

STORNOPHONE 5000
Maintenance Manual
Section 3

CONTENTS

CQM5110	Technical Specifications	60.377-E1
	General Description	60.378-E1
	Block Diagram	D402.632
	Adjustment Procedure	60.381-E2
	Appendix A. CQM5000 Adj.	60.386-E1
	Adjustable Components RF	D402.623
	Adjustable Components XS	D402.624
RF5110	Schematic Diagram	D402.613/4
	Component Lay-out	D402.640
	Parts list	X402.653
XS5001	Schematic Diagram	D402.615
	Component Lay-out	D402.637
	Parts List	X402.648
XS5111	Schematic Diagram	D402.635
	Schematic Diagram	D402.616
	Component Lay-out	D402.617/3
	Parts List	X402.647
XS5112	Schematic Diagram	D402.636
	Schematic Diagram	D402.618
	Component Lay-out	D402.619/3
	Parts List	D402.646

Service Coordination

TECHNICAL SPECIFICATIONS

CQM5110

Guaranteed performance specifications unless otherwise noted.

Typical values are given in brackets.

GENERAL

Frequency Range

146 - 174 MHz

Channel Separation

CQM5112: 30/25kHz

CQM5113: 20kHz

CQM5114: 12.5kHz

Maximum Frequency Deviation

CQM5112: ± 5 kHz

CQM5113: ± 4 kHz

CQM5114: ± 2.5 kHz

Modulation Frequency Range

CQM5112: 300 - 3000Hz

CQM5113: 300 - 3000Hz

CQM5114: 300 - 2700Hz

Maximum RF Bandwidth

1.5MHz

Antenna Impedance

50 Ω

Maximum Number of Channels

6

Supply Voltage

Minimum : 10.8V

Nominal : 13.2V

Maximum : 16.6V

Negative potential to chassis

Temperature Range

-30 $^{\circ}$ 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), $\frac{1}{2}$ e.m.f.

0.3 μ V (0.23 μ V)

Measuring conditions:

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

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

CQM5112: 0.75 μ V (0.55 μ V)

CQM5113: 0.75 μ V (0.55 μ V)

CQM5114: 1.0 μ V (0.75 μ V)

Δf 60% x Δf max; $f_{mod} = 1$ kHz.

Measured with psophometric filter.

Crystal Frequency Range

45.1 - 54.5MHz

Crystal Frequency Calculation (fx)

$$f_x = \frac{F_s - 10.7}{3} \text{MHz}$$

Frequency Stability

Conforms with government regulations

Modulation Acceptance Bandwidth (EIA)CQM5112: ± 7 KHz (± 7.5 KHz)Adjacent Channel Selectivity

EIA

CQM5112: 75dB (90dB)

FTZ

CQM5113: 70dB (88dB)

CEPT

CQM5112: 75dB (90dB)

CQM5114: 65dB (88dB)

Spurious Rejection

EIA

80dB (85dB)

Intermodulation Attenuation

EIA

CQM5112: 70dB (72dB)

CQM5113: 70dB (72dB)

CEPT

CQM5112: 70dB (75dB)

CQM5113: 70dB (75dB)

CQM5114: 70dB (73dB)

Blocking

90dB/uV (104dB/uV)

Radiation

CQM5112:

Conducted: max. 0.8nW

CQM5113:

Radiated: max. 0.8nW

CQM5114:

Radiated: max. 0.8nW

AF Load Impedance (Loudspeaker)4 Ω AF Power Output

EIA: 3W (3.6W)

CEPT: 1.5W

AF Distortion

5% (1.5%)

 $\Delta f = 60\% \Delta f \text{ max.}, 1\text{KHz}, 1\text{W}, \text{RF } 1\text{mV}$ Audio Frequency Response

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

Relative to 1000Hz, -6dB/octave

fm: CQM5112: 300 - 3000Hz

CQM5113: 300 - 3000Hz

CQM5114: 300 - 2600Hz

Hum and Noise

Squelched : 80dB (better than 85dB)

Unsquelched : 55dB (60dB)

Squelch Recovery Time

100 ms (10 ms)

Squelch Attack Time

150 ms (110 ms)

Squelch Closing Time

150 ms (20 ms)

Current Consumption

Squelched: 150mA (130mA)

AF 2W : 500mA (450mA)

(1 channel, without tone equipment, 13.2V supply)

TRANSMITTER

RF Power Output

CQM5110-6/10: 6 or 10W

CQM5110-25: 25W

RL = 50Ω

Crystal Frequency Range

48.6 - 58MHz

Crystal Frequency Calculation (fx)

$$f_x = \frac{F_s}{3}$$

Frequency Stability

Conforms with government regulations

Undesired Radiation

max. 0.2uW

Sideband Noise Power, CEPT

less than 70db

AF Input Impedance

560 ohm

Modulation Sensitivity

70mV ± 2dB

(60% Δf max, 1kHz)

Modulation Response

300 - 3000 Hz

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

relative to 1000Hz, 6dB/octave

400 - 2700Hz

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

relative to 1000Hz, 6dB/octave

Modulation Distortion

fm = 1000Hz: max. 3%

Δf = ±3.0KHz

fm = 300Hz: max. 5%

Δf = ±0.9KHz

measured with 750 μ sec de-emphasis

FM Hum and Noise

70dB

CEPT (measured with 750 μsec de-emphasis)
and psophometric filter.Current Consumption

6W: less than 3.5A (2.5A)

10W: less than 4.0A (3.0A)

25W: less than 6.0A (5.0A)

GENERAL DESCRIPTION

CQM5110

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.

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

Type	CQM5112		CQM5113		CQM5114	
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	6		6		6	

ACCESSORIES

STANDARD ACCESSORIES

Mounting frame	MC5001	Fist microphone with retractable spiral cable for mobile installation.
Power cable	HS5001	Retainer for MC5001
Fist microphone with retainer or Fixed - mount microphone	HS5002	Retainer, with switches, for MC5001
External loudspeaker	MC5002	Cylindrical handmicrophone with build-in amplifier and press-to talk switch. Fitted with a coiled cord terminated into a connector which fits into the microphone retainer.
External switches	HS5003	Retainer for MC5002, without hook switch.
LS701 Loudspeaker enclosed in a plastic housing, complete with cable.	HS5004	Retainer for MC5002, with hook switch.
MC702b Dynamic fist microphone with adjustable output level.	MK5001	Installation kit containing connectors, power cable, fuses and fuseholders.
JB701a Junction box for MC702b. Consists of a plastic housing provided with cable for soldering assembly. Junction box is to mounted behind the first microphone retainer.	MN703	Desk stand for fixed installations.
MC703a Desk microphone with PTT (Push -to - Talk) switch for fixed installations.	MN704	Mounting bracket for the radio cabinet.
MC704 Microphone with chockabsorbing mounting bracket for mobile installation.	MN5001	Mounting frame for mobile installations allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.
MK704 Mounting kit consisting of 2 flexible tubes, used for mounting the MC704 in close-talk position.	MN5002	Mounting cassette for the radio cabinet (see mechanical layout).
	MT5001	Microphone with retainer. The retainer 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 column.
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 220V AC	VOLTAGE +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 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 in sets with multichannel option.

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 pushbutton mount directly on 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
- 455kHz 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 crystal filter. The front-end, antenna relay, first

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Channel Spacing kHz	30/25		20		12, 5	
Max. Number of Channels	6		6		6	

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 column.

SU702

Transmitter keying switch for mounting on the dashboard.

PS702

Power supply regulator for 24V car battery installations.

PS5001

Power supply for 220V AC mains.

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

(refer to functional block diagram)

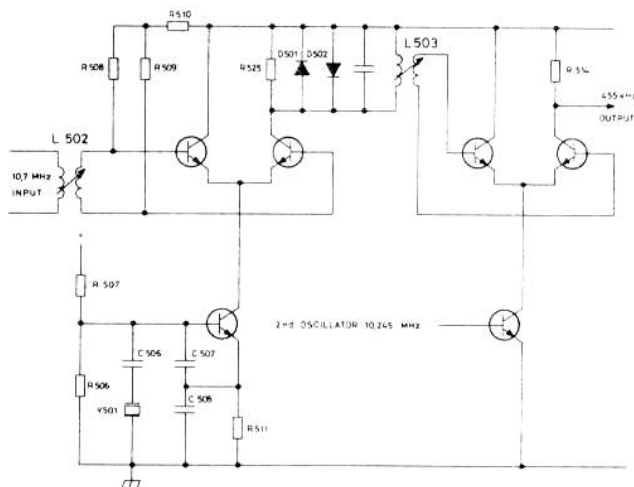
Front-End

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mixer and part of the transmitter PA inter-connections are design in micro-stripline techniques on the mainboard.

1st IF

The first IF frequency is 10.7MHz. 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 455kHz 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

Squelch

The audio line signal (Vol/Sq - HI) is fed to a selective amplifier stage, where noise (frequencies around 8kHz) is extracted from the audio signal. Via the squelch potentiometer R607, this signal reaches an expander stage which improves the level discrimination characteristics 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 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 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 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 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 feedback 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 deviation 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 biased by a voltage generated by the feedback network C255, D201, Q201, Q209, Q208.

OSCILLATORS

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 plug-in type.

A multifrequency board is required for more than one frequency channel. This board is available in two versions; one (XS5111) has space for accommodating 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 and a binary converter, U901-U902. The BCD signal is applied to three pins in J911. 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 varicap (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 fusible printed wiring path which will open in case of the ground wire being accidentally 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 S602. The other section of the ON/OFF switch controls the VB + to the voltage regulator U602 consisting of a monolithic regulator. The regulator output is fixed at 8.5V by means of a factory adjusted resistor.

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

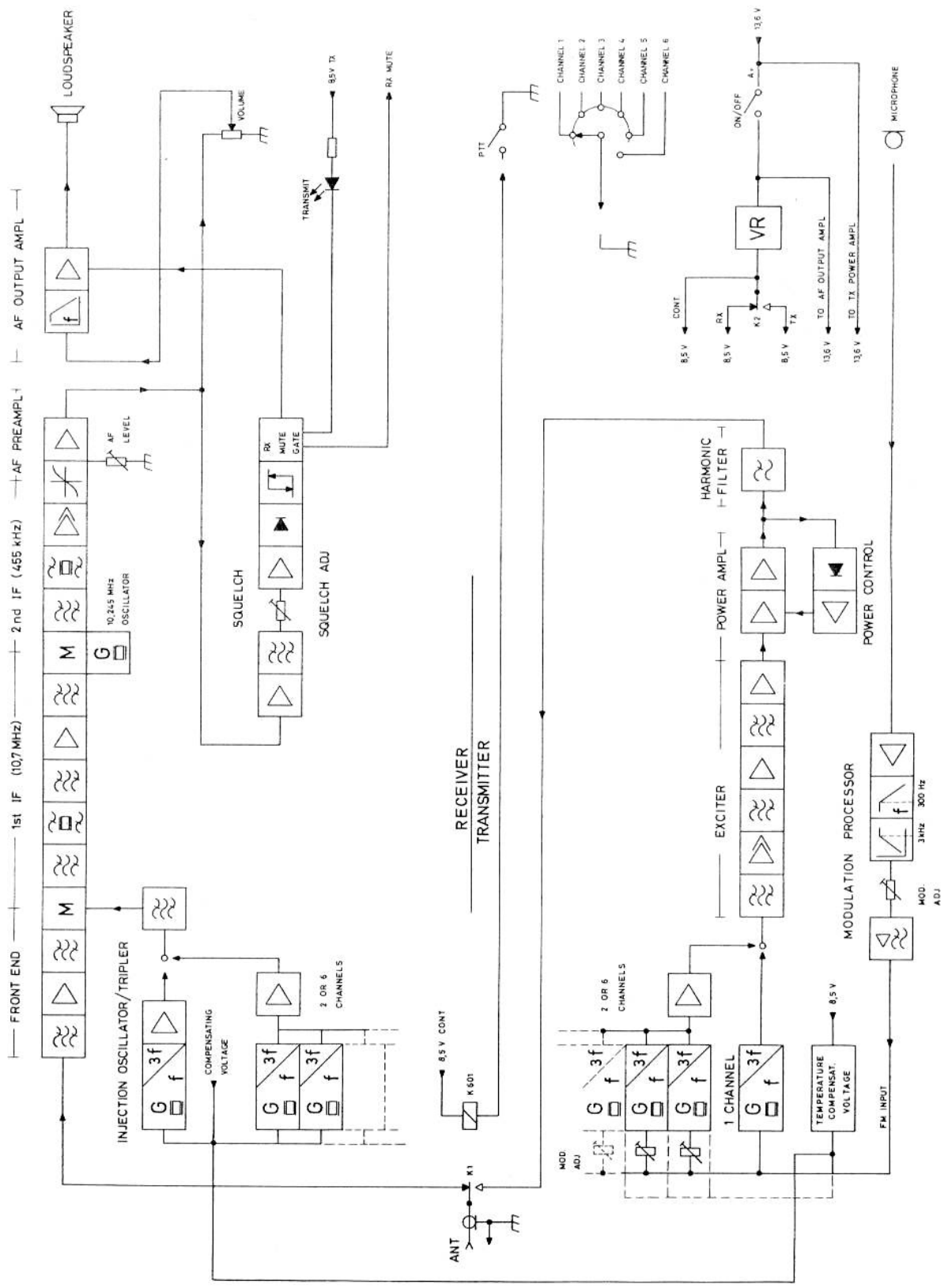
The squelch circuit, the modulation processor and parts of the IF amplifier U502 is supplied directly from the continuous 8.5 V.

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



FUNCTIONAL BLOCK DIAGRAM
 CQM 5110

D402.632

ADJUSTMENT PROCEDURE

CQM5110

General

This adjustment procedure applies to the following radiotelephone types:

CQM5112	-	30/25 kHz Channel spacing
CQM5113	-	20 kHz Channel spacing
CQM5114	-	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	$R_{in} \geq 1\text{Mohm}$
AC Voltmeter	$Z_{in} > 1\text{Mohm}/50\text{pF}$
Multimeter	$R_i \geq 20\text{Kohm/Volt}$
Distortion meter	e. g. Storno E11c
RF Watt meter	25 W/50 ohm/145-175MHz
RF generator	$Z_{out} = 50\text{ ohm}; 145-175\text{ MHz}$
10,7 MHz signal generator	e. g. Storno TS-G21B
Frequency counter with attenuator	$Z_{in} = 50\text{ohm};$ sensitivity 100mV af 175 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/3W resistor	3 x Storno code 82. 5026
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

RECEIVER ADJUSTMENTS

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 1A.

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 J 901 pin 3 and read the voltage.

