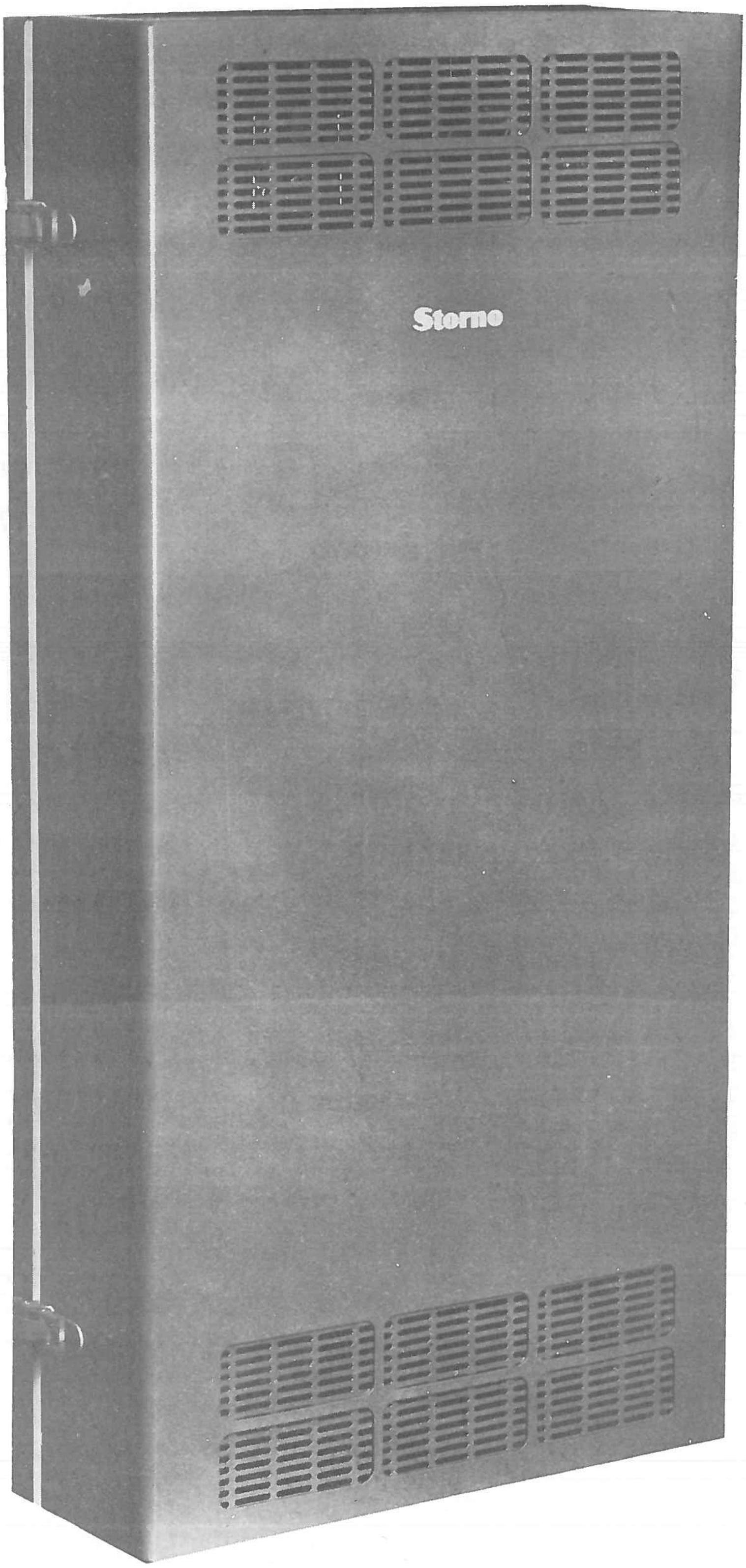
VHF MARITIME RADIOTELEPHONE
MODEL MARINEPHONE
TYPE CQF13-2
152 . . 174 Mc/s

C o n t e n t s

Storno

Storno



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CHAPTER I. GENERAL DESCRIPTION

A. General

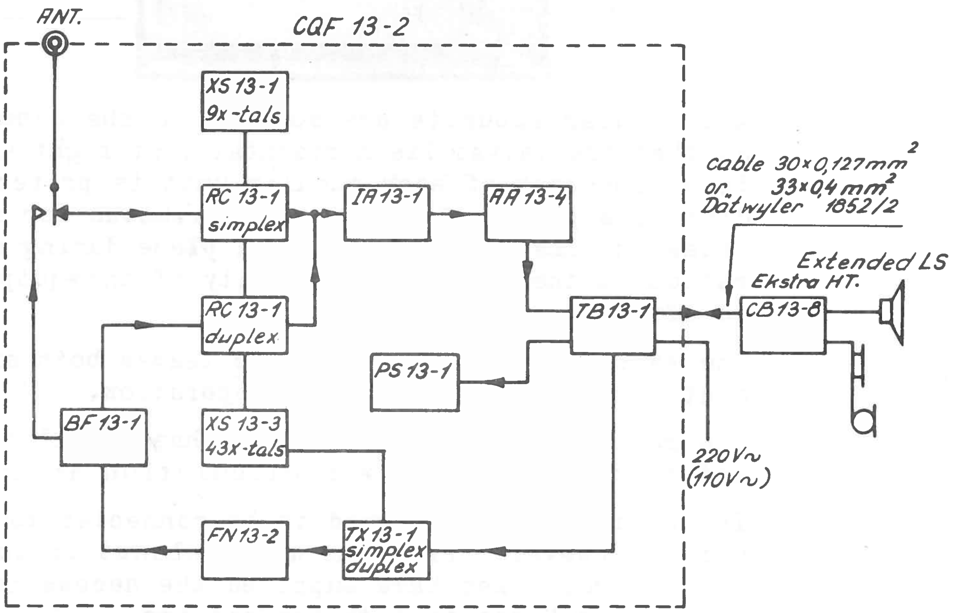
STORNO maritime VHF/FM radiotelephone equipment type CQF13-2 is especially designed for ship-to-ship and ship-to-shore communication within the frequency band 152 Mc/s to 174 Mc/s. It satisfies the requirements for maritime equipment as laid down by the Hague convention of 1957, and furthermore the STORNO MARINEPHONE possesses a number of special features that facilitates installation and operation.

The equipment is designed to provide dependable service under the most adverse climatic conditions. It is fully tropicalized and quality components are used throughout.

The radiotelephone may be used on all international frequency channels, for simplex and duplex operation as desired. Two receiver converter units that are partially independent of each other are used for these two types of operation.

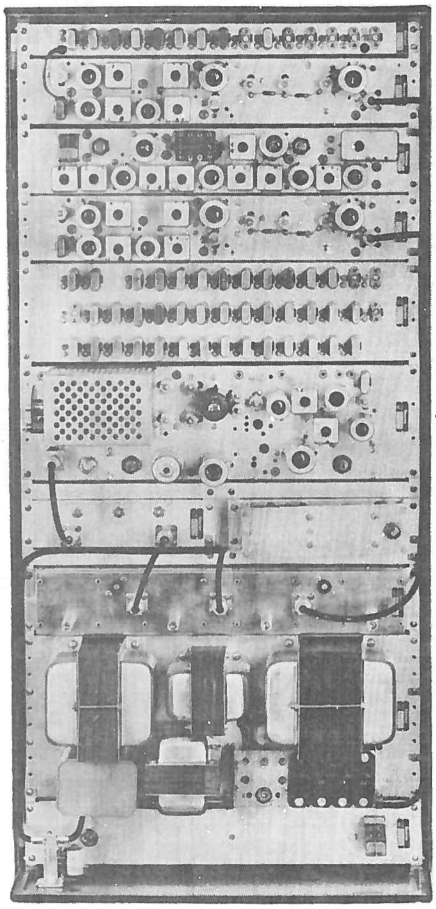
A complete installation consists of the following items:

- Wall-mounted cabinet containing transmitter/receiver
- Remote control box with watertight handset
- Omni-directional antenna
- Possibly additional control box with handset and junction box
- Installation accessories such as cables, connectors, etc.



Construction

The cabinet is designed for wall-mounting and can be fitted with shock absorbers if required. The cabinet is made up of a rear panel, which supports the common swinging frame for the radio subunits and it also provides a method of mounting the equipment to the wall. A dust cover is placed over the equipment and fixed to the rear panel with four quick release fasteners.



All modular subunits are mounted to the common swinging frame so that the valves lie horizontally at right angles to the front face. The rear of each modular unit is protected from dust and dirt by a plate, which is easily removed for servicing. In most cases the dust cover must be in place during alignment and operation as the frequency stability of the equipment otherwise may be affected.

The swinging frame construction leaves both sides of the equipment accessible - even during operation.

The main dust cover at the front has ventilation louvers at top and bottom to permit air circulation around the equipment.

The equipment is designed to be connected to 220 V or 110 V ac mains. However - only the main cabinet is connected to mains. The control boxes have supplied the necessary control voltages from the cabinet through the cabling.

Modifications

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 in this Manual.

B. Notes on Installation

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 instructions in this chapter.

Packing

Immediately after reception of each consignment from STORNO each item should be unpacked and checked with the 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 container should be used if possible, and the final test report for the complete equipment must always be returned with the equipment, too.

Main Parts

The following items are required for a correct installation:

1. Transmitter/receiver cabinet CQF13-2.
2. Remote control box CB13-8a ("Master box")
3. Possibly remote control box CB13-8 ("Slave box")
4. Omnidirectional antenna AN11-21
5. Coaxial antenna cable RG-8/U with connector UG-21B/U
6. Mains cable NKTP 12519 2x0,75 mm
7. Control multi-cable (see below)
8. Loudspeaker cable (see below)
9. Max. three extension and hailing loudspeakers (not supplied as standard)
10. Handset type MT13-1 W (included in Control box)

Lay-out

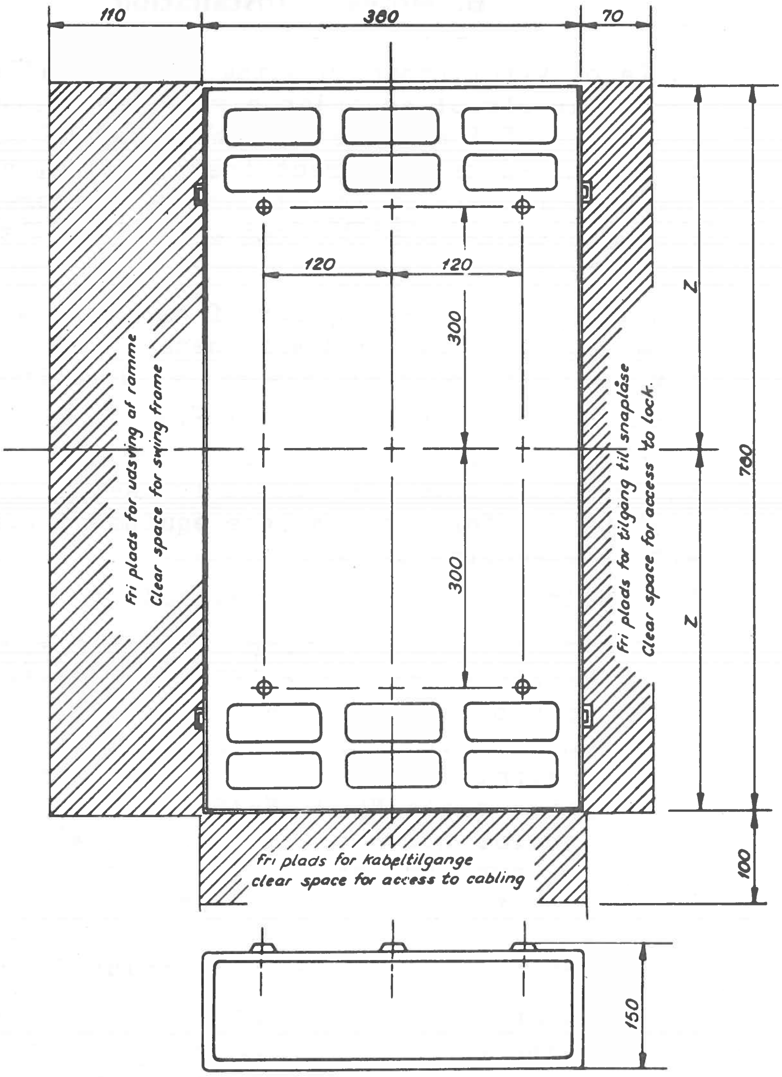
Before starting the installation work the cabling lay-out and the placing of cabinet and accessories must be decided. The cabinet must be mounted in a room, which is dry and well ventilated. The control box(es) must be placed at the ship's bridge or at any other convenient place within easy reach of the operator. The boxes and the handsets are watertight, but if possible they should be mounted at a site not directly exposed to rain or salt water. Depending of the cables used the boxes must not be placed more than 12 or 40 metres from the cabinet.

The loudspeakers may be placed at any convenient position as long as the loop resistance of the cabling does not become too high. The antenna can be mounted on top of a mast, but the coaxial feeder cable should be kept as short as possible.

The multi-cable must also be as short as possible. It should be kept absolutely clear of all movable parts and hot pipes. Furthermore the cable should be fastened by a sufficient number of cleats and relieved in all lead-in bushes and at sharp bendings.

Cabinet

The cabinet is designed for wall-mounting and can be fitted with shock absorbers if required. The cabinet is made up of a rear panel, which supports the swinging frame and also provides a method of mounting the equipment on the wall by 3/8" bolts or screws. The illustration below shows the overall dimensions of the cabinet.



Temperature

The ambient temperature of the room in question should not normally exceed 45°C. Occasionally it may rise to 60°C, but not for sustained periods. If the temperature remains above 60°C for more than an hour continuously, the equipment is considered to be operating under adverse conditions and damage may result.

The limits specified are based on continuous operation on standby/receive with intermittent operation of the transmitter 50 % of the time. A single transmitting period must not exceed one half hour. The equipment should not be operated at temperatures lower than -30°C.

The optimum operating range for an economic life of the components is between -10°C and +35°C. If necessary, an exhaust fan with thermostat control must be installed. In this case, dust filters at the fresh-air intake should be considered.

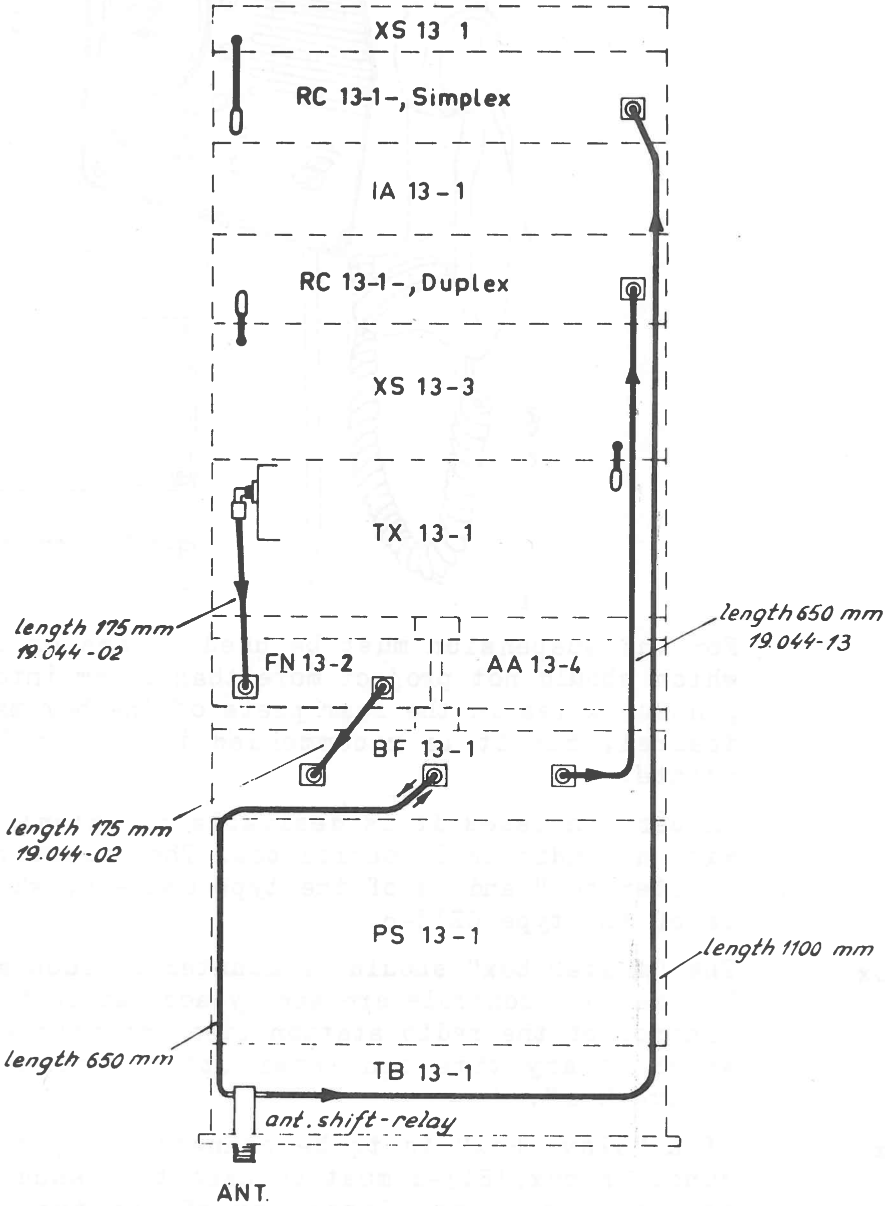
Mains Voltage

The supply voltage must be 110 V or 220 V ac, and in all other cases an autotransformer must be inserted. It is essential that the supply voltage be equal to the nominal value for the equipment. Random variations must never exceed 10 % - for best life of valves 5 %.

If necessary, voltage regulating transformers or other regulating devices must be provided. The equipment will - however - function with voltage variations up to ±20 %.

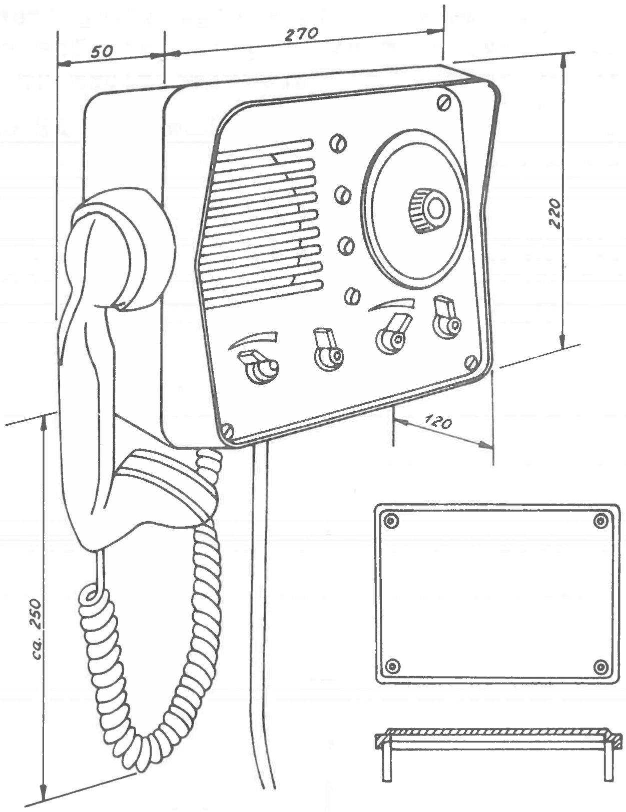
RF-connections

On the illustration is shown the RF-cabling between the modular subunits.



Control Boxes

The remote control box type CB13-8 contains all operating knobs and indicating devices necessary to operate the maritime radio-telephone equipment. The overall dimensions appear from the illustration.



For the suspension must be used screws or bolts the heads of which should not project more than 10 mm into the box. The suspension holes in the rear plate of the box may be drilled where desired, but it is recommended to use at least 4 suspension points.

In certain cases it is desirable to extend the control system with an additional control box. The priority box is then named "master box" and is of the type CB13-8a, while the "slave box" is of the type CB13-8.

Master Box

The "master box" should be mounted in such a position that the handset and controls are easily accessible for the operator. The control of the radio station lies entirely at the "master box", which at any time can interrupt the communication from the "slave box".

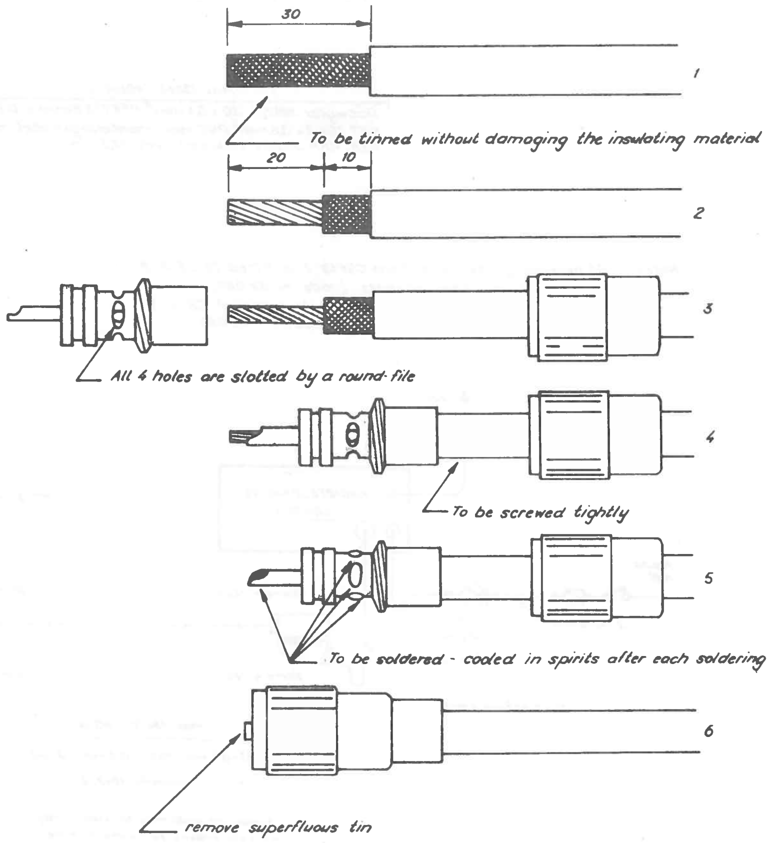
Slave Box

If a "slave box" is to be connected to the system a special junction box JB13-1 must be used to branch off the cable from the radio cabinet. Depending of the type of cable used the maximum total length from cabinet to each to the control boxes must not exceed 12 metres or 40 metres respectively.
A total of 17 wires are branched to either box, while the remaining wires are relay-branched. When the relays are de-energized, the control of the radio station lies at the "master box".

Take care that the start relay in the radio power supply PS13-1 has its contacts a1 and a2 shorted.

Mains Cabling For the mains supply cabling should be used a 2 x $0.75 mm^2$ cable. Furthermore it is advisable to install a main circuit breaker next to the cabinet together with a main fuse (min. 2 Amp. at 220 V, min. 4 Amp. at 110 V).

Antenna Cabling The suspension of the connector PL 259 to the coaxial antenna cable RG-8/U should be made according to the procedure shown in the illustration.



Antenna Mounting The antenna should be placed as high and as clear as possible in order to obtain the best possible matching and radiation.

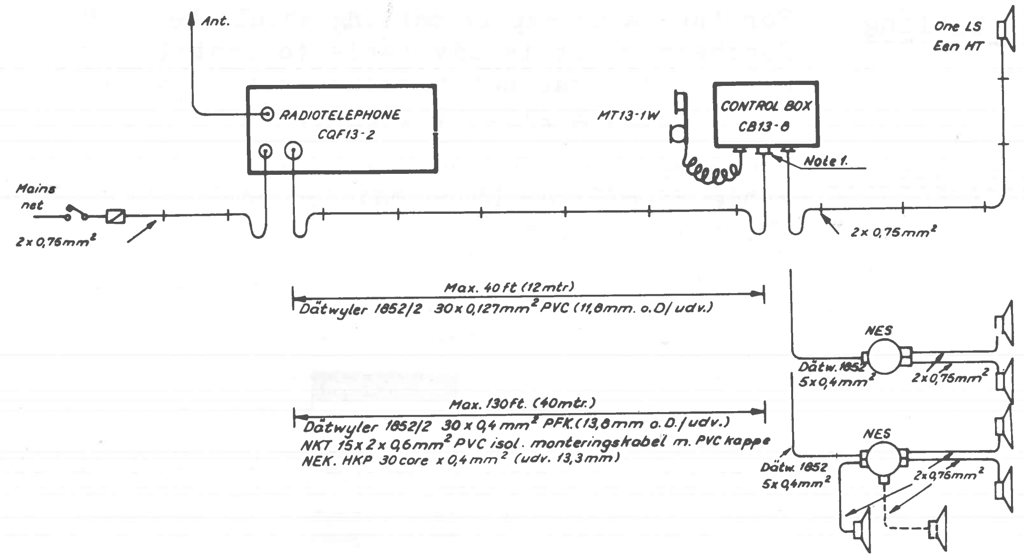
Erection of an antenna too close to an obstacle (e.g. the radar antenna reflector, the smoke-stack, etc.) may introduce an undesired directivity.

Main Cabling For the cabling between cabinet and boxes the following cables are recommended:

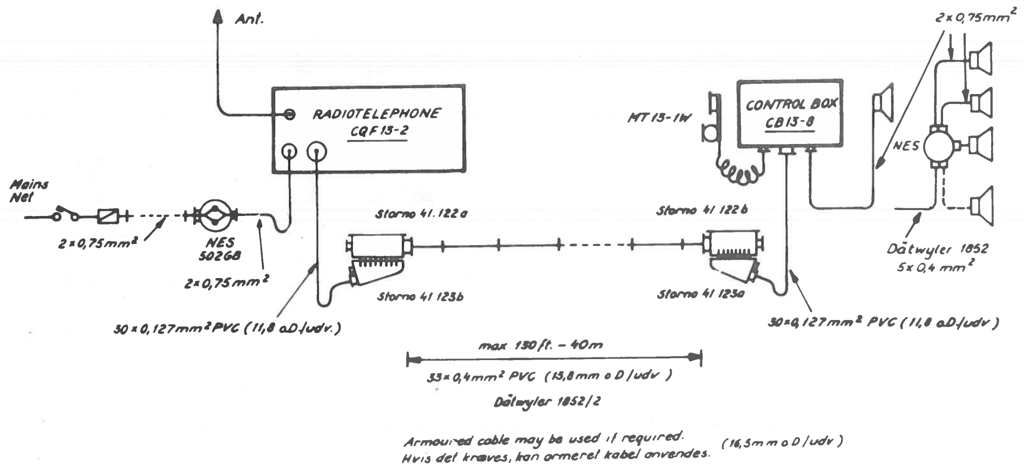
a) 30 x $0{,}127 mm^2$ plastic covered with an external diameter of 11,8 mm (7/16"). Suitable for lengths up to 12 m (39 ft).

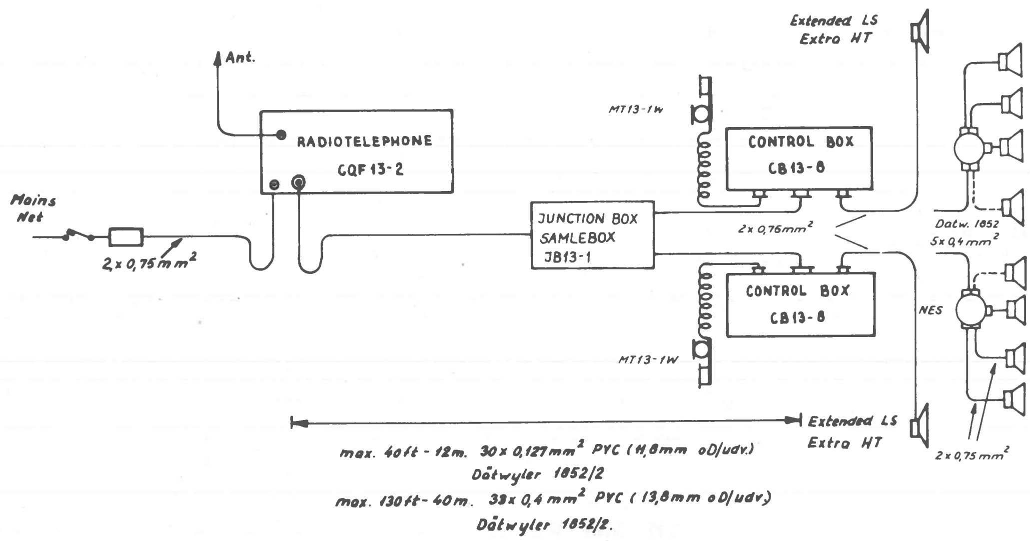
b) 33 x $0{,}4 mm^2$ plastic covered with screen, external diameter 13,8 mm (17/32"). The screen is also used for chassis return purposes. Suitable for lengths up to 40m (125 ft) in connection either with special rubber gaskets in the watertight glands in cabinet and boxes or in connection with two short lengths of cable a) and two waterproof junction boxes.

Chapter I. General Description



Note 1. If necessary the cable from CQF13-2 is fitted to CB13-8 by means of rubber gaskets (code nr. 32.087)
Kablet fra CQF13-2 tilpasses om nødvendigt CB13-8 ved hjælp af gummipakninger (Kode nr. 32.087)





c) 33 x 0,4 mm^2 armoured, plastic covered with an external diameter of 16,5 mm (11/16") Diameter of cable is 13,8 mm (17/32"). The screen is also used for chassis return purposes. Suitable for lengths up to 40 m (125 ft) in connection with two short lengths of cable a) and two watertight junction boxes.

For lengths above 40 metres (125 ft.) must be used a special cable with either more wires or greater wire dimensions depending upon the total length required.

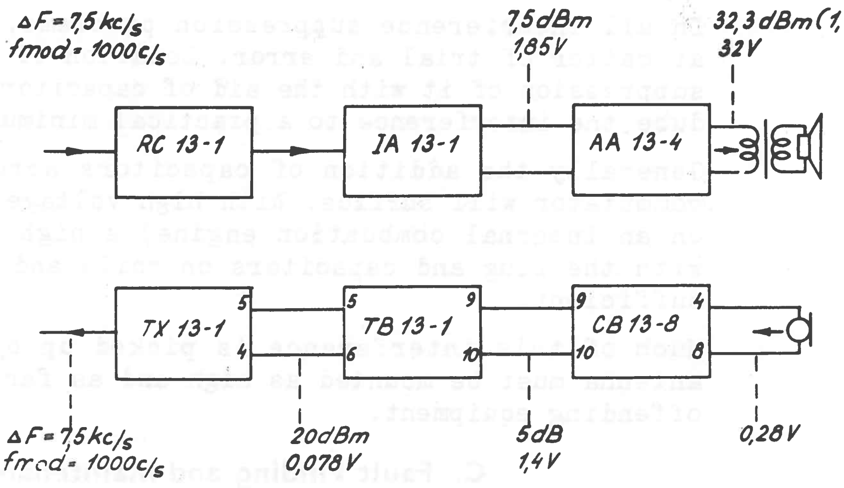
Loudspeakers

Up to three extra loudspeakers may be connected to the system. A hailing loudspeaker can be connected to terminals 2 and 3 and an external loudspeaker can be connector to terminals 1 and 3. Furthermore a monitoring loudspeaker can be connected to terminal 20 and 12. The hailing and the external loudspeaker should contain a 600 Ω matching transformer, while the monitoring loudspeaker should have a matching transformer of at least 6000 Ω and furthermore contain a volume control or an on/off switch.

