STORNOPHONE 800
UHF PERSONAL RADIOTELEPHONE

Type CQP863
420 - 470 MHz

Spec. C2 x 8 M.O.D.

Produced by Service Coordination

2 - 76

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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) 20 dB S/N (FTZ)	 0.5 µV 0.6 µV		 0.5 µV 0.6 µV		 0.7 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

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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.

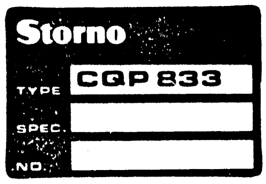
Type specification is arrived at as follows:

specification	code
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.



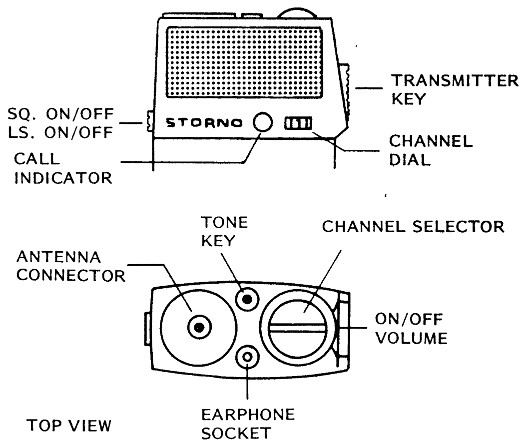
OPERATING INSTRUCTIONS

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.

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

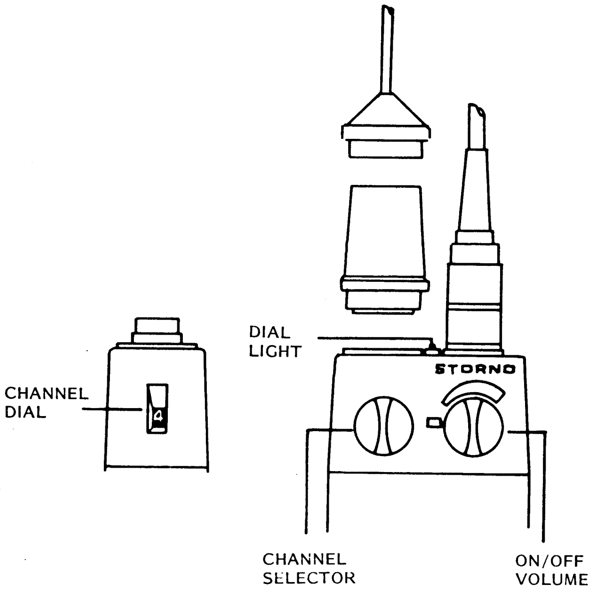
The radio set can be fitted with tone equipment which is contained in a separate panel placed between the control head and the transmitter/ receiver circuitry. Incorporating tone equipment into an existing radio set increases the total length of the unit and requires a new, longer casing. Tone signalling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

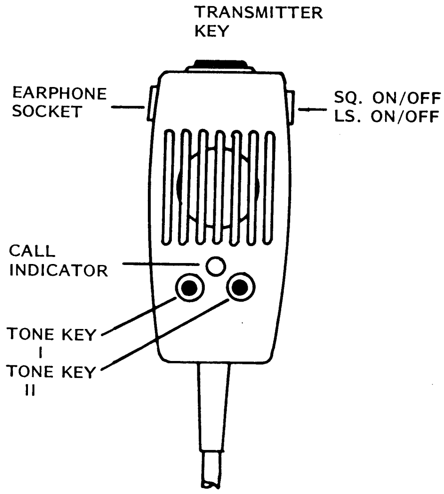
TT801	single or double tone transmitter, tone frequencies from 885 Hz to 2900 Hz
ST801	four or five tone sequential tone transmitter, tone frequencies from 885 Hz to 2800 Hz.
SR801	four or five tone sequential tone receiver, tone frequencies from 885 Hz to 2900 Hz. (can also be coded for use as a double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

Carrying Devices

The following devises 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)





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.

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 following π 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 top 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:

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

(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.

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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.

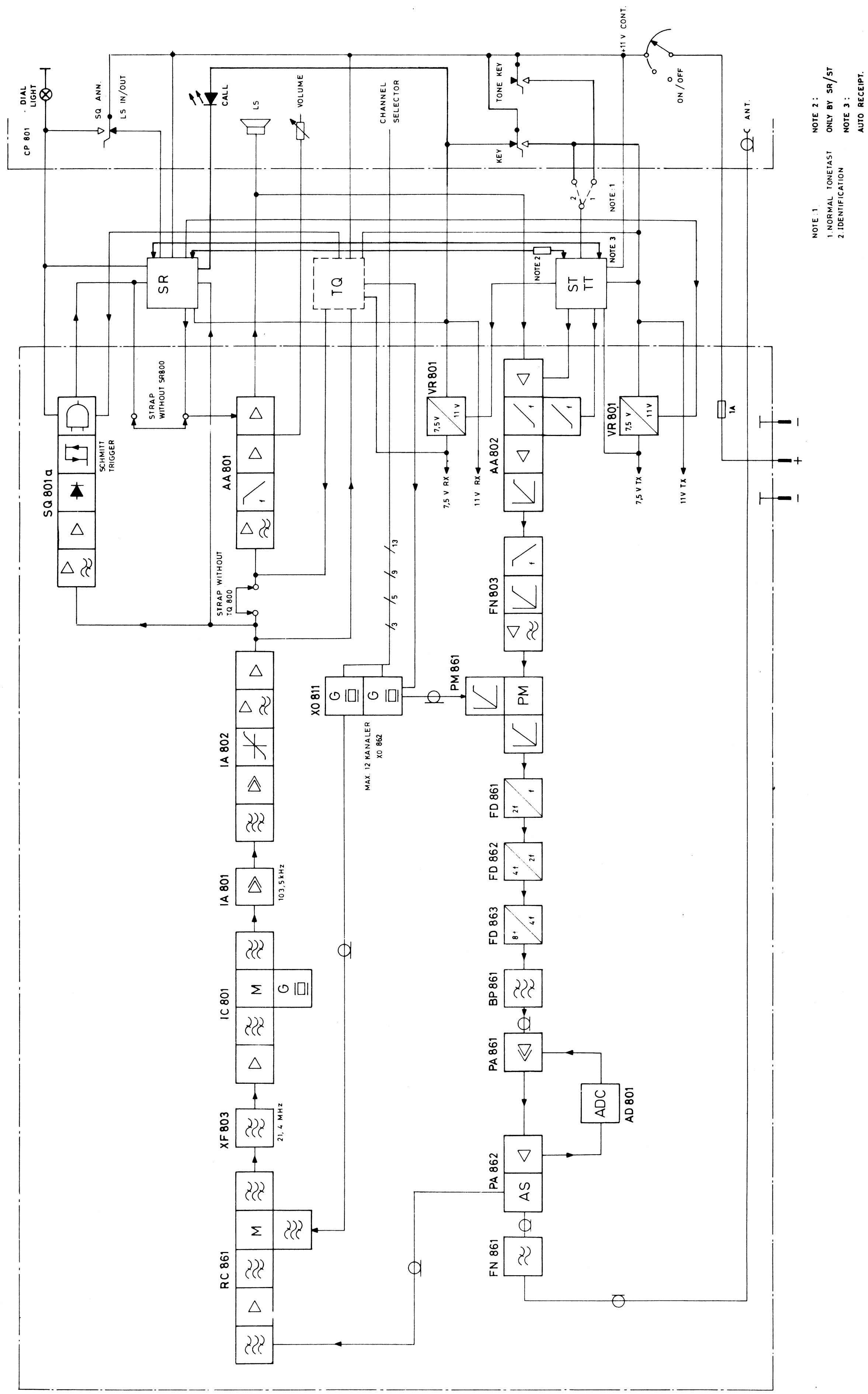
The Squelch Circuit can block the AF signal path by grounding the squelch terminal (5). When the squelch output goes positive again, the audio amplifier will operate normally.

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

STORNOPHONE 800 ANTENNAS
Technical Specifications

	Frequency range MHz	Nominal impedance Ω	Bandwidth (VSWR ≤ 2) MHz	Max. difference between TX - RX freq. MHz	Typical gain performance rel. to λ/4 whip dB	Length mm	Weight g	Remarks
AN831 * Compact	68- 88	50	0.7	6	-11.5	36	38	Contains solid state aut. tuning device TXpos; I_{DC}= 10 mA
AN832 * Shortened λ/8 whip	68- 88	50	6	6	-7	320	44	
AN833 ** Shortened λ/4 whip	68- 88	50	>20	>20	-2.5	730	62	
AN811 * Compact	146-174	50	2.5	10	-5	36	38	Contains solid state aut. tuning device TXpos; I_{DC}= 10 mA
AN812 * Shortened λ/8 whip	146-174	50	9	9	-3	206	40	
AN813 ** λ/4 whip	146-174	50	>30	>30	0	510	50	
AN814 *	146-160	50	14	14	1) -6 hand held	105	20	1) -14 dB TXpos. -19 dB RXpos. Clipped to revers.
AN861 * Compact	420-470	50	10	10	-2	36	38	
AN862 ** λ/4 whip	420-470	50	>50	>50	0	160	35	
AN863 ** Heliflex	420-470	50	50	50	-2	65	47	
AN841 * Heliflex	TX: 105-108 RX: 136-148	50	TX: 2, 8 RX: 11, 5	50		160	60	Contains solid state aut. tuning device TX pos: 1 DC=10mA

* Adjustable to working frequencies.

** Factory adjusted.

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COMPACT ANTENNA
AN861

AN861 is a compact UHF antenna for STORNOPHONE 800 adjustable to frequencies in the 420-470 MHz band.

The radiating element consists of a short top-loaded helix wound on a DURAN glass tube form.

A tap on the helix provide means for adjusting the antenna to the working frequency band and to achieve correct impedance matching.

In order to optimalize the VSWR/bandwidth a trimming capacitor Cp is inserted from the feeding point of the antenna to chassis.

AN861 is primary intended for local controlled radiosets and can be recommended for remote controlled radiosets only if maximum communication range is not demanded.

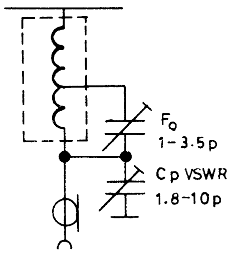
Adjustment Procedure for min. VSWR

Instruments:

CQP800 Rho Detector type TS-D36;
Storno code U95B0476
RF generator with Amplitude Modulation (> 80%).
AF voltmeter; $Z_{in} \geq 1\ M\Omega$; sensitivity better than 30 mV f.s.d.
Capacitor adjustment tool; Storno code no 17.0053.
Calibrated mismatch (VSWR 2:1)

Test set up

The cables from the Rho Detector is connected to the RF generator and to the AF voltmeter as shown in fig. 1.



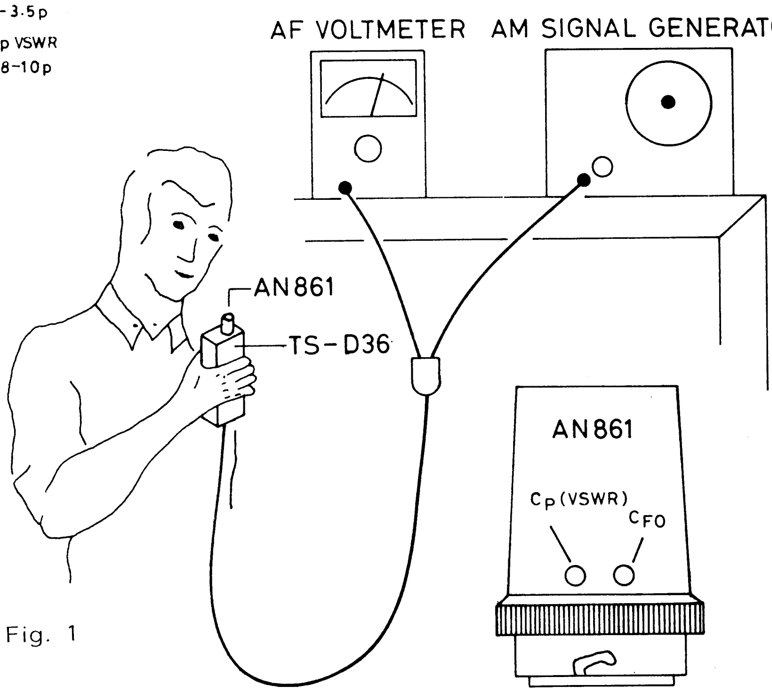


Fig. 1

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Adjustment to working frequency

AM modulate the RF generator and set the frequency to the working frequency.

Adjust the RF generator output for a suitable deflection on the AF voltmeter.

Note the AF voltmeter deflection with the calibrated mismatch connected to the Rho - Detector, ref. VSWR = 2 : 1.

Connect the antenna to the Rho - Detector (fig. 1), hold it by your right hand in the normal speaking position, and adjust the trimmers through the holes in the antenna housing.

1. C_{Fo} is adjusted for minimum deflection on the AF voltmeter at the TX - RX mean frequency.
2. Cp (min. VSWR) is adjusted for minimum deflection on the AF voltmeter.
3. Repeat step 1 and 2.

Checking the bandwidth

Note the AF voltmeter deflection at the specified frequency bandwidth limits for constant RF generator output.

The deflection must not exceed that noted for VSWR = 2 : 1.

NOTE:

The Rho - Detector can be used in conjunction with a Sweep equipment, e.g. Rhode & Swarz Poly scopes.

This will illustrate the symmetry and the bandwidth of the antenna (see Fig. 2).

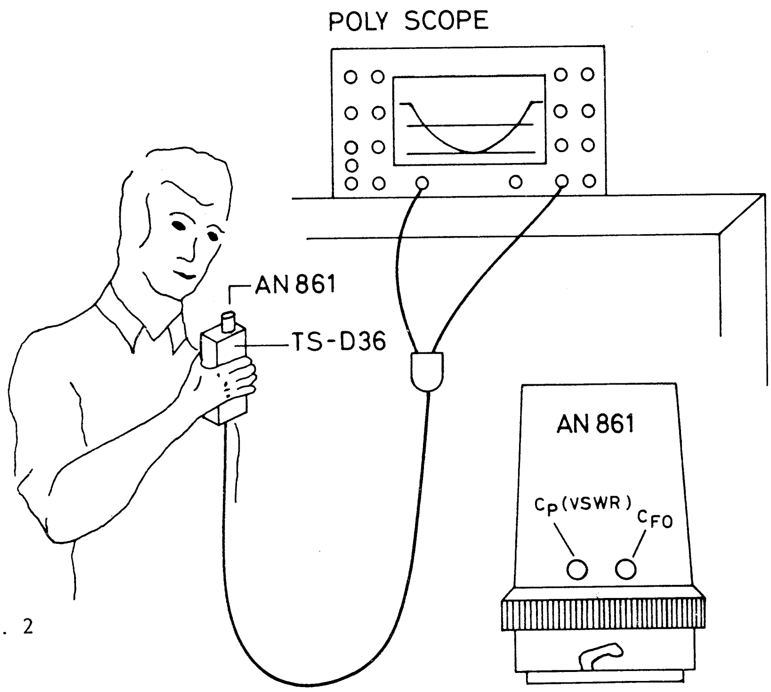

Fig. 2

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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 M Ω
AC Voltmeter	Z_{in} = > 2MΩ//50pF
FM signal generator	420 - 470 MHz
AF generator	Z_{out} = 600 Ω
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 continously 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.

