

SYSTEMA PRZEMIAN
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STORNOPHONE 800
UHF PERSONAL RADIOTELEPHONE

Type CQP863
420-470 MHz

Storno

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Contents

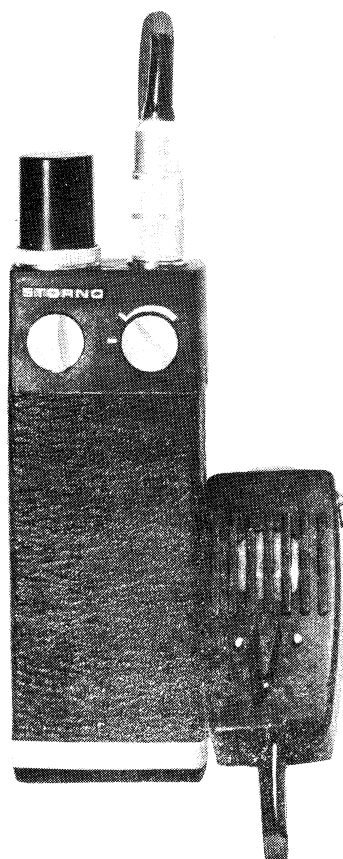
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TECHNICAL SPECIFICATIONS

GENERAL						
Type	CQP	813	814	833	834	863
Frequency band in MHz		146 to 174		68 to 88		420 to 470
Channel separation in kHz		20 or 25	12.5	20 or 25	12.5	20 or 25
Maximum RF bandwidth		1.5 MHz		1.5 MHz		2.0 MHz
Number of RF channels		2, 4, 8, or 12 channels				
Antenna impedance		50 Ω				
Ambient temperature range		Operating range		-25 ^o C to +55 ^o C		
		Functioning range		-30 ^o C to +60 ^o C		
TRANSMITTER						
Type	CQP	813	814	833	834	863
RF output (adjustable)		0.1 to 1.5W		0.1 to 1.5W		0.1 to 1.0W
Modulation		Phase (PM)				
AF response		+6 dB pr. octave preemphasis				
300 to 3000 Hz		X		X		X
300 to 2400 Hz			X		X	
Maximum frequency swing in kHz		± 4 or 5	± 2.5	± 4 or 5	± 2.5	± 4 or 5
Spurious and harmonic radiation		Attenuated to meet government specifications				
RECEIVER						
Type	CQP	813	814	833	834	863
Sensitivity e.m.f. for:						
12 dB SINAD (EIA)		0.5 μV		0.5 μV		0.7 μV
20 dB S/N (FTZ)		0.6 μV		0.6 μV		0.8 μV
Intermodulation attenuation (EIA)		75 dB		75 dB		70 dB
Adjacent channel selectivity		85 dB				
Spurious attenuation		85 dB				
AF output power		0.2 W				
AF response		-6 dB pr. octave deemphasis				
300 to 3000 Hz		X		X		X
300 to 2400 Hz			X		X	

Battery Data for CQP800				
Type	Min. Voltage	Nom. Voltage	Max. Voltage	Max. RF Output Power
BU801	9.6V	12V	14.4V	0.5W
BU802	9.9V	10.8V	13.5V	1.0W
BU803	10V	12V	15V	1.5W

GENERAL DESCRIPTION AND OPERATING INSTRUCTIONS



The Stornophone 800 portable radiotelephone is a combination transmitter and receiver for FM radio communication service on fixed, crystal controlled frequencies.

The CQP800 is available in either a local controlled or a remote controlled edition and can be fitted with 2, 4, 8 or 12 channels plus optional tone signalling equipment, according to individual customer requirements.

A complete radiotelephone unit consists of three sections, beginning from the bottom, these are:

- 1) the battery
- 2) the transmitter and receiver modules section
- 3) the control head

Local controlled sets have all of their operating controls as well as the speaker/mikrophone and the antenna connector placed in the control head, itself, and is fastened to the top of the radiotelephone.

On remote controlled radios, only the channel switch and the volume control are situated on the radiotelephone proper, while the control head, containing the transmit key, tone key and loudspeaker/squelch switches, the speaker/microphone and an earphone socket, is connected to the set by means of a cable. There are two connectors fitted on the top of the radio set, one is for the remote control cable and the other is for the antenna.

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

Type	CQP833	CQP834
4m band (VHF)	68 to 88 MHz	
channel spacing	20 / 25 kHz	12,5 kHz
number of channels	accomodation for 2, 4, 8 or 12 channels	
output power	0,1 to 1,5 W (factory adjusted)	

Type	CQP813	CQP814
2m band (VHF)	146 to 174 MHz	
channel spacing	20 / 25 kHz	12,5 kHz
number of channels	accomodation for 2, 4, 8 or 12 channels	
output power	0,1 to 1,5 W (factory adjusted)	

Type	CQP863
0,7m band (UHF)	420 to 470 MHz
channel spacing	20 / 25 kHz
number of channels	accomodation for 2, 4, 8 or 12 channels
output power	0,1 to 1,0 W (factory adjusted)

The size of a particular equipment will depend upon the number of channels, battery size, whether it includes tone equipment and, of course, whether it is local remote controlled.

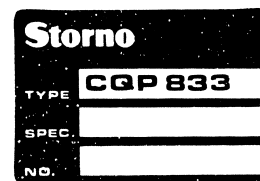
Type specification is arrived at as follows:

<u>specification</u>	<u>code</u>
local controlled	C1
remote controlled	C2
2 channels	X2
4 channels	X4
8 channels	X8
12 channels	X12
tone equipment	T

Thus a four-channel, remote controlled radio-telephone having selective calling would be designated:

C 2 X 4 T

For easy identification, each equipment has a type plate such as the one pictured below, showing its specifications.



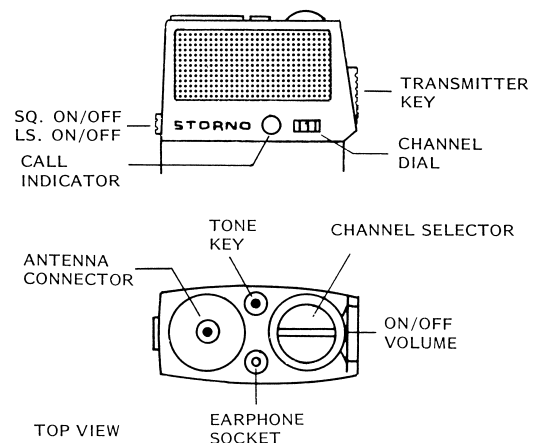
OPERATING INSTRUCTIONS

Local Controlled

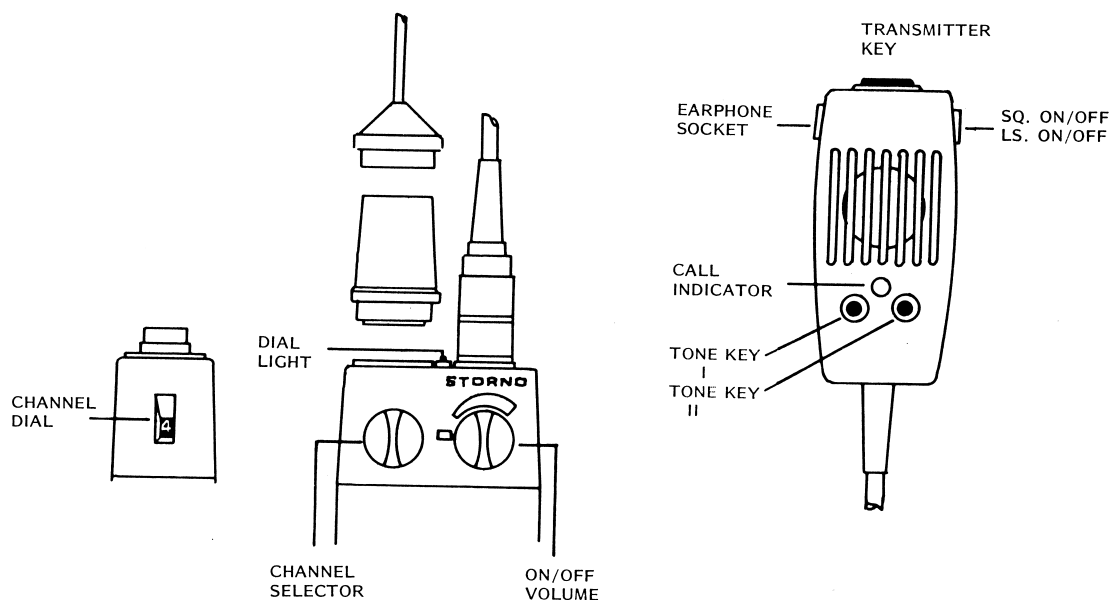
Local controlled equipments are fitted with CP801 control heads which interconnect with the various transmitter and receiver modules, channel switch and tone equipment, where applicable, via an internal wiring harness.

The following functions are incorporated in the CP801:

1. push button for keying the transmitter
2. push button for tone keying
3. push button for squelch cancelling + LS IN/OUT and channel pilot lamp
4. dial-type knob for volume control and ON/OFF switch
5. 12-position channel switch
6. socket for earphone
7. antenna connector



Before switching the set on, ensure that the antenna and battery are properly connected.



Receiving (without selective calling)

Turn the radiotelephone on by turning the volume control clockwise.

If no signal can be heard, the volume control can be set by pressing the SQ cancelling button while adjusting the volume control for the desired sound level, using the background noise for sound.

Set the channel selector switch to the channel to be used and release the SQ cancelling button. Any traffic on that channel will now be heard from the loudspeaker.

Receiving (with selective calling)

Adjusting the sound level is done just as in the sets without tone equipment except that it might be necessary to press the button twice. This is because now there are two circuits, namely the Squelch circuit and the Loudspeaker circuit, sharing the same switch.

Transmitting (without selective calling)

When the channel is clear, simply press the transmitter key button and speak with a normal voice into the loudspeaker, which functions as a microphone when transmitting.

Transmitting (with selective tone receiver)

Before transmitting, turn on the loudspeaker with the LS IN/OUT button, do not transmit until the channel is free.

Press the transmitter key and speak into the loudspeaker/microphone.

To return to stand by, turn off the loudspeaker again with the LS IN/OUT button.

Transmitting (with selective tone transmitter)

To initiate a call, press the tone key button. When the connection is made, use the ordinary transmitter key button when transmitting (when the tone key is activated the microphone is blocked).

When no longer in use, switch the radiotelephone off by turning the volume control completely counter-clockwise.

ACCESSORIES

Antennas

The following antennas are developed for use with the STORNOPHONE 800 series radiotelephones:

AN811	36 mm Compact Antenna	146 - 174 MHz
AN812	Shortened Whip Antenna	146 - 174 MHz
AN831	36 mm Compact Antenna	68 - 88 MHz
AN832	Shortened Whip Antenna	68 - 88 MHz
AN861	36 mm Compact Antenna	420 - 470 MHz
AN862	1/4 Wavelength Antenna	420 - 470 MHz

All antennas are fitted with bayonet type plugs that fit into the antenna receptacle.

Batteries

The following Battery types are available:

BU801	silver-zink (AgZn) battery, 12V, 300 mAh
BU802	nickel-cadmium (NiCd) battery, 10, 8V, 225mAh
BU803	nickel-cadmium (NiCd) battery, 12V, 450 mAh

The batteries are encased in a high-impact cast plastic kassette with snap action locks, automatically securing the battery when slid into place.

Battery Chargers

Available battery chargers:

CU801	charging unit with two outlets
CU802	charging unit with ten outlets

Since the various battery types have different charging requirements, each outlet must be coded for one particular type.

The battery chargers can be operated from either a 110 V or a 220 V AC mains.

Earphone

An earphone, HP801, is available for use in areas where high background noise is encountered. The earphone is supplied complete with cable, connector and ear hanger. Plugging in the earphone does not disconnect the built-in speaker.

