STR 25 SUR

MARINE VHF FM RADIOTELEPHONE

SERVICE MANUAL

ITT Marine

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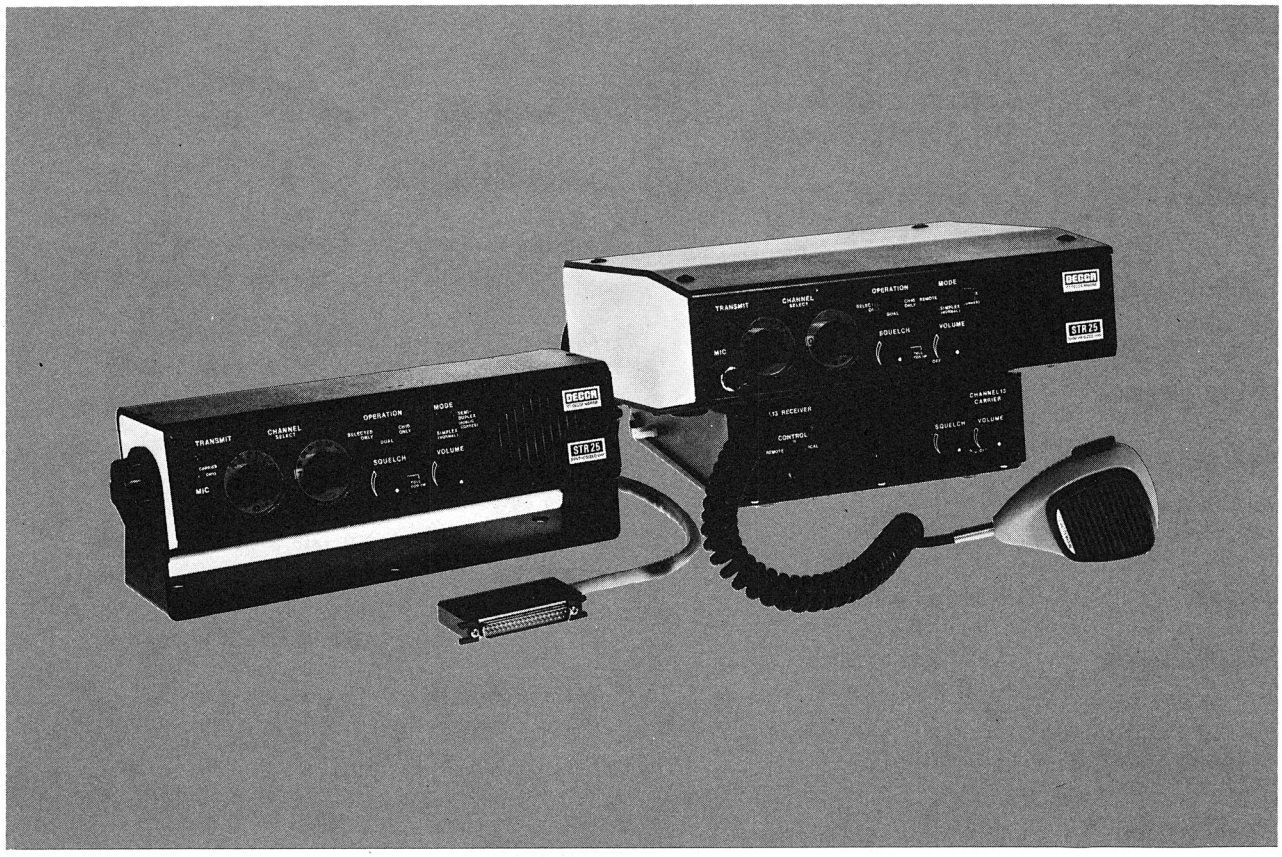


1.1 GENERAL

This manual describes the ITT STR 25 synthesized Marine VHF FM Radiotelephone and provides information to allow qualified service technicians to maintain and repair the set. It also contains installation and operation instructions.

Available options are discussed in the manual. Other options will be added and either described in separate manuals or in news sheets.

1.2 GENERAL DESCRIPTION

The "STR 25" Radiotelephone actually includes a complete system for efficient VHF FH radio communication.

- a dual conversion superheterodyne receiver with FM detector and audio amplifier,
- a FM transmitter with a max. output power of 25 W, reducible to 1 W for low power operation.
- a frequency synthesizer provides up to 58 frequency channels, simplex (one frequency) or duplex (two frequency, spaced 4.6 MHz). One or two of 5 Aux channels may be employed for receive-only channels (weather channels). To arrange duplex and weather channels, diodes are employed.
- a switching unit (optional) which provides the connections for a full control remote box.

1.3 ACCESSORIES

Following is a list of accessories available for use with the radiotelephone.

a. Coaxial antenna 50 ohm.
b. Coaxial cable RG-213/U (formerly RG-8A/U)
c. Coaxial connector, plug, PL-259
d. External watertight loudspeaker
e. Power pack 24/32-13,6 V DC
f. Power pack 220/110 V ac.
g. Extension board
h. Switching unit
i. Remote control box

1.4. SPECIFICATIONS

The technical characteristics of the radio-telephone are listed in table 1.1.

GENERAL

Frequency range	: 156,0 -157,425 MHz 160,625-162,025 MHz (162,050-163,0 MHz optional)
Channels	: 58 Synthesized 5 Optional (with extra plug-in board)
Emission classification	: 16F3
Channel spacing	: 25 KHz
Mode of operation	: Simplex, semiduplex
Crystal	: 1 crystal per AUX channel
Temperature range	: - 20° C to + 55°C - 4° F to + 131°F
Frequency stability	: ± 10 x 10^{-6}
Supply voltage	: 12 V Battery (test voltage 13,8 EIA) Optional: 24 V/32 V battery with external power pack 110/220 V AC with external power pack
Current drain at 13,8 V DC	: Transmit high power (25 W) 5 A Transmit low power (1 W) 1.1 A Receive 0.4 A
Dual watch	: Channel 16 (safety and calling) and any other channel selected.

RECEIVER

Dual conversion	: I.F. 10,7 MHz/455KHz 0,7uv EMF 12 dB sinad
Selectivity EIA	: 80 dB
Intermodulation EIA	: 70 dB
Squelch	: Adjustable from - 2 + 6 dB relative to 0,7 uV EMF
Noise	: 40 dB
Limiter	: 1 dB (input up to 100 dB above sensitivity)
Audio output	
STR 25 SU	2 W into 8 ohm int. speaker
STR 25 SUR	2 W into 8 ohm ext. speaker max 7 W into 2 ohm (with speaker disconnected)
Audio distortion	: 10% at 7 W

TRANSMITTER

Power output	25 - 22,5 W ~~simplex or semiduplex~~
	1 W reduced power
Max. Deviation	: ± 5 KHz
Noise	: 40 dB
Distortion	: 5%

Chapter 2

INSTALLATION

NOTE: Failure to apply the following instructions, particularly those involving cables, could result in loss of warranty.

2.1 GENERAL

For trouble free, efficient operation it is essential to follow the installation instructions listed below.

2.2 UNPACKING and INSPECTION

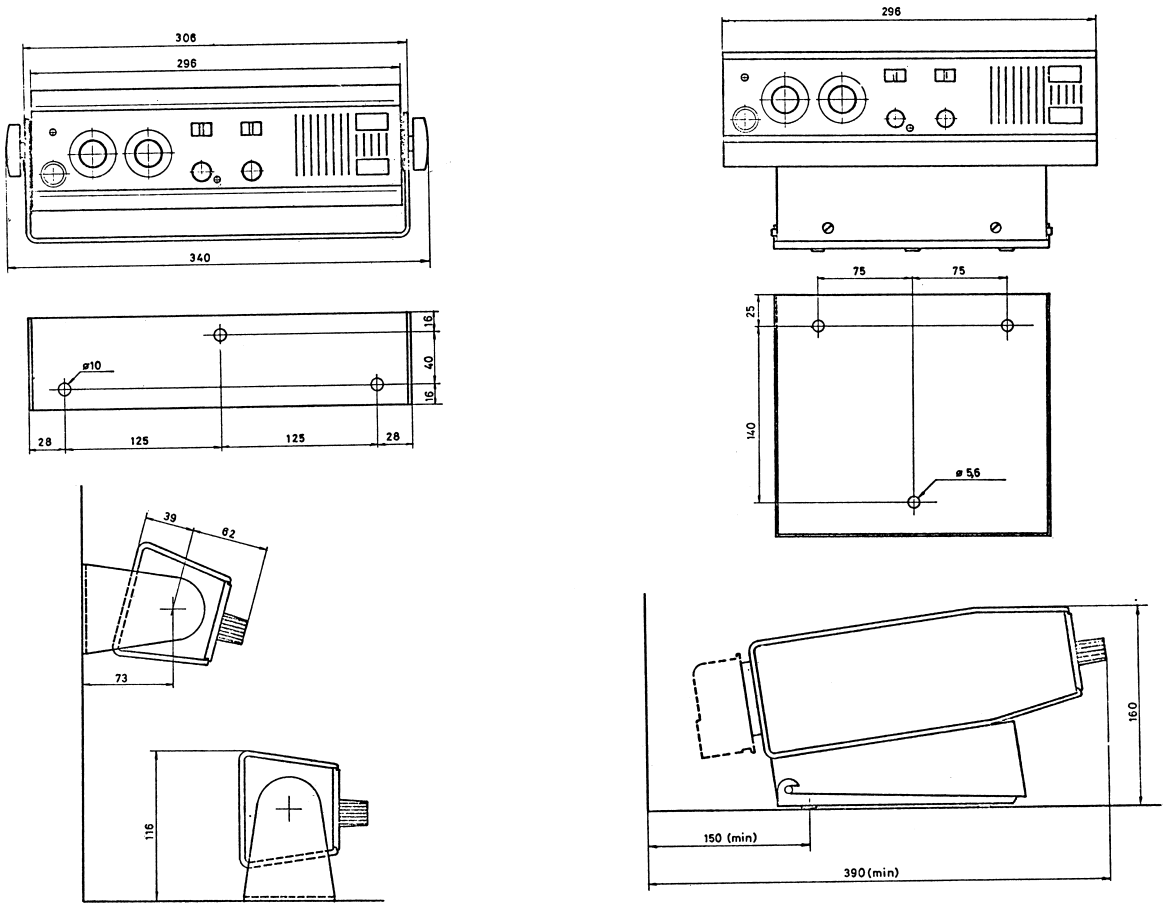
Remove the radiotelephone from the shipping container.Inspect carefully for signs of damage. If any is evident, save the packing material and notify the carrier immediately.

2.3 SITING

The equipment should be located on the bridge, in the chartroom or another suitable place where it is readily accessible and reasonably protected from splashwater. The antenna should be located as high as practicable and in an area which is free from obstructions.

For a typical marine installation, the following suggestions will aid in making an efficient installation.

a. Mount the set with its Mounting Wedge horizontally on top of a table or a bench. The Mounting Bracket on the remote unit can be mounted either vertically beside a bulkhead or horizontally on top of a table or a bench.



The figure 2.1 shows the mounting positions and outline dimensions of the set.

b. Utilize the external loudspeaker facility to improve watchkeeping, especially in noisy localities. For outdoor use a water-tight model is availalble.

c. The antenna should preferably be located on top of the mast, but other alternatives could be considered. When the antenna site has been decided upon, make the coaxial cable run as short as possible.

d. Full remote control from a remote control box can be included as an option.

2.4 MOUNTING

When the siting of the radiotelephone has been fixed secure the set to the bulkhead with three screws.

6 mm (1/4") screws with a nut and lock washer are recommended. Screws may be fixed onto hard wood, provided the treated section penetrates to a deapth of a least 1".

2.5 EXTERNAL CONNECTIONS

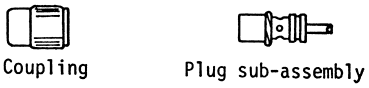
2.5.1 COAXIAL CABLE

The type of coaxial cable between the radio-telephone and the antenna should be RG-213/U or similar 50 ohm cable.

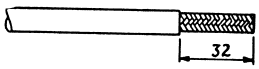
Keep the cable length as short as possible - on these frequencies the attenuation is 3 dB per 30 meter (or 100 Ft.), which means a loss of 50% of the available power output.

Fit the coaxial cable with an UHF plug PL-259 or similar type at the equipment end and also at the antenna end when appropriate. Refer to figure 2.2.A for mounting instructions.

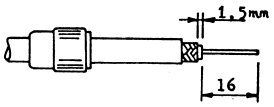
To protect the coaxial cable from mechanical damage in exposed surroundings, it is recom-mended that the cable is placed inside a steel pipe. Alternatively an armoured cable such as RG-215/U could be employed.



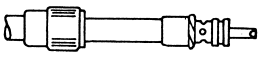
Plug type PL-259



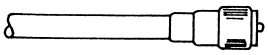
Coaxial cable RG-213/U (formerly RG-8A/U)
Cut end of cable even.
Remove vinyl jacket 32 mm.



Bare 16 mm of center conductor.
Trim braided shield. Slide coupling ring on cable. Tin exposed center conductor and braid.



Screw the plug sub-assembly on cable. Solder assembly to braid through solder holes, making a good bond between braid and shell. Solder conductor to contact. DO NOT USE EXCESSIVE HEAT.



For final assembly, screw coupling ring on plug sub-assembly.

FIG 2.2A MOUNTING INSTRUCTIONS FOR COAXIAL CABLE CONNECTOR

FIG. 2.2B EXTERNAL CONNECTIONS AND CABLING

NOTE: See section 4.4.7 for further details on external speaker connections.

UNGROUNDED (FLOATING) MAINS

THE SET DESIGNED WITH FLOATING CONNECTIONS FOR ANTENNA AND POWER LEADS, AND THE SET ITSELF WILL NOT GROUND ANY SIDE OF A GROUND FREE SHIP'S MAINS.

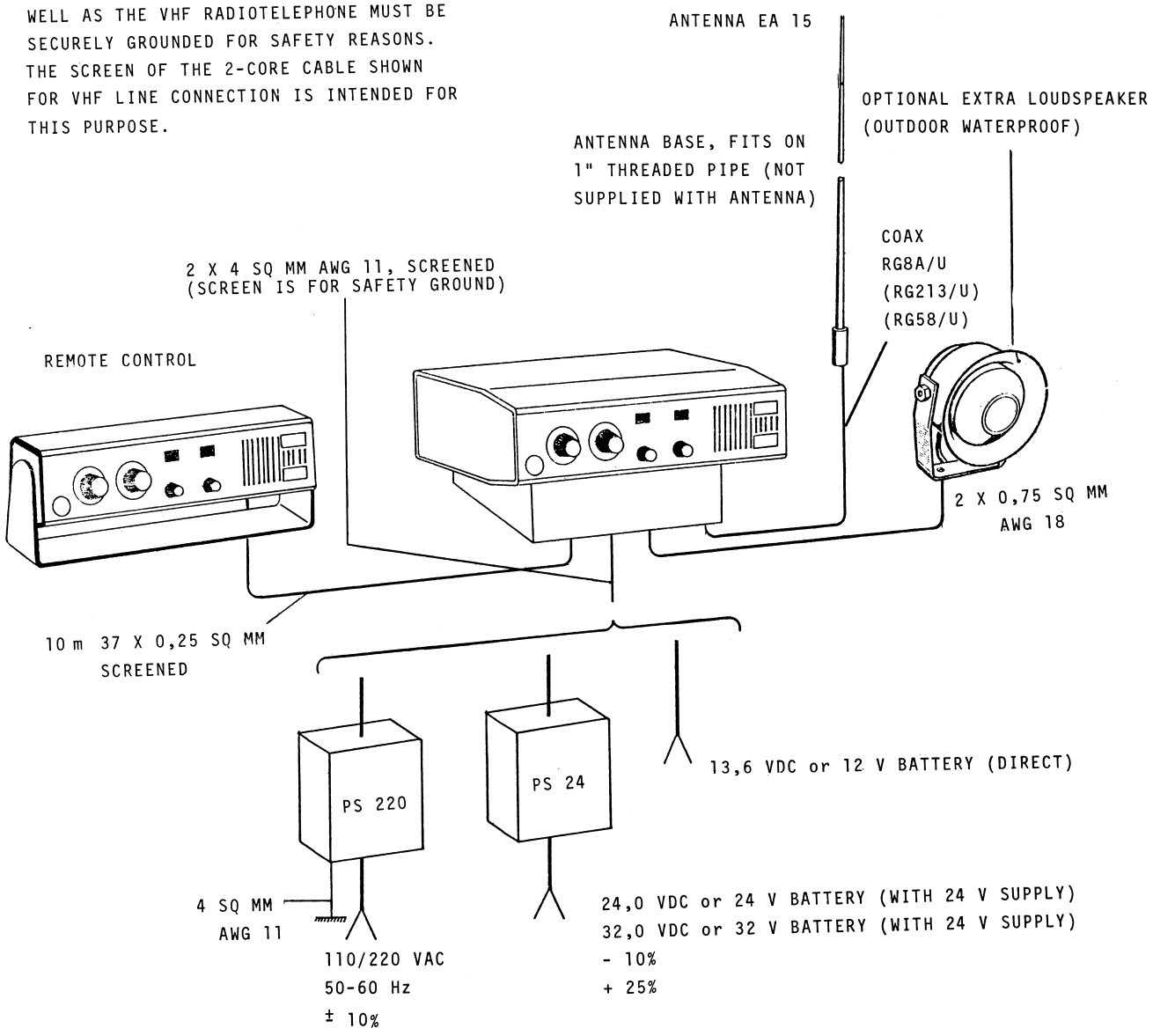
EXTERNAL LOUDSPEAKER

WHEN FULL ADVANTAGE IS TO BE TAKEN OF THE POWERFUL 7 WATT AUDIO AMPLIFIER, THE LOUDSPEAKER TYPE H44 MAY BE INSTALLED.

THE H44 LOUDSPEAKER IS COMPLETELY WATERPROOF AND CAN BE USED FOR OUTDOOR APPLICATIONS UNDER EXTREME WEATHER CONDITIONS.

CAUTION

WHEN INSTALLING POWER SUPPLY PS 220 OR ANY OTHER AC SUPPLY, THE SUPPLY CASE AS WELL AS THE VHF RADIOTELEPHONE MUST BE SECURELY GROUNDED FOR SAFETY REASONS. THE SCREEN OF THE 2-CORE CABLE SHOWN FOR VHF LINE CONNECTION IS INTENDED FOR THIS PURPOSE.



2.5.2 CONNECTION OF SUPPLY VOLTAGE

The battery voltage is connected as shown in figure 2.3

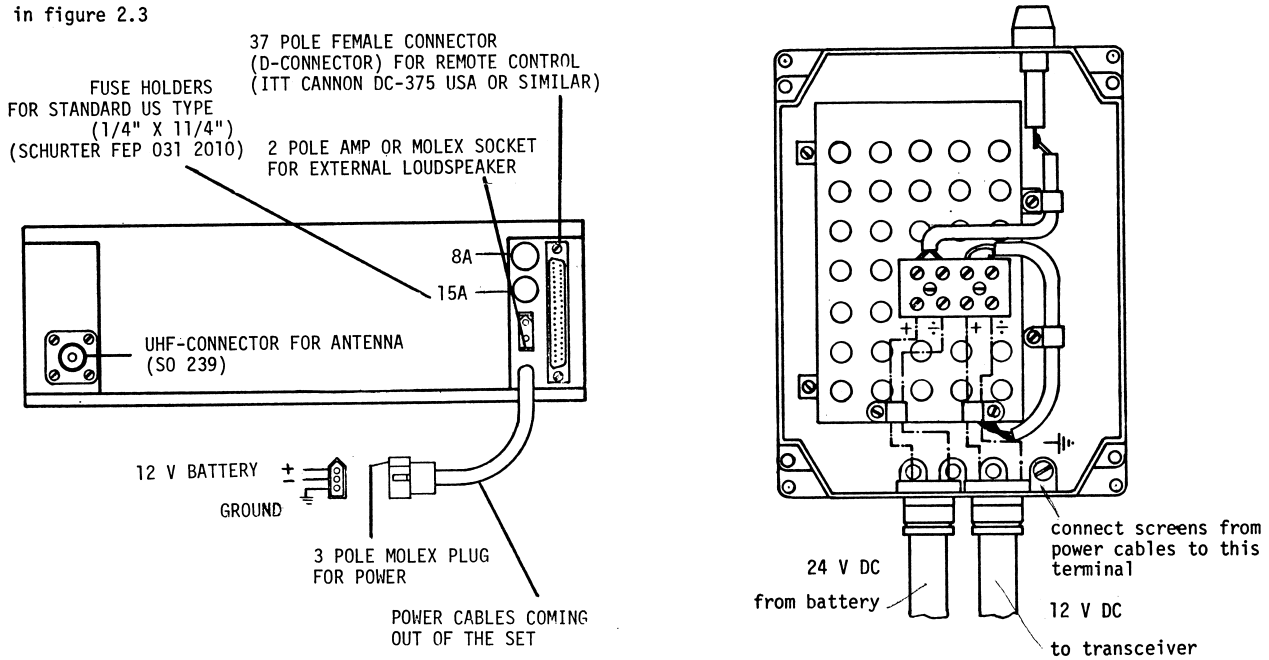


Fig. 2.3 CONNECTION OF SUPPLY VOLTAGE

NOTE:

Connect the power supply cables directly to the battery terminals to avoid damaging transients from ignition switch etc.

The conductor size of the battery leads is to be calculated from the table 2.1 below

12 V Battery

Cable Area Sq. mm	AWG	Distance to battery in meter and feet Meter	Feet
1,0	17	2,5	7,5
1,5	15	4,0	12,0
2,5	13	6,0	20,0
4,0	11	10,0	33,0
6,0	9	16,0	55,0
10,0	7		

24/32 V Battery

1,5	15	0-30	0-100

2.5.3 CONNECTION OF EXTERNAL HANDSET AND SPEAKER

As shown in Fig. 2.4

See also Motherboard diagram 10.7

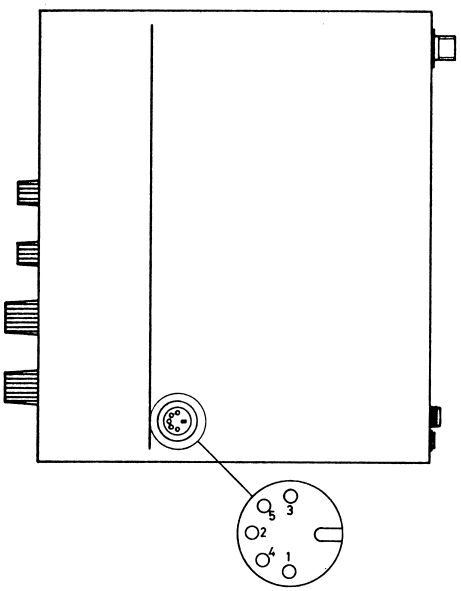


FIG. 2.4 CONNECTION FOR EXTERNAL LOUDSPEAKER AND HANDSET

2.5.4 CONNECTION OF LOCAL MICROPHONE

As shown in Fic. 2.5A for standard version

As in Fig. 2.5B when using extended Mic. or handset

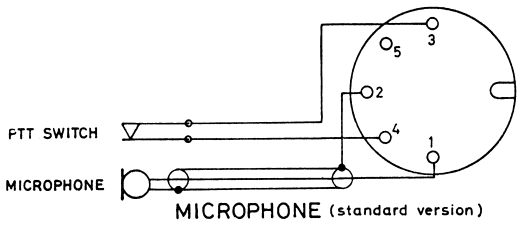
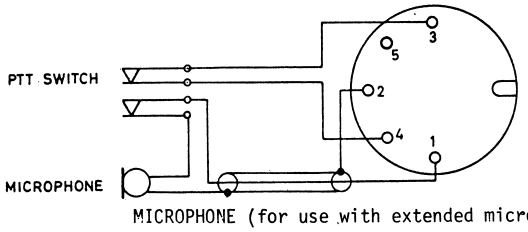


Fig. 2.5A



MICROPHONE (for use with extended microphone)

Fig. 2.5B

Fig. 2.5 A,B Connections for local Microphone

2.5.5 CONNECTION FOR LOCAL HANDSET

As shown in Fig. 2.5C for standard version

As in Fig. 2.5D when using extended mic. or handset

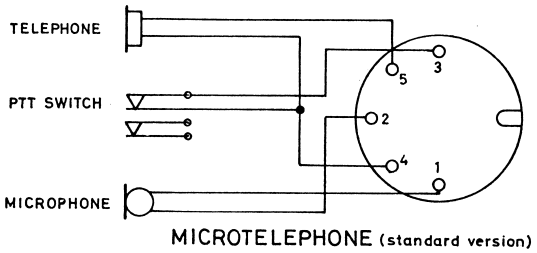
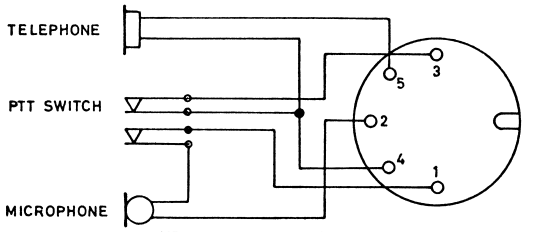


Fig. 2.5C



MICROTELEPHONE (for use with extended micrptelephone)

Fig. 2.5D

Fig. 2.5 C,D Connections for local Microtelephone

Chapter 3

OPERATION

5 OPERATION

IN "DUAL POSITION, CHANNEL 16 IS SAMPLED, INDICATED BY FLASHING DIAL LAMP, WHILE LISTENING TO THE CHANNEL SHOWN IN THE DIAL WINDOW. A SIGNAL ON CH 16 WILL EXTINQUISH DIAL LAMP AND LOCK THE RECEIVER TO CHANNEL 16. POSITION "CH 16 ONLY" WILL DISABLE CHANNEL SELECTORS AND LOCK BOTH TRANSMITTER AND RECEIVER TO CH 16.

3 CHANNEL SELECTORS

LEFT SETS FIRST CHANNEL DIGIT, RIGHT SETS SECOND DIGIT. FIVE AUXILIARY CHANNELS (WE 1, WE 2, AND THREE SPARE POSITIONS) ARE SET BE LEFT KNOB.

6 MODE

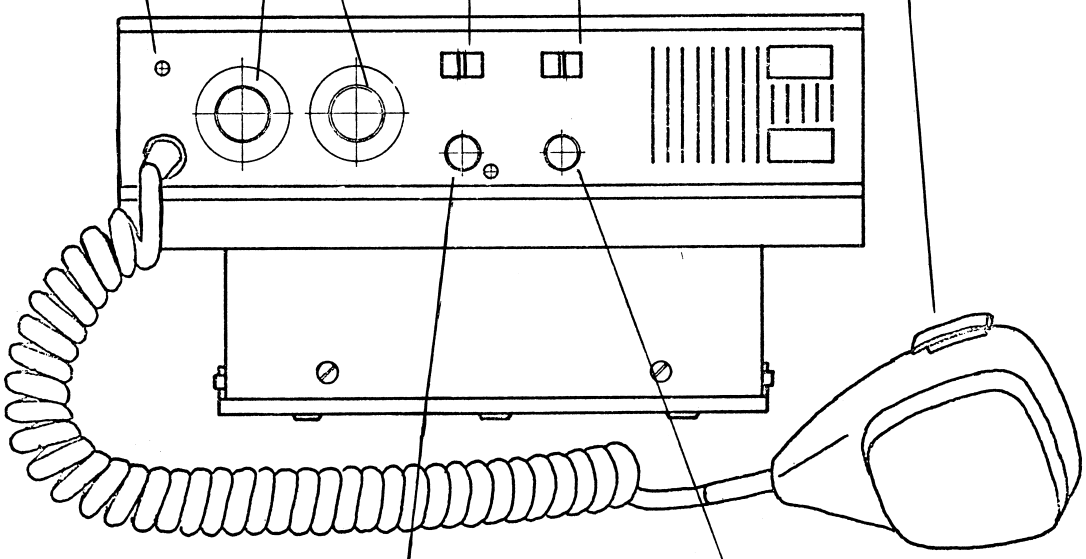
SELECTS SINGLE OR TWO-FREQUNCY OPERATION (SIMPLEX OR DUPLEX CHANNEL). LEFT POSITION DISCONNECTS LOCAL CONTROL TO ENABLE REMOTE OPERATIONS.

8 TRANSMIT LAMP

INDICATES TRANSMITTER "ON".

7 MIKE PRESSEL SWITCH

PRESSING THIS SWITCH WILL ACTIVATE TRANSMITTER, RELEASE TO LISTEN LISTEN.



1 MIKE RECEPTACLES

RECEPTACLES FOR LOCAL AND EXTENSION MICROPHONES/HANDSETS.

2 SQUELCH

WILL SILENCE RECEIVER NOISE IN NO-SIGNAL PERIODS. PUSH KNOB FOR 25 W ANTENNA POWER, PULL FOR REDUCTION TO 1 W.

4 VOLUME

LOUDSPEAKER AUDIO VOLUME, INCORPORATING ON/OFF SWITCH.

3.2 OPERATING INSTRUCTIONS

3.2.1 RECEIVE ONLY

Switch on the equipment by turning the volume control clockwise, pull squelch knob for REDUCED POWER.

Select the channel to be monitored. Turn the squelch knob fully anticlockwise to make squelch inoperative. Turn volume control for appropriate audio level (noise is heard). Turn the squelch knob slowly clockwise intil the noise stops. The selected channel is now being monitored.

3.2.2 RECEIVE ONLY, DUAL WATCH

Follow procedure given in 3.2.1 and set select switch to position "DUAL".

Channel 16 and the channel selected on the dial are now monitored.

The dial lamp will indicate scanning. If a signal is received on the channel selected on the dial, the watch function will interrupt the signal for 1/10 of a second every second, but not disturb the readability.

If a signal is received on channel 16, the receiver locks on to this channel until the transmission is finished. The dial lamp is switched off during reception on channel 16.

3.2.3 RECEIVE AND TRANSMIT

Switch on the equipment, power switch in position low. Use low power for transmissions unless conditions warrant high power.

Select the desired channel. Be sure others are not using the channel.

To transmit, remove the handset from the cradle, depress the pressel switch and speak into the microphone in a normal voice. Address call to appropriate coast station or vessel, giving complete station identity. ~~On duplex channels the transmitter can be operated continiously, on simplex channels~~ the pressel switch must be released during reception.

3.2.4 COMMUNICATION PRECEDURE

The user of the radiotelephone is obliged to follow the rules and regulations issued by the Administrative Authorities.

Following are some basic rules, which should be observed when communicating:

a. Before using a particular channel, be sure that it is designated for the intended use. A list of channels is published in the User's Handbook.
b. Before initiating a channel 16 call, be sure to pre-determine a working channel that is not occupied.
c. Before initiating any call, be sure that the selected channel is not occupied.
d. Keep all transmissions short and to the point. Avoid unnecessarily long transmissions.
e. After completion of communication, return to channel 16 - safety and calling.

3.3 OPTIONS

3.3.1 REMOTE CONTROL

For remote controlling the set can be supplied with a remote control unit, including a 37 core multicable, which makes it possible to control all the functions of the set except the ON/OFF switch. Furthermore, the remote box rear panel contains sockets for external loudspeaker and remote loudspeaker for channel 13 receiver (if installed). On the front plate a LED indicator shows when there is a carrier on the channel 13 receivers. One limitation occurs when the channel 13 remote loudspeaker is connected directly to the remote box, that is the omission of two positions for private channels on the left hand dial knob (2 P and 3 P). Actuation of those channels can be done easily by connecting the remote loudspeaker directly to the channel 13 receiver and by making two strap connections on the switching unit, see par. 4.4.12 page 4-14.

3.3.2 CHANNEL 13 RECEIVER

For operation of the optional channel 13 receiver, reference is made to appendix 1.

Chapter 4

THEORY OF OPERATION

4.1 GENERAL

In this chapter the principles of operation are discussed, starting from the functional block diagram, figure 4.1. Then the signal flow is analysed with the aid of figure 4.2, the signal flow block diagram. The frequency stabilisation system is analysed separately and with reference to figure 4.3. The principles of the channel scanning are discussed in connection with figure 4.4.

The operation of individual circuits is discussed with reference mainly to the circuit diagrams.

4.2 FUNCTIONAL DESCRIPTION

The radiotelephone equipment is a double-conversion receiver and a frequency-modulated transmitter for voice communications in the 160 MHz marine VHF band. It transmits and receives on channels allocated for this service. These may be either single-frequency (simplex) or two-frequency (duplex) channels. The transition from receive to transmit is controlled from the pressel switch of the handset.

The frequency control of the set is achieved by a frequency synthesizer or optional crystals, one quartz crystal per private channel, through a synthesizer type, phase-locked generator.

Another characteristic of the set is the ability to scan channel 16 while the set is tuned to any one of the channels available, and under these conditions lock the receiver to channel 16 when a transmission is received.

Refer to the block diagram 4.1 (SEMI-DUPLEX), which describe the functional blocks of the radiotelephone. The blocks are mainly housed on eight separate printed circuit boards. see fig. 4.0

On transmit, the microphone of the handset delivers audio signals to the microphone amplifier, which is followed by limiter and filters. The audio signals frequency-modulate two rf oscillators- one of these is in operation on simplex channels (10.7 MHz) while the other operates when a duplex channel has been selected, on 15.3 MHz.

The frequency-modulated rf signal of 10.7 MHz or 15.3 MHz is applied to the phase discriminator or the frequency generator. The second input to the phase discriminator is derived from the mixer and the mixer output frequency is exactly the same as the signal from the FM oscillator when phase lock had been obtained.

The phase discriminator controls and modulates the VCO, which is followed by an amplifier. The output rf signal is further amplified in the driver of the power amplifier and in the final power amplifier. A low-pass filter for attenuation of harmonic signals follows before the antenna relay switches the transmitter output (through the duplex filter when fitted) to the antenna.

On receive, the antenna connects via the duplex filter (when fitted) and duplex-semiplex switch to the rf amplifier, which is tuned to the reception bands for simplex and duplex by matched varicap diodes. The first mixer produces a difference frequency of 10.7 MHz - the channel oscillator (multiplied) frequency is F_{tx} + 10.7 MHz on simplex channels and F_{tx} + (10.7 + 4.6) MHz on duplex channels.

The 1st amplifier is followed by the 2nd mixer, which is fed by a 2nd oscillator signal of 10.245 MHz to obtain the 2nd IF on 455 KHz.

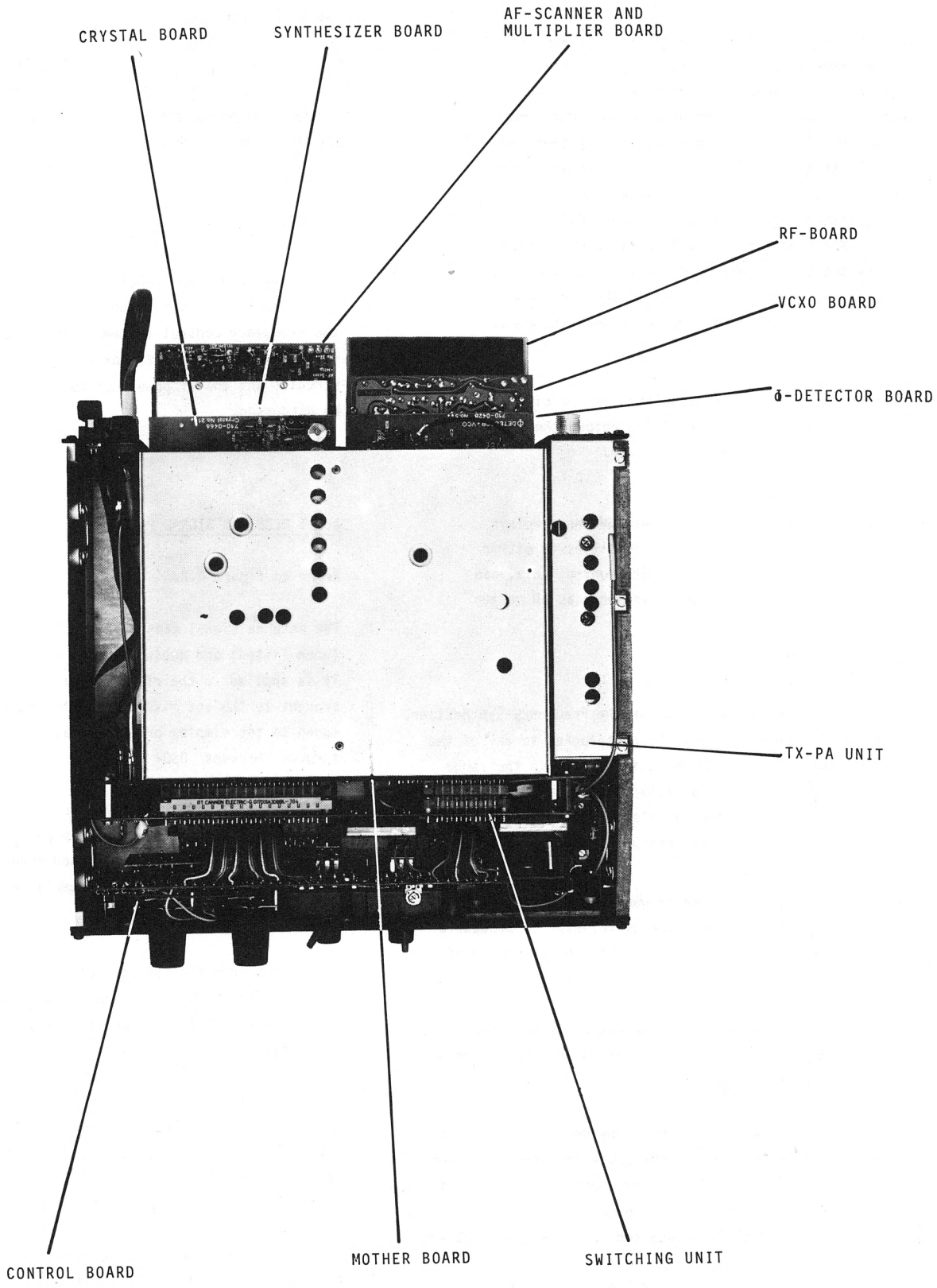
The 2nd IF amplifier with limiter circuits and detector, (discriminator) is in one IC unit.

The audio output from the detector is squelch controlled before being amplified in the audio amplifier which drives the internal loudspeaker (also handset receiver) and external speakers when fitted.

The system for frequency stabilization was partly described above in conjunction with the transmitter operation. Starting from the synthesizer, frequencies are selected to suit the requirements imposed by the receiver 1st mixer:
The 1st oscillator injection frequency is to be 10.7 MHz above the frequency received.

The frequency stabilization system utilizes the fact that the synthesizer output is 15.7 MHz above the transmitter on simplex and duplex channels.

FIG. 4.0 LOCATION OF PRINTED CIRCUIT BOARDS



The aux oscillator output (multiplied) is 10.7 MHz above the transmitter on simplex (one-frequency) channels, and 10.7 + 4.6 = 15.3 MHz above the transmitter on duplex (two frequency) channels.