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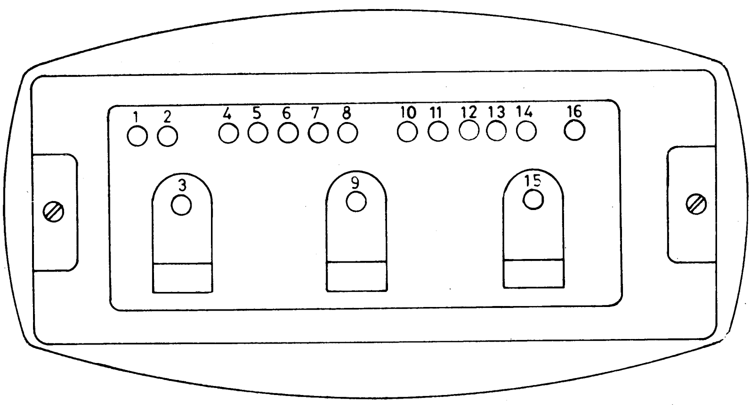
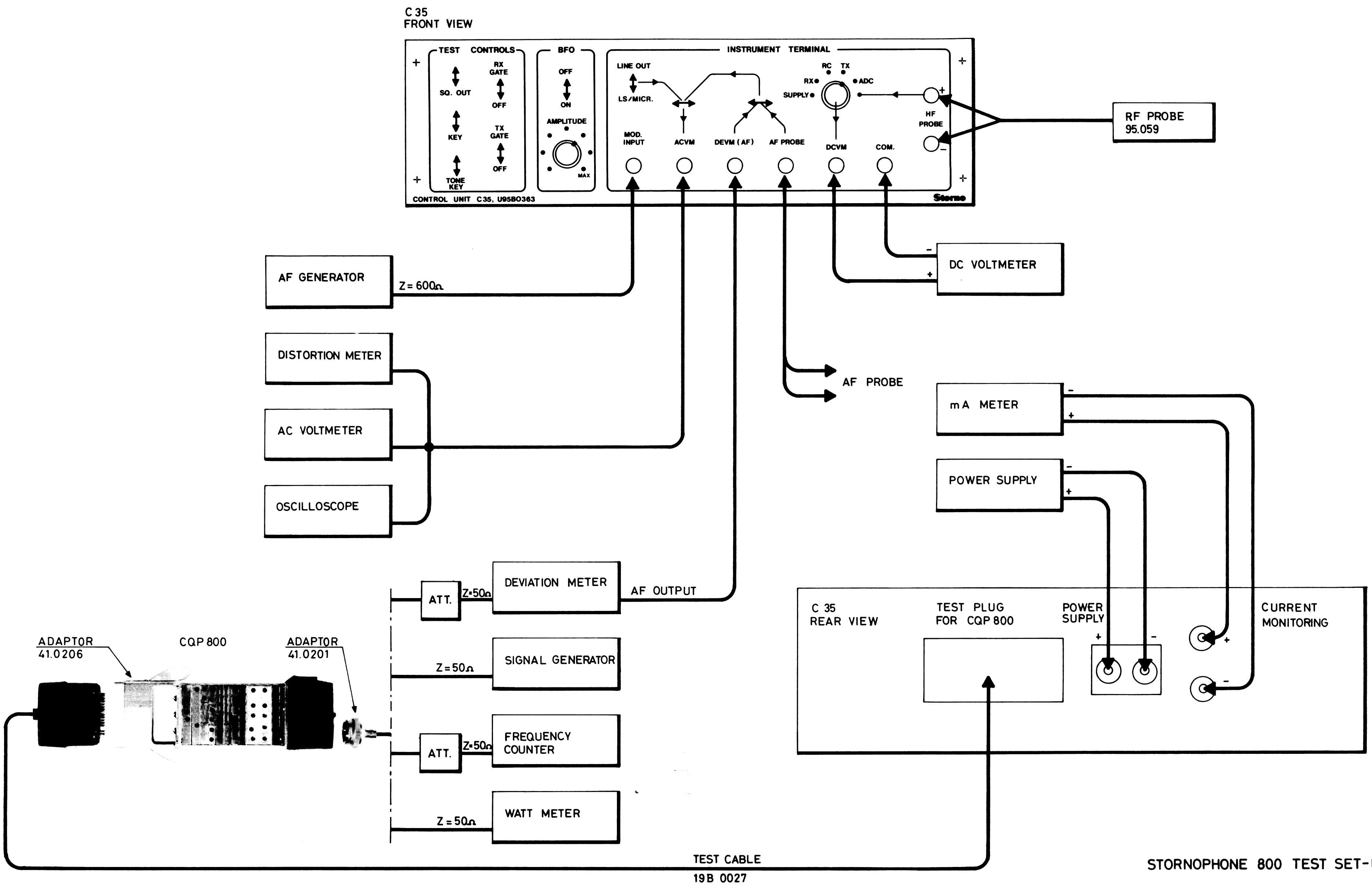
LINE OUT LS/MICR	Switches the AC voltmeter between the receiver line output and the loudspeaker/microphone.
ACVM switch	Switches the AC voltmeter between the **LINE OUT - LS/MICR** switch and **DEVM (AF) - AF PROBE** switch.
DEVM (AF) switch	Switches the AC voltmeter input between the deviation meter and the AF probe.
DCVM switch	6-position DC voltmeter switch. 1. **SUPPLY** Voltage. 2. **RX** + 7, 5 V stabilized RX voltage. 3. **RC** Receiver converter test point. 4. **TX** + 7, 5 V stabilized TX voltage 5. **ADC** voltage 6. **RF PROBE**
AMPLITUDE	**BFO** output attenuator

Test Point	Function
1	+ 7, 5 V TX stabilized
2	+ 7, 5 V RX regulator gate
3	DC ground (connected to point 15)
4	ADC voltage
5	Audio output - microphone input
6	Tone Key
7	+ 7, 5 V TX regulator gate
8	+ V_B Battery voltage measured after the fuse.
9	+ 11 V Battery
10	+ 11 V TX
11	+ 7, 5 V RX stabilized
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



BOTTOM VIEW

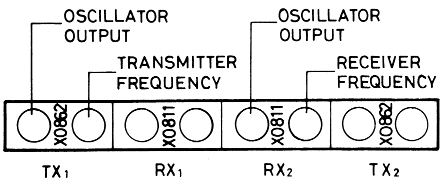
CQP800 Test Point Location
Bottom View



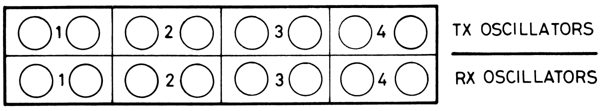
STORNOPHONE 800 TEST SET-UP

D402.093

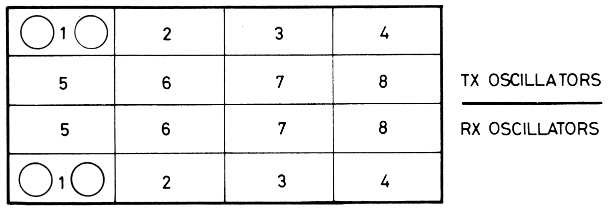
LOCATION OF OSCILLATORS



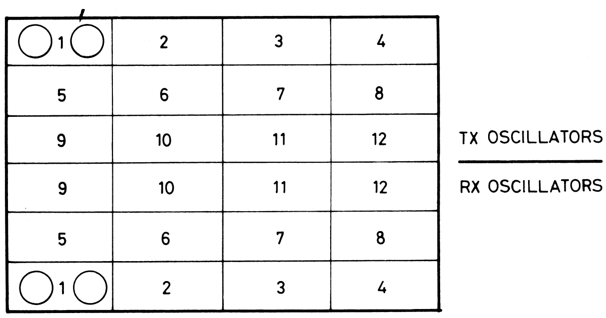
2 CHANNELS (CH803)



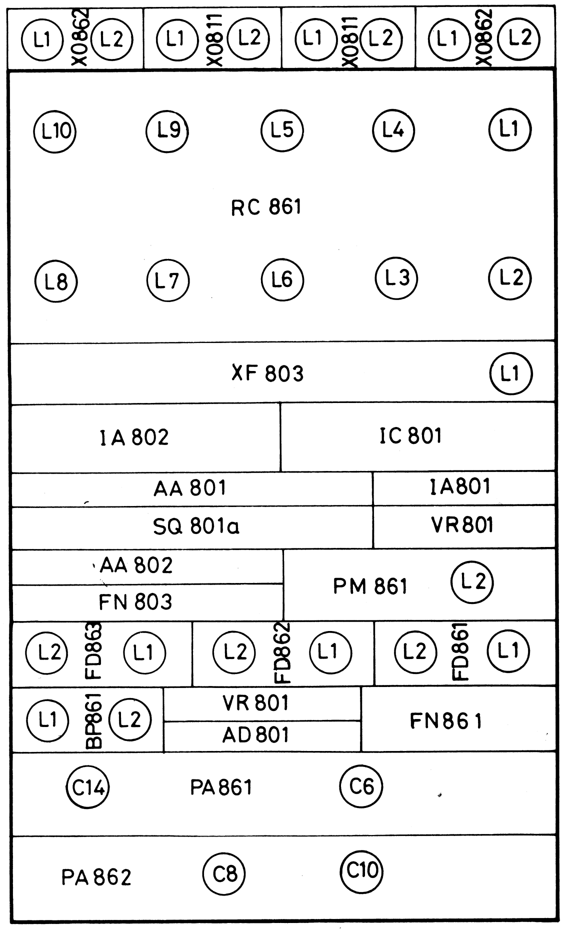
4 CHANNELS (CH804)



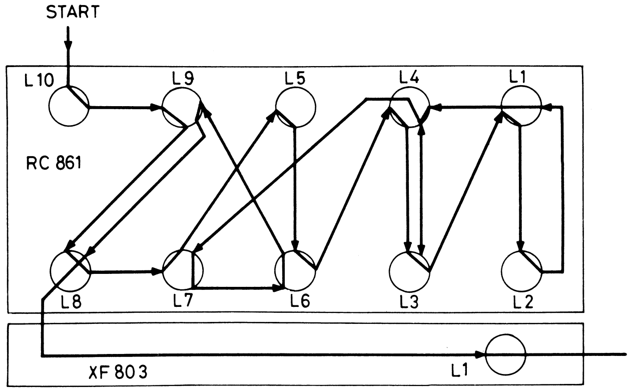
8 CHANNELS (CH 805)



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 kΩ for 0,1 to 0,5 W output power
4,7 kΩ 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 ± 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 (∿ 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: ± 0,5 x 10^{-6}.

Checking and adjustment of Modulator.

10. Connect the deviation meter through an attenuator to the antenna connector.
Set the **DEVM (AF) - AF PROBE** switch to **DEVM (AF)**.
Set the **ACVM** switch to **DEVM (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 Δ f 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 x Δ F max. at 1000 Hz.
± 3,5 kHz for 25 kHz channel spacing.
± 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_{total} : < 100 mA

3. Set the **DCVM** switch to **RX**.
Read the stabilized RX voltage.
Requirement: 7,5 V ± 0,15 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 x Δ f max.

± 3, 5 kHz for 25 kHz channel spacing.
± 2, 8 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 μ 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.
(100-6dB=50, 50-6dB=25).

In practice our first condition is achieved by feeding a minimum of 1000μ V of RF-signal modulated with 1000 Hz at 0. 7 x Δ f max. to the receiver. The audio output (which must be at least 50% of the receiver's audio rating) is measured with the distortion meter in position CAL and adjusted with potentiometer ADJ. FSD. to a reading of 100.

Storno

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 RFgenerator, thereby lowering the RFinput 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 RFgenerator's calibrated attenuator now shows the value of RFsignal 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 μ V e.m.f.
   Typical value: 0,7 μ 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 μ 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 x Δ f max.
   ± 3,5 kHz for 25 kHz channel spacing.
   ± 2,8 kHz for 20 kHz channel spacing.
   Set the signal generator output to 100 μ V e.m.f.
   Switch the **ACVM** to **LINE OUT**.
   Read the **AF** Line voltage.
   Requirement: 110 mV ± 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 μ 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 ± 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%

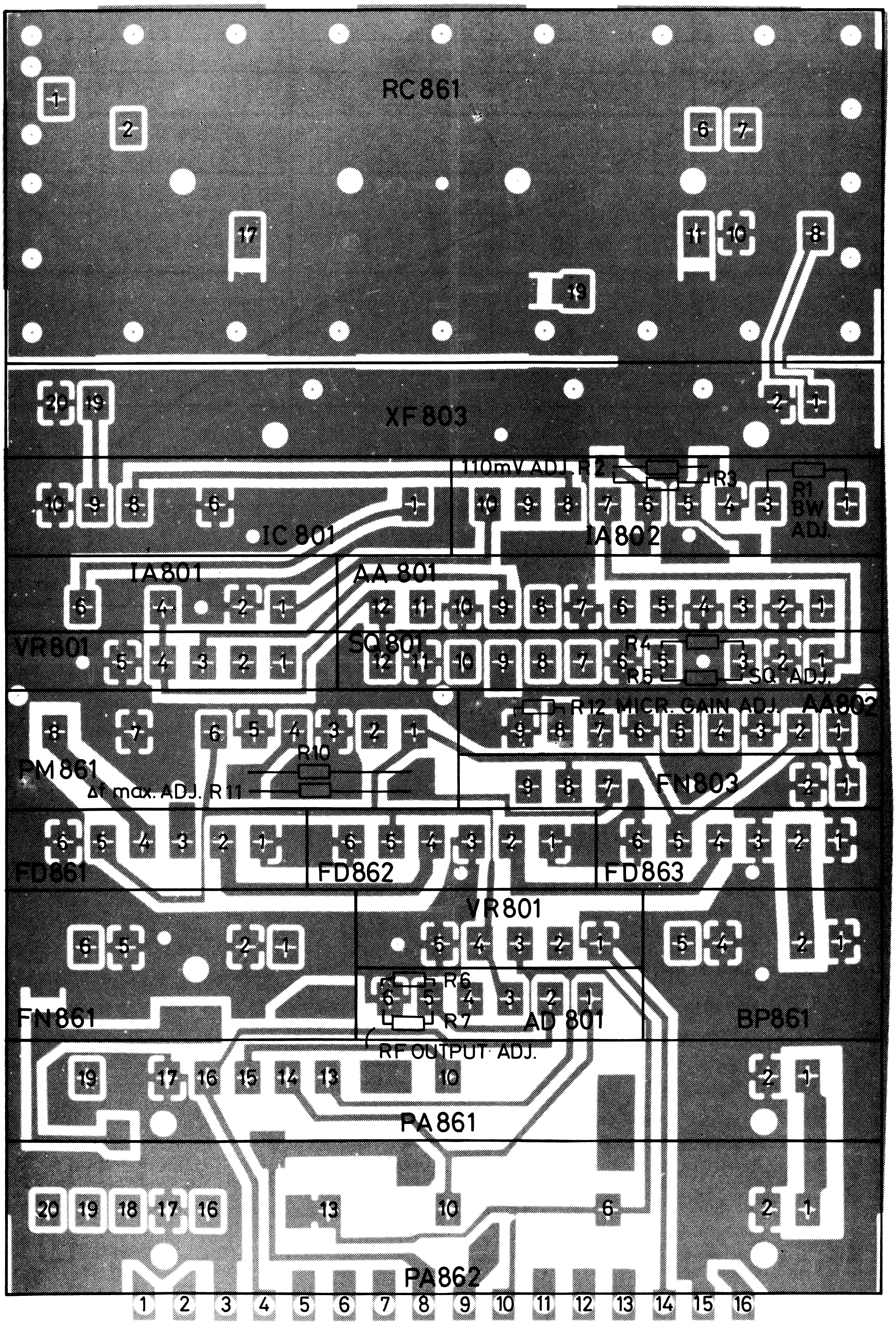
Adjustment and Checking the Squelch function.

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.


RC861
XF803
110mV ADJ. R2
R3
R1
BW
ADJ.
IC801
IA802
IA801
AA801
VR801
SQ801
R4
R5
SQ. ADJ.
R12 MICR. GAIN ADJ.
AA802
PM861
R10
Δf max. ADJ. R11
FN803
FD861
FD862
FD863
VR801
R6
R7
FN861
AD 801
BP861
RF OUTPUT ADJ.
PA861
PA862

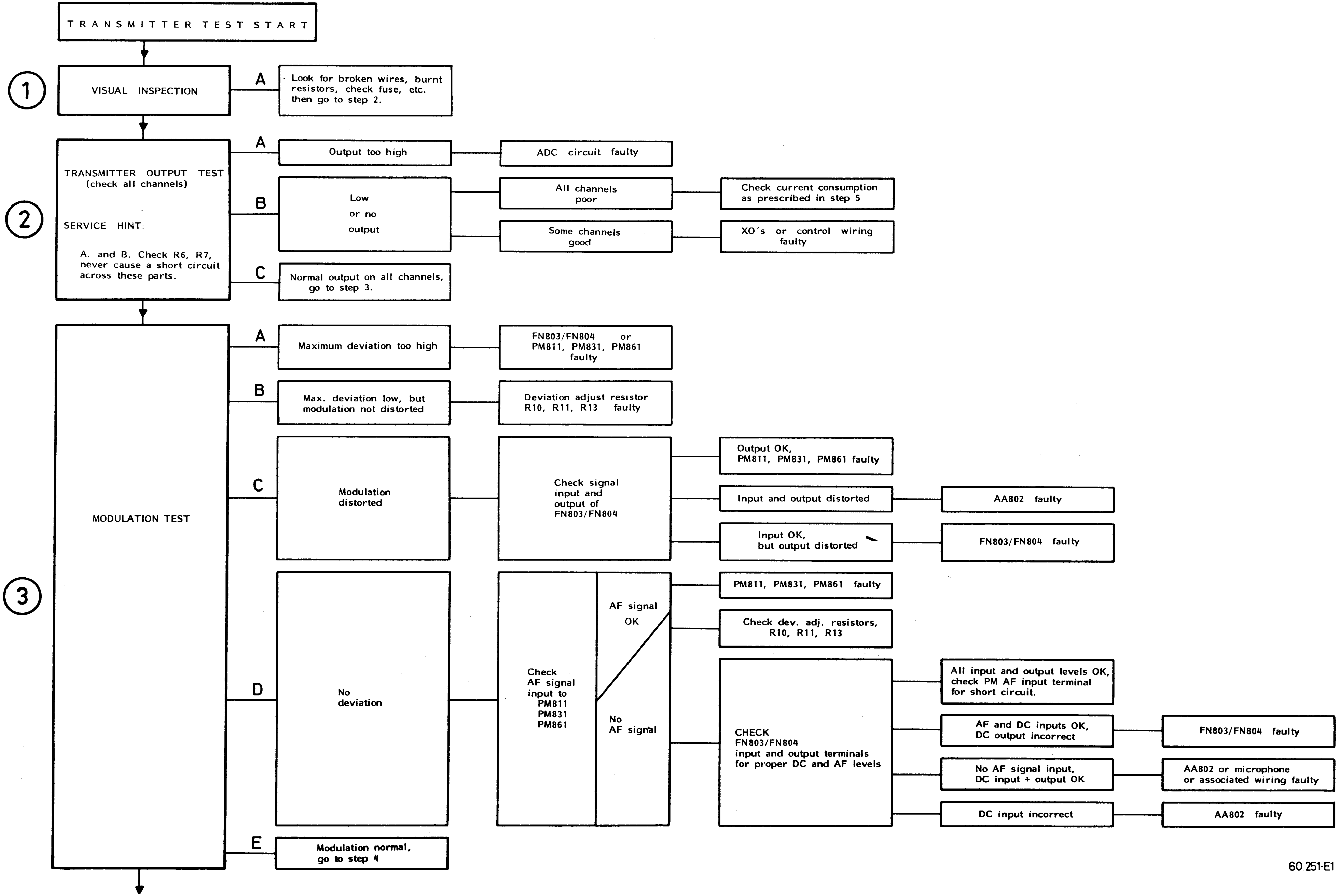
SUMMARY
TRANSMITTER ADJUSTMENT
CQP860

	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 ± 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 Δ F max. THD = < 7%