Tone Equipment

The radio set can be fitted with tone equipment which is contained in a separate panel placed between the control head and the transmitter/receiver circuitry. Incorporating tone equipment into an existing radio set increases the total length of the unit and requires a new, longer casing. Tone signalling sub-units for CQP800 are as follows:

TT801	single or double tone transmitter, tone frequencies from 885 Hz to 2900 Hz
ST801	four or five tone sequential tone transmitter, tone frequencies from 885 Hz to 2800 Hz.
SR801	four or five tone sequential tone receiver, tone frequencies from 885 Hz to 2900 Hz. (can also be coded for use as a double tone receiver)

Carrying Devices

The following devices are available for carrying the CQP about:

CK801	carrying harness consisting of mounting hardware, short and long straps, belt and clamps
CK802	screw mounted pocket clip
CK803	shoulder strap with retainer for remote control panel (for remote control, only)

CQP860

CIRCUIT DESCRIPTION

Transmitter Circuit (see block diagram)

The transmitter is built up of several modules, each of which is completely enclosed (shielded) and has connector pins protruding from the bottom of the module. All the modules are then mounted onto a mother board that is common to both transmitter and receiver circuits. The transmitter section consists of the following modules:

XO862	Crystal Oscillator
AA802	Modulation Amplifier
FN803	Modulation Filter for 20/25 kHz channel separation
PM861	Phase Modulator
FD861	1st Frequency Doubler
FD862	2nd Frequency Doubler
FD863	3rd Frequency Doubler
BP861	Band Pass Filter
PA861	1st Power Amplifier
PA862	2nd Power Amplifier and Antenna Switch
FN861	Antenna Filter
AD801	ADC Circuit
VR801	Voltage Regulator

Modulation Amplifier AA802 and FN803

The modulation amplifier function is carried out by the Modulation Amplifier, AA802 in conjunction with a Modulation Filter, FN803. The microphone signal is applied to an operational amplifier, the degree of negative feedback, and thus the amplifier gain, can be adjusted by means of an external resistor. Microphone sensitivity can then be adjusted to suit individual requirements. In radio sets with built-in tone transmitters or sequential tone transmitters, the microphone amplifier is disabled by the tone key.

The amplified AF signal is applied to a limiter via a differentiating network. The limiter is likewise an operational amplifier utilising negative feedback. Following the limiter is an integration network and an active lowpass filter where the active element is another operational amplifier. The active filter removes any harmonics of the original input signal that arise during limiting action, and it also keeps the frequency excursions within the tolerances required for the channel spacing used in the particular equipment. An extra limiter is inserted between the integration network and the active lowpass filter to prevent strong input signals of low frequencies from overloading the filter.

Transmitter Oscillator XO862

The transmitter exciter signal is generated by a crystal, Colpitts-type oscillator operating on the crystal's fundamental frequency, which will be in the range of 52.50 to 58.75 MHz. The oscillator starts when the channel selector completes the circuit path to chassis ground. The collector circuit is tuned by a variable capacitance diode which also detunes the resonant circuit whenever the channel switch breaks the ground connection. Thus several oscillators can be tied in parallel without mutual loading effects. The output signal is capacitively taken off the tank circuit. The maximum number of channels is 12, with all oscillators placed in an oscillator panel.

Phase Modulator PM861

The Phase Modulator consists of an input- and an output buffer plus a phase modulator stage. The exciter signal from the oscillator is fed to the input buffer stage. This amplifier, with fol-

lowing network, ensures a constant sine wave signal to the phase modulator. The modulator is a transistor amplifier stage where the modulating audio signal is applied to the emitter, which is RF decoupled. The modulation signal varies the transconductance (gm) of the amplifier and thus the phase angle (ϕ) of the RF signal at its output. To function properly, the modulator must work into a constant load and is therefore followed by a buffer stage whose output signal is sufficient in amplitude to drive the following stage, a frequency doubler.

Multiplier Chain FD861, FD862, FD863

The multiplier chain consists of three very similar frequency doubler stages. Each frequency doubler operates as a grounded emitter transistor amplifier followed by two inductively coupled LC circuits that are tuned to the second harmonic of the input frequency.

Band Pass Filter BP861

To ensure suppression of the undesired harmonics that arise in the frequency multiplying process, the multiplier chain is terminated by a double tuned band pass filter, the BP861.

Power Amplifier PA861 and PA862

The output power from the Multiplier chain (approx. 15 mW) is amplified to the required antenna power (0.1 to 1.0 W) in a three-stage amplifier composed of the PA861 and the PA862 modules.

PA861 contains two amplifier stages. The collector voltage to the first transistor is supplied via the ADC Circuit, and is variable. If more gain is required to drive the following PA862 stage, the collector supply (ADC) voltage will rise. On the other hand, if the drive signal is more than enough, the ADC voltage will drop.

PA862 contains the transmitter final amplifier plus a circuit for electronically switching the antenna between the transmitter and the receiver. Collector current for the second transistor in PA861 passes through the switching diodes, whereby they can be considered to be virtual short circuits. This connects the Power Amplifier output to the antenna while short circuiting the receiver input. When receiving, the diodes become reverse biased, effectively isolating the transmitter from the antenna while connecting the antenna to the receiver input.

ADC Circuit AD801

The transmitter output current is kept very nearly constant by means of the ADC Circuit. The voltage drop across a small resistor (1 ohm) in the output transistor's collector return is monitored by the ADC stage, which then regulates the collector voltage to the first transistor amplifier in the PA861 stage with the net effect of cancelling any variations and thus keeping the RF output at a constant value. The amount of current through the output stage, and thus the output power, can be set by means of a resistor mounted on the mother board.

Antenna Filter FN861

A nine-pole lowpass filter having a cutoff frequency of 470 MHz is inserted between the transmitter output and the antenna. The filter suppresses any harmonics created in PA862. A 21.4 MHz band pass filter at the FN861 input prevents any signals close to the intermediate frequency from reaching the receiver circuits.

Receiver Circuit (see block diagram)

The receiver is a double conversion superheterodyne using intermediate frequencies of 21.4 MHz and 103.5 kHz. Channel selectivity is achieved by means of a crystal filter in the first IF circuit. The radiotelephone can be fitted with up to 12 channels, one oscillator per channel.

All the oscillators are arranged in parallel on a special oscillator panel which also contains the transmitter oscillators. The receiver employs an electronic squelch circuit whose threshold can be set with a resistor on the mother board. There is a pushbutton on the control panel for cancelling the squelch.

The receiver consists of the following modules:

RC861	Receiver Converter
XO811	Crystal Oscillator
XF803	Crystal Filter for 20/25 kHz channel separation
IC801	IF Converter
IA801	1st IF Amplifier
IA802	2nd IF Amplifier and Discriminator
SQ801a	Squelch Circuit
AA801	AF Amplifier
VR801	Voltage Regulator

Receiver Converter RC861

The RC861 converts the frequency of the antenna signal to the 1st IF frequency of 21.4 MHz. The incoming signal path from the antenna is through the Antenna Filter, FN861, and then via the antenna switching circuit in PA862 to the input of the RC861. The signal then passes through a two-element bandpass filter to a transistor operating as a grounded base amplifier. After amplification, the signal passes through a three-element UHF filter. This filter is what mainly determines the selectivity of the converter. The signal is taken off at a 50-ohm tap and fed to the mixer via L7, a transformer that serves as an adjustment for achieving optimal sensitivity/gain. The local oscillator signal from the XO module(s), after passing through a lowpass filter, proceeds to a frequency tripler. The filter allows only the oscillator signal to reach the tripler. The signal from the tripler output is then applied to the gate of the mixer transistor, which is a field effect transistor operating in the grounded source configuration.

The IF signal is taken off via a combination autotransformer/L network to match the impedance of the following crystal filter.

Oscillator XO811

The local oscillator signal of 124 to 153 MHz is generated in the Hartley type crystal oscillator where the transistor operates as a grounded base amplifier, the oscillator starts when the channel selector switch completes the emitter circuit path to chassis ground. The collector circuit is tuned by a variable capacitance diode which also detunes the resonant circuit whenever the channel switch breaks the ground connection. Thus several oscillators can be tied in parallel without mutual loading effects. The output signal is capacitively taken off the tank circuit.

The local oscillator signal frequency lies 21.4 MHz under the antenna frequency and the formula for calculating the crystal frequency is therefore:

$$f_x = f_a - \frac{21,4 \text{ MHz}}{3}$$

(where f_x = crystal frequency
and f_a = antenna frequency)

Crystal Filter XF803

The Crystal Filter unit comprises an eight-pole monolithic crystal filter and an impedance matching transformer for matching the output to the impedance of the following IF converter. Practically all of the receiver selectivity is achieved in the crystal filter.

XF803 is employed in equipment with 20/25 kHz channel spacing.

IF Converter IC801

The first IF frequency (21.4 MHz) is converted to the second IF frequency (103.5 kHz) in this module, which contains an amplifier, a mixer and an oscillator. The output signal is taken off from a center tap on the coil in the mixer transistor's collector circuit and applied to an intermediate frequency amplifier, IA801.

IF Amplifier and Discriminator IA801 and IA802

The first Intermediate Frequency Amplifier, IA801, consists of two differential amplifiers in cascade. The output signal is applied to the second Intermediate Frequency Amplifier, IA802, which contains a 103.5 kHz bandpass filter, a quadrature detector, a lowpass filter and an audio frequency amplifier.

The IF amplifier, detector and AF amplifier are all included in one integrated circuit.

The balanced quadrature detector has excellent AM suppression and contains only one tuned circuit. Inserted between the detector and the AF amplifier is an active lowpass filter which removes any superimposed IF signal. The detector bandwidth and the audio amplifier output voltage can be regulated by means of two external resistors on the mother board (AF output at 1000 Hz = 110 mV.)

LF Amplifier AA801

The audio frequency signal from IA802 is fed to the AA801 AF Amplifier where it becomes amplified to the desired audio power level. First the signal passes through an active high-pass filter that rejects any low noise frequencies. Next comes an integration network which gives the required de-emphasis. An integrated circuit containing two separate amplifiers makes up the amplifier and output stages. The volume control is inserted between these two amplifiers.

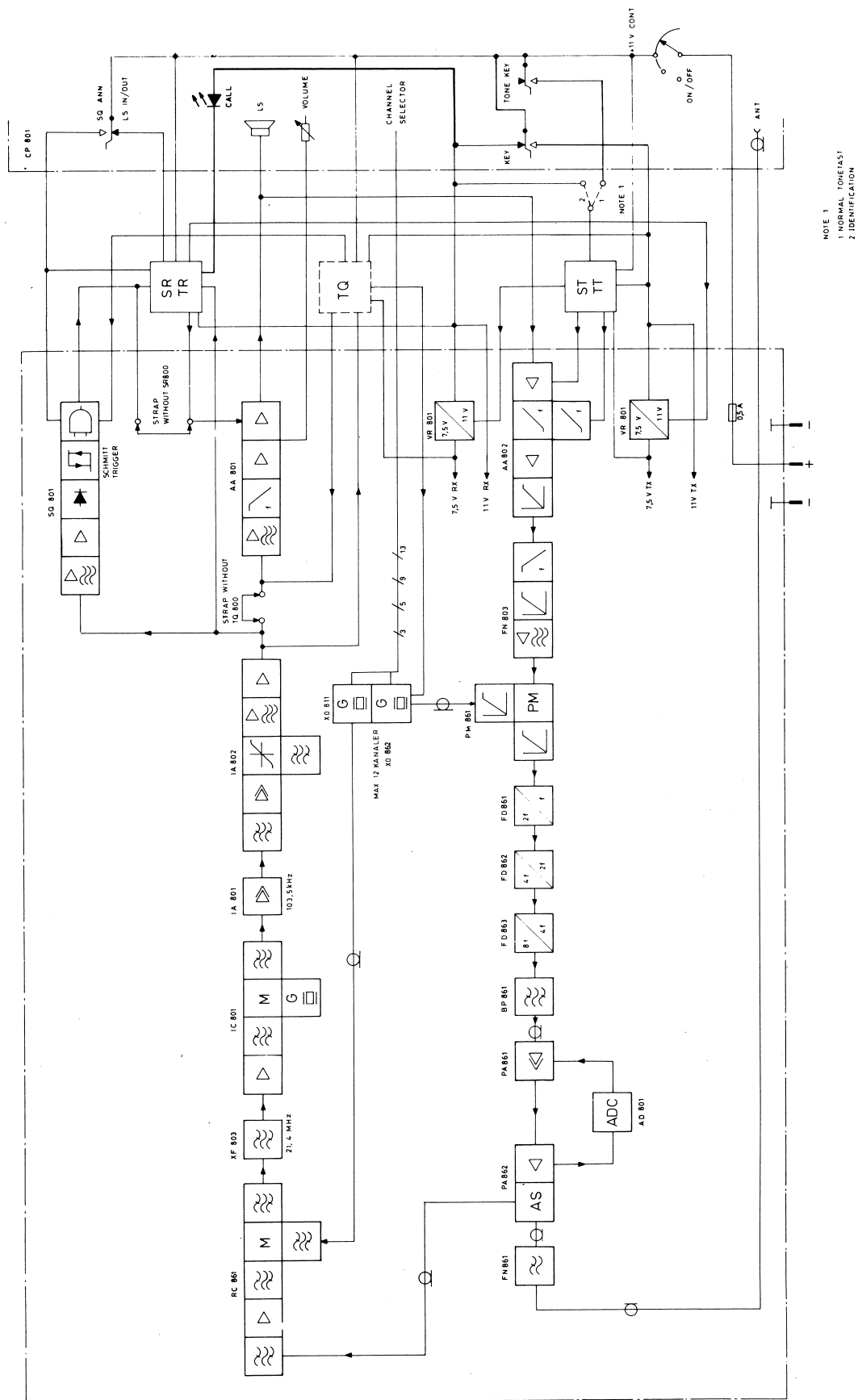
The Squelch Circuit can block the AF signal path by grounding the squelch terminal (5). When the squelch output goes positive again, the audio amplifier will operate normally.

