Kg
TRP2000 AC	29.5 Kg

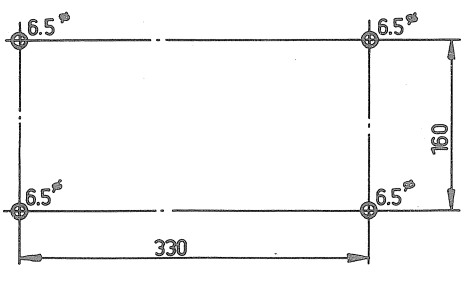
Tolerances: ± 1mm
Dimensions are in mm

Fig. 3-2

BENCH MOUNTING OF TRP2000

x = Min 140 with handset
x = Min 70 without handset

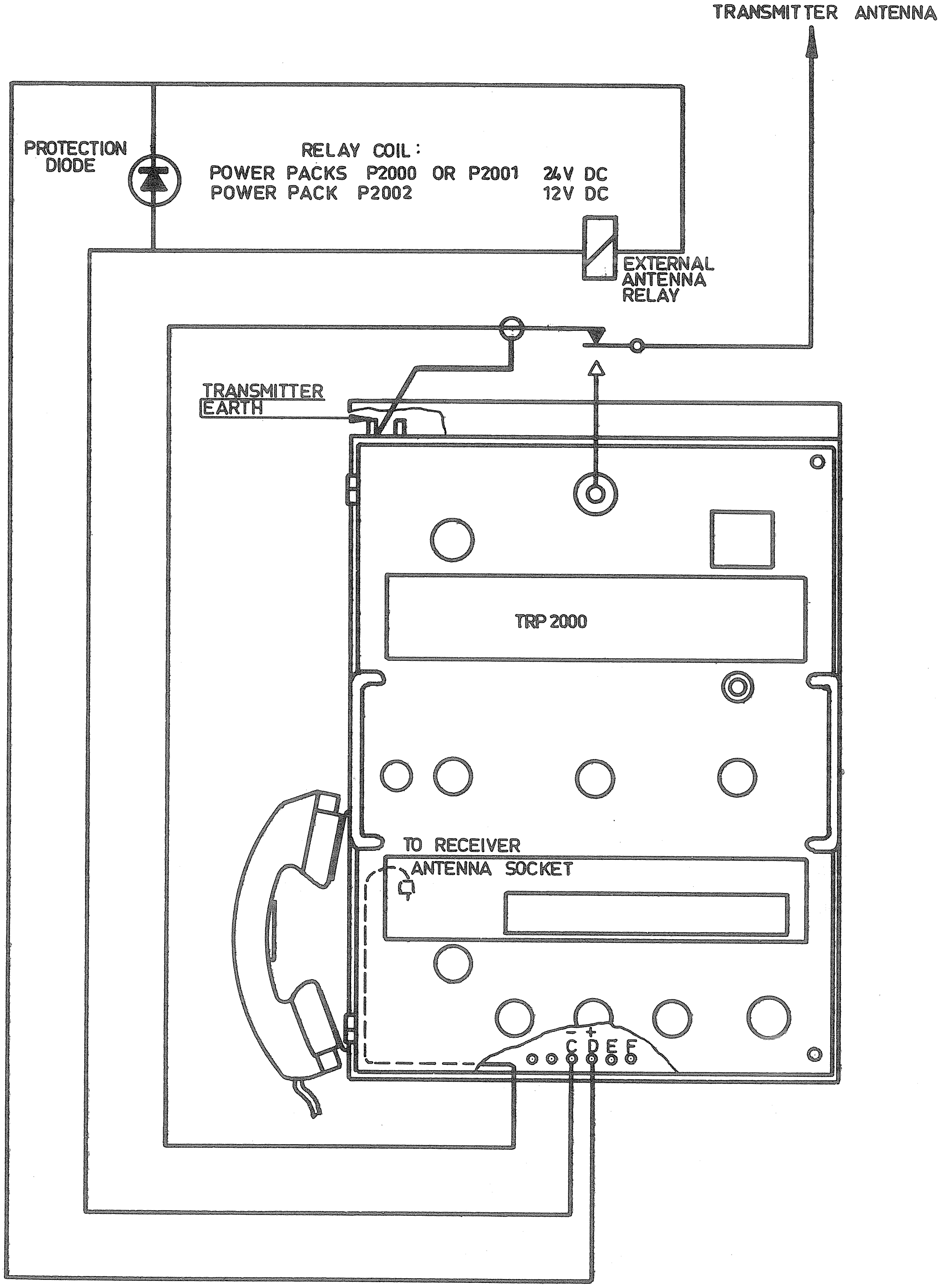




Horisontal drilling plan for bench mounting

UNIT:	Appr. weight:
TRP2000 DC	25.5 Kg
TRP2000 AC	29.5 Kg

Tolerances: ± 1mm
Dimensions are in mm



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

Fig. 3-4

T2000 TUNING CHART

Ship: ______________________ Harbour: ______________________

Technician: ____________ Date:_____ 19___ TRP2000 serial no:______________

Supply voltage ____V DC/AC - 50/60 Hz Antenna: ______________________

Meter readings are taken with "POWER"-switch in position "FULL POWER SIMPLEX" and "MODE"-switch in position "A3H (TUNE)".
ANTENNA CURRENT is measured with meter switch /122\ S1 in position "ANTENNA CURRENT" (upwards) and LEVEL is measured with /122\ S1 in position "LEVEL" (downwards).

Mark in plan below positions on drum switch in which programming tabs have been inserted.

2182 kHz ANTENNA COIL A/B

CHAN-NEL	FREQ. kHz	LEVEL	ANTEN-NA CUR-RENT	DRUM WAFER NO.														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2182																	
16																		
2																		
17																		
3																		
18																		
4																		
19																		
5																		
20																		
6																		
21																		
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12																		
27																		
13																		
28																		
14																		
29																		
15																		
30																		

S48

NOTE: When the plan has been filled out be sure to set the meter switch /122\ S1 to the "ANTENNA CURRENT" position (upwards).

4. TECHNICAL DATA

4.1. Transmitter T 2000

Modes of Operation

A3H, A3J and A3A, all upper sideband.
Simplex, Semi-Duplex and Duplex.
On 2182 kHz A3H only.

Power Output

More than 200 W PEP (Peak Envelope Power), with reduction to less than 60 W PEP.

Operating Frequencies

30 frequencies in the 1605-4150 kHz range.

Modulation

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

Alarm Generator

A two-tone alarm generator is incorporated.

4.2. Receiver R 2000

Modes of Operation

AM (A2, A2H, A3, A3H) and SSB (A1, A3A, A3J).
DF (A1 and A2) in all bands (optional).

Selectivity

AM:	max 6 dB at ±2.7 kHz
	min 60 dB at ± 10 kHz
SSB:	max 6 dB at 350 and 2700 Hz
	min 60 dB at -500 and +3400 Hz

Audio Output Power

More than 4 W

Facility for connecting an external loudspeaker (4 ohms)

Spot Frequency Receiver

Frequency Ranges

30 spot frequencies in the 1605-4450 kHz range

Sensitivity

SSB: better than 1 uV for 10 dB S/N
AM: better than 5 uV for 10 dB S/N

Rejection of IF, Image Frequency and Other Spurious Responses

Better than 60 dB

Tunable Receiver

Frequency Ranges

LW: 150 - 450 kHz
MW: 525 - 1605 kHz
SW: 1600 - 4450 kHz

4.3. Radiotelephone TRP 2000

Supply Voltage

12V battery with P 2002 Power Pack
24V battery with P 2000 Power Pack or
110/115/120 or 220/230/240V single- or two-phase AC
50-60 Hz with Power Pack P 2001.

Supply Voltage Variations

DC: -10% to +25%
AC: ±10%

Consumption

	12V battery	24V battery	AC mains
Receive only	1.5A	0.7A	25 VA
Stand-by	5.5A	2.5A	75 VA
Duplex operation A3J	20A	10A	350 VA
Duplex operation A3H	30A	15A	500 VA

Dimensions and Weight

Height:	520 mm
Width:	380 mm
Depth (cabinet only):	242 mm
Depth (overall):	282 mm
Weight:	25 kgs

5 TECHNICAL DESCRIPTION

5.1. Mechanical

The equipment consists of three main units: transmitter, receiver and power pack, built on separate rugged alodine treated aluminium chassis. The construction ensures a good ventilation through the cabinet, efficiently keeping the temperature down in the equipment. The transmitter and the receiver chassis are designed so that they also provide RF screening between the various sections.

The transmitter contains three printed circuit boards, all of which except board /123\ become accessible when the cabinet is opened. Board /123\ is housed in a screening can and becomes accessible when the lid of this is removed.

The receiver contains six printed circuit boards. All of these except board /136\ are housed in two screening cans to prevent direct signal pick up from the transmitter. The receiver chassis is insulated from the front panel. This feature permits connecting the receiver to a separate earth.

5.2. Circuit Discription, General.

Each of the printed circuit boards and also the chassis-mounted components in this equipment has been allocated an identification number between /120\ and /150\. The designation of a component or terminal includes this number as a prefix, e.g. 121R3 (resistor R3 on board /121\) or 121-12 (terminal No. 12 on board /121\).

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, Transmitter.

5.3.1. The circuit diagram is divided into a wiring diagram on page 8-55 showing interconnections between the printed circuit boards of which the transmitter is composed, and circuit diagrams of the individual printed circuit boards. The block diagram on page 8-28 illustrates the operation of the transmitter.

5.3.2. The microphone signal is fed to the AF-compressor on board /122\. In the "TRANSMIT ALARM" position of the "MODE"-switch the alarm signal generated on board /121\ is applied to the compressor.

The compressed signals are fed to a balanced mixer in which they are converted to a 1.4 MHz double sideband signal. The upper sideband is removed in a crystal filter and the lower sideband is applied to the mixer on board /123\. A 1.4 MHz signal for carrier re-insertion, if desired, is also applied to this mixer. The carrier level is controlled from the "MODE"-switch.

The mixer on board /123\ converts the lower sideband signal directly to the desired frequency in the range 1.6 - 4.15 MHz as an upper sideband signal.

The signal is then passed through an LP-filter and thereafter fed through an attenuator controlled by the "POWER"-switch.

The signal, now ready for use, is amplified on board /122\ and then applied to the driver which is also a part of board /122\.
Three chassis mounted, parallel connected valves step the signal up to the desired power level. Antenna tuning is preselected with the "CHANNEL"-switch, and fine tuning is performed with the "ANTENNA TUNING"-variometer.

5.3.3. The necessary 1.4 MHz injection signal is generated in a crystal oscillator on borad /122\. The channel information is generated on board /123\ controlled by the "CHANNEL"-switch.

5.3.4. All transistor circuits are powered from a voltage regulator in the power pack. The high tension part of the power pack and the receiver is controlled from the keying circuit on board /121\.
The power pack P 2000, P 2001 or P 2002 used with the equipment is started with the "POWER"-switch.

5.4. Circuit Description, Transmitter.

5.4.1. /120\ PA Stage and Antenna Tuning.

The power amplifier employs three parallel-connected valves operating in class AB in a common grid configuration.

An L-network performs antenna tuning and matching. When using long antennas the L-network can be extended to a π-network.

The various components in the network are selected by means of a drum switch driven by the "CHANNEL SELECTOR" knob which can be programmed individually for each of the channels. The programming is performed by inserting programming tabs into the appropriate wafers on the drum switch.

5.4.2. /121\ Two Tone Alarm-Generator and Keying Circuit.

The alarm-generator is composed of two tone oscillators TR1 and TR7 which are tuned to 2.2 kHz and 1.3 kHz, respectively. The oscillators are started and stopped alternately for periodes of nominally 250 ms by an astable multivibrator TR2 and TR6. The period time of the multivibrator is determined mainly by resistors R14 and R18 and by capacitors C7 and C8.

The operating period of the alarm generator, nominally 45 seconds, is measured by a Miller integrator combined with a trigger circuit composed of TR3, TR4 and TR5. Here the period time is determined by resistors R9 and R12 and capacitor C6.

The transmitter, power pack and receiver are controlled by transmit relay RL1.

A voltage for remote indication of the "transmit" condition is likewise controlled by the transmit relay.

The relay-coil current is controlled either from the handset key (simplex-semiduplex) or from the "POWER"-switch (duplex).

With the "MODE"-switch in the "TRANSMIT ALARM" position the relay-coil current is also controlled by transistor TR8 driven by the Miller-integrator.

5.4.3. 122 Compressor, Carrier Oscillator, Mixer, Amplifier and Driver.

The compressor is composed of transistors TR1 and TR2 and integrated amplifier IC1. In it, part of the output signal is taken off and rectified to provide control voltage for transistor TR2, which functions as a variable emitter resistor for the left hand transistor in IC1.

The 1.4 MHz carrier oscillator is crystal controlled and the active elements are housed in integrated circuit IC3. The frequency of the oscillator can be adjusted by means of a trimmer capacitor C5 series connected to the crystal.

The compressed audio signal and the 1.4 MHz signal are both fed to the balanced mixer IC2 and a 1.4 MHz double-sideband suppressed-carrier signal is therefore present across the secondary of transformer T1. An attenuator controlled by the "MODE"-switch determins the level of this signal. The signal is amplified in TR4 and fed through crystal filter X2 which removes the upper sideband and suppresses the carrier still further.

Carrier reinsertion is performed by applying the 1.4 MHz oscillator signal via an attenuator, also controlled by the "MODE"-switch, to TR7. Automatic selection of the A3H levels in both attenuators on the 2182 kHz frequency (channel 1) is carried out by means of transistor TR3 which is controlled from the "CHANNEL"-switch.

The 1.4 MHz SSB signal is now fed to board 123 via terminal 122-21 and after mixing to the desired channel fed back to board 122 at terminal 122-13.

A broad band amplifier composed of TR5 and TR6 raises the signal level and the signal is applied to the driver stage employing three parallel connected transistors.

Finally this board also contains an RF-detector. The input to this detector is selected by switch S1 which has two positions: Antenna Current and Level.

5.4.4. 123 Channel Oscillator, Mixer and Amplifier.

The channel oscillator has 30 crystal positions. The frequency of each crystal can be individually adjusted by means of a trimmer capacitor series connected to the crystal. The level of the oscillator is controlled to ensure that the harmonic content of the crystal frequency will be low.

The balanced mixer IC1 converts the 1.4 MHz SSB signal to the desired channel frequency. The image signal from the mixing process is removed in an 11-order low pass filter and the wanted signal is applied to TR4.

The amplification in TR4 is controlled by the "POWER"-switch for power reduction.

The signal is hereafter further amplified in transistor TR5.

5.5. Circuit Summary, Receiver.

5.5.1. The circuit diagram is divided into a wiring diagram on page 8-54 showing interconnections between the printed circuit boards of which the receiver is composed, and circuit diagrams of the individual printed circuit boards. The block diagram on page 8-29 illustrates the operation of the receiver.

5.5.2. The incoming signal is fed via the "BAND"-switch on board /134\ to the spot frequency input filters on boards /131\ and /132\ or to one of the input filters for SW, MW and LW on board /134\. This board also contains a mixer stage that converts the input signal frequency to the intermediate frequency 1.4 MHz by mixing it with the signal from the SW, MW and LW oscillator or the crystal frequency signal from the channel oscillator on board /133\.

The IF signal is fed to the AM or the SSB crystal filters dependent on the setting of the "SERVICE"-switch. On the IF board /135\ the signal is amplified and detected and the audio frequency output signal is fed to the "VOLUME" control.

The audio frequency amplification takes place on the AF board /136\, which also contains components for RFI filtering and the interconnection socket for connecting the receiver to the transmitter and power supply units.

5.6. Circuit Description, Receiver Boards.

5.6.1. /131\ 1. Coil Board and

/132\ 2. Coil Board

Each board contains 30 coils, two by two selected from the "CHANNEL SELECTOR"-switch. The coils together with the remaining components constitute a double band-pass input filter the frequency of which can be preset to the desired spot frequency by adjusting the cores of the coils in question.

5.6.2. /133\ Channel Oscillator.

The channel oscillator has 30 crystal positions. The frequency of each crystal can be individually adjusted by means of the trimmer capacitor series connected to the crystal. The signal voltage is taken out across C33. The level is kept constant by means of an ALC circuit on board /134\ controlling the base voltage of the oscillator transistor TR1. The control voltage is applied via the same coaxcable that feeds the output-signal from the oscillator to board /134\. When the "BAND"-switch is in the SW, MW or LW positions the base voltage is zero by which the oscillator is stopped.

5.6.3. /134\ Tunable Receiver and Mixer.

The antenna input filters of the tunable receiver consist of the coils L4, T1 and T2 and associated components. The tuning is made with the variable capacitor 130C1. The oscillator transistor is TR1. It is permanently connected to the LW coil T3 which in the MW and SW bands is shunted by L5 or L6 respectively.

The variable capacitor is connected through the padding capacitors C4, C5 or C8. In the SW band the frequency can be fine tuned by means of the variable capacitance diode D1 which is connected to the "CLARIFIER" control. The oscillator frequency is in all bands 1.4 MHz above the signal frequency.

The oscillator is followed by a buffer amplifier TR4 and a level detector TR5. The ALC voltage from the collector of TR5 is connected via the "BAND"-switch to either the base of TR1 or to the channel oscillator.

The mixer consists of the field effect transistors TR2 and TR3. The 1.4 MHz output signal is connected by diode switching to the AM or the SSB filter. Switching is controlled from the "SERVICE"-switch.

5.6.4. ⚠135 IF Amplifier, Detector and AGC.

The IF amplifier consists of the transistors TR1 and TR2. A 1.4 MHz band-pass filter connects the amplifier to the signal detector IC1. This integrated circuit contains a balanced mixer and a high-gain limiting amplifier. The signal voltage is applied balanced to the one input port of the mixer, terminals 7 and 9 of the integrated circuit.

When the detector works as an AM detector the signal voltage is also fed to the amplifier input, terminal 14, via D11. This signal is amplified and clipped to constant amplitude and internally connected to the other input port of the balanced mixer where it is mixed with the modulated signal. The difference frequency which contains the wanted AF-signal is taken off at the mixer output, terminal 8.

In the SSB mode D11 is blocked while D10 is conducting and the amplifier is now working as a 1.4 MHz oscillator in connection with the crystal X1, the variable capacitance diode D12 and the coil L3. The mixer is working in the same manner as before except that now the oscillator signal is the reinserted carrier.

The frequency of the oscillator can be varied from the "CLARIFIER" control by means of the variable capacitance diode.

Also the sum frequency of the two input signals is present at the mixer output. This signal is used for automatic gain control and is taken off across the 2.8 MHz tuned circuit. It is amplified in TR4 and rectified in the AGC detector TR3. The current of TR3 increases for increasing signal level causing the collector voltage to drop. The collector is connected to the bases of the IF transistors and a lower collector voltage means reduced gain in the IF amplifier.

The AGC time constants are determined by C5 and C8. The circuit combines a short attack time and a long decay time. The resistor R14 in series with C8, which mainly determines the decay time, prevents short noise pulsed from giving a long decay time.

The gain can also be controlled manually by means of the "SENSITIVITY" control which in combination with the diode D1 determines the maximum collector voltage of TR3 and with that the highest available gain of the IF amplifier.

The AGC is switched off by disconnecting the emitter current of TR4. The base voltage of the IF transistors is then controlled only by means of the "SENSITIVITY" control.

5.6.5. △136 AF Amplifier and RFI Filters.

The AF amplifier is an integrated circuit provided with a built-in thermal limiting circuit and protection against accidental short-circuiting of the output.

The AF signal from the "VOLUME" potentiometer is fed to the integrated circuit via resistors R2 and R4 which together with C3 and C7 and the amplifier itself form an active low-pass filter.

RFI filters are inserted in the power supply, muting and AF output lines in order to suppress noise and interference on these lines.

5.7. Circuit Summary, P 2000 and P 2002, 24V and 12V DC Power Packs.

5.7.1. The complete circuit diagrams are shown on pages 8-49 and 8-51. The block diagram on page 8-30 illustrates the operation of the power packs.

5.7.2. Filament supply for the transmitter output valves is obtained direct from the battery, while the remaining necessary supply voltages for both transmitter and receiver are generated in converters. Converter transformers give full isolation between the battery voltage and chassises permitting these to be earthed without causing the supply leads to be earthed.

5.7.3. Low tension for transmitter and receiver is generated by the LT-converter followed by rectifiers and a voltage stabilizer.

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

5.7.4. High tension for transmitter power amplifier is generated by the HT-converter followed by rectifiers.

The HT-converter is driven from a secondary winding on the LT-converter transformer.

5.8. Circuit Description, P 2000 and P 2002, 24V and 12V DC Power Packs.

5.8.1. △140, △143 LT- and HT-Converters.

The current which energizes relay RL1 is controlled by the "POWER" switch in the associated T 2000 transmitter. Turning the switch from "OFF" to "RECEIVE ONLY" connects terminals 1a and 1b of multi-wire connector SK1 together. A diode inserted in series with the relay coil ensures that the relay cannot operate if the battery voltage does not have the correct polarity.

The LT-converter is composed of transistors TR3 and TR4 and the square wave output signal is coupled through transformer T1 to the LT-rectifier and as a drive signal to the HT-converter.

The HT-converter contains transistors TR1 and TR2 and the output signal is coupled through transformer T2 to the HT-rectifiers.

5.8.2. /141\ /144\ Converter Driver, LT-Rectifier and -Stabilizer and HT-Rectifiers.

A bistable multivibrator composed of transistors TR2 and TR3 is driven by oscillator TR1 with the nominal frequency 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^{o} are used as driving signals for the LT-converter.

The output signal from the LT-converter is rectified in the bridge D8-D11 which is followed by a voltage stabilizer having a nominal output voltage of 12.5V.

The current which energizes relay RL1 passes transmitter safety switch 120S3 and is controlled by the keying relay in the transmitter. Via the contacts of RL1 base drive is applied to the HT-converter transistors and the square wave output is rectified in three bridge circuits. The DC-outputs of each bridge are series connected to obtain the plate supply voltage for the transmitter power amplifier, while the DC-output of the bridge having one side connected to ground is used as screen grid supply voltage.

5.9. Circuit Summary, P 2001, AC Power Pack.

5.9.1. The complete circuit diagram is shown on page 8-53. The block diagram on page 8-31 illustrates the operation of the power pack.

5.9.2. Filament supply for the transmitter output valves and low-tension for transistor circuitry are obtained from transformer T1.

Transformers T2 and T3 have two secondaries each and supply plate- and screen grid-voltages for transmitter power amplifier.

5.10. Circuit Description, P 2001, AC Power Pack.

5.10.1. /146\ Transformers.

A double pole mechanically operated safety switch is inserted in the mains input leads. The primary current of transformer T1 is controlled by the "POWER"-switch of the associated transmitter T 2000. Turning the switch from "OFF" to "RECEIVE ONLY" connects terminals 1a and 1b of multi-wire connector SK1 together, and low-tension is supplied to receiver R 2000. Relay 147RL1 connects primary windings of transformers T2 and T3 to the mains.

5.10.2. /147\ LT-Rectifiers and -Stabilizer and HT-Rectifiers.

The low tension output from transformer T1 is rectified in the bridge circuit D2-D5 and stabilized to a nominal voltage of 12.5V in the LT-stabilizer.

The current which energizes relay RL1 passes transmitter safety switch 120S3 and is controlled by the keying relay in the transmitter.

Transformers T2 and T3 supply four bridge rectifier circuits connected in series to obtain the plate supply voltage for the transmitter power amplifier. The DC-output voltage from the bridge having one side connected to ground is used as screen grid supply voltage.

6 SIMPLE SERVICE

6.1. Incorrect Operation.

If the equipment is not functioning the way it should a check should be made whether it is being operated correctly. Go through adjustment procedures 2.2, 2.3 and 2.4 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 rize 5 - 10 mm above the plates).