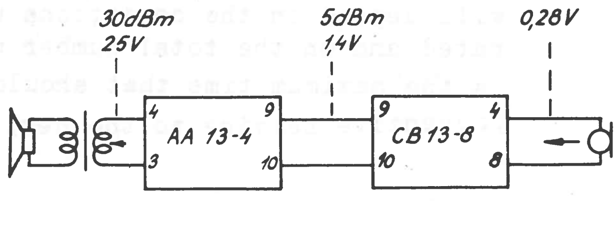
A junction box is used for branching off the different loudspeaker cables (2 x 0,75 mm^2). If a hailing loudspeaker is not used, terminals 2 and 3 must be shorted, and if an external loudspeaker is not used, terminals 1 and 3 must be shorted.

Initial Testing

Normally the equipment has crystals fitted and it is tuned and set for immediate operation, but if required the equipment may be supplied without crystals. Thus the station must be aligned in strict accordance with the alignment procedure given later in this manual.



Receiving and transmitting
Modtagning og sending



Hailing

However - it is recommended that the equipment has the crystals fitted at STORNO, as the initial setting up requires measurements of frequencies in the range 6 to 10 Mc/s with an accuracy of more than 2×10^{-6}.

Do not attemp any initial testing before carefully reading through the whole instruction manual. Switch on one group of units at a time and check operation by means of a service meter and the numbered testpoints. Comparison between figures in supplied test report and readings may prove valuable.

If operation is not successfull at first, check for installation faults, defective valves, etc. The equipment has been tested and operated at the factory before shipping, for which reason defects in workmanships can be said to be rather rare.

WARNING

Do not attemp to retune factory-set and locked circuits. This may necessitate extensive realignment work later on. This is particular important with respect to the branching filter. Do not remove the cover plate merely for inspection, but only when a fault is narrowed down to the filter itself. If the plate is removed and replaced, it is necessary to make a complete retuning of the branching filter.

Interference Suppression

If noise is present, such as noise produced by comutation, spark plugs, telegraph apparatus, etc. weak signals will be difficult to hear and therefore some suppression of the noise source will be necessary. The equipment itself has been designed to attenuate such interference by using ferrox beads, decoupling capacitors and coils wherever possible.

In all interference suppression problems, the cure is largely at matter of trial and error. Location of the interference and suppression of it with the aid of capacitors and chokes will reduce the interference to a practical minimum.

Generally the addition of capacitors across the brushes of a commutator will suffice. With high voltage systems (spark plugs on an internal combustion engine) a high resistance in series with the plug and capacitors on coils and distributors will be sufficient.

Much of this interference is picked up by the antenna so the antenna must be mounted as high and as far as possible from the offending equipment.

C. Fault Finding and Maintenance

When the maritime radiostation CQF13-2 has been correctly installed and checked for satisfactory operation it should not thereafter be left to itself until breakdowns occur. Every equipment should be inspected at regular intervals and readjusted if 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 one year is the maximum time that should be permitted to elapse from one preventive service to the next.

Through conservative dimensionning of the circuits employed in the radio station the STORNO company has created a piece of radio equipment that may be expected to have long life.

Testpoints

All significant currents and voltages are specified in the circuit diagrams. All modular units moreover have marked metering testpoints to permit rapid checking of the operational condition of the equipment. These DC testpoints are shown on the units as a circle with a figure, thus ①. All measurements are taken with respect to ground with a ammeter with an internal resistance of 1000 Ω and a 50-0-50 uA scale. The STORNO service instruments types SI05, SI06 and SI07 have been designed for such applications.

Test Report

Each radio station shipped from the factory is accompanied by a final test report giving the testpoint readings for that equipment as read by the Final Testing Department. This test report 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, seeing that 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 comparisons will clearly show when readjustments and valve replacements should be made.

Routine Inspections

A normal routine inspection should comprise a complete check of all testpoints in the equipment, and in addition to this the following operations should be made:

1) Remove dust and dirt from the equipment by means of a soft brush or through cautious use of compressed air.
2) Inspect visually valves, transistors, diodes, etc. Fasten any component that may have worked loose.
3) Check the supply voltage
4) Check cable connections for corroded joints and broken leads.
5) Measure the output power delivered by the transmitter and readjust the PA-circuit and the antenna link if necessary.
6) Measure the receiver sensitivities and readjust the receiver input circuits if necessary.
7) Check locks, 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 contact surfaces.
9) Check the antenna mounting, the feeder cable and measure if possible the standing wave ratio of the antenna.

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 cabinet.
   Such faults can be supply voltage failures, absence of modulating signal, faulty connections in cable connectors, defective antenna, etc. The recognition of such faults are easy.
b) Faulty adjustment of the signal circuits.
   Such faults arise gradually, which is clearly seen when

comparing the "log" figures over a certain period of time. The proper realignment of the circuits around the said test-point will restore the equipment.

c) Defective valves, transistors, or diodes, and faulty connections in valve sockets or relay sockets.
Such faults can be traced partly by measuring the voltages and currents given on the diagrams with a 20.000 Ω/V multimeter and partly by a complete test of the functioning of the equipment.

d) Burned-out resistors, broken wires, shorted capacitors, etc. Such defective components or broken wires can be found visually. However - great care should be displayed when replacing a component that the wiring and placing is exactly as before.

However, repairing a fault that has been located is not always enough. Especially in the case of fault of the type described under c) and d) it is important that the cause of the fault be found and steps be taken that will prevent the fault from occuring 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 modular units the best plan is usually to try to locate the defective modular unit, thereafter proceeding to inspect and check that unit in detail.

Spare Parts

When ordering spare parts reference should be made to the code number given in the parts lists. Also the type and serial number of the particular subunit should be quoted.

D. Technical Specifications

For detailed technical specifications of the subunits are referred to the section E. Additional Technical Specifications in chapter II.

Frequency Range

152 Mc/s to 174 Mc/s.

Frequency Deviation

Maximum ±15 kc/s.

Frequency Stability

Better than $\pm 15 \times 10^{-6}$ within the ambient temperature range $-10^{\circ}C$ to $+40^{\circ}C$.

Antenna Impedance

50 Ω nominal.

Maximum Frequency Separation between Extreme Channels

1,4 Mc/s at 3 dB points.

Transmitter

Output Power

20/0.5 watt.

Spurious Radiation

Attenuated more than 70 dB.

Modulation Characteristic

Phase modulation in the range 300 c/s to 3000 c/s with a max. deviation +1, -3 dB relative to 1000 c/s, including the microphone characteristic.

Modulation Splatter

Less than 9 µWatt.

Valve Complement

ECC81, EF91, M8100/5654, QQE03/12, QQE03/20, OA200 and GEX66.

Receiver

Sensitivity

12 dB signal-to-noise ratio for less than 0.9 µV emf with Δf = 10 kc/s and fm = 1000 c/s.

Noise Figure

Approx. 6 dB.

Selectivity

At least 70 dB for ±35 kc/s.
Less than 6 dB at ±15 kc/s.

Spurious Selectivity

Better than 80 dB.

Demodulating Characteristic

-6 dB/octave in the range 300 c/s to 3000 c/s, +1, -3 dB relative to 1000 c/s.

Audio Output

Maximum 3 watts in 600 Ω.

Valve Complement

E188CC, ECC81, M8100/5654, OA81, and OA200.

Power Supply

Consumption

Receive: Approx. 85 watts.
Transmit, full power: Approx. 145 watts.
Transmit, reduced power: Approx. 130 watts.
Transmit, duplex: Approx. 185 watts.

CHAPTER II. DESCRIPTION OF SUBUNITS

A. General

Module Units

The MARINEPHONE radiotelephone equipment CQF13-2 contains the following subunits as a minimum:

TX13-1	20/0.5 watt transmitter unit with 7 valves
FN13-2	Antenna filter subunit
RC13-1	Simplex receiver converter with 5 valves
RC13-1	Duplex receiver converter with 5 valves
IA13-1	IF-amplifier for 50 kc/s spacing with 6 valves
PS13-1/1a	Common power supply for all subunits
XS13-1	Crystal shift unit for simplex receiver converter crystals
XS13-3	Crystal shift unit for simplex/duplex transmitter crystals and duplex receiver converter crystals
AA13-4	Audio amplifier
TB13-1	Terminal panel
BF13-1	Duplex antenna branching filter

The module subunits mentioned above are detailed described on the pages following. Diagrams and parts list are found in chapter IV.

B. Transmitter Section

The transmitter section comprises description of the transmitter subunit TX13-1 and the antenna filter subunit FN13-2.

TX13-1

TX13-1 is a FM transmitter designed for communication within the frequency range 152-174 Mc/s. It is phase modulated and supplied with two modulation inputs, a speech channel with modulation limiter, which operates in the range 300 to 3000 c/s together with a tone channel which has a range of 300 to 8000 c/s. The maximum frequency deviation is 15 kc/s up to 3000 c/s. The transmitter is crystal controlled with a frequency stability better than $\pm 15 \times 10^{-6}$ within normal temperature range.

Mechanical

The transmitter, which occupies 4" of rack space, is built on the module principle and fits into a swinging frame. The swinging frame is mounted on a back plate, which in turn may be mounted in a standard 19" rack.

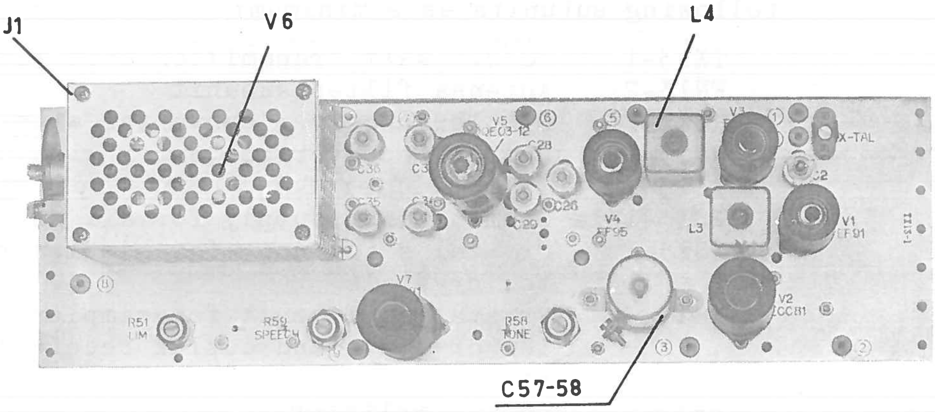
All power leads and signal carrying leads out or into the unit are fed through capacitors and ferrox beads. The chassis is screened with a backplate which helps to stabilize the transmitter and to prevent dust and dirt from entering.

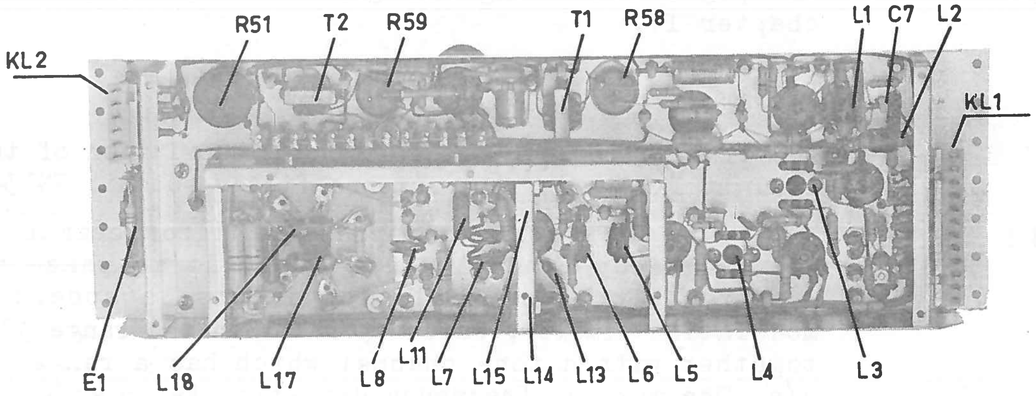
Electrical

The crystal oscillator and phase modulator is followed by a frequency multiplier chain which has a factor of 24. The output is a push-pull amplifier, capable of giving approximately 25 watts.

Storno

The crystal oscillator (V1) is a Pierce-Colpitts circuit and the crystal is connected across the screen and control grid. This arrangement gives a reasonably good stability against voltage variations. When a separate crystal shift unit is used the connection is made to the crystal socket on the transmitter chassis as the twin-lead output from the crystal unit terminates in a crystal holder. Because this connecting lead is to be as short as possible, the crystal unit must be mounted immediately above the transmitter unit.





Phase Modulator

The oscillator output is fed via the phase shifting network L1-C7, L2 and the coupling capacitor C8 to the phase modulator PM (V2a) which is half an ECC81. The outputs from the speech limiter and the tone input circuits are also fed into the phase modulator. The principle of phase modulation produces a large deviation for a low input level. The output voltage of the phase modulator may be measured at testpoint 3.

Doubler and Quadrupler

The phase modulator is followed by a doubler stage DB (V2b) which is one half of an ECC81. The plate circuit L3, a double filter, is tuned to the second harmonic of the crystal frequency and the output is directly coupled to the quadrupler V3. L4 is tuned to the 8th harmonic and resonance may be indicated on a meter connected to testpoint 5.

Tripler

From the quadrupler the signal is fed to a tripler stage V4 which is an EF95. The tuned plate circuit is adjusted by C26 to resonate at the 24th harmonic of the crystal fundamental, which is the output frequency. The input to the driver stage is directly coupled to the push-pull driver stage through L5 and L6 and it is balanced by the trimmers C28 and C29. The grid voltage may be checked at testpoint 6.

Driver

The driver stage DR (QQE03/12) is a tetrode operating in push-pull which amplifies the signal and feeds it to the power stage. The correct frequency is filtered out by L7 and L8. The output valve is a QQE03/20 and also operating in push-pull, and it delivers approximately 25 watts of power to the antenna connector J1. C38 is a butterfly capacitor used for tuning the last circuit.

Monitor

A small probe in the proximity of the antenna coupling coil L10 picks up a signal, which is rectified by E1 and fed to testpoint 8 and to an external connection. This DC voltage is proportional to the output power and therefore used as a monitor.

All valves in the transmitter are protected from damage if the drive should fail. This is achieved by a fixed negative bias and the use of cathode resistors.

Modulators

The transmitter modulator stage has two balanced inputs, one for tones and the other for speech. The tone circuit is a simple matching transformer circuit and the amplitude of the signal is controlled by R58. The range for the tone channel is from 300 to 8000 c/s, but by connecting in the 48 uS circuit, the band is from 300 c/s to 3400 c/s.

Speech Limiter

The speech channel consists of a speech limiter and an amplifier with pre-emphasis and de-emphasis circuits, which correct the modulation before feeding it to the modulator stage.

From the transformer and the level setting potentiometer, the signal is fed via the differentiating circuit C68-R57 to the grid of the speech limiter valve V7a. The amplified signal is then fed via the clipper diodes E2 and E3 and the integrating circuit consisting of R48-C63, to the AF valve V7b. Negative feedback is supplied to the valve by C60-R46, C61-R45, which gives the stage a low-pass characteristic with a cut-off at about 3000 c/s. Thus the harmonic distortion products due to the speech limiter are attenuated so they do not pass to the modulator and the danger of modulation splatter in neighbouring channels is greatly reduced.
The clipping level potentiometer R51 is normally set to give a frequency deviation of ±15 kc/s. The output from V7b is fed via the terminal strip to the grid of the modulation valve.

The filament circuit may be used with 12.6 or 6.3 V and is not grounded. If 6.3 V is used, then terminals 2 and 4 must be joined.

FN13-2

The filter FN13-2 is a low-pass filter designed to attenuate the spurious radiation from a transmitter working in the range 152-174 Mc/s.

The filter consists of four T-sections, combined to form a constant K filter with an impedance of 52 Ω.

Properly loaded with 52 Ω the filter has a band-pass range of 0 - 220 Mc/s. However, some rippling above 174 Mc/s may reduce the use of the filter above this frequency.

C. Receiver Section

The receiver section comprises description of the receiver converter subunit RC13-1 and the intermediate amplifier subunit IA13-1.

RC13-1

The receiver converter amplifies the received antenna signal and converts it to the second intermediate frequency of 455 kc/s. One crystal is used together with a frequency multiplier chain to produce the sixteenth harmonic, which is mixed with the incoming signal to produce the first intermediate frequency of approximately 10 Mc/s. The fundamental frequency of the same crystal is mixed with the first intermediate frequency to produce the second intermediate frequency. The converter is used in connection with a 455 kc/s IF-amplifier, which is a separate subunit.

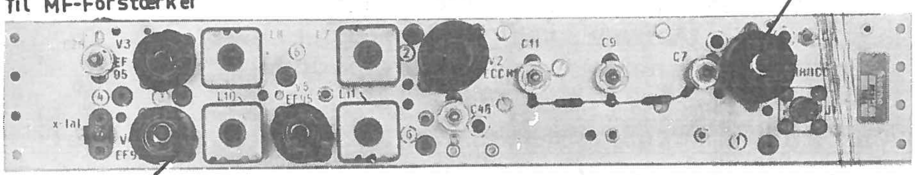
R.F. Circuits

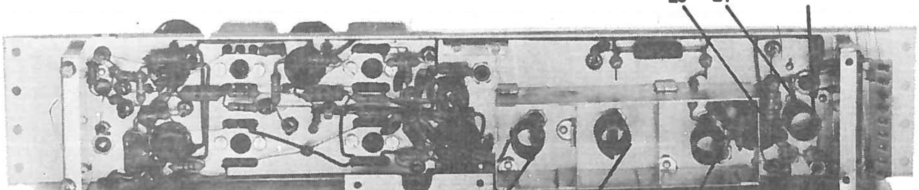
The antenna signal is fed via the antenna connector J1 to the antenna link L1, which is inductively coupled to the circuit C1-L2 in the RF-amplifier V1. V1 is a double triode type E188CC, connected in cascode. The cascode stage is followed by a triple band-pass filter C7-L4, C9-L5 and C11-L6 which gives the receiver a large input selectivity.

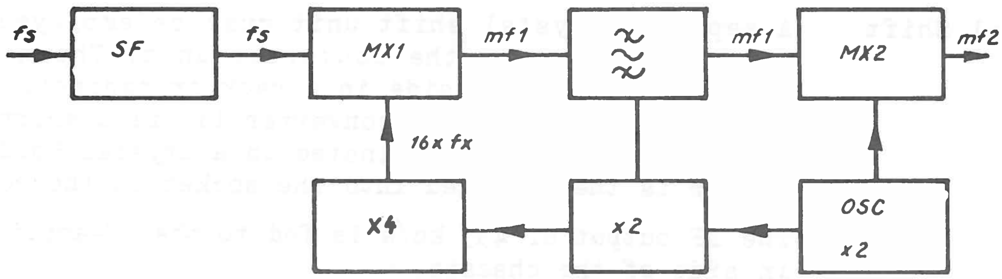
The signal is then fed to the control grid of the first mixer stage MX1 (V2a) together with the local oscillator frequency, which is the 16th harmonic of the fundamental crystal frequency. V2a is one half of a double triode ECC81, the other half forms part of the crystal multiplier circuit.

The plate circuit of the first mixer contains a two-circuit filter L7, followed by a similar filter L8, which selects the resultant frequency and feeds it to the grid of the second mixer valve MX2 (V3) which is a pentode M8100/5654.

The crystal fundamental is also fed to the grid of the mixer valve MX2 (V3).







Mixing

From the diagram it can be seen that double superhetrodyne reception with only one crystal is used and that the first intermediate frequency is dependent on the signal frequency.

$$f_s = 16\ f_x + If_1 \qquad (1)$$

$$IF_1 = f_x + 0.455\ Mc/s \qquad (2)$$

Solving for f_x'

$$f_x = \frac{f_s - 0.455}{17}\ Mc/s \qquad (3)$$

where f_s is the input frequency in Mc/s.

Solving for If_1'

$$If_1 = \frac{f_s + 7.28}{17}\ Mc/s \qquad (4)$$

From (4) it is seen that the change of the 1st intermediate frequency for a given change in signal frequency is:

$$\Delta If_1 = \frac{\Delta f_s}{17}$$

Multiplier Circuits

The oscillator and 1st doubler, which is a pentode of the type M8100/5654 is a Pierce-Colpitts oscillator with the crystal inserted between the control and screen grids. This arrangement allows the crystal to operate at a very low level and the frequency is independent of normal variations of plate and filament voltages. The oscillator plate circuit L10 is tuned to the second harmonic and the signal is fed to the second doubler stage via C37. The oscillator frequency is also fed to the grid of the 2nd mixer from the screen grid.

The second doubler is also M8100/5654 whose plate circuit is tuned to the fourth harmonic of the fundamental by the two-stage filter L11. Oscillator and 2nd doubler grid currents can be measured at test points 4 and 5. The secondary of L11 is coupled to the quadrupler QD, which is the half of an ECC81 (V2b). The quadrupler grid current can be measured at test point 6. In the plate of V2b, the 16th harmonic is filtered out by C46-L12 and fed to the first mixer valve.

Crystal Shift

A separate crystal shift unit must be employed and placed in a position next to the converter unit. The normal method of mounting is side by side in a rack or cabinet. Connection from the crystal unit to the converter is via a short piece of twin-lead cable which is terminated in a crystal holder. The crystal holder is then plugged into the socket on the converter.

The IF output of 455 kc/s is fed to the IF-amplifiers via a hole in side of the chassis.

Power Supply

The power for the unit is supplied by a separate supply and is connected to the converter via feed-through capacitors and ferrox beads. A screening plate protects the unit from dust and dirt and also tends to stabilise the receiver.
The heaters may be connected for 6.3 or 12.6 volts operation, but when using 6.3 volts, terminals 6 and 7 on Kl.1 are shorted together.

IA13-1

The I.F. amplifier subunit amplifies the 455 kc/s signal from the second mixer stage in the receiver converter subunit, and after having passed limiting and demodulating circuits the signal is amplified to a suitable level in a line amplifier stage. The subunit also provides a noise operated squelch circuit with facilities for extension of alarm circuits.

I.F. stages

The 455 kc/s I.F.-signal is amplified in two stages comprising a total of 3 filters each containing 4 double-tuned circuits (L1/L2 = V1 - L3/L4 - V2 - L5/L6). The amplifier stages are provided with a special AVC-circuitry by which each stage generates a control voltage of its own by grid rectification.

Limiter

The I.F. amplifier is followed by two limiter stages (V3 and V4) having different time constants in order to reach the best possible static and dynamic limiter characteristics. A coupling circuit L7 forms the connection between the two limiter valves. The bandwidth of this circuit is large, and it contributes practically nothing to the total selectivity of the receiver.

Discriminator

The de-emphasis network gives a -6 dB/octave de-emphasis within the range 0.3 to 3.0 kc/s and a flat characteristic above 3 kc/s. A -6 dB/octave response covering the whole range 0.3 to 8.0 kc/s may be obtained by short-circuiting R53 and a flat response may be obtained by open-circuiting the network C43-R35.

Line amplifier

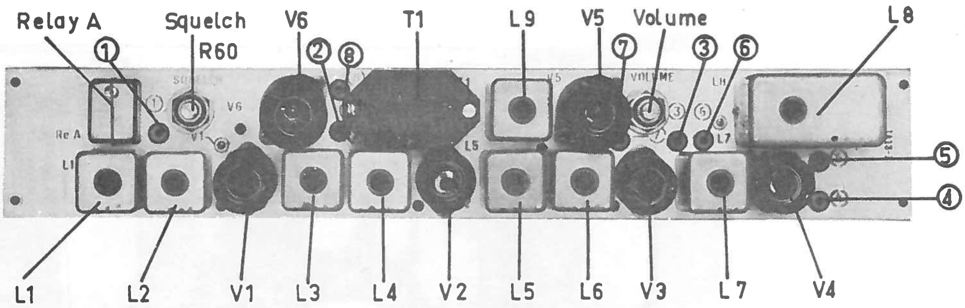
The line amplifier (V5a) amplifies the de-modulated signal to the desired output level.

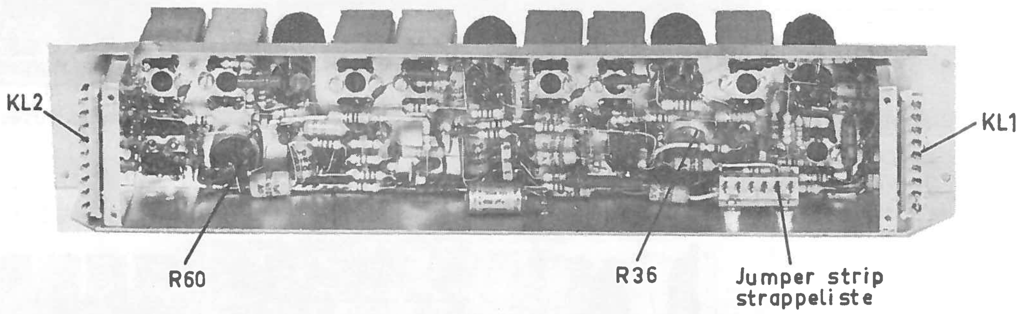
Current feedback in the cathode of the line amplifier valve (V5a) via R38 provides for low distortion and correct output impedance (600Ω). The output level is adjusted by potentiometer R36.

Squelch

The squelch circuit consists of a noise amplifier valve (V5b) a combined filter and detector network (L9), and a squelch valve (V6).

The signal which controls the operation of the squelch circuitry is taken from the discriminator. The signal is amplified in V5b, and all frequencies below approx. 20 kc/s are strongly attenua-





ted in L9. The noise signals are rectified and applied to the grid of the squelch valve (V6a). The rectified noise voltage is positive with respect to ground and to this voltage is added a negative bias voltage, which is taken from the grid of the second limiter valve across R59 - R60. This bias voltage is adjusted by potentiometer R60, and therefore this potentiometer is used for adjustment of the receiver squelch sensitivity. The relay (A) is energized, when a signal is received. If the signal disappears, the rectified noise voltage increases, V6a conducts, the squelch relay (A) is de-energized, and contact a2 breaks the current flow through the line amplifier valve (V5a), and the signal path through the receiver is interrupted.

Alarm Contact al on the squelch relay is brought out to terminal strip kl.2 and may be used for external alarm purposes.

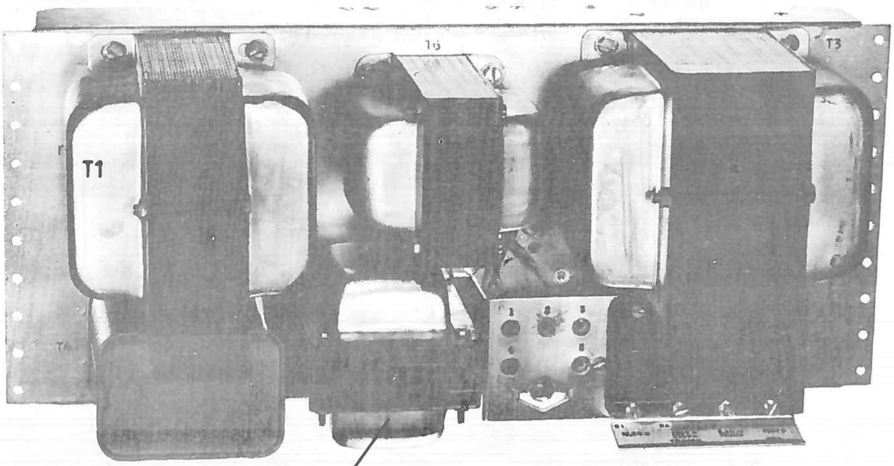
Filaments The filament circuits are connected in such a way that the valves may be operated on 6.3 V or 12.6 V which ever is most convenient.

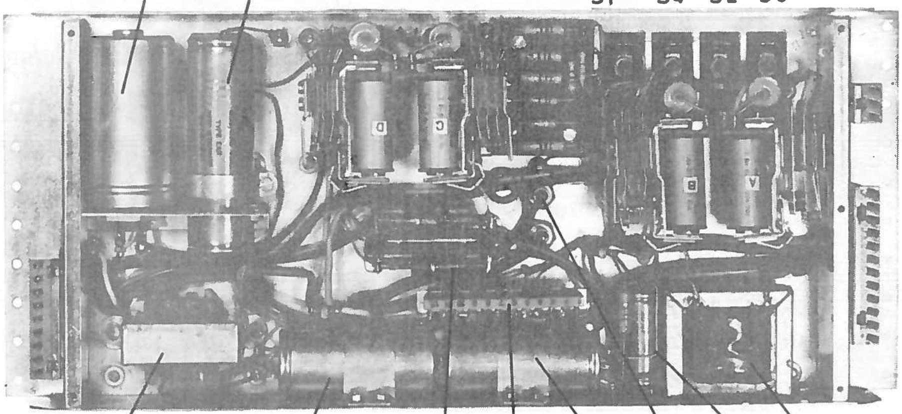
Test points The unit is provided with numbered test points at which the most important currents and voltages can be measured. The grid current in limiter 1 and the discriminator output voltage may also be measured at terminal strip kl.2.

D. Common Subunits

The common subunit section comprises description of the power supply PS13-1/1a, the crystal shift units XS13-1 and XS13-3, the audio amplifier unit AA13-4, the terminal panel TB13-1 and the antenna branching filter BF13-1.

PS13-1, -1a The PS13-1/1a is a mains driven power supply which provides the equipment with the necessary operating voltages. There are three separate transformers which are independently fused on the primary side to supply these voltages. The outputs may be measured at the appropriate test-points.





Conversion

The unit is designed to operate from 110 or 220 volts AC. Conversion of the unit from one input voltage to the other is achieved by connecting the appropriate terminals on the mains tapping strip as shown on the circuit diagram. It is also necessary to change the fuses in accordance with the parts list.

Fuses

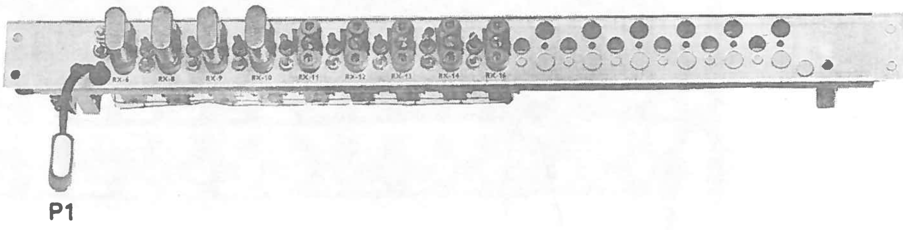
The fuses may be used as mains on-off switches, as the mains is removed from the transformers when the fuses are tripped, but the mains is still applied to the equipment via a terminal panel.

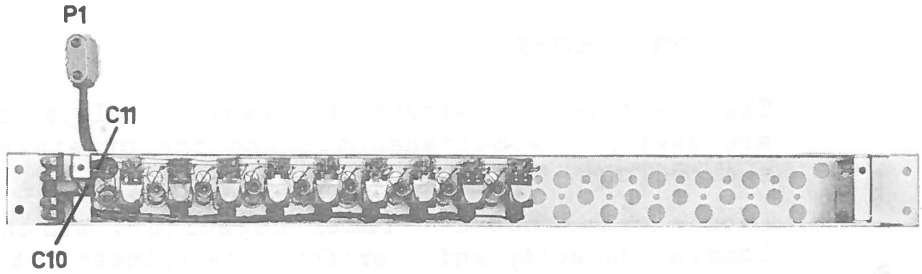
Fuse Panel

A small panel carries the automatic fuses, test-points and a pilot light which is lit when mains is applied to the equipment when the fuse S1 is closed.