Squelch Circuit SQ801a

The receiver Squelch Circuit operates automatically, according to the noise content of the antenna signal. Weak signals contain greater noise than acceptable signal levels. The output AF signal from IA802 is also present at the input to SQ801a, where it must first pass through an active highpass filter that suppresses frequencies under 7 kHz. Higher frequencies become amplified, then detected and whenever the signal-to-noise ratio is objectionable, the detected noise signal will be sufficient to turn off the audio amplifiers by depriving them of their collector voltage. With an acceptable signal strength at the antenna, the noise content will be too low to trigger the squelch, and the positive collector supply ($+V_{cc}$) will be available to the audio amplifiers, allowing them to operate normally. An external resistor sets the squelch to open the path for a signal-to-noise ratio of ≥ 12 dB SINAD. A pushbutton on the control head allows manual cancelling of the squelch function.

Power Supply and Voltage Regulator VR801

Because of variations in the battery voltage as the battery discharges, two VR801 type Voltage Regulators are employed to supply many of the transmitter and receiver circuits in the CQP800 with a constant 7.5 V potential. The regulators are short circuit protected.



BLOCK DIAGRAM CQP860

ADJUSTMENT PROCEDURE CQP860

The following measuring instruments are required for tracing faults in and making adjustments to the transmitter/receiver circuits:

Control Unit C35	code 95B0363, including
Test cable	code 19B0027
Test cable adaptor	code 41.0206
Antenna connector adaptor	code 41.0201
RF Test probe	code 95.0059
DC ampere meter	10mA/100mA/1A
DC Voltmeter	$Z_{in} = > 0,5 \text{ M}\Omega$
AC Voltmeter	$Z_{in} = > 2\text{M}\Omega // 50\text{pF}$
FM signal generator	420 - 470 MHz
AF generator	$Z_{out} = 600 \Omega$
RF Wattmeter	0 - 2 W
Modulation meter	
Distortion meter	
Oscilloscope	
Power supply	0 - 20V/1A Preset current limiter 0-0,5 A
Frequency counter	

OPERATING CONTROL UNIT C35

The control unit and test cable C35 are designed for testing and adjusting STORNOPHONE 800.

The instruments connect to the unit and remain connected during procedure.

The front panel of the unit is divided into three parts.

1. The **TEST CONTROLS** are used to control the radio circuits.
2. The **BFO** is a 21,4 MHz crystal controlled oscillator.
3. The **INSTRUMENT TERMINAL** is used for measuring instrument connections.

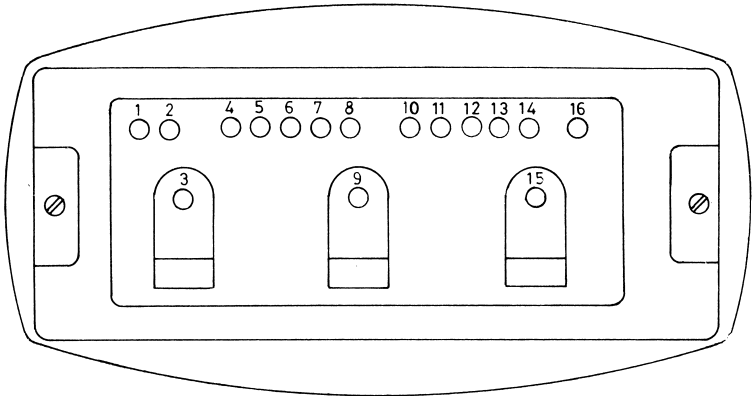
Connections on the rear panel.

TEST PLUG	34-way connector for the test cable.
POWER SUPPLY	Jacks for power supply.
CURRENT MONITOR	Jacks for current monitor.

Connections on the front panel.

RF PROBE	Jacks for RF probe
DCVM	Jacks for DC voltmeter
AF PROBE	BNC connector for AF probe. Probe consist of shielded leads to be connected whenever measuring of audio is desired.
DEVM(AF)	BNC connector for the AF output of the deviation meter
ACVM	BNC connector for AF voltmeter, distortion meter and oscilloscope.
MOD INPUT	BNC connector for AF generator.
Toggle switches	
SQ OFF	Disables the squelch circuit of the receiver (loudspeaker continuously open).
KEY	Switches the transmitter on, the receiver off, and connects the AF generator input jack (J13) to the LS/MICR switch.
TONE KEY	Transmitter key for radio sets with tone transmitter.
RX GATE	Switches the receiver's + 7,5 V on/off.
TX GATE	Switches the transmitter's + 7,5 V on/off.
ON-OFF	21,4 MHz crystal controlled BFO on/off.

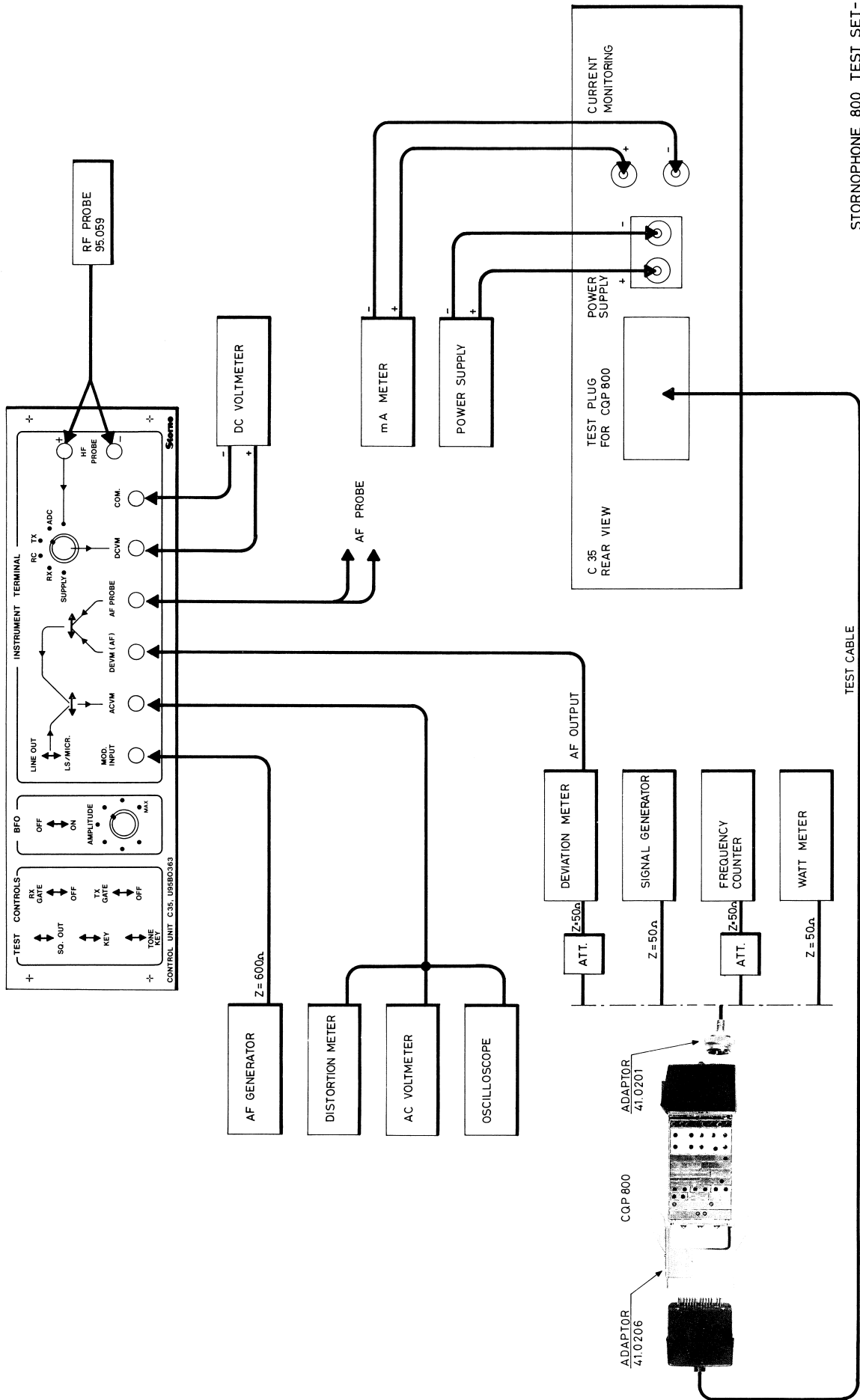
LINE OUT	Switches the AC voltmeter	Test Point	Function
LS/MICR	between the receiver line output and the loudspeaker/microphone.	1	+ 7,5 V TX stabilized
ACVM	Switches the AC voltmeter between	2	+ 7,5 V RX regulator gate
switch	the LINE OUT - LS/MICR switch and DEVM (AF) - AF PROBE switch.	3	DC ground (connected to point 15)
DEVM (AF)	Switches the AC voltmeter input	4	ADC voltage
switch	between the deviation meter and the AF probe.	5	Audio output - microphone input
DCVM	6-position DC voltmeter switch.	6	Tone Key
switch	1. SUPPLY Voltage.	7	+ 7,5 V TX regulator gate
	2. RX + 7,5 V stabilized RX voltage.	8	+ V _B Battery voltage measured after the fuse.
	3. RC Receiver converter test point.	9	+ 11 V Battery
	4. TX + 7,5 V stabilized TX voltage	10	+ 11 V TX
	5. ADC voltage	11	+ 7,5 V RX stabilized
	6. RF PROBE	12	Squelch disable
		13	Receiver converter test point
		14	21,4 MHz BFO signal input
		15	DC ground (connected to point 3)
		16	Discriminator and Receiver line output
AMPLITUDE	BFO output attenuator		



BOTTOM VIEW

CQP800 Test Point Location
Bottom View

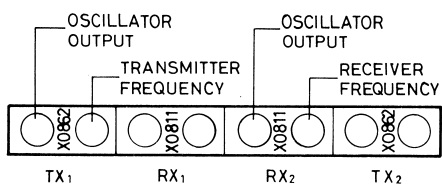
C 35
FRONT VIEW



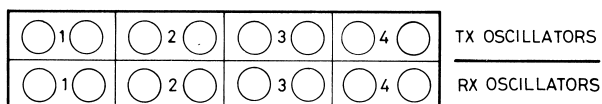
STORNOPHONE 800 TEST SET-UP

D402.093

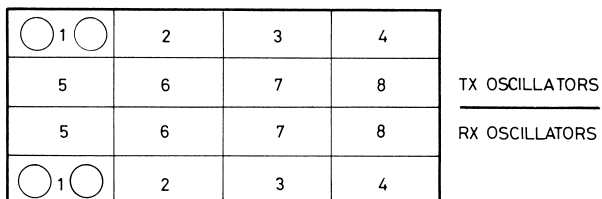
LOCATION OF OSCILLATORS



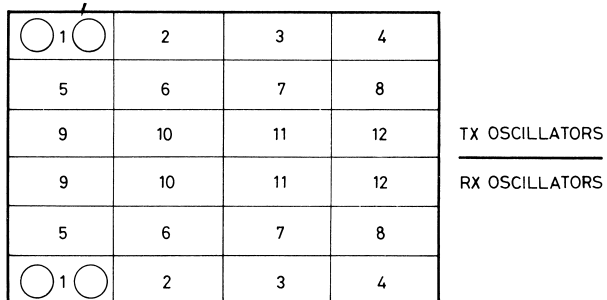
2 CHANNELS (CH803)



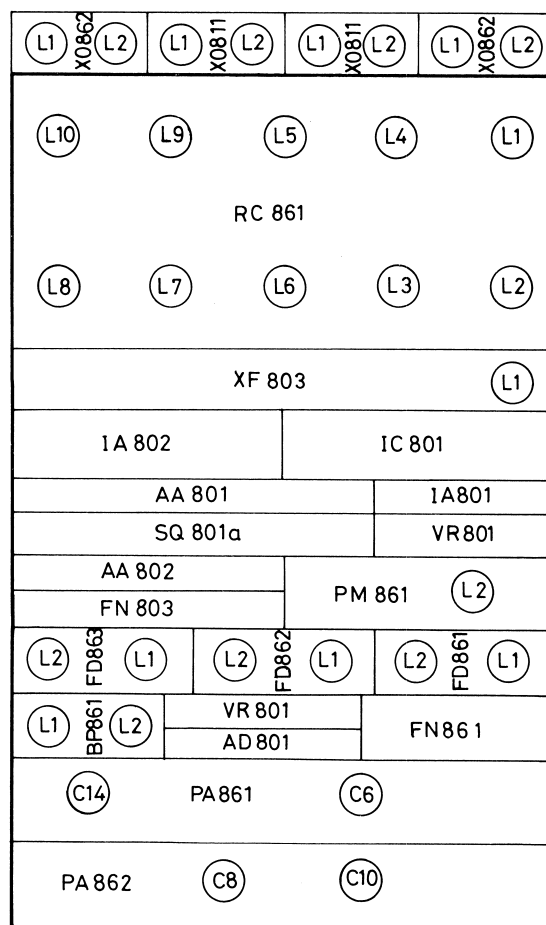
4 CHANNELS (CH804)



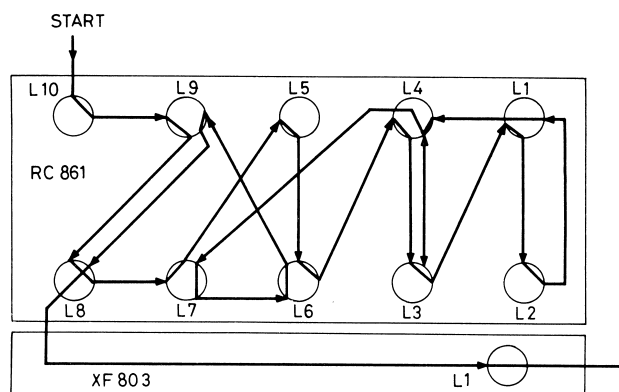
8 CHANNELS (CH 805)



12 CHANNELS (CH806)



CQP 860



RC 861 L7, L9, L10 : Maximum voltage (Vgs)
L1, L2, L3, L4, L5, L6, L7 : Maximum sensitivity
L8 : Minimum distortion.