Requirement: $8.5\text{ V} \pm 0.15\text{ V}$

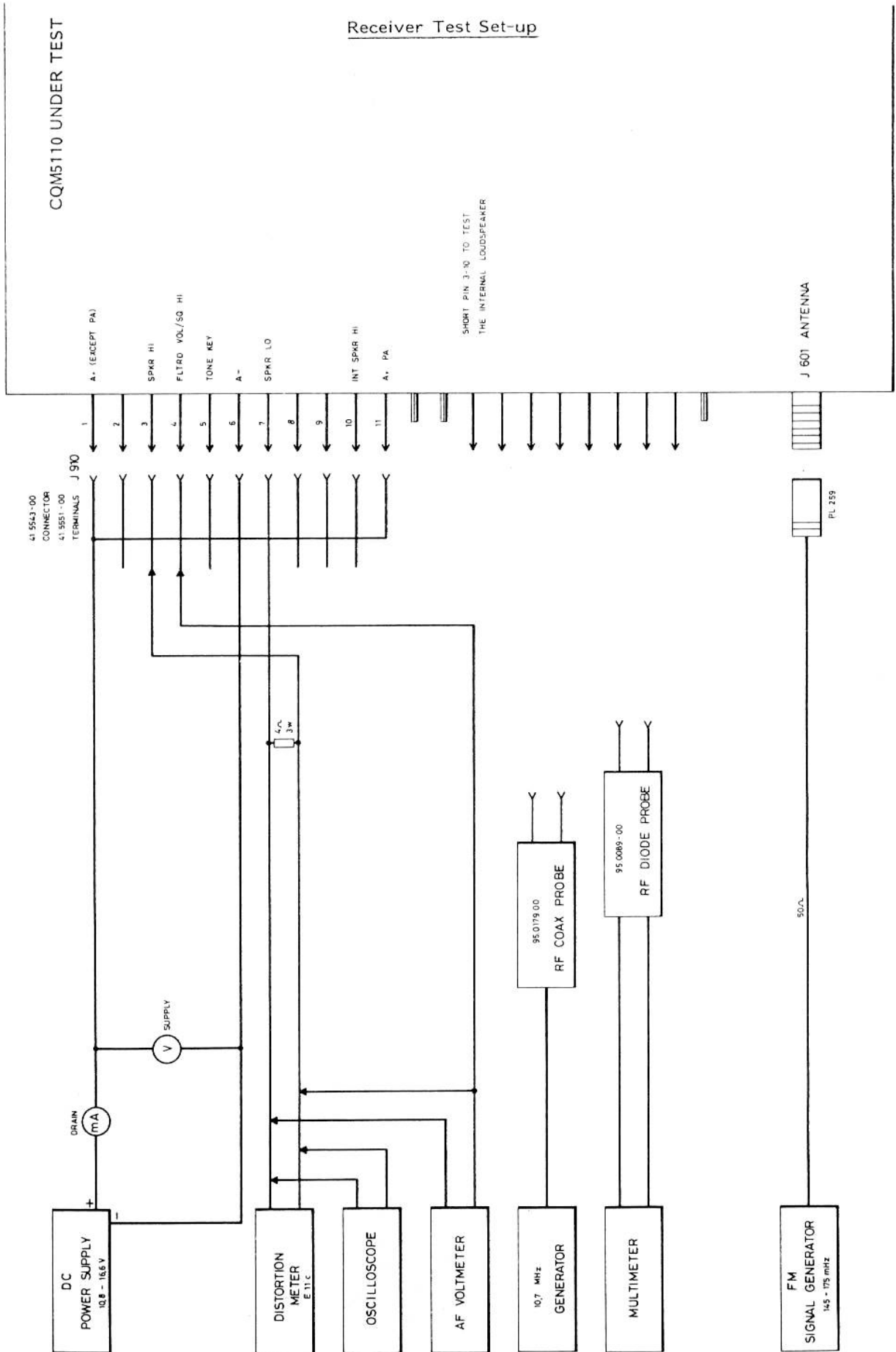
If the requirement is not fulfilled check resistor R636 against the colour code of U602.

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: $\leq 50\text{ mV}$

Repeat the procedure with the power supply adjusted for 10.8 V



Oscillator(s) and Frequency Multiplier

In single channel sets the receiver oscillator is located on the RF5110 board. In multichannel sets all oscillators are on the XS5111 board (2 Channels) or XS5112 (6 Channels).

Select the channel whose frequency is closest to center frequency. If not otherwise indicated adjustments should be performed on that channel.

Connect RF diode probe 95.0089-00 leads to the multimeter and select the most sensitive voltage range.

Connect the probe to TP401 with the dot to the live terminal.

Single channel sets

Adjust L301 for maximum deflection

Multichannel sets

Adjust the following coils for maximum deflection:

L961,	Channel 1
L962,	Channel 2
L963,	Channel 3
L964,	Channel 4
L965,	Channel 5
L966,	Channel 6

Adjust L303 and L305 for maximum deflection;
Typical 2 to 3 volts
Requirement: $\geq 1\text{ V}$

Receiver frequency adjustment

Connect coax probe 95.0179-00 to testpoint TP401. Connect the frequency counter to the probe, and read the frequency.

The frequency is measured after the tripler and shall be $F_{\text{antenna}} - 10,7\text{ MHz}$

Single channel sets

Adjust L301 for the specified frequency ($3x f_x$)

This adjustment shall be performed at 25°C
Requirement: $F_{\text{nom}} \pm 0.4\text{ ppm}$ ($\pm 60\text{ Hz}$ at 150 MHz)

Multichannel sets

Adjust the following coils on the XS board to the specified receiver frequencies ($3x f_x$)

L961,	Channel 1
L962,	Channel 2
L963,	Channel 3
L964,	Channel 4
L965,	Channel 5
L966,	Channel 6

Requirement: $F_{\text{nom}} \pm 0.4\text{ ppm}$ ($\pm 60\text{ Hz}$ at 150 MHz)
 $\text{ppm} = \text{parts per million} = x 10^{-6}$

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. (50uA 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 50uA 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. (50uA 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 50uA 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 must not 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.

IF demodulator

Standard Test condition:

Connect the RF generator to antenna generator and adjust the output to 1 mV.

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

CQM5112	= ± 3 KHz
CQM5113	= ± 2.4 KHz
CQM5114	= ± 1.5 KHz

Connect a 4 ohm/3W resistor load to connector J910/3-7 (SPKR HI-SPKR LO).

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

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 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, SINAD

EIA or CEPT method may be used.

The SINAD sensitivity of a receiver is the minimum input signal that will provide at least 50% of the receiver's rated audio power with 20dB signal + noise + distortion to noise + distortion.

Method of measurement.

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

The first condition is the one where a modulated RF-signal drives the receiver into full limiting. The audio output is measured with the distortion meter (in the CAL position) through a psophometric filter and, disregarding the amplitude of the audio, this is adjusted to read 100% on the meter; 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 20dB below the first condition, as read on the distortion meter scale. This corresponds to a reading of 10%, 10 being 20dB 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% Δf max. to the receiver.

The audio output (which must be at least 50% of the receiver's audio rating) is measured with the distortion meter in position CAL and adjusted with potentiometer ADJ. FSD. to a reading of 100.

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

By backing off the attenuator of the RF-generator thereby lowering the RF-input to the receiver, the noise will eventually increase; the attenuator 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. 12dB SINAD sensitivity.

The EIA method differ from CEPT by omitting the psophometric filter and adjusting the RF generator for $2/3 \times \Delta f_{max}$. The SINAD sensitivity is measured as a 12dB ratio between signal + noise + distortion and noise + distortion, which corresponds to a reading of 25% noise + distortion.

Lower the RF generator output to obtain 12dB SINAD (25% THD as measured with the distortion meter). Readjust L402 for the best SINAD value, e. i. lowest generator output for 10% THD.

Measuring 20dB SINAD

Adjust the volume control for 2.45 V as measured with an AF voltmeter across the load. Adjust the RF generator output to obtain 20dB SINAD condition.

Read the 20dB SINAD sensitivity (e. m. f.) Requirement: $\leq 0.75\mu V$

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 CQM5112 Type CQM5114	300 Hz	+9dB	+1dB/-3dB
	1000 Hz	0dB	
	3000 Hz	-9.5dB	+1dB/-3dB
Type CQM5113	300 Hz	+10.5dB	+1.5dB/-3dB
	400 Hz	+8dB	+1.5dB/-1.5dB
	1000 Hz	0dB	
	2700 Hz	-8.6dB	+1.5dB/-1.5dB
	3000 Hz	-9.5dB	+1.5dB/-3dB
	6000 Hz	<-20dB	

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 Ω 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.

Current consumption

Measure the current consumption at 13.2 V.

Requirements

Condition	1 channel	2 channels	6 channels
Standby	≤ 150 mA	≤ 160 mA	≤ 200 mA
Receive 2 W AF ~ 2,83 V r. m. s. across 4 ohm.	≤ 500 mA	≤ 510 mA	≤ 550 mA

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

TRANSMITTER ADJUSTMENTS

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, L151, L204, L205, L208, and L209, to be flush with the coil form top.

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

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

Connect a Wattmeter, (25W) to the antenna connector, J601.

Oscillator adjustment

In single channel sets the transmitter oscillator is located on the RF5110 board. In multichannel sets all oscillators are on the XS5111 board (2 channels) or XS5112 (6 channels). Select the channel whose frequency is closest to the center frequency. If not otherwise indicated adjustments should be performed on that channel.

Key the Transmitter.

Single channel sets

Adjust L153 for maximum deflection on the multimeter. The increase deflection is small and gently tuning is required. If the frequency is in the low end of the band it may be necessary to turn the slug of L151 (L921 - L926) partly into the coil form to obtain a multimeter deflection.

Adjust L151 for maximum meter reading, typical 1.2 V.

Multichannel sets

Adjust the following coils for maximum deflection on the multimeter, typical 1.2 V.

L921,	channel 1
L922,	channel 2
L923,	channel 3
L924,	channel 4
L925,	channel 5
L926,	channel 6

Exciter, coarse adjustment

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

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 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 V.

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

Transmitter frequency adjustment

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

Single channel sets

Adjust L151 to specified transmitter frequency.

Multichannel sets

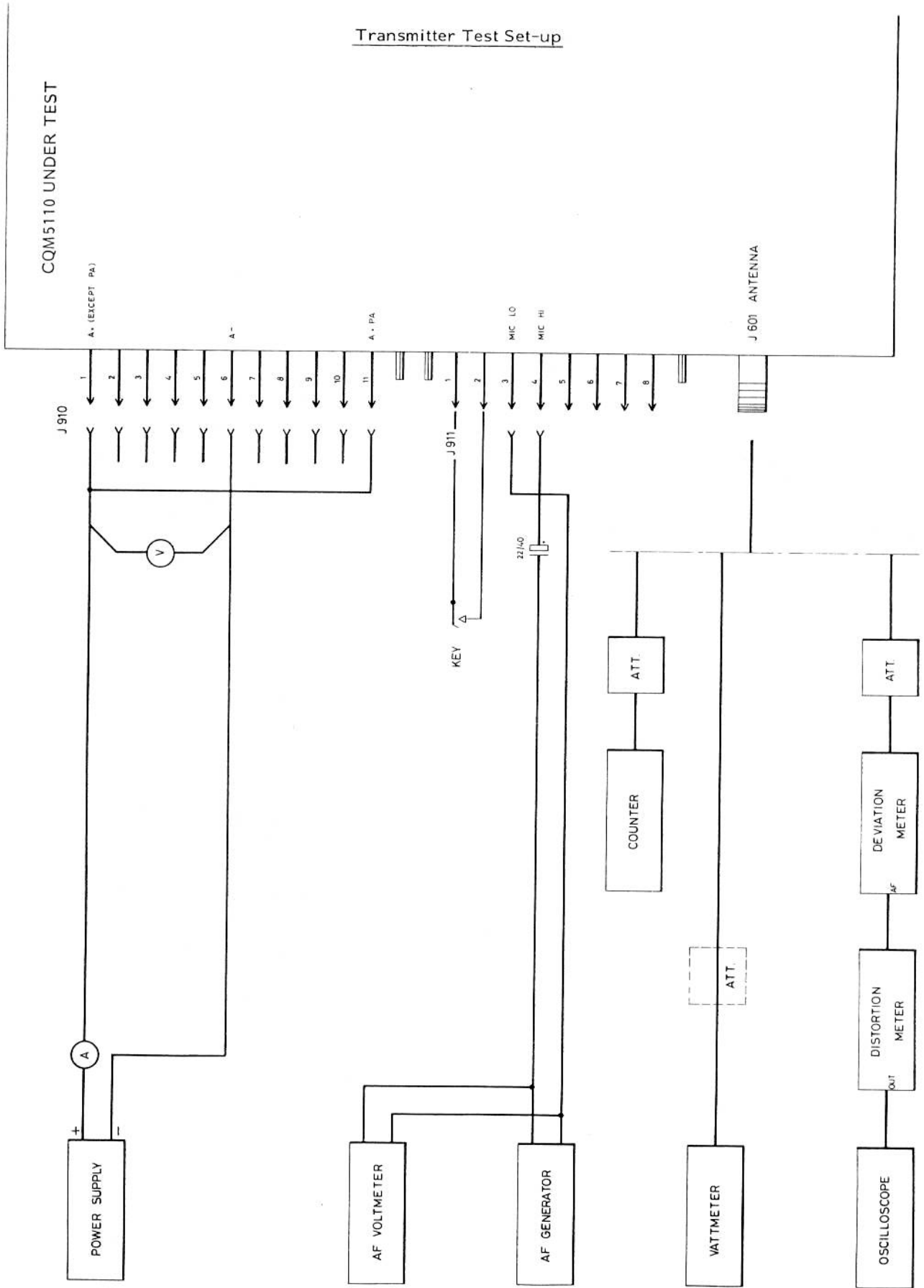
Adjust the following coils on the XS board to the specified transmitter frequencies:

L921,	channel 1
L922,	channel 2
L923,	channel 3
L924,	channel 4
L925,	channel 5
L926,	channel 6

The frequency adjustment shall be performed at 25°C.

Requirement: $F_{nom} \pm 0.4 \text{ ppm}$.

Transmitter Test Set-up



Exciter, fine adjustment

Connect the multimeter to test point TP201.
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.

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

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)	$\leq 5.8 \text{ A}$
13.2 V	$\geq 24 \text{ W}$	$\leq 5.8 \text{ A}$
10.8 V	$\geq 20 \text{ W}$	$\leq 5.8 \text{ A}$

Requirements (10 W):

Voltage	Power	Current
16 V	10 W (ref)	$\leq 3.2 \text{ A}$
13.2 V	$\geq 9 \text{ W}$	$\leq 3.2 \text{ A}$
10.8 V	$\geq 8 \text{ W}$	$\leq 3.2 \text{ A}$

Requirements (6 W):

Voltage	Power	Current
16 V	6 W (ref)	$\leq 2.6 \text{ A}$
13.2 V	$\geq 5.5 \text{ W}$	$\leq 2.6 \text{ A}$
10.8 V	$\geq 5.2 \text{ W}$	$\leq 2.6 \text{ A}$

MODULATION ADJUSTMENT

Set the power supply voltage to 13.2 V.

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

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.

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
CQM5112	30/25 KHz	$\pm 5 \text{ KHz}$
CQM5113	20 KHz	$\pm 4 \text{ KHz}$
CQM5114	12.5 KHz	$\pm 2.5 \text{ KHz}$

Requirement

Difference between + and - deviation: $\leq 10\%$

Multichannel sets

In multichannel sets R116 is turned fully clockwise and the modulation adjustment is adjusted individually for each channel using the Δf max potentiometers on the XS board.

