Stormo

TECHNICAL SPECIFICATIONS

CQM5110-2RC

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

146 - 174 MHz

Channel Separation

CQM5112-2RC: 30/25 kHz

CQM5113-2RC: 20 kHz

CQM5114-2RC: 12.5 khz

Maximum Frequency Deviation

CQM5112-2RC: ±5 kHz

CQM5113-2RC: ±4 kHz

CQM5114-2RC: ±2.5 kHz

Modulation Frequency Range

CQM5112-2RC: 300 - 3000 Hz

CQM5113-2RC: 300 - 3000 Hz

CQM5114-2RC: 300 - 2550 Hz

Maximum RF Bandwidth

1.5 MHz. 2 channel groups within

a 15 MHz frequency range

Antenna Impedance

50 ohm

Number of Channels

2 to 6

Supply Voltage

Minimum: 10.8 V

Nominal: 13.2 V

Maximum: 16.6 V

Negative potential to chassis

Temperature Range

 -30° C to $+60^{\circ}$ C

Dimensions

B x D x H: 180 x 190 x 60mm

Weight

1.8 Kg

RECEIVER

Sensitivity

12dB SINAD (EIA), ½e.m.f.

0.4 uV (0.25 uV)

20 dB SINAD (CEPT) e.m.f.

CQM5112-2RC: 0.75 uV (0.55 uV)

CQM5113-2RC: 0.75 uV (0.55 uV)

CQM5114-2RC: 1.0 uV (0.75 uV)

Measured with psophometric filter.

Crystal Frequency Range

45.1 - 54.5 MHz

Crystal Frequency Calculation (fx)

 $fx = \frac{Fs - 10.7}{3}MHz$

Frequency Stability

Conforms with government regulations

Modulation Acceptance Bandwidth (EIA)

CQM5112-2RC: ±7 kHz (±7.5 KHz)

Adjacent Channel Selectivity

EIA

CQM5112-2RC: 75 dB (90 dB)

FTZ

CQM5113-2RC: 70 dB (88 dB)

CEPT

CQM5112-2RC: 75 dB (90 dB)

CQM5114-2RC: 65 dB (88 dB)

Spurious Rejection

EIA

80 dB (85 dB)

Intermodulation Attenuation

EIA

CQM5112-2RC: 70 dB (72 dB)

CQM5113-2RC: 70 dB (72 dB)

CEPT

CQM5112-2RC: 70 dB (75 dB)

CQM5113-2RC: 70 dB (75 dB)

CQM5114-2RC: 70 dB (73 dB)

Blocking

90dB/uV (104 dB/uV)

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

Δf=60% Δf max., 1 KHz, 1 W, RF 1mV

Audio Frequency Response

+1/-3 dB (+0/-1.5 dB) CEPT

Relative to 1000 Hz, -6 dB/octave

fm: CQM5112-2RC: 300 - 3000 Hz

CQM5113-2RC: 300 - 3000 Hz

CQM5114-2RC: 300 - 2550 Hz

+1/-1.5 dB (+0/-1 dB) FTZ

fm: CQM5113-2RC: 400 - 2700 Hz

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (60 dB)

Squelch Recovery Time

250 ms (200 ms)

Squelch Attack Time

150 ms (110 ms) EIA

Squels Closing Time

150 ms (50 ms) EIA

Current Consumption

Squelched: 180 mA (160 mA)

AF 2W:

550 mA (500 mA)

(2 channels, without tone equipment,

13.2 V supply)

TRANSMITTER

RF Power Output

CQM5110-2RC 6/10:

6 or 10 W

CQM5110-2RC 25:

25 W

RL = 50 ohm

Crystal Frequency Range

48.6 - 58 MHz

Crystal Frequency Calculation (fx)

 $fx = \frac{Fs}{}$

3

Frequency Stability

Conforms with government regulations

Unde sired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

70 db

AF Input Impedance

560 ohm

Modulation Sensitivity

90 mV ± 2dB

(60% ΔF max, 1 KHz)

Modulation Response

300 - 3000 Hz, 300 - 2550 Hz

+1/-3.0 dB (+0.5/-2 dB) EIA

relative to 1000 Hz, 6 dB/octave

400 - 2700 Hz

+1/-1.5 dB (+0.5/-1 dB) FTZ

relative to 1000 Hz, 6 dB/octave

Modulation Distortion

fm = 1000 Hz: 3% CEPT

fm = 300 Hz: 5%

 $\Delta f = 60\% \Delta f \text{ max}.$

FM Hum and Noise

70 dB

CEPT (measured with 750 usec de-emphasis)

Current Consumption

6W: less than 3 A (2.5 A)

10W: less than 3.5 A (3.0 A)

25W: less than 5.9 A (5.0 A)

GENERAL DESCRIPTION

CQM5110-2RC

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

A comparison of the various models are presented in the table below.

Althrough compact in size, it contains a transmitter/receiver, optimal 5-tone sequential encoder/ decoder or Channel Guard, and up to 6 transmit and receive channels.

Туре	CQM511	2-2RC	CQM511	3-2RC	CQM511	4-2RC
SPEC	6/10	25	6/10	25	6/10	25
Frequency Range MHz	146 - 17	74	146 - 17	74	146 - 17	74
RF Power W	6/10	25	6/10	25	6/10	25
Channel Spacing kHz	30/25		20		12,5	
Number						
of Channels	2 to 6		2 to 6		2 to 6	

CQM5110-2RC is identical with CQM5110 with the following changes:

RF5110 is replaced by RF5110-2RC and an interface unit, IU5001, is mounted on the channel selector board side in the CQM5000.

The interface unit IU5001 includes of a diode matrix selecting the receiver channel group and an adjustable DC-voltage network determining the distance between the two receiver channel groups.

The receiver channel frequencies may be arbitrarily selected from two groups within a 15 MHz antenna frequency range.

The transmitter channel frequencies can be selected within a 5 MHz antenna frequency range. RF5110-2RC has no built-in RX and TX oscillators for one channel set. The channel switches (multifrequency boards) XS 5111 and 5112 must therefore always be used.

Switching between simplex and semi-duplex channels is performed by the normal channel selector switch.

ACCESSORIES

Standard accessories include:

Mounting frame

Power cable

Fist microphone with retainer or

Fixed - mount microphone

External loudspeaker

External switches

MN5001

Mounting frame for mobile installations allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.

MN 703

Desk stand for fixed installations.

MN704a

Mounting frame for mobile installations and direct attachment to the vehicle.



MC5001

Fist microphone with retractable spiral cable for mobile installation.

HS5001 Retainer for MC5001

HS5002 Retainer, with switches,

for MC5001

MC704

Microphone with chockabsorbing mounting bracket for mobile installation.

MC703

Desk microphone with PTT switch for fixed installations.

MK5001

Installation kit containing connectors, power cable, fuses and fuseholders.

LS 701

Loudspeaker enclosed in a plastic housing, complete with cable.

SU701

Transmitter keying switch for mounting on the steering coloum.

SU702

Transmitter keying switch for mounting on the dashboard.

PS702/PS704

Power supply regulators for 24 V car battery installations, PS702: 25 W, PS704: 10 W max.

PS5001/PS703

Power supply for 220 V AC mains.

PS5001: 25 W and 10 W max.

PS 703: 10 W max.

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and reight sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via a System Interconnect Board located on the option side of the H-frame. A test connector is also located on the system board and is accessible from the rear of the radio.

This board also serves as channel switch unit.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ) and the multifrequency board (XS) mount in the top section of the chassis. Their switches and push buttons mount directly to the boards and protrude through the front.

Thin casted shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

Receiver front end 1st IF section with first and second oscillator 455 kHz 2nd IF portion with demodulator.

FRONT-END

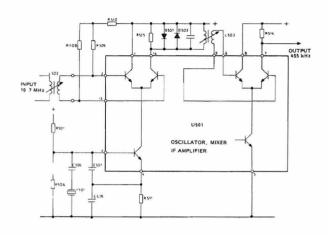
The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are design in micro-stripline techniques on the main-board.

RF5110-2RC has a varicap diode in each of the five receiver front-end coils (L401, L402, L403, L404,L405) and in each af the two receiver injection coils (L303, L305).

The DC-voltage for the varicap diodes is supplied from the interface unit output terminal (H9).

1st IF

The first IF frequency is 10.7 MHz. The output from the crystal filter is fed to a dual-gate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455kHz IF signal. Two diodes, D501-502, limit the output from the mixer.



455kHz IF/DEMODULATOR

The selectivity of the 455kHz IF amplifier is formed by a ceramic filter fed from a 455kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the quadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

SQUELCH

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605.

In the squelched condition and during transmissions this output is +1.5V and mutes the audio power amplifier. The transmit indicater is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO CIRCUITS

In sets with Pilot tone option, the audio line as signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629–C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not.

These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time.

The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

INTERFACE UNIT 1U5001

The choise of receiver channel group, low- or high antenna frequency, is made by connecting or disconnecting the wires (W101 to W106) from the channel selector (S901) on the XS5111/2 board to the input terminals (H1 to H6) on the IU5001 board.

With connections (the lower freq. group), the transistor (Q901) on XS 5111/2 earth the IU5001 input terminal and the voltage for the varicap diodes is determined by the setting of the potentiometer R102.

With no connections (the higher freq. group), the voltage for the diodes is fixed (app. 7 V) and determined by the voltage divider R101 and R103.

D107, in series with the varicap diode voltage, is a diode for temperature compensation.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the main board along with the receiver.

The exciter contains an FM oscillator, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing

harmonics and a circuitry which permits adjustment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the XS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by R116 in single channel sets. In multichannel sets the potentiometer is turned to maximum and the diviation adjusted individually; refer to XS5111 and XS5112.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the FM oscillator.

EXCITER

The exciter takes the third harmonic of the crystal oscillator, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter. The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is based by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

OSCILLATORS AND MULTIPLIER

The oscillators are located on the main board for single frequency radio sets. All parts for the oscillators and compensation network are soldered to the board except the crystal which is a plugin type.

A multifrequency board is required for more than one frequency channel. This board is available is two versions; one (XS5111) has space for accomodating two transmit and two receive channels; one (XS5112) has space for up to six channels and an option for selecting the channels by a 3-digit BCD signal binary converter, U901-U902. The BCD signal is applied to three pins in D911. Separate active circuitry is used for each oscillator and all have their outputs connected to two buffer amplifiers Q927-Q967. The buffers' outputs are fed to their resonant circuit on the main board by a plug-in connection (J301-J151).

The required oscillator is selected by switching the emitter of the oscillator transistor to the negative DC supply. The compensation voltage and audio for the oscillators is obtained from the same circuit on the main board via J902.

The maximum transmitter frequency deviation for the system is set by adjusting potentiometers, one for each channel, individually on each channel.

The oscillator uses a Colpitt's configuration with a bipolar transistor as the active element. The frequency is controlled by a third mode crystal which is operated at one third of the output frequency. This output frequency is selected by a tuned circuit in the transistor collector circuit. To provide modulation and compensation capability, the crystal, a variable inductor, and a vari-

cap (variable capacitance diode) are connected in series. The inductor provides adjustment of the frequency to set the oscillator to the channel frequency. The varicap permits electrical adjustment of the frequency. Compensation voltage is generated by a resistor – thermistor network and applied to the varicap. A resistor in parallel with the crystal prevents oscillations with the crystal removed from the circuit.

TRANSMITTER OSCILLATOR

In the transmitter the circuit is used with the following additions. First, an inductor is placed

across the crystal to resonate C_0 thus minimizing the audio distortion in the modulated output. Second, the audio voltage is superimposed on the compensating bias voltage to give the required deviation.

RECEIVER OSCILLATOR

In the receiver the oscillator circuit has a buffer amplifier connected between the collector of the oscillator transistor and the tuned circuit, to provide the required power level.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the interconnect board. Both inputs are connected to reverse polarity protection diodes D901, D902. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the interconnect board via a feed-through capacitor and a connector P201 to the transmitter PA stages. The other input feeds through P903 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections U602. The other section of the ON/OFF switch controls the $\rm V_B$ + to the voltage regulator S602 consisting of a monolitic regulator. The regulator output is fixed at 8.5V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

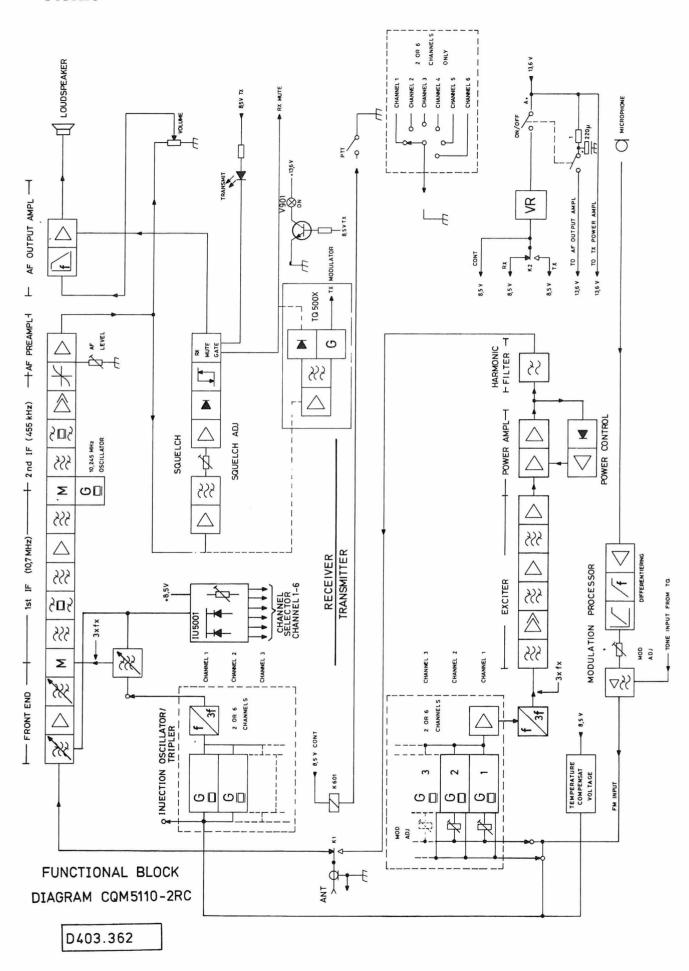
The squelch circuit, the modulation processor and parts of the IF amplifier U502 is supplied directly from the continuous 8.5 V.

The receiver front-end, the receiver oscillator, the 10.7 MHz IF stages and the second oscillator are supplied from 8.5 V RX. The transmitter oscillator and the exciter are supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



ADJUSTMENT PROCEDURE

CQM5110-2RC

The adjustment procedure for CQM5110 (next chapter, 60.381-E2) also applies to CQM5110-RC2 with the following modifications in the receiver adjustment.

CONNECTIONS

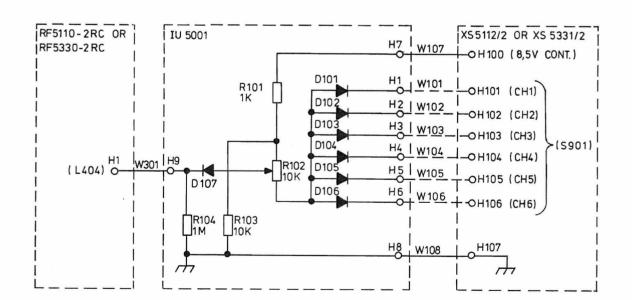
Check that all necessary straps are made on XS5111/XS5112. See IU5001 diagrams D403.111 and D403.112.

When the simplex/semi-duplex frequencies and channel number assignation are known, modification of the wiring W101-106 between XS511X and IU5001 can be made.

Remove the wires (W10X) for the numbers of receiver channels chosen to be in the high antenna frequency group and connect (solder) the wires (W10X) on the XS board for the rest of the receiver channels, chosen to be in the low antenna frequency group.

Storno

			From UI5001	To XS5000
Channel	1:	W101	Н1	H101
Channel	2:	W102	H2	H102
Channel	3:	W103	Н3	H103
Channel	4:	W104	H4	H104
Channel	5:	W105	H5	H105
Channel	6:	W106	H6	H106



INTERFACE UNIT IU5001
D403.111

OSCILLATORS AND MULTIPLIER

High frequency group

No connections between IU5001 and XS5111/2. The crystals are inserted.

Select the center channel frequency of the high frequency group. Set potentiometer R102 on IU5001 approximately to mid-position.

Proceed with the adjustment as in the rest of the adjustment procedure for CQM5110 (from "Oscillators and frequency multipliers"), adjusting only the coils corresponding to this group.

Low frequency group

The connections between IU5001 and XS5111/2 have to be inserted.

The crystals are inserted.

Select the center frequency channel of low group.

Connect the probe to the multimeter. Connect the probe to TP401.

Adjust the coils L96x - L96y for maximum deflexion on the multimeter (adjust only the coils corresponding to this group).

Adjust R102 on IU5001 for max. reading on the multimeter.

Connect the frequency counter to the probe. Read the frequency. Adjust L96x - L96y for specified frequency. Requirement: $F_{nom} \pm 0.4 \text{ p.p.m.}$ at 25°C . ($\pm 60 \text{ Hz}$ at 150 MHz)

Adjust the RF generator to the new center frequency.

SENSITIVITY

Check the 12 dB SINAD sensitivity on all channels in the group.

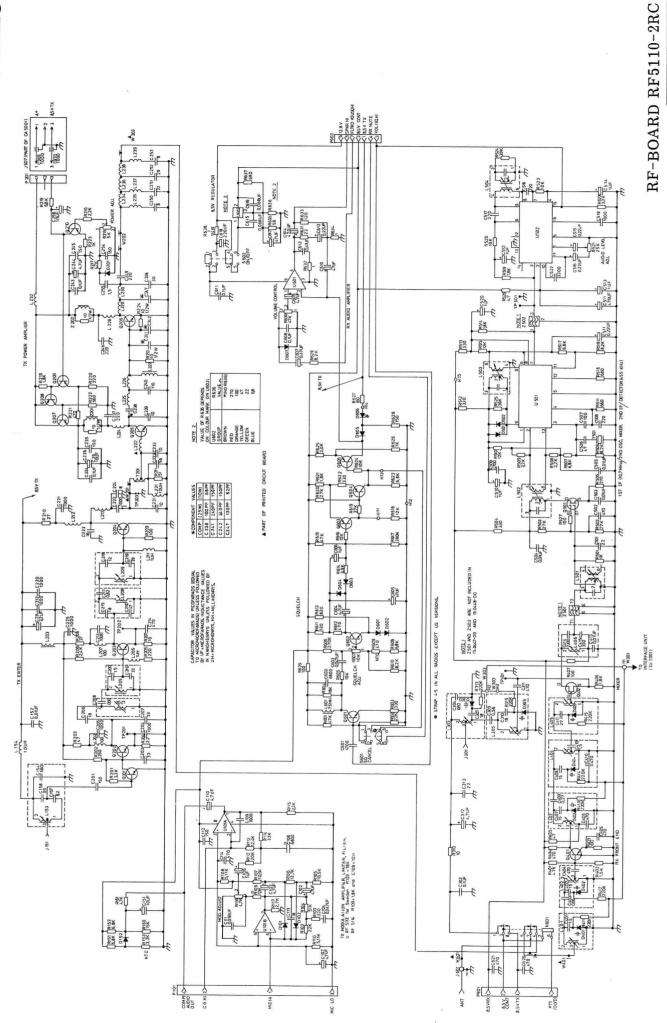
Readjust R102 on IU5001 for highest SINAD reading.

Requirement: Sensitivity <0, 4 u V.

If sensitivity requirement is not fullfilled readjust L401 - 402 - 403 - 404 - 405 for maximum sensitivity. Refer to the adjustment procedure of CQM5110.

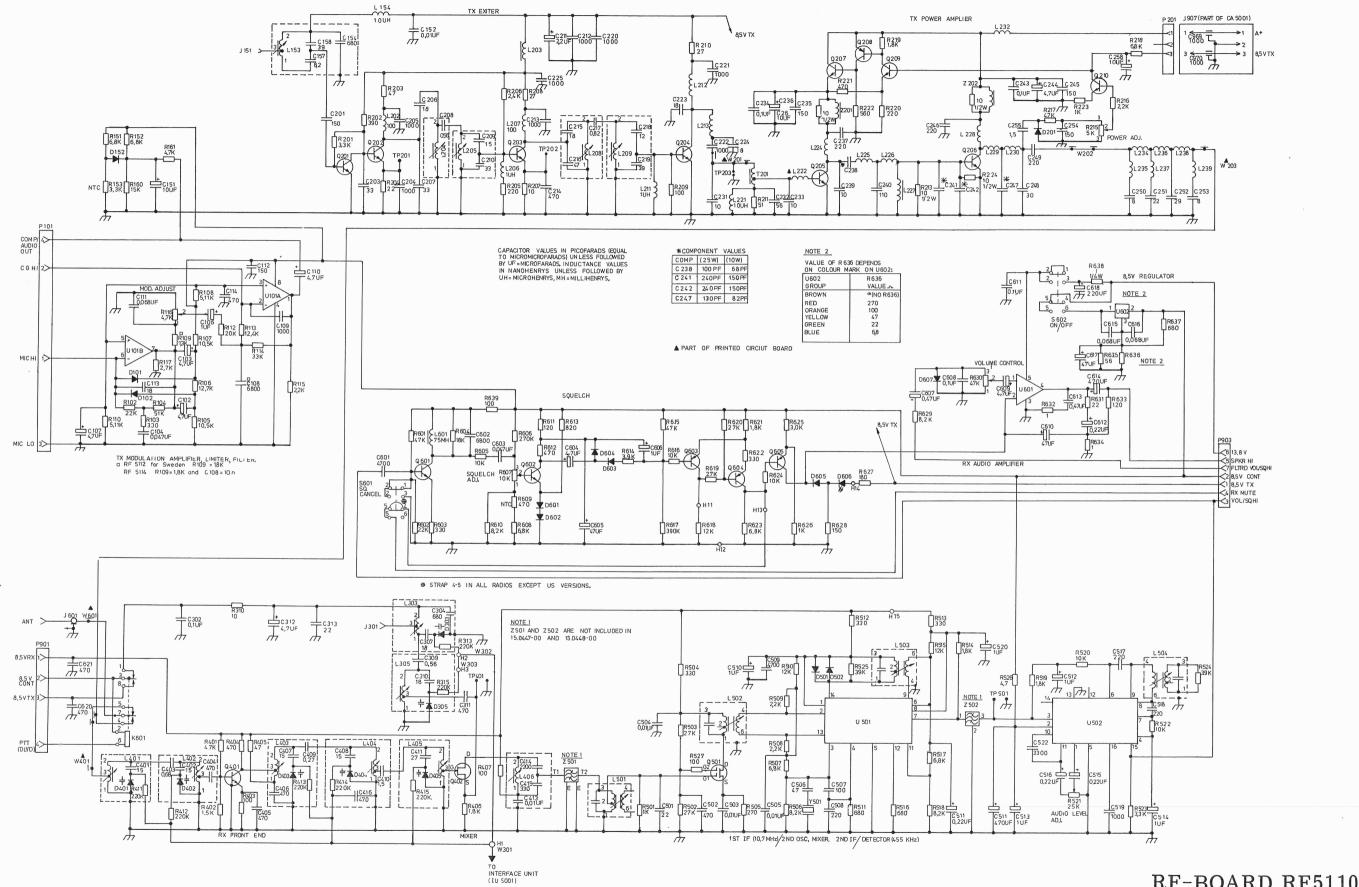
Check sensitivity on high frequency channel group.

Repeat adjustment of the front end until sensitivity requirement is fullfilled for both high and low channel groups.



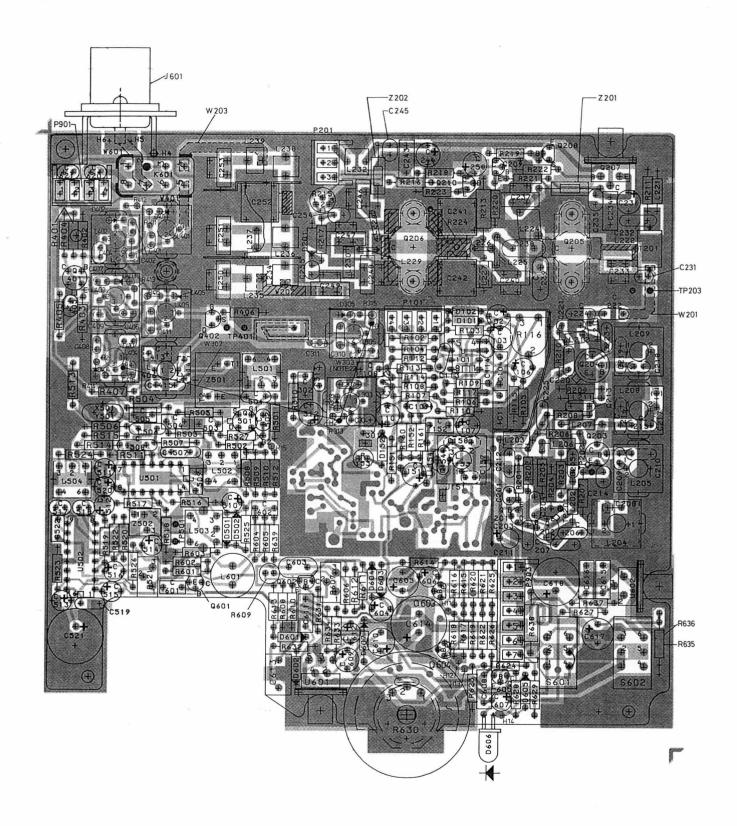
D403, 109

Storno

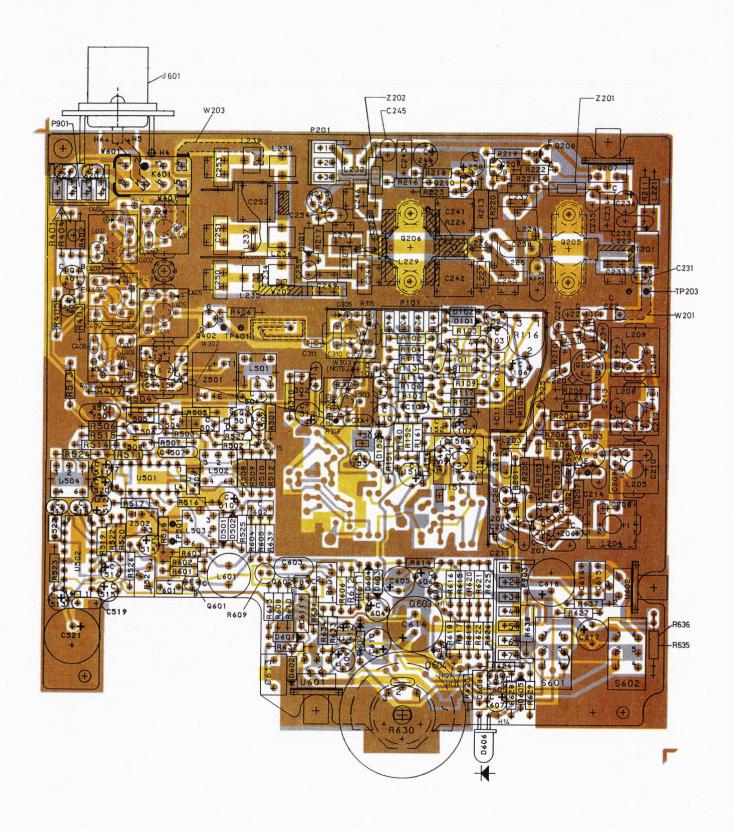


RF-BOARD RF5110-2RC

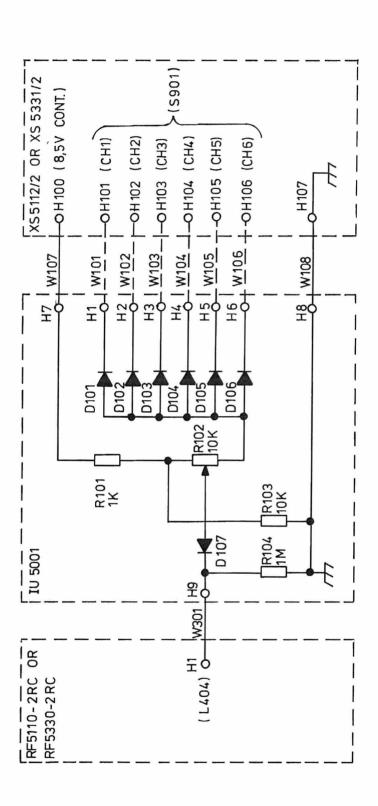
Storno Storno



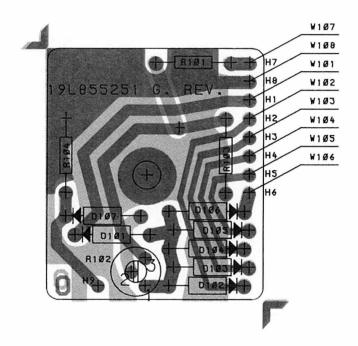
RF-BOARD RF5110-2RC COMPONENT LAYOUT



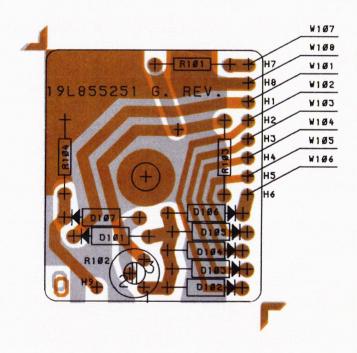
RF-BOARD RF5110-2RC COMPONENT LAYOUT



INTERFACE UNIT 105001



INTERFACE UNIT 1U5001 COMPONENT LAYOUT



INTERFACE UNIT 1U5001 COMPONENT LAYOUT

TECHNICAL SPECIFICATIONS

CQM5110 S12

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

146 - 174 MHz

Channel Separation

CQM5112: 30/25 kHz CQM5113: 20 kHz

CQM5114: 12.5 kHz

Maximum Frequency Deviation

CQM5112: ±5 kHz

CQM5113: ±4 kHz

CQM5114: ±2.5 kHz

Modulation Frequency Range

CQM5112: 300 - 3000 Hz

CQM5113: 300 - 3000 Hz

CQM5114: 300 - 2550 Hz

Maximum RF Bandwidth

RX: 1.5 MHz

TX: 2.5 MHz

Antenna Impedance

50 ohm

Maximum Number of Channels

12

Supply Voltage

Minimum: 10.8 V

Nominal: 13.2 V

Maximum: 16.6 V

Negative potential to chassis

Temperature Range

 -30° C to $+60^{\circ}$ C

Dimensions

 $B \times D \times H$: $180 \times 90 \times 60$ mm

Weight

1.8 Kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f.

0,4 uV (0,3 uV)

 $60\% \Delta \text{fmax}$; $f_{\text{mod}} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f. CQM5112: 0.75 uV (0.55 uV) CQM5113: 0.75 uV (0.55 uV)

CQM5114: 1.0 uV (0.75 uV)

60% Δ fmax; $f_{mod} = 1 \text{ kHz}$.

Measured with psophometric filter.

Crystal Frequency Range

43 - 53 MHz

Receiver VCO Frequency Range

135 - 163 MHz

Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth (EIA)

CQM5112: ±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

EIA

CQM5112: 75 dB (87 dB)

FTZ

CQM5113: 70 dB (87 dB)

CEPT

CQM5112: 75 dB (87 dB)

CQM5114: 65 dB (85 dB)

Spurious Rejection EIA

80 dB

Intermodulation Attennuation

EIA

CQM5112: 70 dB (72 dB)

CEPT

CQM5112: 70 dB (75 dB)

CQM5113: 70 dB (75 dB)

CQM5114: 70 dB (73 dB)

FTZ

CQM5113: 70 dB (72 dB)

Blocking

90 dB/uV (104 dB/uV)

Radiation

Conducted: max 0.8 nW

Radiated: max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W

AF Distortion

5% (1.5%)

60% Δf max., 1 kHz, 1 W, RF 1 mW

Modulation Response

CQM5112

<u> 300 - 3000 Hz</u>

+1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5113

400 - 2700 Hz

+1/-1.5 dB (+0.5/-1 dB)

300 - 400 Hz

2700 - 3000 Hz

+1.5/-3 dB (+0.5/3 dB)

relative to 1000 Hz, 6 dB/octave

CQM5114

300 - 2550 Hz

+1/-3 dB (+0.5/-2 dB)

Relative to 1000 Hz, -6 dB/octave

Hum and Noise (EIA)

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Recovery Time

250 ms (200 ms)

Attack Time (EIA)

150 ms (110 ms)

Squelch Closing Time (EIA)

150 ms (50 ms)

Current Consumption

Squelched: 350 mA (330 mA)

Receive; AF 2 W: 750 mA (730 mA)

(without tone equipment, 13.2 V supply)

TRANSMITTER

RF Power Output

CQM5110-6/10 W: 6/10 W

CQM5110 25 W: 25 W

 $R_1 = 50 \text{ ohm}$

Crystal Frequency Range

47 - 56 MHz

Crystal Frequency Multiplication

x3

Transmitter VCO Frequency Range

146 - 174 MHz

Frequency Stability

Conforms with government regulations

Undersired Radiation

max. 0.2 uW

Sideband Noise Power (CEPT)

Better than 70 dB

AF Input Impedance

560 ohm

Modulation Sensitivity

90 mV ±3 dB

(60% Δf max, 1 kHz)

Modulation Response

CQM5112

300 - 3000 Hz

+1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5113

400 - 2700Hz

+1/-1.5 dB (+0.5/-2 dB)

300 - 400 Hz

2700 - 3000 Hz

+1.5/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5114

300 - 2550 Hz

+1/3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

Modulation Distortion

fm = 1000 Hz: max. 3%

 $60\% \Delta f \text{ max}$.

fm = 300 Hz: max. 5%

5.5% Δf max.

measured with 750 us de-emphasis

FM Hum and Noise (CEPT)

55 dB (57 dB)

(measured with 750 us de-emphasis

and psophometric filter).

Current Consumption

CQM5110 -6/10 W: less than 3/3.5 A (2.5/3 A)

CQM5110 -25 W: less than 5.9 A (5 A)

GENERAL DESCRIPTION

CQM5110 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker. Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 12 transmit and receive channels.

A comparison of the various models is presented in the table below.

Туре	CQM5	112	CQM5	113	CQM5	114
SPEC	6/10	25	6/10	25	6/10	25
Frequency Range MHz	146 -	174	146 -	174	146 -	- 174
RF Power W	6/10	25	6/10	25	6/10	25
Channel Spacing kHz	30/2	25	20		12,	5
Max. Number					4	
of Channels	12		12		12	

ACCESSORIES

STANDARD	ACCESSORIES	MC5001	Fist microphone with retractables
			piral cable for mobile installation.
Mounting fr	rame	HS5001	Retainer for MC5001
Power cabl	e	HS5002	Retainer, with switches, for MC5001
Fist microp	hone with retainer or	MC5002	Cylindrical handmicrophone with
Fixed - mount microphone External loudspeaker External switches LS701 Loudspeaker enclosed in a plastic housing, complete with cable. MC702b Dynamic fist microphone with adjustable output level. JB701a Junction box for MC702b. Consists of a plastic housing provided with			build-in amplifier and press-to talk
Fist microphone with retainer or Fixed - mount microphone External loudspeaker External switches LS701 Loudspeaker enclosed in a plastic housing, complete with cable. MC702b Dynamic fist microphone with adjustable output level. JB701a Junction box for MC702b. Consists			switch. Fitted with a coiled cord
External sv	vitches		terminated into a connector which
LS701	Loudspeaker enclosed in a plastic		fits into the microphone retainer.
	housing, complete with cable.	HS 5003	Retainer for MC5002, without hook
MC702b	Dynamic fist microphone with adjust-		switch.
	able output level.	HS5004	Retainer for MC5002, with hook switch.
JB701a	Junction box for MC702b. Consists	MK5001	Installation kit containing connectors,
	of a plastic housing provided with		power cable, fuses and fuseholders.
	cable for soldering assembly. Junction	MN703	Desk stand for fixed installations.
	box is to mounted behind the first	MN704	Mounting bracket for the radio cabinet.
	microphone retainer.	MN5001	Mounting frame for mobile installa-
MC703a	Desk microphone with PTT (Push -to		tions allowing the radio to be fixed
	- Talk) switch for fixed installations.		in 36 positions. Includes a base plate
MC704	Microphone with chockabsorbing moun -		with locking screw.
	ting bracket for mobile installation.	MN5002	Mounting cassette for the radio
MK704	Mounting kit consisting of 2 flexible		cabinet (see mechanical layout).
	tubes, used for mounting the MC704	MT5001	Microphone with retainer. The retai-
	in close-talk position.		ner contains a microswitch which is

	used to switch off the internal loud-
	speaker, when the microphone is lifted.
SU701	Transmitter keying switch for
	mounting on the steering coloum.
SU702	Transmitter keying switch for
	mounting on the dashboard.
SU704	Switch circuit for autoradio mounting.
SU5003	External alarm with timer (Horn Alarm).

POWER SUPPLY UNITS:

Equipment	SUPPLY	VOLTAGE
	220V AC	+24V DC
CQM5000, max. 5 W	PS703	PS704
CQM5000, max. 20 W	PS5001	PS702

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FS), and the Frequency Control (FC) mount in the top section of the chassis. Their switches and push buttons mount directly to the boards and protrude through the front. Thin casted shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

RECEIVER DESCRIPTION

The receiver circuitry is placed on the main board and can be divided into:

Receiver front end

1st IF section with first and second oscillator 455 kHz 2nd IF portion with demodulator. (refer to functional block diagram)

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to the cry-

stal filter. The front-end, antenna relay, first mixer and part of the transmitter PA inter-connections are designed in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 10.7 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

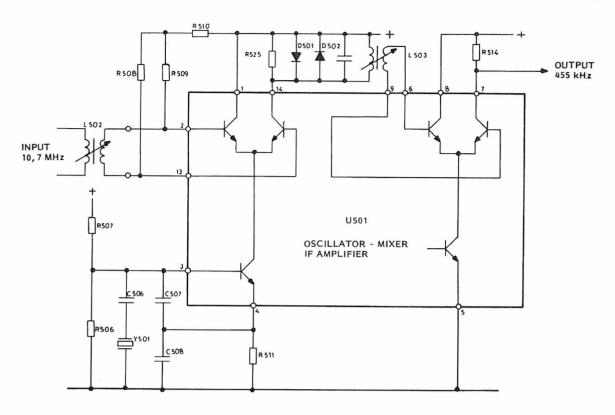


FIG. 1. SECOND OSCILLATOR , IF MIXER , AND IF AMPLIFIER

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The

final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the guadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

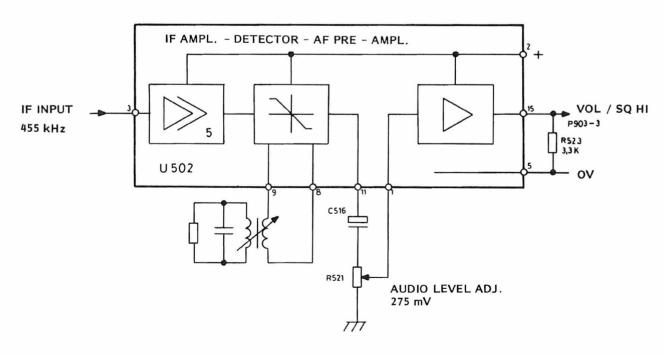


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicater is part of the muting function. A push button switch, S601, cancels the

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629-C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not. These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the main board along with the receiver.

The exciter contains, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjust-

ment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the FS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-

back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV.MAX. potentiometer on the RF board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the VCO on the Frequency Synthesizer board.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter.

The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages-Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1, 4: 1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is biased by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

FREQUENCY SYNTHESIZER

The frequency synthesizer provides up to 12 Channels and is built on a printed wiring board which mounts in the top section of the radioset. There are two versions of the board, a single channel board, FS5111, and a multichannel board, FS5112.

The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board uses a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the synthesizer board and protrudes through the front panel.

The Frequency Control unit FC5001 fits into a shield which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through P903 – J903 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections S602. The other section of the ON/OFF switch controls the

 ${
m V}_{
m B}$ + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

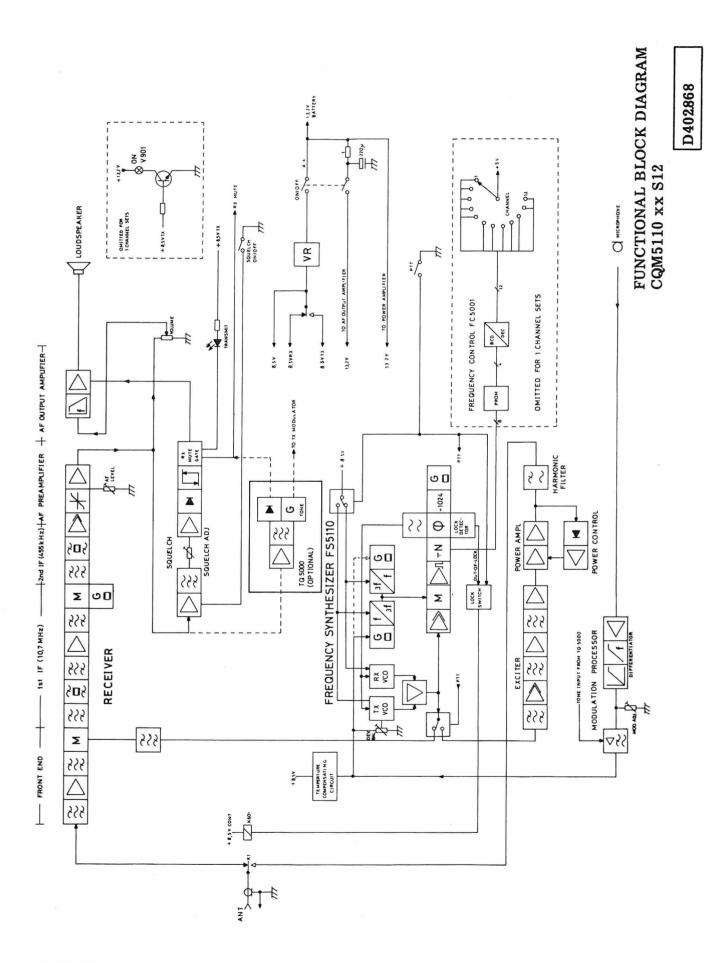
The squelch circuit, the modulation processor, parts of the IF amplifier U502, and the Frequency Synthesizer are supplied directly from the continuous 8.5 V.

The receiver front-end, the 10.7 MHz IF sta-, ges and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



CHANNEL PROGRAMMING INSTRUCTIONS

CQM5110 S12

Programming of the PROM which contains the data for the channel frequencies will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 17 or 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19)
Programming Pak, interchangeable
Socket adaptor
or universal programming pack.
DATA I/O UNIPAK (adaptable for

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

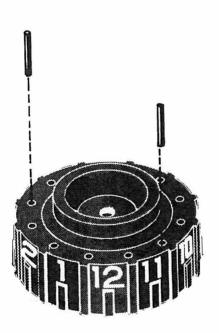
The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- Use receiver formula to calculate "V_{DEC}" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

- After completing the worksheet the next steps are:
- Enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.
- Insert the channel knob stop (if needed) if less than 9 channels, refer to fig. 1.
- In case of more than 8, but less than
 12 channels are used, transmission on
 unauthorized channels must be avoided.
 This is done by burning the unused
 channel locations in the PROM with
 the highest channel HEX CODE.

CHANNEL STOP

LOWEST	INSERT	HIGHEST	INSERT
CH.	PIN BETWEEN	CH.	PIN BETWEEN
1	10 and 11	1	3 and 4
2	11 and 12	2	4 and 5
3	12 and 1	3	5 and 6
4	1 and 2	4	6 and 7
5	2 and 3	5	7 and 8
6	3 and 4	6	8 and 9
7	4 and 5	7	9 and 10
8	5 and 6	8	10 and 11
9	6 and 7	9	11 and 12
10	7 and 8	10	12 and 1
11	8 and 9	11	1 and 2
12	9 and 10	12	2 and 3



Note:

If 8 channels are used insert only one PIN.

If more than 8 channels are used stop is not possible and no

PINs are inserted.

Fig. 1. SETTING OF CHANNEL KNOB STOP.

RECOMMENDED CRYSTAL FREQUENCIES CQM5110

CQM5112 - CQM5114	CQM5113	The state of the s
FREQUENCY RANGE	FREQUENCY RANGE	RX CRYSTAL
TREQUENCT RANGE	TREQUERCT RANGE	
145.2 - 148.3875		43.766666
146.2 - 149.3875	145.56 - 148.11	44.1
147.2 - 150.3875	146.56 - 149.11	44.433333
148.2 - 151.3875	147.56 - 150.11	44.766666
149.2 - 152.3875	148.56 - 151.11	45.1
150.2 - 153.3875	149.56 - 152.11	45.433333
151.2 - 154.3875	150.56 - 153.11	45.766666
152.2 - 155.3875	151.56 - 154.11	46.1
153.2 - 156.3875	152.56 - 155.11	46.433333
154.2 - 157.3875	153.56 - 156.11	46.766666
155.2 - 158.3875	154.56 - 157.11	47.1
156.2 - 159.3875	155.56 - 158.11	47.433333
157.2 - 160.3875	156.56 - 159.11	47.766666
158.2 - 161.3875	157.56 - 160.11	48.1
159.2 - 162.3875	158.56 - 161.11	48.433333
160.2 - 163.3875	159.56 - 162.11	48.766666
161.2 - 164.3875	160.56 - 163.11	49.1
162.2 - 165.3875	161.56 - 164.11	49.433333
163.2 - 166.3875	162.56 - 165.11	49.766666
164.2 - 167.3875	163.56 - 166.11	50.1
165.2 - 168.3875	164.56 - 167.11	50.433333
166.2 - 169.3875	165.56 - 168.11	50.766666
167.2 - 170.3875	166.56 - 169.11	51.1
168.2 - 171.3875	167.56 - 170.11	51.433333
169.2 - 172.3875	168.56 - 171.11	51.766666
170.2 - 173.3875	169.56 - 172.11	52.1
171.2 - 174.3875	170.56 - 173.11	52.433333
172.2 - 175.3875	171.56 - 174.11	52.766666
173.2 - 176.3875	172.56 - 175.11	53.1
	173.56 - 176.11	53.433333

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5110

CQM5112 - CQM5114	CQM5113	
FREQUENCY RANGE	FREQUENCY RANGE	TX CRYSTAL
- TALQUENOT KANGE	TREGEROT KARGE	
145.5 - 148.6875	144.86 - 147.41	47.433333
146.5 - 149.6875	145.86 - 148.41	47.766666
147.5 - 150.6875	146.86 - 149.41	48.1
148.5 - 151.6875	147.86 - 150.41	48.433333
149.5 - 152.6875	148.86 - 151.41	48.766666
150.5 - 153.6875	149.86 - 152.41	49.1
151.5 - 154.6875	150.86 - 153.41	49.433333
152.5 - 155.6875	151.86 - 154.41	49.766666
153.5 - 156.6875	152.86 - 155.41	50.1
154.5 - 157.6875	153.86 - 156.41	50.433333
155.5 - 158.6875	154.86 - 157.41	50.766666
156.5 - 159.6875	155.86 - 158.41	51.1
157.5 - 160.6875	156.86 - 159.41	51.433333
158.5 - 161.6875	157.86 - 160.41	51.766666
159.5 - 162.6875	158.86 - 161.41	52.1
160.5 - 163.6875	159.86 - 162.41	52.433333
161.5 - 164.6875	160.86 - 163.41	52.766666
162.5 - 165.6875	161.86 - 164.41	53.1
163.5 - 166.6875	162.86 - 165.41	53.433333
164.5 - 167.6875	163.86 - 166.41	53.766666
165.5 - 168.6875	164.86 - 167.41	54.1
166.5 - 169.6875	165.86 - 168.41	54.433333
167.5 - 170.6875	166.86 - 169.41	54.766666
168.5 - 171.6875	167.86 - 170.41	55.1
169.5 - 172.6875	168.86 - 171.41	55.433333
170.5 - 173.6875	169.86 - 172.41	55.766666
171.5 - 174.6875	170.86 - 173.41	56.1
172.5 - 175.6875	171.86 - 174.41	56.433333
173.5 - 176.6875	172.86 - 175.41	56.766666
174.5 - 177.6875	173.86 - 176.41	57.1
175.5 - 178.6875	174.86 - 177.41	57.433333
176.5 - 179.6875	175.86 - 178.41	57.766666

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY

SELFQUIETING FREQUENCIES CQM5112, CQM5114

	T	1
RECEIVER CRYSTAL	V	USE
FREQUENCY, MHz	DEC	ALTERNATIVE ⁺
		All of the second secon
43.766666	428	1
44.1	336	4
44.1	428	1
44.433333	256	4
44.433333	428	1-
44.766666	428	1
45.1	428	1
45.433333	428	1
45.766666	428	1
45.766666	454	2
46.1	374	2
46.433333	294	2
46.766666	428	1
47.1	428	1
47.433333	428	1
47.766666	428	1
48.1	428	1
48.433333	428	1
48.766666	428	1
49.1	428	1
49.1	472	2
49.1	474	2
49.433333	393	2
49.433333	394	2
49.433333	428	1
49.766666	313	2
49.76666	314	2
49.766666	428	1
50.1	428	1
50.1	432	4

TABLE 3A. SELFQUIETING FREQUENCIES

Continued on table 3B

⁺refer to worksheet

SELFQUIETING FREQUENCIES CQM5112, CQM5114

RECEIVER CRYSTAL	V	USE
FREQUENCY, MHz	DEC	ALTERNATIVE ⁺
50.433333	428	1
50.766666	272	3
50.766666	428	1
51.1	428	1
51.433333	428	1
51.766666	320	4
51.766666	428	1
52.1	344	4
52.1	428	1
52.433333	428	1
52.766666	304	4

TABLE 3B. SELFQUIETING FREQUENCIES

SELFQUIETING FREQUENCIES CQM5113

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE [†]
44.1	311	4
46.1	467	2
46.433333	367	2
46.766666	260	4
46.766666	267	2
49.433333	492	2
49.766666	392	2
50.1	292	2
50.433333	290	Avoid this frequency
53.1	390	4

TABLE 3C. SELFQUIETING FREQUENCIES

⁺refer to worksheet

⁺refer to worksheet

HEX CODE CONVERSION TABLE

0	-	2	3	4	2	9	7	8	6	٨	В	U	۵	ш	ட
256	257	258	259	260	261	262	263	797	265	592	267	268	269	270	271
272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
352	353	354	355	326	357	358	359	360	361	362	363	364	365	366	367
368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
384	382	386	387	388	389	390	391	392	393	394	395	396	397	398	399
400	401	402	403	404	405	9017	407	804	604	410	411	412	413	414	415
416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
432	433	434	435	436	437	438	439	044	441	442	443	444	445	944	447
844	644	450	451	452	453	424	455	456	457	458	459	094	461	462	463
†9 †	465	994	467	891	691	470	471	472	473	474	475	9/1	477	478	479
480	481	482	483	484	485	486	487	488	489	490	491	492	493	464	495
96ħ	467	498	664	200	501	502	203	504	202	206	202	208	209	510	511
Signifi	icant		of Hex	Code.			"V DE	L L	ımbers						
	256 272 272 288 304 320 336 352 368 384 400 416 432 448 448 464 480	256 257 272 273 272 273 288 289 304 305 320 321 336 337 352 353 368 369 384 385 400 401 416 417 416 417 432 433 448 449 464 465 480 481 496 497	1 2 257 258 273 274 289 290 305 306 321 322 337 338 353 354 369 370 385 386 401 402 417 418 433 434 449 450 465 466 481 482 481 482	b	3 259 275 291 307 323 339 355 371 403 419 419 451 467 483 499	3 4 259 260 275 276 291 292 307 308 323 324 339 340 355 356 371 372 387 388 403 404 419 420 436 420 451 452 467 468 483 484 499 500	3 4 5 259 260 261 275 276 277 291 292 293 307 308 309 323 324 325 339 340 341 355 356 357 371 372 373 403 404 405 419 420 421 435 436 437 451 452 453 467 468 469 483 484 485 499 500 501	3 4 5 6 259 260 261 262 275 276 277 278 291 292 293 294 307 308 309 310 323 324 325 326 339 340 341 342 355 356 357 358 371 372 373 374 403 404 405 406 419 420 421 422 451 452 454 454 451 452 454 456 467 468 469 470 483 484 485 486 499 500 501 502	3 4 5 6 7 8 259 260 261 262 263 26 275 276 277 278 279 28 291 292 293 294 295 29 307 308 309 310 311 31 307 308 309 313 34 34 339 340 341 343 34 34 357 356 357 359 36 36 36 371 372 373 374 375 37 40 403 404 405 406 407 40 419 420 421 423 42 42 451 452 453 439 44 42 467 468 469 470 47 47 483 484 485 486 487 48 <	3 4 5 6 7 8 259 260 261 262 263 26 275 276 277 278 279 28 291 292 293 294 295 29 307 308 309 310 311 31 307 308 309 313 34 34 339 340 341 343 34 34 357 356 357 359 36 36 36 371 372 373 374 375 37 37 387 388 389 390 391 39 40 403 404 405 406 407 40 41 419 420 421 423 42 42 42 467 468 469 470 47 48 48 483 484 485 </td <td>3 4 5 6 7 8 9 259 260 261 262 263 264 265 275 276 277 278 279 280 281 291 292 293 294 295 296 297 307 308 309 310 311 312 313 323 324 325 326 296 297 339 340 341 342 343 344 345 339 340 341 342 343 344 345 371 372 373 374 375 376 377 387 388 389 390 391 392 393 403 404 405 406 407 408 409 413 420 421 422 424 425 426 427 467 468 469</td> <td>3 4 5 6 7 8 9 A 259 260 261 262 263 264 265 266 275 276 277 278 279 280 281 282 291 292 293 294 295 296 297 298 307 308 309 310 311 312 313 314 307 328 326 326 297 298 329 330 339 340 341 342 343 344 345 346 339 340 341 343 344 345 346 331 341 342 343 344 345 346 403 340 343 344 345 346 403 404 407 408 409 410 410 410 407 408 406 410</td> <td>3 4 5 6 7 8 9 A B 259 260 261 262 263 264 265 266 267 275 276 277 278 279 280 281 282 283 291 292 293 294 295 296 297 298 299 307 308 309 310 311 312 313 314 315 323 324 325 326 236 237 328 329 330 339 340 341 342 343 344 345 346 347 339 340 341 342 348 349 340 341 341 341 341 341 341 341 341 341 342 341 342 341 342 341 341 441 441 441 441 441 <</td> <td>3 4 5 6 7 8 9 A B C 259 260 261 262 263 264 265 266 267 268 267 268 267 268 267 268 267 268 267 268 267 268 267 268 267 268 268 289 289 389 389 389 380 310 311 312 313 314 315 314 318 318 389 380 380 380 380 380 380 380 380 380 380 381 381 381 382 389 380 381 382 388 389 380</td> <td>3 4 5 6 7 8 9 A B C D 259 260 261 262 263 264 265 266 267 268 269 267 268 269 269 269 269 269 269 269 283 284 285 269 281 282 289 289 289 289 289 289 289 289 289 289 289 289 380 301 311 312 313 314 315 381 381 381 381 381 381 381 381 381 381 381 381 381 381 381 382 382 382 382 383</td>	3 4 5 6 7 8 9 259 260 261 262 263 264 265 275 276 277 278 279 280 281 291 292 293 294 295 296 297 307 308 309 310 311 312 313 323 324 325 326 296 297 339 340 341 342 343 344 345 339 340 341 342 343 344 345 371 372 373 374 375 376 377 387 388 389 390 391 392 393 403 404 405 406 407 408 409 413 420 421 422 424 425 426 427 467 468 469	3 4 5 6 7 8 9 A 259 260 261 262 263 264 265 266 275 276 277 278 279 280 281 282 291 292 293 294 295 296 297 298 307 308 309 310 311 312 313 314 307 328 326 326 297 298 329 330 339 340 341 342 343 344 345 346 339 340 341 343 344 345 346 331 341 342 343 344 345 346 403 340 343 344 345 346 403 404 407 408 409 410 410 410 407 408 406 410	3 4 5 6 7 8 9 A B 259 260 261 262 263 264 265 266 267 275 276 277 278 279 280 281 282 283 291 292 293 294 295 296 297 298 299 307 308 309 310 311 312 313 314 315 323 324 325 326 236 237 328 329 330 339 340 341 342 343 344 345 346 347 339 340 341 342 348 349 340 341 341 341 341 341 341 341 341 341 342 341 342 341 342 341 341 441 441 441 441 441 <	3 4 5 6 7 8 9 A B C 259 260 261 262 263 264 265 266 267 268 267 268 267 268 267 268 267 268 267 268 267 268 267 268 267 268 268 289 289 389 389 389 380 310 311 312 313 314 315 314 318 318 389 380 380 380 380 380 380 380 380 380 380 381 381 381 382 389 380 381 382 388 389 380	3 4 5 6 7 8 9 A B C D 259 260 261 262 263 264 265 266 267 268 269 267 268 269 269 269 269 269 269 269 283 284 285 269 281 282 289 289 289 289 289 289 289 289 289 289 289 289 380 301 311 312 313 314 315 381 381 381 381 381 381 381 381 381 381 381 381 381 381 381 382 382 382 382 383

Example "VDEC"= 345 equals to hex code 59.—LSD "VDEC"= 469 equals to hex code D5.

Table 4. "V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

PROGRAMMING WORKSHEET FOR CQM5110 S12

Storno

				Ī	T	Γ			Γ		T		Τ		T		Г		
	PROM	ADDRESS (HEX)	10	11	12	13	14	15	16	17	18	19	1A	18	701): D=	(D × 3)			ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING: 1. SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY 2. SELECT HIGH SIDE INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 11.15500 MHz INSTEAD OF 10.245000 MHz 3. USE SLIGHTLY OFFSET REFERENCE CRYSTAL
TRANSMITTER	>	нех													REQ. (Y7	В			E RECEIV CRYSTAL FREQUENC OF 10.245 RENCE CF
TRANS	>	DEC													YSTAL F	V _{DEC} =			S IF THI C MIXER ECTION I VSTEAD ET REFE
	L	Ξ													XER CR'	FORMULA:			THER RX SIDE INJ 0 MHz IT
	B FREQUENCY	MHz													TRANSMITTER MIXER CRYSTAL FREQ. (Y701): D=	FO	REFERENCE FREQUENCY:	F= 0.01 F= 0.0125	ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SE 1. SELECT ANOTHER RX MIXER CRYSTAL FREQUI 2. SELECT HIGH SIDE INJECTION FREQUENCY FOR 21 Y501= 11.15500 MHz INSTEAD OF 10.245000 MHz 3. USE SLIGHTLY OFFSET REFERENCE CRYSTAL
	PROM	ADDRESS (HEX)	00	10	02	03	04	05	90	07	80	60	0A	08		<u>x 3)</u>	REFERENCE CRYSTAL (Y703):	10.240000 MHz 12.800000 MHz	703) PART No. 19J706361P1 19J706361P6 19J706361P6 19J706361P2
	>	HEX													J) - (C × 3)		.Hz .Hz	ALS (Y
/ER	>	DEC														(A - 10.7)	CHANNEL SPACING:	20 KHz 12.5/25 KHz	ERENCE CRYSTAL FREQUENCY, MHz 12.800000 12.801000 12.000500 10.240000
RECEIVER		Ξ													FREQ.				FERENC FREQU 12. 12. 10.
	A FREQUENCY	MHz													RECEIVER MIXER CRYSTAL FREQ. (Y702):	FORMULA: V _{DEC} =			LIST OF REFERENCE CRYSTALS (Y703) MODE FREQUENCY, MHz PAI Standard 5112/5114 12.800000 19J Offset 5112 12.801000 19J Standard 5113 10.240000 19J Offset 5113 10.240000 19J
	CHAN-	NEL	-	2	3	#	5	9	7	8	6	10	11	12	RECEIVE	-			Sta

CHANNEL PROGRAMMING INSTRUCTIONS

CQM5110SxxS99

Programming of the PROM which contains the Personality data with normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 17 or 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19) Programming Pak, interchangeable Socket adaptor or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

Complete list of receiver channel frequencies. (A).

- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- 8. Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511,
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

After completing the worksheet the next steps are:

 Enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.

RECOMMENDED CRYSTAL FREQUENCIES CQM5110S×xS99

CQM5112 - CQM5114	CQM5113	
FREQUENCY RANGE	FREQUENCY RANGE	RX CRYSTAL
1/15 2 1/10 2075		W2 70000
145.2 - 148.3875	1,15,56, 4,10,44	43.766666
146.2 - 149.3875	145.56 - 148.11	44.1
147.2 - 150.3875	146.56 - 149.11	44.433333
148.2 - 151.3875	147.56 - 150.11	44.766666
149.2 - 152.3875	148.56 - 151.11	45.1
150.2 - 153.3875	149.56 - 152.11	45.433333
151.2 - 154.3875	150.56 - 153.11	45.766666
152.2 - 155.3875	151.56 - 154.11	46.1
153.2 - 156.3875	152.56 - 155.11	46.433333
154.2 - 157.3875	153.56 - 156.11	46.766666
155.2 - 158.3875	154.56 - 157.11	47.1
156.2 - 159.3875	155.56 - 158.11	47.433333
157.2 - 160.3875	156.56 - 159.11	47.766666
158.2 - 161.3875	157.56 - 160.11	48.1
159.2 - 162.3875	158.56 - 161.11	48.433333
160.2 - 163.3875	159.56 - 162.11	48.766666
161.2 - 164.3875	160.56 - 163.11	49.1
162.2 - 165.3875	161.56 - 164.11	49.433333
163.2 - 166.3875	162.56 - 165.11	49.766666
164.2 - 167.3875	163.56 - 166.11	50.1
165.2 - 168.3875	164.56 - 167.11	50.433333
166.2 - 169.3875	165.56 - 168.11	50.766666
167.2 - 170.3875	166.56 - 169.11	51.1
168.2 - 171.3875	167.56 - 170.11	51.433333
169.2 - 172.3875	168.56 - 171.11	51.766666
170.2 - 173.3875	169.56 - 172.11	52.1
171.2 - 174.3875	170.56 - 173.11	52.433333
172.2 - 175.3875	171.56 - 174.11	52.766666
173.2 - 176.3875	172.56 - 175.11	53.1
	173.56 - 176.11	53.433333
		-

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5110S×xS99

CQM5112 - CQM5114	CQM5113	
FREQUENCY RANGE	FREQUENCY RANGE	TX CRYSTAL
TREQUEROT RATIOE	THE GENOT WHOLE	
145.5 - 148.6875	144.86 - 147.41	47.433333
146.5 - 149.6875	145.86 - 148.41	47.766666
147.5 - 150.6875	146.86 - 149.41	48.1
148.5 - 151.6875	147.86 - 150.41	48.433333
149.5 - 152.6875	148.86 - 151.41	48.766666
150.5 - 153.6875	149.86 - 152.41	49.1
151.5 - 154.6875	150.86 - 153.41	49.433333
152.5 - 155.6875	151.86 - 154.41	49.766666
153.5 - 156.6875	152.86 - 155.41	50.1
154.5 - 157.6875	153.86 - 156.41	50.433333
155.5 - 158.6875	154.86 - 157.41	50.766666
156.5 - 159.6875	155.86 - 158.41	51.1
157.5 - 160.6875	156.86 - 159.41	51.433333
158.5 - 161.6875	157.86 - 160.41	51.766666
159.5 - 162.6875	158.86 - 161.41	52.1
160.5 - 163.6875	159.86 - 162.41	52.433333
161.5 - 164.6875	160.86 - 163.41	52.766666
162.5 - 165.6875	161.86 - 164.41	53.1
163.5 - 166.6875	162.86 - 165.41	53.433333
164.5 - 167.6875	163.86 - 166.41	53.766666
165.5 - 168.6875	164.86 - 167.41	54.1
166.5 - 169.6875	165.86 - 168.41	54.433333
167.5 - 170.6875	166.86 - 169.41	54.766666
168.5 - 171.6875	167.86 - 170.41	55.1
169.5 - 172.6875	168.86 - 171.41	55.433333
170.5 - 173.6875	169.86 - 172.41	55.766666
171.5 - 174.6875	170.86 - 173.41	56.1
172.5 - 175.6875	171.86 - 174.41	56.433333
173.5 - 176.6875	172.86 - 175.41	56.766666
174.5 - 177.6875	173.86 - 176.41	57.1
175.5 - 178.6875	174.86 - 177.41	57.433333
176.5 - 179.6875	175.86 - 178.41	57.766666
		•

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY

SELFQUIETING FREQUENCIES CQM5112SxxS99, CQM5114SxxS99

RECEIVER CRYSTAL	V	USE
FREQUENCY, MHz	DEC	ALTERNATIVE+
		And the second s
43.766666	428	1
44.1	336	4
44.1	428	1
44.433333	256	4
44.433333	428	1
44.766666	428	1
45.1	428	1
45.433333	428	1
45.766666	428	1
45.766666	454	2
46.1	374	2
46.433333	294	2
46.766666	428	1
47.1	428	1
47.433333	428	1
47.766666	428	1
48.1	428	1
48.433333	428	1
48.766666	428	ĭ
49.1	428	1
49.1	472	2
49.1	474	2
49.433333	393	2
49.433333	394	2
49.433333	428	1
49.766666	313	2
49.76666	314	2
49.766666	428	1
50.1	428	1
50.1	432	4

TABLE 3A. SELFQUIETING FREQUENCIES

⁺refer to worksheet

Continued on table 3B

SELFQUIETING FREQUENCIES CQM5112SxxS99, CQM5114SxxS99

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE [†]
50.433333	428	1
50.766666	272	3
50.766666	428	1
51.1	428	1
51.433333	428	1
51.766666	320	4
51.766666	428	, 1
52.1	344	4
52.1	428	1
52.433333	428	1
52.766666	304	4
	-	
	,	

TABLE 3B. SELFQUIETING FREQUENCIES

SELFQUIETING FREQUENCIES CQM5113S×xS99

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE [†]
44.1	311	ц
46.1	467	2
46.433333	367	2
46.766666	260	4
46.766666	267	2
49.433333	492	2
49.766666	392	2
50.1	292	2
50.433333	290	Avoid this frequency
53.1	390	4

TABLE 3C. SELFQUIETING FREQUENCIES

⁺refer to worksheet

⁺refer to worksheet

HEX CODE CONVERSION TABLE

L				Ē											1000		
_		0		7	3	77	2	9	7	8	6	A	В	ပ	Ω	Ш	ш
	0	256	257	258	259	260	261	262	263	797	265	266	267	268	269	270	271
	-	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
	2	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
-	3	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
	4	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
	2	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
	9	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
-	7	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
	8	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
-	6	004	401	402	403	404	405	901	407	804	604	410	411	412	413	414	415
	4	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
	В	432	433	434	435	436	437	438	439	044	441	442	443	444	445	944	447
	ပ	844	644	450	451	452	453	454	455	456	457	458	459	094	461	462	463
	Ω	11911	465	994	194	894	6917	470	471	472	473	474	475	914	477	478	479
	Ш	480	481	482	483	484	485	984	487	488	684	490	491	492	493	464	495
	ш	964	467	864	664	200	501	502	503	504	202	909	202	208	509	510	511
	-																
W	st	Most Significant Digit	icant		of Hex	Code.			"VDE	"VDEC" Numbers.	ımbers						

Example " V_{DEC} "= 345 equals to hex code 59.—LSD " V_{DEC} "= 469 equals to hex code D5.

Table 4. "V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

PROGRAMMING WORKSHEET CQM5110S×xS99

NEC A FREQUENCY L V V V PPOM B FREQUENCY L V V PROM		RECEIVER	VER					TRANSMITTER	MITTER	
00 01 02 03 04 06 05 06 06 07 08 08 08 08 08 08 08			ec <	V HEX	PROM ADDRESS (HEX)	B FREQUENCY MHz	_ _ =	v DEC	HEX <	PROM ADDRESS (HEX)
(Y702): C= 01 (Y702): C= 06 (Y702): C= 08 (Y703): FFERENCE RE SPACING: CRYSTAL (Y703): FF 12.5/25 kHz 10.240000 MHz 1. 12.5/25 kHz 10.240000 MHz 1. 12.5/25 kHz 12.800000 MHz 1. 12.5/25 kHz 12.800000 MHz 1. 12.6/25/25 kHz 12.800000 MHz 1. 12.6/26/26/26/26/26/26/26/26/26/26/26/26/26					00					10
(Y702): C= 004 · · · 05 · · · 06 · · · · 06 · · · · 06 · · · ·					10					11
(Y702): C=		ı			02					12
04 05 06 07 08 09 09 08 09 08 108			1		03					13
05 06 06 07 08 08 08 08 08 08 08					. 50					14
06 07 08 08 09 09 09 09 09 09					05					15
(Y702): C=					90					16
(Y702): C=				1	07					17
(Y702): C=					80					18
(Y702): C=					60					19
(Y702): C= TRA (A - 10.7) - (C x 3) CHANNEL REFERENCE RE SPACING: CRYSTAL (Y703): Fi 12.5/25 kHz 10.240000 MHz 12.5/25 kHz 12.800000 MHz SE CRYSTALS (Y703) SE CRYSTALS (Y703) 19.706361P7 1. 10.240000 19.706361P6 10.240000 19.706361P6 10.240000 19.706361P6 10.240000 19.706361P6 10.240000 19.706361P9					0A					1A
(Y702): C= TRA (A - 10.7) - (C x 3) CHANNEL REFERENCE SPACING: CRYSTAL (Y703): FI 20 kHz 10.240000 MHz 12.5/25 kHz 12.800000 MHz IENCY, MHz PART No. 19.706361P1 1. S00000 19.706361P6 2. 2.40000 19.706361P6 3. 2.240000 19.706361P6 3. 2.240000 19.706361P9 4.				`	9B					18
- 10.7) - (C x 3) HANNEL REFERENCE RE PACING: CRYSTAL (Y703): Fi 20 kHz 10.240000 MHz 1.5/25 kHz 12.800000 MHz CRYSTALS (Y703) NCY, MHz PART No. 19.706361P7 1. 00000 19.706361P6 2. 40000 19.706361P6 3. 400500 19.706361P6 3.	FRE] ÷	(Y702): C=	ii ii		TRANSMITTER MIX	KER CRY	STAL F	REQ. (Y	701): D=
HANNEL REFERENCE REPAINEL (Y703): FF CRYSTAL (Y703): FF CRYSTAL (Y703): FF CRYSTALS (Y703)	"U			- (C ×	3)	FOF	RMULA:	V _{DEC} =		(D × 3) F
20 kHz 10.240000 MHz 1.5/25 kHz 12.800000 MHz 12.800000 MHz 12.800000 MHz 12.800000 MHz 12.800000 MHz 12.800000 MHz 19.706361P1 1.800000 19.706361P6 19.706361P6 19.706361P6 19.706361P6 19.706361P9 4.		,	CHANNEL SPACING:	CR	EFERENCE RYSTAL (Y703):	REFERENCE FREQUENCY:				
CRYSTALS (Y703) NCY, MHz PART No. 00000 19J706361P1 1. 00500 19J706361P2 2. 40000 19J706361P2 3. 40650 19J706361P9 4.			20 KH 12.5/25 KH		10.240000 MHz 12.800000 MHz	F= 0.01 F= 0.0125			,	
ALT PART No. 19J706361P1 19J706361P7 2. 19J706361P2 19J706361P2 3.	FERE	Z		LS (Y7	.03)					
19.706361P7 2. 19.706361P6 3. 19.706361P9 4.	FRE	20	BOODD MH	z	PART No.	ALTERNATIVE SO	LUTIONS	S IF THE	E RECEIN	VER IS SELFQUIETING:
19J706361P9 4.		0 12 12 12	.801000 .000500 .240000		19J706361P7 19J706361P6 19J706361P6		THER RX SIDE INJE MHZ IN	MIXER ECTION F ISTEAD T REFER	CRYSTA FREQUEN OF 10.24	.L FREQUENCY CY FOR 2nd OSCILLATOR 15000 MHz RYSTA1
		0	.240650		19J 706361P9		NC; NO	ALTERN	ATIVE R	EQUIRED

Customer:

Storno Storno

ADJUSTMENT PROCEDURE

CQM5110 S12

This adjustment procedure applies to the following radiotelephone types:

CQM5112 S12 30/25 kHz Channel spacing COM5113 S12 20 kHz Channel spacing CQM5114 S12 12.5 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type tabel and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment. All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter

 $R_{in} \ge 1$ Mohm

AC Voltmeter

 $Z_{in} > 1 \text{ Mohm}//50 pF$

Multimeter

 $R_i \ge 20 \text{ Kohm/Volt}$

Distortion meter

e.g. Storno E11c

RF Watt meter

25 W/50 ohm/145-175 MHz

Deviation meter

145-175 MHz

RF generator

 $Z_{out} = 50$ ohm; 145-175 MHz

10.7 MHz signal gen. e.g. Storno TS-G21B

Frequency counter with attenuator

Z_{in}= 50 ohm; sensitivity

100 mV at 175 MHz

RF diode probe

Storno 95.0089-00

RF coaxial probe DC power supply Storno 95, 0179-00

10.8 V - 16.6 V; 6 A

Oscilloscope

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026

22 uF/40 V electrolytic

capacitor

Storno code 73, 5107-00

Connector, 11-pin house Connector, 8-pin house

Storno code 41.5543-00 Storno code 41.5542-00

Pins for connectors

Storno code 41, 5551-00

Trimming tools

The following tables show the frequency ranges of the CQM5110 S12 radiotelephone signals:

SIGNAL	Frequency, MHz
TX VCO TX Crystal TX Crystal multiplication	146 - 174 47 - 56 ×3
RX VCO RX Crystal RX Crystal multiplication	135 - 163 43 - 53 ×3

Table 1

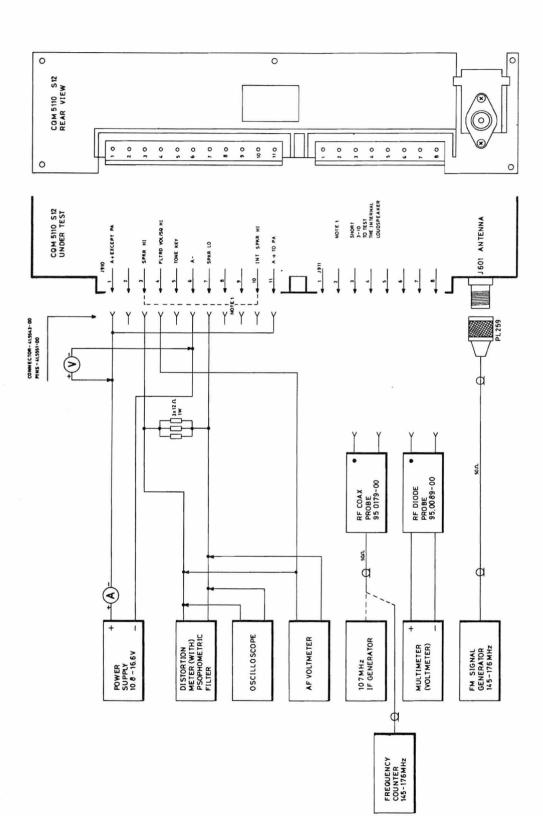
Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	. kHz
20	10. 240	2.560	5. 110	10
12.5 or 25 ¹⁾	12. 800	3.200	6. 3875	12.5
15.0 or 30 ¹⁾	15. 360	3.840	7. 665	15

Table 2

¹⁾ Two steps per channel

RECEIVER TEST SET-UP
CQM5110 S12

D402.876



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the voltage.

Requirement: 8.5 V ±0.15 V.

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

R636 Value
omit
270
100
47
22
6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 volt regulated to the value obtained at 13.2 V.

Requirement: <50 mV

Repeat the procedure with the power supply adjusted for 10.8 V.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and prom codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 250 mV ± 125 mV

(corresponding to -10 dBm

to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum ana-

Receiver VCO

lyzer.

Connect the multimeter, 10 V range, to test point TP706. The synthesizer's lock signal is accessible at TP706. +8 V DC with very narrow pulses (0.1 u sec) indicates normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "Low". Select the channel whose frequency is closest to the center frequency.

Await locked condition, constant voltage. Adjust C745 for 8 Volts on the multimeter. Connect the multimeter to test point TP703. Adjust C745 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 1.

Requirement: The voltage shall be in the ran-

ge 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

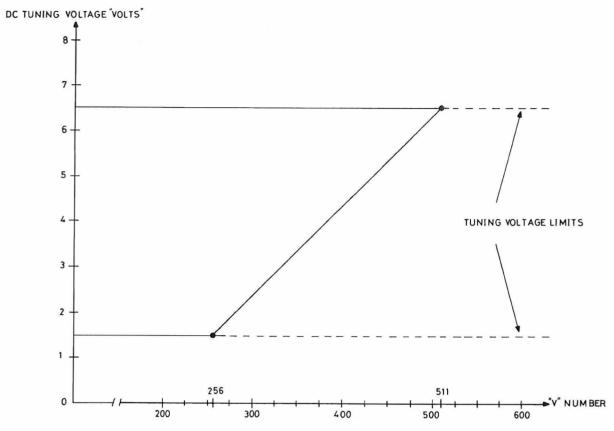


Fig. 1. Tuning voltage vs. V. number.

