PERSONAL RADIOTELEPHONE
MODEL STORNOPHONE 800 US
TYPE CQP812 US
TYPE CQP813 US
TYPE CQP814 US
146 - 174 MHz

CONTENTS

Service Coordination
10 - 81
1st Edition

TECHNICAL SPECIFICATIONS

CQP810US

Specifications are based on the measuring methods prescribed by EIA publications RS152A and RS204A, British Home Office MPT1301and CEPT specifications.
Figures in ( ) are guaranteed values.

GENERAL SPECIFICATIONS

Frequency Range
146-174 MHz

Channel Spacing
CQP813US: 20/25 kHz
CQP814US: 12.5 kHz

Maximum Frequency Deviation
CQP813US: ±4 kHz or ±5 kHz
CQP814US: ±2.5 kHz

Modulation Frequency Range
CQP813US: 300 - 3000 Hz
CQP814US: 300 - 2400 Hz

VHF Bandwidth
1.5 MHz

Number of Channels
4 or 12 ← 32×8 BIT PROM
PROM (depending on the type of frequency control unit, FC801 or FC802)

Antenna Impedance
50 ohm at multiwire connector

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

TRANSMITTER SPECIFICATIONS

RF Power Output
CQP810US 1 W: 0.1 - 1.0 W ±1 dB
CQP810US 3 W: 1.0 - 3.0 W ±1 dB

Measured at V_B= 11 V and $25^{o}C$.
Degradation under extreme conditions according to CEPT.

Mixer Crystal Frequency Range
48 - 58 MHz

Frequency Stability
Conforms with Authorities' specification

Spurious Radiation, CEPT
Less than 0.2 uW

Side Band Noise, CEPT
CQP813US: -80 dB (-70 dB)
CQP814US: -70 dB (-60 dB)

FM Hum and Noise, CEPT
CQP813US: -50 dB (-40 dB)
CQP814US: -45 dB (-40 dB)

Tone Input Modulation Sensitivity

110 mV

Terminal voltage for 60% Δf_{max}; 1 kHz

Modulation Frequency Response, CEPT

CQP813US: 0/-2 dB (+1/-3 dB) 300 - 2700 Hz

CQP814US: 0/-2 dB (+1/-3 dB) 300 - 2400 Hz

relative to 1000 Hz; 6 dB/octave

Modulation Distortion

2% (5%)

measured with 750 usec. de-emphasis

RECEIVER SPECIFICATIONS

Sensitivity, EIA, MPT

0.5 uV (1.0 uV) at 25°C

e.m.f. for 12 dB SINAD

Sensitivity, CEPT

0.7 uV (1.2 uV) at 25°C

e.m.f. for 20 dB SINAD

Squelch Sensitivity, EIA

0.4 uV at 25°C

Mixer Crystal Frequency Range

122 - 137.175 MHz

Frequency Stability

Conforms with Authorities' specification

Modulation Pass Band, EIA

CQP813US: ±7 kHz (±5 kHz)

CQP814US: ±4.5 kHz (±3 kHz)

measured at 25°C

Adjacent Channel Selectivity, CEPT

CQP813US: at least 70 dB

Adjacent Channel Selectivity, MPT

CQP813US: 80 dB (70 dB)

CQP814US: 70 dB (60 dB)

Spurious Selectivity, CEPT

At least 70 dB

Spurious Selectivity, MPT

75 dB (70 dB)

Blocking, MPT

100 dB (90 dB)

Intermodulation, MPT

70 dB (60 dB)

Spurious Radiation, CEPT

Less than 0.2 nW

AF Output Power, CEPT

At least 400 mW

measured at R_L = 25 ohm
V_B = 11 V
distortion= 10%
AF= 1 kHz

AF Distortion

2% (7%)

measured at Δf= 60%
AF= 1 kHz, 300 mW

AF Response, CEPT

+0/-1.5 dB (+1.0/-3 dB)