XS13-1

The Crystal Shift Unit XS13-1 is designed for use with the receiver converter unit. The 9 crystals are switched by means of relays and both terminals are switched simultaneously. The crystals not in use are shorted. Each crystal has a trimmer capacitor of its own, which is part of the loading capacity and therefore the trimmer determines the exact frequency. The capacitor is adjusted to set the frequency but only when suitable frequency measuring equipment is available.



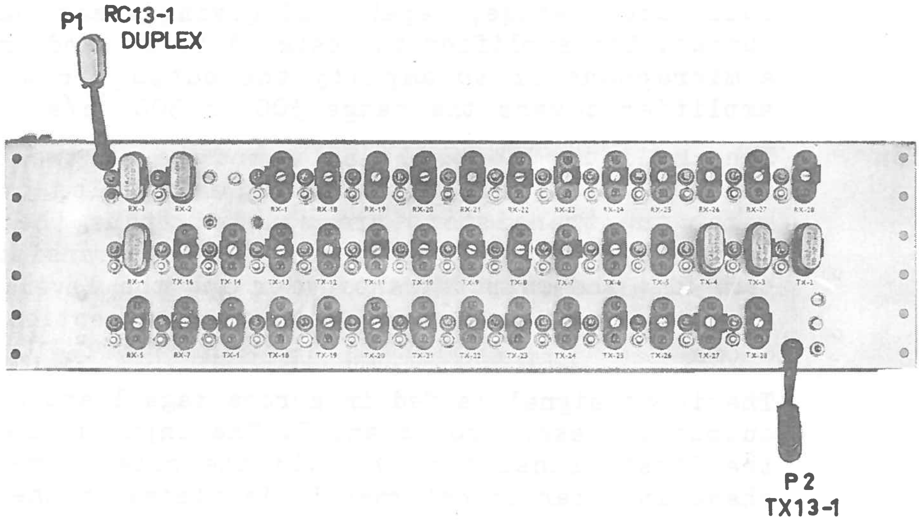


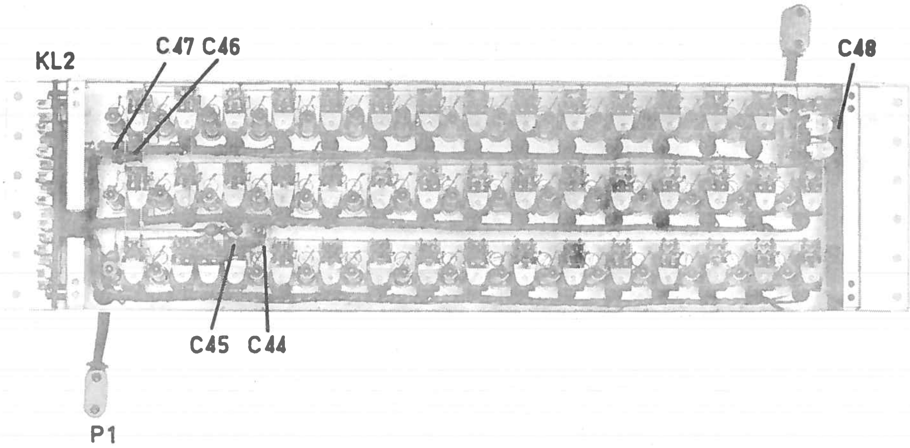
Connection

The unit is connected to the oscillator circuit in the transmitter or receiver module by a twin-lead connector which is terminated in a crystal holder. This holder is plugged into the crystal socket on the main unit. As the lead must be as short as possible, the crystal shift unit must be mounted next to and above the transmitter or receiver in the rack.

XS13-3

The Crystal Shift Unit XS13-3 is designed for use with a combined simplex/duplex system for maritime services. It has provision for all international maritime simplex/duplex transmitter frequencies, 26 in all, together with all duplex receiver frequencies, 17 in all, making a total of 43 channels on the chassis.





RC13-1 DUPLEX

The crystals are switched by means of relays and both terminals are switched simultaneously and the crystals not in use are shorted out.

Adjustment

Each crystal has a trimmer capacitor, which is part of the loading capacity and therefore the trimmer determines the exact frequency.

The trimmer may be adjusted to set the frequency, but only when suitable frequency measuring equipment is available.

Group Relay

To reduce the wiring the crystals are divided into two groups and the output from any group is directed via its group relay to the receiver or transmitter.

Connection

The unit is connected to the oscillator circuit in the transmitter and receiver module by twin-lead connectors which is terminated in a crystal holder. This holder is plugged into the crystal socket on the main unit. As the leads must be as short as possible, the crystal shift unit must be mounted between the transmitter and receiver in the rack.

AA13-4

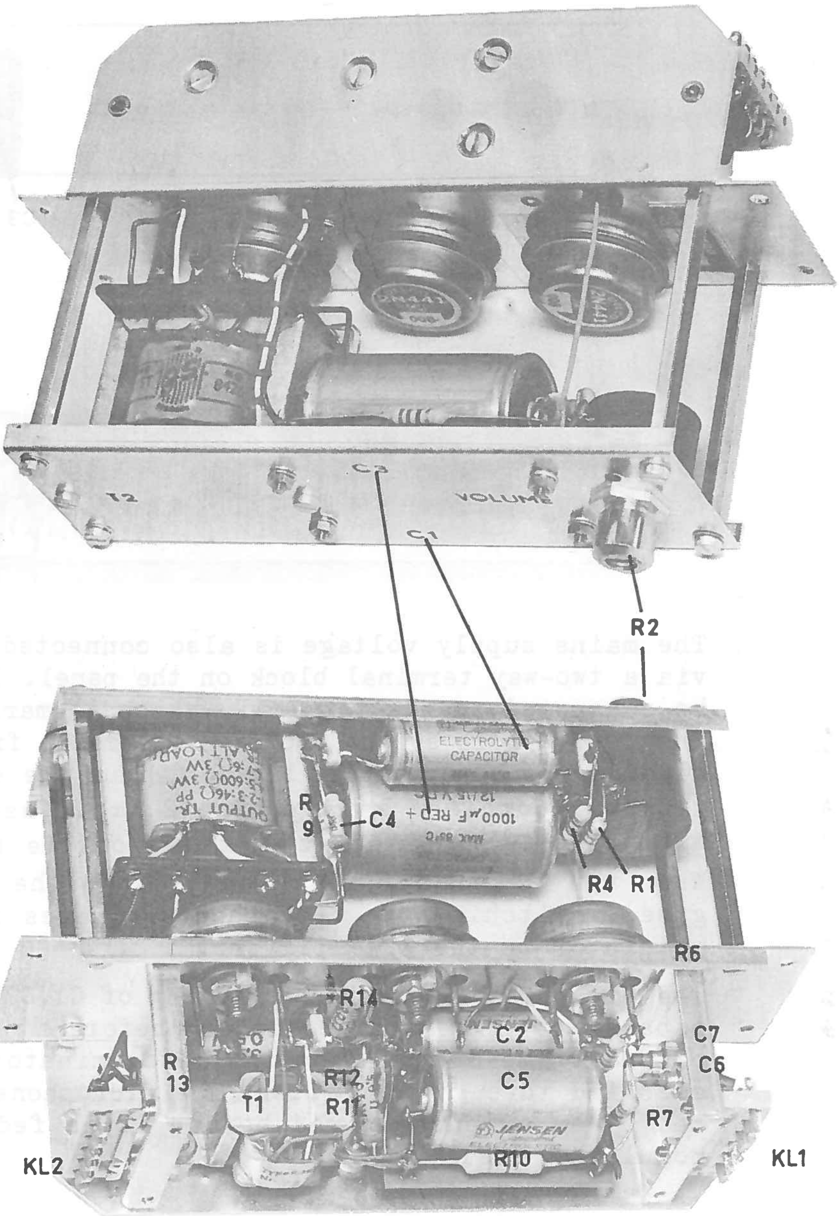
The amplifier AA13-4 is a transistorized amplifier with a push-pull output stage, capable of giving a maximum of three watts output. The amplifier is designed to be used in connection with a microphone or to amplify the output from a receiver. The amplifier covers the range 300 to 5000 c/s.

Construction

The amplifier is built as a module in two sections. It is mounted in a frame with the other modules by the section on which the transistors are mounted, thus the chassis and the large frame act as a heat sink for the transistors. The section carrying the output transformer and the level adjusting potentiometer stands off from the transistor section by approximately 6 cms.

Operation

The input signal is fed in across tags 1 and 2 on kl.2, and the output is taken from 4 and 5. The input is fed to the base of the first transistor (Q1) via the potentiometer R2 and C1. A phase inverter transformer T1 is placed in the collector circu-



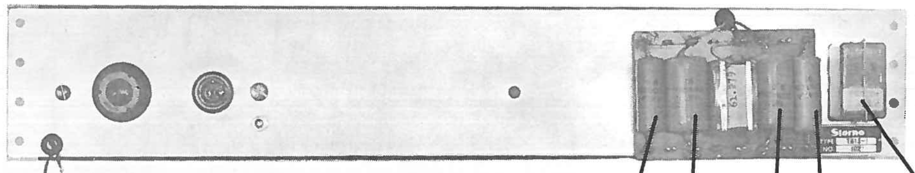
it and this is coupled to the push-pull output circuit consisting of Q2 and Q3. To ensure that the transistors are not destroyed by high temperatures, a NTC resistor is connected parallel with R11, in the base circuit. The output transformer has two output windings, one 600 Ω and the other 6Ω. Part of the 600Ω winding is used for negative feedback via R9 and C4.

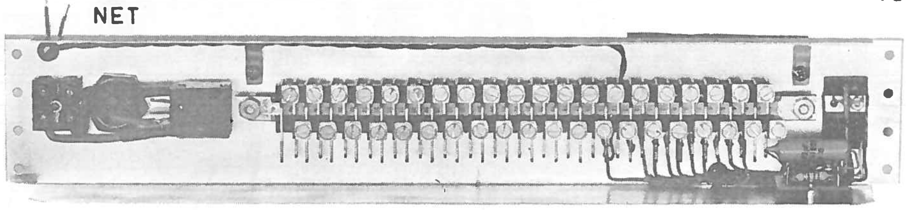
Power Supply

The amplifier is isolated from the chassis and normally only used in connection with a power unit giving -12 volts.

TB13-1

The terminal panel TB13-1 contains a terminal strip, a terminal block, a fuse, a hail relay, and a high-pass filter. The internal control wiring is connected at this point.





Mains The mains supply voltage is also connected to the installation via a two-way terminal block on the panel. The phase lead should be connected to the terminal, which is marked with a red spot. The double pole switch isolates the mains from the equipment including the power supply section, thus the equipment may be serviced in complete safety. The 2 Amp. fuse protects the rack wiring up to the reset type fuses on the power supply unit.

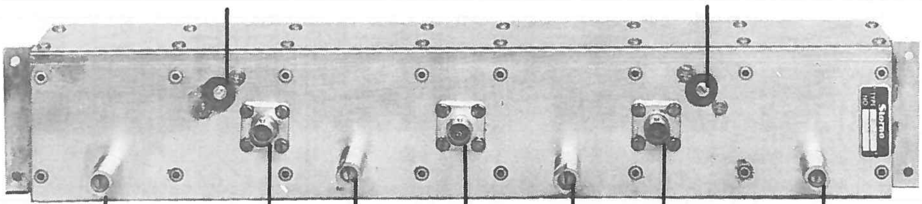
Hail Relay When the loudhailer is in operation, the HAIL relay is energised, switching the microphone voltages from the transmitter modulator to the AF-amplifier.

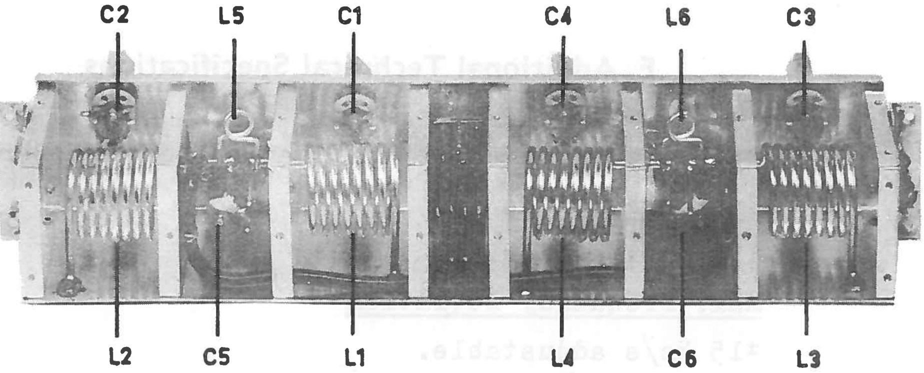
Filter The high-pass T-network consisting of C1,C2,C3,C4, and L1 act as a bass-cut filter on the speech before it is fed to the AF amplifier. The output from the discriminator in the receiver is also fed through the filter. The microphone voltage is attenuated by an attenuator pad before it is fed to the transmitter modulator unit.

BF13-1

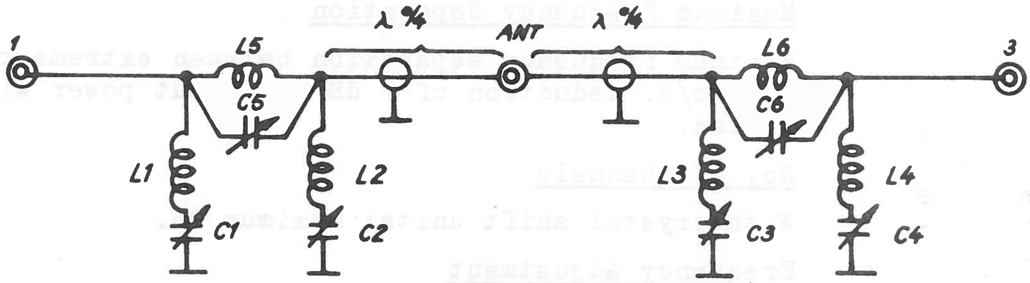
The branching filter BF13-1 connects one transmitter and one receiver to the same antenna. The frequency spacing is from 4.6 - 12 Mc/s in the frequency band 144 - 174 Mc/s.

Construction The filter is mounted on a silver plated chassis, divided into compartments, which contain the filter elements.





All controls are mounted on the front face of the chassis, together with the connectors to connect the filter to the antenna and to the receiver and transmitter for duplex operation. The connectors are standard type UG290/U. The whole chassis is screened by a cover plate which is attached by twenty self-cutting screws.



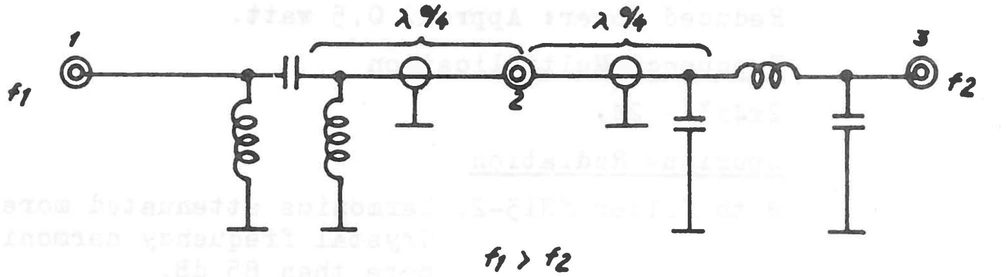
Circuit analysis

The illustration shows a simplified diagram of BF13-1. The two identical sections of lumped constants are connected to the common connector (ANT) by means of λo/4 coaxial cables. λo = electrical wavelength at 165 Mc/s.

Band stop function

The isolation between terminal 1 and terminal 3 is achieved by series resonance of L1, C1 - L2, C2 with respect to f2 and L3, C3 - L4, C4 with respect to f1, thus effectively shortening the line for the unwanted signal. This short circuits are transformed by means of the λo/4 coaxial cable to a high impedance at the antenna terminal. An incoming signal from the antenna f.inst. f1 is thus directed to terminal 1 and a signal f2 is directed to terminal 3.

Band pass function



The illustration shows an equivalent diagram of BF13-1 in the band pass case. The series resonance circuits as mentioned above, will act as reactive shunts on the line, positive or negative, depending on which frequency is the highest. To compensate these shunt reactances for the pass band frequencies, a tunable reactance is added in series to form a π-section with an impedance equal of that of the characteristic impedance of the coaxial cable used.

E. Additional Technical Specifications

See also Technical Specifications in Chapter I.

General

Frequency Range

152 to 174 Mc/s.

Max. Frequency Deviation

±15 kc/s adjustable.

Frequency Stability

Better than $\pm 15 \times 10^{-6}$ in the temperature range -10 to $+70^{\circ}$C in the cabinet.

Antenna Impedance

50 Ω.

Maximum Frequency Separation

Maximum frequency separation between extreme channels is 1.4 Mc/s. Reduction of 3 dB in output power with this separation.

No. of channels

With crystal shift units: maximum 26.

Frequency Adjustment

With a trimmer $\pm 25 \times 10^{-6}$ from the crystal frequency with 30 pF loading.

Crystal Specifications

Holder HC G/U or Nato type 1, or DEF 5271 style D.
Loading 30 pF.
Frequency Tolerance $\pm 25 \times 10^{-6}$ from -20 to $+70^{\circ}$C.
Cutting Tolerance Less than 20×10^{-6} at 25°C.
Storno number: Storno type 1.
The crystals, RC-18/U (American). DEF 5271 style D (English) or NATO type 1 are suitable for the equipment.

TX13-1

Output Power

Full power: Minimum 20 watts.
Reduced power: Approx. 0.5 watt.

Frequency Multiplication

2x4x3 = 24.

Spurious Radiation

With filter FN13-2. Harmonics attenuated more than 70 dB.
Crystal frequency harmonics attenuated more than 85 dB.

FM-Hum and Noise Level

Attenuated more than 40 dB relative to $\Delta f = 7.5$ kc/s at 1000 c/s. (EIA standard RS-152 pt. 7).

AM-Hum and Noise

Attenuated more than 34 dB (EIA standard RS-152 pt. 16).

Sideband Noise Level

Attenuated more than 75 dB. (EIA standard RS-152 pt. 17).

Modulation Splatter

Less than 1 µW. (G.P.O. Spec. TSC 53 (d) pt. 4.3.2.).

Modulation

a. Speech Channel

Input impedance: Approx. 600 Ω balanced.
Sensitivity: -20 dBm for Δf = 7.5 kc/s at 1000 c/s with 5% harmonic distortion.
Frequency Characteristic: 6 dB/octave, +0.5 dB to -2 dB in the range 300 to 3000 c/s relative to 1000 c/s Sharply cut off above 3000 c/s.

b. Tone Channel

Input impedance: Approx. 600 Ω balanced.
Sensitivity: -10 dBm for Δf = 10 kc/s at 1000 c/s with 3% harmonic distortion.
Frequency Characteristic: 6 dB/octave, +0.5 to -1.5 dB. Flat above 3000 c/s if required.

Modulation Limiting

The maximum deviation, normally ±15 kc/s are not exceeded with an AF-signal of 20 dB above that which gives 2/3 of rated deviation.

Power Supplies

3.7A at 6.3V or 2.0A at 12.6V AC
75 mA at 250V
110 mA at 430V
-30V Bias supply.

Valve Complement

		European	U.S.	Spec.Qual.
Oscillator	V1	EF91	6AM6	6064
Modulator and doubler	V2	ECC81	12AT7	6201
Quadrupler	V3	EF91	6AM6	6064
Tripler	V4	M8100/5654	6AK5	5654
Driver	V5	QQE03/12	6360	
Power Amplifier	V6	QQE03/20	6252	
Modulation amplifier	V7	ECC81	12AT7	6201

FN13-2

Insertion Loss

Max. 1 dB in the range 152-174 Mc/s.

Band-pass Attenuation

Above 300 Mc/s, better than 50 dB down.

Maximum Power

60 Watts.

Nominal Impedance

52 Ω.

Filter Impedance

VSWR Less than 1.7 in the range 152-174 Mc/s.

Connectors

BNC UG-290/U.

RC13-1

Noise Figure

Approx. 6 dB.

Rejection of Spurious Frequencies

Better than 85 dB (EIA standard RS-204).

Sensitivity

Better than 0.8 µV emf at 12 dB signal/noise ratio with Δf = 10 kc/s and fm = 1000 c/s.

Overall Gain

Approx. 30 dB (from antenna input to MX2 grid).

Heater Consumption

1.27 A at 6.3 V or 0.635 A at 12.6 V.

Crystal

Crystal Multiplication

2 x 2 x 4 = 16.

Calculation of Crystal Frequency

$$\text{Crystal frequency} = \frac{\text{Receiver frequency in Mc/s} - 0.455}{17} \text{ Mc/s.}$$

Crystal Frequency Range

8.9 to 10.2 Mc/s.

IF

Calculation of 1st IF

$$IF_1 = \frac{\text{Receiver frequency in Mc/s} + 7,28}{17} \text{ Mc/s.}$$

Or if the crystal frequency is known,

IF_1 = Crystal Frequency in Mc/s + 0.455 Mc/s.

1st Intermediate Frequency Range

9.3 to 10.7 Mc/s.

Valves

Valve Complement

		European	U.S.	Spec.Qual.
RF-Amplifier	V1	E188CC	7308	E188CC
1st. Mix.	V2	ECC81	12AT7	6201
Oscillator	V4	M8100/5654	6AK5	5654
2nd. Doubler	V5	M8100/5654	6AK5	5654
2nd. Mixer	V3	M8100/5654	6AK5	5654

IA13-1

2nd Intermediate Frequency

455 kc/s.

Attenuation

ΔF_o = ±15 kc/s, attenuation maximum 6 dB.
ΔF_o = ±35 kc/s, attenuation minimum 70 dB.

Gain

Voltage Amplification

At 455 kc/s from grid of 2nd mixer in receiver converter to grid of 1st limiter in 2nd I.F. amplifier: approx. 108 dB. In one I.F. stage incl. filter losses: approx. 36 dB.

Discriminator

Discriminator Curve

ΔF_o = ±5 kc/s, I = approx. ±18 μA
(Measured at test point no.5 or external meter).

Demodulation

Demodulation Characteristic Curve

3.0 to 8.0 kc/s: flat. 0.3 to 3.0 kc/s: -6 dB/octave. 0.3 to 8.0 kc/s: flat.

Tolerances

0.3 - 1.0 kc/s: +1/-3 dB, relative to 1 kc/s.
1.0 - 8.0 kc/s: ±1.5 dB, relative to 1 kc/s.

Output

Output Impedance

0.3 - 8.0 kc/s: 600 Ω ±20%, balanced.

Output Level

With F_m = 1.0 kc/s, ΔF = ±7.5 kc/s (50%) (test level) is obtained max. 7.5 dBm.

Distortion

Distortion

F_m = 1.0 kc/s, ΔF = ±5 kc/s: max. 2%.
F_m = 1.0 kc/s, ΔF = ±10 kc/s: max. 5%.

Consumption

Total Plate Current

At 150 V DC: approx. 40 mA.

Total Filament Current

At 6.3 V: 1.4 Amp.

Valves

Valve Complement

		European	U.S.	Spec.Qual.
Amplifier 1	V1	M8100/5654	6AK5	5654
Amplifier 2	V2	M8100/5654	6AK5	5654
Limiter 1	V3	M8100/5654	6AK5	5654
Limiter 2	V4	M8100/5654	6AK5	5654
AF/Noise Ampl.	V5	E188CC	7308	E188CC
Squelch	V6	E188CC	7308	E188CC

PS13-1

Nominal Supply Voltage

110 Vac or 220 V ac.

Filament Voltage

7.58 Amp at 6.35 ac.

Bias Voltage

Approx. -30 V dc.

Plate Voltages

Supply to	150 V dc	250 V dc	420 V dc
IA13-1	40 mA		
RC13-1 simplex	25 mA		
RC13-1 duplex	25 mA		
TX13-1, full power			110 mA
TX13-1, low power		75 mA	

Supply to control box

12.6 nominal, depending on the load.
Max. Supply. approx. 2A, measured at C6.

Power Consumption

Receiver/Standby: 82 watts approx.
Transmit. (simplex): 142 watts. approx.
Transmit. (duplex): 182 watts. approx.

The power supply is designed for continious operation at stand-by and intermittent operation of the transmitter up to 50% of the time. A single transmitting period must not be more than 1/2 hour.

XS13-1

No. of channels

Maximum 9.

Relay

Relay Voltage

6.3 V.

Relay Current

Approx. 70 mA.

Crystal

Crystal

HC-6/U, Nato type 1, DEF 5271 style D, or Storno Type 1.

XS13-3

No. of channels

Maximum: 17 duplex receiver
: 26 simplex/duplex transmitter.

Relay

Relay Voltage

6.3 V.

Relay Current

Approx. 70 mA.

Crystals

Crystal

HC-6/U, Nato type 1, DEF 5271 style D, or Storno type 1.

AA13-4

Output Power

3 watts with less than 10% distortion at 1000 c/s.

Frequency Characteristics

+0 -1 dB within the range 300 - 5000 c/s relative to 1000 c/s at an output power of 1.5 watts.

Input Power

10 mW for 3 W output.

Impedances

Input Impedance

600 ohms ±20% in the range 300 to 5000 c/s.

Output Impedance

a) Approx. 280 ohms unbalanced between terminals 1 and 4 on Kl. 2.
b) Approx. 2.8 ohms balanced between terminals 5 and 6 on Kl. 2.

Load Impedance

a) Nominal 600 ohms between terminals 1 and 4 on Kl. 2.
b) Nominal 6 ohms between terminals 5 and 6 on Kl. 2.

Temperature Range

$-20^{\circ}C$ to $+80^{\circ}C$. At $-30^{\circ}C$ the low frequency characteristic falls.

Consumption

Power Supply

Approximately 90 mA at 12.6 volts with no signal.
Approximately 600 mA at 12.6 volts with max. signal.

TB13-1

Filter Impedance

600 Ω.

Filter Attenuation

Less than 1.0 dB at 300 c/s.
More than 10 dB at 100 c/s.
More than 25 dB at 50 c/s.

Attenuator Impedance

600 Ω.

Attenuator Loss

Approx. 24-28 dB at 1000 c/s.

BF13-1

Frequency Range

144 - 175 Mc/s.

Duplex Spacing

4.6 - 12.0 Mc/s.

Isolation

Max. Isolation between Units

70 - 75 dB.

Isolation

36 - 40 dB at a band width of ±0.7 Mc/s.

Losses

Insertion Losses

At a frequency spacing of 4.6 Mc/s: 0.7 - 1.2 dB (depending on the band width).

At a frequency spacing of 9.0 Mc/s: 0.3 dB.

Nominal Impedance

50 Ω.

Max. Standing Wave Ratio

1.5 for 4.6 Mc/s ±0.7 Mc/s.

Power

Power Handling Capacity

70 watts at 4.6 Mc/s duplex spacing.

CHAPTER III. REMOTE CONTROL BOX CB13-8

A. General Description

Introduction

The maritime VHF/FM radio station CQF13-2 can be completely controlled from the remote control box CB13-8. Up to two parallel connected control boxes may be used, one of which is a "priority" box or "master box", as this box at any time may be used to interrupt and take over the control from the "slave" box.

The "priority" box is normally mounted on the ship's bridge within easy reach of the operator. The possibly "slave" box may be mounted at any other convenient place on the ship, the only limitation of installation being the cable length as mentioned in chapter I under the description of the installation.

Construction

The control box consists of a cast box with watertight cable entries. A rest for a handset, in which the watertight handset is kept when not in use is mounted on the left hand side of the box. All control knobs and indicator lights are placed on the front face of the control box, and the functions of each control are clearly marked. The control box requires no connection to mains as all necessary control voltages and pilot lamp voltages are fed to the box from the main cabinet through the multi-cable.

The front face of the box also has slots for the loudspeaker, and in order to keep the box watertight the slots are covered by a PVC sheet.

Mounting

The rear plate of the control box is attached to the wall by four screws, which are screwed up from the front face. The complete box is rendered watertight by a rubber gasket.

Handset

The watertight handset contains a built-in pressel switch for keying the transmitter. Furthermore the rubber holder on the side of the box incorporates a micro-switch, which returns the equipment automatically to the calling and safety channel (channel no. 16).

Amplifier

The carbon microphone cartridge in the handset is connected to the input of a transistorized one stage amplifier (in control box), which gives approximately 20 dB gain from an OC72 transistor operating under grounded emitter conditions. The amplified AF-output is either routed to the transmitter input terminals or to the AF-amplifier, depending upon the position of the FUNCTION switch. The filter T2-C3 is common for microphone and transistor stage, and the filter R9-C2 is for the base voltage of the transistor.

Channels

If the output from the microphone is too high or too low, R7 is used for adjusting to the correct level. To save the number of control leads, only channel number 16 and channel number 14 are taken to separate contacts on the CHANNEL PRESELECTOR switch, while the remainder of the contacts are connected in pairs. In the main radio equipment channels 2 to 16 are in one group and channels 18 to 28 in another group. The groups are controlled by their respective group relay.

The box is set for duplex operation by grounding terminal 16 and thus changing over the antenna relay and the power supply.

PRESET CHANNEL

The PRESET CHANNEL IN switch (05) is spring loaded in both directions. In the TONE CALL position ground is put on contact 23, and this facility is used if a selective calling system is built into the equipment. In the left spring loaded position IN the "master" box takes over the control from a "slave" box. By keeping the switch on the left the "master" box may control the radiostation irrespectively of the setting of the controls on the "slave" box. The pilot lamps in the "slave" box are extinquished, and the normal procedure will therefore be to switch the PRESET CHANNEL to the left position a couple of times whereby the blinking of the pilot lamps on the "slave" box indicates for the operator there that the "master" box operator wishes to take over. The "slave" box operator then turns the FUNCTION switch to OFF, and the "master" box has full control of the radio station.

In either the TONE CALL or the PRESET CHANNEL IN position, relay B will operate, and if the handset is off the rest, the relay is held in by its holding contact b1.

Thus: Contact b2 extinguishes the blue pilot lamp (CHANNEL 16 ON).

Contact b3 transfers the squelch indication from relay C to the green lamp (REC.).

Contact b4 removes the ground contact from the channel number 16 line and puts it to the selector wiper.

CALLING AND SAFETY CHANNEL

When the handset is replaced at its rest after use, the microswitch 06 breaks the circuit to relay B and it falls out. Then the equipment will return to the CALL and SAFETY CHANNEL number 16, and the blue pilot lamp lights. If a call is now received, the squelch operates relay C, which will be held by its own contact c1 over the microswitch 06.

Contact c4 lights the white (CALL) lamp.

These conditions prevail until the handset is removed from the rest or the CHANNEL PRESELECTOR switch is operated.

DIMMER

The DIMMER switch 04 switches resistors in series with the pilot lamps in order to adjust the intensity of the lamps.

Transmitting

When the pressel switch in the handset is closed, relay A operates.

Contact set a2 disconnects the internal loudspeaker and couples in a suitable loading resistor.

Contact set a3 connects the keying lead to ground, thus providing a current path through the transmitter high voltage (keying) relay.

Contact set a4 lights the red (TRANSMIT) pilot lamp.

The circuits through contact sets a3 and a4 are broken, when FUNCTION switch is thrown into position HAIL.

FUNCTION

The FUNCTION switch 03 is shown in in the extreme left position on all diagrams. In the position OPEN the terminals 15 (start) and 21 (squelch opening) are connected to ground, and thus the receiver is open for both noise and signal.

In the third position NORMAL the ground connection of terminal 21 is broken and the audio amplifier will only operate on reception of a signal.

