STORNOPHONE 700
MAINTENANCE MANUAL
VOLUME I

Volume I

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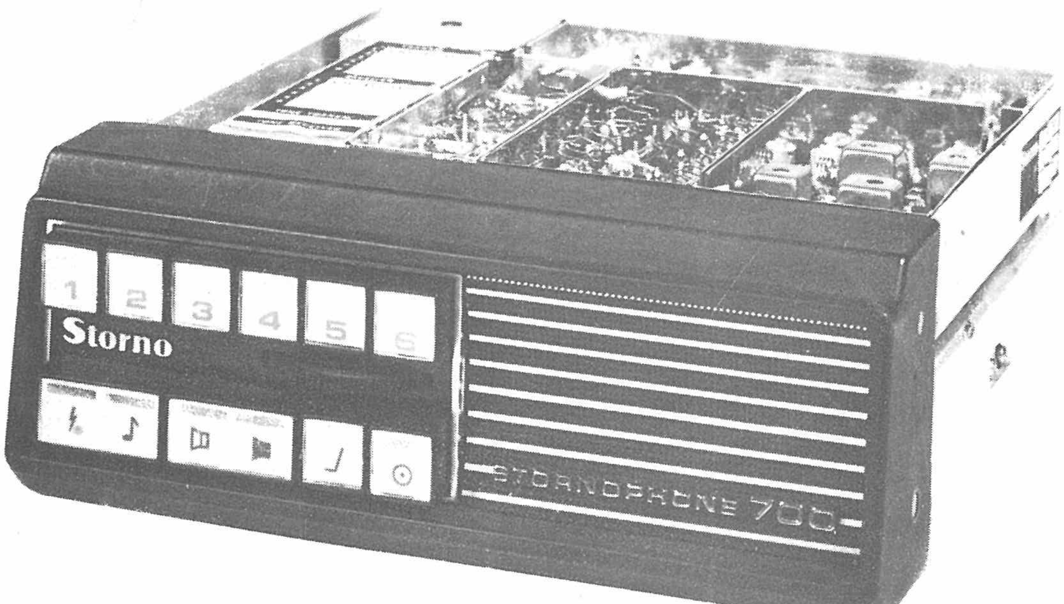
Photo CQM700	60.138-E1
Mechanical layout CQM700	D401.873/2

Service Coordination
2 - 79

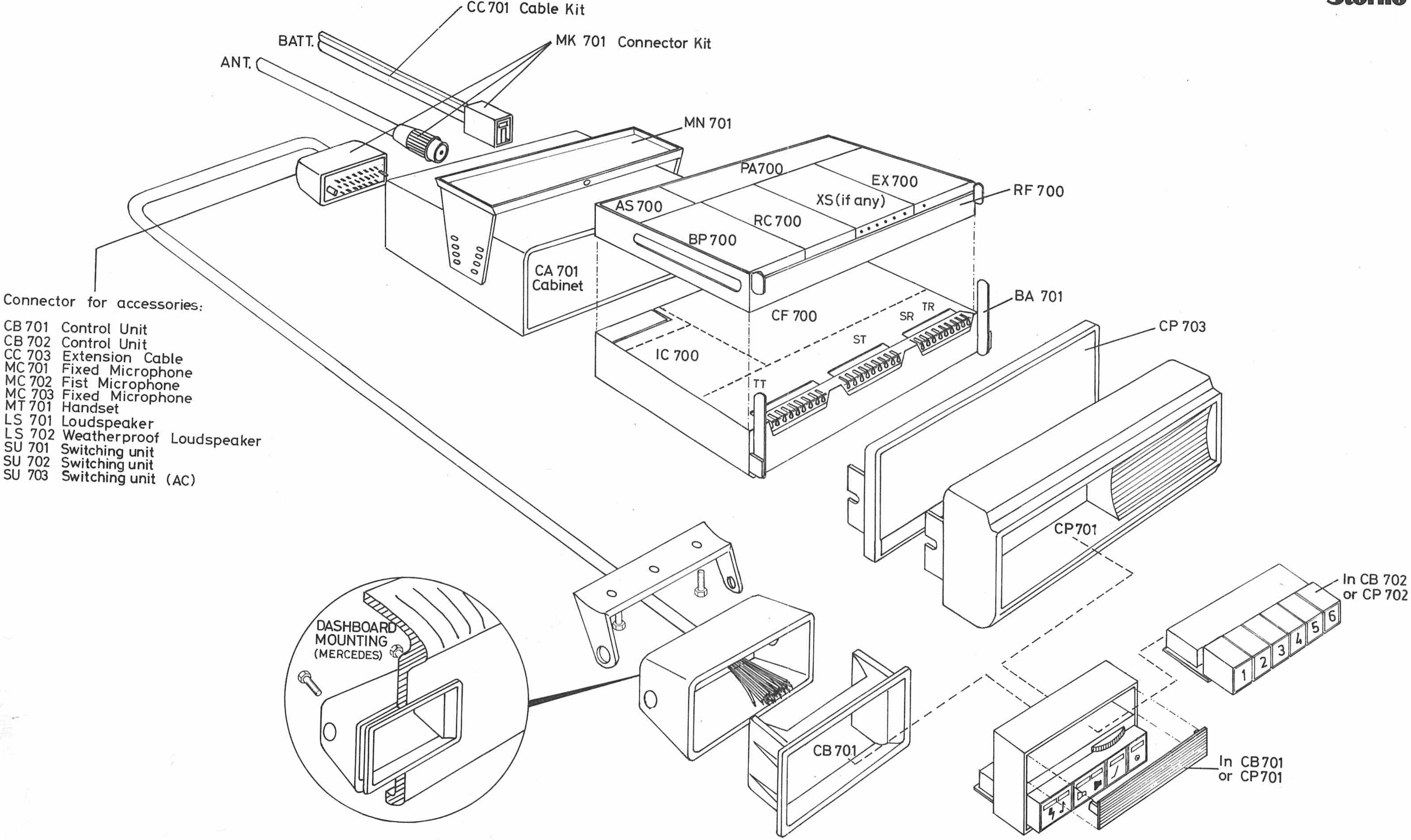
Storno



MOBILE RADIOTELEPHONE CQM700

60.138-E1

Storno



Mechanical lay-out, CQM700

D 401.873/2

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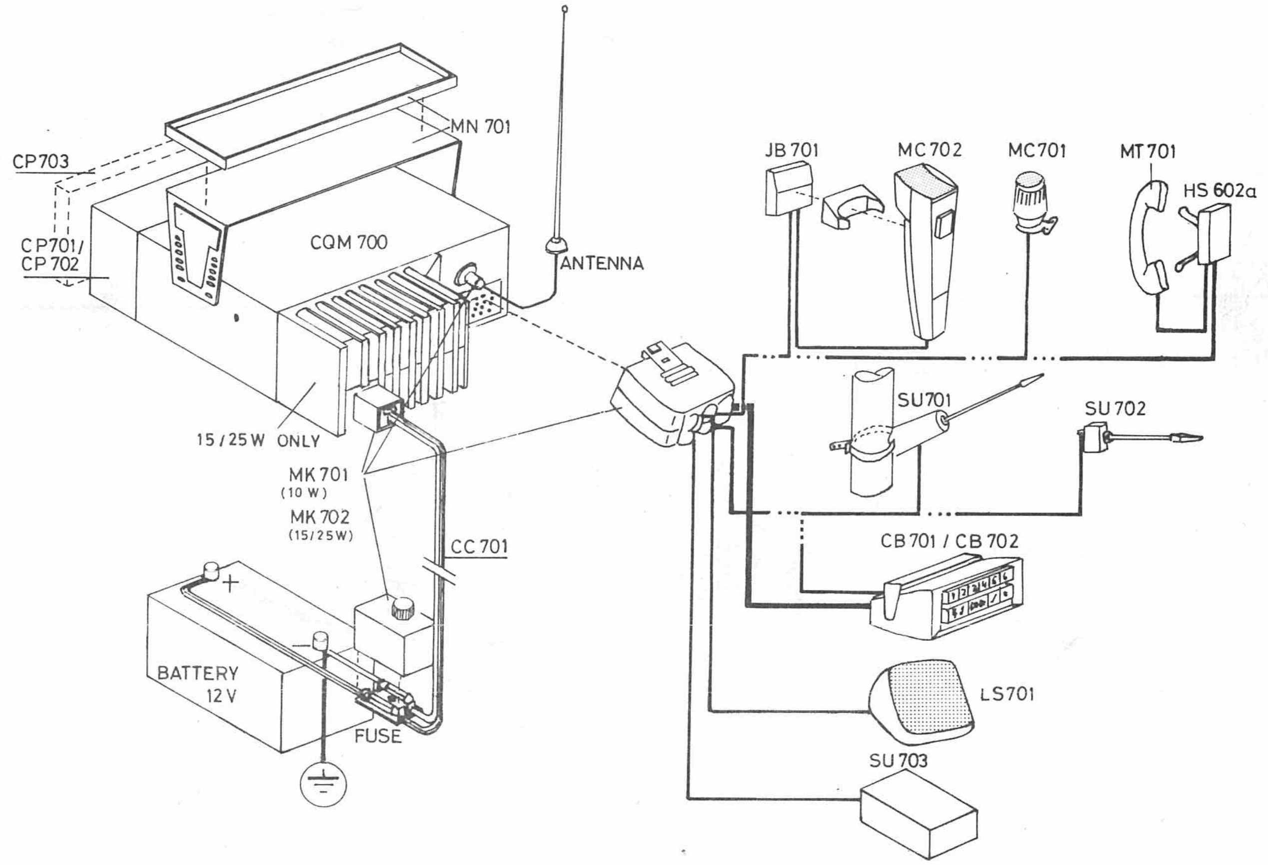
Section 2

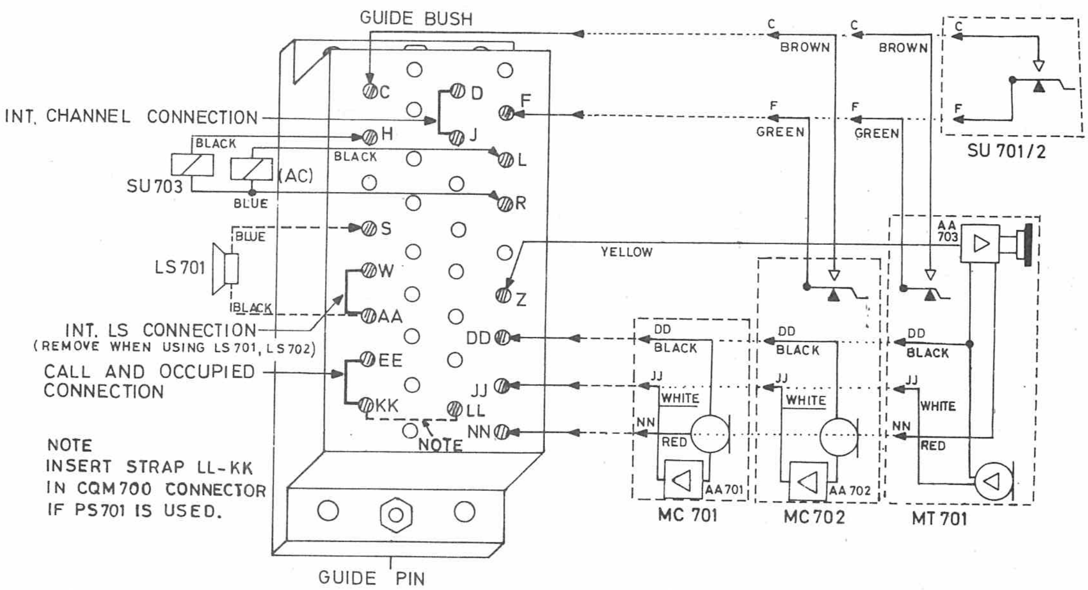
TITLE		Code
CQM700	Installation 1 - 4	60.205-E3
CQM713D		
	Installation with CB704	D402.077/5
CQM763D		
CQM700D	Installation with CB2706	D402.078/3
CQM700D	Installation with CP705	D402.104/3
		D402.118/3
CQM700a	Installation	D402.450
CQM713P3	Installation	D402.494
MT704	Installation	D402.507

Storno

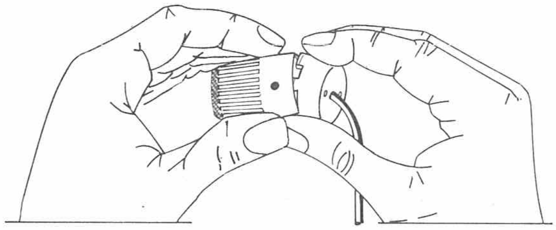
CONNECTING ACCESSORIES TO CQM700

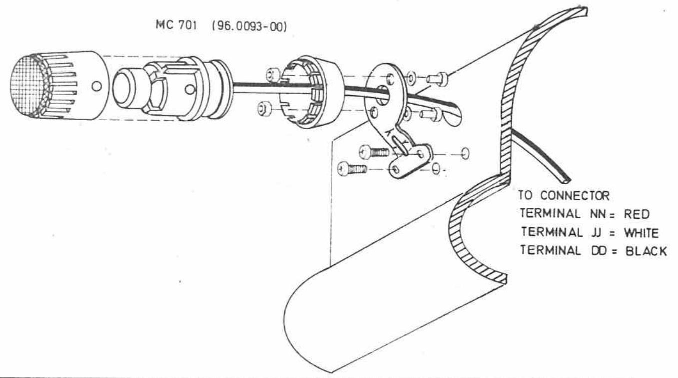


ACCESSORY CONNECTIONS TO MULTI-WIRE CONNECTOR IN CQM700

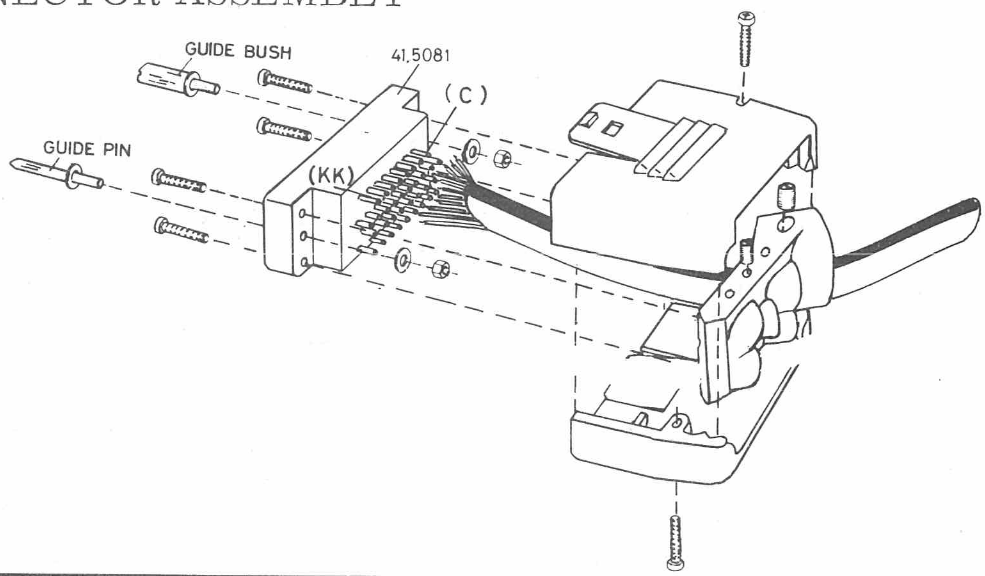


DISASSEMBLING MICROPHONE MC701

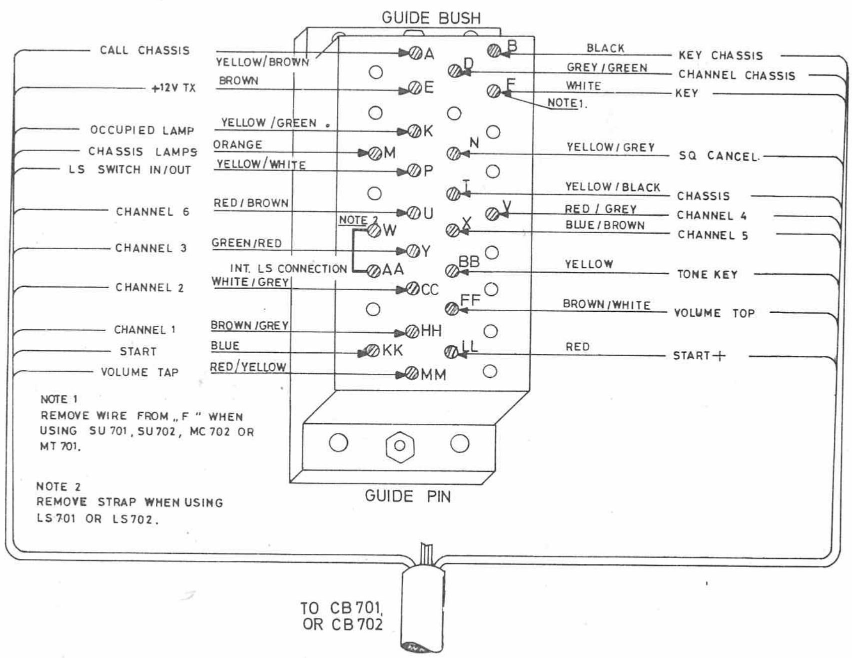




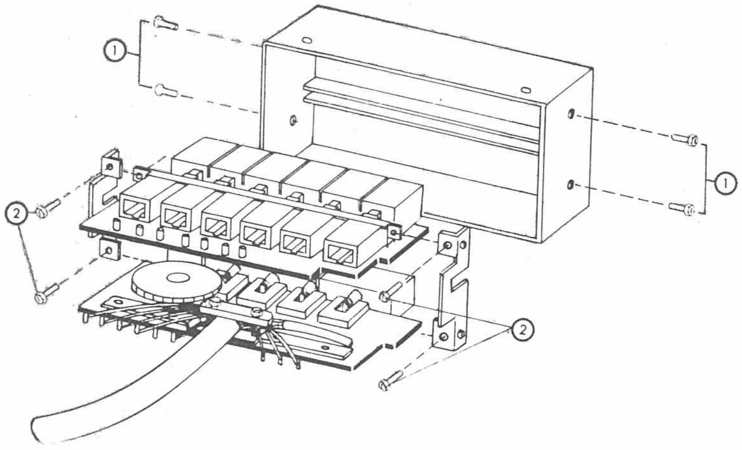
CONNECTOR ASSEMBLY

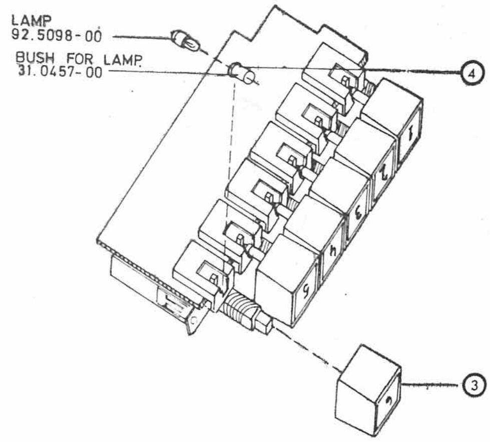


CONNECTING CB700 CONTROL CABLE TO MULTIWIRE-WIRE CONNECTOR IN CQM700

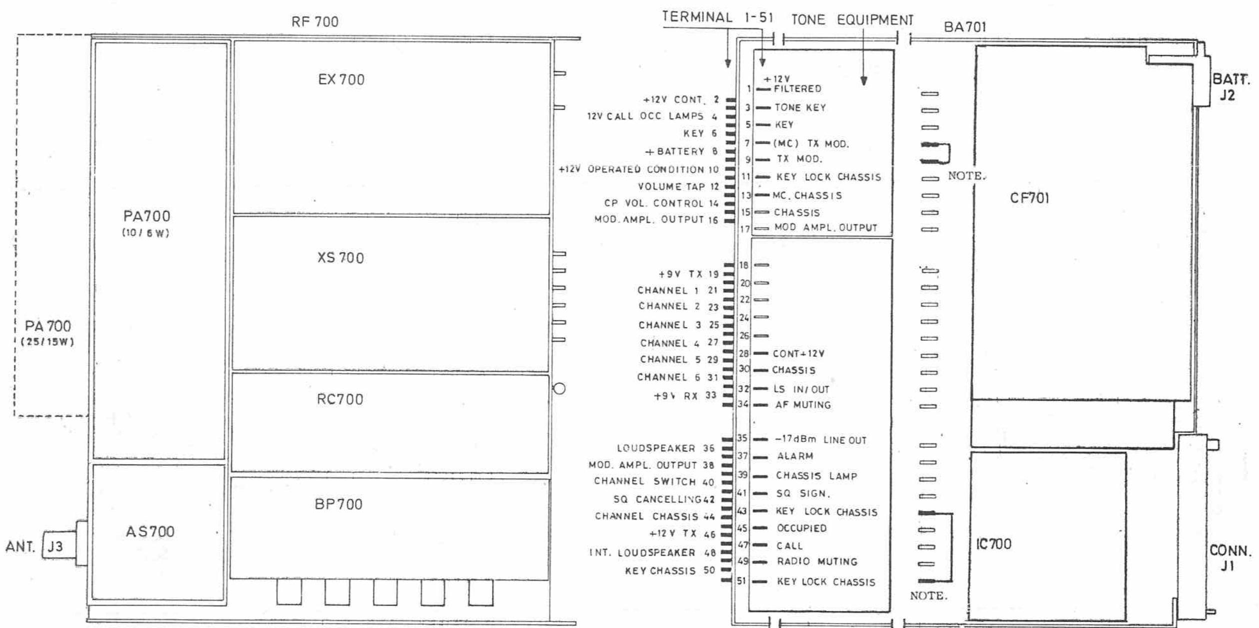


REPLACING INDICATOR LAMPS





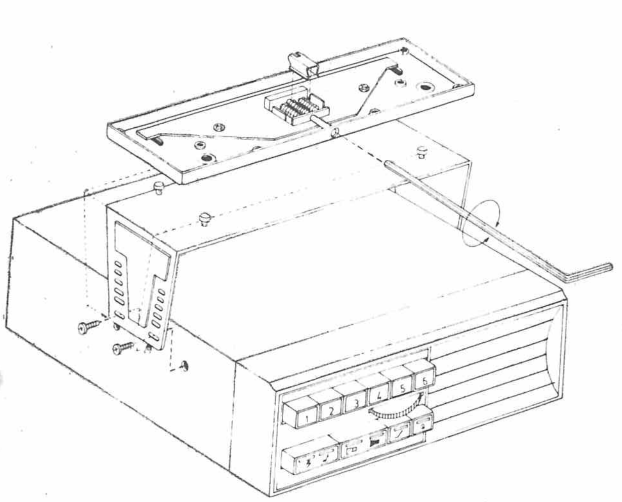
MODULE LAY-OUT CQM700



CQM 710 (BP711, RC711, EX711, PA710, AS711, XS701, IC703/4, CF701)
CQM 730 (BP731, RC731, EX731, PA730, AS731, XS701, IC703/4, CF701)
CQM 760 (BP761, RC761, EX761, PA760, AS761, XS700, IC701/3, CF701)

NOTE. STRAP ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT
NOTE. STRAPNING ANVENDES KUN I RADIOTELEFON UDEN TONEUDSTYR

MOUNTING FRAME MN701

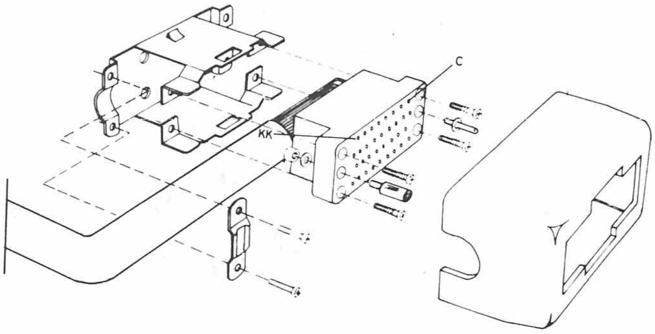


Mounting Frame type MN701 is designed for installing CQM700 equipment. The holes in the Mounting Frame are so arranged that they allow for a total of 36 mounting positions.

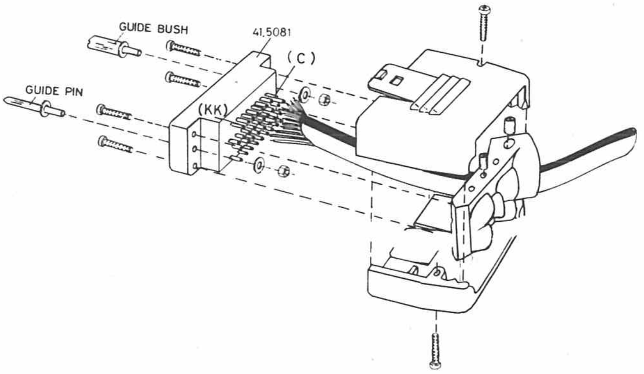
With an Allen wrench, adjust the Safety Lock to the point where it will release the CQM cabinet when bumped or jarred in a traffic accident.

Where the Mounting Frame is installed in a lorry or other vehicle that is exposed to shocks greater than 5 g, the Safety Lock should be blocked by inserting the clip "A" as shown in the illustration.

CONNECTOR AND EXTENTION CABLE ASSEMBLY CC703

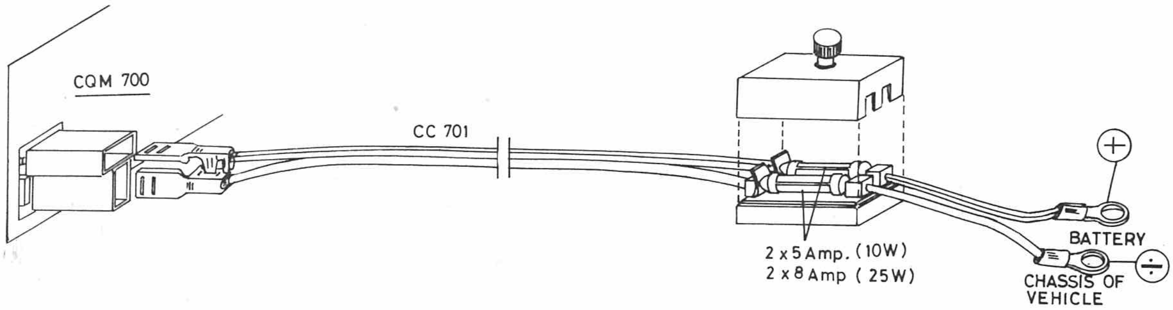


CONNECTOR ASSEMBLY 41.0191-01

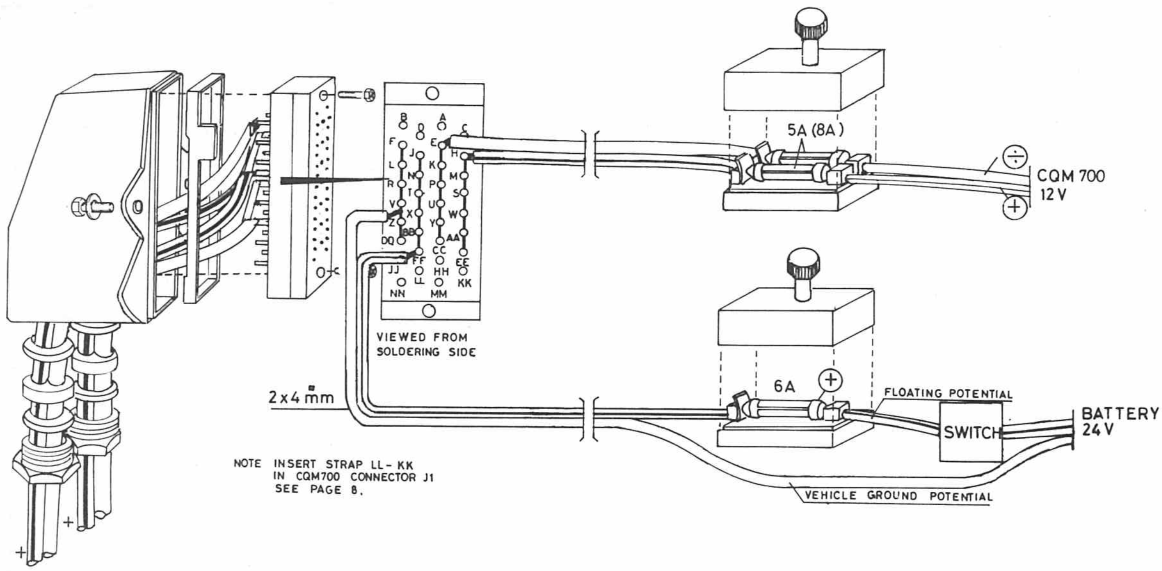


Terminal A	Yellow/Brown	Terminal V	Grey/Red
Terminal B	Black	Terminal W	White/Red
Terminal C	Blue/Red	Terminal X	Blue/ Brown
Terminal D	Green-Grey	Terminal Y	Green/Red
Terminal E	Brown	Terminal Z	Green/White
Terminal F	White	Terminal AA	Grey
Terminal H	Black/Red	Terminal BB	Yellow
Terminal J	Black/Green	Terminal CC	Grey/White
Terminal K	Yellow/Green	Terminal DD	Green/Brown
Terminal L	Blue/Green	Terminal EE	Blue/Yellow
Terminal M	Orange	Terminal FF	Brown/White
Terminal N	Yellow/Grey	Terminal HH	Brown/Grey
Terminal P	Yellow/White	Terminal JJ	Green
Terminal R	White/Blue	Terminal KK	Blue
Terminal S	Violet	Terminal LL	Red
Terminal T	Black/Yellow	Terminal MM	Red/Yellow
Terminal U	Red/Brown	Terminal NN	Blue/Grey

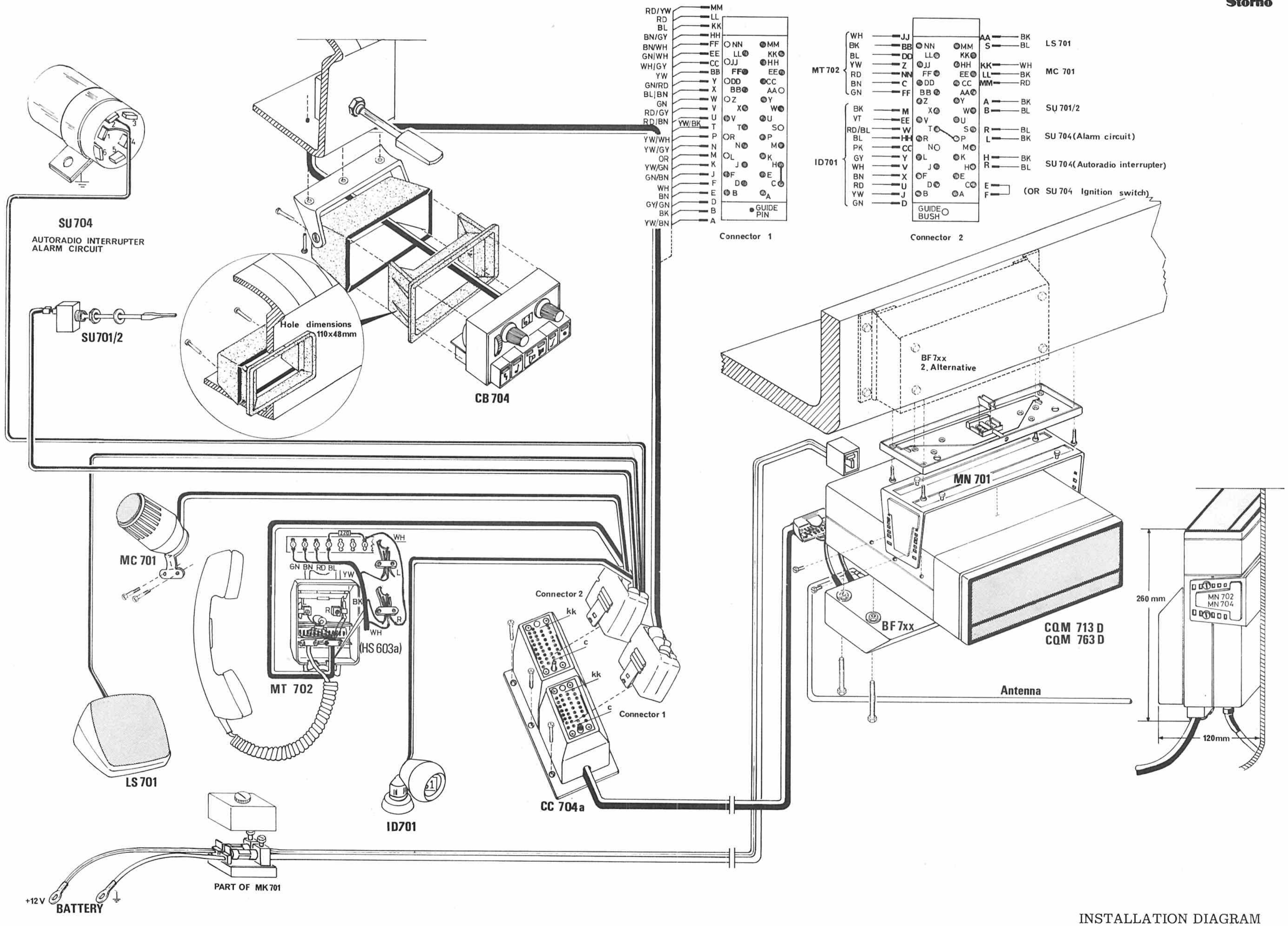
BATTERY CABLE FOR 12V INSTALLATIONS



WIRING OF CONNECTOR TO PS701 FOR 24V INSTALLATIONS



Storno



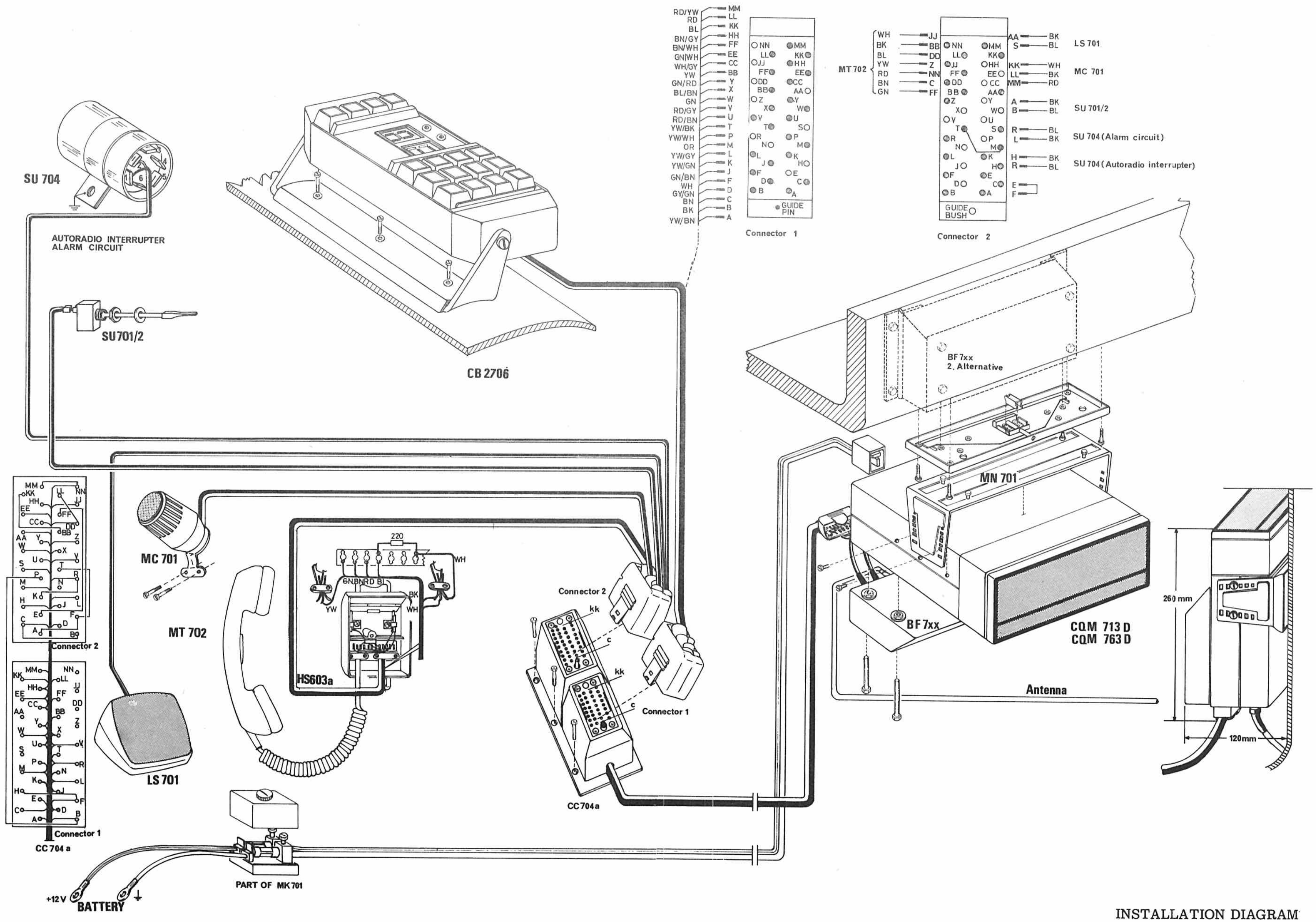
Storno

INSTALLATION DIAGRAM

CQM713D
CQM763D WITH CB704

D402.077/5

Storno

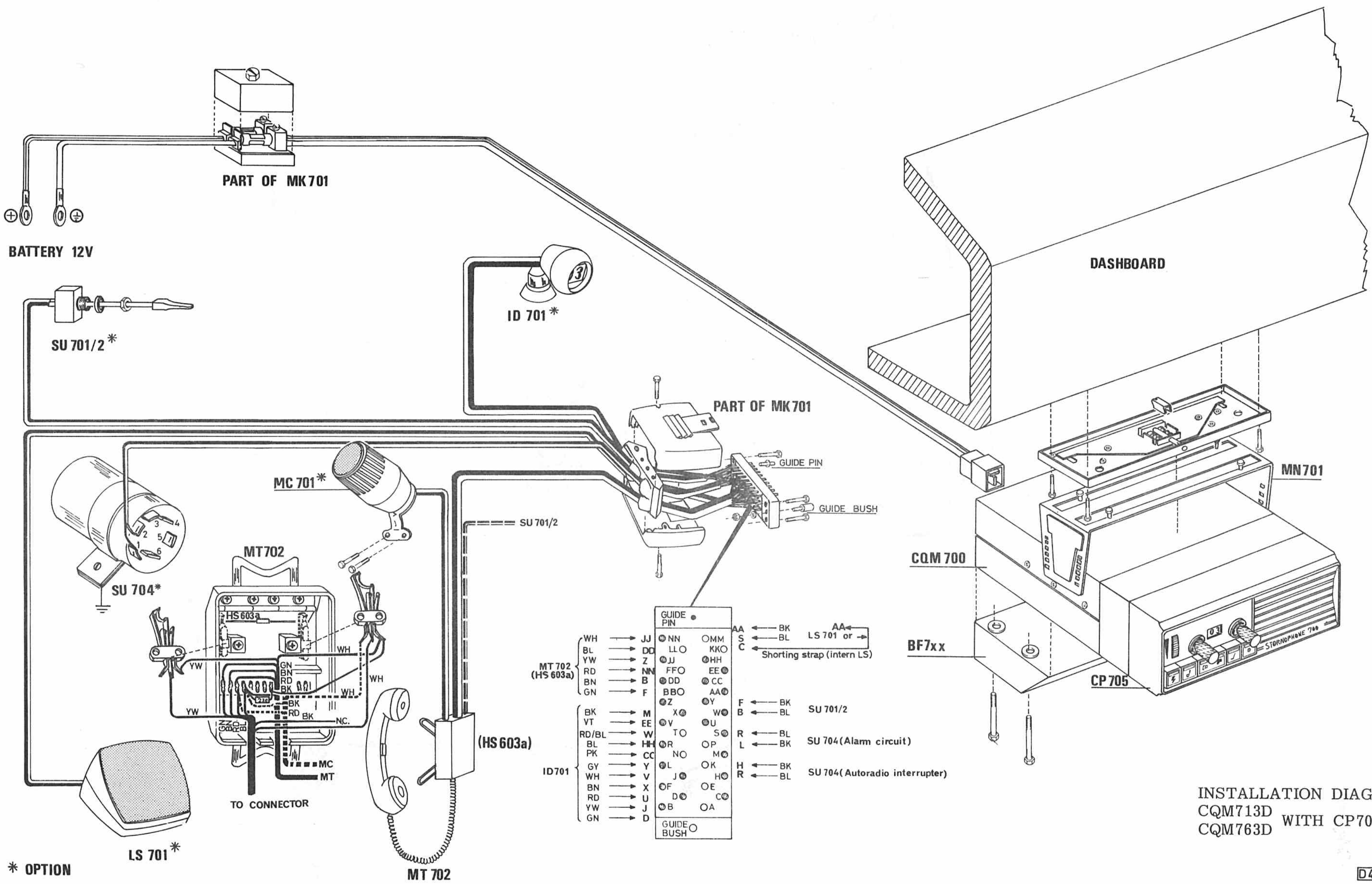


INSTALLATION DIAGRAM

CQM713D
CQM763D WITH CB2706

D402,076/3

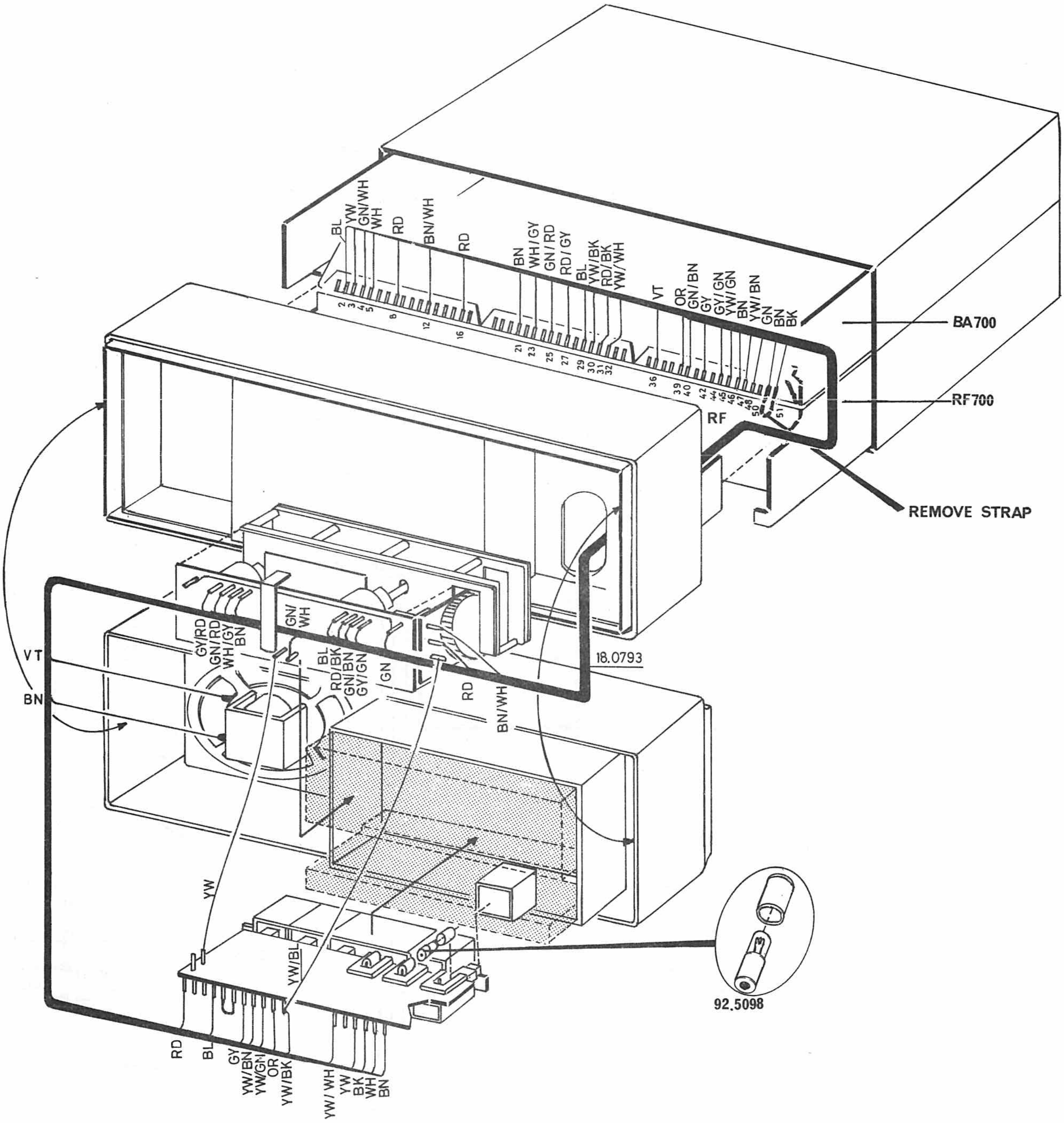
Storno



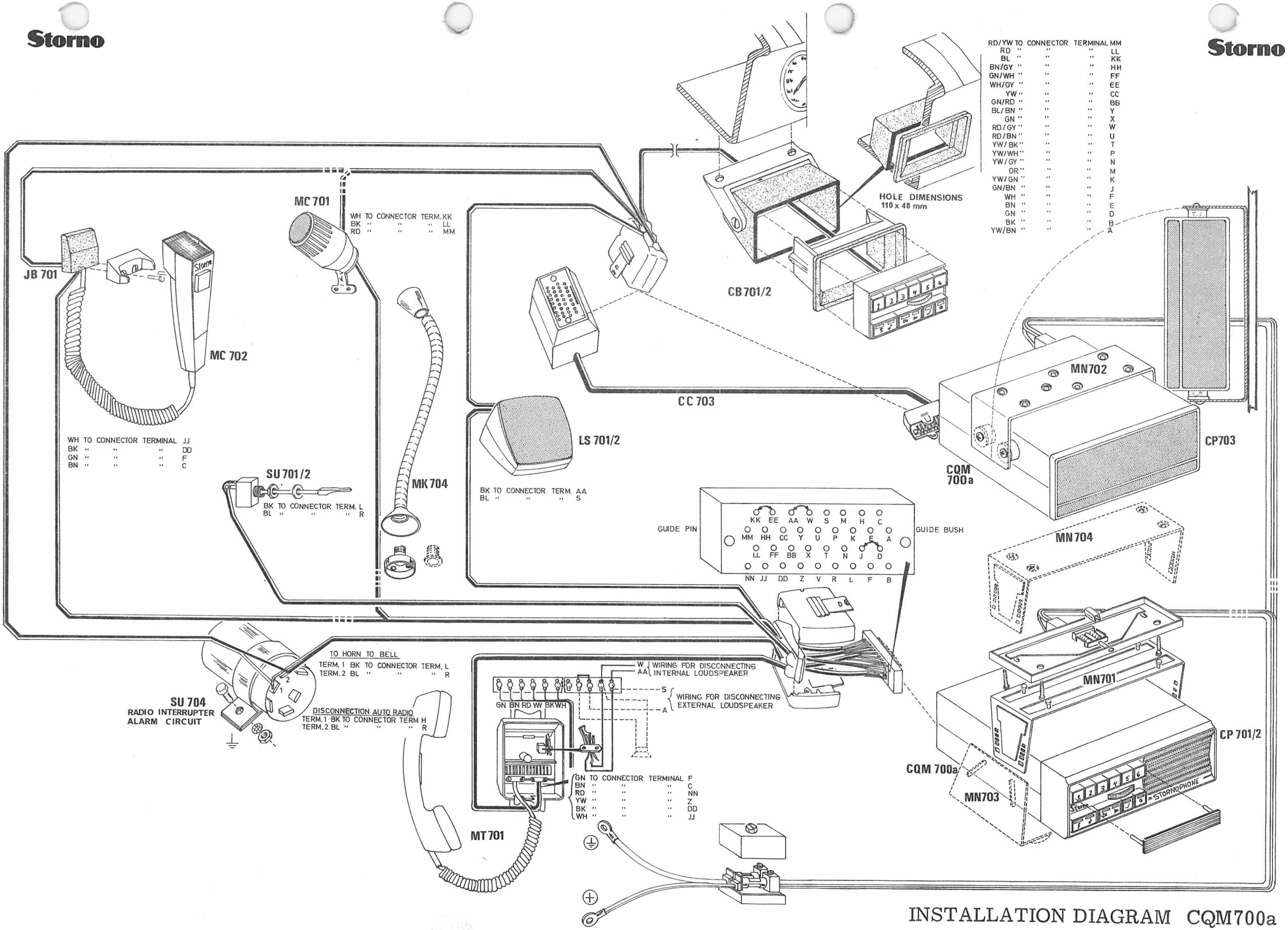
* OPTION

INSTALLATION DIAGRAM
CQM713D
CQM763D WITH CP705

D402.104/3

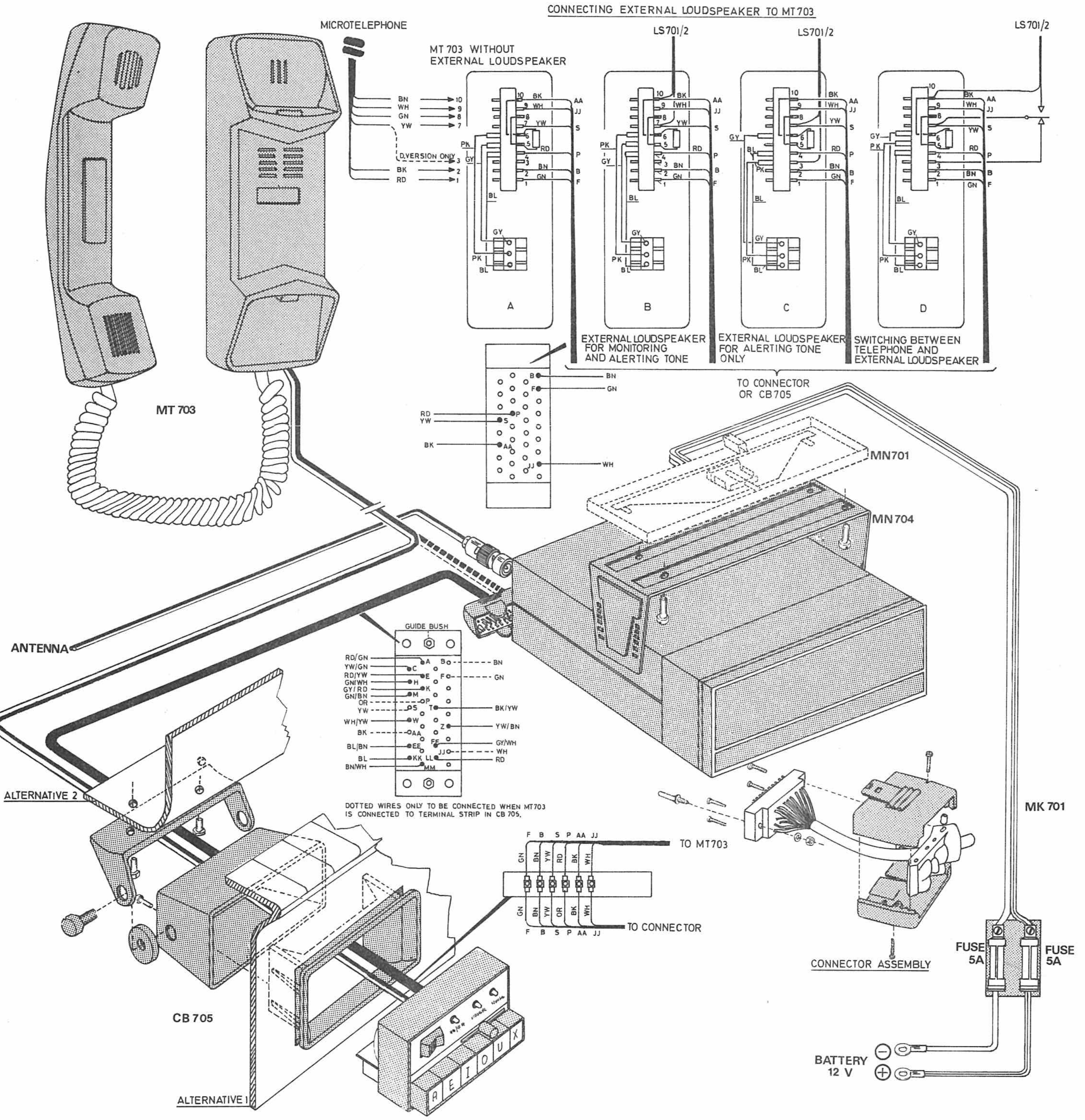


ASSEMBLY AND WIRING OF CONTROL HEAD
CQM700D

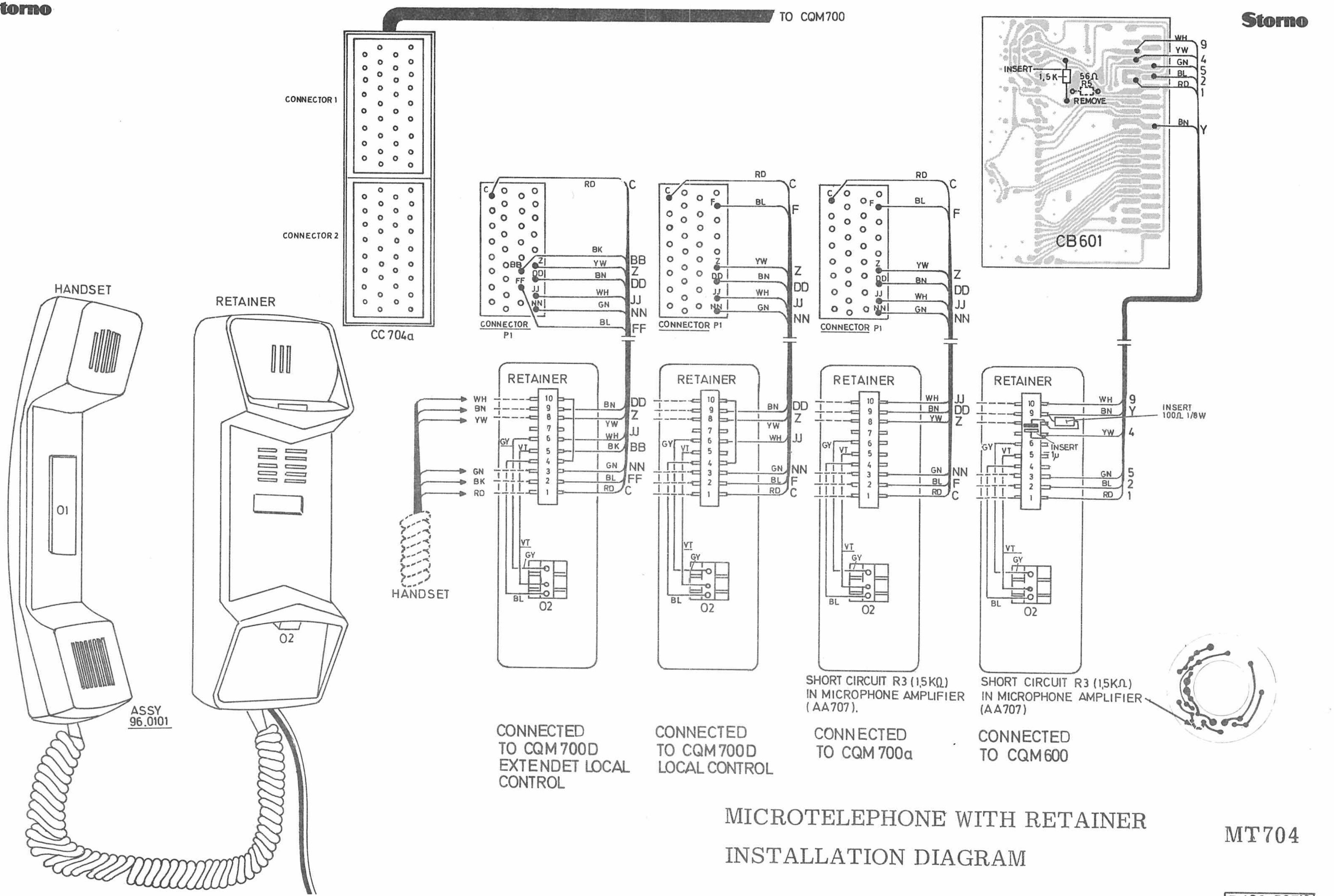


INSTALLATION DIAGRAM CQM700a

D402. 450


CONNECTING EXTERNAL LOUDSPEAKER TO MT703
MICROTELEPHONE
MT 703 WITHOUT EXTERNAL LOUDSPEAKER
LS701/2
LS701/2
LS701/2
D.VERSION ONLY
A
B
C
D
EXTERNAL LOUDSPEAKER FOR MONITORING AND ALERTING TONE
EXTERNAL LOUDSPEAKER FOR ALERTING TONE ONLY
SWITCHING BETWEEN TELEPHONE AND EXTERNAL LOUDSPEAKER
TO CONNECTOR OR CB705
MT 703
MN701
MN704
ANTENNA
GUIDE BUSH
DOTTED WIRES ONLY TO BE CONNECTED WHEN MT703 IS CONNECTED TO TERMINAL STRIP IN CB 705.
ALTERNATIVE 2
TO MT703
TO CONNECTOR
MK 701
CONNECTOR ASSEMBLY
FUSE 5A
FUSE 5A
BATTERY 12 V
CB 705
ALTERNATIVE 1

Storno



MICROTELEPHONE WITH RETAINER
INSTALLATION DIAGRAM

MT704

D402.507/2

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Section 3

TITLE		Code
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	Adjustment Procedure 1 - 8	60.177-E1
	Radio Assembly RF710	D401.827
	Basic Assembly BA701	D401.826
CQM713D	Technical Specifications	60.284-E1
	General Description	60.285-E1
	Circuit Description	60.285-E1
	Adjustment Procedure	60.286-E1
	Radio Assembly RF713	D402.232/2
	Basic Assembly BA702	D402.233
CQM713D	Technical Specifications	60.284-E2
	General Description	60.285-E2
	Circuit Description	60.391-E1
	Adjustment Procedure	60.286-E2
	Radio Assembly RF713	D402.232/2
	Basic Assembly BA704	D402.388/2
CQM710a	Specifications	60.306-E1
	General Description	60.307-E1
	Adjustment Procedure	60.308-E1
	Radio Assembly RF714	D402.390
	Basic Assembly BA703, BA704	D402.388/2
CQM713P3	Specifications	60.342-E2
	General Description	60.343-E2
	Functional Diagram	D402.559
	Adjustment Procedure	60.344-E1
	Testpoints and Adjustment	D402.524
	Components	D402.525

CQM710
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS152A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range
146 - 174 MHz

Min. Channel Separation
CQM713: 20 kHz or 25 kHz
CQM714: 12.5 kHz

Max. Frequency Deviation
CQM713: ± 4 kHz or ± 5 kHz
CQM714: ± 2.5 kHz

Frequency Stability
Meets government specifications

Max. VHF Bandwidth
1 MHz

Number of Channels
Max. 6

Antenna Impedance
50 Ω

Temperature Range
Operating range: -25^{o} - $+50^{o}$C
Functioning range: -30^{o} - $+60^{o}$C

Dimensions
Locally controlled version: 180 x 190 x 68 mm
Extended local control: 180 x 160 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight
Locally controlled version: 2.1 Kg
Extended local control: 1.9 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output
10 W or 6 W (adjustable)

Type of Modulation
Phase

AF Response
6 dB/octave preemphasis
CQM713: 300-3000 Hz
+0/−1.5 dB (+0.5/−3 dB)
CQM714: 300-2500 Hz
+0/−1.5 dB (+0.5/−3 dB)

Modulation Distortion (measured with deemphasis)
3% (5%)

Modulation Sensitivity
220 mV e.m.f. (600 Ω) ± 2 dB

AF Input Impedance
560 Ω

Adjacent Channel Selectivity
Attenuated to meet government specifications

FM Hum and Noise (measured without deemphasis)
CQM713: 50 dB (40 dB)
CQM714: 45 dB (38 dB)

Spurious Radiation (FTZ)
Less than 0.2 μW

Harmonic Radiation (FTZ)
Less than 0.2μW (2μW)

RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD EIA

0.6 μV (0.9 μV)

Squelch

Electronic, adjustable

Adjacent Channel Selectivity EIA

CQM713: 90 dB (80 dB)
CQM714: 80 dB (75 dB)

Adjacent Channel Selectivity FTZ, MPT

CQM713: 90 dB (80 dB)
CQM714: 85 dB (75 dB)

Intermodulation attenuation EIA

CQM713: 80 dB (75 dB)
CQM714: 78 dB (75 dB)

Intermodulation attenuation FTZ, MTP

CQM713: 75 dB (70 dB)
CQM714: 78 dB (75 dB)

Blocking MPT

190 mV (100 mV)

Spurious Radiation

Less than 0.5 nW (2 nW)

Spurious Response Attenuation

90 dB (80 dB)

AF Output Power EIA

2 W (load 5 Ω)

AF Distortion

CQM713: 3% (7%)
CQM714: 4% (7%)

AF Response

CQM713: −6 dB/octave from 300-3000 Hz
+0/−1.5 dB (+0.5/−3 dB)
CQM714: −6 dB/octave from 300-2500 Hz
+0/−1.5 dB (+0.5 dB/−3 dB)

Hum and Noise, squelched

80 dB (60 dB)

Hum and Noise, unsquelched

CQM713: 50 dB (45 dB)
CQM714: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

CURRENT CONSUMPTION AT 13.6 V

Stand by: 160 mA (190 mA)
Transmit: 2.7 A (3.1 A)
Receive AF output 2W: 470 mA (540 mA)

Storno

CQM710 GENERAL DESCRIPTION

Introduction

The Stornophone CQM710 radiotelephone is a mobile transmitter/receiver for simplex operated FM radio communication on the 146 to 174 MHz frequency band.

The CQM710 comes in a choice of channel spacings:

CQM713 for 20 or 25 kHz channel spacing
CQM714 for 12.5 kHz channel spacing

For both versions there is a choice of 6, 10 or 25 W RF output power.

There are also two mechanically different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Each radio set can be equipped for either single or multichannel service. Multichannel sets will have a channel selector arranged as a row of push buttons on the control panel, accommodating up to 6 channels. Choice of channels (frequencies) must naturally take into account the RF bandwidth of the radiotelephone, which is 1 MHz.

Construction

The radio chassis slides into the cabinet from the front and is held in place by four screws from the rear of the cabinet. The chassis consists of two circuit panels hinged onto the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF711, contains all the circuits which are dependent upon channel frequencies. These are:

antenna filters
receiver VHF circuits
crystal selector unit, where included
exciter
transmitter power output amplifier

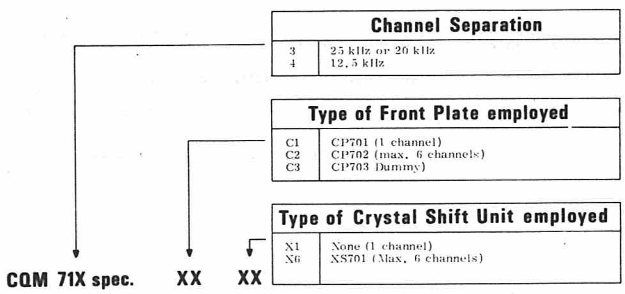
The lower circuit panel, designated BA701, contains those units common to all the frequency bands within the CQM710 programme:

audio amplifier
intermediate frequency amplifier
squelch circuit
voltage regulators
tone equipment, where included

The solid-state circuitry is built up as functional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:



Control Equipment

The locally controlled CQM710 will have one of the following front panels:

CP701 Front panel with controls and built-in speaker. This panel has no channel selector, limiting the equipment to single-channel service.

CP702 Front panel like CP701 with the addition of 6 push buttons for multichannel service.

The CQM710 for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703. One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB701 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone. This control unit has no channel selector (single-channel service).

CB702 Control unit similar to CB701, and containing 6 push buttons for the channel selector (multichannel service).

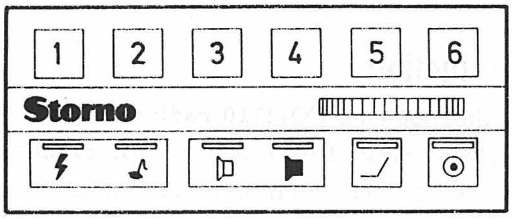
Where more than one RF channel is required (multichannel operation), the radiotelephone must be fitted with one of the following crystal switching units:

XS701 Channel selector unit for a maximum of 6 channels.

XS702 Channel selector unit for a maximum of 4 channels with temperature compensation for operation in extremely cold climates.

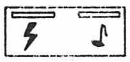
Operating Controls

The controls located on the front panel are as shown:



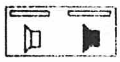
CP 702 FRONT PANEL

Push buttons for channel selection.



Tone button and lamp indication when the channel is engaged (in equipment with built-in tone transmitters).

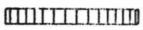
Transmit button and transmit indicator lamp (in radiotelephones without built-in tone transmitters).



Button for switching the loudspeaker on and off, provided with a lamp indicating when a tone call is received. (This button is only used in conjunction with tone equipment).

Squelch button for overriding the squelch function.

ON/off switch and indicator lamp.


Volume control

Notice:
For radiotelephones with built-in tone transmitters an external keying device (e.g. a steering column switch or microphone button) must be employed as the transmitter key, since the regular button on the front panel is used for keying the tone transmitter.

Storno

Accessories

Accessories available for the CQM710 series radiotelephones are listed in this section. Some of them, such as installation materials, antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier

MC702 Fist microphone with built-in amplifier, transmit button and retainer.

MC703 Fixed microphone for mounting on steering column.

MT701 Handset with built-in amplifier and transmitter keying switch.

All of the above are supplied with cables terminated in solderless crimp pins for insertion in a special multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit, consisting of 2 flexible metal tubes (length 20 and 35 cm), is available.

Antenna

AN19-5 1/4 wavelength whip antenna for the 146 to 174 MHz frequency band. 50 ohm impedance matches Stornophone CQM710. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM710 radio set will require some or all of the following installation kits:

MN701 Mounting frame for radio cabinet

CC701 Cable kit containing battery cable and antenna cable necessary for installing the radiotelephone.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with the battery cables.

MK702 Mounting kit similar to MK701, to be used when installing 25 W transmitters.

For extended local control the distance between control unit and radio set may be increased by inserting:

CC703 Extension cable kit with connectors.

Loudspeakers

When using the extended local control system it is necessary to install an external loudspeaker. The following types are available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable terminated in solderless crimp pins to be inserted in the accessories connector.

LS702 Weatherproof version of loudspeaker.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for dashboard mounting.

SU703 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

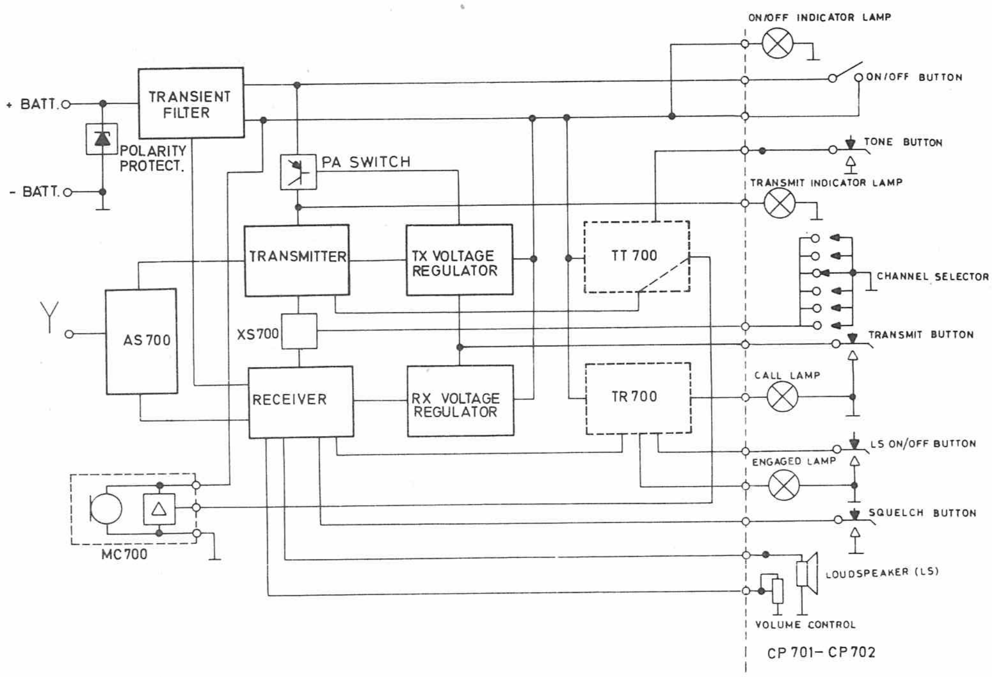
Power Supplies

PS701 Power supply for 24 V car battery, any battery polarity.

PS702 Power supply for 24 V car battery, negative pole to chassis.

CIRCUIT DESCRIPTION

Functional Diagram



General

The nominal 12V supply from the battery is applied to the connector designated "BATT". A reverse biased zener diode across the battery input protects the radiotelephone against incorrect supply polarity. The supply voltage is fed, via a transient filter, to both the ON/OFF switch and to the transmitter power amplifier through a transistor switch.

The filtered battery voltage is applied to two 9V regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment, if fitted.

The incoming signal passes through the antenna switching unit to the input of the receiver. The antenna switching is controlled by the stabilized supplies from the transmitter and receiver voltage regulators.

In the single channel edition of CQM710 a crystal controlled oscillator is incorporated in the transmitter section. Similary, a single oscillator is provided in the receiver section.

Channel switching unit XS is fitted in the multichannel edition of CQM700 and is controlled by the channel selector.

The audio output from the receiver is applied to the loudspeaker (LS). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output signal may be connected to the tone receiver TR700 used in selective tone calling systems. The tone receiver enables the AF output circuits of the receiver to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "call" and "engaged" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) via the tone generator TT700, if fitted.

During transmission of tone calls, the microphone will be switched off automatically so that the transmitter is modulated by the tone signal from TT700 only.

The transmitter is keyed by depressing the transmit button. This will block the receiver voltage regulator and cancel the blocking of the transmitter voltage regulator. When the transmitter voltage regulator operates, supply voltage is applied to the exciter and via a transistor switch to the transmitter power amplifier.

The "transmitter on" condition is indicated by the transmit indicator lamp.

In the radiotelephone fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched on manually by means of the loudspeaker ON/OFF button.

RECEIVER

The CQM710 receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having a low insertion loss.

Adjacent channel selectivity is obtained by using two bandpass filters: a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 6 crystal controlled oscillators, one for each channel, can be provided. The oscillators are connected in parallel and channel selection is performed by grounding the negative supply lead of the appropriate oscillator.

The receiver comprises the following subunits:

Antenna switching unit	AS711
Preselector filter	BP711
Receiver converter with 1st mixer and 1st local oscillator	RC711
Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter:	
for 25 and 20 kHz channel spacing	IC703
for 12.5 kHz channel spacing	IC704
455 kHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator	CF701
(for other circuits of CF701 see page 8)	
Channel switching unit:	
maximum 6 channels	XS701
maximum 4 channels, temperature compensated	XS702

Signal Path

From the antenna switching unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage. This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver.

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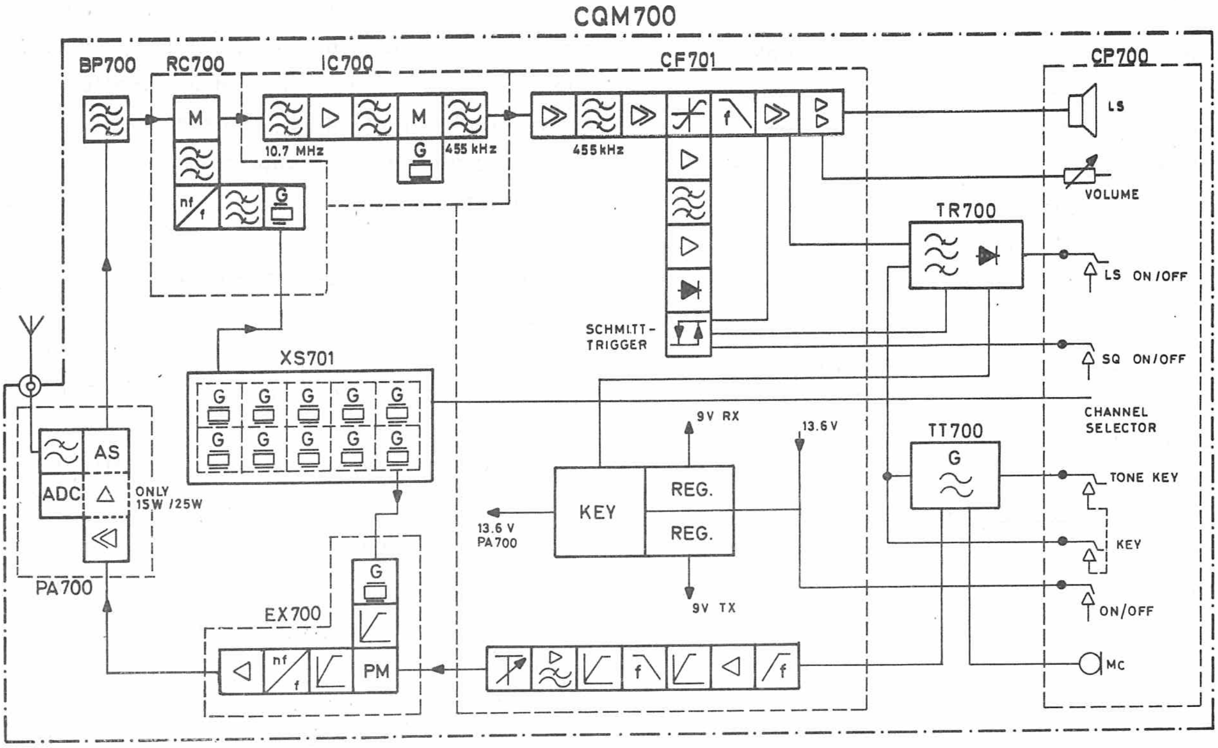

The BP711 filter consists of five tuned circuits which can be adjusted over the band 146-174 MHz. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network tranforms the output impedance of the filter to the impedance required by the field-effect transistor (FET) of the mixer stage.

The local oscillator and the received signals are applied to the gate of the FET. The mixer output at 10.7 MHz is taken from the drain circuit.

First Local Oscillator

The local oscillator signal is generated in an oscillator operating on the fundamental frequency of the crystal. The oscillator operates within the frequency range 11.35 MHz to 12.75 MHz, depending on the crystal frequency used.

In the oscillator, the 3rd harmonic of the crystal frequency is selected and applied to a multiplier chain consisting of two doubler stages. The output frequency is thus 12 times the fundamental frequency of the oscillator.

The last doubler stage is followed by a filter consisting of three capacitively coupled tuned circuits. The filter attenuates undesired frequencies generated by the multiplier chain and prevents these from reaching the mixer stage.

The injection signal is 10.7 MHz below the received signal and is calculated as follows:

$$fx = \frac{f_a - 10.7}{12} \text{ MHz}$$

where fx is the crystal frequency, MHz and f_a is the received signal, MHz.

The receiver converter RC711 includes an oscillator intended for use in single-channel receivers. When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

XS701 contains oscillators for five RF channels thus allowing the receiver to be equipped with a maximum of 6 channels.

XS702 is a temperature compensating unit employed where radiotelephones are to work in very low temperatures. The compensation is provided by heating the crystals when the ambient temperature falls below -5°C approximately.

XS702 contains oscillators for a maximum of 4 channels.

Intermediate Frequency Circuits

From the mixer in RC711 the 10.7 MHz signal passes to the intermediate frequency converter, type IC703 or IC704 depending on the channel separation used, which provides the channel selectivity of the receiver.

The first IF signal passes through the 10.7 MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal controlled oscillator whose frequency is normally 455 kHz below 10.7 MHz. In instances where a harmonic of the local oscillator coincides with the frequency of the received signal, a crystal oscillator frequency of 455 kHz above 10.7 MHz is chosen.

In the first case the crystal frequency is:
10.7 MHz - 0.455 MHz = 10.245 MHz

In the second case the crystal frequency is:
10.7 MHz + 0.455 MHz = 11.155 MHz.

The crystal frequency of 11.155 MHz is used when the received frequencies are within the following bands:

152.5 - 154.9 MHz
162.7 - 165.1 MHz
173.0 - 174.9 MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455 kHz ceramic filter in the IC703 or IC704 converter and is then applied to the intermediate frequency amplifier in CF701.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a deemphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

The signal is then applied to a three stage amplifier in which a field-effect transistor, operating as an electronic on/off switch, has been placed between the second and third stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level of -17 dBm (110 mV).

The signal is passed to the loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 2W into a 5 Ω load. The input stage is a high-pass active filter which attenuates frequencies below 250 Hz.

A variable resistor, forming part of the collector load, permits a preset 12 dB adjustment of the gain.

Manual gain adjustment, and thus the loudspeaker output level, is effected by the volume control on the control panel of the radio· telephone. Electrically, the volume control is connected between the first and second AF amplifier stages.

The AF output stage consists of two complementary power transistors operating in Class AB push-pull.

Temperature conpensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the output amplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM700 is operated by noise components contained in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load. The resonant frequency of this circuit can be changed by a strapping arrangement to suit the channel separation of the receiver.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise amplifier.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

(See block diagram on page 6)

The transmitter is phase modulated. Its output frequency is 12 times the oscillator frequency. Phase modulation is performed at the fundamental frequency.

The transmitter comprises the following subunits:

Exciter	EX711
RF power amplifier	PA711
Antenna switching unit	AS711
Modulation amplifier, transmitter switch and voltage regulator	CF701
(These circuits constitute part of CF701)	

Channel switching unit:

Maximum 6 channels	XS701
Maximum 4 channels, temperature compensated	XS702

AF Circuits

The modulating signal from the mircophone is fed, through the tone generator if fitted, to the modulation amplifier where it is differentiated, amplified, limited, integrated and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the phase modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the phase modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the phase modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The fundamental RF signal is generated in a crystal controlled oscillator contained in the exciter EX711.

When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

As in the receiver, channel selection is performed by grounding the negative return of the appropriate oscillator.

The exciter provides the following:

(a) phase modulation
(b) frequency multiplication
(c) drive power for the power amplifier PA711.

The RF signal from the oscillator is applied to the 1st buffer amplifier, then to the phase modulator, followed by the 2nd buffer amplifier. The buffer amplifiers provide constant input levels and correct impedance matching.

The phase modulator is a "transconductance modulator" as the phase modulation is produced by varying the transconductance of a transistor.

The modulating signal is applied to the emitter of the transistor whose operating point and transconductance thus change instantaneously with the modulating signal.

From the 2nd buffer amplifier, the signal is fed to a frequency multiplier chain consisting of a tripler, 1st doubler and 2nd doubler. The transmitter output frequency is therefore 12 times the crystal frequency.

The three multipliers are designed as balanced circuits resulting in suppression of some of the harmonic frequencies.

The tripler suppresses the even harmonics and the doublers suppress the odd harmonics.

Double tuned bandpass filters are used with close-to-critical coupling between tuned circuits. These filters limit the bandwidth of the exciter and attenuate undesired harmonics generated in the frequency multiplication process.

The output signal from the 2nd doubler is fed to an amplifier operating at the final frequency of the transmitter. Tuned input and output bandpass filters of the amplifier provide additional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the RF power amplifier PA711. The nominal RF output power of EX711 is 50 mW into a 50 Ω load.

The bandwidth of the transmitter and thus the maximum frequency spread of the channels is determined by the selectivity of the exciter, which is 1 MHz.

RF Power Amplifier

The power amplifier contains three transistor amplifier stages. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency Class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading the power transistor. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

In the 25 W version, a power booster and a temperature protection circuit are also included in the PA stage.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through an electronic antenna switching unit and a low-pass filter to the antenna.

The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The low-pass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple.

The filter attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonics of the transmitter frequency.

The antenna filter is not adjustable.

Power Supply and Switching Circuits

CQM700 is powered directly from a 12 volt car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A transient filter is provided to suppress noise and transients generated by the vehicle's electrical system.

A reverse biased zener diode connected across the battery input terminals limits the peak voltage to approx. 20 volts and protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the diode to conduct and blow the fuses fitted in the battery cable.

The CQM700 contains two identical voltage regulator circuits which deliver 9V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

Each regulator has a blocking transistor controlled by the transmit key button. With the CQM710 in the standby or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed, operation and blocking of the two voltage regulators

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are reversed. The supply voltage for the PA711 power amplifier in the transmitter is taken from the transient filter and applied to the amplifier unit through a transistor switch. This switch is supplied by the transmitter voltage regulator which is controlled by the transmit key button.

NOTE: The voltage applied to the transistor switch cannot be turned off by means of the ON/OFF switch of the radiotelephone.

ADJUSTMENT PROCEDURE FOR CQM710

RECEIVER ALIGNMENT

Before switching on the CQM700 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 100 mA.

With the station switched off, increase the supply voltage until a current drain of 100 mA is reached.

Requirement: $V_{supply} \leq 21$ V

Keeping within these values ensures correct operation of the protective zener diode, E13, in CF701.

Decrease the supply voltage to 13.6 V and set the current limiter to 1 A.

The station may now be switched on.

Check the 9 V RX at terminal 33 on the terminal board.

Requirement: 9 V ± 0.1 V

If necessary, adjust the RX voltage by means of potentiometer R64 in CF701. This potentiometer can be reached from the rear of the module tray BA700.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 kHz generator and the CQM700 chassis.

Apply a 455 kHz signal to the input of CF701. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF701.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 10 μA if an AVO-meter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF701

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box, or by switching the squelch off on the control unit C33/C34. Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the terminal board. On the control units C33/C34 the reading may be taken from LINE OUT.

Adjust coil L1 in CF701 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R16 (AF-RX) may be turned up. This potentiometer can be reached from the rear of the module tray BA700, and turns up counter-clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency counter is available, the frequency may be read at test point [5], IC700. If the input of the frequency counter is DC-coupled, a capacitor (approx. 1 nF) should be connected in series. The frequency will either be 10.245 or 11.115 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF701 and a 10.7 MHz generator to the input of IC700. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC700 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "Line out", 600 ohm audio output, which is accessible on the terminal board, terminal 35, and on the control units C33/C34.

NOTE: The discriminator has no zero adjustment.

Alignment of 1st IF Amplifier (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC700.

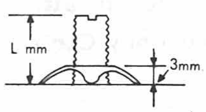
Connect a DC meter with an RF probe (95.089) to test point [1] in CF701.

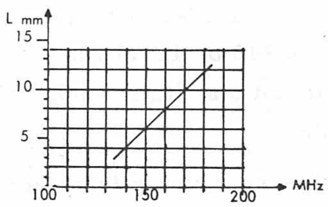
Adjust coils L1, L2 and L3 in IC700 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC700: ≥ 20 dB

Coarse Adjustment of BP711

The trimming slugs, L1, L2, L3 and L4 of the filter BP711 are to be set to the approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency. L5 is to remain in its outermost position.





Alignment of Multiplier Chain in RC711

When crystals have been inserted in RC711 and/or XS701/XS702, select the middle frequency channel.

Connect a DC voltmeter to test point (1) in RC711.

Tune L7 and L8 in RC to maximum, approx. 0.4 V.

Requirement: ≥ 0.3 V.

Connect a DC voltmeter to (2).
Tune L6 for minimum, approx. 8V.
Requirement: ≤ 8.5V

To tune for maximum drive to the 1st mixer, connect a DC voltmeter with an RF probe to test point (2) in RC711.

L5, RC711, is adjusted for maximum meter reading.

L4, RC711, is adjusted for minimum meter reading.

L3, RC711, is adjusted for maximum meter reading.

L1, RC711, is adjusted for minimum meter reading.

Since only very small variations occur at test point (2), especially in the final circuits, the drive to the 1st mixer should be checked:

Connect a DC voltmeter to test point (3) in RC711.

Touch up the tuning of coils L5, L4, L3, and L1 for maximum meter reading.

Stop the oscillator (select a channel with no crystals or take a crystal out).

The voltage at test point (3) with the oscillator stopped will be 1 to 4.5 V.

Start the oscillator.

Requirement: Minimum increase at test point (3), RC711 = 0.5 V.

Adjustment of Temperature Regulating Circuit in XS702

The temperature regulating circuit of XS702 has been adjusted before leaving the factory. However, if necessary, it may be readjusted as follows:

Turn potentiometer R39 in XS702 fully counter-clockwise.

Remove jumper connecting the NTC resistor.

Set the supply voltage for the CQM700 to 13.6 V.

Check the current consumption of XS702 by inserting an ammeter in the orange/blue wire to XS702.

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Adjust the current to 0.45 A by means of R39 (This adjustment should not exceed 30 seconds).

Insert jumper connecting the NTC resistor again and reconnect the orange/blue wire.

Further Alignment of RC711, Fine Tuning of BP711, and Fine Tuning of IC700

Connect a DC EVM with an RF probe to test point [1] in CF701. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF701. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF701, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at test point [1] , CF701.