relative to 1000 Hz; -6 dB/octave

SUPPLY VOLTAGE AND CURRENT DRAIN

Nominal Supply Voltage

11 V

Supply Voltage Range

9.9 V to 13.5 V

Transmitter Current Drain

1 W: 330 mA (360 mA)

3 W: 730 mA (780 mA)

Less tone equipment at nominal voltage

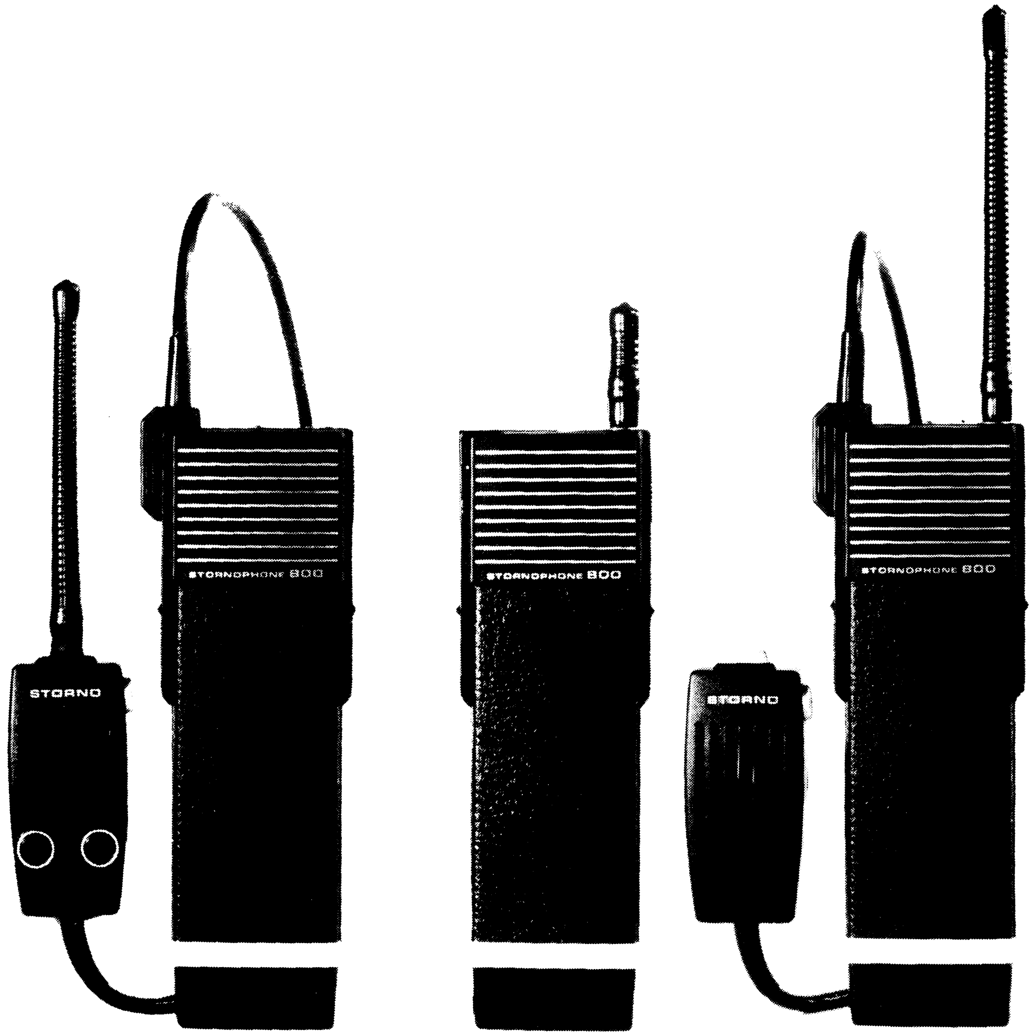
Receiver Current Drain

Standby:	25 kHz:	17 mA (20 mA)
	20 kHz:	19 mA (22 mA)
	12.5 kHz:	17 mA (20 mA)
Receive 250 mW:	25 kHz:	77 mA (92 mA)
	20 kHz:	79 mA (94 mA)
	12.5 kHz:	77 mA (92 mA)

less tone equipment at nominal voltage

GENERAL DESCRIPTION AND OPERATING INSTRUCTIONS.

STORNOPHONE 800U



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

The CQP800U may be either local controlled or remote controlled, 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 four sections, beginning from the bottom these are:

1) the battery
2) the transmitter and receiver modules
3) the tone equipment
4) the control head

LOCAL CONTROL

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

REMOTE CONTROL

On remote controlled radios a control unit containing the transmitter key, tone key, and loudspeaker/ squelch buttons, the speaker/microphone and an earphone socket, is connected to the set by means of a cable. Connecting the control unit automatically operates a switch which transfers the functions of the control head to the control unit.

Control units with the following functions are available:

CB804 Contains loudspeaker/microphone, transmitter key, and a combined dial light-squelch cancelling button.

CB805 Contains loudspeaker/microphone, transmitter key, tone key I, a combined dial light-squelch cancel-loudspeaker in/out button, call indicator, and earphone socket.

CB812 Contains loudspeaker/microphone, transmitter key, tone key I, a combined dial light-squelch cancel-loudspeaker in/out-button, call indicator, and a threaded antenna socket. The unit is used for equipment operating in the 146-174 MHz band.

CB831 Contains loudspeaker/microphone, transmitter key, tone key I, a combined dial light-squelch cancel-loudspeaker in/out-button, call indicator, and a threaded antenna socket. The unit is used for equipment operating in the 68-88 MHz band.

CB851 Contains loudspeaker/microphone, transmitter key, tone key I, a combined dial light-squelch cancel-loudspeaker in/out-button, call indicator, and a threaded antenna socket. The unit is used for equipment operating in the 370-420 MHz band.

CB861 Contains loudspeaker/microphone, transmitter key, tone key I, a combined dial dight-squelch cancel-loudspeaker in/out-button, call indicator, and a threaded antenna socket. The unit is used for equipment operating in the 420-470 MHz band.

The length of a particular equipment will depend upon the number of channels, and whether it includes tone equipment or not.