R956	= channel 1
R957	= channel 2
R958	= channel 3
R959	= channel 4
R960	= channel 5
R961	= channel 6

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 : ± 3.0 KHz
- CQM5113 : ± 2.4 KHz
- CQM5114 : ± 1.5 KHz

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

Requirements:

Modulating signal: 70 mV \pm 2 dB

Distortion: $\leq 7\%$

(measured without deemphasis)

Modulation frequency response

Set the AF generator to 1000 Hz.

Reduce the AF generator output until a deviation of $0.2 \times \Delta f$ max is obtained on the deviation meter.

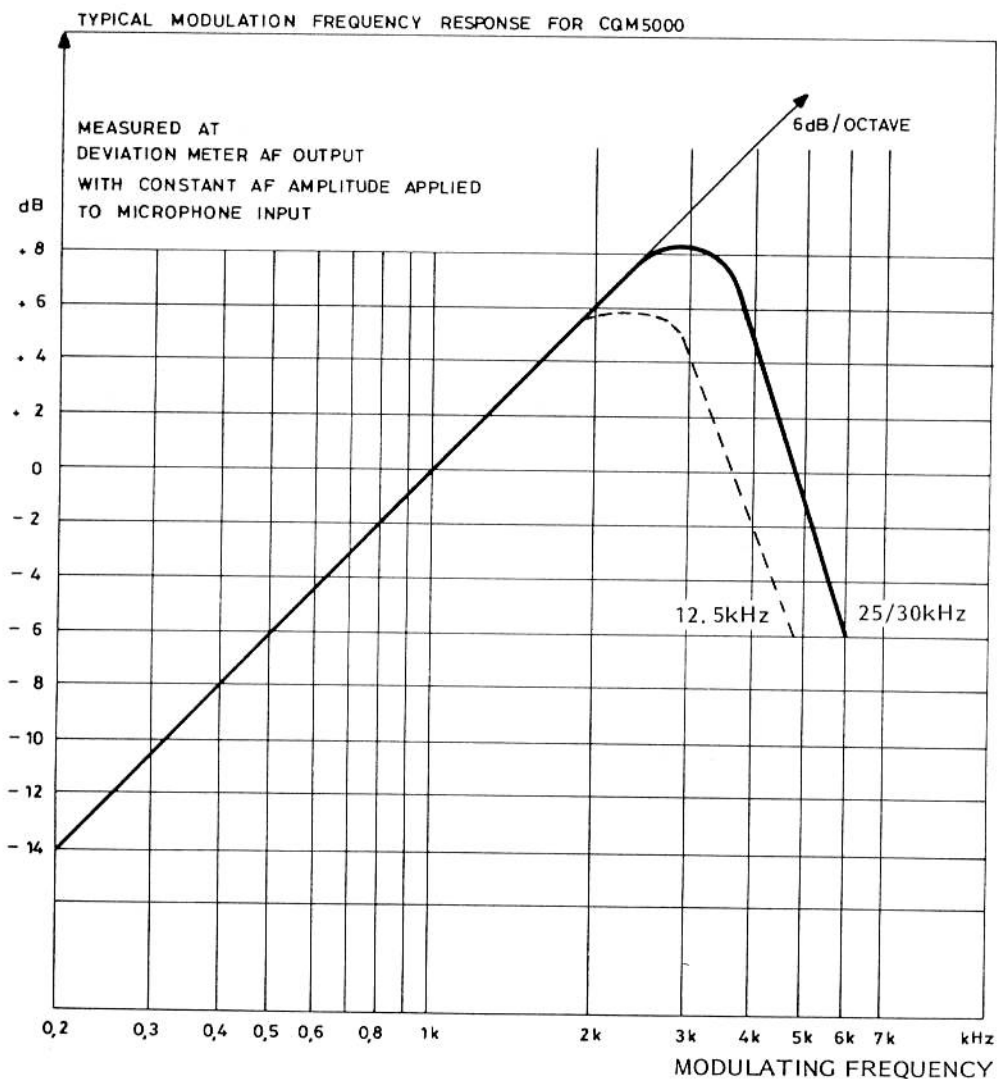
- CQM5112 : ± 1.0 KHz
- CQM5113 : ± 0.8 KHz
- CQM5114 : ± 0.5 KHz

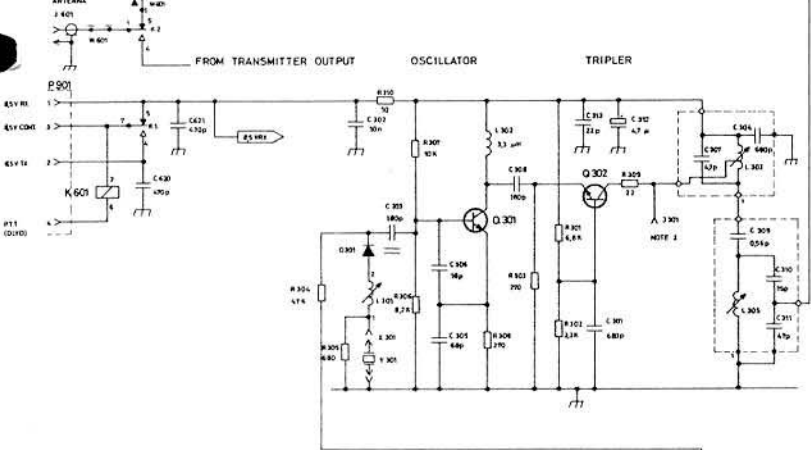
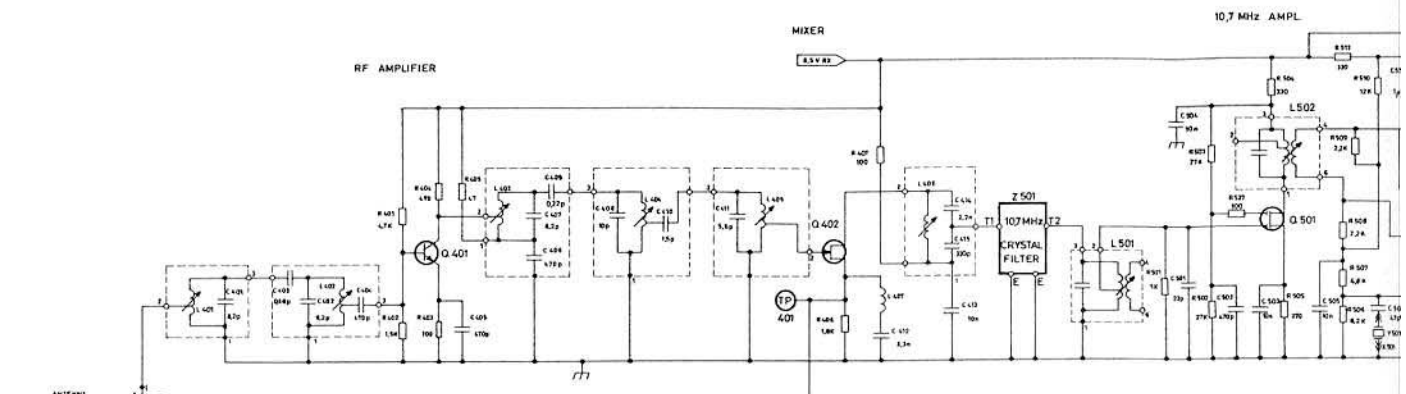
Vary the frequency of the generator and note the deviation changes as referred to the 1000 Hz value.

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 6 dB below the 1 KHz value.

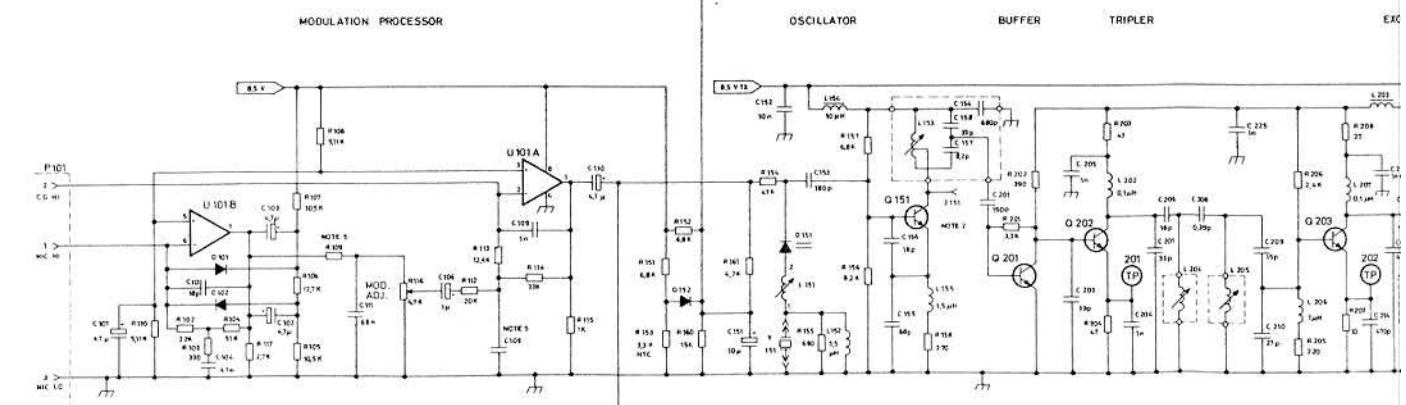


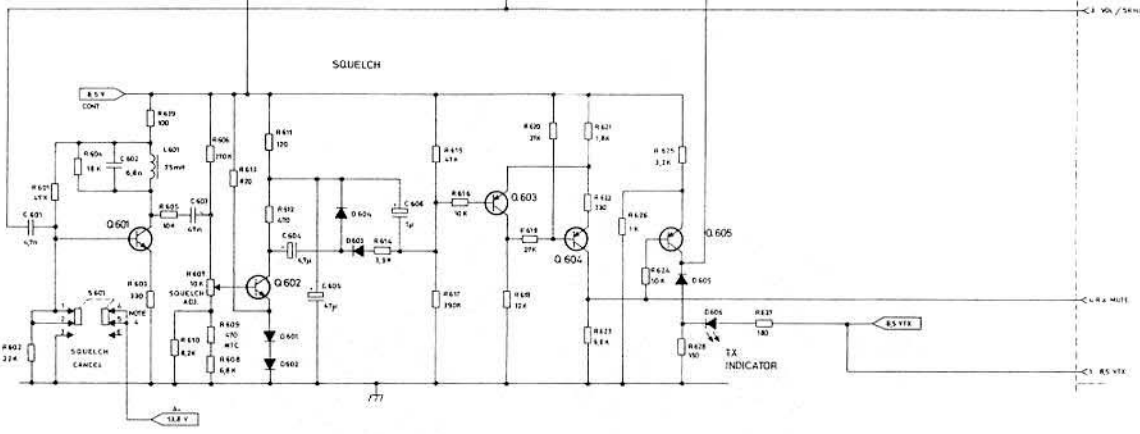
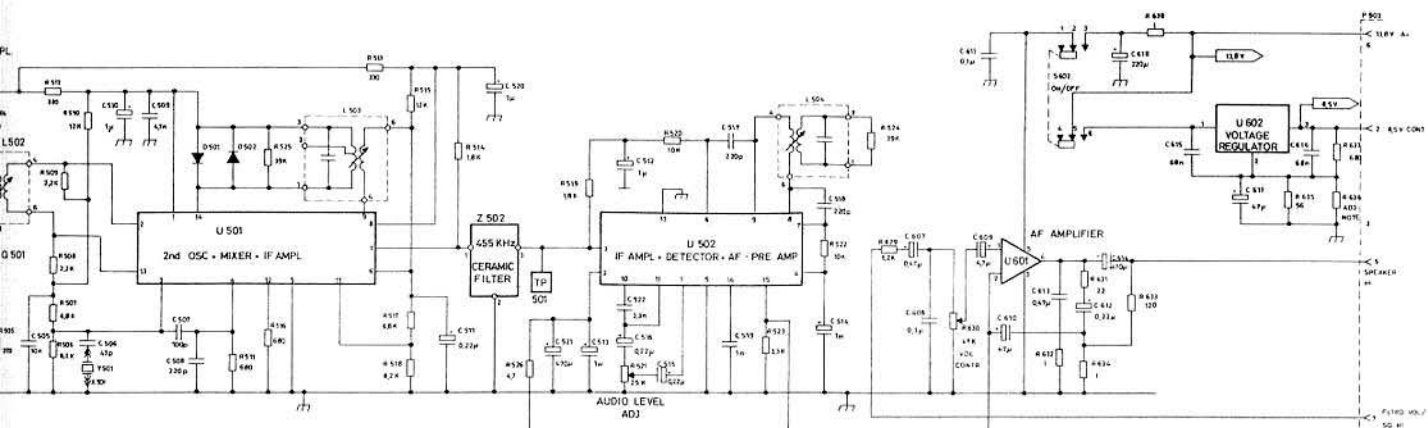


- NOTES: 1. A PART OF PRINTED CIRCUIT.
 2. TO MODIFY FOR MULTIFREQUENCY, REMOVE R157 TO DISABLE TX OSCILLATOR ON RFS10 AND/OR REMOVE R309 TO DISABLE RX OSCILLATOR ON RFS10.
 3. * VALUE OF R636 DEPENDS ON COLOUR MARK ON U602.