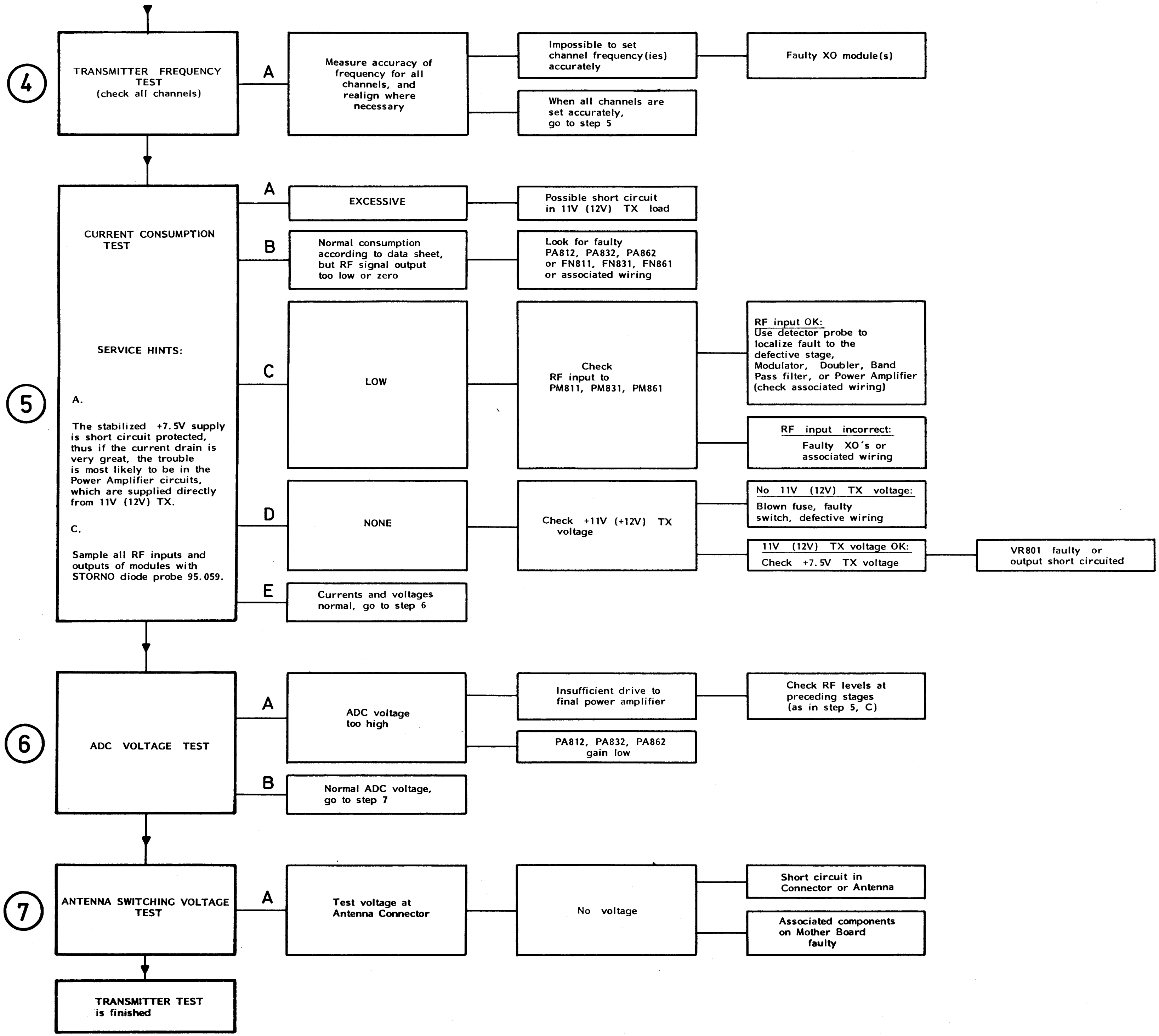
SUMMARY
RECEIVER ADJUSTMENT
CQP860

	TEST	ADJUST	INSTRUMENT	READING
1	Supply voltage	Power supply	DC voltmeter	11 V
2	+ 7,5 V RX	Check	Voltmeter	+ 7,5 V ± 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 μV 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 ± 2 dB 1000 Hz: 0 dB 3000 Hz: + 10 ± 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 DEFFECTIVE MODULE



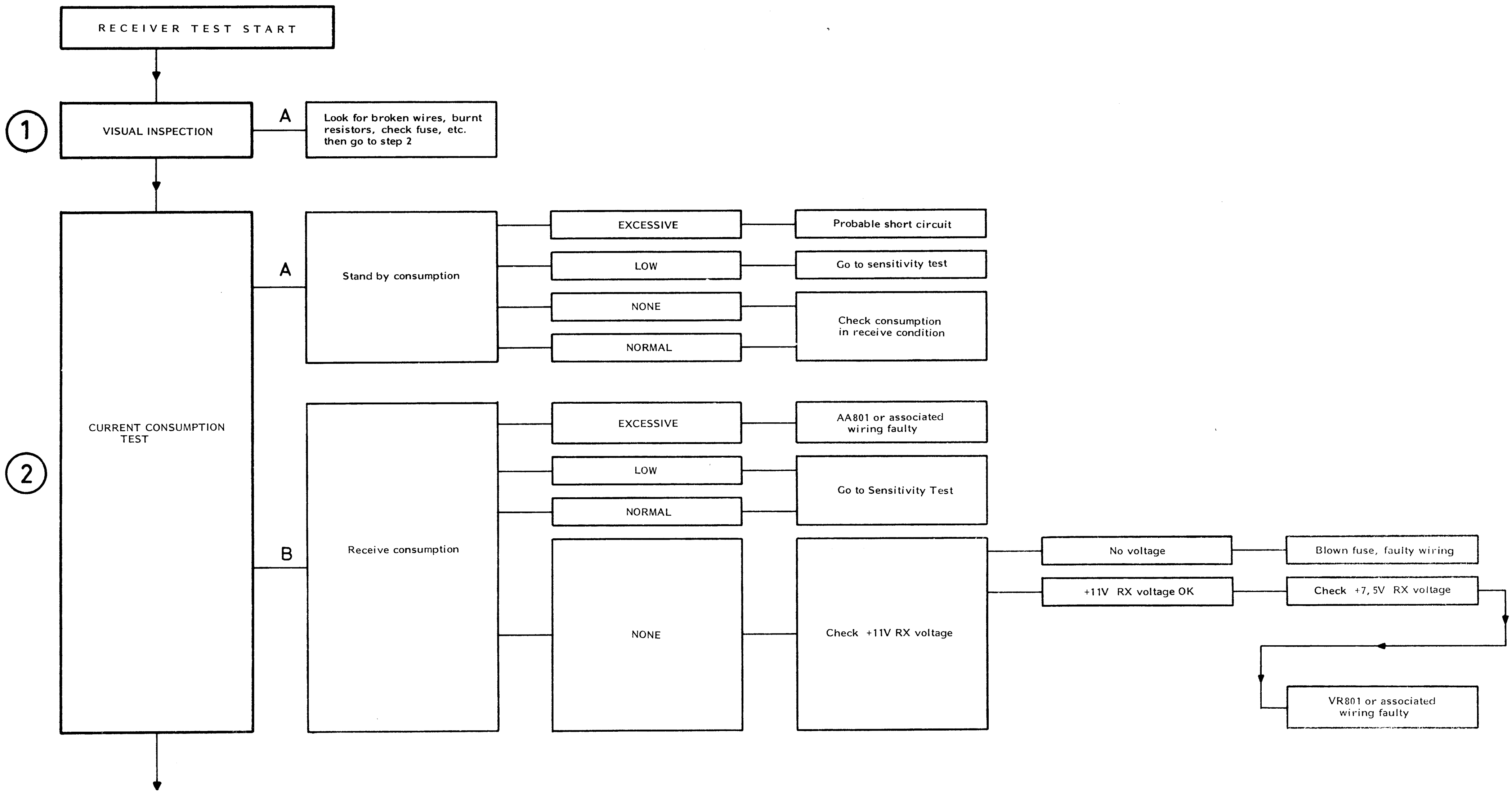
60.251-E1



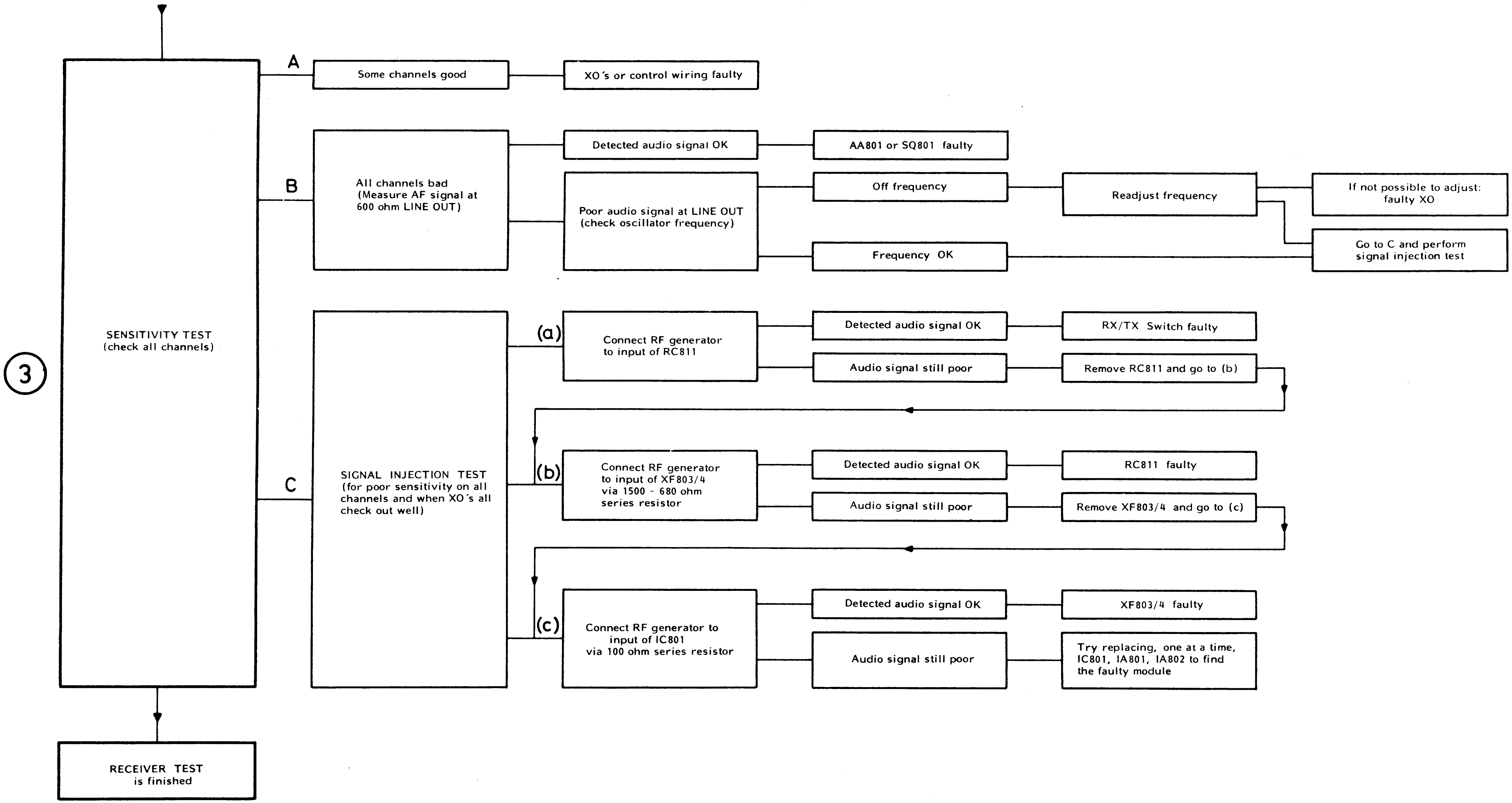
4
TRANSMITTER FREQUENCY TEST (check all channels)
A
Measure accuracy of frequency for all channels, and realign where necessary
Impossible to set channel frequency(ies) accurately
Faulty XO module(s)
When all channels are set accurately, go to step 5
5
CURRENT CONSUMPTION TEST
SERVICE HINTS:
A.
The stabilized +7.5V supply is short circuit protected, thus if the current drain is very great, the trouble is most likely to be in the Power Amplifier circuits, which are supplied directly from 11V (12V) TX.
C.
Sample all RF inputs and outputs of modules with STORNO diode probe 95.059.
A
EXCESSIVE
Possible short circuit in 11V (12V) TX load
B
Normal consumption according to data sheet, but RF signal output too low or zero
Look for faulty PA812, PA832, PA862 or FN811, FN831, FN861 or associated wiring
C
LOW
Check RF input to PM811, PM831, PM861
RF input OK: Use detector probe to localize fault to the defective stage, Modulator, Doubler, Band Pass filter, or Power Amplifier (check associated wiring)
RF input incorrect: Faulty XO's or associated wiring
D
NONE
Check +11V (+12V) TX voltage
No 11V (12V) TX voltage: Blown fuse, faulty switch, defective wiring
11V (12V) TX voltage OK: Check +7.5V TX voltage
VR801 faulty or output short circuited
E
Currents and voltages normal, go to step 6
6
ADC VOLTAGE TEST
A
ADC voltage too high
Insufficient drive to final power amplifier
Check RF levels at preceding stages (as in step 5, C)
PA812, PA832, PA862 gain low
B
Normal ADC voltage, go to step 7
7
ANTENNA SWITCHING VOLTAGE TEST
A
Test voltage at Antenna Connector
No voltage
Short circuit in Connector or Antenna
Associated components on Mother Board faulty
TRANSMITTER TEST is finished

60.251-E1

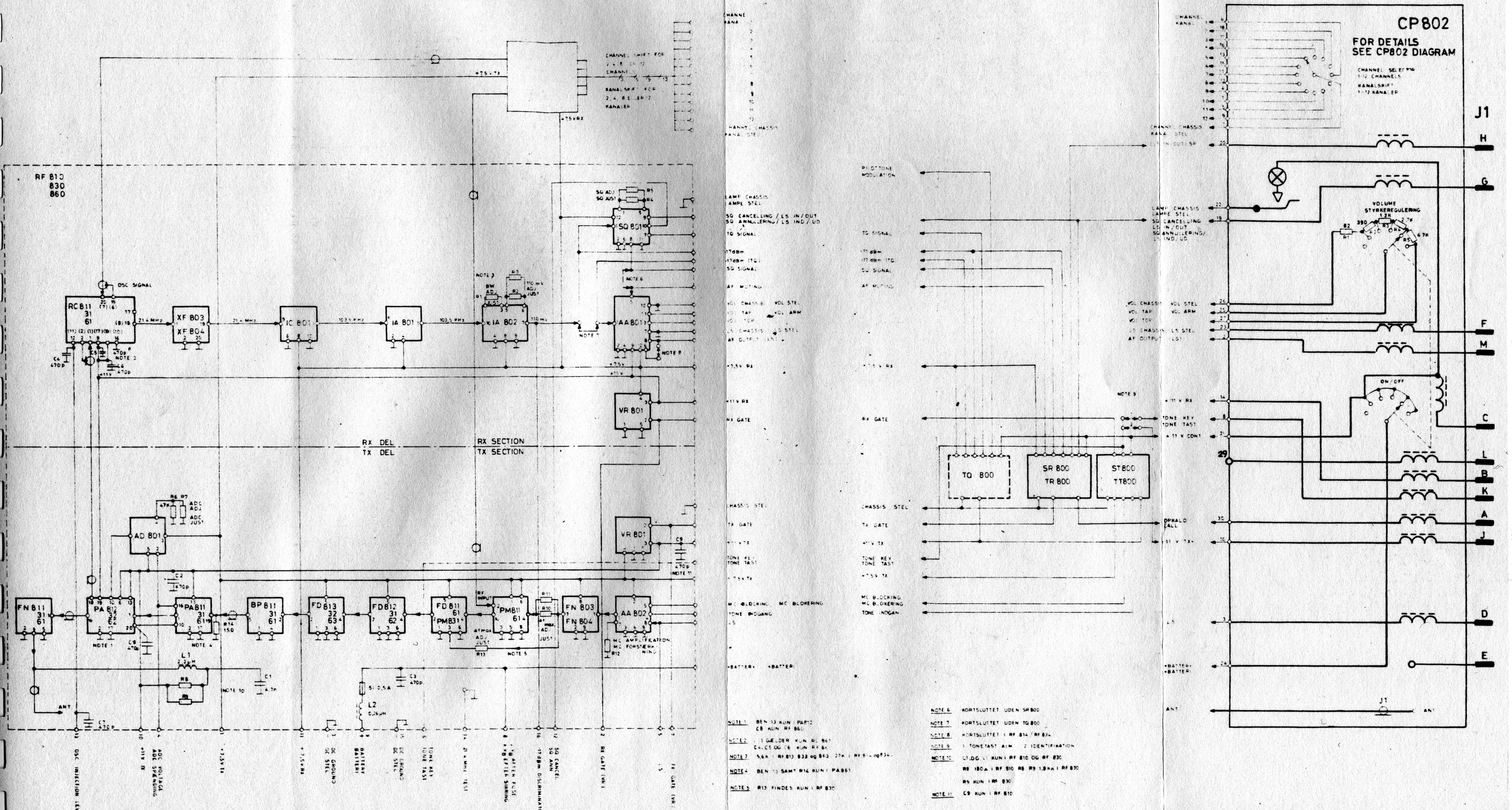
TROUBLESHOOTING SEQUENCE FOR CQP800
TO LOCALIZE FAULTS TO THE DEFECTIVE MODULE



60.252-E1


3
SENSITIVITY TEST
(check all channels)
A
Some channels good
XO's or control wiring faulty
B
All channels bad
(Measure AF signal at
600 ohm LINE OUT)
Detected audio signal OK
AA801 or SQ801 faulty
Poor audio signal at LINE OUT
(check oscillator frequency)
Off frequency
Readjust frequency
If not possible to adjust:
faulty XO
Frequency OK
Go to C and perform
signal injection test
C
SIGNAL INJECTION TEST
(for poor sensitivity on all
channels and when XO's all
check out well)
(a)
Connect RF generator
to input of RC811
Detected audio signal OK
RX/TX Switch faulty
Audio signal still poor
Remove RC811 and go to (b)
(b)
Connect RF generator
to input of XF803/4
via 1500 - 680 ohm
series resistor
Detected audio signal OK
RC811 faulty
Audio signal still poor
Remove XF803/4 and go to (c)
(c)
Connect RF generator to
input of IC801
via 100 ohm series resistor
Detected audio signal OK
XF803/4 faulty
Audio signal still poor
Try replacing, one at a time,
IC801, IA801, IA802 to find
the faulty module
RECEIVER TEST
is finished