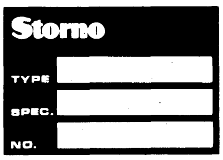
Type specification is as follows:

Specification	code
0.1-1.0 W RF output power	1
1.0-3.0 W RF output power	3
Universal control head CP808	C8
2 channels	X2
4 channels	X4
8 channels	X8
12 channels	X12
Tone equipment	T

Thus a 3 W , four-channel radiotelephone with universal control head and selective calling would be designated:

3 C8 X4T

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



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

Type	CQP833U	CQP834U
4 m VHF band	68 - 88 MHz	
Channel separation	20/25 kHz	12.5 kHz
Number of channels	2, 4, 8 or 12	
Output power	0.1 to 1.0 W or 1.0 to 3.0 W	

Type	CQP813U	CQP814U
2 m VHF band	146 - 174 MHz	
Channel separation	20/25 kHz	12.5 kHz
Number of channels	2, 4, 8 or 12	
Output power	0.1 to 1.0 W or 1.0 to 3.0 W	

Type	CQP863U	CQP864U	CQP853U	CQP854U
0.7 m UHF band	420 - 470 MHz		370 - 420 MHz	
Channel separation	20/25 kHz	12.5 kHz	20/25 kHz	12.5 kHz
Number of channels	2, 4, 8 or 12		2, 4, 8 or 12	
Output power	0.1 to 1 W or 1 to 3 W		0.1 to 1 W	

Type	CQP8414U
Midband	RX 136 - 146 MHz TX 105 - 108 MHz
Channel separation	12.5 kHz
Number of channels	2, 4, 8 or 12
Output power	0.1 to 1 W

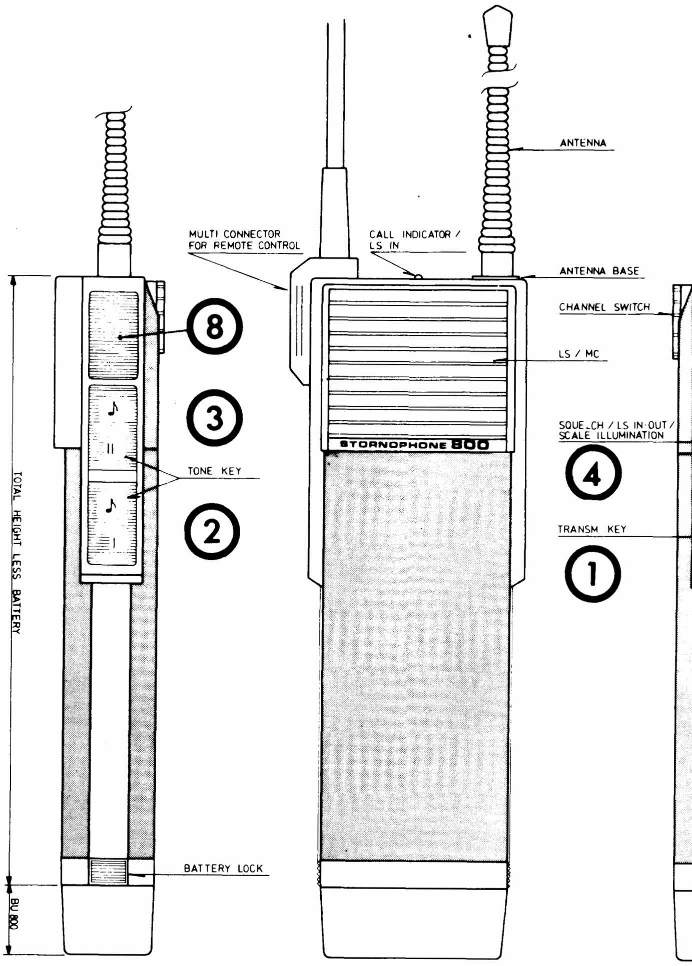
OPERATING INSTRUCTIONS

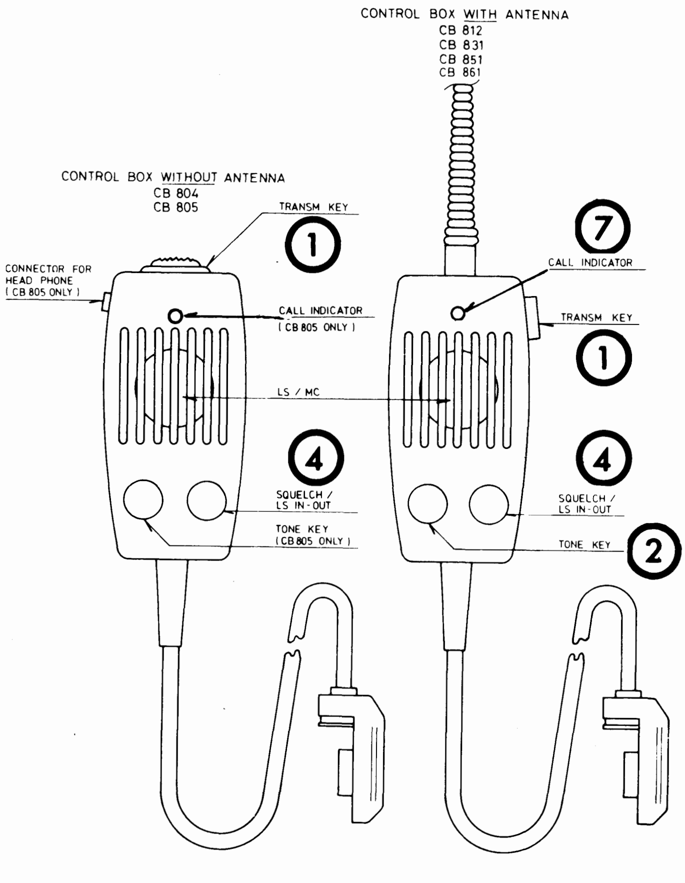
Local controlled equipments are fitted with CP808 control heads which interconnect with the various transmitter and receiver modules, channel switch and tone equipment, where applicable, via an internal wiring harness.