 $f = f_x \times 3$ ($f_x = crystal frequency$) Adjust L711 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.

Connect the frequency counter to the probe. Calculate the injection frequency for all channels.

 $f_{inj} = f_{ant}^{-10.7}$ (MHz) Select, one by one, the channels and read the injection frequency.

Requirement: F_{inj} ±0.4 ppm

IF AMPLIFIERS

Connect a 10.7 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95,0089-00 with multimeter to test point TP501. (50 uA range).

During adjustment the RF generator output must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L403 and 405 as much as possible. Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L403 and 405 as much as possible.

Adjust L404 for maximum deflection on the multimeter. This is the only adjustment of L404 and it <u>must not</u> be touched during the rest of the procedure.

Adjust L403 and L405 for maximum deflection on the multimeter.

Readjust L401 and L402 for maximum deflection. Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f.

Modulate the RF generator with 1000 Hz to 60% of Δf max.

CQM5112 S12/S99

±3 kHz

CQM5113 S12/S99

±2.4 kHz

CQM5114 S12/S99

±1.5 kHz

Connect a 4 ohm/3 W resistor load to connector J910/37 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/47 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.

Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter and Distortion meter across the 4 ohm resistor (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/47 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV.

Read the distortion.

Typical <u>Total Harmonic Distortion</u> (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 amplitide 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 <u>noise</u> and <u>distortion</u> increases to 20 dB below the first condition, as read on the distortion meter scale, This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF signal modulated with 1000 Hz at 60% Δ f max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, with the distor-

tion 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 immeadiately 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise+ distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industrie's Association) Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta f$ max, and measure at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 25% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity

Requirement: ≤ 0.75 uV (e.m.f.)

The sensitivity should be measured on all channels, if more than one.

MEASURING 12 dB SINAD (EIA)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load. Adjust the RF generator to obtain 12 dB SINAD condition. Read the 12 dB SINAD sensitivity. Requirement: \leq 0.4 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across SPKR HI - LO).

At 13.2 V supply, ΔF = 60% ΔF max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
Type CQM5112 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
Type CQM5113 S12	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
!	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	
Type CQM5114 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	2550 Hz	-8 dB	+1 dB/-3 dB

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 145 - 175 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD ≤5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of self quieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2V.

For sets with selective calling facilities add current consumption of the tone unit to the figures.

Requirements

Condition	Current consumption
Standby	<u>≤</u> 400 mA
Receive	≤750 mA
2 W AF	
~2.83 V r.m.s.	
across 4 ohm.	

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

25 W transmitter:

6 A

10 W transmitter:

4 A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L153, L204, L205, L208, and L209, to be flush with the coil form top.

Turn the power control potentiometer, R215, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

connector, J601.

Connect RF probe 95.0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

250 mV ± 125 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analy-

zer,

Transmitter VCO

Connect the multimeter, 10 V range, to test point TP706.

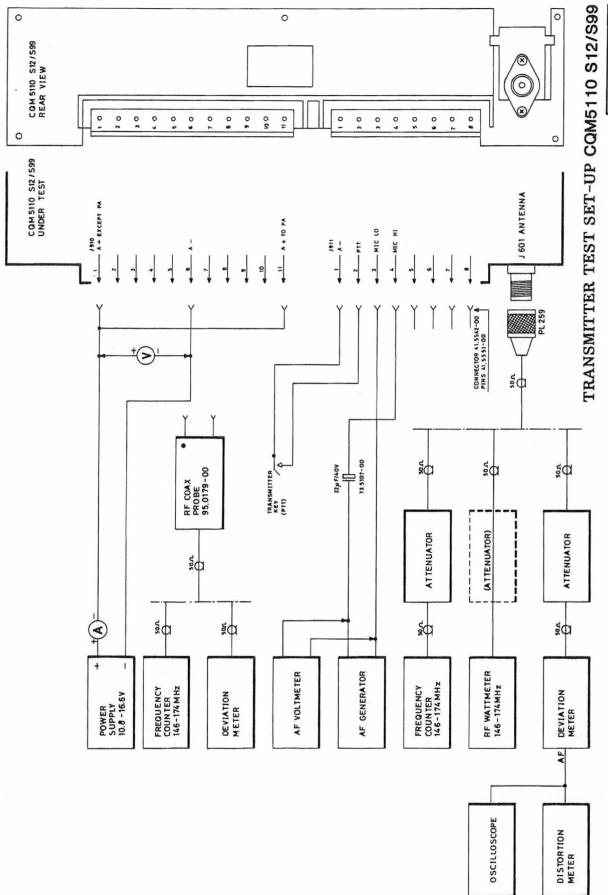
The synthesizer's lock signal is accessible at TP706 and +8 V DC with very narrow pulses (0.1 u sec.) indicate normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "LOW".

Select the channel whose frequency is closest to the center frequency. Key the transmitter. Await locked condition.

Adjust C737 for 8 Volts on the multimeter. Connect the voltmeter to test point TP703. Adjust C737 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 1.

Requirement: The voltage shall be in the ran-

ge 1.5 V to 6.5 V and not deviate from the graph by more than 20%.



Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER

Coarse adjustment

Connect a multimeter (2.5 V range) to test point TP201. Key the transmitter. Adjust L153 for maximum deflection.

Adjust L204 for minimum deflection. The dip is small and careful tuning is required.

Connect the multimeter (1 V range) to test point TP202.

Adjust L205 for maximum deflection on the multimeter, typical 0.4 $\rm V.$

Adjust L208 for minimum reading. The dip is small and careful tuning is required.

Connect diode probe 95.0089-00 and the multimeter to test point TP203.

Adjust L209 for maximum reading on the multimeter, typical 10 $\,\mathrm{V}_{\cdot}$

Adjust the PA power control, R215, for rated transmitter power, 6/10 W or 25 W.

Fine adjustment

Connect the multimeter to test point TP201.

Key the transmitter.

Readjust L153 for maximum reading.

Connect the multimeter to test point TP202.

Peak L204 and L205 for maximum reading.

If the maximum is not well defined detune L153 slightly, adjust L204 and L205, and repeat the adjustment of L153.

Connect the 95.0089-00 RF probe and multimeter to test point TP203.

Peak L208 and L209 for maximum reading.

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601.

Key the transmitter.

Select, one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: $F = F_{ant} \pm 0.4 \text{ ppm.}$ ppm= parts per million= 10^{-6} .

RF POWER OUTPUT, CURRENT CONSUMPTION AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 16 V. The voltage is measured directly at the input connector J910. Readjust the PA power control, R215, for rated transmitter power (P), 6/10 or 25 W.

Requirement: $P_{nom} \pm 0.1 dB$.

Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (25 W):

Voltage	Power	Curr	ent
		S12	S99
16.6 V	25 W (ref)	≤5.8 A	≤6.6 A
13.2 V	≥23 W	≤5.8 A	≤6.6 A
10.8 V	≥16 W	≤5.8 A	<6.6 A

Requirements (10 W):

Voltage	Power	Current	
		S12	S99
16 V	10 W (ref)	≤3.2 A	≤3.7 A
13.2 V	≥9 W	≤3.2 A	≤3.7 A
10.8 V	≥8 W	≤3.2 A	≤3.7 A

Requirements (6 W):

Voltage	Power	Current	
		S12	S99
16 V	6 W (ref)	<2.6 A	≤3.1 A
13.2 V	≥5.5 W	≤2.6 A	≤3.1 A
10.8 V	≥5.2 W	<2.6 A	≤3.1 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V. Select the channel having the highest frequency. Set R116 to mid-position.

Connect coax probe 95.0179-00 to test point TP701.

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect an AF generator and an AF voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Connect the deviation meter through an attenuator to the antenna connector. J601.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect an AF generator and an AF voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Type	Channel spacing	$\Delta f \max$	
CQM5112 S12	30/25 kHz	±5 kHz	
CQM5113 S12	20 kHz	±4 kHz	
CQM5114 S12	12.5 kHz	±2.5 kHz	

Requirement

Difference between + and - deviation: <10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5112 S12 : ±3.0 kHz

CQM5113 S12 : ±2.4 kHz

CQM5114 S12 : ±1.5 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

<7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 \times Δf max is obtained on the de-

viation meter.

CQM5112 S12 : ±1.0 kHz

CQM5113 S12 : ±0.8 kHz

CQM5114 S12 : ±0.5 kHz

Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within



+1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

ADJUSTMENT OF TONE EQUIPMENT

Measuring equipment

Tone Test Generator Storno TS-G13 95B0251-00

Check the connections and the tone combination of the TQ5001/TQ5002/TQ5004/TQ5005 and SU/5002; refer to description and diagrams.

Adjustment of frequency deviation

Apply Standard test condition to the transmitter; refer to transmitter test setup. Establish a shortcircuit between emitter and collector of Q108, on the solderside of the TQ unit, which will produce a continuous tone to the modulator.

Key the transmitter using the tone button.

Adjust R113, TQ5001/TQ5002/TQ5004/TQ5005 for 70% of maximum frequency deviation.

Remove the short circuit.

Connect the G13 Tone Test set to the AF output on the Deviation Meter.

Check that the tone call is properly received when the tone button is depressed.

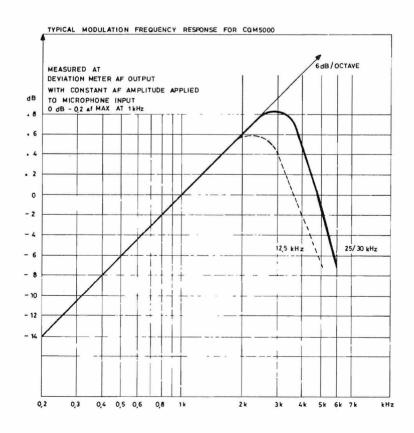
Checking the Tone Receiver

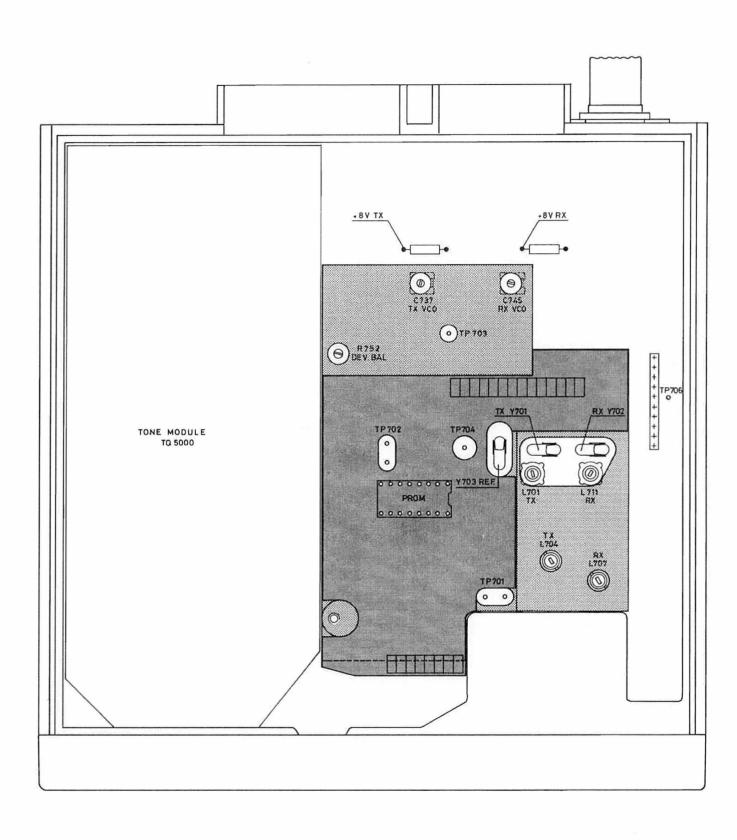
Apply Standard test condition to the receiver; refer to receiver test setup.

Modulate the signal generator with the G13 Tone Test Set.

Set the G13 to the proper tone combination.

Check that the TQ unit responds to a released tone call.





ADJUSTABLE COMPONENTS AND TEST POINTS ON CQM5000XXS12

D402.875

TECHNICAL SPECIFICATIONS

CQM5110SxxS99

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

146 - 174 MHz

Channel Separation

CQM5112: 30/25 kHz CQM5113: 20 kHz

CQM5114: 12.5 kHz

Maximum Frequency Deviation

CQM5112: ±5 kHz CQM5113: ±4 kHz CQM5114: ±2.5 kHz

Modulation Frequency Range

CQM5112: 300 - 3000 Hz CQM5113: 300 - 3000 Hz CQM5114: 300 - 2550 Hz

Maximum RF Bandwidth

RX: 1.5 MHz TX: 2.5 MHz Antenna Impedance

50 ohm

Maximum Number of Channels

99

Supply Voltage

Minimum : 10.8 V Nominal : 13.2 V Maximum : 16.6 V

Negative potential to chassis

Temperature Range

-30°C to +60°C

Dimensions

B × D × H: 180 × 90 × 60 mm

Weight

1.8 Kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f.

0,4 uV (0,3 uV)

 $60\% \Delta \text{fmax}$; $f_{\text{mod}} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f. CQM5112: 0.75 uV (0.55 uV) CQM5113: 0.75 uV (0.55 uV)

CQM5114: 1.0 uV (0.75 uV)

60% Δ fmax; $f_{mod} = 1 \text{ kHz}.$

Measured with psophometric filter.

Crystal Frequency Range

43 - 53 MHz

Receiver VCO Frequency Range

135 - 163 MHz

Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth (EIA)

CQM5112: ±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

ΕIΑ

CQM5112: 75 dB (87 dB)

FTZ

CQM5113: 67 dB (70 dB)

CEPT

CQM5112: 75 dB (87 dB) CQM5114: 65 dB (85 dB)

Spurious Rejection EIA

80 dB (85 dB)

Intermodulation Attennuation

EIA

CQM5112: 70 dB (72 dB)

CEPT

CQM5112: 70 dB (75 dB) CQM5113: 70 dB (75 dB) CQM5114: 70 dB (73 dB)

FTZ

CQM5113: 70 dB (72 dB)

Blocking

90 dB/uV (104 dB/uV)

Radiation

Conducted: max 0.8 nW Radiated: max, 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1,5%)

60% Δf max., 1 kHz, 1 W, RF 1 mW

Modulation Response

COM5112

300 - 3000 Hz (CEPT) +1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5113

400 - 2700 Hz (CEPT/FTZ)

+1/-1.5 dB (+0.5/-1 dB)

300 - 400 Hz

2700 - 3000 Hz

+1.5/-3 dB (+0.5/3 dB)

relative to 1000 Hz, 6 dB/octave

CQM5114

300 - 2550 Hz (CEPT)

+1/-3 dB (+0.5/-2 dB)

Relative to 1000 Hz, -6 dB/octave

Hum and Noise (EIA)

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Recovery Time

250 ms (200 ms)

Attack Time (EIA)

150 ms (110 ms)

Squelch Closing Time (EIA)

150 ms (50 ms)

Current Consumption

Squelched: 1000 mA (750 mA)

Receive; AF 2 W: 1450 mA (1150 mA)

(without tone equipment, 13.2 V supply)

TRANSMITTER

RF Power Output

CQM5110 6/10 W: 6/10 W

CQM5110 25 W: 25 W

 $R_1 = 50$ ohm

Crystal Frequency Range

47 - 56 MHz

Crystal Frequency Multiplication

x3

Transmitter VCO Frequency Range

146 - 174 MHz

Frequency Stability

Conforms with government regulations

Undersired Radiation

max. 0.2 uW

Sideband Noise Power (CEPT)

Better than 70 dB

AF Input Impedance

560 ohm

Modulation Sensitivity

90 mV ±3 dB

(60% Δf max, 1 kHz)

Modulation Response

CQM5112

300 - 3000 Hz (CEPT)

+1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5113

400 - 2700Hz (CEPT/FTZ)

+1/-1.5 dB (+0.5/-2 dB)

300 - 400 Hz

2700 - 3000 Hz

+1.5/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

CQM5114

300 - 2550 Hz (CEPT)

+1/3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

Modulation Distortion

fm = 1000 Hz: max, 3%

60% ∆f max.

fm = 300 Hz: max. 5%

5.5% Δf max.

measured with 750 us de-emphasis

FM Hum and Noise (CEPT)

55 dB (57 dB)

(measured with 750 us de-emphasis

and psophometric filter).

Current Consumption

CQM5110-6/10 W: less than 3.7/4.2 A (3/3.5 A)

CQM5110 -25 W: less than 6.6 A (5.5 A)

GENERAL DESCRIPTION

CQM5110SxxS99

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls keyboard and display.

A comparison of the various models are presented in the table below.

Although compact in size, it contains a transmitter/receiver, a microcomputer controlled synthesizer and tone equipment, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 99 transmit and receive channels.

Туре	CQM5112SxxS99		CQM5113SxxS99		CQM5114SxxS99	
SPEC	6/10	25	6/10	25	6/10	25
Frequency Range MHz	146 - 174		146 - 174		146 - 174	
RF Power W	6/10	25	6/10	25	6/10	25
Channel Spacing kHz	30/25		20		12.5	
Max. Number						
of Channels	99		99		99	

ACCESSORIES

Standard accessories include:	HS5002	Retainer, with switches, for MC5001
Mounting frame	MC704	Microphone with chockabsorbing
Power cable		mounting bracket for mobile installa-
Fist microphone with retainer or		tion,
Fixed - mount microphone	MC703	Desk microphone with PTT switch
External loudspeaker		for fixed installations.
External switches	MK5001	Installation kit containing connectors,
		power cable, fuses and fuseholders.
MN5001 Mounting frame for mobile installa-	LS701	Loudspeaker enclosed in a plastic
tions allowing the radio to be fixed		housing, complete with cable.
in 36 positions. Includes a base plate	SU701	Transmitter keying switch for moun-
with locking screw.		ting on the steering coloumn.
MN703 Desk stand for fixed installations.	SU702	Transmitter keying switch for moun-
MN704a Mounting frame for mobile installations		ting on the dashboard.
and direct attachment to the vehicle.	PS702	Power supply regulator for 24 V car
MC5001 Fist microphone with retractable		battery installations.
spiral cable for mobile installation.	PS5001	Power supply for 220 V AC mains.
HS5001 Retainer for MC5001.		



MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls, display and keyboard are an integral part of the Control Panel.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded control panel and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB), and the Control Logic (CL) mount in the top section of the chassis.

Thin casted shields with adjustment holes are placed over the RF board and the synthesizer board in order to reduce spurious radiation.

RECEIVER DESCRIPTION

The receiver circuitry is placed on the RF board and can be divided into:

Receiver front end
1st IF section with first and second oscillator
455 kHz 2nd IF portion with demodulator.
Squelch
Audio Amplifier

(refer to functional block diagram)

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit

which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 10.7 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

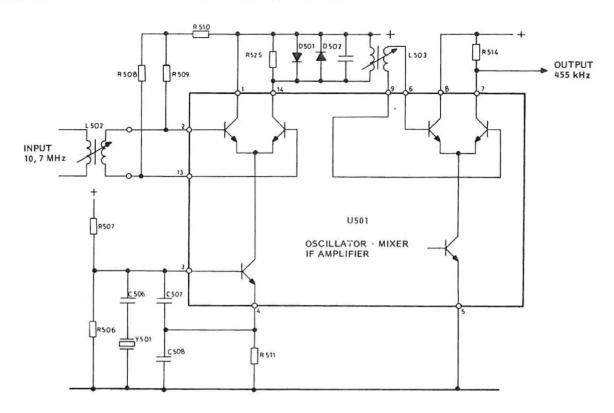


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The

final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the guadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

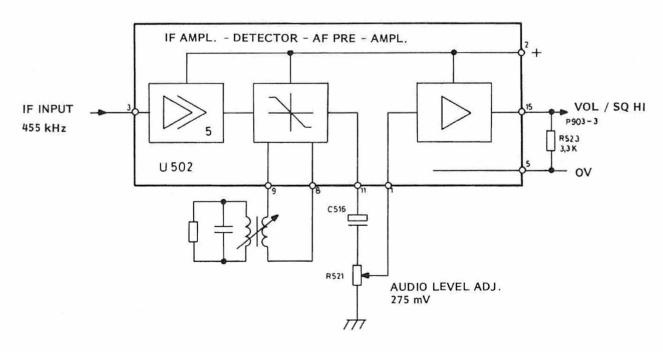


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicater is part of the muting function. A push button switch, S601, cancels the squelch function, when depressed, by groun-

AUDIO

ding the base of Q601.

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629-C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not. These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the RF board along with the receiver.

The exciter contains, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA

low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the FS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV. BAL. po-

tentiometer on the FS board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the VCO on the Frequency Synthesizer board.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter. The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is based by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

FREQUENCY SYNTHESIZER AND CONTROL LOGIC

The frequency synthesizer FS5111 provides up to 99 channels and is built on a printed wiring board which mounts in the top section of the radioset.

The frequency of the synthesizer board is set by a binary code from the control logic board CL5001 which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through P903 – J903 to the RF board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections S602. The other section of the ON/OFF switch controls the $\rm V_B$ + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

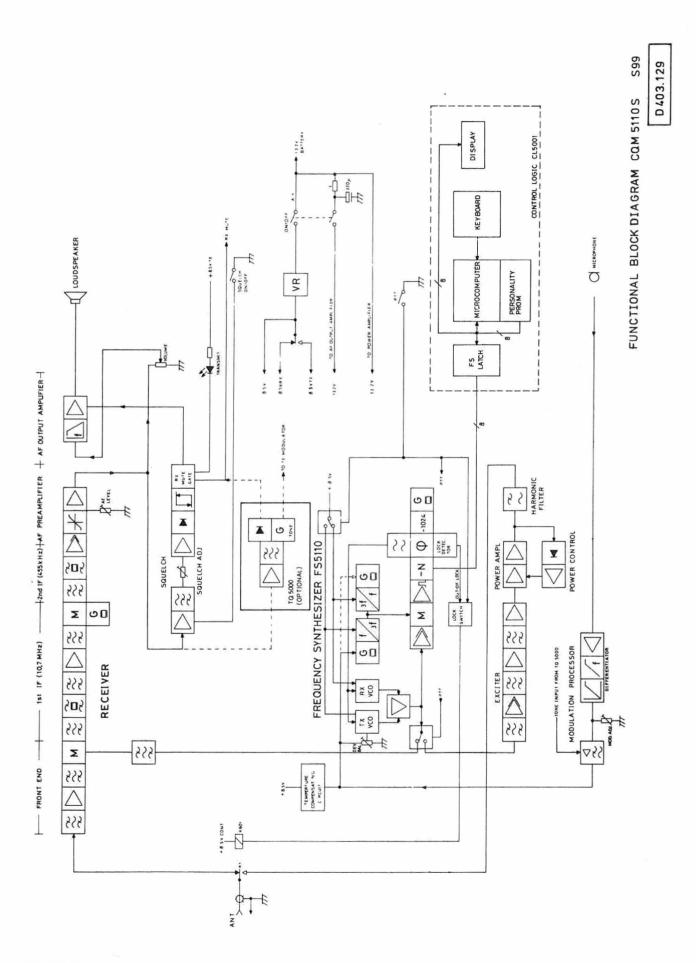
The squelch circuit, the modulation processor, parts of the IF amplifier U502, and the Frequency Synthesizer is supplied directly from the continuous 8.5 V.

The receiver front-end, the 10.7 MHz IF stages and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

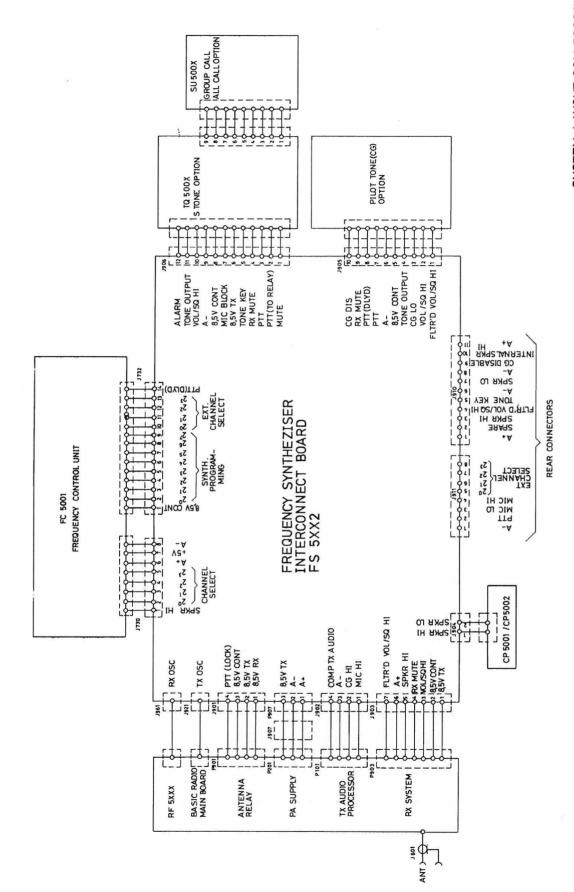
In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



D403.107

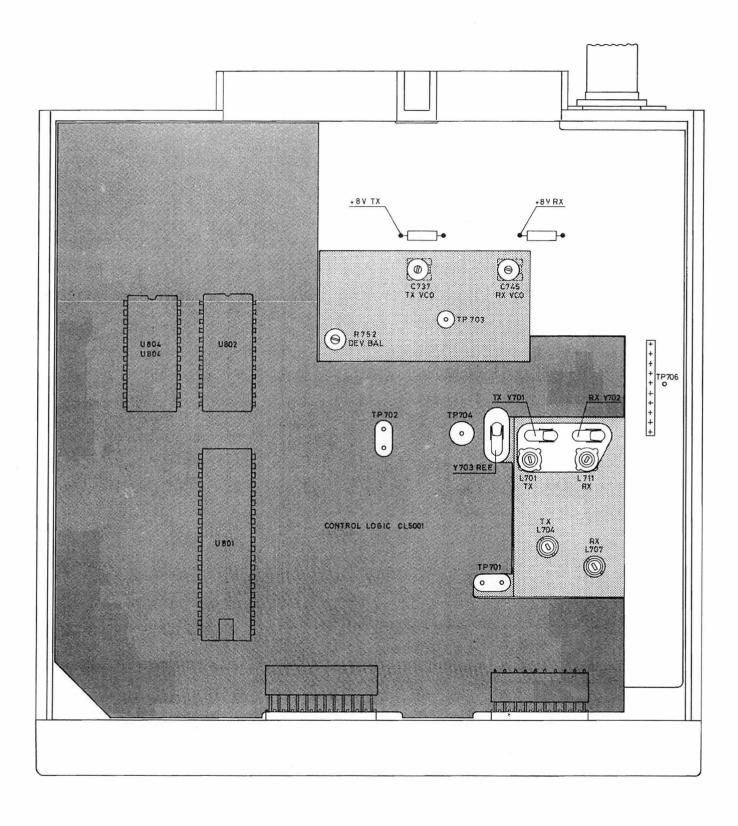


Stormo

REAR CONNECTORS

D403.106

Stormo



ADJUSTABLE COMPONENTS AND TEST POINTS ON CQM5000SXXS99

CHANNEL FREQUENCY SYNTHESIZER

FS5111 and FS5112

The frequency synthesizer generates up to 12 channel frequencies for a STORNOPHONE 5000 operating in the 146 - 174 MHz band. It is built on a printed circuit board which mounts in the top section of the radio set. There are two versions of the board, a single channel board. FS5111 and a multichannel board FS5112. The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board channels are selected with a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the board and protrudes through the front panel, and the Frequency Control module FC5001, fits into the cast shield which is placed over the main section of the synthesizer board.

A metal shield is placed underneath the oscillator and mixer sections of the board.

All circuitry can be accessed and operated for repair and maintenance without the shields and with the FC5001 in its socket.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module and has two connectors at the rear for accessories and power supply cables.

The channel programming is contained in a 256 bit PROM placed in a socket on the Frequency Control module. The PROM can be field programmed if the necessary programming equipment is available. Programming equipment and procedures must be approved by STORNO and the PROM manufacturer, refer to the Channeling Instruction.

CIRCUIT DESCRIPTION

The Frequency Synthesizer generates the local oscillator injection for the receiver and a modulated exciter signal for the transmitter. The circuit is a single-loop phase-locked frequency generator.

The synthesizer frequency is controlled by three crystals, one reference crystal and two mixer crystals, and by a PROM.

The synthesizer can be reprogrammed for new frequencies if these are within the maximum frequency spread of the STORNOPHONE 5000.

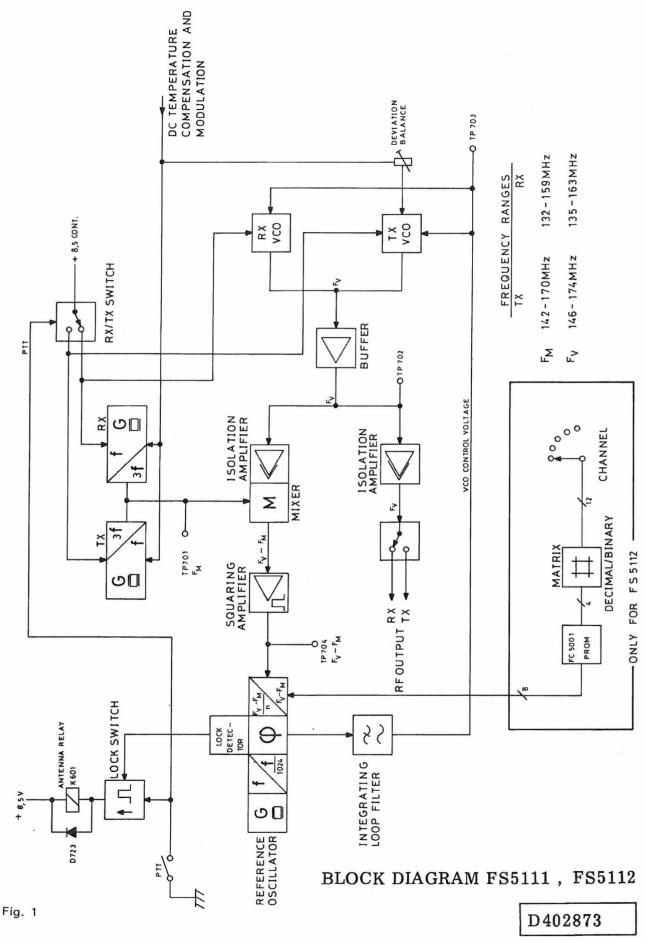
Two voltage controlled oscillators (VCO) are generating the signals which are used as injection for the receiver mixer and excitation signal for the transmitter. The frequency of each VCO can be preset to any frequency

within the band by a variable capacitor, and the fine adjustment is controlled by a variable capacitance diode, varicap, and the phase detector output. The control voltage for the varicaps is filtered in a loop integrating filter. The TX VCO has an additional varicap which is used to modulate the transmitter.

The Push-to-talk switch controls a transistor switch, which switches the supply voltage between the RX VCO and the TX VCO.

The output signal from the VCOs are fed into a buffer amplifier which protects the VCO from load changes.

The buffer amplifier's output is applied to an isolation amplifier and a diode switch before entering the RF board.



The buffer amplifier also connects to another isolation amplifier via a resistive attenuator and feeds the signal to the synthesizer mixer.

The synthesizer mixer mixes the VCO signal and the crystal oscillator signal to a frequency which is within the dividing capability of the programable divider.

Separate crystal oscillators are used in the receive and transmit mode, respectively, and they are both third mode oscillators.

A temperature compensating voltage is applied to the crystal oscillators only in the 5 p. p. m. version. This voltage is kept constant in the 10 p. p. m. version by cutting a diode on the RF board.

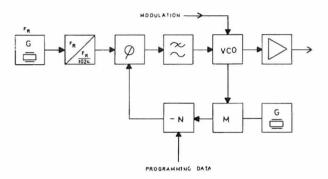


Fig. 2 Phase Locked loop Principle

The output from the synthesizer mixer is fed to a squaring amplifier which drives the programable divider and this divides the frequency by 211 to 511 depending on the logic levels on the 8-bit binary control input. The input frequency range for the divider differs according to the channel spacing and is shown in fig. 3.

The phase detector produces a waveform with variable duty cycle which depends on the phase and frequency difference between its two input signals. The operating frequency range of the phase detector is 4 kHz to 15 kHz and it depends on the channel spacing.

The reference frequency is generated in a crystal oscillator whose output is divided by 1024 and applied to the phase detector.

The output from the phase detector passes through a passive integrating filter which produces a DC voltage proportional to the duty cycle of the phase detector output. This voltage adjusts the frequency of the VCO.

An out-of-lock circuit inhibits the transmitter when the synthesizer loop is out of lock and hunting for the frequency.

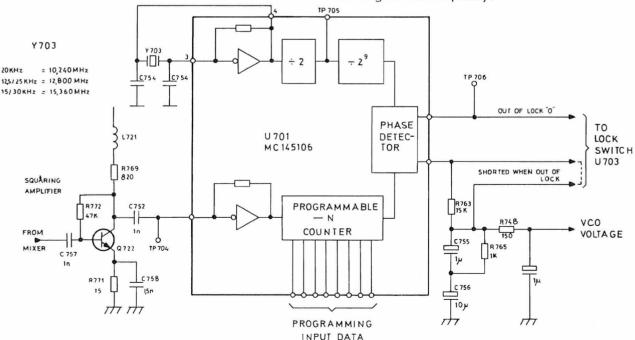


Fig. 3. REFERENCE OSCILLATOR, DIVIDER, AND PHASE DETECTOR

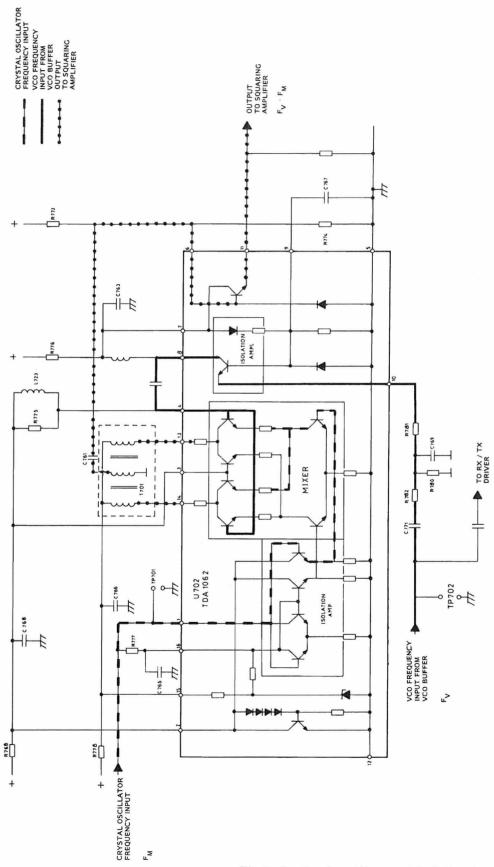


Fig 4. Synthesizer Mixer and Isolation Amplifiers, U702.

The transmitter modulation is applied simultaneously to the transmitter mixer-oscillator and the VCO. The modulation bandwidth also covers sub-audio frequencies used for channel guard (pilot tones). The frequency deviation balance adjustment equalizes the deviation on both oscillators to ascertain low distortion and low noise reference side bands during modulation of the synthesizer because it is operating with a relatively large loop bandwidth.

The frequency control module, FC5001, is built on a separate wiring board which mount on top of the synthesizer shield. This module converts the BCD-code (4 bits) from the chan-

nel selector to an 8-bit binary code for the programmable divides in the synthesizer loop. These 8-bit codes are programmed into a PROM (Programmable Read Only Memory) and are dividing factors expressed in hexadecimal codes

On the FC5001 is a 5-Volt regulator which supply the voltage for the PROM. When the PTT button is pushed the transistor Q801 converts the PTT voltage level to TTL level and puts a logic "0" on the MSB (Most Significant Bit) on the address input of the PROM. This selects the PROM code for the corresponding transmitter channel. The PROM outputs have open collectors with external pull-up resistors.

TECHNICAL SPECIFICATIONS

Supply Voltage

+8.5 Volts regulated

+13.2 Volts unregulated

Current Consumption

max. 80 mA (+8.5 V)

max. 200 mA (+13.2 V)

Channel Spacing

20 kHz

12.5/25 kHz

15/30 kHz

Modulation Input

0.75 V r.m.s. ±2 dB

 $\Delta f = 60\% f_{mod} = 1 \text{ kHz}$

Modulation Bandwidth

70 - 3000 Hz

Modulation Distortion

70 - 300 Hz: <5%

1 kHz:

< 4%

DC Temperature Stabilization Voltage

25°C= 6 V ± 10% (reference)

-30°C= +350 mV ± 10%

 -10° C= -50 mV ± 10%

 $+60^{\circ}$ C= +50 mV ± 10%

The voltage characteristic is approximately linear between these points.

RF Output Level

4 mW ± 1 mW

(open collector output connected to tuned circuit)

TX Output Frequency Range

146 - 174 MHz (VCO)

RX Output Frequency Range

135 - 163 MHz (VCO)

Frequency Stability

5 p.p.m. or 10 p.p.m.

Reference Crystal Frequency

20 kHz:

10.240 MHz

12.5/25 kHz: 12.800 MHz

CHANNEL FREQUENCY SYNTHESIZER

Storno

Signal-to-Noise Ratio (S/N)

>100 dB

 Δf = 25 kHz, BN= 10 kHz

Spurious Attenuation

>85 dB

Lock Time

<30 m sec.

for 1 MHz step

Logic Control Level

LOW= <2 V

HIGH= >6 V

8 bit binary positive logic with built-in pull

down resistors, $I_{in} = 175$ uA per bit.

Temperature range

-30°C to +60°C

Dimensions

 $135 \times 190 \times 45$ mm (BxDxH)

Weight

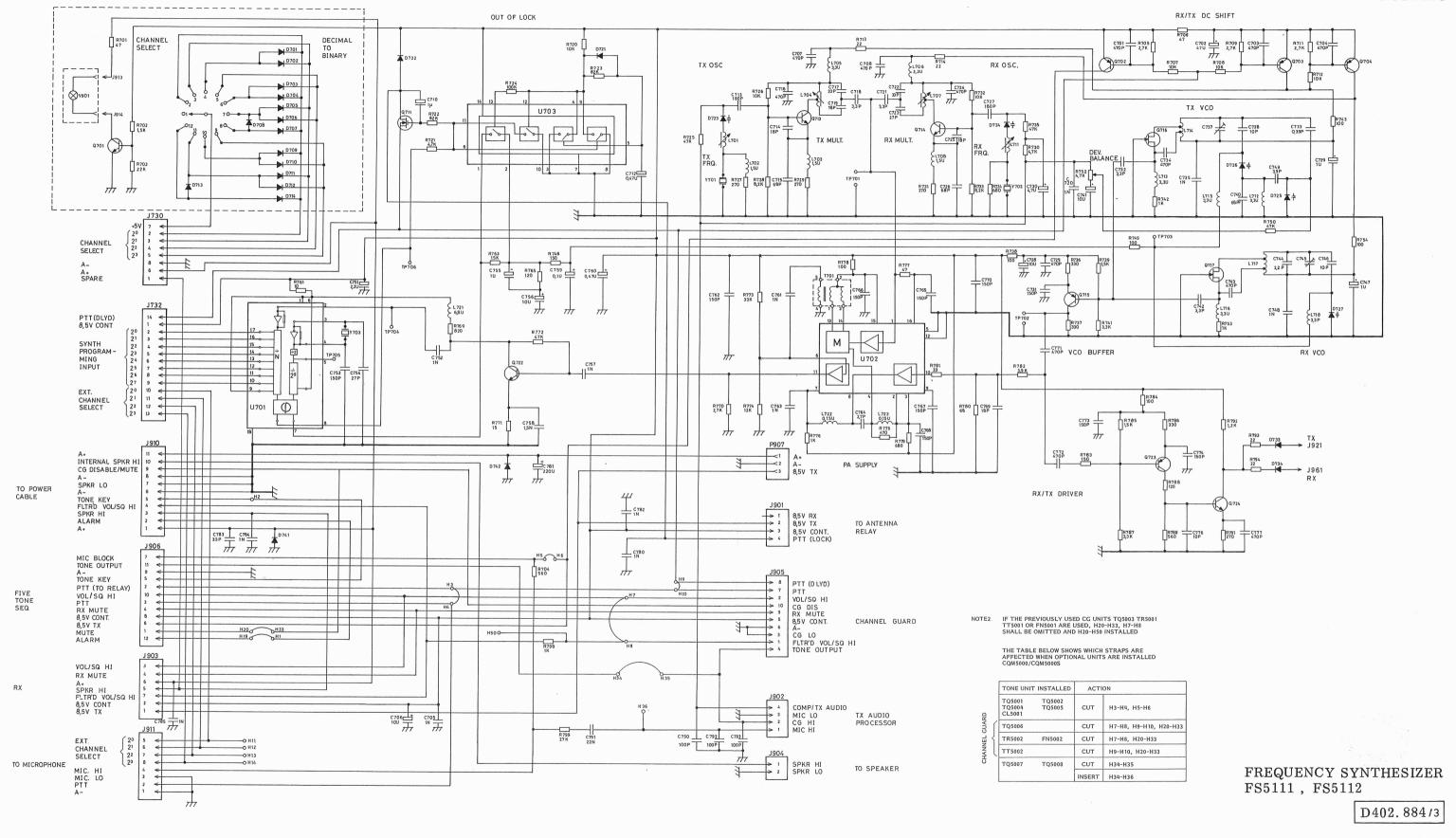
PC board: 150 g

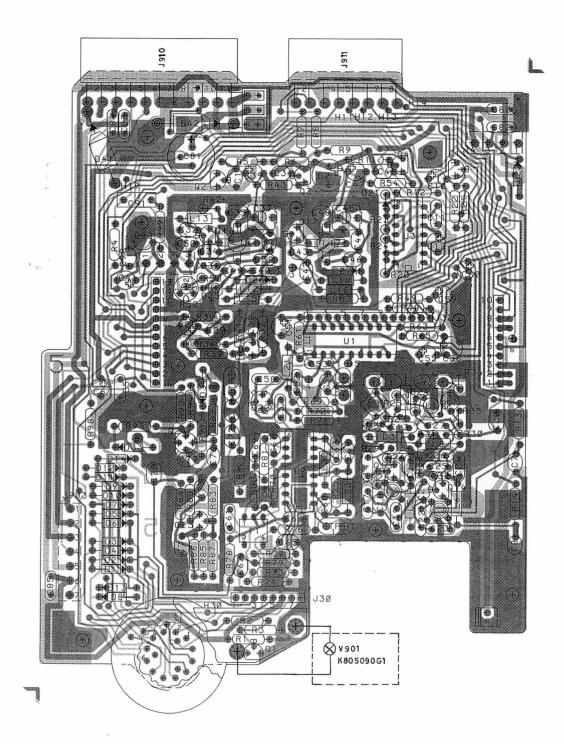
Shield: 75 g

D402.88

PHONE

Storno





COMPONENT LAYOUT | D402.886/3 M905054G1 M905054G2 M905054G3 M905054G4 M905054G5 M905054G6 M905054G7 CODE NO. FS5331 FS5111 FS5112 FS5661 FS5662 FS5652 FS5551 TYPE

FREQUENCY SYNTHESIZER FS5X1,FS5XX2

FREQUENCY SYNTHESIZER FS5111

		VIVO	
C745	J706003P2	2-18 pF Capacitor Variable	
C/46	A700235P13	10 pF Capacitor Ceramic	
C748	A700233P7	1 of Capacitor Commis	35 V
C749	A700235P8	3.9 of Capacitor Ceranic	
C750	A700233P1	100 pF Capacitor Ceranic	
C751	A701534P5	2.2 uF Capacitor Tantalum	35 V
C752	A700233P7	1 nF Capacitor Ceranic	50 V
C753	A700233P2	150 pF Capacitor Ceranic	50 V
C754	A700235P18	27 pF Capacitor Ceramic	50 V
C755	A701534P4	1 uF Capacitor Tantalun	35 V
C756	A701534P7	10 uF Capacitor Tantalum	35 V
C757	A700233P7	1 nF Capacitor Ceramic	20 V
C758	A700233P8	1.5 nF Capacitor Ceramic	50 V
C759	A701534P1	0.1 uF Capacitor Tantalum	35 V
C760	A701534P3	0.47 uF Capacitor Tantalum	35 V
C761	A700233P7	1 nF Capacitor Ceramic	20 N
C/62	A700233P2	150 pF Capacitor Ceramic	20 V
C763	A700233P7	S	20 N
C/64	A700235P6	pF Capacitor	
C/65	A700233P2	pF Capacitor	20 \
7,66	A/00233P2	pF Capacitor	50 V
/6/2	A/00233P2	4	20 \
2768	A/00233P2	ם	50 V
C/69	A/00235P16	٦ ا	20 V
0/70	A700233P2	pF Capacitor	20 \
177	A/00233P5	pF Capacitor	20 N
7/17	A/00233F5	占	20 N
2773	A700233P2	4	50 V
1776	A/00235P2	בו	20 05
27.7	A700233P13	10 pr Capacitor Ceramic	> 05
787	A700233F3	1 of Constitor Commit	> 000
781	1706005P10	220 of Capacitor Floatestotic	> 00
C787	A7002327	1 nF Capacitor Coramic	> 02
783	A70023517	33 of Capacitor Coronic	> 00
C784	A700233P7	1 pF Capacitor Coramic	> >
C785	A700233P7	1 nF Capacitor Ceranic	> 05
C791	J706261P1		100 \
C792	A700233P1	100 of Capacitor Ceranic	20 7
C793	A700233P1		20 \
1111	1000000		

	50 V	790				-				20 V		20 V					20 V			-					>0 ×			35 V	20 V	20 V		> 0 0 0		50 V				50 V	50 V					
DATA	470 oF Capacitor Ceramic	ŽЩ	470 pF Capacitor Ceranic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	10 uF Capacitor Tantalum	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	0.1 uF Capacitor tantal	22 nF Capacitor Pol	0.47 uF Capacitor Tantal	180 pF Capacitor Ceramic	18 pF 11500 Capacitor Ceranic	68 pF N1500 Capacitor Ceramic	470 pF Capacitor Ceramic	33 pF Capacitor Ceramic	3.3 pF Capacitor Ceramic	18 pF Capacitor Ceramic	1 nF Capacitor Ceramic	3.3 pF Capacitor Ceramic	33 pF Capacitor Ceranic	27 pF Capacitor Ceramic	4/0 pr Capacitor Ceramic	18 pr 11500 Capacitor Ceramic	180 of Capacitor Ceramic	10 of Capacitor Tantalum	470 pF Capacitor Ceramic	4.7 uF Capacitor Tantalum	150 pF Capacitor Ceramic	3.3 pF Capacitor Ceramic	0.39 pr Capacitor Phenolic	1 nf Canaditor Commis	1 8-10 of Capacitor Variable	10 pF Capacitor Ceramic	1 uF Capacitor Tantalum	68 pF Capacitor Ceramic	10 uF Capacitor Tantalum	3.3 pF Capacitor Ceramic		4	Ĺ			
CODE	A700233P5	J706005P3	A700233P5	A700233P5	A700233P7	A701534P7	A700233P5	A700233P5	A701534P1	A700234P9	A701534P3	A700235P28	J706256P202	J706256P205	A700233P5	A700235P19	A700235P7	A/00235P16	A/00233P7	A700235P7	A/00235P19	A700235P18	A/00233P5	707222071	A700235P28	A701534P7	A700233P5	A701534P6	A700233P2	A700235P7	A700013P8	A700233P3	1706003P1	A700235P13	A701534P4	A700235P23	A701534P7	A700235P7	A700233P5	A700235P5	•			
ōΝ	C701	C702	C703	C704	C705	C706	C707	C708	C710	C711	C712	C713	C714	C715	C716	C717	C718	61/2	C/20	C721	C/22	C/23	C/24	C726	C727	C728	C729	C730	C731	C732	C/33	C735	C737	C738	C739	C740	C741	C742	C743	C744			ristrative medi	T

=
_
Ā
=
7
w

ōΝ	CODE	DATA
0707	190000024	H GLICO
0703	A700020F1	BC558 Transistor
0704	A700020P1	
0711	A707834P1	Wi0610L Transistor
Q713	J706283P1	
Q714	J706283P1	BFR54 Transistor
Q715	J706264P1	_
Q716	J706038P1	
0717	J706038P1	2N5245 Transistor
Q722	J707515P1	
Q723	J706264P1	BF414 Transistor
Q724	J707515P1	39
R704	A700019P34	ohm Resistor Depos.
R705	A700019P42	\sim
R706	A700019P21	47 ohm Resistor Depos. 0.25 W
R707	A700019P49	10 Kohm Resistor Depos. 0.25 W
R708	A700019P49	Kohm Resistor Depos. 0
R709	A700019P42	2.7 Kohm Resistor Depos. 0.25 W
R711	A700019P42	2.7 Kohm Resistor Depos. 0.25 W
R712	A700019P49	Kohm Resistor Depos. 0
R713	A700019P17	ohm Resistor Depos.
R714	A700019P17	ohm Resistor Depos. 0
R720	A700019P49	0.
R721	A700019P45	7 Kohm Resistor Depos. 0.2
R722	A700019P60	Kohm Resistor Depos. 0.
R723	A700019P60	0.
R724	A700019P61	100 Kohm Resistor Depos. 0.25 W
R725	A700019P57	Kohm Resistor Depos.
K726	A700019P49	ohm Resistor Depos. 0.
K727	A700019P30	ohm Resistor Depos. 0.25
14728	A700019P48	Kohm Resistor Depos. 0.25
K/ 29	A/00019P30	ohm Resistor Depos. 0.25
14/30	A700019P45	Kohm Resistor Depos. 0.
K/31	A700019P30	0
R732	A700019P49	Kohm Resistor Depos. 0
K733	A700019P48	
R734	A700019P35	Depos. 0
R735	A700029P57	\sim
R736	A700029P31	ohm Resistor Depos. 0
R737	A700019P31	ohm Resistor Depos. 0
R738	A700019P25	
R739	A700019P39	1.5 Kohm Resistor Depos. 0.25 W
T		

FREQUENCY SYNTHESIZER FS5111

X402.895/2

Page 2 of 3

ON	CODE	VTVU	
= 1	JOOL	אואט	
R741	A700019P43	3.3 Kohm Resistor Depos.	0.25 W
R742	A700019P37	1 Kohm Resistor Depos.	0.25 W
R743	A700019P25	100 ohm Resistor Depos.	0.25 W
R748	A700019P27		
R749	A700019P25	100 ohm Resistor Depos.	0.25 W
R750	A700019P57	47 Kohm Resistor Depos.	0.25 W
R752	A700016P3	4.7 Kohm Resistor Variable	
K/53	A700019P37	1 Kohm Resistor Depos.	0.25 W
K/54	A700019P25	100 ohm Resistor Depos.	0.25 W
R761	A700019P13		
R763	A700019P51	15 Kohm Resistor Depos.	0.25 W
R765	A700019P26	120 ohm Resistor Depos.	0.25 W
R769	A700019P36	820 ohm Resistor Depos.	.25
R770	A700019P42	2.7 Kohm Resistor Depos.	
R771	A700019P15	0	. 25
R772	A700019P57		
R773	A700019P55	33 Kohm Resistor Depos.	0.25 W
R774	A700019P50		
R775	A700019P33	470 ohm Resistor Depos.	0.25 W
R776	A700010P37	1 Kohrn Resistor Depos.	10
R777	A700019P21	47 ofm Resistor Depos.	0.25 W
R778	A700019P25	100 ohm Resistor Depos.	2
R779	A700019P34	560 ohm Resistor Depos.	
R780	A700019P23	68 ohm Resistor Depos.	
R781	A700019P19		
R782	A700019P44	9	100
R783	A700019P27		10
R784	A700019P25		
R785	A700019P39		10
R786	A700019P31		
R787	A700019P43		25
R788	A700019P26		5.
R789	A700019P3u		25
10701	A700019134		
5070	A700019F30		- 5
5070	218010007		67.
27070	71901007		67.
1070	A700019F17	22 orm Kesistor Depos.	c7.
K/98	A/00019P3/	1 Kohrn Kesistor Depos.	. 75
R799	A700019P54	27 Kohm Resistor Depos.	0.25 W
T701	J706284G1	Transformer	
U701	J706263P1	MC145106	
U702	J706238P1	TDA1062S IC	
		-	

Storno		
VTVU	Y I Y	
		Jumper Jumper
CODE	CODE	А700029Р44 А700184Р1 А700184Р1
ON		U703 W1 W2

FREQUENCY SYNTHESIZER FS5111

X402.895/2

Page 3 of 3

	•		
	E	ij	
	٤	E	
	i	C	
	2	ē	
	۹	ø	
d	۹	2	
•	ā	'n	
•	9		•

		50 V	35 V	50 V	50 V		35 V	50 V	20 V	50 V	35 V	35 V	20 V	20 V	35 V					> 0 5	> 05	> 05	50 V	50 V	20 V	20 V	20 V	20 V	20 \	20 \	20 05	> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	7 67	> 0 5	> > >	> 05	100 V	50 V	20 V
DATA	2-18 pF Capacitor Variable	10 pF Capacitor Ceramic	1 uF Capacitor Tantalum	1 nF Capacitor Ceramic	3.9 pF Capacitor Ceramic	100 pF Capacitor Ceramic	2.2 uF Capacitor Tantalum	1 nF Capacitor Ceramic	150 pF Capacitor Ceramic	27 pF Capacitor Ceramic	1 uF Capacitor Tantalum	10 oF Capacitor Tantalum	1 nF Capacitor Ceramic	1.5 nF Capacitor Ceramic.	0.1 uF Capacitor Tantalum	0.47 uF Capacitor Tantalum	1 nF Capacitor Ceramic	150 pF Capacitor Ceramic	3 L			pF Capacitor	pF Capacitor	of Capacitor C	pF Capacitor	pF Capacitor	pF Capacitor	pF Capacitor	d.	10 pr Capacitor Ceramic	4/0 pr Capacitor Ceramic	330 of Generalic	1 ne Capacitor Electrolytic	33 pF Capacitor Coramic	1 DE Capacitor Commis	1 nF Capacitor Ceramic	22 nF Capacitor Polyester	d	100 pF Capacitor Ceramic
CODE	J706003P2	A700235P13	A701534P4	A700233P7	A700235P8	A700233P1	A701534P5	A700233P7	A700233P2	A700235P18	A701534P4	A701534P7	A700233P7	A700233P8	A701534P1	A/01534P3	A700233P7	A/00233P2	A/00233P/	A700233F0	A700233F2	A700233P2	A700233P2	A700235P16	A700233P2	A700233P5	A700233P5	A700233P2	A700233P2	A700235F13	A/00233P5	170C00ED10	700007V	A700235P7	A700233F7	A700233P7	J706261P1	A700233P1	A700233P1
ōΝ	C745	C746	C747	C748	C749	C750	C751	C752	C753	C754	C755	C756	C757	C758	C759	03/20	C/61	C/62	C763	765	C766	C767	C768	C769	C770	C771	C772	C773	C//4	0770	732	C781	787	C783	C784	C785	C791	C792	C793

FREQUENCY SYNTHESIZER FS5112

X402.896/2

Page 1 of 3

4	
•	
•	×
ŧ	
Į,	
£	3
.3	2

D702 A700028P1 IN4148 Diode Silicon D703 A700028P1 II4148 Diode Silicon D704 A700028P1 II4148 Diode Silicon D705 A700028P1 II4148 Diode Silicon D709 A700028P1 II4148 Diode Silicon D700 A700028P1 II4148 Diode Silicon D710 A700028P1 II4148 Diode Silicon D711 A700028P1 II4148 Diode Silicon D711 A700028P1 II4148 Diode Silicon D711 A700028P1 II4148 Diode Silicon D712 A700028P1 II4148 Diode Silicon D713 A700028P1 II4148 Diode Silicon D714 A700028P1 II4148 Diode Silicon D714 A700028P1 II4148 Diode Silicon D714 A700028P1 II4148 Diode Silicon D722 A700028P1 II4148 Diode Silicon D724 A700028P1 II4148 Diode Silicon D725 A700028P1 II4148 Diode Silicon D724 A700028P1 II4148 Diode Silicon D725	D702		DATA	
A700028P1 III#148 Diode Silicon A700073P1 B8409 Variable Cap. Diode A700073P1 Male Connector A700072P2 Male Connector A700072P3 Male Connector A700072P3 Male Connector A700072P1 Male Connector A70002P1 Male Co		A700028P1	Diode Sil	
A700028P1 IIII1418 Dicde Silicon A700028P1 IIII418 Dicde Silicon A700028P1 III418 Dicde Silicon A700073P1 B8409 Variable Cap. Dicde A700073P1 B8409 Variable Cap. Dicde A700073P1 B8409 Variable Cap. Dicde A700072P1 Male Connector J706026P1 III5401 Dicde Silicon J70602BP1 II5401 Dicde Silicon J70602BP1 II5500 DICCONNECTOR J	03	A700028P1	Diode Sil	
A700028P1 11H148 Dicde Silicon A70003P1 Wariable Cap. Dicde A700073P1 B8409 Variable Cap. Dicde A700073P1 B8409 Variable Cap. Dicde A700073P1 B8409 Variable Cap. Dicde A700073P1 BA28 Dicde D706026P1 115401 Dicde Silicon J70602P1 115401 Dicde Silicon J70602P1 115401 Dicde Silicon J706014P1 Male Connector A700072P2 Male Connector A700072P3 Male Connector A700072P1 Male Connector J706223P1 Wariable Coil J706029P1 1:5 uH Coil A708091P1 1:5 uH Coil	50	A700028P1	Diode Sili	
A700028P1 1144148 Diode Silicon A70003P1 B8409 Variable Cap. Diode A700073P1 Male Connector A700072P1 Male Connector A700072P2 Male Connector A700072P3 Male Connector A700072P1 Male Conn	05	A700028P1	Diode Sili	
A700028P1 INH148 Diode Silicon A700028P1 INH148 Diode Silicon A700028P1 IHH148 Diode Silicon A70003P1 B8409 Variable Cap. Diode B400 Variable Cap. Diode B400 Variable Cap. Diode B400 Variable Cap. Diode B400 Variable Cap. Diode A70003P1 B8409 Variable Cap. Diode A700028P1 IH5401 Diode Silicon J706026P1 IH5401 Diode Silicon J706024P4 Male Connector A700072P2 Male Connector A700072P9 Male Connector A700072P1 Male Connector A700072P1 Male Connector J70623P8 Male Connector J70623P1 Wariable Coil J70603P1 Variable Coil	90	A700028P1	Diode Sili	
A700028P1 114148 Diode Silicon A70003P1 B8409 Variable Cap. Diode A700073P1 Male Connector A700072P1 Ma	/0	A700028P1	Diode Sili	
A700028P1 1114148 Diode Silicon A700028P1 Variable Cap. Diode B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode B8409 Variable Cap. Diode B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode BA282 Diode BA282 Diode A700073P1 B8409 Variable Cap. Diode BA282 Diode A700028P1 Male Connector A70002P1 Male Connector A700072P1 Male Connector A700072P1 Male Connector A700072P1 Male Connector A700072P1 Male Connector A70002P1 Male Male Male Male Male Male Male Male	200	A700028P1	Diode Sili	
A700028P1 IIII118 Diode SILICON A700028P1 IIII18 Diode SILICON A700073P1 B8409 Variable Cap. Diode B409 Variable Cap. Diode B400 Variable Connector B400072P9 Male Connector B400072P9 Male Connector B706214P4 Male Connector B706214P4 Male Connector B706214P4 Male Connector B706214P1 Male Connector B706214P1 Male Connector B706223P1 Male Connector B706223P1 Male Connector B706229P1 Variable Coil B708091P1 I.5 uH Coil B708091P1 I.5 uH Coil B708091P1 I.5 uH Coil B708091P1 Variable Coil B708091P1 Variable Coil	60	A/00028F1	Diode Sili	
A700028P1 III4148 Diode SILICON A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode BA282 Diode BA282 Diode A700073P1 Male Connector A700072P1 Male Connector A	0 ;	A/00028F1	Diode Sili	
A700028P1 III4148 Diode Silicon A700028P1 Variable Cap. Diode J706262P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode BA700073P1 B8409 Variable Cap. Diode BA700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706006P2 BA282 Diode J706026P1 III5401 Diode Silicon J706026P1 III5401 Diode Silicon J706214P4 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P1 Male Connector J706214P1 Male Connector J706214P1 Male Connector J706213P1 Male Connector J706213P1 Variable Coil J706213P1 Variable Coil J706219P1 Variable Coil J706219P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil	- :	A700028FI	Diode Sili	
A700028P1 IIII148 Diode Silicon A700028P1 IIII148 Diode Silicon A700028P1 IIII148 Diode Silicon A700028P1 IIII148 Diode Silicon A700028P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode BA00073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode BA00073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 BA282 Diode J706006P2 BA282 Diode J706015P10 Male Connector J706215P10 Male Connector A700072P2 Male Connector A700072P3 Male Connector A700072P1 Male Connector J706219P1 Male Connector J706219P1 Variable Coil J70623P1 Naiable Coil J70623P1 1:5 uH Coil J70608P1 1:5 uH Coil J70608P1 1:5 uH Coil J70608P1 1:5 uH Coil	7	A/00028F1	Drode Sili	
A700028P1 III4148 Diode Silicon A700028P1 III4148 Diode Silicon A700028P1 III4148 Diode Silicon A700028P1 Variable Cap. Diode A700023P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706006P2 BA282 Diode J706026P1 III5401 Diode Silicon J706015P108 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P9 Male Connector J706214P9 Male Connector J706213P1 Male Connector J706223P1 Variable Coil J706029P4 Variable Coil J706029P4 Variable Coil J706083P1 Variable Coil J706083P1 Variable Coil	13	A700028P1	Diode Sili	
A700028P1 1144148 Diode Silicon A700028P1 114148 Diode Silicon A700028P1 Variable Cap. Diode J706022P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode B8409 Variable Cap. Diode B8409 Variable Cap. Diode B8400 Variable Cap. Diode B8400 Variable Cap. Diode B8400 Variable Cap. Diode B8482 Diode J706006P2 BA282 Diode J706026P1 Male Connector J706026P1 Male Connector J706214P4 Male Connector J706223P1 Male Connector J706223P1 Variable Coil J70623P1 Variable Coil	14	A700028P1	Diode Sili	
A700028P1 1114148 Diode Silicon A706262P1 Variable Cap. Diode J706262P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode B70606P2 BA282 Diode J706006P2 BA282 Diode J706026P1 1115401 Diode Silicon J706026P1 1115401 Diode Silicon J706215P108 Male Connector J706214P2 Male Connector J706214P2 Male Connector A700072P3 Male Connector A700072P4 Male Connector A700072P9 Male Connector J706213P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P2 Male Connector J706223P2 Variable Coil J706209P4 Variable Coil J706029P4 Variable Coil J706083P1 Variable Coil J706083P1	21	A700028P1	S	
A706262P1 Variable Cap. Diode J706262P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706006P2 BA282 Diode J706026P1 H15401 Diode Silicon J706026P1 H15401 Diode Silicon J706215P114 Male Connector J706214P4 Male Connector J706214P7 Male Connector A700072P9 Male Connector A700072P9 Male Connector A700072P9 Male Connector A700072P9 Male Connector J706213P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706219P1 Variable Coil J706219P1 Variable Coil J706219P1 Variable Coil J706219P1 Variable Coil J706029P4 Variable Coil J706083P1 Variable Coil J706003P1 V	.22	A700028P1		
J706262P1 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706006P2 BA282 Diode J706026P1 115401 Diode Silicon J706026P1 Male Connector J706215P104 Male Connector J706215P114 Male Connector J706214P4 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P2 Male Connector J70623P2 Variable Coil J70603P2 Variable Coil J706083P1 Variable	23	A706262P1	Cap.	
A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706006P1 BA282 Diode J706006P1 BA282 Diode J706026P1 H15401 Diode Silicon J706215P108 Male Connector J706215P114 Male Connector J706214P7 Male Connector A700072P9 Male Connector A700072P9 Male Connector J70623P1 Variable Coil J706089P1 J706089P1 J706083P1 Variable Coil J706083P1 J706089P1	.24	J706262P1	Cap.	
A700073P1 B8409 Variable Cap. Diode A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706026P1 H15401 Diode Silicon J706026P1 H15401 Diode Silicon J706025P1 Male Connector J706214P4 Male Connector J706214P7 Male Connector J706214P7 Male Connector A700072P2 Male Connector J706213P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J70623P1 Male Connector J70624P19 Wariable Coil J70603P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil	.25	A700073P1	riable Cap.	
A700073P1 B8409 Variable Cap. Diode J706006P2 BA282 Diode J706026P1 115401 Diode Silicon J706026P1 115401 Diode Silicon J706026P1 Male Connector J706215P104 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P2 Male Connector J706219P1 Variable Connector J706219P1 Variable Coil J706219P1 Variable Coil J706029P4 Variable Coil J706083P1 Variable Coil J706083P1 Variable Coil J706083P1 Variable Coil J706024P1 Variable Coil	726	A700073P1	Variable Cap.	
J76606P2 BA282 Diode J76606P2 BA282 Diode J766026P1 I15401 Diode Silicon J766026P1 Male Connector J76614P4 Male Connector J76614P4 Male Connector J766214P4 Male Connector J76623P1 Male Connector Male Connector J76623P1 Male Connector J76622BP1 Male Connector J76622BP1 Male Connector Male Connector Male Connector J76622BP1 Male Connector Male Connector Male Connector Male Connector J76622BP1 Male Connector Male Connector Male Connector Male Connector J76622BP1 Male Connector Male Co	727	A700073P1	Variable Cap.	
J706006P2 J706026P1 J706026P1 J706026P1 J7060215P108 Male Connector J706215P114 Male Connector J706214P4 Male Connector J706214P7 Male Connector Male Connector A700072P2 A700072P3 Male Connector A700072P1 Male Connector A70002P1 Male Connector J706223P1 J706223P1 J706229P4 Variable Coil J706029P4 J706020P4 J706020P4	733	J706006P2	Diode	
J706026P1 115401 Diode Silicon J706026P1 115401 Diode Silicon J706215P108 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P7 Male Connector A700072P2 Male Connector A700072P9 Male Connector A700072P1 Male Connector A700072P1 Male Connector A700072P1 Male Connector A70002P1 Male Connector J706223P1 Male Connector J70623P1 Wariable Coil J706029P4 Variable Coil J706029P4 Variable Coil J70603P1 1.5 uH Coil J70603P1 3.3 uH Coil	34	1706006P2	RA787 Diode	
J70602671 III5401 Diode Silicon J706215P108 Male Connector J706215P114 Male Connector J706214P4 Male Connector J706214P7 Male Connector J706214P7 Male Connector J706214P7 Male Connector A700072P3 Male Connector A700072P1 Male Connector A700072P1 Male Connector J706223P1 Male Connector J70623P1 Male Connector J70623P1 Male Connector J70623P1 Male Connector J70623P1 Male Connector J706219P1 Male Connector J706219P1 Male Connector J706219P1 Variable Coil J706029P4 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil J70603P1 Variable Coil	7.4.1	17060261	Social Control	
J766215P108 Male Connector J766215P108 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P7 Male Connector A700072P28 Male Connector A700072P1 Male Connector A700072P1 Male Connector A7000223P1 Male Connector A70012P10 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706223P1 Male Connector J706229P1 Male Connector J70629P1 Variable Coil J708091P1 1.5 uH Coil J706083P1 Variable Coil J706083P1 Variable Coil J706084P19 3.3 uH Coil	711.7	1706026F1		
J706213F100 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P4 Male Connector J706214P7 Male Connector A700072P1 Male Connector A700072P1 Male Connector A700102P10 Male Connector A700102P10 Male Connector J706223P1 Male Connector J706223P1 Male Connector J70622BP Male Connector J706219P1 Variable Coil J708091P1 1.5 uH Coil J706083P1 Variable Coil J706083P1 Variable Coil J706084P19 3.3 uH Coil	100	17062150100	or prode	
J70511971 Male Connector J706214P4 Male Connector J706214P7 Male Connector A700072P28 Male Connector A700072P1 Male Connector A700072P1 Male Connector A700102P10 Male Connector A700122B8 Male Connector J70622BP1 Male Connector J70622BP Male Connector J70622BP Male Connector J70622BP1 Male Connector J706219P1 Variable Coil J708091P1 1.5 uH Coil J706083P1 Variable Coil A700024P19 3.3 uH Coil	30	1706215P110		8 pin
J706214P4	70	170621191		<u>-</u>
J706214FT		J/06214P4		
A700072P28 Male Connector 7 p A700072P28 Male Connector 10 A700072P1 Male Connector 12 A700102P1 Male Connector 12 A700102P1 Male Connector 3 p J70623P1 Male Connector 3 p J70623P1 Male Connector 11 J70623P2 Male Connector 8 p J706219P1 Male Connector 8 p J706219P1 Male Connector 9 p J706219P1 Male Connector 9 p J706029P4 Variable Coil 15 uH Coil 15	70	170021454		
A700072P2 Male Connector A700072P9 Pale Connector A700072P1 Male Connector A700072P1 Male Connector J706223P1 Male Connector J70623P1 Male Connector J70623P8 Pale Connector J70623P8 Pale Connector J70623P8 Pale Connector J70623P8 Pale Connector J70623P1 Pale Connector J70623P1 Variable Coil J70603P1 Pale Coil A700024P19 J3.3 uH Coil	0.3	J/06214P/		
A700072P9	10	A700072P28		2 pin
A700072P11 Male Connector A700102P10 Female Connector 3 p J706223P1 Male Connector J70623P8 Male Connector 11 J706219P1 Variable Coil J706029P4 Variable Coil J70603PP1 1.5 uH Coil J706083P1 Variable Coil A700024P19 3.3 uH Coil	05	A700072P9		
A700102P10 Ferale Connector J706223P1 Male Connector J706223P8 Nale Connector J706219P1 Variable Coil J708091P1 1.5 uH Coil J706083P1 Variable Coil A708024P19 3.3 uH Coil	90	A700072P11		
J706223P11 Male Connector J706223P8 Nale Connector J706219P1 Variable Coil J706029P4 Variable Coil J708091P1 1.5 uH Coil J706083P1 Variable Coil A700024P19 3.3 uH Coil	07	A700102P10	Fenale Connector	3 pin
J706223P8 Male Connector J706219P1 J706219P1 J706219P1 Variable Coil J708091P1 T.5 uH Coil J706083P1 Variable Coil A700024P19 3.3 uH Coil	10	J706223P11		11 pos
J706219P1 J706219P1 J70629P4 J708029P4 J708091P1 J708091P1 J706083P1 Variable Coil A700024P19 J3.3 uH Coil	-1	J706223P8		8 pos
J706219P1 J706029P4 J708091P1 J5 uH Coil A708091P1 J5 uH Coil A700024P19 J3.3 uH Coil	21	J706219P1		pin
J706029P4 Variable Coil J708091P1 1.5 uH Coil A708091P1 1.5 uH Coil J706083P1 Variable Coil A700024P19 3.3 uH Coil	61	J706219P1		nia
J708091P1 A708091P1 J706083P1 A700024P19	01	J706029P4	Variable Coil	
A708091P1 J706083P1 A700024P19	.02	J708091P1	1.5 uH Coil	
J706083P1 A700024P19	03	A708091P1	프	
A700024P19	0.4	1706083P1	Variable Coil	
6.6	. L	A7000710	2 2	
	60	A7 00024F19		
			શ	

																										25 W	0.25 W			50			0.25 V			0.25 W		0.25 W
DATA	Coil	e Coil	uH Coil	e Coil	Coil	Coil		Coil	Coil		Coil	uH Coil			Transistor	Transistor	BC558 Transistor	MI0610L Transistor	BFR54 Transistor	Transistor	Transistor	2N5245 Fransistor	ransistor	BFA09 Iransistor BEN1N Twomsistor	BEX89 Transistor	47 ohm Resistor Depos. 0.	.8.			s.			Kobm Resistor Depos. 0.		•			Kohn Resistor Depos. 0.
	3.3 uH	Variable Coi	1.5 uH		\exists	3.3 uH	Coil	픙	프	: : : : : :	3.3 uH Coi	6.8 uH	0.15 LH Coi	0.15 UH CO.	BC548 1	- 1		M10610L	BFR54 T		BF414 T	ZN5245	213245 DEVOO T	DEN111	RFX89 T	47 ohm	1.5 Koh	22 Kohm		/		10 Korn	- ~	2.7 Koh	10 Kohm			10 Kohm
CODE	A700024P19	J706083P1	A700024P15	J706029P4	A700024P19	A700024P19	J706258P1	A700024P19	A700024P19	J706258P1	A700024P19	A/00024P23	A/00024P3	A/00024P3	A700070P1	A700020P1	A700020P1	A707834P1	J706283P1	J706283P1	J706264P1	1705038P1	1707515D1	17052511PT	J707515P1	A700019P21	A700019P39	A700019P53	A700019P34	A700019P42	A700019P21	A700019P49	A700019F49	A700019P42	A700019P49	A700019P17	A700019P17	A/00019P49
ōΝ	L706	L707	L708	L711	L712	L713	L714	L715	L716	L717	L718	17/71	1777	0701	0207	07.03	0704	0711	Q713	Q714	0715	0717	0777	0773	0724	R701	R702	R703	K/04	K/05	F/00	P708	R709	R711	R712	R713	R714	R7.20

FREQUENCY SYNTHESIZER FS5112

X402.896/2 Page 2 of 3

ōΝ	CODE	DATA	
R722	A700019P60		0.25 W
R723	A700019P60	82 Kohm Resistor Depos.	
R724	A700019P61	100 Kohn Resistor Depos.	10
R725	A700019P57	47 Kohm Resistor Depos.	10
R726	A700019P49		10
K/2/	A700019P30		
K728	A700019P48		
R729	A700019P30		-
R730	A700019P45		10
R731	A700019P30	270 ohm Resistor Depos.	-
R732	A700019P49		
R733	A700019P48		
R734	A700019P35	680 ohm Resistor Depos.	
R735	A700029P57	\sim	0.25 W
R736	A700029P31		
R737	A700019P31		
R738	A700019P25		100
R739	A700019P39		2
14/41	A/00019P43		2
17.42	A/00019P37	1 Kohm Kesistor Depos.	.25
K/43	A/00019F25		0
K/48	A700019P2/		57.
K/49	A700019P25	100 orm Resistor Depos.	0.25 17
0753	A700016P3	1 7 Kohm Boriston Variable	. 73
R753	A700019P37	1 Kohm Resistor Donos	0 25 17
R754	A70001955	100 ohm Resistor Depos	
R761	A700019P13	10 ohn Resistor Denos	2 10
R763	A700019P51	15 Kohm Resistor Denos	
R765	A700019P26	120 ohm Resistor Depos.	0.25 W
R769	A700019P36	ohm Resistor Depos	
R770	A700019P42		100
R771	A700019P15	15 ohm Resistor Depos.	
R772	A700019P57		
R773	A700019P55		0.25 W
R774	A700019P50	12 Kohrn Resistor Depos.	. 25
R775	A700019P33	470 ohm Resistor Depos.	.25
R776	A700010P37	1 Kohm Resistor Depos.	.25
R777	A700019P21	\mathbf{c}	.25
R778	A700019P25		.25
R779	A700019P34	0 ohm Resisto	0.25 W
R780	A700019P23	68 ohm Resistor Depos.	2
	ā		

	0.25 W	7.5			0.25 W		0.25 ₩	25		0.25 W		.25	0.25 W													
DATA	33 ohm Resistor Depos.	150 ohm Resistor Depos.				120 chm Resistor Depos.	560 ohm Resistor Denos			0	22 ohm Resistor Depos.	1 Kohm Resistor Depos.	2/ Korm Resistor Depos.		MC145106	TDA1062S IC	71 R990H	LMP.	Jurper							
CODE	A700019P19	A700019P27	A700019P25	A700019P39	A700019P31	A700019P43	A700019F26	A700019P30	A700019P38	A700019P17	A700019P17	A700019P37	A/00019P54	J706284G1	J706263P1	J706238P1	A700029P44	K805090C1	A700184P1							
ōΝ	R781	R783	R784	R785	K/86	K/0/	R789	R791	R792	R793	R794	R798	K/99	1701	U701	U702	U703	1067	7.72							

FREQUENCY SYNTHESIZER FS5112

X402.896/2

Page 3 of 3

Stormo

TECHNICAL SPECIFICATION

CQM5330 S12

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

66 - 88 MHz

Antenna Impedance

50 ohm

Channel Separation

CQM5332: 30/25 kHz

CQM5333:

20 kHz

CQM5334: 12.5 kHz

Minimum: 10.8 V

Maximum: 16.6 V

Maximum number of channels

13.2 V

Supply Voltage

Maximum Frequency Deviation

CQM5332: ±5 kHz

CQM5333: ±4 kHz

CQM5334: ±2.5 kHz

Temperature Range

B x D x H: 180 x 190 x 60 mm

 -30° C to $+60^{\circ}$ C

Dimensions

Nominal:

Modulation Frequency Range

CQM5332: 300 - 3000 Hz

CQM5333: 300 - 3000 Hz

CQM5334: 300 - 2550 Hz

Weight 1.8 kg.

