VHF-FM
PERSONAL RADIO STATION
MODEL STORNOPHONE 500
TYPE CQP511
TYPE CQP512
TYPE CQP514
146 - 174 MHz

CONTENTS

Technical Data and Typical Performance Characteristics

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publication RS-316.

General

Frequency Range
CQP510L: 146-160 MHz.
CQP510H: 156-174 MHz.

Minimum Channel Spacing
CQP511: 50 kHz.
CQP512: 25kHz/20kHz.
CQP514: 12.5 kHz.

Maximum Frequency Swing
CQP511: ±15 kHz.
CQP512: ±5kHz/±4kHz.
CQP514: ±2.5 kHz.

Antenna Impedance
50 Ω.

Maximum Channel Bandwidth
1.4 MHz.

Number of RF Channels
Maximum 3.

Dimensions, Cabinet
196 mm x 72 mm x 33 mm.

Weight
750 grams.

Transmitter

RF Output
500 mW.

Modulation
Phase-modulation.

Modulation Response
CQP511, CQP512:
6 dB/octave preemphasis characteristic from 300 to 3000 Hz, +1dB relative to 1000 Hz.
CQP514:
6 dB/octave preemphasis characteristic from 300 to 2500 Hz, +1dB -3dB relative to 1000 Hz.

Frequency Stability
Meets government specifications.

Crystal Frequency Calculation

$$\text{Crystal frequency} = \frac{\text{signal frequency}}{12}$$

Spurious and Harmonic Radiation
Less than 2×10^{-7} watts.

Crystal
Storno type 98-8, spec. S-98-8.

Receiver Section

Sensitivity
0.8 μV e.m.f. for 12 dB SINAD.

Squelch
Electronic, adjustable.

Adjacent Channel Selectivity
80 dB.

Spurious and Harmonic Radiation
Less than 2×10^{-9} watts.

Intermodulation Attenuation
65 dB.

Spurious Response Attenuation
85 dB.

Crystal Frequency Calculation
CQP510L:

$$\text{Crystal frequency} = \frac{\text{signal frequency} + 10.7}{3} \text{ MHz.}$$

CQP510H:

$$\text{Crystal frequency} = \frac{\text{signal frequency} - 10.7}{3} \text{ MHz.}$$

AF Power Output
200 mW.

Crystal
Storno type 98-9 spec. S-98-9.

Battery

Type
Rechargeable NiCd (Storno BU501).

Number of Cells
10.

Nominal Voltage
12.4 V.

Capacity
225 mAh.

Current Consumption
Standby: 10 mA.
Receive, AF output 200 mW: 40 mA.
Transmit: 120 mA.

Storno reserves the right to change the listed specifications without notice.

SUPPLEMENT FOR 1W TRANSMITTERS CQP510

Technical Data and Guaranteed Performance Characteristics

Unless otherwise stated, specifications are based on the measuring methods precribed in EIA publication RS-316.

Storno reserves the right to change the listed specifications without notice.

General

Frequency Range
CQP510L: 146-160 MHz
CQP510H: 156-174 MHz.

Minimum Channel Spacing
CQP511: 50 kHz
CQP512: 25 kHz
CQP513: 20 kHz
CQP514: 12.5 kHz.

Maximum Frequency Swing
CQP511: ±15 kHz
CQP512: ± 5 kHz
CQP512: ± 4 kHz
CQP514 ± 2.5 kHz.

Antenna Impedance
50 Ω.

Maximum Channel Bandwidth
1.4 MHz.

Number of RF Channels
Maximum 3.

Dimensions, Cabinet
196 mm x 72 mm x 33 mm.

Weight
750 grams.

Transmitter

RF Output
1.0 W

Modulation
Phase-modulation.

Modulation Response
CQP511, CQP512, CQP513:
6 dB/octave preemphasis characteristic from 300 to 3000 Hz, +1 dB relative to 1000 Hz.
CQP514
6 dB/octave preemphasis characteristic from 300 to 2500 Hz, +1 dB −3 dB relative to 1000 Hz.

Frequency Stability
Meets government specifications.

Crystal Frequency Calculation

$$\text{Crystal frequency} = \frac{\text{signal frequency}}{12}$$

Spurious and Harmonic Radiation
Less than 2 x 10^{-7} watts.

Crystal
Storno type 98-8, spec. S-98-8.

Receiver

Sensitivity

0.8 μV e.m.f. for 12 dB SINAD.

Squelch

Electronic, adjustable.

Ajacent Channel Selectivity

80 dB.

Spurious and Harmonic Radiation

Less than 2×10^{-9} watts.

Intermodulation Attenuation

65 dB.

Spurious Response Attenuation

85 dB.

Crystal Frequency Calculation

CQP510L:

$$\text{Crystal frequency} = \frac{\text{signal freq.} + 10.7}{3}\ \text{MHz}$$

CQP510H:

$$\text{Crystal frequency} = \frac{\text{signal freq.} - 10.7}{3}\ \text{MHz}$$

AF Power Output

200 mW.

Crystal

Storno type 98-9, spec. S-98-9.

Battery

Type

Rechargeable NiCd (Storno BU501).

Number of Cells

10.

Nominal Voltage

12.4 V.

Capacity

225 mAh.

Current Consumption

Standby: 10 mA.

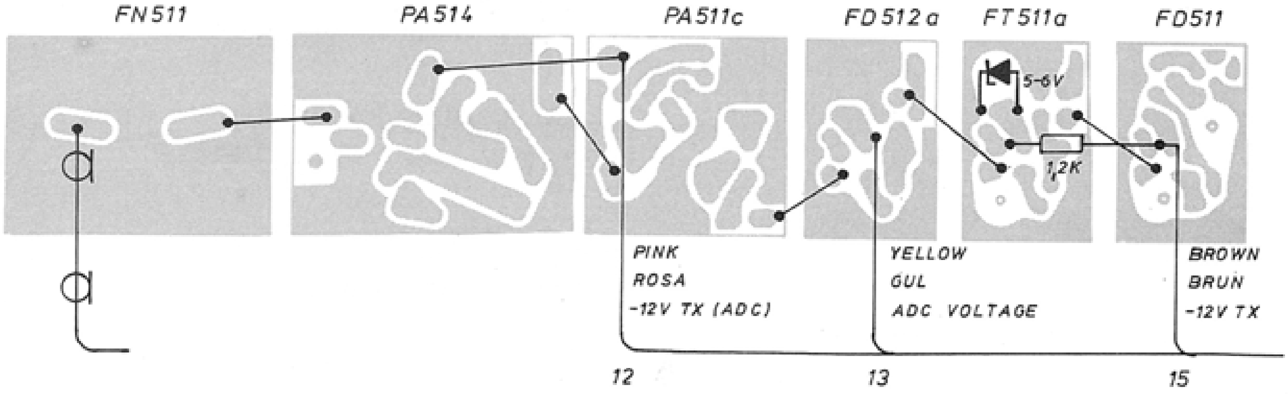
Receive, AF output 200 mW: 40 mA.

Transmit: 200 mA

225 mA for R models.

MODIFICATION OF CABLING FOR 1W TRANSMITTER

(see diagram D401.295 for complete wiring)



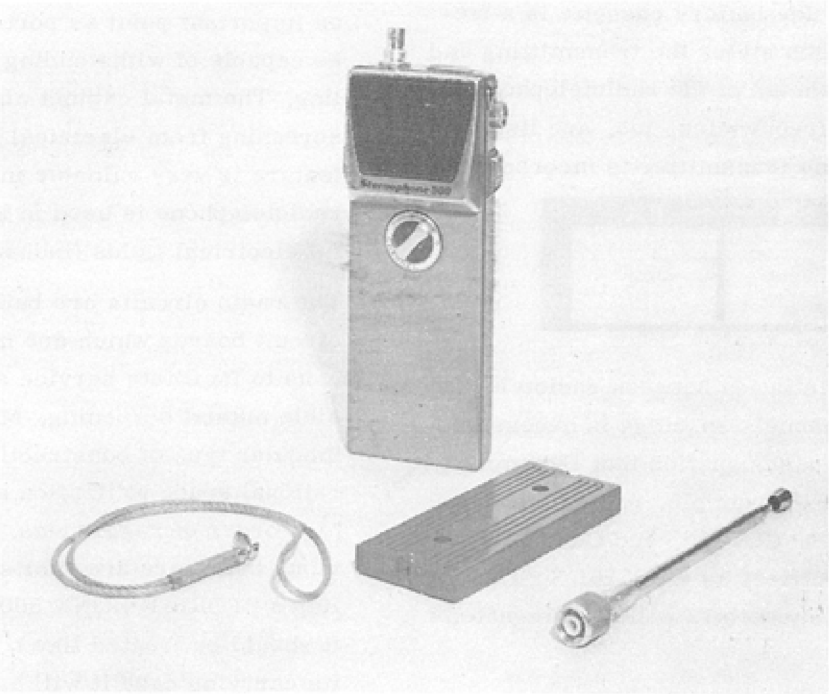
R 1.2 kΩ

E 5.6 V Zener diode

CABLING CQP510(R)-1W

CHAPTER I. GENERAL DESCRIPTION AND OPERATING INSTRUCTIONS

A. Stornophone 500



Introduction

The STORNOPHONE 500 portable radiotelephone comprises a series of combined transmitters and receivers for FM radio communication on fixed crystal-controlled channels. The STORNOPHONE 500 is available in versions for local or remote control with different channel spacings inside the frequency bands 68-88 MHz, 146-174 MHz, and 420-470 MHz. This manual contains descriptions of the locally controlled versions CQP511, CQP512, CQP513, and CQP514, for use in the VHF band from 146 to 174 MHz, and of those categories of accessories which are supplied by STORNO. If your radiotelephone is a special version you will find the relevant modification description and circuit diagrams inserted at the end of this manual or contained in a separate manual.

We at STORNO are constantly processing the experience we gain during the production and operation of our radiotelephones. Minor modifications will therefore be made continually, and all information given in this manual must therefore be subject to such reservations as are a logical consequence of this policy. However, any corrections and modifications will whenever practicable be printed on a special supplement and amendment sheet which will be inserted as the last page of this manual.

Versions

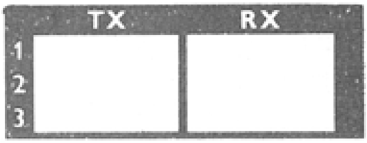
Type	Channel Spacing
CQP511	50 kHz
CQP512	25 kHz
CQP513	20 kHz
CQP514	12.5 kHz

Type Designations

A type plate at the bottom of the back of the cabinet states the type designation of the radiotelephone.

This plate also carries the serial number, which should always be quoted in all communications to STORNO concerning this particular radiotelephone.

At the bottom of the battery cassette is a frequency chart which states the transmitting and receiving frequencies of the radiotelephone in question. Tone frequencies, too, are listed on the chart if a tone transmitter is incorporated.



Where no differentiation between radiotelephones with different channels spacings is necessary, the manual uses a designation that is common to such versions. For example, radiotelephones CQP511, CQP512, CQP513, and CQP514 are designated collectively as CQP510. Similarly, antennas AN511 and AN512 will be designated AN510.

Complete Radiotelephone

A complete STORNOPHONE 500 radiotelephone consists of these components:

A cabinet containing the transmitter/receiver, control knobs, and speaker-microphone	CQP510
A short sling with snap hook	49.096
A nickel-cadmium battery	BU501
An antenna with matching network	AN510

Accessories for special applications are separately available: Lapel microphone, earphone, carrying case, tone transmitters, tone receivers, and various units for charging nickel-cadmium batteries. This equipment is described in detail in Chapter III, ACCESSORIES.

Construction

The radiotelephone cabinet is of pressure-die-cast light alloy metal. This reduces weight to a minimum with no sacrifice of ruggedness - an important point as portable equipment must be capable of withstanding fairly robust handling. The metal cabinet also provides effective screening from electrical interference. This feature is very valuable in cases where the radiotelephone is used in localities with powerful electrical fields (industrial areas etc.).

The radio circuits are built on small printed circuit boards which are mounted in small metal cans to facilitate service and provide best possible mutual screening. Miniturization and the modular type of construction employed mean rational space utilization and an exceedingly high order of ruggedness. However, it is obvious that there are limits to how robust handling a STORNOPHONE 500 can take. In practice it should be treated like a camera. If placed in its carrying case it will have appreciably higher resistance to impacts and robust treatment.

The cabinet is designed so that it can be carried in the usual type of uniform breast pocket. However, the radiotelephone may also be carried in a special leather case either at the belt or in a shoulder sling.

The radio cabinet is splashproof and dustproof, and the relatively modest amount of heat generated by the transistors is dissipated through the metal surface of the cabinet. Also with its battery removed the radiotelephone is splashproof, permitting battery replacement anywhere - also in rainy weather - and without the use of tools.

B. Accessories

Standard Accessories

Storno offers a wide range of accessories for CQP510 radiotelephones, including antennas, microphones, earphones, tone equipment, cases and carrying slings, battery chargers etc.

This section contains a brief description of these accessories and their applications. A more detailed description is given in Chapter III, ACCESSORIES.

Antennas

AN511	Quarter-wave telescoping antenna with matching network for the 146-174 MHz frequency band.
AN512	Quarter-wave whip antenna with matching network for the 146-174 MHz frequency band.
AN516	Body antenna (for fastening to button etc.) for the 146-174 MHz frequency band.
AN517	Belt antenna for the 146-174 MHz frequency band.
AN518	Ribbon antenna for the 146-174 MHz frequency band.
AN519	Short whip antenna (λ /16) with matching network for 146 - 174 MHz frequency band.

Microphones and Headphones

MC501	Lapel microphone with connector and cord for connection to the multi-wire connector on the top terminal surface of the radiotelephone.
HP501	Earphone with cable and connector for connection to the multi-wire connector of the radiotelephone.

Tone Equipment

TT501	Single-tone transmitter for selective calling. For installation in the radiotelephone cabinet.
TT504	Double-tone transmitter for selective calling. For installation in the radiotelephone cabinet.

Carrying Cases

49.100	Black leather carrying case with sling straps for attachment to belt, and with a case for the telescoping antenna.

Pocket Clip

49.094	Screw-on pocket clip. For mounting on the radiotelephone cabinet to protect it from falling out of the pocket.

Battery

BU501	Nickel-cadmium battery, 10 cells, 12.5V, 225 mAh.

Charging Units

CU501	Charging unit for max. 10 battery outlets.
CU502	Charging unit for max. 10 battery outlets and with automatic timer to permit the batteries connected to it to be charged for a previously selected number of hours.
CU503	Charging unit for max. 2 battery outlets.
15.001	Battery outlets for CU501 and CU503.
15.002	Battery outlets for CU502.

C. Operation

Operating Instructions

Operation of the portable radiotelephone is simple. Nevertheless, the user is advised to devote a few minutes to a study of the correct operating procedure.

Before beginning to use the radiotelephone it is necessary to make sure that the antenna is plugged into the antenna connector. If a telescoping antenna is employed, it should be pulled out to full length.

Because the receiver is very sensitive it will under favourable conditions be possible to receive signals with the telescoping antenna fully collapsed, but the telescoping antenna should always be pulled out to full length while transmitting.

Receive

1. Set the channel selector to the desired channel.
2. Adjust the volume control for convenient sound level. If there is any traffic on the channel you will hear it now.
3. Adjust the squelch control while there is no traffic on the channel. When you turn the knob anti-clockwise you will hear a hissing sound; thereafter turn the knob clockwise until the noise only just disappears.

Transmit

1. Set the channel selector to the desired channel. Listen in to make sure that someone is not speaking; do not start transmitting until the channel is clear.
2. Press the transmit button on the radiotelephone cabinet. Speak towards the microphone. Correct speaking distance will be approx. 10 cm (4 in.) at normal voice intensity. Be sure to release the transmit button when you want to listen.
3. If a tone transmitter is installed in your radiotelephone, a calling tone will be transmitted when both the tone button and the transmit button on the radiotelephone cabinet are operated.

Do not operate the transmit button without an antenna connected to the radiotelephone. Do not forget to switch off after use. To switch off, set channel selector to the 0 position.

Checking the Battery Voltage

The battery voltage can be checked by pressing only the tone button on the cabinet. The condition of the battery will be shown by the indicator lamp at the bottom of the cabinet. If the lamp glows dimly or not at all, it is an indication that the battery is almost discharged, and a fully charged battery should be inserted instead.

Proper Care of Batteries

A nickel-cadmium battery can be charged at least 500 times without appreciably reducing its capacity. Ambient temperature, on the other hand, very markedly affects the capacity, which decreases with decreasing temperature. However, the battery may be used at temperature as low as -25°C but its capacity will then be only half of what it is at room temperature.

To remove the battery cassette from the cabinet, press the slide button on the rear of the cabinet upwards, whereupon the cassette can be tipped out. The cassette can be inserted in one way only.

Recommended charging current is the current that will discharge the battery in 10 hours - approx. 23 mA for this type of battery. However, approx. 14 hours will be required for charging a fully discharged battery, due to the fact that the efficiency when charging is approximately 70 per cent. Overcharging the battery should obviously be avoided, but the battery will not normally suffer permanent damage by being charged for up to twice the prescribed charging time. Thus, a fully charged battery will not be permanently damaged by being charged for an additional 14 hours even though repeated overcharging will reduce its capacity and shorten its usable life.

The discharge time obviously depends on the particular nature of the service for which the radiotelephone is employed, but the percentagewise distribution tabulated below should serve as a guide for the great majority of applications:

10 % transmit at 130 mA
80 % standby at 8 mA
10 % squelch open, average 16 mA.

Consequently, average power consumption per working hour will be approx. 21 milliamperehours, corresponding to a total working time of $\frac{225}{21}$ hours = 10.7 hours with a fully charged battery.

During receive periods, the battery voltage will keep fairly constant until the battery is almost discharged, when the voltage drops quite suddenly. However, when the battery is exposed to heavy loads - as will be the case during transmit periods - the voltage will decrease somewhat during the last hours of the discharge period.

The Ni-Cd batteries are charged in a type CU50x charging unit, which is manufactured in different versions. These are described in detail in Chapter III, ACCESSORIES. It should also be kept in mind that a certain amount of self-discharge occurs in the batteries.

Communication

Due to the absence of a ground plane the antenna of the STORNOPHONE 500 radiotelephone is not so efficient as a comparable mobile antenna. However, this slight disadvantage can be offset by choice of a suitable site. Note also that it is important that the antenna is held vertical.

Range in practice depends materially on the nature of the surrounding terrain and on whether communication is to be with another pocket station, a mobile station, or a base station. Also, extended range will be obtained with the STORNOPHONE 500 radiotelephone placed on, say the roof of a car, which will improve the effectiveness of the antenna.

In practice, the best sites have been found to be hilltops and high locations in general: near windows in buildings; in street crossings; and in cars, where the antenna can be put out of the window. However, reduced range must be expected from basements, ferro-concrete buildings, iron-frame bridges, dense woods, narrow streets, etc.

Service

The organization of a preventive maintenance routine is of material importance in securing that the radiotelephone will be capable of peak performance under all conditions.

Chapter IV contains a detailed description of maintenance and service of the radiotelephone. The complete adjustment procedure is described in Chapter IV.

CHAPTER II. CIRCUIT ANALYSIS

A. Controls and Their Functions

The controls of the radiotelephone are placed on the sides of the cabinet and on the front panel. The antenna connector and multi-wire connector are placed on the top terminal surface of the cabinet. The battery indicator, which shows the condition of the battery, is placed in the bottom.

The functions described here are common to both transmitter and receiver. Functions relating only to the transmitter, receiver, or tone transmitter are covered by the respective descriptions of these.

Channel Selection - On/Off

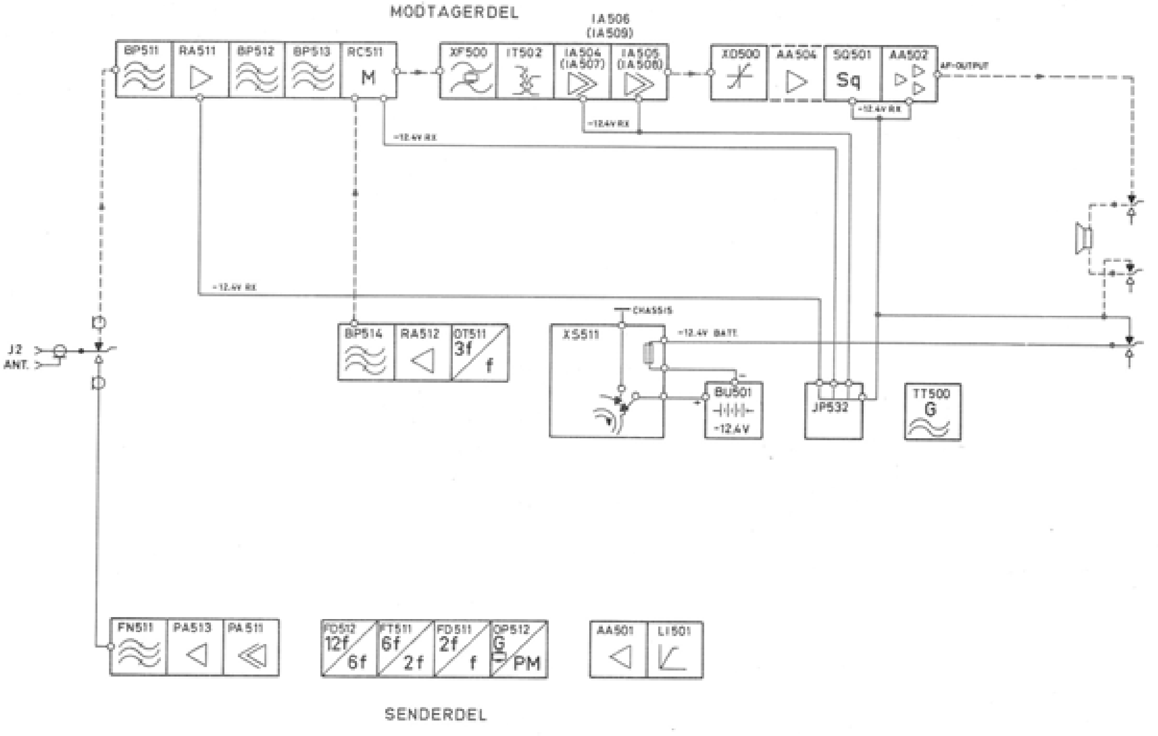
The radiotelephone has a combined on/off-switch and channel selector which applies battery voltage to the radiotelephone and switches between frequency channels 1, 2, and 3.

In the 0 position (extreme left position) one switch section disconnects the battery plus terminal, and the radiotelephone therefore receives no battery voltage.

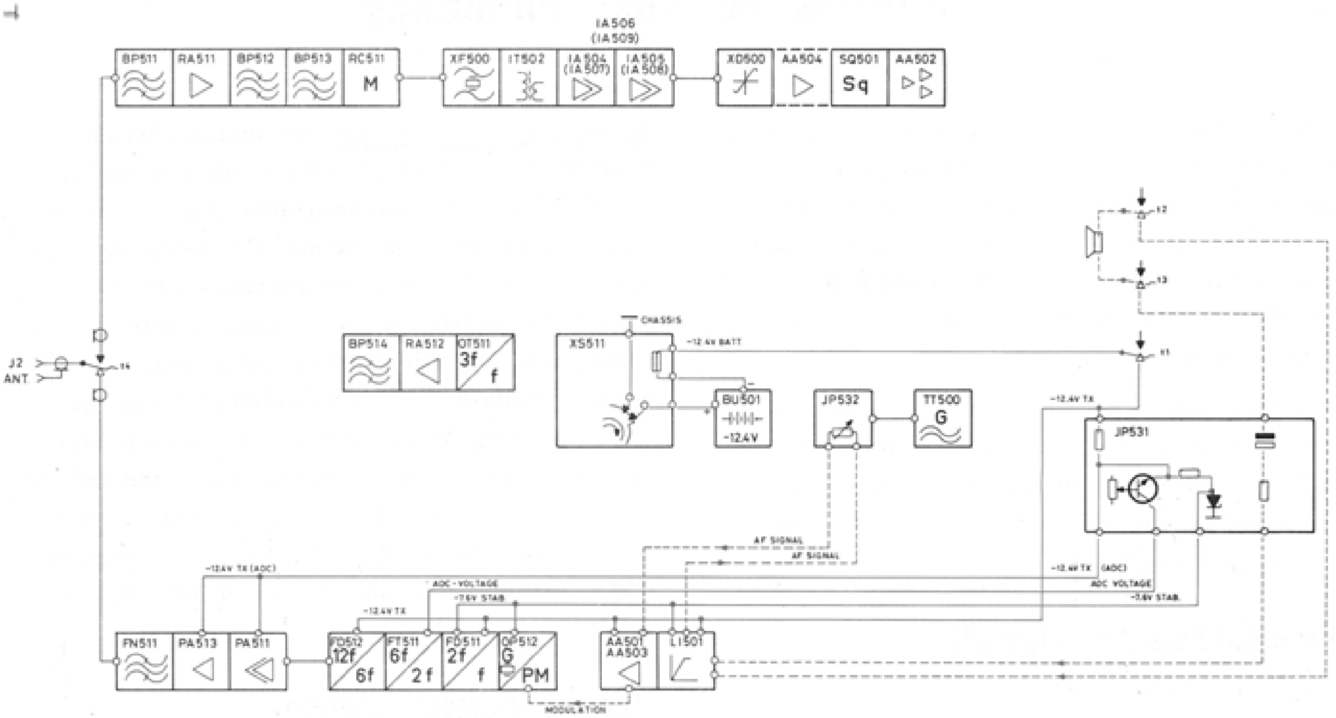
In the 1, 2, or 3 position one switch section connects the battery plus terminal to chassis, and the radiotelephone therefore receives battery voltage and is in the standby condition. The other switch section connects transmitter and receiver crystals for the channel selected. This switch section is devised so that non-used receiver crystals are disconnected whereas the corresponding transmitter crystals are short-circuited. The circuit diagram shows the radiotelephone in the standby condition with channel 1 selected. The red dot-and-dash lines indicate signal paths; solid lines represent DC-current paths.

Transmit-button Function

Before operating the transmit button, the channel selector should be set at either 1, 2, or 3. On the transmit button being operated, the battery voltage is switched from the receiver section to the transmitter section, which receives, in addition to 12.4V, 7.6V stabilized

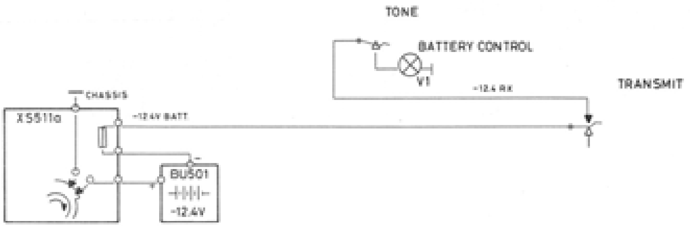


voltage and ADC-controlled voltage from junction panel JP531. Besides, the antenna is connected to the transmitter RF output and the speaker-microphone to the AF input.

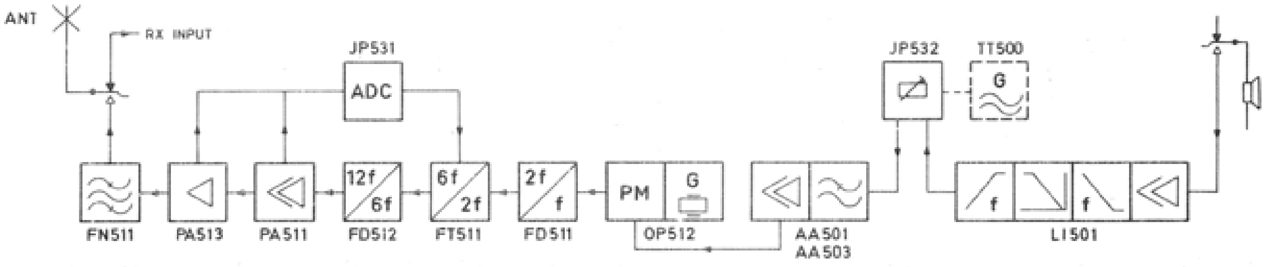


Battery-indicator Function

Battery indication depends on whether the equipment is in the standby condition. On the tone button being operated, the indicator lamp receives battery voltage and shows the condition of the battery.



B. Transmitter Section



General

The transmitter is built on a number of circuit boards which are mounted in screen cans and therefore constitute separate modules. This type of construction ensures a high order of stability and facilitates service.

The transmitter is phase modulated on the fundamental frequency. Its output frequency is in the 146-174 MHz frequency band.

The output frequency is found by multiplying the crystal-oscillator frequency by 12.

The radiotelephone can be provided with 3 frequency channels, and switching between channels is performed by switching the proper crystals. An automatic drive control system (ADC) protects the transmitter output transistor and secures constant carrier output regardless of changes in battery voltage and temperature.

Modules

The transmitter consists of the following modules:

LI501	AF limiter
AA501	AF amplifier for 50, 25, and 20 kHz channel spacing
AA503	AF amplifier for 12.5 kHz channel spacing
OP512	Oscillator and phase modulator
FD511	Frequency doubler
FT511	Frequency tripler
FD512	Frequency doubler
PA511	RF power amplifier
PA513	RF power amplifier
FN511	Antenna filter

Coverage of the full frequency range requires minor modifications to coils and capacitors in the tuned circuits of some of the modules. Such modules have a letter added to their type designations, either H (high sub-band) or L (low sub-band). This division corresponds, in terms of output frequency, to 156 - 174 MHz (H) and 146 - 160 MHz (L).

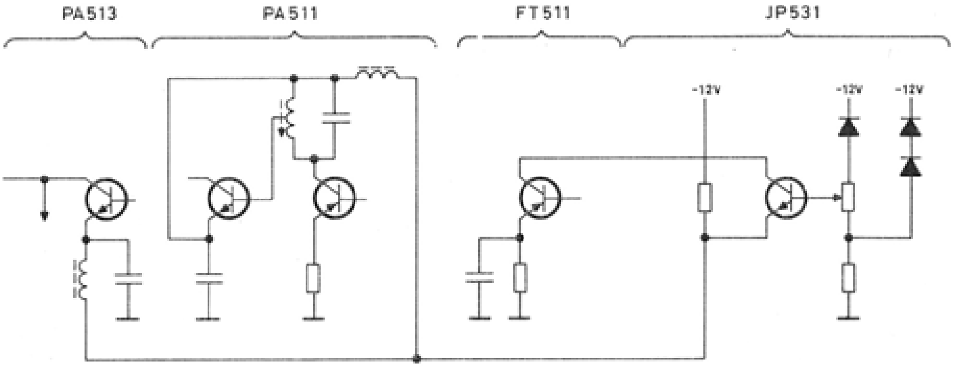
Moreover, some of the transmitter circuits are contained in the following modules which are common to the transmitter and receiver sections:

JP531	Junction panel
JP532	Junction panel
XS511	Crystal shift unit

These modules are described in detail in Section D of this chapter. Tone equipment is described in Chapter III, ACCESSORIES.

ADC Function

The ADC function (automatic drive control) serves the purpose of protecting the power transistors in modules PA511 and PA513 against overloads caused by mismatching such as may occur if the transmit button is operated without the telescoping antenna



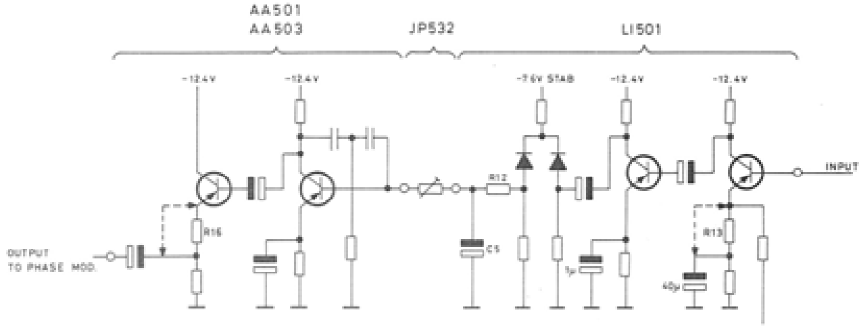
mounted and pulled out. Besides, the ADC circuit minimizes carrier output variations in the case of battery-voltage and temperature changes.

A 2.7 Ω resistor is inserted in the circuits of the transistors in RF power amplifiers PA511 and PA513. Physically, the resistor is located in junction panel JP531 (R4). The voltage drop across the resistor is used to control transistor Q1 in JP531. Q1 is in a DC series connection with the transistor of frequency tripler FT511. The operating voltage of the latter unit and hence also its output will therefore be reduced by any increase in the collector currents of RF power amplifier stages PA511 and PA513. Consequently, any increase in the currents of the RF power amplifier stages will be counteracted by a reduction of the amount of drive applied from frequency tripler FT511. Silicon diodes E3 and E4 in junction panel JP531 operate as voltage stabilizer diodes seeing that the voltage drop (approx. 0.5V) across a diode is virtually independent of the current and hence also of the battery voltage. These diodes and E1 also provide temperature compensation of regulator transistor Q1.

Potentiometer R3 in junction panel JP531 permits adjustment of the regulator transistor base current. This feature permits adjusting the ADC circuit to a condition of balance where the power output is constant at 500 mW.

The following pages contain a circuit analysis and technical specifications of individual modules.

Speech Limiter and Filter Amplifier LI501 and AA501 or AA503



Description

Speech limiter LI501 and filter amplifier AA501 or AA503 constitute the AF section of the transmitter. The speech limiter amplifies and clips the microphone signal applied to it. It is composed of two grounded-emitter amplifier stages. The first stage has unsymmetrical input, the microphone signal being applied to the base of the transistor. An un-bypassed resistor R13 in the emitter circuit reduces the gain. Short-circuiting R13 will increase the gain by 6 dB.

The emitter of the second amplifier transistor is only partly bypassed, providing a reduction in negative feedback at high frequencies.

Thereafter follows a clipper composed of two diodes which are biased in their forward direction. The amount of bias is adjusted for symmetrical clipping. The clipper is followed by an integrating circuit (R12, C5).

The AF circuit of the speech limiter is fed to the limiter potentiometer (in the junction panel) which controls the level of limiting and, from there, to filter amplifier AA501 or AA503. Filter amplifier AA501 is used in radiotelephones with 50 kHz, 25 kHz, and 20 kHz channel spacing whilst filter amplifier AA503 is used in radiotelephones with 12.5 kHz channel spacing.

The filter module amplifies the input signal and cuts off all frequencies above 3000 Hz (AA501) or 2500 Hz (AA503). The filter module contains two stages. The first one of these, a grounded-emitter stage, has an RC filter to suppress the high frequencies inserted between its collector and base. The second stage is an emitter follower, which secures a low value of generator impedance for the following phase modulator. The emitter circuit of the second stage is composed of two resistors. In the AA501 module, one of them (R16) can be strapped, thereby altering the maximum frequency swing from ± 5 kHz to ± 15 kHz.

Technical Specifications

LI501

Supply Voltage and Current Drain

Nominal: 12.4V 5mA.

Diode clipper: Zener regulated, 7.6V 0.1mA.

Sensitivity

Input sensitivity for Δf = 2/3 Δf max. is determined by the setting of the limiter potentiometer, as no gain control is provided.

Output Voltage

For 1 mV input signal at 1000 Hz: Approx. 45mV

Harmonic distortion: Approx. 4%.

Frequency Response

When used with filter amplifier AA501:
Flat 300 - 3000 Hz +1/-3 dB.

When used with filter amplifier AA503:
Flat 300-2500 Hz +1/-3 dB.

AA501/AA503

Supply Voltage
Nominal: 12.4 V.

Current Drain
5 mA.