When the output of the aux oscillator is applied to the mixer stage of the frequency generator, together with a sample of the transmitter VCO-controlled frequency, a difference of 10.7 MHz (simplex) or 15.3 MHz (duplex) is obtained. The synthesized channels give 15.3 MHz on simplex and duplex. This frequency is one of the input signals to the phase discriminator - the other one is the modulated 10.7 or 15.3 MHz signal from the FM oscillator. Differences between the two signals generate an error voltage, which causes the VCO to tune to another frequency and ultimately reduce the frequency error to zero, when phase lock occurs.

A search oscillator is incorporated in the circuit to serve as a coarse tuning device before the phase discriminator fine tuning takes over.

A switching unit, essentially contains three relays for distributing the control possibilities to either the main control unit or the remote control unit, can be installed inside the transceiver unit as an option.

4.2.1. Frequency Synthesizer

The analysis principle is used for the Frequency-Synthesizer. The Frequency-Synthesizer can be phaselocked to any of the 57 discrete frequencies (25 KHz spacing) within the range 171.325 to 172.725 MHz. Basically the Phase-frequency detector compares the phases of the signals derived from the VCO and the crystal controlled Reference-Oscillator.

The instantaneous difference between the phasing of the two voltages causes the phase-frequency detector to produce a voltage which controls the VCO so that the difference of frequencies of the two oscillators becomes zero.

In the simplified diagram synchronisation is possible for one frequency only. However, synchronisation is required on any of the 57 possible frequencies.

Before going into details it should be mentioned that the frequencies to be compared in the phase-frequency detector have to be transposed to 25 KHz. By means of a divider of fixed dividing ratio (n 256:1) the frequency of the reference-oscillator (6.400 MHz) is transposed to the required 25 KHz.

The frequency of the VCO is mixed with 169.175 MHz on simplex or 173.779 MHz on duplex and transmit, which is the 7th harmonic of the crystal controlled frequency of 24.167857 MHz (RX simpl.) or 24.825 MHz (RX dupl. and TX). By this means the VHF-range of the VCO is transposed into the HF-range of 2.450 to 1.050 MHz.

The mixer-stage is followed by a controllable frequency divider which is connected to the phase-frequency detector. The ratio of division of the controllable frequency divider is selectable from n = 98:1 to n = 42:1. This accomplishes the selection of any one of the 57 frequencies.

The selection of a channel (frequency) is accomplished by selection of the right ratio of division in the controllable frequency divider. Only seven wires are required to the control board to select any one of the 57 channels.

4.3 Radiotelephone Signal Flow.

The analysis of the signal flow will first cover the receive path, the transmit path and the frequency control system. Then in addition to these basic circuits, the channel scanning circuits and the rf power control circuits will be discussed.

4.3.1 RECEIVER SIGNAL PATH

Refer to figure 4.2.

The antenna signal passes the duplex filter (when fitted) and duplex-simplex switch before it is applied to the rf amplifier V301 and then brought to the 1st mixer V302 Both stages are tuned to the simplex or duplex frequency band through varicaps D301 to D304.

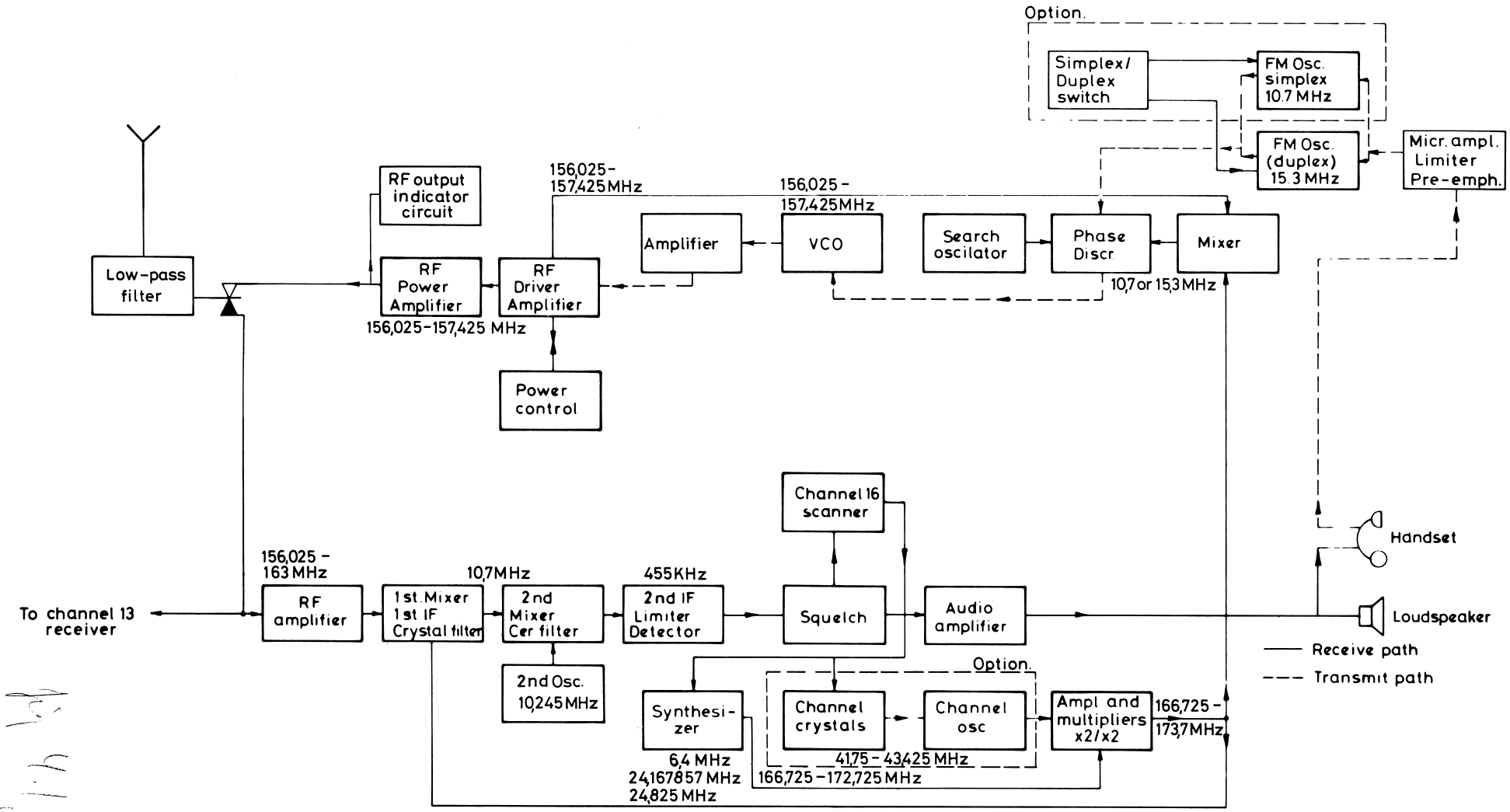
The first oscillator frequency is 10.7 MHz above the received signal and the 1st mixer produces a 1st IF of 10.7 MHz which is passed through a crystal filter (not shown) and amplified in cascade amplifier V303/V304.

The output from the cascade feeds the integrated circuit IC301 which at the same time serves as 2nd crystal-controlled oscillator and 2nd mixer. The frequency of the 2nd oscillator is 10.245 MHz and the 2nd IF is therefore 455 KHz, which is passed through a ceramic filter. The filtered signal is then applied to integrated circuit IC302, which operates as 2nd IF amplifier, limiter and FM discriminator. The recovered audio signals is available at the output of IC302.

The audio signals pass D216, a diode switch controlled from the squelch circuits V209, D214 and V210.

The audio signal is amplified in the integrated circuit amplifier IC201.

RF


Option.
Simplex/ Duplex switch
FM Osc. simplex 10.7 MHz
FM Osc. (duplex) 15.3 MHz
Micr. ampl. Limiter Pre-emph.
RF output indicator circuit
156,025 - 157,425 MHz
156,025 - 157,425 MHz
Amplifier
VCO
Search oscilator
Phase Discr
Mixer
Low-pass filter
RF Power Amplifier
RF Driver Amplifier
156,025-157,425 MHz
10,7 or 15,3 MHz
Power control
Channel 16 scanner
Handset
156,025 - 163 MHz
10,7 MHz
455 KHz
To channel 13 receiver
RF amplifier
1st. Mixer 1st IF Crystal filter
2nd Mixer Cer filter
2nd IF Limiter Detector
Squelch
Audio amplifier
Loudspeaker
Receive path
Transmit path
Option.
2nd Osc. 10,245 MHz
Synthesi-zer
Channel crystals
Channel osc
Ampl and multipliers x2/x2
166,725 - 173,7 MHz
6,4 MHz
24,167857 MHz
24,825 MHz
41,75 - 43,425 MHz
166,725 - 172,725 MHz

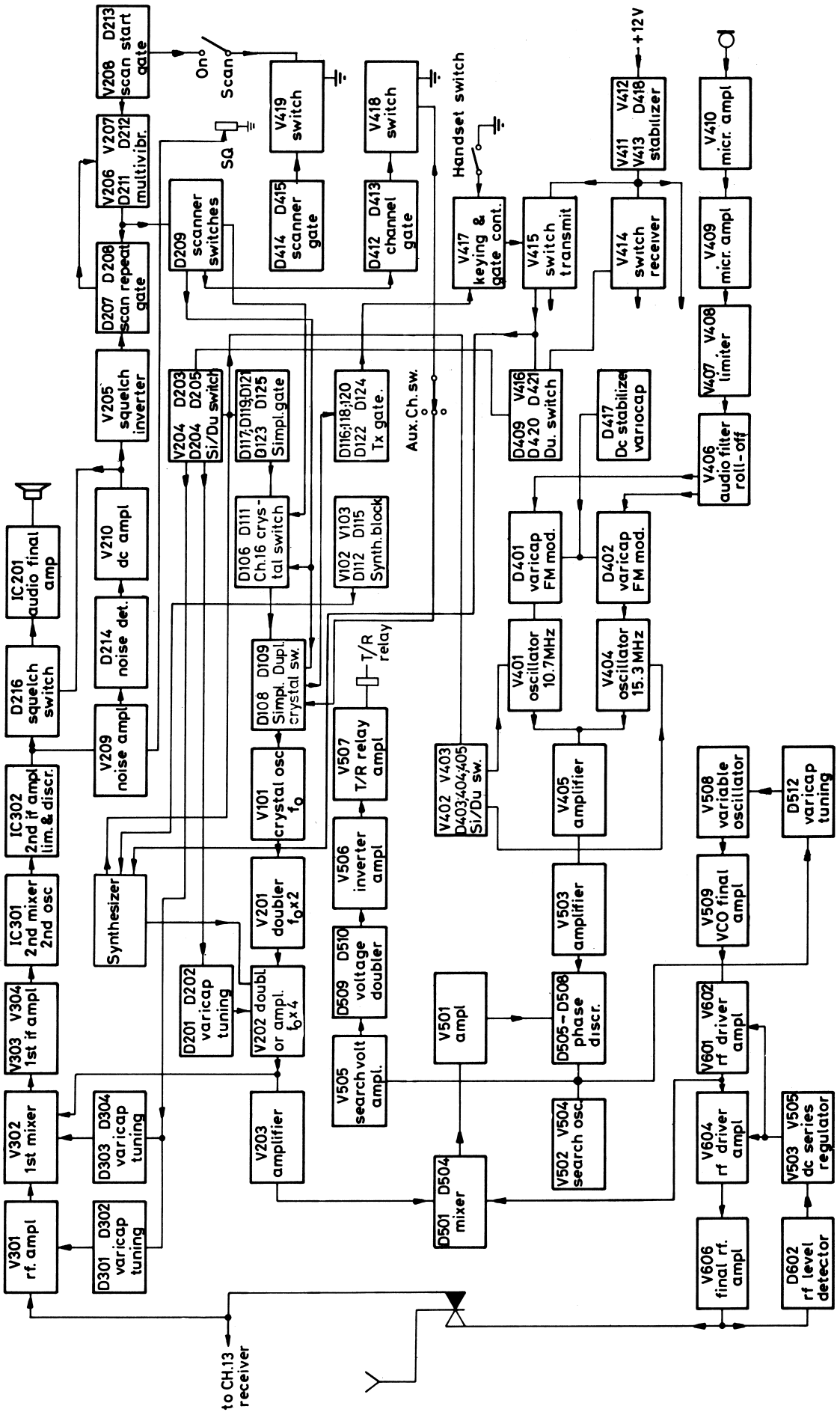


FIG. 4.2 SIGNAL FLOW DIAGRAM

4.3.2 TRANSMITTER SIGNAL PATH

Refer to figure 4.2 for the discussion below. The voice signals from the microphone are amplified in V410 and V409 and then limited in V408/407. Required audio filtering is carried out in the active filter V406.

Two outputs are arranged to the FM modulators D401 and D402 respectively. This first one is effective when the simplex/duplex switch (V402/403/D403/404/D405 has placed oscillator V401 in operation on one-frequency channels. For two-frequency (duplex) operation modulator varicap D402 frequency modulates the 15.3 MHz output from oscillator V404.

Phase discriminator D505-08 is provided with two inputs:

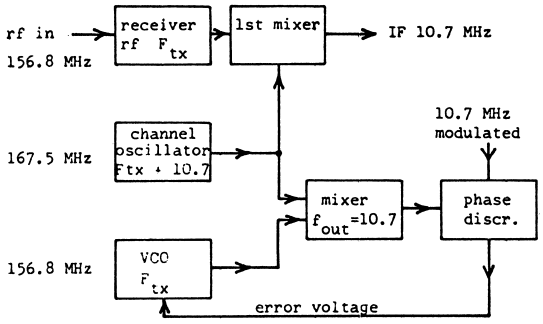
- from V503 FM signals centered at 10.7 MHz or 15.3 MHz,
- from V502, mixer D501-04 output which is the difference between V101 channel oscillator multiplied frequency and V508 transmitter variable oscillator frequency.

Conditions for frequency locking are satisfactory when both input terminals get the same frequency. The implication is that the phase discriminator then locks the frequency of variable oscillator V508 with varicap D512 and the modulation from V503 input is reproduced on the VCO signal.

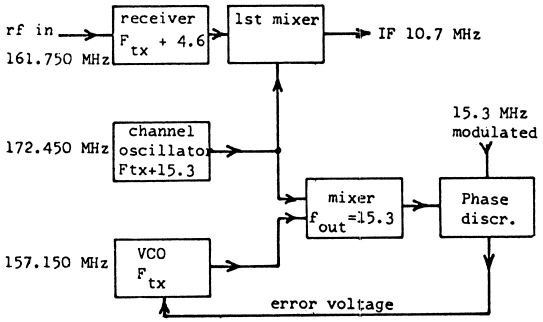
The VCO signal is amplified in V509 before being applied to the 1st rf driver V601, which is followed by 2nd RF driver V602, and the RF amplifiers V604/V606. The rf output passes a harmonic filter and reaches the antenna over closed contacts on the energized antenna relay. (Through the duplex filter when fitted).

4.3.3 FREQUENCY CONTROL SYSTEM

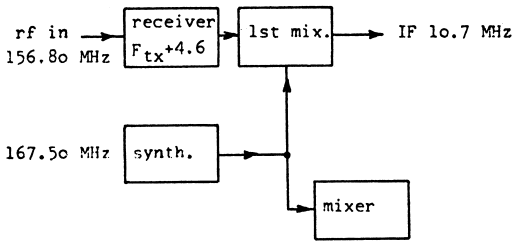
Refer to figure 4.2 and figure 4.3 for the discussion below.



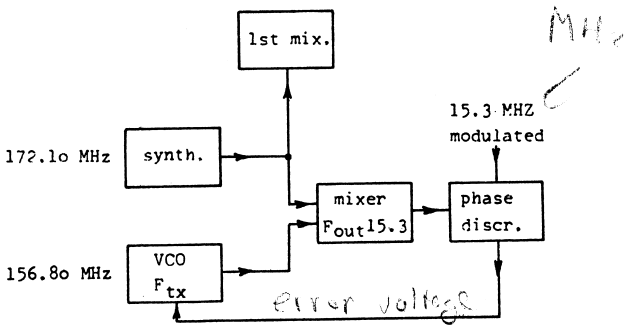
AUX SIMPLEX CHANNELS RX AND TX



AUX + SYNTH. DUPLEX CHANNELS RX AND TX



Rx SIMPLEX CHANNELS (SYNTH.)



Tx SIMPLEX CHANNELS (SYNTH.)

FIG. 4.3 FREQUENCY STABILIZATION

Aux. ch. crystal oscillator V101 is connected to either of the two sets of crystals over switch diodes D109 and D108 respectively. The individual quartz crystals in the two sets are selected via diode switching from the channel switch. When simplex channels are installed, the simplex gate is armed by connecting required number of diodes D117-119-121-123-125 The existence of a diode on a specific channel sets the simplex/duplex switches in simplex mode:

- V204/D203/204/205 - tunes the receiver rf stages V301, and 2nd doubler V202.

- V402/403/D403/405 select the duplex FM oscillator V404.

The aux oscillator output is doubled, then quadrupled by V201 and 202 in turn, and the multiplied signal applied to the first receiver mixer and the Tx mixer D501-D504.

The synthesizer output is applied to the first RCVR mix, and the Tx mix D501-504 after amplification by V202.

The transmitter employs a variable oscillator V508, the output of which is amplified in the driver and a sample of the frequency is brought to the mixer D501-504 The mixer thus receives the VCO frequency, and the shannel oscillator "frequency".

The phase discriminator D505-508 compares the frequency and phase of the frequency-modulated 10.7 or 15.3 MHz signal and the mixer difference frequency 10.7 or 15.3 MHz. An error voltage is generated as long as there is a frequency and phase defference. The error voltage is fed to the VCO to reduce the error, ultimately to zero, then the VCO is precisely 10.7 MHz (or 15.3 MHz on duplex channels) lower than the multiplied channel oscillator frequency, so the modulation frequency deviations have been simultaneously transferred to the VCO automatically.

A protective circuit prevents the radiaton of "non-lock" frequencies. Refer to figure 4.2 phase discriminator and search oscillator V502/V504. Prior to locking the frequency of the VCO, the search oscillator sweeps with a frequency of about 100 Hz. The sweep stops when phase lock is obtained. The sweep voltage at the discriminator output is sensed by amplifier V505, amplified and rectified in D509/D510. The rectified voltage makes V06 conduct heavily, which in fact implies that the antenna relay circuit through switch V507 is switched off. Because of this, transmission is not possible when the search oscillator is sweeping the VCO frequency - i.e. the VCO has not locked. Also the antenna relay does not connect the battery.

4.3.4 CHANNEL SCANNING

Refer to figures 4.2 and 4.4.

When the channel scanning facility is selected, the receiver automatically listens to the channel selected by the channel selector switch, for approximately 0.9 second, and then changes over to channel 16, the distress, safety and calling channel, for about 0.1 second. If a signal is present on channel 16, the receiver stays locked on this channel. If no signal is present on channel 16, the receiver reverts to the other selected channel, for another 0.9 second listening period and a repetition of the scan cycle.
Transistor V419 under normal conditions is conducting and when the function switch is set to scanning, the scanner start-gate V208/D213 changes to "0" (low voltage) from "1" (high voltage). This starts the multivibrator V206/207/D211/D212, which has two fractional periodes. During the first period, when the selected channel is received, the multivibrator output is "1", and scanner switch diode D209 is not conducting. Then the multivibrator switches and the output becomes "0", and the signal is in fact brought back to switch V418 which is cut off. The channel gate D412-413 input is also set to "0" to open transistor switch V418, and in this way disconnects the synthesizer or crystal selected.
At the same time channel 16 scanner control line gets "0" and the synthesizer or crystal changes to channels 16.
The scanner stops on the channel provided that a signal is received, i.e. the squelch is open. The output from the squelch is high ("1") then, and the high output from V205 blocks the scanner repeat gate D207/D208.

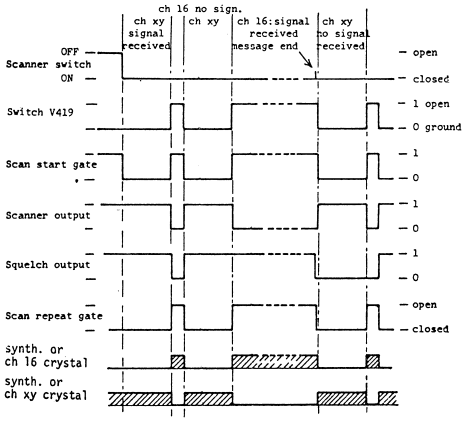


FIG. 4.4 SCANNER SYSTEM SIGNAL DIAGRAM

If no signal is received on channel 16, the reply from the squelch is "0". Because of this the repeat gate is opened. At the end of the last fractional period, the scanner output becomes "1" again, switch V419 closes to ground, and because the feedback via the repeat gate is closed, the cycle starts to repeat itself.

4.4 CIRCUIT DESCRIPTION

4.4.1 SYNTHESIZER BOARD UNIT 20

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-1

The synthesizer is a single phase-lock-loop type where the VCO consists of a field effect transistor (FET) V 01, tuned circuit components L 02, C 07, C 10, C 11 and the vari-cap diode D 02. For side step tunning of 4,6 MHz, the additional components C 12, C 16, C 17, and the PIN diode D 03 are used.

The output from the VCO is coupled through the capacitor C 03 to the output amplifier V 02. C 20 and L 26 are adjusted to provide the required inputs for the amplifier V 02 (biased through D 04, R 16 and the RF signal cable) on the AF scanner board and the two buffer stages formed by two dual gate transistors V 03 and V 04 in conjunction with the tuned circuit C 26 and L 07.

The mixer (V 05) inputs from VCO, V 04 and the 7th harmonic from the crystal oscillator V 10, (tuned by L 12 and C 56) result in a mixer output in the frequency range 1 to 2,5 MHz which is fed to a low pass amplifier chain consisting of the filter C 37, L 09, C 39 and the transistors V 06, V 07, and V 08. The basic signal is fed from V 08 collector to the monostable multivibrator IC 04 which provides the required input pulses for the variable divider IC 03 and IC 02 used in the up-counting mode over the selectable range n=42:1 to n=98:1 (controlled by the channel selector via pins 14, 15, 16, 18, 19, 20, and 21). See channel code on circuit diagram 10.1

The output from the variable divider (25KHz when the VCO is locked) is then compared with the 25KHz reference in the frequency phase detector IC 01. The 25KHz reference is generated by the 6,4 MHz crystal oscillator V 22, amplified by V 21 and divided by 256 to 25KHz by V 06 and V 25.

The advantage of using the phase-frequency detector is that it cannot go out of lock, because as soon as the incoming frequencies are different, the "0" output period from the detector (or "1", depending on wether the difference in frequency is postive or negative) increases until phase-lock is established again.

From the detector IC 01 the DC voltage is amplified and filtered in the loop amplifier consisting of C 20, V 19, R 70, C 68, and C 69. The remaining 25KHz in the output from the loop amplifier is filtered by a bridged T filter R 07, R 08, R 12, C 08, C 09, C 14, and C 15 before the DC is fed to VCO tuning diode D 02 via R 09. The tuning capacitors C 07 and C 11 are used for setting the simplex tuning range and the trimmer capacitor C 17 for setting the duplex and Tx range of the vari-cap D 02 which completes the synthesizer loop.

In order to keep the frequency of the synthesizer within the prescribed stability, the 7th harmonic of two crystals is used. One for simplex Y 02 (24,167857 MHz) and one for duplex Y 01 (24,825MHz). The diodes D 10 and D 09 handle the simplex-duplex crystal switching and together with the side-step tuning of the VCO, make it possible to operate the synthesizer in two bands of 58 channels each.

The control line pin 5, which is directly connected to the duplex diode D 09 via L 10, will on duplex have the state "0" potential and thereby the diode D 09 conducts and D 10 and V 09 are non-conducting. In state "1" the opposite happens V 09 and D 10 conduct while D 09 is non-conducting. An output is taken from the collector of V 09 to the side step tuning circuit. When the collector voltage is in state "1" the pin-diode D 03 is non-conducting, in which case the tuning capacitor C 17 is effective (in the duplex and Tx mode). When V 09 conducts D 03 also conducts and short-circuits the capacitors C 16 and C 17 (in the simplex mode).

When transmitting, V 18 conducts irrespective of the state of pin 5, due to the state "1" level on pin 9. When aux channels are being used the above function is inhibited due to the absence of the synthesizer +8,5 voltage which causes the inhibiting transistor V 17, to remain in a non-conducting state.

The synthesizer + 8.5 voltage is removed in the following manner when an aux. channel is selected. Pin 7 is supplied with a positive voltage from pin 8 on the crystal board, V 16 conducts and drives V 15 into saturation, V 14 cuts off and thereby switches off the +12V supply (pin 1) to the synthesizer voltage stabilizer.

The 5 volt stabilizer, IC 07 which supplies all integrated circuits is also used as a reference for the 8,5V stabilizer, consisting of series regulator V 13 with sense amplifier V 11 and amplifier V 12.

The output is normally +8,5V and can be accurately adjusted by selecting resistor R 50. Diode D 12 protects the stabilizer in the event of a short-circuit across the output. In this condition the diode conducts and cuts off the 5 volts bias reference for V 12. When V 12 is cut off, the implication is that V 13 is also switched off.

4.4.2 AF-SCANNER AND MULTIPLIER BOARD UNIT 22

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-2.

MULTIPLIER

The oscillator output from the crystal board Pin 4 is applied to Pin 3. The oscillator output is multiplied by two in the 1st multiplier V 01 and once more doubled in the 2nd multiplier V 02, while the output from the synthesizer board Pin 3 is applied to Pin 8 and amplified in V 02. This stage is tuned to the center of two bands, separated by 4.6 MHz, through matched varicaps D 01 and D 02. The frequency of the duplex channel band is higher, and therefore a large bias is applied to the varicaps on duplex V 04.

Trimmer potentiometer R 15 adjusts the increase of capacitance on simplex, by setting the lower voltage level associated with higher varicap capacitance. Transistor V 03 separates the outputs to the receiver and the transmitter.

CHANNEL SCANNING

The scanner is essentially a multivibrator with two fractional periods of 0.9 and 0.1 second duration, respectively. When the scanner is non-operative, the input to start gate D 13/V 08 on Pin 21 is at 1-state (high). Therefore, V 08 output is low and multivibrator transistor V 06 is permanently cut-off. The collector voltage of V 06 is at 1-state and the high voltage is coupled via diode D 08 to the base of V 07 to keep this transistor saturated.

The output from V 06 is connected to three diodes D 08 to D 10, which are wired to control switch V 04, channel 16 crystal and the squelch function.

Transistors V 18 and V 19, on the VCXO board fig 10.4, are normally saturated because the base bias is high. V 18 provides ground return for the channel selector switch and V 19 performs the same function for the scanning mode switch. The gate controlling the base bias for V 18 is wired to scanner output diode D-09, and 1-state from this will not affect switch V 18.

Closing the scanner switch places the base of V 08 at 0-state. The collector assumes 1-state and starts to charge C 20 - V 07 is still saturated. When the voltage across C 20 becomes high enough, V 06 is switched on. The scanner output from the collector V 06 falls to 0-state, this causes switch V 18 cut off and simultaneously transistor V 07 is switched off. The implication is:

- the channel selector is disabled because V 18 is cut-off,

- channel 16 control line - which is wired to diode D 10 - is placed on 0-state and the crystal is switched to the oscillator circuit.

When the receiver is tuned to receive channel 16, two distinct possibilities can occur:

1. No transmission is received. Under these circumstances the squelch control voltage is "0" and inverter amplifier V 05 output is "1". The high output is coupled by diode D 07 to the base of non-conducting multivibrator transistor V 07, which starts to pass current after a time set by capacitor C 19, and affects cut-off V 06 via C 20/ D 11. The multivibrator period therefore repeats itself. The 1-state output from the scanner makes switch V 18 close: the specific channel selected is again connected to the oscillator.

2. A channel 16 transmission is received. Now the squelch output is at 1-state and inverter V 05 output is "0", D 07 is non-conducting and the multivibrator stops on this state because the base of V 07 is kept at 0-state. The condition holds as long as a transmission is received on channel 16.

Under the conditions that a signal is received during the scanning period of the selected channel - i.e. inverter output is "0" - the cycle repeats normally as the output 1-state transfers to V 07 to saturate this transistor.

The circuit R 19/D 06/C 18 serves to operate the squelch for a short while when the scanner switches to channel 16, In the event that a transmission is received on the selected channel (not 16), the squelch 1-state builds up and is not immediately removed when channel 16 is scanned. This would cause a noise burst when channel 16 was unoccupied.

The capacitor is connected between two 1-states when the normal transmission is being received, and no charge is accumulated. The transistion to 0-state of the scanner output implies that the voltage at the junction D 06/ C 18 goes negative and temporarily removes the forward-biasing voltage of D 16 (D 06 conducts). Then C 18 charges and after a short while D 06 is cut-off and the squelch output resumes control of D 16 (reverse-biasing if no signal, otherwise forward biasing).

SQUELCH CIRCUIT

Capacitor C 21 essentially passes noise signal to amplifier V 09 which is provided with a tuned circuit L 06/C 23 in the collector. The voltage across the tuned circuit is rectified in D 14 and a positive voltage appears at the output, charging capacitor C 25.

Transistor V 10 is a pnp transistor whose base-emitter voltage - in the absence of noise - is determined by the voltage drop across trimmer potentiometer R 36. The voltage drop is caused by the current which always flows through transistor V 09. Because of this V 10 conducts under normal conditions, i.e. when a signal is received and its noise content is minute. Consequently the voltage across collector resistor

R 37 is high (1-state), and forward-biasing switch diode D 16, the cathode of which is at approximately + 3 V from the emitter follower output of IC-302. Audio signals are thus passed to the audio amplifier's.

When the amount of noise increases, due to a weak transmission or no signal being received, the positive output voltage from D 14 counteracts the negative base-emitter voltage of V 10, and finally affects a complete cut-off. This implies a low voltage across R 37 and D 16 becomes reserve-biased - no audio signals are passed to the audio amplifier. The squelch trip point is set by R 36 to a convenient level.

Means are provided to adjust the squelch function. Resistor R49 in series with the variable squelch adjusting resitor R50,bypassed with capacitor C46, is brought to pc board terminal 20, to where the squelch control via the dual watch switch is connected.

AUDIO POWER AMPLIFIER

The audio signals from the detector are brought to Pin 12 and pass the squelch diode switch D 16 (now assumed to be conducting) to blocking capacitor C 31, to telephone preset potentiometer R53. The OC-03 is a DC controlled attenuator controlled on Pin 2 connected to the volume control. Capacitor C 63 and R 62 provides the 6db/octave de-emphasize response.

The power amplifier is an intergrated circuit type with 7 W output into 2 ohms. The amplifier is boot strapped to allow ground reference for the loudspeaker.

To allow telephone audio level independent of the volume control an amplifier IC-02 is added controlled from R53. Normal setting of R53 gives 1 mW into the telephone.

4.4.3 RF BOARD UNIT 3

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-3.

The rf amplifier V 01 is a field-effect transistor with double-tuned circuits at the input and at the output. The tuned circuits are provided with trimmers for alignment. Tuning between the simplex channel and duplex channel bands is achieved through varicaps D 01 to D 04, which are matched as a quartet.

The varicaps are biased + 8 V on duplex channels via resistor R 08 and trimmer potentiometer R 01. On simplex terminal Pin 7 is closed to ground from the si/du switch (transistor V 04 on the AF-scanner board), reducing the bias to a value set by potentiometer R 01. Bias reduction is associated with an increase of capacitance, and the combination C 08 + D 01, therefore, tunes L 01 to a lower frequency (the differential variation is 4.6 MHz). The operation is similar on all four tuned circuits.
Field effect transistor V 02 operates as 1st mixer with signal input to the gate terminal and the 1st oscillator signal injected across the source resistor R 10. The tuned circuit at the drain terminal consists of coil L 05 and capacitors C 18/C 19. Capacitor C 19 matches to the 10.7 MHz crystal filter input.

The 1st amplifier employs cascade amplifier V 03/V 04 in the first stage. The collector circuit consists of coil L 07 and capacitors C 30 - C 31 to match the input to integrated circuit IC 01.

IC 01 operates as IF amplifier, 2nd oscillator and 2nd mixer. As an oscillator, the injection frequency is controlled by quartz crystal Y 01 with frequency adjusting trimmer capacitor C 05. 2nd IF frequency is 455 KHz and is taken from terminal 6 to L 14 which is a matching inductance to the 455 KHz ceramic filter.

The ceramic filter adds to the selectivity of the receiver and drives the 2nd IF amplifier, integrated circuit IC 02. This block simultaneously performs the task of a limiter and a frequency discriminator. The discriminator function requires external tuned circuit L 15/C 38, tuned to 455 KHz.

Audio output is taken from terminal 1 to Pin 9 via R 23. The IC circuit is actually an emmitter follower at the output, and because of this the dc potential is about + 3 V - this is of importance for the squelch function.

4.4.4 V.C.X.O. BOARD UNIT 4

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-4.

MICROPHONE AMPLIFIER

The input from the dynamic microphone arrives at Pin 4 and is coupled to amplifier V 10 via capacitor C 40. Output is taken at the collector and drives emitter follower V 09 with pre-set gain control R 42 at the output.

The signal from R 42 is applied to transistor V 08, amplified and then applied to the base of V 07. Transistors V 08 and V 07 operates as a limiter to prevent overmodulation. The bias of V 08 is set by R 37 and dc feedback, to obtain a symmetrical clipping of voice peaks.

Following V 07 is an active filter employing transistor V 06 to obtain a pre-emphasis of 6 dB/octave in the audio band, a 12 dB/octave attenuation above the audio band and splatter attenuation.

The output signal from V 06 is applied to potentiometers R 28 and R 29, which set the audio signal level to the FM modulators to obtain specified frequency deviation.

FREQUENCY MODULATORS

There are two almost identical modulators: one operating on 10.7 MHz transistor V 01, crystal Y 01 and varicap diode D 01, and another with transistor V 04, crystal Y 02 and varicap D 02, operating on 15.3 MHz. Only one modulator operates at a time and this is controlled from simplex/duplex information applied to gated transistors V 03 and V 02.

If the optional crystal board is installed , the following describes the operation of both oscillators (10,7 and 15,3) but when the transmitter is operating from the synthesizer (i.e. on a main channel) only the 15,3 MHz oscillator is used, the gate input being maintained in the 0-state for both simplex and duplex operation.

Starting with the switch the si/du information (from the selected channel) appears at the cathode of diode D 03. On simplex channels input is at 1-state, and V 03 is saturated. The output being low, implies that oscillator transistor V 04 is cut-off and simultaneously V 02 is cut-off. Accordingly the 10.7 MHz oscillator transistor V 01 is given a high bias and is operating. Conversely, on duplex the gate input is at 0-state, V 03 is non-conducting and oscillator V 04 (15.3 MHz) is in operation. The high bias drives V 02 into saturation and V 01 is cut-off.

The oscillator proper employs a tuned collector circuit with a capacitive voltage divider and a feed-back path to the emitter. In the feedback path the varicap and quartz are incorporated and variable inductances L 01 (L 04). Adjustments on L 01 (L 04) affect the center frequency of the oscillator, while manipulating L 02 (L 06) enables adjustment of the modulator linearity, to obtain minimum distortion.

The varicap diodes are dc biased from zener diode D 17 and audio signals are superimosed from the frequency deviation control potentiometers R 28 and R 29 of the microphone amplifier.

VOLTAGE STABILIZER AND CONTROL GATE SWITCHES

The voltage stabilizer consists of a series regulator V 11 with sense amplifier V 13, amplifier V 12 and reference zener diode D 18. The output voltage is nominally +8,5 V and can be accurately adjusted by selecting resistor R 61, Diode D 07 protects the stabilizer if a short-circuit occurs at the output.

In such an event the diode conducts and cuts off the bias of V 12. Then when V 12 is cut off, the implication is that V 11 is also switched off.

Transistor V 14 and V 15 operate as switches to make the output voltage available to receiver or transmitter circuits alternatively.

Switch V 15 is controlled from the handset pressel switch via transistor V 17 over gated input R 65 - R 66. Transistor V 17 is normally conducting because base bias is high from R 68. However, when transmission is to be prevented, the transistor can be set non-conducting by setting the base to the 0-state.

The collector of V 15 is high on transmit in simplex operation. This affects the base gate of transistor V 14 - base-emitter voltage goes towards 0 and receiver circuits are not supplied voltage via blocked transistor V 14. In duplex operation V 16 opens and both transmitter and receiver are supplied with 8,3 V.

When the pressel switch is opened, current through V 17, is cut-off and the collector goes towards +8 V. This cuts off V 15 and in turn causes V 17 to conduct.

Gated switch V 18 controls the grounding of the channel selected, the scanner takes control of V 18 which is held non-conducting during the time channel 16 is being scanned.

Gated switch V 19 is for control of the squelch, and scanning functions. All these functions are effective when their circuits are terminated to ground via common switch V 18. Diode D 19 blocks the squelch and scanner function during transmitting. The bias on transistor V 29 is then low and the transistor is then open.

4.4.5 δ-DETECTOR BOARD UNIT 5

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-5.

The two input signals to the phase discriminator across transformers L 01 and L 02 are either 10.7 MHz or 15.3 MHz. The signal from the FM oscillator/modulator is first amplified by V 03 before being applied to the discriminator. The other input signal is derived from the channel oscillator and the VCO-controlled transmitter signals. Mixer D 01-D 04 difference frequency output is amplified in V 01 and feeds the phase discriminator second input over L 02.

The output signal from the phase discriminator is an ac voltage unless both input frequencies are equal. The output then becomes a dc level and the phase and frequency control loop has closed. Now only phase differencies can occur. However, the discriminator is very sensitive to phase differencies - the output changing 1 V/radian - and therefore dc-coupled transistor V 02 is very accurately controlled.

The base network on V 02 provides a PIP-characteristic (Propertional-Integrating-Proportional), i.e. for dc and low frequencies, attenuation is constant and very low, for high frequencies the two resistors determine the attenuation and for frequencies in between an integrating characteristic is obtained. A similar network is part of the collector load and controls the VCO varicap diode. As a result of these networks, a frequency-dependent gain has been obtained, with a maximum at zero-frequency.

Now first assume that phase lock has been established. The dc amplifier V 02 is very heavily feedbacked because the loop gain is of the order of 135 dB for dc (and about 95 dB for 100 Hz signals). Therefore the equivalent collector impedance is very low and the collector voltage closely controlled from the base dc voltage. Any phase deviation changes the discriminator output and causes a VCO response in such a way that the deviation is entirely compensated. The amount of control is at a maximum under the locked condition because gain feedback is at maximum. When the loop has not closed, conditions are quite different. Transistor V 02 with V 04 forms a Wien bridge oscillator which oscillates with a frequency of about 100 Hz. This is due to the reduced or non-existant feedback in the control loop to the base of V 02, which cannot eliminate the oscillator loop gain of 10 to 15 dB. The 100 Hz oscillation is determined by the series-parellel RC networks C 07/R 21 - C 09/R 22, and the amplitude is sufficient to sweep the frequency of the VCO about 6-8 MHz. The beat frequency signal which results from the discriminator appears at the base of V 02, and high frequencies are considerably attenuated in the PIP network. Therefore the beat frequencies will appear as a superimposed ripple on the 100 Hz oscillation, with a level which is low on high frequencies and increasing when the beat frequency approaches zero.