60.252-E1

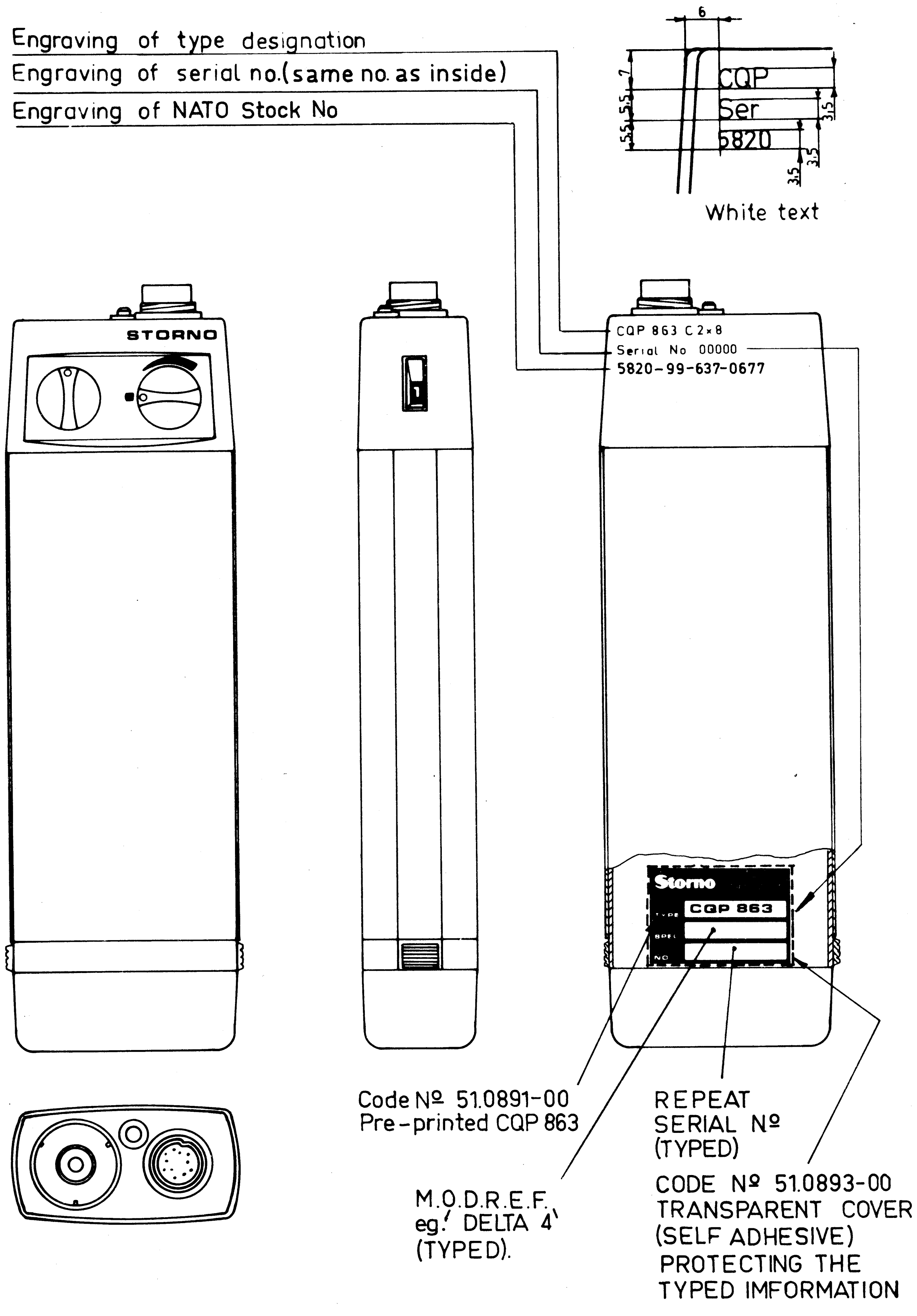


STORNOPHONE 800

REMOTE CONTROL LAY-OUT

D402.282

Storno

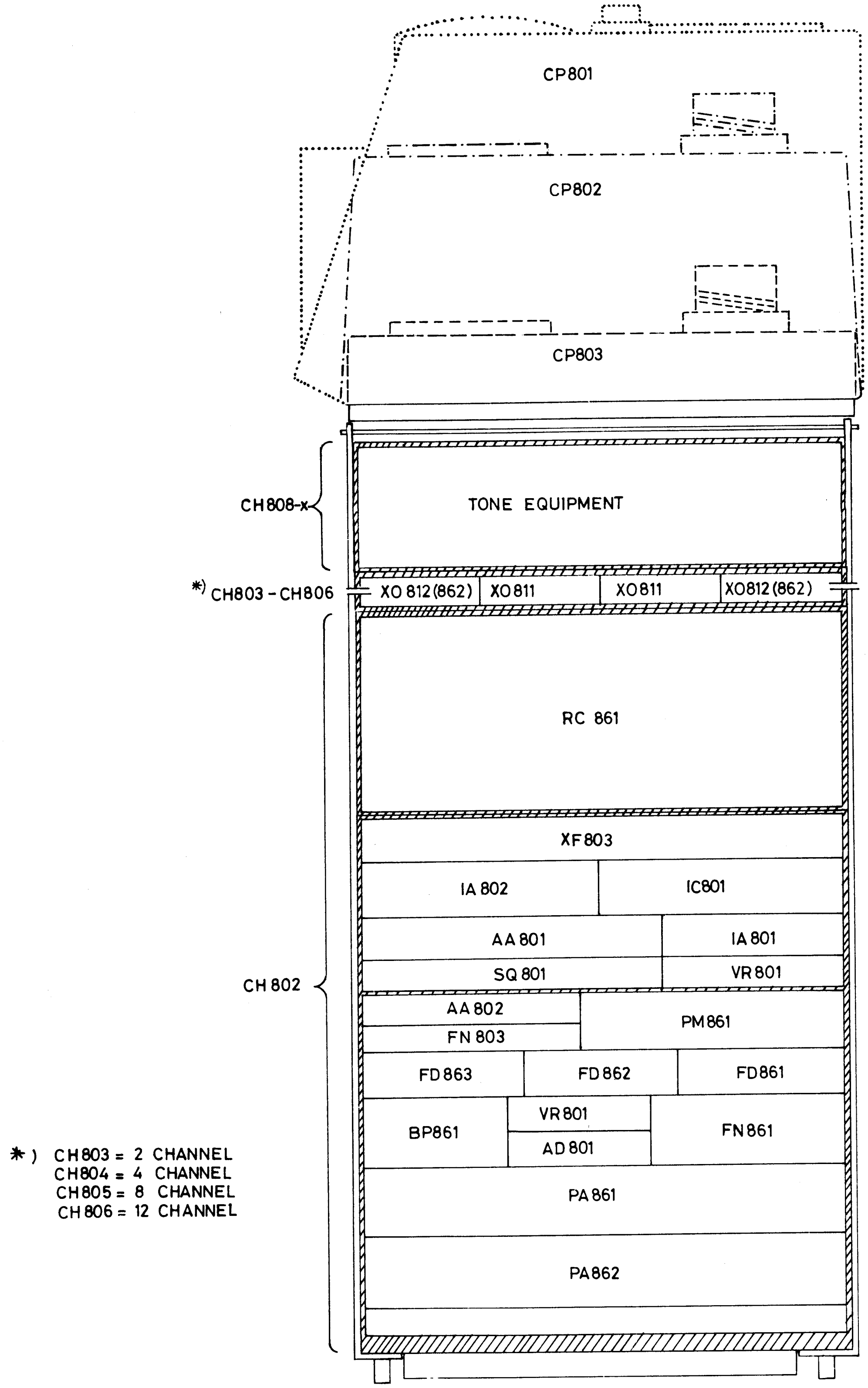


GENERAL LAY-OUT AND ENGRAVINGS

CQP863 C2 x 8 M.O.D

D402. 276

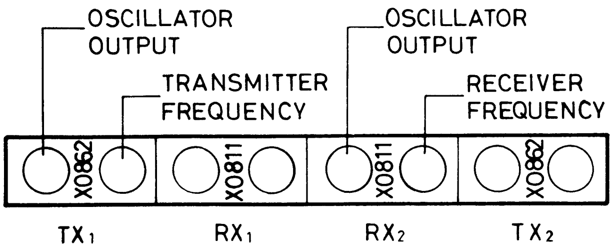
Storno



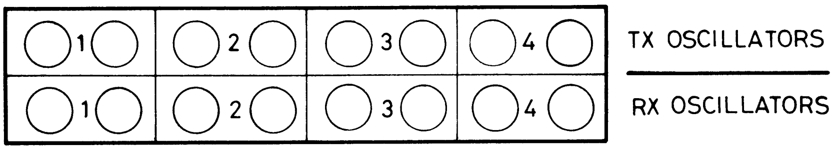
MODULE LOCATION CQP860

D402.075/2

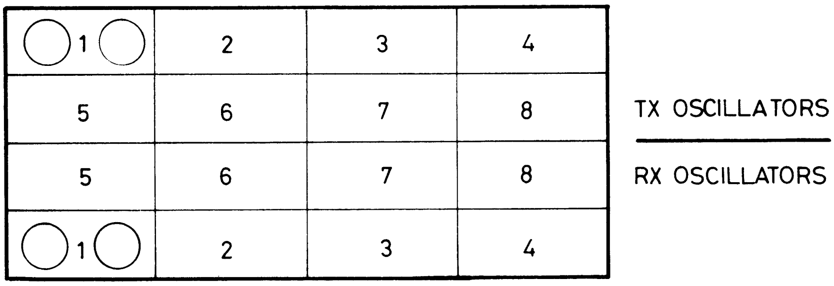
LOCATION OF OSCILLATORS



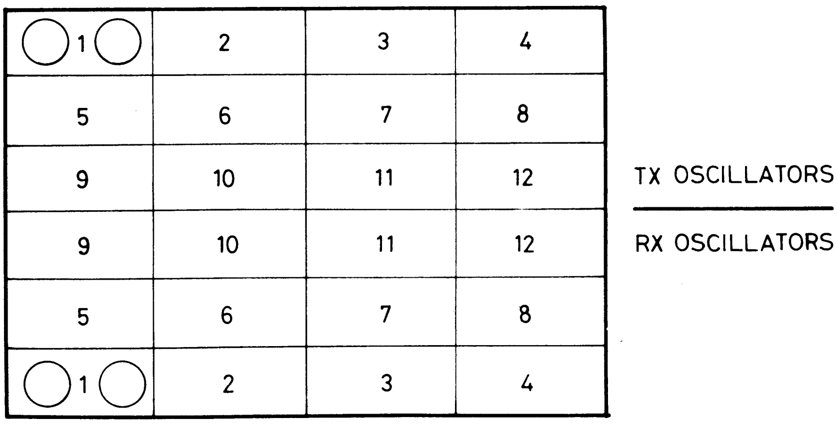
2 CHANNELS (CH803)