The fourth position LOW POWER connects terminal 18 to ground, causing a relay in the power supply PS13-1/1a to operate so that the transmitter output falls to approximately 0,5 watts.

The last two positions of the FUNCTION switch can only be used if extension loudspeakers are connected to the control box. In position EXTENSION the receiver output is fed to an extension loudspeaker, which may be installed in the wireless operator's room, next to the "slave" box, or in any other convenient place. In position HAIL, the output from the microphone amplifier is fed to a separate loudspeaker, which may be used for hailing purposes, e.q. by using a high efficient re-entrant horn loudspeaker.

The HAIL position is spring loaded so that the equipment may not be inadvertently left in the hail position. The receiver is cut off in this position.

VOLUME

The VOLUME control for the built-in loudspeaker is correctly matched to the output transformer in all positions.

JB13-1

A junction box type JB13-1 is used when two control boxes are installed. Besides a terminal strip for all multicable leads the box contains three relays. A total of 17 wires are branched off to either box, while the relays perform the branching of the remaining leads. When no -12 volts are supplied to lug no. 14 in the "slave" box the control of the radio station lies at the "master" box and the three relays are de-energized.

When the FUNCTION switch in the "slave" box is turned away from its OFF position, the relays in the junction box energized and -12 volts are applied to the "slave" box, while the ground return is removed from the "master" or "priority" box.

The "master" box gains complete control of the radio equipment, when the "slave" box operator switches the FUNCTION switch to OFF.

B. Control Box

Switches

The remote maritime control box CB13-8(a) contains the following controls on the front face:

CHANNEL PRESELECTOR

Indicates selected channels, where the hour-glass symbols covers the following system: Both triangles filled out indicates duplex channel, one triangle filled out indicates simplex channel and both triangles empty indicates that the equipment is not supplied with crystals for that channel.

VOLUME

This knob controls the volume of the built-in loudspeaker.

Chapter III. Control Box CB13-8

FUNCTION

The FUNCTION switch has 6 positions:

OFF	This position is blocked in a "master" box.
OPEN	Reception of both signals and noise.
NORMAL	Reception of signals controlled by the squelch system.
LOW POWER	Output power reduced to 0.5 watt for port operations.
EXTERNAL	The received signals are reproduced by the external loudspeaker.
HAIL	In this spring loaded position the receiver/transmitter is interrupted and the microphone signals are amplified and fed to a second external loudspeaker (e.q. a re-trant horn hailing loudspeaker).

PRESET CHANNEL	This switch has three positions, where the two extreme positions are spring loaded. Position TONE CALL (right) is used in connection with possible selective calling equipment, while position IN (left) releases the equipment from channel no. 16 (Calling and Safety) and switches it to the preset channel.
DIMMER	Control knob for regulation of the control lamp intensity.
Handset Rest	The microswitch incorporated in the rest releases the CALL lamp and switches the equipment to channel no. 16 when the handset is placed on the rest.
Pilot Lamps	The maritime control box furthermore contains the following pilot lamps:
CHANNEL 16 ON	This blue pilot lamp indicates when this channel automatically is switched into operation.
TRANSMIT	This red pilot lamp indicates that the transmitter is keyed.
RECEPTION	This green pilot lamp indicates a received signal on a preselected channel only.
CALL	This white pilot lamp indicates a received call on the automatically selected CALL and SAFETY channel (No. 16). The light stays on until it is "released" either by lifting the handset from the rest (microswitch) or by turning the PRESET CHANNEL switch to position IN.
Transmitting	The transmitter is keyed by pressing the pressel switch on the handset. When operating in duplex the switch may be pressed the whole time.

C. Operation Instructions

Initial	The equipment is started by switching the FUNCTION switch to position OPEN, and after approximately 30 seconds for warm up the receiver hiss should be heard in the loudspeaker. The FUNCTION switch should then be switched to position NORMAL thus removing the noise.
Stand-by	With the handset in its rest on the side of the box and with the blue pilot lamp (CALLING and SAFETY CHANNEL ON) on, the equipment is automatically operating on the calling and safety channel (No. 16). On reception of a call the white pilot lamp (CALL) will light, and any message will be heard in the loudspeaker.
Answering a Call	In order to reply a call, the handset is lifted from the rest and the pressel switch is pressed while speaking. The red lamp (TRANSM.) lights thus indicating that the transmitter is operating.
	Having decided that further conversation should be carried out on another channel, then the channel should be selected by the CHANNEL PRESELECTOR switch.
Channels	The CHANNEL PRESELECTOR switch is turned to the required channel and the PRESET CHANNEL switch is flicked to the spring loaded position IN. The blue lamp will be extinguished, when the selection has been made.

Duplex/Simplex The selected channel may be either duplex or simplex, which is indicated on the CHANNEL PRESELECTOR scale by having two or only one black triangles respectively.

During simplex operation the receiver is cut off during transmission, while both transmitter and receiver are operating during duplex operation. Thus on simplex, the pressel switch in the handset must be released to hear a reply, while on duplex it may be pressed the whole time.

Return to CALLING AND SAFETY At the end of the conversation, the handset is replaced in the rest and the microswitch operates. The equipment returns automatically to channel no. 16 (CALLING AND SAFETY). Therefore if a further call is required on the channel just used, and the handset has been hung up, the PRESET CHANNEL must be operated again so that the equipment selects the preset channel.

If it is desired that the equipment is to remain on a selected channel for some time, then the handset should not be hung up in the rest.

Call Indication When the handset is lifted from the rest, a received call is indicated by the green pilot lamp (REC), while a received call on channel no. 16 (CALLING and SAFETY) is indicated by the white pilot lamp (CALL).

Low Power The FUNCTION switch, when in the LOW POWER position, reduces the transmitter output from 20 watts to one half watt. This is used in the vicinity of harbours and when the distances from ship-to-ship or ship-to-shore are in the order of 1 mile or less.

EXTENSION In the position EXTENSION, the built-in loudspeaker is disconnected, and the output from the receiver is switched to an extension loudspeaker. However, any received signals will still be fed to the earpiece of the handset. If no extension loudspeaker is connected and the switch is turned to this position, a strap wire in the box will keep the built-in loudspeaker operative.

HAIL With the FUNCTION switch in position HAIL, the equipment may be used as a loud hailer. In this position the transmitter is not operated so that there is no danger of the hailer message to be fed to the transmitter.

Operating Instruction A shortend version of the operating instructions are also supplied with the equipment. It is protected in a plastic cover and intended to be mounted in a place next to the control box for quick reference. The instructions also include a list of available channels and their frequency and intended use, as set out by the 1957 International Maritime Conference at the Hague.

Two Boxes In order to prevent any incoming calls being lost, neither of the two boxes are able to switch off the equipment. Switching off the equipment must be carried out by the main switch, which is installed next to the cabinet.

In the "master" or "priority" box (CB13-8a) position OFF is mechanically blocked, and in the "slave" box (CB13-8) position OFF is used to transfer the controllability to the "master" box.

Master Box

When the "master" box want to take over the traffic from the "slave" box, the PRESET CHANNEL switch must be flicked to its left spring loaded position, whereby the pilot lamps in the control box light, while at the same time the pilot lights in the "slave" box go out.

The "master" box can secure complete control of the equipment irrespectively of the positions of the controls in the "slave" box by keeping the PRESET CHANNEL switch in the spring loaded position IN.

Slave Box

Operation of the Preset channel switch at the "master" box is indicated at the slave box by the extinguishing of all pilot lights. This indicates that the "master" wishes to take control and the function switch at the slave box must be turned to the position OFF.

D. Technical Specifications

Amplifier

Gain

Approx. 20 dB.

Output Power

+10 dBm (2,5 V in 600 Ω) with approx. 2 % distortion.

Frequency Characteristic

Flat from 300 c/s to 2400 c/s (-2 dB at 300 c/s relative to 1000 c/s).

Current Consumption

Approx. 8 mA (excl. microphone current) at 12,6 V.

Loudspeakers

Input Impedances

Monitor loudspeakers: At least 6000 Ω.
Extension and hailing loudspeakers: 600 Ω.

Volume control

8 positions, approx. 3 dB per step.

CHAPTER IV. ALIGNMENT PROCEDURE

A. General

Introduction

The adjustment procedure described in the following is intended as an aid in aligning a VHF radio station 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 STORNO radio station should perform adjustment and repairs.

Placing the Equipment into Operation

Before being dispatched from STORNO, each individual radio station 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 2×10^{-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 control equipment (if provided).

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

This adjustment procedure has been developed for use with the following types of radio telephone equipment:

CQF11-3 (136-174 Mc/s), 25 kc/s channel separation.
CQF31-3 (68-88 Mc/s), 25 kc/s channel separation.
CQF11-2 (136-174 Mc/s), 50 kc/s channel separation.
CQF31-2 (68-88 Mc/s), 50 kc/s channel separation.
CQF13-2 (152-174 Mc/s), Maritime radiostation

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.

B. Transmitters TX13-1,-4 and TX33-4

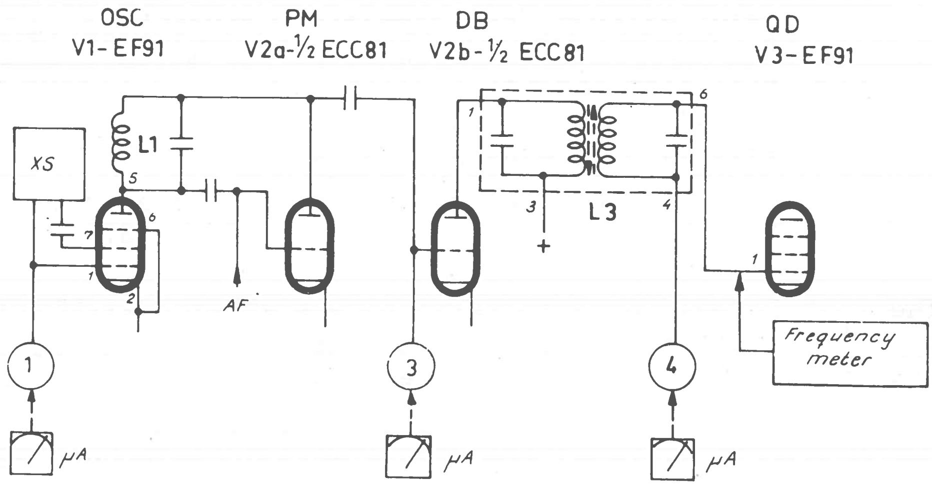
Alignment of Crystal Shift Unit and Oscillator

Instruments

The following measuring instruments are required:

Frequency meter with an accuracy better than 2×10^{-6} covering the frequency ranges: 5.66 .. 7.32 Mc/s for TX33-4, 12.70 .. 14.50 Mc/s for TX13-1,-4.
50-0-50 microammeter, Ri = 1000 Ω (STORNO type SI06).

If connection to the proper antenna is impossible a dummy load must be used (e.g. STORNO type DL11-1).



Setting-up

This phase of the adjustment should not be commenced until the radio equipment has reached its operating temperature (after at least 10 minutes operation). Furthermore it should be checked that the cover plate of the crystal shift unit is in place and that all crystal shift relays are inserted in their sockets. The capacitance of the relays' contacts form part of the crystal loading capacitances.

The frequency meter must be connected after the doubler stage in order to avoid loading of the oscillator. Set the frequency meter to twice the crystal frequency specified for each channel (due to the doubler stage preceeding).

Connect the microammeter to testpoint 1, and connect the antenna or the dummy load to the transmitter output terminal (J1).

Procedure

a) Adjust the crystal trimmers for half capacitance.
b) Key the transmitter and check the oscillator grid current in testpoint 1.
c) Adjust each crystal trimmer to the correct crystal frequency.

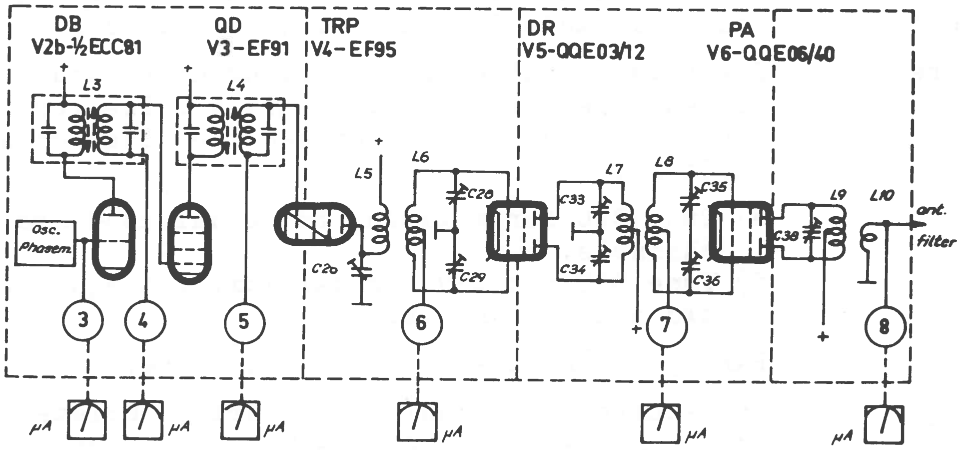
Note: It is important to secure the crystal trimmers from working loose. This can be avoided by laquering.

Alignment of Multipliers and Output Stage

Instruments

The following measuring instruments are required:

50-0-50 microammeter, Ri = 1000 Ω (STORNO type SI06).
Dummy load, 52 Ω/60 watt (STORNO DL11-1).



Setting-up

Connect the dummy load or proper antenna to the antenna connector, and connect the microammeter to testpoint 4.

The following procedure is used if the outer channel separation does not exceed 0.8 Mc/s for TX13-1,-4 and 0.4 Mc/s for TX33-4. For larger channel separations stagger tuning is employed, which is described later.

Procedure

a) Key the transmitter.
b) Tune L3 for maximum reading on the microammeter. It may prove necessary to tune both primary and secondary circuits several times in order to achive a proper maximum.
c) Connect microammeter to testpoint 5 and tune L4 for maximum reading. It may prove necessary to tune both primary and secondary several times in order to acheive a proper maximum.
d) Connect the microammeter to testpoint 6 and set C28 and C29 for equal capacitance.
e) Tune C26 for maximum reading on microammeter.
f) Tune C28 and C29 for maximum reading, but constantly check that the capacitance of the two condensers are equal. (In approximately the same position).

Note: The coupling between L5 and L6 is very critical. It must be carefully readjusted if misaligned by accident.

g) Connect the microammeter to testpoint 7 and set C33 and C34 for equal capacitance. Then tune for maximum reading, but constantly check that the capacitance of the condensers are equal (in approximately the same position).
h) Set C35 and C36 for equal capacitance, and tune them for maximum reading. Check constantly that the capacitance of the two condensers are equal (in approximately the same position).
j) Connect the microammeter to testpoint 8 and tune C38 for maximum reading. It may prove necessary to retune C33 and C34, and C35 and C36 in order to reach maximum output power, which is indicated by maximum microammeter reading.
k) Set the coupling between L10 and L9 for maximum reading.

Chapter IV. Alignment Procedure

Specification

The RF output power must be at least 25 watts or 50 watts, depending on the transmitter strapping.

Note: When antenna filter FN13-1, FN13-2, or FN33-2 is connected and matched to the PA-stage of the transmitter, the nominal output power can be measured only at the output terminals of the antenna filter.

Stagger Alignment

This procedure is used when the outer channel separation exceeds 0.8 Mc/s for TX13-1,-4 or 0.4 Mc/s for TX33-4.

Procedure

The first section of the alignment procedure must be followed as described above (incl. para d). The remaining procedure consists of switching between the outer channels to make comparisons.

e) Tune C26 for maximum, but equal readings on the two outer channels.
f) Tune C28 and C29 for maximum, but equal readings on the two outer channels.

Para g) to k) are as described above.

The stagger alignment is properly completed when the grid drive on the PA-valve is symmetrical about the center frequency, and when the output power from the outer channels are symmetrical about the center frequency and no more than 2 dB down on the outer channels.

Modulation Checking

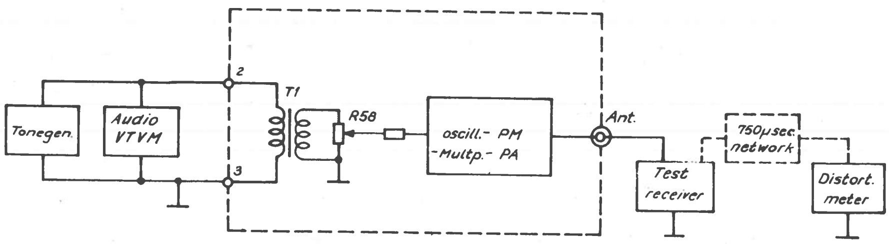
Instruments

The following measuring instruments are required:

Audio tone generator with an internal resistance of 600 Ω.
Audio VTVM.
Test Receiver, calibrated in frequency deviation (STORNO L22).
Distortion Meter.

Setting-up

Tone Input



Connection of test equipment

Set the tone generator to deliver 1000 c/s and connect it to terminal board kl. 2, terminals 2 and 3. Connect the measuring receiver to the transmitter output terminals and adjust it to the transmitter frequency. Turn potentiometer R58 fully clockwise. Adjust the tone generator to a frequency swing of 10 kc/s. Connect the distortion meter across the AF-output of the test receiver through a 750 µSec. network.

Procedure

a) Key the transmitter.
b) The sensitivity is calculated as follows: The signal from the tone generator is measured by the VTVM and the output signal from the transmitter can be read from the test receiver.
The sensitivity should be:

TX13-1,-4: Better than 250 mV (-10 dB).
TX33-4: Better than 440 mV (-5 dB).

c) Adjust the modulation sensitivity by the potentiometer R58.

Note: The distortion must not exceed 5 % with the distortion-meter connected directly to the output terminals of the test receiver without the delay network. When the delay network is inserted the distortion should not exceed 3 %.

Specification

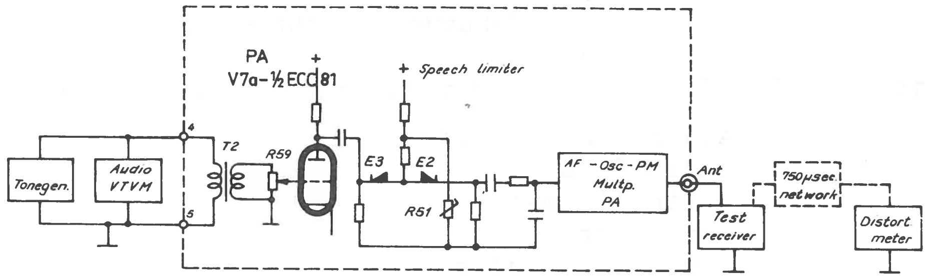
Measuring of frequency curve:

300 c/s = -10.5 dB
1000 c/s = 0 dB (reference value)
3000 c/s = +9,5 dB
6000 c/s = +15 dB.

Tolerances +0.5/-1.5 dB relative to the theoretical curve. The measuring values above are taken without delay network and with a constant input level.

Setting-up

Speech Input



Connection of test equipment

Set the tone generator to deliver 1000 c/s and connect it to terminal board kl. 2, terminals 4 and 5. Connect the test receiver to the transmitter output terminals and set it to the transmitter frequency. Turn potentiometer R59 fully clockwise.

Procedure

Adjustment of Speech Limiter

a) Set the output level from the tone generator to the following frequency swing:
CQF11-3 and CQF31-3: ±3.3 kc/s
CQF13-2, CQF11-2, and CQF31-2: ±10 kc/s.
b) Increase the output level from the tonegenerator by 20 dB, and adjust the limiter potentiometer R51 until maximum permissible frequency swing stated below is obtained:

CQF11-3 and CQF31-3: Max. ±5 kc/s
CQF13-2, CQF11-2 and CQF31-2: Max. ±15 kc/s.

Measuring of Distortion

The distortion should be measured at a frequency deviation, which is 2/3 of the maximum permissible deviation.

The distortion must not exceed 5 % with the delay network inserted between transmitter output and distortion meter, and 9 % without delay network inserted.

Checking and Adjusting Sensitivity

Set the frequency deviation to 2/3 of the maximum permissible deviation of the station by adjusting the output level of the tone generator.

The sensitivity should be less than 78 mV (-20 dB) for TX13-1, -4 and less than 110 mV (-17 dB) for TX33-4.

The modulation sensitivity is set by potentiometer R59.

Specification

Measuring of frequency curve:

300 c/s = -12 dB.
1000 c/s = 0 dB (reference value).
3000 c/s = +8 dB.
6000 c/s = +4 dB.

Tolerance: 6 dB per octave +0.5/-2.0 dB within 300 .. 3000 c/s relative to 1000 c/s.

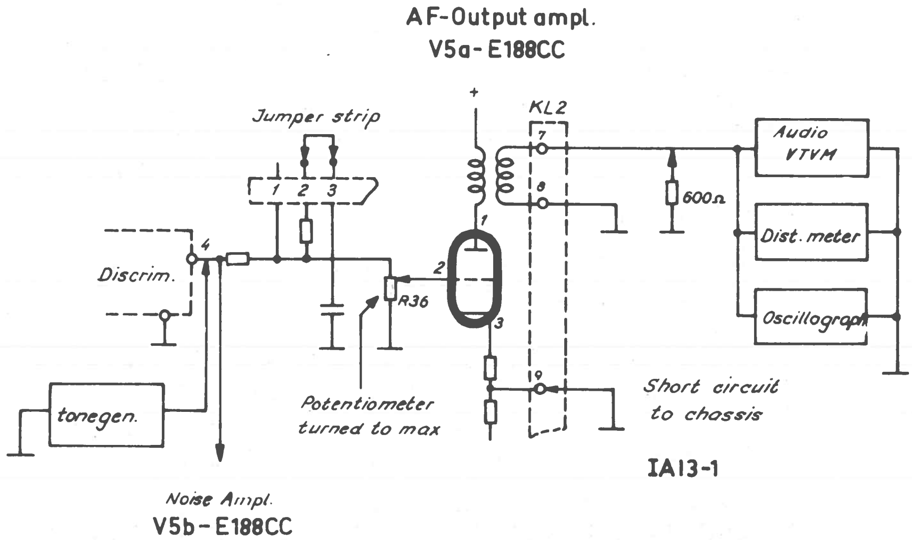
C. Intermediate Amplifiers IA13-1,-2

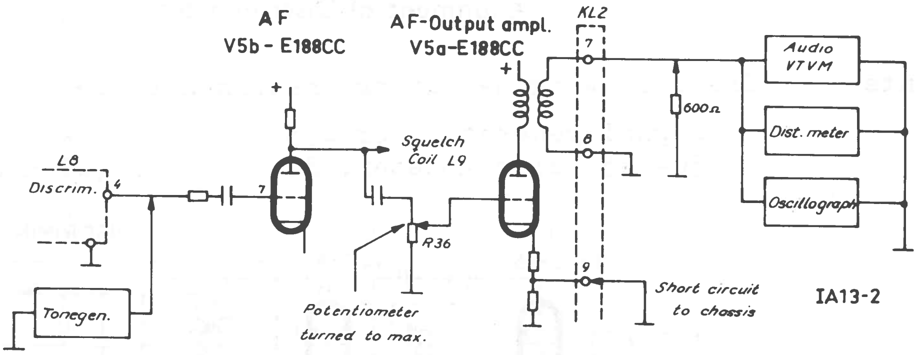
Adjustment of the AF-Section

Instruments

The following measuring instruments are required:

Audio tone generator
Audio VTVM
Distortionmeter
Oscillograph
A 600 Ω resistor.





Setting-up

Connect the Audio tone generator after the discriminator (between pin 4 on L8 and ground). Terminals 7 and 8 on terminal board kl. 2 (the secondary of the output transformer) must be loaded with a 600 Ω resistor, across which the oscillograph, the distortionmeter and the audio VTVM is connected.

Furthermore the squelch function must be disabled by shorting pin 9 on terminal board kl. 2 to ground. Turn the AF-potentiometer R36 fully clockwisw.

Procedure

a) Set the output from the audio tone generator to 1 volt and check the frequency curve with reference to 1000 c/s at the following points:

IA13-1: 300 c/s output voltage from +7 dB to +11 dB
1000 c/s output voltage 0 dB (reference value)
8000 c/s output voltage from -9 dB to -11,5 dB.

IA13-2: 300 c/s output voltage from +7 dB to +11 dB
1000 c/s output voltage 0 dB (reference value)
3000 c/s output voltage from -9 dB to -13 dB.

b) Sensitivity and distortion is checked as follows:

IA13-1: A tone generator output of 3.5 volt at 1000 c/s should give 2.5 volt across 600 Ω at 1 % distortion. A tone generator output of 10 volt at 1000 c/s should give 7 volt across 600 Ω at 3% distortion.

Tolerances:

Variations in sensitivity: ±2 dB (25 %)
Distortion: 1.5 % at 2.5 V out
5 % at 7 V out.

Note: Only the distortion meter must be connected to the AF-output of the receiver during distortion measurements.

IA13-2: A tone generator output of 1 volt at 1000 c/s should give 3 volt across 600 Ω at 2 % distortion.
A tone generator output of 3 volt at 1000 c/s should give 8 volt across 600 Ω at 6 % distortion.

Tolerances:
Variations in sensitivity: ±2 dB (25 %)
Distortion: 3 % at 3 V out
9 % at 8 V out.

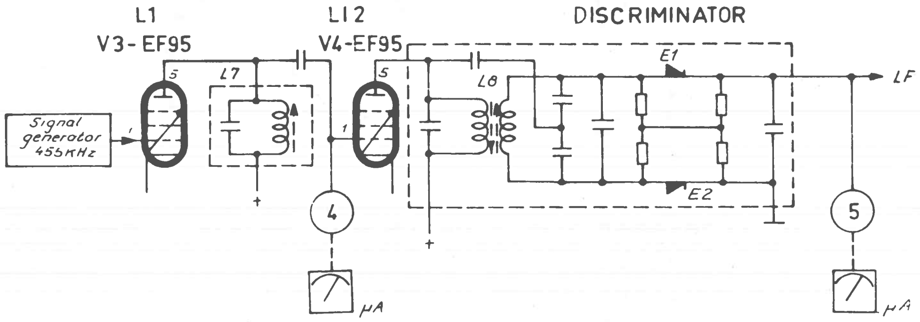
Chapter IV. Alignment Procedure

Alignment of Discriminator

Instruments

The following measuring instruments are required:

Signal generator for 455 kc/s (±0.2 kc/s)
50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06).



Setting-up

Connect the microammeter to testpoint 4. Connect the signal generator to the grid of V3 (pin 1) in the first limiter, and set it to 455 kc/s ±0.2 kc/s (can be checked by a frequency counter). The output from the signal generator should be set for approx. 60 dB to obtain full limiting and constant reading in testpoint 4 (control grid in second limiter).

Procedure

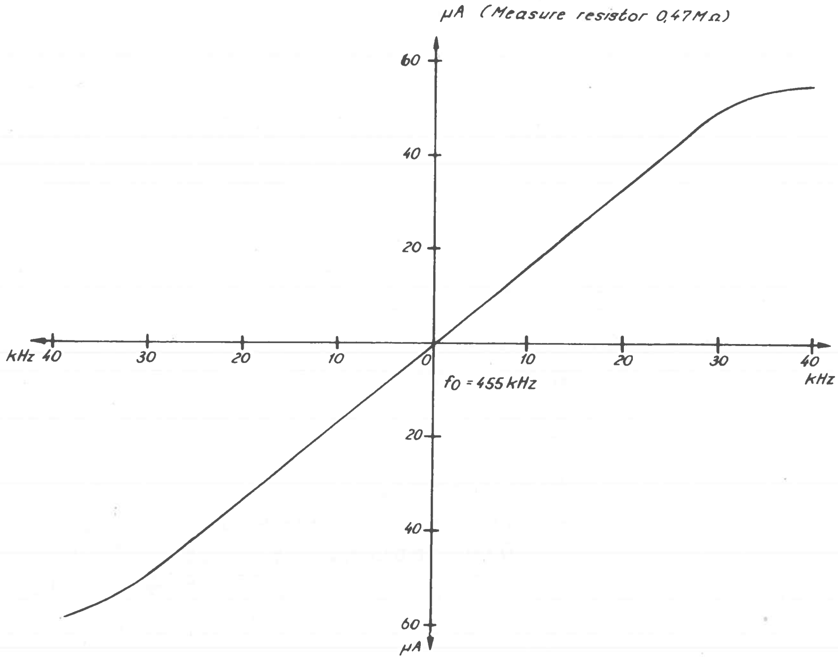
a) Tune L7 for maximum reading.
b) Connect the microammeter to testpoint 5 and tune L8 secondary top slug for zero reading.
c) Tune L8 primary bottom slug for greatest possible symmetry and sensitivity at ±15 kc/s from the center frequency.

The circuits have some action on each other and it may prove necessary to check the zero point of the secondary several times during the alignment and retune if necessary.

Specification

A typical reading in testpoint 5 for ±15 kc/s of the center frequency is 25 μA. See also the curve below.

Tolerances: Sensitivity: ±2 dB (25 %)
Linearity: ±1 dB (12 %) at ±15 kc/s.



Chapter IV. Alignment Procedure

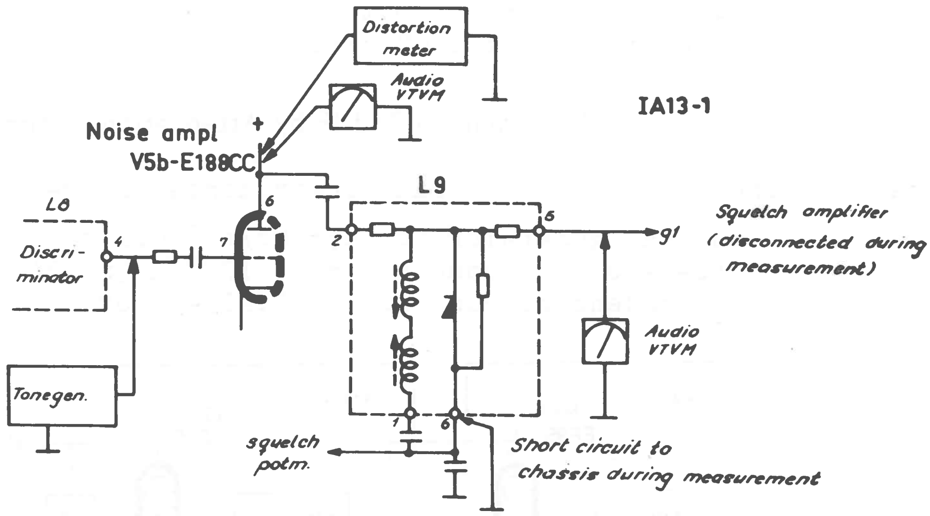
Alignment of Squelch Filter

Instruments

The following measuring instruments are required:

Audio tone generator
Audio VTVM
Distortionmeter.

Setting-up IA13-1



Connect the tone generator after the discriminator (between pin 4 and ground). Connect the audio VTVM between the grid of the squelch valve V6 (pin 2) and ground. Remove the squelch valve V6 from its socket and short circuit pin 6 on L9 to ground. Set the tone generator to give an output of 7 volt.