Maximum RF Bandwidth

RX: 1.5 MHz

TX: 2.5 MHz

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½ e.m.f.:

0.3 uV (0.25 uV)

EIA measuring conditions:

 $\Delta f = \pm 2/3 \Delta f \text{ max}$: $f_{\text{mod}} = 1 \text{ kHz}$

20 dB SINAD (CEPT), e.m.f.:

CQM5332:

0.75 uV (0.55 uV)

CQM5333: 0.75 uV (0.55 uV)

CQM5334: 1.0 uV (0.75 uV)

CEPT measuring conditions:

 $\Delta f= 60\% \Delta f \text{ max}: f_{\text{mod}} = 1 \text{ kHz}$

Measured with psophometric filter

Crystal Frequency Range

36 - 48 MHz

Receiver VCO Frequency Range

77 - 99 MHz



Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth

CQM5332: ±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

EIA

CQM5332: 75 dB (85 dB)

FT7

CQM5333: 70 dB (85 dB)

CEPT

CQM5332: 75 dB (85 dB)

CQM5334: 65 dB (85 dB)

Spurious Rejection EIA

80 dB (85 dB)

Intermodulation Attenuation

EIA

CQM5332: 70 dB (72 dB)

FTZ

CQM5333: 70 dB (72 dB)

CEPT

CQM5332: 70 dB (75 dB)

CQM5333: 70 dB (75 dB)

CQM5334: 70 dB (73 dB)

Blocking

90 dB/uV (104 dB/uV)

Radiation

Conducted: max. 0.8 nW

Radiated:

max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W

AF Distortion

5% (1.5%)

60% Δf max., 1 kHz, 1 W, RF 1 mV

Audio Frequency Response CEPT/FTZ

300 - 3000 Hz

+1/-3 dB (+0/-1.5 dB)

400 - 2700 Hz fm:

+1/-1.5 dB (+0/-1 dB)

fm: 300 - 2550 Hz

+1/-3 dB (+0/-1 dB)

Reletive to 1000 Hz, -6 dB/octave

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Squelch Attack Time (EIA)

150 ms (110 ms)

Squelch Recovery Time

250 ms (200 ms)

Squelch Closing Time (EIA)

150 ms (50 ms)

Current Consumption

Squelched:

350 mA (330 mA)

Receive, AF 2 W:

750 mA (730 mA)

(1 channel without tone equipment, 13.2 V

supply)

TRANSMITTER

RF Power Output

CQM5332-6: 6 W

CQM5332-25: 25 W

CQM5333-6: 6 W

CQM5333-25: 25 W

6 W CQM5334-6:

CQM5334-25: 25 W

 $(R_1 = 50 \text{ ohm})$

Crystal Frequency Range

15 - 21 MHz

Crystal Frequency Multiplication

× 4

Transmitter VCO Frequency Range

66 - 88 MHz

Frequency Stability

Conforms with government regulation

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

Modulation AF Input Impedance

560 ohm

Modulation Sensitivity

70 mV ± 2 dB

(60% Δf max., 1 kHz)

Modulation Response

300 - 3000 Hz

+1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

400 - 2700 Hz

+1/-1.5 dB (+0.5/-1 dB)

relative to 1000 Hz, 6 dB/octave

300 - 2550 Hz

+1/-3 dB (+0.5/-2 dB)

Relative to 1000 Hz, 6 dB/octave

Modulation Distortion (CEPT)

max, 3%

 f_{mod} = 1000 Hz, Δf = 60% Δf max.

max. 5%

 f_{mod} = 300 Hz, Δf = 5.5% Δf max.

measured with 750 usec, de-emphasis

FM Hum and Noise, CEPT

55 dB (57 dB)

measused with 750 usec. de-emphasis

Attack Time

50 ms

Current Consumption

6 W: less than 3 A (2.5 A)

25 W: less than 5.9 A (5.0 A)

GENERAL DESCRIPTION

CQM5330 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

A comparison of the various models is presented in the table below.

Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential encoder/decoder, or Channel Guard (Pilot tone), Group Call, All Call, and up to 12 transmit and receive channels.

Туре	CQN	15332	CQM	5333	CQM	334	
SPEC	6	25	6	25	6/10	25	
Frequency Range MHz	66	- 88	66	- 88	66 -	88	
RF Power W		6	2	:5	6/10 25		
Channel Spacing kHz	30)/25	2	20	12.5		
Max. Number of Channels		12	1	2	12		

ACCESSORIES

Standard	accessories include:	HS5001	Retainer for MC5001
Mounting 1	frame	HS5002	Retainer, with switches, for MC5001
Power cab	le	MC5002	Cylindrical handmicrophone with
Fist micro	phone with retainer or		build-in amplifier and press-to talk
Fixed - mo	ount microphone		switch. Fitted with a coiled cord
External lo	oudspeaker		terminated into a connector which
External s	witches		fits into the microphone retainer.
LS701	Loudspeaker enclosed in a plastic	HS5003	Retainer for MC5002, without hook
	housing, complete with cable.		switch.
MC702b	Dynamic fist microphone with adjust-	HS5004	Retainer for MC5002, with hook switch.
	able output level.	MK5001	Installation kit containing connectors,
JB701a	Junction box for MC702b. Consists		power cable, fuses and fuseholders.
	of a plastic housing provided with	MN703	Desk stand for fixed installations.
	cable for soldering assembly. Junction	MN704	Mounting bracket for the radio ca-
	box is to mounted behind the first		binet.
	microphone retainer.	MN5001	Mounting frame for mobile installa-
MC703a	Desk microphone with PTT (Push -to		tions allowing the radio to be fixed
	- Talk) switch for fixed installations.		in 36 positions. Includes a base plate
MC704	Microphone with chockabsorbing moun		with locking screw.
	ting bracket for mobile installation.	MN5002	Mounting cassette for the radio
MK704	Mounting kit consisting of 2 flexible		cabinet (see mechanical layout).
	tubes, used for mounting the MC704	MT5001	Microphone with retainer. The retai-
	in close-talk position.		ner contains a microswitch which is
MC5001	Fist microphone with retractables		used to switch off the internal loud-
	piral cable for mobile installation.		speaker, when the microphone is lifted.

SU701	Transmitter keying switch for	Power Supply Units:		
	mounting on the steering coloum.	Equipment		
SU702	Transmitter keying switch for		220 V AC	+24 V DC
	mounting on the dashboard.	CQM5000, max. 6/10 W	PS703	PS704
SU704	Switch circuit for autoradio mounting.	CQM5000, max. 25 W	PS5001	PS 702
SU5003	External alarm with timer (Horn Alarm).			•

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB) and the Frequency Control (FC) mount in the top section of the chassis.

Their switches and push buttons mount directly to the boards and protrude through the front.

Thin cast shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

Receiver front end 1st IF section with first and second oscillator 455 kHz 2nd IF section with demodulator.

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, 0402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to

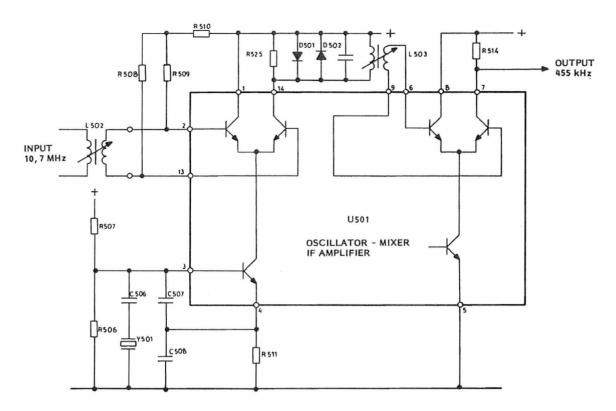


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in microstripline techniques on the mainboard.

1st IF

The first IF frequency is 10.7 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output sig-

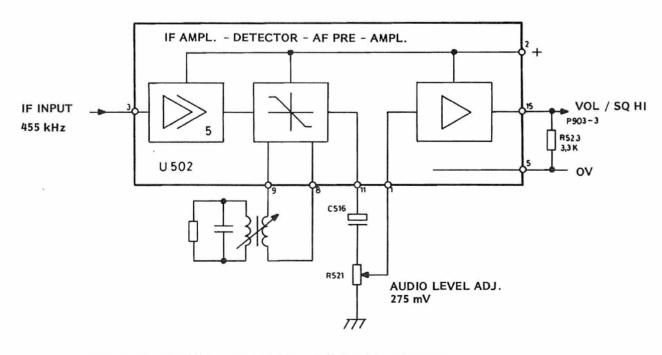


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER



nal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

455 Hz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the quadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 7 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier.

The transmit indicator is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO

In sets with Pilot tone option, the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without Pilot tone this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629-C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not.

These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the main board along with the receiver.

The exciter contains an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter out-



put is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load, R901 on the FS board, is applied to amplifier U101b.

The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV. MAX. potentiometer on the RF Board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the FM oscillator.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Three amplifier stages (Q201-2-3) and four filters (L201-2-4-5) are used in a narrow band design which limits the maximum frequency spread of the transmitter.

The exciter has two test points (TP201-2) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power le-

vels of 6 (10) watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R221, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is biased by a voltage generated by the feedback network C240, D201, Q201, Q209, and Q208.

FREQUENCY SYNTHESIZER

The frequency synthesizer provides up to 12 Channels and is built on a printed wiring board which mounts in the top section of the radio set. There are two versions of the board, a single channel board, FS5331, and a multichannel board, FS5332.

The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board uses a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the synthesizer board and protrudes through the front panel.

The Frequency Control unit FC5001 fits into a shield which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusible printed wiring path which will open in case of the ground wire being accidently connected to A+.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through J903 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections U602. The other section of the ON/OFF switch controls the $\rm V_B$ + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

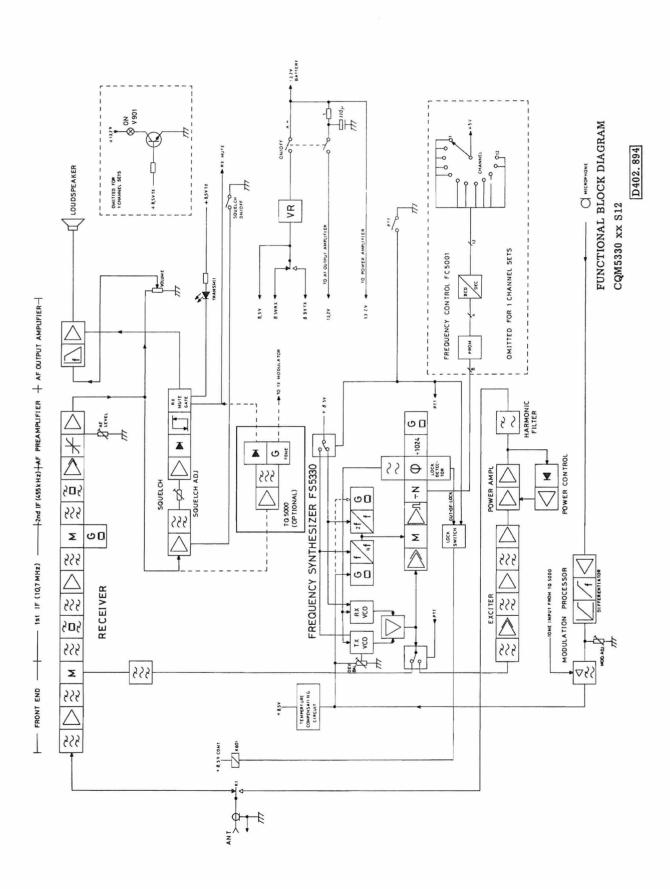
The squelch circuit, the modulation processor, the Frequency Synthesizer and parts of the IF amplifier, U502, are supplied directly from the continuous 8.5 V.

The receiver front-end, the 10.7 MHz IF stages and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



ADJUSTMENT PROCEDURE

CQM5330 S12

This adjustment procedure applies to the following radiotelephone types:

CQM5332 S12 30/25 kHz Channel spacing
CQM5333 S12 20 kHz Channel spacing
CQM5334 S12 12.5 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter

 $R_{in} \ge 1$ Mohm

AC Voltmeter Multimeter $Z_{in} > 1 \text{ Mohm}//50 pF$ $R_{i} \ge 20 \text{ Kohm/Volt}$

Distortion meter

e.g. Storno E11c

RF Watt meter

25 W/50 ohm/66-88 MHz

Deviation meter

66-88 MHz

RF generator 10.7 MHz signal generator $Z_{out} = 50$ ohm; 66-88 MHz

e.g. Storno TS-G21B

Frequency counter with attenuator

Z_{in} = 50 ohm; sensitivity

100 mV at 88 MHz

RF diode probe

Storno 95, 0089-00

RF coaxial probe

Storno 95. 0179-00

DC power supply

10.8 V - 16.6 V; 6A

Oscilloscope

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026-00

22 uF/40 V electrolytic capacitor

Storno code 73, 5107-00

Connector, 11-pin house Connector, 8-pin house Storno code 41,5543-00

Pins for connectors

Storno code 41.5542-00 Storno code 41.5551-00

Trimming tools

nals:

The following tables show the frequency ranges of the CQM5330 S12 radiotelephone sig-

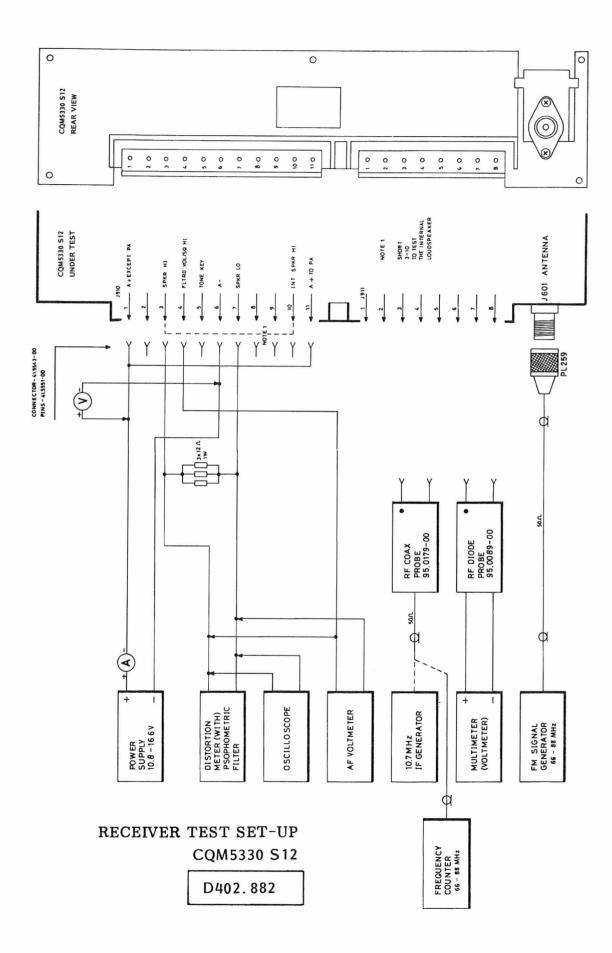
SIGNAL	FREQUENCY MHz
TX VCO TX crystal TX crystal multiplication	66 - 88 15 - 21 ×4
RX VCO RX crystal RX crystal multiplication	77 - 99 36 - 48 ×2

Table 1.

Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	kHz
20	10.240	2.560	5.110	10
12.5 or 25 ¹⁾	12.800	3.200	6.3875	12.5
15.0 or 30 ¹⁾	15.360	3.840	7.665	15

Table 2

¹⁾ Two steps per channel



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ± 0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code	R636 Value
Brown	omit
Red	270
Orange	100
Yellow	47
Green	22
Blue	6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: ≤50 mV

Repeat the procedure with the power supply

adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and prom codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 250 mV ± 125 mV

(corresponding to -10 dBm

to -4 dBm).

Note:

Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition in indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 4.8 volt (4.0 + 0.8)

Center channel reading: 4.0 volts

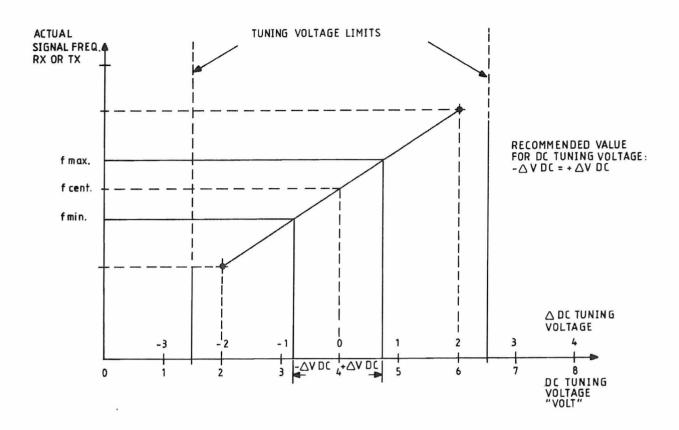
Low channel reading: 3.2 volt (4.0 -0.8)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.



f= $f_x \times 2$ (f_x = crystal frequency) Adjust L711 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95,0179-00 to test point TP401.

Connect the frequency counter to the probe.

Calculate the injection frequency for all channels

f_{inj}= f_{ant}+10.7 (MHz) Select, one by one, the channels and read the injection frequency.

Requirement: F_{ini} ±0.4 ppm

IF AMPLIFIERS

Connect a 10.7 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range).

During adjustment the RF generator output must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection.

Detune L403 and 405 as much as possible.

Adjust L404 for maximum deflection on the multimeter. This is the only adjustment of L404 and it <u>must not</u> be touched during the rest of the procedure.

Adjust L403 and L405 for maximum deflection on the multimeter.

Readjust L401 and L402 for maximum deflection

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δ f max.

CQM5332 S12 ±3 kHz CQM5333 S12 ±2.4 kHz CQM5334 S12 ±1.5 kHz

Connect a 4 ohm/3 W resistor load to connector J910/37 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.

Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).
Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ± 5 mV.

Read the distortion.

Typical Total Harmonic Distortion (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at $60\% \Delta f$ max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, 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 immeadiately 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industrie's Association)
Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + destortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.)

Requirement: <0.75 uV.

The sensitivity should be measured on all channels, if more than one.

MEASURING 12 dB SINAD (EIA)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load. Adjust the RF generator to obtain 12 dB SINAD condition. Read the 12 dB SINAD sensitivity. Requirement: \leq 0.3 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI - LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
Type CQM5332 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
Type CQM5333 S12	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	
Type CQM5334 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	2550 Hz	-8 dB	+1 dB/-3 dB

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 66 - 88 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD <5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

Requirements

Condition	Current comsumption
Standby	≤400 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	≤750 mA

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

25 W transmitter:

6A

6 W transmitter:

4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW). Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95.0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

250 mV ± 125 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition in indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

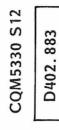
Example:

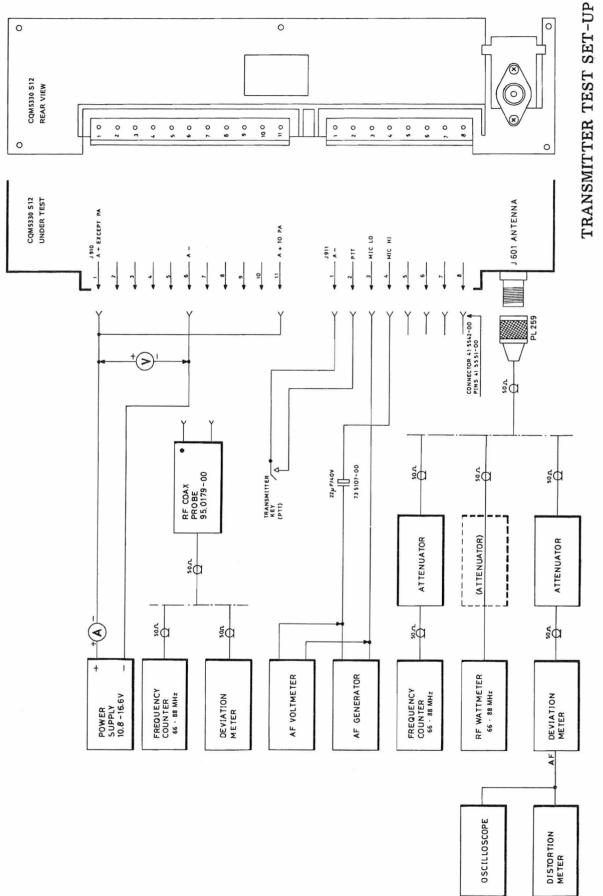
High channel reading: 5.1 volt (4.0 + 1.1)

Center channel reading: 4.0 volts

Low channel reading: 2.9 volt (4.0 -1.1)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.





Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe, key the transmitter and read the frequency. f= $f_x \times 4$ (f_x = crystal frequency). Adjust L701 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6} .

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER

Coarse adjustment

Connect a multimeter (2.5 V range) to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection.

Adjust L201 for minimum deflection. The dip is small

Connect the multimeter (2.5 V range) to test point TP202.

Adjust L202 for maximum deflection on the multimeter, typical 1.0 V.

Adjust L204 for minimum reading. The dip is small.

Connect diode probe 95.0089-00 and the multimeter (25 V range) to test point TP203.

Adjust L204 and L205 for maximum reading on the multimeter, typical 15 V.

Adjust the PA power control, R221, for rated transmitter power, 6/10 W or 25 W.

Fine adjustment

Connect the multimeter to test point TP201. Key the transmitter.

Readjust L153 for maximum reading.

Connect the multimeter to test point TP202.

Peak L201 and L202 for maximum reading.

If the maximum is not well defined detune

L153 slightly, adjust L201 and L202, and repeat the adjustment of L153.

Connect the 95.0089-00 RF probe and multimeter to test point TP203.

Peak L204 and L205 for maximum reading.

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601. Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: $F = F_{ant} \pm 0.4 \text{ ppm}$, $ppm = parts \text{ per million} = 10^{-6}$

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 16 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 6(10) or 25 W. Requirement: $P_{nom} \pm 0.1 \text{ dB}$.

Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (25 W):

Voltage	Power	Current
16.6 V	25 W (ref)	≤5.8 A
13.2 V	≥23.5 W	≤5.8 A
10.8 V	≥20 W	≤5.8 A

Requirements (6 W):

Voltage	Power	Current
16 V	6 W (ref)	≤2.6 A
13.2 V	≥5.2 W	≤2.6 A
10.8 V	≥5.0 W	≤2.6 A

TP701.



MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V.

Select the channel having the highest frequency. Set R116 to mid-position.

Connect coax probe 95.0179-00 to test point

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Connect the deviation meter through an attenuator to the antenna connector, J601.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect an AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Туре	Channel spacing	Δf max
CQM5332 S12	30/25 kHz	±5 kHz
CQM5333 S12	20 kHz	±4 kHz
CQM5334 S12	12.5 kHz	±2.5 kHz

Requirement

Difference between + and - deviation: <10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5332 S12 : ±3.0 kHz CQM5333 S12 : ±2.4 kHz CQM5334 S12 : ±1.5 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

< 7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 x Δf max is obtained on the deviation meter.

CQM5332 S12 : ±1.0 kHz CQM5333 S12 : ±0.8 kHz CQM5334 S12 : ±0.5 kHz

Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

ADJUSTMENT OF TONE EQUIPMENT

Measuring equipment

Tone Test Generator Storno TS-G13 95B0251-00

Check the connections and the tone combination of the TQ5001/TQ5002/TQ5004/TQ5005 and SU/5002; refer to description and diagrams.

Adjustment of frequency deviation

Apply Standard test condition to the transmitter; refer to transmitter test setup.

Establish a shortcircuit between emitter and collector of Q108, on the solderside

of the TQ unit, which will produce a continuous tone to the modulator.

Key the transmitter using the tone button.

Adjust R113, TQ5001/TQ5002/TQ5004/TQ5005 for 70% of maximum frequency deviation.

Remove the short circuit.

Connect the G13 Tone Test set to the AF output on the Deviation Meter.

Check that the tone call is properly received when the tone button is depressed.

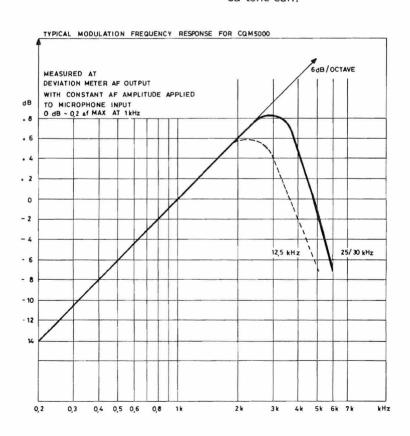
Checking the Tone Receiver

Apply Standard test condition to the receiver; refer to receiver test setup.

Modulate the signal generator with the G13 Tone Test Set.

Set the G13 to the proper tone combination.

Check that the TQ unit responds to a released tone call.



Storno

CHANNEL PROGRAMMING INSTRUCTIONS

CQM5330 S12

Programming of the PROM which contains the data for the channel frequencies will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 17 or 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19)
Programming Pak, interchangeable
Socket adaptor
or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

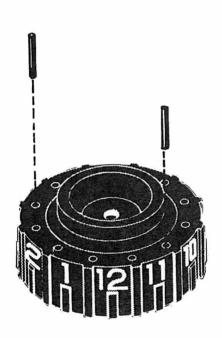
- Complete list of receiver channel frequencies. (A).
- 2. Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- 7. Note channel spacing and Reference frequency (F). See worksheet.
- 8. Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.



- After completing the worksheet the next steps are:
- Enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.
- Insert the channel knob stop (if needed) if less than 9 channels, refer to fig. 1.
- In case of more than 8, but less than 12 channels are used, transmission on unauthorized channels must be avoided. This is done by burning the unused channel locations in the PROM with the highest channel HEX CODE.

CHANNEL STOP

LOWEST	INSERT	HIGHEST	INSERT
CH.	PIN BETWEEN	CH.	PIN BETWEEN
1	10 and 11	1	3 and 4
2	11 and 12	2	4 and 5
3	12 and 1	3	5 and 6
4	1 and 2	4	6 and 7
5	2 and 3	5	7 and 8
6	3 and 4	6	8 and 9
7	4 and 5	7	9 and 10
8	5 and 6	8	10 and 11
9	6 and 7	9	11 and 12
10	7 and 8	10	12 and 1
11	8 and 9	11	1 and 2
12	9 and 10	12	2 and 3



Note:

If 8 channels are used insert only one PIN.

If more than 8 channels are used stop is not possible and no

PINs are inserted.

Fig. 1. SETTING OF CHANNEL KNOB STOP.

RECOMMENDED CRYSTAL FREQUENCIES CQM5330

		T
CQM5332 - CQM5334	CQM5333	RX CRYSTAL
FREQUENCY RANGE	FREQUENCY RANGE	RX CRISIAL
65.2 - 68.3875	64. 56 - 67. 11	36.35
66.2 - 69.3875	65. 56 - 68. 11	36.85
67.2 - 70.3875	66.56 - 69.11	37.35
68.2 - 71.3875	67.56 - 70.11	37.85
69.2 - 72.3875	68.56 - 71.11	38.35
70.2 - 73.3875	69.56 - 72.11	38.85
71.2 - 74.3875	70.56 - 73.11	39.35
72.2 - 75.3875	71. 56 - 74. 11	39.85
73.2 - 76.3875	72.56 - 75.11	40.35
74.2 - 77.3875	73.56 - 76.11	40.85
75.2 - 78.3875	74.56 - 77.11	41.35
76.2 - 79.3875	75. 56 - 78. 11	41.85
77.2 - 80.3875	76.56 - 79.11	42.35
78.2 - 81.3875	77.56 - 80.11	42.85
79.2 - 82.3875	78.56 - 81.11	43.35
80.2 - 83.3875	79.56 - 82.11	43.85
81.2 - 84.3875	80.56 - 83.11	44. 35
82.2 - 85.3875	81.56 - 84.11	44. 85
83.2 - 86.3875	82.56 - 85.11	45.35
84.2 - 87.3875	83.56 - 86.11	45.85
85.2 - 88.3875	84. 56 - 87. 11	46.35
86.2 - 89.3875	85. 56 - 88. 11	46.85
87.2 - 90.3875	86.56 - 89.11	47.35
88.2 - 91.3875	87.56 - 90.11	47. 85

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5330

	T	1
CQM5332 - CQM5334 FREQUENCY RANGE	CQM5333 FREQUENCY RANGE	TX CRYSTAL
65.2 - 68.3875	64. 56 - 67. 11	15.5
66.2 - 69.3875	65.56 - 68.11	15.75
67.2 - 70.3875	66. 56 - 69. 11	16.
68.2 - 71.3875	67.56 - 70.11	16.25
69.2 - 72.3875	68.56 - 71.11	16.5
70.2 - 73.3875	69.56 - 72.11	16.75
71.2 - 74.3875	70.56 - 73.11	17.
72.2 - 75.3875	71.56 - 74.11	17.25
73.2 - 76.3875	72. 56 - 75. 11	17.5
74.2 - 77.3875	73.56 - 76.11	17.75
75.2 - 78.3875	74. 56 - 77. 11	18.
76.2 - 79.3875	75. 56 - 78. 11	18.25
77.2 - 80.3875	76.56 - 79.11	18.5
78.2 - 81.3875	77.56 - 80.11	18.75
79.2 - 82.3875	78.56 - 81.11	19.
80.2 - 83.3875	79.56 - 82.11	19.25
81.2 - 84.3875	80.56 - 83.11	19.5
82.2 - 85.3875	81.56 - 84.11	19.75
83.2 - 86.3875	82.56 - 85.11	20.
84.2 - 87.3875	83.56 - 86.11	20.25
85.2 - 88.3875	84.56 - 87.11	20.5
86.2 - 89.3875	85.56 - 88.11	20.75
87.2 - 90.3875	86.56 - 89.11	21.
88.2 - 91.3875	87.56 - 90.11	21.25

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY

SELFQUIETING FREQUENCIES CQM5332

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE ⁺
All crystal frequencies	428	1
38.35	457	2
38.85	377	2
39.35	297	2
40.85	464	3
41.35	384	3
41.85	304	3
43.35	474	2
43.85	397	2
44.35	314	2

TABLE 3A. SELFQUIETING FREQUENCIES

⁺refer to worksheet

SELFQUIETING FREQUENCIES CQM5333

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE ⁺
38.85 38.85	468 471	3 2
39.35 39.35	368 371	3 2
39.85 39.85	268	3
43.85	271 492	3
43.85 44.35	496 392	3
44. 35 44. 85	396 292	3
44.85	296	2

TABLE 3B. SELFQUIETING FREQUENCIES

⁺refer to worksheet

HEX CODE CONVERSION TABLE

	0	-	2	3	#	2	9	7	8	6	A	В	U	۵	ш	ш
0	256	257	258	259	260	261	262	263	797	265	366	267	268	269	270	271
-	272	273	274	275	276	277	278-	279	280	281	282	283	284	285	286	287
7	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
<u>е</u>	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
#	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
2	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
9	352	353	354	355	326	357	358	359	360	361	362	363	364	365	366	367
7	368	369	370	371	372	373	374	375	376	377	378	379		381	382	383
8	384	385	386		388	389	390	391	392	393	394	395	396	397	398	399
6	400	401	402		†0	405	904	407	804	604	410	411	412	413	414	415
A	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
<u>m</u>	432	433	434	435	436	437	438	439	044	441	442	443	777	445	944	447
<u>၂</u>	844	644	450	451	452	453	454	455	456	457	458	459	094	461	462	463
_	49	465	99ħ	467	891	691	470	471	472	473	474	475	9/4	477	478	479
Ш	480	481	482	483	484	485	981	487	488	489	490	491	492	493	464	495
Щ	96ħ	467	864	499′	200	501	502	503	504	202	206	207	208	209	510	511
Mos	Most Significant Digit	ficant		of Hex	Code.			"VDEC"	". N	Numbers						

Example " V_{DEC} "= 345 equals to hex code 59.—LSD " V_{DEC} "= 469 equals to hex code D5.

Table 4. "V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

Storno

PROGRAMMING WORKSHEET FOR CQM5330 S12

Storno

								NE LINCOLD	
A FREQUENCY		>	>	PROM	B FREQUENCY	٦	>	>	PROM
MHz	I	DEC	HEX	ADDRESS (HEX)	MHz	I	DEC	HEX	ADDRESS (HEX)
				00					10
				01					11
				02					12
				03					13
				. 40					14
				05					15
				90					16
				07					17
				80					18
				60					19
				0A					14
				08					18
RECEIVER MIXER CRYSTAL FREQ. (Y702): C=	- FREQ. (Y	/702): C=_			TRANSMITTER MIXER CRYSTAL FREQ. (Y701) D=	ER CRY	STAL FR	EQ. (Y701	
FORMULA: VDEC =	(A + 10.7)	× (C ×	2)		FORMULA:	A: VDEC=	c= B	, (D ×	(1)
,	CHANNEL SPACING:	INEL ING:	CR	REFERENCE CRYSTAL (Y703):	REFERENCE FREQUENCY:				
-	12.5/	20 kHz 12.5/25 kHz	21 22	10.240000 MHz 12.800000 MHz	F= 0.01 F= 0.0125				
LIST	LIST OF REFERENCE CRYSTALS	ENCE CRY	STALS ((7703)	ALTERNATIVE SC	OLUTIO	NS IF TH	IE RECEIV	ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:
MODE Standard 5332/5334 Offset 5334 Offset 5332 Standard 5113		FREQUENCY, MHz 12.80000 12.801000 12.802000 10.240000	Y, MHz	PART No. 19J06361P1 19J06361P7 19J06361P8	 SELECT ANOTHER RX MIXER CRYSTAL FREQUEN SELECT HIGH INJECTION FREQUENCY FOR 2nd C Y501= 11.15500 MHz INSTEAD OF 10.245000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL 4. WEAK QUIETING; NO ALTERNATIVE REQUIRED 	THER F H INJEC 500 MHz LY OFFS	XX MIXER TION FR INSTEA SET REFI	R CRYSTA EQUENCY D OF 10.2 ERENCE C	SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 11. 15500 MHz INSTEAD OF 10. 245000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL WEAK QUIETING; NO ALTERNATIVE REQUIRED
Offset 5333		10.241300	300	19J06361P10					

Stormo Storno

TECHNICAL SPECIFICATIONS

CQM5330 S99

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

66 - 88 MHz

Channel Separation

CQM5332: 30/25 kHz

CQM5333:

20 kHz

CQM 5334:

12.5 kHz

Maximum Frequency Deviation

CQM5332:

±5 kHz

CQM5333:

±4 kHz

CQM5334: ±2.5 kHz

Modulation Frequency Range

CQM5332: 300 - 3000 Hz

CQM5333:

300 - 3000 Hz

CQM5334:

300 - 2550 Hz

Maximum RF Bandwidth

RX: 1,5 MHz

TX: 2.5 MHz

Antenna Impedance

50 ohm

Maximum number of channels

99

Supply Voltage

Minimum: 10.8 V

Nominal:

13.2 V

Maximum:

16.6 V

Temperature Range

 -30° C to $+60^{\circ}$ C

Dimensions

B x D x H: 180 x 190 x 60 mm

Weight

1.8 kg.

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½ e.m.f.:

0.3 uV (0.25 uV)

EIA measuring conditions:

 $\Delta f = \pm 2/3 \Delta f \text{ max}$: $f_{\text{mod}} = 1 \text{ kHz}$

20 dB SINAD (CEPT), e.m.f.:

CQM 5332:

0.75 uV (0.55 uV)

CQM 5333:

0.75 uV (0.55 uV)

CQM 5334:

1.0 uV (0.75 uV)

CEPT measuring conditions:

 $\Delta f = 60\% \Delta f \text{ max}: f_{\text{mod}} = 1 \text{ kHz}$ Measured with psophometric filter Crystal Frequency Range

38.35 - 49.35 MHz

Receiver VCO Frequency Range

77 - 99 MHz

Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth

CQM5332: ±5 kHz (±5.8 kHz)

Adjacent Channel Selectivity

EIA

CQM5332: 75 dB (85 dB)

FTZ

CQM5333:

70 dB (85 dB)

CEPT

CQM5332: 75 dB (85 dB)

CQM5334:

65 dB (85 dB)

Spurious Rejection EIA

80 dB (85 dB)

Intermodulation Attenuation

EIA

CQM5332: 70 dB (72 dB)

FTZ

CQM5333:

70 dB (72 dB)

CEPT

CQM5332: 70 dB (75 dB)

CQM5333:

70 dB (75 dB)

CQM5334:

70 dB (73 dB)

Radiation

Conducted: max. 0.8 nW

Radiated:

max, 0.8 nW

Blocking

90 dB/uV (104 dB/uV)

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

60% Δf max., 1 kHz, 1 W, RF 1 mV

Audio Frequency Response CEPT/FTZ

fm: 300 - 3000 Hz (CEPT)

+1/-3 dB (+0/-1.5 dB)

fm: 400 - 2700 Hz (FTZ)

+1/-1.5 dB (+0/-1 dB)

fm: 300 - 2550 Hz

+1/-3 dB (+0/-1 dB)

Reletive to 1000 Hz, -6 dB/octave

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Squelch Attack Time (EIA)

150 ms (110 ms)

Squelch Recovery Time

250 ms (200 ms)

Squelch Closing Time (EIA)

150 ms (50 ms)

Current Consumption

Squelched:

1000 mA (750 mA)

Receive, AF 2 W:

1450 mA (1150 mA)

(13.2 V supply)

TRANSMITTER

RF Power Output

CQM 5332-6:

CQM5332-25: 25 W

CQM5333-6:

6 W

CQM5333-25: 25 W

CQM5334-6:

COM5334-25: 25 W

6 W

 $(R_1 = 50 \text{ ohm})$

Storno

TECHNICAL SPECIFICATIONS

Storno

Crystal Frequency Range

15.5 - 21.25 MHz

Crystal Frequency Multiplication

× 4

Transmitter VCO Frequency Range

66 - 88 MHz

Frequency Stability

Conforms with government regulation

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

Modulation AF Input Impedance

560 ohm

Modulation Sensitivity

70 mV ±2 dB

(60% Δf max., 1 kHz)

Modulation Response

300 - 3000 Hz (CEPT)

+1/-3 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

400 - 2700 Hz (FTZ)

+1/-1.5 dB (+0.5/-1 dB)

relative to 1000 Hz, 6 dB/octave

300 - 2550 Hz

+1/-3 dB (+0.5/-2 dB)

Relative to 1000 Hz, 6 dB/octave

Modulation Distortion (CEPT)

max. 3%

 f_{mod} = 1000 Hz, Δf = 60% Δf max.

max. 5%

 f_{mod} = 300 Hz, Δf = 5.5% Δf max.

measured with 750 usec. de-emphasis

FM Hum and Noise, CEPT

55 dB (57 dB)

measused with 750 usec. de-emphasis

Attack Time

50 ms

Current Consumption

6 W: less than 3.7 A (3 A)

25 W: less than 6.6 A (5.5 A)

Storno

GENERAL DESCRIPTION

CQM5330 S99

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls keyboard and display.

A comparison of the various models are presented in the table below. Although compact in size, it contains a transmitter/receiver, a microcomputer controlled synthesizer and tone equipment, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 99 transmit and receive channels.

Туре	CQM533	32 S99	CQM533	3 S99	CQM533	4 S99
SPEC	6/10	25	6/10	25	6/10	25
Frequency Range MHz	6 - 8	38	6 - 8	38	6 - 8	38
RF Power W	6/10	25	6/10	25	6/10	25
Channel Spacing kHz	30/2	5	20		12.	5
Max. Number						
of Channels	99		99		99	

ACCESSORIES

Standard accessories include:

Mounting frame

Power cable

Fist microphone with retainer or

Fixed - mount microphone

External loudspeaker

External switches

MN5001 Mounting frame for mobile installations allowing the radio to be fixed

in 36 positions. Includes a base plate with locking screw.

MN703 Desk stand for fixed installations.

MN704a Mounting frame for mobile installations and direct attachment to the vehicle.

MC5001 Fist microphone with retractable spiral cable for mobile installation.

HS5001 Retainer for MC5001.

HS5002 Retainer, with switches, for MC5001

MC704 Microphone with chockabsorbing mounting bracket for mobile installa-

MC703 Desk microphone with PTT switch for fixed installations.

MK5001 Installation kit containing connectors, power cable, fuses and fuseholders.

LS701 Loudspeaker enclosed in a plastic housing, complete with cable.

SU701 Transmitter keying switch for mounting on the steering coloumn.

SU702 Transmitter keying switch for mounting on the dashboard.

PS702 Power supply regulator for 24 V car battery installations.

PS5001 Power supply for 220 V AC mains.

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls, display and keyboard are an integral part of the Control Panel.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded control panel and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB), and the Control Logic (CL) mount in the top section of the chassis.

Thin casted shields with adjustment holes are placed over the RF board and the synthesizer board in order to reduce spurious radiation.

RECEIVER DESCRIPTION

The receiver circuitry is placed on the RF board and can be divided into:

Receiver front end
1st IF section with first and second oscillator
455 kHz 2nd IF portion with demodulator.
Squelch
Audio Amplifier

(refer to functional block diagram)

FONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET

is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 10.7 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

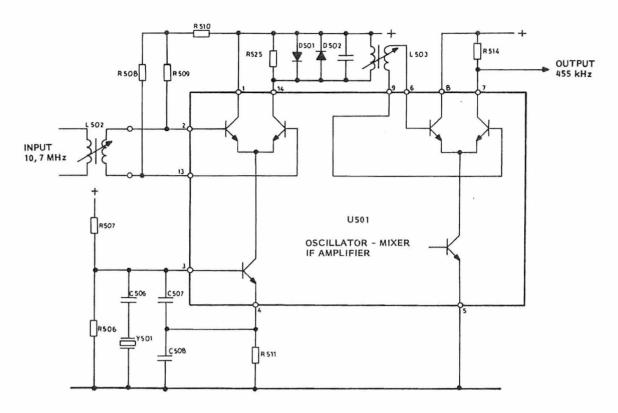


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The

final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the guadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

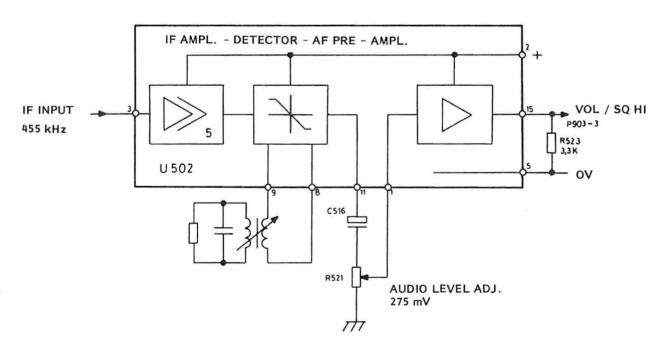


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sg - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1,5 V and mutes the audio power amplifier. The transmit indicater is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629-C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not. These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the RF board along with the receiver.

The exciter contains, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjust-

ment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the FS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105,

R106 and R107. The maximum permissible frequency deviation is set by a DEV. BAL. potentiometer on the FS board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the VCO on the Frequency Synthesizer board.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter. The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is based by a voltage generated by the feedback network C255, D201, Q210, Q209, Q208.

FREQUENCY SYNTHESIZER AND CONTROL LOGIC

The frequency synthesizer FS5331 provides up to 99 channels and is built on a printed wiring board which mounts in the top section of the radioset.

The frequency of the synthesizer board is set by a binary code from the control logic board CL5001 which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through P903 – J903 to the RF board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections S602. The other section of the ON/OFF switch controls the V_B + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

The squelch circuit, the modulation processor, parts of the IF amplifier U502, and the Frequency Synthesizer is supplied directly from the continuous 8.5 V.

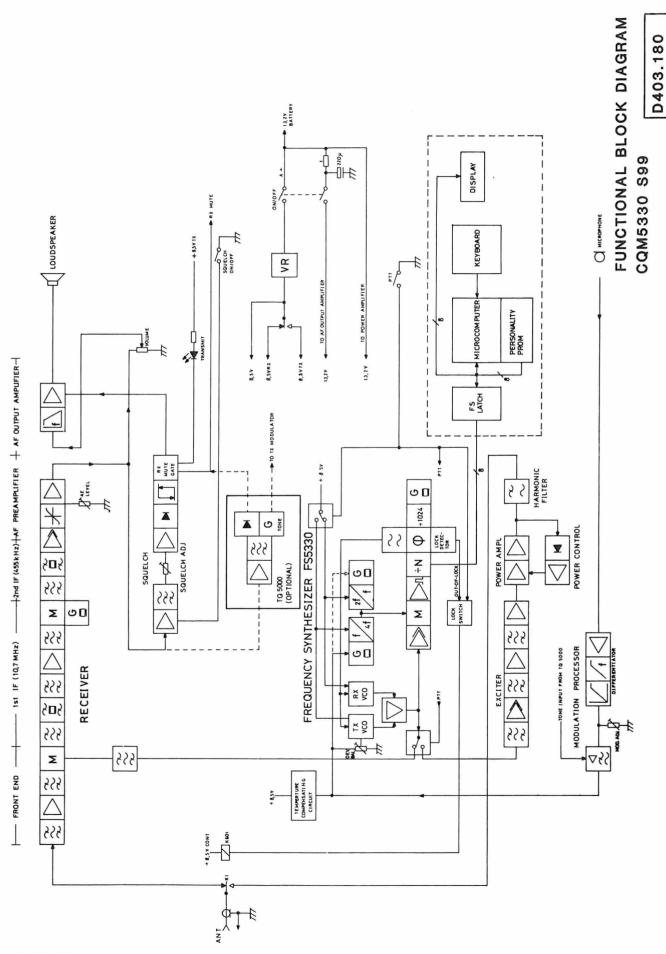
The receiver front-end, the 10.7 MHz IF stages and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through

the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



Storno

CHANNEL PROGRAMMING INSTRUCTIONS

CQM5330 S99

Programming of the PROM which contains the personality data will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19) Programming Pak, interchangeable Socket adaptor or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- Use receiver formula to calculate "V_{DEC}" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

After completing the worksheet enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.



RECOMMENDED CRYSTAL FREQUENCIES

CQM5330 S99

	T	T
CQM5332 - CQM5334	CQM5333	
FREQUENCY RANGE	FREQUENCY RANGE	RX CRYSTAL
65.2 - 68.3875	64. 56 - 67. 11	36.35
66.2 - 69.3875	65.56 - 68.11	36.85
67.2 - 70.3875	66.56 - 69.11	37.35
68.2 - 71.3875	67.56 - 70.11	37.85
69.2 - 72.3875	68.56 - 71.11	38.35
70.2 - 73.3875	69.56 - 72.11	38.85
71.2 - 74.3875	70.56 - 73.11	39.35
72.2 - 75.3875	71. 56 - 74. 11	39.85
73.2 - 76.3875	72.56 - 75.11	40.35
74.2 - 77.3875	73.56 - 76.11	40.85
75.2 - 78.3875	74. 56 - 77. 11	41.35
76.2 - 79.3875	75. 56 - 78. 11	41.85
77.2 - 80.3875	76.56 - 79.11	42.35
78.2 - 81.3875	77. 56 - 80. 11	42.85
·79.2 - 82.3875	78.56 - 81.11	43.35
80.2 - 83.3875	79.56 - 82.11	43.85
81.2 - 84.3875	80. 56 - 83. 11	44.35
82.2 - 85.3875	81.56 - 84.11	44. 85
83.2 - 86.3875	82.56 - 85.11	45.35
84.2 - 87.3875	83.56 - 86.11	45.85
85.2 - 88.3875	84. 56 - 87. 11	46.35
86.2 - 89.3875	85. 56 - 88. 11	46.85
87.2 - 90.3875	86.56 - 89.11	47.35
88.2 - 91.3875	87. 56 - 90. 11	47.85

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5330 S99

CQM5332 - CQM5334 CQM5333 TX CRYSTAL 65. 2 - 68.3875 64.56 - 67.11 15.5 66. 2 - 69.3875 65.56 - 68.11 15.75 67. 2 - 70.3875 66.56 - 69.11 16. 68. 2 - 71.3875 67.56 - 70.11 16.25 69. 2 - 72.3875 68.56 - 71.11 16.5 70. 2 - 73.3875 70.56 - 73.11 17.5 71. 2 - 74.3875 70.56 - 73.11 17.25 73. 2 - 76.3875 71.56 - 74.11 17.25 73. 2 - 76.3875 72.56 - 75.11 17.5 74. 2 - 77.3875 73.56 - 76.11 17.75 75. 2 - 78.3875 74.56 - 77.11 18. 76. 2 - 79.3875 75.56 - 78.11 18.25 77. 2 - 80.3875 75.56 - 78.11 18.5 78. 2 - 81.3875 76.56 - 79.11 18.5 79. 2 - 82.3875 78.56 - 80.11 18.75 79. 2 - 82.3875 78.56 - 81.11 19.25 81. 2 - 84.3875 80.56 - 81.11 19.25 81. 2 - 84.3875 80.56 - 85.11 20. 84. 2 - 87.3875			
66. 2 - 69.3875 65. 56 - 68. 11 15. 75 67. 2 - 70.3875 66. 56 - 69. 11 16. 68. 2 - 71.3875 67. 56 - 70. 11 16. 25 69. 2 - 72.3875 68. 56 - 71. 11 16. 5 70. 2 - 73.3875 69. 56 - 72. 11 16. 75 71. 2 - 74.3875 70. 56 - 73. 11 17. 72. 2 - 75.3875 71. 56 - 74. 11 17. 25 73. 2 - 76.3875 72. 56 - 75. 11 17. 5 74. 2 - 77.3875 73. 56 - 76. 11 17. 75 75. 2 - 78.3875 74. 56 - 77. 11 18. 76. 2 - 79.3875 75. 56 - 78. 11 18. 25 77. 2 - 80.3875 76. 56 - 79. 11 18. 5 78. 2 - 81.3875 77. 56 - 80. 11 18. 75 79. 2 - 82.3875 78. 56 - 81. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 25 84. 2 - 87. 3875 84. 56 - 87. 11 20. 5 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 7			TX CRYSTAL
67. 2 - 70. 3875 66. 56 - 69. 11 16. 68. 2 - 71. 3875 67. 56 - 70. 11 16. 25 69. 2 - 72. 3875 68. 56 - 71. 11 16. 5 70. 2 - 73. 3875 69. 56 - 72. 11 16. 75 71. 2 - 74. 3875 70. 56 - 73. 11 17. 72. 2 - 75. 3875 71. 56 - 74. 11 17. 25 73. 2 - 76. 3875 72. 56 - 75. 11 17. 5 74. 2 - 77. 3875 73. 56 - 76. 11 17. 75 75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 25 81. 2 - 84. 3875 80. 56 - 82. 11 19. 25 81. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	65.2 - 68.3875	64. 56 - 67. 11	15.5
68. 2 - 71. 3875 67. 56 - 70. 11 16. 25 69. 2 - 72. 3875 68. 56 - 71. 11 16. 5 70. 2 - 73. 3875 69. 56 - 72. 11 16. 75 71. 2 - 74. 3875 70. 56 - 73. 11 17. 72. 2 - 75. 3875 71. 56 - 74. 11 17. 25 73. 2 - 76. 3875 72. 56 - 75. 11 17. 75 75. 2 - 78. 3875 73. 56 - 76. 11 17. 75 75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 25 81. 2 - 84. 3875 80. 56 - 82. 11 19. 25 81. 2 - 84. 3875 81. 56 - 84. 11 19. 75 82. 2 - 85. 3875 81. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	66.2 - 69.3875	65. 56 - 68. 11	15.75
69. 2 - 72. 3875 68. 56 - 71. 11 16. 5 70. 2 - 73. 3875 69. 56 - 72. 11 16. 75 71. 2 - 74. 3875 70. 56 - 73. 11 17. 72. 2 - 75. 3875 71. 56 - 74. 11 17. 25 73. 2 - 76. 3875 72. 56 - 75. 11 17. 5 74. 2 - 77. 3875 73. 56 - 76. 11 17. 75 75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 25 81. 2 - 84. 3875 80. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	67.2 - 70.3875	66. 56 - 69. 11	16.
70.2 - 73.3875 69.56 - 72.11 16.75 71.2 - 74.3875 70.56 - 73.11 17. 72.2 - 75.3875 71.56 - 74.11 17.25 73.2 - 76.3875 72.56 - 75.11 17.5 74.2 - 77.3875 73.56 - 76.11 17.75 75.2 - 78.3875 74.56 - 77.11 18. 76.2 - 79.3875 75.56 - 78.11 18.25 77.2 - 80.3875 76.56 - 79.11 18.5 78.2 - 81.3875 77.56 - 80.11 18.75 79.2 - 82.3875 78.56 - 81.11 19. 80.2 - 83.3875 79.56 - 82.11 19.25 81.2 - 84.3875 80.56 - 83.11 19.5 82.2 - 85.3875 81.56 - 84.11 19.75 83.2 - 86.3875 82.56 - 85.11 20. 84.2 - 87.3875 83.56 - 86.11 20.25 85.2 - 88.3875 84.56 - 87.11 20.5 86.2 - 89.3875 85.56 - 88.11 20.75 87.2 - 90.3875 86.56 - 89.11 21.	68.2 - 71.3875	67.56 - 70.11	16. 25
71.2 - 74.3875 70.56 - 73.11 17. 72.2 - 75.3875 71.56 - 74.11 17.25 73.2 - 76.3875 72.56 - 75.11 17.5 74.2 - 77.3875 73.56 - 76.11 17.75 75.2 - 78.3875 74.56 - 77.11 18. 76.2 - 79.3875 75.56 - 78.11 18.25 77.2 - 80.3875 76.56 - 79.11 18.5 78.2 - 81.3875 77.56 - 80.11 18.75 79.2 - 82.3875 78.56 - 81.11 19. 80.2 - 83.3875 79.56 - 82.11 19.25 81.2 - 84.3875 80.56 - 83.11 19.5 82.2 - 85.3875 81.56 - 84.11 19.75 83.2 - 86.3875 82.56 - 85.11 20. 84.2 - 87.3875 83.56 - 86.11 20.25 85.2 - 88.3875 84.56 - 87.11 20.5 86.2 - 89.3875 85.56 - 88.11 20.75 87.2 - 90.3875 86.56 - 89.11 21.	69.2 - 72.3875	68.56 - 71.11	16.5
72. 2 - 75. 3875 71. 56 - 74. 11 17. 25 73. 2 - 76. 3875 72. 56 - 75. 11 17. 5 74. 2 - 77. 3875 73. 56 - 76. 11 17. 75 75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	70.2 - 73.3875	69. 56 - 72. 11	16.75
73. 2 - 76.3875 72. 56 - 75. 11 17. 5 74. 2 - 77.3875 73. 56 - 76. 11 17. 75 75. 2 - 78.3875 74. 56 - 77. 11 18. 76. 2 - 79.3875 75. 56 - 78. 11 18. 25 77. 2 - 80.3875 76. 56 - 79. 11 18. 5 78. 2 - 81.3875 77. 56 - 80. 11 18. 75 79. 2 - 82.3875 78. 56 - 81. 11 19. 80. 2 - 83.3875 79. 56 - 82. 11 19. 25 81. 2 - 84.3875 80. 56 - 83. 11 19. 5 82. 2 - 85.3875 81. 56 - 84. 11 19. 75 83. 2 - 86.3875 82. 56 - 85. 11 20. 84. 2 - 87.3875 83. 56 - 86. 11 20. 25 85. 2 - 88.3875 84. 56 - 87. 11 20. 5 86. 2 - 89.3875 85. 56 - 88. 11 20. 75 87. 2 - 90.3875 86. 56 - 89. 11 21.	71.2 - 74.3875	70.56 - 73.11	17.
74. 2 - 77. 3875 73. 56 - 76. 11 17. 75 75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	72.2 - 75.3875	71.56 - 74.11	17.25
75. 2 - 78. 3875 74. 56 - 77. 11 18. 76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	73.2 - 76.3875	72. 56 - 75. 11	17.5
76. 2 - 79. 3875 75. 56 - 78. 11 18. 25 77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	74.2 - 77.3875	73.56 - 76.11	17.75
77. 2 - 80. 3875 76. 56 - 79. 11 18. 5 78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	75.2 - 78.3875	74. 56 - 77. 11	18.
78. 2 - 81. 3875 77. 56 - 80. 11 18. 75 79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	76.2 - 79.3875	75. 56 - 78. 11	18.25
79. 2 - 82. 3875 78. 56 - 81. 11 19. 80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	77.2 - 80.3875	76.56 - 79.11	18.5
80. 2 - 83. 3875 79. 56 - 82. 11 19. 25 81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	78.2 - 81.3875	77.56 - 80.11	18.75
81. 2 - 84. 3875 80. 56 - 83. 11 19. 5 82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	79.2 - 82.3875	78.56 - 81.11	19.
82. 2 - 85. 3875 81. 56 - 84. 11 19. 75 83. 2 - 86. 3875 82. 56 - 85. 11 20. 84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	80.2 - 83.3875	79.56 - 82.11	19. 25
83.2 - 86.3875 82.56 - 85.11 20. 84.2 - 87.3875 83.56 - 86.11 20.25 85.2 - 88.3875 84.56 - 87.11 20.5 86.2 - 89.3875 85.56 - 88.11 20.75 87.2 - 90.3875 86.56 - 89.11 21.	81.2 - 84.3875	80.56 - 83.11	19.5
84. 2 - 87. 3875 83. 56 - 86. 11 20. 25 85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	82.2 - 85.3875	81.56 - 84.11	19.75
85. 2 - 88. 3875 84. 56 - 87. 11 20. 5 86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	83.2 - 86.3875	82.56 - 85.11	20.
86. 2 - 89. 3875 85. 56 - 88. 11 20. 75 87. 2 - 90. 3875 86. 56 - 89. 11 21.	84.2 - 87.3875	83.56 - 86.11	20.25
87.2 - 90.3875 86.56 - 89.11 21.	85.2 - 88.3875	84. 56 - 87. 11	20.5
	86.2 - 89.3875	85. 56 - 88. 11	20.75
88.2 - 91.3875 87.56 - 90.11 21.25	87.2 - 90.3875	86.56 - 89.11	21.
	88.2 - 91.3875	87.56 - 90.11	21.25

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY

SELFQUIETING FREQUENCIES CQM5332 S99

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE ⁺
All crystal frequencies	428	1
38.35	457	2
38.85	377	2
39.35	297	2
40.85	464	3
41.35	384	3
41.85	304	3
43.35	474	2
43.85	397	2
44.35	314	2

TABLE 3A. SELFQUIETING FREQUENCIES

SELFQUIETING FREQUENCIES CQM5333 S99

RECEIVER CRYSTAL FREQUENCY, MHz	V DEC	USE ALTERNATIVE [†]
38.85 38.85	468 471	3 2
39.35 39.35	368 371	3 2
39.85	268	3
39.85 43.85	271 492	3
43.85 44.35	496 392	2
44.35 44.85	396 292	2
44. 85	296	2

TABLE 3B. SELFQUIETING FREQUENCIES

⁺refer to worksheet

⁺refer to worksheet

HEX CODE CONVERSION TABLE

L			,	,				,	,				1			
	5	-	7	۳ ا	4	2	9	7	∞	6	4	m	ပ	۵	ш	ц
0	256	257	258	25,9	260	261	262	263	797	265	792	267	268	269	270	271
-	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
7	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
ε	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
7	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
2	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
9	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
7	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
∞	384	382	386	387	388	389	390	391	392	393	394	395	396	397	398	399
6	400	401	402	403	404	405	901	407	408	604	410	411	412	413	414	415
4	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
В	432	433	434	435	436	437	438	439	044	441	442	443	1111	445	944	447
U	844	644	450	451	452	453	454	455	456	457	458	459	094	461	462	463
Δ	494	465	9917	467	894	691	470	471	472	473	474	475	9/4	477	478	479
Ш	480	481	482	483	484	485	984	487	488	684	490	491	492	493	464	462
Ц.	96ħ	467	864	664	200	501	502	503	204	202	206	202	208	209	510	511
Mos	Most Significant Digit of	ficant	Digit (of Hex	Code.	5		"VDE	"VDEC" Numbers.	ımbers						

Example " $V_{\rm DEC}$ "= 345 equals to hex code 59. LSD " $V_{\rm DEC}$ "= 469 equals to hex code D5.

Table 4. "V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code



PROGRAMMING WORKSHEET

FOR CQM5330 S99

		T	T	Т	Π			T		T		T			T				
	PROM ADDRESS (HEX)													=Q (- (1			ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:	SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 11. 15500 MHz INSTEAD OF 10. 245000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL WEAK QUIETING; NO ALTERNATIVE REQUIRED
TRANSMITTER	V HEX													EQ. (Y701	- (D × 4) F			E RECEIV	R CRYSTA EQUENCY D OF 10.2 ERENCE CI
TRANS	V DEC													STAL FRI	EC B			ONS IF TH	RX MIXEF CTION FR 2 INSTEA 2 SET REFE
	Η													ER CR)	ے ا			OLUTIC	THER HINJE 500 MH LY OFF
	B FREQUENCY MHz													TRANSMITTER MIXER CRYSTAL FREQ. (Y701) D=	FORMULA: V _{DEC} =	REFERENCE FREQUENCY:	F= 0.01 F= 0.0125	ALTERNATIVE S	 SELECT ANOTHER RX MIXER CRYSTAL FREQUEN SELECT HIGH INJECTION FREQUENCY FOR 2nd C Y501= 11. 15500 MHz INSTEAD OF 10. 245000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL WEAK QUIETING; NO ALTERNATIVE REQUIRED
	PROM ADDRESS (HEX)															REFERENCE CRYSTAL (Y703):	10, 240000 MHz 12, 800000 MHz	(7703)	PART No. 19J06361P1 19J06361P7 19J06361P2 19J06361P10
	> X														ଇ	- R R		STALS	r, MHz 100 100 100 100
ĒR	V DEC								~					(Y702): C=	- (C × 2)	VEL NG:	20 kHz 25 kHz	FERENCE CRYSTALS (Y703)	FREQUENCY, MHz 12.800000 12.801000 12.802000 10.241300
RECEIVER	דר													EQ. (Y	+ 10.7) F	CHANNEL SPACING:	20 kHz 12.5/25 kHz	REFERI	it.
	A FREQUENCY MHz													RECEIVER MIXER CRYSTAL FREQ.	FORMULA: V _{DEC} = (A + 1			LIST OF RE	MODE Standard 5332/5334 Offset 5334 Offset 5332 Standard 5113 Offset 5333
	CHAN-	-	2	3	77	5	9	7	80	6	10	11	12	RECEIVI	FOR!				

Storno

ADJUSTMENT PROCEDURE

CQM5330 S99

This adjustment procedure applies to the

following radiotelephone types:

CQM5332: 30/25 kHz Channel spacing CQM5333: 20 kHz Channel spacing CQM5334: 12.5 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter $R_{in} \ge 1$ Mohm

AC Voltmeter $Z_{in} > 1 \text{ Mohm}//50 \text{ pF}$ Multimeter $R_i \ge 20 \text{ Kohm/Volt}$ Distortion meter e.g. Storno E11c

RF Watt meter 25 W/50 ohm/66-88 MHz

Deviation meter 66-88 MHz

RF generator $Z_{out} = 50 \text{ ohm}; 66-88 \text{ MHz}$

10.7 MHz signal e.g. Storno TS-G21B

generator

Frequency counter with attenuator $Z_{in} = 50$ ohm; sensitivity 100 mV at 88 MHz RF diode probe Storno 95.0089-00 RF coaxial probe Storno 95.0179-00

DC power supply 10.8 V - 16.6 V; 6A

Oscilloscope 0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor 3 x Storno code 82.5026-00
22 uF/40 V electrolytic capacitor Storno code 73.5107-00

Connector, 11-pin house Storno code 41. 5543-00
Connector, 8-pin house Storno code 41. 5542-00
Pins for connectors Storno code 41. 5551-00

Trimming tools

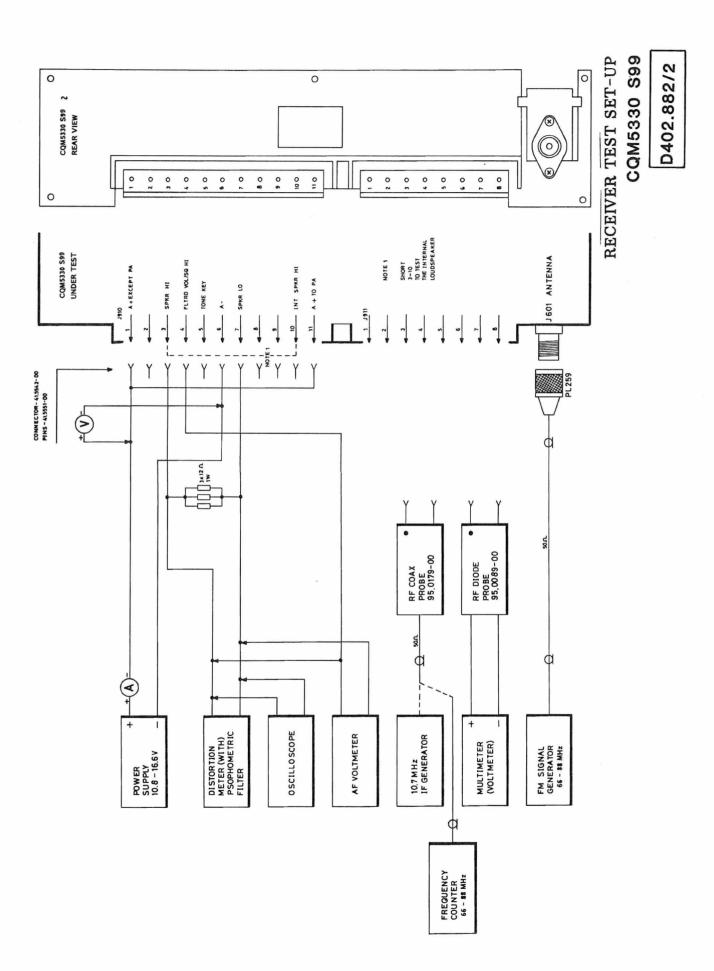
The following tables show the frequency ranges of the CQM5330 S12 radiotelephone signals:

SIGNAL	FREQUENCY MHz
TX VCO	66 - 88
TX crystal	15 - 21
TX crystal multiplication	n x4
RX VCO	77 - 99
RX crystal	38 - 49
RX crystal multiplication	n x2

Table 1.

Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	kHz
20	10.240	2.560	5. 110	10
12.5 or 25 ¹⁾	12.800	3.200	6. 3875	12.5
15.0 or 30 ¹⁾	13.360	3.840	7. 665	15

Table 2 1) Two steps per channel



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ± 0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code R636 Value

omit
270
100
47
22
6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: ≤50 mV

Repeat the procedure with the power supply adjusted for 10.8 $\,\mathrm{V}$

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and prom codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: $250 \text{ mV} \pm 125 \text{ mV}$ (corresponding to -10 dBm to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the multimeter, 10 V range, to test point TP706. The synthesizer's lock signal is accessible at TP706. +8 V DC with very narrow pulses (0.1 u sec) indicates normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "Low". Select the channel whose frequency is closest to the center frequency.

Await locked condition, constant voltage. Adjust C745 for 8 Volts on the multimeter. Connect the multimeter to test point TP703. Adjust C745 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 1.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.



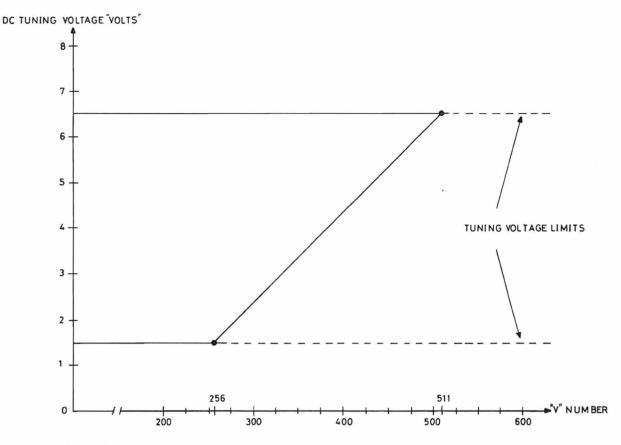


Fig. 1. Tuning voltage vs. V. number.

f= f_x x 2 (f_x = crystal frequency) Adjust L711 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25°C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.

Connect the frequency counter to the probe.

Calculate the injection frequency for all channels.

 $f_{inj} = f_{ant} + 10.7$ (MHz) Select, one by one, the channels and read the injection frequency. Requirement: $F_{ini} \pm 0.4$ ppm

IF AMPLIFIERS

Connect a 10.7 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range). During adjustment the RF generator output must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L403 and 405 as much as possible.

Adjust L404 for maximum deflection on the multimeter. This is the only adjustment of L404 and it <u>must not</u> be touched during the rest of the procedure.

Adjust L403 and L405 for maximum deflection on the multimeter.

Readjust L401 and L402 for maximum deflection.

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δ f max.

CQM5332 S12/S99 ±3 kHz CQM5333 S12/S99 ±2.4 kHz CQM5334 S12/S99 ±1.5 kHz

Connect a 4 ohm/3 W resistor load to connector J910/37 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.

Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV.

Read the distortion.

Typical <u>Total Harmonic Distortion</u> (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at $60\% \Delta f$ max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is mea-

sured through the psophometric filter, 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 immeadiately 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industrie's Association)
Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + destortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/ 4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.) Requirement: <0.75 uV.

The sensitivity should be measured on all channels, if more than one.

MEASURING 12 dB SINAD (EIA)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load.

Adjust the RF generator to obtain 12 dB SINAD condition.

Read the 12 dB SINAD sensitivity. Requirement: \leq 0.3 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI - LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
CQM5332 S12/S99	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
CQM5333 S12/S99	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	
CQM5334 S12/S99	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	2550 Hz	-8 dB	+1 dB/-3 dB

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 66 - $88\ MHz$ band,

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V. Adjust the volume control for 3 W output (3.46 V across the 4 ohm load). Measure the distortion (THD). Requirement: THD <5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

CURRENT CONSUMPTION

CONDITION	S12	S99
Standby	≤350 mA	≤1000 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	<_750 mA	≤1450 mA

For sets with selective calling facilities add current consumption of the tone unit to the figures above.



TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

25 W transmitter:

6 W transmitter:

4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW). Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95, 0089-00 with multimeter to test point TP701 (1 V range). Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

250 mV ± 125 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the multimeter, 10 V range, to test point TP706.

The synthesizer's lock signal is accessible at TP706 and +8 V DC with very narrow pulses (0.1 u sec.) indicate normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "LOW".

Select the channel whose frequency is closest to the center frequency. Key the transmitter. Await locked condition.

Adjust C737 for 8 Volts on the multimeter. Connect the voltmeter to test point TP703. Adjust C737 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 1.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP702.

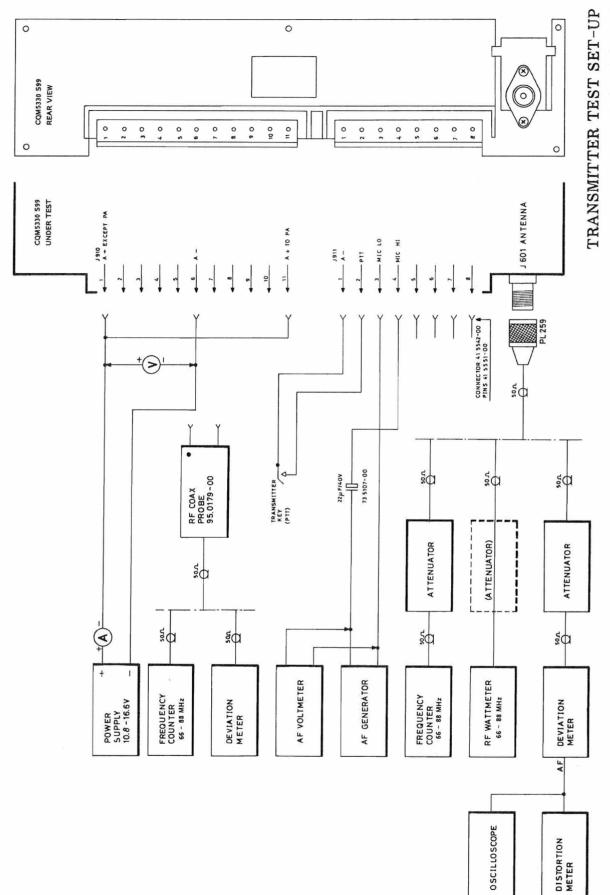
Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f \times 4$ (f = crystal frequency). Adjust L701 to the calculated frequency. Requirement: f ± 0.3 ppm at 25°C. ppm= parts per million= 10⁻⁶.

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

CQM5330 S99 D402.883/2



EXCITER

Coarse adjustment

Connect a multimeter (2.5 V range) to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection.

Adjust L201 for minimum deflection. The dip is small

Connect the multimeter (2.5 V range) to test point TP202.

Adjust L202 for maximum deflection on the multimeter, typical 1.0 V.

Adjust L204 for minimum reading. The dip is small.

Connect diode probe 95.0089-00 and the multimeter (25 V range) to test point TP203. Adjust L204 and L205 for maximum reading on the multimeter, typical 15 V.

Adjust the PA power control, R221, for rated transmitter power, 6/10 W or 25 W.

Fine adjustment

Connect the multimeter to test point TP201. Key the transmitter.

Readjust L153 for maximum reading.

Connect the multimeter to test point TP202.

Peak L201 and L202 for maximum reading. If the maximum is not well defined detune L153 slightly, adjust L201 and L202, and repeat the adjustment of L153.

Connect the 95,0089-00 RF probe and multimeter to test point TP203.

Peak L204 and L205 for maximum reading.

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601.

Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: F= F ant ±0.4 ppm,

ppm= parts per million= 10⁻⁶

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 16 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 6(10) or 25 W.

Requirement: $P_{nom} \pm 0.1 dB$.

Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (25 W):

		S12	S99
Voltage	Power	Current	Current
16.6 V	25 W (ref)	≤5.8 A	≤6.5 A
13.2 V	≥23.5 W	≤5.8 A	<6.5 A
10.8 V	≥20 W	≤5.8 A	≤6.5 A

Requirements (6 W):

		S12	S99
Voltage	Power	Current	Current
16 V	6 W (ref)	≤2.9 A	≤3.6 A
13.2 V	≥5.2 W	≤2.9 A	≤3.6 A
10.8 V	≥5.0 W	≤2.9 A	≤3.6 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V. Select the channel having the highest frequency. Set R116 to mid-position.

Connect coax probe 95, 0179-00 to test point

TP701.

Connect a deviation meter to the coax probe. Connect a distortion meter and oscilloscope to the deviation meter output. Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

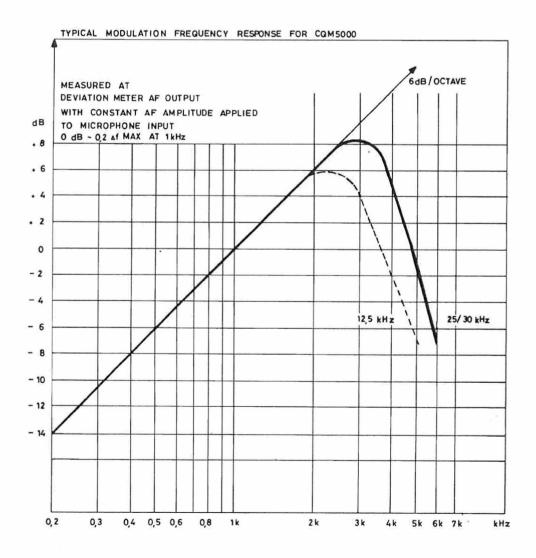
Disconnect the deviation meter from the coaxprobe and connect it through an attenuator to the antenna connector, J601. Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Туре	Channel spaci	ng ∆f max
CQM5332	30/25 kHz	±5 kHz
CQM5333	20 kHz	±4 kHz
CQM5334	12.5 kHz	±2.5 kHz

Requirement

Difference between + and - deviation: ≤10%



MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5332: ±3.0 kHz CQM5333: ±2.4 kHz CQM5334: ±1.5 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

<7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 x Δf max is obtained on the deviation meter.

CQM5332 : ±1.0 kHz CQM5333 : ±0.8 kHz CQM5334 : ±0.5 kHz

Vary the frequency of the generator and note the deviation changes as refered to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

CHANNEL FREQUENCY SYNTHESIZER

FS5331 and FS5332

The frequency synthesizer generates up to 12 channel frequencies for a STORNOPHONE 5000 operating in the 66 - 88 MHz band. It is built on a printed circuit board which mounts in the top section of the radio set. There are two versions of the board, a single channel board. FS5331 and a multichannel board FS5332. The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board channels are selected with a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the board and protrudes through the front panel, and the Frequency Control module FC5001, fits into the cast shield which is placed over the main section of the synthesizer board.