The following coils are tuned for maximum meter reading in this order:

L1, RC711
L5, BP711
L4, BP711
L3, BP711
L2, BP711
L1, BP711

Due to interaction, especially between L1 in RC, and L5 in BP, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting L1, RC711, the oscillator drive signal to the first mixer will have decreased. L3, RC711, must be fine tuned for maximum reading on a DC voltmeter connected to test point (3) , RC711.

Now, when stopping the oscillator, the voltage at test point (3) should fall at least 0.3 V.

L2 in RC, and L1, L2 and L3 in IC700, are now fine tuned for maximum reading at test point [1] , CF701. The circuits in IC700 should be aligned two or three times, as they influence each other.

Fine Tuning of L1 in CF701

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM700, approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz, (for CQM734: ± 1.75 kHz).

Connect an audio voltmeter to test point [2] in CF701. This test point becomes accessible by unscrewing the upper PC-board of CF701.

Peak coil L1 in CF701, for maximum meter reading.

Requirement: ≥ 65 mV (for CQM714: ≥32 mV)

NOTE: Terminal 35 "Line out", on the terminal board or the connector "Line out" on the control units may be used instead of test point [2] . However, this reading is dependent on the setting of potentiometer R16, AF-RX, in CF701, and it must be checked that an audio level of ≥110 mV can be obtained from "Line out" for the appropriate frequency deviation as shown below.

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 kHz, and set the frequency deviation to 0.7 x Δ f max.:

CQM713 (25 kHz channel spacing) 3.5 kHz
CQM713 (20 kHz channel spacing) 2.8 kHz
CQM714 (12.5 kHz channel spacing) 1.75 kHz

Set the RF generator output level to approx. 1 mV EMF.

If the CQM700 is provided with tone equipment press the LS in/out button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to "Line out".

Adjust the audio output level to 110 mV by means of R16 in CF701.

Connect a 5 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker. The load is incorporated in the control units C33/C34.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals or to LS in/out on C33/C34. Set the volume control for 2.25 V on the meter.

Check the distortion.

Requirement: k ≤ 5%.

NOTE: Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 2 W (by means of potentiometer R83 on CF701) for an audio input of 110 mV from LINE OUT (AF -17 dBm),
- a base bias to the output amplifier transistors ensuring a suitable no-signal current in the stage.

Consequent adjustment of the no-signal current in the output stage is performed in the following way:

Turn the station off, and the volume control down.

Turn potentiometer R99 fully counter-clockwise (viewed from the component side of CF701).

Set the supply voltage to 16 V.

Insert a milliammeter in the positive supply lead to the output amplifier (brown lead between the two PC-boards of CF701, terminals C/C of CF701).

Turn the station on. The reading will be approx. 15-25 mA.

Turn potentiometer R99 clockwise until the current drain has increased by 2 mA.

Checking the Audio Power Output

Set the volume control for 3.16 V across the audio output load (corresponding to a power output of 2 W) for an input signal of 1 kHz, 110 mV.

Connect the distortion meter across the output and read the distortion.

Requirement: k ≤ 7%.

Adjustment of Oscillator Frequency in RC711

The frequency is measured after the doubler with a counter connected to test point (2) in RC711. The frequency should be $f_{antenna}$ −10.7 MHz. The oscillator frequency is adjusted with C27, RC711.

In CQM700 with XS701/XS702 frequency adjustment must be performed on each channel with the trimmer capacitor of the appropriate oscillator.

Requirement:
CQM713: Better than $\pm 1 \times 10^{-6}$
CQM714: Better than $\pm 0.5 \times 10^{-6}$

The tolerances are valid only for a crystal temperature of 25° C.

Checking Receiver Sensitivity

Modulate the RF generator with 1 kHz, and a frequency deviation of 0.7 x max. Δ f.
Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 5 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the RF generator output until 12 dB SINAD is obtained on the distortion meter.

Read the calibrated RF voltage from the RF generator.

Requirement: for 12 dB SINAD ≤0.8 μV EMF.

If more than one channel is provided, the procedure should be repeated on all channels.

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Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R38 in CF701 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage.

Requirement:

CQM700 without tone equipment, in stand by, single channel = 200 mA (typically 170 mA)

CQM700 without tone equipment, in stand by, multichannel = 270 mA (typically 240 mA)

TRANSMITTER ADJUSTMENT

Unless the receiver alignment procedure has been performed, check for correct operation of the protection diode, E13, on CF701. This test is described in the first paragraphs under "Receiver Alignment".

Then set the supply voltage to 13.6 V, and the current limiter to 4 A.

If tone equipment is installed, the LS in/out button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9 V TX at terminal 19 on the terminal board.

NOTE: If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.

Requirement: 9 V TX = 9 V ± 0.1 V.

If necessary, adjust the TX voltage by means of potentiometer R72 on CF701. This potentiometer can be reached from the rear of module tray BA701.

Alignment of Exciter EX711

Remove the RF signal lead between EX711 and PA711.

Connect a 47 Ω resistor across the output of EX711 (this load may also be soldered across the input of an RF probe, STORNO 95.059, and the probe connected across the output of EX711 for the duration of the alignment of the exciter).

When crystals have been inserted in EX711 and/or XS701/XS702, select the middle frequency channel and key the transmitter.

Connect a DC voltmeter to test point (1) in EX711.

Adjust L4 and L5 for maximum meter reading, approx. 1.4 V.

Move the voltmeter to test point (2) in EX711.

Adjust L7 and L6 for maximum meter reading, approx. 0.8 V.

Move the meter to test point (3), EX711.

Adjust L9 and L8 for maximum, approx. 0.05 V.

Adjust L10 for maximum output.

Adjust L6, L7, L8, L9, and L10 for maximum RF output from EX711.

Requirement: $P_{out} \geq 80$ mW.

(Measured with a DC voltmeter and RF probe 95.059, the voltage should read more than 4.5 V).

Alignment of RF Power Amplifier (PA711)

Reestablish the connection between EX711 and PA711.

Connect a Wattmeter to the antenna output.

PA711 should be aligned at a supply voltage of 13 V.

Turn the ADC potentiometer, R2, PA711 up (clockwise).

Set all trimmer capacitors for half capacity.

NOTE: The PA711 should be aligned with its shielding lid in place, and insulated trimming tools should be used.

Install the lid and key the transmitter.

Remove shorting link designated "A" and insert a DC ammeter instead.

Adjust trimmer capacitor C7 for maximum reading on DC ammeter.

Remove shorting link designated "B" and insert the DC ammeter instead.

Adjust trimmer capacitor C11 for maximum reading on DC ammeter.

Remove shorting link designated "C" and insert the DC ammeter instead.

Adjust trimmer capacitor C16 for maximum reading on the DC ammeter.

If no current can be obtained increase the capacity of trimmer C22 and repeat the adjustment of C16.

Adjust trimmer capacitors C22 and C23 for maximum power output (repeat the adjustment a couple of times.)

Adjust trimmer capacitors C14 and C16 for maximum power output (repeat the adjustment a couple of times).

Repeat the alignment of C22, C23, C14 and C16.

Adjust trimmer capacitors C10 and C11 for maximum power output

Adjust trimmer capacitors C6 and C7 for maximum power output.

Make the final adjustments for for C6, C7, C10, C11, C14, C16, C22 and C23, in that order, for maximum power output.

Set the ADC potentiometer, R2 in PA711, for 12 watts power output with 13.6 V supply voltage from the power supply. This will ensure a power output of more than 10 W if the supply voltage is increased to 16 volts taking into account that the ADC circuit will reduce the power output with increasing supply voltage

Adjustment of Transmitter Frequency

The counter is connected to the transmitter output via a suitable (10 W capacity) attenuator. The antenna frequency is adjusted with C2 in EX711 and/or the trimmer capacitors in XS701/XS702. The frequency must be adjusted on all channels and at crystal temperatures of 25°C.

Requirement:
CQM713: Better than $\pm 1 \times 10^{-6}$
CQM714: Better than $\pm 0.5 \times 10^{-6}$

Automatic Drive Control (ADC) Circuit

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

At 10.5 V supply voltage:
Current Drain: 2.9 A (≤3A)
Power Output: 6 W

At 13.6 V supply voltage:
Current Drain: 3.0 A (≤3.1 A)
Power Output: 10 W

At 16.0 V supply voltage:
Current drain: 2.9 A (≤3A)
Power Output: 13 W ± 1 W.

These values for total current drain apply to stations without tone equipment. The values in brackets apply to stations with XS701/XS702

The relationship between supply voltage, power output, and current consumption in the individual stages of PA711 is dependent on the antenna frequency. The current in individual stages may be read by substituting an ammeter for the shorting links, A, B and C, in the collector leads of transistors Q1, Q2 and Q3 in PA711.

Requirements:

At 10.5 V supply voltage,
Power output: > 6 W
Current in "C": < 1.0 A
Current in "B": < 0.35 A
Current in "A": < 80 mA

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At 13.6 V supply voltage,

Power input:	=12 W
Current in "C":	<1.6 A
Current in "B":	<0.5 A
Current in "A":	<80 mA

At 16.0 V supply voltage,

Power current:	≥ 10 W
Current in "C":	< 1.6 A
Current in "B":	< 0.3 A
Current in "A":	< 80 mA

Correct values here also indicates that the ADC circuit is operating satisfactorily.

Use of Control Unit C33/C34 When Adjusting Modulation

The control units C33/C34 may be used for stations with or without tone equipment and a voltage divider and a DC blocking capacitor is incorporated.

Where a tone transmitter is installed the modulation signal must pass through the switching transistor (the AFgate) in the tone transmitter. The emitter resistor for this transistor is situated in the microphone amplifier, which is disconnected when adjusting the modulation. An alternate DC path must therefore be provided for the switching transistor in the tone transmitter to allow it to pass the modulation to the modulation amplifier of the CQM700. The DC supply voltage for the microphone amplifier in MC700 is also obtained through the switching transistor. This DC voltage should be isolated from the audio generator output.

A resistor R3, in fig. 2 has been installed to provide the DC path for the switching transistor. This resistor would, as far as AC is concerned, seem to be in parallel with R112 in CF701. To the audio generator the two would present an impedance of 280 Ω which is only half the required value. Another resistor, consisting of R1 and R2 in C33/C34, places 280 Ω in series with the input signal, bringing the input impedance up to 560 Ω. At the same time, a capacitor in series with the signal effectively blocks the DC voltage from CF701, which is normally fed to the microphone amplifier in MC700 through terminal 7 of the terminal board.

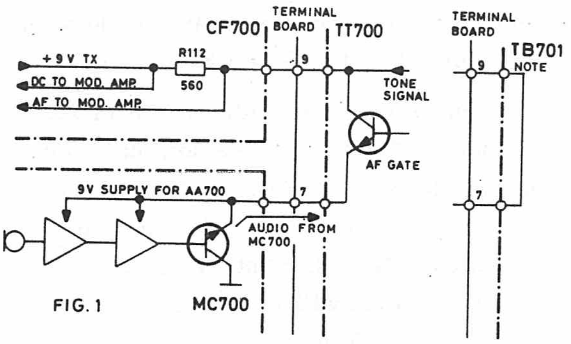

FIG. 1

MODULATION PATH FROM MC700 TO CF700, AND 9V SUPPLY FROM CF700 TO MC700.
NOTE: WITHOUT TONE TRANSMITTER TB701 MUST BE INSTALLED

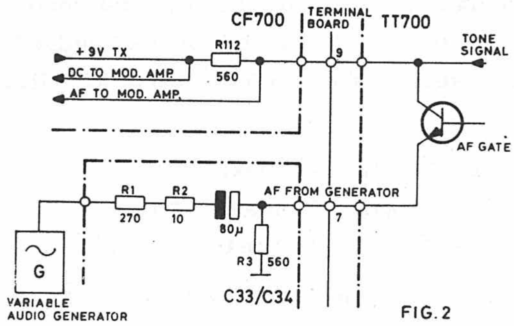

FIG. 2

MODULATION THROUGH USE OF CONTROL UNIT C33/C34 (SEE ALSO NOTE IN FIG.1)

The resistors combine as a voltage divider when seen from the input to the control unit marked "modulation, AF gen.". This voltage divider attenuates the audio generator output by 6 dB in passing through C33/C34 to the modulation amplifier on CF701. The generator output must therefore be set 6 dB above the required input to the amplifier modulation. The adjustment procedure takes this into account.

Adjustment of Modulation and Frequency Deviation

NOTE: Where an ST7845 is installed, TB701 must be substituted during the following procedure.

Connect the deviation meter to the transmitter output via an attenuation network (10 W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM700 to 13.6 V.

Connect an audio generator to the modulation input of control unit C33 or C34.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF701. The 6 dB loss in C33/C34 is also taken into account, and the nominal input level will be found to be
2.2 V −26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 kHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R124 on CF701.

CQM713 (25 kHz) Δf max. = ±5 kHz
CQM713 (20 kHz) Δf max. = ±4 kHz
CQM714 (12.5 kHz) Δf max. = ± 2.5 kHz

Set the audio generator to 1000 Hz and attenuate the output until a frequency deviation of 0.7 x Δf max. is read on the deviation meter.

CQM713 (25 kHz) 0.7 x Δf max. = ± 3.5 kHz
CQM713 (20 kHz) 0.7 x Δf max. = ± 2.8 kHz
CQM714 (12.5 kHz) 0.7 x Δf max. = ± 1.75 kHz

Requirement: V_{mod} = 220 mV ± 2 dB
(175 mV - 275 mV) input
to C33/C34.

Check the distortion on the audio output of the deviation meter.

Requirement: k $\leq$ 7% (without de-emphasis)

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5 - 40 MHz.

The existence of parasitic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

For further details please refer to STORNO Service News No. 38 of May, 1969.

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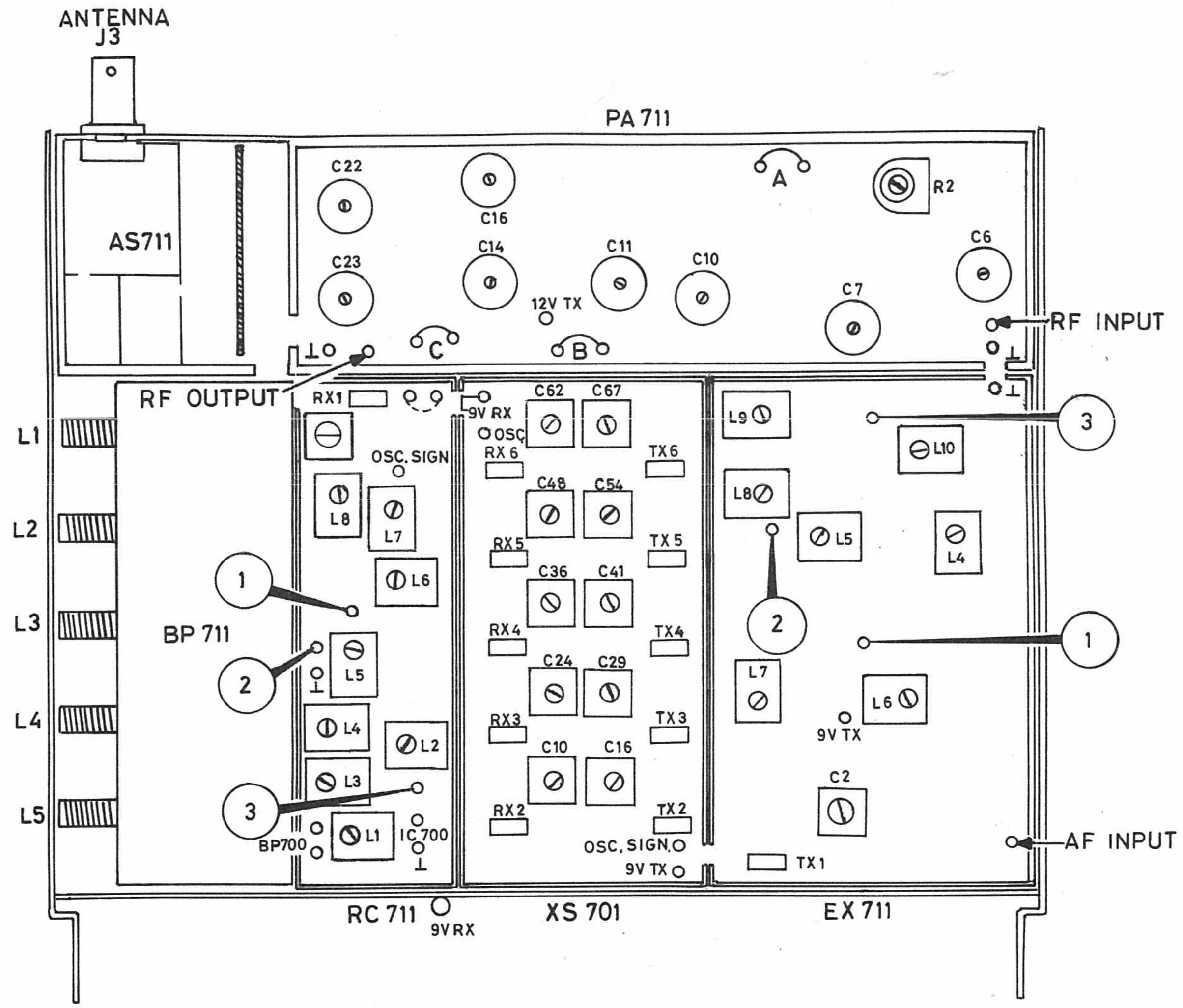

RADIO ASSEMBLY RF710 (CQM710)

Location of Test Points and Adjustable Components

D401.827

TECHNICAL SPECIFICATIONS

The stated specifications apply to all channels.
All measurements include antenna branching filter.
The receiver specifications are measured with simultaneously transmitting.
Figures given in brackets are typical values.

Measuring method references:

EIA: RS204
EIA: RS152A
TN: teledirektoratet Norge Nov. 73
MTD06 - 68181 - 1
GPO - W6289

GENERAL SPECIFICATIONS

Frequency range, transmitter

CQM713D x 49 DK: 159.4 MHz - 160.625 MHz
CQM713D x 46 N : 159.5 MHz - 160.625 MHz

Frequency range, receiver

CQM713D x 49 DK: 168.4 MHz - 169.625 MHz
CQM713D x 46 N : 167.5 MHz - 168.625 MHz

Duplex frequency separation

CQM713D x 49 DK: 9.0 MHz
CQM713D x 46 N : 8.0 MHz

RF Bandwidth

1.25 MHz

Channel frequency separation

25 KHz

Number of channels

CQM713D x 49 DK: 47
CQM713D x 46 N : 46

Type of modulation

Phase

Modulation frequency range

300 Hz to 3000 Hz

Maximum frequency deviation

± 5 KHz

Nominal frequency deviation

CQM713D x 49 DK: ± 3.3 KHz
CQM713D x 46 N : ± 3.0 KHz

Antenna impedance

50 Ω

Temperature range

Operating range: -25^{o} C to $+55^{o}$ C
Functioning range: -30^{o} C to $+60^{o}$ C

Dimensions

Locally controlled version:	180 x 250 x 70 mm
Extended local control:	180 x 210 x 70 mm
Antenna branching filter:	185 x 160 x 31 mm
Control unit CB704:	120 x 65 x 55 mm

Weight

Locally controlled version:	2.7 kg
Extended local control:	2.43 kg
Antenna branching filter:	0.8 kg
Control unit CB704:	0.2 kg.

RECEIVER SPECIFICATIONS

Sensitivity, e.m.f. for 12 dB SINAD, EIA.

1.0 µV, (0.7 µV)

Squelch sensitivity, EIA

0.9 µV, (0.5 µV)

Crystal oscillator frequency, RC712

CQM713D x 49 DK: 142.7 MHz
CQM713D x 46 N : 141.8 MHz

Frequency stability, -25^{o} C to $+55^{o}$ C

± 2 KHz (± 1.5 KHz)

Modulation acceptance bandwidth, EIA

± 5 KHz (± 7 KHz)

Adjacent channel selectivity, EIA

70 dB (80 dB)

Spurious attenuation, EIA

75 dB (80 dB)

Spurious attenuation, TN

70 dB (75 dB)

Capture ratio, TN

8 dB (6 dB)

Intermodulation (EIA)

70 dB (80 dB)

Intermodulation (TN)

70 dB (75 dB)

Blocking (TN)

90 dB / 1 µV (96 dB / 1µV)

Blocking (GPO)

< 1 dB

Spurious and harmonic emission into an artificial load (TN)

< 2 nW (< 0.4 nW)

Loudspeaker impedance

5 Ω

Microtelephone impedance

10.000 Ω

AF output power, TN

2.0W (2.5W)

Harmonic distortion

< 6% (3%) measured at 1 mV RF input, 1W AF output, F_{mod} = 1 KHz and Δf_{nom}

Audio frequency characteristic, EIA

-6 dB / octave + 0.5 dB / -3 dB (+ 0 dB / -1.5 dB)
300 - 3000 Hz

measured at the loudspeaker output.

Hum and noise

60 dB (70 dB); squelched condition.
40 dB (45 dB); unsquelched condition.

TRANSMITTER SPECIFICATIONS

RF output

10 W - 1 dB

Crystal oscillator frequency, EX712

CQM713D x 49 DK: 144.4 MHz
CQM713D x 46 N : 144.5 MHz

Frequency stability, -25^{o}C to $+55^{o}$C

± 2 KHz (± 1.5 KHz)

Spurious radiation

Harmonics, TN: < 2.5 µW (< 0.2 µW)
Adjacent channel, MTD: < 2 µW (< 0.5 µW)
Adjacent channel, TN: < 1 µW (< 0.3 µW)
Other frequencies, TN: < 0.5 µW (< 0.2 µW)

Chassis radiation, TN

< 300 µV / m

AF input impedance

560 Ω

Modulation sensitivity, EIA

110 mV ± 1 dB

Modulation distortion, EIA

< 5% (2%)

Modulation distortion, TN

< 10% (3%)

Modulation frequency characteristic, TN

+6 dB / octave +1 / -3 dB (+0 / -2 dB)
300 - 3000 Hz

FM hum and noise, EIA

-45 dB (-60 dB)

FM hum and noise, TN

-40 dB (-50 dB)

Transmitter load

Meets TN specifications pt. 7.1.

POWER SUPPLY SPECIFICATIONS

Nominal battery voltage

13,6 V

Current consumption

Receive, stand by: 1.0 A (0.8A)
Receive, 2W AF: 1.3 A (0.8A)
Transmit 10W : 4.0A (3.5A)
SR 781, TT781 and ID701 incl.

CQM713D
GENERAL DESCRIPTION

Introduction

The Stornophone CQM713D radiotelephone is a mobile transmitter/receiver for the duplex operated public radiotelephone systems in Denmark and Norway.

The only differences between the Danish system and the Norwegian system are the channel frequencies and the duplex spacing.

From the frequency allocation tables, it appears that channel numbers and channel frequencies are not systematized. This requires programmed frequency control units between the channel selector and the frequency synthesizer unit to produce the channels in the right order.

	Transmitter frequency range	Receiver frequency range	Duplex spacing
Denmark (DK)	159.4MHz - 160.625MHz	168.4MHz - 169.625MHz	9.0MHz
Norway (N)	159.5MHz - 160.625MHz	167.5MHz - 168.625MHz	8.0MHz

There are also two mechanical different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Construction

The radio chassis slides into the cabinet from the front and is held in place by screws from the rear of the cabinet. The chassis consists of two circuit panels hinged on to the front control panel. When separated, the two chassis halves open out like a book.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

The upper circuit panel, designated RF713, contains all the circuits which are dependent upon channel frequencies. These are:

- preselector filter
- receiver synthesizer unit
- exciter
- RF amplifier
- transmitter power output amplifier

The lower circuit panel, designated BA702, contains:

- intermediate frequency converter
- intermediate frequency amplifier
- squelch circuit
- voltage regulators
- tone equipment, where included.

Between the circuit panels and the front control panel are placed

- a frequency control unit
- a 5 volt switching regulator

The solid state circuitry is built up as functional modul units for ease in servicing.

Reading the type plate:

CQM713D spec XX X XXXX

XX:
- C4 Remote control (CP703)
- C5 Local control (CP705)

XXXX:
- 49DK Denmark 49 channels
- 46N Norway 46 channels

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Control Equipment

The locally controlled model will have the following front panel:

CP705 Front panel with controls, built-in loudspeaker and channel selector.

The CQM713D for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703.

One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB704 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone.

CB2706 Automatic control unit housed in a cast aluminium cabinet and containing operating controls for the radiotelephone.

Accessories

Accessories available for the CQM713D radiotelephone are listed in this section. Some of them, such as installation materials, antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier.

MC703 Fixed microphone for mounting on steering wheel column.

MT702 Handset with built-in amplifier and transmitter keying switch.

HS702 Retainer for MT702.

All of the above items are supplied with cables for termination in a multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit consisting of 2 flexible metal tubes (goose necks), length 20 and 35cm, is available.

Channel Indicator

ID701 Channel indicator for displaying the channel in operation. Theindicator can be used with all types of control unit.

Antenna

AN195 1/4 wave length whip antenna for the 146174MHz frequency band and the impedance matches 50 Ω. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM713D radio set will require some or all of the following installation kits.:

MN701 Mounting frame for radio cabinet.

CC704 Cable kit containing extension cable terminated in multiconnectors for control unit CB704 and accessories.

CC701 Battery cable.

CC2705 Extension cable for automatic control unit CB2706 and accessories.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with battery cable.

Loudspeakers

When using the extended control system it is necessary to install an external loudspeaker. The following type is available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable to be soldered to the accessory connector.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for mounting on dashboard.

SU703 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

Power Supplies

PS701 Power supply for 24V car battery, any battery polarity.

PS702 Power supply for 24V car battery, negative pole to chassis.

CQM713D

CIRCUIT DESCRIPTION

General

The nominal 12V supply from the battery is applied to the connector designated "BATT". A reverse biased zener diode across the battery input protects the radiotelephone against incorrect supply polarity. The supply voltage is fed, via a transient filter, to both the ON/OFF switch and to the transmitter power amplifier through a transistor switch.

The filtered battery voltage is applied to two 9 volt regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment.

The incomming signal passes through the antenna branching filter unit (BF) to the input of the receiver.

The audio from the receiver is applied to the loudspeaker (LS) or to the microtelephone (MT). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output may be connected to the sequential tone receiver SR781 used in selective tone signalling systems. The tone receiver enables the AF output circuits to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "CALL" and "ENGAGED" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) or the microtelephone (MT) via the tone generator TT781.

During transmissions of a tone signal, the microphone signal is switched off automatically so that the transmitter is modulated by the tone signal only.

The transmitter is keyed by depressing the transmit button, which operate the transmitter voltage regulator and a transistor switch to the transmitter power amplifier. The "transmitter on" condition is indicated by the transmit indicator lamp.

If the radiotelephone is fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched ON manually by means of the loudspeaker ON/OFF button.

RECEIVER

The receiver is a double conversion superheterodyne using intermediate frequencies of 10.7MHz and 455KHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having low insertion loss.

Adjacent channel selectivity is obtained by using two band pass filters:

a 10.7 MHz crystal filter and
a 455 KHz ceramic filter.

The receiver comprizes the following subunits:

Antenna branching filter BF713
Preselector filter BP712
Receiver converter with 1st mixer, local oscillator and synthesizer mixer RC712
Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter IC703
455 kHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator CF702

Signal Path

From the antenna branching filter unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage. This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver. The BP712 filter consists of five tuned circuits which can be adjusted over the band. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required by the field-effect transistor (FET) of the mixer stage.

The local oscillator signal and the received signals are applied to the gate of the FET. The mixer output at 10.7KHz is taken from the drain circuit.

The mixer injections signal is 10.7MHz below the antenna frequency and is produced by mixing the signal from a crystal oscillator with the synthesizer signal.

The crystal oscillator is a 7th overtone series resonance oscillator; which is followed by a double-gate-FET buffer amplifier. The buffer output is mixed with the synthesis signal in

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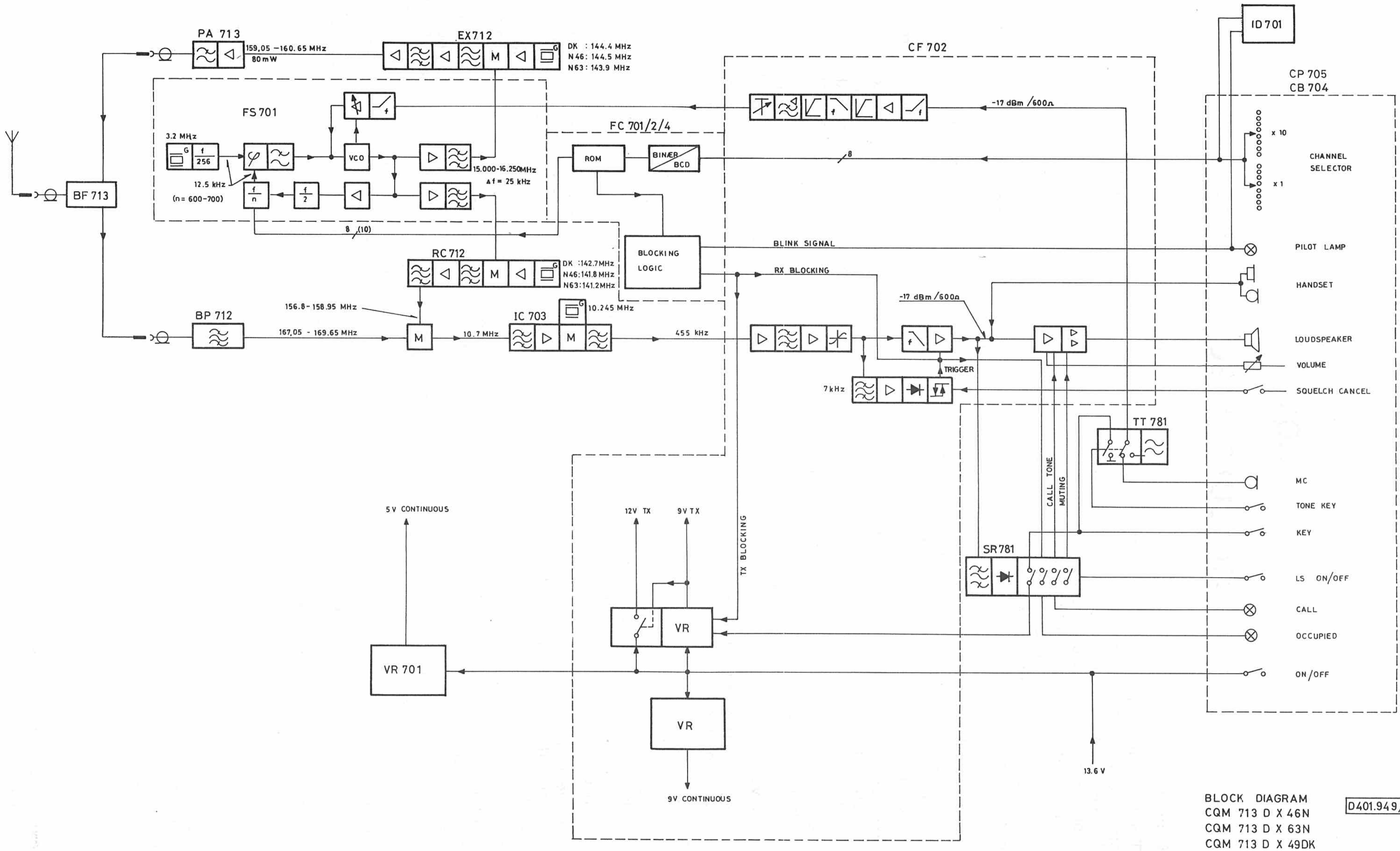


BLOCK DIAGRAM
CQM 713 D X 46N
CQM 713 D X 63N
CQM 713 D X 49DK

D401.949/2

a second FET and the mixer output is filtered and amplified in order to obtain adequate drive for the RF mixer. The filters are helix circuits in order to suppress spurious signals, especially the oscillator frequency.

The conversions can be expressed as follows:

$$f_{RX} = f_{xRX} + f_S + IF_1$$

f_{RX} = Antenna frequency

f_{xRX} = Crystal oscillator frequency

f_S = Synthesizer signal frequency

IF_1 = 10.7MHz

Intermediate Frequency Circuits.

From the mixer in RC712 the 10.7MHz signal passes to the intermediate frequency converter, type IC703, which provides the channel selectivity of the receiver. The first IF signal passes through the 10.7MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal oscillator whose frequency is 455 kHz below 10.7 MHz. The crystal frequency is calculated:

10.7MHz 0.455MHz = 10.245MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455KHz ceramic filter in the IC703 converter and is then applied to the intermediate frequency amplifier in CF702.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a de-emphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

The signal is then applied to a three stage amplifier in which a fieldeffect transistor, operating as an electronic on/off switch, has been placed between the second and third stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level of -17 dBm (110 mV).

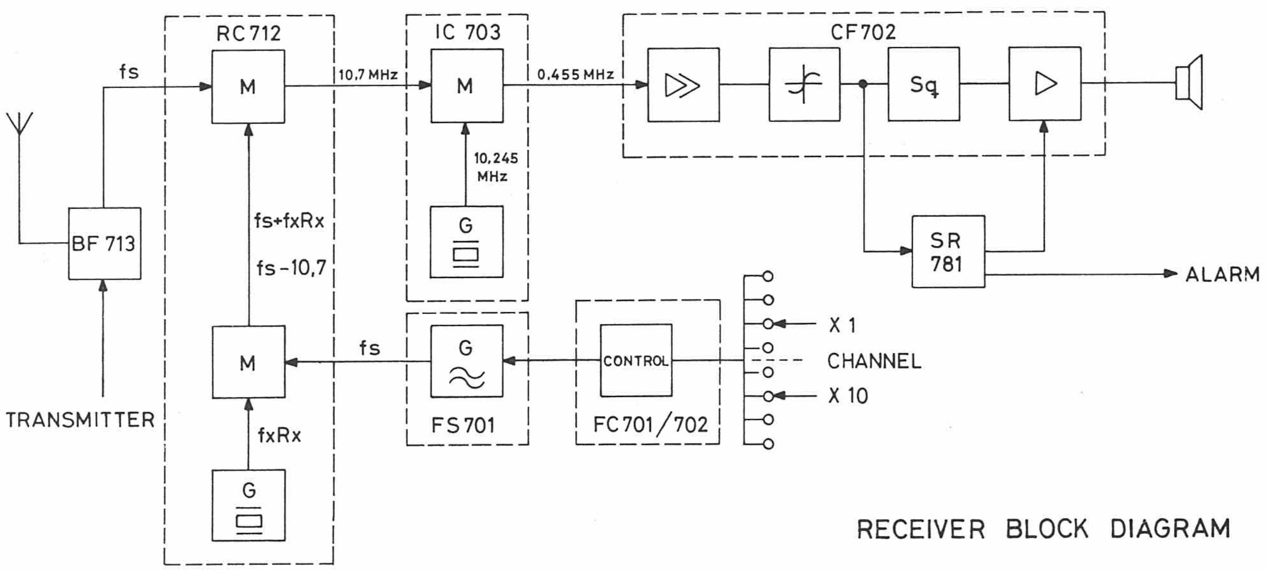
The signal is passed to the loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 2W into a 5 Ω load. The input stage is a high-pass active filter which attenuates frequencies below 250 Hz.

A variable resistor, forming part of the collector load, permits a preset 12 dB adjustment of the gain.

Manual gain adjustment, and thus loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the first and second AF amplifier stages.

The AF output stage consists of two complementary power transistors operating in Class AB pushpull.



RECEIVER BLOCK DIAGRAM

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the output amplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM700 is operated by noise components in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise amplifier.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

The transmitter is phase modulated and the output frequency is produced by mixing the syntesizer signal with the signal from a crystal controlled oscillator.

The transmitter comprises the following subunits:

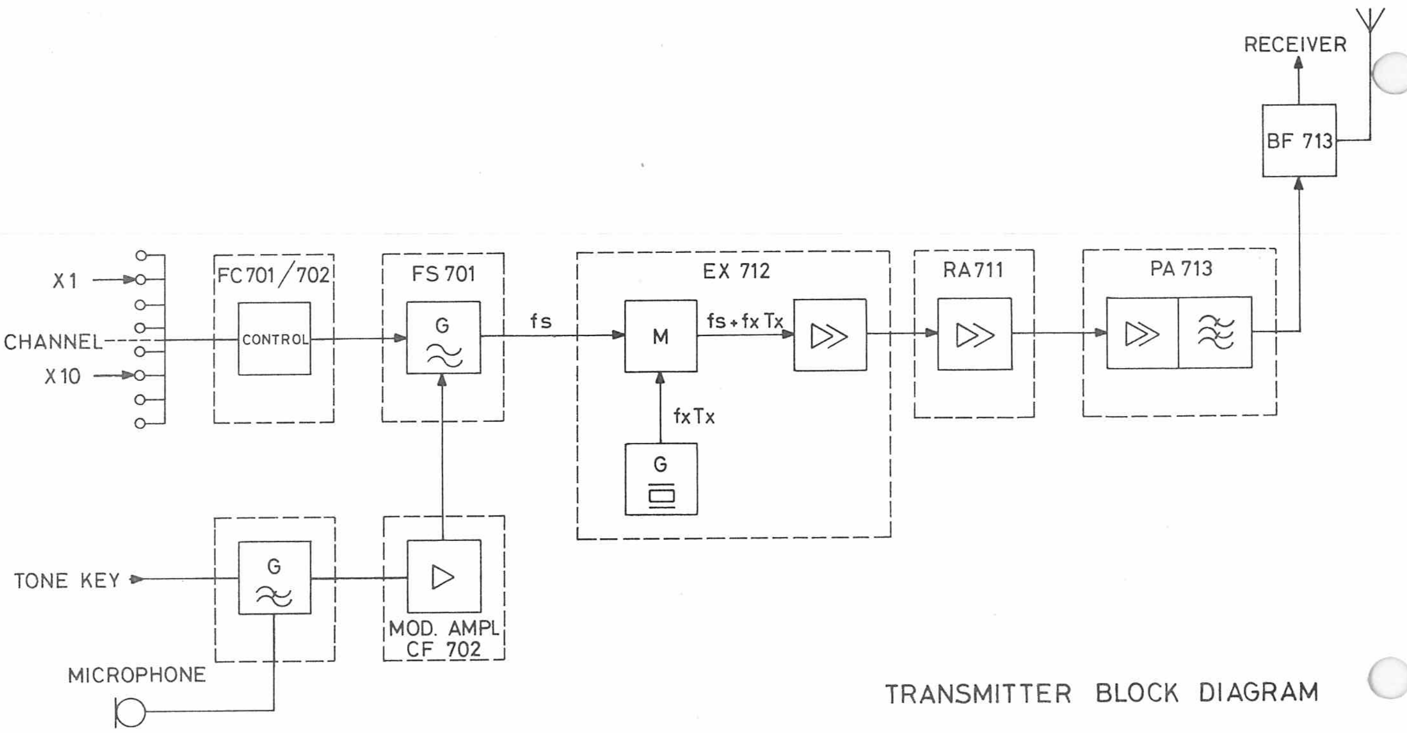
Exciter with crystal oscillator and mixer circuits	EX712
RF amplifier	RA711
RF power amplifier	PA713
Antenna Branching filter	BF713
Modulation amplifier, transmitter switch and voltage regulator (these circuits constitute part of CF702).	CF702

AF Circuits

The modulating signal from the microphone is fed, through the tone generator to the modulation amplifier where it is differentiated, amplified, limited, integrated and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.



TRANSMITTER BLOCK DIAGRAM

This limiter has been provided to prevent the modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the modulator, the modulating signal is filtered in a harmonic filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The RF signal is generated in a crystal controlled oscillator contained in the exciter EX712.

The oscillator signal is applied to a buffer amplifier, whose output is mixed with the synthesis signal. The mixer output is filtered and amplified in order to obtain an adequate signal for the RA711.

In order to suppress spurious signals, especially the oscillator frequency, 3 circuit helix filters are used.

The conversions can be expressed as follows:

$$f_{TX} = f_{xTX} + f_S$$

f_{TX} = Transmitting frequency

f_{xTX} = Crystal oscillator frequency

f_S = Synthesizer signal

The output signal from the exciter is fed to an RF amplifier (RA711) operating at the final frequency of the transmitter. Tuned input and output band pass filters of the amplifier provide aditional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the final RF power amplifier PA713. The nominal RF output power of RA711 is 100 mW into 50 Ω load.

RF Power Amplifier

The power amplifier contains three transistor amplifier stages. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency Class C amplifier. An Automatic Drive Control (ADC) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading the power transistor, and to reduce the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

The transmitter output power is adjusted to the required level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through a low pass 7pole Chebish filter. The antenna filter having low insertion loss and ripple attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonies of the transmitter frequency.

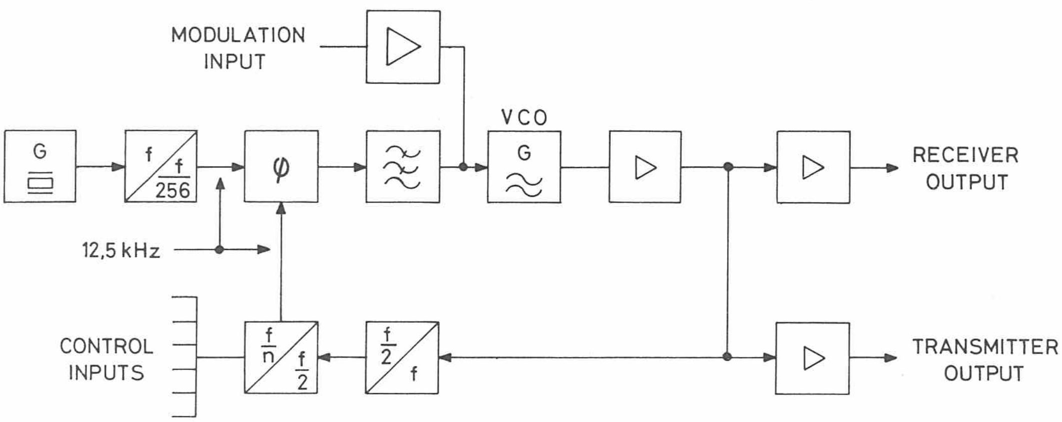
The antenna filter is not adjustable.

The transmitter signal at the output connector is fed through the antenna branching filter BF713 to the antenna.

Synthesizer Circuits.

The frequency synthesizer unit FS701 produces the synthesizer signal by the digital frequency synthesis method.

The signal is generated in a voltage controlled oscillator VCO whose output is amplified. The VCO is part of a phase locked loop consisting of a buffer amplifier, a programable frequency divider, a phase detector, a prescaler and a low pass filter.



SYNTHESIZER BLOCK DIAGRAM

The phase detector compares the divided VCO frequency to a 12.5 KHz reference frequency. Any difference in frequency will be opposed by the DC voltage at the low pass filter output adjusting the VCO frequency up or down until it locks to the reference frequency.

The 12.5 kHz reference frequency is produced by dividing the output of a 3.2 MHz crystal controlled oscillator by 256.

The RC oscillator frequency and the EX oscillator frequency are so chosen, that the lowest transmitting frequency corresponds to dividing by 600 in the programable divider. The three decades in the counter are controlled by the 9complement of the divisor expressed in the BCD code.

Frequency control

The incoherency between channel numbers and frequencies requires a frequency control unit (FC701 or FC702) to convert the channel number to the corresponding divisor. The conversion takes place in two 256 bit ROMs Read Only Memory) programmed to produce the 9-complement BCD code at the output when receiving the channel number BCD code at the input.

The inputs and the outputs of the two ROM's are connected in parallel and the enable input used to select the active ROM.

32 channels (00 31) are contained in the first ROM and the following 32 channels (32 63) in the second ROM.

The channel information from the channel selector is transmitted in the BCD code.

The ROM inputs, however requires the number to be expressed in the binary code and the conversion is implemented by IC1 and IC2.

The circuits in FC701/FC702 allow conversion of maximum 64 channels, the remaining 36 channels are blocked by additional logic circuits.

Channels not used in the public radiotelephone service are also blocked, as the blocking informations are programmed into the ROM's. When the channel selector is set to a blocked channel, the frequency control unit produce blocking voltages to blocking gates in the transmitter and receiver circuits, and an astable multivibrator flashes the channel display and the ON/OFF lamp.

The only difference between FC701 (DK) and FC702 (N) is the programming of the ROMs.

Power Supply and Switching Circuits

CQM713D is powered directly from a 12 volt car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A transient filter is provided to suppress noise and transients generated by the vehicle's electrical system.

A reverse biased zener diode connected across the battery input terminals limits the peak voltage to approx. 20 volts and protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the diode to conduct and blow the fuses fitted in the battery cable.

The CQM700 contains two almost identical voltage regulator circuits which deliver 9 V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

The transmitter regulator has a blocking transistor controlled by the transmit key button and the blocking voltage from the frequency control unit.

With the CQM713D in the standby or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed the blocking is superseeded. However, this requires the channel selector not to be set to a blocked channel and the tone receiver to be in condition "LS IN", if fitted.

The supply voltage for the PA713 power amplifier in the transmitter is taken from the transient filter and applied to the amplifier unit through a transistor switch. This switch is supplied by the transmitter voltage regulator which is controlled by the transmit key button.

The voltage to the transistor switch cannot be turned off by means of the ON/OFF switch of the radiotelephone.

Supply voltage for the TTL logic circuits is derived from a selfoscillating switching regulator (VR701) ensuring low loss and high efficiency.

CQM713D
ADJUSTMENT PROCEDURE

The following measuring instruments are required for making adjustments to the CQM713D radiotelephone.

RF Test probe	Storno code nr. 95.089
FM Signal generator	146 - 174 MHz
455 kHz crystal controlled generator	Storno G21b
Deviation meter	Radiometer BKF 6
Distortion meter	Storno E11
RF Wattmeter	0 - 0.1W / 0 - 10W
Multimeter	20 kΩ / V or better
Electronic DC Voltmeter	$R_{in} > 2$ MΩ / 1 V
DC Amperemeters	0.1 / 2.0 / 4.0 A
Power Supply	10.5 V - 21 V Preset current limiter 0.1 A - 4.0 A
Frequency Counter	

For testing toneequipment:

Tone Signalling Generator	Storno G13

RECEIVER ALIGNMENT

Before switching on the CQM713D connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6V and the current limiter to 100 mA.

With the station switched off inncrease the supply voltage until a current drain of 100 mA is reached.

Requirement: $V_{supply} \leq 21$ V.

Keeping within these values ensures correct operation of the protective zener diode, E13, in CF702.

Decrease the supply voltage to 13.6V and set the current limiter to 1A.

The station may now be switched on.

Check the 9V RX at terminal 3 on the IF converter.

Requirement: 9V ± 0.1V

If necessary, adjust the RX voltage by means of potentiometer R64 in CF702. This potentiometer can be reached from the rear of the module tray BA702.

Check the regulated 5V supply at the output terminal of VR701.

Requirement: 5V ± 0.1V

If necessary, adjust the 5V by means of potentiometer R11 in VR701. This potentiometer can only be reached, when the front panel has been removed and the VR701 screen box opened.

ALIGNMENT OF 2nd IF AMPLIFIER

To protect the IF amplifier input stages, establish a good chassis connection between a 455 kHz generator and the station.

Apply a 455 kHz signal to the input of CF702. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF702.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 10 µA if a multimeter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a constant or decreasing meter reading.

COARSE ADJUSTMENT OF L1 IN CF701

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box.

Connect an AC EVM to terminal 35 LINE OUT (AF 17 dBm) on the terminal board.

Adjust coil L1 in CF702 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R16 (AFRX) may be turned up. This potentiometer can be reached from the rear of the module tray BA702, and turns up counterclockwise.

ADJUSTMENT OF OSCILLATOR FREQUENCY IN IC700

If a frequency counter is available, the frequency may be read at test point [5] , IC703. If the input of the frequency counter is DC-coupled a capacitor (approx. 1 nF) should be connected in series. The frequency will be 10.245 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF702 and a 10.7 MHz generator to the input of IC703. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by activating buttons. The 10.7 MHz output is fixed, and the 455 KHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC703 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "Line out", 600 ohm audio output, which is accessible on the terminal board, terminal 35.

NOTE: The discriminator has no zero adjustment.

ALIGNMENT OF 1st IF AMPLIFIER (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC703.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF702.

Adjust coils L1, L2 and L3 in IC703 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC703: $\geq$ 20 dB

Alignment of the frequency synthesizer reference oscillator.

Select the channel corresponding to an output frequency of 16.000 MHz.

DK (Denmark) = 01
N (Norway) = 24

Connect a frequency counter to the TX output of the FS701.

Adjust C1 in FS701 for 16.000000 MHz ± 10 Hz.

Check all channels for correct synthesizer frequency according to the frequency allocation tables.

The receiver shall be blocked (no RF noise when pressing the SQ button and the LS in button) and the ON/OFF lamp and the channel display shall start flashing, when the channel selector is set to not used channels.

Alignment of mixer injection signal to RC712.

Connect a DC voltmeter to test points (1) and (2) in RC712.

Adjust L3 in RC712 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2mm.

The voltage with the oscillator stopped (short the crystal to chassis) will be approx. 0.25 V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to test point (4) in RC712.

Adjust L5 and L6, RC712, for maximum meter reading.

The voltage at test point (4) with the oscillator stopped will be approx. 0.7V.

Start the oscillator.

Requirement: Minimum increase must be $\geq$ 0.25V
Typical: 0.6V

Adjustment of crystal oscillator frequency, RC712.

Connect a frequency counter to test point [3] in RC712. Adjust L1, RC712, for correct frequency.

Requirement: DK = Denmark; f = 142.700 MHz ± 150 Hz.
N = Norway; f = 141.800 MHz ± 150 Hz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to RC712 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked, and any readjustment requires the frequency to be readjusted.

Checking the FS701 output level.

Connect an RF probe 95.089 and a multimeter to terminal 5 in RC712.

Set the channel selector to the centre channel.

DK = channel 26
N = channel 03

Stop the RC crystal oscillator and measure the RF level (approx. 0.4V).

Select the channels having the higher frequency and the lower frequency and measure the RF level.

Maximum deviation relative to centre channel

2dB~approx. ± 0.1V.

If the level is low in one position, L7 in RF amplifier I in FS701 is adjusted for best symetry.

Alignment of filters and RF amplifier, RC712.

Connect a voltmeter to test point (5) in RC712.

Stop the crystal oscillator in RC712 (short the crystal to chassis).

Course tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 158MHz. Adjust L8, L9, L10, L14, L15, L16, and L17 for maximum reading on the voltmeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select the centre frequency channel

DK = channel 26
N = channel 03

Turn the tuning slug of L5 in BP712 flush with the outside of the chassis.

L8, L9, L10, L14, L15, L16, and L17 is adjusted for maximum meter reading in test point (5).

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 10% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

The voltage at test point (5) with the oscillator stopped will be approx. 3V.

Start the oscillator.

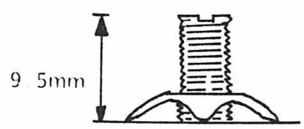
Requirement: Minimum increase at test point (5), is 1.0V

Check the voltage at the higher frequency and the lower frequency.

If the voltage drops at higher or lower frequencies, small corrections of the filter alignment may be implemented.

COARSE ADJUSTMENT OF BP712

The trimming slugs, L1, L2, L3, and L4 of the filter BP712 are to be set to the approximate positions. The picture indicate the mechanical position of the slugs . L5 is to remain in its position as set during the fine tuning of the filters.



FURTHER ALIGNMENT OF RC712,
FINE TUNING OF BP712, and
FINE TUNING OF IC703

Connect a DC EVM with an RF probe to test point [1] in CF702. An multimeter with 20kΩ/V may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700,

Select the centre frequency channel

DK = channel 26
N = channel 03

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF702, or 10.7 MHz to the IC703 input. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF702, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at test point [1], CF702.

The following coils are tuned for maximum meter reading in this order:

L17, RC712
L 5, BP712
L 4, BP712
L 3, BP712
L 2, BP712
L 1, BP712
L18, RC712
L 1, IC703
L 2, IC703
L 3, IC703

Due to interaciton, especially between L17 in RC, and L5 in BP, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting L17, RC712, the oscillator drive signal to the RF mixer will have decreased. L16, RC712, must be fine tuned for maximum reading on a DC voltmeter connected to test point (5), RC712.

Now, when stopping the oscillator, the voltage at test point (5) should fall at least 0.5V. L1, L2, and L3 in IC703, are now fine tuned for maximum reading at test point [1], CF702. The circuits in IC703 should be aligned two or three times, as they influence each other.

FINE TUNING OF L1 in CF702

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM713D, approx. 1 mV EMF from the generator.

Modulate the generator with 1 KHz to a frequency swing of ± 3.0 KHz.

Connect an audio voltmeter to test point [2] in CF702. This test point becomes accessible by unscrewing the upper PC-board of CF702.

Peak coil L1 in CF702, for maximum meter reading.

Requirement: ≥ 65 mV

NOTE: Terminal 35 "Line out", on the terminal board or the connector "Line out" on the control

units may be used instead of test point [2].
However, this reading is dependent on the setting of potentiometer R16, AF-RX, in CF702, and it must be checked that an audio level of ≥ 110 mV can be obtained from "Line out" for the appropriate frequency deviation as shown below.

ADJUSTMENT AND CHECKING OF AUDIO CIRCUITS

Modulate the RF generator with 1 KHz, and set the frequency deviation to 0.7 x Δ f max.: 3.5 kHz.

Set the RF generator output level to approx. 1 mV EMF.

If the CQM713D is provided with tone equipment press the LS in/out button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to "Line out".

Adjust the audio output level to 110 mV by means of R16 in CF702.

Connect a 5 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals. Set the volume control for 2.25 V on the meter.

Check the distortion.

Requirement: k ≤ 5%

NOTE: Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 2 W (by means of potentiometer R83 on CF702) for an audio input of 110 mV from LINE OUT (AF 17 dBm),
- a base bias to the output amplifier transistors ensuring a suitable no-signal current in the stage.

Consequent adjustment of the no-signal current in the output stage is performed in the following way:

Turn the station off, and the volume control down.

Turn potentiometer R99 fully counter-clockwise (viewed from the component side of CF702).

Set the supply voltage to 16 V.

Insert a milliammeter in the positive supply lead to the output amplifier (brown lead between the two PC-boards of CF702, terminals C / C of CF702.

Turn the station on. The reading will be approx. 15-25 mA.

Turn potentiometer R99 clockwise until the current drain has increased by 2 mA.

CHECKING THE AUDIO POWER OUTPUT

Set the volume control for 3.16 V across the audio output load (corresponding to a power output of 2W) for an input signal of 1 KHz, 110 mV.

Connect the distortion meter across the output and read the distortion.

Requirement: k ≤ 7%.

RECEIVER SENSITIVITY MEASUREMENT

EIA (Electronic Industri's Association)

Standard, definition:

The SINAD sensitivity of a receiver is the minimum input signal that will provide at least 50% of the receiver's rated audio output power with 12 dB signal + noise + distortion to noise + distortion.

METHOD OF MEASUREMENT

The purpose of the measurement is to define the ratio of one condition to another.

The first condition is the one where a modulated RF-signal drives the receiver into full limiting. The audio output is measured with the distortion meter (in the CAL position) and, disregarding the amplitude of the audio, this is adjusted to read 100 on the meter scale; this is our reference condition consisting of signal + noise + distortion, where 'signal' is the modulation of the RF, 'noise' is the lowest possible amount achieved from that particular receiver, when receiving a strong carrier, and 'distortion' is the modulation being slightly distorted in passing through the receiver.

The second condition is the one where the signal (modulation) is removed with a notch filter and the RF-signal is lowered in amplitude until the remaining noise and distortion increases to 12 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 25%, 25 being 12 dB below 100, which was our reference condition.
(100-6dB = 50, 50-6dB = 25).

In practice our first condition is achieved by feeding a minimum of 1000μ V of RF-signal modulated with 1000 Hz at 0.7 x Δ f max. to the receiver. The audio output (which must be at least 50% of the receiver's audio rating) is measured with the distortion meter in position CAL and adjusted with potentiometer ADJ. FSD. to a reading of 100.

The notch filter is then inserted in series with the audio by pressing one of the buttons marked in %. The meter needle immediately drops to indicate a low value, this being the receiver's inherent audio distortion.

By backing off the attenuator of the RF-generator, thereby lowering the RF-input to the receiver, the noise will eventually increase; The attenuator being adjusted for a reading on the distortion meter scale of 25%.

At this stage it must be ensured that the increased noise and the signal (with the notch filter switched out while checking) still equals 100 on the meter scale.

The RF-generator's calibrated attenuator now shows the value of RF-signal required to achieve a 12 dB ratio between signal + noise + distortion and noise + distortion, i. e. 12 dB SINAD sensitivity.

CHECKING RECEIVER SENSITIVITY

Modulate the RF generator with 1 kHz, and a frequency deviation of 0.7 x max. Δ f, i.e. ± 3.5 kHz.

Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 5 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the calibrated RF voltage from the RF generator, until 12 dB SINAD is obtained.

Requirement: ≤ 1.0 µV EMF.

The procedure should be repeated on all channels.

ADJUSTMENT AND CHECK OF SQUELCH

Adjust the squelch by means of potentiometer R38 in CF702 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

CHECKING OVERALL CURRENT CONSUMPTION

Check the current drain at 13.6 V supply voltage.

Requirement: CQM713D with tone equipment, TT781, SR781, and channel indicator ID701.
≤ 900 mA.

TRANSMITTER ADJUSTMENT

Unless the receiver alignment procedure has been performed, check for correct operation of the protection diode, E13, on CF702. This test is described in the first paragraphs under "Receiver Alignment".

Then set the supply voltage to 13.6 V, and the current limiter to 4 A.

If tone equipment is installed, the LS in/out button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9V TX at terminal 19 on the terminal board.

NOTE: If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.

Requirement: 9 V TX = 9 V ± 0.1 V.

If necessary, adjust the TX voltage by means of potentiometer R72 on CF702. This potentiometer can be reached from the rear of module tray BA702.

Alignment of mixer injection signal to EX712.

Connect a DC voltmeter to test point (1) and (2) in EX712.

Adjust L3 in EX712 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2mm.

The voltage with the oscillator stopped (short circuit the crystal to chassis) will be approx. 0.25 V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to test point (4) in EX712.

Adjust L5 and L6, EX712, for maximum meter reading.

The voltage at test point (4) with the oscillator stopped will be approx. 0.7 V.

Start the oscillator.

Requirement: Minimum increase at test point (4), EX712 = 0.25 V.

Adjustment of crystal oscillator frequency, EX712.

Connect a frequency counter to test point [3].

Adjust L1, EX712, for correct frequency.

Requirement: DK = Denmark; f = 144.400 MHz.
N = Norway; f = 144.500 MHz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to EX712 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked and any readjustment requires the frequency to be readjusted.

Checking the FS701 output level.

Connect an RF probe 95.089 and a multimeter to terminal 5, EX712. Set the channel selector to the centre channel.

DK = channel 26
N = channel 03

Stop the RC crystal oscillator and measure the RF level (approx. 0.4V)

Select the channels having the higher frequency and the lower frequency and measure the RF level.

Maximum deviation relative to centre channel:

2dB~approx. ±0.1V.

If the level is low in one position, L6 in FS701 is adjusted for best symetry.

Alignment of filters and RF amplifier, EX712.

Connect an RF probe 95.089 and a multimeter to testpoint 8 in EX712 (output terminal).

Stop the crystal oscillator in EX712 (short the crystal to chassis).

Course tuning

Connect an RF generator for the input of BP-filter I, and set the generator for 160.0 MHz. Adjust L8, L9, L10, L14, L15, and L16 for maximum reading on the multimeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select the centre frequency channel.

DK = channel 26
N = channel 03

Adjust L8, L9, L10, L14, L15, and L16 for maximum meter reading, approx. 5.6V.

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 10% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

Alignment of RF amplifier RA711

Connect a voltmeter to test point (10) in RA711.

Adjust L16 in EX712 for minimum meter reading. Adjust L1, L2, L3, L4, and L5 in RA711 for minimum meter reading, approx. 4.0 V.

Remove the RF signal load between RA711 and PA713.

Connect an RF Watt meter 0 - 0.1 W to the RA711 output.

Adjust L6, RA711 for maximum output.

Adjust L1, L2, L3, L4, L5, and L6 for maximum output.

Repeat the adjustment until no further increase in meter reading can be obtained.

Requirement: $P_{OUT} \geq 80$ mW.

The requirement should be fulfilled on all channels. The total variation in output power should be less than 1 dB within the bandwidth.

Alignment of RF Power Amplifier, PA713.

Reestablish the connection between RA711 and PA713.

Connect a wattmeter to the antenna output.

Select the centre frequency channel.

DK = channel 26
N = channel 03

Set the supply voltage to 13,6 V.

Turn the ADC potentiometer, R2, in PA713 up (clockwise).

Set all trimmer capacitors for half capacity.

NOTE: The PA713 should be aligned with its shielding lid in place, and insulated trimming tools should be used.

Install the lid and key the transmitter.

Remove shorting link designated "A" and insert a DC amperemeter instead.

Adjust trimmer capacitor C7 for maximum reading on DC amperemeter.

Remove shorting link designated "C" and insert the DC amperemeter.

If no current can be obtained increase the capacity of trimmer C22 and repeat the adjustment of C16.

Adjust trimmer capacitors C22 and C23 for maximum power output (repeat the adjustment a couple of times.)

Adjust trimmer capacitors C14 and C16 for maximum power output (repeat the adjustment a couple of times).

Repeat the alignment of C22, C23, C14 and C16.

Adjust trimmer capacitors C10 and C11 for maximum power output.

Adjust trimmer capacitors C6 and C7 for maximum power output.

Make the final adjustments for C6, C7, C10, C11, C14, C16, C22, and C23, in that order, for maximum power output.

Set the ADC potentiometer, R2 in PA713, for 10 watts power output with 13,6V supply voltage from the power supply. This will ensure a power output of more than 8W if the supply voltage is increased to 16 volts taking into account that the ADC circuit will reduce the power output with increasing supply voltage.

The relationship between supply voltage, power output, and current consumption in the individual stages of PA713 is dependent on the antenna frequency.

The current in individual stages may be read by substituting an amperemeter for the shorting links, A, B, and C, in the collector leads of transistors Q1, Q2, and Q3 in PA713.

Requirements:

At 10.5V supply voltage,

Power output: > 6W

Current in "C": < 1.6 A

At 13.6V supply voltage,

Power output: = 10 W

Current in "C": < 1.8 A

Current in "B": < 0.6 A

Current in "A": < 80 mA

At 16.0 V supply voltage,

Power output: ≥ 8 W

Current in "C": < 1.8 A

Current in "B": < 0.5 A

Current in "A": < 80 mA

Correct values here also indicates that the ADC circuit is operating satisfactorily.

Storno

The power deviation between channels selected at random should not be greater than 0.5 dB.

Measure the total current consumption, tone equipment and channel display included, at 13.6 V.

Requirement: $I_{total} \leq 3.9$ A

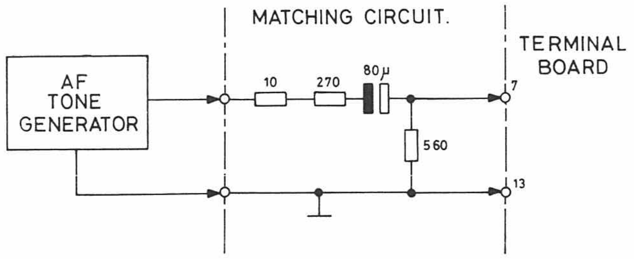
Adjustment of Modulation and Frequency Deviation

Connect the deviationmeter to the transmitter out put via an attenuation network (10 W capacity).

Connect a distortion meter to the audio output of the deviation meter.

Set the power supply voltage to the CQM713 to 13.6 V.

Connect a tonegenerator to terminal 7 and 13 (chassis) on the terminal board through a network as outlined below.



Select the channel having the higher frequency.

DK = Denmark = channel 05.
N = Norway = channel 15.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF702. The 6 dB loss in the network is also taken into account, and the nominal input level will be found to be 2.2 V~26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 KHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R124 on CF702 to Δ f max. $\geq \pm$ 5 kHz.

Select the centre frequency channel

DK = channel 26
N = channel 03

Set the audio generator to 1000 Hz and the output to 220 mV.

Adjust R133 in CF702 for nominal frequency deviation:

CQM713D x 49 DK: $\Delta f_{nom} = 3.3$ kHz

CQM713D x 46 N: $\Delta f_{nom} = 3.0$ kHz

Check the frequency deviation, Δf_{nom}, at 1000 kHz on all channels.

Requirement: $V_{mod} = 220$ mV $\pm$ 26 mV

Check the distortion on the audio output of the deviation meter.

Requirement: $k \leq 7\%$ (without deemphasis).

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5-40 MHz.

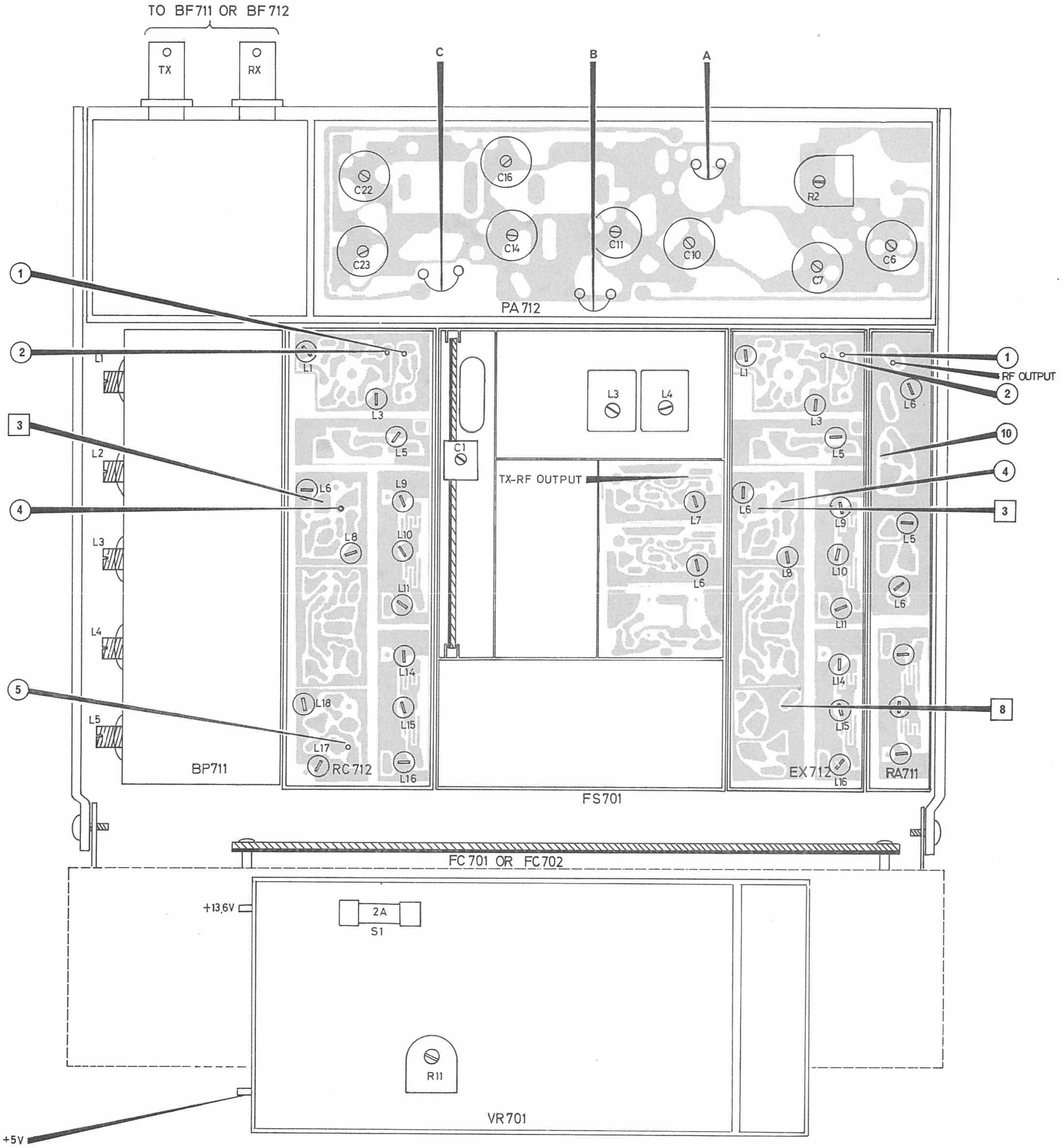
The existence of parametric oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TSF42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5V and 16V.

For further details please refer to STORNO Service News No. 38 of May 1969.

Antenna Branching Filter

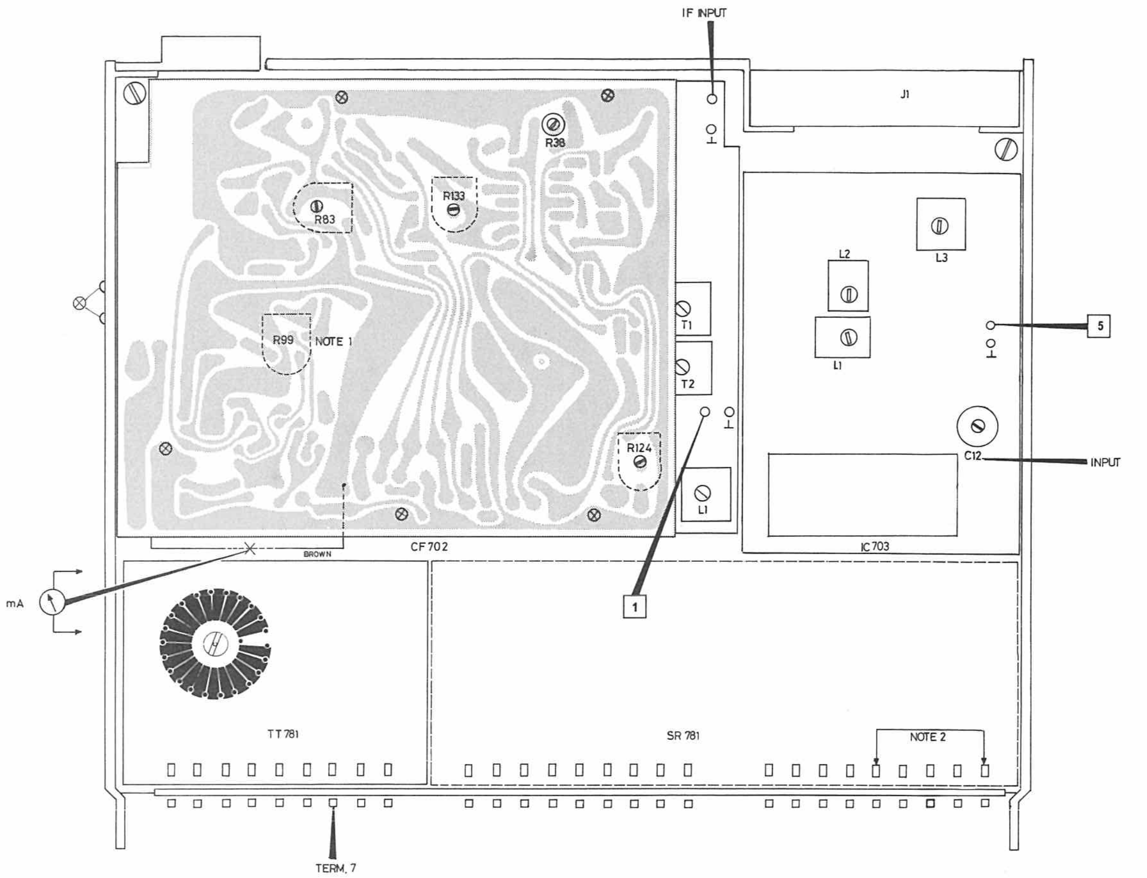
The filter is factory aligned and should never be touched.

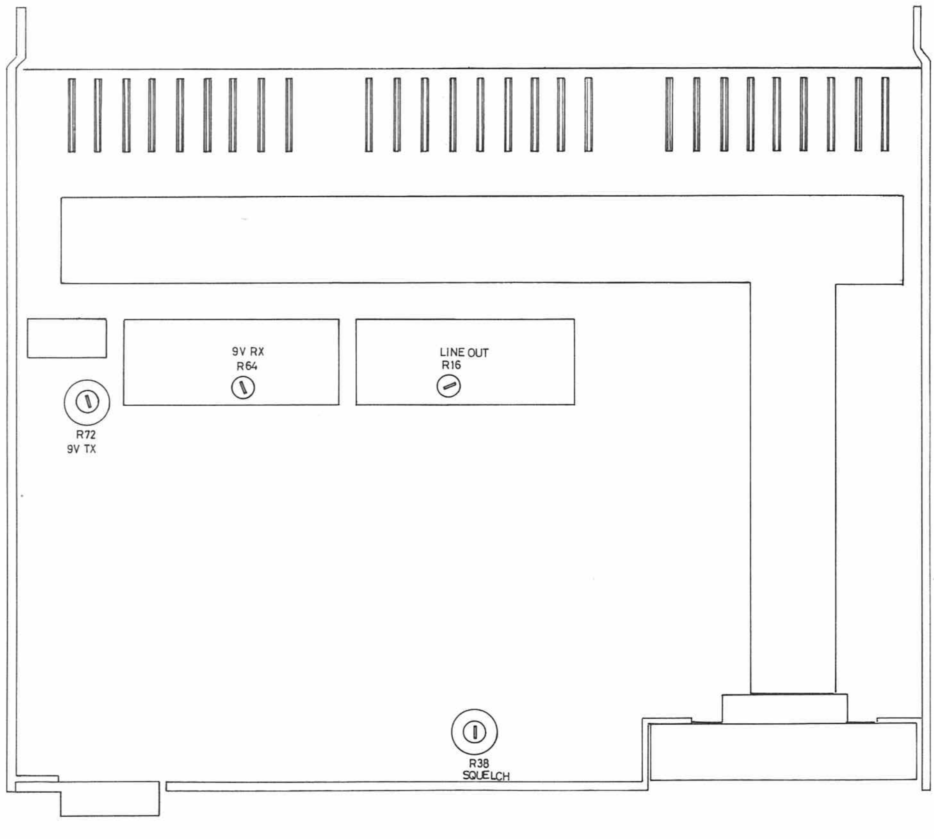


RADIO ASSEMBLY RF713 (CQM713D)

Location of Test Points and Adjustable Components

Storno



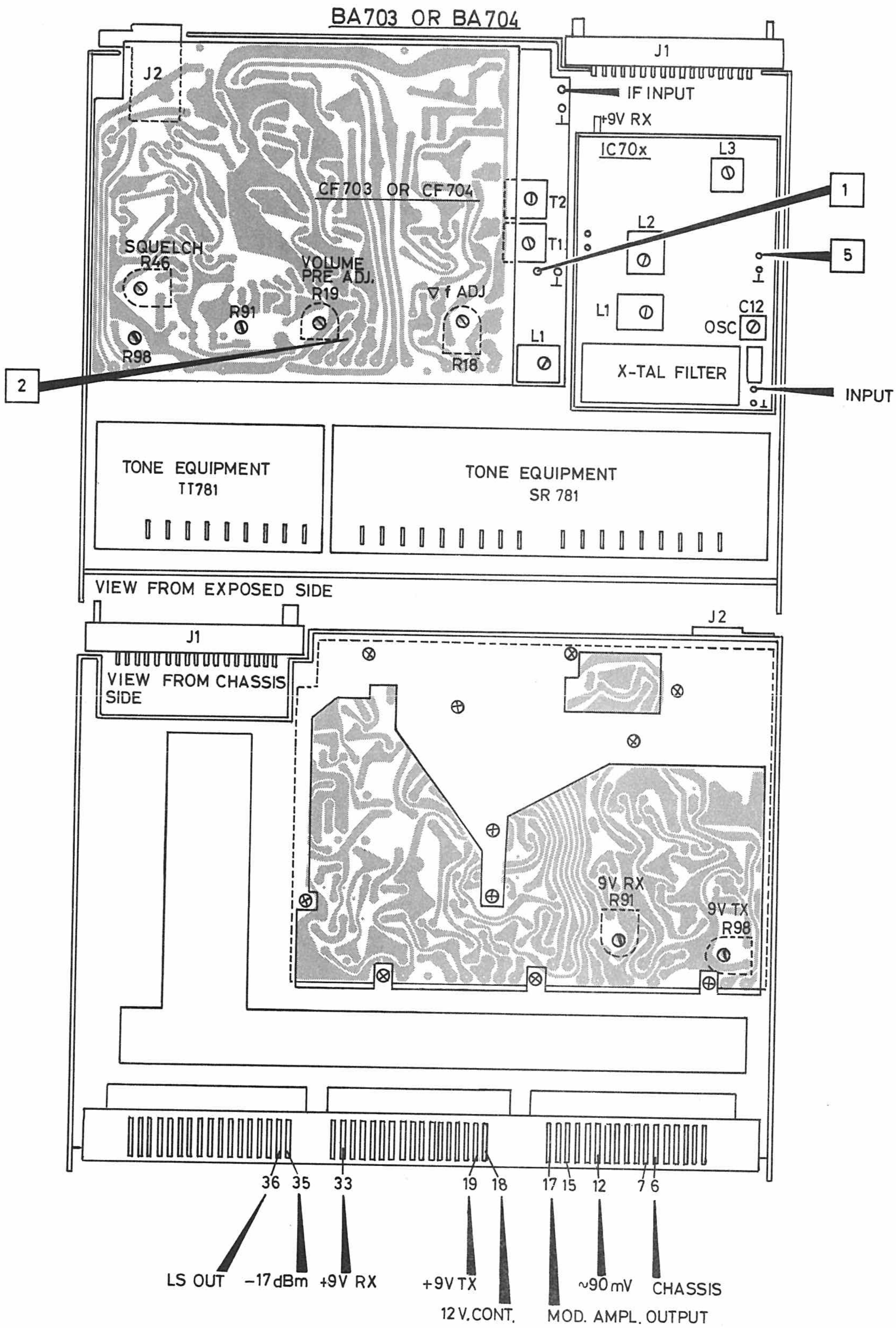


BASIC ASSEMBLY BA702 (CQM700D)

Location of Test Points and Adjustable Components

D402.233

Storno



BASIC ASSEMBLY BA703 AND BA704

Location of Test Points and Adjustable Components

Storno

CQM710a

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS152A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

GENERAL SPECIFICATIONS

Frequency Range

146 - 174 MHz

Min. Channel Separation

CQM713: 20 kHz or 25 kHz
CQM714: 12.5 kHz

Max. Frequency Deviation

CQM713: ± 4 kHz or ± 5 kHz
CQM714: ± 2.5 kHz

Frequency Stability

Meets government specifications

Max. VHF Bandwidth

1 MHz

Number of Channels

Max. 6

Antenna Impedance

50 Ω

Temperature Range

Operating range: $-25^{\circ}C$ to $+50^{\circ}C$
Functioning range: $-30^{\circ}C$ to $+60^{\circ}C$

Dimensions

Locally controlled version: 180 x 190 x 68 mm
Extended local control: 180 x 160 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight

Locally controlled version: 2.1 Kg
Extended local control: 1.9 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output

CQM710a: 25 W
CQM710a-6: 6 W

Type of Modulation

Phase

AF Response

6 dB/octave preemphasis

CQM713: 300 - 3000 Hz
+0/-1.5 dB (+0.5/-3 dB)

CQM714: 300 - 2500 Hz
+0/-1.5 dB (+0.5/-3 dB)

Modulation Distortion (measured with deemphasis)

3% (7%)

Modulation Sensitivity

110 mV e.m.f. (600 Ω) ± 3 dB

AF Input Impedance

560 Ω

Adjacent Channel Selectivity

Attenuated to meet government specifications

FM Hum and Noise (measured without deemphasis)

CQM713: 50 dB (40 dB)
CQM714: 45 dB (38 dB)

Spurious Radiation (FTZ)

Less than 0.2 µW

Harmonic Radiation (FTZ)

Less than 0.2 µW (2 µW)

RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD EIA

0.4 µV (0.6 µV)

Squelch

Electronic, adjustable

Adjacent Channel Selectivity EIA

CQM713: 85 dB (80 dB)
CQM714: 80 dB (75 dB)

Adjacent Channel Selectivity FTZ, MTP

CQM713: 85 dB (80 dB)
CQM714: 80 dB (75 dB)

Intermodulation Attenuation EIA

CQM713: 75 dB (70 dB)
CQM714: 75 dB (70 dB)

Intermodulation Attenuation FTZ, MTP

CQM713: 70 dB (66 dB)
CQM714: 75 dB (70 dB)

Blocking MPT

300 mV (100 mV)

Spurious Radiation

Less than 0.5 n W (2 nW)

Spurious Response Attenuation

90 dB (80 dB)

AF Output Power EIA

4 W (load 4 Ω)

AF Distortion

CQM713: 3% (7%)
CQM714: 4% (8%)

AF Response

CQM713: -6 dB/octave from 300 - 3000 Hz
+0/-1.5 dB (+0.5/-3 dB)

CQM714: -6 dB/octave from 300 - 2500 Hz
+0/-2 dB (+0.5 dB/-3 dB)

Hum and Noise, squelched

70 dB (60 dB)

Hum and Noise, unsquelched

CQM713: 50 dB (45 dB)
CQM714: 45 dB (40 dB)

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POWER SUPPLY SPECIFICATIONS

CURRENT CONSUMPTION AT 13.6 V

Stand by: 180 mA (250 mA).
Receive, 2W AF output: 0.5 A (0.6 A).
Transmit: CQM710a: 3.6 A (4.6 A).
CQM710a-6: 1.3 A (2.0 A).

Storno

CQM710a
GENERAL DESCRIPTION

Introduction

The Stornophone CQM710a radiotelephone is a mobile transmitter/receiver for simplex operated FM radio communication on the 146 to 174 MHz frequency band.

The CQM710 comes in a choice of channel spacings:

CQM713 for 20 or 25 kHz channel spacing
CQM714 for 12.5 kHz channel spacing

For both versions there is a choice of 6 or 25 W RF output power.

CQM710a - 6: 6 W RF output power
CQM710a : 25 W RF output power.

There are also two mechanically different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Each radio set can be equipped for either single or multichannel service. Multichannel sets will have a channel selector arranged as a row of push buttons on the control panel, accomodating up to 6 channels. Choice of channels (frequencies) must naturally take into account the RF bandwidth of the radiotelephone, which is 1 MHz.

Construction

The radio chassis slides into the cabinet from the front and is held in place by screws from the rear of the cabinet. The chassis consists of two circuit panels hinged onto the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF714, contains all the circuits which are dependent upon channel frequencies. These are:

antenna filters
receiver VHF circuits
crystal selector unit, where included
exciter
transmitter power output amplifier.

The lower circuit panel, designated BA703, contains those units common to all the frequency bands within the CQM710 programme:

audio amplifier
intermediate frequency amplifier
squelch circuit
voltage regulators
tone equipment, where included

The solid-state circuitry is built up as functional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:

Channel Separation

3 25 kHz or 20 kHz
4 12.5 kHz

Type of Front Plate employed

C1 CP701 (1 channel)
C2 CP702 (max. 6 channels)
C3 CP703 (Dummy)

Type of Crystal Shift Unit employed

X1 None (1 channel)
X6 XS701 (max. 6 channels)

CQM71xa spec. XX XX

Control Equipment

The locally controlled CQM710 will have one of the following front panels:

- CP701 Front panel with controls and built-in speaker. This panel has no channel selector, limiting the equipment to single-channel service.
- CP702 Front panel like CP701 with the addition of 6 push buttons for multi-channel service.

The CQM710 for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703. One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

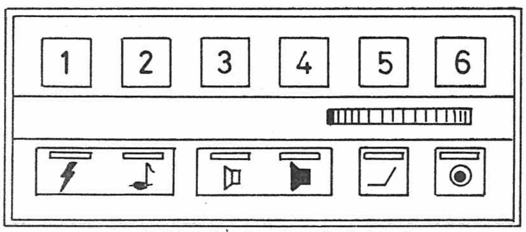
- CB701 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone. This control unit has no channel selector (single-channel service).
- CB702 Control unit similar to CB701, and containing 6 push buttons for the channel selector (multichannel service).

Where more than one RF channel is required (multichannel operation), the radiotelephone must be fitted with one of the following crystal switching units:

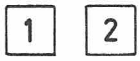
- XS701 Channel selector unit for a maximum of 6 channels.
- XS702 Channel selector unit for a maximum of 4 channels with temperature compensation for operation in extremely cold climates.

Operating Controls

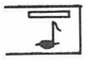
The controls located on the front panel are as shown:

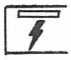


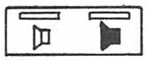
CP/CB FRONT PANEL



Push buttons for channel selection.

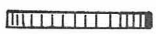
 Tone button and lamp indication when the channel is engaged (in equipment with built-in tone transmitters).

 Transmit button and transmit indicator lamp (in radiotelephones without built-in tone transmitters).

 Button for switching the loudspeaker on and off, provided with a lamp indicating when a tone call is received, (This button is only used in conjunction with tone equipment).

 Squelch button for overriding the squelch function.

 ON/OFF switch and indicator lamp.

 Volume control.

Notice:

For radiotelephones with built-in tone transmitters an external keying device (e.g. a steering column switch or microphone button) must be employed as the transmitter key, since the regular button on the front panel is used for keying the tone transmitter.