XF 803 L1 : Minimum distortion.

TRANSMITTER ADJUSTMENT

For location of components see page 10.

Before starting adjustment of the transmitter, check the resistor (R6) located between pin 4 and 6 of AD801.

6,8 k Ω for 0,1 to 0,5 W output power

4,7 k Ω for 1,0 W output power

A second resistor R7 is paralled with R6 for fine adjustment of the output power.

Checking Supply Voltage and Current Drain

1. Select the channel closest to the center frequency, if more than one.
Set the DCVM switch to **SUPPLY**.
Connect a wattmeter to the antenna connector.
Adjust the power supply to 11 V.
Set the current limiter to 0,5 A.
2. **KEY** the transmitter.
Read the current drain on the mA meter.
Current drain without output: approx. 70 mA.
Current drain with output: < 400 mA.
3. Unplug the oscillator and read the current drain.

Requirement: < 70 mA.

4. Set the DCVM switch to **TX**.
Read the TX stabilized voltage.

Requirement: 7,5 V \pm 0,15 V.

Crystal Oscillator Output Adjustment.

5. Set the DCVM switch to **RF PROBE**.
KEY the transmitter.
Connect the RF probe to pin 2 on PM861 and hold the probe's metal housing against chassis.
Adjust L1 in XO862 for maximum DC voltage, approx. 0,8 V.
Repeat the adjustment on all channels.

Adjustment of Frequency Multipliers and Power Amplifiers.

Select center transmitting channel, if more than one.

Set the tuning slugs in PM861, FD862, FD863, and BP861 to the approximate position.

High frequency (> 445 MHz) = upper position

Low frequency (< 445 MHz) = lower position

Medium frequency (\sim 445 MHz) = middle position.

KEY the transmitter.

6. Adjust the following coils and capacitors for maximum current drain using an insulated trimming tool:

L1 and L2 in FD861

L1 and L2 in FD862

L1 and L2 in FD863

L1 and L2 in BP861

C6 and C14 in PA861

Adjust C8 and C10 in PA862 for maximum power output.

7. Set DCVM switch to **ADC**.
Adjust L1 and L2 in FD861 for minimum ADC voltage.
Adjust L1 and L2 in FD862 for minimum ADC voltage.
Adjust L1 and L2 in FD863 for minimum ADC voltage.
Adjust L1 and L2 in BP861 for minimum ADC voltage.
Adjust C6 and C14 in PA861 for minimum ADC voltage.
Adjust C8 and C10 in PA862 maximum power output.
Repeat the adjustments under 6 for minimum ADC voltage and maximum power output until no further improvement is obtainable.

Check the power output on all channels.

To increase the power output a resistor (R7) may be connected in parallel with R6 (see page 10).

Read the ADC voltage.

Requirement: 4 V to 10 V.

Typical ADC voltage at 1 W: 5 V.

8. Read the total current drain.

Requirements:

0,5 W power output: approx. 220 mA.

1,0 W power output: approx. 380 mA.

Transmitter Frequency Adjustment

9. Connect a frequency counter through an attenuator to the antenna connector.
Set the **KEY** switch down.
Adjust L2 in XO862 to the channel frequency.
Repeat the adjustment on all channels.
Requirement at 25°C: $\pm 0,5 \times 10^{-6}$.

Checking and adjustment of Modulator.

10. Connect the deviation meter through an attenuator to the antenna connector.
Set the **DEV(M)AF** - **AF PROBE** switch to **DEV(M)AF**.

Set the **ACVM** switch to **DEV(M)AF**

Short circuit resistor combination R10//R11 see page 10.

KEY the transmitter.

Set the **AF** generator to 1000 Hz and adjust the output to give a transmitter frequency deviation of approx. ± 3 kHz.

The output should be below clipping level as seen at the **AF** output of the deviation meter.

Adjust L2 in PM861 for minimum distortion.

Remove the short circuit R10//R11.

11. Set the tone generator output to 30 mV.
Check that Δf_{max} is not exceeded at frequencies between 300 Hz and 3000 Hz.
If necessary adjust R11//R10. (see fig. page 11).
Set the generator output to $0,7 \times \Delta F_{\text{max}}$ at 1000 Hz.
 $\pm 3,5$ kHz for 25 kHz channel spacing.
 $\pm 2,8$ kHz for 20 kHz channel spacing.
Check the total harmonic distortion on the output of the deviation meter.

Requirement: THD < 7% (without de-emphasis)

RECEIVER ADJUSTMENT

For location of components see page 10.

Supply voltage and current drain.

Before making adjustments to the receiver circuits check the discriminator bandwidth resistor between pin 1 and pin 3 of IA802.

CQP863 - R3 = 5,6 kΩ

1. Set the **DCVM** switch to **SUPPLY**
Adjust the power supply to 11 V.
Set the current limiter to 0,1 A.
2. Read the current drain.

$I_{\text{total}} : < 100 \text{ mA}$

3. Set the **DCVM** switch to **RX**.
Read the stabilized **RX** voltage.
Requirement: $7,5 \text{ V} \pm 0,15 \text{ V}$

Adjustment of Receiver Converter

4. Set the trimming slugs of L1, L2, L3, L4, L5, and L6 in RC861 to the outer position.
Set the slugs of L7, L8, L9, and L10 to the middle position.
Set the **DCVM** switch to **RC**.

NOTE: The helix circuits are sensitive to the adjustment tool.

Remove the tool before measuring the result of turning the slugs.

Adjust L1 in all receiver oscillators (XO811) for maximum DC voltage.
 Set the channel selector to the channel closest the center frequency, if more than one.
 Adjust L10 in RC861 for maximum DC voltage.
 Adjust L9 in RC861 for maximum DC voltage.
 Adjust L7 in RC861 for maximum DC voltage.
 When stopping the oscillator the DC voltage should fall at least 0,1 V.

5. Set the signal generator to the receiver frequency.
 Modulate the generator with 1 kHz to a frequency deviation of $0,7 \times \Delta f \text{ max.}$
 - $\pm 3,5 \text{ kHz}$ for 25 kHz channel spacing.
 - $\pm 2,8 \text{ kHz}$ for 20 kHz channel spacing.

Set SQ OUT switch down.

Set LINE OUT - LS/MICR down.

Set ACVM switch to LS/MICR.

Adjust the signal generator output to 12 dB SINAD.

Turn the volume switch to the 3rd position. (approx. 0,5 V on the ACVM, no clipping).
 As the receiver sensitivity increases during the adjustment, the signal generator output must be reduced to maintain 12 dB SINAD.

Adjust L8 in RC861 best signal to noise ratio.

Adjust L7 in RC861 for best signal to noise ratio.

Adjust L5 in RC861 for best signal to noise ratio.

This is the ONLY adjustment of L5.

The following coils are adjusted for best signal to noise ratio in this order:

L6, RC861

L4, RC861

L3, RC861

L1, RC861

L2, RC861

L1, RC861

L3, RC861

L4, RC861

Readjust L7 in RC861 for maximum DC voltage.

Readjust L6 in RC861 for best signal to noise ratio.

Readjust L9 in RC861 for maximum DC voltage (2-3 V).

6. Set the signal generator output to approx. $100 \mu \text{V e.m.f.}$
 Adjust L8 in RC861 and L1 in XF803 for minimum distortion.

Receiver sensitivity measurement.

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 output power with 12 dB signal + noise + distortion to noise + distortion.

Method of measurement.

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

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

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

In practice our first condition is achieved by feeding a minimum of $1000 \mu \text{V}$ of RF-signal modulated with 1000 Hz at $0,7 \times \Delta f \text{ max.}$ to the receiver.

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

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

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

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

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

7. The sensitivity must be minimum $1,0 \mu V$ e.m.f.
Typical value: $0,7 \mu V$ e.m.f.
Changing the supply voltage from 9,6 V to 15 V should not influence the sensitivity obtained at 11 volt.
If more than one channel is provided, the sensitivity check should be repeated on all channels.

Oscillator Frequency Adjustment

8. Set the signal generator to the receiver frequency using the frequency counter.
Remove the signal generator modulation and set the output to approx. $100 \mu V$ e.m.f.
Turn the BFO on.

Adjust BFO AMPLITUDE to produce a clear beat tone.
Set ACVM switch to LINE OUT.
Adjust L2 in XO811 for zero beat as seen on the oscilloscope.
If more than one channel is provided the adjustment should be repeated on all channels.
When adjustments are completed, turn the BFO OFF.

Checking Receiver Line Voltage

9. Modulate the signal generator with 1 kHz and $0,7 \times \Delta f$ max.
 $\pm 3,5$ kHz for 25 kHz channel spacing.
 $\pm 2,8$ kHz for 20 kHz channel spacing.
Set the signal generator output to $100 \mu V$ e.m.f.
Switch the ACVM to LINE OUT.
Read the AF Line voltage.
Requirement: $110 mV \pm 3 dB$.
If necessary connect a resistor in parallel with R2 (IA802, pin 5-6) until 110 mV is obtained.
The graph page 9 indicate the value of the resistor, which should be the closest higher standard value.

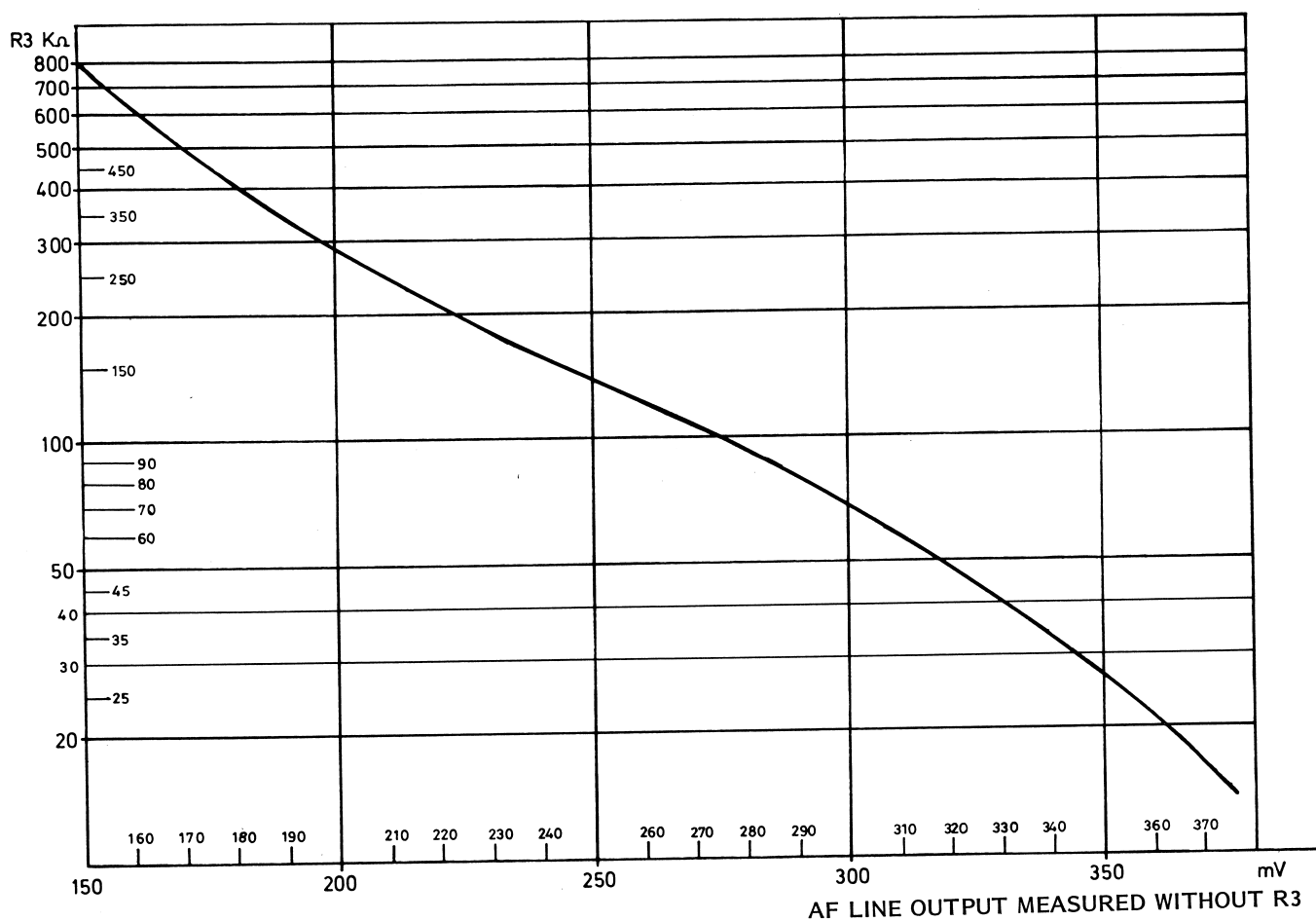
Checking the AF Frequency Response.