A metal shield is placed underneath the oscillator and mixer sections of the board. All circuitry can be accessed and operated for repair and maintenance without the shields and with the FC5001 in its socket.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module and has two connectors at the rear for accessories and power supply cables.

The channel programming is contained in a 256 bit PROM placed in a socket on the Frequency Control module. The PROM can be field programmed if the necessary programming equipment is available. Programming equipment and procedures must be approved by STORNO and the PROM manufacturer, refer to the Channeling Instruction.

CIRCUIT DESCRIPTION

The Frequency Synthesizer generates the local oscillator injection for the receiver and a modulated exciter signal for the transmitter. The circuit is a single-loop phase-locked frequency generator.

The synthesizer frequency is controlled by three crystals, one reference crystal and two mixer crystals, and by a PROM.

The synthesizer can be reprogrammed for new frequencies if these are within the maximum frequency spread of the STORNOPHONE 5000.

Two voltage controlled oscillators (VCO) are generating the signals which are used as injection for the receiver mixer and excitation signal for the transmitter. The frequency of each VCO can be preset to any frequency

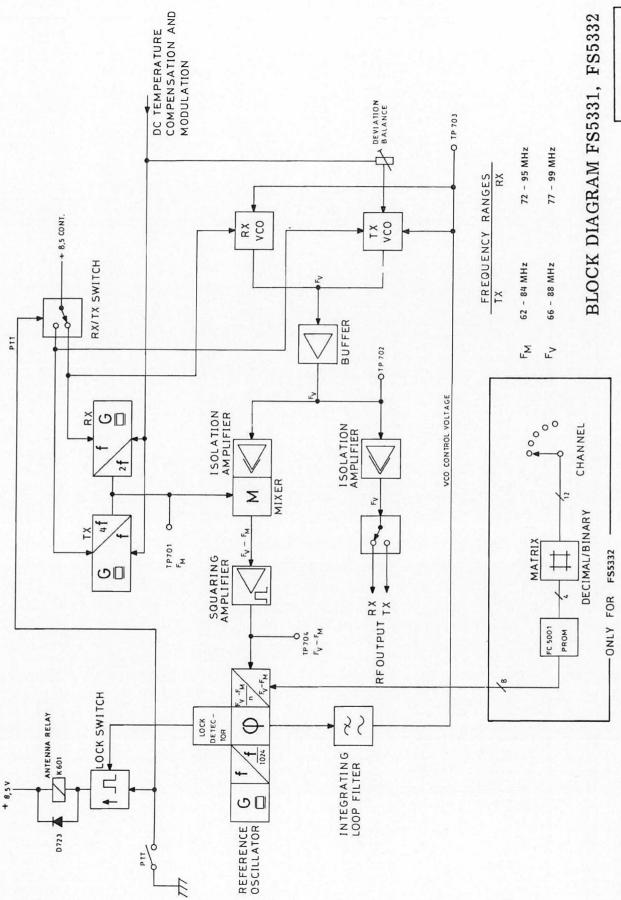
within the band by a variable capacitor, and the fine adjustment is controlled by a variable capacitance diode, varicap, and the phase detector output. The control voltage for the varicaps is filtered in a loop integrating filter. The TX VCO has an additional varicap which is used to modulate the transmitter.

The Push-to-talk switch controls a transistor switch, which switches the supply voltage between the RX VCO and the TX VCO.

The output signal from the VCO's are fed into a buffer amplifier which protects the VCO from load changes.

The buffer amplifier's output is applied to an isolation amplifier and a diode switch before entering the RF board.

D402.878



The buffer amplifier also connects to another isolation amplifier via a resistive attenuator and feeds the signal to the synthesizer mixer.

The synthesizer mixer mixes the VCO signal and the crystal oscillator signal to a frequency which is within the dividing capability of the programable divider.

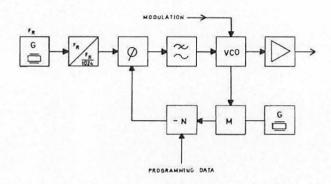


Fig. 2 Phase Locked loop Principle

Separate crystal oscillators are used in the receive and transmit mode, respectively, and they are both third mode oscillators.

A temperature compensating voltage is applied to the crystal oscillators only in the 5 p.p.m. version. This voltage is kept constant in the 10 p.p.m. version by cutting a diode on the RF board.

The output from the synthesizer mixer is fed to a squaring amplifier which drives the programable divider and this divides the frequency by 256 to 511 depending on the logic levels on the 8-bit binary control input. The input frequency range for the divider differs according to the channel spacing and is shown in fig. 3.

The phase detector produces a waveform with variable duty cycle which depends on the phase and frequency difference between its two input signals. The operating frequency range of the phase detector is 4 kHz to 15 kHz and it depends on the channel spacing.

The reference frequency is generated in a crystal oscillator whose output is divided by 1024 and applied to the phase detector.

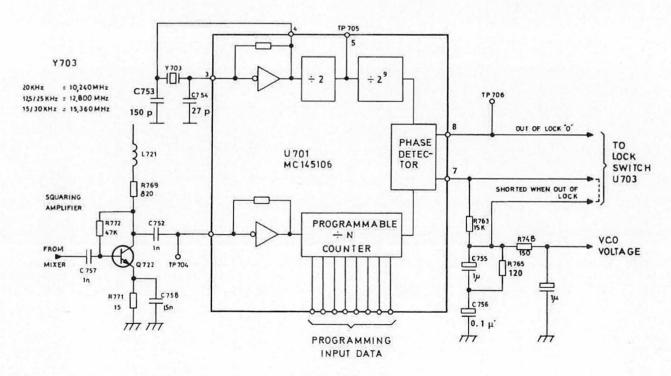


Fig. 3. REFERENCE OSCILLATOR, DIVIDER, AND PHASE DETECTOR



The output from the phase detector passes through a passive integrating filter which produces a DC voltage proportional to the duty cycle of the phase detector output. This voltage adjusts the frequency of the VCO.

An out-of-lock circuit inhibits the transmitter when the synthesizer loop is out of lock and hunting for the frequency.

The transmitter modulation is applied simultaneously to the transmitter mixer-oscillator and the VCO. The modulation bandwidth also covers sub-audio frequencies used for channel guard (pilot tones). The frequency deviation balance adjustment equalizes the deviation on both oscillators to ascertain low distortion and low noise reference side bands during modulation of the synthesizer because it is operating with a relatively large loop bandwidth.

The frequency control module, FC5001, is built on a separate wiring board which mount on top of the synthesizer shield. This module converts the BCD-code (4 bits) from the channel selector to an 8-bit binary code for the programmable divides in the synthesizer loop. These 8-bit codes are programmed into a PROM (Programmable Read Only Memory) and are dividing factors expressed in hexadecimal codes.

On the FC5001 is a 5-Volt regulator which supply the voltage for the PROM. When the PTT button is pushed the transistor Q801 converts the PTT voltage level to TTL level and puts a logic "0" on the MSB (Most Significant Bit) on the address input of the PROM. This selects the PROM code for the corresponding transmitter channel. The PROM outputs have open collectors with external pull-up resistors.

TECHNICAL SPECIFICATION

Supply Voltage

+8.5 Volts regulated

+13.2 Volts unregulated

Current Consumption

max. 80 mA (+8.5 V)

max. 200 mA (+13.2 V)

Channel Spacing

20 kHz

12.5/25 kHz

15/30 kHz

Modulation Input

0.75 V r.m.s. ±2 dB

 $\Delta f = 60\% f_{mod} = 1 \text{ kHz}$

Modulation Bandwidth

70 - 3000 Hz

Modulation Distortion

70 - 300 Hz: <5%

1 kHz: <4%

DC Temperature Stabilization Voltage

25°C= 6 V ± 10% (reference)

-30°C= +350 mV ± 10%

 -10° C= -50 mV ± 10%

+60°C= +50 mV ± 10%

The voltage characteristic is approximately linear between these points.

RF Output Level

4 mW ± 1 mW

(open collector output connected to tuned circuit)

TX Output Frequency Range

66 - 88 MHz (VCO)

RX Output Frequency Range

77 - 99 MHz (VCO)

Frequency Stability

5 p.p.m. or 10 p.p.m.

Reference Crystal Frequency

20 kHz:

10.240 MHz

12.5/25 kHz: 12.800 MHz

Signal-to-Noise Ratio (S/N)

>100 dB

 Δf = 25 kHz, BW (Bandwidth) = 10 kHz

Spurious Attenuation

>85 dB

Lock Time

<30 m sec.

for 1 MHz step

Logic Control Level

LOW= <2 V

HIGH=>6 V

8 bit binary positive logic with built-in pull

down resistors, I_{in}= 175 uA per bit.

Temperature range

 -30° C to $+60^{\circ}$ C

Dimensions

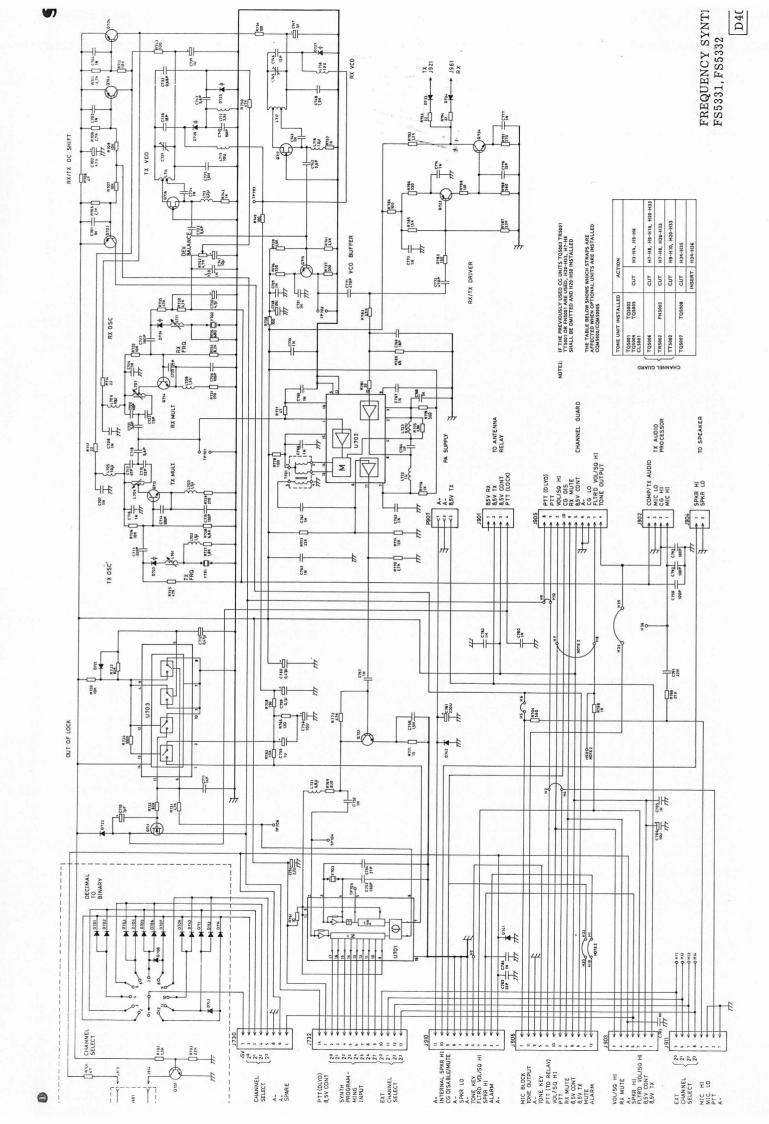
 $135 \times 190 \times 45$ mm (BxDxH)

Weight

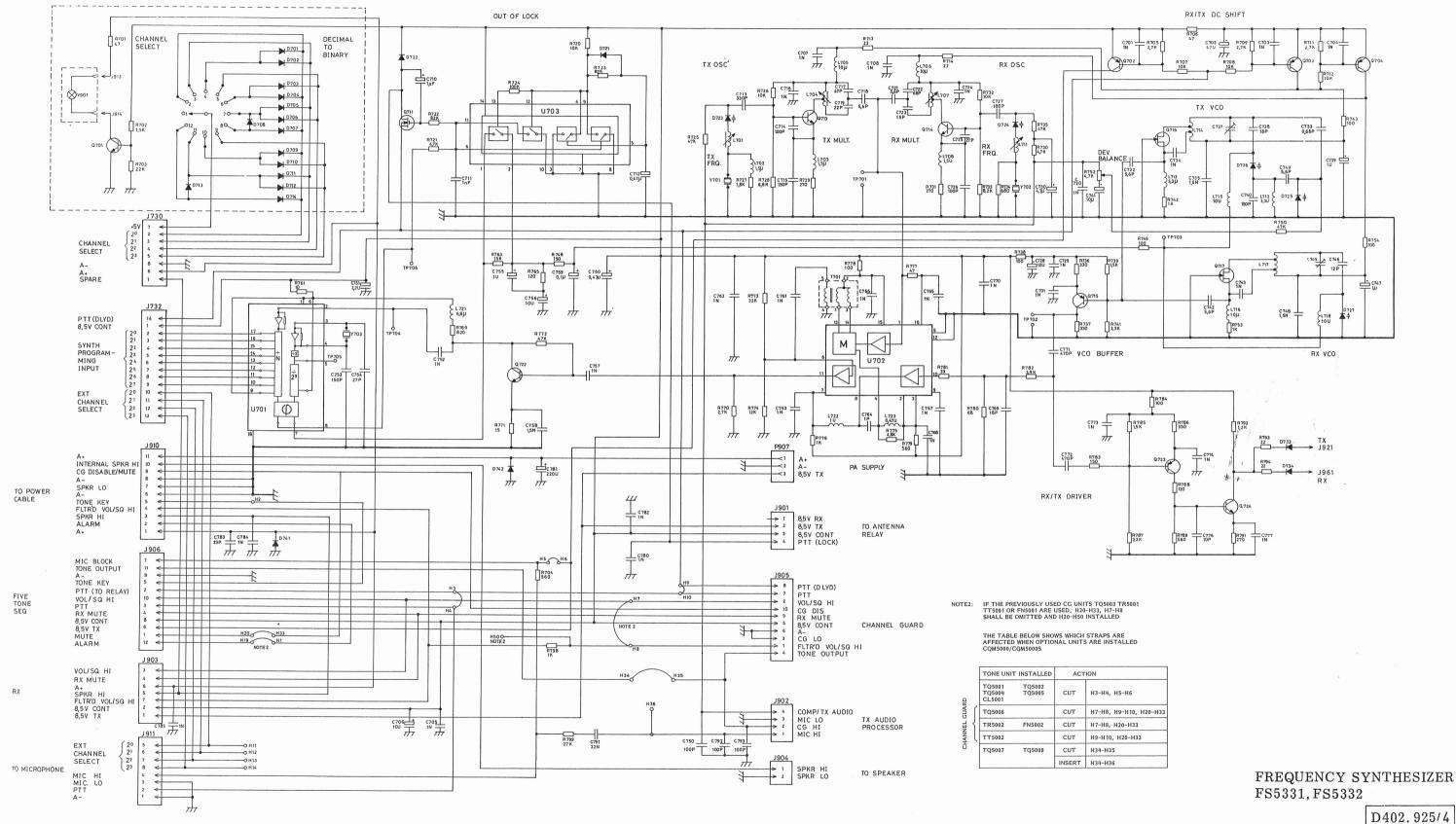
PC board: 150 g

Shield:

75 g



Storno



	ì	É	3	١
	i	ì	í	i
	Ì	þ	i	i
		ķ	P	١
	1	E	3	١
,	i	÷	3	i
	ì	7	Ň	
۱	d	ij	7	١

	200	
DATA	1 nF Capacitor Ceramic 47 uF Capacitor Electrolytic 1 nF Capacitor Ceramic 2. 2 uF Capacitor Ceramic 1 nF Capacitor Ceramic 2. 2 uF Capacitor Ceramic 1 nF Capacitor Ceramic 2. 2 nF Capacitor Ceramic 2. 2 nF Capacitor Ceramic 330 pF Capacitor Ceramic 2. 5 pF Capacitor Ceramic 3. 6 pF Capacitor Ceramic 3. 7 pF N1500 Capacitor Ceramic 3. 6 pF Capacitor Ceramic 4. 7 uF Capacitor Ceramic 5. 6 pF Capacitor Ceramic 5. 6 pF Capacitor Ceramic 6. 7 pF Capacitor Ceramic 6. 8 pF Cap	
CODE	19A700233P7 19A700233P7 19A700233P7 19A700233P7 19A700233P7 19A700233P7 19A700233P7 19A700235P3 19A700235P3 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700233P8 19J706033P7 19A700233P8 19J706003P2 19A700233P8 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700233P1 19A700233P1	
ο̈Ν	C701 C703 C703 C704 C706 C706 C711 C711 C711 C711 C711 C711 C712 C723 C723 C723 C723 C724 C724 C724 C733 C734 C734 C734 C734 C744 C744 C74	

N O	CODE	DATA	
751	19A700003P5	2.2 uF Capacitor Tantalum	35 V
C753	19A700233P2	150 pF Capacitor Ceramic	20 <
C754	19A 700235P18	27 pF Capacitor Ceramic	50 V
C755	19A700003P4	1 uF Capacitor Tantalum	35 V
C756	19A700003P7	10 uF Capacitor Tantalum	35 V
C757	19A700233P7	1 nF Capacitor Ceramic	20 V
C758	19A700233P8	1.5 nF Capacitor Ceramic	20 N
C759	19A700003P4	1 uF Capacitor Tantalum	35 V
C760	19A700003P3	0.47 uF Capacitor Tantalum	35 V
C/61	19A700233P7	1 nF Capacitor Ceramic	20 \
C/62	19A700233P7	Capacitor	20 \
2 -	19A / 00233F /	Capacitor	20 \
C765	19A /00235P1	1 pF Capacitor Ceramic	20 <
C766	19A 700233P7	1 PE Capacitor Cerallic	> > >
C767	19A 7002 33P 7	1 nF Capacitor Ceramic	> 00
C768	19A700233P7	Capacitor	
C769	19A700235P16	18 pF Capacitor Ceramic	> >
C770	19A700233P7	1 nF Capacitor Ceramic	> 05
C771	19A700233P5	470 pF Capacitor Ceramic	20 \
C772	19A700233P5	470 pF Capacitor Ceramic	50 V
C773	19A700233P7	1 nF Capacitor Ceramic	20 \
C774	19A700233P7	1 nF Capacitor Ceramic	20 ^
C776	19A700235P13	10 pF Capacitor Ceramic	20 \
C777	19A700233P7	1 nF Capacitor Ceramic	20 \
C780	19A700233P7	1 nF Capacitor Ceramic	20 \
C781	19J706005P5	220 uF Capacitor Electrolytic	16 V
782	19A 700233P7	1 nF Capacitor Ceramic	20 \
C/83	19A700235P19	33 pF Capacitor Ceramic	20 ^
+ 1	19A /00233P7	1 nF Capacitor Ceramic	20 \
(7,85	19A/00233P/	1 nF Capacitor Ceramic	20 \
791	19J 706261P1	22 nF Capacitor Polyester	100 \
767	19A 700233P1	100 pF Capacitor Ceramic	20 \
/93	19A 700233P1	100 pF Capacitor Ceramic	20 \
177	19A700028P1	1N4148 Diode Silicon	
7770	19A 700028P1	1N4148 Diode Silicon	
D723	19A700073P1	BB409 Variable Cap. Diode	
47/	193/06262P1		
725	19A700073P1	BB409 Variable Cap. Diode	

FREQUENCY SYNTHESIZER FS5331

X402.897/2

Page 1 of 3

D726 D727 D733 D734 D741 D741 J730 J901	19A700073P1	BB409 Variable Cap. Diode	
	19A700073P1	BB409 Variable Cap. Diode	
	19470007201		
	1 1570001751	BB409 Variable Cap. Diode	
	19J706006P2	BA282 Diode	
	19J706006P2	BA282 Diode	
	19J706026P1	1N5401 Diode Silicon	
1730 1732 1901 1902	19J706026P1	1N5401 Diode Silicon	
1732 1901 1902	19J706215P108	Male Connector	8 pin
1901	19J706215P114	Male Connector	14 pin
1902	19J706214P4	Male Connector	4 pin
1903	19J706214P4	Male Connector	4 pin
200	19J706214P7	Male Connector	7 pin
	19A700072P28		2 pin
	19A700072P9	Male Connector	10 pin
9061	19A700072P11		12 pin
1907	19A700102P21	Female Connector	3 pin
. 0161	19J706223P11	Male Connector	11 pos
. 1161	19J706223P8	Male Connector	8 pos
1921	19J706219P1		pin
1961	19J706219P1		nia
L701	19J706029P6	Variable Coil	
L702	19A700184P1	Jumper Wire	
L703	19A700184P1	Jumper Wire	
L704	19J706083P6	Variable Coil	
_705	19A700024P25	10 uH Coil	
9027	19A700024P25	10 uH Coil	
_707	19J706083P6	Variable Coil	
L708	19A700024P15	1.5 uH Coil	
	19J706029P3	Variable Coil	
L712	19A700024P25	10 uH Coil	
L713	19A700024P25	10 uH Coil	
L714	19J706258P3	Coil	
L715	19A700024P25	10 uH Coil	
L716	19A700024P25	10 uH Coil	
L717	19J706258P2	Coil	
L718	19A700024P25	10 uH Coil	
L721	19A700024P23	6.8 uH Coil	
_722	19A700024P13	1 uH Coil	
L723	19A700024P9	0.47 uH Coil	
Q702	19A700020P1	BC558 Transistor	
0703	19A700020P1	BC558 Transistor	
4070	19A700020P1	BC558 Transistor	
0711	19A700017P2	BC548 Transistor	
0713	19J706283P1	BFR54 Transistor	
Q714	19J706283P1	BFR54 Transistor	
Q715	19J706264P1	BF414 Transistor	
9116	19J706038P1	2N5245 Transistor	

			0.25 W		25	0.25 W	25	100	25	. 25	. 25	25	0.25 W	. 25	0.25 W	. 25	. 25	0.25 W	2 7	25	25	25	. 25	0.25 W	0.25 W	. 25	25	0.25 W	0.25 W	0.25 W	0.25 W	0.25 W	0.25 W
DATA	2N5245 Transistor BF357S Transistor BF414 Transistor BF357S Transistor	560 ohm Resistor Depos.	47 ohm Resistor Depos.	10 Kohm Resistor Depos.	10 Kohm Resistor Depos.	2.7 Kohm Resistor Depos.	10 Kohm Resistor Depos.	22 ohm Resistor Depos.	22 ohm Resistor Depos.	1 Kohm Resistor Depos.		82 Kohm Resistor Depos.	Kohm	47 Kohm Resistor Depos.	10 Kohm Resistor Depos.	1.8 Kohm Resistor Depos.	6.8 Kohm Kesistor Depos.	1 7 Kohm Besistor Depos.	270 ohm Resistor Depos.	10 Kohm Resistor Denos	8.2 Kohm Resistor Denos	680 ohm Resistor Depos.	47 Kohm Resistor Depos.	330 ohm Resistor Depos.	330 ohm Resistor Depos.	100 ohm Resistor Depos.	1.5 Kohm Resistor Depos.	3.3 Kohm Resistor Depos.	1 Kohm Resistor Depos.	100 ohm Resistor Depos.	150 ohm Resistor Depos.	100 ohm Resistor Depos.	47 Kohm Resistor Depos.
CODE	19J706038P1 19J706146P1 19J706164P1 19J706146P1	19A700019P34	19A700019P21	19A700019P49	19A700019P49	19A /00019P42	19A700019P49	19A700019P17	19A700019P17	19A 700019P37	19A / 00019P45	194700019760	19A700019P49	19A700019P57	19A700019P49	19A700019P40	19A / 000 19P4 /	19A 700019P30	19A 700019P30	19A700019P49	19A700019P48	19A700019P35	19A700029P57	19A700029P31	19A 700019P31	19A700019P25	19A700019P39	19A700019P43	19A700019P37	19A700019P25	19A700019P27	19A700019P25	19A 700019P57
o N	Q717 Q722 Q723 Q724	R704	R706	R707	R708	R/09 R711	R712	R713	R714	K/20	K/21	R723	R724	R725	R726	R727	7770	R730	R731	R732	R733	R734	R735	R736	R737	R738	R739	R741	R742	R743	R748	R749	R750

FREQUENCY SYNTHESIZER FS5331

X402.897/2

Page 2 of 3

Stormo

R752			
	19A 700016P3	1 7 Kohm Besistor Variable	
R753	19A 700019P37	1 Kohm Resistor Denos	W 2C 0
R754	19A700019P25	100 ohm Resistor Depos.	0.25 W
R761	19A700019P13	10 ohm Resistor Depos.	
R763	19A700019P51	15 Kohm Resistor Depos.	. 25
R765	19A700019P26	120 ohm Resistor Depos.	
R769	19A700019P35	820 ohm Resistor Depos.	25
R770	19A700019P42		25
R771	19A700019P15	15 ohm Resistor Depos.	25
R772	19A700019P57	47 Kohm Resistor Depos.	25
R773	19A700019P55	33 Kohm Resistor Depos.	25
R774	19A700019P50	12 Kohm Resistor Depos.	25
R775	19A700019P40	1.8 Kohm Resistor Depos.	25
R776	19A700010P37	1 Kohm Resistor Depos.	25
K///	19A /00019P21	47 ohm Resistor Depos.	25
K//8	19A 700019P25	100 ohm Resistor Depos.	25
K//9	19A / 00019P34	550 ohm Resistor Depos.	25
R/80	19A / 00019P 23	68 ohm Resistor Depos.	25
0707	144700019F19	33 onm Resistor Depos.	52
D783	194700019P44	150 chm Resistor Depos.	57
D784	194 700019025	100 ohm Besister Despos.	27
R785	19A700019P39	1 5 Kohm Resistor Depos.	0.25 W
R786	19A700019P31	330 ohm Resistor Denos	35
R787	19A700019P43	3.3 Kohm Resistor Denos	35
R788	19A700019P26	120 ohm Resistor Depos.	25
R789	19A700019P34	560 ohm Resistor Depos.	25
R791	19A700019P30	270 ohm Resistor Depos.	0.25 W
R792	19A700019P38	1.2 Kohm Resistor Depos.	0.25 W
R793	19A700019P17		0.25 W
R794	19A700019P17	22 ohm Resistor Depos.	0.25 W
R798	19A700019P37	1 Kohm Resistor Depos.	0.25 W
R799	19A700019P54	27 Kohm Resistor Depos.	0.25 W
1701	19J 706284G1	Transformer	
10/01	192/0626371		
11703	194 700029PI	MAGGE IC	

Stormo		
	DATA	
	CODE	
	ōΝ	

FREQUENCY SYNTHESIZER FS5331

X402.897/2 Page 3 of 3

	ļ	į	į	
	Ì	į		
	i	á		,
	Ì		2	
ŧ	d		١	Ì

	_	_	-		-	-				-	-	_	-	-		_	_	_	_	_	_	-	-				_			-		_	_		_	_		_	_	_	_					_		- 17
	50 V	16 V	20 V	20 N	20 V			20 V					20 \	2.00								50 V			50 V	16 V	50 V	35 V	50 V	50 V	200 V	20 N	20 N		>0 00	35 V			20 \	20 \		20 \			20 N	20 \	35 V	
DATA	1 nF Capacitor Ceramic	47 uF Capacitor Electrolytic		1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	10 uF Capacitor Tantalum	1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	0.1 uF Capacitor Tantalum	2.2 uF Capacitor Tantalum	330 pF Capacitor Ceramic	100 DE N750 Capacitor Ceramic	150 pF Capacitor Ceramic	1 nF Capacitor Ceramic	47 of Capacitor Ceramic	5. 6 pF Capacitor Ceramic	22 pF Capacitor Ceramic	1 nF Capacitor Ceramic	5.6 pF Capacitor Ceramic	68 pF Capacitor Ceramic	15 pF Capacitor Ceramic	1 nF Capacitor Ceramic	27 pF N 1500 Capacitor Ceramic	100 pF N1500 Capacitor Ceramic	180 pF Capacitor Ceramic	10 uF Capacitor Tantalum	1 nF Capacitor Ceramic	4.7 uF Capacitor Tantalum	1 nF Capacitor Ceramic	5.6 pF Capacitor Ceramic	0.68 pF Capacitor Phenolic		1.5 nF Capacitor Ceramic	2-18 pr Capacitor Variable	1 of Capacitor Ceramic	150 of Capacitor Lantalum.	150 pr Capacitor Ceramic	10 ur Capacitor Lantalum	5.6 pF Capacitor Ceramic	1 nF Capacitor Ceramic	2-18 pF Capacitor Variable	12 pF Capacitor Ceramic		1.5 nF Capacitor Ceramic	PF	PF	2.2 uF Capacitor Tantalum	
CODE	19A700233P7	19J706005P3	19A700233P7	19A700233P7	19A700233P7	19A700003P7	19A700233P7	19A700233P7	19A700003P1	19A700003P5	19A700235P31	191706256P101	19A700235P27	19A700233P7	19A700235P21	19A700235P10	19A700235P17	19A700233P7	19A700235P10	19A700235P23	19A700235P15	19A700233P7	19J706256P203	19J706256P206	19A700235P28	19A700003P7	19A700233P7	19A700003P6	19A700233P7	19A700235P10	19A700013P11	19A700233P7	19A700233P8	193 /06003F2	194 70000357 10	19470003F4	100 200002	19A /00003P /	19A /00235F10	19A /00233P7	191706003P2	19A 700235P14	19A700003P4	19A700233P8	19A700235P10	19A700233P1	19A700003P5	
ōΝ	C701	C702	C703	C704	C705	C706	C707	C708	C711	C712	C713	C714	C715	C716	C717	C718	C719	C720	C721	C722	C723	C724	C725	C726	C727	C728	C729	C730	C731	C732	C733	C734	C735	C/3/	C730	07710	0110	11.5	C/42	C/43	C/45	C/46	C747	C748	C749	C750	C/51	

	50 V	20 \	20 V	35 V	35 V	20 V	20 V	35 V	n 35 V	50 V	20 V	20 \	20 N	20 V	20 \	50 V	50 V	20 V	20 V	20 V	20 \	20 \	20 \	20 N	20 \	20 V	ic 16 V	20 V	20 V	20 \	20 N	100 V	20 \	20 \						
DATA	1 nF Capacitor Ceramic	150 pF Capacitor Ceramic	27 pF Capacitor Ceramic	1 uF Capacitor Tantalum	10 uF Capacitor Tantalum	1 nF Capacitor Ceramic	1.5 nF Capacitor Ceramic	1 uF Capacitor Tantalum	0.47 uF Capacitor Tantalum				1 pF Capacitor Ceramic	Capacitor		1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	18 pF Capacitor Ceramic	1 nF Capacitor Ceramic	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	I nr Capacitor Ceramic	10 pF Capacitor Ceramic	1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	220 uF Capacitor Electrolytic	1 nF Capacitor Ceramic	33 pF Capacitor Ceramic	1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	22 nF Capacitor Polyester		100 pr Capacitor Ceramic	1N4148 Diode Silicon	IN4148 Diode Silicon	Diode	Diode	1N4148 Diode Silicon	000
CODE	19A700233P7	19A 700233P2	19A700235P18	19A700003P4	19A700003P7	19A700233P7	19A700233P8	19A 700003P4	19A700003P3	19A700233P7	19A700233P7	19A700233P7	19A700235P1	19A700233P7	19A700233P7	19A700233P7	19A700233P7	19A700235P16	19A700233P7	19A700233P5	19A /00233P5	19A 700233P7,	19A /00235F/	19A 700235P13	194 /00233P/	19A 700233P7	19J706005P5	19A700233P7	19A 700235P19	19A /00233P7	19A700233P7	19J 706261P1	19A 700233P1	19A / 00233F1	19A /00028P1	198/00028F1	19A 700028P1	19A/00028F1	19A 700028P1	14A/000/8F
ο̈́N	C752	C/53	C754	C755	C756	C757	C758	C759	C760	C761	C762	C763	C764	C765	C766	C767	C768	C769	C770	C771	0717	C//3	111	0//0	0100	C/80	C781	C782	C783	C/84	C/85	C/91	C/92	0.793	0.707	2070	0,03	10/04	0702	00/0

FREQUENCY SYNTHESIZER FS5332

X402.898/2 Page 1 of 3

			_	
		(i	₽
		1		
		1	ŀ	
		(₽
	1	¢	į	2
ì	ŧ	á	Į	7

N	CODE	DAIA	
0020	108 70007 801	0000	
D709	19A 700028P1	1N4148 Diode Silicon	
D710	19A700028P1	Diode	
D711	19A700028P1	1N4148 Diode Silicon	
D712	19A700028P1		
D713	19A700028P1		
D714	19A700028P1	1N4148 Diode Silicon	
D721	19A700028P1	1N4148 Diode Silicon	
D722	19A700028P1		
D723	19A700073P1	BB409 Variable Cap. Diode	
D724	19J 706262P1		
0776	19A 700073P1	BB409 Variable Cap. Diode	
D727	19A700073P1		
D733	19J706006P2		
D734	19J706006P2	BA282 Diode	
D741	19J706026P1	1N5401 Diode Silicon	
D742	19J706026P1	1N5401 Diode Silicon	
1730	19J706215P108		8 pin
1732	19J706215P114	Male Connector	14 pin
1901	19J/06214P4	Male Connector	4 pin
1903	191706214F4	Male Connector	4 7
1904	19A 700072P28	Male Connector	2 pin
1905	19A 700072P9	Male Connector	10 pin
906	19A700072P11	Male Connector	12 pin
1907	19A700102P21	Female Connector	3 pin
1910	19J706223P11	Male Connector	11 pos
1911	19J706223P8	Male Connector	sod 8
1921	19J706219P1		pin
1961	19J706219P1		pin
L701	19J706029P6	Variable Coil	
L702	19A 700184P1	Jumper Wire	
L/03	19A /00184P1	Jumper Wire	
1 705	194 70002 195	10 U Coil	
1706	19A 700024P25	10 CB	
L707	19J706083P6	Variable Coil	
L708	19A700024P15	1.5 uH Coil	
L711	19J706029P3	Variable Coil	
L712	19A700024P25	10 uH Coil	
-	19A 700024P25	10 uH Coil	
1714	19J 706258P3	Coil	
	19A 700024F 23	100 Hi 01	
L717	19J706258P2		
L718	19A700024P25	10 uH Coil	

ο̄Ν	CODE	DATA	
1771	250000000000000000000000000000000000000	0	
1722	19A700024F23	0.8 un Coll	
1 723	19A 700024P9	100 11 0	
0701	19A 700017P1	BC548 Transistor	
0702	19A 700020P1	BC558 Transistor	
0703	19A700020P1	C558	
Q704	19A700020P1	558	
0711	19A700017P2	C548	
Q713	19J706283P1	BFR54 Transistor	
9714	19J706283P1	BFR54 Transistor	
Q715	19J706264P1		
9716	19J706038P1		
0717	19J706038P1	2N5245 Transistor	
0/22	197/0614621	BF357S Transistor	
0777	197/0616461	Br414 ransistor	
R701	19A 700019D21	17 ohm Posistor Donos	W 100
R702	19A 700019P39	1 5 Kohm Resistor Denos	0.23 W
R703	19A700019P53	22 Kohm Resistor Denos	750
R704	19A700019P34	560 ohm Resistor Depos.	25
R705	19A700019P42	2.7 Kohm Resistor Depos.	. 25
R706	19A700019P21	47 ohm Resistor Depos.	. 25
R707	19A700019P49	10 Kohm Resistor Depos.	25
K708	19A 700019P49	10 Kohm Resistor Depos.	
R709	19A700019P42	2.7 Kohm Resistor Depos.	
R711	19A700019P42	2.7 Kohm Resistor Depos.	
R712	19A 700019P49	10 Kohm Resistor Depos.	0.25 W
R713	19A 700019P17	22 ohm Resistor Depos.	
R714	19A700019P17	22 ohm Resistor Depos.	25
R720	19A700019P37	1 Kohm Resistor Depos.	
R721	19A700019P45		7
R722	19A700019P60		7
R723	19A700019P58	56 Kohm Resistor Depos.	0.25 W
R724	19A700019P49		25
R725	19A700019P57	47 Kohm Resistor Depos.	0.25 W
R726	19A700019P49	10 Kohm Resistor Depos.	2
R727	19A700019P40	1.8 Kohm Resistor Depos.	7
R728	19A 700019P47	6.8 Kohm Resistor Depos.	7
-	19A700019P30	0	
R730	19A700019P45	4.7 Kohm Resistor Depos.	0.25 W

FREQUENCY SYNTHESIZER FS5332

X402.898/2 Page 2 of 3

Stormo

		צועט	
194	9A700019P30	270 ohm Resistor Depos	0 25 W
194	9A700019P49	10 Kohm Resistor Depos.	0.25 W
19,4	9A700019P48	8.2 Kohm Resistor Depos.	25
19,4	9A700019P35	680 ohm Resistor Depos.	. 25
194	9A700029P57	John Resistor	. 25
19,4	9A700029P31	330 ohm Resistor Depos.	. 25
197	9A700019P31	ohm Resistor	
19/	9A700019P25	00	. 25
197	9A /00019P39		0.25 W
76.	9A /00019P43	3.3 Kohm Resistor Depos.	. 25
96	9A /00019P3/	1 Kohm Kesistor Depos.	. 25
461	9A /00019P25	100 ohm Resistor Depos.	. 25
197	9A /00019P2/	150 ohm Resistor Depos.	. 25
197	9A /00019P25	100 ohm Resistor Depos.	. 25
197	9A /00019P5 /	4/ Kohm Resistor Depos.	0.25 W
100	9A 700019P3	1 Kohm Besistor Variable	W ac o
100	9A 700019P37	100 ohm Bosieton Depos.	0. 25 W
194	9A 700019P13	10 ohm Besistor Depos	25
19.4	9A700019P51	15 Kohm Resistor Denos	25
19.4	9A700019P26	120 ohm Resistor Depos.	25
19	9A700019P34	560 ohm Resistor Depos.	. 25
194	9A700019P42	2.7 Kohm Resistor Depos.	. 25
194	9A700019P15	15 ohm Resistor Depos.	. 25
194	9A700019P57	Kohm Resistor	. 25
194	9A700019P55		. 25
197	9A700019P50	12 Kohm Resistor Depos.	25
19/	9A700019P40	1.8 Kohm Resistor Depos.	25
194	9A 700010P37	1 Kohm Resistor Depos.	. 25
197	9A /00019P21	47 ohm Resistor Depos.	. 25
197	9A / 00019P25	100 ohm Resistor Depos.	. 25
761	9A / 000 19P3 5	680 ohm Resistor Depos.	. 25
197	9A 7000 19P 23	33 ohm Resistor Depos.	0.25 W
194	9A 700019P44	3 9 Kohm Resistor Denos	25
194	9A700019P27	150 ohm Resistor Denos	25
194	9A700019P25	100 ohm Resistor Depos.	25
194	9A700019P39	1.5 Kohm Resistor Depos.	. 25
19,4	9A700019P31	30	. 25
19	9A700019P43	3.3 Kohm Resistor Depos.	0.25 W
194	9A700019P26	120 ohm Resistor Depos.	. 25
194	9A700019P34		. 25
194	9A700019P30	270 ohm Resistor Depos.	. 25
194	9A700019P38		. 25
194	9A700019P17	2	. 25
100	9A700019P17	22 ohm Resistor Denos.	0.25 W

	0.25 W 0.25 W			
DATA	1 Kohm Resistor Depos. 27 Kohm Resistor Depos. Channel Switch Transformer MC145106 INT CKT TDA 1062 S 4066B IC			
CODE	19A700019P37 19A700019P54 19J706322G1 19J706284G1 19J706263P1 19J706238P1 19A700029P44			
ο̈́N	R798 R799 S901 T701 U702 U703			

FREQUENCY SYNTHESIZER FS5332

X402.898/2

Page 3 of 3

TECHNICAL SPECIFICATIONS

CQM5550 S12

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

370 MHz - 420 MHz

Channel Separation

CQM5552: 25 kHz CQM5553: 20 kHz

Maximum Frequency Deviation

CQM5552: ±5 kHz CQM5553: ±4 kHz

Modulation Frequency Range

300 - 3000 Hz

Maximum RF Bandwidth

RX: 3.0 MHz TX: 5.5 MHz

Antenna Impedance

50 ohm

Maximum Number of Channels

12

Supply Voltage

Minimum: 10.8 V Nominal: 13.2 V Maximum: 16.6 V

Negative potential to chassis

Temperature Range

-30°C to +60°C

Dimensions

B x D x H: 180 x 190 x 60 mm

Weight 1.8 kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f. 0.4 uV (0.3uV)

Measuring conditions:

 $\Delta f \pm 2/3 \times \Delta fmax$; $f_{mod} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f. 1.0 uV (0.7 uV) Δ F 60% × Δ fmax; f_{mod} = 1 kHz. Measured with psophometric filter.

Crystal Frequency Range

56 - 64 MHz

Receiver VCO Frequency Range

116 - 132 MHz

Crystal Frequency Multiplication

×2

Frequency Stability

Conforms with government regulations

Modulation Acceptance Bandwidth (EIA)

±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

EIA

75 dB (80 dB)

CEPT

75 dB (80 dB)

Spurious Rejection

EIA

85 dB

Intermodulation Attenuation

EIA

70 dB

CEPT

70 dB (78dB)

Blocking

90 dB/uV (100 dB/uV)

Radiation

Conducted: max. 0.8 nW

Radiated: max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

 $\Delta f = \pm 3 \text{ kHz}$, 1 kHz, 1 W; RF 1 mV

Audio Frequency Response, CEPT/FTZ

+1/-3 dB (+0/-1.5 dB)

Relative to 1000 Hz, -6 dB/octave

fm: 300 - 3000 Hz

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Recovery Time

250 ms (200 ms)

Attack Time, EIA

150 ms (110 ms)

Squelch Closing Time, EIA

150 ms (50 ms)

Current Consumption

Squelched: 350 mA (330 mA)

AF 2 W: 750 mA (730 mA)

(1 channel, without tone equipment, 13.2 V

supply)

TRANSMITTER

RF Power Output

CQM5550-20 W: 20 W

 $R_1 = 50$ ohm

Crystal Frequency Range

59 - 68 MHz

Crystal Frequency Multiplication

×2

Transmitter VCO Frequency Range

123 - 140 MHz

Frequency Stability

Conforms with government regulations

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

TECHNICAL SPECIFICATIONS

Stormo

AF Input Impedance

560 ohm

Modulation Sensitivity

90mV ±3 dB

 $(\Delta f = \pm 3 \text{ kHz}, 1 \text{ kHz})$

Modulation Response (CEPT)

300 - 3000 Hz

+1/-3.0 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

Modulation Distortion, CEPT

fm= 1000 Hz: max. 3%

 $(\Delta f= \pm 3.0 \text{ kHz})$

fm= 300 Hz: max. 5%

FM Hum and Noise, CEPT

55 dB (>57 dB)

(measured with 750 usec de-emphasis)

Attack time

50 ms

Current Consumption

less than 5.5 A (5.0 A)

GENERAL DESCRIPTION

CQM5550 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 12 transmit and receive channels.

A comparison of the various models is presented in the table below.

Туре		CQM5552	CQM5553
SPEC		20	20
Frequency Range	MHz	370 - 420	370 - 420
RF Power	W	20	20
Channel Spacing	kHz	30/25	20
Max. Number			
of Channels		12	12

ACCESSORIES

Mounting	frame	MC5001	Fist microphone with retractable
Power cab	ole		spiral cable for mobile installation.
Fist micro	ophone with retainer or		
Fixed - m	ount microphone	HS5001	Retainer for MC5001.
External I	oudspeaker		
External	switches	HS5002	Retainer, with switches, for MC5001.
MN5001	Mounting frame for mobile instal-	MC704	Microphone with chock absorbing
	lations allowing the radio to be		mounting bracket for mobile instal-
	fixed in 36 positions. Includes a		lation.
	base plate with locking screw.		
		MC703	Desk microphone with PTT
MN 703	Desk stand for fixed installations.		(Push - to - Talk) switch for
			fixed installations.
MN 704a	Mounting frame for mobile instal-		
	lations and direct attachment to	MK5001	Installation kit containing connec-
	the vehicle.		tors, power cable, fuses and fu-
			se holders.

LS701	Loudspeaker enclosed in plastic housing, complete with cable.
SU701	Transmitter keying switch for mounting on the steering column.
SU702	Transmitter keying switch for mounting on the dashboard.

POWER SUPPLY UNITS:

EQUIPMENT	SUPPLY	VOLTAGE
	220 V AC	+24 V DC
CQM5000, max. 6 W	PS703	PS704
CQM5000, max. 20 W	PS5001	PS 702

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slide under the edges of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FS) and the Frequency Control (FC) mount in the top section of the chassis. Their switches and push buttons mount directly to the boards and protrude through the front.

Thin cast shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

Receiver front end
1st IF section with first and second oscillator.

455 kHz 2nd IF section with demodulator.

(refer to functional block diagram)

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter

PA interconnections are designed in microstripline techniques on the mainboard.

1st IF MIXER

The first IF frequency is 21.4 MHz. The out-

put from the crystal filter is fed to a dualgate MOS-FET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

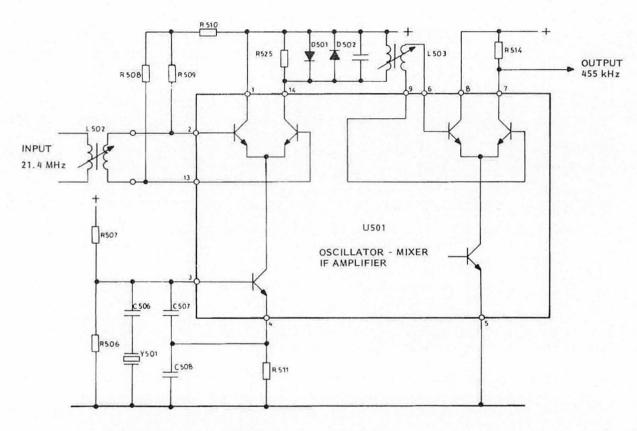


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

455 kHz IF AMPLIFIER AND DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit , U502, which also contains the quadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

SQUELCH

The audio line signal (Vol/Sq - HI) is fed to

a selective amplifier stage, where noise (frequencies around 7 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603–D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicator

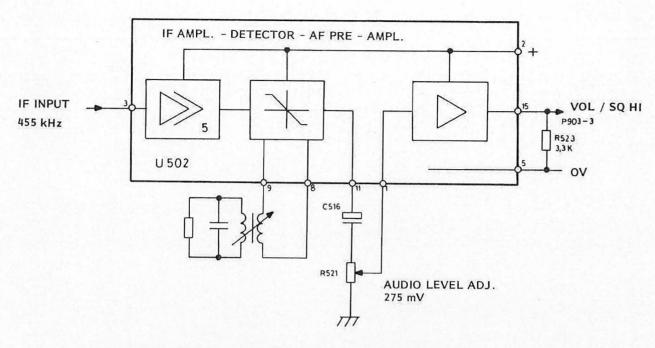


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO CIRCUITS

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive de-emphasis network R629-C608 followed by the volume control.

The volume control potentiometer R630 is mounted directly on the RF board and protrudes through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired

power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to decide whether the amplifier should be active or not.

These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible.

The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time.

The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all

assembled on the main board along with the receiver.

The exciter contains an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks.

The exciter output is at the carrier frequency when applied to the power amplifier.

The power amplifier boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the XS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV potentiometer on the RF board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the FM oscillator.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4), of which Q202 is a frequency tripler, and three filters (L203-4, L208-9, L211-12) are used in a narrow band design which limits the maximum frequency spread of the transmitter.

The exciter has four test points (TP201-2-3-4) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and

employs two broadband untuned amplifier stages Q205, Q206. The amplifier configurations provides a power level of 20 watt. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible.

The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is biased by a voltage generated by the feedback network C253, D201, Q210, Q209, Q208.

FREQUENCY SYNTHESIZER

The frequency synthesizer provides up to 12 channels and is built on a printed wiring board which mounts in the top section of the radio set. There are two versions of the board, a single channel board, FS5551, and a multichannel board, FS5552.

The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board uses a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the synthesizer board and protrudes through the front panel.

The Frequency Control unit FC5001 fits into a shield which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone mo-

dules and the RF module, and it has two connectors at the rear for the accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D901, D902. The ground lead comes through the same connector and is connected to chassis ground through a fusible printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector, P907, to the transmitter PA stages. The other input feeds through J903 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 - C618 and one of the ON/OFF switch sections S602. The other section of the ON/OFF switch controls the V_B + to the voltage regulator U602 consisting of a monolithic regulator. The regulator output

is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulator.

The squelch circuit, the modulation processor and parts of the IF amplifier U502 are supplied directly from the continuous 8.5 V.

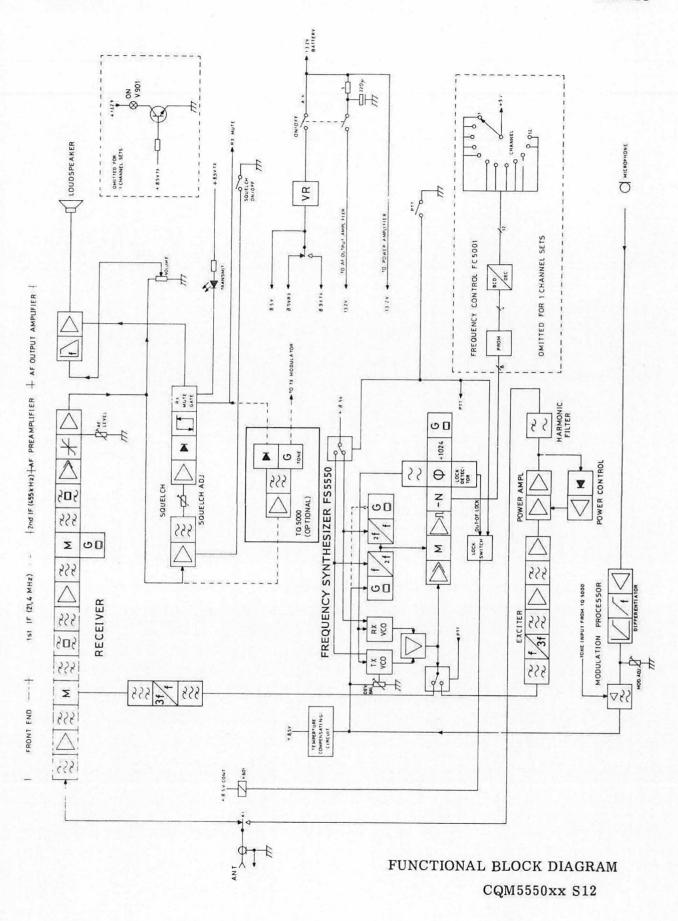
The receiver front-end, the 21.4 MHz IF stages and the second oscillator are supplied from 8.5 V RX.

The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllium which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistors may be hazardous.



D403.030

CHANNEL PROGRAMMING INSTRUCTIONS

CQM5550 S12

Programming of the PROM which contains the data for the channel frequencies will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 17 or 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19) Programming Pak, interchangeable Socket adaptor or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

After completing the worksheet the next steps are:

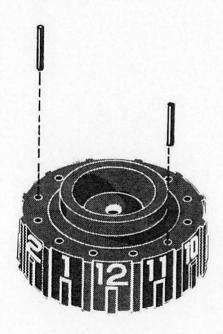
 Enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.

- Insert the channel knob stop (if needed) if less than 9 channels, refer to fig. 1.
- 3. In case of more than 8, but less than

12 channels are used, transmission on unauthorized channels must be avoided. This is done by burning the unused channel locations in the PROM with the highest channel HEX CODE.

CHANNEL STOP

LOWEST	INSERT	HIGHEST	INSERT
CH.	PIN BETWEEN	CH.	PIN BETWEEN
1	10 and 11	1	3 and 4
2	11 and 12	2	4 and 5
3	12 and 1	3	5 and 6
4	1 and 2	4	6 and 7
5	2 and 3	5	7 and 8
6	3 and 4	6	8 and 9
7	4 and 5	7	9 and 10
8	5 and 6	8	10 and 11
9	6 and 7	9	11 and 12
10	7 and 8	10	12 and 1
11	8 and 9	11	1 and 2
12	9 and 10	12	2 and 3



Note:

If 8 channels are used insert only one PIN.

If more than 8 channels are used stop is not possible and no

PINs are inserted.

Fig. 1. SETTING OF CHANNEL KNOB STOP.

RECOMMENDED CRYSTAL FREQUENCIES CQM5550 S12

CQM5552	CQM5553	RX CRYSTAL
FREQUENCY RANGE	FREQUENCY RANGE	MHz
368.9 - 375.275	267 62 272 72	50.05
371, 4 - 377, 775	367. 62 - 372. 72 370. 12 - 375. 22	56.85
373.9 - 380.275	370. 12 - 375. 22	57. 266666
376.4 - 382.775	372.62 - 377.72	57. 6833333
378.9 - 385.275		58. 1
381, 4 - 387, 775	377.62 - 382.72 380.12 - 385.22	58. 516666
383.9 - 390.275		58. 933333
386.4 - 392.775	382.62 - 387.72	59.35
388.9 - 395.275	385. 12 - 398. 22	59.766666
391.4 - 397.775	387.62 - 392.72	60. 183333
PARTY OF THE PARTY OF	390. 12 - 395. 22	60.6
393.9 - 400.275	392.62 - 397.72	61.016666
396.4 - 402.775	395. 12 - 400. 22	61. 433333
398.9 - 405.275	397.62 - 402.72	61.85
401.4 - 407.775	400. 12 - 405. 22	62.26666
403.9 - 410.275	402.62 - 407.72	62. 683333
406.4 - 412.775	405. 12 - 410. 22	63.1
408.9 - 415.275	407.62 - 412.72	63.516666
411.4 - 417.775	410.12 - 415.22	63.933333
413.9 - 420.275	412.62 - 417.72	64.35
416.4 - 422.775	415.12 - 420.22	64.76666
418.9 - 425.275	417.62 - 422.72	65.183333
421.4 - 427.775	420. 12 - 425. 22	65.6

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY



RECOMMENDED CRYSTAL FREQUENCIES CQM5550 S12

CQM5552 FREQUENCY RANGE	CQM5553 FREQUENCY RANGE	TX CRYSTAL MHz
370 376.375	368.72 - 373.82	60.6
372.5 - 378.875	371.22 - 376.32	61.016666
375 381.375	373.72 - 378.82	61. 433333
377.5 - 383.875	376.22 - 381.32	61.85
380 386.375	378.72 - 383.82	62.266666
382.5 - 388.875	381.22 - 386.32	62.683333
385 391.375	383.72 - 388.82	63.1
387.5 - 393.875	386.22 - 391.32	63.516666
390 396.375	388.72 - 393.82	63.933333
392.5 - 398.875	391.22 - 396.32	64.35
395 401.375	393.72 - 398.82	64. 766666
397.5 - 403.875	396.22 - 401.32	65. 183333
400 406.375	398.72 - 403.82	65.6
402.5 - 408,875	401.22 - 406.32	66.016666
405 411.375	403,72 - 408.82	66. 433333
407.5 - 413.875	406.22 - 411.32	66.85
410 416.375	408.72 - 413.82	67. 266666
412,5 - 418.875	411.22 - 416.32	67.683333
415 421.375	413.72 - 418.82	68.1
417.5 - 423.875	416.22 - 421.32	68.516666
420 426.375	418.72 - 423.82	68.933333
	421.22 - 426.32	69.35

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY

SELFQUIETING FREQUENCIES CQM5552

RECEIVER CRYSTAL	V	USE
FREQUENCY MHz	DEC	ALTERNATIVE *
56.850	321	4
56.850	366	4
60. 183	404	2
60.600	304	2
63.100	384	4
63.516	469	4
63.933	369	4
63.933	415	4
63.933	424	4
64.350	269	4
64.350	278	4
64.350	324	4
64.350	428	4
64. 766	428	4
65. 183	428	4
65.600	428	4

SELFQUIETING FREQUENCIES CQM5553

RECEIVER CRYSTAL	V	USE
FREQUENCY, MHz	DEC	ALTERNATIVE [†]
56.850	458	4
60. 183	505	4
60.600	380	4
60.600	426	4
61.016	301	4
61.850	375	4
63.933	473	4
64.350	348	4
64.350	394	4
64.350	405	4
64.766	269	4
64.766	280	4

Table 3. SELFQUIETING FREQUENCIES

[†]refer to worksheet

268 269 284 285 300 301 316 317 332 333 348 349 364 365 364 365 380 381 412 413 412 413 428 429 444 445 460 461 476 477 492 493 508 509	256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 289 289 289 289 289 289 289 289 289 289 289 289 289 289 289 389	A	0	-	2	3	4	2	9	7	8	6	V	В	U	O	ш	Щ
272 273 274 275 277 278 279 280 281 282 283 284 285 288 289 289 290 291 292 293 294 295 296 297 298 299 300 304 305 306 307 308 309 310 311 312 313 314 315 316 301 301 301 301 311 312 313 314 315 316 301 301 301 311 312 313 314 315 316 301 301 301 301 302 329 302 303	275 276 277 278 289 281 282 283 284 285 286 287 288 289 309 301 302 286 289 289 289 289 289 289 300 301 302 <td>3</td> <td></td> <td>257</td> <td>258</td> <td>259</td> <td>260</td> <td>261</td> <td>262</td> <td>263</td> <td>264</td> <td>265</td> <td>266</td> <td>267</td> <td>268</td> <td>269</td> <td>270</td> <td>271</td>	3		257	258	259	260	261	262	263	264	265	266	267	268	269	270	271
288 289 289 289 299 291 292 293 294 295 296 297 298 299 309 301 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 319 310 311 312 313 314 315 316 317 318 319 319 319 328 326 327 328 329 340 341 342 344 345 346 347 348 349 340 341 342 348 349 340 341 342 349 346 347 348 348 359 360 361 362 363 364 365 364 365 364 365 364 365 364 365 364 365 366 361 361 361 362 363 364	291 292 293 294 295 296 297 298 300 301 302 303 <td></td> <td>272</td> <td>273</td> <td>274</td> <td>275</td> <td>276</td> <td>277</td> <td>278</td> <td>279</td> <td>280</td> <td>281</td> <td>282</td> <td>283</td> <td>284</td> <td>285</td> <td>286</td> <td>287</td>		272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
304 305 306 307 308 309 310 311 312 313 314 315 316 317 312 313 314 315 316 317 318 319 311 312 313 314 <td>323 324 325 326 327 328 329 330 331 332 333 334 323 324 325 326 327 328 329 330 331 332 334 342 342 342 342 345 346 347 348 349 340 341 342 343 344 345 346 347 348 349 350 351 352 356 357 358 359 360 361 362 363 364 365 365 367 388 389 390 391 392 393 394 395 396 397 398 340 440 405 406 407 408 409 410 411 412 413 414 445 445 452 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 504 505 505 506 507 508 509 510 ex Code.</td> <td>7</td> <td>288</td> <td>289</td> <td>290</td> <td>291</td> <td>292</td> <td>293</td> <td>294</td> <td>295</td> <td>296</td> <td>297</td> <td>298</td> <td>299</td> <td>300</td> <td>301</td> <td>302</td> <td>303</td>	323 324 325 326 327 328 329 330 331 332 333 334 323 324 325 326 327 328 329 330 331 332 334 342 342 342 342 345 346 347 348 349 340 341 342 343 344 345 346 347 348 349 350 351 352 356 357 358 359 360 361 362 363 364 365 365 367 388 389 390 391 392 393 394 395 396 397 398 340 440 405 406 407 408 409 410 411 412 413 414 445 445 452 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 454 455 453 504 505 505 506 507 508 509 510 ex Code.	7	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
320 321 322 324 325 326 326 327 328 329 330 331 3324 325 326 327 328 329 330 349 341 342 344 345 346 347 348 349 344 345 346 347 348 349 349 360 361 362 361 362 363 361 362 361 362 361 362 361 362 363 361 362 361 362 362 362 361 362 363 361 362 361 362 363 364 365 369 369 361 362 363 364 365 361 362 361 362 361 362 362 362 362 362 362 362 362 362 362 362 362 362 362 362 362 362 362 362 <td>323 324 325 326 327 328 329 330 331 332 333 334 334 345 346 347 348 349 350 355 356 357 358 359 360 361 362 363 364 365 365 367 368 369 361 362 363 364 365 365 367 372 373 374 375 376 377 378 379 380 381 382 389 390 391 392 393 394 395 396 397 398 404 405 406 407 408 409 410 411 412 413 414 415 422 423 424 425 426 427 428 429 430 430 431 445 445 456 457 458 459 460 461 465 467 468 469 470 471 472 473 474 475 476 477 478 488 489 490 491 495 500 501 502 503 504 505 506 507 508 509 510</td> <td><u>е</u></td> <td>304</td> <td>305</td> <td>306</td> <td>307</td> <td>308</td> <td>309</td> <td>310</td> <td>311</td> <td>312</td> <td>313</td> <td>314</td> <td>315</td> <td>316</td> <td>317</td> <td>318</td> <td>319</td>	323 324 325 326 327 328 329 330 331 332 333 334 334 345 346 347 348 349 350 355 356 357 358 359 360 361 362 363 364 365 365 367 368 369 361 362 363 364 365 365 367 372 373 374 375 376 377 378 379 380 381 382 389 390 391 392 393 394 395 396 397 398 404 405 406 407 408 409 410 411 412 413 414 415 422 423 424 425 426 427 428 429 430 430 431 445 445 456 457 458 459 460 461 465 467 468 469 470 471 472 473 474 475 476 477 478 488 489 490 491 495 500 501 502 503 504 505 506 507 508 509 510	<u>е</u>	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
356 357 388 349 341 342 343 344 342 343 344 342 344 345 346 347 348 346 347 347 347 347 347 347 347 347 347 347 347 347 347 347 <td>355 356 357 358 359 360 361 362 363 364 345 356 363 364 365 366 371 372 373 374 375 356 357 358 359 390 391 392 393 394 395 388 389 380 391 392 393 394 395 396 397 398 403 404 405 406 407 408 409 410 411 412 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 415 413 414 415 415 415 415 415 415 415 415 415</td> <td>7</td> <td>-</td> <td>321</td> <td>322</td> <td>323</td> <td>324</td> <td>325</td> <td>326</td> <td>327</td> <td>328</td> <td>329</td> <td>330</td> <td>331</td> <td>332</td> <td>333</td> <td>334</td> <td>335</td>	355 356 357 358 359 360 361 362 363 364 345 356 363 364 365 366 371 372 373 374 375 356 357 358 359 390 391 392 393 394 395 388 389 380 391 392 393 394 395 396 397 398 403 404 405 406 407 408 409 410 411 412 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 413 414 415 415 413 414 415 415 415 415 415 415 415 415 415	7	-	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
352 353 354 355 356 357 358 359 360 361 362 363 364 365 365 360 361 362 361 362 363 364 365 364 365 364 365 367 367 376 377 378 379 381 389 390 391 392 393 394 395 389 389 389 390 391 392 393 394 395 389 389 389 389 390 391 392 393 394 395 389 389 389 389 389 390 391 408 409 401 401 401 401 402 403 404 405 406 407 408 409 410 411 412 413 414 414 414 414 414 414 414 414 414 414 414 414 <td>355 356 356 361 362 363 364 365 366 371 372 373 374 375 376 377 378 379 380 381 382 387 388 389 390 391 392 393 394 395 396 397 388 403 404 405 406 407 408 409 410 411 412 413 414 419 420 421 422 426 425 426 429 430 430 435 436 437 448 425 426 427 428 449 445 446 446 451 445 445 446 447 447 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 <t< td=""><td>Γ.</td><td></td><td>337</td><td>338</td><td>339</td><td>340</td><td>341</td><td>345</td><td>343</td><td>344</td><td>345</td><td>346</td><td>347</td><td>348</td><td>349</td><td>350</td><td>351</td></t<></td>	355 356 356 361 362 363 364 365 366 371 372 373 374 375 376 377 378 379 380 381 382 387 388 389 390 391 392 393 394 395 396 397 388 403 404 405 406 407 408 409 410 411 412 413 414 419 420 421 422 426 425 426 429 430 430 435 436 437 448 425 426 427 428 449 445 446 446 451 445 445 446 447 447 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 446 <t< td=""><td>Γ.</td><td></td><td>337</td><td>338</td><td>339</td><td>340</td><td>341</td><td>345</td><td>343</td><td>344</td><td>345</td><td>346</td><td>347</td><td>348</td><td>349</td><td>350</td><td>351</td></t<>	Γ.		337	338	339	340	341	345	343	344	345	346	347	348	349	350	351
368 369 370 371 372 373 374 375 376 377 378 379 381 384 385 386 387 388 389 390 391 392 393 394 395 396 397 400 401 402 406 407 408 409 410 411 412 413 410 411 412 421 422 423 424 425 426 427 428 429 416 417 418 420 421 422 423 424 425 426 427 428 429 432 433 434 435 436 437 440 441 442 443 444 445 448 449 452 454 455 456 457 458 469 461 464 465 466 470 471	371 372 373 374 375 376 377 378 389 380 381 382 389 414 411 412 413 414 413 420 423 424 425 426 427 428 429 430 446 451 452 454 445 440 441 442 444 444 446 446 451 453 454 456 457 458 459 450 450 451 452 460 468 469 470 473 474 475 476	9	-	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
384 385 386 387 389 390 391 392 393 394 395 395 397 400 401 402 406 407 408 409 411 411 413 413 416 417 418 419 420 421 424 425 426 427 428 429 432 433 434 435 436 437 438 439 440 441 442 428 429	387 388 388 389 390 391 392 393 394 395 396 397 398 403 404 405 406 407 408 409 410 411 412 413 414 419 420 421 422 426 426 427 428 429 430 435 436 439 440 441 442 443 444 445 446 447 446	7	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
400 401 402 403 404 405 406 407 408 409 410 411 412 413 416 417 418 419 420 421 423 424 425 426 427 428 429 432 433 434 435 436 437 438 439 440 441 442 443 444 445 448 449 450 451 454 455 456 457 458 459 461 477 480 481 482 486 487 488 489 490 491 491 492 493 496 497 498 499 500 501 502 503 506 507 508 509	404 405 406 407 408 409 410 411 412 413 414 419 420 421 423 424 425 426 427 428 429 439 435 436 439 440 441 442 443 444 445 446 451 452 456 457 458 459 460 461 462 467 468 469 477 478 478 476 477 478 483 484 489 489 490 491 492 494 499 500 501 502 503 504 505 506 507 508 509 510	∞		385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
416 417 418 419 420 421 423 424 425 426 427 428 429 432 433 434 435 436 437 438 439 440 441 442 443 444 448 449 451 452 453 454 455 456 457 458 459 461 464 465 467 470 471 472 473 474 475 476 480 481 488 489 489 489 489 489 489 489 490 491 493 496 497 486 486 486 487 488 489 489 490 491 492 493	419 420 421 424 425 426 427 428 429 430 435 436 439 440 441 442 443 444 445 446 446 446 446 446 446 446 446 446 446 446 446 446 447 4478 4488 489	6	-	401	402	403	404	405	904	407	408	604	410	411	412	413	414	415
432 433 434 435 437 438 439 440 441 442 443 444 445 445 445 456 457 458 459 460 461 448 449 465 467 468 469 470 471 472 473 474 475 476 477 480 481 482 486 487 488 489 490 491 492 493 496 497 498 499 500 501 502 503 506 507 508 509	435 436 437 438 439 440 441 442 443 444 445 446 451 452 456 457 458 459 460 461 462 467 468 470 471 472 473 474 475 476 477 478 483 484 485 486 489 490 491 492 493 494 499 500 501 502 503 504 505 506 507 508 509 510 ex Code. 100	4		417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
448 446 451 452 453 454 455 456 457 458 459 460 461 464 465 467 468 469 470 471 472 473 474 475 476 477 480 481 482 483 484 485 486 487 489 490 491 492 493 496 497 498 500 501 502 503 504 505 506 509 509	451 452 453 456 457 458 459 460 461 462 467 468 469 470 471 472 473 474 475 476 477 478 483 484 485 489 490 491 492 494 494 499 500 501 502 503 504 505 506 507 508 509 510 ex Code. 100	Ш		433	434	435	436	437	438	439	0440	441	442	443	444	445	944	447
464 465 466 467 468 469 470 471 472 473 474 475 476 477 480 481 482 483 484 485 486 487 489 490 491 492 493 496 497 498 500 501 502 503 504 505 506 507 508 509	467 468 469 470 471 472 473 474 475 476 477 478 483 484 489 490 491 492 493 494 499 500 501 502 503 504 505 506 507 508 510 ex Code. 100	0		644	450	451	452	453	454	455	456	457	458	459	094	461	462	463
480 481 482 484 485 486 487 488 489 491 492 493 496 497 498 499 500 501 502 503 504 505 506 507 508 509	483 484 485 486 487 488 489 490 491 492 493 494 499 500 501 502 503 504 505 506 507 508 509 510 ex Code. "Variant Numbers.			465	991	467	894	6917	470	471	472	473	474	475	944	477	478	479
496 497 498 499 500 501 502 503 504 505 506 507 508 509	t99 500 501 502 503 504 505 506 507 508 509 510 ex Code.	Ш		481	482	483	484	485	984	487	488	489	064	491	492	493	464	495
	ex Code.	Ш		497	864	664	200	501	502	503	504	202	909	202	208	509	510	511

Example "V_{DEC}"= 345 equals to hex code 59.

"V_{DEC}"= 469 equals to hex code D5.

Table 4.
"V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

	W	S (HEX)																		FQUIETING:	NCY	SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 21,85500 MHz INSTEAD OF 20,94500 MHz	
	PROM	ADDRESS (HEX)	10	F	12	13	14	15	16	17	18	19	1A	18	1) D=	(P)				FR IS SEL	AL FREQUE	FOR 2nd 94500 MHz	RYSTAL
TRANSMITTER	>	HEX													EQ. (Y70	3 y				E RECEIV	R CRYSTA	EQUENCY D OF 20.9	ERENCE C
TRANS	>	DEC													STAL FR	V _{DEC} = B				NS IF TH	RX MIXER	ZTION FR Z INSTEA	SET REFI O ALTER
	د	I													(ER CRY				$\ $	SOLUTIC	OTHER	SH INJECTION IN INDICATORI IN INDICATORI INDICATORI IN IN	TING; N
	B FREQUENCY	MHz													TRANSMITTER MIXER CRYSTAL FREQ. (Y701) D=	FORMULA:	REFERENCE FREQUENCY:	F= 0.006666 F= 0.008333		ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:		 SELECT HIGH INJECTION FREQUENCY FOR 2nd Y501= 21, 85500 MHz INSTEAD OF 20, 94500 MHz 	3. USE SLIGHTLY OFFSET REFERENCE CRYSTAL 4. WEAK QUIETING; NO ALTERNATIVE REQUIRED
	PROM	ADDRESS (HEX)	00	01	02	03	70	05	90	07	80	60	0A	0B			REFERENCE CRYSTAL (Y703):	6.8263 MHz 8.5333 MHz		(Y703)	PART No.	19J706361P4	
	>	HEX														(9)	C. R.			LIST OF REFERENCE CRYSTALS (Y703)	SY, MHz	1333 166	
VER	>	DEC													702): C=	x X X	NEL ING:	20 KHz 25 KHz		ENCE CR	FREQUENCY, MHz	6.826666	
RECEIVER	اد	Ξ													REQ. (Y	- 21.4)	CHANNEL SPACING:	20 25		FREFER	Щ		
	A FREQUENCY	MHz													ER CRYSTAL	ULA: VDEC= (A				LIST 01	MODE	Standard 5553	
	CHAN-	NEL	-	2	3	4	2	9	7	88	6	10		12	RECEIVE	FORMULA:							

Customer:

Storno Stormo

ADJUSTMENT PROCEDURE

CQM5550 S12

This adjustment procedure applies to the following radiotelephone types:

CQM5552 S12 30/25 kHz Channel spacing CQM5553 S12 20 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter

Rin >1 Mohm

AC Voltmeter Multimeter

Z_{in} >1 Mohm//50 pF R; >20 Kohm/Volt e.g. Storno E11c

Distortion meter RF Watt meter

25 W/50 ohm/370-420 MHz

Deviation meter

370-420 MHz Z_{out}= 50 ohm; 370-420 MHz

RF generator 21.4 MHz signal

generator

e.g. Storno TS-G21B

Frequency counter with attenuator

Z_{in} = 50 ohm; sensitivity

100 mV at 420 MHz

RF diode probe

Storno 95. 0089-00

RF coaxial probe

Storno 95. 0179-00 10.8 V - 16.6 V; 6A

DC power supply Oscilloscope

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026-00

22 uF/40 V electrolytic

capacitor

Storno code 73, 5107-00

Connector, 11-pin house

Storno code 41, 5543-00 Storno code 41, 5542-00

Connector, 8-pin house Pins for connectors

Storno code 41, 5551-00

Trimming tools

The following tables show the frequency ranges of the CQM5550 S12 radiotelephone signals:

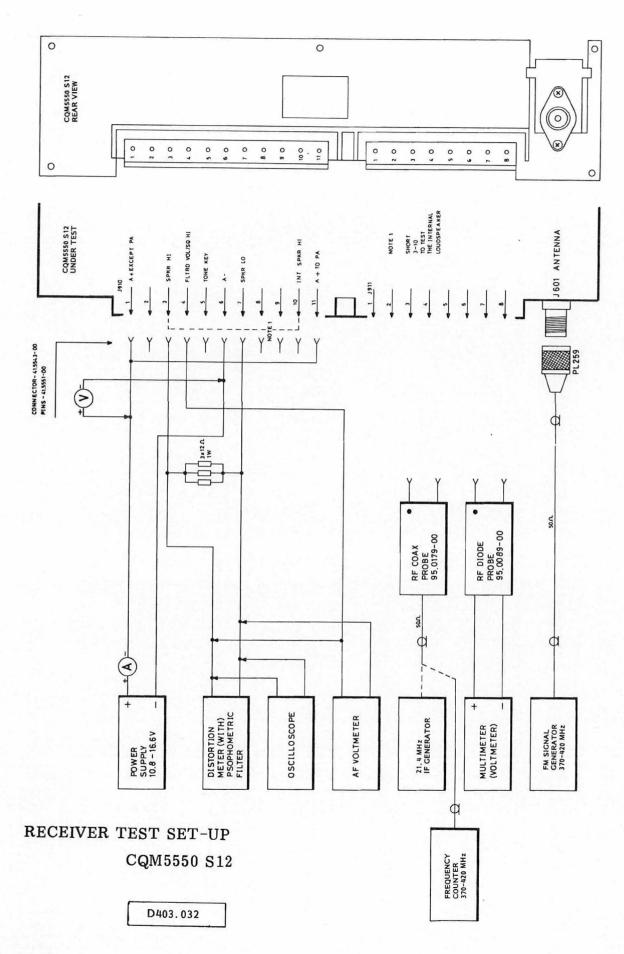
SIGNAL	FREQUENCY MHz
TX VC0	123 - 140
TX crystal	59 - 68
TX crystal multiplication	×2
RX VC0	116 - 132
RX crystal	56 - 64
RX crystal multiplication	×2

Table 1.

Channel	Reference	Min. Divider	Max. Divider input frequency MHz	Reference
spacing	Crystal	input frequency		frequency
kHz	MHz	MHz		kHz
20	6, 8266	1.7066	3.4066	6.666
30 or 25 ¹⁾	5, 8533	2.1333	4.2583	8.333

Table 2

¹⁾ Two steps per channel



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.
Depress the Squelch button.
Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

sistor R636 against the colour code of U602.

Requirement: 8.5 V $\pm\,0.15$ V lf the requirement is not fulfilled check re-

U602 colour code	R636 ohm			
Brown	omit			
Red	270			
Orange	100			
Yellow	47			
Green	22			
Blue	6.8			

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: <50 mV

Repeat the procedure with the power supply adjusted for 10.8 $\,\mathrm{V}$

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and PROM codes.

Mixer crystal output

Connect RF diode probe 95, 0089-00 with mul-

timeter to test point TP701. (1 V range). Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 45 mV ± 15 mV

(corresponding to -10 dBm

to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the multimeter, 10 V range, to test point TP706. The synthesizer's lock signal is accessible at TP706. +8 V DC with very narrow pulses (0.1 u sec) indicates normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "Low". Select the channel whose frequency is closest to the center frequency.

Await locked condition, constant voltage. Adjust C745 for 8 Volts on the multimeter. Connect the multimeter to test point TP703. Adjust C745 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 3.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

 $f = f_X \times 3$ ($f_X = crystal frequency$) Adjust L711 to the calculated frequency.

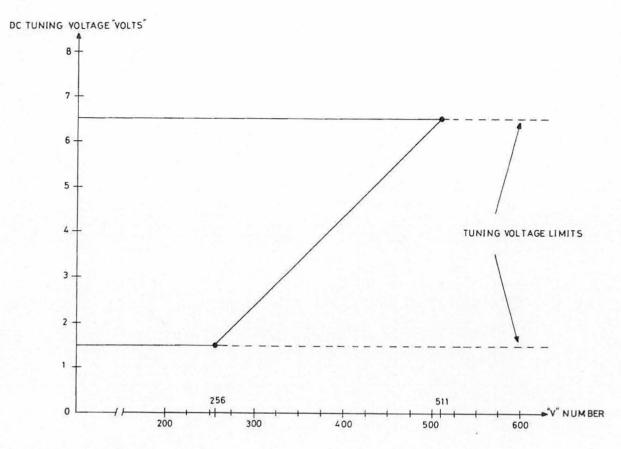


Fig. 1. Tuning voltage vs. V. number.

Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.

Connect the frequency counter to the probe.

Calculate the injection frequency for all channels.

 f_{inj} = f_{ant} -21.4 MHz Select, one by one, the channels and read the injection frequency.

Requirement: Finj ±0.2 ppm

IF AMPLIFIERS

Connect a 21.4 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range). During adjustment the RF generator output

must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i. e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection.

Adjust L401 and L402 for maximum deflection. Detune L406. Adjust L405 and L407 for maximum deflection on the multimeter.

Adjust L406 for maximum deflection.

Readjust L401 and L402 for maximum deflection.

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δf max.

CQM5552 S12

±3 kHz

CQM5553 S12

±2.4 kHz

Connect a 4 ohm/3 W resistor load to connector J910/3-7 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.
Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV.

Read the distortion.

Typical Total Harmonic Distortion (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 <u>noise</u> and <u>distortion</u> increases to 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at 60% Δ f max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industries Association)
Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.)

Requirement: ≤1.0 uV.

The sensitivity should be measured on all

MEASURING 12 dB SINAD (EIA)

channels, if more than one.

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load. Adjust the RF generator to obtain 12 dB SINAD condition. Read the 12 dB SINAD sensitivity. Requirement: \leq 0.4 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI – LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
Type CQM5552 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
Type CQM5553 S12	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 420 - 470 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD <5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

Condition	Current comsumption
Standby	≤400 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	≤750 mA

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

20 W transmitter: 6A 5 W transmitter: 4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.
Turn the power control potentiometer,

R221, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95.0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

40 mV ± 15 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the multimeter, 10 V range, to test point TP706.

The synthesizer's lock signal is accessible at TP706 and +8 V DC with very narrow pulses (0.1 u sec.) indicate normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "LOW".

Select the channel whose frequency is closest to the center frequency. Key the transmitter. Await locked condition.

Adjust C737 for 8 Volts on the multimeter.

Connect the voltmeter to test point TP703. Adjust C737 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 3.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f_x \times 3$ ($f_y = crystal frequency$). Adjust L701 to the calculated frequency. Requirement: f ± 0.3 ppm at 25°C. ppm= parts per million= 10⁻⁶.

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER, COARSE ADJUSTMENT

Connect a multimeter (1.0 V range) to test point TP201.

Adjust L203 for minimum deflection. The dip is small.

Connect the multimeter, (1 V range) to test point TP202.

Adjust L204 for maximum deflection on the multimeter, typical 0.9 V.

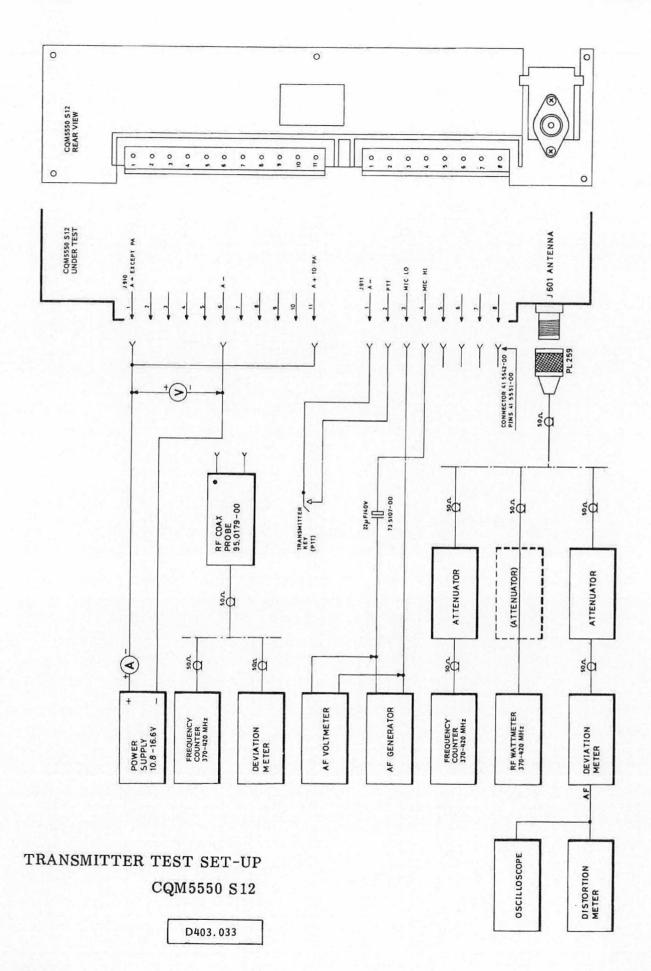
Repeat the adjustments of L203, L153, and L151 (L921-L926) until no further improvements is obtainable.

Adjust C213 for minimum reading. The dip is

Connect the multimeter, 1 volt range, to test point TP203.

Adjust C215 for maximum reading on the multimeter, typical 0.5 V.

Repeat the adjustment of C213 and L204 until no further improvement is obtainable.



Adjust C221 to minimum deflection. The dip is small and careful tuning is required.

Connect the multimeter, 10 volt range, to the RF probe.

Connect RF diode probe 95.0089-00 to TP204. Adjust C221 and C223 for maximum deflection (typical $4.0~\rm V$).

Adjust the PA power control, R215, for rated transmitter power, 5 W or 20 W.

EXCITER, FINE ADJUSTMENT

Connect the multimeter to test point TP201.
Readjust L153 for maximum reading.
Connect the multimeter to test point TP202.
Peak L203 and L204 for maximum reading.
Connect the multimeter to test point TP203.
Peak C213 and C215 for maximum reading.
Connect the 95.0089-00 RF probe and multimeter to TP204.

Adjust C221 and C223 for maximum reading.

TYPICAL TEST POINT READINGS

TP201:	0.5 V
TP202:	0.9 V
TP203:	0.5 V
TP204:	4.0 V

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suit-

able attenuator to the antenna connector J601. Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: $F=F_{ant} \pm 0.2 \text{ ppm}$, $ppm= parts per million= 10^{-6}$

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 13.2 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 20 W or 5 W. Requirement: $P_{nom} \pm 0.2$ dB. Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (20 W):

Voltage	Power	Current
16 V	<25 W (ref)	5.4 A
13.2 V	20 W	5.4 A
10.8 V	≥12 W	5.4 A

Requirements (5 W):

Voltage	Power	Current
16 V	<6.5 W	1.7 A
13.2 V	5 W	1.7 A
10.8 V	≥3.5 W	1.7 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V. Select the channel having the highest frequency. Set R116 to mid-position.

Connect coax probe 95.0179-00 to test point TP701.

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope

to the deviation meter output.

Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to

ensure full limiting in the modulation processor.

Note the deviation read at TP701. Connect the deviation meter to test point

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Connect the deviation meter through an attenuator to the antenna connector, J601,

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect an AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δf max) to ensure full limiting in the modulation processor.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Type	Channel spacing	Δf max
CQM5552 S12	30/25 kHz	±5 kHz
CQM5553 S12	20 kHz	±4 kHz

Requirement

Difference between + and - deviation: <10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5552 S12 : ±3.0 kHz CQM5553 S12 : ±2,4 kHz Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

< 7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 x Δ f max is obtained on the deviation meter.

CQM5552 S12 : ±1.0 kHz

CQM5553 S12 : ±0.8 kHz

Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave charac-

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

ADJUSTMENT OF TONE EQUIPMENT

Measuring equipment

Tone Test Generator

Storno TS-G13

95B0251-00

Check the connections and the tone combination of the TQ5001/TQ5002/TQ5004/TQ5005 and SU/5002; refer to description and diagrams.

Adjustment of frequency deviation

Apply Standard test condition to the transmitter; refer to transmitter test setup.

Establish a shortcircuit between emitter and collector of Q108, on the solder side of the TQ unit, which will produce a continuous tone to the modulator.

Key the transmitter using the tone button.

Adjust R113, TQ5001/TQ5002/TQ5004/TQ5005 for 70% of maximum frequency deviation.

Remove the short circuit.

Connect the G13 Tone Test set to the AF output on the Deviation Meter.

Check that the tone call is properly received when the tone button is depressed.

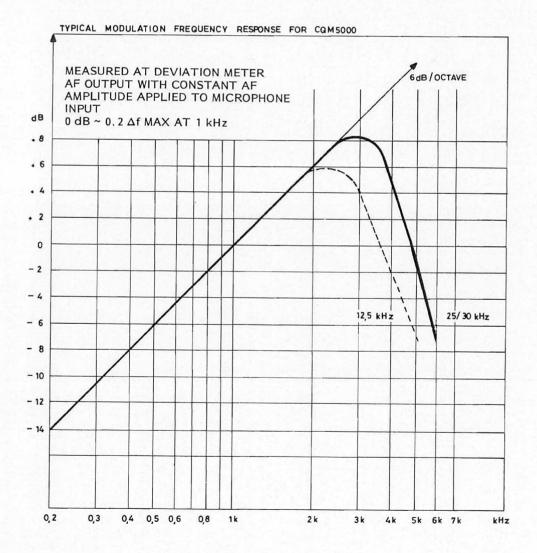
Checking the Tone Receiver

Apply Standard test condition to the receiver; refer to receiver test setup.

Modulate the signal generator with the G13 Tone Test Set.

Set the G13 to the proper tone combination.

Check that the TQ unit responds to a released tone call.



Storno

TECHNICAL SPECIFICATIONS

CQM5550 S99

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

370 MHz - 420 MHz

Channel Separation

CQM5552: 25 kHz

Maximum Frequency Deviation

CQM5552: ±5 kHz

Modulation Frequency Range

300 - 3000 Hz

Maximum RF Bandwidth

RX: 3.0 MHz

TX: 5.5 MHz

Antenna Impedance

50 ohm

Maximum Number of Channels

99

Supply Voltage

Minimum: 10.8 V

Nominal: 13.2 V

Maximum: 16.6 V

Negative potential to chassis

Temperature Range

-30°C to +60°C

Dimensions

B x D x H: 180 x 190 x 60 mm

Weight

1.8 kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f.

0.4 uV (0.3uV)

Measuring conditions:

 $\Delta f \pm 2/3 \times \Delta fmax$; $f_{mod} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f.

1.0 uV (0.7 uV)

 Δ F 60% x Δ fmax; $f_{mod} = 1$ kHz. Measured with psophometric filter.

Crystal Frequency Range

56.85 - 65.6 MHz

Receiver VCO Frequency Range

116 - 132 MHz

Crystal Frequency Multiplication

×2

Frequency Stability

Conforms with government regulations

Modulation Acceptance Bandwidth (EIA)

±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

EIA

75 dB (80 dB)

CEPT

75 dB (80 dB)

Spurious Rejection

EIA

85 dB

Intermodulation Attenuation

EIA

70 dB

CEPT

70 dB (78dB)

Blocking

90 dB/uV (100 dB/uV)

Radiation

Conducted: max. 0.8 nW

Radiated: max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

 Δf = ±3 kHz, 1 kHz, 1 W; RF 1 mV

Audio Frequency Response, CEPT

+1/-3 dB (+0/-1.5 dB)

Relative to 1000 Hz, -6 dB/octave

fm: 300 - 3000 Hz

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Recovery Time

250 ms (200 ms)

Attack Time, EIA

150 ms (110 ms)

Squelch Closing Time, EIA

150 ms (50 ms)

Current Consumption

Squelched: 1000 mA (750 mA)

AF 2 W: 1450 mA (1150 mA)

(13.2 V supply)

TRANSMITTER

RF Power Output

CQM5550-20 W: 20 W

 $R_1 = 50$ ohm

Crystal Frequency Range

60.6 - 69.35 MHz

Crystal Frequency Multiplication

x2

Transmitter VCO Frequency Range

123 - 140 MHz

Frequency Stability

Conforms with government regulations

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

AF Input Impedance

560 ohm

Modulation Sensitivity

90mV ±3 dB

(Δf=±3 kHz, 1 kHz)

Modulation Response (CEPT)

300 - 3000 Hz

+1/-3.0 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

Modulation Distortion, CEPT

fm= 1000 Hz: max. 3%

 $(\Delta f= \pm 3.0 \text{ kHz})$

fm= 300 Hz: max. 5%

FM Hum and Noise, CEPT

55 dB (>57 dB)

(measured with 750 usec de-emphasis)

Attack time

50 ms

Current Consumption

less than 6.2 A (5.5 A)

GENERAL DESCRIPTION

CQM5550 S99

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls keyboard and display.

A comparison of the various models are presented in the table below.

Although compact in size, it contains a transmitter/receiver, a microcomputer controlled synthesizer and tone equipment, optional 5tone sequential encoder/decoder or Channel Guard, and up to 99 transmit and receive channels.

Туре	CQM5552 S99
SPEC	20
Frequency Range MHz	370 - 420
RF Power W	20
Channel Spacing kHz	30/25
Max. Number of Channels	99

ACCESSORIES

Standard	accessories	include:	
----------	-------------	----------	--

Mounting frame Power cable

Fist microphone with retainer or

Fixed - mount microphone

External loudspeaker

External switches

MN5001 Mounting frame for mobile installations allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.

MN703 Desk stand for fixed installations.

MN704a Mounting frame for mobile installations and direct attachment to the vehicle.

MC5001 Fist microphone with retractable spiral cable for mobile installation.

HS5001 Retainer for MC5001.

HS5002 Retainer, with switches, for MC5001

MC704 Microphone with chockabsorbing mounting bracket for mobile installation.

MC703 Desk microphone with PTT switch for fixed installations.

MK5001 Installation kit containing connectors, power cable, fuses and fuseholders.

LS701 Loudspeaker enclosed in a plastic housing, complete with cable.

SU701 Transmitter keying switch for mounting on the steering coloumn.

SU702 Transmitter keying switch for mounting on the dashboard.

PS702 Power supply regulator for 24 V car battery installations.

PS5001 Power supply for 220 V AC mains.

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls, display and keyboard are an integral part of the Control Panel.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded control panel and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB), and the Control Logic (CL) mount in the top section of the chassis.

Thin casted shields with adjustment holes are placed over the RF board and the synthesizer board in order to reduce spurious radiation.

RECEIVER DESCRIPTION

The receiver circuitry is placed on the RF board and can be divided into:

Receiver front end 1st IF section with first and second oscillator 455 kHz 2nd IF portion with demodulator. Squelch Audio Amplifier

(refer to functional block diagram)

FONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET

is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 21.4 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

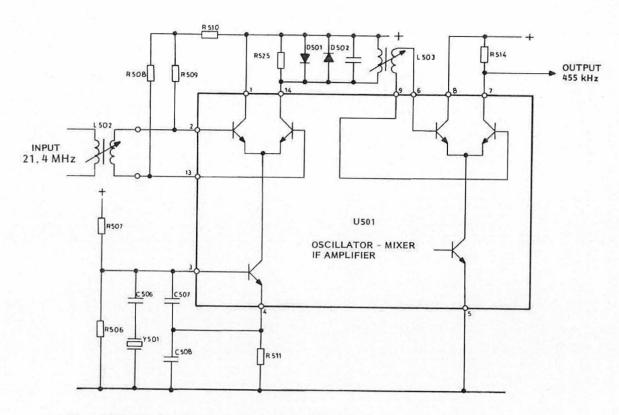


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the guadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the

necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicater is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629-C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel. The audio output amplifier U601 is a monoli-

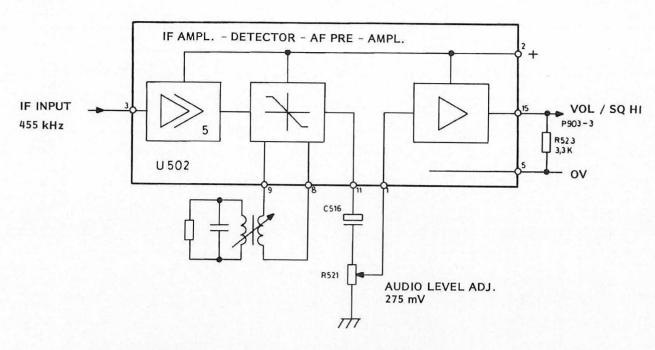


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

thic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not. These inputs are:

> Regulated TX Voltage Squelch cancel Squelch signal

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the RF board along with the receiver.

The exciter contains, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier

boosts the signal to the proper level, and includes a low pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the FS board is applied to amplifier U101b.

The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV. BAL. potentiometer on the FS board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the VCO on the Frequency Synthesizer board.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter. The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3: 1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is based by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

FREQUENCY SYNTHESIZER AND CONTROL LOGIC

The frequency synthesizer FS5551 provides up to 99 channels and is built on a printed wiring board which mounts in the top section of the radioset.

The frequency of the synthesizer board is set by a binary code from the control logic board CL5001 which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through P903 – J903 to the RF board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections S602. The other

section of the ON/OFF switch controls the V_B + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

The squelch circuit, the modulation processor, parts of the IF amplifier U502, and the Frequency Synthesizer is supplied directly from the continuous 8.5 V.

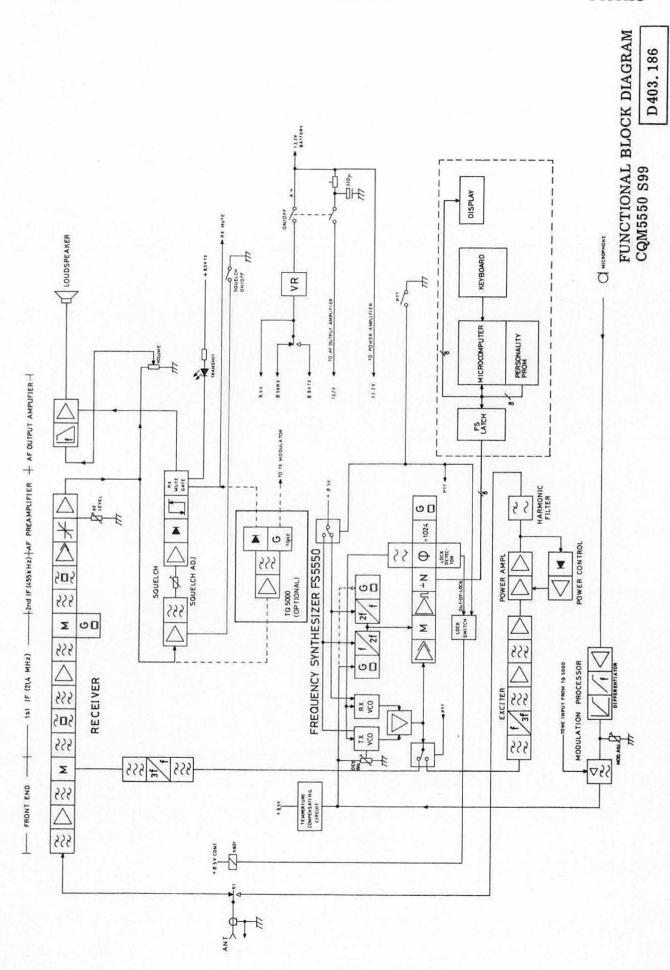
The receiver front-end, the 21.4 MHz IF sta-

ges and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



Storno

CHANNEL PROGRAMMING INSTRUCTIONS

CQM5550 S99

Programming of the PROM which contains the personality data will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19)
Programming Pak, interchangeable
Socket adaptor
or universal programming pack.
DATA I/O UNIPAK (adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the prom data.

It is also possible to use a computer to calculate the prom data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

After completing the worksheet, enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.



RECOMMENDED CRYSTAL FREQUENCIES CQM5550 S99

CQM5552	CQM5553	RX CRYSTAL
FREQUENCY RANGE	FREQUENCY RANGE	MHz
368.9 - 375.275	367.62 - 372.72	56.85
371.4 - 377.775	370. 12 - 375. 22	57.266666
373.9 - 380.275	372.62 - 377.72	57.683333
376.4 - 382.775	375. 12 - 380. 22	58.1
378.9 - 385.275	377.62 - 382.72	58. 516666
381.4 - 387.775	380.12 - 385.22	58.933333
383.9 - 390.275	382.62 - 387.72	59.35
386.4 - 392.775	385. 12 - 398. 22	59.766666
388.9 - 395.275	387.62 - 392.72	60.183333
391.4 - 397.775	390. 12 - 395. 22	60.6
393.9 - 400.275	392.62 - 397.72	61.016666
396.4 - 402.775	395. 12 - 400. 22	61.433333
398.9 - 405.275	397.62 - 402.72	61.85
401.4 - 407.775	400.12 - 405.22	62.26666
403.9 - 410.275	402.62 - 407.72	62.683333
406.4 - 412.775	405. 12 - 410. 22	63.1
408.9 - 415.275	407.62 - 412.72	63.516666
411.4 - 417.775	410.12 - 415.22	63.933333
413.9 - 420.275	412.62 - 417.72	64.35
416.4 - 422.775	415. 12 - 420. 22	64.76666
418.9 - 425.275	417.62 - 422.72	65. 183333
421.4 - 427.775	420.12 - 425.22	65.6

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5550 S99

CQM5552	CQM5553	TX CRYSTAL
FREQUENCY RANGE	FREQUENCY RANGE	MHz
370 376.375	368.72 - 373.82	60.6
372.5 - 378.875	371.22 - 376.32	61.016666
375 381.375	373.72 - 378.82	61. 433333
377.5 - 383.875	376.22 - 381.32	61.85
380 386.375	378.72 - 383.82	62.266666
382.5 - 388.875	381.22 - 386.32	62.683333
385 391.375	383.72 - 388.82	63.1
387.5 - 393.875	386.22 - 391.32	63.516666
390 396.375	388.72 - 393.82	63.933333
392.5 - 398.875	391.22 - 396.32	64.35
395 401.375	393.72 - 398.82	64.766666
397.5 - 403.875	396.22 - 401.32	65. 183333
400 406.375	398.72 - 403.82	65.6
402.5 - 408.875	401.22 - 406.32	66.016666
405 411.375	403.72 - 408.82	66. 433333
407.5 - 413.875	406.22 - 411.32	66.85
410 416.375	408.72 - 413.82	67. 266666
412.5 - 418.875	411.22 - 416.32	67. 683333
415 421.375	413.72 - 418.82	68. 1
417.5 - 423.875	416.22 - 421.32	68.516666
420 426.375	418.72 - 423.82	68. 933333
	421.22 - 426.32	69.35

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY



SELFQUIETING FREQUENCIES CQM5552 S99

RECEIVER CRYSTAL	V	USE
FREQUENCY MHz	DEC	ALTERNATIVE [†]
56.850	321	4
56.850	366	4
60.183	404	2
60.600	304	2
63. 100	384	4
63.516	469	4
63.933	369	4
63.933	415	4
63.933	424	4
64.350	269	4
64.350	278	4
64.350	324	4
64.350	428	4
64. 766	428	4
65. 183	428	4
65.600	428	4

TABLE 3A. SELFQUIETING FREQUENCIES

⁺refer to worksheet

SELFQUIETING FREQUENCIES CQM5553 S99

RECEIVER CRYSTAL	V	USE
FREQUENCY, MHz	DEC	ALTERNATIVE 1
56.850	458	4
60. 183	505	4
60.600	380	4
60.600	426	4
61.016	301	4
61.850	375	4
63.933	473	4
64.350	348	4
64.350	394	4
64.350	405	4
64.766	269	4
64.766	280	4

TABLE 3B. SELFQUIETING FREQUENCIES

⁺refer to worksheet

HEX CODE CONVERSION TABLE

			7	m	4	2	9	,	œ	ת	V	ω	U	Ω	щ	ш.
0	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271
-	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
7	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
m	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
4	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
2	336	337	338	339	340	341	345	343	344	345	346	347	348	349	350	351
9	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
/	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
œ	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
6	004	401	402	403	404	405	904	407	408	604	410	411	412	413	414	415
V	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
В	432	433	434	435	436	437	438	439	0440	441	442	443	444	445	944	447
O	844	644	450	451	452	453	454	455	456	457	458	459	460	461	462	463
Q	11917	465	994	467	894	691	470	471	472	473	474	475	924	477	478	479
ш	084	481	482	483	484	485	984	487	488	489	490	491	492	493	464	495
ш	964	497	498	664	200	501	502	503	504	505	909	207	208	509	510	511

Example "VDEC"= 345 equals to hex code 59.

"VDEC"= 469 equals to hex code D5.

-MSD

Table 4. "V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

PROGRAMMING WORKSHEET

FOR CQM5550 S99

		RECEIVED	VED									г
		NECE.	VEN						TRANSMITTER	AITTER		_
CHAN-	A FREQUENCY	د	>	>	PROM	B FREQUENCY	ζζ	۔	>	>	PROM	
NEL	MHz	I	DEC	HEX	ADDRESS (HEX)	MHz			DEC	HEX	ADDRESS (HEX)	-
-												_
2												_
3												_
4												_
5												_
9												-
7												_
80		A										-
6												_
10												_
11												-
12				0 0								_
RECEIVE	RECEIVER MIXER CRYSTAL FREQ. (Y702): C=	REQ. (Y	′702): C=			TRANSMITTER MIXER CRYSTAL FREQ. (Y701) D=	ER MIXER	CRYST	AL FRE	Q. (Y701	1) D=	
FORMULA:	ULA: V _{DEC} = (A	- 21.	4) - (C × 6) 3 × F	(9)		F	FORMULA:	V _{DEC} =	8	- (D × 6) 3 × F	(9) F	
		CHANNEL SPACING:	ING:	R C R	REFERENCE CRYSTAL (Y703):	REFE	REFERENCE FREQUENCY:					
		20 KH 25 KH	20 kHz 25 kHz		6.8263 MHz 8.5333 MHz	F= 0.006666 F= 0.008333	F= 0.006666 F= 0.008333					
	LIST OF	FREFER	ENCE CR	LIST OF REFERENCE CRYSTALS (Y703)	(Y703)	ALTERNA	TIVE SOL	UTIONS	IF THE	RECEIV	ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:	
	MODE Standard 5552	ш	FREQUENCY, MHz	5Y, MHz	PART No.	1. SELEC	CT ANOTH	HER RX	MIXER	CRYSTA	SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY	
	Standard 5553		6. 826666	999	19J706361P4		= 21.85500	MHZ IN	ON FRE	OF 20.9	SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 21.85500 MHz INSTEAD OF 20.94500 MHz	
						3. USE 9	USE SLIGHTLY OFFSET REFERENCE CRYSTAL WEAK QUIETING; NO ALTERNATIVE REQUIRED	G; NO A	T REFE	RENCE C	RYSTAL	
-						1						_

Stormo Stormo

ADJUSTMENT PROCEDURE

CQM5550 S99

This adjustment procedure applies to the following radiotelephone types:

CQM5552: 30/25 kHz Channel spacing CQM5553: 20 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter $R_{in} \ge 1$ Mohm

AC Voltmeter Z_{in} >1 Mohm//50 pF $R_i \ge 20 \text{ Kohm/Volt}$ Multimeter Distortion meter e.g. Storno E11c

RF Watt meter 25 W/50 ohm/370-420 MHz

370-420 MHz Deviation meter

Z_{out}= 50 ohm; 370-420 MHz RF generator

21.4 MHz signal e.g. Storno TS-G21B

generator

Frequency counter with attenuator

Z_{in} = 50 ohm; sensitivity

100 mV at 420 MHz

RF diode probe

Storno 95.0089-00

RF coaxial probe DC power supply Storno 95.0179-00

Oscilloscope

10.8 V - 16.6 V; 6A

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026-00

22 uF/40 V electrolytic

capacitor

Storno code 73, 5107-00

Connector, 11-pin house Connector, 8-pin house

Storno code 41,5543-00 Storno code 41, 5542-00

Pins for connectors

Storno code 41, 5551-00

Trimming tools

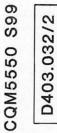
The following tables show the frequency ranges of the CQM5550 S12 radiotelephone signals:

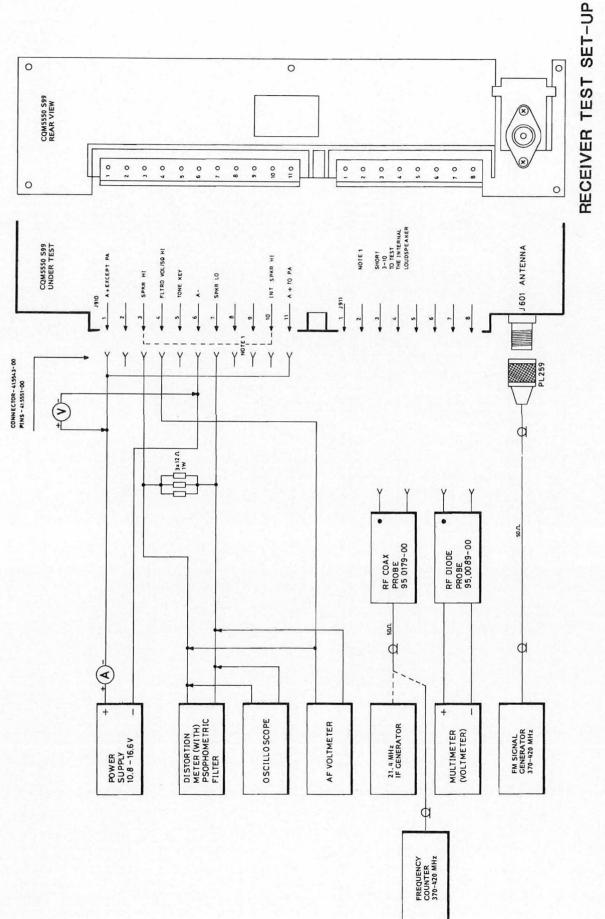
SIGNAL	FREQUENCY MHz	
TX VCO	123 - 140	
TX crystal	60 - 69	
TX crystal multiplication	×2	
RX VCO	116 - 132	
RX crystal	56 - 65	
RX crystal multiplication	×2	

Table 1.

Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	kHz
20	6. 8263	1.7066	3.4066	6.666
30 or 25 ¹⁾	8. 5333	2.1333	4.2583	8.333

1) Two steps per channel Table 2





RECEIVER ADJUSTMENT

CHECKING 8,5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ±0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code R636 ohm

Brown	omit
Red	270
Orange	100
Yellow	47
Green	22
Blue	6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: ≤50 mV

Repeat the procedure with the power supply adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and PROM codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: $45 \text{ mV} \pm 15 \text{ mV}$ (corresponding to -10 dBm to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the multimeter, 10 V range, to test point TP706. The synthesizer's lock signal is accessible at TP706. +8 V DC with very narrow pulses (0.1 u sec) indicates normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "Low". Select the channel whose frequency is closest to the center frequency.

Await locked condition, constant voltage. Adjust C745 for 8 Volts on the multimeter. Connect the multimeter to test point TP703. Adjust C745 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 3.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

 $f = f_x \times 2$ ($f_x = crystal frequency$)

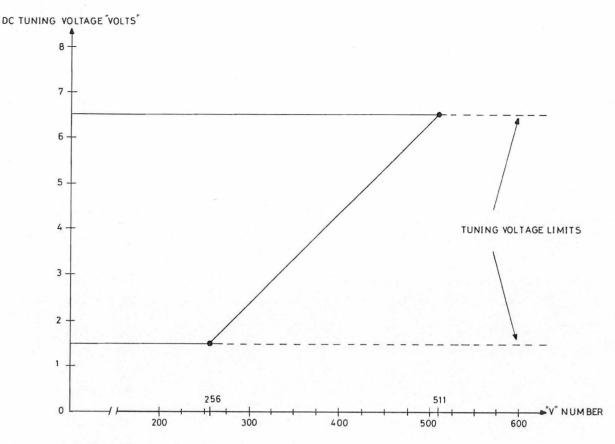


Fig. 1. Tuning voltage vs. V. number.

Adjust L711 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.

Connect the frequency counter to the probe. Calculate the injection frequency for all channels.

 $f_{inj} = f_{ant}^{-21.4} \text{ MHz}$ Select, one by one, the channels and read

Requirement: Finj ±0.2 ppm

the injection frequency.

IF AMPLIFIERS

Connect a 21.4 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95, 0089-00 with multimeter to test point TP501. (50 uA range). During adjustment the RF generator output must be kept low enough to prevent limiting

in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L406. Adjust L405 and L407 for maximum deflection on the multimeter.

Adjust L406 for maximum deflection.

Readjust L401 and L402 for maximum deflection.

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δf max.

CQM5552 S12/S99

±3 kHz

CQM5553 S12/S99

±2.4 kHz

Connect a 4 ohm/3 W resistor load to connector J910/3-7 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up. Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load,

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV.

Read the distortion.

Typical Total Harmonic Distortion (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

The purpose of the measurement is to define

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,

the ratio of one condition to another.

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 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at 60% Δ f max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industries Association)
Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.)

Requirement: ≤1.0 uV.

The sensitivity should be measured on all channels, if more than one.

MEASURING 12 dB SINAD (EIA)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load.

Adjust the RF generator to obtain 12 dB SINAD condition.

Read the 12 dB SINAD sensitivity.

Requirement: <0.4 uV (½ e.m.f.)

The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI - LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
CQM5552 S12/S99	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
CQM5553 S12/S99	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 420 - 470 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB. Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.
Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD <5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

CURRENT CONSUMPTION

CONDITION	S12	S99
Standby	≤350 mA	≤1000 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	≤750 mA	≤1450 mA

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

20 W transmitter: 7 A 5 W transmitter: 4 A

Refer to Receiver Alignment for measuring 8.5 V regulated supply. Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95,0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

40 mV ± 15 mV (corresponding to -10 dBm to -4 dBm)

Note: Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the multimeter, 10 V range, to test point TP706.

The synthesizer's lock signal is accessible at TP706 and +8 V DC with very narrow pulses (0.1 u sec.) indicate normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "LOW".

Select the channel whose frequency is closest to the center frequency. Key the transmitter. Await locked condition.

Adjust C737 for 8 Volts on the multimeter. Connect the voltmeter to test point TP703. Adjust C737 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 3.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP702.

Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f_{\times} \times 2$ ($f_{\times} = \text{crystal frequency}$). Adjust L701 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6} .

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER, COARSE ADJUSTMENT

Connect a multimeter (1.0 V range) to test point TP201.

Adjust L203 for minimum deflection. The dip is small

Connect the multimeter, (1 V range) to test point TP202.

Adjust L204 for maximum deflection on the multimeter, typical 0.9 $\,\mathrm{V}_{\cdot}$

Repeat the adjustments of L203, L153, and L151 (L921-L926) until no further improvements is obtainable.

Adjust C213 for minimum reading. The dip is small.

Connect the multimeter, 1 volt range, to test point TP203.

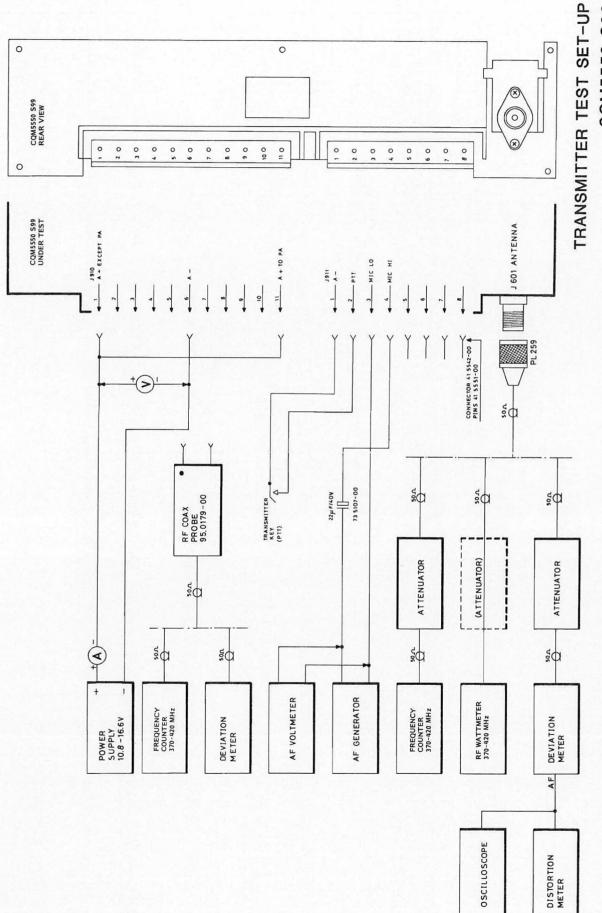
Adjust C215 for maximum reading on the multimeter, typical 0.5 V.

Repeat the adjustment of C213 and L204 until no further improvement is obtainable.

Adjust C221 to minimum deflection. The dip is small and careful tuning is required.

Connect the multimeter, 10 volt range, to the RF probe.

CQM5550 S99 D403.033/2



Connect RF diode probe 95.0089-00 to TP204. Adjust C221 and C223 for maximum deflection (typical 4.0 V).

Adjust the PA power control, R215, for rated transmitter power, 5 W or 20 W.

EXCITER, FINE ADJUSTMENT

Connect the multimeter to test point TP201.
Readjust L153 for maximum reading.
Connect the multimeter to test point TP202.
Peak L203 and L204 for maximum reading.
Connect the multimeter to test point TP203.
Peak C213 and C215 for maximum reading.
Connect the 95.0089-00 RF probe and multimeter to TP204.
Adjust C221 and C223 for maximum reading.

TYPICAL TEST POINT READINGS

TP201:	0.5 V
TP202:	0.9 V
TP203:	0.5 V
TP204:	4.0 V

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601. Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: $F = F_{ant} \pm 0.2 \text{ ppm}$, $ppm = parts \text{ per million} = 10^{-6}$

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 13.2 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 20 W or 5 W.

Requirement: P_{nom} ±0.2 dB.

Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (20 W):

		S12	S99
Voltage	Power	Current	Current
16 V	<25 W (ref)	≤5.4 A	<6.1 A
13,2 V	20 W	≤5.4 A	≤6.1 A
10.8 V	≥12 W	≤5.4 A	<6.1 A

Requirements (5 W):

		S12	S99
Voltage	Power	Current	Current
16 V	<6.5 W (ref)	≤1.7 A	≤2.4 A
13.2 V	5 W	≤1.7 A	<2.4 A
10.8 V	≥3.5 W	≤1.7 A	<2.4 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V.
Select the channel having the highest frequency. Set R116 to mid-position.
Connect coax probe 95.0179-00 to test point TP701.

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s.

This voltage is approx. 20 dB above the nominal modulation input level (60% Δf max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Disconnect the deviation meter from the coaxprobe and connect it through an attenuator to the antenna connector, J601.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Type	Channel spacing	Δf max
CQM 5552	30/25 kHz	±5 kHz
CQM 5553	20 kHz	±4 kHz

Requirement

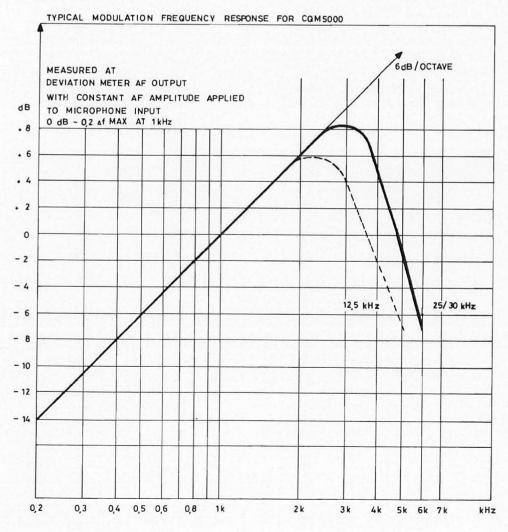
Difference between + and - deviation: ≤10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5552 : ±3.0 kHz CQM5553 : ±2.4 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.



Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

<7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 x Δ f max is obtained on the deviation meter.

CQM5552: ±1.0 kHz CQM5553: ±0.8 kHz Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

Storno

CHANNEL FREQUENCY SYNTHESIZER

FS5551 and FS5552

The frequency synthesizer generates up to 12 channel frequencies for a STORNOPHONE 5000 operating in the 370 - 420 MHz band. It is built on a printed circuit board which mounts in the top section of the radio set. There are two versions of the board, a single channel board, FS5551 and a multichannel board FS5552. The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board channels are selected with a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the board and protrudes through the front panel, and the Frequency Control module FC5001, fits into the cast shield which is placed over the main section of the synthesizer board.

A metal shield is placed underneath the oscillator and mixer sections of the board. All circuitry can be accessed and operated for repair and maintenance without the shields and with the FC5001 in its socket.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module and has two connectors at the rear for accessories and power supply cables.

The channel programming is contained in a 256 bit PROM placed in a socket on the Frequency Control module. The PROM can be field programmed if the necessary programming equipment is available. Programming equipment and procedures must be approved by STORNO and the PROM manufacturer, refer to the Channel Programming Instructions.

CIRCUIT DESCRIPTION

The Frequency Synthesizer generates the local oscillator injection for the receiver and a modulated exciter signal for the transmitter. The circuit is a single-loop phase-locked frequency generator.

The synthesizer frequency is controlled by three crystals, one reference crystal and two mixer crystals, and by a PROM.

The synthesizer can be reprogrammed for new frequencies if these are within the maximum frequency spread of the STORNOPHONE 5000.

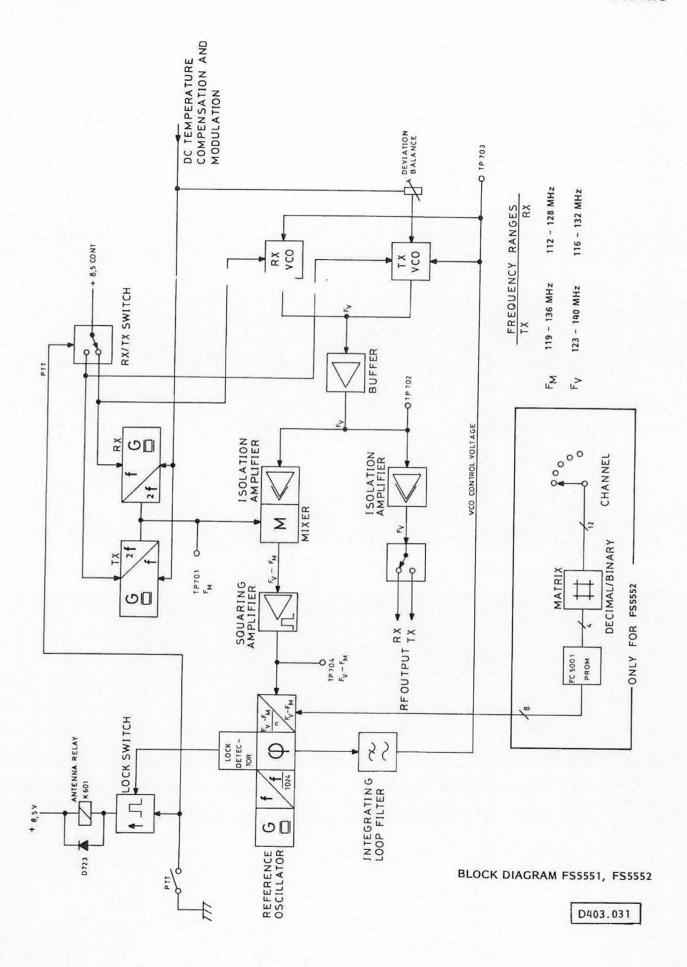
Two voltage controlled oscillators (VCO) are generating the signals which are used as injection for the receiver mixer and excitation signal for the transmitter. The frequency of

each VCO can be preset to any frequency within the band by a variable capacitor, and the fine adjustment is controlled by a variable capacitance diode, varicap, and the phase detector output. The control voltage for the varicaps is filtered in a loop integrating filter. The TX VCO has an additional varicap which is used to modulate the transmitter.

The Push-to-talk switch controls a transistor switch, which switches the supply voltage between the RX VCO and the TX VCO.

The output signal from the VCO's are fed into a buffer amplifier which protects the VCO from load changes.

The buffer amplifier's output is applied to an



isolation amplifier and a diode switch before entering the RF board.

The buffer amplifier also connects to another isolation amplifier via a resistive attenuator and feeds the signal to the synthesizer mixer.

The synthesizer mixer mixes the VCO signal and the crystal oscillator signal to a frequency which is within the dividing capability of the programable divider.

Separate crystal oscillators are used in the receive and transmit mode, respectively, and they are both third mode oscillators.

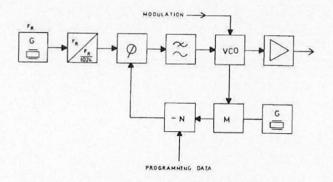


Fig. 2. Phase Locked loop PRINCIPLE

A temperature compensating voltage is applied to the crystal oscillators only in the 5 p.p.m. version. This voltage is kept constant in the 10 p.p.m. version by cutting a diode on the RF board.

The output from the synthesizer mixer is fed to a squaring amplifier which drives the programable divider and this divides the frequency by 256 to 511 depending on the logic levels on the 8-bit binary control input. The input frequency range for the divider differs according to the channel spacing and is shown in fig. 3.

The phase detector produces a waveform with variable duty cycle which depends on the phase and frequency difference between its two input signals. The operating frequency range of the phase detector is 1.7 kHz to 3.5 kHz and it depends on the channel spacing.

The reference frequency is generated in a crystal oscillator whose output is divided by 1024 and applied to the phase detector.

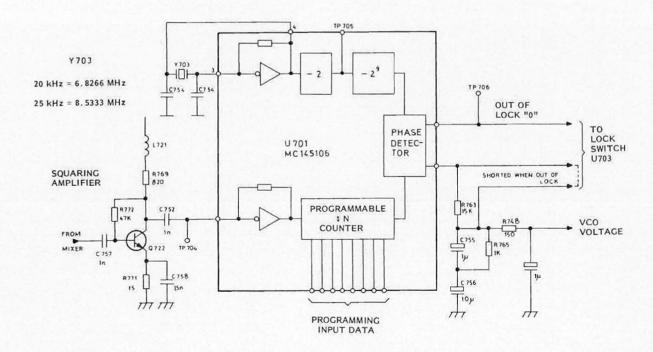
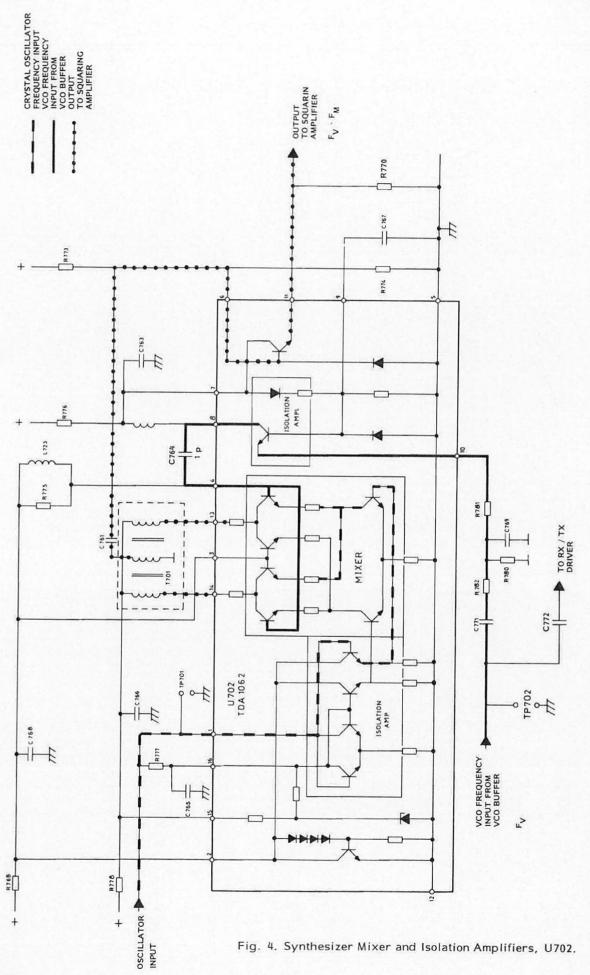


Fig. 3. REFERENCE OSCILLATOR, DIVIDER, AND PHASE DETECTOR



The output from the phase detector passes through a passive integrating filter which produces a DC voltage proportional to the duty cycle of the phase detector output. This voltage adjusts the frequency of the VCO.

An out-of-lock circuit inhibits the transmitter when the synthesizer loop is out of lock and hunting for the frequency.

The transmitter modulation is applied simultaneously to the transmitter mixer-oscillator and the VCO. The modulation bandwidth also covers sub-audio frequencies used for channel guard (pilot tones). The frequency deviation balance adjustment equalizes the deviation on both oscillators to ascertain low distortion and low noise reference side bands during modulation of the synthesizer because it is operating with a relatively large loop bandwidth.

The frequency control module, FC5001, is built on a separate wiring board which mount on top of the synthesizer shield. This module converts the BCD-code (4 bits) from the channel selector to an 8-bit binary code for the programmable divides in the synthesizer loop. These 8-bit codes are programmed into a PROM (Programmable Read Only Memory) and are dividing factors expressed in hexadecimal codes.

On the FC5001 is a 5-Volt regulator which supply the voltage for the PROM. When the PTT button is pushed the transistor Q801 converts the PTT voltage level to TTL level and puts a logic "0" on the MSB (Most Significant Bit) on the address input of the PROM. This selects the PROM code for the corresponding transmitter channel. The PROM outputs have open collectors with external pull-up resistors.

TECHNICAL SPECIFICATIONS

Supply Voltage

+8.5 Volts regulated

+13.2 Volts unregulated

Current Consumption

max. 80 mA (+8,5 V)

max. 200 mA (+13, 2 V)

Channel Spacing

30/25 kHz

20 kHz

15/30 kHz

Modulation Input

0.75 V r.m.s. ±2 dB

 $\Delta f = 60\% f_{\text{mod}} = 1 \text{ kHz}$

Modulation Bandwidth

70 - 3000 Hz

Modulation Distortion

70 - 300 Hz: <5%

1 kHz:

<48

DC Temperature Stabilization Voltage

25°C= 6 V ± 10% (reference)

 -30° C= +350 mV ± 10%

 -10° C= -50 mV ± 10%

 $+60^{\circ}$ C= +50 mV $\pm 10\%$

The voltage characteristic is approximately linear between these points.

RF Output Level

4 mW ± 1 mW

(open collector output connected to tuned circuit)

TX Output Frequency Range

370 - 420 MHz (VCO)

RX Output Frequency Range

116 - 132 MHz (VCO)

Frequency Stability

5 p.p.m. or 10 p.p.m.

Reference Crystal Frequency

20 kHz: 10.240 MHz

12.5/25 kHz: 12.800 MHz

Signal-to-Noise Ratio (S/N)

>100 dB

 $\Delta f= 25 \text{ kHz}$, BW (Bandwidth) = 10 kHz

Spurious Attenuation

>85 dB

Lock Time

<30 m sec.

for 1 MHz step

Logic Control Level

LOW= <2 V

HIGH= >6 V

8 bit binary positive logic with built-in pull

down resistors, I_{in} = 175 uA per bit.

Temperature range

-30°C to +60°C

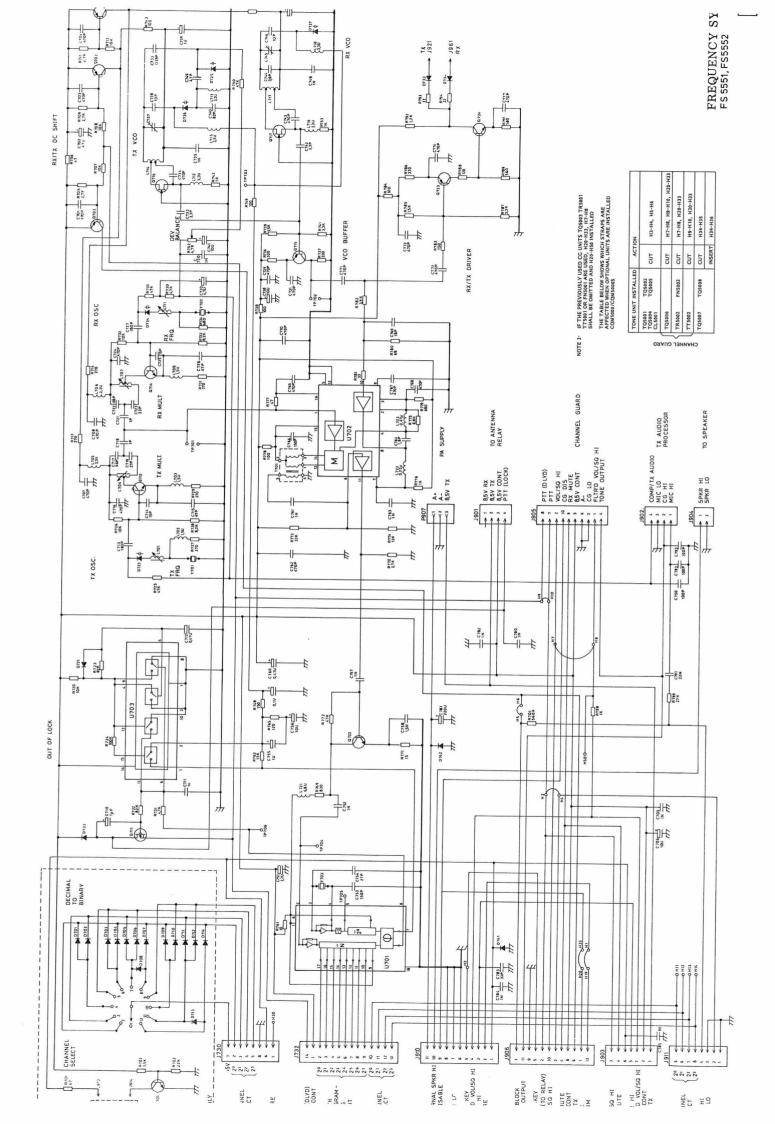
Dimensions

135 x 190 x 45 mm (BxDxH)

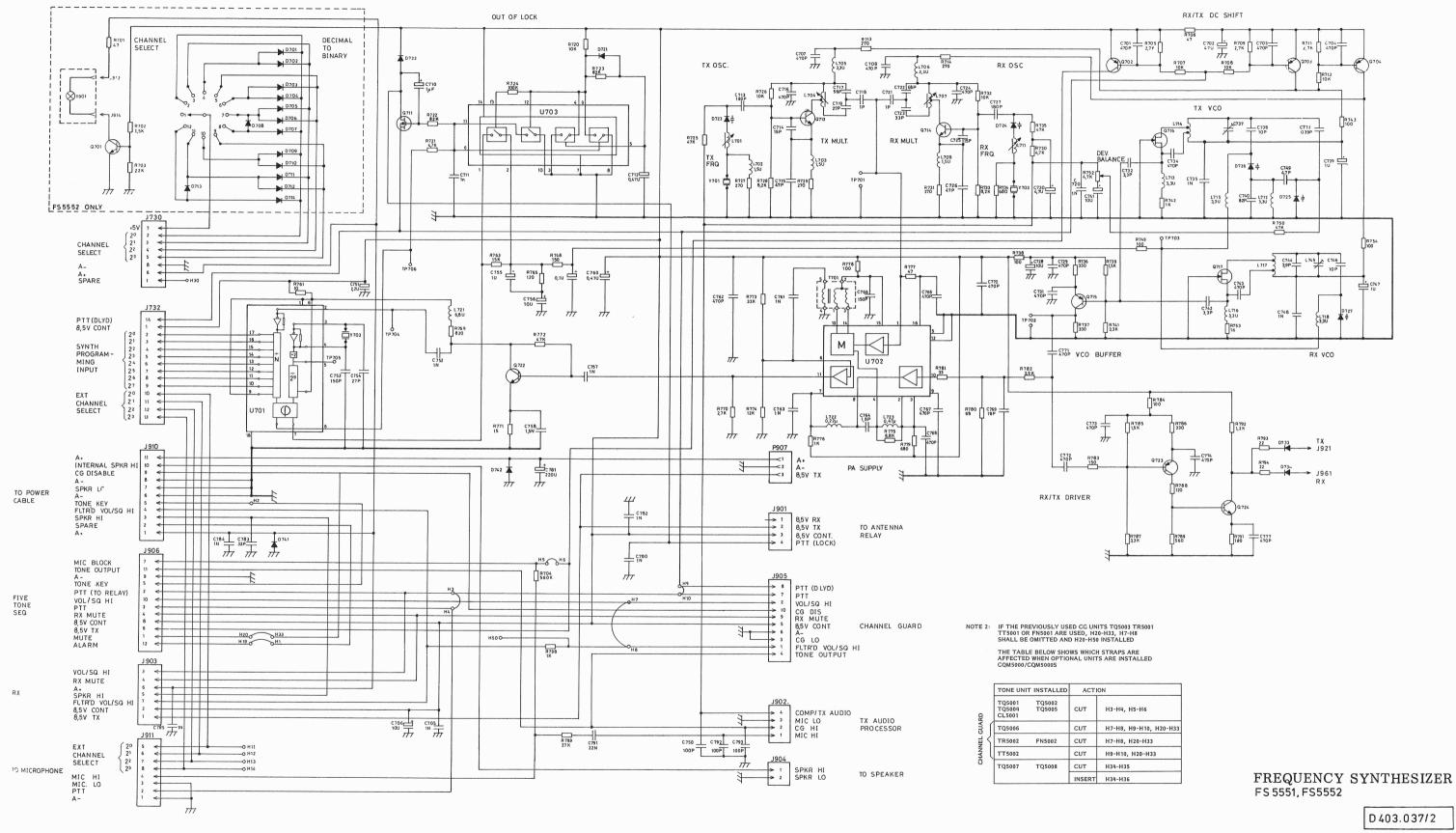
Weight

PC board: 150 g

Shield: 75 g



Storno



o N	CODE	ATAG	
		2120	
C701	19A700233P5	470 of Capacitor Ceramic	. 03
C702	19J706005P3		20.0
C703	19A 700233P5	470 pF Capacitor Ceramic	
C704	19A700233P5	470 pF Capacitor Ceramic	> 05
C705	19A700233P7	1 nF Capacitor Ceramic	20 < >
C706	19A700003P7	10 uF Capacitor Tantalum	16 V
C707	19A700233P5	470 pF Capacitor Ceramic	
C708	19A 700233P5	470 pF Capacitor Ceramic	50 V
577	19A 700003P1	0.1 uF Capacitor Tantalum	
C/12	19A700003P5	2.2 uF Capacitor Tantalum	
C/13	19A700235P28	180 pF Capacitor Ceramic	50 V
C/14	19J706256P201	15 pF N1500 Capacitor Ceramic	
C/15	19J 706256P204	47 pF N1500 Capacitor Ceramic	
C/16	19A700233P5	470 pF Capacitor Ceramic	50 V
C/17	19A700235P22	56 pF Capacitor Ceramic	50 V
6/18	19A700235P7	3.3 pF Capacitor Ceramic	20 \
C719	19A700235P18	27 pF Capacitor Ceramic	
C720	19A700233P7		
C721	19A700235P7	U	
C722	19A700235P23		50 V
C723	19A700235P19		50 V
C724	19A700233P5		20 \
C725	19J706256P201		
C726	19J706256P204	amic	50 V
C727	19A700235P28		50 V
C728	19A 700003P7		16 V
C729	19A700233P5		50 V
C730	19A700003P6	_	35 V
C731	19A700233P5		50 V
C732	19A700235P7	3.3 pF Capacitor Ceramic	50 V
C733	19A700013P8		200 V
C734	19A700233P5		50 V
C735	19A700233P7		50 V
C737	19J706003P1	1.8-10 pF Capacitor Variable	
C/38	19A700235P13		50 V
C/39	19A700003P4		35 V
C/40	19A700235P7		
C/41	19A700003P7		16 V
C742	19A700235P7	Capacitor Ceramic	
C743	19A700233P5		20 V
C744	19A 700235P8	Capacitor Ceramic	20 V
C745	19J706003P2	2-18 pF Capacitor Variable	
07.46	19A 700235P13		20 V
C/47	19A 700003P4	_	
01/18	19A /00233P7	- Capacitor Ceramic	20 V
61/1	19A / 00235P9	4.7 pF Capacitor Ceramic	20 V

0	_			-					_																			_														
Storno		50 V	> 55	> 00	> 00 10	> 00	35 V	35 V	50 V	20 N	35 V	35 V	20 N	50 V	50 V	20 V	50 V	20 N	20 N	50 V	20 V	20 N	20 \	20 \	20 \	50 V	20 V	20 V	50 V	16 V	50 V	20 \	20 N	50 V	100 V	50 V	50 V					
	DATA	100 pF Capacitor Ceramic	1 nF Capacitor Commis	150 DE Capacitor Coramic	27 DE Capacitor Coramio	1 of Capacitor Test	10 Capacitor lantalum	10 ur Capacitor Tantalum	1 nF Capacitor Ceramic	1.5 nF Capacitor Ceramic	1 uF Capacitor Tantalum	0.47 uF Capacitor Tantalum	1 nF Capacitor Ceramic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	Capacitor		470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	18 pF Capacitor Ceramic	Capacitor	oF Capacitor	HC.	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	10 pF Capacitor Ceramic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	220 uF Capacitor Electrolytic	1 nF Capacitor Ceramic	33 pr Capacitor Ceramic	1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	22 nF Capacitor Polyester	100 pF Capacitor Ceramic	100 pF Capacitor Ceramic	1N4148 Diode Silicon	1N4148 Diode Silicon	Variable Cap. Diode	Variable Cap. Diode	
	CODE	19A700233P1	19A700233P7	19A700233P2	19A700235P18	19A700003P4	10000001001	194 1990 197	19A/00233P/	19A / 00233P8	19A /00003P4	19A 700003P3	19A /00233P7	19A 700233P5	19A /00233P7	19A 700235P4	19A 700233P5	19A 700233P5	19A 700233P5	19A /00233P5	19A / 00235P16	19A /00233P5	19A /00233P5	194/00233P5	19A 700233P5	19A700233P5	19A700235P13	19A700233P5	19A700233P7	193 / 06005 PS	19A 700233P7	194700235F19	19A /00233P7	19A /00233P7	19J 706261P1	19A700233P1	19A700233P1	19A 700028P1	19A700028P1	19A706262P1	19J 706262P1	
	Oi N	C750 C751	C752	C753	C754	C755	0256	777	010	01128	(138	C/60	(76)	79/5	(763	0,164	C/65	7/66	(/6/	7,68	(1/69	0//0	112	0117	0773	0717	C//6	7/10	C/80	C/81	C/87	2000	0,784	(782	C/91	C/92	C793	D721	D722	D723	D724	

FREQUENCY SYNTHESIZER FS5551

X403.047

Page 1 of 3

	8 pin 14 pin 4 pin 7 pin 10 pin 12 pin 11 pos 8 pin pin pin
DATA	Cap. Diode Cap. Diode Cap. Diode Licon Licon
	BB409 Variable Cap. BB409 Variable Cap. BB409 Variable Cap. BA282 Diode 1N5401 Diode Silicon 1N5401 Diode Silicon Male Connector Male Connect
CODE	19A700073P1 19A700073P1 19A700073P1 19J706006P2 19J706006P2 19J706026P1 19J706026P1 19J706021P1 19J706214P4 19J706214P4 19J706214P1 19J706213P11 19J706213P1 19J706213P1 19J706213P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70622P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J706283P1 19J706283P1 19J706283P1
o N	D725 D725 D726 D727 D733 D733 D734 D741 J902 J902 J906 J906 J906 J906 J907 J907 J907 J907 J907 J907 J907 J907

6					
Storno		25 25 25 25 25		222222222222222222222222222222222222222	
DATA	2N5245 Transistor 2N5245 Transistor BF357S Transistor BF414 Transistor BF357S Transistor	560 ohm Resistor Depos. 2.7 Kohm Resistor Depos. 47 ohm Resistor Depos. 10 Kohm Resistor Depos. 10 Kohm Resistor Depos.	2.7 Kohm Resistor Depos. 2.7 Kohm Resistor Depos. 10 Kohm Resistor Depos. 22 ohm Resistor Depos. 22 ohm Resistor Depos. 1 Kohm Resistor Depos. 4.7 Kohm Resistor Depos.	82. Kohm Resistor Depos. 56. Kohm Resistor Depos. 10. Kohm Resistor Depos. 10. Kohm Resistor Depos. 10. Kohm Resistor Depos. 270 ohm Resistor Depos. 270 ohm Resistor Depos. 270 ohm Resistor Depos. 17. Kohm Resistor Depos. 17. Kohm Resistor Depos. 18. 2. Kohm Resistor Depos. 18. 2. Kohm Resistor Depos. 18. 2. Kohm Resistor Depos. 19. Mohm Resistor Depos. 230 ohm Resistor Depos. 230 ohm Resistor Depos. 230 ohm Resistor Depos. 23. Kohm Resistor Depos. 25. Kohm Resistor Depos. 26. Kohm Resistor Depos. 27. Kohm Resistor Depos. 28. Kohm Resistor Depos. 29. Kohm Resistor Depos. 29. Kohm Resistor Depos. 20. Kohm Resistor Depos.	
CODE	19J706038P1 19J706038P1 19J706146P1 19J706164P1	19A 700019P34 19A 700019P42 19A 700019P21 19A 700019P49	19A700019P42 19A700019P42 19A700019P49 19A700019P17 19A700019P37 19A700019P45	194700019P60 194700019P58 194700019P57 194700019P30 194700019P48 194700019P48 194700019P48 194700019P35 194700019P35 194700019P35 194700019P35 194700019P37 194700019P37 194700019P37 194700019P37 194700019P37	
οN	Q716 Q717 Q722 Q723 Q724	R704 R705 R706 R707 R708	R709 R711 R712 R713 R714 R720	R 722 R 722 R 722 R 725 R 726 R 729 R 733 R 733 R 733 R 733 R 733 R 734 R 734 R 734 R 744 R 744 R 744 R 744	

FREQUENCY SYNTHESIZER FS5551

X403.047

Page 2 of 3

4. 7 Kohm Resistor Variable 1 Kohm Resistor Depos. 100 ohm Resistor Depos. 110 ohm Resistor Depos. 110 ohm Resistor Depos. 1110 ohm Resistor Depos. 1110 ohm Resistor Depos. 1110 ohm Resistor Depos. 1111 ohm Resistor Depos. 112 Kohm Resistor Depos. 113 Kohm Resistor Depos. 114 Kohm Resistor Depos. 115 Kohm Resistor Depos. 116 Kohm Resistor Depos. 117 Kohm Resistor Depos. 118 Kohm Resistor Depos. 119 Kohm Resistor Depos. 110 ohm Resistor Depos. 111 Kohm Resistor Depos. 112 Kohm Resistor Depos. 113 ohm Resistor Depos. 114 Kohm Resistor Depos. 115 Kohm Resistor Depos. 116 ohm Resistor Depos. 117 Kohm Resistor Depos. 118 ohm Resistor Depos. 119 ohm Resistor Depos. 110 ohm Resistor Depos. 110 ohm Resistor Depos. 111 Kohm Resistor Depos. 112 Kohm Resistor Depos. 113 ohm Resistor Depos. 114 Kohm Resistor Depos. 150 ohm Resistor Depos. 160 ohm Resistor Depos. 17 Kohm Resistor Depos. 180 ohm Resistor Depos. 180 ohm Resistor Depos. 190 ohm
ohm Resistor Depos.
hm Resistor Depos. ohm Resistor Depos.
ohm Resistor Depos. ohm Resistor Depos. ohm Resistor Depos. Cohm Resistor Depos. ohm Resi
Kohm Resistor Depos.
Kohm Resistor Depos. On R
hm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 Kohm Resistor Depos. 0.25 hm Resistor Depos. 0.25 ohm Resistor Depos. 0.25
ohm Resistor Depos.
ohm Resistor Depos. Kohm Resistor Depos. Mark Resistor Depos. M
Kohm Resistor Depos. hm Resistor Depos. o. 25 hm Resistor Depos. o. 25 ohm Resistor Depos.
hm Kesistor Depos. hm Resistor Depos. ohm Resistor Depos. ohm Resistor Depos. ohm Resistor Depos. chm Resistor Depos. ohm Resistor Depos. ohm Resistor Depos. ohm Resistor Depos. chm Resistor Depos. ohm Resistor Depos.
hm Resistor Depos. On Separation Depos. On
ohm Resistor Depos. The Resis
hm Resistor Depos. 0.25 hm Resistor Depos. 0.25 Kohm Resistor Depos. 0.25 ohm Resistor Depos. 0.25
hm Resistor Depos. 0.25 Kohm Resistor Depos. 0.25 John Resistor Depos 0.25 John Resis
Kohm Kesistor Depos. 0.25 Johm Resistor Depos. 0.25 John Resistor Depos. 0.25
ohm Resistor Depos.
Achin Resistor Depos. Wohm Resistor Depos.
ohm Resistor Depos. Chan Resistor Depos. C
Kohm Resistor Depos. 0.25 Jhm Resistor Depos. 0.25 Justormer 0.25 Justo
ohm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 Kohm Resistor Depos. 0.25 hm Resistor Depos. 0.25 hm Resistor Depos. 0.25 hm Resistor Depos. 0.25 ohm Resistor Depos. 0.25 sisformer 45106 B IC
onin Resistor Depos. 0.25 Shm Resistor Depos. 0.25 And Resistor Depos. 0.25 Am Resistor Depos. 0.25 Am Resistor Depos. 0.25 And Resistor Depos. 0.25 And Resistor Depos. 0.25 Aformer 45106 B IC
Annual Nesistor Depos. 0.25 Ann Resistor Depos. 0.25 Ann Resistor Depos. 0.25 Ann Resistor Depos. 0.25 Ann Resistor Depos. 0.25 Asformer 45106 B IC
0.25 0.25 0.25 0.25
0.25
0.25
0.25
C145106 DA1062 IC 066B IC
DA 1062 IC 366B IC

Storno	DATA	
	CODE	
	ο̈́N	

FREQUENCY SYNTHESIZER FS5551

X403.047

Page 3 of 3

Stormo

C701 C702 C703 C704 C706 C706 C707 C711	19A700233P5 19J706005P3	470 pF Capacitor Ceramic 47 uF Capacitor Electrolytic	20 \
C702 C703 C704 C706 C706 C707 C711	19J706005P3	47 uF Capacitor Electrolytic	> 00
C703 C704 C705 C706 C707 C711 C711			76 \
C704 C705 C706 C707 C707 C711	19A700233P5	470 pF Capacitor Ceramic	20 \
C705 C706 C707 C708 C711 C712	19A700233P5	470 pF Capacitor Ceramic	50 V
C706 C707 C708 C711 C712	19A700233P7	1 nF Capacitor Ceramic	50 V
C707 C708 C711 C712	19A700003P7	10 uF Capacitor Tantalum	16 V
C708 C711 C712	19A700233P5	470 pF Capacitor Ceramic	20 \
C711 C712 C713	19A 700233P5	470 pF Capacitor Ceramic	50 V
C712 C713	19A700003P1	 1 uF Capacitor Tantalum 	35 V
. 713	19A700003P5	2.2 uF Capacitor Tantalum	35 V
	19A700235P28	180 pF Capacitor Ceramic	20 N
C714	19J706256P201	15 pF N1500 Capacitor Ceramic	
0715	19J /06256P204	47 pr N1500 Capacitor Ceramic	
0/10	19A 700233P5	4/0 pr Capacitor Ceramic	
27.2	19A700235F22	3 of Capacitor Ceramic	> 00
C719	19A700235P18	27 oF Capacitor Ceramic	
C720	19A700233P7	1 nF Capacitor Ceramic	
C721	19A700235P7	3.3 pF Capacitor Ceramic	
C722	19A700235P23	68 pF Capacitor Ceramic	
C723	19A700235P19	33 pF Capacitor Ceramic	20 N
C724	19A700233P5	470 pF Capacitor Ceramic	20 N
C725	19J706256P201	15 pF N1500 Capacitor Ceramic	
C726	19J706256P204	47 pF N1500 Capacitor Ceramic	20 \
C727	19A700235P28	180 pF Capacitor Ceramic	20 N
C728	19A700003P7	10 uF Capacitor Tantalum	16 V
C729	19A700233P5	470 pF Capacitor Ceramic	20 \
C730	19A700003P6	4.7 uF Capacitor Tantalum	35 V
C731	19A700233P5	470 pF Capacitor Ceramic	20 N
C732	19A700235P7	3.3 pF Capacitor Ceramic	20 <
C733	19A700013P8	0.39 pF Capacitor Phenolic	200 V
C734	19A700233P5	470 pF Capacitor Ceramic	20 \
C735	19A700233P7	1 nF Capacitor Ceramic	20 \
C737	19J706003P1	1.8-10 pF Capacitor Variable	
C738	19A700235P13	10 pF Capacitor Ceramic	20 \
C739	19A700003P4	1 uF Capacitor Tantalum	35 V
C740	19A700235P7	82 pF Capacitor Ceramic	20 \
C741	19A700003P7	10 uF Capacitor Tantalum	16 V
C742	19A700235P7	3.3 pF Capacitor Ceramic	20 \
C743	19A700233P5	470 pF Capacitor Ceramic	50 V
C744	19A700235P8	3.9 pF Capacitor Ceramic	50 V
C745	19J706003P2	2-18 pF Capacitor Variable	
C746	19A700235P13	10 pF Capacitor Ceramic	20 \
C747	19A700003P4	1 uF Capacitor Tantalum	35 V
C748	19A700233P7	1 nF Capacitor Ceramic	20 \
C749	19A700235P9	4.7 pF Capacitor Ceramic	20 \

					_					_								-	_	_																		
	50 V	> 05	50 V	50 V	35 V	35 V	20 V	20 N	35 V	35 V	20 \	20 \	50 V		> 0 <	> 0 2	> 05	> 05	50 V	50 V	50 V	20 V	20 V	20 V	20 \	20 \	16 V	> 05	> 00	> 00	100 \	> 05	50 V					
DATA	100 pF Capacitor Ceramic	1 nF Capacitor Ceramic	150 pF Capacitor Ceramic	27 pF Capacitor Ceramic	1 uF Capacitor Tantalum	10 uF Capacitor Tantalum	1 nF Capacitor Ceramic	1.5 nF Capacitor Ceramic	1 uF Capacitor Tantalum	0.47 uF Capacitor Tantalum	1 nF Capacitor Ceramic	470 pr Capacitor Ceramic	1 nF Capacitor Ceramic	Capacitor	apacitor	pr Capacitor	2 4	0	470 pF Capacitor Ceramic		Capacitor	Capacitor	470 pF Capacitor Ceramic	10 pF Capacitor Ceramic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	220 uF Capacitor Electrolytic	22 at Capacitor Ceramic	1 DE Capacitor Ceramic	1 DE Capacitor Ceramic	22 of Capacitor Polyester	100 pF Capacitor Ceramic	Capacitor	Diode Sili	Diode	1N4148 Diode Silicon	Diode	
CODE	19A 700233P1	19A700233P7	19A700233P2	19A700235P18	19A700003P4	19A700003P7	19A700233P7	19A700233P8	19A 700003P4	19A 700003P3	19A 700233P7	19A / 00233P5	19A /00233P7	194 700235P4	19A / 00233P5	19A 700733P5	19A700233P5	19A700235P16	19A700233P5	19A 700233P5	19A700233P5	19A700233P5	19A 700233P5	19A700235P13	19A700233P5	19A700233P7	191/06005P5	19A / 00233P /	194 70073307	19A700733P7	191706261P1	19A700233P1	19A700233P1	19A700028P1	19A700028P1	19A / 00028P1	1 7070007 751	
ο̈́N	C750	C752	C753	C754	-	C756	C757	C758	C759	C760	C761	C/62	C/63	1010	C/65	C767	C768	C769	C770	C771	C772	C773	C774	C776	C777	C780	(78)	C/82	C787	0.785	0.791	C792	C793	D701	D702	D 703	t 0 0	

FREQUENCY SYNTHESIZER FS5552

X403.048

Page 1 of 3

S N	CODE	DATA	
D705 D706 D706 D707 D709 D710 D711 D711 D721 D721 D722 D724 D724 D724 D724 D727 D726 D726 D727 D733 D734 D742 D742 D742 D742 D742 D742 D742 D74	194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700028P1 194700073P1 194700073P1 194700073P1 194700073P1 194700073P1 194700026P1 194700026P1 194700026P1 194700026P1 194700026P1 1947000215P114 1947000214P4		8 pin 14 pin 4 pin 4 pin 7 pin 2 pin 10 pin
7906 7907 7907 7907 7907 7907 7007 7006 7006 7006 7006 7007	194700072P11 194700102P21 19J706223P8 19J706219P1 19J706219P1 19J706029P 19A700024P15 19A700024P15 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19	Male Connector Female Connector Male Connector Male Connector Male Connector Male Connector Variable Coil 3.3 uH Coil 3.3 uH Coil Variable Coil 1.5 uH Coil 3.3 uH Coil Coil 3.3 uH Coil Coil Soil Coil Coil Coil Soil Coil Coil Coil Coil Coil Coil Coil C	12 pin 3 pin 11 pos 8 pos pin pin

		222222222222222222222222222222222222222
DATA	3.3 uH Coil 3.3 uH Coil Coil 6.8 uH Coil 6.8 uH Coil 0.22 uH Coil 0.47 uH Coil 8C548 Transistor BC558 Transistor BC558 Transistor BC558 Transistor BC558 Transistor BC548 Transistor BC548 Transistor BC548 Transistor BFR54 Transistor	1. 5 Kohm Resistor Depos. 22 Kohm Resistor Depos. 560 ohm Resistor Depos. 2. 7 Kohm Resistor Depos. 47 ohm Resistor Depos. 10 Kohm Resistor Depos. 2. 7 Kohm Resistor Depos. 3. 7 Kohm Resistor Depos. 4. 7 Kohm Resistor Depos. 4. 7 Kohm Resistor Depos. 6. Kohm Resistor Depos.
CODE	19A700024P19 19A700024P19 19J706258P4 19A700024P19 19A700024P5 19A700024P5 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706283P1 19J70638P1 19J70638P1 19J706146P1 19J706146P1 19J706146P1 19J706146P1	19A 700019P39 19A 700019P34 19A 700019P42 19A 700019P49 19A 700019P49 19A 700019P42 19A 700019P49 19A 700019P47 19A 700019P17 19A 700019P17 19A 700019P60 19A 700019P60 19A 700019P60 19A 700019P60
ο̈́N	L715 L716 L717 L718 L721 L722 Q701 Q701 Q701 Q711 Q711 Q714 Q714 Q714 Q715 Q716 Q715 Q716 Q715 Q716 Q716 Q717	R702 R703 R704 R706 R706 R706 R707 R711 R711 R711 R712 R713 R721 R721 R721 R721 R721 R722 R724 R725

FREQUENCY SYNTHESIZER FS5552

X403.048

Page 2 of 3

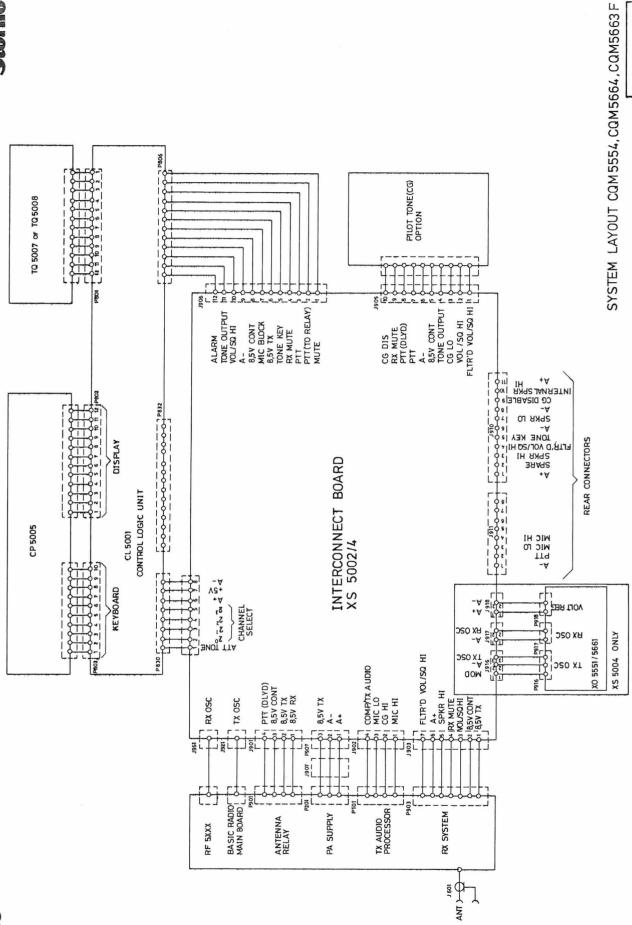
ōΝ	CODE	DATA	
R727	19A700019P30	270 ohm Resistor Depos.	0.25 W
R728	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R729	19A700019P30	270 ohm Resistor Depos.	0.25 W
R730	19A700019P45	4.7 Kohm Resistor Depos.	0.25 W
R732	19A700019P49	10 Kohm Resistor Depos.	25
R733	19A700019P48	8.2 Kohm Resistor Depos.	25
R734	19A700019P35	680 ohm Resistor Depos.	25
R735	19A700029P57	47 Kohm Resistor Depos.	25
R736	19A700029P31	330 ohm Resistor Depos.	25
R737	19A700019P31	330 ohm Resistor Depos.	25
R738	19A700019P25	100 ohm Resistor Depos.	2
R739	19A700019P39	1.5 Kohm Resistor Depos.	25
R741	19A 700019P43	3.3 Kohm Resistor Depos.	25
K/42	194/00019P3/	1 Kohm Resistor Depos.	25
K/43	19A / 00019P25		25
07/10	194700019721	100 ohm Resistor Depos.	57.
R750	19A 700019P57	100 orim Resistor Depos.	0.25 W
R752	19A700016P3	4 7 Kohm Resistor Variable	2.53
R753	19A 700019P37	1 Kohm Besistor Denos	W 2C 0
R754	194 700019975	100 ohm Resistor Depos	
R761	19A 700019P13	10 ohm Resistor Depos	25
R763	19A700019P51	15 Kohm Besistor Denos	2 5
R765	194700019P26	120 ohm Resistor Depos	25
R769	19A700019P35	820 ohm Resistor Depos	7,5
R770	19A700019P42	2.7 Kohm Resistor Depos.	25
R771	19A700019P15	15 ohm Resistor Depos.	25
R772	19A700019P57	47 Kohm Resistor Depos.	25
R773	19A700019P55	33 Kohm Resistor Depos.	
R774	19A700019P50	12 Kohm Resistor Depos.	25
R775	19A700019P47	6.8 Kohm Resistor Depos.	
R776	19A700010P37	1 Kohm Resistor Depos.	25
R777	19A700019P21	47 ohm Resistor Depos.	25
K//8	194/00019P25	100 ohm Resistor Depos.	25
K//9	19A / 000 19P35	680 ohm Resistor Depos.	52
D 701	100 700019723	32 ohm Resistor Depos.	0.25 W
R787	194 70001994		72
R783	19470001927	. L	25
R784	194700019P25	100 ohm Resistor Depos	25
R785	19A700019P39		25
R786	19A700019P31		25
R787	19A700019P43	3	25
R788	19A700019P26	20	25
R789	19A700019P34	560 ohm Resistor Depos.	0.25 W
R791	19A700019P28	180 ohm Resistor Depos.	0.25 W

-	
	0.25 W 0.25 W 0.25 W 0.25 W 0.25 W
DATA	1. 2 Kohm Resistor Depos. 22 ohm Resistor Depos. 22 ohm Resistor Depos. 1 Kohm Resistor Depos. 27 Kohm Resistor Depos. 27 Kohm Resistor Depos. Channel Switch Transformer MC145106 TDA1062 IC 4066B IC
CODE	19A700019P38 19A700019P17 19A700019P37 19A700019P54 19J706284G1 19J706238P1 19J706238P1 19J706238P1 19A700029P444
ο̈Ν	R792 R794 R799 S901 U701 U702 U703

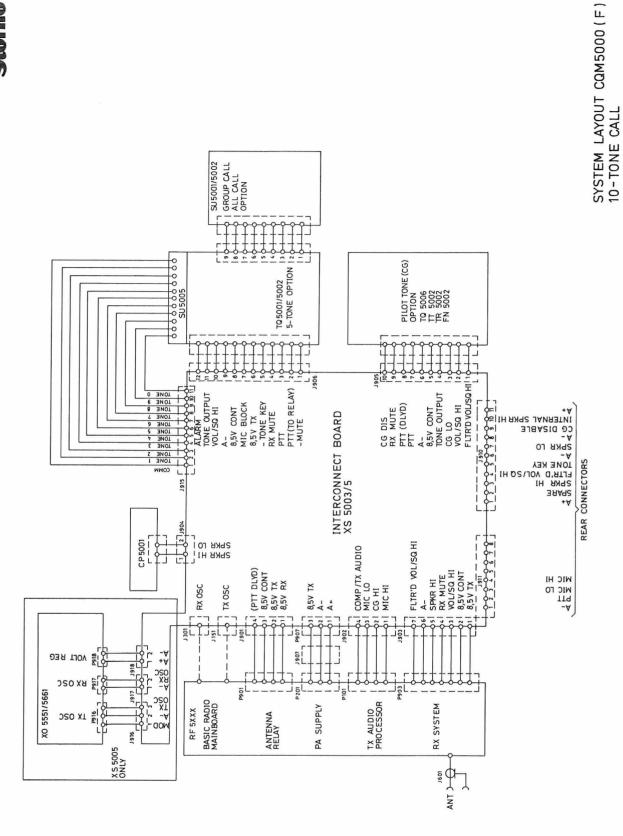
FREQUENCY SYNTHESIZER FS5552

X403.048

Page 3 of 3



Storm



TECHNICAL SPECIFICATIONS

CQM5660 S12

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

420 - 470 MHz

Channel Separation

CQM5662: 30/25 kHz

CQM5663: 20 kHz

Maximum Frequency Deviation

CQM5662: ±5 kHz

CQM5663: ±4 kHz

Modulation Frequency Range

300 - 3000 Hz

Maximum RF Bandwidth

RX: 3.0 MHz

TX: 5.5 MHz

Antenna Impedance

50 ohm

Maximum Number of Channels

12

Supply Voltage

Minimum: 10.8 V

Nominal: 13.2 V

Maximum: 16.6 V

Negative potential to chassis

Temperature Range

 -30° C to $+60^{\circ}$ C

Dimensions

B x D x H: 180 x 190 x 60 mm

Weight

1.8 kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f.