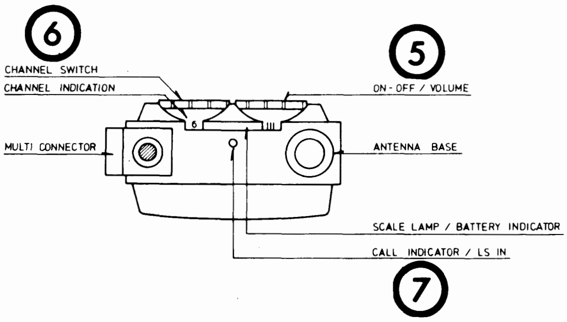
The following functions are incorporated in the CP808:

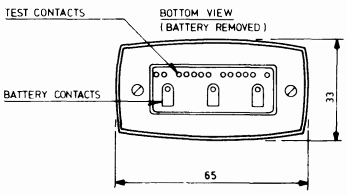
1. push button for keying the transmitter
2. push button for tone keying, tone I
3. push button for tone keying, tone II
4. push button for squelch cancelling-LS in/out.
5. dial-type knob for volume control and on/off switch.
6. 12-position dial-type channel knob
7. call indicator
8. hinged lid for access to the antenna tuning circuit
9. socket for remote control unit
10. socket cover
11. threaded antenna base

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


ANTENNA
MULTI CONNECTOR FOR REMOTE CONTROL
CALL INDICATOR / LS IN
ANTENNA BASE
CHANNEL SWITCH
LS / MC
SQUELCH / LS IN-OUT / SCALE ILLUMINATION
TRANSM KEY
TONE KEY
BATTERY LOCK
TOTAL HEIGHT LESS BATTERY
BU 800
STORNOPHONE 800
8
3
2
4
1


CONTROL BOX WITH ANTENNA
CB 812
CB 831
CB 851
CB 861
CONTROL BOX WITHOUT ANTENNA
CB 804
CB 805
TRANSM KEY
CONNECTOR FOR HEAD PHONE (CB 805 ONLY)
CALL INDICATOR (CB 805 ONLY)
LS / MC
SQUELCH / LS IN-OUT
TONE KEY (CB 805 ONLY)
CALL INDICATOR
TRANSM KEY
SQUELCH / LS IN-OUT
TONE KEY
1
4
7
2


CHANNEL SWITCH
CHANNEL INDICATION
ON-OFF / VOLUME
MULTI CONNECTOR
ANTENNA BASE
SCALE LAMP / BATTERY INDICATOR
CALL INDICATOR / LS IN
6
5
7


TEST CONTACTS
BOTTOM VIEW (BATTERY REMOVED)
BATTERY CONTACTS
33
65

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 squelch cancelling button while adjusting the volume control for the desired sound level, using the background noise for sound.
Set the channel selector to the channel to be used and release the squelch cancelling button. Any traffic on that channel will now be heard from the loudspeaker.

RECEIVING (WITH SELECTIVE CALLING)

Adjusting the sound level is done as in the sets without tone equipment except that it is necessary to press the SQ/LS button momentarily to switch on the loudspeaker before opening the squelch circuit.

After the setting of the volume control again press the SQ/LS button momentarily to switch off the loudspeaker.

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)

To initiate a call, 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)

Turn on the loudspeaker with the LS IN/OUT button, do not transmit until the channel is free. 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, i.e. the O on the dial is visible.

ACCESSORIES

ANTENNA

The following antennas are approved for use with radiotelephones type CQP800U and can be attached to either the control head CP808-IS or the control unit.

AN834 200 mm Heliflex Antenna		68 - 88 MHz
AN815 500 mm Whip Antenna		68 - 88 MHz
	and	146-174 MHz
AN816 150 mm Heliflex Antenna		146-174 MHz
AN864 46 mm Heliflex Antenna		420-470 MHz
	and	370-420 MHz
AN865 155 mm Whip Antenna		420-470 MHz
	and	370-420 MHz

All antennas are fitted with a threaded bolt that fits the antenna socket on the control head and on the control units type CB812, CB831, CB851 or CB861.

BATTERY

To power the equipment the following battery types are available:

BU802/808 nickel-cadmium (NiCd) battery, 10.8 V, 225 mAh.

BU807 nickel-cadmium (NiCd) battery, 10,8 V, 450 mAh.

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

BATTERY CHARGER

Available battery chargers:

CU801 Charging unit with two outlets for BU802, automatic type.

CU802 Charging unit with ten outlets for BU802, automatic type.

CU804 Charging unit with one outlet. A switch selects high or low charging current as to charge the different battery tupes.

CU805 Charging unit with six outlets and built-in timer; for all types of batteries.