6.3. Replacement of Dial Lamps.

The dial lamps for the channel displays become accessible when opening the door of the cabinet. Pull off the lamp holder and the lamp may be replaced.

The dial lamp of the tunable receiver can be replaced in the same way without dismantling the receiver from the front panel by using a pair of flat nose pliers through the opening at the top of the receiver.

All dial lamps are rated 12-15 Volts, 0.1A.

6.4. Replacement of Fuses.

If the equipment ceases to work a check should be made of the fuses in the power pack. They become accessible when the door of the cabinet is opened.

NOTE: Set the "POWER"-switch to "OFF" and open external supply voltage switch before opening the equipment.

If neither the transmitter nor the receiver is working and there are no dial lights, check the two input fuses at the bottom of the power pack near the input terminals and the external fuses.

If neither the transmitter nor the receiver is working but the channel display of the transmitter can be illuminated, check the fuse for the LT-stabilizer FS1 at the top of the printed circuit board.

If the receiver is working but not the transmitter, check the screen grid and plate fuses, FS2 and FS3. Observe that if the plate fuse has blown the screen grid fuse has also blown.

For fuse ratings see circuit board location plans.

NOTE: Do not use fuses of higher ratings than those specified.

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 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 two figures, pages 8-26 and 8-27. Locations of components on each circuit board appear from 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.

Most circuit boards contain one or more test points that permit checking the active elements on each board. 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.

Solder terminals on the circuit boards may to a great extent also be regarded as test points. Typical voltages are therefore also listed against relevant solder 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 the 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 -10 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.

Two tone generators are used for producing the two-tone signal.

Alternatively, the TWO-TONE ALARM GENERATOR incorporated in the transmitter may be employed.

The procedure in providing the modulating signal is described under 7.11. Realignment of Compressor, Carrier oscillator, Mixer, Amplifier and Driver, page 7-4.

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.

7.8. Typical Sensitivity Levels, Receiver R 2000.

The following table gives typical values of input voltages to be applied to various points in the receiver signal path to obtain an AF output voltage of 3V RMS, 1000 Hz measured accross the AF-output terminals 136SK2-5 and 136SK2-7

Input to:	Generator output impedance	Generator Frequency	Generator Modulation	"SERVICE" switch	Typical Sensitivity
Terminal 136-8	600 ohms	1 kHz	-	-	50 mV
135C19/ 135C20	50 ohms +0.1 µF	1399 kHz	0	SSB	62 dB/1µV
			30% 1 kHz	AM	75 dB/1µV
Base 135TR2	50 ohms +0.1 µF	1399 kHz	0	SSB	28 dB/1µV
			30% 1 kHz	AM	41 dB/1µV
Terminal 135-7	50 ohms +0.1 µF	1399 kHz	0	SSB	5 dB/1µV
Terminal 135-9			30% 1 kHz	AM	19 dB/1µV
Terminal 134-13	50 ohms +0.1 µF	Channel frequency +1 kHz	0	SSB	0 dB/1µV
		Channel frequency	30% 1 kHz	AM	14 dB/1µV
Antenna Terminal	10 ohms +500 pF	Channel frequency +1 kHz	0	SSB	-1 dB/1µV
		Channel frequency	30% 1 kHz	AM	8 dB/1µV

Receiver Control Settings:

BAND: Channel Selector
CLARIFIER: "0"
SENSITIVITY: fully clockwise
VOLUME: fully clockwise

7.9. Adjustments

The following sections describe alignment procedures for each individual module (subunit) that contains adjustable components. Keep in mind that no adjustment 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.

7.10. △121 Realignment of Two Tone Alarm Generator and Keying Circuit.

Measuring equipment:

Frequency Counter having an accuracy better than 10^{-4} and a sensitivity of at least 1V.

Oscilloscope or AF Voltmeter having an input impedance better than 100 kohms and sensitivity of at least 1V.

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling out its plunger.

Control settings:

POWER: SIMPLEX FULL POWER

MODE: TEST ALARM

(1) Connect frequency counter between terminals 121-10 and 121-8 (ground).

(2) Connect terminals 121-1 and 121-2 together using a crocodile clip etc.

(3) Depress and release ALARM START button.

(4) Adjust coil 121T1 (colour coded red/red) until counter reads 2200 Hz ± 1 Hz.

(5) Remove connection referred to under (2) above.

(6) Connect terminals 121-2 and 121-3 together (crocodile clip).

(7) Depress and release ALARM START button.

(8) Adjust coil 121T2 (colour coded brown/orange) until counter reads 1300 Hz ± 1 Hz.

(9) Remove connection referred to under (6) above and remove connection to frequency counter.

7.11. △122 Realignment of Compressor, Carrier Oscillator, Mixer, Amplifier and Driver.

Measuring equipment:

DC-amperemeter having a full scale deflection of 0.5 - 1 amp.

Dummy Antenna: 10 ohms in series with 250 pF, (100W mean power).

Oscilloscope having a sensitivity better than 50mV/div.
Input impedance 10 Mohms in parallel with 7 pF and a 3-dB upper limiting frequency greater than 10 MHz.

Frequency Counter having an accuracy better than 10^{-6} and a sensitivity of at least 100mV.

Two Tone Generators which between them can deliver a signal consisting of two equal signals (700 and 2500 Hz) having a total amplitude of 9.5Vpp in 180 ohms. Generator output impedance: 60 ohms.

Alternatively the Two Tone Alarm Generator △121 incorporated in the transmitter may be used as follows:

Set POWER switch to OFF.
Connect a 1 kohm resistor between terminals 121-1 and 121-8.
Connect a 1 kohm resistor between terminals 121-3 and 121-8.
Disconnect orange leads from terminal 122-26.
Connect terminals 121-4 and 121-12 together.
A two tone signal can now be applied to the compressor irrespective of the MODE-switch setting by depressing the ALARM START button.
The signal will be present for approx. 45 seconds controlled by the timer in the alarm generator circuit

7.11.1. Realignment of 1.4 MHz OSCILLATOR.

Open the high tension circuit of the power pack by operating safety switch 120S3, and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling out its plunger.

Control settings:

POWER: DUPLEX FULL POWER

MODE: A3H (TUNE)

(1) Connect Frequency Counter between terminals 122-21 and 122-22 (ground).

(2) Adjust trimmer capacitor 122C5 until the counter reads 1400000 Hz.

(3) Disconnect counter.

7.11.2. Realignment of CARRIER BALANCE 122R13.

Control settings:

POWER: SIMPLEX FULL POWER

MODE: A3J.

CHANNEL SELECTOR: Any channel equipped with a channel crystal except channel 1 (2182 kHz).

(1) Connect oscilloscope between terminals 122-2 and 122-4 (ground)

(2) Close the high tension circuit of the power pack by operating the safety switch 120S3, and if power pack P 2001 (AC) is installed, also safety switch 146S1.

(3) Key transmitter by depressing handset key.

(4) Adjust potentiometer 122R13 for minimum response on oscilloscope.

(5) Release handset key and disconnect oscilloscope.

7.11.3. Realignment of 1.4 MHz Transformer 122T1.

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling out its plunger.

Control settings:

POWER: DUPLEX FULL POWER

MODE: A3J.

(1) Connect oscilloscope between terminals 121-21 and 122-22 (ground).

(2) Apply a two tone modulating signal to the microphone terminals in the handset through a 470 uF/16V capacitor, amplitude 9.5Vpp.

(Alternatively the built-in Two Tone Alarm Generator may be used as described in section 7.11.)

(3) Adjust transformer 122T1 for maximum deflection on oscilloscope.

(4) Disconnect oscilloscope.
If the built-in Two Tone Alarm Generator was employed for making the adjustment, be sure to remove all temporary connections and disconnections and check that the alarm function is restored.

7.11.4. Realignment of 1.4 MHz Coil 122L8.

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling out its plunger.

Control settings:

POWER: DUPLEX FULL POWER

MODE: A3H (TUNE)

(1) Short-circuit capacitor 123C2 using a crocodile clip.

(2) Connect oscilloscope probe tip to the junction 122R78 - 122C42 and oscilloscope ground clip to terminal 122-23.

(3) Adjust coil 122L8 for maximum response on oscilloscope.

(4) Disconnect oscilloscope and crocodile clip.

7.11.5. Realignment of AUDIO (SIDE BAND) LEVEL 122R37 and CARRIER LEVEL 122R43.

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, also open mains safety switch 146S1. (Both safety switches are automatically opened when the cabinet door is opened).

Remove plate voltage fuse FS3 in power pack and connect amperemeter (0.5 - 1 A f.s.d.) between fuseholder clips (and if power pack P 2001 is used, close 146S1 by pulling out its plunger).

Control settings:

POWER: SIMPLEX FULL POWER

MODE: A3J

CHANNEL SELECTOR: Select a channel having a frequency in the middle of the CT-range (do not use channel 1).

(1) Disconnect transmitter antenna.

(2) Apply a two tone modulating signal to the microphone terminals in the handset through a 470 uF/16V capacitor, amplitude 9.5Vpp. (Alternatively, the built-in Two Tone Alarm Generator may be used as described in section 7.11.)

(3) Depress handset key.

(4) Adjust potentiometer 122R37 until the amperemeter reads 420mA.

(5) Release handset key and connect (dummy) antenna.

(6) Depress handset key and tune ANTENNA TUNING for maximum ANTENNA CURRENT:

(7) Couple oscilloscope to antenna and observe the two tone envelope.

(8) Set "MODE"-switch to A3H (TUNE)

(9) Adjust potentiometer 122R43 until the three tone envelope has the same peak to peak value as the two tone envelope observed in step (7).

(10) Release handset key and open safety switch(es).
Remove amperemeter and reinsert fuse FS3 in power pack.
If the built-in Two Tone Alarm Generator was employed for making the adjustment, be sure to remove all the temporary connections and disconnections and check that the alarm function is restored.

7.12. △123 Realignment of Channel Oscillator, Mixer and Amplifier.

Measuring equipment:

DC-Amperemeter having a full scale deflection of 0.5 - 1 amp.

Oscilloscope having a sensitivity better than 50 mV/div. Input impedance 10 Mohm in parallel with 7 pF and a 3 dB upper limiting frequency greater that 10 MHz.

Standard Signal Generator covering the range 1.6 - 10 MHz and having an accuracy better than 10^{-3}.

Spectrum Analyzer heterodyne voltmeter or a receiver covering the range 1.6 - 10 MHz.

7.12.1. Realignment of 1.4 MHz Transformer 123T1.

Open the high tension circuit of the power pack by operating safety switch 120S3, and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling out its plunger.

Control settings:

POWER: DUPLEX FULL POWER.

MODE: A3H (TUNE).

(1) Connect oscilloscope probe tip to the junction 122R78 - 122C42 and oscilloscope ground clip to terminal 122-23.

(2) Adjust transformer 123T1 for minimum response on oscilloscope.

(3) Disconnect oscilloscope.

7.12.2. Realignment of BALANCE Potentiometer 123R5.

Open the high tension circuit of the power pack by operating safety switch 120S3, and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling its plunger.

Control settings:

POWER: DUPLEX FULL POWER

MODE: A3J.

CHANNEL SELECTOR: Any channel below 2.8 MHz except channel 1 (2182 kHz).

(1) Connect spectrum analyzer between terminals 123-5 and 123-6 (ground) through a 0.1 uF capacitor.

(2) Identify channel oscillator signal 1400 kHz above the selected channel frequency.

(3) Adjust 123R5 for minimum channel oscillator signal feed-through.

(4) Disconnect spectrum analyzer.

7.12.3. Realignment of LOW PASS FILTER.

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, close the mains safety switch 146S1 by pulling its plunger.

Control settings:

POWER: DUPLEX FULL POWER

MODE: A3J

CHANNEL SELECTOR: A channel not equipped with a crystal.

(1) Remove strap between terminals 123-3 and 123-4 and connect standard signal generator between same two terminals (123-3 is ground).

(2) Connect spectrum analyzer between test point 123TP5 and terminal 123-6 (ground) through a 0.1 μF capacitor.

(3) Set signal generator to 10.0 MHz, 100 mV_{rms} .

(4) Adjust coil 123L2 for minimum response on spectrum analyzer.

(5) Set signal generator to 5.14 MHz.

(6) Adjust coil 123L3 for minimum response on spectrum analyzer.

(7) Set signal generator to 4.50 MHz.

(8) Adjust coil 123L5 for minimum response on spectrum analyzer.

(9) Set signal generator to 4.60 MHz.

(10) Adjust coil 123L6 for minimum response on spectrum analyzer.

(11) Set signal generator to 6.00 MHz.

(12) Adjust coil 123L7 for minimum response on spectrum analyzer.

(13) Check that LP-filter response is within 2 dB in the frequency range 1.6 - 4.15 MHz.

(14) Remove signal generator and spectrum analyzer and strap terminals 123-3 and 123-4 together.

7.12.4. Realignment of Coil 123L9

Open the high tension circuit of the power pack by operating safety switch 120S3 and if power pack P 2001 (AC) is installed, also open mains safety switch 146S1. (Both safety switches are automatically opened when the cabinet door is opened).

Remove plate voltage fuse FS3 in power pack and connect amperemeter (0.5 - 1A f.s.d.) between fuseholder clips (and if power pack P 2001 is used, close 146S1 by pulling out its plunger).

Control settings:

POWER: SIMPLEX FULL POWER

MODE: A3H (TUNE)

CHANNEL SELECTOR: Select the channel having the lowest frequency.

(1) Disconnect transmitter antenna and close safety switch 120S3.

(2) Depress handset key and note amperemeter reading.

(3) Release handset key and set CHANNEL SELECTOR to the channel having a frequency as near to but not above 3500 kHz.

(4) Depress handset key and adjust coil 123L9 until the amperemeter reading is the same as obtained in step (2).

(5) Release handset key and set CHANNEL SELECTOR to the channel having the lowest frequency.

(6) Depress handset key and adjust coil 123L9 until the amperemeter reading is the mean value of the figures obtained in step (2) and (4).

(7) Repeat the procedure until equal amperemeter readings are obtained on the two channels without any adjustment of coil 123L9.

(8) Open safety switch(es). Remove amperemeter and reinsert fuse FS3 in power pack.

7.13. △134 Realignment of Tunable Receiver and Mixer.

Measuring equipment:

Standard Signal Generator covering the range 150 - 4450 kHz. Artificial antenna: 10 ohms + 500 pF.

Frequency Counter having a sensitivity of at least 50 mV.

AF Output Meter

Oscilloscope or RF millivoltmeter

7.13.1. Realignment of Mixer Output Circuit.

(1) Connect signal generator to antenna input terminal through the artificial antenna and tune it to the frequency for which the receiver is set.

(2) Switch AGC off and adjust "SENSITIVITY" to a convenient output level.

(3) Adjust the core of 134T5 for maximum AF output.

7.13.2. Realignment of 1.4 MHz Trap.

(1) Insert a 1.4 MHz crystal in a vacant socket of the channel oscillator and set the receiver to that channel number.

(2) Connect oscilloscope or RF millivoltmeter to the counter output terminals 134-7 and 134-9, and adjust the core of 134L7 for minimum voltage. Remove the 1.4 MHz crystal.

7.13.3. Realignment of Balancing Potentiometer 134R9.

(1) Set the receiver to the lowest channel frequency.

(2) Tune the signal generator to the intermediate frequency 1.4 MHz and increase the output level until a signal is heard.

(3) Adjust 134R9 for minimum AF output.

7.13.4. Realignment of Tunable Receiver.

(1) Connect counter between terminals 134-7 and 134-9.

(2) Rotate the "TUNING" control fully anticlockwise and check that the dial pointer corresponds exactly to the mark at the lower left side corner of the frequency dial plate.

(3) Rotate the "TUNING" control until the dial pointer is positioned exactly at the 1700 kHz mark. Adjust the cores of the coils listed in the table below until the stated frequencies are shown on the frequency counter with the "BAND" switch set to the respective bands. Note that adjustment of 134T3 affects the frequency alignment on the other two bands, and this coil is therefore to be realigned first, followed by a realignment of 134L5 and 134L6.

(4) Set the dial pointer to the 4100 kHz mark and adjust the trimming capacitors until the stated frequencies are obtained.
NOTE: "CLARIFIER" control should be in its "0" position.

(5) Repeat (3) and (4) as many times as necessary.

(6) Disconnect counter and adjust the antenna circuits to maximum output using the signal generator at the alignment frequencies as given in the table below.

BAND	Dial pointer at 1700 kHz		Dial pointer at 4100 kHz	
Oscillator	Oscillator freq. (kHz)	Adjust	Oscillator freq. (kHz)	Adjust
LW	1556.4	134T3	1802	134C6
MW	1960	134L5	2844	134C7
SW	3100	134L6	5500	134C1
Antenna Circuits	Generator freq. (kHz)	Adjust	Generator freq. (kHz)	Adjust
LW	156.4	134L4	402	134C13
MW	560	134T1	1444	134C14
SW	1700	134T2	4100	134C15

7.14. 135 Realignment of IF Amplifier and AGC

Measuring equipment:

Standard signal generator covering 1.4 MHz

Frequency counter having an accuracy better than 10^{-6}.

AF output meter

7.14.1. Realignment of 1.4 MHz IF Filter and 2.8 MHz AGC Filter.

(1) Connect signal generator to antenna input and tune it to e.g. 2182 kHz. Signal level approx. 20 dB/1µV.

(2) Set the receiver to the same frequency, set "SERVICE" to "AM-AGC ON" and turn "SENSITIVITY" fully clockwise.

(3) Adjust cores in 135L1 and 135T1 for maximum AF output.

(4) Increase signal generator level to approx. 40 dB/1µV and adjust 135L2 for minimum AF output.

7.14.2. Realignment of Clarifier Oscillator.

(1) Connect frequency counter to testpoint 135TP6.

(2) Set "SERVICE" switch to "SSB" and "CLARIFIER" to "0".

(3) Adjust core in 135L3 until the counter shows 1 400 000 Hz.

8 PARTS LISTS AND CIRCUIT DIAGRAMS

8.1. Numbering

An identification number between △120 and △150 is assigned to each module. The designation of a component or terminal includes this number as a prefix - example: 121R3 (resistor R3 on module △121), or 121-12 (terminal No. 12 on module △121).

8.2. Switches

Switches with stops are shown in the extreme anticlockwise position. The "CHANNEL" switch is shown in the "CHANNEL 1" 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 and from the circuit-board location plans.

On the vertical circuit boards, terminal numbers always start in the top left-hand corner, reading from left to right with the equipment placed in its normal position.

In the circuit diagrams, each terminal is identified by a number (example: 121-12) and in most cases by an explanatory text. In addition to this, the number of the module and terminal to which the lead connects are indicated (example: 122 -22). 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 in the circuit diagrams next to the points to which they refer and are marked with a "V".

Typical AC voltages are likewise indicated in the circuit diagrams. They are marked with "Vpp" or "mVpp".

For measuring conditions see Chapter 7.

8.5. Test Points

Location of test points appear from the component location drawings and from the circuit board location plans. Typical DC voltages at test points are indicated in the circuit diagrams.

8.6. 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

Vl... = 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

120

120C 1- 5	0.1 μF	10%	250V	Polyes.
C 6- 7	2.2 μF	10%	250V	Polyes.
C 8- 9	4.7 nF	10%	5KV	Cer.
C10	0.1 μF	10%	250V	Polyes.
C11	27 pF	5%	1.6KV	Cer.
C12	47 pF	5%	1.6KV	Cer.
C13-19	100 pF	5%	1.6KV	Cer.
C20	300 pF	20%	3KVS	Cer.
C21	160 pF	20%	3KVS	Cer.
C22	160 pF	20%	8KVS	Cer.
C23-25	800 pF	20%	4KVS	Cer.
120L 1	RF-CHOKE			CODE: T-1068
L 2	RF-CHOKE			CODE: T-1069
L 3	COIL 2182 kHz			CODE: T-1076
L 4	VARIOMETER CT			CODE: T-1101
120ME 1	INSTRUMENT			CODE: T-1136
120PL 1	CONNECTOR (PLUG)			
PL 2	CONNECTOR (PLUG)			
120R 1	2.7 ohms	5%	30W	WW
R 2	12 ohms	5%	2/3W	Car.
R 3- 5	3.3 Mohms	5%	1W	Car.
120S 1	POWER ROTARY SWITCH			CODE: T-1014
S 2	MODE ROTARY SWITCH			CODE: T-1013
S 3	SAFETY SWITCH			
S 4	DRUM SWITCH			
S 5	ALARM START PUSH-BUTTON			
120SK 1	CONNECTOR (SOCKET)			
120SL 1	LAMP 12V	0.1A	E10	
120T 1	TRANSFORMER			CODE: T-1121
120V 1- 3	EL 509 (6KG6A)			

PARTS LIST

FOR

121

121C 1	0.1 µF	10%	250V	Polyes.
C 2	22 nF	10%	250V	Polyes.
C 3	0.15 µF	1%	63V	Polyst.
C 4- 5	0.1 µF	10%	250V	Polyes.
C 6- 8	6.8 µF	10%	100V	Polyes.
C 9	0.15 µF	1%	63V	Polyst.
C10	0.1 µF	10%	250V	Polyes.
121D 1-13	1S920			
121R 1	100 Kohms	5%	1/3W	Car.
R 2	1.2 Kohms	5%	1/3W	Car.
R 3	100 ohms	5%	1/3W	Car.
R 4	1.82 Kohms	1%	0.4W	MF
R 5	6.81 Kohms	1%	0.4W	MF
R 6	22 Kohms	5%	1/3W	Car.
R 7- 8	1 Kohm	5%	1/3W	Car.
R 9	787 Kohms	1%	1/2W	MF
R10	1.8 Kohms	5%	1/3W	Car.
R11	6.8 Kohms	5%	1/3W	Car.
R12	787 Kohms	1%	1/2W	MF
R13	10 Kohms	5%	1/3W	Car.
R14	56 Kohms	5%	1/3W	Car.
R15	10 Kohms	5%	1/3W	Car.
R16	470 ohms	5%	1/3W	Car.
R17	4.7 Kohms	5%	1/3W	Car.
R18	56 Kohms	5%	1/3W	Car.
R19-20	10 Kohms	5%	1/3W	Car.
R21	1 Kohm	5%	1/3W	Car.
R22	6.8 Kohms	5%	1/3W	Car.
R23	1.8 Kohms	5%	1/3W	Car.
R24	10 Kohms	5%	1/3W	Car.
R25	4.7 Kohms	5%	1/3W	Car.
R26	1 Kohm	5%	1/3W	Car.
R27	22 Kohms	5%	1/3W	Car.
R28	68 ohms	5%	1/3W	Car.
121RL 1	RELAY	4 CHANGE OVER, 12V COIL		
121T 1	TRANSFORMER			CODE: T-0072
T 2	TRANSFORMER			CODE: T-0071
121TR 1	BC547B			
TR 2- 6	BC558B			
TR 7- 8	BC547B			

PARTS LIST

FOR

122 (in triangle)

122C 1	0.1 µF	10%	250V	Polyes.
C 2	100 µF		25V	W.alum.
C 3- 4	0.1 µF	10%	250V	Polyes.
C 5	23 pF	Var.		
C 6	680 pF	1%	500V	Polyst.
C 7	0.1 µF	10%	250V	Polyes.
C 8	18 pF	5%	400V	Cer.NPO
C 9	0.1 µF	10%	250V	Polyes.
C10	22 µF		15V	Tan.
C11	0.1 µF	10%	250V	Polyes.
C12-13	560 pF	1%	500V	Polyst.
C14	0.1 µF	10%	250V	Polyes.
C15	4.7 nF	-20/+80%	30V	Cer.
C16	1 µF	10%	250V	Polyes.
C17	0.1 µF	10%	250V	Polyes.
C18	22 µF		15V	Tan.
C19	4.7 nF	-20/+80%	30V	Cer.
C20	1 µF	10%	250V	Polyes.
C21-22	0.1 µF	10%	250V	Polyes.
C23	680 pF	1%	500V	Polyst.
C24-26	0.1 µF	10%	250V	Polyes.
C27	4.7 nF	-20/+80%	30V	Cer.
C28	6.8 µF	10%	100V	Polyes.
C29	0.1 µF	10%	250V	Polyes.
C30	1 µF	10%	250V	Polyes.
C31-36	0.1 µF	10%	250V	Polyes.
C37	100 µF		25V	W.alum.
C38-41	0.1 µF	10%	250V	Polyes.
C42	1.8 nF	1%	500V	Polyst.
C43	1 µF	10%	250V	Polyes.