Oscillations of the search oscillator will continue, because the negative feedback is not sufficient to stop the oscillator.

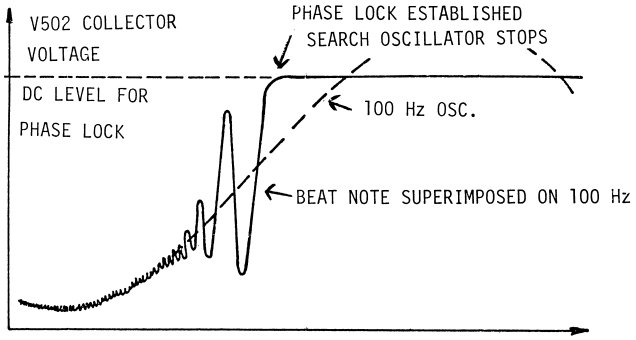


FIG 4.5 PHASE DISCRIMINATOR AND SEARCH OSCILLATOR SIGNALS

However, because the correct VCO frequency corresponds to a certain collector voltage, this voltage will be reached on ripple peaks before the 100 Hz wave itself attains that voltage, and the implications is that the range for catching control of the swept VCO becomes about 200 KHz. The beat note is reduced towards zero, and when zero the phase discriminator takes over and the associated negative feedback stops the oscillation of the search oscillator.

The VCO itself employs transistor V 08 in the oscillator circuit with coil L 05 and varicap diode D 12 for tuning. The PIP network R 29/C 18/R 37 forms the dynamic characteristics for control. The frequency of the the oscillator is the same as the transmitted frequency, and the frequency modulation from the 10.7 (or 15.3) MHz FM modulator is preserved via the phase discriminator and VCO control.

Therefore amplifier V 09 and subsequent amplifiers are straight amplifiers, because both frequency and modulation are as required when the signal leaves the vco.

The VCO is carefully screened to prevent undesired radiation. It must be provided with the screens on both sides of the printed circuit card for proper operation.

Transistors V 05, V 06, and V 07 form a guard circuit against non-locked frequency operation by the antenna relay. The coil of the relay is connected to the collector of V 07 and is closed to ground when the transistor conducts, which characterizes transmit conditions.

When a transmission is ordered (the pressel switch on the handset is closed), +8 V is applied to the circuit and a positive pulse is obtained over differenting network C 15/ R 31 to the base of V 06, turning the transistor on. Transistor V 07 base voltage is obtained from integrating network R 35/

C 17, and therefore V 06 is much faster - turned on V 06 takes the base of V 07 to ground giving a prolonged cut-off.

The initial pulse of V 06 will not last long, and V 06 then returns to the non-conducting state. The clamp of V 07 base bias is removed simultaneously, and V 07 conducts. Any charge which may remain in capacitor C 15 is discharged by regenerative diode D 11 when V 07 is saturated. Previosly, before V-507 saturates, C 15/R 32 had provided for a 50 ms delay of the antenna relay.

However, under the conditions that the search oscillator, oscillates a positive bias is delivered from V 05 over voltage doubler rectifier D 09/D 10 to transistor V 06. In this way the initial positive pulse is prolonged, until oscillations cease, and the antenna relay switch transistor V 07 is accordingly kept in its non-conducting state.

4.4.6 RF POWER AMPLIFIER UNIT 6

NOTE: All components numbers should be prefixed wi the above unit number.

Refer to circuit diagram and assembly draw 10-6.

The amplifier is a straight amplifier throughout with transitors V 01, V 02, and V 04 acting as drivers, while V 06 is the final amplifier. The resonant circuits are fitted with trimmer capacitors for tuning. The RF output from V 06 is passed through the antenna relay and a 3-section low-pass filter to efficiently attenuate harmonics from the amplifier. From the collector of V 02 a sample of RF signal is taken out and fed back to the mixer on the VCO board. Capacitor C 21 couples the RF signal to diode D 01 for peak rectification. The rectified output is a negative DC voltage, which is applied to the base of V 05 via the variable resistor R 16, V 05 is also connected to the +8 V, and consequently the base bias is made dependent on the rectified D.C. level, i.e. the RF power level. When Pin 6 is closed to ground, the relay 02 leaves R19 open,and V 05 controls the series transistor V 03, which provides the collector voltage for the two driver amplifiers V 01 and V 02. Pin 6 is connected to the high-low power switch and is grounded on low power, and open on high power.

R 16 is controlling the low power level by controlling the driver amplifier's collector voltage. The peak rectifier D 02 coupled to the collector circuit of V 06, together with zener diode D 03 forms a circuit to provide almost constant RF output level if the supply voltage is raised above normal level.

The transmit indicator is coupled to the input collector circuit of VOL through the capacitors C 58 and C 01. When RF is present, the output of rectifier D 01 is a positive DC voltage, which is applied to the base of V 01 whose turn on point is controlled by the variable resistor R 03. The DC voltage which activates the transmit lamp switch transistor is taken from terminal 10 on the RF power amplifier.

4.4.7 MOTHER BOARD UNIT 27

Refer to assembly drawing 10-7

The mother board provides the connections between the plug-in P.C. boards.
This board also provides two possibilities for connecting the external loudspeaker. By moving the wire going to socket for external speaker from terminal ~~Z18~~ Z19, where internal and external speakers are in parallel (when switching unit is installed) to terminal ~~Z19~~ Z18 where the output is constant i.e. independent of the position of the remote switch. In case the switching units are left out, the wire has to be connected to ~~Z19~~ Z18.

4.4.8 CONTROL BOARD UNIT 28

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-8.

The control board mainly houses all external controls like channel switches, volume controls, dimmer control, squelch ~~switch~~ control, dial lamp, and signal indicators.

~~The control lamp current passes through transistor V 02 which is biased via the variable dimmer potentiometer R 07, and consequently the light emission is controlled by R 07.~~ The built-in loudspeaker and the optional external loudspeaker audio level is controlled by volume control R ~~06~~ 24.

The dial lamp is controlled via the transistors V 01 from the channel selectors. The diodes D 03 and D 53 protect the set against (reversed polarised) supply voltage.

4.4.10 CRYSTAL BOARD UNIT 21 (OPTIONAL)

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-10.

The oscillator V01 operates with grounded collector, and a series resonant quartz crystal in a network from base to ground. Feedback from emitter to base is obtained via C15. The frequency of the quartz crystal in the base-to ground path can be pulled by trimmer capacitor adjustment, and an inductance coil (L01 or L02) in series provides compensation for the frequency offset, which is associated with the series capacitor. Oscillator output is taken from the emitter resistor ~~R24~~ R25 to 1st doubler V01, on the Af-scanner and multipliter board unit 2.

The transistors V 02 and V 03 form a DC switch for the supply voltage to the oscillator V 01. On AUX channels the grounding of Pin 10 is removed, and V 02 and V03 are conducting, and from Pin 8 a blocking voltage is applied to Pin 7 on the synthesizer board.

4.4.11 SWITCHING REGULATOR 24/32-13,6 V UNIT 11

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-11.

The highly efficient regulator reduces input supply voltages between 20 and 40 V to a regulated voltage of 13,8 V at the output terminals. Both input and output terminals are filtered for efficient suppression af radio frequency noise and the diode D 04 protects the regulator against wrong supply voltage polarity.

The switching regulator is self-oscillating at a frequency around 30 KHz mainly determined by the coil L 03 and the capacitor C 08

The output voltage is preset on R 10 and the capacitor C 06 serves to minimize output ripple by causing the full ripple to appear on the feedback terminal of the IC 01. The IC 01 controls the switching transistors V 01 and V 02 and during off periods the fast recovery diode D 01 allows the current to continue to flow in the coil L 03.

The transistors V 03 and V 04 together with the zener diodes D 02 and D 03 provide short circuit protection of the output terminals controlled from the voltage drop across sense resistor R 03. Diode D-05 is used to increase a too low short circuit current. It must be higher than 5 A.

4.4.12 SWITCHING UNIT 12 (OPTIONAL)

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-12.

The switching unit is mainly a P.C. board containing the relays R 01, R 02, and R 03, which switch-on 17 of the 37 wires going to the multiconnector Z05, for the remote control box (Z06), if the lever switch SW 03 on the transceiver control unit is in position "REMOTE". The rest of the wires (i.e. 17) going to the remote control unit, are connected in parallel with the wires going to the transceiver control unit. The remained ones of the wires are used for remote carrier indicator and remote loudspeaker, both for the channel 13 receiver. The diodes D 01 - D 07 together with the zener diode D 08, series resistor R 01 and de-coupling capacitor C 01 provide overvoltage protection for the seven synthesizer channel code lines.

The connectors Z01 and Z02 are plugged into the mother board connectors Z06 and Z09 respectively, corresponding to connection to the control board Z01,and Z02 is done by Z03 and Z04. The two single connectors Z06 and Z07 serve as input terminals for the channel 13 remote loudspeaker connector Z04 on the remote box.

When the connectors Z06 and Z07 are used,the two straps electically going from the Pins 16 and 15 (AUX crystal ~~contract~~ control lines for channel 2P and 3P) on Z01 have to be removed.

Otherwise, if the channel 13 option is not on, it enables the used one of the wire for connecting the last two auxiliary channels 2P and 3P on the remote box, by strapping the two points on the switching board. Then re-connect the blue/brown wire and the yellow/red wire to terminals 16 and 15 on Z01 (silk screened only) on the remote control board. Finally, move the stop screw of the front of the index of SW01 two steps clockwise. See par. 7.2.6 removal of control board, and 8.5 installing auxiliary channels.

4.4.13 REMOTE CONTROL UNIT 90 (OPTIONAL)

NOTE: All components numbers should be prefixed with the above unit number.

Refer to circuit diagram and assembly drawing 10-13.

The remote control unit contains a control board similar to the control board on the main set (see par. 4.4.8), but without the fuse F01, the supply switch, and "remote" position on mode switch. Additions are carrier indicator for channel 13 receiver, connectors for external loudspeaker, and remote loudspeaker for channel 13 receiver. The remote control unit is connected to the transceiver unit through a 37 cores screened cable (max 30 feet) fitted with the multiconnector Z06 for insertion to Z05 placed on the rear side of the transceiver unit.

NOTE: For installation of auxiliary channels see also par. 4.4.12 and par. 8.5.

Chapter 5

ROUTINE MAINTENANCE

5.1 GENERAL

This chapter contains information about service test equipment and routine maintenance procedures which can be carried out by anyone with a good general knowledge of radio equipment.

Should troubles occur which are outside the scope of this chapter, consult a qualified technician, familiar with VHF equipment and solid-state circuitry. He will be able to troubleshoot, repair and align the set with the aid of the following chapters of this manual.

Paragraph 5.9 describes the general procedures for performance tests. On-board tests cannot usually be carried out to the same extent as service lab. test, so the serviceman will have to use his experience to compensate for lack of available equipment e.g.

- testing modulation properties with voice and another station listening-in,
- evaluating receiver sensitivity from output noise level with open squelch.

NOTE

Following chapters are for service work:

TROUBLESHOOTING	- how to locate the fault,
REPAIR	- how to dismantle and reassemble internal assemblies,
ALIGNMENT	- how to restore the set to original performance.

5.2 PARTS REPLACEMENT

Common items listed in the parts list should be obtained locally or from a service agent. Special components used should be ordered from the manufacturer. Identify components by Part Numbers as given in the part list. When in doubt or when ordering parts which are not listed, order by complete description, model of equipment, serial number or date when unit was delivered.

5.3 TEST EQUIPMENT AND SPECIAL TOOLS

Following is a list of test equipment and special tools necessary for maintenance of the radio equipment.

Equivalent substitutes are acceptable.

NOTE

Item a. to c. contain the basic setup for maintenance in situ. The remaining items should be available at the workshop for maintenance procedures of a more comprehensive nature.

a. General purpose ac/dc testmeter sensivity 20K ohm/volt or better - METRIX MX 202 A.

b. RF directional wattmeter. BIRD Thruline model 43 with plug-in element 25 W. Also 40 dB directional coupler type 4274.

c. Frequency counter, minimum 200 MHz - ELDORADO model 1460.

d. RF vtvm for low level measurements - BOONTON ELECTRONICS model 91C or MARCONI TF2604 - complete with T-connector and 50 ohms termination.

e. VHF signal generator, covering 156-174 MHz, and in addition 10.7 MHz. Attenuator for 0.5 uV - MARCONI TF 995 B/S.

f. Audio signal generator, 600 ohms - HP 200 AB.

g. Dummy load, 50 ohms, 50 W BIRD model 80A or 8130.

h. Carrier deviation meter. MARCONI TF 791D or RADIOMETER AF M3.

i. Distortion meter - RADIOMETER BKF6 (see also J. below). This is also an audio mV and V-meter.

j. Audio mV-meter - RADIOMETER BKF6 or BRUEL & KJAER 2409.

k. Screwdriver for trimmers, insulated

5.4 TRANSISTORS AND INTEGRATED CIRCUITS

Be careful not to damage transistors and integrated circuits when testing or servicing. These components are easily damaged when electrodes are short-circuited by too heavy test prods. Another cause of damage is a potential between a soldering iron or test equipment and the equipment chassis.

Do not remove or replace components with power switched on. Always seek the real cause of a failure - it may not be the transistor itself.

Transistor and integrated circuit base configurations are given in figure 5.1 and table 5.1 lists semiconductors by type, case type (metal, plastic or ceramic) and the corresponding base view in figure 5.1.

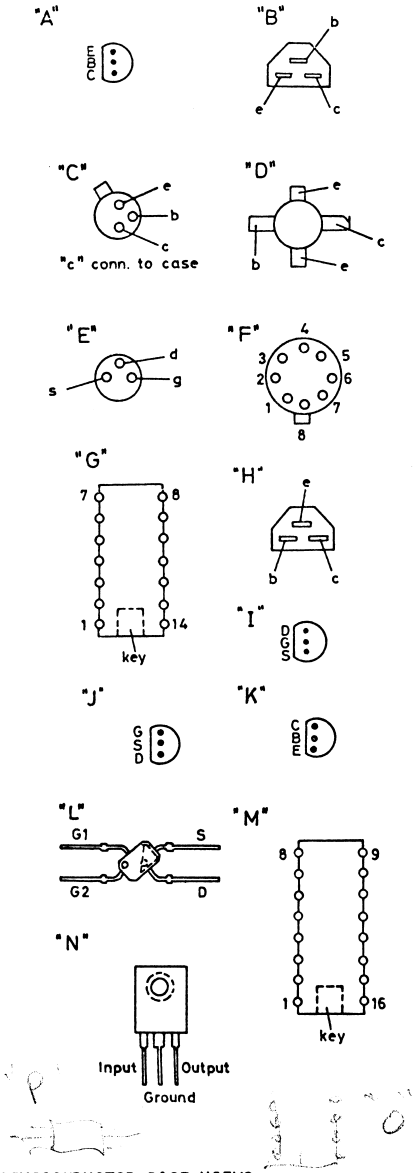


FIG 5.1 SEMICONDUCTOR BASE VIEWS

TABLE 5.1 SEMICONDUCTOR BASE CONFIGURATIONS

SEMICOND.	TYPE	BASE VIEW	CASE TYPE
BF-194	NPN	H	P
BF-197	NPN	H	P
BC-147B	NPN	B	P
BF-195	NPN	H	P
BC-337	NPN	A	P
BC-327	PNP	A	P
BF-256L/A	N-CHAN	I	P
2N2905A	PNP	C	M
2N4072	NPN	C	M
2N4427	NPN	C	M
U1837E	N-CHAN	E	P
BLY-87A	NPN	D	1/4" CAPSTAN
BLY-89A	NPN	D	1/4" CAPSTAN
TBA-641	IC	G	P
LM-3028A	IC	F	M
LM-2111	IC	G	P
LM-305A	IC	F	M
2N5089	NPN	K	P
2N5486	NPN	J	P
MFP132	N-CH-DUAL GATE	L	P
MPSA13	NPN DARLINGTON	K	P
MC7805	IC	N	P
MC4044	IC	G	P
SN74121	IC	G	P
SN7493	IC	G	P
SN74192	IC	M	P

5.5 EQUIPMENT REMOVAL

To remove a transceiver for servicing, two screws located on the front side of the wedge have to be unscrewed.
When unscrewed, swing-up the front of the set approx. 5 cm (2 in) and move it forwards, making it possible to remove the connections on the rear side of the set.

1. Unscrew the antenna.
2. Remove the plug from socket placed on the power cable.
3. Remove the 37 ways multiplug for the remote control.
4. Remove the plug for external loudspeaker.
5. Remove the plug for external ch 13 loudspeaker placed on the left side of the wedge.

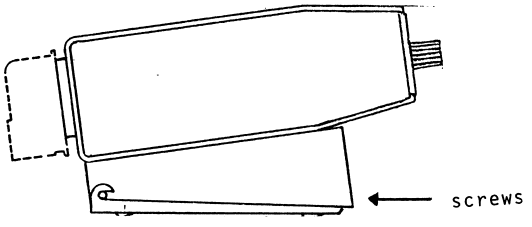


FIG 5.2 REMOVAL PROCEDURE

5.6 PREVENTIVE MAINTENANCE

Preventive maintenance of the radiotelephone should include the following items:

Batteries: replacement, charging, connections

Antenna: connections, wear, general condition

Radio set: mechanical wear, interior conditions

Bracket and options: wear, corrosion

BATTERIES

Check connections periodically to prevent deterioration of performance due to corrosion. Check the charging system to ensure that the battery voltage does not exceed 110% of the nominal voltage. Measure the voltage at the set with the engine racing. High line voltage can damage the set. Therefore adjust the charging system if required.

ANTENNA SYSTEM

Connections to antenna should be inspected periodically and at the same time the general condition of the antenna and the coaxial cable. Water or humidity which enters the cable (e.g. through leaks or damaged cable jacket) greatly increases RF losses and causes reduced performance.

RADIO SET

Rotary switches may require a small amount of grease when the detent mechanism feels dry. (Use grease sparingly). Do not let grease spread to near-by parts. Periodically check that no water has penetrated into the set.

5.7 FUSE REPLACEMENT

Two fuses are located on the rear panel as shown in fig. 5.3 below, and one fuse located on the rear side of the control board see fig 7-3 on page 7-2.

F-5001	Protects the set	8A Fuse
F-5002	Protects the battery	15A Fuse
F-801	Protects small signal circuit	1,6A Fuse

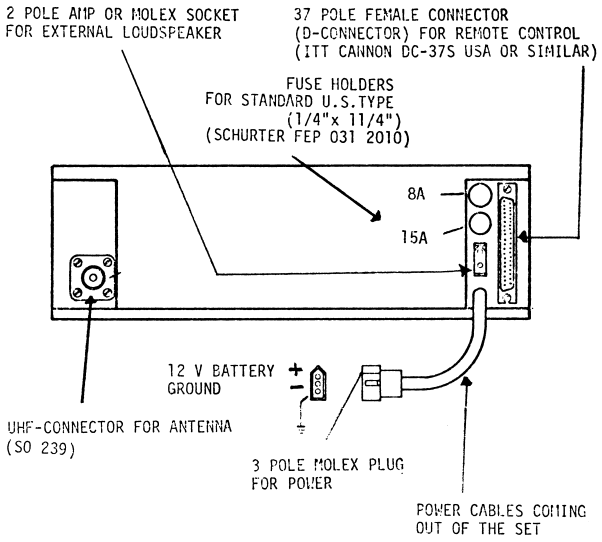


FIG 5.5 LOCATION OF FUSES

5.8 PERFORMANCE TEST

5.8.1 GENERAL

Following are procedures to check that the set is operating up to full specification.

Results may indicate that a problem exists - other than a complete failure - and which functional section of the set is involved.

Note if the problem relates to transmit only, receive only, or both. In order to Pin-point the faulty functional section.

5.8.2 TRANSMITTER POWER OUTPUT AND MODULATION TEST

a. Connect the set to a power supply.

b. Connect a 50 ohms load (antenna or dummy load) to the output, in series with a directional wattmeter. - A VHF absorption powermeter capable of handling at least 25 W.

c. Select a simplex channel and key the transmitter from the handset pressel switch. The output power should be 22-25 W.

d. Switch to low power: the output should be 1.0 W maximum.

e. Repeat tests c. and d. on a duplex channel.

f. Return to a simplex channel. Connect FM deviation meter to the transmitter output (via attenuator of 20-40 dB) and use a distortion meter to analyze the demodulated signal. Apply approx. 3 mV EMF, 1 kHz audio from the audio generator (Rg= 200 ohms) to microphone terminals in microtelephone.

Frequency deviation should amount to ± 3.0 KHz and distortion to not more than 5%.

NOTE

A simplified modulation test is to call a coast station and ask them to evaluate the modulation. Also when an FM deviation meter is available, talk into the microphone and evaluate the modulation performance: a "mean" deviation is 3.0 KHz and max. deviation on high voice levels of 5 KHz.

g. Repeat step f on a duplex channel.

5.8.3 CHANNEL FREQUENCY TESTS - TRANSMITTER

a. Connect the set to a power supply.

b. Couple the attenuated signal from the antenna terminal to a frequency counter capable of operation on 160 MHz.

c. Measure the frequency on all channels. The acceptable tolerance is +/- 5 x 10^{-6}, i.e. on 160 MHz +/-800 Hz.

It is imperative that the actual accuracy of the frequency counter is not less than 1 x 10^{-6}.

5.8.4 RECEIVER SENSITIVITY AND AUDIO OUTPUT TESTS

a. Connect the set to a power supply.

b. Connect a distortion meter across the loudspeaker and a VHF signal generator to the antenna connector. Be careful not to key the transmitter when the signal generator is connected. Adjust the generator to the channel frequency and modulate with 1000 Hz, deviation ± 3.0 KHz.

c. Check on simplex channels and on duplex channels. The sensitivity should not be less than 1.0 uV EMF for 12 dB sinad. The squelch should open for signals which are 1 to -2 dB below the above signal level.

d. Increase input to 1 mV EMF and keep same deviation. Turn the volume control to the position for maximum audio output. The voltage across the loudspeaker terminals should be 3.6 V. For the ~~24S-SU~~ 24SU version and 4.0 V for the 24S and 25S versions

Distortion should measure less than 10%.

5.8.5 RECEIVER CHANNEL SCANNER TESTS

a. Connect the set to a power supply.

b. Connect a VHF signal generator to the antenna connector. Be careful not to key the transmitter while the generator is connected. Adjust the generator to channel 16 - 156.8 MHz - and the output signal to 1.0 uV EMF.

c. Select a channel other than channel 16 on channel selector. Set dual watch switch in on position.

Check that locking occurs below 1 uV when the signal is increased from below squelch level.

Chapter 6
TROUBLE SHOOTING

6.1 GENERAL

The first step in troubleshooting a defective radio set is to isolate the fault to a particular section or assembley. The second step is to localize the fault or defective part responsible for the trouble. Some faults, such as burned-out resistors, arcing and short circuits may be found through visual inspection. However, the majority of problems will have to be located by logical troubleshooting procedures, including checking stage output and DC voltages.

D.C. voltages and significant signal levels are given in this chapter along with necessary set up procedures. Tests are arranged in logical sequence to facilitate effective troubleshooting. Both DC and AC levels may deviate to some extent from the nominal values given, especially if the power source has a voltage different from the nominal rated input voltage of the set. Some voltages are affected by control settings, and all voltages may vary by as much as the tolerance of the components in the circuit. These variations are to be expected and are of no major consequence.

Paragraph 6.3 provides a generalized troubleshooting procedure to help in locating the faulty functional section and in solving some simple problems.

6.2 PRECAUTIONS

Following are some general rules to observe in troubleshooting the set. Due to the wide use of transistors and printed circuit boards, it is suggested that these rules be observed closely to prevent damage and to aid in troubleshooting.

1. In solid state circuits, the resistances and impedances are generally of much lower values than in the tube type circuits. A discrepancy of a few ohms can affect performance. Also, transistors can be damaged by high current or high voltage ohmmeter circuits. Therefore, use only the low resistance ranges of the ohmmeter and use a meter with a sensitivity rating of 20kohm/volt or greater to make accurate measurements and to avoid damaging transistors or integrated circuits.

2. Transistors are best checked in the circuit, using AC and DC voltage indications for the troubleshooting. AC signal levels are given in the remaining paragraphs of this chapter together with test setup information. Be sure to check the emitter resistor voltage drop and the base bias. Change in transistor bias may be causing a problem if a resistor has been overheated gone open circuit, changed value, shorted.

3. A transistor can be checked out of the circuit with a sensitive ohmmeter as follows:

   To check a PNP transistor, connect the positive lead of the ohmmeter to the base of the transistor, connect the negative lead to the emitter and then to the collector. Generally a resistance reading of 50 kohm or more should be obtained in each case. Reconnect the meter with the negative lead to the base and the positive lead to the emitter. A resistance of 500 ohm or less should be obtained. When the positive lead is connected to the collector, a value of 500 ohms or less should likewise be obtained. With the positive lead on the collector and the negative lead on the emitter, the resistance should be high.

   Similar tests are made on an NPN transistor, and in that case should produce similar results with opposite polarity. With the negative lead on the emitter or collector, the resistance should be high. With the positive lead on the base and the negative lead on the emitter or collector, the resistance should be low. With the negative lead on the collector and the positive lead on the emitter, the resistance should be high.

NOTE

If a transistor is found defective, make certain that the circuit is in operating order before installing a replacement transistor. If the malfunction is not corrected, putting in another transistor will most likely result in burning out the new component. Do not depend upon fuses to protect transistors. Never remove or replace a semiconductor device with the voltage applied. Transients thus produced can damage them.

4. Do not use grounded test instruments with sets operated from positive ground systems, since a ground connection to a line can short the power source. If necessary, completely isolate the set from the ground before connecting test equipment.
5. Care must be exercised, when checking transistor circuits, not to short the leads to the case or surrounding circuits. It is usually convenient to use the lead of a resistor connected to a transistor element as a test point. This is preferable to trying to get at the transistor lead itself.
6. The radiotelephone was accurately aligned at the factory. Many of the adjustments are critical, and are not necessarily adjusted for maximum output indication. Some require special test equipment and test set-ups. Random adjustment of controls in "optimizing performance" should be avoided. Alignment should be performed only when necessary after repair or accidential disturbance and then only according to chapter 8.
7. The preferred power source for a DC power supply unit is a fully charged battery capable of the current drain required. Observe polarity when making the connection. If a battery eliminator is used in place of a battery, it must have no ripple, since the transistor circuits of the set operate directly from the source of power. Good voltage regulation is necessary. The power switch on the set should be turned off before the battery eliminator is turned on or off to prevent transient voltages from damaging transistors or capacitors which are sensitive to excess voltage.

NOTE

Be careful not to key the transmitter while a signal generator is connected to the antenna connector.

6.3 LOCATING THE FAULTY FUNCTIONAL SECTION

6.3.1 GENERAL

Following are two logical procedures for locating a fault. The procedure in section 6.3.2 will reduce the amount of work in finding the problem by leading to one particular circuit board or unit. The procedure in section 6.3.3 should reveal the faulty component on a circuit board or on a circuit unit.

NOTE

Before any faultfinding is carried out perform the test listed in par. 5.8. When a fault is observed remove the cover held by the four"Dzus" fasteners, located on the top of the set.

6.3.2 TROUBLESHOOTING PROCEDURE TO LOCATE FAULTY CIRCUIT BOARD

TRANSMITTER AND RECEIVER FAILS TO OPERATE

Check supply voltage, fuses (see Fig 5.3 for fuse locations), and the regulated output voltage from the switching regulator (used only when the set is operated from a 24 V battery). Normal output voltage is 13,6 V fully loaded and about 14,5 V when the set is switched off. Continue to check the antenna installation (i.e. cable and connectors, see Fig 2.2 for mounting instructions), duplex filter (when fitted) and voltage regulator. V out from the regulator 8,5 V is measured on Pin 1 on the crystal board. Measure the oscillator injection to the receiver and transmitter, normal output from the multiplier to the receiver is 350 mV measured with a RF V.T.V.M. on test point 2 on the RF unit, and normal output to the transmitter is 180 mV measured on Pin 14 on the ϕ - detector board. If no reading is obtained check the output from the synthesizer board or crystal board.

Normal output measured on Pin 3 on the synthesizer board is 500 mV and the output on Pin 4 on the crystal board is 70-90 mV. Check the handset cord and connectors. Broken strains could cause the same effect as a transmitter or receiver fault.

TRANSMITTER FAILS TO OPERATE

Connect a watt-meter to the antenna and set the power switch in position "high power". Switch-on the transmitter and measure the RF output power. Normal RF-power is 25-22 W from a simplex version and more than 17,5 W from a duplex version (Vbb=13,6 V). Switch to low power and check that the output power is less than 1 W. With normal output power continue to check the modulation system i.e. microphone, microphone-amplifier and VCXO. Check that the DC voltage on the VCXO board on test point 2 is 8,3 V. Connect a deviation meter to a attenuated RF signal outlet or the power meter. Remove the microphone capsule and connect an audio generator to the microphone input terminals, and switch-on the transmitter. 3 KHz deviation is a normal reading for 3mV audio input at 1kHz. The same deviation is obtained when the audio generator is con-

nected to the microphone connector. In order to measure the output from the microphone amplifier, remove the ϑ-detector board, switch-on the transmitter and check the output across R 28 on the VCXO board with a V.T.V.M. Normal reading is approx. 1,5 V when a 3 mV 1 KHz audio signal is applied to the microphone input terminals. Replace the ϑ-detedtor board and check the output from the VCXO with a VTVM on test point 3. Normal output is 40 mV. (Check both a simplex and a duplex channel).

When no RF output power is measured check the DC voltage on testpoint 2 on the VXCO board and Pin 16 on the ϑ-detector board. It should be 8,3 V. Continue to check the inputs to the ϑ-detector board, (with RF VTVM). Check the input from the VCXO on test point 2. The level is normally 1,5 V on both simplex and duplex channels.

The output from the synthesizer is amplified via the AF Scan board (Pin 8 in and Pin 15 out) while the AUX channel oscillator output is multiplied via the AF Scan board (Pin 3 in and Pin 15 out). These outputs can be measured across Pin 14/12 of the ϑ-detector board and are normally 90-120 mV.

The feedback from the RF amplifier is measured on Pins 17/18 and is normally 1 to 1,5 V (power switch in position high) Check output from the VCO on Pins 9/8. Normal output is o,7-1 V.

Check the voltages to the power amplifier (terminals on the mother board side of the multiconnector for the power ampl.). Switch on the transmitter: Pin 13 is normally 8,3 V
- 11 - - 13 V
- 2,3,4,5, and 7 are battery minus
- 8 and 9 are battery plus
- 6 low power (12 V)
- 12 PTT (0 V)
- 10 TX indicator (1,5 V)

NOTE

The antenna relay is switched on only when phase-lock is obtained. I.e. all inputs to the ϑ-detector unit must be present in order to switch on the last 2 stages in the RF amplifier.

RECEIVER FAILS TO OPERATE

Set squelch control in off position. (Volume control approx. 3/4 clockwise). When no noise is heard in the loudspeaker or telephone, check hte DC voltages and the audio amplifier.

On test point 3 on the AF-scanner and multiplier board, the DC voltage is normally 8,3 V and on Pin 12 the reading should be 12,5 V. Connect a VTVM across the loudspeaker and inject a 1kHz 140 mV signal from an audio generator via 0,1 µF capacitor to Pin 12 on the AF-scanner and multiplier board. The reading on the VTVM should be 4 V.

Check the oscillator injection on test point 2 on the RF board, normal reading is 350 mV. Inject a 10 mV RF signal modulated with 1kHz, 3 KHz deviation, to the antenna connector and measure the audio signal after the discriminator on Pin 9. Normal reading is 120 mV. Reduce the signal level and check the sensitivity, for 12 dB SINAD ratio measured across the loudspeaker. This should be around 1uV EMF. Check both duplex and simplex channels.

6.3.3. TROUBLESHOOTING PROCEDURE TO LOCATE FAULTY COMPONENT

SYNTHESIZER BOARD:

Check following DC voltages (AVO-meter):

		Simplex
V01	S	1,9
	G	0
	D	8,5
V02	E	1,4
	B	1,9
	C	7,5
V03	S	1,2
	G1	0
	G2	3,1
	D	6,7
V04	S	0,7
	G1	0
	G2	3,1
	D	8,2
V05	E	0
	B	0
	C	6,1
V07	E	1,6
	B	2,0
	C	3,1
V08	E	0
	B	0
	C	1,25

		Simplex	Duplex	Tx
V09	E	0	0	0
	B	0,7	0	0
	C	0,1	7,7	7,7
V10	E	1,8		
	B	2,45		
	C	8,2		
V11	E	4,55		
	B	5,2		
	C	8,5		
V12	E	4,55		
	B	5,1		
	C	12,5		
V13	E	13,1		
	B	12,5		
	C	8,5		
V14	E	13,4		
	B	13,3		
	C	12,5		
V16	E	0		
	B	0		
	C	13,1		

		Simplex	Duplex	Tx
V17	E	0,25		0,65
	B	0,8		1,25
	C	0,2		8,15
V18	E	0	0	0
	B	0,25	0,25	0,65
	C	13,2	0,1	0,08
V19	E	0,05 CH00-CH88		
	B	1,1-1,0		
	C	2,6-6,6		
V20	E	1,1-1,0		
	B	1,4-1,3		
	C	2,6-6,6		
V21	E	0		
	B	0,65		
	C	1,0		
V22	E	2,8		
	B	3,25		
	C	6,45		
IC7	E	5,1		
	C	0		
	B	10,6		

SYNTHESIZER TESTPOINTS

TP 1: 5 V DC ± 0,25 V
TP 2: 8,5 V DC ± 0,2 V
TP 3: 6,4 MHz , 3 Vpp
TP 4: 25 KHz , 3,5 Vpp
TP 5: Simplex: 0,15 V Duplex: 8,5 V
TP 6: Receive: 12,5 V Transmit: 0,1 V
TP 7: Approx. 1,1-1,6 V DC
TP 8: Approx. 24 MHz , 900 mV
TP 9: Simplex: approx. 167 MHz , 500-700 mV
Duplex : approx. 172 MHz , 500-700 mV
TP 10: Simplex: approx. 167 MHz , 200-300 mV
Duplex : approx. 172 MHz , 200-300 mV
TP 11: Ch.61: 2,4 MHz, 3 Vpp. Ch.87: 1,1 MHz, 4 Vpp
TP 12: Ch.61: 2,4 MHz, 3,5 Vpp. Ch87: 1,1 MHz, 3,5 Vpp
TP 13: 25 KHz , 4 Vpp
TP 14: Ch.61: 2,4 MHz, 0,3 Vpp. Ch.87: 1,1 MHz, 0,6 Vpp

AF-SCANNER AND MULTIPLIER BOARD:

Connect the board to the set via an extension board, turn channel selector to channel 16 and set Dual watch switch to off.

MULTIPLIER CIRCUIT:

Check the following DC voltages(AVO-meter):

	Synthesizer channels	AUX channels
Pin 1 supply voltage	8,5 V	
- 3	7,8 V	
V 01 base	0,0 V	1,4 V
V 01 emitter	0,0 V	0,7 V
V 01 collector	0,5 V	8,5 V
V 02 base	0,7 V	
V 02 emitter	1,1 V	
V 02 collector	8,5 V	
V 03 base	4,1 V	
V 03 emitter	3,4 V	
V 03 collector	8,4 V	
Pin 2	8,4 V	
Pin 2 (on duplex channels)	0,1 V	

SQUELCH CIRCUIT:

Check the following DC voltages:

V 09 base	2,3 V
V 09 emitter	1,7 V
V 09 collector	7,1 V
V 10 base	7,9 V
V 10 emitter	8,4 V
V 10 collector	0,45 V

Check the noise levels with an oscilloscope:

Pin 12	1,0 Vpp
Test point 5	2,5 Vpp

Set squelch switch in off position and check that the DC voltage on test point 4 is 8,4 V.

MULTIVIBRATOR CIRCUIT

Set dual watch switch in off position and check the following DC voltages:

Pin 21	1,2 V
V 08 base	0,7 V
V 08 emitter	0,0 V
V 08 collector	0,05 V
V 07 base	0,7 V
V 07 emitter	0,0 V
V 07 collector	0,2 V
V 06 base	0,0 V
V 06 emitter	0,0 V
V 06 collector	8,0 V
V 05 base	7,8 V
V 05 emitter	8,5 V
V 05 collector	8,4 V

Turn channel selector to any channel other than 16 and set dual watch switch in position on: Check with an oscilloscope that the multivibrator output is:

Test point 1 (9/10 of switching period)	6,2V
- - 1 (1/10 - - -)	0,2V

For further measurement see fig. 4.4.

AUDIO AMPLIFIER

Check the following DC voltages:

IC 01 Pin 1	12,70 V
- - - 2	7,16 V
- - - 3	0,57 V
- - - 4	0,00 V
- - - 5	0,50 V
- - - 6	0,03 V
- - - 7	0,00 V
- - - 8	0,00 V
- - - 9	0,00 V
- - - 10	0,00 V
- - - 11	0,00 V
- - - 12	6,30 V
- - - 13	0,00 V
- - - 14	12,80 V

See section 6.3.2 (Receiver fails to operate) for AC parameter check.

DC VOLUME CONTROL

IC-03	A	0,01 V
	B	6,20 V
	C	6,20 V
	D	0,00 V
	E	0,01 V
	F	7,15 V
	G	12,40 V
	H	0,01 V

TELEPHONE AMPLIFIER

~~K~~ IC 02	1	0,00 V
	2	4,80 V
	3	1,80 V
	4	12,40 V
	5	7,35 V
	6	8,10 V

RF BOARD

Connect the board to the set via an extension board, turn channel selector to a duplex channel. Check the following DC voltages:

V 01 gate	0,0 V
V 01 source	0,4 V
V 01 drain	8,4 V
V 02 gate	0,0 V
V 02 source	1,6 V
V 02 drain	8,4 V
V 03 base	5,7 V
V 03 emitter	4,5 V
V 03 collector	8,4 V
V 04 base	2,1 V
V 04 emitter	1,4 V
V 04 collector	4,5 V
IC 01 Pin 1	5,4 V
- - - 2	2,7 V
- - - 3	0,0 V
- - - 4	2,2 V
- - - 5	5,3 V
- - - 6	8,4 V
- - - 7	8,4 V
- - - 8	8,4 V
IC 02 Pin 1	4,2 V
- - - 2	3,3 V
- - - 3	0,0 V
- - - 4	1,3 V
- - - 5	1,3 V
- - - 6	1,3 V
- - - 7	0,0 V
- - - 8	0,0 V
- - - 9	0,2 V
- - - 10	1,4 V
- - - 11	2,7 V
- - - 12	3,3 V
- - - 13	8,3 V
- - - 14	4,9 V

Pin 7	8,4 V duplex channels
- 7	0,1 - simplex -

Check that the second oscillator output and frequency is:

Test point 3	10,245MHz±100Hz
- - -	= 700 mV

Connect a signal generator modulated with 1KHz, 3 KHz devation to the antenna connector and tune to the selected duplex channel. Set input RF level to 10mV and check the audio output:

Pin 9	≥ 120 mV

Reduce input level to 2o uV ½EMF and check the amplification.