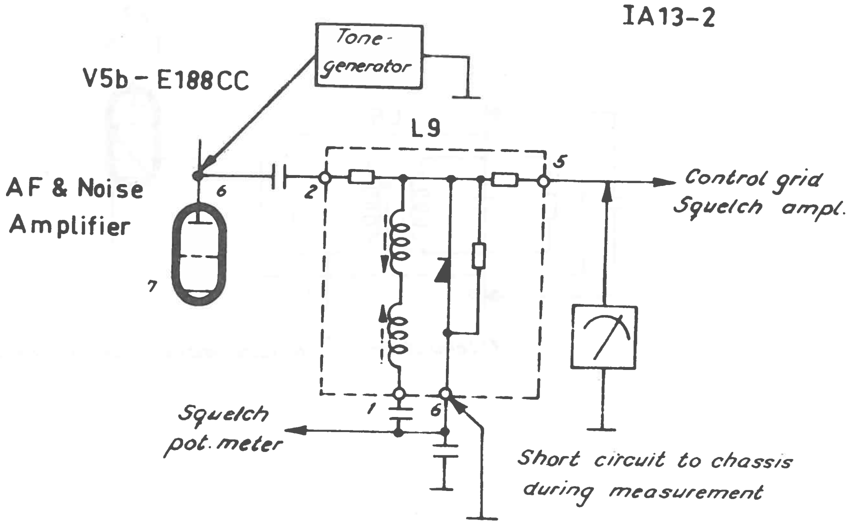
Procedure

a) Check the squelch filter and adjust the series resonance to be lying between 6 and 9 kc/s.
b) Check that the output at 20 kc/s is approx. 20 .. 30 dB higher than at 1000 c/s.
c) Check the sensitivity and distortion at the plate of the squelch valve V5b at an input voltage from the tone generator of 8 volt at 1000 c/s. The output voltage should be 28 volt at 5 % distortion.

Specification

Tolerances: Sensitivity ±3 dB.
Distortion: less than 8 %.

Setting-up IA13-2



Break the plate and filament supply to the unit. Connect the tone generator to the plate of V5b (pin 6). Connect the VTVM between the grid of the squelch valve V6 (pin 2) and ground. Short circuit pin 6 on L9 to ground. Set the tone generator output to 0.2 volt at 1000 c/s measured by the VTVM.

Procedure

a) Check the squelch filter and adjust the series resonance to be lying between 3 and 5 kc/s.
b) Check that the output at 15 kc/s is approx. 20 .. 30 dB higher than at 1000 c/s.

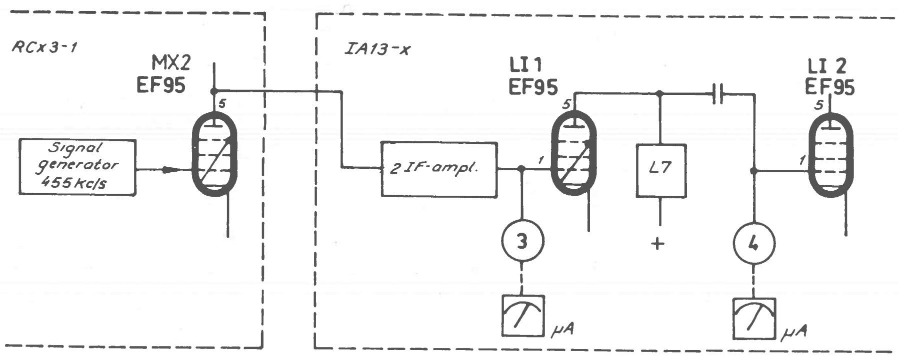
Alignment of 2nd IF by Attenuation Method

Instruments

The following measuring instruments are required:

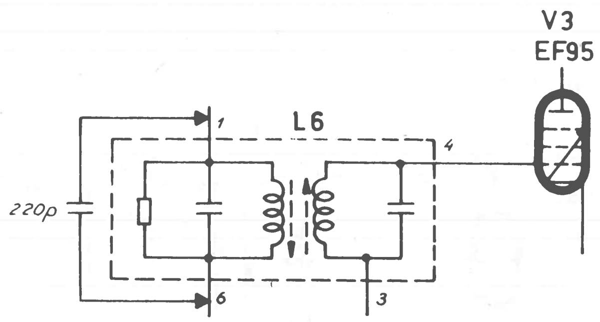
Signal generator for 455 kc/s (±0.2 kc/s)
50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06)
2 condensers each 100 pF (IA13-1) or 220 pF (IA13-2).

Setting-up

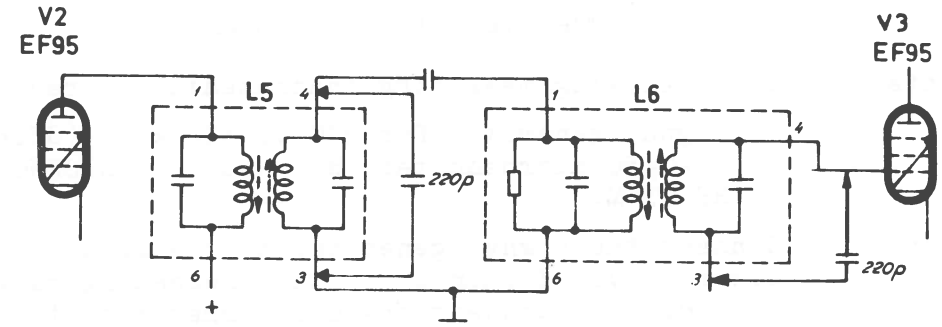


Connect the microammeter to testpoint 4. Set the signal generator to 455 kc/s, and connect it to the control grid of V3 (pin 1) in the second mixer stage of the preceeding receiver converter unit RCx3-1. Set the signal generator output voltage to obtain a suitable reading on the microammeter.

The circuits on each side of the circuit to be adjusted should be loaded by a condenser as shown on the illustration (100 pF for IA13-1 and 220 pF for IA13-2). This does not apply to L7, which is a single adjustable coil.



Attenuation of L6 secondary during adjustment



Attenuation of L5 and L6 primaries during adjustment

Procedure

a) Tune L7 for maximum reading.
b) Load the primary of L6 with the condenser and tune the secondary of L6 for maximum reading.
c) Load the secondary of L5 with the condenser and use the detuning condenser from the primary of L6 to detune the secondary of L6. Tune the primary of L6 and the primary of L5 for maximum reading.
d) Load the circuits on each side of the secondary of L5. Tune secondary of L5 for maximum reading.
e) When completed tuning of L5 and L6 the microammeter must be connected to testpoint 3.
f) Tune the circuits L4, L3, L2 and L1 for maximum reading as described above.

Checking Bandwidth

Instruments

The following measuring instruments are required:

Signal generator for 400 .. 500 kc/s (STORNO type L20)
50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06) RF VTVM.

Setting-up

Connect the signal generator to the grid of V3 (pin 1) in the second mixer stage of the preceeding receiver converter unit RCx3-1. Connect the microammeter to testpoint 5 in IA13-1,-2. Connect the VTVM to testpoint 3 in IA13-1,-2.

Procedure

a) Set the signal generator frequency to obtain zero reading in testpoint 5, and set the attenuator to obtain a reading of 10 μA in testpoint 3. Read the attenuator setting in dB.
b) Set the signal generator frequency to ±5 kc/s from the center frequency for IA13-2 and ±15 kc/s from the center frequency for IA13-1.
c) For each frequency change the attenuator should be reset to keep the reading in testpoint 3 at 10 μA. Read the increased dB value.

Specification

The dB readings should not exceed 2 dB for IA13-2 or 6 dB for IA13-1.

Measurement of the IF Selectivity

Instruments

The following measuring instruments are required:

Signal generator for 400 .. 500 kc/s (STORNO L20)
50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06)
RF VTVM.

Setting-up

Connect the signal generator to the grid of the second mixer valve V3 (pin 1) in the preceeding receiver converter unit RCx3-1. Connect the microammeter to testpoint 5 in IA13-1,-2. Connect the VTVM to testpoint 3 in IA13-1,-2.

Procedure

a) Set the signal generator frequency to obtain zero reading in testpoint 5. Adjust the generator attenuator to obtain a 2 μA reading in testpoint 3. Read the attenuator setting in dB.
b) Set the generator frequency to ±12 kc/s from the center frequency for IA13-2 and ±35 kc/s from the center frequency for IA13-1.
c) For each frequency change the attenuator should be reset to keep the reading in testpoint 3 at 2 μA. Read the increased dB value.

Specification

The dB readings should be at least 34 dB for IA13-2 and at least 70 dB for IA13-1.

If the bandwidth and the selectivity is not correct a complete retuning of the IF-circuits must be considered.

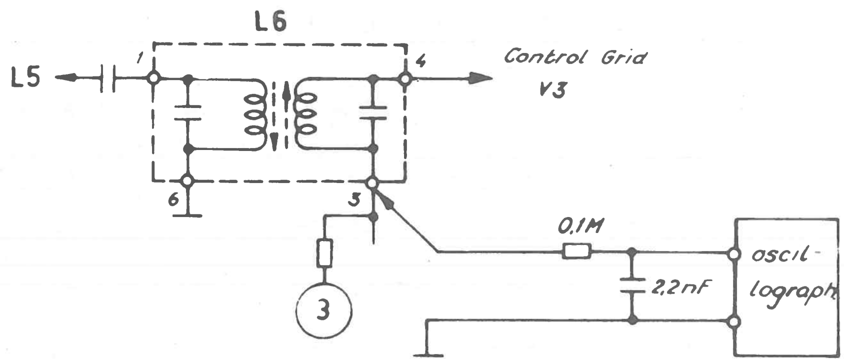
Alignment of the 2nd IF by Sweep Generator and Oscillograph

Instruments

The following measuring instruments are required:

Sweep generator (STORNO L20)
Oscillograph.

Setting-up



Connect the oscillograph to L6, pin 3, by a low-pass filter as shown on the illustration. The sweep generator must be syncronized with the oscillograph, and the signal is applied to L6, pin 1.

Procedure

a) Tune L6 secondary (top) for maximum curve height.
b) Apply the generator signal to L5, pin 4, and tune L6 primary (bottom) for maximum curve height.
c) Apply the generator signal to L5, pin 1, and tune L5 secondary for maximum curve height.

d) Apply the generator signal to the grid of V2 (pin 1), and tune L5 primary (bottom) for maximum curve height.

e) L4, L3, L2, and L1 are tuned in the same manner with the sweep generator connected across the circuit just ahead of the circuit to be tuned. When tuning the primary of L1 the sweep generator should hence be connected to control grid of the second mixer valve in RCx3-1.

Specification

Tolerances:	IA13-1:	±15 kc/s maximum 6 dB attenuation
		±35 kc/s at least 70 dB attenuation
	IA13-2:	±5 kc/s maximum 2 dB attenuation
		±12 kc/s at least 34 dB attenuation
Sensitivity:	IA13-X:	40 µV on gl MXII (high IF dissoldered) = 10 µA in testpoint 3 (1st limiter)
		Tolerance: ±6 dB.

D. Receiver Converters RC13-1 and RC33-1

Alignment of the Crystal Shift, Oscillator and Multiplier

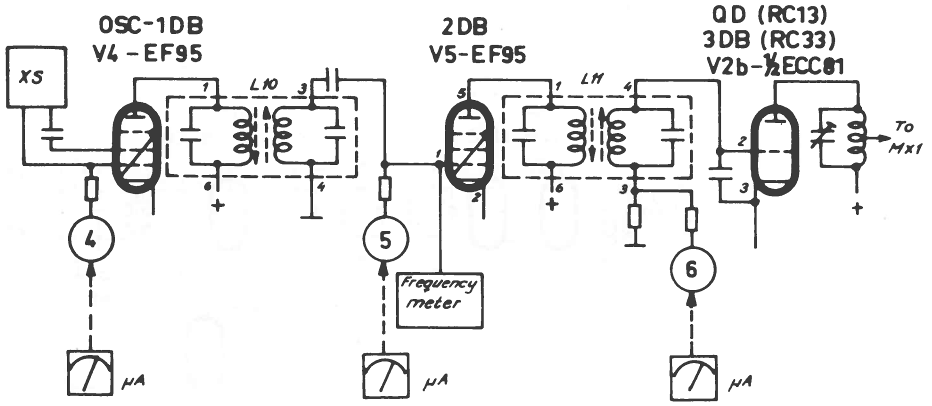
Instruments

The following measuring instruments are required:

Frequency meter covering the range 15.2 .. 20.4 Mc/s with an accuracy better than 2×10^{-6}.

50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06).

Setting-up



This phase of the alignment should not be commenced until the radio equipment has warmed up (after at least 10 minutes operation). Furthermore it should be checked that the bottom cover plate of the crystal shift unit is in place and that all crystal shift relays are inserted in their sockets. The capacitance of the relay's contacts form part of the crystal loading capacitances.

The frequency meter must be connected after the common oscillator/doubler stage in order to avoid loading of the oscillator. Set the frequency measuring set to twice the crystal frequency specified for each channel due to the doubling in the oscillator plate circuit L10.

Procedure

a) Adjust the crystal trimmers for half capacitance.
b) Connect the microammeter to testpoint 4 and check the oscillator grid current.
Minimum 10 µA, maximum 50 µA.
c) Adjust each crystal trimmer at the correct crystal frequency.

Note: It is important to secure the crystal trimmers from working loose, which can be avoided by laquering.

d) Switch the equipment to the central channel.
e) Connect the microammeter to testpoint 5, and tune L10 for maximum reading.
RC13-1: At least 30 µA
RC33-1: At least 25 µA.
f) Connect the microammeter to testpoint 6, and tune L11 for maximum reading.
RC13-1: At least 17 µA
RC33-1: At least 25 µA.

Note: The values stated above apply to a crystal with PI 30 pF = 30 kΩ.

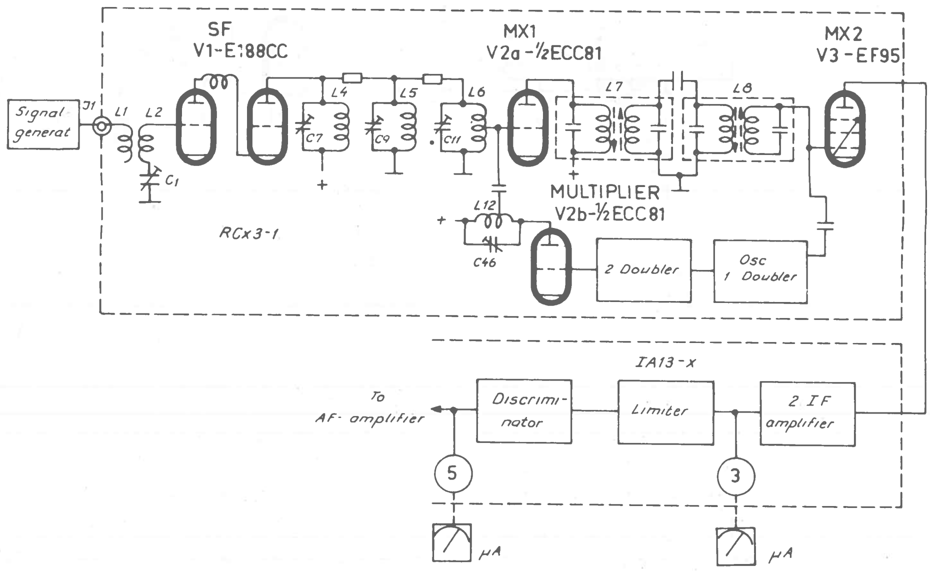
Alignment of 1st IF and SF Amplifier

Instruments

The following measuring instruments are required:

Signal generator covering the ranges 68 .. 88 Mc/s and 152 .. 174 Mc/s.
50-0-50 microammeter, Ri = 1000 Ω (SI06).

Setting-up



The following procedure is used if the outer channel separation does not exceed 0.8 Mc/s for RC13-1 or 0.4 Mc/s for RC33-1. With larger channel separations stagger tuning is employed as is the case for the maritime equipment, where a channel separation of maximum 1.4 Mc/s is required. Connect the microammeter to testpoint 5 in IA13-1,-2.

Procedure

a) Set the signal generator to the receiver frequency of the channel to be tuned, and connect it to the antenna connector J1.
b) Reset the frequency output from the signal generator to obtain zero reading on the microammeter.
c) Connect the microammeter to testpoint 3 (1st limiter) in IA13-1,-2.
d) Adjust the output level from the signal generator to a suitable level, e.g. 10 µA.
e) Tune the filter circuits in the 1st IF (L8 and L7) for maximum readings.
f) Tune the RF-circuits C11, C9, C7 and C1 for maximum reading
g) Tune C46 in the quadrupler plate circuit (doubler plate circuit in RC33-1) for maximum reading.

Note: Trimmers C46 and C11 may act on each other and should be readjusted.

WARNING

As a precaution to avoid damage to the attenuator of the signal generator the fuse for the high voltage from the transmitter power supply must be open during alignment in the receiver unit.

Stagger Tuning

The stagger tuning procedure should be followed in cases where the channel separation exceeds 0.8 Mc/s for RC13-1 and 0.4 Mc/s for RC33-1.

Normally it will suffice to tune the circuit C11 - L6 at the lowest frequency (channel). The remaining circuits should be tuned at the centre frequency (channel). The alignment of the receiver converter may be considered satisfactory if the sensitivity (quieting) and gain lie within 3 dB down from the best channel.

Checking Sensitivity

Instruments

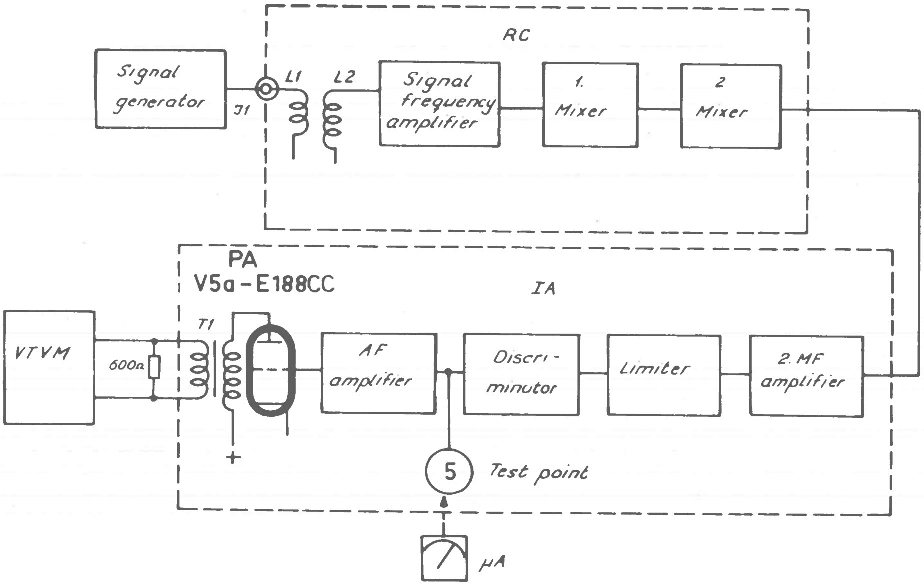
The following instruments are required:

Signal generator covering the ranges 68 .. 88 Mc/s and 152 .. 174 Mc/s.
RF VTVM.
50-0-50 microammeter, Ri = 1000 Ω (STORNO SI06).
600 Ω resistor.

Setting-up

Connect the signal generator across the receiver input terminals (J1). Connect the VTVM and a 600 Ω resistor across the secondary of the output transformer (terminal board kl. 2, terminals 7 and 8).

The following procedure should not be completed unless the receiver converter has been aligned at the excact frequencies.



Procedure

a) With no input signal to the antenna input terminal the noise level should be read off the scale on the VTVM.
b) Connect the microammeter to testpoint 5 in the discriminator stage.
c) Adjust the signal generator to deliver an unmodulated signal at the receiver frequency and check that the microammeter reading is zero.
d) Set the output voltage from the signal generator to a level, which gives a 12 dB lower reading on the VTVM than obtained in para a).
e) Check that the sensitivity is better than 0.8 μV emf for RC13-1 and 0.7 μV emf for RC33-1.
f) Adjust the coupling between L1 and L2 in order to obtain the greatest quieting under the level recorded in para a).
g) Retune C11, C9, C7 and C1.

Note: The voltages mentioned above are the unloaded output voltages from the frequency measuring set. Two methods are used when calibrating the attenuator of a signal generator:

1. The output voltage engraved on the attenuator is the unloaded generator voltage.
2. The output voltage engraved on the attenuator is the voltage across an external load, which corresponds to the output impedance of the signal generator.

In the first example is used the voltage engraved on the attenuator, while the double voltage value engraved on the attenuator should be used in the second example.

WARNING

As a precaution to avoid damage to the attenuator of the signal generator the fuse for the high voltage from the transmitter power supply should be open during alignment of the receiver unit.

E. Antenna Branching Filter BF13-1

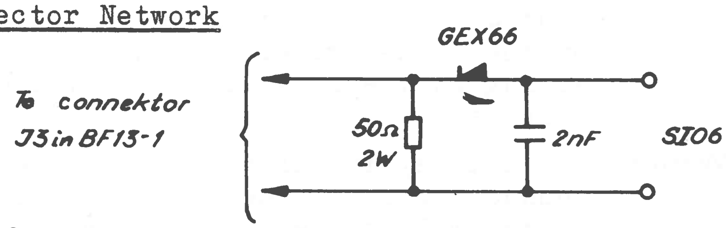
Instruments

The following measuring instruments are required:

50-0-50 microammeter, Ri = 1000 Ω (STORNO SI05, SI06 or SI07).
Signal generator covering the range 144 - 174 Mc/s.
Detector network (as shown on diagram below).
A 6 dB 50-50 Ω attenuator network.
Two dummy loads, 50 Ω/60 watt (STORNO DL11-1).

Setting-up

Detector Network



Procedure

The following procedure is to be used in cases where a transmitter and a receiver are connected for duplex operation. Do not feed maximum power into the branching filter until a coarse adjustment of the filter has been completed.

Band-stop

1. Adjustment of the band-stop circuit at the transmitter frequency.

a) Connect the transmitter to connector J1.
b) Connect a dummy load to connector ANT (J2).
c) Connect a dummy load with the microammeter in series with connector J3.
d) Adjust C3 and C4 for minimum reading on the microammeter.

For the final fine adjustment a sensitive indicator should be used. The detector network in connection with the microammeter will suffice.

Note: Owing to the high Q of the circuitry the adjustment must be performed with the utmost care.

2. Adjustment of the band-stop circuit at the receiver frequency.

a) Connect the receiver to connector J1.
b) Connect the signal generator to connector ANT (J2).
c) Connect a dummy load to connector J3.
d) Adjust the signal generator to the receiver frequency.
e) Adjust C1 and C2 to obtain minimum limiter current in the receiver unit.

Check the adjustment of the band-stop circuits performed so far (if necessary repeat 1. and 2.).

Band-pass

3. Adjustment of the band-pass circuit at the transmitter frequencies.

a) Connect the transmitter to connector J1.
b) Connect a dummy load in series with the microammeter to antenna connector ANT (J2).
c) Key the transmitter.
d) Adjust C5 for maximum reading on the microammeter.

4. Adjustment of the band-pass circuit at the receiver frequency.

a) A correct loading of the filter is obtained by short-circuiting the AVC-circuit in the receiver and inserting a 6 dB 50-50 Ω attenuator network between filter and receiver.
b) Connect the receiver to connector J3.
c) Connect the signal generator to the antenna connector ANT (J2).
d) Adjust the signal generator to the receiver frequency.
e) Adjust C6 to obtain maximum limiter current (The output from the signal generator should be kept so low that limiting in the receiver is prevented otherwise it will be impossible to get correct maximum indication).

Warning: Do not key the transmitter while it is connected to connector J1 as the attenuator of the signal generator will be destroyed. The best way to prevent this is to open the fuse in the transmitter power supply unit.

F. Antenna Branching Filter BF33-1

Instruments

The following measuring instruments are required:

50-0-50 microammeter, Ri = 1000 Ω (STORNO SI05, SI06 or SI07).
Signal generator covering the range 68 - 88 Mc/s.
Detector network (as shown on the diagram in BF13-1).
A 6 dB 50-50 Ω attenuator network.
Two dummy loads, 50 Ω/60 watt (STORNO DL11-1).

Procedure

The following procedure is to be used in cases where a transmitter and a receiver are connected to duplex operation. Do not feed maximum power into the filter until a coarse adjustment of the filter has been completed.

A. Transmitter Frequency higher than Receiver Frequency

Band-stop

1. Adjustment of the band-stop circuit at the transmitter frequency.

a) Connect the transmitter to connector J2.
b) Connect a dummy load to antenna connector ANT (J3).
c) Connect a dummy load with the microammeter in series to connector J1.
d) Adjust C1 and C2 for minimum reading on the micro-ammeter.

For the final fine adjustment a sensitive indicator should be used. The detector network in connection with the micro-ammeter will suffice.

Note: Owing to the high Q of the band-stop circuitry the adjustment must be performed with the utmost care.

2. Adjustment of the band-stop circuit at the receiver frequencies.

a) Connect the receiver to connector J2.
b) Connect the signal generator to antenna connector ANT (J3).
c) Connect a dummy load to connector J1.
d) Adjust the signal generator to the receiver frequency.
e) Adjust C3 and C4 to obtain minimum limiter current in the receiver unit.

Check the adjustment of the band-stop circuits performed so far (if necessary repeat 1. and 2.).

Band-pass

3. Adjustment of band-pass circuitry at the transmitter frequency.

a) Connect the transmitter to connector J2.
b) Connect a dummy load in series with the microammeter to antenna connector ANT (J3).
c) Key the transmitter.
d) Adjust C6 for maximum reading on the microammeter.

4. Adjustment of the band-pass circuitry at the receiver frequency.

a) A correct loading of the filter is obtained by short-circuiting the AVC-circuit in the receiver and inserting a 50-50 Ω attenuator network between filter and receiver.
b) Connect the receiver to connector J1.
c) Connect the signal generator to the antenna connector ANT (J3).
d) Adjust the signal generator to the receiver frequency.
e) Adjust C5 to obtain maximum limiter current in the receiver unit (The output from the signal generator should be kept so low that limiting in the receiver is prevented otherwise it will be impossible to get correct maximum indication).

WARNING: Do not key the transmitter while connected to connector J2 as the attenuator of the signal generator will be destroyed. The best way to prevent this is to open the fuse in the transmitter power supply.

B. Receiver Frequency higher than Transmitter Frequency

Band-stop

1. Adjustment of band-stop circuitry at the transmitter frequency.

a) Connect the transmitter to connector J1.
b) Connect a dummy load to antenna connector ANT (J3).
c) Connect a dummy load with the microammeter in series to connector J2.
d) Adjust C3 and C4 for minimum reading on the microammeter.

For the final adjustment a sensitive indicator should be used. The detector network in connection with the microammeter will suffice.

Note: Owing to the high Q of the band-stop circuitry the adjustment must be performed with the utmost care.

2. Adjustment of the band-stop circuitry at the receiver frequency.

a) Connect the receiver to connector J1.
b) Connect the signal generator to antenna connector ANT (J3).
c) Connect a dummy load to connector J2.
d) Adjust the signal generator to the receiver frequency.
e) Adjust C1 and C2 in order to obtain minimum limiter current in the receiver unit.

Check the adjustment of the band-stop circuits performed so far (repeat 1. and 2. if necessary).

Band-pass

3. Adjustment of band-pass circuitry at the transmitter frequency.

a) Connect the transmitter to connector J1.
b) Connect a dummy load with the microammeter in series to the antenna connector ANT (J3).
c) Key the transmitter.
d) Adjust C5 for maximum reading on the microammeter.

4. Adjustment of band-pass circuitry at the receiver frequency.

a) A correct loading of the filter is obtained by short-circuiting the AVC-circuit in the receiver and inserting 6 dB 50-50 Ω attenuator network between filter and receiver.
b) Connect the receiver to connector J2.
c) Connect the signal generator to antenna connector ANT (J3).
d) Adjust the signal generator to the receiver frequency.
e) Adjust C6 in order to obtain maximum limiter current in the receiver (The output from the signal generator should be kept so low that limiting in the receiver is prevented as it otherwise will be impossible to get a correct maximum indication).

Warning: Do not key the transmitter while connected to connector J1 as the attenuator of the signal generator will be destroyed. The best way to prevent this mishap is to open the fuse in the transmitter power supply unit.

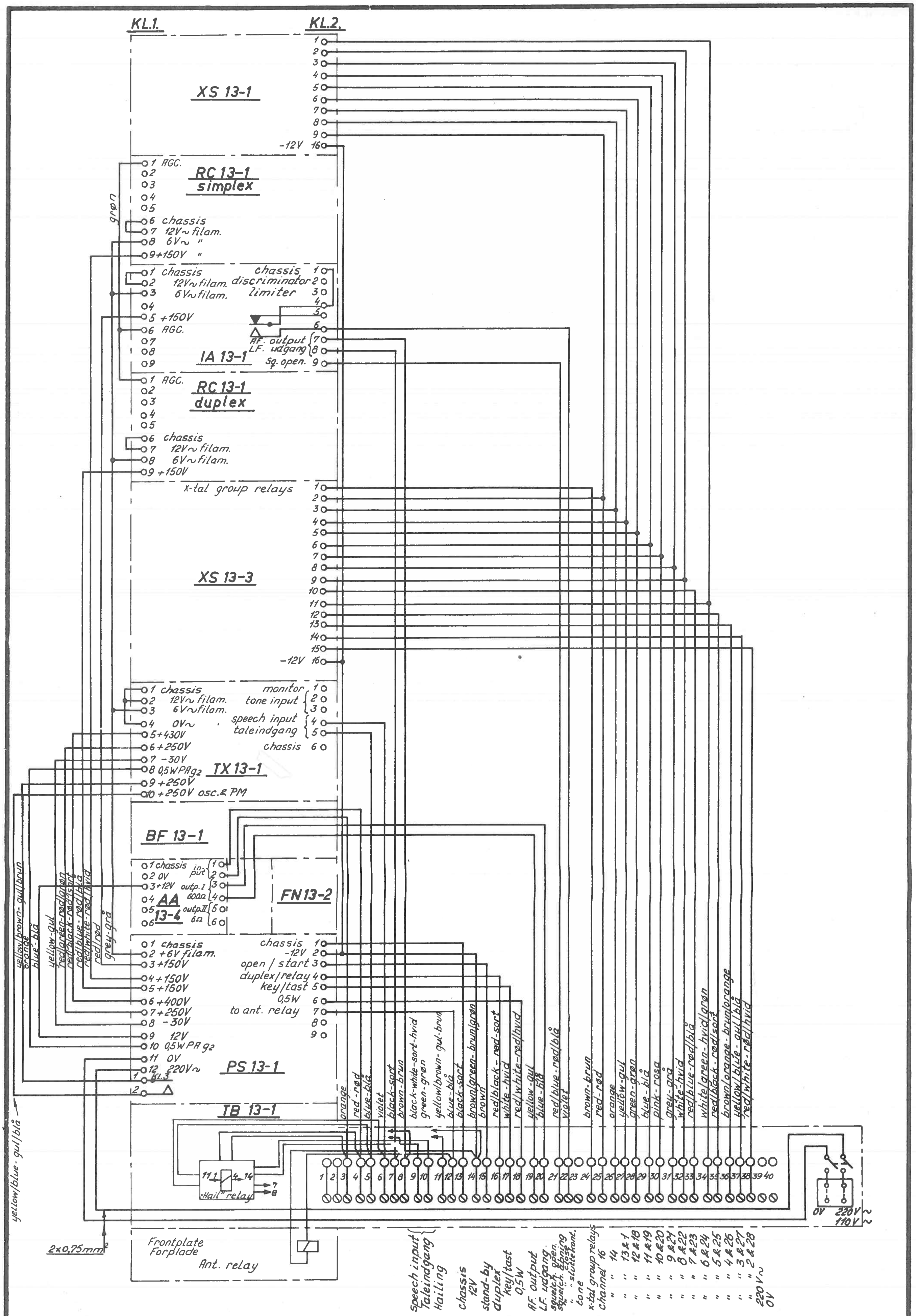
DIAGRAMS AND PARTS LISTS

Introduction

The diagrams and the function schematics of the modular units in the radiotelephone equipment model MARINEPHONE can be found on the following pages. Each modular diagram is accompanied by an electrical part list with component specifications and STORNO stock numbers.