122D 1- 7	1S920
D 8	AAZ17

122IC 1	CA3046
IC 2	MC1496
IC 3	CA3046

122L 1- 4	100 µH	RF CHOKE	10%
L 5	220 µH	RF CHOKE	10%
L 6	100 µH	RF CHOKE	10%
L 7	1 mH	RF CHOKE	10%
L 8	COIL		

CODE: T-1047

122R 1	10 Kohms	5%	1/3W	Car.
R 2	39 ohms	5%	1/3W	Car.
R 3	470 ohms	5%	1/3W	Car.
R 4	180 ohms	5%	1/2W	Car.
R 5	15 Kohms	5%	1/3W	Car.
R 6	220 ohms	5%	1/3W	Car.
R 7	1 Kohms	5%	1/3W	Car.
R 8	4.7 Kohms	5%	1/3W	Car.
R 9	10 Kohms	5%	1/3W	Car.
R10	1.2 Kohms	5%	1/3W	Car.
R11	1.8 Kohms	5%	1/3W	Car.
R12	1.5 Kohms	5%	1/3W	Car.
R13	47 Kohms	Var.		
R14	22 Kohms	5%	1/3W	Car.
R15	100 Kohms	5%	1/3W	Car.
R16	1 Kohm	5%	1/3W	Car.
R17	10 Kohms	5%	1/3W	Car.
R18	22 Kohms	5%	1/3W	Car.
R19	12 ohms	5%	1/3W	Car.
R20	1 Kohm	5%	1/3W	Car.
R21-22	470 ohms	5%	1/3W	Car.
R23	220 Kohms	5%	1/3W	Car.
R23-25	22 Kohms	5%	1/3W	Car.
R26	680 Ohms	5%	1/3W	Car.
R27	2.2 Kohms	5%	1/3W	Car.
R28	330 ohms	5%	1/3W	Car.
R29	150 ohms	5%	1/3W	Car.
R30	100 Kohms	5%	1/3W	Car.
R31	10 Kohms	5%	1/3W	Car.
R32	4.7 Kohms	5%	1/3W	Car.
R33	2.2 Kohms	5%	1/3W	Car.
R34	100 ohms	5%	1/3W	Car.
R35	10 Kohms	5%	1/3W	Car.
R36	22 Kohms	5%	1/3W	Car.
R37	1 Kohm	Var.		
R38	47 ohms	5%	1/3W	Car.
R39	10 Kohms	5%	1/3W	Car.
R40	1.2 Kohms	5%	1/3W	Car.
R41	1 Kohm	5%	1/3W	Car.
R42	470 ohms	5%	1/3W	Car.
R43	1 Kohm	Var.		
R44	10 Kohms	5%	1/3W	Car.
R45	1.5 Kohms	5%	1/3W	Car.
R46	560 ohms	5%	1/3W	Car.
R47	10 Kohms	5%	1/3W	Car.
R48	100 ohms	5%	1/3W	Car.
R49	10 Kohms	5%	1/3W	Car.
R50	6.8 Kohms	5%	1/3W	Car.
R51	1.5 Kohms	5%	1/3W	Car.
R52	4.7 Kohms	5%	1/3W	Car.
R53	47 Kohms	5%	1/3W	Car.
R54	560 ohms	5%	1/3W	Car.
R55-56	470 Kohms	5%	1/3W	Car.
R57	4.7 Kohms	5%	1/3W	Car.
R58	10 Kohms	5%	1/3W	Car.

122R59	8.2 Kohms	5%	1/3W	Car.
R60	2.2 Kohms	5%	1/3W	Car.
R61	1.5 Kohms	5%	1/3W	Car.
R62	47 Kohms	5%	1/3W	Car.
R63	470 ohms	5%	1/3W	Car.
R64	150 ohms	5%	1/3W	Car.
R65	680 ohms	5%	1/3W	Car.
R66	150 ohms	5%	1W	Car.
R67	47 ohms	5%	1/3W	Car.
R68	68 ohms	5%	1/3W	Car.
R69	12 Kohms	5%	1/3W	Car.
R70-72	33 ohms	5%	1/3W	Car.
R73	2.2 Kohms	5%	1/3W	Car.
R74-75	1 Kohm	5%	1/3W	Car.
R76	180 ohms	5%	1/3W	Car.
R77	100 ohms	5%	1/3W	Car.
R78	47 ohms	5%	1/3W	Car.
R79	27 ohms	5%	1/3W	Car.
R80	56 ohms	5%	1/3W	Car.
R81	2.7 Kohms	5%	1/3W	Car.
R82	8.2 Kohms	5%	1/3W	Car.
R83	820 ohms	5%	1/3W	Car.
R84-86	12 ohms	5%	2/3W	Car.
R87	820 ohms	5%	1/3W	Car.
R88	47 ohms	5%	2W	Car.
R89	270 ohms	5%	1/3W	Car.
R90-92	12 ohms	5%	2/3W	Car.
122S 1	SLIDE switch			CODE: SMB
122T 1	TRANSFORMER			CODE: T-1048
122TR 1	BC558 B			
TR 2	BF245 B			
TR 3	BC558 B			
TR 4	BC337-25			
TR 5- 6	BD135-10			
TR 7	BC547 B			
TR 8- 9	BC337-25			
TR10	NOT USED			
TR11-13	D44 C10			
122X 1	CRYSTAL	1.4 MHz		CODE: T-1000
X 2	FILTER	1.4 MHz	LSB	

PARTS LIST

FOR

123

123C 1	23 pF	Var.		
C 2	1.8 nF	1%	500V	Polyst.
C 3	18 pF	5%	400V	Cer.NPO
C 4	23 pF	Var.		
C 5	47 nF	10%	250V	Polyes.
C 6	0.1 µF	10%	250V	Polyes.
C 7	18 pF	5%	400V	Cer.NPO
C 8- 9	23 pF	Var.		
C10-11	18 pF	5%	400V	Cer.NPO
C12-13	23 pF	Var.		
C14-15	18 pF	5%	400V	Cer.NPO
C16-17	23 pF	Var.		
C18-19	18 pF	5%	400V	Cer.NPO
C20	23 pF	Var.		
C21-22	0.1 µF	10%	250V	Polyes.
C23	23 pF	Var.		
C24	18 pF	5%	400V	Cer.NPO
C25	0.1 µF	10%	250V	Polyes.
C26	18 pF	5%	400V	Cer.NPO
C27-28	23 pF	Var.		
C29	18 pF	5%	400V	Cer.NPO
C30	0.1 µF	10%	250V	Polyes.
C31	68 pF	5%	400V	Cer.N150
C32	18 pF	5%	400V	Cer.NPO
C33	23 pF	Var.		
C34	8.2 pF	±0.25 pF	400V	Cer.N150
C35	23 pF	Var.		
C36	18 pF	5%	400V	Cer.NPO
C37	0.1 µF	10%	250V	Polyes.
C38	91 pF	5%	400V	Cer.N150
C39	0.1 µF	10%	250V	Polyes.
C40	18 pF	5%	400V	Cer.NPO
C41	23 pF	Var.		
C42-43	56 pF	5%	400V	Cer.N150
C44	18 pF	5%	400V	Cer.NPO
C45	110 pF	5%	400V	Cer.N150
C46	680 pF	1%	500V	Polyst.
C47	22 µF		15V	TAN
C48	47 pF	5%	400V	Cer.N150
C49-50	390 pF	1%	500V	Polyst.
C51	23 pF	Var.		
C52	91 pF	5%	400V	Cer.N150
C53	4.7 nF	-20/+80%	30V	Cer.
C54	23 pF	Var.		
C55	18 pF	5%	400V	Cer.NPO
C56	0.1 µF	10%	250V	Polyes.
C57	68 pF	5%	400V	Cer.N150
C58	18 pF	5%	400V	Cer.NPO
C59	23 pF	Var.		
C60	33 pF	5%	400V	Cer.N150

123C61	39 pF	5%	400V	Cer.N150
C62	23 pF	Var.		
C63	18 pF	5%	400V	Cer.NPO
C64-65	0.1 µF	10%	250V	Polyes.
C66	18 pF	5%	400V	Cer.NPO
C67-68	23 pF	Var.		
C69	18 pF	5%	400V	Cer.NPO
C70	4.7 nF	-20/+80%	30V	Cer.
C71	18 pF	5%	400V	Cer.NPO
C72	23 pF	Var.		
C73-74	0.1 µF	10%	250V	Polyes.
C75	23 pF	Var.		
C76-77	18 pF	5%	400V	Cer.NPO
C78-79	23 pF	Var.		
C80-81	18 pF	5%	400V	Cer.NPO
C82-83	23 pF	Var.		
C84-85	18 pF	5%	400V	Cer.NPO
C86-87	23 pF	Var.		
C88-89	18 pF	5%	400V	Cer.NPO
C90	23 pF	Var.		
C91	18 pF	5%	400V	Cer.NPO
123D 1	1S920			
123IC 1	CA3046			
123L 1	100 µH	RF CHOKE	10%	
L 2	COIL			CODE: T-1112
L 3	COIL			CODE: T-1113
L 4	100 µH	RF CHOKE	10%	
L 5	COIL			CODE: T-1114
L 6	COIL			CODE: T-1115
L 7	COIL			CODE: T-1116
L 8	22 µH	RF CHOKE	10%	
L 9	COIL			CODE: T-1118
123R 1	47 Kohms	5%	1/3W	Car.
R 2- 3	121 ohms	1%	0.4W	MF
R 4	1.8 Kohms	5%	1/3W	Car.
R 5	1 Kohm	Var.		
R 6	1.8 Kohms	5%	1/3W	Car.
R 7- 8	220 ohms	5%	1/3W	Car.
R 9	1.8 Kohms	5%	1/3W	Car.
R10	68 ohms	5%	1/3W	Car.
R11	270 ohms	5%	1/3W	Car.
R12	39 ohms	5%	1/3W	Car.
R13	33 ohms	5%	1/3W	Car.
R14	680 ohms	5%	1/3W	Car.
R15	270 ohms	5%	1/3W	Car.
R16	12 Kohms	5%	1/3W	Car.
R17	10 Kohms	5%	1/3W	Car.

123R18	680 ohms	5%	1/3W	Car.
R19	47 Kohms	5%	1/3W	Car.
R20	10 Kohms	5%	1/3W	Car.
R21	22 Kohms	5%	1/3W	Car.
R22	1 Kohm	5%	1/3W	Car.
R23	2.2 Kohms	5%	1/3W	Car.
R24	10 Kohms	5%	1/3W	Car.
R25	560 ohms	5%	1/3W	Car.
R26	270 ohms	5%	1/3W	Car.
R27-28	470 ohms	5%	1/3W	Car.
R29	180 ohms	5%	1/3W	Car.
R30	390 ohms	5%	1/3W	Car.
R31	47 ohms	5%	1/3W	Car.
123S1	ROTARY SWITCH			CODE: T-1011
S2	ROTARY SWITCH			CODE: T-1012
123T 1	TRANSFORMER			CODE: T-1119
T 2	TRANSFORMER			CODE: T-1023
T 3	TRANSFORMER			CODE: T-1022
123TR 1- 3	BC547 B			
TR 4	BC337-25			
TR 5	BD135-10			

PARTS LIST

FOR

130

130C 1a,b	2x518 pF	Var.		Air
130L 1	2.2 µH	RF CHOKE	10%	
130LS 1	SPEAKER	8 ohms		
130R 1	22 Kohms	5%	1/2W	Car.
R 2	47 Kohms	lin.		CODE: R-1073
R 3	33 Kohms	5%	1/3W	Car.
R 4a	10 Kohms	lin.		CODE: R-1074
R 4b	10 Kohms	log.		CODE: R-1074
R 5	56 ohms	5%	1W	ww
R 6	10 ohms	5%	1/2W	Car.
R 7	56 ohms	5%	1W	ww
R 8	10 ohms	5%	1/2W	Car.
130PL 3	CONNECTOR (PLUG)			
130S 1	MODE	ROTARY SWITCH		CODE: R-1014
S 2	BAND	ROTARY SWITCH		CODE: R-1015
S 3	LIGHT	SLIDE SWITCH		CODE: T-1015
S 4	SPEAKER	SLIDE SWITCH		CODE: T-1016
130SK 1	CONNECTOR (SOCKET) UHF			
SK 3	CONNECTOR (SOCKET)			
130SL 1	LAMP	12V	0.1A	E10
SL 2	LAMP	12V	0.1A	E10
130X 1	FILTER AM	1.4 MHz		
X 2	FILTER LSB	1.4 MHz		

PARTS LIST

FOR

△131

131C 1	68 pF	5%	400V	Cer.N150
C 2	140 pF	5%	400V	Cer.N150
131L 1-30	COIL			CODE: R-1054
131R 1	100 Kohms	5%	1/3W	Car.
131S 1	ROTARY SWITCH			CODE: R-1012
S 2	ROTARY SWITCH			CODE: R-1011
131SL 1	SURGE ARRESTER			

PARTS LIST

FOR

△ 132

132C 1	8.2 nF	1%	63V	Polyst.
C 2	270 pF	1%	500V	Polyst.
C 3	680 pF	1%	500V	Polyst.
132L 1-30	COIL			CODE: R-1054
132S 1	ROTARY SWITCH			CODE: R-1012
S 2	ROTARY SWITCH			CODE: R-1011

PARTS LIST

FOR

133

133C 1- 2	23 pF	Var.		
C 3	18 pF	5%	400V	Cer.NPO
C 4	0.1 µF	10%	250V	Polyes.
C 5	18 pF	5%	400V	Cer.NPO
C 6- 7	23 pF	Var.		
C 8- 9	18 pF	5%	400V	Cer.NPO
C10-11	23 pF	Var.		
C12-13	18 pF	5%	400V	Cer.NPO
C14-15	23 pF	Var.		
C16-17	18 pF	5%	400V	Cer.NPO
C18-19	23 pF	Var.		
C20-21	18 pF	5%	400V	Cer.NPO
C22-23	23 pF	Var.		
C24	4.7 nF	-20/+80%	30V	Cer.
C25-26	18 pF	5%	400V	Cer.NPO
C27-28	23 pF	Var.		
C29-30	18 pF	5%	400V	Cer.NPO
C31	23 pF	Var.		
C32	18 pF	5%	400V	Cer.NPO
C33	680 pF	1%	500V	Polyst.
C34	23 pF	Var.		
C35-36	390 pF	1%	500V	Polyst.
C37	23 pF	Var.		
C38-39	18 pF	5%	400V	Cer.NPO
C40-41	23 pF	Var.		
C42-43	18 pF	5%	400V	Cer.NPO
C44	0.1 µF	10%	250V	Polyes.
C45-46	23 pF	Var.		
C47-48	18 pF	5%	400V	Cer.NPO
C49-50	23 pF	Var.		
C51-52	18 pF	5%	400V	Cer.NPO
C53-54	23 pF	Var.		
C55-56	18 pF	5%	400V	Cer.NPO
C57-58	23 pF	Var.		
C59-60	18 pF	5%	400V	Cer.NPO
C61-62	23 pF	Var.		
C63-64	18 pF	5%	400V	Cer.NPO
C65	23 pF	Var.		
C66	18 pF	5%	400V	Cer.NPO
133R 1	47 Kohms	5%	1/3W	Car.
R 2	330 ohms	5%	1/3W	Car.
R 3	47 Kohms	5%	1/3W	Car.
R 4	22 Kohms	5%	1/3W	Car.
R 5	680 ohms	5%	1/3W	Car.
R 6	100 Kohms	5%	1/3W	Car.
133S 1	ROTARY SWITCH			CODE: R-1012
S 2	ROTARY SWITCH			CODE: R-1011
133TR 1	BC547 B			

PARTS LIST

FOR

134

134C 1	23 pF	Var.		
C 2	0,1 µF	10%	250V	Polyes.
C 3	22 pF	5%	400V	Cer.N150
C 4	110 pF	1%	500V	Polyst.
C 5	270 pF	1%	500V	Polyst.
C 6- 7	23 pF	Var.		
C 8	590 pF	1%	500V	Polyst.
C 9	120 pF	5%	400V	Cer.N150
C10	56 pF	5%	400V	Cer.N150
C11	15 pF	5%	400V	Cer.N150
C12	22 pF	5%	400V	Cer.N150
C13-15	23 pF	Var.		
C16	4,7 pF	±0,25 pF	400V	Cer.NPO
C17	4,7 nF	-20/+80%	30V	Cer.
C18	10 nF	10%	250V	Polyes.
C19	0,1 µF	10%	250V	Polyes.
C20	4,7 nF	-20/+80%	30V	Cer.
C21-22	0,1 µF	10%	250V	Polyes.
C23	330 pF	1%	500V	Polyst.
C24	4,7 nF	-20/+80%	30V	Cer.
C25	0,1 µF	10%	250V	Polyes.
C26	1 nF	1%	500V	Polyst.
C27-28	4,7 nF	-20/+80%	30V	Cer.
C29	1 nF	1%	500V	Polyst.
C30	0,1 µF	10%	250V	Polyes.
C31	22 µF		15V	Tan.
134D 1	BA138b	Varicap.		
D 2- 7	1S920			
134L 1	5 mH	RF CHOKE	10%	
L 2	680 µH	RF CHOKE	10%	
L 3	100 µH	RF CHOKE	10%	
L 4	COIL			CODE: R-1050
L 5	COIL			CODE: R-1052
L 6	COIL			CODE: R-1051
L 7	COIL			CODE: R-1067
L 8	100 µH	RF CHOKE	10%	
134R 1	10 kohms	5%	1/3W	Car.
R 2	Not used			
R 3	100 kohms	5%	1/3W	Car.
R 4	6,8 kohms	5%	1/3W	Car.
R 5	22 kohms	5%	1/3W	Car.
R 6	470 ohms	5%	1/3W	Car.
R 7	33 ohms	5%	1/3W	Car.
R 8	470 ohms	5%	1/3W	Car.
R 9	1 kohm	Var.		
R10	22 kohms	5%	1/3W	Car.

134R11	470 ohms	5%	1/3W	Car.
R12	6,8 kohms	5%	1/3W	Car.
R13	12 kohms	5%	1/3W	Car.
R14	270 ohms	5%	1/3W	Car.
R15	6,8 kohms	5%	1/3W	Car.
R16	4,7 kohms	5%	1/3W	Car.
R17-18	10 kohms	5%	1/3W	Car.
R19-20	3,3 kohms	5%	1/3W	Car.
R21	100 ohms	5%	1/3W	Car.
R22	33 ohms	5%	1/3W	Car.
134S 1	ROTARY SWITCH			CODE: R-1015
S 2	ROTARY SWITCH			CODE: R-1016
134T 1	TRANSFORMER			CODE: R-1049
T 2	TRANSFORMER			CODE: R-1048
T 3	TRANSFORMER			CODE: R-1053
T 4	TRANSFORMER			CODE: R-1068
T 5	TRANSFORMER			CODE: R-1066
134TR 1	BC547B			
TR 2-3	TIS88A			
TR 4-5	BC547B			

PARTS LIST

FOR

135 (in triangle)

135C 1- 2	0,1 µF	10%	250V	Polyes.
C 3	4,7 nF	-20/+80%	30V	Cer.
C 4	0,1 µF	10%	250V	Polyes.
C 5	22 µF		15V	Tan.
C 6	2,2 pF	±0,5 pF	400V	Cer.NPO
C 7	0,1 µF	10%	250V	Polyes.
C 8	100 µF		16V	W.alum.
C 9	4,7 nF	-20/+80%	30V	Cer.
C10-13	0,1 µF	10%	250V	Polyes.
C14	1 nF	1%	500V	Polyst.
C15	4,7 nF	-20/+80%	30V	Cer.
C16-17	0,1 µF	10%	250V	Polyes.
C18	10 pF	±0,5 pF	400V	Cer.N150
C19	1,2 nF	1%	500V	Polyst.
C20	10 nF	10%	250V	Polyst.
C21	0,1 µF	10%	250V	Polyes.
C22	120 pF	5%	400V	Cer.N150
C23	470 pF	1%	500V	Polyst.
C24	0,47 µF	10%	250V	Polyes.
C25	4,7 nF	-20/+80%	30V	Cer.
C26	0,1 µF	10%	250V	Polyes.
C27	10 nF	10%	250V	Polyes.
C28-29	0,1 µF	10%	250V	Polyes.
C30	4,7 nF	-20/+80%	30V	Cer.
C31-35	0,1 µF	10%	250V	Polyes.
135D 1- 6	1S920			
D 7	AAZ17			
D 8-11	1S920			
D12	BA138b	Varicap.		
D13	BZX79B9V1	Zener		
135IC 1	TBA120			
135L 1	COIL			CODE: R-1069
L 2	COIL			CODE: R-1072
L 3	COIL			CODE: R-1071
L 4- 5	100 µH	RF CHOKE	10%	
135R 1- 2	3,3 kohms	5%	1/3W	Car.
R 3	100 ohms	5%	1/3W	Car.
R 4	330 ohms	5%	1/3W	Car.
R 5	6,8 kohms	5%	1/3W	Car.
R 6	4,7 kohms	5%	1/3W	Car.
R 7	10 kohms	5%	1/3W	Car.
R 8	100 ohms	5%	1/3W	Car.
R 9	10 kohms	5%	1/3W	Car.
R10	680 ohms	5%	1/3W	Car.
R11	1 kohm	5%	1/3W	Car.