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

EARPHONE

In conjunction with control unit CB805 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. The lower positions of the volume control are intended as settings for earphone reception.

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 CQP800U are as follows:

TT801 single or double tone transmitter, tone frequencies from 885 Hz to 2900 Hz.

TT802 single or double tone transmitter, tone frequencies from 1010 Hz to 3047 Hz.

ST801 four or five tone sequential tone transmitter, tone frequencies from 885 Hz to 2800 Hz.

ST802 four or five tone sequential tone transmitter, tone frequencies, from 960 Hz to 2110 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).

SR802 four or five tone sequential tone receiver, tone frequencies from 960 Hz to 2110 Hz.

TQ802 three, four, or five sequential tone transmitter/receiver, tone frequencies from 885 Hz to 2800 Hz. By means of a plug-in module, SU808, the TQ802 can detect group calls.

TQ803 three, four, or five sequential tone transmitter/receiver, tone frequencies from 960 Hz to 2110 Hz. By means of a plug-in module, SU808, the TQ803 can detect group calls.

CARRYING DEVICES

The following devices are available for carrying the CQP800U:

CK801a	carrying harness for all types of equipment, mounting hardware, short and long straps, belt and clamps.
CK802	screw mounted pocket clip.
CK803a	shoulder strap with retainer for remote control unit. (for remote control, only).

CIRCUIT DESCRIPTION

CQP810US

TRANSMITTER CIRCUITS

(refer to block diagram)

The transmitter is built up of several modules, each of which is completely shielded and has connector pins protruding from the bottom of the module. All modules are mounted into a motherboard.

The transmitter section consists of the following modules:

XO817	Crystal Oscillator
AA802	Modulation Amplifier
FN807G1	Modulation Filter for 20/25 kHz Channel spacing
or	
FN807G2	Modulation Filter for 12.5 kHz Channel spacing
RA811	RF Buffer Amplifier
PA811a	1st Power Amplifier for 1 W transmitters
PA812a	2nd Power Amplifier and Antenna Switch for 1 W transmitters
or	
PA813	1st Power Amplifier for 3 W transmitters
PA814	2nd Power Amplifier and Antenna Switch for 3 W transmitters
FN811	Antenna Filter
AD801	ADC-Automatic Drive Control Circuit
VR801	Voltage Regulator

MODULATION AMPLIFIER
AA802 AND FN807G1/FN807G2

The modulation amplifier function is carried out by the Modulation Amplifier AA802 in conjunction with the Modulation Filter FN807G1 or FN807G2.
The microphone signal is applied to an operational amplifier whose 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 tone transmitters, the Modulation Amplifier is disabled by the Tone Key.

The amplified AF signal is applied to a limiter circuit via a differentiating network. The limiter is an operational amplifier utilising negative feedback. Following the limiter is an active lowpass filter where the active element is another operational amplifier. The lowpass filter removes any harmonics of the original input signal that arise during the limiting action and the correct modulation frequency response is also obtained by the filter.

RF BUFFER AMPLIFIER
RA811

The amplifier buffers the synthesizer output and consists of a grounded emitter transistor stage with a tuned collector circuit. Another transistor in series with the supply line is controlled by the synthesizer lock signal and used to inhibit the transmitter signal when the synthesizer is out of lock.

POWER AMPLIFIER
PA811a - PA812a and PA813 - PA814

The power output signal from the Buffer Amplifier, approx. 10 mW, is amplified to the required antenna power in a three-stage amplifier composed of two modules.

PA811a and PA812a are used for 0.1 - 1.0 W and PA812 and PA814 are used for 1.0 - 3.0 W. PA811a and PA813 contain two amplifier stages. The collector voltage to the first transistor is supplied via the ADC circuit, AD801, and is variable. If more gain is required to drive the final PA 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.
PA812a and PA814 contain the final transmitter stage, plus a circuit for electronically switching the antenna between the receiver and transmitter.
The collector current of the second transistor stage in PA811a - PA813 passes through the switching diodes, whereby these 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 and effectively isolate the transmitter from the antenna while the receiver input is connected to the antenna.

ADC CIRCUIT
AD801

The transmitter output current is kept very nearly constant by the ADC circuit. The voltage drop across a small resistor in the final output transistor's collector return is monitored by the ADC stage, which then regulates the collector voltage to the first transistor of PA811a - PA813. The net effect is that any variations are concelled and the RF power is kept at a constant level.
The current flowing through the final output stage, and thus the output power, can be set by means of an external resistor mounted on the mother board.

ANTENNA FILTER
FN811

A nine-pole, lowpass filter having a cut off frequency of 180 MHz is inserted between the transmitter output and the antenna. The filter suppresses any harmonics created in the final power stage.

RECEIVER CIRCUITS

(refer to 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 receiver can be used on up to 12 channels which are generated by a frequency synthesizer. The receiver contains an electronic squelch circuit whose threshold can be set with a resistor on the mother board. A pushbutton on the Control Head or the Control Unit, which ever is used, can cancel the squelch.