0.4 uV (0.3 uV)

Measuring conditions:

 $\Delta f. \pm 2/3 \times \Delta fmax$; $f_{mod} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f.

1.0 uV (0.7 uV)

 Δ F 60% x Δ fmax; f = 1 kHz. Measured with psophometric filter.

Crystal Frequency Range

420 - 450 MHz: 47 - 50 MHz

440 - 470 MHz: 45 - 48 MHz

Receiver VCO Frequence Range

139 - 157 MHz

Crystal Frequency Multiplication

 $\times 3$

Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth (EIA)

±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

ΕIA

75 dB (80 dB)

CEPT

75 dB (80 dB)

Spurious Rejection

EIA

85 dB

Intermodulation Attennuation

EIA

70 dB

CEPT

70 dB (78 dB)

Blocking

90 dB/uV (100 dB/uV)

Radiation

Conducted: max. 0.8 nW

Radiated: max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

 Δf = ±3 kHz, 1 kHz, 1 W, RF 1 mV

Frequency Response

CQM5662 S12, CQM5663 S12

+1/-3 dB (+0/-1.5 dB) CEPT

Relative to 1000 Hz, -6 dB/octave

fm: 300 - 3000 Hz

CQM5663 S12

+1/-1.5 dB (+0/-1 dB) CEPT/FTZ

Relative to 1000 Hz, -6 dB/octave

fm: 400 - 2700 Hz

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Squelch Recovery Time

250 ms (200 ms)

Squelch Attack Time, EIA

150 ms (110 ms)

Squelch Closing Time, EIA

150 ms (50 ms)

Current Consumption

Squelched: 350 mA (330 mA)

AF 2 W : 750 mA (730 mA)

(1 channel, without tone equipment, 13.2 V

supply)

TRANSMITTER

 $\times 3$

RF Power Output

CQM5660-5 W:

5 W

CQM5660-20 W:

20 W

 $R_1 = 50$ ohm

Transmitter VCO Frequency Range

Crystal Frequency Multification

140 - 156 MHz

Crystal Frequency Range

45 - 50 MHz

Frequency Stability

Conforms with government regulations

TECHNICAL SPECIFICATIONS

Storno

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

AF Input Impedance

560 ohm

Modulation Sensitivity

90 mV ±3 dB

(60%, $\Delta f = \pm 3 \text{ kHz}$, 1 kHz)

Modulation Response

300 - 3000 Hz

+1/-3.0 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

400 - 2700 Hz

+1/-1.5 dB (+0.5/-1 dB) relative to 1000 Hz,

6 dB/octave

Modulation Distortion

fm= 1000 Hz: max. 3%

fm= 300 Hz: max. 5%

CQM5662: Δf= ±3 kHz

CQM5663: Δf= ±2.4 kHz

FM Hum and Noise

55 dB (57 dB)

CEPT (measured with 750 usec de-emphasis)

Attack Time

50 ms

Current Consumption

5 W: less than 1.8 A (1.5 A)

20 W: less than 5.5 A (5 A)

GENERAL DESCRIPTION

CQM5660 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential
encoder/decoder or Channel Guard, and up
to 12 transmit and receive channels.

A comparison of the various models is presented in the table below.

Туре	CQ	M5662	CQ	M5663
SPEC	5	20	5	20
Frequency Range MHz	420	- 470	420	- 470
RF Power W	5	20	5	20
Channel Spacing kHz	30	/25	2	0
Max. Number				
of Channels	1	2	1	2

ACCESSORIES

STANDARD	ACCESSORIES	MC5001	Fist microphone with retractables
			piral cable for mobile installation.
Mounting fr	rame	HS5001	Retainer for MC5001
Power cable	e	HS5002	Retainer, with switches, for MC5001
Fist microp	hone with retainer or	MC5002	Cylindrical handmicrophone with
Fixed - mou	unt microphone		build-in amplifier and press-to talk
External loa	udspeaker		switch. Fitted with a coiled cord
External sw	vitches		terminated into a connector which
LS701	Loudspeaker enclosed in a plastic		fits into the microphone retainer.
	housing, complete with cable.	HS5003	Retainer for MC5002, without hook
MC702b	Dynamic fist microphone with adjust-		switch.
	able output level.	HS5004	Retainer for MC5002, with hook switch.
JB701a	Junction box for MC702b. Consists	MK5001	Installation kit containing connectors,
	of a plastic housing provided with		power cable, fuses and fuseholders.
	cable for soldering assembly. Junction	MN703	Desk stand for fixed installations.
	box is to mounted behind the first	MN704	Mounting bracket for the radio cabinet.
	microphone retainer.	MN5001	Mounting frame for mobile installa-
MC703a	Desk microphone with PTT (Push -to		tions allowing the radio to be fixed
	- Talk) switch for fixed installations.		in 36 positions. Includes a base plate
MC704	Microphone with chockabsorbing moun -		with locking screw.
	ting bracket for mobile installation.	MN5002	Mounting cassette for the radio
MK704	Mounting kit consisting of 2 flexible		cabinet (see mechanical layout).
	tubes, used for mounting the MC704	MT5001	Microphone with retainer. The retai-
	in close-talk position.		ner contains a microswitch which is

	used to switch off the internal loud-
	speaker, when the microphone is lifted.
SU701	Transmitter keying switch for
	mounting on the steering coloum.
SU702	Transmitter keying switch for
	mounting on the dashboard.
SU704	Switch circuit for autoradio mounting.
SU5003	External alarm with timer (Horn Alarm).

POWER SUPPLY UNITS:

Equipment	SUPPLY	VOLTAGE
	220V AC	+24V DC
CQM5000, max. 5 W	PS703	PS704
CQM5000, max. 20 W	PS5001	PS702

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slide under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FS) and the Frequency Control (FC) mount in the top section of the chassis. Their switches and push buttons mount directly to the boards and protrude through the front.

Thin casted shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

Receiver front end
1st IF section with first and second oscillator.
455 kHz 2nd IF section with demodulator.

(refer to functional block diagram)

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in microstripline techniques on the mainboard.

1ST IF

The first IF frequency is 21.4 MHz. The output from the crystal filter is fed to a dualgate MOS-FET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the quadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

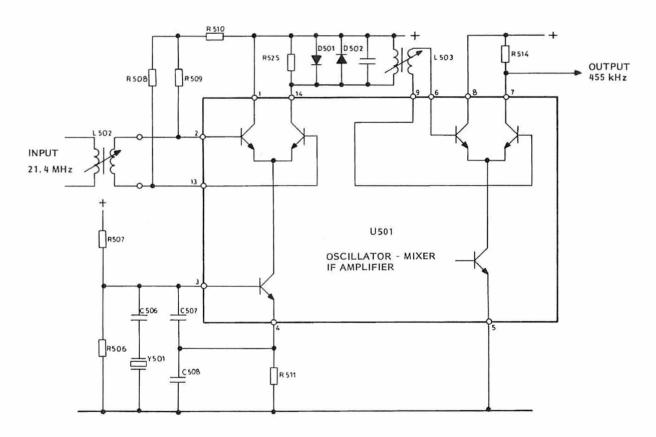


FIG. 1. SECOND OSCILLATOR , IF MIXER , AND IF AMPLIFIER

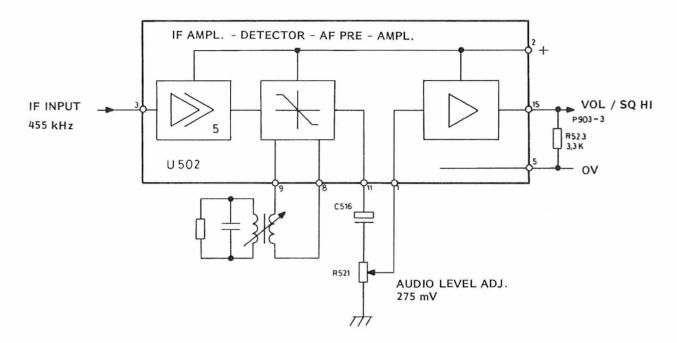


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

SQUELCH

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 7 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicator is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO CIRCUIT

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive de-emphasis network R629-C608 followed by the volume control.

The volume control potentiometer R630 is mounted directly on the RF board and protrudes through the front panel. The audio output amplifier U601 is a monolithic IC package capable of driving the loudspeaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to decide whether the amplifier should be active or not.

Regulated TX Voltage Squelch cancel Squelch signal

These inputs are:

In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible.

The value of C610 in the feedback loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time.

The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the main board along with the receiver.

The exciter contains an au audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks.

The exciter output is at the carrier frequency when applied to the power amplifier.

The power amplifier boosts the signal to the proper level, and includes a low-pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA low-pass filter connects to the antenna relay via a stripline on the

MODULATION PROCESSOR

board.

The signal from the microphone load R901 on the FS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV potentiometer on the RF board.

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the FM oscillator.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4), of which Q202 is a frequency tripler, and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter.

The exciter has four test points (TP201-2-3-4) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 5 watts or 20 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage.

This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible.

The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is biased by a voltage generated by the feedback network C255, D210, Q210, Q209, Q208.

FREQUENCY SYNTHESIZER

The frequency synthesizer provides op to 12 channels and is built on a printed wiring board which mounts in the top section of the radio set. There are two versions of the board, a single channel board, FS5661, and multichannel board, FS5662.

The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board uses a channel selector and

a Frequency Control unit, FC5001. The channel selector is mounted directly on the synthesizer board and protrudes through the front panel.

The Frequency Control unit FC5001 fits into a shield which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for the accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D901, D902. The ground lead comes through the same connector and is connected to chassis ground through a fusible printed wiring path which will open in case of the ground wire being accidently connected to A+.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through J903 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 - C618 and one of the ON/OFF switch sections S602. The other

section of the ON/OFF switch controls the $V_{\rm B}$ + to the voltage regulator U602 consisting of a monolithic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.

Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

The squelch circuit, the modulation processor, the Frequency Synthesizer and parts of the IF amplifier U502 are supplied directly from the continuous 8.5 V.

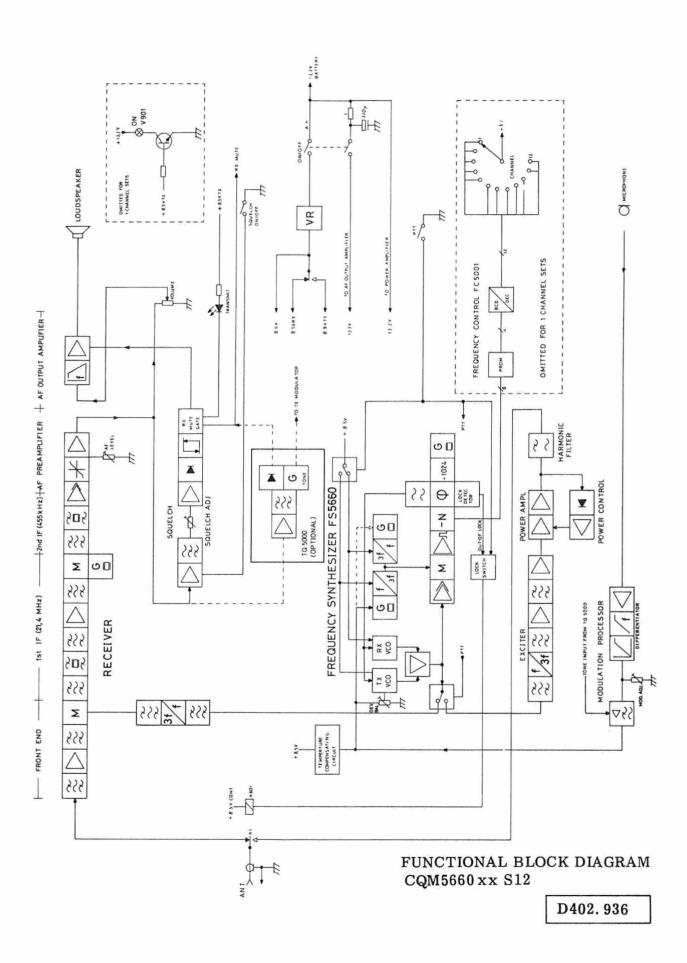
The receiver front-end, the 21.4 MHz IF stages and the second oscillator are supplied from 8.5 V RX.

The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistors may be hazardous.



CHANNEL PROGRAMMING INSTRUCTIONS

CQM5660 S12

Programming of the PROM which contains the data for the channel frequencies will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 17 or 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19)
Programming Pak, interchangeable
Socket adaptor
or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the PROM data.

It is also possible to use a computer to calculate the PROM data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- 13. Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.
 - After completing the worksheet the next steps are:
- 1. Enter correct Prom addresses and corresponding data ($V_{\mbox{\scriptsize HEX}}$) on the

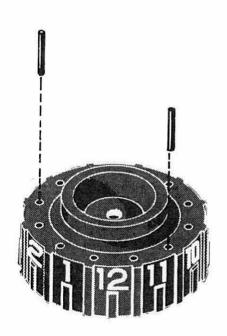
Programmer (DATA I/O), refer to Programmer Operating Instructions.

- Insert the channel knob stop (if needed) if less than 9 channels, refer to fig. 1.
- 3. In case of more than 8, but less than

12 channels are used, transmission on unauthorized channels must be avoided. This is done by burning the unused channel locations in the PROM with the highest channel HEX CODE.

CHANNEL STOP

LOWEST	INSERT	HIGHEST	INSERT
CH.	PIN BETWEEN	CH.	PIN BETWEEN
1	10 and 11	1	3 and 4
2	11 and 12	2	4 and 5
3	12 and 1	3	5 and 6
4	1 and 2	4	6 and 7
5	2 and 3	5	7 and 8
6	3 and 4	6	8 and 9
7	4 and 5	7	9 and 10
8	5 and 6	8	10 and 11
9	6 and 7	9	11 and 12
10	7 and 8	10	12 and 1
11	8 and 9	11	1 and 2
12	9 and 10	12	2 and 3



Note: If 8 channels are used insert only one PIN.

If more than 8 channels are used stop is not possible and no

PINs are inserted.

Fig. 1. SETTING OF CHANNEL KNOB STOP.

RECOMMEND CRYSTAL FREQUENCIES CQM 5660 S 12

CQM5662	CQM5663	
FREQUENCY RANGE	FREQUENCY RANGE	RX CRYSTAL
418.6 - 424.9755	417.32 - 422.42	48. 177777
421.1 - 427.4755	419.82 - 424.92	48. 455555
423.6 - 429.9755	422.32 - 427.42	48.733333
426.1 - 432.4755	424.82 - 429.92	49.011111
428.6 - 434.9755	427.32 - 432.42	49.288888
431.1 - 437.4755	429.82 - 434.92	49.566666
433.6 - 439.9755	432.32 - 437.42	49.844444
436.1 - 442.4755	434.82 - 439.92	50. 122222
438.6 - 444.9755	437.32 - 442.42	50.399999
441.1 - 447.4755	439.82 - 444.92	50.677777
443.6 - 449.9755	442.32 - 447.42	50.955555
446.1 - 452.4755	444.82 - 449.92	51.233333
441.4 - 447.7755	440.12 - 445.22	45. 955555
443.9 - 450.2755	442.62 - 447.72	46.233333
446.4 - 452.7755	445.12 - 450.22	46.511111
448.9 - 455.2755	447.62 - 452.72	46.788888
451.4 - 457.7775	450.12 - 455.22	47.066666
453.9 - 460.2775	452.62 - 457.72	47.344444
456.4 - 462.7755	455.12 - 460.22	47.622222
458.9 - 465.2755	457.62 - 462.72	47.899999
461.4 - 467.7755	460.12 - 465.22	48.177777
463.9 - 470.2755	462.62 - 467.72	48.455555
466.4 - 472.7755	465.12 - 470.22	48, 733333
468.9 - 475.2755	467.62 - 472.72	49.011111

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES CQM5660 S12

	T	
CQM5662	CQM 5663	
FREQUENCY RANGE	FREQUENCY RANGE	TX CRYSTAL
420.0 - 426.375	418.72 - 423.82	137.866666
422.5 - 428.875	421.22 - 426.32	138.7
425.0 - 431.375	423.72 - 428.82	139.533333
427.5 - 433.875	426.22 - 431.32	140.366666
430.0 - 436.375	428.72 - 433.82	141.2
432.5 - 438.875	431.22 - 436.32	142.033333
435.0 - 441.375	433.72 - 438.82	142.866666
437.5 - 443.875	436.22 - 441.32	143.7
440.0 - 446.375	438.72 - 443.82	144. 533333
442.5 - 448.875	441.22 - 446.32	145.366666
445.0 - 451.375	443.72 - 448.82	146.2
447.5 - 453.875	446.22 - 451.32	147.033333
450.0 - 456.375	448.72 - 453.82	147.866666
452.5 - 458.875	451.22 - 456.32	148.7
455.0 - 461.375	453.72 - 458.82	149.533333
457.5 - 463.875	456.22 - 461.32	150.366666
460.0 - 466.375	458.72 - 463.82	151.2
462.5 - 468.875	461,22 - 466,32	152.033333
465.0 - 471.375	463.72 - 468.82	152.866666
467.5 - 473.875	466.22 - 471.32	153.7

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY



SELFQUIETING FREQUENCIES CQM5662

V DEC	USE ALTERNATIVE ⁺
428	1
265	2
274	4
416	4
459	4
466	2
366	2
266	2
397	4
465	2
328	2
	428 265 274 416 459 466 366 266 397 465

⁺refer to worksheet

TABLE 3A. SELFQUIETING FREQUENCIES



SELFQUIETING FREQUENCIES CQM5663

RECEIVER CRYSTAL FREQUENCY. MHz	V DEC	USE ALTERNATIVE ⁺
	1.000	
48. 177	278	4
48,177	286	2
48.177	331	4
49.566	290	4
50.122	458	4
50.122	503	4
50.399	333	2
50.399	378	2
45.955	284	4
46.511	374	2
46.788	375	4
47.899	399	4
47.899	411	4
47.899	456	2
48.177	274	4
48. 177	286	4
48.177	331	4
48.177	420	2
48.733	390	4
48.733	394	2
49.011	265	4

⁺refer to worksheet

TABLE 3B. SELFQUIETING FREQUENCIES

C B X " Numbers. "VDEC Most Significant Digit of Hex Code. 3 2 1 B A C Ш L

Example "V_{DEC}"= 345 equals to hex code 59.

"V_{DEC}"= 469 equals to hex code D5.

MSD

"V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

Table 4.

PROGRAMMING WORKSHEET FOR CQM5660 S12

1		RECEIVER	VER					TRANSMITTER	MITTER	
1	A FREQUENCY		>	>	PROM	B FREQUENCY	L	>	>	PROM
	MHz	I	DEC	HEX	ADDRESS (HEX)	MHz	I	DEC	HEX	ADDRESS (HEX)
					00					10
					01					
					02					12
					03					13
					04					14
					05					15
- 1					90					16
					07					17
- 1					80					18
- 1					60					19
- 1					0A					14
					90					18
	420 - 450 MHz: V _{DEC} = 440 - 470 MHz: V _{DEC} =	(A + 2)	+21.4) - (C 3 x F -21.4) - (C 3 x F	(6 × O)		FORMULA: VDEC = B - (D x 9)	A: VDEC	m 	3 × F	(6
		CHANNEL SPACING:	NEL ING:	RE CR	REFERENCE CRYSTAL (Y703):	REFERENCE FREQUENCY:		-		
			20 kHz	-	6.8266 MHz	F= 0.006666	25			
			25 kHz		8. 5333 MHz	F= 0.008333	~			
			12.5 kHz		4. 26667 MHz	F= 0.004166	2			
	LIST OF REF	F REFER	ERENCE CRYSTALS (Y703)	YSTALS	(Y703)	ALTERNATIVE S(OLUTIO	NS IF THI	E RECEIV	ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:
	MODE	ш	FREQUENCY, MHz	Y, MHz	PART No.		THER F	X MIXER	CRYSTA	SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY
	Standard 5662 Standard 5663		8.5333333	8.5333333	19J706361P3	2. SELECT HIGH INJECTION FREQUENCY FOR 2nd C	H INJEC	TION FRI	EQUENCY	SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR
	Standard 5664		4.26667	295	19J706361P5		LY OFF	SET REFE	RENCE	RYSTAL
						4. WEAK QUIETING; NO ALTERNATIVE REQUIRED	ING; NG) ALTERI	VATIVE	tequired

Customer:

Storno Storno

ADJUSTMENT PROCEDURE

CQM5660 S12

This adjustment procedure applies to the following radiotelephone types:

CQM5662 S12 30/25 kHz Channel spacing CQM5663 S12 20 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter

 $R_{in} \ge 1$ Mohm

AC Voltmeter

Z_{in} >1 Mohm//50 pF

Multimeter

 $R_i \ge 20 \text{ Kohm/Volt}$

Distortion meter

e.g. Storno E11c

RF Watt meter

25 W/50 ohm/420-470 MHz

Deviation meter

420-470 MHz

RF generator

Z_{out}= 50 ohm; 420-470 MHz

21.4 MHz signal generator

e.g. Storno TS-G21B

Frequency counter with attenuator

Z_{in} = 50 ohm; sensitivity

100 mV at 470 MHz

RF diode probe RF coaxial probe Storno 95, 0089-00 Storno 95.0179-00

DC power supply

10.8 V - 16.6 V; 6A

Oscilloscope

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026-00

22 uF/40 V electrolytic

capacitor

Storno code 73, 5107-00

Connector, 11-pin house

Storno code 41.5543-00

Connector, 8-pin house Pins for connectors

Storno code 41, 5542-00 Storno code 41, 5551-00

Trimming tools

The following tables show the frequency ranges of the CQM5660 S12 radiotelephone signals:

SIGNAL	FREQUENCY MHz	
TX VCO	140 - 156	
TX crystal	45 - 50	
TX crystal multiplication	×3	
RX VCO	139 - 157	
RX crystal	47 - 50 (420 - 450)	
and the second	45 - 48 (440 - 470)	
RX crystal multiplication	×3	

Table 1.

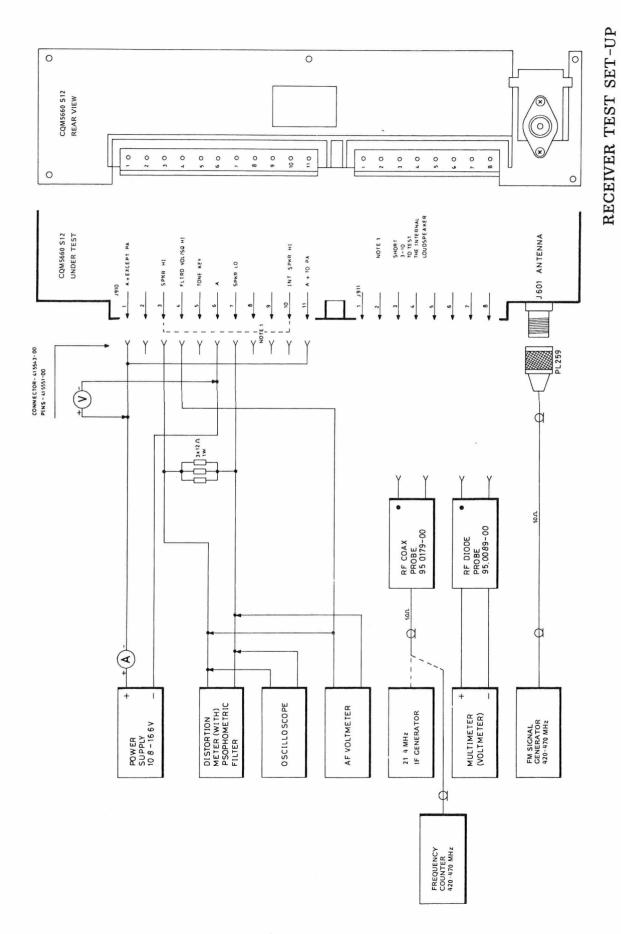
Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	kHz
20	6. 8266	1. 7066	3.4066	6.666
30 or 25 ¹⁾	5. 8533	2. 1333	4.2583	8.333

Table 2

¹⁾ Two steps per channel

CQM5660 S12

D402.935



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ±0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

R636 Value
omit
270
100
47
22
6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: <50 mV

Repeat the procedure with the power supply adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and PROM codes.

Mixer crystal output

Connect RF diode probe 95, 0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 45 mV ± 15 mV

(corresponding to -10 dBm to -4 dBm).

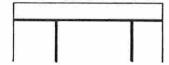
Note:

Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition in indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 4.8 volt (4.0 + 0.8)

Center channel reading: 4.0 volts

Low channel reading: 3.2 volt (4.0 - 0.8)

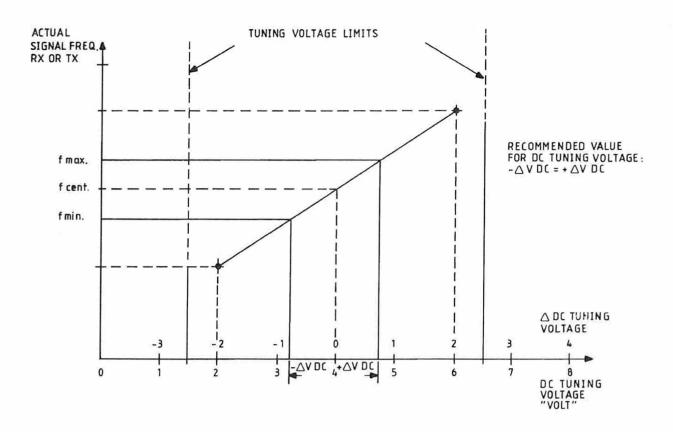
The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

 $f = f_x \times 3$ ($f_x = crystal frequency$) Adjust L711 to the calculated frequency.



Requirement: $f \pm 0.3$ ppm at 25° C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.

Connect the frequency counter to the probe.

Calculate the injection frequency for all channels

$$f_{inj} = f_{ant}^{-21.4}$$
 (MHz)

Select, one by one, the channels and read the injection frequency.

Requirement: F_{inj} ±0.2 ppm

IF AMPLIFIERS

Connect a 21.4 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range). During adjustment the RF generator output must be kept low enough to prevent limiting

in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L406: Adjust L405 and L407 for maximum deflection on the multimeter.

Adjust L406 for maximum deflection.

Readjust L401 and L402 for maximum deflection

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δf max.

CQM5662 S12 ±3 kHz CQM5663 S12 ±2,4 kHz

Connect a 4 ohm/3 W resistor load to connector J910/3-7 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7
(FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.

Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV.

Read the distortion.

Typical <u>Total Harmonic Distortion</u> (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 purpose of the measurement is to define

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 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at $60\% \Delta f$ max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industries Association) Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the

distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.)

Requirement: ≤1.0 uV.

The sensitivity should be measured on all

MEASURING 12 dB SINAD (EIA)

channels, if more than one.

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load. Adjust the RF generator to obtain 12 dB SINAD condition. Read the 12 dB SINAD sensitivity. Requirement: \leq 0.4 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI - LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

	Frequency	Level	Tol.
Type CQM5662 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
Type CQM5663 S12	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	-
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 420 - 470 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD <5%.

SQUELCH

Release the squelch cancel button. Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

Condition	Current comsumption
Standby	≤400 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	<750 mA

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

20 W transmitter:

6A

5 W transmitter:

4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW). Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95,0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

40 mV ± 15 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

zer.

Transmitter VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition in indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter. If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 5.1 volt (4.0 + 1.1)
Center channel reading: 4.0 volts
Low channel reading: 2.9 volt (4.0 - 1.1)
The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f_X \times 3$ ($f_X = \text{crystal frequency}$). Adjust L701 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25°C . ppm= parts per million= 10^{-6} .

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER

Connect a multimeter (1.0 V range) to test point TP201.

Adjust L203 for minimum deflection. The dip is small.

Connect the multimeter, (1 V range) to test point TP202.

Adjust L204 for maximum deflection on the multimeter, typical 0.7 V.

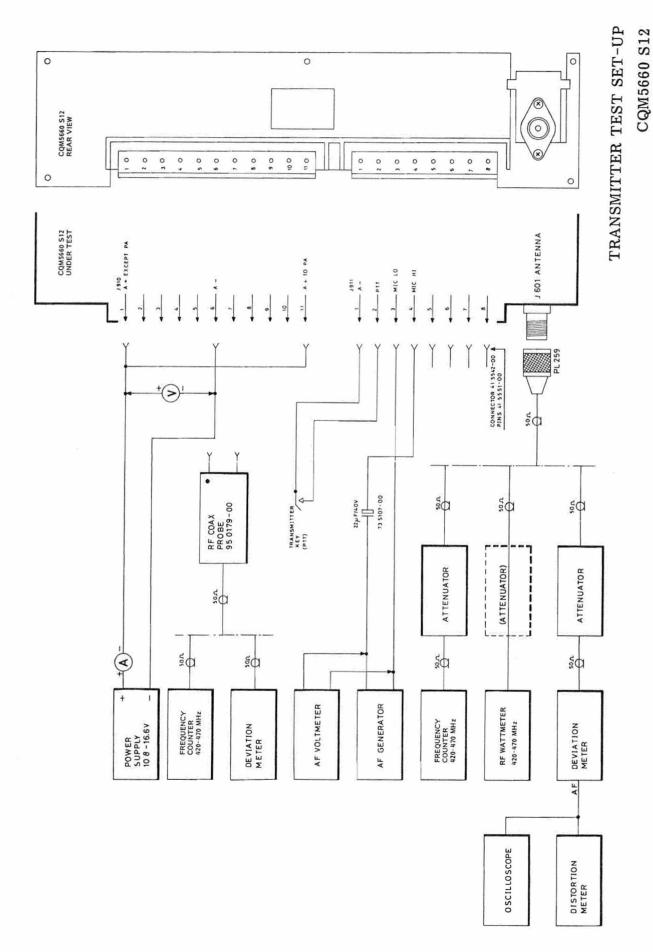
Repeat the adjustments of L203, L153, and L151 (L921-L926) until no further improvements is obtainable.

Adjust C213 for minimum reading. The dip is small.

Connect the multimeter, 1 volt range, to test point TP203.

Adjust C215 for maximum reading on the multimeter, typical 0.5 $\ensuremath{\text{V}}.$

D402.937



Repeat the adjustment of C213 and L204 until no further improvement is obtainable.

Adjust C221 munimum deflection. The dip is small and careful tuning is required.

Connect the multimeter, 10 volt range, to the RF probe.

Connect RF diode probe 95.0089-00 to TP204. Adjust C221 and C223 for maximum deflection (typical 4.0 V).

Adjust the PA power control, R215, for rated transmitter power, 5 W or 20 W.

EXCITER, FINE ADJUSTMENT

Connect the multimeter to test point TP201.
Readjust L153 for maximum reading.
Connect the multimeter to test point TP202.
Peak L203 and L204 for maximum reading.
Connect the multimeter to test point TP203.
Connect C213 and C215 for maximum reading.
Connect the 95.0089-00 RF probe and multimeter to TP204.

Adjust C221 and C223 for maximum reading.

TYPICAL TEST POINT READINGS

TP201: 0.2 V TP202: 0.7 V TP203: 0.5 V TP204: 4.0 V

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601.

Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels.

Requirement: $F = F_{ant} \pm 0.2 \text{ ppm}$, $ppm = parts \text{ per million} = 10^{-6}$

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 13.2 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 20 W or 5 W. Requirement: $P_{nom} \pm 0.2$ dB. Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (20 W):

Voltage	Power	Current
16 V	<25 W (ref)	5.4 A
13.2 V	20 W	5.4 A
10.8 V	≥12 W	5.4 A

Requirements (5 W):

Voltage	Power	Current
16 V	≤6.5 W	1.7 A
13.2 V	5 W	1.7 A
10.8 V	>3.5 W	1.7 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V.
Select the channel having the highest frequency. Set R116 to mid-position.
Connect coax probe 95.0179-00 to test point

TP701.

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Connect the deviation meter through an attenuator to the antenna connector, J601.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect an AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Type	Channel spacing	Δf max
CQM5662 S12	30/25 kHz	±5 kHz
CQM5663 S12	20 kHz	±4 kHz

Requirement

Difference between + and - deviation: ≤10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5662 S12 : ±3.0 kHz CQM5663 S12 : ±2.4 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

Requirements:

Modulating signal: 75 mV ±3 dB

Distortion: <7%

(measured without deemphasis)

MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 x Δf max is obtained on the deviation meter.

CQM5662 S12 : ±1.0 kHz CQM5663 S12 : ±0.8 kHz

Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

ADJUSTMENT OF TONE EQUIPMENT

Measuring equipment

Tone Test Generator Storno TS-G13 95B0251-00

Check the connections and the tone combination of the TQ5001/TQ5002/TQ5004/TQ5005 and SU/5002; refer to description and diagrams.

Adjustment of frequency deviation

Apply Standard test condition to the transmitter; refer to transmitter test setup. Establish a shortcircuit between emitter and collector of Q108, on the solder side of the TQ unit, which will produce a continuous tone to the modulator.

Key the transmitter using the tone button.

Adjust R113, TQ5001/TQ5002/TQ5004/TQ5005 for 70% of maximum frequency deviation.

Remove the short circuit.

Connect the G13 Tone Test set to the AF output on the Deviation Meter.

Check that the tone call is properly received when the tone button is depressed.

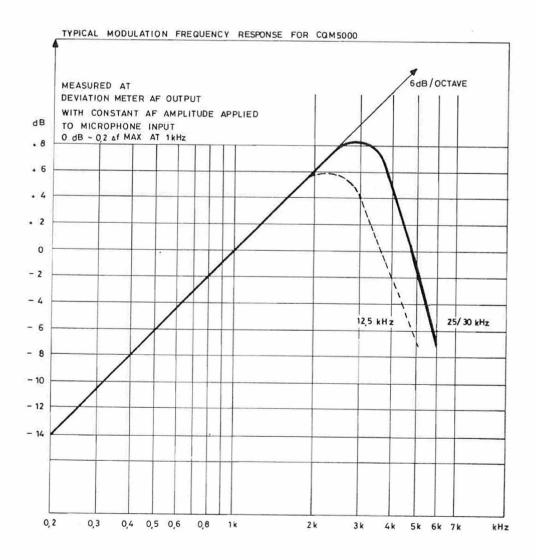
Checking the Tone Receiver

Apply Standard test condition to the receiver; refer to receiver test setup.

Modulate the signal generator with the G13 Tone Test Set.

Set the G13 to the proper tone combination.

Check that the TQ unit responds to a released tone call.



Storno

TECHNICAL SPECIFICATIONS

CQM5660 S99

Guaranteed performance specifications unless otherwise noted,

Typical values are given in brackets.

GENERAL

Frequency Range

420 - 470 MHz

Channel Separation

CQM5662: 30/25 kHz

CQM5663: 20 kHz

Maximum Frequency Deviation

CQM5662: ±5 kHz CQM5663: ±4 kHz

Modulation Frequency Range

300 - 3000 Hz

Maximum RF Bandwidth

RX: 3.0 MHz

TX: 5.1 MHz

Antenna Impedance

50 ohm

Maximum Number of Channels

99

Supply Voltage

Minimum: 10.8 V

Nominal: 13.2 V

Maximum: 16.6 V

Negative potential to chassis

Temperature Range

-30°C to +60°C

Dimensions

B x D x H: 180 x 190 x 60 mm

Weight

1,8 kg

RECEIVER

Sensitivity

12 dB SINAD (EIA), ½e.m.f.

0.4 uV (0.3 uV)

Measuring conditions:

 $\Delta f. \pm 2/3 \times \Delta fmax$; $f_{mod} = 1 \text{ kHz}$

20 dB SINAD (CEPT) e.m.f.

1.0 uV (0.7 uV)

 $\Delta F 60\% \times \Delta fmax$; $f_{mod} = 1 \text{ kHz}$.

Measured with psophometric filter.

Crystal Frequency Range

420 - 450 MHz: 48.17 - 51.23 MHz 440 - 470 MHz: 45, 95 - 49, 01 MHz

Receiver VCO Frequence Range

139 - 157 MHz

Crystal Frequency Multiplication

Frequency Stability

Conforms with governments regulations

Modulation Acceptance Bandwidth (EIA)

±7 kHz (±7.5 kHz)

Adjacent Channel Selectivity

EIA

75 dB (80 dB)

CEPT

75 dB (80 dB)

Spurious Rejection

EIA

85 dB

Intermodulation Attenuation

EIA

70 dB

CEPT

70 dB (78 dB)

Blocking

90 dB/uV (100 dB/uV)

Radiation

Conducted: max. 0.8 nW

Radiated: max. 0.8 nW

AF Load Impedance (Loudspeaker)

4 ohm

AF Power Output

3 W (3.6 W)

AF Distortion

5% (1.5%)

 Δf = ±3 kHz, 1 kHz, 1 W, RF 1 mV

Frequency Response

CQM5662S99, CQM5663S99

+1/-3 dB (+0/-1.5 dB) CEPT

Relative to 1000 Hz, -6 dB/octave

fm: 300 - 3000 Hz

CQM5663S99

+1/1.5 dB (+0/-1 dB) CEPT/FTZ

Relative to 1000 Hz, -6 dB/octave

fm: 400 - 2700 Hz

Hum and Noise

Squelched: 80 dB (better than 85 dB)

Unsquelched: 55 dB (57 dB)

Squelch Recovery Time

250 ms (200 ms)

Squelch Attack Time, EIA

150 ms (110 ms)

Squelch Closing Time, EIA

150 ms (50 ms)

Current Consumption

Squelched: 1000 mA (750 mA)

AF 3 W:

1450 mA (1150 mA) (13.2 V supply)

TRANSMITTER

RF Power Output

CQM5660-5 W:

5 W

CQM5660-20 W:

20 W

 $R_1 = 50$ ohm

Crystal Frequency Range

45.95 - 51.23 MHz

Crystal Frequency Multification

×3

Storno

TECHNICAL SPECIFICATIONS

Storno

Transmitter VCO Frequency Range

140 - 156 MHz

Frequency Stability

Conforms with government regulations

Undesired Radiation

max. 0.2 uW

Sideband Noise Power, CEPT

less than 70 dB

AF Input Impedance

560 ohm

Modulation Sensitivity

90 mV ±3 dB

(60%, $\Delta f = \pm 3 \text{ kHz}$, 1 kHz)

Modulation Response

300 - 3000 Hz (CEPT)

+1/-3.0 dB (+0.5/-2 dB)

relative to 1000 Hz, 6 dB/octave

400 - 2700 Hz

+1/-1.5 dB (+0.5/-1 dB) relative to 1000 Hz.

6 dB/octave

Modulation Distortion

fm= 1000 Hz: max. 3%

fm= 300 Hz: max. 5%

CQM5662: Δf= ±3 kHz

CQM5663: Δf= ±2,4 kHz

FM Hum and Noise

55 dB (57 dB)

CEPT (measured with 750 usec de-emphasis)

Attack Time

50 ms

Current Consumption

5 W: less than 2, 5 A (2 A)

20 W: less than 6.2 A (5.5 A)

GENERAL DESCRIPTION

CQM5660 S99

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls keyboard and display.

A comparison of the various models are presented in the table below.

Although compact in size, it contains a transmitter/receiver, a microcomputer controlled synthesizer and tone equipment, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 99 transmit and receive channels.

Туре	CQM5	662 S99	CQM5	663 S99
SPEC	5	20	5	20
Frequency Range MHz	420 -	- 470	420 -	470
RF Power W	5	20	5	20
Channel Spacing kHz	30,	/25	20)
Max. Number of Channels	99	9	9	9

ACCESSORIES

Standard accessories include:

Mounting frame
Power cable
Fist microphone with retainer or
Fixed - mount microphone
External loudspeaker
External switches

MN5001 Mounting frame for mobile installations allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.

MN703 Desk stand for fixed installations.

MN704a Mounting frame for mobile installations and direct attachment to the vehicle.

MC5001 Fist microphone with retractable spiral cable for mobile installation.

HS5001 Retainer for MC5001.

HS5002 Retainer, with switches, for MC5001

MC704 Microphone with chockabsorbing mounting bracket for mobile installation.

MC703 Desk microphone with PTT switch for fixed installations.

MK5001 Installation kit containing connectors, power cable, fuses and fuseholders.

LS701 Loudspeaker enclosed in a plastic housing, complete with cable.

SU701 Transmitter keying switch for mounting on the steering coloumn.

SU702 Transmitter keying switch for mounting on the dashboard.

PS702 Power supply regulator for 24 V car battery installations.

PS5001 Power supply for 220 V AC mains.

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls, display and keyboard are an integral part of the Control Panel.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded control panel and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB), and the Control Logic (CL) mount in the top section of the chassis.

Thin casted shields with adjustment holes are placed over the RF board and the synthesizer board in order to reduce spurious radiation.

RECEIVER DESCRIPTION

The receiver circuitry is placed on the RF board and can be divided into:

Receiver front end
1st IF section with first and second oscillator
455 kHz 2nd IF portion with demodulator.
Squelch
Audio Amplifier

(refer to functional block diagram)

FONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET

is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 21.4 MHz. The output from the crystal filter is fed to a dualgate MOSFET amplifier, Q501, the output signal of which is fed to the second mixer, U501, a single balanced, self-oscillating, active mixer. Out of the second mixer comes the 455 kHz IF signal. Two diodes, D501-502, limit the output from the mixer.

455 kHz IF/DEMODULATOR

The selectivity of the 455 kHz IF amplifier is formed by a ceramic filter fed from a 455 kHz amplifier/impedance transforming stage. The final 455 kHz amplification and limiting is performed by an integrated circuit, U502, which also contains the guadrature FM detector and the AF amplifier/output emitter follower for the audio line signal.

SQUELCH AND AUDIO CIRCUITS

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8 kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination charateristics of the circuit. A passive voltage doubler circuit (D603-D604) with high source impedance performs the action of an average

value rectifier. A Schmitt Trigger gives the necessary hysteresis and a well-defined output from the following buffer stage, Q605. In the squelched condition and during transmissions this output is +1.5 V and mutes the audio power amplifier. The transmit indicater is part of the muting function.

A push button switch, S601, cancels the squelch function, when depressed, by grounding the base of Q601.

AUDIO

In sets with Pilot tone option (CG), the audio line signal is fed to the Pilot tone board for filtering and back to the main board. In sets without CG this path is bypassed and the audio line signal is fed directly to the passive deemphasis network R629–C608 followed by the volume control. The volume control potentiometer R630 is mounted directly on the RF board and protrude through the front panel.

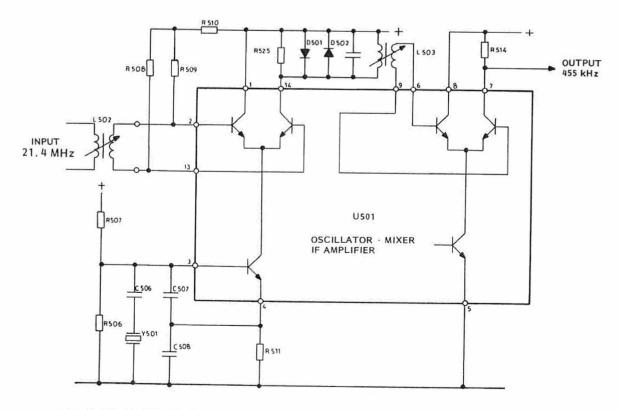


FIG. 1. SECOND OSCILLATOR, IF MIXER, AND IF AMPLIFIER

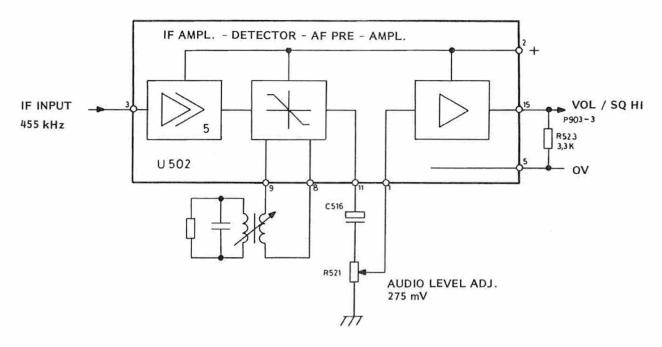


FIG. 2. IF AMPLIFIER, DETECTOR, AND AF PREAMPLIFIER

The audio output amplifier U601 is a monolithic IC package capable of driving the loud-speaker at the desired power level. The output amplifier can be muted with a DC signal from the audio mute gate, which combines different logic signals to deside whether the amplifier should be active or not. These inputs are:

Regulated TX Voltage Squelch cancel Squelch signal In sets equipped with Pilot tone and/or 5-tone sequential option, an RX mute function is routed from the option board to make the extra mute conditions possible. The value of C610 in the feed back loop is chosen as the best compromise between battery ripple rejection and receiver squelch attack time. The pilot lamp in the channel knob is supplied from A+, but controlled by the regulated 8.5 V via transistor Q968.

TRANSMITTER

The transmitter consists of a modulation processor, an exciter, and a power amplifier, all assembled on the RF board along with the receiver.

The exciter contains, an audio processor, all frequency multiplier functions, and includes those stages operating at low enough power levels to avoid heat sinks. The exciter output is at the carrier frequency when applied to the power amplifier. The power amplifier boosts the signal to the proper level, and in-

cludes a low pass filter for suppressing harmonics and a circuitry which permits adjustment of the operating power level. The PA low pass filter connects to the antenna relay via a stripline on the board.

MODULATION PROCESSOR

The signal from the microphone load R901 on the FS board is applied to amplifier U101b. The transmitter audio frequency response is shaped by the feedback network R104-R103-C104.

The modulation limiting is obtained in the feed-back network formed by D101, D102, R105, R106 and R107. The maximum permissible frequency deviation is set by a DEV. BAL. potentiometer on the FS board.

Amplifier U101A is operated as an active low-

Amplifier U101A is operated as an active lowpass splatter filter feeding the modulating input of the VCO on the Frequency Synthesizer board.

EXCITER

The exciter takes the synthesized signal, filters it to reduce spurious signals and amplifies it. Four amplifier stages (Q201-2-3-4) and four filters (L204-5-8-9) are used in a narrow band design which limits the maximum frequency spread of the transmitter. The exciter has three test points (TP201-2-3) for measurements and alignment.

POWER AMPLIFIER

The PA is constructed on the main board and employs two broadband untuned amplifier stages Q205, Q206. Two amplifier configurations are available providing options of power levels of 10 watts or 25 watts. A power control circuit is included to sense the output RF level and keep it constant with variations in temperature and supply voltage. This circuit also limits the peak power to less than maximum, as specified by the authorities, while still maintaining the output as near maximum as possible. The output power level can be set with a potentiometer, R215, over at least a 3:1 range. The transmitter delivers rated power into a 50-ohm load. A load SWR of 1.4:1 will result in more than 90% of the power being radiated. The transmitter will operate into a load with up to 3:1 SWR.

The power adjustment is achieved by controlling the supply voltage of power amplifier Q205 via transistor Q207. This series transistor is based by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

FREQUENCY SYNTHESIZER AND CONTROL LOGIC

The frequency synthesizer FS5661 provides up to 99 channels and is built on a printed wiring board which mounts in the top section of the radioset.

The frequency of the synthesizer board is set by a binary code from the control logic board CL5001 which is placed over the main section of the synthesizer board.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module, and it has two connectors at the rear for accessories and the power supply cable.

SUPPLY VOLTAGE DISTRIBUTION SYSTEM

The battery voltage (A + BATT) enters the radio via two pins of the rear system connector to the synthesizer board. Both inputs are connected to reverse polarity protection diodes D741, D742. The ground lead comes through the same connector and is connected to chassis ground through a fusable printed wiring path which will open in case of the ground wire being accidently connected to A +.

One battery input goes directly from the synthesizer board via a feed-through capacitor and a connector P907 to the transmitter PA stages. The other input feeds through P903 – J903 to the RF board for two functions. One branch for the audio amplifier passes through an RC-ripple filter R638 – C618 and one of the ON/OFF switch sections S602. The other section of the ON/OFF switch controls the V_B + to the voltage regulator U602 consisting of a monolitic regulator. The regulator output is fixed at 8.5 V by means of a factory adjusted resistor.



Regulated 8.5 V is switched to either the receiver or the transmitter by the antenna relay. The antenna relay is also supplied by the 8.5 V regulated.

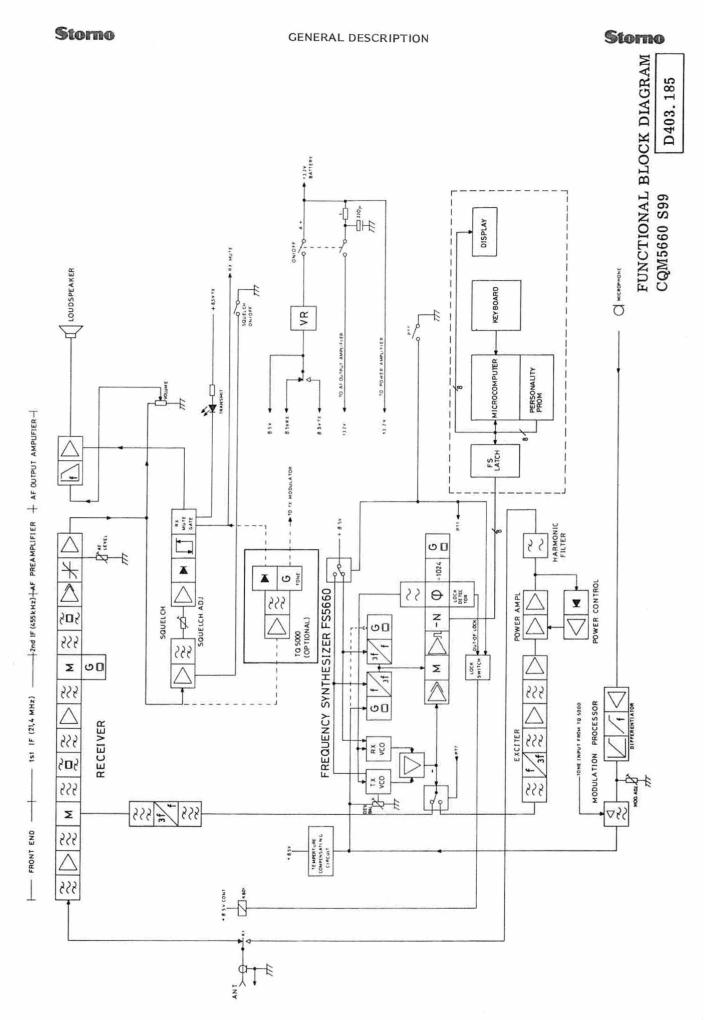
The squelch circuit, the modulation processor, parts of the IF amplifier U502, and the Frequency Synthesizer is supplied directly from the continuous 8.5 V.

The receiver front-end, the 10.7 MHz IF stages and the second oscillator are supplied from 8.5 V RX. The transmitter exciter is supplied from 8.5 V TX.

In sets with 5-tone sequential option or Pilot tone, the PTT (Push to talk) lead runs through the option board to provide for correct tone keying function.

WARNING

The transmitter PA transistors contain Beryllia which is poisonous when absorbed by the human body. Dissection, filing, or grinding of these transistor may be hazardous.



Storno

CHANNEL PROGRAMMING INSTRUCTIONS

COM5660 S99

Programming of the PROM which contains the personality data will normally be part of the factory process, but it may also be field programmed.

The PROM programming unit must be approved by the PROM manufacturer, as for example (DATA I/O SYSTEM 19).

The programmer consists of the following items:

Programmer (DATA I/O SYSTEM 19)
Programming Pak, interchangeable
Socket adaptor
or universal programming pack.

DATA I/O UNIPAK

(adaptable for more than 200 types of PROM devices).

To program a PROM the channel frequencies for all allocated channels and the channel spacing must be known.

It is recommended to complete a worksheet when calculating the PROM data.

It is also possible to use a computer to calculate the PROM data and Storno will be able to supply software programs for certain types of computers.

Operating instructions for the Programmer is supplied by the vendor.

WORKSHEET

For each PROM to be programmed a worksheet should be completed to calculate the input data for each channel.

The procedure for completing the worksheet is:

- Complete list of receiver channel frequencies. (A).
- Complete list of transmitter channel frequencies. (B).
- Find highest (H) and lowest (L) receiving frequencies.
- Find highest (H) and lowest (L) transmitting frequencies.
- Select receiver mixer crystal frequency (C) from table 1. The highest and lowest receiver frequencies must be within the selected band.
- Select transmitter mixer crystal frequency (D) from table 2. The highest and lowest transmitter frequencies must be within the selected band.
- Note channel spacing and Reference frequency (F). See worksheet.
- 8. Use receiver formula to calculate "VDEC" (divisor) for all receiver channels.
- Use transmitter formula to calculate "V_{DEC}" (divisor) for all transmitter channels.
- Check "V_{DEC}" for all channels to be between 256 and 511.
- Use receiver crystal frequency and V_{DEC} to check for selfquieting frequencies, table 3.
- In case of selfquieting select appropriate alternative and possibly recalculate "V".
- Convert all "V_{DEC}" numbers to hexadecimal code. Refer to tabel 4.
- Assign the hexadecimal codes to the corresponding channels and the PROM adresses.

After completing the worksheet enter correct Prom addresses and corresponding data (V_{HEX}) on the Programmer (DATA I/O), refer to Programmer Operating Instructions.

RECOMMENDED CRYSTAL FREQUENCIES

CQM5660 S99

		T
CQM5662	CQM5663	
FREQUENCY RANGE	FREQUENCY RANGE	RX CRYSTAL
140 0 VOI 0000		
418.6 - 424.9755	417.32 - 422.42	48. 177777
421.1 - 427.4755	419.82 - 424.92	48. 455555
423.6 - 429.9755	422.32 - 427.42	48.733333
426.1 - 432.4755	424.82 - 429.92	49.011111
428.6 - 434.9755	427.32 - 432.42	49.288888
431.1 - 437.4755	429.82 - 434.92	49.566666
433.6 - 439.9755	432.32 - 437.42	49.844444
436.1 - 442.4755	434.82 - 439.92	50. 122222
438.6 - 444.9755	437.32 - 442.42	50.399999
441.1 - 447.4755	439.82 - 444.92	50. 677777
443.6 - 449.9755	442.32 - 447.42	50.955555
446.1 - 452.4755	444.82 - 449.92	51.233333
441.4 - 447.7755	440.12 - 445.22	45. 955555
443.9 - 450.2755	442.62 - 447.72	46.233333
446.4 - 452.7755	445.12 - 450.22	46.511111
448.9 - 455.2755	447.62 - 452.72	46.788888
451.4 - 457.7775	450.12 - 455.22	47.066666
453.9 - 460.2775	452.62 - 457.72	47.344444
456.4 - 462.7755	455.12 - 460.22	47.622222
458.9 - 465.2755	457.62 - 462.72	47.899999
461.4 - 467.7755	460.12 - 465.22	48.177777
463.9 - 470.2755	462.62 - 467.72	48.45555
466.4 - 472.7755	465.12 - 470.22	48. 733333
468.9 - 475.2755	467.62 - 472.72	49.011111

TABLE 1. RECEIVER MIXER CRYSTAL FREQUENCY

RECOMMENDED CRYSTAL FREQUENCIES

CQM5660 S99

p		
CQM5662 FREQUENCY RANGE	CQM5663 FREQUENCY RANGE	TX CRYSTAL
420.0 - 426.375	418.72 - 423.82	45. 955555
422.5 - 428.875	421.22 - 426.32	46. 233333
425.0 - 431.375	423.72 - 428.82	46. 511111
427.5 - 433.875	426.22 - 431.32	46. 788888
430.0 - 436.375	428.72 - 433.82	47. 066666
432.5 - 438.875	431.22 - 436.32	47.344444
435.0 - 441.375	433.72 - 438.82	47.622222
437.5 - 443.875	436.22 - 441.32	47.899999
440.0 - 446.375	438.72 - 443.82	48.177777
442.5 - 448.875	441.22 - 446.32	48.455555
445.0 - 451.375	443.72 - 448.82	48.733333
447.5 - 453.875	446.22 - 451.32	49.011111
450.0 - 456.375	448.72 - 453.82	49.288888
452.5 - 458.875	451.22 - 456.32	49.566666
455.0 - 461.375	453.72 - 458.82	49.844444
457.5 - 463.875	456.22 - 461.32	50. 122222
460.0 - 466.375	458.72 - 463.82	50. 399999
462.5 - 468.875	461.22 - 466.32	50. 677777
465.0 - 471.375	463.72 - 468.82	50. 955555
467.5 - 473.875	466.22 - 471.32	51. 233333

TABLE 2. TRANSMITTER MIXER CRYSTAL FREQUENCY



SELFQUIETING FREQUENCIES CQM5662 S99

RECEIVER CRYSTAL	V	USE
FREQUENCY. MHz	DEC	ALTERNATIVE [†]
All crystal frequencies 48.177 48.177	428 265 274	1 2 4
48.733	416	4
48.733	459	4
49.844	466	2
50.122	366	2
50.399	266	2
50.399 47.622	397 465	2
47.899	328	2

⁺refer to worksheet

TABLE 3A. SELFQUIETING FREQUENCIES



SELFQUIETING FREQUENCIES CQM5663 S99

		T.
RECEIVER CRYSTAL	V	USE
FREQUENCY. MHz	DEC	ALTERNATIVE ⁺
48. 177	278	4
48. 177	286	2
48. 177	331	4
49. 566	290	4
50.122	458	4
50. 122	503	4
50.399	333	2
50.399	378	2
45. 955	284	4
46. 511	374	2
46.788	375	4
47.899	399	4
47.899	411	4
47.899	456	2
48. 177	274	4
48. 177	286	4
48.177	331	4
48.177	420	2
48.733	390	4
48.733	394	2
49.011	265	4

⁺refer to worksheet

TABLE 3B. SELFQUIETING FREQUENCIES

HEX CODE CONVERSION TABLE

	0	-	2	3	4	5	9	7	80	6	⋖	В	U	۵	Ш	ш
	256	257	258	259	260	261	262	263	797	265	266	267	268	269	270	271
	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
	288	289	290	291	292	293	794	295	296	297	298	299	300	301	302	303
<u>г</u>	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
7	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
2	336	337	338	339	340	341	345	343	344	345	346	347	348	349	350	351
9	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
_	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
6	400	401	405	403	404	405	904	407	408	604	410	411	412	413	414	415
⋖	۱ 416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	43.1
Δ	3 432	433	434	435	436	437	438	439	044	441	442	443	444	445	944	447
<u> </u>	844	644	450	451	452	453	454	455	456	457	458	459	0917	461	462	463
Δ	h9h (465	991	467	894	694	470	471	472	473	474	475	9/4	477	478	479
ш	480	481	482	483	484	485	981	487	488	684	064	491	492	493	464	495
Щ	964 :	467	864	664	200	501	502	503	504	202	206	202	208	209	510	511
₩ W	↑ Most Significant Digit of Hex	ficant D	igit of		Code.				"VDEC" Numbers.	nbers.						

Example "VDEC"= 345 equals to hex code 59.
"VDEC"= 469 equals to hex code D5.

-MSD

"V" Number to hex code conversion table.

-Least Significant Digit (LSD) of Hex Code

Table 4.

PROGRAMMING WORKSHEET

FOR CQM5660 S99

NEL, MHz H DEC F 1 2 3 4 4 5 6 6 7 7 8 9 10 11 12 RECEIVER MIXER CRYSTAL FREQ. (Y702). C=	HEX ADDRESS (HEX)	TRANSMITTER MIXER CRYSTAL FREQ. (Y701) DE	HEX ADDRESS (HEX)
AIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FR	EQ. (Y701) D=
AIXER CRYSTAL FREQ. (Y702): C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
MIXER CRYSTAL FREQ. (Y702). C=		TRANSMITTER MIXER CRYSTAL FRI	EQ. (Y701) D=
420 - 450 MHz: V _{DEC} = (A +21.4) - (C × 3 × F 440 - 470 MHz: V _{DEC} = (A -21.4) - (C × 3 × F	(C × 9)	DEC DEC	3 × F
V _{DEC} = (A -21.4) - (C 3 × F	×		
CHANNEL SPACING:	REFERENCE CRYSTAL (Y703):	REFERENCE FREQUENCY:	
20 KHz 25 KHz	6.8266 MHz 8.5333 MHz	F= 0.006666 F= 0.008333	
LIST OF REFERENCE CRYSTALS (Y703)	STALS (Y703)	ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:	HE RECEIVER IS SELFQUIETING:
MODE FREQUENCY, MHz Standard 5662 8.5333333 Standard 5663 6.8266666	, MHz PART No. 333 19J706361P3 666 19J706361P4	 SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCI Y501= 21.85500 MHz INSTEAD OF 20.945000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL 	SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY SELECT HIGH INJECTION FREQUENCY FOR 2nd OSCILLATOR Y501= 21.85500 MHz INSTEAD OF 20.945000 MHz USE SLIGHTLY OFFSET REFERENCE CRYSTAL

Stormo

ADJUSTMENT PROCEDURE

CQM5660 S99

This adjustment procedure applies to the following radiotelephone types:

CQM5662: 30/25 kHz Channel spacing CQM5663: 20 kHz Channel spacing

Before making adjustments to the radiotelephone transmitter/receiver, read the type label and note the channel frequencies. Check all straps according to the notes on the diagrams. Also check the selective calling tone equipment, if any, against the coding instructions; refer to description of tone equipment.

All screens must be in place and properly secured during the adjustments.

MEASURING INSTRUMENTS

The following list contains instruments necessary for adjusting the radiotelephone and checking its performance characteristics:

DC Voltmeter

 $R_{in} \ge 1$ Mohm

AC Voltmeter

 $Z_{in} > 1 \text{ Mohm}//50 pF$

Multimeter

 $R_i \ge 20 \text{ Kohm/Volt}$

Distortion meter

e.g. Storno E11c

RF Watt meter

25 W/50 ohm/420-470 MHz

Deviation meter

420-470 MHz

RF generator

Z_{out}= 50 ohm; 420-470 MHz

21.4 MHz signal generator

e.g. Storno TS-G21B

Frequency counter with attenuator

Z_{in} = 50 ohm; sensitivity

100 mV at 470 MHz

RF diode probe

Storno 95,0089-00

RF coaxial probe

Storno 95. 0179-00

DC power supply

10.8 V - 16.6 V; 6A

Oscilloscope

0 - 5 MHz min.

MISCELLANEOUS

4 ohm/3 W resistor

3 x Storno code 82, 5026-00

capacitor

22 uF/40 V electrolytic

Storno code 73, 5107-00

Connector, 11-pin house

Storno code 41, 5543-00

Connector, 8-pin house Pins for connectors

Storno code 41.5542-00 Storno code 41,5551-00

Trimming tools

The following tables show the frequency ranges of the CQM5660 S12 radiotelephone sig-

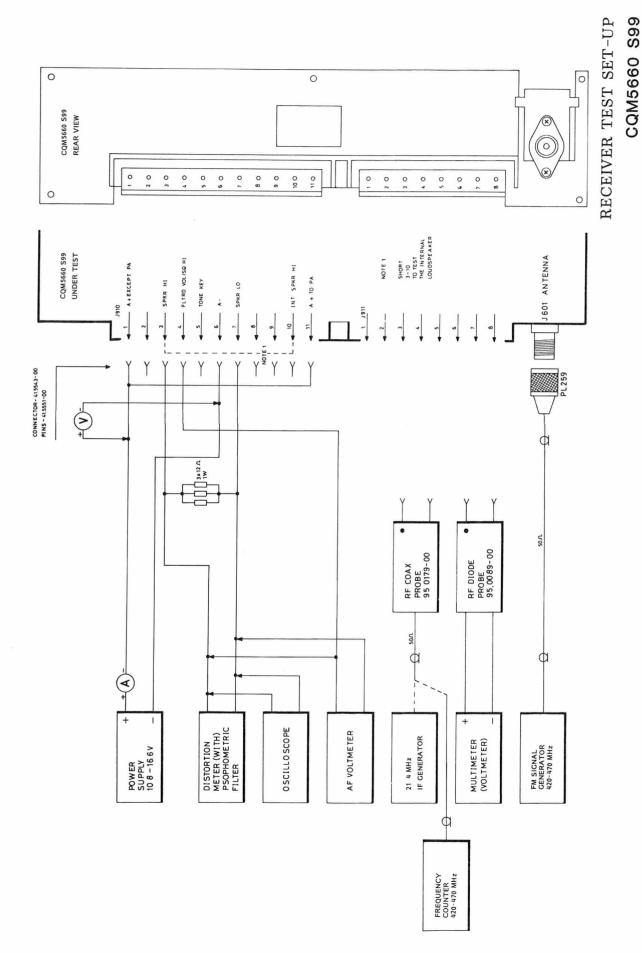
SIGNAL	FREQUENCY MHz	
TX VCO	140 - 156	
TX crystal	45 - 50	
TX crystal multiplication	×3	
RX VCO	139 - 157	
RX crystal	47 - 50 (420 - 450)	
7	45 - 48 (440 - 470)	
RX crystal multiplication	×3	

Table 1.

Channel	Reference	Min. Divider	Max. Divider	Reference
spacing	Crystal	input frequency	input frequency	frequency
kHz	MHz	MHz	MHz	kHz
20	6.8266	1. 7066	3.4066	6.666
30 or 25 ¹⁾	8.5333	2. 1333	4.2583	8.333

Table 2

¹⁾ Two steps per channel



RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ±0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code	R636 Value	
Brown	omit	
Red	270	
Orange	100	
Yellow	47	
Green	22	
Blue	6.8	

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: ≤50 mV

Repeat the procedure with the power supply adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and PROM codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 45 mV ± 15 mV

(corresponding to -10 dBm

to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum ana-

lyzer.

Receiver VCO

Connect the multimeter, 10 V range, to test point TP706. The synthesizer's lock signal is accessible at TP706. +8 V DC with very narrow pulses (0.1 u sec) indicates normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "Low". Select the channel whose frequency is closest to the center frequency.

Await locked condition, constant voltage. Adjust C745 for 8 Volts on the multimeter. Connect the multimeter to test point TP703. Adjust C745 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 3.

Requirement: The voltage shall be in the ran-

ge 1.5 V to 6.5 V and not deviate from the graph by more

than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

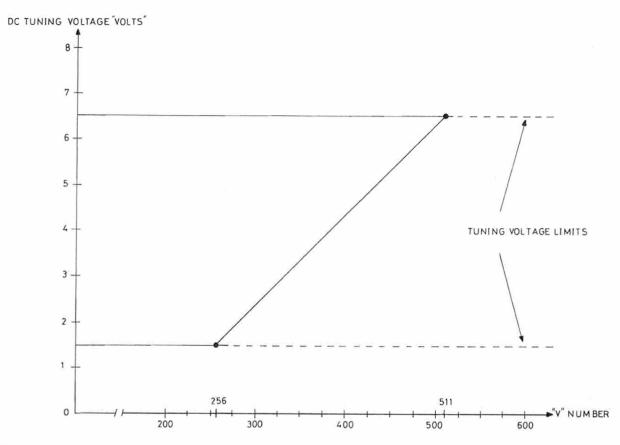


Fig. 1. Tuning voltage vs. V. number.

f= f_X x 3 (f_X = crystal frequency) Adjust L711 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25°C. ppm= parts per million= 10^{-6}

Injection Frequency

Connect coax probe 95,0179-00 to test point TP401.

Connect the frequency counter to the probe. Calculate the injection frequency for all channels.

f_{inj}= f_{ant}-21.4 (MHz) Select, one by one, the channels and read

the injection frequency.

Requirement: F_{ini} ±0.2 ppm

IF AMPLIFIERS

Connect a 21.4 MHz signal generator to TP401 via coax probe 95.0179-00.

Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range).

During adjustment the RF generator output must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter,

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95,0089-00 and the multimeter to test point TP501. (50 uA range). Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection. Detune L406: Adjust L405 and L407 for maximum deflection on the multimeter.