Test point 4	≥ 80 mV

VCXO BOARD

Connect the board to the set via an extension board. Turn channel selector to channel 16 and set dual watch switch to off position. Check the following DC voltages:

VOLTAGE STABLIZER:

Pin 20	13,6 V
- 5	8,5 V
- 12	8,4 V
- 14	13,6 V
V 11 base	13,0 V
V 11 emitter	13,6 V
V 11 collector	8,5 V
V 12 base	5,9 V
V 12 emitter	5,3 V
V 12 collector	13,0 V
V 13 base	5,9 V
V 13 emitter	5,3 V
V 13 collector	8,5 V
V 14 base	7,7 V
V 14 emitter	8,5 V
V 14 collector	8,4 V

Switch on the transmitter and check the following DC voltages:

MICROPHONE AMPLIFIER:

V 06 base	4,3 V
V 06 emitter	3,1 V
V 06 collector	7,5 V
V 07 base	1,6 V
V 07 emitter	1,0 V
V 07 collector	3,6 V
V 08 base	1,0 V
V 08 emitter	0,7 V
V 08 collector	1,6 V
V 09 base	4,3 V
V 09 emitter	3,6 V
V 09 collector	7,5 V
V 10 base	1,0 V
V 10 emitter	0,4 V
V 10 collector	4,3 V

VCXO	Synthesizer and AUX. duplex	AUX Simplex
V 01 base	2,5 V	
V 01 emitter	1,9 V	
V 01 collector	8,3 V	
V 02 base	0,6 V	0,05 V
V 02 emitter	0,0 V	0,0 V
V 02 collector	0,0 V	2,5 V
V 03 base	0,7 V	0,6 V
V 03 emitter	0,0 V	0,0 V
V 03 collector	2,1 V	0,05 V
V 05 base	4,1 V	
V 05 emitter	3,3 V	
V 05 collector	8,3 V	
V 04 base	0,4 V	
V 04 emitter	0,0 V	
V 04 collector	8,3 V	

Check that the RF output from the VXCO is:

Test point 3	30-50mV duplex
- - -	- - - simplex

Check the microphone amplifier as per 6.3.2.

ð-DETECTOR

Turn channel selector to channel 16 and switch on the transmitter (high power). Check the following DC voltages.

V 01 base	3,4 V
V 01 emitter	2,7 V
V 01 collector	8,2 V
V 02 base	1,9 V
V 02 emitter	1,2 V
V 02 collector	4,3 V
V 03 base	3,7 V
V 03 emitter	2,9 V
V 03 collector	8,3 V
V 04 base	1,8 V
V 04 emitter	1,2 V
V 04 collector	8,3 V
V 05 base	4,3 V
V 05 emitter	3,7 V
V 05 collector	8,3 V
V 06 base	0,0 V
V 06 emitter	0,0 V
V 06 collector	0,8 V
V 07 base	0,8 V
V 07 emitter	0,0 V
V 07 collector	0,1 V
V 08 base	4,0 V
V 08 emitter	3,4 V
V 08 collector	8,2 V
V 09 base	1,6 V
V 09 emitter	0,9 V
V 09 collector	8,3 V

Test point 1 4,2 V

Remove channel crystal and check that the 100 Hz sweep frequency on test point 1 is 6Vpp. Reinsert crystal. Check the RF level with a RF VTVM.

Pin 14	120 mV
- 17	1,25 V
Test point 3	1,0 V
Pin 5	100 mV
Test point 2	1,4 V
Pin 9	1,6 V

TRANSMITTER POWER AMPLIFIER

Turn channel selector to channel 16 and set power switch in position high. Check the following DC voltages with a AVO-meter:

Pin 8/9	13,o V	(10,4 V low power)
- 13	8,3 V	(8,3 V - -)
- 11	13,0 V	(13,5 V - -)
- 6	12,0 V	(1,0 V - -)
V 03 base	11,1 V	(11,1 V - -)
V 03 emitter	11,9 V	(12,5 V - -)
V 03 collector	10,7 V	(2,0 V - -)
V 05 base	1,5 V	(1,0 V - -)
V 05 emitter	0,7 V	(0,4 V - -)
V 05 collector	7,8 V	(10,1 V - -)
V 01 base	0,6 V	(Tx on - -)
V 01 emitter	0,0 V	(- - - -)
V 01 collector	0,05 V	(- - - -)

Check the RF level with a RF VTVM

Pin 1	1,o V	(700 mV low power)
- 11	1,7 V	(550 mV - -)

CONTROL BOARD

With dual watch in "selected only" position.

Pin 4		on Z02 13,5 V
- 1 and 2		- Z02 13,5 V
- 3	12,9 V	- Z01 13,5 V

V 01 B	1,5 V	
V 01 E	0,7 V	
V 01 C	0,8 V	
V 03 B	13,3 V (12,0 V)	Transmitter switched on
V 03 E	13,5 V (12,7 V)	
V 03 C	0,0 V (13,2 V)	

AUX CRYSTAL BOARD:

Turn channel selector to one of the AUX positions and set dual watch switch in position CH 16 only. Check the following DC voltages (AVO-meter)·

Pin 1 supply votage	8,5 V
- 7 control line channel 16	0,3 V
All other control lines	approx. 8-10V
V 01 base	2,6 V
V 01 emitter	1,9 V
V 01 collector	8,5 V
V 02 emitter	8,5 V
V 02 base	7.8 V
V 02 collector	8,5 V
V 03 emitter	0,0 V
V 03 base	0,7 V
V 03 collector	0,03V

Check the oscillator RF output voltage at Pin 4.
Normal level: 70-90 mV.

SWITCHING REGULATOR

Switch on the transmitter on high power.
Check the following DC voltages (with an AVO-meter (voltage 24 V)

Output terminal 13,6 V (adjustable on R 1110)

V 01 base	14,9 V
V 01 emitter	14,2 V
V 01 collector	22,4 V
V 02 base	21,8 V
V 02 emitter	22,4 V
V 02 collector	14,9 V
IC 01 Pin 1	5,6 V
IC 01 - 2	21,8 V
IC 01 - 3	22,4 V
IC 01 - 4	0,0 V
IC 01 - 5	1,7 V
IC 01 - 6	1,7 V
IC 01 - 7	6,3 V
IC 01 - 8	5,4 V
V 03 base	22,3 V
V 03 emitter	22,4 V
V 03 collector	1,7 V

Check that the switching frecquency on an oscilloscope accros D 1101 is about 30 kHz.

Chapter 7
REPAIR

7.1 GENERAL

This chapter contains information on repair after the fault has been located. The first section contains some general information on repairing solid state equipment, and the remaining sections describe methods for removing, dismantling and replacing a particular assembly in the equipment.

Special handling of printed circuit boards and semiconductors is necessary to avoid damaging these parts. Use only a low-heat soldering iron when installing or removing soldered-in parts. When removing a part from a printed circuit board, first unbend the crimped leads. Use only the necessary amount of heat to unsolder the part. Clear excess solder from mounting eyelets, making sure that mounting holes are clear before installing the new part. When removing a transformer or other part having a several leads, straighten all leads first and then heat leads one at a time, working around the part, until the part can be gently rocked out. A solder sucker type of desoldering iron will greatly simplify removal of multiple lead components.

Note e.g. that a toothpick can be used to clear molten solder from holes.

When installing or removing a soldered-in semiconductor, grasp the lead, to which heat is being applied, between the solder joint and the semiconductor with long-nose pliers. This will dissipate some of the heat that would otherwise conduct into the semiconductor device from the soldering iron. Make certain that all wires soldered to semiconductor terminals have first been properly tinned so that the necessary connection can be made quickly. Excessive heat will permanently damage a semiconductor.

If the copper of the PC board is damaged, a piece of small buss wire can be used to bridge the gap. It is seldom necessary to replace a board because of a break in the copper.

Capacitors, resistors, and other two lead components can be replaced without removing the old leads, using the following procedure. This method is not as good as when removing old leads, but it can sometimes be used to advantage if access to the printed side of the boards is difficult.

a. Cut the component in half with diagonal cutter.

b. Crush the remains of the component, and break the pieces away from the leads. This will leave the maximum lead length remaining.

c. Bend the leads close to the board to form a terminal loop.

d. Connect the leads of the new component to the terminals formed by the old leads, and solder the connections. Be careful to trim the leads so they do not contact nearby leads.

7.2 ACESS TO ASSEMBLY

All Small signal units are placed on plug-in P.C. Boards. Only four "dzus" fasteners on the top cover panel have to be removed, and the cover can be lifted off.

All units are designed to prevent faulty insertion.

7.2.1 POWER TRANSISTOR REPLACEMENT

The power transistor can conveniently be removed without dismounting the printed circuit board.

This is actually an advantage since the power transistor can be remounted without first having to ensure that PC board alignment with the heat sink will not cause breakage of the board or transistor housing, when the transistor is bolted to the heat sink. At the end of the instructions, the procedure is outlined for the case where the printed circuit board has also been removed. (steps h. and i.).

a. Undo the screw which holds the power amp. to buttom cover and to the front plate, and move the power stage sideways for the multiconnector being let off.

b. Undo the six self-tapping screws along the side if the stage and likewise the six small self-tapping screws along the edge of the rear plate, hereafter the cover can be removed. See fig. 7.1.

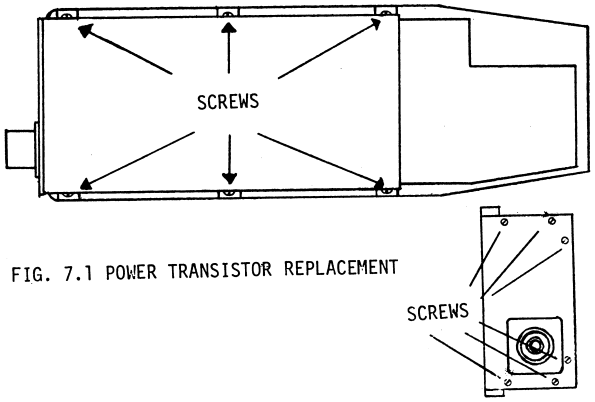


FIG. 7.1 POWER TRANSISTOR REPLACEMENT

c. Clamp the flat end of the bolt of the transistor with a pair of pliers to prevent the bolt turning when the nut is loosened. Remove the nut from the screw.

d. Melt the solder with a soldering iron at the transistor terminals and remove as much solder as possible with a solder sucker.

e. Heat again and insert a thin knife blade to lift the transistor terminals - one at a time - from the printed circuit board.

f. Remove the transistor when the four terminals have been unsoldered.

g. Install the new transistor, place the nut on the bolt and clamp the bolt to prevent it from turning when the nut is screwed tight.

h. Solder the transistor terminals to the printed board.

NOTE

The steps detailed below apply when the printed circuit board has been removed and new power transistors are to be installed. See fig. 7.2.

i. Installing the printed circuit board without power transistors. - Remove excess solder from the transistor contact areas before the PC board is installed.

j. Insert the transistor as described in step f. above and solder as in step g.

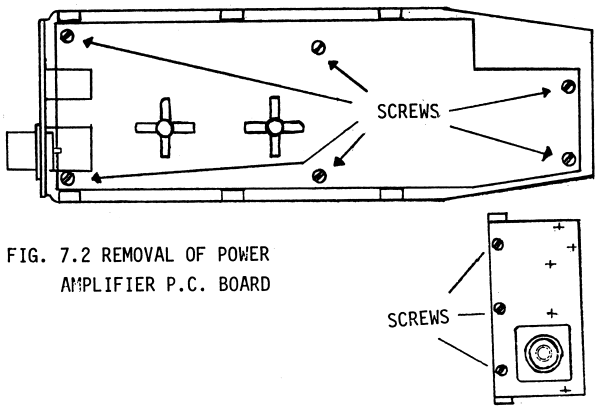


FIG. 7.2 REMOVAL OF POWER AMPLIFIER P.C. BOARD

7.2.3 DIAL LAMP AND SIGNAL LED REPLACEMENT

To replace the fial lamp and the signal LED's the top cover has to be removed. Four "dzus" fasteners secure the top cover. The lamp is accessible from the rear side of the front panel. See fig. 7.3. The lampholder is slottet into a flat pin contact.

The LED's replacement has to be done by unscrewing the four screws holding the front plate and disconnecting the two multiconnectors, hereafter cut the leads to the defect LED.

NOTE

Special care has to be taken, when the new divise is inserted. A pliers must be placed between the soldering point and the LED body to prevent heat from solder point going to the LED body.

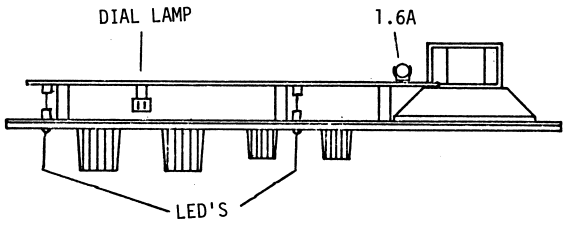


FIG. 7.3 DIAL LAMP AND SIGNAL LED REPLACEMENT

7.2.4 ANTENNA RELAY REPLACEMENT

The antenna relay is located onside the power amplifier stage. The relay is soldered into the printed board, therefore the power amplifier has to be removed. See par. 7.2.1 and 7.2.5.

7.2.5 REMOVAL OF TRANSMITTER POWER AMPLIFIER

The power amplifier P.C. board is mounted on the heatsink located on the right side of the main equipment in a vertical position. The amplifier is protected with a cover secured to the heatsink. To get access to the amplifier unscrew the four screws located on the bottom edge of the heatsink and the two screws on the front panel on the right side, and the amplifier can be taken out sideways. The unit is now connected to the equipment only through the three coaxial cables with plugs. Two of the sockets are placed on the power amplifier and one on the mother board. The cover can be removed when the screws described in par. 7.2.1.b. securing the cover are removed. See fig. 7.4.

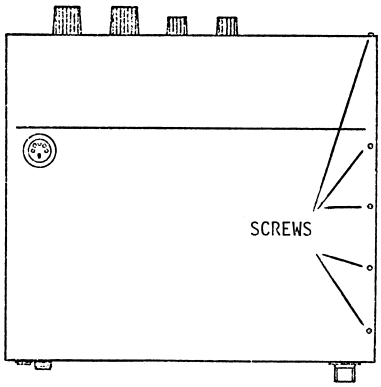


FIG. 7.4 RF POWER AMPLIFIER REMOVAL

7.2.6 REMOVAL OF CONTROL BOARD

The control board is secured to the front plate rear side by six screws, and to get access to the board the front plate must be removed. Release the four "dzus" fasteners and lift off the top cover. Unscrew the channel selector knobs, the squelch knob, the volume knob, and the four screws securing the front plate to power stage and left side cover, then the front plate is released. See fig. 7.4. The board is now connected to the equipment only through the flat cables to the 31 pole connector and 13 pole connector.

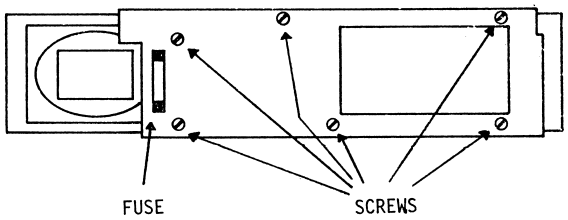


FIG. 7.5 CONTROL BOARD REMOVAL

7.2.7 REMOVAL OF SWITCHING UNIT

The switching unit consists of a plug-in P.C. board connected to mother board, and a flat cable connection to the 37 pole multisocket placed on the rear side of the set.

To get access to the board the front plate must be removed. See par. 7.2.6. Disconnect the two flat cable connections between the control board and the switching unit. By unscrewing the five screws, one in each corner and one in the center, the board can be removed. If replacing the switching unit, release the two screws securing the 37 pole connector,and slide it through the hole in the rear panel.

Chapter 8

ALIGNMENT

8.1 GENERAL

This chapter contains procedures for alignment of each sub-assembly. It also contains comprehensive instructions for installing new channel crystals.

The layout reflects the troubleshooting procedure: first alignments are described of assemblies or circuits used in both transmit and receive modes, then transmitter alignments are described and finally adjustments which relate to the receiver.

NOTE

Alignment should be done only when necessary, only for circuits necessary and only according to instructions. There are circuits which are adjusted for critical parameters and not merely maximum output.

When connecting grounded test equipment to the set, never operate a dc power system with a positive ground.

Alignment is possible only when an extension board is available.

8.2 CIRCUITS COMMON TO TRANSMITTER AND RECEIVER

8.2.1 GENERAL

The common circuits are the 24/32 V regulator, the voltage stabilizer, the duplex filter, the antenna relay, and the channel oscillator with doubler stages.

As a general rule for these tests, the basic test set-up should be arranged as follows:

a. Remove the cover from the equipment, but let the assemblies remain intact as far as possible.

b. Connect the set to a power supply with output voltage around 13,8 V or 24 V if the optional regulator is used.

c. Connect a 50 ohm dummy load 25 W to the antenna.

8.2.2 SWITCHING REGULATOR ALIGNMENT

a. Prepare connections as per 8.2.1 above.

b. Switch-on the transmitter and adjust the output voltage to 13,8 V with R 10.

c. Switch off the transmitter and observe the output voltage rises to less than 1 V.

8.2.3 VOLTAGE STABILIZER ALIGNMENT

VCXO

a. Prepare connections as per 8.2.1 above.

b. Remove the VCXO board and connect the board via the extension board.

c. Align the D.C. output voltage, as measured with a reliable D.C. voltmeter at pin 5 on the VCXO board to + 8,5 V $\pm$ 0,2 V, trying out different values of resistor R 61. Use pin 9 as ground terminal.

d. Switch off the set and replace the board.

8.2.4 MULTIPLIER ADJUSTMENTS, AF-SCANNER AND MULTIPLIER

a. Prepare connections as per 8.2.1 above.

b. Remove the AF-scanner board and connect it to the set via the extension board.

c. Connect a RF vtvm to the output from the doublers, using pins 15/16.

d. Select a duplex channel, preferably in the band centre (EG CH NO. 24), and align for maximum signal, on L 02, C 08, and C 13.

e. Switch to channels near the band limits (eg. CH NO. 1 and Wx 1), and readjust C-13 and possibly C 08 to obtain as flat a response as possible. Normal output on pins 13/14 is 350 to 500 mV, and on pins 17/16 150 to 200 mV.

CAUTION

The coupling between coils L 04 and L 05 has been adjusted at the factory using swept frequency technique. A displacement will affect the flatness and cause objectionable output variations.

f. Select a channel in the centre of the simplex band (EG CH NO. 11), and adjust potentiometer R 15 for maximum output.

g. Try other channels, at the band limits (EG CH NOS 6 and 16), and possibly re adjust R 15 for equal levels. The output signal is to be as in e. above.

h. When there is a marked difference in output levels between simplex and duplex channels, realign L 02 to reduce this difference.

i. Reinstall the AF-scanner board.

8.2.5 AUX CHANNEL OSCILLATOR FREQUENCY ALIGNMENTS

a. The frequency must be checked and adjusted, if required, after repairs which have affected the oscillator and 1st doubler circuits.

b. Prepare connections as per 8.2.1 above.

c. Installation of new channels - see chapter 8.5.

d. Connect a frequency counter to testpoint 2 on the RF board and read the multiplied frequency of the channel crystal selected (operate on receive).

NOTE

The frequency read on the counter is 10.700 MHz above the frequency of the assigned channel.

e. Align the frequency to the assigned frequency of the channel - with 10.700 MHz added - to better than ± 100 Hz with the trimmer capacitor of the crystal connected.

f. Check all channels installed, using the appropriate trimmer capacitor each time to align the oscillator frequency.

g. Connect a counter to Pin 4 on the crystal board. Select an AUX channel and insert a 33 ohm resistor in the socket corresponding to the selected channel and turn the trimmer capacitor to maximum capacitance.

Align the coil L02 for an oscillator frequency of 39.8 - 39.9 MHz. For duplex operation and coil L01 for an oscillator frequency of 38.8 - 38.9 MHz for simplex operation. Reinsert the crystal and check the frequency of each crystal as detailed above.

Note

If it is found that the range of one or several channel trimmers is inadequate, use group trimmer coils L01, L02 to centre the adjustment range.

After one of these coils has been adjusted with a view to centre the range, all channels belonging to the group must be realigned.

8.2.6 SYNTHESIZER ALIGNMENT

Note: All the following points must be carried out with the bottom covers of the four screened compartments securely soldered.

a. prepare connections as for 8.2.1 above

b. remove the AUX channel oscillator board, if installed, to give access to the synthesizer board below, for checking and aligning. The synthesizer board is completely screened with a metal box which divides the circuit into four individually screened compartments interconnected via feed-through Π filters. The top cover of the box may be unscrewed but is fitted with three holes as shown in Fig. 8.1 to permit adjustment (on receive) of the crystals and to allow to VCO to be checked on TP07 without the cover being removed.

c. Connect a frequency counter to testpoint 2 on the RF board and read the frequency of the channel selected. On receive, the frequency read on the counter is 10.700 MHz above the frequency of the asigned channel.

d. Check one channel in the middle of each band e.g. ch 14 (167.400 MHz) on simplex and ch 18 (172.200 MHz) on duplex.

e. Align the two frequencies to the assigned frequency to better than ± 100 Hz using the tuning capacitor C 50 for the simplex channel and tuning capacitor 49 for the duplex channel

f. Check two end range channel frequencies e.g. ch 02 and ch 28 and if the tolerance of ± 100 Hz results in more than 50 Hz deviation from each other, the 6,4 MHz crystal tunner C 81 must be aligned and this means removing the cover as described in "h".

g. The free runing frequencies can easily be checked by connecting the test point TP 7 to ground. TP 7 can be located through the hole in the top-cover shown in Fig. 8.1. On a simplex channel the frequency on the counter should be 168.650 MHz ± 100 KHz and on a duplex channel the frequency shall be 173.250 MHz ± 100 KHz. If one of the frequencies is out of range the top-cover has to be removed and the VCO trimmers readjusted as described in "h".

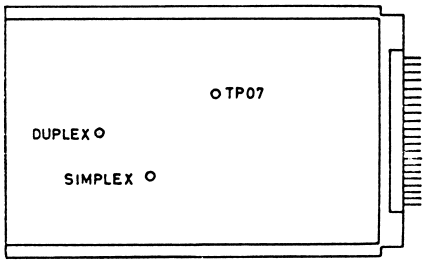


FIG. 8.1 SYNTHESIZER ALIGNMENT HOLES

h. Remove the synthesizer board and unscrew the 9 self-tapping screws and the 3 MG screw securing the top-cover.

i. Check that the +5 V i.c. stabilized voltage on TP 1 is is in the range +4,75 to +5,25 V, if not, check the +12 V on pin 1 or FL 18.

j. If required, align the DC output voltage at TP2 to +8.5V ±0.2V by trying different values of resistor R 50 (3.3 KΩ to 6.8 KΩ)

k. Connect a frequency counter to TP3 and adjust C 81 to 6,4 MHz ± 20 Hz. The 25 KHz output from the fixed divider remains on TP 4.

l. Connect a 22 KΩ resistor between TP7 and TP2, and a counter together with an RF VTVM to TP9. Select a simplex channel and adjust C 11 to 167,600 MHz ± 100 KHz. Adjust C 20 to give a max reading on the RF meter. The output on TP8 shall be 500-700 mV.

m. Align C 11 to 166,200 MHz ± 100 KHz.

n. With TP7 shortcircuited to the synthesizer chassis minus, adjust C 07 to 168,750 MHz ± .25 KHz.

o. Repeat points "m" and "n" until both frequencies are within the stated tolerences. (remember to remove the shortcircuit while carrying out point m).

p. Switch to a duplex channel and shortcircuit TP7 to minus, adjust C 17 to 173,350 MHz ± 25 KHz.

q. Remove the 22 KΩ resistor.

r. Select a simplex mid -range channel e.g. channel 17. Connect the RF VTVM to TP 14 and adjust C 26 to max. reading.

s. Switch to channel 28 duplex and adjust L 12 for max reading on TP 14 (typical 0,1-0,2 V)

t. Replace cover and check point "g." Connect the frequency counter to TP2 on the RF board and adjust C 50 on channel 14 to 167,400 MHz ± 100 Hz.

u. Select channel 18 (duplex) and adjust C 49 to 172,200 MHz ± 100 Hz.

Repeat points u and r until the above tolerence is achieved.

8.3 TRANSMITTER CIRCUIT ALIGNMENT

8.3.1 GENERAL

The circuits to be aligned in this transmitter are located on two plug-in PC boards (VCXO and ϕ - detector) and on the power amplifier screwed to the rear side of the main frame. For these operations the following basic connections are to be prepared:

a. Connect the set to a power supply with the nominal test voltage 13,8 V, for 24 V operations the test voltage is 24 V.

b. Connect a 50 Ohm load to the antenna connector with power meter and facilities to take out a sample of the RF power for analysis of frequency, deviation and distortion.

c. Operate the transmitter on high power, unless specified.

8.3.2 FM OSCILLATOR FREQUENCY ALIGNMENT, VCXO UNIT

a. Connect the set as described in 8.3.1.

b. Remove the VCXO board and connect it to the set via the extension board.

c. Shortcircuit the output of the VCO units using pins 9 and 8.

d. Connect a frequency counter to pins 17, 16. A vtvm should be connected to the same pins to measure the voltage level.

e. Switch on the equipment, select a simplex channel and set to transmit (pressel switch closed).

f. Align L 03 for maximum output signal.

g. Align the frequency of the oscillator to 10.7 MHz ± 10 Hz, through L 01.

h. Readjust L 03 and 01 again.

i. Switch to a duplex channel.

j. Align L 05 for maximum output signal.

k. Align the frequency of the oscillator to 15.3 MHz ± 10 Hz through L 04.

l. Readjust L 05 and L 04 again.

m. Switch off and remove the shortcircuit of the VCO terminals and the test connections.

8.3.3 PHASE DISCRIMINATOR/SEARCH OSCILLATOR ALIGNMENT, δ DETECTOR UNIT

a. Connect the set as described in 8.3.1.

b. Shortcircuit the output of the VCO unit, using pins 9 and 8.

c. Connect an oscilloscope to testpoint 1.

d. Switch on the transmitter and adjust trimmer potentiometer R 24 to maximum peak-to-peak reading on the oscilloscope, about 6 V pp.

e. Switch off the set and remove the shortcircuit from the VCO output terminals.

8.3.4 VCO ALIGNMENTS, δ DETECTOR UNIT

a. Connect the set as described in 8.3.1.

b. Connect a vtvm to the VCO output terminals, pins 9 and 8, and a dc voltmeter to test point 1 (or the oscilloscope as in 8.3.3 c, if dc-coupled).

c. Proper operation of the power amplifier drivers is required for this alignment. Therefore, with a power amplifier completely off-tune, reference is made to the next paragraph for initial setting of trimmers.

d. Select channel 16, 156,80 MHz.

e. Switch on the equipment and adjust the VCO frequency with L 05 to obtain phase lock, i.e. a steady dc voltage of + 4,2 V on testpoint 1.

f. Align L 06 for maximum output and realign L 05 if required.

g. Check on other channels that phase lock is maintained.

h. Switch off the equipment.

8.3.5 POWER AMPLIFIER ALIGNMENTS

NOTE

Alignments should be done only with the cover mounted in normal position.

a. Connect the set as described in 8.3.1.

b. Preset trimmer capacitors as shown in figure 8.2.A.

c. Set potentiometers R 16 fully counter clockwise and R 18 fully clockwise shown in figure 8.2.B.

d. Switch on the transmitter, using channel 16, 156,8 MHz.

e. Align all trimmer capacitors for maximum output power, starting with C 02, C 05, and C 08 etc.. Realign several times to eliminate mutual influence between amplifier stages. The output power should be 22-25 WATT on a simplex version and more than 17 W on a duplex version.
Check the output on the other channels

f. Return to channel 16, switch to low power and align R 16 to approx. 0,4 W output. For transmit indicator alignment turn R 03 until the transmit lamp just lights up, then align R 16 to a maximum of 1 W.

g. Switch to high power and turn R 18 until the output power is slightly affected. then turn the potentiometer back slightly so that the output power is not influenced at all.

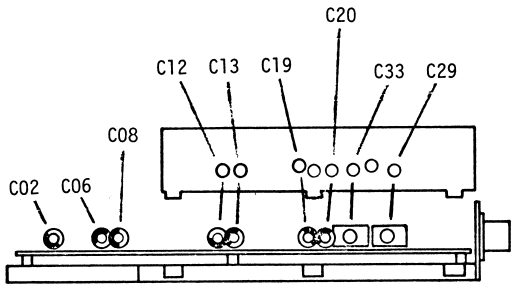


FIG. 8.2.A POWER AMPLIFIER TRIMMER POSITIONING

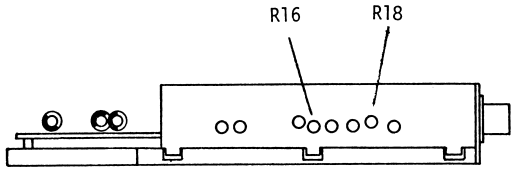


FIG. 8.2.B LOCATION OF TRIMMERS AND POTENTIOMETERS

8.3.6 MICROPHONE AMPLIFIER ALIGMENT, VCXO UNIT

a. Connect the set as described in 8.3.1.

b. Remove the VCXO board and connect it to the set via the extension board.

c. Disconnect the handset microphone capsule and connect an audio generator.

d. Connect an oscilloscope to testpoint 4.

e. Set audio generator to 1000 Hz and the output to about 5 mV rms.

f. Set Potentiometer R 42 fully clockwise.

g. Select channel 16 and switch on the transmitter.

h. Increase audio input till peak clipping is observed on the oscilloscope. Adjust the symmetry of the clipping with R 37.

i. Set the audio generator to 30 mV at the input terminals of the microphone amplifier and adjust the gain of the amplifier with potentiometer R 42 to just attain the clipping knee point. See fig. 8.2.

j. Switch off the transmitter.

k. Let the audio input remain for successive alignments of the modultator.

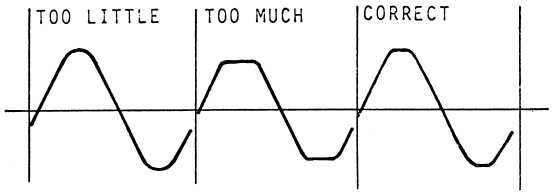


FIG 8.3 ADJUSTMENT FOR CORRECT CLIPPING

8.3.7 MODULATOR ALIGNMENTS, VCXO UNIT 4

a. Connect the set as described in 8.3.1.

b. Remove the VCXO board and connect it to the set via the extension board.

c. Disconnect the handset microphone capsule and connect the audio generator as in 8.3.6 step b.

d. Connect a frequency deviation meter to the attenuated rf signal outlet of the power meter, and a distortion meter to the demodulated signal outlet of the deviation meter.

e. Select channel 16 on the AUX-channel selector. This is done by setting the dial to one of the AUX-channels and placing the Dual Switch in position "CH 16 ONLY!"

f. The audio signal at the input is adjusted to 30 mV.

g. Set potentiometer R 29 for a deviation of ± 4.7 KHz and then decrease the audio signal to obtain ± 3 KHz deviation.

h. Check harmonic distortion and adjust L 02 for minimum distortion, below 5%.

i. Recheck maximum deviation (steps f. and g. and readjust if required. Finally check step h. again.

j. Select a synthesized channel, simplex or duplex.

k. Adjust audio input to 30 mV.

l. Adjust R 28 to a deviation of ± 4.7 KHz, and then decrease audio signal to obtain ± 3 KHz deviation.

m. Check harmonic distortion and adjust L 06 for minimum, better than 5%.

n. Recheck maximum deviation (steps k. and l.) and readjust if required. Finally check step m. again.

o. Switch off the transmitter, replace the handset microphone capsule.

p. Switch on and check that the peak deviation does not exceed 5 KHz on loud speech in the microphone and that the mean deviation is about 3 KHz on normal voice levels. Readjust gain potentiometer R 42 if required, to match the sensitivity of the microphone.

q. Check the frequency of the two FM oscillators as per para. 8.3.2.

IMPORTANT

Due to the method of frequency generation, it is imperative to check and realign the FM oscillator frequencies before the set is ready for operation on an antenna.

Note

This concludes the alignments of the transmitter. However, attention is drawn to the fact that the synthesizer channels and AUX-channels oscillator may also have to checked using the procedure given in para 8.2.5 and para 8.2.6.

8.4 RECEIVER ALIGNMENTS

8.4.1 GENERAL

The receiver circuits are located on two plug-in PC-boards and include RF unit, AF-scanner and multiplier unit. Operate the set normally with dual watch switched off.

NOTE

The signal voltages are given as open circuit (emf) voltages with generator internal resistance 50 ohm. The quivalent terminal voltage figure is half the emf figure (0.7 uV emf correspond to 0.35 uV terminal voltage).

a. Remove the cover from the equipment.

b. Connect the set to a power supply with the nominal test voltage 13,8 V.

For 24 V operation the voltage is 24 V.

8.4.2 AUDIO AMPLIFIER ALIGNMENT, AF-SCANNER AND MULTIPLIER

a. Connect the set as described in 8.4.1.

b. Remove the AS-scanner board and connect it to the set via the extension board.

c. Connect an audio generator via 0,1 uF to Pin 12, and an audio vtvm across the loudspeaker. Set the frequency to 1000 Hz.

d. Turn vol. control fully clockwise and preset potentiometer R 33 fully clockwise.

e. Switch on the receiver.

f. Increase the input signal to obtain 4 V rms output. The input signal should then be about 70 mV.

g. Check that clipping starts at about 4,1 V AC (with an oscilloscope connected across the loudspeaker when the input is increased).

h. Final adjustment of R 33 is made when the RF unit is aligned.

j. Connect the vtvm across the telephone capsule and increase the input level from the audio generator to 120 mV and adjust R 53 to 1 mW (0,63 V).

8.4.3 SQUELCH ALIGNMENT, AF-SCANNER AND MULTIPLIER

a. Connect the set as described in 8.4.1.

b. Remove the AF-scanner board and connect it to the set via the extension board.

c. Connect an audio generator via 0,1 F to pin 12 and set the frequency to about 6.5 KHz.

d. Set potentiometer R 36 midway.

e. Switch on the receiver with the squelch in operation (R 23 fully clockwise) and dual watch switch in position "SELECTED ONLY"

f. Connect an oscilloscope to test point 5 and inject 50 mV from the generator. Vary the frequency to find resonance (6-7 KHz).

g. Reduce input signal to zero and measure the testpoint 4 voltage - correct value is + 8 V.

h. Increase the signal injected till the testpoint 5 voltage drops to 0 V. The level should be 50 to 80 mV.

i. Final adjustment of R 36 is made when the rf circuits have been aligned, see para. 8.4.5.

j. Remove the connections to pin 12, after the power has been switched off.

8.4.4 RECEIVER IF ALIGNMENTS, RF UNIT

a. Connect the set as described in 8.4.1.

b. Remove the RF board and connect it to the set via the extension board.

c. Connect a counter to test point 3 via a resistor of 1K ohm and a blocking capacitor of 10 nF.

d. Switch on the receiver and adjust the frequency to 10.245 MHz ± 100 Hz with trimmer capacity C 05.

e. Connect a VTCM to test point 3 and measure the signal level, which should be minimum 700 mV.

f. Switch off the receiver and remove the counter from test point 3.

   Connect an oscilloscope to test point 4 to check the second IF to 455 KHz.

g. Switch on again and inject an unmodulated signal on the channel selected, to the antenna. Set the signal level to obivate clipping of the amplifiers.

h. Aligh L 07 for max. response on the oscilliscope.

i. Switch off the receiver and remove the oscilloscope from test point 4. Connect the oscilliscope to pin 9 and switch on again.

j. Modulate the signal (with 1 KHz) to a deviation of ± 3,0 KHz and view the result at the oscilloscope.

k. Align L 15 for max. response. The peak to peak value should be more than 340 mV. During this measurement the input signal frequency must be tuned to the nominal frequency ± 100 Hz.

l. Connect a distortionmeter across the loudspeaker and reduce the input signal until 12 dB SINAD is obtained, Align L 05, L 06 and L 14 for maximum sensitivity.

NOTE

This concludes alignments of the I.F. and discriminator circuits.

8.4.5 RECEIVER RF CIRCUIT ALIGNMENTS

a. Connect the set as described in 8.4.1.

b. Remove the RF board and connect it to the set via the extension board.

c. Select a duplex channels with dual watch switch in "SELECTED ONLY" position and tune the signal generator to the channel centre. Inject signal at the antenna input.

d. Connect a distortion meter over the loudspeaker for SINAD tests.

e. Switch on the receiver. Modulate the generator with 1000 Hz, deviation ± 3.0 KHz.

f. Align C 01, C 02, C 03, and C 04 for maximum sensitivity.

g. Check the sensitivity figure, which should be 0,7 emf for 12 dB SINAD.

h. Repeat checks at the band limits.

i. Switch to channel 16 simplex and adjust R 01 for maximum sensitivity in the band centre. Results should be commensurate with those from step g.

j. Repeat checks at the band limits.

k. Increase the input to about 3 u V emf. Set potentiometer R 50 midway. With the squelch control R 23 fully clockwise adjust the squelch potentiometer R 36 (placed on AF-scanner) just enough to keep the receiver muted.

l. Switch to position "DUAL". Decrease the input to about 1 u V emf and adjust the preset squelch potentiometer R 22 just enough to keep the receiver muted.

m. Switch off the signal generator and turn the squelch knob slowly anti-clockwise until receiver noise is just heard. Adjust the potentiometer R 50 placed on the AF-scanner to give the same squelch control knob "JUST MUTING" position (within a few degrees) when the dual watch switch is switched between position "DUAL" and position "SELECTED ONLY".

n. Increase the input 10 mV and switch off the modulation. Then the volume control fully clockwise. Adjust R 33 until the noise level across the loudspeaker is -40 db below 4 V rms. Switch on the modulation and check that the volume across the loudspeaker is more than 4 V.

8.5 INSTALLING AUXILIARY CHANNELS

8.5.1. GENERAL

Specification of quartz crystals for the AUX channel oscillator is given in chapter 9. The specification lists two categories of temperature range, to suit U.S. and European requirements.

The frequency of the crystal is calculated from para 8.5.2 and the procedure for installation given in para 8.5.3.