4 CHANNELS (CH804)

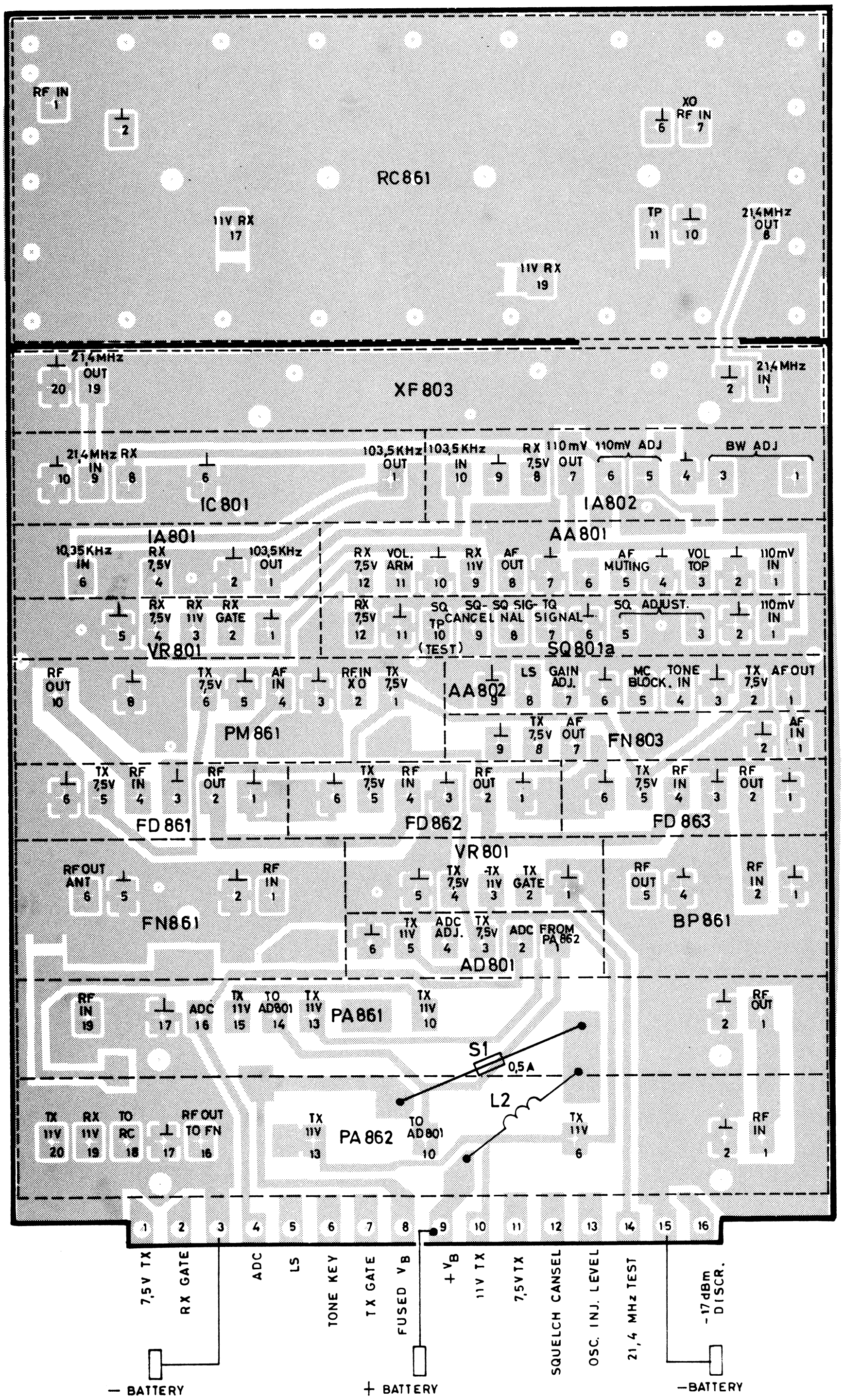


8 CHANNELS (CH 805)



12 CHANNELS (CH806)

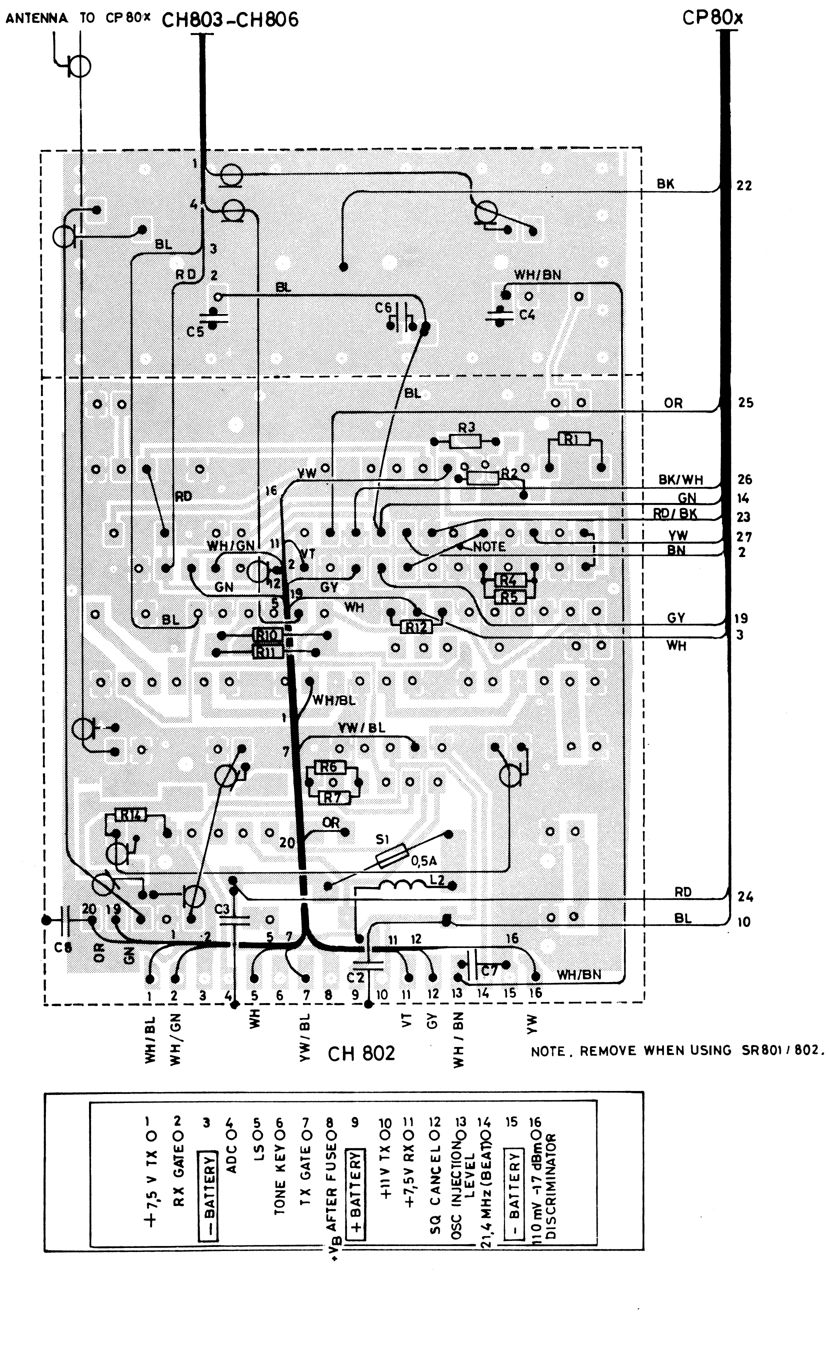
LOCATION OF OSCILLATORS



PIN LOCATION CQP860

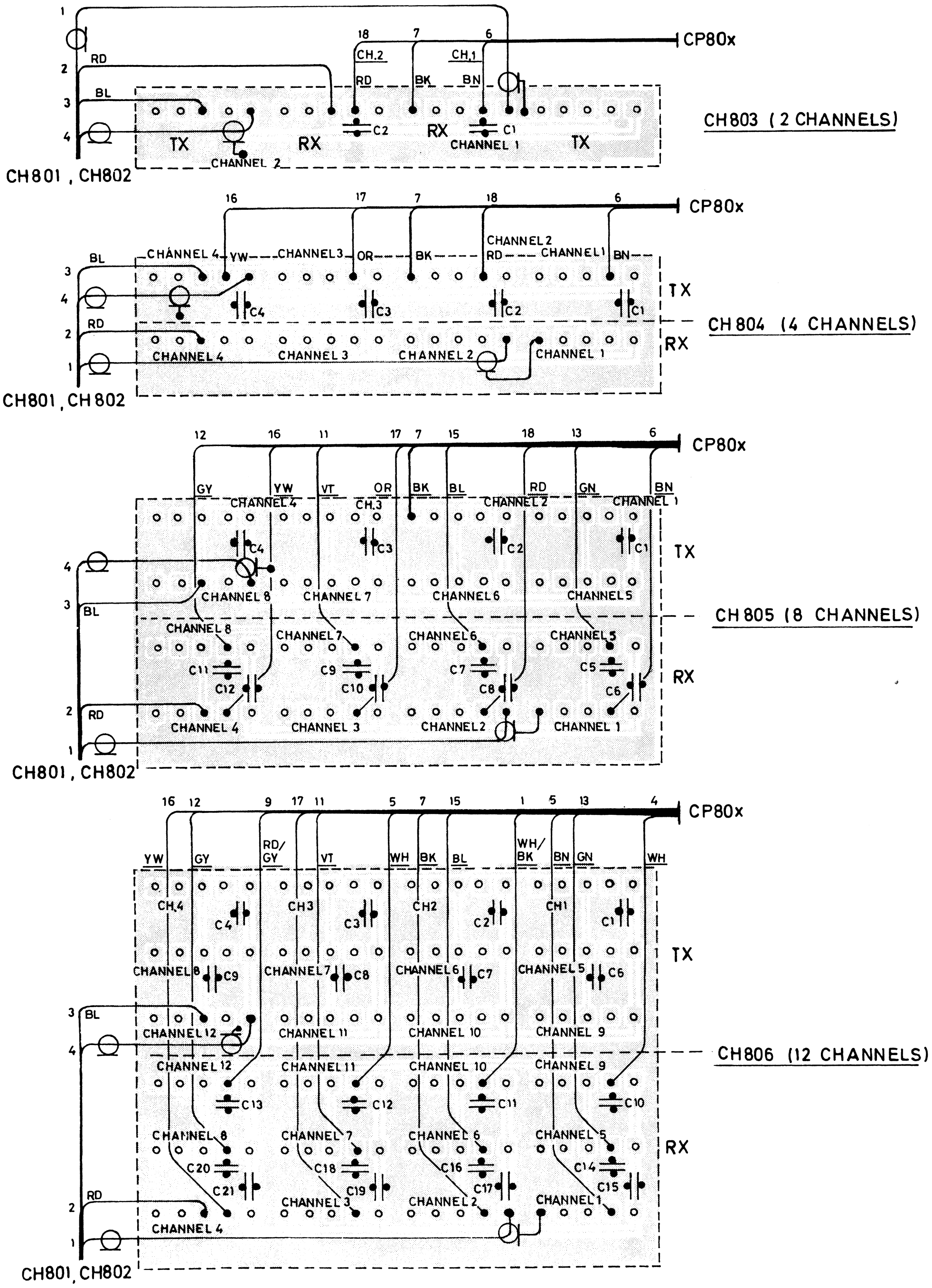
D402.069

Storno

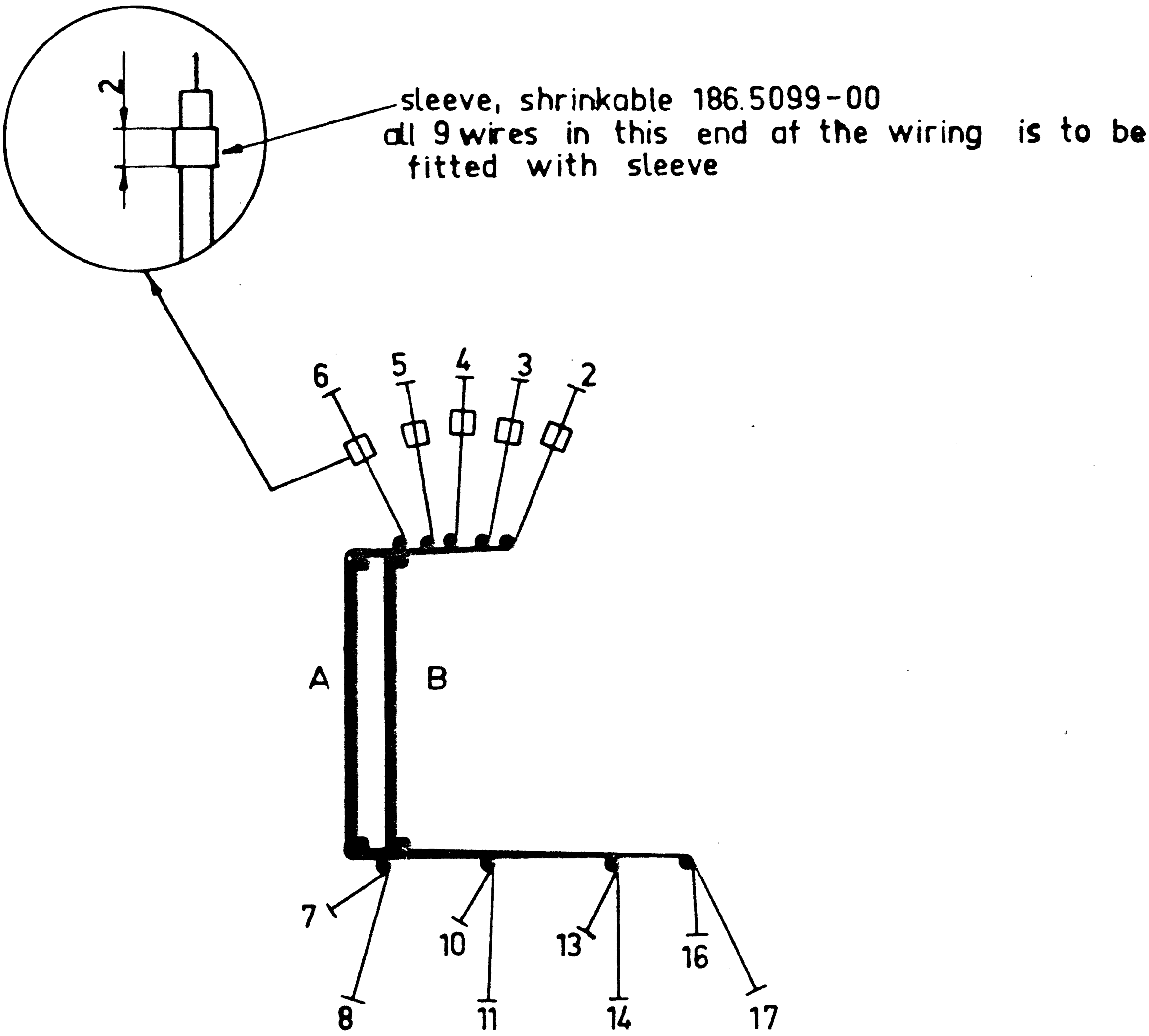


WIRING DIAGRAM CQP860

Storno



WIRING DIAGRAM CH803, CH804, CH805, CH806



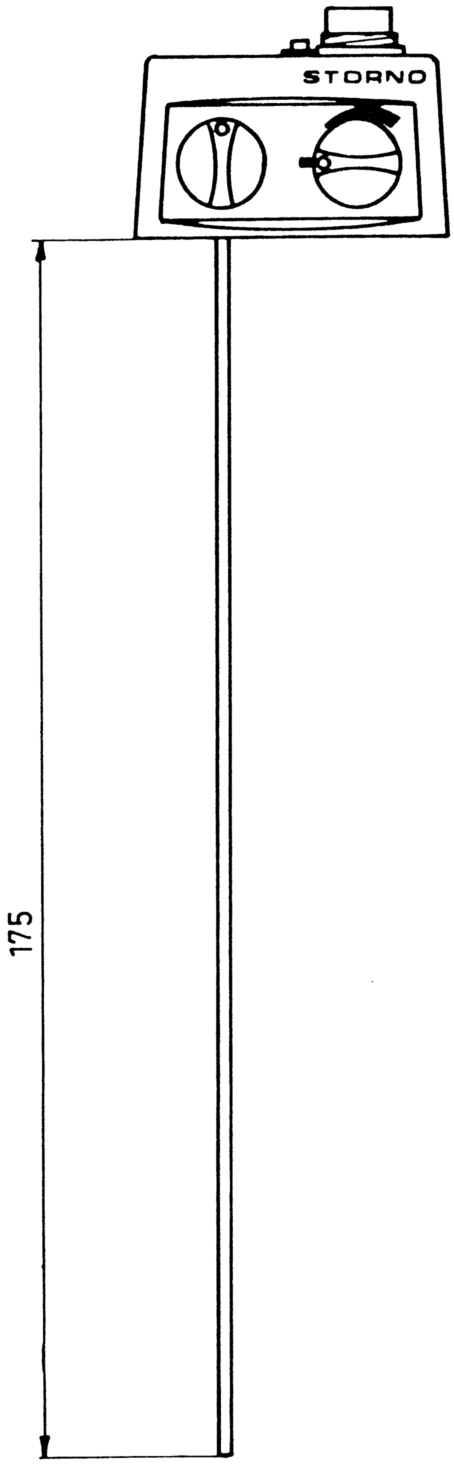
FROM				TO	
6	-	B	-	13	RED
5	-	B	-	14	BLUE
5	-	B	-	17	GREEN
6	-	A	-	7	YELLOW
3	-	A	-	11	BLACK
4	-	A	-	8	GREY
4	-	A	-	11	VIOLET
6	-	A	-	10	ORANGE
2	-	B	-	16	BROWN