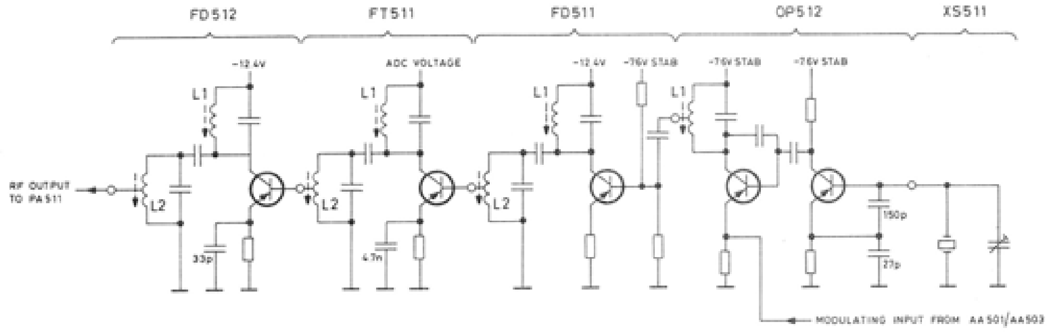
Frequency Response (AA501)
When used with speech limiter LI501, with reference to 1000 Hz:

300 - 3000 Hz: Flat +1/-3 dB
3000 - 6000 Hz: -18 dB/octave
6000 - 20.000 Hz: -20 dB/octave.

Frequency Response of Filter Amplifier AA503
When used with speech limiter LI501, with reference to 1000 Hz:

300 - 2500 Hz, flat +1/-3 dB.
2500 - 5000 Hz, -18 dB/octave.
5000 - 10000 Hz, -20 dB/octave.

Oscillator, Modulator and Frequency Multiplier
OP512, FD511, FT511 and FD512



Description

The transmitter oscillator and multiplier chain is composed of the following modules:

OP512	Crystal oscillator and phase modulator
FD511	Frequency doubler
FT511	Frequency tripler
FD512	Frequency doubler.

Crystal Oscillator and Phase Modulator OP512

The crystal oscillator operates in a Pierce-Colpitts circuit, the output signal being taken off across a resistor in the collector circuit. Two capacitors, between base and emitter and between emitter and chassis potential, constitute part of the crystal load capacitance in addition to serving as voltage divider for the feedback circuit.

Trimmer capacitors in shunt across the crystals permit fine adjustment of the oscillator frequencies. Both the crystals and trimmer capacitors are mounted in a crystal shift unit which is common to the transmitter and receiver. The oscillator output signal is fed to the phase modulator through a capacitor. Modulation is produced by applying AF voltage to the emitter circuit, thereby varying the mutual conductance of the transistor.

Frequency Doubler FD511

The frequency doubler transistor operates in Class A with its emitter grounded. The base bias network connects to a stabilized 7.6V supply. The advantage of this arrangement is that the input impedance is virtually independent of battery voltage and that the output level is stable. The transistor works into two circuits which in conjunction with a coupling capacitor constitute a top-coupled band-pass filter.

Frequency Tripler FT511

The frequency tripler transistor operates in Class B-C without fixed base bias, which is possible due to the relatively high input signal level. This results in good DC stability and high efficiency. The transistor works into a band-pass filter composed of two circuits with capacitive top coupling and an inductive tap on the output circuit. Operating voltage for the frequency tripler is controlled by the ADC circuit described elsewhere in this manual.

Frequency Doubler FD512

The frequency doubler is similar to the FT511 multipliers in circuitry and operation. An exception is that the emitter resistor is bypassed only for the desired frequency range, thereby preventing radiation on any subharmonic frequencies.

Technical Specifications

Crystal Oscillator/Phase Modulator OP512

Frequency Range

12.16 - 14.5 MHz.

Crystal Frequency Calculation

$$f_x = \frac{\text{signal frequency}}{12}$$

Frequency Pulling

$\pm 20 \times 10^{-6}$.

Frequency Stability

Better than ±1.8 kHz.

Crystal Power Rating

Max. 1 mW.

Supply Voltage

12.4 V.
7.6 V stabilized.

Modulating Frequency

300 - 3000 Hz.

Modulation Sensitivity (1000 Hz)

Input voltage for $\Delta f = \pm 0.84$ rad. corresponding to Δf ±10 kHz at the output frequency: 100 mV.

Harmonic Distortion

Measured at 1000 Hz and $\Delta f = \pm 10$ Hz: 8%.

RF Output Level

Approx. 35 mV.

Frequency Doubler FD511

Frequency Range

Input frequency: 12.16 - 14.50 MHz
Output frequency: 24.33 - 29.00 MHz

RF Input Level

Approx. 35 mV.

RF Output Level

1.5 V.

Current Drain (at 12.4 V)

Without input signal: 1.6 mA
With input signal: 1.8 mA.

Frequency Tripler FT511

Frequency Range

Input frequency (L): 24.33 - 26.66 MHz
Output frequency (L): 73.00 - 80.00 MHz
Input frequency (H): 26.00 - 29.00 MHz
Output frequency (H): 78.00 - 87.00 MHz.

RF Input Level

1.5 V.

RF Output Level

0.9 V.

Current Drain (at 12.4 V)

Approx. 2 mA.

Frequency Doubler FD512

Frequency Range

Input frequency (L): 73 - 80 MHz
Output frequency (L): 146 - 160 MHz
Input frequency (H): 78 - 87 MHz
Output frequency (H): 156 - 174 MHz.

Input Level

0.9 V.

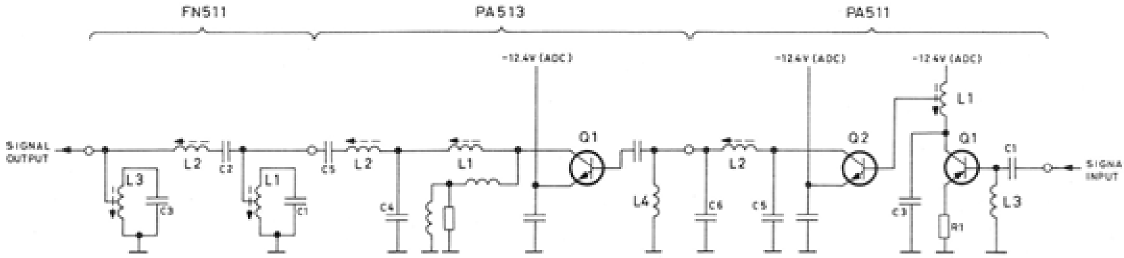
RF Output Level

1.7 V.

Current Drain (at 12.4 V)

Approx. 2 mA.

RF Power Amplifier and Antenna Filter
PA511, PA513 and FN511



Description

The power amplifier chain of the transmitter is composed of the following modules:

PA511 1st power amplifier
PA513 2nd power amplifier
FN511 Antenna filter.

RF Power Amplifier PA511

RF power amplifier PA511 operates on the signal frequency. It is composed of a straight amplifier Q1, and a driver stage, Q2.

The signal is applied to Q1 via C1, which in conjunction with choke coil L3 suppresses radiation at subharmonic frequencies. The collector impedance is a single-tuned circuit. The emitter R1 makes it possible to measure the current through Q1. Driver transistor Q2 is an NPN type with its operating voltage applied to the emitter. The base is coupled directly to a tap on L1, through which it receives its DC potential. The anode is tuned by a pi-section (L2-C5-C6), which provides good matching and efficiency.

RF Power Amplifier PA513

RF power amplifier PA513 operates in Class C without emitter resistor in order to accomplish maximum power gain. The PA513 requires a nominal input level of approx. 50 mW.
This corresponds to a nominal output level of approx. 500 mW, taking losses in the antenna filter and antenna switch into account.

The collector circuit is a pi-section (the output capacitance of Q1 and L1 and C4) which is followed by a series-tuned circuit (L2 and C5), and these two circuits constitute a tunable output transformer. By adjustment of L1 and L2, matching between the transistor and its load is obtained, together with adequate suppression of harmonic radiation.

The input coil (L4) provides a DC path for the preceding stage (PA511).

Antenna Filter FN511

Antenna filter FN511 is a band-pass filter which provides strong suppression of spurious and harmonic radiation from the transmitter section. It is a pi-filter consisting of three circuits (L1-C1, L2-C2, and L3-C3) in which L1, L2 as well as L3 are adjustable. The module has two inside screens to reduce coupling between coils.

Technical Specifications

RF Power Amplifier PA511

Frequency Range
PA511L: 146 - 160 MHz
PA511H: 156 - 174 MHz.

RF Input Voltage
Nominal approx. 1.7 V.

RF Output Power
Approx. 130 mW.

RF Power Amplifier PA513

Frequency Range
146 - 174 MHz.

RF Input Level
Approx. 130 mW.

RF Output Level

600 mW into 50 Ω.

Load Impedance

50 Ω.

Current Drain with Normal Drive Applied

70 mA.

Antenna Filter FN511

Pass Band

146 - 174 MHz.

3 dB Attenuation Points

124 and 190 MHz.

Insertion Loss

Max. 0.4 dB (measured between PA513 and 50 Ω load in range 146 - 174 MHz).

Attenuation

More than 20 dB at 87 MHz

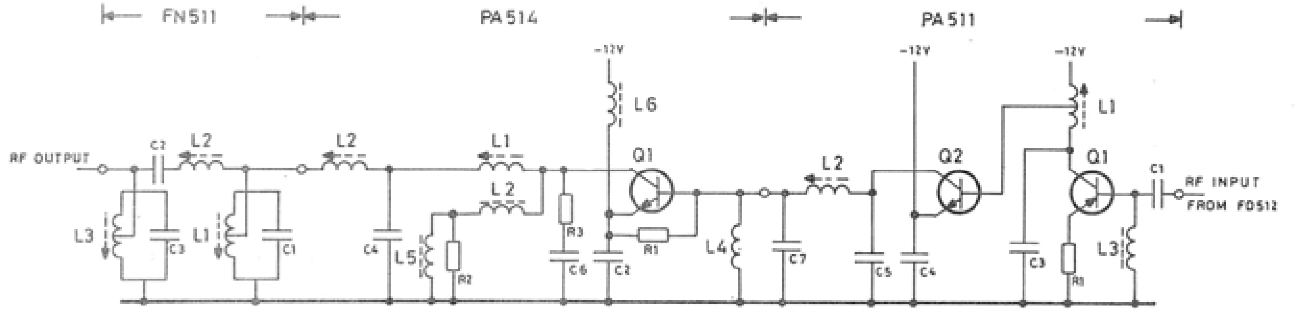
More than 30 dB at 292 MHz

(measured between 50 Ω generator and 50-ohm load).

Maximum RF Power

2 watts.

RF Power Amplifier and Antenna Filter PA511, PA535, and FN511



RF Power Amplifier PA511

RF power amplifier PA511 operates on the signal frequency. PA511 is composed of a linear amplifier, Q1, and a driver stage, Q2.

The signal is applied to Q1 via C1, which in conjunction with choke coil L3 suppresses radiation at subharmonic frequencies. The collector impedance is a single-tuned circuit.

Emitter resistor R1 provides a simple method of measuring current through Q1. Normal operating current is approx. 6 mA.

Driver transistor Q2 is an NPN type having its operating voltage applied to the emitter. The base is coupled directly to a tap on L1, through which it also receives its DC potential.

The collector is tuned by network L2, C5 and C6, which provides good matching and efficiency. Normal operating current is approx. 20 mA.

RF Power Amplifier PA514

RF power amplifier PA514 operates in Class C without an emitter resistor in order to achieve maximum power gain.

The PA514 requires an input signal power of approx. 150 mV in order to deliver 1.0 W output power, taking losses in the antenna filter and antenna switch into account.

Q1 works into a pi-network consisting of its own collector capacity, coil L1 and capacitor C4, which, together with coil L2, constitutes a tunable, impedance matching output transformer, also providing for adequate suppression of harmonic radiation.

Input coil L4 and capacitor C1 serve as a matching network at the input to the stage. L4 also provides a DC path for the preceding stage (PA511).

Antenna Filter FN511

Antenna Filter FN511 is a band-pass filter which provides strong suppression of spurious and harmonic radiation from the transmitter section.

It is a filter consisting of three circuits (L1-C1, L2-C2, and L3-C3), where all three coils are adjustable.

Two shields placed inside the module reduce coupling between coils.

Technical Specifications

RF Power Amplifier PA511

Frequency Range

PA511L: 146 - 160 MHz
PA511H: 156 - 174 MHz.

RF Input Voltage

Nominal approx. 1.2 V.

RF Output Power

Approx. 150 mW.

Current Drain with Normal Drive:

20 mA.

RF Power Amplifier PA514

Frequency Range

146 - 174 MHz.

RF Input Level

Approx. 150 mW.

RF Output Level

1.0 W into 50 Ω

Load Impedance

50 Ω

Current Drain with Normal Drive Applied

175 mA.

Antenna Filter FN511

Pass Band

146 - 174 MHz.

3 dB Attenuation Points

124 and 190 MHz.

Insertion Loss

Max. 0.4 dB (measured between PA513 and 50 Ω load in range 146 - 174 MHz).

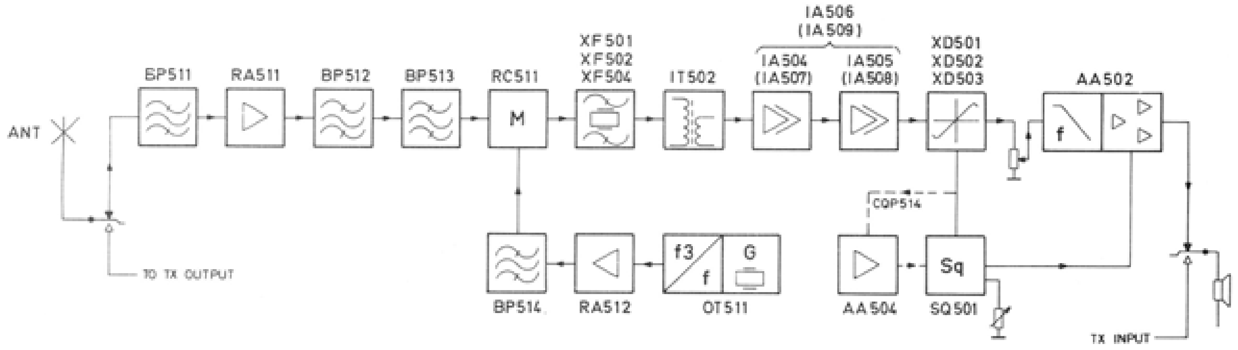
Attenuation

More than 20 dB at 87 MHz
More than 30 dB at 292 MHz
(measured between 50 Ω generator and 50-ohm load).

Maximum RF Power

2 watts.

C. Receiver Section



General

The receiver is built on a number of circuit boards which are mounted in screen cans and therefore constitute separate modules. This type of construction ensures a high order of stability and facilitates service.

The receiver is a single-conversion superheterodyne.

The frequency specifications of the receiver are as follows:

Signal-frequency Range

High sub-band	156-174 MHz
Low sub-band	146-160 MHz
Intermediate frequency	10.7 MHz

Crystal frequency Range

High sub-band	52.2-56.9 MHz
Low sub-band	48-54.4 MHz

An IF crystal filter provides the degree of selectivity required for channel spacing. A maximum of three crystal-controlled channels can be provided. Channel selection is performed by switching the crystals. An electronic squelch circuit is also provided.

Modules

The receiver is composed of the following modules:

BP511	Band-pass filter
RA511	Signal-frequency amplifier
BP512	Band-pass filter
BP513	Band-pass filter
RC511	Mixer
OT511	Oscillator and frequency tripler
RA512	Amplifier
BP514	Band-pass filter
XF501	Crystal filter for 50 kHz channel spacing
XF502	Crystal filter for 25/20 kHz channel spacing
XF504	Crystal filter for 12.5 kHz channel spacing
IT502	Impedance transformer
IA506	IF amplifier for 50, 25, and 20 kHz channel spacing, comprising IF modules IA504 and IA505
IA509	IF amplifier for 12.5 kHz channel spacing, comprising IF modules IA507 and IA508
XD501	Crystal discriminator for 50 kHz channel spacing
XD502	Crystal discriminator for 25/20 channel spacing
XD503	Crystal discriminator for 12.5 kHz channel spacing.
AA504	Noise amplifier for 12.5 kHz channel spacing
SQ501	Squelch circuit
AA502	AF amplifier.

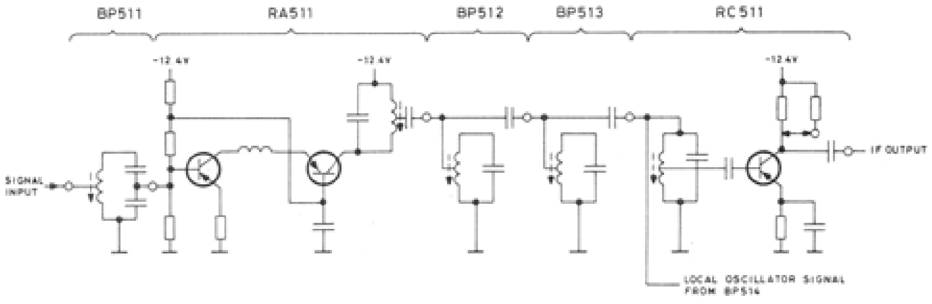
Coverage of the full frequency range requires minor modifications to coils and capacitors in the tuned circuits of some of the modules. Such modules have a letter added to their type designations, either H (high sub-band) or L (low sub-band). This division corresponds, in terms of output frequency, to 156 - 174 MHz (H) and 146 - 160 MHz (L).

Moreover, part of the receiver circuit is contained in the following modules which are common to the transmitter and receiver sections:

JP531	Junction panel
JP532	Junction panel
XS511	Crystal shift unit.

These modules are described in detail in Section D of this chapter. Tone equipment is described in Chapter III, ACCESSORIES.

Front End BP511, RA511, BP512, BP513 and RC511



The receiver front end is composed of the following modules:

BP511	Input filter
RA511	Signal-frequency amplifier
BP512	Band-pass filter
BP513	Band-pass filter
RC511	Mixer.

Band-pass Filter BP511

Band-pass filter BP511 is employed as antenna input circuit for the receiver section but also operates as impedance matching network between the antenna and RF amplifier module RA511. Impedance matching is accomplished by means of a tap on coil L1 on the antenna side and a capacitive tap (C1 - C2) on the receiver side.

Signal-frequency Amplifier RA511

RF amplifier RA511 amplifies the signals received from the antenna before they are fed to the mixer (RC511) through two band-pass filters (BP512 and BP513). The amplifier is a cascode circuit, which possesses the advantages of high gain and minimum feedback from output to input.

Coil L1, which connects the collector of Q1 to the emitter of Q2, acts as a wideband circuit tuned by the series connection of the collector-to-chassis capacitance and the emitter-to-chassis capacitance. The two transistors are in series for DC so that each receives approximately half battery voltage.

Band-pass Filters BP512 and BP513

Additional RF selectivity is obtained by inserting three band-pass filters between signal-frequency amplifier RA511 and mixer RC511. Two of these filters are individual modules and designated BP512 and BP513 whereas the third circuit is part of the following mixer module, RC511.

Mixer RC511

Mixer RC511 receives the incoming signal from the antenna and the local oscillator signal.

The signal from band-pass filter BP511 is coupled to a parallel-tuned circuit (L1-C1). From a tap on the coil, the signal is fed to the base of the mixer (Q1).

Low impedance to the IF and good stability are obtained by using a tap on the coil and relatively high value of coupling capacitance.

The local oscillator signal is taken out from the circuit L1 - C2 in filter module BP514 and fed to the input of mixer RC511 together with the signal from band-pass filter BP513.

The following crystal filter makes it necessary to introduce provision for varying the output impedance of the mixer. This can be done by means of a strap.

Technical Specifications

Band-pass Filter BP511

Frequency Ranges

BP511L: 146 - 160 MHz
BP511H: 156 - 174 MHz.

Input Impedance

Nominal: 50 ohms.

RF Amplifier RA511

Frequency Range

RA511L: 146 - 160 MHz
RA511H: 156 - 174 MHz.

Gain

Voltage gain is approx. 35 dB.

Band-pass Filters BP512 and BP513

Frequency Ranges

BP512L and BP513L: 146 - 160 MHz.
BP512H and BP513H: 156 - 174 MHz.

Mixer RC511

Frequency Range

146 - 174 MHz.

Voltage Gain

50 kHz channel spacing: approx. 19 dB.
20/25/12.5 kHz channel spacing: approx. 22 dB.

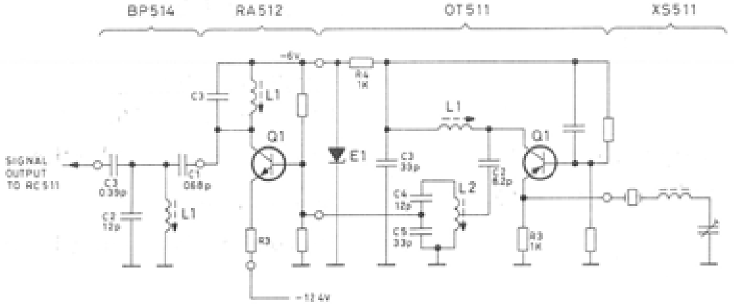
IF

10.7 MHz.

Current Drain

With oscillator signal: approx. 1.5 mA.
Without oscillator signal: approx. 1.2 mA.

Oscillator and Frequency Multiplier OT511, RA512 and BP514



The oscillator and multiplier section generates the injection signal for the receiver mixer. It is composed of the following modules:

OT511	Oscillator and frequency tripler
RA512	RF amplifier
BP514	Band-pass filter.

Oscillator and Frequency Tripler OT511

The oscillator/tripler unit contains a third-overtone crystal oscillator the output frequency of which is three times the oscillator frequency. Basically, the oscillator is a Colpitts oscillator with the crystal in series with the emitter of the oscillator transistor. The oscillator will therefore operate at the frequency of minimum crystal impedance - the series resonance of the crystal - provided the collector circuit is tuned to approximately that frequency.

The receiver crystals (maximum three crystals) are placed in sockets in a separate crystal shift unit, XS511, in which the transmitter crystals too are placed.

The pi-section of the collector circuit (L1 - C2 - C3) has been made so wide that frequency pulling will have no appreciable influence on its impedance. The third harmonic of the oscillator frequency is selected in the parallel-resonant circuit, from whose capacitive tap the local oscillator signal is fed to the following RF amplifier, RA512.

The oscillator/tripler module is in a DC series connection with the following amplifier stage and either stage therefore operates at only approximately half battery voltage.

RF Amplifier RA512

Amplifier module RA512 amplifies the local oscillator signal to a power level that is adequate for mixer module RC511.

Under normal operating conditions the amplifier stage is driven so hard that limiting of the output signal occurs. This limiting has been introduced intentionally in order to compensate for variations in the output of the oscillator module. The collector circuit (L1 - C3) is tuned to three times the local oscillator frequency (like C2 - C4 - C5 in oscillator/tripler OT511).

Band-pass Filter BP514

A band-pass filter between the RF amplifier module and the mixer module reduces spurious signals.

Technical Specifications

Oscillator/Tripler OT511

Crystal Frequency Ranges

OT511H: 48.4 - 54.4 MHz
OT511L: 52.2 - 56.9 MHz.

Output Frequency Ranges

OT511H: 145.2 - 163.2 MHz
OT511L: 156.6 - 170.7 MHz.

Crystal Frequency Calculation

Low sub-band, 146 - 160 MHz:

$$fx = \frac{fs + 10.7}{3} \text{ MHz.}$$

High sub-band, 156 - 174 MHz:

$$fx = \frac{fs - 10.7}{3} \text{ MHz}$$

where fx is the crystal frequency in MHz and fs is the receiver signal frequency in MHz.

Crystal Specification

Storno type 98-9, spec. s-98-9.

Crystal Power Rating

Approx. 0.1 mW.

Frequency Stability

Better than ±2 x 10^{-6} at 23°C and a voltage variation of ±20%.

Frequency Pulling

Crystal trimmer permits pulling the crystal frequency not less than ±25 x 10^{-6}.

Power Output

Approx. 200 μW.

Amplifier RA512

Frequency Ranges

RA512H: 145 - 163 MHz

RA512L: 156 - 171 MHz.

Power Gain

Approx. 8 dB (during limiting).

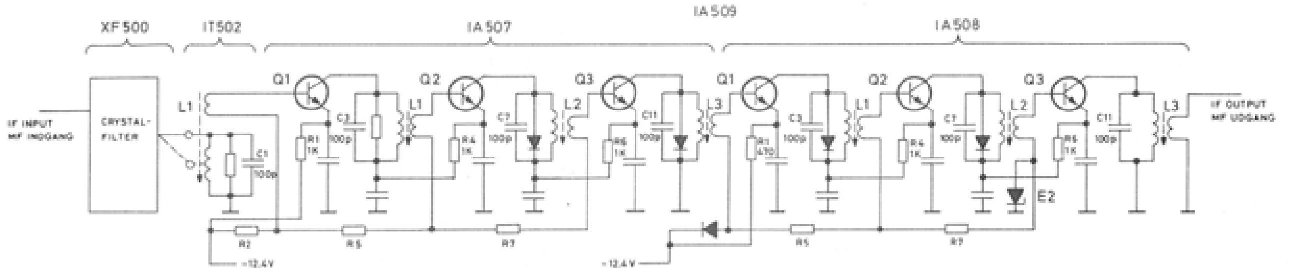
Band-pass Filter BP514

Frequency Ranges

BP514H: 145 - 163 MHz.

BP514L: 156 - 171 MHz

IF Amplifier XF500, IT502, IA506 or IA509



Description

The IF chain of the receiver consists of the following modules:

XF500 10.7 MHz crystal filter unit. Different types with different bandwidths are used, depending on the channel spacing employed in the particular radiotelephone.

- XF501 is used for 50 kHz channel spacing.
- XF502 is used for 20/25 kHz channel spacing.
- XF504 is used for 12.5 kHz channel spacing.

IT502 Impedance transformer.

IA509 10.7 MHz IF amplifier consisting of:

- IA507 1st 3-stage IF amplifier
- IA508 2nd 3-stage IF amplifier

Crystal Filter Unit and Impedance Transformer, XF500 and IT502

The 10.7 MHz IF signal from the mixer is fed to the crystal filter input. After the required degree of selectivity has been obtained in the filter, the signal is fed to impedance transformer IT502, which operates as a matching network between the crystal filter and the following IF amplifier. Because the input and output impedances of the various crystal filter units are not identical it is necessary to provide some means of altering the impedance transformation in module IT502. This has been accomplished by means of taps on the transformer primary. For example, crystal filter type XF501 connects to the top of the coil whereas crystal filters XF502, and XF504 connect to the tap on the coil.

IF Amplifier IA509

The IF amplifier employed consists of two 3-stage amplifier units, IA507 and IA508, which are enclosed in a common screen can. The screen can is divided into six compartments which provide mutual screening between the individual amplifier stages.

The two IF amplifier units, IA507 and IA508, are practically identical grounded-emitter amplifiers whose collector circuits are tuned to 10.7 MHz. The three stages of both amplifiers are connected in a DC series chain across the battery voltage so that each stage receives one-third of the battery voltage.

The only difference between the two units is that two diodes are included in the biasing network of the IA508 unit. One of these, E1, secures constant current through the transistors and, consequently, stable gain. The other one, zener diode E2, secures a constant output level for the following discriminator at battery voltages between 10 and 15 V.

The IF amplifier operates both as amplifier and amplitude limiter, the two last stages of the IA508 unit operating solely as noise-limiter stages.

Technical Specifications

XF500

Frequency

10.7 MHz.

Insertion Loss

Max. 5 dB.

Bandwidth

XF501: max. 6 dB drop at ±15 kHz.

XF502: max. 6 dB drop at ±7.5 kHz.

XF504: max. 3 dB drop at ±2.75 kHz.

Input Impedance

XF501: 2 kΩ//25 pF

XF502: 820 Ω//25 pF

XF504: 910 Ω//25 pF.

Output Impedance

XF501: 2 kΩ//25 pF.

XF502: 820 Ω//25 pF.

XF504: 910 Ω//25 pF.

IT502

Frequency

10.7 MHz.

Input Impedance

With XF501: 2 kΩ//25 pF.

With XF502: 820 Ω//25 pF.

With XF504: 910 Ω//25 pF.

IA509

Frequency Range

10.7 MHz.

Supply Voltage

Nominal: 12.4 V

Maximum: 15.0 V

Minimum: 10.0 V

Must be capable of operation at: 9V.

3 dB Bandwidth

IA507: 150 kHz

IA508: 150 kHz.

Gain (typical)

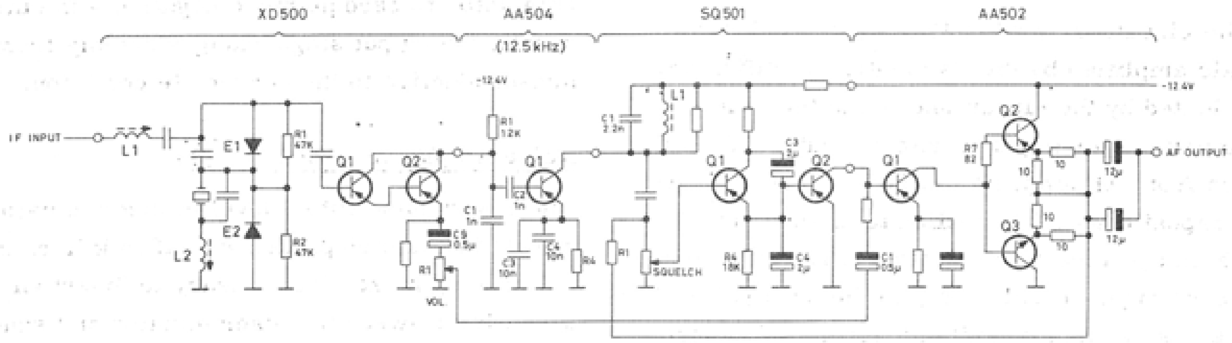
IA507: 65 dB

IA508: 75 dB.

Current Drain (at 12.4 V)

3 mA.

Discriminator, Squelch Circuit and AF Amplifier XD500, AA504, SQ501 and AA502



Description

The AF section of the receiver consists of the following modules:

XD500	Crystal discriminator. Depending on the channel spacing employed in the particular receiver, the following discriminator types are used: For 50 kHz channel spacing: XD501 For 25 kHz channel spacing: XD502 For 20 kHz channel spacing: XD502 For 12.5 kHz channel spacing: XD503.
SQ501	Squelch circuit.
AA502	AF amplifier.

For 12.5 kHz channel spacing only: AA504 Noise amplifier for SQ501.

Discriminator XD500

The discriminator employs a crystal whose points of parallel and series resonance are determined by coil L2 in conjunction with capacitors C3 and C4.

The 30 pF frequency of the crystal is approx. 10.715 MHz. The symmetry of the demodulation characteristic is adjusted with coil L1.

Because the discriminators require a high value of load impedance whereas the following amplifier AA505 requires a low value of generator impedance, the discriminator module incorporates an impedance converter in the form of a Darlington amplifier, which is characterized by having high input impedance and low output impedance. Its gain at the centre frequency is approx. -0.2 dB. The collector circuit of the Darlington amplifier is described in detail under Squelch Circuit SQ501 below.

AF Amplifier AA502

In order to be able to understand the operation of the squelch circuit it is necessary to study the AF amplifier AA502 first. This module consists of the following stages:

Driver stage
Push-pull output stage.

The driver stage, which uses transistor Q1, is a grounded-emitter amplifier with frequency-dependent negative feedback. The input signal from the crystal discriminator is applied to the base via the volume-control potentiometer (R1) which is mounted on the cabinet proper.

The push-pull stage (Q2 and Q3) contains two complementary transistors (NPN and PNP). The transistors are matched and should not normally be replaced individually. They operate in Class B in a common collector configuration. The output is transformerless and matched for a 40-ohm speaker.

Squelch Circuit SQ501

The squelch circuit serves to suppress noise (hiss) and reduce current drain during non-signal periods (stand-by). The squelch circuit is operated by noise voltages in the output signal of discriminator XD500.

The squelch circuit incorporates a squelch filter (L1 - C1) and a detector (Q1) followed by a DC amplifier (Q2) which performs a relay function.

The parallel-tuned circuit L1 - C1 is the collector circuit of the Darlington amplifier.

The circuit is tuned to 12 kHz, and noise signals amplified by the Darlington amplifier are selected by the circuit and fed to the squelch potentiometer together with a feedback DC voltage from AF amplifier AA502, whereafter the composite signal is applied to the base of Q1, which operates as a detector. This will cause a DC voltage, roughly equal to the peak value of the base signal, to build up across RC circuit R4 - C4. This DC voltage is fed directly to the base of transistor Q2, which operates as relay transistor. When the DC voltage reaches a certain level (approx. 0.5V), the internal resistance of the transistor will drop to a very low value and its collector potential approaches 0V (chassis potential).

Because the collector of the relay transistor connects directly to the base of the driver transistor Q1 of the AF amplifier, the bias of the latter transistor will be very nearly short-circuited.

The voltage at the junction of R8, R9, R10, and R11 in AF amplifier AA502 will approach the full battery voltage owing to the fact that the base bias of the control transistor is nearly short-circuited. This negative potential is fed back to the base of detector transistor Q1 in squelch circuit SQ501 via resistor R1 in SQ501 and the squelch potentiometer. This produces an increasing amount of feedback which shuts off AF amplifier AA502 even more effectively.

When a signal is being received, the noise components will be partly suppressed, causing the noise signal which is fed from the squelch filter to the base of the detector stage (Q1) to drop to below 0.5 V and the relay transistor (Q2) to begin to cut off. The result of this is that the control transistor in AF amplifier AA502 will again receive base bias, and the voltage at the junction of R8, R9, R10, and R11 begins to decrease towards one-half the battery voltage.

This voltage, as described above, is fed back to the detector stage in squelch circuit SQ501, causing it to become less conductive. This will in turn cause the collector voltage of the relay transistor to become more negative - in other words: the output stage changes rapidly from the non-conductive to the conductive condition.

Noise Amplifier AA504

The lower noise output level of discriminator XD503 in radiotelephones with 12.5 kHz channel spacing makes it necessary to insert an amplifier between the discriminator and squelch circuit SQ501. The load on the Darlington amplifier in this case is a resistor, and the load on the noise amplifier is the parallel-tuned circuit L1 - C1 in the SQ501 module.

The amplifier proper is a single transistor in a grounded-emitter circuit. A capacitor, C1, short-circuits the IF signal from discriminator XD503, and modulating frequencies are cut off by capacitors C2, C3, and C4. This arrangement results in maximum gain at 12 kHz.

Technical Specifications

XD500

Supply Voltage

Nominal: 12.4 V
Maximum: 15.0 V
Minimum: 10.0 V
Must be capable of operation at: 9.0 V.

Current Drain

At -12 V: 1.2 mA.

Bandwidth

XD501 (50 kHz channel spacing): ±25 kHz
XD502 (25/20 kHz channel spacing): ±12 kHz.
XD503 (12.5 kHz channel spacing): ±6 kHz.

Output Voltage

XD501: at 1000 Hz and Δf = ±10 kHz: 500 mV.
XD502: at 1000 Hz and Δf = ±3.3 kHz: 350 mV.
XD503: at 1000 Hz and Δf = ±1.7 kHz: 350 mV.

Harmonic Distortion

XD501: at Δf = ±10 kHz: 3.5%
XD502: at Δf = ±3.3 kHz: 3.5%
XD503: at Δf = ±1.7 kHz: 3.5%.

Noise Amplifier AA504

Supply Voltage

Nominal: 12.4 V

Maximum: 15 V

Minimum: 10 V.

Current Drain

At 12.4 V: 0.45 mA.

Gain

At 12 kHz and 12.4 V: 18 dB +4 dB/-2 dB.

SQ501

Supply Voltage

12.4 V nominal.

Current Drain

In squelched condition: Max. 0.5 mA.

In unsquelched condition: Approx. 0.03 mA.

Squelch Sensitivity (EIA measuring method)

After 40 dB suppression of the output noise, the squelch circuit must be capable of opening at a signal-to-noise ratio of 8 dB.
(At $\Delta f = 2/3\ \Delta f_{max}$ and $F_{mod} = 1000$ Hz).

Maximum Output-noise Attenuation

Output noise must be capable of not less than 60 dB attenuation.

AF Amplifier AA502

Supply Voltage

Nominal: 12.4 V

Maximum: 15.0 V

Minimum: 10.0 V

Must be capable of operation at: 9.0 V.

Current Drain

At nominal voltage without signal, with squelch: 0.6 mA. With signal: 3.0 - 34 mA.

Power Output

At nominal voltage and nominal input level: 200 mW.