Spare Parts

When ordering spare parts from STORNO please state STORNO stock numbers together with component position number and type designation of modular unit. Position designation is not sufficient information as the components in each modular units is numbered from 1. As an example more than ten resistors have been designed R5 in this radiotelephone station.



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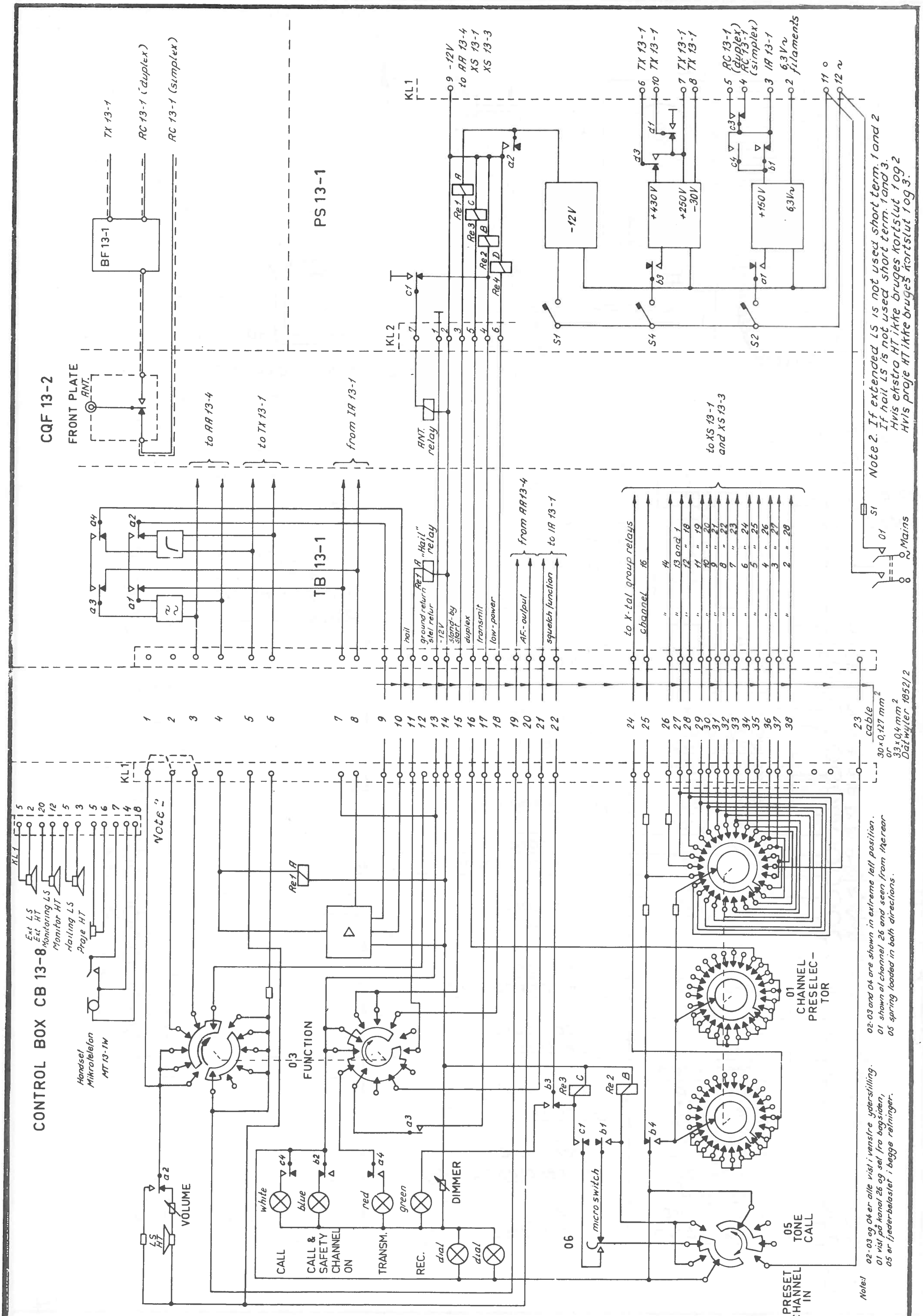
godk.	CABLEFORM KABLING	CQF 13-2
komp.liste		D10949

Storno



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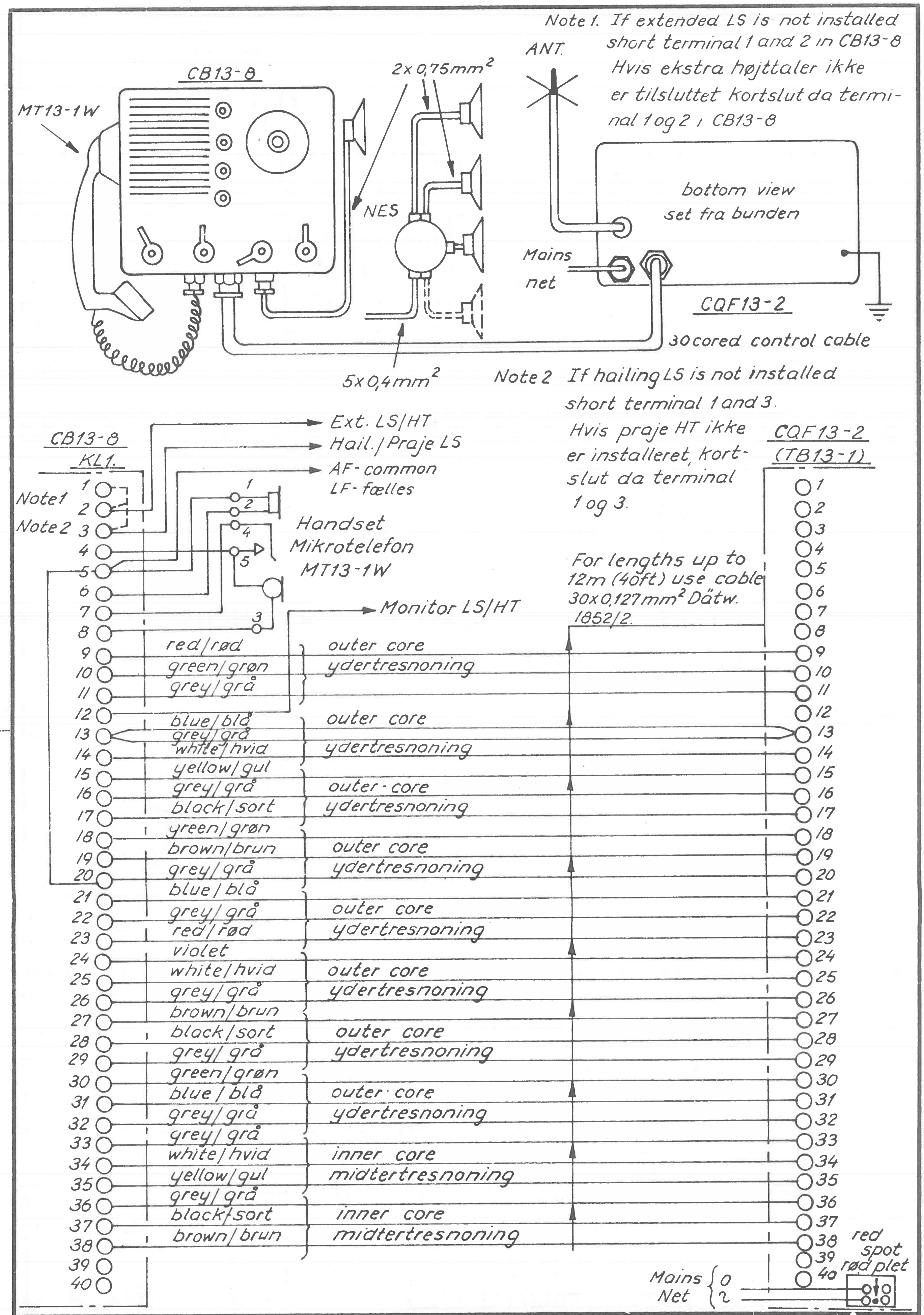
konstr./tegn. KH. GM. 8-5-61	FUNCTION DIAGRAM	CQF 13-2	D 10907/2
godk. KH 8-5-61	FUNKTIONSDIAGRAM		
komp.liste			

Storno



Storno

konstr./tegn. KN/BM
23-10-62
godk.
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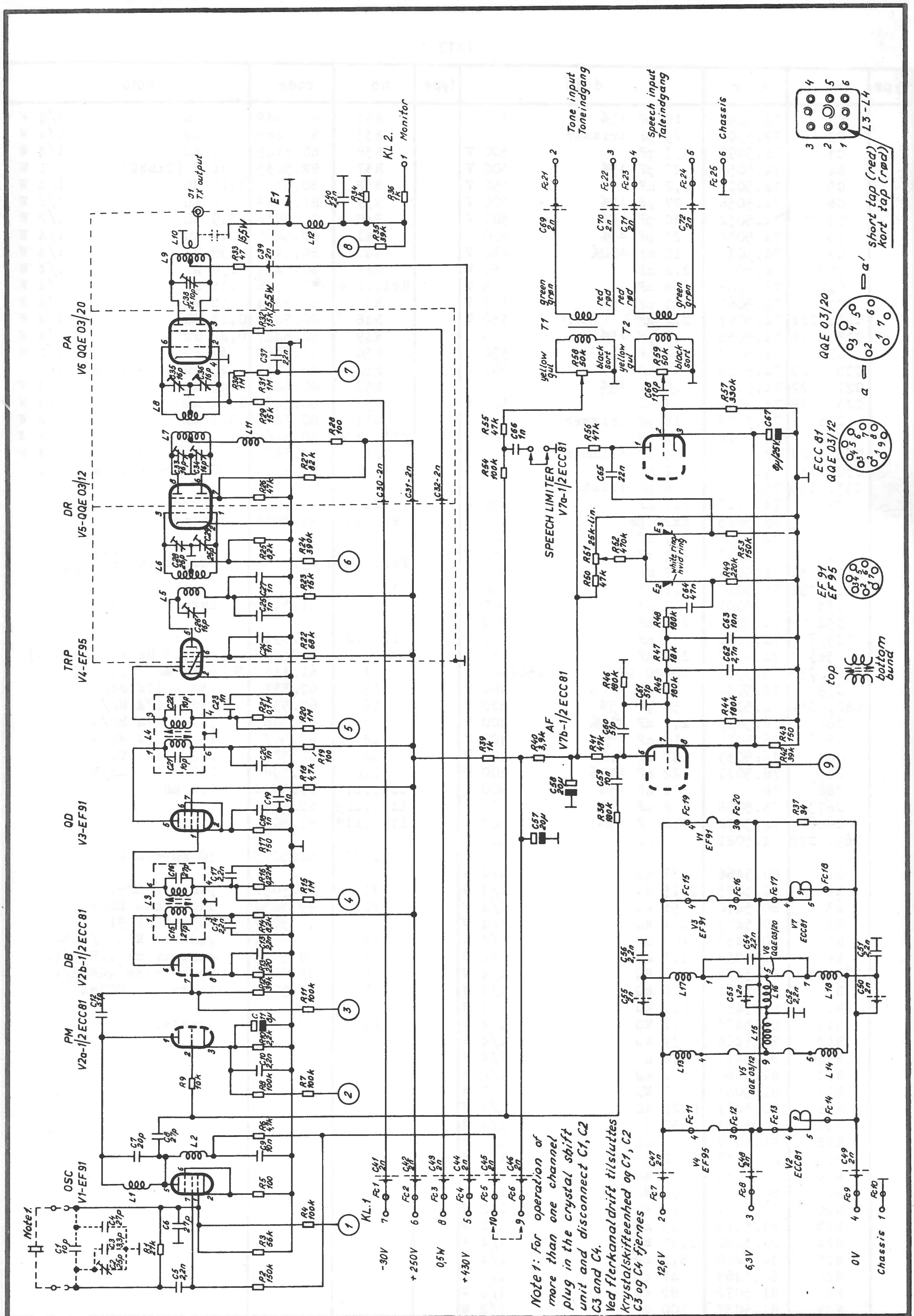
MARINE EQUIPMENT
MARINESTATION
Installation diagram

CQF13-2

D10977



Storno

konstr./tegn. SM-G.M. 12-4-60.

godk. SM/HN

komp.liste X10771

TRANSMITTER

SENDER

TX 13-1

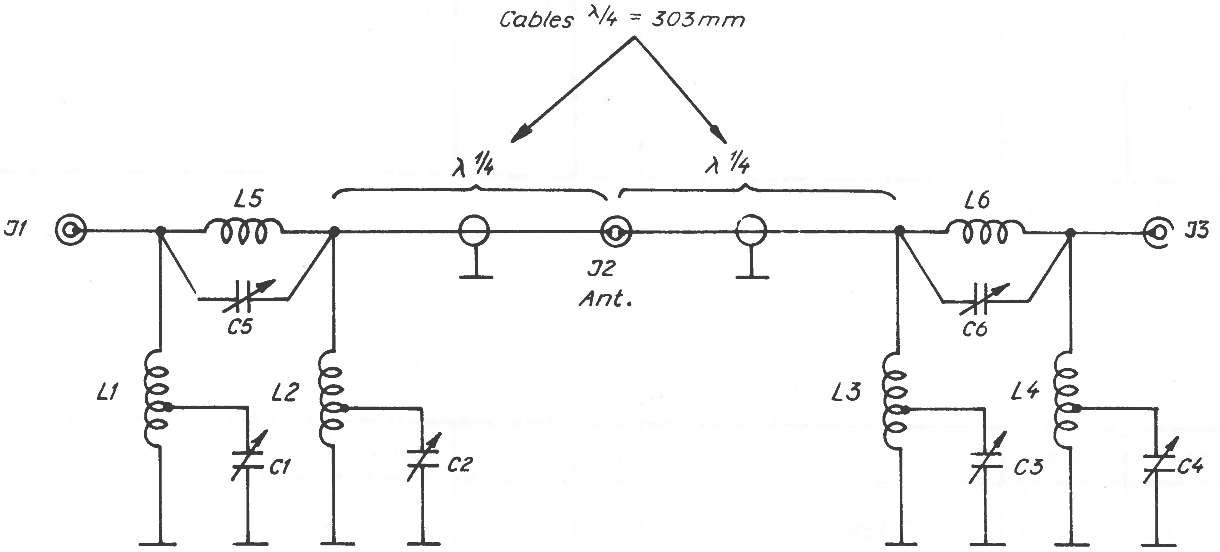
D10770

type	no	code	data
	C1	74.5042	10 pF ±5% 500 V
	C2	78.5005	25 pF trimmer
	C3	74.5095	3,3 pF 500 V
	C4	74.5056	27 pF ±5% 500 V
	C5	74.5017	2,2 nF 350 V
	C6	74.5056	27 pF ±5% 500 V
	C7	74.5052	20 pF ±5% 500 V
	C8	74.5056	27 pF ±5% 500 V
	C9	76.5030	10 nF ±10% 400 V
	C10	74.5017	2,2 nF 350 V
	C11	73.5008	8 µF 25 V
	C12	74.5061	51 pF ±5% 500 V
	C13..C14	74.5017	2,2 nF 350 V
	C15..C16	74.5056	27 pF ±5%
	C17	74.5017	2,2 nF 350 V
	C18..C20	74.5016	1 nF 500 V
	C21..C22	74.5042	10 nF ±5%
	C23..C25	74.5016	1 nF 500 V
	C26	78.5016	16 pF trimmer
	C27	74.5016	1 nF 500 V
	C28..C29	78.5004	25 pF trimmer
	C30..C32	74.5081	2 nF 500 V
	C33..C36	78.5016	16 pF trimmer
	C37	74.5017	2,2 nF 350 V
	C38	78.5013	2x10 pF
	C39	74.5081	2 nF 500 V
	C40	74.5017	2,2 nF 350 V
	C41..C50	74.5081	2 nF 500 V
	C51..C52	74.5017	2,2 nF 350 V
	C53	74.5081	2 nF 500 V
	C54	74.5017	2,2 nF 350 V
	C55	74.5081	2 nF 500 V
	C56	74.5017	2,2 nF 350 V
	C57..C58	73.5018	20+20 µF 450/500 V
	C59	76.5030	10 nF ±10% 400 V
	C60..C61	74.5061	51 pF ±5% 500 V
	C62	76.5023	2,7 nF ±10% 400 V
	C63	76.5011	10 nF ±5% 400 V
	C64	76.5033	47 nF ±10% 125 V
	C65	76.5031	22 nF ±10% 400 V
	C66	76.	1 nF ±5% 600 V
	C67	73.5008	8 µF 25 V
	C68	74.5072	110 pF ±5% 500 V
	C69..C72	74.5081	2 nF 500 V
	R1	80.5466	27 kΩ 1/4 W
	R2	80.5475	0,15 MΩ 1/4 W
	R3	80.5470	56 kΩ 1/4 W
	R4	80.5473	0,1 MΩ 1/4 W
	R5	80.5437	100 Ω 1/4 W
	R6	81.5057	4,7 kΩ 1/2 W
	R7..R8	80.5473	0,1 MΩ 1/4 W
	R9	80.5461	10 kΩ 1/4 W
	R10	80.5453	2,2 kΩ 1/4 W
	R11	80.5473	0,1 MΩ 1/4 W
	R12	80.5468	39 kΩ 1/4 W
	R13	80.5441	220 Ω 1/4 W
	R14	81.5060	8,2 kΩ 1/2 W
	R15	81.5085	1 MΩ 1/2 W
	R16	80.5477	0,22 MΩ 1/4 W
	R17	80.5439	150 Ω 1/4 W
	R18	81.5057	4,7 kΩ 1/2 W
	R19	80.5437	100 Ω 1/4 W
	R20	81.5085	1 MΩ 1/2 W
	R21	80.5473	0,1 MΩ 1/4 W
	R22	81.5071	68 kΩ 1/2 W
	R23	81.5063	15 kΩ 1/2 W
	R24	80.5480	0,39 MΩ 1/4 W
	R25	80.5460	8,2 kΩ 1/4 W
	R26	80.5469	47 kΩ 1/4 W
	R27	81.5072	82 kΩ 1/2 W
	R28	81.5037	100 Ω 1/2 W
	R29	81.5063	15 kΩ 1/2 W
	R30..R31	81.5085	1 MΩ 1/2 W
	R32	84.5007	1,5 kΩ 5,5 W
	R33	84.5003	47 Ω 5,5 W

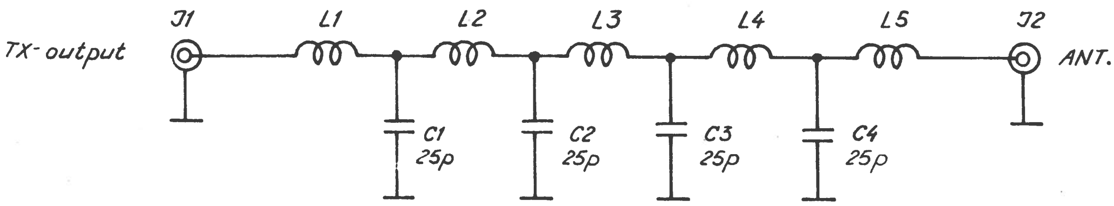
type	no	code	data
	R34	80.5449	1 kΩ 1/4 W
	R35	80.5468	39 kΩ 1/4 W
	R36	80.5449	1 kΩ 1/4 W
	R37	82.5035	34 Ω (2x68Ω) 1 W
	R38	80.5476	0,18 MΩ 1/4 W
	R39	81.5049	1 kΩ 1/2 W
	R40	81.5056	3,9 kΩ 1/2 W
	R41	80.5469	47 kΩ 1/4 W
	R42	80.5468	39 kΩ 1/4 W
	R43	80.5439	150 Ω 1/4 W
	R44..R46	80.5476	0,18 MΩ 1/4 W
	R47	80.5464	18 kΩ 1/4 W
	R48	80.5476	0,18 MΩ 1/4 W
	R49	80.5477	0,22 MΩ 1/4 W
	R50	81.5069	47 kΩ 1/2 W
	R51	86.5012	25 kΩ potentiom. lin.
	R52	80.5481	0,47 MΩ 1/4 W
	R53	80.5475	0,15 MΩ 1/4 W
	R54	80.5473	0,1 MΩ 1/4 W
	R55..R56	80.5469	47 kΩ 1/4 W
	R57	80.5479	0,33 MΩ 1/4 W
	R58..R59	86.5014	50 kΩ potentiom. log.
	E1	99.5046	diode
	E2..E3	99.5028	diode
	Fc1..Fc25	65.	Ferroxcube beads perler
	J1	41.5101	Ant. connector
	L1..L2	62.099	
	L3	61.447	12,6-14,5 Mc/s (C15-C16)
	L4	61.448	50,6-58 Mc/s (C21-C22)
	L5	62.532	152 - 174 Mc/s
	L6	62.531	152 - 174 Mc/s
	L7	62.506	152 - 174 Mc/s
	L8	62.507	152 - 174 Mc/s
	L9	62.505	152 - 174 Mc/s
	L10	62.508	152 - 174 Mc/s
	L11..L12	63.5004	2,2 µH
	L13..L15	62.474	
	L16..L18	62.504	
	T1..T2	60.5003	50 kΩ-600 Ω
	V1	99.5057	pentode EF91
	V2	99.5054	duotriode ECC81
	V3	99.5057	pentode EF91
	V4	99.5002	pentode M8100/5654
	V5	99.5004	duotetrode QQE03/12
	V6	99.5056	duotetrode QQE03/20
	V7	99.5054	duotriode ECC81
	X1	98.	Crystal

X 10.771

BF13-1



FN13-2



konstr./tegn. EBN/BM 5-12-62 godk. komp.liste	BRANCHING FILTER/DELEFILTER BF13-1 ANTENNA FILTER FN13-2	D 10.735 D 10.921

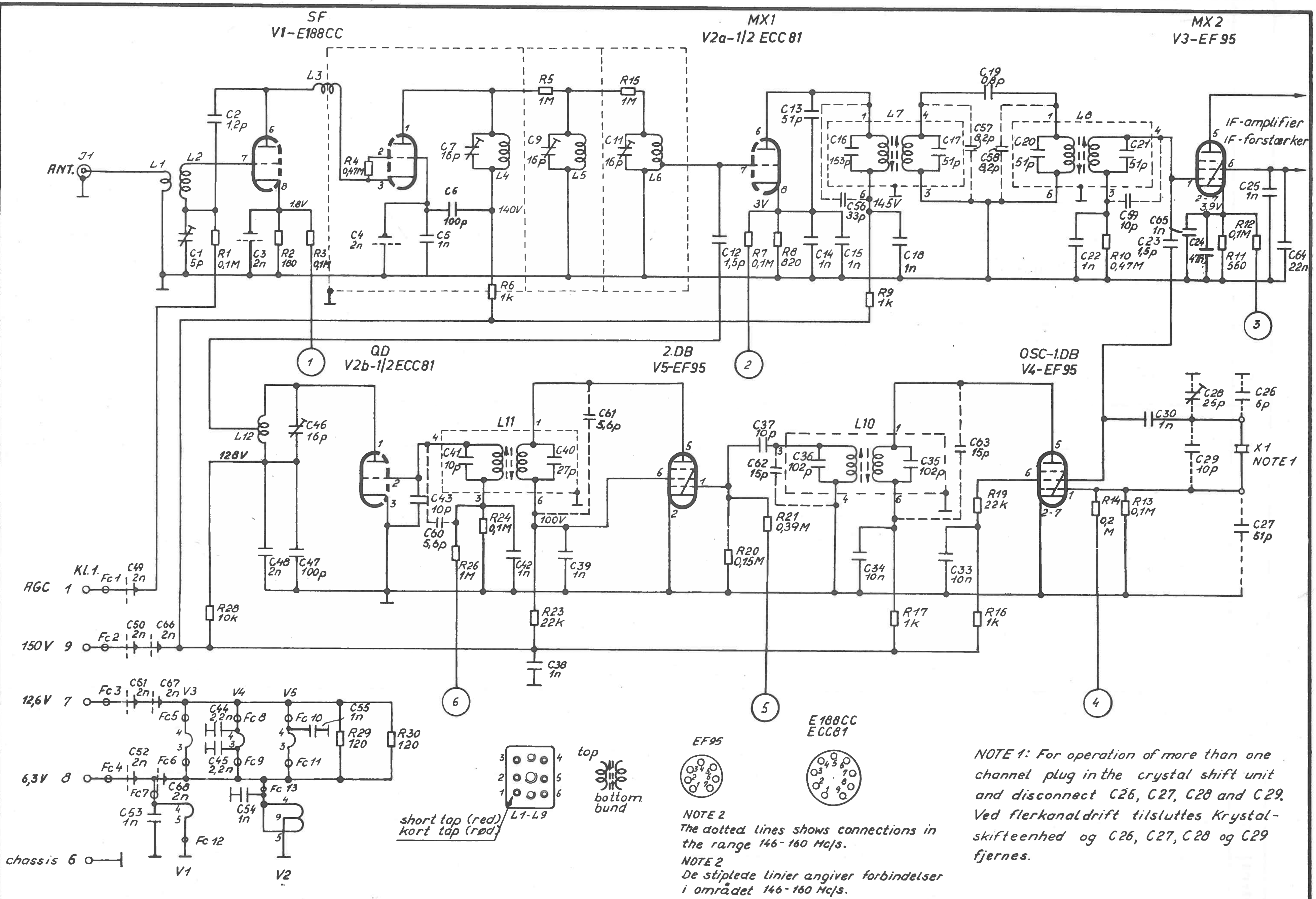
Storno

BF13-1

type	no	code	data	type	no	code	data
	C1..C4	78.005	trimmer 500 V		L4	62.501	Filter coil
	C5..C6	78.006	3-40 pF 700 V		L5..L6	62.503	"
	L1	62.502	Filter coil		J1..J3	41.5131	Connector
	L2	62.501	"				
	L3	62.502	"				

FN13-2

type	no	code	data	type	no	code	data
	C1..C4	74.5054	25 pF ±5% 500V		L4	62.548	filter coil
					L5	62.546	filter coil
	L1	62.547	filter coil		J1..J2	41.5131	connector
	L2	62.549	filter coil				
	L3	62.549	filter coil				



NOTE 1: For operation of more than one channel plug in the crystal shift unit and disconnect C26, C27, C28 and C29.
Ved flerkanaldrift tilsluttes Krystalskifteenhed og C26, C27, C28 og C29 fjernes.

NOTE 2
The dotted lines shows connections in the range 146-160 Mc/s.

NOTE 2
De stiplede linier angiver forbindelser i området 146-160 Mc/s.

Storno

konst./tegn. S.M./G.M.
9-9-59.
godk. 3-11/ HV
3-11-59
komp. liste
x 10358

27-4-62
6-10-61

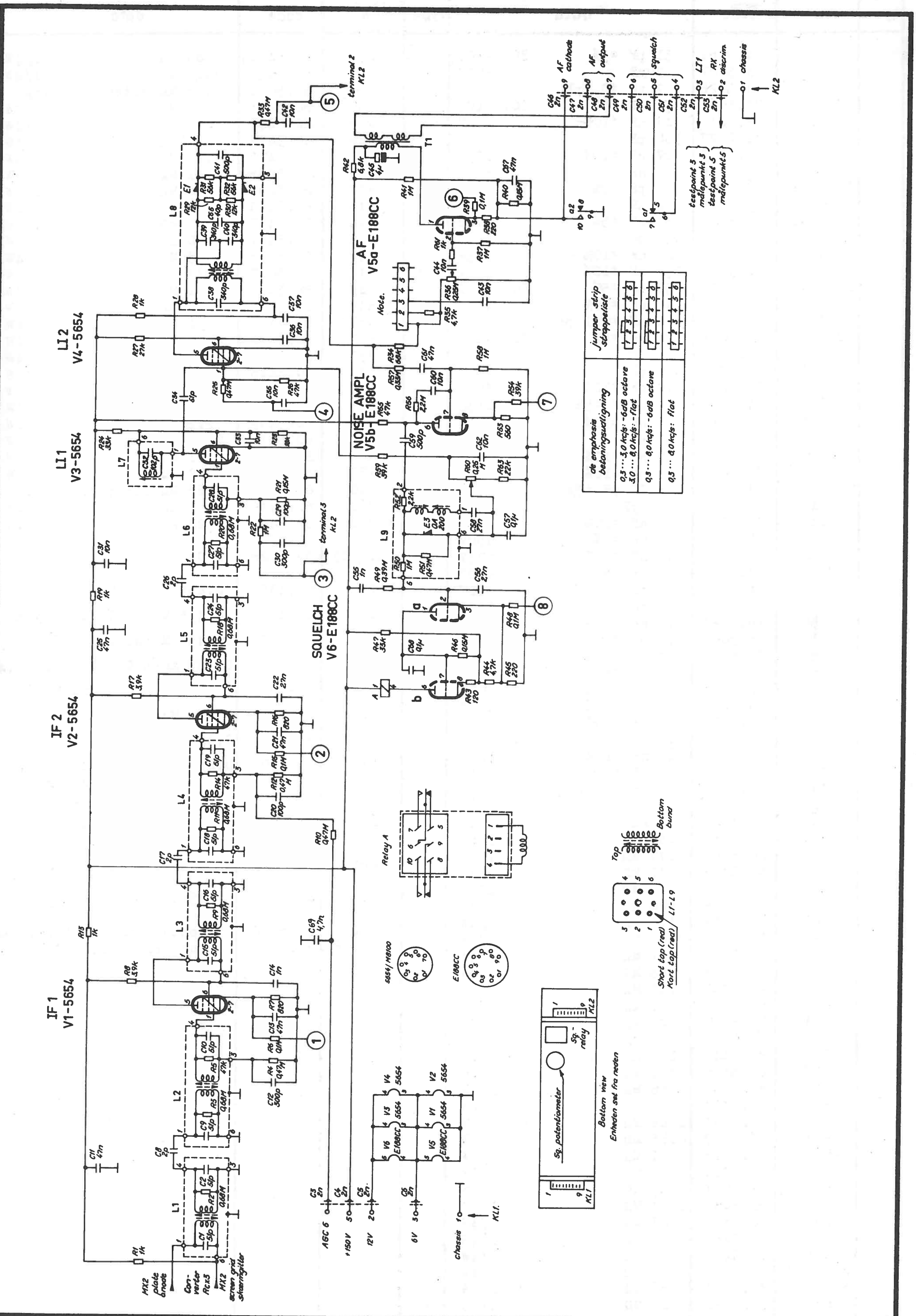
RECEIVER CONVERTER RC 13-1 L

D10244

type	no	code	data
	C1	78.5014	5 pF trimmer
	C2	74.5002	1.2 pF ±0,1 pF
	C3..C4	74.5080	2 nF 500V
	C5	74.5016	1 nF 500V
	C6	74.5069	100 pF 500V
	C7	78.5015	16 pF trimmer
	C9..C11	78.5016	16 pF "
	C12	74.5003	1,5 pF ±20%
	C13	74.5061	51 pF ±5%
	C14..C15	74.5016	1 nF 500V
	C16	74.5061	3x51 pF ±5%
	C17	74.5061	51 pF ±5%
	C18	74.5016	1 nF 500V
	C19	74.5023	0,8 pF ±0,1 pF
	C20..C21	74.5061	51 pF ±5%
	C22	74.5016	1 nF 500V
	C23	74.5003	1,5 pF ±20%
	C24	76.5033	47 nF 125V
	C25	74.5016	1 nF 500V
	C26	74.5035	6 pF only used
	C27	74.5061	51 pF ±5% on one channel
	C28	78.5005	25pF trimmer benyttes kun ved 1 kanal
	C29	74.5042	10 pF ±0,5pF 500V
	C30	74.5016	1 nF 500V
	C33..C34	76.5030	10 nF 400V
	C35..C36	74.5061	2x51pF ±5%
	C37	74.	10 pF ±0,5pF 500V
	C38..C39	74.5016	1 nF 500V
	C40	74.5056	27 pF ±5%
	C41	74.5042	10 pF ±5%
	C42	74.5016	1 nF 500V
	C43	74.5042	10 pF ±5%
	C44	74.5017	2,2 nF
	C45	74.5017	2,2 nF
	C46	78.5015	16 pF trimmer
	C47	74.5069	100 pF
	C48..C52	74.5080	2 nF 500V
	C53..C55	74.5016	1 nF 500V
13L	C56	74.5085	33 pF±5% ceram. 500V
-	C57..C58	74.5036	8,2 pF ±0,25pF ceram. 500V
-	C59	74.5042	10 pF ±5% " 500V
-	C60..C61	74.5005	5,6 pF ±0,25pF " 500V
-	C62..C63	74.5046	15 pF ±5% " 500V
	C64	76.5031	22 nF ±10% 400V
	C65	74.5016	1 nF " 500V
	C66..C68	74.5081	2 nF 500V
	R1	80.5473	0,1 MΩ 1/4W
	R2	80.5440	180 Ω 1/4W
	R3	80.5473	0,1 MΩ 1/4W
	R4	80.5481	0,47 MΩ 1/4W
	R5	81.5085	1 MΩ 1/2W
	R6	80.5449	1 kΩ 1/4W
	R7	80.5473	0,1 MΩ 1/4W
	R8	80.5448	820 Ω 1/4W
	R9	80.5449	1 kΩ 1/4W
	R10	80.5481	0,47 MΩ 1/4W
	R11	80.5446	560 Ω 1/4W
	R12..R13	80.5473	0,1 MΩ 1/4W
	R14	80.5473	0,2 MΩ (2x0,1MΩ) 1/4W
	R15	81.5085	1 MΩ 1/2W
	R16..R17	80.5449	1 kΩ 1/4W
	R19	80.5465	22 kΩ 1/4W
	R20	80.5475	0,15 MΩ 1/4W
	R21	80.5480	0,39 MΩ 1/4W
	R23	80.5465	22 kΩ 1/4W
	R24	80.5473	0,1 MΩ 1/4W
	R26	81.5085	1,0 MΩ 1/4W
	R28	80.5461	10 kΩ 1/4W
	R29..R30	80.5438	120 Ω 1/4W
	Fc1-Fc13	65.	ferroxcube beads

type	no	code	data
	J1	41.5131	coax connector
	L1	62.446	
	L2	62.447	152-174 Mc/s
	L3	62.236	"
	L4	62.438	"
	L5	62.440	"
	L6	62.438	"
	L7	61.389	9,4-10,7 Mc/s, C16, C17
	L8	61.391	9,4-10,7 Mc/s, C20, C21
	L10	61.445	18,4-20,4 Mc/s, C35, C36
	L11	61.428	36-41 Mc/s, C40, C41
	L12	62.439	144-164 Mc/s
	V1	99	duotriode E188CC
	V2	99	duotriode ECC81
	V3..V5	99	pentode 5654

X10.358



1-1-63

Storno

konstr./tegn. FHI BM 3-5-60

godk.

