GENERAL SPECIFICATIONS

Frequency range	136-174 Mc/s in two part ranges: 136-156 Mc/s 152-174 Mc/s	
Antenna impedance	50 Ω nominal	
Min. channel spacing	CQM19-50: 50 kc/s	CQM19-25: 25 kc/s
Frequency stability -15°C to +50°C	Better than ±5 kc/s	Better than ±3 kc/s
Max. frequency deviation	±15 kc/s	±5 kc/s
Quartz crystal type	Storno type 98-1	Storno type 98-5
Max. total bandwidth	800 kc/s	
Number of RF channels	Max. 1, 2, 4 og 8 RF channels	
Dimensions, transmit./receiver	4" x 10" x 13"	
Weight	15 lbs.	

TRANSMITTER SPECIFICATIONS

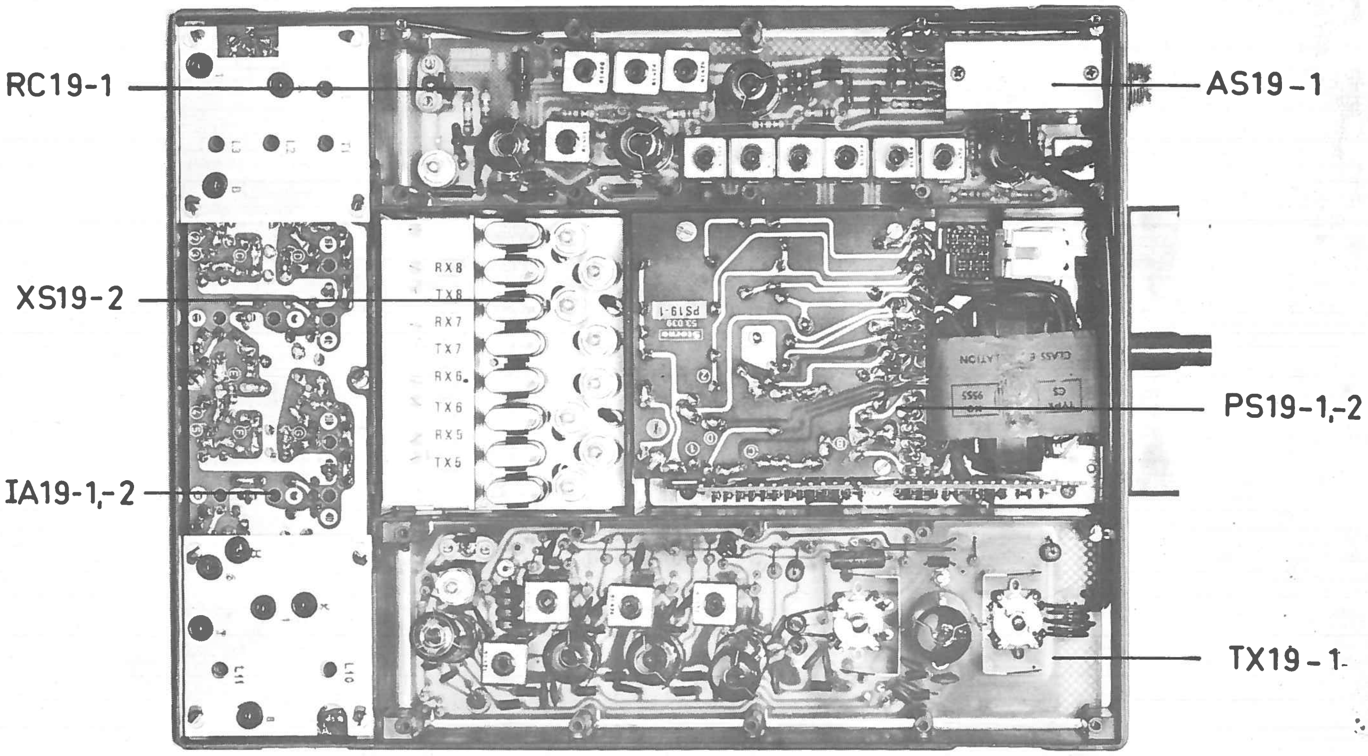
RF-output power	Normal: 10 watt Reduced: 6 watt Marine application: 10/0.5 watt
Modulation	Phase modulation 300-3000 c/s
Modulation response	6 dB per octav pre-emphasis 300-3000 c/s Sharp cut off above 3000 c/s
FM noise	CQM19-50: 50 dB below standard test modulation CQM19-25: 40 dB below standard test modulation
Spurious and harmonic radiation	Below $2x10^{-7}$
Valves, transistors and diodes	E90F, 5654/M8100, EL95, QQE03/12, AC107, OC71, OC83, (OC79) and OA81

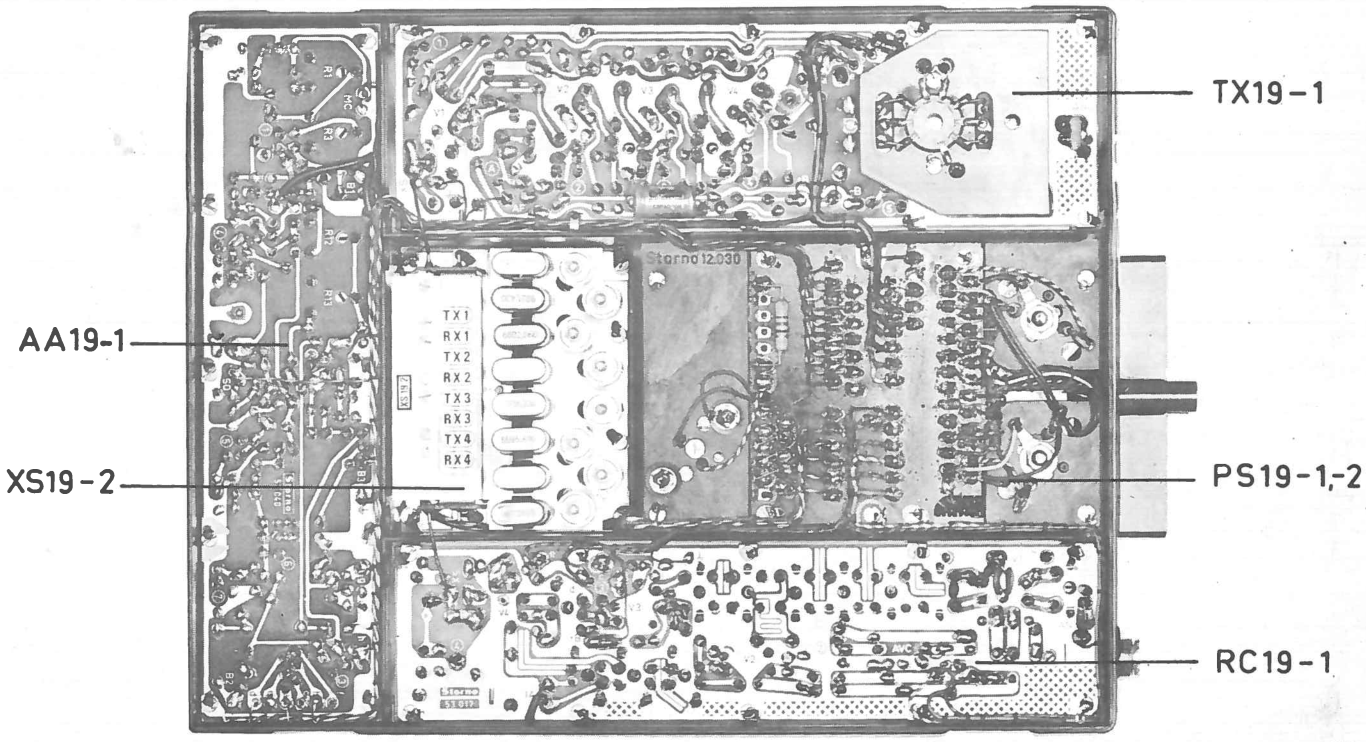
RECEIVER SPECIFICATIONS

Sensitivity	Better than 1.0μV EMK at 12 dB signal/noise
Squelch	Electronic, adjustable, fast acting Open at less than 0.6 μV EMK
Adjacent channel selectivity	Better than 70 dB (EIA to-signal Method)
Image and spurious radiation attenuation	Better than 75 dB
Intermodulation	Better than 60 dB (EIA-method)
AF-output power	2 watt
Valves, transistors and diodes	5654/M8100, AF117, AC107, OC83, (OC79), OC26 (for 6/12V) or ASZ15 (for 12/24V), OA79.

POWER SUPPLY SPECIFICATIONS

Model		6/12 V		12/24 V	
Battery voltage		6.3 V	12,6V	12,6V	25,2 V
Current consumption	receive standby transmit	2.0 A 3.5 A 12.0 A	1.0A 1.7A 6.0A	1.0A 1.7A 6.0A	0.6 A 1.0 A 3.0 A
Transistors		2N441		ASZ15	


RC19-1
XS19-2
IA19-1,-2
AS19-1
PS19-1,-2
TX19-1
RX8
TX8
RX7
TX7
RX6
TX6
RX5
TX5


AA19-1
XS19-2
TX19-1
PS19-1,-2
RC19-1
TX1
RX1
TX2
RX2
TX3
RX3
TX4
RX4

CQM19-25/50

CHAPTER I. DESCRIPTION

A. General Description

Introduction

The model STORNOPHONE V radiotelephone, types CQM19-50 and CQM19-25, is a combination transmitter-receiver for mobile VHF FM radio communication in the frequency range 136-174 Mc/s, with channel separations of 50 kc/s and 25 kc/s, respectively.

A complete installation consists of these units: Transmitter/receiver unit, control box, microphone or handset, antenne, junction box, installation kit, and special-purpose equipment (if required), for instance for selective calling.

STORNO is constantly processing the experience gained during the production, testing, and operation of the company's radiotelephone installations. Minor modifications and changes will therefore appear from time to time. Information of this nature is listed on the last page of this Manual.

Standard Versions

The transmitter/receiver unit is available in the following standard versions, each of which is characterized by a code designation on the type plate in the space headed SPEC. (see also Survey of Types, pages 1-2).

Supply voltage: changeable between 6 and 12 V or between 12 and 24 V.
The maximum number of RF channels may be 1, 2, 4, or 8.
Output power: 10 watts or 6 watts, or switchable between 10 watts and 0.5 watt.
Built-in tone transmitter and receiver for selective calling systems.

The accessories specified below may be supplied with the transmitter/receiver unit. The various accessories have been grouped for maximum ease of reading. For instance, there is nothing to prevent using the watertight control box in conjunction with the non-watertight handset.

Standard Control Equipment

This series of control equipment will normally find application in passenger cars or in similar places where no special requirements are made with respect to watertight construction, special ruggedness, etc.

CB19-1 Control box in grey impact-proof plastic with built-in loudspeaker and controls. Mounting hardware included.

MC19-1 Fist microphone with built-in push-to-talk button, magnetic microphone cartridge, and one-stage transistor amplifier. Plastic holder included.

Microphone for fixed mounting, dynamic microphone cartridge and built-in two-stage transistor amplifier. Mounting hardware included.

MT19-1 Handset with built-in push-to-talk button, dynamic microphone, and one-stage transistor amplifier. Rubber suspension included.

LS13 Separate external loudspeaker. Supplied with suspension hardware. For connection to the CB19-1 control box instead of the built-in loudspeaker.

Watertight Control Equipment

This series of control equipment will normally find application on open vehicles (trucks, fork lifts, tractors, etc.), ships, locomotives, and motor cycles. The equipment is watertight and dustproof, corrosion-proof and salt-water-resistant, will withstand rough handling, and is capable of operation in a high ambient noise level.

CB19-2 Watertight control box in grey pressure die cast light-alloy metal.

LS19-1 Watertight saltwater-resistant folded-horn loudspeaker.

MT19-2 Watertight unbreakable handset with built-in push-to-talk button, magnetic microphone, and one-stage transistor amplifier. Rubber suspension included.

LM19-1 Loudspeaker microphone with built-in transistor amplifier. Operates as folded-horn loudspeaker during reception and as microphone during transmission. Choice of press-to-talk button on control box or separate press-to-talk button near the loudspeaker microphone.

Antennas

The Stornophone V is designed for operation with a 50-ohm antenna. The following types of antennas are available:

AN19-1 Whip with specially designed mount that permits installation from outside with no risk of damaging the car upholstery.

AN19-2 Whip with resilient mount of particularly rugged construction.

AN19-3 5/8 wave whip, particularly suited for motorcycle installations.

Installation Kit

In addition to the accessories listed above, the installation of a Stornophone V radiotelephone requires the following installation materials:

17.008 Standard Installation Kit consisting of a JB19-1 junction box with fuse wire, antenna connector with protective cap and adapter, and a multiconnector for control cable.

We also supply:

19.050 Standard Installation Kit consisting of standard lengths of antenna cable, multi-wire control cable, and battery cable.

47.5012 Steering-wheel switch for use with a type MC19-2 fixed microphone.

Tone Equipment

Where the selective calling feature is desired, The STORNO-PHONE V may be supplied with the necessary tone equipment, either mounted in a separate box or installed in the transmitter/receiver case. The following standard tone equipments are described in this technical manual:

TT19-1 Tone transmitter for single tone.

TT19-2 Tone transmitter for double tone.

TR19-1 Tone receiver for single tone.

TR19-2 Tone receiver for double tone.

If the radiotelephone installation is equipped with special tone equipment, the necessary diagrams, descriptions etc. are contained in a separate technical manual.

Special-purpose Accessories

Motorcycle installations require normal watertight control equipment. However, it is also necessary to use special mountings which will vary with the make of motorcycle and the customer's special requirements. Consequently, such motorcycle installations are not described in this technical manual, but the necessary directions will be supplied with the special mountings.

Directions for Mounting

Brief directions for mounting are supplied with each accessory. Chapter III of this manual also contains such directions.

Moreover, STORNO will be glad to supply any information not contained in this technical manual.

Service on STORNOPHONE V radio telephones should be performed only by such skilled personnel as have made themselves acquainted with the operation of the radiotelephone by studying this technical manual.

B. Description of the Transmitter/Receiver

Construction

The transmitter/receiver is proof against operation in tropical climates because it is hermetically sealed and because printed wiring boards, metals, insulation, and components are made with a view to such service. The cabinet has no ventilating louvers, and emission of heat is solely from the surface of the cabinet.

When the four snap fasteners of the transmitter/receiver are loosened, both covers will come off at the same time and all circuit boards, valves, transistors, and alignment points are thereupon immediately accessible.

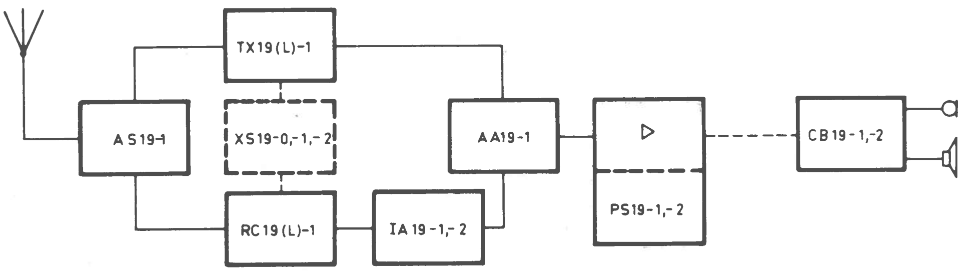
Modular Units

The CA19-1 transmitter/receiver case basically contains the following modular units:

TX19(L)-1	10-watt transmitter containing 5 valves.
RC19(L)-1	Receiver converter containing 4 valves.
IA19-1,-2	455 kc/s IF amplifier for 50-kc/s or 25 kc/s channel separation, each containing 7 transistors.
AA19-1	Audio amplifier and squelch circuit, and audio amplifiers for transmitter and receiver, respectively. This unit has 7 transistors.
AS19-1	Antenna shift unit with low-pass filter.
PS19-1,-2	Transistor power supply for 6/12 V or 12/24V, respectively, using two transistors. This unit also contains the audio output stage, which uses one power transistor.

If the radiotelephone has only 1 RF channel, the two quartz crystals are mounted in sockets in the transmitter and in the receiver converter. If the radiotelephone is equipped with two or more RF channels, one of the following crystal shift units is provided in the transmitter/receiver cabinet:

XS19-0	Crystal shift unit for max. 2 RF channels.
XS19-1	Crystal shift unit for max. 4 RF channels.
XS19-2	Crystal shift unit for max. 8 RF channels.



The following pages contain a detailed discussion of the theory of operation of the individual modular units and circuits. Diagrams and parts lists are given in Chapter V.

$$fx = \frac{\text{RF output frequency}}{18}$$

RF output frequency = fx x 18
where fx = quartz crystal frequency.

Phase Modulator

The modulator contains two coupled circuits which also serve the purpose of passing the signal from the oscillator to the first tripler (V2). The oscillator plate circuit (L2 - C6) is a conventional LC-circuit whereas the tripler grid circuit (L4) is tuned both by a fixed capacitance and a reactance that is capable of being modulated.

The reactance consists of a capacitor (C10) in series with a diode with positive biasing. Current flows through the capacitor in one direction whereas the current in the opposite direction cannot exceed the forward current, which has been chosen so that the RF current can flow through the capacitor during two thirds to three fourths of the cycle. As viewed from the circuit, the effective capacitance of the capacitor is somewhat lower than its static capacitance.

When the forward current varies in time with the modulation, the effective capacitance and hence also the secondary resonant frequency will vary. In the present case a linear phase deviation of 0.83 rad. has been obtained, corresponding to a frequency deviation of 15 kc/s at 1000 c/s for a total multiplication of 18 times.

A relative measurement of the phase modulator output voltage may be made at test point No. 2.

Tripler Stages

The two tripler stages (V2 and V3) are largely identical and of conventional design. Double-tuned bandpass filters are used as coupling circuits (T1 and T2) in order to obtain best possible suppression of undesired signals.

The plate circuit of the first tripler (T1) is tuned to the third harmonic of the crystal oscillator. Check measurements of resonance and output voltage level may be made at test point No. 3.

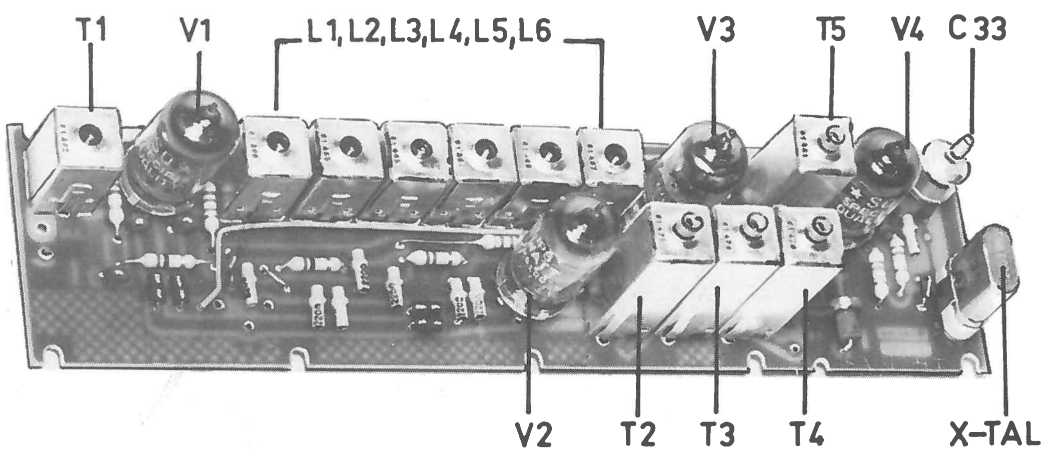
The plate circuit of the second tripler (T2) is tuned to the ninth harmonic of the crystal oscillator. Check measurements of resonance and output voltage level may be made at test point No. 4.

Doubler/Driver Stage

The doubler stage, too, is of conventional design. Its selective element is a double-tuned bandpass filter (L6-L7). This is tuned to the 18th harmonic of the crystal oscillator, which is the output frequency of the transmitter. Check measurements of resonance and output voltage level may be made at test point No.4.

Output Stage	The transmitter output stage consists of a double tetrode (V5) operating Class C push-pull. Both the secondary circuit of the bandpass filter (L7) and the output tube plate circuit (L10) are symmetrical. Output power is coupled inductively into the antenna via a coupling coil (L11).
Protection	Fixed grid bias is applied to the tripler stages, the doubler stage, and the output stage in order to prevent the tubes from being ruined in the case of excitation failure. It has not been necessary to protect the oscillator tube in this manner as this stage has its own bias supply.
Filament Current	The filament circuit is not grounded. It may be switched for operation from either 6.3V, 12.6V, or 25.2V. Switching is done in the power supply unit - not in the transmitter unit.
Crystal Shift	The transmitter is equipped with a quartz crystal socket, trimmer capacitor, etc. for one RF channel. If the radiotelephone has been supplied with a crystal shift unit, the strap between terminals M and N has been removed, and the lead from the crystal shift unit has been soldered directly into the printed wiring board.
Test Points	See under Chapter IV.

RC19(L)-1



The receiver converter is built on a printed wiring board. It consists of the following stages:

- Signal frequency amplifier
- First mixer stage
- Mixer circuit for second mixer stage (in the IA unit)
- Oscillator with tripler circuit
- Quintupler stage.

The receiver converter serves the purpose of amplifying the incoming antenna signal and convert it to a first IF of approx. 10 Mc/s which, with the oscillator signal, is applied to the second mixer stage in the IF amplifier (IA19-x).

SF Stage

The incoming signal is applied, via a tuned circuit (T1) to the control grid of the signal frequency amplifier (V1). The amplified signal is passed through a 4-circuit filter (L1, L2, L3, L4) to the control grid of the first mixer tube (V2).

1st Mixer

The amplified signal is applied to the mixer grid together with the 15th harmonic of the crystal frequency. The resulting intermediate frequency is selected in the conventional manner by means of 5 tuned circuits (T2, T3, T4).

A low-impedance coupling coil couples the last circuit (T4) to the second mixer stage, which is located in the IA19-x IF amplifier unit. Output at the fundamental frequency of the crystal oscillator is coupled capacitively to the top of the last circuit (T4) and fed to the second mixer stage together with the first IF of approx. 10 Mc/s.

Conversion

The double conversion system employed means, for one thing that the first IF will be dependent on the signal frequency received (fs). The receiver converter is manufactured for the following sub-bands:

RC19L-1: 136 ... 156 Mc/s
RC19-1: 152 ... 174 Mc/s

In both cases the crystal frequency (fx) is higher than the first IF (IF1).

The following expressions explain the principle of frequency conversion:

(1) RC19-1 $fs = 15\,fx + IF1$

$IF1 = fx - 0.455$

(2) RC19L-1 $fs = 15fx - IF1$

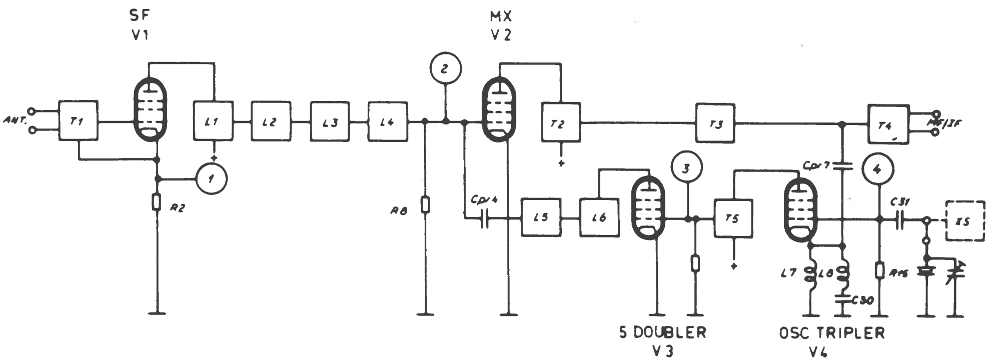
$IF1 = fx - 0.455$

Solving the equations for fx,

(3) RC19-1 $fx = \frac{fs + 0.455}{16}$ Mc/s Empfänger

(4) RC19L-1 $fx = \frac{fs - 0.455}{14}$ Mc/s

After filling in fs in terms of Mc/s IF1 may be calculated.



Osc./Tripler

The oscillator (V4) with the tripler circuit is a Colpitts oscillator with the quartz crystal connected between control grid and ground. Output from the local oscillator, for use as injection voltage for the second mixer, is taken off across the cathode load (L7).

The grid bias voltages at the oscillator and the quintupler may vary quite considerably with the crystal Q. It is therefore important to keep the operating voltage at its correct value and to make check measurements on the channel (frequency) stated on the test report supplied with the equipment.

The oscillator plate circuit is tuned to the third harmonic of the crystal frequency. The oscillator grid current may be checked at test point No. 4. The plate circuit of the quintupler stage (V3) selects the 15th harmonic of the crystal frequency, which is applied to the control grid of the first mixer stage (V2). The quintupler grid current may be checked at test point No. 3, and the first mixer grid current may be checked at test point No. 2.

The series-resonant wavetrap (L8 - C30) between the oscillator cathode and ground is tuned to the third harmonic of the crystal frequency and so neutralizes the feedback from plate to cathode via the suppressor grid.

Filament Current

The filament circuit is not grounded. It may be switched for operation from either 6.3 V, 12.6 V, or 25.2 V. The switching operation is performed in the power supply, not in the receiver converter.

Crystal Shift

The receiver converter is provided with a quartz crystal socket, trimmer capacitor, etc. for one RF channel. If the radiotelephone has been supplied with a crystal shift unit, the strap after the series capacitance C31 (2.2 nF) has been removed, and the lead from the crystal shift unit has been soldered directly into the printed wiring board.

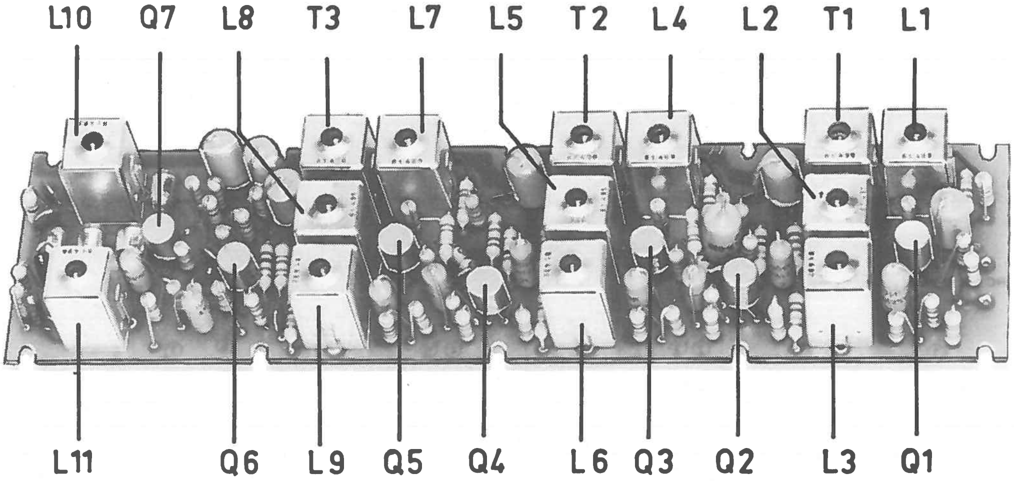
Test points

See Chapter V.

IA19-1,-2

IF units IA19-1 and IA19-2 are functionally identical, the former being employed in radiotelephones with 50 kc/s channel separation and the latter in equipments with 25 kc/s channel separation. Both IF units are constructed on printed wiring boards and consist of the following stages:

Second mixer stage, with one transistor.
Selective amplifier stage, with one transistor.
Selective amplifier with three 4-circuit filters and four transistors.
Limiter stages with two transistors.
Discriminator, with two germanium diodes.

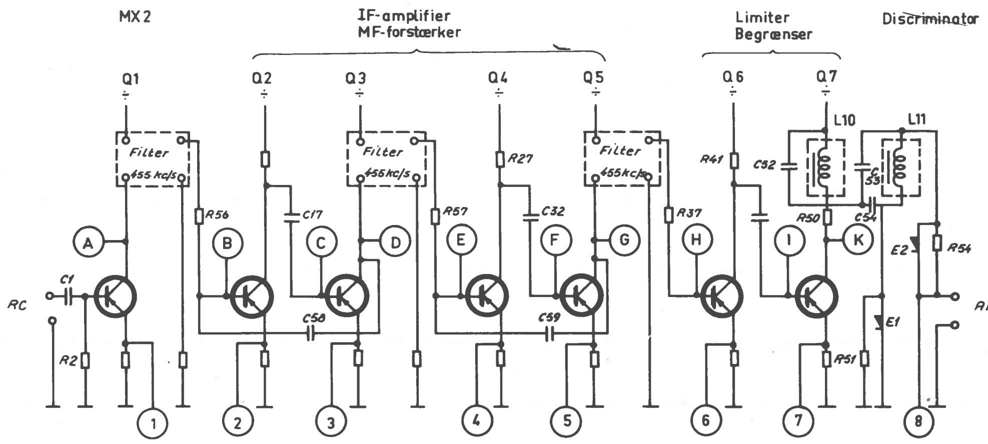


2nd Mixer

The 1st. IF at approx. 10 Mc/s and the local-oscillator signal are fed from the last circuit (T4) of the 1st. IF filter in the RC19(L)-1 receiver converter to the base of the mixer stage (Q1). Low-impedance coupling is used in order to reduce the noise figure.

2nd IF

The second mixer stage (Q1) produces the second IF of 455 kc/s, which is amplified in the following four transistor stages (Q2, Q3, Q4, Q5) comprising a total of twelve tuned circuits grouped into three separate 4-circuit filters. The coil taps for transistors have been chosen o that variations in the transistor parameters have little influence on the frequency response curve.



Limiter

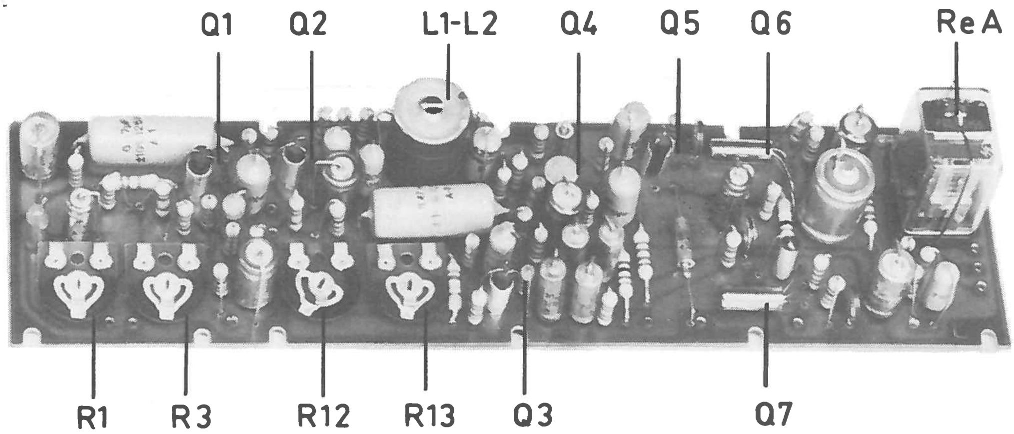
The IF amplifier stages are followed by two limiter stages (Q6, Q7) whose operating points are chosen so that limiting occurs almost simultaneously in both transistors.

Discriminator

The capacitively coupled Foster-Seeley detector contains two matched germanium diodes. The frequency response characteristic of the discriminator is linear up to 3000 c/s.

Test Points

The IF amplifier has test points for DC as well as for signal voltages. DC test points carry number designations while signal test points have letter designations. See also Chapter IV.



AA19-1

The audio amplifier is constructed on a printed wiring board. It has the following functions:

Amplification and clipping of audio signals for transmitter.

Amplification of audio signals for receiver.

Automatic squelch circuit.

Audio for Transmitter

When the audio unit is operated as a speech amplifier for the transmitter it receives its supply voltage through terminals B1 and B2. No voltage is present at terminal B3.

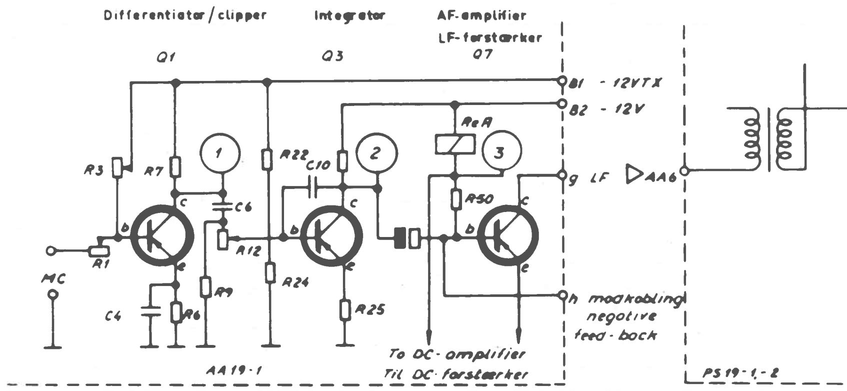
Principle of Operation

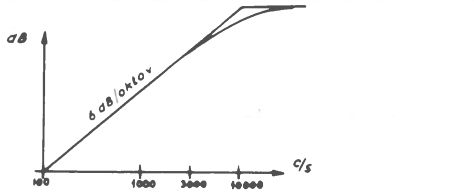
The output voltage from the microphone (MC) is differentiated (preemphasized), causing the resulting voltage to become proportional to the modulating frequency. Strong signals are clipped, whereafter the signal is integrated (deemphasized) so that the voltage will again be proportional to the microphone signal, assuming that the signal level is so low that no clipping occurs. Lastly, the signal is fed to the transmitter's phase modulator.

From the above it will be understood that the input and output signals are proportional to the phase shift. Therefore the voltage after differentiation (preemphasis) is proportional to

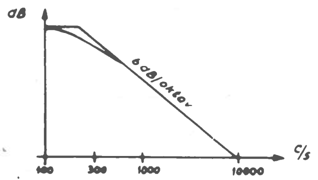
phase shift x modulating frequency = frequency swing

and the clipper consequently keeps the transmitter frequency swing within certain limits. This is necessary to prevent the transmitter from causing interference to adjacent channels in the case of loud speech.
Various curve forms in the circuit are shown below.
The clipping process causes the speech voltage to be distorted into square-wave voltages which, however, are afterwards rounded in the integrator stage. The remaining distortion products are further reduced by a filter located in the power supply immediately ahead of the phase modulator.

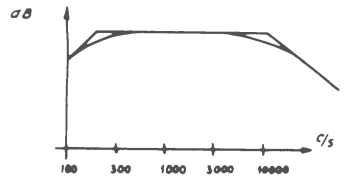




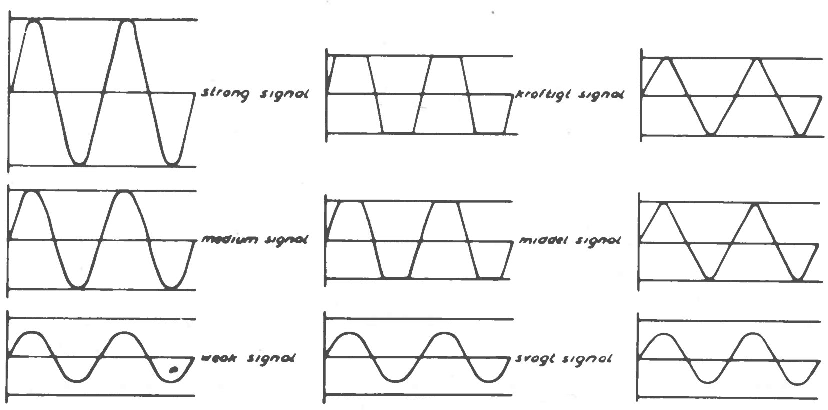
Curve for differentiator (Q1, C4, R4)+C6 (R7+R9)
Kurve for differentieringsled (Q1, C4, R4)+C6 (R7+R9)



Curve for integrating circuit Q2, C7, R22 R24
Kurve for integreringsled, Q2, C7, R22, R24



Combined differentiating- and integrating curve for weak signals with limiter out of function.
Sammenlagt kurve for differentierings og integreringsled for svage signaler, når klipperen ikke er trådt i funktion.



voltage at point Q1b — *spændingen i punkt Q1b*
voltage at point Q1c — *spændingen i punkt Q1c*
voltage at point Q3c — *spændingen i punkt Q3c*

Differentiator

Output from the microphone terminals MC is fed to the differentiator/clipper stage (Q1). The emitter circuit R6-C4 of this stage introduces a preemphasis of +6 db/octave in the frequency range 700-10000 c/s. This stage also introduces clipping if the signal voltages across the base-emitter section exceed a certain preset limit. The voltage swing at the collector will be equal to the collector-emitter voltage. The symmetry of the clipping may be adjusted with the potentiometer R3.

The network R7, R6, R9 introduces further differentiation of the frequencies up to approx. 700 c/s so that, at low signal levels that cannot operate the clipper, amplification and a preemphasis of +6 db/octave in the entire frequency range 100 - 10000 c/s are obtained.

Integrator

After amplification, differentiation, and clipping, the signal is fed from transistor Q1 to the integrator stage (Q3) via potentiometer R12, which is used for adjusting the maximum frequency swing of the transmitter. The signal is applied to the base of transistor Q3, and the stage provides a -6 db/octave curve in the frequency range 200 - 10,000 c/s. Integration (deemphasis) is obtained by means of capacitive negative feedback (C10) from collector to base.

Audio Amplifier

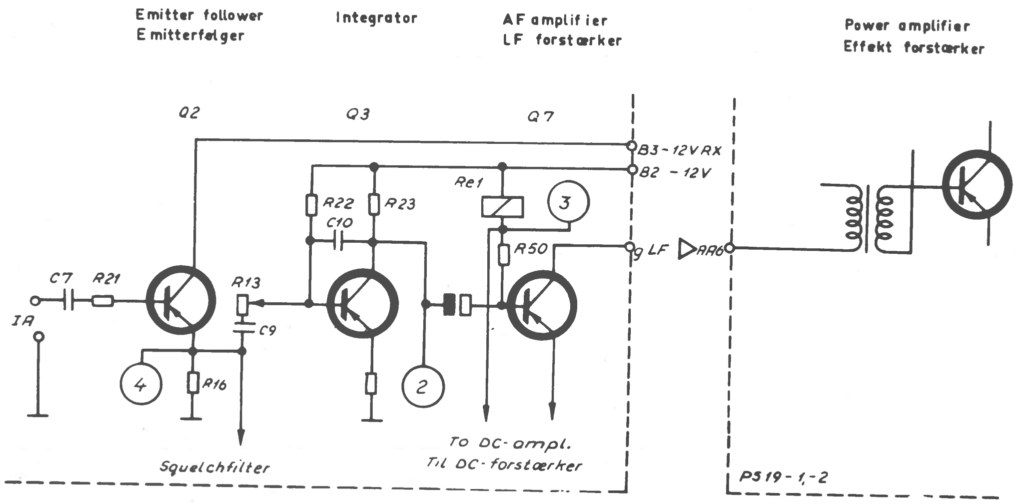
After deemphasis, the signal is passed to the audio amplifier stage (Q7), which is transformer coupled to a power amplifier stage located in the power supply unit. The amplified signal is taken off at terminal g, and negative feedback from the power amplifier stage is applied to the base of Q7 via terminal h.

The phase deviation of the transmitter is proportional to the audio signal applied - in other words, the frequency deviation is proportional to the modulating frequency. This in turn means that the modulation process in itself reintroduces preemphasis of the high voice frequencies in the modulator.

Audio from Receiver

When the audio unit is operated as an audio amplifier for the receiver, it receives its supply voltage through terminals B2 and B3. No voltage is present at terminal B1.

Demodulated receiver output voltage is applied across terminals IA and fed, via capacitor C7 and resistor R21, to the base of amplifier stage Q2, which is a low-distortion emitter follower. The emitter follower has a voltage gain of one and low output impedance. The output voltage is branched off to the integrator stage (Q3) and the squelch filter.



Integrator

The integrator stage provides deemphasis of the demodulated output voltage corresponding to the preemphasis introduced in the transmitter's phase modulator. Deemphasis at this point results in a reduction of the noise, which is largely centered in the highest portion of the voice frequency range.

The signal is applied to the integrator stage via potentiometer R13, which serves as gain control. After integration the signal is fed to the base of the audio amplifier (Q7).

DC Amplifier

When a signal is being received (see below), the DC amplifier (Q6) will be cut off while the audio amplifier (Q7) is normally biased. The amplified signal is passed to the power amplifier in the power supply, from where it goes to the loudspeaker.

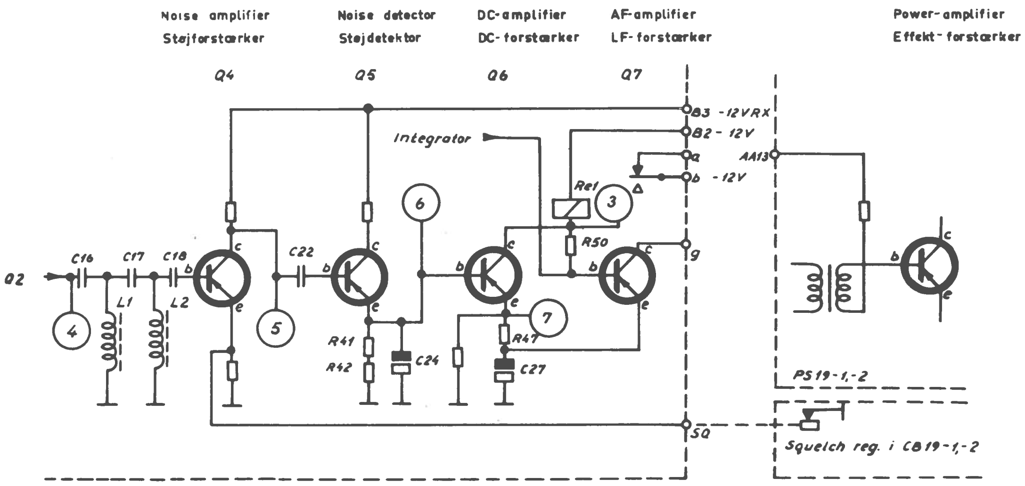
Squelch Circuit

The squelch circuit serves the purpose of attenuating the audio output power during periods of too poor signal/noise ratio, due either to a too weak incoming signal or to no signal at all, as evidenced by a strong increase in the noise level.

Demodulated noise is passed from the emitter follower (Q2) via a squelch filter (C16, L1, C17, L2, C18) to the noise amplifier stage (Q4). The squelch filter is a highpass filter whose cutoff frequency is approx. 4000 c/s and which serves the purpose of removing speech frequencies that would otherwise affect the proper functioning of the squelch circuit.

Noise Amplifier

The noise amplifier stage (Q4) is a so-called amplitude-selective amplifier. Its operating point is adjusted for a collector current that is so high that only the positive noise peaks on the base-emitter section will be able to reduce the collector current. This adjustment is made with the SQUELCH potentiometer, located in the control box.



Noise Detector

The noise detector (Q5) consequently provides - in time with the noise pulses - a number of negative voltage pulses which cause a negative increase of the mean DC voltage at the emitter. The resulting rectified noise voltage is smoothed by the resistor-capacitor combination R41, R42, C24.

DC Amplifier

When the rectified noise voltage is applied directly to the base of the DC amplifier (Q6) the base-emitter current will increase markedly, causing the transistor to draw current. The voltage drop across the relay coil (Rel) will cause the base potential of Q7 to approach zero, and the high value of collector current in Q6 will result in an increase in the emitter potential of Q6 - and hence also in that of Q7 - in a negative direction. The result is that Q7 is driven to cut-off - in other words, its collector current will be very nearly zero. The receiver is now squelched (the loudspeaker is muted).