Input Level

Nominal input level at 1000 Hz and full power output: 200 mV.

Frequency Response

With reference to 1000 Hz and -6 dB/octave, the limits are +2 dB and -8 dB.

Harmonic Distortion

At 1000 Hz and 200 mW output: 5%.

AF Noise Attenuation in Squelched Condition

At nominal input voltage: 40 dB.

D. Common Modules

Those functions of the radiotelephone which are common to both transmitter and receiver are handled by the following modules:

JP531	Junction panel containing voltage stabilizer circuit, and circuits for the speaker-microphone.
JP532	Junction panel containing circuits for adjustment of transmitter AF level as well as filters for operating voltage for individual receiver modules.
XS511 or XS531	Crystal shift unit for transmitter and receiver containing switch, sockets, and circuits for three transmitter and three receiver crystals. XS511 is used in type CQP510 radiotelephones and XS531 in type CQP530 radiotelephones.

Junction Panel JP 531

Junction panel JP531 contains the ADC circuit which protects the RF transistors in the transmitter output stage. This circuit is described in the text covering the transmitter section. A built-in zener regulator provides a stabilized 7.6 V supply. Junction panel JP531 also contains some resistors and capacitors which are employed in conjunction with the microphone circuit, and some of the connections to the multiwire connector pass through the panel.

Junction Panel JP 532

Junction panel JP532 contains potentiometers for setting the maximum frequency swing of the transmitter (R1) and the tone level from a built-in tone transmitter (R2).
The panel also contains filters for operating voltages for a number of receiver modules.

Crystal Shift Unit XS531or XS511

The crystal shift unit contains sockets for three receiver crystals and three transmitter crystals. The maximum number of channels with which the radiotelephone can be equipped is therefore three

The receiver crystals are overtone crystals oscillating on their series resonant frequency (near the third harmonic). In series with each crystal is a series-resonant circuit consisting of a coil and a trimmer capacitor. By means of the variable capacitance, the frequency may be pulled to exactly the nominal frequency of the crystal.

In parallel with each transmitter crystal is a trimmer capacitor by means of which the frequency can be pulled to the nominal frequency of the crystal.

The channel selector has four positions three of which are used for switching between the three channels. In the fourth position, the radiotelephone is switched off. The switch sections are so designed that unused receiver crystals are disconnected whilst unused transmitter crystals are short-circuited to chassis potential.

The crystal shift unit moreover contains a main fuse through which flows the entire amount of current consumed by the radiotelephone, and a protective diode. Should voltage of the wrong polarity be applied, the diode will conduct and so short-circuit the battery voltage, with the result that the fuse blows and thus removes voltage from the radiotelephone.

Battery BU 501

The replaceable nickel-cadmium battery BU501 supplies the operating voltage required by the radiotelephone (nominal voltage is 12.4 V).

In normal operation the battery may be used for approx. ten hours before charging is necessary (see also Chapter I, section Operation).

The condition of the battery is checked by means of a filament lamp at the bottom of the radiotelephone cabinet as explained in Section A, Control Functions).

Speaker-Microphone Circuit

The speaker-microphone is integral with the cabinet and operates as a speaker during reception and as a microphone during transmission. Switching between the two functions is performed by two contact pairs which are actuated when the transmit button is operated (see also Section A, Control Functions).

Multi-Wire Connector J1

The multi-wire connector J1 on the top of the cabinet is used for making a few important check measurements on the equipment and for connecting various extra accessories such as lapel microphone, earphone, etc.

The multi-wire connector contains nine pins. The table below specifies the points in the radiotelephone to which the individual pins connect as well as the functions performed by them.

Pin	Purpose
1	Battery voltage, negative with respect to chassis (pin 6)
2	Connection for earphone etc.
3	Connection for external microphone (between pins 3 and 8)
4	Short-circuits the speaker-microphone to pin 3 when an external microphone is connected.
5	Audio for an external tone receiver (if provided), taken off after the discriminator but ahead of the volume control.
6	Chassis (connects directly to the positive battery terminal when the equipment is switched on).
7	Discriminator test point, connects to test point 6 through 1 MΩ resistor.
8	Connection for external microphone (between pins 3 and 8)
9	Available for special-purpose accessories

CHAPTER III. ACCESSORIES

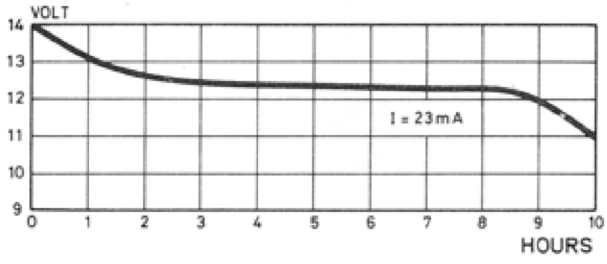
A. Charging Units

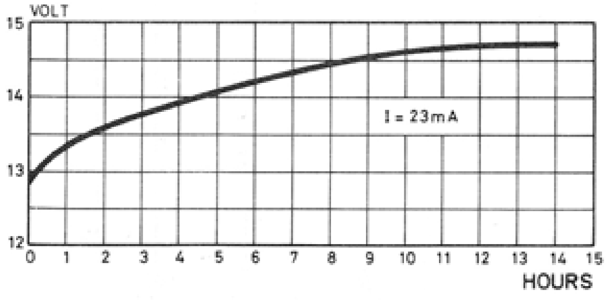
Additional nickel-cadmium batteries and three types of charging units are available as standard accessories.

BU501	10-cell nickel-cadmium battery, 225 mAh.
CU501	Charging unit with provision for connection of up to ten battery outlets.
CU502	Charging unit with provision for connection of up to ten battery outlets and with built-in timer.
CU503	Charging unit with provision for connection of up to two battery outlets.

Battery BU501

As mentioned in Chapter I, the battery may be charged more than 500 times without appreciable reduction of its capacity. However, it should not be overcharged repeatedly as this will reduce its capacity.



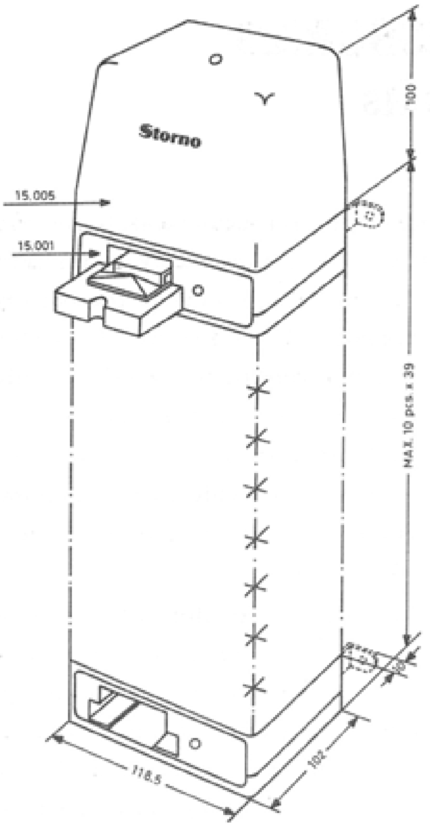


As shown in the illustration, the discharge curve is essentially straight-lined at a discharge current of 23 mA. When the voltage has dropped to approx. 11 volts, in practice corresponding to approximately ten hours of operation, the voltage curve drops fairly sharply, and if the voltage across the battery goes below approx. 10 V there will be a risk of repolarization of one or more cells, which may then be ruined the next time the battery is charged. Strong polarity reversal of one or more cells will be evidenced by somewhat lower voltage for a normally charged (not overcharged) battery.

In cases where one radiotelephone is used by several persons or where other factors make it impossible to keep a check on the operating time so that the charging time cannot be predetermined with certainty, there are two methods of solving this problem. One consists in always operating the radiotelephone until the built-in pilot lamp shows that the battery is discharged, thereafter replacing the discharged battery with a fully charged spare battery. This can easily be carried in a pocket, thanks to its small size. The other method consists in discharging the battery before recharging it. However, the discharge current should not exceed 115 mA, which means that the shorting resistor employed should not be smaller than 110 Ω and be rated at not less than 3W. Discharge should not be allowed to continue past the point where the battery terminal voltage has dropped to approx. 11 V.

Charging Unit CU501

Charging unit CU501 consists of a power supply (15.005) to which a maximum of ten identical battery outlets (15.001) may be connected. A built-in switch permits switching the mains voltage input between 110 V AC and 220 V AC. The output from the secondary of the mains transformer (T1) is rectified in a bridge circuit (E1) and fed to the battery outlets. In each outlet, the charging current for the battery



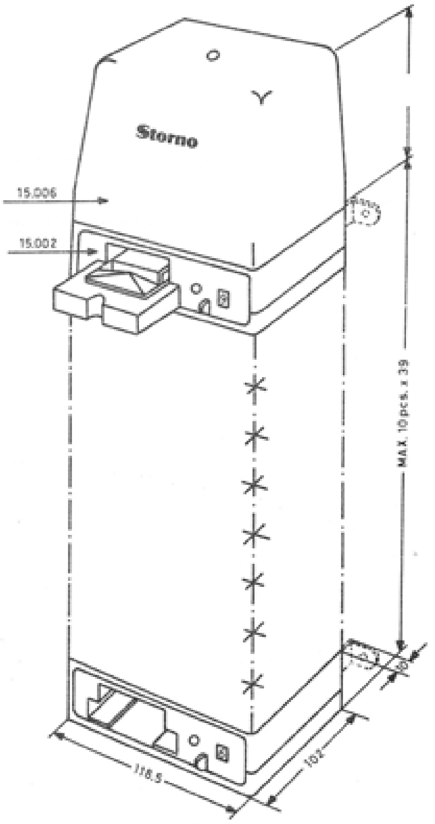
flows through a resistor (R4) and a filament lamp (V1) which operates both as current regulator and pilot lamp. Normal charging current for each battery outlet is approx. 25 mA, and the time normally required for charging a discharged battery is 14 hours.

Charging Unit CU502

Charging unit CU502 consists of a power supply (15.006) to which a maximum of ten identical battery outlets (15.002) may be connected. Besides a bridge rectifier (E1), the power supply section contains a synchronous motor the driving shaft of which makes 1/12 revolution per hour, thanks to a gear reduction system. Each battery outlet moreover has a built-in counter which may be set to charge the battery for any desired number of periods between 1 and 9. The length of each period is one hour and a half, corresponding to approximately one hour's normal operation of the radiotelephone.

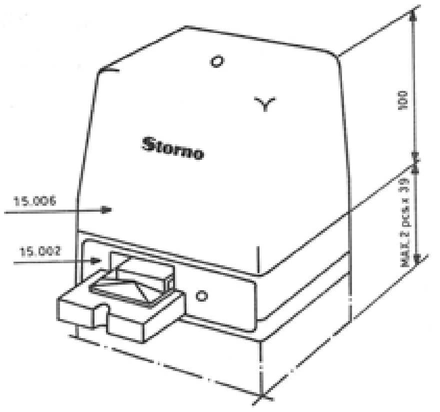
The cam wheel of the synchronous motor sees to it that contacts 01 make every one and one-half hours, thereby causing electrolytic capacitor C1 to discharge through contacts 01, counter coil A, rectifier E2, and relay contacts A. This will cause counter relay A to move backwards one digit, and when digit 0 has been reached, the counter relay operates, causing contacts a to break the battery charging circuit. However, a very low value of charging current (approx. 0.6 mA) flows through a resistor (R3) to compensate for self-discharge.

When contacts a of the counter relay are open, rectifier E2 will prevent charging current from flowing through the counter coil to the other battery outlets. Similarly, rectifier E3 will prevent the battery from discharging through the counter relay coil and the other battery outlets. Lamp V1 operates both as current regulator and pilot lamp.
Contacts a of the counter relay remain open until the outlet counter is once again set for charging.



Charging Unit CU 503

Charging Unit CU503 consists of a power supply (15. 007) to which a maximum of two identical battery outlets (15. 001) may be connected. The mains transformer (T1) has taps for both 110 V AC and 220 V AC. When the charging unit is rewired for operation from another mains voltage, the fuse should be replaced with one of suitable rating. The output from the secondary of the mains transformer (T1) is rectified in a bridge circuit (E1) and fed to the battery outlets. In each outlet, charging current for each battery flows through a resistor (R4) and a filament lamp (V1) which operates both as current regulator and pilot lamp.



Common Specifications

Supply Voltage

110 V or 220 V AC, 50 Hz.

Charging Current

When battery is discharged: 22 - 27 mA.
When battery is fully charged: 20 - 25 mA.
(except as specified for CU502).

No-load Voltage

40 V DC.

B. Selective Tone Equipment

General

Space is provided in the cabinet for installation of a tone transmitter, and the cabinet is equipped with the cabling required for the purpose.

If the radiotelephone does not incorporate a tone transmitter, the space set aside for its installation will be covered by a plate to which the tone equipment cabling is soldered.

Either a TT501 single-frequency tone transmitter or a TT504 double-tone transmitter may be installed. In type CQP500R radiotelephones a TT503 tone transmitter may be installed in conjunction with control unit CB503. The TT503 permits switching between two tone frequencies. The tone frequency or frequencies desired should be stated when ordering the tone transmitter.

Single-tone Transmitter TT501

Tone transmitter TT501 is housed in an 18x18mm module can. The tone transmitter consists of a Hartley-type oscillator with feedback between the emitter and base.

The tuning coil L1 is wound on a miniature cup core with air gap and has a ferrite tuning slug for accurate adjustment of the oscillator frequency.

The total tuning capacitance is composed of three parallel-connected capacitors, C2, C3, and C4, of the type having a very small temperature coefficient.

In order to make the output voltage and frequency independent of any variations in operating voltage, the DC supply voltage for the oscillator is stabilized by a zener diode (E1).

Technical Specifications

Supply Voltage

Nominal	12.4 V
Minimum	10.0 V
Maximum	14.0 V.

Current Drain

Nominal 20 mA at 12.4 V.

Frequencies

One of the following frequencies: 1435 Hz, 1520 Hz, 1530 Hz, 1670 Hz, 1750 Hz, 1830 Hz, 1860 Hz, 1980 Hz, 2000 Hz, 2135 Hz, 2200 Hz, 2280 Hz, 2400 Hz, 2450 Hz, 2600 Hz, 2812 Hz, 2900 Hz, 3047 Hz.

Frequency Stability

±1%.

Harmonic Distortion

Max. 6%.

Output Level

3V ±1 dB loaded by 1 MΩ.

Single-tone Transmitter TT503

Tone transmitter TT503 can be installed only in type CQP500R radiotelephones in conjunction with control unit CB503, which has a switch for selecting between high and low tone. The module is housed in an 18 x 18 mm can and consists of a Hartley-type oscillator with feedback between emitter and base. Tuning coil L1 is wound on a miniature cup core with air gap and has a ferrite tuning slug for accurate adjustment of oscillator frequency.

The total tuning capacitance is composed of two capacitors, C1 and C2, which have a very small temperature coefficient.

When a low tone is to be transmitted, an additional capacitor is added across the tuning capacitance. This capacitor is located on junction panel JP504 owing to space considerations. To transmit tone I (lower frequency), the switch on control box CB503 feeds -12V to terminal 3, and diode E2 is biased in the forward direction, diode E3 is blocked, and voltage is fed to the oscillator while limiter LI502 is disabled via terminal 2. The external tuning capacitor is connected to terminal 1 and the -12V battery terminal and will thus affect the oscillator frequency.

To transmit tone II, -12V is fed to terminal 4, and diode E3 is biased in the forward direction, diode E2 is blocked, and voltage is fed to the oscillator. Limiter LI502 is disabled via terminal 2, and in AF amplifier module AA501/ AA503 negative voltage is applied to the emitter of Q1 via a resistor, R5. This will reduce the gain so much that the two tones will produce the same frequency swing on the transmitter.

Technical Specifications

Supply Voltage

Nominal	12.4 V
Minimum	10.0 V
Maximum	14.0 V.

Current Drain at 12.4V
20 mA.

Frequency Stability
± 1%.

Harmonic Distortion
Maximum 6%.

Output Voltage
7V ± 1 dB (load 1 MΩ).

Frequencies
1750 and 2135 Hz.

Frequency Deviation
Max. ± 5 Hz.

Difference Between Tone Levels
Maximum 0.5 dB.

Double-tone Transmitter TT504

Double-tone transmitter TT504 delivers two tones simultaneously. It is housed in an 18 x 18 mm module can except for the tuning capacitors which are mounted outside the module can owing to space considerations.

The tone transmitter consists of two Hartley-type oscillators with feedback between emitter and base. The tuning coils, L1 and L2, are wound on miniature cup cores with air gap and have ferrite tuning slugs for accurate adjustment of the oscillator frequencies.

The tuning capacitors are polystyrene capacitors of the type having a small temperature coefficient.
The two oscillators are connected together via two 1 MΩ resistors so that feedback between the oscillators is avoided. In order to make the output voltage and the frequencies independent of any variations in operating voltage, the DC supply voltage for the module is stabilized by zener diode E1.

Technical Specifications

Supply Voltage
Nominal 12.4 V.

Current Drain
Nominal 3.8 mA at 12.4 V.

Frequencies
1400 Hz, 1530 Hz, 1670 Hz, 1830 Hz, 2000 Hz, 2200 Hz, 2400 Hz, 2600 Hz, 2900 Hz.

Frequency Stability
± 1%.

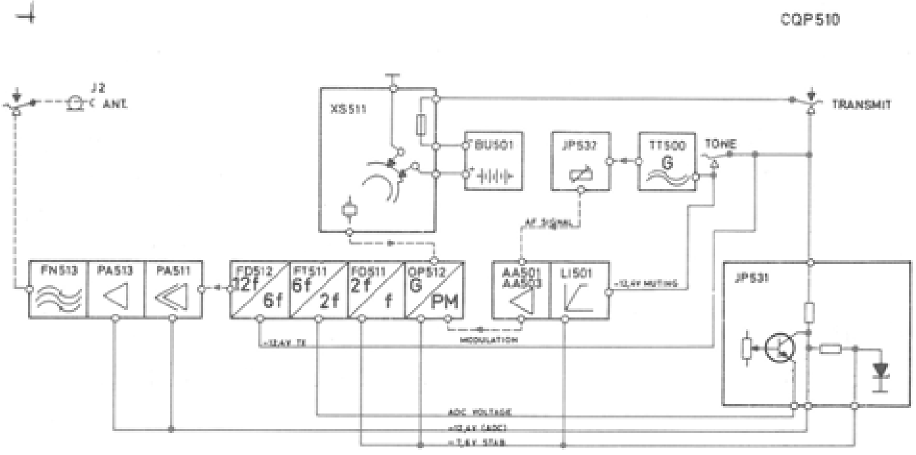
Harmonic Distortion
Max. 6%.

Output Voltage
Loaded by 1 MΩ and with one oscillator switched off: 1.8 V.

Tone-button Function in Locally Controlled Radiotelephone

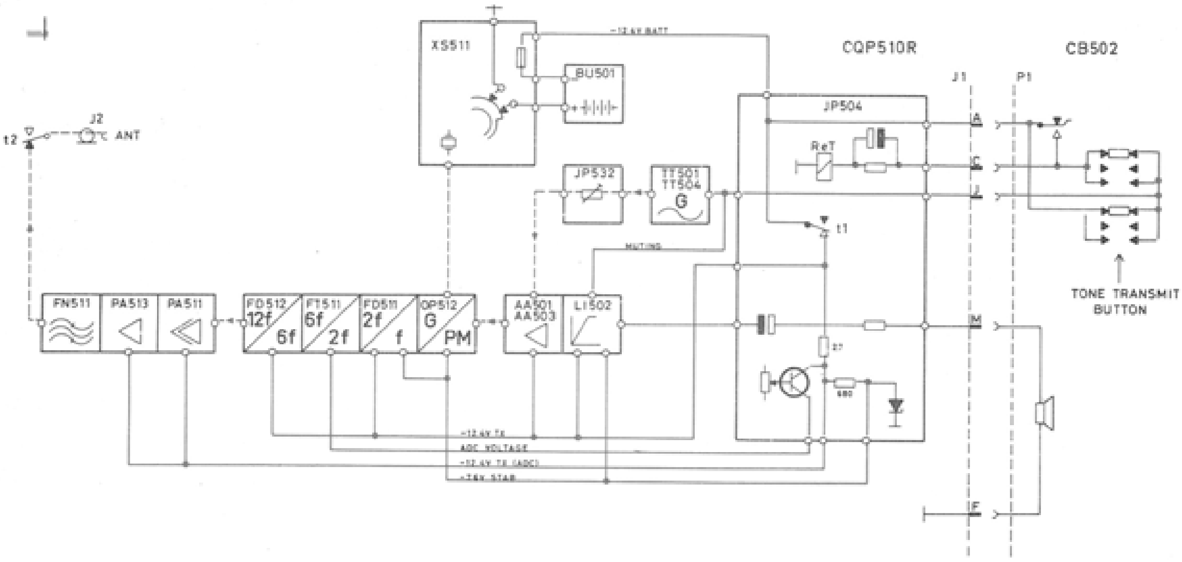
A tone call signal from a locally controlled radiotelephone is transmitted by pressing both the transmit button and the tone button at the same time.

The transmit button applies 12 V operating voltage to the transmitter and, via the tone button, to the tone transmitter. The tone signal from the operated tone transmitter is fed via the level control potentiometer in junction panel JP532 to the modulation input of the AF amplifier. Moreover, speech limiter module LI501 is disabled, thereby muting the signal from the microphone.



Tone-button Function in Remotely Controlled Radiotelephone

Transmission of a tone call signal from a remotely controlled radiotelephone only requires operation of the tone button on the control box. This will cause the transmitter to be switched on and operating voltage to be applied to the tone transmitter; also, speech limiter LI502 will be disabled. The tone signal from the tone transmitter is fed via the level control potentiometer in junction panel JP532 to the modulation input of the AF amplifier



CHAPTER IV. SERVICE

A. General

As dispatched from Storno, the Stornophone 500 portable radiotelephone is completely tested and - unless otherwise agreed upon - tuned to the desired frequencies with an accuracy better than ±2 x 10^{-6} Hz/Hz.

In order to ensure optimum performance at any time, the Stornophone 500 radiotelephone should be subjected to preventive service inspections at regular intervals and tuned up if necessary. The frequency of such service inspections will depend both on the total number of operating hours and on operating conditions, but intervals between service inspections should not exceed six months.

Adjustments and repairs of mechanical or electrical defects outside module cans can be performed by any skilled radio technician who has the necessary tools and measuring equipment at his disposal and has acquainted himself with the operation of the Stornophone 500 radiotelephone by studying this manual.

Circuit repairs inside individual module cans should not be attempted as a rule, not only because of the miniaturization resulting from the use of small components as well as high component density but also because it will be cheaper in the great majority of cases to replace a module than to try to repair it.
to try to repair it.

Ordering of Spare Parts

When ordering components, modules, or mechanical parts for the Stornophone 500 radiotelephone please state their code numbers and designations. These are given in the electrical and mechanical parts lists of this manual.

Check Measurements

The Stornophone 500 radiotelephone is equipped with a number of test points for use when checking its general condition and when performing adjustments to it.

Electrical locations of test points and a number of typical voltages and currents are stated in the circuit diagrams of Chapter V of this manual.

Physical locations of test points appear from drawing No. D401.242 at the end of the section "Adjustment Procedure".

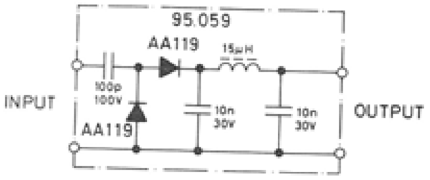
Measuring Instruments

The following measuring instruments are required for tracing faults in and making adjustments to the transmitter-receiver circuits:

Power supply, variable between 10 and 15V/300 mA/Ri < 2Ω.

Multimeter, $Z_{in} > 20$ kΩ/V (e.g. Unigor).

Probe, Storno type 95.059 (see diagram below).



Signal generator, 10,7 MHz, crystal controlled (e.g. Storno type G21, Code No. 95.163).

Signal generator, 146-174 MHz (e.g. Marconi type TF1066B).

AF valve voltmeter (e.g. Radiometer RV36).

DC oscilloscope (e.g. Telequipment S32A) or DC valve voltmeter ($R_i > 1$ MΩ).

Distortion meter (e.g. Radiometer type BKF6).

Tone generator, 300-5000 Hz (e.g. Philips model PM5100).

Deviation meter (e.g. Radiometer type AFM1).

RF wattmeter, 50 Ω 0-1W (e.g. Bird model 6254).

Modulation transformer with attenuator pad (Storno No. 60.5100).

If frequency adjustment is to be made, also:

Frequency counter, 146-174 MHz (e.g. HP model 5245L with 5253B).

Opening the Cabinet

Remove the battery by sliding the locking pawl knob on the cabinet back plate upwards. This will release the battery, permitting it to be tipped out.

Thereafter remove the six screws holding the cabinet lid (identified in Fig.) and lift the lid off.

Installing Crystals

If your radiotelephone was dispatched to you with no crystals installed in it the cabling diagram in Chapter V will tell you where to place the crystals.

Tuning to frequency is performed as described in section D, "Adjustments".

Crystal Ageing

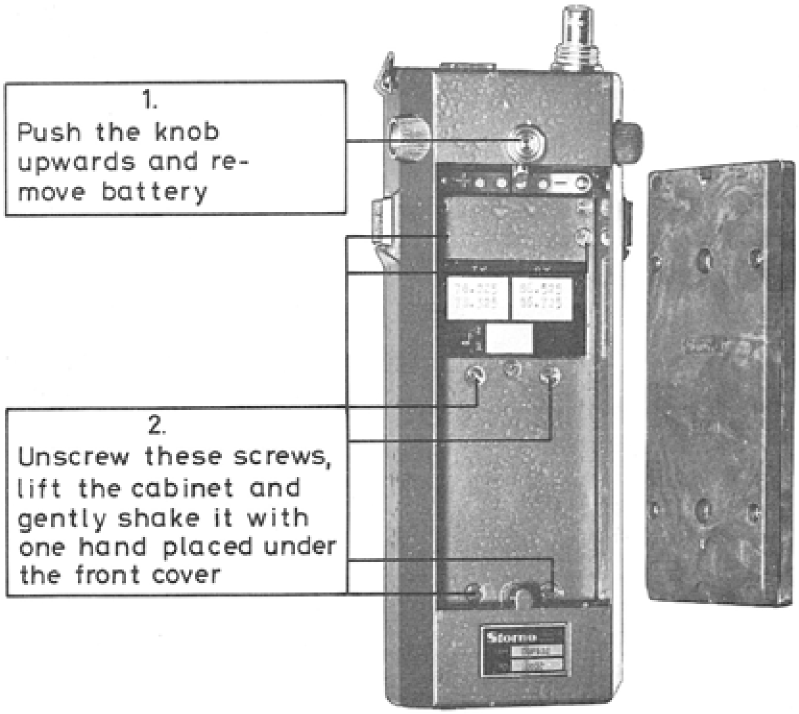
The increasingly rigorous demands on frequency stability make the problem of crystal ageing grow in proportion.

The problem is chiefly associated with mechanical vibrations in consequence of which all factors causing an increase or reduction in the effective mass of the quartz plate, either during or after its manufacture, will invariably result in a frequency change.

Some of the factors contributing to undesired ageing are infinitesimal changes in crystal mass due to inadequate cleanliness and to contamination of the crystal surface. Other causes are poor electrode materials checking and excessive humidity of the air or gas trapped in the crystal holder after it has been sealed.

Indirect causes of mass changes such as unnoticed surface tension and strain introduced by the crystal mountings will likewise produce frequency drift.

Undesired frequency ageing in metal-encased and hermetically sealed high-frequency crystal units is chiefly due to difficulties in regard to securing the necessary component purity and preventing the ingress of flux vapours and other volatile substances during the process of sealing the crystal holder. A contributory cause is the difficulty of securing an airtight enclosure that will last the life of the crystal unit - a result of weakness in



the solder used and of the glass-to-metal closure.

It has been found that these ageing processing are intensified at high operating temperatures.

Reduction of Frequency Ageing Processes

Unfortunately, the frequency drift caused by long-term ageing cannot be countered by any kind of compensation technique because so many unpredictable factors enter the picture. However, it can be countered by adjusting the oscillator frequency at regular intervals, and in many cases this represents a satisfactory solution to the problem.

Undesired ageing occurring after production of the crystal has made it impossible for manufacturers to offer a guarantee against frequency changes caused by ageing. Instead a typical figure is stated, usually of the order of $\pm 10 \times 10^{-6}$ per year.

With AT cuts in metal holders, one year of ageing will cause frequency changes of the order of 5 to 10 10^{-6}. It should be noted that ageing processes vary with frequency, being more pronounced for high-frequency crystals (thin plates) than for low-frequency crystals.

Readjustment of Frequencies

In consequence of the long-term ageing described above Storno recommend that radiotelephones which must meet stringent demands for frequency stability be subjected to readjustment of their oscillator crystals at intervals.

If the requirements for frequency stability exceed $\pm 5 \times 10^{-6}$ we wish to stress the need for such frequency adjustments. The times for making readjustments depend not only on individual crystals but on operating temperature as well. As a guide, however, it is suggested that the first adjustment be made after three or four months. The second readjustment should be made six or eight months later (these times are based on operation at normal ambient temperature).

Oven crystals will age somewhat more quickly. In this case, the first adjustment should be made after two or three months of operation, the second readjustment four or six months later.

B. Fault-finding

Visual Inspections

Any fault-finding operation should begin with careful visual inspection of the equipment. The technician should especially look for the following sources of trouble:

Defective cabling in the form of broken or loose wires.

Loose screws, these being frequent causes of poor chassis connections.

Foreign elements in the cabinet such as loose blobs of solder or cut-off wire ends from earlier jobs. Such particles can cause short-circuits in all parts of the circuits.

Measurements

Feed 12.4 V from an external power supply to the battery clips.

Check that the receiver section receives operating voltage when in the stand by and receive conditions.

Turn the transmitter on and check the operating voltage for the transmitter section. If no operating voltage for the transmitter and receiver sections is present, check to see if the fuse in XS511 has blown.

Receiver Faults

If the loudspeaker is dead or only a hissing sound is heard, check for signal continuity in the AF section, IF chain, oscillator chain, and antenna change-over contacts.

The AF section may be checked by feeding an AF signal from a tone generator to terminal 5 of connector J1 and listening whether the signal is coming through the speaker. The squelch and volume controls should be in their full clockwise positions during this check.

The check on the IF chain should be made in two phases. First, apply a modulated 10.7 MHz signal to test point $\boxed{3}$ of the input of the last IF amplifier unit, IA505/IA508.

AS DC voltage appears at test point $\boxed{3}$ the signal should be applied through a capacitor.

If the signal is heard in the loudspeaker, the IF gain should be checked at test point $\boxed{6}$. Typical gain in IA505/IA508: 75 dB (approx. 25 dB per stage).

Thereafter check the first half of the IF chain comprising IT502 and IA504/IA507 by applying a modulated 10.7 MHz signal to test point $\boxed{9}$. If there is signal continuity, check the gain of IF module IA504/IA507 by feeding a 10.7 MHz signal to the input of the module and measuring the gain at test point $\boxed{3}$.

Typical gain in IA504/IA507: 65 dB (approx. 22 dB per stage).

NOTE: In all gain measurements, the input signal level should be kept as low as possible in order to avoid limiting

Check the injection signal for mixer stage RC511 at test point $\boxed{2}$. A reading of 3 μA should be obtained.

Feed a modulated RF signal through the antenna connector. If desired, the antenna change-over contacts may be checked for voltage drops across the closed contacts.

Check the gain of the receiver RF section and mixer stage.

With an input signal of 4 mV EMF, 20 mV should be present at test point $\boxed{9}$ (in IT502), measuring with an RF probe and multimeter.

The tracing of faults to one more modules should be followed up by DC measurements. For this purpose a number of typical voltages are given in the circuit diagrams in this manual. Check to see if these voltages are present.

The transistors should be checked by measuring their emitter and base voltages. The difference (the base bias) should be approx. 0.6V for silicon transistors and approx. 0.15V for germanium transistors.

NOTE: Both PNP and NPN transistors are used. On PNP transistors, base and emitter voltages should be measured with respect to chassis potential and collector voltages with respect to -12.4V. On NPN transistors, the same voltages should be measured with respect to the opposite potential.

The transistors of defective stages may be checked by resistance measurements of their diode junctions (with no operating voltage applied to the stages in question).

Using the ohmmeter, the base-emitter and base-collector junctions should be measured in both the forward and back directions.

Low resistance should be measured in the forward direction (of the order of a few hundred ohms).

High resistance should be measured in the back direction (of the order of 1 kΩ to 100 kΩ), determined by the shunt resistors of the stages in question.

NOTE: At no time during resistance measurements on transistors may the ohmmeter current exceed 1 mA.

Transmitter Faults

Connect a wattmeter to the transmitter output (antenna connector J2). If output is low or entirely absent, check the output signals of the individual transmitter units, using a multimeter and RF probe.

Start making measurements at the transmitter output, working backwards towards the oscillator.

Outputs of individual units are designated as test points for which typical readings are given in the following test point chart.

The measurement of DC voltages on transistors in the power amplifier stages of the transmitter is difficult as these stages operate in Class C.

However, it is possible to measure the emitter voltage of a stage if it receives drive from the preceding stage.

Also in the case of the transmitter section it should be kept in mind that both PNP and NPN transistors are used. To facilitate checking of the transmitter circuits a number of typical DC voltages and currents are stated on the circuit diagrams.

The charts below list a number of test-point values which will be a useful aid in judging the performance of the radiotelephone in subsequent check measurements. In addition, they will provide an indication of whether readjustment is required.

Transmitter Section

Test Point	Module	Reading	Instruments
11	OP512	0, 5 V	RF probe + multimeter
Collector Q1	FD511	1, 0 V	RF probe + multimeter
12	FT511	1, 6 V	RF probe + multimeter
Emitter Q1	FT511	0, 5 V	RF probe + multimeter
ADC	FT511	4-6 V	DC-Voltmeter
13	FD512	1, 6 V	RF probe + multimeter
Emitter Q1	FD512	0, 5 V	RF probe + multimeter
14	PA511	3, 5 V	RF probe + multimeter
Output	PA511	4, 5 V	RF probe + multimeter
Output	PA513	17 V	RF probe + multimeter
Transmitter output	Ant. Connec.	500 mW	Wattmeter

Receiver Section

Input Signal (emf)	Test Point	Module	Reading	Instruments
None	1	OT511	3 μA	RF probe + multimeter
None	2	RC511	1 V	
10 mV ●	Signal Output	RA511	0, 3 V	
4 mV ●	9	IT502	20 mV	
3 mV ▲	3	IA505/508	30 mV	
3 mV ▲	4	IA505/508	70 mV	
3 mV ▲	5	IA505/508	1 V	
1 mV ▲	6	IA505/508	0, 2-0, 3V	

● Signal generator set to the receiver frequency and connected to input of the receiver.

▲ Signal generator set to 10, 7 MHz and connected to input of 1st IF Amplifier Module IA504/507.

Multimeter

The above table was compiled using a multimeter type Unigor S4. If other instruments are used, the instrument must have an input impedance of not less than 100 kΩ/V in order that the readings have some relevance.

C. Repairs

Replacing Modules

Replacements of module cans will not normally cause difficulties if reasonable care is taken. In particular, care should be taken to avoid damaging adjoining modules during the removal and insertion of modules.

If the module to be removed is located below one of the screen plates, the screen should be removed first. To do this, insert a tool having a wide contact face (the blade of a knife or a screwdriver having a broad blade) under the screen plate. Care should be taken to avoid inserting the tool between the screen plate and the modules below it in order to avoid damaging the module cabling. Unsolder the cabling of the module you wish to replace - it is a good plan to make a few notes about the wiring connections first so as to make it possible to have exactly the same cabling after the replacement job as before it.

Best possible chassis connection between the module cans is secured by solder tags on each can which are soldered to the tags of adjoining cans. One side should be unsoldered at a time. While applying the hot soldering iron, press the blade of a small knife down between the cans and free the can you wish to replace by wriggling it while the solder is still liquid.