135R12	10 kohms	5%	1/3W	Car.
R13	27 ohms	5%	1/3W	Car.
R14-15	1 kohm	5%	1/3W	Car.
R16	10 kohms	5%	1/3W	Car.
R17	1 kohm	5%	1/3W	Car.
R18	1,2 kohms	5%	1/3W	Car.
R19	150 kohms	5%	1/3W	Car.
R20	330 ohms	5%	1/3W	Car.
R21	10 kohms	5%	1/3W	Car.
R22	470 ohms	5%	1/3W	Car.
R23	330 ohms	5%	1/3W	Car.
R24	1 kohm	5%	1/3W	Car.
R25	4,7 kohms	5%	1/3W	Car.
R26	100 ohms	5%	1/3W	Car.
R27-28	100 kohms	5%	1/3W	Car.
R29	33 ohms	5%	1/3W	Car.
R30	1 kohm	5%	1/3W	Car.
R31	100 kohms	5%	1/3W	Car.
R32	330 ohms	5%	1/3W	Car.
R33	6,8 kohms	5%	1/3W	Car.
R34	4,7 kohms	5%	1/3W	Car.
R35-37	10 kohms	5%	1/3W	Car.
R38	100 kohms	5%	1/3W	Car.
R39-40	3,3 kohms	5%	1/3W	Car.
R41	100 ohms	5%	1/3W	Car.
R42	1,2 kohms	5%	1/2W	Car.
R43	10 kohms	5%	1/3W	Car.
R44	1 kohm	5%	1/3W	Car.
R45	10 kohms	5%	1/3W	Car.
135T 1	TRANSFORMER			CODE: R-1070
135TR 1- 2	BF240			
TR 3	BC547B			
TR 4	BF240			
TR 5	BC547B			
135X 1	CRYSTAL	1,4 MHz		CODE: R-1001

PARTS LIST

FOR

136 (in triangle)

136C 1	0,47 µF	10%	250V	Polyes.
C 2	10 nF	10%	250V	Polyes.
C 3	22 nF	10%	250V	Polyes.
C 4	22 µF		15V	Tan.
C 5	0,1 µF	10%	250V	Polyes.
C 6	100 µF		25V	W.alum.
C 7	10 nF	10%	250V	Polyes.
C 8	470 µF		16V	W.alum
C 9	5,6 nF	1%	125V	Polyst.
C10	1,2 nF	1%	500V	Polyst.
C11	470 µF		16V	W.alum.
C12	100 µF		25V	W.alum.
C13	0,1 µF	10%	250V	Polyes.
C14	470 µF		16V	W.alum
C15	0,1 µF	10%	250V	Polyes.
136IC 1	TBA810S			
136L 1- 3	25 µH	RF CHOKE	10%	
L 4	100 µH	RF CHOKE	10%	
136R 1	10 kohms	5%	1/3W	Car.
R 2	680 ohms	5%	1/3W	Car.
R 3	56 ohms	5%	1/3W	Car.
R 4	3,3 kohms	5%	1/3W	Car.
R 5	100 kohms	5%	1/3W	Car.
R 6	10 ohms	5%	1/3W	Car.
R 7	100 ohms	5%	1/3W	Car.
R 8	1 ohm	5%	2W	WW
136SK 2	CONNECTOR (SOCKET)			

PARTS LIST

FOR

140

140C 1- 2	0,1 µF	10%	250V	Polyes.
C 3	470 µF		40V	W.alum.
C 4	1 µF	10%	250V	Polyes.
C 5	68 nF	10%	100V	Polyes.
C 6	1 µF	10%	250V	Polyes.
C 7	68 nF	10%	100V	Polyes.
140D 1	BZY93C33	ZENER		
140FS 1- 2	25A	SLOW	7x32mm	
140L 1	FILTER			CODE: P-1016
140R 1	220 kohms	5%	1W	Car.
R 2	2,2 kohms	5%	1W	Car.
R 3	27 ohms	5%	5W	WW
R 4	1 ohm	5%	11W	WW
R 5	27 ohms	5%	5W	WW
140RL 1	RELAY	2 MAKE, 24V COIL		
140SK 1	CONNECTOR (SOCKET)			
140T 1	TRANSFORMER			CODE: P-1011
T 2	TRANSFORMER			CODE: P-1013
140TR 1- 2	2N6258			
TR 3- 4	2N6254			
TR 5	BD234-10			
TR 6	2N3055			

PARTS LIST

FOR

141

141C 1	47 nF	10%	250V	Polyes.
C 2	0,1 µF	10%	250V	Polyes.
C 3	2200 µF		40V	W.alum.
C 4-5	47 nF	10%	250V	Polyes.
C 6	0,47 µF	10%	250V	Polyes.
C 7	2200 µF		40V	W.alum.
C 8-10	47 µF		450V	W.alum.
C11	100 µF		25V	W.alum.
C12	0,1 µF	10%	250V	Polyes.
141D 1	10D05			
D 2-5	1S920			
D 6-7	21PT5			
D 8-11	1N5401			
D12-13	1S920			
D14-25	10D10			
D26	BZX79 B5V6	ZENER		
D27	BZX79 B6V2	ZENER		
141FS1	1A	FAST	6,3x32mm	
FS2	0,2A	SLOW	6,3x32mm	
FS3	0,63A	SLOW	6,3x32mm	
141R 1	22 ohms	5%	1/2W	Car.
R 2	220 kohms	5%	1/3W	Car.
R 3	27 ohms	5%	1/3W	Car.
R 4	NOT USED			
R 5	4,7 kohms	5%	1/3W	Car.
R 6	1,2 kohms	5%	1/3W	Car.
R 7	330 ohms	5%	5W	WW
R 8	10 kohms	5%	1/3W	Car.
R 9	220 ohms	5%	1/3W	Car.
R10	10 kohms	5%	1/3W	Car.
R11	150 ohms	5%	1/3W	Car.
R12	10 kohms	5%	1/3W	Car.
R13	150 ohms	5%	1/3W	Car.
R14	330 ohms	5%	5W	WW
R15	10 kohms	5%	1/3W	Car.
R16-17	100 ohms	5%	1/2W	Car.
R18	15 ohms	5%	1/2W	Car.
R19	10 kohms	5%	1/2W	Car.
R20	1 ohm	5%	5W	WW
R21	150 ohms	5%	1/3W	Car.
R22-24	220 kohms	5%	1W	Car.
R25	68 ohms	5%	1/3W	Car.
141RL 1	RELAY	1 MAKE, 24V COIL		
141TR 1	2N6027			
TR 2-4	BC337-25			

PARTS LIST

FOR

143

143C 1- 2	0,1 μF	10%	250V	Polyes.
C 3	1000 μF		25V	W.alum.
C 4	0,68 μF	10%	100V	Polyes.
C 5	2,2 μF	10%	250V	Polyes.
C 6	0,68 μF	10%	100V	Polyes.
143D 1	BZY93 C16	ZENER		
143FS 1- 2	40A	FAST	7x32mm	
143L 1	FILTER			CODE: P-1043
143R 1	220 kohms	5%	1W	Car.
R 2	330 ohms	5%	1W	Car.
R 3- 4	2,2 ohms	5%	16W	
R 5	8,7 ohms	5%	5W	
143RL 1	RELAY	1 MAKE, 12V COIL		
143SK 1	CONNECTOR (SOCKET)			
143T 1	TRANSFORMER			CODE: P-1012
T 2	TRANSFORMER			CODE: P-1014
143TR 1- 2	2N4280			
TR 3- 4	2N3055			
TR 5	BD234-10			
TR 6	2N3055			

PARTS LIST

FOR

144

144C 1	47 nF	10%	250V	Polyes.
C 2	0,1 µF	10%	250V	Polyes.
C 3	4700 µF		25V	W.alum.
C 4- 5	0,1 µF	10%	250V	Polyes.
C 6	0,47 µF	10%	250V	Polyes.
C 7	2200 µF		40V	W.alum.
C 8-10	47 µF		450V	W.alum.
C11	100 µF		25V	W.alum.
C12	0,1 µF	10%	250V	Polyes.
144D 1- 2	10D05			
D 3- 5	1S920			
D 6	NOT USED			
D 7	NOT USED			
D 8-11	1N5401			
D12-13	1S920			
D14-25	10D10			
D26	BZX79 B5V6	ZENER		
D27	BZX79 B6V2	ZENER		
144FS 1	1A	FAST	6,3x32mm	
FS 2	0,2A	SLOW	6,3x32mm	
FS 3	0,63A	SLOW	6,3x32mm	
144R 1	220 kohms	5%	1/3W	Car.
R 2	27 ohms	5%	1/3W	Car.
R 3	2,2 kohms	5%	1/3W	Car.
R 4	560 ohms	5%	1/3W	Car.
R 5	82 ohms	5%	5W	WW
R 6- 7	1,8 kohms	5%	1/3W	Car.
R 8	100 ohms	5%	1/3W	Car.
R 9	1,8 kohms	5%	1/3W	Car.
R10	100 ohms	5%	1/3W	Car.
R11	82 ohms	5%	5W	WW
R12	1,8 kohms	5%	1/3W	Car.
R13	15 ohms	5%	1/3W	Car.
R14	10 kohms	5%	1/3W	Car.
R15	1 ohm	5%	5W	WW
R16	150 ohms	5%	1/3W	Car.
R17-19	220 kohms	5%	1W	WW
R20	68 ohms	5%	1/3W	Car.
144RL 1	RELAY	1 MAKE, 12V COIL		
144TR 1	2N6027			
TR 2- 3	BC337-25			

PARTS LIST

FOR

146

146C 1	0,1 µF	10%	1000V	MP
C 2- 5	330 µF		350V	W.alum
146FS 1- 2	6,3A	SLOW 6,3x32mm	110/115/120V	
FS 1- 2	3,15A	SLOW 6,3x32mm	220/230/240V	
146L 1	FILTER			CODE: P-1016
146S 1	SAFETY SWITCH			
146SK 1	CONNECTOR (SOCKET)			
146T 1	TRANSFORMER			CODE: P-1046
T 2- 3	TRANSFORMER			CODE: P-1045
146TR 1	BD234-10			
TR 2	2N3055			

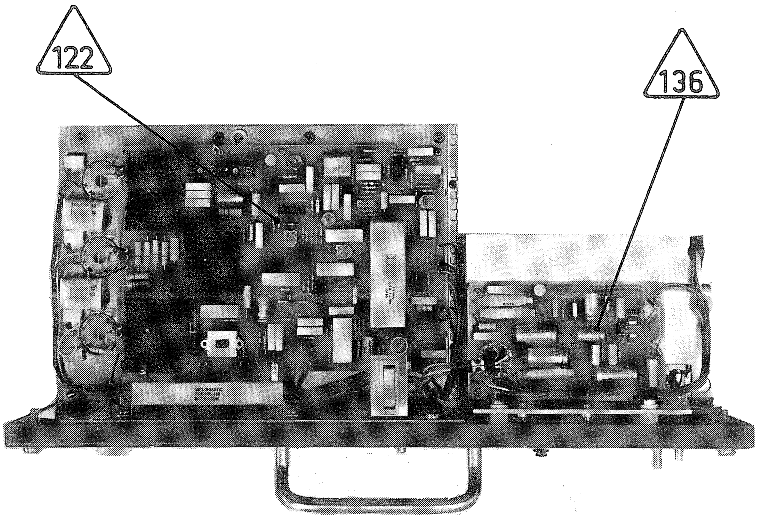
PARTS LIST

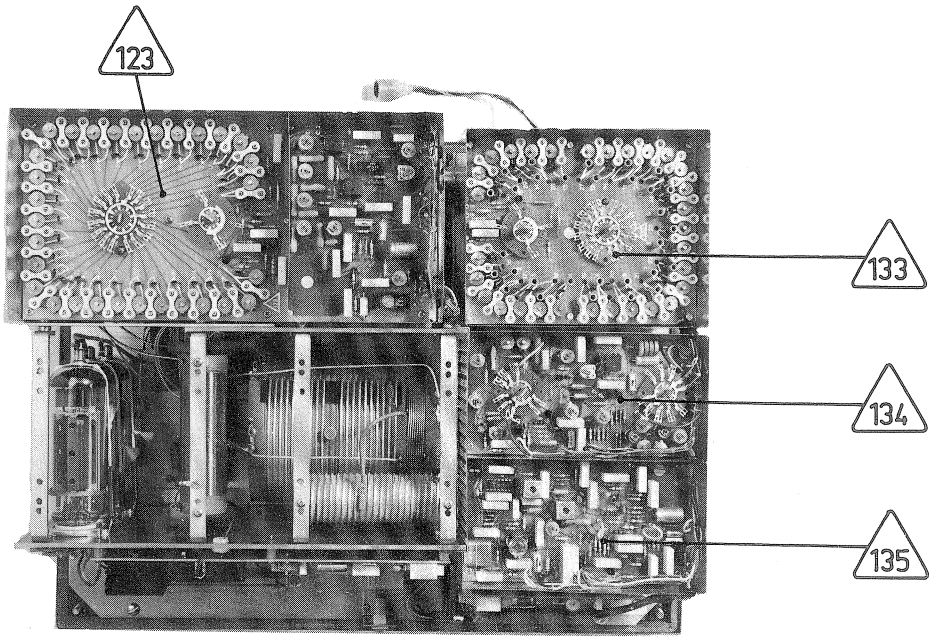
FOR

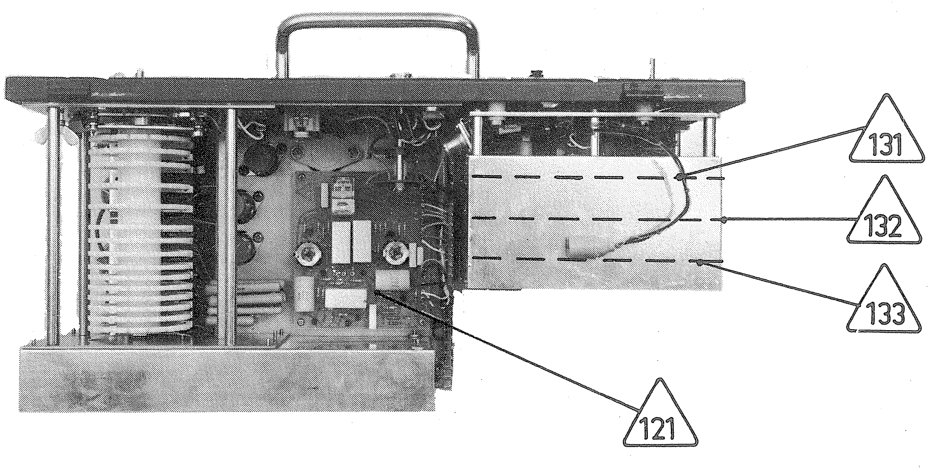
△147

147C 1	0,47 µF	10%	250V	Polyes.
C 2- 5	0,1	10%	400V	Polyes.
C 6	2200 µF		40V	W.alum.
C 7	100 µF		25V	W.alum.
C 8	0,1 µF	10%	250V	Polyes.
C 9	10 nF	10%	1600V	Polyes.
C10	100 µF		25V	W.alum
147D 1	1S920			
D 2- 5	1N5401			
D 6-21	10D10			
D22-23	1S920			
D24	BZX79 B5V6	ZENER		
D25	BZX79 B6V2	ZENER		
147FS1	1,6A	FAST	6,3x32mm	
FS2	0,2A	SLOW	6,3x32mm	
FS3	0,63A	SLOW	6,3x32mm	
147R 1	1 ohm	5%	5W	WW
R 2- 5	4700 ohms	5%	1/2W	Car.
R 6	180 ohms	5%	1W	Car.
R 7	15 ohms	5%	1/3W	Car.
R 8-11	100 kohms	5%	1W	Car.
R12	10 kohms	5%	1/3W	Car.
R13	1 ohm	5%	5W	WW
R14	150 ohms	5%	1/3W	Car.
R15	68 ohms	5%	1/3W	Car.
147RL 1	RELAY	2 MAKE, 24V COIL		
147TR 1	BC337-25			

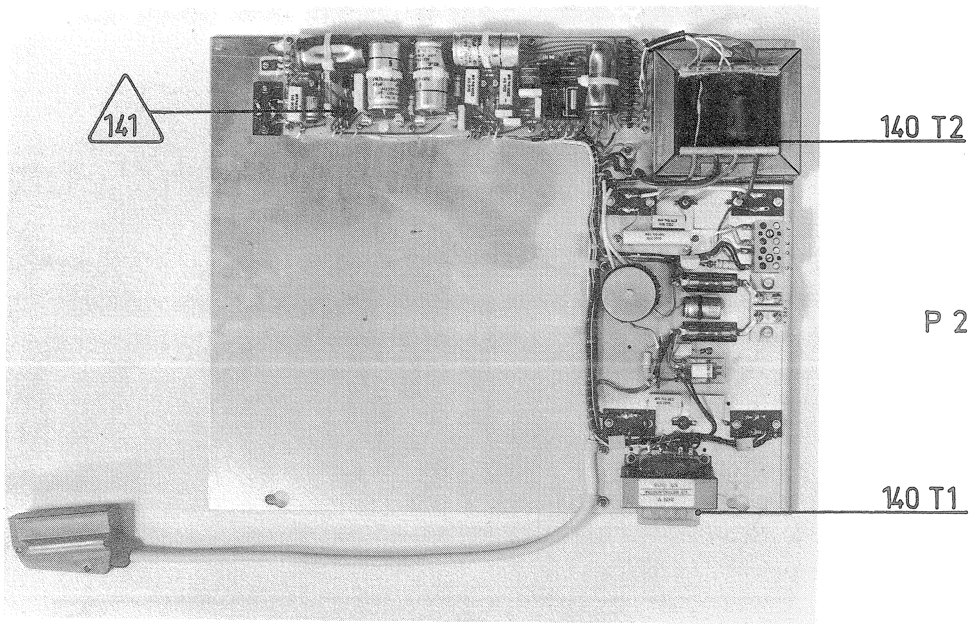
Location of Circuit boards Transmitter T 2000 and Receiver R 2000



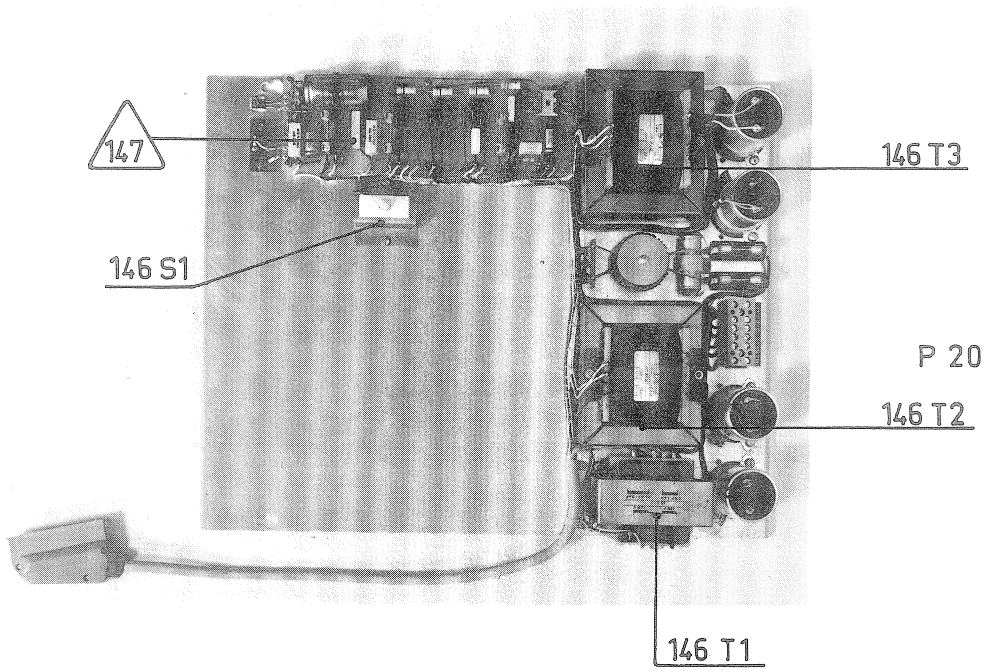




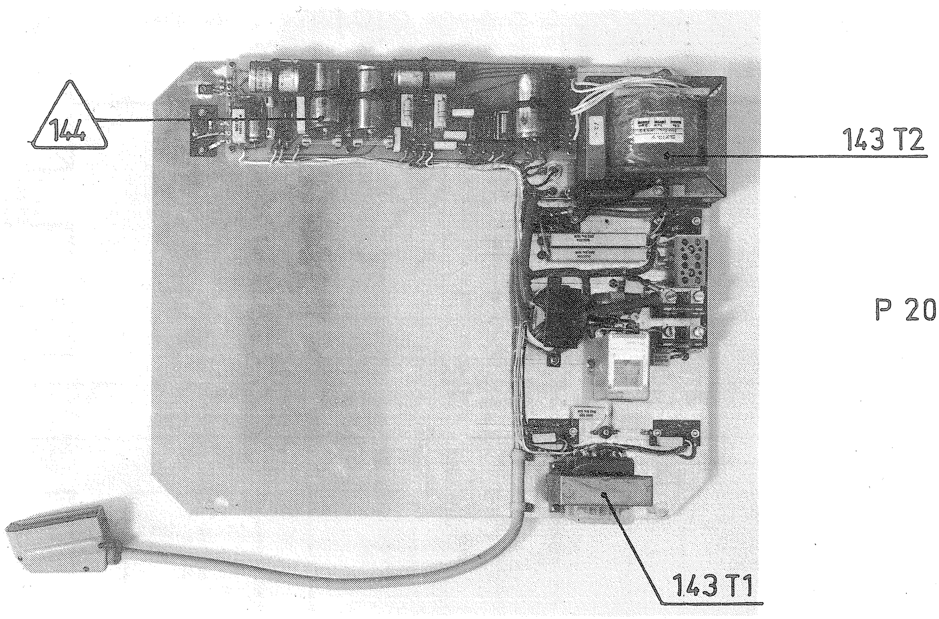
Location of circuit boards Power Packs.