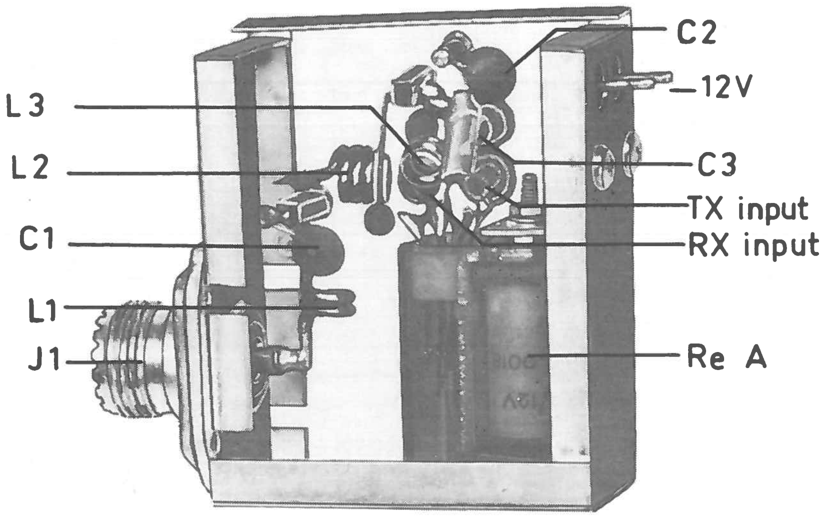
When a signal is being received, the demodulated noise at terminals IA is reduced. This in turn reduces the noise peaks at the base of the noise amplifier (Q4) and when they are below the base-emitter DC voltage level their action on the collector current will be reduced or may even disappear entirely. Since the noise amplifier (Q4) is amplitude selective, only a very slight drop in the audio noise voltage is required to produce a large reduction of the corresponding output at the collector. The negative noise pulses at the base of the noise detector (Q5) disappear, and consequently the transistor Q5 is driven to cut-off. This in turn causes the emitter of the noise detector and the base of the DC amplifier (Q7) to assume zero potential. Consequently, the DC amplifier too has now been cut off whereas the audio amplifier (Q7) becomes conductive due to the fact that its base potential drops while at the same time its emitter potential increases.
The squelch is now open, and the loudspeaker in the control box will reproduce the incoming signal.

Squelch Relay

The squelch relay (Re5) operates when the receiver is squelched. The relay contacts are employed for reducing the power amplifier current in the absence of a usable signal.

Test Points

See Chapter IV.



AS19-1

The AS19-1 antenna switching unit consists of a change-over relay and a low-pass filter. The relay serves the purpose of connecting the antenna to either the transmitter output terminal or the receiver input terminal. The low-pass filter reduces radiation and pick-up of undesired signals at undesired frequencies.

Low-pass Filter

The low-pass filter is a constant-K filter dimensioned for generator and load impedances of 50 ohms. The filter consists of two T sections and has an insertion loss of max. 0.5 dB within the pass band 0 - 185 Mc/s. Its cut-off frequency is 260 Mc/s.

Change-over Relay

When the relay is at rest, the antenna is connected to the receiver input via the low-pass filter. When the transmitter is keyed, the relay coil receives -12 V. The relay operates, connecting the antenna to the transmitter output terminal via the low-pass filter.

The other pair of contacts is employed for grounding that pair of transmitter or receiver contacts which is not connected to the low-pass filter at the time in question. The ground connection is set up via a 33 pF capacitor which introduces series tuning of the lead inductances.

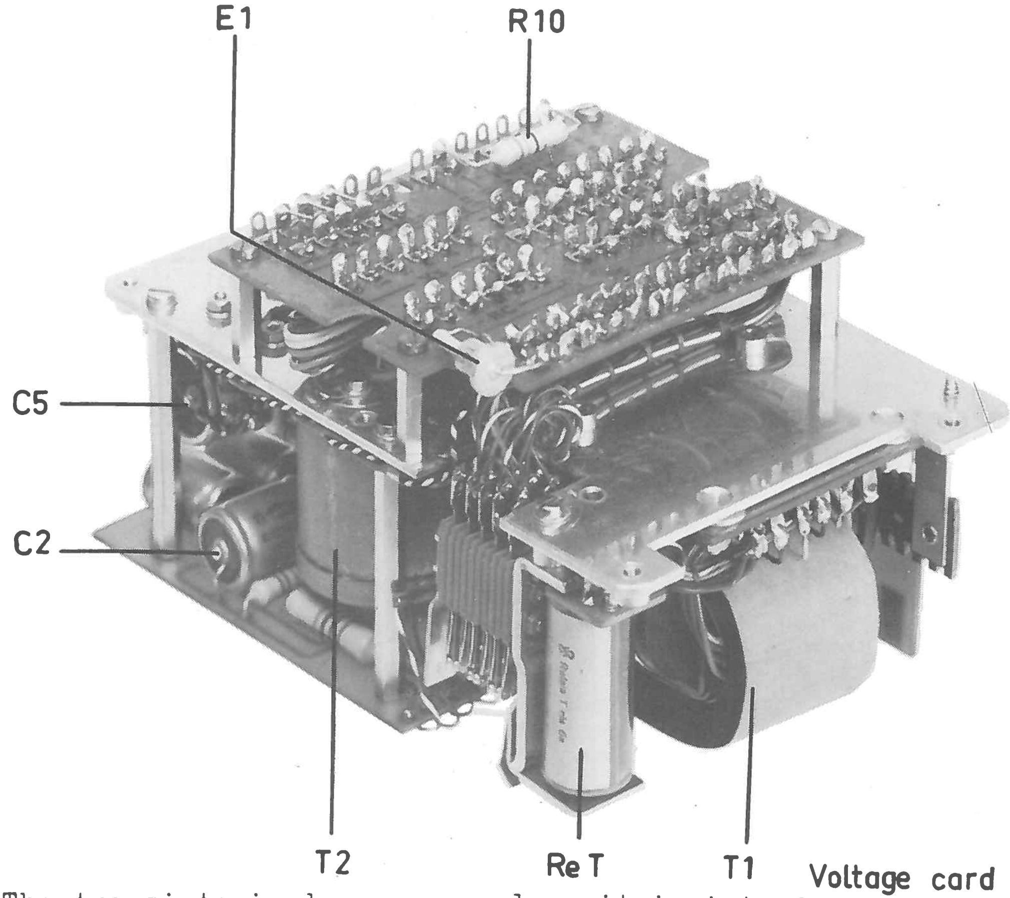
PS19-1,-2

Power supply units PS19-1 or PS19-2 furnish the necessary operating voltages for the transmitter and the receiver. In addition to the transistorized power supply, each unit contains an audio output stage and a terminal strip to which all cabling in the complete radiotelephone station is connected.

The two types are largely identical as to construction and operation except that the PS19-1 is intended for operation from 6/12 V whereas the PS19-2 is intended for operation from 12/24 V.

The two power supply units differ as to component values, transistor types, and filament circuits. Also, the output stage in the PS19-2 has a special feedback system. Otherwise, the two units are identical.

The operation of the transistorized power supply is shown in the diagram below.



Power Supply

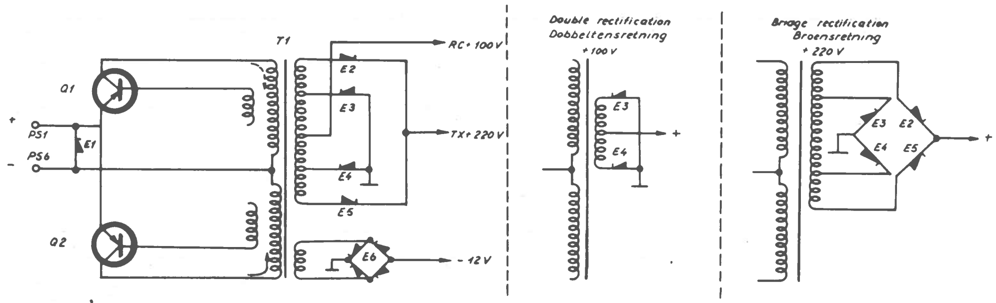
The transistorized power supply unit is intended for operation from 6/12 V DC or 12/24 V DC. Switching between 6 and 12 V or between 12 and 24 V may be performed by means of a voltage card, described later in this chapter.

The DC supply voltage is converted to AC by means of two power transistors (Q1 and Q2) operating push-pull in a common-emitter circuit. The transistors are controlled by feedback windings on the transformer in such a manner that they are alternately conductive and cut off. This in turn causes the current from the power source to flow alternately through the two halves of the primary, with the result that a stepped-up AC voltage appears across the secondary.

The secondary voltage is rectified in a circuit that combines the functions of a conventional full-wave rectifier (+100 V) and a bridge rectifier (+220 V). The two output voltages serve as plate supply voltages for the receiver and the transmitter, respectively. Also provided is a bridge rectifier for -12 V for transistors, relays, and control grids in the transmitter.

Protection Diode

A protection diode (E1) inserted in the power supply leads protects the transistors from permanent damage due to faulty polarization of the supply voltage. When the polarity is correct the diode is blocked and consequently inactive. In the case of faulty polarization the diode will instantaneously cause a dead short, causing the fuse wires in the JB19-1 junction box to blow. This may ruin the diode, which must be replaced if necessary.



Voltage Cards

Each of the two power supply units has its own voltage card, which is designed as a printed wiring board. To change between 6 and 12 V or between 12 and 24 V it is only necessary to reverse the voltage card as indicated thereon. The switching operation comprises not only the transistorized power supply but also the heater circuits; which, incidentally, are separate from the transistor circuit. The output impedance and base voltage of the power transistor stage are also switched.

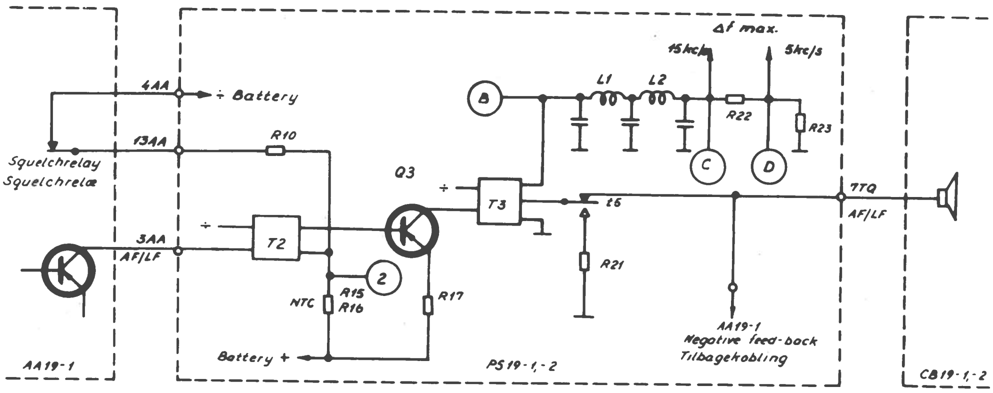
In some cases voltage cards for one supply voltage only are used, thus eliminating any possibility of mistakes. Special overvoltage cards with dropping resistors may be used in installations having constant overvoltage on their batteries. Such overvoltage cards are supplied for either 6 V only, 12 V only, or 24 V only.

Reduced Power

For certain services, the maximum permitted transmitter output is 6 watts. This requires certain modifications in the transmitter unit and the power supply unit. In the transmitter unit, the resistor R17 is shorted and a 22 k ohm resistor (2 W) is soldered in series with the resistor R23. This has been effected by unsoldering one end of R23 from the tubular rivet serving as tie point and thereafter soldering the new resistor into the rivet, following which the two free ends of the resistors have been twisted together and soldered. In the power supply unit, the terminals of transformer T1 have been rewired (see diagram, Note 1).

Audio Amplifier

As mentioned above, the power supply contains an audio output stage consisting of input transformer (T2), power transistor (Q3), and output transformer (T3). The amplifier operates Class A and is capable of delivering 2 watts of audio output into a 3-ohm load. However, this amount of output will be available only when terminals 4AA and 13AA on the terminal strip are shorted, which is effected by means of the squelch relay (Rel) in the AA19-1 audio unit.



The squelch relay will set up a short circuit in the following cases:

(a) When a carrier is being received and the radio-telephone is switched for reception.
(b) When the transmitter is keyed.

During the remaining part of the time, the power transistor is cut off, thus reducing the overall power consumption.

During transmission the loudspeaker is switched off and the stage loaded by a 3-ohm resistor (R21). The modulation signal is fed to the transmitter phase modulator via a low-pass filter (and, for 5-kc/s frequency deviation, a voltage divider).

The power transistor receives its operating voltage directly from the power supply source, not through the transistorized power supply. The switching operation with the above-mentioned voltage card also alters the load impedance and the voltage at the base of the power transistor.

Stabilization

The resistor R17 and the two NTC resistors R15 and R16 serve the purpose of stabilizing the operating point of the transistor. Negative feedback voltage for the AA19-1 audio amplifier is brought out to terminal 7AA (feedback circuit). This amount of feedback is excessive in the PS19-2, however, so a positive feedback circuit is inserted here.

Transmit Relay

When the push-to-talk button in the control box is pressed (keying), the coil of relay T is grounded, and the relay operates. Contacts t1 remove plate voltage from the receiver converter while contacts t2 connect plate voltage to the transmitter. The AA19-1 audio amplifier receives voltage via contacts t3 during both reception and transmission. During transmission, the voltage supply to the IA19-x IF amplifier is switched off while on the other hand operating voltage is fed to the relay of the antenne switching unit (AS19-1).

Test Points

See under Chapter IV, Service.

Terminal Board

All leads from modular units and the control box are connected to the terminal board, also all leads employed for voltage-change-over operations or for the connection of other units (selective calling etc.).

The terminals are arranged in groups on the board. The groups are marked with combinations of letters corresponding to the respective units (TX, AA, RC, etc.). Terminals are numbered within each group (9TX, 3RC, etc.), and identical designations are given on the diagrams above the modular units.

C. Additional Technical Specifications

See also Technical Specifications for transmitter/receiver on page 1-3. Technical specifications for accessories are given with the description of the item in chapter II. Accessories.

TX19(L)-1

Output Power

Minimum 11 watt (escl. antenna filter).

Quartz Crystal

Crystal Frequency Range

TX19L-1: 7.555 Mc/s - 8.667 Mc/s
TX19-1: 8.444 Mc/s - 9.667 Mc/s.

Crystal Frequency Setting

The crystal trimmer condenser can alter the oscillator frequency at least $\pm 30 \times 10^{-6}$.

Crystal Frequency Multiplication

3 x 3 x 2 = 18 times.

Modulation

Modulation

Phase modulation, +6 dB/octave ±1 dB within 300 to 3000 c/s.

Modulation Sensitivity

CQM19-50: Approx. 2,8 V for ±15 kc/s frequency deviation
CQM19-25: Approx. 0,93 V for ±5 kc/s frequency deviation.

Valve Complement **Valves and Diodes**

Oscillator	V1	E90F
Tripler 1	V2	5654/M8100/6AK5W/E95F
Tripler 2	V3	5654/M8100/6AK5W/E95F
Doubler	V4	EL95
PA-valve	V5	QQE03/12
Phase modulator	E1	OA81

RC19(L)-1

Sensitivity

Better than 1.0 μV emf at 12 dB signal-to-noise ratio at ΔF = 10 kc/s and fm = 1000 c/s.

Noise Figure

Approx. 10 dB.

Voltage Gain

From antenna input to base of 2nd mixer: Approx. 30 dB.

Quartz Crystal

Crystal Frequency Range

RC19L-1: 9.680 Mc/s - 11.110 Mc/s
RC19-1: 9.530 Mc/s - 10.900 Mc/s

Crystal Frequency Setting

The crystal trimmer condenser can alter the oscillator frequency at least $\pm 30 \times 10^{-6}$.

Crystal Frequency Multiplication

3 x 5 = 15 times.

First IF

Frequency Range for First IF

RC19L-1: 9.227 Mc/s - 10.655 Mc/s
RC19-1: 9.073 Mc/s - 10.448 Mc/s.

Valve Complement Valves

SF-amplifier	V1	5654/M8100/6AK5W/E95F
1st mixer	V2	5654/M8100/6AK5W/E95F
Quintupler	V3	5654/M8100/6AK5W/E95F
Oscillator/tripler	V4	5654/M8100/6AK5W/E95F

IA19-1,-2

Second IF

455 kc/s.

Max. Frequency Deviation

IA19-1: ±15 kc/s
IA19-2: ±5 kc/s.

<u>Band-filter Response</u>

	Detuning	Attenuation
IA19-1	±10 kc/s ±35 kc/s	max. 2 dB min. 80 dB
IA19-2	±3.3 kc/s ±17,5 kc/s	max. 2 dB min. 80 dB

<u>Voltage Gain</u>

From Q1, base, to Q6, base: Approx. 100 dB.

Demodulation

<u>AF Response</u>

Straight ±1 dB from 100 c/s to 3000 c/s.

<u>Output Level</u>

IA19-1: 0.25 V at Fm = 1000 c/s and ΔF = ±10 kc/s
IA19-2: 0.25 V at Fm = 1000 c/s and ΔF = ±3.3 kc/s.

<u>Distortion</u>

IA19-1: Max. 6 % at Fm = 1000 c/s and ΔF = ±10 kc/s
IA19-2: Max. 6 % at Fm = 1000 c/s and ±F = 3.3 kc/s.

Transistors

<u>Transistor Complement</u>

2nd mixer	Q1	AF117
Amplifier 1	Q2	AF117
Amplifier 2	Q3	AF117
Amplifier 3	Q4	AF117
Amplifier 4	Q5	AF117
Amplifier 5	Q6	AF117
Amplifier 6	Q7	AF117
Discriminator	E1-E2	OA79 (matched)

AA19-1

The specifications given below apply to AA19-1 in connection with the final transistor stage in the power supply unit.

AF for TX

<u>Nominal Input Level</u>

0.23 V at 1000 c/s, corresponding to ΔF = 1/2 ΔF max.

<u>Distortion</u>

Less than 4 % at an input level of 0.23 V +3 dB at 1000 c/s.

<u>Frequency Response</u>

The frequency response curve is straight +0.5 dB, -2.5dB, at an input voltage of 0.14 V at 1000 c/s within 300 c/s to 3000 c/s.

Strong attenuation below 300 c/s.

AF for RX

<u>Nominal Input Level</u>

0.17 V at 1000 c/s, corresponding to ΔF = 1/2 ΔF max.

Output Power

1 watt for nominal input level
2 watt for nominal input level + 3 dB at 1000 c/s.

Distortion

Less than 3 % for 2 watt output power at 1000 c/s.

Frequency Response

-6 dB/octave within 300 - 3000 c/s, +1 dB, relative to 1000 c/s.

Strong attenuation below 300 c/s.

Squelch

Sensitivity of Electronic Squelch

Opens for a signal-to-noise ratio of approx. 7 dB with a modulated antenna signal, where ΔF = 2/3 ΔF max., 1000 c/s.

Minimum Squelch Sensitivity

At its most non-sensitive position the squelch circuits opens for approx. 30 dB noise suppression.

Transistors

Transistor Complement

Differentiator/clipper	Q1	AC107
Emitterfollower	Q2	AC107
Integrator	Q3	AC107
Noise amplifier	Q4	AF117
Noise detector	Q5	AC107
DC-amplifier	Q6	OC83 (OC79)
AF-amplifier	Q7	OC83 (OC79)

AS19-1

Band-pass Range

0 - 185 Mc/s.

Band-pass Attenuation

Measured between transmitter input and 50 Ω load within the range 0 - 185 Mc/s: Max. 0.5 dB.

Band-stop Attenuation

The 2nd harmonic is attenuated more than 25 dB.
The 3rd harmonic is attenuated more than 40 dB.

Cross-talk Attenuation

Approx. 30 dB at 50 Ω loading.

Permissible Power

Max. 15 watt.

PS19-1

Voltages and Currents

Note 1	Supply voltage		Rectifier		Terminal
	6 V	12 V	mA	Volt	
Receiving	6.5 V	13.7 V	25	100	6RC
Transmitting 10 W	6.1 V	13.5 V	155	225	12TX
Transmitting 5 W	6.3 V	13.6 V	135	185	12TX
-12 V (transmitting)	6.1 V	13.5 V	400	12.6	6XS

Note 1: The voltage values stated above are measured on the input terminals mentioned in accordance with the EIA standards.

Hum Voltage

100 V: Less than 0.6 % when receiving.
225 V: Less than 0.36 % when transmitting.
-12 V: Less than 0.12 % when transmitting.

AF Amplifier

Distortion

Less than 5 % at 2 W output power.

Negative Feedback

At 6 V supply voltage: Approx. 9 dB
At 12 V supply voltage: Approx. 13 dB.

Emitter Current

At 6 V supply voltage: Max. 1.2 A
At 12 V supply voltage: Max. 0.7 A.

Sensitivity

Measured across primary of T2: Better than 2.3 V for 1 watt output power into a 3.2 Ω load at 1000 c/s.

CHAPTER II. ACCESSORIES

A. Control Boxes

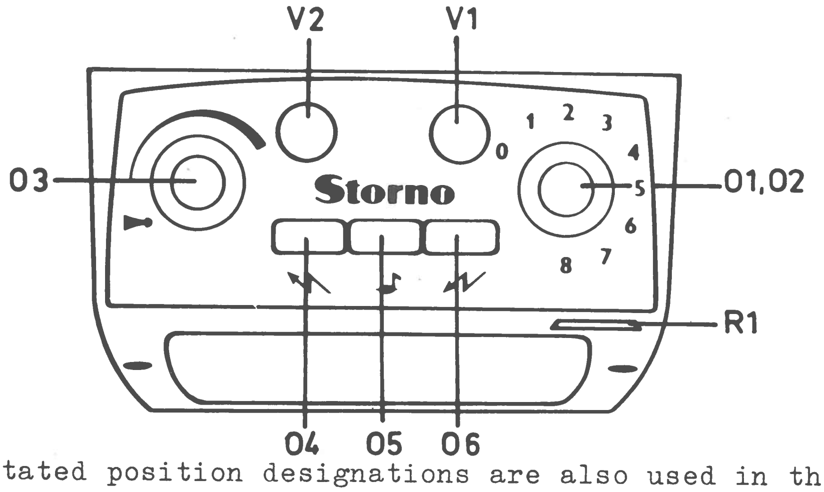
CB19-1

The control box type CB19-1 is intended for remote control of the radiotelephone equipment STORNOPHONE V in cases where no special requirements are made with respect to watertight casing or rugged construction. The control box can be mounted under the dash board in a vehicle, placed on a wall, or be used as desk-set in semi-permanent installations.

The control box contains a built-in loudspeaker and all necessary switches, potentiometers and pilot lamps. Furthermore it is provided with terminals for connection of different types of microphones, handsets, external loudspeaker, and steering wheel switch.

Front Plate

All operation knobs are located on the front plate of the control box as shown on the illustration below.



The stated position designations are also used in the diagrams and conceal the following functions:

01, 02 (revolving knob)	Channel selector (max. 8 channels) ON-OFF switch (extreme left position).
03 (revolving knob)	Volume control + external alarm.
04 (push-button)	Transmitter key + loudspeaker-off switch for possible broadcast receiver.
05 (push-button)	Button for possible selective tone equipment.
06 (push-button)	Current saving knob.
R1 (revolving knob)	Squelch control.
V1 (green)	Stand-by pilot lamp.
V2 (red)	TRANSMIT pilot lamp.

Channel selector

The channel selector has 9 positions. In the extreme left position (02) current supply to the radio equipment is cut off. The remaining 8 positions are numbered (01) according to the max. number of RF-channels available in the radio equipment.

With the channel selector turned away from its extreme left position (the OFF-position), the green stand-by pilot lamp (V1) lits. After a short heating up period (approx. 30 seconds) the equipment is ready for reception.

The channel shifting is constructed as a group shifting system in order to decrease the required number of wires in the multi-cable. The system is described in detail under crystal shift unit XS19-2.

Squelch

The electronic squelch system in the receiver can be adjusted by the squelch knob (R1). The most sensitive setting is obtained by turning the knob clockwise until a hissing noise is heard. Then the knob must be turned counterclockwise until the hissing just disappears.

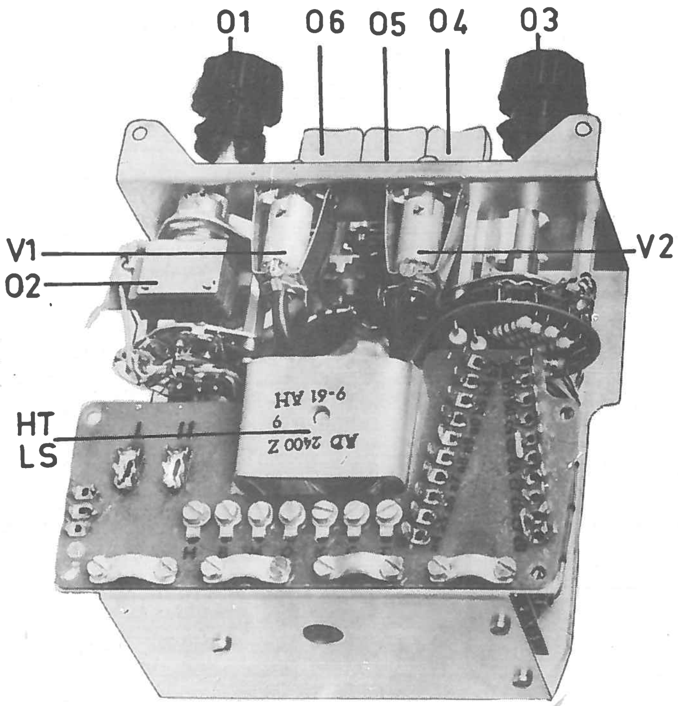
The squelch circuit and its function is detailed described under AA19-1 in chapter I.

Volume Control

The combined volume/alarm control (03) has 7 positions. The 6 positions are used for a step-by-step regulation of the loudspeaker output, while the 7th position (extreme left position) interrupts the loudspeaker connection, but connects a possible alarm circuit, which operates in connection with the squelch circuit or with a selective calling system.

Current Saving

When the current saving push-button (06) is pressed, the filament supply to the transmitter valves is interrupted, whereby the total current consumption is decreased by approximately 40 %. The push-button is released by a light push. After a heating-up period of approx. 30 seconds the transmitter is ready to transmit.



Transmitter Key

During transmission the transmitter key (04) must be pressed, and the red TRANSMIT pilot lamp (V2) is lit. One contact set of the transmitter key closes the current path through the keying relay (T) in the power supply unit PS19-x. If required a steering wheel keying switch can be connected in parallel with the built-in transmitter key.

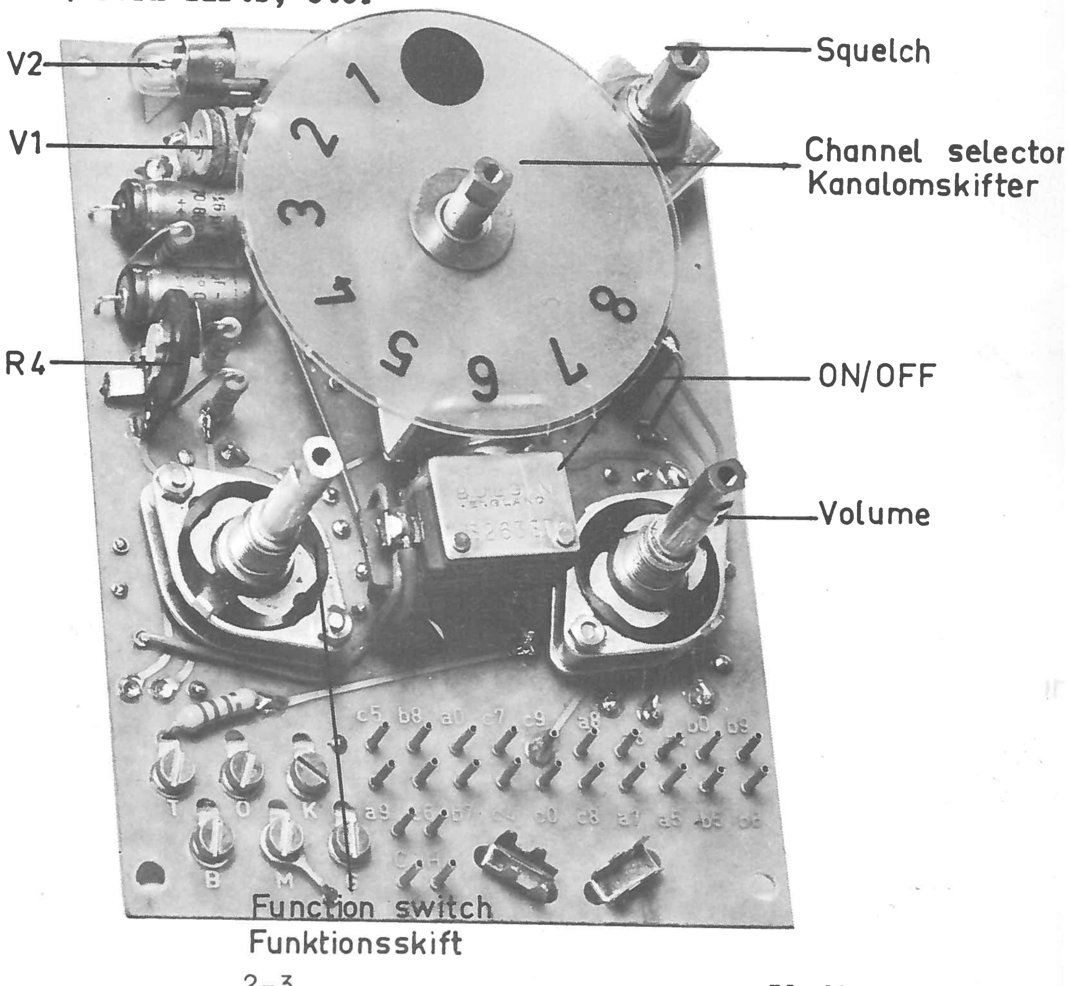
The transmitter key is provided with an extra contact set, which may be used for breaking the loudspeaker connection for a common broadcast receiver, thus removing possibly receiver background noise during transmission.

Selective Calling Systems

The control box is fitted to be used in connection with selective calling facilities if the necessary tone generator and/or tone receiver are incorporated in the transmitter/receiver cabinet. Connections and function of the control box with standard selective tone units stated on page 1-7 are further described in this chapter in section D. Other types of selective calling devices are described in a special manual.

CB19-2

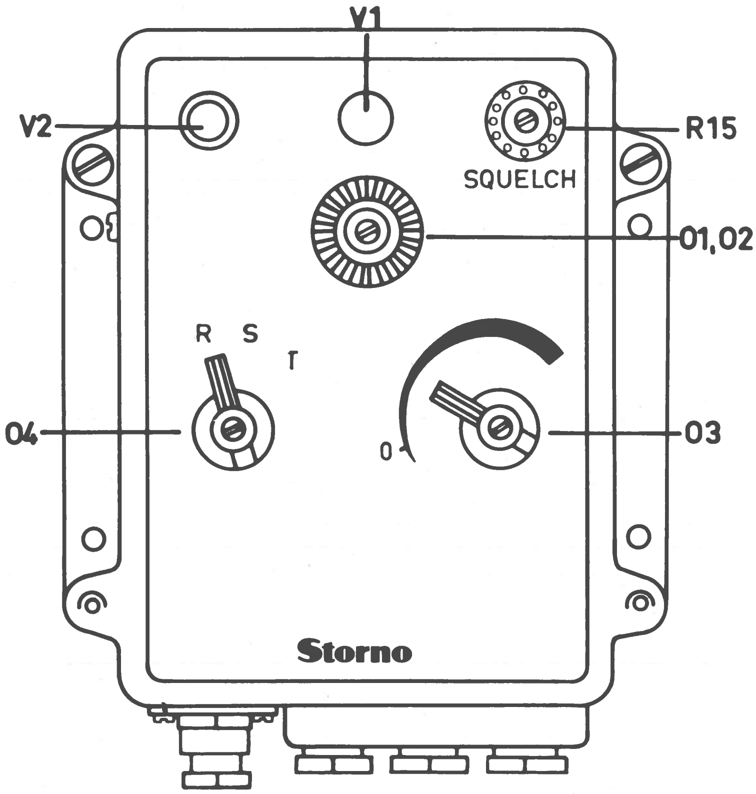
Control box type CB19-2 is intended for remote control of the radiotelephone equipment STORNOPHONE V in such cases where special requirements are made with respect to water-tight casing and rugged construction. The box is made from grey pressure die cast light-alloy metal, and it can be suspended on a wall or on any plane surface. When a suitable suspension plate is used, it can be fitted also on motorcycles, fork lifts, etc.



The control box contains the necessary switches, potentiometers and pilot lamps. Furthermore it is provided with terminals for connection of different types of microphones, handsets, loudspeakers, loudspeaker microphone and external transmitter key.

Front Plate

All operation knobs are located on the front plate of the control box as shown on the illustration below.



The stated position designations are also used on the diagrams and conceals the following functions:

01 02	(revolving knob)	Channel selector (max. 8 channels) with lit-up channel indicator ON-OFF switch (extreme left position).
03	(revolving knob)	Volume control.
04	(revolving knob)	Selector (R = receiver stand-by, (S = transmitter stand-by, T = transmitting).
R15	(revolving knob)	Squelch control.
V1	(white)	Equipment ON pilot lamp in connection with channel indicator.
V2	(red)	TRANSMIT pilot lamp.

Channel Selector

The channel selector has 9 positions. In the extreme left position (02) the current supply to the radio equipment is cut off. The remaining 8 numbered positions corresponds to the max. number of RF-channels available in the equipment.

With the channel selector turned away from its extreme left position (the OFF-position), the white stand-by pilot lamp (V1) behind the channel number indicator is lit. After a short heating-up period (approx. 30 seconds) the equipment is ready for reception.

The channel shifting is constructed as a group shifting system in order to decrease the required number of wires in the multi-cable. The system is described in detail under crystal shift unit XS19-2.

Squelch

The electronic squelch system in the receiver can be adjusted by the squelch knob (R15). The most sensitive setting is obtained by turning the knob clockwise until a hissing noise is heard. Then the knob should be turned counterclockwise until the hissing just disappears.
The squelch circuit and its function is detailed described under AA19-1 in chapter I.

Volume Control

The volume selector (O3) has 7 positions. The 6 positions are used for a step-by-step regulation of the external loudspeaker output, while the 7th position (extreme left position without lock) interrups the loudspeaker connection in connection with a possible selective calling system.

R-S-T Selector

This selector (O4) has 3 positions, the letter designation of which covers the following functions:

R = receiver stand-by (current saving position with 40 % less current drain as no filament current is supplied to the transmitter valves).

S = Transmitter stand-by (transmitter valves have supplied filament current. Approx. 30 seconds after switching from R to S the transmitter can be keyed).

T = Transmit position without lock. A possible external transmitter key is connected in parallel with this position. Keying by either one causes the red TRANSMIT pilot lamp (V2) to lit. The position may be used for tone call, when it is combined with selective calling facilities.

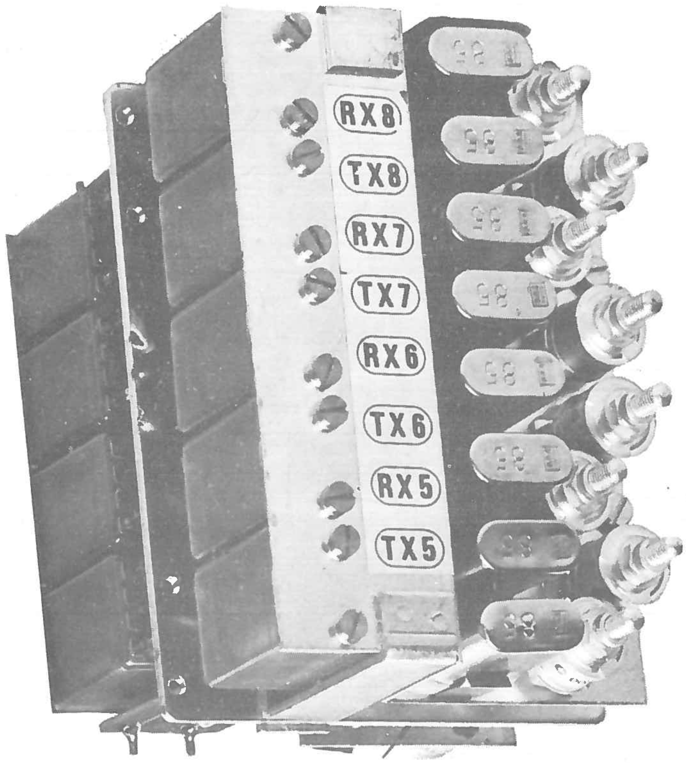
Selective Calling Systems

The control box can be used in connection with selective calling facilities if the necessary tone generator and/or tone receiver have been incorporated in the transmitter/receiver cabinet.

Connections and function of the control box with standard selective calling units stated on page 1-7 are further described in this chapter in section D. Other types of selective calling devices are described in a special manual.

B. Crystal shift Units

Three types of crystal shift units can be supplied with the STORNOPHONE V equipment, - types XS19-0 for max. 2 channels, XS19-1 for max. 4 channels and XS19-2 for max. 8 channels. When the equipment operates on one channel only no crystal shift unit is necessary as the two quartz crystals are inserted in special sockets in the transmitter unit and the receiver converter unit respectively.



Construction

The crystal shift units are constructed on metal chassis, and all relays are soldered directly into the circuits without the use of sockets. One relay is used for each RF-channel as each relay is capable of shifting both transmitter and receiver crystals. The relay contact sets are wire contacts in order to reduce the undesired capacity.

The crystal shift units are supplied from the factory complete with all relays, trimmers, etc. for the max. number of channels, but supplied with crystals for the wanted number of RF-channels only.

Connection

The crystal shift units are housed in the vacant compartment in the middle of the transmitter/receiver cabinet. The cabling for the channel shifting function are led to a terminal board on the power supply unit PS19-x.

The connection between the crystal shift unit and the radio units (transmitter unit and receiver converter unit) is made by short wires, which are soldered directly into the printed wiring boards.

Quartz Crystal The quartz crystal type required depends upon the frequency stability wanted. See General Specifications on page 1-3. One terminal of each crystal is grounded, and the terminals on each crystal are shunted by a trimmer condenser for the final frequency setting.

XS19-0 The crystal shift unit XS19-0 consists of crystal sockets, trimmers, etc. for 2 RF-channels and takes up half of the space in the compartment in the middle of the transmitter/receiver cabinet. The other half of the compartment may be used to house selective calling equipment.

Shifting Shifting between the two RF-channels are executed by the channel selector in the control box, which grounds the relay corresponding to the selector channel marking on the front plate. The crystals not activated are shorted to ground. Only this crystal shift unit has added two fixed condensers to compensate for the smaller capacities in this unit.

XS19-1 The crystal shift unit XS19-1 consists of crystal sockets, trimmers, etc. for 4 RF-channels and takes up half of the available space in the compartment in the middle of the transmitter/receiver cabinet. The other half of the compartment may be used to house selective calling equipment.

Shifting The shifting between the four RF-channels are executed by the channel selector in the control box, which grounds the relay corresponding to the selector channel marking on the front plate. The crystals not activated are shorted to ground.

XS19-2 The crystal shift unit XS19-2 consists of crystal sockets, trimmers, etc. for 8 RF-channels and takes up all the available space in the compartment in the middle of the transmitter/receiver cabinet.

Shifting Shifting between the eight channels are executed by the channel selector in the control box. The 8 shifting relays are divided in two groups each consisting of 4 relays. Shifting between these two groups are executed by an extra relay named group relay. Thus the required number of wires in the control cable are reduced from 8 to 5. Furthermore the undesired capacities are reduced, because the group relay only couples in 4 relays at a time. All relays not activated are shorted to ground with the exception of the complementary relay in the other group (shifting relay 1 and 5, shifting relay 2 and 6, etc.), which is connected to the common wire on the open contract set of the group relay.

Specifications

	XS19-0	XS19-1	XS19-2
Max. number of channels	2	4	8
Adjustment range	$\pm 50 \times 10^{-6}$	$\pm 50 \times 10^{-6}$	$\pm 35 \times 10^{-6}$
Current consumption	28 mA/-12V	28mA/-12V	84mA/-12V
Crystal sockets	HC-6/U	HC-6/U	HC-6/U

CHAPTER III. INSTALLATION

A. General

Introduction

It is of vital importance that the installation is made properly and in strict accordance with the directions. The excellent qualities of the radio equipment may be seriously impaired due to a scamped or incorrect installation, and the risk of catastrophic failure of the equipment is increased. It is therefore strongly recommended to read and follow the assembly instructions in this chapter.

Unfortunately it is impossible to give detailled installation instructions for the radiotelephone STORNOPHONE V, as the number of models and types of vehicles are too numerous and the special requirements too varied. In many cases the customer has special wishes about the placing of the accessories - especially when the equipment is to be installed on ships, locomotives, fork-lift trucks, etc.

All problems, which cannot be solved by reading this technical handbook, should be directed to STORNO.

Packing

Immediately after reception of each consignment from STORNO each item should be unpacked and checked with packing lists and invoices. If the goods are not as described, damaged or not as ordered the fact should be reported to STORNO immediately.

When returning equipment to STORNO for any reason whatsoever, the original containers should be used if possible and the final test report for the complete equipment must always be returned.

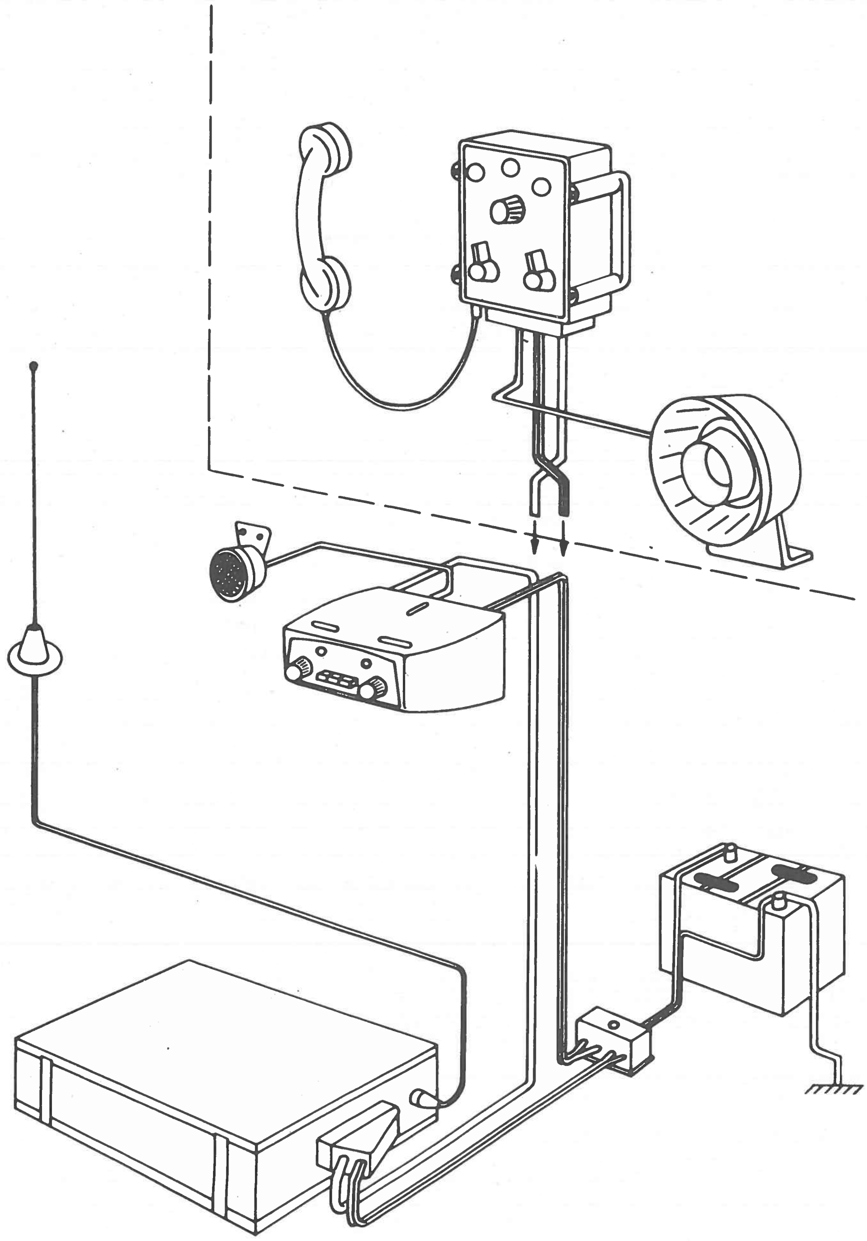
Main Parts

The following items are required for a correct installation:

1. Transmitter/receiver cabinet CQMx9-25,-50.
2. Control box (CB19-1 or CB19-2).
3. Either Microphone, handset or loudspeaker-microphone.
4. Antenna with base.
5. Standard set of accessories, consisting of antenna connector, multi-way connector and junction box.
6. Standard installation set, consisting of battery cable, control cable and antenna cable, all cut to specified lengths.