When free, the module can should be pulled out carefully. Before inserting the new module can, the solder tags of adjoining modules should be cleaned of excess solder. Thereafter push the new module into place, carefully solder the tags together and solder the cabling to the new module

If the replaced module contains adjustable components, that module as well as adjacent modules should be adjusted in accordance with the directions given in this chapter.

Soldering

As mentioned above, soldering on the circuits boards used in the radiotelephone requires great care.

A low-voltage soldering iron of approx. 15W rating is required for soldering directly on circuit boards while a 220V soldering iron of approx. 30W rating may be used for unsoldering tags in connection with replacements of module cans.

When soldering on, or in the immediate vicinity of, circuit boards, the soldering iron should not be applied for more than three seconds. The circuit boards are made of a glass fibre material which is perfectly capable of withstanding the heat for a short time, but there is a risk that the heat may cause the copper foil to work loose from the base material; there is also a risk that components may be damaged or detach themselves from the circuit board and fall down into the module can.

Correct soldering temperature is 270°C, and the use of a soldering iron having a tip not more than 3-4 mm in diameter is recommended. The tip should be shaped like a chisel or screwdriver.

Conventional 60/40 solder may be used, but solder having a flux content of approx. 0.5% is better suited. Conventional solder contains approx. 3.5% flux.

Excess solder should be removed with isopropyl alcohol, but this solvent should not be permitted to come into contact with components.

Repairing Modules

Repairs to circuits in module cans should be carried out only in very special cases, and the greatest care should be shown in order to avoid degrading the performance and specifications of the radiotelephone.

After having been taking out, the module can should be placed in a device which can hold it in a horizontal position but without gripping it so firmly that the can is damaged. Using a sharp knife (a scalpel is recommended), pry the circuit board loose while heating, with a soldering iron, the soldered joints between the module can and the copper foil of the circuit board. When all four sides have been pried loose, the circuit board may be taken out. A pump should be used to suck away liquid solder while heat is being applied.

Replacements of components in the circuits require a high order of accuracy as the wiring and placement of components must not be altered New components should meet the same specifications as the ones which were removed. Liquid solder may be removed during replacement of components by means of a length of coaxial-cable braiding.

When the fault has been repaired, the circuit board should be put back in the screen can. Because of the miniature construction, the capacity of the can is fully utilized for which reason great care should be taken to prevent bare wires from getting into contact with the screen can, and to ensure that the internal insulating fail is properly placed in the can.

If the can was damaged during the repair job, it should be replaced with a new one.

When the circuit board is in place, a soldered joint should be made between the screen can and the chassis connection of the circuit board.

After having been repaired and put back in place, the module must be adjusted, as must also the adjoining circuits.

Replacement of Squelch and Volume Potentiometers

Access to the potentiometers is obtained by loosening the transmit and tone button contact pairs by removing the screws on the cabinet back plate (see sketch). The contact pairs may then be removed if care is taken. In order to avoid damaging the cabling and connections to the contact pairs, care should be taken to avoid pulling too hard.

Thereafter remove the potentiometer control knob, proceeding as follows:

a) Remove the circlip holding the knob label in place.

b) Take out label.

c) Loosen screw.

d) Release the grip of the collet on the potentiometer shaft by pulling the knob outwards while pressing the loosened screw inwards against the collet. Remove collet, sealing ring, screw, and knob.

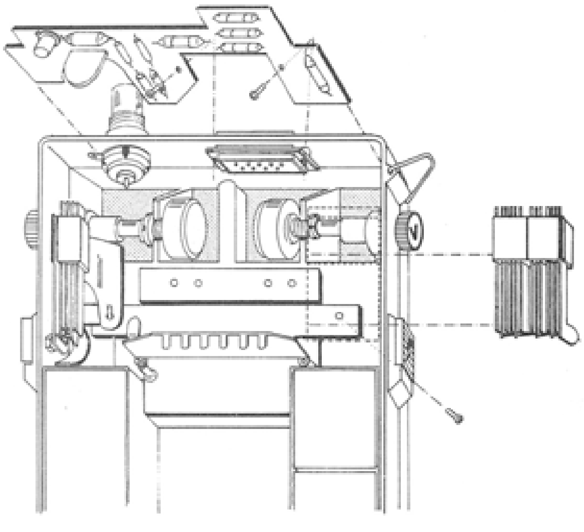
Unsolder the potentiometer cabling.

Release the potentiometer from the cabinet by loosening the potentiometer nut (a Storno No. 17.011 spanner may be used).

When installing a new potentiometer the control knob sealing ring should be lubricated with silicone grease before being put back.

While being clamped, the knob should be pressed so hard against the cabinet that a sufficiently high turning moment is obtained.

On completion of the job, any silicone grease that may have leaked from the sealing ring should be wiped off the cabinet and control knob.



Replacing Junction Panel JP531

To replace junction panel JP531, first loosen the contact pairs as described above. Then loosen the two screws holding the panel and multi-wire connector. The junction panel may now be lifted up carefully and the cabling unsoldered.

Replacing Connectors

To replace connectors, loosen junction panel JP531 as described in the preceding paragraph. Then unsolder the connector cabling and remove the connector. A Storno No. 17.012 spanner may be used for replacement of the antenna connector.

Replacement of Lamp in Charging Unit

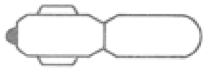
Replacement of the indicator lamp in charging outlets type 15.001 and type 15.002 requires a sleeve, Storno Code No. 17.050, or a sleeve consisting of an 80 mm length of screened PVC tubing of 6.0 mm inside diameter and 0.5 mm wall thickness.

Remove the red indicator lamp glass from the front panel.

Press the sleeve down over the top of the lamp bulb. Press down and turn anti-clockwise. Then pull the sleeve and lamp out.

Place a new lamp in the sleeve or tubing. Press the lamp down to grip the lamp holder. Press down and turn clockwise.

Pull out sleeve and insert the red indicator lamp glass.



LAMP NO. 92.5003

EXTRACTOR NO. 17.050

Adjustment of Charging Current

Replacement of the indicator lamp should always be followed by an adjustment of the charging current.

To do this connect a milliammeter in series with a zenerdiode (12.4V ±5%, code no. 99.5030) across the battery terminals.

Adjust potentiometer R6 for a meter reading of 22mA ±1mA. The potentiometer is accessible through a hole in the rear of the cassette.

D. Adjustment Procedure

General

If the radiotelephone has three channels, adjustment should be made on a basis of the middle frequency. Two-channel radiotelephones should be adjusted for equal performance on both channels. This can be accomplished by changing back and forth between channels during the process of adjustment and is important especially if the frequencies are widely separated. Because there is interaction between the circuits, the adjustments should be repeated several times until maximum performance and stability are obtained.

RECEIVER ADJUSTMENT

During adjustment, the radiotelephone must be powered from an external supply capable of being varied between 0 and 15V and delivering a minimum of 300 mA. The power supply should be set to deliver 12.4V. During adjustment of the receiver, the power supply should be set for 25-30 mA current limiting.

Adjustment of Oscillator and Multiplier, OT511, RA512 and BP514

Instruments

RF probe, Storno type 95.059.
Multimeter.

Procedure

Connect multimeter via RF probe to test point $\boxed{1}$.

Adjust coil L1 in OT511 for minimum multimeter reading. 0,05 V

Connect multimeter via RF probe to test point $\boxed{2}$.

Adjust coil L2 in OT511, coil L1 in RA512, and coil L1 in BP514 for maximum multimeter reading. ca 0,5 V

Adjustment of IF. and Discriminator, IT502, IA500, and XD500

Instruments

RF probe, Storno type 95.059.
Multimeter.
10.7 MHz signal generator, crystal controlled.
DC valve voltmeter or DC oscilloscope.

Procedure

Terminate signal cable from signal generator in coupling coil (2 turns, 3 mm dia.). Couple coil to L1 in IT502 by pushing it in below the screen at IT502.

Connect multimeter via RF probe to test point $\boxed{3}$.

Tune coils L1, L2, and L3 in IA504/IA507 and coil L1 in IT502 for maximum multimeter reading at minimum signal generator output.

Connect multimeter via RF probe to test point $\boxed{4}$.

Adjust coil L1 in IA505/IA508 for maximum multimeter reading at minimum signal generator output so that limiting does not occur.

Connect multimeter via RF probe to test point $\boxed{5}$.

Adjust coil L2 in IA505/IA508 for maximum reading.

Connect multimeter via RF probe to test point $\boxed{6}$.

Adjust coil L3 in IA505/IA508 for maximum reading.

Connect DC valve voltmeter or DC oscilloscope to test point $\boxed{7}$.

Adjust coil L2 in XD500 for 0V DC at test point $\boxed{7}$.

Adjustment of VHF Circuits, BP511, RA511, BP512, BP513, and RC511

Instruments

Signal generator, 146-174 MHz.
RF probe, Storno type 95.059.
Multimeter.
DC valve voltmeter or DC oscilloscope

Procedure

Connect signal generator to antenna connector J2 and set it to the receiving frequency.

Connect DC valve voltmeter or DC oscilloscope to test point $\boxed{7}$.

Connect multimeter via RF probe to test point $\boxed{3}$.

Increase signal generator output level until discriminator 0 can be read at test point $\boxed{7}$.

Adjust coil L2 in RA511 for maximum multimeter reading.

Adjust coil L1 in BP512, coil L1 in BP513, and coil L1 in RC511 for maximum multimeter reading.

While making the adjustments, the signal generator output should be reduced so that the multimeter reading is kept inside the most sensitive range.

Gain in the VHF circuits may be checked at test point $\boxed{9}$.

For an RF input signal of 4 mV EMF, approx. 20 mV should be read on the multimeter.

Adjustment of Distortion and Sensitivity

Instruments

Signal generator, 146-174 MHz.
Distortion meter.
AF valve voltmeter (if not incorporated in the distortion meter).
DC valve voltmeter or DC oscilloscope.

Procedure

Connect DC oscilloscope or DC valve voltmeter to "Discriminator Zero", test point $\boxed{7}$.
Connect distortion meter and (if used) AF valve voltmeter across loudspeaker terminals.
Connect signal generator to antenna connector J2 and adjust frequency to produce 0V DC at test point $\boxed{7}$.
Frequency-modulate signal generator with 1000Hz and frequency swing of Δf = 70% Δf max.

70% Δf max. is:

for radiotelephones with 50 kHz channel spacing: 10.5 kHz.
for radiotelephones with 25 kHz channel spacing: 3.5 kHz.
for radiotelephones with 20 kHz channel spacing: 2.8 kHz.
for radiotelephones with 12.5 kHz channel spacing: 1.75 kHz.

Set signal generator output level to 1 mV.
Adjust coil L3 in IA505/IA508 for maximum AF voltage.
Adjust coil L1 in XD500 for minimum distortion.
Adjust coil L1 in IT502 for minimum distortion.
Adjust coil L1 in IA504/IA507 for minimum distortion.

Requirement: Distortion ≤5%.

As the adjustment of coil L1 in XD500 influence on the zero setting of the discriminator, all such adjustments should be followed by a checking of the discriminator zero with a 10.7 MHz signal applied as described in paragraph "Adjustment of IF and Discriminator".

The squelch should be open - that is, squelch potentiometer turned fully anti-clockwise.

Set volume control for 0.5V af voltage.

Calibrate the distortion meter so that the sum of signal, noise, and distortion corresponds to 100% when the filter is not inserted.

Insert the filter to remove the modulating frequency.

Reduce the output of the signal generator until the distortion meter reading increases to 25%, corresponding to a 12-dB ratio between signal + noise + distortion and noise + distortion (12dB SINAD).

Adjust L1 in BP511 for best possible signal-to-noise ratio.

It should be possible to obtain a 12-dB signal-to-noise ratio for 0.8μV emf.

Checking the AF Output Amplifier

Instruments

Signal generator, 146-174 MHz.
Distortion meter.
DC oscilloscope or DC valve voltmeter.

Procedure

Connect DC oscilloscope or DC valve voltmeter to test point $\boxed{7}$.
Connect signal generator to antenna connector J2 and set its frequency accurately to produce 0V DC at test point $\boxed{7}$. Adjust signal generator output level to 1 mV EMF modulated by 1000 Hz at frequency swing of Δf = 70% Δf max.
Output power should be not less than 200 mW with volume control turned full on.
Back off volume control until output power is 200 mW, corresponding to 2.8V across 40 Ω.

Check distortion. Requirement: ≤ 5%.

Checking the Squelch Circuit

Instruments

Signal generator, 146-174 MHz.
Distortion meter with AF valve voltmeter.
DC oscilloscope or DC valve voltmeter.

Procedure

Connect signal generator to antenna connector J2 and adjust to receiving frequency.
Connect DC oscilloscope or DC valve voltmeter to test point $\boxed{7}$.
Turn squelch potentiometer fully clockwise - that is, squelch closed.
Increase supply voltage to 15 V.
Increase signal generator output level until squelch opens.

Squelch circuit should be capable of being opened by signal of 3 μV EMF.
Adjust supply voltage to 12.4V. Switch off signal generator (which should remain connected to the antenna connector).
Check that the squelch will close and open, both at nominal supply voltage of 12.4 V and at minimum supply voltage of 10 V.

Adjustment of Crystal Frequency XS511

Instruments

Frequency counter, 146-174 MHz.
Signal generator, 146-174 MHz.
DC oscilloscope or DC valve voltmeter.
T-network.

Procedure

Owing to considerable interaction in the multiplier chain the crystal frequency will be affected if a frequency counter is connected directly to it. It is therefore necessary to insert a T-network between the signal generator and the antenna connector and connect the frequency counter to the T-network.

Set the signal generator so that the counter indicates correct receiving frequency. Connect the DC oscilloscope or DC valve voltmeter to discriminator zero, pins 6 and 7 of connector J1. Instrument sensitivity should be sufficiently high to permit clear readings of frequency changes (approx. 1V).

Because the crystal frequency will change slightly when the lid is put on, adjustments should be made through holes in the back, with the lid screwed on. Adjust the trimmer capacitor for the channel selected to produce zero indication on the DC oscilloscope or DC valve voltmeter. On completion of the adjustment, the frequency should be accurate to better than $\pm 2 \times 10^{-6}$ - that is, ± 300 Hz at 150 MHz.

TRANSMITTER ADJUSTMENT

The transmitter should be adjusted with the external power supply set to deliver 12.4V and produce approx. 300 mA current limiting.

Adjustment of Oscillator, Multiplier Chain, and Power Amplifier OP512, FD511, FT511, FD512, PA511, PA513, and FN511

Instruments

RF wattmeter, 50 Ω, 0-1W.
RF probe, Storno type 95.059.
Multimeter.

Procedure

Connect wattmeter to antenna connector J2.
Turn ADC potentiometer fully anti-clockwise to produce maximum ADC voltage.
Turn transmitter on.
Connect multimeter via RF probe to test point $\boxed{11}$.
Adjust coil L1 in OP512 for maximum multimeter reading. 2 mV
Connect multimeter via RF probe to test point $\boxed{12}$.
Adjust coils L1 and L2 in FD511 to produce maximum multimeter reading. 40 mV
Connect multimeter via RF probe to test point $\boxed{13}$.
Adjust coils L1 and L2 in FT511 for maximum multimeter reading. 20 mV
Connect multimeter via RF probe to test point $\boxed{14}$.
Adjust coils L1 and L2 in FD512 for maximum multimeter reading. 350 mV
If a wattmeter reading is obtained while making these adjustments, adjust for maximum output power while backing off the ADC potentiometer so that power output does not exceed 500 mW.
Adjust the following coils for maximum output:
L1 and L2 in PA511. 5,4 V
L1 and L2 in PA513. 16-17 V
L1, L2, and L3 in FN511.
While making adjustments the ADC potentiometer should constantly be backed off so that output does not exceed 500 mW.

Reduce supply voltage until output is down to 200 mW.
Adjust coils L1 and L2 in FT511 and coils L1 and L2 in FD512 for maximum output. If circuits are flat-topped or saddle-shaped, middle of curve should be used.
Set supply voltage to 12.4V and ADC potentiometer to produce 500 mW output.
Check transmitter current drain.

Requirement: Current drain at 12.4V supply voltage and 500 mW output: 120 mA.

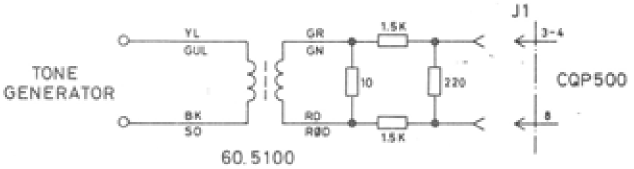
On completion of the adjustments set the supply voltage to 10V and check that output is 250 mW on all channels.

Adjustment of Modulation

Instruments

Tone generator.
AF valve voltmeter.
Deviation meter.
Distortion meter.
Matching transformer, Storno type 60.5100.
750 μsec de-emphasis network.

Procedure



Connect tone generator via matching transformer to pins 3/4 and 8 of connector J1.
Connect deviation meter to antenna connector J2 through suitable attenuator pad.
Turn transmitter on.
Set input voltage from tone generator to 10 mV and vary the frequency between 300 and 3000 Hz to obtain maximum possible frequency swing (the valve voltmeter must not be connected to the connector pins during the subsequent measurements in order to avoid ripple voltages).
Adjust potentiometer R1 in JP532 for maximum permissible frequency swing on deviation meter.
Check frequency swing at both positive and negative readings.
Maximum permissible frequency swing, Δf max., is as follows:

For radiotelephones with 50 kHz channel spacing: 15 kHz.
For radiotelephones with 25 kHz channel spacing: 5 kHz.
For radiotelephones with 20 kHz channel spacing: 4 kHz.
For radiotelephones with 12.5 kHz channel spacing: 2.5 kHz.

Reduce input signal voltage to 70% Δf max. at modulating frequency of 1000 Hz.
Sensitivity should be better than 2 mV.

Connect distortion meter to AF output of deviation meter through 750 μsec de-emphasis network.

Adjust coil L1 in OP512 for minimum distortion.

Requirement: Distortion ≲ 7%.

Remove connector P1 from input (P1) and test the loudspeaker as a microphone.

Adjustment of Crystal Frequency XS511

Instruments

Frequency counter, 146-174 MHz.
Attenuator pad.

Procedure

Connect frequency counter via suitable attenuator pad to antenna connector J2.
Screw lid on.
Turn transmitter on.
Adjust trimmer capacitor for the selected channel until the correct output frequency is indicated by the frequency counter. Because the lid affects the crystal frequency, adjustments should be made through holes in the back of the cabinet.

Requirement: Frequency accuracy on completion of the adjustments should be better than $\pm 2 \times 10^{-6}$, that is: ± 300 Hz at 150 MHz.

TONE TRANSMITTER ADJUSTMENT

Adjustment of Tone Transmitter TT501

Instruments

Frequency counter.
Deviation meter.
Distortion meter.

Procedure

Connect deviation meter to antenna connector J2.

Connect distortion meter and frequency counter to AF output of deviation meter.

Press transmit button and tone button.

Adjust frequency swing to 70% Δf max., using potentiometer R2 in JP532.

Adjust tone frequency to nominal value, using coil L1 in TT501.

Requirement: ≤ 0.5% (5 Hz per 1000 Hz).

Distortion measured with distortion meter and without de-emphasis in deviation meter: Distortion ≤3%.

Adjustment of Tone Transmitter TT504

Instruments

Frequency counter.
Deviation meter.
Distortion meter.

Procedure

One oscillator in TT504 should be switched off while the other one is being checked. To do this, short-circuit to chassis the base of the transistor you wish to switch off.

Connect deviation meter to antenna connector J2.

Connect distortion meter and frequency counter to AF output of deviation meter.

Operate transmitter button and tone button.

Adjust frequency swing, using potentiometer R2 in JP532, to 35% Δf max. for one tone.

Then switch to other tone and check frequency swing.
Because of de-emphasis network R3-C4 in JP532 the two tones should produce identical readings ±1 dB.

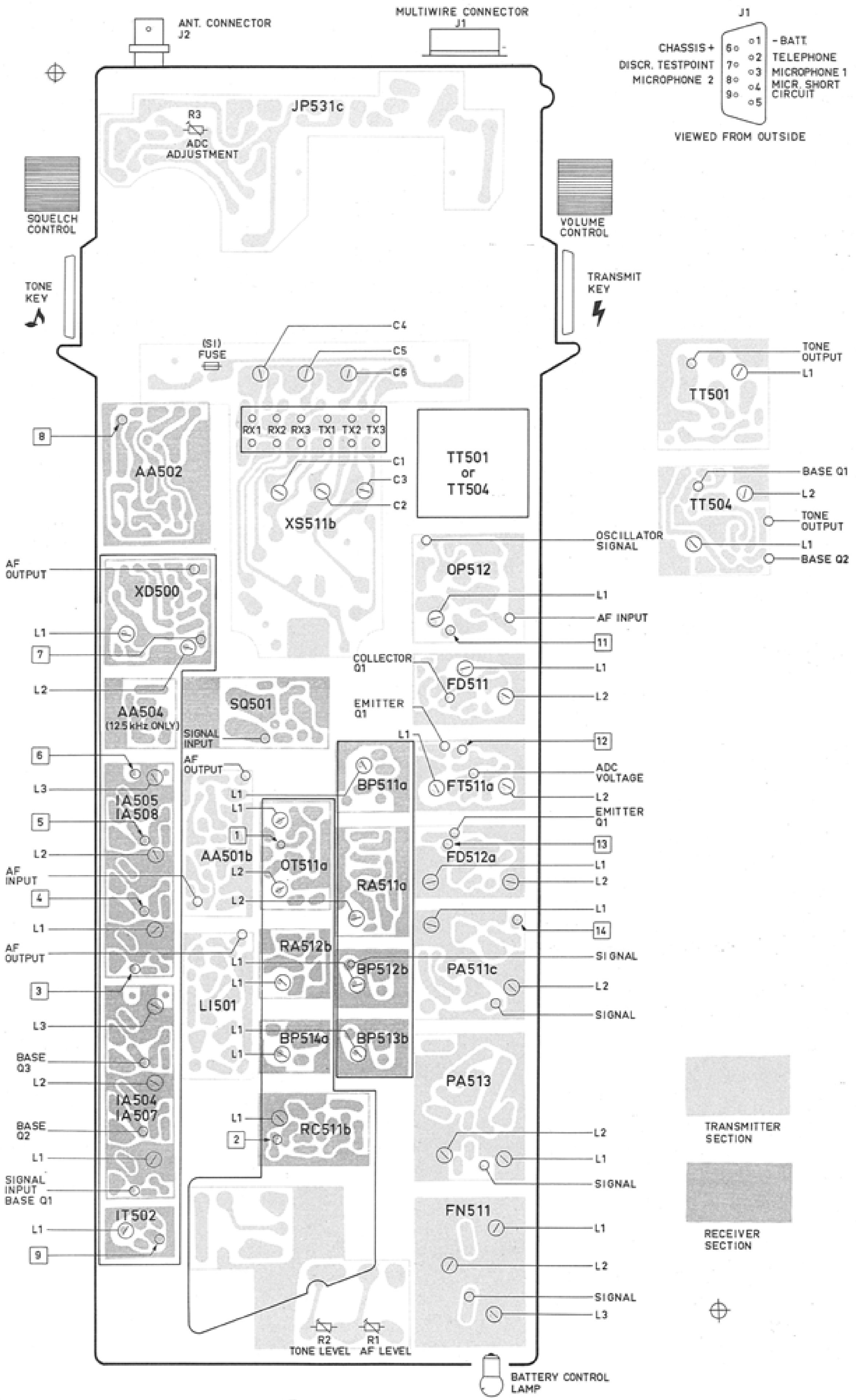
Alternatively, adjust potentiometer R2 in JP532 so that mean frequency swing for the two tones is 35% ΔFmax.

Requirement: $\Delta f_{tone} = 70\% \ \Delta f_{max.}$ ±1 dB.

Tone frequencies should be adjusted to nominal frequencies by the aid of coils L1 and L2 in TT504.

Requirement: Frequency accuracy should be better than 0.5% (5 Hz per 1000 Hz).

Distortion, measured with distortion meter and without de-emphasis in deviation meter: Distortion ≤3%.

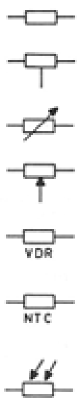


LOCATION OF TEST POINTS AND ADJUSTABLE COMPONENTS IN CQP510
MÅLEPUNKTER OG JUSTERBARE KOMPONENTERS PLACERING I CQP510

CHAPTER V. DIAGRAMS AND ELECTRICAL PARTS LISTS

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Resistors (R)



Resistor

Resistor with fixed tap

Variable resistor

Resistor with movable tap

Varistor (voltage-dependent resistor)

Temperature-dependent resistor with negative temperature coefficient

Light-sensitive resistor (Photosensitive resistor)

Capacitors (C)

Capacitor

Variable capacitor

Trimmer capacitor

Feedthrough capacitor

Electrolytic capacitor

Coils (L)

RF coil, air core

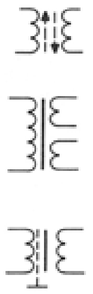
Coupled RF coils, air core

RF coil with core

RF coil with adjustable core

AF choke

Transformers (T)

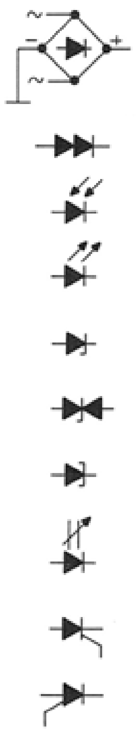


Transformer with adjustable RF cores

Transformer with iron core

Transformer with screen connected to chassis

Diodes (E)



Diode

Bridge rectifier

Series-connected stabilizer diodes within one case

Light-sensitive diode (Photosensitive diode)

Light-emitting diode

Zener diode (unidirectional)

Zener diode (bidirectional)

Tunnel diode

Varactor diode (capacitance diode)

Controlled rectifier, PNPN (N-thyristor)

Controlled rectifier, NPNP (P-thyristor)

Transistors (Q)

Transistor, PNP

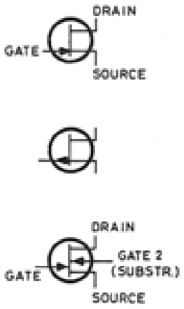
Transistor, NPN

Light-sensitive transistor

Unipolar transistor with N-type base

Unipolar transistor with P-type base

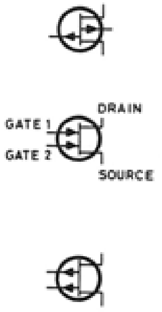
Junction Field Effect Transistors (JFET)



N-channel JFET

P-channel JFET

N-channel dual gate JFET

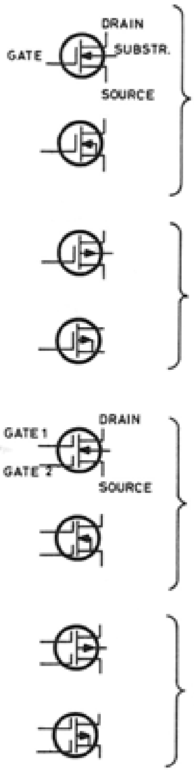


P-channel dual gate JFET

N-channel JFET tetrode

P-channel JFET tetrode

Insulated Gate Field Effect Transistors (IGFET or MOS)



N-channel IGFET (MOS)

P-channel IGFET (MOS)

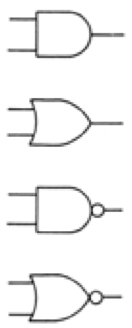
N-channel dual gate IGFET (MOS)

P-channel dual gate IGFET (MOS)

Integrated Circuits (IC)

Several integrated circuits contained within one case are designated by one common number followed by an identifying letter (a, b, c etc.). Thus, circuits IC1a, IC1b and IC1c are contained within one case.

Gates



AND gate

OR gate

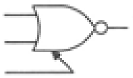
NAND gate

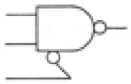
NOR gate

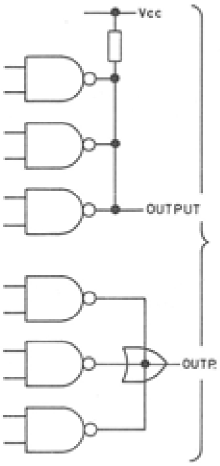
GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Gates, continued


Exclusive OR gate


NOR gate with expander input (high)

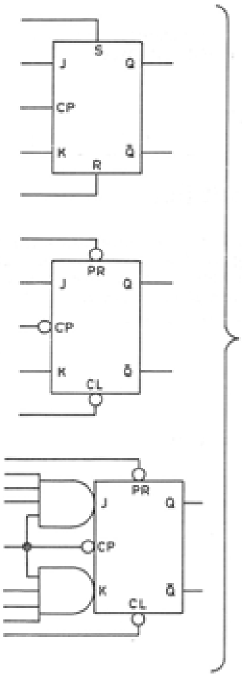

NAND gate with expander input (low)



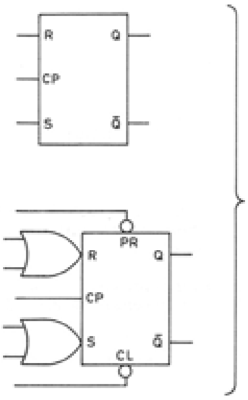
Wired OR (combined OR outputs) (presentation at top is used in detailed diagrams; presentation below is used in functional diagrams)

Flip-flops

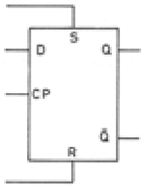
Abbreviations used:
S = Set
R = Reset
CP = Clock Pulse
PR = Preset
CL = Clear



J-K Flip-flops



R-S Flip-flops

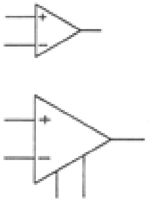


D Flip-flop

Inverters

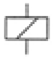

Inverter

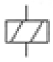
Operational Amplifiers

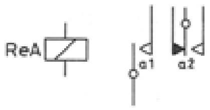


Operational amplifiers

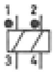
Relays (RE)


Single-coil relay

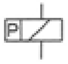

Dual-coil relay



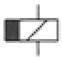
Relay with make contacts and change-over contacts

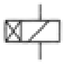


Relay with direction of winding indicated. Dot indicates two coils wound in the same direction



Polarized relay


Coil for slow-release relay


Coil for slow-acting relay

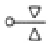
Contacts

Contacts are always shown in their non-operated positions unless otherwise specified


Make contacts

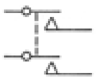

Break contacts


Change-over contacts


Change-over contacts, centre off

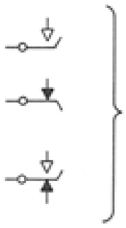

Make contacts, delayed operation

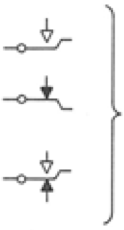

Make contacts, delayed release

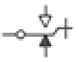

Mechanically coupled make contacts

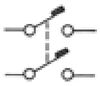
Switches and Keys (O)

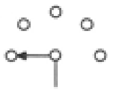

On/off switch


Locking keys or switches; push on, push off


Non-locking self-releasing keys or switches

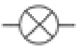

Locking mutually releasing keys or switches (in row of push-buttons etc.)


Self-releasing switch (overcurrent switch etc.)

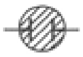

Rotary switch

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Lamps (V)



Indicator lamp



Neon lamp

Fuses and Cut-outs (S)

Fuse

Circuit-breaker

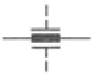
Tag Strips (KL)

Tag strip - dashed frame may be wholly or partly omitted

Batteries (BT)

Battery

Feedthrough Filters (F)



Feedthrough filter

Ferrite Beads (FB)

Ferrite bead

Crystals (X)

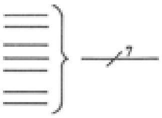
Crystal

Cables and Wires (W)

Usual conductor

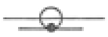
Three conductors

Eight conductors



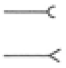
Shift from multiple-line to single-line presentation

Screened wire



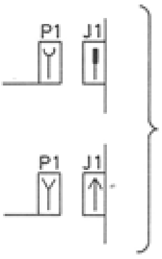
Coaxial cable

Connectors (J and P)

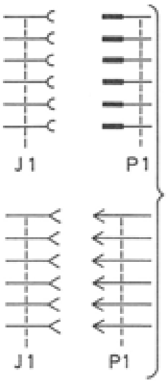


Female connector (socket). Lower symbol discontinued

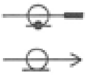
Male connector (plug). Lower symbol discontinued



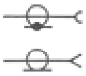
Schematic symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)
Multi-wire connectors are always designated "J" when permanently mounted on a cabinet or unit etc., "P" when fitted to cables



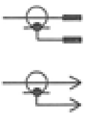
Detail symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)
Where both connectors are fitted to cables, male connector is designated "P" and female connector "J"



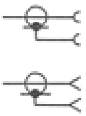
Coaxial plug



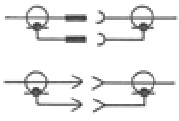
Coaxial socket



Coaxial plug for floating screen

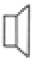


Coaxial socket for floating screen



Coaxial plug with mating socket

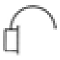
Loudspeakers (LS)



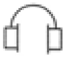
Loudspeaker

Telephones (TEL)

Telephone



Single headphone (earphone)



Double headphone (headset)

Microphones (M)

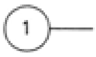
Meters etc.

Indicating instrument

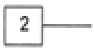
Balancing instrument

Inkwriter, recording instrument

Test Points

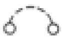


DC test point

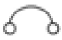


AC test point

Replaceable Connections



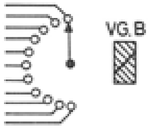
Cross-field connection (jumper)



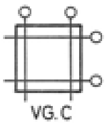
Strap

Selectors (VG)

Schematic symbol for rotary selector with designation of number of contact points



Detail symbol for rotary selector



Co-ordinate selector

Replacement of Contact Sets in CQP510/CQP530

The conversion parts listed below are required for the replacement of spring contact sets 47.0278 and 47.0277 with microswitches:

Microswitch complete with mounting hardware and operating lever (for tone button). Storno No. 47.0558.

Microswitch complete with mounting hardware, operating lever, and wiring board (for transmit button). Storno No. 47.0559.

Coaxial cabling. Storno No. 18.0649.

A 0.3 μF tantalum capacitor, Storno No. 73.5079, is required in some cases.

Procedure

Unsolder and remove the coaxial cabling going from the transmit button spring contact set to the antenna connector, receiver input, and transmitter output.

Loosen screw marked "A". The transmit button contact set may now be tipped up above the cabinet side.

① Unsolder two pink leads from pin 4 of connector J1. Solder them together and insulate them.

② In equipments including Junction Panel JP531c (recent type) turn over capacitor C5 (0.3 μF) so that its minus terminal faces resistors R5 and R6.