NOTE

If switching unit is installed, see par. 4.4.12.

8.5.2 FREQUENCY CALCULATION

The frequency of the quartz crystal is given by the following formula

$$f_x = \frac{fRx + 10,7}{4}$$

8.5.3 DIODE CONNECTIONS FOR AUXILIARY CHANNELS

Up to 5 aux. channels can be installed in one of the following three modes:

1. Simplex (International, US and private frequency range)
2. Semiduplex (International, US and private frequency range)
3. Duplex (International and US frequency range with duplex filter fitted).

Referring to the crystal board layout diagram NO. 10.10 NOTE that crystal NO. 6 in the furthest right hand socket is for channel 16 operation, and should not be altered or confused with the remaining five Aux. crystal positions, numbered 1 to 5 from right to left, and corresponding to five successive clockwise steps beyond the "8" of the left hand channel selector (independent of the right hand channel selector position).

Diode Pair D05 and D25 determines the mode of the first aux. channel (crystal NO. 1)

" " D04 " D23 determines the mode of the 2nd Aux. channel (crystal NO. 2)

" " D03 " D21 determines the mode of the 3rd Aux. channel (crystal NO. 3)

" " D02 " D19 determines the mode of the 4th Aux. channel (crystal NO. 4)

" " D01 " D17 determines the mode of the 5th Aux. channel (crystal NO. 5)

The following rules should then be applied to obtain the required mode for each channel.

1. For simplex operation on any given channel, connect the appropriate diode pair to their respective holes marked "S" on crystal board diagram (upper diode connections always remain fixed).
2. For semiduplex operation on any channel, the first diode of the appropriate Aux. channel is connected to its "D" hole, and the second of the pair to its hole marked "SD" on the crystal board diagram.
3. For duplex operation on any channel, the first diode of the appropriate pair is connected to its "D" hole, as for semiduplex, while the second diode of the pair is removed from the board.

NOTE: Diodes D24, D22, D20, D18 and D16 prevent transmission on Aux. channels 1, 2, 3, 4 and 5 respectively, and should only remain fitted in positions where "RECEIVE ONLY" channels are required

After installing a new crystal carry out the alignment procedure as described in par. 8.2.5.

NOTE

This concludes the alignment on the set. Remove all test connections and restore the set for normal operation.

Chapter 9
PARTSLIST

NOTE: Please quote the part. no. when ordering any component.

9 Transceiver

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
unit 20	Synthesizer board				710-0467
- 32	AF-scan + multiplier				710-0957
- 03	RF-board				710-0981
- 04	VCXO-board				710-0982
- 05	ϕ-detector + VCO-board				710-0428
- 36	TX-PA				710-0956
- 37	Mother board				710-0958
- 38	Control board				710-0952
- 21	Crystal board				710-0466
- 11	Switching regulator	24/32 - 13,6 V			710-0962
- 38	Remote Control Board				710-0960
- 12	Switching unit				710-0953
	Microtelephone (if required)				710-0458
	Extension board				710-0434
	It is suggested that the above listed units and components are held in stock in larger service departments.				
	Front panel				763-1378
	Top cover				763-1384
C8001-C8002	Capacitor ceramic	1nF+80%-20% K2000 400 V	9/01299	FERROPERM	210-1062
C8003	" polyestor	0,1pF+20%-20% 250 V		PHILIPS	211-1105
	2 Short knobs 15 mm				132-2081
	2 Caps with spot				132-2082
	2 Standard knobs 21 mm				132-2078
	1 Figure dial left				132-1382
	1 Figure dial right				132-1383
	Loudspeaker plug			MOLEX	151-7074
	2 Terminals male	1190		MOLEX	151-7066
	" female	1189		MOLEX	151-7065
	Socket for battery			MOLEX	151-7068
	3 Terminals female	1189		MOLEX	151-7065
	" male	1190		MOLEX	151-7060
	Dzus spring	SB 4-2		FASTENERS	133-3051
	" stud.	AJ -50		"	133-5052
	Fuse holder		FEP 031-2010	SCHURTER	152-7054
	Fuse	1,63 A	480621	BUSSMANN	152-6079
	Fuse	8 A	480628	"	152-6076
	Fuse	15 A	480630	"	152-6077

Loudspeaker

SYNTHESIZER BOARD UNIT 20 — 710-0467

NOTE: When Quoting Prefix Component Nos with Unit 20 E.G. C01 = C2001.

DIAGRAM No.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
C 01-02	Capacitor Ceramic	100pF±2% 100V	2222/63858101	PHILIPS	210-1592
C 03	" "	1.8pF±0.25pF 100V	2222/63809188	"	210-1530
C 04	" "	100pF±2% 100V	2222/63858101	"	210-1592
C 05	" "	220pF±10% 100V	2222/63002221	"	210-1301
C 06	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 07	" " Trim	2.5-6pF 250V	7S-TRIKO 03	STETTNER	213-0011
C 08-09	" "	330pF±2% 100V	2222/63858331	PHILIPS	210-1598
C 10	" "	3.3pF±0.25pF 100V	2222/63209338	"	210-1333
C 11	" " Trim	2.5-6pF 250V	7S-TRIKO 03	STETTNER	213-0011
C 12	" "	3.9pF±0.25pF 63V	2222/63833398	PHILIPS	210-1555
C 13	" "	4.7nF-100-20% 40V	2222/62902472	"	210-1322
C 14-15	" "	330pF±2% 100V	2222/63858331	"	210-1598
C 16	" "	10pF±2% 63V	2222/63834109	"	210-1406
C 17	" " Trim	2.5-6pF 250V	7S-TRIKO 02	STETTNER	213-0002
C 18-19	" "	4.7nF+100-20% 40V	2222/62902472	PHILIPS	210-1322
C 20	" " Trim	2.5-6pF 250V	7S-TRIKO 02	STETTNER	213-0002
C 21	" "	220pF ±10% 100V	2222/63002221	PHILIPS	210-1301
C 22	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 23-24	" "	220pF±10% 100V	2222/63002221	"	210-1301
C 25	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 26	" " Trim	3.5-13pF 160V	7S-TRIKO 02	STETTNER	213-0017
C 27	" "	4.7nF+100-20% 40V	2222/62902472	PHILIPS	210-1322
C 28	" "	3.3pF±0.25pF 100V	2222/63209338	"	210-1333
C 29-30	" "	220pF±10% 100V	2222/63002221	"	210-1301
C 31	" "	4.7+100-20% 40V	2222/62902472	"	210-1322
C 32	" "	3.3pF±0.25pF 100V	2222/63209338	"	210-1333
C 33	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 34	" "	220pF±10% 100%	2222/63002221	"	210-1301
C 35	" "	33pF+_2% 100V	2222/63210339	"	210-1345
C 36	Not Used				
C 37	Capacitor Ceramic	39pF±2% 100V	2222/63210399	"	210-1346
C 38	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 39	" "	12pF±2% 100V	2222/63210129	"	210-1240
C 40	" "	1nF±10% 100V	2222/63002102	"	210-1309
C 41	" "	10nF+100-20% 40V	2222/62903103	"	210-1523
C 42	" "	150pF±2% 100V	2222/63258151	"	210-1394
C 43	" "	1nF±10% 100V	2222/63002102	"	210-1309
C 44	Capacitor Tantalum	1uF+50-20% 25V	25123	SEL-STC	214-0108
C 45	" Ceramic	1nF±10% 100V	2222/63002102	PHILIPS	210-1309
C 46	" "	10nF+100-20% 40V	2222/62902103	"	210-1323
C 47	" "	10nF+100-20% 40V	2222/62903103	"	210-1523
C 48	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 49-50	" " Trim	3.5-13pF 110V	7S-TRIKO 02	STETTNER	213-0017
C 51	" "	3.9pF±0.25pF 100V	2222/63209398	PHILIPS	210-1334
C 52	" "	47 pF±2% 100V	2222/63210479	"	210-1347

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
C 53	Capacitor Ceramic	10nF+100-20% 40V	2222/62903103	PHILIPS	210-1523
C 54	" "	22pF±2% 100V	2222/63210229	"	210-1343
C 55	" "	100pF±2% 100V	2222/63258101	"	210-1392
C 56	" "	5.6pF±0.25pF 63V	2222/63233568	"	210-1357
C 57	" "	4.7nF+100-20% 40V	2222/62902472	"	210-1322
C 58	" "	3.3pF±0.25pF 100V	2222/63209338	"	210-1333
C 59	" "	10nF+100-20% 40V	2222/62903103	"	210-1523
C 60	Capacitor Electrolytic	47uF+50-10% 16V	FRAKO EP	SIEMENS	212-0619
C 61-62	" Ceramic	10nF+100-20% 40V	2222/62902103	"	210-1323
C 63	" Tantalum	22uF±20% 16V	TAG. ISOL.	SEL-STC	214-0140
C 64	" "	1uF±20% 25V	TAG.	"	214-0108
C 65	" Polyester	15nF±20% 250V	2222/34244153	PHILIPS	211-1101
C 66	" Ceramic	10nF+100-20% 40V	2222/62903103	"	210-1523
C 67	" Tantalum	4.7uF+50-20% 20V	TAG.	SEL-STC	214-0122
C 68	" Styro	600pF±5% 30V	HS 7/A	SUFLEX	211-0721
C 69	" Tantalum	0.47uF+50-20% 25V	TAG.	SEL-STC	214-0105
C 70-71	" Ceramic	10nF+100-20% 40V	2222/62903103	PHILIPS	210-1523
C 72	" "	10nF+100-20% 40V	2222/62902103	PHILIPS	210-1323
C 73	Not Used				
C 74-76	" "	10nF+100-20% 40V	2222/62903103	"	210-1523
C 77	Capacitor Styro	600pF±5% 30V	HS7/A	SUFLEX	211-0721
C 78	" Ceramic	68pF±2% 63V	2222/63234689	PHILIPS	210-1370
C 79	" Styro	1nF±5% 30V	HS7/A	SUFLEX	211-0724
C 80	" Ceramic	33pF±2% 100V	2222/63210339	PHILIPS	210-1345
C 81	" " Trim	3.5-13pF 160V	7S-TRIKO 02	STETTNER	213-0017
C 82-84	" "	10nF+100-20% 40V	2222/62902103	PHILIPS	210-1323
C 85	" "	3.9pF±0.25pF 100V	2222/63257398	"	210-1375
L 01	Choke	1.5uH±10%	71,1/1.5 uH	JAHRE	222-3007
L 02	Coil				710-0472
L 03-05	Choke	1.5uH±10%	71,1/1.5uH	"	222-3007
L 06-08	"	0.15uH±10%	71,1/0.15uH	"	222-3004
L 09	"	22uH	1587	FERROPERM	222-3048
L 10-11	"	220uH	1582	"	222-3055
R 01	Resistor Carbon	180±5%, 0.25W	SBB 0207	BEYSCHLAG	201-8318
R 02	" "	100k ±5%, 0.25W	"	"	201-8610
R 03	" "	180 ±5%, 0.25W	"	"	201-8318
R 04	" "	4.7k ±5%, 0,25W	"	"	201-8447
R 05	" "	1.5k ±5%, 0,25W	"	"	201-8415
R 06	" "	220 ±5%, 0,25W	"	"	201-8322
R 07-08	" "	18k ±5%, 0.25W	"	"	201-8518
R 09	" "	33k ±5%, 0.25W	"	"	201-8533
R 10-11	" "	1.2k ±5%, 0.25W	"	"	201-8412
R 12	" "	10k ±5%, 0.25W	"	"	201-8510
R 13	" "	22k ±5%, 0.25W	"	"	201-8522
R 14	" "	150 ±5%, 0.25W	"	"	201-8315
R 15	" "	68 ±5%, 0.25W	"	"	201-8268
R 16	" "	1k ±5%, 0.25W	"	"	201-8410
R 17	" "	82k ±5%, 0.25W	"	"	201-8582
R 18	" "	100k ±5%, 0.25W	"	"	201-8610
R 19	" "	10 ±5%, 0.25W	"	"	201-8210

DIAGRAM NO.	DESCRIPTION	SPECIFICATION		MNF TYPE NO.	MNF	PART NO.
R 20	Resistor Carbon	47 ±5%,	0.25W	SSB 0207	BEYSCHLAG	201-8247
R 21	" "	220 ±5%,	0.25W	"	"	201-8322
R 22	" "	330 ±5%,	0.25W	"	"	201-8333
R 23	" "	100 ±5%	0.25W	"	"	201-8310
R 24	" "	82k ±5%,	0.25W	"	"	201-8582
R 25	" "	100k ±5%,	0.25W	"	"	201-8610
R 26	" "	1k ±5%,	0.25W	"	"	201-8410
R 27	" "	220 ±5%,	0.25W	"	"	201-8322
R 28	" "	100 ±5%,	0.25W	"	"	201-8310
R 29	" "	470 ±5%,	0.25W	"	"	201-8347
R 30	" "	10k ±5%,	0.25W	"	"	201-8510
R 31	" "	12k ±5%,	0.25W	"	"	201-8512
R 32	" "	220 ±5%,	0.25W	"	"	201-8322
R 33	" "	47k ±5%,	0.25W	"	"	201-8547
R 34	" "	2.2k ±5%,	0.25W	"	"	201-8422
R 35	" "	1.5k ±5%,	0.25W	"	"	201-8415
R 36	" "	220 ±5%,	0.25W	"	"	201-8322
R 37	" "	2.2k ±5%,	0.25W	"	"	201-8422
R 38	" "	10k ± 5%,	0.25W	"	"	201-8510
R 39	" "	68k ±5%,	0.25W	"	"	201-8568
R 40	" "	10k ±5%,	0.25W	"	"	201-8510
R 41	" "	47k ±5%,	0.25W	"	"	201-8547
R 42	" "	8.2k ±5%,	0.25W	"	"	201-8482
R 43-44	" "	150k ±5%,	0.25W	"	"	201-8615
R 45	" "	5.6k ±5%,	0.25W	"	"	201-8456
R 46	" "	15k ±5%,	0.25W	"	"	201-8515
R 47	" "	100 ±5%,	0.25W	"	"	201-8310
R 48	" "	1.2k ±5%,	0.25W	"	"	201-8412
R 49	" "	100 ±5%,	0.25W	"	"	201-8310
R 50	" "	4.7k ±5%,	0.25W	"	"	201-8447
R 51-52	" "	1.5k ±5%,	0.25W	"	"	201-8415
R 53	" "	3.3k ±5%,	0.25W	"	"	201-8433
R 54	" "	1.2k ±5%,	0.25W	"	"	201-8412
R 55	" "	470 ±5%,	0,25W	"	"	201-8347
R 56	" "	1k ±5%,	0.25W	"	"	201-8410
R 57	" "	8,2 ±5%	1/2 W	SBE 0414	"	200-5182
R 58	" "	1.2k ±5%,	0.25W	SSB 0207	"	201-8412
R 59	" "	8.2k ±5%,	0.25W	"	"	201-8482
R 60	" "	2.2k ±5%,	0.25W	"	"	201-8422
R 61	" "	8.2k ±5%	0.25W	"	"	201-8482
R 62	" "	15k ±5%,	0.25W	"	"	201-8515
R 63	" "	18k ±5%,	0.25W	"	"	201-8518
R 64	" "	15k ±5%,	0.25W	"	"	201-8515
R 65	" "	47k ±5%,	0.25W	"	"	201-8547
R 66	" "	2.2k ±5%,	0.25W	"	"	201-8422
R 67	" "	10k ±5%,	0.25W	"	"	201-8510
R 68	" "	47 ±5%,	0.25W	"	"	201-8247
R 69	" "	3.9k ±5%,	0.25W	"	"	201-8439
R 70	" "	2.7k ±5%,	0.25W	"	"	201-8427
R 71-72	" "	8.2k ±5%,	0.25W	"	"	201-8482

DIAGRAM NO.	DISCRIPTION	SPECIFICATION		MNF TYPE NO.	MNF	PART NO.
R 73-79	" "	4.7k ±5%,	0.2 W	CR 16	MINIWATT	201-9447
R 80	" "	3.3k ±5%,	0.25W	SSB 0207	BEYSCHLAG	201-8433
R 81	" "	390 ±5%,	0.25W	"	"	201-8339
R 82	" "	47k ±5%,	0.25W	"	"	201-8547
R 83	" "	68k ±5%,	0.25W	"	"	201-8568
R 84	Resistor Carbon	3.3k ±5%,	0.25W	SSB 0207	BEYSCHLAG	201-8433
R 85	" "	1k ±5%,	0.25W	"	"	201-8410
R 86-87	" "	27k ±5%,	0.25W	"	"	201-8527
D 01	Diode Hot Carrier			HP 5082-2800	HEWLETT-PACKARD	232-5001
D 02	" Varicap			BB 141	ITT	232-5000
D 03	" Silicon			PIN MPN 3401	MOTOROLA	232-2048
D 04-06	" "			IN 4148	SESCO	232-2005
D 07	" germanium			AA 143	"	232-3006
D 08	" silicon			IN 4148	"	232-2005
D 09-10	" "			BA 244	ITT/MINIWATT	232-2047
D 11	" "			IN 4148	SESCO	232-2005
D 12	" Germanium			AA 143	ITT	232-3006
D 13	" Silicon			IN 4148	SESCO	232-2005
D 14	" Zenner	7.5V,	430 mW	ZDP 7.5	ITT	232-1045
V 01	Transistor			2N 5089	MOTOROLA	240-0412
V 02	"			BF 197	PHILIPS	240-0537
V 03-04	"			MPF 132	MOTOROLA	240-0414
V 05-08	"			BF 197	PHILIPS	240-0537
V 09	"			BC 147B	"	240-0536
V 10	"			BF 197	PHILIPS	240-0537
V 11-12	"			BC 147B	"	240-0536
V 13-15	"			BC 327	"	240-0543
V 16-18	"			BC 147B	"	240-0536
V 19	"			MPS A13	MOTOROLA	240-0413
V 20	"			2N 5089	"	240-0412
V 21-22	"			BF 197	PHILIPS	240-0537
IC 01	IC Phase Detector			MC 4044P	MOTOROLA	261-2001
IC 02-03	Integrated Circuit			74192 N	TEX. I	261-1074
IC 04	" "			74121 N	TEX. I	261-1061
IC 05-06	" "			7493 N	TEX. I	261-1053
IC 07	IC Voltage Regulator	5V STAB.		MC 7805 CP	MOTOROLA	262-0022
FL 01-18	Ceramic II-Filter	2x1.5nF,	0.5uH	9/0168.5	FERROPERM	210-1803
	Ferrite Bead	4Bø3, 5x1, 3x3		4322-020-34220	PHILIPS	220-4077
Y 01	Crystal	24.825000 MHz			GROVEN	253-0006
Y 02	"	24.167857 MHz			"	253-0005
Y 03	"	6.400 MHz			"	253-0007
Z 01	Connector	21 Pole		G.17D21A4DEBL-704	CANNON	151-7704
	Coax Cable	50 ohm		50 SMDT		156-3006
	Bead				PHILIPS	220-4077
	Crystal holders			QS25GS	INOTEC	151-8030
Z 01	Connector			G6170D21A4DEBL-704	CANNON	151-7704

NOTE: When quoting Prefix Component Nos with Unit 22 E.G. C01 = C2201.

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART No.
C01	Capacitor ceramic	2,2nF±10% High-k 100 V	2222/63003222	PHILIPS	210-1513
C02	Not assigned				
C03	" "				
C04	Capacitor ceramic	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C05	Not assigned				
C06	Capacitor ceramic	1nF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C07	" "	2,7pF±0,25pF N150 250 V	9/0116,9	FERROPERM	210-1053
C08	" trimmer	2-6pF 250 V	10S-triko 06	STETTNER	213-0000
C09	" ceramic	3,9pF±0,25pF N150 63 V	2222/63833398	PHILIPS	210-1555
C10	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C11	Capacitor ceramic	1nF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C12	" "	3,9pF±0,25pF N150 63 V	2222/6383398	"	210-1555
C13	" trimmer	2-6pF 250 V	10S-triko 06	STETTNER	213-0000
C14	" ceramic	1,5pF±0,25pF N150 250 V	9/0116,4	FERROPERM	210-1052
C15	" "	22pF±2% N150 63 V	2222/63834229	PHILIPS	210-1564
C16	Capacitor ceramic	22pF±2% N150 63 V	2222/63834229	PHILIPS	210-1564
C17	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C18	" tantalum	4,7uF±50-20% 25 V	TAG	I T T	214-0170
C19	" "	2,2uF+50-20% 25 V	"	"	214-0112
C20	" "	33uF+5½-20% 10 V	"	"	214-0166
C21	Capacitor polystyr.	2,2nF±5% 30V	HS 7/C	SUFLEX	211-0730
C22	" "	0,22uF±10% 250 V	2222/34245333	PHILIPS	211-1116
C23	" "	68nF±20% 250V	2222/54244638	"	211-1110
C24	" ceramic	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C25	" tantalum	3,3uF+50-20% 16 V	TAG	I T T	214-0118
C26	Capacitor tantalum	22uF+50-20% 6,3 V	TAG	I T T	212-0135
C27	" polyester	0,1uF±20% 250 V	2222/34244104	PHILIPS	211-1105
C28	" ceramic	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C29	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C30	" tantalum	3,3uF+50-20% 16 V	TAG	I T T	214-0118
C31	Capacitor polyester	0,1uF±20% 250 V	2222/34244104	PHILIPS	211-1105
C32	Not assigned				
C33	" "				
C34	" "				

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
C35	Not assigned				
C36	" "				
C37	" "				
C38	" "				
C39	" "				
C40	" "				
C41	Capacitor ellyt	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C42	Not assigned				
C43	Not assigned				
C44	Capacitor ceramic	220pF±10% 100 V	2222/63002181	PHILIPS	210-1301
C45	" "	0,82pF±1% 400 V	NPJ-PDAL3	STETTNER	210-0501
C46	Capacitor polystyr.	0,1uF±20% 250 V	2222/34244104	PHILIPS	211-1105
C47	" tantalum	33uF±20% 10 V	TAG SEL	I T T	214-0166
C48	Not assigned				
C49	" "				
C50	" "				
C51	Not assigned				
C52	Capacitor ellyt	220uF+100-10% 16 V	EP 2 W GPF	FRAKO	212-0515
C53	" "	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C54	" tantalum	0,47uF+50-20% 35 V	TAG SEL	I T T	214-0105
C55	" ceramic	4,7nF±10% 100 V	2222/630/03472	PHILIPS	210-1517
C56	Capacitor tantalum	0,47µF+50-20% 35 V	TAG SEL	I T T	214-0105
C57	Not assigned				
C58	Capacitor polyester	680pF±1% 125 V	2222/425/46801	PHILIPS	211-2004
C59	" ellyt	47uF+100-10% 16 V	EN 12,35	I T T	212-1200
C60	" tantalum	47uF+50-20% 6,3 V	TAG SEL	I T T	214-0134
C61	Capacitor ceramic	10nF+100-20% 40 V	2222/629/03103	PHILIPS	210-1523
C62	" ellyt	220uF+100-10% 16 V	EP 2 W GPF	FRAKO	212-0615
C63	" ceramic	1nF±10% high K 100V	222/630/03102	PHILIPS	210-1509
C64	" tantalum	47µF+50-20% 35 V	TAG SEL	I T T	214-0105
C65	" polyester	0,1µF±20% 250 V	222/342/4104	PHILIPS	211-1105
C66	Capacitor ellyt	1000uF+50-10% 16 V	KE	FRAKO	212-0612
C67	" "	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C68	" "	100µF+100-10% 16 V	EN 12,35	I T T	212-1201
C69	" ceramic	470pF±10% 100 V	2222/630/03471	PHILIPS	210-1505
C70	" ellyt	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C71	Capacitor ceramic	68pF±2% 100 V	2222/638/10689	PHILIPS	210-1549
C72	" polyester	0,33uF±20% 250 V	2222/342/45334	"	211-1109
C73	" ellyt	1000uF+50-10% 16 V	KE	FRAKO	212-0612
C74	Not assigned				
C75	Capacitor ceramic	1nF±10% high 100 V	2222/030/03102	PHILIPS	210-1509
L01	Choke	3,3uH±10%	1587	FERROPERM	222-3050
L02	Coil				710-0451
L03	Choke	3,3uH±10%	1587	"	222-3050

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
R01	Not assigned				
R02	Resistor carbon	4,7k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8447
R03	" "	390±5% 0,2 W	"	"	201-8339
R04	" "	47k±5% 0,2 W	"	"	201-8547
R05	" "	4,7k±5% 0,2 W	"	"	201-8447
R06	" "	180±5% 0,2 W	"	"	201-8318
R07	Resistor carbon	56k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8556
R08	" "	56k±5% 0,2 W	"	"	201-8556
R09	" "	15k±5% 0,2 W	"	"	201-8515
R10	" "	15k±5% 0,2 W	"	"	201-8515
R11	" "	1,5k±5% 0,2 W	"	"	201-8415
R12	Resistor carbon	47k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8547
R13	" "	47k±5% 0,2 W	"	"	201-8547
R14	" "	1k±5% 0,2 W	"	"	201-8410
R15	" trimmer	2,5k 0,1 W	60150-001	PREH	209-3346
R16	" carbon	56k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8556
R17	Resistor carbon	180k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8618
R18	" "	56k± 5% 0,2 W	"	"	201-8556
R19	" "	39k±5% 0,2 W	"	"	201-8539
R20	" "	56k±5% 0,2 W	"	"	201-8556
R21	" "	3,3k±5% 0,2 W	"	"	201-8433
R22	Resistor carbon	56k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8556
R23	" "	3,3k±5% 0,2 W	"	"	201-8433
R24	" "	56k±5% 0,2 W	"	"	201-8556
R25	" "	56k±5% 0,2 W	"	"	201-8556
R26	" "	3,3k±5% 0,2 W	"	"	201-8433
R27	Resistor carbon	56k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8556
R28	" "	1k±5% 0,2 W	"	"	201-8410
R29	" "	10k±5% 0,2 W	"	"	201-8510
R30	" "	56k±5% 0,2 W	"	"	201-8556
R31	" "	56k±5% 0,2 W	"	"	201-8556
R32	Resistor carbon	47k±5% 0,2 "	SBB 0207	BEYSCHLAG	201-8547
R33	" "	18k±5% 0,2 W	"	"	201-8518
R34	" "	1,2k±5% 0,2 W	"	"	201-8412
R35	" "	12k±5% 0,2 W	"	"	201-8512
R36	" trimmer	1k±5% 0,2 W	1-9833	PREH	209-3302
R37	Resistor carbon	10k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R38	" "	22k±5% 0,2 W	"	"	201-8522

R39	Not assigned				
R40	"	"			
R41	"	"			
R42	"	"			
R43	"	"			
R44	"	"			
R45	"	"			
R46	"	"			
R47	Resistor carbon	68± 5% 0,2 W	SBB 0207	BEYSCHLAG	201-8268
R48	" "	15k±5% 0,2 W	"	"	201-8515
R49	" "	2,2k±5% 0,2 W	"	"	201-8422
R50	Potentiometer	25k 0,1 W LIN	60152-001	PREH	209-3356
R51	Resistor carbon	39,0±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8339
R52	Not assigned				
R53	Potentiometer	25K ohm 0,1 W LIN	06152-001	PREH	209-3356
R54	Resistor carbon	4,7K ohm 5% 0,2 W	SBB 0207	BEYSCHLAG	201-8447
R55	" "	"	"	"	201-8447
R56	Resistor carbon	10K ohm ±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R57	" "	"	"	"	201-8510
R58	Not assigned				
R59	Resistor carbon	47K ohm ±5% 0,2 W	"	"	201-8518
R60	" "	2,2M ohm ±5% 0,2 W	"	"	201-8722
R61	Not assigned				
R62	Resistor carbon	22K ohm ±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8522
R63	" "	100K ohm ±5% 0,2 W	"	"	201-8610
R64	" "	180K ohm ±5% 0,2 W	"	"	201-8218
R65	" "	47 ohm ±5% 0,2 W	"	"	201-8247
R66	Resistor carbon	270 ohm ±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8327
R67	" "	1 ohm ±5% o,2 W	"	"	201-8110
R68	" "	47 ohm ±5% 0,2 W	"	"	201-8247
V01	Transistor silicon	BF 197		PHILIPS	240-0537
V02	" "	BF 197		"	240-0537
V03	" "	BF 197		"	240-0537
V04	" "	BC 147 b		"	240-0536
V05	" "	BC 327		"	240-0543
V06	Transistor silicon	BC 147 b		PHILIPS	240-0536
V07	" "	BC 147 b		"	240-0536
V08	" "	BC 147 b		"	240-0536
V09	" "	BC 147 b		"	240-0536
V10	" "	BC 327		"	240-0543
IC01	Integrated circuit	TDA1042		C S F	262-0026
IC02	" "	MC1741CP1		MOTOROLA	262-0024
IC03	" "	MFC6040		"	262-0025

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
D01-02	Diode variocap	12-BB105G		MOTOROLA	232-5016
D03-04	" germanium	AA 143		I T T	232-2020
D05-08	" silicon	1N4148		SESCO	232-2005
D09	" germanium	AA 143		I T T	232-2020
D11-13	Diode silicon	1N4148		SESCO	232-2005
D14	" germanium	AA143		I T T	232-2020
D15	Not used				
D16	Diode silicon	1N4148		SESCO	232-2005
	Bead			PHILIPS	220-4077
Z02	Connector		G17D21A4DEBL-704	CANNON	151-7704

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.3 RF Print Board Unit 3					710-0981
NOTE: When Quoting Prefix Component Nos with Unit 3 E.G. C01 = C301.					
C01-04	Capacitor trimmer	2-6pF N033 250 V	10S-triko 06	STETTNER	213-0000
C05	" "	4,5-20pF N750 160 V		"	213-0014
C06	" ceramic	2,2pF±0,25pF N150 250 V	9/0116,9	FERROPERM	210-1054
C07	" "	15pF±2% N150 63 V	2222/63834159	PHILIPS	210-1562
C08-11	" "	3,9pF±0,25pF N150 63 V	2222/63833398	"	210-1555
C12-14	Capacitor ceramic	1nF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C15	" "	3,3pF±0,25pF N150 400 V	9/0116,9	FERROPERM	210-1005
C16-17	" "	3,3pF±10% High-k 100 V	2222/63003332	PHILIPS	210-1515
C18	" "	68pF±2% N150 63 V	2222/63834689	"	210-1570
C19	" "	56pF±2% N150 63 V	2222/63834569	"	210-1569
C20-25	Capacitor polyester	0,1uF±20% 250 V	2222/34249104	PHILIPS	211-1105
C26-28	" ceramic	10nF±100-20% High-k 46 V	2222/62903103	"	210-1523
C29	" "	27pF±2% N150 63 V	2222/63834279	"	210-1574
C30-32	" "	150pF±2% N150 63 V	2222/63834151	"	210-1574
C33	" Polystyr.	470pF±5% 30 V	HS 7/A	SUFLEX	211-0739
C34	Capacitor ceramic	4,7pF±0,25pF N150 63 V	2222/63833398	PHILIPS	210-1556
C35	" "	1,0pF±0,25pF NPO 250 V	9/0112,9	FERROPERM	210-1051
C36	" "	10pF±2% N150 63 V	2222/63833420	PHILIPS	210-1406
C37	" "	18pF±2% N150 63 V	2222/63834189	"	210-1563
C38-39	" polystyr.	560pF±5% 30 V	HS 7/A	SUFLEX	211-0740
C40	Capacitor polystyr.	2,2nF±5% 30 V	HS 7/A	SUFLEX	211-0730
C41	" polyester	68nF±20% 250 V	2222/34244683	PHILIPS	211-1110
C42	" ellyt	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C43	" tantalum	1,0uF+50-20% 35 V	TAG SEL	"	214-0167
C44-45	" ceramic	3,3nF±10% High-k 100 V	2222/63003332	PHILIPS	210-1515
C46-47	Capacitor ceramic	15pF±2% N150 63 V	2222/63834159	PHILIPS	210-1562
L01-03	Coil				763-1101
L04	"				710-0436
L05	"				710-0437
L06	Not assigned				
L07	Coil				710-0438
L08-09	Choke	10uH±10%	1587	FERROPERM	222-3046
L10-11	"	3,3uH±10%	1587	"	222-3050
L12	"	10uH±10%	1587	"	222-3046
L13	"	100uH±10%	1587	"	222-3016
L14	Not assigned				
L15	Coil				710-0439

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
L16	Choke	15uH±10%	1587	FERROPERM	220-3047
L17	"	68nH±20%	1588	"	222-3056
R01	Resistor trimmer	10k 0,1 W lin	60150-001	PREH	209-3348
R02-05	" carbon	56k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8556
R06	" "	100±5% 0,2 W	"	"	201-8310
R07-09	Resistor carbon	10k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R10	" "	56±5% 0,2 W	"	"	201-8256
R11	" "	5.6K±5% 0,2 W	"	"	201-8456
R12-13	" "	3,9k±5% 0,2 W	"	"	201-8439
R14	" "	2,7k±5% 0,2 W	"	"	201-8427
R15	Resistor carbon	820±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8382
R16	" "	18±5% 0,2 W	"	"	201-8218
R17	" "	8,2k±5% 0,2 W	"	"	201-8482
R18	" "	1,2k±5% 0,2 W	"	"	201-8412
R19	" "	18k±5% 0,2 W	"	"	201-8518
R20	Resistor carbon	27k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8527
R21	" "	3,3k±5% 0,2 W	"	"	201-8433
R22	" "	27k±5% 0,2 W	"	"	201-8527
R23	" "	560±5% 0,2 W	"	"	201-8356
V01	Transistor FET	U1837E		TELEDYNE	240-1300
V02	Transistor silicon	BF 256L/A		TEXAS INSTR.	240-0924
V03-04	" "	BF 195		PHILIPS	240-0527
IC01	Integrated circuit	LM 3028A		NATIONAL	262-0014
IC02	" "	LM 2111N		"	262-0015
D01-04	Diode variocap	12-BB105G		MOTOROLA	232-5016
D05	" germanium	AA 143		I T T	232-2020
L01-L06	Crystal filter/coil		HMC-10 M-3B+10B10	TOYO	250-0008
L07-L14	Ceramic filter/coil		TBF - 25A	VERNITRON	255-0000
Y01	Crystal	10,245 MHz		CROVEN	251-0002
Z03	Connector		G17D21A4DEBL-704	CANNON	151-7704
	Bead			PHILIPS	220-4077
	Coax cable	50 18 cm & 5 cm			156-3006

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.4 VCXO-Print Unit 4					710-0982
NOTE: When Quoting Prefix Component Nos with Unit 4 E.G. C01 = C401.					
C01	Capacitor ceramic	100pF± 2% N150 63 V	2222/63834101	PHILIPS	210-1572
C02	" "	3,3nF±10% High-k 100 V	2222/63003332	"	210-1515
C03	" mica	680pF±5% 300 V	WDM 15	RIFA	215-0301
C04	" ceramic	22pF±2% N150 63 V	2222/63834229	PHILIPS	210-1564
C05	" "	33pF±2% N150 63 V	2222/63834339		
C06	Capacitor polystyr.	4,7nF±5% 30 V	HS 10/A	SUFLEX	211-0733
C07	" ceramic	1nF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C08	" "	3,3nF± High-k 100 V	2222/63003332	"	210-1515
C09	" "	4,7nF±10% High-k 100 V	2222/63003472	"	210-1517
C10	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C11	Capacitor polyester	0,1uF±20% 250 V	2222/34244104	PHILIPS	211-1105
C12	" ceramic	3,3uF±10% High-k 100 V	2222/63003332	"	210-1515
C13-14	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C15	" "	33pF±2% N150 63 V	2222/63834339	"	210-1566
C16	" "	22pF±2% N150 63 V	2222/63834229	"	210-1564
C17	Capacitor mica	470pF±5% 500 V	WDM 15	RIFA	215-0300
C18	" polystyr.	4,7nF±5% 30 V	HS 10/A	SUFLEX	211-0733
C19	" ceramic	3,3nF±10% High-k 100 V	2222/63003337	PHILIPS	210-1515
C20	" "	100pF±2% N150 63 V	2222/63834101	"	210-1572
C21-22	" polyester	0,1uF±20% 250 V	2222/34244104	"	211-1105
C23	Capacitor polyester	33nF±20% 250 V	2222/34244333	PHILIPS	211-1103
C24	" polystyr.	1,2nF±5% 30 V	HS 7/B	SUFLEX	211-0738
C25	" "	6,8nF±5% 30 V	HS 6800/5	"	211-0741
C26	" ceramic	100pF±2% N150 63 V	2222/63834101	PHILIPS	210-1572
C27	" tantalum	22uF±50-20% 16 V	TAG	I T T	214-0140
C28	Capacitor tantalum	10uF±50-20% 16 V	TAG	I T T	214-0129
C29	" ellyt	100uF±100-10% 16 V	EN 12,35	"	212-1201
C30	" polyester	0,1uF±20% 250 V	2222/34244104	PHILIPS	211-1105
C31	" "	0,33uF±10% 250 V	2222/34244334	"	211-1109
C32-33	" ceramic	56pF±2% N150 63 V	2222/63834569	"	210-1569
C34	Capacitor polyester	47nF±20% 250 V	2222/34245974	PHILIPS	211-1104
C35	" ellyt	100uF+100-10% 16 V	EN 12,35	I T T	212-1201
C36	" ceramic	4,7nF±10% High-k 100 V	2222/63003472	PHILIPS	210-1517
C37	" ellyt	100uF±100-10% 16 V	EN 12,35	I T T	212-1201
C38	" ceramic	10nF+100-20% 40 V	2222/62903103	PHILIPS	210-1523
C39	Capacitor tantalum	100uF+50-20% 3 V	TAG	I T T	214-0171
C40	" "	4,7uF+50-20% 25 V	TAG	"	214-0170
C41	" "	1uF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C42-43	" ellyt	47uF+100-10% 16 V	EN 12,35	I T T	212-1200
C44	" ceramic	10nF+100-20% 40 V	2222/62903103	PHILIPS	210-1523
C45-46	Capacitor ceramic	1nF±10% High-k 100 V	2222/63003102	PHILIPS	210-1509
C47	" "	47nF+80-20% High-k 25 V	9/0141,8	FERROPERM	210-1056