Item 6 is designed to cover most installations in private cars and smaller lorries, but in some cases the lengths will be insufficient and a non-standard installation set will be required.

Each accessory and larger item is accompained by an illustrated instruction sheet in four languages.



Standard Procedures

Before starting the installation work the cabling lay-out must be decided, and the following facts should be considered:

a. The cabling must be as short as possible.
b. All cables should be kept absolutely clear of movable parts such as springs, cables, shock absorbers, etc.
c. All cables should be kept from motors and all hot parts (exhaust pipes, radiators, etc.).
d. If possible an existing cable channel should be used, but in private cars the cables may be run between roof and upholstry. Do not run the cables under the bottom of the vehicle without protection.

e. To ensure the highest protection in case of short circuits the fuse box should be placed as close as possible to the battery.
f. Fasten the cables by a sufficient numbers of cleats and relieve the cables in lead-in bushes and at sharp bendings.

Soldering

A large, pointed soldering iron should be used for all soldering work in order to avoid damage by heat. Do not use any kind of flux except what is contained in the solder itself.

When assembling coaxial cables, the soldering time should be kept very short and followed by rapid cooling in spirit in order to prevent melting of the insulating material.

Temperature

All electrical circuits in the STORNOPHONE V equipment are temperature stabilized, and the cabinet is constructed to dissipate the heat from the surface without the use of ventilation louvres. The ambient temperature should not exceed the range -15°C to +50°C during continuous operation, but the equipment will continue to function within the temperature range -30°C to +60°C. No permanent damage will result of operation at such temperatures over a reasonable period of time (hot summer days, cold winter nights).

When not in operation the equipment will withstand much lower or higher temperatures without any damage.

These temperature limits are no different from those valid for valve-type stations. The difference is that while a valve-station will survive brief periods of far higher temperatures, whereas the transistors in the Stornophone V may be permanently damaged by operation at, say 80° - 90°C for several hours. In tropical or subtropical countries, the advisability of operating such a radiotelephone equipment under such adverse temperature conditions should be considered. It should be noted that the luggage compartment of an automobile can become unbelievably hot if the car is left in the sun for a whole day.

Special

In cases where the radiotelephone must be installed in special vehicles, which require the use of shock absorbers or special suspensions (f.ex. motor cycles), the necessary assembly instructions will be supplied with the individual items.

Testing

Noise suppression is described in detail and testing of the radiotelephone equipment after installation in sections F and G in this chapter.

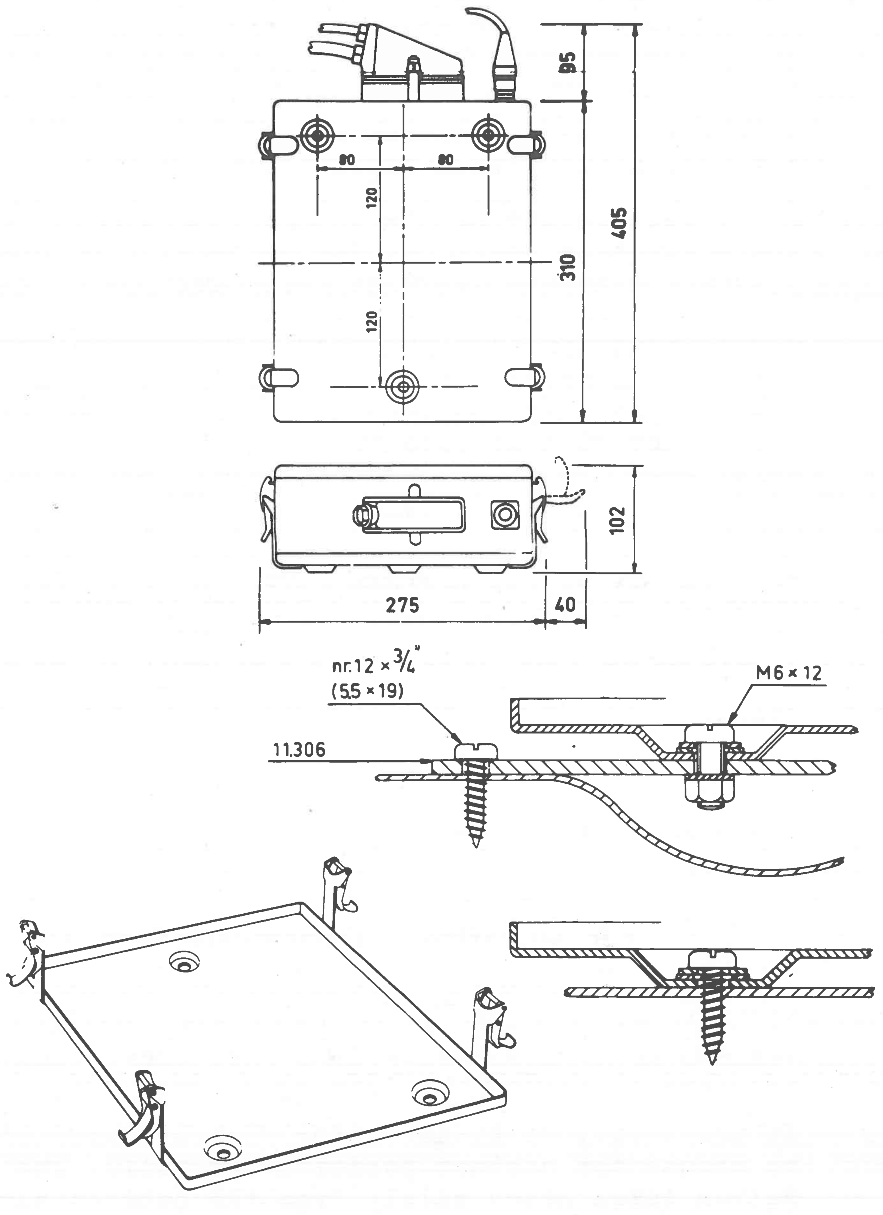
B. Mounting of Transmitter/Receiver

Transmitter/ Receiver

With the transmitter/receiver cabinet is supplied two suspension pieces and selfcutting screws. The cabinet dimensions appear on the drawing below.

As previously mentioned under "Temperature" it is necessary to choose the cabinet position carefully. The heat dissipation takes place solely from the cabinet surface therefore the floor of the luggage compartment in an automobile can be considered to be a unfavourable placing as the cabinet may be completely covered by baggage, carpets, etc. The back or side wall of the luggage compartment or under the front seat in larger vehicles are suitable mounting sites. In ships or on locomotives the mounting possibilities are numerous, but a position where the equipment is protected against direct sunlight and moisture should be selected.

The bottom cover of the cabinet can be used as a jig when marking the suspension holes. The cabinet may be placed in any position, and the suspension surface does not have to be plane, as the suspension pieces may be shaped or bent to suit any purpose. However - it is best if the cabinet is mounted in such a way that the printed wiring boards are at the bottom of the cabinet.



Standard Set of Accessories

A STORNO standard set of accessories (17.008) is composed of the following items:

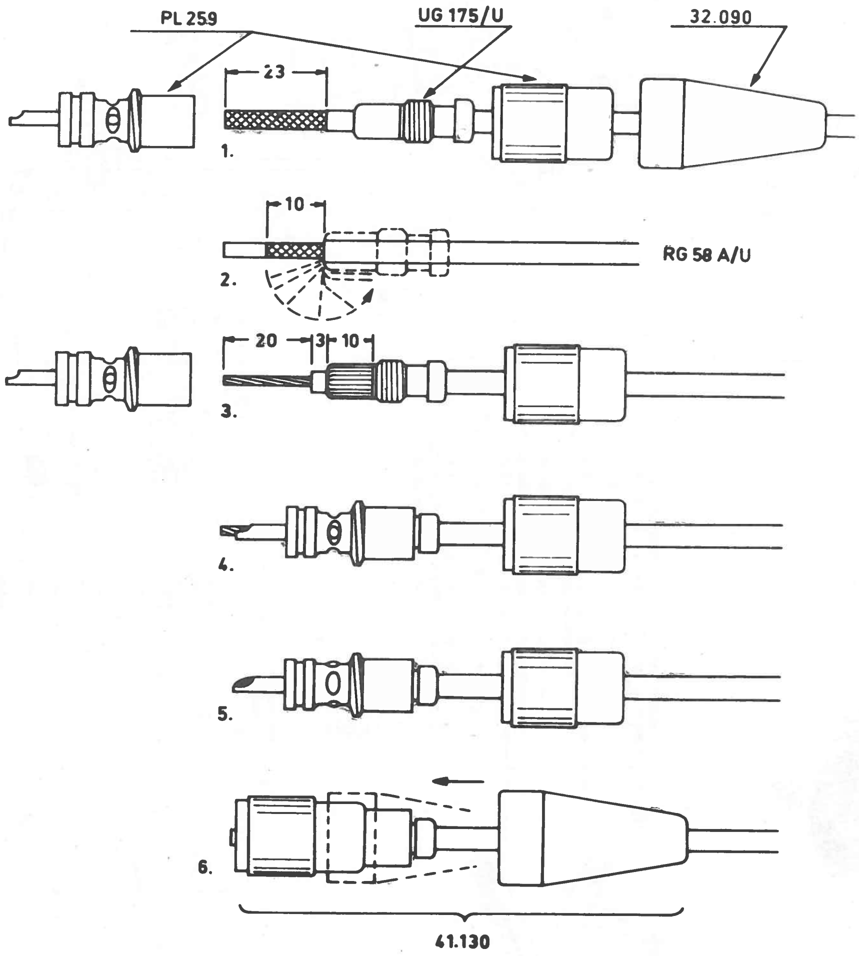
Antenna connector (41.130)
Watertight multi-connector (41.124b)
Junction box JB19-1 with silver fuse wire.

Antenna Connector

The antenna connector (41.130) is made up by connector PL259 adaptor UG175/U, and STORNO protective cap 32.090.
Slide parts over the cable end as shown and remove the PVC sleeve without nicking braid wires.

Cut off the braid wires and comb wires over the adaptor. Remove the dielectric carefully in order to prevent damage to the thin conductor wires. Slide the connector section over the cable and tighten it well to the adaptor. Solder the cable braid and the inner conductor to the connector section.

Cut off all excess cable and remove excess solder. Screw coupling ring on the plug assembly and push the protective cab over the plug as shown.



Multi-connector

The watertight multi-connector (41.124b) has two entrances one for the control cable (20 x 0,4 mm^2) and the other for the battery cable (2 x 6 mm^2).

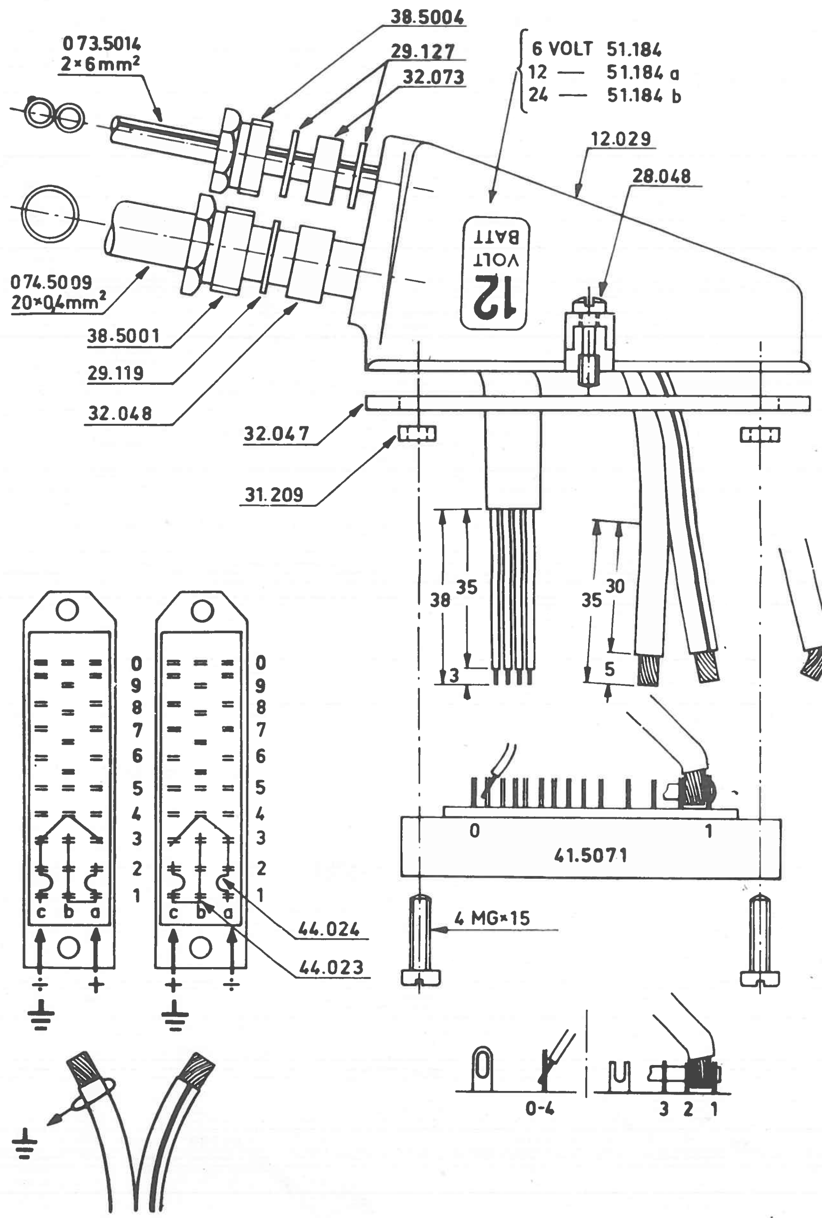
Control Cable

Solder the coloured wires of the control cable to the connector pins according to the terminal colour table on page

Battery Cable

Solder the shorting strips to the connector lugs as shown, depending on the vehicles battery polarity. The unmarked section of cable must always be used as the chassis connection.

Hold the battery cable in the recess of the shorting strips and solder properly. Take care that solder does not spread into the wires more than absolutely necessary.



Pull the connector into its housing and fasten by means of screws supplied, after sliding washers (31.209) over screws. Push the washers and the gaskets in place and tighten the nut. Finally set the gasket (32.047) in place.

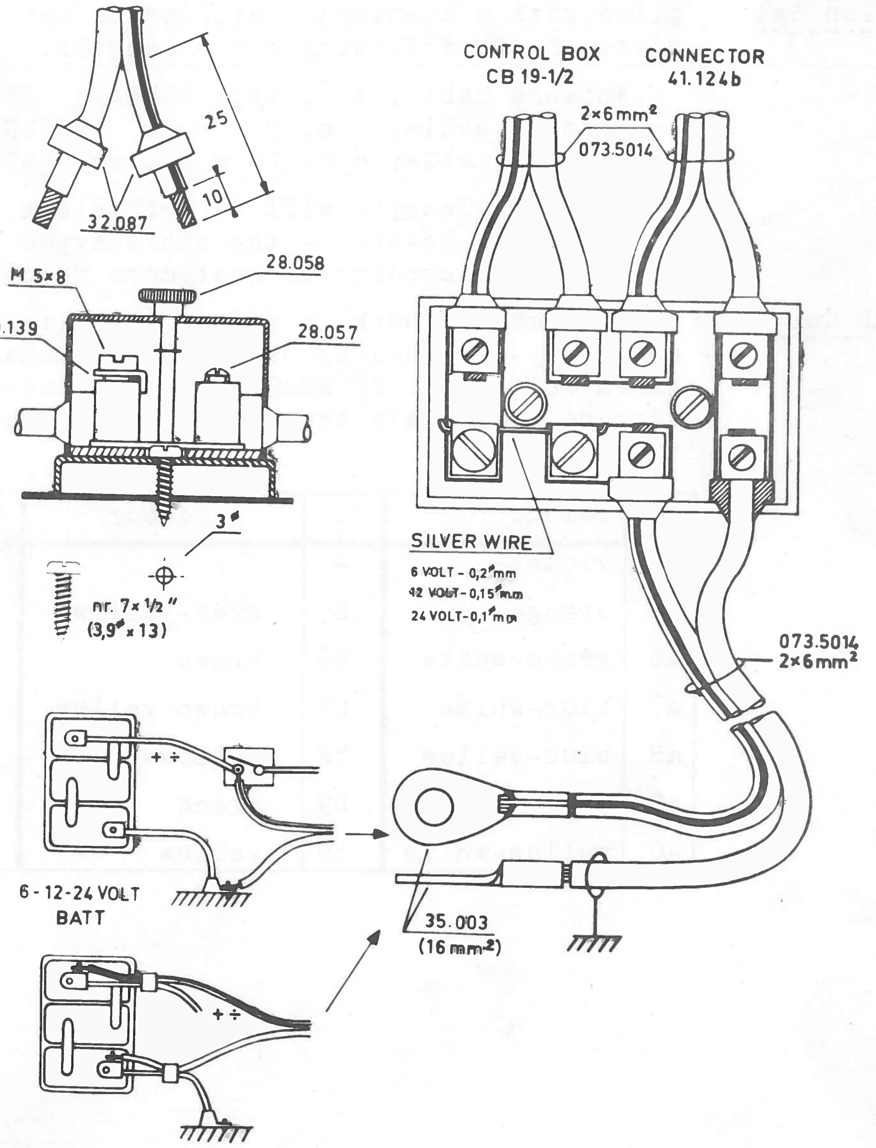
The battery voltage of the installation is shown on a label. Clean the surface of the housing with gasoline or similar. Then remove protective paper from label, place it correctly and press firmly.

JB19-1

The junction box JB19-1 should be mounted by using the self-cutting screws supplied and placed as close as possible to the battery.

Split the battery cables to length given, push the plastic sleeves on and bare the cable ends as shown.

Push the cable ends (must not be soldered) into the terminals and tighten the locking screws. Push the plastic sleeves in place and connect the cables to battery, to connector and to control box as shown. Insert fuse wire corresponding to battery voltage.



Battery voltage	6 V	12 V	24 V
Fuse Wire	0,2 mm	0,15 mm	0,1 mm

The lug may be attached to the battery supply in one of two ways:

a. Connect the marked section of the cable to a heavy batte wire, i.e. at the starting relay or on a main junction terminal. Connect the unmarked section of cable to chass junction point of battery.

b. Fix the battery lug to the cable end and grease with vas line in order to prevent corrosion.

Avoid future confusion by binding together matching cables (e.g with tape).

The unmarked section of cable between battery and junction box is ALWAYS chassis.

Standard Installation Set

Radiotelephone equipment STORNOPHONE V may have been supplied with a standard installation set (19.050), which consists of the following cable lengths:

Antenna cable, 4 m, type RG58A/U (STORNO 075.5013)
Battery cable, 8 m, 2 x 6 mm^2 (STORNO 073.5014)
Control cable, 6 m, 20 x 0,4 mm^2 (STORNO 074.5009)

These cable lengths will be sufficient in most vehicle installations. However - the cable types may also be supplied in lengths according to customers requirements.

Terminal Colour Code

The assembling work in connection with the multi-way control cable may be eased by using the terminal colour code table given below. All STORNOPHONE V stations installed in our service dept. have been installed in accordance with this table.

Pin	Colour	Pin	Colour	Pin	Colour
a4	violet	-	-	c4	green-blue
a5	orange	b5	grey-yellow	c5	green-blue
a6	green-white	b6	brown	c6	grey
a7	blue-white	b7	brown-yellow	c7	blue
a8	blue-yellow	b8	yellow-green	c8	blue-grey
a9	red	b9	green	c9	blue-brown
a0	yellow-white	b0	yellow	c0	black

C. Mounting of Normal Control Equipment

General

The following additional parts are required for the installation of a STORNOPHONE V in cases, where no particular demands for sturdy construction or watertight types have been made.

Control box CB19-1
Microphone MC19-2 er MC19-1 or handset MT19-1.

CB19-1

The control box CB19-1 may be used on a desk, mounted on a wall or placed under the instrument panel in a vehicle.

The desk application is shown in fig. A. The cables are then mounted on the support bracket supplied.

The normal vehicle mounting is shown in fig. B. Use the mounting plate with slots as a jig. Suspend the plate at the front end by three screws as shown. If it is impossible to secure a screw at the rear of the plate, the mounting bracket supplied must be shaped into a supporting leg as illustrated. After finishing the cable assembly the box must be fixed to the mounting bracket by the two long screws in the box.

Control Cable

Remove PVC-sleeve as shown and shorten the single wires. Connect each coloured wire to the terminals in the box in accordance with the table on page

Battery Cable

The battery cable connects the control box with the junction box JB19-1.

Insert the section of the bared cable in the soldering tag, pinch the jaws together and solder the cable. The unmarked section of the cable should be soldered to the soldering tag marked "I".

Screw Terminals

The screw terminals T, G, K, O, M and B may be used for connection of an auxiliary microphone or handset.

The screw terminal "H" is intended to be used in connection with alarms, by buzzer, horn, etc.

The three soldering tags at the left hand side are connected to an extra contact set on the transmit key in the control box. They may be used for breaking the wires to a loudspeaker of a car-radio, when the transmitter is keyed.

Pilot Lamps

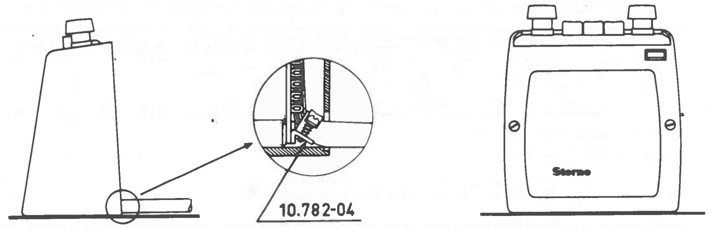
Insert pilot lamp V1 in its socket after the installation has been completed.

Battery	Lamp with bayonet socket	Type
6 V	12 V/2 watt	Philips type 12913
12 V	24 V/3 watt	Philips type 13913
24 V	24 V/3 watt△	Philips type 13913

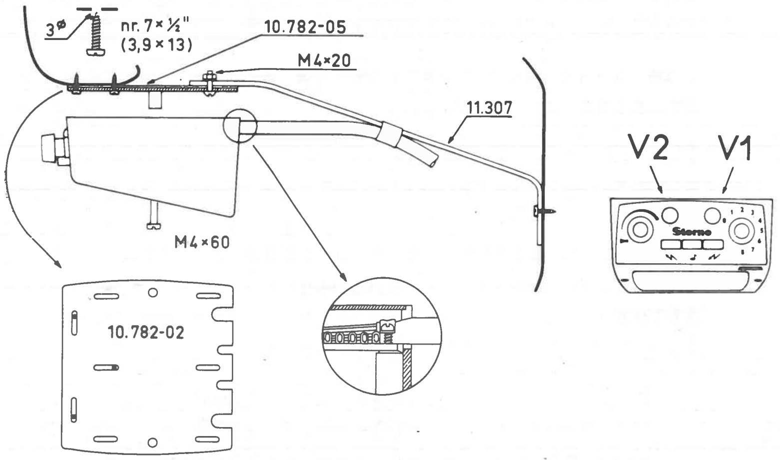
△Preferably with series resistor, See note on diagram of PS19-2.

Pilot lamp V2 is supplied inserted in its socket (24 V/3 watt, Philips 13913).

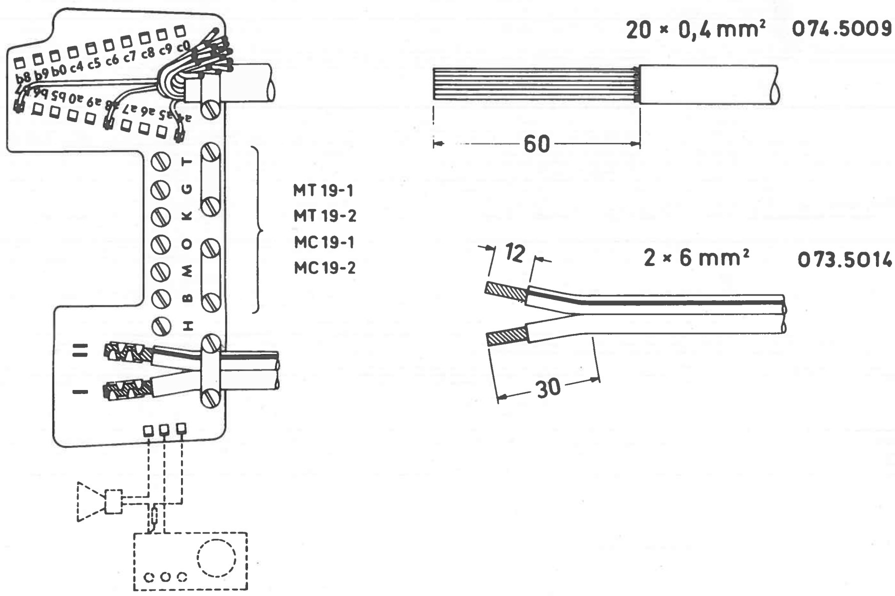
A.



B.



C.

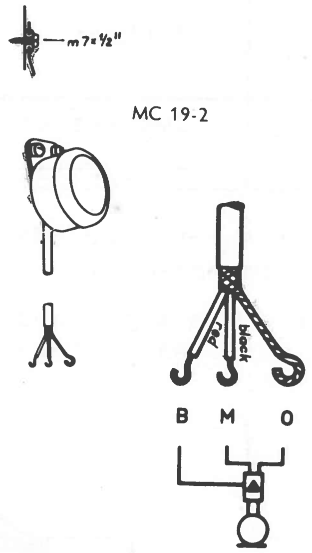


MC19-2

Fixed microphone MC19-2 should be mounted in such way that the distance from the mouth does not exceed approx. 8 - 13 inches. In a vehicle the microphone is most commenly mounted on one of the corner posts.

Drill 3 holes each 3 mm and attach the microphone by screws, but do not tighten hard as the PVC-grommets act as shock absorbers and avoid "rumble".

Form the coloured wire ends and connect them to control box terminals marked with the letters shown in the table below.



Red wire	B	supply voltage for transistor amplifier
Black wire	M	connection through transistor amplifier
Screen	O	to dynamic microphone

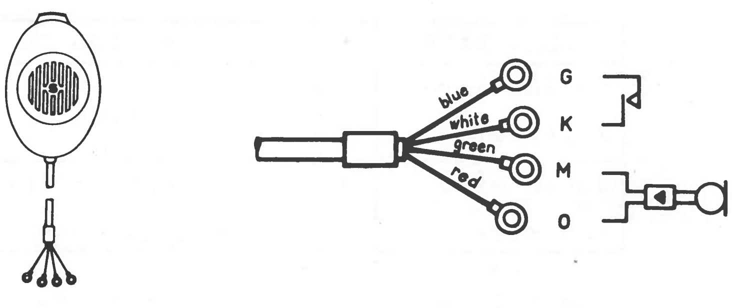
MC19-1

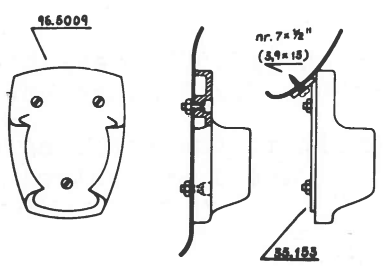
The fist microphone MC19-1 and the holder should be mounted at a suitable place near the control box.

Use the holder as a jig and drill 3 holes each 4,5 mm. Use the screws supplied to fasten the holder.

If the position chosen has a sloped or curved surface the fixing bracket supplied may be used.

Connect the coloured wire ends to the control box terminals marked with the letters shown in the table below.



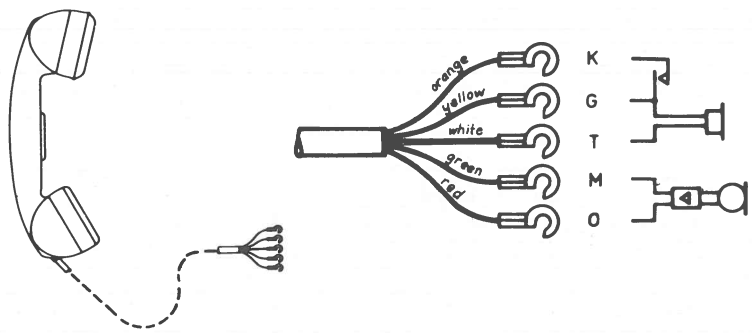


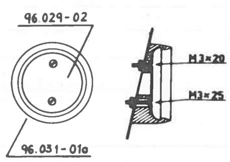
Blue wire Red wire	G K	Connection to transmit key
Green wire White wire	M O	Connection through transistor preamplifier to dynamic microphone

MT19-1

The handset and the holder should be mounted at a suitable place near the control box.

Use the holder as a jig and drill 2 holes each 3,5 mm. Use the screws supplied to fasten the holder.





Connect coloured wire ends to the control box terminals marked with the letters shown in the table below.

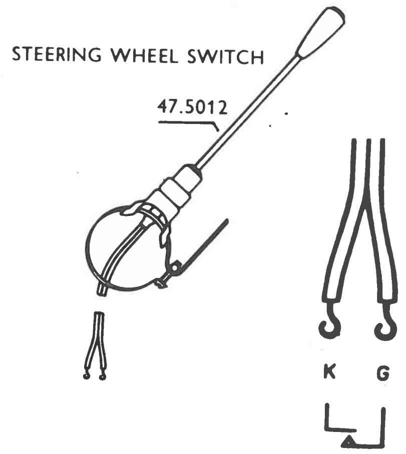
Orange wire	K	Connection to transmit key
Yellow wire White wire	G T	Connection to telephone
Green wire Red wire	M O	Connection through transistor amplifier to dynamic microphone

The following items are sometimes required and installed as follows:

Steering Wheel Switch

The steering wheel switch (47.5012) may be used as a transmit key in connection with the fixed microphone MC19-2.

Clamp the switch assembly to the steering column, and connect wire ends to terminals K and G in control box.



Loudspeaker

The extra loudspeaker LS13 should be placed in such a position that the output is directed towards the operator.

Connect loudspeaker wires to terminals c0 and b9 in the control box. Disconnect the built-in loudspeaker.

If both loudspeakers must be connected, the loudspeakers should be connected in series.

D. Mounting of Watertigth Control Equipment

General

In cases where special requirements have been made for equipment being watertight, salt-resistant and able to withstand rough handling the following parts are required for the installation:

Control box CB19-2, with loudspeaker-microphone LM19-1, or loudspeaker LS19-1
Handset MT19-2

CB19-2

The control box CB19-2 is watertight and intended to be mounted on a plane surface, a wall or the like. It may also be mounted on a supporting bracket for use on motor cycles, fork-lift, trucks, etc.

The terminals are accessible for cable mounting when the front plate have been removed.

Push cable ends through nuts, washers, gaskets, etc. in the order shown.

Pilot Lamps

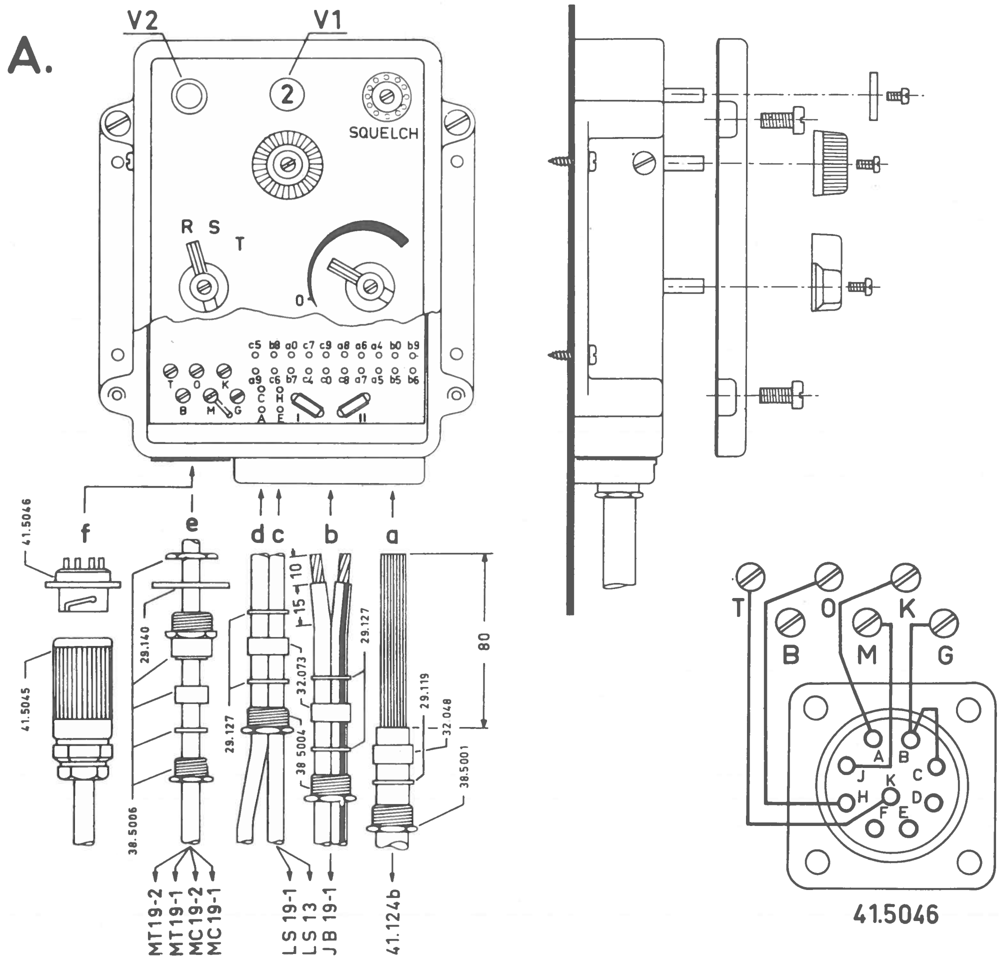
Insert pilot lamp V1 in its socket after the installation has been completed.

Battery	Lamp with bayonet socket	Type
6 V	12 V/2 watt	Philips 12913
12 V	24 V/3 watt	Philips 13913
24 V	24 V/3 watt△	Philips 13913

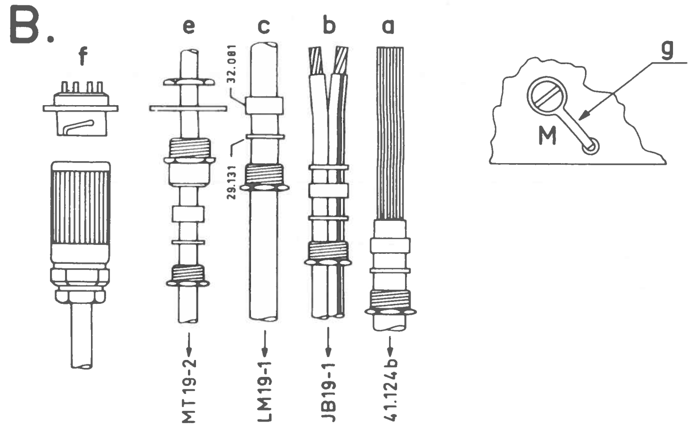
△Preferable with series resistor. See note on PS19-2 diagram.

Pilot lamp V2 is supplied inserted in its socket (24 V/3 watt, Philips 13913).

A.



B.



Control Cable

Remove PVC-sleeve as shown. Solder each coloured wire to the terminal number given in the colour code table on page 3 - 8.

Battery Cable

Bare the cable as shown and connect it to the control box. Insert the bared cable section in the soldering tag, pinch the jaws together and solder.

The <u>unmarked</u> section of cable must be connected to the soldering <u>tag marked "I".</u>

Loudspeaker

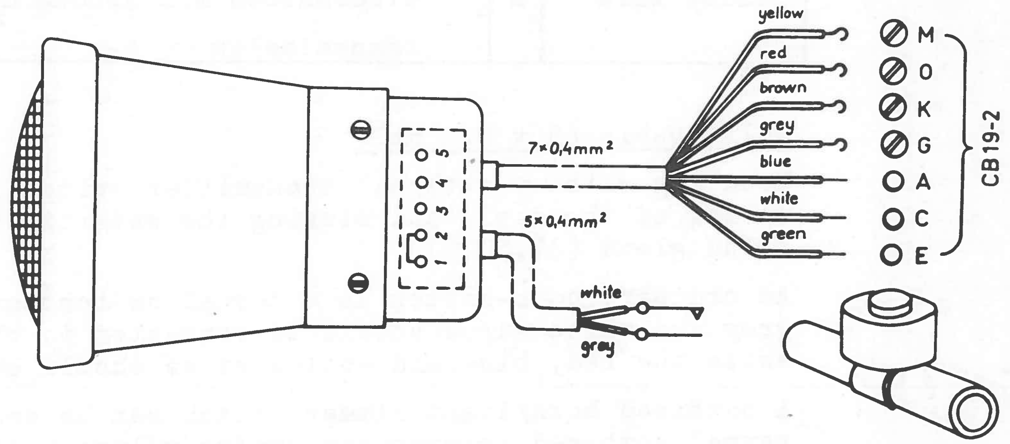
Connect the loudspeaker cable to terminals E and G (fig.A) through nut and washer supplied.

LM19-1

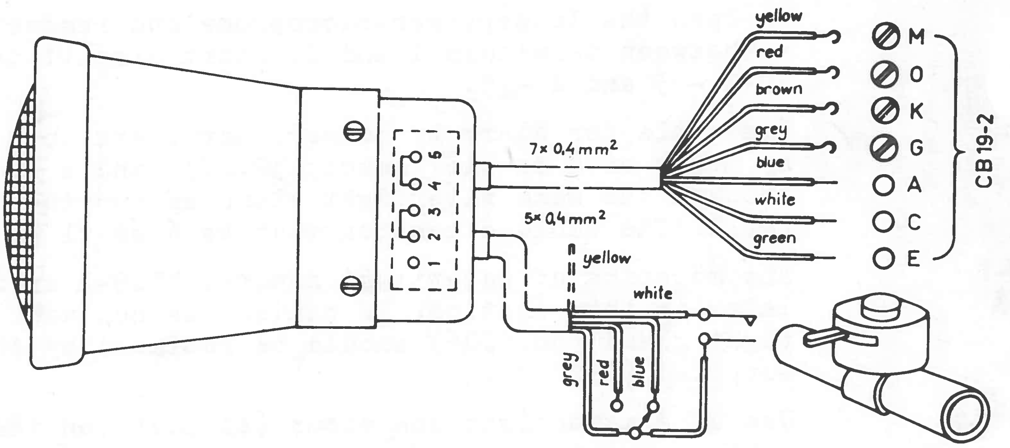
The loudspeaker-microphone LM19-1 is primarily intended to be used for motor cycle applications, and the following is a suggested installation procedure.

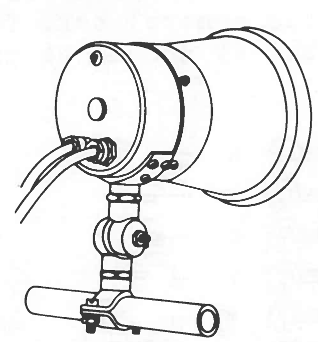
Connect the cable from loudspeaker-microphone, using the nut, washer and gasket, to control box in accordance with the table below. Remove the shorting bar on terminal M.

A.



B.





Multi-cable (7 x 0,4 mm^2)

White wire	C	-12 V
Blue wire	A	Connection through transistor amplifier
Red wire	O	to the microphone section of loudspeaker
Brown wire	K	Connection with transmit switch
Grey wire	G	Common
Green wire	E	Connection with loudspeaker section
Yellow wire	M	Disconnects microphone during transmission

Multi-cable (5 x 0,4 mm^2)

Mounting without external transmitter switch calls for removing of the cable and closing the watertight gland by a blind gland (37.5020).

An ordinary horn-switch as external switch can be used. The grey and white wires should be connected to the switch, while the red, blue and yellow wires should be cut off.

A combined horn/light dimmer switch can be used as an external combined transmitter switch/volume control (2 positions).

Open the loudspeaker-microphone and remove the short between terminals 1 and 2. Short circuit terminals 2 - 3 and 4 - 5.

Alarm

The cable for alarm by buzzer, horn, etc. can be connected by means of a double gasket (32.073) and a washer (29.127) through the same watertight gland as for the loudspeaker cable. The cable dimension must be 6 mm ±1 mm.

MT19-1

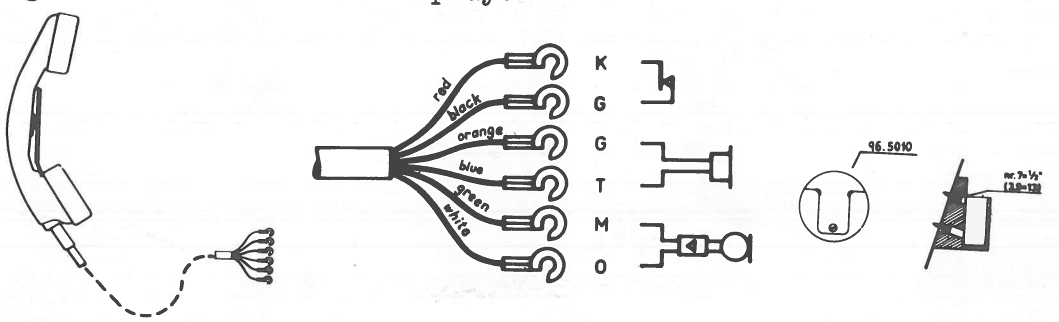
The mounting of watertight handset MT19-1 is described later in this section. If handset is not used the watertight gland (38.5006) should be replaced by the blind gland supplied (29.142).

Connector

Use of a watertight connector (41.5045) on the handset cable necessitates the mounting of its counterpart (41.5046) on the control box by four screws and the reconnecting of the wires to the control box screwing terminals.

MC19-2

The watertight handset MT19-2 and its holder should be mounted at a suitable place near the control box. The handset is intended for outdoor use, but it should be protected against direct rain or spray.



Use the holder as a jig and drill 3 holes each 3,0 mm. Use the screws supplied to fasten the holder.

The thin coloured wires with the terminals should be connected to the terminals in the control box in accordance with the table below.

Red wire	K	Connection to transmit key
Black wire	G	
Orange wire	G	Connection to telephone
Blue wire	T	
Green wire	M	Connection through transistor amplifier
White wire	O	to dynamic microphone

Loudspeaker

The watertight re-entrant horn loudspeaker must be connected to the control box by a two-way cable with an external diameter of 6 mm ±1 mm.

E. Standard Antennas

The antenna should be placed as high and as clear as possible in order to obtain the best possible matching and radiation. The antenna should be placed on the roof of an automobile. Mounting the antenna on e.g. a fender or on the lid of the luggage compartment must be avoided as unwanted directivity and poor impedance matching will be introduced.