Accessories

Accessories available for the CQM710a series radiotelephones are listed in this section. Some of them such as installation materials, antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

- MC701 Fixed microphone with built-in amplifier.
- MC702 Fixed microphone with built-in amplifier, transmit button and retainer.
- MC703 Fixed microphone for mounting on steering column.
- MT701 Handset with built-in amplifier and transmitter keying switch.

All of the above are supplied with cables for termination in a special multiconnector providing connections between accessories and the radio cabinet.

- MK701 To bring the microphone into close talk position this mounting kit, consisting of 2 flexible metal tubes (length 20 and 35 cm), is available.

Storno

Antenna

AN19-5 1/4 wavelength whip antenna for the 146 to 174 MHz frequency band. 50 Ω impedance matches Stornophone CQM710a. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM710a radio set will require some or all of the following installation kits:

MN701 Mounting frame for radio cabinet

CC701 Cable kit containing battery cable and antenna cable necessary for installing the radiotelephone.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with the battery cables.

MK702 Mounting kit similar to MK701, to be used when installing 25 W transmitters.

For extended local control the distance between control unit and radio set may be increased by inserting:

CC703 Extension cable kit with connectors.

Loudspeakers

When using the extended local control system it is necessary to install an external loudspeaker. The following types are available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable to be soldered into the accessories connector.

LS702 Weatherproof version of loudspeaker.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for dashboard mounting.

SU704 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

Power Supplies

PS701 Power supply for 24 V car battery, any battery polarity.

PS702 Power supply for 24 V car battery, negative pole to chassis.

CIRCUIT DESCRIPTION

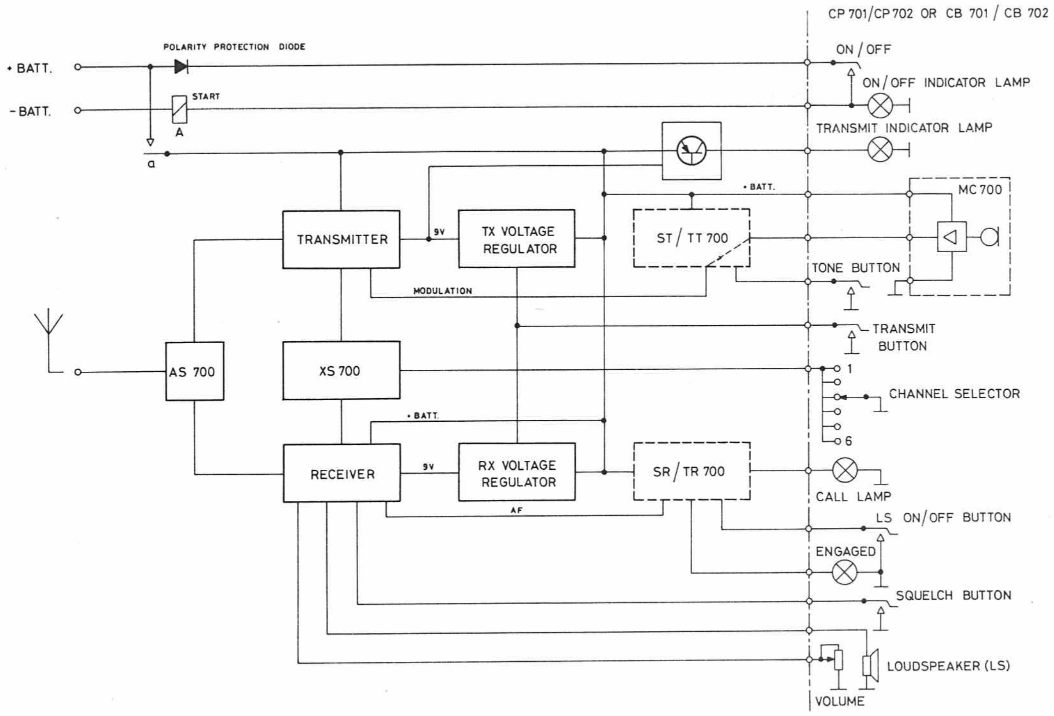
General

The nominal 12 V supply from the battery is applied to the connector designated "BATT". Start relay in series with a diode across the battery input protects the radiotelephone against incorrect supply polarity. The battery voltage is applied to two 9 V regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment, if fitted.

The incoming signal passes through the antenna switching unit to the input of the receiver. The antenna switching is controlled by the stabilized supplies from the transmitter and receiver voltage regulators.

In the single channel edition of CQM710a a crystal controlled oscillator is incorporated in the transmitter section. Similary, a single oscillator is provided in the receiver section.

FUNCTIONAL DIAGRAM CQM 700



Channel switching unit XS is fitted in the multi-channel edition of CQM700 and is controlled by the channel selector.

The audio output from the receiver is applied to the loudspeaker (LS). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output signal may be connected to the tone receiver TR700 used in selective tone calling systems. The tone receiver enables the AF output circuits of the receiver to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.
When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "call" and "engaged" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) via the tone generator TT700, if fitted.

During transmission of tone calls, the microphone will be switched off automatically so that the transmitter is modulated by the tone signal from TT700 only.

The transmitter is keyed by depressing the transmit button. This will block the receiver voltage regulator and cancel the blocking of the transmitter voltage regulator. When the transmitter voltage regulator operates, supply voltage is applied to the exciter.

The "transmitter on" condition is indicated by the transmit indicator lamp.

In the radiotelephone fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched on manually by means of the loudspeaker ON/OFF button.

RECEIVER

The CQM710a receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. The high RF sensitivity characteristic of the receiver is provided by a RF amplifier.

Adjacent channel selectivity is obtained by using two bandpass filters: a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 6 crystal controlled oscillators, one for each channel, can be provided. The oscillators are connected in parallel and channel selection is performed by grounding the negative supply lead of the appropriate oscillator.

The receiver comprises the following subunits:

Antenna switching unit	AS713
RF amplifier	RA712
Receiver converter with 1st mixer and 1st local oscillator	RC711
Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator, and 455 kHz ceramic filter:	
for 25 and 20 kHz channel spacing	IC703
for 12.5 kHz channel spacing	IC704
455 kHz intermediate frequency amplifier, squelch circuit, AF amplifier, and voltage regulator (for other circuits of CF703 see page 6)	CF703
Channel switching unit: maximum 6 channels	XS701

Signal Path

From the antenna switching unit the input signal is passed through the RF amplifier to the mixer stage.

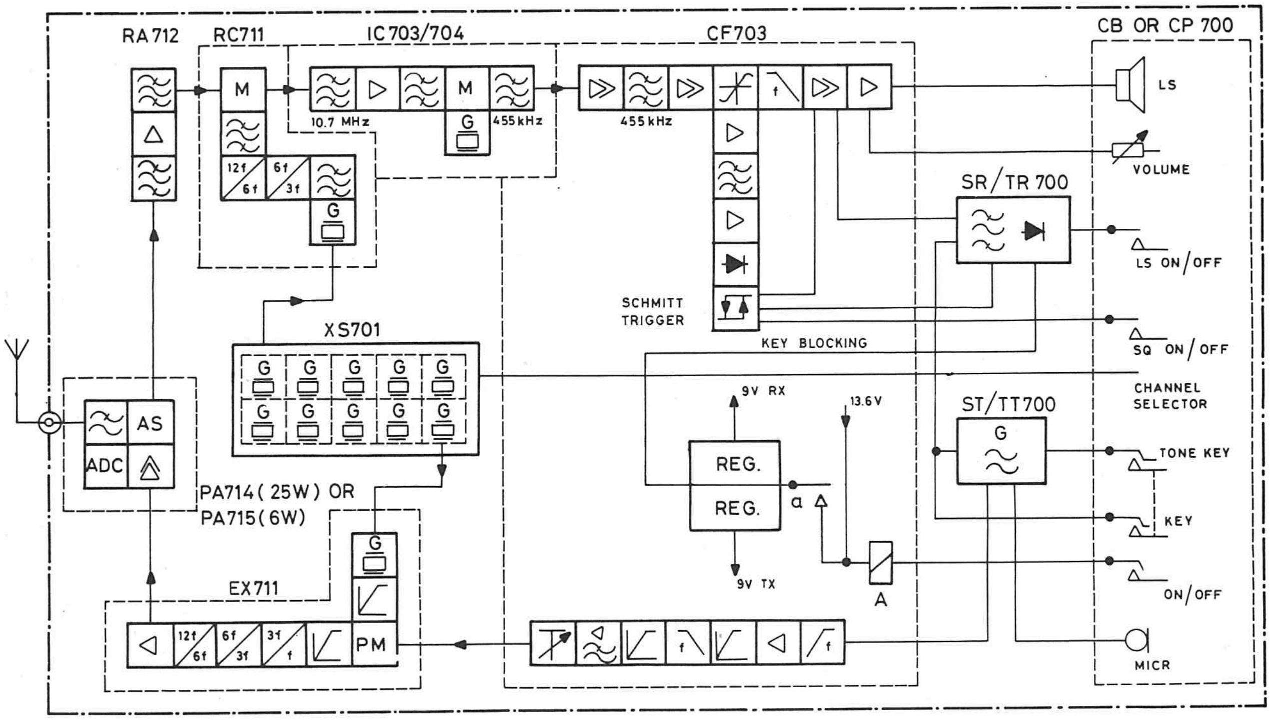
The local oscillator and the received signals are applied to the gate of the FET. The mixer output at 10.7 MHz is taken from the drain circuit.

First Local Oscillator

The local oscillator signal is generated in an oscillator operating on the fundamental frequency of the crystal. The oscillator operates within the frequency range 11.35 MHz to 12.75 MHz, depending on the crystal frequency used.

In the oscillator, the 3rd harmonic of the crystal frequency is selected and applied to a multiplier chain consisting of two doubler stages. The output frequency is thus 12 times the fundamental frequency of the oscillator.

The last doubler stage is followed by a filter consisting of three capacitively coupled tuned circuits. The filter attenuates undesired frequencies generated by the multiplier chain and prevents these from reaching the mixer stage.



Storno

The injection signal is 10.7 MHz below the received signal and is calculated as follows:

$$fx = \frac{f_a - 10.7}{12} \text{ MHz}$$

where fx is the crystal, MHz and f_a is the received signal, MHz.

The receiver converter RC711 includes an oscillator intended for use in single-channel receivers. When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

XS701 contains oscillators for five RF channels thus allowing the receiver to be equipped with a maximum of 6 channels.

XS702 is a temperature compensating unit employed where radiotelephones are to work in very low tempetatures. The compensation is provided by heating the crystals when the ambient temperature falls below -5° C approximately.

XS702 contains oscillators for a maximum of 4 channels.

Intermediate Frequency Circuits

From the mixer in RC711 the 10.7 MHz signal passes to the intermediate frequency converter, type IC703 or IC704 depending on the channel separation used, which provides the channel selectivity of the receiver.

The first IF signal passes through the 10.7 MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal controlled oscillator whose frequency is normally 455 kHz below 10.7 MHz. In instances where a harmonic of the local oscillator coincides with the frequency of the received signal, a crystal oscillator frequency of 455 kHz above 10.7 MHz is chosen.

In the first case the crystal frequency is:
10.7 MHz - 0.455 MHz = 10.245 MHz

In the second case the crystal frequency is:
10.7 MHz + 0.455 MHz = 11.155 MHz.

The crystal frequency of 11.155 MHz is used when the received frequencies are within the following bands:

152.5 - 154.9 MHz
162.7 - 165.1 MHz
173.0 - 174.9 MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455 kHz ceramic filter in the IC703 or IC704 converter and is then applied to the intermediate frequency amplifier in CF703.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a deemphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the reciever.

The signal is then applied to an integrated amplifier in which a transistor, operating as an electronic on/off switch, has been placed between the two stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level of -17 dB (110 mV).

The signal is passed to the integrated loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to a maximum output level of 4 W into a 4 Ω load (EIA), 2 W (CEPT). The amplifier attenuates frequencies below 250 Hz.

Manual gain adjustment, and thus the loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the preamplifier and AF output amplifier.

The AF output stage consists of an integrated AF power module.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the preamplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM710a is operated by noise components contained in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise detector.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

(See block diagram on page 5)

The transmitter is phase modulated. Its output frequency is 12 times the oscillator frequency. Phase modulation is performed at the fundamental frequency.

The transmitter comprises the following subunits:

Exciter	EX711
RF power amplifier 25 W	PA714
RF power amplifier 6 W	PA715
Antenna switching unit 25 W	AS713
Modulation amplifier and voltage regulator	CF703
(These circuits constitute part of CF703)	

Channel switching unit:

Maximum 6 channels	XS701
Maximum 4 channels, temperature compensated	XS702

AF Circuits

The modulating signal from the microphone is fed, through the tone generator if fitted, to the modulation amplifier where it is differentiated, amplified, limited, integrated, and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the phase modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

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The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the phase modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the phase modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The fundamental RF signal is generated in a crystal controlled oscillator contained in the exciter EX711.

When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

As in the receiver, channel selection is performed by grounding the negative return of the appropriate oscillator.

The exciter provides the following:

(a) phase modulation
(b) frequency multiplication
(c) drive power for the power amplifier PA714 or PA715.

The RF signal from the oscillator is applied to the 1st buffer amplifier, then to the phase modulator, followed by the 2nd buffer amplifier. The buffer amplifiers provide constant input levels and correct impedance matching.

The phase modulator is a "transconductance modulator" as the phase modulation is produced by varying the transconductance of a transistor.

The modulating signal is applied to the emitter of the transistor whose operating point and transconductance thus change instantaneously with the modulating signal.

From the 2nd buffer amplifier, the signal is fed to a frequency multiplier chain consisting of a tripler, 1st doubler and 2nd doubler. The transmitter output frequency is therefore 12 times the crystal frequency.

The three multipliers are designed as balanced circuits resulting in suppression of some of the harmonic frequencies.

The tripler suppresses the even harmonics and the doublers suppress the odd harmonics.

Double tuned bandpass filters are used with close-to-dritical coupling between tuned circuits. These filters limit the bandwidth of the exciter and attenuate undesired harmonics generated in the frequency multiplication process.

The output signal from the 2nd doubler is fed to an amplifier operating at the final frequency of the transmitter. Tuned input and output bandpass filters of the amplifier provide additional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the RF power amplifier. The nominal RF output power of EX711 is 50 mW into a 50 Ω load.

The bandwidth of the transmitter and thus the maximum frequency spread of the channels is determined by the selectivity of the exciter, which is 1 MHz.

Storno

RF Power Amplifier

The power amplifier contains three (PA715 = two) transistor amplifier stages. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency Class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading the power transistor. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage. In the 25 W version the ADC circuit is also controlled by the heat sink temperature of the power amplifier.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through an electronic antenna switching unit and a low-pass filter to the antenna.

The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The low-pass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple.

The filter attenuates signals at undesired frequencies to an acceptable low level, e.g. harmomics of the transmitter frequency.

The antenna filter is not adjustable.

Power Supply and Switching Circuits

CQM710a is powered directly from a 12 volt car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A start relay connected across the battery input terminals protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the relay series diode not to conduct and thus the relay refuses to operate.

The CQM710a contains two identical voltage regulator circuits which deliver 9 V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

Each regulator has a blocking transistor controlled by the transmit key button. With the CQM710a in standby or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed, operation and blocking of the two voltage regulators are reversed. The supply voltage for the power amplifier in the transmitter is taken from the battery and applied directly to the amplifier.

ADJUSTMENT PROCEDURE FOR CQM710
RECEIVER ALIGNMENT

Before switching on the CQM700 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 1 A.

The station may now be switched on.

Check the 9 V RX at terminal 33 cn the terminal board.

Requirement: 9 V ± 0.1 V

If necessary, adjust the RX voltage by means of potentiometer R91 in CF703. This potentiometer can be reached from the rear of the module tray BA700.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 kHz gene rator and the CQM700 chassis.

Apply a 455 kHz signal to the input of CF703. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF703.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF703

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box, or by switching the squelch off on the control unit C33/C34. Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the teerminal board. On the control units C33/C34 the reading may be taken from LINE OUT.

Adjust coil L1 in CF703 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R19 (AF-RX) may be turned up. This potentiometer can be reached from the top of the module tray BA700, and turns up counter-clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency counter is available, the frequency may be read at test point [5], IC700. If the input of the frequency counter is DC-coupled, a capacitor (approx. 1 nF) should be connected in series. The frequency will either be 10.245 or 11.115 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF703 and a 10.7 MHz generator to the input of IC700. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC700 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "Line out", 600 Ω audio output, which is accessible on the terminal board, terminal 35, and on the control units C33/C34.

NOTE: The discriminator has no zero adjustment.

Storno

Alignment of 1st IF Amplifier (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC700.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF703.

Adjust coils L1, L2, and L3 in IC700 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC700: $\geq$ 20 dB.

Alignment of Multiplier Chain in RC711

When crystals have been inserted in RC711 and/ or XS701/XS702, select the middle frequency channel.

Connect a DC voltmeter to test point (1) in RC711.

Tune L7 and L8 in RC to maximum, approx. 0.4V.

Requirement: $\geq$ 0.3 V.

Connect a DC voltmeter to testpoint (2) in RC711.
Adjust L6 to minimum, approx. 8 V.
Requirement: $\leq$ 8.5 V.

To tune for maximum drive to the 1st mixer, connect a DC voltmeter with an RF probe to test point (2) in RC711.

L5, RC711, is adjusted for maximum meter reading.
L4, RC711, is adjusted for minimum meter reading.
L3, RC711, is adjusted for maximum meter reading.
L1, RC711, is adjusted for minimum meter reading.

Since only very small variations occur at test point (2), especially in the final circuits, the drive to the 1st mixer should be checked:

Connect a DC voltmeter to test point (3) in RC711.

Touch up the tuning of coils L5, L4, L3, and L1 for maximum meter reading.

Stop the oscillator (select a channel with no crystals or take a crystal out).

The voltage at test point (3) with the oscillator stopped will be 1 to 4.5 V.

Start the oscillator.

Requirement: Minimum increase at test point (3), RC711 = 0.5 V.

Adjustment of Temperature Regulating Circuit in XS702

The temperature regulating circuit of XS702 has been adjusted before leaving the factory. However, if necessary, it may be readjusted as follows:

Turn potentiometer R39 in XS702 fully counterclockwise.

Remove jumper connecting the NTC resistor.

Set the supply voltage for the CQM700 to 13.6 V.

Check the current consumption of XS702 by inserting an ammeter in the orange/blue wire to XS702.

Adjust the current to 0.45 A by means of R39 (This adjustment should not exceed 30 seconds).

Insert jumper connecting the NTC resistor again and reconnect the orange/blue wire.

Further Alignment of RC711, Tuning of RA712, and Fine Tuning of IC700

Connect a DC EVM with an RF probe to test point [1] in CF703. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700. Set the RF output level to 100 mV.

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF703. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

During adjustment the RF generator output should be kept low enough to prevent limiting in CF703, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at test point [1], CF703.

The following coils are tuned for maximum meter reading in this order:

L1, RA712
L2, RA712
L3, RA712
L4, RA712
L5, RA712

Due to interaction, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting L1, RC711, the oscillator drive signal to the first mixer will have decreased. L3, RC711, must be fine tuned for maximum reading on a DC voltmeter connected to test point (3), RC711.

Now, when stopping the oscillator, the voltage at test point (3) should fall at least 0.3 V.

L2 in RC, and L1, L2, and L3 in IC700, are now fine tuned for maximum reading at test point [1], CF703. The circuits in IC700 should be aligned two or three times, as they influence each other.

Fine Tuning of L1 in CF703

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM700, approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz, (for CQM714: ± 1.75 kHz).

Connect an audio voltmeter to test point [2] in CF703. Peak coil L1 in CF703, for maximum meter reading.

Requirement: $\geq$ 50 mV

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 kHz, and set the frequency deviation to 0.7 x Δ f max.:

CQM713a (25 kHz channel spacing) 3.5 kHz.
CQM713a (20 kHz channel spacing) 2.8 kHz.
CQM714a (12.5 kHz channel spacing) 1.75 kHz.

Set the RF generator output level to approx. 1 mV EMF.

If the CQM700 is provided with tone equipment press the LS in/out button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to terminal 35.

Adjust the audio output level to 110 mV by means of R19 in CF703.

Measure the AF voltage at the telephone output, on C33/C34 or pin z on the multiwire connector.

Requirement: 90 mV ± 1.2 mV.

Connect a 4 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker. The load is incorporated in the control units C33/C34.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals or to LS in/out on C33/C34. Set the volume control for 3.16 V on the meter. ∿ 2.5 W.

Check the distortion.

Requirement: CQM713a (-5): K $\leq$ 7%.
CQM714a (-5): K $\leq$ 9%.

NOTE:

Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 4 W (by means of potentiometer R19 on CF703) for an audio input of 110 mV from LINE OUT (AF -17 dBm).

Adjustment of Oscillator Frequency in RC711

The frequency is measured after the doubler with a counter connected to test point (2) in RC711. The frequency should be

$f_{antenna}$ -10.7 MHz. The oscillator frequency is adjusted with C27, RC711.

In CQM700, with XS701/XS702 frequency adjustment must be performed on each channel with the trimmer capacitor of the appropriate oscillator.

Requirement:

CQM713: Better than ± 1 x 10^{-6}
CQM714: Better than ± 0.5 x 10^{-6}

The tolerances are valid only for a crystal temperature of 25° C.

Checking Receiver Sensitivity

Modulate the RF generator with 1 kHz, and a frequency deviation of 0.7 x max. Δ f. Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 4 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the RF generator output until 12 dB SINAD is obtained on the distortion meter.

Read the calibrated RF voltage from the RF generator.

Requirement: for 12 dB SINAD $\leq$ 0.55 μ V EMF.

If more than one channel is provided, the procedure should be repeated on all channels.

Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R46 in CF703 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

TRANSMITTER ADJUSTMENT

Then set the supply voltage to 13.6 V, and the current limiter to 5 A. (1.8 A for 6 W transmitter)

If tone equipment is installed, the LS in/out butto must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9 V TX at terminal 19 on the terminal board.

Requirement: 9 V TX = 9 V ± 0.2 V.

If necessary, adjust the TX voltage by means of potentiometer R98 on CF703.

Alignment of Exciter EX711

Remove the RF signal lead between EX711 and PA714 (715).

Connect a 47 Ω resistor across the output of EX711 (this load may also be soldered across the input of an RF probe, STORNO 95.059, and the probe connected across the output of EX711 for the duration of the alignment of the exciter).

When crystals have been inserted in EX711 and/or XS701/XS702, select the middle frequency channel and key the transmitter.

Connect a DC voltmeter to test point (1) in EX711.

Adjust L4 and L5 for maximum meter reading, approx. 1.4 V.

Move the voltmeter to test point (2) in EX711.

Adjust L7 and L6 for maximum meter reading. approx. 0.8 V.

Move the meter to test point (3) , EX711.

Adjust L9 and L8 for maximum, approx. 0.05 V.

Adjust L10 for maximum output.

Adjust L6, L7, L8, L9, and L10 for maximum RF output from EX711.

Requirement: $P_{out} \geq 100$ mW.

(Measured with a DC voltmeter and RF probe 95.059, the voltage should read more than 5.0 V).

Alignment of RF Power Amplifier.

Reestablish the connection between EX711 and PA714.

Connect a Wattmeter to the antenna connector.

The power amplifier should be aligned at a supply voltage of 12.5 V. This ensures highest possible output power at low supply voltage and a resonable high efficiency at high supply voltage.

Power Amplifier PA714 (25 W)

Turn the ADC potentiometer, R11, PA714 up (clockwise), but observe that the current drain does not exceed 5 A during the adjustments.

Adjust trimmer capacitors C2, C6, C8, C9, C13, and C15 in that order for maximum current drain until a Wattmeter deflection is obtained.

Repeat the adjustment until maximum output power is obtained.

a. During the following adjustment the ADC potentiometer, R11, is set to 20 W output power.

b. Connect a voltmeter to testpoint (1) .

c. Adjust capacitors C2 for minimum voltage.

d. Adjust capacitors C6, C8, C9, C13, and C15 for maximum output power.

Repeat steps a to d.

Increase the supply voltage to 16 V and set the ADC potentiometer, R11, to 22 W output power.

Remove link NOTE 1 and set R12 to 4 W output power.

Insert link NOTE 1.

Readjust the ADC potentiometer for 22 W output power.

Measuring RF Output Power, Current Consumption and the Function of the ADC Circuit.

The RF output power and the current consumption are measured at 16 Volt, 13.6 Volt and 10.5 Volt supply.

Requirements:

Supply voltage	Power	Current
16 V	= 22 W	≤ 3.8 A
13.6 V	≥ 20 W	≤ 4.3 A
10.5 V	≥ 12 W	≤ 4.3 A

If the figures above can be obtained on all channels the ADC circuit is operating properly.

Power Amplifier PA715 (6 W)

Turn the ADC potentiometer R6, PA715, up (clockwise), but observe that the current drain does not exceed 1.8 A during the adjustments.

Adjust trimmer capacitors C2, C12, C15, and C14 in that order for maximum current drain until a Wattmeter deflection is obtained.

Repeat the adjustment until maximum output power is obtained.

a. During the following adjustment the ADC potentiometer is set to 6 W output power.

b. Connect a voltmeter to the ADC testpoint.

c. Adjust trimmer capacitor for minimum ADC voltage.

d. Adjust capacitors C12, C14, and C15 for maximum output power.

e. Repeat steps a to d.

Increase the supply voltage to 16 V and set the ADC potentiometer, R6, to 6 W output power.

Measuring RF Output Power, Current Consumption, and the Function of the ADC Circuit.

The RF output power and the current consumption are measured at 16 V, 13.6 V, and 10.5 V supply.

Requirements:

Supply Voltage	Power	Current
16 V	= 6 W	≤ 1.6 A
13.6 V	≥ 5.5 W	≤ 1.8 A
10.5 V	≥ 3.5 W	≤ 1.6 A

If the figures above can be obtained on all channels the ADC circuit is operating properly.

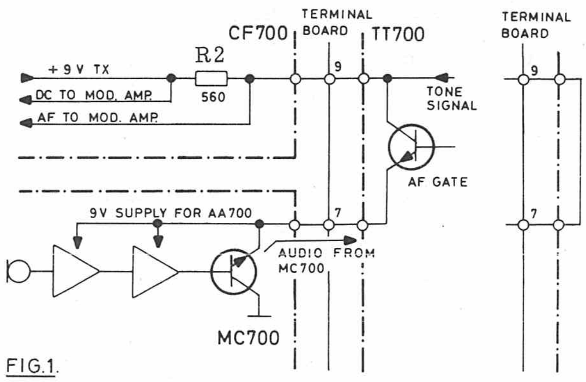
Use of Control Unit C33/C34 When Adjusting Modulation

The control units C33/C34 may be used for stations with or without tone equipment and a voltage divider and a DC locking capacitor is incorporated.

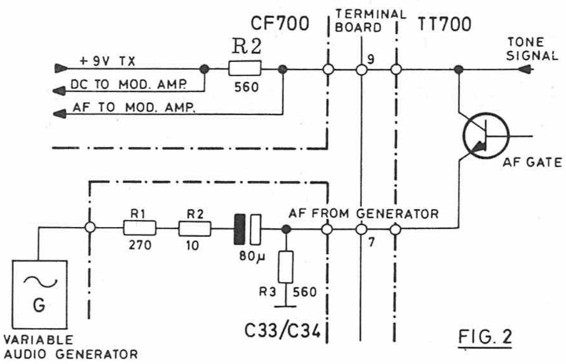
Where a tone transmitter is installed the modulation signal must pass through the switching transistor (the AF gate) in the tone transmitter. The emitter resistor for this transistor is situated in the microphone amplifier, which is disconnected when adjusting the modulation. An alternate DC path must therefore be provided for the switching transistor in the tone transmitter to allow it to pass the modulation to the modulation amplifier of the CQM700. The DC supply voltage for the microphone amplifier in MC700 is also obtained through the switching transistor. This DC voltage should be isolated from the audio generator output.

A resistor R3, in fig. 2 has been installed to provide the DC path for the switching transistor.

This resistor would, as far as AC is concerned, seem to be in parallel with R2 in CF703. To the audio generator the two would present an impedance of 280 Ω which is only half the required value. Another resistor, consisting of R1 and R2 in C33/C34, places 280 Ω in series with the input signal, bringing the input impedance up to 560 Ω. At the same time, a capacitor in series with the signal effectively blocks the DC voltage from CF703, which is normally fed to the microphone amplifier in MC700 through terminal 7 of the terminal board.



MODULATION PATH FROM MC700 TO CF700, AND 9V SUPPLY FROM CF700 TO MC700.



MODULATION THROUGH USE OF CONTROL UNIT C33/C34

The resistors combine as a voltage divider when seen from the input to the control unit marked "modulation, AF gen.". This voltage divider attenuates the audio generator output by 6 dB in passing through C33/C34 to the modulation amplifier on CF703. The generator output must therefore be set 6 dB above the required input to the amplifier modulation. The adjustment procedure takes this into account.

Adjustment of Modulation and Frequency Deviation

NOTE:

Where an ST7845 is installed, STRAPS must be substituted during the following procedure.

Connect the deviation meter to the transmitter output via an attenuation network (25 W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM700 to 13.6 V.

Connect an audio generator to the modulation input of control unit C33 or C34.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF 703. The 6 dB loss in C33/C34 is also taken into account, and the nominal input level will be found to be

2.2 V -26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 kHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R18 on CF703.

CQM713a (-6)	(25 kHz)	Δ f max. = ± 5 kHz
CQM713a	(20 kHz)	Δ f max. = ± 4 kHz
CQM714a	(12.5 kHz)	Δ f max. = ± 2.5 kHz

NOTE:

If the adjustment of Δ f is impossible, e.g. the deviation is too high, the brown wire to terminal 23 on CF703 is moved to terminal 24 and capacitor C8 (47 nF) is removed.

Set the audio generator to 1000 Hz and attenuate the the output until a frequency deviation of 0.7 x Δ f max. is read on the deviation meter.

CQM713	(25 kHz)	0.7 x Δ f max. = ± 3.5 kHz
CQM713	(20 kHz)	0.7 x Δ f max. = ± 2.8 kHz
CQM714	(12.5 kHz)	0.7 x Δ f max. = ± 1.75 kHz

Requirement:

V_{mod} = 220 mV ± 2 dB
(175 mV - 275 mV) input to C33/C34.

Storno

Check the distortion on the audio output of the deviation meter.

Requirement: k $\leq$ 10% (without de-emphasis)

Checking the Transmitter Stability

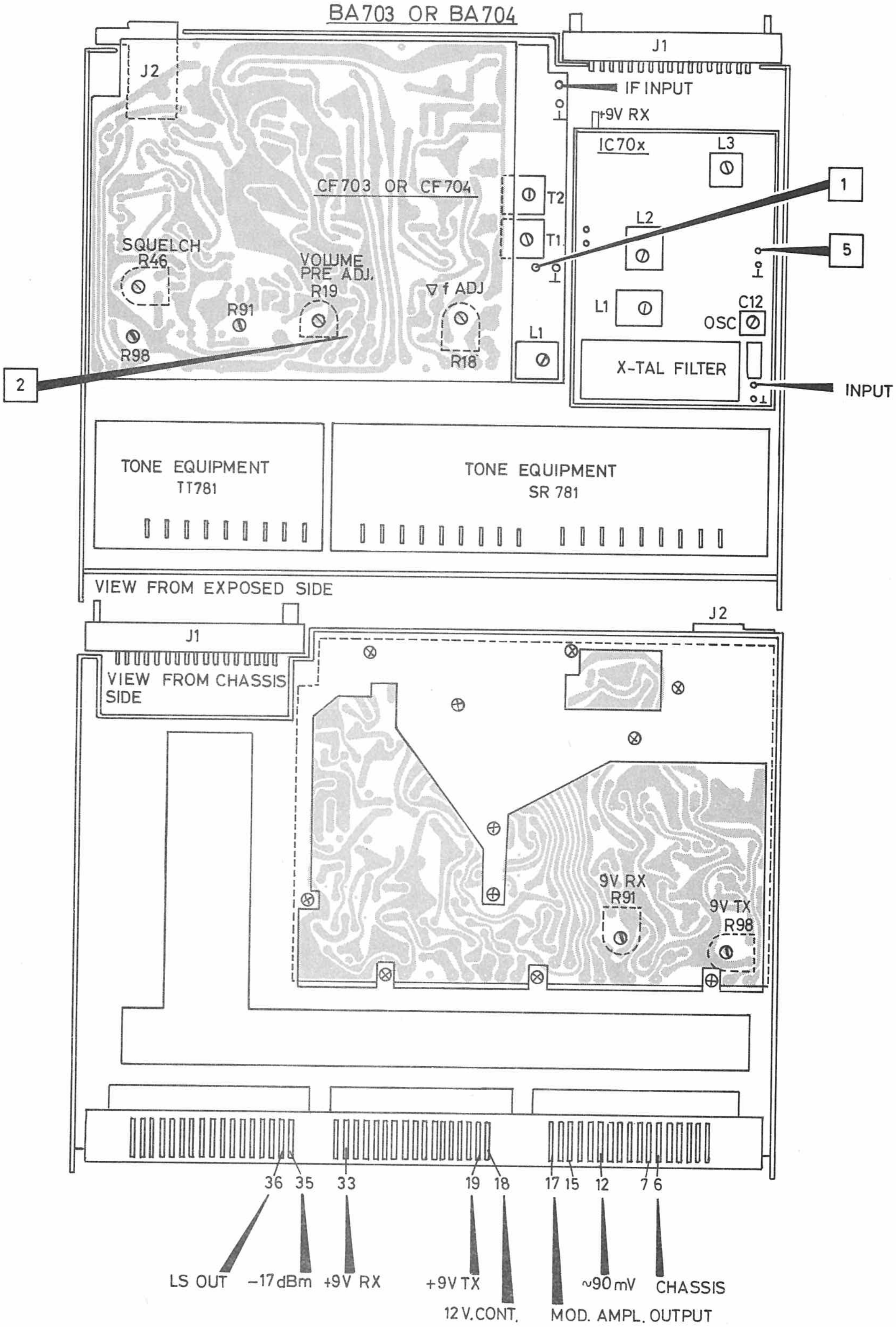
Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between

0.5 - 40 MHz.

The existence of parasitic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

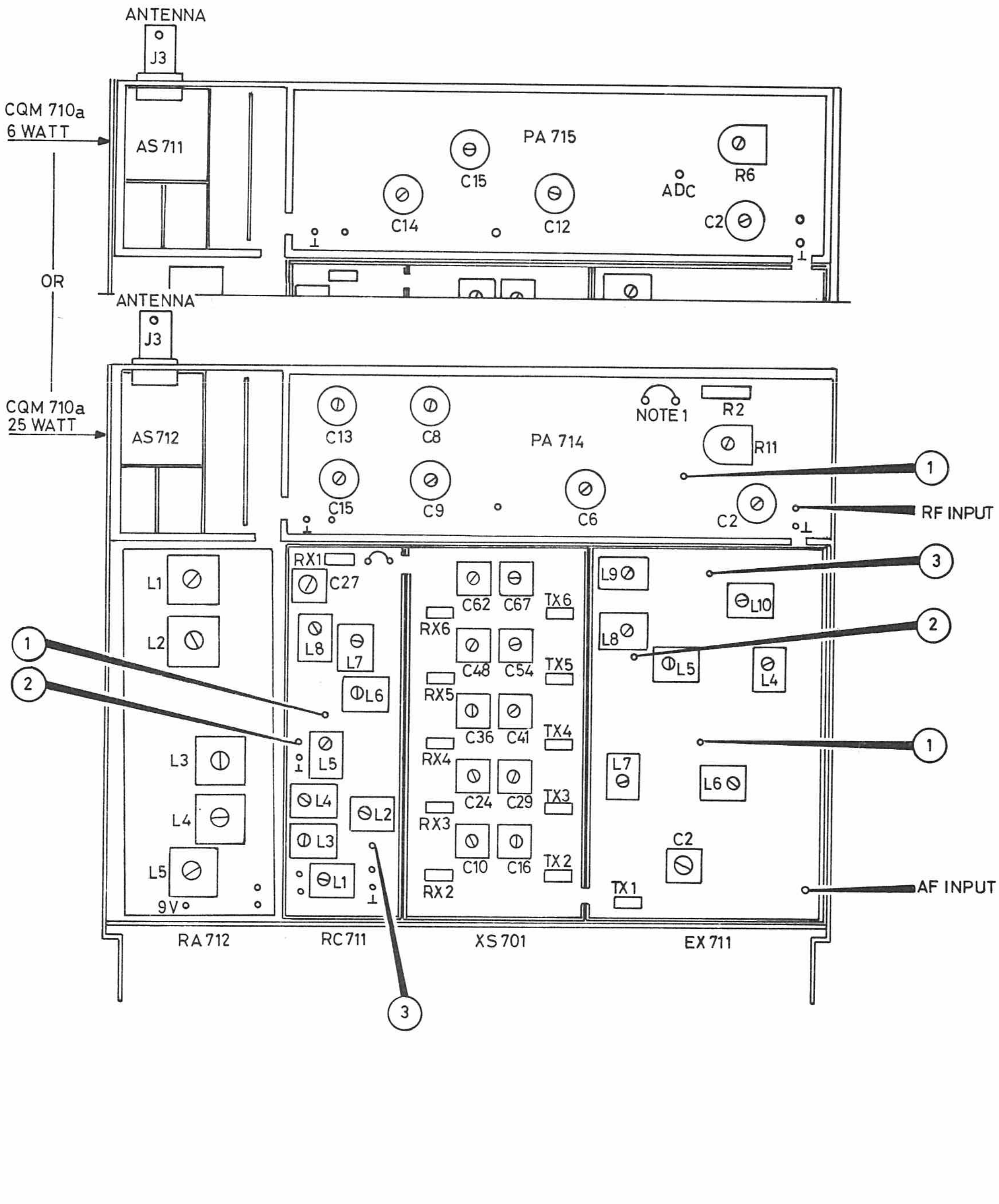
For further details please refer to STORNO Service News No. 38 of May, 1969.



BASIC ASSEMBLY BA703 AND BA704

Location of Test Points and Adjustable Components

Storno



RADIO ASSEMBLY RF714 (CQM713a, CQM714a)

Location of Test Points and Adjustable Components

D402.390

CQM713 P3
TECHNICAL SPECIFICATIONS

Figures given in brackets are typical values.

GENERAL SPECIFICATIONS

Frequency Rangé

RX: 163.050 - 164.400 Hz
TX: 158.550 - 159.900 Hz

RF Bandwidth

1.35 MHz

Channel Separation

25 kHz

Channel Number

55 channels

Type of Modulation

Phase

Modulation Frequency Range

300 - 3000 Hz.

Maximum Frequency Deviation

± 5 kHz.

Nominal Frequency Deviation

± 3.5 kHz.

Antenna Impedance

50 Ω

Supply Voltage (minus on chassis)

13.6 V ± 10%

Temperature Range

-10°C - +40°C

Dimensions

180 x 210 x 70 mm

Weight

2.5 Kg.

RECEIVER SPECIFICATIONS

Sensitivity

2.5 µV e.m.f. for 20 dB S/N
20 µV e.m.f. for 40 dB S/N

Squelch open

1.8 µV e.m.f.

Squelch close

0.5 µV e.m.f.

Squelch hysteresis

0.5 µV e.m.f.

Squelch delay

open: 50 ms (45 ms)
close: 2000 ms (40 ms)

Crystal Frequency, RC712

136.275 MHz

Frequency Stability (-10°C - +40°C)

1.5 kHz.

Modulation Pass Band (EIA)

5 kHz (7 kHz)

Adjacent Channel Selectivity

+15°C - +30°C: 10 mV
-10°C - +40°C: 3 mV

Blocking, fant > ± 150 kHz.

100 mV

Intermodulation

S/N 20 dB: 50 dB
+20 dB: 40 dB
+40 dB: 30 dB

Spurious Attenuation

3 mV

Radiation into an Artificial Load

20 nW

AF Load Impedance

Loudspeaker: 4 Ω
MT703 : 20 Ω in series with 470 Ω

AF Output to Loudspeaker

3 W (4 W)

AF Output to MT703

1 mW

Distortion

10% (3%)

AF Frequency Response

6 dB/octave de-emphasis + 1 dB/-5 dB (+0 dB/-1.5 dB).
1000 Hz - 3000 Hz

Hum and Noise

40 dB

Squelch Attenuation

50 dB

Current Consumption

Receive with MT703: 1.0 A
Receive with loudspeaker, AF output 2 W: 1.3 A

TRANSMITTER SPECIFICATIONS

RF Power Output

10 - 25 W

Crystal Frequency, EX712

142.475 MHz

Frequency Stability (-10°C - +40°C)

1.5 kHz.

Spurious Radiation from Antenna

Adjacent channel: 12 μW
Other : 2.5 μW

Modulation Input Impedance

510 Ω

Microphone Impedance

2700 Ω

Modulation Sensitivity

500 mV ± 2 dB e.m.f.

Modulation Distortion

10%

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Modulation Frequency Response

6 dB/octave pre-emphasis +1 dB/-3 dB
300 Hz - 3000 Hz

FM Hum and Noise

40 dB

Current Consumption

Transmit: 5 A

TRANSMITTER TONE SIGNALLING

Tone Transmit	Duration -10°C - +40°C	750 ms ± 150 ms
	Distortion	10%
Respond	Modulation frequency -10°C - +40°C	2600 Hz ± 13 Hz
	Frequency deviation	3 kHz ± 300 Hz
Call and Acknowledge	Modulation frequency -10°C - +40°C	2400 Hz ± 12 Hz
	Frequency deviation	3 kHz ± 300 Hz
Clear	Modulation frequencies -10°C - +40°C	2400 Hz ± 12 Hz 2600 Hz ± 13 Hz
	Frequency deviation (Combined signal)	4.7 kHz ± 300 Hz

RECEIVER SEQUENTIAL TONE SIGNALLING

The equipment responds to a five-digit selective call from a Control Channel transmitter. The following specifications apply to the temperature range -10°C - +40°C.

Selective Calling Tones

Digit	Frequency (Hz)	Deviation (± kHz)
1	1060 ± 1%	3.03 ± 10%
2	1160 ± 1%	3.15 ± 10%
3	1270 ± 1%	3.24 ± 10%
4	1400 ± 1%	3.36 ± 10%
5	1530 ± 1%	3.45 ± 10%
6	1670 ± 1%	3.54 ± 10%
7	1830 ± 1%	3.66 ± 10%
8	2000 ± 1%	3.78 ± 10%
9	2200 ± 1%	3.90 ± 10%
0	2400 ± 1%	4.02 ± 10%
Repeat	2600 ± 1%	4.14 ± 10%

Tone Duration

70 ms ± 5 ms

Period separating two consecutive tones

$<$ 15 ms

Period between successive calls

$>$ 210 ms ± 15 ms

The receiver accepts +3 dB/-6 dB deflection in frequency deviation within temperature range +15°C - +30°C.

MARKING SIGNAL DETECTION

The equipment is capable of detecting any one of six Marking signals, which are transmitted according to the following specifications over Traffic channels (temperature range -10°C - +40°C):

Designation of Marking signal	Two tone frequencies	Individual tone peak deviation	Peak Vector-sum deviation
A	2200Hz ± 10Hz 2000Hz ± 10Hz	1.75kHz ± 0.25kHz	3.5kHz ± 0.5kHz
E	2200Hz ± 10Hz 1830Hz ± 10Hz		
I	2200Hz ± 10Hz 1670Hz ± 10Hz		
O	2000Hz ± 10Hz 1830Hz ± 10Hz		
U	2000Hz ± 10Hz 1670Hz ± 10Hz		
X	1830Hz ± 10Hz 1670Hz ± 10Hz		

TIMING CIRCUIT CHARACTERISTICS

ambient temperature range: -10°C - +40°C
supply voltage: 13.6 V ± 10%

Channel Search, 55 channels

7.5 seconds (<10s) carrier on all channels

Alerting Signal Tone

Duration 2-5 seconds (3.4s)
Frequency 1650 Hz ± 30%

Call Indication

2-5 minutes (3.5 min.)

Squelch Clear Down

5-10 seconds (6.7s)

Transmitter Inhibit on Channel 17

<2 seconds (1.5s)

Connection of Communication after Emitting Call/Respond

0.5 second ± 0.25 s

Measuring methods refer to Post Office Specification RC4402a and Home Office Specification W6601 unless otherwise stated.

CQM713 P3

GENERAL DESCRIPTION

Introduction

The Stornophone CQM713 P3 radiotelephone is a mobile transmitter/receiver with Automatic Channel Searching and Traffic Channel Signalling for The Public Land Radiotelephone.

The equipment is designed to operate in the simplex mode on 55 two-frequency channels in the 2 metre band using phase modulation and 25 kHz carrier frequency separation. (see Frequency Allocation Table).

The transmit and receive frequencies of each channel are separated 4.5 MHz.

The equipment is operated from a control unit (CB705) and a handmicrotelephone (MT703) connecting to the radio proper via a cable and multiconnector. A separate loudspeaker is optional and may be connected to the MT703 rest.

The CQM713 P3 is designed to connect directly to a 12 Volt vehicle storage battery and the equipment's negative potential is connecting to the chassis.

In order to avoid wrong voltage polarity being connected to the equipment the battery cable connector is so designed that it can be connected one way only. If a wrong voltage polarity (as may accidentally happen during tests) is applied a diode in the start relay circuit prevents the equipment from being turned ON.

The CQM713 P3 is built up as functional sub-units for ease in servicing and fault-finding. The unit consists of two panels hinged together (BA705 and RF716) and a chassis CL703.

The panel, designated RF716, contains all the circuits which are dependent on the channel frequencies.

These are:

- receiver input
- frequency synthesizer unit
- exciter
- transmitter power output amplifier
- antenna switch and antenna filter.

The panel, designated BA705, contains those units which are independent on the channel frequencies.

These are:

- intermediate frequency amplifier
- detector
- squelch
- audio amplifiers
- voltage regulators
- tone transmitter
- sequential tone receiver

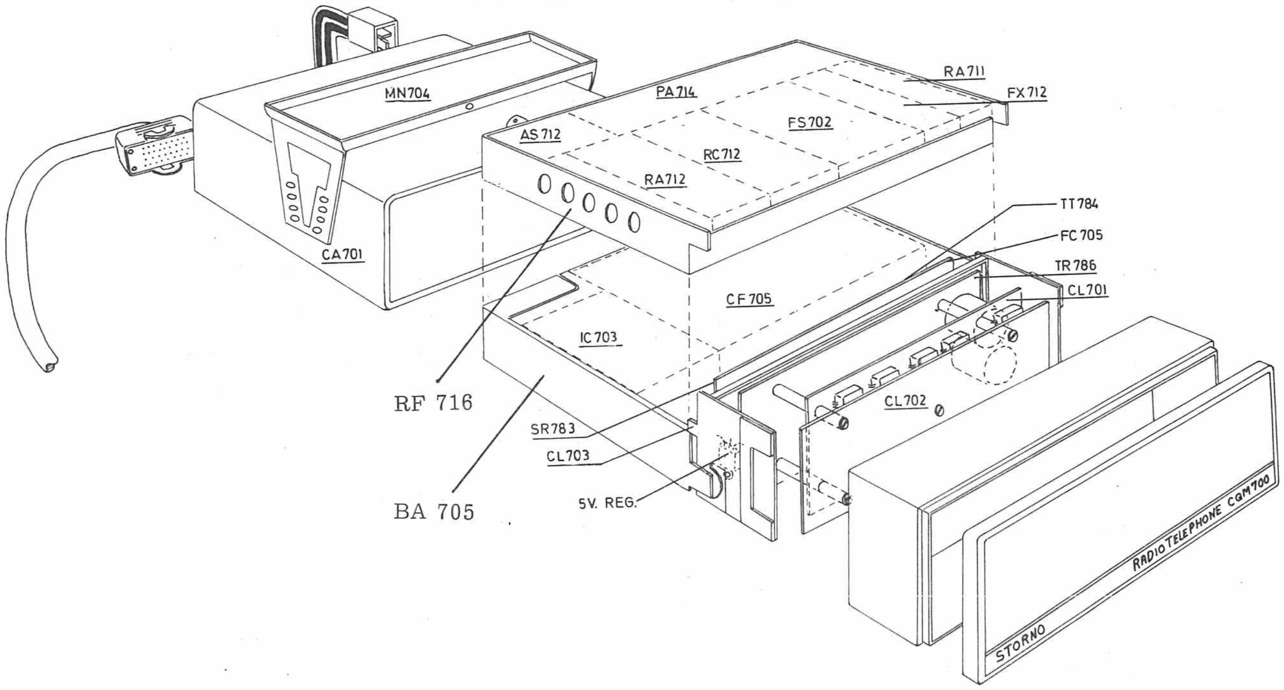
The chassis, designated CL703, contains the logic circuits controlling the Automatic Channel Selection, tone signalling and inhibiting of the transmitter and the receiver.

For mechanical construction see pictorial view page

Principle of Operation

The CQM713 P3 radiotelephone is designed for The Public Land Radiophone service-system 3.

The system, which is covering the entire country, is divided into Radiophone Areas comprising one or more base stations. Where several base stations are necessary to provide the requisite coverage within the Area their services may overlap. The number of channels allocated to individual base stations forming part of a radiophone Area are according to the traffic requirements of that Area.



At each base station there is a number of traffic channels, the frequencies of which is not reused elsewhere in that same Area. A common control channel (channel 17) is available at certain base stations to provide full coverage of the Area for calling purposes. No facilities for speach excists on the control channel.

Calls to mobile equipments are transmitted over the control channel as a sequential tone signal, first from one base station, then consecutive from the remaining stations.

A free channel in a Radiophone Area is marked modulating the carrier with one of six different marking signals. The same marking signal is used at all base stations within the area, and a marking Signal selection Control is provided on the Control unit allowing the user to select any of the six Marking signals.

Calls to Mobile Equipments

When receiving a correct sequential tone signal on the control channel the mobile equipment automatic transmits the Acknowledge tone signal.

At the same time a tone generator is energised and the called lamp on the control unit is lit. The tonegenerator emits an Alerting tone to the receiver of the handmicrotelephone the duration being 3.5 seconds. The Called lamp extinguishes automatically after 3 1/2 minutes.

When the handmicrotelephone is removed from its rest the alerting signal stops and the Called lamp extinguishes. The Searching lamp is lit and the equipment automatically selects a free channel, transmits a Respond signal and reverts to the receive mode.

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If the handmicrotelephone is removed from its rest after the called lamp has extinguished it is considered as a call from the mobile.

Calls from Mobile Equipments

A call to the base station is initiated by removing the handmicrotelephone from its rest. The Searching lamp is lit and the equipment automatically selects a free channel and a Call tone signal is transmitted.

Conversation.

After having transmitted a Call signal or a Respond signal the equipment reverts to the receive mode and monitors the received signal. If the marking signal is removed from the base station carrier within approx. 1/2 second the call is succesful and connection is established.

The equipment then removes the inhibit from the transmitter and receiver audio output, and the Searching lamp extinguishes.

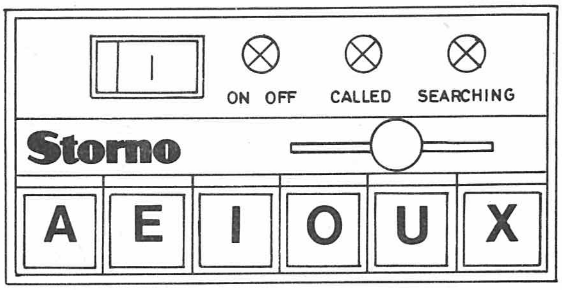
The conversation is performed in the simplex mode from the mobile and in the duplex mode at the base station.

Cleardown of Connection

At the completion of a call over the traffic channel, the connection will be cleared by either the user or the exchange operator.

User cleardown is performed by restoring the handmicrotelephone to its rest. The equipment immediately transmits a Clear signal over the traffic channel in use, reverts to the control channel, and inhibits the transmitter and the receiver audio output.

Operator cleardown is performed by removing the base station carrier thus closing the receiver squelch and after approx. 6.7 seconds the transmitter and the receiver output is inhibited. Restoring the handmicrotelephone to its rest thereafter causes the equipment to go to the control channel without transmission of the Clear signal.



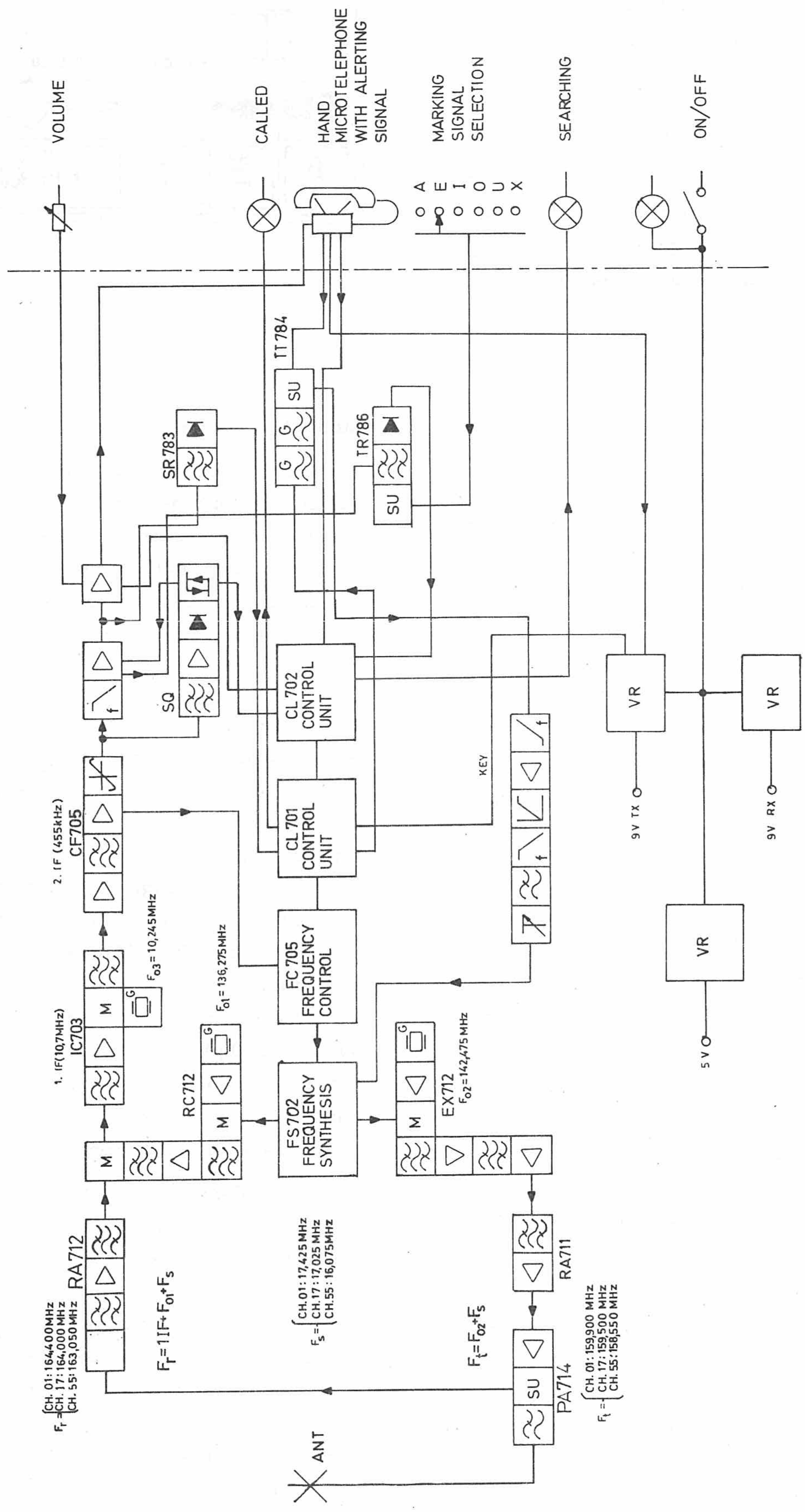
Automatic Channel Search

The channel search is initiated by removing the handmicrotelephone from its rest. First channel 1 is selected then consecutively all channels.
If a free channel is not available the search is repeated until either a suitable channel is selected or the user restores the handmicrotelephone to its rest.

During the search the receiver monitors each traffic channel carrier. If the r.f. signal strength at the input to the receiver is less than R (where R is between 2 μV and 4 μV) the equipment quickly (approx. 30 ms) switches to the next channel. If the r.f. signal strength is greater than R, a pause (approx. 130 ms) for detection of the marking signal is established. If the equipment during the search selects a free channel whose r.f. signal strength is greater than P (where P is between 40 μV and 80 μV) the search stops and the Call tone signal or the Respond tone signal is transmitted. If the connection is not established the channel search is resumed.

If, during the channel search, no channels with a signal strength greater than P is available, all channels are checked. Have free channels with signal strength greater than R been registered, the channel having the greatest is selected, and it is checked that the Marking signal is still present. If so, the Call tone signal or the Respond tone signal is transmitted. If the Marking signal is no longer present or the connection is not established, the channel search is repeated.

55 CHANNEL MOBILE EQUIPMENT FOR RADIOPHONE SYSTEM 3



RECEIVER CIRCUITS

Frequencies

The conversion of the frequencies can be expressed as follows:

Receiver: $f_{RX} = f_s + f_{XRX} + 10.7$ MHz

Transmitter: $f_{TX} = f_s + f_{XTX}$

f_s = frequency of the synthesizer signal, adjustable in steps of 25 kHz in the range 16.075 MHz to 17.425 MHz.

f_{XRX} = RC712 oscillator frequency 136.275 MHz.

f_{RX} = Receiver input frequency.

f_{XTX} = EX712 oscillator frequency 142.475 MHz.

f_{TX} = Transmitter output frequency.

Receiver

The CQM713 P3 receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. Adjacent channel selectivity is obtained by using two bandpass filters:

a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 55 channels are available the corresponding injection frequencies being generated by digital frequency synthesis in the range 16.075 MHz to 17.425 MHz.

The receiver comprises the following subunits:

Antenna switch	AS713
RF amplifier	RA712
Receiver converter 1st mixer, local oscillator and synthesizer mixer	RC712
Intermediate frequency converter, 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter	IC703
455 kHz intermediate frequency amplifier, discriminator, squelch, a.f. amplifier and voltage regulator	CF705
Frequency synthesizer	FS702

Signal Path

From the antenna switch the input signal passes to the RA712 amplifier. The r.f. amplifier is constructed as a 5-circuit filter with an amplifier between 2nd and 3rd filter The configuration ensures good blocking, selectivity, and intermodulation characteristics. The input circuit is adjustable to the entire 2-metre band (146-174). The impedance translation to the mixer stage is achieved by a tuned circuit with a low Q-factor. The received signal and the injection signal are both applied to the gate of a field effect transistor (FET) and the IF signal at 10.7 MHz is taken from the drain circuit.

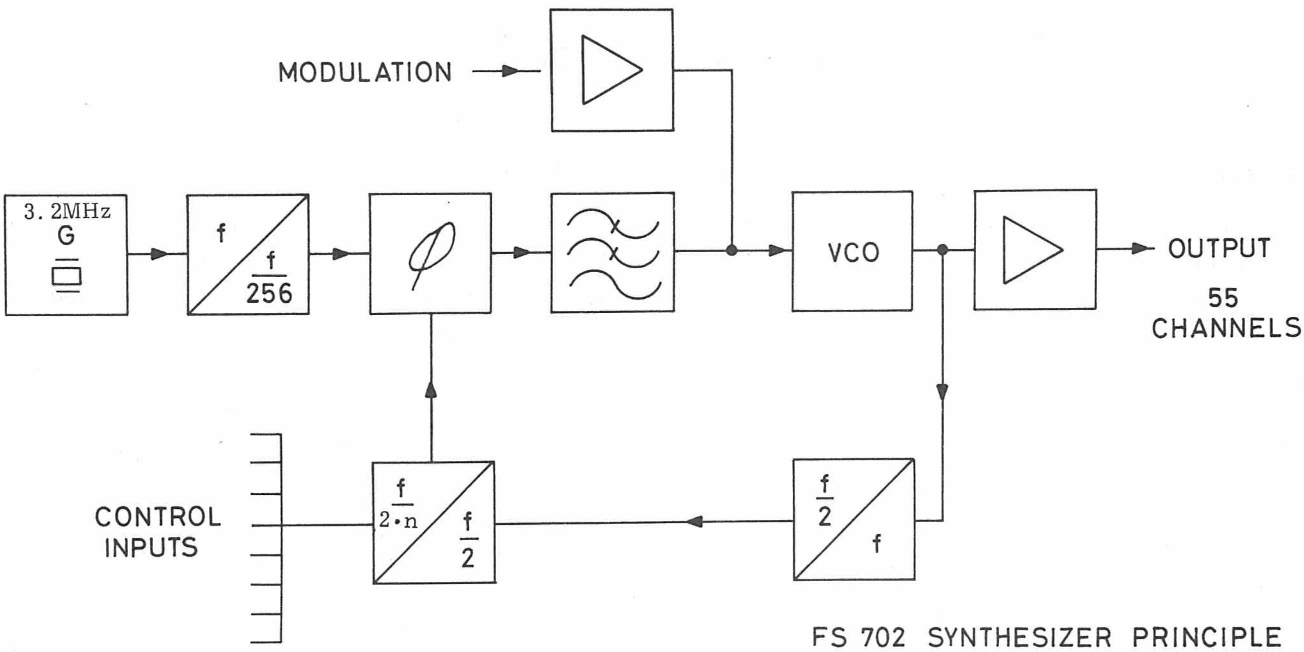
Injection Signal to 1st Mixer.

The mixer injection signal is 10.7 MHz below the input signal and is produced by mixing the signal from a crystal oscillator with the synthesizer signal. The crystal oscillator is a 7th overtone series resonance oscillator which is followed by a double-gate-FET buffer amplifier. The buffer output is mixed with the synthesizer signal in a second FET and the mixer output is filtered and amplified in order to obtain adequate drive for the r.f. mixer. The filter consists of 6 LC circuits in order to reject spurious signals, especially the oscillator frequency.

Frequency Synthesizer FS702

The FS702 generates the synthesizer signal by the digital frequency synthesis method. The signal is generated in a voltage controlled oscillator, VCO, the output of which is amplified. The VCO is forming part of a phase locked loop consisting of a buffer amplifier, a divide- by-two prescaler, a programable frequency divider, a detector, and a low pass filter.

The phase detector compares the divided VCO frequency to a 12.5 kHz reference frequency. Any difference in frequency will be opposed by the DC voltage at the low pass filter output ad-



FS 702 SYNTHESIZER PRINCIPLE

justing the VCO frequency up or down until it locks to the reference frequency.

The 12.5 kHz reference frequency is produced by dividing the output of a 3.2 MHz crystal controlled oscillator by 256.

Using the principles of a phase locked loop the long time stability of the reference oscillator is transfered to the VCO. The short time stability of the VCO (noise) is gennerally determined by the highest achievable Q-factor of the VCO tank circuit.

Reference crystal frequency, f_{ref} and VCO frequency relationship is given by:

$$\frac{f_s}{2 \cdot n} = \frac{f_{ref}}{256}$$

As $\frac{f_{ref}}{256} = 12.5$ kHz $\quad f_s = 25 \times n$ kHz

Changing the devisor n, produces f_s in steps of 25 kHz.

The RC oscillator frequency (and the EX) is so chosen that the lowest antenna frequency corresponds to dividing by 643 in the programable divider (f_s = 16.075 MHz). The three decades in the divider are controlled by the 9-complement of the divider expressed in the BCD code. Note that the third decade (x 100) is fixed programmed to divide by 6.

Intermediate Frequency Circuits

From the mixer in RC712 the 10.7 MHz signal passes to the intermediate frequency converter, type IC703 which provides the channel selectivity of the receiver. The i.f. signal passes a 10.7 MHz crystal filter and then a single amplifier stage before being applied to the base of the 2nd mixer and converted to 455 kHz. The injection signal to the mixer stage is generated by a crystal oscillator, the frequency of which is 455 kHz below 10.7 MHz, i.e. 10.245 MHz.

The second intermediate frequency, 455 kHz, proceeds through the ceramic filter in the IC703 and is then applied to the i.f. amplifier of subunit CF705.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal. The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provide efficient rejection of any amplitude modulated signals that may be present. The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed to a potentiometer preset to suit the a.f. signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver. The potentiometer also adjusts the level to the squelch circuit. The signal is then applied to an integrated two stage amplifier the first amplifier of which introduces deemphasis and amplification to a level of 110 mV. The signal is then fed to a tone receiver and, via an electronic switch, to the second half of the i.c. which constitutes a high-pass filter with strong attenuation of low frequencies (below 250 Hz). The electronic switch is controlled by the squelch circuit. From the amplifier output the signal is applied to a sequential tone receiver, SR783, and, via an inhibiting circuit and volume control in the control unit, CB705, to the a.f. power amplifier and loudspeaker. The loudspeaker amplifier consists of an integrated a.f. power module with a maximum output of approx. 4 W. The amplifier has a special input, which is independant on the setting of the volume control. This input is used for the Alerting signal. The amplifier is inhibited when transmitting.

Squelch Circuit

The squelch circuit is operated by noise components contained in the demodulated signal. The a.f. signal from the detector is passed through a frequency selective amplifier and an amplitude selective amplifier (expander), rectified, and applied to a Schmitt trigger, which controls the electronic switch in the a.f. circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the a.f. output signal is switched off. The Schmitt trigger also controls a squelch signal circuit ot indicate the function of the aquelch. The squelch sensitivity is adjusted by means of a potentiometer at the imput of the amplitude selective amplifier.

TRANSMITTER CIRCUITS

The transmitter is phase modulated and the output frequency is produced by mixing the synthesizer signal with the signal from a crystal controlled oscillator. This principle transfers the number of channels and the modulation contained in the synthesizer signal to the output frequency. After the mixing the signal is amplified to an adequate power level at the output. Also a sharp selection is introduced in order to obtain sufficient attenuation of spurious side band frequencies, especially the crystal oscillator signal.

The transmitter comprises the following subunits:

Frequency synthesizer with modulator	FS702
Modulation amplifier, key circuit, and voltage regulator	CF705
Exciter with crystal oscillator and mixer for synthesizer signal	EX712
RF amplifier	RA711
RF power amplifier and antenna switch (AS713)	PA714

The FS702 and CF705 subunits are common to transmitter and receiver, and it should be noted that the frequency of the synthesizer signal for EX712 is the same as for RC712.

AF Circuits

The modulating signal from the microphone is fed, through the tone generator, to the modulation amplifier where it is differentiated, amplified, limited, integrated, and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

For normal signals the deviation/modulation characteristic is a curve increasing at a rate of 6 dB/octave.

As the r.f. carrier is not to be deviated more than ±5kHz a sharp cutting lowpass filter follows the modulation amplifier so that the carrier deviation at high modulating frequencies (above 3 kHz) decreases. For very strong modulation signals the amplitude characteristic, as measured at the output of the amplifier, is falling 6 dB/octave because of the limiter. Under these circumstances the deviation, Δf, will, principally, be constant and equal to the maximum deviation, Δf_{max}.

A potentiometer at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

Modulator

The modulating signal is applied to the VCO of FS702 in parallel to the internal control voltage in the phase locked loop. A preemphasis circuit produces phase modulation, i.e. Δf increases 6 dB/octave for increasing frequency of the modulating signal. In order to keep the modulation sensitivity constant over the band (16 - 17.5 MHz), a compensating circuit is introduced, the gain of which varies with the VCO control voltage and hence the curving characteristic of the VCO control diode is compensated. The synthesizer is modulated to the full frequency deviation.

Exciter EX712

The r.f. signal is generated in a crystal controlled oscillator contained in EX712. The oscillator signal is applied to a buffer amplifier whose output is mixed with the synthesizer signal. The mixer output is filtered and amplified to obtain an adequate signal for the RA711.

RF Amplifier RA711

The output signal from the exciter is fed to an r.f. amplifier, RA711. Tuned input and output bandpass filters provide additional selectivity and attenuates undesired signals. The amplifier raises the signal to the level required by the r.f. power amplifier. The nominal output power is 100 mW into a 50 Ω load.

RF Power Amplifier PA714

The power amplifier contains three transistor stages the interconnection consisting of tuned matching networks with low loaded Q-factors. The r.f. amplifiers are high efficiency class C amplifiers.

An Automatic Drive Control, ADC, circuit regulates the supply voltage to the first stage and consequently the drive to the following stages. The regulation is controlled by the current of the output transistor, the supply voltage, and the temperature of the heat sink.

The purpose of the ADC circuit is to prevent overloading the power transistors, and to reduce the dependence of the output power of the r.f. power amplifier on supply voltage.

The transmitter output power is adjusted to the required level by means of a potentiometer provided in the ADC circuit.

Antenna Switch

The signal generated by the transmitter is passed through an electronic antenna switching unit and a lowpass filter to the antenna. The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The lowpass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple. The filter is not adjustable.

POWER SUPPLY AND SWITCHING CIRCUITS

The CQM713 P3 is powered directly from a 12 V storage battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A start relay with a series diode connected across the battery input terminals protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the relay series diode not to conduct and thus the relay refuses to operate.

The CQM713 P3 contains two identical voltage regulator circuits which deliver 9V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker amplifier, transmitter power amplifier tone generator, and the 5 V regulator is taken from the battery and is unstabilized. The 5 V regulator for the logic circuits is mounted on the CL703 chassis. The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value. In the receive mode (stand-by) the 9 V transmitter regulator is inhibited which is cancelled when energising the transmitter. In the transmit mode the receiver a.f. output amplifier is inhibited by the 9 V to the transmitter.

TONE SIGNALLING CIRCUITS

Tone Generator TT784

The tone generator is controlled by CL701 which submit control signals for the different tone combinations. Simultaneously the CL701 is supplying a signal to the transmitter voltage regulator which is then energized for approx. 750 ms. The TT784 modulates the transmitter of the equipment and, while activated, inhibits the modulating signal from the microtelephone by means of a gate circuit.

The TT784 generates supervisory signals as follows:

Acknowledge signal, 2400 Hz, is emitted over the control channel upon receipt of the correct selective calling signal.

Call signal, 2400 Hz, is emitted over a traffic channel to call a base station.

Respond signal, 2600 Hz, is emitted over a traffic channel to answer a call from the base station.

Clear signal, 2400 and 2600 Hz, is emitted over a traffic channel when a call is terminated.

Sequential Tone Receiver SR783

The input of the sequential tone receiver connects to the receiver's a.f. signal line after the squelch gate so that a sequential tone call can be received only when the received signal is sufficiently strong to open the receiver squelch (approx. 1 μV).

SR783 is designed to receive a 5 tone sequential signal. The coding of the number to be received is made by connecting five leads to the tone coil. The 5 consecutive tones enable 100000 combinations to be coded.

Receipt of the correct selective calling signal causes the SR783 to emit a Call pulse of approx. 70 ms duration.

Two-tone Receiver TR786

The input of the TR786 connects to the receivers a.f. line ahead of the squelch gate in order to avoid time delay caused by the opening of the squelch. During channel searching the tone receiver registers free channels, i.e. the carrier is modulated with a correct Marking signal. In order to achieve a short searching time the response time is short (approx. 65 ms). The tone combination is selected by push-buttons on the control unit. When coding a marking signal a control lead is connected to V_{B+}, and by means of tone gates the tone coils are set to the combinations used.

When a correct Marking signal is accepted (after approx. 65 ms) a Call pulse is emitted. If the received signal strength is greater than R (where R is between 2 μV and 4 μV) a sample pulse is applied to CL702 where the signal strenght level is registered.

Storno

The TR786 tone combinations are:

A - 2000 Hz and 2200 Hz.
E - 1830 Hz and 2200 Hz.
I - 1670 Hz and 2200 Hz.
O - 1830 Hz and 2000 Hz.
U - 1670 Hz and 2000 Hz.
X - 1670 Hz and 1830 Hz.

Control Logic CL701

The CL701 contains the following functions to be used in the call and channel searching procedures:

Tone generator control circuit.
Alerting signal circuit.
Squelch closing circuit.
Control channel decoder and inhibiting circuit.

Tone Generator Control Circuit

The circuit comprises three flip-flops all controlled by a common timer and a flip-flop that ensures the Respond tone to be transmitted after receipt of a sequential tone signal.

Activation of one of the three flip-flops triggers the timer, and after 750 ms the flip-flop is reset. The transmitter and the tone generator TT784 is energized during the activation of the timer. The tone combination to be emitted by TT784 is controlled by CL701 via two control leads. The tone signalling timer can, during service and tests, be inhibited from a test box in order to measure the tone signalling characteristics.

Alerting Signal Circuit

Receipt of a correct sequential tone signal first causes the Acknowledge tone to be transmitted, then a timer in CL701 to be triggered. The timer controls the Called lamp on the control unit and the tone generator which emits an Alerting signal. Removing the handmicrophone from its rest causes automaticcally cessation of the Alerting signals.

The Alerting tone persists for approx. 3. 5 seconds and the called lamp for approx. 3 1/2 minutes. The receipt of another selective call before the visual time-out has expired will re-activate the timer, and the Alerting tone will be repeated. If the handmicrotelephone is removed from its rest during the persistence of the Called lamp the equipment transmits the Respond signal.

Squelch Closing Circuit

A timer on CL701 is controlled by the receiver squelch when the equipment selects a traffic channel. In the receive mode the squelch, when closing, will activate the timer which clears the connection after approx. 6-7 seconds.

Control Channel Decoder and Inhibiting Circuit

A decoder supervises the control signals to FS702 and records whenever the equipment is set to the control channel (channel 17). When the equipment selects channel 17 CL701 submit an inhibiting signal to tone receiver TR786 in order to ensure that intermodulation products, if any present, may open the tone receiver and thus channel 17 cannot be recognized as a free channel during channel searching.

A fail-safe circuit becomes operative and inhibits the transmitter voltage regulator on CF705 when the equipment is set to the control channel and the transmitter is energized for a period exceeding approx. 1. 5 seconds. This circuit prevents the control channel from being occupied in the event of equipment failure. The circuit does not interfere with the normal Acknowledge transmission. The inhibiting of the transmitter, caused by the fail-safe circuit, can only be cancelled by turning the equipment OFF and then again ON.

Frequency Control Subunit FC705

The FC705 controls the frequency synthesizer, FS702, by the 9 complement of the devisor expressed in BCD code.

The FC705 contains three different circuits for controlling the programable divider in FS702 as follows:

1. A fixed coded circuit for the control channel (channel 17).

2. A BCD counter with addition network which adds two to the output signal from the BCD counter. When the channel selection is initiated the counter is reset and thereafter controlled by a clock pulse generator with a period time of approx. 30 ms and each channel is monitored in turn.

   The FC705 also contains a detector circuit the input of which is connected to the output of the IC703. For antenna signal inputs greater than R (where R is between 2 μV and 4μV) the clock generator pulse for controlling of the BCD counter is delayed approx. 130 ms. ensuring sufficient time for the TR786 to detect the Marking signal. At the completion of the channel search, i.e. when channel 56 is selected, the FC705 emits informations to CL702.

3. A register where a channel number can be stored. The register is controlled by a Sample and hold circuit on the CL702. A channel number will be stored in the register if the signal strength is greater than level R and appropriately marked. If an appropriately marked channel is selected later and the signal strength of that channel is greater than the former the number of that channel is stored in the register. At the end of the search the number stored in the register will be the channel having the greatest signal strength, and the register is switched to control the FS702.

The selection of the circuit to control the FS702 is by means of Bus Line drivers.

A test box connected to the multiconnector of the equipment enables the three circuits to be disabled and the FS702 to manually be set to any channel.

Control Logic CL702

The CL702 contains functions for controlling the automatic channel search as follows:

1. Reset Circuit

   The reset circuit is activated every time the channel search is repeated. Besides resetting circuits on CL702 the reset circuits emits a reset pulse to the BCD counter on the FC705 and, via the CL701, a reset pulse for the TR786.

2. Sample and Hold

   If, during the channel search, the equipment selects an appropriately marked channel and the signal strength is higher than R, a sample pulse is applied to the CL702. The detector on the FC705 connects to the input of the sample circuit. If the detector voltage is higher than the capacitor voltage in the sample circuit a charging commences, during which a read pulse is applied to the register on FC705 and the number of the selected channel is stored. If the detector voltage is less than the voltage of the capacitor, the sample pulse is not released.

3. Channel 1 Switch Delay

   The reset circuit triggers a timer which inhibits the clock pulse generator on the FC705 for approx. 300 ms. in order to stabilize the FS702 after a 1.4 MHz frequency switch.

4. Channel search cease for signal strength > P

   When the equipment selects a free channel with a signal strenght greater than P a flip-flop is toggled and the clock generator on the FC705 is inhibited. Simultaneously a trigger pulse to CL701 is emitted and the Call tone or Respond tone is transmitted.

5. Channel Search Cease for Signal Strength < P.

   If, at the end of a search, only free channels with signal strength levels between R and P are available, the CL702 switches the FC705 to the channel number stored in the register.

After a time delay of approx. 300 ms (to stabilize the FS702) the channel is checked for the presence of the Marking signal. If the Marking signal is no longer present (channel occupied) the channel search is repeated.

If the Marking signal is still present a trigger pulse is released to the CL701 and the Call tone or the Respond tone is transmitted.

6. Inhibiting Circuit

In the stand-by mode and during the search and select cycle the receiver audio output and the transmitter is inhibited.

After transmission of a Call or Respond tone a timer is activated and approx. 0.5 second later the channel is checked for the presence of the Marking signal. If the marking signal is not present the inhibit from the transmitter and the receiver audio output is removed, and the communication can be established over the traffic channel.

The channel search procedure is repeated if the marking signal is still present after 0.5 second.

7. Searching Lamp

When the channel search is initiated the Searching lamp on the control unit is lit. The lamp extinguishes when the receiver and transmitter inhibits are removed or the handmicrotelephone restored to its rest.

RADIO CHANNELS FOR THE PUBLIC RADIOPHONE SERVICE - SYSTEM 3

Chan. No.	Mobile Transmit	Mobile Receive	Chan. No.	Mobile Transmit	Mobile Receive
1	159.900 MHz	164.400 MHz	31	159.150 MHz	163.650 MHz
2	159.875 "	164.375 "	32	159.125 "	163.625 "
3	159.850 "	164.350 "	33	159.100 "	163.600 "
4	159.825 "	164.325 "	34	159.075 "	163.575 "
5	159.800 "	164.300 "	35	159.050 "	163.550 "
6	159.775 "	164.275 "	36	159.025 "	163.525 "
7	159.750 "	164.250 "	37	159.000 "	163.500 "
8	159.725 "	164.225 "	38	158.975 "	163.475 "
9	159.700 "	164.200 "	39	158.950 "	163.450 "
10	159.675 "	164.175 "	40	158.925 "	163.425 "
11	159.650 "	164.150 "	41	158.900 "	163.400 "
12	159.625 "	164.125 "	42	158.875 "	163.375 "
13	159.600 "	164.100 "	43	158.850 "	163.350 "
14	159.575 "	164.075 "	44	158.825 "	163.325 "
15	159.550 "	164.050 "	45	158.800 "	163.300 "
16	159.525 "	164.025 "	46	158.775 "	163.275 "
17	159.500 "	164.000 "	47	158.750 "	163.250 "
18	159.475 "	163.975 "	48	158.725 "	163.225 "
19	159.450 "	163.950 "	49	158.700 "	163.200 "
20	159.425 "	163.925 "	50	158.675 "	163.175 "
21	159.400 "	163.900 "	51	158.650 "	163.150 "
22	159.375 "	163.875 "	52	158.625 "	163.125 "
23	159.350 "	163.850 "	53	158.600 "	163.100 "
24	159.325 "	163.825 "	54	158.575 "	163.075 "
25	159.300 "	163.800 "	55	158.550 "	163.050 "
26	159.275 "	163.775 "			
27	159.250 "	163.750 "			
28	159.225 "	163.725 "			
29	159.200 "	163.700 "			
30	159.175 "	163.675 "			

The Control Channel is Chan. No. 17. All other channels are Traffic Channels.

CQM713 P3

ADJUSTMENT PROCEDURE

The following measuring instruments are required for making adjustments to the CQM713 P3 radiotelephone:

Test box for CQM713 P3	Storno U95B0518
AF millivoltmeter,	Z in 2 MΩ//50 pF Accuracy better than 3% in the range 50 Hz - 100 kHz.
Multimeter	20 kΩ/V or better
Distortionmeter	
Electronic DC voltmeter	R in > 2 MΩ/ 1 V
Deviation meter	
DC Ampere meters	1.0/5.0A
Power supply	10.5 - 16V Preset current limiter 0.1 - 5.0 A
RF Watt meter	0 - 25 W
FM signal generator (s)	146 - 174 MHz
Tone generator	
Tone signalling generator	Storno G13
Crystal controlled generator 455 kHz/10.7 MHz	Storno G21
Frequency counter	
RF Test probe	Storno 95.0089
Signal splitter, 6 dB/160 MHz	Storno 95.2003
Attenuator	40 dB/25W 50Ω
Psophometric filter	
Variable Reactance Load	W52C

Connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 1.0 A.

The station may now be turned on.

Check the 9 V RX at terminal 3 on the IF converter.

Requirement: 9 V ± 0.2 V

If necessary, adjust the RX voltage by means of potentiometer R91 in CF705. This potentiometer can be reached from the rear of the module chassis BA705.

Check the 5 V regulated supply.

Requirement: 5 V ± 0.2 V

ALIGNMENT OF 2nd IF AMPLIFIER

To protect the IF amplifier input stages, establish a good chassis connection between a 455 kHz generator and the station.

Apply a 455 kHz signal to the input of CF705. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF705.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 10 µA if a multimeter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage result in a constant or decreasing meter reading.

COARSE ADJUSTMENT OF L2 IN CF705

Disconnect the generator and disable the squelch by pushing the "Cancel Squelch" button on the control box.

Connect an AC EVM to terminal 35 LINE OUT (AF 17 dBm) on the terminal board.

Adjust coil L2 in CF705 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R19 (AFRX) may be turned up. This potentiometer can be reached from the rear of the module tray BA705, and turns up counterclockwise.

ADJUSTMENT OF OSCILLATOR FREQUENCY IN IC703

If a frequency counter is available, the frequency may be read at test point [5] , IC703. If the input of the frequency counter is DC-coupled a capacitor (approx. 1 nF) should be connected in series. The frequency will be 10.245 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF705 and a 10.7 MHz generator to the input of IC703. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by activating two buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat tone is produced in the speaker.

Adjust trimmer capacitor C12 in IC703 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "Line out", 600 Ω audio output, which is accessible on the terminal board, terminal 35.

NOTE: The discriminator has no zero adjustment.

ALIGNMENT OF 1st IF AMPLIFIER (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC703.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF705.

Adjust coils L1, L2, and L3 in IC703 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC703: ≥ 20 dB

Alignment of the Frequency Synthesizer Reference Oscillator.

Select channel 01.

Connect a frequency counter to the TX output of the FS702.

Adjust C1 in FS702 for 17.425000 MHz ± 10 Hz.

Check all channels for correct synthesizer frequency according to the frequency allocation tables.

Alignment of Mixer Injection Signal to RC712.

Connect a DC voltmeter to test points (1) and (2) in RC712.

Adjust L3 in RC712 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2 mm.

The voltage with the oscillator stopped (short the crystal to chassis) will be approx. 0.25 V. Minimum increase, with the oscillator working, will be approx. 30 mV.

Connect the voltmeter to test point (4) in RC712.

Adjust L5 and L6, RC712, for maximum meter reading.

The voltage at test point (4) with the oscillator stopped will be approx. 0.7 V.

Start the oscillator.

Requirement: Minimum increase must be ≥ 0.25 V
Typical: 0.6 V

Adjustment of Crystal Oscillator Frequency, RC712.

Connect a frequency counter to test point [3] in RC712. Adjust L1, RC712, for correct frequency.

Requirement: 136.275000 MHz ± 150 Hz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to RC712 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked, and any readjustment requires the frequency to be readjusted.

Checking the FS702 Output Level.

Connect an RF probe 95.089 and a multimeter to terminal 5 in RC712.

Set the channel selector to channel 28.

f_{synt} = 16.750 MHz.

Stop the RC crystal oscillator and measure the RF level (approx. 0.4 V).

Select the channel having the highest frequency, and the lowest frequency and measure the RF level.

Maximum deviation relative to centre channel.

2 dB ~ approx. ± 0.1 V.

If the level is low in one position, L6 in RF amplifier I in FS702 is adjusted for best symmetry.

Alignment of Filters and RF Amplifier, RC712.

Connect a voltmeter to test point (5) in RC712.

Stop the crystal oscillator in RC712 (short the crystal to chassis).

Coarse tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 153 MHz.

Adjust L8, L9, L10, L11, L14, L15, L16, and L17 for maximum reading on the voltmeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select channel 28.

Turn the tuning slug of L5 in RA712 flush with the outside of the coil can.

L8, L9, L10, L11, L14, L15, L16, and L17 is adjusted for maximum meter reading in test point (5).

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 10% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

The voltage at test point (5) with the oscillator stopped will be approx. 3 V.

Start the oscillator.

Requirement: Minimum increase at test point (5), is 1.0 V.

Check the voltage at the highest frequency and the lowest frequency.

If the voltage drops at higher or lower frequencies, small corrections of the filter alignment may be implemented.

FURTHER ALIGNMENT OF RC712, RF AMPLIFIER RA712, and FINE TUNING OF IC703.

Connect a DC EVM with an RF probe to test point [1] in CF705. A multimeter with 20 kΩ/V may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Select channel 28.