WIRING LAY-OUT

CH805 to CP802

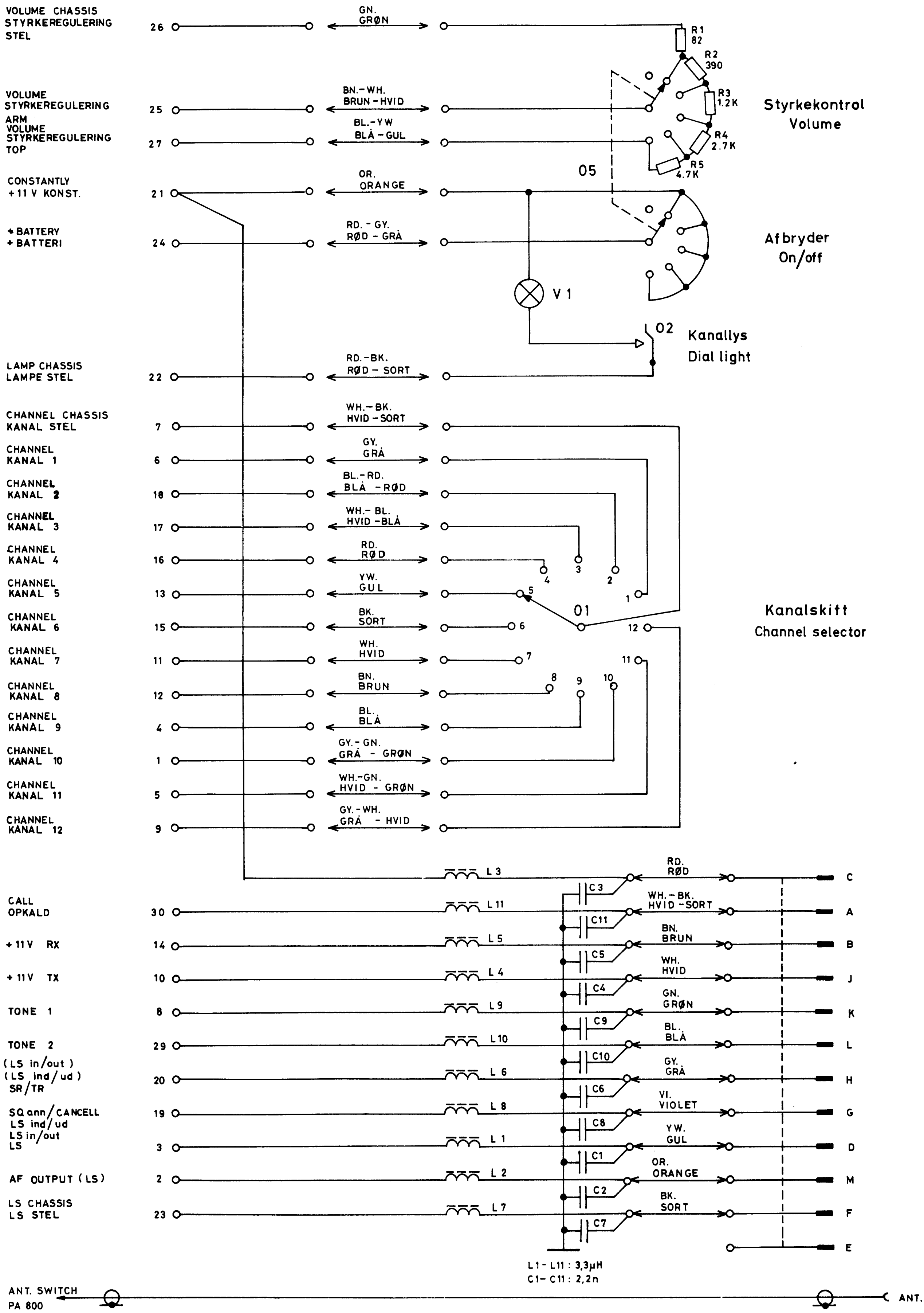
CQP863 C2 x 8 M.O.D

D402.275



SHORTENING OF RF CABLE

Storno



CONTROL PANEL CP802

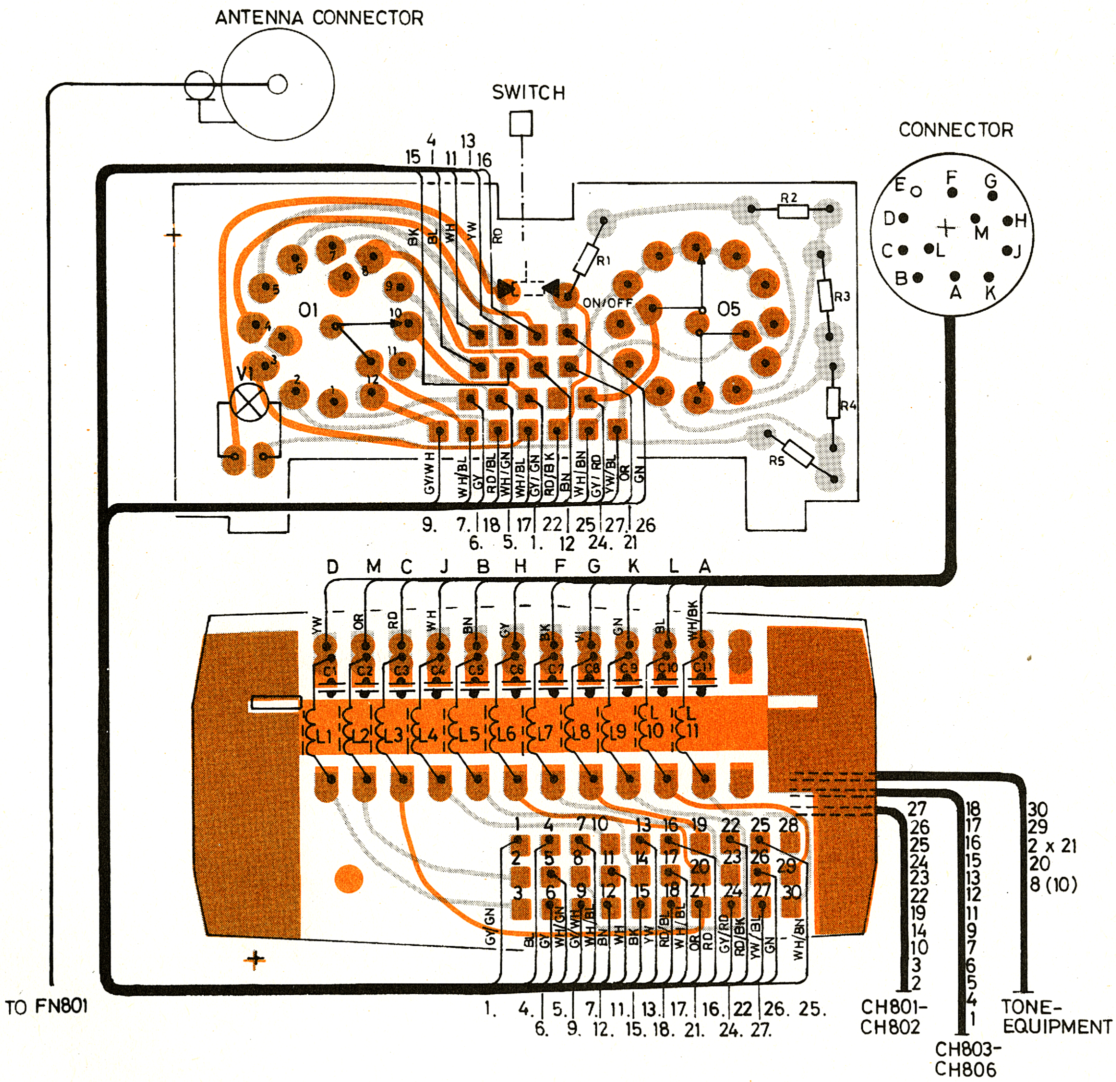
D402.026

TYPE	NO.	CODE	DATA
CP802		10.2967-00	Remote Control Head
	C1	74.5278	2.2nF 20% ceram CP 50V
	C2	74.5278	2.2nF 20% ceram CP 50V
	C3	74.5278	2.2nF 20% ceram CP 50V
	C4	74.5278	2.2nF 20% ceram CP 50V
	C5	74.5278	2.2nF 20% ceram CP 50V
	C6	74.5278	2.2nF 20% ceram CP 50V
	C7	74.5278	2.2nF 20% ceram CP 50V
	C8	74.5278	2.2nF 20% ceram CP 50V
	C9	74.5278	2.2nF 20% ceram CP 50V
	C10	74.5278	2.2nF 20% ceram CP 50V
	C11	74.5278	2.2nF 20% ceram CP 50V
	R1	80.5036	82 Ω 5% carbon film 1/10W
	R2	80.5044	390 Ω 5% " 1/10W
	R3	80.5050	1.2KΩ 5% " 1/10W
	R4	80.5044	2.7KΩ 5% " 1/10W
	R5	80.5047	4.7KΩ 5% " 1/10W
	V1	92.5105	Lamp 18V; 26mA
	01	47.0613	Channel switch
	02	49.0243	Dial light button
	J1	41.0199	Antenna Connector
	J2	41.5085	Multiwire Connector for CB800

Storno

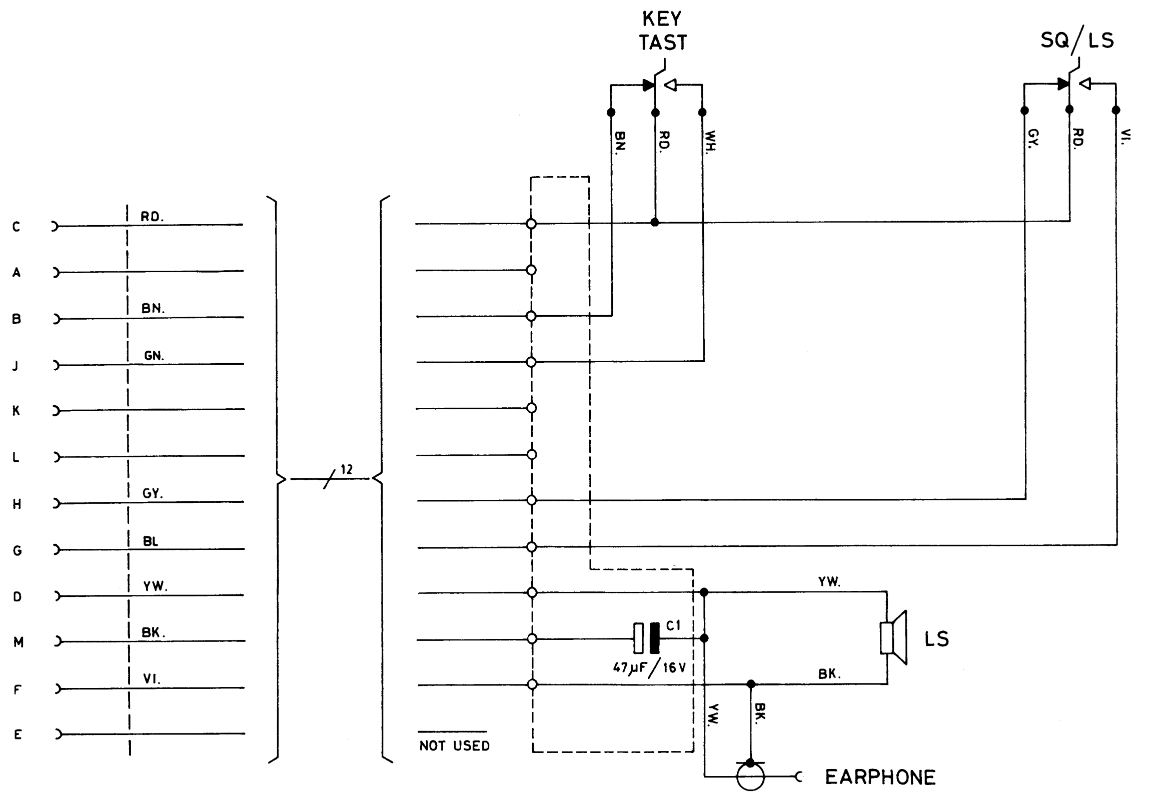
TYPE	NO.	CODE	DATA

CONTROL PANEL CP802



WIRING DIAGRAM CP802.

D 402.133



CONTROL UNIT CB803

D.402.168/3

Storno

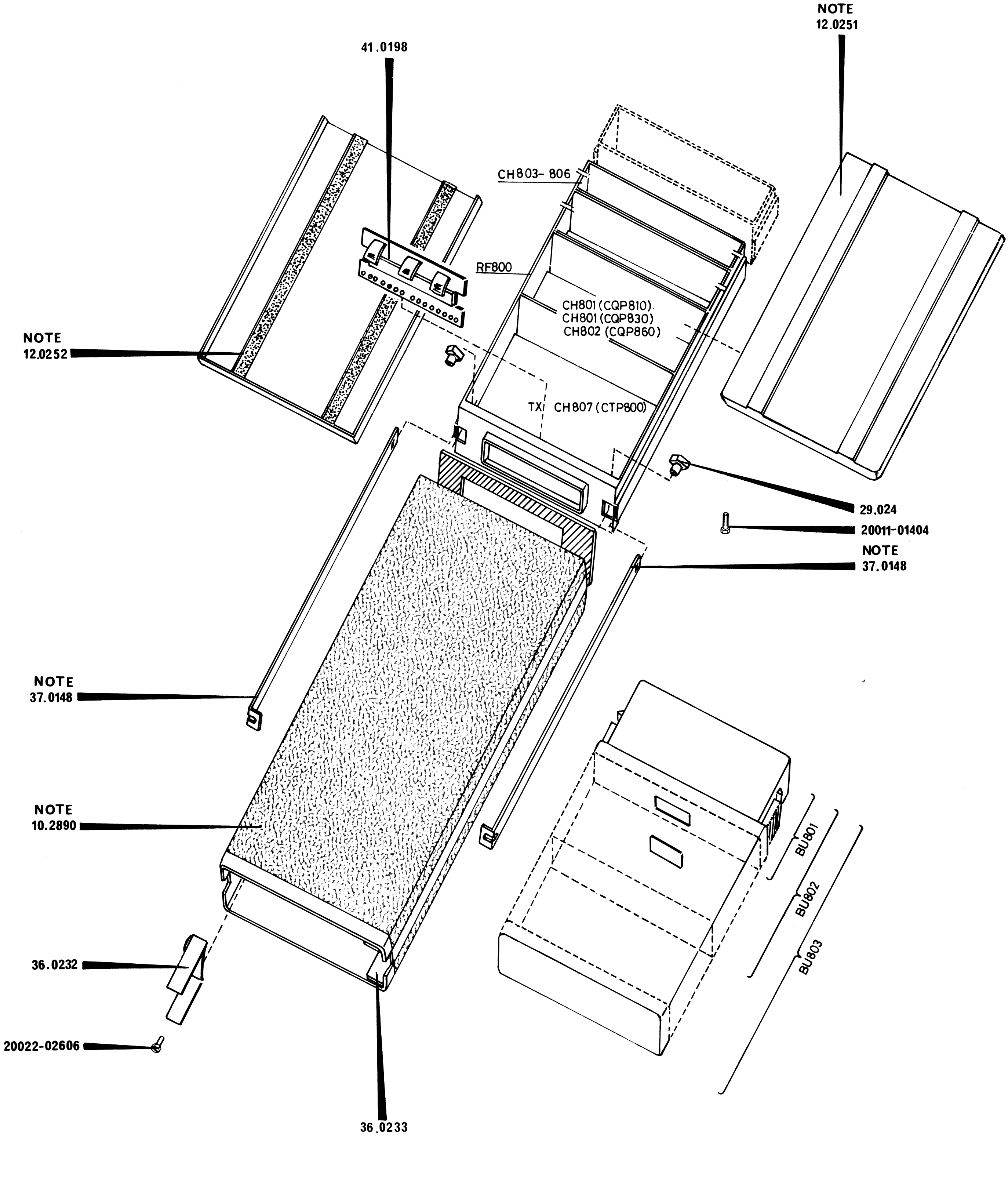
TYPE	Nº	CODE	DATA
		10.3159	Control Unit CB803
	C1	73.5149	47 µF 20% tantal 16 V
	LS	96.5086	Dynamic microphone 20 Ω
		41.5160	Earphone socket
		47.0614	SQ/LS Switch assembly
		47.5033	Key Switch

Storno

TYPE	Nº	CODE	DATA

CONTROL UNIT CB803

X402.377

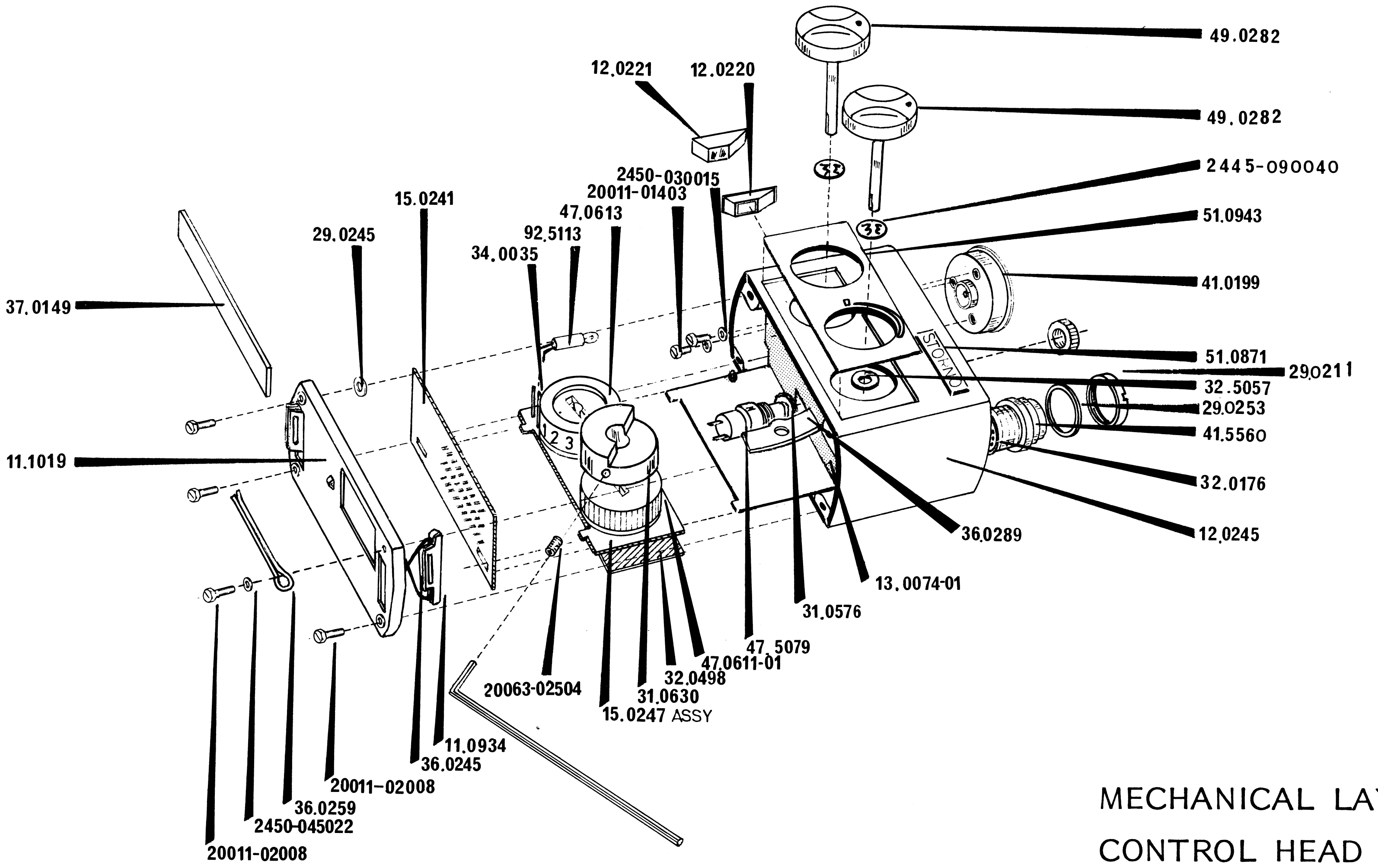


STORNOPHONE 800

MECHANICAL LAYOUT

M405.061

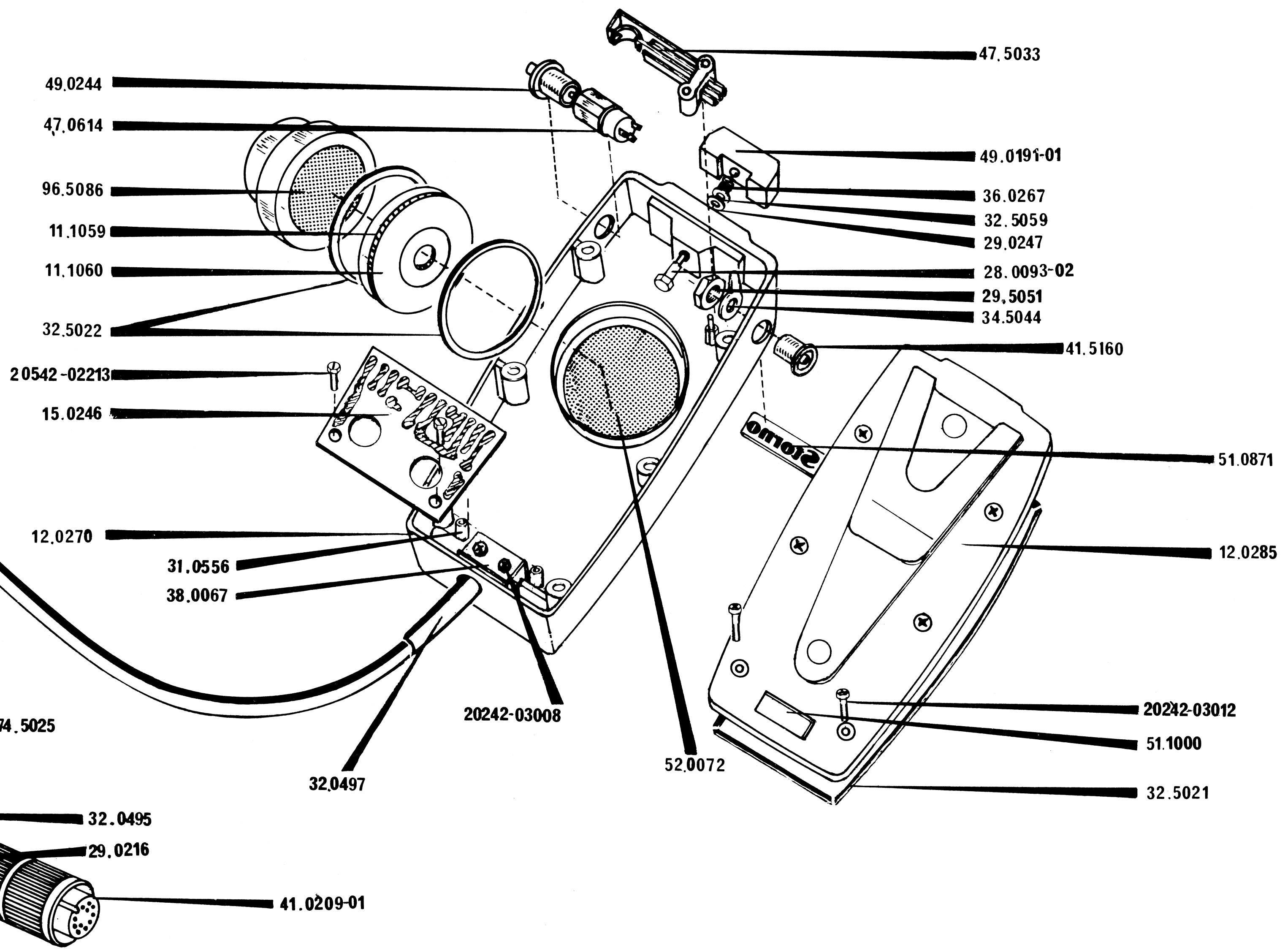
Storno



MECHANICAL LAYOUT
CONTROL HEAD CP802.