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
L01	Coil				710-0440
L02	"				710-0448
L03	"				710-0441
L04	"				710-0442
L05	Coil				710-0443
L06	"				710-0449
L07-08	Choke	10uH±10%	1587	FERROPERM	222-3046
R01	Resistor carbon	100k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8610
R02	" "	22k±5% 0,2 W	"	"	201-8522
R03	Resistor carbon	10k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R04	" "	68±5% 0,2 W	"	"	201-8268
R05	" "	1,5k±5% 0,2 W	"	"	201-8415
R06	" "	1,8k±5% 0,2W	"	"	201-8418
R07	" "	15k±5% 0,2 W	"	"	201-8515
R08	Resistor carbon	33k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8533
R09	" "	100k±5% 0,2 W	"	"	201-8610
R10	" "	470±5% 0,2 W	"	"	201-8347
R11	" "	33k±5% 0,2 W	"	"	201-8533
R12	" "	39k±5% 0,2 W	"	"	201-8539
R13	Resistor carbon	220±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8322
R14	" "	1,5k±5% 0,2 W	SBB 0207	"	201-8415
R15-16	" "	15k±5% 0,2 W	"	"	201-8515
R17	" "	220±5% 0,2 W	"	"	201-8322
R18	" "	1,5k±5% 0,2 W	"	"	201-8415
R19	Resistor carbon	33k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8533
R20	" "	15k±5% 0,2 W	"	"	201-8515
R21	" "	1,8±5% 0,2 W	"	"	201-8418
R22	" "	1,5k±5% 0,2 W	"	"	201-8415
R23	" "	68±5% 0,2 W	"	"	201-8268
R24	Resistor carbon	10k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R25	" "	100k±5% 0,2 W	"	"	201-8610
R26	" "	22k±5% 0,2 W	"	"	201-8522
R27	" "	1,2k±5% 0,2 W	"	"	201-8412
R28-29	Potentiometer carbon	25k 0,1 W	60750-001	PREH.	209-3349
R30	Resistor carbon	2,2k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8422
R31-32	" "	22 K ± 5% , 0.2W	"	"	201-8522
R33	" "	33k±5% 0,2 W	"	"	201-8533
R34	" "	56k±5% 0,2 W	"	"	201-8556
R35	" "	2,2k±5% 0,2 W	"	"	201-8422
R36	Resistor carbon	10k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8510
R37	Potentiometer carbon	500 0,1 W	60150 001	PREH.	209-3344
R38	Resistor carbon	220±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8322
R39	" "	22k±5% 0,2 W	"	"	201-8522
R40	" "	470±5% 0,2 W	"	"	201-8347
R41	Resistor carbon	3,3k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8433
R42	Potentiometer carbon	100 0,1 W	60150 001	PREH.	209-3343
R43	Resistor carbon	100±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8310
R44	" "	470±5% 0,2 W	"	"	201-8347
R45	" "	33±5% 0,2 W	"	"	201-8233

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
R46	Resistor carbon	6.8k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8468
R47	" "	100k±5% 0,2 W	"	"	201-8610
R48	" "	180±5% 0,2 W	"	"	201-8318
R49	" "	820±5% 0,2 W	"	"	201-8382
R50	" "	33k±5% 0,2 W	"	"	201-8533
R51	Resistor carbon	390±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8339
R52	" "	33k±5% 0,2 W	"	"	201-8533
R53	" "	1k±5% 0,2 W	"	"	201-8410
R54-55	" "	470±5% 0,2 W	"	"	201-8347
R56	" "	1k±5% 0,2 W	"	"	201-8410
R57	Resistor carbon	1,2k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8412
R58	" "	3,9k±5% 0,2 W	"	"	201-8439
R59	" "	1k±5% 0,2 W	"	"	201-8410
R60	" "	1,5k±5% 0,2 W	"	"	201-8415
R61	" "	4,7±5% 0,2 W	"	"	201-8447
R62	Resistor carbon	1k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8410
R63	" "	680±5% 0,2 W	"	"	201-8368
R64	" "	1,5k±5% 0,2 W	"	"	201-8415
R65	" "	4.7k±5% 0,2 W	"	"	201-8447
R66	" "	1,5k±5% 0,2 W	"	"	201-8415
R67	Resistor carbon	4,7k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8447
R68	" "	8,2k±5% 0,2 W	"	"	201-8482
R69	" "	10k±5% 0,2 W	"	"	201-8510
R70-71	" "	15k±5% 0,2 W	"	"	201-8515
R72	" "	10k±5% 0,2 W	"	"	201-8510
R73	Resistor carbon	47k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8547
V01	Transistor silicon	BF197		PHILIPS	240-0537
V02-03	" "	BC147B		"	240-0536
V04-05	" "	BF197		"	240-0537
V06-10	" "	BC147B		"	240-0536
V11	Transistor silicon	2N2905A		I T T	240-0314
V12-13	" "	BC147B		PHILIPS	240-0536
V14-16	" "	BC327		"	240-0543
V17-19	" "	BC147B		"	240-0536
D01-02	Diode variocap	MV2209		MOTOROLA	232-5017
D03-05	Diode silicon	IN4148		SESCO	232-2005
D06-07	" germanium	AA143		I T T	232-2020
D08-15	" silicon	1N4148		SESCO	232-2005
D16	Not assigned				
D17	Diode zener	ZPD5,6		I T T	232-1046
D18	Diode zener	ZPD6,2		I T T	232-1074
D19-22	" silicon	1N4148		SESCO	232-2005
Y01	Crystal	10,7 MHz		CROVEN	253-0000
Y02	"	15,3 MHz		"	253-0001
Z04	Connector		G17D21A4DEBL-704	CANNON	151-7704
	transistor holder				158-0016
	Bead			PHILIPS	220-4080
	Heat sink				158-4004

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.5 ϑ-detector + VCO Unit 5					710-0428
NOTE: When Quoting Prefix Component Nos with Unit 5 E.G. C01 = C501.					
C01	Capacitor ceramic	3,3nF±10% High-k 100 V	2222/63003181	PHILIPS	210-1515
C02	" "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
C03	" "	22pF±2% N150 63 V	2222/63834229	"	210-1564
C04	" "	10nF+100-20% High-k 40 V	2222/62903102	"	210-1523
C05-07	" polyester	0,1uF±20% 250 V	2222/34245223	"	211-1105
C08	Capacitor tantalum	4,7uF+50-20% 25 V	TAG	I T T	214-0170
C09	" polyester	0,1uF±20% 250 V	2222/34245223	PHILIPS	211-1105
C10	" ceramic	22pF±2% N150 63 V	2222/63834229	"	210-1564
C11	" "	3,3nF±10% High-k 100 V	2222/63003181	"	210-1515
C12	" "	10nF+100-20% High-k 40 V	2222/62903102	"	210-1523
C13	Capacitor polyester	0,1uF±20% 250 V	2222/34245223	PHILIPS	211-1105
C14-15	" tantalum	1uF+50-20% 35 V	TAG	I T T	214-0167
C16	" "	6,8uF+50-20% 35 V	"	"	214-0127
C17	" "	1uF+50-20% 35 V	"	"	214-0167
C18	" ceramic	150pF±2% N150 63 V	2222/63834151	"	210-1574
C19	Capacitor ceramic	3,9pF±0,25pF N150 63 V	2222/63833398	PHILIPS	210-1555
C20	" "	3,3pF±0,25pF N150 400 V	9/0116,9	FERROPERM	210-1005
C21	" "	12pF±2% N150 63 V	2222/63834129	PHILIPS	210-1561
C22	" "	22pF±2% N150 63 V	2222/63834229	"	210-1564
C23	" "	10pF±2% N150 63 V	2222/63833420	"	210-1406
C24	Capacitor ceramic	100pF±2% N150 63 V	2222/63834101	PHILIPS	210-1572
C25-26	" "	18pF±2% N150 63 V	2222/63834189	"	210-1563
C27-28	" "	1nF±10 High-k 100 V	2222/63003102	"	210-1509
C29	" "	10nF+100-20% High-k 40 V	2222/62903103	"	210-1523
C30	" "	18pF±2% N150 63 V	2222/63834189	"	210-1563
C31	Capacitor ceramic	10pF±2% N150 63 V	2222/63834109	PHILIPS	210-1406
C32	Not assigned				
C33	Capacitor "	1nF±10% High-k 100 V	2222/63003102	"	210-1509
L01-02	Coil				710-0445
L03	"				710-0446
L04	Coil				710-0447
L05-06	"				710-0444
L07-08	Choke	15uH±10%	1587	FERROPERM	222-3047
R01	Resistor carbon	18±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8218
R02	" "	82±5% 0,2 W	"	"	201-8282
R03	Resistor carbon	18±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8218
R04-05	" "	33±5% 0,2 W	"	"	201-8233
R06	" "	39±5% 0,2 W	"	"	201-8239
R07-08	" "	15k±5% 0,2 W	"	"	201-8515
R09	" "	330±5% 0,2 W	"	"	201-8333
R10	Resistor carbon	4.7k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8447
R11	" "	470±5% 0,2 W	"	"	201-8347
R12	" "	3,3k±5% 0,2 W	"	"	201-8433
R13	" "	270±5% 0,2 W	"	"	201-8327
R14	" "	330±5% 0,2 W	"	"	201-8333
R15-18	Resistor carbon	220±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8322
R19	" "	8,2k±5% 0,2 W	"	"	201-8482
R20	" "	10k±5% 0,2 W	"	"	201-8510
R21	" "	15k±5% 0,2 W	"	"	201-8515
R22	" "	10k±5% 0,2 W	"	"	201-8510

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
R23	Resistor carbon	1,8k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8418
R24	Potentiometer carbon	2,5k±10% 0,1 W	60150-001	PREH	209-3346
R25	Resistor carbon	15k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8515
R26	" "	180±5% 0,2 W	"	"	201-8318
R27	" "	330±5% 0,2 W	"	"	201-8333
R28	Resistor carbon	15k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8515
R29	" "	5,6k±5% 0,2 W	"	"	201-8456
R30	" "	2,2k±5% 0,2 W	"	"	201-8422
R31	" "	1k±5% 0,2 W	"	"	201-8410
R32	" "	47k±5% 0,2 W	"	"	201-8547
R33	Resistor carbon	33k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8533
R34	" "	10k±5% 0,2 W	"	"	201-8510
R35	" "	1,5k±5% 0,2 W	"	"	201-8415
R36	" "	2,2k±5% 0,2 W	"	"	201-8422
R37	" "	820±5% 0,2 W	"	"	201-8382
R38	Resistor carbon	1,5k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8415
R39	" "	10k±5% 0,2 W	"	"	201-8510
R41	" "	1k±5% 0,2 W	"	"	201-8410
R42	" "	4,7k±5% 0,2 W	"	"	201-8447
R43	" "	1,2k±5% 0,2 W	"	"	201-8412
R44	Resistor carbon	120±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8312
V01	Transistor silicon	BF197		PHILIPS	240-0537
V02	" "	BC147B		"	240-0536
V03	" "	BF197		"	240-0537
V04-06	" "	BC147B		"	240-0536
V07	Transistor silicon	BC337B		PHILIPS	240-0545
V08-09	" "	BF197		"	240-0537
D01-10	Diode germanium	AA143		I T T	232-2020
D11	" silicon	1N4148		SESCO	232-2005
D12	" variocap	12BB 105G		MOTOROLA	232-5016
Z05	Connector		G17D21A4DEBL-704	CANNON	151-7704
	Coax-cable				156-3006

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.6 Tx-PA Unit 36					710-0956
C01	Capacitor ceramic	27pF±2% N150 63 V	2222/63834279	PHILIPS	210-1565
C02	" trimmer	10-60pF N1500	10S-TRIKO 24	STETTNER	213-0019
C03	" tantalum	1uF+50-20% 35 V	TAG SEL	I T T	214-0167
C04	" ceramic	10nF±20% high K 40 V	2222/62903102	PHILIPS	210-1523
C05	" "	1nF±10% high K 100 V	2222/63003102	"	210-1509
C06	Capacitor trimmer	10-40pF N750	10S-TRIKO 24	STETTNER	213-0020
C07	" ceramic	1nF±10% high K 100 V	2222/63003102	PHILIPS	210-1509
C08	" trimmer	4-20pF N470	10S-TRIKO 24	STETTNER	213-0018
C09	" ceramic	2,2pF±0,25PF N150 250 V	9/0116,4	FERRPERM	210-1054
C10	" "	10nF±20% high K 40 V	2222/62903102	PHILIPS	210-1523
C11	Capacitor ceramic	1nF±10% high K 400 V	2222/63003102	"	210-1509
C12	" "	4-20pF N470	10S-TRIKO 24	STETTNER	213-0018
C13	" trimmer	10-40pF N750	10S-TRIKO 24	"	213-0020
C14	" tantalum	2,2uF+50%-20% 35 V	TAG SEL	I T T	214-0169
C15-16	" ceramic	1nF±10% high K 40 V	2222/63003102	PHILIPS	210-1509
C17	Capacitor ceramic	10nF±20% high K 40 V	2222/62903102	PHILIPS	210-1523
C18	" polyester	0,1uF±20% 250 V	2222/34244104	"	211-1105
C19	" trimmer	4-20pF N470	10S-TRIKO 24	STETTNER	213-0018
C20	" "	10-40pF N750	10S-TRIKO 24	"	213-0020
C21	Capacitor ceramic	6,8pF±0,25 N150 63 V	2222/63833688	PHILIPS	210-1558
C22	" "	4,7pF±0,25 N150 63 V	2222/63833478	"	210-1556
C23	" "	33pF±2% N150 63 V	2222/63834339	"	210-1566
C24-25	" "	1nF±1% high K 40 V	2222/63003102	"	210-1509
C26	Capacitor ceramic	100pF±2% N150 63 V	2222/53834101	PHILIPS	210-1572
C27	" "	4,7pF±0,25 N150 63 V	2222/63833478	"	210-1556
C28	" "	5,6±0,25pF N150 63 V	2222/63833568	"	210-1557
C29	" trimmer	7-100pF	D4203/1x	EL-MENCO	213-0707
C30	" tantalum	1uF+50%-20% 35 V	TAG SEL	I T T	214-0167
C31	Capacitor ceramic	10nF±20% high K 40 V	2222/62403102	PHILIPS	210-1523
C32	" tantalum	4,7pF +50%-20% 25 V	TAG SEL	I T T	214-0170
C33	" trimmer	7-100pF	D4203/1x	EL-MENCO	213-0707
C34	" ceramic	15pF±2% N150 63 V	2222/63834159	PHILIPS	210-1562
C35	Not assigned				
C36-37	Capacitor ceramic	15pF±2% N150 63 V	2222/63834159	PHILIPS	210-1562
C38	" "	33pF±2% N150 63 V	2222/63834339	"	210-1566
C39	Not assigned				
C40-42	Capacitor ceramic	15pF±2% N150 63 V	2222/63834159	"	210-1562
C43	Not assigned				
C44-49	Capacitor ceramic	1nF+80%-20% K2000 40 V	9/0129,9	FERROPERM	210-1062
C50	Not assigned				
C51	Not assigned				
C52	Capacitor ceramic	10pF±2% N150 63 V	2222/6383410	PHILIPS	210-1406
C53	Not assigned				
C54	" "				
C55	" "				

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
C56	Not assigned				
C57	" "				
C58	" "				
C59	Capacitor ceramic	10nF+80%-20% K2000 40 V	9/0129,9	FERROPERM	210-1062
C60-66	Capacitor ceramic	1nF±10% high K 100 V	2222/63003102	PHILIPS	210-1509
C67-68	" "	1,5nF+80%-20% 400 V	D9000 TEFK 7	STETTNER	210-0507
C69	" "	0,68pF±0,25pF P100 63 V	2222/6380368	PHILIPS	210-1411
C70-77	" "	1nF±10% high K 100 V	2222/63003102	"	210-1509
L01	Not assigned				
L02	Choke		4312-020-36700	PHILIPS	222-3053
L03	"	0,47uH ±10%	1587	FERROPERM	222-3042
L04	Not assigned				
L05	Choke	10uH ±10%	1587	"	222-3046
L06	Choke		4312-020-36700	PHILIPS	222-3053
L07	"	0,1uH ±10%	1587	"	222-3051
L08	Not assigned				
L09	" "				
L10	Choke	0,1uH ±10%	1587	FERROPERM	222-3051
L11	Choke		4312-020-36700	PHILIPS	222-3053
L12	"	0,68uH ±10%	1587	"	222-3043
L13	"	0,22uH ±10%	1587	"	222-3052
L14	Not assigned				
L15	" "				
L16	Choke	0,22uH ±10%	1587	FERROPERM	222-3052
L17	"		4312-020-36700	PHILIPS	222-3053
L18	Coil				763-1108
L25	Choke		4312-020-36700	PHILIPS	222-3053
L26-27	"	1uH ±10%	1587	FERROPERM	222-3044
R01	Resistor carbon	15K ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8515
R02	" "	470 ohm ±5% 0,2 W	"	"	201-8347
R03	" "	6,8 ohm ±5% 0,2 W	"	"	201-8168
R04	" "	10 ohm ±5% 0,2 W	"	"	201-8210
R05	" "	47 ohm ±5% 0,2 W	"	"	201-8247
R06	Resistor carbon	1 ohm ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8110
R07	" "	220 ohm ±50% 0,2 W	"	"	201-8322
R08	" "	470 ohm ±5% 0,2 W	"	"	201-8347
R09	" "	33 ohm ±5% 0,2 W	"	"	201-8233
R10	" "	3,3 ohm ±5% 0,2 W	"	"	201-8133
R11	Resistor carbon	100 ohm ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8310
R12	" "	5,6 K ±5% 0,2 W	"	"	201-8456
R13	" "	18K ±5% 0,2 W	"	"	201-8518
R14	Not assigned				
R15	Resistor carbon	270 ohm ±5% 0,2 W	"	"	201-8327
R16	Potentiometer carbon	25K ohm 0,1 W	60-152-001	PREH	209-3356
R17	Resistor "	100 ohm ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8310
R18	Potentiometer "	25K ohm 0,1 W	60-152-001	PREH	209-3356
R19	Resistor "	4,7K ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8447
R20	" "	4,7 ohm ±5% 0,2 W	"	"	201-8147

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
R21	Resistor carbon	1K ohm ±5% 0,2 W	SBB0207	BEYSCHLAG	201-8410
R22-23	" "	10K ohm ±5% 0,2 W	"	"	201-8510
R24	" "	3,3K ohm ±5% 0,2 W	"	"	201-8433
R25	Potentiometer carbon	25K 0,1 W	60-152-001	PREH	209-3356
R26	Resistor NT C	47K ohm	2322-642-11473	PHILIPS	209-5002
V01	Transistor silicon	2N4072		MOTOROLA	240-0410
V02	" "	2N4427		MOTOROLA	240-0409
V03	" "	2N2905A		I T T	240-0314
V04	" "	BLY87A		PHILIPS	240-0547
V05	" "	BC147B		"	240-0536
V06	" "	BLY89A		"	240-0546
V07	" "	BC147B		"	240-0536
D01-02	Diode silicon	IN4448			232-2037
D03	" zener	ZPD15±5%		I T T	232-1028
D04-05	" silicon	IN4148		SESCO	232-2005
D06	" "	IN4004		I T T	232-2000
D07	" "	IN4148		SESCO	232-2005
RE01	Antenna relay	265/12 G2 V		MAGNETIC DEIK	141-3054
RE02	Relay for product power	REL 10	RS-12 V	ERNI	141-3059
	Heat zink		KK-502	SIEFERT	158-4009
	" "		KK-501 S	"	158-4004
SW01	Termoswitch	80°C	28.018.0	ELECTROVAC	155-1504
Z01	Antenna connector	SO-239	83-1-R	AMPHENOL	151-7604
Z02	Not assigned				
Z03	Phono plug red		RZ07	ZEHNDER	151-7643
Z04-05	Connector phono female		RZ58	"	151-7641
Z06	"	13 pole	G17D13A3DBBM704	CANNON	151-7700

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.7 Mother Board Unit 37					710-0958
C01	Capacitor polyester	47nF±20% 250 V	2222/34245474	PHILIPS	211-1104
C02-05	" ceramic	1nF+80%-20% K2000 400 V	9/0129,9	FERROPERM	210-1062
C06	" "	10nF+100-20% 40 V	2222/62903103	PHILIPS	210-1523
C07	" "	33pF±2% N150 63 V	2222/63834339	"	210-1566
C08	" "	10nF+100-20% 40 V	2222/62903103	"	210-1523
C09	" "	1nF+80%-20% K2000 400 V	9/0129,9	FERROPERM	210-1062
C10	" "	18pF±2% NPO 100 V	2222/53210189	PHILIPS	210-1342
C11-13	Capacitor ceramic	1nF+80%-20%	K2000 400 V 9/0129,9	FERRPERM	210-1062
C14-17	" "	1nF±10% 100 V	2222/63003102	PHILIPS	210-1509
C18-19	" ellyt	1000uF+50-10% 16 V	KE	FRAKO	212-0612
L01-02	Choke		4312-020-36700	PHILIPS	222-3053
D01	Diode germanium	AA143		PHILIPS	
Z01-05	Connector	21 ~~13~~ pole female	G17D21A3DBBM-704	CANNON	151-7703
Z06	"	31 pole male	G17D31A4DBBM-704	"	151-7713
Z07	"	21 pole female	G17D21A3DBBM-704	"	151-7703
Z08	"		MG/PR5/L	CHIRI	151-7569
Z09	"	13 pole male	G1211058-1032	CANNON	151-7712
Z10	"	13 pole male 90°	G17D13A4DEBM-704	"	151-7701
Z11-12	" phono coax		RZ58	ZEHNDER	151-7641
	phono plug yellow		RZ07	"	151-7642
	" " red		RZ07	"	151-7643
9.8 Control Board Unit 38					710-0952
				SW-board	765-0375
C01	Not assigned				
C02-06	Capacitor ceramic	1nF+80-20% K2000 400 V	9/0129,9	FERROPERM	210-1062
R01-04	Not assigned				
R05	Resistor carbon	4,7K ±5% 0,2 W	SBB	BEYSCHLAG	201-8447
R06-12	Not assigned				
R13	Resistor carbon	22K ±5% 0,2 W	"	"	201-8522
R14	" "	4,7K ±5% 0,2 W	"	"	201-8447
R15	" "	100K ±5% 0,2 W	"	"	201-8610
R16	Resisitor carbon	4,7K ±5% 0,2 W	SBB	BEYSCHLAG	201-8447
R17	" "	33K ±5% 0,2 W	"	"	201-8533
R18-20	Not assigned				
R21	Resistor carbon	3,3K ±5% 0,2 W	"	"	201-8433
R22	Potentiometer carbon	500K LIN 0,1 W	60-152-001	PREH	209-3357
R23	" "	2,5M Log 0,08 W	63472-00069804-000	PREH	209-3362
R24	Potentiometer carbon	~~25K LIN 0,15 W~~ 22K ÷log 0,08W	63470-00064804-000 69902-101	PREH	209-3363 72
R25-32	Not assigned				
R33	Potentiometer carbon	10K LIN 0,1 W	60-152-001	"	209-3348
R34-35	Resistor "	1,2K ±5% 0,2 W	SBB	BEYSCHLAG	201-8412
R36	Not assigned				
R37	Resistor carbon	100±5% 0,2 W	"	"	
V01+06	Transistor silicon	BC147 B		PHILIPS	240-0536
V02	Not assigned				
V03	Transistor silicon	BC327		"	240-0543
V04-05	Not assigned				

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
D01-02	Not assigned				
D03	Diode silicon	IN5404		TEXAS	232-2005
D04-06	Not assigned				
D07-08	Diode germanium	AA143		PHILIPS	232-3006
D09	" silicon	IN4148		SESCO	232-2005
D10-14	" germanium	AA143		PHILIPS	232-3006
D15	Not assigned				
D16-22	Diode germanium	AA143		"	232-3006
D23-24	Not assigned				
D25-26	Diode germanuim	AA143		"	232-3006
D27-30	" silicon	IN4148		SESCO	232-2005
D31-33	" germanium	AA143		PHILIPS	232-3006
D34-35	Not assigned				
D36	Diode silicon	IN4148		SESCO	232-2005
D37-45	Not assigned				
D46-48	Diode silicon	IN4148		SESCO	232-2005
D49	Not assigned				
D50-51	LED red	ED209		EEP	269-1002
D52	Not assigned				
D53	Diode zener	BZX-C18 ±5% 2,5 W		PHILIPS	232-1078
LA01	Lamp	12-15 V 30 mA W 2x4,63	No2322	OSRAM	153-1070
	Lamp socket		4080030	ALWEGA	252-2052
F01	Fuse	1,6A F	480621	BUSSMANN	152-6079
	Fuse holder		751.0035	SCHURTER	152-7055
SW01	Main selector	11 positions		MEC	155-3118
SW02	" "	10 "		"	155-3117
SW03-04	Lever switches	3x3 YB3RUS		SHADOW	155-3114
Z01	Connector	31 pole	G17D31A3DABM	CANNON	151-7711
Z02	"	13 "	G17D13A3DABM	"	151-7702
Z03	"	5 pole stereo female	MG/PR/5-CS	CHIRI	151-7574

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.10 Crystal print board Unit 21					710-0466
NOTE: When Quoting Prefix Component Nos with Unit 21 E.G. C01 = C2101.					
C01	Capacitor trimmer	5,5-65pF 300 V	2222/80801001	PHILIPS	213-0404
C02	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C03	" trimmer	5,5-65pF 300 V	2222/80801001	"	213-0404
C04	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C05	" trimmer	5,5-65pF 300 V	2222/80801001	"	213-0404
C06	Capacitor ceramic	2,2nF±10% High-k 100 V	2222/63003222	PHILIPS	210-1513
C07	" trimmer	5,5-65pF 300 V	2222/80801001	"	213-0404
C08	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C09	" trimmer	5,5-65pF 300 V	2222/80801001	"	213-0404
C10	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C11	Capacitor trimmer	5,5-65pF 300 V	2222/80801001	PHILIPS	213-0404
C12	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C13	" ceramic	2,2nF±10% High-k 100 V	2222/63003222	"	210-1513
C14	" ceramic	100pF±2% N150 63 V	2222/63834829	"	210-1572
C15	" ceramic	47pF±2% N150 63 V	2222/63834479	"	210-1568
C16	Capacitor ceramic	18pF±2% N150 63 V	2222/63834189	PHILIPS	210-1563
C17	" ceramic	4,7nF±10% High-1 100 V	2222/63063472	"	210-1517
C18	" polyester	47nF±20% 250 V	2222/34244473	"	211-1104
C19	" ceramic	6,8pF±0,25pF N150 63 V	2222/63833688	"	210-1558
C20	" ceramic	2,2nF+10% High-k 100 V	2222/63003222	"	210-1513
C21	Capacitor ceramic	4,7nF±10% High-k 40 V	2222/62902472	PHILIPS	210-1322
L01	Coil				710-0450
L02	Coil				710-0450
L03	Not used				
L04	Choke	10uH±10%	1587	FERROPERM	322-3046
L05	Choke	3,3uH±10%	1587	"	222-3050
L06	Choke	3,3uH±10%	1587	FERROPERM	222-3050
R01	Resistor carbon	47k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8547
R02	" "	1,2k±5% 0,2 W	"	"	201-8412
R03	" "	2,2k±5% 0,2 W	"	"	201-8422
R04	" "	47±5% 0,2 W	"	"	201-8547
R05	Resistor carbon	1,2k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8412
R06	" "	2,2k±5% 0,2 W	"	"	201-8422
R07	" "	47k±5% 0,2 W	"	"	201-8547
R08	" "	1,2k±5% 0,2 W	"	"	201-8412

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
R09	" "	2,2k±5% 0,2 W	"	"	201-8547
R10	Resistor carbon	47k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8547
R11	" "	1,2k±5% 0,2 W	"	"	201-8412
R12	" "	2,2k±5% 0,2 W	"	"	201-8422
R13	" "	47k±5% 0,2 W	"	"	201-8547
R14	" "	1,2k±5% 0,2 W	"	"	201-8412
R15	Resistor carbon	2,2k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8422
R16	" "	47k±5% 0,2 W	"	"	201-8547
R17	" "	1,2k±5% 0,2 W	"	"	201-8412
R18	" "	2,2k±5% 0,2 W	"	"	201-8422
R19	" "	47k±5% 0,2 W	"	"	201-8547
R20	Resistor carbon	47k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8547
R21	" "	680±5% 0,2 W	"	"	201-8368
R22	" "	2,2k±5% 0,2 W	"	"	201-8422
R23	" "	15k±5% 0,2 W	"	"	201-8515
R24	" "	6,8k±5% 0,2 W	"	"	201-8468
R25	Resistor carbon	1,2k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8412
R26	" "	1,5k±5% 0,2 W	"	"	201-8415
R27	" "	4,7k±5% 0,2 W	"	"	201-8447
R28	" "	33k±5% 0,2 W	"	"	201-8533
R29	" "	8,2k±5% 0,2 W	"	"	201-8482
R30	Resistor carbon	22k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8522
D01-D06	Diode silicon	1N4148		ITT	232-2005
D07	" germanium	AA143		"	232-2020
D08-10	" silicon	1N4148		"	232-2005
D11	" germanium	AA143		"	232-2020
D12-D16	Diode silicon	1N4148		ITT	232-2005
D17	" germanium	AA143		"	232-2020
D18	" silicon	1N4148		"	232-2005
D19	" germanium	AA143		"	232-2020
D20	" silicon	1N4148		"	232-2005
D21	Diode germanium	AA143		ITT	232-2020
D22	" silicon	1N4148		"	232-2005
D23	" germanium	AA143		"	232-2020
D24	" silicon	1N4148		"	232-2005
D25	" germanium	AA143		"	232-2020
D26	Diode silicon	1N4148		ITT	232-2005
V01	Transistor silicon	BF194		PHILIPS	240-0526
V102	"	BC327		"	240-0543
V103	"	BC147B		"	240-0536

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
Y01	(optional) crystal WE1	43.312.50 MHz	701-0011		252-0614
Y02	(") " WE2	43.275.0 MHz	701-0011		252-0613
Y06	" CH16	41.875.0 MHz	701-0011		252-0616
	Bead			PHiLIPS	220-4077
	Crystal Holders		QS25GS	INOTEC	151-8030
Z01	Connector		G17D21AGDEBL-704	CANNON	151-7704

9.11 Switching Regulator 24/32-13,6 V Unit 11 — 710-0962

NOTE: When Quoting Prefix Component Nos with 11 E.G. C01 = C1101.

C01	Capacitor polyester	220nF±10% 250 V	2222/34245224	PHILIPS	211-1116
C02	" "	330nF±10% 250 V	2222/34245334	"	211-1109
C03	" "	220nF±10% 250 V	2222/34245224	"	211-1116
C04	" ellyt	470uF+50-10% 40 V	EF/FPF	FRAKO	212-0623
C05	Not assigned				
C06	Capacitor polyester	100nF±20% 250 V	2222/34244104	PHILIPS	211-1105
C07-08	" ellyt	100uF+50-10% 25 V	KEI/FPF	FRAKO	212-0622
C09-10	" "	100uF+50-10% 63 V	FPF	"	212-0603
C11-14	" feedthro.ceramic	1nF+50-10% 350 V	2222/70005102	PHILIPS	210-0400
C15-18	" ellyt	100uF+50-10% 63 V	FPF	FRAKO	212-0603
C19	Capacitor polyester	100nF±20% 250 V	2222/34244104	PHILIPS	211-1105
C20	" "	15nF±20% 250 V	2222/34244153	"	211-1101
L01-02	Choke	10mH±10%	1585 I=6	FERROPERM	222-3054
L03	Coil	0,4mH	C4401-083/6-400/0,8	B F I	222-2025
L04-05	Choke	10mH±10%	1585 I=6	FERROPERM	222-3054
R01	Resistor carbon	68±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8268
R02	" "	1M±5% 0,2 W	"	"	201-8710
R03	" "	22±5% 0,2 W	"	"	201-8222
R04	" "	10k±5% 0,2 W	"	"	201-8510
R05	" "	560±5% 0,2 W	"	"	201-8356
R06-07	Resistor carbon	5,6k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8456
R08	" "	220±5% 0,2 W	"	"	201-8322
R09	" wire wound	0,1±5% 3 W	A1	MODULOHM	209-1140
R10	Potentiometer carbon	500 0,1 W LIN	60150-001	PREH.	209-3344
R11	Resistor carbon	12k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8512
R12	Resistor carbon	1,5k±5% 0,2 W	SBB 0207	BEYSCHLAG	201-8415
V01	Transistor silicon	BDY56		COSEM	240-0009
V02-03	" "	2N2905A		I T T	240-0314
V04	" "	BC147B		PHILIPS	240-0536
D01	Diode silicon	BYX50-200R		"	232-2045
D02-03	Diode zener	ZPD 5,6		I T T	232-1046
D04	" silicon	BYX49-300R		PHILIPS	232-2044
D05	" germanium	AA143		"	232-3006
IC01		LM305AH		NATIONAL	262-0003
	Transistor holder			JERMYN	158-0016
	Heat sink		KK-5013	SEIFERT	158-4004
	Micro washer			MINIWATT	158-0029
	Micro washer			"	158-0030
	Fuse holder		HKP	BUSSMANN	152-7052
F01	Fuse	8A	480628	"	152-6076
F02	"	15A	480630	"	152-6077
	Box				763-1419

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
9.12 Switching Unit 12					710-0953
C01	Capacitor tantalum	100uF±20% 10V	ET05,10F16		214-0200
R01	Resistor carbon	100 ohm ±5% 1 W	SBH	BEYSCHLAG	201-3310
D01-07	Diode silicon	IN4004		I T T	232-2000
D08	" zener	IN5336B 4,3±5% 5 W		IR	232-1079
D09-11	" silicon	In4148		SESCO	232-2005
Z01	Connector	31 pole female	G17D31A3DBBM-704	CANNON	151-7709
Z02	"	13 " female	G17D13A3DBBM-704	"	151-7700
Z03	"	31 " male	G17D31A4DBBM-704	"	151-7713
Z04	"	13 pole male	G121058-1032	"	151-7712
Z05	"		SOC DC-37S	"	151-7425
RE01-03	Relay	6 SHIFT 12 V	V23030-C1017-A106,6	SIEMENS	141-3058
9.13 Remote Control Board					710-0960
				SW-board	765-0375
C01	Not assigned				
C02-06	Capacitor ceramic	1nF+80-20% K2000 400 V	9/0129,9	FERROPERM	210-1062
R01-04	Not assigned				
R05	Resistor carbon	4,7K ±5% 0,2 W	SBB	BEYSCHLAG	201-8447
R06-12	Not assigned				
R13	Resistor carbon	22K ±5% 0,2 W	"	"	201-8522
R14	" "	4,7K ±5% 0,2 W	"	"	201-8447
R15	" "	100K ±5% 0,2 W	"	"	201-8610
R16	Resistor carbon	4,7K ±5% 0,2 W	SBB	BEYSCHLAG	201-8447
R17	" "	33K ±5% 0,2 W	"	"	201-8533
R18-20	Not assigned				
R21	Resistor carbon	3,3K ±5% 0,2 W	"	"	201-8433
R22	Potentiometer carbon	500K LIN 0,1 W	60-152-001 9	PREH	209-3357
R23	" "	2,5M Log 0,08 W	63472-00061804-000	PREH	209-3362
R24	" "	~~25K LIN 0,15 W~~ 22K÷Log 0,08W	~~63470-00064804-000~~ 63406-000	PREH	~~209-3363~~ 71
R25-32	Not assigned				
R33	Potentiometer carbon	10K LIN 0,1 W	60157-001	PREH	209-3348
R34-36	Resistor carbon	1,2K ±5% 0,2 W	SBB	BEYSCHLAG	201-8412
R37	" "	100 ohm ±5% 0,2 W	"	"	201-8310
V01-	Transistor silicon	BC147B		PHILIPS	240-0536
V02	Not assigned				
V03	Transistor silicon	BC327		PHILIPS	240-0543
V04-05	Not assigned				
V06	Transistor silicon	BC147B		PHILIPS	240-0536
D01-06	Not assigned				
D07-08	Diode germanium	AA143		PHILIPS	232-3006
D09	" silicon	IN4148		SESCO	232-2005
D10-14	" germanium	AA143		PHILIPS	232-3006
D15	Not assigned				
D16-22	Diode germanium	AA143		"	232-3006
D23-24	Not assigned				
D25-26	Diode germanium	AA143		"	232-3006
D27-30	Diode silicon	IN4148		SESCO	232-2005

DIAGRAM NO.	DESCRIPTION	SPECIFICATION	MNF TYPE NO.	MNF	PART NO.
D31-33	Diode germanium	AA143		PHILIPS	232-3006
D34-35	Not assigned				
D35	Diode silicon	IN4148		SESCO	232-2005
D37-45	Not assigned				
D45-49	Diode silicon	IN4148		SESCO	232-2005
D50-52	LED red	ED209		EEP	264-1002
D53	Not assigned				
LA01	Lamp	12-15 V 30 mA W 2X4,63	No 2322	OSRAM	152-1070
	Lamp socket		4080030	ALWEGA	257-2052
F01	Not assigned				
SW01	Main selector	11 positions		MEC	155-3118
SW02	" "	10 "		"	155-3117
SW03-04	Lever switches	3X3 "	YB3R3US	SHADOW	155-3114
Z01-02	Not assigned				
Z03	Connector	5 pole stereo female	MG/PR/5-CS	CHIRI	151-7574
Z04-05	" receptacle		1545-R	MOLEX	151-7063
	Terminal female		1189	"	151-7065

loudspeaker

QUARTS CRYSTAL SPECIFICATION FOR STR 25

1. General specification

The crystal holder shall meet the requirements of D.E.F. 5271 style K (USA type HC-25/U), unless otherwise specified.

2. Mechanical data

All dimensions in mm.