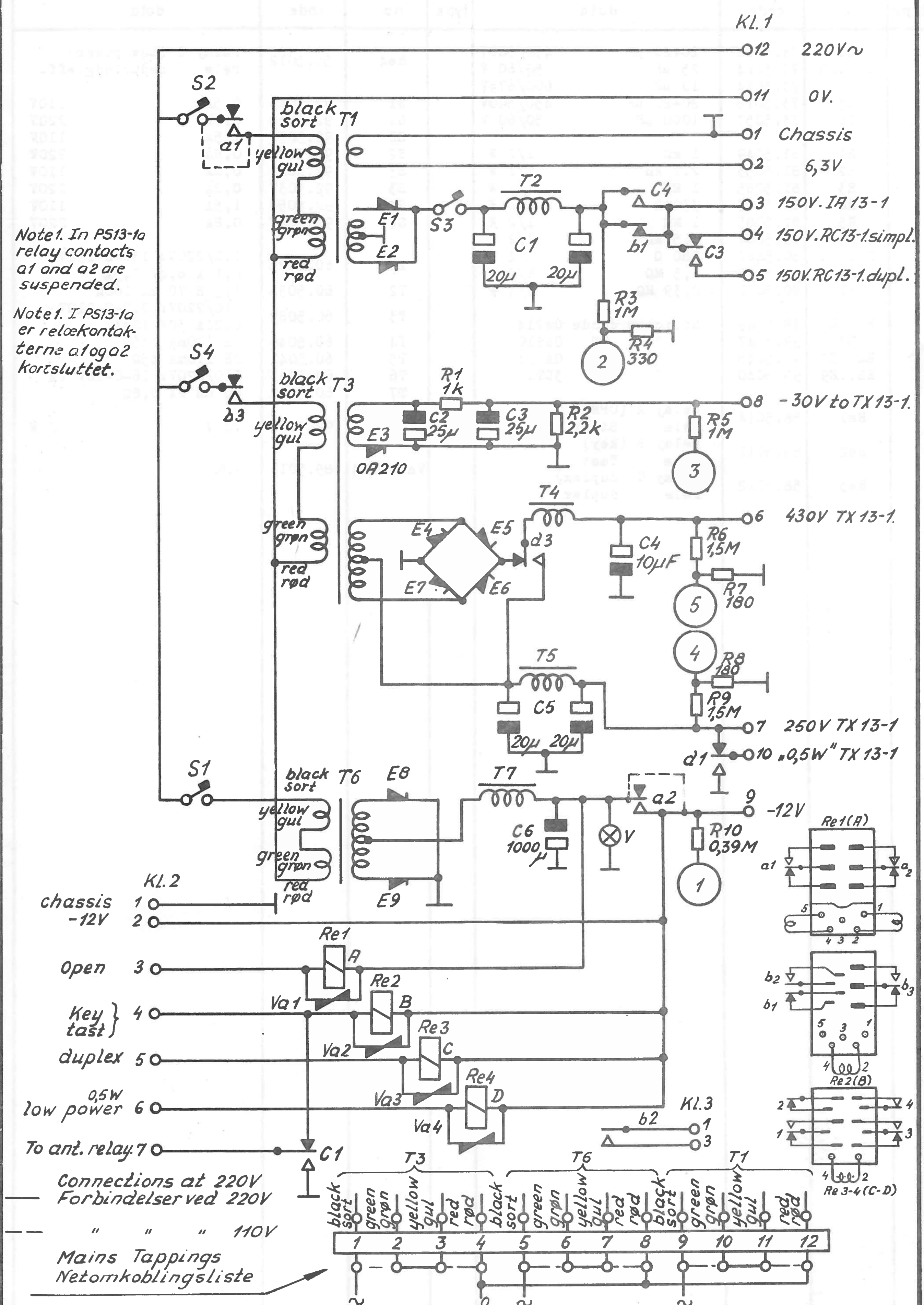
komp.liste X 10027

IF-AMPLIFIER
MF-FORSTÆRKER

IA13-1

D 10026

type	no	code	data
	C1..C2	74.5061	51 pF ±5% TC: -100
	C3..C6	74.5081	2 nF 500V
	C8	74.5028	2 pF ±0,1pF
	C9..C10	74.5061	51 pF ±5% TC: -100
	C11	76.5035	47 nF ±10% 400V
	C12	74.5077	300 pF
	C13	76.5033	47 nF ±10% 125V
	C14	47.5016	1 nF 500V
	C15..C16	74.5061	51 pF ±5% TC: -100
	C17	74.5028	2 pF
	C18..C19	74.5061	51 pF ±5% TC: -100
	C20	74.5070	100 pF
	C21	76.5033	47 nF ±10% 125V
	C22	76.5023	2,7 nF ±10% 400V
	C23..C24	74.5061	51 pF ±5% TC: -100
	C25	76.5035	47 nF ±10% 400V
	C26	74.5028	2 pF ±0,1 pF
	C27..C28	74.5061	51 pF ±5% TC: -100
	C29	74.5070	100 pF
	C30	74.5077	300 pF
	C31	76.5030	10 nF ±10% 400V
	C32	74.5061	2x51 pF ±5% TC: -100
	C33	76.5028	10 nF ±10% 125V
	C34	74.5063	51 pF
	C35..C36	76.5028	10 nF ±10% 125V
	C37	76.5030	10 nF ±10% 400V
	C38..C40	74.5075	2x170 pF ±5%
	C41	74.5079	500 pF 500V
	C42	76.5028	10 nF ±10% 125V
	C43	76.5011	10 nF ±5% 400V
	C44	76.5028	10 nF ±10% 125V
	C45	73.5004	4 µF 85° 250V
	C46..C53	74.5081	2 nF 500V
	C55	74.5016	1 nF 500V
	C56	76.5023	2,7 nF ±10% 400V
	C57	76.5036	0,1 µF ±10% 125V
	C58	76.5032	27 nF ±10% 125V
	C59	74.5079	500 pF ±5% 350V
	C60	76.5030	10 nF ±10% 400V
	C61	76.5033	47 nF ±10% 125V
	C62	76.5028	10 nF ±10% 125V
	C65	74.5057	40 pF ±5% TC: -750
	C67	76.5033	47 nF ±10% 125V
	C68	76.5036	0,1 µF ±10% 125V
	C69	74.5020	4,7 nF -20/+50% 500V
	R1	80.5449	1 kΩ 1/4W
	R2..R3	80.5483	0.68 MΩ 1/4W
	R4	80.5481	0.47 MΩ 1/4W
	R5	80.5469	47 kΩ 1/4W
	R6	80.5473	0.1 MΩ 1/4W
	R7	80.5448	820 Ω 1/4W
	R8	80.5456	3,9 kΩ 1/4W
	R9	80.5483	0.68 MΩ 1/4W
	R10	80.5481	0.47 MΩ 1/4W
	R11	80.5483	0.68 MΩ 1/4W
	R12	80.5481	0.47 MΩ 1/4W
	R13	81.5049	1 kΩ 1/2W
	R14	80.5469	47 kΩ 1/4W
	R15	80.5473	0,1 MΩ 1/4W
	R16	80.5448	820 Ω 1/4W
	R17	80.5456	3,9 kΩ 1/4W
	R18	80.5483	0.68 MΩ 1/4W
	R19	80.5449	1 kΩ 1/4W
	R20	80.5483	0.68 MΩ 1/4W
	R21	80.5475	0.15 MΩ 1/4W
	R22	80.5485	1 MΩ 1/4W
	R23	81.5064	18 kΩ 1/2W
	R24	81.5067	33 kΩ 1/2W
	R25	80.5481	0,47 MΩ 1/4W
	R26	80.5469	47 kΩ 1/4W
	R27	80.5466	27 kΩ 1/4W
	R28	80.5449	1 kΩ 1/4W
	R29..R30	80.5462	12 kΩ 1/4W
	R31..R32	80.5470	56 kΩ 1/4W
	R33	80.5481	0.47 MΩ 1/4W
	R34	80.5471	68 kΩ 1/4W
	R35	80.5457	4.7 kΩ 1/4W
	R36	86.5020	0.25 MΩ potentiom.(log)
	R37	80.5485	1 MΩ 1/4W
	R38	80.5441	220 Ω 1/4W
	R39	80.5473	0.1 MΩ 1/4W
	R40	80.5475	0,15 MΩ 1/4W
	R41	80.5485	1 MΩ 1/4W
	R42	81.5059	6.8 kΩ 1/2W
	R43	80.5438	120 Ω 1/4W
	R44	80.5457	4.7 kΩ 1/4W
	R45	80.5441	220 Ω 1/4W
	R46	80.5475	0,15 MΩ 1/4W
	R47	81.5067	33 kΩ 1/2W
	R48	80.5473	0.1 MΩ 1/4W
	R49	80.5456	0.39 MΩ 1/4W
	R50	80.5485	1 MΩ 1/4W
	R51	80.5481	0.47 MΩ 1/4W
	R52	80.5453	2.2 kΩ 1/4W
	R53	80.5446	560 Ω 1/4W
	R54	80.5458	39 kΩ 1/4W
	R55	80.5469	47 kΩ 1/4W
	R56	80.5489	2.2 MΩ 1/4W
	R57	80.5479	0.33 MΩ 1/4W
	R58	80.5485	1 MΩ 1/4W
	R59	80.5468	39 kΩ 1/4W
	R60	86.5019	0.25 MΩ lin.potentiom.
	R61	80.5449	1 kΩ 1/4W
	R62..R63	80.5465	22 kΩ 1/4W
	E1..E3	99.5028	OA200
	L1	61.435	0,455 Mc/s, C1,C2,R2
	L2	61.438	0,455 Mc/s, C9,C10,R3,R5
	L3	61.437	0,455 Mc/s, C15,C16,R9
	L4	61.438	0,455 Mc/s,C18,C19,R11,R14
	L5	61.437	0,455 Mc/s,C23,C24,R18
	L6	61.439	0,455 Mc/s,C27,C28,R20
	L7	61.395	0,455 Mc/s, C32
	L8	61.440	0,455 Mc/s, C38,C39,C40, C41,C65,R29,R30,R31,R32, E1,E2
	L9	61.427	High pass filter R50, R51, R52, E3
	ReA	58.5019	Squelch relay
	T1	60.5022	25kΩ/1200Ω
	V1..V4	99.5002	pentode EF95/5654/M8100
	V5..V6	99.5052	duo triode E188CC



Note 1. In PS13-1a relay contacts a1 and a2 are suspended.

Note 1. I PS13-1a er relækontakterne a1 og a2 kortsluttet.

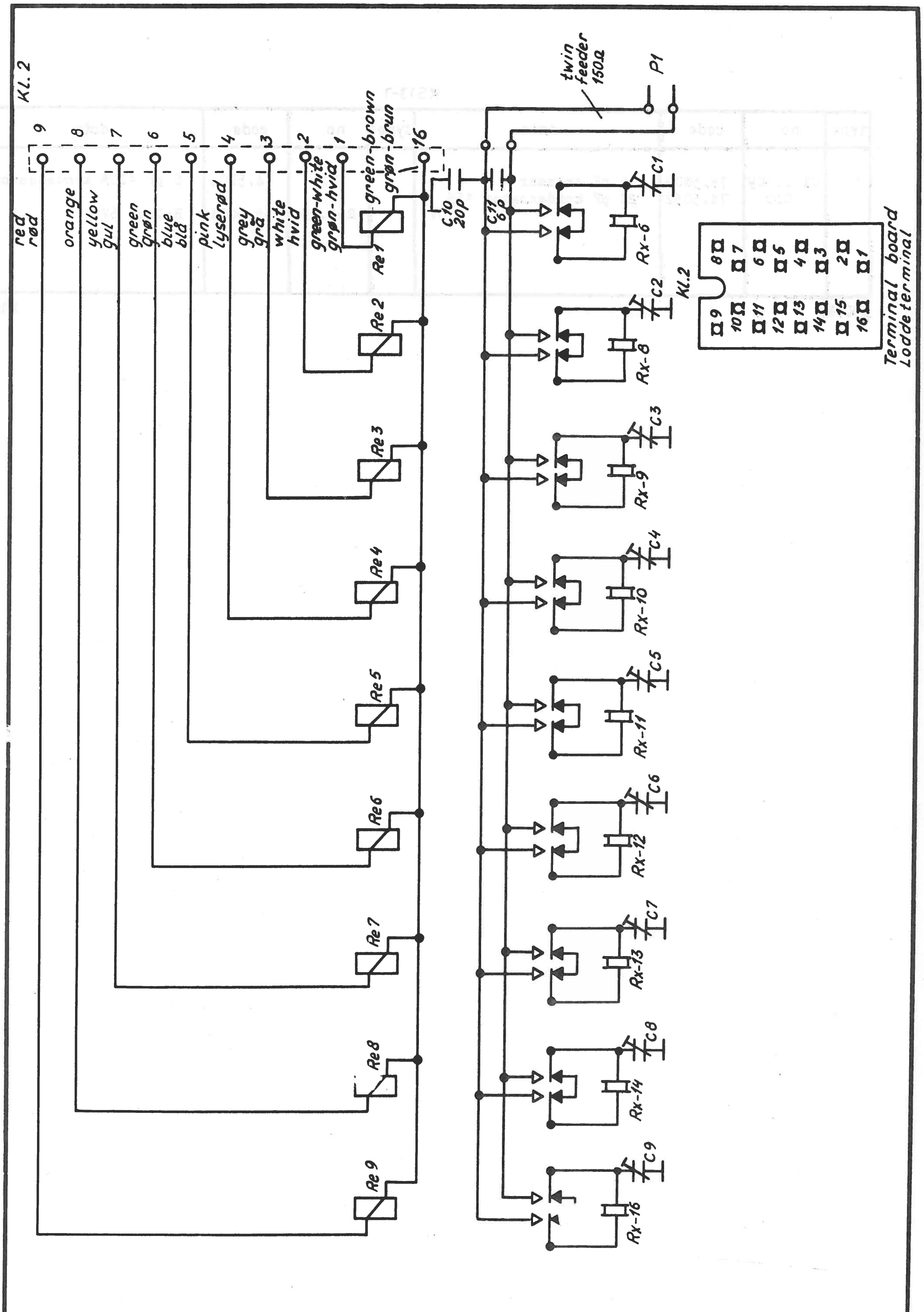
Storno	konstr./tegn. KN-GM. 21-4-60 godk. KN komp.liste x10755	POWER SUPPLY STRØMFORSYNING	PS 13-1/1a	D10762

-62

type	no	code	data	
	C1	73.5018	20+20 µF	450/500V
	C2..C3	73.5024	25 µF	50/60 V
	C4	73.5014	10 µF	600/675V
	C5	73.5018	20+20 µF	450/500V
	C6	73.5057	1000 µF	50/60 V
	R1	81.5049	1 kΩ	1/2 W
	R2	81.5053	2,2 kΩ	1/2 W
	R3	81.5085	1 MΩ	1/2 W
	R4	80.5443	330 Ω	1/4 W
	R5	81.5085	1 MΩ	1/2 W
	R6	81.5087	1,5 MΩ	1/2 W
	R7..R8	80.5440	180 Ω	1/4 W
	R9	81.5087	1,5 MΩ	1/2 W
	R10	80.5480	0,39 MΩ	1/4 W
	E1..E2	99.5049	Silicium diode OA214	
	E3	99.5047	" " OA210	
	E4..E7	99.5048	" " OA211	
	E8..E9	99.5040	" " 3CT1	
	Re1	58.5014	relay A (OPEN) relæ Start	
	Re2	58.5011	relay B (key) relæ Tast	
	Re3	58.5012	relay C (duplex) relæ duplex	

type	no	code	data	
	Re4	58.5012	relay D (Low power) relæ reduc.udg.eff.	
	S1	92.5043	0,5A	110V
	S1	92.5038	0,3A	220V
	S2	92.5050	1,5A	110V
	S2	92.5047	0,8A	220V
	S3	92.5041	0,4A	110V
	S3	92.5037	0,2A	220V
	S4	92.5050	1,5A	110V
	S4	92.5047	0,8A	220V
	T1	60.5085	110/220V: 130-0-130V 0,1 A 6,4V 7,5A	
	T2	60.5031	3,5 H 70 mA 160Ω	
	T3	60.5089	110/220V: 210-0-210V 0,21A 30V 10mA	
	T4	60.5049	5H 100mA 145Ω	
	T5	60.5041	2H 110mA 45Ω	
	T6	60.5063	110/220V: 16-0-16V 2A	
	T7	60.5064	60 mH 2A 0,8Ω	
	V1	92.5002	24 V	2 W
	Va1..Va4	89.5013	VDR	

 X10.795



Storno

konstr./tegn.	KN-GM. 28-3-60.
godk.	4-4-60
komp. liste	x10749.

X-TAL SHIFT UNIT

X-TAL SKIFTEENHED

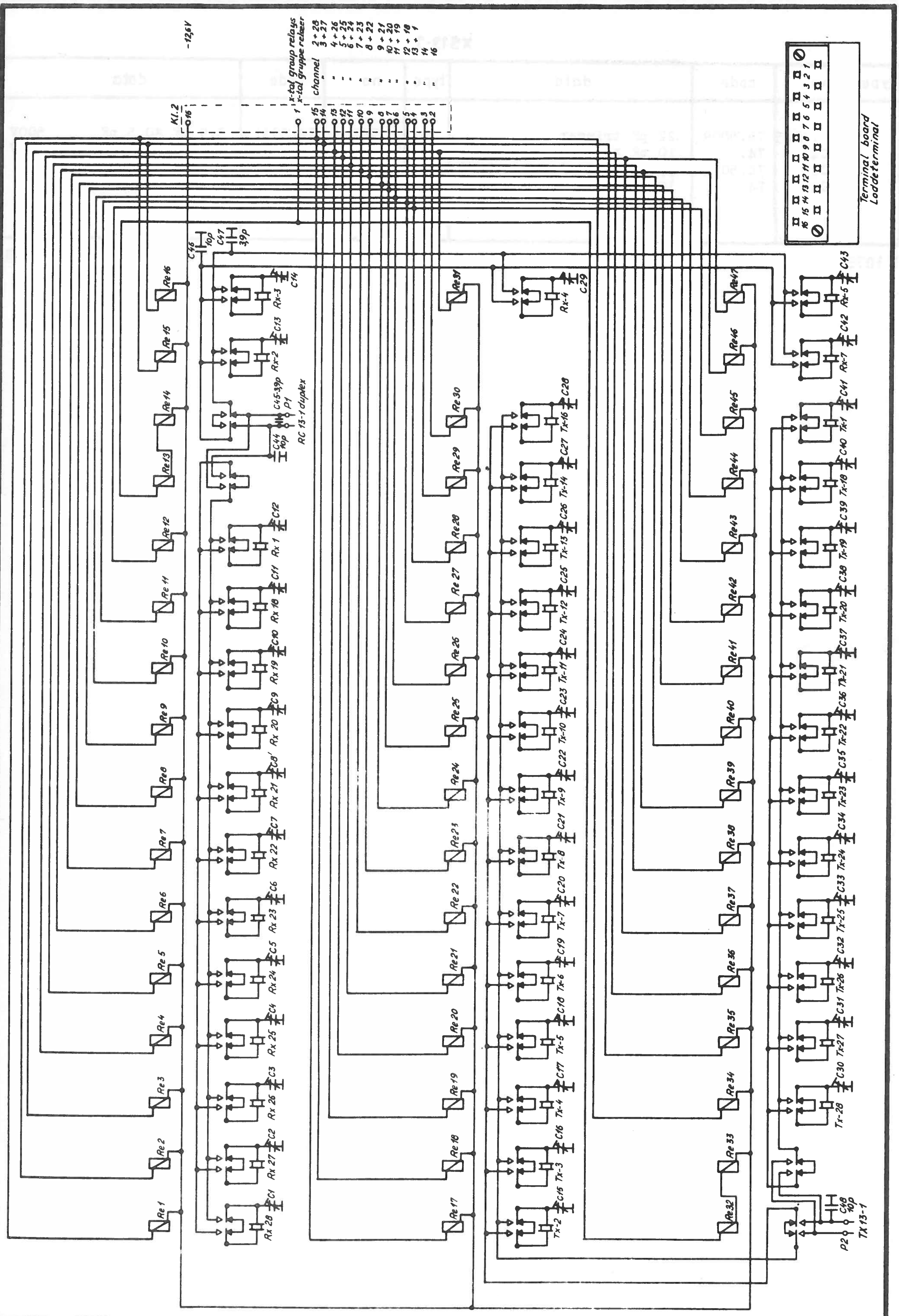
XS 13-1

D10748

XS13-1

type	no	code	data	type	no	code	data
	C1 .. C9 C10	78.5009 74.5052	22 pF trimmer 20 pF kondensator ±5% 500V		C11 Rel..9	74.5104 58.5004	6 pF ±10% kondensator Relays 6V

X10.749 X10.749



Storno

konstr./tegn.	KN-GM. 22-4-60.
godk.	KN 22-4-60.
komp.liste	X 10751

X TAL SHIFT UNIT

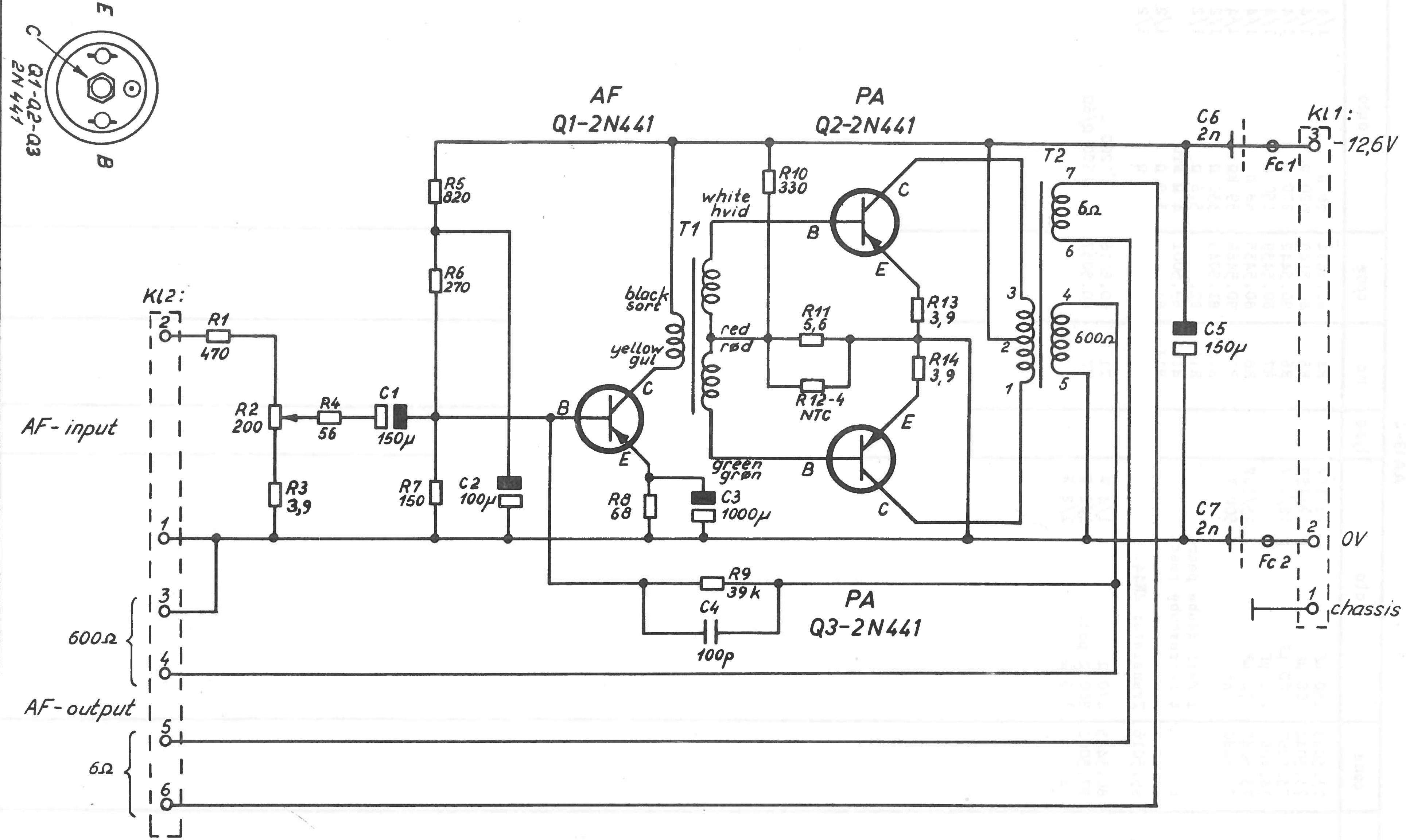
X TAL SKIFTEENHED

XS 13-3

D10750

type	no	code	data	type	no	code	data
	C1 ..C43	78.5009	22 pF trimmer		C47	74.5031	3,9 pF ±0,5 pF 500V
	C44	74.	10 pF ±5% 500V		C48	74.	10 pF ±5% 500V
	C45	74.5031	39 pF ±0,5 pF 500V				
	C46	74	10 pF ±5% 500V		Rel-47	58.5004	Relays 6V

X 10.751 X10.751



Storno

konstr./tegn. SM/GM 6-10-59

godk. S-M/ 6-11-59

komp.liste X10353

AUDIO AMPLIFIER

LAVFREKVENSFORSTÆRKER

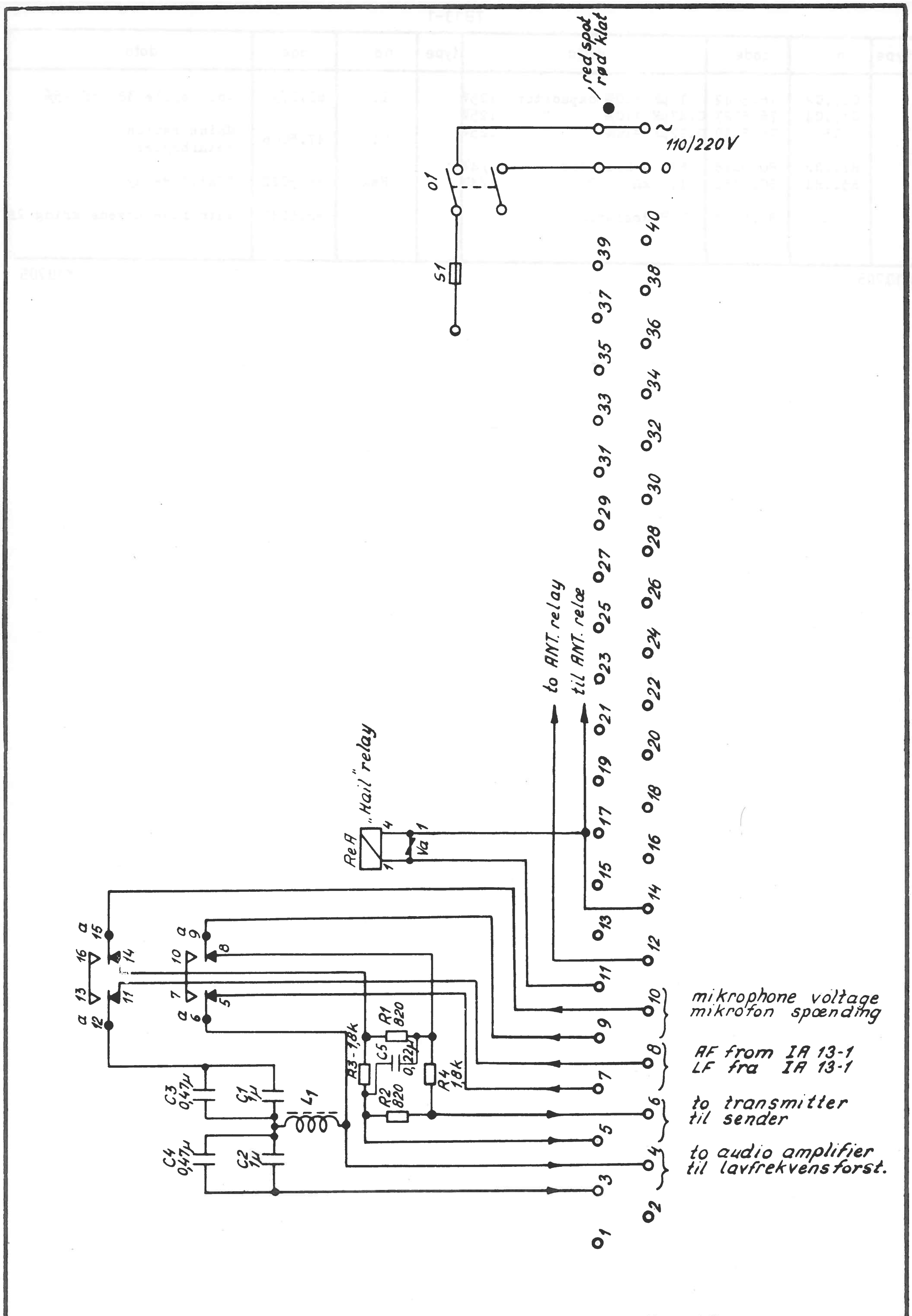
AA 13-4

D10352

type	no	code	data
	C1	73.5039	150 µF 12/15V
	C2	73.5044	100 µF 12/15V
	C3	73.5067	1000 µF 12/15V
	C4	74.5069	100 pF
	C5	73.5040	150 µF 25/30V
	C6..C7	74.5080	2 nF 500 V
	Fc1	65.	1 Ferroxcube pearl
	Fc2	65.	4 Ferroxcube pearl
	Q1..Q3	99.5016	Transistor 2N441
	R1	80.5445	470 Ω 1/4 W
	R2	87.5002	200 Ω pot. 1/2 W
	R3	81.	3,9 Ω 1/2 W

type	no	code	data
	R4	80.5434	56 Ω 1/4 W
	R5	80.5448	820 Ω 1/4 W
	R6	80.5442	270 Ω 1/4 W
	R7	80.5439	150 Ω 1/4 W
	R8	80.5435	68 Ω 1/4 W
	R9	80.5468	39 kΩ 1/4 W
	R10	81.5043	330 Ω 1/2 W
	R11	82.	5,6 Ω 1/2 W
	R12	89.5001	4 Ω NTC
	R13	81.	3,9 Ω 1/2 W
	R14	81.	3,9 Ω 1/2 W
	T1	60.5016	600/1200 Ω
	T2	60.5037	46/600 Ω/6Ω