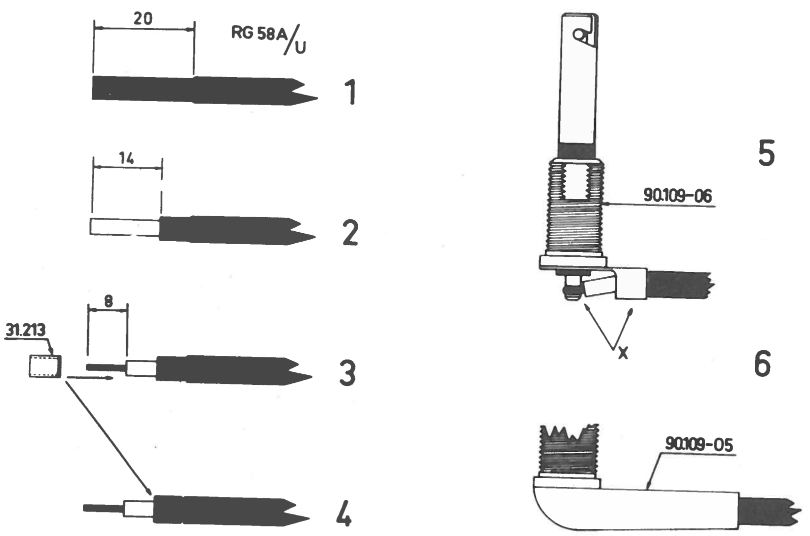
Antenna Base

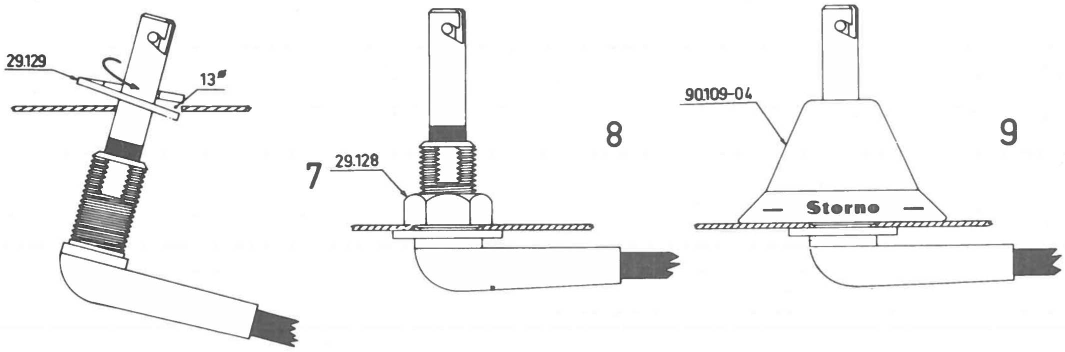
1-3) Remove the sleeve from coaxial cable RG58A/U as shown. Do not nick the braid.

4) Slide the soldering bush over the cable insulation, but under the braid wires. Lightly tin braid the wires over the soldering bush.

5) Feed the cable into the cable eye on the antenna base. Squeeze the soldering laps together around the braid wires, thereby fixing the cable mechanically. Solder at the points marked "X".

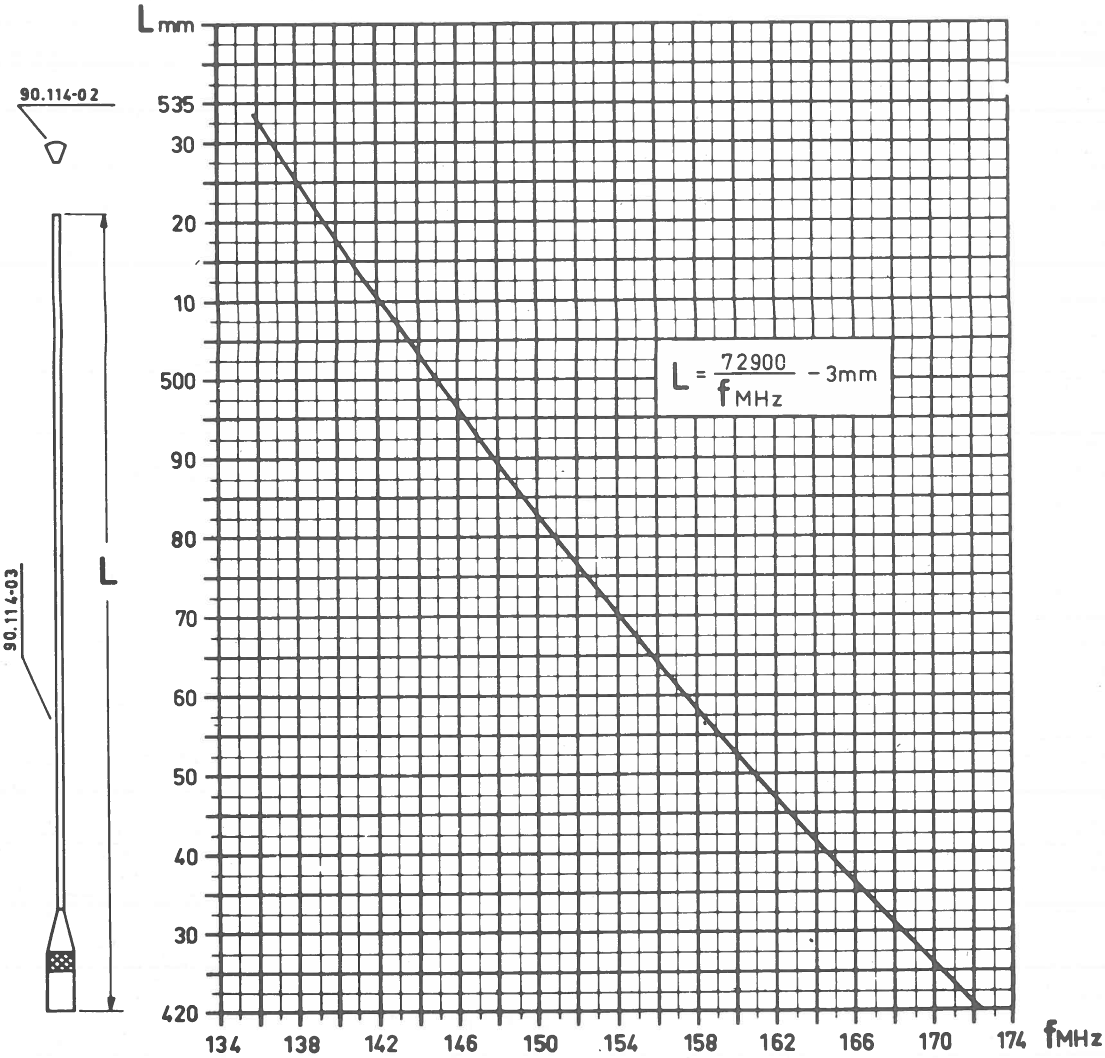
6) Remove excess wire, solder, etc., and place the protective cap in position.





7) Drill a 13 mm hole (min. 13 mm, max. 13,5 mm) at the point selected. Push the free cable end through the hole and between the roof and upholstry if any and run it to the transmitter/receiver cabinet. Place the antenna base in the hole, screw the spiral washer through the hole and place the antenna base correctly. In case mounting of the antenna base can be done from the inside, the spiral washer should be replaced by a large washer 29.144 (50⌀ x 11⌀ x 1,5 mm), which is also supplied.
8) Tighten the lock nut (the antenna base is provided with two flats for this purpose).
9) Press the top cap over the base and screw it onto the support.

AN19-1

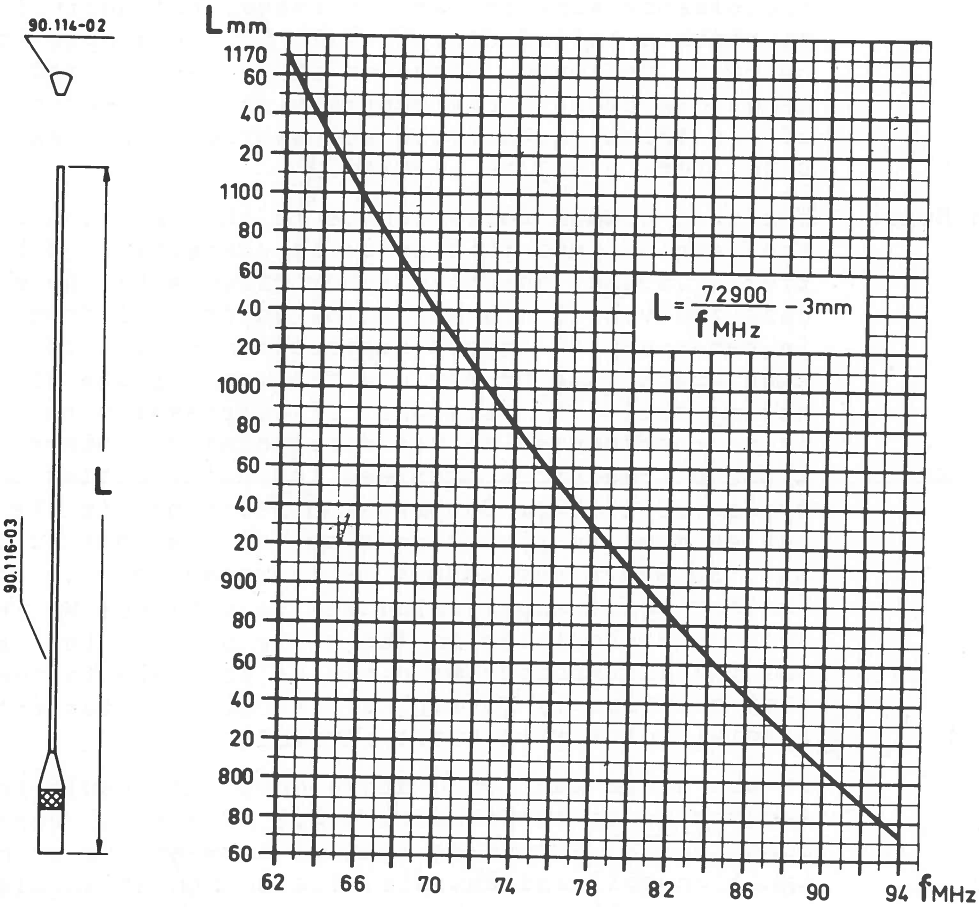


Whip Antenna

Whip antennas AN19-1 and AN39-1 must be cut to lengths corresponding to the operating frequencies. If transmitter and receiver frequencies differ, the average frequency should be taken.

The exact length of a said whip antenna can be read on the curves or calculated from the formula.

AN39-1



F. Noise Suppression

Introduction

Noise interference in mobile radio communication can either be caused by the vehicle's own electrical system or be generated by external noise sources such as other vehicles, electrical generators, street cars, electrical wires, X-ray apparatus, etc.

The external noise cannot be avoided, but care has been taken in the design of the Stornophone V to attenuate the effect as much as possible. Such noisy periods will normally be of short duration if the vehicle is on the move.

The electrical noise generated by the vehicle's own electrical system can often be suppressed sufficiently by simple means.

It should be kept in mind, however, that as long as the radio-telephone equipment is operating close to the main station the noise will normally not be noticed. The noise will only be heard in the loudspeaker, when the equipment is at a greater distance from the main station, where the antenna signal into the receiver is somewhat weaker.

Complete noise suppression of an electrical system can be a troublesome work in certain cases, but normally it is possible to reach a satisfactory result if the simple advice given below is followed. Moreover it is recommended that the special handbooks about noise suppression published by the manufactors of electrical automobile accessories (such as Bosch, Lucas, Ducellier, etc.) be studied.

Ignition Noise

The most common noise source is the ignition system in a petrol engine, and this noise is characterized by a regular ticking sound, which is syncronized with the motor speed. In case the vehicle is not noise suppressed from the factory it is necessary to insert suppression resistors in series with each spark plug or replace the spark plugs with spark plugs having built-in resistors. If suppression resistors are used it is recommended to use wire-wound resistors (5 kΩ), as these types of resistors suppress the noise better than the carbon types (10-15 kΩ). Suppression resistors in the spark plug cables must be placed as close as possible to the spark plugs, and the spark gap should be increased by 0,1 mm.
Further noise suppression may be obtained by inserting a suppressor resistor in the cable between the ignition coil and the distributor as close as possible to the later. The best solution is to replace the distributor rotor by a special rotor with built-in resistor.

If the steps mentioned above does not result in a satisfactory noise suppression a 0,1 μF coaxial condenser (e.g. Bosch 9Z17Z) should be mounted between the primary of the ignition coil and chassis. The condenser should be suspended near the coil with the chassis wire as short as possible.

Finally it should be borne in mind that dirty or burned distributor contacts may cause noise similar to ignition noise.

Generator Noise

The generator noise is characterized by a whine, where the frequency and strength is syncronized with the motor speed. Normally this noise is due to arcing between dirty or worn-down brushes and the commutator. Cleaning or possibly replacement of the carbon brushes will normally remove the noise

In more difficult cases it may be necessary to insert a filter in the generator circuit. A noise suppressor condenser (e.g. Bosch EMKO 15Z10Z) should be inserted in the lead from the ignition coil (connection to ignition switch) and in the outgoing battery wire from the generator terminal. Do not remove more insulating material than absolutely necessary in order to minimize the risk of shorting.

Other Noise Sources

Noise from the voltage regulator can be identified by a rasping noise in the loudspeaker. This noise can normally be removed by mounting a coaxial condenser in the generator lead,

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as close as possible to the regulator housing. The other end of the condenser snould be connected to chassis.

All electrical instruments and motors may introduce noise into the radiotelephone. The windscreen wiper motor can as an example be suppressed by a conventional noise suppression condenser (e.g. Bosch EMKO 9Z9Z). The different noise sources can be easy detected by switching on and off the suspected noise sources one by one. As other noise sources may be mentioned the electric clock, the petrol gauge, the oil lamp, etc., and in all cases the noise can be sufficiently suppressed by correct use of cendensers.

Type static can sometimes produce interference and in such cases a big improvement may be obtained by mounting special shorting springs in each wheel.

31.021-E1

CHAPTER IV. SERVICE

A. Maintenance

Preventive Service Inspections

When a STORNOPHONE V radio equipment has been correctly installed and checked for satisfactory operation it should not thereafter be left to itself until breakdowns begin to occur. Every equipment should be inspected at regular intervals and readjusted it necessary. The frequency of such routine inspections will depend on the conditions under which the equipment is operated and on the total number of operating hours, but twelve months is the maximum time that should be permitted to elapse from one preventive service inspection to the next.

Through conservative dimensioning of the circuits employed in the STORNOPHONE V, the STORNO company has created a piece of radio equipment that may be expected to have long life. Easy service and fault finding were two other important design considerations. All significant currents and voltages are specified in the circuit diagrams. On each circuit diagram is printed a screen picture of the circuit board, showing the diagram symbols of the individual components. All module units moreover have marked metering points to permit rapid checking of the operational condition of the equipment. When a module unit is to be serviced on the bench it may be a great help to illuminate the board strongly from behind, which will cause the printed wiring to stand out clearly.

Metering Chart

Each STORNOPHONE V shipped from the factory is accompanied by a metering chart giving the metering-point values for that equipment as read by the Final Testing Department. These readings vary somewhat from one equipment to the next, so the metering chart for an equipment will provide a useful standard of comparison when future checks are being made. On the whole, it is a good plan to keep a sort of "log" of the check readings for each individual equipment, seeing that a comparison of readings made over a certain period of time will provide the radio technician with a good picture of the general condition of the station. Also, such a comparison will clearly show when readjustments and tube replacements should be made.

Metering Points

Most module units have two types of metering points: DC metering points (marked with figures) and signal metering points (marked with letters). Measurements at DC metering points require the use of a 50-0-50 microammeter having an internal resistance of 1000 ohms (STORNO type SI service meters are specially designed for such measurements). Signal measurements require the use of a vacuum-tube voltmeter with max. input capacitance 20 pF.

Metering-point Tolerances

Below follows a complete list of all marked metering points in a STORNOPHONE V radio equipment, including obtainable readings and permissible tolerances.

+ Signal generator connected to antenna and adjusted to provide 100-mV reading at metering point E, whereafter measurements may be made at points B, C, and D.

o Signal generator connected to antenna and adjusted to provide 100-mV reading at metering point H, whereafter measurements may be made at points F, G, and I.

□ Terminals MC and IA shorted.

Constant signal generated by crystal-controlled oscillator.

xx Constant reading due to limiting.

Metering Point		Reading	Tolerance
TX19-1 Transmitter Unit			
A	Modulator, signal voltage Δf = 10 kc/s	2 V	±0.8 V
A	Modulator, signal voltage Δf = 3.3 kc/s	0.7 V	±0.2 V
1	V1, oscillator grid current	18 µA	±8 µA
2	Modulator, output voltage	20 µA	±2 µA
3	V2, resonance and output level	35 µA	±10 µA
4	V3, resonance and output level	35 µA	±10 µA
5	V4, resonance and output level	38 µA	±10 µA
RC19-1 Receiver Converter			
1	V1, cathode voltage	23 µA	±5 µA
2	V2, grid voltage	7 µA	-2+10 µA
3	V3, grid voltage	32 µA	±10 µA
4	V4, grid voltage	22 µA	±10 µA
RC39-1 Receiver Converter			
1	V1, cathode voltage	23 µA	±5 µA
2	V2, grid voltage	13 µA	-7+10 µA
3	V3, grid voltage	32 µA	±10 µA
4	V4, grid voltage	22 µA	±10 µA

IA19-1 Intermediate Frequency Amplifier			
1	Q1, emitter voltage	27 µA	-5+10 µA
2	Q2, emitter voltage	27 µA	-5+10 µA
3	Q3, emitter voltage	27 µA	-5+10 µA
4	Q4, emitter voltage	27 µA	-5+10 µA
5	Q5, emitter voltage	34 µA	-5+10 µA
6	Q6, emitter voltage	28 µA	-5+10 µA
7	Q7, emitter voltage	25 µA	-5+10 µA
8	Discriminator output	0 µA	±2 µA
A	Q1, collector, signal voltage	70 mV #	
B	Q2, base, signal voltage	0.7 mV +	±9 dB
C	Q3, base signal voltage	7 mV +	±6 dB
D	Q3, collector, signal voltage	210 mV +	±3 dB
E	Q4, base, signal voltage	100 mV +	0 dB
F	Q5, base, signal voltage	13 mV o	±6 dB
G	Q5, collector, signal voltage	520 mV o	±3 dB
H	Q6, base, signal voltage	100 mV o	0 dB
I	Q7, base, signal voltage	1000 mV o	±3 dB xx
K	Q7, collector, signal voltage	3000 mV	±6 dB
IA19-2 Intermediate Frequency Amplifier			
1	Q1, emitter voltage	27 µA	-5+10 µA
2	Q2, emitter voltage	27 µA	-5+10 µA
3	Q3, emitter voltage	27 µA	-5+10 µA
4	Q4, emitter voltage	27 µA	-5+10 µA
5	Q5, emitter voltage	34 µA	-5+10 µA
6	Q6, emitter voltage	28 µA	-5+10 µA
7	Q7, emitter voltage	25 µA	-5+10 µA
8	Discriminator output	0 µA	±2 µA
A	Q1, collector, signal voltage	30 mV #	
B	Q2, base, signal voltage	1 mV +	±9 dB
C	Q3, base, signal voltage	10 mV +	±6 dB
D	Q3, collector, signal voltage	260 mV +	±3 dB
E	Q4, base, signal voltage	100 mV +	0 dB
F	Q5, base, signal voltage	17 mV o	±6 dB
G	Q5, collector, signal voltage	520 mV o	±3 dB
H	Q6, base, signal voltage	100 mV o	0 dB
I	Q7, base, signal voltage	1000 mV o	±3 dB xx
K	Q7, collector, signal voltage	3000 mV	±6 dB

AA19-1 Audio Amplifier			
1	Q1, collector voltage	28 µA	±5 µA
2	Q3, collector voltage	31 µA	±5 µA
3	Q6, collector voltage	24 µA □	±5 µA
4	Q2, emitter voltage	27 µA □	±5 µA
5	Q4, collector voltage	27 µA □	±5 µA
6	Q5, emitter voltage	1 µA □	-1+5 µA
7	Q6, emitter voltage	13 µA □	±4 µA
PS19-1a Power Supply			
2	Q3, base bias ((2) - emitter)	0.5 V	±0.1 V
B	T3, secondary, audio voltage	4.0 V	±1.6 V
C	Audio voltage for modulator, Δf=10 kc/s	2.0 V	±0.8 V
D	Audio voltage for modulator, Δf=3.3kc/s	0.7 V	±0.2 V
PS19-2a Power Supply			
2	Q3, base bias ((2)- emitter)	0.3 V	±0,1 V
B	T3, secondary, audio voltage	6,0 V	±1,6 V
C	Audio voltage for modulator,Δf=10 kc/s	2,0 V	±0,8 V
D	Audio voltage for modulator,Δf=3.3 kc/s	0,7 V	±0,2 V

Routine Inspections

A normal routine inspection should comprise a complete check of all metering points in the equipment, and the readings obtained should thereafter be checked against the readings obtained in previous routine inspections. In addition to this, however, routine inspections should comprise the operations specified below:

1) Remove dust and dirt from the equipment by means of a soft brush or through cautious use of compressed air.

2) Inspect (visually) tubes, transistors, diodes, etc. Fasten any components that may have worked loose.

3) Check the supply voltage, which should not be outside these values: 6.6 V ±10 %; 13.8 V ±10 %; 26.4 V ±10%.

4) Check cable connections, fuse box, battery (look for corroded joints; fill up with distilled water if necessary). Also check the current drain of the equipment.

5) Measure the output power delivered by the transmitter and readjust the power amplifier stage if necessary.

6) Measure the receiver sensitivity and readjust the receiver input circuits if necessary.

7) Check logs, surfaces etc. for incipient rust or corrosion. Be careful when cleaning the surfaces so that rust and particles of enamel will not get into the station cabinet.

8) Clean relay pins and connector pins.

9) Call the base station of the scheme for a communication and speech test.

10) Check the antenna mounting, especially for rust.

Replacing Module Units

In certain situations, time can be saved by replacing a probably defective module unit with a new module unit of the same type. The new module unit may require a few minor readjustments even if it is known to be fully aligned.

B. Fault-finding and Repairs

Ordinary service on tube-equipped radio stations must be assumed to be well known to all radio technicians. The use of transistors and printed circuit boards is not quite so widely known, however. Below follow some directions for handling transistors and repairing circuit boards.

Transistors

Seen from a service point of view, transistors differ from radio tubes by requiring much lower operating voltages and much more drive. In most cases transistors have so low impedance that conventional fault-finding methods for radio tubes connot always be employed. Though a relatively new component in the electronic world, the transistor has already proved its superiority over radio tubes as far as ruggedness and long life are concerned. However, transistors cannot be exposed to excess currents or temperatures over 85-90°C without being permanently damaged, for which reason some directions for handling these semiconductors will be necessary.

Soldering

When soldering semiconductors it is important that a pair of flat-nose pliers be used as a heat sink. The pliers must not be placed between the point of soldering and the semiconductor, and the soldering operation must be performed rapidly. The same rule applies to soldering on a transistor socket from which the transistor has not been removed. Generally, it is inadvisable to solder at points closer to the semiconductor than approx. 5 mm.

A transistor should not be replaced unless one has ascertained with reasonable certainty that it is defective. Even transistors of the same type and make may show varying data so that, when a transistor has been replaced, it is usually necessary to check over the associated circuits and readjust them (if required).

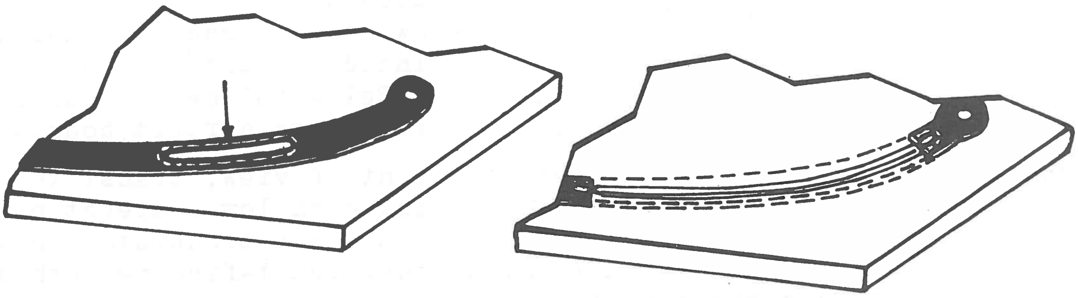
Resistance Measurement

Two precautionary measures are necessary when making resistance measurements on transistor circuits. Firstly, it is necessary to make sure that the ohmmeter current does not exceed one milliampere, which may very well be the case with certain types of vacuum-tube voltmeters. Secondly, the ohmmeter voltage may cause the transistor to become conductive, with incorrect readings as the obvious result. Since most faults are either short circuits or open circuits, accurate measurement of resistance is not normally required.

Circuit Boards

The circuit boards employed in the STORNOPHONE V are very robust, but in unfortunate cases the printed wiring may break or detach itself from the board. Usually, this happens only when excessive heat is applied when soldering or when a soldering operation takes too long time. Fine cracks in the wiring or the circuit board itself are mostly difficult to spot with the naked eye, in which case a magnifying glass will be a good help. This type of fault may also be the cause of trouble of an intermittent nature.

Such faults are easily cirrected by soldering a short length of wire across the treak on the circuit board. The circuit boards also carry some fixed capacitances. Here, repairs must be made with some caution in order to avoid changes in capacitance.



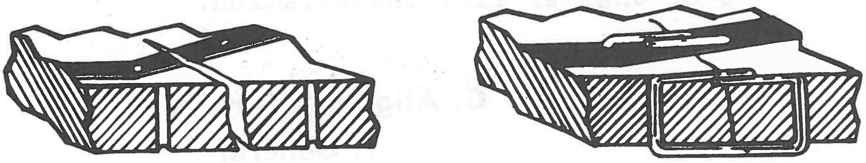
Replacement of Components

Replacement of resistors, capacitors and similar components on printed circuit boards requires the use of a pencil-type soldering iron of 45- to 75-watt rating so as to permit rapid soldering. Do not attempt to pull the component off the circuit board until the solder flows smoothly as there is otherwise a risk of pulling some of the printed wiring off the board. As a general rule the soldering iron should not be applied to the board for a longer time than strictly necessary. Also, it is recommended that components be replaced as follows: cut off the defective components and thereafter use their leads as tie points for the new components as shown in the sketch below.

When a component has been soldered on the circuit board, make sure that no short circuits have been caused by excess solder. Do not use more solder than strictly necessary. Large blobs of solder can reduce the specing between the printed wires, and even if there is no actual short circuit it is possible for the resistance between wires to be reduced to a few megohms, which is low enough to produce undesired effects in RF circuits and degrading their properties.

Repairing Circuit Boards

Careless handling or mechanical stresses may cause a circuit board to crack. A number of holes (the exact number will be determined by the length of the crack) are drilled on either side of the crack and U-shaped wire lengths are inserted in them. The two free ends should be long enough so that, when bent, they can be laid parallel to each other and soldered together. Broken printed wiring is repaired as described above. Care in drilling the holes is particularly important with circuit boards having printed wiring on both sides; care must of course also be taken that the U-shaped relieving clamps cannot short any of the printed wires.



Fault-finding

Fault-finding should be performed only by skilled personnel who have the necessary measuring instruments at their disposal and have acquainted themselves with the functioning of the equipment.

Simple Faults

Simple faults may be divided into these groups:

a. Faults due to causes outside the transmitter/receiver. Such faults are supply-voltage failures, absence of modulating signal, faulty connections in cable connectors, a defective antenna, faults in the base station, etc.

b. Faulty adjustment of the signal circuits.

c. Defective tubes, transistors, or diodes.

d. Faulty connections in tube sockets or relay sockets.

e. Visually conspicuous faults, such as burned-out resistors, broken wires, etc.

The above-mentioned faults are relatively easy to locate and repair, for instance by checking all metering points and thereafter checking the readings against the values listed in the metering shart or the log. However, repairing a fault that has been located is not always enough. Especially in the case of faults of the type described under c. and e. it is important that the cause of the fault be found and that steps be taken that will prevent the fault from occurring again.

Complicated Faults

If a fault cannot be classified as a "simple fault", a more methodical approach will have to be employed. General rules cannot be laid down, but since the equipment is composed of module units the best plan is usually to try to locate the defective module unit, thereafter proceeding to inspect and check that unit in detail.

The STORNOPHONE V has a number of alignment points which should not be touched unless the necessary measuring instruments are available. Incidentally, the directions given in the alignment manual should be followed closely in each individual case if a satisfactory result is to be obtained.

Outside Noise Sources

In designing the STORNOPHONE V, every effort was made to suppress noise from outside sources. This was done by means of ferroxcube beads and by-passes in all module units.

Obviously, no further measures can be taken against noise caused by street cars, stationary engines and motors, other vehicles, overhead wires, etc., but interference of this type will on the other hand merely be of an intermittent nature. All noise picked up by the antenna connot be further suppressed without reducing the receiver sensitivity as well, which will not normally be desirable.

Elimination of the noise generated by the vehicle or the ship's own electrical system is described in detail in Section G of Chapter III: Installation.

C. Alignment Procedure

1. General

Introduction

The adjustment procedure described in the following is intended as an aid in aligning a STORNOPHONE V radio telephone and therefore is not to be considered the only correct procedure. Certain adjustments can with advantage be performed differently if more advanced measuring equipment is available. However, the directions given here should only be departed from in cases where the technician can foresee with certainty that modified alignment methods will not degrade the specifications stipulated or complicate subsequent alignment procedures.

Only such skilled radio technicians as have already acquainted themselves with the operation of the STORNOPHONE V radio telephone should perform adjustment and repairs.

Placing the STORNOPHONE V into Operation

Before being dispatched from STORNO, each individual radio telephone has been checked and tested. In the absence of any special agreement, the testing department has:

1. Inserted quartz crystals for the channels ordered.
2. Aligned the complete radio telephone so that the accuracy of the transmitting and receiving frequencies is better than 3×10^{-6}.
3. Adjusted the receiver's power output and the speech limiter clipping level according to specifications; and
4. adjusted and tested the built-in tone equipment (if provided).

When the installation has been completed and its proper execution checked, it will normally be necessary to retune the transmitter PA plate tank circuit with the proper antenna connected to the antenna connector. The transmitter's modulation sensitivity should also be checked.

These two adjustments should likewise be performed in all cases where the radio telephone has been removed from its normal place of installation or is transferred to another vehicle, ship, etc.

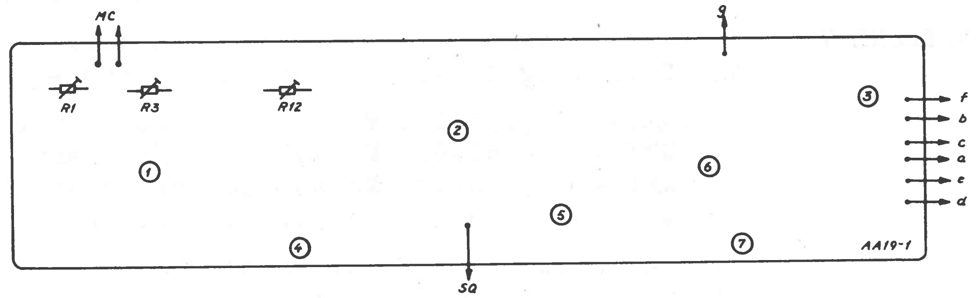
CAUTION	Great care should be shown when measuring voltages, currents etc. in circuits in which transistors are used. Even brief short circuits caused by the test prod of a measuring instruments can in certain cases ruin a transistor.
STORNOPHONE V	This adjustment procedure has been developed for use with the following types of radio telephone equipment: CQM19-25 (136-174 Mc/s), 25 kc/s channel separation CQM39-25 (68-88 Mc/s), 25 kc/s channel separation CQM19-50 (136-174 Mc/s), 50 kc/s channel separation CQM39-50 (68-88 Mc/s), 50 kc/s channel separation. This adjustment procedure also comprises a procedure for adjustment of tone transmitters TT19-1 and TT19-2 and of tone receivers TR19-1 and TR19-2.
Measuring Equipment	Each section of this adjustment procedure begins by specifying the types of measuring instruments that are a condition for performing the alignment in question in the correct and proper manner. Reference is made to a number of measuring instruments which STORNO has developed specifically for service and adjustment of STORNO radio equipment, but other measuring equipment may of course be used if its specifications are similar to, or better than, the specifications for the corresponding STORNO measuring instruments. It is assumed that the necessary service facilities are available, such as a battery power supply, charger, etc. so that the STORNOPHONE V radio equipments under test can be operated from the correct supply voltages (6.5 V, 13.6 V, and 26.4 V). These voltages are accumulator terminal voltages in connection with a "standard" installation (an installation with a total cable length of 2 x 3 m, 6 sq. mm, a JB19-1 fuse box, and a CB19-1 or CB12-2 control box). Adjustment of the speech limiter and of the audio output level is to be performed with the equipment operated from the supply voltage from which the equipment is to operate in the final installation. In cases where the actual supply voltage of the equipment is not known, the afore-mentioned adjustments are to be made at 12 V for 6/12 V equipments and at 24 V for 12/24 V equipments.

2. Alignment of Transmitter

Adjustment of Modulation and Speech Limiter

Instruments	The following measuring instruments are required: Tone generator with internal resistance of 5 k ohms. Audio VTVM. Dummy load, 52 ohms/15 W (STORNO DL11-1). Measuring receiver, calibrated in frequency swing (STORNO L22).
Set-up	Connect the dummy load to the antenna connector and tune the measuring receiver to the transmitter output frequency. Connect the VTVM across the tone generator output terminals.

Connect the tone generator to terminals MC in the AA19-1 audio amplifier unit and adjust it to deliver an output voltage of 306 mV at 1000 c/s.



Procedure

a) Key the transmitter.
b) Set potentiometer R12 in AA19-1 audio unit for maximum sensitivity.
c) Increase the audio voltage (306 mV) by 20 dB.
d) Adjust potentiometer R12 so that the frequency swing does not exceed ±5 kc/s for the CQMx9-25 (±15 kc/s for the CQMx9-50) at any frequency between 300 and 3000 c/s and any voltage between 306 mV and 3.06 V.
e) Reduce the tone generator output voltage to its original level of 306 mV.
f) Adjust potentiometer R1 in the AA19-1 audio unit until the frequency swing is ±3.3 kc/s for the CQMx9-25 (±10 kc/s for the CQMx9-50).
g) Adjust potentiometer R3 in the AA19-1 audio unit for minimum distortion at the frequency swing specified under (f).
h) Repeat (c) to (f).
i) Recheck that the frequency-swing limits specified under (f) are not exceeded when the tone-generator frequency and output voltage are varied within the range 306 mV to 3.06V. Readjust R1 and R12 if necessary.

Specification

Maximum frequency swing must not exceed:

CQMx9-25: ±5 kc/s
CQMx9-50: ±15 kc/s

at all audio input signals between 306 mV and 3.06 V and at all audio frequencies between 300 c/s and 3000 c/s.

Modulation sensitivity is to be:

CQMx9-25: ±3.3 kc/s
CQMx9-50: ±10 kc/s

for a 306-mV audio signal at 1000 c/s.

Microphone Sensitivity

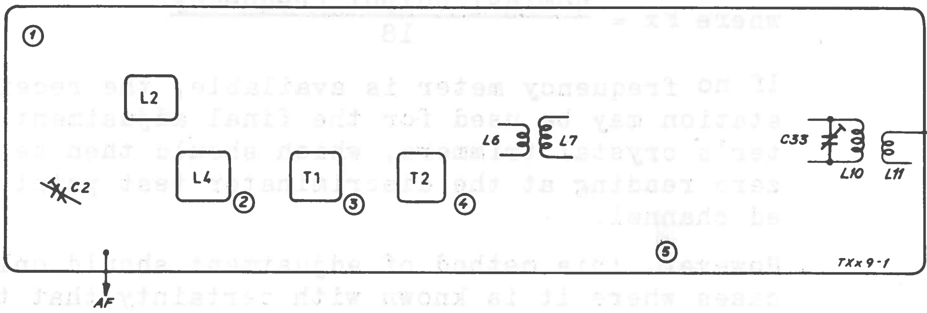
The microphone sensitivity is adjusted by means of potentiometer R4 in the control box belonging to the equipment. This adjustment should be made with a screwdriver with the transmitter in the key-down condition, in such a manner that the frequency swing reaches maximum when whistling into the microphone at normal strength and at normal distance from the microphone.

Adjustment of Phase Modulator, Frequency Multipliers and Output Stage.

Instruments The following instruments are required:

50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).
Dummy load, 52 ohms/15 W (STORNO DL11-1).
RF wattmeter, min. 15 watts.

Set-up Connect the dummy load to the antenna connector. The two transformers T1 and T2 have two points of resonance. The point at which the two tuning slugs are farthest apart is the correct point of resonance.



Procedure

a) Key the transmitter.
b) Connect the microammeter to test point 2 and tune modulator circuits L2 and L4 for maximum reading until the two circuits are at resonance.
c) Connect the microammeter to test point 3 and tune T1 for maximum reading.
d) Connect the microammeter to test point 4 and tune T2 for maximum reading.
e) Connect the microammeter to test point 5 and tune L6 and L7 for maximum reading.
f) Connect the RF wattmeter to the antenna connector and adjust C33 and the coupling between link L11 and L10 for maximum power output.

Specification RF power output is to be at least 10 watts.

Crystal Oscillator

Instruments The following measuring instruments are required:

Frequency meter with an accuracy better than 1×10^{-6}.
50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

Set-up This phase of the adjustment should not be commenced until the radio equipment has warmed fully up. The frequency meter is to be coupled loosely to coil L6 in the transmitter section, using a four-turn link. The frequency being measured is therefore half the output frequency or, in other words, nine times the crystal frequency.

Procedure

a) Connect the microammeter to test point 1. Key the transmitter and check that the microammeter reads approx. 20 µA.

b) Adjust the crystal frequency by means of C2. In radio telephone equipments with crystal shift units, trimmer capacitors C2, C4, C6, C8, C10, C12, C14, and C16 are to be used, depending on the number of channels provided in the equipment (there is a trimmer for each crystal).

Specification

On completion of the adjustment, each of the transmitter's frequencies is to lie within these limits:

CQM19-25, CQM19-50: 9 x Fx ±40 c/s
CQM39-25, CQM39-50: 9 x Fx ±20 c/s

$$\text{where } Fx = \frac{\text{nominal output frequency}}{18}$$

Note

If no frequency meter is available, the receiver at the base station may be used for the final adjustment of the transmitter's crystal trimmers, which should then be adjusted for zero reading at the discriminator test point for each adjusted channel.

However, this method of adjustment should only be used in cases where it is known with certainty that the receiver frequencies of the base station are absolutely correct.

3. Alignment of Intermediate Frequency (455 kc/s)

The IF section must be in its place in the station cabinet during adjustment and testing as undesired feedback may otherwise be the result. Also, the cover plates on the undersides of the IF units must be in place.

Discriminator

Instruments

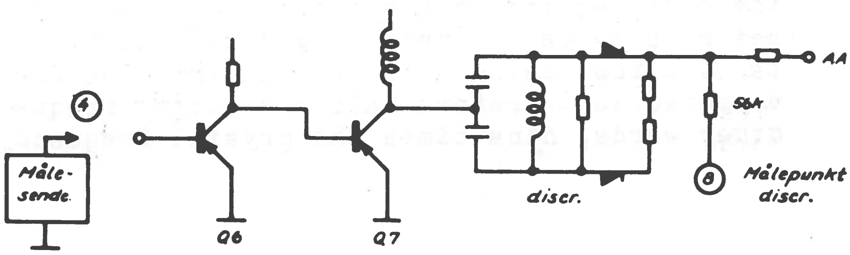
The following measuring instruments are required:

Signal generator or sweep generator for 455 kc/s (STORNO L20).

50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

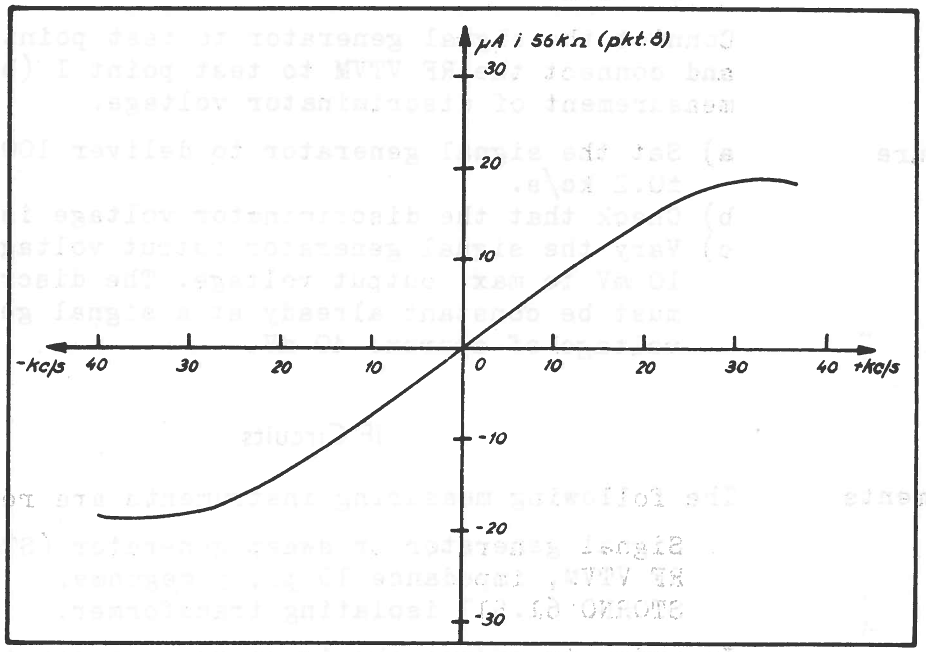
Set-up

The signal generator is to be connected to test point H (base of Q6), and the output voltage is to be over 50 mV for full limiting action. If the rest of the receiver is aligned, the noise reaching the limiter should be reduced, which may be done by short-circuiting test point E (base of Q4) to chassis by means of a 10 nF capacitor.

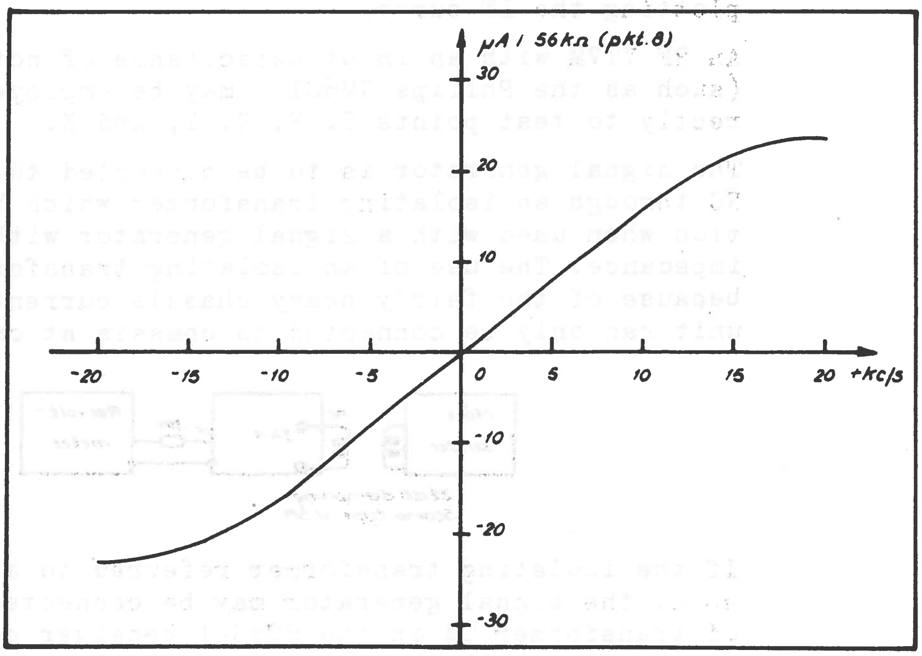


Procedure

a) Set the signal generator to the centre frequency of 455 kc/s ±0.2 kc/s.
b) Tune L11 for zero reading at test point 8. The coil has two points of resonance; the point nearest the circuit board is to be used.
c) Tune L10 for greatest possible balance and sensitivity within ±5 kc/s for the CQMx9-25 (±15 kc/s for the CQMx9-50). The coil has two points of resonance; the point nearest the circuit board is to be used.
d) Check the discriminator zero reading at test point 8 and retune L11 if necessary.



Discriminator curve for IA19-1.



Discriminator curve for IA19-2.

Specification

CQMx9-25: Sensitivity at ±5 kc/s: 8 µA ±2.0 µA (±2 dB).
Linearity at ±5 kc/s: better than ±1 dB (12 %).
CQMx9-50: Sensitivity at ±15 kc/s: 11 µA ±3.0 µA (±2 dB).
Linearity at ±15 kc/s: better than ±1 dB (12 %).