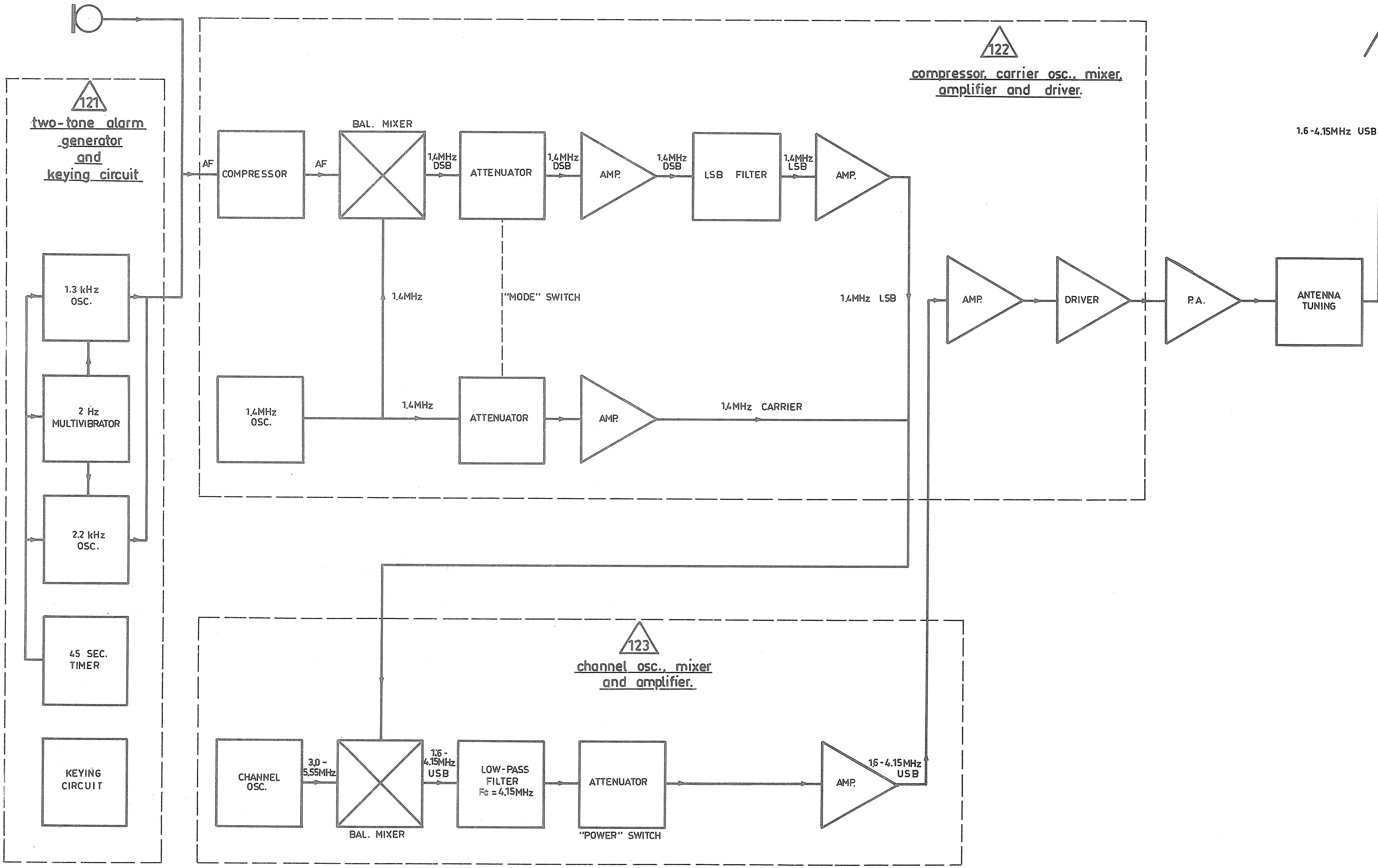
P 2000



P 2001

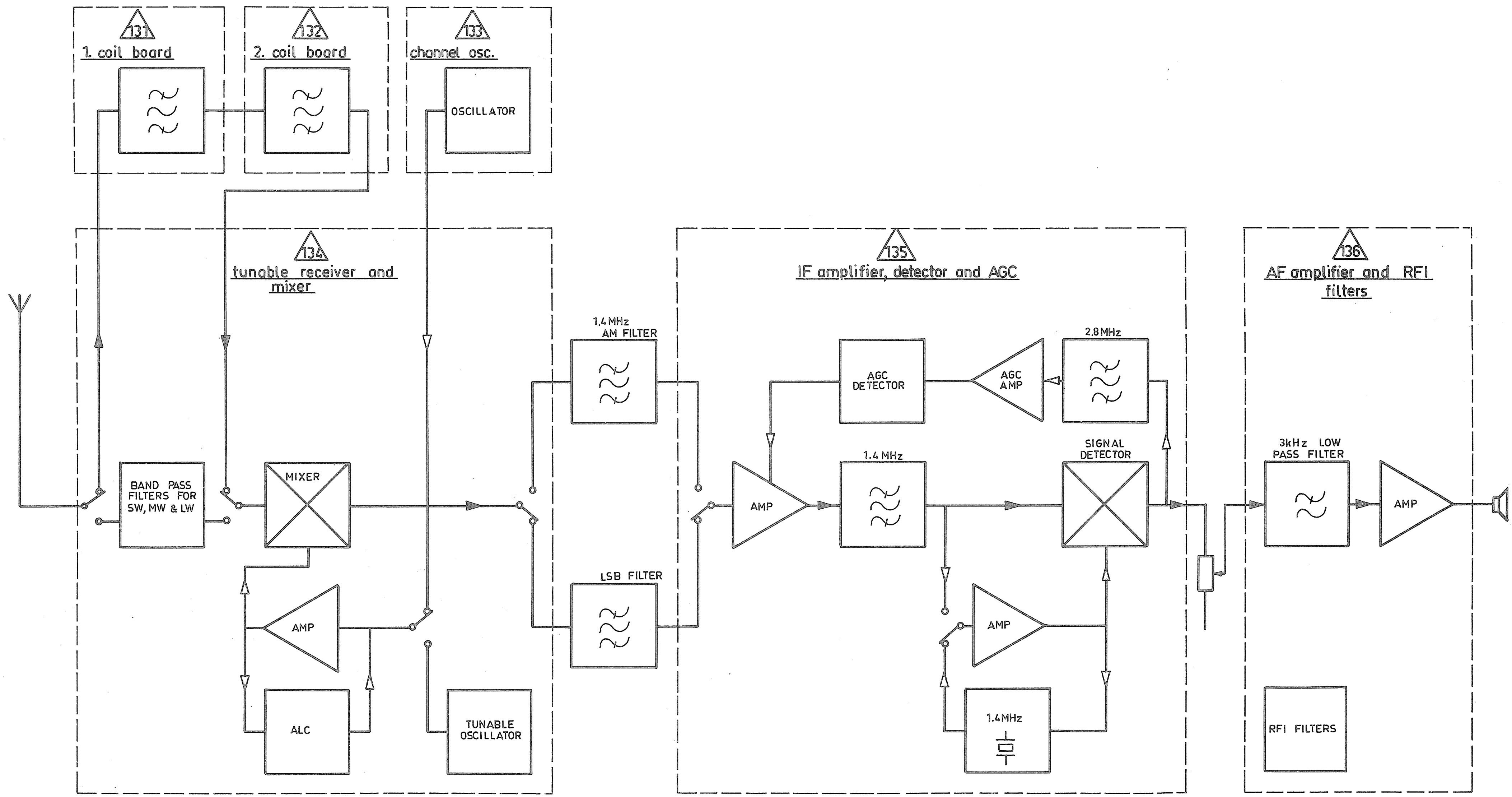


P 2002



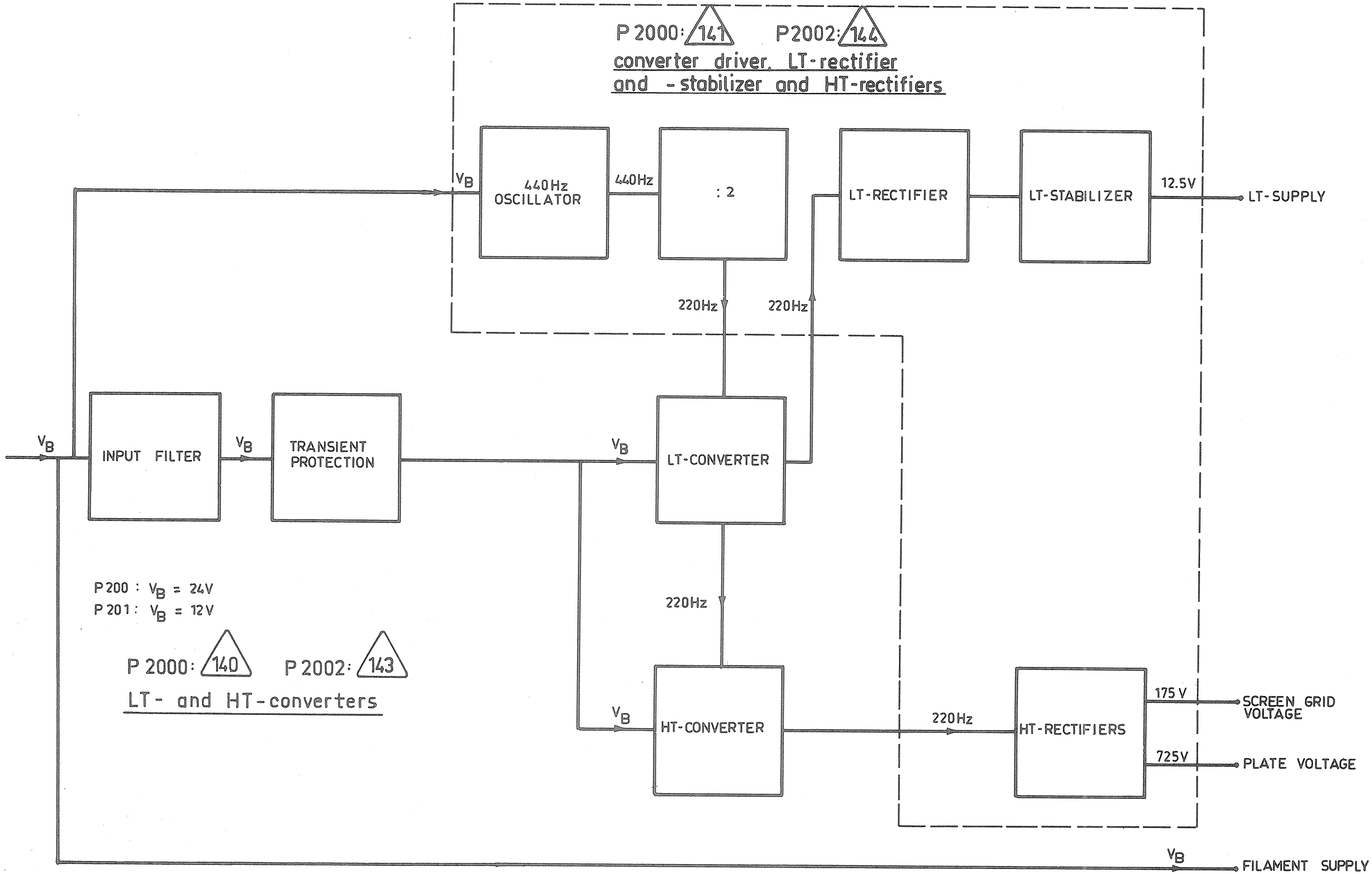
T-1038-1

T2000 TRANSMITTER BLOCK DIAGRAM



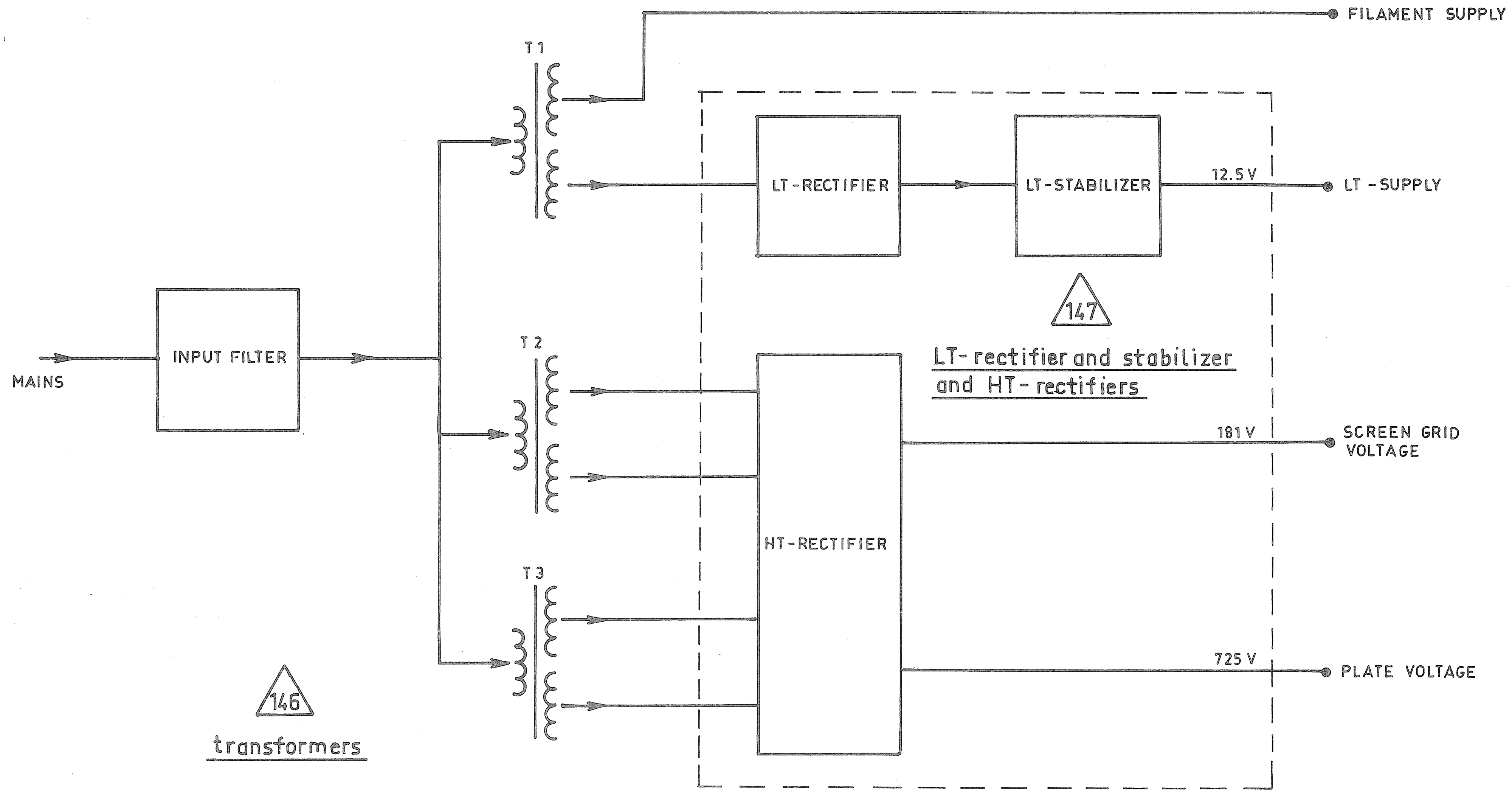
R-1063-1

R2000 RECEIVER BLOCK DIAGRAM



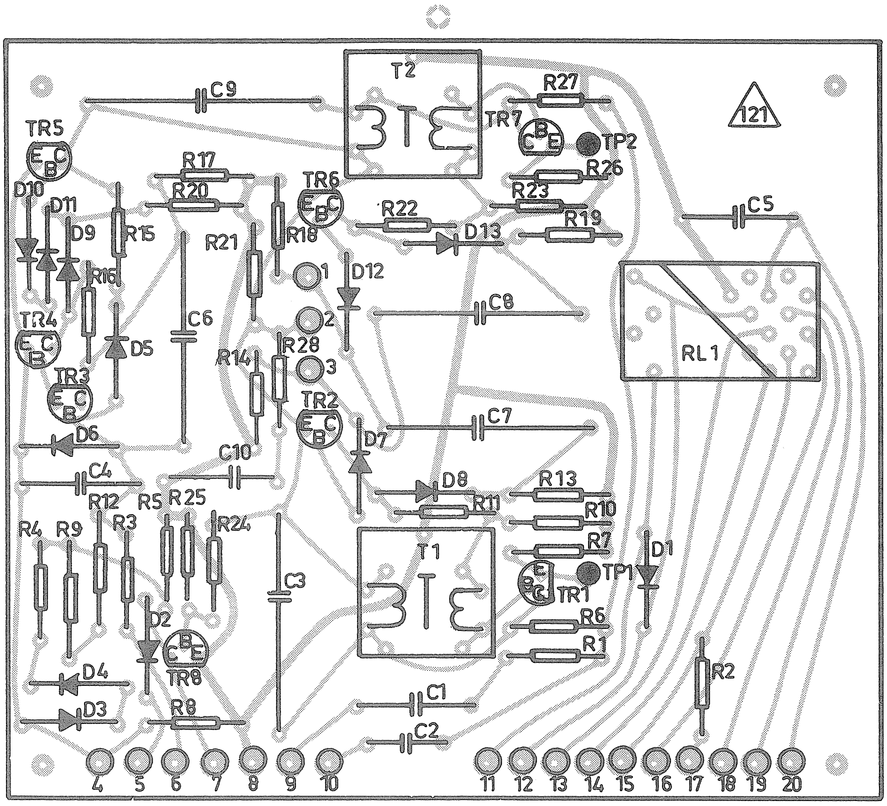
P 2000 24V DC POWER PACK
P 2002 12V DC POWER PACK
BLOCK DIAGRAM

P-1009-1

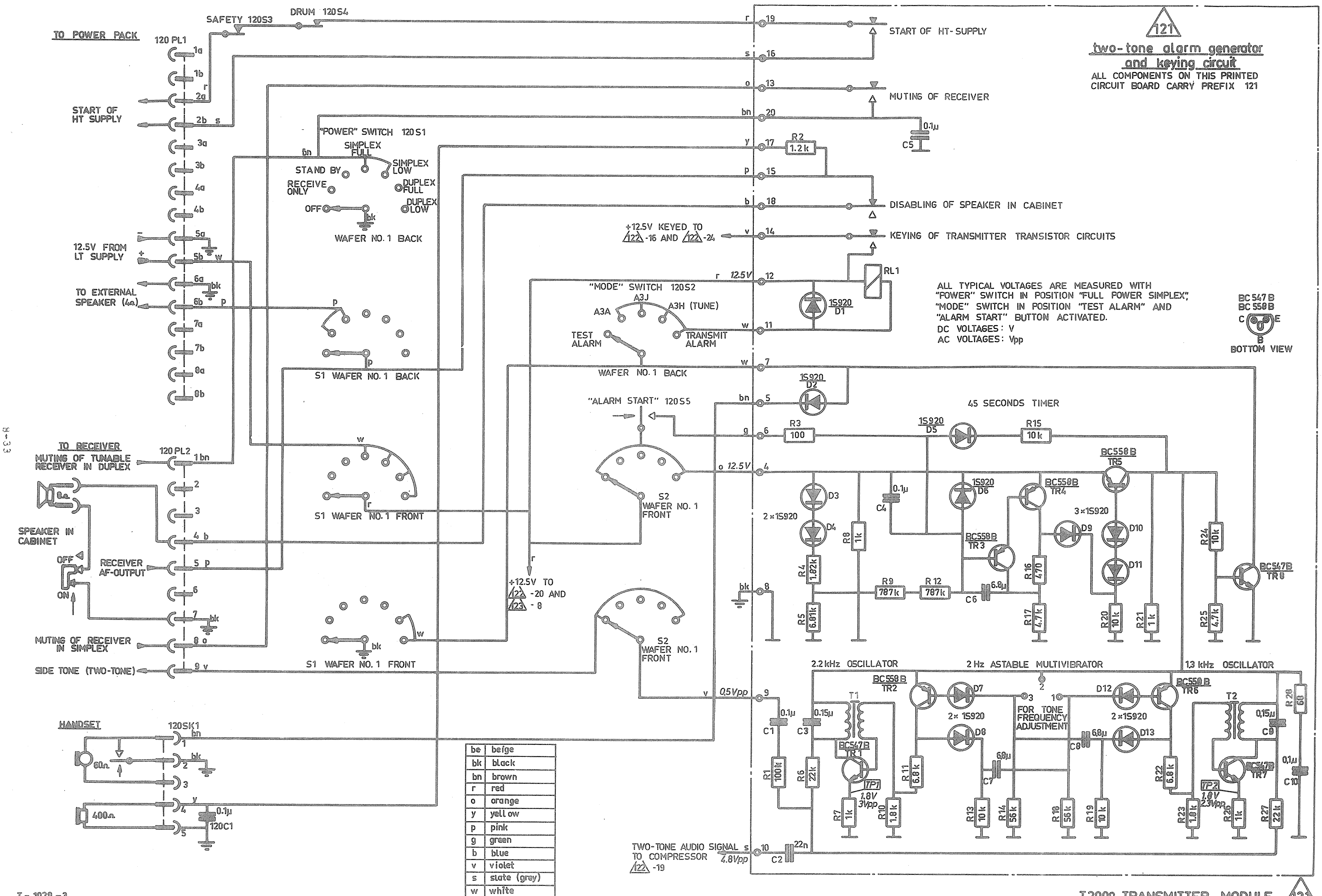


P2001 AC POWER PACK BLOCK DIAGRAM

P-1058-1



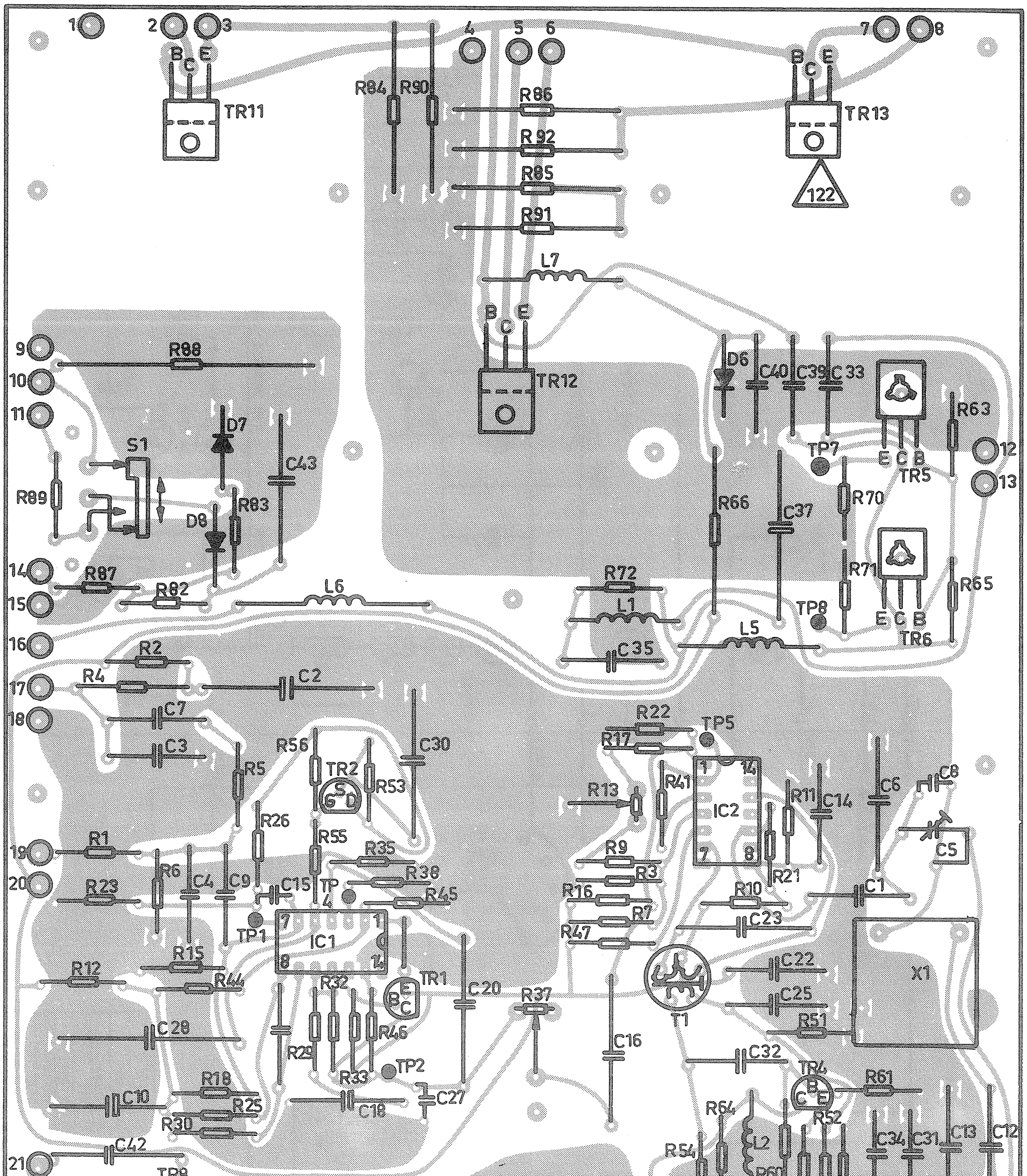
PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



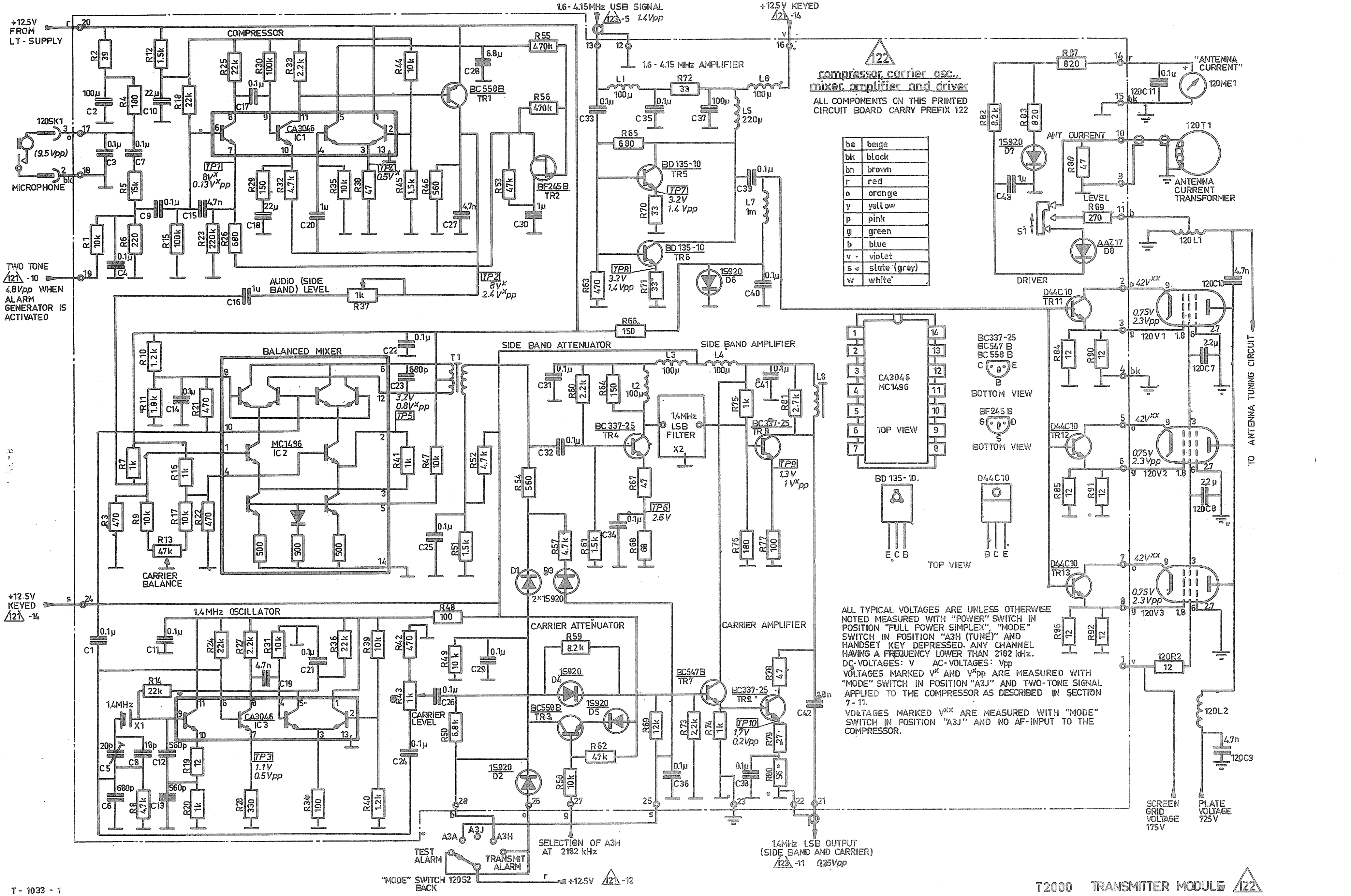
be	beige
bk	black
bn	brown
r	red
o	orange
y	yellow
p	pink
g	green
b	blue
v	violet
s	slate (grey)
w	white