Adjust L406 for maximum deflection. Readjust L401 and L402 for maximum deflection.

Remove the RF diode probe.

Standard Test condition:

Connect the RF generator to antenna connector and adjust the output to 1 mV e.m.f. Modulate the RF generator with 1000 Hz to 60% of Δf max.

CQM5662 S12/S99

±3 kHz

CQM5663 S12/S99

±2,4 kHz

Connect a 4 ohm/3 W resistor load to connector J910/3-7 (SPKR HI-SPKR LO).

Connect an AF voltmeter to J910/4-7 (FLTD VOL SPKR LO).

IF DEMODULATOR

Turn R521 halfway up.

Adjust L504 for maximum reading on the AF voltmeter.

Connect a distortion meter and AF voltmeter across the 4 ohm resistor. (if Storno E11c distortion meter is used switch the function to AF voltmeter).

Adjust the volume control for approx. 2 V across the load.

Adjust L501 and L406 for minimum distortion. The demodulated signal may be monitored on an oscilloscope connected in parallel with the distortion meter.

Connect the AF voltmeter and distortion meter to J910/4-7 (FLTD VOL - SPKR LO).

Adjust R521 for a reading of 275 mV on the AF voltmeter.

Requirement: 275 mV ±5 mV,

Read the distortion.

Typical Total Harmonic Distortion (THD) will be less than 5%.

RECEIVER SENSITIVITY

EIA or CEPT method may be used.

Method of measurement CEPT

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 20 dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20 dB below 100, which was our reference condition.

In practice our first condition is achieved by feeding a minimum of 1000 uV of RF- signal modulated with 1000 Hz at $60\% \Delta f$ max. to the receiver.

The audio output (which must be at least 100% of the receiver's audio rating) is measured through the psophometric filter, 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 is now adjusted for a 10% reading on the distortion meter scale.

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 20 dB ratio between signal + noise + distortion and noise + distortion, i.e. 20 dB SINAD sensitivity.

EIA Method

EIA (Electronic Industries Association)
Standard, definition:

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

The EIA method differs from CEPT by omitting the psophometric filter, adjusting the RF generator for $2/3 \times \Delta \text{fmax.}$, and measure the distortion at 50% of the receiver's rated AF power. The SINAD sensitivity is measured as a 12 dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

ADJUSTING THE SENSITIVITY

Lower the RF generator output to obtain 20 dB SINAD (10% THD as measured with the

distortion meter). Readjust L402 for the best SINAD value, e.i. lowest generator output for 10% THD.

MEASURING 20 dB SINAD (CEPT)

Adjust the volume control for 2.45 V (1.5 W/ 4 ohm) as measured with an AF voltmeter across the load.

Adjust the RF generator output to obtain 20 dB SINAD condition.

Read the 20 dB SINAD sensitivity (e.m.f.) Requirement: \leq 1.0 uV.

The sensitivity should be measured on all channels, if more than one.

MEASURING 12 dB SINAD (EIA)

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load.

Adjust the RF generator to obtain 12 dB SINAD condition.

Read the 12 dB SINAD sensitivity. Requirement: \leq 0.4 uV ($\frac{1}{2}$ e.m.f.) The sensitivity should be measured on all channels, if more than one.

AUDIO FREQUENCY RESPONSE

Set the signal generator to Standard Test Condition.

Adjust the volume control for 0.82 V across the load. (4 ohm across (SPKR HI - LO). At 13.2 V supply, $\Delta F = 60\% \Delta F$ max and 1000 Hz measure the output voltage according to the following table:

A STATE OF THE STA	Frequency	Level	Tol.
CQM5662 S12/S99	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
CQM5663 S12/S99	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 420 – 470 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels. The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB. Requirement: Quieting <6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.
Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load). Measure the distortion (THD). Requirement: THD \leq 5%.

SQUELCH

Release the squelch cancel button.

Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

CURRENT CONSUMPTION

CONDITION

S12

S99

Standby

<350 mA

<1000 mA

Receive ~ 2.83 V r.m.s.

2 W AF/<750 mA 3 W AF/<1450 mA

across 4 ohm.

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

20 W transmitter:

7 A

5 W transmitter:

4 A

Refer to Receiver Alignment for measuring 8.5 V regulated supply. Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95,0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

40 mV ± 15 mV

(corresponding to -10 dBm to -4 dBm)

Note:

Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the multimeter, 10 V range, to test point TP706.

The synthesizer's lock signal is accessible at TP706 and +8 V DC with very narrow pulses (0.1 u sec.) indicate normal locked condition. Unlocked condition is indicated by a variable duty signal or logic "LOW".

Select the channel whose frequency is closest to the center frequency. Key the transmitter. Await locked condition.

Adjust C737 for 8 Volts on the multimeter. Connect the voltmeter to test point TP703. Adjust C737 for a voltage corresponding to the variable divider ratio (V) as indicated by the graph fig. 1.

Requirement: The voltage shall be in the range 1.5 V to 6.5 V and not deviate from the graph by more than 20%.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP702.

Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f_{\times} \times 3$ ($f_{\searrow} = crystal frequency$). Adjust L701 to the calculated frequency. Requirement: $f \pm 0.3$ ppm at 25° C.

ppm= parts per million= 10⁻⁶

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER

Connect a multimeter (1.0 V range) to test point TP201.

Adjust L203 for minimum deflection. The dip is small,

Connect the multimeter, (1 V range) to test point TP202.

Adjust L204 for maximum deflection on the multimeter, typical 0.7 V.

Repeat the adjustments of L203, L153, and L151 (L921-L926) until no further improvements is obtainable.

Adjust C213 for minimum reading. The dip is small.

Connect the multimeter, 1 volt range, to test point TP203.

Adjust C215 for maximum reading on the multimeter, typical 0.5 V.

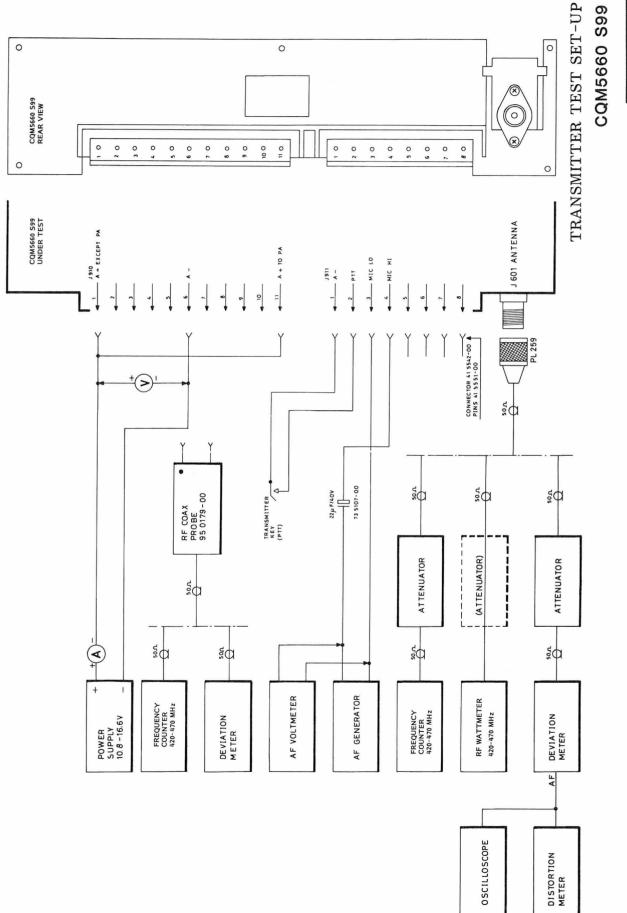
Repeat the adjustment of C213 and L204 until no further improvement is obtainable.

Adjust C221 m inimum deflection. The dip is small and careful tuning is required.

Connect the multimeter, 10 volt range, to the RF probe.

Connect RF diode probe 95, 0089-00 to TP204. Adjust C221 and C223 for maximum deflection (typical 4.0 V).

Adjust the PA power control, R215, for rated transmitter power, 5 W or 20 W.



EXCITER, FINE ADJUSTMENT

Connect the multimeter to test point TP201.
Readjust L153 for maximum reading.
Connect the multimeter to test point TP202.
Peak L203 and L204 for maximum reading.
Connect the multimeter to test point TP203.
Connect C213 and C215 for maximum reading.
Connect the 95.0089-00 RF probe and multimeter to TP204.

Adjust C221 and C223 for maximum reading.

TYPICAL TEST POINT READINGS

TP201:

0.2 V

TP202:

0.7 V

TP203:

0.5 V

TP204:

4.0 V

TRANSMITTER FREQUENCY ADJUSTMENT

Connect a frequency counter through a suitable attenuator to the antenna connector J601. Key the transmitter.

Select one by one, the channels and read their frequencies.

Adjust L701 for best frequency tracking on all channels,

Requirement: $F = F_{ant} \pm 0.2 \text{ ppm}$, $ppm = parts \text{ per million} = 10^{-6}$

RF POWER OUTPUT, CURRENT CONSUMPTION, AND POWER CONTROL

Connect the Watt meter to the antenna connector, J601.

Increase the supply voltage to 13.2 V. The voltage is measured directly at the input connector J910.

Readjust the PA power control, R221, for rated transmitter power (P), 20 W or 5 W. Requirement: $P_{nom} \pm 0.2$ dB.

Measure the RF power output at 16 V, 13.2 V and 10.8 V.

Requirements (20 W):

CQM5660		S12	S99
Voltage	Power	Current	Current
16.6 V	<25 W (ref) ≤5.4 A	≤6.1 A
13.2 V	20 W	≤5.4 A	<6.1 A
10.8 V	≥20 W	≤5.4 A	<6.1 A

Requirements (5 W):

CQM5660		S12	S99
Voltage	Power	Current	Current
16 V	\leq 6.5 W	≤1.7 A	<2.4 A
13.2 V	5 W	≤1.7 A	<2.4 A
10.8 V	≥3.5 W	≤1.7 A	<2.4 A

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V. Select the channel having the highest frequency. Set R116 to mid-position.

Connect coax probe 95.0179-00 to test point TP701.

Connect a deviation meter to the coax probe.

Connect a distortion meter and oscilloscope to the deviation meter output.

Connect a AF generator and an AF Voltmeter to the microphone input via a 22 uF capacitor; refer to test setup.

Set the AF generator to 1000 Hz.

Adjust the AF generator output to 1 V r.m.s. This voltage is approx. 20 dB above the nominal modulation input level (60% Δ f max) to ensure full limiting in the modulation processor.

Note the deviation read at TP701.

Connect the deviation meter to test point TP702.

Adjust R752 (Dev. Bal.) for same deviation as measured at TP701.

Disconnect the deviation meter from the coaxprobe and connect it through an attenuator to the antenna connector, J601.

Find the AF frequency between 200 Hz and 3000 Hz giving the greatest frequency deviation as read on the deviation meter with the transmitter keyed.

Check the maximum deviation for both positive and negative deviation polarity. At that audio frequency set the maximum frequency deviation Δf max with R116.

Type	Channel spacing	Δf max
CQM5662	30/25 kHz	±5 kHz
CQM5663	20 kHz	±4 kHz

Requirement

Difference between + and - deviation: <10%

MODULATION SENSITIVITY AND MODULATION DISTORTION

Set the AF generator frequency to 1000 Hz Adjust the generator output until 60% of Δf max is obtained on the deviation meter.

CQM5662 : ±3.0 kHz CQM5663 : ±2.4 kHz

Read the AF generator output and measure the modulation distortion on the audio output of the deviation meter.

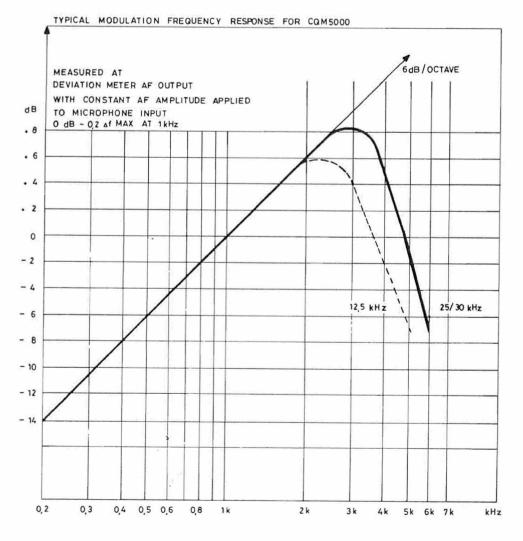
Requirements:

Modulating signal: 75 mV ±3 dB

Distortion:

< 7%

(measured without deemphasis)



MODULATION FREQUENCY RESPONSE

Set the AF generator to 1000 Hz. Reduce the AF generator output until a deviation of 0.2 \times Δf max is obtained on the deviation meter.

CQM5662 : ± 1.0 kHz CQM5663 : ± 0.8 kHz Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

Requirement:

Within the frequency range 400-2700 Hz the frequency characteristic shall lie within +1 dB/-1.5 dB related to a 6 dB/octave characteristic.

With 6 kHz modulation frequency the deviation shall be attenuated at least 6 dB below the 1 kHz value.

CHANNEL FREQUENCY SYNTHESIZER

FS5661 and FS5662

The frequency synthesizer generates up to 12 channel frequencies for a STORNOPHONE 5000 operating in the 420 - 470 MHz band. It is built on a printed circuit board which mounts in the top section of the radio set. There are two versions of the board, a single channel board, FS5661 and a multichannel board FS5662. The frequency of the single channel board is set by putting a binary code directly on the programmable divider input while the multichannel board channels are selected with a channel selector and a Frequency Control unit, FC5001. The channel selector is mounted directly on the board and protrudes through the front panel, and the Frequency Control module FC5001, fits into the cast shield which is placed over the main section of the synthesizer board.

A metal shield is placed underneath the os-

cillator and mixer sections of the board.

All circuitry can be accessed and operated for repair and maintenance without the shields and with the FC5001 in its socket.

The Frequency Synthesizer board also carries all interconnections between the tone modules and the RF module and has two connectors at the rear for accessories and power supply cables.

The channel programming is contained in a 256 bit PROM placed in a socket on the Frequency Control module. The PROM can be field programmed if the necessary programming equipment is available. Programming equipment and procedures must be approved by STORNO and the PROM manufacturer, refer to the Channel Programming Instructions.

CIRCUIT DESCRIPTION

The Frequency Synthesizer generates the local oscillator injection for the receiver and a modulated exciter signal for the transmitter. The circuit is a single-loop phase-locked frequency generator.

The synthesizer frequency is controlled by three crystals, one reference crystal and two mixer crystals, and by a PROM.

The synthesizer can be reprogrammed for new frequencies if these are within the maximum frequency spread of the STORNOPHONE 5000.

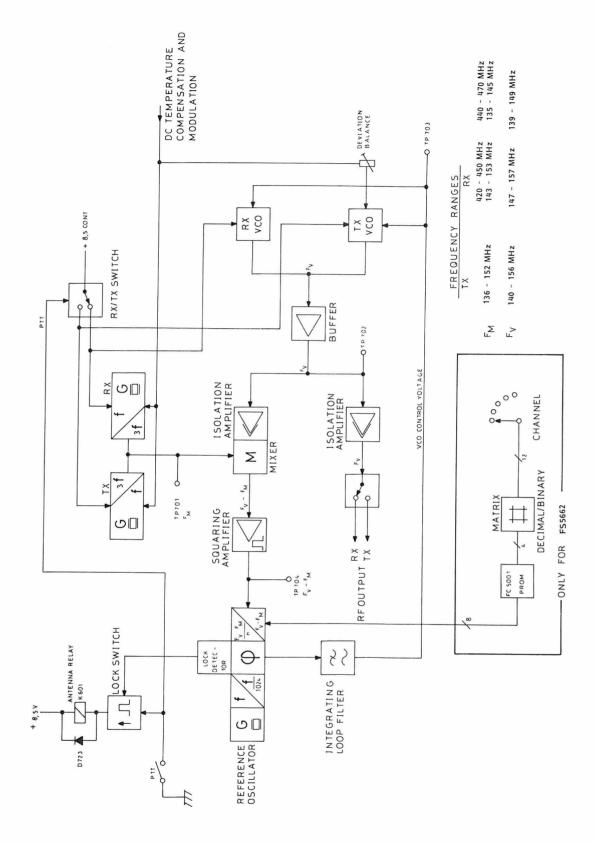
Two voltage controlled oscillators (VCO) are generating the signals which are used as injection for the receiver mixer and excitation signal for the transmitter. The frequency of

each VCO can be preset to any frequency within the band by a variable capacitor, and the fine adjustment is controlled by a variable capacitance diode, varicap, and the phase detector output. The control voltage for the varicaps is filtered in a loop integrating filter. The TX VCO has an additional varicap which is used to modulate the transmitter.

The Push-to-talk switch controls a transistor switch, which switches the supply voltage between the RX VCO and the TX VCO.

The output signal from the VCO's are fed into a buffer amplifier which protects the VCO from load changes.

The buffer amplifier's output is applied to an



BLOCK DIAGRAM FS5661, FS5662

D402.934

isolation amplifier and a diode switch before entering the RF board.

The buffer amplifier also connects to another isolation amplifier via a resistive attenuator and feeds the signal to the synthesizer mixer.

The synthesizer mixer mixes the VCO signal and the crystal oscillator signal to a frequency which is within the dividing capability of the programable divider.

Separate crystal oscillators are used in the receive and transmit mode, respectively, and they are both third mode oscillators.

A temperature compensating voltage is applied to the crystal oscillators only in the 5 p.p.m. version. This voltage is kept constant in the 10 p.p.m. version by cutting a diode on the RF board.

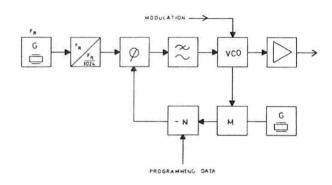


Fig. 2. Phase Locked loop Principle

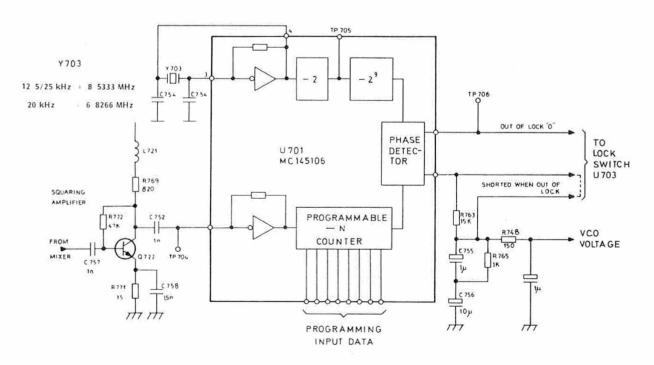
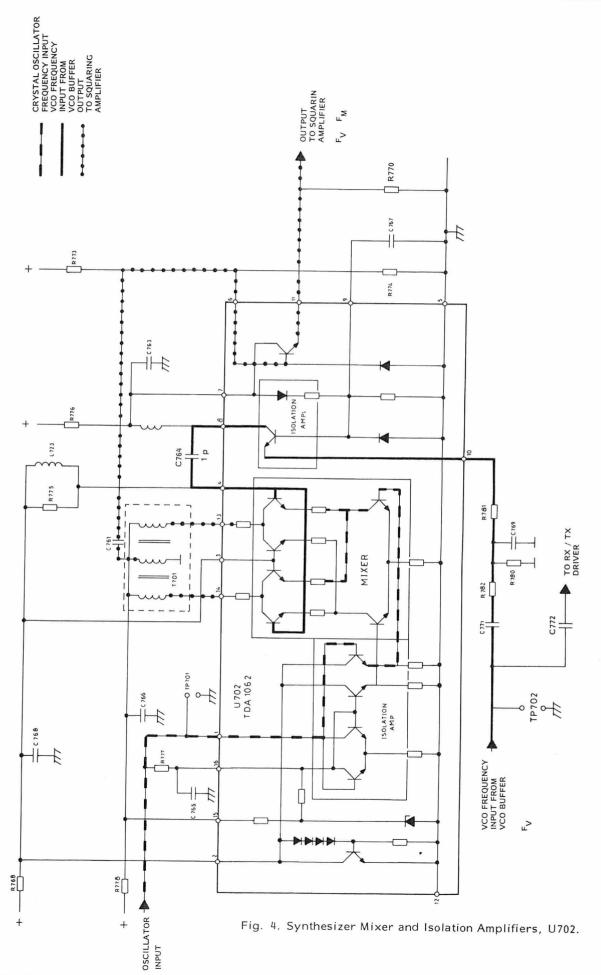


FIG. 3. REFERENCE OSCILLATOR, DIVIDER, AND PHASE DETECTOR



The output from the synthesizer mixer is fed to a squaring amplifier which drives the programmable divider and this divides the frequency by 256 to 511 depending on the logic levels on the 8-bit binary control input. The input frequency range for the divider differs according to the channel spacing and is shown in fig. 3.

The phase detector produces a waveform with variable duty cycle which depends on the phase and frequency difference between its two input signals. The operating frequency range of the phase detector is 1.7 kHz to 3.5 kHz and it depends on the channel spacing.

The reference frequency is generated in a crystal oscillator whose output is divided by 1024 and applied to the phase detector.

The output from the phase detector passes through a passive integrating filter which produces a DC voltage proportional to the duty cycle of the phase detector output. This voltage adjusts the frequency of the VCO.

An out-of-lock circuit inhibits the transmitter when the synthesizer loop is out of lock and hunting for the frequency.

The transmitter modulation is applied simul-

taneously to the transmitter mixer-oscillator and the VCO. The modulation bandwidth also covers sub-audio frequencies used for channel guard (pilot tones). The frequency deviation balance adjustment equalizes the deviation on both oscillators to ascertain low distortion and low noise reference side bands during modulation of the synthesizer because it is operating with a relatively large loop bandwidth.

The frequency control module, FC5001, is built on a separate wiring board which mounts on top of the synthesizer shield. This module converts the BCD-code (4 bits) from the channel selector to an 8-bit binary code for the programmable divider in the synthesizer loop. These 8-bit codes are programmed into a PROM (Programmable Read Only Memory) and are dividing factors expressed in hexadecimal codes.

On the FC5001 is a 5-Volt regulator which supplies the voltage for the PROM. When the PTT button is pushed the transistor Q801 converts the PTT voltage level to TTL level and puts a logic "0" on the MSB (Most Significant Bit) on the address input of the PROM. This selects the PROM code for the corresponding transmitter channel. The PROM outputs have open collectors with external pull-up resistors.

TECHNICAL SPECIFICATIONS

Supply Voltage

+8.5 Volts regulated

+13.2 Volts unregulated

Current Consumption

max. 80 mA (+8.5 V)

max. 200 mA (+13.2 V)

Channel Spacing

30/25 kHz

20 kHz

Modulation Input

0.75 V r.m.s. ±2 dB

 $\Delta f= 60\%$, $f_{mod}=1$ kHz

Modulation Bandwidth

70 - 3000 Hz

Modulation Distortion

<4%

70 - 300 Hz: <5%

1 kHz:

DC Temperature Stabilization Voltage

 25° C= 6 V ± 10% (reference)

 -30° C= +350 mV ± 10%

 -10° C= $-50 \text{ mV} \pm 10\%$

 $+60^{\circ}$ C= +50 mV ± 10%

The voltage characteristic is approximately

linear between these points.

RF Output Level

4 mW ±1 mW

(open collector output connected to tuned

circuit)

TX Output Frequency Range

420 - 470 MHz (VCO)

RX Output Frequency Range (VCO)

420 - 450 MHz: 147 - 157 MHz

440 - 470 MHz: 139 - 149 MHz

Frequency Stability

5 p.p.m. or 10 p.p.m. $(p.p.m. = 10^{-6})$

Reference Crystal Frequency

20 kHz: 10.240 MHz

12.5/25 kHz: 12.800 MHz

Signal-to-Noise Ratio (S/N)

>100 dB

 Δf = 25 kHz, BW (Bandwidth) = 10 kHz

Spurious Attenuation

>85 dB

Lock Time

<30 m sec.

for 1 MHz step

Logic Control Level

LOW= <2 V

HIGH= >6 V

8 bit binary positive logic with built-in pull

down resistors, $I_{in} = 175$ uA per bit.

Temperature range

 -30° C to $+60^{\circ}$ C

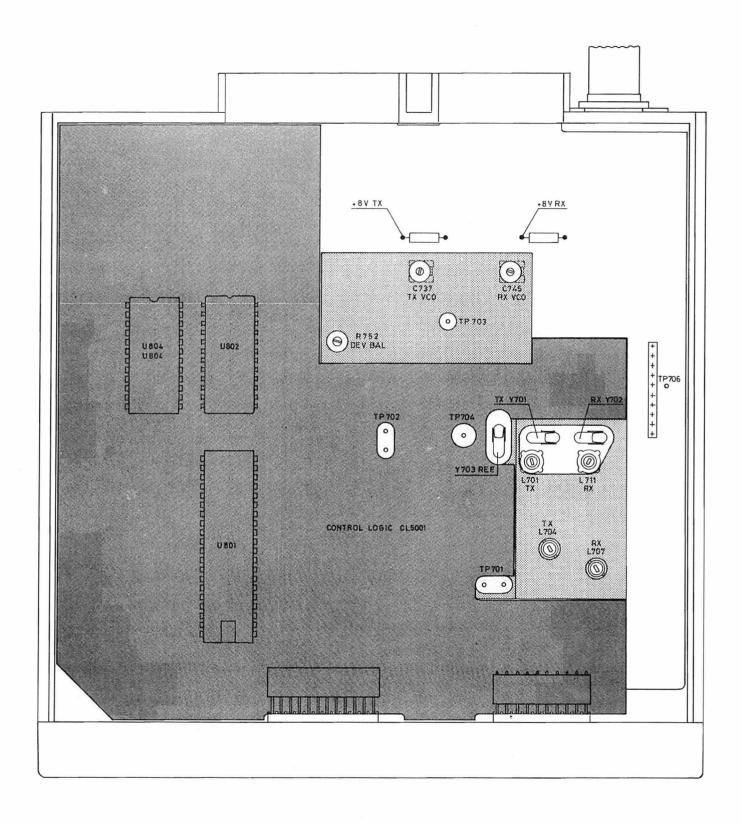
Dimensions

 $135 \times 190 \times 45 \text{ mm (BxDxH)}$

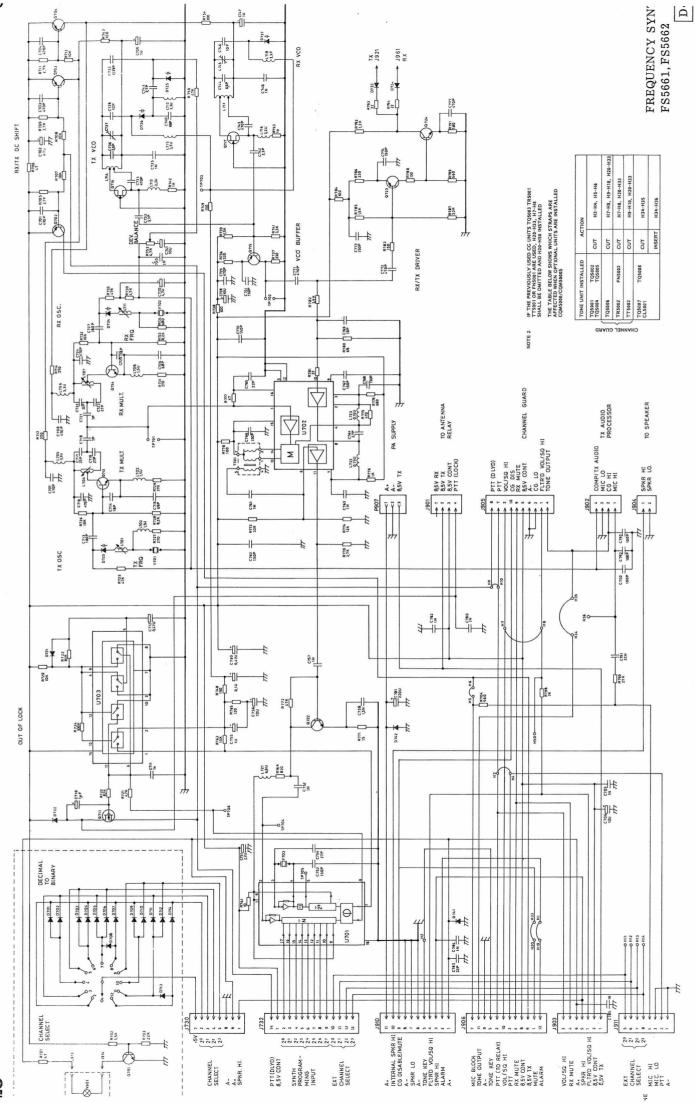
Weight

PC board: 150 g

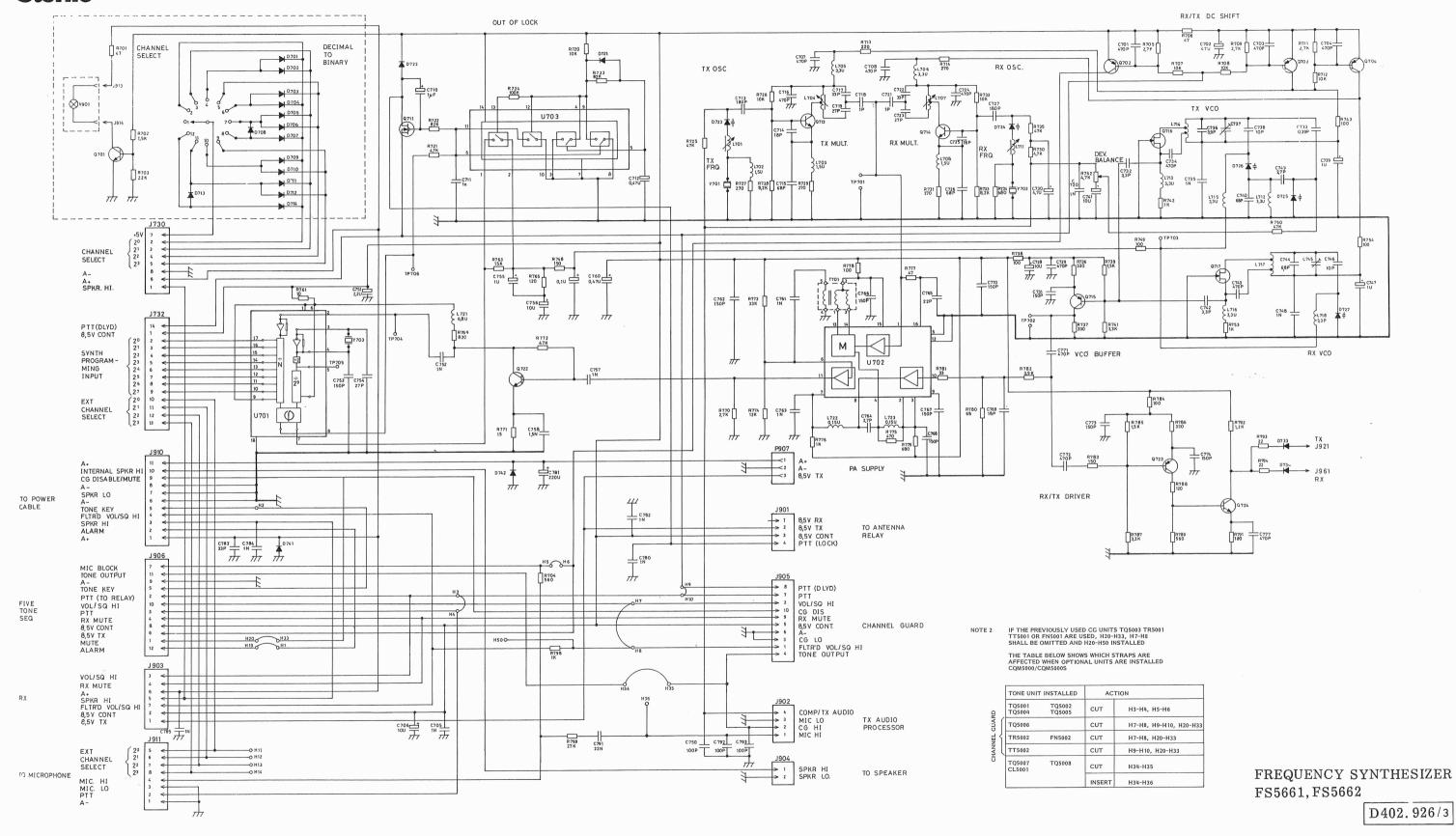
Shield: 75 g



ADJUSTABLE COMPONENTS AND TEST POINTS ON CQM5000SXXS99



Storno



	>	_ >	-	>	>	>	>	>	>	>	>			>	>	>	>	>	>	>	>	>	>	>	> :	> :	> >	> :		> ?	-		>		>	>	>	>	>	>	>		>	>	>	>
	50	16	20	20	20	16	20	20	35	35	20			20	50	20	20	20	20	20	20				20	9	200	200	2000	200	2002	20	20		20	35	20	16	20	20	20		20	35	20	20
DATA	470 pF Capacitor Ceramic	47 uF Capacitor Electrolytic	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	1 nF Capacitor Ceramic	10 uF Capacitor Tantalum	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	0.1 uF Capacitor Tantalum	2.2 uF Capacitor Tantalum	180 pF Capacitor Ceramic	18 pF N1500 Capacitor Ceramic	68 pF N1500 Capacitor Ceramic	470 pF Capacitor Ceramic	33 pF Capacitor Ceramic	3.3 pF Capacitor Ceramic	27 pF Capacitor Ceramic	1 nF Capacitor Ceramic	3.3 pF Capacitor Ceramic	33 pF Capacitor Ceramic	27 pF Capacitor Ceramic	470 pF Capacitor Ceramic	18 pF N1500 Capacitor Ceramic	68 pF N1500 Capacitor Ceramic	180 pF Capacitor Ceramic	10 ur Capacitor Lantalum	4/0 pr Capacitor Ceramic	150 of Capacitor Lantaium	3 3 PE Capacitor Ceramic	0 39 DE Capacitor Dhanolic	470 oF Capacitor Ceramic	1 nF Capacitor Ceramic	3.9 pF Capacitor Ceramic	1.8-10 pF Capacitor Variable	10 pF Capacitor Ceramic	1 uF Capacitor Tantalum	68 pF Capacitor Ceramic	10 uF Capacitor Tantalum	3.3 pF Capacitor Ceramic	470 pF Capacitor Ceramic	6.8 pF Capacitor Ceramic	1.8-10 pF Capacitor Variable	10 pF Capacitor Ceramic	1 uF Capacitor Tantalum	1 nF Capacitor Ceramic	3.9 pF Capacitor Ceramic
CODE	19A700233P5	19J 706005P3	19A700233P5	19A700233P5	19A700233P7	19A700003P7	19A700233P5	19A700233P5	19A700003P1	19A 700003P5	19A700235P28	19J706256P202	19J706256P205	19A700233P5	19A700235P19	19A700235P7	19A700235P18	19A700233P7	19A 700235P7	19A700235P19	19A 700235P18	19A 700233P5	191706256P202	19J706256P205	19A 700235P28	1967000057	194 70000356	100000000000000000000000000000000000000	19A 70023F2	19A700013P8	19A700233P5	19A700233P7	19A 700235P8	19J706003P1	19A700235P13	19A700003P4	19A 700235P23	19A700003P7	19A700235P7	19A 700233P5	19A700235P11	19J706003P1	19A700235P13	19A700003P4	19A700233P7	19A700235P8
ōΝ	C701	C702	C703	C704	C705	C706	C707	C708	C711	C712	C713	C714	C715	C716	C717	C718	C719	C720	C/21	C722	C/23	C724	C725	C/26	C727	0770	C730	1277	C737	C733	C734	C735	C736	C737	C738	C739	C740	C741	C742	C743	C744	C745	C746	C747	C748	C749

П		
	200 200 200 200 200 200 200 200 200 200	
DATA	100 pF Capacitor Ceramic 2. 2 uF Capacitor Tantalum 1 nF Capacitor Ceramic 150 pF Capacitor Ceramic 27 pF Capacitor Ceramic 1 uF Capacitor Tantalum 10 uF Capacitor Tantalum 10 uF Capacitor Tantalum 11 nF Capacitor Tantalum 11 nF Capacitor Ceramic 12 nF Capacitor Ceramic 150 pF Capacitor Ceramic 170 pF Capacitor Ceramic 171 nF Capacitor Ceramic 172 nF Capacitor Ceramic 173 pF Capacitor Ceramic 174 pF Capacitor Ceramic 175 pF Capacitor Ceramic 176 pF Capacitor Ceramic 177 pF Capacitor Ceramic 178 pF Capacitor Ceramic 178 pF Capacitor Ceramic 178 pF Capacitor Ceramic 179 pF Capacitor Ceramic 170 pF Capacitor Ceramic	
CODE	19A700233P1 19A700033P5 19A7000233P7 19A700033P4 19A700033P4 19A700033P4 19A700033P7 19A700233P7 19A700233P7 19A700233P2 19A700233P2 19A700233P2 19A700233P2 19A700233P2 19A700233P2 19A700233P2 19A700233P3 19A700233P7 19A700233P7 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700233P1 19A700238P1	
ο̈Ν	C750 C751 C752 C753 C754 C755 C755 C756 C760 C760 C760 C760 C760 C760 C760 C76	

FREQUENCY SYNTHESIZER FS5661

X403.049

Page 1 of 3

Stormo

D725 19A700073P1 BB409 Variable Cap. Diode D727 19A700073P1 BB409 Variable Cap. Diode D734 19A700073P1 BB409 Variable Cap. Diode D734 19J70600662 BA282 Diode D734 19J70600662 1NS401 Diode Silicon D730 19J706018P1 Male Connector 4 pin J930 19J706218P104 Male Connector 4 pin J930 19J706214P4 Male Connector 7 pin J930 19J706214P4 Male Connector 7 pin J90 19J706214P4 Male Connector 2 pin J90 19J706213P1 Male Connector 2 pin J90 19J706232P1 Male Connector 10 pin J91 19J706232P1 1 Sulf Coil 1 Sulf Coil	ōΝ	CODE	DATA	
194700073P1 BB409 Variable Cap. Diode 194700073P1 BB409 Variable Cap. Diode 194706006P2 BA282 Diode 194706006P2 BA282 Diode 194706006P1 194706006P1 194706006P1 194706021P1 19470621PP4 Male Connector 19470621PP1 Male Connector 19470603PP1 Male Connector 19470621PP1 Male Connector 19470603PP1 Male Connector 19470603PP1 Male Connector 19470603PP1 Male Connector 19470002PP1 Male Connector 19470603PP1 Male Connector 19470603PP1 Male Connector 19470603PP1 Male Connector 19470603PP1 Male Connector 19470002PP1 Male	D725	19A 700073P1	Variable Can	
194700073P1 BB409 Variable Cap. Diode 19J706006P2 BA282 Diode 19J706006P2 19J706006P2 19J706005P1 19J706005P1 19J706015P1 19J706015P1 19J70611P1 19J70621P1 19J70602P1 19J7062SP1 19J70	D726	19A700073P1	Variable Cap.	
19,706006P2 BAA28.2 Diode 19,706006P2 BAA28.2 Diode 19,706026P1 1N5401 Diode Silicon 19,7060219P1 Male Connector 19,706214P4 Male Connector 19,706214P7 Male Connector 19,706219P1 Male Conline 19,706219P1 Male Connector 19,706218P1 Male C	D727	19A700073P1	Cap.	
19J 000006P2 19J 000006P2 19J 000006P2 19J 000006P2 19J 0000006D1 1N5401 Diode Silicon 19J 006215P114 Male Connector 19J 006214P4 Male Connector 19J 006214P4 Male Connector 19J 006214P7 Male Connector 19J 006214P7 Male Connector 19J 006213P1 Male Connector 19J 006223P1 Male Connector 19J 00623P1 Male Connector 19J 00623P1 Male Connector 19J 00623P1 Male Connector 19J 00624P1 Male Connector 19J 0062	D733	19J 706006P2		
19.770602671 19.770602671 19.770602671 19.77060215P114 Male Connector 19.7706214P4 Male Connector 19.7706214P4 Male Connector 19.7706214P4 Male Connector 19.7706214P7 Male Connector 19.77060219P1 Male Connector 19.7706022P1 Male Connector 19.7706024P1 Male Connector 19.770623P1 Male Connector 19.770623P1 Male Connector 19.770623P1 Male Connector 19.770624P1 Male Connector 19.770623P1 Male Connector 19.770624P1 Male Connector 19.77	D/34	191706026P1	BA282 Diode	
19J706215P108 Male Connector 19J706214P4 Male Connector 19J706214P4 Male Connector 19J706214P7 Male Connector 19J706214P7 Male Connector 19A700072P3 Male Connector 19A700072P1 Male Connector 19J70623P1 Male Connector 19J70624P2	D742	19J 706026P1	1N5401 Diode Silicon	
19J706215P114 Male Connector 19J706214P4 Male Connector 19J706214P7 Male Connector 19J706214P7 Male Connector 19J706214P1 Male Connector 19J706223P1 Male Connector 19J70623P1 Male Connector 19J70623P1 Male Connector 19J70623P1 Male Connector 19J706023P1 Male Connector 19J706023P1 Male Connector 19J70603P1 Male Connector 19J70623P1 Male Connector 19J70624P1 Male Connector 19J70623P1 Male Connector 19J70624P1 Male Connector 19J706	J730	19J706215P108	Male Connector	8 pin
19J706214P4 Male Connector 19J706214P7 Male Connector 19J706214P7 Male Connector 19A700072P3 19A700072P1 19J70623P1 19J70623P1 19J70623P1 19J706029P4 19J706029P4 19J706029P4 19J706029P4 19J706029P4 19J706029P4 19J706029P1 19J70603P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70603P1 19J70628P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P1 19J70623P	J732	19J706215P114	Male Connector	14 pin
19J706214P4 Male Connector 19J706214P7 Male Connector 19J70622P8 Male Connector 19J70622P1 Male Connector 19J70623P1 Male Connector 19J70623P1 Male Connector 19J70623P1 Male Connector 19J70623P1 Male Connector 19J70633P1 Male Connector 19J70633P1 Male Connector 19J70633P1 Male Connector 19J70633P1 Male Connector 19J70623P1 Male	1901	19J706214P4	Male Connector	4 pin
193706214P7 Male Connector 194700072P2 Male Connector 194700072P2 Male Connector 194700072P1 Tale Connector 194700072P1 Tale Connector 19470002P1 Female Connector 19J0623PP1 Male Connector 19J0623PP1 Male Connector 19J0623PP1 Variable Coil 19J06029P4 T. 5 uH Coil 19J0603PP1 T. 5 uH Coil Coil 19J0603PP1 T. 5 uH Coil S. 3 uH Coil 19J0603PP1 T. 5 uH Coil S. 3 uH Coil 19J0603PP1 T. 5 uH Coil S. 3 uH Coil 19J0603PP1 T. 5 uH Coil S. 3 uH Coil 19J0603PP1 T. 5 uH Coil S. 3 uH Coil 19J06028PP1 T. 5 uH Coil S. 3 uH Coil S. 4 uH C	1902	19J706214P4	Male Connector	4 pin
194 7000 72P2	1903	19J706214P7	Male Connector	
194700072P3 194700072P3 194700002P11 19J706223P11 19J706223P1 19J70623P1 19J70623P1 19J706224P15 19J706024P15 19J706024P15 19J706024P15 19J70603P4 194700024P19 19J70603P4 194700024P19 19J70603P4 194700024P19 19J70602P4 194700024P19 19J70623P1 19J70623P1 19J70623P1 19J70624P19 19J70624P19 19J70624P19 19J70624P19 19J70624P2 19J70624P19 19J70624P2 19J70624P3 19J70624P19 19J70624P3 19J70624P3 19J70628P1 19J7	1904	19A 7000 7278	(ale Connector	7 pin
194700102211 19J706223P1 19J706223P1 19J706219P1 19J706219P1 19J706029P4 194700024P19 19J706083P1 19J706083P1 19J706083P1 19J706083P1 19J706083P1 19J706028P1 19J706028P1 19J70628P1	1906	19A 700072F9	Male Connector	10 pin
19J 706223P11 Male Connector 19J 706223P8 Male Connector 19J 706219P1 19J 706219P1 19J 706229P4 1.5 uH Coil 19A 700024P15 19J 706083P1 19A 700024P19 3.3 uH Coil 19A 700024P2	1907	19A700102P21	Female Connector	3 nin
19J706223P8 Male Connector 19J706219P1 19J706219P1 19J706029P4 1.5 uH Coil 19A700024P19 19J706083P1 19A700024P19 19J706083P1 1.5 uH Coil 19A700024P19 1.5 uH Coil 19A700024P19 1.5 uH Coil 19J706029P4 19A700024P19 19J706258P1 19A700024P19 19J706258P1 19A700024P19 19J706258P1 19A700024P19 19A700024P2 19A700024P2 19A700024P2 19A700024P3 19A70024P3 19A700024P3 19A7002	J910	19J 706223P11	Male Connector	11 pos
19J706219P1 19J706219P1 19J706029P4 19J706024P15 11.5 uH Coil 19J706083P1 23.3 uH Coil 19J706083P1 33.3 uH Coil 19J706029P4 33.3 uH Coil 19J706029P4 33.3 uH Coil 19J706029P4 33.3 uH Coil 19J706258P1 33.3 uH Coil 19J70624P19 33.3 uH Coil 19J706258P1 35.3 uH Coil 19J706258P1 35.3 uH Coil 19J706258P1 35.3 uH Coil 19J70628P1 19J70	1911	19J706223P8	Male Connector	sod 8
191706219P1 194706029P4 194700024P15 194700024P15 195.0H Coil 194700024P19 194700024P23 194700024P3 194700024P3 194700024P3 194700024P3 194700024P3 194700020P1 19470020P1 194700020P1 194700020P1 194700020P1 194700020P1 19470020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 19470020P1 19470020P1 19470020P1 19470020P1 19470020P1 19470020P1 19470020P1 19470020P1 194700020P1 19470020P1 194700020P1 19470020P1 194700020P1 19470020P1 194700	1921	19J706219P1		nid
19J706029P4 19A700024P15 19A700024P15 19J706083P1 19A700024P19 19J706083P1 19J706029P4 19J706029P4 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P3 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1	1961	19J706219P1		pin
19A700024P15 19A700024P15 19J706083P1 19A700024P19 19J706083P1 19J706029P4 19J706029P4 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P19 19A700024P3 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1 19A700020P1	L701		Variable Coil	
194700024P15 194706083P1 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P3 194700024P3 194700024P3 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1	L702	19A700024P15	1. 5 uH Coil	
194.700024P19 194.700024P19 194.700024P19 19.1706028P1 19.1706028P1 19.1706228P1 19.1706258P1 19.1706258P1 19.1706258P1 19.1706258P1 19.170624P19 19.170024P19 19.170024P23 19.170024P23 19.19.19020P1 19.170020P1 19.1706283P1 19.1706283P1	L/03	19A/00024P15	Ę	
194700024P19 194700024P19 19J706083P1 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P3 194700024P3 194700024P3 194700020P1 194700020P1 194700020P1 194700017P2 19J706283P1 19J706283P1	1704	193 /0608371	7	
194700024P19 194706083P1 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P3 194700024P3 194700024P3 194700024P3 194700020P1 194700020P1 194700017P2 194700017P2 191706283P1 191706283P1	1705	19A /00024P19	3.3 uH Coll	
194.70000.5171 194.70002.4P15 194.70002.4P19 194.70002.4P19 194.70002.4P19 194.70002.4P19 194.70002.4P19 194.70002.4P3 194.70002.4P3 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1 194.70002.0P1	1 707	19A / 00024P 19	3. 3 UH COII	
19.706029P4 19.4700024P19 19.4700024P19 19.4700024P19 19.4700024P19 19.4700024P19 19.4700024P3 19.4700024P3 19.4700024P3 19.4700020P1 19.4700020P1 19.4700020P1 19.4700017P2 19.4700017P2	1 708	194 70002 UP15	Variable Coll	
194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P19 194700024P3 194700024P3 194700024P3 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1 194700020P1	1711	19 17060395/1	Variable Coll	
19A700024P19 19J706258P1 19A700024P19 19A700024P19 19A700024P3 19A700024P3 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706283P1	1712	19A 700024P19	3 3 LH Coil	
19.706.25.8P1 19.47000.24P19 19.47000.24P19 19.47000.24P19 19.47000.24P3 19.47000.24P3 19.47000.24P3 19.47000.20P1 19.47000.20P1 19.47000.20P1 19.47000.20P1 19.47000.28.3P1 19.4706.28.3P1	1 713	19A 700024P19	3 3 JH Coil	
19A700024P19 19A700024P19 19J706258P1 19A700024P3 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	1714	19.1706258P1	-	
19A700024P19 19J706258P1 19A700024P19 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706283P1	L715	19A 700024P19	프	
19J706258P1 19A700024P19 19A700024P3 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L716	19A700024P19		
19A700024P19 19A700024P23 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L717	19J706258P1	Coil	
19A700024P23 19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L718	19A700024P19	3.3 uH Coil	
19A700024P3 19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L721	19A700024P23	6.8 uH Coil	
19A700024P3 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L722	19A700024P3	15 uH	
19A700020P1 19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	L723	19A700024P3	0.15 uH Coil	
19A700020P1 19A700020P1 19A700017P2 19J706283P1 19J706264P1	Q702	19A700020P1	BC558 Transistor	
19A700020P1 BC558 19A700017P2 BC548 19J706283P1 BFR54 19J706264P1 BF414	Q703	19A700020P1	BC558 Transistor	
19A700017P2 BC548 19J706283P1 BFR54 19J706284P1 BFR54 19J706264P1 BF414	Q704	19A700020P1	558	
19J706283P1 BFR54 19J706264P1 BFR14 T	0711	19A700017P2		
19J706264P1 BF414	9/13	191/06283P1		
715 19J706264P1 BF414	0714	19J 706283P1	BFR54 Transistor	
	0715	19J706264P1		

ōΝ	CODE	DATA	
Q716 Q717 Q722 Q723	19J7Co038P1 15J706038P1 19J706146P1 19J706164P1	2N5245 Transistor 2N5245 Transistor BF357S Transistor BF414 Transistor	
Q724 R704 R705	19J / 06146P1 19A 700019P34 19A 700019P42	BF357S Transistor 560 of m Resistor Depos.	25
R706	19A700019P21	47 ohm Resistor Depos.	. 25
R/0/ R708	19A700019P49 19A700019P49	10 Kohm Resistor Depos.	0.25 W
R709	19A700019P42	2.7 Kohm Resistor Depos.	. 25
R712	19A 7000 19P4 2	2.7 Kohm Resistor Depos.	0.25 W
R713	19A700019P17	22 ohm Resistor Depos.	25
R714	19A700019P17	2 ohm Resistor Depos.	. 25
R/20	19A / 00019P3 / 19A 700019P45	1 Kohm Resistor Depos.	0.25 W
R722	19A700019P60	82 Kohm Resistor Depos	27
R723	19A700019P58	56 Kohm Resistor Depos.	. 25
R724	19A700019P49	10 Kohm Resistor Depos.	. 25
R725	19A700019P57	Resistor	. 25
R727	19A700019P49	10 Kohm Resistor Depos.	7.0
R728	19A700019P48	8 2 Kohm Resistor Denos	n u
R729	19A700019P30	270 ohm Resistor Depos.	25
R730	19A700019P45	4.7 Kohm Resistor Depos.	25
R732	19A700019P49	10 Kohm Resistor Depos.	
R733	19A700019P48	8.2 Kohm Resistor Depos.	. 25
K/34	19A / 000 19P3 5	680 ohm Resistor Depos.	. 25
R736	19A700029F37	47 Kohm Resistor Depos.	0.25 W
R737	19A700019P31	330 ohm Resistor Depos	75
R738	19A700019P25	100 ohm Resistor Denos	2 2
R739	19A700019P39	1.5 Kohm Resistor Depos.	25
R741	19A700019P43	3.3 Kohm Resistor Depos.	25
R742	19A700019P37	1 Kohm Resistor Depos.	. 25
R743	19A 700019P25	100 ohm Resistor Depos.	0.25 W
K/48	19A 700019P27	150 ohm Resistor Depos.	. 25
K/49 D750	19A /00019P25	100 ohm Resistor Depos.	-
R752	19A 700016P3	4/ Kohm Resistor Depos.	0.25 W
		4: / NOTIFI NESTS OF VARIABLE	

FREQUENCY SYNTHESIZER FS5661

X403.049

Page 2 of 3

Stormo

_		
	0.25 W W W W W W W W W W W W W W W W W W W	
DATA	1 Kohm Resistor Depos. 10 ohm Resistor Depos. 10 ohm Resistor Depos. 15 Kohm Resistor Depos. 22 ohm Resistor Depos. 23 ohm Resistor Depos. 47 Kohm Resistor Depos. 47 Ohm Resistor Depos. 48 Ohm Resistor Depos. 58 Ohm Resistor Depos. 59 Ohm Resistor Depos. 50 Ohm Resistor Depos. 72 Ohm Resistor Depos. 73 Kohm Resistor Depos. 74 Ohm Resistor Depos. 75 Kohm Resistor Depos. 75 Ohm Resistor Depos. 76 Ohm Resistor Depos. 77 Kohm Resistor Depos. 78 Ohm Resistor Depos.	
CODE	194700019P37 194700019P25 194700019P25 194700019P26 194700019P36 194700019P57 194700019P57 194700019P27 194700019P27 194700019P27 194700019P28 194700019P27 194700019P27 194700019P28 194700019P28 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38 194700019P38	
ōΝ	R753 R753 R754 R765 R776 R770 R771 R772 R773 R773 R778 R778 R778 R778 R778 R778	

Storno		
	DATA	
	CODE	
	ο̈ν	

FREQUENCY SYNTHESIZER FS5661

Page 3 of 3

C701 19A700233P5 470 pF Capacitor Ceramic 50 V C702 19J706005P3 470 pF Capacitor Ceramic 50 V C704 19A700233P5 470 pF Capacitor Ceramic 50 V C705 19A700033P7 10 uF Capacitor Ceramic 50 V C706 19A700033P5 10 uF Capacitor Ceramic 50 V C707 19A700033P5 10 uF Capacitor Ceramic 50 V C711 19A700033P5 10 uF Capacitor Ceramic 50 V C711 19A700033P1 1.0 uF Capacitor Ceramic 50 V C711 19A700033P1 1.0 uF Capacitor Ceramic 50 V C713 19A700238P2 18 pF N 1500 Capacitor Ceramic 50 V C714 19J706256P205 18 pF N 1500 Capacitor Ceramic 50 V C715 19A700238P1 3.3 pF Capacitor Ceramic 50 V C716 19A700238P2 3.3 pF Capacitor Ceramic 50 V C717 19A700238P3 3.7 pF Capacitor Ceramic 50 V C718 19A700238P3 3.7 pF Capacitor Ceramic 50 V C72				
19J706005P3		19A700233P5	470 pF Capacitor Ceramic	50 V
194700233P5		19J706005P3	47 uF Capacitor Electrolytic	
194700233P5 196700233P5 196700033P7 196700033P7 196700033P5 196700033P5 196700033P5 196700033P5 196700033P5 196700033P5 196700033P5 196700033P5 196700233P5 196700233P5 196700233P5 196700233P5 196700233P7 19670033P7 196700033P7 19670033P7 19670003P7 1967003P7 19670003P7 1967000		19A700233P5	470 pF Capacitor Ceramic	
194700233P7 1 nF Capacitor Ceramic 194700233P5 470 pF Capacitor Tantalum 19.470003P1 0.1 uF Capacitor Tantalum 19.470003P1 0.1 uF Capacitor Ceramic 19.470003P2 0.1 uF Capacitor Ceramic 19.470003P2 180 pF Capacitor Ceramic 19.470023P5 180 pF Capacitor Ceramic 19.470023P7 180 pF Capacitor Ceramic 19.470023P2 180 pF Capacitor Ceramic 19.470023P2 180 pF Capacitor Ceramic 19.470023P2 180 pF Capacitor Ceramic 19.47003P2 180 pF Capacitor Ceramic 19.47003P2 180 pF Capacitor Ceramic 19.470003P2 180 pF Capacitor Ceramic 19.470003P2 180 pF Capacitor Ceramic 19.470003P2 180 pF Capacitor Ceramic 19.47003P2 180 pF Capacitor Ceramic 19.470023P2 180 pF Capacitor Ceramic 19.470003P2 18		19A700233P5	470 pF Capacitor Ceramic	
19470000397 1947000395 194700233P5 470 pF Capacitor Tantalum 1947000395 1947000395 1947000395 1947000395 195 pF Capacitor Tantalum 194700235P28 18 pF N1500 Capacitor Ceramic 19J706256P205 18 pF N1500 Capacitor Ceramic 19J706256P205 18 pF N1500 Capacitor Ceramic 194700235P1 18 pF N1500 Capacitor Ceramic 194700235P1 18 pF N1500 Capacitor Ceramic 194700235P1 194700235P1 194700235P1 194700235P2 194700235P3 194700233P2 19470033P2 194700503P2 1		19A700233P7	1 nF Capacitor Ceramic	
470 pF Capacitor Ceramic 470 pF Capacitor Ceramic 0.1 uF Capacitor Tantalum 18 op F Capacitor Tantalum 18 op F Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 33 pF Capacitor Ceramic 33 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF N1500 Capacitor Ceramic 29 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF N1500 Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 21 pF Capacitor Ceramic 22 pF Capacitor Ceramic 23 pF Capacitor Ceramic 24 pF Capacitor Ceramic 25 pF Capacitor Ceramic 26 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 21 pF Capacitor Ceramic 22 pF Capacitor Ceramic 23 pF Capacitor Ceramic 24 pF Capacitor Ceramic 25 pF Capacitor Ceramic 26 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 21 pF Capacitor Ceramic 22 pF Capacitor Ceramic 23 pF Capacitor Ceramic 24 pF Capacitor Ceramic 25 pF Capacitor Ceramic 26 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 21 pF Capacitor Ceramic 22 pF Capacitor Ceramic 23 pF Capacitor Ceramic 24 pF Capacitor Ceramic 25 pF Capacitor Ceramic 26 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 21 pF Capacitor Ceramic 22 pF Capacitor Ceramic 23 pF Capacitor Ceramic 24 pF Capacitor Ceramic 25 pF Capacitor Ceramic 26 pF Capacitor Ceramic 27 pF Capacitor Ceramic 28 pF Capacitor Ceramic 29 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceramic 20 pF Capacitor Ceram		19A700003P7	10 uF Capacitor Tantalum	
470 pF Capacitor Ceramic 0.1 uF Capacitor Tantalum 1.2 uF Capacitor Tantalum 1.2 uF Capacitor Tantalum 1.8 pF N1500 Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 3.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 4.7 pF Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 19 pF Capacitor Ceramic 10 uF Capacitor Ceramic 2.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic		19A700233P5	470 pF Capacitor Ceramic	
0. 1 uF Capacitor Tantalum 2.2 uF Capacitor Tantalum 180 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 3.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 2.7 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 4.7 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 19 pF Capacitor Ceramic 10 uF Capacitor Ceramic 2.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 1.8 pF Capacitor Ceramic 1.9 pF Capacitor Ceramic		19A 700233P5	470 pF Capacitor Ceramic	
2.2 uF Capacitor Tantalum 180 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 3.3 pF Capacitor Ceramic 2.3 pF Capacitor Ceramic 2.3 pF Capacitor Ceramic 2.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 1 nF Capacitor Ceramic 2.4 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 1 nF Capacitor Ceramic 1 pF N1500 Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 19 pF Capacitor Ceramic 10 uF Capacitor Ceramic 2.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 1 nF Capacitor Ceramic 1 uF Capacitor Ceramic		19A700003P1	0.1 uF Capacitor Tantalum	
180 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 470 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 27 pF Capacitor Ceramic 1 nF Capacitor Ceramic 27 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 27 pF Capacitor Ceramic 27 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 19 pF Capacitor Ceramic 10 uF Capacitor Ceramic 23 pF Capacitor Ceramic 1 nF Capacitor Ceramic 1 uF Capacitor Ceramic		19A700003P5		
18 pF N1500 Capacitor Ceramic 68 pF N1500 Capacitor Ceramic 470 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 27 pF Capacitor Ceramic 17 pF Capacitor Ceramic 17 pF Capacitor Ceramic 27 pF Capacitor Ceramic 470 pF Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 18 pF N1500 Capacitor Ceramic 19 pF Capacitor Tantalum 470 pF Capacitor Ceramic 4.7 uF Capacitor Ceramic 6.39 pF Capacitor Ceramic 6.39 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1.9-10 pF Capacitor Ceramic 1.9-10 pF Capacito		19A700235P28	180 pF Capacitor Ceramic	20 N
194706256P205 194700238P5 194700238P5 194700235P19 1954700235P19 1954700235P19 1954700235P18 1954700235P19 1954700235P19 1954700235P19 1954700235P19 1954700235P19 1954700235P19 1954700235P19 1954700235P19 1954700235P28 1954700235P28 1954700233P5 1954700233P5 1954700233P5 1954700233P5 1954700233P5 1954700233P5 1954700235P3 195470		19J706256P202	18 pF N1500 Capacitor Ceramic	
194700233P5 194700233P5 194700235P7 194700235P7 194700235P7 194700235P7 194700233P7 195700233P7 195700235P18 195700235P18 195700235P18 195700235P28 195700235P28 195700235P28 195700035P7 19570033P7 195700033P7 19570003		19J706256P205	68 pF N1500 Capacitor Ceramic	
194700235P7 194700235P3 195 Capacitor Ceramic 194700235P3 195 Capacitor Ceramic 194700235P3 196 Capacitor Ceramic 194700235P3 197 Capacitor Ceramic 194700233P5 199 Capacitor Ceramic 19470033P5 199 Capacitor Ceramic 19470033P7 199 Capacitor Ceramic 194700235P3 199 Capacitor Ceramic 194700235P3 199 Capacitor Ceramic 194700235P3 199 Capacitor Ceramic 194700235P3 199 Capacitor Ceramic 19470033P4 199 Capacitor Ceramic 19470033P1 199 Capacitor Ceramic 19470039P1 199 Capacitor Ceramic 19470039P1 199 Capacitor Ceramic 199 Capacitor		19A 700233P5	470 pF Capacitor Ceramic	20 \
194700235P7 194700235P7 194700235P18 194700233P7 1		19A700235P19	33 pF Capacitor Ceramic	20 \
19A700235P18		19A700235P7	3.3 pF Capacitor Ceramic	20 \
19A70023877 1 nF Capacitor Ceramic 19A70023877 3. 3 pF Capacitor Ceramic 19A70023879 3. 3 pF Capacitor Ceramic 19A70023879 470 pF Capacitor Ceramic 19J706256P202 18 pF N1500 Capacitor Ceramic 19J706256P202 18 pF N1500 Capacitor Ceramic 19A700023872 180 pF Capacitor Ceramic 19A7000387 470 pF Capacitor Ceramic 19A7000387 19A7000387 19A70023872 19A7000387 19A70023872 19A70023873 19 pF Capacitor Ceramic 19A70023873 19 pF Capacitor Ceramic 19A70023872 19A70023873 19 pF Capacitor Ceramic 19A70023873 10 pF Capacitor Ceramic 19A70023873	N.F.	19A700235P18	27 pF Capacitor Ceramic	20 \
19A700235P7 3. 3 pF Capacitor Ceramic 19A700235P18 19A700233P5 19J706256P202 19J706256P202 19J706256P203 18 pF N1500 Capacitor Ceramic 19J706256P203 18 pF N1500 Capacitor Ceramic 19J706256P203 18 pF N1500 Capacitor Ceramic 19A700033P7 19A700033P7 19A700033P5 19A700233P5 19A700233P5 19A700233P5 19A700233P7 10 pF Capacitor Ceramic 19A700233P7 10 pF Capacitor Ceramic 19A700233P7 10 pF Capacitor Ceramic 19A700233P3 10 pF Capacitor Ceramic 19A700235P1 11 PCapacitor Ceramic 19A70033P1 11 PCapacitor Ceramic 19A70033P1 11 PCapacitor Ceramic 19A70033P1 11 PCapacitor Ceramic 19A70033P1 11 PCAPACITOR 11 PCAP		19A700233P7	1 nF Capacitor Ceramic	20 \
19A700235P19 33 pF Capacitor Ceramic 19A700235P18 19A700233P5 19J706256P202 18 pF N1500 Capacitor Ceramic 19J706256P202 18 pF N1500 Capacitor Ceramic 19J706258P203 18 pF N1500 Capacitor Ceramic 19A70003P7 19A70003P7 19A700233P2 19A700233P2 19A700233P3 19A700235P3 10 pF Capacitor Ceramic 19A70038P4 10 pF Capacitor Ceramic 19A70033P7 10 pF Capacitor Ceramic 19A70030P1 10 pF Capacitor Ceramic 19A70030P1 10 pF Capacitor Ceramic 19A70010P1 10 pF Capacitor Ceramic 10 pF Capacitor C		19A700235P7	3.3 pF Capacitor Ceramic	50 V
19A700235P18 27 pF Capacitor Ceramic 19A70023P5 19J706256P202 18 pF N1500 Capacitor Ceramic 19J706256P205 18 pF N1500 Capacitor Ceramic 19A700035P2 19A700033P5 19A700233P5 19A700233P5 19A700233P7 10 uF Capacitor Tantalum 19A700233P7 10 uF Capacitor Ceramic 19A700233P7 10 uF Capacitor Ceramic 19A700233P7 10 uF Capacitor Ceramic 19A700233P7 10 pF Capacitor Ceramic 19A700233P7 10 pF Capacitor Ceramic 19A700235P1 10 pF Capacitor Ceramic 19A700235P1 10 pF Capacitor Ceramic 19A700235P1 10 pF Capacitor Ceramic 19A700033P7 10 pF Capacitor Ceramic 19A700033P7 10 pF Capacitor Ceramic 19A700035P1 10 pF Capacitor Ceramic 19A700235P1 11 uF Capacitor Ceramic 19A700235P1 12 pF Capacitor Ceramic 19A700235P1 13 pF Capacitor Ceramic 19A700235P1 14 pF Capacitor Ceramic 19A700235P1 16 pF Capacitor Ceramic 19A700235P1 17 pF Capacitor Ceramic 19A700235P1 18 -10 pF Capacitor Ceramic 19A700235P1 10 pF Capacitor Ceramic 19A70023P1 10 pF Capacitor Ceramic 10 pF Capacitor Ceramic 10	45.2	19A700235P19	33 pF Capacitor Ceramic	50 V
194700233P5 194700233P5 195706256P202 18 pF N1500 Capacitor Ceramic 194706256P205 18 pF N1500 Capacitor Ceramic 194700235P28 194700033P7 194700033P5 194700233P5 194700233P7 194700233P7 194700233P7 194700235P8 194700235P8 194700235P8 194700235P9 194700235P9 194700235P1 194700235P1 194700235P7 19470033P7 19470033P7 19470033P7 19470033P7 194700235P7 19470033P7 194700233P7 19470033P7 194700233P7 194700233P7 194700233P7 194700033P7 194700233P7 194700233P7 194700233P7 194700233P7	700	19A700235P18	27 pF Capacitor Ceramic	20 N
19J706256P202 18 pF N1500 Capacitor Ceramic 19J706256P205 18 pF N1500 Capacitor Ceramic 19A700235P2 19A700039P7 19A700033P5 19A700033P6 19A700233P5 19A700233P7 19A700233P7 19A700233P7 10A Capacitor Ceramic 19A700233P7 10A Capacitor Ceramic 19A700233P3 10A Capacitor Ceramic 19A700233P3 10A Capacitor Ceramic 19A700233P3 10A Capacitor Ceramic 19A700235P3 10A Capacitor Ceramic 19A700039P3 10A Capacitor Ceramic 19A700235P3 10A Capacitor Ceramic 10A Capacitor Ceramic 19A700235P3 10A Capacitor Ceramic 10A Capacitor Ceramic 19A700235P3 10A Capacitor Ceramic 10A Capacitor Ceramic 19A700235P3	250.0	19A700233P5	470 pF Capacitor Ceramic	
19J706256P205 180 pF Capacitor Ceramic 19A700235P2 19A700039P7 19A700033P5 19A700033P6 19A700233P2 19A700233P7 19A700233P7 19A700233P7 19A700235P8 19A700235P8 19A700235P8 19A700235P8 19A700235P1 10 pF Capacitor Ceramic 19A700235P1 11 pF Capacitor Ceramic 19A700033P7 12 pF Capacitor Ceramic 19A700033P7 13 pF Capacitor Ceramic 19A700033P7 10 pF Capacitor Ceramic 19A700235P1 11 pF Capacitor Ceramic 19A700235P1 11 pF Capacitor Ceramic 19A700038P1 11 pF Capacitor Ceramic 11 pF Capacitor Ceramic 19A700038P1 11 pF Capacitor Ceramic 11		19J706256P202	18 pF N1500 Capacitor Ceramic	
19A700235P28 180 pF Capacitor Ceramic 19A7000397 10 uF Capacitor Tantalum 19A700033P5 470 pF Capacitor Ceramic 19A700233P2 3.3 pF Capacitor Ceramic 19A700233P7 3.3 pF Capacitor Ceramic 19A700233P7 1 nF Capacitor Ceramic 19A700233P7 1 nF Capacitor Ceramic 19A700233P7 3.9 pF Capacitor Ceramic 19A700235P8 3.9 pF Capacitor Ceramic 19A700235P1 1 nF Capacitor Ceramic 19A700235P3 1 uF Capacitor Ceramic 19A700235P3 1 uF Capacitor Ceramic 19A700235P3 3.3 pF Capacitor Ceramic 19A700235P3 1 uF Capacitor Ceramic 19A700235P3 3.3 pF Capacitor Ceramic 19A700235P1 1 uF Capacitor Ceramic 19A700235P1 1 uF Capacitor Ceramic 19A700235P1 1 uF Capacitor Ceramic 19A700038P1 1 uF Capacitor Ceramic 19A700038P4 1 uF Capacitor Ceramic 19A700038P4 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Cer	1100	19J706256P205	68 pF N1500 Capacitor Ceramic	
19A700003P7		19A700235P28	180 pF Capacitor Ceramic	
470 pF Capacitor Ceramic 4.7 uF Capacitor Tantalum 150 pF Capacitor Ceramic 3.3 pF Capacitor Ceramic 0.39 pF Capacitor Ceramic 1 nF Capacitor Ceramic 1 nF Capacitor Ceramic 1 nF Capacitor Ceramic 1 8-10 pF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Tantalum 68 pF Capacitor Tantalum 68 pF Capacitor Tentalum 3.3 pF Capacitor Ceramic 10 uF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic 1 uF Capacitor Ceramic	72	19A700003P7	10 uF Capacitor Tantalum	
19A 700003P6 4. 7 uF Capacitor Tantalum 19A 700233P2 150 pF Capacitor Ceramic 19A 70023SP7 3. 3 pF Capacitor Ceramic 19A 70023SP5 4.70 pF Capacitor Ceramic 19A 70023SP3 1 nF Capacitor Ceramic 19A 70023SP1 1 nF Capacitor Ceramic 19A 70003SP4 1 nF Capacitor Tantalum 19A 70023SP2 1 n		19A700233P5	470 pF Capacitor Ceramic	
19A700233P2 150 pF Capacitor Ceramic 19A700235P7 3.3 pF Capacitor Ceramic 19A700233P5 10 pF Capacitor Ceramic 19A700233P7 1 nF Capacitor Ceramic 19A700235P1 1 nF Capacitor Ceramic 19A70003P1 1 nF Capacitor Ceramic 19A70003P4 1 nF Capacitor Tantalum 19A70003P4 1 nF Capacitor Tantalum 19A70003P7 2.3 pF Capacitor Tantalum 19A700235P7 3.3 pF Capacitor Ceramic 19A70023P5 1 n		19A 700003P6	4.7 uF Capacitor Tantalum	35 V
19A 700235P7 19A 700235P7 19A 700013P8 19A 700013P8 19A 700023P5 19A 700233P7 1		19A700233P2	150 pF Capacitor Ceramic	20 N
19A 700013P8		19A /00235P7	3.3 pF Capacitor Ceramic	20 \
470 pF Capacitor Ceramic 1 nF Capacitor Ceramic 3.9 pF Capacitor Ceramic 1.8-10 pF Capacitor Variable 10 pF Capacitor Tentalum 68 pF Capacitor Tantalum 68 pF Capacitor Tantalum 3.3 pF Capacitor Ceramic 470 pF Capacitor Ceramic 470 pF Capacitor Ceramic 6.8 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1 pF Capacitor Ceramic 1 nF Capacitor Ceramic		19A 700013P8	0.39 pF Capacitor Phenolic	200 V
19A 700235P7		19A /00233P5	470 pF Capacitor Ceramic	20 \
19A/00235P8 1.8-10 pF Capacitor Ceramic 19J706003P1 1.8-10 pF Capacitor Variable 19A700235P13 1.8-10 pF Capacitor Ceramic 19A70003P4 1.0F Capacitor Tantalum 19A700033P7 1.3 pF Capacitor Ceramic 19A700233P5 19A700235P1 1.8-10 pF Capacitor Ceramic 19J706003P1 1.8-10 pF Capacitor Ceramic 19A700235P1 1.8-10 pF Capacitor Ceramic 19A700235P1 1.8-10 pF Capacitor Variable 19A70003P4 1.0 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 1.8-10 pF Capacitor Ceramic 19A700235P13 10 pF Capacitor Ceramic 19A70003P4 1 nF Capacitor Ceramic 20 19A70003P4 1 nF Capacitor Ceramic 20 19A70003P4 1 nF Capacitor Ceramic 20 19A70003P4 20 10 10 10 10 10 10 10 10 10 10 10 10 10		19A 700233P7	1 nF Capacitor Ceramic	20 \
194700235P13		194/00235P8	3.9 pF Capacitor Ceramic	20 \
19A700235P13		19170600371	1.8-10 pF Capacitor Variable	
19A/00003P4 1 UF Capacitor Tantalum 35 19A/00023Fp2 68 pF Capacitor Ceramic 50 19A700235P7 3.3 pF Capacitor Ceramic 50 19A700233P5 6.8 pF Capacitor Ceramic 50 19A700235P1 1.8-10 pF Capacitor Ceramic 50 19A700235P1 1.8-10 pF Capacitor Ceramic 50 19A70003P4 1 UF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50 19A70023P7 1 nF Capacitor Ceramic 50 19A70024 1 nF Capacitor Cera		19A /00235P13	10 pF Capacitor Ceramic	
19A700235P23 19A700033P7 19A700033P7 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 19A700235P1 10P Capacitor Ceramic 19A70003P4 1 UP Capacitor Ceramic 19A70003P4 1 UP Capacitor Ceramic 19A70003P4 1 UP Capacitor Ceramic 19A70003P7 1 UP Capacitor Ceramic 19A70003P4 1 UP Capacitor Ceramic 19A70000P4 1 UP Capacitor Ceramic 19A70000P4 1 UP Capacitor Ceramic 19A7000P4 1 UP Capa		19A /00003P4	1 uF Capacitor Tantalum	
19A700003P7		19A /00235P23	68 pF Capacitor Ceramic	
19A700235P7 3.3 pF Capacitor Ceramic 50 19A700233P5 470 pF Capacitor Ceramic 50 19A700235P11 6.8 pF Capacitor Ceramic 50 19J706003P1 1.8-10 pF Capacitor Variable 10 A700035P13 10 pF Capacitor Ceramic 50 19A70003P4 1 uF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50		19A700003P7	10 uF Capacitor Tantalum	
19A700233P5 470 pF Capacitor Ceramic 50 19A700235P11 6.8 pF Capacitor Ceramic 50 19J706003P1 1.8-10 pF Capacitor Variable 19A700235P13 10 pF Capacitor Ceramic 50 19A70003P4 1 uF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50		19A700235P7	3.3 pF Capacitor Ceramic	
19A700235P11 6.8 pF Capacitor Ceramic 50 19J706003P1 1.8-10 pF Capacitor Variable 19A700235P13 10 pF Capacitor Ceramic 50 19A70003P4 1 uF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50		19A700233P5	470 pF Capacitor Ceramic	
19J706003P1 1.8-10 pF Capacitor Variable 19A700235P13 10 pF Capacitor Ceramic 50 19A70003P4 1 uF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50		19A700235P11	6.8 pF Capacitor Ceramic	20 \
19A700235P13		19J706003P1	1.8-10 pF Capacitor Variable	
19A70003P4 1 uF Capacitor Tantalum 35 19A700233P7 1 nF Capacitor Ceramic 50		19A700235P13	10 pF Capacitor Ceramic	-
1 nF Capacitor Ceramic		19A 700003P4	1 uF Capacitor Tantalum	
		19A 700233P7	1 nF Capacitor Ceramic	20 \