Checking Limiters

Instruments

The following measuring instruments are required:

Signal generator or sweep generator (STORNO L20).
RF VTVM.

Set-up

Connect the signal generator to test point H (base of Q6) and connect the RF VTVM to test point I (base of Q7) for measurement of discriminator voltage.

Procedure

a) Set the signal generator to deliver 100 mV at 455 kc/s ±0.2 kc/s.
b) Check that the discriminator voltage is approx. 1.1 V.
c) Vary the signal generator output voltage from approx. 10 mV to max. output voltage. The discriminator voltage must be constant already at a signal generator output voltage of approx. 40 mV.

IF Circuits

Instruments

The following measuring instruments are required:

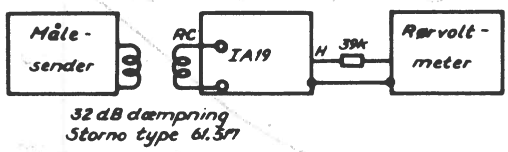
Signal generator or sweep generator (STORNO L20).
RF VTVM, impedance 10 pF, 5 megohms.
STORNO 61.517 isolating transformer.

In order to reduce the input capacitance it is necessary to insert a 39 k ohm resistor in series with the RF VTVM when plotting the IF curve.

An RF VTVM with an input capacitance of not more than 20 pF (such as the Philips GM6012) may be employed, connected directly to test points C, F, H, I, and K.

Set-up

The signal generator is to be connected to input terminals RC through an isolating transformer which has 32 dB attenuation when used with a signal generator with 10-ohm output impedance. The use of an isolating transformer is necessary because of the fairly heavy chassis currents, and the IF unit can only be connected to chassis at one point.

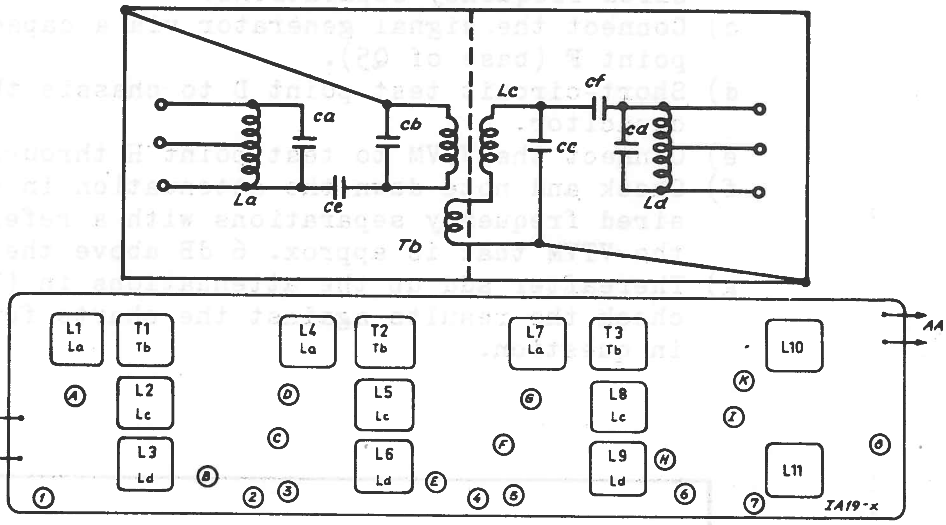


If the isolating transformer referred to above is not available, the signal generator may be connected to the primary of transformer T4 in the RCx9-1 receiver converter unit. The sensitivity will then be approx. 5 dB better than when using an isolating transformer, and the overall curveform of the second IF will then be 1 - 2 dB more irregular at its top owing to excessive capacitive coupling between secondary and primary.

Throughout the procedure care must be taken to adjust the signal generator output voltage so that the VTVM reading lies above the noise limit but below the limiting threshold.

The coils of the IF filters have two points of resonance, but the point nearest to the circuit board gives the greater Q. It is therefore necessary to begin alignment by screwing all tuning slugs all the way in so that they project slightly from the coil formers. In this event it is certain that the slugs will be far from resonance from the beginning.

The circuits are to be aligned only once after which they must not be touched again.



Procedure

a) Filter L1-T1-L2-L3

1) Set the signal generator to deliver a high output voltage and connect the VTVM to test point A.
2) Adjust L1 (La) for maximum VTVM reading.
3) Adjust T1 (Tb) for minimum VTVM reading.
4) Adjust L2 (Lc) for maximum VTVM reading.
5) Adjust L3 (Ld) for minimum VTVM reading.

b) Filter L4-L5-L6-T2

1) Connect the VTVM to test point D.
2) Adjust L4 (La) for maximum VTVM reading.
3) Adjust T2 (Tb) for minimum VTVM reading.
4) Adjust L5 (Lc) for maximum VTVM reading.
5) Adjust L6 (Ld) for minimum VTVM reading.

c) Filter L7-L8-L9-T3

1) Connect the VTVM to test point G.
2) Short-circuit test point D to chassis by means of a 10 nF capacitor, in order to reduce the gain.
3) Adjust L7 (La) for maximum VTVM reading.
4) Adjust T3 (Tb) for minimum VTVM reading.
5) Adjust L8 (Lc) for maximum VTVM reading.
6) Adjust L9 (Ld) for minimum VTVM reading.

Checking IF Amplifier

Instruments The following measuring instruments are required:

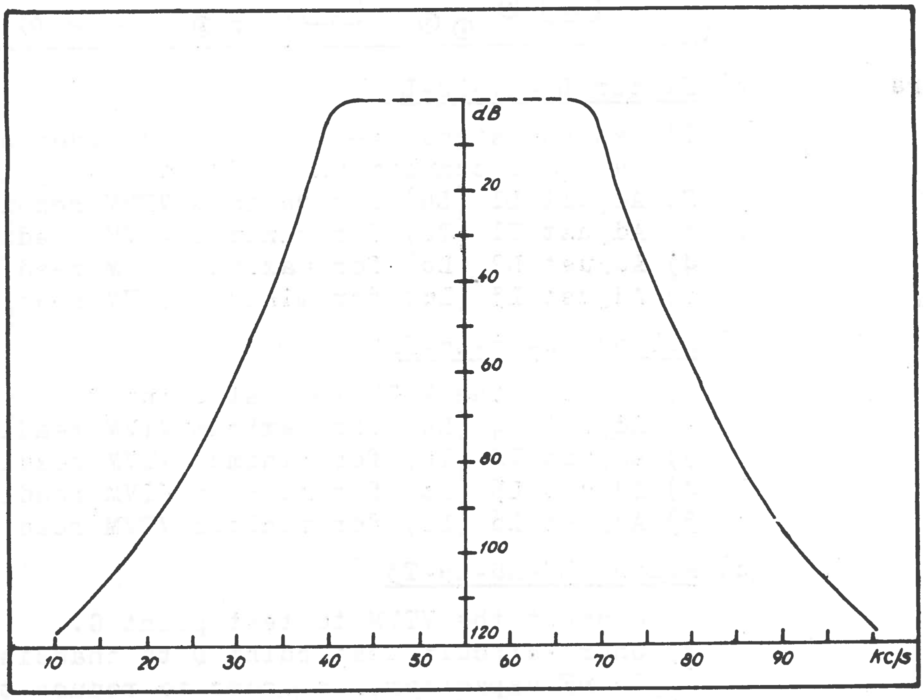
As in the preceding section, "IF circuits".

Set-up Connect the signal generator to terminals RC as described in the preceding section. Connect the VTVM to test point H (base of Q6) through a 39 k ohm resistor. A level that is 6 dB above the noise should be chosen as reference value on the VTVM.

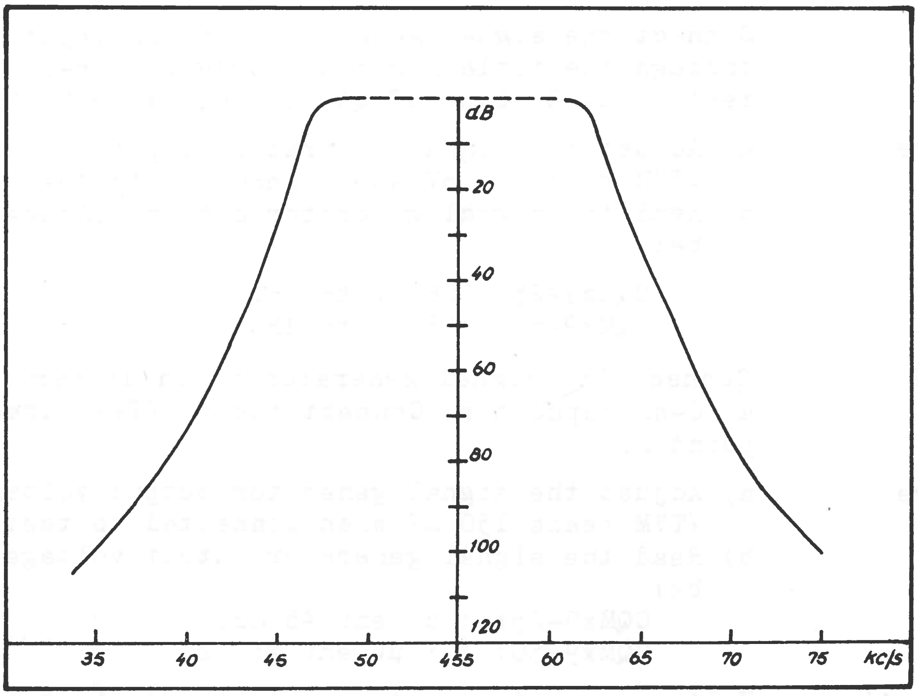
Since it is difficult to measure frequency deviations greater than ±12 kc/s (CQMx9-25) or ±20 kc/s (CQMx9-50) it is necessary to measure the attenuation in two operations.

Procedure

a) Connect the VTVM to test point E through 39 k ohms.
b) Check and note down the attenuation in dB at the desired frequency separations.
c) Connect the signal generator via a capacitance to test point F (base of Q5).
d) Short-circuit test point D to chassis through a 10-nF capacitor.
e) Connect the VTVM to test point H through 39 k ohms.
f) Check and note down the attenuation in dB at the desired frequency separations with a reference level on the VTVM that is approx. 6 dB above the noise.
g) Thereafter add up the attenuations in (b) and (f) and check the results against the charts for the IF units in question.



IF curve for IA19-1.



IF curve for IA19-2.

Specification

CQMx9-25: Attenuation at ±5 kc/s: not more than 2 dB.
Attenuation at ±12 kc/s: not more than 40 dB.
CQMx9-50: Attenuation at ±10 kc/s: not more than 2 dB.
Attenuation at ±35 kc/s: not more than 80 dB.

If the above specifications are not met, the curves may be readjusted as described below. See note on T4 in the RCx9-1 in the section "IF Circuits" if no isolating transformer was used.

Adjustment of IF Amplifier

Instruments

Sweep generator (STORNO L20).
Oscillograph.

Set-up

Connect the sweep generator to terminals RC instead of the signal generator. Connect the oscillograph to test point H (base of Q6) through the test probe.

Procedure

a) Set the sweep generator to deliver the same output voltage as the signal generator.
b) Retune the circuits; as a rule it is only necessary to retune coils T1, T2, and T3, where the tuning slugs are to be screwed approx. one eight of a turn further in.

Checking Gain

Instruments

The following measuring instruments are required:

Signal generator, 10-ohm output impedance.
RF VTVM, input capacitance max. 20 pF.
STORNO 61.517 isolating transformer.

Set-up 1 — Connect the signal generator through input terminals RC through the isolating transformer. Connect the VTVM to test point H (base of Q6) through a 39 k ohm resistor.

Procedure
a) Adjust the signal generator output voltage until the VTVM reads 70 mV when connected to test point H.
b) Read the signal generator output voltage, which should be:

CQMx9-25: 126 µV ±6 dB.
CQMx9-50: 75 µV ±6 dB.

Set-up 2 — Connect the signal generator to input terminals RC through a 10-nF capacitor. Connect the RF VTVM directly to test point H.

Procedure
a) Adjust the signal generator output voltage until the VTVM reads 130 mV when connected to test point H.
b) Read the signal generator output voltage, which should be:

CQMx9-25: 3 µV emf ±6 dB.
CQMx9-50: 1.5 µV emf ±6 dB.

Specification — Voltage gain in two transistors with four-circuit filter (test point B to test point E) is:

CQMx9-25: 44 dB.
CQMx9-50: 42 dB.

Voltage gain from input terminal (RC) to base of 2nd limiter (Q7) is:

CQMx9-25: Greater than 90 dB.
CQMx9-50: Greater than 90 dB.

4. Alignment of Receiver

The receiver converter is to be adjusted when in place in the cabinet, which should also contain the IA19-x IF amplifier and the AA19-1 audio amplifier both of which units must be in a completely aligned condition.

Adjustment of Oscillator and Multiplier

Instruments — The following measuring instruments are required:

50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

Set-up — If the radio equipment contains a crystal shift unit it should be kept in mind that relay-spring capacitance and wiring capacitance form part of the capacitance across the crystals and consequently will affect the frequency. If one of the relays in a crystal shift unit is removed, all other crystal frequencies will shift somewhat. It is therefore necessary that all relays have been mounted in their places before starting alignment. On the other hand it makes no difference whether or no all crystals are mounted in their respective sockets.

Procedure

a) Connect the 50-0-50 microammeter to test point 3.
b) Tune secondary coil T5 for maximum reading. The top tuning slug is to be adjusted for resonance between the coils nearest the circuit board), the lower tuning slug being adjusted for resonance furthest out.
c) Check the activity of the crystal by connecting the microammeter to test point 4.
d) Connect the microammeter to test point 8 in the IA19-x (discriminator).
e) Adjust the crystal to its nominal frequency by means of the crystal trimmer and with a signal from the transmitter belonging to the scheme. However, this adjustment should be made only if it is known with certainty that the base-station transmitter frequencies are absolutely correct.
f) Connect the microammeter to test point 2. Adjust the quintupler plate circuit, L5 and L6, for maximum meter reading. Adjustment of L5 and L6 may be facilitated somewhat by tuning L4 to resonance on the same frequency.

Adjustment of High IF

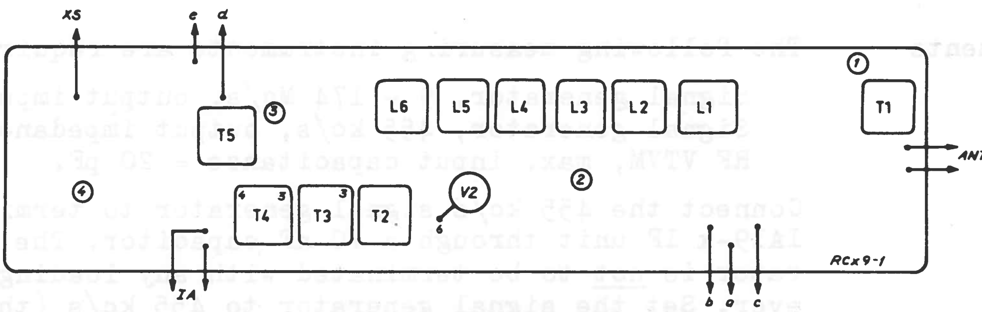
Instruments

The following measuring instruments are required:

Signal generator.
RF VTVM, max. input capacitance 20 pF.
50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

Set-up

Set the signal generator to a frequency equal to the crystal frequency minus the low IF (455 kc/s). Connect the VTVM to the collector of Q3 (point D in the IA19-x IF amplifier) through a 39 k ohm resistor.



Procedure

a) Connect the signal generator between pin 4 of transformer T3 and chassis.
b) Readjust the signal generator output frequency for zero reading at the discriminator (test point 8 in the IA19-x).
c) Tune transformer T4 to resonance (tuning slug furthest away from the circuit board).
d) Connect the signal generator between pin 3 of the primary of transformer T3 and chassis.
e) Tune the secondary of T3 to resonance (top). The top tuning slug is to be tuned to resonance between the coils, the lower tuning slug being tuned to resonance furthest out.
f) Connect the signal generator to pin 6 of V2 (MIX 1).
g) Tune the primary of T3 to resonance.

h) Tune the primaries and secondaries of T2 for maximum reading. The upper slug is to be tuned to resonance between the coils, the lower slug being tuned to resonance furthest out.
i) Touch up all circuits.

Adjustment of Signal Frequency Circuits

Instruments The following measuring instruments are required:

RF signal generator, 68 - 174 Mc/s.
RF VTVM, max. input capacitance 20 pF.
50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

Procedure

a) Readjust the signal generator output frequency until the discriminator reading (test point 8) is zero.
b) Tune the secondary of transformer T1, coils L1, L2, L3, and L4, for maximum VTVM reading.
c) Connect the microammeter to test point 2.
d) Tune coils L5 and L6 for maximum VTVM reading, taking care to retain the maximum reading at test point 2.
e) Touch up all circuits, retaining the maximum microammeter reading at test point 2.
f) Check the 12-dB signal-to-noise ratio or 12 dB quieting.
g) Retune transformer T1 to exact resonance with the slug farthest away from the circuit board as optimum signal-to-noise ratio is obtained at this point.

Specification 12 dB signal-to-noise ratio: Better than 1 µV emf.

Checkning Gain

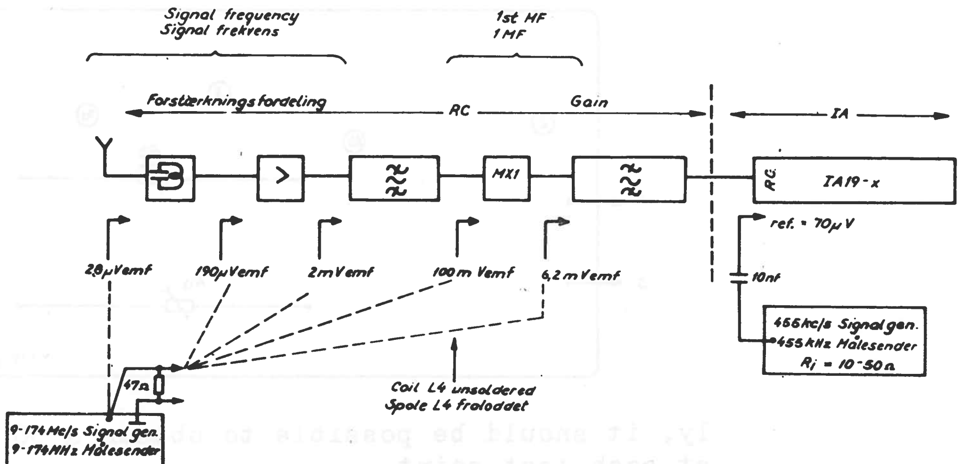
Instruments The following measuring instruments are required:

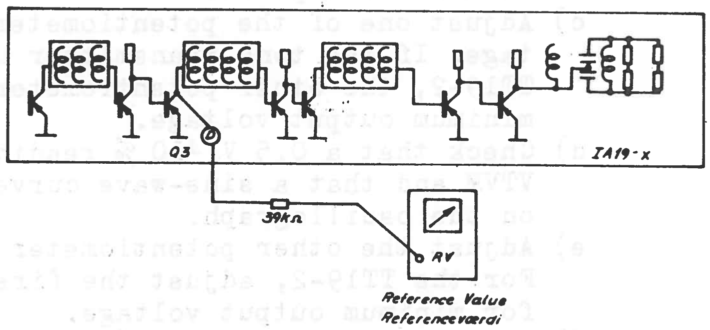
Signal generator, 9 - 174 Mc/s, output impedance = 50 ohms.
Signal generator, 455 kc/s, output impedance = 10 - 50 ohms.
RF VTVM, max. input capacitance = 20 pF.

Set-up Connect the 455 kc/s signal generator to terminals RC in the IA19-x IF unit through a 10 nF capacitor. The signal generator is not to be terminated with any loading resistor, however. Set the signal generator to 455 kc/s (the reading at test point 8 (discriminator) in the IA19-x is to be zero), and adjust the output voltage to 70 µV emf. Connect the VTVM to test point D in the IA19-x through a 39 k ohm resistor.

Procedure

a) Note down the VTVM reading at test point D (normal reading: approx. 70 mV). The reading obtained is to be employed as a reference value during the subsequent measurements.
b) Connect the signal generator (9 - 174 Mc/s), point by point, to the receiver converter as shown in the sketch and check that the voltages specified (±6 dB) produce the same VTVM reading as that noted under (a). In all measurements, the signal generator frequency must be readjusted for zero reading at test point 8 in the IA19-x (discriminator).





Note — Except for the measurement at the antenna input, the signal generator cable is to be terminated with a 47-ohm 1/4-watt resistor as indicated in the sketch.

5. Alignment of Tone Transmitter

Tone Transmitter TT19-1,-2

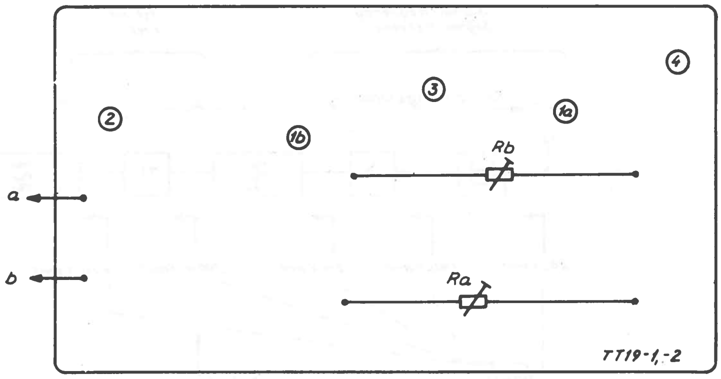
Instruments — The following measuring instruments are required:

- Audio VTVM.
- Oscillograph.
- 0-100 milliammeter.
- 50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

Set-up — The TT19-1 tone transmitter with one oscillator is adjusted in the same manner as the TT19-2 tone transmitter with two oscillators, each oscillator section being adjusted separately.

Connect a 1.5 k ohm resistance load across the output terminals a and b of the tone transmitter. Connect both the oscillograph and the audio VTVM in parallel to the said output terminals.

Procedure
a) Check the power consumption, which is to be approx. 30 mA for the TT19-1 and approx. 45 mA for the TT19-2.
b) Connect the microammeter consecutively to test points 1a, 1b, 2, and 3. If the transistors are functioning correct-



ly, it should be possible to obtain a 30 μA ±10 % reading at each test point.

c) Adjust one of the potentiometers for maximum output voltage. If the tone transmitter under adjustment is a type TT19-2, the other potentiometer is to be adjusted for minimum output voltage.
d) Check that a 0.5 V ±10 % reading is obtained on the audio VTVM and that a sine-wave curve of regular shape appears on the oscillograph.
e) Adjust the other potentiometer for maximum output voltage. For the TT19-2, adjust the first-mentioned potentiometer for minimum output voltage.
f) Check that a 0.5 V ±10 % reading is obtained on the VTVM and that a sine-wave curve of regular shape appears on the oscillograph (this applies only to the TT19-2).

6. Alignment of Tone Receiver

Tone Receiver TR19-1

It is assumed that the radio equipment has been adjusted and tested with the tone receiver unit in place in the cabinet.

Instruments

The following measuring instruments are required:

Frequency-modulated signal generator.
AC-type VTVM.
50-0-50 microammeter, Ri = 1000 ohms (STORNO SI05, SI06, or SI07).

If the adjustment is to be performed outside the range of the base station of the scheme, an accurately calibrated tone generator for modulating the signal generator will also be required.

Set-up

Connect the signal generator to the antenna connector of the equipment and adjust for 66 % of maximum frequency swing at 1000 c/s. Connect the VTVM to test point A in the tone receiver.

Procedure

a) Adjust potentiometer R13 in the AA19-1 audio amplifier for a 2.5 V reading on the VTVM.
b) Receive a tone signal corresponding to the La tone circuit of the tone receiver, either from the base station of the

scheme or perhaps from the signal generator. In both cases, modulation should be 66 % of the maximum frequency swing.

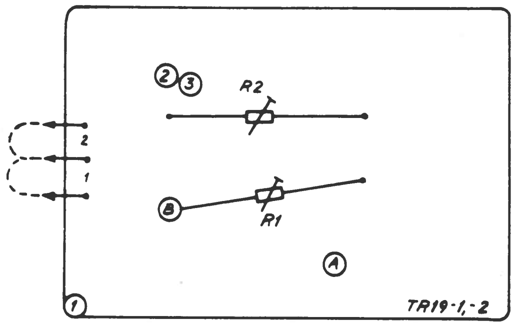
c) Note down the VTVM reading at test point A.
d) Adjust potentiometer R13 so that the voltage referred to under c) has dropped to half of that value (-6 dB)
e) Connect the AC VTVM to test point B.
f) Set sliding resistor R1 to its centre position.
g) Turn the slug in coil La for maximum VTVM reading, all the time adjusting sliding resistor R1 to keep the reading at approx. 0.8 V.
h) Adjust the sensitivity of the tone receiver by pushing potentiometer R1 slightly back and forth until relay Rel only just operates.
i) Shift the AC VTVM back to test point A.
j) Adjust potentiometer R13 in the AA19-1 audio amplifier until the same meter reading is obtained as that noted down under c).
k) The tone receiver has now been adjusted for relay operation with 6 dB certainty.

Tone Receiver TR19-2

If the base station is used for the adjustment, which is generally to be preferred, it will be necessary to prevent transmission of more than one tone at a time from the control box. In control boxes with 51 tone combinations (containing a type CO81-3 code unit), such prevention is accomplished by simultaneously depressing two buttons in the tone group to be blocked. For other types of tone units it is necessary to open the control box and connect a strap between terminals 11 and 12 (B11 and B12) or terminals 15 and 16 (B15 and B16) on the TT81-2 tone transmitter - depending on whether the first or the second digit is to be blocked.

Set-up

Connect the signal generator to the antenna connector of the equipment and set it to 66 % of maximum frequency swing at 1000 c/s. Connect the AC VTVM to test point A and short-circuit the terminals on either side of point 2, for instance with an alligator clip.



Procedure

a) Use the same procedure as that described under TR19-1 from a) to h) except that the tone frequency applied for the first digit is to be modulated 33 % of maximum frequency swing.

i) Transfer the shorting strap from the terminals on either side of point 2 to the terminals on either side of point 1.
j) Receive a tone corresponding to the other tone circuit, Lb, of the tone receiver - either from the base station of the scheme or perhaps from the signal generator. In both cases, modulation is to be 33 % of maximum frequency swing.
k) Connect the AC VTVM to test point C.
l) Set sliding resistor R2 to its centre position.
m) Turn the slug in coil Lb for maximum VTVM reading, all the time, however, adjusting sliding resistor R2 to keep the reading at approx. 0.8 V.
n) Adjust the sensitivity of the tone receiver by sliding potentiometer R2 slightly back and forth until relay Rel only just operates.
o) Shift the AC VTVM back to test point A.
p) Adjust potentiometer R13 in audio amplifier AA19-1 for a meter reading identical with the value noted down under (c) during adjustment of the first tone circuit.
q) The tone receiver has now been adjusted for relay operation with 6 dB certainty.

CHAPTER V. DIAGRAMS AND PART LISTS

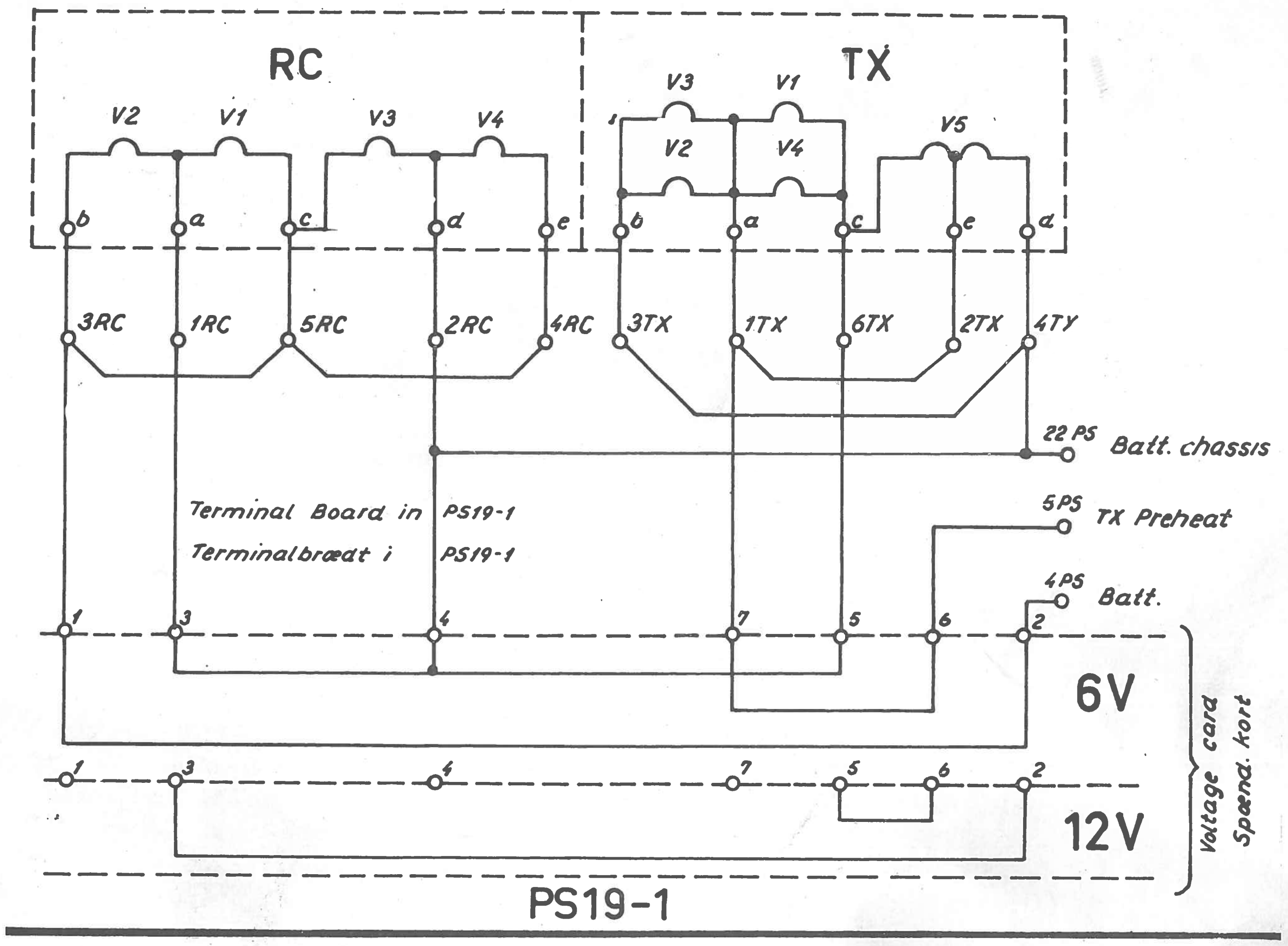
Introduction

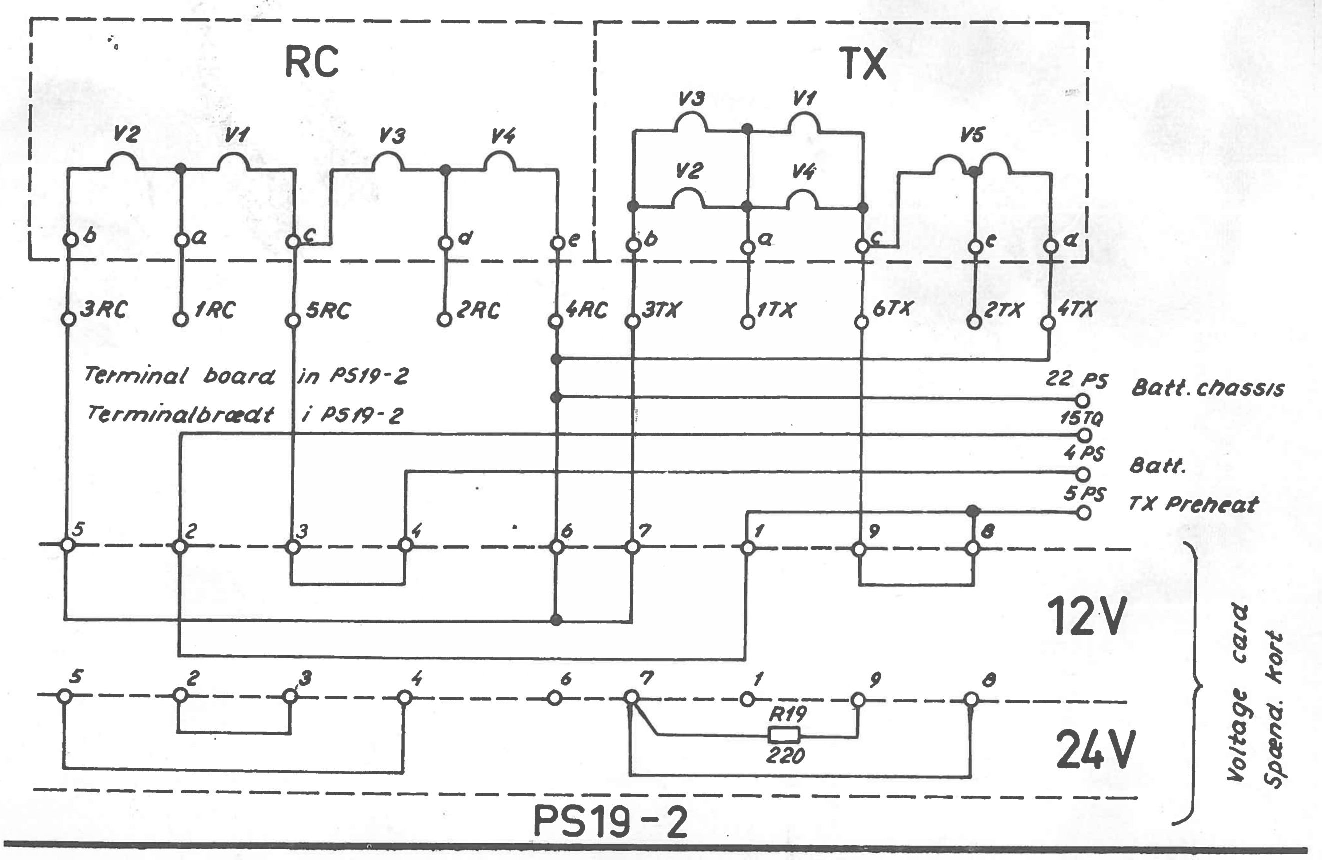
The diagrams and function schematics of the modular units in the radiotelephone equipment STORNOPHONE V can be found on the following pages. In all cases where the units are constructed on printed wiring boards are added a screen reprint of the board wiring with component placing shown in the diagram symbols.

Furthermore each diagram has attached an electrical parts list complete with specifications and STORNO code numbers.

Spare Parts

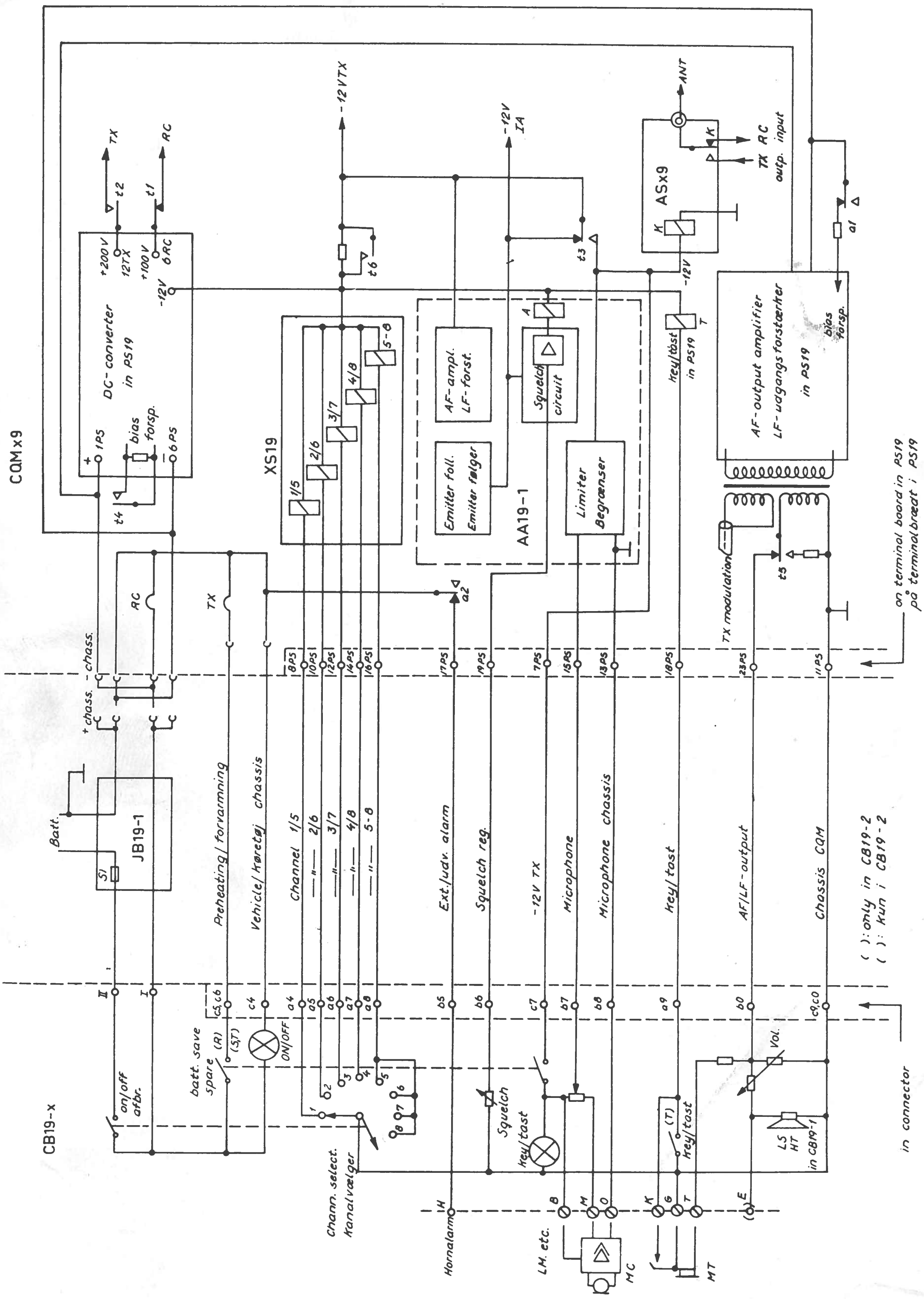
When ordering spare parts from STORNO please state the STORNO code number together with the type designation of the modular unit in which the said component is to be used. Position designation is not sufficient information. An example: All resistors in the each modular units have been numbered R1, R2, etc., for what reason more than 10 resistors in a STORNO radiotelephone equipment have been designated R1.