The receiver consists of the following modules:

RC811a	Receiver Converter
XF803a	Crystal Filter for 20/25 kHz channel spacing
or	
XF804a	Crystal Filter for 12.5 kHz channel spacing
IC801	IF Converter
IA801	1st IF Amplifier
IA802	2nd IF Amplifier and Discriminator
SQ801a	Squelch Circuit
AA801a	AF Amplifier
VR801	Voltage Regulator

RECEIVER CONVERTER
RC811a

The RC811a converts the antenna signal frequency to the 1st IF of 21.4 MHz. The incomming signal path from the antenna is through the Antenna Filter FN811, and then via the antenna switching circuit in PA812a/PA814 to the input of RC811a.
The signal then passes through a two-element bandpass filter to a field effect transistor (J-FET) operating as a grounded gate amplifier. After amplification, the signal passes through a three-element bandpass filter. This filter is what mainly determines the RF bandwith of the converter. Following the filter is the mixer which is a grounded source J-FET. The injection signal is applied to the mixer gate together with the antenna signal. The IF signal from the mixer is taken off via a combination autotransformer/L-network to match the impedance of the following crystal filter.

CRYSTAL FILTER
XF803a and XF804a

XF803a is used in equipment with 20/25 kHz channel spacing.
XF804a is used i equipment with 12.5 kHz channel spacing.

The crystal filter module comprises an eight-pole monolitic crystal filter and an impedance matching network for matching the output to the impedance of the following IF converter. Practically all of the receiver's selectivity is achieved in the crystal filter.

IF CONVERTER
IC801

The first IF at 21.4 MHz is converted to the second IF at 103.5 kHz in this module which contains an IF amplifier stage, a mixer and a crystal controlled oscillator. The output signal is taken off from a center tap on the coil in the mixer transistor's collector circuit and applied to the IF 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 AMPLIFIER
AA801d

The audio signal from the IA802 is applied to the AA801d AF amplifier where it is amplified to the desired audio power level to drive the loudspeaker. The input stage is coupled as an active highpass filter that suppresses any pilot tone or low frequency noise. An integrated circuit containing two separate amplifiers which makes up the filter and output stage.

The volume control is inserted between the two amplifiers and the receiver de-emphasis is performed by the output amplifier's feedback network. The audio signal path can be blocked by grounding the squelch terminal (5). When the squelch voltage on terminal 5 is positive (more than 5 V) the amplifier will work 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 amplifier. 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 amplifier's gating terminal allowing it 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/ control unit allows manual cancelling of the squelch function.

FREQUENCY SYNTHESIZER CIRCUITS

(refer to block diagram)

The Frequency Synthesizer generates the signals required for the receiver injection and the transmitter power amplifiers. The signals are generated by a phase locked loop (PLL) controlling a voltage controlled oscillator (VCO) at the desired output frequency. The PLL circuit is working on a relative low frequency (f_{FS}) (0.5 - 3.2 MHz) to which the VCO frequency (f_{VCO}) is converted by mixing with a signal from a crystal controlled oscillator (f_{XO}).
The converted signal f_S from the mixer is applied to a programable divider whose output signal frequency is compared with a fixed reference signal frequency (f_{REF}) in a phase comparator. The output of the phase comparator is a DC voltage proportional to the phase difference between the two signal frequencies and it is used to control the VCO frequency. When the programable divider's frequency division ratio is changed the VCO frequency will change and thus generate a new channel. When the frequency synthesizer circuit is working and locked the following equation applies:

$$1) \quad f_{VCO} = f_{XO} + N \cdot f_{REF}$$

f_{VCO}=	VCO frequency.
f_{XO}=	Crystal oscillator frequency.
N=	Division ratio.
f_{REF}=	Reference frequency.

The Frequency Synthesizer consists of the following modules:

FG811	Voltage controlled oscillator for the receiver.
FG812	Voltage controlled oscillator for the transmitter.
RA812	Buffer Amplifier.
MX811	VCO signal mixer.
XO811	Crystal oscillator for converting the receiver VCO frequency.
XO817	Crystal oscillator for converting the transmitter VCO frequency.
IA803	Buffer amplifier for the MX811 output signal.
PL801	Phase locked loop circuit, programmable divider and reference signal frequency generator.

VOLTAGE CONTROLLED OSCILLATORS
FG811 and FG812

The voltage controlled oscillators are Hartley LC-oscillators using a J-FET with grounded gate as the active element. Part of the tuning capacitance is provided by a variable

capacitance diode. Changing the diode bias voltage causes the VCO frequency to change. The maximum frequency change is approximately 3 MHz and the center frequency is set by tuning the coil.
FG812 is the transmitter VCO and has two capacitance diodes in the tuning circuit. The second diode is used to modulate the VCO with the AF modulation signal.

BUFFER AMPLIFIER
RA812

The buffer amplifier is used for two purposes. First, during receive, the receiver injection signal is obtained from the output. Second, during transmit, the transmitter signal is obtained from the output. The input signal from the VCO is amplified in the input stage and applied both to the output and to an isolation amplifier which prevents the mixer crystal oscillator frequencies from interfering with the receiver injection signal or the transmitter signal. The isolation amplifier is only partly contained in the module, the remaining stage is part of the MX811.

MIXER
MX811

The mixer contains the last stage of the isolation amplifier and a mixer stage whose active element is a J-FET. Both the VCO signal coming through the isolation amplifier and the crystal controlled signal are injected into the mixer's gate.