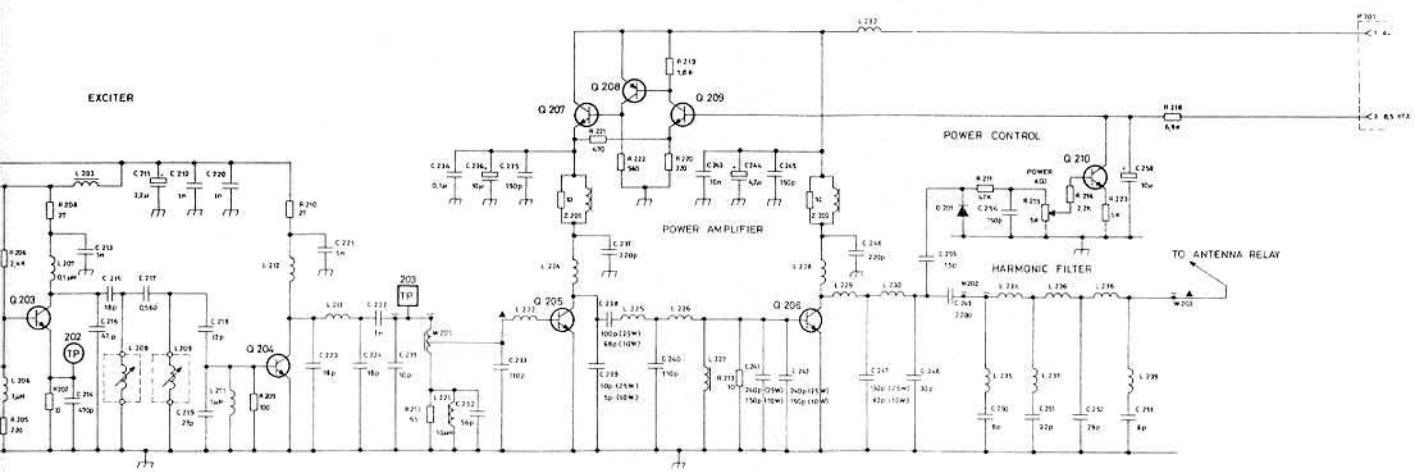
U602	R636 VALUE Ω
BROWN	OM IT
RED	270
ORANGE	100
YELLOW	47
GREEN	22
BLUE	6.8

S. 125 KHz CHANNEL SPACING
 C108: 10n
 R109: 15K



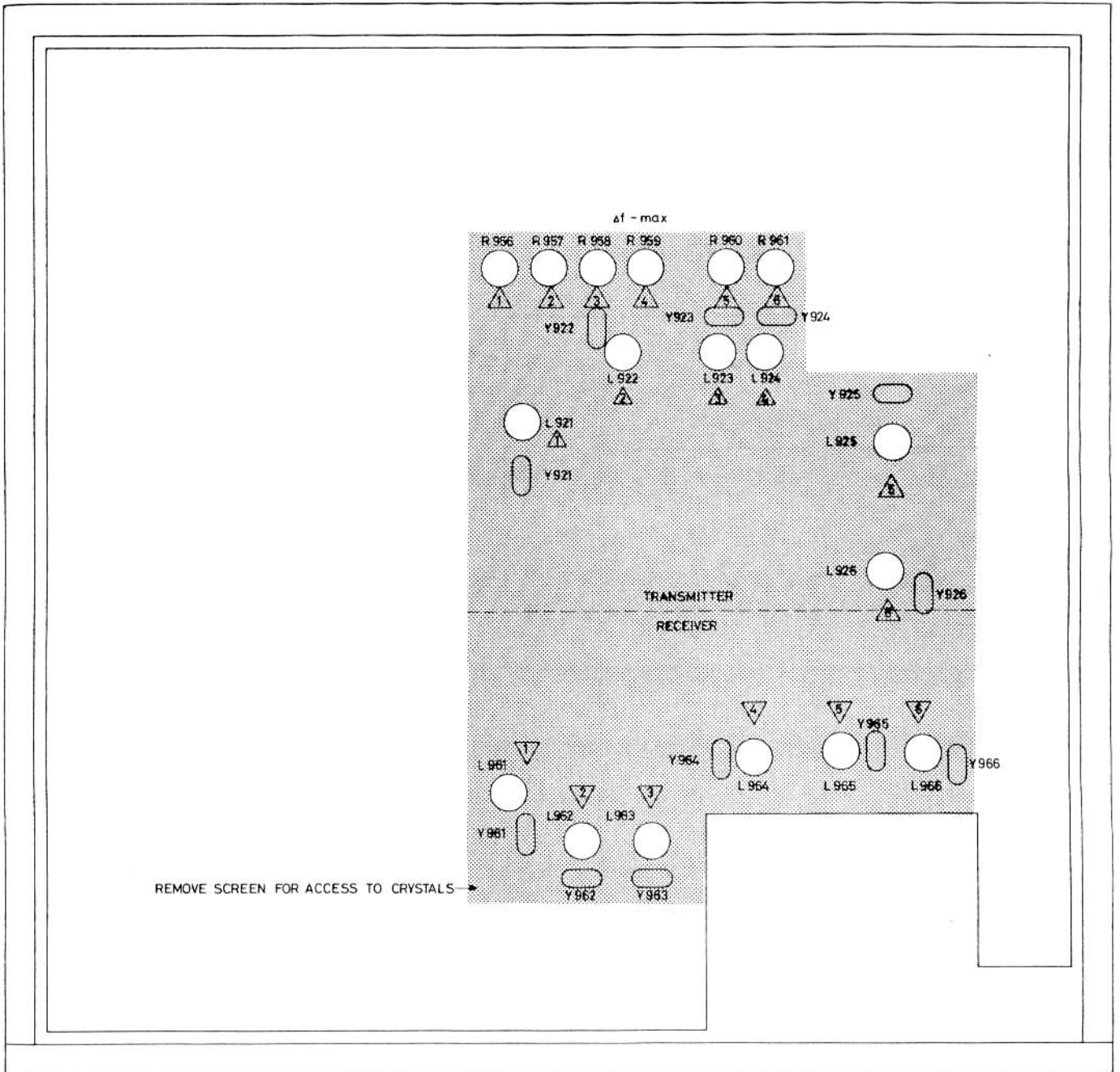


NOTE A: STRAP 0-1 IN ALL RADIOS EXCEPT US VERSIONS.



RF UNIT RF5110

D402 613J4

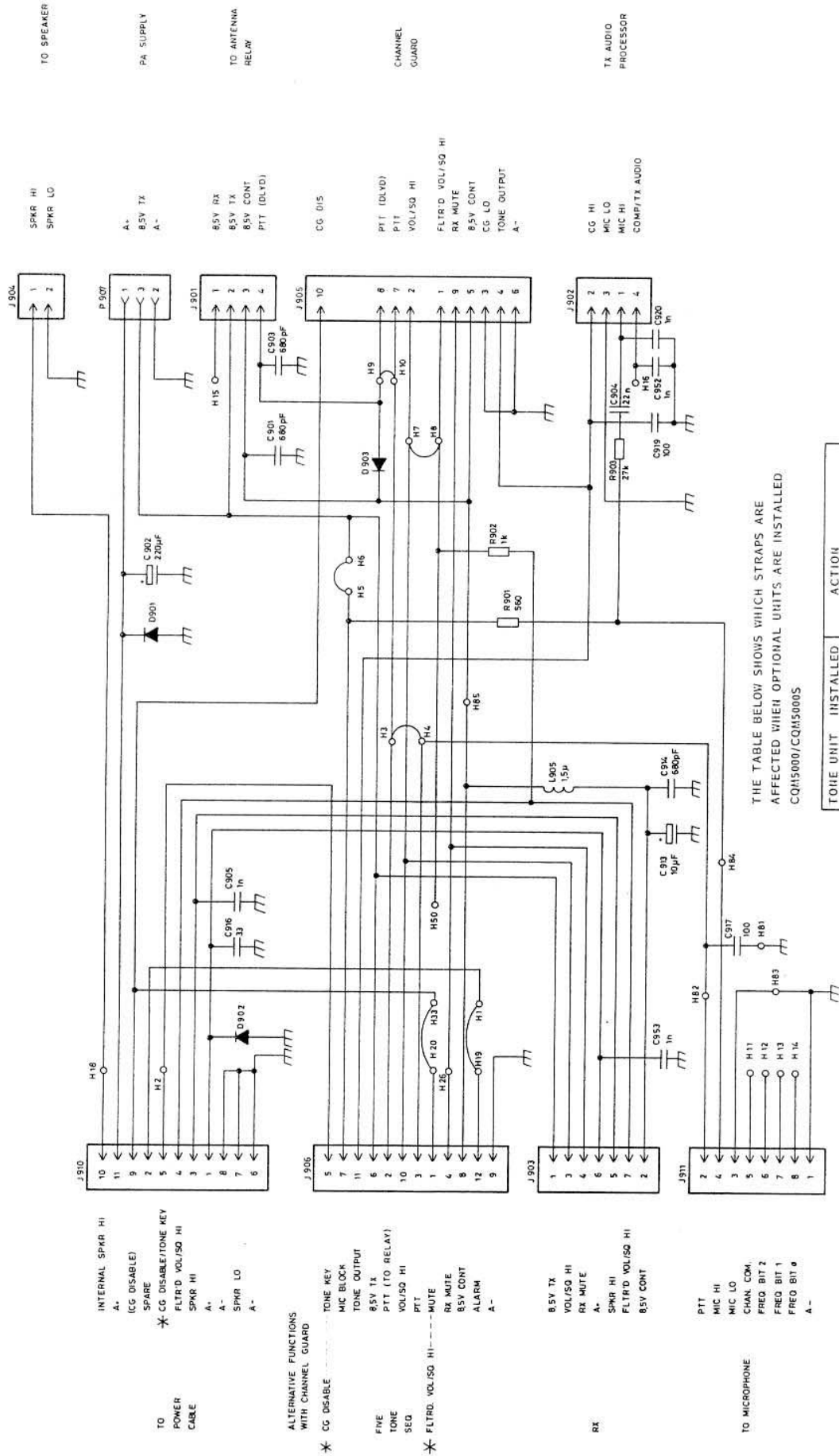


▽ = RECEIVER CHANNEL

△ = TRANSMITTER CHANNEL

ADJUSTABLE COMPONENTS AND TEST POINTS ON XS5111 / XS5112

D402.624

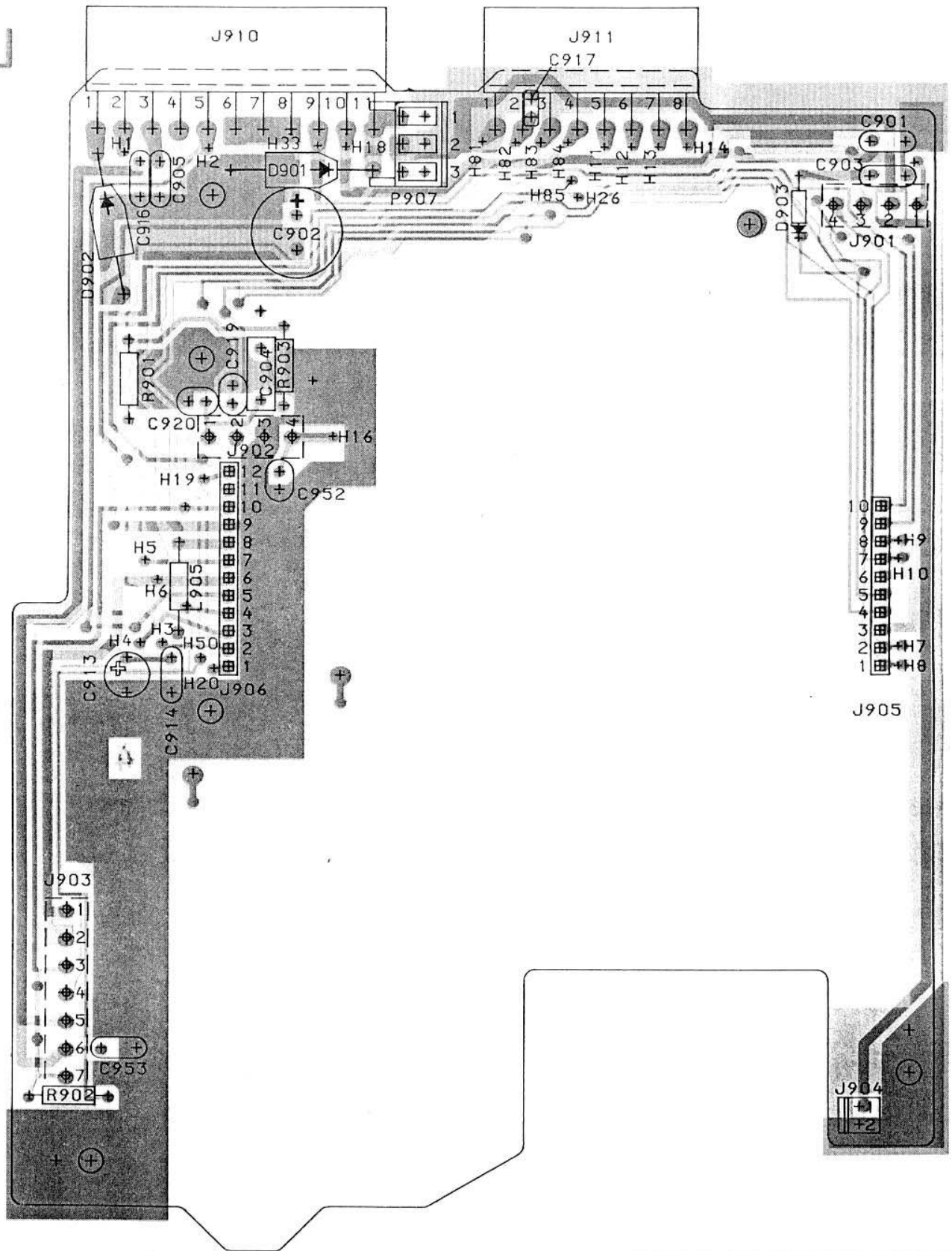


THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED. CQM15000/CQM50005

TORE UNIT	INSTALLED	ACTION
TQ5001	TQ5002	CUT H3-H4, H5-H6
TQ5004	TQ5005	CUT H7-H8, H9-H10, H20-H33
CL5001		CUT H7-H8, H9-H10, H20-H33
TQ5006		CUT H7-H8, H9-H10, H20-H33
TR5002	FH5002	CUT H7-H8, H9-H10, H20-H33
TT5002		CUT H9-H10, H20-H33

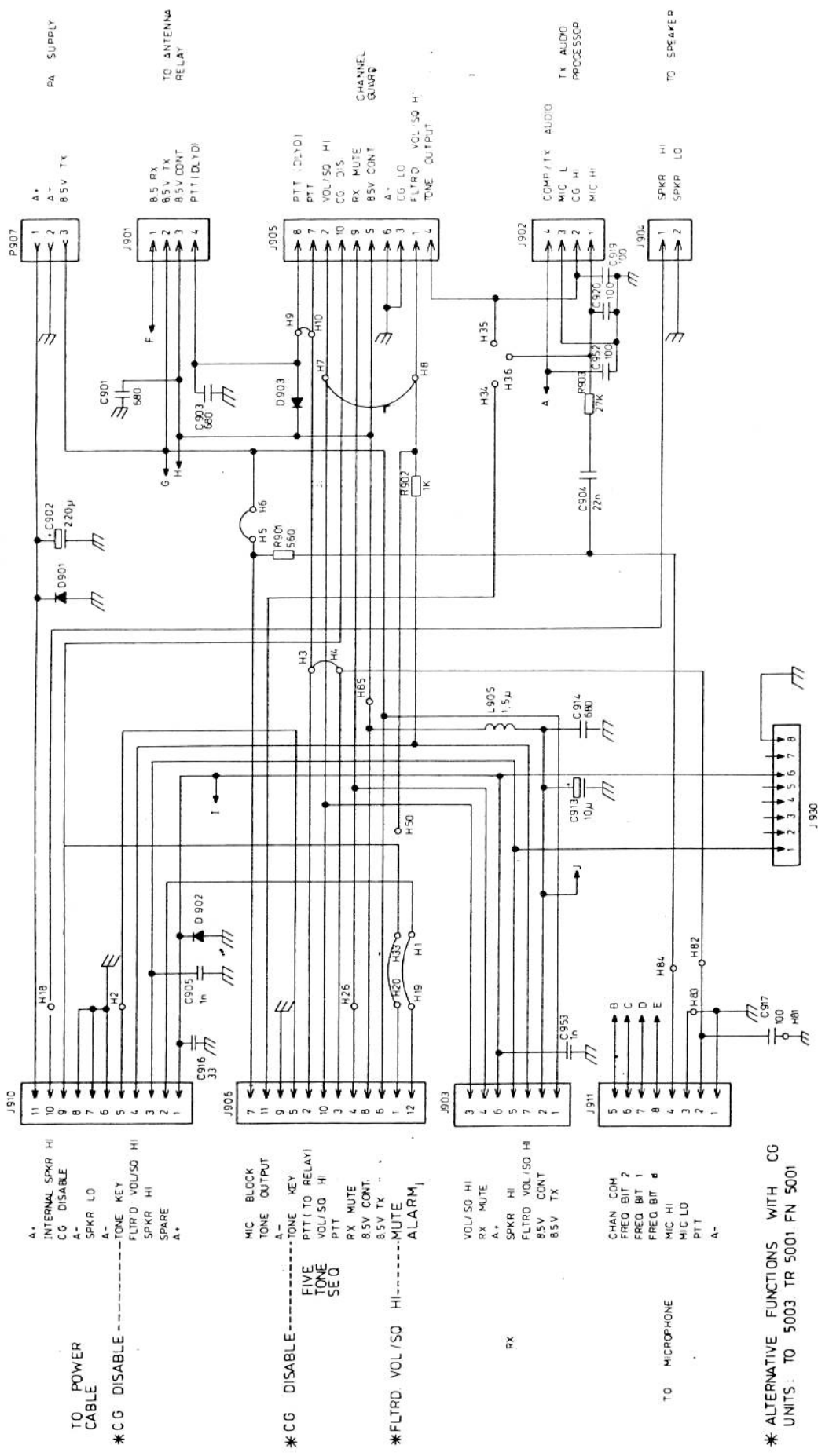
* ALTERNATIVE FUNCTIONS WITH CG UNITS:
TG 5003, ST 5001, SR 5001, FN 5001

**INTERCONNECT UNIT
XS 5001**



INTERCONNECT UNIT XS50T
COMPONENT LAYOUT

D402.637/2



TO POWER CABLE

A+ INTERNAL SPKR HI
 A- CG DISABLE
 A- SPKR LO
 A- SPKR HI
 A- TONE KEY
 FLTRD VOL/50 HI
 SPKR HI
 SPARE
 A+.