T-1029-3

T2000 TRANSMITTER MODULE 121



PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE

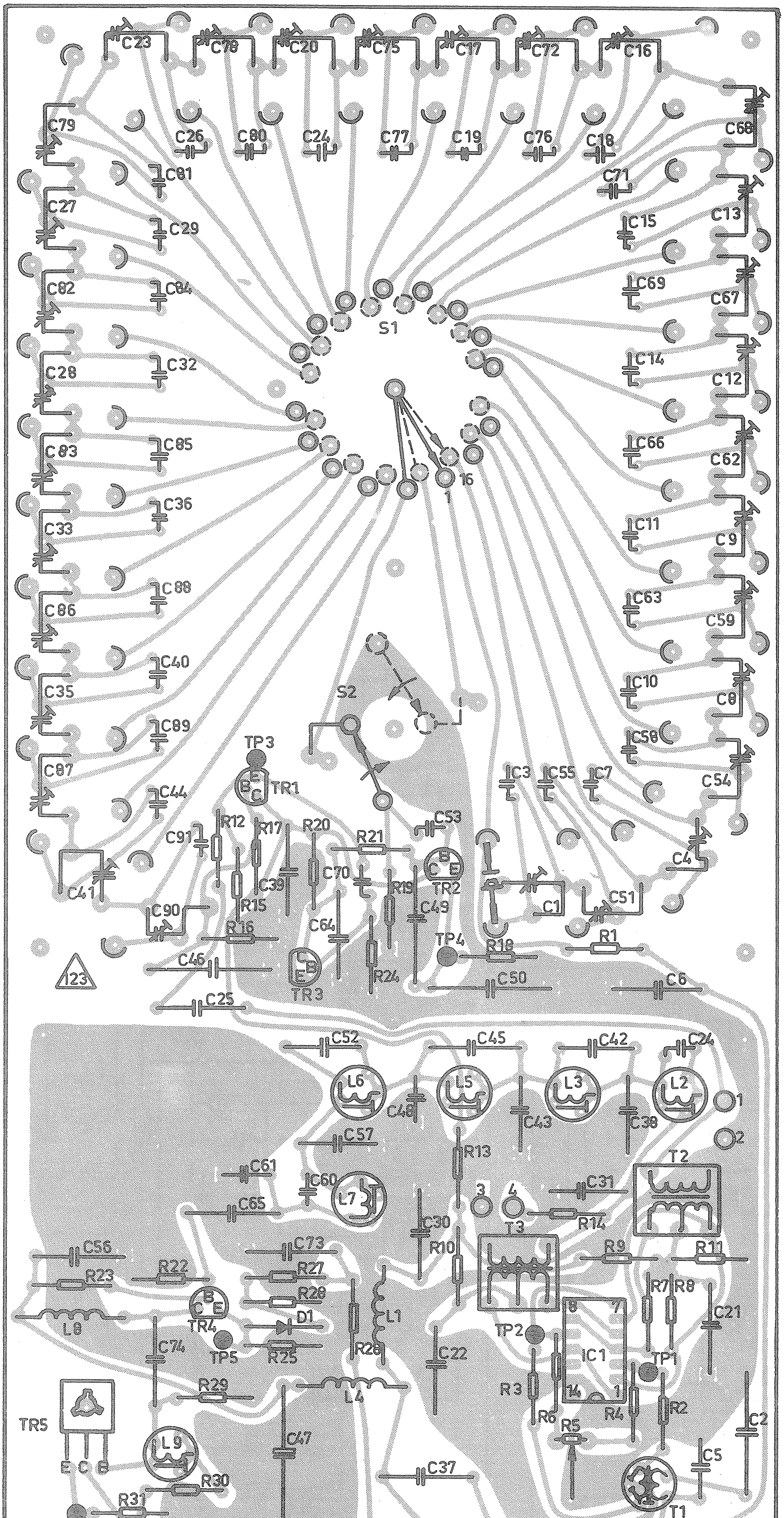


be	beige
bk	black
bn	brown
r	red
o	orange
y	yellow
p	pink
g	green
b	blue
v	violet
s o	slate (grey)
w	white

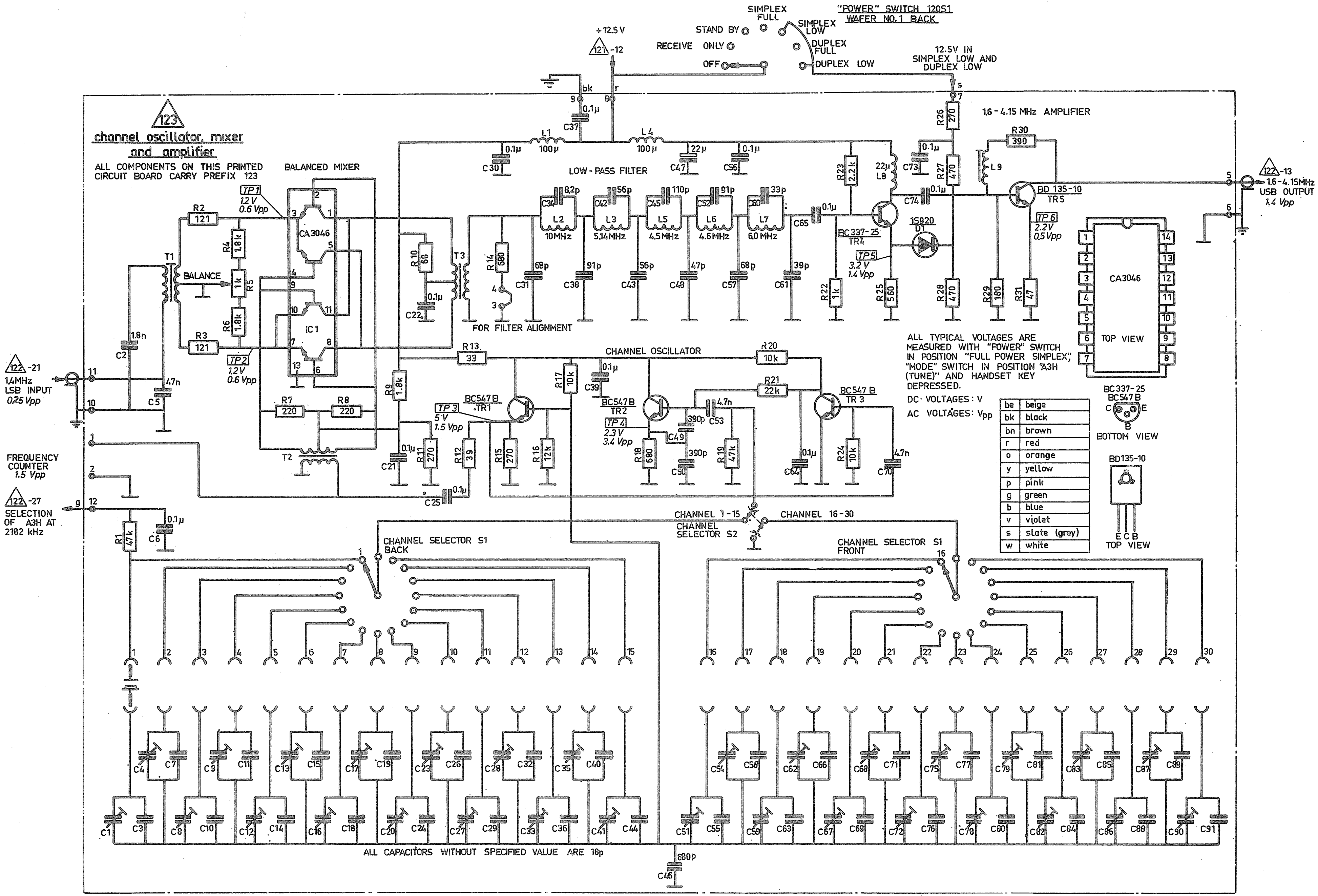
ALL TYPICAL VOLTAGES ARE UNLESS OTHERWISE NOTED MEASURED WITH "POWER" SWITCH IN POSITION "FULL POWER SIMPLEX", "MODE" SWITCH IN POSITION "A3H (TUNE)" AND HANDSET KEY DEPRESSED. ANY CHANNEL HAVING A FREQUENCY LOWER THAN 2182 kHz.
DC-VOLTAGES: V AC-VOLTAGES: Vpp
VOLTAGES MARKED V^x AND V^xpp ARE MEASURED WITH "MODE" SWITCH IN POSITION "A3J" AND TWO-TONE SIGNAL APPLIED TO THE COMPRESSOR AS DESCRIBED IN SECTION 7-11.
VOLTAGES MARKED V^{xx} ARE MEASURED WITH "MODE" SWITCH IN POSITION "A3J" AND NO AF-INPUT TO THE COMPRESSOR.