RECEIVER CRYSTAL OSCILLATOR
XO811

The crystal oscillator is a Hartley type with a grounded base transistor as the active element. The output signal is capacitively taken off the collector tank circuit and applied to the mixer MX811. Using formula 1) to find the crystal frequency yields:

$$2)\ f_{XO} = f_{VCO} - N \cdot f_{REF}$$

As the receiver VCO frequency is 21.4 MHz below the antenna signal frequency, the exact calculation of the crystal frequency depends on the division ratio N.
For selection of crystal frequency and division ratio refer to the programming instruction for the Frequency Control modules.

TRANSMITTER CRYSTAL OSCILLATOR
XO817

The transmitter crystal oscillator is a Colpitts type oscillating on one third of the output frequency.
A tank circuit in the oscillator transistor's collector is tuned to the output frequency.
Two variable capacitance diodes are inserted in series with the crystal and allow the oscillator to be modulated with the AF modulation signal. Both the transmitter VCO and the crystal oscillator are modulated, the modulation being adjusted to the same frequency deviation.
The effect of this is that the mixer output, when transmitting, is not modulated and hence ensures that the phase comparator functions correctly.
Using formula 1) to find the oscillator frequency yields:

$$3)\ f_{XO} = f_{VCO} - N \cdot f_{REF}$$

As the transmitter VCO is oscillating on the transmitter output frequency, the exact calculation of the crystal frequency depends on the devision ratio N.

For selection of crystal frequency and division ratio refer to the programming instruction for the Frequency Control module.

BUFFER AMPLIFIER
IA803

The Buffer Amplifier IA803 provides a sufficient drive level to the PLL circuitry and consists of a three stage amplifier. The input and intermediate stage are DC series connected and the latter drives a complementary emitter follower output stage.
This configuration means that the amplifier is able to source and sink the current of a capacitive load.
A switching diode isolates the receiver injection input from the amplifier during transmit periods.

PHASE LOCKED LOOP CIRCUITS PL801

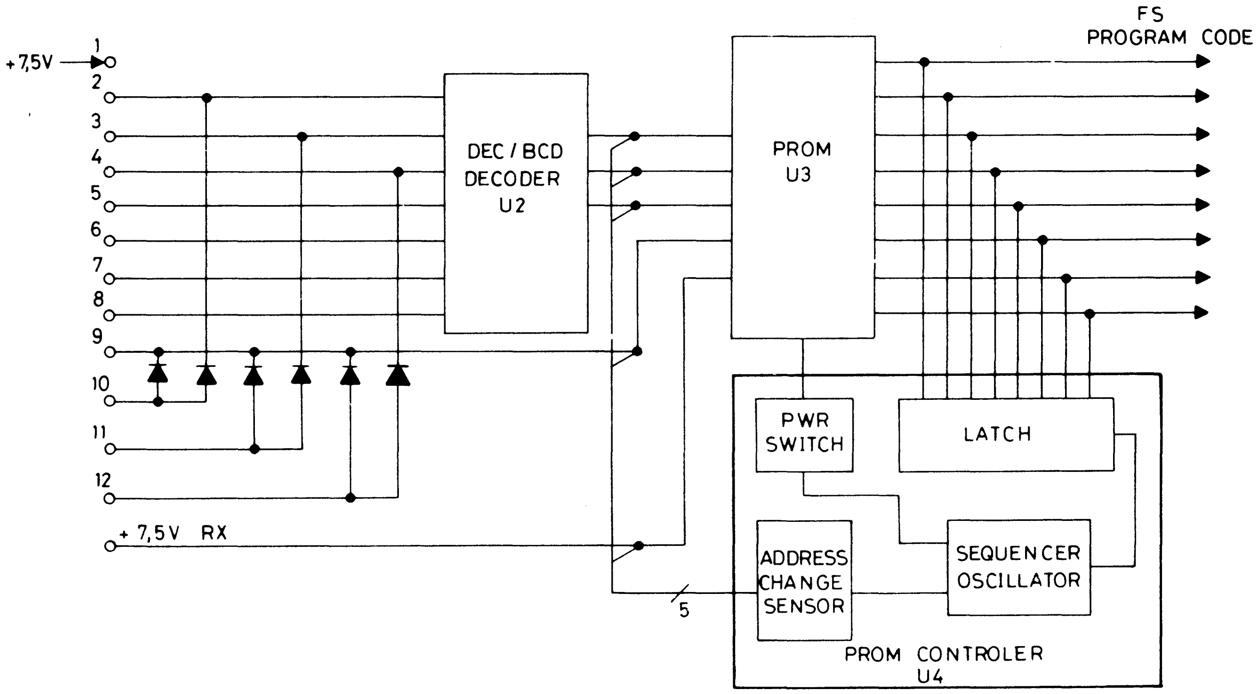
The PL801 module contains the phase locked loop of the frequency synthesizer the main functions being performed by one integrated circuit.

The IC contains a programmable divider, a phase detector, a reference frequency oscillator and amplifier with fixed divider and a lock detector circuit.