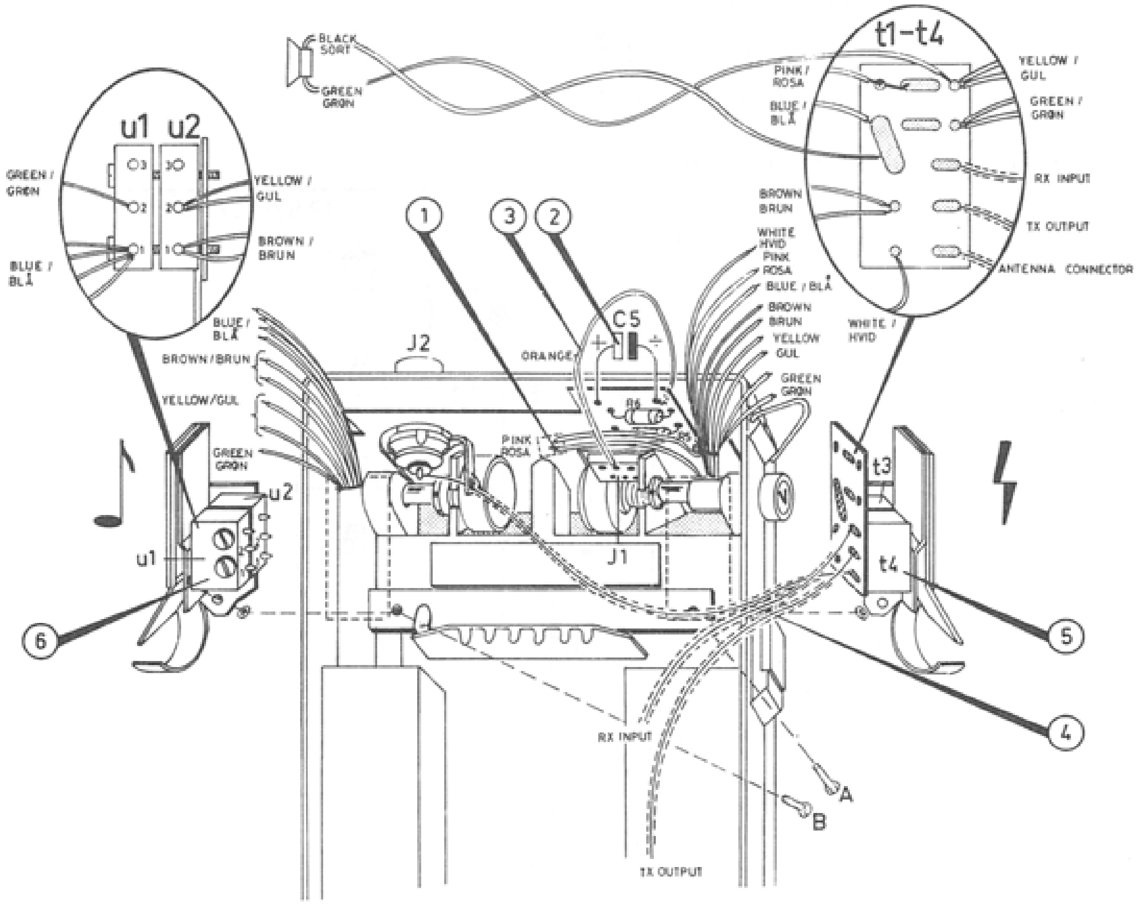
In equipments including Junction Panel JP531 (early type) replace resistor R7 (470 Ω) with a 0.3 μF capacitor (C5), Storno No. 73.5079. Connect the capacitor with its minus terminal facing resistors R5 and R6.

③ Install an orange lead from the minus terminal of C5 on JP531 or JP531c to pin 4 of connector J1.

Remove the transmit button contact set after having previously unsoldered the connected cabling.

④ Connect the new coaxial cabling, No. 18.0649, to the wiring board on microswitch 47.0559 (as shown in the sketch).

Solder the coaxial cabling to the antenna connector.



Insert the microswitch in the cabinet and secure it with the screw marked "A".

⑤ The cabling of the contact set which was removed previously should next be soldered to the microswitch (as shown in the sketch).

Connect the coaxial cabling to the receiver input and transmitter output.

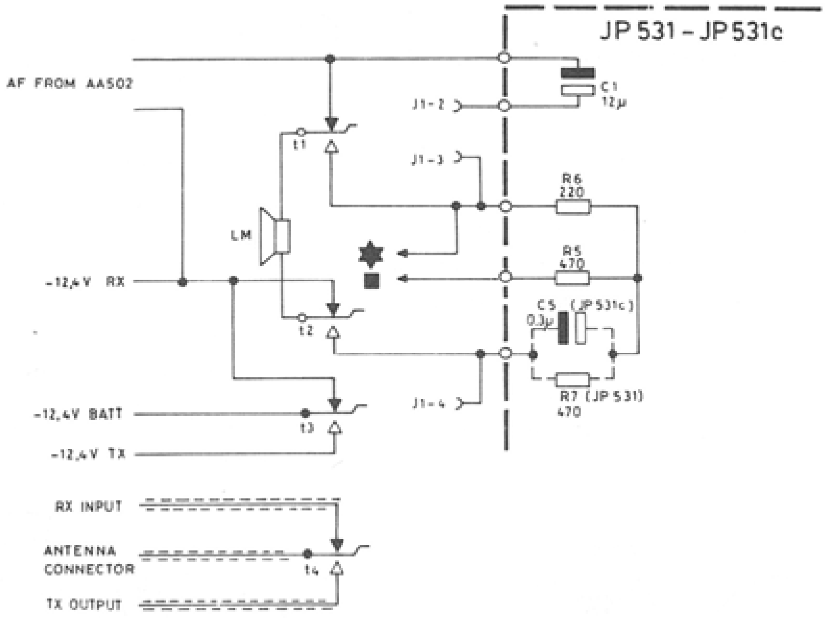
Remove the tone button spring contact set by loosening the screw marked "B" in the sketch and unsoldering the contact set cabling.

⑥ Solder the cabling to microswitch 47.0558 (see sketch for connections).

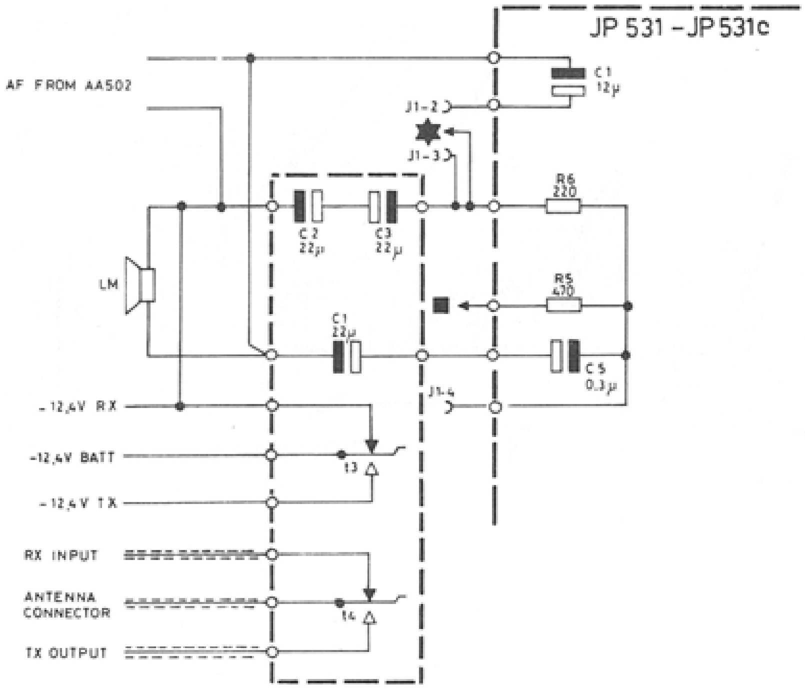
Insert microswitch in the cabinet and secure it with the screw marked "B".

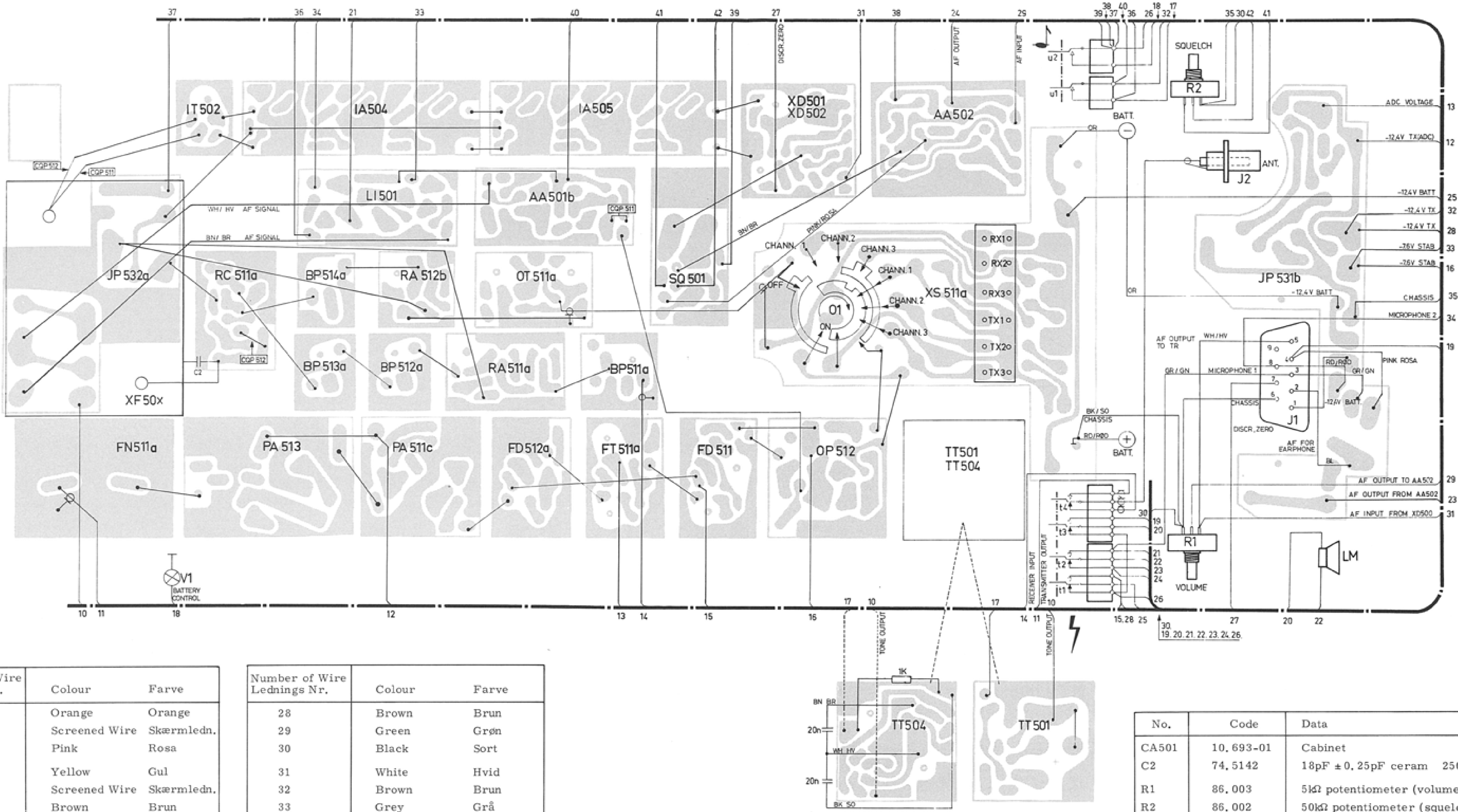
Mode of Operations

Contact functions before replacement of contact set:



Contact functions after introduction of microswitches:





Number of Wire Lednings Nr.	Colour	Farve
10	Orange	Orange
11	Screened Wire	Skærmledn.
12	Pink	Rosa
13	Yellow	Gul
14	Screened Wire	Skærmledn.
15	Brown	Brun
16	Grey	Grå
17	Yellow	Gul
18	Green	Grøn
19	Pink	Rosa
20	Black	Sort
21	Green	Grøn
22	Green	Grøn
23	Yellow	Gul
24	Yellow	Gul
25	White	Hvid
26	Blue	Blå
27	Yellow	Gul

Number of Wire Lednings Nr.	Colour	Farve
28	Brown	Brun
29	Green	Grøn
30	Black	Sort
31	White	Hvid
32	Brown	Brun
33	Grey	Grå
34	Red	Rød
35	Black	Sort
36	Yellow	Gul
37	Blue	Blå
38	Blue	Blå
39		
40	Brown	Brun
41	Orange	Orange
42	Red	Rød

CQP510 → Connections which are only used in the framed type(s) of radiotelephone(s).

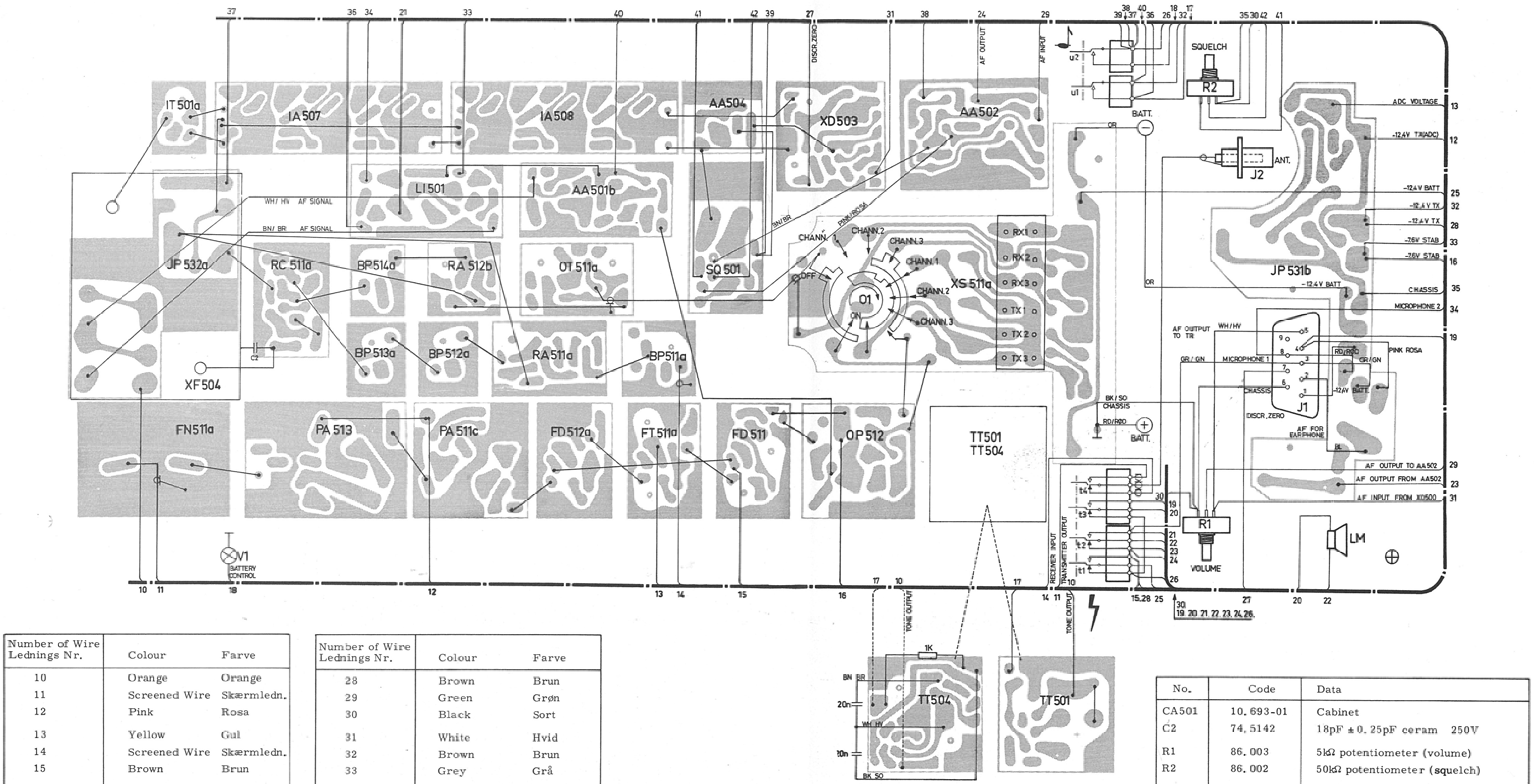
Forbindelser der kun benyttes i de(n) indrammede type(r) radiotelefonanlæg.

No.	Code	Data
CA501	10.693-01	Cabinet
C2	74.5142	18pF ± 0,25pF ceram 250V
R1	86.003	5kΩ potentiometer (volume)
R2	86.002	50kΩ potentiometer (squelch)
t1-t4	47.277	Spring Contact Set (key/tast) Fjederkontaktsæt
u1-u2	47.278	Spring Contact Set (tone) Fjederkontaktsæt
V1	92.5013	Lamp 12V 130mA
J1	41.5077	Connector (male/han)
J2	41.144	Connector (antenna)
LM	97.5011	Loudspeaker-Microphone 40Ω 0,3W

CABLE FORM
KABLING

CQP511, CQP512

D401.249



Number of Wire Lednings Nr.	Colour	Farve
10	Orange	Orange
11	Screened Wire	Skærmledn.
12	Pink	Rosa
13	Yellow	Gul
14	Screened Wire	Skærmledn.
15	Brown	Brun
16	Grey	Grå
17	Yellow	Gul
18	Green	Grøn
19	Pink	Rosa
20	Black	Sort
21	Green	Grøn
22	Green	Grøn
23	Yellow	Gul
24	Yellow	Gul
25	White	Hvid
26	Blue	Blå
27	Yellow	Gul

Number of Wire Lednings Nr.	Colour	Farve
28	Brown	Brun
29	Green	Grøn
30	Black	Sort
31	White	Hvid
32	Brown	Brun
33	Grey	Grå
34	Red	Rød
35	Black	Sort
36	Yellow	Gul
37	Blue	Blå
38	Blue	Blå
39		
40	Brown	Brun
41	Orange	Orange
42	Red	Rød

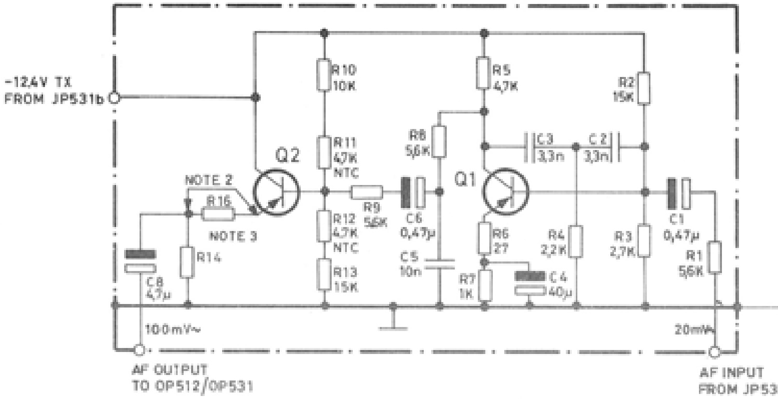
No.	Code	Data
CA501	10.693-01	Cabinet
C2	74.5142	18pF ± 0.25pF ceram 250V
R1	86.003	5kΩ potentiometer (volume)
R2	86.002	50kΩ potentiometer (squelch)
t1-t4	47.277	Spring Contact Set (key/tast) Fjederkontaktsæt
u1-u2	47.278	Spring Contact Set (tone) Fjederkontaktsæt
V1	92.5013	Lamp 12V 130mA
J1	41.5077	Connector (male/han)
J2	41.144	Connector (antenna)
LM	97.5011	Loudspeaker-Microphone 40Ω 0.3W

CABLE FORM
KABLING

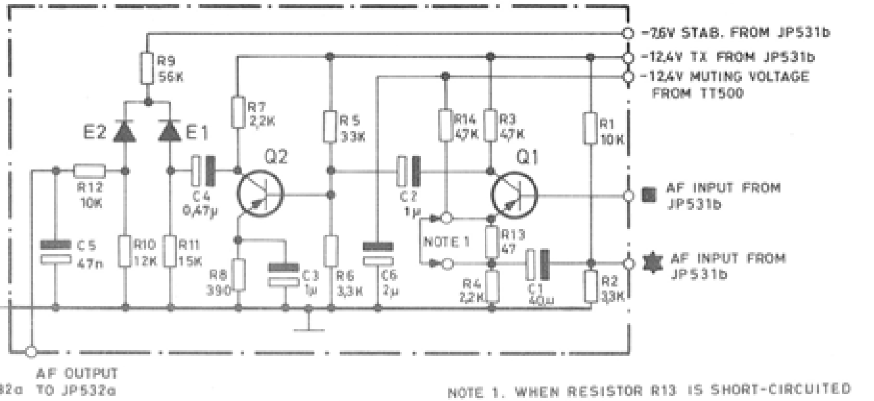
CQP514

D401.250

AA501b
AA503



LI501



NOTE 1. WHEN RESISTOR R13 IS SHORT-CIRCUITED THE INPUT SENSITIVITY IS INCREASED BY 6 dB.
NÅR MODSTAND R13 KORTSLUTTES FORØGES INDGANGSFØLSOMHEDEN MED 6 dB.

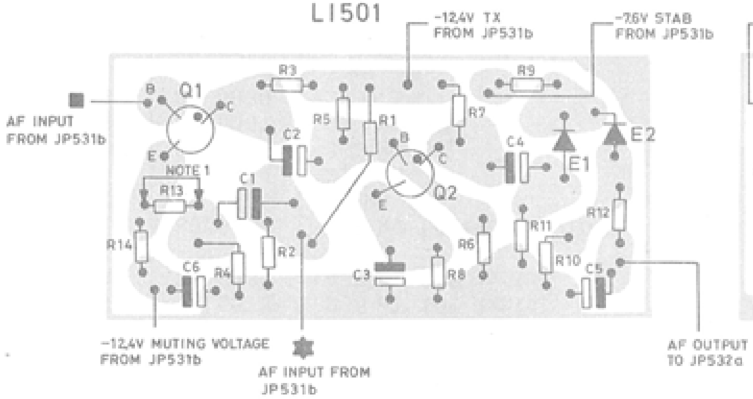
NOTE 2. INSERT STRAP IN 50kHz EQUIPMENT
INFØR STRAPNING I 50kHz ANLÆG

NOTE 3.

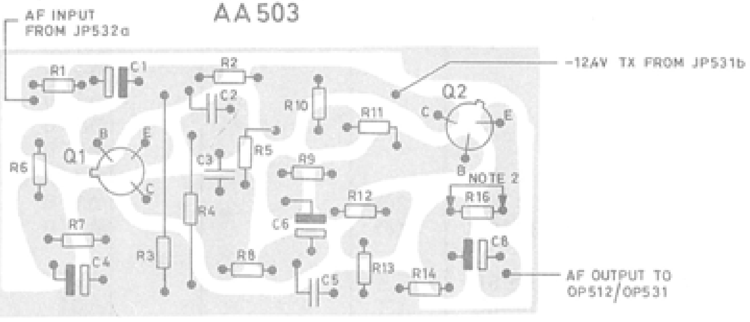
	R14	R16
AA501	1,8K	820 Ω
AA503	820 Ω	1,8K

PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

LI501



AA501b
AA503



TRANSMITTER SECTION
SENDERSEKTION

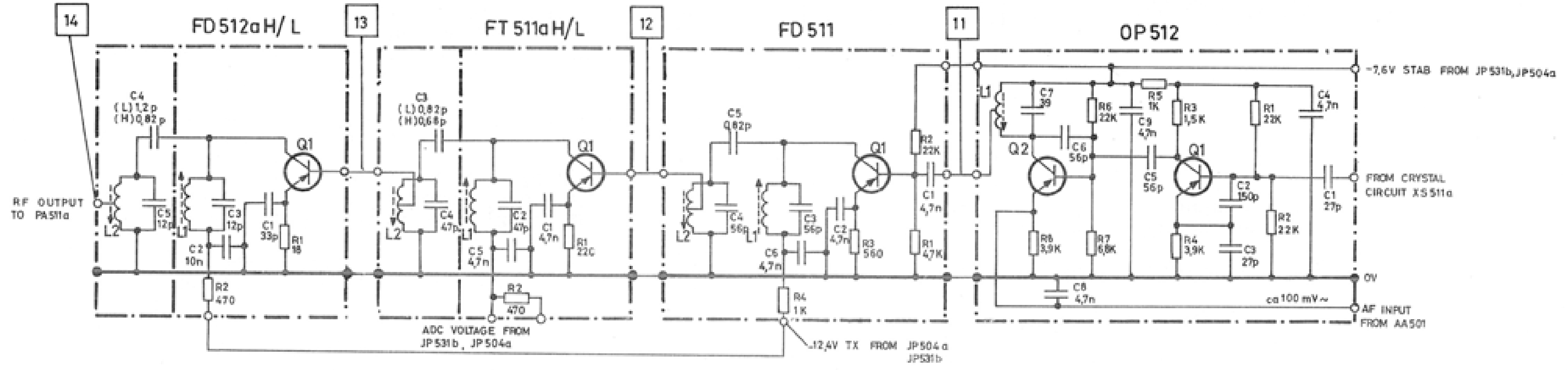
CQP510, CQP530

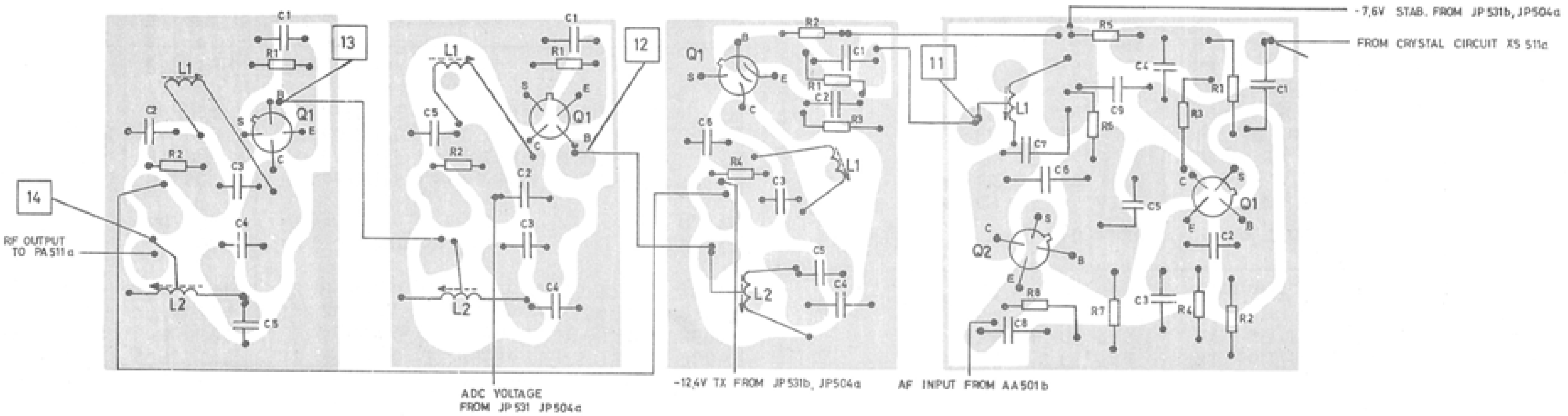
D401.165/3

TYPE	NO.	CODE	DATA	
AA501b		10.1143	Audio Amplifier	
AA503		10.2019	Audio Amplifier	
	C1	73.5073	0.5 µF 10% tantal	10V
	C3	76.5060	3.3 nF 10% polyest. FL	50V
	C4	73.5075	40 µF -20 +75% tantal	3V
	C5	76.5070	10 nF 10% polyest. FL	50V
	C6	73.5073	0.5 µF 10% tantal	10V
	C8	73.5080	4.7 µF 20% tantal	10V
	R1	80.5058	5.6 kΩ 5% carbon film	0.1W
	R2	80.5063	15 kΩ 5% " "	0.1W
	R3	80.5054	2.7 kΩ 5% " "	0.1W
	R4	80.5053	2.2 kΩ 5% " "	0.1W
	R5	80.5057	4.7 kΩ 5% " "	0.1W
	R6	80.5030	27 Ω 5% " "	0.1W
	R7	80.5049	1 kΩ 5% " "	0.1W
	R8	80.5058	5.6 kΩ 5% " "	0.1W
	R9	80.5058	5.6 kΩ 5% " "	0.1W
	R10	80.5061	10 kΩ 5% " "	0.1W
	R11	89.5009	4.7 kΩ 20% NTC	
	R12	89.5009	4.7 kΩ 20% NTC	
	R13	80.5063	15 kΩ 5% carbon film	0.1W
AA501	R14	80.5052	1.8 kΩ 5% " "	0.1W
AA503	R14	80.5048	820 Ω 5% " "	0.1W
AA501	R16	80.5048	820 Ω 5% " "	0.1W
AA503	R16	80.5052	1.8 kΩ 5% " "	0.1W
	Q1	99.5115	Transistor BC179	
	Q2	99.5019	Transistor OC306/2	
LI501		10.996	Limiter Amplifier	
	C1	73.5075	40 µF -20 +75% tantal	3V
	C2	73.5134	0,47 µF -20 +50% tantal	16V
	C3	73.5135	1 µF -20 +50% tantal	16V
	C4	73.5134	0,47 µF -20 +50% tantal	16V
	C5	73.5131	47 nF -20 +50% tantal	20V
	C6	73.5098	2 µF -20 +50% tantal	15V
	R1	80.5061	10 kΩ 5% carbon film	0.1W
	R2	80.5055	3.3 kΩ 5% " "	0.1W
	R3	80.5057	4.7 kΩ 5% " "	0.1W
	R4	80.5053	2.2 kΩ 5% " "	0.1W
	R5	80.5067	33 kΩ 5% " "	0.1W
	R6	80.5055	3.3 kΩ 5% " "	0.1W
	R7	80.5053	2.2 kΩ 5% " "	0.1W
	R8	80.5044	390 Ω 5% " "	0.1W

TYPE	NO.	CODE	DATA	
	R9	80.5070	56 kΩ 5% carbon film	0.1W
	R10	80.5062	12 kΩ 5% " "	0.1W
	R11	80.5063	15 kΩ 5% " "	0.1W
	R12	80.5061	10 kΩ 5% " "	0.1W
	R13	80.5033	47 Ω 5% " "	0.1W
	R14	80.5057	4.7 kΩ 5% " "	0.1W
	E1	99.5028	Diode OA200	
	E2	99.5028	Diode OA200	
	Q1	99.5019	Transistor OC306/2	
	Q2	99.5019	Transistor OC306/2	

TRANSMITTER SECTION CQP510,
SENDERSEKTION CQP530





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

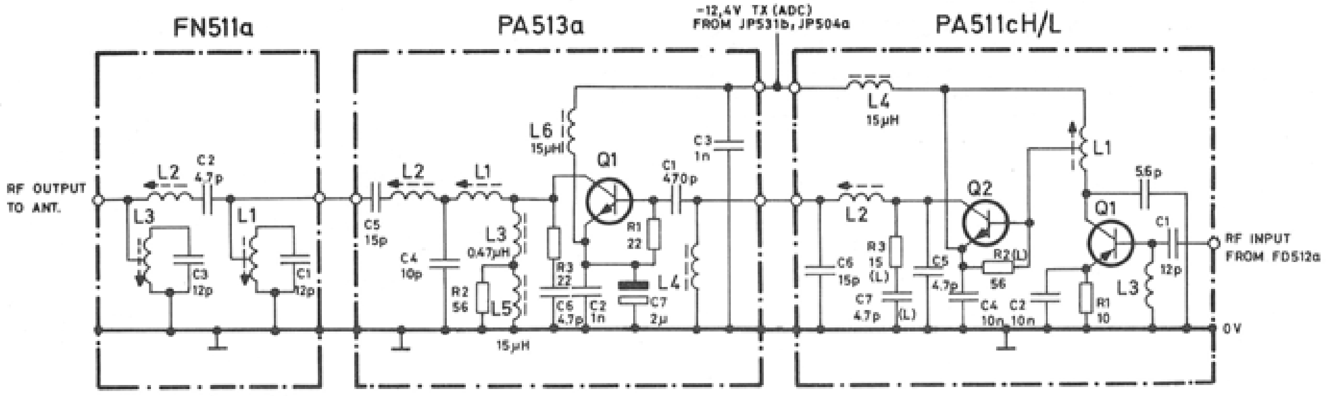
TRANSMITTER SECTION CQP510(R)
SENDERSEKTION

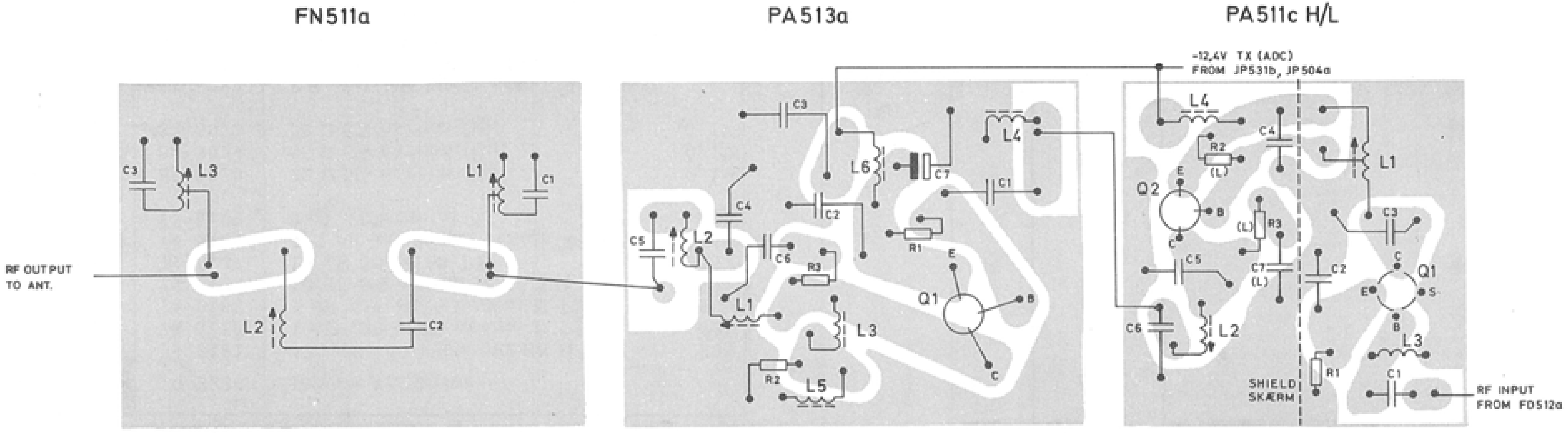
D401.168/3

TYPE	NO.	CODE	DATA	
FD512aH		10.1316	Frequency Doubler	
FD512aL		10.1317	Frequency Doubler	
	C1	74.5116	33 pF 2% ceram NO75 TB	250V
	C2	74.5109	10 nF -20 +80% ceram II PL	20V
	C3	74.5141	12 pF ±0,5 pF ceram NO75 TB	250V
FD512H	C4	74.5122	0,82 pF ±0,1 pF ceram P100 BD	250V
FD512L	C4	74.5124	1,2 pF ±0,25 pF ceram N150 BD	250V
	C5	74.5141	12 pF ±0,5 pF ceram NO75 TB	250V
	R1	80.5028	18 Ω 5% carbon film	0,1W
	R2	80.5045	470 Ω 5% " "	0,1W
FD512H	L1	61.907	RF coil/HF spole 156-176 MHz	
FD512L	L1	61.905	RF coil/HF spole 146-156 MHz	
FD512H	L2	61.993	RF coil/HF spole 156-176 MHz	
FD512L	L2	61.904	RF coil/HF spole 146-156 MHz	
	Q1	99.5169	Transistor AF202S	
FT511aH		10.1318	Frequency Tripler	
FT511aL		10.1319	Frequency Tripler	
	C1	74.5108	4,7 nF -20 +80% ceram II PL	20V
	C2	76.5090	47 pF 5% polystyr TB	63V
FT511H	C3	74.5121	0,68 pF ±0,1 pF P100 BD	250V
FT511L	C3	74.5122	0,82 pF ±0,1 pF P100 BD	250V
	C4	76.5090	47 pF 5% polystyr TB	63V
	C5	74.5108	4,7 nF -20 +80% ceram II PL	20V
	R1	80.5041	220 Ω 5% carbon film	0,1W
	R2	80.5045	470 Ω 5% " "	0,1W
	L1	61.905	RF coil/HF spole 73-89 MHz	
FT511H	L2	61.903	RF coil/HF spole 78-89 MHz	
FT511L	L2	61.908	RF coil/HF spole 73-78 MHz	
	Q1	99.5067	Transistor AF106	
FD511		10.1086	Frequency Doubler	
	C1	74.5108	4,7 nF -20 +80% ceram II PL	20V
	C2	74.5108	4,7 nF -20 +80% ceram II PL	20V
	C3	74.5111	56 pF 2% ceram NO75 TB	250V
	C4	74.5111	56 pF 2% ceram NO75 TB	250V
	C5	74.5122	0,82 pF ±0,1 pF ceram P100 BD	500V
	C6	74.5108	4,7 nF -20 +80% ceram II PL	20V
	R1	80.5057	4,7 kΩ 5% carbon film	0,1W
	R2	80.5065	22 kΩ 5% " "	0,1W
	R3	80.5046	560 Ω 5% " "	0,1W
	R4	80.5049	1 kΩ 5% " "	0,1W
	L1	61.744	RF coil/HF spole 24,3 - 29 MHz	
	L2	61.745	RF coil/HF spole 24,3 - 29 MHz	
	Q1	99.5067	Transistor AF106	
OP512		10.1120	Phase Modulator	
	C1	74.5107	27 pF 2% ceram NO75 TB	250V
	C2	76.5103	150 pF 2,5% polystyr	30V
	C3	74.5156	27 pF 2% ceram N750 TB	250V
	C4	76.5061	4,7 nF 10% polyest FL	50V
	C5	74.5111	56 pF 2% ceram NO75 TB	250V
	C6	74.5111	56 pF 2% ceram NO75 TB	250V
	C7	74.5117	39 pF 2% ceram NO75 TB	250V
	C8	76.5061	4,7 nF 10% polyest FL	50V
	C9	76.5061	4,7 nF 10% polyest FL	50V
	R1	80.5065	22 kΩ 5% carbon film	0,1W
	R2	80.5065	22 kΩ 5% " "	0,1W
	R3	80.5051	1,5 kΩ 5% " "	0,1W
	R4	80.5056	3,9 kΩ 5% " "	0,1W
	R5	80.5049	1 kΩ 5% " "	0,1W
	R6	80.5065	22 kΩ 5% " "	0,1W
	R7	80.5059	6,8 kΩ 5% " "	0,1W
	R8	80.5056	3,9 kΩ 5% " "	0,1W
	L1	61.783	Coil/spole 11,3 - 14,6 MHz	
	Q1	99.5066	Transistor AF121	
	Q2	99.5073	Transistor AF124	