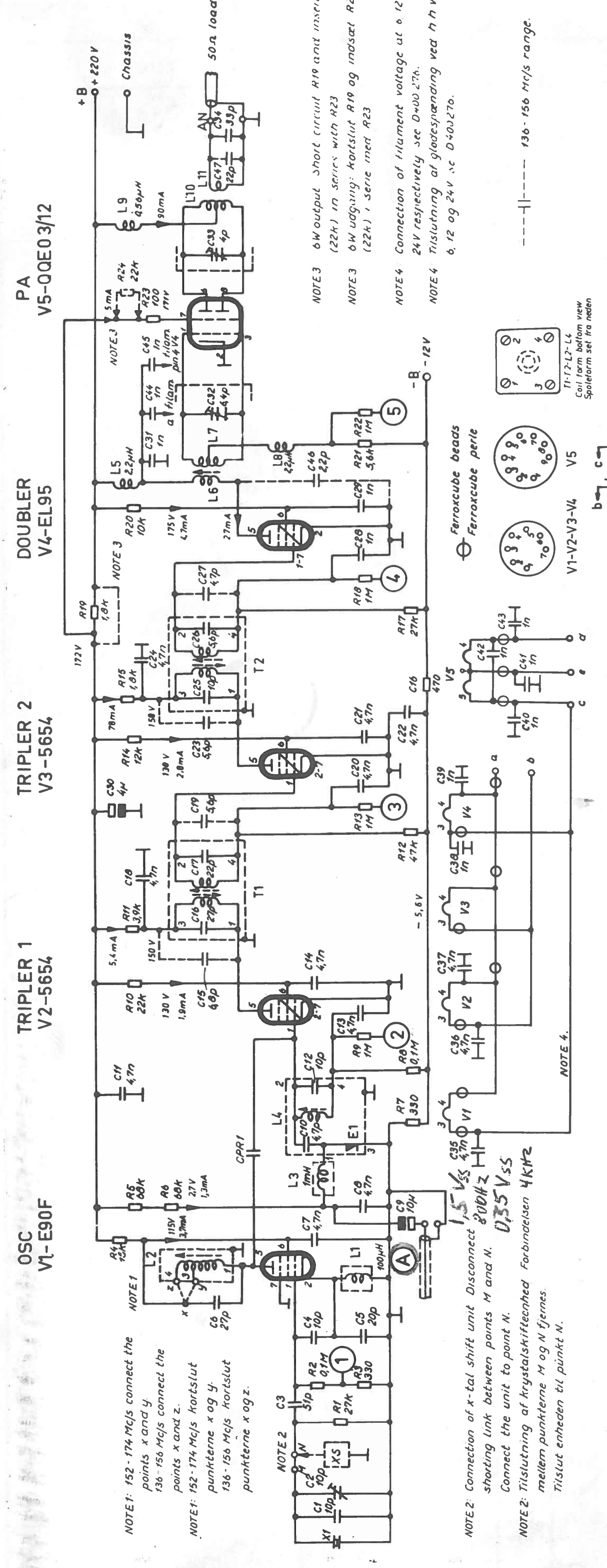
Filament voltage circuit in TX19/39
Glødespændingskredsløb i RC19/39

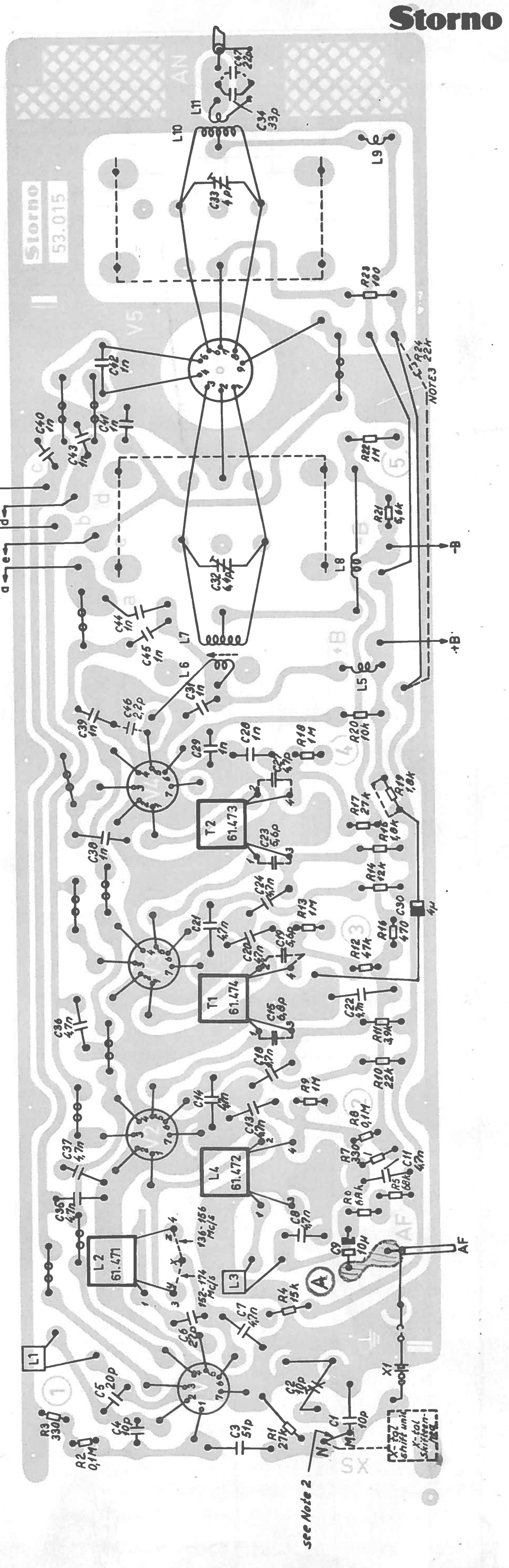
 Storno



FUNCTION LAY OUT
FUNKTIONSDIAGRAM
STORNOPHONE V

Storno

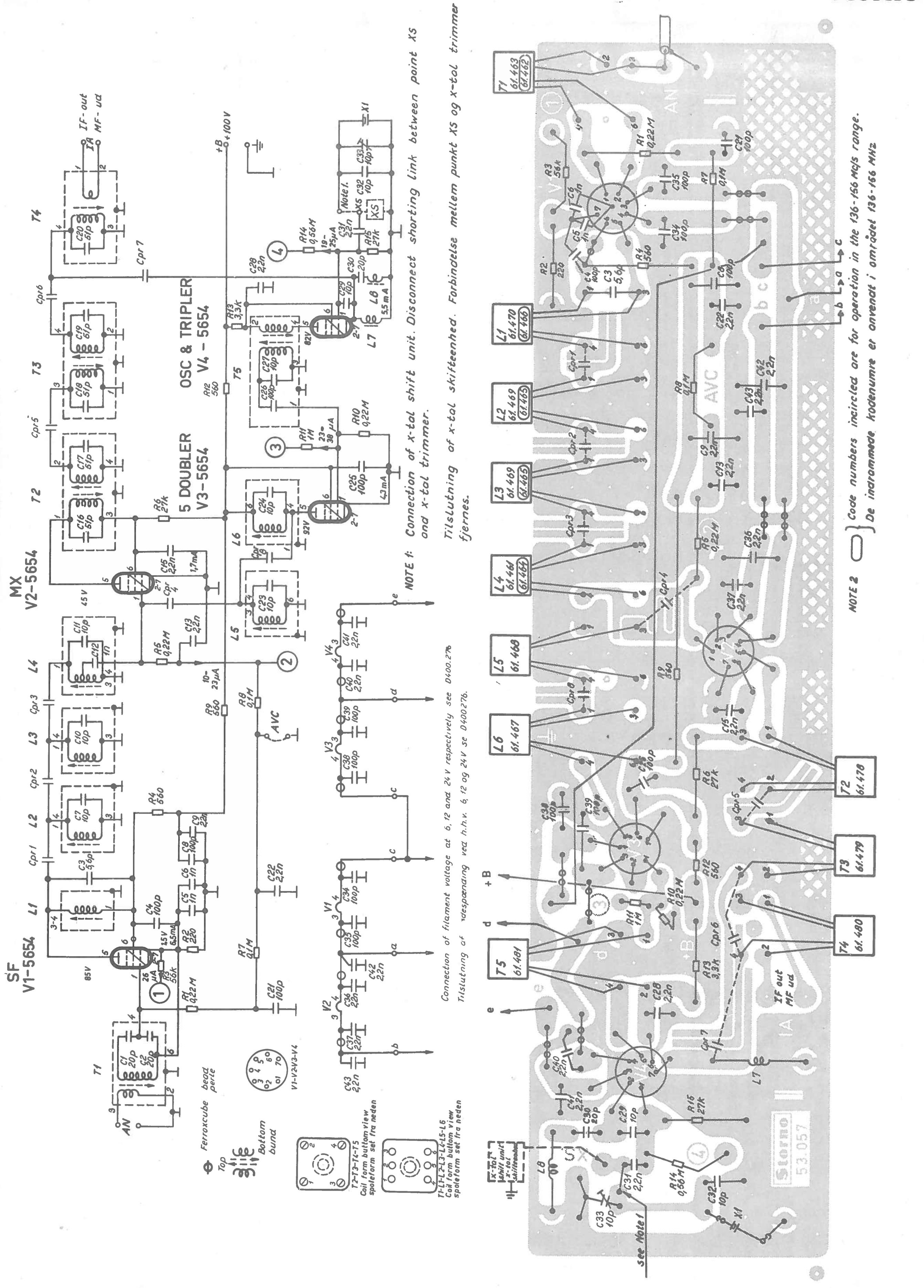




TRANSMITTER TX19-1
SENDER TX19L-1

type	no	code	data
	C1	74.5006	10pF ±5% ceram. 500V
	C2	78.5001	10pF trimmer 200V
	C3	74.5012	51pF ±5% ceram. 250V
	C4	74.5006	10pF ±5% " 500V
	C5	74.5007	20pF ±5% " 500V
	C6	74.5009	27pF ±5% " 500V
	C7	74.5020	4.7nF -20/+50% ceram. 500V
	C8	74.5020	4.7nF -20/+50% " 500V
	C9	73.5001	10 µF -10/+50% el.lyt. 25V
	C10	74.5001	4.7pF ±0.2pF ceram. 500V
	C11	74.5020	4.7nF -20/+50% " 500V
	C12	74.5006	10 pF ±5% " 500V
	C13	74.5020	4.7nF -20/+50% " 500V
	C14	74.5020	4.7nF -20/+50% " 500V
19L	C15	74.5021	6.8pF ±0.25pF " 500V
	C16	74.5009	27pF ±5% ceram. 500V
	C17	74.5008	22pF ±5% " 500V
	C18	74.5020	4.7nF -20/+50% ceram. 500V
19L	C19	74.5004	5.6pF ±0.25pF " 500V
	C20	74.5020	4.7nF -20/+50% " 500V
	C21	74.5020	4.7nF -20/+50% " 500V
	C22	74.5020	4.7nF -20/+50% " 500V
19L	C23	74.5004	5.6pF ±0.25pF " 500V
	C24	74.5020	4.7nF -20/+50% " 500V
	C25	74.5014	100pF ±5% N150 " 500V
	C26	74.5004	5.6pF ±0.25pF " 500V
19L	C27	74.5001	4.7pF ±0.25pF " 500V
	C28	74.5016	1nF -20/+50% " 500V
	C29	74.5016	1nF -20/+50% " 500V
	C30	73.5004	4 µF el.lyt. 250V
	C31	74.5016	1nF -20/+50% " 500V
	C32	78.5002	6.4pF trimmer
	C33	78.5003	4.0pF trimmer
	C34	74.5010	33pF ±5% ceram. 250V
	C35	74.5020	4.7nF -20/+50% ceram. 500V
	C36	74.5020	4.7nF -20/+50% " 500V
	C37	74.5020	4.7nF -20/+50% " 500V
	C38	74.5016	1nF -20/+50% " 500V
	C39	74.5016	1nF -20/+50% " 500V
	C40	74.5016	1nF -20/+50% " 500V
	C41	74.5016	1nF -20/+50% " 500V
	C42	74.5016	1nF -20/+50% " 500V
	C43	74.5016	1nF -20/+50% " 500V
	C44	74.5016	1nF -20/+50% " 500V
	C45	74.5016	1nF -20/+50% " 500V
	C46	74.5029	2,2pF ±0,25pF " 500V
	C47	74.5008	22pF ±5% " 500V
	R1	80.5466	27kΩ ±5% carbon $\frac{1}{4}$W
	R2	80.5473	0.1MΩ " " $\frac{1}{4}$W
	R3	80.5443	330Ω " " $\frac{1}{4}$W
	R4	81.5063	15kΩ " " $\frac{1}{2}$W
	R5	80.5471	68kΩ " " $\frac{1}{4}$W
	R6	80.5471	68kΩ " " $\frac{1}{4}$W
	R7	80.5443	330Ω " " $\frac{1}{4}$W
	R8	80.5473	0.1MΩ " " $\frac{1}{4}$W
	R9	80.5485	1MΩ " " $\frac{1}{4}$W
	R10	80.5465	22kΩ " " $\frac{1}{4}$W
	R11	80.5456	3.9kΩ " " $\frac{1}{4}$W
	R12	80.5469	47kΩ " " $\frac{1}{4}$W
	R13	80.5485	1MΩ " " $\frac{1}{4}$W
	R14	80.5462	12kΩ " " $\frac{1}{4}$W
	R15	80.5452	1.8kΩ " " $\frac{1}{4}$W
	R16	80.5445	470Ω " " $\frac{1}{4}$W
	R17	80.5466	27kΩ " " $\frac{1}{4}$W
	R18	80.5485	1MΩ " " $\frac{1}{4}$W
	R19	84.5001	1.8kΩ " Wirewound 5.5W
	R20	81.5061	10kΩ ±5% carbon $\frac{1}{2}$W
	R21	80.5458	5.6kΩ " " $\frac{1}{4}$W
	R22	80.5485	1MΩ " " $\frac{1}{4}$W
	R23	80.5437	100Ω " " $\frac{1}{4}$W
	R24	83.5065	22kΩ " " 2W
	E1	99.5005	Germ.diode OA81

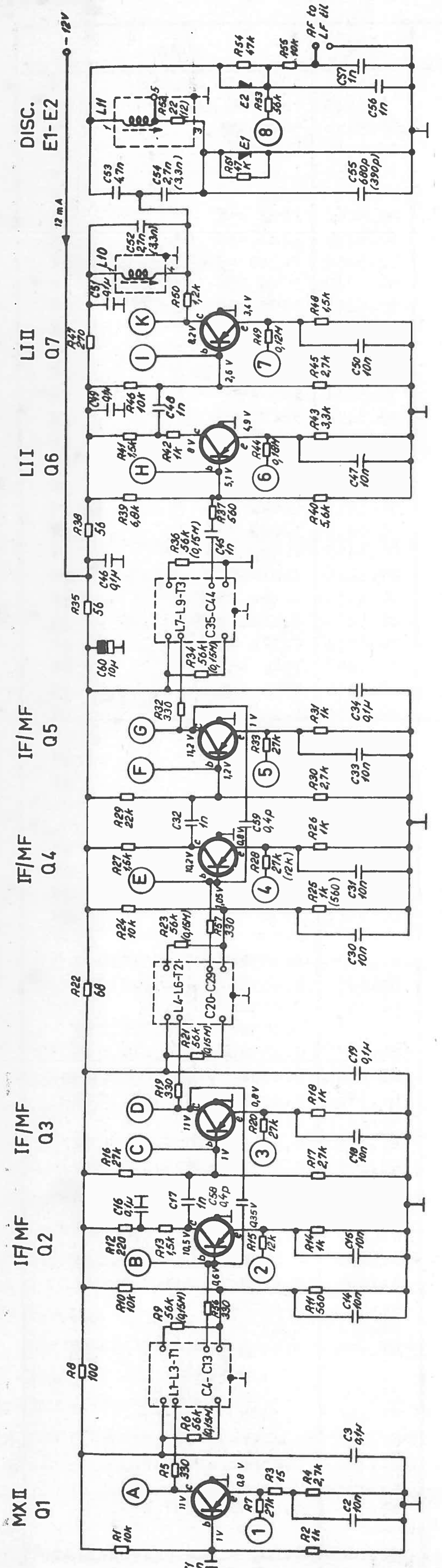
type	no	code	data
	L1	61.5004	100 µH choke
	L2	61.471	7.5-9.7 Mc/s coil
	L3	61.5005	1 mH choke
	L4	61.472	7.5-9.7 Mc/s coil C10,C12,E1
	L5	63.5002	0,56 µH ±10% choke
	L6	61.488	136-174 Mc/s coil
19L	L7	62.581	136-156 Mc/s coil
19	L7	62.576	152-174 Mc/s coil
	L8	63.5004	2,2 µH ±10% choke
	L9	63.5002	0,56 µH ±10% choke
	L10	62.582	136-174 Mc/s coil
	L11	62.583	136-174 Mc/s ant. coil
	T1	61.474	22,7-29 Mc/s Transf. C16,C17
	T2	61.473	68-87 Mc/s Transf. C25,C26
	V1	99.5001	penthode E90F
	V2	99.5002	" 5654/M8100
	V3	99.5002	" 5654/M8100
	V4	99.5003	" EL95
	V5	99.5004	duotetrode QQE03/12
	X1	98.	X-tal Storno type 98-5 (25 kc/s chann. sep.)
		98.	X-tal Storno type 98-1 (50 kc/s chann. sep.)

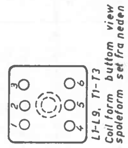


RECEIVER RC19-1
MODTAGER RC19L-1

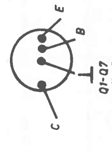
type	no	code	data
	C1	74.5007	20pF ±5% N150 ceram. 500V
	C2	74.5007	20pF ±5% N150 " 500V
	C3	74.5005	5,6pF ±0,25pF N750 500V
	C4	74.5013	100pF ±20% ceram. 500V
	C5	74.5016	1nF -20/+50% " 500V
	C6	74.5016	1nF -20/+50% " 500V
	C7	74.5006	10pF ±5% N150 " 500V
	C8	74.5013	100pF ±20% " 500V
	C9	74.5017	2,2nF -20/+50% " 500V
	C10	74.5006	10pF ±5% N150 " 500V
	C11	74.5006	10pF ±5% N150 " 500V
	C12	74.5016	1nF -20/+50% " 500V
	C13	74.5017	2,2nF -20/+50% " 500V
	C15	74.5017	2,2nF -20/+50% " 500V
	C16	74.5012	51pF ±5% N150 " 250V
	C17	74.5012	51pF ±5% N150 " 250V
	C18	74.5012	51pF ±5% N150 " 250V
	C19	74.5012	51pF ±5% N150 " 250V
	C20	74.5012	51pF ±5% N150 " 250V
	C21	74.5013	100pF ±20% " 500V
	C22	74.5017	2,2nF -20/+50% " 500V
	C23	74.5006	10pF ±5% N150 " 500V
	C24	74.5006	10pF ±5% N150 " 500V
	C25	74.5013	100pF ±20% " 500V
	C26	74.5013	100pF ±20% " 500V
	C27	74.5006	10pF ±5% N150 " 500V
	C28	74.5017	2,2nF -20/+50% " 500V
	C29	74.5006	10pF ±5% N150 " 500V
	C30	74.5007	20pF ±5% N150 " 500V
	C31	74.5017	2,2nF -20/+50% " 500V
	C32	74.5006	10pF ±5% N150 " 500V
	C33	78.5001	10pF trimmer 200V
	C34	74.5013	100pF ±20% " 500V
	C35	74.5013	100pF ±20% " 500V
	C36	74.5017	2,2nF -20/+50% " 500V
	C37	74.5017	2,2nF -20/+50% " 500V
	C38	74.5013	100pF ±20% " 500V
	C39	74.5013	100pF ±20% " 500V
	C40	74.5017	2,2nF -20/+50% " 500V
	C41	74.5017	2,2nF -20/+50% " 500V
	C42	74.5017	2,2nF -20/+50% " 500V
	C43	74.5017	2,2nF -20/+50% " 500V
	R1	80.5477	0,22 MΩ ±5% carbon ¼W
	R2	80.5441	220 Ω ±5% " ¼W
	R3	80.5470	56 kΩ ±5% " ¼W
	R4	80.5446	560Ω ±5% " ¼W
	R5	80.5477	0,22MΩ ±5% " ¼W
	R6	80.5466	27 kΩ ±5% " ¼W
	R7	80.5473	0,1 MΩ ±5% " ¼W
	R8	80.5473	0,1 MΩ ±5% " ¼W
	R9	80.5446	560 Ω ±5% " ¼W
	R10	80.5477	0,22 MΩ " ¼W
	R11	80.5485	1 MΩ ±10% " ¼W
	R12	80.5446	560Ω ±5% " ¼W
	R13	80.5455	3,3kΩ ±5% " ¼W
	R14	80.5482	0,56 MΩ ±5% " ¼W
	R15	80.5466	27kΩ ±5% " ¼W
19-1	L1	61.470	RF coil
19L-1	L1	61.466	RF coil
19-1	L2	61.469	RF coil C7
19L-1	L2	61.465	RF coil C7
19-1	L3	61.469	RF coil C10
19L-1	L3	61.465	RF coil C7
19-1	L4	61.461	RF coil C11, C12
19L-1	L4	61.464	RF coil C11, C12

type	no	code	data
	L5	61.468	5 xF coil C23
	L6	61.467	5 xF coil C24
	L7	61.5004	100 μH
	L8	61.482	tripler coil
19-1	T1	61.463	ant. coil C1,C2
19L-1	T1	61.462	ant. coil C1,C2
	T2	61.478	high IF coil 9,05-10,65Mc/s C16,C17
	T3	61.479	high IF coil 9,05-10,65Mc/s C18,C19
	T4	61.480	high IF coil 9,05-10,65Mc/s C20
	T5	61.481	tripler coil 28,5-32,7Mc/s C26,C27
	V1	99.5002	Pentode 5654/6AK5W
	V2	99.5002	Pentode 5654/6AK5W
	V3	99.5002	Pentode 5654/6AK5W
	V4	99.5002	Pentode 5654/6AK5W
	X1	98.	X-tal Storno type 98-5 (for 25kc/s chann.sep.)
		98.	X-tal Storno type 98-1 (for 50kc/s chann. sep.)



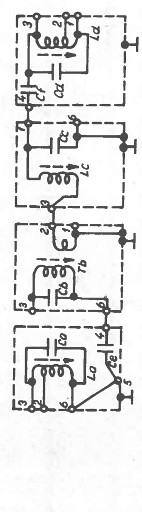


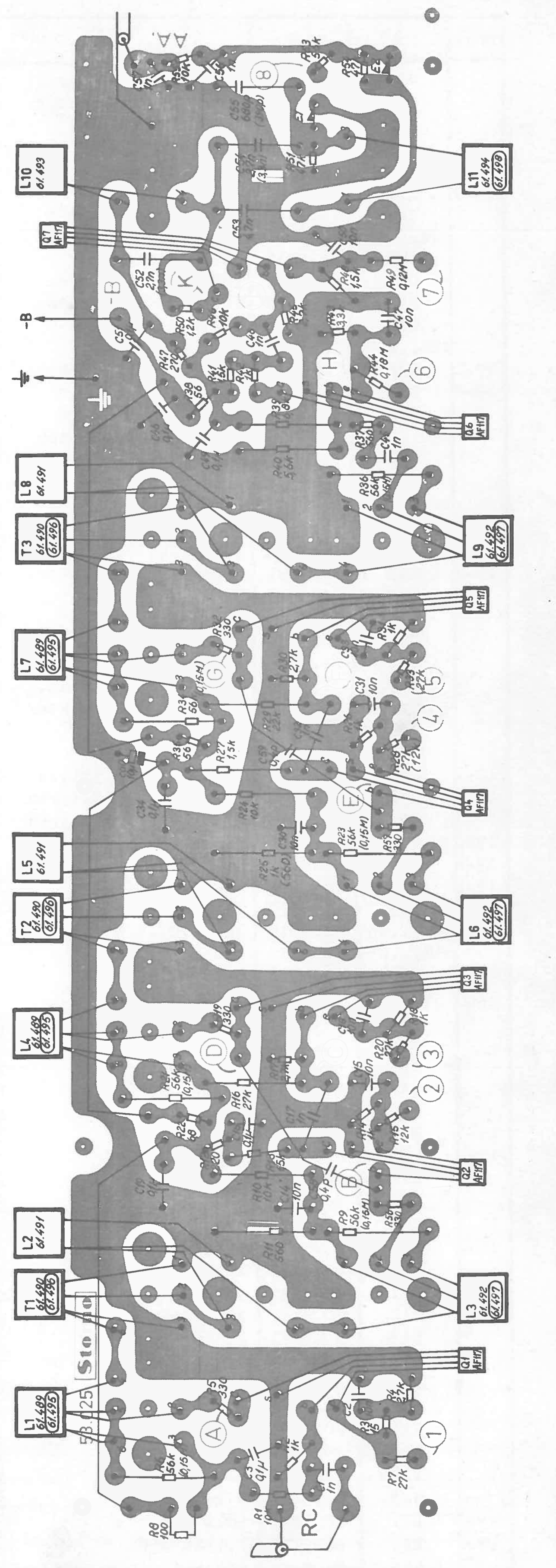
IA19-2
( ) Values changed
( ) Værdier ændret



Ca - C4-5 C20-21 C35-36
Cb - C6-7 C22-23 C37-38
Cc - C8-9 C24-25 C39-40
Cd - C10-11 C26-27 C41-42
Ce - C12 - C28 - C43
Cf - C13 - C29 - C44

La - L1, L4, L7
Tb - T1, T2, T3
Lc - L2, L5, L8
Ld - L3, L6, L9

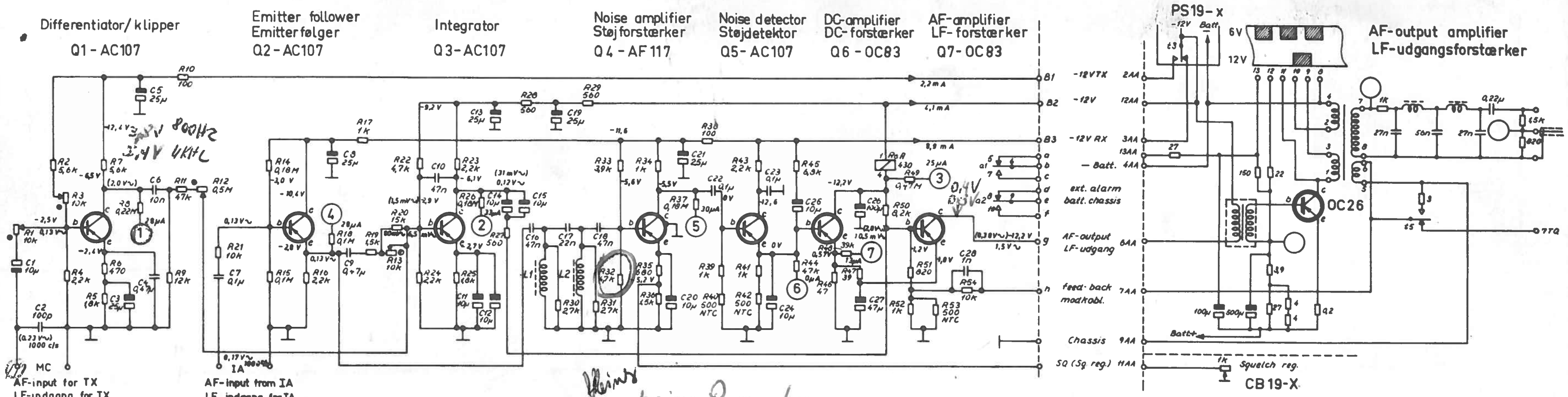




IF-AMPLIFIER IA19-1
MF-FORSTÆRKER IA19-2

type	no	code	data	
	C1	74.5015	1nF -20/+50 ceram.	500V
	C2	76.5028	10nF ±10% Polyester	125V
	C3	76.5036	0.1 µF ±10% "	125V
	C4...C11	74.5018	68pF ±5% ceram.	500V
19-1	C12	74.5019	7,5pF ±0,25pF ceram.	500V
19-2	C12	74.5091	3,9pF ±0,25pF "	500V
	C13	74.5019	7,5pF ±0,25pF "	500V
	C14...C15	76.5028	10nF ±10% Polyester	125V
	C16	76.5036	0.1µF ±10% "	125V
	C17	74.5015	1nF -20/+50% ceram.	500V
	C18	76.5028	10nF ±10% Polyester	125V
	C19	76.5036	0.1µF ±10% "	125V
	C20...C27	74.5018	68pF ±5% ceram.	500V
19-1	C28	74.5019	7,5pF ±0,25pF ceram.	500V
19-2	C28	74.5091	3,9pF ±0,25pF "	500V
	C29	74.5019	7,5pF ±0,25pF "	500V
	C30...C31	76.5028	10nF ±10% Polyester	125V
	C32	74.5015	1nF -20/+50% ceram.	500V
	C33	76.5028	10nF ±10% Polyester	125V
	C34	76.5036	0.1µF ±10% "	125V
	C35...C42	74.5018	68pF ±5% ceram.	500V
19-1	C43	74.5019	7,5pF ±0,25pF ceram.	500V
19-2	C43	74.5091	3,9pF ±0,25pF "	500V
	C44	74.5019	7,5pF ±0,25pF "	500V
	C45	74.5015	1nF -20/+50% "	500V
	C46	76.5036	0,1µF ±10% Polyester	125V
	C47	76.5028	10nF ±10% "	125V
	C48	74.5015	1nF -20/+50% ceram.	500V
	C49	76.5036	0,1µF ±10% Polyester	125V
	C50	76.5028	10nF ±10% "	125V
	C51	76.5036	0,1µF ±10% "	125V
19-1	C52	76.5019	2,7nF ±5% Polystyren	125V
19-2	C52	76.5020	3,3nF ±5% Polystyren	125V
	C53	76.5021	4,7nF ±5% Polystyren	125V
19-1	C54	76.5019	2,7nF ±5% "	125V
19-2	C54	76.5020	3,3nF ±5% "	125V
19-1	C55	76.5018	680pF ±5% "	125V
19-2	C55	76.5017	390pF ±5% "	125V
	C56...C57	74.5015	1nF -20/+50% ceram.	500V
	C58...C59	74.5022	0,4pF ±0,1pF "	500V
	C60	73.5001	10µF el.lyt.	25V
	R1	80.5461	10kΩ ±5% carbon	¼W
	R2	80.5449	1kΩ ±5% "	¼W
	R3	80.5427	15Ω ±5% "	¼W
	R4	80.5454	2.7kΩ ±5% "	¼W
	R5	80.5443	330Ω ±5% "	¼W
19-1	R6	80.5470	56kΩ ±5% "	¼W
19-2	R6	80.5475	0.15MΩ ±5% "	¼W
	R7	80.5466	27kΩ ±5% "	¼W
	R8	80.5437	100Ω ±5% "	¼W
19-1	R9	80.5470	56kΩ ±5% "	¼W
19-2	R9	80.5475	0.15MΩ ±5% "	¼W
	R10	80.5461	10kΩ ±5% "	¼W
	R11	80.5446	560Ω ±5% "	¼W
	R12	80.5441	220Ω ±5% "	¼W
	R13	80.5451	1.5kΩ ±5% "	¼W
	R14	80.5449	1kΩ ±5% "	¼W
	R15	80.5462	12kΩ ±5% "	¼W
	R16	80.5466	27kΩ ±5% "	¼W
	R17	80.5454	2.7kΩ ±5% "	¼W
	R18	80.5449	1kΩ ±5% "	¼W
	R19	80.5443	330Ω ±5% "	¼W
	R20	80.5466	27kΩ ±5% "	¼W
19-1	R21	80.5470	56kΩ ±5% "	¼W
19-2	R21	80.5475	0.15MΩ ±5% "	¼W
	R22	80.5435	68Ω ±5% "	¼W
19-1	R23	80.5470	56kΩ ±5% "	¼W
19-2	R23	80.5475	0.15MΩ ±5% "	¼W

type	no	code	data	
	R24	80.5461	10kΩ ±5% carbon	¼W
19-1	R25	80.5449	1kΩ ±5% carbon	¼W
19-2	R25	80.5446	560Ω ±5% "	¼W
	R26	80.5449	1kΩ ±5% "	¼W
	R27	80.5451	1.5kΩ ±5% "	¼W
19-1	R28	80.5466	27kΩ ±5% "	¼W
19-2	R28	80.5462	12kΩ ±5% "	¼W
	R29	80.5465	22kΩ ±5% "	¼W
	R30	80.5454	2.7kΩ ±5% "	¼W
	R31	80.5449	1 kΩ ±5% "	¼W
	R32	80.5443	330Ω ±5% "	¼W
	R33	80.5466	27kΩ ±5% "	¼W
19-1	R34	80.5470	56kΩ ±5% "	¼W
19-2	R34	80.5475	0.15MΩ ±5% "	¼W
	R35	80.5434	56Ω ±5% "	¼W
19-1	R36	80.5470	56kΩ ±5% "	¼W
19-2	R36	80.5475	0.15MΩ ±5% "	¼W
	R37	80.5446	560Ω ±5% "	¼W
	R38	80.5434	56Ω ±5% "	¼W
	R39	80.5459	6.8kΩ ±5% "	¼W
	R40	80.5458	5.6kΩ ±5% "	¼W
	R41	80.5451	1.5kΩ ±5% "	¼W
	R42	80.5449	1kΩ ±5% "	¼W
	R43	80.5455	3.3kΩ ±5% "	¼W
	R44	80.5476	0.18MΩ ±5% "	¼W
	R45	80.5454	2.7kΩ ±5% "	¼W
	R46	80.5461	10kΩ ±5% "	¼W
	R47	80.5442	270Ω ±5% "	¼W
	R48	80.5451	1.5kΩ ±5% "	¼W
	R49	80.5474	0.12MΩ ±5% "	¼W
	R50	80.5450	1.2kΩ ±5% "	¼W
	R51	80.5469	47kΩ ±5% "	¼W
19-1	R52	80.5029	22Ω ±5% "	0.1W
19-2	R52	80.5026	12Ω ±5% "	0.1W
	R53	80.5470	56kΩ ±5% "	¼W
	R54	80.5469	47kΩ ±5% "	¼W
	R55	80.5461	10kΩ ±5% "	¼W
	R56..R57	80.5443	330Ω ±5% "	¼W
19-1	L1	61.489	0.455Mc/s C4,C5,C12	
19-2	L1	61.495	0.455Mc/s C4,C5,C12	
	L2	61.491	0.455Mc/s C8,C9	
19-1	L3	61.492	0.455Mc/s C10,C11,C13	
19-2	L3	61.497	0.455Mc/s C10,C11,C13	
19-1	L4	61.489	0.455Mc/s C20,C21,C28	
19-2	L4	61.495	0.455Mc/s C20,C21,C28	
	L5	61.491	0.455Mc/s C24,C25	
19-1	L6	61.492	0.455Mc/s C26,C27,C29	
19-2	L6	61.497	0.455Mc/s C26,C27,C29	
19-1	L7	61.489	0.455Mc/s C35,C36,C43	
19-2	L7	61.495	0.455Mc/s C35,C36,C43	
	L8	61.491	0.455Mc/s C39,C40	
19-1	L9	61.492	0.455Mc/s C41,C42,C44	
19-2	L9	61.497	0.455Mc/s C41,C42,C44	
	L10	61.493	0.455Mc/s	
19-1	L11	61.494	0.455Mc/s R52	
19-2	L11	61.498	0.455Mc/s R52	
19-1	T1	61.490	0.455Mc/s C6,C7	
19-2	T1	61.496	0.496Mc/s C6,C7	
19-1	T2	61.490	0.455Mc/s C22,C23	
19-2	T2	61.496	0.455Mc/s C22,C23	
19-1	T3	61.490	0.455Mc/s C37,C38	
19-2	T3	61.496	0.455Mc/s C37,C38	
	E1-E2	95.5006	Germ. diode OA79 udmålt	
	Q1...Q7	99.5007	Transistor AF117	



beim Rauschen R32 u.U. verkleinern

Mod. f. Sender
0,6 Vss 800Hz
1,2 Vss 4 KHz

Remarks to DC-measurement:

a: Set the Sq. reg. to 40 dB att. of output noise

b: Short circuit the terminals IA and MC.

c: DC valve-voltmeter is used.

Bemærkninger til DC-målinger:

a: Indstil Sq. reg. til 40 dB dæmpning af udg. støj

b: Klemmerne IA og MC kortsluttes

c: Målingerne foretages med DC-rørvoltmeter.

Remarks to AC-measurements:

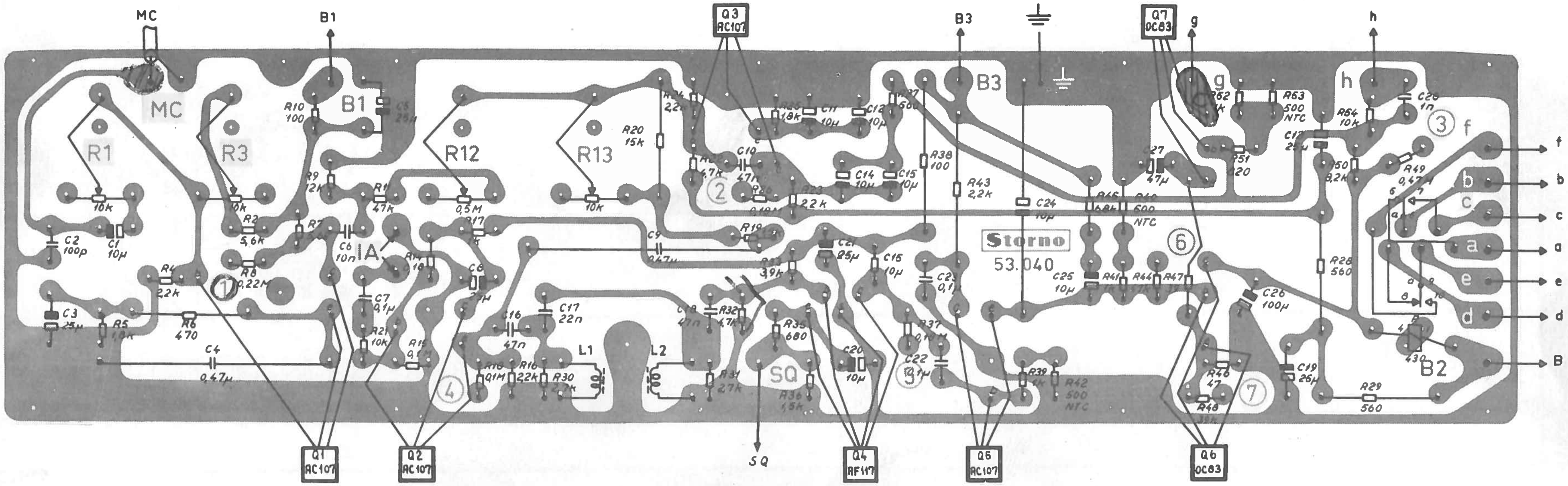
Values in ( ) are valid from term. MC to TQ/7

Values without ( ) are valid from term. IA to TX/11

Bemærkninger til AC-målinger.

Værdier i ( ) gælder fra klemmerne MC til TQ/7

Værdier uden ( ) gælder fra klemmerne IA til TX/11



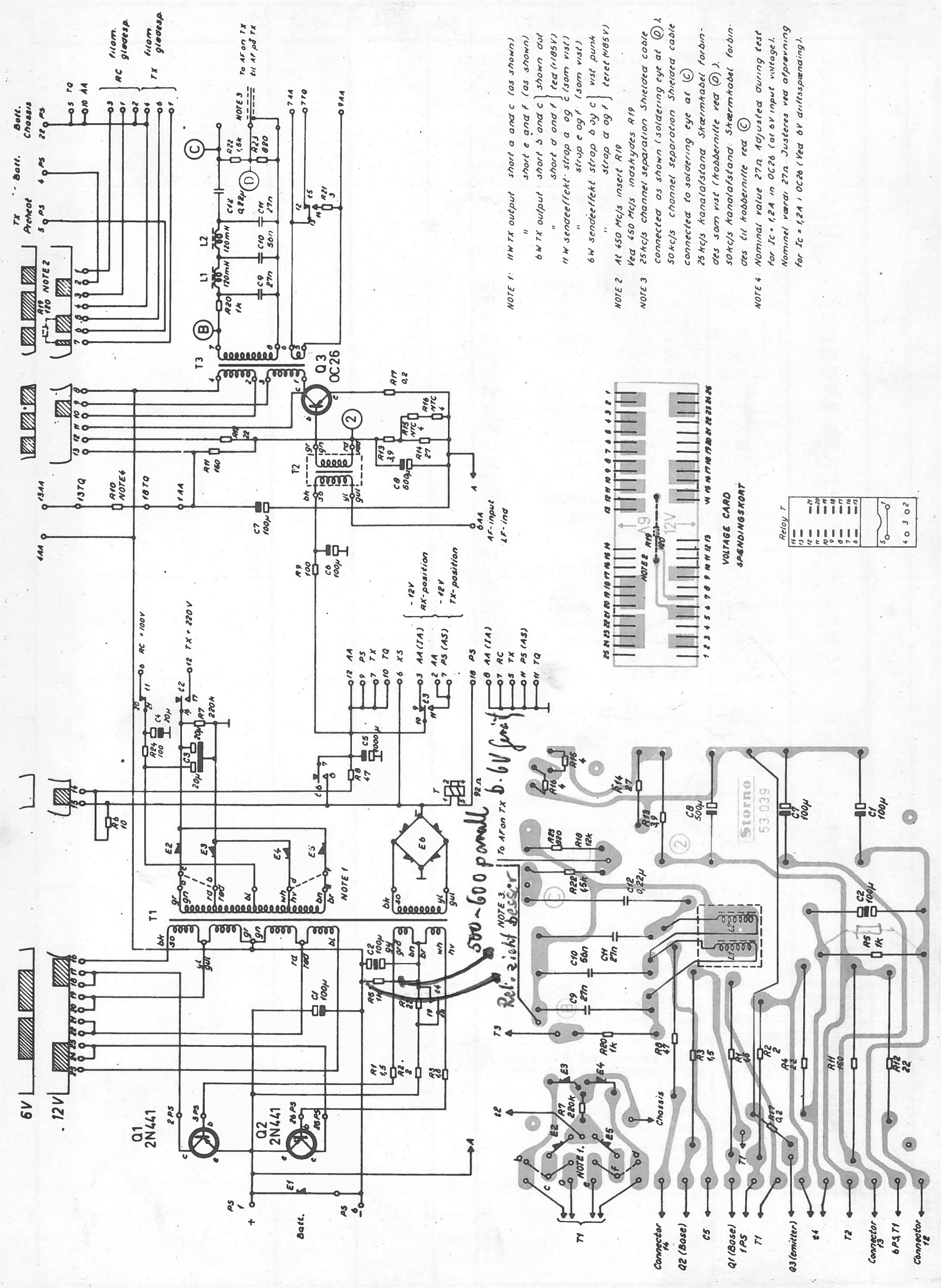
AF-AMPLIFIER
LF-FORSTÆRKER

AA19-1

type	no	code	data
	C1	73.5001	10µF -10/+50% el.lyt 25V
	C2	74.5014	100pF ±5% N150 ceram. 500V
	C3	73.5023	25µF -10/+50% el.lyt. 25V
	C4	76.5027	0.47µF ±10% polyest. 125V
	C5	73.5023	25µF -10/+50% el.lyt 25V
	C6	76.5028	10nF ±10% polyest. 125V
	C7	76.5036	0.1µF ±10% " 100V
	C8	73.5023	25µF -10/+50% el.lyt 25V
	C9	76.5027	0.47 ±10% polyest. 125V
	C10	76.5033	47nF ±10% " 125V
	C11	73.5001	10µF -10/+50% el.lyt 25V
	C12	73.5001	10µF -10/+50% " 25V
	C13	73.5023	25µF -10/+50% " 25V
	C14	73.5001	10µF -10/+50% " 25V
	C15	73.5001	10µF -10/+50% " 25V
	C16	76.5033	47nF ±10% polyest. 125V
	C17	76.5029	22nF ±10% " 125V
	C18	76.5033	47nF ±10% " 125V
	C19	73.5023	25µF -10/+50% el.lyt 25V
	C20	73.5009	10µF ±20% tantal 10V
	C21	73.5023	25µF -10/+50% el.lyt 25V
	C22	76.5036	0.1µF ±10% polyest. 125V
	C23	76.5036	0.1µF ±10% 125V
	C24	73.5009	10µF ±20% tantal 10V
	C25	73.5001	10µF -10/+50% el.lyt 25V
	C26	73.5052	100µF " 25V
	C27	73.5029	47µF -20/+50% " 6V
	C28	76.5022	1nF ±10% polyest. 400V
	R1	86.5008	10kΩ pot. carbon ¼W
	R2	80.5458	5.6kΩ ±5% " ¼W
	R3	86.5008	10kΩ pot. " ¼W
	R4	80.5453	2.2kΩ ±5% " ¼W
	R5	80.5452	1.8kΩ ±5% " ¼W
	R6	80.5445	470Ω ±5% " ¼W
	R7	80.5458	5.6kΩ ±5% " ¼W
	R8	80.5477	0.22MΩ ±5% " ¼W
	R9	80.5462	12kΩ ±5% " ¼W
	R10	80.5437	100Ω ±5% " ¼W
	R11	80.5469	47kΩ ±5% " ¼W
	R12	86.5023	0.5MΩ pot. " ¼W
	R13	80.5008	10kΩ pot. " ¼W
	R14	80.5476	0.18MΩ ±5% " ¼W
	R15	80.5473	0.1MΩ ±5% " ¼W
	R16	80.5453	2.2kΩ ±5% " ¼W
	R17	80.5449	1kΩ ±5% " ¼W
	R18	80.5473	0.1MΩ ±5% " ¼W
	R19	80.5452	1.8kΩ ±5% " ¼W
	R20	80.5451	1.5kΩ ±5% " ¼W
	R21	80.5461	10kΩ ±5% " ¼W
	R22	80.5457	4.7kΩ ±5% " ¼W
	R23	80.5453	2.2kΩ ±5% " ¼W
	R24	80.5453	2.2kΩ ±5% " ¼W
	R25	80.5452	1.8kΩ ±5% " ¼W
	R26	80.5475	0.15MΩ ±5% " ¼W
	R27	80.5446	560Ω ±5% " ¼W
	R28	80.5446	560Ω ±5% " ¼W
	R29	80.5446	560Ω ±5% " ¼W
	R30	80.5454	2.7kΩ ±5% " ¼W
	R31	80.5454	2.7kΩ ±5% " ¼W
	R32	80.5457	4.7kΩ ±5% " ¼W
	R33	80.5456	3.9kΩ ±5% " ¼W
	R34	80.5449	1kΩ ±5% " ¼W
	R35	80.5447	680Ω ±5% " ¼W
	R36	80.5451	1.5kΩ ±5% " ¼W
	R37	80.5476	0.18MΩ ±5% " ¼W
	R38	80.5437	100Ω ±5% " ¼W
	R39	80.5449	1kΩ ±5% " ¼W
	R40	89.5005	500Ω NTC 1W

type	no	code	data
	R41	80.5449	1kΩ ±5% carbon ¼W
	R42	89.5005	500Ω NTC 1W
	R43	80.5453	2.2kΩ ±5% " ¼W
	R44	80.5469	47kΩ ±5% " ¼W
	R45	80.5459	6.8kΩ ±5% " ¼W
	R46	80.5433	47Ω ±5% " ¼W
	R47	80.5432	39Ω ±5% " ¼W
	R48	80.5468	39kΩ ±5% " ¼W
	R49	80.5481	0.47MΩ ±5% " ¼W
	R50	80.5460	8.2kΩ ±5% " ¼W
	R51	80.5448	820Ω ±5% " ¼W
	R52	80.5449	1kΩ ±5% " ¼W
	R53	89.5005	500Ω NTC 1W
	R54	80.5461	10kΩ ±5% " ¼W
	L1	61.486	Squelch filter coil
	L2	61.486	Squelch filter coil
	Q1	99.5008	Transistor AC 107
	Q2	99.5008	Transistor AC 107
	Q3	99.5008	Transistor AC 107
	Q4	99.5007	Transistor AF 117
	Q5	99.5008	Transistor AC 107
	Q6	99.5021	Transistor OC 83
	Q7	99.5021	Transistor OC 83
	Re A	58.5023	Squelch relay