10. Set the signal generator output approx. to $100 \mu V$ e.m.f.
Set LINE OUT - LS/MICR switch down.
Turn the volume switch to the 4th position.
Read the AF voltage on the ACVM (reference)
Set the modulation frequency to 300 Hz.
AF voltage: -10 ± 2 dB rel. to 1000 Hz.
Set the modulation frequency to 3000 Hz.
AF voltage: $+10 \pm 2$ dB rel. to 1000 Hz.
11. Turn the volume switch to the 5th position.
Check the total harmonic distortion at 1000 Hz.
Requirement: THD = $< 7\%$

Adjustment and Checking the Squelch function.

12. Set the volume to the 5th position.
Set the SQ OUT switch up.
Increase the signal generator output until the squelch circuit opens the signal path.
Requirement: 10 to 12 dB SINAD.

Decrease the value of R4 if SINAD is less than 10 dB.
Increase the value of R4 if SINAD is more than 12 dB.



Checking the Overall Receiver Current Drain.

13. Set the DCVM switch to **SUPPLY**.

Set the supply voltage to 11 V.

Disconnect the signal generator.

Read the current drain on the mA meter.

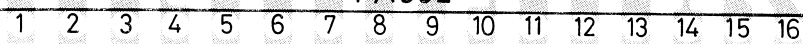
Requirement: < 9,5 mA.

Set the **SQ OUT** switch down.

Set the volume switch to the 5th position.

Read the current drain.

Requirement: < 70 mA.



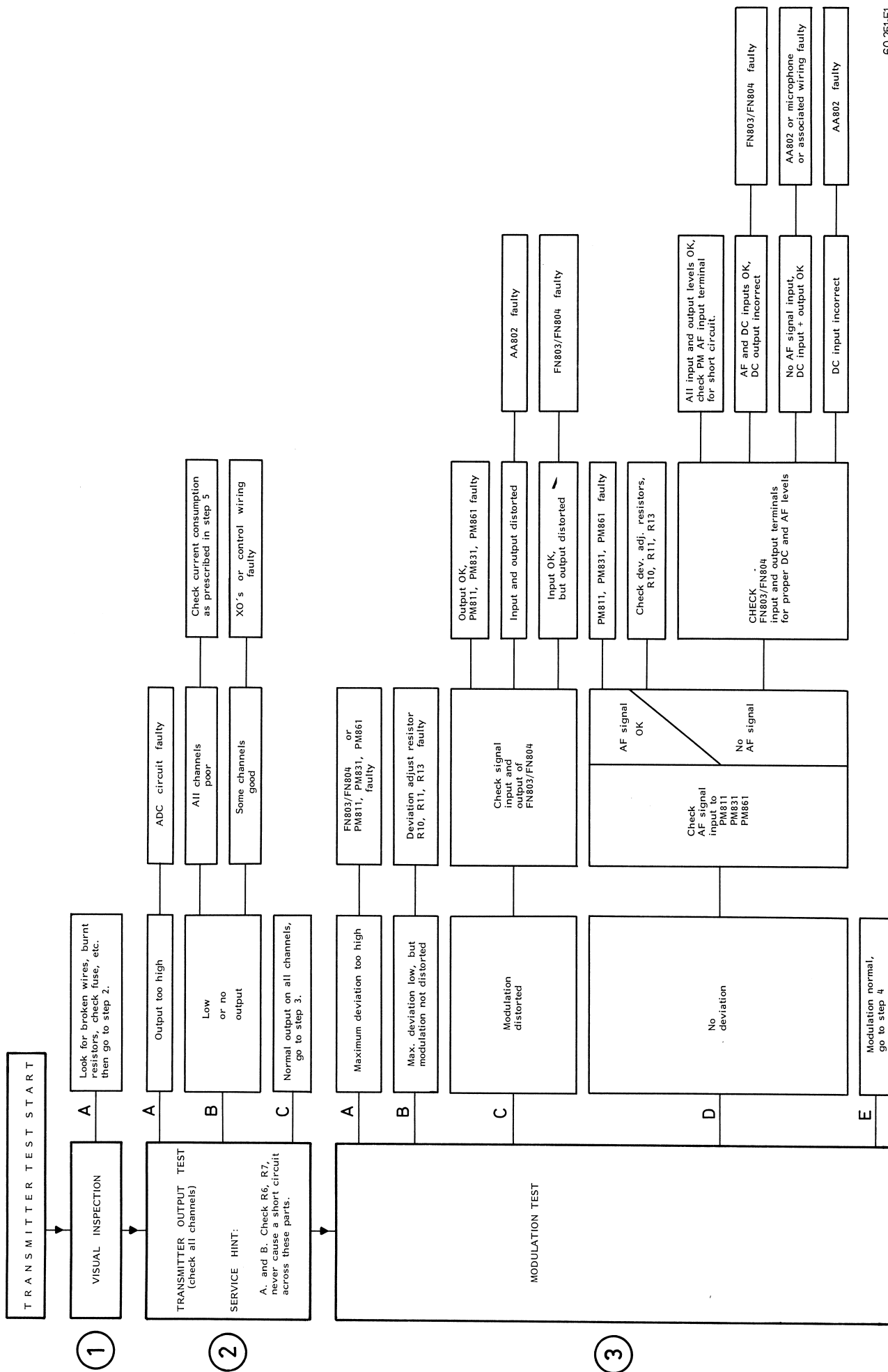
SUMMARY TRANSMITTER ADJUSTMENT CQP860

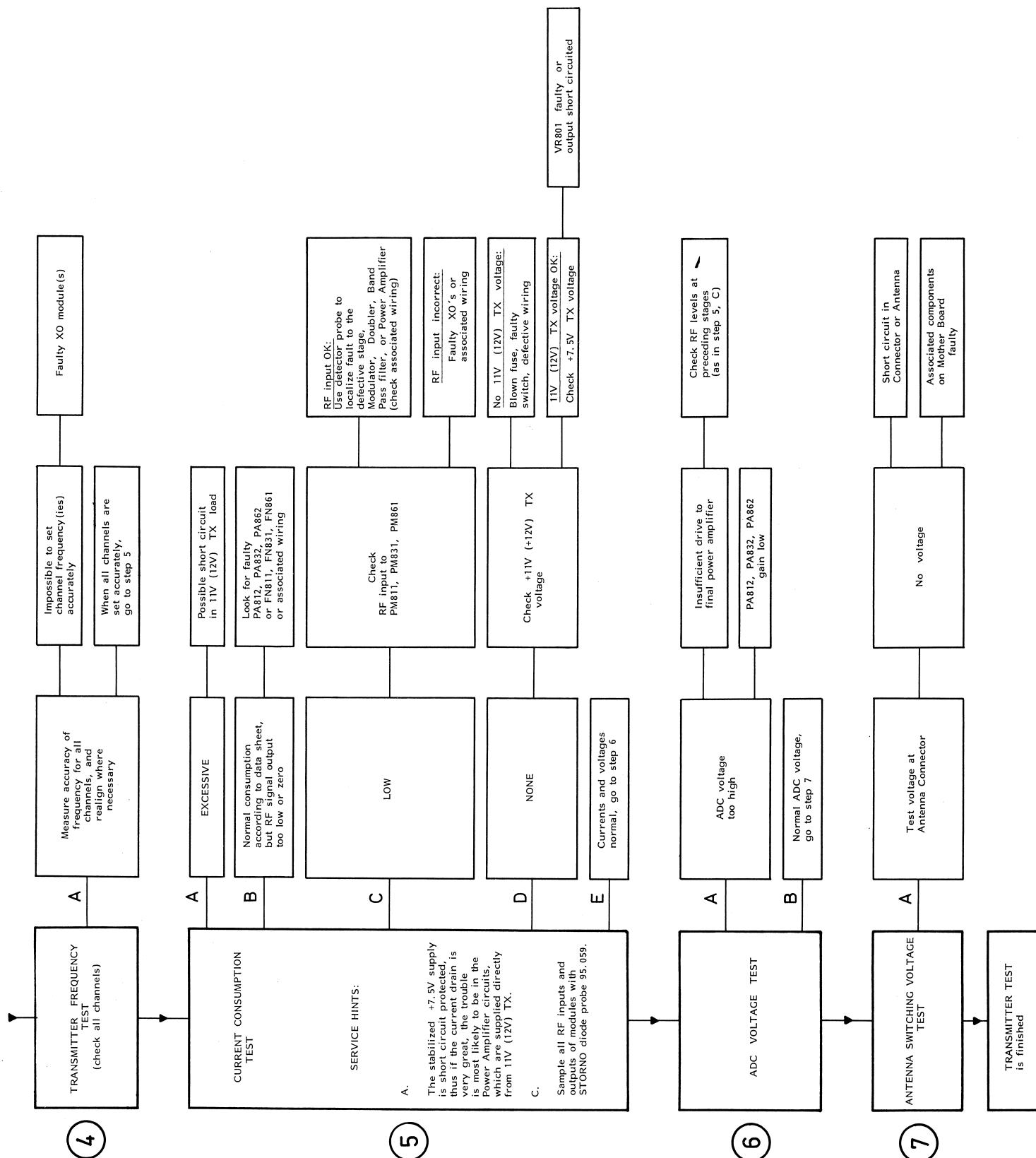
	TEST	ADJUST	INSTRUMENT	READING
1	Supply Voltage	Power supply	Voltmeter	11 V
2	Current drain	Check	mA meter	70 - 400 mA
3	Current drain without oscillator	Check	mA meter	< 70 mA
4	+ 7,5 V TX	Check	Voltmeter	+ 7,5 V \pm 0,15 V
5	Oscillator output	XO862 - L1	95.059 + VM	maximum
6	Current drain	FD861 - L1, L2 FD862 - L1, L2 FD863 - L1, L2 BP861 - L1, L2 PA861 - C6, C14	mA meter	maximum
7	Power output ADC voltage	FD861 - L1, L2 FD862 - L1, L2 FD863 - L1, L2 BP861 - L1, L2 PA861 - C6, C14 PA862 - C8, C10	Wattmeter Voltmeter	maximum power output 0,5 - 1,0 W minimum ADC voltage 4 - 10 V
8	Current drain	Check	mA meter	0,5W - app. 220mA 1,0W - app. 380mA
9	Frequency	XO862 - L2	Frequency counter	$f_{ant} \pm 0,5 \times 10^{-6}$
10	Modulator	PM861 - L2	AF Generator Deviation meter Distortion meter	minimum distortion
11	30 mV AF input	R11 - R10	AF Generator Deviation meter Distortion meter	0,7 x ΔF max. THD = < 7%