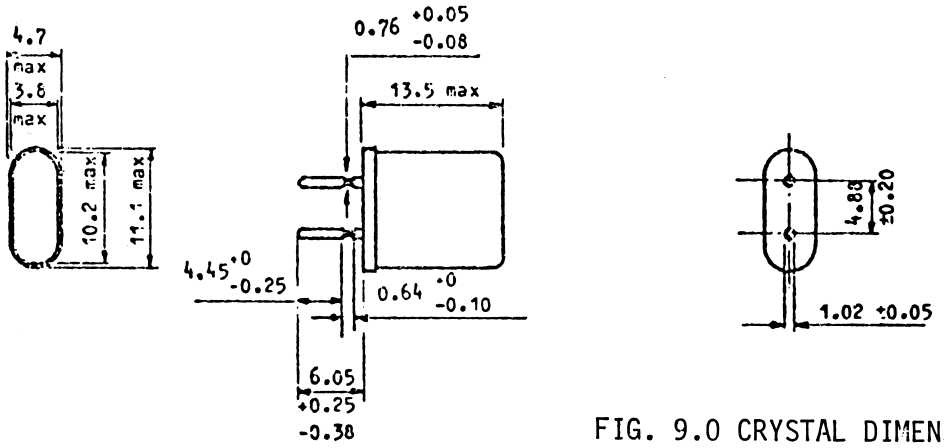


FIG. 9.0 CRYSTAL DIMENSIONS

2.1 Environmental data

Applicable to E.S.R., level of drive, shock, vibration and climatic tests	MIL-C-3098C

3. Maximum ratings

	Variant 1.	Variant 2.
Operating temperature range	-10 ... +60°C	-20 ... +60°C

4. Characteristics

Frequency range	41.750 - 43.494 KHz
Mode of operating	3rd overtone, AT-cut
Frequency tolerance at +25°C	0 ... + 20 ppm
Frequency tolerance within temp. ranges according to above	± 10 ppm rel. to freq. at +25°C
Series resonance	Series resistance <40 Ω
Power dissipation	<1 mV
Parallel capacitance C_o	<6 pF
Dynamic capacitance C_1	>1,4 mPF
Spurious response	<6 dB

5. Marking

One side	701-0011
Other side	Manufacturer and crystal oscillatin frequency
Top	Channel designator

Table 9.1 International (European) VHF Marine Mobile Channels

STR 25 VHF RADIO TELEPHONE

AUX CHANNEL/FREQUENCY CHART

Top mark AUX Channel Designators	Frequencies MHz		STR 25 AUX channel crystal oscillating frequency
	Transmit	Receive	
60	156.025	160.625	42.831.25
01	156.050	160.650	42.837.5
61	156.075	160.675	42.843.75
02	156.100	160.700	42.850.0
62	156.125	160.725	42.856.25
03	156.150	160.750	42.862.5
63	156.175	160.775	42.868.75
04	156.200	160.800	42.875.0
64	156.225	160.825	42.881.25
05	156.250	160.850	42.887.5
65	156.275	160.875	42.893.75
06	156.300	156.300	41.750.0
66	156.325	160.925	42.906.25
07	156.350	160.950	42.912.5
67	156.375	156.375	41.768.75
08	156.400	156.400	41.775.0
68	156.425	156.425	41.781.25
09	156.450	156.450	41.787.5
69	156.475	156.475	41.793.75
10	156.500	156.500	41.800.0
70	156.525	156.525	41.806.25
11	156.550	156.550	41.812.5
71	156.575	156.575	41.818.75
12	156.600	156.600	41.825.0
72	156.625	156.625	41.831.25
13	156.650	156.650	41.837.5
73	156.675	156.675	41.843.75
14	156.700	156.700	41.850.0
74	156.725	156.725	41.856.25
15	156.750	156.750	41.862.5

STR 25 VHF RADIO TELEPHONE

AUX CHANNEL/FREQUENCY CHART

Top mark - AUX Channel Designators	Frequencies MHz		STR 25 AUX channel crystal oscillating frequency
	Transmit	Receive	
75		Guard-band	-
16	156.800	156.800	41.875.0
76		Guard-band	-
17	156.850	156.850	41.887.5
77	156.875	156.875	41.893.75
18	156.900	161.500	43.050.0
78	156.925	161.525	43.056.25
19	156.950	161.550	43.062.5
79	156.975	161.575	43.068.75
20	157.000	161.600	43.075.0
80	157.025	161.625	43.081.25
21	157.050	161.650	43.087.5
81	157.075	161.675	43.093.75
22	157.100	161.700	43.100.0
82	157.125	161.725	43.106.25
23	157.150	161.750	43.112.5
83	157.175	161.775	43.118.75
24	157.200	161.800	43.125.0
84	157.225	161.825	43.131.25
25	157.250	161.850	43.137.5
85	157.275	161.875	43.143.75
26	157.300	161.900	43.150.0
86	157.325	161.925	43.156.25
27	157.350	161.950	43.162.5
87	157.375	161.975	43.168.75
28	157.400	162.000	43.175.0
88	157.425	162.025	43.181.25
WX 1	-	162.550	43.312.50
WX 2	-	162.400	43.275.0

Note: For U.S. Channels, see table 9.2 overleaf.

Table 9.2 U.S. VHF Marine Mobile Channels

STR 25 VHF TELEPHONE

AUX CHANNEL/FREQUENCY CHART

Top mark - AUX Channel Designators	Frequencies MHz		STR 25 AUX channel crystal oscillating frequency
	Transmit	Receive	
65S	156.275	156.275	41.743.75
06	156.300	156.300	41.750.0
66S	156.325	156.325	41.756.25
07	156.350	156.350	41.762.5
67	156.375	156.375	41.768.75
08	156.400	156.400	41.775.0
68	156.425	156.425	41.781.25
09	156.450	156.450	41.787.5
69	156.475	156.475	41.793.75
10	156.500	156.500	41.800.0
70	156.525	156.525	41.806.25
11	156.550	156.550	41.812.5
71	156.575	156.575	41.818.75
12	156.600	156.600	41.825.0
72	156.625	156.625	41.831.25
13	156.650	156.650	41.837.5
73	156.675	156.675	41.843.75
14	156.700	156.700	41.850.0
74	156.725	156.725	41.856.25
15	156.750	156.750	41.862.5

STR 25 VHF RADIO TELEPHONE

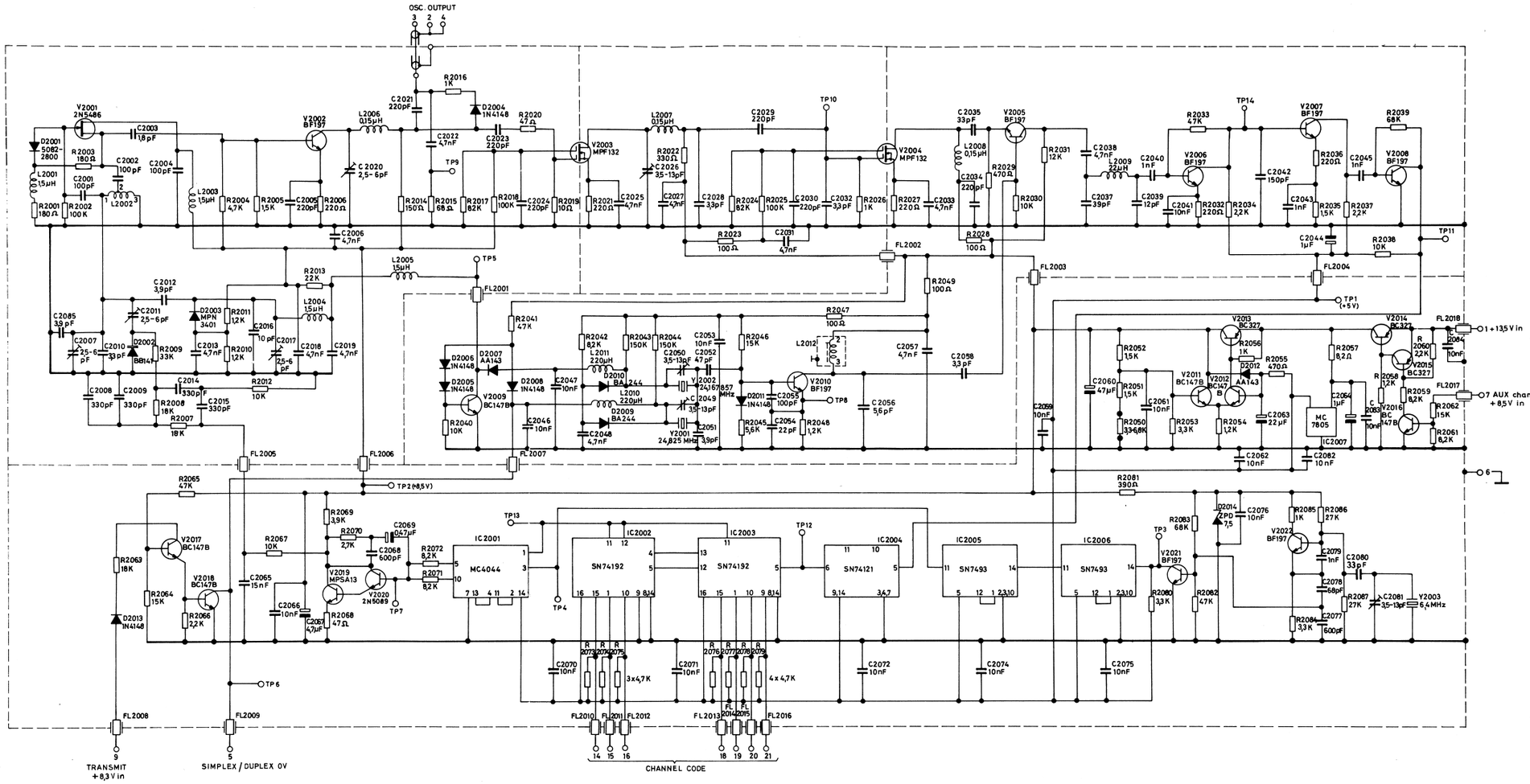
AUX CHANNEL/FREQUENCY CHART

Top mark - AUX Channel Designators	Frequencies MHz		STR 25 AUX channel crystal oscillating frequency
	Transmit	Receive	
75		Guard-band	-
16	156.800	156.800	41.875.0
76		Guard-band	-
17	156.850	156.850	41.887.5
77	156.875	156.875	41.893.75
18S	156.900	156.900	41.900.0
78S	156.925	156.925	41.906.25
19S	156.950	156.950	41.912.5
79S	156.975	156.975	41.918.75
20	157.000	161.600	43.075.0
80S	157.025	157.025	41.931.25
24	157.200	161.800	43.125.0
84	157.225	161.825	43.131.25
25	157.250	161.850	43.137.5
85	157.275	161.875	43.143.75
26	157.300	161.900	43.150.0
86	157.325	161.925	43.156.25
27	157.350	161.950	43.162.5
87	157.375	161.975	43.168.75
28	157.400	162.000	43.175.0
88S	157.425	157.425	42.031.25
WX 1	-	162.550	43.312.50
WX 2	-	162.400	43.275.0

OSCILLATOR FREQUENCY MHz		Dividing ratio	Code							Channel no.	
Rx simplex	Rx duplex & Tx	n:1	14	15	16	18	19	20	21		
166,725	171,325	98								60	
166,750	171,350	97									01
166,775	171,375	96								61	
166,800	171,400	95									02
166,825	171,425	94								62	
166,850	171,450	93									03
166,875	171,475	92								63	
166,900	171,500	91									04
166,925	171,525	90								64	
166,950	171,550	89									05
166,975	171,575	88								65	
167,000	171,600	87									06
167,025	171,625	86								66	
167,050	171,650	85									07
167,075	171,675	84								67	
167,100	171,700	83									08
167,125	171,725	82								68	
167,150	171,750	81									09
167,175	171,775	80								69	
167,200	171,800	79									10
167,225	171,825	78								70	
167,250	171,850	77									11
167,275	171,875	76								71	
167,300	171,900	75									12
167,325	171,925	74								72	
167,350	171,950	73									13
167,375	171,975	72								73	
167,400	172,000	71									14
167,425	172,025	70								74	
167,450	172,050	69									15
167,475	172,075	68								75	
167,500	172,100	67									16
167,525	172,125	66								76	
167,550	172,150	65									17
167,575	172,175	64								77	
167,600	172,200	63									18
167,625	172,225	62								78	
167,650	172,250	61									19
167,675	172,275	60								79	
167,700	172,300	59									20
167,725	172,325	58								80	
167,750	172,350	57									21
167,775	172,375	56								81	
167,800	172,400	55									22
167,825	172,425	54								82	
167,850	172,450	53									23
167,875	172,475	52								83	
167,900	172,500	51									24
167,925	172,525	50								84	
167,950	172,550	49									25
167,975	172,575	48								85	
168,000	172,600	47									26
168,025	172,625	46								86	
168,050	172,650	45									27
168,075	172,675	44								87	
168,100	172,700	43									28
168,125	172,725	42								88	

▨ Ground potential

☐ Free (+5V potential)



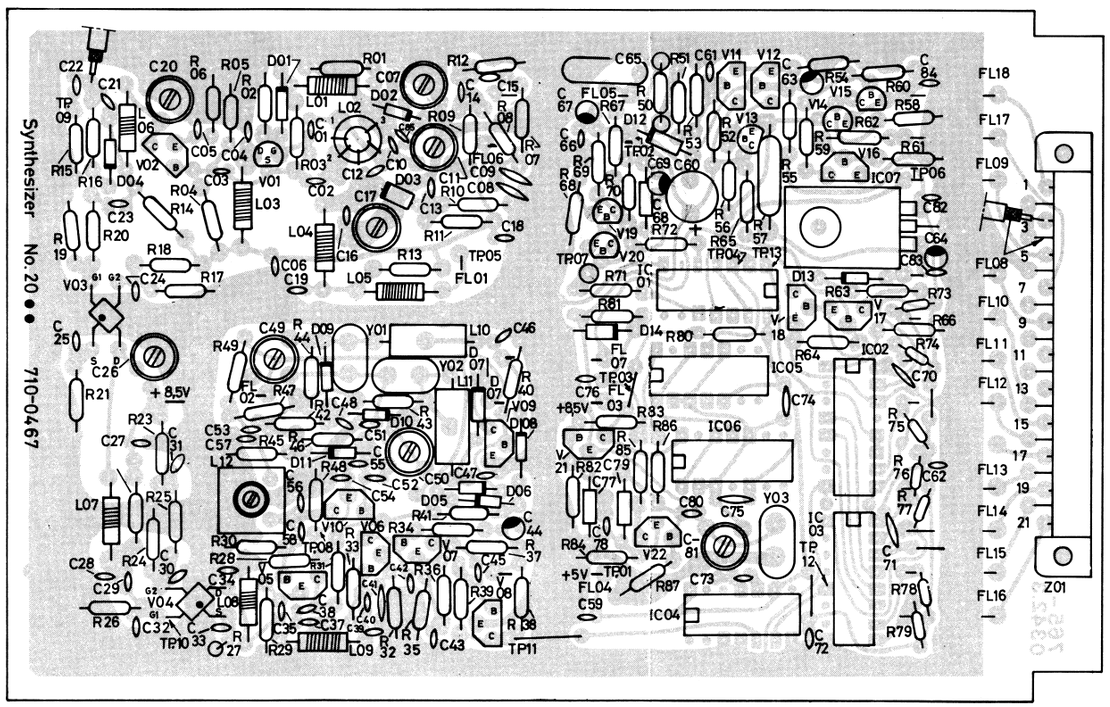
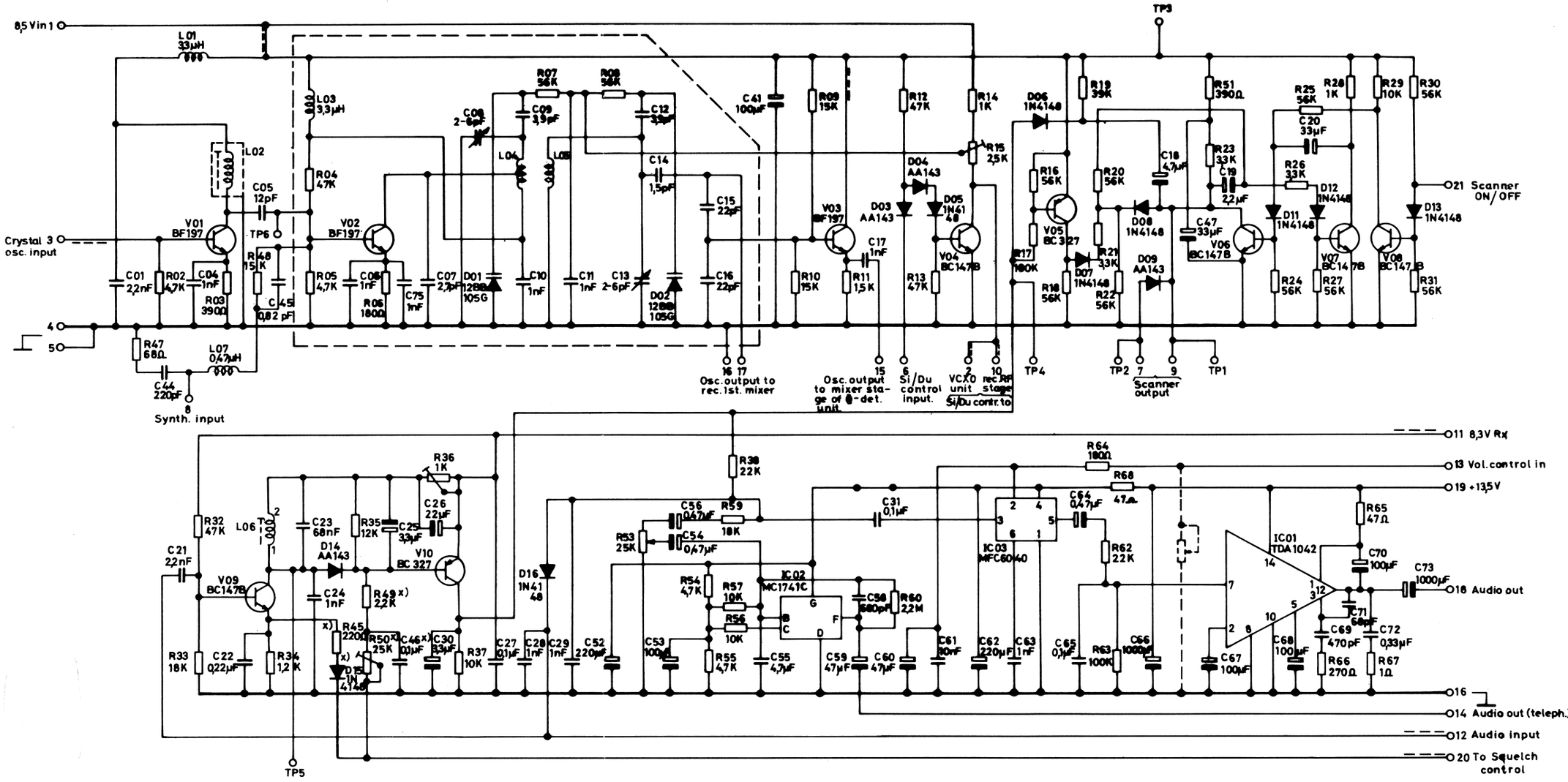
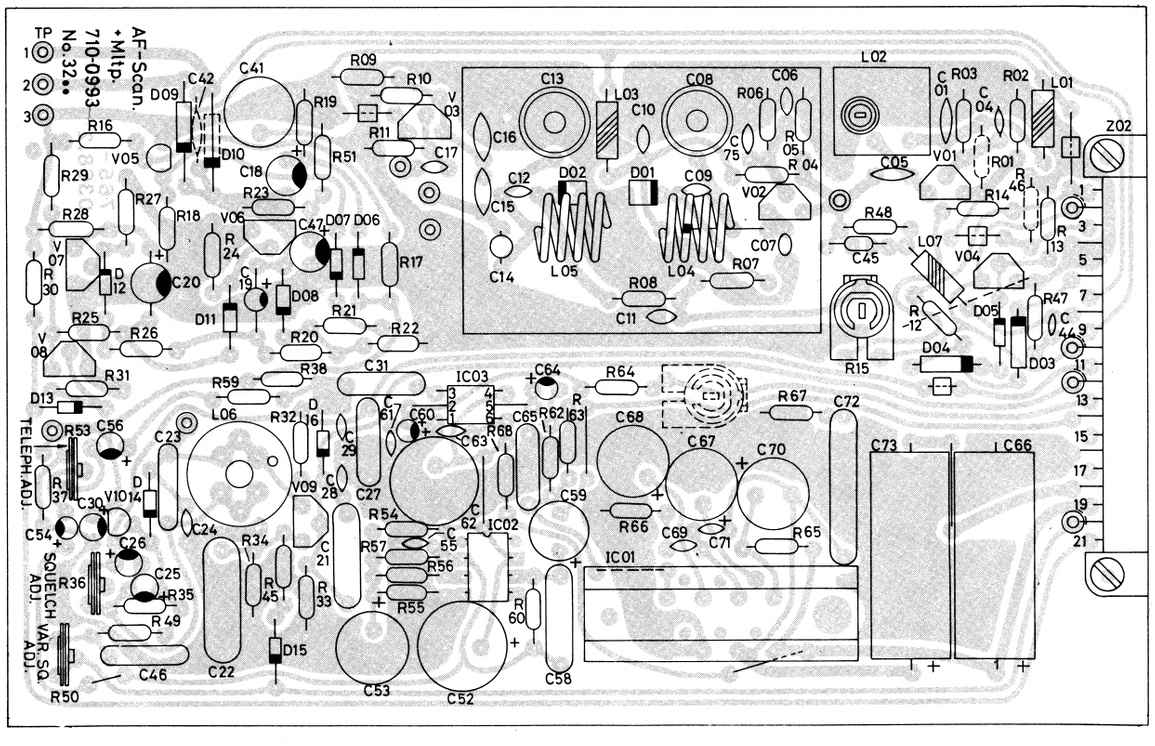


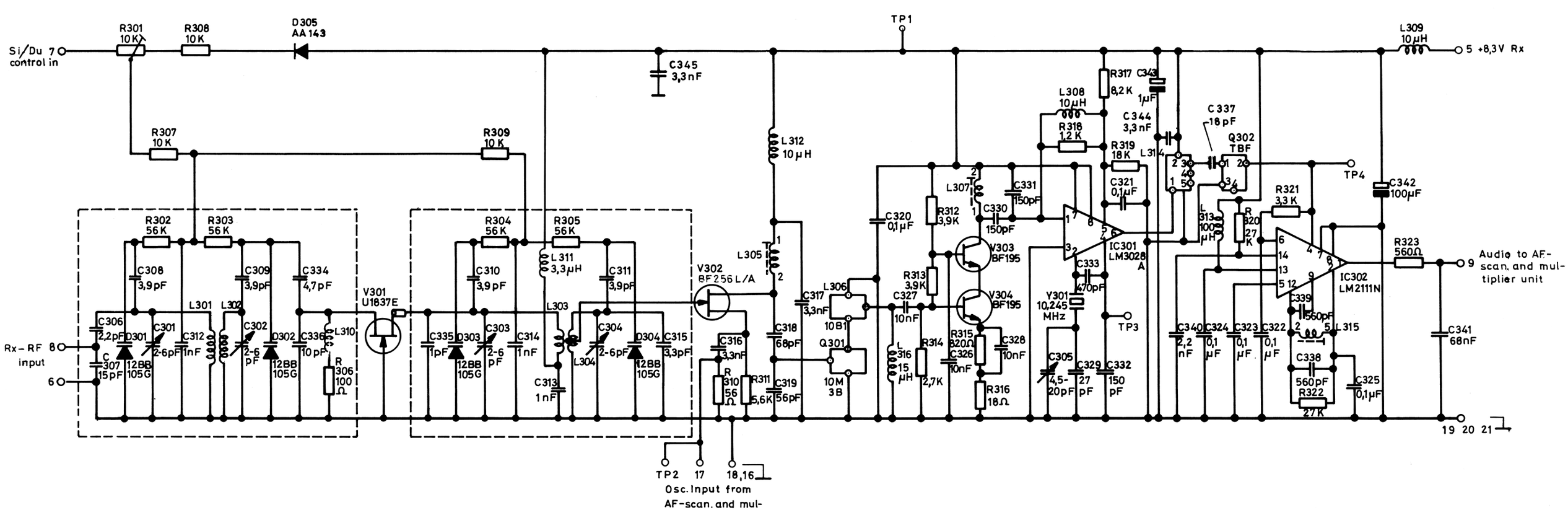
FIG. 10.1 SYNTHESIZER BOARD





AF-SCANNER AND MULTIPLIER BOARD

FIG. 10.2



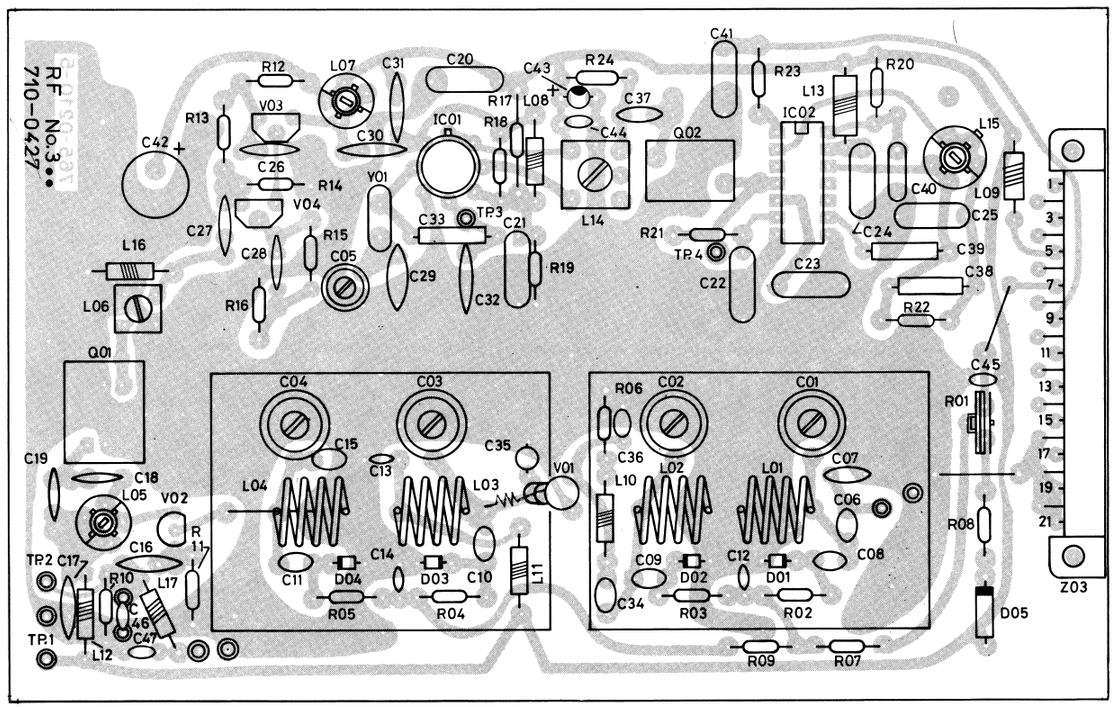


FIG. 10.3 RF-BOARD

Si/Du (or Synth. ch.) inform. from Control unit (or synth. unit).

TP1 11 TP2

TP4

8 +8,3V TX

D417 ZPD5,6

C430 0,1µF

R445 33Ω

D406 AA143

R446 6,8K

L407 L408

R401 100K C402 3,3nF

C403 680pF L403 C408 3,3nF R408 33K

R409 100K D403 1N4148 R410 470Ω C410 1nF D404 1N4148 C411 0,1µF D405 1N4148

L405 C412 3,3nF R419 33K C417 470pF C419 3,3nF R425 100K

R423 68Ω L404

L401 C404 22pF C405 33pF R404 68Ω R405 1,5K D401 MV2209 V401 BF197

L402 C406 4,7nF C407 1nF V401 10,7 MHZ R403 10K R406 1,8K R407 15K V402 BC147B R412 39K

R418 1,5K V404 BF197 C418 4,7nF R421 1,8K C413 1nF C414 1nF R420 15K

C416 22pF C415 33pF R422 1,5K D402 MV2209 L406 V402 15,3MHZ R424 10K

R426 22K C421 0,1µF C420 100pF C423 33nF

R427 1,2 K R428 25K R430 2,2K C426 100pF

R401 100K C402 3,3nF

R402 22K C401 100pF

R413 220Ω R417 220Ω

R415 15K R416 15K R414 1,5K V405 BF197

TP3 C409 4,7nF

FM signal out 17

(10,7 or 15,3 MHz) 16

R429 25K C422 0,1µF

V406 BC147B R431 15K R432 15K C427 22µF R433 33K C428 10µF R435 2,2K R436 10K C437 100µF C436 4,7nF C433 56pF

V407 BC147B R441 3,3K

C424 1,2nF C425 6,8nF

R434 56K C429 100 µF R438 220 Ω C431 0,33 µF C440 470Ω C432 56pF

V408 BC147B R439 22K C434 47 nF C447 47nF

V409 BC147B C435 100µF R442 100Ω R443 100Ω

V410 BC147B C438 10 nF R448 180Ω R444 4700Ω C439 100 µF R449 820 Ω R450 33K

R447 100K C440 4,7µF

R452 33K R451 390 Ω R453 1K C441 1nF

4 Micr. input

2 (Ext. micr. input)

3

20 +13,5V in

R465 4,7K

V411 2N2905 A

R454 470Ω R456 1K R455 470Ω D407 AA143

C443 47uF R459 1K C444 10nF R460 1,5K R458 3,9K R461 4,7K

V412 BC147B V413 BC147B

C442 47µF D418 ZPD6,2 R457 1,2K

R462 1K V414 BC327 D408 1N4148 R 463 680 Ω D409 1N4148 R473 47K R466 1,5K R468 8,2K D422 1N4148 D420 1N4148

V415 BC327 D421 1N4148

R467 4,7K D410 1N4148 V416 BC327 V417 BC147B R464 1,5K

5 +8,5 V out

12 +8,3 V Rx out

8 +8,3 V Tx out

10 To Si/Du to Sw. unit

7 Si/Du inform. from AF-scan.

6 Si/Du inform. from Control unit and Crystal unit

14 Tx blocking inform.

9

D411 - 1N4148

18 To PTT sw.

R470 15 K R471 15 K C445 1nF R472 10K D412 1N4148 D413 1N4148 R469 10K D 414 1N4148 D 415 1N4148 C446 1nF D419 1N4148

V418 BC147 B V419 BC147B

19 Sq/Scan. sw. return

13 Scanner input

21 To ch. sw.

* DECCA VERSION :
C 447 10nF added
R 431 and R 432; read 22Kn.
R467 gain tie stel 1st Nil bank

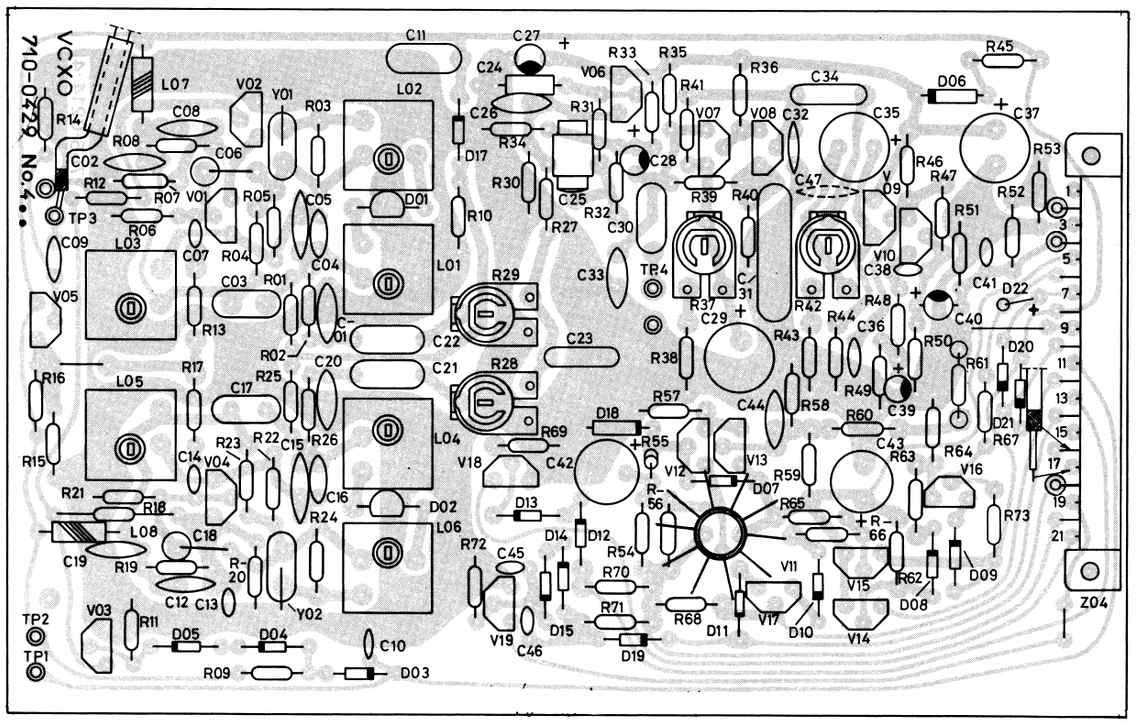
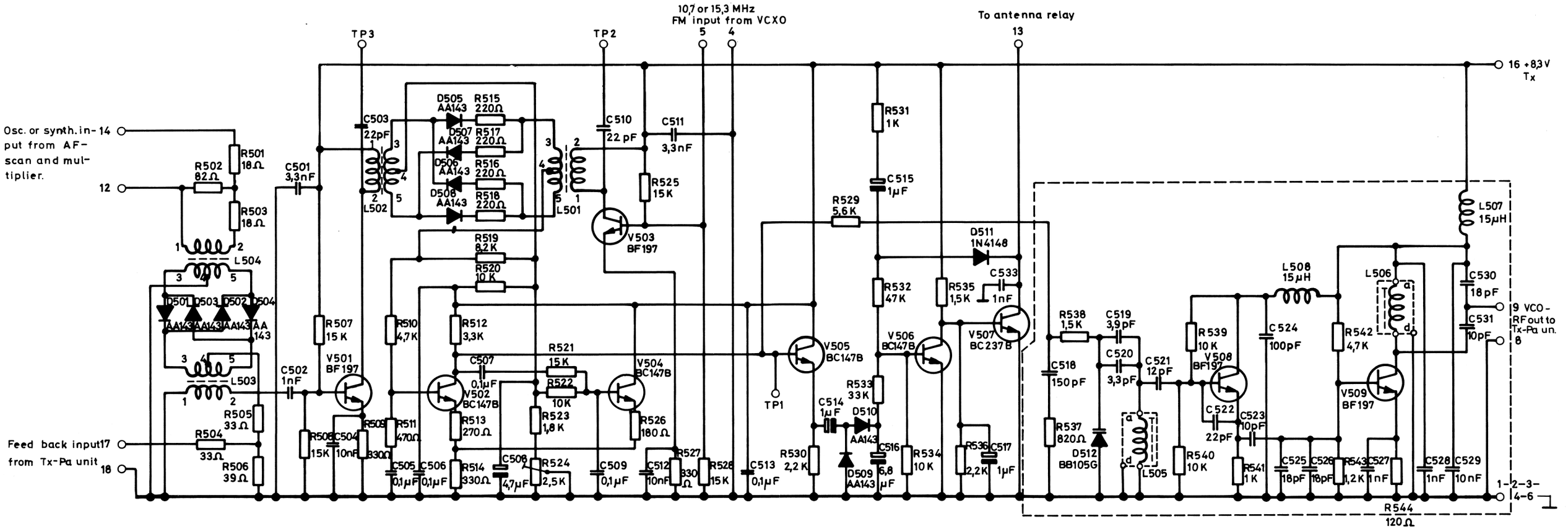