Set the generator to the receiver frequency.

Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF705, or 10.7 MHz to the IC703 input. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat.

If the beat tone is to be monitored in the loudspeaker, the squelch and RX inhibit must be cancelled.

The RF generator output should be kept low enough to prevent limiting in CF705, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at test point [1], CF705.

Storno

The following coils are tuned for maximum meter reading in this order:

L1 , RA712
L2 , RA712
L3 , RA712
L4 , RA712
L5 , RA712
L17, RC712
L18, RC712
L1 , IC703
L2 , IC703
L3 , IC703

Due to interaction, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting L17, RC712, the oscillator drive signal to the RF mixer will have decreased. L16, RC712, must be fine tuned for maximum reading on a DC voltmeter connected to test point (5) , RC712.

Now, when stopping the oscillator, the voltage at test point (5) should fall at least 0.5 V. L1, L2, and L3 in IC703, are now fine tuned for maximum reading at test point [1] , CF705. The circuits in IC703 should be aligned two or three times, as they influence each other.

FINE TUNING OF L2 IN CF705

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM713, approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz.

Connect an AF millivoltmeter to terminal 22 on BA705.

Adjust L2 in CF705 for maximum reading.

Adjust potentiometer R19 on CF705 for 110 mV +1/-0 dB.

Measure the AF voltage at terminal 35 on BA705.

Requirement: 90 mV ± 1.5 dB.

Connect a 4 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals. Set the volume control for 3.16 V (~ 2.5 W) on the meter.

Check the distortion.

Requirement: $k \leq 7\%$.

CHECKING RECEIVER SENSITIVITY

Modulate the RF generator with 1 kHz, and a frequency deviation of ± 1.5 kHz.

Set the generator output to 1 mV e.m.f.

Connect an AF millivoltmeter and a Psophometric filter across the loudspeaker terminals, substituring a 4Ω (4W) resistor for the speaker.

Set the volume control for 1 V across the load.

Turn the modulation off and reduce the calibrated RF voltage until a reading of 10 mV is obtained on the meter.

Requirement: $\leq$ 15 µV e.m.f.

This procedure should be repeated on all channels.

Reduce the RF voltage further until a reading of 0.1 V is obtained on the meter.

Requirement: $\leq$ 2 µV e.m.f.

This procedure should be repeated on all channels.

ADJUSTMENT AND CHECKING THE SQUELCH

Adjust the squelch by means of potentiometer R46 in CF705 to open the audio signal path for 0.5 µV e.m.f. antenna signal.

Increase the antenna signal and check that the squelch opens the audio output at approx.:

1µV e. m. f.

CHECKING OVERALL RECEIVER CURRENT CONSUMPTION

Measure the current drain at 13.6 V supply voltage.

Requirement: $\leq$ 1.0 A (typical 750 mA).

Storno

TRANSMITTER ADJUSTMENT

Set the supply voltage to 13.6 V, and the current limiter to 5 A.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9 V TX at terminal 19 on the terminal board.

NOTE: If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.

Requirement: 9 V TX = 9 V ± 0.2 V.

If necessary, adjust the TX voltage by means of potentiometer R98 on CF705. This potentiometer can be reached from the rear of module tray BA705.

Alignment of Mixer Injection Signal to EX712

Connect a DC voltmeter to test point (1) and (2) in EX712.

Adjust L3 in EX712 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2 mm.

The voltage with the oscillator stopped (short circuit the crystal to chassis) will be approx. 0.25 V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to test point (4) in EX712.

Adjust L5 and L6, EX712, for maximum meter reading.

The voltage at test point (4) with the oscillator stopped will be approx. 0.7 V.

Start the oscillator.

Requirement: Minimum increase at test point (4), EX712 = 0.25 V.

Adjustment of Crystal Oscillator Frequency, EX712.

Connect a frequency counter to test point [3].

Adjust L1, EX712, for correct frequency.

Requirement: 142.475 MHz ± 150 Hz

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to EX712 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked and any readjustment requires the frequency to be readjusted.

Checking the FS702 Output Level

Connect an RF probe 95.089 and a multimeter to terminal 5, EX712.

Select channel 28 (f_{synt} = 16.750 MHz)

Stop the RC crystal oscillator and measure the RF level (approx. 0.4 V).

Select the channel having the highest frequency, and the lowest frequency, and measure the RF level.

Maximum deviation relative to centre channel:

2 dB ∼ approx. ± 0.1 V.

If the level is low in one position, L7 in FS702 is adjusted for best symmetry.

Alignment of Filters and RF Amplifier, EX712.

Connect an RF probe 95.089 and a multimeter to test point [8] in EX712 (output terminal).

Stop the crystal oscillator in EX712 (short the crystal to chassis).

Coarse tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 159,0 MHz. Adjust L8, L9, L10, L11, L14, L15, and L16 for maximum reading on the multimeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select channel 28.

Adjust L8, L9, L10, L11, L15, and L16 for maximum meter reading, approx. 5.6 V.

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 10% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

Alignment of RF Amplifier RA711.

Connect a voltmeter to test point (10) in RA711.

Adjust L16 in EX712 for minimum meter reading. Adjust L1, L2, L3, L4, and L5 in RA711 for minimum meter reading. approx. 4.0 V.

Remove the RF signal lead between RA711 and PA714.

Connect an RF Watt meter 0 -0.3 W to the RA711 output.

Adjust L6, RA711 for maximum output.

Adjust L1, L2, L3, L4, L5, and L6 for maximum output.

Repeat the adjustment until no further increase in meter reading can be obtained.

Requirement: $P_{OUT} \geq 80$ mW.

The requirement should be fulfilled on all channels. The total variation in output power should be less than 1 dB within the bandwidth.

Alignment of RF Power Amplifier, PA714.

Reestablish the connection between RA711 and PA714.

Connect a wattmeter to the antenna output.

Select channel 28.

Set the supply voltage to 13.6 V.

Set all trimmer capacitors for half capacity.

Key the transmitter
Turn the ADC potentiometer, R11 in PA714 up until a current increase is obtained but do not exceed 5.0 A.

NOTE: Insulated trimming tools should be used.

a. Adjust C2, C6, C8, C9, C13, and C15 in that order for maximum current drain until a deflection on the wattmeter is obtained. Then adjust for maximum output power.

b. During the following procedure keep the ADC potentiometer set to 20 W.

c. Connect a voltmeter to test point (1) in PA714. Adjust C2 for minimum deflection.

d. Adjust C6, C8, C9, C13, and C15 for maximum output power.

Repeat steps b-d.

Increase the supply voltage to 16 V and set the ADC potentiometer to 22 W output power.

Remove shorting link designated "NOTE 1" and adjust potentiometer R12 for 4 W output power.

Insert "NOTE 1" and adjust potentiometer R11 for 22 W output power.

CHECKING THE RF OUTPUT, CURRENT CONSUMPTION, AND THE FUNCTION OF THE ADC CIRCUIT.

The current drain and output are measured as follows:

Supply voltage	P_{OUT}	Current drain
16.0 V	22 W	$\leq$ 4.3 A
13.6 V	$\geq$ 20 W	$\leq$ 4.8 A
10.5 V	$\geq$ 12 W	$\leq$ 4.8 A

Correct values here also indicate that the ADC circuit is operating satisfactorily.

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5 - 40 MHz.

The existence of parametric oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TSF42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

For further details please refer to STORNO Service News No. 38 of May 1969.

Adjustment of Modulation and Frequency Deviation

Connect the deviationmeter to the transmitter output via an attenuation network (25 W capacity).

Connect a distortionmeter to the output of the deviationmeter.

Set the power supply to 13.6 V.

Connect a tone generator to the modulation input on the test box. Set the generator output to 1.1 V (110 mV + 20 dB).

Select channel number 1.

Find the audio generator frequency between 300 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter. At that audio frequency adjust potentiometer R18 on CF705 for ± 5 kHz deviation.

Reduce the audio generator output to 110 mV.

Set the frequency to 1 kHz.

Check the frequency deviation, ± 3.5 kHz, on all channels.

Requirement: V_{mod} = 110 mV ± 3 dB.

Check the distortion on the audio output of the deviation meter.

Requirement: K = $\leq$ 10% (without deemphasis).

CHECKING THE SEQUENTIAL TONE RECEIVER

Test Set Up

Connect an RF generator to the CQM713 P3 through Attenuators as shown.

Connect the tone signalling generator G13 to modulate the RF generator.

Adjust the RF generator output to 10 mV.

Set the G13 amplifier, A1, to FLAT RESPONSE and the output to HIGH and the Tone Burst Generator to HOLD TONE 1. Adjust the attenuator of A1 for ± 3.0 kHz frequency deviation.

Set the Tone Burst Generator to 70 ms bursts and 15 ms interval.

Set the Tone Generator to the tone code of SR783.

Switch the equipment to standby on the control channel.

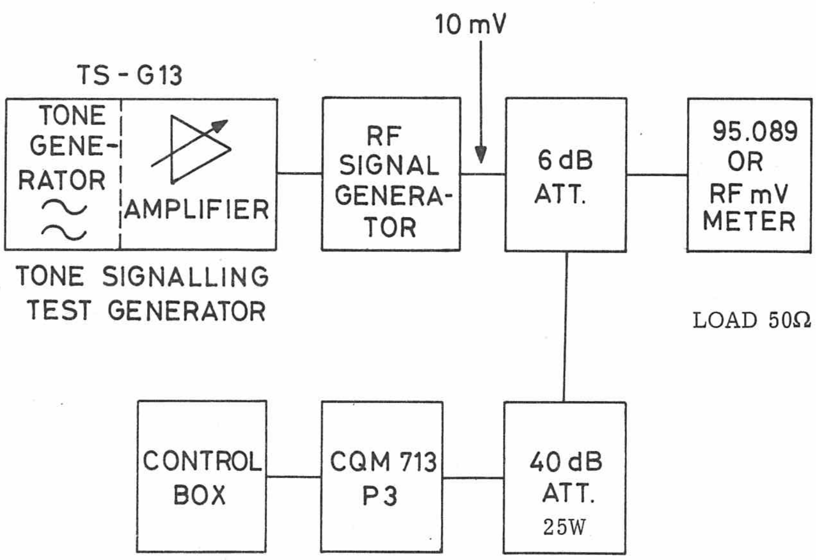


Fig. 1. Sequential Tone Receiver Test

Key the tone generator and check the following functions:

1. The Acknowledge tone is emitted.
   Measure the voltage, in stand-by, on the inhibit terminals of TT784, terminal 5 and 11.
   The voltage should be approx. 11 V.
   During transmission of Acknowledge tone the voltages change for approx. 750 ms as follows:
   terminal 5 = approx. 1.5 V
   terminal 11 = approx. 7.0 V

2. The Alerting tone is activated.
   The Alerting tone shall fullfil the following requirements:
   Duration 2 - 5 seconds (typical 3.4 s).
   Voltage: > 3.4 $V_{p.p}$ (typical 6 $V_{p.p}$)
   measured at the Loudspeaker output terminals.

3. The Called Lamp is turned on.
   Check the Called Lamp is ON for 2 - 5 minutes (typical 3.5 min.).

CHECKING THE TONE RECEIVER SENSITIVITY

Check the tone receiver for proper functioning with the tone signalling generator output reduced 6 dB, the procedure as described above.

CHECKING THE MARKING SIGNAL DETECTOR, TONE RECEIVER TR786

Test Set Up
See fig. 2.

Set the signal generator output to 10 mV.

Set the A1 amplifier to "Flat Response" and the output to "High".

Set the tone generator to 2000 Hz.

Adjust the attenuator of amplifier A1 for ± 1.5 kHz frequency deviation.

Select a traffic channel, f.ex. channel 16, by means of the manual channel selector on the control box.

Set the MT switch on the control box to "In rest".

Check by changing tones A and D that the marking signal detector TR786, generates call pulse and energize the transmitter for all of the following tone combinations.

Combination	Tone A, Hz	Tone D, Hz
A	2000	2200
E	1830	2200
I	1670	2200
O	1830	2000
U	1670	2000
X	1670	1830

Select channel 17.

Check that none of the tone combinations above causes the equipment to perform a call.

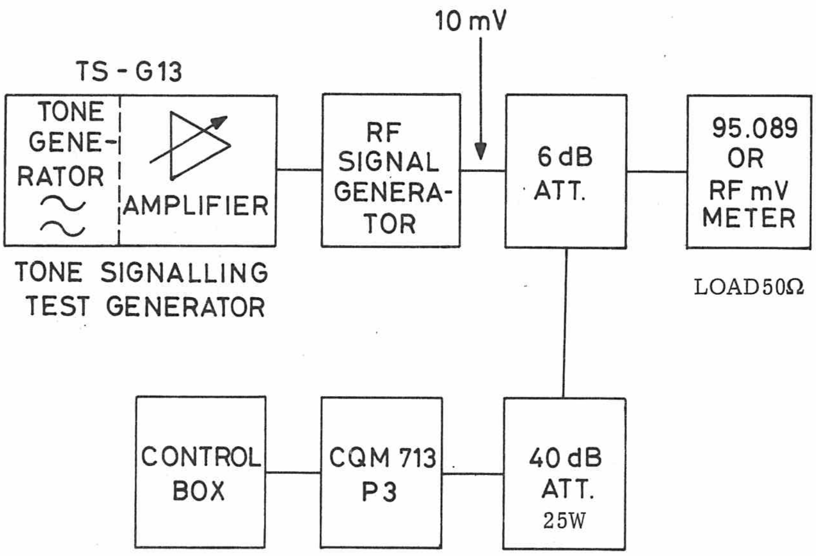


Fig. 2. Marking Signal Detector Test

Adjustment of the RF Level Detector.

Set the RF generator to the frequency of channel 28 and adjust the output for 8 mV e.m.f. corresponding to 40 µV input at the antenna connector. On the control box set the MT switch to Removed, and check that the automatic channel search is initiated.

Set the tone generator to correct combination as selected (A, E, I, O, U, X) on the control box.

Watch the channel searching on the channel display on the control box.

Adjust potentiometer R12 on FC705, P-level, so that the transmitter is energized during the channel search.

Adjust the generator output to 500 µV e.m.f. corresponding to 2.5 µV input at the antenna connector. Adjust potentiometer R30 on FC705, R-level, so that the equipment, after having searched all channels, switches to channel 28 and energizes the transmitter.

The R-level is to be checked on channel 1 and channel 55.

Requirement: nom. R-level + 2 dB / -0 dB.

Checking the Tone Transmitter TT784

Connect a deviation meter through an attenuator to the antenna connector.

Select channel 1.

Activate the tone transmitter, TT784, by means of the Tone Key switch on the control unit.

The frequency deviation should be ±3 kHz ±300Hz

By changing the value of resistor R15 in TT784 the frequency deviation may be adjusted to be within tolerance.

The resistor should be the closest lower standard value (E12 series) to the resistance giving a frequency deviation of ± 3 kHz.

Checking the Call, Respond, and Clear Functions

Test Set-Up
See fig. 3.

Call Tone

Set the signal generator to channel 28.

Modulate the signal generator with a marking signal as described under Checking of the Marking Signal Detector.

Set the control box to automatic channel search.

Depress "Hold Tone Key".

Set the "MT" switch to "Remove".

The equipment shall select channel 28 and transmit the call tone.

Read the Call Tone frequency on the counter; the frequency may be adjusted with the trimming slug of L1 on TT784.

Requirement: f = 2400 Hz ± 1 Hz.

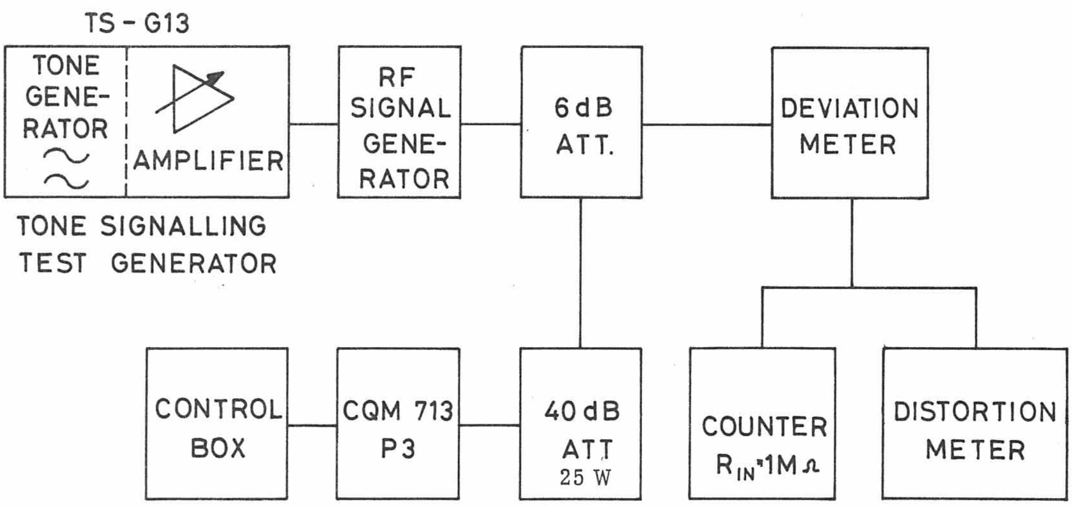


Fig. 3. Call, Respond, and Clear Function Test

Check the frequency deviation as read on the deviation meter.

Requirement: Δ f = ± 3 kHz ± 300 Hz.

Measure the distortion at the output of the deviation meter.

Requirement: THD < 10%
typical < 3%

Respond Tone

Set the signal generator to channel 17.

Modulate the signal generator with a signal as described under Checking of the Sequential Tone Receiver.

Set the MT switch to "In rest".
Release a sequentioal tone call to the station.

Perform measurements as described for the Call Tone.

Requirements:

Frequency, f = 2600 Hz ± 1 Hz
Frequency deviation, Δf = ± 3 kHz ± 300Hz.
Distortion, THD < 10%, typical < 3%.
The frequency may be adjusted with the trimming slug of L2 in TT 784

Repeat the measurements with the exception that the Called Lamp shall be extinguished before the MT switch is set to "Removed". The emitted tone shall be the Call tone (2400 Hz).

Clear Tone

Perform the Call tone test as described.

Disconnect the modulating signal to the RF signal generator.

Release "Hold Tone Key" for more than 1 second and then depress.

Set the MT switch to "In rest".

Check the frequency deviation.

Requirement: Δ f = ± 4.7 kHz ± 300 Hz.

Checking the Channel Searching Circuit

Test Set-up
See fig. 4.

Checking The Channel Selection

Set the frequencies of the two signal generators to two individual traffic channels.

Set the signal generator outputs to 2 mV e.m.f. corresponding to 10 μV input at the antenna connector.

Set the equipment for automatic channel control on the control box.

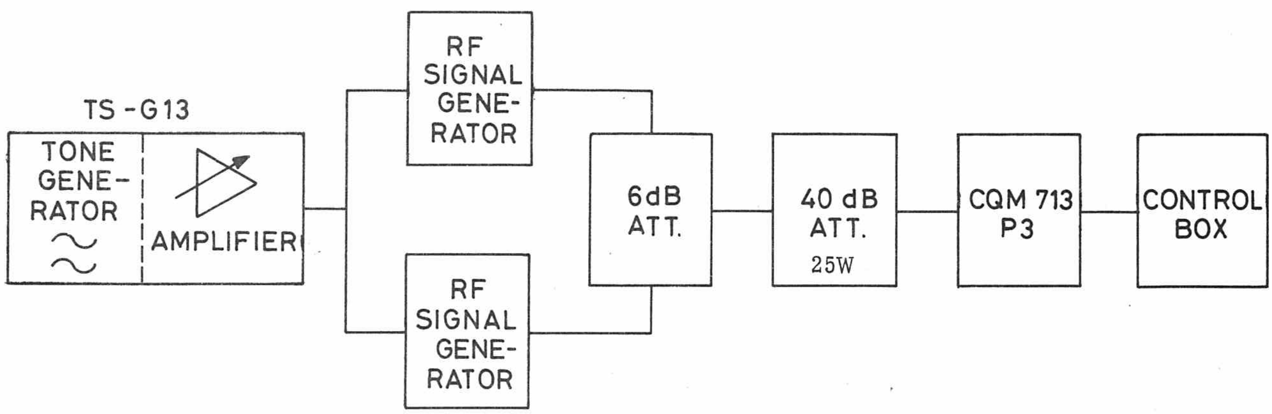


Fig. 4. Channel Searching Circuit Test

Storno

Alternately, increase the RF signal generator outputs 4 dB.

Check that the equipment selects the channel having the greater signal.

Checking the Network Connection

Test Set-Up
See fig. 2

Set the RF signal generator to channel 28.

Set the RF signal generator output to 2 mV e.m.f.

Modulate the RF signal generator as described under Checking the Marking Signal Detector.

The equipment shall search all channels, revert to channel 28, emit the Call tone, and repeat the channel search starting at channel 1.

Removing the marking signal while searching channel 29 - 55 (after channel 28 has been registered) shall cause the equipment to revert to channel 28 without the transmitter being energized and then the channel search shall be repeated starting at channel 1.

Removing the marking signal while the Call tone emission is in progress the equipment shall stop the channel search, the Searching Lamp shall extinguish and the receiver and the transmitter inhibit shall be removed.

Decreasing the RF signal until the squelch closes and then again increased, or energizing the transmitter for less than 5 seconds shall not cause the receiver to be inhibited.

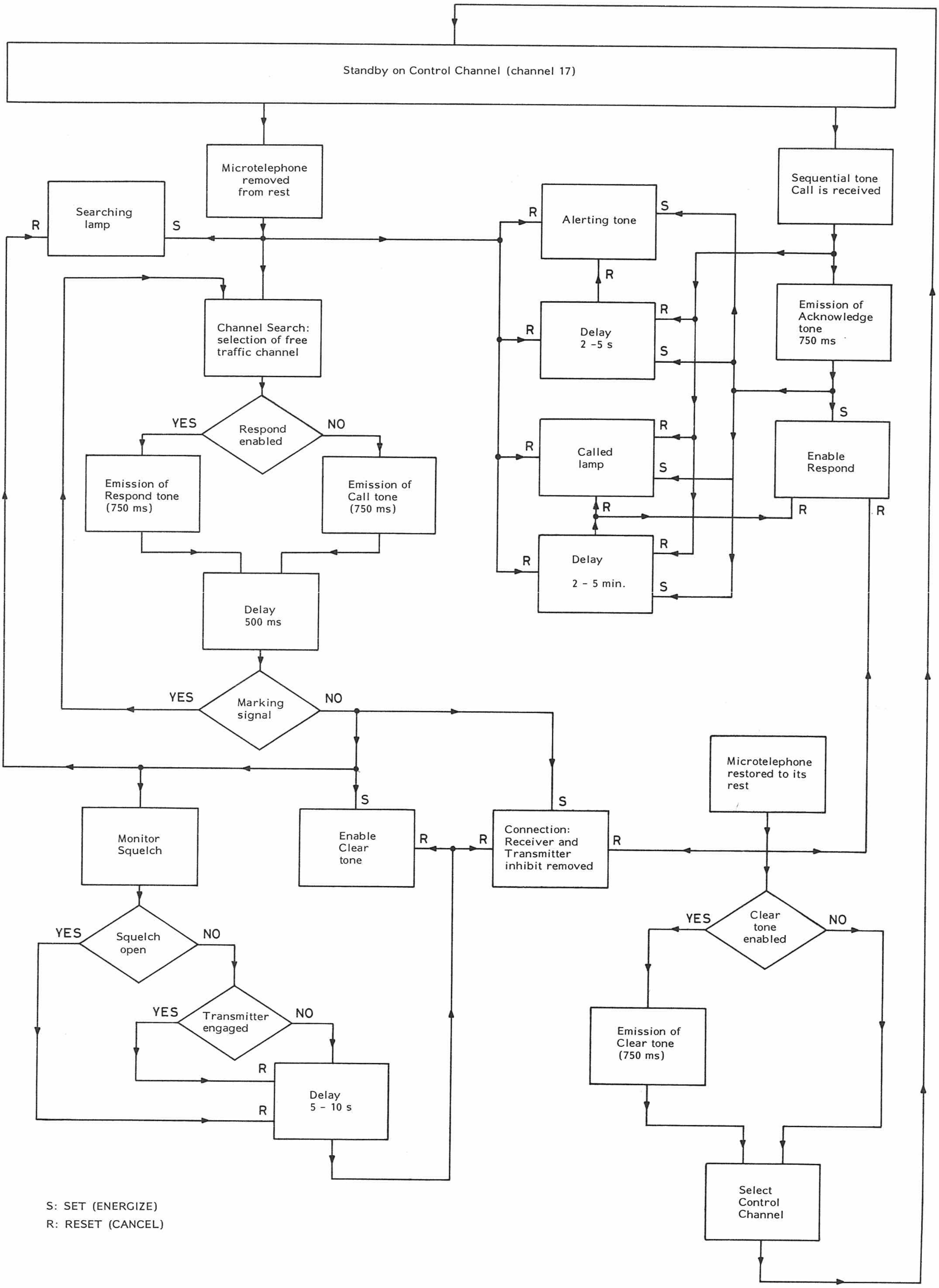
Closing the squelch for more than 10 seconds shall cause the receiver and transmitter to be inhibited, and setting the MT switch to "In rest", the equipment shall select channel 17 without emitting the Clear tone.

Checking the Control Channel Time-out

Select channel 17 and key the transmitter.

Activate the "Cancel TX Block" switch.

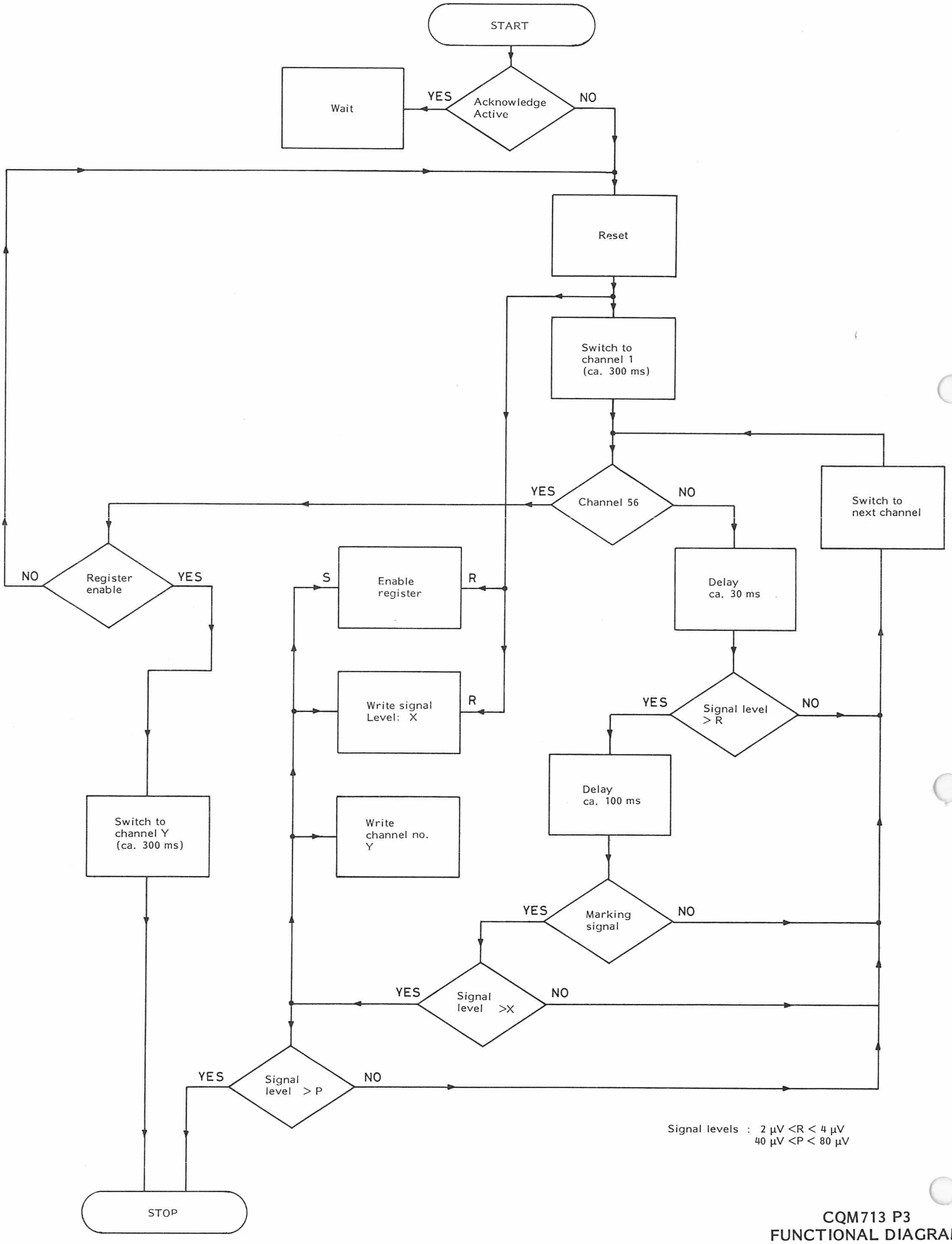
The transmitter shall be energized for 1 - 2 seconds and the equipment shall then revert to the receive mode.



S: SET (ENERGIZE)
R: RESET (CANCEL)

CQM713 P3
FUNCTIONAL DIAGRAM

D402.558

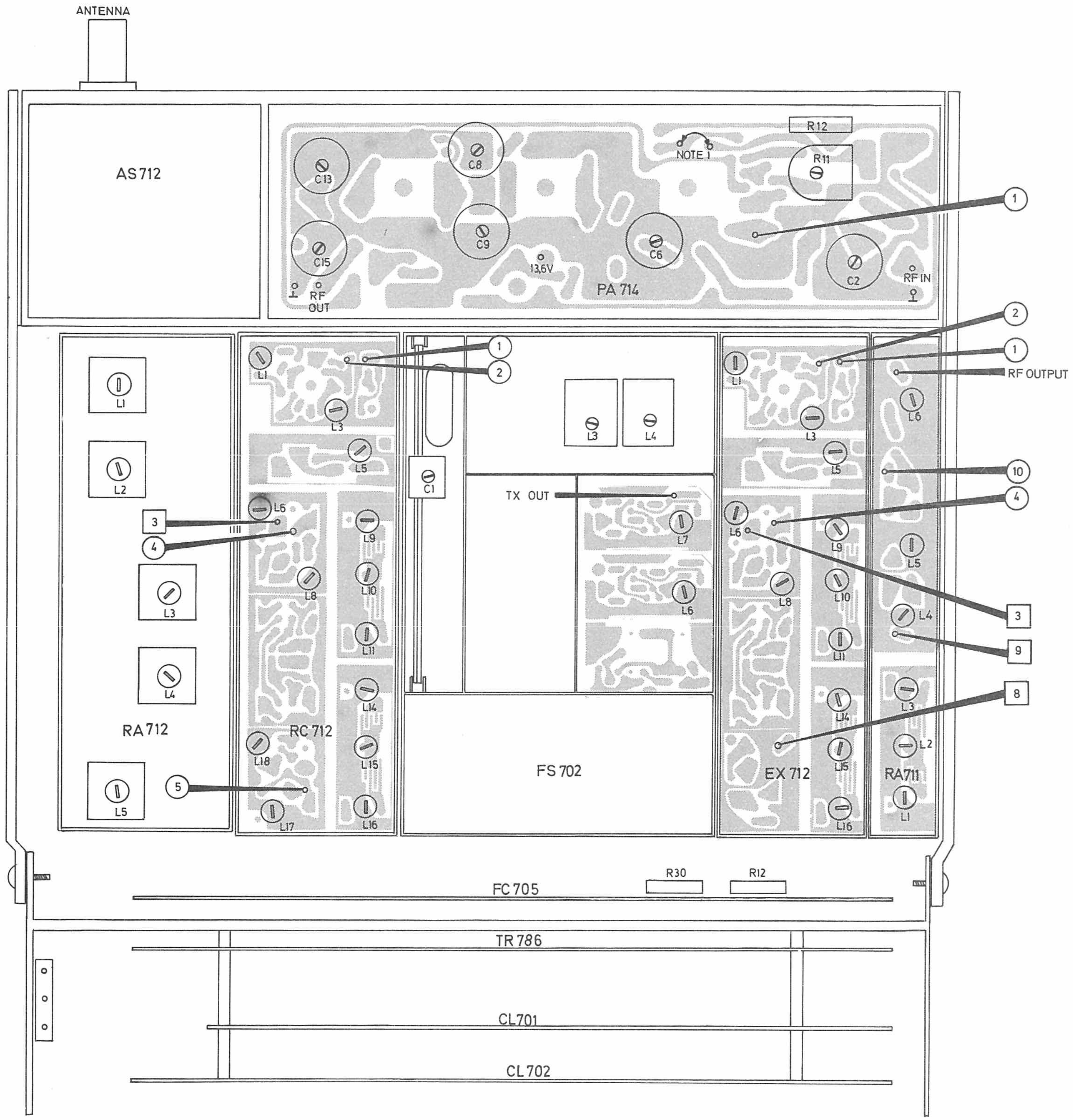


Signal levels : 2 µV <R < 4 µV
40 µV <P < 80 µV

CQM713 P3
FUNCTIONAL DIAGRAM
(Channel search)

D402.559

Storno

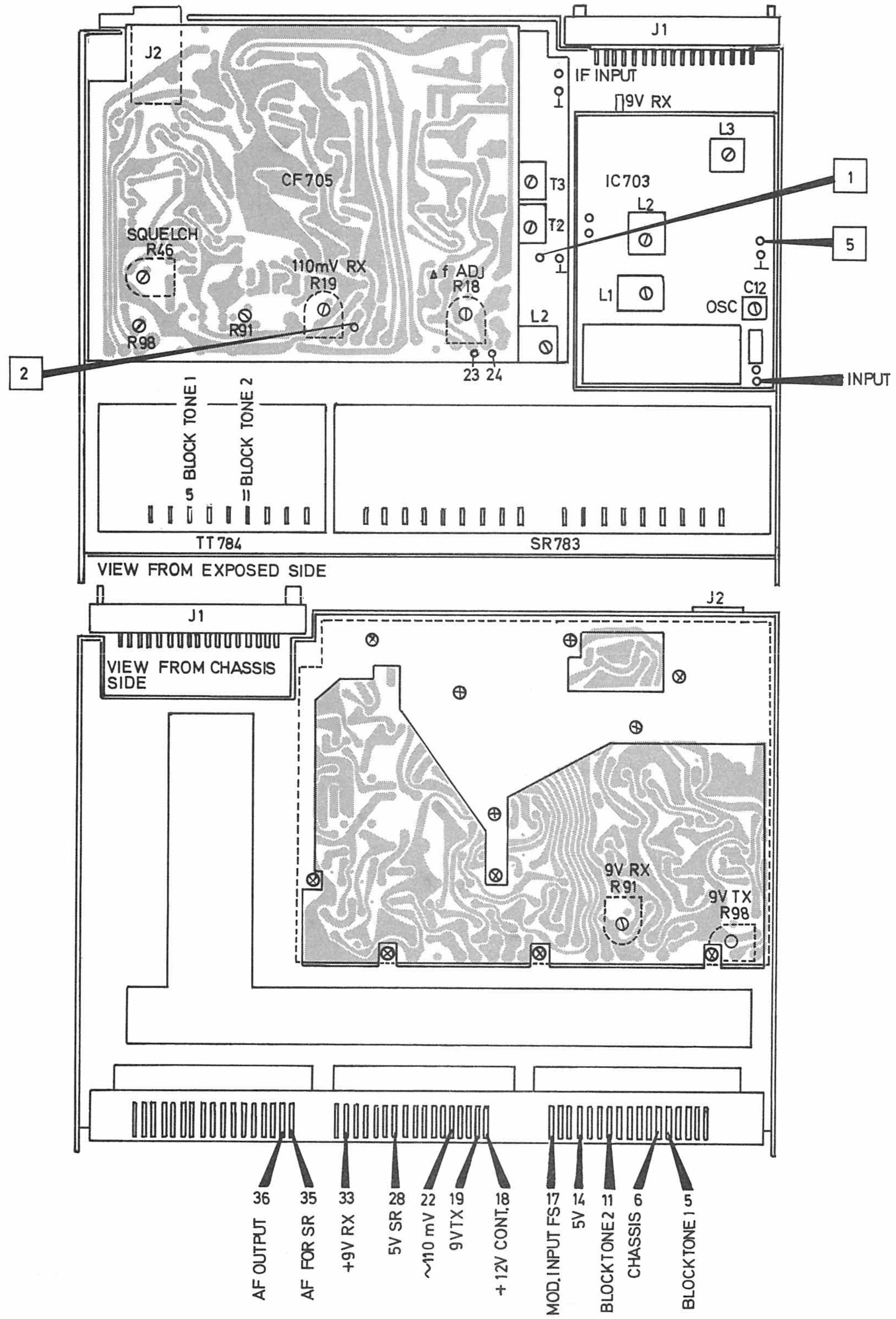


TEST POINTS AND ADJUSTABLE COMPONENTS

CQM713 P3

D 402.524

Storno



TEST POINTS AND ADJUSTABLE COMPONENTS

CQM713 P3

D402.525

STORNOPHONE 700
MAINTENANCE MANUAL
VOLUME I
Section 4

TITLE		Code
CQM730	Specification 1 - 2	60.207-E1
	General Description 1 - 9	60.160-E2
	Adjustment Procedure 1 - 8	60.172-E2
	Radio Assembly RF730	D401.828
	Basic Assembly BA701	D401.826
	Basic Assembly BA703, BA704	D402.388/2

CQM730
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS152A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range
68 - 88 MHz

Min. Channel Separation
CQM733: 20 kHz or 25 kHz
CQM734: 12.5 kHz

Max. Frequency Deviation
CQM733: ± 4 kHz or ± 5 kHz
CQM734: ± 2.5 kHz

Frequency Stability
Meets government specifications

Max. VHF Bandwidth
1 MHz

Number of Channels
Max. 6

Antenna Impedance
50 Ω

Temperature Range
Operating range: −25°C to +50°C
Functioning range: −30°C to +60°C

Dimensions
Locally controlled version: 180 x 190 x 68 mm
Extended local control: 180 x 160 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight
Local controlled version: 2.1 Kg
Extended local control: 1.9 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output
10 W or 6 W (adjustable)

Type of Modulation
Phase

AF Response
6 dB/octave preemphasis
CQM733: 300 - 3000 Hz
+0/−1.5 dB (+0.5/−3 dB)
CQM734: 300 - 2500 Hz
+0/−1.5 dB (+0.5/−3 dB)

Modulation Distortion (measured with deemphasis)
3% (5%)

Modulation Sensitivity
220 mV e.m.f. (600 Ω) ± 2 dB

AF Input Impedance
560 Ω

Adjacent Channel Selectivity
Attenuated to meet government specifications

FM Hum and Noise (measured without deemphasis)
CQM733: −50 dB (−40 dB)
CQM734: −45 dB (−38 dB)

Spurious Radiation
Less than 0.2 μW

Harmonic Radiation
Less than 0.2 μW (2 μW)

RECEIVER SPECIFICATIONS

Sensitivity emf. for 12 dB SINAD
0.6 µV (0.9 µV)

Squelch
Electronic, adjustable

Adjacent Channel Selectivity, EIA
CQM733: 90 dB (80 dB)
CQM734: 80 dB (75 dB)

Adjacent Channel Selectivity, FTZ, MPT
CQM733: 75 dB (70 dB)
CQM734: 85 dB (75 dB)

Intermodulation Attenuation, EIA
CQM733: 80 dB (75 dB)
CQM734: 78 dB (75 dB)

Intermodulation Attenuation, FTZ, MPT
CQM733: 75 dB (70 dB)
CQM734: 78 dB (75 dB)

Blocking, MPT
190 mV (100 mV)

Spurious Radiation
Less than 0.5 nW (2 n W)

Spurious Response Attenuation
90 dB (80 dB)

AF Output Power
2 W (load 5 Ω)

AF Response
CQM733: −6 dB/octave from 300-3000 Hz
+0/−1.5 dB (+0.5 /−3 dB)
CQM734: −6 dB/octave from 300-2500 Hz
+0/−2 dB (+0.5/−3 dB)

AF Distortion
CQM733: 3% (7%)
CQM734: 4% (7%)

Hum and Noise, squelched
80 dB (60 dB)

Hum and Noise, unsquelched
CQM733: 50 dB (45 dB)
CQM734: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

Current Consumption at 13.6 V
Stand by: 160 mA (190 mA)
Transmit: 2.7 A (3.1 A)
Receive, AF output 2 W: 470 mA (540 mA)

CQM730 GENERAL DESCRIPTION

Introduction

The Stornophone CQM730 radiotelephone is a mobile transmitter/receiver for simplex operated FM radio communication on the 68 to 88 MHz frequency band.

The CQM730 comes in a choice of channel spacings:

CQM733 for 20 or 25 kHz channel spacing
CQM734 for 12.5 kHz channel spacing.

For both versions there is a choice of 6, 10 or 25 W RF output power.

There are also two mechanically different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Each radio set can be equipped for either single or multichannel service. Multichannel sets will have a channel selector arranged as a row of push buttons on the control panel, accommodating up to 6 channels. Choice of channels (frequencies) must naturally take into account the RF bandwidth of the radiotelephone, which is 1 MHz.

Construction

The radio chassis slides into the cabinet from the front and is held in place by four screws from the rear of the cabinet. The chassis consists of two circuit panels hinged onto the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF731, contains all the circuits which are dependent upon channel frequencies. These are:

antenna filters
receiver VHF circuits
crystal selector unit, where included
exciter
transmitter power output amplifier

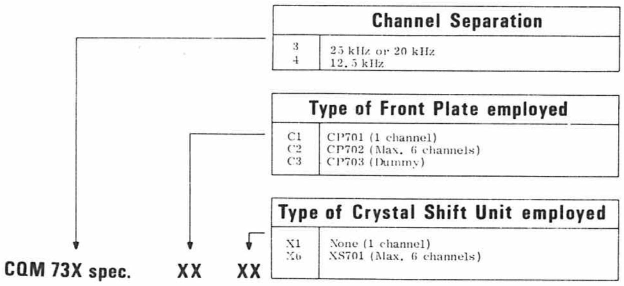
The lower circuit panel, designated BA701, contains those units common to all the frequency bands within the CQM730 programme:

audio amplifier
intermediate frequency amplifier
squelch circuit
voltage regulators
tone equipment, where included

The solid-state circuitry is built up as functional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:



Control Equipment

The locally controlled CQM730 will have one of the following front panels:

CP701 Front panel with controls and built-in speaker. This panel has no channel selector, limiting the equipment to single-channel service.

CP702 Front panel like CP701 with the addition of 6 push buttons for multi-channel service.

The CQM730 for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703. One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB701 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone. This control unit has no channel selector (single-channel service)

CB702 Control unit similar to CB701, and containing 6 push buttons for the channel selector (multichannel service).

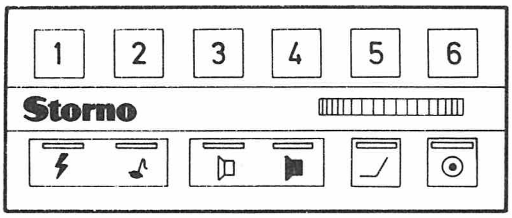
Where more than one RF channel is required (multichannel operation), the radiotelephone must be fitted with one of the following crystal switching units:

XS 701 Channel selector unit for a maximum of 6 channels.

XS702 Channel selector unit for a maximum of 4 channels with temperature compensation for operation in extremely cold climates.

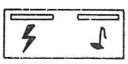
Operating Controls

The controls located on the front panel are as shown:



CP 702 FRONT PANEL

1 2 Push button for channel selection.



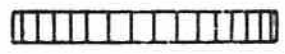
Tone button and lamp indicating when the channel is engaged (in equipment with built-in tone transmitters).

Transmit button and transmit indicator lamp (in radiotelephones without built-in tone transmitters).

Button for switching the loudspeaker on and off, provided with a lamp indicating when a tone call is received. (This button is only used in conjunction with tone equipment).

Squelch button for overriding the squelch function.

On/off switch and indicator lamp.



Volume control.

NOTE: For radiotelephones with built-in tone transmitters an external keying device (e.g. a steering column switch or microphone button) must be emplcyed as the transmitter key, since the regular button on the front panel is used for keying tone transmitter.

Accessories

Accessories available for the CQM730 series radiotelephone are listed in this section. Some of them, such as installation materials, antenna and microphone, are neccessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier.

MC702 Fist microphone with built-in amplifier, transmit button and retainer.

MC703 Fixed microphone for mounting on steering column.

MT701 Handset with built-in amplifier and transmitter keying switch.

All of the abcve are supplied with cables terminated in solderless crimp pins for insertion in a special multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit consisting of 2 flexible metal tubes (length 20 and 35 cm) is available.

Antenna

AN39-5 1/4 wavelength whip antenna for the 68 to 88 MHz frequency band. 50 Ω impedance matches Stornophone CQM730. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM730 radio set will require some or all of the following installation kits:

MN701 Mounting frame for radio cabinet

CC701 Cable kit containing battery cable and antenna cable necessary for installing the radiotelephone.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for intallation in series with the battery cables.

For extended local control the distance between control unit and radio set may be increased by inserting:

CC703 Extension kit with connectors.

Loudspeakers

When using the extended local control it is necessary to install an external loudspeaker. The following types are available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable terminated in solderless crimp pins to be inserted in the accessories connector.

LS702 Weatherproof version of loudspeaker.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for dashboard mounting.

SU703 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

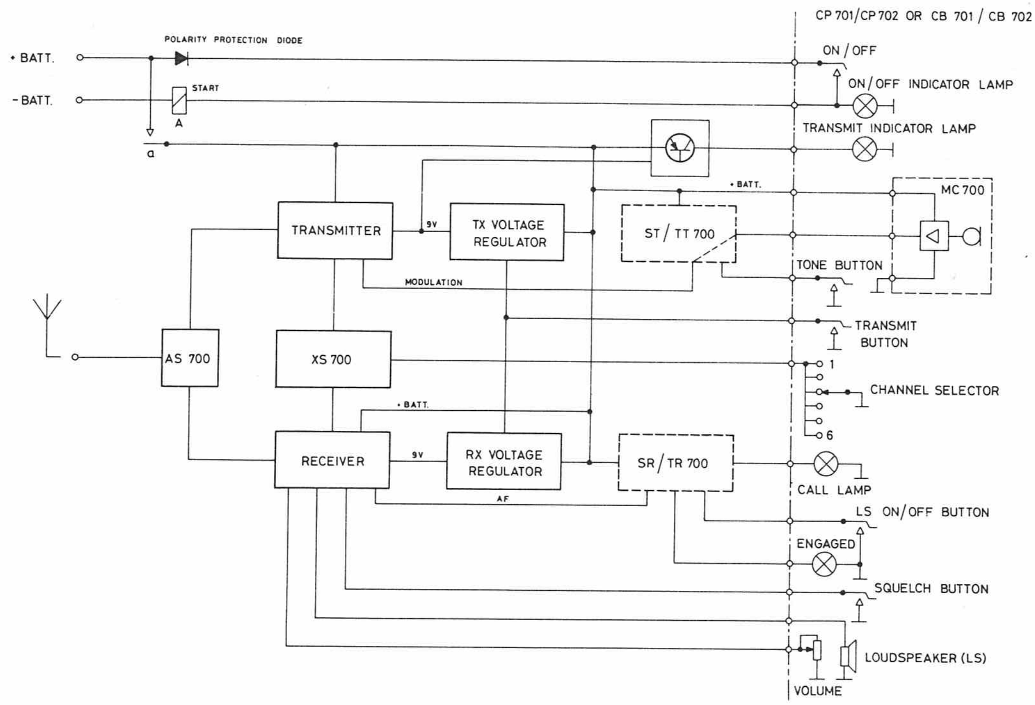
Power Supplies

PS701 Power supply for 24 V car battery, any battery polarity.

PS702 Power supply for 24 V car battery, negative pole to chassis.

CIRCUIT DESCRIPTION

Functional Diagram



General

The nominal 12 V supply from the battery is applied to the connector designated "BATT". A relay in series with a diode across the battery input protects the radiotelephone against incorrect supply polarity.

The filtered battery voltage is applied to two separate 9 V regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment, if fitted.

The incoming signal passes through the antenna switching unit to the input of the receiver. The antenna switching is controlled by the stabilized supplies from the transmitter and receiver voltage regulators.

In the single channel edition of CQM730 a crystal controlled oscillator is incorporated in the transmitter section. Similarly, a single oscillator is provided in the receiver section.

Channel switching unit XS700 is fitted in the multichannel edition of CQM700 and is controlled by the channel selector.

The audio output from the receiver is applied to the loudspeaker (LS). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output signal may be connected to the tone receiver TR700 used in selective tone calling systems. The tone receiver enables the AF output circuits of the receiver to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "call" and "engaged" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) via the tone generator TT700, if fitted.

During transmission of tone calls, the microphone will be switched off automatically so that the transmitter is modulated by the tone signal from TT700 only.

The transmitter is keyed by depressing the transmit button. This will block the receiver voltage regulator and cancel the blocking of the transmitter voltage regulator. When the transmitter voltage regulator operates, supply voltage is applied to the exciter.

The "transmitter on" condition is indicated by the transmit indicator lamp.

In the radiotelephone fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched on manually by means of the loudspeaker ON/OFF button.

RECEIVER

The CQM730 receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having a low insertion loss.

Adjacent channel selectivity is obtained by using two bandpass filters: a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 6 crystal controlled oscillators, one for each channel, can be provided. The oscillators are connected in parallel and channel selection is performed by grounding the negative supply lead of the appropriate oscillator.

The receiver comprises the following subunits:

Antenna switching unit	AS731
Preselector filter	BP731

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Receiver converter with 1st mixer and 1st local oscillator RC731

Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter:

- for 25 and 20 kHz channel spacing IC703
- for 12.5 kHz channel spacing IC704

455 kHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator **CF703**
(for other circuits of **CF703** see page 7).

Channel switching unit:

- Maximum 6 channels XS701
- Maximum 4 channels, temperature compensated XS702.

Signal Path

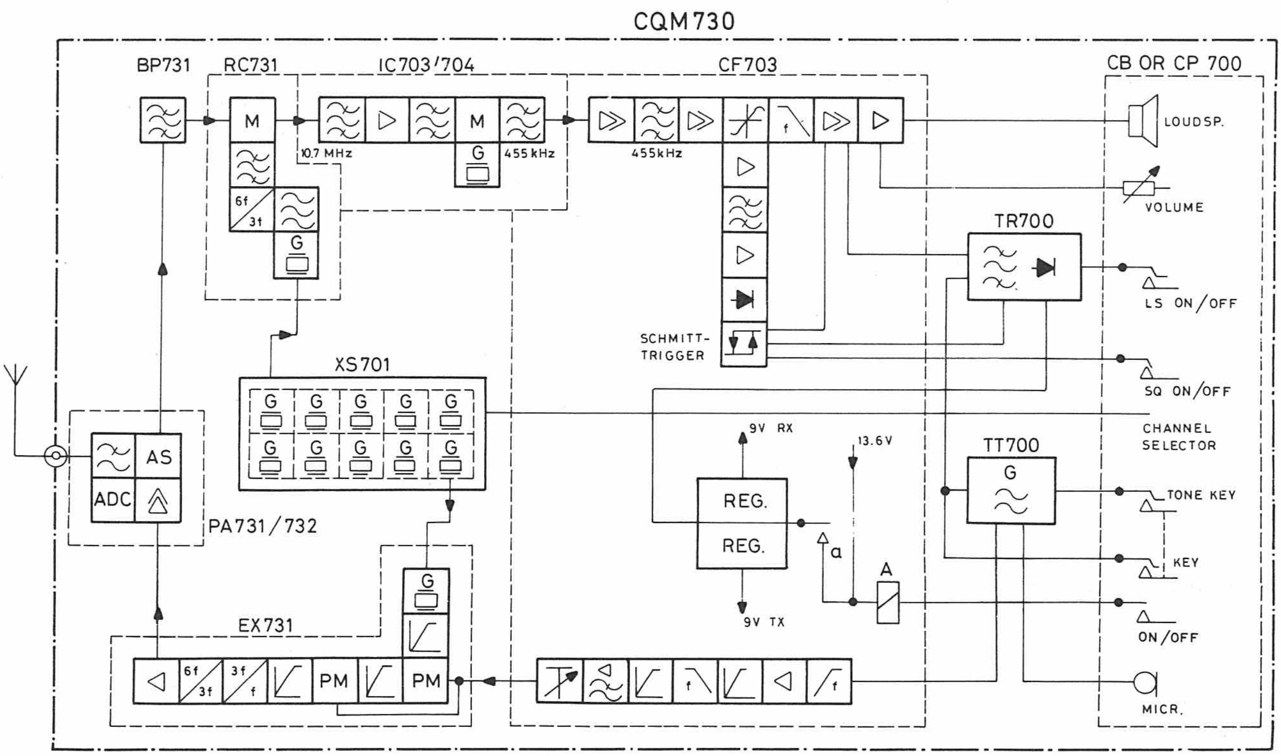
From the antenna switching unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage. This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver.

The BP731 filter consists of five tuned circuits which can be adjusted over the band 68-88 MHz. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required by the field-effect transistor (FET) of the mixer stage.

The local oscillator and the received signals are applied to the gate of the FET. The mixer output at 10.7 MHz is taken from the drain circuit.

First Local Oscillator

The local oscillator signal is generated in an oscillator operating on the fundamental frequen-



cy of the crystal. The oscillator operates within the frequency range 9.55 MHz to 12.9 MHz, depending on the crystal frequency used.

In the oscillator, the 3rd harmonic of the crystal frequency is selected and applied to a buffer stage and then to a doubler. The output frequency is thus 6 times the fundamental frequency of the oscillator.

The doubler stage is followed by a filter consisting of three capacitively coupled tuned circuits. The filter attenuates undesired frequencies generated by the multiplier chain and prevents these from reaching the mixer stage.

The injection signal is 10.7 MHz below the received signal and is calculated as follows:

$$fx = \frac{f_a - 10.7}{6} \text{ MHz}$$

where fx is the crystal frequency, MHz, and f_a os the received signal, MHz.

The receiver converter RC731 includes an oscillator intended for use in single-channel receivers. When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

XS701 contains oscillators for five RF channels thus allowing the receiver to be equipped with a maximum of 6 channels.

XS702 is a temperature compensating unit employed where radiotelephones are to work in very low temperatures. The compensation is provided by heating the crystals when the ambient temperature falls below -5°C approximately.

XS702 contains oscillators for a maximum of 4 channels.

Intermediate Frequency Circuits

From the mixer in RC731 the 10.7 MHz signal passes to the intermediate frequency converter, type IC703 or IC704 depending on the channel separation used, which provides the channel selectivity of the receiver.

The first IF signal passes through the 10.7 MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal controlled oscillator whose frequency is normally 455 kHz below 10.7 MHz. In instances where a harmonic of the local oscillator coincides with the frequency of the received signal, a crystal oscillator of 455 kHz above 10.7 MHz is chosen.

In the first case the crystal frequency is:

10.7 MHz - 0.455 MHz = 10.245 MHz

In the second case the crystal frequency is:
10.7 MHz + 0.455 MHz = 11.155 MHz.

The crystal frequency of 11.155 MHz is used when the received frequencies are within the following bands:

70.5 - 72.9 MHz
80.8 - 83.2 MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455 kHz ceramic filter in the IC703 or IC704 converter and is then applied to the intermediate frequency amplifier in CF703 .

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a deemphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

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The signal is then applied to an integrated amplifier in which a transistor, operating as an electronic on/off switch, has been placed between the two stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level ov -17 dB (110 mV).

The signal is passed to the loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 4 W into a 4 Ω load.

The output is 2 W into a 4 Ω load when temperature and voltage variations are taken into consideration as the CEPT specifications do.

Manual gain adjustment, and thus the loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the first and second AF amplifier stages.

The AF output stage consists of an integrated power module.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the pre-amplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM700 is operated by noise components contained in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load. The resonant frequency of this circuit can be changed by a strapping arrangement to suit the channel separation of the receiver.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise amplifier.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

(See block diagram on page 6).

The transmitter is phase modulated. Its output is 6 times the oscillator frequency. Phase modulation is performed at the fundamental frequency.

The transmitter comprises the following subunits:

Exciter	EX731
RF power amplifier	PA731
Antenna switching unit	AS731
Modulation amplifier, transmitter switch and voltage regulator	CF703
Channel switching unit:	
Maximum 6 channels	XS701
Maximum 4 channels, temperature compensated	XS702.

AF Circuits

The modulating signal from the microphone is fed, through the tone generator if fitted, to the modulation amplifier where it is differentiated, amplified, limited, integrated, and filtered. The modulation amplifier transforms the micro-

Storno

phone output to a signal suitable for the phase modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also opertes as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the phase modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the phase modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The fundamental RF signal is generated in a crystal controlled oscillator contained in the exciter EX731.

When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

As in the receiver, channel selection is performed by grounding the negative return of the appropriate oscillator.

The exciter provides the following:

a. phase modulation

b. frequency multiplication

c. drive power for the power amplifier PA731.

The RF signal from the oscillator is applied to the 1st buffer amplifier, then to the phase modulator, followed by the 2nd buffer amplifier. The buffer amplifiers provide constant input levels and correct impedance matching.

The phase modulator is made up of two modulators working in series in order to achieve sufficient phase shift with minimum distortion.

The modulating signal is applied to the emitters of both transistors whose operating points and transconductances thus change instantaneously with the modulating signal.

From the 3rd buffer amplifier, the signal is fed to a frequency tripler and then to a doubler. The transmitter output frequency is therefore 6 times the crystal frequency.

Both multipliers are designed as balanced circuits to suppress harmonics of the oscillator frequency.

The tripler suppresses the even harmonics and the doubler suppresses the odd harmonics.

Double tuned bandpass filters are used with close-to-critical coupling between tuned circuits. These filters limit the bandwidth of the exciter and attenuate undesired harmonics generated in the frequency multiplication process.

The output signal from the doubler is fed to an amplifier operating at the final frequency of the transmitter. Tuned input and output bandpass filters of the amplifier provide additional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the RF power amplifier PA731. The nominal RF output power of EX731 is 50 mW into a 50 Ω load.

The bandwidth of the transmitter and thus the maximum frequency spread of the channels is determined by the selectivity of the exciter, which is 1 MHz.

RF Power Amplifier

The power amplifier contains three transistor amplifier stages. The coupling between the stages consists of tuned matching networks with low loaded Q values.

Storno

The RF power amplifier is a high efficiency Class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading the power transistor. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

In the 25 W version, a power booster and a temperature protection circuit are also included in the PA stage.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through an electronic antenna switching unit and a low-pass filter to the antenna.

The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The low-pass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple.

The filter attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonics of the transmitter frequency.

The antenna filter is not adjustable.

Power Supply and Switching Circuits

CQM700 is powered directly from a 12 V car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A relay in series with a diode connected across the battery input terminals protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the diode not to conduct and thus the relay refuses to operate.

The CQM700 contains two identical voltage regulator circuits which deliver 9 V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

Each regulator has a blocking transistor controlled by the transmit key button. With the CQM730 in the standby or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed, operation and blocking of the two voltage regulators are reversed. The supply voltage for the PA731 power amplifier in the transmitter is taken from the battery and applied to the amplifier.

ADJUSTMENT PROCEDURE FOR CQM730

RECEIVER ALIGNMENT

Before switching on the CQM700 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 1 A.

The station may now be switched on.

Check the 9 V RX at terminal 33 on the terminal board.

Requirement: 9 V ± 0.1 V.

If necessary, adjust the RX voltage by means of potentiometer R91 in CF703. This potentiometer can be reached from the rear of the module tray BA700.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 kHz generator and the CQM700 chassis.

Apply a 455 kHz signal to the input of CF701. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF701.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 10 µA if an AVO-meter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF701

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box, or by switching the squelch off the control unit C33/C34. Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the terminal board. On the control units C33/C34 the reading may be taken from LINE OUT.

Adjust coil L1 in CF703 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R19 (AF-RX) may be turned up. This potentiometer can be reached from the top of the module tray BA700, and turns up counter-clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency is available, the frequency may be read at test point [5], IC700. If the input of the frequency counter is DC-coupled, a capacitor (approx. 1 nF) should be connected in series. The frequency will either be 10.245 or 11.115 MHz. Refer to circuit description, "Intermediate Frequency circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF703 and a 10.7 MHz generator to the input of IC700. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS IN/OUT must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC700 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the LINE OUT (-17 dBm) 600 ohm audio output, which is accessible on the terminal board, terminal 35, and on the control units C33 / C34.

NOTE: The discriminator has no zero adjustment.

Alignment of 1st IF Amplifier (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC700.

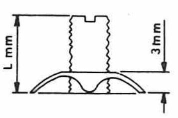
Connect a DC meter with an RF probe (95.089) to test point [1] in CF701.

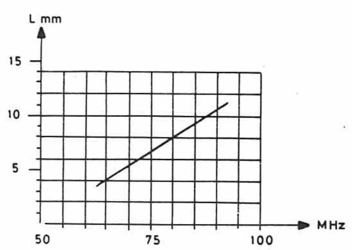
Adjust coils L1, L2 and L3 in IC700 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC700: ≥ 20 dB

Coarse Adjustment of BP731

The trimming slugs, L1, L2, L3, L4, and L5 of the filter BP731 are to be set to the approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency.





Alignment of Multiplier Chain in RC731

When crystals have been inserted in RC731 and/or XS701/XS702, select the middle frequency channel.

Connect a DC voltmeter to test point (1) in RC731.

Tune L6 and L7 in the RC to minimum, approx. 8.4 V.

Requirement: 8.6 V

To tune for maximum drive to the 1st mixer, connect a DC voltmeter with an RF probe to test point (1) in RC731.

L5, RC731, is adjusted for maximum meter reading.

L4, RC731, is adjusted for minimum meter reading.

L3, RC731, is adjusted for maximum meter reading.

L1, RC731, is adjusted for minimum meter reading.

Since only very small variations occur at test point (1), especially in the final circuits, the drive to the 1st mixer should be checked:

Connect a DC voltmeter to test point (2) in RC731.

Touch up the tuning of coils L5, L4, L3 and L1 for maximum meter reading.

Stop the oscillator (select a channel with no crystals or take a crystal out).

The voltage at test point (2) with the oscillator stopped will be between 1 to 4.5 V.

Start the oscillator.

Requirement: Minimum increase at test point (2), RC731 = 0.5 V.

Adjustment of Temperature Regulating Circuit in XS702

The temperature regulating circuit of XS702 has been adjusted before leaving the factory.

However, if necessary, it may be readjusted as follows:

Turn potentiometer R39 in XS702 fully counter-clockwise.

Remove jumper connecting the NTC resistor.

Set the supply voltage for the CQM700 to 13.6 V.

Check the current consumption of XS702 by inserting an ammeter in the orange/blue wire to XS702.

Adjust the current to 0.45 A by means of R39 (this adjustment should not exceed 30 seconds).

Insert jumper connecting the NTC resistor again and reconnect the orange/blue wire.

Further Alignment of RC731, Fine Tuning of BP731, and Fine Tuning of IC700

Connect a DC EVM with an RF probe to test point [1] in CF703. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF703. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF701, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at test point [1] , CF703.

The following coils are tuned for maximum meter reading in this order:

L1, RC731	L3, BP731,
L5, BP731,	L2, BP731,
L4, BP731,	L1, BP731.

Due to interaction, especially between L1 in RC, and L5 in BP, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting L1, RC731, the oscillator drive signal to the first mixer will have decreased.

L3, RC731, must be fine tuned for maximum reading on a DC voltmeter connected to test point (2) , RC731.

Now, when stopping the oscillator, the voltage at test point (2) should fall at least 0.3 V.

L2 in RC, and L1, L2, and L3 in IC700, are now fine tuned for maximum reading at test point [1] , CF703. The circuits in IC700 should be aligned two or three times, as they influence each other.

Fine Tuning of L1 in CF703

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM700, approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz, (for CQM714: ± 1.75 kHz).

Connect an audio voltmeter to test point [2] in CF703. Peak coil L1 in CF703, for maximum meter reading.

Requirement: $\geq$ 50 mV.

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 kHz, and set the frequency deviation to 0.7 x Δ f max.:

CQM733 (25 kHz channel spacing) 3.5 kHz.
CQM733 (20 kHz channel spacing) 2.8 kHz.
CQM734 (12.5 kHz channel spacing) 1.75 kHz.

Set the RF generator output level to approx. 1 mV EMF.

If the CQM700 is provided with tone equipment, press the LS in/out button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to terminal 35.

Adjust the audio output level to 110 mV by means of R19 in CF703.

Measure the AF voltage at the telephone output, on C33/C34 on pin z on the multiwire connector.

Requirement: 90 mV ± 1.2 mV.

Connect a 4 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker. The load is incorporated in the control units C33/C34.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals or to LS on/out on C33/C34. Set the volume control for 3.16 V on the meter. ∿ 2.5 W.

Check the distortion.

Requirement: CQM713a (-5): K $\leq$ 7%.
CQM714a (-5): K $\leq$ 9%.

NOTE:

Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 4 W (by means of potentiometer R19 on CF703) for an audio input of 110 mV from LINE OUT (AF -17 dBm).

Adjustment of Oscillator Frequency in RC731

The frequency is measured after the doubler with a counter connected to test point (1) in RC731. The frequency should be:

$f_{antenna}$ -10.7 MHz.

The oscillator frequency is adjusted with L25, RC731.

In CQM700 with XS701/XS702 frequency adjustment must be performed on each channel with the trimmer capacitor of the appropriate oscillator.

Requirement:

CQM733: Better than $\pm 1 \times 10^{-6}$
CQM734: Better than $\pm 0.5 \times 10^{-6}$

The tolerances are valid only for a crystal temperature of 25°C.

Checking Receiver Sensitivity

Modulate the RF generator with 1 kHz, and a frequency deviation of 0.7 x max. Δ f. Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 5 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the RF generator output until 12 dB SINAD is obtained on the distortion meter.

Read the calibrated RF voltage from the RF generator.

Requirement: for 12 dB SINAD
0.8 µV EMF

If more than one channel is provided, the procedure should be repeated on all channels.

Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R46 in CF703 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage.

Requirement:

CQM700 without tone equipment, in stand by, single channel = 250 mA (typically 180 mA)

CQM700 without tone equipment, in stand by, multichannel = 330 mA (typically 250 mA)

TRANSMITTER ADJUSTMENT

Set the supply voltage to 13.6 V, and the current limiter to 4 A.

If tone equipment is installed, the LS in/out button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9 V TX at terminal 19 on the terminal board.

NOTE: If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.

Requirement: 9 V TX = 9 V ± 0.1 V.

If necessary, adjust the TX voltage by means of potentiometer R72 on CF701. This potentiometer can be reached from the rear of module tray BA701.

Alignment of Exciter EX731

Remove the RF signal lead between EX731 and PA731.

Connect a 47 Ω resistor across the output of EX731 (this load may also be soldered across the input of an RF probe, STORNO 95.059, and the probe connected across the output of EX731 for the duration of the alignment of the exciter).

When crystals have been inserted in EX731 and/or XS701/XS702, select the middle frequency channel and key the transmitter.

Connect a DC voltmeter to test point (1) in EX731.

Adjust L5 for maximum meter reading, approx. 1.8 V.

Adjust L6 for minimum meter reading.

Move the voltmeter to test point (2) in EX731.

Adjust L7 and L6 for maximum meter reading, approx. 2 V.

Adjust L8 for minimum.

Move the meter to test point (3), EX731.

Adjust L9 and L8 for maximum, approx. 0.3 V.

Connect a DC voltmeter with an RF probe, STORNO 95.059 (95.089 may also be used), across the RF output terminals of EX731.

Adjust L10 and L11 for maximum output.

Connect a DC voltmeter to test point (1), EX731, and adjust L5 for maximum meter reading.

Move the DC voltmeter to test point (2), and adjust L6 and L7 for maximum reading.

Adjust L8, L9, L10, and L11 for maximum RF output from EX731.

Requirement: $P_{out} \geq 50$ mW.

(Measured with a DC voltmeter and RF probe 95.059, the voltage should read more than 3.5 V).

Alignment of RF Power Amplifier (PA731)

Reestablish the connection between EX731 and PA731.

Connect a Wattmeter to the antenna output.

PA731 should be aligned at a supply voltage of 13 V.

Turn the ADC potentiometer, R10, PA731, half-way up (clockwise).

Set trimmer capacitors C4, C10, C18, and C21 for minimum capacity.

NOTE: The PA731 should be aligned with its shielding lid in place, and insulated trimming tools should be used.

Install the lid and key the transmitter.

Adjust C4 for maximum power output.

Adjust C10 for maximum power output.
Adjust C18 for maximum power output.
Adjust C21 for maximum power output.

Repeat the adjustment of the trimmer capacitors until maximum power output has been obtained.

Increase the supply voltage to 16 V.

Set the ADC potentiometer, R10, for

$$P_{out} = 13\text{ W}.$$

Decrease the supply voltage to 13 V.

Readjust trimmer capacitors C4, C10, C18, and C21 for maximum power output.

Increase the supply voltage to 16 V.

Requirement: $P_{out} = 13\text{ W} \pm 0.25\text{ W}$.

If necessary, readjust R10 at 16 V, and repeat the adjustment of the trimmer capacitors at a supply voltage of 13 V, until the above requirement is fulfilled.

Adjustment of Transmitter Frequency

The counter is connected to the transmitter output via a suitable (100 W capacity) attenuator. The antenna frequency is adjusted with C2 in EX731 and/or the trimmer capacitors in XS701/XS702. The frequency must be adjusted on all channels and at crystal temperatures of 25°C.

Requirement:

CQM733: Better than $\pm 1 \times 10^{-6}$

CQM734: Better than $\pm 0.5 \times 10^{-6}$

Automatic Drive Control (ADC) Circuit

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

Supply Voltage	Current Drain	Power Output
10.5 V	< 2.9 A (< 3 A)	≥ 6 W
13.6 V	< 3.0 A (< 3.1 A)	≥ 10 W
16.0 V	< 2.9 A (< 3 A)	=13 W ± 1 W

These values for total current drain apply to stations without tone equipment. The values in brackets apply to stations with XS701/XS702.

The relationship between supply voltage, power output, and current consumption in the individual stages of PA731 is dependent on the antenna frequency. The current in individual stages may be read by substituting an Ammeter for the shorting links, A, B, and C, in the collector leads of transistors Q1, Q2, and Q3 in PA731.

Typical Values at 68 MHz

Supply Voltage	Current Consumption in Q1	Q2	Q3	Power Output
10.5 V	100 mA	0.5 A	1.1 A	8 W
13.6 V	80 mA	0.55 A	1.4 A	12,5 W
16 V	80 mA	0.5 A	1.3 A	13 W

Typical Values in 80 MHz

Supply Voltage	Current Consumption in Q1	Q2	Q3	Power Output
10.5 V	80 mA	0.4 A	1.2 A	8 W
13.6 V	80 mA	0.45 A	1.7 A	12.5 W
16 V	80 mA	0.4 A	1.6 A	13 W

Use of Control Unit C33/C34 When Adjusting Modulation

The control units C33/C34 may be used for stations with or without tone equipment and a voltage divider and a DC-blocking capacitor is incorporated.

Where a tone transmitter is installed, the modulation signal must pass through the switching transistor (the AF gate) in the tone transmitter. The emitter resistor for this transistor is situated in the microphone amplifier, which is disconnected when adjusting the modulation. An alternate DC path must therefore be provided for the switching transistor in the tone transmitter to

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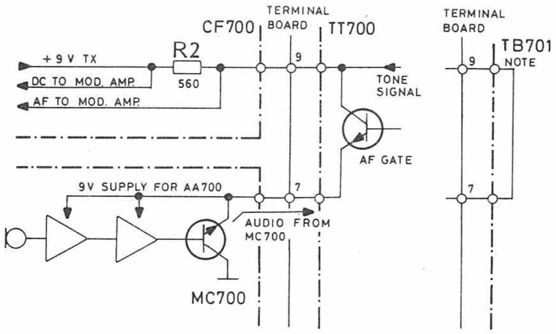
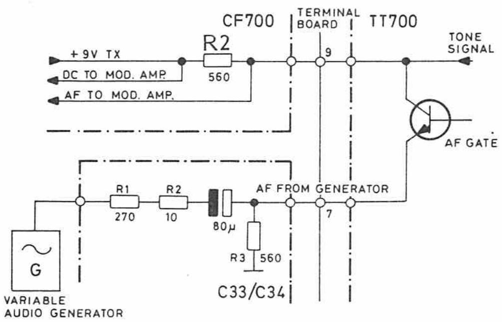
allow it to pass the modulation to the modulation amplifier of the CQM700. The DC supply voltage for the microphone amplifier in MC700 is also obtained through the switching transistor. This DC voltage should be isolated from the audio generator output.

A resistor, R3, in fig. 2 has been installed to provide the DC path for the switching transistor. This resistor would, as far as AC is concerned, seem to be in parallel with R112 in CF701. To the audio generator the two would present an impedance of 280 Ω, which is only half the required value. Another resistor, consisting of R1 and R2 in C33/C34, places 280 Ω in series with the input signal, bringing the input impedance up to 560 Ω. At the same time, a capacitor in series with the signal effectively blocks the DC voltage from CF703, which is normally fed to the microphone amplifier in MC700 through terminal 7 of the terminal board.



MODULATION PATH FROM MC700 TO CF700, AND 9V SUPPLY FROM CF700 TO MC700.
NOTE: WITHOUT TONE TRANSMITTER TB701 MUST BE INSTALLED



MODULATION THROUGH USE OF CONTROL UNIT C33/C34 (SEE ALSO NOTE IN FIG.1)

The resistors combine as a voltage divider when seen from the input to the control unit marked "modulation, AF gen.". This voltage divider attenuates the audio output by 6 dB in passing through C33/C34 to the modulation amplifier on CF701. The generator output must therefore be set 6 dB above the required input to the amplifier modulation. The adjustment procedure takes this into account.

Adjustment of Modulation and Frequency Deviation

NOTE: Where an ST7845 is installed, TB701 must be substituted during the following procedure.

Connect the deviation meter to the transmitter output via an attenuating network (10 W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM700 to 13.6 V.

Connect an audio generator to the modulation input of control unit C33 or C34.

Set the generator for an audio output of 2.2 V.

This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF703. The 6 dB loss in C33/C34 is also taken into account, and the nominal input level will be found to be

2.2 V - 26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 kHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R18 on CF703.

If the adjustment of Δ f is impossible, e.g. the deviation is too high, the brown wire to terminal 23 on CF703 is moved to terminal 24 and capacitor C8 (47 nF) is removed.

CQM733 (25 kHz) Δ f max. = ± 5 kHz.
CQM733 (20 kHz) Δ f max. = ± 4 kHz.
CQM734 (12.5 kHz) Δ f max. = ± 2.5 kHz.

Set the audio generator to 1000 Hz and attenuate the output until a frequency deviation of 0.7 x Δ f max. is read on the deviation meter.

CQM733 (25 kHz)	0.7 x Δf max.	=	±	3.5 kHz
CQM733 (20 kHz)	0.7 x Δf max.	=	±	2.8 kHz
CQM734 (12.5 kHz)	0.7 x Δf max.	=	±	1.75 kHz

Requirement: V_{mod} = 220 mV ± 2 dB

(175 - 275 mV) imput to C33/C34.

Check the distortion on the audio output of the deviation meter.

Requirement: k $\leq$ 10% (without de-emphasis).

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5 - 40 MHz.

The existence of parasitic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

For further details please refer to STORNO Service News No. 38 of May, 1969.

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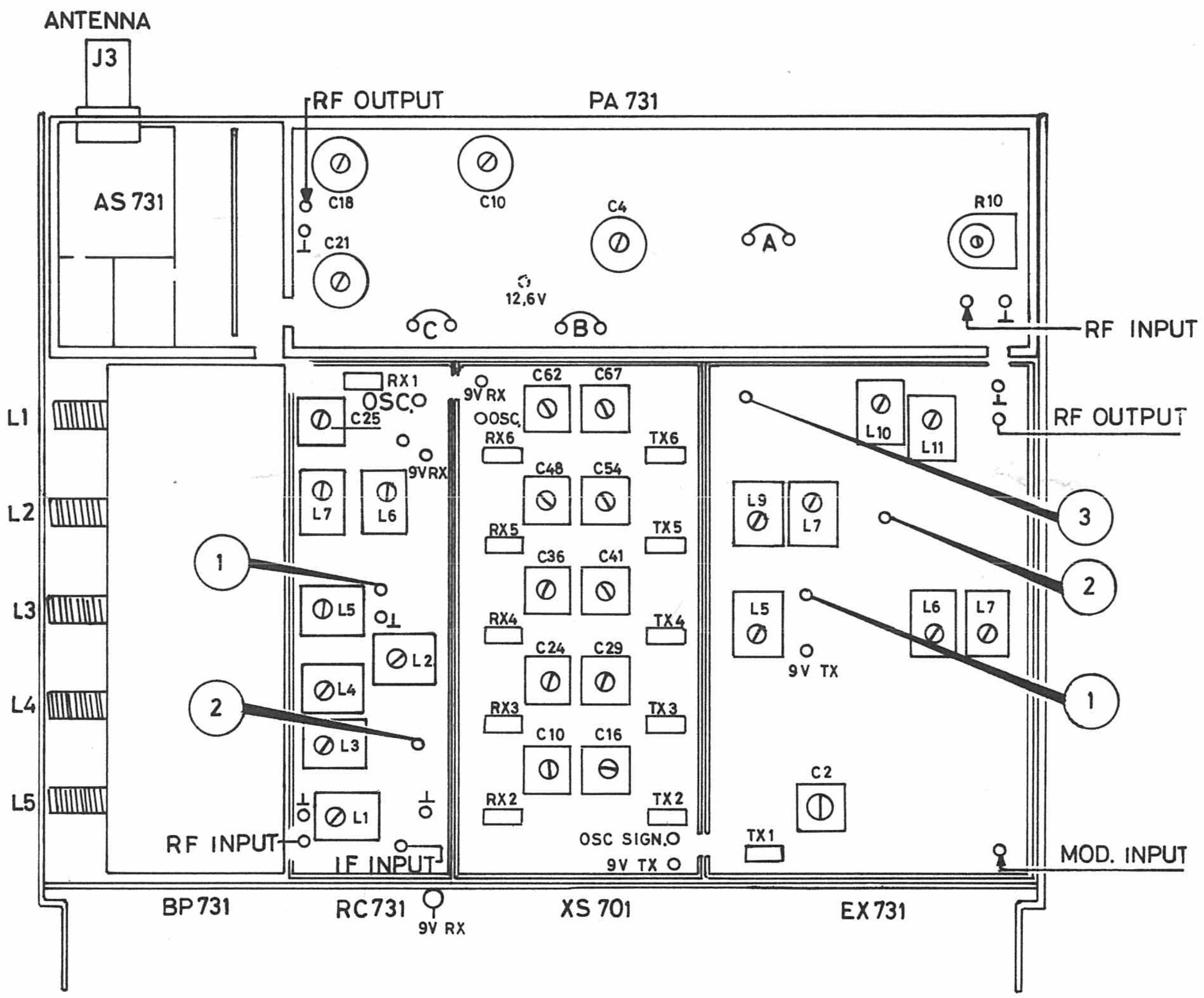

RADIO ASSEMBLY RF730 (CQM730)

Location of Test Points and Adjustable Components

D401.828

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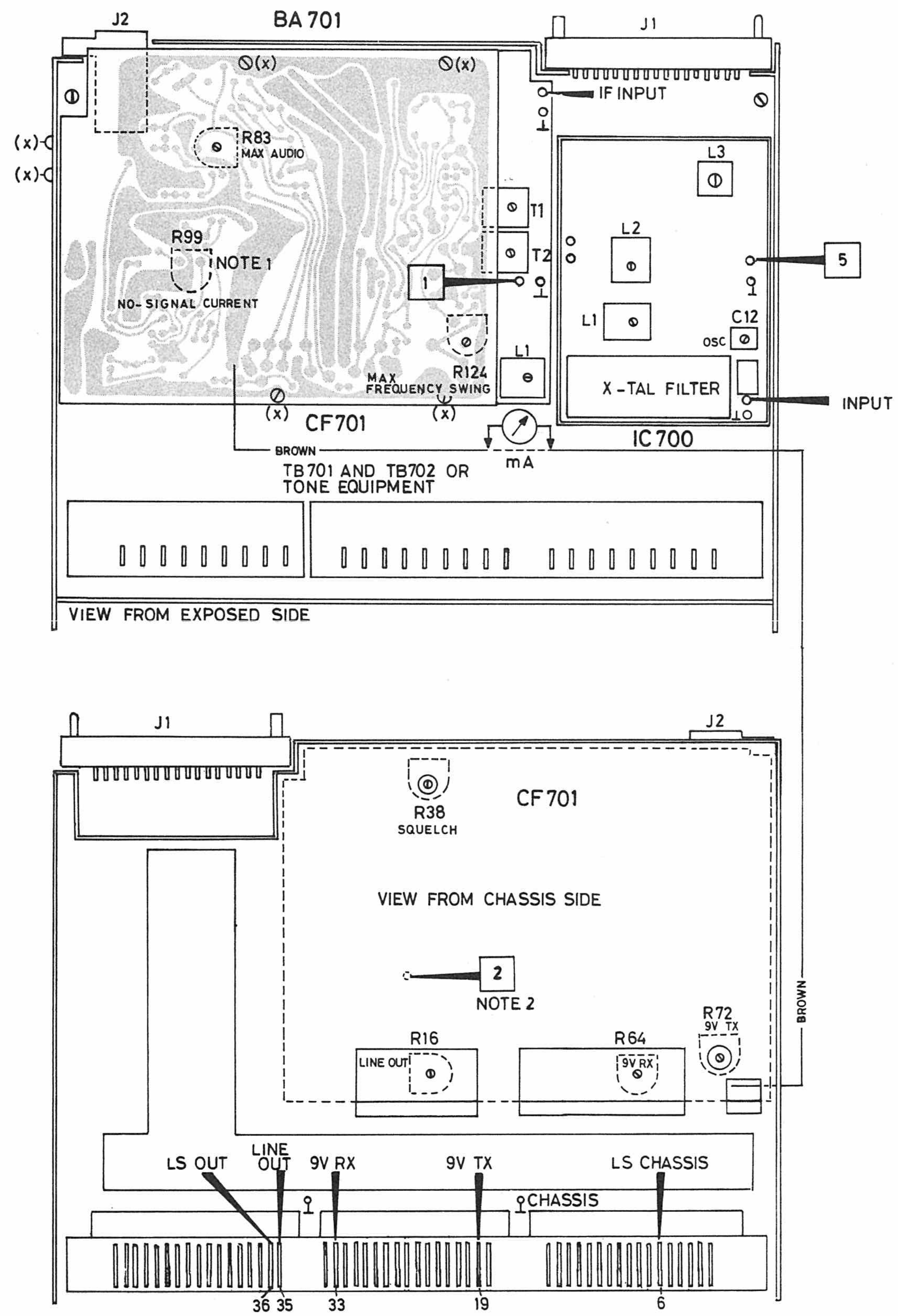

NOTE 1. ACCESS TO R99 ON THE UPPER P-C BOARD ONLY FROM COMPONENT SIDE.

NOTE 2. ONLY FROM COMPONENT SIDE
(x) REMOVE SCREWS FOR ACCESS TO LOWER P-C BOARD.

BASIC ASSEMBLY BA701 (CQM700)

Location of Test Points and Adjustable Components

D401.826

CQM760
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS152A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range
420-470 MHz

Min. Channel Separation
CQM761: 50 kHz
CQM763: 20 kHz or 25 kHz

Max. Frequency Deviation
CQM 761: ± 15 kHz
CQM763: ± 4 kHz or ± 5 kHz

Frequency Stability
Meets government specifications

Max. UHF Bandwidth
1 MHz

Number of Channels
Max. 6

Antenna Impedance
50 Ω

Temperature Range
Operating range: -25^{o}C to $+50^{o}$C
Functioning range: -30^{o} to $+60^{o}$C

Dimensions
Locally controlled version: 180 x 190 x 68 mm
Extended local control: 180 x 160 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight
Locally controlled version: 2.1 Kg
Extended local control: 1.9 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output
6 W

Type of Modulation
Phase

AF Response
6 dB/octave preemphasis 300-3000 Hz
+0/–1.5 dB (+0.5/– 3 dB)

Modulation Distortion (measured with de-emphasis)
CQM761: 2.5 % (7%)
CQM763: 2% (7%)

Modulation Sensitivity
220 mV e.m.f ± 2 dB

AF Input Impedance
560 Ω

Adjacent Channel Selectivity
Attenuated to meet government specifications

FM Hum and Noise (measured without de-emphasis)
CQM761: –50 dB (–40 dB)
CQM763: –45 dB (–38 dB)

Spurious Radiation FTZ
Less than 2 μW

Harmonic Radiation
Less than 2 μW

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RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD

CQM761: 1.0 μV (1.3 μV)

CQM763: 0.8 μV (1.1 μV)

Squelch

Electronic, adjustable

Adjacent Channel Selectivity EIA

CQM761: 85 dB (80 dB)

CQM763: 83 dB (80 dB)

Adjacent Channel Selectivity FTZ

CQM763: 80 dB (78 dB)

Intermodulation Attenuation EIA

75 dB (73 dB)

Intermodulation Attenuation FTZ

CQM763: 72 dB (70 dB)

Blocking MPT

190 mV (100 mV)

Spurious Radiation FTZ

0.4 nW (2 nW)

Spurious Response Attenuation

95 dB (80 dB)

AF Output Power

2 W (load 5 Ω)

AF Response

−6 dB/octave 300 Hz - 3000 Hz

+0/−1.5 dB (+0.5/−3 dB)

AF Distortion

3% (6%)

Hum and Noise, squelched

80 dB (60 dB)

Hum and Noise, unsquelched

CQM761: 50 dB (45 dB)

CQM763: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

Current Consumption at 13.6 V

Stand by: 160 mA (190 mA)

Transmit: 1.8 A (2.2 A)

Receive, AF output 2 W: 470 mA (540 mA)

CQM760 GENERAL DESCRIPTION

Introduction

The Stornophone CQM760 radiotelephone is a mobile transmitter/receiver for simplex operated FM radio communication on the 420 to 470 MHz frequency band.