SUMMARY RECEIVER ADJUSTMENT CQP860

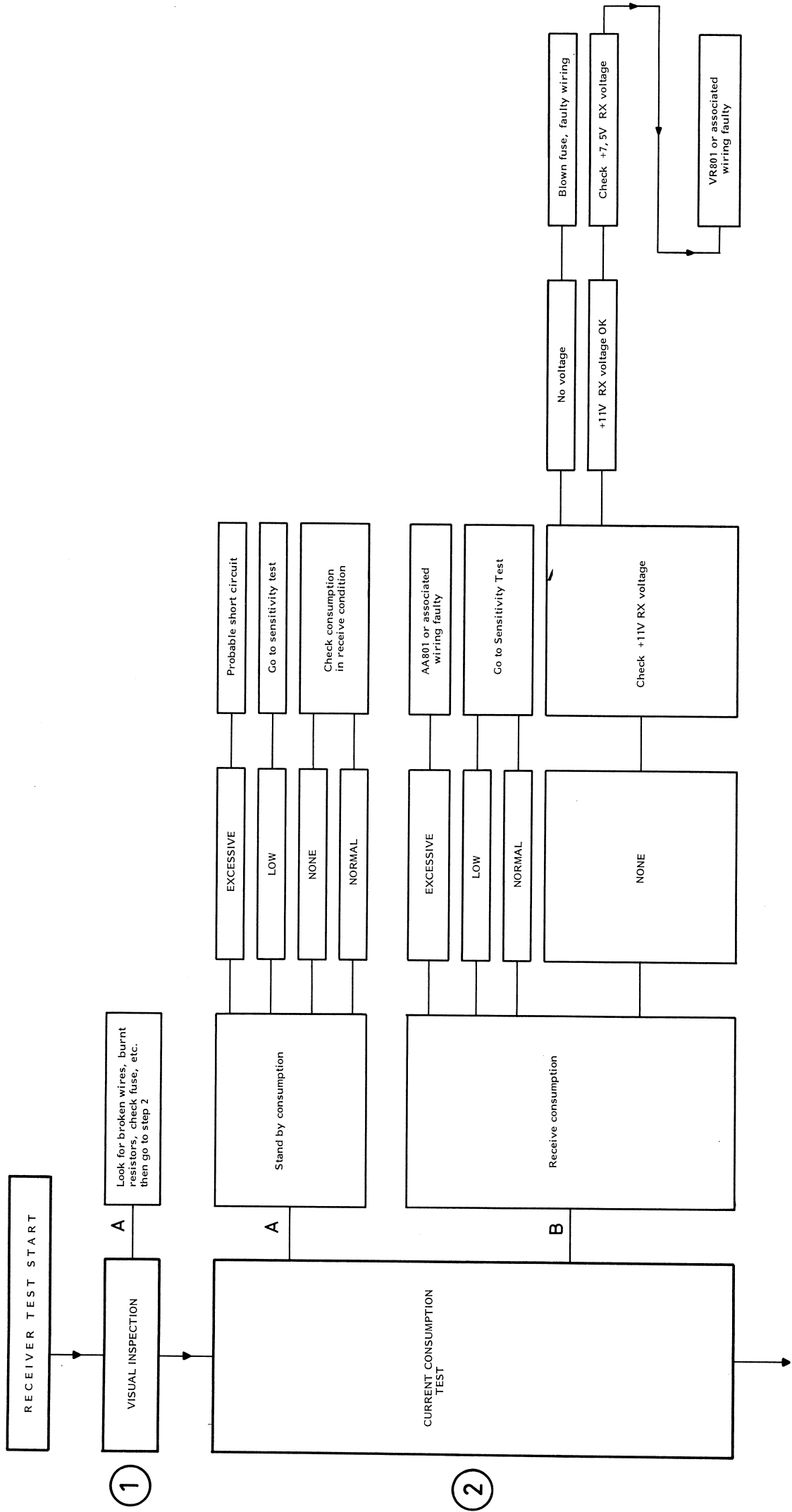
TEST	ADJUST	INSTRUMENT	READING
1 Supply voltage	Power supply	DC voltmeter	11 V
2 + 7,5 V RX	Check	Voltmeter	+ 7,5 V \pm 0,15 V
3 Current drain	Check	mA meter	< 100 mA
4 RC test point without oscillator	XO811 - L1 RC861 - L10, L9, L7	DC voltmeter	maximum - 0,1 V
5 Receiver sensitivity	RC861 - L8, L7, L5 L3, L4	RF Generator Distortion meter	minimum distortion
	L7, L9 L6	DC voltmeter Distortion meter	maximum minimum
6	RC861 - L8 XF800 - L1	RF Generator high output	minimum distortion
7 Sensitivity	Check		12 dB SINAD < 1,0 μ V e.m.f.
8 Frequency	XO811 - L2	RF Generator 21,4 MHz BFO oscilloscope	zero beat
9 Line output	IA802 (R3)	RF Generator (high output) AC voltmeter	110 mV AF
10 AF response	Check	RF Generator (high output) AC Voltmeter	300 Hz: -10 \pm 2 dB 1000 Hz: 0 dB 3000 Hz: + 10 \pm 2 dB
11 Distortion	Check	Distortion meter	THD = < 7%
12 Squelch	R4	RF Generator	opens at 10 - 12 dB SINAD
13 Current drain	Volume to 5.	mA meter	no signal; Sq. off < 9,5 mA no signal; sq. on < 70 mA