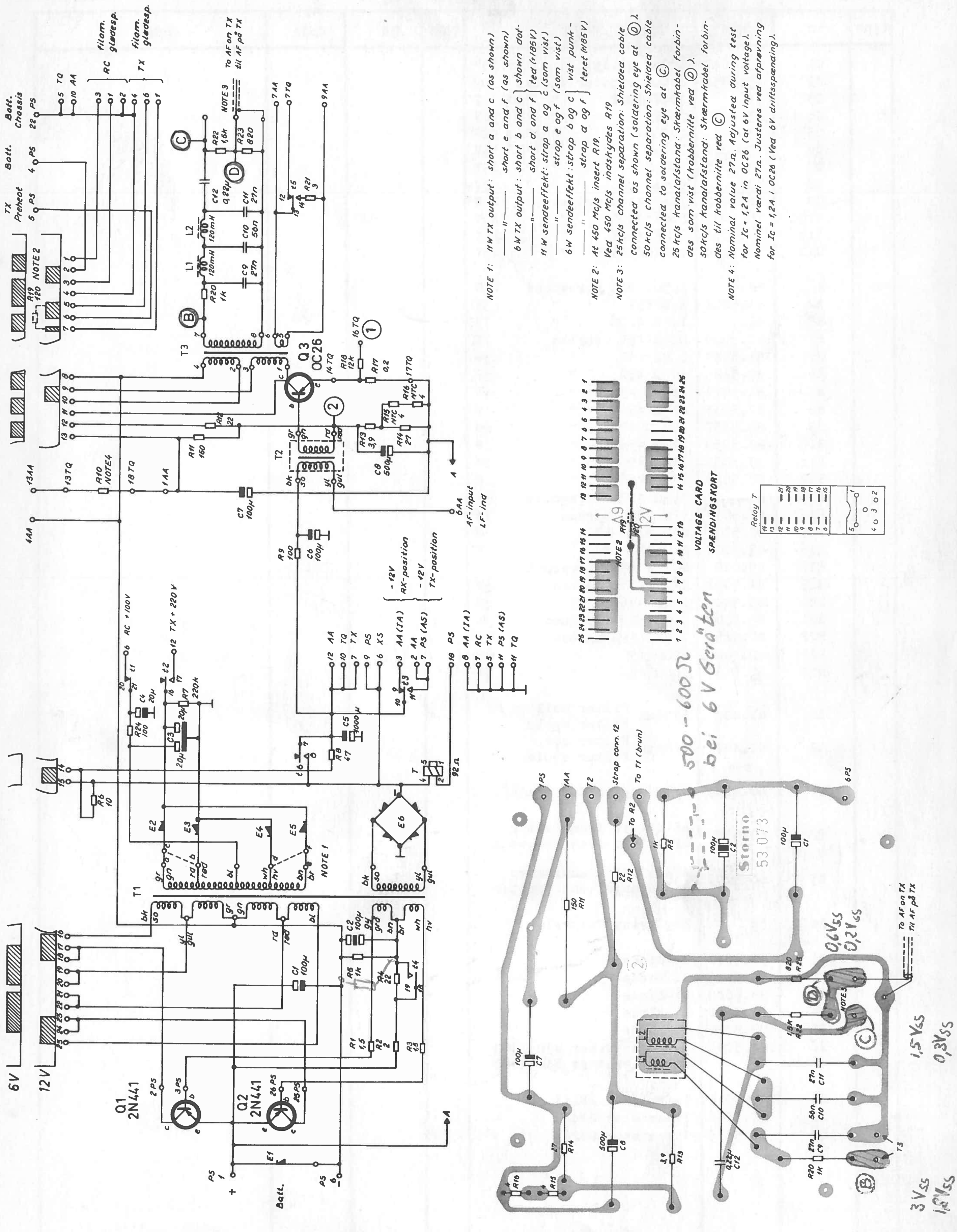
Storno



POWER SUPPLY and AF-OUTPUT AMPLIFIER
STRØMFORSYNING og LF-UDG. FORSTÆRKER

PS19-1

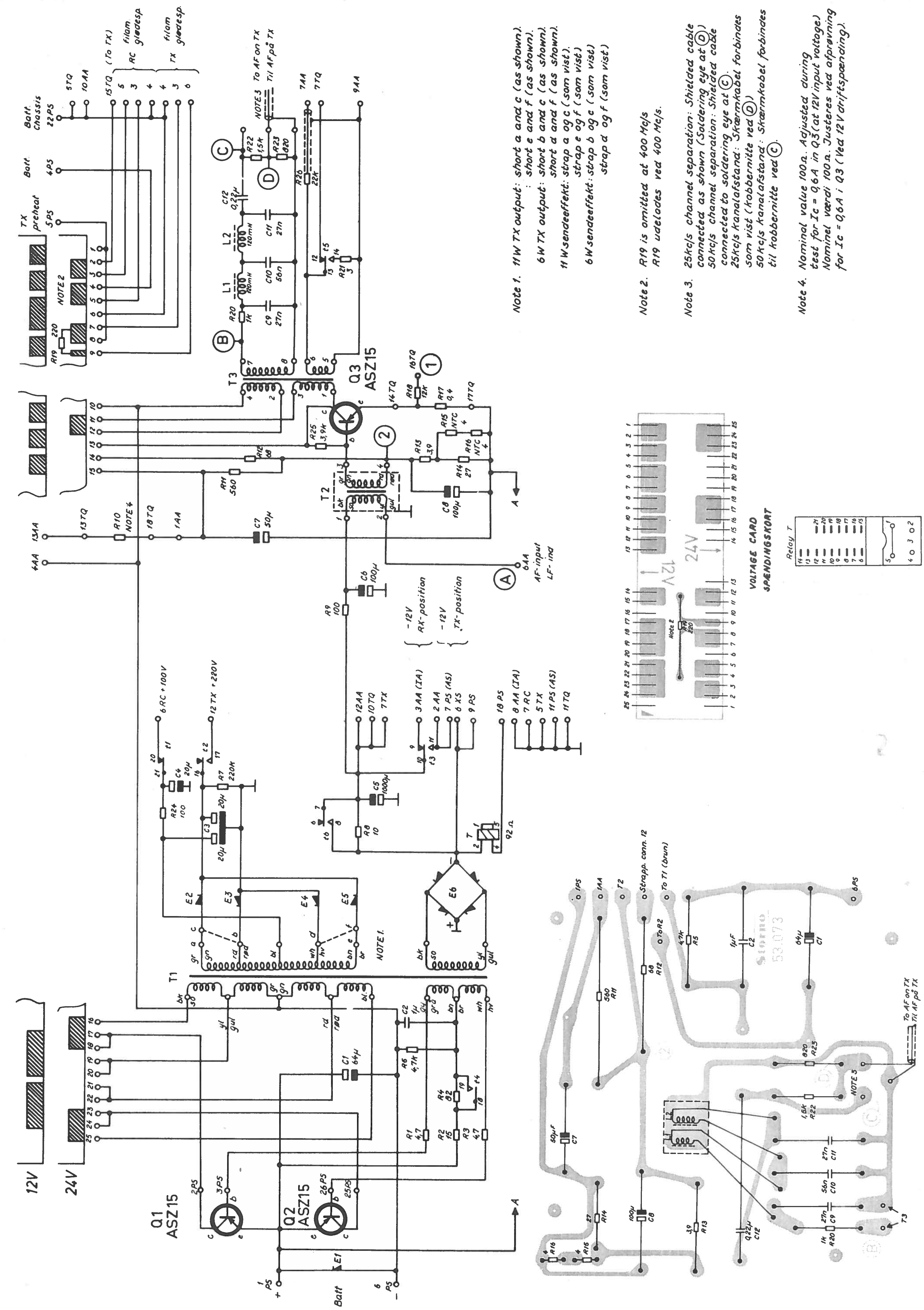
type	no	code	data	type	no	code	data
	C1	73.5042	100µF el.lyt 15V				
	C2	73.5054	100µF bipolar el.lyt 30V				
	C3	73	20µF+20µF " "400/175				
	C4	73.5017	20µF " " 250V				
	C5	73.5047	1000µF " " 20V				
	C6	73.5042	100µF " " 15V				
	C7	73.5042	100µF " " 15V				
	C8	73.	500µF " " 3V				
	C9	76.5032	27nF ±10% polyest. 125V				
	C10	76.5037	56nF ±10% " 125V				
	C11	76.5032	27nF ±10% " 125V				
	C12	76.5039	0.22µF ±10% " 125V				
	R1	82.	1,5Ω ±10% wirewound 1W				
	R2	83.5201	2 Ω ±5% " 3W				
	R3	82.	1,5Ω ±10% " 1W				
	R4	82.5029	22 Ω ±5% carbon 1W				
	R5	81.5049	1 kΩ ±5% " ½W				
	R6	80.5425	10 Ω ±5% " ¼W				
	R7	81.5077	220kΩ ±5% " ½W				
	R8	82.5033	47 Ω ±5% " 1W				
	R9	80.5437	100 Ω ±5% " ¼W				
	R10	82.5030	27 Ω ±5% " 1W				
	R11	83.5039	150Ω ±5% " 2W				
	R12	82.5029	22 Ω ±5% " 1W				
	R13	81.	3,9Ω ±10% wirewound ½W				
	R14	82.5030	27Ω ±5% carbon 1W				
	R15	89.5002	4 Ω ±10% NTC 1W				
	R16	89.5002	4 Ω ±10% NTC 1W				
	R17	89.018	0,2 Ω ±5% wirewound				
	R19	81.5038	120 Ω ±5% carbon ½W				
	R20	80.5449	1 kΩ ±5% " ¼W				
	R21	83.5202	3 Ω ±5% wirewound 3W				
	R22	80.5451	1,5kΩ ±5% carbon ¼W				
	R23	80.5448	820Ω ±5% " ¼W				
	R24	80.5437	100Ω ±5% " ¼W				
	L1	61.487	120 mH Filter coil / Filter spole				
	L2	61.487	120 mH Filter coil / Filter spole				
	T1	60.5103	6/12V converter transf.				
	T2	60.5100	AF-driver transformer / LF-driver transformator				
	T3	60.5101	AF-output transformer / LF-udgangstransformator				
	Re T	58	Key relay/Tastrelæ				
	E1	99.5022	Si-diode				
	E2	99.5020	Si-diode				
	E3	99.5020	Si-diode				
	E4	99.5020	Si-diode				
	E5	99.5020	Si-diode				
	E6	94.5001	Sel. rectifier B30 C600 / Sel. ensretter B30 C600				
	Q1	99.5016	Transistor 2N441				
	Q2	99.5016	Transistor 2N441				
	Q3	99.5015	Transistor OC26				



POWER SUPPLY and AF-OUTPUT AMPLIFIER
STRØMFORSYNING og LF-UDG. FORSTÆRKER

PS19 - 1a

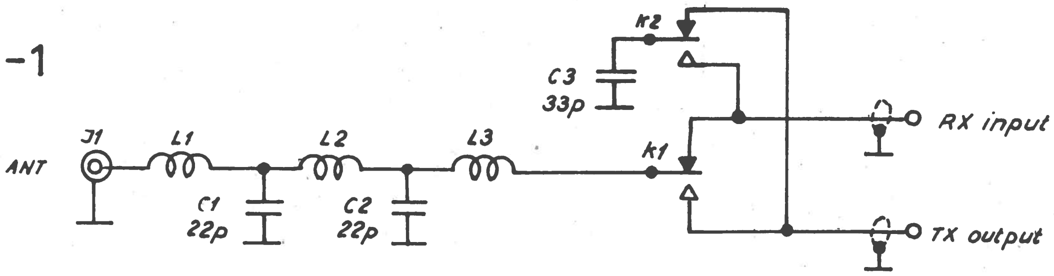
type	no	code	data	type	no	code	data
	C1	73.5042	100µF el.lyt 15V				
	C2	73.5054	100µF bipolar el.lyt 30V				
	C3	73	20µF+20µF " "400/175				
	C4	73.5017	20µF " " 250V				
	C5	73.5047	1000µF " " 20V				
	C6	73.5042	100µF " " 15V				
	C7	73.5042	100µF " " 15V				
	C8	73.	500µF " " 3V				
	C9	76.5032	27nF ±10% polyest. 125V				
	C10	76.5037	56nF ±10% " 125V				
	C11	76.5032	27nF ±10% " 125V				
	C12	76.5039	0.22µF ±10% " 125V				
	R1	82.	1,5Ω ±10% wirewound 1W				
	R2	83.5201	2 Ω ±5% " 3W				
	R3	82.	1,5Ω ±10% " 1W				
	R4	82.5029	22 Ω ±5% carbon 1W				
	R5	81.5049	1 kΩ ±5% " ½W				
	R6	80.5425	10 Ω ±5% " ¼W				
	R7	81.5077	220kΩ ±5% " ½W				
	R8	82.5033	47 Ω ±5% " 1W				
	R9	80.5437	100 Ω ±5% " ¼W				
	R10	82.5030	27 Ω ±5% " 1W				
	R11	83.5039	150Ω ±5% " 2W				
	R12	82.5029	22 Ω ±5% " 1W				
	R13	81.	3,9Ω ±10% wirewound ½W				
	R14	82.5030	27Ω ±5% carbon 1W				
	R15	89.5002	4 Ω ±10% NTC 1W				
	R16	89.5002	4 Ω ±10% NTC 1W				
	R17	89.018	0,2 Ω ±5% wirewound				
	R19	81.5038	120 Ω ±5% carbon ½W				
	R20	80.5449	1 kΩ ±5% " ¼W				
	R21	83.5202	3 Ω ±5% wirewound 3W				
	R22	80.5451	1,5kΩ ±5% carbon ¼W				
	R23	80.5448	820Ω ±5% " ¼W				
	R24	80.5437	100Ω ±5% " ¼W				
	L1	61.487	120 mH Filter coil / Filter spole				
	L2	61.487	120 mH Filter coil / Filter spole				
	T1	60.5103	6/12V converter transf.				
	T2	60.5100	AF-driver transformer / LF-driver transformator				
	T3	60.5101	AF-output transformer / LF-udgangstransformator				
	Re T	58	Key relay/Tastrelæ				
	E1	99.5022	Si-diode				
	E2	99.5020	Si-diode				
	E3	99.5020	Si-diode				
	E4	99.5020	Si-diode				
	E5	99.5020	Si-diode				
	E6	94.5001	Sel. rectifier B30 C600 / Sel. ensretter B30 C600				
	Q1	99.5016	Transistor 2N441				
	Q2	99.5016	Transistor 2N441				
	Q3	99.5015	Transistor OC26				

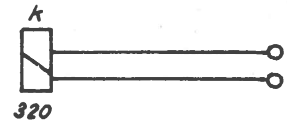


POWER SUPPLY and AF-OUTPUT AMPLIFIER
STRØMFORSYNING og LF-UDG. FORSTÆRKER PS19-2a

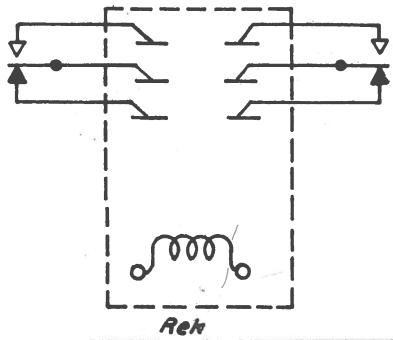
type	no	code	data	type	no	code	data
	C1	73.5063	64 µF el.lyt. 40V				
	C2	76.5042	1 µF ±10% polyest. 125V				
	C3	73.5065	20+20 µF el.lyt. 350/150V				
	C4	73.5017	20 µF el.lyt. 250V				
	C5	73.5047	1000 µF el.lyt. 15V				
	C6	73.5042	100 µF el.lyt. 15V				
	C7	73.5030	50 µF el.lyt. 25V				
	C8	73.5042	100 µF el.lyt. 15V				
	C9	76.5032	27 nF ±10% polyest. 125V				
	C10	76.5037	56 nF ±10% " 125V				
	C11	76.5032	27 nF ±10% " 125V				
	R1		4,7Ω ±10% wirewound 1/2W				
	R2	82.5027	15Ω ±5% carbon 1W				
	R3		4,7Ω ±10% wirewound 1/2W				
	R4	81.5036	82Ω ±5% carbon 1/2W				
	R5	81.5057	4,7kΩ ±5% " 1/2W				
	R7	81.5077	220kΩ ±5% " 1/2W				
	R8	80.5425	10Ω ±5% " 1/4W				
	R9	80.5437	100Ω ±5% " 1/4W				
	R10	82.5037	100Ω ±5% " 1W				
	R11	83.5046	560Ω ±5% " 2W				
	R12	82.5035	68Ω ±5% " 1W				
	R13		3,9Ω ±10% wirewound 1/2W				
	R14	80.5430	27Ω ±5% carbon 1/4W				
	R15	89.5002	4Ω ±10% NTC				
	R16	89.5002	4Ω ±10% NTC				
	R17	80.019	0,4Ω ±5% wirewound 1/2W				
	R18	80.5462	12kΩ ±5% carbon 1/4W				
	R19	82.5041	220Ω ±5% " 1W				
	R20	80.5449	1kΩ ±5% " 1/4W				
	R21	83.5202	3Ω ±5% wirewound 3W				
	R22	80.5451	1,5kΩ ±5% carbon 1/4W				
	R23	80.5448	820Ω ±5% " 1/4W				
	R24	80.5437	100Ω ±5% " 1/4W				
	R25		3,9kΩ				
	R26	80.5467	22kΩ ±5% " 1/4W				
	L1	61.487	120 mH Filter coil Filter spole				
	L2	61.487	120 mH Filter coil Filter spole				
	T1	60.5016	12/24V Converter transf.				
	T2	60.5100	AF-driver transformer LF-driver transformer				
	T3	60.5015	AF-output transformer LF-udgangstransformator				
	ReT	58.5033	Key relay/tastrelæ 2x45Ω				
	E1	99.5022	Si-diode				
	E2	99.5020	Si-diode				
	E3	99.5020	Si-diode				
	E4	99.5020	Si-diode				
	E5	99.5020	Si-diode				
	E6	94.5001	Sel. rectifier B30 C600 Sel. ensretter B30 C600				
	Q1		Transistor ASZ15				
	Q2		Transistor ASZ15				
	Q3		Transistor ASZ15				

AS19-1

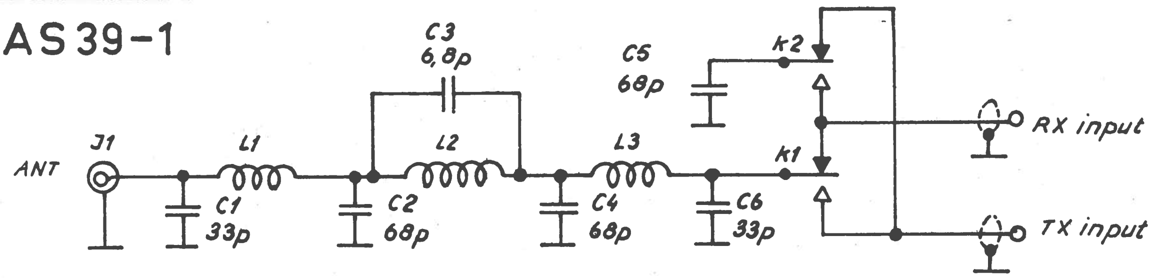


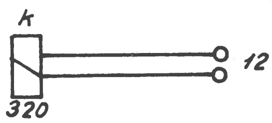


no	code	data
C1	74.5008	22pF±5% N150 500V
C2	74.5008	22pF±5% N150 500V
C3	74.5010	33pF±5% N150 250V
J1	41.5114	connector S0239
L1	62.571	filter coil
L2	62.572	filter coil
L3	62.573	filter coil
ReK	58.5034	relay 12V 320Ω

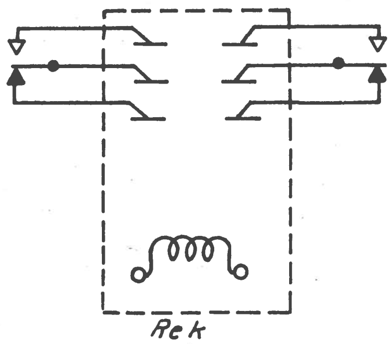


AS39-1

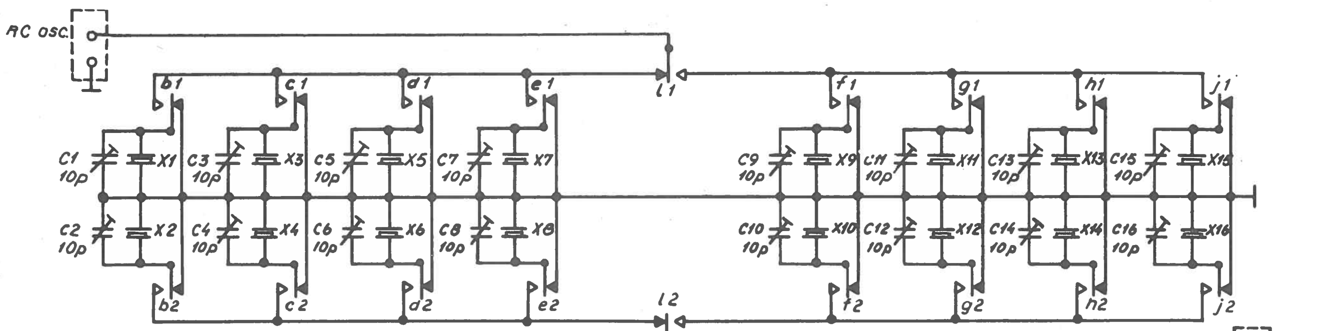




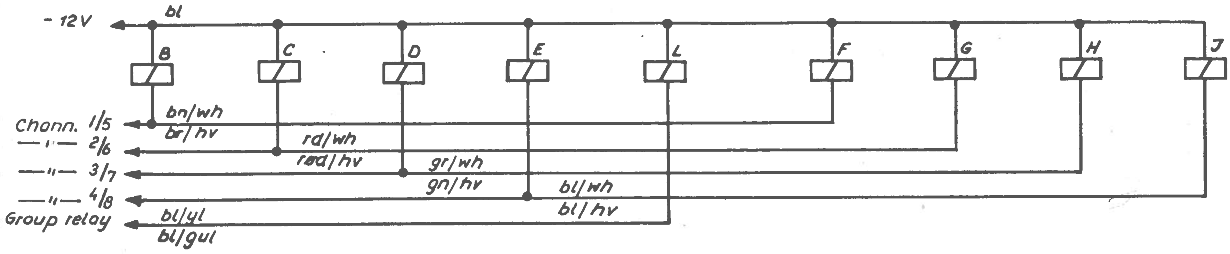
no	code	data
C1	74.5085	33pF ±5% N150 500V
C2	74.5018	68pF ±5% N150 500V
C3	74.5021	6,8pF ±5% N150 500V
C4	74.5018	68pF ±5% N150 500V
C5	74.5018	68pF ±5% N150 500V
C6	74.5085	33pF ±5% N150 500V
L1	62.584	Coil/spole
L2	62.585	Coil/spole
L3	62.586	Coil/spole
J1	41.5114	Connector S0-239
ReK	58.5034	Relay/relæ 12V

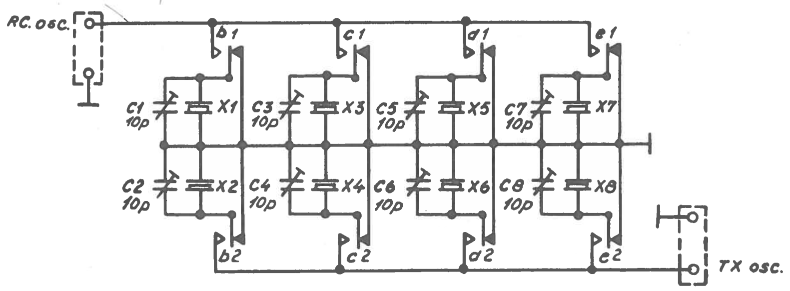


ANTENNA SHIFT UNIT AS19-1
ANTENNESKIFTEENHED AS39-1

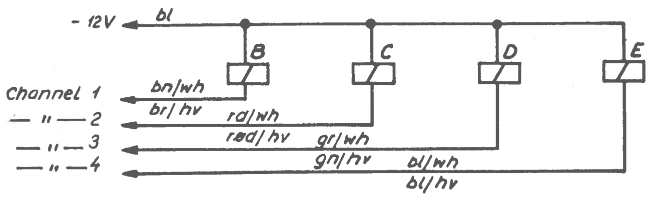


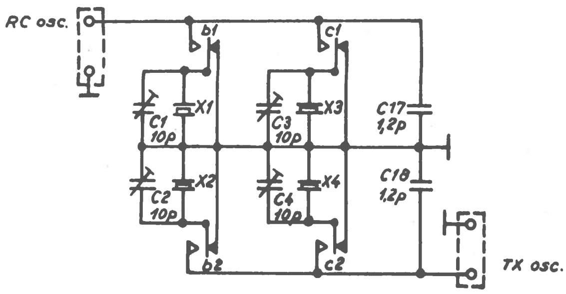
XS 19-2



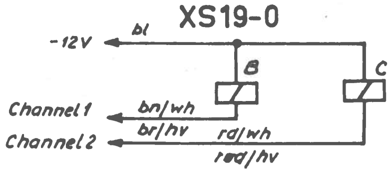


XS 19-1





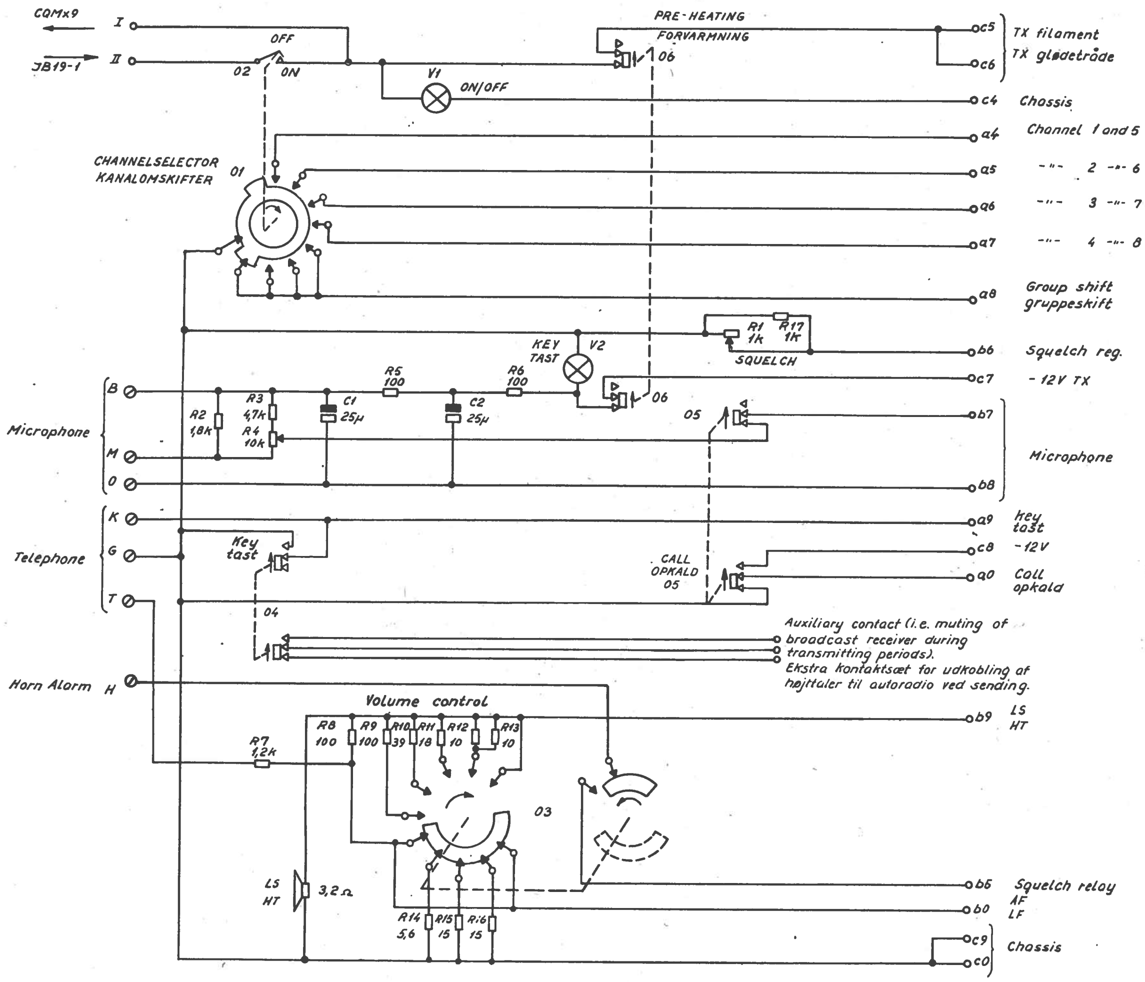
XS19-0

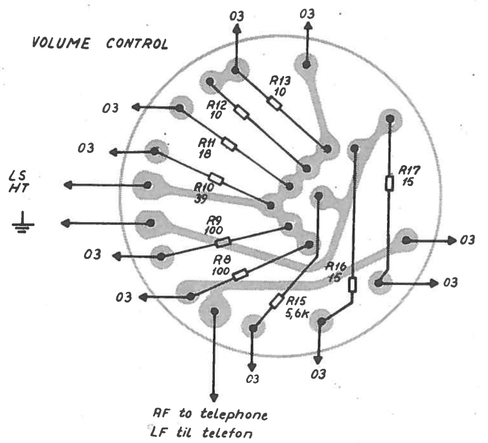


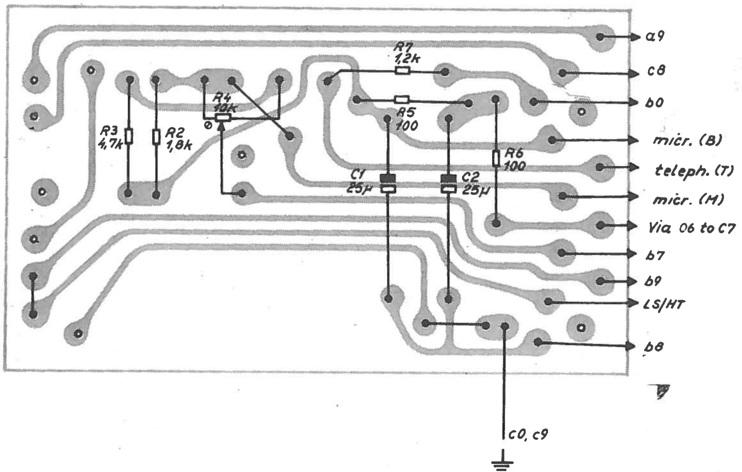
XS19-0,-1,-2

no	code	data.
C17, C18	74.5024	1,2pF ± 0,25pF ceram 500V
	78.5006	10pF Trimmers 650V
	58.5035	Relays/Relæer 8-24V 430Ω

X-TAL SHIFT UNIT XS19-0,-1,-2
X-TAL SKIFTEENHED



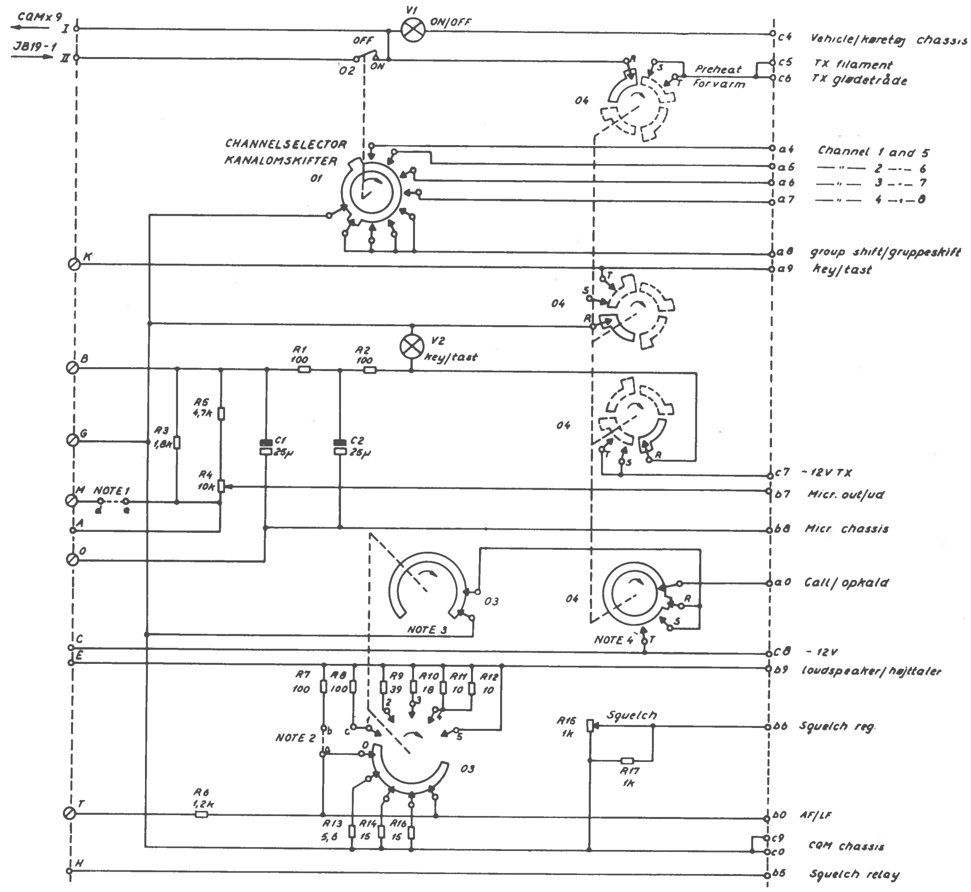


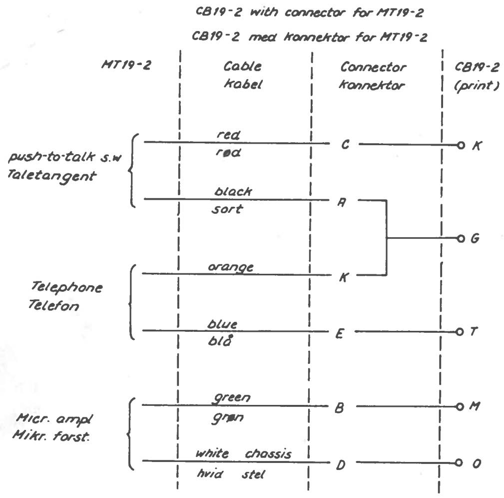


CONTROL BOX CB19-1

type	no	code	data	type	no	code	data
	C1	73.5023	25µF -10/+50% elektr. 25V				
	C2	73.5023	25µF -10/+50% " 25V				
	R1	86.5004	1 kΩ variable carbon 0,1W				
	R2	80.5452	1,8kΩ ±5% " ¼W				
	R3	80.5457	4,7kΩ ±5% " ¼W				
	R4	86.5008	10 kΩ pot. " ¼W				
	R5	80.5437	100Ω ±5% " ¼W				
	R6	80.5437	100Ω ±5% " ¼W				
	R7	80.5450	1,2 kΩ ±5% " ¼W				
	R8	80.5437	100Ω ±5% " ¼W				
	R9	80.5437	100Ω ±5% " ¼W				
	R10	80.5432	39 Ω ±5% " ¼W				
	R11	80.5428	18 Ω ±5% " ¼W				
	R12	80.5425	10 Ω ±5% " ¼W				
	R13	80.5425	10 Ω ±5% " ¼W				
	R14	84.5002	5,6 Ω ±10% wirewound 5,5W				
	R15	81.5027	15 Ω ±5% carbon ½W				
	R16	81.5027	15 Ω ±5% " ½W				
	R17	80.5449	1 kΩ ±5% " ¼W				
	01	47.214	Selector (channel) Omskifter (kanal)				
	02	47.5015	Switch (ON/OFF) Afbryder				
	03	47.215	Selector (volume) Omskifter (volume)				
	04 05 06	47.213	Pushbutton assy Trykknaprække				
	V1	92.5001	12V 2W				
	V2	92.5002	24V 3W				
	LS	97.5001	Loudspeaker 3,2Ω Højttaler 3,2Ω				

Storno



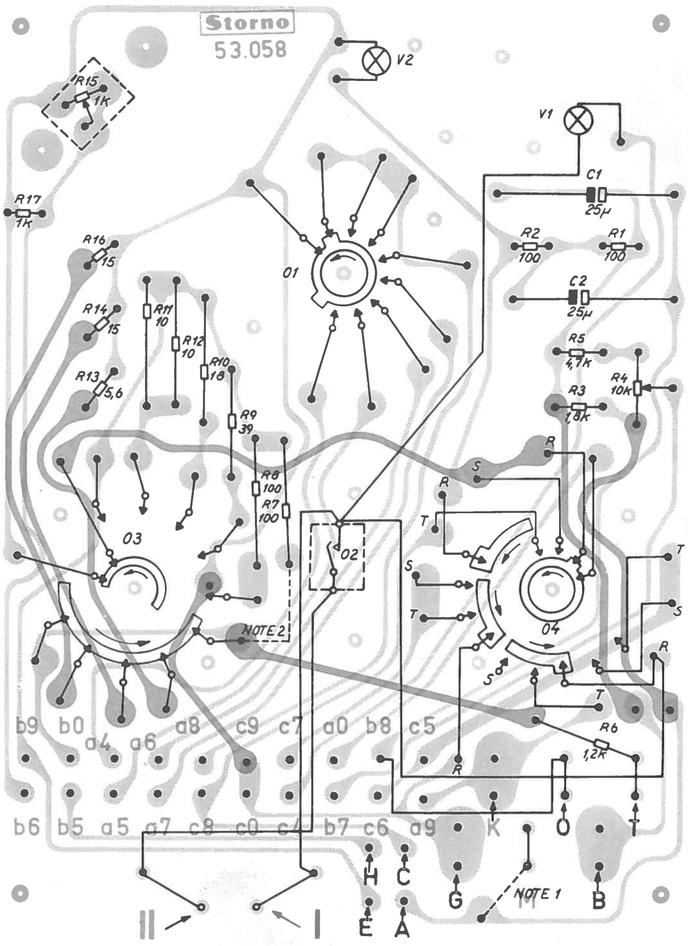


NOTE 1: If LM19-1 is not used: short circuit d and e.
Hvis LM19-1 ikke benyttes: Forbind d og e.

NOTE 2: For 30 dB in position 0: Short circuit a and b.
For ∞dB in position 0: Short circuit b and c.
For 30 dB i stilling 0: Forbind a og b.
For ∞dB i stilling 0: Forbind b og c.

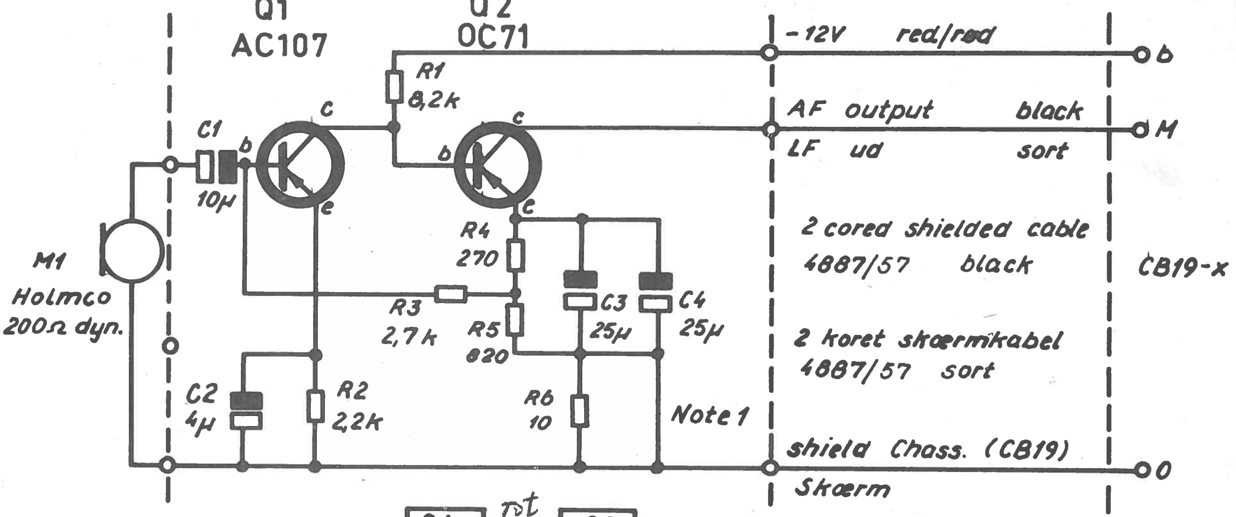
NOTE 3. 03 returns automatically from its extreme c.c.w position (-1).
03 er fjederpåvirket i sin højre yderstilling. (-1)

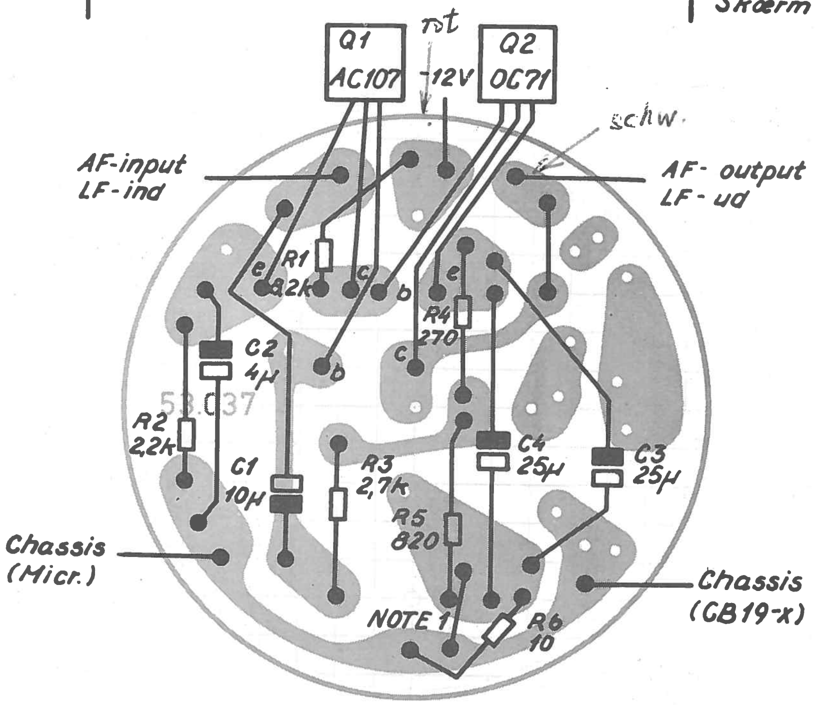
NOTE 4. Position T: non shorting and spring loaded (returns automatically to position 5).
Stilling T: Omskifteren bryder før den slutter i denne stilling, som er fjederpåvirket.