The CQM760 comes in a choice of channel spacings:

CQM761 for 50 kHz channel spacing
CQM763 for 25 or 20 kHz channel spacing.

For both versions there is a choice of 6 W or 15 W RF output power.

There are also two mechanically different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Each radio set can be equipped for either single or multichannel service. Multichannel sets will have a channel selector arranged as a row of push buttons on the control panel, accomodating up to 6 channels. Choice of channels (frequencies) must naturally take into account the RF bandwidth of the radiotelephone, which is 1 MHz.

Construction

The radio chassis slides into the cabinet from the front and is held in place by four screws from the rear of the cabinet. The chassis consists of two circuit panels hinged onto the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF 761 contains all the circuits which are dependent upon channel frequencies. These are:
antenna filters
receiver VHF circuits
crystal selector unit, where included
exciter
transmitter power output amplifier.

The lower circuit panel, designated BA701, contains those units common to all the frequency bands within the CQM700 programme:

audio amplifier
intermediate frequency amplifier
squelch circuit
voltage regulators
tone equipment, where included.

The solid-state circuitry is built up as functional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:

CQM76X XX XX

Channel Separation	
1	50 kHz
3	25 kHz or 20 kHz

Type of Front Plate employed	
C1	CP701 (1 channel)
C2	CP703 (max. 6 channels)
C3	CP703 (Dummy)

Type of Crystal Shift Unit employed	
X1	None (1 channel)
X4	XS702 (Max. 4 channels)
X6	XS701 (Max. 6 channels)

Control Equipment

The locally controlled CQM760 will have one of the following front panels:

CP701 Front panel with controls and built-in speaker. This panel has no channel selector, limiting the equipment to single-channel service.

CP702 Front panel like CP701 with the addition of 6 push buttons for multichannel service.

The CQM760 for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703. One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB701 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone. This control unit has no channel selector (single channel-service).

CB702 Control unit similar to CB701, and containing 6 push buttons for the channel selector (multichannel service).

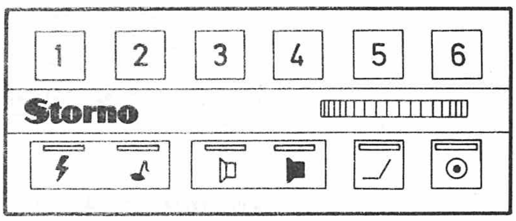
Where more than one RF channel is required (multichannel operation), the radiotelephone must be fitted with one of the following crystal switching units:

XS701 Channel selector unit for a maximum of 6 channels.

XS702 Channel selector unit for a maximum of 4 channels with temperature compensation for operation in extremely cold climates.

Operating Controls

The controls located on the front panel are as shown:



CP 702 FRONT PANEL

1 2 Push buttons for channel selection.

Tone button and lamp indicating when the channel is engaged (in equipment with built-in tone transmitters).

Transmit button and transmit indicator lamp (in radiotelephones without built-in tone transmitters.)

Button for switching the loudspeaker on and off, provided with a lamp indicating when a tone call is received. (This button is only used in conjunction with tone equipment).

Squelch button for overriding the squelch function.

On/off switch and indicator lamp.

Volume control

Notice: For radiotelephones with built-in tone transmitters an external keying device (e.g. a steering column switch or microphone button) must be employed as the transmitter key, since the regular button on the front panel is used for keying the tone transmitter.

Accessories

Accessories available for the CQM760 series radiotelephones are listed in this section. Some of them, such as installation materials antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier

MC702 Fist microphone with built-in amplifier, transmit button and retainer.

MC703 Fixed microphone for mounting on steering column.

MT701 Handset with built-in amplifier and transmitter keying switch.

All of the above are supplied with cables terminated in solderless crimp pins for insertion in a special multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit, consisting of 2 flexible metal tubes (length 20 and 35 cm), is available.

Antenna

AN19-5 1/4 wavelength whip antenna for the 420 to 470 MHz frequency band. 50 Ω impedance matches Stornophone CQM760 Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM760 radio set will require some or all of the following installation kits:

MN701 Mounting frame for radio cabinet

CC701 Cable kit containing battery cable and antenna cable necessary for installing the radiotelephone.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with the battery cables.

For extended local control the distance between control unit and radio set may be increased by inserting:

CC703 Extension cable kit with connectors.

Loudspeakers

When using the extended local control system it is necessary to install an external loudspeaker. The following types are available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable terminated in solderless crimp pins to be inserted in the accessories connector.

LS702 Weatherproof version of loudspeaker.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for dashboard mounting.

SU703 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

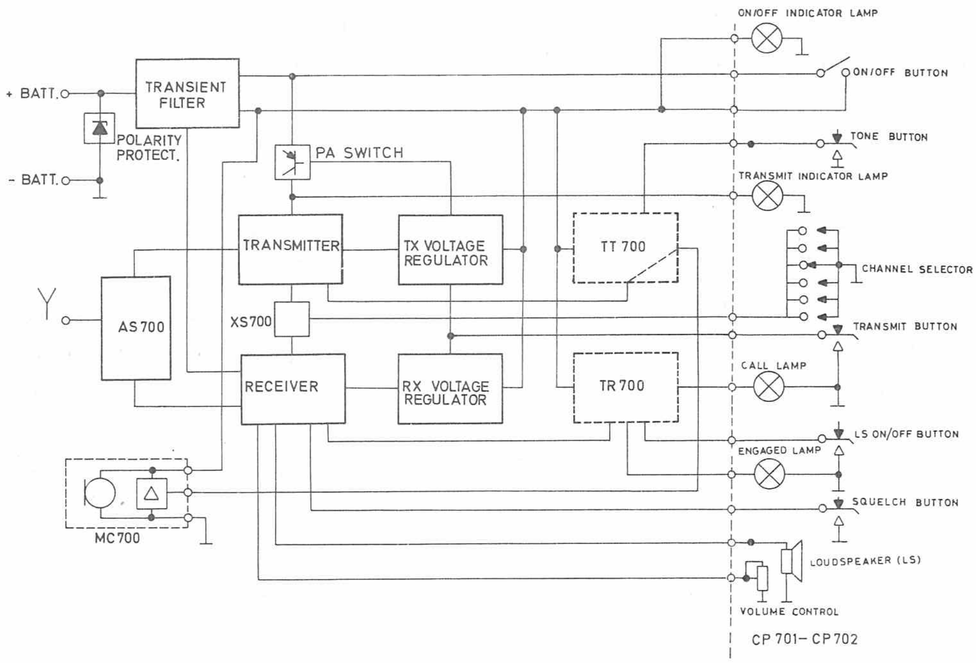
Power Supplies

PS701 Power supply for 24 volt car battery, any battery polarity.

PS702 Power supply for 24 volt car battery, negative pole to chassis.

CIRCUIT DESCRIPTION

Functional Diagram



General

The nominal 12 V supply from the battery is applied to the connector designated "BATT". A reverse biased zener diode across the battery input protects the radiotelephone against incorrect supply polarity. The supply voltage is fed, via a transient filter, to both the ON/OFF switch and to the transmitter power amplifier through a transistor switch.

The filtered battery voltage is applied to two separate 9 V regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment, if fitted.

The incoming signal passes through the antenna unit to the input of the receiver. The antenna switching is controlled by the stabilized supplies from the transmitter and receiver voltage regulators.

In the single channel edition of CQM760 a crystal controlled oscillator is incorporated in the transmitter section. Similarly, a single oscillator is provided in the receiver section.

Channel switching unit XS700 is fitted in the multichannel edition of CQM700 and is controlled by the channel selector.

The audio output from the receiver is applied to the loudspeaker (LS). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output signal may be connected to the tone receiver TR700 used in selective tone calling systems. The tone receiver enables the AF output circuits of the receiver to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "call" and "engaged" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) via the tone generator TT700, if fitted.

During transmission of tone call , the microphone will be switched off automatically so that the transmitter is modulated by the tone signal from TT700 only.

The transmitter is keyed by depressing the transmit button. This will block the receiver voltage regulator and cancel the blocking of the transmitter voltage regulator. When the transmitter voltage regulator operates, supply voltage is applied to the exciter and via a transistor switch to the transmitter power amplifier.

The "transmitter on" condition is indicated by the transmit indicator lamp.

In the radiotelephone fitted with a tone receiver the transmitter cannot be operated until the loudspeaker has been switched on manually by means of the loudspeaker ON/OFF button.

RECEIVER

The CQM760 receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having a low insertion loss.

Adjacent channel selectivity is obtained by us-using two bandpass filters: a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 6 crystal controlled oscillators, one for each channel, can be provided. The oscillators are connected in parallel and channel selection is performed by grounding the negative supply lead of the appropriate oscillator.

The receiver comprises the following subunits:

Antenna switching unit	AS761
Preselector filter	CP761
Receiver converter with 1st mixer and 1st local oscillator	RC761

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Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter:	
for 25 and 20 kHz channel spacing	IC703
for 12.5 kHz channel spacing	IC704
455 kHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator (for other circuits of CF701 see page 7).	CF701
Channel switching unit:	
maximum 6 channels	XS701
maximum 4 channels, temperature compensated	XS702.

Signal Path

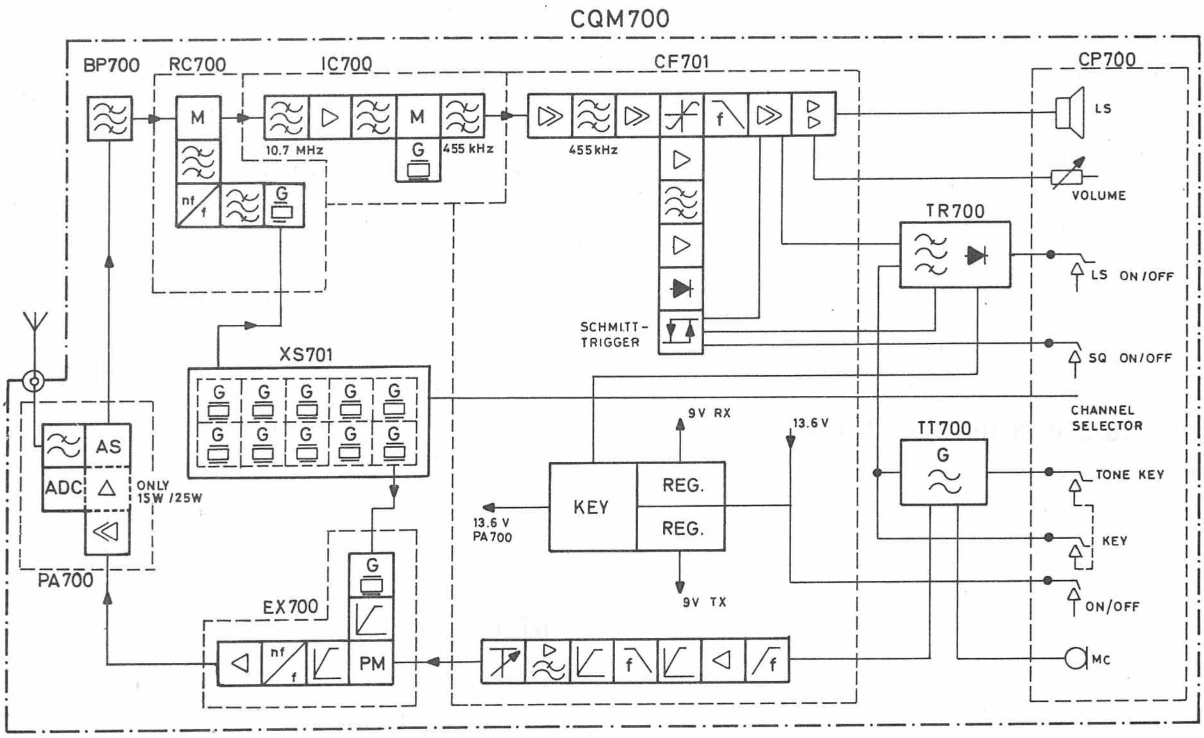
From the antenna switching unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage. This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver.

The BP761 filter consists of five tuned circuits which can be adjusted over the band 420-470 MHz. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required by the field-effect transistor (FET) of the mixer stage.

The local oscillator and the received signals are applied to the gate of the FET. The mixer output at 10.7 MHz is taken from the drain circuit.

First Local Oscillator

The local oscillator signal is generated in an oscillator operating on the fundamental frequency of the crystal. The oscillator operates within the frequency range 11.35 MHz to 12.75 MHz, depending on the crystal frequency used.



In the oscillator, the 3rd harmonic of the crystal frequency is selected and applied to a multiplier chain consisting of a tripler and two doubler stages. The output frequency is thus 36 times the fundamental of the oscillator.

The last doubler stage is followed by a filter consisting of three capacitively coupled tuned circuits. The filter attenuates undesired frequencies generated by the multiplier chain and prevents these from reaching the mixer stage.

The injection signal is 10.7 MHz below the received signal is calculated as follows:

$$fx = \frac{f_a - 10.7}{36} \text{ MHz.}$$

where fx is the crystal frequency, MHz and f_a is the received signal, MHz.

The receiver converter RC761 includes an oscillator intended for use in single-channel receivers. When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

XS701 contains oscillators for five RF channels thus allowing the receiver to be equipped with a maximum of 6 channels.

XS702 is a temperature compensating unit employed where radiotelephones are to work in very low temperatures. The compensation is provided by heating the crystals when the ambient temperature falls below $-5^{\circ}C$ approximately.

XS702 contains oscillators for a maximum of 4 channels.

Intermediate Frequency Circuits

From the mixer in RC761 the 10.7 MHz signal passes to the intermediate frequency converter type IC703 or IC704 depending on the channel separation used, which provides the channel selectivity of the receiver.

The first IF signal passes through the 10.7 MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal controlled oscillator whose frequency is normally 455 kHz below 10.7 MHz. In instances where a harmonic of the local oscillator coincides with the frequency of the received signal, a crystal oscillator frequency of 455 kHz above 10.7 MHz is chosen.

In the first case the crystal frequency is:
10.7 MHz - 0.455 MHz = 10.245 MHz.

In the second case the crystal frequency is:
10.7 MHz + 0.455 MHz = 11.155 MHz.

The crystal frequency of 11.155 MHz is used when the received frequencies are within the following bands:

420.0 - 421.5 MHz
428.9 - 431.7 MHz
439.1 - 441.9 MHz
449.4 - 452.2 MHz
459.6 - 462.4 MHz
469.8 - 474.7 MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455 MHz ceramic filter in the IC703 or IC704 converter and is then applied to the intermediate frequency amplifier in CF701.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage intergrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a deemphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing og the receiver.

The signal is then applied to a three stage amplifier in which a field-effect transistor, operating as an electronic on/off switch, has been placed between the second and third stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level of –17 dBm (110 mV).

The signal is passed to the loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 2 W into a 5 Ω load. The input stage is a high-pass active filter which attenuates frequencies below 250 Hz.

A variable resistor, forming part of the collector load, permits a preset 12 dB adjustment of the gain.

Manual gain adjustment, and thus the loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the first and second AF amplifier stages.

The AF output stage consists of two complementary power transistors operating in Class AB push-pull.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to "muting terminal" on the output amplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM700 is operated by noise components contained in the demodulated signal.

The AF signal from the descriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load. The resonant frequency of this circuit can be changed by a strapping arrangement to suit the channel separation of the receiver.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a vertain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise amplifier.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

(See block diagram on page 5).

The transmitter is phase modulated. Its output frequency is 36 times the oscillator frequency. Phase modulation is performed at the fundamental frequency.

The transmitter comprises the following subunits:

Exciter	EX761
RF power amplifier	PA761
Antenna switching unit	AS761
Modulation amplifier, transmitter switch and voltage regulator	CF701
Channel switching unit:	
maximum 6 channels	XS701
maximum 4 channels, temperature compensated	XS702.

AF Circuits

The modulating signal from the microphone is fed, through the tone generator if fitted, to the modulation amplifier where it is differentiated, amplified, limited, integrated and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the phase modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the phase modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the phase modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The fundamental RF signal is generated in a crystal controlled oscillator contained in the exciter EX761.

When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

As in the receiver, channel selection is performed by grounding the negative return of the appropriate oscillator.

The exciter provides the following:

(a) phase modulation

(b) frequency multiplication

(c) drive power for the power amplifier PA761

The RF signal from the oscillator is applied to the 1st buffer amplifier, then to the phase modulator, followed by the 2nd buffer amplifier. The buffer amplifiers provide constant input levels and correct impedance matching.

The phase modulator is a "transconductance modulator" as the phase modulation is produced by varying the transconductance of a transistor.

The modulating signal is applied to the emitter of the transistor whose operating point and transconductance thus change instantaneously with the modulating signal.

From the 2nd buffer amplifier, the signal is fed to a frequency multiplier chain consisting of the 1st tripler, 1st doubler, 2nd tripler, and 2nd doubler. The transmitter output frequency is therefore 36 times the crystal frequency.

The first three multipliers are designed as balanced circuits resulting in suppression of some of the harmonic frequencies.

The triplers suppress the even harmonics and the doublers suppress the odd harmonics.

Double tuned bandpass filters are used with close-to-critical coupling between tuned circuits. These filters limit the bandwidth of the exciter and attenuate undesired harmonics generated in the frequency multiplication process.

The output signal from the 2nd doubler is fed to an amplifier operating at the final frequency of the transmitter. Tuned input and output bandpass filters of the amplifier provide additional selectivity and thus also attenuation of undesired signal. The amplifier raises the signal to the level required by the RF power amplifier PA 761 The nominal RF output power of EX761 is 50 mW into a 50 Ω load.

The bandwidth of the transmitter and thus the maximum frequency spread of the channels is determined by the selectivity of the exciter, which is 1 MHz.

RF Power Amplifier

The power amplifier contains four transistor amplifier stages. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency Class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading the power transistor. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

In the 15 W version, a power booster and a temperature protection circuit are also included in the PA stage.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC network.

Antenna Circuits

The signal generated by the transmitter is passed through an electronic antenna switching unit and a low-pass filter to the antenna.

The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The low-pass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple.

The filter attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonics of the transmitter frequency.

The antenna filter is not adjustable.

Power Supply and Switching Circuits

CQM700 is powered directly from a 12 V car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A transient filter is provided to suppress noise and transients generated by the vehicle's electrical system.

A reverse biased zener diode connected across the battery input terminals limits the peak voltage to approx. 20 V and protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the diode to conduct and blow the fuses fitted in the battery cable.

The CQM700 contains two identical voltage regulator circuits which deliver 9 V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

Each regulator has a blocking transistor controlled by the transmit key button. With the CQM760 in the standby or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed, operation and blocking of the two voltage regulators are reversed. The supply voltage for the PA761 power amplifier in the transmitter is taken from the transient filter and applied to the amplifier unit through a transistor switch. This switch is supplied by the transmitter voltage regulator which is controlled by the transmit key button.

NOTE: The voltage applied to the transistor switch cannot be turned off by means of the ON/OFF switch of the radiotelephone.

ADJUSTMENT PROCEDURE FOR CQM760

RECEIVER ALIGNMENT

Before switching on the CQM700 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 100 mA.

With the station switched off, increase the supply voltage until a current drain of 100 mA is reached.

Requirement: $V_{supply} \leq 21$ V

Keeping within these values ensures correct operation of the protective zener diode, E13, in CF701.

Decrease the supply voltage to 13.6 V and set the current limiter to 1 A.

The station may now be switched on.

Check the 9 V RX at terminal 33 on the terminal board.

Requirement: 9 V ± 0.1 V

If necessary, adjust the RX voltage by means of potentiometer R64 in CF701. This potentiometer can be reached from the rear of the module tray BA700.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 kHz generator and the CQM700 chassis.

Apply to a 455 kHz signal to the input of CF701. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF701.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the circuit so limiting occurs. The readings should be kept below approx. 10 μA if an AVO-meter is used, and below approx.

500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF701

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box, or by switching the squelch off on the control unit C33/C34. Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the terminal board. On the control units C33/C34 the reading may be taken from LINE OUT (600 Ω).

Adjust coil L1 in CF701 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R16 (AF-RX) may be turned up. This potentiometer can be reached from the rear of the module tray BA700, and turns up counter-clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency counter is available, the frequency may be read at test point [5], IC700. If the input of the frequency counter is DC-coupled, a capacitor (approx. 1 nF) should be connected in series. The frequency will either be 10.245 or 11.115 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows: Connect a 455 kHz generator to the IF input of CF701, and a 10.7 MHz generator to the input of IC700. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC700 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "LINE OUT", 600 ohm audio output, which is accessible on the terminal board, terminal 35, and on the control units C33/C34.

NOTE: The discriminator has no zero adjustment.

Alignment of 1st IF Amplifier (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC700.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF701.

Adjust coils L1, L2 and L3 in IC700 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC700: ≥ 20 dB.

Alignment of Multiplier Chain in RC761

When crystals have been inserted in RC761 and/or XS701/XS702, select the middle frequency channel.

Connect a DC voltmeter to test point (1) in RC761.

Tune L8 and L9 in the RC to maximum, approx. 0.6 V.

Requirement: ≥ 0.4 V

Move the voltmeter to test point (2), RC761.

Adjust L7 for maximum meter reading, approx. 0.5 V.

Requirement: ≥ 0.35 V.

Connect the voltmeter to test point (3).

Adjust L6 for minimum reading (upper minimum if more than one).

The reading at test point (3) is typically 8 V.

Requirement: ≤ 8.5 V.

To tune for maximum drive to the 1st mixer, connect a DC voltmeter with an RF probe to test point (3) in RC761.

Turn the tuning slug in L5, BP761, out until flush with the outer edge of the chassis.

C16, RC761, is adjusted for maximum meter reading.

C14, RC761, is adjusted for minimum meter reading.

C12, RC761, is adjusted for maximum meter reading.

C2, RC761 is adjusted for minimum meter reading.

If maxima and minima are not immediately apparent, the above capacitors should be adjusted very slowly through their full revolution, or until the appropriate maximum/minimum is found.

The variations in test point (3) will be small, especially in the final circuits, and the drive to the 1st mixer should be checked.

Connect the DC voltmeter to test point (4), RC761.

Adjust capacitors C16, C14, C12 and C2 in RC761, for maximum reading.

Stop the oscillator (select a channel with no crystal or take a crystal out).

The voltage at test point (4), RC761, with the oscillator stopped, will be 1 to 4.5 V.

Start the oscillator.

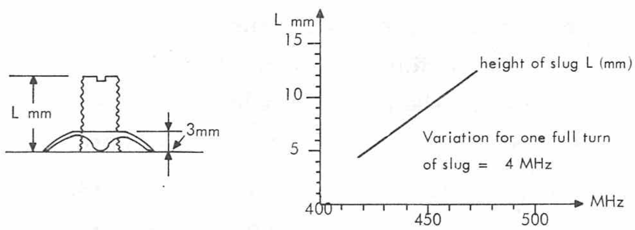
Requirement:
Minimum increase in test point (4), RC761 = 0.3 V

Maximum increase in test point (4), RC761 = 1.3 V.

Should the increase exceed 1.3 V, C12 should be detuned to a reading of 1.3 V at test point (4).

Coarse Adjustment of BP761

The trimming slugs L1, L2, L3, L4 and L5 in BP761 are set to their approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency.



Adjustment of Temperature Regulating Circuit in XS702

The temperature regulating circuit of XS702 has been adjusted before leaving the factory. However if necessary, it may be adjusted as follows:

Turn potentiometer R39 in XS702 fully counter-clockwise.

Remove jumper connecting the NTC resistor.

Set the supply voltage for the CQM700 to 13.6 V.

Check the current consumption of XS702 by inserting an ammeter in the orange/blue wire to XS702.

Adjust the current to 0.45 A by means of R39 (this adjustment should not exceed 30 seconds).

Insert jumper connecting the NTC resistor again and reconnect the orange/blue wire.

Further Alignment of RC761, Fine Tuning of BP761, and Fine Tuning of IC700

Connect a DC EVM with an RF probe to test point [1] in CF701. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF701 (first connect CQM700 chassis to generator earth). Tune the RF generator for zero beat with the LS-IN depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF701, i.e. a reading on a DC EVM with an RF probe at test point [1] , CF701, of approx. 500 mV.

The following coils are tuned for maximum meter reading:

L5, BP761
L4, BP761,
L3, BP761,
L2, BP761,
L1, BP761
L2, RC761,
L3, IC700
L2, IC700
L1, IC700

The circuits in IC700 should be retuned until no further increase can be obtained.

C2, RC761, is adjusted for maximum meter reading at test point [1] , CF701.

The tuning slugs of BP761, L5, L4, L3, L2 and L1 are to be adjusted until no further increase in meter reading can be obtained.

Finally the drive to the 1st mixer is checked:

Measure the voltage with a DC voltmeter at test point (4), RC761.

Stop the oscillator.

The voltage should decrease by more than 0.3 V. Where the drive is found to be too low, C12, C14 and C18, RC761, may be retuned to a maximum meter reading at test point (4), RC761.

Requirement: $\geq$ 0.3 V

Fine Tuning of L1 in CF701

Keep the RF generator connected as described, and set its output attenuator for full limiting (in the CQM700), approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz.

Connect an audio voltmeter to test point [2] in CF701. This test point becomes accessible by unscrewing the upper PC-board of CF701.

Peak coil L1 in CF701, for maximum meter reading.

Requirement: $\geq$ 65 mV.

NOTE: Terminal 35 LINE OUT (AF-17 dBm) on the terminal board or the connector "Line out" on the control units may be used instead of test point [2] . However, this reading is dependent on the setting of potentiometer R16, AF-RX, in CF701, and it must be checked that an audio level of $\geq$ 110 mV can be obtained from "Line out" for the appropriate frequency as shown below.

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 kHz and set the frequency deviation to 0.7 x Δ f max.:

CQM761 (50 kHz channel spacing) ± 10.5 kHz
CQM763 (25 kHz channel spacing) ± 3.5 kHz
CQM763 (20 kHz channel spacing) ± 2.8 kHz

Set the RF generator output level to approx. 1 mV EMF.

If the CQM700 is provided with tone equipment, press the LS-IN/OUT button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to "Line out".

Adjust the audio output level to 110 mV by means of R16 in CF701.

Connect a 5 Ω load resistor across the loudspeaker output terminals instead of the loudspeaker. The load is incorporated in the control units C33/C34.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals or to LS in/out on C33/C34. Set the volume control for 2.25 V on the meter.

Check the distortion.

Requirement: k $\leq$ 5%

NOTE: Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 2 W (by means of potentiometer R83 on CF701) for an audio input of 110 mV from LINE OUT (-17 dBm), terminal 35.
- a base bias to the output amplifier transistors ensuring a suitable no-signal current in the stage.

Consequent adjustment of the no-signal current in the output stage is performed in the following way:

Turn the station off, and the volume control down.

Turn potentiometer R99 fully counter-clockwise (viewed from the component side of CF701).

Set the supply voltage to 16 V.

Insert a milliammeter in the positive supply lead to the output amplifier (brown lead between the two PC-boards of CF701, terminals C/C of CF701).

Turn the station on. The reading will be approx. 15-25 mA.

Turn potentiometer R99 clockwise until the current drain has increased by 2 mA.

Checking the Audio Power Output

Set the volume control for 3.16 V across the audio output load (corresponding to a power output of 2 W) for an input signal of 1 kHz, 110 mV.

Connect the distortion meter across the output, and read the distortion.

Requirement: k $\leq$ 7%.

Adjustment of Oscillator Frequency in RC761

The frequency is measured with a counter connected to test point (3) in RC761. The frequency should be $f_{antenna}$ −10.7 MHz.

Adjust the oscillator frequency by means of trimmer capacitor C39 in RC761.

In CQM700 with XS701/XS702, frequency adjustment must be performed on each channel with the trimmer capacitor for the appropriate oscillator.

After adjustment, the accuracy should be:

CQM761: Better than $\pm 1 \times 10^{-6}$

CQM763: Better than $\pm 0.5 \times 10^{-6}$

The tolerances are valid only for a crystal temperature of 25°C.

Checking Receiver Sensitivity

Modulate the RF generator with 1 kHz and a frequency deviation of 0.7 x max. Δ f. Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 5 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the RF generator output until 12 dB SINAD is obtained on the distortion meter.

Read the calibrated RF voltage from the RF generator.

Requirement:

For 12 dB SINAD: $\leq$ 1.25 μV EMF in CQM761
$\leq$ 0.95 μV EMF in CQM763

If more than one channel is provided, the procedure should be repeated on all channels.

Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R38 in CF701 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage

Requirement:

CQM760 without tone equipment, in stand by, single channel $\leq$ 200 mA. (typically 170 mA)

CQM760: without tone equipment, in stand by, multichannel $\leq$ 270 mA. (typically 240 mA)

TRANSMITTER ADJUSTMENT

Unless the receiver alignment procedure has been performed, check for correct operation of the protection diode, E13, on CF701. This test is described in the first paragraphs under "Receiver Alignment".

Then set the supply voltage to 13.6 V, and the current limiter to 4 A.

If tone equipment is installed, the LS-IN/OUT button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter, and check 9 V TX at terminal 19 on the terminal board.

NOTE: If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.
Requirement: 9 V TX = 9 V ± 0.1 V

If necessary, adjust the TX voltage by means of potentiometer R72 on CF701. This potentiometer can be reached from the rear of module tray BA701.

Alignment of Exciter EX761

Remove the RF signal lead between EX761 and PA761.

Connect a 47 Ω resistor across the output of EX761 (this load may also be soldered across the input of an RF probe, STORNO 95.059, and the probe connected across the output of EX761 for the duration of the alignment of the exciter).

When crystals have been inserted in EX761 and/or XS701/XS702, select the middle frequency channel, and key the transmitter.

Connect a DC voltmeter to test point (1) in EX761.

Adjust L3 and L4 for maximum meter reading, approx. 1.6 V.

Move the voltmeter to test point (2) .

Adjust L5 and L6 for maximum, approx. 1.3 V.

Connect the voltmeter to test point (3) .

Adjust C40 and C41 for maximum, approx. 1.2V.

Set C47 to maximum capacity, and adjust C46 for maximum meter reading at test point (3) .

Adjust C47 for maximum meter reading.

Connect a DC voltmeter with an RF probe, STORNO 95.059 across the RF output terminals of EX761.

Adjust capacitors C50, C52, C46 and C47 for maximum RF output from EX761.

Detune C46 slightly, and retune C47. If an increase in RF output is obtained, repeat the procedure until maximum RF output is reached.

Storno

Readjust L3, L4, L5, L6, C40, C41, C50, C52 C46 and C47 until maximum RF output is obtained.

Requirement: $P_{out} \geq 50$ mW

(Measured with a DC voltmeter and RF probe 95.059, the voltage should read more than 3.5 V).

Alignment of RF Power Amplifier (PA761)

Reestablish the connection between EX761 and PA761.

Connect a Wattmeter to the antenna output.

PA761 should be aligned at a supply voltage of 12.5 V.

1. Turn the ADC potentiometer, R2 in PA761 up (clockwise), but back the potentiometer off if necessary during the alignment. The total current consumption while aligning must be limited with the ADC potentiometer to 2A (without tone equipment)

   Adjust C3, C7, C11, C15, C16, C21 and C22 in PA761, in this order, for maximum current consumption from the power supply.

   Repeat until the Wattmeter shows RF output, and proceed to adjust the above capacitors for maximum RF output.

2. During the following alignment, keep the ADC potentiometer set for a maximum output of 6 W.

   Adjust C3 for minimum DC voltage on the collector (the transistor housing) of Q1, PA761.

   Adjust C7, C11, C15, C16, C21 and C22 for maximum RF output.

3. Repeat step 2.

Increase the supply voltage to 16 V and set the ADC potentiometer for an RF output of 6 W.

Adjustment of Transmitter Frequency

The counter is to be connected to the transmitter output via a suitable (6 W capacity) attenuator.

The antenna frequency is adjusted with C2 in EX761 and/or the trimmer capacitors in XS701/XS702. The frequency must be adjusted on all channels, and at a crystal temperature of 25°C.

Requirement:

CQM761: Better than $\pm\ 1 \times 10^{-6}$

CQM763: Better than $\pm\ 0.5 \times 10^{-6}$

Automatic Drive Control (ADC) Circuit

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

Supply Voltage	Current Drain	Power output
10.5 V	≤ 2.0 A (2.1 A)	≥ 3.5 W
13.6 V	≤ 2.1 A (2.2 A)	≥ 6.0 W
16.0 V	≤ 2.0 A (2.1 A)	≥ 6.0 W

These figures for total current drain apply to stations without tone equipment. The values in brackets apply to stations with more than one channel.

Where more than one channel is in use, the output power must be checked on all channels.

Use of Control Unit C33/C34 When Adjusting Modulation

The control units C33/C34 may be used for stations with or without tone equipment and a voltage divider and a DC blocking capacitor is incorporated.

Where a tone transmitter is installed, the modulation signal must pass through the switching transistor (the AF gate) in the tone transmitter. The emitter resistor for this transistor is situated in the microphone amplifier, which is disconnected when adjusting the modulation. An alternate DC path must therefore be provided for the switching transistor in the tone transmitter to allow it to pass the modulation to the modulation amplifier of the CQM700. The DC supply voltage for the microphone amplifier in MC700 is also obtained through the switching transistor. This DC voltage should be isolated from the audio generator output.

A resistor, R3, in Fig. 2, has been installed to provide the DC path for the switching transistor. This resistor would, as far as AC is concerned, seem to be in parallel with R112 in CF701. To the audio generator the two would present an impedance of 280 Ω, which is only half the required value. Another resistor, consisting of R1 and R2 in C33/C34, places 280 Ω in series

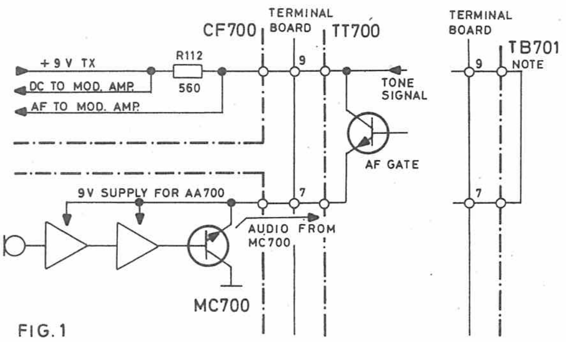


FIG.1

MODULATION PATH FROM MC700 TO CF700, AND 9V SUPPLY FROM CF700 TO MC700.
NOTE: WITHOUT TONE TRANSMITTER TB701 MUST BE INSTALLED

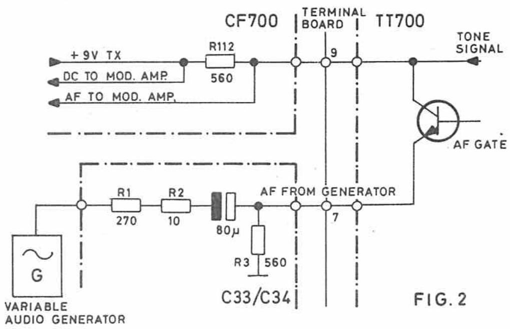


FIG.2

MODULATION THROUGH USE OF CONTROL UNIT C33/C34
(SEE ALSO NOTE IN FIG.1)

with the input signal, adding the input impedance up to 560 Ω. At the same time, a capacitor in series with the signal effectively blocks the DC voltage from CF701, which is normally fed to the microphone amplifier in MC700 through terminal 7 of the terminal board.

The resistors combine as a voltage divider when seen from the input to the control unit marked "modulation, AF gen.". This voltage divider attenuates the audio generator output by 6 dB in passing through C33/C34 to the modulation amplifier on CF701. The generator output must therefore be set 6 dB above the required input to the modulation amplifier. The adjustment procedure takes this into account.

Adjustment of Modulation and Frequency Deviation

NOTE: Where an ST7845 is installed, TB701 must be substituted during the following procedure.

Connect the deviation meter to the transmitter output via an attenuating network (6 W capacity)

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM700 to 13.6 V.

Connect an audio generator to the modulation input of control unit C33 or C34.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF701. The 6 dB loss in C33/C34 is also taken into account, and the nominal input level will be found to be 2.2 V - 26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 kHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency, set the maximum deviation with R124 on CF701.

CQM761 (50 kHz)	Δ f max.	= ± 15 kHz
CQM763 (25 kHz)	Δ f max.	= ± 5 kHz
CQM763 (20 kHz)	Δ f max.	= ± 4 kHz

Set the audio generator to 1000 Hz, and attenuate the output until a frequency deviation of 0.7 Δ f max. is read on the deviation meter.

CQM761 (50 kHz)	0.7 x Δ f max.	= ± 10.5 kHz
CQM763 (25 kHz)	0.7 x Δ f max.	= ± 3.5 kHz
CQM763 (20 kHz)	0.7 x Δ f max.	= ± 2.8 kHz

Requirement: V_{mod} = 220 mV ± 1 dB (195 mV - 245 mV) input to C33/C34.

Check the distortion on the audio output of the deviation meter.

Requirement: k $\leq$ 7% (without deemphasis).

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5 - 40 MHz.

The existence of parastic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with TS-K61, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

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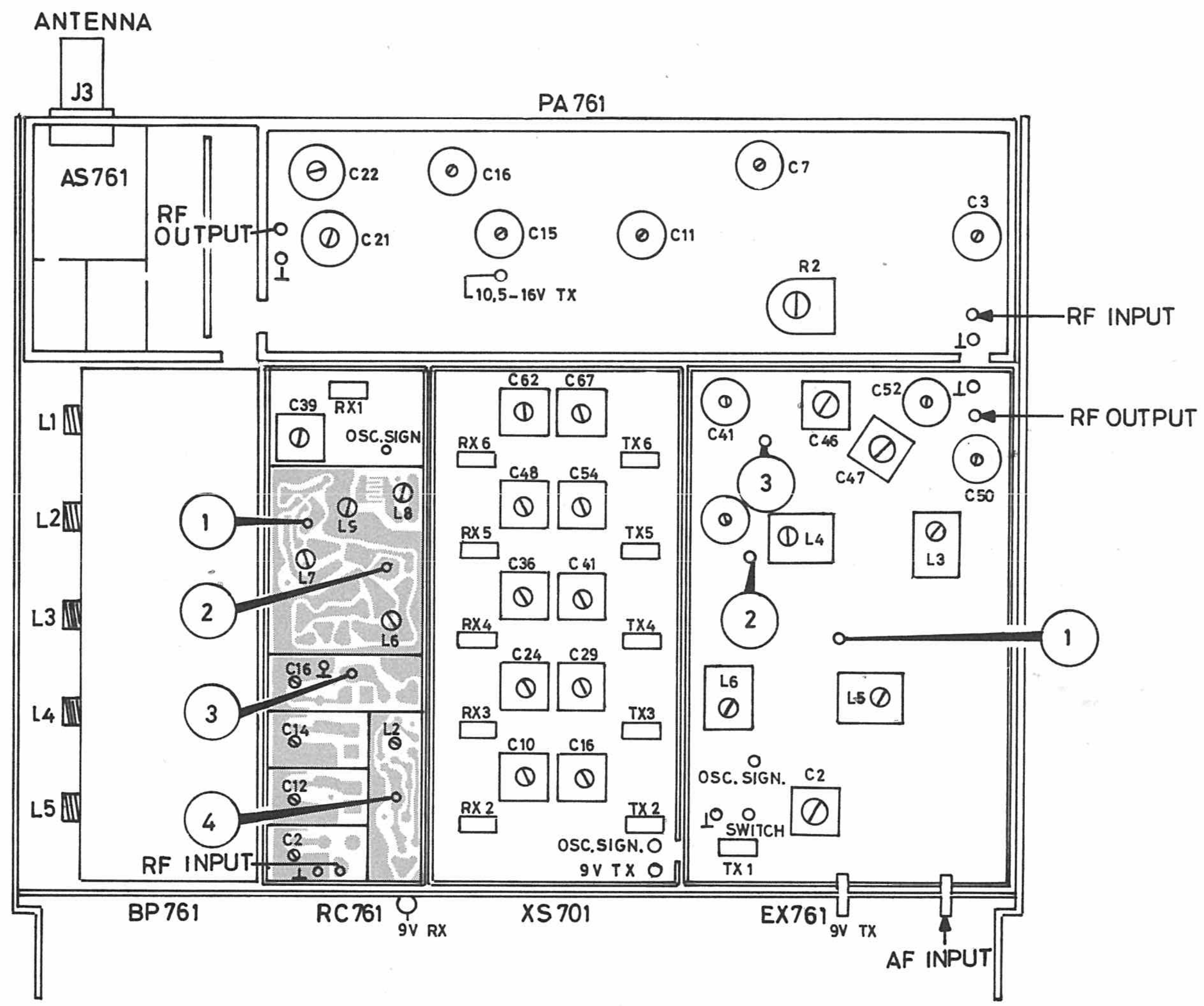

RADIO ASSEMBLY RF760 (CQM760)

Location of Test Points and Adjustable Components

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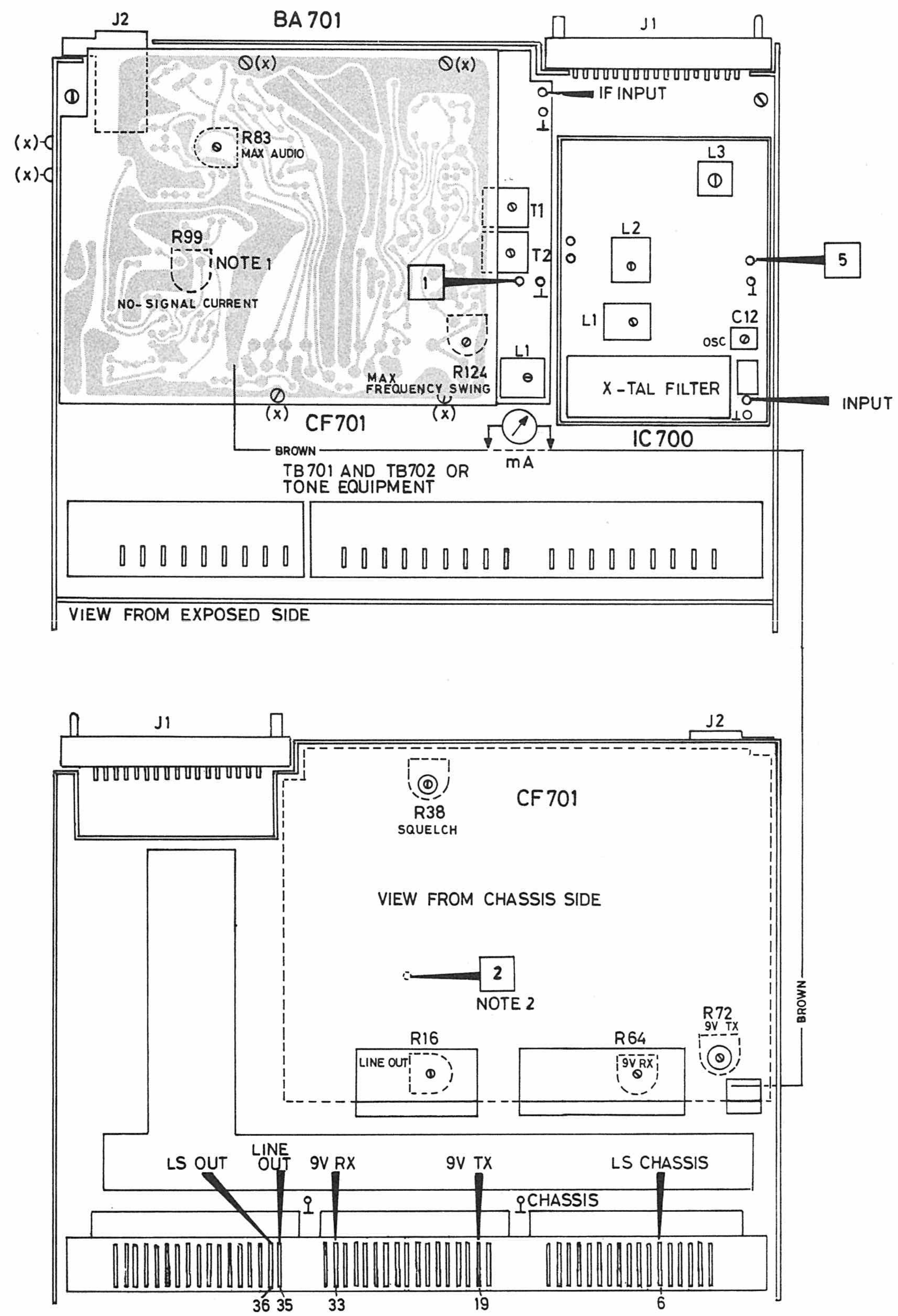

NOTE 1. ACCESS TO R99 ON THE UPPER P-C BOARD ONLY FROM COMPONENT SIDE.

NOTE 2. ONLY FROM COMPONENT SIDE
(x) REMOVE SCREWS FOR ACCESS TO LOWER P-C BOARD.

BASIC ASSEMBLY BA701 (CQM700)

Location of Test Points and Adjustable Components

TECHNICAL SPECIFICATIONS

CQM763D

The stated specifications apply to all channels.
All measurements include antenna branching filter.
The receiver specifications are measured with simultaneous transmitting.
Figures in brachets are typical values.

GENERAL SPECIFICATIONS

Frequency range, transmitter

CQM763D x 80 DK: 453.0 MHz to 455.0 MHz
CQM763D x 80 S : 452.5 MHz to 455.0 MHz [1]

Frequency range, receiver

CQM763D x 80 DK: 463.0 MHz to 465.0 MHz
CQM763D x 80 S : 462.5 MHz to 465.0 MHz [1]

[1] 19 private channels included.

Duplex frequency separation

10 MHz

RF bandwidth

CQM763D x 80 DK: 2.0 MHz
CQM763D x 80 S : 2.5 MHz (19 private channels incl.)

Channel frequency separation

25 KHz

Number of channels

CQM763D x 80 DK: 80
CQM763D x 80 S : 80 + 19

Type of modulation

Phase

Modulation frequency range

CQM763D x 80 DK: 300 Hz to 3000 Hz
CQM763D x 80 S : 300 Hz to 2400 Hz

Maximum frequency deviation

± 5 KHz

Nominal frequency Deviation

CQM763D x 80 DK: ± 3.3 KHz
CQM763D x 80 S : ± 3.0 KHz

Antenna impedance

50 Ω

Temperature range

Operating range: -25°C to +55°C
Functioning range: -30°C to +60°C

Dimensions

Locally controlled version:	180 x 250 x 70 mm
Extended local control:	180 x 210 x 70 mm
Antenna branching filter:	235 x 130 x 30 mm
Control unit CB704:	120 x 65 x 55 mm

Weight

Locally controlled version:	2.7 kg
Extended local control:	2.43 kg
Antenna branching filter:	1.07 kg
Control unit CB704:	0.2 kg

RECEIVER SPECIFICATIONS

Sensitivity, e.m.f. for 12 dB SINAD, EIA

Channel 01 - 80: 1.1 µV (0.85 µV)
Channel 81 - 99: 1.2 µV (1.0 µV)

Squelch sensitivity, EIA

1.0 µV (0.7 µV)

Crystal oscillator frequency, RC762

145.758 MHz

Frequency stability, -25°C to +55°C

± 2.5 KHz (± 2.0 KHz)

Modulation acceptance bandwidth

± 5 KHz (± 7 KHz)

Adjacent channel selectivity selectivity, EIA

70 dB (77 dB)

Adjacent channel selectivity, SEN

65 dB (72 dB)

Spurious attenuation, EIA

75 dB (85 dB)

Spurious attenuation, SEN

70 dB (80 dB)

Intermodulation, EIA

70 dB / 1 μV (75 dB / 1 μV)

Blocking, MTD

86 dB / 1 μV (88 dB / 1 μV)

Blocking, GPO

< 1 dB

Spurious and harmonic SR mission into an artificial load (SEN)

< 2 nW (0.4 nW)

Loudspeaker impedance

5 Ω

Microphone impedance

10.000 Ω

AF output power

2 W (2.5 W)

Harmonic distortion

< 6% (3%) measured at 1 mV RF input, 1 W AF output, F_{mod} = 1 KHz and Δf_{nom}.

Audio frequency characteristic, EIA

-6 dB / octave +0.5 dB / -3 dB (+0 dB / -1.5 dB)

Hum and noise, EIA

60 dB (70 dB); squelched condition
40 dB (40 dB); unsquelched condition

Hum and noise, MTD

40 dB (45 dB); pt. 2.2.11a
30 dB (36 dB); pt. 2.2.11b

TRANSMITTER SPECIFICATIONS

RF output

6W

Crystal oscillator frequency, EX762

145.992 MHz

Frequency stability, -25°C to +55°C

± 2.5 KHz (± 2-0 KHz)

Spurious radiation

Harmonics: < 2 μW (< 0.2 μW)
Adjacent channels, MTD: < 2 μW (< 0.5 μW)
Other frequencies: < 0.2 μW (< 0.1 μW)

AF input impedance

560 Ω

Modulation sensitivity, EIA

110 mV ± 1 dB

Modulation distortion, EIA

< 5% (2%)

Modulation distortion, MTD

< 7% (2%)

Modulation frequency characteristic, MTD

+6 dB / octave +1 dB / -3 dB (+0 dB / -2 dB)
CQM763D x 80 DK: 300 Hz to 3000 Hz
CQM763D x 80 S : 300 Hz to 2400 Hz

FM hum and noise, EIA

-45 dB (-60 dB)

FM hum and noise, MTD

35 dB (40 dB); pt. 2.1.9a
30 dB (35 dB); pt. 2.1.9b

AM, MTD

7% (1.5%)

Transmitter load

Meets the MTD requirements pt. 2.1.2a, b and c.

POWER SUPPLY SPECIFICATIONS

Nominal battery voltage

13.6V

Current consumption

Receive, stand by:	0.9A	(0.75 A)
Receive, 2W AF :	1.4A	(1.1 A)
Transmit 6W :	3.0A	(2.5 A)

Measuring method references.

EIA:	RS152A
EIA:	RS204
SEN:	470601
MTD:	06-68181-1
GPO:	W. 6289

GENERAL DESCRIPTION

CQM763D

Introduction

The Stornophone 763D radiotelephone is a mobile transmitter for the UHF duplex operated public radiotelephone systems in Denmark and Sweden.

The only difference between the Danish equipment and the Swedish equipment is the option for 19 private channels (81 - 99) in the Swedish equipment.

From the frequency allocation table, the channel numbers, channel frequencies and the relationship to the synthesizer signal appear. As the channel selector is in the BCD code and the programable divider requires the 9-complement of the BCD code, a converter is inserted.

	Transmitter frequency range	Receiver frequency range	Duplex spacing
CQM763D x 80 DK	453.0 MHz - 455.0 MHz	463.0 MHz - 465.0 MHz	10 MHz
CQM763D x 80 S[x]	452.5 MHz - 455.0 MHz	462.5 MHz - 465.0 MHz	10 MHz

[x] 19 private channels included.

There are two mechanical different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Construction

The radio chassis slides into the cabinet from the front and is held in place by screws from the rear of the cabinet. The chassis consists of two circuit panels hinged on to the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF763, contains all the circuits which are dependent upon channel frequencies. These are:

- preselector filter
- receiver
- synthesizer unit
- exciter
- RF amplifier
- transmitter power output amplifier

The lower circuit panel, designated BA702, contains:

- intermediate frequency converter
- intermediate frequency amplifier
- squelch circuit
- voltage regulators
- tone equipment, where included

Between the circuit panels and the front control panel are placed

- a frequency control unit
- a 5 volt switching regulator

The solid state circuitry is built up as funtional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:

CQM763D spec XX X XXXX

C4	Remote control (CP703)
C5	Local control (CP705)
80DK	Denmark 80 channels
80S	Sweden 80 channels

Control Equipment

The locally controlled model will have the following front panel:

CP705 Front panel with controls, built-in loud-speaker and channel selector.

The CQM763D for extended local control will have a blank front panel with neither controls nor loudspea-ker and is designated CP703.

One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB704 Control unit housed in a cast plastic ca-binet and containing operating controls for the radiotelephone.

CB706 Automatic control unit housed in a cast aluminium cabinet and containing operat-ing controls for the radiotelephone.

Accessories

Accessories available for the CQM763D radiotelephone are listed in this section. Some of them, such as installation materials, antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier.

MC703 Fixed microphone for mounting on steering wheel column.

MT702 Handset with built-in amplifier and trans-mitter keying switch.

HS602 Retainer for MT702.

All of the above items are supplied with cables for termination in a multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit, consisting of 2 flexible metal tubes (goose necks), length 20 and 35cm, is available.

Channel Indicator

ID701 Channel indicator for displaying the channel in operation. The indicator can be used with all types of control unit.

Antenna

AN63-3 1/4 wave length whip antenna for the 420-470Mhz frequency band and the im-pedance matches 50 Ω. Base design per-mits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM763D radio set will require some or all of the following installation kits.:

MN701 Mounting frame for radio cabinet.

CC704 Cable kit containing extension cable terminated in multiconnectors for con-trol unit and accessories.

CC701 Battery Cable.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation series with the battery cable.

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Loudspeakers

When using the extended control system it is necessary to install an external loudspeaker. The following type is available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable to be soldered to the accessory connector.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for mounting on dashboard.

SU703 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

Power Supplies

PS701 Power supply for 24V car battery, any battery polarity.

PS702 Power supply for 24V car battery, negative pole to chassis.

60.295-E1

CIRCUIT DESCRIPTION
CQM763D

General

The nominal 12V supply from the battery is applied to the connector designated "BATT". A reverse biased zener diode across the battery input protects the radiotelephone against incorrect supply polarity. The supply voltage is fed, via a transient filter, to both the ON/OFF switch and to the transmitter power amplifier through a transistor switch.

The filtered battery voltage is applied to two 9 volt regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment.

The incomming signal passes through the antenna branching filter unit (BF) to the input of the receiver.

The audio from the receiver is applied to the loudspeaker (LS) or to the microtelephone (MT). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output may be connected to the sequential tone receiver SR700 used in selective tone signalling systems. The tone receiver enables the AF output circuits to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "CALL" and "ENGAGED" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the receiver is derived from the microphone (MC) or the microtelephone (MT) via the tone generator TT780.

During transmissions of a tone signal, the microphone signal is switched off automatically so that the transmitter is modulated by the tone signal only.

The transmitter is keyed by depressing the transmit-button which operates the transmitter voltage regulator and a transistor switch to the transmitter power amplifier. The "transmitter on" condition is indicated by the transmit indicator lamp.

If the radiotelephone is fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched ON manually by means of the loudspeaker ON/OFF button.

RECEIVER

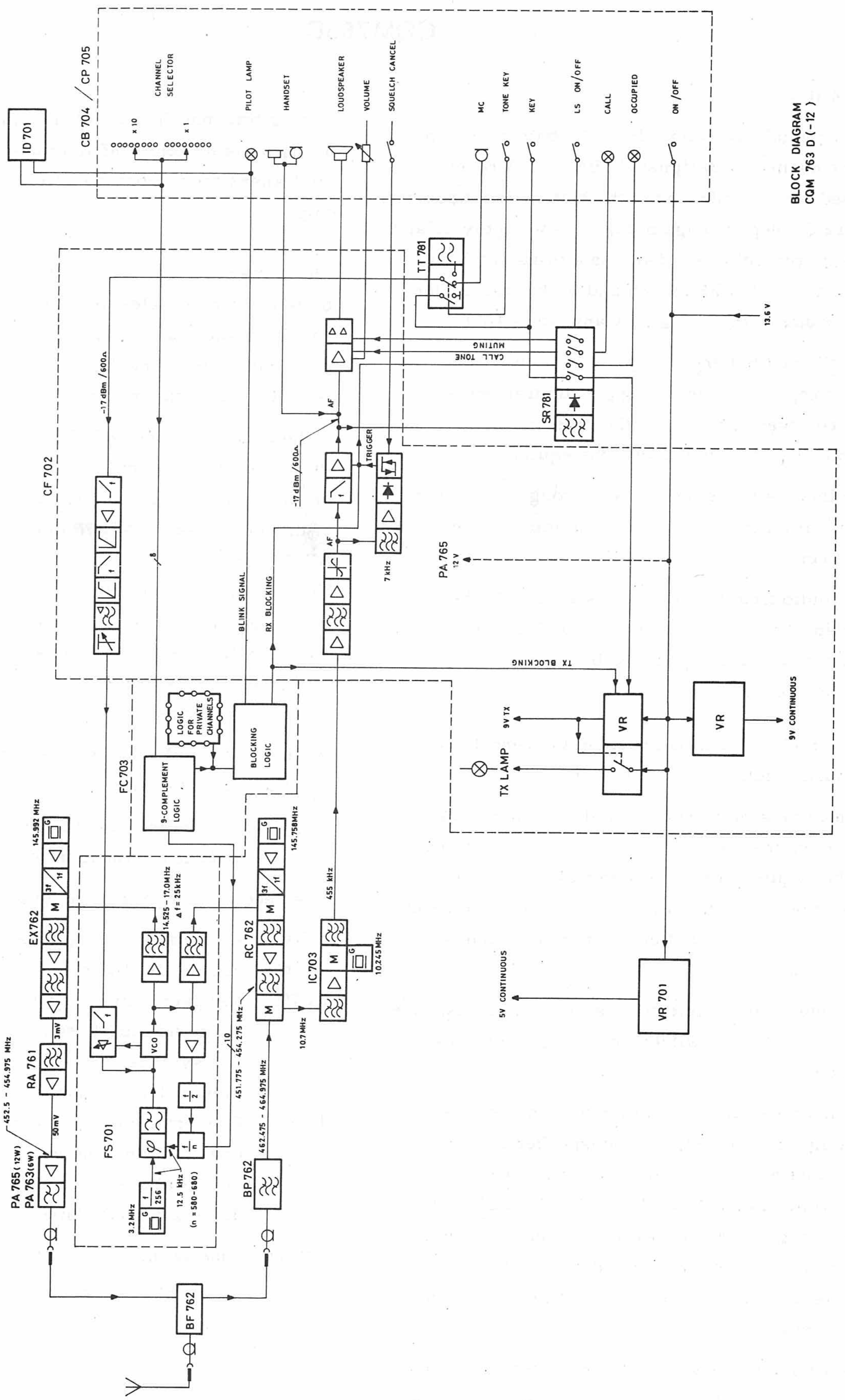
The receiver is a double conversion superheterodyne using intermediate frequencies of 10.7MHz and 455KHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having low insertion loss.

Adjacent channel selectivity is obtained by using two band pass filters:

a 10.7MHz crystal filter and
a 455KHz ceramic filter.

The receiver comprizes the following subunits:

BF762	Antenna branching filter
BP762	Preselector filter
RC762	Receiver converter with 1st mixer, local oscillator and synthesis mixer
IC703	Intermediate frequency Converter with 10.7MHz crystal filter, 2nd mixer, 2nd local oscillator and 455KHz ceramic filter
CF702	455KHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator



BLOCK DIAGRAM
CQM 763 D (-12)

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RECEIVER

Signal Path

From the antenna branching filter unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage.

This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver. The BP762 filter consists of five tuned circuits which can be adjusted over the band. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required by the field-effect transistor (FET) of the mixer stage.

The local oscillator signal and the received signals are applied to the gate of the FET. The mixer output at 10.7KHz is taken from the drain circuit.

The mixer injections signal is 10.7MHz below the antenna frequency and is produced by mixing the signal from a crystal oscillator with the synthesis signal.

The crystal oscillator is a 7th overtone series resonance oscillator, which is followed by a double-gate-FET buffer amplifier. The buffer output is mixed with the synthesis signal in a second FET and the mixer output is filtered and amplified in order to obtain adequate drive for the RF mixer. The filters are helix circuits in order to suppress spurious signals, especially the oscillator frequency. To compensate for oscillator drift at low temperatures the unit incorporates a partial crystal oven.

The conversions can be expressed as follows:

$$f_{RX} = f_{XRX} + f_S + IF_1$$

f_{RX} = Antenna frequency

f_{XRX} = Crystal oscillator frequency

f_S = Synthesizer signal frequency

IF_1 = 10.7MHz

Intermediate Frequency Circuits

From the mixer in RC762 the 10.7MHz signal passes to the intermediate frequency converter, type IC703, which provides the channel selectivity of the receiver. The first IF signal passes through the 10.7MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455KHz.

The injection signal to the mixer stage is generated by a crystal oscillator whose frequency is 455KHz below 10.7MHz. The crystal is calculated:

$$10.7\text{MHz} - 0.455\text{MHz} = 10.245\text{MHz}$$

The second intermediate frequency signal from the mixer stage proceeds through the 455KHz ceramic filter in the IC703 converter and is then applied to the intermediate frequency amplifier in CF702.

The 455KHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a de-emphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

The signal is then applied to a three stage amplifier in which a field-effect transistor, operating as an electronic on/off switch, has been placed between the second and third stages. This switch is controlled

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by squelch circuit. The amplifier has nominal output level of -17dBm (110 mV).

The signal is passed to the loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 2W into a 5 Ω load. The input stage is a high-pass active filter which attenuates frequencies below 250 Hz.

A variable resistor, forming part of the collector load, permits a preset 12 dB adjustment of the gain.

Manual gain adjustment, and thus loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the first and second AF amplifier stages.

The AF output stage consists of two complementary power transistors operating in Class AB push-pull.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the output amplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM700 is operated by noise components in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise amplifier.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

The transmitter is phase modulated and the output frequency is produced by mixing the synthesizer signal with the signal from a crystal controlled oscillator.

The transmitter comprises the following subunits:

Exciter with crystal oscillator and mixer circuits	EX762
RF amplifier	RA761
RF power amplifier	PA763 or PA765
Antenna Branching filter	BF762
Modulation amplifier, transmitter switch and voltage regulator (these circuits constitute part of CF702)	CF702

AF Circuits

The modulating signal from the microphone is fed, through the tone generator to the modulation amplifier where it is differentiated, amplified, limited, integrated and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The RF signal is generated in a crystal controlled oscillator contained in the exciter EX712.

The oscillator signal is applied to a buffer amplifier, whose output is mixed with the synthesis signal. The mixer output is filtered and amplified in order to obtain an adequate signal for the RA761.

In order to suppress spurious signals, especially the oscillator frequency, 3 circuit helix filters are used. To compensate oscillator drift at low temperatures the unit incorporates a partial crystal oven.

The conversions can be expressed as follows:

$$f_{TX} = f_{XTX} + f_S$$

f_{TX} = Transmitting frequency

f_{XTX} = Crystal oscillator frequency

f_S = Synthesizer signal

The output signal from the exciter is fed to an RF amplifier (RA761) operating at the final frequency of the transmitter. Tuned input and output band pass filters of the amplifier provide aditional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the final RF power amplifier PA763 or PA765. The nominal RF output power of RA761 is 100 mW into 50 Ω load.

RF Power Amplifier

The power amplifier PA763 contains three transistor amplifier stages, power amplifier PA765 one transistor stage and a power module. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through a low pass 7-pole Chebishev filter. The antenna filter having low insertion loss and ripple attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonies of the transmitter frequency.

The antenna filter is not adjustable.

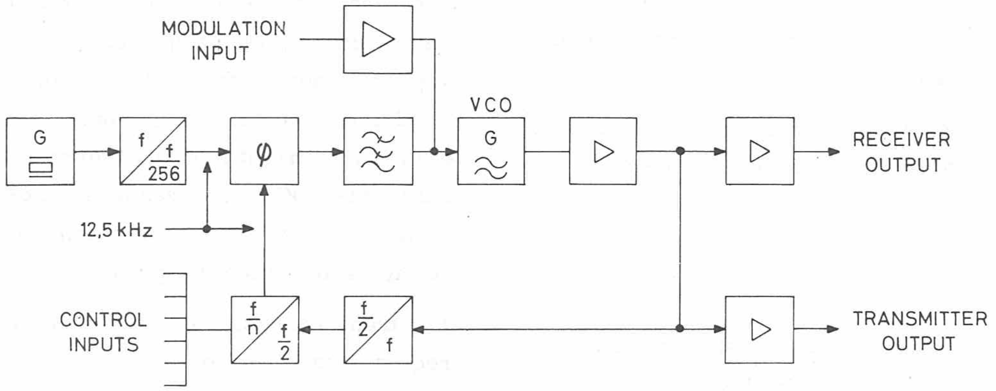
The transmitter signal at the output connector is fed through the antenna branching filter BF761 to the antenna.

Synthesizer Circuits

The frequency synthesis unit FS701 produces the synthesis signal by the digital frequency synthesis method.

The signal is generated in a voltage controlled oscillator (VCO) whose output is amplified, and fed to the exciter and to the receiver converter. The VCO is part of a phase locked loop consisting of a buffer amplifier, a programable frequency divider, a phase detector, a prescaler and a low pass filter.

The phase detector compares the divided VCO frequency to a 12.5 KHz reference frequency. Any difference in frequency will be opposed by the DC voltage at the low pass filter output, adjusting the VCO frequency up or down until it locks to the reference frequency.



SYNTHESIZER BLOCK DIAGRAM

The 12.5 reference frequency is produced by dividing the output of a 3.2 MHz crystal controlled oscillator by 256.

The RC oscillator frequency and the EX oscillator frequency are so chosen, that the lowest transmitting frequency corresponds to dividing by 600 in the programable divider. The three decades in the counter are controlled by the 9-complement of the divisor expressed in the BCD code.

The third decade counter is fixed programmed to divide by 6.

Frequency Control

The conversion of the channel selector BCD code to its 9-complement code takes place in the frequency control unit FC703.

The circuits allow conversion of maximum 99 channels of which 19 channels are blocked by additional logic circuits. When the channel selector is set to a blocked channel, the frequency control unit produce blocking voltages to blocking gates in the transmitter and receiver circuits, and an astable multivibrator flashes the channel display and the ON/OFF lamp.

In Swedish units one or some of the remaining 19 channels may be opened and used as private channels.

Power Supply and Switching Circuits

CQM763D is powered directly from a 12 volt car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A transient filter is provided to suppress noise and transients generated by the vehicle's electrical system.

A reverse biased zener diode connected across the battery input terminals limits the peak voltage to approx. 20 volts and protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the diode to conduct and blow the fuses fitted in the battery cable.

The CQM763D contains two almost identical voltage regulator circuits which deliver 9V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

The transmitter regulator has a blocking transistor controlled by the transmit key button and the blocking voltage from the frequency control unit. With

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the CQM763D in the standby or receive condition, the key button is in the "OFF" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed the blocking is superseeded. However, this requires the channel selector not to be set to a blocked channel and the tone receiver to be in condition "LS IN", if fitted.

The supply voltage for the power amplifier in the transmitter is taken from the transient filter and applied to the amplifier unit through a transistor switch.

This switch is supplied by the transmitter voltage regulator which is controlled by the transmit key button.

The voltage to the transistor switch cannot be turned off by means of the ON/OFF switch of the radiotelephone.

Supply voltage for the TTL logic circuits is derived from a selfoscillating switching regulator (VR701) ensuring low loss and high efficiency.

FREQUENCY ALLOCATION TABLE

CQM763D

(Without private channels)

Relationship between transmitter frequency, receiver frequency, synthesizer frequency, programable divisor, and BCD control code for FS701.

3. fosc RX = 3 x 145.758 = 437.275MHz

3. fosc TX = 3 x 145.992 = 437.975MHz

Channel	f_{TX} [MHz]	f_{RX} [MHz]	f_{synt} [MHz]	d.f.	BCD Control Code for FS701		
					x100	x10	x1
					K J	D C B A	D C B A
0		Blocked	15.000	600	0011	1 0 0 1	1 0 0 1
1	453.000	463.000	15.025	601	0011	1 0 0 1	1 0 0 0
2	453.025	463.025	15.050	602	0011	1 0 0 1	0 1 1 1
3	453.050	463.050	15.075	603	0011	1 0 0 1	0 1 1 0
4	453.075	463.075	15.100	604	0011	1 0 0 1	0 1 0 1
5	453.100	463.100	15.125	605	0011	1 0 0 1	0 1 0 0
6	453.125	463.125	15.150	606	0011	1 0 0 1	0 0 1 1
7	453.150	463.150	15.175	607	0011	1 0 0 1	0 0 1 0
8	453.175	463.175	15.200	608	0011	1 0 0 1	0 0 0 1
9	453.200	463.200	15.225	609	0011	1 0 0 1	0 0 0 0
10	453.225	463.225	15.250	610	0011	1 0 0 0	1 0 0 1
11	453.250	463.250	15.275	611	0011	1 0 0 0	1 0 0 0
12	453.275	463.275	15.300	612	0011	1 0 0 0	0 1 1 1
13	453.300	463.300	15.325	613	0011	1 0 0 0	0 1 1 0
14	453.325	463.325	15.350	614	0011	1 0 0 0	0 1 0 1
15	453.350	463.350	15.375	615	0011	1 0 0 0	0 1 0 0
16	453.375	463.375	15.400	616	0011	1 0 0 0	0 0 1 1
17	453.400	463.400	15.425	617	0011	1 0 0 0	0 0 1 0
18	453.425	463.425	15.450	618	0011	1 0 0 0	0 0 0 1
19	453.450	463.450	15.475	619	0011	1 0 0 0	0 0 0 0
20	453.475	463.475	15.500	620	0011	0 1 1 1	1 0 0 1
21	453.500	463.500	15.525	621	0011	0 1 1 1	1 0 0 0
22	453.525	463.525	15.550	622	0011	0 1 1 1	0 1 1 1
23	453.550	463.550	15.575	623	0011	0 1 1 1	0 1 1 0
24	453.575	463.575	15.600	624	0011	0 1 1 1	0 1 0 1
25	453.600	463.600	15.625	625	0011	0 1 1 1	0 1 0 0
26	453.625	463.625	15.650	626	0011	0 1 1 1	0 0 1 1
27	453.650	463.650	15.675	627	0011	0 1 1 1	0 0 1 0
28	453.675	463.675	15.700	628	0011	0 1 1 1	0 0 0 1
29	453.700	463.700	15.725	629	0011	0 1 1 1	0 0 0 0
30	453.725	463.725	15.750	630	0011	0 1 1 0	1 0 0 1
31	453.750	463.750	15.775	631	0011	0 1 1 0	1 0 0 0
32	453.775	463.775	15.800	632	0011	0 1 1 0	0 1 1 1
33	453.800	463.800	15.825	633	0011	0 1 1 0	0 1 1 0
34	453.825	463.825	15.850	634	0011	0 1 1 0	0 1 0 1
35	453.850	463.850	15.875	635	0011	0 1 1 0	0 1 0 0
36	453.875	463.875	15.900	636	0011	0 1 1 0	0 0 1 1
37	453.900	463.900	15.925	637	0011	0 1 1 0	0 0 1 0
38	453.925	463.925	15.950	638	0011	0 1 1 0	0 0 0 1
39	453.950	463.950	15.975	639	0011	0 1 1 0	0 0 0 0
40	453.975	463.975	16.000	640	0011	0 1 0 1	1 0 0 1
41	454.000	464.000	16.025	641	0011	0 1 0 1	1 0 0 0
42	454.025	464.025	16.050	642	0011	0 1 0 1	0 1 1 1
43	454.050	464.050	16.075	643	0011	0 1 0 1	0 1 1 0

FREQUENCY ALLOCATION TABLE

CQM763D

Channel	f_{TX} [MHz]	f_{RX} [MHz]	f_{synt} [MHz]	d.f.	x100	x10				x1			
					K J	D	C	B	A	D	C	B	A
44	454.075	464.075	16.100	644	0011	0	1	0	1	0	1	0	1
45	454.100	464.100	16.125	645	0011	0	1	0	1	0	1	0	0
46	454.125	464.125	16.150	646	0011	0	1	0	1	0	0	1	1
47	454.150	464.150	16.175	647	0011	0	1	0	1	0	0	1	0
48	454.175	464.175	16.200	648	0011	0	1	0	1	0	0	0	1
49	454.200	464.200	16.225	649	0011	0	1	0	1	0	0	0	0
50	454.225	464.225	16.250	650	0011	0	1	0	0	1	0	0	1
51	454.250	464.250	16.275	651	0011	0	1	0	0	1	0	0	0
52	454.275	464.275	16.300	652	0011	0	1	0	0	0	1	1	1
53	454.300	464.300	16.325	653	0011	0	1	0	0	0	1	1	0
54	454.325	464.325	16.350	654	0011	0	1	0	0	0	1	0	1
55	454.350	464.350	16.375	655	0011	0	1	0	0	0	1	0	0
56	454.375	464.375	16.400	656	0011	0	1	0	0	0	0	1	1
57	454.400	464.400	16.425	657	0011	0	1	0	0	0	0	1	0
58	454.425	464.425	16.450	658	0011	0	1	0	0	0	0	0	1
59	454.450	464.450	16.475	659	0011	0	1	0	0	0	0	0	0
60	454.475	464.475	16.500	660	0011	0	0	1	1	1	0	0	1
61	454.500	464.500	16.525	661	0011	0	0	1	1	1	0	0	0
62	454.525	464.525	16.550	662	0011	0	0	1	1	0	1	1	1
63	454.550	464.550	16.575	663	0011	0	0	1	1	0	1	1	0
64	454.575	464.575	16.600	664	0011	0	0	1	1	0	1	0	1
65	454.600	464.600	16.625	665	0011	0	0	1	1	0	1	0	0
66	454.625	464.625	16.650	666	0011	0	0	1	1	0	0	1	1
67	454.650	464.650	16.675	667	0011	0	0	1	1	0	0	1	0
68	454.675	464.675	16.700	668	0011	0	0	1	1	0	0	0	1
69	454.700	464.700	16.725	669	0011	0	0	1	1	0	0	0	0
70	454.725	464.725	16.750	670	0011	0	0	1	0	1	0	0	1
71	454.750	464.750	16.775	671	0011	0	0	1	0	1	0	0	0
72	454.775	464.775	16.800	672	0011	0	0	1	0	0	1	1	1
73	454.800	464.800	16.825	673	0011	0	0	1	0	0	1	1	0
74	454.825	464.825	16.850	674	0011	0	0	1	0	0	1	0	1
75	454.850	464.850	16.875	675	0011	0	0	1	0	0	1	0	0
76	454.875	464.875	16.900	676	0011	0	0	1	0	0	0	1	1
77	454.900	464.900	16.925	677	0011	0	0	1	0	0	0	1	0
78	454.925	464.925	16.950	678	0011	0	0	1	0	0	0	0	1
79	454.950	464.950	16.975	679	0011	0	0	1	0	0	0	0	0
80	454.975	464.975	17.000	680	0011	0	0	0	1	1	0	0	1
81		Blocked	17.025	681	0011	0	0	0	1	1	0	0	0
82		"	17.050	682	0011	0	0	0	1	0	1	1	1
83		"	17.075	683	0011	0	0	0	1	0	1	1	0
84		"	17.100	684	0011	0	0	0	1	0	1	0	1
85		"	17.125	685	0011	0	0	0	1	0	1	0	0
86		"	17.150	686	0011	0	0	0	1	0	0	1	1
87		"	17.175	687	0011	0	0	0	1	0	0	1	0
88		"	17.200	688	0011	0	0	0	1	0	0	0	1
89		"	17.225	689	0011	0	0	0	1	0	0	0	0
90		"	17.250	690	0011	0	0	0	0	1	0	0	1
91		"	17.275	691	0011	0	0	0	0	1	0	0	0
92		"	17.300	692	0011	0	0	0	0	0	1	1	1
93		"	17.325	693	0011	0	0	0	0	0	1	1	0
94		"	17.350	694	0011	0	0	0	0	0	1	0	1
95		"	17.375	695	0011	0	0	0	0	0	1	0	0
96		"	17.400	696	0011	0	0	0	0	0	0	1	1
97		"	17.425	697	0011	0	0	0	0	0	0	1	0
98		"	17.450	698	0011	0	0	0	0	0	0	0	1
99		"	17.475	699	0011	0	0	0	0	0	0	0	0
00		"	15.000	600	0011	1	0	0	1	1	0	0	1

FREQUENCY ALLOCATION TABLE

CQM763D

Private channels 81 - 99

					x100	x10	x1
Channel	f_{TX} [MHz]	f_{RX} [MHz]	f_{synt} [MHz]	d.f.	K J	D C B A	D C B A
81	452.500	462.500	14.525	581	0100	0 0 0 1	1 0 0 0
82	452.525	462.525	14.550	582	0100	0 0 0 1	0 1 1 1
83	452.550	462.550	14.575	583	0100	0 0 0 1	0 1 1 0
84	452.575	462.575	14.600	584	0100	0 0 0 1	0 1 0 1
85	452.600	462.600	14.625	585	0100	0 0 0 1	0 1 0 0
86	452.625	462.625	14.650	586	0100	0 0 0 1	0 0 1 1
87	452.650	462.650	14.675	587	0100	0 0 0 1	0 0 1 0
88	452.675	462.675	14.700	588	0100	0 0 0 1	0 0 0 1
89	452.700	462.700	14.725	589	0100	0 0 0 1	0 0 0 0
90	452.725	462.725	14.750	590	0100	0 0 0 0	1 0 0 1
91	452.750	462.750	14.775	591	0100	0 0 0 0	1 0 0 0
92	452.775	462.775	14.800	592	0100	0 0 0 0	0 1 1 1
93	452.800	462.800	14.825	593	0100	0 0 0 0	0 1 1 0
94	452.825	462.825	14.850	594	0100	0 0 0 0	0 1 0 1
95	452.850	462.850	14.875	595	0100	0 0 0 0	0 1 0 0
96	452.875	462.875	14.900	596	0100	0 0 0 0	0 0 1 1
97	452.900	462.900	14.925	597	0100	0 0 0 0	0 0 1 0
98	452.925	462.925	14.950	598	0100	0 0 0 0	0 0 0 1
99	452.950	462.950	14.975	599	0100	0 0 0 0	0 0 0 0
00		Blocked	15.000	600	0011	1 0 0 1	1 0 0 1

NOTE:
Equipment with private channels will have the blocking function suspended for one or more channels in the range 81 - 99. This requires the programable divisor to be changed from 6xx (K = 0 and J = 1) to 5xx (K = 1 and J = 0). The two controlled decades will still be expressed as the 9-complement of the channel number.

ADJUSTMENT PROCEDURE
CQM763D

RECEIVER ALIGNMENT

Before switching on the CQM763D connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6V and the current limiter to 100 mA.
With the station switched off, increase the sypply voltage until a current of 100mA is reached.

Requirement: $V_{supply} \leq 21V$.

Keeping within these values ensures correct operation of the protective zener diode, E13, in CF702.

Decrease the supply voltage to 13.6V and set the current limiter to 1A.

The station may now be switched on.

Check the 9V RX at terminal 3 on the IF converter.

Requirement: 9V ± 0.1V.

If necessary, adjust the RX voltage by means of potentiometer R64 in CF702. This potentiometer can be reached from the rear of the module tray BA702.

Check the regulated 5V supply at the output terminal of VR701.

Requirement: 5V ± 0.1V.

If necessary, adjust the 5V by means of potentiometer R1 in VR701. This potentiometer can only be reached, when the front panel has been removed and the VR701 screen box opened.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 KHz generator and the chassis.

Apply a 455 KHz signal to the input of CF702. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF702.

Adjust transformers T1 and T2 for maximum meter reading attenuating the generator output before overloading the IF amplifier, causing limiting.

The readings should be kept below approx. 10 µA if an AVO-meter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF702

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box.

Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the terminal board.

Adjust coil L1 in CF702 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R16 (AF-RX) may be turned up. This potentiometer can be reached from the rear of the module tray BA702, and turns up counter- clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency counter is available, the frequency may be read at test point [5], IC703. If the input of the frequency counter is DC-coupled a capacitor (approx. 1 nF) should be connected in series. The frequency will be 10.245 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 KHz generator to the IF input of CF702 and a 10.7 MHz generator to the input of IC703, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 KHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 KHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust trimmer capacitor C12 in IC703 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "Line out", 600 ohm audio output, which is accessible on the terminal board, terminal 35.

NOTE: The discriminator has no zero adjustment.

Alignment of 1st IF Amplifier (10.7 MHz)

Apply a 10.7 MHz signal to the input of IC703.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF702.

Adjust coils L1, L2 and L3 in IC703 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC703: $\geq$ 20 dB

Alignment of the frequency synthesizer reference oscillator.

Select channel 40 corresponding to an output frequency of 16.000 MHz.

Connect a frequency counter to the TX output of the FS701.

Adjust C1 in FS 701 for 16.000.000 ± 10 Hz.

Check all channels for correct synthesizer frequency according to the frequency allocation tables.

The receiver shall be blocked (no RF noise when pressing the SQ button and the LS in button) and the ON/OFF lamp and the channel display shall start flashing, when the channel selector is set to channels not used.

Alignment of Mixer Injection Signal to RC762

Connect a DC voltmeter to testpoint (1) and testpoint (2) in RC762.

Adjust L3 in RC762 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2 mm.

The voltage with the oscillator stopped (short the crystal to chassis) will be approx. 0.25V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to testpoint (1) and testpoint (3) in RC762.

Adjust L5, RC762 for maximum meter reading.

The voltage with the oscillator stopped will be approx. 0.05V.

Start the oscillator.

Requirement:
Minimum voltage increase $\leq$ 0.45V

Typical: 0.8V

Adjustment of Tripler Circuit, RC762

The following procedure must be followed carefully as capacitor C13 can be adjusted to the third harmonic of the input frequency and to the second harmonic as well. Four settings of C13 will normally produce a resonance peak as it can be turned 360°.

Connect a DC voltmeter to testpoint (1) and testpoint (3) in RC762.

Adjust C13 for minimum voltage.

As mentioned above there will be four dips, of which the smaller is chosen.

Connect the DC voltmeter to testpoint (5) in RC762.

Connect a frequency counter to testpoint [4].

Read the frequency, approx. 437.0 MHz, to make certain that Q3 is working as a tripler. If necessary choose an other setting of C13.

Remove the frequency counter and adjust capacitor C15 for maximum reading on the voltmeter. Due to interaction the adjustment of C13 and C15 should be repeated until no further increase in voltage at testpoint (5) is obtained.

The voltage at testpoint (5) with the oscillator stopped will be approx. 0.6V. Minimum voltage increase with the oscillator working $\geq$ 0.3V; Typical: 0.6V.

Storno

Adjustment of Crystal Oscillator Frequency, RC762

Connect a frequency counter to testpoint [4] in RC762. Adjust L1, RC762, for correct frequency.

Requirement: f = 437.275 MHz ± 200 Hz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to RC762 ciagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked, and any readjustment requires the frequency to be readjusted.

Checking the FS701 Output Level

Connect an RF probe and volt meter to test point [4] RC

Set the channel selector to channel 30.

Stop the RC crystal oscillator and measure the RF level.

Requirement: 0.82 - 1.04 V.

Select the channels having the higher frequency and lower frequency and measure the RF level.

If the level is low in one position, L7 in RF amplifier I in FS701 is adjusted for best symetry.

Alignment of Filters and RF Amplifier, RC762

Connect a voltmeter to testpoint (6) in RC762.

Stop the crystal oscillator in RC762 (short the crystal to chassis).

Course tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 452.3 MHz. Adjust L9, L10, L11, L12 L15, L17 and C50 for maximum reading on the voltmeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select channel 01.

Turn the tuning slug of L5 in BP762 flush with the outside of the chassis.

L9, L10, L11, L12, L15, L16, L17, and C50 is adjusted for maximum meter reading in testpoint (6).

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 3.5% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

The voltage at testpoint (6) with the oscillator stopped will be approx. 3V.

Start the oscillator.

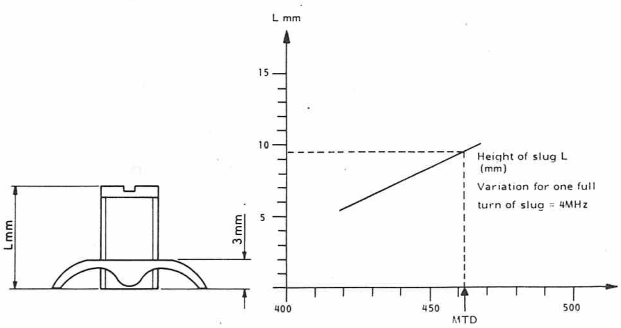
Requirement:
Minimum increase at testpoint (6),
RC762 = 0.5V

Check the voltage at the higher frequency and the lower frequency.

If the voltage drops at higher or lower frequencies, small corrections of the filteralignment may be implemented.

Coarse Adjustment of BP762

The trimming slugs, L1, L2, L3, and L4 of the filter BP762 are set to the approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency. L5 is to remain in its position as set during the fine tuning of the filters.