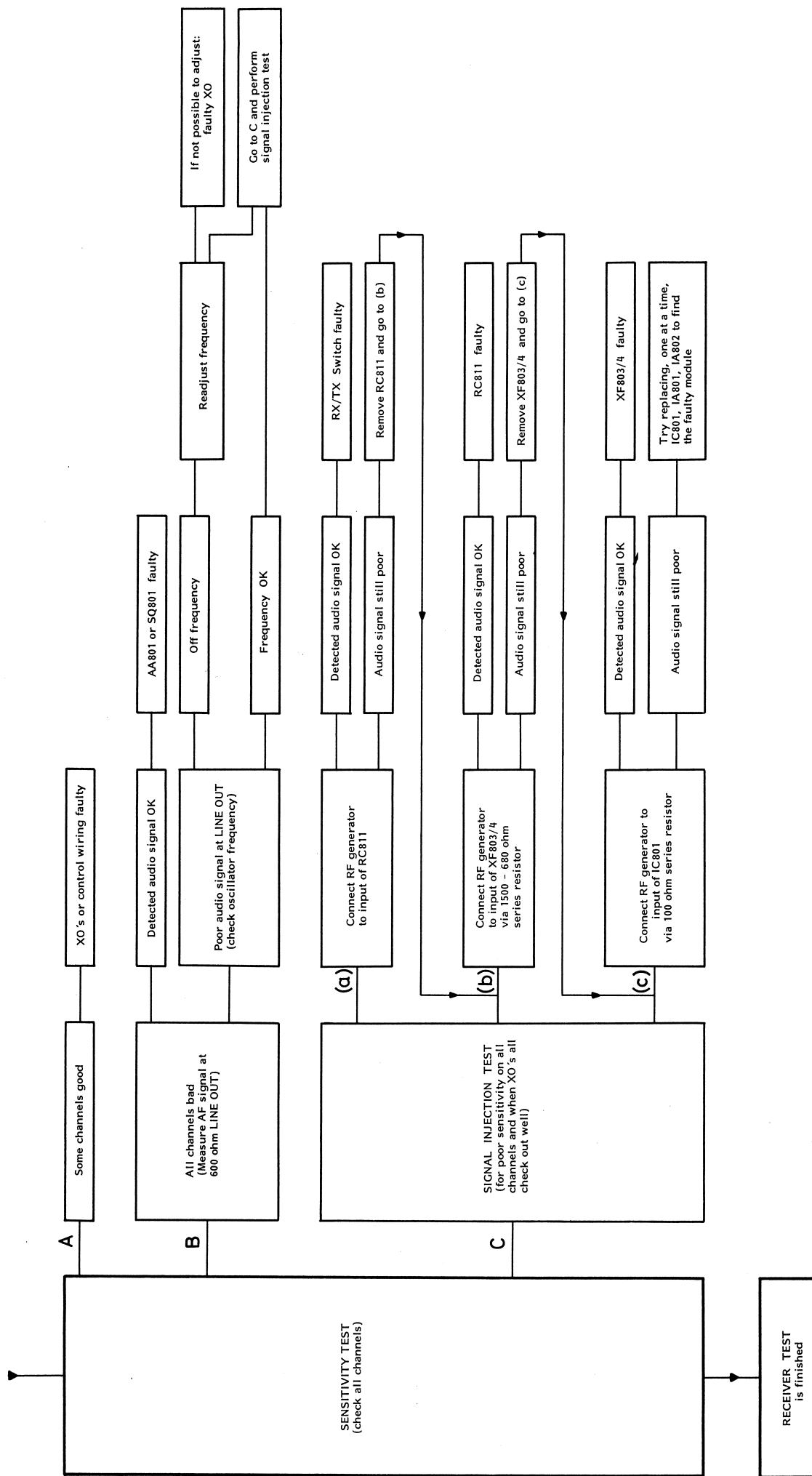
TROUBLESHOOTING SEQUENCE FOR CQP 800
TO LOCALIZE FAULTS TO THE DEFECTIVE MODULE

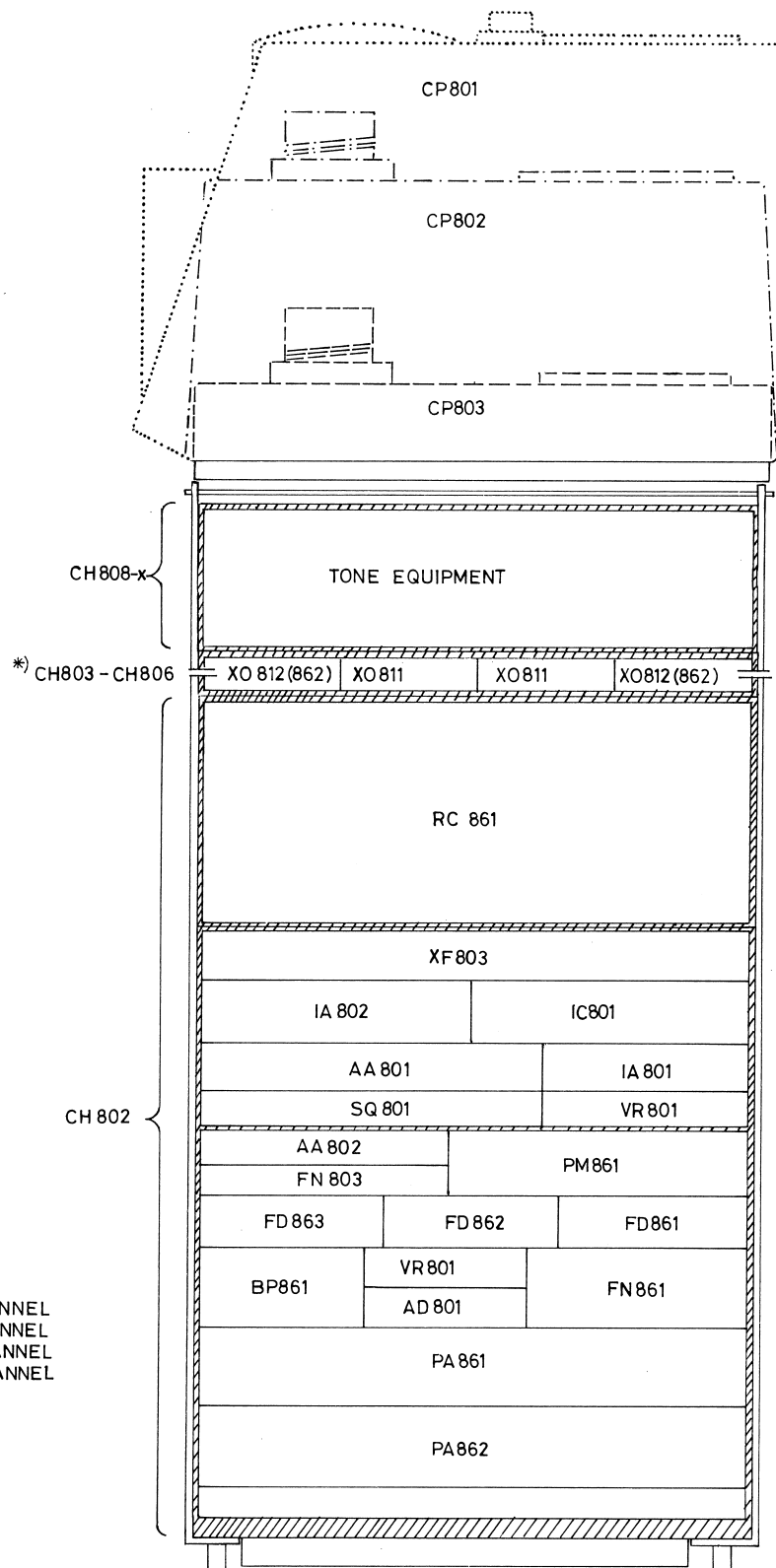




TROUBLESHOOTING SEQUENCE FOR CQP800
 TO LOCALIZE FAULTS TO THE DEFECTIVE MODULE

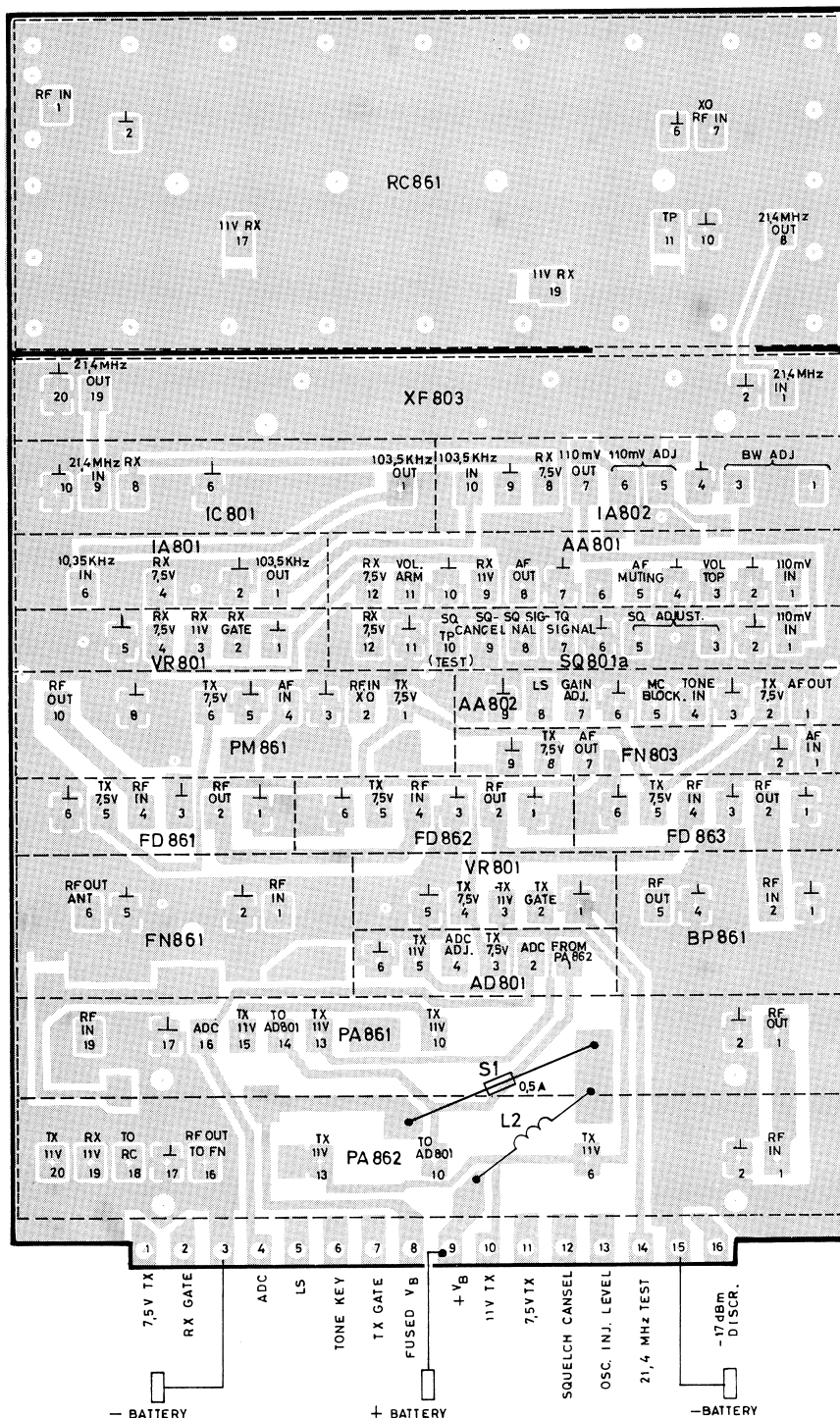




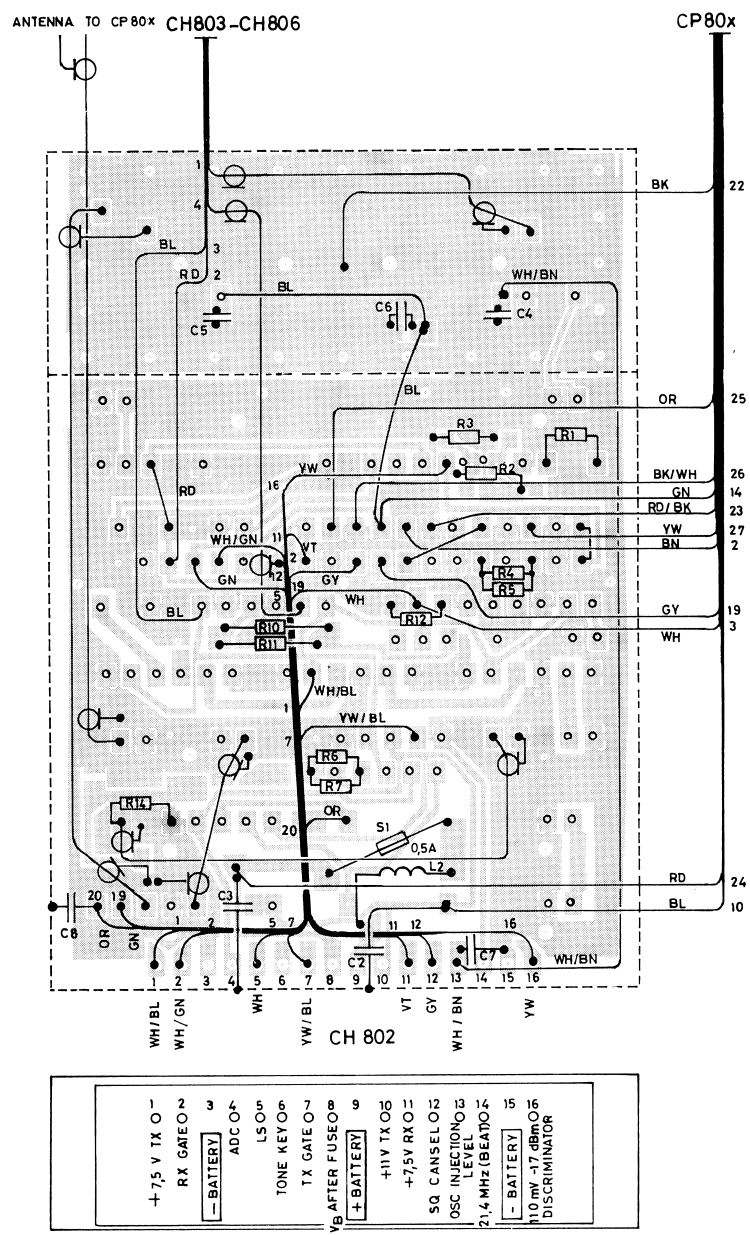


*) CH803 = 2 CHANNEL
CH804 = 4 CHANNEL
CH805 = 8 CHANNEL
CH 806 = 12 CHANNEL

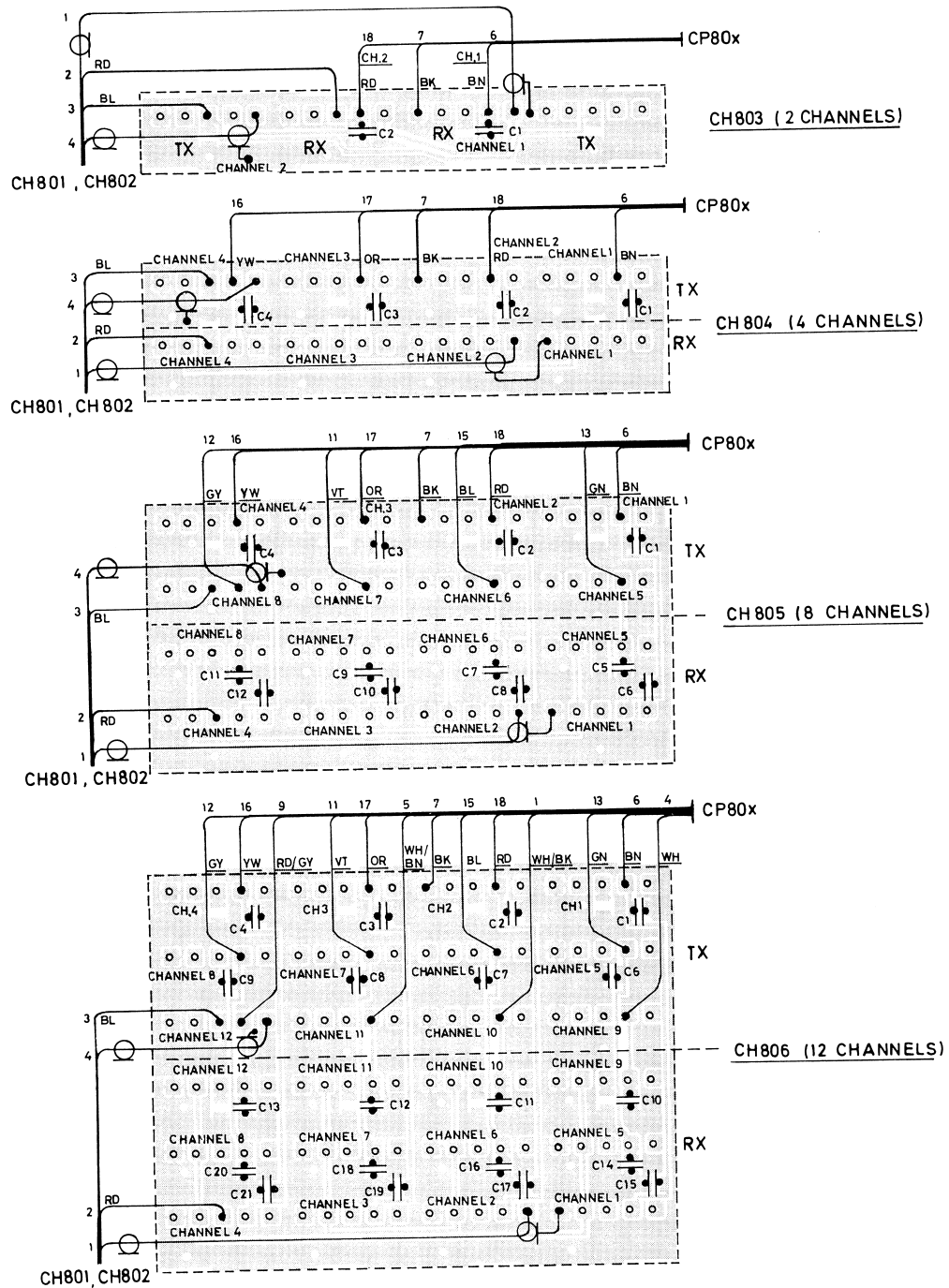
MODULE LOCATION CQP860



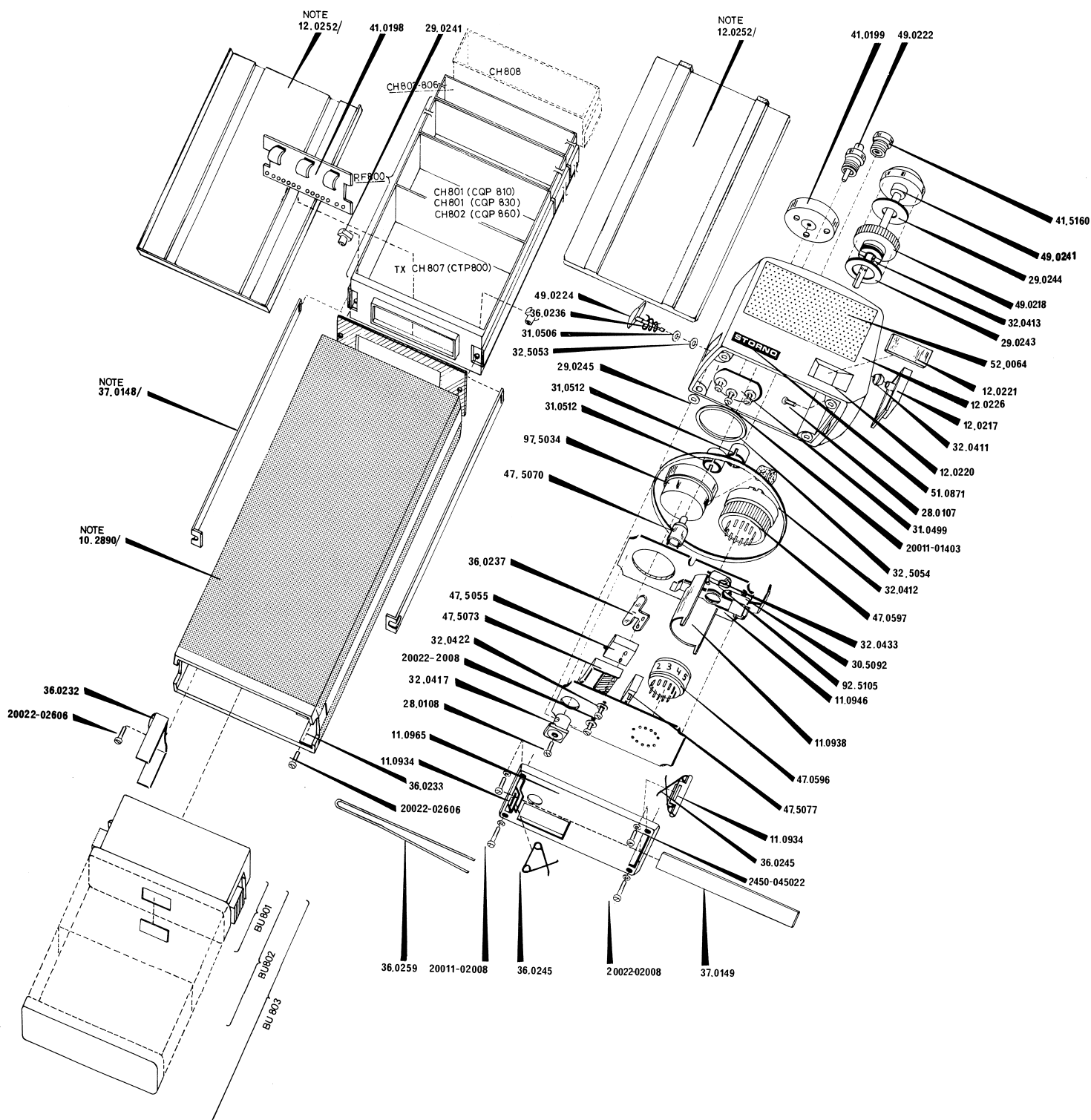
PIN LOCATION CQP860



WIRING DIAGRAM CQP860











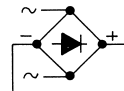



































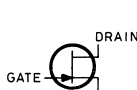





WIRING DIAGRAM CH803, CH804, CH805, CH806



STORNOPHONE 800

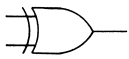
MECHANICAL LAYOUT AND SPARE PART NUMBERS

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

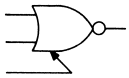
<div>Resistors (R)</div> <div><div>Resistor</div><div>Resistor with fixed tap</div><div>Variable resistor</div><div>Resistor with movable tap</div><div>VDR Varistor (voltage-dependent resistor)</div><div>NTC Temperature-dependent resistor with negative temperature coefficient</div><div>Light-sensitive resistor (Photosensitive resistor)</div></div>	<div>Diodes (E)</div> <div><div>Diode</div><div>Bridge rectifier</div><div>Series-connected stabilizer diodes within one case</div><div>Light-sensitive diode (Photosensitive diode)</div><div>Light-emitting diode</div><div>Zener diode (uni-directional)</div><div>Zener diode (bidirectional)</div><div>Tunnel diode</div><div>Varactor diode (capacitance diode)</div><div>Controlled rectifier, PNPN (N-thyristor)</div><div>Controlled rectifier, NPNP (P-thyristor)</div></div>	<div><div>P-channel dual gate JFET</div><div><div><div>GATE 1 GATE 2 DRAIN SOURCE</div><div>N-channel JFET tetrode</div></div><div>P-channel JFET tetrode</div><div>Insulated Gate Field Effect Transistors (IGFET or MOS)</div><div><div><div>GATE DRAIN SUBSTR. SOURCE</div><div>N-channel IGFET (MOS)</div></div><div>P-channel IGFET (MOS)</div><div><div><div>GATE 1 GATE 2 DRAIN SOURCE</div><div>N-channel dual gate IGFET (MOS)</div></div><div>P-channel dual gate IGFET (MOS)</div></div></div></div></div>
<div>Capacitors (C)</div> <div><div>Capacitor</div><div>Variable capacitor</div><div>Trimmer capacitor</div><div>Feedthrough capacitor</div><div>Electrolytic capacitor</div></div>	<div>Transistors (Q)</div> <div><div>Transistor, PNP</div><div>Transistor, NPN</div><div>Light-sensitive transistor</div><div>Unipolar transistor with N-type base</div><div>Unipolar transistor with P-type base</div></div>	<div>Integrated Circuits (IC)</div> <div><p>Several integrated circuits contained within one case are designated by one common number followed by an identifying letter (a, b, c etc.). Thus, circuits IC1a, IC1b and IC1c are contained within one case.</p><div>Gates</div><div><div>AND gate</div><div>OR gate</div><div>NAND gate</div><div>NOR gate</div></div></div>
<div>Coils (L)</div> <div><div>RF coil, air core</div><div>Coupled RF coils, air core</div><div>RF coil with core</div><div>RF coil with adjustable core</div><div>AF choke</div></div>	<div>Junction Field Effect Transistors (JFET)</div> <div><div>DRAIN GATE SOURCE N-channel JFET</div><div>P-channel JFET</div><div><div><div>DRAIN GATE GATE 2 (SUBSTR.) SOURCE</div><div>N-channel dual gate JFET</div></div></div></div>	
<div>Transformers (T)</div> <div><div>Transformer with adjustable RF cores</div><div>Transformer with iron core</div><div>Transformer with screen connected to chassis</div></div>		

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

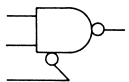