*CG DISABLE-----TONE KEY
 *FLTRD VOL/50 HI

MIC BLOCK

TONE OUTPUT
 A- TONE KEY
 PTT (TO RELAY)
 FIVE TONE SEQ
 VOL/50 HI
 PTT
 RX MUTE
 85V CONT.
 85V TX
 MUTE
 ALARM₁

*CG DISABLE-----TONE KEY
 *FLTRD VOL/50 HI-----MUTE
 ALARM₁

RX

VOL/50 HI
 RX MUTE
 A+
 SPKR HI
 FLTRD VOL/50 HI
 85V CONT
 85V TX

TO MICROPHONE

CHAN COM
 FREQ BIT 2
 FREQ BIT 1
 FREQ BIT 0
 MIC HI
 MIC LO
 PTT
 A-.

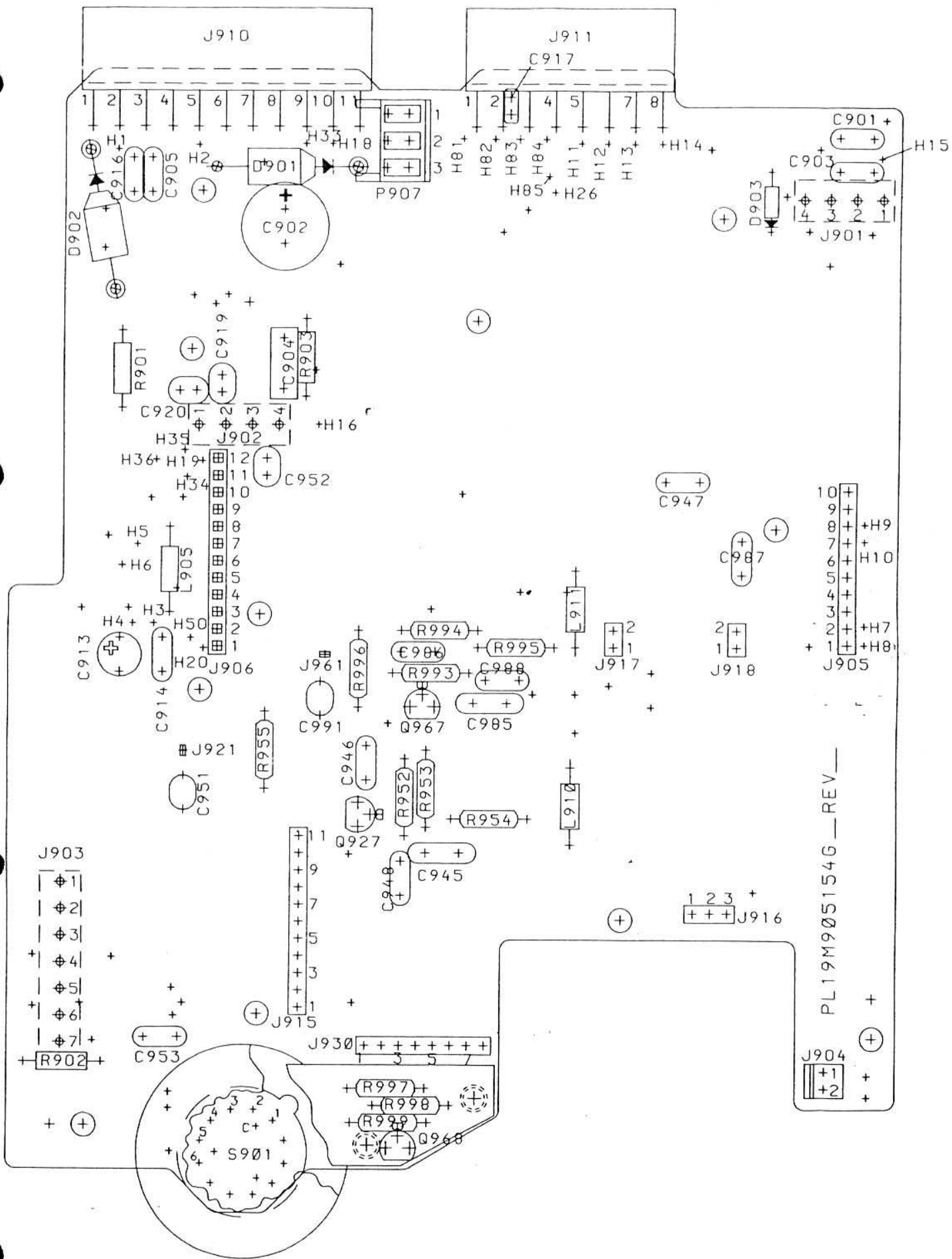
*ALTERNATIVE FUNCTIONS WITH CG
 UNITS TO 5003 TR 5001 FN 5001

ALTERNATIVE FUNCTIONS WITH CG UNITS TO 5003 TR 5001 FN 5001

NOTE: IF THE PREVIOUSLY USED CG UNITS TO 5003 TR 5001 OR FN 5001 ARE USED, H20-H33, H7-H8 SHALL BE OMITTED AND H20-H50 INSTALLED

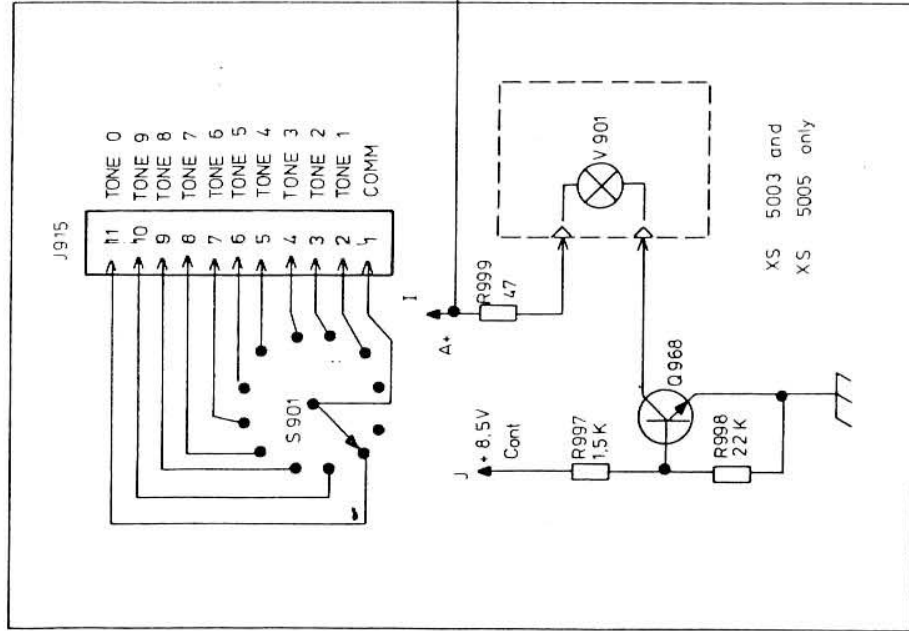
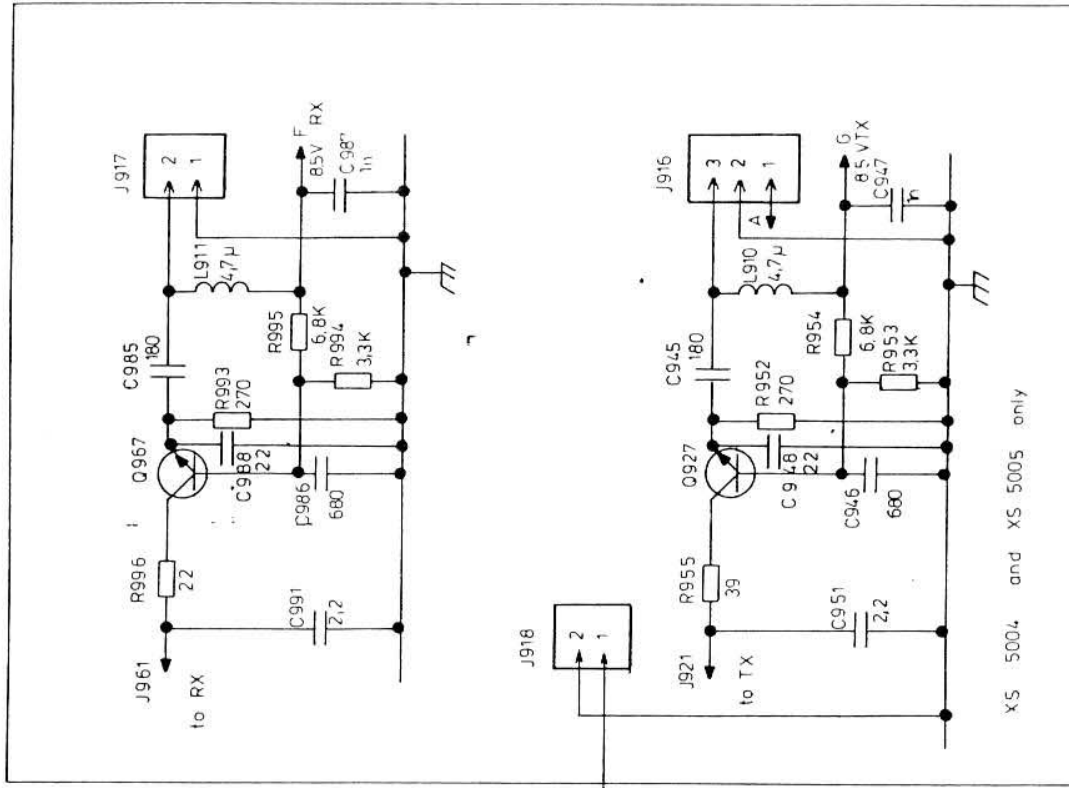
THE TABLE BELOW SHOWS WHICH RELAYS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED

OPTIONAL UNIT	RELAYS AFFECTED	ACTION
TR 5001	H1-H8	INSTALL
TR 5002	H9-H18	INSTALL
FN 5001	H20-H33	INSTALL
FN 5002	H34-H43	INSTALL
FN 5003	H44-H50	INSTALL
FN 5004	H51-H58	INSTALL
FN 5005	H59-H66	INSTALL
FN 5006	H67-H74	INSTALL
FN 5007	H75-H82	INSTALL
FN 5008	H83-H90	INSTALL