Storno

Further Alignment of RC762

Fine Tuning of BP762, and

Fine Tuning of IC703

Connect a DC EVM with an RF probe to testpoint [1] in CF702. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Select channel 30.

Set the generator to the receiver frequency (463,725MHz). Fine tuning of the generator frequency may be done by loosely coupling a 455 KHz signal to the IF input of CF702. (First connect CQM700 chassis to generator earth.) Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF702, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at testpoint [1], CF702.

The following coils are tuned for maximum meter reading in this order:

C50, RC762
L 5, BP762
L 4, BP762
L 3, BP762
L 2, BP762
L 1, BP762
L18, RC762
L 1, IC703
L 2, IC703
L 3, IC703

Due to interaction, especially between C50 in RC, and L5 in BP, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting C50, RC762, the oscillator drive signal to the RF mixer will have decreased. L17, RC762, must be fine tuned for maximum reading on a DC voltmeter connected to test point (6), RC762

Now, when stopping the oscillator, the voltage at testpoint (6) should fall at least 0.3V. L1, L2, and L3 in IC703, are now fine tuned for maximum reading at test point [1], CF702. The circuits in IC703 should be aligned two or three times, as they influence each other.

Fine Tuning of L1 in CF702

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM763D, approx. 1 mV EMF from the generator.

Modulate the generator with 1 KHz to a frequency swing of ± 3.5 KHz.

Connect an audio voltmeter to testpoint [2] in CF702. This testpoint becomes accessible by unscrewing the upper PC-board of CF702.

Peak coil L1 in CF702, for maximum meter reading.

Requirement: $\geq$ 65 mV

NOTE: Terminal 35 "Line out", on the terminal board or the connector "Line out" on the control units may be used instead of test point [2]. However, this reading is dependent on the setting of potentiometer R16, AF-RX, in CF702, and it must be checked that an audio level of $\geq$ 110 mV can be obtained from "Line out" for the appropriate frequency deviation as shown below.

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 KHz, and set the frequency deviation to 0.7 x Δ f max.: 3.5 KHz.

Set the RF generator output level to approx. 1mV EMF

If the CQM763D is provided with tone equipment press the LS in/out button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to "Line out".

Adjust the audio output level to 110 mV by means of R16 in CF702.

Connect a 5Ω load resistor across the loudspeaker output terminals instead of the loudspeaker.

Storno

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals. Set the volume control for 2.25V on the meter.

Check the distortion.

Requirement: k ≤ 5%

NOTE: Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 2 W (by means of potentiometer R83 on CF702) for an audio input of 110 mV from LINE OUT (AF-17 dBm),
- a base bias to the output amplifier transistors ensuring a suitable no-signal current in the stage.

Consequent adjustment of the nosignal current in the output stage is performed in the following way:

Turn the station off, and the volume control down.

Turn potentiometer R99 fully counter-clock-wise (viewed from the component side of CF702).

Set the supply voltage to 16V.

Insert a milliammeter in the positive supply lead to the output amplifier (brown lead between the two PC-boards of CF702, terminals C / C of CF702).

Turn the station on. The reading will be approx. 15 - 25 mA.

Turn potentiometer R99 clockwise until the current drain has increased by 2 mA.

Checking the Audio Power Output

Set the volume control for 3.16 V across the audio output load (corresponding to a power output of 2W) for an input signal of 1 KHz, 110 mV.

Connect the distortion meter across the output and read the distortion.

Requirement: k ≤ 7%

Checking Receiver Sensitivity

Modulate the RF generator with 1 KHz, and a frequency deviation of 3.0 x max. Δ f.

Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 5Ω resistor for the speaker.

Set the volume control for 1V across the load.

Reduce the calibrated RF voltage from the RF generator.

Requirement:
for 12 dB SINAD ≤ 1.0 μV EMF. (channels 01-80)
for 12 dB SINAD ≤ 1.1 μV EMF. (channels 81-99)

The procedure should be repeated on all channels.

Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R38 in CF702 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage.

Requirement:
CQM763D with tone equipment, TT781, SR781, and channel indicator ID701.
≤ 900 mA.

TRANSMITTER ADJUSTMENT

Unless the receiver alignment procedure has been performed, check for correct operation of the protection diode, E13, on CF702. This test is described in the first paragraphs under "Receiver Alignment". Then set the supply voltage to 13.6V, and the current limiter to 4A.

If tone equipment is installed, the LS in/out button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9V TX at terminal 19 on the terminal board.

NOTE: If 9V RX was not present or was set too low before keying the transmitter, the 9V TX series regulator will not start.

Requirement: 9V TX = 9V ± 0.1V.

If necessary, adjust the TX voltage by means of potentiometer R72 on CF702. This potentiometer can be reached from the rear of module tray BA702.

Alignment of Mixer Injection Signal to EX762

Connect a DC voltmeter to testpoints (1) and (2) in EX762.

Adjust L3 in EX762 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2mm.

The voltage with the oscillator stopped (short circuit the crystal to chassis) will be approx. 0.25V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to testpoints (1) and (3) in EX762.

Adjust L5 EX762, for maximum meter reading.

The voltage at test point (1) and (3) with the oscillator stopped will be approx. 0.05V.

Start the oscillator.

Requirement:
Minimum increase at testpoints (1) - (3), EX762 = 0.45V.

Adjustment of Tripler Circuit EX762

The following procedure is to be followed carefully as capacitor C13 can be adjusted to the third harmonic of the input frequency and to the second harmonic as well. As C13 has no stop there will normally be four points of resonance.

Connect a DC voltmeter to testpoint (1) and testpoint (3) in EX762.

Adjust capacitor C13 for minimum voltage.

Storno

As mentioned above there will be four dips of which the smaller is chosen.

Connect the DC voltmeter to testpoint (5) in EX762.

Adjust capacitor C15 for maximum reading.

Connect a frequency counter to testpoint [4].

Read the frequency, approx. 438 MHz, to make certain that Q3 is working as a tripler.

Remove the frequency counter and adjust C13 for maximum voltmeter reading.

Due to interaction the adjustment of C13 and C15 should be repeated until no further increase in voltage at testpoint (5) is obtainable. The voltage at testpoint (5) with the oscillator stopped will be approx. 0.6V.

Minimum increase at testpoint (5) $\geq$ 0.3V.

Adjustment of Crystal Oscillator Frequency, EX762

Connect a frequency counter to testpoint [4].

Adjust L1, EX762, for correct frequency.

Requirement:
437.975 MHz ± 200 Hz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered. Refer to EX762 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked and any readjustment requires the frequency to be readjusted.

Checking the FS701 Output Level

Connect an RF probe and voltmeter to testpoint [4], EX762
Set the channel selector to channel 30.

Stop the EX crystal oscillator and measure the RF level.

Requirement: 0.82 - 1.04 V.

Select the channels having the higher frequency and the lower frequency and measure the RF level.

If the level is low in one position, L7 in RF-amplifier II is adjusted for best symetry.

Alignment of Filters and RF Amplifier EX762

Connect an RF probe and voltmeter to testpoint [9] in EX762 (output terminal).

Stop the crystal oscillator in EX762 (short the crystal to chassis).

Course tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 453.00 MHz. Adjust L9, L10, L11, L12, L15, L16, and L17 for maximum reading on the voltmeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select channel 30.

Adjust L9, L10, L11, L12, L15, L16, and L17 for maximum meter reading.

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 3.5% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

Alignment of RF Amplifier RA761

Connect a voltmeter to testpoint (11) in RA761.

Select channel 01.

Adjust L17 in EX762 for minimum meter reading. Adjust L1, L2, L3, L4, L5, and C5 in RA761 for minimum meter reading, approx. 4.5V.

Remove the RF signal lead between RA 761 and PA763.

Connect an RF Watt meter to the RA761 output.

Adjust L6, RA761 for maximum output. Adjust L1, L2, L3, L4, L5, L6, and C5 for maximum output.

Repeat the adjustment until no further increase in meter reading can be obtained.

Requirement: $P_{OUT} \geq 60$ mW.

Measure the voltage at testpoint (11) in RA761.

Requirement: $\leq$ 6V

These requirements should be fulfilled on all channels. The total variation in output power should be less than 1 dB within the bandwidth.

Alignment of RF Power Amplifier PA763

Reestablish the connection between RA761 and PA763.

Connect a wattmeter to the antenna output.

Select channel 30.

PA763 should be aligned at a supply voltage of 12.5V.

1. Turn the ADC potentiometer, R2 in PA763 up (clockwise), but back the potentiometer off if necessary during the alignment. The total current consumption while aligning must be limited with the ADC potentiometer to 3A (with tone equipment).

   Adjust C3, C7, C11, C16, C21 and C22 in PA763, in this order, for maximum current consumption from the power supply.

   Repeat until the Wattmeter shows RF output, and proceed to adjust the above capacitors for maximum RF output.

2. During the following alignment, keep the ADC potentiometer set for a maximum output of 6W.

   Adjust C3 for minimum DC voltage on the collector (the transistor housing) of Q1, PA763.

   Adjust C7, C11, C15, C16, C21, and C22 for maximum RF output.

3. Repeat step 2.

Increase the supply voltage to 16V and set the ADC potentiometer for an RF output of 6W.

Storno

Automatic Drive Control Circuit (ADC)

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

Requirements:

Supply Voltage	Current Drain	Power Output
16.0 V	$\leq$ 2.8 A	$\geq$ 5.5 W
13.6 V	$\leq$ 2.9 A	$\geq$ 5.0 W
10.5 V	$\leq$ 2.8 A	$\geq$ 3.0 W

The power deviation between channels selected at random should not be greater than 0.1 dB.

Measure the total current consumption, tone equipment and channel display included, at 13.6 V.

Requirement: $I_{total} \leq 2.9$ A

Adjustment of Modulation and Frequency Deviation

Connect the deviation meter to the transmitter output via an attenuation network (10W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM763D to 13.6 V.

Connect a tonegenerator to terminal 7 and 13 (chassis) on the terminal board through a network as outlined below.

Select channel 80.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF702. The 6 dB loss in the network is also taken into account, and the nominal input level will be found to be 2.2 V∼26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 KHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R124 on CF702.

Requirement: $\Delta f_{max} = \pm 5$ KHz.

Select channel 40.

Set the audio generator to 1000 Hz and the output to 220 mV.

Adjust R133 in CF702 for nominal frequency deviation:

CQM763D x 80 DK: $\Delta f_{nom} = 3.3$ KHz
CQM763D x 80 S : $\Delta f_{nom} = 3.0$ KHz

Check the frequency deviation, Δf_{nom}, at 1000 Hz on all channels.

Requirement: $V_{mod} = 220$ mV $\pm$ 1 dB

Check the distortion on the audio output of the deviation meter.

Requirement: $k \leq 7\%$ (without deemphasis).

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5-40 MHz.

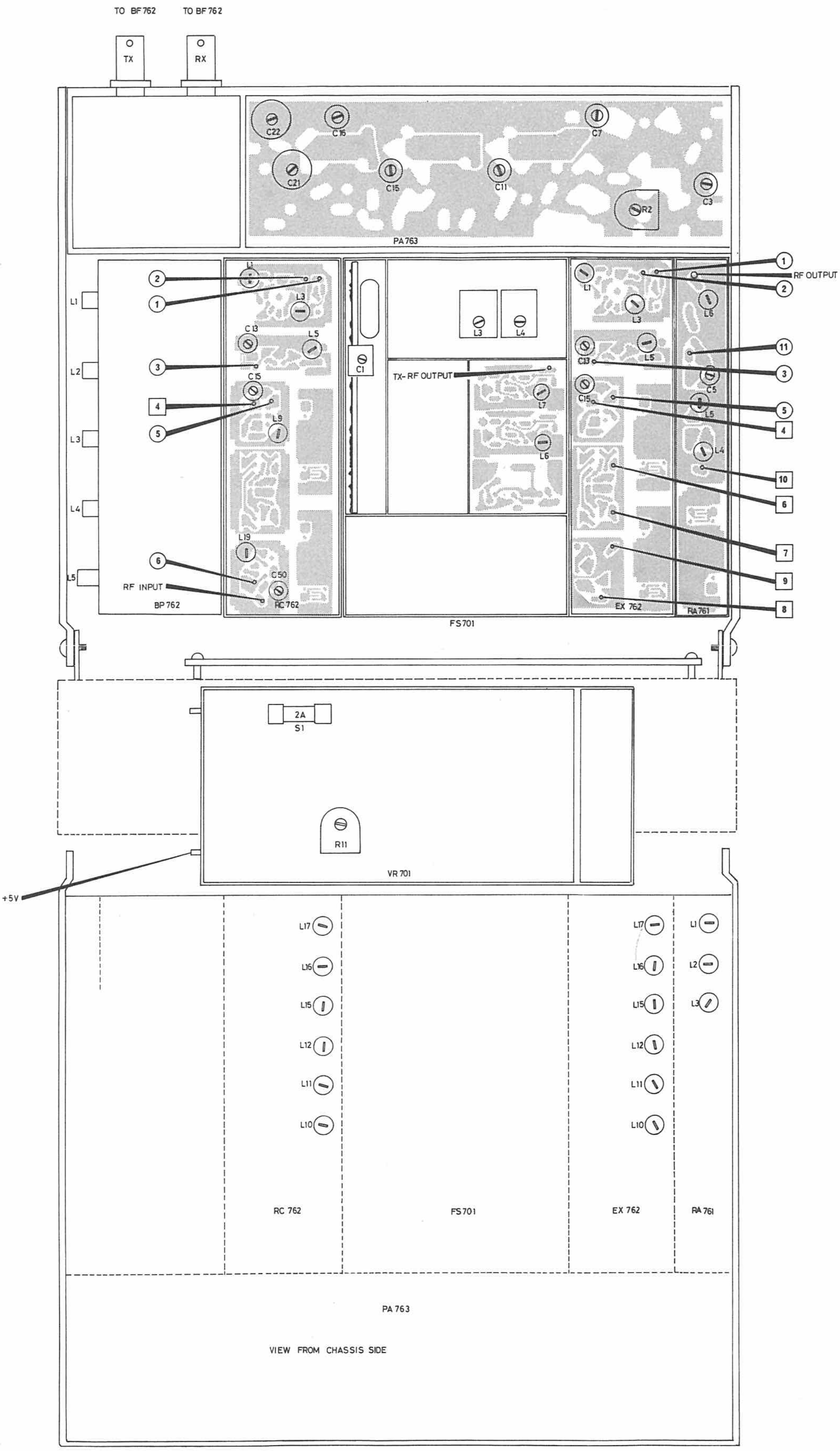
The existence of parasitic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivoltmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TSF42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5V and 16V.

For further details please refer to STORNO Service News No. 38 of May 1969.

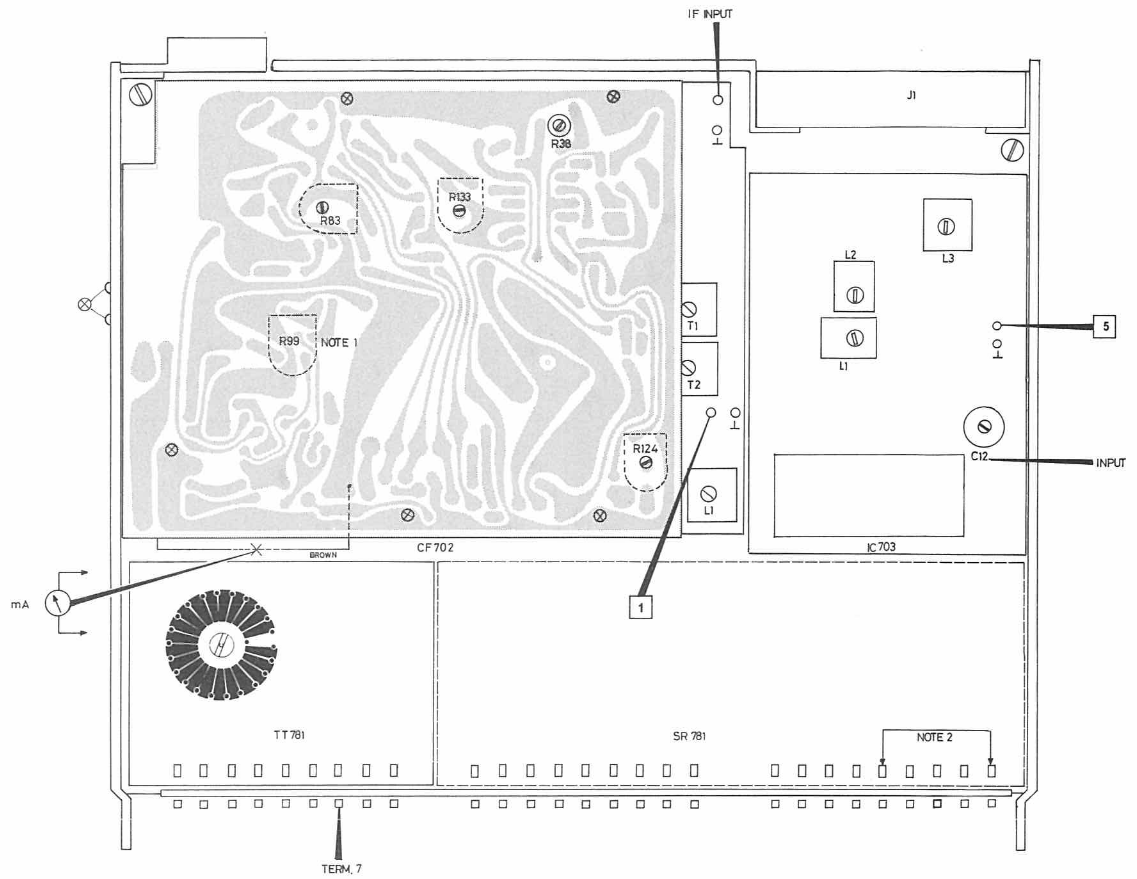
Antenna Branching Filter BF763

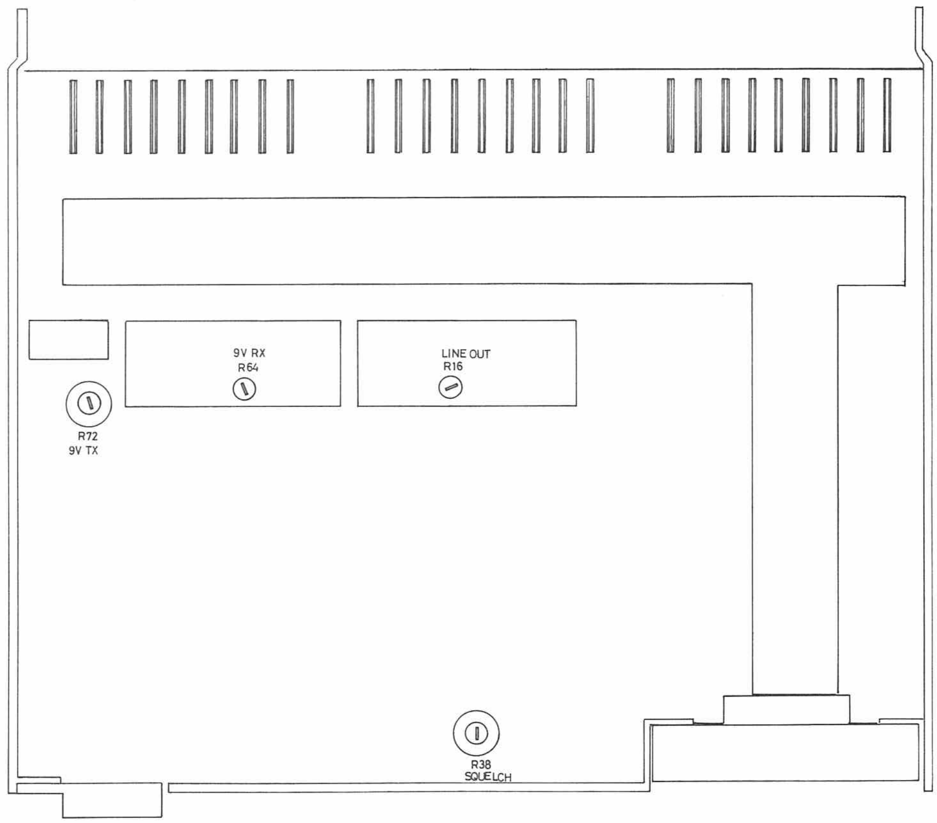
The filter is factory aligned and should never be touched.



RADIO ASSEMBLY RF763 (CQM763D)
Location of Test Points and Adjustable Components

D402.231





BASIC ASSEMBLY BA702 (CQM700D)

Location of Test Points and Adjustable Components

D402.233

TECHNICAL SPECIFICATIONS
CQM763D-12

The stated specifications apply to all channels.
All measurements include antenna branching filter.
The receiver specifications are measured with simultaneous transmitting.
Figures in brachets are typical values.

GENERAL SPECIFICATIONS

Frequency range, transmitter

CQM763D x 80 DK: 453.0MHz to 455.0 MHz
CQM763D x 80 S : 452.5 MHz to 455.0 MHz [1]

Frequency range, receiver

CQM763D x 80 DK: 463.0 MHz to 465.0 MHz
CQM763D x 80 S : 462.5 MHz to 465.0 MHz[1]

[1] 19 private channels included.

Duplex frequency separation

10 MHz

RF bandwidth

CQM763D x 80 DK: 2.0 MHz
CQM763D x 80 S : 2.5 MHz (19 private channels incl.)

Channel frequency separation

25 KHz

Number of channels

CQM763D x 80 DK: 80
CQM763D x 80 S : 80 + 19

Type of modulation

Phase

Modulation frequency range

CQM763D x 80 DK: 300 Hz to 3000 Hz
CQM763D x 80 S : 300 Hz to 2400 Hz

Maximum frequency deviation

± 5 KHz

Nominal frequency deviation

± 3.0 KHz

Antenna impedance

50 Ω

Temperature range

Operating range: -25°C to + 55°C
Functioning range: -30°C to + 60°C

Dimensions

Locally controlled version:	180 x 250 x 70 mm
Extended local control:	180 x 210 x 70 mm
Antenna branching filter:	235 x 130 x 30 mm
Control unit CB704:	120 x 65 x 55 mm

Weight

Locally controlled version:	2.7 kg
Extended local control:	2.43 kg
Antenna branching filter:	1.07 kg
Control unit CB704:	0.2 kg

RECEIVER SPECIFICATIONS

Sensitivity, e.m.f. for 12 dB SINAD, EIA

Channel 01 - 80.	1.1µV	(0.85 µV)
Channel 81 - 99:	1.2µV	(1.0 µV)

Squelch sensitivity, EIA

1.0 µV (0.7 µV)

Modulation acceptance bandwidth

± 5 KHz (± 7 KHz)

Adjacent channel selectivity, EIA

70 dB (77 dB)

Adjacent channel selectivity, SEN

65 dB (72 dB)

Spurious attenuation , EIA

75 dB (85 dB)

Spurious attenuation, SEN

70 dB (80 dB)

Intermodulation, EIA

70dB / 1 µV (75 dB / 1 µV)

Blocking, MTD

86 dB / 1 µV (88 dB / 1 µV)

Blocking, GPO

H 1 dB

< 1 dB

Spurious and harmonic emission into an artificial load (SEN)

< 2nW (0.4 nW)

Loudspeaker impedance

4 Ω

Microphone impedance

10.000 Ω

AF output power into 4 Ω

4 W (3 W)

Harmonic distortion

< 6% (3%) measured at 1 mV RF input. 1 W AF output, F_{mod} = 1 KHz and Δf_{nom}

Audio frequency characteristic, EIA

-6 dB / octave +0.5 dB / -3 dB (+0 dB / -1.5 dB)

Hum and noise , EIA

60 dB (70 dB),	squelched condition
40 dB (45 dB),	unsquelched condition

Hum and noise, MTD

40 dB (45 dB),	pt. 2.2. 11a
30 dB (36 dB),	pt. 2.2. 11b

TRANSMITTER SPECIFICATIONS

RF output

12W - 1.5 dB

Crystal oscillator frequency, EX762

145.992 MHz

Frequency stability, -25°C to +55°C

± 2.5 KHz (± 2,0 KHz)

Spurious radiation

Harmonics:	<2 µW (<0.2 µW)
Adjacent channels, MTD:	<2 µW (<0.5 µW)
Other frequencies:	<0.2 µW (< 0.1 µW)

AF input impedance

560 Ω

Modulation sensitivity, EIA

110 mV ± 1 dB

Modulation distortion, EIA

< 5% (2%)

Modulation distortion, MTD

< 7% (2%)

Modulation frequency characteristic, MTD

+6 dB / octave +1 dB / -3 dB (+0 dB / -2 dB)

CQM763D x 80 DK:	300 Hz to 3000 Hz
CQM763D x 80 S :	300 Hz to 2400 Hz

FM hum and noise , EIA

-45 dB (-60 dB)

FM hum and noise, MTD

35 dB (40 dB),	pt. 2.1.9a
30 dB (35 dB),	pt. 2.1.9b

AM, MTD

7% (1.5%)

Transmitter load

Meets the MTD requirements pt. 2.1.2a, b and c.

POWER SUPPLY SPECIFICATIONS

Nominal battery voltage

13.6V

Current consumption

Receive, stand by:	1.0A (0.8A)
Receive, 2W AF:	1.4A (1.1A)
Transmit:	5.0A (4.0A)

Measuring method references.

EIA:	RS152A
EIA:	RS204
SEN:	470601
MTD:	06-68181-1
GPO:	W. 6289

GENERAL DESCRIPTION
CQM763D-12

Introduction

The Stornophone 763D radiotelephone is a mobile transmitter for the UHF duplex operated public radiotelephone systems in Denmark and Sweden.

The only difference between the Danish equipment and the Swedish equipment is the option for 19 private channels (81 - 99) in the Swedish equipment.

From the frequency allocation table, the channel numbers, channel frequencies and the relationship to the synthesizer signal appear. As the channel selector is in the BCD code and the programable divider requires the 9-complement of the BCD code, a converter is inserted.

Type	Transmitter frequency range	Receiver frequency range	Duplex Spacing
CQM763D-12x80 DK	453.0 MHz - 455.0 MHz	463.0 MHz - 465.0 MHz	10 MHz
CQM763D-12x80 S+	452.5 MHz - 455.0 MHz	462.5 MHz - 465.0 MHz	10 MHz

+) 19 private channels included.

There are two mechanical different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Construction

The radio chassis slides into the cabinet from the front and is held in place by screws from the rear of the cabinet. The chassis consists of two circuit panels hinged on to the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF765 contains all the circuits which are dependent upon channel frequencies. These are:

- preselector filter BP762
- receiver converter RC764
- synthesizer unit FS701
- exciter EX762
- RF amplifier RA761
- transmitter power output amplifier PA765

The lower circuit panel, designated BA704, contains:

- intermediate frequency converter IC705
- intermediate frequency amplifier CF704
- squelch circuit CF704
- voltage regulators CF704
- tone equipment, where included SR781, TT781

Between the circuit panels and the control panel are placed

Storno

a frequency control unit FC703
a 5 volt switching regulator VR701

The solid state circuitry is built up as funtional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:

CQM763D-12 spec XX XXXX

XX	C4	Remote control (CP703)
XX	C5	Local control (CP705)
XXXX	80DK	Denmark, 80 channels
XXXX	80S	Sweden, 80 channels

Control Equipment

The locally controlled model will have the following front panel:

CP705 Front panel with controls, built-in loudspeaker and channel selector.

The CQM763D for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703.

One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB704 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone.

CB706 Automatic control unit housed in a cast aluminium cabinet and containing operating controls for the radiotelephone.

Accessories

Accessories available for the CQM763D radiotelephone are listed in this section. Some of them, such as installation materials, antenna and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier.

MC703 Fixed microphone for mounting on steering wheel column.

MT704 Handset with

MT704 Handset with built-in amplifier and transmitter keying switch.

Retainer for MT704.

All of the above items are supplied with cables for termination in a multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit, consisting of two flexible metal tubes (goose necks), length 20 and 35 cm, is available.

Channel Indicator

ID701 Channel indicator for displaying the channel in operation. The indicator can be used with all types of control unit.

Storno

Antenna

AN63-3 1/4 wave length whip antenna for the 420-470Mhz frequency band, and its impedance matches 50Ω. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM763D-12 radio set will require some or all of the following installation kits.:

MN701 Mounting frame for radio cabinet.

CC704a Cable kit containing extension cable terminated in multiconnectors for control unit and accessories.

CC701 Battery Cable.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with the battery cable.

Loudspeakers

When using the extended control system it is necessary to install an external loudspeaker. The following type is avaible:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable to be soldered to the accessory connector.

External Switches, Relays etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for mounting on dashboard.

SU704 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

Power Supplies

PS701 Power supply for 24V car battery, any battery polarity.

PS702 Power supply for 24V car battery, negative pole to chassis.

PS704 12 volt regulator for 24V car battery, negative pole to chassis.

CIRCUIT DESCRIPTION
CQM763D-12

General

The nominal 12V supply from the battery is applied to the connector designated "BATT". A relay in series with a diode across the battery input terminals protects the radiotelephone against incorrect supply polarity.

The filtered battery voltage is applied to two 9 volt regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment.

The incomming signal passes through the antenna branching filter unit (BF) to the input of the receiver.

The audio from the receiver is applied to the loudspeaker (LS) or to the microphone (MT). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output may be connected to the sequential tone receiver SR700 used in selective tone signalling systems. The tone receiver enables the AF output circuits to be switched on and off.

In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "CALL" and "ENGAGED" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the receiver is derived from the microphone (MC) or the microphone (MT) via the tone generator TT780.

During transmissions of a tone signal, the microphone signal is switched off automatically so that the transmitter is modulated by the tone signal only.

The transmitter is keyed by depressing the transmitbutton which operates the transmitter voltage regulator and the "transmitter on" condition is indicated by the transmit indicator lamp.

If the radiotelephone is fitted with a tone receiver, the transmitter cannot be operated until the loudspeaker has been switched ON manually by means of the loudspeaker ON/OFF button.

RECEIVER

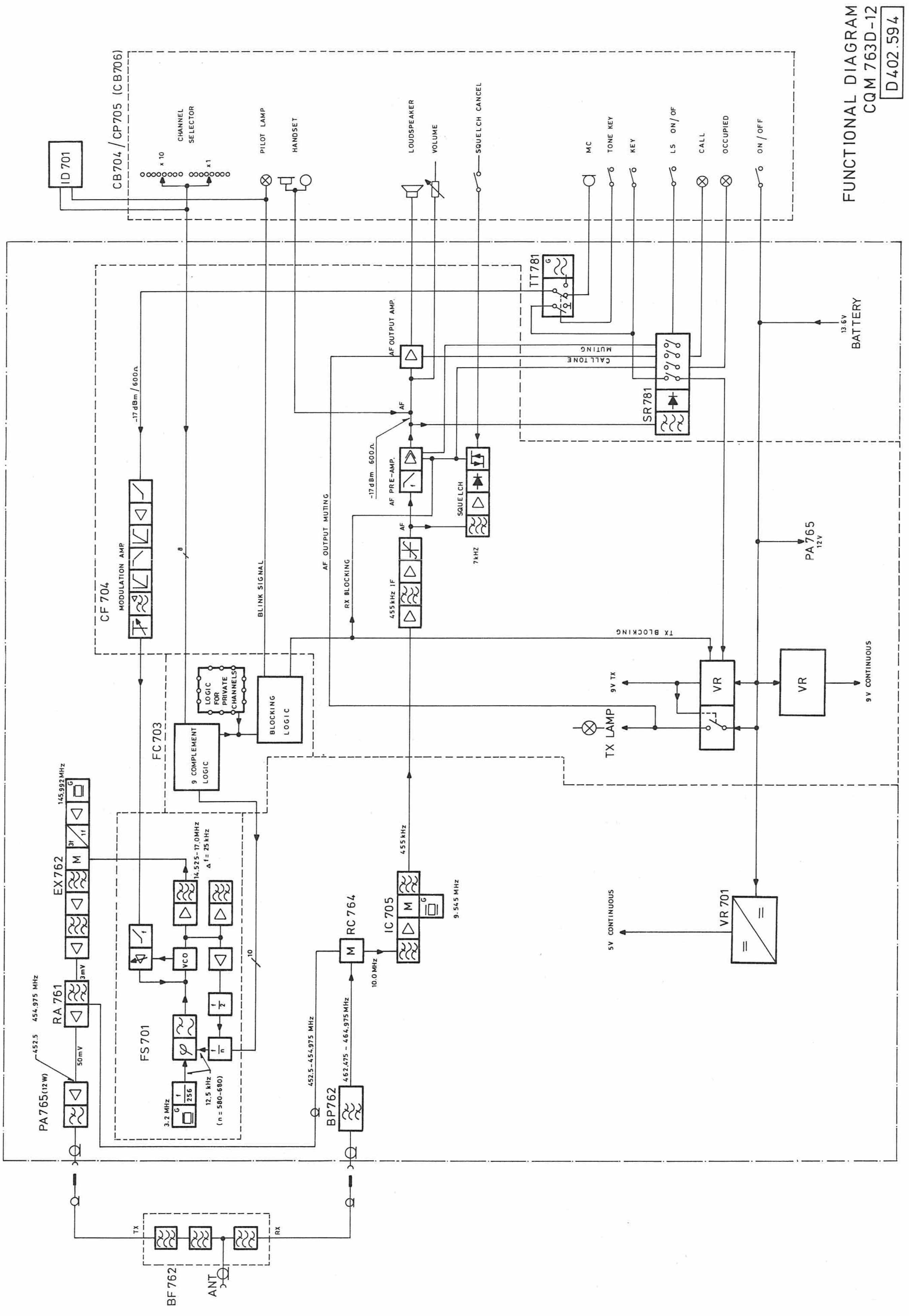
The receiver is a double conversion superheterodyne using intermediate frequencies of 10.0 MHz and 455KHz. The high RF sensitivity characteristic of the receiver is provided by a five element helix filter having low insertion loss.

Adjacent channel selectivity is obtained by using two band pass filters:

a 10.0MHz crystal filter and
a 455KHz ceramic filter.

The receiver comprizes the following subunits:

BF762	Antenna branching filter
BP762	Preselector filter
RC764	Receiver converter



FUNCTIONAL DIAGRAM
CQM 763D-12
D402.594

IC705	Intermediate frequency Converter with 10. 0MHz crystal filter, 2nd mixer, 2nd local oscillator and 455KHz ceramic filter
CF704	455KHz intermediate frequency amplifier, squelch circuit, AF amplifier and voltage regulator

RECEIVER

Signal Path

From the antenna branching filter unit the input signal is passed through the preselector filter and an impedance matching network directly to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity without an RF amplifier stage.

This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver. The BP762 filter consists of five tuned circuits which can be adjusted over the band. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required be the field-effect transistor (FET) of the mixer stage.

The local oscillator signal and the received signals are applied to the gate of the FET. The mixer output at 10. 0MHz is taken from the drain circuit.

The mixer injections signal is 10. 0MHz below the antenna frequency and is produced by mixing with the signal from the transmitter exciter r. f. amplifier PA761.

The signal derived from point 10 and is relatively independant of the transmitter being on or not. The injection signal is fed to the mixer via a coaxial cable tuned to one half wavelength in order to avoid unwanted impedance transformations and hence also avoid adverse loading conditions. .

The conversions can be expressed as follows:

$$f_{RF} = f_{TX} + IF_1$$

f_{RX} = Antenna Frequency

IF_1 = 10. 0MHz

Intermediate Frequency Circuits

From the mixer in RC762 the 10. 0MHz signal passes to the intermediate frequency converter, type IC705, which provides the channel selectivity of the receiver. The first IF signal passes through the 10. 0MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer and converted to the second IF signal of 455KHz.

The injection signal to the mixer stage is generated by a crystal oscillator whose frequency is 455KHz below 10. 0MHz. The crystal is calculated:

$$10.0\text{MHz} - 0.455\text{MHz} = 9.545\text{MHz}$$

The second intermediate frequency signal from the mixer stage proceeds through the 455KHz ceramic filter in the IC705 converter and is then applied to the intermediate frequency amplifier in CF704.

The 455KHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a de-emphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

The signal is then applied to an integrated amplifier in which a transistor, operating as an electronic on/off switch, has been placed between the two stages. This switch is controlled by the squelch circuit. The amplifier has nominal output level of-17dBm (110mV).

The signal is passed to the integrated loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 4W (depending on battery voltage) into a 4 Ω load. The input stage is a high-pass active filter which attenuates frequencies below 250Hz.

Manual gain adjustment, and thus loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the preamplifier and the AF output amplifier.

The AF output stage consists of an integrated AF power module.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to a "muting terminal" on the preamplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM763D-12 is operated by noise components in the demodulated signal.

The AF signal from the discriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise detector.

The Schmitt trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

The transmitter is phase modulated and the output frequency is produced by mixing the synthesizer signal with the signal from a crystal controlled oscillator.

The transmitter comprises the following subunits:

Exciter with crystal oscillator and mixer circuits	EX762
RF amplifier	RA761
RF power amplifier	PA765
Antenna Branching filter	BF762
Modulation amplifier, transmitter switch and voltage regulator (these circuit constitute part of CF704)	CF704

AF Circuits

The modulating signal from the microphone is fed, through the tone generator to the modulation amplifier where it is differentiated, amplified, limited, integrated and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The RF signal is generated in a crystal controlled oscillator contained in the exciter EX762.

The oscillator signal is applied to a buffer amplifier, whose output is mixed with the synthesizer signal. The mixer output is filtered and amplified in order to obtain an adequate signal for the RA761.

In order to suppress spurious signals, especially the oscillator frequency, 3 circuit helix filters are used. To compensate oscillator drift at low temperatures the unit incorporates a partial crystal oven.

The conversions can be expressed as follows:

$$f_{TX} = f_{XTX} + f_S$$

f_{TX} = Transmitting frequency

f_{XTX} = Crystal oscillator frequency

f_S = Synthesizer signal

The output signal from the exciter is fed to an RF amplifier (RA761) operating at the final frequency of the transmitter. Tuned input and output band pass filters of the amplifier provide aditional selectivity and thus also attenuation of undesired signals. The amplifier raises the signal to the level required by the final RF power amplifier PA765. The nominal RF output power of RA761 is 100 mW into 50 Ω load.

Storno

RF Power Amplifier

The power amplifier contains one transistor stage and a power module. The coupling between the stages consists of tuned matching networks with low loaded Q values.

The RF power amplifier is a high efficiency class C amplifier. An ADC (Automatic Drive Control) circuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the following stages. The purpose of the ADC circuit is to prevent overloading. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC circuit.

Antenna Circuits

The signal generated by the transmitter is passed through a low pass 7-pole Chebishev filter. The antenna filter having low insertion loss and ripple attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonies of the transmitter frequency.

The antenna filter is not adjustable.

The transmitter signal at the output connector is fed through the antenna branching filter BF762 to the antenna.

Synthesizer Circuits

The frequency synthesis unit FS701 produces the synthesis signal by the digital frequency synthesis method.

The signal is generated in a voltage controlled oscillator (VCO) whose output is amplified, and fed to the exciter.

The VCO is part of a phase locked loop consisting of a buffer amplifier, a programable frequency divider, a phase detector, a prescaler and a low pass filter.

The phase detector compares the divided VCO frequency to a 12.5 KHz reference frequency. Any difference in frequency will be opposed by the DC voltage at the low pass filter output, adjusting the VCO frequency up or down until it locks to the reference frequency.

The 12.5 reference frequency is produced by dividing the output of a 3.2 MHz crystal controlled oscillator by 256.

The RC oscillator frequency and the EX oscillator frequency are so chosen, that the lowest transmitting frequency corresponds to dividing by 600 in the programable divider. The three decades in the counter are controlled by the 9-complement of the divisor expressed in the BCD code.

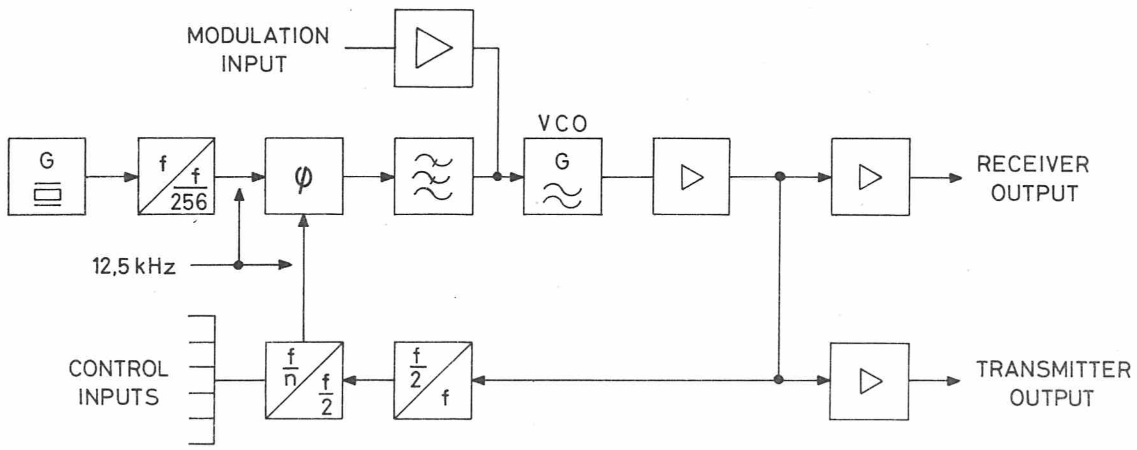
The third decade counter is fixed programmed to divide by 6.

Frequency Control

The conversion of the channel selector BCD code to its 9-complement code takes place in the frequency control unit FC703.

The circuits allow conversion of maximum 99 channels of which 19 channels are blocked by additional logic circuits. When the channel selector is set to a blocked channel, the frequency control unit produce blocking voltages to blocking gates in the transmitter and receiver circuits, and an astable multivibrator flashes the channel display and the ON/OFF lamp.

In Swedish units one or some of the remaining 19 channels may be opened and used as private channels.



SYNTHESIZER BLOCK DIAGRAM

Power Supply and Switching Circuits

CQM763D-12 is powered directly from a 12 volt car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A start relay connected across the battery input terminals potects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the relay series diode not to conduct and thus the relay refuses to operate.

The CQM763D-12 contains two almost identical voltage regulator circuits which deliver 9V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstablized.

The voltage regulators are protected at the output agains short circuit by limiting the maximum current to a safe value.

The transmitter regulator has a blocking transistor controlled by the transmit key button and the blocking voltage from the frequency control unit. With the CQM763D-12 in the standby or receive mode, the key button is in the "OFF" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed the blocking is superseeded. However, this requires the channel selector not to be set to a blocked channel and the tone receiver to be in condition "LS IN", if fitted.

The supply voltage for the PA765 power amplifier in the transmitter is taken from the battery and applied directly to the amplifier.

Supply voltage for the TTL logic circuits is derived from a selfoscillating switching regulator (VR701) ensuring low loss and high efficiency.

ADJUSTMENT PROCEDURE
CQM763D-12

GENERAL

Before switching on the CQM763D-12 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6V and the current limiter to 1 A.

The station may now be switched on.

Check the 9V RX at terminal 3 on the IF converter.

Requirement: 9V ± 0.1V.

If necessary, adjust the RX voltage by means of potentiometer R91 in CF704. This potentiometer can be reached from the rear of the module tray BA704.

Set the current limiter to 5 A.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter and check 9V TX at terminal 19 on the terminal board.

If tone equipment is installed, the LS in/out button must be pressed to establish a DC path for the transmitter keying function.

NOTE: If 9V RX was not present or was set to low before keying the transmitter, the 9V TX series regulator will not start.

Requirement: 9V TX = 9V ± 0.1V

if necessary, adjust the TX voltage by means of potentiometer R98 on CF704. This potentiometer can be reached from the rear of module tray BA704.

Check the regulated 5V supply at the output terminal of VR701.

Requirement: 5V ± 0.1V.

If necessary, adjust the 5V by means of potentiometer R1 in VR701. This potentiometer can only be reached, when the front panel has been removed and the VR701 screen box opened.

Adjustment of Reference Oscillator, FS701

Check all connections to be in accordance with the notes on the diagram.

Set the channel selector to channel 40.

Connect a frequency counter to the EX-output. Adjust capacitor C1 in FS701 for 16.000 MHz as read on the counter.

Requirement: fsynth. = 16.000.000 ± 10 Hz.

Select channel 01 and measure the frequency
f synth = 15.025 MHz

Select channel 80 and measure the frequency.
f synth = 17.000 MHz

Check that one channel up is equal to 25 kHz up.

Check private channel, if fitted.

Check the receiver blocking on channels not used, and channel 00.
The blocking causes the loudspeaker to silence even when depressing the SQ-button and the LS-input button, and the ON/OFF lamp and the channel display to flash at a rate of approx. 1 per second.

TRANSMITTER ADJUSTMENTS

Alignment of Mixer Injection Signal to EX762

Connect a DC voltmeter to testpoints (1) and (2) in EX762.

Adjust L3 in EX762 for maximum meter reading. Distance between the tuning slug and the top of the coil form should be approx. 2mm.

The voltage with the oscillator stopped (short circuit the crystal to chassis) will be approx. 0.25V. Minimum increase with the oscillator working will be approx. 30 mV.

Connect the voltmeter to testpoints (1) and (3) in EX762.

Adjust L5 EX762, for maximum meter reading.

The voltage at test point (1) and (3) with the oscillator stopped will be approx. 0.05V.

Start the oscillator.

Requirement:
Minimum increase at testpoints (1) - (3), EX762 = 0.45V.

Adjustment of Tripler Circuit EX762

The following procedure is to be followed carefully as capacitor C13 can be adjusted to the third harmonic of the input frequency and to the second harmonic as well. As C13 has no stop there will normally be four points of resonance.

Connect a DC voltmeter to testpoints (1) and testpoint (3) in EX762.

Adjust capacitor C13 for minimum voltage.

As mentioned above there will be four dips of which the smaller is chosen.

Connect the DC voltmeter to testpoint (5) in EX762.

Adjust capacitor C15 for maximum reading.

Connect a frequency counter to testpoint [4].

Read the frequency, approx. 438 MHz, to make certain that Q3 is working as a tripler.

Remove the frequency counter and adjust C13 for maximum voltmeter reading.

Due to interaction the adjustment of C13 and C15 should be repeated until no further increase in voltage at testpoint (5) is obtainable. The voltage at testpoint (5) with the oscillator stopped will be approx. 0.6V.

Minimum increase at testpoints (5) > 0.3V.

Adjustment of Crystal Oscillator Frequency, EX762

Connect a frequency counter to testpoint [4].

Adjust L1, EX762, for correct frequency.

Requirement:
437.975 MHz ± 200 Hz.

If the frequency cannot be pulled to the correct reading the strap in the oscillator circuit must be altered.

Refer to EX762 diagram.

The frequency should be adjusted at 25°C ambient temperature.

Due to interaction between L1 and L3, the adjustment of L3 should be checked and any readjustment requires the frequency to be readjusted.

Checking the FS701 Output Level

Connect an RF probe and voltmeter to testpoint [4], EX762. Set the channel selector to channel 30.

Stop the EX crystal oscillator and measure the RF level.

Requirement: 0.82 - 1.04 V.

Select the channels having the higher frequency and the lower frequency and measure the RF level.

If the level is low in one position, L7 in RF-amplifier II is adjusted for best symetry.

Aligment of Filters and RF Amplifier EX762

Connect an RF probe and voltmeter to testpoint [9] in EX762 (output terminal).

Stop the crystal oscillator in EX762 (short the crystal to chassis).

Course tuning

Connect an RF generator to the input of BP-filter I, and set the generator for 453.00 MHz. Adjust L9, L10, L11, L12, L15, L16, and L17 for maximum reading on the voltmeter.

Fine tuning

Remove the RF generator and start the crystal oscillator.

Select channel 30.

Adjust L9, L10, L11, L12, L15, L16, and L17 for maximum meter reading.

Due to interaction the adjustments should be repeated until no further increase in meter reading can be obtained.

As the crystal oscillator frequency is only 3.5% below the desired frequency, care must be taken not to resonate the filter circuits at the wrong frequency.

Alignment pf RF Amplifier RA761

Connect a voltmeter to testpoint (11) in RA761

Select channel 01.

Adjust L17 in EX762 for minimum meter reading. Adjust L1, L2, L3, L4, L5, and C5 in RA761 for minimum meter reading, approx. 4.5V.

Remove the RF signal lead between RA 761 and PA765.

Connect an RF Watt meter to the RA761 output.

Adjust L6, RA761 for maximum output. Adjust L1, L2, L3, L4, L5, L6, and C5 for maximum output.

Repeat the adjustment until no further increase in meter reading can be obtained.
Requirement $P_{out} > 60$ mW.

Measure the voltage at testpoint (11) in RA761.

Requirement: < 6V

These requirements should be fulfilled on all channels. The total variation in output power should be less than 1 dB within the bandwidth.

ADC Circuit adjustment, PA765

Reestablish the connection between RA761 and PA765.

Connect a wattmeter to the antenna output.

Select channel 30.

Set the supply voltage to 13.6V.

Turn the ADC potentiometer, R8, fully counterclockwise.

Key the transmitter.

Adjust the ADC potentiometer for 12W RF output, or maximum if not obtainable.

Under all circumstances the ADC circuit must be working and to ensure this back off the ADC potentiometer to decrease the output 0.2 dB.

Connect a voltmeter to testpoint (1) in PA765.

Adjust L6, RA761, for minimum voltage.

Set the supply voltage to 16.0V.

Adjust the ADC potentiometer for 12W RF output.
Check the ADC circuit to be working.

Remove shorting link NOTE 1 and adjust potentiometer R9 for 3W RF output.
Insert the shorting link again and readjust ADC potentiometer R8 for 12W RF output.
When the ADC circuit is operating properly, the following figures must be obtained:

Requirements:

Supply Voltage	Current Drain	Power output
16V	< 4.5A	> 11W (all channels)
13.6V	< 5A	> 9W (all channels)
10.5V	< 4.5A	> 5W (all channels)
16V		> 11.5W (channel 30)

The RF power deviation between channels selected at random should not be greater than 0.1 dB when measured at the same supply voltage.

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5-40 MHz.

The existence of parasitic oscillations can be determined by means of a detector followed be a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, a millivolmeter, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with W52C, check that no deflection appears on the AM indicator at any supply voltage between 10.5V and 16V.

For further details please refer to STORNO Service News No. 38 of May 1969.

Antenna Branching Filter BF763

The filter is factory aligned and should never be touched.

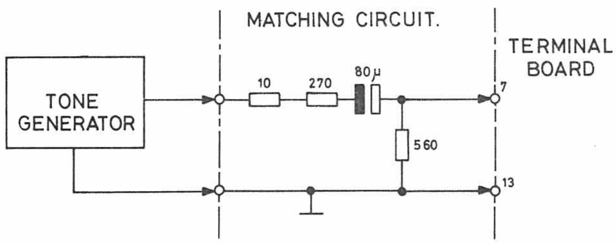
Adjustment of Modulation and Frequency Deviation

Connect the deviation meter to the transmitter output via an attenuation network (10W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM763D to 13.6V.

Connect a tonegenerator to terminal 7 and 13 (chassis) on the terminal board through a network as outlined below.



Select channel 80.

Set the generator for an audio output of 2.2V.
This value is 20 dB above the norminal modulation input level to ensure full limiting in the modulation amplifier on CF704. The 6 dB loss in the network is also taken into account, and the nominal input level will be found to be
2.2 V ~26 dB = 110 mV.
Find the audio generator frequency between 300 Hz and 3 KHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency set the maximum deviation with R18 on CF704.

Requirement: Δfmax = ± 5 KHz

If it is not possible to reduce the frequency deviation sufficiently the brown wire on terminal 23, CF704, is moved to terminal 24, and capacitor C8 (47nF) is removed. Refer to notes on diagrams.

Select channel 40.

Set the audio generator to 1000 Hz and the output to 220 mV.

Check the frequency deviation, Δf_{nom}, at 1000Hz on all channels to be 3,0 KHz.

Requirement: V_{mod} = = 220 mV ± 3dB for Δf = 3.0 KHz.

Check the distortion on the audio output of the deviation meter.

Requirement: k < 7% (without deemphasis

RECEIVER ADJUSTMENT

Alignment of 2nd IF Amplifier (455 KHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 KHz generator and the chassis.

Apply a 455 KHz signal to the input of CF704. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF704.

Adjust transformers T1 and T2 for maximum meter reading attenuating the generator output before overloading the IF amplifier, causing limiting. The readings should be kept below approx. 10 µA if an AVO-meter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L2 in CF704.

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box.

Connect an AC EVM to terminal 35 LINE OUT (AF 17 dBm) on the terminal board.

Adjust coil L2 in CF704 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R19 (AF-RX) may be turned up. This potentiometer can be reached from the rear of the module tray BA704, and turns up counter-clockwise.

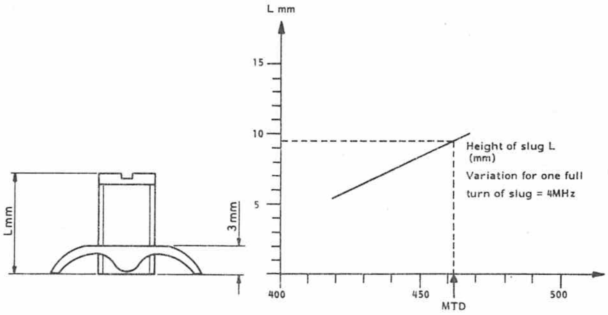
Adjustment of Oscillator Frequency in IC705

If a frequency counter is available, the frequency may be read at test point [5], IC705. If the input of the frequency counter is DC-coupled a capacitor (approx. 1 nF) should be connected in series.

The frequency will be 9.545 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Coarse Adjustment of BP762

The trimming slugs, L1, L2, L3, and L4 of the filter BP762 are set to the approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency. L5 is to remain in its position as set during the fine tuning of the filters.



Checking the RF mixer injection signal, RC764.

Connect a voltmeter to testpoint (6), RC764.

Adjust C50, RC764 for maximum voltage.

Measure the voltage increase in testpoint (6), caused by the injection signal, on all channels.

Requirement: Δ V > 0.5V.

If the requirement cannot be fulfilled at the band limits minor readjustments of L3 and /or L4, RA761 may be implemented, but this requires the RA761 to be tested again.
Also perform the test with the transmitter keyed.

Receiver adjustment for maximum gain.

Connect a DC EVM with an RF probe to testpoint [1] in CF704. An AVO-meter may be used, but the deflection will only be on the order of tens of microamperes.

Connect an unmodulated RF generator to the antenna input of the CQM763D-12.

Select channel 30.

Set the generator to the receiver frequency (463.725MHz).

Fine tuning of the generator frequency may be done be loosely coupling a 455 KHz signal to the IF input of CF704. (First connect the chassis to generator earth). Tune the RF generator for zero beat with the LS in/out depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF704, i.e. a reading of approx. 500 mV on a DC EVM with an RF probe at testpoint [1], CF704.

The following coils are tuned for maximum meter reading in this order:

C50, RC764
L 5, BP762
L 4, BP762
L 3, BP762
L 2, BP762
L 1, BP762
L 19, RC764
L 1, IC705
L 2, IC705
L 3, IC705

Due to interaction, especially between C50 in RC, and L5 in BP, the procedure should be repeated until no further increase in meter reading can be obtained.

By adjusting C50, RC764, the oscillator drive signal to the RF mixer will have decreased.

Now, when stopping the oscillator, the voltage at testpoint (6) should fall at least 0.3V.

If this requirement is not fulfilled, L3 in RA761 may be readjusted, but then the performance characteristics the RA761 should be checked.

L1, L2, and L3 in IC705 are now fine tuned for maximum reading at test point [1], CF704. The circuit in IC705 should be aligned two or three times, as they influence each other.

Adjustment and Checking the AF signal

Keep the RF generator connected as described and set its output attenuator for full limiting in the CQM763D-12, approx. 1 mV EMF from the generator.

Modulate the generator with 1 KHz to a frequency swing of ± 3.0KHz.

Connect an AF voltmeter to terminal 35 on the BA704.
Adjust potentiometer R19 in CF704 for 110mV + 1/-0dB.

Connect a 4Ω load resistor across the loudspeaker output terminals instead of the loudspeaker.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals. Set the volume control for 3. 16V on the meter.

Check the distortion.

Requirement: k < 7%

Checking Receiver Sensitivity

Modulate the RF generator with 1 KHz, to a frequency deviation of 3, 0 KHz.

Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 4Ω resistor for the speaker.

Set the volume control for 1V across the load.

Reduce the calibrated RF voltage from the RF generator until obtaining 25% distortion (12dB SINAD).

Requirement:
for 12 dB SINAD < 1. 0 μV EMF. (channels 01-80)
for 12 dB SINAD < 1. 1 μV EMF. (channels 81-99)

The procedure should be repeated on all channels.

Receiver sensitivity measurement

EIA (Electronic Industrie´s Association)
Standard, definition:
The SINAD sensitivity of a receiver is the minimum input signal that at least 50% of the receivers rated audio output power with 12 dB signal + noise +distortion to noise + distotion.

Method of measurement.

The purpose of the measurement is to define the ratio of one condition to another.

The first condition is the one where a modulated RF-signal drives the receiver into full limiting.

The audio output is measured with the distortion meter (in the CAL position) and, disregarding the amplitude of the audio, this is adjusted to read 100 on the meter scale, this is our reference condition consisting of signal + noise + distortion, where 'signal' is the modulation of the RF, 'noise' is the lowest possible amount achieved from that particular receiver, when receiving a strong carrier, and 'distortion' is the modulation being slightly distorted in passing trough the receiver.

The second condition is the one where the signal (modulation) is removed with a notch filter and the RF-signal is lowered in amplitude until the remaining noise and distortion increases to 12 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 25%, 25 being 12 dB below 100, which was our reference condition.

(100-6dB = 50, 50-6dB = 25).

In practice our first condition is achieved by feeding a minimum of 1000μ V of RF-signal modulated with 1000 Hz at 0. 7 x Δ f max. to the receiver. The audio output (which must be at least 50% of the receivers audio rating) is measured with the distortion meter in position CAL and adjusted with potentiometer ADJ. FSD. to a reading of 100.

The notch filter is then inserted in series with the audio be pressing one of the buttons marked in %. The meter needle immediately drops to indicate a low value, this being the receiver's inherent audio distortion.

By backing off the attenuator of the RF generator, thereby lowering the RF input to the receiver, the noise will eventually increase, as the attenuator is being adjusted for a reading on the distortion meter scale of 25%.

At this stage it must be ensured that the increased noise and the signal (with the notch filter switched out while checking) still equals 100 on the meter scale.

The RF generator's calibrated attenuator now shows the value of RF signal required to achieve a 12 dB ratio between signal+noise+distortion and noise+distortion, i. e. 12 dB SINAD sensitivity.

Adjustment and Check of Squelch

Release the squelch button.
Adjust the squelch by means of potentiometer R46 in CF704 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch closes and blocks the audio output within short time, i. e. less than 50 ms (milliseconds). Check that the audio path reopens when the squelch button is depressed.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage.

CQM763D-12 with tone equipment, TT781 SR781 and channel indicator ID701.

Requirement: $I < 1A$. (typical 0.75A).

CQM763a
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS152A and RS204. Storno reserves the right to change the listed specifications withour notice. Figures given in brackets are guaranteed values.

Frequency Range

420 - 470 MHz

Min. Channel Separation

20 kHz or 25 kHz

Max. Frequency Deviation

± 4 kHz or ± 5 kHz

Frequency Stability

Meets government specifications

Max. UHF Bandwidth

1 MHz

Number of Channels

Max. 6

Antenna Impedance

50 Ω

Temperature Range

Operating Range: -25°C to +50°C
Functioning range: -30°C to +60°C

Dimensions

Locally controlled version: 180 x 190 x 68 mm
Extended local control: 180 x 160 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight

Locally controlled version: 2.1 Kg
Extended local control: 1.9 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output

12W or 6W

Type of Modulation

Phase

AF Response

6 dB/octave preemphasis 300 - 3000 Hz
+0/-1.5 dB (+0.5/-3 dB)
Modulation Distortion (measured with deemphasis)
2% (7%)

Modulation Sensitivity

110 mV e.m.f ± 3 dB

AF Input Impedance

560 Ω

Adjacent Channel Selectivity

Attenuated to meet govern specifications

FM Hum and Noise (measured without deemphasis)
-45 dB (-38 dB)

Spurious Radiation FTZ

Less than 0,2 μW

Harmonic Radiation

Less than 2 μW

RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD

0.6 µV (0.8 µV)

Squelch

Electronic, adjustable

Adjacent Channel Selectivity EIA

80 dB (77 dB)

Adjacent Channel Selectivity FTZ

77 dB (75 dB)

Intermodulation Attenuation EIA

75 dB (73 dB)

Intermodulation Attenuation FTZ

72 dB (70 dB)

Blocking MPT

190 mV (100 mV)

Spurious Radiation FTZ

0.4 nW (2 nW)

Spurious Response Attenuation

90 dB (80 dB)

AF Output Power

4 W (load 4 Ω) EIA
2 W (load 4 Ω) CEPT

AF Response

-6 dB/octave 300 - 300 Hz
+0/-1.5 dB (+0.5/-3 dB)

AF Distortion

3% (7%)

Hum and Noise, squelched

70 dB (60 dB)

Hum and Noise, unsquelched

45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

Current Consumption at 13.6 V

Stand by: 180 mA (250 mA)
Transmit 12 W: 3.5 A (4.0 A)
Transmit 6 W: 2.8 A (3.3 A)
Receive, AF output 2 W: 500 mA (600 mA)

CQM763a
GENERAL DESCRIPTION

Introduction

The Stornophone CQM763a radiotelephone is a mobile transmitter/receiver for simplex operated FM radio communication on the 420 to 470 MHz frequency band, 25 or 20 kHz channel spacing and 12 W RF output power.

There are also two mechanically different systems available, local control and extended local control. Local control applies to the dashboard-mounted model with built-in loudspeaker, which is operated by controls on the front panel of the radio cabinet. Extended local control applies to the model which is operated from a dash-mounted control unit connecting to the radiotelephone proper via a cable and multiconnector. The radio chassis is then placed elsewhere in the vehicle. A separate loudspeaker must also be installed with the latter model.

Each radio set can be equipped for either single or multichannel service. Multichannel sets will have a channel selector arranged as a row of push buttons on the control panel, accomodating up to 6 channels. Choice of channels (frequencies) must naturally take into account the RF bandwidth of the radiotelephone, which is 1 MHz.

Construction

The radio chassis slides into the cabinet from the front and is held in place by screws from the rear of the cabinet. The chassis consists of two circuit panels hinged onto the front control panel. When separated, the two chassis halves open out like a book.

The upper circuit panel, designated RF764 contains all the circuits which are dependent upon channel frequencies. These are:

antenna filters
receiver VHF circuits
exciter crystal selector unit, where included
transmitter power output amplifier.

The lower circuit panel, designated BA703, contains those units common to all the frequency bands within the CQM700 programme:

audio amplifier
intermediate frequency amplifier
squelch circuit
voltage regulators
tone equipment, where included

The solid-state circuitry is built up as functional module units for ease in servicing.

A type plate located on the radio cabinet states the type designation of the radiotelephone, showing the service for which it is intended.

Reading the type plate:

CQM76Xa XX XX

Channel Separation
(1) 50 kHz
3 25 or 20 kHz

Type of Front Plate employed
C1 CP701 (1 channel)
C2 CP703 (max. 6 channels)
C3 CP703 (Dummy)

Type of Crystal Shift Unit employed
X1 None (1channel)
X4 XS702 (max. 4 channels)
X6 XS701 (max. 6 channels)

Control Equipment

The locally controlled CQM763a will have one of the following front panels:

CP701 Front panel with controls and built-in speaker. This panel has no channel selector, limiting the equipment to single-channel service.

CP702 Front panel like CP701 with the addition of 6 push buttons for multichannel service.

The CQM763a for extended local control will have a blank front panel with neither controls nor loudspeaker and is designated CP703. One of the following types of control units, intended for dashboard-mounting, must also be installed for extended local control:

CB701 Control unit housed in a cast plastic cabinet and containing operating controls for the radiotelephone. This control unit has no channel selector (single channel-service).

CB702 Control unit similar to CB701, and containing 6 push buttons for the channel selector (multichannel service).

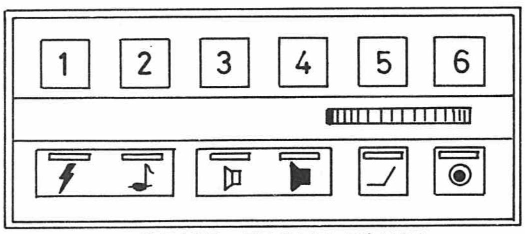
Where more than one RF channel is required (multichannel operation), the radiotelephone must be fitted with one of the following crystal switching units:

XS701 Channel selector unit for a maximum of 6 channels.

XS702 Channel selector unit for a maximum of 4 channels with temperature compensation for operation in extremely cold climates.

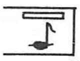
Operating Controls

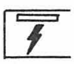
The controls located on the front panel are as shown:



CP/CB FRONT PANEL

1 2 Push buttons for channel selection.

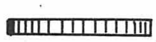

Tone button and lamp indication when the channel is engaged (in equipment with built-in tone transmitters).


Transmit button and transmit indicator lamp (in radiotelephones without built-in tone transmitters).


Button for switching the loudspeaker on and off, provided with a lamp indicating when a tone call is received. (The button is only used in conjunction with tone equipment).


Squelch button for overriding the squelch function.


On/off switch and indicator lamp.


Volume control.

Notice: For radiotelephones with built-in tone transmitters an external keying device (e.g. a steering column switch or microphone button) must be employed as the transmitter key, since the regular button on the front panel is used for keying the tone transmitter.

Accessories

Accessories available for the CQM763a radiotelephone are listed in this section. Some of them, such as installation materials, antenna, and microphone, are necessary in order to install and to operate the equipment.

Microphones

MC701 Fixed microphone with built-in amplifier.

MC702 Fixed microphone with built-in amplifier, transmit button and retainer.

MC703 Fixed microphone for mounting on steering column.

MT701 Handset with built-in amplifier and transmitter keying switch.

All of the above are supplied with cables for termination in a special multiconnector providing connections between accessories and the radio cabinet.

MK704 To bring the microphone into close talk position this mounting kit, consisting of 2 flexible metal tubes (length 20 and 35 cm), is available.

Storno

Antenna

AN69-1 1/4 wavelength whip antenna for the 420 to 470 MHz frequency band. 50 Ω impedance matches Stornophone CQM760. Base design permits mounting from the outside without damaging the car upholstery.

Installation Kits

The installation of a CQM763a radio set will require some or all of the following installation kits:

MN701 Mounting frame for radio cabinet

CC701 Cable kit containing battery cable and antenna cable necessary for installing the radiotelephone.

MK701 Mounting kit containing connectors for connecting battery, antenna and accessories to the radio cabinet plus fuse box and fuses for installation in series with the battery cables.

For extended local control the distance between control unit and radio set may be increased by inserting:

CC703 Extension cable kit with connectors.

Loudspeakers

When using the extended local control system it is necessary to install an external loudspeaker. The following types are available:

LS701 Loudspeaker enclosed in a plastic housing, complete with cable for termination in the accessories connector.

LS702 Weatherproof version of loudspeaker.

External Switches, Relays, etc.

SU701 Transmitter keying device for mounting on steering column.

SU702 Transmitter keying device for dashboard mounting.

SU704 Auto relay for equipment with built-in tone receivers, connects to external alarm devices such as auto horn, etc.

Power Supplies

PS701 Power supply for 24 volt car battery, any battery polarity.

PS702 Power supply for 24 volt car battery, negative pole to chassis.

Circuit Description

General

The nominal 12 V supply from the battery is applied to the connector designated "BATT". A relay in series with a diode across the battery input protects the radiotelephone against incorrect supply polarity.

The battery voltage is applied to two separate 9 V regulators which supply the transmitter and receiver sections, to the receiver audio output amplifier and to the tone equipment, if fitted.

The incoming signal passes through the antenna unit to the input of the receiver. The antenna switching is controlled by the stabilized supplies from the transmitter and receiver voltage regulators.

In the single channel edition of CQM763a a crystal controlled oscillator is incorporated in the transmitter section. Similarly, a single oscillator is provided in the receiver section.

Channel switching unit XS700 is fitted in the multichannel edition of CQM700 and is controlled by the channel selector.

The audio output from the receiver is applied to the loudspeaker (LS). The output level is adjusted by means of the volume control.

The squelch button is provided to override the squelch function of the receiver.

As may be seen from the simplified functional diagram, the receiver output signal may be connected to the tone receiver TR700 used in selective tone calling systems. The tone receiver enables the AF output circuits of the receiver to be switched on and off.

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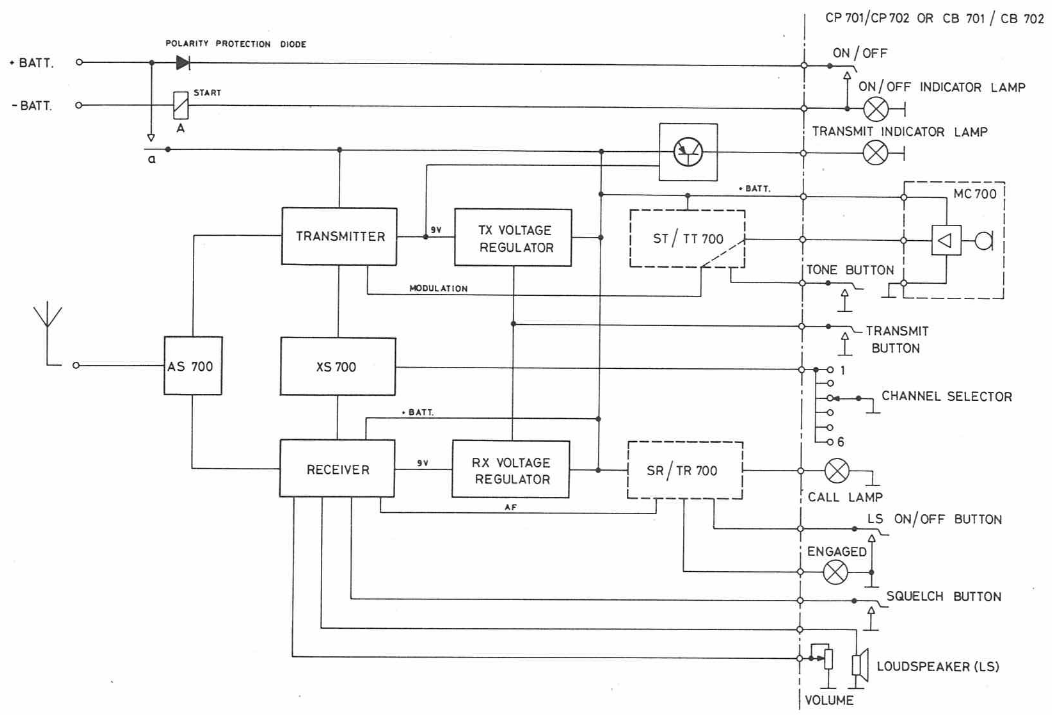
FUNCTIONAL DIAGRAM CQM 700



In systems using selective calling, the loudspeaker will normally be switched off using the LS ON/OFF button.

When a tone call, correct for the tone receiver setting, is received, the loudspeaker will be switched on automatically. The tone receiver also controls the "call" and "engaged" lamps indicating that a call has been received or that the radio channel is occupied. These lamps are not used in radiotelephones not fitted with tone receivers.

The modulating signal to the transmitter is derived from the microphone (MC) via the tone generator TT700, if fitted.

During transmission of tone call, the microphone will be switched off automatically so that the transmitter is modulated by the tone signal from TT700 only.

The transmitter is keyed by depressing the transmit button. This will block the receiver voltage regulator and cancel the blocking of the transmitter voltage regulator. When the transmitter voltage regulator operates, supply voltage is applied to the exciter. The transmitter power amplifier is continuously supplied from the battery.

The "transmitter on" condition is indicated by the transmit indicator lamp.

In the radiotelephone fitted with a tone receiver the transmitter cannot be operated until the loudspeaker has been switched on manually by means of the loudspeaker ON/OFF button.

Receiver

The CQM763a receiver is a double conversion superheterodyne using intermediate frequencies of 10.7 MHz and 455 kHz. The high RF selectivity characteristic of the receiver is provided by a five element helix filter having a low insertion loss.

Adjacent channel selectivity is obtained by using two bandpass filters: a 10.7 MHz crystal filter and a 455 kHz ceramic filter.

A maximum of 6 crystal controlled oscillators, one for each channel, can be provided. The oscillators are connected in parallel and channel selection is performed by grounding the negative supply lead of the appropriate oscillator.

The receiver comprises the following subunits:

Antenna switching unit	AS763
Preselector filter	BP761

Receiver converter with RF amplifier 1st mixer and 1st local oscillator	RC763
Intermediate frequency converter with 10.7 MHz crystal filter, 2nd mixer, 2nd local oscillator and 455 kHz ceramic filter for 25 and 20 kHz channel spacing	IC703
455 kHz amplifier, squelch circuit, AF amplifier and voltage regulator (for other circuits of CF703 see page 7).	CF703
Channel switching unit: maximum 6 channels	XS701
maximum 4 channels, temperature compensated	XS702

Signal Path

From the antenna switching unit the input signal is passed through the preselector filter and an RF amplifier to the mixer stage. Because of the low insertion loss in the filter, it has been possible to obtain excellent receiver sensitivity with one RF amplifier stage. This approach has resulted in superior blocking, selectivity, and intermodulation characteristics of the receiver.

The BP761 filter consists of five tuned circuits which can be adjusted over the band 420 - 470 MHz. The coupling between the filter and the mixer stage is provided by an impedance matching network loaded to a low Q. This network transforms the output impedance of the filter to the impedance required by the amplifier transistor of the RC763.

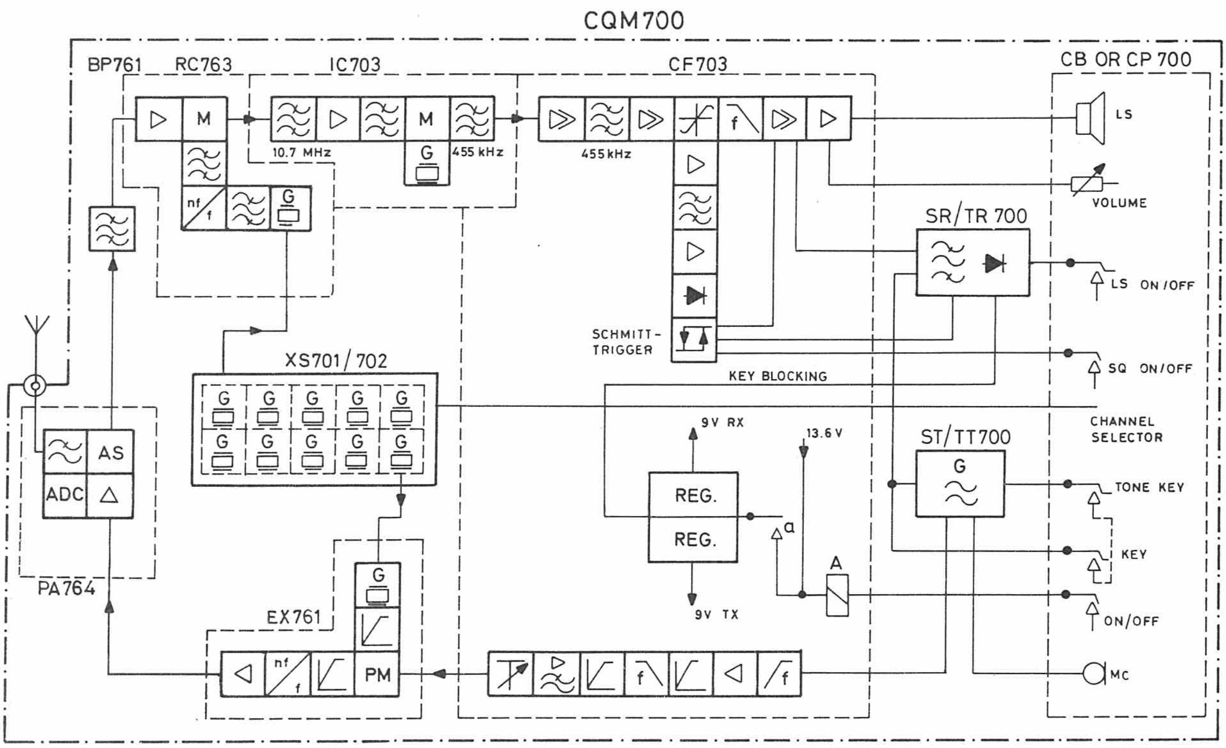
The local oscillator and the received signals are applied to the gate of the FET (field-effect transistor). The mixer output at 10.7 MHz is taken from the drain circuit.

First Local Oscillator

The local oscillator signal is generated in an oscillator operating on the fundamental frequency of the crystal. The oscillator operates within the frequency range 11.35 MHz to 12.75 MHz, depending on the crystal frequency used.

In the oscillator, the 3rd harmonic of the crystal frequency is selected and applied to a multiplier chain consisting of a tripler and two doubler stages. The output frequency is thus 36 times the fundamental of the oscillator.

The last doubler stage is followed by a filter consisting of two capacitively coupled tuned circuits. The filter attenuates undesired frequencies gene-



rated by the multiplier chain and prevents these from reaching the mixer stage.

The injection signal is 10.7 MHz below the received signal is calculated as follows:

$$fx = \frac{f_a - 10.7}{36} \text{ MHz}$$

where fx is the crystal frequency, MHz and f_a is the received signal, MHz.

The receiver converter RC763 includes an oscillator intended for use in single-channel receivers. When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

XS701 contains oscillators for five RF channels thus allowing the receiver to be equipped with a maximum of 6 channels.

XS702 is a temperature compensating unit employed where radiotelephones are to work in very low temperatures. The compensation is provided by heating the crystals when the ambient temperature falls below -5°C approximately.

XS702 contains oscillators for a maximum of 4 channels.

Intermediate Frequency Circuits

From the mixer in RC763 the 10.7 MHz signal passes to the intermediate frequency converter type IC703 which provides the channel selectivity of the receiver.

The first IF signal passes through the 10.7 MHz crystal filter and is then amplified in a single IF amplifier stage. It is then applied to the transistor in the 2nd mixer stage and converted to the second IF signal of 455 kHz.

The injection signal to the mixer stage is generated by a crystal controlled oscillator whose frequency is normally 455 kHz below 10.7 MHz. In instances where a harmonic of the local oscillator coincides with the frequency of the received signal, a crystal oscillator frequency of 455 kHz above 10.7 MHz is chosen.

In the first case the crystal frequency is:
10.7 MHz - 0.455 MHz = 10.245 MHz.

In the second case the crystal frequency is:
10.7 MHz + 0.455 MHz = 11.155 MHz.

The crystal frequency of 11.155 MHz is used when the received frequencies are within the following bands:

420.0 - 421.5 MHz
428.9 - 431.7 MHz
439.1 - 441.9 MHz
449.4 - 452.2 MHz
459.6 - 462.4 MHz
469.8 - 474.7 MHz

The second intermediate frequency signal from the mixer stage proceeds through the 455 MHz ceramic filter in the IC703 converter and is then applied to the intermediate frequency amplifier in CF703.

The 455 kHz intermediate frequency amplifier consists of two RC coupled stages followed by a double tuned filter and a three stage integrated circuit amplifier. The last two stages provide the required limiting of the signal.

The amplified and limited signal is then demodulated in a phase detector incorporated in the integrated circuit.

The balanced quadrature (or product) detector also provides efficient rejection of any amplitude modulated signals that may be present.

The detector has only one tuned circuit and is simple to adjust.

AF Circuits

The demodulated signal is fed through a deemphasis network to a potentiometer, preset to suit the AF signal level obtained from the detector. This level depends on the maximum frequency deviation in use as determined by the channel spacing of the receiver.

The signal is then applied to an integrated amplifier in which a transistor, operating as an electronic on/off switch, has been placed between the two stages. This switch is controlled by the squelch circuit. The amplifier has a nominal output level of -17 dB (110 mV).

The signal is passed to the integrated loudspeaker amplifier and to the tone receiver, if fitted.

The loudspeaker amplifier amplifies the AF input signal of 110 mV to an output level of 4W (dependant on battery voltage) into a 4 Ω load. The amplifier attenuates frequencies below 250 Hz.

Manual gain adjustment, and thus the loudspeaker output level, is effected by the volume control on the control panel of the radiotelephone. Electrically, the volume control is connected between the preamplifier and AF output amplifier.

The AF output stage consists of an integrated AF power module.

Temperature compensation and negative feedback are employed in the output amplifier to improve stabilization.

By applying a positive voltage to "muting terminal" on the preamplifier it is possible to mute the AF output to the loudspeaker. This muting occurs during periods of transmission and when controlled by tone equipment, if fitted.

Squelch Circuit

The squelch circuit in CQM763a is operated by noise components contained in the demodulated signal.

The AF signal from the descriminator is passed to a frequency selective amplifier with a resonant circuit as the collector load.

The noise signal is passed through an amplitude selective noise amplifier, rectified and applied to a Schmitt Trigger, which controls the electronic switch in the AF circuit.

When the noise level exceeds a certain value, i.e. when the signal to noise ratio falls below a certain value, the trigger circuit is activated and the AF output signal is switched off.

The Schmitt Trigger also controls a squelch signal circuit which, in conjunction with a tone receiver, will operate the "engaged" lamp when there is traffic on the channel.

The squelch sensitivity is adjusted by a potentiometer located at the input of the noise detector.

The Schmitt Trigger can be blocked manually by means of the squelch button on the control panel of the radiotelephone, thus overriding the squelch circuit.

TRANSMITTER

(see block diagram on page 5).

The transmitter is phase modulated. Its output frequency is 36 times the oscillator frequency. Phase modulation is performed at the fundamental frequency.

The transmitter comprises the following subunits:

Exciter	EX761
RF power amplifier	PA764
Antenna switching unit	AS763
Modulation amplifier, transmitter switch and voltage regulator	CF703
Channel switching unit:	
maximum 6 channels	XS701
maximum 4 channels, temperature compensated	XS702

AF Circuits

The modulating signal from the microphone is fed, through the tone generator if fitted, to the modulation amplifier where it is differentiated, amplified, limited, integrated, and filtered. The modulation amplifier transforms the microphone output to a signal suitable for the phase modulator and limits the signal amplitude so that the maximum permissible frequency deviation is not exceeded.

The modulation amplifier is designed around an integrated circuit containing two operational amplifiers. Differentiation is performed by an RC network at the input of the first amplifier. A high degree of negative feedback ensures constant gain of the amplifier which also operates as an amplitude limiter.

The output signal is then applied through an RC network to a second limiter consisting of two dual diodes.

This limiter has been provided to prevent the phase modulator from being overdriven at low modulating frequencies. For normal frequencies and deviations the limiter will be inoperative.

Before being applied to the phase modulator, the modulating signal is filtered in a splatter filter which has been designed as an active element using the second amplifier of the integrated circuit.

A potentiometer located at the output of the modulation amplifier is used to adjust the maximum frequency deviation.

RF Circuits

The fundamental RF signal is generated in a crystal controlled oscillator contained in the exciter EX761.

When more than one channel is required the radiotelephone will be provided with a channel switching unit type XS701 or XS702.

As the receiver, channel selection is performed by grounding the negative return of the appropriate oscillator.

The exciter provides the following:

(a) phase modulation
(b) frequency multiplication
(c) drive power for the power amplifier PA764.

The RF signal from the oscillator is applied to the 1st buffer amplifier, then to the phase modulator, followed by the 2nd buffer amplifier. The buffer amplifiers provide constant input levels and correct impedance matching.

The phase modulator is a "transconductance modulator" as the phase modulation is produced by varying the transconductance of a transistor.

The modulating signal is applied to the emitter of the transistor whose operating point and transconductance thus change instantaneously with the modulating signal.

From the 2nd buffer amplifier, the signal is fed to a frequency multiplier chain consisting of the 1st tripler, 1st doubler, 2nd tripler, and 2nd doubler. The transmitter output frequency is therefore 36 times the crystal frequency.

The first three multipliers are designed as balanced circuits resulting in suppression of some of the harmonic frequencies.

The triplers suppress the even harmonics and the doublers suppress the odd harmonics.

Double tuned bandpass filters are used with close-to-critical coupling between tuned circuits. These filters limit the bandwidth of the exciter and attenuate undesired harmonics generated in the frequency multiplication process.

The output signal from the 2nd doubler is fed to an amplifier operating at the final frequency of the transmitter. Tuned input and output bandpass filters of the amplifier provide additional selectivity and thus also attenuation of undesired signal. The amplifier raises the signal to the level required by the RF power amplifier PA764. The nominal RF output power of EX761 is 50 mW into a 50 Ω load.

The bandwidth of the transmitter and thus the maximum frequency spread of the channels is determined by the selectivity of the exciter, which is 1 MHz.

RF Power Amplifier

The power amplifier contains one transistor amplifier stage and an integrated RF power module. The coupling between the stages consists of a matching network with low loaded Q value.

The RF power amplifier is a high efficiency UHF amplifier. An ADC (Automatic Drive Control) cir-

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cuit in the power amplifier unit regulates the supply voltage to the first stage and consequently the drive to the output amplifier. The purpose of the ADC circuit is to prevent overloading the power module. Additionally, the ADC circuit reduces the dependence of the output of the RF power amplifier on supply voltage and ambient temperature.