Gates, continued



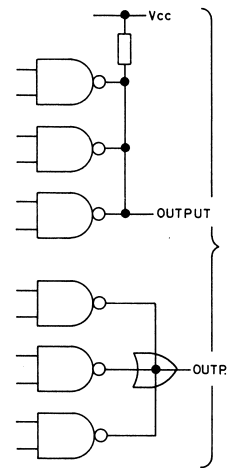
Exclusive OR gate



NOR gate with expander input (high)



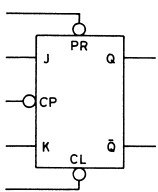
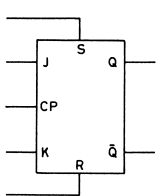
NAND gate with expander input (low)



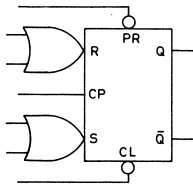
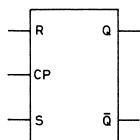
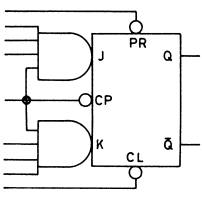
Wired OR (combined OR outputs) (presentation at top is used in detailed diagrams; presentation below is used in functional diagrams)

Flip-flops

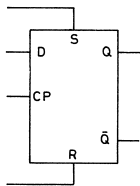
Abbreviations used: S = Set
R = Reset
CP = Clock Pulse
PR = Preset
CL = Clear



J-K Flip-flops

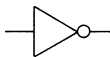


R-S Flip-flops



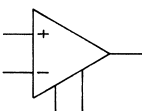
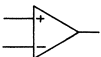
D Flip-flop

Inverters



Inverter

Operational Amplifiers



Operational amplifiers

Relays (RE)



Single-coil relay



Dual-coil relay



Relay with make contacts and change-over contacts



Relay with direction of winding indicated. Dot indicates two coils wound in the same direction



Polarized relay



Coil for slow-release relay



Coil for slow-acting relay

Contacts

Contacts are always shown in their non-operated positions unless otherwise specified



Make contacts



Break contacts



Change-over contacts



Change-over contacts, centre off



Make contacts, delayed operation



Make contacts, delayed release



Mechanically coupled make contacts

Switches and Keys (0)





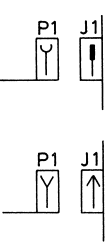
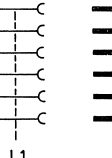
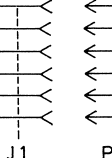
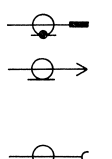







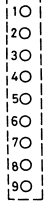
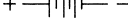






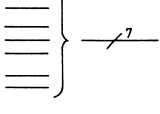















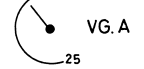
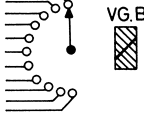
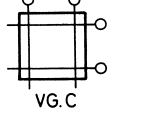


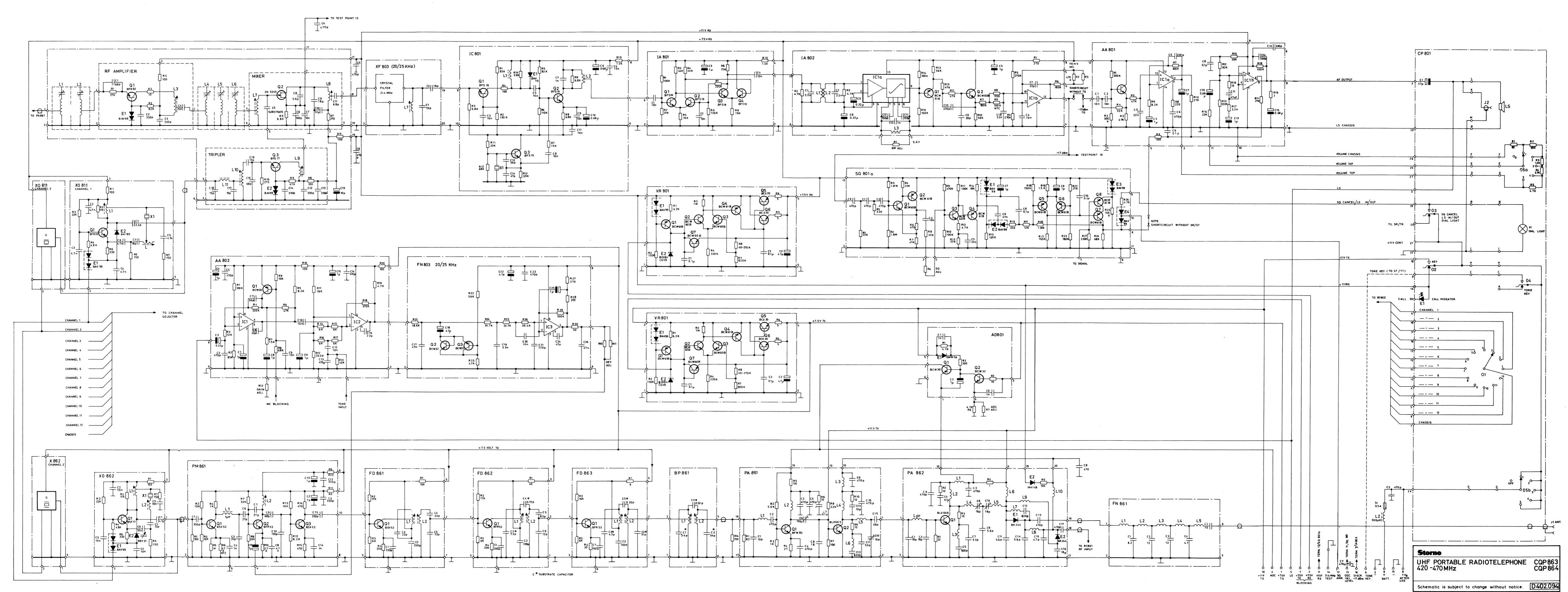
On/off switch



Rotary switch

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Lamps (V)  Indicator lamp  Neon lamp	Connectors (J and P)  Female connector (socket). Lower symbol discontinued  Male connector (plug). Lower symbol discontinued  Schematic symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)  Multi-wire connectors are always designated "J" when permanently mounted on a cabinet or unit etc., "P" when fitted to cables  Detail symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)  Where both connectors are fitted to cables, male connector is designated "P1" and female connector "J1"	Loudspeakers (LS)  Loudspeaker Telephones (TEL)  Telephone  Single headphone (earphone)  Double headphone (headset) Microphones (M) 
Fuses and Cut-outs (S)  Fuse  Circuit-breaker		
Tag Strips (KL)  Tag strip - dashed frame may be wholly or partly omitted		
Batteries (BT)  Battery		
Feedthrough Filters (F)  Feedthrough filter		
Ferrite Beads (FB)  Ferrite bead		
Crystals (X)  Crystal		
Cables and Wires (W)  Usual conductor  Three conductors  Eight conductors  Shift from multiple-line to single-line presentation  Screened wire  Coaxial cable  Coaxial plug  Coaxial socket  Coaxial plug for floating screen  Coaxial socket for floating screen  Coaxial plug with mating socket  Coaxial socket with mating plug		
		Meters etc.  Indicating instrument  Balancing instrument  Inkwriter, recording instrument
		Test Points  DC test point  AC test point
		Replaceable Connections  Cross-field connection (jumper)  Strap
		Selectors (VG)  Schematic symbol for rotary selector with designation of number of contact points  Detail symbol for rotary selector  Co-ordinate selector



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