FIG. 10.4 VCXO-BOARD



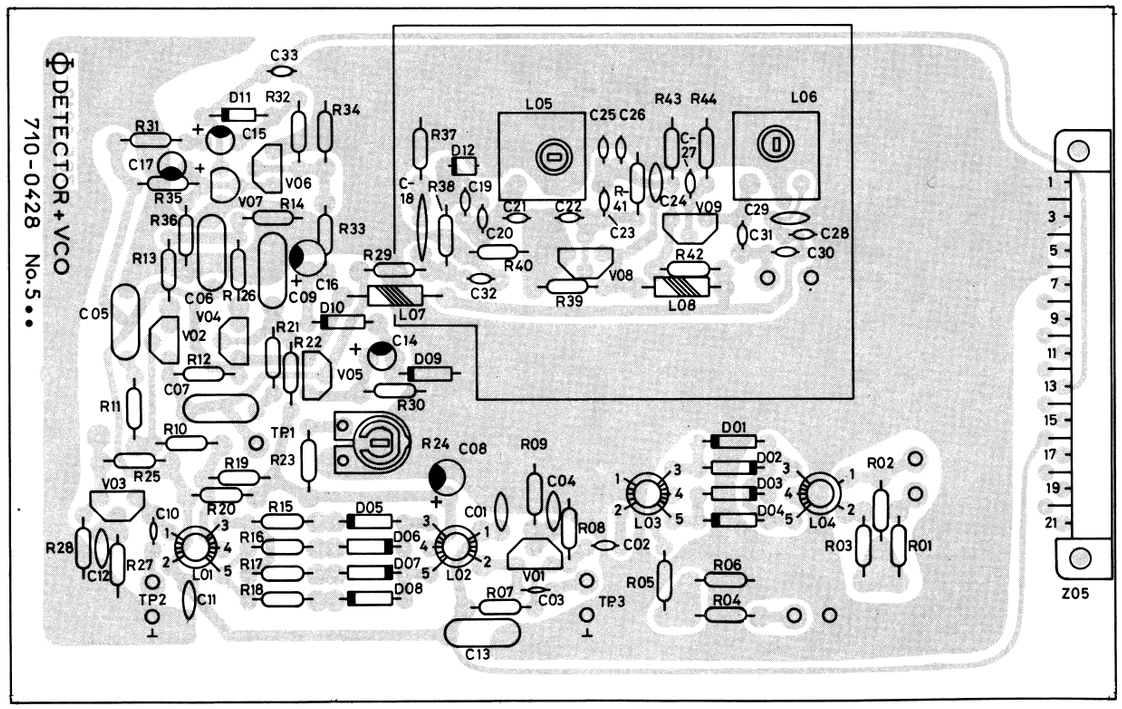


FIG. 10.5 Φ-DETECTOR BOARD

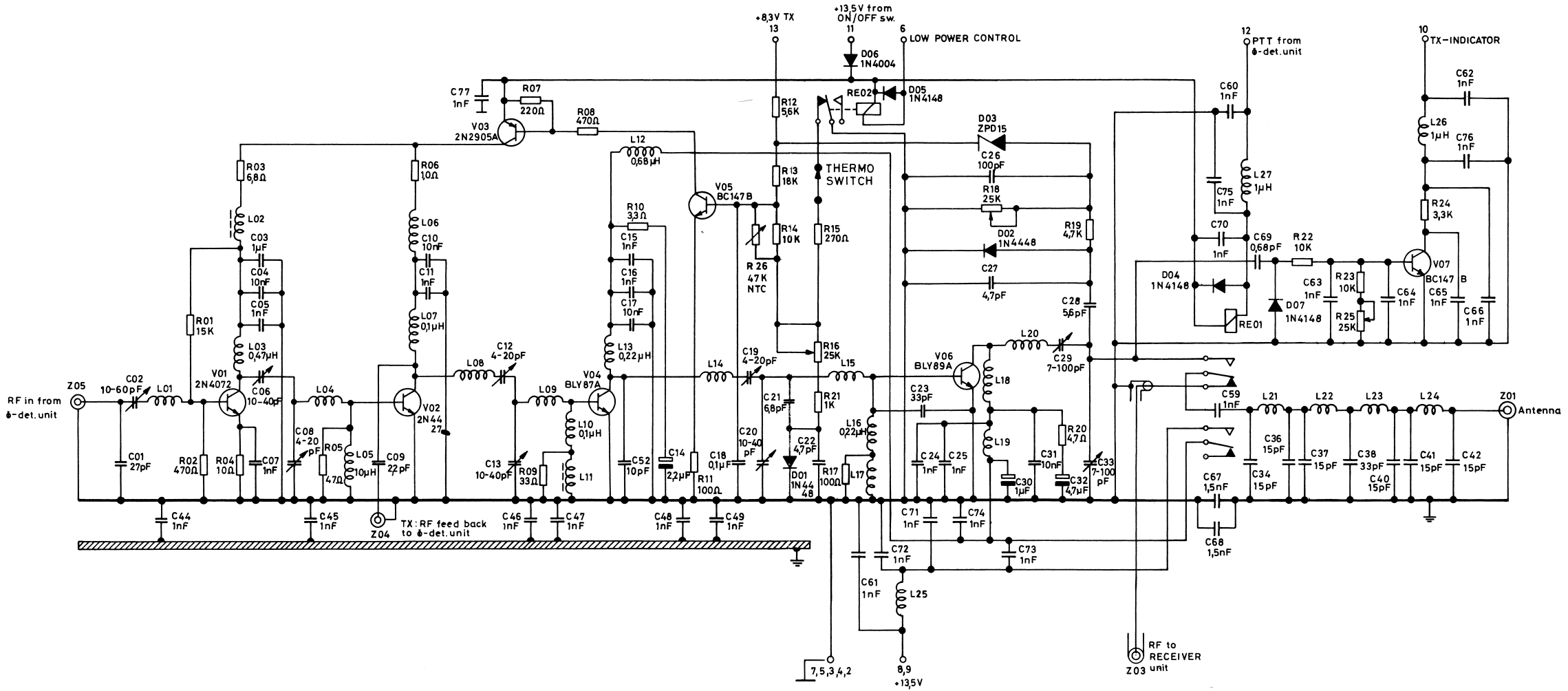


FIG. 10.6 TX-PA BOARD

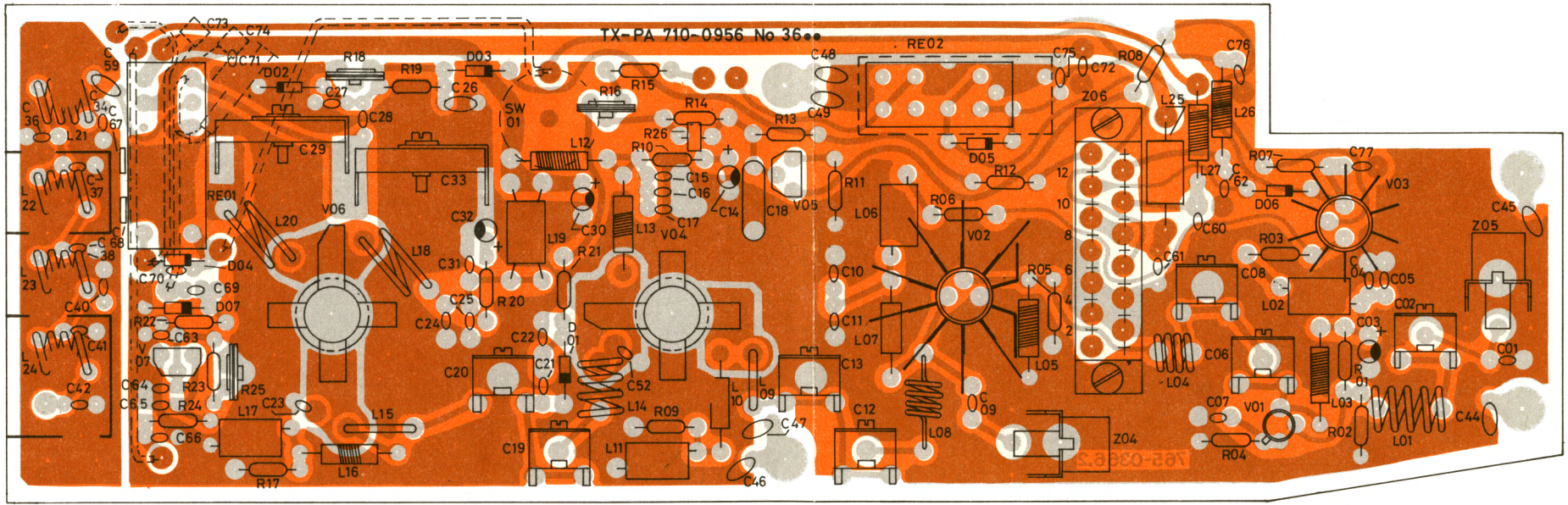
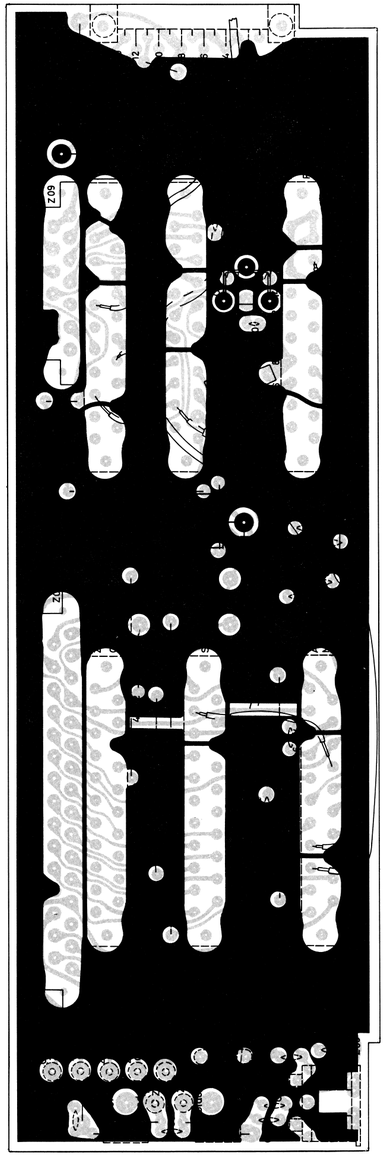


FIG. 10.6 TX-PA BOARD



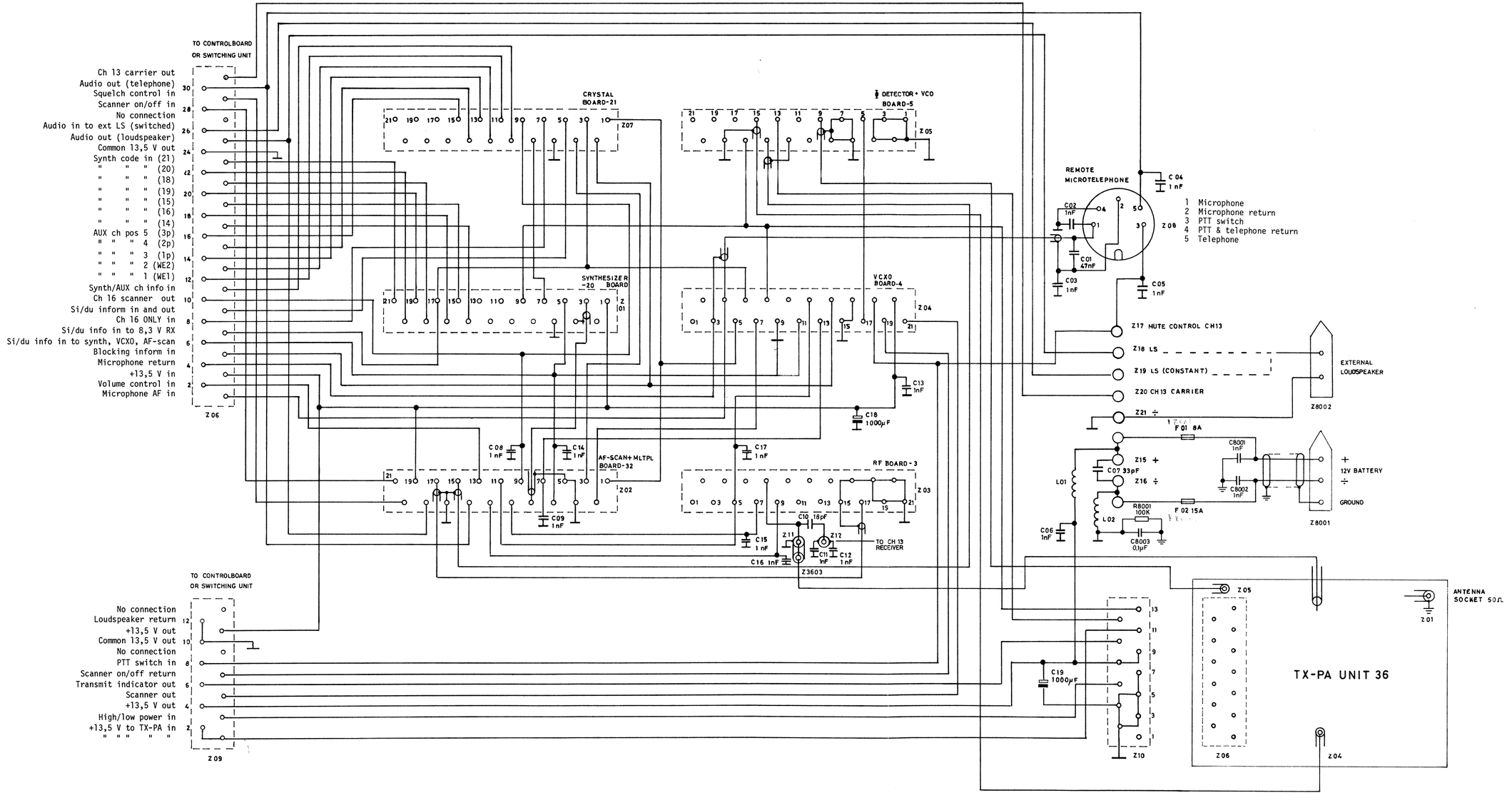


FIG. 10.7 MOTHER BOARD

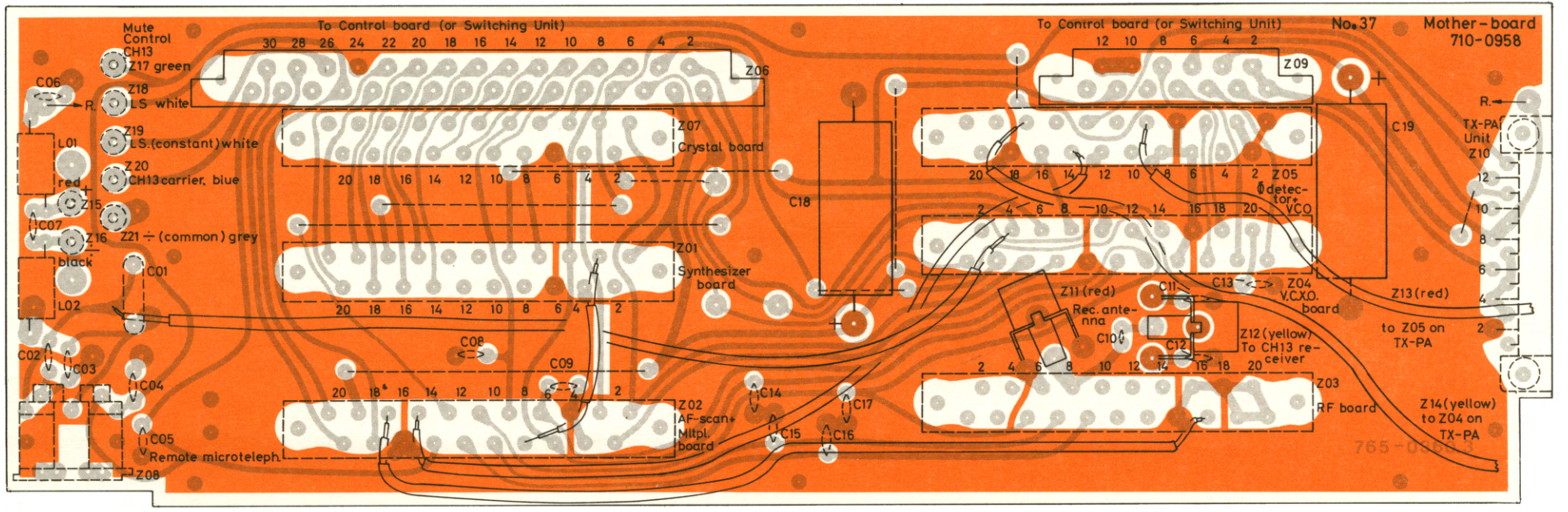
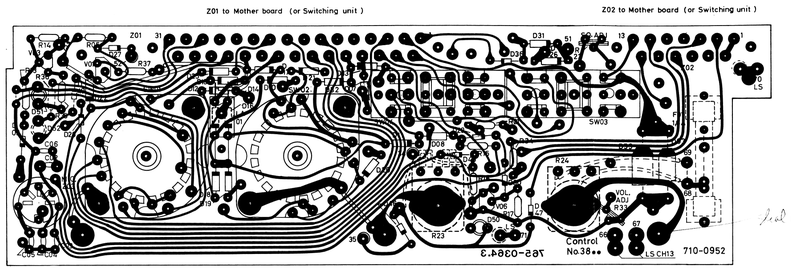
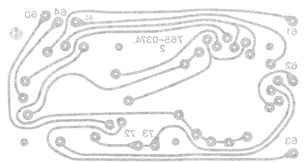


FIG. 10.7 MOTHER BOARD





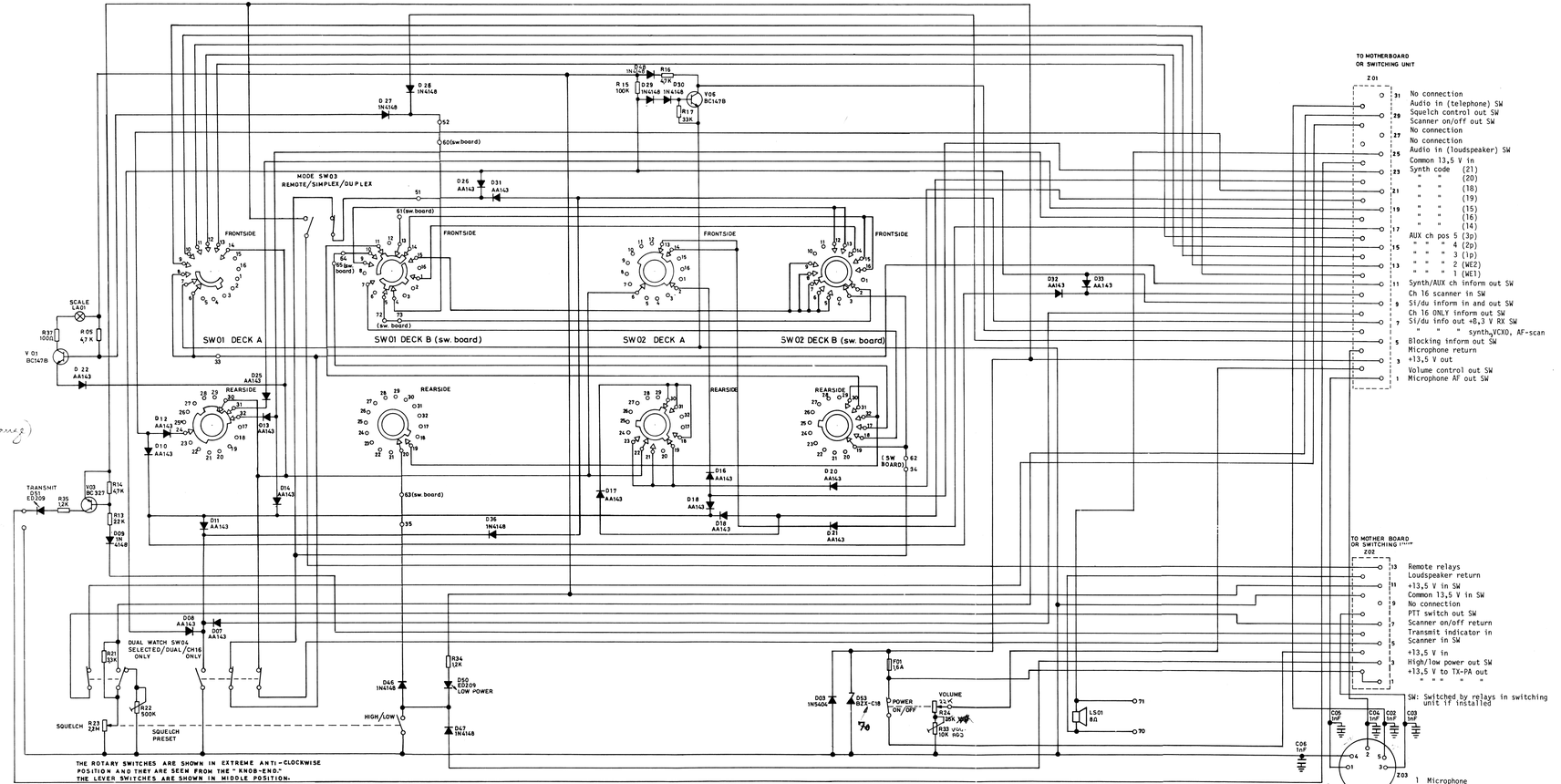


FIG. 10.8 CONTROL BOARD

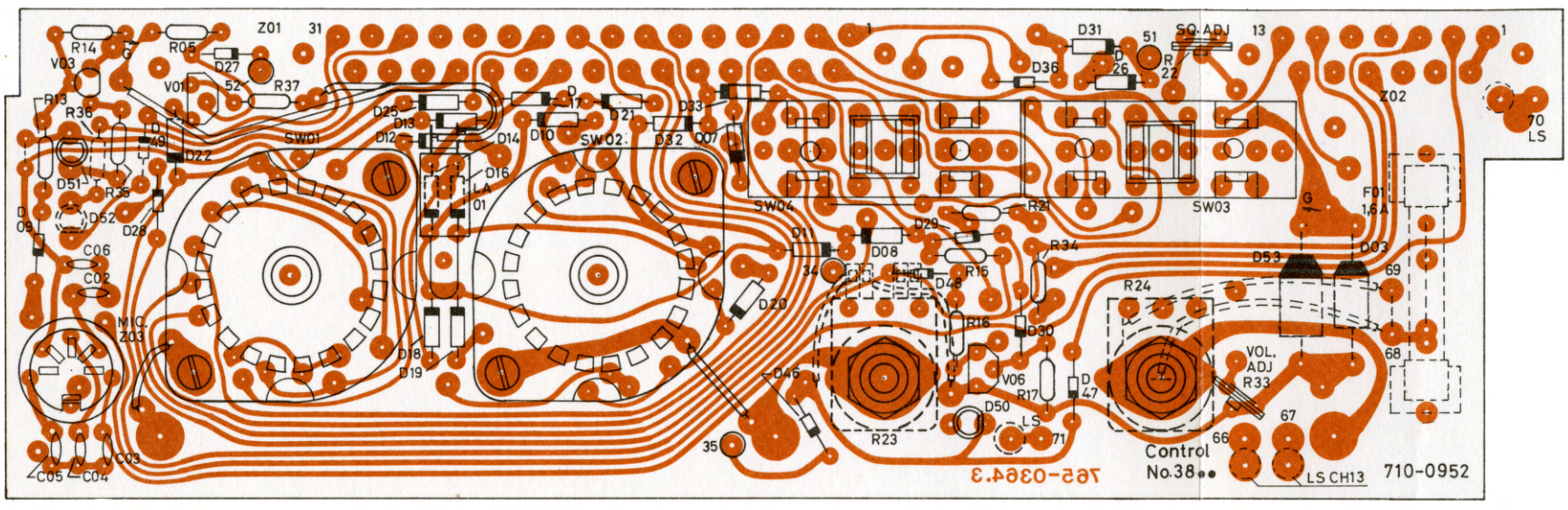
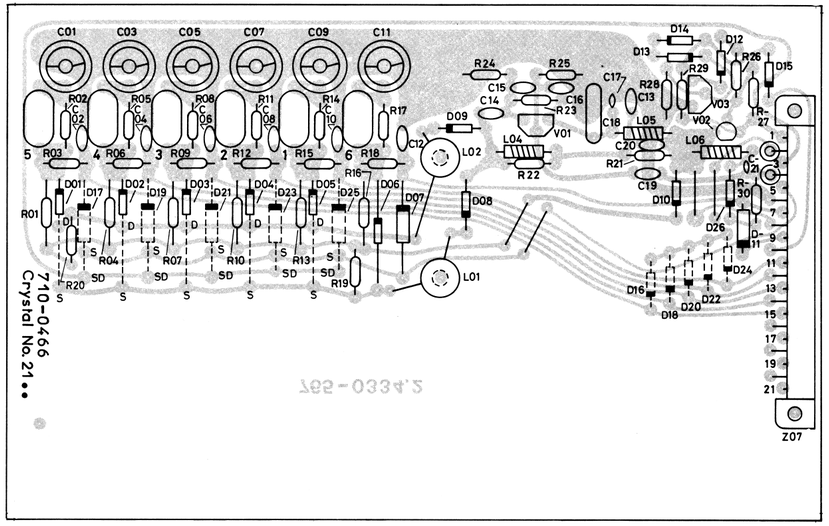


FIG. 10.8 CONTROL BOARD



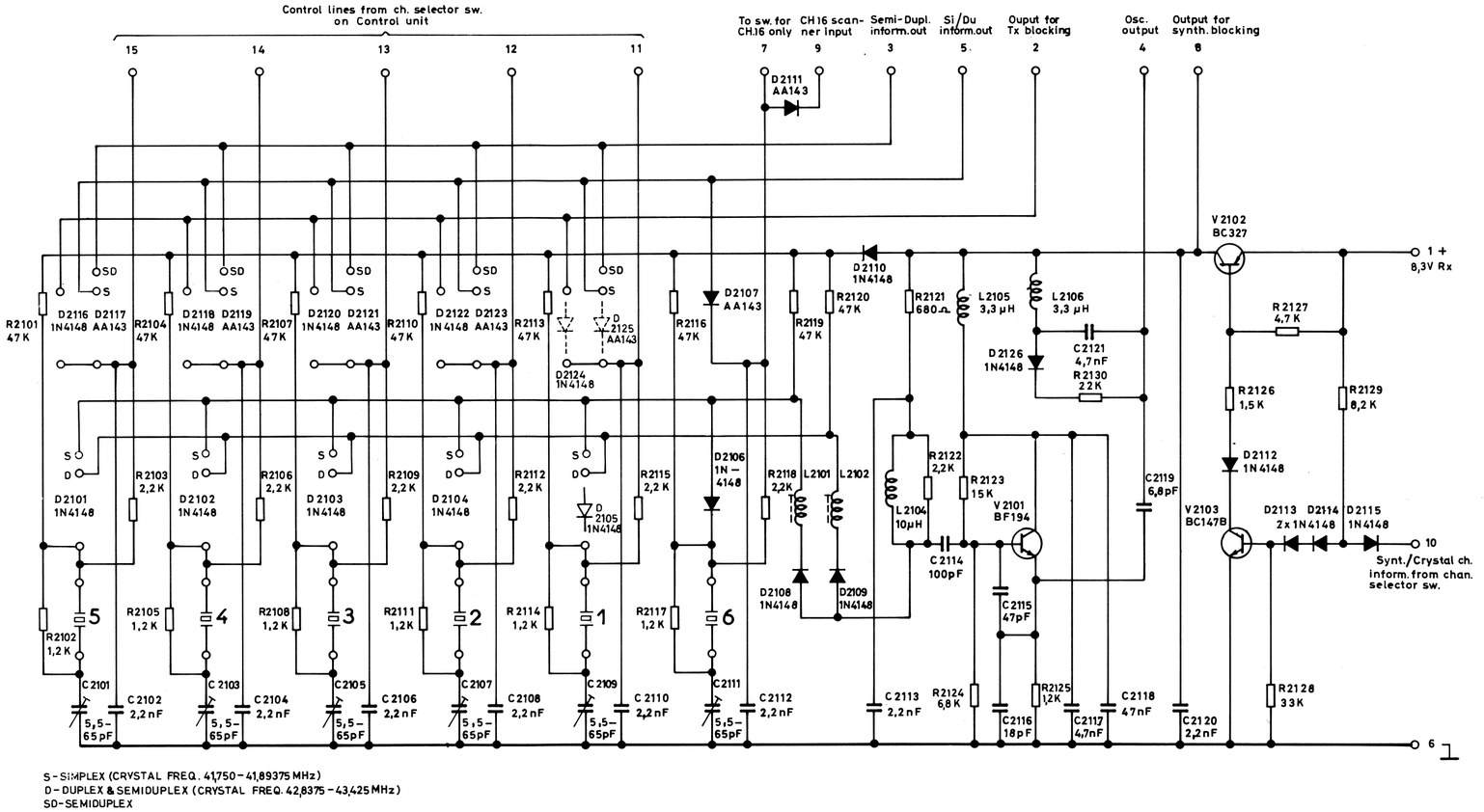
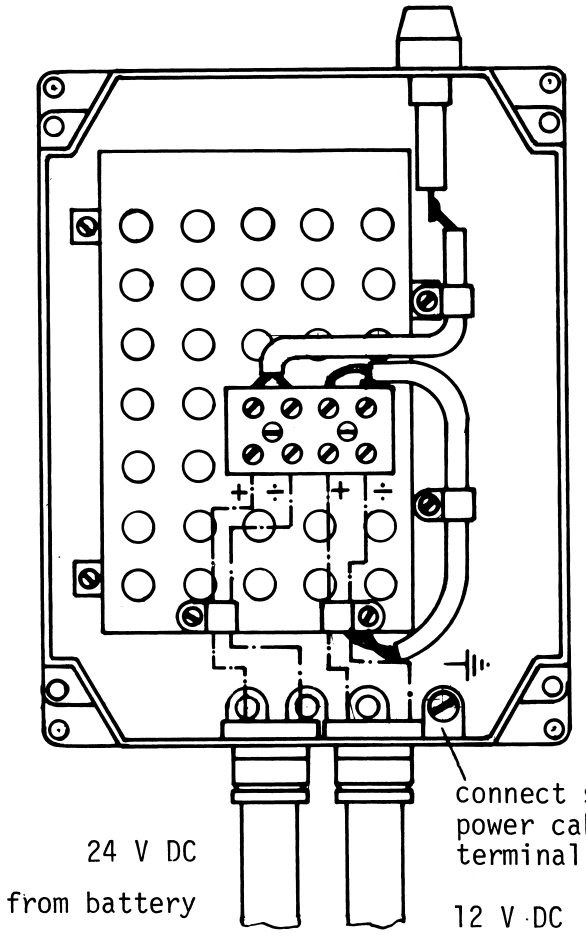


FIG. 10.10 CRYSTAL BOARD

F_1 8 amps fuse

F_2 15 amps fuse



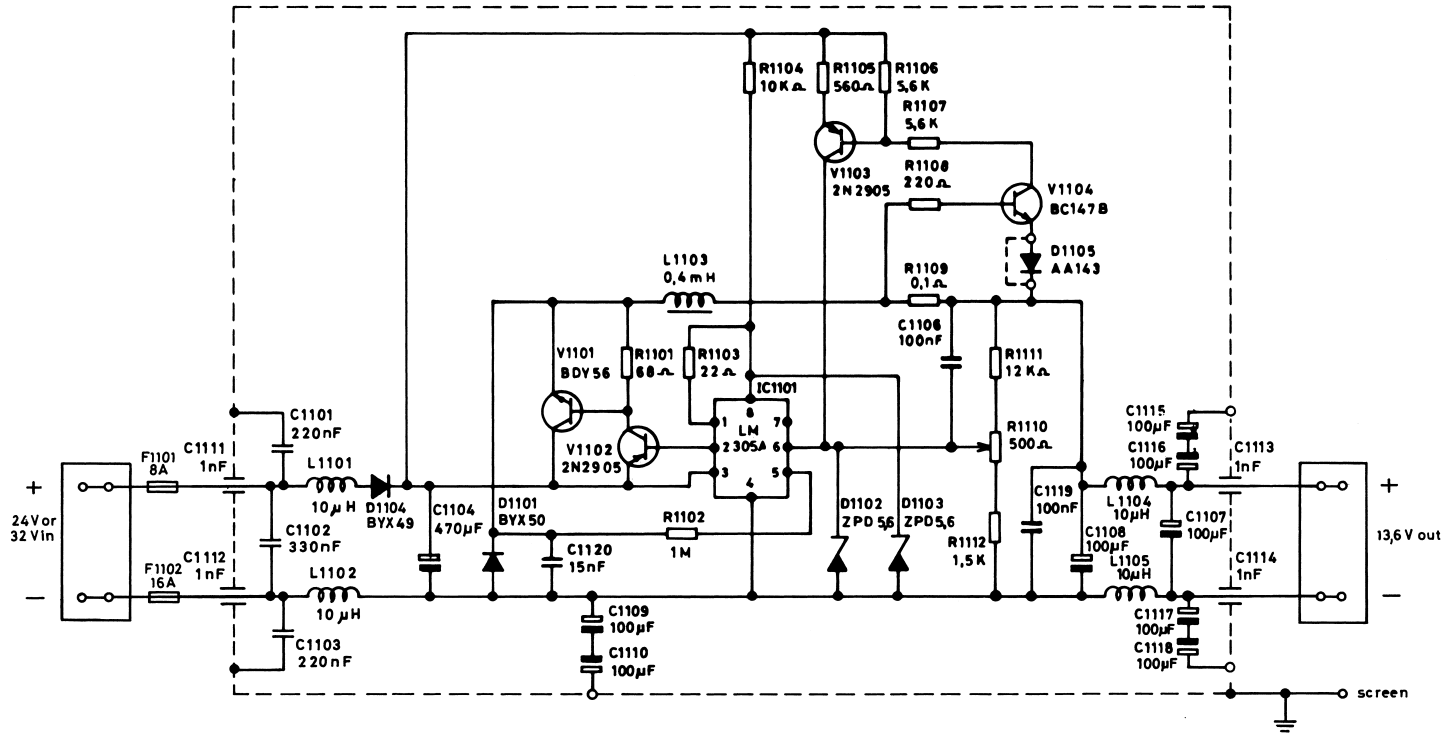


FIG. 10.11
24/32 ~~V~~ -13,6V SWITCHING REGULATOR

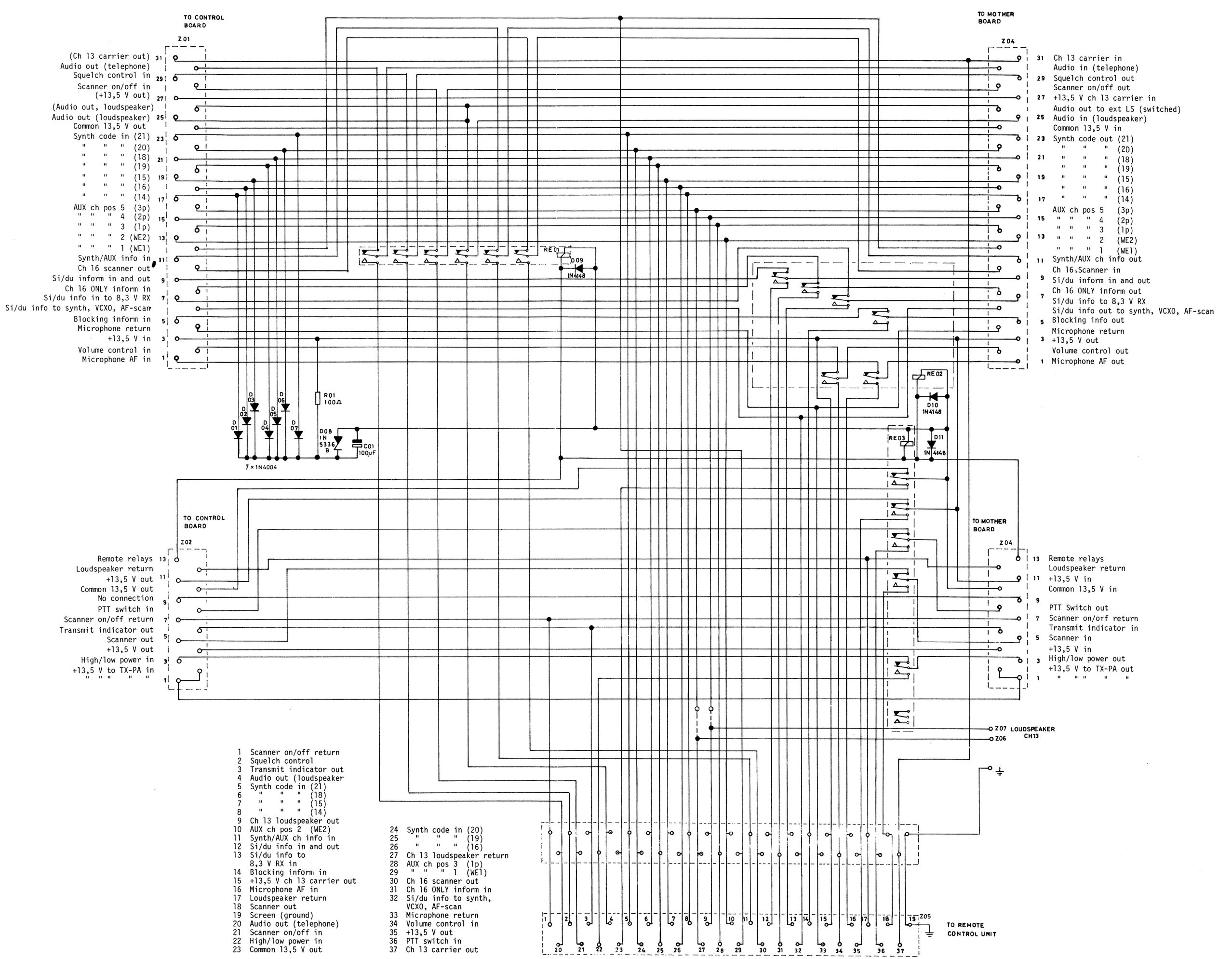


FIG. 10.12 SWITCHING BOARD

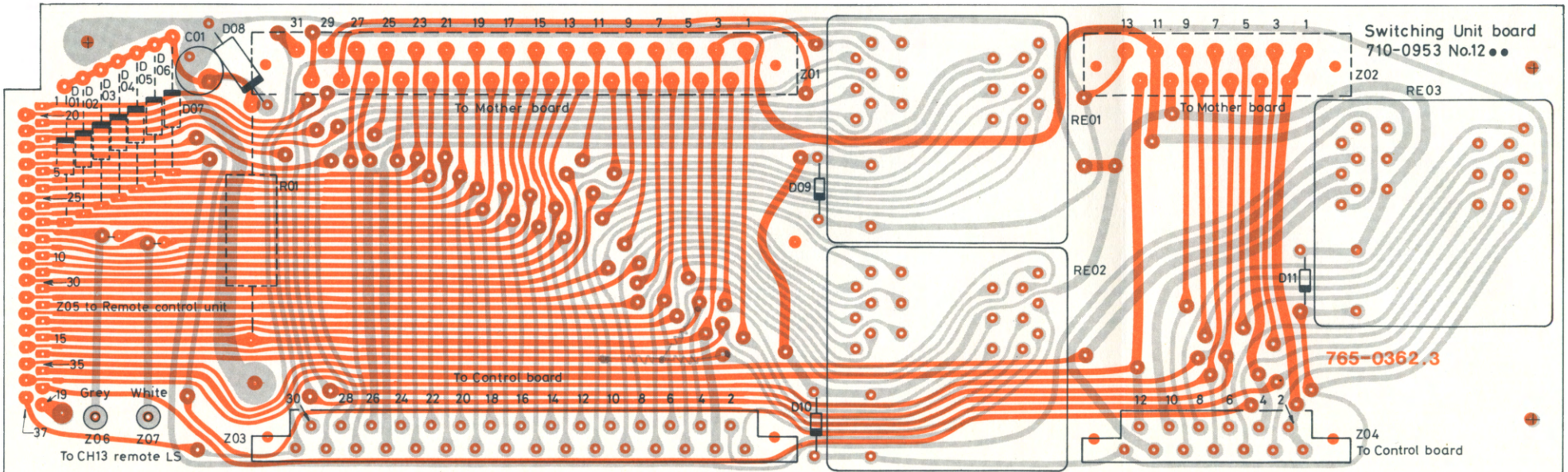


FIG. 10.12 SWITCHING BOARD

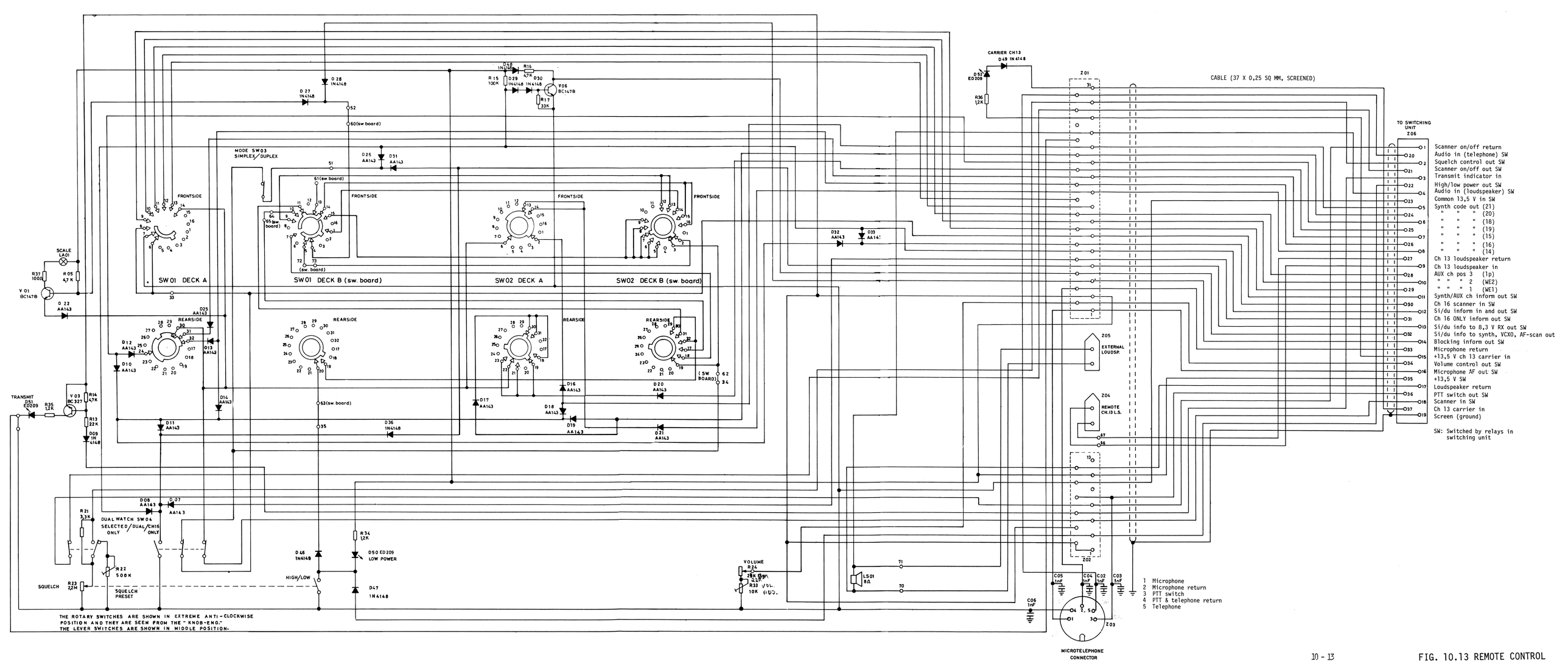


FIG. 10.13 REMOTE CONTROL