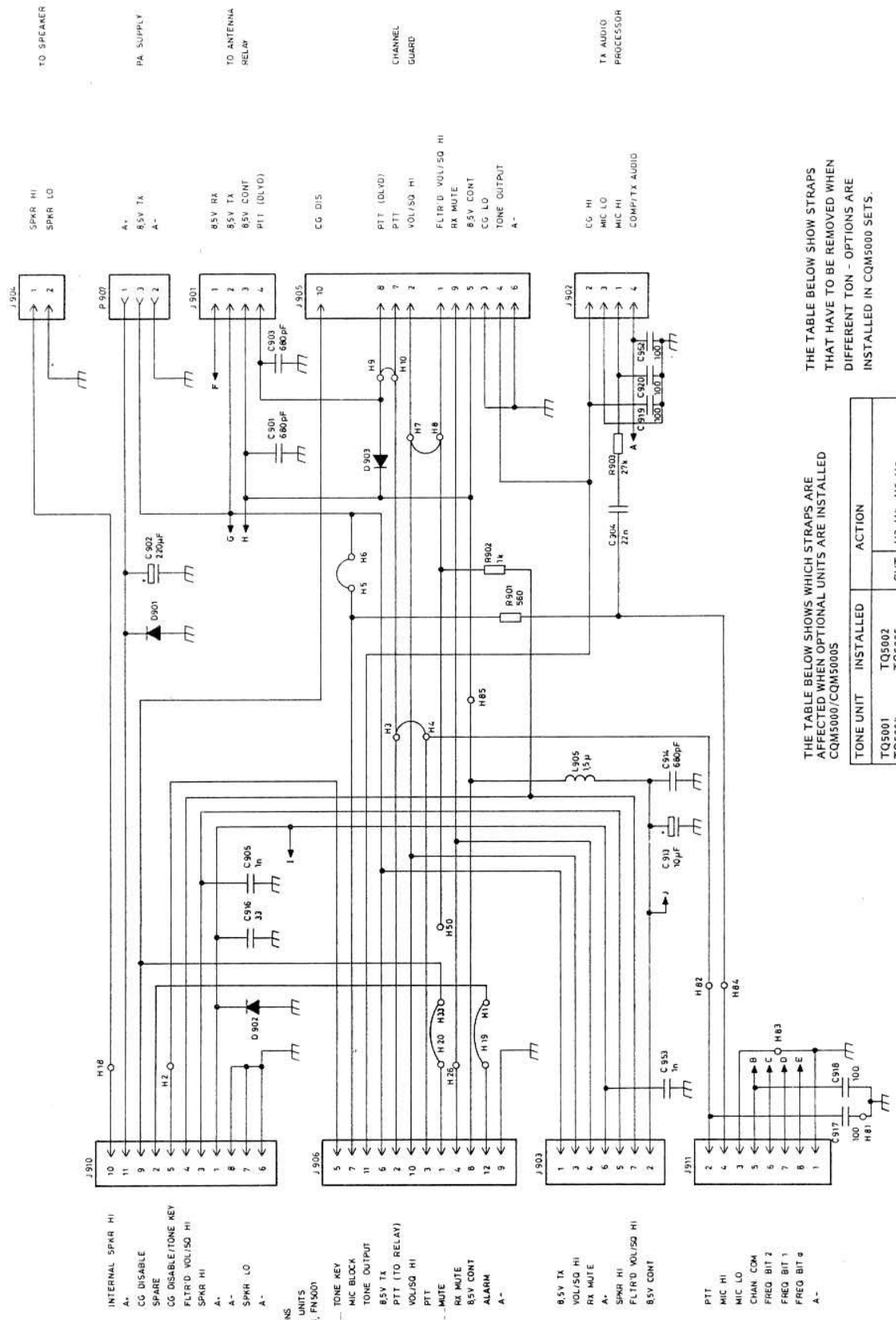
COMPONENT LAYOUT XS5002

D402.996



INTERCONNECT BOARD XS5002, XS5003, XS5004, XS5005

D402.995



THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5000S

TO NE	TO NW	TO SW	TO SE	TO S	TO E	TO W	TO N
TO S	TO E	TO W	TO N	TO S	TO E	TO W	TO N

TO NE	TO NW	TO SW	TO SE	TO S	TO E	TO W	TO N
TO S	TO E	TO W	TO N	TO S	TO E	TO W	TO N

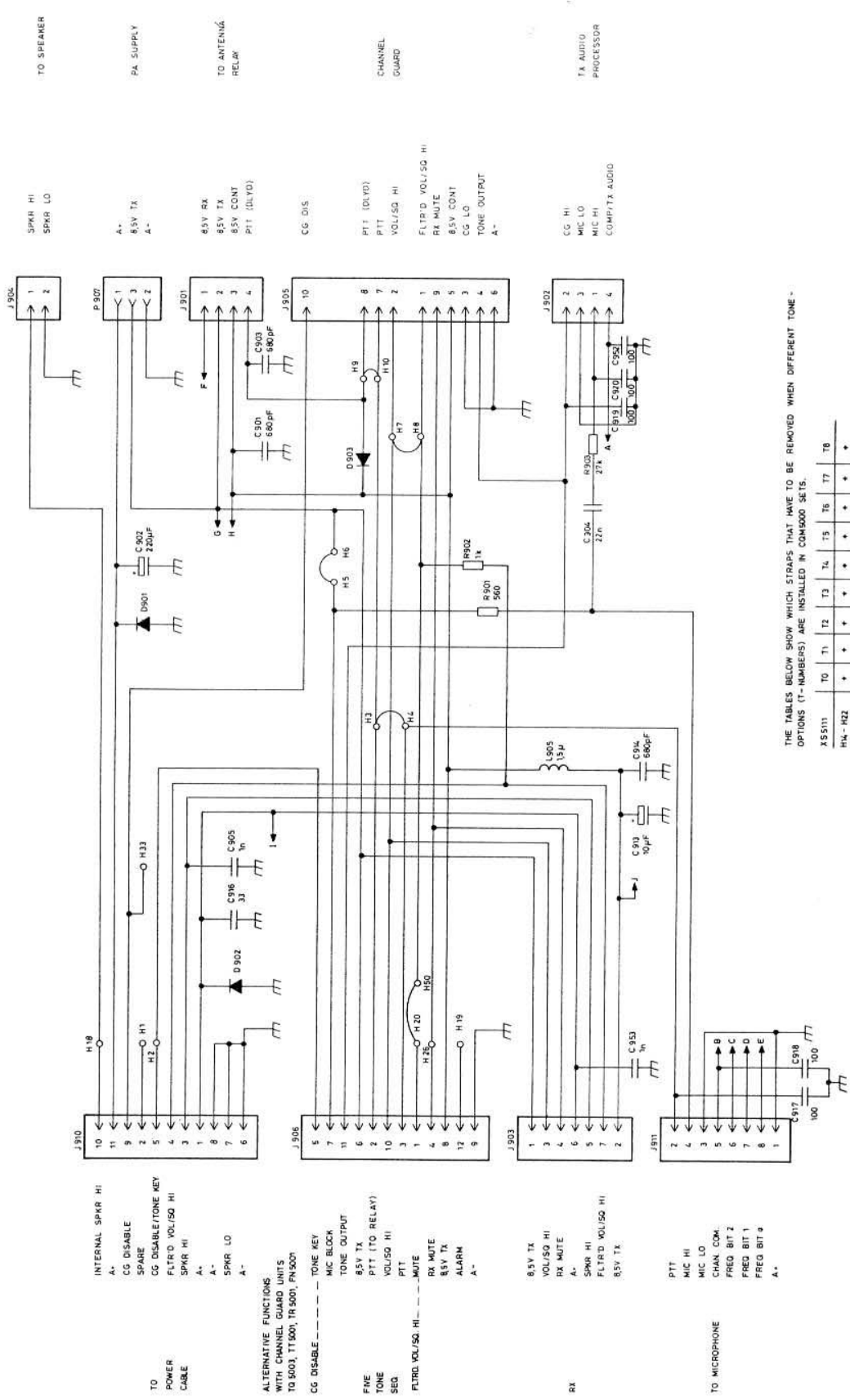
TO NE	TO NW	TO SW	TO SE	TO S	TO E	TO W	TO N
TO S	TO E	TO W	TO N	TO S	TO E	TO W	TO N

THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5000S

THE TABLE BELOW SHOWS STRAPS THAT HAVE TO BE REMOVED WHEN DIFFERENT TON - OPTIONS ARE INSTALLED IN CQM5000 SETS.

CHANNEL SELECTOR UNIT

XS 5111

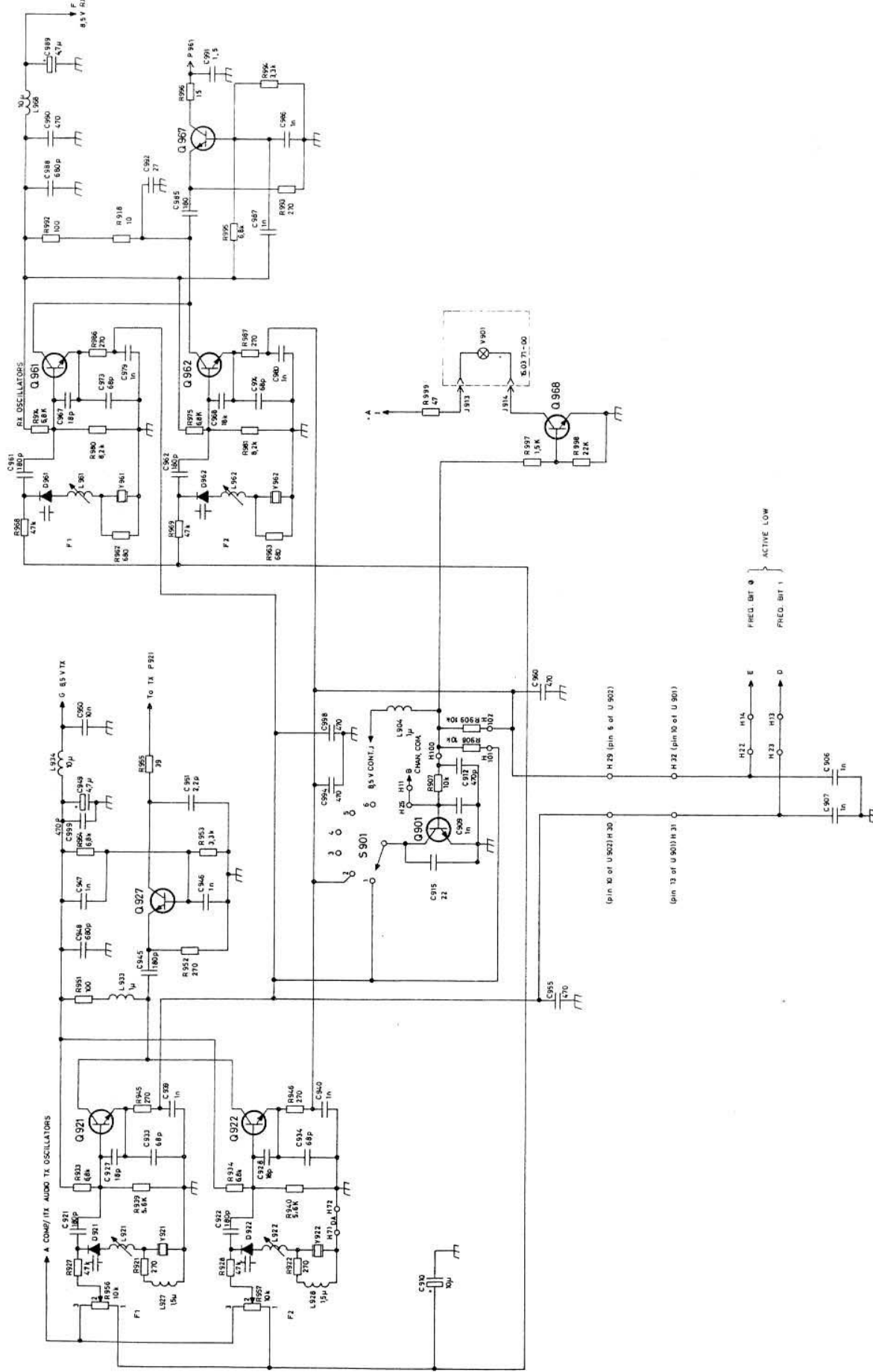


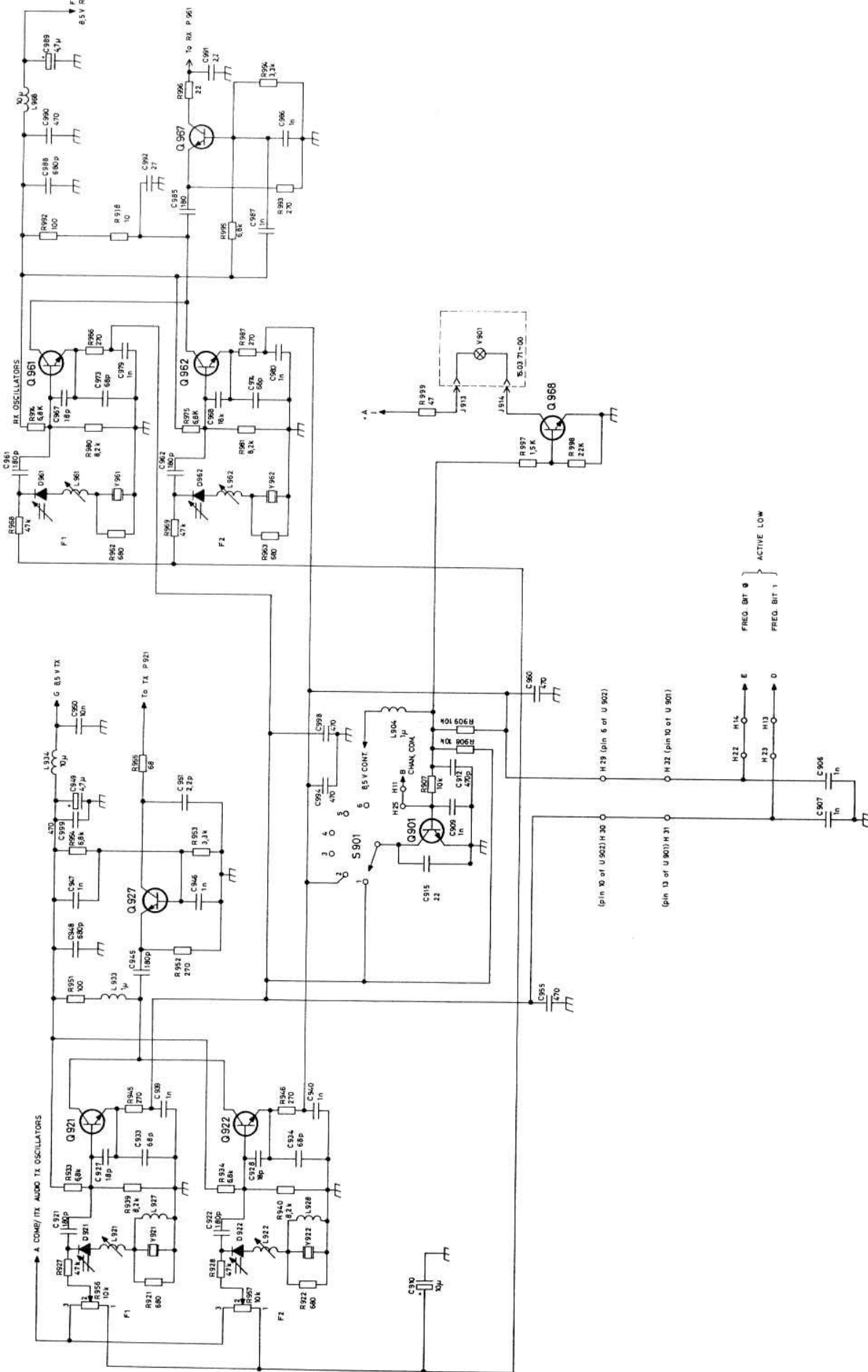
THE TABLES BELOW SHOW WHICH STRAPS THAT HAVE TO BE REMOVED WHEN DIFFERENT TONE-
OPTIONS (T-NUMBERS) ARE INSTALLED IN COM5000 SETS.

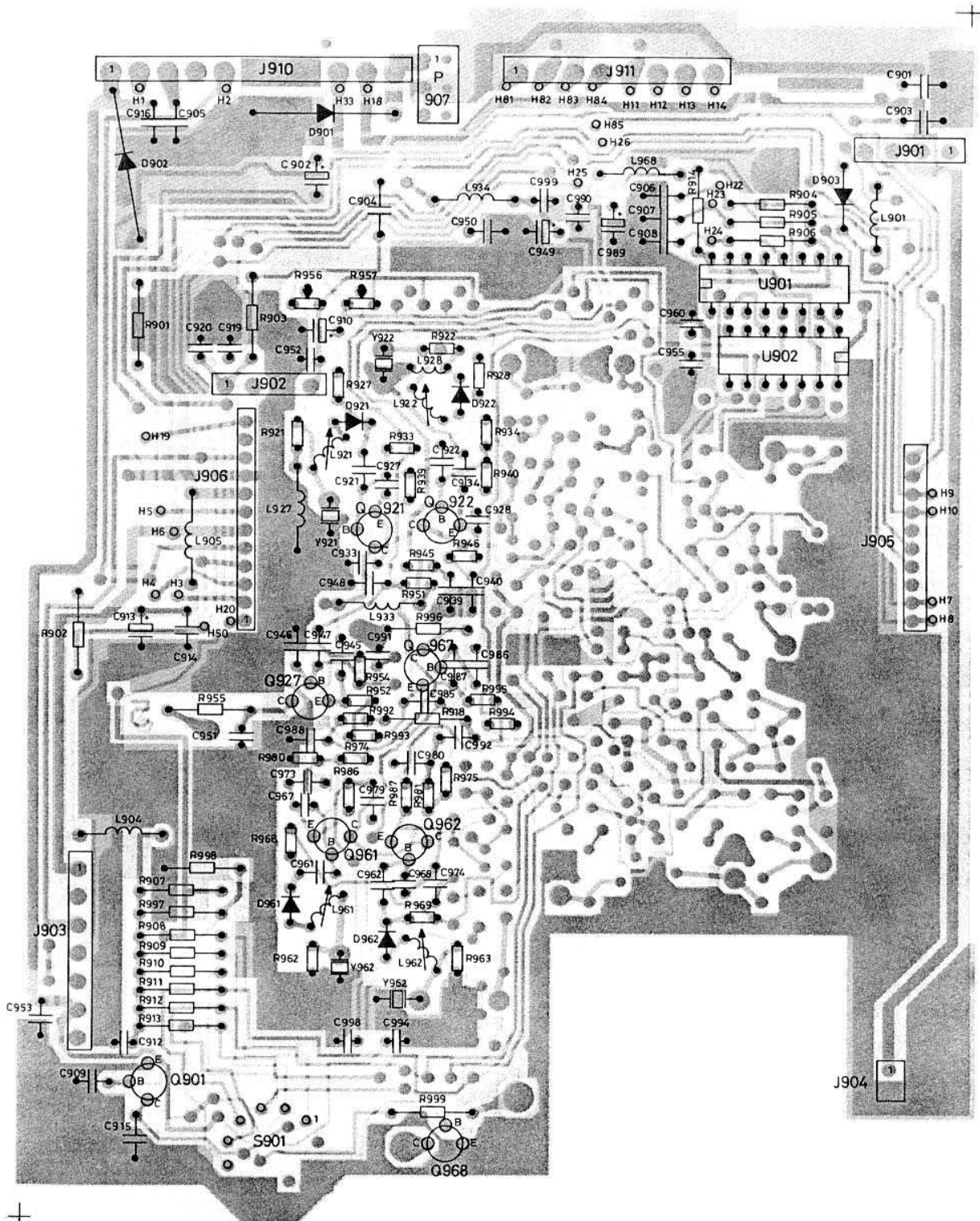
X55111	T0	T1	T2	T3	T4	T5	T6	T7	T8
H4 - H22	+	+	+	+	+	+	+	+	+
H3 - H23	+	+	+	+	+	+	+	+	+
H11 - H25	+	+	+	+	+	+	+	+	+
H12 - H28	+	+	+	+	+	+	+	+	+
H27 - H30	+	+	+	+	+	+	+	+	+
H2 - H4	-	-	-	-	-	-	-	-	-
H5 - H6	-	-	-	-	-	-	-	-	-
H7 - H8	-	-	-	-	-	-	-	-	-
H9 - H10	-	-	-	-	-	-	-	-	-
H20 - H29	-	-	-	-	-	-	-	-	-