	20 02	20.0		> 00	> 00		> 00 0				35		20 \	20 N	20 \	20 \	20 \	> 0 <	> 05	50 V		20 V	20 V	20 \	20 <	20 <	50 V		20 \	20 \	50 V	100 V	20 V	20 V		
DATA	3.9 pF Capacitor Ceramic		1 oF Capacitor Ceramic	150 pF Capacitor Caramic	27 DE Capacitos Ceraille	1 IF Capacitor Teramic	10 JE Capacitor Tantalum	1 nF Capacitor Coramic	1.5 nF Capacitor Ceramic	1 uF Capacitor Tantalum	0.47 uF Capacitor Tantalum	1 nF Capacitor Ceramic	150 pF Capacitor Ceramic	1 nF Capacitor Ceramic	2. / pF Capacitor Ceramic	150 pr Capacitor Ceramic	150 pr Capacitor Ceramic	150 of Capacitor Ceramic	18 pF Capacitor Ceramic	150 pF Capacitor Ceramic	470 pF Capacitor Ceramic	470 pF Capacitor Ceramic	150 pF Capacitor Ceramic	150 pF Capacitor Ceramic	10 pr Capacitor Ceramic	1 PE Capacitor Ceramic	220 UE Capacitor Electrolytic	1 nF Capacitor Ceramic	33 pF Capacitor Ceramic	1 nF Capacitor Ceramic	1 nF Capacitor Ceramic	22 nF Capacitor Polyester	100 pF Capacitor Ceramic	100 pF Capacitor Ceramic	1N4148 Diode Silicon	1N4148 Diode Silicon
CODE	19A700235P8	19A700003P5	19A700233P7	19A 700233P2	194700235018	19A700003P4	19A700003P7	19A700233P7	19A700233P8	19A 700003P4	19A 700003P3	19A 700233P7	19A 700233P2	194 / 002337 /	19A / 00235P6	19A 700233P2	19470023372	19A 700233P2	19A700235P16	19A700233P2	19A700233P5	19A700233P5	19A700233P2	19A / 00233P2	19470023513	19A 700733P7	191706005P5	19A700233P7	19A700235P19	19A700233P7	19A700233P7	19J706261P1	19A700233P1	19A700233P1	19A / 00028P	19A700028P1
ο̈ν	C749 C750	C751	C752	C753	C754	C755	C756	C757	C758	C759	C760	C761	C/62	0.703	7765	766	797	C768	C769	C770	C771	C772	C//3	4//0	0777	C780	C781	C782	C783	C784	C785	C791	C792	C/93	2070	D703

FREQUENCY SYNTHESIZER FS5662

X403.050

Page 1 of 3

N O	CODE	DATA	
0704	19A700028P1	Diode	
D705	19A700028P1	Diode	
D706	19A700028P1	Diode	
D707	19A700028P1	Diode	
D708	19A700028P1	1N4148 Diode Silicon	
D709	19A700028P1	1N4148 Diode Silicon	
D710	19A700028P1	Diode	
D711	19A700028P1	Diode	
D712	19A700028P1	1N4148 Diode Silicon	
D713	19A700028P1		
D714	19A700028P1	1N4148 Diode Silicon	
D721	19A700028P1	1N4148 Diode Silicon	
D722	19A700028P1	1N4148 Diode Silicon	
D723	19A706262P1	Variable Cap. Diode	
J724	19J706262P1	Variable Cap. Diode	
D725	19A700073P1	Variable Cap.	
D726	19A700073P1	Variable Cap.	
D727	19A700073P1	BB409 Variable Cap. Diode	
D733	19J706006P2	BA282 Diode	
734	19J706006P2	BA282 Diode	
D741	19J706026P1	1N5401 Diode Silicon	
D742	19J 706026P1	1N5401 Diode Silicon	
1730	19J706215P108	Male Connector	8 pin
1732	19J 706215P114	Male Connector	14 pin
1901	19J 706214P4		4 pin
1902	19J 706214P4	Male Connector	4 pin
1903	19J706214P7	Male Connector	7 pin
1004	19A700072P28		2 pin
1905	19A700072P9	Male Connector	10 pin
906	19A700072P11	Male Connector	12 pin
1907	19A700102P21	Female Connector	3 pin
1910	19J706223P11	Male Connector	11 pos
1911	19J706223P8	Male Connector	sod 8
1921	19J706219P1		pin
1961	19J 7062 19P1		niq
701		Variable Coil	
707	19A /00024P15	1.5 uH Coil	
-/03	19A / 00024P 15	1.5 uH Coil	
104	19470603F1	COII	
207	194 /00024719	3.3 UH COII	
707	194700024F19	3.3 uH Coll	
700	194 70003 P1	Variable Coll	
711	197/000247 13	Variable Coil	
712	19A700024P19	3 3 TH Coil	
L713	19A700024P19	3.3 uH Coil	

0	_	_																																										
Storno																								W 25 0	24.	07	67.		27.	2	57	27		57.	. 25	. 25	0.25 W	. 25	. 25	25	. 25	25	. 25	
	DATA				3.3 uH Coil	Coil	3.3 uH Coil	6,8 uH Coil	0.15 uH Coil	0. 15 uH Coil	BC548 Transistor	BC558 Transistor	BC558 Transistor	558	BC548 Transistor	BFR54 Transistor	BFR54 Transistor	BF414 Transistor	2N5245 Transistor		BF357S Transistor	BE414 Transistor	BE3575 Transistor	47 ohm Resistor Denos	1 5 Kohm Resistor Denos	22 Kohm Besistor Depos.	560 ohm Docietor Docos	2 7 Kohm Besister Deser-	17 ohm Design Depos.	10 Kohm Besistor Depos.	10 Kelm Resistor Depos.	2 7 Volum Resistor Depos.	2.7 Norm Resistor Depos.	10 1/2 In Resistor Depos.	10 Kohm Resistor Depos.	22 ohm Resistor Depos.	22 ohm Resistor Depos.	1 Kohm Resistor Depos.	4.7 Kohm Resistor Depos.	82 Kohm Resistor Depos.	56 Kohm Resistor Depos.	10 Kohm Resistor Depos.	Resistor	
	CODE			19A 700024P19	19A700024P19	19J706258P1	19A700024P19	19A700024P23	19A700024P3	19A700024P3	19A700017P1	19A700020P1	19A700020P1	19A700020P1	19A700017P2	19J706283P1	19J706283P1	19J706264P1	19J706038P1	19J706038P1	19J706146P1	19J706164P1	19J706146P1	19A700019P21	19A700019P39	19A 700019P53	19A 7000 19B3 #	1977,000191 34 19A 700019B42	10070001	19A 700019P21	19 7000191 49	19A 700019F 49	100 70001 42	19070019142	194700019F49	194/0001971	19A700019P17	19A700019P37	19A700019P45	19A700019P60	19A700019P58	19A700019P49	19A700019P57	
	ο̈́N		_		L716	L717	L718	L721	L722	L723	Q701	Q702	Q703	Q704	Q711	Q713	Q714	Q715	Q716	Q717	Q722	0723	0724	R701	R702	R703	R704	R705	R706	R707	8708	R709	0711	0717	21.7	21.12	K714	R720	R721	R722	R723		R725	

FREQUENCY SYNTHESIZER FS5662

X403.050

Page 2 of 3

R726 19A700019P49 10 Kohm Resistor Depos. R728 19A700019P30 270 ohm Resistor Depos. R729 19A700019P30 270 ohm Resistor Depos. R732 19A700019P49 8.2 Kohm Resistor Depos. R733 19A700019P49 8.2 Kohm Resistor Depos. R734 19A700019P3 8.2 Kohm Resistor Depos. R734 19A700019P3 330 ohm Resistor Depos. R735 19A700019P3 330 ohm Resistor Depos. R736 19A700019P25 1.5 Kohm Resistor Depos. R737 19A700019P25 1.5 Kohm Resistor Depos. R741 19A700019P25 1.5 Kohm Resistor Depos. R742 19A700019P25 1.6 Kohm Resistor Depos. R743 19A700019P25 1.7 Kohm Resistor Depos. R744 19A700019P25 1.7 Kohm Resistor Depos. R752 19A700019P25 1.7 Kohm Resistor Depos. R754 19A700019P25 1.7 Kohm Resistor Depos. R754 19A700019P25 1.7 Kohm Resistor Depos. R754 19A700019P25 1.7 Kohm Resistor Depos. <	ōΝ	CODE	DATA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
194700019P30 27 194700019P48 8. 194700019P49 19 4700019P49 8. 194700019P49 8. 194700019P35 194700019P31 133 194700019P25 194700019P26 194700019P28	R726	19A700019P49	10 Kohm Resistor Depos.	0.25 W
194700019P48 194700019P45 194700019P45 194700019P49 194700019P31 194700019P31 194700019P31 194700019P31 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P37 194700019P37 194700019P37 194700019P38	R727	19A700019P30	270 ohm Resistor Depos.	0.25 W
194700019P30 194700019P45 194700019P45 194700019P48 8. 194700019P35 194700019P31 133 194700019P25 104700019P25 104700019P26 104700019P26 104700019P26 104700019P26 104700019P26 104700019P26 104700019P26 104700019P28	R728	19A700019P48	8.2 Kohm Resistor Depos.	25
194700019P45 194700019P48 8. 194700019P48 8. 194700019P35 194700019P31 133 194700019P25 194700019P25 194700019P27 194700019P27 194700019P27 194700019P25 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28	R729	19A700019P30	270 ohm Resistor Depos.	. 25
194/20019P48 194/20019P35 194/200019P35 194/200019P31 133 194/200019P31 133 194/200019P31 134 194/200019P31 137 194/20019P25 1194/20019P25 1194/20019P27 1194/20019P25 1194/20019P25 1194/20019P25 1194/20019P25 1194/20019P25 1194/20019P25 1194/20019P25 1194/20019P26	R730	19A700019P45	4.7 Kohm Resistor Depos.	25
194/00019948 194/00019955 194/00019957 194/00019931 133 194/00019931 133 194/00019931 13-194/00019933 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019924 194/00019924 194/00019924 194/00019924	K/32	19A 700019P49	10 Kohm Resistor Depos.	0.25 W
194/00019P35 194/00019P31 194/00019P31 194/00019P31 194/00019P35 194/00019P25 194/00019P27 194/00019P27 194/00019P27 194/00019P25 194/00019P37 194/00019P37 194/00019P35 194/00019P35 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P21 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P27 194/00019P25 194/00019P27 194/00019P27 194/00019P27 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28 194/00019P28	K/33	19A 700019P48		. 25
19A/00029F31 33 19A700019P25 10 19A700019P31 33 19A700019P25 10 19A700019P31 33:0 19A700019P31 33:0 19A700019P31 33:0 19A700019P31 33:0 19A700019P31 33:0 19A700019P31 33:0 19A700019P34 33:0 19A700019P34 10	K/34	19A / 00019P35	680 ohm Resistor Depos.	. 25
194/00019P31 33 194/00019P31 33 194/00019P25 10 194/00019P25 10 194/00019P25 10 194/00019P27 11 194/00019P27 11 194/00019P27 11 194/00019P25 10 194/00019P26 10 194/00019P26 10 194/00019P26 10 194/00019P26 10 194/00019P26 10 194/00019P28 10	R/35	194 /00029P57	47 Kohm Resistor Depos.	. 25
194700019751 155 16 194700019751 15 194700019751 15 194700019752 17 194700019757 17 194700019757 17 194700019757 17 194700019757 194700019757 17 194700019757 17 194700019757 17 194700019758 194700019758 1847000197	R/36	19A /00029P31	ohm Resistor	. 25
194700019P25 194700019P43 194700019P25 194700019P27 194700019P27 194700019P57 194700019P51 194700019P51 194700019P57 194700019P57 194700019P57 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P28	D729	104 700019731	330 ohm Resistor Depos.	. 25
194700019F39 194700019F39 194700019P25 194700019P27 194700019P27 194700019P27 194700019P37 194700019P37 194700019P35 194700019P35 194700019P37 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P31 194700019P31 194700019P27 194700019P31	R730	19A700019F25	100 ohm Resistor Depos.	. 25
194700019F45 194700019P25 194700019P25 194700019P25 194700019P37 194700019P37 194700019P25 194700019P26 194700019P25 194700019P26 194700019P27 194700019P26 194700019P28	R741	100 700019539	1.5 Kohm Resistor Depos.	. 25
194700019P25 194700019P25 194700019P27 194700019P27 194700019P37 194700019P25 194700019P26 194700019P35 194700019P37 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27	R747	194 700010027	3.3 Kohm Resistor Depos.	. 25
19A700019P27 19A700019P27 19A700019P25 19A700019P37 19A700019P26 19A700019P26 19A700019P35 19A700019P35 19A700019P57 19A700019P57 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P28 19A700019P28 19A700019P28 19A700019P28 19A700019P28 19A700019P28 19A700019P28 19A700019P28 19A700019P28	R743	194 7000 1953	100 of the Book Book	. 25
194700019P25 194700019P25 194700019P37 194700019P37 194700019P26 194700019P35 194700019P42 194700019P57 194700019P57 194700019P59 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P27 194700019P27 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28 194700019P28	R748	70001007001	100 onm Resistor Depos.	. 75
194700019F57 194700019F57 194700019P57 194700019P51 194700019P51 194700019P55 194700019P57 194700019P57 194700019P57 194700019P57 194700019P21 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P24 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P26 194700019P26 194700019P26 194700019P26 194700019P26	R749	19470001952	100 of Project Depos.	. 25
19A700016P3 19A700019P37 19A700019P25 19A700019P51 19A700019P51 19A700019P57 19A700019P57 19A700019P57 19A700019P57 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P24 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P26 11.91 11.	R750	194 7000 1957	17 Volum Resistor Depos.	. 25
194700019F37 11 194700019F37 11 194700019F25 10 194700019F26 12 194700019F35 82 194700019F35 15 194700019F37 47 194700019F37 47 194700019F25 33 194700019F25 19 194700019F25 19 194700019F25 10 194700019F33 11 194700019F33 11 194700019F34 11 194700019F36 11 194700019F37 11	B753	100 70001 500	47 Norm Resistor Depos.	0.25 W
19A700019P37 19A700019P13 19A700019P51 19A700019P51 19A700019P57 19A700019P57 19A700019P57 19A700019P57 19A700019P50 19A700019P21 19A700019P21 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P23 19A700019P24 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25 19A700019P25	D752	100 700016P3	4. / Kohm Kesistor Variable	
194700019P25 194700019P13 194700019P26 194700019P42 194700019P42 194700019P57 194700019P55 194700019P57 194700019P21 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P25 194700019P27 194700019P27 194700019P27 194700019P27 194700019P27 194700019P28 194700019P28 194700019P28 194700019P28	0727	194700019F37	I Kohm Kesistor Depos.	. 25
194/00019P13 194/00019P26 194/00019P26 194/00019P42 194/00019P35 194/00019P57 194/00019P57 194/00019P37 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23	K/54	194700019P25	100 ohm Resistor Depos.	. 25
194700019P51 194700019P26 194700019P42 194700019P15 194700019P57 194700019P57 194700019P50 194700019P21 194700019P21 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23	10/2	194700019813	10 ohm Resistor Depos.	
194700019P26 194700019P35 194700019P42 194700019P57 194700019P55 194700019P57 194700019P21 194700019P21 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P23 194700019P24 194700019P24 194700019P24 194700019P24 194700019P24 194700019P24 194700019P27	K/63	19A700019P51	15 Kohm Resistor Depos.	0.25 W
194/00019935 194/00019942 194/00019942 194/00019957 194/00019953 194/00019953 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019924 194/00019924 194/00019924 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925 194/00019925	K/65	19A 700019P26	120 ohm Resistor Depos.	0.25 W
194/00019942 194/00019915 194/00019957 194/00019950 194/00019923 194/00019921 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019924 194/00019924 194/00019925 194/00019925 194/00019926 194/00019926	K/69	19A / 00019P35	820 ohm Resistor Depos.	.25
194/00019P15 194/00019P57 194/00019P55 194/00019P50 194/00019P21 194/00019P21 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P23 194/00019P23 194/00019P27 194/00019P27 194/00019P27 194/00019P24 194/00019P26 194/00019P26 194/00019P26	K//0	19A 700019P42	2.7 Kohm Resistor Depos.	
19A700019P57 19A700019P55 19A700019P50 19A700019P21 19A700019P21 19A700019P25 19A700019P25 19A700019P25 19A700019P19 19A700019P29 19A700019P29 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P27 19A700019P28	- X	19A 700019P15	15 ohm Resistor Depos.	0.25 W
194/00019P55 194/00019P50 194/00019P33 194/00019P21 194/00019P25 194/00019P25 194/00019P25 194/00019P25 194/00019P23 194/00019P23 194/00019P27 194/00019P27 194/00019P27 194/00019P27 194/00019P24 194/00019P24 194/00019P26	K//2	19A 700019P57	47 Kohm Resistor Depos.	0.25 W
194/00019P50 194/00019P33 194/00010P21 194/00019P25 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P23 194/00019P27 194/00019P27 194/00019P27 194/00019P31 194/00019P26 194/00019P26	K//3	19A700019P55	Resistor	2
194/00019933 194/00010921 194/00019925 194/00019923 194/00019923 194/00019923 194/00019923 194/00019923 194/00019927 194/00019927 194/00019924 194/00019926 194/00019926 194/00019926	X//4	19A 700019P50	12 Kohm Resistor Depos.	25
194/0001093/ 194/00019P21 194/00019P23 194/00019P23 194/00019P23 194/00019P4 194/00019P27 194/00019P27 194/00019P27 194/00019P27 194/00019P31 194/00019P31 194/00019P26 194/00019P26	K//5	19A 700019P33	470 ohm Resistor Depos.	
194/00019P21 194/00019P25 194/00019P23 194/00019P23 194/00019P24 194/00019P27 194/00019P27 194/00019P27 194/00019P31 194/00019P31 194/00019P34 194/00019P26 194/00019P26	K//0	19A / 0001 0P3 /	1 Kohm Resistor Depos.	25
194/00019P25 194/00019P23 194/00019P49 194/00019P44 194/00019P27 194/00019P27 194/00019P27 194/00019P39 194/00019P39 194/00019P39 194/00019P34 194/00019P26	7/1	19A 700019P21	47 ohm Resistor Depos.	
19A/00019P35 19A700019P23 19A700019P19 19A700019P27 19A700019P25 19A700019P31 19A700019P31 19A700019P34 19A700019P34 19A700019P26	K//8	19A700019P25	100 ohm Resistor Depos.	0.25 W
19A 700019P23 6 19A 700019P19 3 19A 700019P19 3 19A 700019P27 1 19A 700019P3 1 19A 700019P3 1 19A 700019P26 1 19A 700019P28 1 19A 700019P28 1 19A 700019P28	K//9	19A700019P35	680 ohm Resistor Depos.	
782 19A700019P19 3 782 19A700019P44 3 783 19A700019P27 1 784 19A700019P25 1 785 19A700019P31 3 786 19A700019P31 3 787 19A700019P26 1 789 19A700019P26 1 789 19A700019P26 1	K/80	19A 700019P23	68 ohm Resistor Depos.	0.25 W
782 19A700019P44 3 783 19A700019P27 1 784 19A700019P25 1 785 19A700019P31 3 787 19A700019P43 3 787 19A700019P26 1 789 19A700019P26 1 789 19A700019P26 1 789 19A700019P26 1	K/81	19A700019P19	33 ohm Resistor Depos.	0.25 W
783 19A700019P27 150 784 19A700019P25 100 785 19A700019P39 1.5 786 19A700019P31 330 787 19A700019P43 3.3 788 19A700019P26 120 789 19A700019P28 560	K/82	19A 700019P44	3.9 Kohm Resistor Depos.	2
784 19A700019P25 100 785 19A700019P39 1.5 786 19A700019P31 330 787 19A700019P26 120 789 19A700019P26 120 789 19A700019P28 180	K783	19A700019P27	150 ohm Resistor Depos.	0.25 W
785 19A700019P39 1.5 786 19A700019P31 330 787 19A700019P43 3.3 788 19A700019P26 120 789 19A700019P34 560 791 19A700019P28 180	K784	19A700019P25	100 ohm Resistor Depos.	-
786 19A700019P31 330 787 19A700019P43 3.3 788 19A700019P26 120 789 19A700019P34 560 791 19A700019P28 180	R785	19A700019P39		25
787 19A700019P43 3.3 788 19A700019P26 120 789 19A700019P34 560 791 19A700019P28 180	R786	19A700019P31	30	25
788 19A700019P26 120 789 19A700019P34 560 791 19A700019P28 180	R787	19A700019P43		25
789 19A700019P34 560 791 19A700019P28 180	R788	19A700019P26		25
791 19A700019P28 180	R789	19A700019P34		. 25
	-	19A700019P28		0.25 W

	0. 25 W 0. 25 W 0. 25 W 0. 25 W 0. 25 W
DATA	1.2 Kohm Resistor Depos. 22 ohm Resistor Depos. 22 ohm Resistor Depos. 1 Kohm Resistor Depos. 27 Kohm Resistor Depos. Channel Switch Transformer MC145106 TDA1062 IC 4066B IC
CODE	19A700019P38 19A700019P17 19A700019P37 19A700019P54 19J706284G1 19J706284G1 19J706283P1 19J706238P1 19A700029P44
ο̈́N	R792 R793 S701 T701 U702 U703

FREQUENCY SYNTHESIZER FS5662

Page 3 of 3

CONTROL LOGIC BOARD

CL5001

CL5001 is a microcomputer controlled logic board used in CQM5000. The logic board interfaces the keyboard and 4-digit LED-display (CP5005), the synthesizer (FS5000), the RF-board through the FS5000/XS5002 board and the tone module (TO5007/8).

The program ROM U802 determines the functional behavior of the logic while the personality PROM U804 determines the system mode and contains customer specified data such as channel information for the synthesizer and tonetables/ tonecodes for the TQ5007/8.

CIRCUIT DESCRIPTION

The control logic board CL5001 includes the following circuit blocks:

- 1. Microcomputer U801 and program ROM U802
- 2. Personality PROM U804
- 3. Latches for RF-Synthesizer (U806, U807, U810)
- Keyboard decoder/multiplexer, individual and group tone detector (U805)
- 5. Attention oscillator (U812)
- Control inputs from RF5000 through FS5000/XS5002
- 7. Control outputs to RF5000
- 8. Control outputs to TQ5007/5008
- Display interface (U808/9), dimmer and LS-indicator (LED)
- 10. Voltage regulator (U813/15)

MICROCOMPUTER SYSTEM

Description

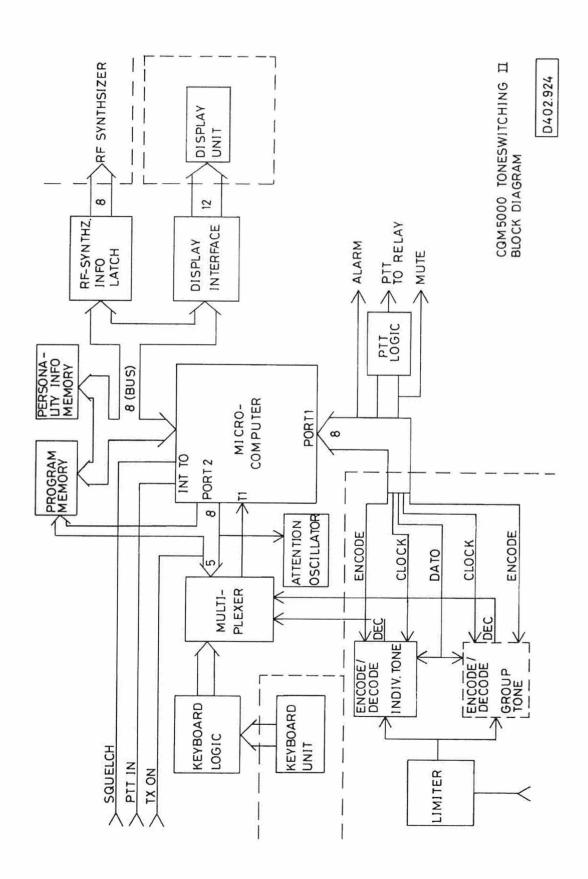
The microcomputer system processes all functions and information, and controls the data communication between the different modules of the radio unit and other accessories.

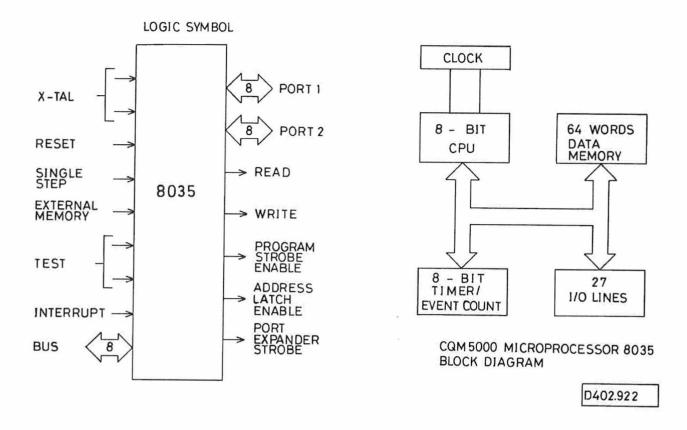
The system consists of a microcomputer U801, type 8035 with a 128 byte RAM memory, a 2-Kbyte EPROM U802 where the program is stored and an address latch U803.

The 8 bit common bus (data and address bus) and the 3 bit address bus interconnects those three devices.

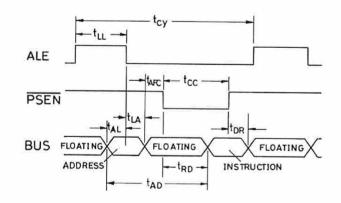
Instruction fetch

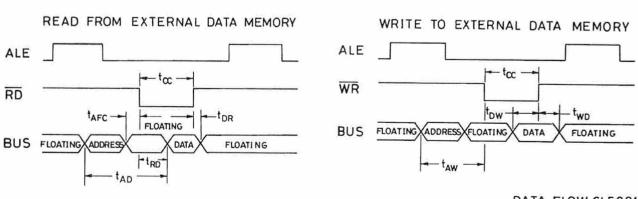
- When the EA-pin (External access) goes
 HIGH, the busses ar used for external program instruction fetches.
- The 8 LSB (least significant bits) of the program counter are placed on the common bus and the 3 MSB (most significant bits)
 on the lower half of port 2 (P20-P21-P22).
- The ALE pin (address latch enable) indicates a valid address. Just when ALE goes LOW, the address is stored at the output of U803.
- The PSEN-pin (Program Store Enable) indicates that an address is in progress on the busses and just when it goes LOW, the external memory U802 is enabled and the data corresponding to the address are placed at the output of U802.
- The common bus then reverts to input mode (floating) and transfers the data to the microcomputer which accepts its 8 bit content as an instruction or data word.





INSTRUCTION FETCH FROM EXTERNAL PROGRAM MEMORY





DATA FLOW CL5001

D403.005

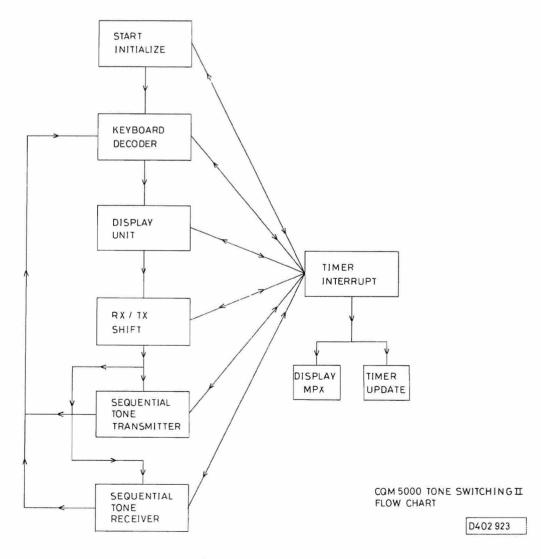
Data memory operation

The personality PROM U804, the seven-segment decoder U808 and the two quad latches U806 and U807 act in the microcomputer system as external data memories and are therefore addressable via the databus by using the read or write pulses. Pin 8, RD, output of the read pulse and pin 10, WR, output of the write pulse are active LOW. These pulses clock or enable inputs to the integrated circuits.

The data memory operation takes place as follows:

- The wanted address which is controlled by the program is placed on the common 8 bits bus.
- ALE indicates that the address is valid and as explained in the precedent section, just when ALE goes LOW, the address is stored at the output of U803.

- The WR pulse is used to enable U806/7,
 U808 and U809 which are processing the data output.
 - To enable U806/U807 the WR pulse is not enough. They are enabled only when the WR pulse is combined with a pulse coming through the address lead A7.
- The RD pulse (read pulse) enables the personality PROM U804. Input data from U804 are valid when the RD pulse is LOW.
- The 8 bit common bus transfers all in or out data to the microcomputer.
- When the operator writes, on the keyboard, to the display, the address is available at U809 input and waits for a write pulse to be clocked in. Just when WR goes LOW, the information is clocked in and just when WR goes HIGH the data is stored.



Reset

If the voltage supply falls more than 10% below the 5 volt nominal, transistors Q819 and Q820 ensure a proper reset of the microcomputer system.

PERSONALITY PROM U804

The personality PROM contains the customer specified data of the system's functional behaviour and information about tones and channels being used in the equipment. Data informations stored in the PROM are clocked out by the RD pulse and transfered to microcomputer U801 through the common bus.

LATCHES FOR RF SYNTHESIZER

The channel information sent to the RF-synthesizer via the 8 bit bus is stored in the two quad latches U806 and U807 by the write pulse.

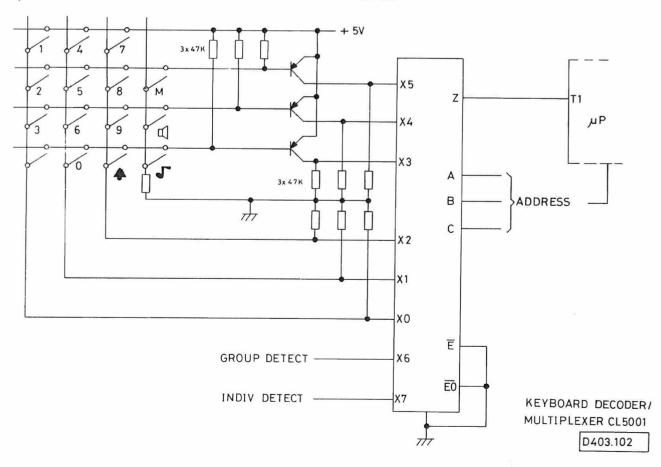
The transistor array U810 inverts each output from U806/U807 and supplies sharp logic outputs.

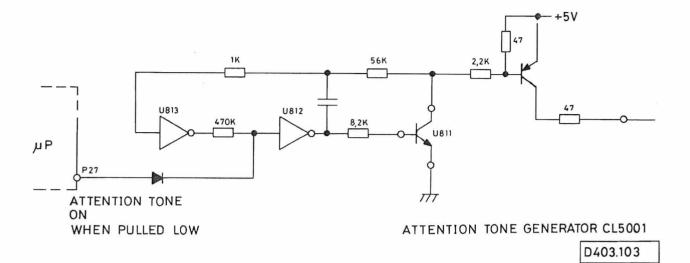
DECODER AND DETECTOR U805

The decoding circuit is able to decode a 4×4 matrix keyboard. The decoder output is fed into the detector (dataselector) U805 at inputs 1-6. The decoded outputs are 6 binary coded lines. The microcomputer scans the 6 lines through inputs A, B and C and read the information through U805 output z (pin 14).

This information is then decoded in order to make the microcomputer determine the function of the key being depressed.

The two remaining input lines 7 and 9 of U805 are used as detect inputs from the individual and group tone receiver; they are directly connected to TQ5007/5008 through connector P801. The microcomputer scans these inputs too to be able to set up the next tone to be received.





ATTENTION OSCILLATOR U812

Attention oscillator U812 generates an acoustic feed-back from the loudspeaker when a push button is depressed.

The microcomputer controls U812 through P27, and when diode D801 goes off, U812 starts working. The oscillator circuit includes: the two inverters of U812, capacitor C808 and one transistor of the transistor array U811 (input B7-output C7). The generated signal passes through transistor Q818 and is sent via the connector P830 of the XS/FS board to the loudspeaker.

CONTROL INPUTS FROM RF5000

- Correspondance between the CL5001 and the RF board takes place through connector P806.
- The push-to-talk (PTT) function is directly connected to the interrupt pin (INT-pin 6) of the microcomputer and isolated from the PTT to relay by Q802. This transistor is controlled by the microcomputer output P10 (pin 27).
- The external tone-key function is transferred from connector P806 to keyboard decoder through the same lead as TONE-KEY button.
- RX-mute function is transferred through Q803 and one transistor in the transistor array U811 to the squelch detect input on the microcomputer TO (pin 1).

- 8,5 V TX passes through the voltage divider R803/R804 before entering the microcomputer at input P24 (pin 35).
- The VOL/SQ HI signal is transferred from the RF board through connector P806, pin 10, to the tone board TQ5007/5008 through connector P801, pin 9.

CONTROL OUTPUTS TO RF5000

- The RX mute depends on the transistor
 Q803 which is controlled by the output P10
 (pin 27) of the microcomputer through an inverter.
- The mute output is controlled by the same output P10 (pin 27) through one of the transistors in the transistor array U811.
- The PTT signal from the RF board (pin 3 on connector P806) is directly transferred to the PTT-to-Relay output (pin 2 connector P806) when the transistor Q802 is on. The PTT to Relay is also controlled by the microcomputer output P11 through an inverter and a transistor in U811.
- The output P11 (pin 28) of the microcomputer enables the MIC BLOCK function through one of the array transistors in U811 and transistor Q801 when the PTT to relay is activated by the same port.

- The output P12 (pin 29) of the microcomputer controls the external alarm function pin 12 on P806 through an inverter and one of the array transistors in U811.
- The tone output is transferred from the tone board TQ5007/5008 through connector P801, pin 10, to the RF board through connector P806, Pin 11.

CONTROL OUTPUTS TO TQ5007/5008.

- Correspondance between the CL board and the tone board takes place through connector P801.
- The system clock, which is the sample frequency for the DTD chip, is output from counter U814 at pin 2 on connector P801. The counter U814 divides the microcomputers clock frequency (3.579545 MHz) by 16 to give 223.72 KHz. This counter is controlled by the keyboard through connector P803 pin 10.
- To set up a tone, the microcomputer loads the DTD chip with 15 bits applied to P17 (pin 34). The first five bits determine the Q-value while the last ten bits program the tone frequency either to be received or to be transmitted by the TQ unit. The data are transferred at pin 1 on P801.
- In order to load the programming bits, the microcomputer generates a data clock for each DTD chips (A101 and A102 if TQ5008) at P16 (pin 32) for A101 (indiv. call) and P14 (pin 31) for A102 (gr./all call). The data clock is sent to the chips cyncronnously with the data bits at pin 5 and 6 on connector P801.
- To start and stop the tone transmission, the microcomputer controls the tone output from the TQ by two enable pins P15 (pin 32 for INDV.) and P13 (pin 30 for GR/ALL.), one for each DTD-chip.

 The detect output of each DTD-chip (pin 11 and 12 on P801) is connected to the microcomputer input T1 (pin 39) through the data selector U805.

DISPLAY INTERFACE, DIMMER AND LS-LED

- The display is a 4-digit multiplexed display.
 Correspondance between the CL board and the display takes place through connector P802. Pins 1 to 4 transfer information about the number to be displayed, pins 5 to 11 transfer information about which digit is going to be written.
- The microcomputer sends digit information, colon and call indicator instructions to the HEX latch U809 through the address latch U803. The write pulse from the microcomputer clocks the data in. Outputs Q0 to Q3 (pin 2, 5, 7 and 10) of U809 control 4 transistors Q807, 808, 809 and 810 whose collectors are connected to connector P802 (pin 1, 2, 3 and 4) and their emitters in series with the dimmer circuit.
- In order to turn on some or all the seven segments of one of the digits, the micro-computer places 4 bits on the common bus.
 The write pulse clocks them into the BCD-to-7 Segment latch decoder-drivers where they are stored, and decoded. The drivers seven outputs are connected to pin 5 11 on connector P802.
- The dimmer circuit consists of three transistors in cascade Q815, Q816, Q817 shunted with two diodes, and connected in series with the display driver transistors.
 When the photo transistor Q817 is subjected to strong light, transistor Q815 conducts and allows maximum current to pass through the display drivers. With weak light the transistor Q815 is cut-off and the diodes give a 2 x 0,7 volts drop in the voltage supply to the display, which then is dimmed.

VOLTAGE REGULATORS

The CL5001 is supplied by 13.6 volt nominal switched by the series transistors Q814 and Q813 which are controlled by 8.5 V cont. The 5 volt regulator U815 receives 13.6 V and supplies the entire CL and TQ board.

The other 5 volt regulator U813 ensures a continuous 5 volt supply for the data RAM in the microcomputer and gives the system a constant memory.

To interface the FS5000, 8.5 V. cont. is used to pull up the output level.

TECHNICAL SPECIFICATIONS

Voltage supply

13.6 V nom.

8.5 V regulated, continuous

Generated on CL5001

5.0 V regulated, switched

5.0 V regulated, continuous

Current consumption

420 mA +/-50 mA

max 30 mA standby, (data RAM)

Logic levels

LOW: max 0.8 V

HIGH: min 2.4 V

Squelch detect input

LOW: max 0.6 V

HIGH: min 6.5 V

Synthesizer output

LOW: max 0.3 V

HIGH: min 7.5 V

Microcomputer clock frequency

3.579545 MHz: Crystal controlled

Sample clock for TQ-unit

223.72 KHz, (Crystal/16)

Weight

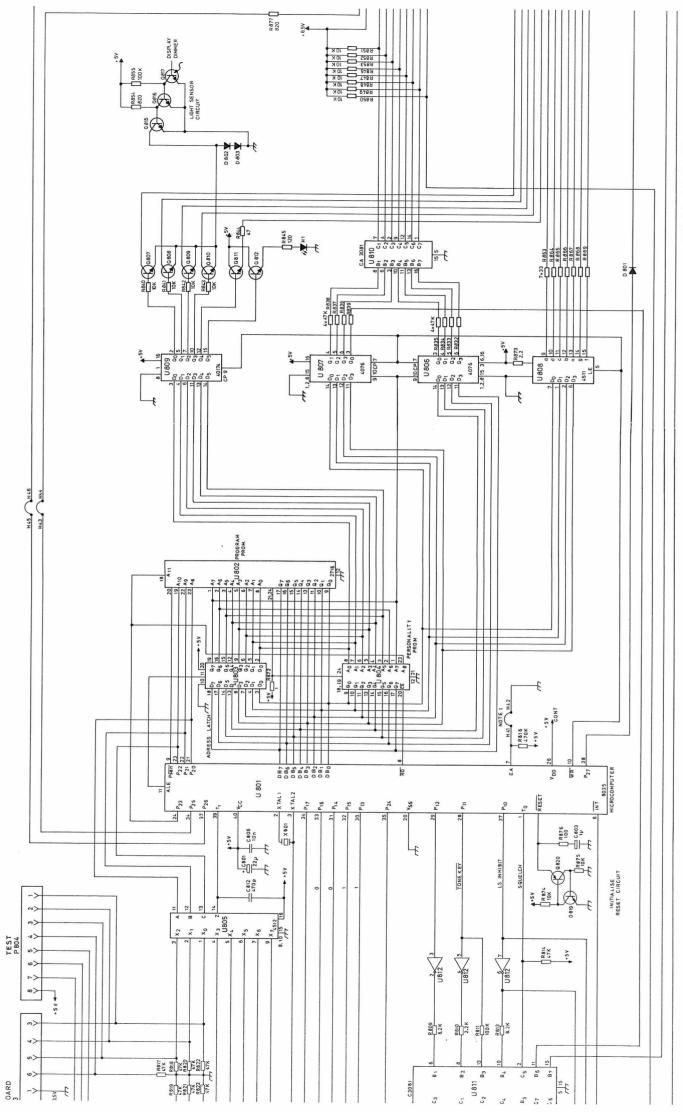
150 g

Dimensions

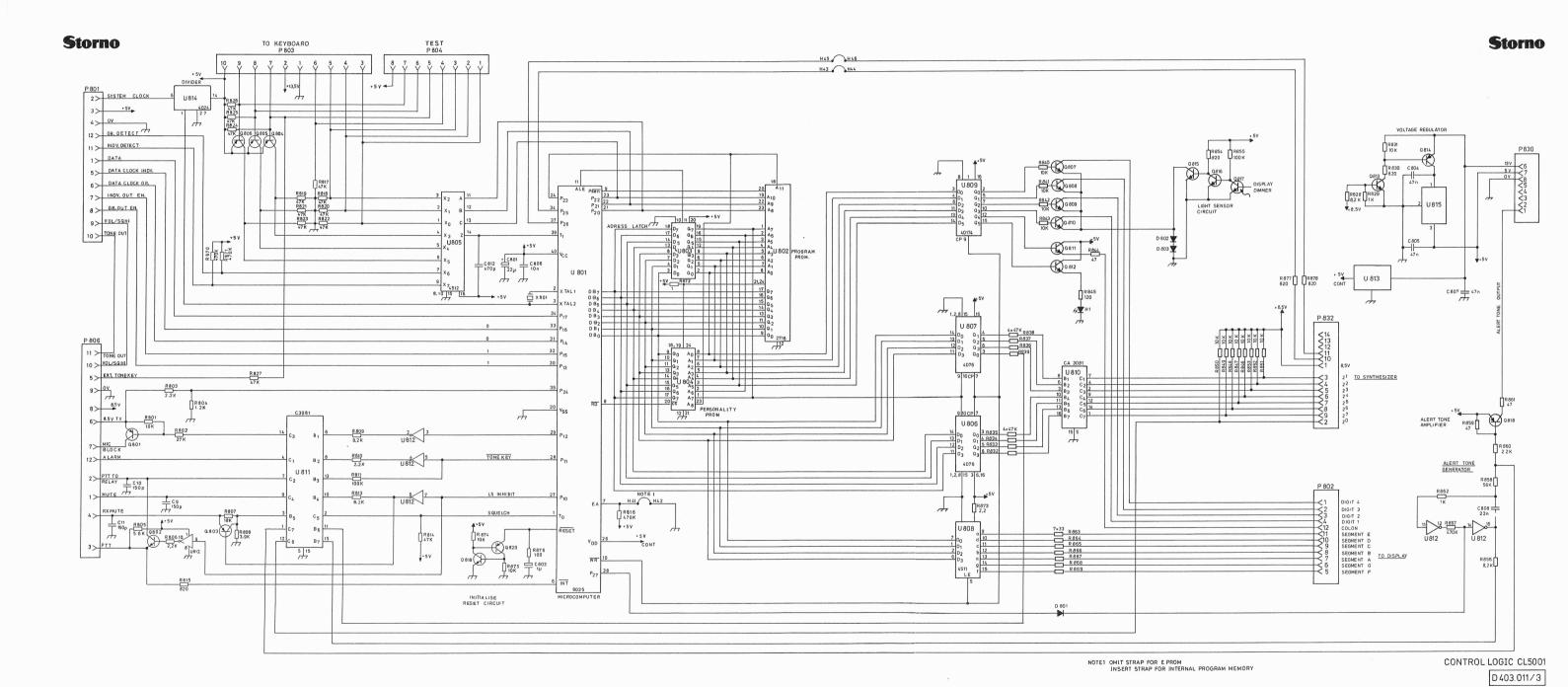
 $(b \times d \times h)$ 150 × 160 × 10 mm

Temperature range (ambient)

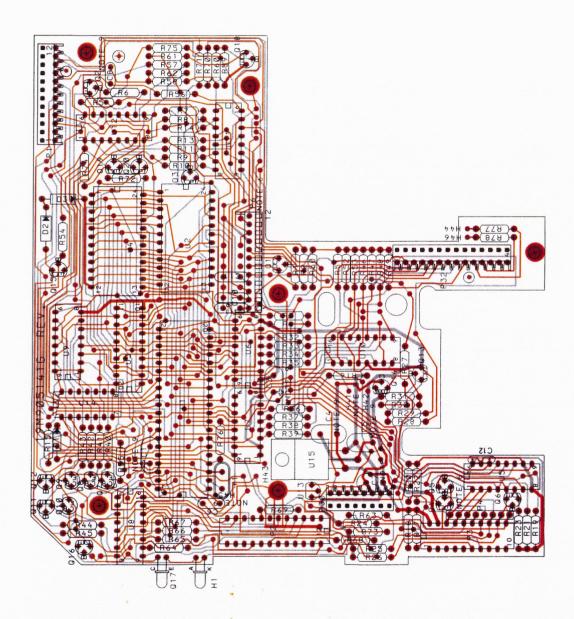
 -30° C to $+60^{\circ}$ C



NOTE! OMIT STRAP FOR E PROM INSERT STRAP FOR INTERNAL PROGRAM MEMORY



D403.039/2



o N	CODE	DATA	
C801	19J706339P8	22 uF Elco	
C803	19A701352P7	1 uF Elco	
C804	19A700005P11	L L	20 N
C805	19A700005P11	47 NF Polyester	
C806	19A700005P7	10 NF Polyester	20 <
C807	19A 700005P11	47 NF Polyester	
C808	19A700005P9		20 \
C809	19A700233P27	PH	
C810	19A700233P27	PF	
C811	19A700233P27	150 pF Ceramic	
C812	19A700233P27	PF	
C813	19A700233P27	PF	
C814	19A700233P27	PF	
C815	19A700233P27	PF	
C816	19A700233P27	150 pF Ceramic	
D801	19A700028P1	1N4148 Diode	
D802	19J706100P1	1N4004 Diode	
D803	19J706100P1	1N4004 Diode	
H1	19J706493P2	LED/YW	
P801	19A700041P11	Connector, Fem.	12 pos
P802	19J706143P4		12 pos
P803	19J706143P2		
P804	19J706215P8		sod 8
P806	19A700041P61		12 pos
P830	19A700041P7	Connector, Fem.	8 pos
P832	19A700041P13		14 pos
Q801	19A700020P1	BC308 Transistor	
Q802	19A700017P1	BC238 Transistor	
Q803	19A700020P1	BC308 Transistor	
4080	19A700020P1	BC308 Transistor	
Q805	19A700020P1	BC308 Transistor	
0806	19A700020P1	BC308 Transistor	
Q807	19J706133P1	MPSA13 Transistor	
0808	19J706133P1	MPSA13 Transistor	
0809	19J706133P1	MPSA13 Transistor	
Q810	19J706133P1	MPSA13 Transistor	
0811	19A700017P1	-	
0812	19A700017P1		
Q813	19A700017P1		
Q814	19A700026P1	BC369 Transistor	
Q815	19A700017P1	BC238 Transistor	
Q816	19A700017P1	BC238 Transistor	
Q817	19J 706036P1	istor,	Photo
Q818	19A700020P1		
Q819	19A700017P1	BC238 Transistor	
0000	100000001	10,000 T 200,000	
7870	12070007061	DOSIGN I GUSTON	

ο̈Ν	CODE	DATA	
P802	194 700019054	27 Vohm Booiston	M uc o
0002	100000000000000000000000000000000000000	2 2 1/ Fesision	57.
Kous	194/0001964		. 75
K804	19A 700019P38	1.2 Kohm Resistor	0.25 W
R805	19A700019P46	5.6 Kohm Resistor	0.25 W
R806	19A700019P41	2.2 Kohm Resistor	0.25 W
R807	19A700019P52	18 Kohm Resistor	. 25
R808	19A700019P44	3.9 Kohm Resistor	. 25
R809	19A700019P48	8.2 Kohm Resistor	25
R810	19A700019P41	2 Kohm	25
R811	19A700019P61		25
R813	19A700019P48		. 25
R814	19A700019P57	47 Kohm Resistor	. 25
R815	19A700019P36	820 ohm Resistor	. 25
R816	19A700010P69	470 Kohm Resistor	. 25
R817	19A700019P57	47 Kohm Resistor	. 25
R818	19A700019P57	47 Kohm Resistor	0.25 W
R819	19A700019P57	47 Kohm Resistor	
R820	19A700019P57	47 Kohm Resistor	0.25 W
R821	19A700019P57	47 Kohm Resistor	0.25 W
R822	19A700019P57	Kohm	0.25 W
R823	19A700019P57	47 Kohm Resistor	0.25 W
R824	19A700019P57	47 Kohm Resistor	0.25 W
R825	19A700019P57	47 Kohm Resistor	0.25 W
R826	19A700019P57	47 Kohm Resistor	0.25 W
R827	19A700019P57	47 Kohm Resistor	. 25
R828	19A700019P48	8.2 Kohm Resistor	
R829	19A700019P37	1 Kohm Resistor	0.25 W
R830	19A700018P40	1.8 Kohm Resistor	
R831	19A700019P49	10 Kohm Resistor	25
R832	19A700019P57	47 Kohm Resistor	0.25 W
R833	19A700019P57	47 Kohm Resistor	0.25 W
R834	19A700019P57	47 Kohm Resistor	25
R835	19A700019P57	47 Kohm Resistor	0.25 W
R836	19A700019P57	47 Kohm Resistor	. 25
R837	19A700019P57	47 Kohm Resistor	
R838	19A700019P57	47 Kohm Resistor	
R839	19A700019P57	47 Kohm Resistor	0.25 W
R840	19A700019P49	10 Kohm Resistor	. 25
R841	19A700019P49	10 Kohm Resistor	0.25 W
R842	19A700019P49	10 Kohm Resistor	
R843	19A700019P49	10 Kohm Resistor	25
			2
	The state of the s		

CONTROL LOGIC CL5001

X403.023 Page 1 of 2

Stormo

40 pos 24 pos 24 pos 3. 579545 MHz

78L05 Int. Circuit HEF4024 Int. Circuit MC7805 Int. Circuit Socket Socket Socket Crystal

19J706031P1 19A700029P18 19J706032P1 19J706331P6 19J706331P8 19J706335P1

U813 U814 U815 X801 X802 X803 Y801

Stormo

DATA

CODE

ōΝ

ο̈́N	CODE	DATA	
R844	19A700019P21	0.	2 W
R845	19A700019P26	120 ohm Resistor 0, 25	2 M
R846	19A700019P49	-	× ×
R847	19A700010P49	10 Kohm Resistor 0.25	2 W
R848	19A700010P49	Resistor 0.	2 %
R849	19A700019P49		2 M
R850	19A700019P49	Kohm Resistor	2 W
R851	19A700019P49	Kohm Resistor	2 M
R852	19A700019P49	Kohm Resistor 0.	2 W
R853	19A700019P49	Kohm Resistor 0.	
R854	19A700019P36	Resistor 0.	
R855	19A700019P61	2	
R856	19A700019P48	Resistor 0.	
R857	19A700019P69	70 Kohm Resistor	
R858	19A700019P58	0	
R859	19A700019P41	. 0	
R860	19A700019P41	. 2 Kohm Resistor 0	
R861	19A700019P21	7 ohm Resistor 0.	
R862	19A700019P37	Sohm Resistor	
R863	19A700019P19	3 ohm Resistor	
R864	19A700019P19	3 ohm Resistor	-
R865	19A700019P19	3 ohm Resistor	-
R866	19A700019P19	3 ohm Resistor 0.2	
R867	19A700019P19	3 ohm Resistor	
R868	19A700019P19	ohm Resistor	
R869	19A700019P19	ohm Resistor	
R870	19A700019P69	70 Kohm Besistor	
R871	19A 700019F69		
D872	19077001001	. 0	
D 9 7 2	19610001	0.2	
2000	194 70001975	0.2	
K8/4	19A 700019P49	0.2	-
K8/5	19A 700019P49	r 0.2	
R876	19A700019P37	0.2	-
R877	19A700019P36	0.2	-
R878	19A700019P36	820 ohm Resistor 0.25	× 5
1080	191706033P1		
0802			
U803	19A7000037P115		
U804	19A700117P1		
U805	19A700029P205	Int.	
9080	19A700029P59	HEF4076 Int. Circuit	
U807	19A700029P59	HEF4076 Int. Circuit	
U808	19A700029P204	HEF4511 Int. Circuit	
080A	19A700029P53	74 In	
U810	19A706383P1	CA3081 Int. Circuit	
U811	19J706383P1		
U812	19A700176P1	HEF4049 Int. Circuit	-

CONTROL LOGIC CL5001

က
2
0
$^{\circ}$
0
7
×
X

Page 2 of 2

CQM 5000 TONESWITCHING II

OPERATOR CONTROLS AND INDICATORS

GENERAL

The tone switching II version is a CQM5000 set with operator – programmable 5-tone sequential equipment and, if more than 1 RF-channel is used, a frequency synthesizer.

Standard controls and indicators: (ref. fig. 1)

ON/OFF SWITCH

Controls the DC power supply to all the radio circuits except system memory, i.e. the system state remains unchanged even after power OFF and ON.

SQUELCH CANCEL SWITCH

Depressing this button will cancel the noise squelch so that the noise of an unused channel can be heard, if at the same time the tone receiver status is "LS-open".

VOLUME CONTROL

Adjusts AF amplifier output level.

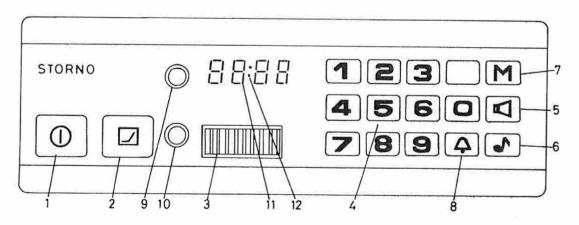


Fig. 1.

- 1. ON/OFF SWITCH
- 2. SQUELCH CANCEL SWITCH
- 3. VOLUME CONTROL
- 4. NUMERICAL KEYBOARD 0 9
- 5. LS ON/OFF (MONITOR)
- 6. TONE KEY

- 7. MODE, I.E. TONE/RF CHANNEL SELECTION
- 8 EXTERNAL ALARM SELECT
- 9. LS INDICATOR YELLOW
- 10. TRANSMIT INDICATOR RED
- 11. 4 DIGIT DISPLAY, TONE-/RF- CHANNEL NUMBER
- 12. COLON, BUSY/EXTERNAL ALARM INDICATOR

NUMERICAL KEYBOARD

Is used for entering tone-call numbers and - if more than one RF channel is available - also the RF channel number.

Whenever a key is activated a short alert tone is heard in the loudspeaker.

KEYBOARD ENTRY MODE

Depressing the "Mode"-key (7) alternately prepares the system for input of tone number or RF channel number respectively.

The display (11) indicates which input mode has been selected by showing a "0" followed by a blank as the two leftmost positions in the RF-channel input mode, whereas a leading zero followed by a blank will never exist when a tone call number is displayed.

LS ON/OFF

Depressing the LS ON/OFF key will normally alternately open respectively close the tone receiver's AF-gate i.e. switch the LS ON and OFF.

This key will not be able to open the AF channel if the "Privacy" option is selected.

TONE KEY

Pressing the tone key will cause the RF-transmitter to be keyed and remain so while the tone transmit telegram is transmitted – except in a situation where the RF channel is occupied and the LS is closed. Attempt to press the tone key in this situation will only produce a warning signal in the loudspeaker. Upon the termination of the transmission, the LS will be opened.

"MODE"

Select keyboard entry mode - see clause 4.

EXTERNAL ALARM SELECT

Pressing the External Alarm key causes an alarm transducer – if employed – to sound for approx. 1 sec. whenever a correct tone telegram has been received. The selection of this function is indicated by the display being blank except that the colon (12) is lit.

Pressing the key again makes the system return to the previous state i.e. disables the alarm and lights the display.

LS INDICATOR

Is a yellow LED which, when lit, indicates that the AF gate of the tone receiver is open (LS is ON).

The LED can either flash or show constant light.

Flashing light indicates that a call has been received, but not yet answered.

When a call is answered - either by tonekeying or normal keying of the transmitter, the LED changes to constant light.

The LED will also show constant light when the operator has opened the LS manually, i.e. by means of the LS ON/OFF key (5).

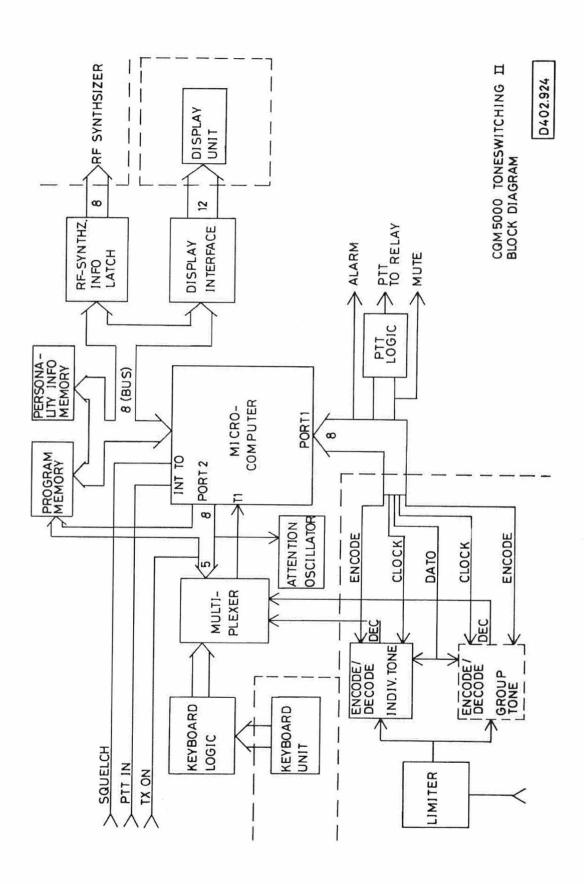
TRANSMIT INDICATOR

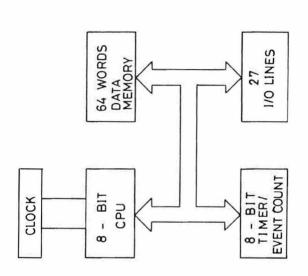
Is a red LED, indicating that the RF transmitter is on.

4 DIGIT DISPLAY

Indicates which RF frequency channel number and tonecall number has been entered by the operator.

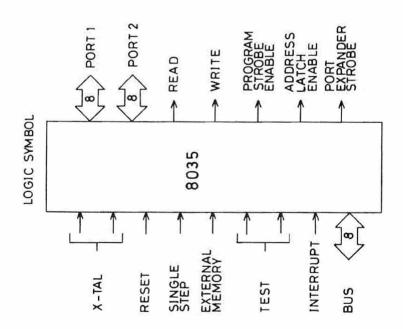
See clauses 4 and 8 for explanation of display modes.

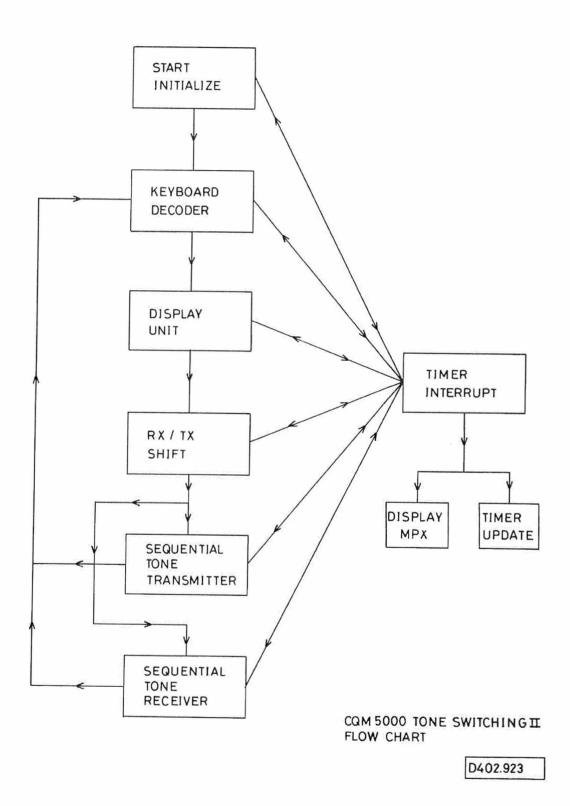




CQM 5000 MICROPROCESSOR 8035 BLOCK DIAGRAM

0402.922





60.523-E1

- 5 -

COLON

Is used as a squelch indicator - also called "busy lamp".

This means that the colon will flash whenever the receiver RF-channel is occupied i.e. when the channel is busy.

As explained in clause 8, a lit colon in an otherwise blank display indicates that external alarm has been selected.

Four independent telegrams can be specified

ist tone transmit	j.
2nd tone transmit	2
acknowledgement/3rd tone	
transmit	3

Options within each of the 4 telegrams

0 - 7 tones	

Prolonged 1st tone

tone receiver

- Transmit telegram twice or
- Transmit next telegram after this one
- Specify which tone-number for each position or
- Specify as operator selectable (max. 4 total) - can be up to 7, but only the 4 last entries are shown on the display.

Tone system

- ZVEI or CCIR tone tables can be specified including misc. variants
- ZVEI or CCIR timing

Tone transmit

- Always 1st telegram
- Can be repeated or
- Can be followed by 2nd telegram
- Programmable tones can be positioned anywhere in all sequences - 4 total; up to 7 in special cases - display will only show 4.

Acknowledge

- Transmitted automatically after reception of valid call. - after carrier has disappeared/or immediately after valid call.
- Can be any of the 4 telegrams (repeated or followed by next telegram)

"I. D"

- Automatic transmission of 1 (or more)
 telegram(s) when pushing transmit key
 - while LS closed
 - and channel is not busy
- Use as ID
 - status
 - tone transmit

Group call receive (with TQ5008 only)

- Any tone in tone table
- At any position in tone receive telegram
- Hierarchical Group Call/All Call
- Two types of All Call

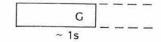
Hierarchical group call

			100	-
11	12	G	R	G

"All-Call", hierarchical



"All-Call", old fashioned



Privacy

- Operator cannot open LS manually
- Keying and tonekeying is not possible if channel is busy - (true also without Privacy if LS is closed).
- LS will close automatically 1/4s 1 min after last transmission or reception of carrier.

RF channel control

 Up to 99 channels can by specified (RF bandwidth may limit to lower number).

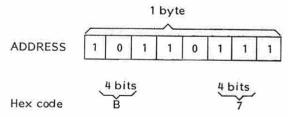
INTRODUCTION TO PROGRAMMING THE PERSONALITY PROM

- The "Personality Prom" contains customer specified information on the system's functional behavior, and about tones and channels being used in the equipment.
- The Personality Prom is a 512 x 8 bits Prom.
- For Programming the Prom, Storno recommends to use "DATA I/O System 19".
- For addressing the information in the Prom 8 bits (1 byte) are used.
 The addressing is made in Hex code.
- The data output is 8 bits, and controlled by the selected address.
- Data is programmed into the Prom in Hex code using DATA I/O System 19.
- All binary codes shall be converted to Hex-code before programming the Prom in "DATA I/O System 19".

The Hex code

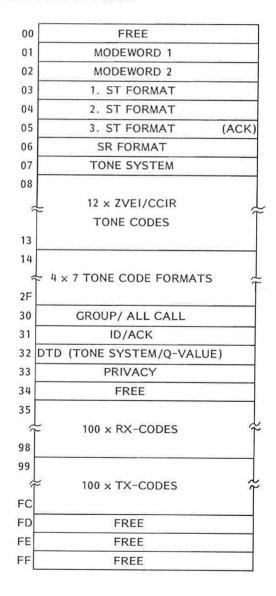
BINARY VALUE	HEX VALUE	DEC
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	Α	10
1011	В	11
1100	С	12
0001 0010 0011 0100 0101 0110 0111 1000 1001 1010	D	13
1110	E	14
1111	F	15

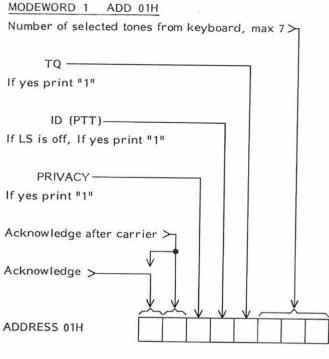
ex. of converting 8 bits to Hex code.

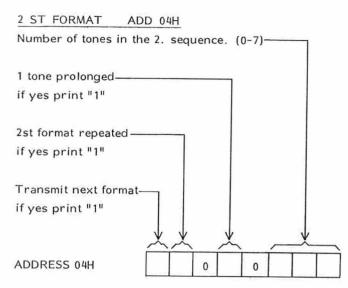


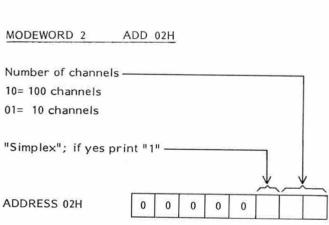
INFORMATION IN THE PERSONALITY-PROM (U804)

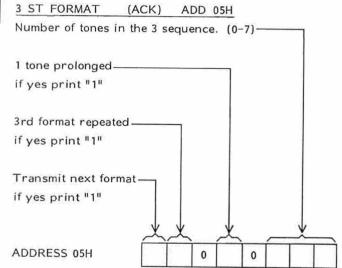
ADDRESS IN HEX CODE

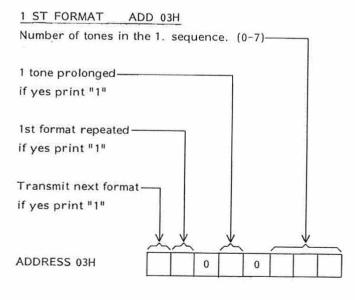


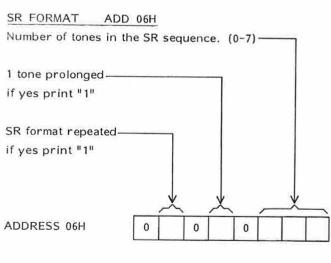












TONE SYSTEM ADD 07H

Which tone system is going to be used

If tone system =ZVEI (STORNO)

Then 07H in address 07H

0 0 0 0 1

Tone system =CCIR

Then 0AH

0 0 0 0 1 0 1 0

Tone system = EEA (OPTION)

Then 04H

in address 07H

in address 07H

0 0 0 0 0 0

12 x ZVEI/CCIR TONE CODES ADDRESS 08H - 13H

Address		Fr	eque	ency	in b	inar	у со	de		Hz	Hex code	Internal tone index	Digit
in PROM	80	1	0	1	1	1 0 0 0 0 2400 B0 00		00	0				
	09	0	1	0	0	1	1	1	0	1060	4E	01	1
	0A	0	1	0	1	0	1	0	1	1160	55	02	2
	0B	0	1	0	1	1	1	0	1	1270	5D	03	3
	0C	0	1	1	0	0	1	1	1	1400	67	04	4
ZVEII	0D	0	1	1	1	0	0	0	0	1530	70	05	5
Frequency	0E	0	1	1	1	1	0	1	0	1670	7A	06	6
	0F	1	0	0	0	0	1	1	0	1830	86	07	7
	10	1	0	0	1	0	0	1	0	2000	92	08	8
	11	1	0	1	0	0	0	0	1	2200	A1	09	9
Note 1	12	1	0	1	1	1	1	1	0	2600	BE	0A	Repeat
Note 2	13	1	1	0	0	1	1	0	1	2800	CD	0B	Alarm
ZVEI II													
Note 1:	12	0	1	0	0	0	1	1	1	970	47	0A	
Note 2:	13	0	1	0	0	0	0	0	1	885	41	0B	

To be programmed into the PROM

from ADD. 08H- 13H.

12 × ZVEI/CCIR TONE CODES ADDRESS 08H - 13H

Address in PROM

CCIR

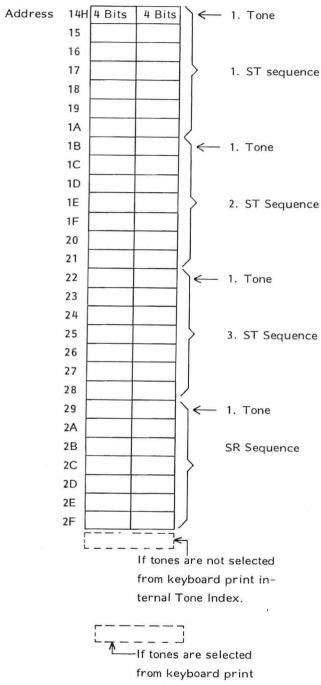
	Fr	eque	ency	in b	inar	у со	de		Hz	Hex code	Internal tone index	Digit
8	1	0	0	1	0	0	0	1	1981	91	00	0
9	0	1	0	1	0	0	1	0	1124	52	01	1
A	0	1	0	1	1	0	0	0	1197	58	02	2
В	0	1	0	1	1	1	0	1	1275	5D	03	3
c	0	1	1	0	0	0	1	1	1358	63	04	4
	0	1	1	0	1	0	1	0	1446	6A	05	5
	0	1	1	1	0	0	0	1	1540	71	06	6
7	0	1	1	1	1	0	0	0	1640	78	07	7
)	1	0	0	0	0	0	0	0	1747	80	08	8
	1	0	0	0	1	0	0	0	1860	88	09	9
	1	0	0	1	1	0	1	1	2110	9B	0A	Repeat
	1	0	1	0	0	1	0	1	2247	A5	0B	Spec.

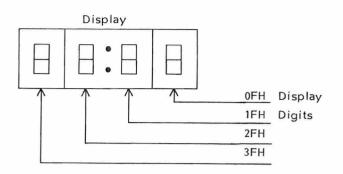
To be programmed into the $\ensuremath{\mathsf{PROM}}$

from ADD 08H - 13H.

4 x 7 TONE CODE FORMATS

Address 14 - 2F





Position in the sequence where the > GROUP/ALL TONE is comming (1-7) Frequency of GROUP/ALL call tone > internal tone index. Address 30 0

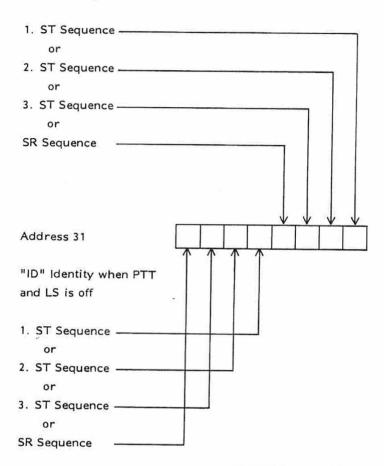
ADDRESS 30

GROUP/ALL CALL

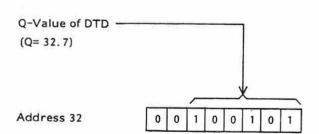
display digits.

ID/ACK Address 31

"Acknowledge" when SR is activated

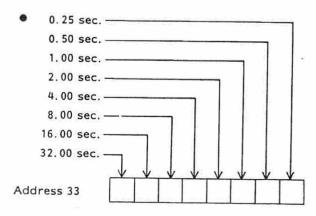


DTD (TONESYSTEM/Q - VALUE) ADDRESS 32



PRIVACY ADDRESS 33

- The operator cannot open LS manually
- Keying and tone keying is not possible if the channel is busy - (true also without Privacy if LS is closed).
- LS will close automatically 0.25s 1 min after last transmission or reception of carrier.



100 x RX - CODES ADDRESS 35/98

100 x TX - CODES ADDRESS 99/FC

For channel 00-99 use the formula

 $V_{DEC} = \frac{(A-10.7)-(C\times3)}{E}$

Refer to CQM5110's handbook.

Convert then V_{DEC} - Data Hex code and insert the Hex code from address 35 channel 00 to address 98= channel 99

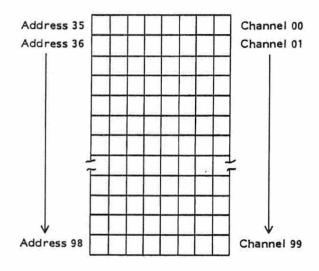
For channel 00-99 use the formula

V_{DEC}= B - (Dx3)

Refer to COM5110's handbook.

Convert then V_{DEC} - Data Hex code and insert the Hex code from address 99= channel 00 to address FC= channel 99

8 Bits



Address 99 Channel 00 Address 9A Channel 01 Address FC Channel 99

NOTE: ALL UNUSED/NOT CALCULATED CHANNELS SHALL BE PROGRAMMED FF/FREE.

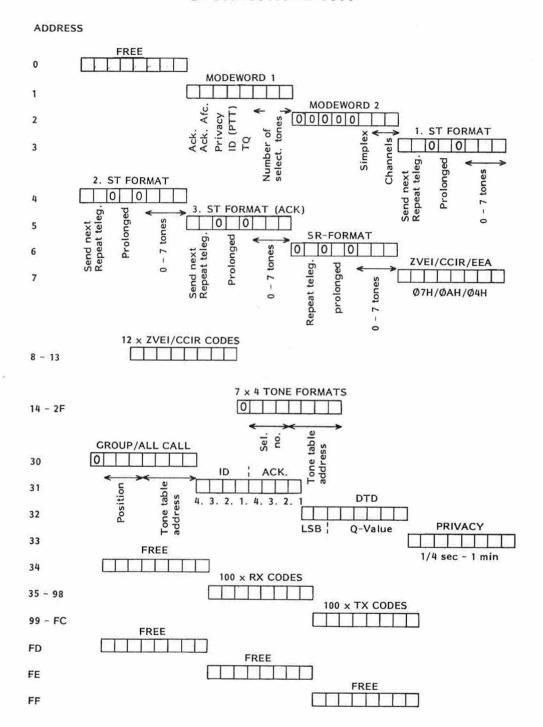
Ex. for RX: (ADDRESS 35/98)

If ADDRESS 95 - 98 are unused:

		ADR		BITS			•			
THEN PROGRAMM:	95 F F	95	1	1	1	1	1	1	1	1
	96 F F	96	1	1	1	1	1	1	1	1
	97 F F	97	1	1	1	1	1	1	1	1
	98 F F	98	1	1	1	1	1	1	1	1

PERSONALITY PROM

STORNOPHONE 5000



	laster construction	-		Tonomato.	-							PAGE 1
ADDR.	HEX. CODE	T	31	NA	R	Υ	C	OD	E		FUNCTION / COMMENTS	
HEX.	4			-				-				
00	FF	1X	X	(1)	4	X	Х	X	X	X	FREE	
01		┰	+	, ,	+	-	V	_	_		MODE WORD 1	
02		╂^	4	(1)	7	4	\ \	-	_		MODE WORD 2 X = DON'T CAP	RE
03		+	+	_	Y.	_	χ.	-			1. ST FORMAT	
		╀	+		4		X	-			2. ST FORMAT	
05		-	+)			X	4	-		3. ST FORMAT	
06		X	+)	4	+	X	-	-	-	TR FORMAT	
07		╀	+	+	+	\dashv	-	\dashv	-	_	ZVEI/CCIR/EEA Ø7/ØA/Ø4	
08		╀	+	+	+	+	-	+				and the state of t
0A		╁	+	+	+	+	-	\dashv	\dashv			
OB		╁	+	+	+	+	+	\dashv	+			
0C		╀	+	+	+	+	-	+				
00		╀	╀	+	+	+	\dashv	+	-			
0E		╀	+	+	+	+	+	+	-	-	12:: 7451/ 6615 66556	
0F		╀	┝	+	+	+	+	+	-	-	12x ZVEI / CCIR CODES	
Control of the last of the las		+	+	+	+	+	4	-	-	_		
10		╁	+	+	+	+	+	-	+	-		
12		╁	+	-	+	+	-		+	-		
13		╁	+	+	+	+	+	+	+	\dashv		······································
14		╁	╁	╁	÷	+	+	+	+	-	(
15		╁	+	+	+	+	+	+	+	-		
16	-	╁	┢	+	+	+	+	+	+	\dashv		
17		┢	\vdash	+	+	+	+	+	+	\dashv		
18		H	\vdash	+	+	+	+	+	+	\dashv		
19		\vdash	<u> </u>	+	+	+	+	+	+	+		Martin and the second s
1 A	***************************************		\vdash	1	t	\dagger	+	+	+	\dashv		
1B		\vdash		1	1		+	+	+	+		
1C				T	+	+	1	+		7		
1 D	-	T		T	1	+	+	T	+	1		
1E				T	T	1	+	1	\top	\dashv		
1F					T	+	T	1	T	1		
20	WHOLE STONE OF THE		-	-	1	-			1	十	> 4x7 TONE FORMATS	
21					1				1	1		
22					T	1	T		1	1		The second secon
23		100		2 (1)			1		1	1		
24						T				T		
25		П						T		T		
26				16		I						The second secon
27				77.11		I				T		The state of the s
28								T	T	1		The state of the s
29	1							T	T	T		
2A						I	T	T		1		
2B		Just				Τ		170		1		
2C								I		1		
2D			111				T	I	I	T		
2E		\Box					I	\prod	I	T		
2F		I						\prod		\mathbf{I}		
30		X					T	T	T	T	GROUP/ALL CALL	
31							Ι	I		T	ID /ACK	**************************************
32		\prod					\prod	\prod		T	DTD	
33	I					L			I		PRIVACY	The control of the co
34	FF	X .	X	X	X	X	X	X	X		REE	
	1		- 1						1			

STORNOPHONE 5000 TONE SWITCHING II

PAGE ADDR. HEX. BINARY CODE FUNCTION / COMMENTS HEX. CODE 6 7 9 В D E 0 1 3 4 5 6 7 8 9 A В C D E F 0 1 2 3 4 5 6 7 8 9 A B С D E F 0 1 2 3