TRANSMITTER SECTION
SENDERSEKTION

CQP510(R)





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

TRANSMITTER SECTION
SENDERSEKTION

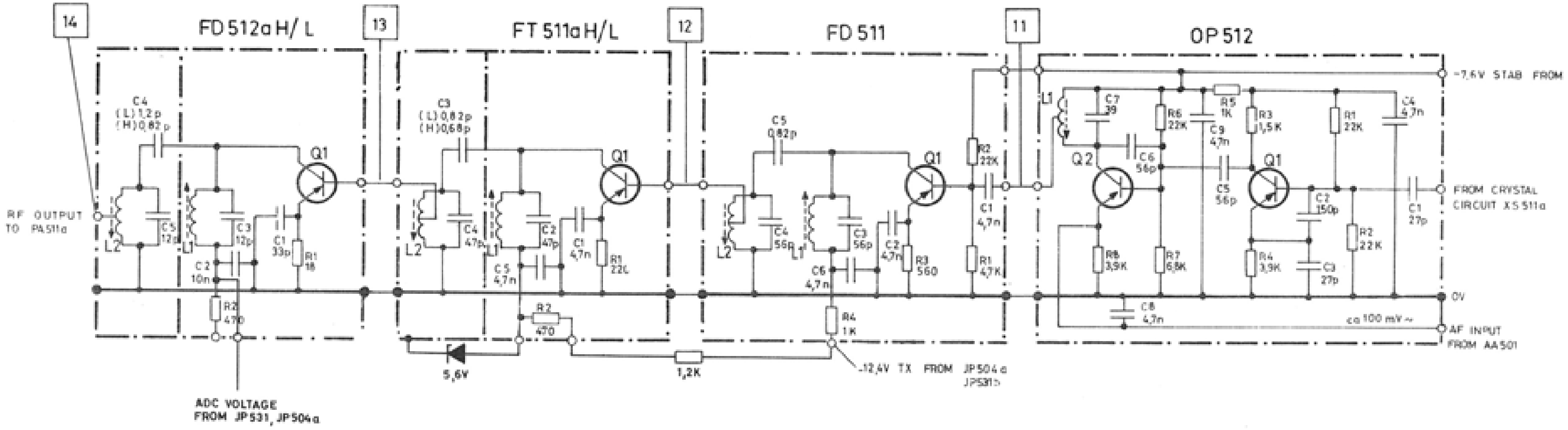
CQP510(R)

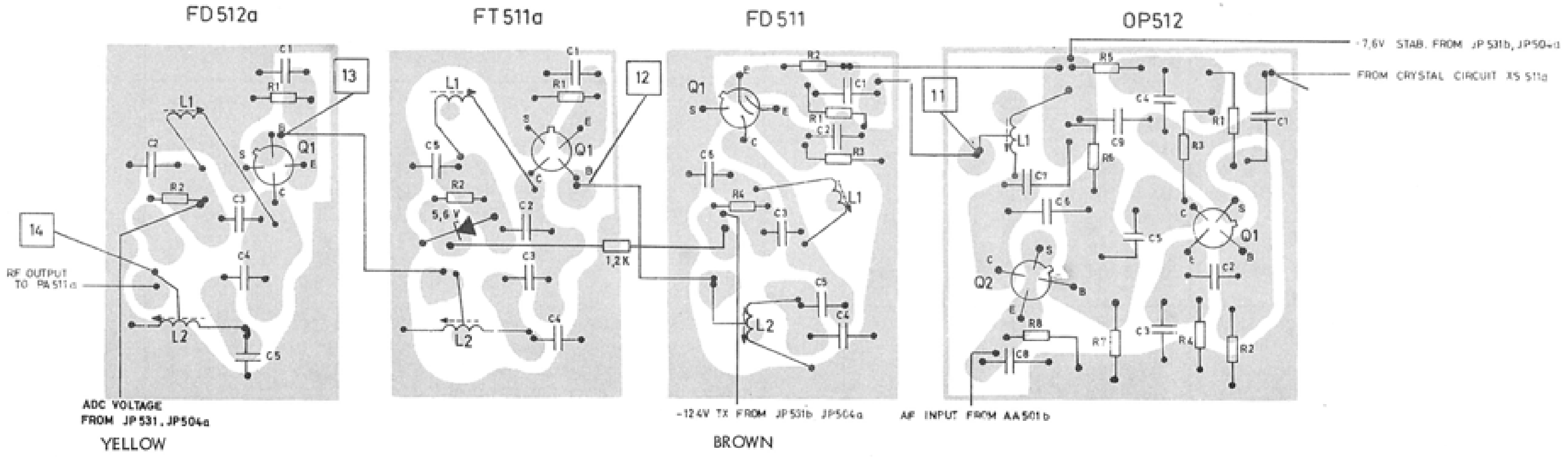
D401.210/3

TYPE	NO.	CODE	DATA
FN511a		10.1548	Antenna Filter
	C1	74.5136	12 pF 5% ceram N150 DI 125V
	C2	74.5131	4,7 pF ±0,25 pF ceram N150 DI 125V
	C3	74.5136	12 pF 5% ceram N150 DI 125V
	L1	61.976	RF coil/HF spole 146-174 MHz
	L2	61.975	RF coil/HF spole 146-174 MHz
	L3	61.974	RF coil/HF spole 146-174 MHz
PA513a		10.2324	Power Amplifier
	C1	74.5161	470 pF -20 +80% ceram II PL 63V
	C2	74.5155	1 nF -20 +80% ceram II PL 63V
	C3	74.5155	1 nF -20 +80% ceram II PL 63V
	C4	74.5135	10 pF 5% ceram N150 TB 125V
	C5	74.5137	15 pF 5% N150 TB 125V
	C6	74.5131	4,7 pF ±0,25 pF ceram N150 TB 125V
	C7	73.5102	2 μF 20% tantal 35V
	R1	80.5029	22 Ω 5% carbon film 0,1W
	R2	80.5034	56 Ω 5% carbon film 0,1W
	R3	80.5029	22 Ω 5% carbon film 0,1W
	L1	61.1084	RF coil/HF spole 146-176 MHz
	L2	61.1084	RF coil/HF spole 146-176 MHz
	L3	63.5008	0,47 μH 20% RF choke/HF drossel
	L4	63.5008	0,47 μH 20% RF choke/HF drossel
	L5	63.5007	15 μH 10% RF choke/HF drossel 0,5A
	L6	63.5007	15 μH 10% RF choke/HF drossel 0,5A
	Q1	99.5229	Transistor 2N4427
PA511cH		10.1314	Power Amplifier
PA511cL		10.1315	Power Amplifier
	C1	74.5136	12 pF 5% ceram N150 DI 125V
	C2	74.5109	10 nF -20 +80% ceram II PL 20V
	C3	74.5132	5,6 pF ±0,25 pF ceram N150 DI 250V
	C4	74.5109	10 nF -20 +80% ceram II PL 20V
	C5	74.5131	4,7 pF ±0,25 pF ceram N150 DI 250V
	C6	74.5137	15 pF 5% ceram N150 DI 125V
	C7	74.5131	4,7 pF ±0,25 pF ceram N150 DI 250V
	R1	80.5025	10 Ω 5% carbon film 0,1W
PA511L	R2	80.5034	56 Ω 5% carbon film 0,1W
PA511L	R3	80.5027	15 Ω 5% carbon film 0,1W

TYPE	NO.	CODE	DATA
PA511H	L1	61.0906	RF coil/HF spole 156-176 MHz
PA511L	L1	61.0901	RF coil/HF spole 146-156 MHz
PA511H	L2	61.0902	RF coil/HF spole 156-176 MHz
PA511L	L2	61.0900	RF coil/HF spole 146-156 MHz
	L3	62.0651	Choke/drosselspole
	L4	63.5007	15 μH 10% choke/drossel 500 mA
	Q1	99.5169	Transistor AF2025
	Q2	99.5139	Transistor BSX 19

TRANSMITTER SECTION CQP510(R)
SENDERSEKTION





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

TRANSMITTER SECTION
SENDERSEKTION

CQP510(R)-1W

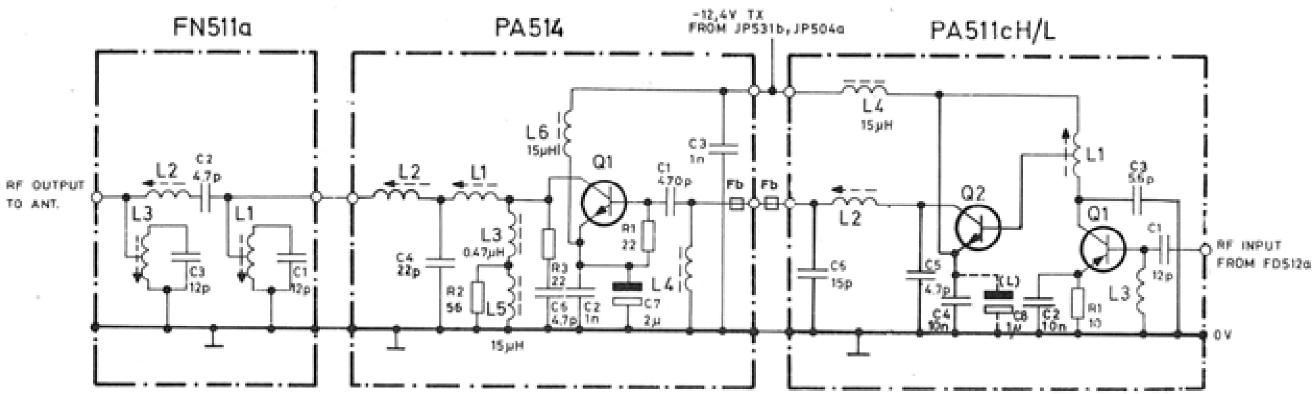
D 401.724

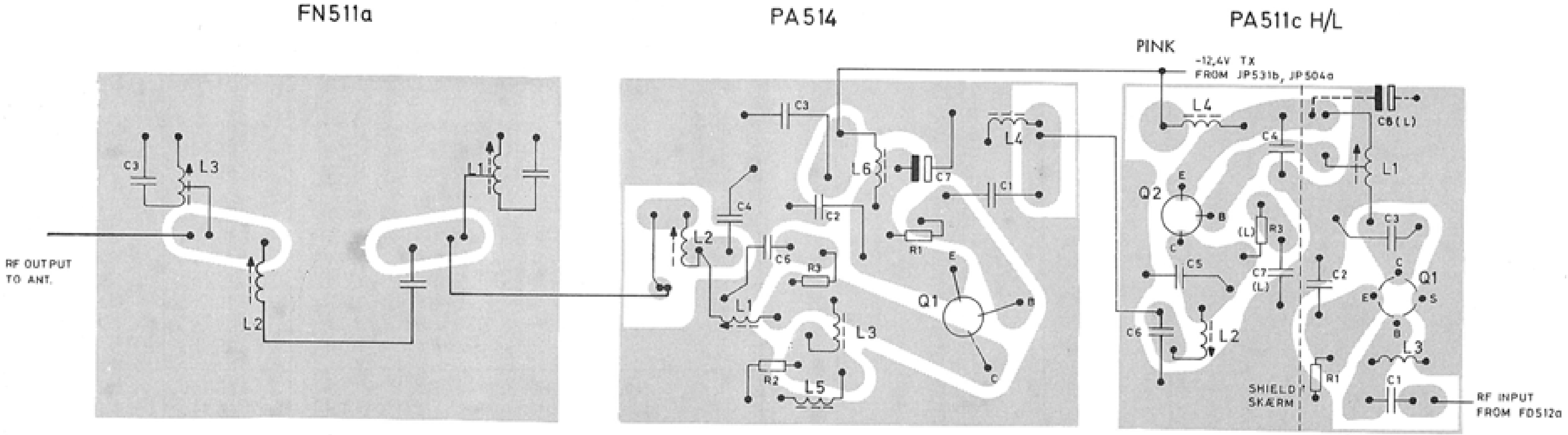
TYPE	NO.	CODE	DATA
FD512aH		10.1316	Frequency Doubler
FD512aL		10.1317	Frequency Doubler
	C1	74.5116	33 pF 2% ceram NO75 TB 250V
	C2	74.5109	10 nF -20 +80% ceram II PL 20V
	C3	74.5141	12 pF ±0,5 pF ceram NO75 TB 250V
FD512H	C4	74.5122	0,82 pF ±0,1 pF ceram P100 BD 250V
FD512L	C4	74.5124	1,2 pF ±0,25 pF ceram N150 BD 250V
	C5	74.5141	12 pF ±0,5 pF ceram NO75 TB 250V
	R1	80.5028	18 Ω 5% carbon film 0,1W
	R2	80.5045	470 Ω 5% " " 0,1W
FD512H	L1	61.907	RF coil/HF spole 156-176 MHz
FD512L	L1	61.905	RF coil/HF spole 146-156 MHz
FD512H	L2	61.993	RF coil/HF spole 156-176 MHz
FD512L	L2	61.904	RF coil/HF spole 146-156 MHz
	Q1	99.5169	Transistor AF202S
FT511aH		10.1318	Frequency Tripler
FT511aL		10.1319	Frequency Tripler
	C1	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C2	76.5090	47 pF 5% polystyr TB 63V
FT511H	C3	74.5121	0,68 pF ±0,1 pF P100 BD 250V
FT511L	C3	74.5122	0,82 pF ±0,1 pF P100 BD 250V
	C4	76.5090	47 pF 5% polystyr TB 63V
	C5	74.5108	4,7 nF -20 +80% ceram II PL 20V
	R1	80.5041	220 Ω 5% carbon film 0,1W
	R2	80.5045	470 Ω 5% " " 0,1W
	L1	61.905	RF coil/HF spole 73-89 MHz
FT511H	L2	61.903	RF coil/HF spole 78-89 MHz
FT511L	L2	61.908	RF coil/HF spole 73-78 MHz
	Q1	99.5067	Transistor AF106
FD511		10.1086	Frequency Doubler
	C1	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C2	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C3	74.5111	56 pF 2% ceram NO75 TB 250V
	C4	74.5111	56 pF 2% ceram NO75 TB 250V
	C5	74.5122	0,82 pF ±0,1 pF ceram P100 BD 500V
	C6	74.5108	4,7 nF -20 +80% ceram II PL 20V
	R1	80.5057	4,7 kΩ 5% carbon film 0,1W
	R2	80.5065	22 kΩ 5% " " 0,1W
	R3	80.5046	560 Ω 5% " " 0,1W
	R4	80.5049	1 kΩ 5% " " 0,1W
	L1	61.744	RF coil/HF spole 24,3 - 29 MHz
	L2	61.745	RF coil/HF spole 24,3 - 29 MHz
	Q1	99.5067	Transistor AF106
OP512		10.1120	Phase Modulator
	C1	74.5107	27 pF 2% ceram NO75 TB 250V
	C2	76.5103	150 pF 2,5% polystyr 30V
	C3	74.5156	27 pF 2% ceram N750 TB 250V
	C4	76.5061	4,7 nF 10% polyest FL 50V
	C5	74.5111	56 pF 2% ceram NO75 TB 250V
	C6	74.5111	56 pF 2% ceram NO75 TB 250V
	C7	74.5117	39 pF 2% ceram NO75 TB 250V
	C8	76.5061	4,7 nF 10% polyest FL 50V
	C9	76.5061	4,7 nF 10% polyest FL 50V
	R1	80.5065	22 kΩ 5% carbon film 0,1W
	R2	80.5065	22 kΩ 5% " " 0,1W
	R3	80.5051	1,5 kΩ 5% " " 0,1W
	R4	80.5056	3,9 kΩ 5% " " 0,1W
	R5	80.5049	1 kΩ 5% " " 0,1W
	R6	80.5065	22 kΩ 5% " " 0,1W
	R7	80.5059	6,8 kΩ 5% " " 0,1W
	R8	80.5056	3,9 kΩ 5% " " 0,1W
	L1	61.783	Coil/spole 11,3 - 14,6 MHz
	Q1	99.5066	Transistor AF121
	Q2	99.5073	Transistor AF124

TRANSMITTER SECTION
SENDERSEKTION

CQP510(R)

X401.156





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

TRANSMITTER SECTION
SENDERSEKTION

CQP510(R)-1W

D 401.345

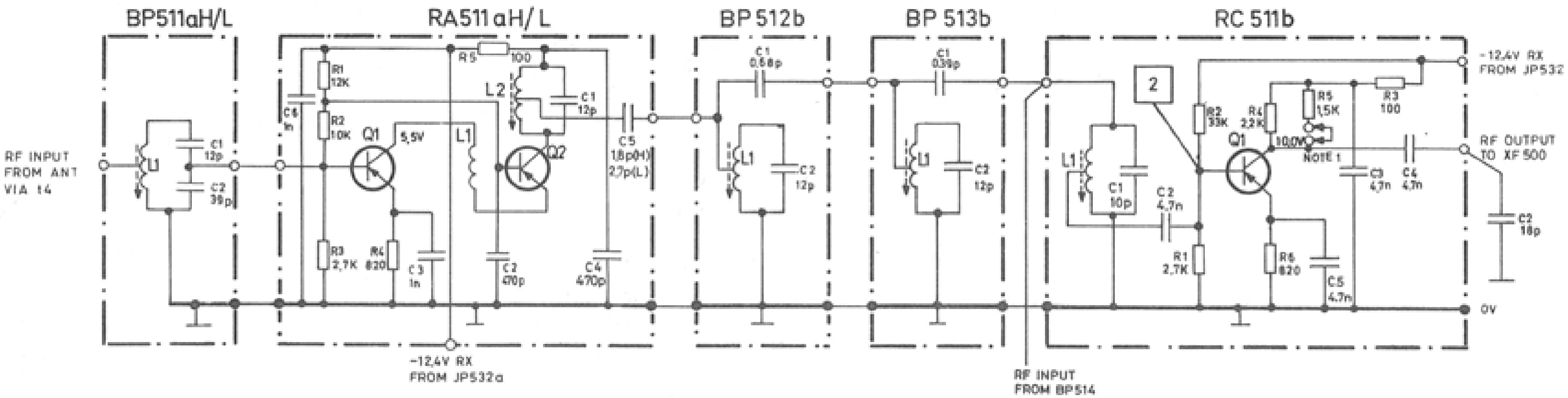
TYPE	NO.	CODE	DATA
FN511a		10.1548	Antenna Filter
	C1	74.5136	12 pF 5% ceram N150 DI 125 V
	C2	74.5131	4.7 pF ± 0.25 pF ceram N150 DI 125 V
	C3	74.5136	12 pF 5% ceram N150 DI 125 V
	L1	61.976	RF coil/HF spole 146-174 MHz
	L2	61.975	RF coil/HF spole 146-174 MHz
	L3	61.974	RF coil/HF spole 146-174 MHz
PA514		10.2579	Power Amplifier
	C1	74.5161	470 pF -20+80% ceram II PL 63 V
	C2	74.5155	1 nF -20+80% ceram PL 63 V
	C3	74.5155	1 nF -20+80% ceram II PL 63 V
	C4	74.5106	22 pF 5% ceram TB 160 V
	C6	74.5131	4.7 pF ± 0.25 pF ceram N150 TB 160 V
	C7	73.5102	2 µF 20% tantal 35 V
	R1	80.5029	22 Ω 5% carbon film 0.1 W
	R2	80.5034	56 Ω 5% carbon film 0.1 W
	R3	80.5029	22 Ω 5% carbon film 0.1 W
	L1	61.1084	RF coil/HF spole 146-174 MHz
	L2	61.1084	RF coil/HF spole 146-174 MHz
	L3	63.5008	0.47 µH 20% RF choke/HF drossel
	L4	62.0651	0.08 µH RF choke/HF drossel
	L5	63.5007	15 µH 10% RF choke/HF drossel 0.5 A
	L6	63.5007	15 µH 10% RF choke/HF drossel 0.5 A
	Q1	99.5256	Transistor BLX65
PA511cH		10.1314-02	Power Amplifier 156-174 MHz
PA511dL		10.1315-03	Power Amplifier 146-156 MHz
	C1	74.5136	12 pF 5% ceram N150 DI 125 V
	C2	74.5109	10 nF -20+80% ceram II PL 20 V
	C3	74.5132	5.6 pF ± 0.25 pF ceram N150 DI 250 V
	C4	74.5109	10 nF -20+80%ceram II PL 20 V
	C5	74.5131	4.7 pF ± 0.25 pF ceram N150 DI 250 V
	C6	74.5137	15 pF 5% ceram N150 DI 125 V
	R1	80.5025	10 Ω 5% carbon film 0.1 W
PA511H	L1	61.0906	RF coil/HF spole 156-174 MHz
PA511L	L1	61.0901	RF coil/HF spole 146-156 MHz
PA511H	L2	61.0902	RF coil/HF spole 156-174 MHz
PA511L	L2	61.0900	RF coil/HF spole 146-156 MHz

TYPE	NO.	CODE	DATA
	L3	62.0651	Choke/drosselspole
	L4	63.5007	15 µH 10% choke/drossel 500 mA
	Q1	99.5169	Transistor AF202S
	Q2	99.5139	Transistor BSX19

TRANSMITTER SECTION
SENDERSEKTION

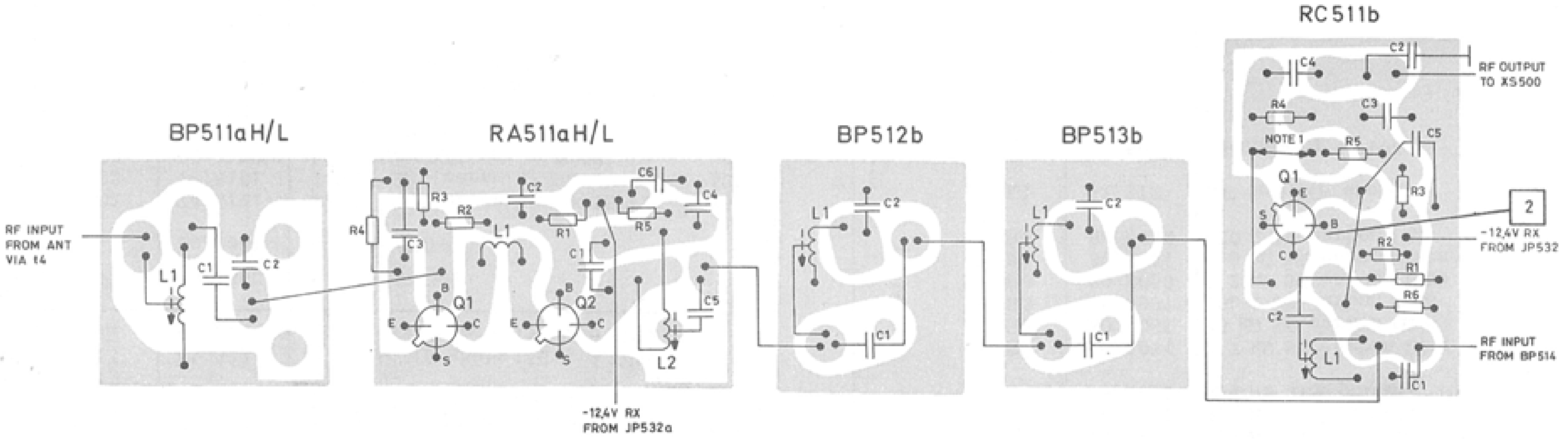
CQP510(R)-1W

X401.335



NOTE 1. THE STRAP IS OMITTED IN CQP511
STRAPNINGEN UDELADES I CQP511

PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN



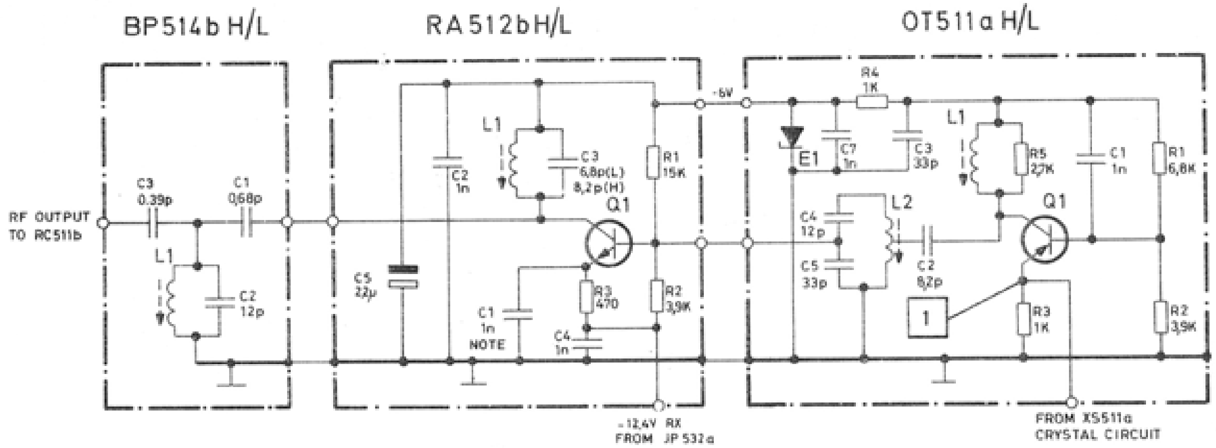
RECEIVER SECTION
MODTAGERSEKTION

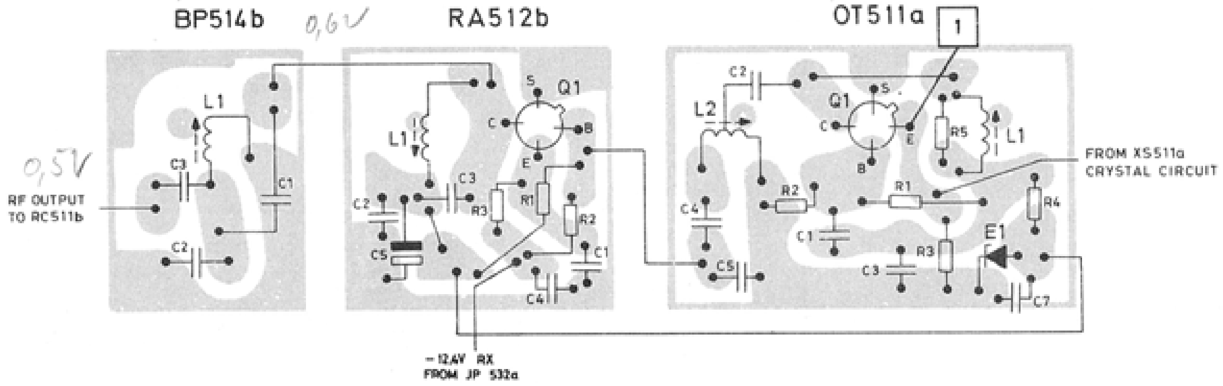
CQP510(R)

D401.217/3

TYPE	NO.	CODE	DATA	
BP511aH		10.1355	Bandpass Filter	
BP511aL		10.1350	Bandpass Filter	
	C1	74.5141	12 pF ±0.5 pF ceram NO75 TB	250V
	C2	74.5117	39 pF 2% ceram NO75 TB	250V
BP511H	L1	61.922	RF coil/HF spole 156-174 MHz	
BP511L	L1	61.917	RF coil/HF spole 146-160 MHz	
RA511aH		10.1356	RF-Amplifier	
RA511aL		10.1351	RF-Amplifier	
	C1	74.5141	12 pF ±0.5 pF ceram NO75 TB	250V
	C2	74.5161	470 pF 20% ceram II PL	125V
	C3	74.5112	1 nF -20 +80% ceram II PL	20V
	C4	74.5161	470 pF 20% ceram II PL	125V
RA511H	C5	74.5126	1.8 pF ±0.25 pF ceram N150 BD	250V
RA511L	C5	74.5128	2.7 pF ±0.25 pF ceram N150 DI	250V
	C6	74.5112	1 nF -20 +80% ceram II PL	20V
	R1	80.5062	12 kΩ 5% carbon film	0.1W
	R2	80.5061	10 kΩ 5% carbon film	0.1W
	R3	80.5054	2.7 kΩ 5% carbon film	0.1W
	R4	80.5048	820 Ω 5% carbon film	0.1W
	R5	80.5037	100 Ω 5% carbon film	0.1W
	L1	62.614	Coil/spole 68-88 MHz, 146-174 MHz	
RA511H	L2	61.923	RF coil/HF spole 156-174 MHz	
RA511L	L2	61.916	RF coil/HF spole 146-160 MHz	
	Q1	99.5067	Transistor AF106	
	Q2	99.5067	Transistor AF106	
BP512b		10.1357	Bandpass Filter	
	C1	74.5121	0.68 pF ±0.1 pF ceram P100 BD	500V
	C2	74.5141	12 pF ±0.5 pF ceram NO75 TB	250V
	L1	61.1060	RF coil/HF spole 156-174 MHz	
BP513b		10.1358	Bandpass Filter	
	C1	74.5120	0.39 pF ±0.1pF ceram P100 BD	500V
	C2	74.5141	12 pF ±0.5 pF ceram NO75 TB	250V
	L1	61.1060	RF coil/HF spole 156-174 MHz	

TYPE	NO.	CODE	DATA	
RC511a		10.1325	Receiver Converter	
	C1	74.5141	12 pF ±0.5 pF ceram NO75 TB	250V
	C2	74.5108	4.7 nF -20 +80% ceram II PL	20V
	C3	76.5061	4.7 nF 10% polyest. FL	50V
	C4	76.5061	4.7 nF 10% polyest. FL	50V
	R1	80.5054	2.7 kΩ 5% carbon film	0.1W
	R2	80.5067	33 kΩ 5% carbon film	0.1W
	R3	80.5037	100 Ω 5% carbon film	0.1W
	R4	80.5053	2.2 kΩ 5% carbon film	0.1W
	R5	80.5051	1.5 kΩ 5% carbon film	0.1W
	R6	80.5048	820 Ω 5% carbon film	0.1W
	L1	61.912	RF coil/HF spole	
	Q1	99.5067	Transistor AF106	





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

RECEIVER SECTION
MODTAGERSEKTION
CQP510(R)

D401.218/3

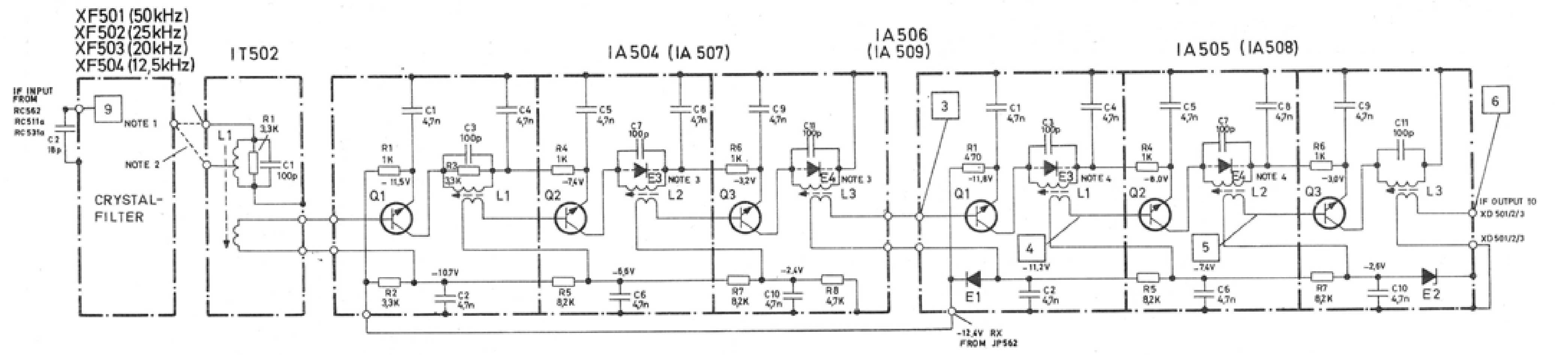
TYPE	NO.	CODE	DATA
BP514bH		10.1359	Bandpass Filter
BP514bL		10.1347	Bandpass Filter
	C1	74.5121	0,68 pF ±0,1 pF ceram P100 BD 250V
	C2	74.5141	12 pF ±0,5 pF ceram NO75 TB 250V
	C3	74.5120	0,39 pF -20 +80% ceram II PL 20V
BP514H	L1	61.925	RF coil/HF spole 145-168 MHz
BP514L	L1	61.919	RF coil/HF spole 156,7-170,7 MHz
RA512bH		10.1360	RF Amplifier
RA512bL		10.1346	RF Amplifier
	C1	74.5112	1 nF -20 +80% ceram II PL 20V
	C2	74.5112	1 nF -20 +80% ceram II PL 20V
RA512H	C3	74.5134	8,2 pF 5% ceram N150 TB 125V
RA512L	C3	74.5133	6,8 pF ±0,5 pF ceram NO75 TB 250V
	C4	74.5112	1 nF -20 +80% ceram II PL 20V
	C5	73.5129	2,2 μF -20 +50% tantal 10V
	R1	80.5063	15 kΩ 5% carbon film 0,1W
	R2	80.5056	3,9 kΩ 5% carbon film 0,1W
	R3	80.5045	470 Ω 5% carbon film 0,1W
	L1	61.1083	RF coil/HF spole 130-170 MHz
	Q1	99.5168	Transistor BF173
OT511aH		10.1361	Oscillator Tripler
OT511aL		10.1345	Oscillator Tripler
	C1	76.5069	1 nF 10% polyest. FL 50V
	C2	74.5160	8,2 pF ±0,5 pF ceram N750 DI 250V
	C3	74.5116	33 pF 2% ceram NO75 TB 250V
	C4	74.5141	12 pF ±0,5 pF ceram NO75 TB 250V
	C5	74.5116	33 pF 2% ceram NO75 TB 250V
	C7	74.5112	1 nF -20 +80% ceram II PL 20V
	R1	80.5059	6,8 kΩ 5% carbon film 0,1W
	R2	80.5056	3,9 kΩ 5% carbon film 0,1W
	R3	80.5049	1 kΩ 5% carbon film 0,1W
	R4	80.5049	1 kΩ 5% carbon film 0,1W
	R5	80.5054	2,7 kΩ 5% carbon film 0,1W

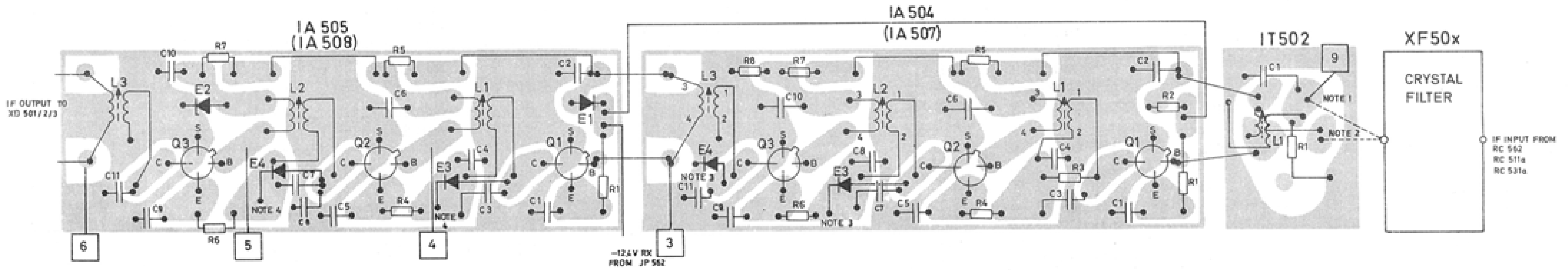
TYPE	NO.	CODE	DATA
	L1	61.915	RF coil/HF spole 52.23-56.9 MHz
OT511H	L2	61.927	RF coil/HF spole 145-168 MHz
OT511L	L2	61.914	RF coil/HF spole 156.7-170 MHz
	E1	99.5114	Zenerdiode BZY 57
	Q1	99.5067	Transistor AF106

RECEIVER SECTION
MODTAGERSEKTION

CQP510(R)

X401.220





NOTE 1: STRAP FOR 50kHz CHANNEL SEPARATION
STRAPNING FOR 50kHz KANALAFSTAND

NOTE 2: STRAP FOR 25, 20 AND 12,5kHz CHANNEL SEPARATION
STRAPNING FOR 25, 20 OG 12,5kHz KANALAFSTAND

NOTE 3: DIODES E3 AND E4 ARE INSERTED IN IA507 ONLY.
DIODER E3 OG E4 INDSÆTTES KUN I IA 507.