CHANNEL SELECTOR UNIT
XS 5111

D402.635

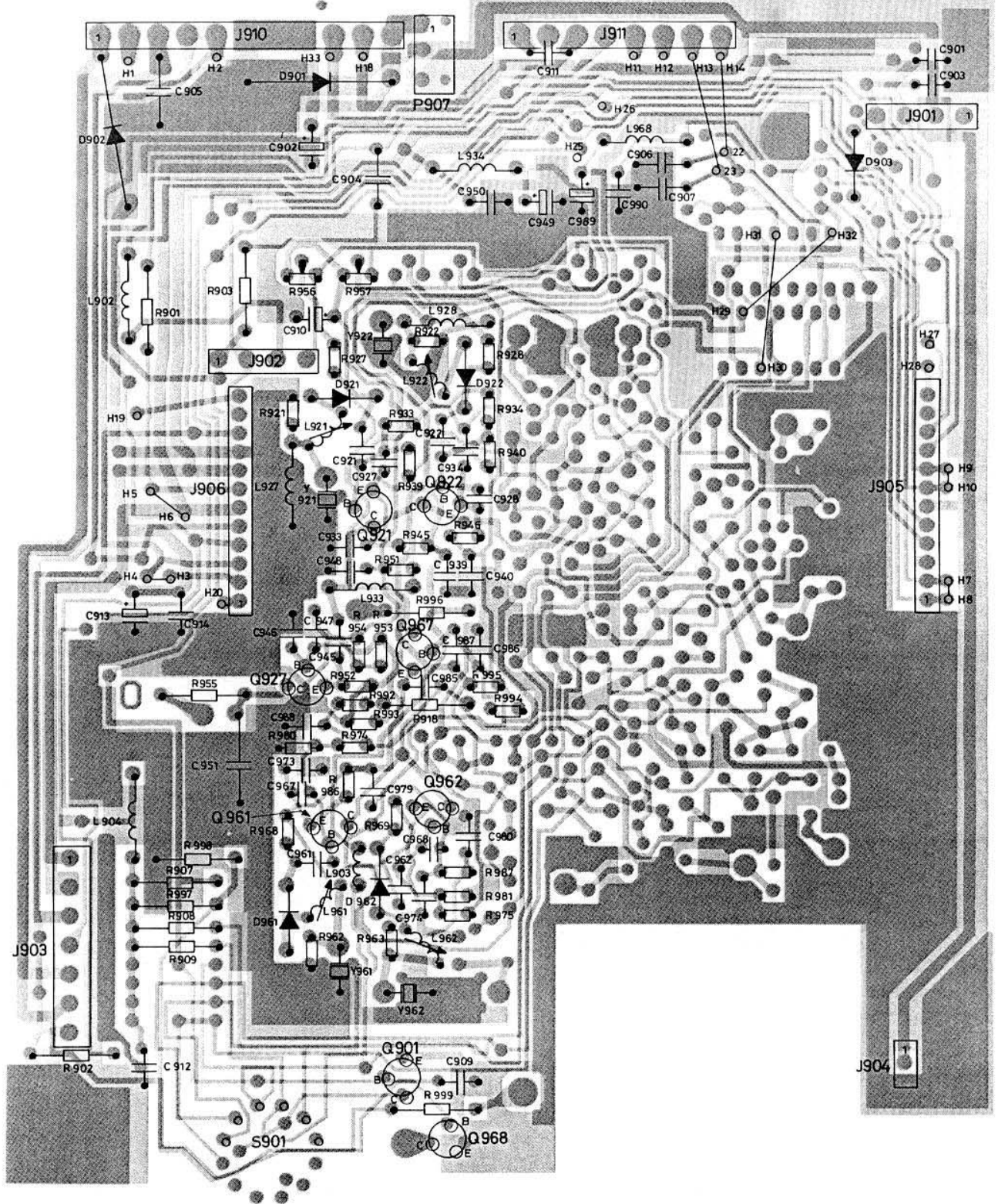






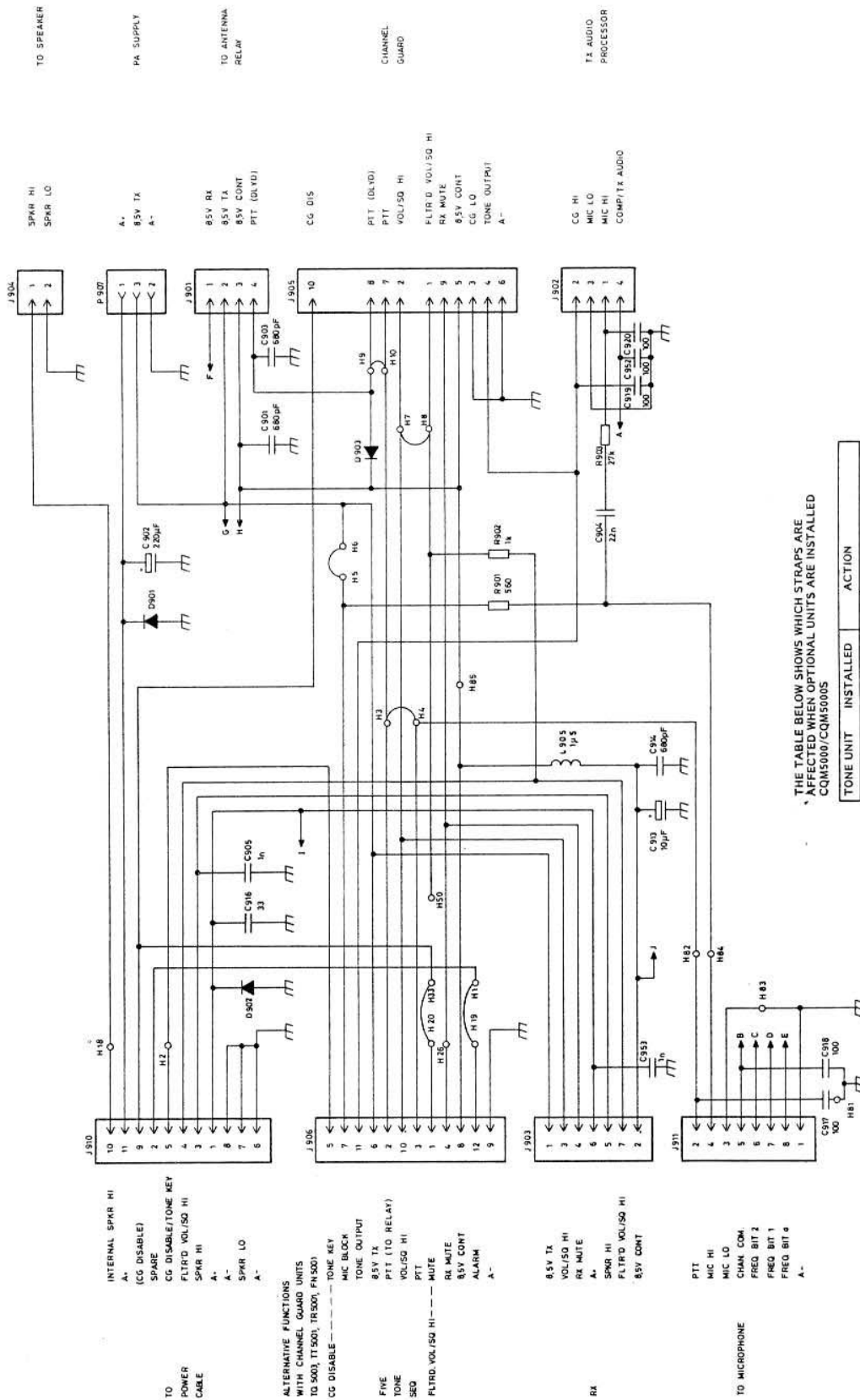
CHANNEL SELECTOR UNIT XS 511
INTERCONNECTION SECTION

D402.617/3



CHANNEL SELECTOR UNIT XS 5111
INTERCONNECTION SECTION

D402.617

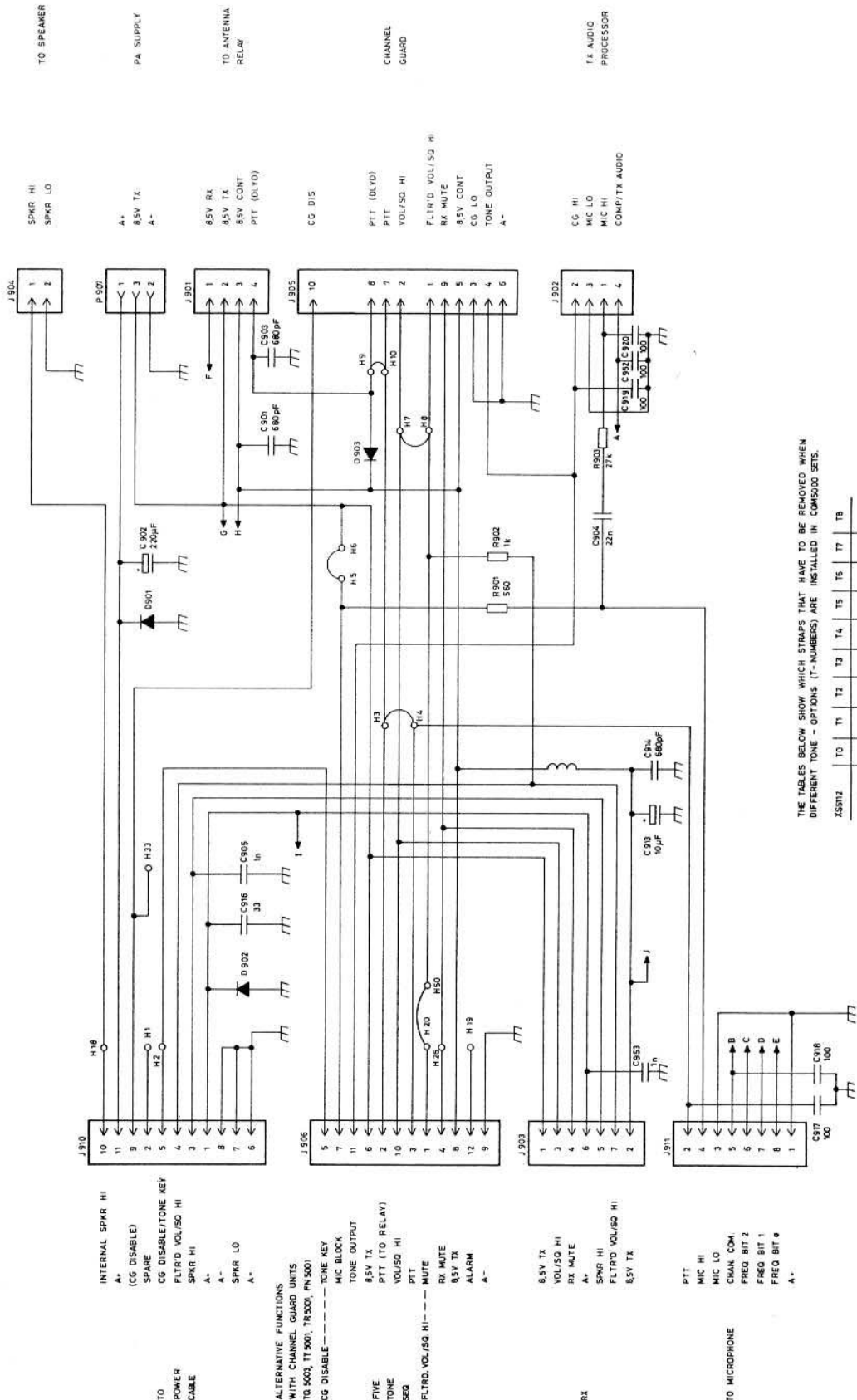


THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5000S

TO NE UNIT	INSTALLED	ACTION
TQ5001	TQ5002	CUT H3-H9, H5-H6
TQ5004	TQ5005	
CL5001		
TQ5006		CUT H7-H8, H9-H10, H20-H33
TR5002	FN5002	CUT H7-H8, H20-H33
TT5002		CUT H9-H10, H20-H33