M405.057/5

Storno

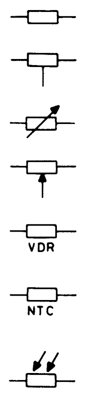


MECHANICAL LAYOUT
CONTROL UNIT CB803

M405.059/4

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Resistors (R)



- Resistor
- Resistor with fixed tap
- Variable resistor
- Resistor with movable tap
- Varistor (voltage-dependent resistor)
- Temperature-dependent resistor with negative temperature coefficient
- Light-sensitive resistor (Photosensitive resistor)

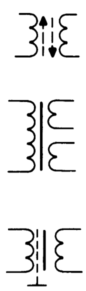
Capacitors (C)

- Capacitor
- Variable capacitor
- Trimmer capacitor
- Feedthrough capacitor
- Electrolytic capacitor

Coils (L)

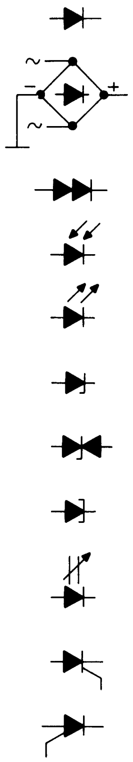
- RF coil, air core
- Coupled RF coils, air core
- RF coil with core
- RF coil with adjustable core
- AF choke

Transformers (T)



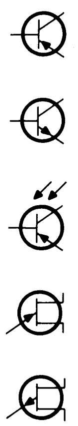
- Transformer with adjustable RF cores
- Transformer with iron core
- Transformer with screen connected to chassis

Diodes (E)



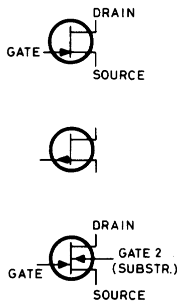
- Diode
- Bridge rectifier
- Series-connected stabilizer diodes within one case
- Light-sensitive diode (Photosensitive diode)
- Light-emitting diode
- Zener diode (unidirectional)
- Zener diode (bidirectional)
- Tunnel diode
- Varactor diode (capacitance diode)
- Controlled rectifier, PNPN (N-thyristor)
- Controlled rectifier, NPNP (P-thyristor)

Transistors (Q)

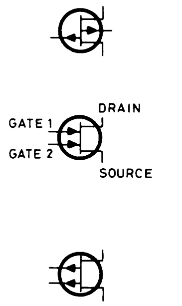


- Transistor, PNP
- Transistor, NPN
- Light-sensitive transistor
- Unipolar transistor with N-type base
- Unipolar transistor with P-type base

Junction Field Effect Transistors (JFET)

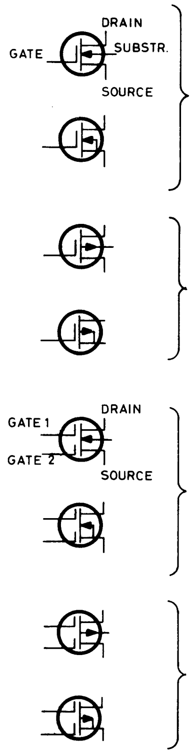


- N-channel JFET
- P-channel JFET
- N-channel dual gate JFET



- P-channel dual gate JFET
- N-channel JFET tetrode
- P-channel JFET tetrode

Insulated Gate Field Effect Transistors (IGFET or MOS)

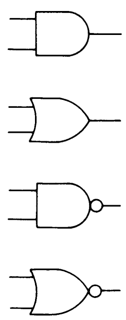


- N-channel IGFET (MOS)
- P-channel IGFET (MOS)
- N-channel dual gate IGFET (MOS)
- P-channel dual gate IGFET (MOS)

Integrated Circuits (IC)

Several integrated circuits contained within one case are designated by one common number followed by an identifying letter (a, b, c etc.). Thus, circuits IC1a, IC1b and IC1c are contained within one case.

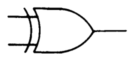
Gates

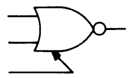


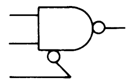
- AND gate
- OR gate
- NAND gate
- NOR gate

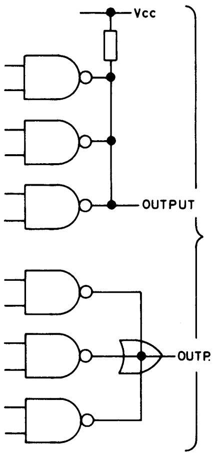
GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

Gates, continued


Exclusive OR gate


NOR gate with expander input (high)

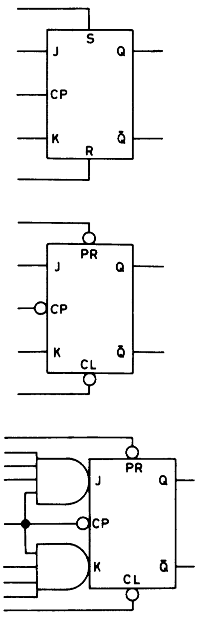

NAND gate with expander input (low)



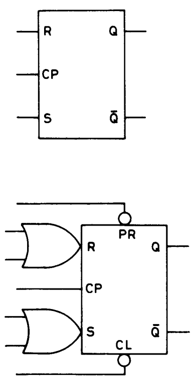
Wired-OR (combined OR outputs) (presentation at top is used in detailed diagrams; presentation below is used in functional diagrams)

Flip-flops

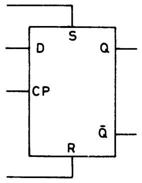
Abbreviations used: S = Set
R = Reset
CP = Clock Pulse
PR = Preset
CL = Clear



J-K Flip-flops

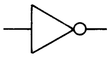


R-S Flip-flops

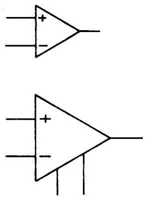


D Flip-flop

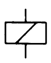
Inverters

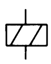

Inverter

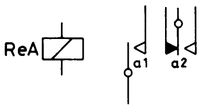
Operational Amplifiers


Operational amplifiers

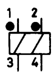
Relays (RE)


Single-coil relay

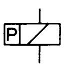

Dual-coil relay



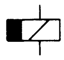
Relay with make contacts and change-over contacts

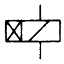


Relay with direction of winding indicated. Dot indicates two coils wound in the same direction



Polarized relay


Coil for slow-release relay


Coil for slow-acting relay

Contacts

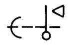
Contacts are always shown in their non-operated positions unless otherwise specified

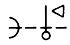

Make contacts

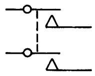

Break contacts


Change-over contacts

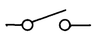

Change-over contacts, centre off

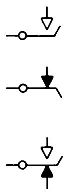

Make contacts, delayed operation

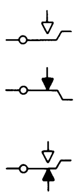

Make contacts, delayed release

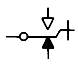

Mechanically coupled make contacts

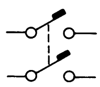
Switches and Keys (O)

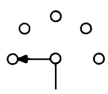

On/off switch


Locking keys or switches; push on, push off


Non-locking self-releasing keys or switches

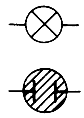

Locking mutually releasing keys or switches (in row of push-buttons etc.)


Self-releasing switch (overcurrent switch etc.)


Rotary switch

GRAPHICAL SYMBOLS USED IN STORNO CIRCUIT DIAGRAMS

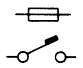
Lamps (V)



Indicator lamp

Neon lamp

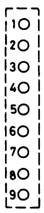
Fuses and Cut-outs (S)



Fuse

Circuit-breaker

Tag Strips (KL)

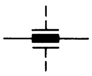


Tag strip - dashed frame may be wholly or partly omitted

Batteries (BT)

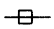
Battery

Feedthrough Filters (F)



Feedthrough filter

Ferrite Beads (FB)

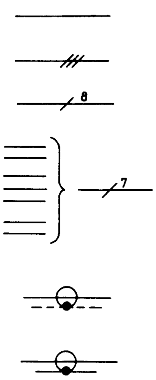


Ferrite bead

Crystals (X)

Crystal

Cables and Wires (W)



Usual conductor

Three conductors

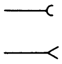
Eight conductors

Shift from multiple-line to single-line presentation

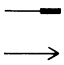
Screened wire

Coaxial cable

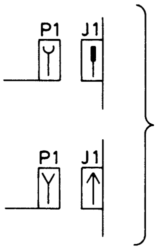
Connectors (J and P)



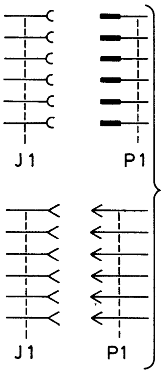
Female connector (socket). Lower symbol discontinued



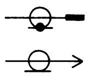
Male connector (plug). Lower symbol discontinued



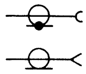
Schematic symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)
Multi-wire connectors are always designated "J" when permanently mounted on a cabinet or unit etc., "P" when fitted to cables



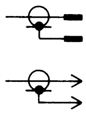
Detail symbols for multi-wire connectors. (Upper symbol will gradually supersede lower symbol)
Where both connectors are fitted to cables, male connector is designated "P" and female connector "J"



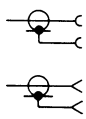
Coaxial plug



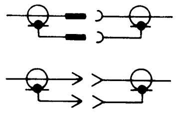
Coaxial socket



Coaxial plug for floating screen



Coaxial socket for floating screen

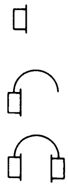


Coaxial plug with mating socket

Loudspeakers (LS)

Loudspeaker

Telephones (TEL)



Telephone

Single headphone (earphone)

Double headphone (headset)

Microphones (M)

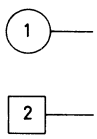
Meters etc.

Indicating instrument

Balancing instrument

Inkwriter, recording instrument

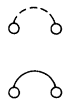
Test Points



DC test point

AC test point

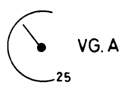
Replaceable Connections



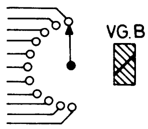
Cross-field connection (jumper)

Strap

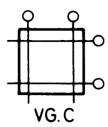
Selectors (VG)



Schematic symbol for rotary selector with designation of number of contact points



Detail symbol for rotary selector



Co-ordinate selector

CHARGING UNITS CU801 AND CU802

Description

General

CU801 and CU802 are mains operated automatic fast charging units for two and ten batteries respectively.

The chargers are designed as desk apparatuses, but may also be installed on a wall. The chargers are totally automatic, which means that they have no operating buttons but only a control indicator (LED) at each battery outlet.

Each battery outlet on the two chargers may be coded individually to the two battery types:
BU802 and BU803.

This is done by means of code pins in such a way that it is ensured that the different battery types can be charged only in the corresponding outlets.

Furthermore, each battery outlet, possibly at a later time, can be changed to charge another type of battery without the use of new materials and without soldering, as the code pins can be moved and all wires are changed by moving shorting links.

Each charger is supplied with a kit containing code pins, shorting links, and labels for changing a single outlet or all outlets.

The code pin system used in the chargers makes it possible to use a max. of 5 battery types, without mechanical work on the charger.

In the final test dept., before shipping to customers, the chargers are coded and marked with labels showing the type of battery to which the outlets are coded.

The chargers are delivered to specifications, for instance:

CU801 spec. 1/2 - 1/3

2 - outlet charger coded for 1 BU802 and 1 BU803.

CU802 spec. 3/2 - 7/3

10 - outlet charger coded for 3 BU802, and 7 BU803.

CU801 and CU802 are composed of modules built on printed wiring boards.

CU801 contains 1 "Control panel" module with electronics for two outlets and 1 "Supply panel" module.

CU802 contains 5 identical "Control panel" modules each with electronics for two outlets and 1 "Supply panel" module.

CU801 and CU802 are short circuit safe and protected against mains dropouts, e.g. the charging is automatically continued when the mains is reconnected.

Charging the Ni/Cd batteries BU802/803

The charging starts and the charging indicator turns ON when the battery is inserted in the outlet. As long as the charging indicator is ON, the battery is charged with a high charging current (fast charging). The fast charging discontinues and the charging indicator turns off by means of a voltage rise measurement across the battery. The voltage rise occurs when the battery has been charged to approx. 70% of its specified capacity. Though, after a longer period of storing or first time charging, this voltage rise may be too small or fail to appear, and then the fast charging is continued.

Storno

Continuation of the fast charging brings the Ni/Cd battery into a state of overcharge which causes the internal temperature of the battery of rise.

All BU802 and BU803 batteries have a built-in PTC resistor, which via the battery terminals is inserted in the measuring circuit of the charger. The PTC resistor interrupts the fast charging if the voltage rise is insufficient and latest when the internal battery temperature reaches 50°C.

When the charging indicator turns off, the BU802 and BU803 batteries in the CU800 are trickle charged with a low current, which the batteries can sustain for a longer time. After approx. 2½ hours of trickle charge (after fast charge) BU803 and BU802 reach 100% capacity.

Though BU802 and BU803 ought not to be trickle charged for more than 2 weeks. When the CU800 is disconnected from the mains the batteries should be removed from the outlets as 3mA will discharge via CU800 causing a loss of approx. 75mAh in 24 hours.

The fast charging time of Ni/Cd batteries is depending on the state of charge when inserted in the charger.

The period, the charging indicator is turned on, may be as short as a few seconds. When a fully charged BU802 or BU803 (95-100%) is inserted in the outlet, the fast charging does not start, but only the trickle charge. Nor does the fast charging start, if the battery, regardless of its charge, is more than 55°C warm when inserted in the outlet.

Because of the built-in PTC resistor in the BU802 and BU803, it is necessary to orientate the batteries when inserted in the outlet, which is ensured by the code pins. Note, that the highest battery capacity, when charging is reached under nominal conditions, which is applicable to all types BU802 and BU803 batteries.

Circuit Description

The transformer, which is identical in CU801 and CU802 has two iron cores the secondaries of which are connected in counter phase.

In CU801 the load is split with one outlet on each transformer iron core.

In CU802 the load is divided with 5 outlets (A-C-E-G and I) on one iron core and 5 (B-D-F-H-J) on the other.

The "Supply panel" module, which is identical in the two chargers, supplies the necessary DC voltages: +6.3V stabilized voltage to the comparators, and +10V to the charging indicators, and +20V as control voltage to SCR and charging indicator circuits.

The "Control panel" module with electronics for two outlets, are built up around one integrated circuit containing 4 separate comparators. Each outlet has a voltage doubler in order to achieve a more constant charging current. The doubler is composed of C4 (C3), E8 and the SCR E19, which also functions as a charging current switch.

The termostat O1 and the diode E51 is only implemented in CU802.

During periods of long and heavy loads (continously fast charging on all outlets for BU802 and BU803) the charging time may be a little longer than specified, as the transformer, for reasons of safety, is supplied with a thermostat (Reed switch), which opens at 60°C on the outside of the transformer, and thus disconnects all ten SCRs turning the fast charging to the trickle charge state.

When the transformer has cooled sufficiently off, the fast charging switches on again.

During the interruption of the fast charging, the charging indicator is not turned off, so that it is not mistakenly believed that the charging of the batteries has finished.

Storno

The SCRs are turned off by supplying +10V via E51 to terminal 9 instead of +20V via 01, thereby disconnecting the gate current to E19 while Q2 is still conducting and LED E1 is lit.

Principles of function

Function of CU800 coded to charge BU802 and BU803

As shown in the function diagram fig. 1, R19 is not in circuit when the battery is removed from the outlet, and so pin 9 of the comparator is held at a higher potential than pin 8 by means of the trickle charge circuit. This causes the comparator output (pin 14) to be in off state producing a short-circuit at the succeeding comparator output (pin 13). This conditions causes the SCR E19 and transistor Q2 both to be nonconducting. The voltage to the trickle charge circuit (R2 - R3 - E20) is derived ahead of the voltage doubler in order not to exceed 35V, which is max. permissible voltage at the positive outlet terminal with the battery removed.

Diode E25 protects C5 tantalum capacitor against higher than 0.5V reverse voltage when the battery is removed from the outlet.

During a possible short-circuit of the outlet terminals E19 held in the off state as both comparator inputs (pin 8 and 9) are supplied from the positive bus.

The short-circuit current is determined by the components in the trickle charge circuit and the charging control circuit is thus protected in case of output terminal short-circuits.

When a battery is inserted in the outlet the control circuit measures the battery voltage via R17, R18, R19, and the PTC resistor.

If the battery voltage is below the preset level for the start voltage (1.37V/cell, adjusted by R14) the comparators change state, E19, Q2, and E1 will conduct and the fast charging starts. The fast charging continues hereafter until the voltage across the battery reaches the preset stop voltage (adjusted with R18) at which the comparators switches E19, Q2, and E1 off, and the charging of the battery is continued via the trickle charge circuit.