The transmitter output power is adjusted to the required safe level by means of a potentiometer provided in the ADC network.

Antenna Circuits

The signal generated by the transmitter is passed through an electronic antenna switching unit and a low-pass filter to the antenna.

The antenna switching unit consists of diodes which are forward biased during transmission and reverse biased during reception. The low-pass antenna filter is a 7-pole Chebishev filter having low insertion loss and ripple.

The filter attenuates signals at undesired frequencies to an acceptable low level, e.g. harmonics of the transmitter frequency.

The antenna filter is not adjustable.

Power Supply and Switching Circuits

CQM763a is powered directly from a 12 V car battery. The negative battery terminal connects directly to the cabinet of the radiotelephone.

A start relay connected across the battery input terminals protects the radiotelephone against damage caused by incorrect supply polarity. Incorrect battery connection will cause the relay series diode not to conduct and thus the relay refuses to operate.

The CQM763a contains two identical voltage regulator circuits which deliver 9 V stabilized supply voltages for operating the transmitter and receiver sections of the radiotelephone. The supply to the loudspeaker output amplifier and the transmitter RF power amplifier is taken from the battery and is unstabilized.

The voltage regulators are protected at the output against short circuit by limiting the maximum current to a safe value.

Each regulator has a blocking transistor controlled by the transmit key button. With the CQM763a in stand by or receive condition, the key button is in the "off" position, i.e. not depressed. The receiver voltage regulator operates normally and operation of the transmitter voltage regulator is blocked. When the key button is pressed, operation and blocking of the two voltage regulators are reversed. The supply voltage for the PA764 power amplifier in the transmitter is taken from the battery and applied directly to the amplifier.

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ADJUSTMENT PROCEDURE FOR CQM760
RECEIVER ALIGNMENT

Before switching on the CQM700 connect a power supply with the correct polarity to the battery connector.

Set the supply voltage to 13.6 V and the current limiter to 1 A.

The station may now be switched on.

Check the 9 V RX at terminal 33 on the terminal board.

Requirement:

9 V ± 0.1 V

If necessary, adjust the RX voltage by means of potentiometer R91 in CF703. This potentiometer can be reached from the rear of the module tray BA700.

Alignment of 2nd IF Amplifier (455 kHz)

To protect the IF amplifier input stages, establish a good earth connection between a 455 kHz generator and the CQM700 chassis.

Apply a 455 kHz signal to the input of CF703. The IF generator STORNO G21 is well suited.

Connect a DC voltmeter with RF probe, STORNO 95.089, to test point [1] in CF703.

Adjust transformers T1 and T2 for maximum meter reading, attenuating the generator output before overloading the circuit so limiting occurs. The readings should be kept below approx. 10 μA if an AVO-meter is used, and below approx. 500 mV if an EVM (electronic voltmeter) is used, and in any case below the point where an increase in generator output voltage results in a decreasing meter reading.

Coarse Adjustment of L1 in CF703

Disconnect the generator and disable the squelch by pushing the "Squelch out" button on the control panel/control box, or by switching the squelch off on the control unit C33/C34. Connect an AC EVM to terminal 35 LINE OUT (AF - 17 dBm) on the terminal board. On the control units C33/C34 the reading may be taken from LINE OUT (600 Ω).

Adjust coil L1 in CF703 for maximum meter reading. If two maxima are obtainable, adjust for the greater.

If no reading can be obtained, the potentiometer R19 (AF-RX) may be turned up. This potentiometer can be readhed from the top of the module tray BA700, and turns up counter-clockwise.

Adjustment of Oscillator Frequency in IC700

If a frequency counter is available, the frequency may be read at test point [5] , IC700. If the input of the frequency counter is DC-coupled, a capacitor (approx. 1 nF) should be connected in series. The frequency will either be 10.245 or 11.115 MHz. Refer to circuit description, "Intermediate Frequency Circuits".

Where no counter is at hand, proceed as follows:

Connect a 455 kHz generator to the IF input of CF703, and a 10.7 MHz generator to the input of IC700. A modified G21 may be used, i.e. the two oscillators, 455 kHz and 10.7 MHz, both in operation at the same time by pressing both buttons. The 10.7 MHz output is fixed, and the 455 kHz variable by means of the attenuator. The accuracy of the generator signal should be checked to be 10.7 MHz ± 20 Hz.

Adjust the output level of the 455 kHz generator until a beat note is produced in the speaker (LS in/out must be pressed if tone equipment is installed).

Adjust the trimmer capacitor C12 in IC700 for zero beat.

The frequency difference may also be observed on an oscilloscope connected to the "LINE OUT", 600 Ω audio output, which is accessible on the terminal board, terminal 35, and on the control units C33/C34.

NOTE:

The discriminator has no zero adjustment.

Alignment of the 1st IF amplifier (10.7 MHz).

Apply a 10.7 MHz signal to the input of IC700.

Connect a DC meter with an RF probe (95.089) to test point [1] in CF703.

Adjust coils L1, L2, and L3 in IC700 for maximum meter reading. The input level should be kept low enough to prevent limiting.

Gain of IC700: $\geq$ 20 dB.

Alignment of Multiplier Chain in RC763

When crystals have been inserted in RC763 and/ or XS701/XS702, select the middle frequency channel.

Connect a DC voltmeter to test point (1) in RC763.

Tune L8 and L9 in the RC to maximum, approx. 0.6 V.

Requirement:

$\geq$ 0.4 V

Move the voltmeter to test point (2), RC763.

Adjust L7 for maximum meter reading, approx. 0.5 V.

Requirement:

$\geq$ 0.35 V.

Connect the voltmeter to test point (3).

Adjust L6 for minimum reading (upper minimum if more than one).

The reading at test point (3) is typically 8 V.

Requirement:

$\leq$ 8.5 V.

To tune for maximum drive to the 1st mixer, connect a DC voltmeter with an RF probe to test point (3) in RC763.

Turn the tuning slug in L5, BP761, out until flush with the outer edge of the chassis.

C16, RC763, is adjusted for maximum meter reading.

C12, RC763, is adjusted for minimum meter reading.

C2, RC763, is adjusted for maximum meter reading.

If maxima and minima are not immediately apparent, the above capacitors should be adjusted very slowly through their full revolution, or until the appropriate maximum/minimum is found.

The variations in test point (3) will be small, especially in the final circuits, and the drive to the 1st mixer should be checked.

Connect the DC voltmeter to test point (4), RC763.

Adjust capacitors C16, C12, and C2 in RC763, for maximum meter reading.

Stop the oscillator (select a channel with no crystal or take a crystal out).

The voltage at test point (4), RC763, with the oscillator stopped, will be 1 to 4.5 V.

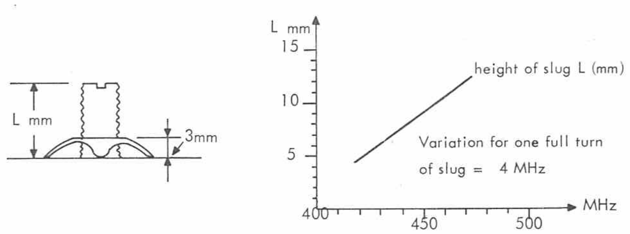
Start the oscillator.

Requirement:

Minimum increase in test point (4), RC763 = 0.4 V.

Coarse Adjustment of BP761

The trimming slugs L1, L2, L3, and L5 in BP761 are set to their approximate positions according to the graph. The graph and the picture indicate the mechanical position of the slugs as a function of the receiver antenna frequency.



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Adjustment of Temperature Regulating Circuit in XS702

The temperature regulating circuit of XS702 has been adjusted before leaving the factory. However, if necessary, it may be adjusted as follows:

Turn potentiometer R39 in XS702 fully counter-clockwise.

Remove jumper connecting the NTC resistor.

Set the supply voltage for the CQM700 to 13.6 V.

Check the current consumption of XS702 by inserting an ammeter in the orange/blue wire to XS702.

Adjust the current to 0.45 A by means of R39 (this adjustment should not exceed 30 seconds).

Insert jumper connecting the NTC resistor again and reconnect the orange/blue wire.

Further Alignment of RC761, Fine tuning of BP761, and Fine Tuning of IC700

Connect a DC EVM with an RF probe to test point [1] in CF703. An AVO-meter may be used, but the deflection will only be on the order of tens of micropamperes.

Connect an unmodulated RF generator to the antenna input of the CQM700.

Set the generator to the receiver frequency. Fine tuning of the generator frequency may be done by loosely coupling a 455 kHz signal to the IF input of CF703 (first connect CQM700 chassis to generator earth). Tune the RF generator for zero beat with the LS-IN depressed if tone equipment is installed.

The RF generator output should be kept low enough to prevent limiting in CF703, i.e. a reading on a DC EVM with an RF probe at test poin t [1], CF703, of approx. 500 mV.

The following coils are tuned for maximum meter reading:

C2, RC763	L1, BP761
L5, BP761	L2, RC763
L4, BP761	L1, IC700
L3, BP761	L2, IC700
L2, BP761	L3, IC700

The circuits in IC700 should be retuned until no further increase can be obtained.

C2, RC763, is adjusted for maximum meter reading at test point [1], CF703.

The tuning slugs of BP761, L5, L4, L3, L2, and L1 are to be adjusted until no further increase in meter reading can be obtained.

Finally the drive to the 1st mixer is checked:

Measure the voltage with a DC voltmeter at test point (4), RC763.

Stop the oscillator.

The voltage should decrease by more than 0.3 V. Where the drive is found to be too low, C12 and C16, RC763, may be retuned to a maximum meter reading at test point (4), RC763.

Minimum increase in test point (4), RC763 = 0.4V.
Maximum increase in test point (4), RC763 = 1.3V.

Should the increase exceed 1.3 V, C16, RC763, should be detuned to a reading of 1.3 V at test point (4).

Fine Tuning of L1 in CF703

Keep the RF generator connected as described, and set its output attenuator for full limiting (in the CQM700), approx. 1 mV EMF from the generator.

Modulate the generator with 1 kHz to a frequency swing of ± 3.5 kHz.

Connect an audio voltmeter to test point [2] in CF703. This test point is accessible at the upper PC-board of CF703.

Peak coil L1 in CF703, for maximum meter reading.

Requirement: $\geq$ 50 mV.

Adjustment and Checking of Audio Circuits

Modulate the RF generator with 1 kHz and set the frequency deviation to 0.7 x Δ f max.:

CQM763 (25 kHz channel spacing) ± 3.5 kHz.
CQM763 (20 kHz channel spacing) ± 2.8 kHz.

Set the RF generator output level to approx. 1 mV EMF.

If the CQM700 is provided with tone equipment, press the LS-IN/OUT button.

Check the frequency of the RF generator.

Back off the volume control on the control unit, and on the control box/control panel, if any.

Connect an audio voltmeter to terminal 35.

Adjust the audio output level to 110 mV by means of R19 in CF703.

Measure the AF voltage at the telephone output on C34/C35 or pin Z on the multiwire connector.

Requirement: 90 mV ± 17 mV.

Connect a 4 Ω load resistor across the loudspeaker terminals instead of the loudspeaker. The load is incorporated in the control units C33/C34.

Connect an audio voltmeter and a distortion meter across the loudspeaker terminals or to LS in/out on C33/C34. Set the volume control for 3.16 V on the meter.

Check the distortion.

Requirement: $k \leq 7\%$.

NOTE:

Before leaving the factory, the audio output amplifier has been adjusted for:

- a power output of 4 W (by means of potentiometer R19 on CF703) for an audio input of 110 mV from LINE OUT (-17 dBm).

Adjustment of Oscillator Frequency in RC761

The frequency is measured with a counter connected to test point (3) in RC763. The frequency should be $f_{antenna}$ -10.7 MHz.

Adjust the oscillator frequency by means of trimmer capacitor C39 in RC763.

In CQM700 with XS701/XS702, frequency adjustment must be performed on each channel with the trimmer capacitor for the appropriate oscillator.

After adjustment, the accuracy should be:

Better than $\pm 0.5 \times 10^{-6}$.

The tolerances are valid only for a crystal temperature of 25° C.

Checking Receiver Sensitivity

Modulate the RF generator with 1 kHz and a frequency deviation of 0.7 x max. Δ f. Set the generator output to 1 mV EMF.

Connect the distortion meter across the loudspeaker terminals, substituting a 4 Ω resistor for the speaker.

Set the volume control for 1 V across the load.

Reduce the RF generator output until 12 dB SINAD is obtained on the distortion meter.

Readjust L4 and L5, BP761, for best sensitivity (approx. ½ turn).

Read the calibrated RF voltage from the RF generator.

Requirement:

For 12 dB SINAD $\leq$ 0.7 µV e.m.f.

If more than one channel is provided, the procedure should be repeated on all channels.

Adjustment and Check of Squelch

Adjust the squelch by means of potentiometer R46 in CF703 to open the audio signal path for an antenna signal of 10 to 12 dB SINAD across the speaker terminals.

Remove the antenna signal and check that the squelch will close and block the audio output.

Check that the audio path reopens when the squelch button is activated.

Checking Overall Current Consumption

Check the current drain at 13.6 V supply voltage

Requirement:

CQM763 without tone equipment, in stand by, single channel $\leq$ 250 mA. (typically 200 mA)

CQM763 without tone equipment, in stand by, multichannel $\leq$ 330 mA. (typically 250 mA)

TRANSMITTER ADJUSTMENT

Set the supply voltage to 13.6 V, and the current limiter to 4 A.

If tone equipment is installed, the LS-IN/OUT button must be pressed to establish a DC path for the transmitter keying function.

With the transmitter output loaded (antenna or dummy load connected), key the transmitter, and check 9 V TX at terminal 19 on the terminal board.

NOTE:

If 9 V RX was not present or was set too low before keying the transmitter, the 9 V TX series regulator will not start.

Requirement:

9 V TX = 9 V ± 0.1 V.

If necessary, adjust the TX voltage by means of potentiometer R98 on CF703. This potentiometer can be reached from the rear of module tray BA700.

Alignment of Exciter EX761

Remove the RF signal lead between EX761 and PA764.

Connect a 47 Ω resistor across the output of EX761 (this load may also be soldered across the input of an RF probe, STORNO 95.059, and the probe connected across the output of EX761 for the duration of the alignment of the exciter).

When crystals have been inserted in EX761 and/or XS701/XS702, select the middle frequency channel, and key the transmitter.

Connect a DC voltmeter to test point (1) in EX761.

Adjust L3 and L4 for maximum meter reading, approx. 1.6 V.

Move the voltmeter to testpoint (2).

Adjust L5 and L6 for maximum, approx. 1.3 V.

Connect the voltmeter to test point (3).

Adjust C40 and C41 for maximum, approx. 1.2 V.

Set C47 to maximum capacity, and adjust C46 for maximum meter reading at test point (3).

Adjust C47 for maximum meter reading.

Connect a DC voltmeter with an RF probe, STORNO 95.059 across the RF output terminals of EX761.

Adjust capacitors C50, C52, C46, and C47 for maximum RF output from EX761.

Detune C46 slightly, and retune C47. If an increase in RF output is obtained, repeat the procedure until maximum RF output is reached.

Readjust L3, L4, L5, L6, C40, C41, C50, C52, C46, and C47 until maximum RF output is obtained.

Requirement: $P_{out} \geq 50$ mW.

(Measured with a DC voltmeter and RF probe 95.059, the voltage should read more than 3.5 V).

Checking RF Power Amplifier (PA764)

Reestablish the connection between EX761 and PA764.

Turn the ADC potentiometer, R8 in PA764 down (counter clockwise).

Set the supply voltage to 16 V.

Key the transmitter.

Turn the ADC potentiometer, R8 in PA764 up clockwise, until 12 W RF output is obtained.

Remove the shorting link designated NOTE 1 and adjust potentiometer R9 to 3 W RF output power. Insert the shorting link and readjust R8 to 12 W RF output power.

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Automatic Drive Control (ADC) Circuit

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

Supply Voltage	Current Drain	Power Output
10.5 V	≤ 3.7 A (3.8 A)	≥ 6.0 W
13.6 V	≤ 3.7 A (3.8 A)	≥ 10 W
16.0 V	≤ 3.7 A (3.8 A)	≥ 12 W

These figures for total current drain apply to stations without tone equipment. The values in brackets apply to stations with more than one channel.

Where more than one channel is in use, the output power must be checked on all channels.

Adjusting the Power Amplifier for 6 W, PA764

The connection between EX761 and PA764 is re-established.

Turn the ADC potentiometer, R8 in PA764 down (counter clockwise).

Connect a Wattmeter to the antenna output.

Remove the shorting link designated NOTE 2.

Set the supply voltage to 16 V.

Key the transmitter.

Adjust the ADC potentiometer, R8 in PA764 to 6 W output power.

Remove the shorting link NOTE 1 and adjust potentiometer R9 for 3 W output power.

Insert shorting link NOTE 1 and readjust R8 to 6 W output power.

Automatic Drive Control (ADC) Circuit

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

Supply Voltage	Current Drain	Power Output
16 V	≤ 3.0 A (3.1 A)	6.0 W
13.6 V	≤ 3.0 A (3.1 A)	6.0 W
10.5 V	≤ 3.2 A (3.3 A)	5.0 W

These figures for total current drain apply to stations without tone equipment. The values in brackets apply to stations with more than one channel.

Where more than one channel is in use, the output power must be checked on all channels.

Use of Control Unit C33/C34 When Adjusting Modulation

The control units C33/C34 may be used for stations with or without tone equipment and a voltage divider and a DC blocking capacitor is incorporated.

Where a tone transmitter is installed, the modulation signal must pass through the switching transistor (the AF gate) in the tone transmitter. The emitter resistor for this transistor is situated in the microphone amplifier, which is disconnected when adjusting the modulation. An alternate DC path must therefore be provided for the switching transistor in the tone transmitter to allow it to pass the modulation to the modulation amplifier of the CQM700. The DC supply voltage for the microphone amplifier in MC700 is also obtained through the switching transistor. The DC voltage should be isolated from the audio generator output.

A resistor, R3, in fig. 2, has been installed to provide the DC path for the switching transistor. This resistor would, as far as AC is concerned, seem to be in parallel with R2 in CF703. To the audio generator the two would present an impedance of 280 Ω, which is only half the required value. Another resistor, consisting of R1 and R2 in C33/C34, places 280 Ω in series with the input signal, adding the input impedance up to 560 Ω. At the same time, a capacitor in series with the signal effectively blocks the DC voltage from CF703, which is normally fed to the microphone amplifier in MC700 through terminal 7 of the terminal board.

Storno

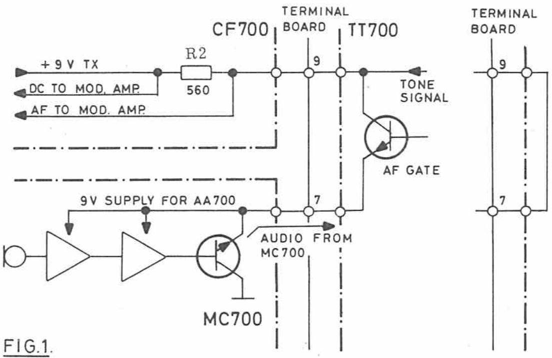


FIG.1.

MODULATION PATH FROM MC700 TO CF700, AND 9V SUPPLY FROM CF700 TO MC700.

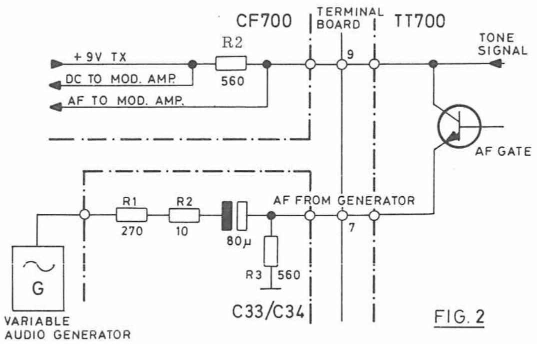


FIG. 2

MODULATION THROUGH USE OF CONTROL UNIT C33/C34

The resistors combine as a voltage divider when seen from the input to the control unit marked "modulation, AF gen.". This voltage divider attenuates the audio generator output by 6 dB in passing through C33/C34 to the modulation amplifier on CF703. The generator output must therefore be set 6 dB above the required input to the modulation amplifier. The adjustment procedure takes this into account.

Adjustment of Modulation and Frequency Deviation

NOTE:

Where an ST7845 is installed, straps must be substituted during the following procedure.

Connect the deviation meter to the transmitter output via an attenuating network (12 W capacity).

Connect a distortion meter and an audio voltmeter to the audio output of the deviation meter.

Set the power supply voltage to the CQM700 to 13.6 V.

Connect an audio generator to the modulation input of control unit C33 or C34.

Set the generator for an audio output of 2.2 V. This value is 20 dB above the nominal modulation input level to ensure full limiting in the modulation amplifier on CF703. The 6 dB loss in C33/C34 is also taken into account, and the nominal input level will be found to be

2.2 V - 26 dB = 110 mV.

Find the audio generator frequency between 300 Hz and 3 kHz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed. At that audio frequency, set the maximum deviation with R18 on CF703.

CQM763 (25 kHz) Δ f max. = ± 5 kHz.
CQM763 (20 kHz) Δ f max. = ± 4 kHz.

Set the audio generator to 1000 Hz, and attenuate the output until a frequency deviation of 0.7 Δ f max. is read on the deviation meter.

CQM763 (25 kHz) 0.7 x Δ f max. = ± 3.5 kHz.
CQM763 (20 kHz) 0.7 x Δ f max. = ± 2.8 kHz.

Requirement: V_{mod} = 220 mV ± 2.5 dB
(165 mV - 293 mV) input to C33/C34

Check the distortion on the audio output of the deviation meter.

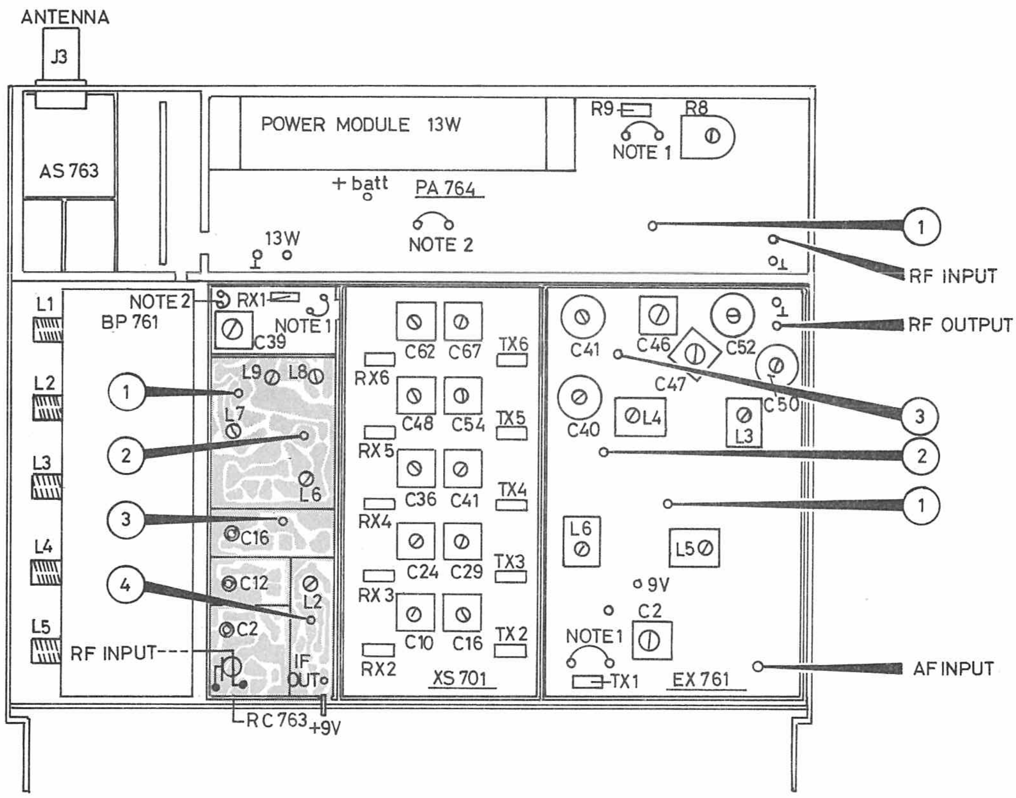
Requirement: k $\leq$ 10% (without deemphasis).

Checking the Transmitter Stability

Transmitter instability appears as AM modulation of the transmitted carrier by a modulating frequency which may vary between 0.5 - 40 MHz.

The existence of parasitic oscillations can be determined by means of a detector followed by a filter, which removes the carrier, and an indicator, e.g. an oscilloscope, or simply a multimeter with a diode detector. When using the latter, an amplifier is required, e.g. STORNO amplifier detector type TS-F42A.

While varying the phase angle with TS-K61, check that no deflection appears on the AM indicator at any supply voltage between 10.5 V and 16 V.

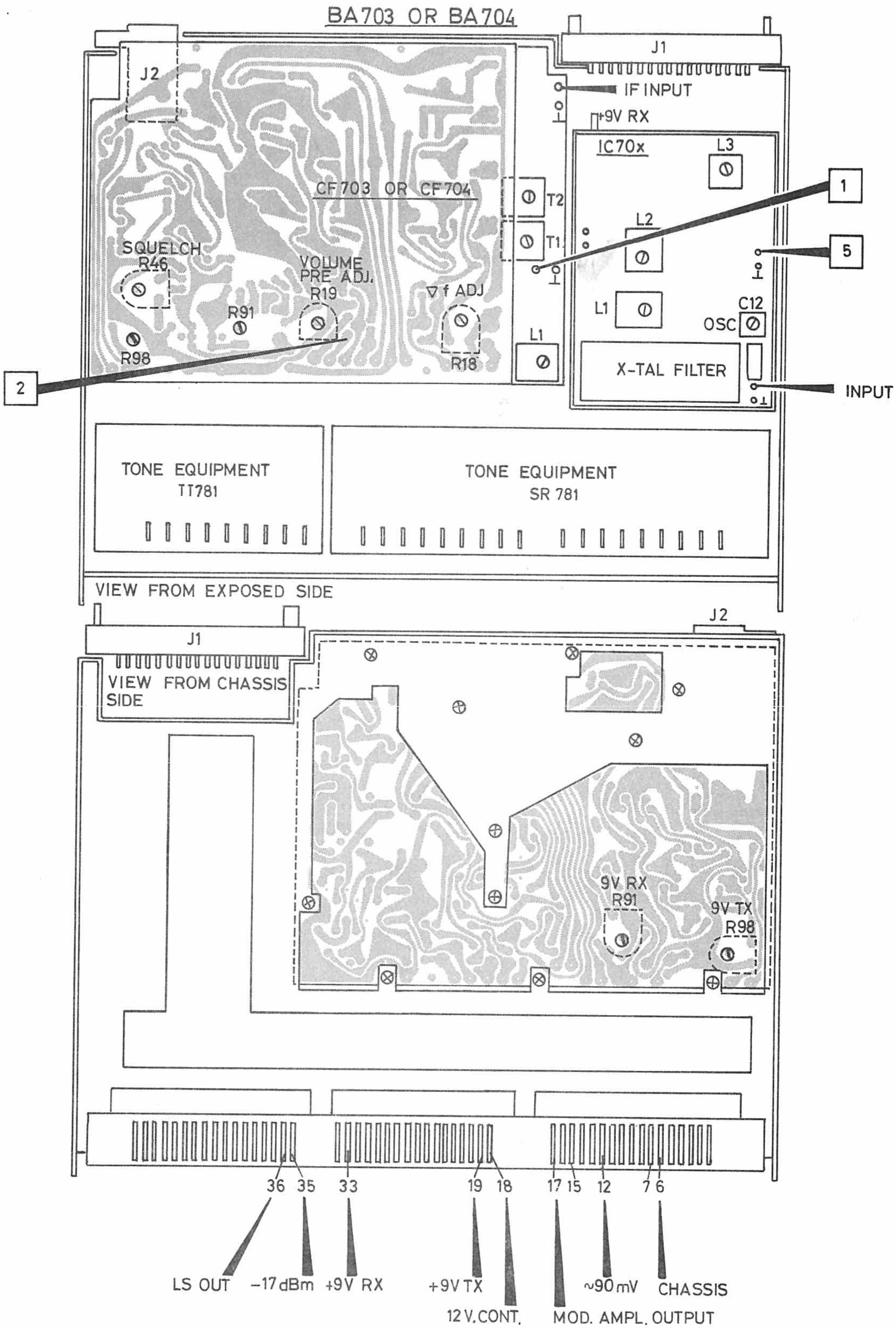


RADIO ASSEMBLY RF764 (CQM763a)

Location of Test Points and Adjustable Components

D402.389

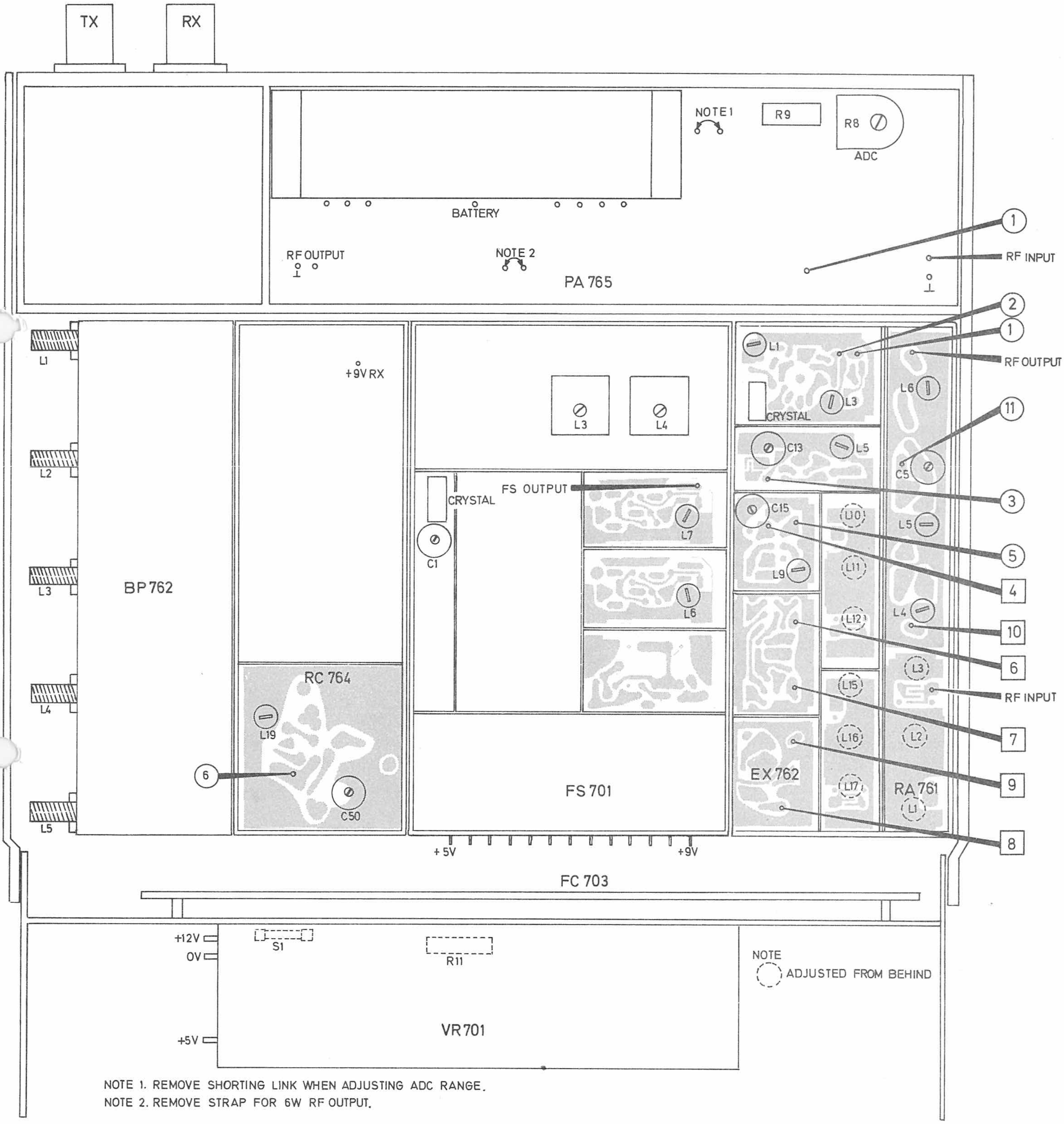
Storno



BASIC ASSEMBLY BA703 AND BA704

Location of Test Points and Adjustable Components

Storno



NOTE 1. REMOVE SHORTING LINK WHEN ADJUSTING ADC RANGE.
NOTE 2. REMOVE STRAP FOR 6W RF OUTPUT.

RADIO ASSEMBLY RF765 (CQM763D-12)

Location of Test Points and Adjustable Components

D402.562

STORNOPHONE700
MAINTENANCE MANUAL
VOLUME 1
Section 6

TITLE		Code
CQM710-25	General Specification 1 - 2	60.221-E1
	Adjustment Procedure 1 - 3	60.233-E1

Storno

CQM710-25
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS1 52A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range

146 - 174 MHz

Min. Channel Separation

CQM713-25: 20 kHz or 25 kHz

CQM714-25: 12, 5 kHz

Max. Frequency Deviation

CQM713-25: ± 4 kHz or ± 5 kHz

CQM714-25: ± 2, 5 kHz

Frequency Stability

Meets government specifications

Max. VHF Bandwidth

1 MHz

Number of Channels

Max. 6

Antenna Impedance

50 Ω

Temperature Range

Operating range: -25^{o} - $+50^{o}C$

Functioning range: -30^{o} - $+60^{o}C$

Dimensions

Locally controlled version: 180 x 260 x 68 mm

Extended local control: 180 x 225 x 68 mm

Control unit CB700: 118 x 65 x 55 mm

Weight

Locally controlled version: 2.8 Kg

Extended local control: 2.6 Kg

Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output

25W

Type of Modulation

Phase

AF Response

6 dB/octave preemphasis

CQM713-25: 300-3000 Hz +0/-1, 5 dB (+0.5/-3 dB)

CQM714-25: 300-2500 Hz +0/-1.5 dB (+0.5/-3 dB)

Modulation Distortion (measured with deemphasis)

3% (5%)

Modulation Sensitivity

220 mV e.m.f. (600 Ω) ± 2 dB

AF Input Impedance

560 Ω

Adjacent Channel Selectivity

Attenuated to meet government specifications

FM Hum and Noise (measured without deemphasis)

CQM713-25: 50 dB (40 dB)

CQM714-25: 45 dB (38 dB)

Spurious Radiation (FTZ)

Less than 0.2 μW

Harmonic Radiation (FTZ)

Less than 0.2 μW (2μW)

60.221-E1

Storno

RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD EIA
0.6 μV (0.9 μV)

Squelch
Electronic, adjustable

Adjacent Channel Selectivity EIA
CQM713-25: 90 dB (80 dB)
CQM714-25: 80 dB (75 dB)

Adjacent Channel Selectivity FTZ, MPT
CQM713-25: 90 dB (80 dB)
CQM714-25: 85 dB (75 dB)

Intermodulation attenuation EIA
CQM713-25: 80 dB (75 dB)
CQM714-25: 78 dB (75 dB)

Intermodulation attenuation FTZ, MTP
CQM713-25: 75 dB (70 dB)
CQM714-25: 78 dB (75 dB)

Blocking MPT
190 mV (100 mV)

Spurious Radiation
Less than 0.5 n W (2 n W)

Spurious Response Attenuation
90 dB (80 dB)

AF Output Power EIA
2W (load 5 Ω)

AF Distortion
CQM713-25: 3% (7%)
CQM714-25: 4% (7%)

AF Response
CQM713-25: -6 dB/octave from 300-3000 Hz
+0/-1.5 dB (+0.5/-3 dB)
CQM714-25: -6 dB/octave from 300-2500 Hz
+0/-1.5 dB (+0.5 dB/-3 dB)

Hum and Noise, squelched
80 dB (60 dB)

Hum and Noise, unsquelched
CQM713-25: 50 dB (45 dB)
CQM714-25: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

CURRENT CONSUMPTION AT 13.6 V

Stand by: 160 mA (190 mA)
Transmit: 4.6A (5.5A)
Receive AF output 2W: 470 mA (540 mA)

60.221-EI

Storno

ADJUSTMENT PROCEDURE FOR CQM710-25

Amendment to 60.177-E1

RECEIVER ALIGNMENT

The receiver section is aligned as described for CQM710, refer to 60.177-E1.

TRANSMITTER ALIGNMENT

The initial tests and adjustment of Exciter EX711 are performed as described in 60.177-E1, except for the power supply current limiter setting, which should be 8 A.

Adjustment of Power Amplifier (PA712)

Reestablish the connection between EX711 and PA712. Remove the shorting link between terminals 7 and 8 in the booster.
Connect a wattmeter to terminals 6 and 7 (driver output). Insert a shorting link in the temperature protection circuit between terminals 11 and 12.
Turn the ADC-potentiometer R2, PA712 up (clockwise).
Set the power supply voltage to 13.6 V.
Set all trimmer capacitors for half capacity.

NOTE: The PA712 should be aligned with its shielding lid in place, and insulated trimming tools should be used.

Install the lid and key the transmitter.

Remove shorting link designated "A" and insert a DC ammeter instead.

Adjust trimmer capacitor C7 for maximum reading on DC ammeter.

Remove shorting link designated "B" and insert the DC ammeter instead.

Adjust trimmer capacitor C11 for maximum reading on DC ammeter.

Remove shorting link designated "C" and insert the DC ammeter instead.

Adjust trimmer capacitor C16 for maximum reading on the DC ammeter.

If no current can be obtained increase the capacity of trimmer C22 and repeat the adjustment of C16.

Adjust trimmer capacitors C22 and C23 for maximum power output (repeat the adjustment a couple of times).

Adjust trimmer capacitors C14 and C16 for maximum power output (repeat the adjustment a couple of times).

Repeat the alignment of C22, C23, C14 and C16.

Adjust trimmer capacitors C10 and C11 for maximum power output.

Adjust trimmer capacitors C6 and C7 for maximum power output.

Make the final adjustments for C6, C7, C10, C11, C14, C16, C22 and C23, in that order, for maximum power output.

Set the ADC potentiometer, R2 in PA712, for 12 watts power output with 13.6 V supply voltage from the power supply. This will ensure a power output from the driver of more than 10 W if the supply voltage is increased to 16 volts taking into account that the ADC circuit will reduce the power output with increasing supply voltage.

When the driver circuit is operating properly, the following figures must be obtainable on all channels:

At 10.5 V supply voltage:
Power output 6W.
At 13.6 V supply voltage:
Power output 12W.
At 16.0 V supply voltage:
Power output 10W.

Storno

Reestablish the shorting link between terminals 7 and 8.
Connect the Wattmeter to the antenna output.
Turn potentiometer R107 half way up.
Install the lid and key the transmitter.
Adjust trimmer capacitors C102, C108, and C110 for maximum power output.
Use ADC potentiometer R2 to keep the power output at 26W.
Repeat these adjustments until no further improvements are obtained.

Since the heat sink has been removed from the power amplifier, the adjustments should be performed before the rising temperature influences the results (less than 5 min.).

AUTOMATIC DRIVE CONTROL (ADC) CIRCUIT

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

At 10.5 V supply voltage:
Current Drain: 4.9 A (5.0 A)
Power Output: 14W

At 13.6 V supply voltage:
Current Drain: 5.4 A (5.5 A)
Power Output: 25W

At 16.0 V supply voltage:
Current Drain: 5.4 A (5.5 A)
Power Output: 25W ± 5W

These values for total current drain apply to stations without tone equipment. The values in brackets apply to stations with XS701/ XS702. The relationship between supply voltage, power output, and current consumption in the individual stages of PA712 is dependent on the antenna frequency. The current in individual stages may be read by substituting an ammeter for the shorting links, A, B, and C, in the collector leads of transistors Q1, Q2, and Q3 in PA712.

Requirements:

At 10.5 V supply voltage:
Current in "C": < 1.0 A
Current in "B": < 0.35 A
Current in "A": < 80 mA
At 13.6 V supply voltage:
Current in "C": < 1.6 A
Current in "B": < 0.5 A
Current in "A": < 80 mA

At 16.0 V supply voltage:
Current in "C": < 1.6 A
Current in "B": < 0.3 A
Current in "A": < 80 mA

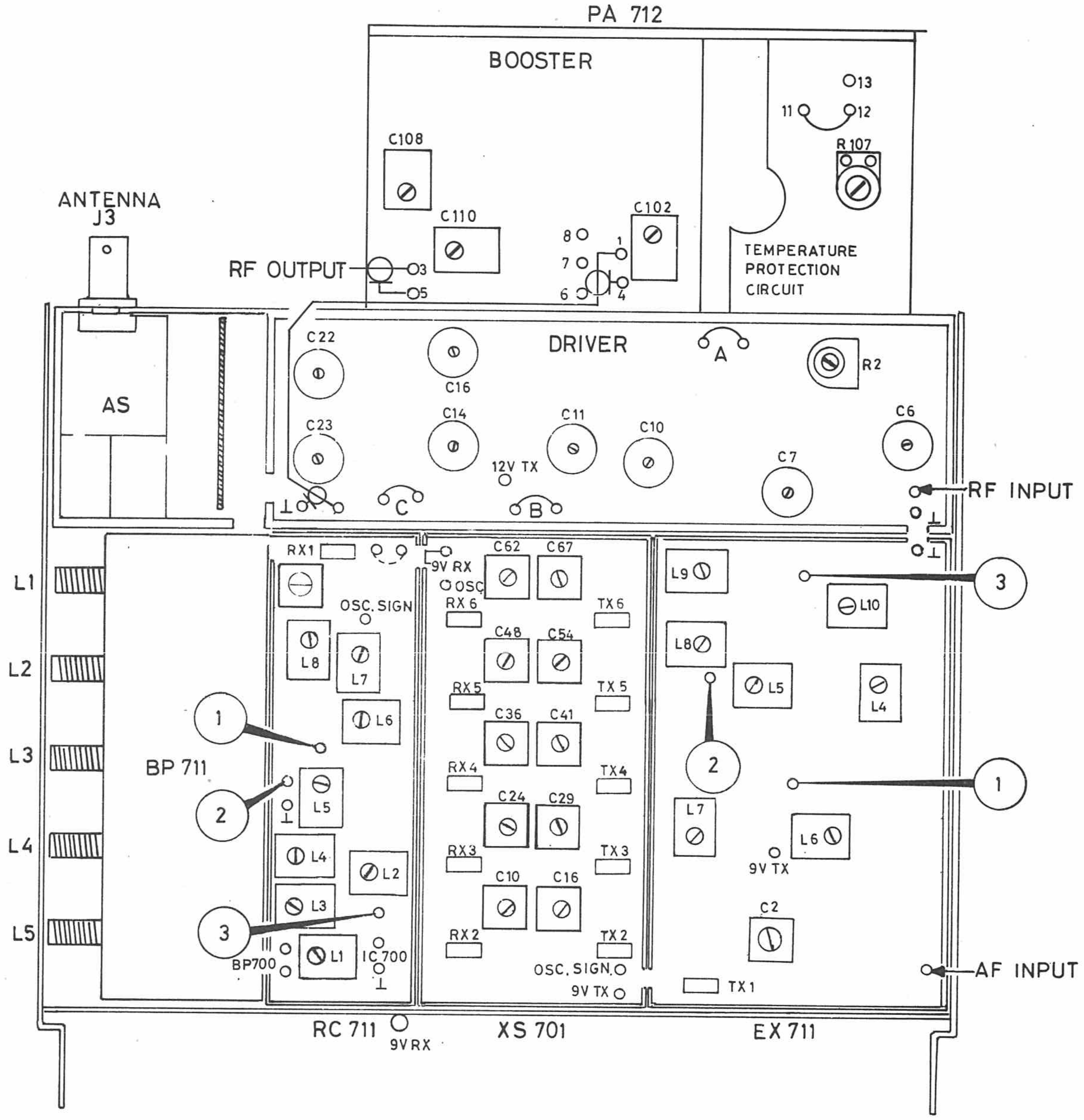
Correct values here also indicates that the ADC circuit is operating satisfactorily.

Temperature Protection Circuit Adjustment

The following adjustment should not be performed before the power amplifier chassis has cooled to room temperature.
Set the supply voltage to 13.6 V.
Key the transmitter and let the power amplifier heat for 5 minutes. (Output 25W).

Move the shorting link between terminals 11 and 12 to terminals 12 and 13.
Intall the lid.
Adjust potentiometer R107 for 8W ± 0.2W, output power.
Reestablish shorting link between terminals 11 and 12.

Adjustment of Transmitter Frequency
Adjustment of Modulation and Frequency Deviation
Refer to 60.177-E1, Adjustment procedure for CQM710.


PA 712
BOOSTER
C108
C110
C102
ANTENNA J3
RF OUTPUT
TEMPERATURE PROTECTION CIRCUIT
R 107
AS
DRIVER
C22
C16
C23
C14
C11
C10
C7
C6
R2
12V TX
RF INPUT
L1
L2
L3
L4
L5
BP 711
BP700
RX1
OSC. SIGN
9V RX
RX 6
TX 6
C62
C67
C48
C54
C36
C41
C24
C29
C10
C16
RX5
TX5
RX4
TX4
RX3
TX3
RX2
TX2
IC 700
OSC. SIGN.
9V TX
L9
L10
L8
L5
L4
L7
L6
9V TX
C2
TX1
AF INPUT
RC 711
9V RX
XS 701
EX 711

STORNOPHONE700
MAINTENANCE MANUAL
VOLUME 1
Section 7

TITLE		Code
CQM730-25	Specifications 1-2	60.222-E1
	Adjustment Procedure 1-3	60.234-E1

CQM730-25

GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS1 52A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range
68 - 88 MHz

Min. Channel Separation
CQM733-25: 20 kHz or 25 kHz
CQM734-25: 12.5 kHz

Max. Frequency Deviation
CQM733-25: ± 4 kHz or ± 5 kHz
CQM734-25: ± 2.5 kHz

Frequency Stability
Meets government specifications

Max. VHF Bandwidth
1 MHz

Number of Channels
Max. 6

Antenna Impedance
50 Ω

Temperature Range
Operating range: -25°C to +50°C
Functioning range: -30°C to +60°C

Dimensions
Locally controlled version: 180 x 260 x 68 mm
Extended local control: 180 x 225 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight
Local controlled version: 2.8 Kg
Extended local control: 2.6 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output
25W

Type of Modulation
Phase

AF Response
6 dB/octave preemphasis
CQM733-25:300 - 3000 Hz
+0/-1.5 dB (+0.5/-3 dB)
CQM734-25:300 - 2500 Hz
+0/-1.5 dB (+0.5/-3 dB)

Modulation Distortion (measured with deemphasis)
3% (5%)

Modulation Sensitivity
110 mV e.m.f. (600 Ω) ± 3 dB

AF Input Impedance
560 Ω

Adjacent Channel Selectivity
Attenuated to meet government specifications

FM Hum and Noise (measured without deemphasis)
CQM733-25: -50 dB (-40 dB)
CQM734-25: -45 dB (-38 dB)

Spurious Radiation
Less than 0.2 μW

Harmonic Radiation
Less than 0.2 μW (2 μW)

Storno

RECEIVER SPECIFICATIONS

Sensitivity emf. for 12 dB SINAD
0.6 μV (0.9 μV)

Squelch
Electronic, adjustable

Adjacent Channel Selectivity, EIA
CQM733-25: 90 dB (80 dB)
CQM734-25: 80 dB (75 dB)

Adjacent Channel Selectivity, FTZ, MPT
CQM733-25: 75 dB (70 dB)
CQM734-25: 85 dB (75 dB)

Intermodulation Attenuation, EIA
CQM733-25: 80 dB (75 dB)
CQM734-25: 78 dB (75 dB)

Intermodulation Attenuation, FTZ, MPT
CQM733-25: 75 dB (70 dB)
CQM734-25: 78 dB (75 dB)

Blocking, MPT
190 mV (100 mV)

Spurious Radiation
Less than 0.5 nW (2 nW)

Spurious Response Attenuation
90 dB (80 dB)

AF Output Power
4 W (load 4 Ω) EIA
2 W (load 4 Ω) CEPT

AF Response
CQM733-25: -6 dB/octave from 300-3000 Hz
+0/-1.5 dB (+0.5/-3 dB)
CQM734-25: -6 dB/octave from 300-2500 Hz
+0/-2 dB (+0.5/-3 dB)

AF Distortion
CQM733-25: 3% (7%)
CQM734-25: 4% (7%)

Hum and Noise, squelched
80 dB (60 dB)

Hum and Noise, unsquelched
CQM733-25: 50 dB (45 dB)
CQM734-25: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

Current Consumption at 13.6 V

Stand by: 180 mA (250 mA)
Transmit: 5.4 A (5.5 A)
Receive, AF output 2 W: 500 mA (600 mA)

60.222-E2

ADJUSTMENT PROCEDURE FOR CQM730-25

Amendment to 60.172-E1

RECEIVER ALIGNMENT

The receiver section is aligned as described for CQM730, refer to 60.172-E1.

TRANSMITTER ALIGNMENT

The initial tests and adjustment of Exciter EX731 are performed as described in 60.172 -E1, except for the power supply current Limiter setting, which should be 8A.

Adjustment of Power Amplifier PA732

Reestablish the connection between EX731 and PA732.
Remove the shorting link between terminals 7 and 8 in the booster.
Connect a Wattmeter to terminals 1 and 4 (driver output).
Insert a shorting link in the temperature protection circuit between terminals 11 and 12.
Turn the ADC-potentiometer R10, PA732 up (clockwise).
Set all trimmer capacitors for half capacity.
Set the supply voltage to 13.6 V.

NOTE: The PA732 should be aligned with its shielding lid in place, and insulated trimming tools should be used.

Install the lid and key the transmitter.

Adjust C4 for maximum power output.

Adjust C10 for maximum power output.

Adjust C18 for maximum power output.

Adjust C21 for maximum power output.

Repeat the adjustment of the trimmer capacitors until maximum power output has been obtained.

Set the ADC-potentiometer R10 for 8W ± 0.2W.

Readjust trimmer capacitors C4, C10, C18 and C21 for maximum power output.

The relationship between supply voltage, power output, and current consumption in the individual stages of PA732 is dependent on the antenna frequency. The current in individual stages may be read by substituting an ampere meter for the shorting links, A, B, and C in the collector leads of Q1, Q2, and Q3 in PA732.

Requirements:

Supply voltage	Power	I_{Q1}	I_{Q2}	I_{Q3}
10.5V	> 5W	<150mA	<210mA	< 1A
13.6V	> 7W	<110mA	<145mA	< 1.1A
16.0V	6W± 0.5W	< 95mA	<120mA	< 1A

Storno

Connect a 3 dB attenuator (50Ω, 8W) between terminals 1-4 and 6-8.
Set capacitors C101, C102, C109, and C110 for half capacity.
Connect a Wattmeter (P 25W) to antenna connector J3.
Adjust trimmer capacitors C101, C102, C109, and C110 for maximum output power.
Do not touch the ADC potentiometer during the adjustment.
Repeat these adjustments until no further improvements are obtainable.
Adjust ADC potentiometer R10 for 15W output power.
Remove the attenuator and reestablish the shorting link between terminals 1 and 6.
Adjust C109 and C110 for maximum output power.
Use the ADC potentiometer to keep the output power at 25W.
Since the heat sink has been removed from the power amplifier, the adjustments should be performed before the rising temperature influences the results (less than 2 min.).
Finally adjust the ADC potentiometer for 26W ± 0.2W.

Temperature Protection Circuit Adjustment

The following adjust should not be performed before the power amplifier chassis has cooled to room temperature.
Set the supply voltage to 13.6 V.
Key the transmitter and let the power amplifier heat for 5 minutes. (Output = 25W).

Move the shorting link between terminals 11 and 12 to terminals 12 and 13.

Install the lid.

Adjust potentiometer R107 for 8W ± 0.2W output power.

Reestablish the shorting link between terminals 11 and 12.

AUTOMATIC DRIVE CONTROL (ADC) CIRCUIT

When the ADC circuit is operating properly, the following figures must be obtainable on all channels.

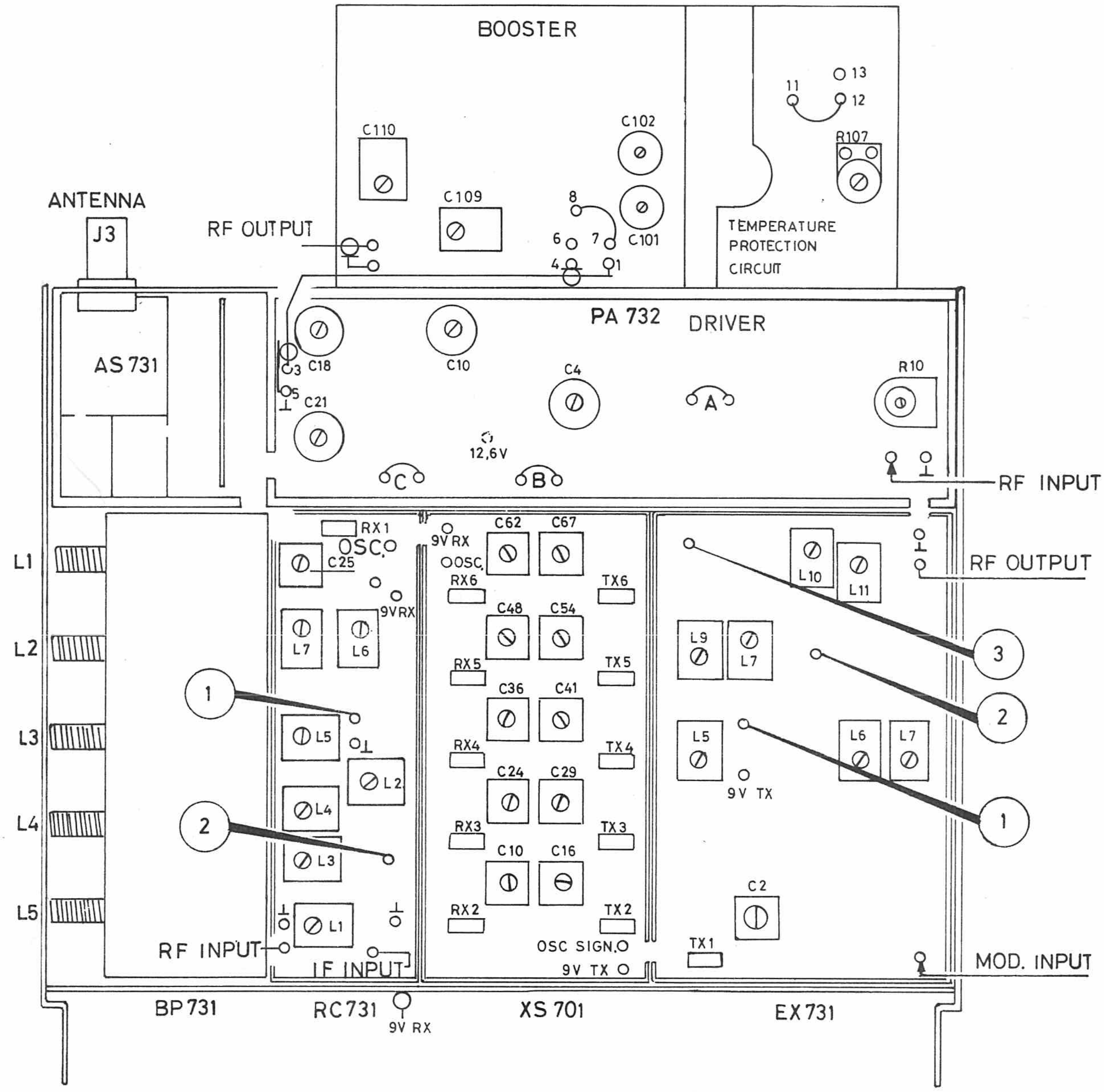
At 10.5 V supply voltage:
Current drain: 4.9A (5.0A)
Power output: 14W

At 13.6 V supply voltage:
Current drain: 5.4A (5.5A)
Power output: 25W

At 16.0 V supply voltage:
Current drain: 5.4A (5.5A)
Power output: 25W ± 5W.

These values for total current drain apply to stations without tone equipment.
The values in brackets apply to stations with XS701/XS702.

Adjustment of Transmitter Frequency
Adjustment of Modulation and Frequency Deviation
Refer to 60.172-E1, Adjustment Procedure for CQM730.


BOOSTER
C110
C109
C102
C101
8
6
7
4
1
11
13
12
R107
TEMPERATURE
PROTECTION
CIRCUIT
ANTENNA
J3
RF OUTPUT
AS 731
PA 732
DRIVER
C18
C10
C4
C21
R10
12,6V
A
B
C
RF INPUT
L1
L2
L3
L4
L5
RX1
OSC
C25
9V RX
OSC
RX6
C62
C67
TX6
L7
L6
9VRX
C48
C54
L10
L11
RF OUTPUT
RX5
TX5
C36
C41
L9
L7
1
2
3
L5
L2
RX4
TX4
C24
C29
L5
9V TX
L6
L7
L4
RX3
TX3
L3
C10
C16
C2
L1
RX2
TX2
RF INPUT
IF INPUT
OSC SIGN.
9V TX
TX1
MOD. INPUT
BP731
RC731
9V RX
XS 701
EX731

STORNOPHONE700
MAINTENANCE MANUAL
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Section 8

TITLE		Code
CQM760-15	Specifications 1-2	60.223-E1
	Adjustment Procedure 1-3	60.235-E1

CQM760-15
GENERAL SPECIFICATIONS

Unless otherwise stated, specifications are based on the measuring methods prescribed in EIA publications RS1 52A and RS204. Storno reserves the right to change the listed specifications without notice. Figures given in brackets are guaranteed values.

Frequency Range
420-470 MHz

Min. Channel Separation
CQM761-15: 50 kHz
CQM763-15: 20 kHz or 25 kHz

Max. Frequency Deviation
CQM761-15: ± 15 kHz
CQM763-15: ± 4 kHz or ± 5 kHz

Frequency Stability
Meets government specifications

Max. UHF Bandwidth
1 MHz

Number of Channels
Max. 6

Antenna Impedance
50 Ω

Temperature Range
Operating range: -25°C to +50°C
Functioning range: -30° C to +60°C

Dimensions
Locally controlled version: 180 x 260 x 68 mm
Extended local control: 180 x 225 x 68 mm
Control unit CB700: 118 x 65 x 55 mm

Weight
Locally controlled version: 2.8 Kg
Extended local control: 2.6 Kg
Control unit CB700: 0.2 Kg

TRANSMITTER SPECIFICATIONS

RF Power Output
15W

Type of Modulation
Phase

AF Response
6 dB/octave preemphasis 300-3000 Hz
+0/-1.5 dB (+0.5/-3 dB)

Modulation Distortion (measured with de-emphasis)
CQM761-15: 2.5% (7%)
CQM763-15: 2% (7%)

Modulation Sensitivity
220 mV e.m.f. ± 2 dB

AF Input Impedance
560 Ω

Adjacent Channel Selectivity
Attenuated to meet government specifications

FM Hum and Noise (measured without de-emphasis)
CQM761-15: -50 dB (-40 dB)
CQM763-15: -45 dB (-38 dB)

Spurious Radiation FTZ
Less than 2 μW

Harmonic Radiation
Less than 2 μW

Storno

RECEIVER SPECIFICATIONS

Sensitivity e.m.f. for 12 dB SINAD

CQM761-15: 1.0 μV (1.3 μV)

CQM763-15: 0.8 μV (1.1 μV)

Squelch

Electronic, adjustable

Adjacent Channel Selectivity EIA

CQM761-15: 85 dB (80 dB)

CQM763-15: 83 dB (80 dB)

Adjacent Channel Selectivity FTZ

CQM763-15: 80 dB (78 dB)

Intermodulation Attenuation EIA

75 dB (73 dB)

Intermodulation Attenuation FTZ

CQM763-15: 72 dB (70 dB)

Blocking MPT

190 mV (100 mV)

Spurious Radiation FTZ

0.4 nW (2 nW)

Spurious Response Attenuation

95 dB (80 dB)

AF Output Power

2 W (load 5 Ω)

AF Response

-6 dB/octave 300 Hz - 3000 Hz

+0/-1.5 dB (+0.5/-3 dB)

AF Distortion

3% (6%)

Hum and Noise, squelched

80 dB (60 dB)

Hum and Noise, unsquelched

CQM761-15: 50 dB (45 dB)

CQM763-15: 45 dB (40 dB)

POWER SUPPLY SPECIFICATIONS

Current Consumption at 13.6 V

Stand by: 160 mA (190 mA)

Transmit: 3.7A (4.5A)

Receive, AF output 2 W: 470 mA (540 mA)

60.223-EI

ADJUSTMENT PROCEDURE FOR CQM760-15

Amendment to 60.171-E1

RECEIVER ALIGNMENT

The receiver section is aligned as described for CQM760, refer to 60.171-E1.

TRANSMITTER ALIGNMENT

The initial tests and adjustment of Exciter EX761 are performed as described in 60.171-E1, except for the power supply current limiter setting, which should be 7 A.

NOTE: The PA762 should be aligned with its shielding lid in place, and insulated trimming tools must be used.

Adjustment of Power Amplifier PA762

Reestablish the connection between EX761 and PA762.
Remove the shorting link between terminals 1 and 6 in the booster.
Connect a Wattmeter to terminals 1 and 4 (driver output).
Insert a shorting link in the temperature protection circuit between terminals 11 and 12.
Turn ADC potentiometer R2 half way up (clockwise).
Set the supply voltage to 13.0 V.
Install the lid and key the transmitter.

1. Adjust C3, C7, C11, C15, C16, C21 and C22 in PA761, in this order, for maximum current consumption from the power supply.

   Repeat until the Wattmeter shows RF output, and proceed to adjust the above capacitors for maximum RF output.

   Set the supply voltage to 16.0 V and adjust ADC potentiometer R2 for an RF output of 7W ± 0.1W.

   Set the supply voltage to 13.0 V.

2. During the following alignment, keep the ADC potentiometer set for a maximum output of 7W.

   Adjust C3 for minimum DC voltage on the collector (the transistor housing) of Q1, PA761.

   Adjust C7, C11, C15, C16, C21 and C22 for maximum RF output.

3. Repeat step 2.

Increase the supply voltage to 16 V and set the ADC potentiometer for an RF output of 7W.

When the driver circuit is operating properly, the following figures must be obtainable:

Supply Voltage:	10.5 V
Power output:	4.5W
Supply Voltage:	13.6 V
Power output:	6.8W
Supply Voltage:	16.0 V
Power output:	7.0W ± 0.1W

Reestablish the shorting link between terminals 1 and 6.
Connect a Wattmeter to the Antenna output.

Set trimmer capacitors C101, C102, C105, and C109 to minimum capacity, if adjusting to a frequency in the higher part of the frequency band.

Set the trimmer capacitors to maximum, if the frequency is in the lower part of the band.

Turn potentiometer R107 half way up.
Set the supply voltage to 13.6 V.

Storno

Install the lid and key the transmitter.
Adjust trimmer capacitors C101, C102, C105, C109, C21, and C22 for maximum output power.
Use ADC potentiometer R2 to keep the power output at 18W.

Repeat these adjustments until no further improvements are obtainable. Since the heat sink has been removed from the power amplifier, the adjustments should be performed before the rising temperature influences the results (less than 5 min.).

AUTOMATIC DRIVE CONTROL (ADC) CIRCUIT

When the ADC circuit is operating properly, the following figures must be obtainable on all channels:

At 10.5 V supply voltage:
Current drain: 3.7A (3.8A)
Power output: 8W

At 13.6 V supply voltage:
Current drain: 4.4A (4.5A)
Power output: 16.5W ± 1.5W

At 16.0 V supply voltage:
Current drain: 4.4A (4.5A)
Power output: 18W ± 3W

These figures for total current drain apply to stations without tone equipment. The values in brackets apply to stations with more than one channel.

Where more than one channel is in use, the output power must be checked on all channels.

Temperature Protection Circuit Adjustment

The following adjustment should not be performed before the power amplifier chassis has cooled to room temperature.

Set the supply voltage to 13.6 V.
Key the transmitter and let the power amplifier heat for 5 minutes. (output 15W).

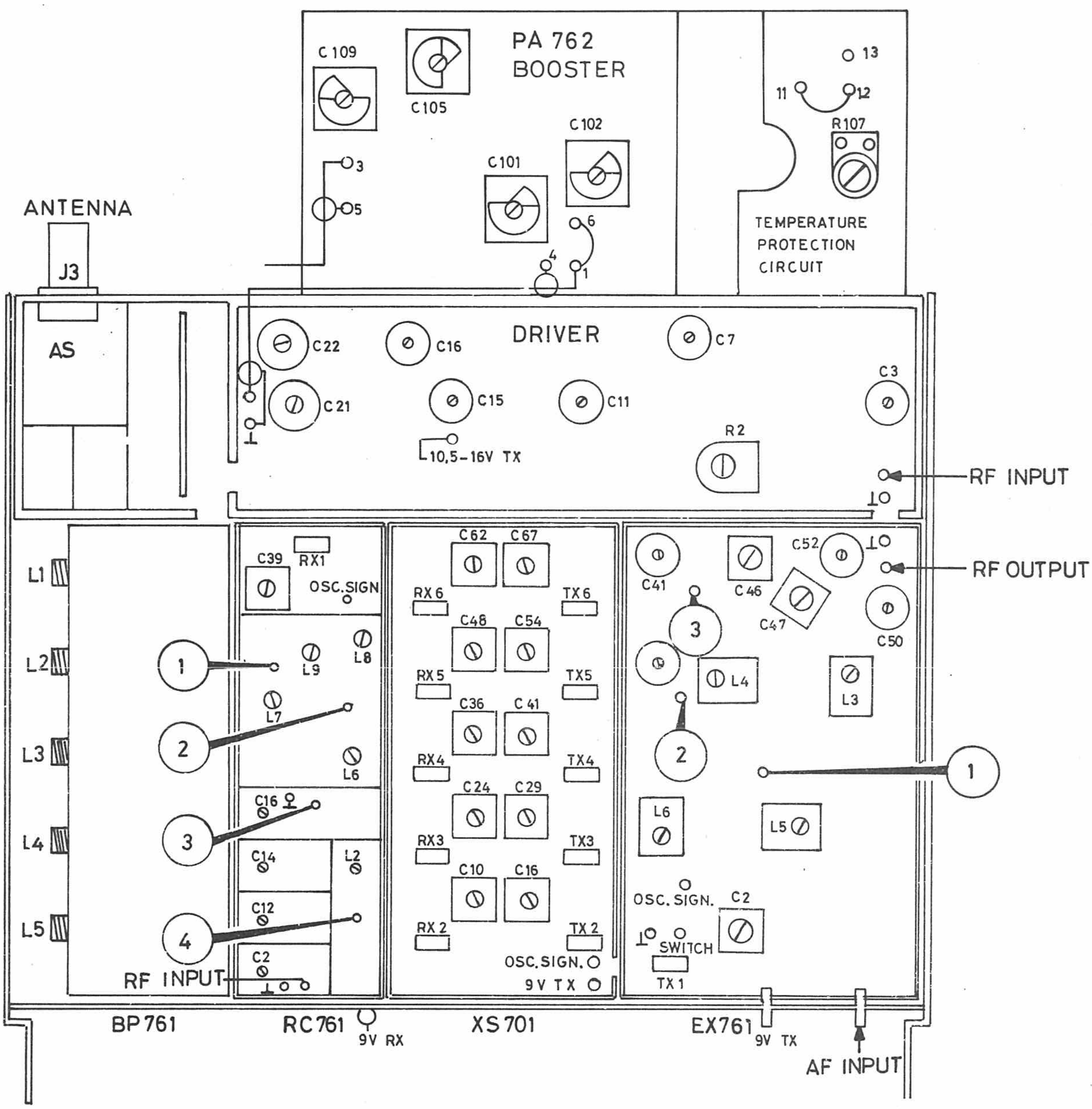
Move the shorting link between terminals 11 and 12 to terminals 12 and 13.
Install the lid and adjust R107 for 6W ± 0.1W output power.

Reestablish shorting link between terminals 11 and 12.

Adjustment of Transmitter Frequency

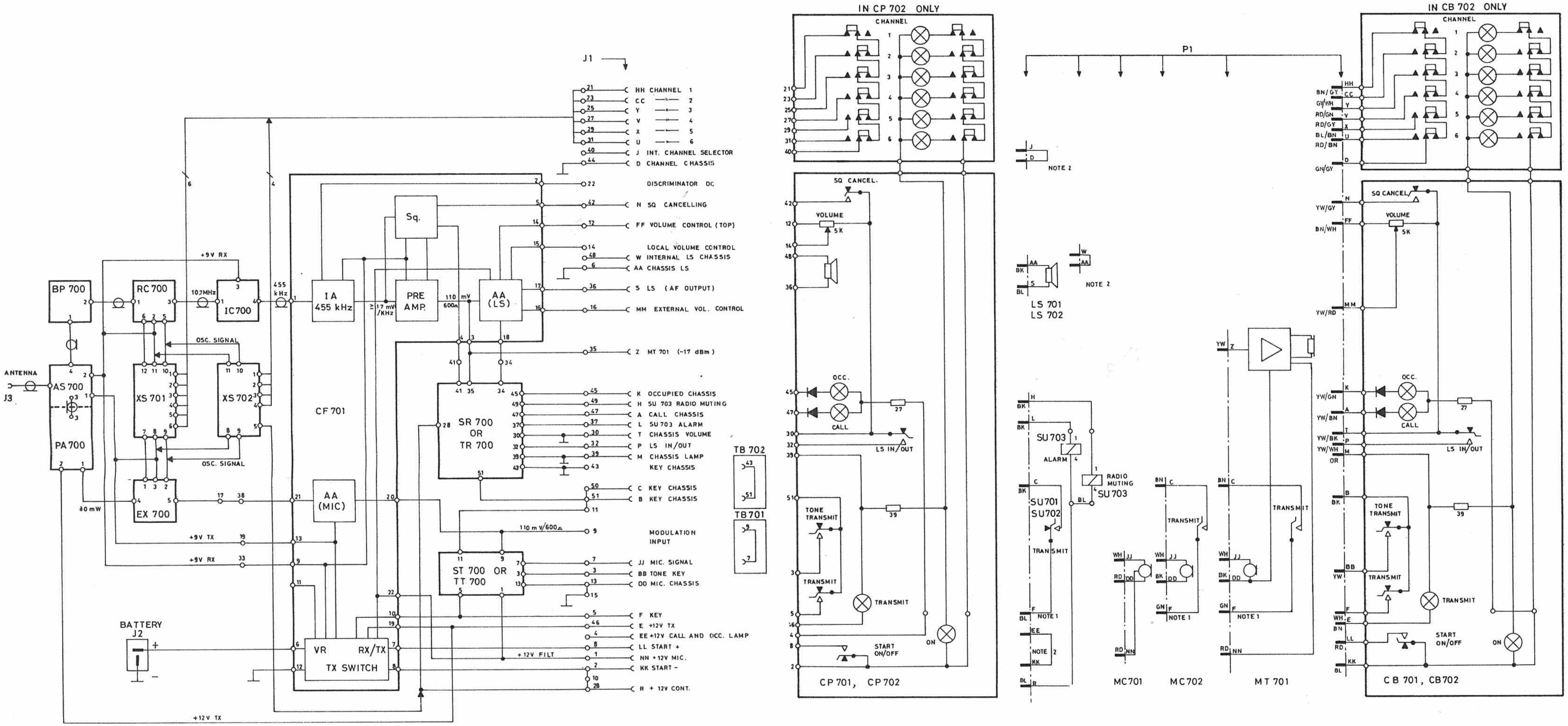
Adjustment of Modulation and Frequency Deviation

Refer to 60.171-E1, Adjustment procedure for CQM760.


PA 762
BOOSTER
C 109
C 105
C 102
C 101
13
11
12
R107
TEMPERATURE
PROTECTION
CIRCUIT
ANTENNA
J3
AS
DRIVER
C 22
C 16
C 7
C 21
C 15
C 11
C 3
R 2
10,5-16V TX
RF INPUT
RF OUTPUT
L1
L2
L3
L4
L5
C39
RX1
OSC.SIGN
L9
L8
L7
L6
C16
C14
L2
C12
C2
RF INPUT
C 62
C 67
RX 6
TX 6
C48
C54
RX 5
TX5
C36
C 41
RX4
TX4
C 24
C 29
RX3
TX3
C 10
C 16
RX 2
TX 2
OSC.SIGN.
9 V TX
C41
C46
C52
C47
C50
L4
L3
L6
L5
OSC. SIGN.
C2
SWITCH
TX 1
BP 761
RC 761
9V RX
XS 701
EX 761
9V TX
AF INPUT

STORNOPHONE 700
MAINTENANCE MANUAL
VOLUME I
Section 9

TITLE		Code
System Layout		D401.707
System Layout CQM700a		D402.360
Cabling Local Controlled CQM700		D401.579
Cabling Extended Local Controlled CQM700		D401.580
Cabling Extended/ Local Controlled CQM700		D401.581
Cabling Local Controlled CQM700a		D402.392/2
Cabling Local/Extended Controlled CQM700a		D402.393
Cabling Extended Controlled CQM700a		D402.394/2
CQM710	Schematic	D401.788
CQM730	Schematic	D401.831
CQM760	Schematic	D401.830
CQM700D	External Cabling	D402.017/6
CQM700D	Internal Wiring	D402.871/3
CQM713D	Cable Form	D402.361
CQM763D-12	Cable Form	D402.381
CQM713P3	Cable Form	D402.452
CQM700D	Casette Retainer	D402.417/2



17 WIRE NUMBER CORRESPONDING TO NUMBERS ON TERMINAL BOARD.
LEDNINGSNUMMER SVARENDE TIL NUMRE PÅ TERMINALBRÆT.

10 TERMINAL NUMBER CORRESPONDING TO NUMBERS ON SCHEMATIC.
TERMINALNUMMER SVARENDE TIL NUMRE PÅ DIAGRAMMER.

TB 701 REPLACES TONETRANSMITTER.
ERSTATTER TONESENDER.

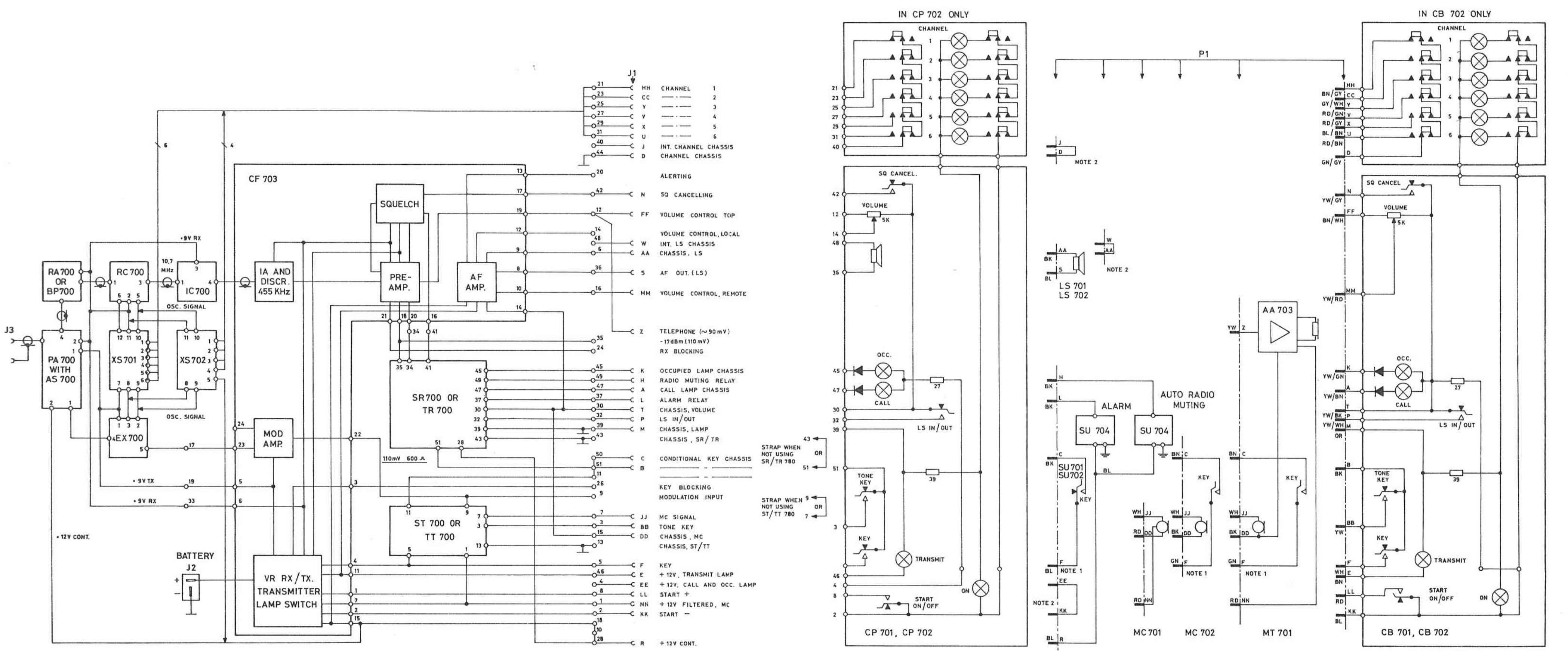
TB 702 REPLACES TONERECEIVER.
ERSTATTER TONEMODTAGER.

NOTE 1: DO NOT CONNECT F TO CB701/2, WHEN USING SU701, SU702, MC 702 OR MT 701
F FORBINDES IKKE TIL CB701/2, NÅR SU701/2, MC 702 ELLER MT 701 ANVENDES

NOTE 2: STRAPS FOR LOCAL CONTROLLED EQUIPMENT.
STRAPNINGER FOR LOKALBETJENT ANLÆG.

SYSTEM LAY-OUT. CQM 700
SYSTEM DIAGRAM.

D401.707



WIRE NUMBER CORRESPONDING TO NUMBERS ON TERMINAL BOARD.
LEDNINGSNUMMER SVARENDE TIL NUMRE PÅ TERMINALBRÆT.

TERMINAL NUMBER CORRESPONDING TO NUMBERS ON SCHEMATIC.
TERMINALNUMMER SVARENDE TIL NUMRE PÅ DIAGRAMMER.

NOTE 1: DO NOT CONNECT F TO CB 701/2, WHEN USING SU 701, SU 702, MC 702 OR MT 701.
F FORBINDES IKKE TIL CB 701/2, NÅR SU 701/2, MC 702 ELLER MT 701 ANVENDES.

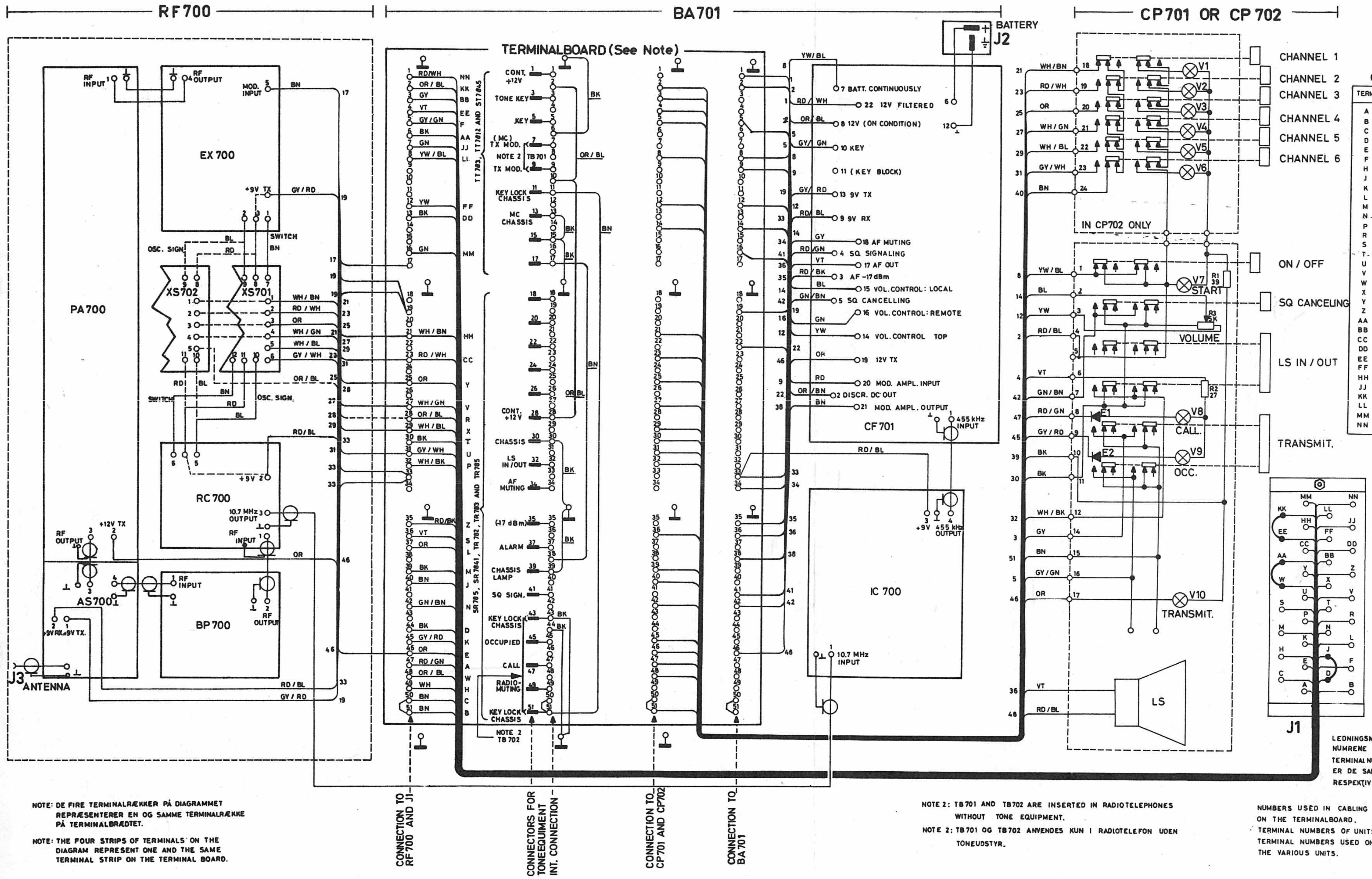
NOTE 2. STRAPS FOR LOCAL CONTROLLED EQUIPMENT.
STRAPNINGER FOR LOKAL BETJENT ANLÆG.

SYSTEM LAY-OUT
SYSTEMDIAGRAM.
CQM 700a

D402.360

Storno

Storno



CONNECTOR J1

TERM.	FUNCTION
A	CALL. CHASSIS
B	KEY. CHASSIS
C	KEY CHASSIS
D	CHANNEL CHASSIS
E	12V TX
F	KEY
H	SU 703 RADIO MUTING
J	INT. CHANNEL SELECTOR
K	OCCUPIED CHASSIS
L	SU 703 ALARM
M	CHASSIS. LAMP
N	SQ CANCELLING
P	LS IN / OUT
R	+12V CONT.
S	LS (AF OUT)
T	CHASSIS VOL
U	CHANNEL 6
V	CHANNEL 4
W	INT. LS CHASSIS
X	CHANNEL 5
Y	CHANNEL 3
Z	MT 701 (-17dBm)
AA	CHASSIS. LS
BB	TONE KEY
CC	CHANNEL 2
DD	MC CHASSIS
EE	+12V CALL LAMP
FF	VOLUME CONTROL TOP
HH	CHANNEL 1
JJ	MC SIGNAL
KK	START-
LL	START+
MM	VOLUME CONTROL EXT.
NN	MC +12V

LEDNINGSNUMRENE REFFERERER TIL NUMRENE PA TERMINALBRÆDTET. TERMINALNUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER.

NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON THE TERMINAL BOARD.

NOTE 2: TB701 AND TB702 ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT.

NOTE 2: TB701 OG TB702 ANVENDES KUN I RADIOTELEFON UDEN TONEUDSTYR.