CHANNEL SELECTOR UNIT
XS 5112

D402.636/2

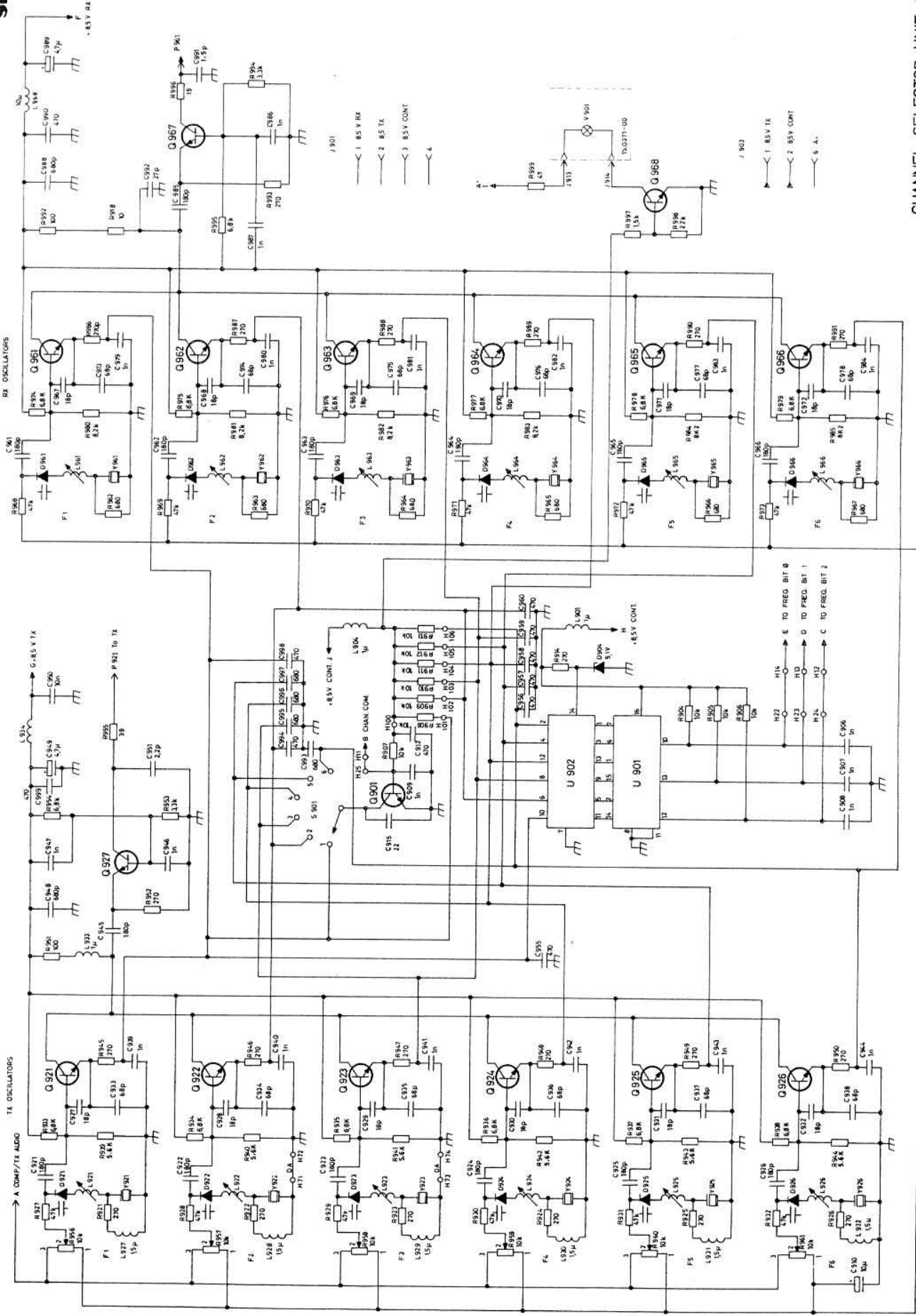


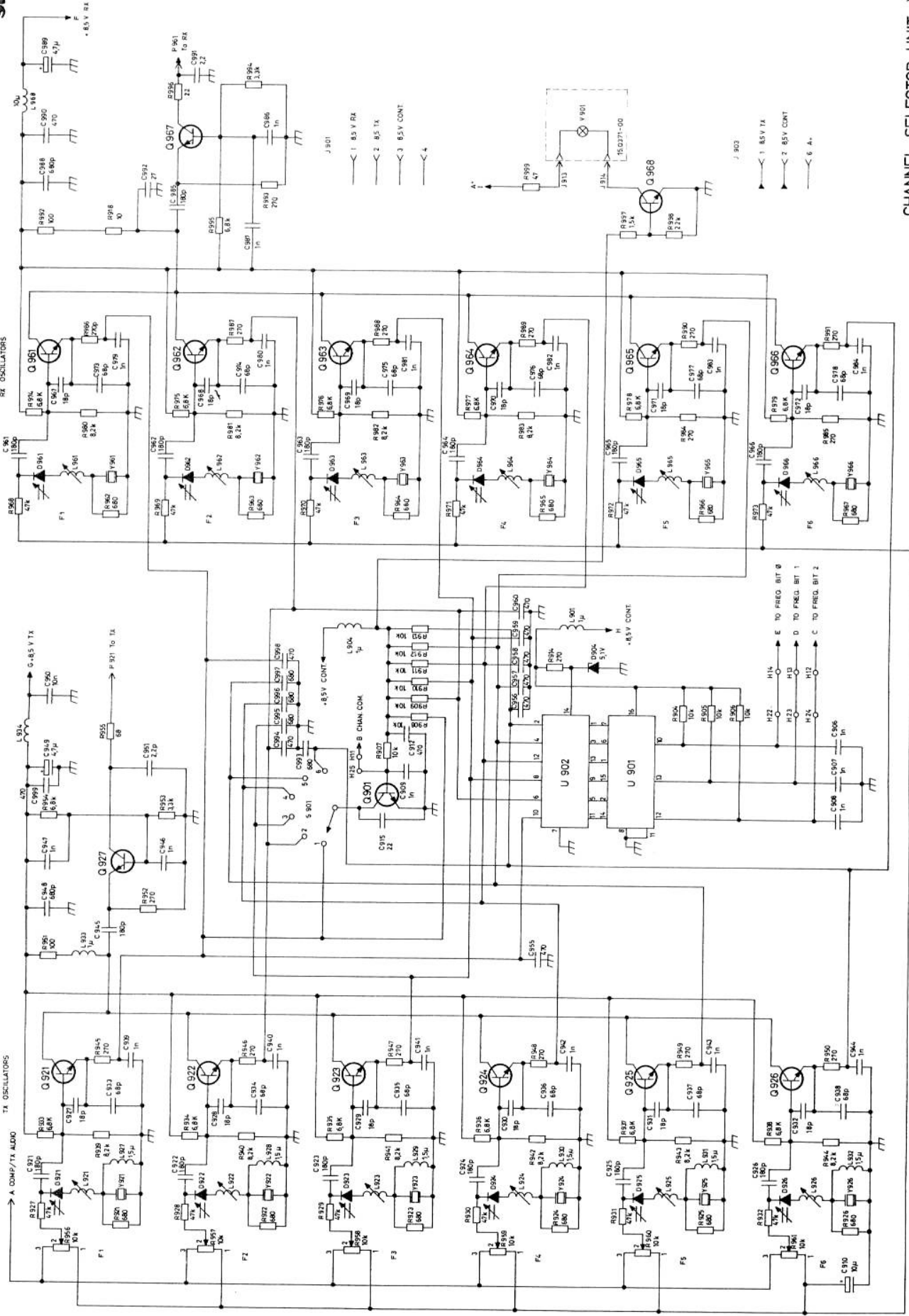
THE TABLES BELOW SHOW WHICH STRAPS THAT HAVE TO BE REMOVED WHEN DIFFERENT TONE - OPTIONS (T-NUMBERS) ARE INSTALLED IN COM5000 SETS.

XS5112	T0	T1	T2	T3	T4	T5	T6	T7	T8
H14 - H22	+	+	+	+	+	+	+	+	+
H13 - H23	+	+	+	+	+	+	+	+	+
H12 - H24	+	+	+	+	+	+	+	+	+
H11 - H25	+	+	+	+	+	+	+	+	+
H3 - H4	+	-	-	-	-	-	-	-	-
H5 - H6	+	-	-	-	-	-	-	-	-
H7 - H8	+	-	-	-	-	-	-	-	-
H9 - H10	+	-	-	-	-	-	-	-	-
H20 - H50	+	-	-	-	-	-	-	-	-

CHANNEL SELECTOR UNIT
XS 5112

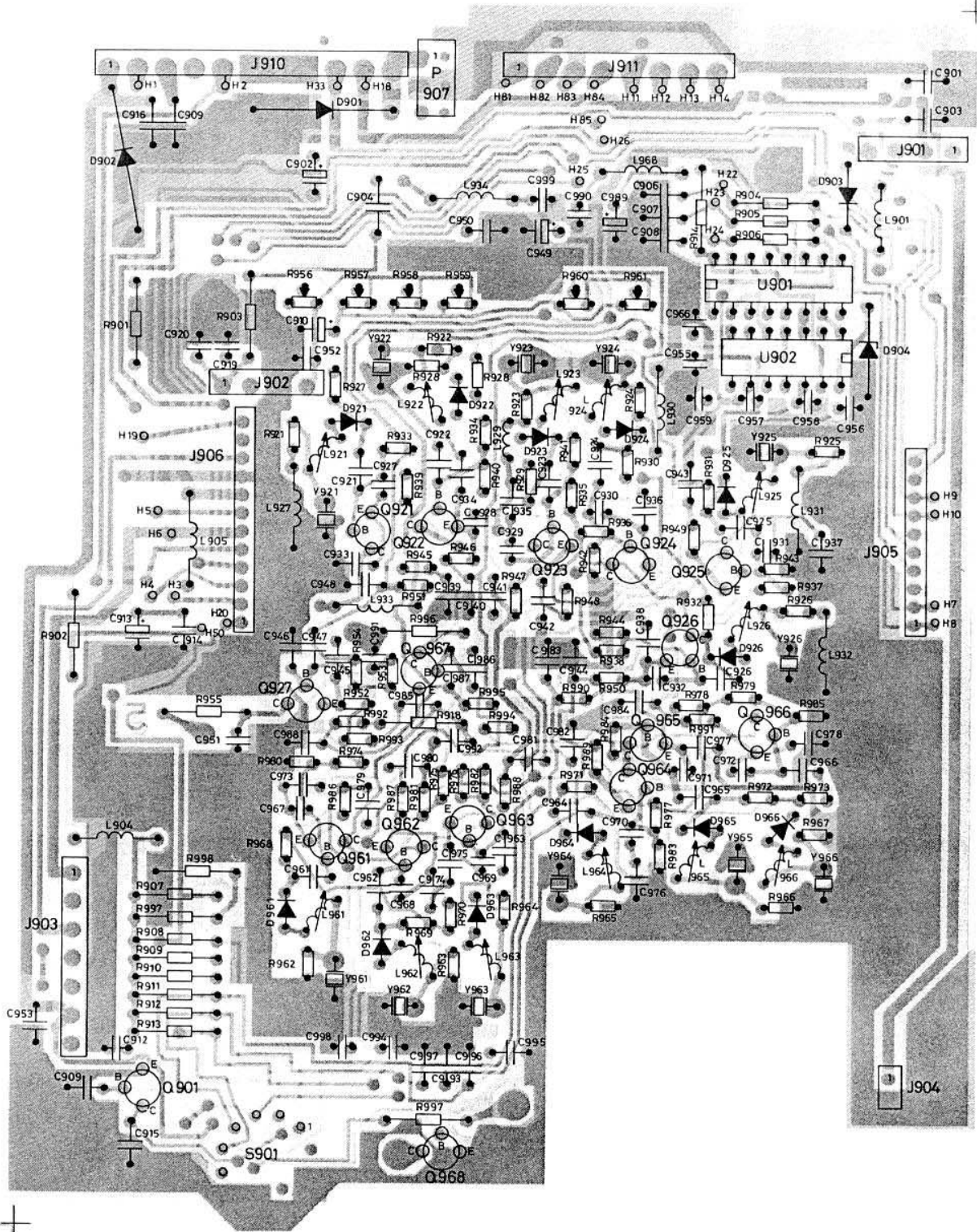
D402.636





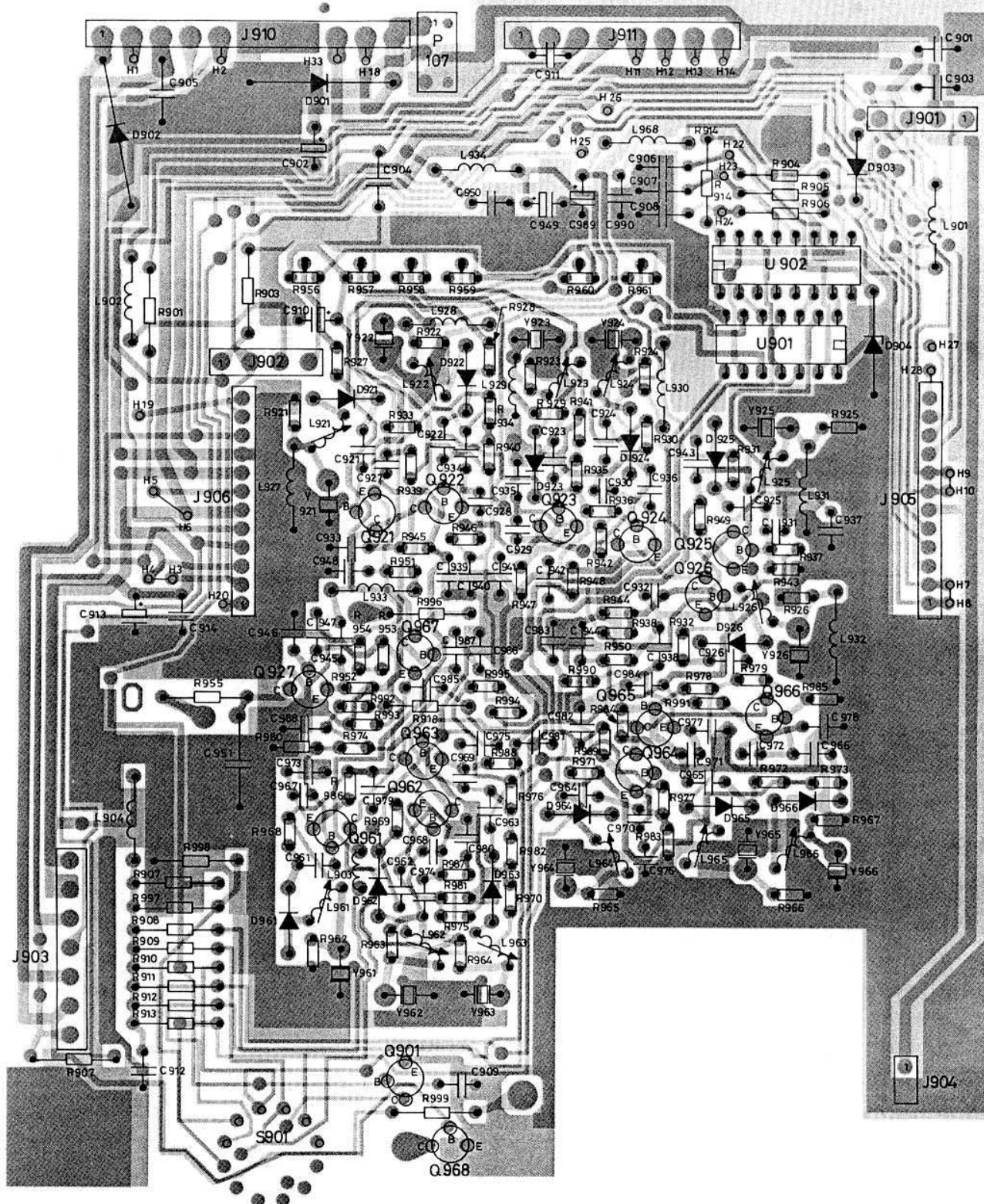
CHANNEL SELECTOR UNIT XS 5112
OSCILLATOR SECTION

D.402.618



CHANNEL SELECTOR UNIT XS5112
INTERCONNECTION SECTION

D402.619/3



CHANNEL SELECTOR UNIT XS 5112
INTERCONNECTION SECTION

D402.619