NOTE 4: DIODES E3 OG E4 ARE INSERTED IN IA 508 ONLY.
DIODER E3 OG E4 INDSÆTTES KUN I IA 508.

PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

RECEIVER SECTION
MODTAGERSEKTION

CQP500

D401.105/4

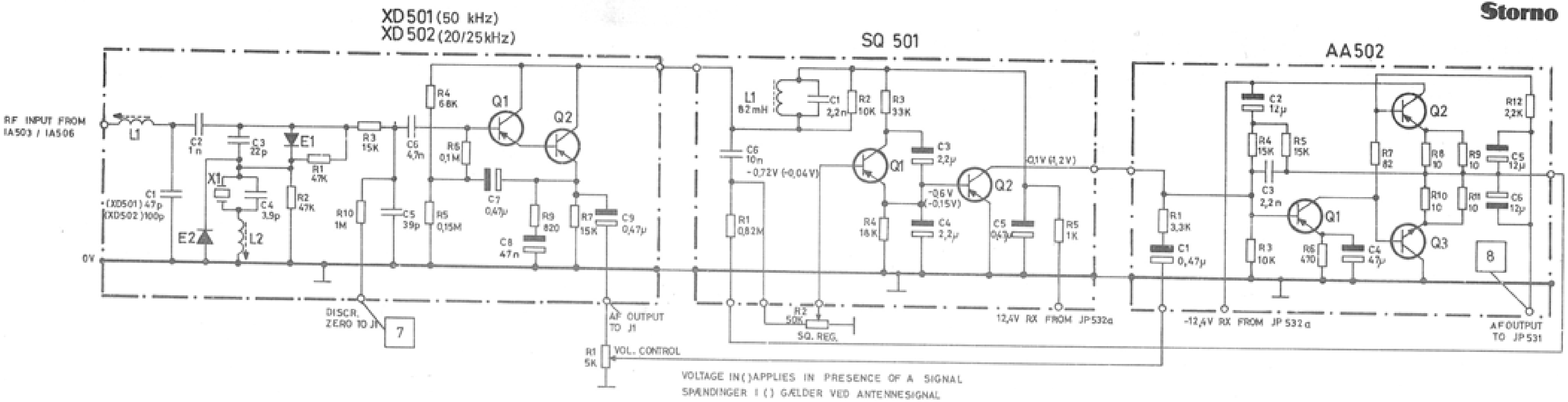
TYPE	NO.	CODE	DATA
XF501		69.5002	Crystal Filter 50 kHz
XF502		69.5001	Crystal Filter 25/20 kHz
XF504		69.5012	Crystal Filter 12.5 kHz
IT502		10.1991	Impedance Transformer Unit
	C1	76.5102	100 pF 2.5% polystyr. TB 25V
	R1	80.5055	3.3 kΩ 5% carbon film 0.1W
	L1	61.1047	Coil/spole 10.7 MHz
IA506		10.1918	IA504 + IA505
IA509		10.2493	IA507 + IA508
IA504		10.1893	IF Amplifier Unit
IA507		10.2491	IF Amplifier Unit
	C1	76.5061	4.7 nF 10% polyest. FL 50V
	C2	76.5061	4.7 nF 10% " FL 50V
	C3	76.5102	100 pF 2.5% polystyr TB 25V
	C4	76.5061	4.7 nF 10% polyest. FL 50V
	C5	76.5061	4.7 nF 10% " FL 50V
	C6	76.5061	4.7 nF 10% " FL 50V
	C7	76.5102	100 pF 2.5% polystyr TB 25V
	C8	76.5061	4.7 nF 10% polyest. FL 50V
	C9	76.5061	4.7 nF 10% " FL 50V
	C10	76.5061	4.7 nF 10% " FL 50V
	C11	76.5102	100 pF 2.5% polystyr TB 25V
	R1	80.5049	1 kΩ 5% carbon film 0.1W
	R2	80.5055	3.3 kΩ 5% " " 0.1W
	R3	80.5055	3.3 kΩ 5% " " 0.1W
	R4	80.5049	1 kΩ 5% " " 0.1W
	R5	80.5060	8.2 kΩ 5% " " 0.1W
	R6	80.5049	1 kΩ 5% " " 0.1W
	R7	80.5060	8.2 kΩ 5% " " 0.1W
	R8	80.5057	4.7 kΩ 5% " " 0.1W
	L1	61.1045	RF coil/HF spole 10.7 MHz
	L2	61.1045	RF coil/HF spole 10.7 MHz
	L3	61.1045	RF coil/HF spole 10.7 MHz
IA507	E3	99.5237	Diode 1N4148
IA507	E4	99.5237	Diode 1N4148

TYPE	NO.	CODE	DATA
	Q1	99.5166	Transistor BF167
	Q2	99.5166	Transistor BF167
	Q3	99.5166	Transistor BF167
IA505		10.1894	IF Amplifier Unit
IA508		10.2492	IF Amplifier Unit
	C1	76.5061	4.7 nF 10% polyest. FL 50V
	C2	76.5061	4.7 nF 10% polyest. FL 50V
	C3	76.5102	100 pF 2.5% polystyr. TB 25V
	C4	76.5061	4.7 nF 10% polyest FL 50V
	C5	76.5061	4.7 nF 10% " FL 50V
	C6	76.5061	4.7 nF 10% " FL 50V
	C7	76.5102	100 pF 2.5% polystyr. TB 25V
	C8	76.5061	4.7 nF 10% polyest. FL 50V
	C9	76.5061	4.7 nF 10% " FL 50V
	C10	76.5061	4.7 nF 10% " FL 50V
	C11	76.5102	100 pF 2.5% polystyr. TB 25V
	R1	80.5045	470 Ω 5% carbon film 0.1W
	R4	80.5049	1 kΩ 5% " " 0.1W
	R5	80.5060	8.2 kΩ 5% " " 0.1W
	R6	80.5049	1 kΩ 5% " " 0.1W
	R7	80.5060	8.2 kΩ 5% " " 0.1W
	L1	61.1045	RF coil/HF spole 10.7 MHz
	L2	61.1045	RF coil/HF spole 10.7 MHz
	L3	61.1045	RF coil/HF spole 10.7 MHz
	E1	99.5209	Diode Stab. ZE 1.5
	E2	99.5210	Zenerdiode 3.3V 5% 400mW
IA508	E3	99.5237	Diode 1N4148
IA508	E4	99.5237	Diode 1N4148
	Q1	99.5166	Transistor BF167
	Q2	99.5166	Transistor BF167
	Q3	99.5166	Transistor BF167

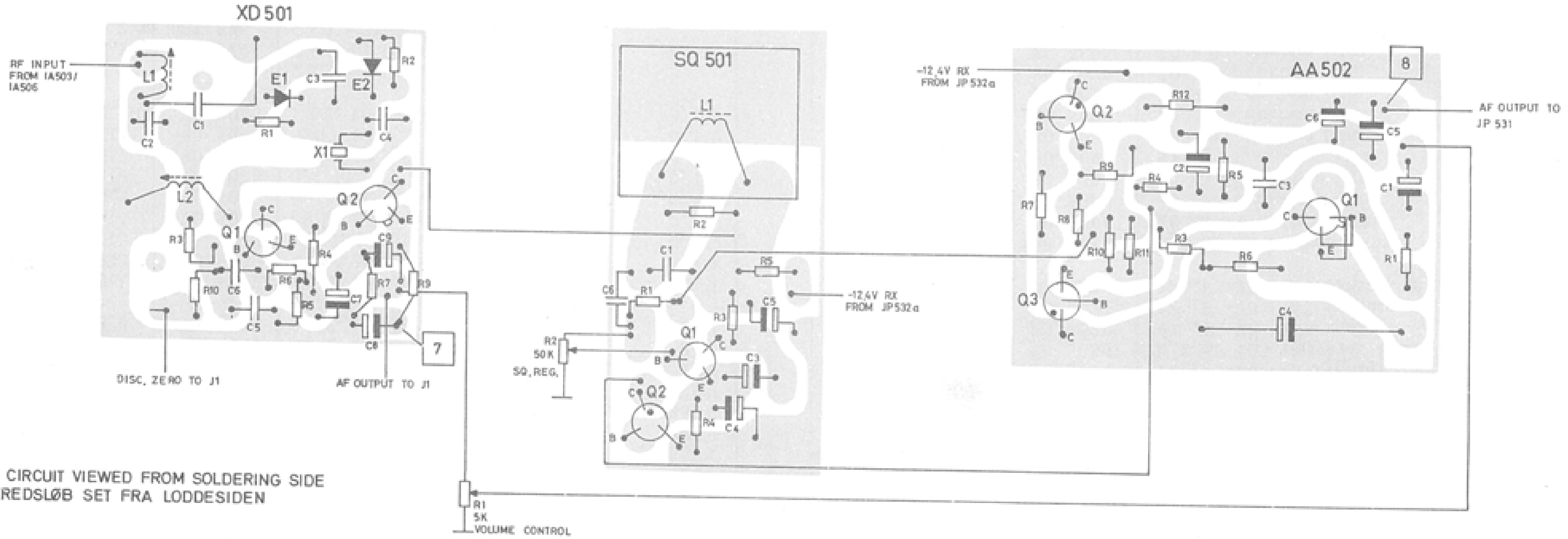
RECEIVER SECTION
MODTAGERDEL

CQP500

X401.251



VOLTAGE IN ( ) APPLIES IN PRESENCE OF A SIGNAL
SPÆNDINGER I ( ) GÆLDER VED ANTENNESIGNAL



PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

RECEIVER SECTION CQP510(R)
MODTAGERSEKTION CQP530(R)

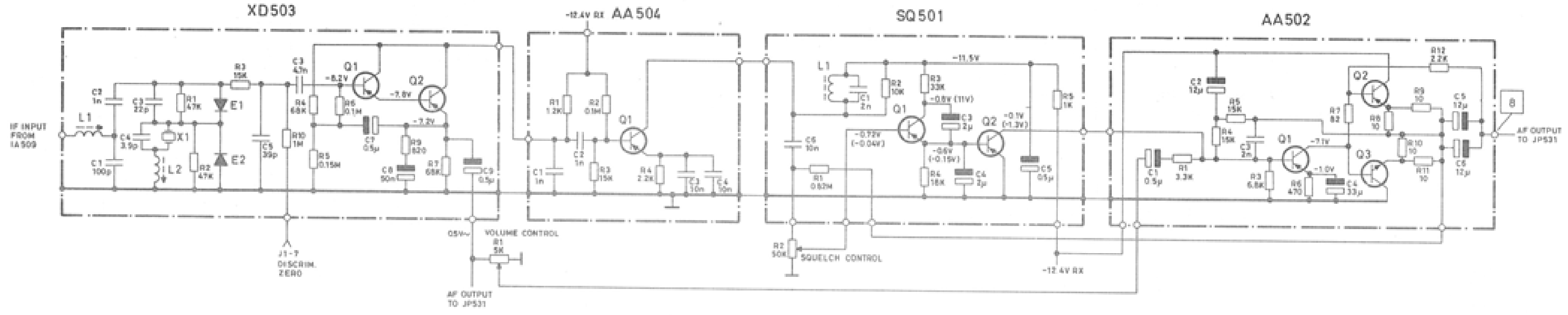
D401.169/3

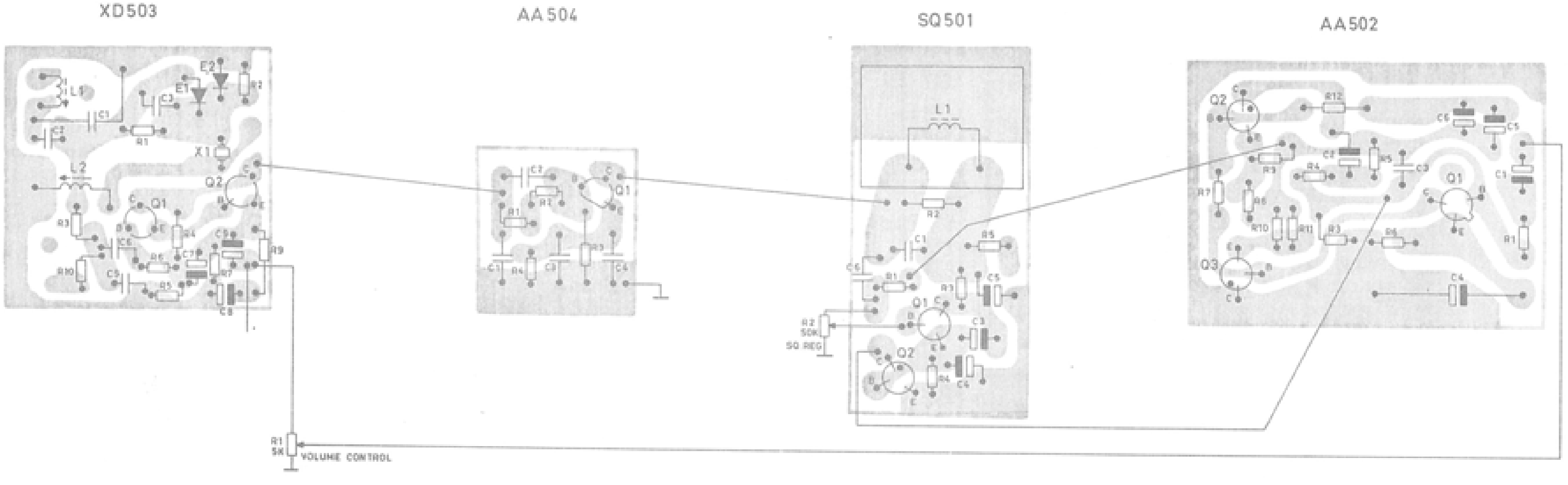
TYPE	NO.	CODE	DATA	
XD501 XD502		10.984	Crystal Discriminator	
		10.1004	Crystal Discriminator	
XD501	C1	74.5118	47 pF 2% ceram NO75 TB	250V
XD502	C1	76.5102	100 pF 2,5% polystyr N150 TB	30V
	C2	74.5112	1 nF -20 +80% ceram PL	20V
	C3	74.5106	22 pF ± 0,5pF ceram NO75 TB	250V
	C4	74.5130	3,9 pF ± 0,25pF ceram N150 DI	500V
	C5	74.5117	39 pF 2% ceram NO75 TB	250V
	C6	74.5108	4,7 nF -20 +80% ceram PL	20V
	C7	73.5134	0,47 μF -20 +50% tantal	16V
	C8	73.5131	47 nF -20 +50% tantal	20V
	C9	73.5134	0,47 μF -20 +50% tantal	16V
	R1	80.5069	47 kΩ 5% carbon film	0,1W
	R2	80.5069	47 kΩ 5% carbon film	0,1W
	R3	80.5063	15 kΩ 5% carbon film	0,1W
	R4	80.5071	68 kΩ 5% carbon film	0,1W
	R5	80.5075	0,15 MΩ 5% carbon film	0,1W
	R6	80.5073	0,1 MΩ 5% carbon film	0,1W
	R7	80.5063	15 kΩ 5% carbon film	0,1W
	R9	80.5048	820 Ω 5% carbon film	0,1W
	R10	80.5085	1 MΩ 10% carbon film	0,1W
XD501	L1	61.594	Coil/spole 10,7 MHz	
XD502	L1	61.614	Coil/spole 10,7 MHz	
	L2	61.595	Coil/spole 10,7 MHz	
	E1	99.5074	Diode AA119	
	E2	99.5074	Diode AA119	
	Q1	99.5043	Transistor BCZ13	
	Q2	99.5043	Transistor BCZ13	
	X1	98.5003	Crystal type 98-7	
SQ501		10.967	Squelch Unit	
	C1	76.5059	2,2 nF 10% polyest. FL	50V
	C3	73.5129	2,2 μF -20 +50% tantal	10V
	C4	73.5129	2,2 μF -20 +50% tantal	10V
	C5	73.5134	0,47 μF -20 +50% tantal	16V
	C6	76.5070	10 nF 10% polyest FL50	
	R1	80.5084	0,82 MΩ 5% carbon film	0,1W
	R2	80.5061	10 kΩ 5% carbon film	0,1W
	R3	80.5067	33 kΩ 5% carbon film	0,1W
	R4	80.5064	18 kΩ 5% carbon film	0,1W

TYPE	NO.	CODE	DATA	
	R5	80.5049	1 kΩ 5% carbon film	0,1W
	L1	61.577	Coil/spole 82 mH	
	Q1	99.5043	Transistor BCZ13	
	Q2	99.5043	Transistor BCZ13	
AA502		10.991	AF amplifier	
	C1	73.5134	0,47 μF -20 +50% tantal	16V
	C2	73.5074	12 μF -20 +75% tantal	15V
	C3	76.5059	2,2 nF 10% polyest. FL	50V
	C4	73.5029	47 μF -20 +50% tantal	6V
	C5	73.5074	12 μF -20 +75% tantal	15V
	C6	73.5074	12 μF -20 +75% tantal	15V
	R1	80.5055	3,3 kΩ 5% carbon film	0,1W
	R3	80.5061	10 kΩ 5% carbon film	0,1W
	R4	80.5063	15 kΩ 5% carbon film	0,1W
	R5	80.5063	15 kΩ 5% carbon film	0,1W
	R6	80.5045	470 Ω 5% carbon film	0,1W
	R7	80.5036	82 Ω 5% carbon film	0,1W
	R8	80.5025	10 Ω 5% carbon film	0,1W
	R9	80.5025	10 Ω 5% carbon film	0,1W
	R10	80.5025	10 Ω 5% carbon film	0,1W
	R11	80.5025	10 Ω 5% carbon film	0,1W
	R12	80.5053	2,2 kΩ 5% carbon film	0,1W
	Q1	99.5115	Transistor BC179	
	Q2 Q3	99.5068	Transistor pair (Q2-AC132, Q3-AC127)	

RECEIVER SECTION CQP510(R)
MODTAGERSEKTION CQP530(R)

X401.153





RECEIVER SECTION
MODTAGERSEKTION

CQP514(R), CQP534(R)

D401.252

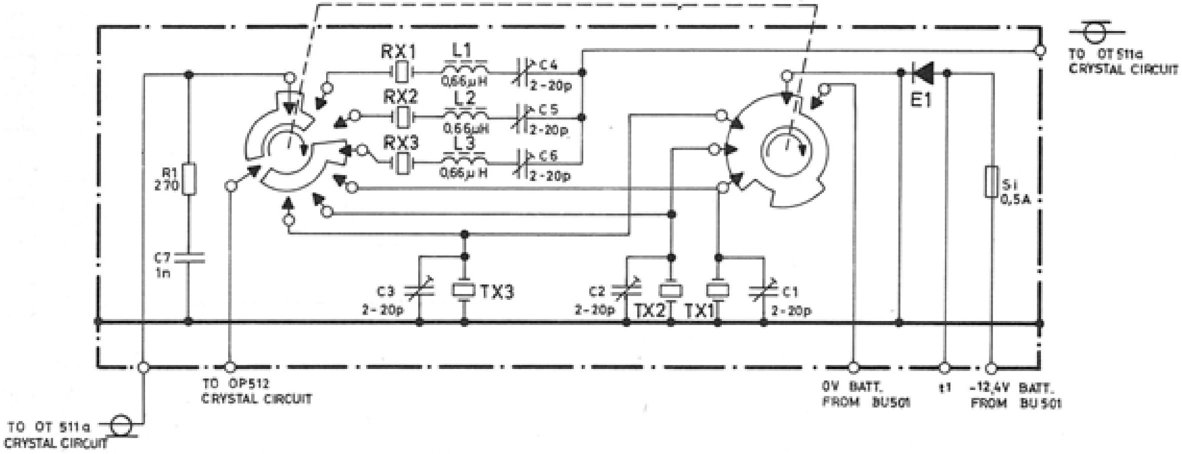
TYPE	NO.	CODE	DATA
AA502		10.991	AF amplifier
	C1	73.5134	0,47 µF -20 +50% tantal 16V
	C2	73.5074	12 µF -20 +75% " 15V
	C3	76.5059	2.2 nF 10% polyest FL 50V
	C4	73.5029	47 µF -20 +50% tantal 6V
	C5	73.5074	12 µF -20 +75% " 15V
	C6	73.5074	12 µF -20 +75% " 15V
	R1	80.5055	3.3 kΩ 5% carbon film 0,1W
	R3	80.5061	10 kΩ 5% " " 0,1W
	R4	80.5063	15 kΩ 5% " " 0,1W
	R5	80.5063	15 kΩ 5% " " 0,1W
	R6	80.5045	470 Ω 5% " " 0,1W
	R7	80.5036	82 Ω 5% " " 0,1W
	R8	60.5025	10 Ω 5% " " 0,1W
	R9	80.5025	10 Ω 5% " " 0,1W
	R10	80.5025	10 Ω 5% " " 0,1W
	R11	80.5025	10 Ω 5% " " 0,1W
	R12	80.5053	2.2 kΩ 5% " " 0,1W
	Q1	99.5115	Transistor BC179
	Q2 Q3	99.5068	Transistor pair (Q2-AC132, Q3-AC127)
AA504		10.2062	Noise Amplifier
	C1	76.5069	1 nF 10% polyest FL 50V
	C2	76.5069	1 nF 10% polyest FL 50V
	C3	76.5070	10 nF 10% " FL 50V
	C4	76.5070	10 nF 10% " FL 50V
	R1	80.5050	1.2 kΩ 5% carbon film 0,1W
	R2	80.5073	0.1 MΩ 5% " " 0,1W
	R3	80.5063	15 kΩ 5% " " 0,1W
	R4	80.5053	2.2 kΩ 5% " " 0,1W
	Q1	99.5043	Transistor BC214L
SQ501		10.967	Squelch Unit
	C1	76.5059	2.2 nF 10% polyest FL 50V
	C3	73.5129	2.2 µF -20 +50% tantal 10V
	C4	73.5129	2.2 µF -20 +50% " 10V
	C5	73.5134	0,47 µF -20 +50% " 16V
	C6	76.5070	10 nF 10% polyest FL 50V
	R1	80.5084	0.82 MΩ 5% carbon film 0,1W
	R2	80.5061	10 kΩ 5% " " 0,1W

TYPE	NO.	CODE	DATA
	R3	80.5067	33 kΩ 5% carbon film 0,1W
	R4	80.5064	18 kΩ 5% " " 0,1W
	R5	80.5049	1 kΩ 5% " " 0,1W
	L1	61.577	Coil/spole 82 mH
	Q1	99.5043	Transistor BCZ13
	Q2	99.5043	Transistor BCZ13
XD503		10.2020	Crystal Discriminator
	C1	76.5102	100 pF 2.5% polystyr TB 30V
	C2	74.5112	1 nF -20 +80% ceram PL 20V
	C3	74.5106	22 pF ± 0.5 pF ceram TB 250V
	C4	74.5130	3.9 pF ± 0.25pF " DI 500V
	C5	74.5117	39 pF 2% " TB 250V
	C6	74.5108	4.7 nF -20 +80% " PL 20V
	C7	73.5134	0.47 µF -20 +50% tantal 16V
	C8	73.5131	47 nF -20 +50% tantal 20V
	C9	73.5134	0.47 nF -20 +50% tantal 16V
	R1	80.5069	47 kΩ 5% carbon film 1/10W
	R2	80.5069	47 kΩ 5% " " 1/10W
	R3	80.5063	15 kΩ 5% " " 1/10W
	R4	80.5071	68 kΩ 5% " " 1/10W
	R5	80.5075	0.15 MΩ 5% " " 1/10W
	R6	80.5073	0.1 MΩ 5% " " 1/10W
	R7	80.5063	15 kΩ 5% " " 1/10W
	R9	80.5048	820 Ω 5% " " 1/10W
	R10	80.5085	1 MΩ 10% " " 1/10W
	L1	61.614	Coil/spole 10,7 MHz
	L2	61.595	Coil/spole 10,7 MHz
	E1	99.5074	Diode AA119
	E2	99.5074	Diode AA119
	Q1	99.5043	Transistor BCZ13
	Q2	99.5043	Transistor BCZ13
	X1	98.5009	Crystal Type 98-25

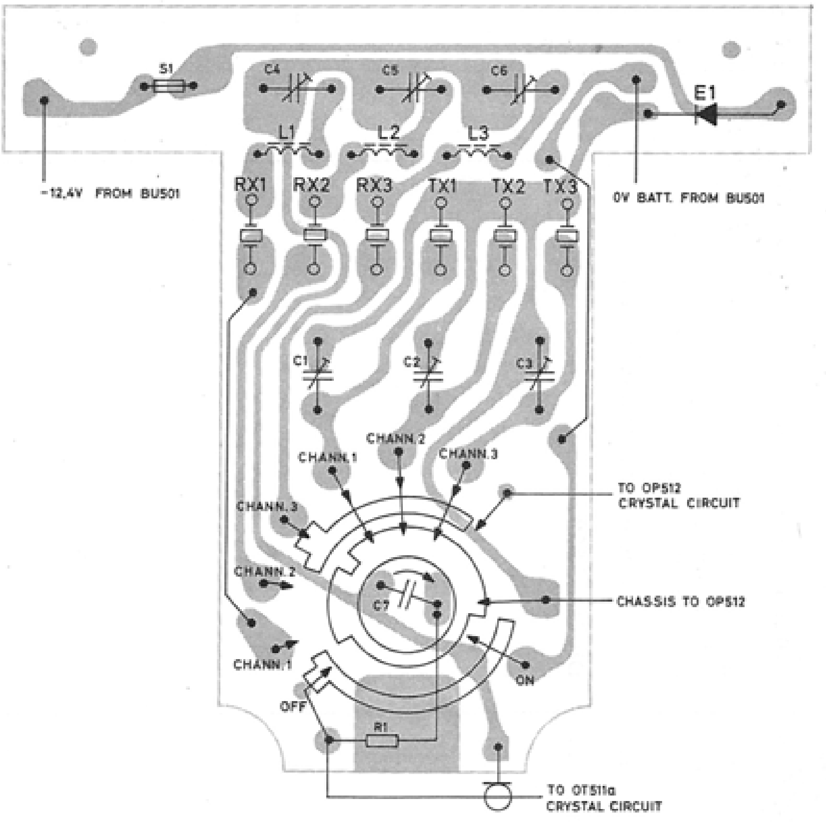
RECEIVER SECTION
MODTAGERSEKTION CQP534 CQP514

X401.257

XS511b



XS511b



gl. type

TxL

1 2 3 456

PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN

CRYSTAL SHIFT UNIT
KRYSTALSKIFTEENHED
XS511b

D401.174

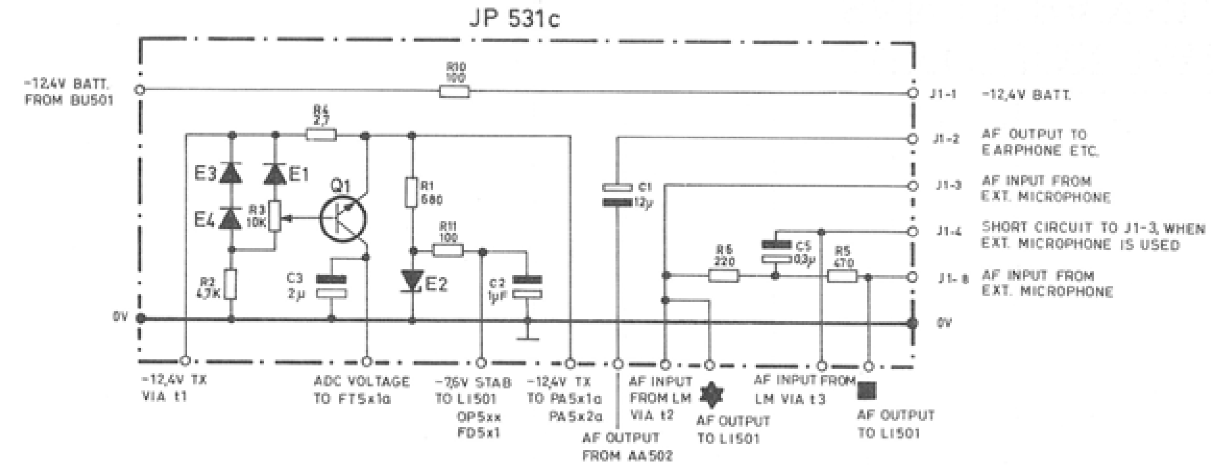
TYPE	NO.	CODE	DATA
XS511b		10.1507	Crystal shift Panel
	C1	78.5046	2/20 pF teflon N250 500V
	C2	78.5046	2/20 pF teflon N250 500V
	C3	78.5046	2/20 pF teflon N250 500V
	C4	78.5046	2/20 pF teflon N250 500V
	C5	78.5046	2/20 pF teflon N250 500V
	C6	78.5046	2/20 pF teflon N250 500V
	C7	74.5155	1 nF -20 +50% ceram II PL 50V
	R1	80.5042	270 Ω 5% carbon film 0,1W
	L1	62.720	coil/spole 0,66 μH
	L2	62.720	coil/spole 0,66 μH
	L3	62.720	coil/spole 0,66 μH
	O1	47.257	Channel selector/kanalomskifter
	E1	99.5028	Diode OA200

TYPE	NO.	CODE	DATA

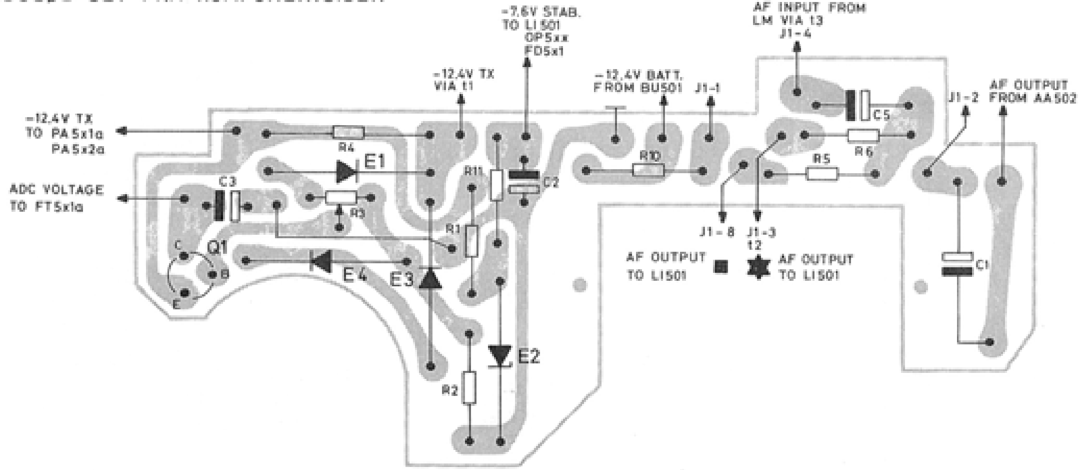
CRYSTAL SHIFT UNIT
KRYSTALSKIFTEENHED

XS511

X401.163



PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN



JUNCTION PANEL
SAMLEPANEL

JP531c

D401.173

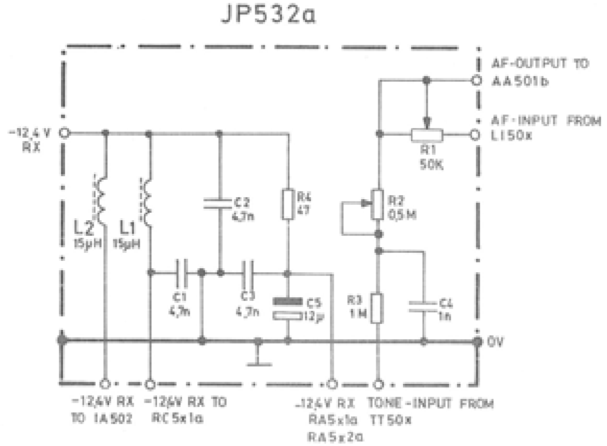
TYPE	NO.	CODE	DATA
JP531c		10.1117	Junction Panel
	C1	73.5074	12 μF -20 +75% tantal 15V
	C2	73.5135	1 μF 20% tantal 30V
	C3	73.5102	2,2 μF 20% tantal 35V
	C5	73.5079	0.3 μF 10% tantal 10V
	R1	80.5047	680 Ω 5% carbon film 0,1W
	R2	80.5057	4.7 kΩ 5% carbon film 0,1W
	R3	86.5037	10 kΩ potm. Lin. carb. film 0,05W
	R4	89.5021	2,7 Ω 5% metall. 1/16W
	R5	80.5045	470 Ω 5% carbon film 0,1W
	R6	80.5041	220 Ω 5% carbon film 0,1W
	R10	89.5022	100 Ω 20% metaloxyd 1/4W
	R11	80.5037	100 Ω 5% carbon film 0,1W
	E1	99.5028	Diode OA200
	E2	99.5075	Zenerdiode BZY61
	E3	99.5028	Diode OA200
	E4	99.5028	Diode OA200
	Q1	99.5076	Transistor BSY39

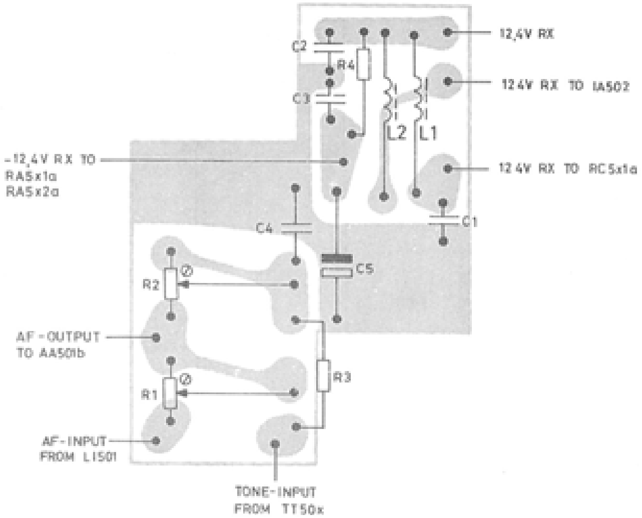
TYPE	NO.	CODE	DATA

JUNCTION PANEL
SAMLEPANEL

JP531c

X401.157





PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN

JUNCTION PANEL
SAMLEPANEL

JP532a

D401.171

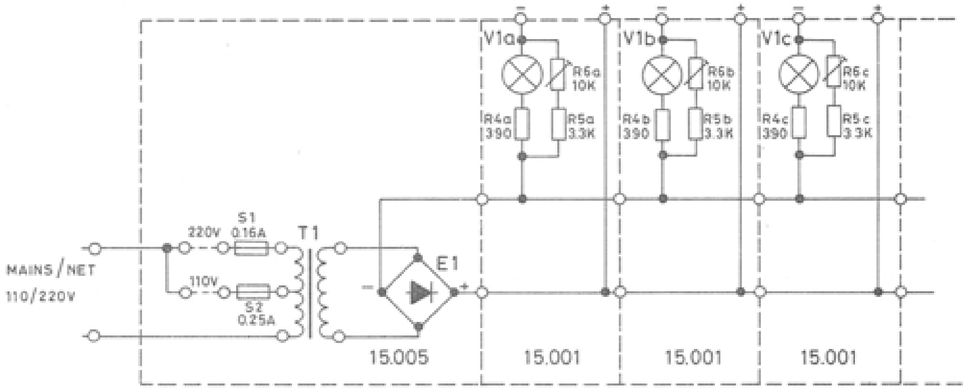
TYPE	NO.	CODE	DATA
JP532a		10.1021	Junction Panel
	C1	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C2	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C3	74.5108	4,7 nF -20 +80% ceram II PL 20V
	C4	76.5109	1 nF 2,5% polystyr 30V
	C5	73.5074	12 μF -20 +75% tantal 15V
	R1	86.5036	50 kΩ potm. Lin carbon film 0,05W
	R2	86.5038	0,5 MΩ potm. Lin carbon film 0,05W
	R3	80.5085	1 MΩ 10% carbon film 0,1W
	R4	80.5033	47 Ω 5% carbon film 0,1W
	L1	63.5007	15 μH 10% Filter Coil/drosselspole
	L2	63.5007	15 μH 10% Filter Coil/drosselspole