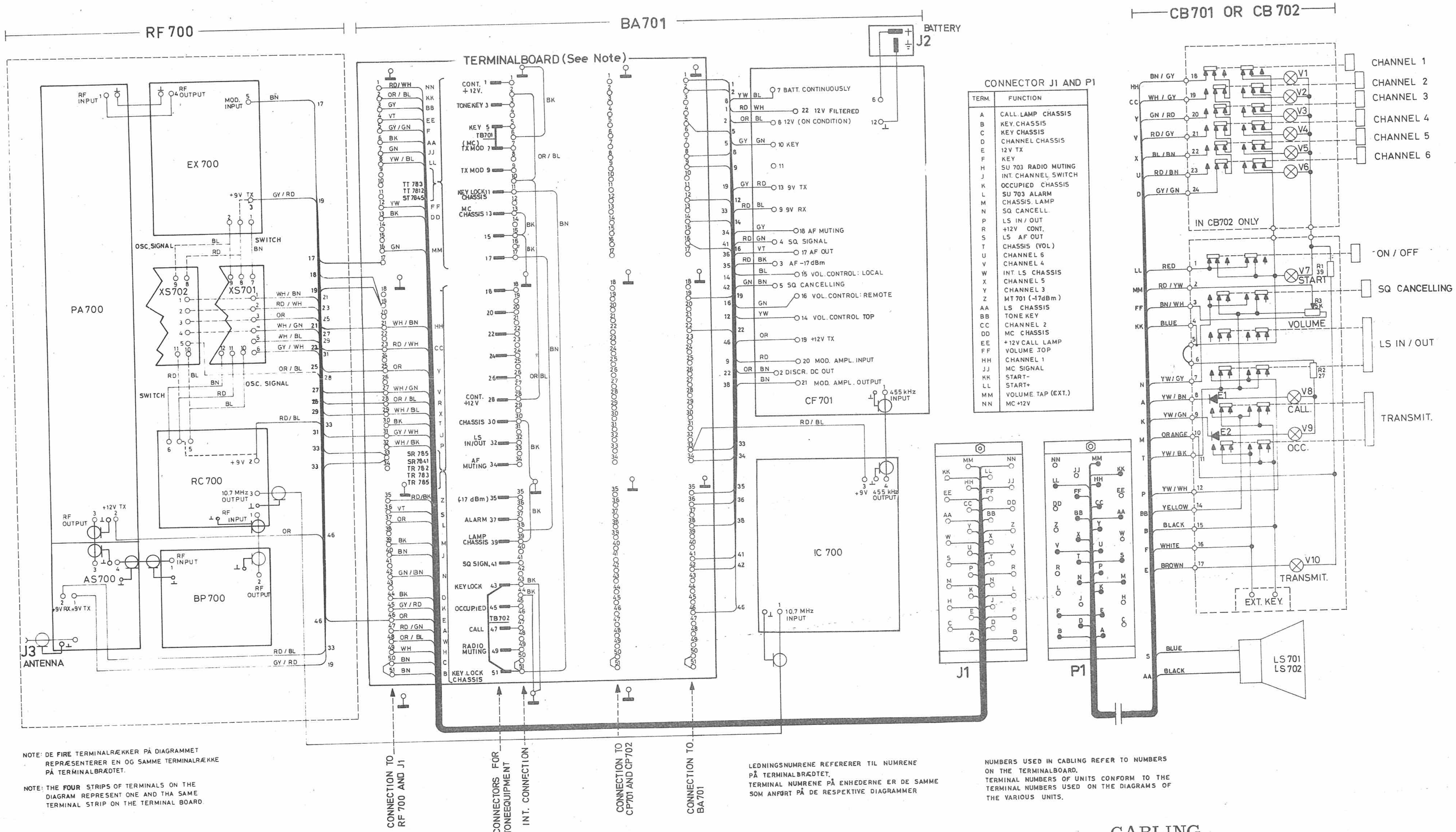
NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD.
TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAM OF THE VARIOUS UNITS.

CABLING
LOCAL CONTROLLED
LOKAL BETJENT

CQM700

D401.579

Storno



NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THA SAME TERMINAL STRIP ON THE TERMINAL BOARD.

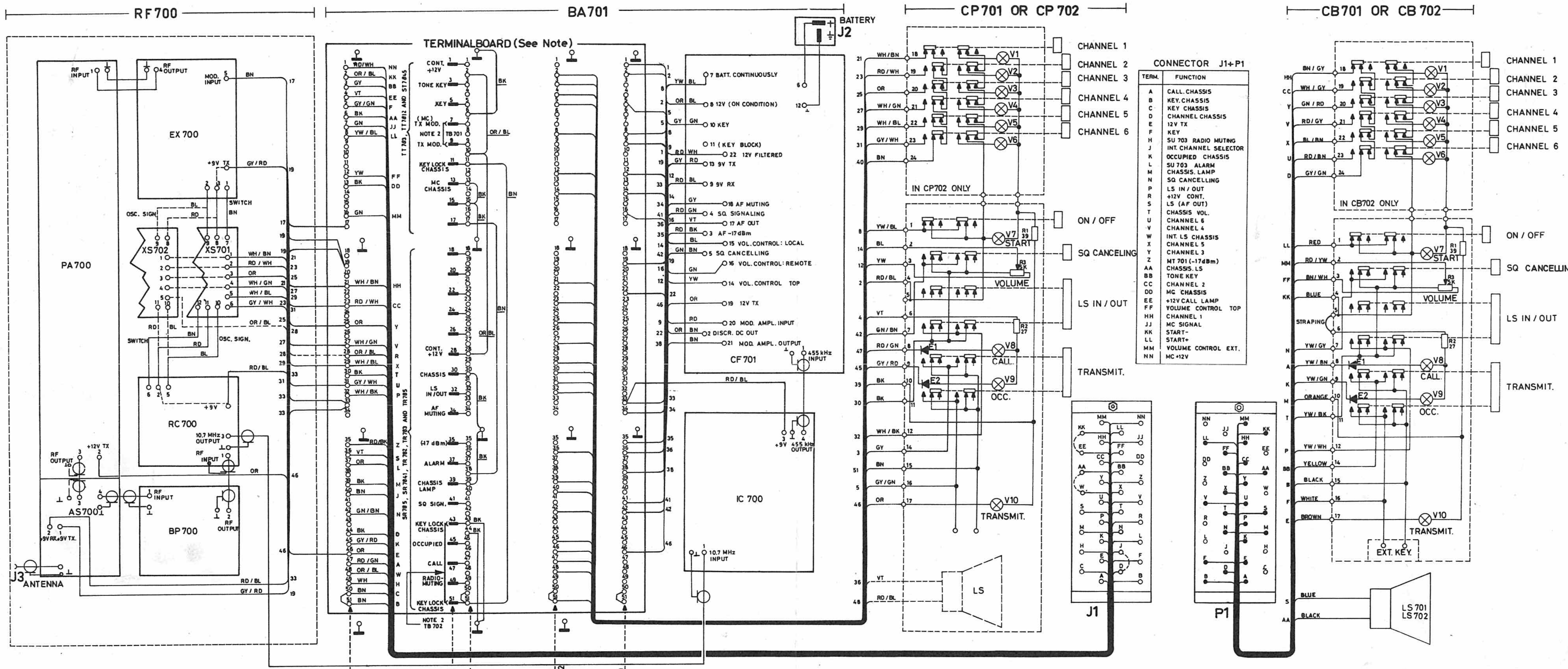
LEDNINGSNUMRENE REFERERER TIL NUMRENE PÅ TERMINALBRÆDTET. TERMINAL NUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD. TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAMS OF THE VARIOUS UNITS.

CABLING
EXTENDED LOCAL CONTROLLED CQM700
FJERNBETJENT CQM700

D401.580

Storno



NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON THE TERMINAL BOARD.

NOTE 2: TB701 AND TB702 ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT.

NOTE 2: TB701 OG TB702 ANVENDES KUN I RADIOTELEFON UDEN TONEUDSTYR.

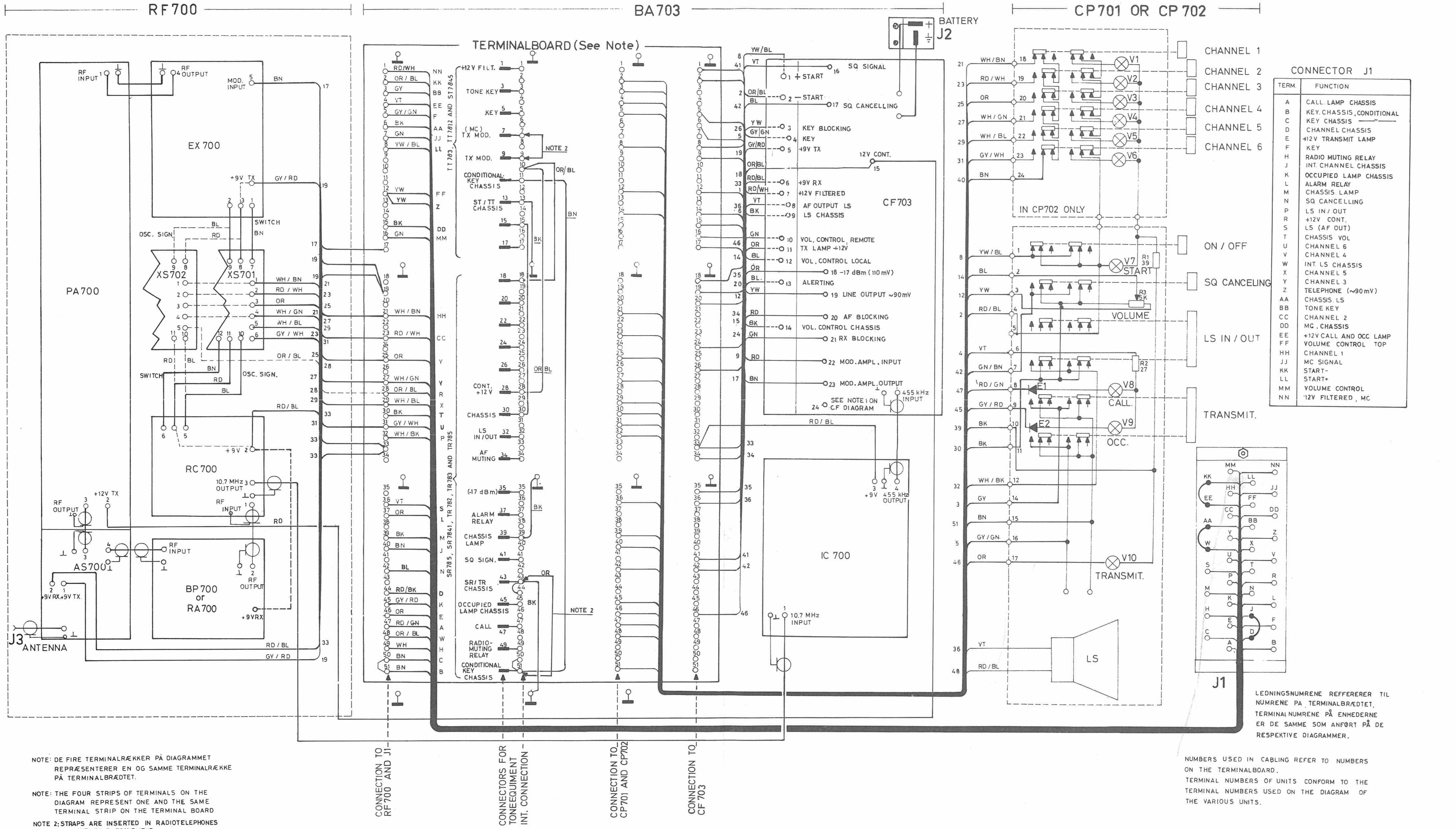
NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD.
TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAM OF THE VARIOUS UNITS.

LEDNINGSNUMRENE REFFERERER TIL NUMRENE PA TERMINALBRÆDTET.
TERMINALNUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER.

CABLING
LOCAL/EXTENDED LOCAL CONTROLLED CQM700
LOKAL/FJERNBETJENT CQM700

D401.581

Storno



CONNECTOR J1

TERM.	FUNCTION
A	CALL. LAMP CHASSIS
B	KEY. CHASSIS, CONDITIONAL
C	KEY CHASSIS ——"——
D	CHANNEL CHASSIS
E	+12V TRANSMIT LAMP
F	KEY
H	RADIO MUTING RELAY
J	INT. CHANNEL CHASSIS
K	OCCUPIED LAMP CHASSIS
L	ALARM RELAY
M	CHASSIS. LAMP
N	SQ CANCELLING
P	LS IN / OUT
R	+12V CONT.
S	LS (AF OUT)
T	CHASSIS VOL
U	CHANNEL 6
V	CHANNEL 4
W	INT. LS CHASSIS
X	CHANNEL 5
Y	CHANNEL 3
Z	TELEPHONE (~90 mV)
AA	CHASSIS. LS
BB	TONE KEY
CC	CHANNEL 2
DD	MC, CHASSIS
EE	+12V CALL AND OCC LAMP
FF	VOLUME CONTROL TOP
HH	CHANNEL 1
JJ	MC SIGNAL
KK	START-
LL	START+
MM	VOLUME CONTROL
NN	12V FILTERED, MC

NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON THE TERMINAL BOARD

NOTE 2: STRAPS ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT.

NOTE 2 STRAPNINGER INDSÆTTES I ANLÆG UDEN TONEUDSTYR.

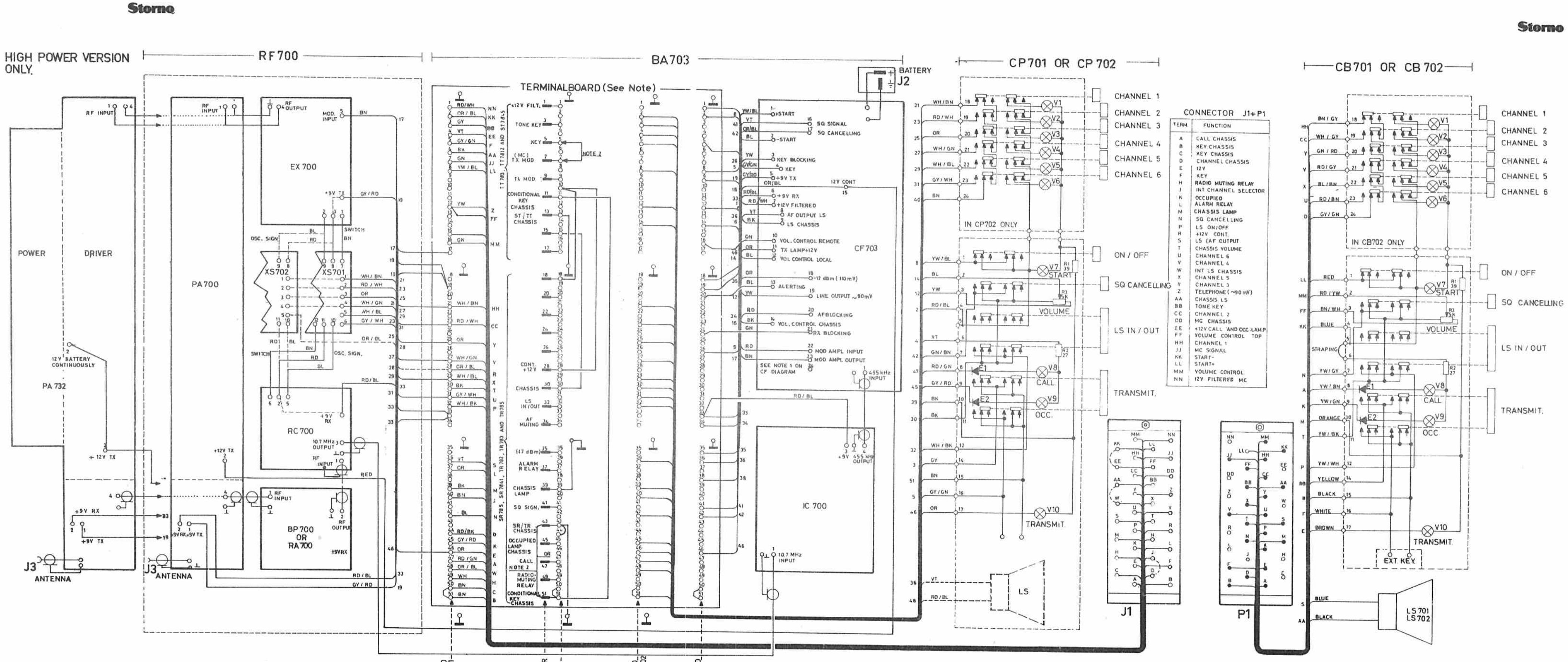
LEDNINGSNUMRENE REFFERERER TIL NUMRENE PÅ TERMINALBRÆDTET. TERMINALNUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER.

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD. TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAM OF THE VARIOUS UNITS.

CABLING
LOCAL CONTROLLED
LOKAL BETJENT

CQM700a

D402.392/2



NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON THE TERMINAL BOARD.

NOTE 2 STRAPS ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT.

NOTE 2 STRAPNINGER INDSÆTTES I ANLÆG UDEN TONEUDSTYR.

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD. TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAM OF THE VARIOUS UNITS.

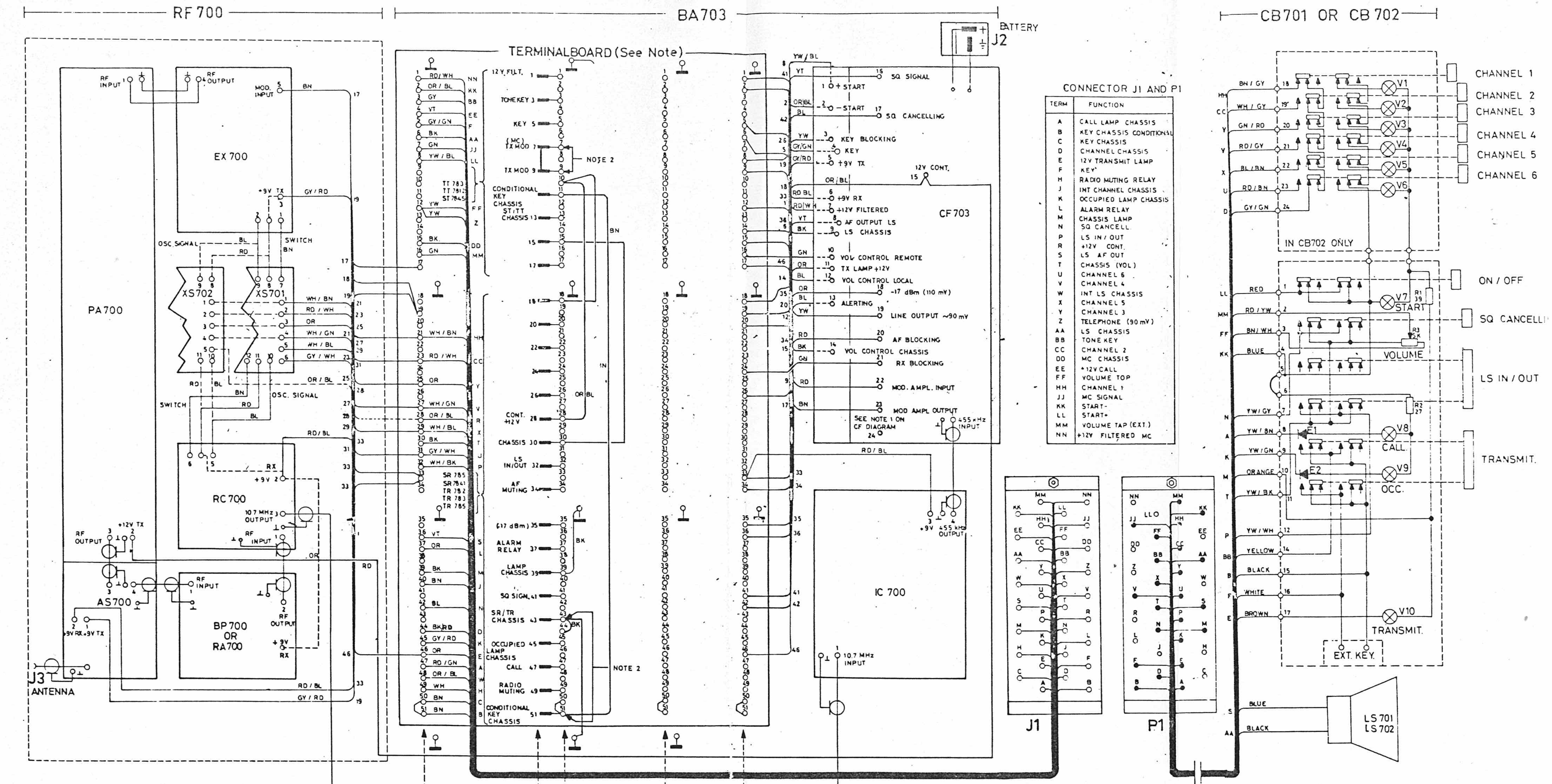
LEDNINGSNUMRENE REFFERERER TIL NUMRENE PÅ TERMINALBRÆDTET. TERMINALNUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER.

CABLING

LOCAL / EXTENDED LOCAL CONTROLLED

CQM700a

D402.393



TERM	FUNCTION
A	CALL LAMP CHASSIS
B	KEY CHASSIS CONDITIONAL
C	KEY CHASSIS
D	CHANNEL CHASSIS
E	12V TRANSMIT LAMP
F	KEY'
H	RADIO MUTING RELAY
J	INT CHANNEL CHASSIS
K	OCCUPIED LAMP CHASSIS
L	ALARM RELAY
M	CHASSIS LAMP
N	SQ CANCELL
P	LS IN / OUT
R	+12V CONT.
S	LS AF OUT
T	CHASSIS (VOL)
U	CHANNEL 6
V	CHANNEL 4
W	INT LS CHASSIS
X	CHANNEL 5
Y	CHANNEL 3
Z	TELEPHONE (90 mV)
AA	LS CHASSIS
BB	TONE KEY
CC	CHANNEL 2
DD	MC CHASSIS
EE	+12V CALL
FF	VOLUME TOP
HH	CHANNEL 1
JJ	MC SIGNAL
KK	START-
LL	START+
MM	VOLUME TAP (EXT.)
NN	+12V FILTERED MC

NOTE DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THA SAME TERMINAL STRIP ON THE TERMINAL BOARD

NOTE 2 STRAPS ARE INSERTED IN RADIOTELEPHONES WITOUT TONE EQUIPMENT.

NOTE 2 STRAPNINGER INDSÆTTES I ANLÆG UDEN TONEUDSTYR

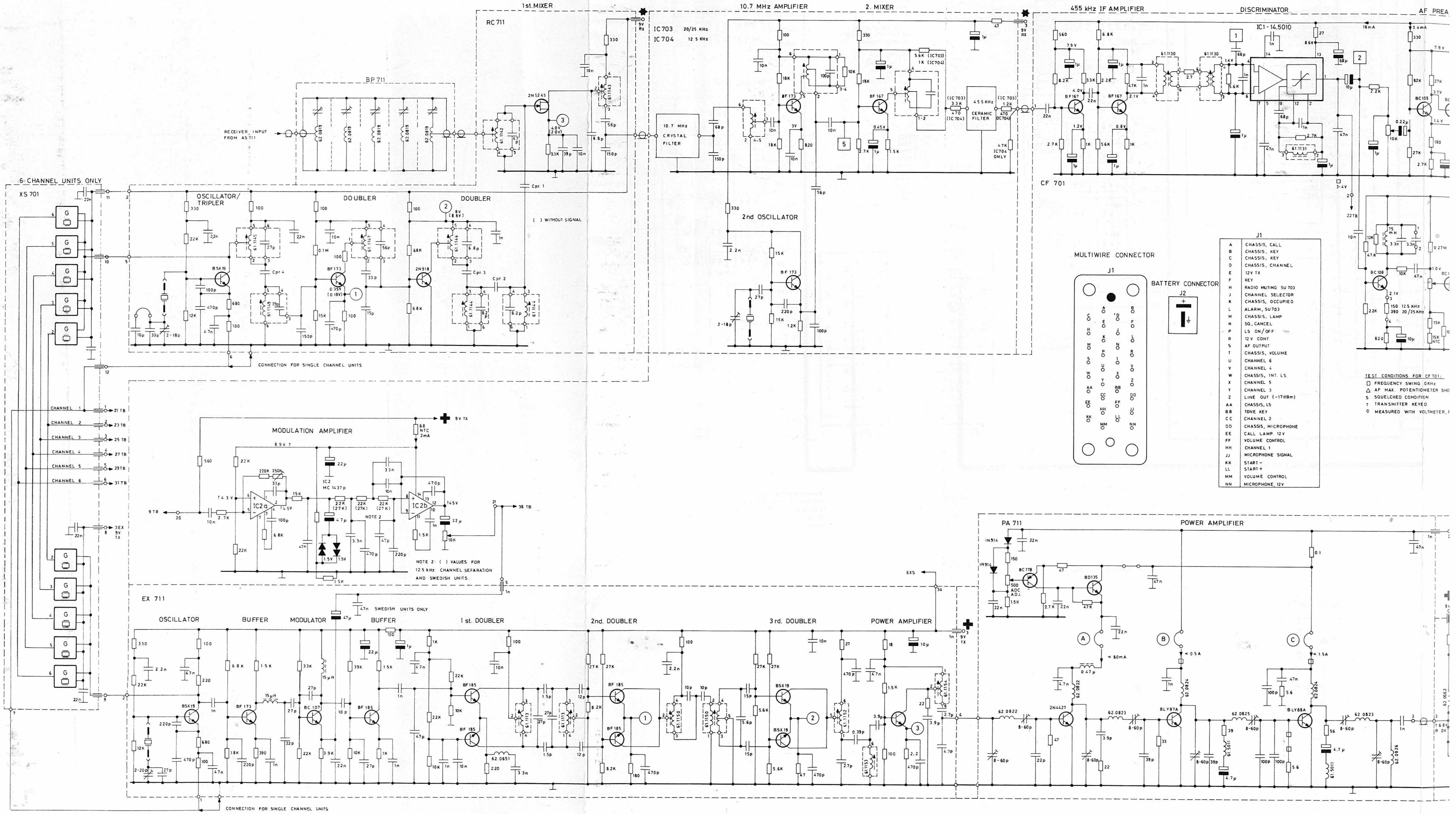
LEDNINGSNUMRENE REFERERER TIL NUMRENE PÅ TERMINALBRÆDTET. TERMINAL NUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER

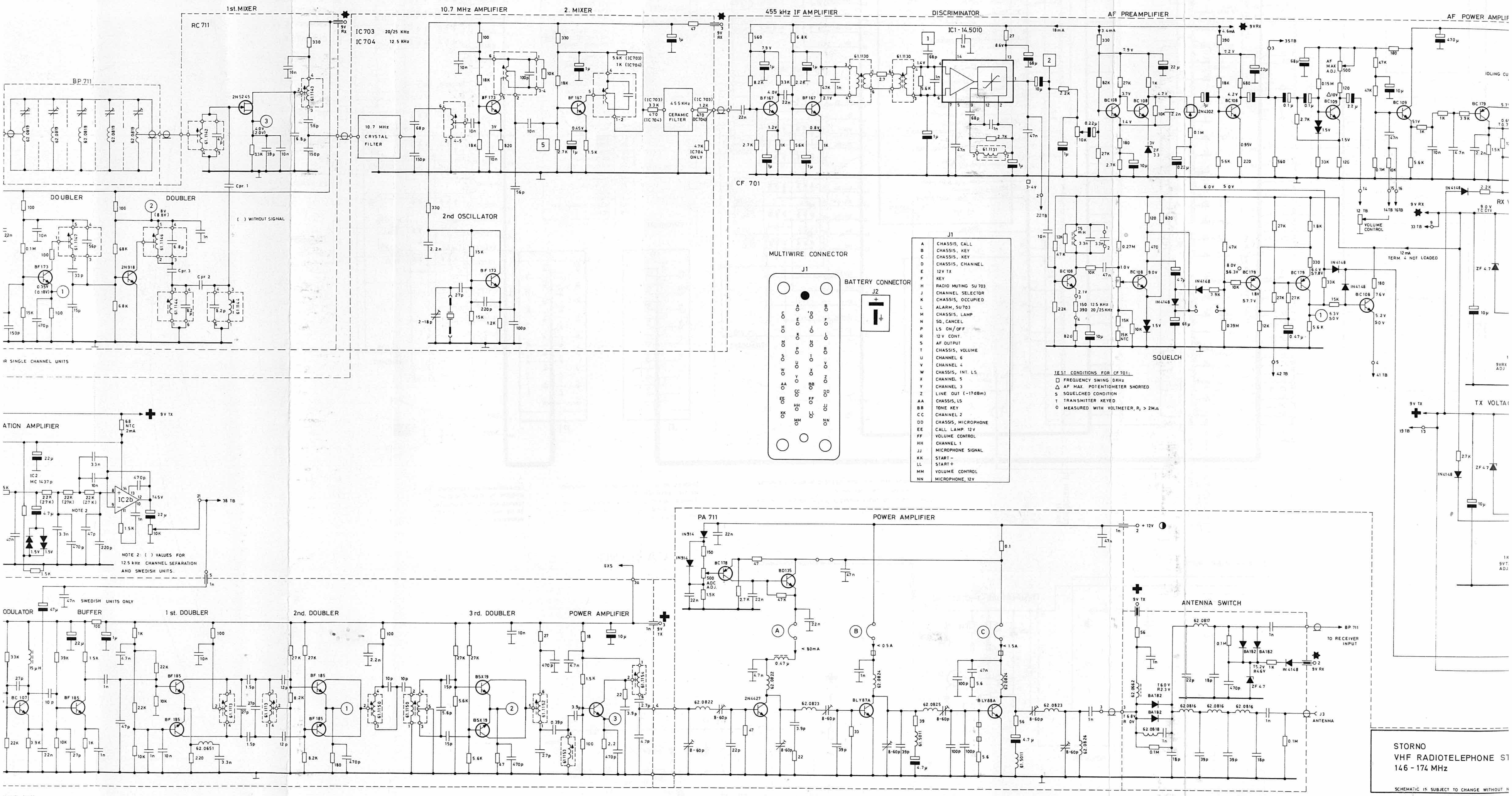
NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD. TERMINAL NUMBERS USED ON UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAMS OF THE VARIOUS UNITS.

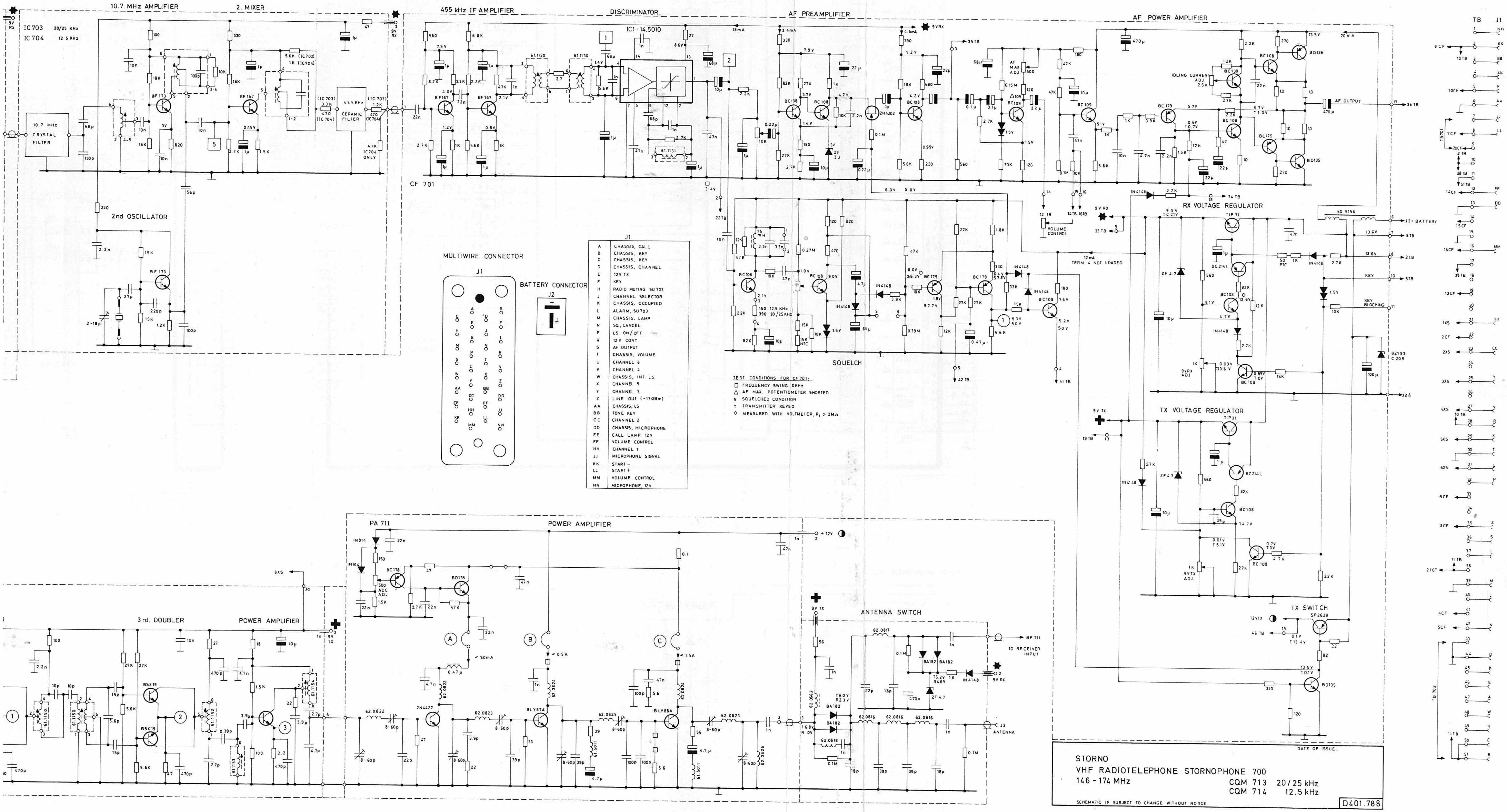
CABLING
EXTENDED LOCAL CONTROLLED

CQM

D 402.394


1st. MIXER
RC 711
10.7 MHz AMPLIFIER
2. MIXER
455 kHz IF AMPLIFIER
DISCRIMINATOR
AF PREA
BP 711
RECEIVER INPUT FROM AS 711
IC 703 20/25 KHz
IC 704 12.5 KHz
10.7 MHz CRYSTAL FILTER
CERAMIC FILTER
IC1 - 14.5010
CF 701
6 CHANNEL UNITS ONLY
XS 701
OSCILLATOR/ TRIPLER
DOUBLER
DOUBLER
( ) WITHOUT SIGNAL
2nd OSCILLATOR
CONNECTION FOR SINGLE CHANNEL UNITS
MULTIWIRE CONNECTOR
J1
BATTERY CONNECTOR
J2
CHANNEL 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
CHANNEL 5
CHANNEL 6
MODULATION AMPLIFIER
IC2 MC 1437p
NOTE 2: ( ) VALUES FOR 12.5 kHz CHANNEL SEPARATION AND SWEDISH UNITS.
SWEDISH UNITS ONLY
EX 711
OSCILLATOR
BUFFER
MODULATOR
BUFFER
1 st. DOUBLER
2nd. DOUBLER
3 rd. DOUBLER
POWER AMPLIFIER
PA 711
POWER AMPLIFIER
CONNECTION FOR SINGLE CHANNEL UNITS
J1
A CHASSIS, CALL
B CHASSIS, KEY
C CHASSIS, KEY
D CHASSIS, CHANNEL
E 12V TX
F KEY
H RADIO MUTING SU 703
J CHANNEL SELECTOR
K CHASSIS, OCCUPIED
L ALARM, SU 703
M CHASSIS, LAMP
N SQ, CANCEL
P LS ON/OFF
R 12 V CONT
S AF OUTPUT
T CHASSIS, VOLUME
U CHANNEL 6
V CHANNEL 4
W CHASSIS, INT. LS
X CHANNEL 5
Y CHANNEL 3
Z LINE OUT (-17dBm)
AA CHASSIS, LS
BB TONE KEY
CC CHANNEL 2
DD CHASSIS, MICROPHONE
EE CALL LAMP 12 V
FF VOLUME CONTROL
HH CHANNEL 1
JJ MICROPHONE SIGNAL
KK START -
LL START +
MM VOLUME CONTROL
NN MICROPHONE, 12 V
TEST CONDITIONS FOR CF 701:
FREQUENCY SWING 0KHz
AF MAX. POTENTIOMETER SHO
S SQUELCHED CONDITION
T TRANSMITTER KEYED
O MEASURED WITH VOLTMETER,


1st.MIXER
RC 711
10.7 MHz AMPLIFIER
2. MIXER
455 kHz IF AMPLIFIER
DISCRIMINATOR
IC1-14.5010
AF PREAMPLIFIER
AF POWER AMPLI
BP 711
DOUBLER
DOUBLER
2nd OSCILLATOR
10.7 MHz CRYSTAL FILTER
455 kHz CERAMIC FILTER
IC 703 20/25 KHz
IC 704 12.5 KHz
( ) WITHOUT SIGNAL
CF 701
SQUELCH
MULTIWIRE CONNECTOR
J1
BATTERY CONNECTOR
J2
A CHASSIS, CALL
B CHASSIS, KEY
C CHASSIS, KEY
D CHASSIS, CHANNEL
E 12V TX
F KEY
H RADIO MUTING SU703
J CHANNEL SELECTOR
K CHASSIS, OCCUPIED
L ALARM, SU703
M CHASSIS, LAMP
N SQ, CANCEL
P LS ON/OFF
R 12V CONT.
S AF OUTPUT
T CHASSIS, VOLUME
U CHANNEL 6
V CHANNEL 4
W CHASSIS, INT. LS
X CHANNEL 5
Y CHANNEL 3
Z LINE OUT (-17dBm)
AA CHASSIS, LS
BB TONE KEY
CC CHANNEL 2
DD CHASSIS, MICROPHONE
EE CALL LAMP 12V
FF VOLUME CONTROL
HH CHANNEL 1
JJ MICROPHONE SIGNAL
KK START-
LL START+
MM VOLUME CONTROL
NN MICROPHONE, 12V
TEST CONDITIONS FOR CF 701:
□ FREQUENCY SWING 0KHz
△ AF MAX. POTENTIOMETER SHORTED
S SQUELCHED CONDITION
T TRANSMITTER KEYED
O MEASURED WITH VOLTMETER, Ri > 2MΩ
ATION AMPLIFIER
IC2 MC 1437P
NOTE 2: ( ) VALUES FOR 12.5 kHz CHANNEL SEPARATION AND SWEDISH UNITS.
SWEDISH UNITS ONLY
ODULATOR
BUFFER
1 st. DOUBLER
2nd. DOUBLER
3rd. DOUBLER
POWER AMPLIFIER
PA 711
POWER AMPLIFIER
ANTENNA SWITCH
TO RECEIVER INPUT
ANTENNA
TX VOLTA
STORNO
VHF RADIOTELEPHONE ST
146 - 174 MHz
SCHEMATIC IS SUBJECT TO CHANGE WITHOUT N



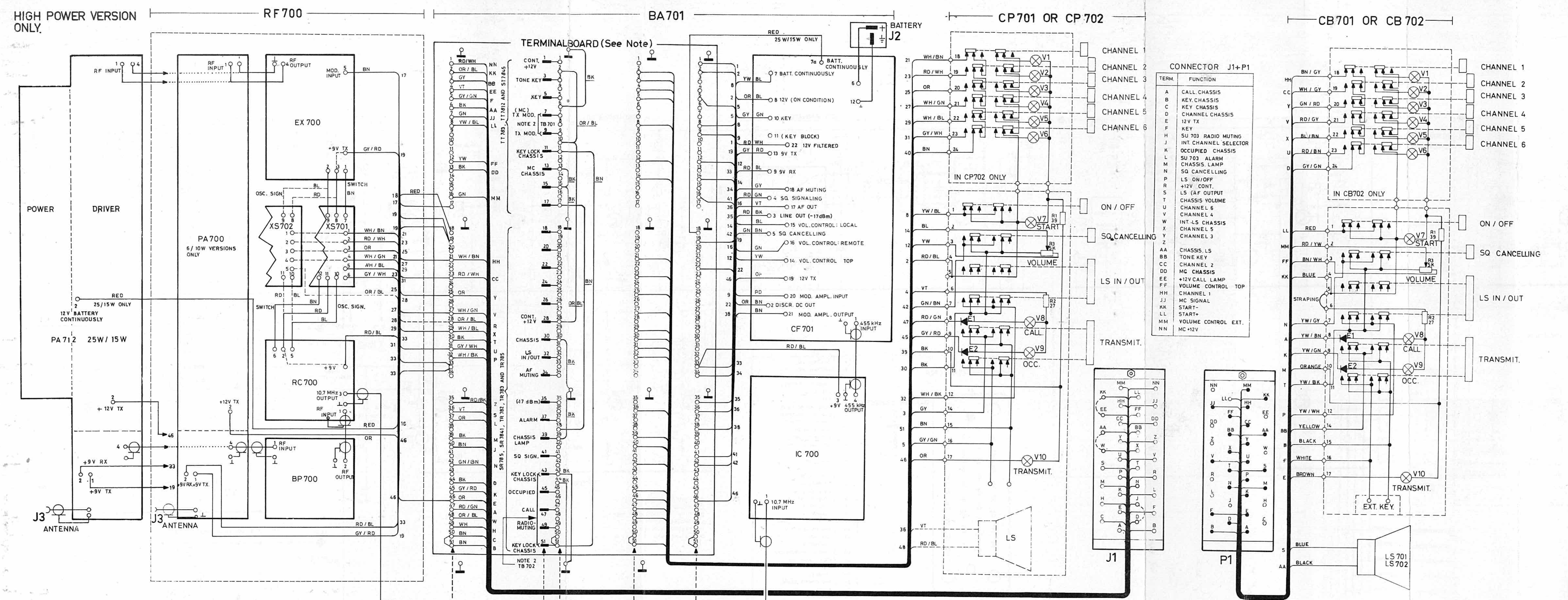
J1

A	CHASSIS, CALL
B	CHASSIS, KEY
C	CHASSIS, KEY
D	CHASSIS, CHANNEL
E	12V TX
F	KEY
H	RADIO MUTING SU 703
J	CHANNEL SELECTOR
K	CHASSIS, OCCUPIED
L	ALARM, SU703
M	CHASSIS, LAMP
N	SQ, CANCEL
P	LS ON/OFF
R	12 V CONT
S	AF OUTPUT
T	CHASSIS, VOLUME
U	CHANNEL 6
V	CHANNEL 4
W	CHASSIS, INT. LS
X	CHANNEL 5
Y	CHANNEL 3
Z	LINE OUT (-17dBm)
AA	CHASSIS, LS
BB	TONE KEY
CC	CHANNEL 2
DD	CHASSIS, MICROPHONE
EE	CALL LAMP 12V
FF	VOLUME CONTROL
HH	CHANNEL 1
JJ	MICROPHONE SIGNAL
KK	START −
LL	START +
MM	VOLUME CONTROL
NN	MICROPHONE, 12V

STORNO
VHF RADIOTELEPHONE STORNOPHONE 700
146 - 174 MHz
CQM 713 20/25 kHz
CQM 714 12,5 kHz

SCHEMATIC IS SUBJECT TO CHANGE WITHOUT NOTICE

D401.788



CONNECTOR J1+P1

TERM.	FUNCTION
A	CALL CHASSIS
B	KEY CHASSIS
C	KEY CHASSIS
D	CHANNEL CHASSIS
E	12V TX
F	KEY
H	SU 703 RADIO MUTING
J	INT. CHANNEL SELECTOR
K	OCCUPIED CHASSIS
L	SU 703 ALARM
M	CHASSIS LAMP
N	SQ CANCELLING
P	LS ON/OFF
R	+12V CONT.
S	LS (AF OUTPUT
T	CHASSIS VOLUME
U	CHANNEL 6
V	CHANNEL 4
W	INT-LS CHASSIS
X	CHANNEL 5
Y	CHANNEL 3
Z	
AA	CHASSIS LS
BB	TONE KEY
CC	CHANNEL 2
DD	MC CHASSIS
EE	+12V CALL LAMP
FF	VOLUME CONTROL TOP
HH	CHANNEL 1
JJ	MC SIGNAL
KK	START-
LL	START+
MM	VOLUME CONTROL EXT.
NN	MC +12V

NOTE: DE FIRE TERMINALRÆKKER PÅ DIAGRAMMET REPRÆSENTERER EN OG SAMME TERMINALRÆKKE PÅ TERMINALBRÆDTET.

NOTE: THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON THE TERMINAL BOARD.

NOTE 2: TB701 AND TB702 ARE INSERTED IN RADIOTELEPHONES WITHOUT TONE EQUIPMENT.

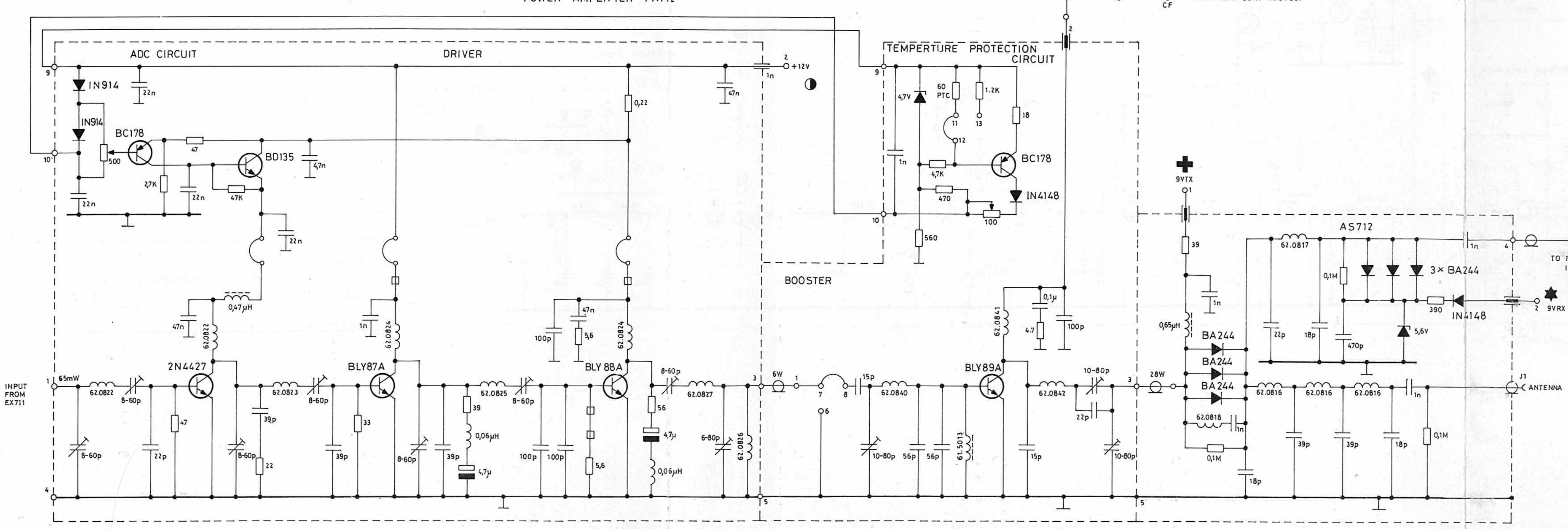
NOTE 2: TB701 OG TB702 ANVENDES KUN I RADIOTELEFON UDEN TONEUDSTYR.

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD. TERMINAL NUMBERS OF UNITS CONFORM TO THE TERMINAL NUMBERS USED ON THE DIAGRAM OF THE VARIOUS UNITS.

LEDNINGSNUMRENE REFFERERER TIL NUMRENE PÅ TERMINALBRÆDTET. TERMINALNUMRENE PÅ ENHEDERNE ER DE SAMME SOM ANFØRT PÅ DE RESPEKTIVE DIAGRAMMER.

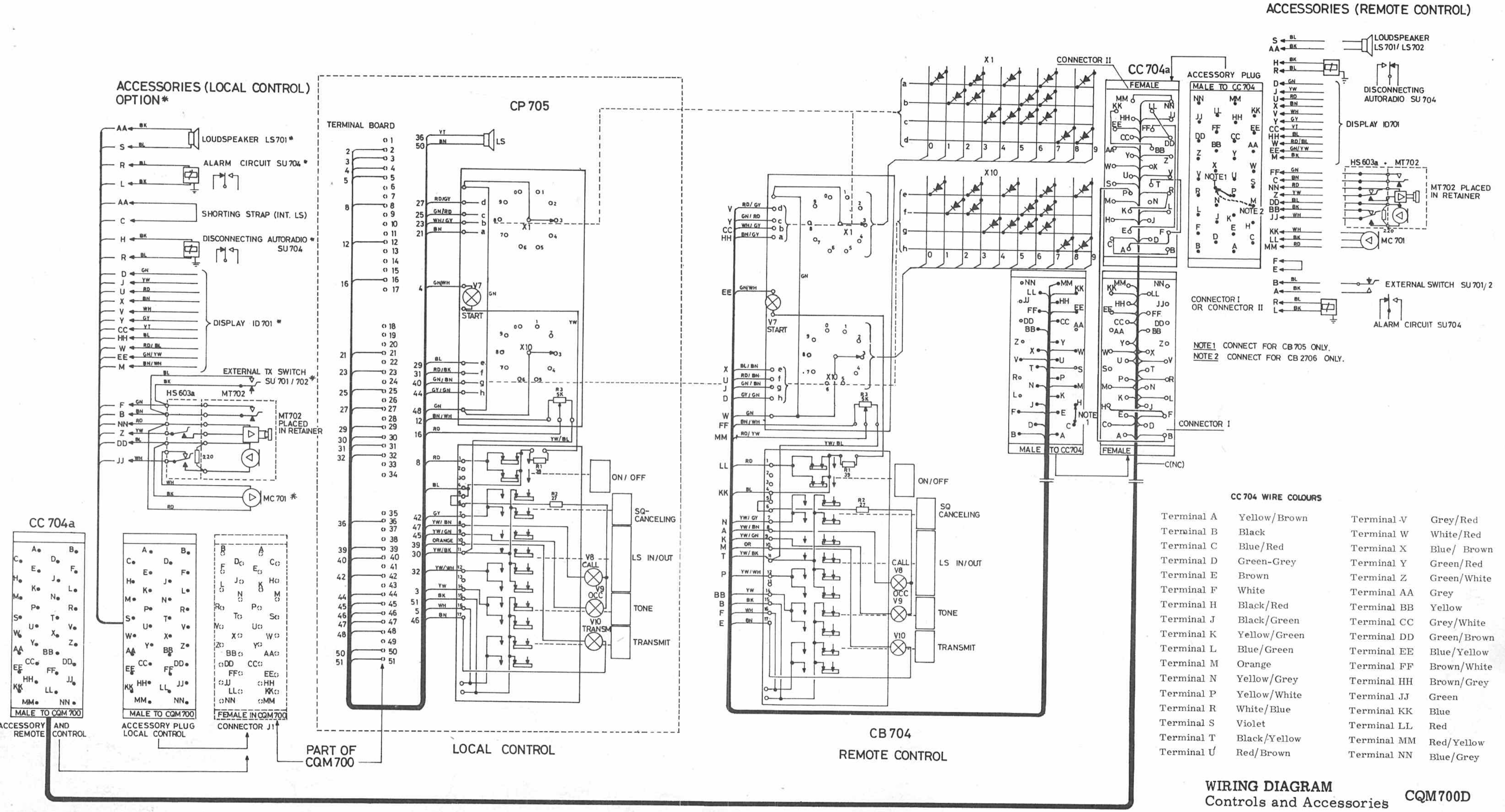
CABLING

POWER AMPLIFIER PA712



CQM713-25
CQM714-25

Storno



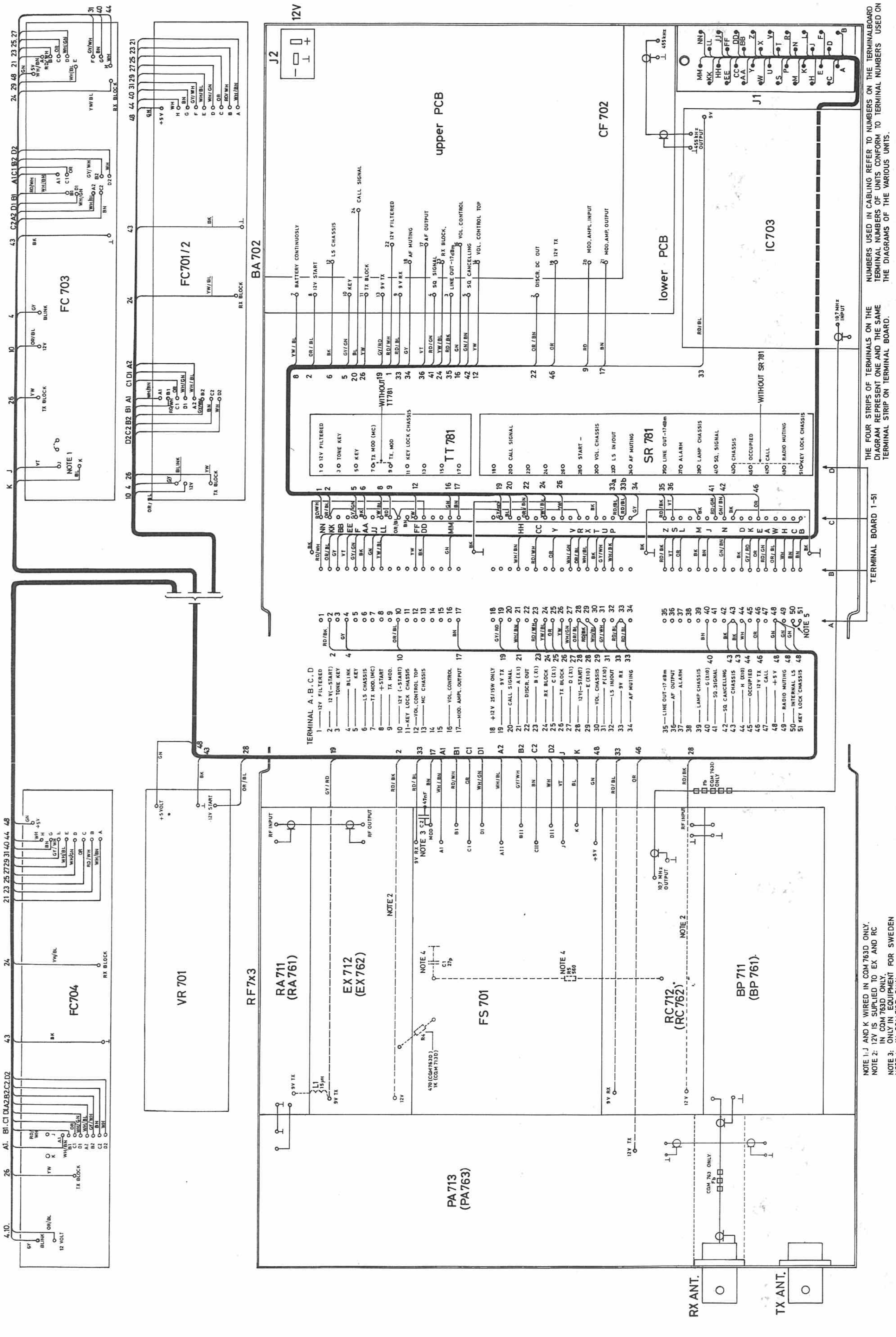
CC 704 WIRE COLOURS

Terminal A	Yellow/Brown	Terminal V	Grey/Red
Terminal B	Black	Terminal W	White/Red
Terminal C	Blue/Red	Terminal X	Blue/ Brown
Terminal D	Green-Grey	Terminal Y	Green/Red
Terminal E	Brown	Terminal Z	Green/White
Terminal F	White	Terminal AA	Grey
Terminal H	Black/Red	Terminal BB	Yellow
Terminal J	Black/Green	Terminal CC	Grey/White
Terminal K	Yellow/Green	Terminal DD	Green/Brown
Terminal L	Blue/Green	Terminal EE	Blue/Yellow
Terminal M	Orange	Terminal FF	Brown/White
Terminal N	Yellow/Grey	Terminal HH	Brown/Grey
Terminal P	Yellow/White	Terminal JJ	Green
Terminal R	White/Blue	Terminal KK	Blue
Terminal S	Violet	Terminal LL	Red
Terminal T	Black/Yellow	Terminal MM	Red/Yellow
Terminal U	Red/Brown	Terminal NN	Blue/Grey

WIRING DIAGRAM
Controls and Accessories

CQM700D

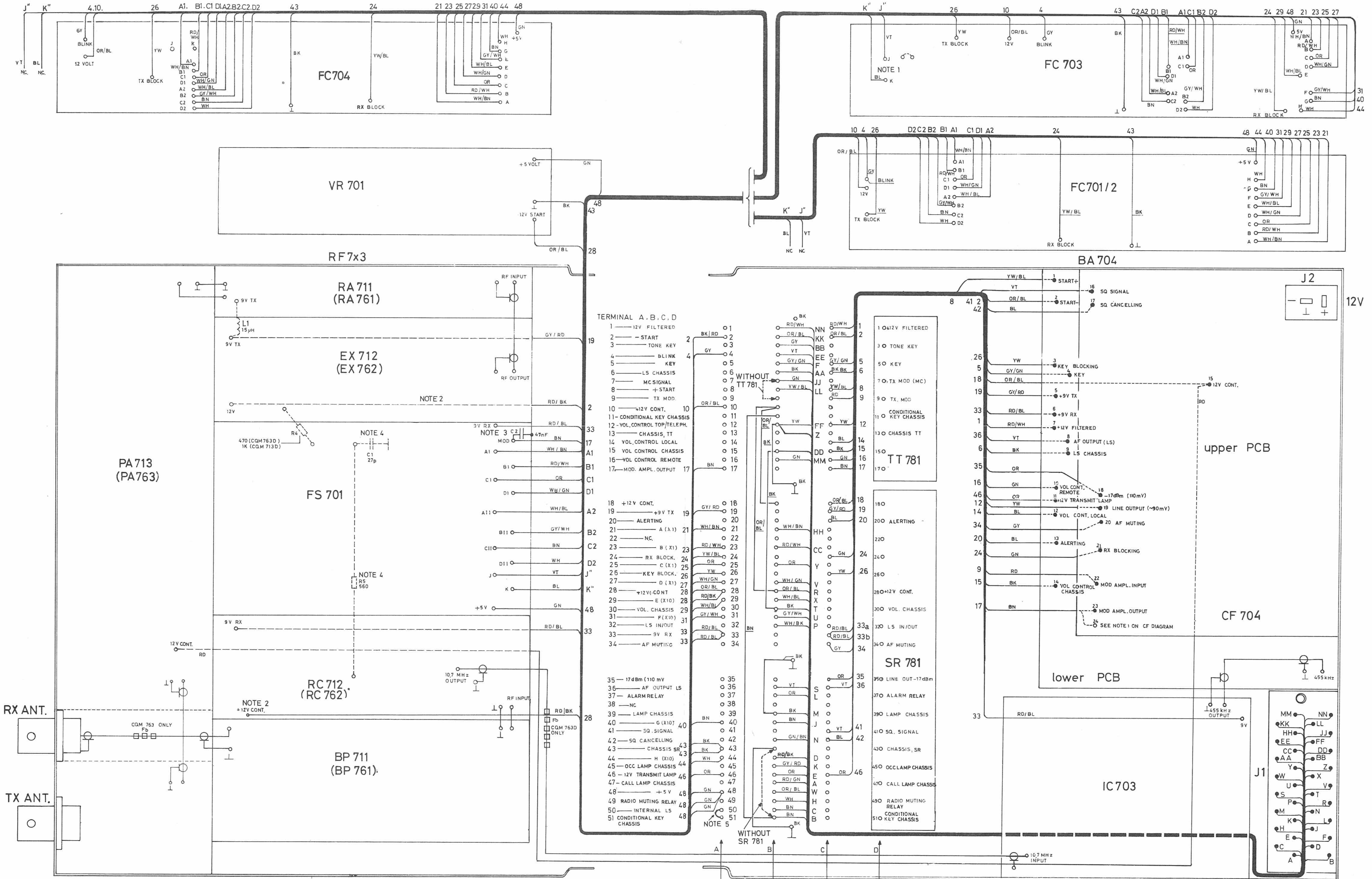
D 402.017/6



WIRING DIAGRAM CQM700D

D401.871/3

Storno Storno



THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON TERMINAL BOARD.

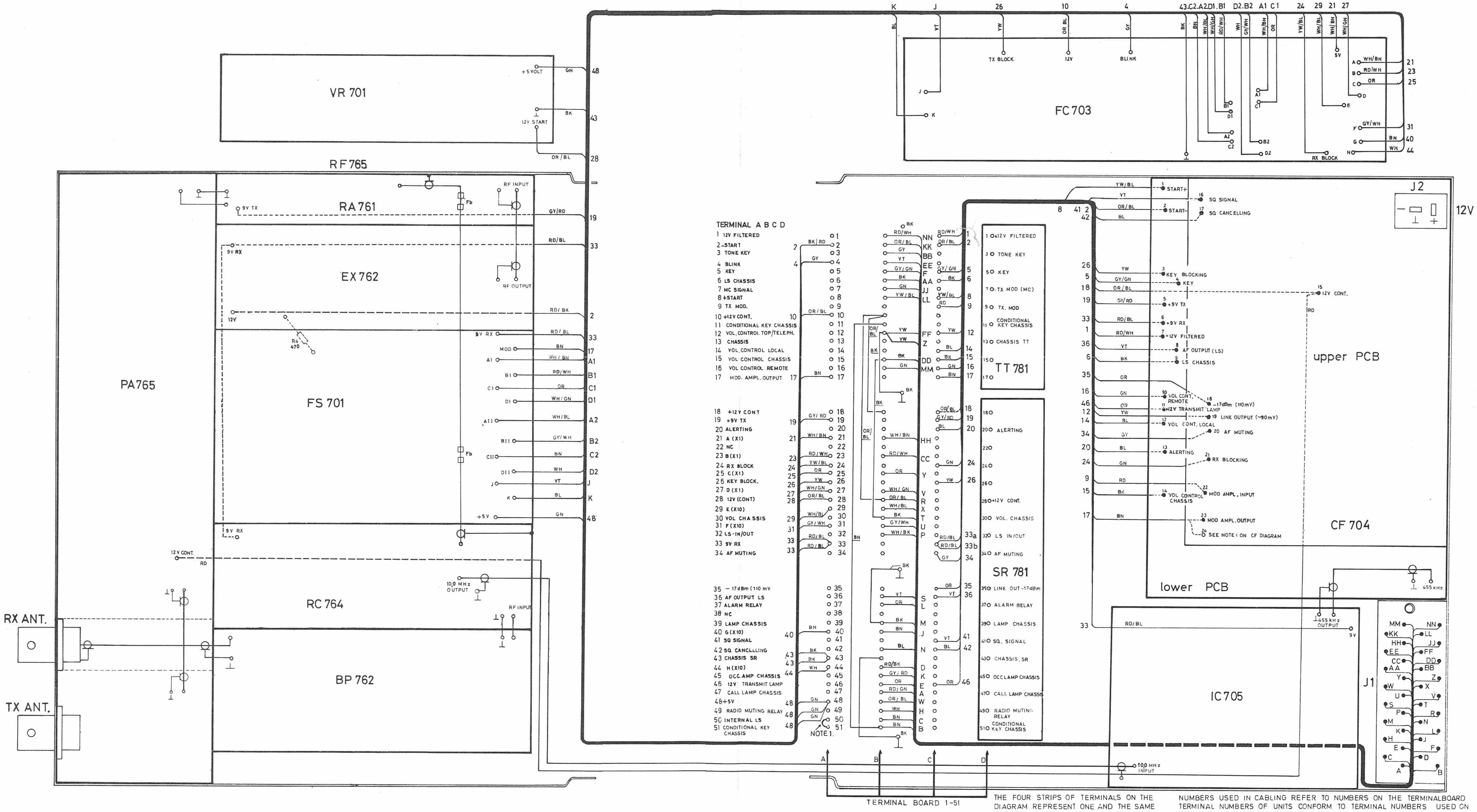
NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD TERMINAL NUMBERS OF UNITS CONFORM TO TERMINAL NUMBERS USED ON THE DIAGRAMS OF THE VARIOUS UNITS.

NOTE 1: J AND K WIRED IN CQM 763D ONLY.
NOTE 2 IS SUPLIED TO EX AND RC IN CQM 763D ONLY.
NOTE 3: ONLY IN EQUIPMENT FOR SWEDEN
NOTE 4: IN CQM 713D ONLY.
NOTE 5: IN LOCAL CONTROLLED UNITS: REMOVE CONNECTING WIRE

CABLE FORM CQM713D

D402.361

Storno



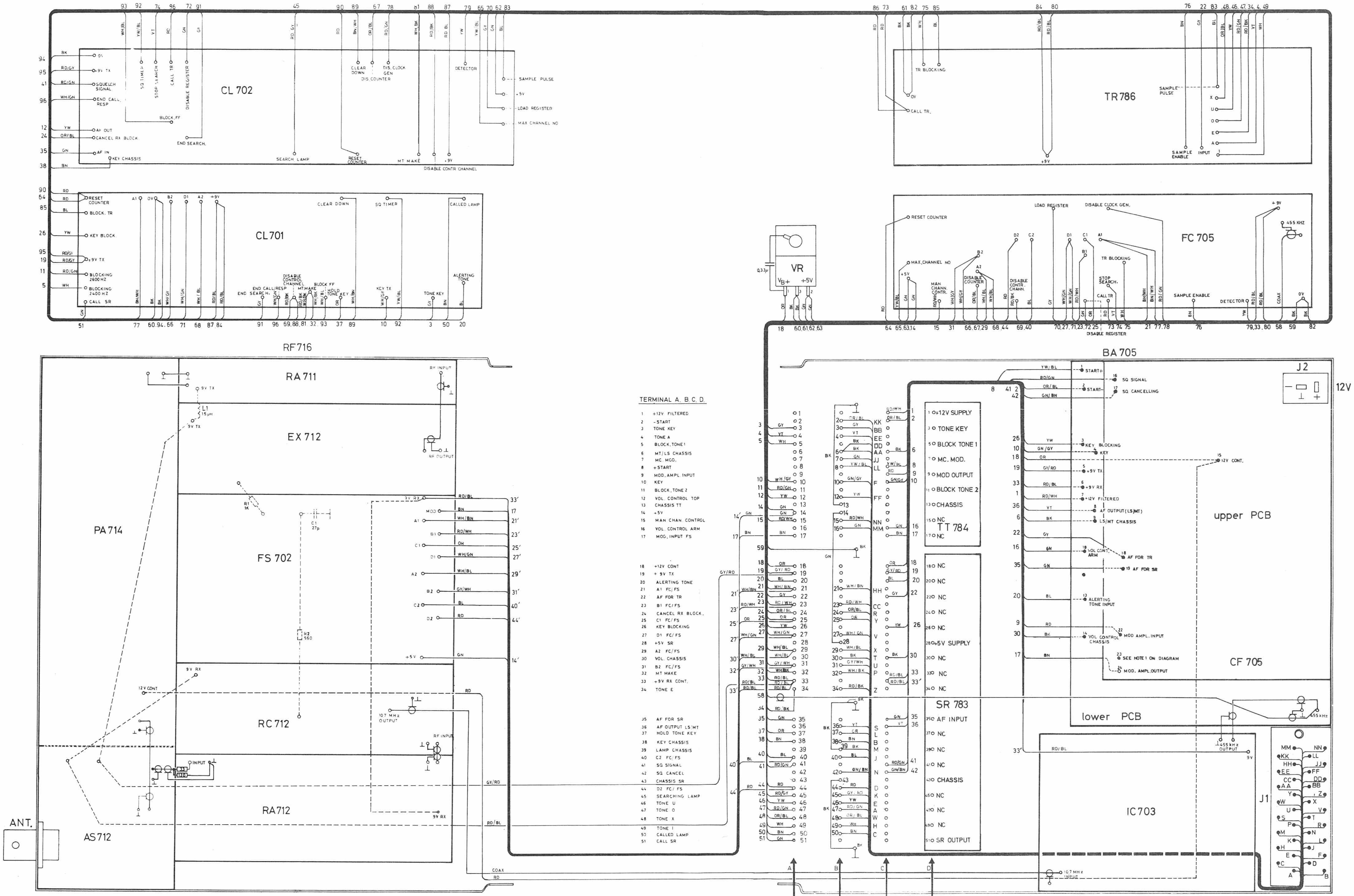
THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON TERMINAL BOARD.

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD TERMINAL NUMBERS OF UNITS CONFORM TO TERMINAL NUMBERS USED ON THE DIAGRAMS OF THE VARIOUS UNITS.

NOTE 1: IN LOCAL CONTROLLED UNITS: REMOVE CONNECTING WIRE

CABLE FORM CQM763D-12

D402.381

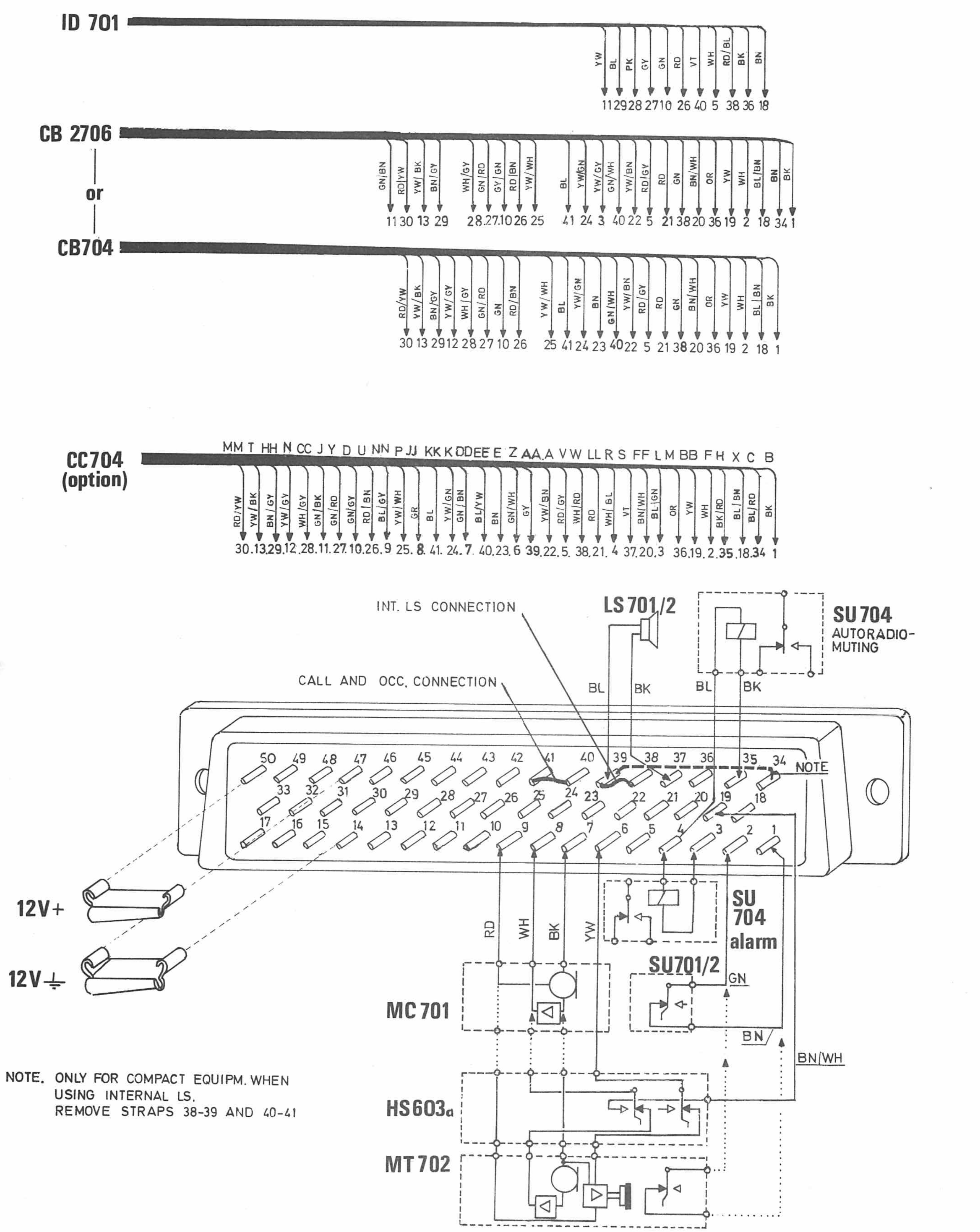


THE FOUR STRIPS OF TERMINALS ON THE DIAGRAM REPRESENT ONE AND THE SAME TERMINAL STRIP ON TERMINAL BOARD

NUMBERS USED IN CABLING REFER TO NUMBERS ON THE TERMINALBOARD TERMINAL NUMBERS OF UNITS CONFORM TO TERMINAL NUMBERS USED ON THE DIAGRAMS OF THE VARIOUS UNITS.

CABLE FORM CQM713-P3

D402.452



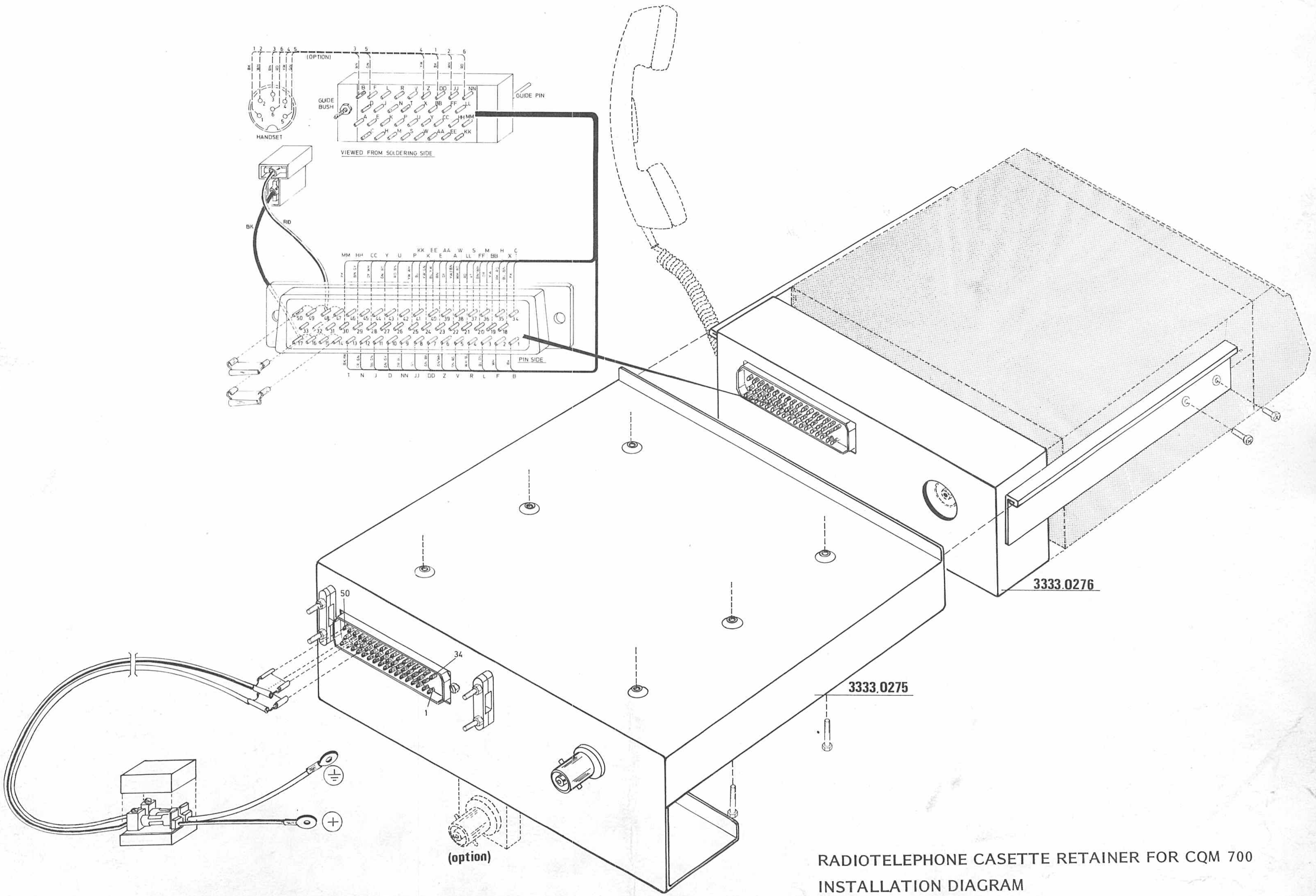
NOTE. ONLY FOR COMPACT EQUIPM. WHEN USING INTERNAL LS. REMOVE STRAPS 38-39 AND 40-41

RADIOTELEPHONE CASETTE RETAINER FOR CQM 700 D

CABLE CONNECTIONS

D402. 417/2

Storno



RADIOTELEPHONE CASETTE RETAINER FOR CQM 700
INSTALLATION DIAGRAM

D402.415

STORNOPHONE700

MAINTENANCE MANUAL

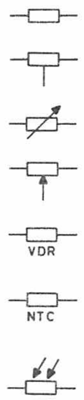
VOLUME 1

Section 10

TITLE	Code
Graphical Symbols 1-3	60.085-E1

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Resistors (R)



Resistor

Resistor with fixed tap

Variable resistor

Resistor with movable tap

Varistor (voltage-dependent resistor)

Temperature-dependent resistor with negative temperature coefficient

Light-sensitive resistor (Photosensitive resistor)

Capacitors (C)

Capacitor

Variable capacitor

Trimmer capacitor

Feedthrough capacitor

Electrolytic capacitor

Coils (L)

RF coil, air core

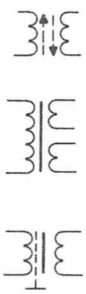
Coupled RF coils, air core

RF coil with core

RF coil with adjustable core

AF choke

Transformers (T)

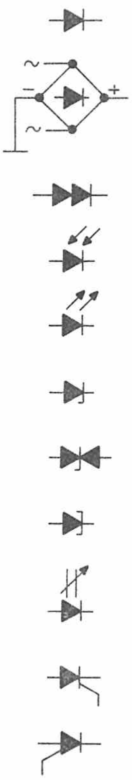


Transformer with adjustable RF cores

Transformer with iron core

Transformer with screen connected to chassis

Diodes (E)



Diode

Bridge rectifier

Series-connected stabilizer diodes within one case

Light-sensitive diode (Photosensitive diode)

Light-emitting diode

Zener diode (unidirectional)

Zener diode (bidirectional)

Tunnel diode

Varactor diode (capacitance diode)

Controlled rectifier, PNPN (N-thyristor)

Controlled rectifier, NPNP (P-thyristor)

Transistors (Q)

Transistor, PNP

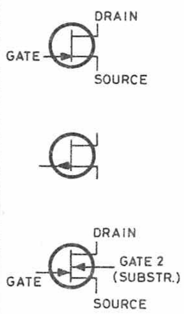
Transistor, NPN

Light-sensitive transistor

Unipolar transistor with N-type base

Unipolar transistor with P-type base

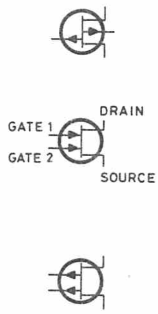
Junction Field Effect Transistors (JFET)



N-channel JFET

P-channel JFET

N-channel dual gate JFET

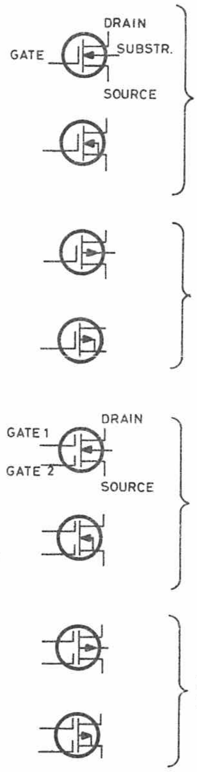


P-channel dual gate JFET

N-channel JFET tetrode

P-channel JFET tetrode

Insulated Gate Field Effect Transistors (IGFET or MOS)



N-channel IGFET (MOS)

P-channel IGFET (MOS)

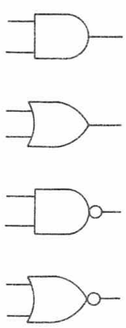
N-channel dual gate IGFET (MOS)

P-channel dual gate IGFET (MOS)

Integrated Circuits (IC)

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

Gates



AND gate

OR gate

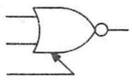
NAND gate

NOR gate

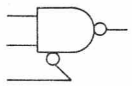
GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Gates, continued

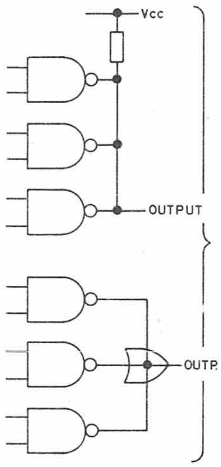
Exclusive OR gate



NOR gate with expander input (high)



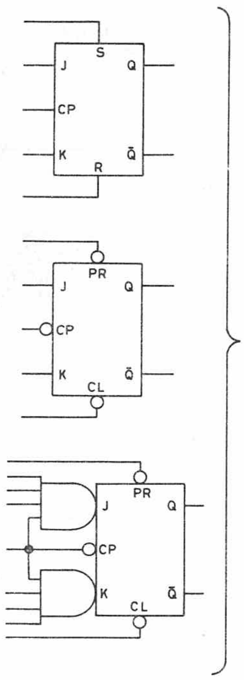
NAND gate with expander input (low)



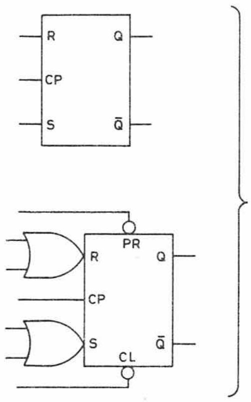
Wired OR (combined OR outputs) (presentation at top is used in detailed diagrams; presentation below is used in functional diagrams)

Flip-flops

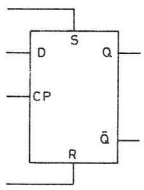
Abbreviations used:
S = Set
R = Reset
CP = Clock Pulse
PR = Preset
CL = Clear



J-K Flip-flops

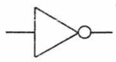


R-S Flip-flops



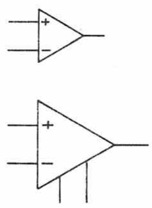
D Flip-flop

Inverters



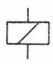
Inverter

Operational Amplifiers

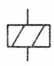


Operational amplifiers

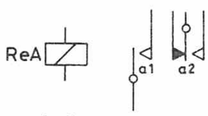
Relays (RE)



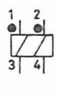
Single-coil relay



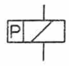
Dual-coil relay



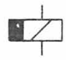
Relay with make contacts and change-over contacts



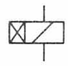
Relay with direction of winding indicated. Dot indicates two coils wound in the same direction



Polarized relay



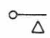
Coil for slow-release relay



Coil for slow-acting relay

Contacts

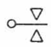
Contacts are always shown in their non-operated positions unless otherwise specified



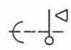
Make contacts

Break contacts

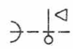
Change-over contacts



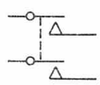
Change-over contacts, centre off



Make contacts, delayed operation

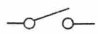


Make contacts, delayed release

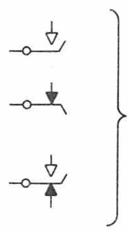


Mechanically coupled make contacts

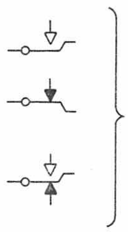
Switches and Keys (O)



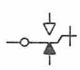
On/off switch



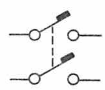
Locking keys or switches; push on, push off



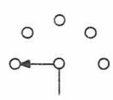
Non-locking self-releasing keys or switches



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



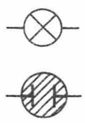
Self-releasing switch (overcurrent switch etc.)



Rotary switch

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

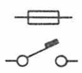
Lamps (V)



Indicator lamp

Neon lamp

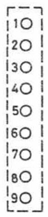
Fuses and Cut-outs (S)



Fuse

Circuit-breaker

Tag Strips (KL)



Tag strip - dashed frame may be wholly or partly omitted

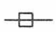
Batteries (BT)

Battery

Feedthrough Filters (F)

Feedthrough filter

Ferrite Beads (FB)

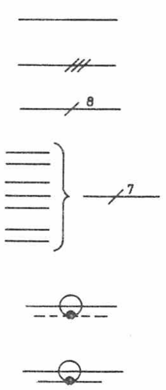


Ferrite bead

Crystals (X)

Crystal

Cables and Wires (W)



Usual conductor

Three conductors

Eight conductors

Shift from multiple-line to single-line presentation

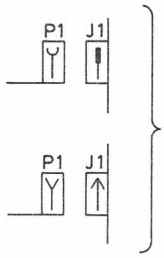
Screened wire

Coaxial cable

Connectors (J and P)

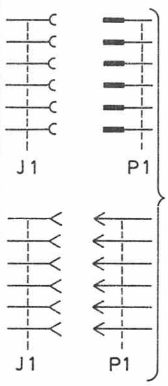
Female connector (socket). Lower symbol discontinued

Male connector (plug). Lower symbol discontinued



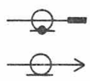
Schematic symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)

Multi-wire connectors are always designated "J" when permanently mounted on a cabinet or unit etc., "P" when fitted to cables

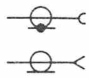


Detail symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)

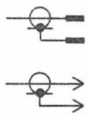
Where both connectors are fitted to cables, male connector is designated "P" and female connector "J"



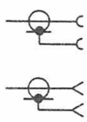
Coaxial plug



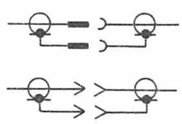
Coaxial socket



Coaxial plug for floating screen



Coaxial socket for floating screen



Coaxial plug with mating socket

Loudspeakers (LS)

Loudspeaker

Telephones (TEL)

Telephone

Single headphone (earphone)

Double headphone (headset)

Microphones (M)

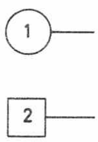
Meters etc.

Indicating instrument

Balancing instrument

Inkwriter, recording instrument

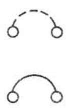
Test Points



DC test point

AC test point

Replaceable Connections

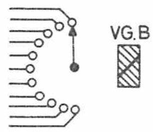


Cross-field connection (jumper)

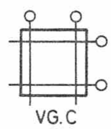
Strap

Selectors (VG)

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



Detail symbol for rotary selector



Co-ordinate selector