T-1033-1

T2000 TRANSMITTER MODULE 122

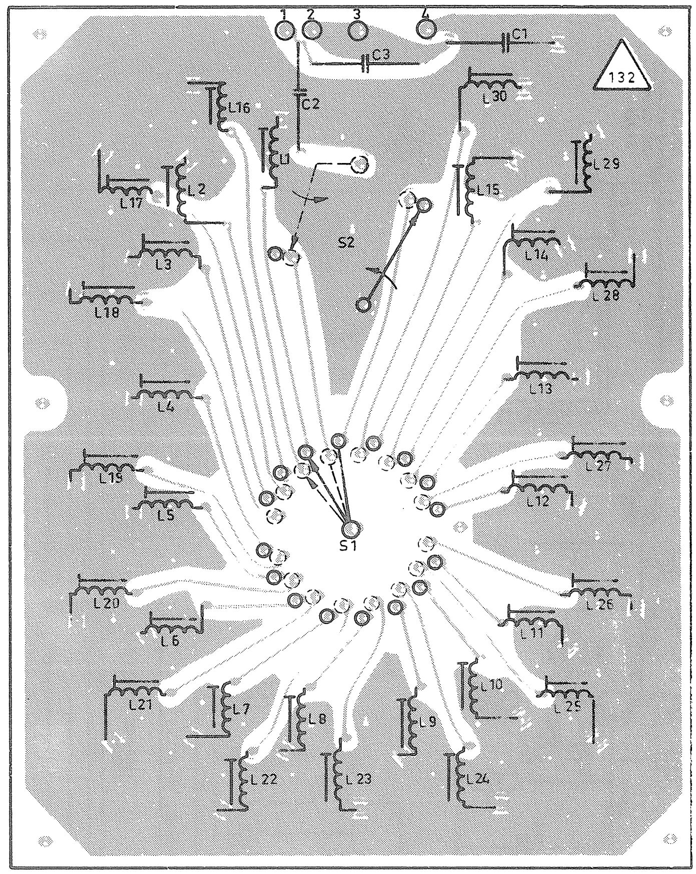


PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



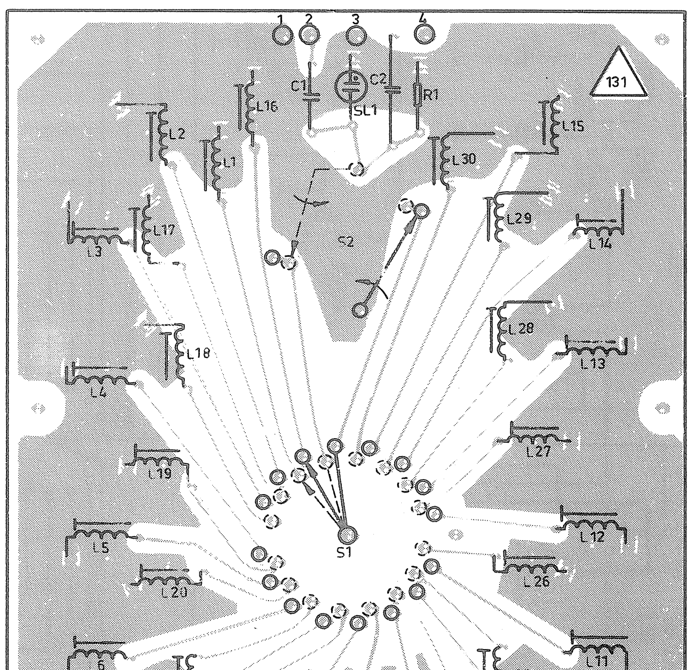
T - 1037 - 1

T2000 TRANSMITTER MODULE 123

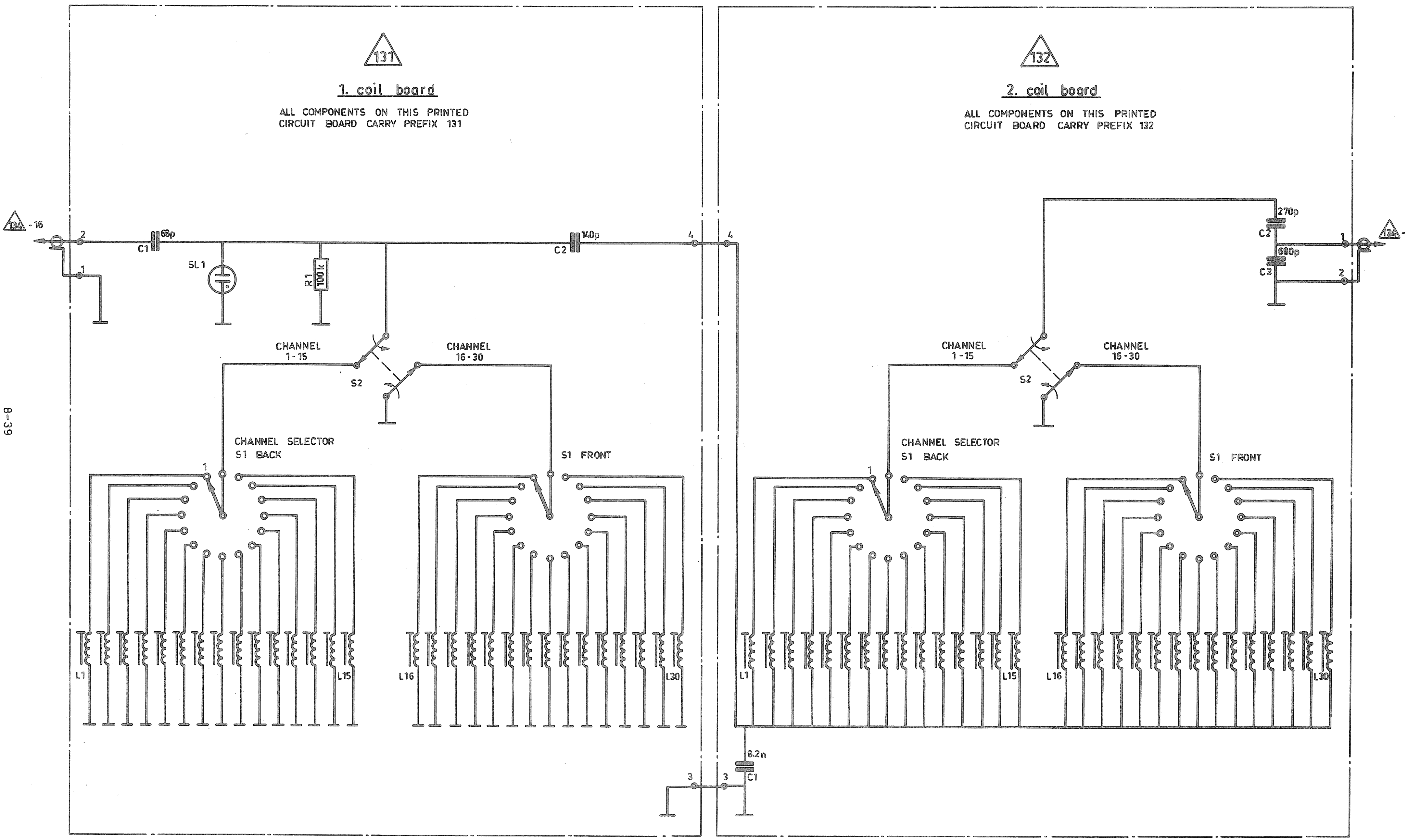


R - 1042-1

PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE

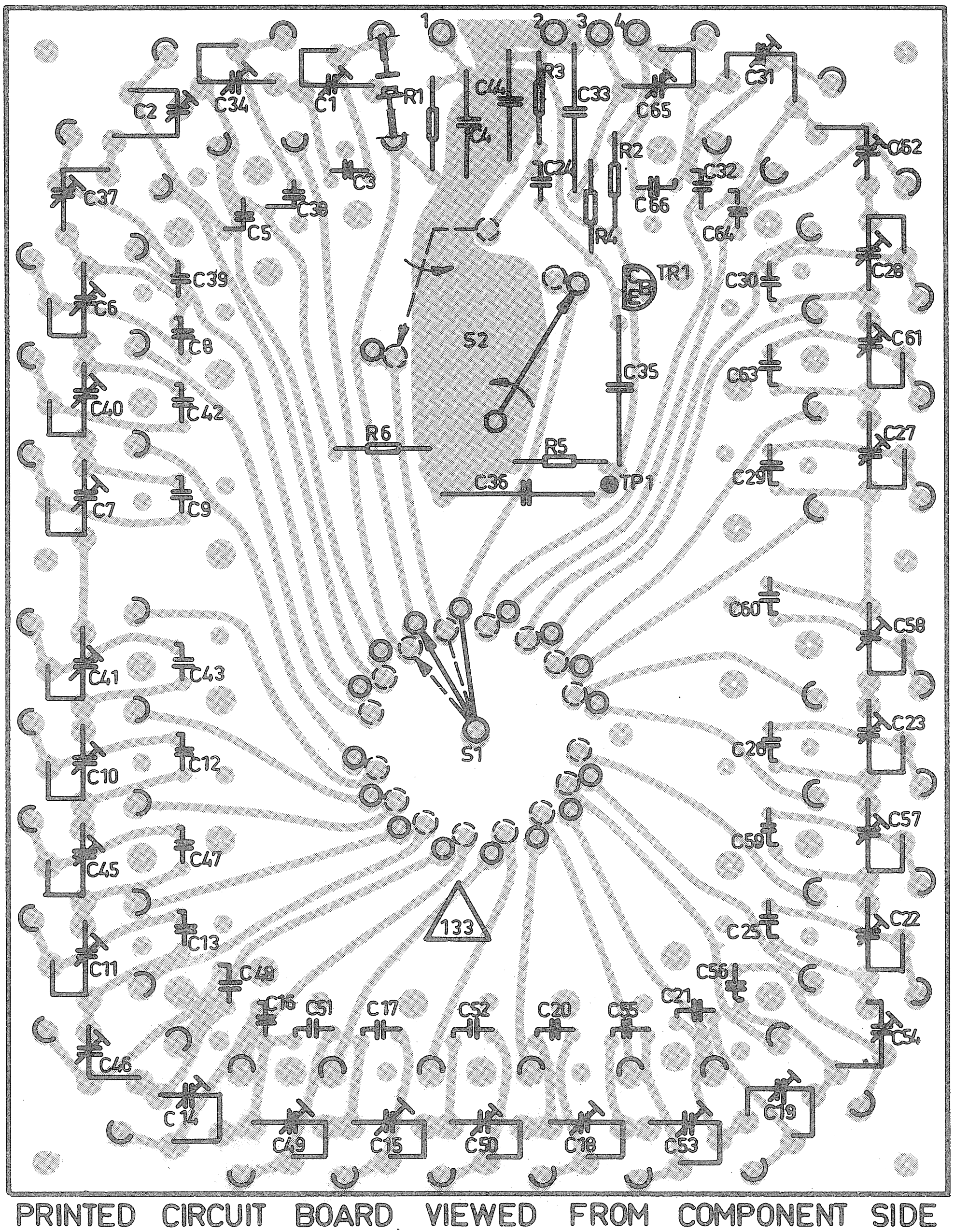


PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE

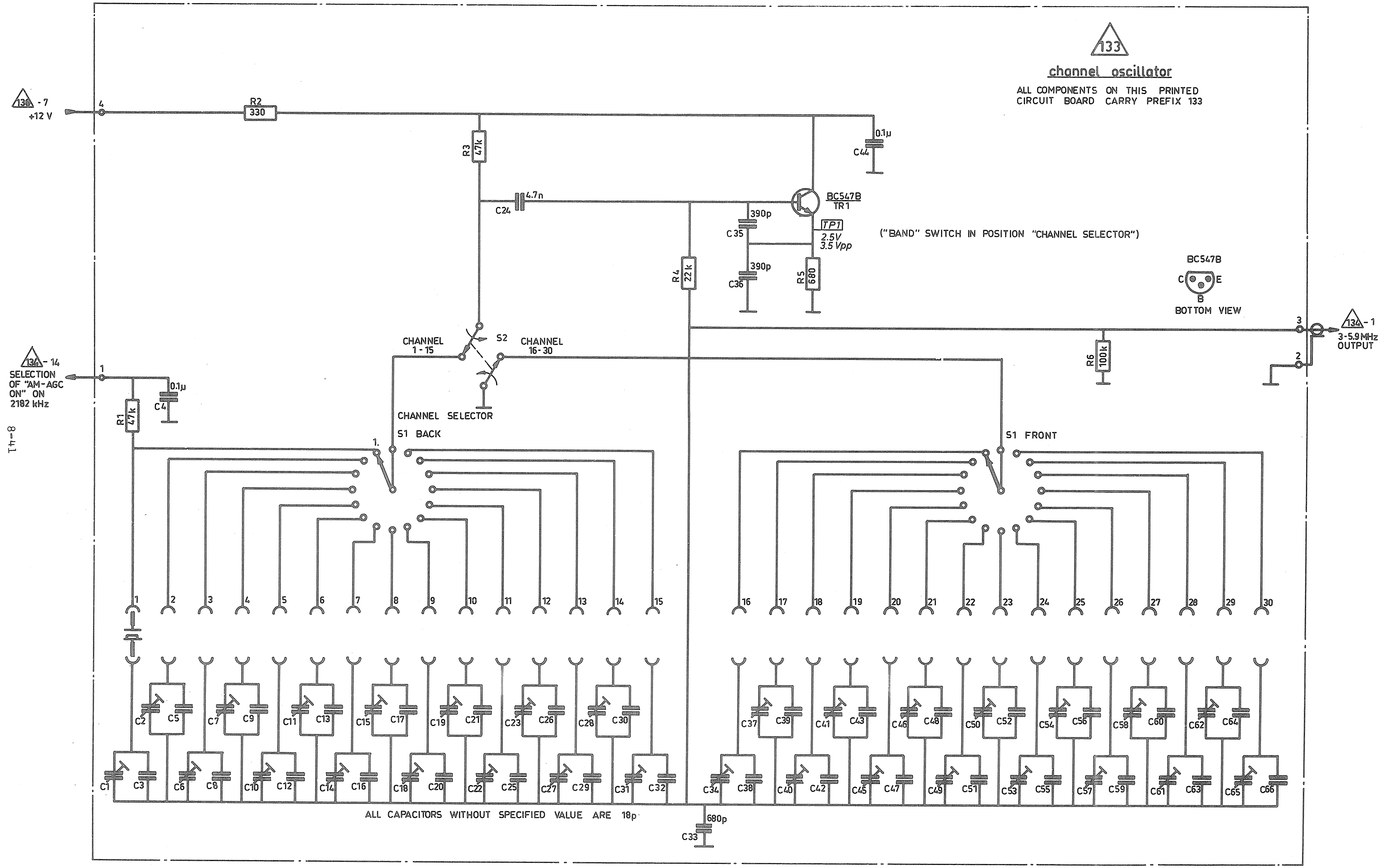


R - 1039 - 1

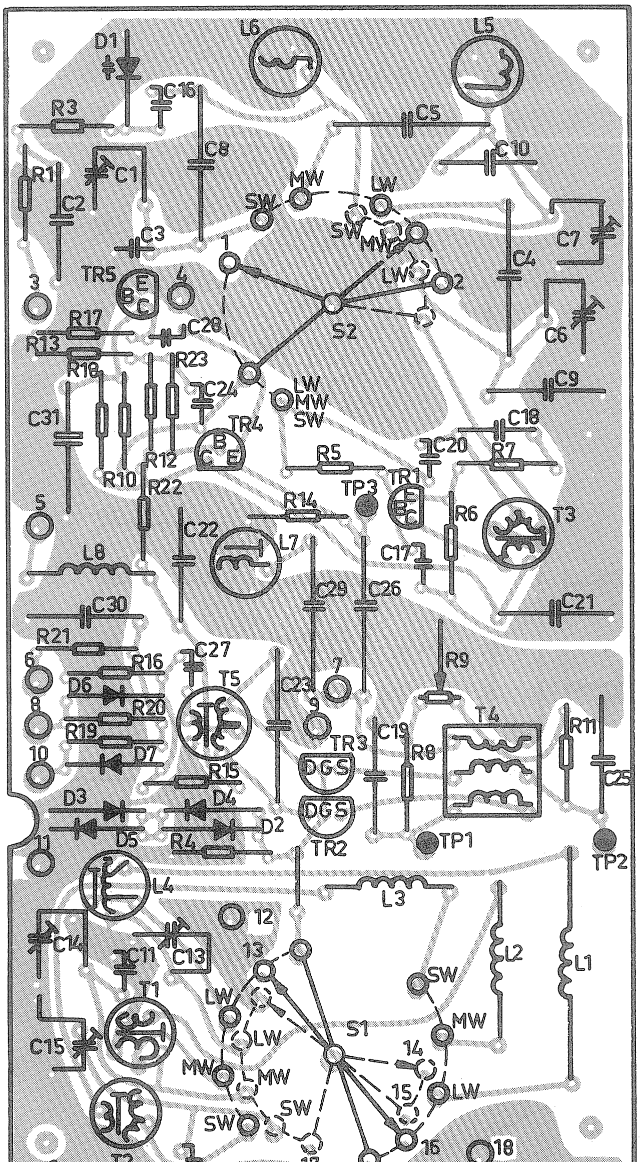
R2000 RECEIVER MODULES 131 AND 132



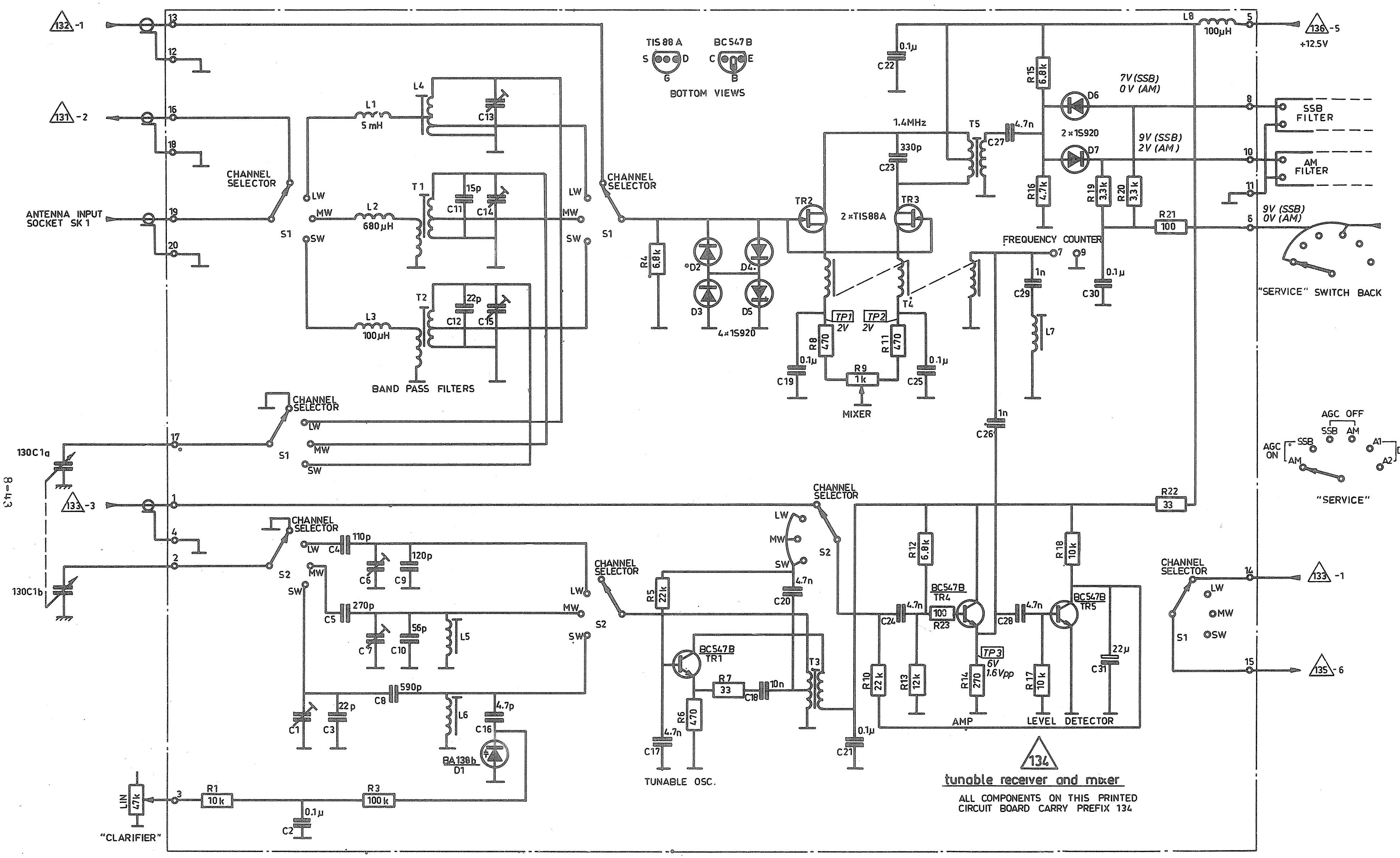
PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



R2000 RECEIVER MODULE 133



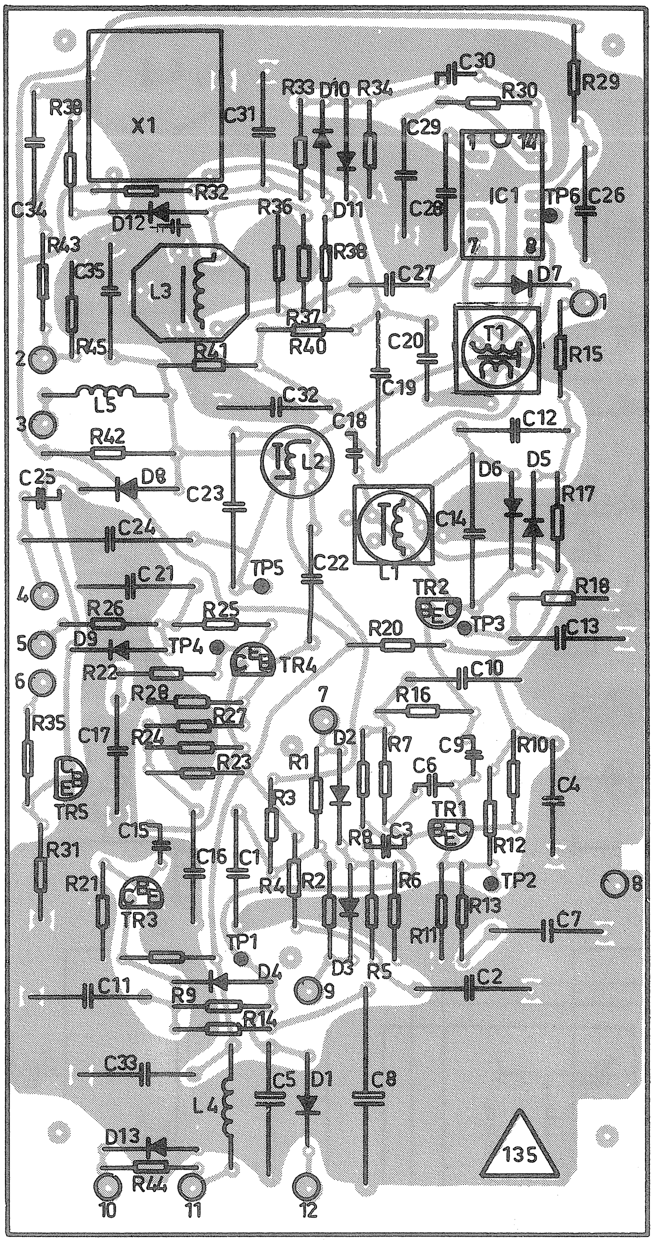
PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



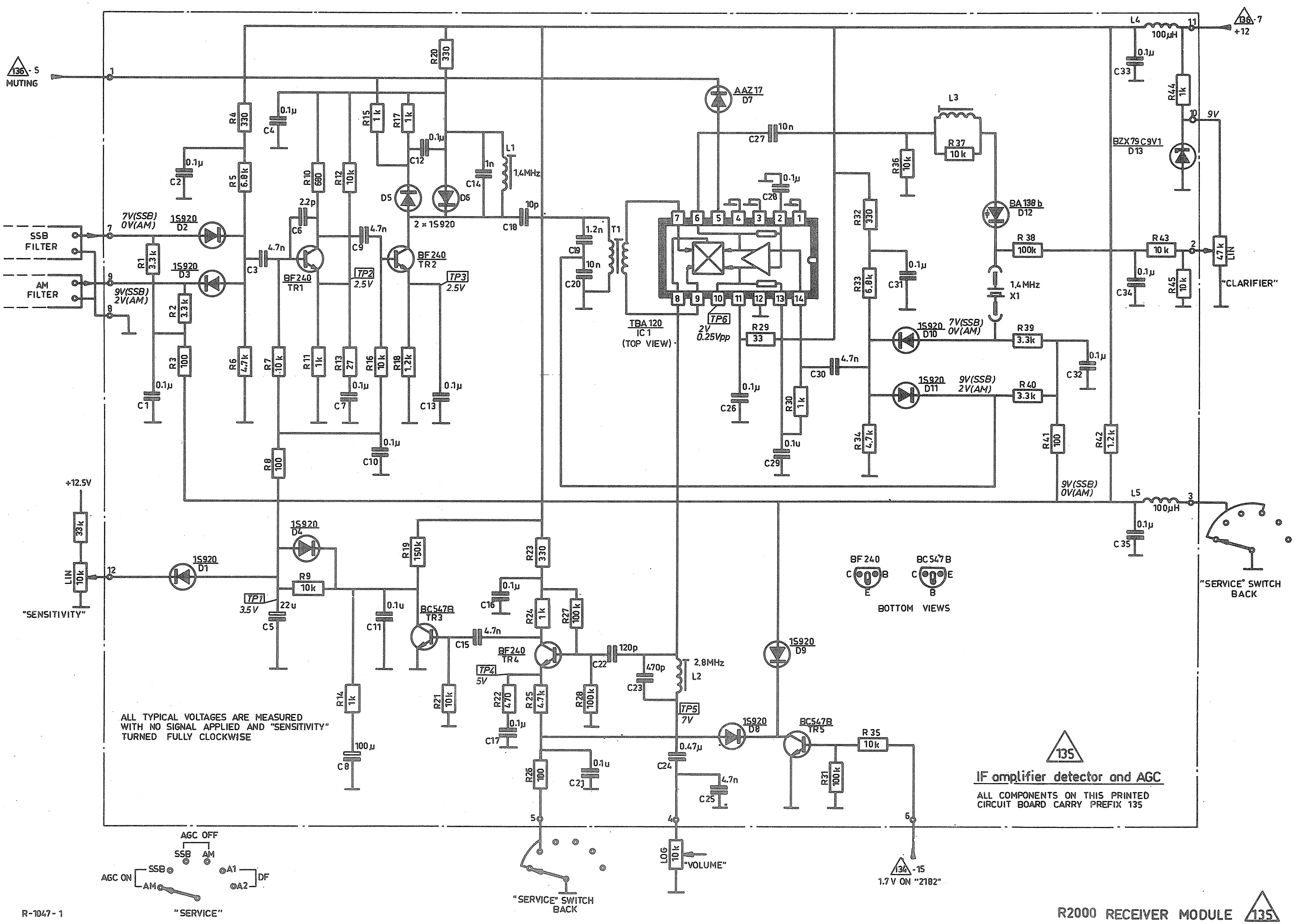
8-43

R - 1035 - 1

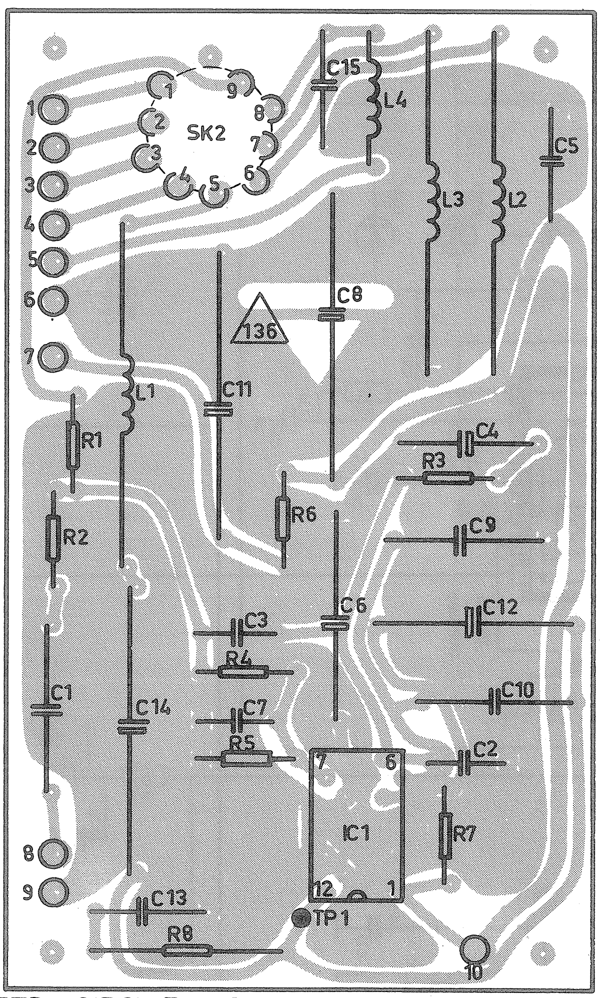
R2000 RECEIVER MODULE 134



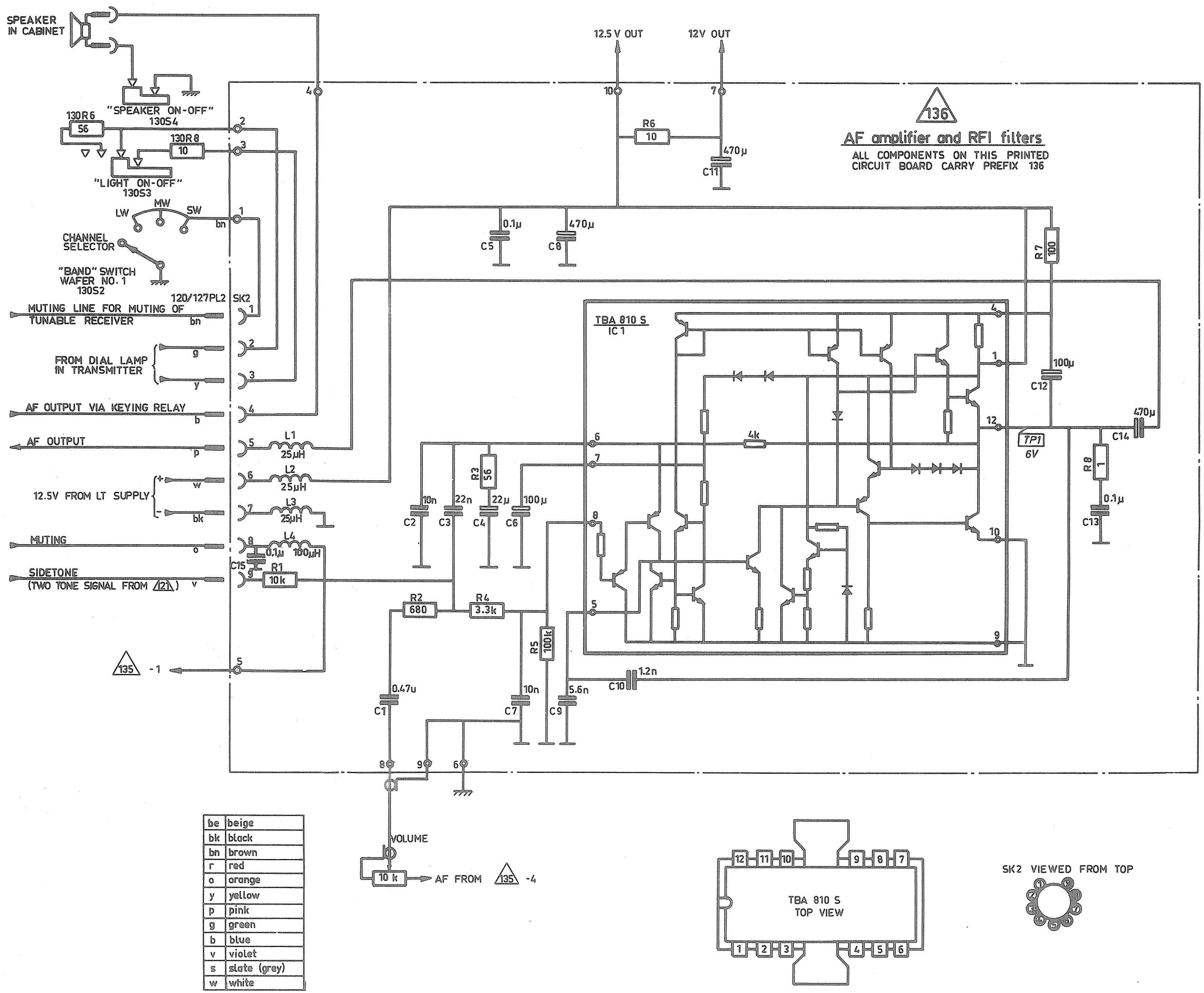
PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



R2000 RECEIVER MODULE 135



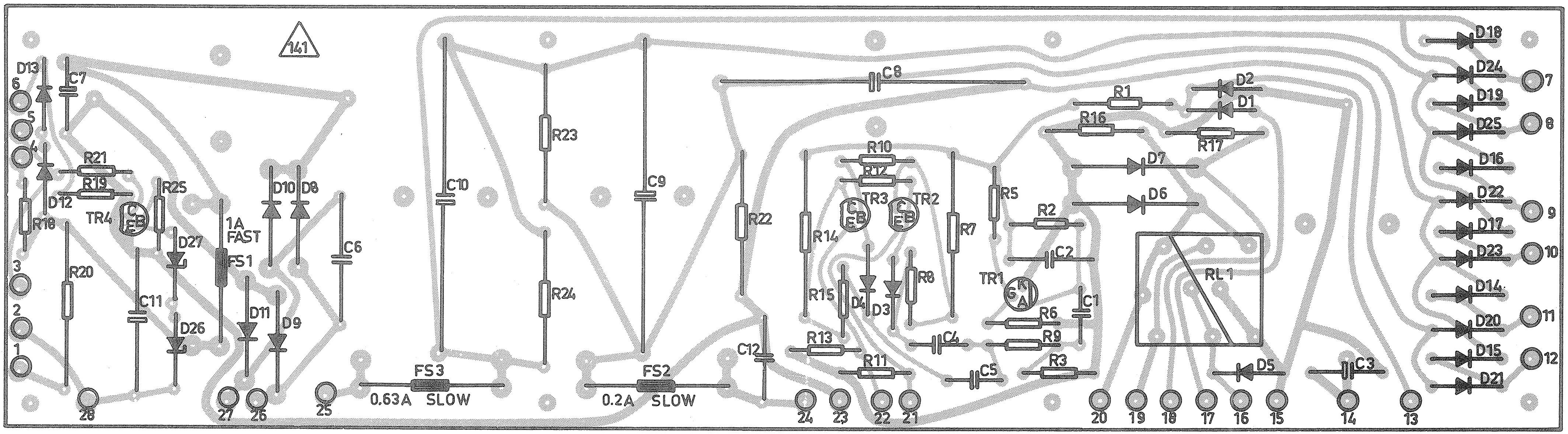
PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



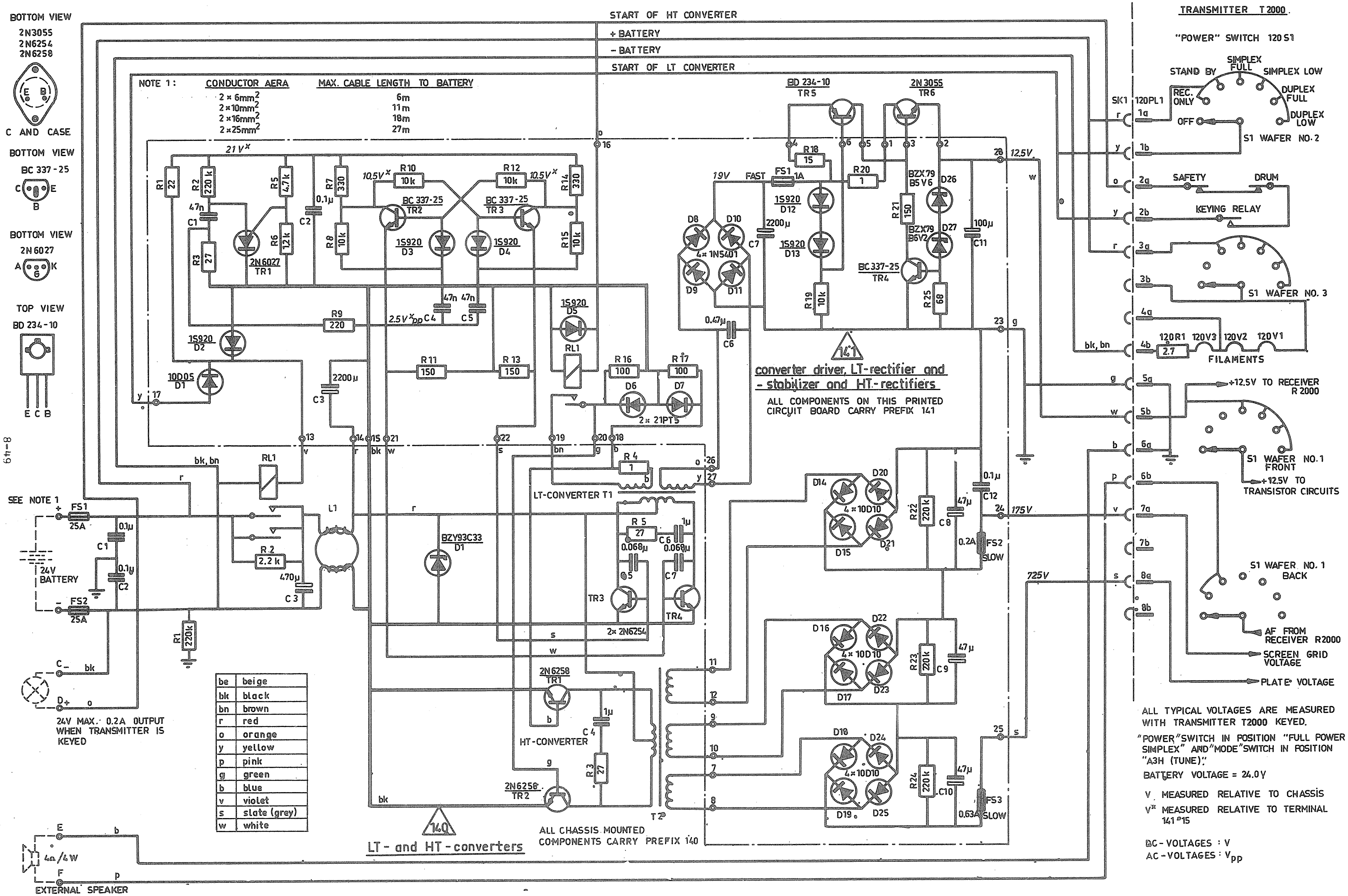
be	beige
bk	black
bn	brown
r	red
o	orange
y	yellow
p	pink
g	green
b	blue
v	violet
s	slate (grey)
w	white

R - 1058 - 1

R2000 RECEIVER MODULE 136



PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



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

ALL TYPICAL VOLTAGES ARE MEASURED WITH TRANSMITTER T2000 KEYED.