TYPE	NO.	CODE	DATA

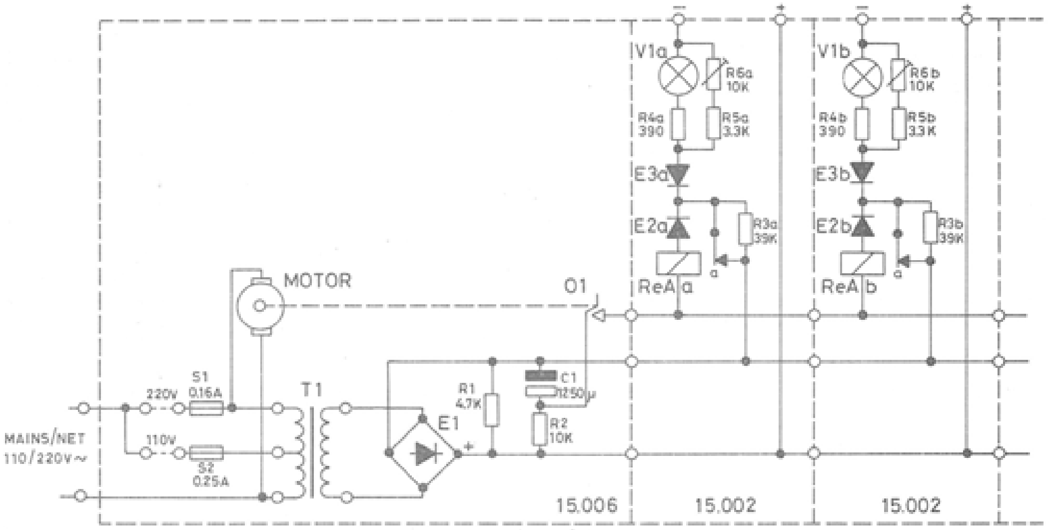
JUNCTION PANEL
SAMLEPANEL

X401.158

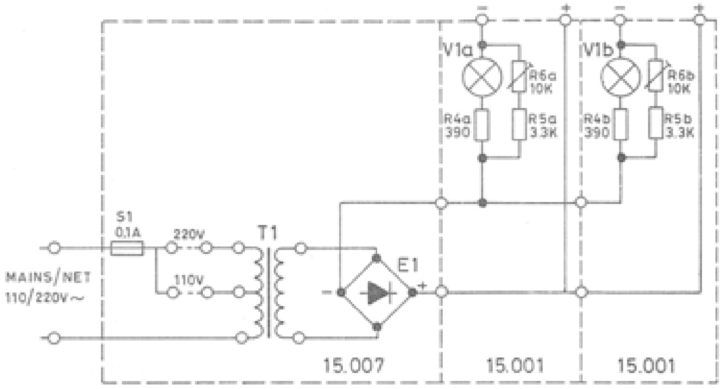
JP532a



CU501



CU502



CU503

CHARGING UNIT
LADEENHED
CU501, CU502, CU503

D401.232

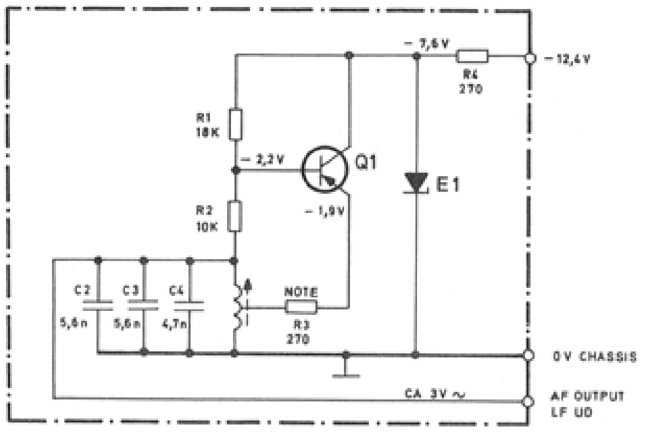
TYPE	NO.	CODE	DATA	
CU501		15.0005 15.0001	Charging Unit Battery Outlets/Ladekassetter	
	R4	81.5044	390 Ω 5% carbon film	1/2W
	R5	80.5055	3, 3 kΩ 5% carbon film	1/4W
	R6	86.5007	10 kΩ 20% potm. carbon film	0.2W
	T1	60.5125	Transformer	
	E1	94.5016	Rectifier/Ensretter B60 C500	
	V1	92.5071	Lamp/Lampe 30V 30 mA	
	S1	92.5027	Fuse/sikring 160 mA T	
	S2	92.5029	Fuse/sikring 250 mA T	
CU502		15.0006 15.0002	Charging Unit Battery Outlets/Ladekassetter	
	C1	73.50099	1250 μF -10 +50% elco	40 V
	R1	82.5057	4, 7 kΩ 5% carbon film	2 W
	R2	81.5061	10 kΩ 5% carbon film	1/2W
	R3	80.5468	39 kΩ 5% carbon film	1/4W
	R4	81.5044	390 Ω 5% carbon film	1/2W
	R5	80.5455	3, 3 kΩ 5% carbon film	1/4W
	R6	86.5007	10 kΩ 20% potm. carbon film	0, 2W
	T1	60.5125	Transformer	
	E1	94.5016	Rectifier/Ensretter B60 C500	
	E2	94.5020	Diode 1N4004	
	E3	94.5020	Diode 1N4004	
	O1	47.0301	Contact set/Kontaktsæt	
	V1	92.5003	Lamp/Lampe 30V 30 mA	
	ReA	58.5048	Counter/Tæller	
	S1	92.5027	Fuse/Sikring 160 mA T	
	S2	92.5029	Fuse/Sikring 250 mA T	
	Motor	93.5007	Synchronous motor with gear Synkronmotor med gear	

TYPE	NO.	CODE	DATA	
CU503		15.0007 15.0001	Charging Unit Battery Outlets/Ladekassetter	
	R4	81.5044	390 Ω 5% carbon film	1/2W
	R5	80.5055	3, 3 kΩ 5% carbon film	1/4W
	R6	86.5007	10 kΩ 20% potm. carbon film	0.2W
	T1	60.5126	Transformer	
	E1	94.5006	Rectifier/Ensretter B60 C160	
	V1	92.5071	Lamp/Lampe 30V 30 mA	
	S1	92.5025	Fuse/Sikring 100 mA T	

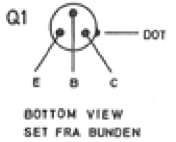
CHARGING UNIT
LADEENHED

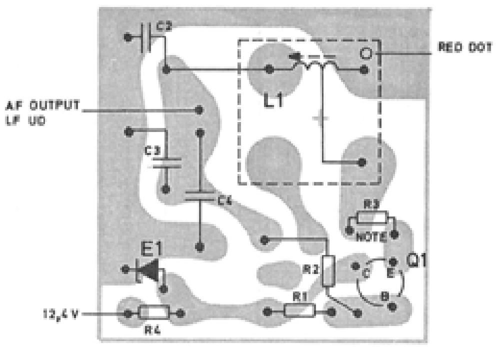
CU501, CU502, CU503

X401.234



NOTE: NOM. 270Ω, ADJUSTED/JUST.





PRINTED CIRCUIT VIEWED FROM SOLDERING SIDE
TRYKT KREDSLØB SET FRA LODDESIDEN

CODE	FREQ.
61.1078-11	1530 Hz
61.1078-12	1670 Hz
61.1078-13	1850 Hz
61.1078-13	1860 Hz
61.1078-14	2000 Hz
61.1078-15	2200 Hz
61.1078-15	2280 Hz
61.1078-16	2400 Hz
61.1078-16	2450 Hz
61.1078-17	2600 Hz
61.1078-18	2900 Hz
61.1078-25	1750 Hz
61.1078-26	1980 Hz
61.1078-27	1435 Hz
61.1078-28	2135 Hz
61.1078-33	3047 Hz
61.1078-34	2812 Hz

TONE TRANSMITTER
TONESENDER

TT501

D 400.557/2

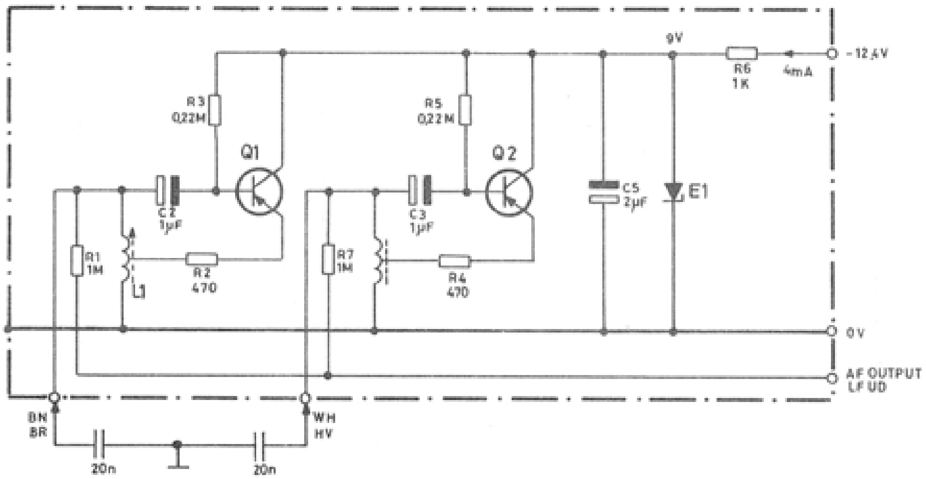
TYPE	NO.	CODE	DATA
	C2	76.5051	5.6 nF 2.5% polystyr TB 25V
	C3	76.5051	5.6 nF 2.5% " TB 25V
	C4	76.5051	4.7 nF 2.5% " TB 25V
	R1	80.5064	18 kΩ 5% carbon film 0.1W
	R2	80.5061	10 kΩ 5% " " 0.1W
	R3	80.5042	270 Ω 5% " " 0.1W
	R4	80.5042	270 Ω 5% " " 0.1W
	L1	61.1078	coil/spole
	E1	99.5075	BZY61 zenerdiode
	Q1	99.5043	BCZ 13 transistor

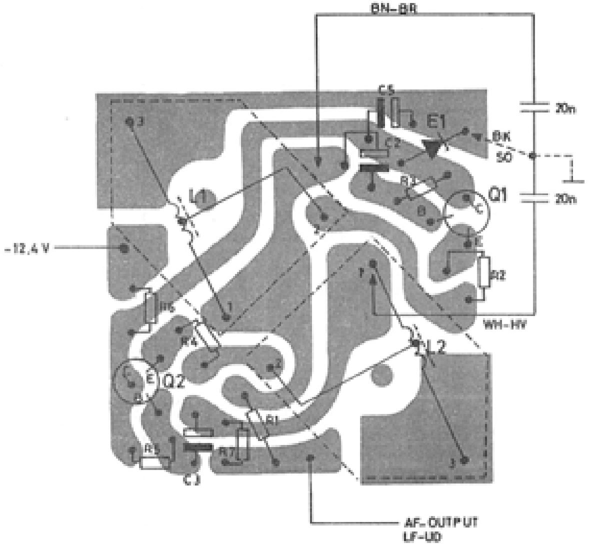
TYPE	NO.	CODE	DATA

TONE TRANSMITTER
TONESENDER

X400.077/2

TT501





TONE TRANSMITTER
TONESENDER

TT504

D400.908/2

TYPE	NO.	CODE	DATA	
	C2	73.5098	2 µF -20% +50%	15V
	C3	73.5098	2 µF -20% +50%	15V
	C5	73.5098	2 µF -20% +50%	15V
	R1	80.5085	1 MΩ 5% carbon film	0.1W
	R2	80.5045	470 Ω 5% " "	0,1W
	R3	80.5077	0.22 MΩ 5% " "	0,1W
	R4	80.5045	470 Ω 5% " "	0,1W
	R5	80.5077	0.22 MΩ 5% " "	0,1W
	R6	80.5049	1 kΩ 5% " "	0,1W
	R7	80.5085	1 MΩ 5% " "	0.1W
	L1	61.1052	coil/spole	
	L2	61.1052	coil/spole	
	E1	99.5042	zenerdiode 9V	
	Q1	99.5043	NS6063 Transistor	
	Q2	99.5043	NS6063 Transistor	

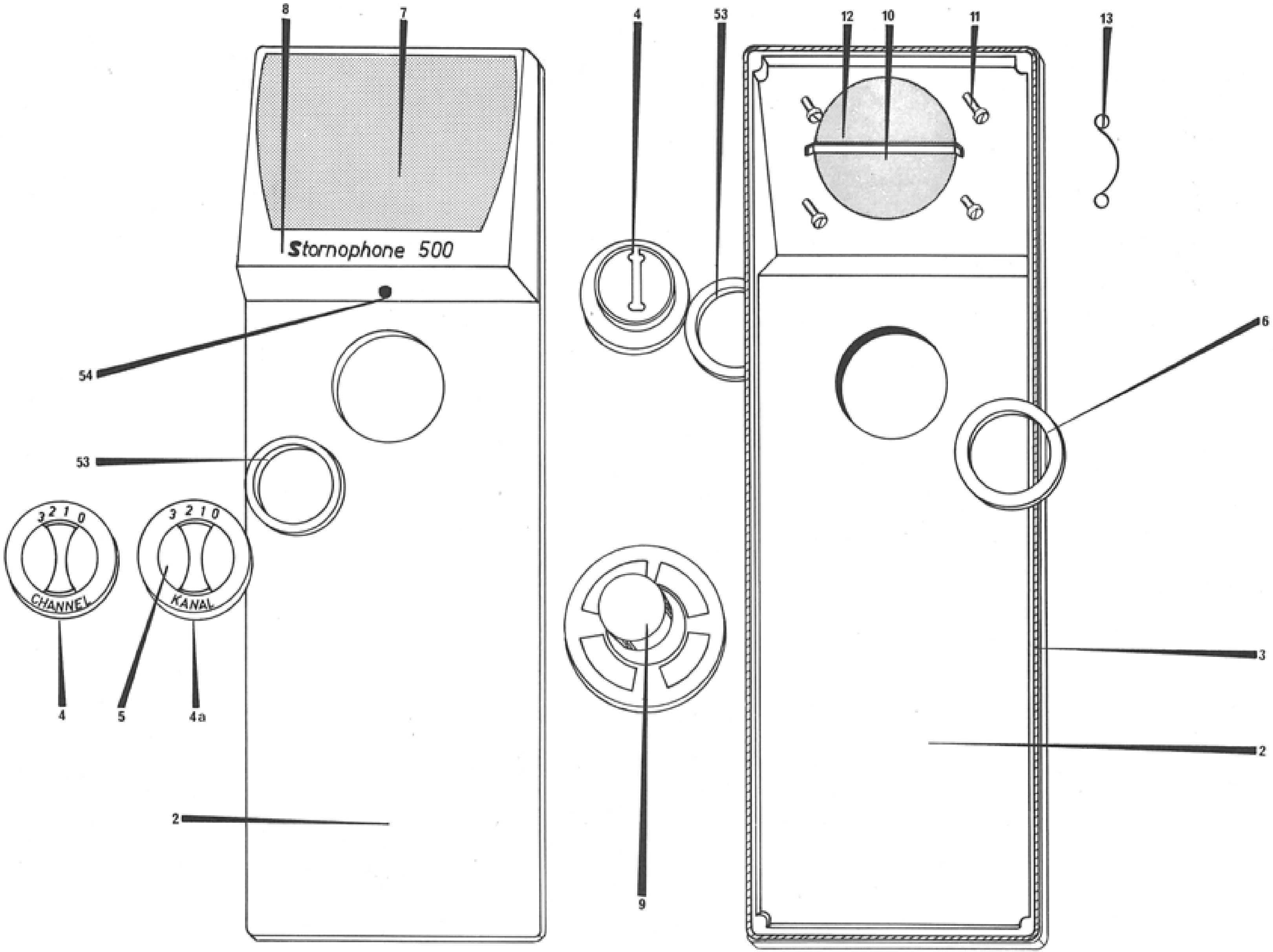
TYPE	NO.	CODE	DATA

TONE TRANSMITTER
TONESENDER
TT504

X401.079

CHAPTER VI. MECHANICAL PARTS LISTS

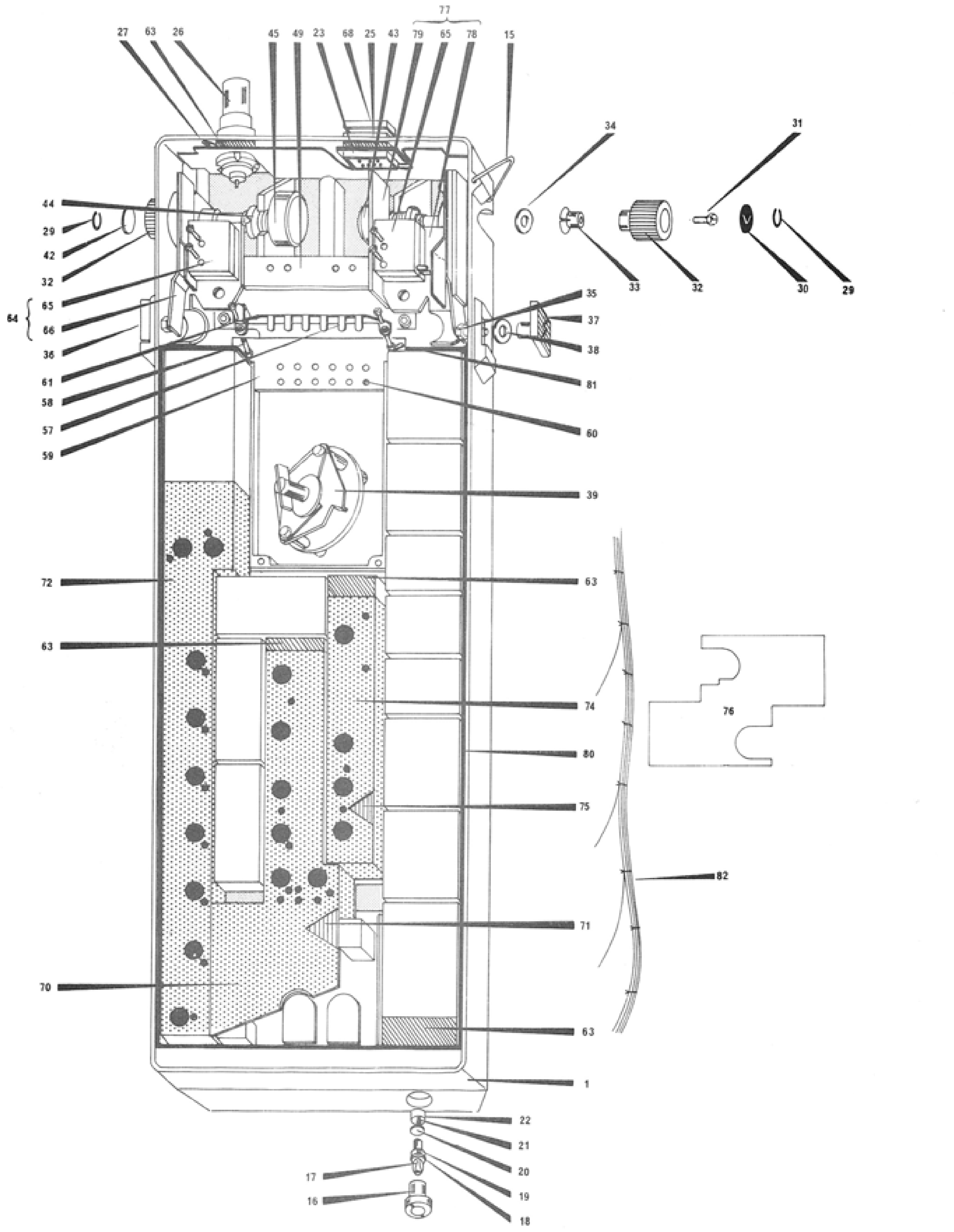
When ordering mechanical parts from Storno please state the code numbers and descriptions given in the parts lists.



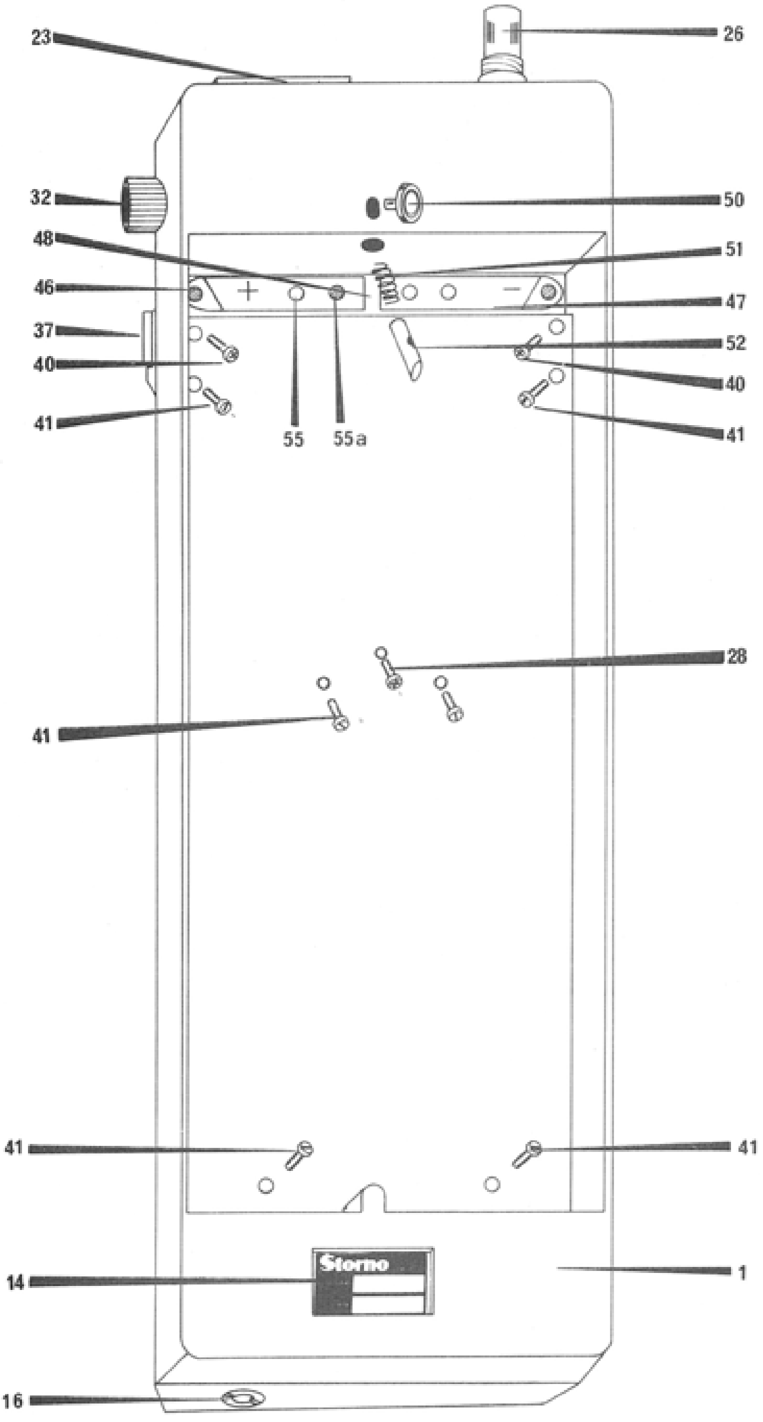
RADIOTELEPHONE
TASCHENFUNKGERÄT

CQP510, CQP530

M405.011a



RADIOTELEPHONE
TASCHENFUNKGERÄT CQP510, CQP530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Storno
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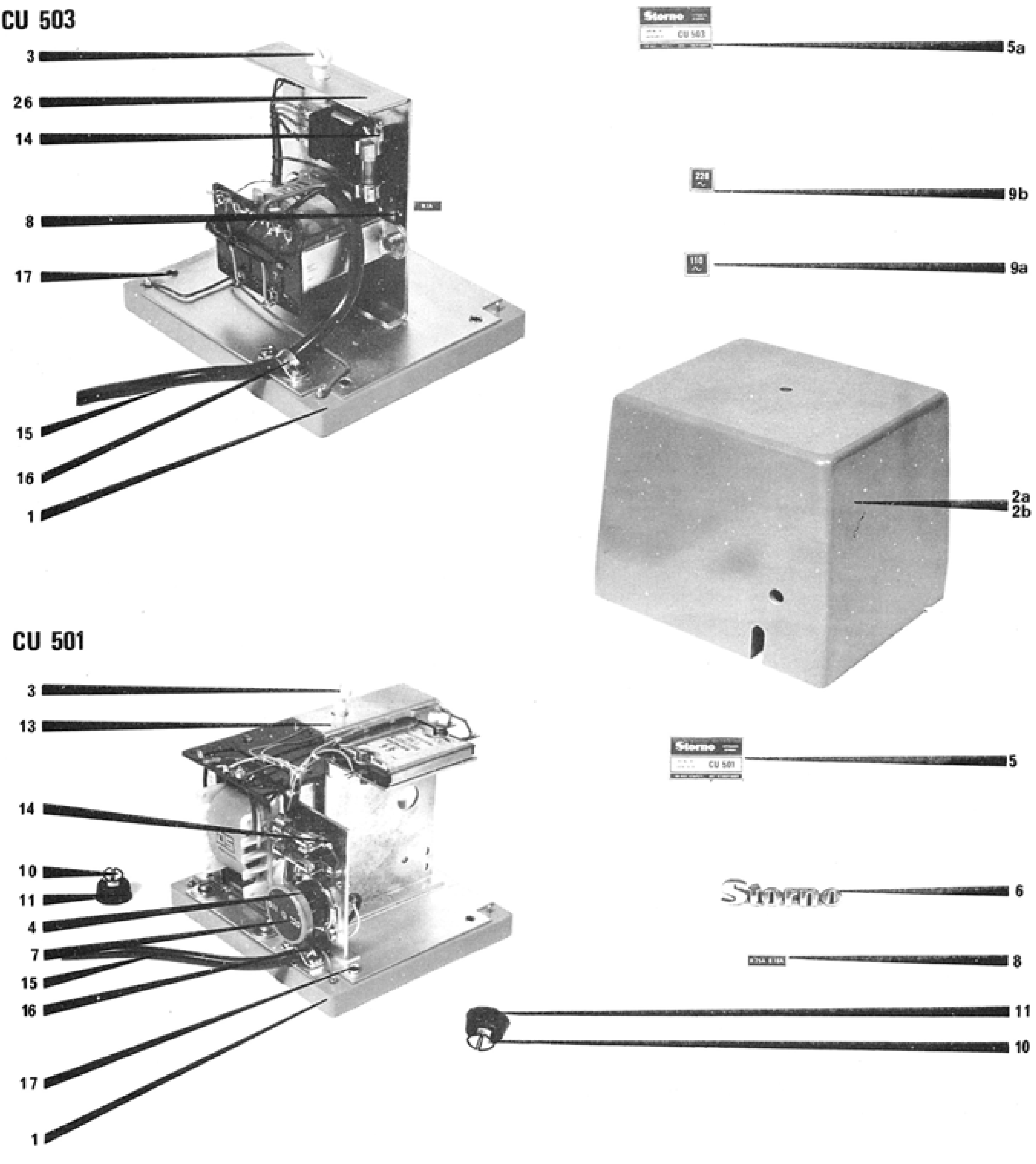
16

ITEM	CODE	DESCRIPTION
1	12.0039	Cabinet Kabinet
2	15.0012	Cover assembly Låg komplet
	12.0040	Cover without loudspeaker and channel selector Låg uden højttaler og kanalvælger
3	32.0110	Gasket for item 2 Pakning for position 2
4	49.0097	Channel knob assy (Channel) Omskifterknap komplet (Channel)
4a	49.0106	Channel knob assy (Kanal) Omskifterknap kompl. (Kanal)
5	51.0309	Semi-circular cover plate for items 4 and 4a Halvcirkelformet dækplade for pos. 4 og 4a
6	32.0255	Washer Skive
7	52.0018	Speaker grille Højttalergitter
8	52.0017	Speaker frame with text Højttalerramme med tekst
9	97.5011	Speaker Højttaler
10	36.0154	Spring strip Fjeder, lang
11	20011-02605	Screw M2,6 x 5 Skrue M2,6 x 5
12	32.0136	Dust cover Støvdæksel
13	36.0209	Spring retainer Fjeder for højttaler
14	51.0306	Label 'STORNOPHONE 500' Firmaskilt
15	36.0105	Lanyard clip Øsken
16	29.0154	Lamp retainer Lampeholder
17	92.5013	Lamp 12V 130 mA Lampe 12V 130 mA
18	32.5015	'O' ring O-ring
19	29.0157	Washer Skive
20	30.0008	Contact dish Kontaktstift
21	36.0113	Spring Fjeder
22	32.0125	Insulating bush Isolationsbøsning
23	41.5077	Multiconnector, male Multikonnektor, han
24	20011-02604	Screw M2,6 x 4 Skrue M2,6 x 4
25	32.0117	Gasket for item 23 Pakning for pos. 23
26	41.0144	Antenna connector assy Antennekonnektor komplet

ITEM	CODE	DESCRIPTION
27	34.0038	Solder tag Loddeflig
28	20052-02606	Screw M2.6 x 6 with recessed head Skrue M2,6 x 6 med krydskærv
29	36.0122	Circlip Låsering
30	51.0280	Label, volume knob Skilt til volumen kontrolknap
31	20011-02604	Screw M2 x 8 Skrue M2 x 8
32	49.0091-01	Knob Knap
33	31.0246	Bøsning Collect
34	32.0112	Sealing ring Pakning
35	28.0059	Screw Skrue
36	49.0090	Push button 'TONE' Trykknap "TONE"
37	49.0185	Push button 'KEY' Trykknap "TAST"
38	32.0113	Sealing ring Pakning
39	47.0257	ON/Off-Channel selector assy Omskifter komplet
40	20052-02606	Screw M2.6 x 6 with recessed head Skrue med krydskærv
41	20041-03012	Screw M3 x 12 Skrue M3 x 12
42	51.0281	Label, squelch knob Skilt til squelch knap
43	86.0003	Potentiometer, volume Potentiometer, volumen
44	29.0152	Potentiometer, nut Potentiometer møtrik
45	86.0002	Potentiometer, squelch Potentiometer, squelch
46	36.0109	Battery contact, positive Batterifjeder, positiv
47	36.0110	Battery contact, negative Batterifjeder, negativ
48	32.0115-01	Insulating plate Isolationsplade
49	32.0116-01	Insulating plate Isolationsplade
50	49.0093	Knob, battery catch Låseknap
51	36.0114	Spring, battery catch Låsefjeder
52	37.0053	Lock bar, battery catch Låsepal
53	32.0111	Switch sealing ring Pakning for omskifter
54	30.5004	Channel indicating pip, red $2^{\varnothing}$ x 5 Kærvnitte, rød, $2^{\varnothing}$ x 5

ITEM	CODE	DESCRIPTION
55	30.0007-01	Rivet Nitte
55a	32.0109	Bush Bøsning
56	21081-02004	Screw Skrue
57	36.0103-01	Crystal retainer Krystalholder
58	31.0228	Spacing bush Afstandsbøsning
59	32.0114	Crystal mounting board Monteringsplade for krystaller
60	34.0019	Sockets for item 59 Bøsninger for pos. 59
61	36.0130	Fuse retainer Bøjle for sikring
62	29.0151	Washer Skive
63	32.0139	Packing blocks (4 ea.) Gummiklodser
64	47.5058	Microswitch Assembly (incl. Item 65, 66) Mikroswitch komplet (inkl. pos. 65, 66)
65	47.5055	Microswitch (excl. Item 66) Mikroswitch (ekskl. pos. 66)
66	33.0375	Activation Spring for Microswitch Aktiveringsarm for Mikroswitch
67	46.5005	Fuse holder Sikringsholder
68	32.0128-01	Protection cap for item 23 Beskyttelseshætte for pos. 23
69	33.0186-01	Clamp Bøjle
70	13.002-01	Screen plate Skærmplade
71	32.0344	Insulating plate Isolationsplade
72	13.0071	Screen plate for CQP with IA501 and IA502 Skærmplade for CQP med IA501 og IA502
	13.0072	Screen plate for CQP with IA506 or IA509 Skærmplade for CQP med IA506 og IA509
74	13.0021-01	Screen plate Skærmplade
75	32.0346	Insulating plate Isolationsplade
76	32.0138	Insulating plate Isolationsplade
77	47.0559	Microswitch assembly (incl. pos. 65, 78, 79) Mikroswitch, kompl. (inkl. pos. 65, 78, 79)
78	33.0374	Activation Spring for item 65 Aktiveringsarm for pos. 65
79	15.0042	Printed Circuit Board for item 77 Lederplade for pos. 77
80	13.0057-01	Mounting Box for Module Units Monteringskasse til modulenheder
81	34.	Solder Tag FRP 4052D Loddeflig FRP 4052D
82	18.0389	Cabling Kabling



CHARGING UNIT
LADEGERÄTE

CU501, CU503

M405.019

ITEM	CODE	DESCRIPTION
		CU503
	15.0007	Charging unit for 2 batteries Ladeensretter for 2 kassetter
1	12.0046	Base plate Bundstykke
2a	12.0049	Top cover less hole for voltage switch Dæksel uden hul for spændingsomsk.
3	21101-15001	Nylon screw M5 x 10 Nylonskrue M5 x 10
5a	51.0317	Type label Typeskilt
6	51.0171	'Storno' motif Firmaskilt
8	51.0328	Fuse holder label Skilt for sikringsholder
9a	51.0329	Label 110V AC Skilt 110V
9b	51.0327	Label 220V AC Skilt 220V~
14	46.5002	Fuse holder Sikringsholder
15	173-5012	Cable Ledning
16	38.5011	Cable clamp Kabelbøjle
17	30.5022	Tubular rivet Rørnitte
26	11.0326-02	Chassis plate complete Chassisplade komplet
		CU501
	15.0005	Charging unit for 10 batteries Ladeensretter for 10 kassetter
1	12.0046	Base plate Bundstykke
2b	12.0045-01	Top cover with hole for voltage switch Dæksel med hul for spændingsomskifter
3	21101-05010	Nylon screw M5 x 10 Nylonskrue M5 x 10
4	47.0502	Voltage selector 110-220V Spændingsomskifter 110-220V
5	51.0315	Type label Typeskilt
6	51.0171	'Storno' motif Firmaskilt
7	51.0339	Voltage selector label Skilt for spændingsomskifter
8	51.0326	Fuse label Skilt for sikringsholder
10	28.5001	Insulating screw Isoleringsskrue
11	56.0007	Rubber feet Gummiben

ITEM	CODE	DESCRIPTION
14	46.5002	Fuse holder Sikringsholder
15	173-5012	Cable Ledning
16	38.5011	Cable clamp Kabelbøjle
17	30.5022	Tubular rivet Rørnitte