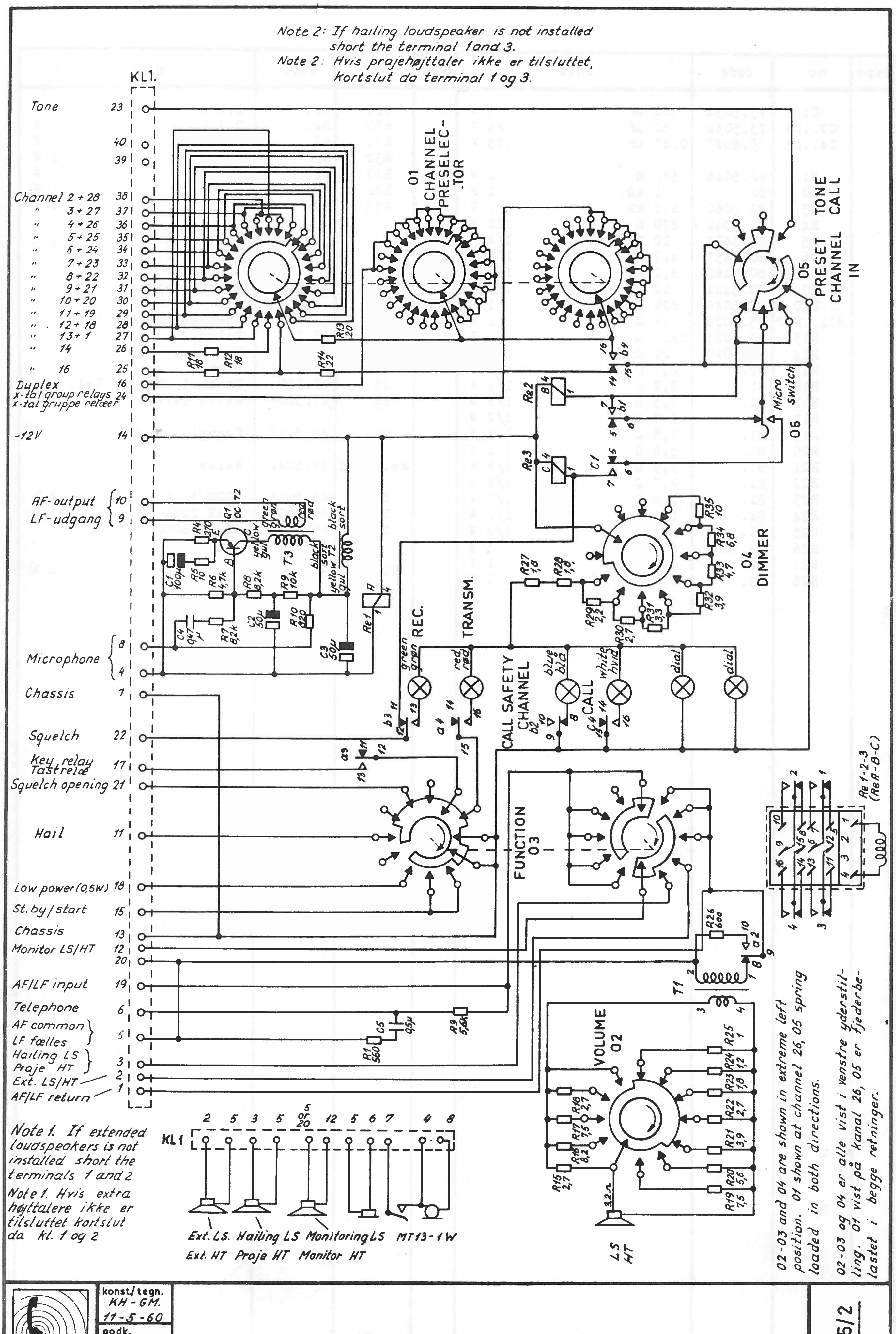
X10.353



Storno konstr./tegn. KN-GM. 31-3-60. godk. KN 4-4-60 komp.liste X10705	TERMINAL PANEL TERMINALENHED	TB 13-1
		D10754

type	no	code	data	type	no	code	data
	C1..C2	76.5042	1 µF ±10% capacitor 125V		L1	61.279	Coil/spole 380 mH ±5%
	C3..C4	76.5027	0,47µF ±10% " 125V				
	C5	76.5039	0,22µF ±10% " 125V		O1	47.5006	Mains switch Netafbryder
	R1..R2	80.5448	820 Ω Resistor 1/4W				
	R3..R4	80.5452	1,8 kΩ " 1/4W		ReA	58.5022	"Hail" Relay
	Val	89.5013	VDR Resistor		S1	92.5031	Main fuse/hovedsikring 2A

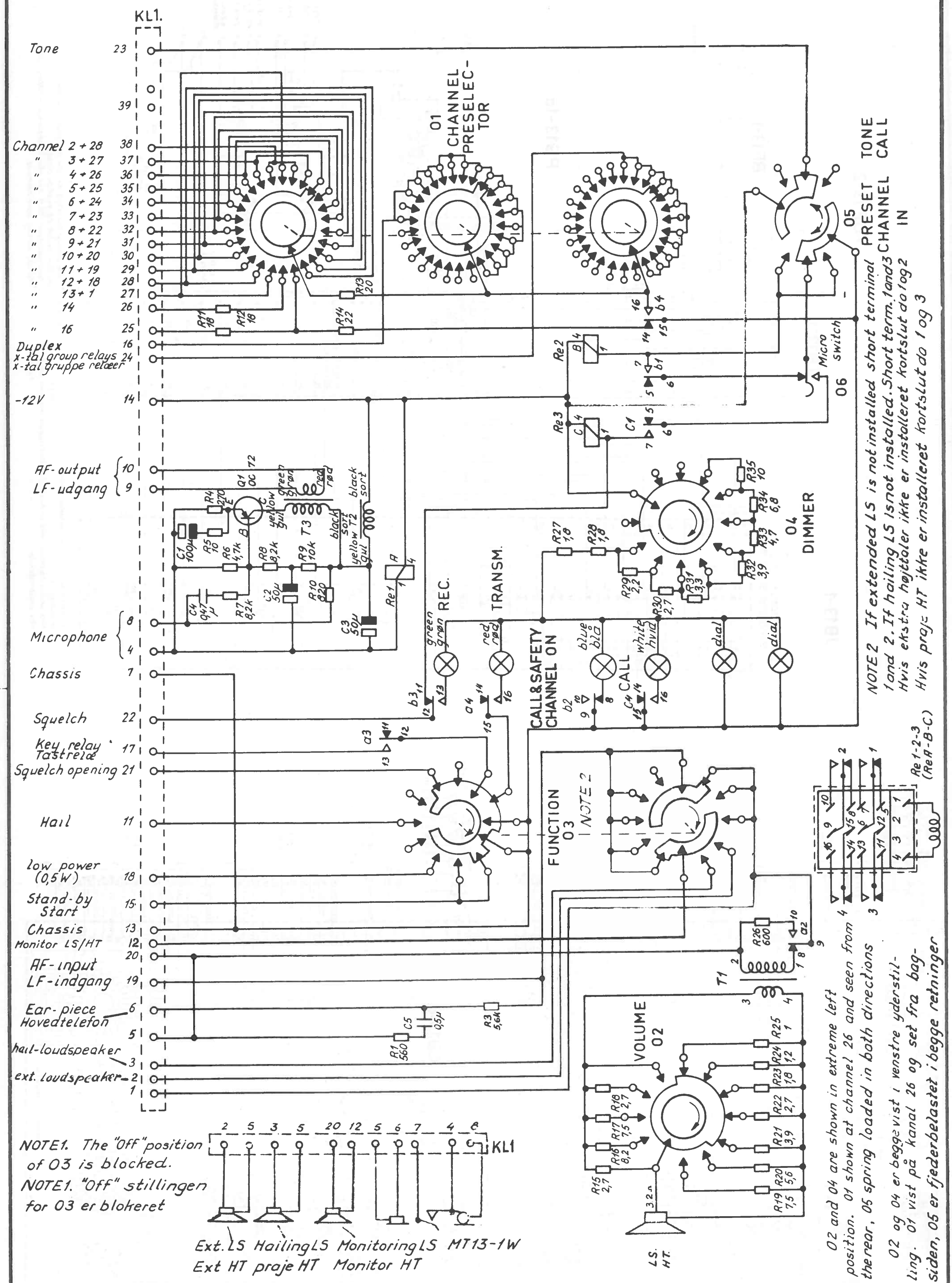
X10.705 X10.705



Storno	konst./tegn. KH - GM. 11-5-60	CONTROL BOX CB13-8	D 10.795/2
	godk.		
	komp. liste X 10796		

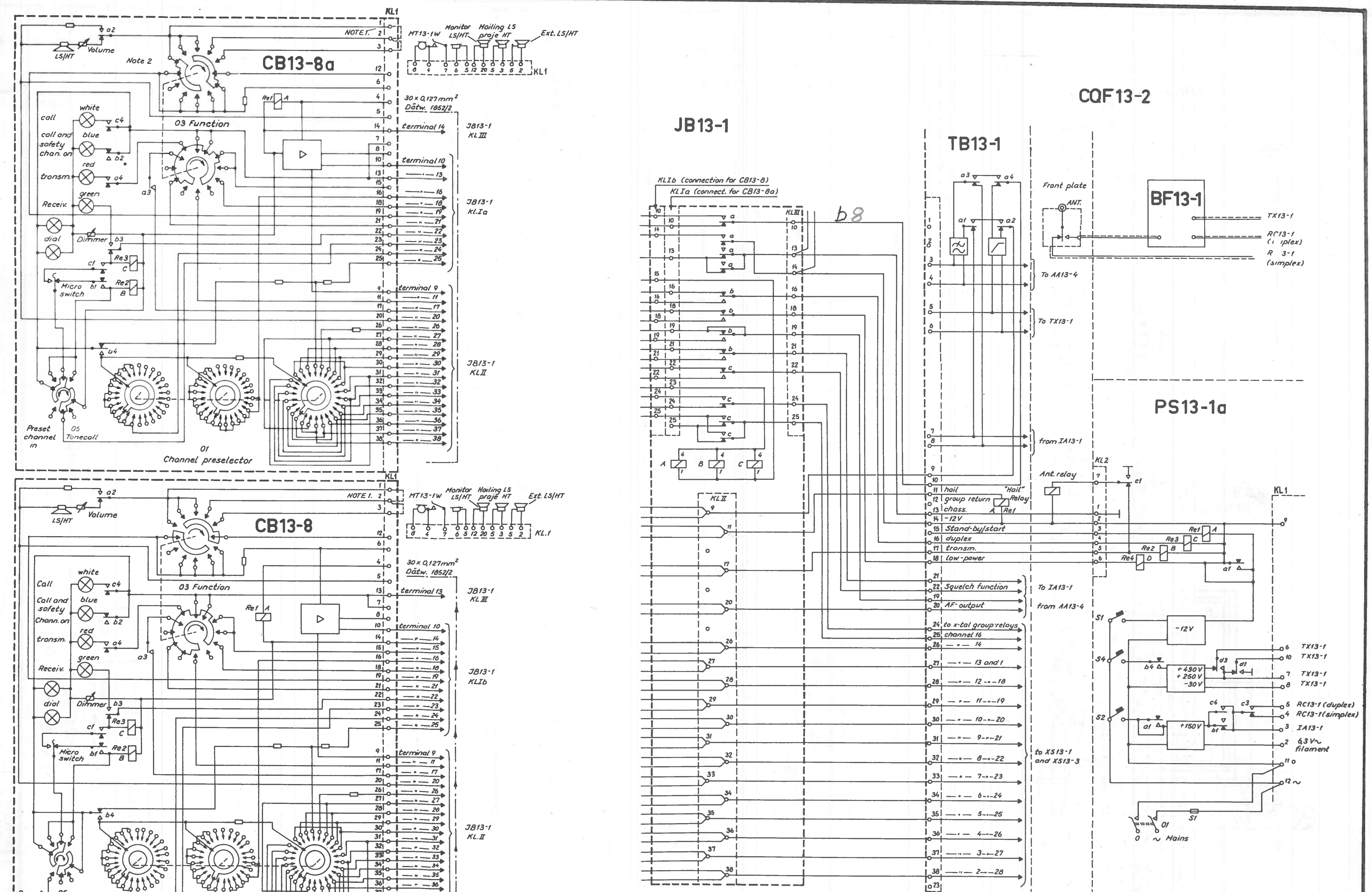
type	no	code	data		type	no	code	data	
	C1	73.5034	100 µF	3 V		R29	82.	2,2 Ω	1 W
	C2..C3	73.5032	50 µF	25 V		R30	82.	2,7 Ω	1 W
	C4..C5	76.5027	0,47 µF	125 V		R31	82.	3,3 Ω	1 W
						R32	82.	3,9 Ω	1 W
	R1	82.5046	560 Ω	1 W		R33	82.	4,7 Ω	1 W
	R2	82.	1 kΩ	1 W		R34	82.	6,8 Ω	1 W
	R3	82.5060	8,2 kΩ	1 W		R35	82.	10 Ω	1 W
	R4	81.5042	270 Ω	1/2 W					
	R5	80.5425	10 Ω	1/4 W		LS	97.5010	Loudspeaker Højttaler	3,2 Ω
	R6	80.5457	4,7 kΩ	1/4 W					
	R7..R8	80.5460	8,2 kΩ	1/4 W					
	R9	80.5461	10 kΩ	1/4 W		MT	MT13-1W	Microtelephone	
	R10	82.5048	820 Ω	1 W					
	R11..R12	83.5028	18 Ω	2 W		01	47.196	Channel preselector	
	R13	83.5025	2x10 Ω	2 W		02	47.190	Volume	
	R14	83.5029	22 Ω	2 W		03	47.197	Function	
	R15	82.	2,7 Ω	1 W		04	47.188	Dimmer	
	R16	81.	8,2 Ω	1/2 W		05	47.189	Channel IN-Tone Call	
	R17	81.	7,5 Ω	1/2 W		06	47.5008	Micro Switch	
	R18	81.	2,7 Ω	1/2 W					
	R19	81.	7,5 Ω	1/2 W		Q1	99.5012	Transistor OC72	
	R20	81.	5,6 Ω	1/2 W					
	R21	81.	3,9 Ω	1/2 W		Re1..Re3	58.5022	Relay	
	R22	81.	2,7 Ω	1/2 W					
	R23	81.	1,8 Ω	1/2 W		T1	60.5036	600Ω/3,5Ω	4 W
	R24	81.	1,2 Ω	1/2 W		T2	60.5008	0,8H 20mA	25 Ω
	R25	81.	1 Ω	1/2 W		T3	60.5017	1200Ω/600Ω	
	R26	83.5204	600 Ω	3 W					
	R27	82.	1,8 Ω	1 W		V1..V6	92.5001	12 V	2 W
	R28	82.	1.8 Ω	1 W					

X10.796



Storno	konst./tegn. KH - GM. 11-5-60 godk. KH 14-9-62 komp. liste X 10796	CONTROL BOX CB 13–8a Master box Fortrinsbox	D 400.334

-1-63



NOTE 1. If extended LS is not installed short circuit terminal 1 and 2
If hailing LS — — — 1 and 3
Hvis ekstra højttaler ikke er tilsluttet, kortslut da klemme 1 og 2
Hvis proje Højttaler — — — 1 og 3

NOTE 2 In the priority box (CB13-8a) the OFF-position of the function switch 03 must be blocked.
I fortrinsboksen (CB13-8a) skal funktionsomskifteren 03's Afbrudt stilling være blokeret.

Storno

tegn. EBN/BM 12-10-62

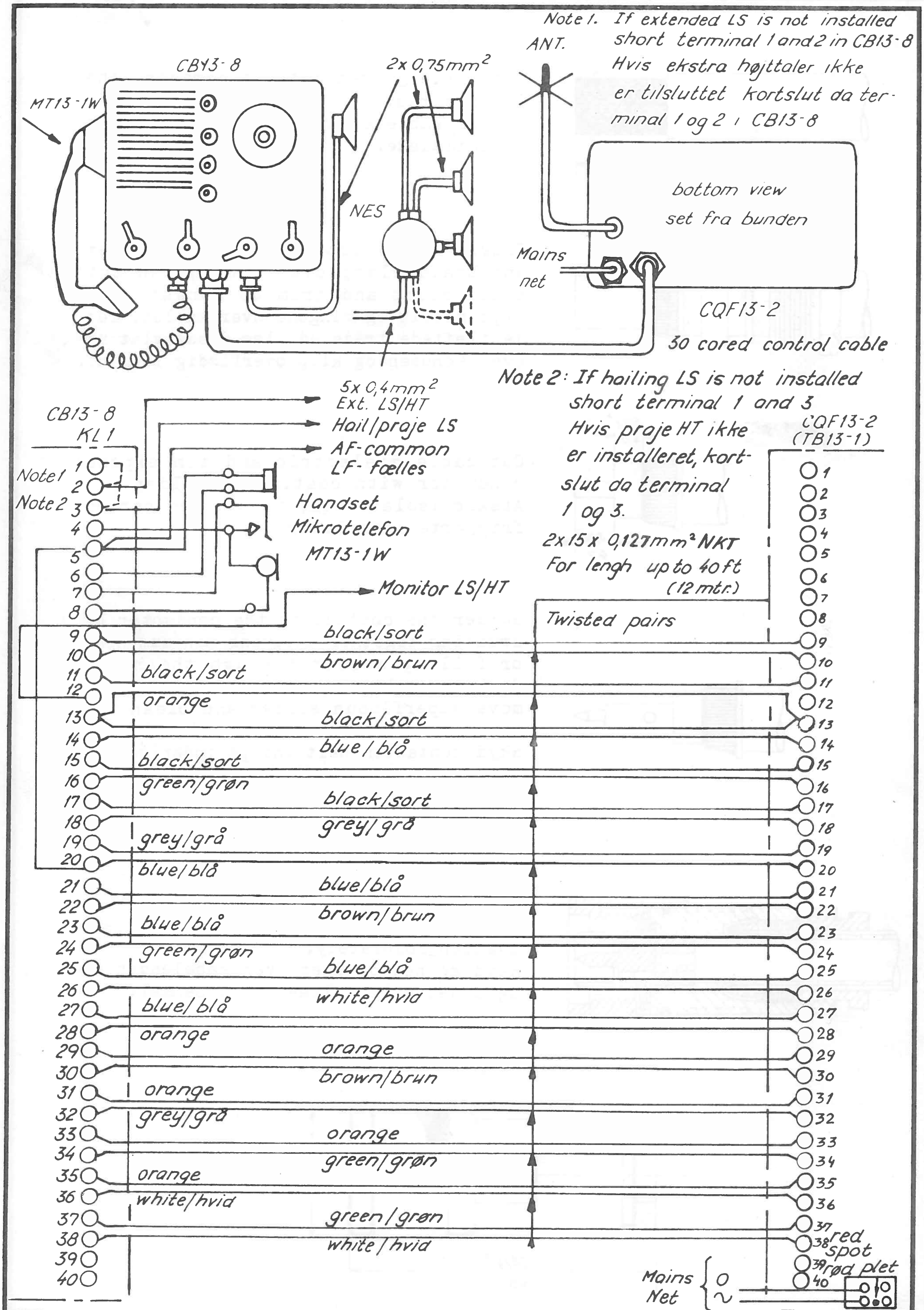
godk. KH

komp. liste

MARITIME VHF RADIOTELEPHONE with two Control Boxes CB13-8/8a

CQF13-2

D 400.189



konstr./tegn. II/BØ 3-4-63

godk.

komp.liste

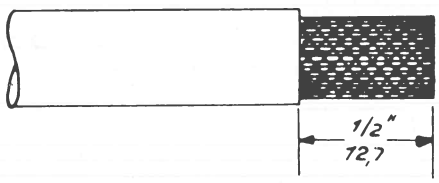
Storno

MARINE EQUIPMENT

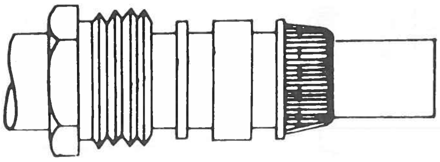
MARINESTATION CQF13-2

Installation diagram

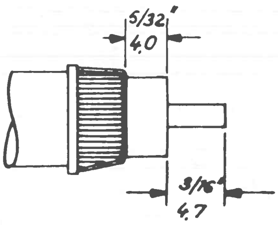
D400.379



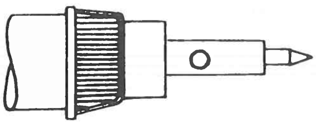
Cut cable jacket without damaging the braid wires.
Afskær kablets kappe uden at beskadige skærmtrådene.



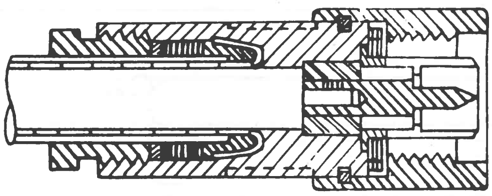
Insert clamp nut, washers, gasket and braid clamp over cable, fan out braid clamp and trim to lenght.
Skyd møtrik og ringene over kablet, ret de flettede tråde ud, læg disse glat ud over konusen og klip overflødig tråd af.



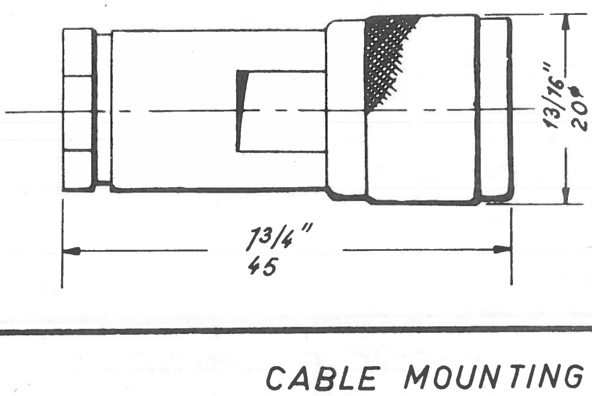
Cut cable dielectric and tin exposed conductor with coating of solder.
Afskær isolationen, fortin den herved frigjorte inderleder.



Solder the contact to the conductor by sweating together applying minimum heat or fill up solder through the hole. Cool the soldering point in spirit, remove superfluous solder and clean the contact.
Skyd kontakten helt ind på inderlederen og fastlod denne ved mindst mulig varme, ev. efterfyld med tin igennem hullet. Afkøl lodningen med sprit, fjern overflødigt tin og rens kontakten.



Insert assembly into connector body and tighten moderately.
Skyd konnektorhuset over kabelenden og skru det hele tilpas hårdt sammen.



Storno	konstr./tegn. O.K. E.O. 4-5-59 godk. komp.liste	CABLE MOUNTING KABELMONTAGE -N-CONNECTOR: UG-21B/U CABLE: RG8/U-RG11/U	I 9912

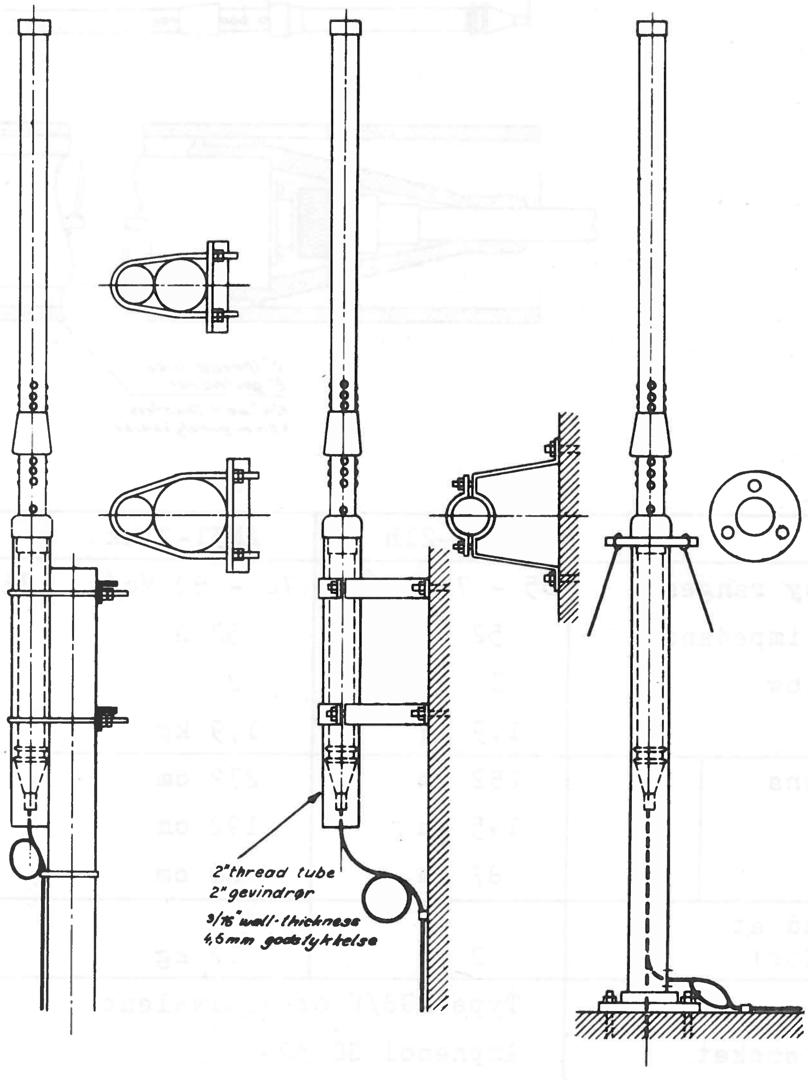
Storno

OMNIDIRECTIONAL BROADBAND ANTENNA ANx1-21

General

STORNO antenna type ANx1-21 is an omnidirectional broad-band antenna of novel design. This half-wave antenna is constructed generally for use with a fixed station in VHF mobile or maritime systems. Light weight and low wind resistance permit semi mobile use.

The polarization is vertical with a radiation pattern circular in the horizontal plane. The antenna is equally suited for transmission and reception.



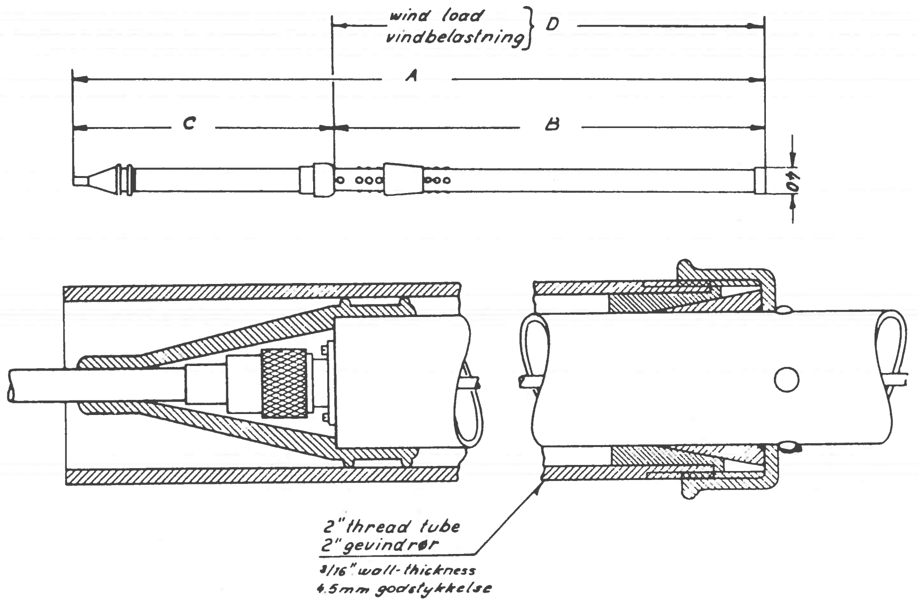
Construction

The radiating element is a half wavelength long 1,5" aluminium tube mounted on a low loss heavy duty ceramic insulator. No ground plane elements are used. The lower part of the antenna is used also for fixing it to the mast and contains an impedance transformer matching the antenna to 52 ohm.

Installation

The installation appears from the drawings. The antenna is intended for erection on an ordinary 2" pipe, and special fittings are supplied.

Technical Specifications



		AN31-21h	AN31-21hk	AN31-21kl	AN11-21
Frequency ranges		65 - 78 Mc/s	70 - 82 Mc/s	75 - 88 Mc/s	145-175 Mc/s
Nominal impedance		52 Ω	52 Ω	52 Ω	52 Ω
WSWR below		2	2	2	1,5
Weight		1,9 kg	1,9 kg	1,9 kg	1,9 kg
Dimensions	A	282 cm	272 cm	254 cm	138 cm
	B	195 cm	192 cm	183 cm	98 cm
	C	87 cm	80 cm	71 cm	40 cm
Wind load at 14 Beaufort		12 kg	12 kg	12 kg	6,5 kg
Feeder		Type RG8/U or equivalent			
Coaxial socket		Amphenol SO 329			
Connector		Amphenol PL 259			