"POWER" SWITCH IN POSITION "FULL POWER SIMPLEX" AND "MODE" SWITCH IN POSITION "A3H (TUNE)".

BATTERY VOLTAGE = 24.0V

V MEASURED RELATIVE TO CHASSIS

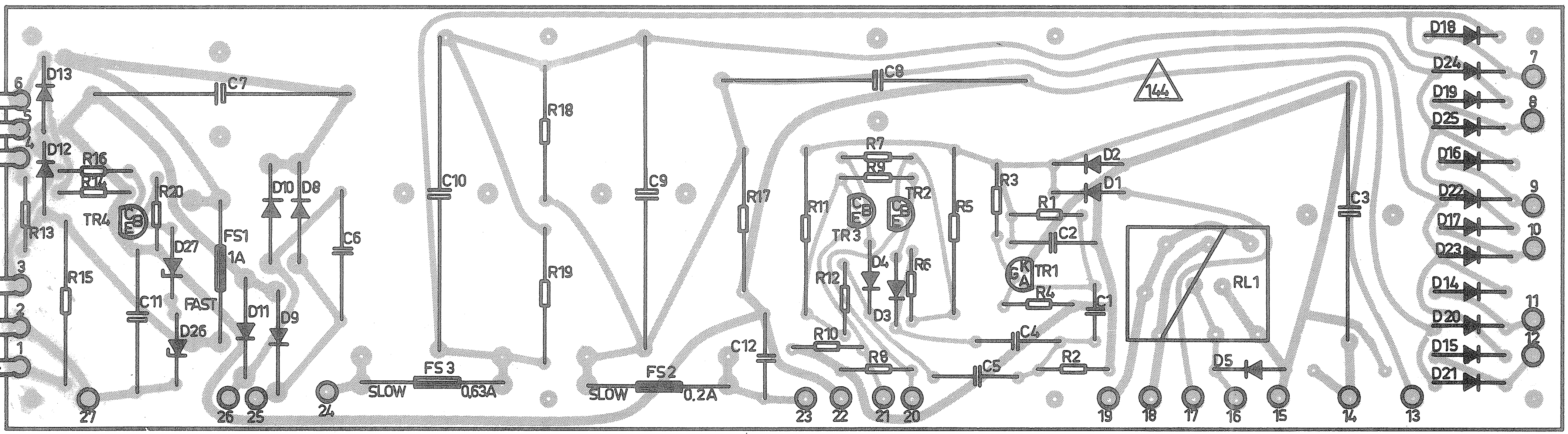
V[x] MEASURED RELATIVE TO TERMINAL 141°15

DC-VOLTAGES : V

AC-VOLTAGES : V_{pp}

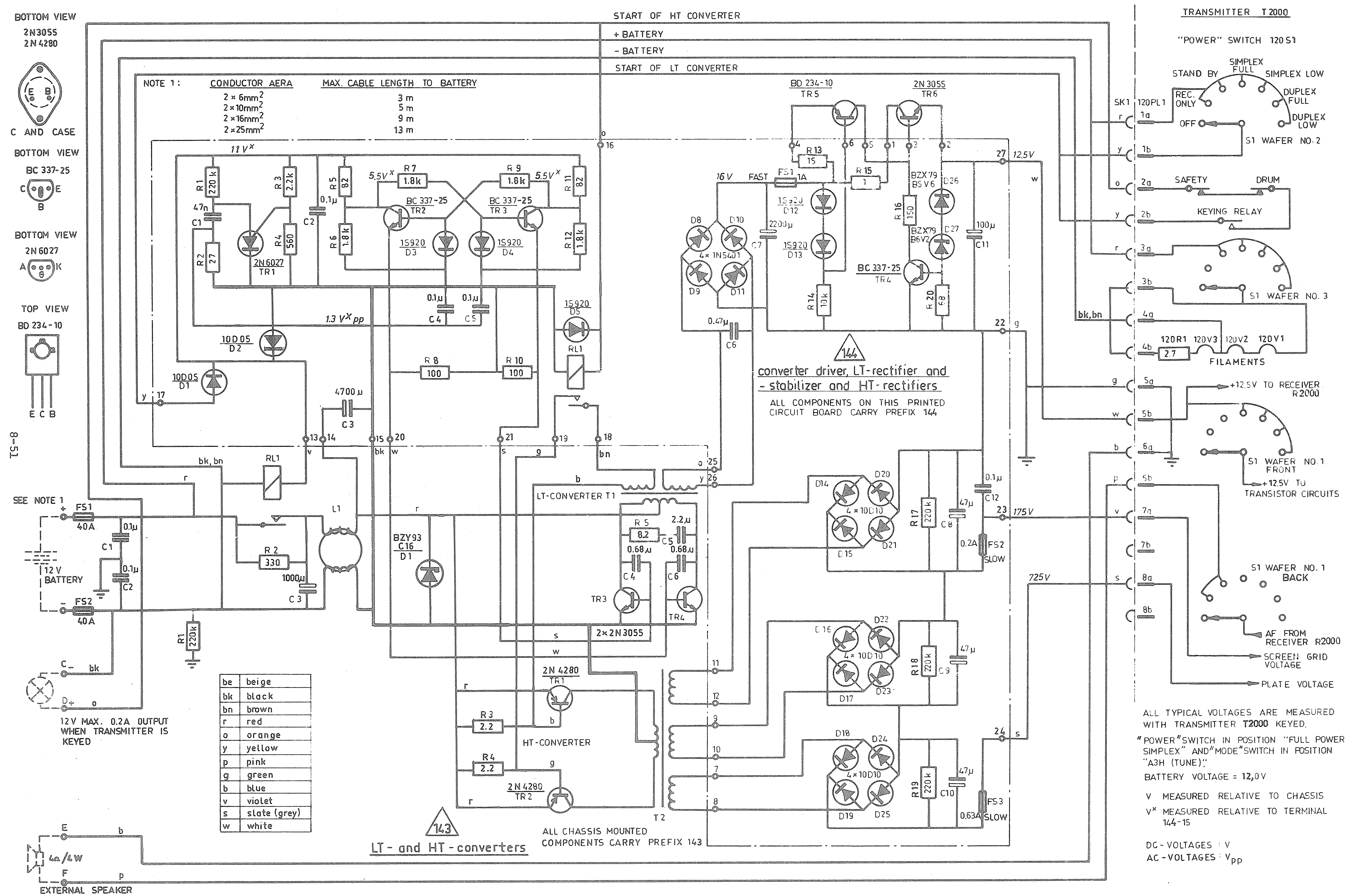
P-1004-2

P2000 24V DC POWER PACK



PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE

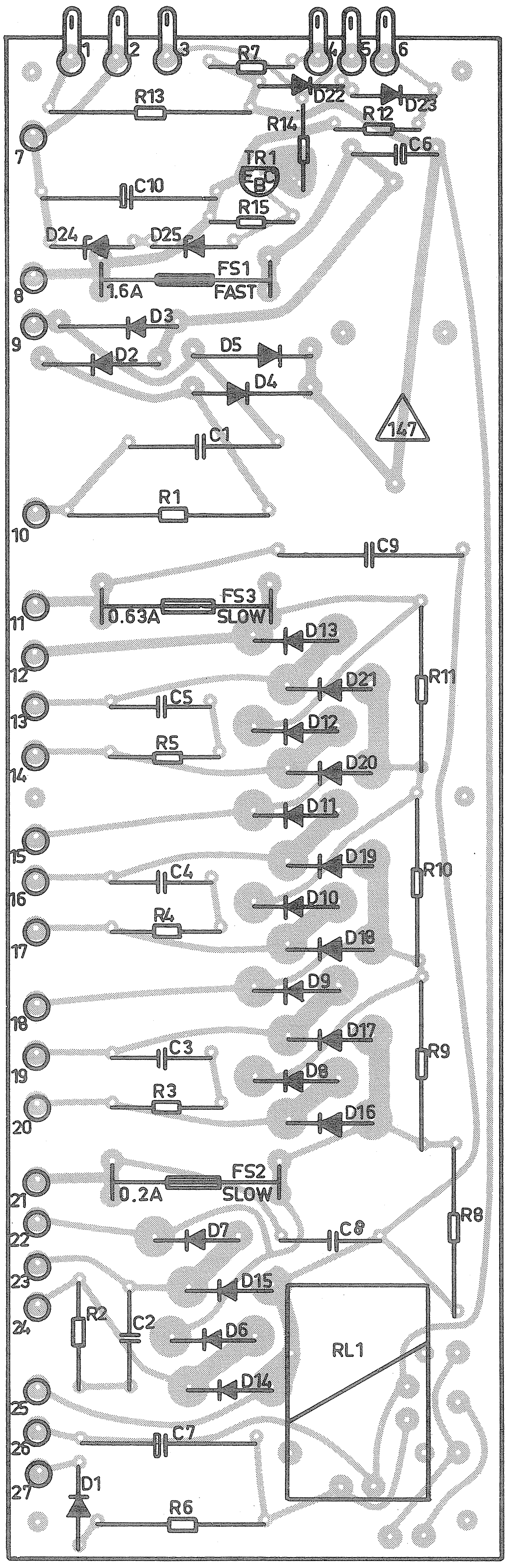
P – 1036 - 1



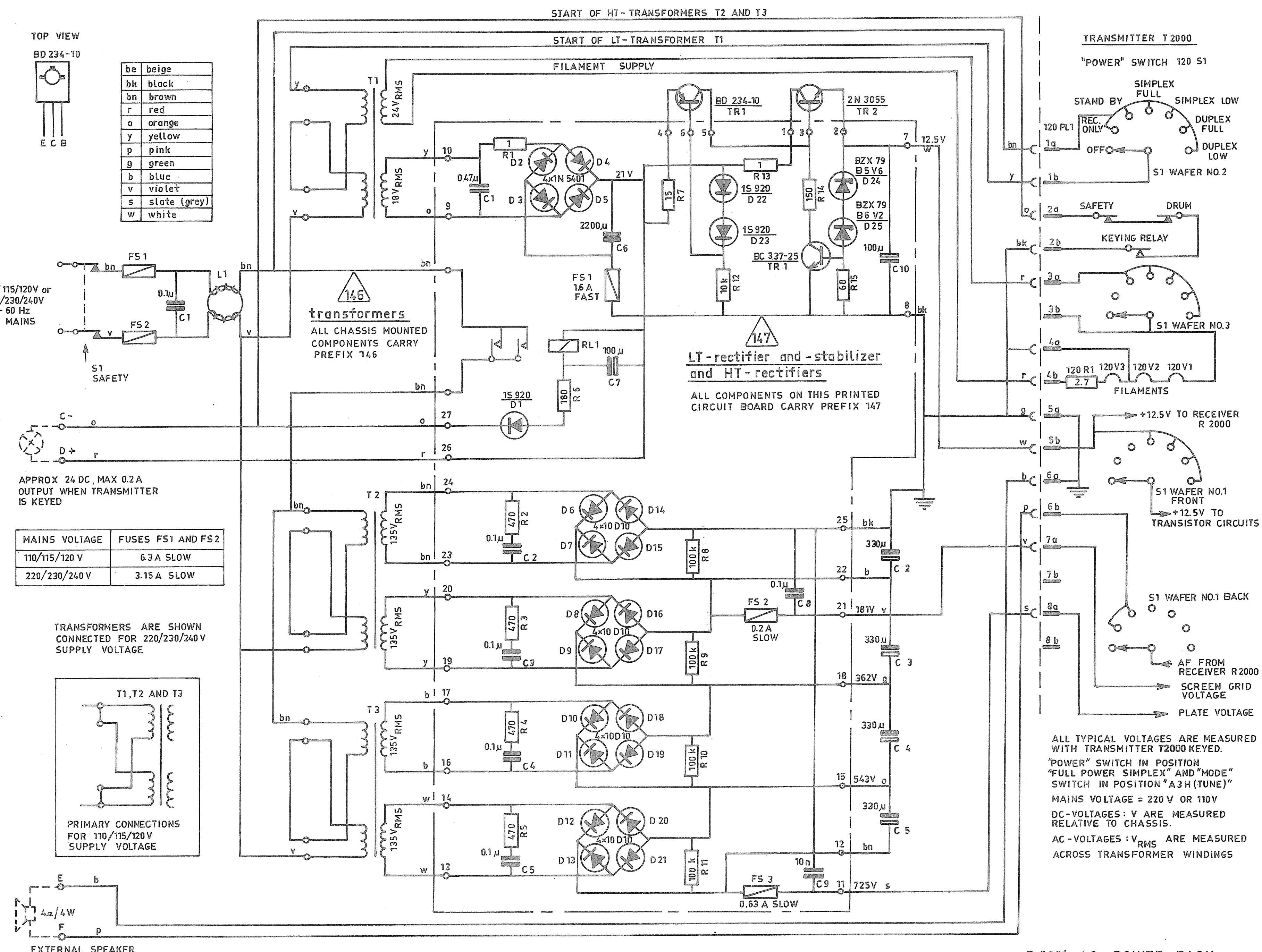
8-51

P-1005-1

P2002 12V DC POWER PACK



PRINTED CIRCUIT BOARD VIEWED FROM COMPONENT SIDE



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

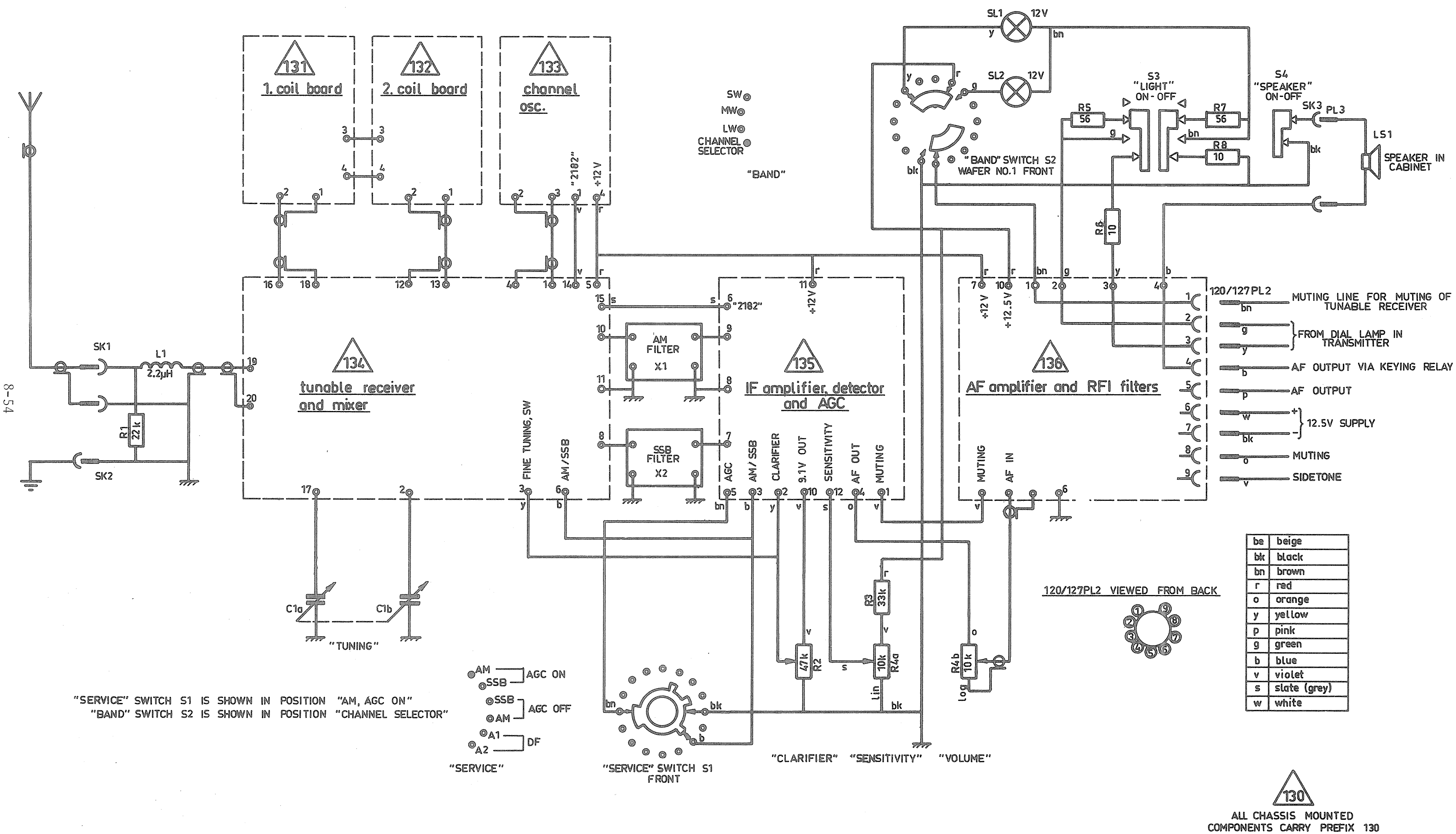
MAINS VOLTAGE	FUSES FS1 AND FS2
110/115/120 V	6.3 A SLOW
220/230/240 V	3.15 A SLOW

TRANSFORMERS ARE SHOWN CONNECTED FOR 220/230/240 V SUPPLY VOLTAGE

ALL TYPICAL VOLTAGES ARE MEASURED WITH TRANSMITTER T2000 KEYED.
"POWER" SWITCH IN POSITION "FULL POWER SIMPLEX" AND "MODE" SWITCH IN POSITION "A3H (TUNE)"
MAINS VOLTAGE = 220 V OR 110 V
DC-VOLTAGES: V ARE MEASURED RELATIVE TO CHASSIS.
AC-VOLTAGES: V_{RMS} ARE MEASURED ACROSS TRANSFORMER WINDINGS

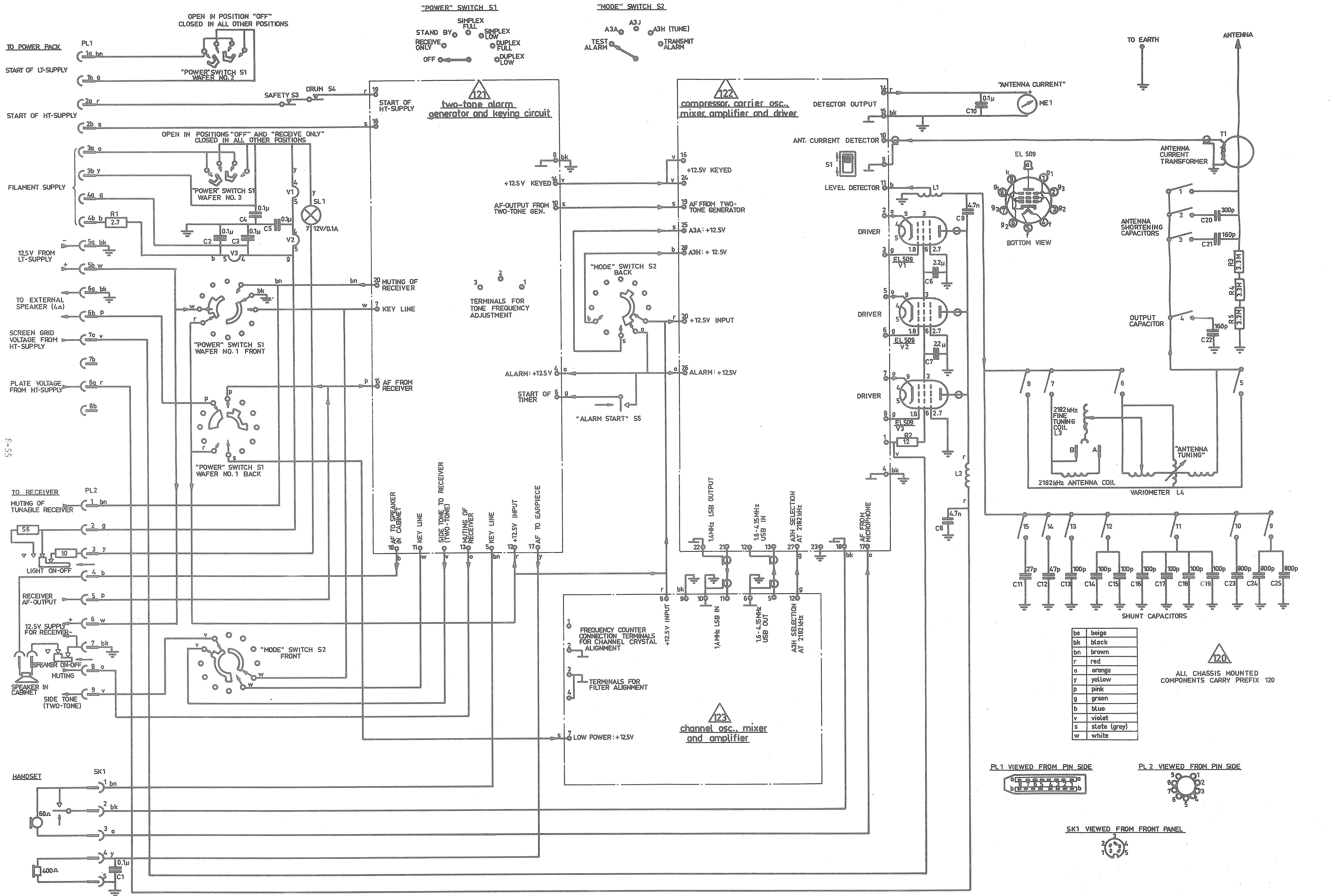
P 2001 AC POWER PACK

P-1054-1



R-1064-1

R2000 RECEIVER WIRING DIAGRAM



T2000 TRANSMITTER WIRING DIAGRAM

T-1039-1