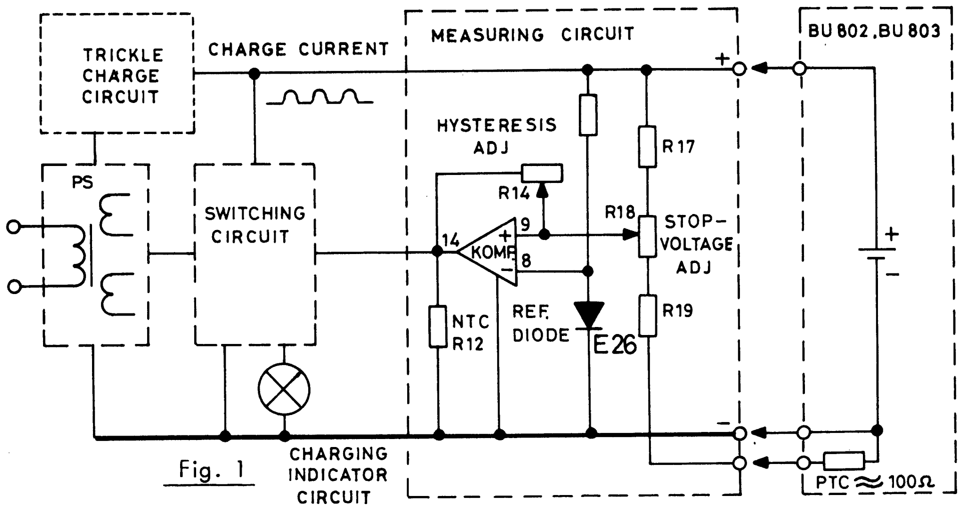


Fig. 1

If the voltage rise of the battery is insufficient, the PTC resistor in the battery is heated and thus rising the sensor voltage to the comparator to the stop voltage level so stopping the fast charging. As long as the sensor voltage is artificially increased (hot PTC resistor), the start voltage level is decreased accordingly because of the hysteresis being constant.

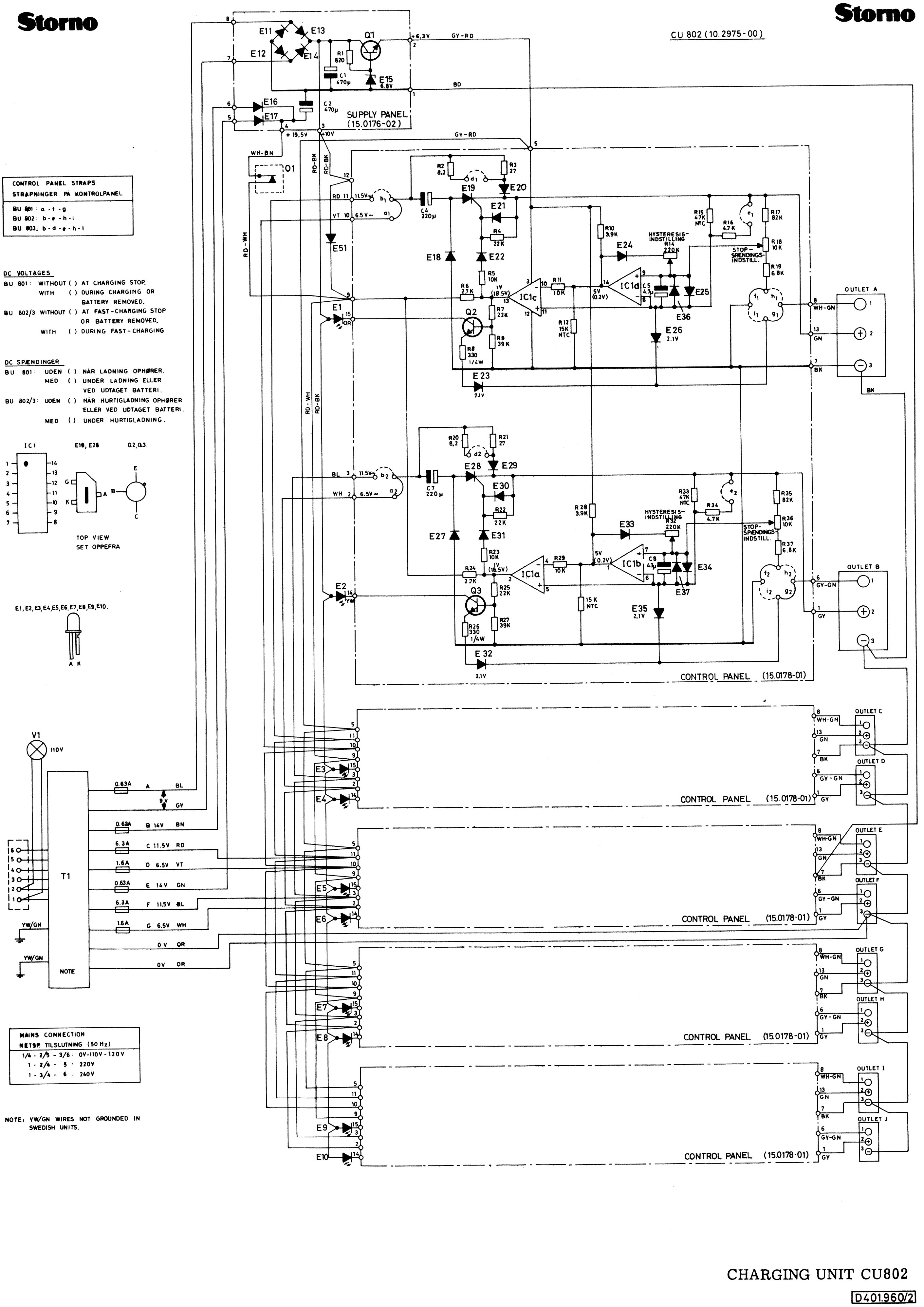
The stop voltage is adjusted individually, according to type of battery, rate of charge and ambient temperature. By means of the temperature coefficient of reference diode E26 the stop voltage is regulated decreasingly 4mV/^{o}C/battery cell. In order to cancel the influence of E26 on the start voltage level, which is to be uniform in the whole temperature range, R12 is a NTC resistor.

By feeding the reference diode E26 from the positive bus there has been obtained, except for the short circuit safety, an ensurance for automatic continuation of the charging after mains failure. When the mains is disconnected pin 9 of the comparator has lower potential than pin 8 originating from the voltage of the battery, and the comparator therefore opens E19, when the mains returns.

Storno

Storno

CU 802 (10.2975-00)



CHARGING UNIT CU802

D401.960/2

TYPE	NO.	CODE	DATA	
JP562		10.1928	Junction Panel	
	C1	74.5108	4.7 nF -20+80% ceram II PL	20V
	C2	74.5108	4.7 nF -20+80% ceram II PL	20V
	C3	74.5108	4.7 nF -20+80% ceram II PL	20V
	C4	76.5109	1 nF 2.5 % polystyr.	30V
	C5	73.5074	12 μF -20+75% tantal	15V
	C6	73.5131	0.047 μF -20+50% tantal	20V
Altern.	C6	73.5077	0.05 μF 10% tantal	10V
	R1	86.5036	50 kΩ 20% potm. carbon film	0.05W
	R2	86.5038	0.5 MΩ 20% potm. lin. carb. film	0.05W
	R3	80.5085	1 MΩ 10% carbon film	0.1W
	R4	80.5033	47 Ω 5% carbon film	0.1W
	L1	63.5007	15 μH Filter coil/filterspole	
	L2	63.5007	15μH Filter coil/filterspole	

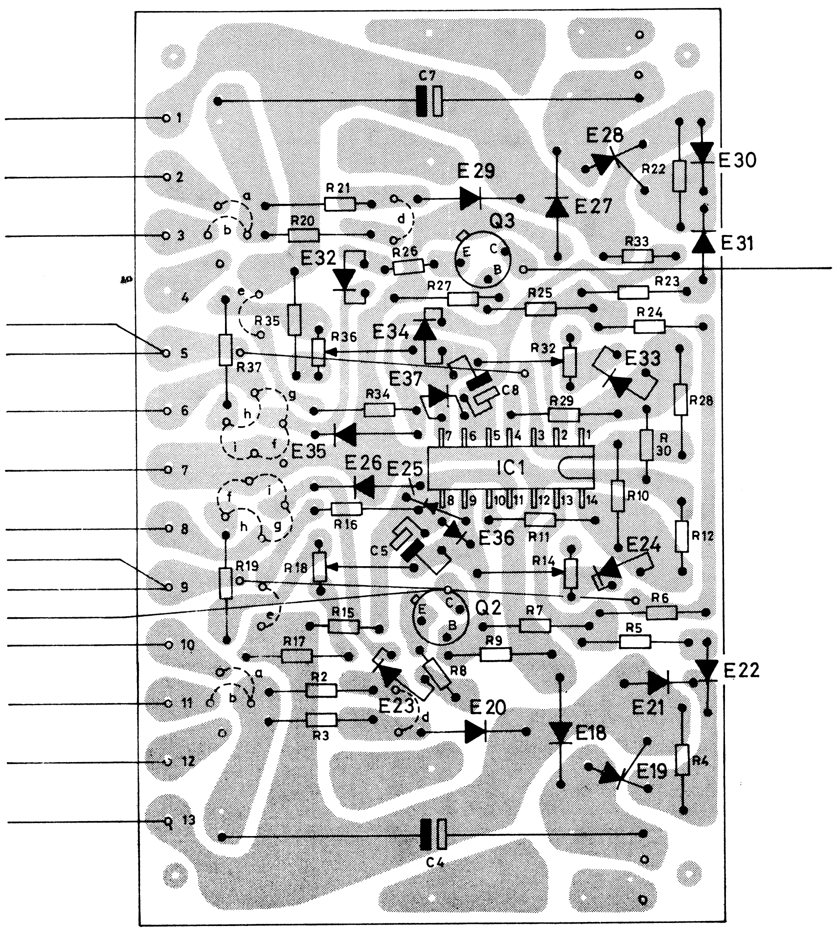
Storno

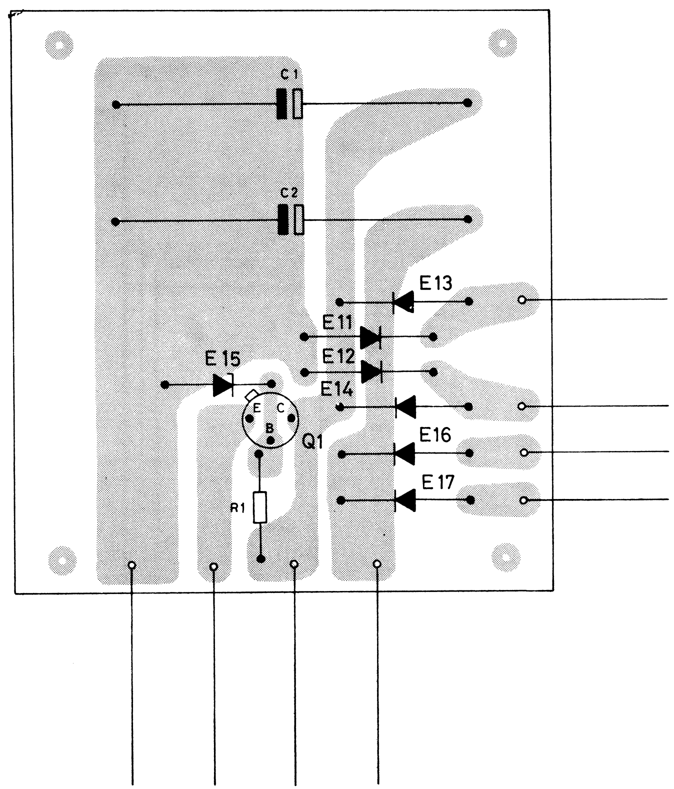
TYPE	NO.	CODE	DATA

JUNCTION PANEL
SAMLEPANEL

X401.102

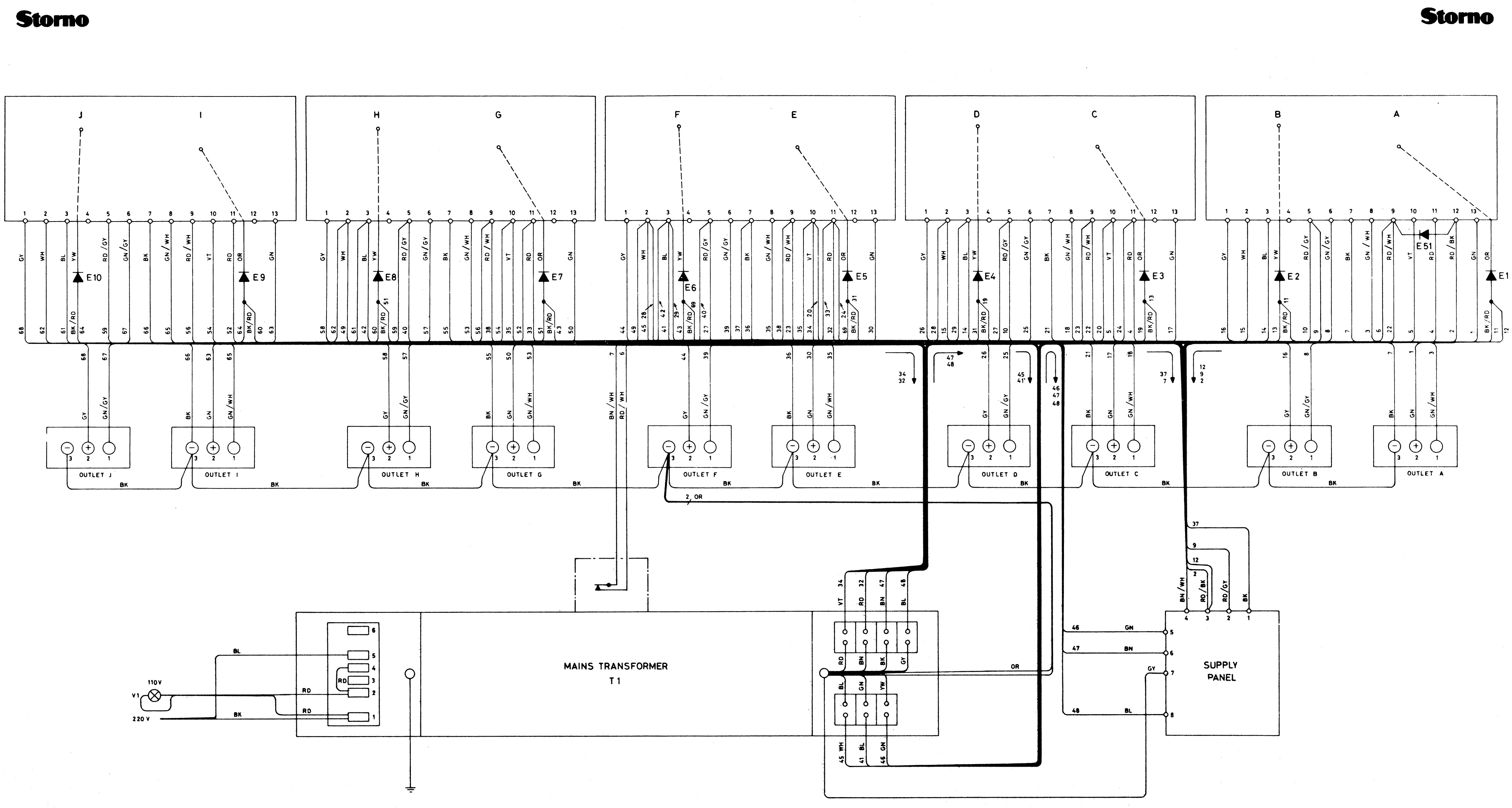
JP562





BESTÜCKUNGSPLAN CU801, CU802

D402.278



BESTÜCKUNGSPLAN
VERDRAHTUNG

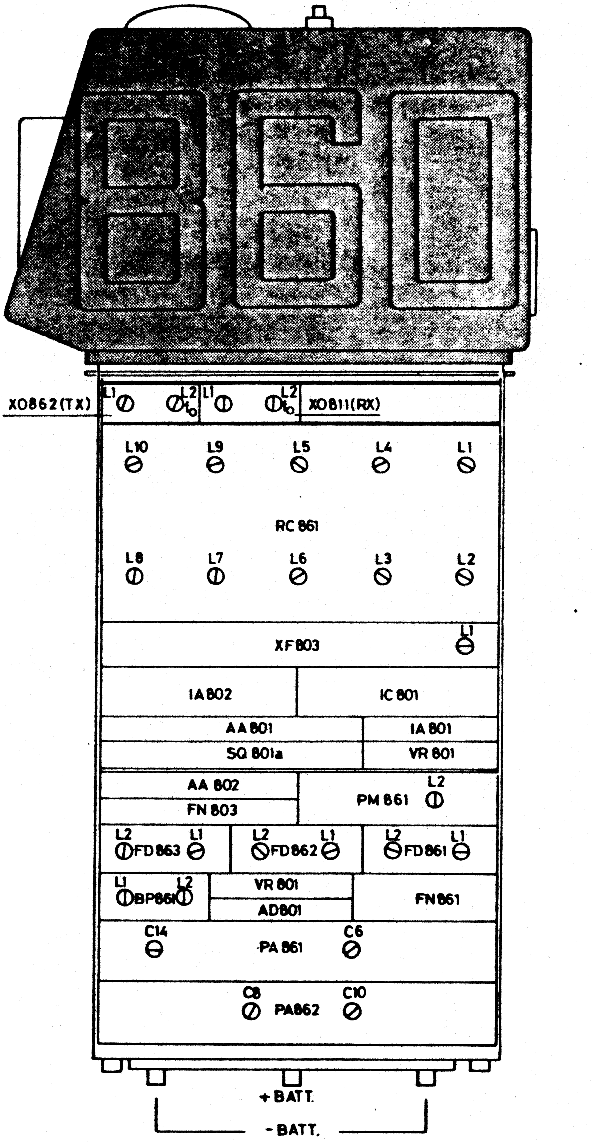
CU802

D402.281

Storno

SERIES 800

ALIGNMENT CARD



D402.091