CONTROL BOX CB19-2

type	no	code	data	type	no	code	data
	C1	73.5023	25µF el.lyt. 25V				
	C2	73.5023	25µF " 25V				
	R1	80.5437	100Ω ±5% carbon $\frac{1}{4}$W				
	R2	80.5437	100Ω ±5% " $\frac{1}{4}$W				
	R3	80.5452	1.8kΩ ±5% " $\frac{1}{4}$W				
	R4	86.5007	10kΩ pot.lin. 0.2W				
	R5	80.5457	4.7kΩ ±5% " $\frac{1}{4}$W				
	R6	80.5450	1.2kΩ ±5% " $\frac{1}{4}$W				
	R7	80.5437	100Ω ±5% " $\frac{1}{4}$W				
	R8	80.5437	100Ω ±5% " $\frac{1}{4}$W				
	R9	80.5432	39Ω ±5% " $\frac{1}{4}$W				
	R10	80.5428	18Ω ±5% " $\frac{1}{4}$W				
	R11	80.5425	10Ω ±5% " $\frac{1}{4}$W				
	R12	80.5425	10Ω ±5% " $\frac{1}{4}$W				
	R13	84.5002	5.6Ω ±10% wire wound 5.5W				
	R14	81.5027	15Ω ±5% carbon $\frac{1}{2}$W				
	R15	86.5028	1kΩ pot.lin " 0.1W				
	R16	81.5027	15Ω ±5% $\frac{1}{2}$W				
	R17	80.5449	1kΩ ±5% carbon $\frac{1}{4}$W				
	01	47.224	Selector (channel) Omskifter (kanal)				
	02	47.5015	Switch (On/Off) Afbryder				
	03	47.226	Selector (Volume) Omskifter (Volume)				
	04	47.226	Selector (Function) Omskifter (funktion)				
	V1	92.5001	6/12V 12V 2W				
		92.5002	12/24V 24V 3W				
	V2	92.5002	6/12/24V 24V 3W				



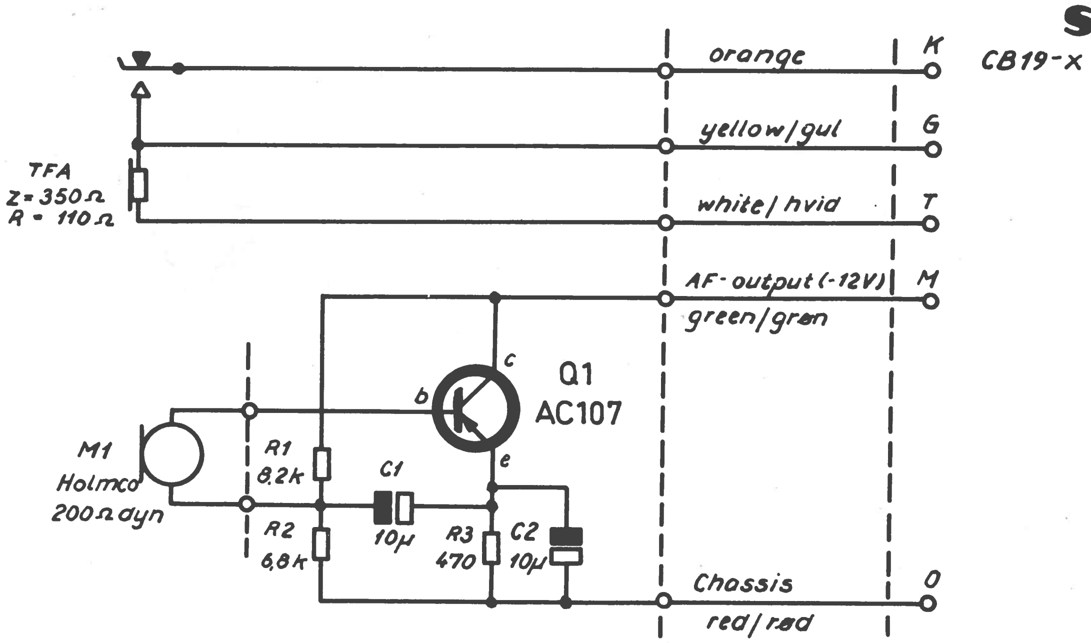


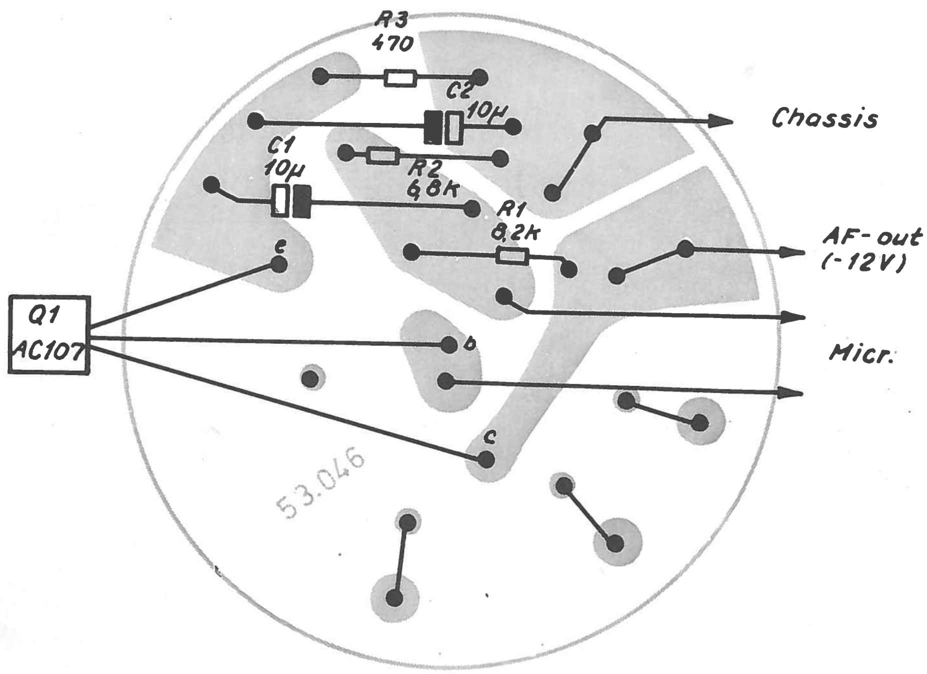
NOTE 1: If noise level is high short-circuit across R6 is removed.

NOTE 1: Ved høj støjniveau fjernes kortslutning over R6.

no	code	data	
C1	73.5011	10 μF electr.	16V
C2	73.5006	4 μF "	4V
C3	73.5021	25 μF "	4V
C4	73.5021	25 μF "	4V
R1	80.5060	8.2 kΩ ±5% carb.	0.1W
R2	80.5053	2.2 kΩ ±5% "	0.1W
R3	80.5054	2.7 kΩ ±5% "	0.1W
R4	80.5042	270 Ω ±5% "	0.1W
R5	80.5048	820 Ω ±5% "	0.1W
R6	80.5025	10 Ω ±5% "	0.1W
Q1	99.5008	Transistor AC107	
Q2	99.5010	Transistor OC71	
M1	96.5001	Microphone Holmco 200Ω dyn.	

MICROPHONE MC19-2

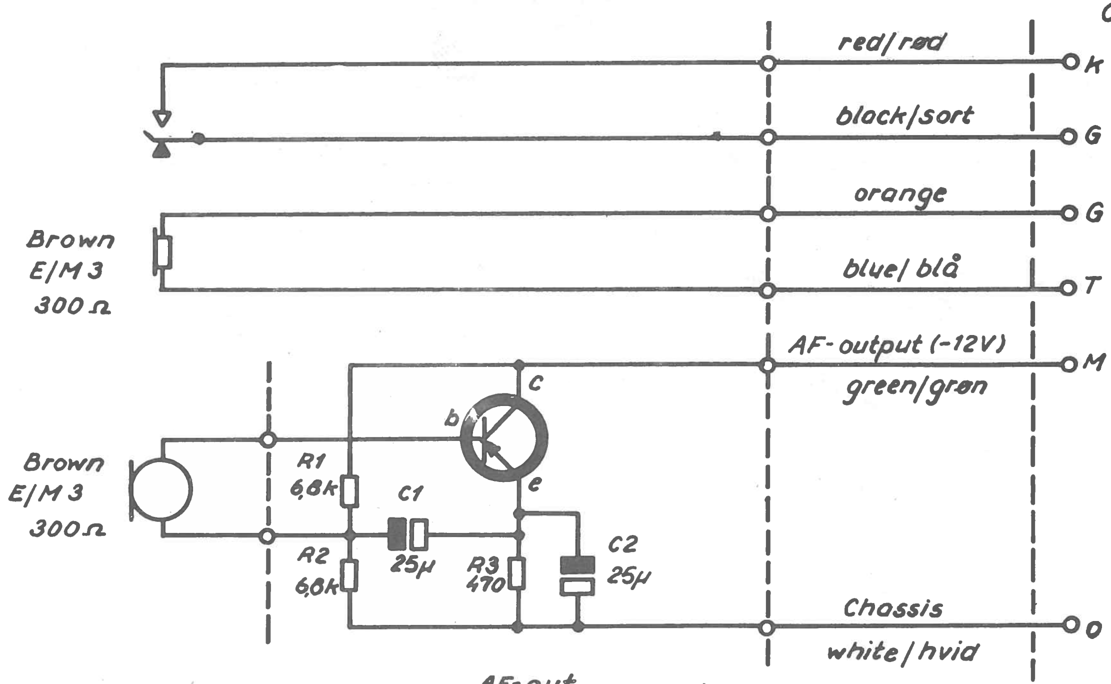


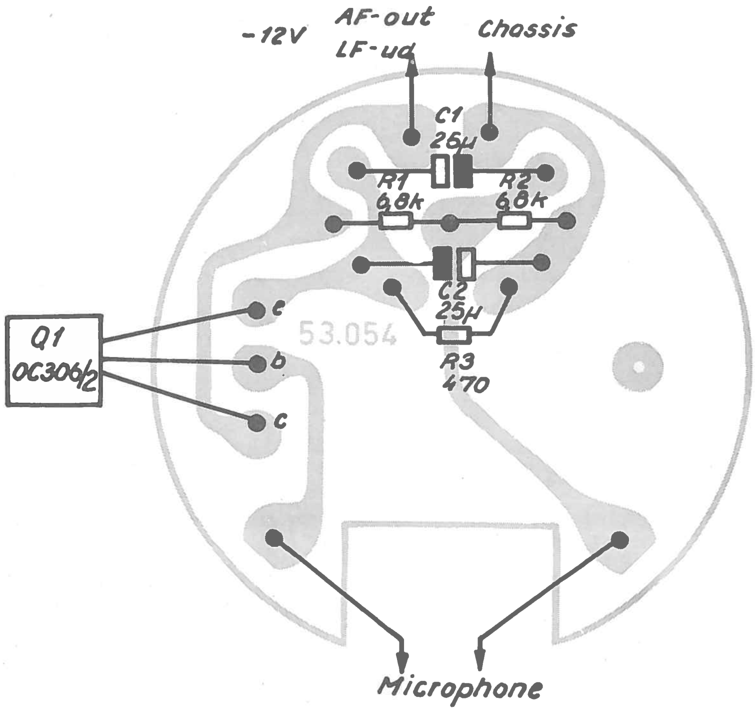


no	code	data
C1	73.5011	10 μF electr. 16V
C2	73.5011	10 μF " 16V
R1	80.5060	8.2 kΩ ±5% carb. 0.1W
R2	80.5059	6.8 kΩ ±5% " 0.1W
R3	80.5045	470 Ω ±5% " 0.1W
Q1	99.5008	Transistor AC107
M1	96.5002	Microphone Holmco 200Ω dyn.
TFA	96.5003	Telephone 350 Ω

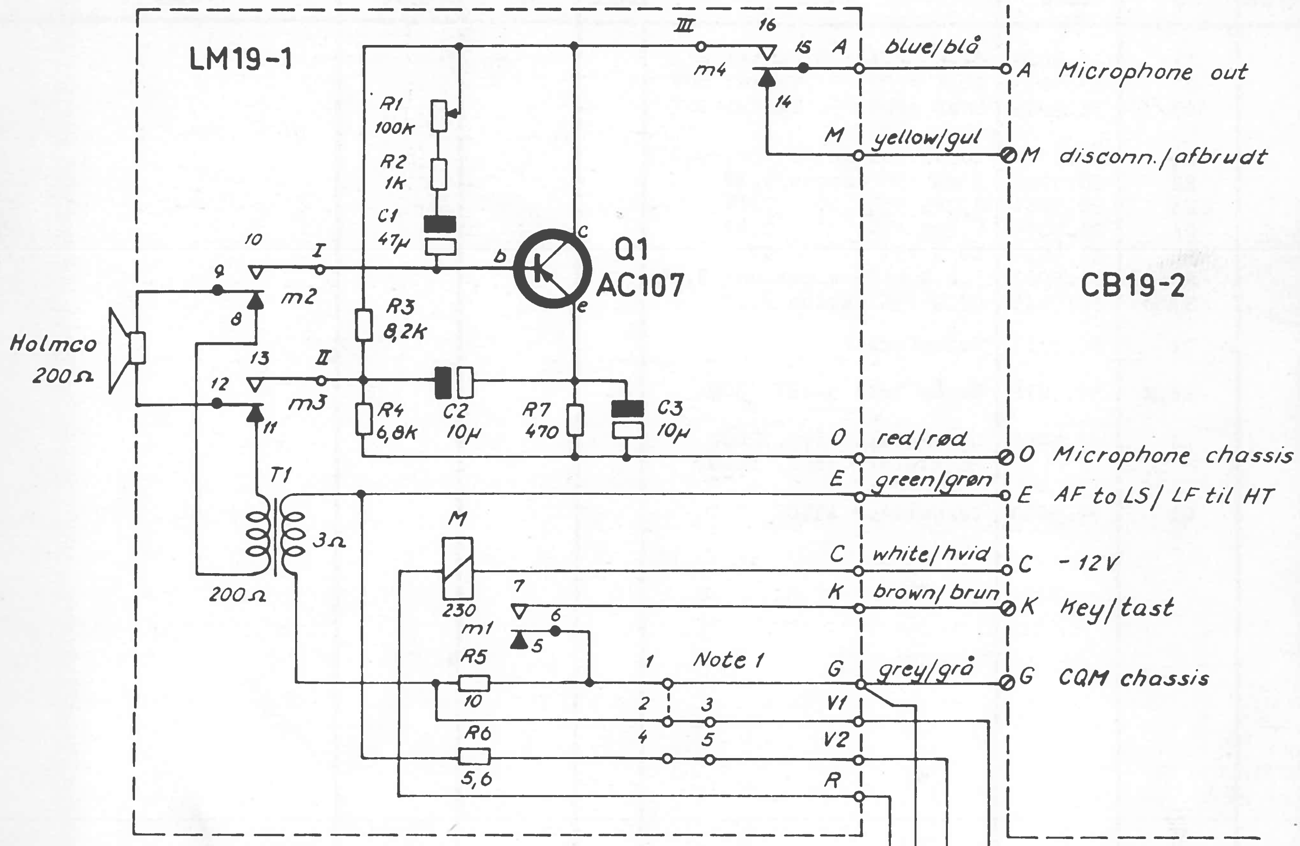
MICROTELEPHONE MT19-1

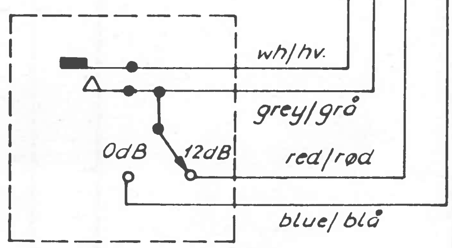
CB19-x





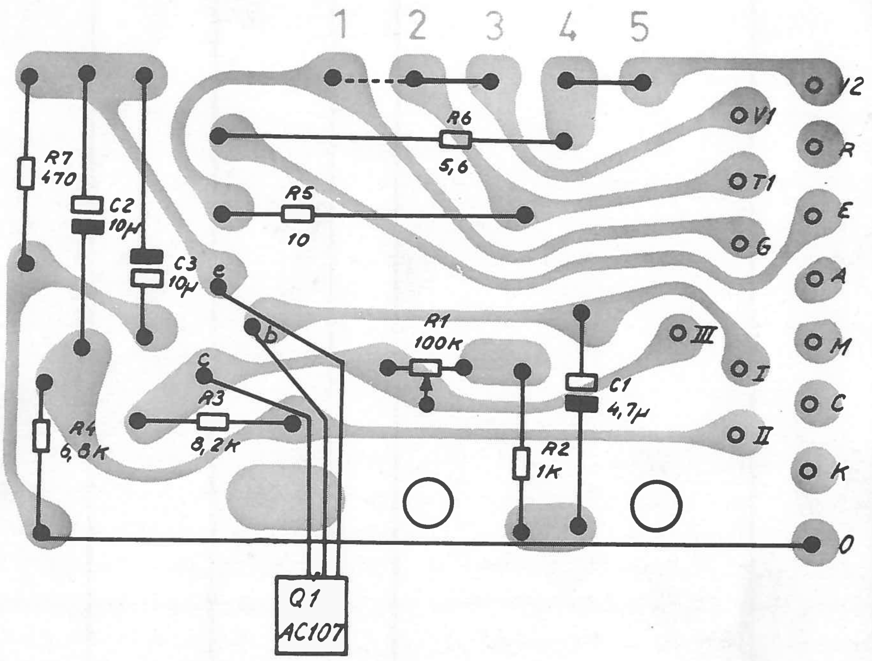
no	code	data	
C1	73.5053	25 µF Tantal	4V
C2	73.5053	25 µF "	4V
R1	80.5059	6.8 kΩ ±5% carb.	0.1W
R2	80.5059	6.8 kΩ ±5% "	0.1W
R3	80.5045	470 Ω ±5% "	0.1W
Q1	99.5019	Transistor OC306/2	
	96.5006	Microtelephone el. magn 300Ω E/M nr.3	





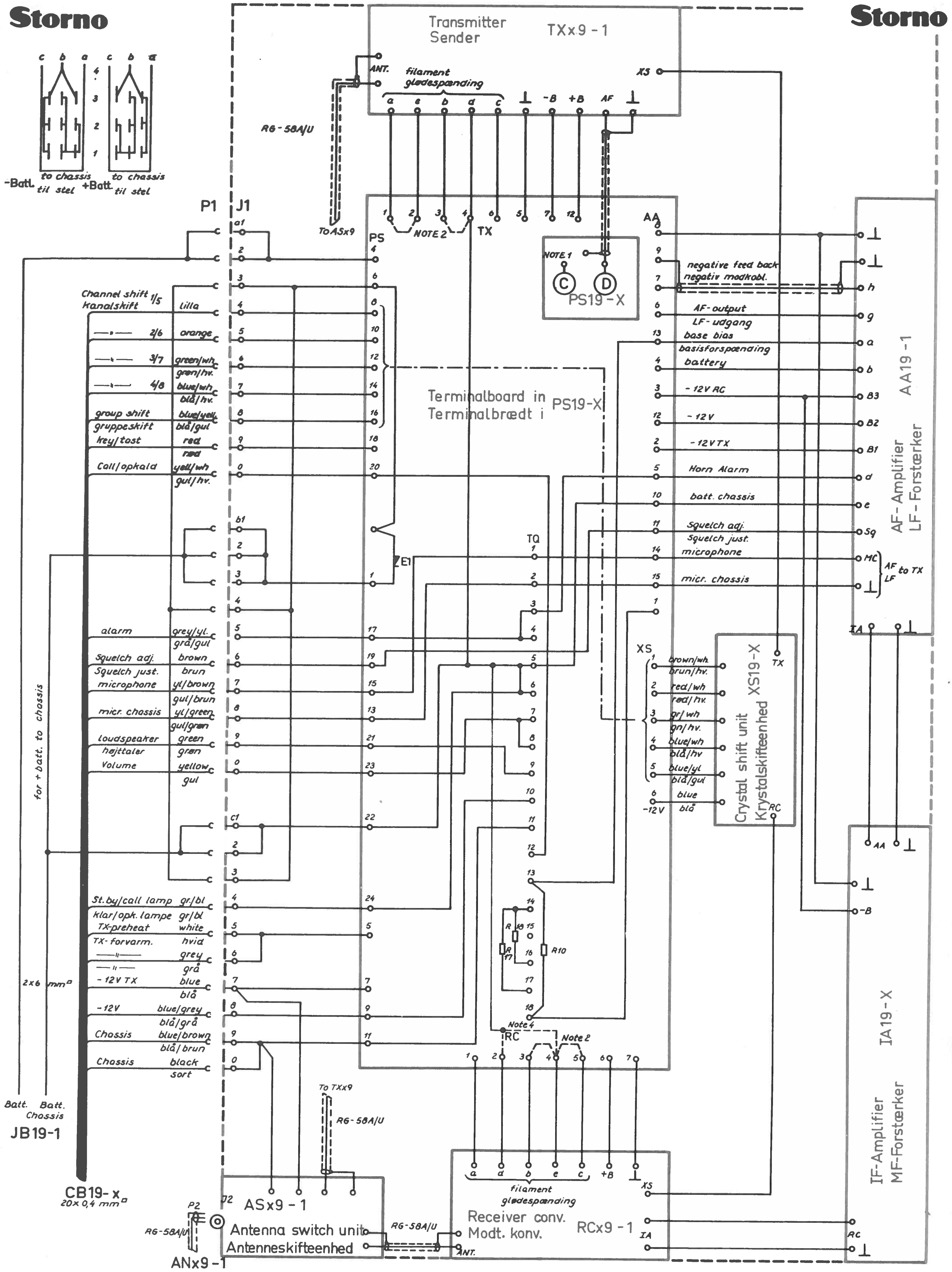
Note 1.
If extra volume control is not used short circuit 1 and 2.
If extra volume control is used Short circuit 2 and 3 as shown Short circuit 4 and 5 as shown
Hvis ekstra volumenkontrol ikke bruges: Strap 1 og 2.
Hvis ekstra volumenkontrol bruges: Strap 2 og 3, samt 4 og 5 som vist.

Steering-wheel switch and volume control
Rattast og vol. kontrol



LOUDSPEAKER-MICROPHONE
HØJTTALER - MIKROFON
LM19-1

type	no	code	data	type	no	code	data
	C1	73.5029	47µF -20/+50% Tantal 6V				
	C2	73.5009	10µF ±20% Tantal 10V				
	C3	73.5009	10µF ±20% Tantal 10V				
	R1	86.5030	100kΩ pot.meter lin. 0,05W				
	R2	80.5049	1 kΩ ±5% carbon 0,1W				
	R3	80.5060	8,2kΩ ±5% " 0,1W				
	R4	80.5059	6,8kΩ ±5% " 0,1W				
	R5	81.5025	10 Ω ±5% " ½W				
	R6	84.5002	5,6 Ω ±10% wirewound 5,5W				
	R7	80.5045	470Ω ±5% carbon 0,1W				
	T1	60.5113	Transformer				
	Re.M	58.5022	Relay/Relæ 9-18V 230Ω				
	LS	97.5008	Loudspeaker dyn. 200Ω Højttaler dyn. 200Ω				
	Q1	99.5008	Transistor AC107				



NOTE 1. Shield connected to soldering eye between Ⓒ and Ⓓ
25 kc/s channel separation: Conductor connected to Ⓓ (as shown)
50 kc/s channel separation: Conductor connected to Ⓒ

NOTE 1. Skærm forbundet til loddepunkt mellem Ⓒ og Ⓓ
25 kc/s kanalafstand: inderleder forbundet til Ⓓ (som vist)
50 kc/s kanalafstand: inderleder forbundet til Ⓒ

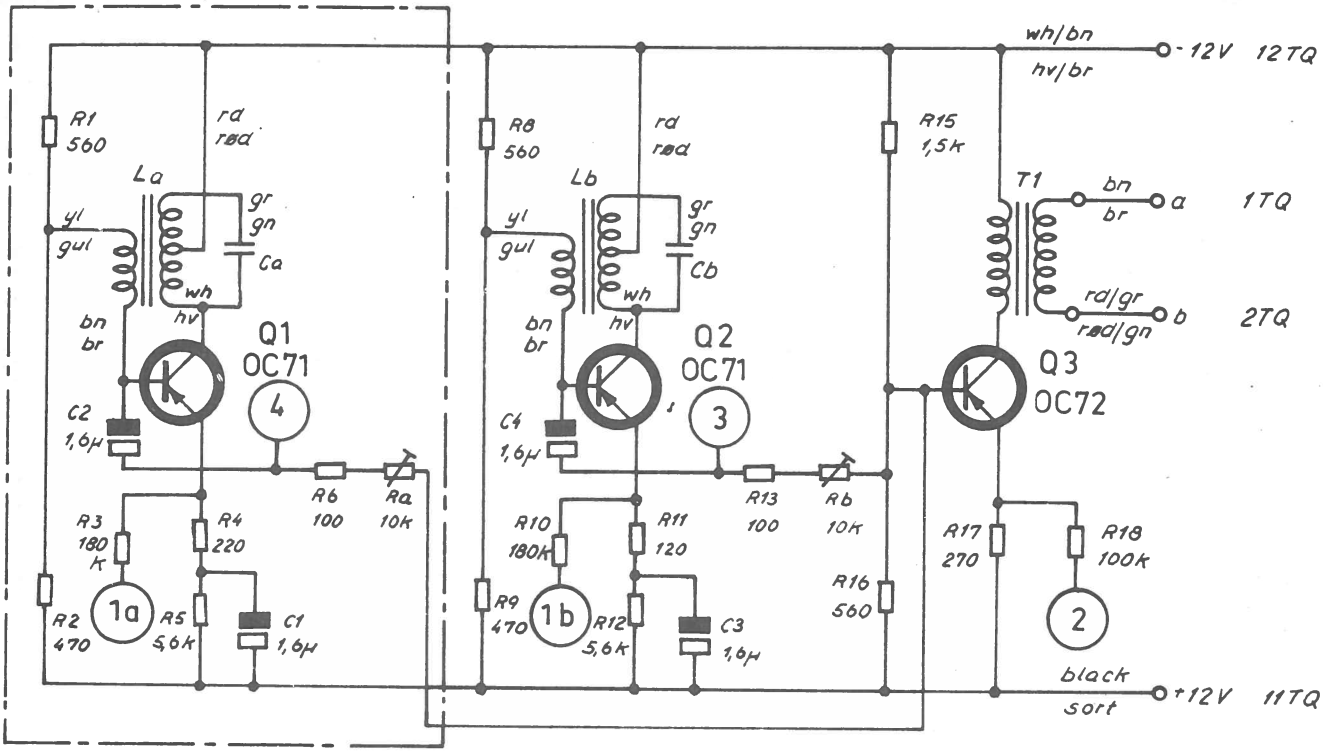
NOTE 2. Permanent connections in PS19-1.

NOTE 2. Faste forbindelser i PS19-1.

NOTE 4: PS19-1: Connect 5TQ to 2RC.
PS19-2: Connect 5TQ to 4RC.
PS19-1: Forbind 5TQ til 2RC
PS19-2: Forbind 5TQ til 4RC.

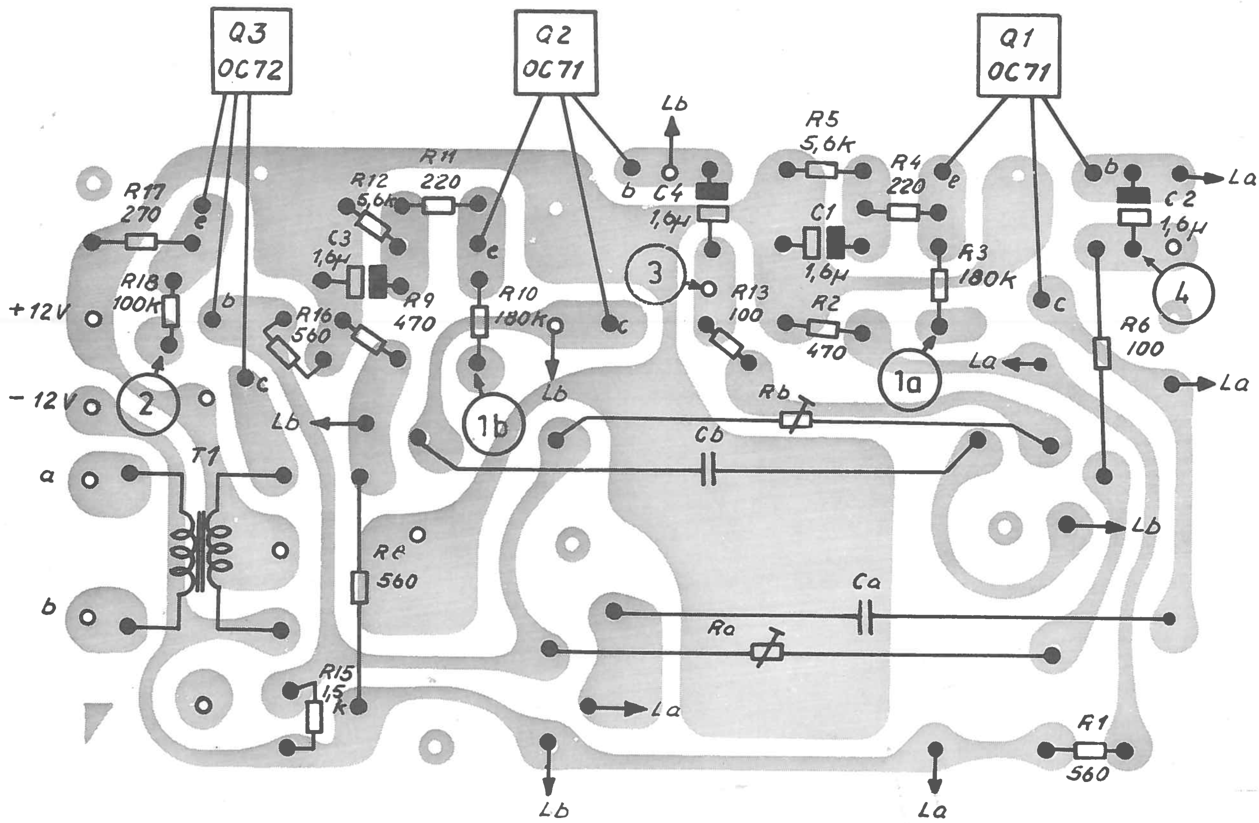
CABLEFORM KABLING CQM 19/39

Storno



NOTE 1: In TT19-1: The framed tone circuit (Q1) is omitted.

NOTE 1: I TT19-1: Det indrammede tone kredsløb (Q1) er udeladt.



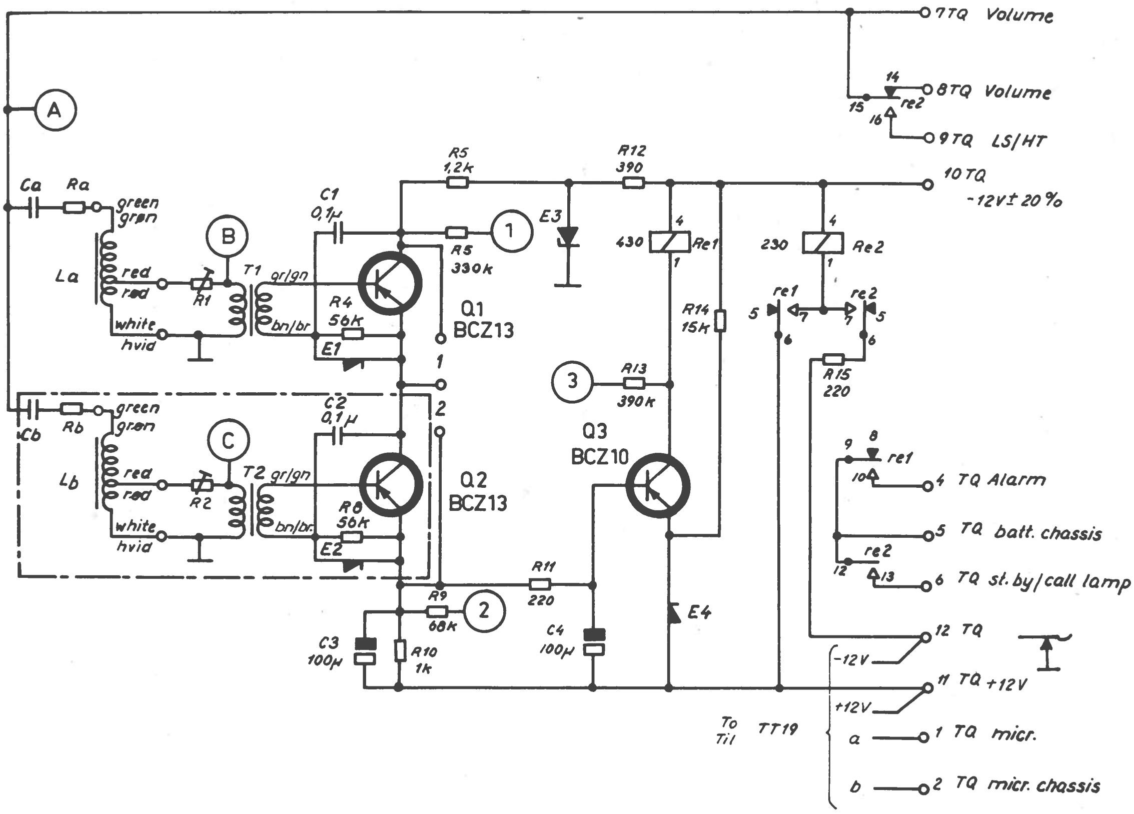
TONE TRANSMITTER
TONE SENDER

TT19-1,-2

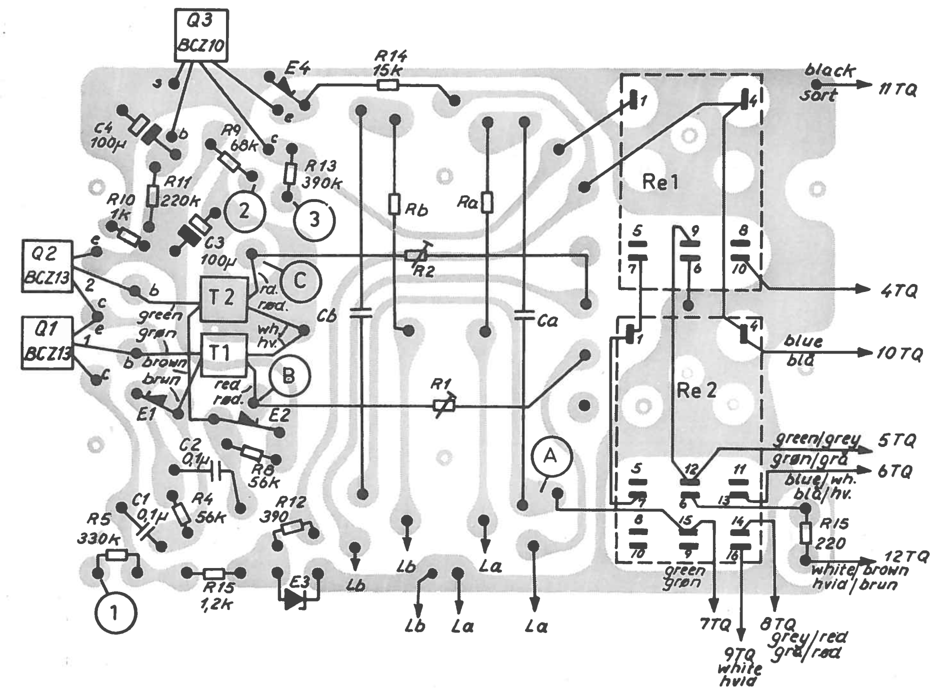
type	no	code	data
-2	C1	73.	1.6µF el. lyt 65V
-2	C2	73.	1.6µF el. lyt 65V
	C3	73.	1.6µF el. lyt 65V
	C4	73.	1.6µF el. lyt 65V
	C_a	76.	Value depending of frequency Værdi afhængig af frekvens
	C_b	76.	Value depending of frequency Værdi afhængig af frekvens
-2	R1	80.5446	560Ω ±5% carbon $\frac{1}{4}$W
-2	R2	80.5445	470Ω ±5% - $\frac{1}{4}$W
-2	R3	80.5476	180kΩ ±5% - $\frac{1}{4}$W
-2	R4	80.6441	220Ω ±5% - $\frac{1}{4}$W
-2	R5	80.5458	5.6kΩ ±5% - $\frac{1}{4}$W
-2	R6	80.5437	100Ω ±5% - $\frac{1}{4}$W
-2	Ra	86.	10kΩ pot. lin. - 0.2W
	R8	80.5446	560Ω ±5% - $\frac{1}{4}$W
	R9	80.5475	470Ω ±5% - $\frac{1}{4}$W
	R10	80.5476	180kΩ ±5% - $\frac{1}{4}$W

type	no	code	data
	R11	80.5441	220Ω ±5% carbon $\frac{1}{4}$W
	R12	80.5458	5.6kΩ ±5% - $\frac{1}{4}$W
	R13	80.5437	100Ω ±5% - $\frac{1}{4}$W
	Rb	86.	10kΩ pot. lin. - 0.2W
	R15	80.5451	1.5kΩ ±5% - $\frac{1}{4}$W
	R16	80.5446	560Ω ±5% - $\frac{1}{4}$W
	R17	80.5442	270Ω ±5% - $\frac{1}{4}$W
	R18	80.5473	100Ω ±5% - $\frac{1}{4}$W
-2	L_a	61.511-	Value depending of frequency Værdi afhængig af frekvens
	L_b		Value depending of frequency Værdi afhængig af frekvens
	T1	60.5110	Transformer 0.6kΩ: 10kΩ
	Q1	99.5010	Transistor OC71
	Q2	99.5010	Transistor OC71
	Q3	99.5012	Transistor OC72

Frekv.	La/Lb	Ca/Cb
Standard		
615 c/s	Transformer 61.511-01	76.5003 0,1µF ±0,5% 100 VDC
675 -	- " - 61.511-02	76.5003 0,1µF ±0,5% 100 VDC
735 -	- " - 61.511-03	76.5003 0,1µF ±0,5% 100 VDC
805 -	- " - 61.511-04	76.5003 0,1µF ±0,5% 100 VDC
885 -	- " - 61.511-05	76.5003 0,1µF ±0,5% 100 VDC
970 -	- " - 61.511-06	76.5003 0,1µF ±0,5% 100 VDC
1060 -	- " - 61.511-07	76.5003 0,1µF ±0,5% 100 VDC
1160 -	- " - 61.511-08	76.5003 0,1µF ±0,5% 100 VDC
1270 -	- " - 61.511-09	76.5003 0,1µF ±0,5% 100 VDC
1400 -	- " - 61.511-10	76.5002 0,05µF ±0,5% 100 VDC
1530 -	- " - 61.511-11	76.5002 0,05µF ±0,5% 100 VDC
1670 -	- " - 61.511-12	76.5002 0,05µF ±0,5% 100 VDC
1850 -	- " - 61.511-13	76.5001 0,02µF ±0,5% 100 VDC
2000 -	- " - 61.511-14	76.5001 0,02µF ±0,5% 100 VDC
2200 -	- " - 61.511-15	76.5001 0,02µF ±0,5% 100 VDC
2400 -	- " - 61.511-16	76.5001 0,02µF ±0,5% 100 VDC
2600 -	- " - 61.511-17	76.5001 0,02µF ±0,5% 100 VDC
2900 -	- " - 61.511-18	76.5001 0,02µF ±0,5% 100 VDC
Tysk		
825 c/s	Transformer 61.511-19	76.5003 0,1µF ±0,5% 100 VDC
1010 -	- " - 61.511-20	76.5003 0,1µF ±0,5% 100 VDC
1240 -	- " - 61.511-21	76.5003 0,1µF ±0,5% 100 VDC
1520 -	- " - 61.511-22	76.5002 0,05µF ±0,5% 100 VDC
1860 -	- " - 61.511-23	76.5001 0,02µF ±0,5% 100 VDC
2280 -	- " - 61.511-24	76.5001 0,02µF ±0,5% 100 VDC
Spec.		
1750 c/s	Transformer 61.511-25	76.5002 0,05µF ±0,5% 100 VDC
1980 -	- " - 61.511-26	76.5001 0,02µF ±0,5% 100 VDC



NOTE 1 In TR19-1: The framed tone circuit (Q2) is omitted.
The terminals marked 2 are short circuited.
I TR19-1: Det indrammede tonekredsløb (Q2) er udeladt.
Terminalerne mærket 2 kortsluttes.



TONE RECEIVER
TONEMODTAGER

TR19-1,-2

type	no	code	data	type	no	code	data
	C1	76.5036	0,1uF ±10% polyester 125V		E1	99.	GEX23 Diode
-2	C2	76.5036	0,1uF ±10% - " - 125V	-2	E2	99.	GEX23 Diode
	C3	73.5035	100uF el.lyt 4V		E3	99.	QZ9,1 T5 Zenerdiode
	C4	73.5035	100uF el.lyt 4V		E4	99.5028	OA2000 Si. Diode
	R1	86.	50KΩ pot.meter 0,2W		Q1	99.	BCZ13 Si. Transistor
-2	R2	86.	50KΩ pot.meter 0,2W	-2	Q2	99.	BCZ13 Si. Transistor
	R4	80.5470	56KΩ ±5% carbon $\frac{1}{4}$W		Q3	99.	BCZ10 Si. Transistor
	R5	80.5450	1,2KΩ ±5% - " - $\frac{1}{4}$W				
	R6	80.5479	330KΩ ±5% - " - $\frac{1}{4}$W		Re.1	58.5023	Relay/Relæ 430Ω
-2	R8	80.5470	56KΩ ±5% - " - $\frac{1}{4}$W		Re.2	58.5022	Relay/Relæ 230Ω
	R9	80.5471	68KΩ ±5% - " - $\frac{1}{4}$W				
	R10	80.5449	1 KΩ ±5% - " - $\frac{1}{4}$W		T1	61.525	Transformer
	R11	80.5441	220Ω ±5% - " - $\frac{1}{4}$W	-2	T2	61.525	Transformer
	R12	80.5444	390Ω ±5% - " - $\frac{1}{4}$W				
	R13	80.5480	390KΩ ±5% - " - $\frac{1}{4}$W				
	R14	80.5463	15KΩ ±5% - " - $\frac{1}{4}$W				
	R15	80.5441	220Ω ±5% - " - $\frac{1}{4}$W				

Frekv.	La/Lb	Ca/Cb	Ra/Rb
Standard			
615 c/s	coil/spole 61.483-01	76.5003 0,1µF ±0,5% 100 VDC	
675 c/s	- " - 61.483-02	76.5003 0,1µF ±0,5% 100 VDC	
735 c/s	- " - 61.483-03	76.5003 0,1µF ±0,5% 100 VDC	
805 c/s	- " - 61.483-04	76.5003 0,1µF ±0,5% 100 VDC	80.5425 10Ω ±5% carbon $\frac{1}{4}$W
885 c/s	- " - 61.483-05	76.5003 0,1µF ±0,5% 100 VDC	80.5425 10Ω ±5% -"- $\frac{1}{4}$W
970 c/s	- " - 61.483-06	76.5003 0,1µF ±0,5% 100 VDC	80.5426 12Ω ±5% -"- $\frac{1}{4}$W
1060 c/s	- " - 61.483-07	76.5003 0,1µF ±0,5% 100 VDC	80.5426 12Ω ±5% -"- $\frac{1}{4}$W
1160 c/s	- " - 61.483-08	76.5003 0,1µF ±0,5% 100 VDC	80.5425 10Ω ±5% -"- $\frac{1}{4}$W
1270 c/s	- " - 61.483-09	76.5003 0,1µF ±0,5% 100 VDC	80.5427 15Ω ±5% -"- $\frac{1}{4}$W
1400 c/s	- " - 61.483-10	76.5002 0,05µF ±0,5% 100 VDC	80.5430 27Ω ±5% -"- $\frac{1}{4}$W
1530 c/s	- " - 61.483-11	76.5002 0,05µF ±0,5% 100 VDC	80.5430 27Ω ±5% -"- $\frac{1}{4}$W
1670 c/s	- " - 61.483-12	76.5002 0,05µF ±0,5% 100 VDC	80.5431 33Ω ±5% -"- $\frac{1}{4}$W
1850 c/s	- " - 61.483-13	76.5001 0,02µF ±0,5% 100 VDC	80.5435 68Ω ±5% -"- $\frac{1}{4}$W
2000 c/s	- " - 61.483-14	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
2200 c/s	- " - 61.483-15	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
2400 c/s	- " - 61.483-16	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
2600 c/s	- " - 61.483-17	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
2900 c/s	- " - 61.483-18	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
Tysk			
825 c/s	coil/spole 61.483-19T	76.5003 0,1µF ±0,5% 100 VDC	80.5425 10Ω ±5% carbon $\frac{1}{4}$W
1010 c/s	- " - 61.483-20T	76.5003 0,1µF ±0,5% 100 VDC	80.5426 12Ω ±5% -"- $\frac{1}{4}$W
1240 c/s	- " - 61.488-21T	76.5003 0,1µF ±0,5% 100 VDC	80.5426 12Ω ±5% -"- $\frac{1}{4}$W
1520 c/s	- " - 61.483-22T	76.5002 0,05µF ±0,5% 100 VDC	80.5430 27Ω ±5% -"- $\frac{1}{4}$W
1860 c/s	- " - 61.483-23T	76.5001 0,02µF ±0,5% 100 VDC	80.5435 68Ω ±5% -"- $\frac{1}{4}$W
2280 c/s	- " - 61.483-24T	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W
Spec:			
1750 c/s	coil/spole 61.483-25	76.5002 0,05µF ±0,5% 100 VDC	80.5432 39Ω ±5% carbon $\frac{1}{4}$W
1980 c/s	- " - 61.483-26	76.5001 0,02µF ±0,5% 100 VDC	80.5434 56Ω ±5% -"- $\frac{1}{4}$W

La, Ca and Ra: lowest frequency
La, Ca og Ra: laveste frekvens

Lb, Cb and Rb: highest frequency
Lb, Cb og Rb: højeste frekvens.