The programmable divider divides the variable frequency f_s down to the reference frequency. The division ratio N is set by the Frequency Control module and any change in N causes a change in the output frequency.

The phase detector provides the VCO control voltage and has a three-state output which has high impedance when the loop is locked. With the loop out of lock the output is either logic high or low depending on the phase-frequency error polarity.

The reference frequency oscillator is crystal controlled and its output frequency is divided by 1024. The reference frequency sets the channel spacing and the lowest possible frequency step which is equal to the reference frequency (f_{XREF} ÷1024)



CHANNEL SWITCHING FUNCTIONAL DIAGRAM
CQP800US

D403.029

Different crystal frequencies are used to obtain the channel spacing as follows:

12.5 kHz/25 kHz=	6.4 MHz
20 kHz=	10.24 MHz
20 kHz=	5.12 MHz

The lock detector has an output which goes logic high when the loop is locked.

Furthermore the module contains switching circuitry to disable the transmitter and mute the receiver whenever the Frequency Synthesizer is out of lock.

VOLTAGE REGULATOR
VR801

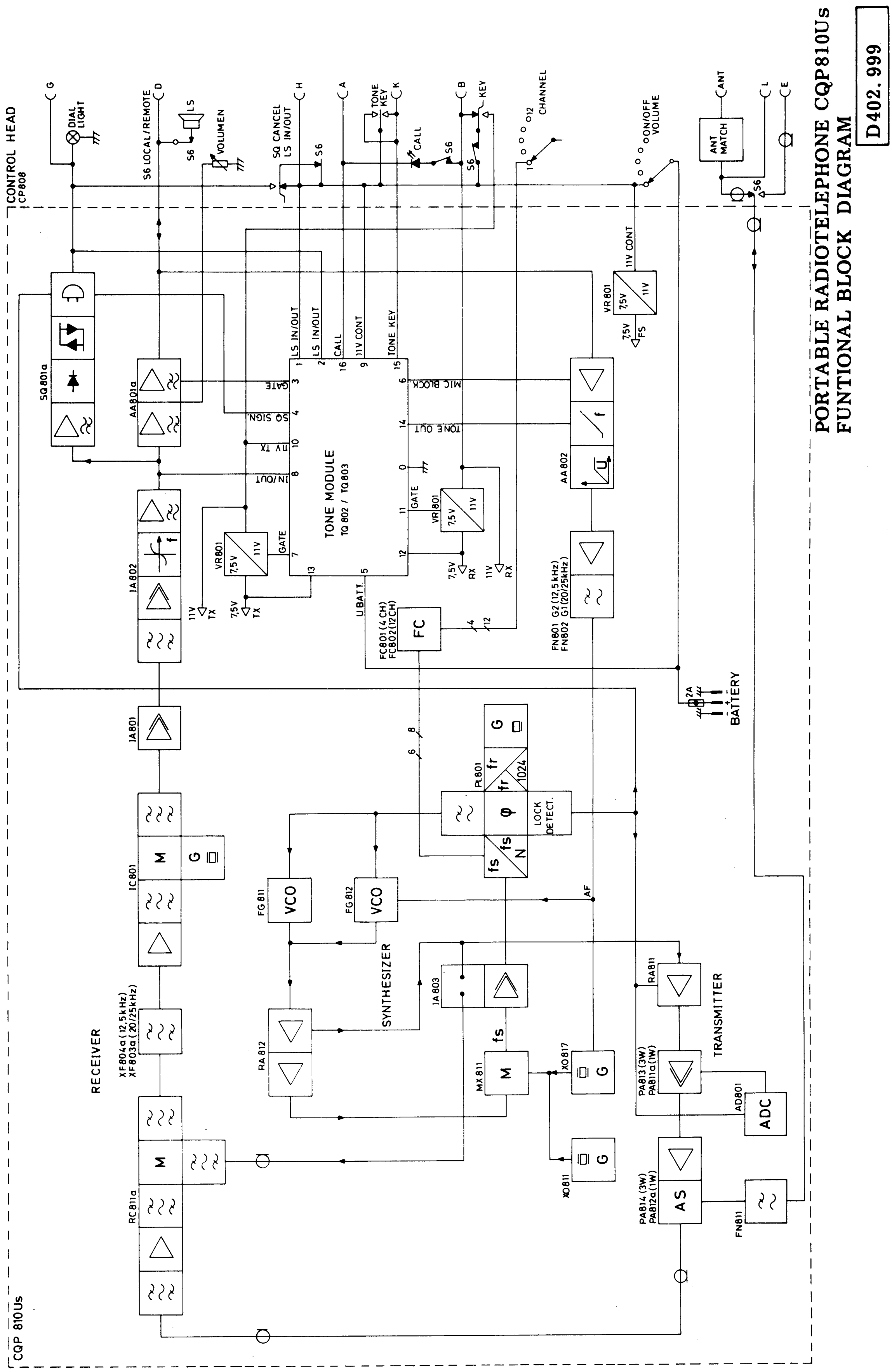
Because of variation in the battery voltage during discharge three voltage regulators type VR801 are used to supply the transmitter, the receiver and the synthesizer circuits with a constant +7.5 V potential. The voltage regulators are short circuit protected and have an input terminal which can be used to switch the output voltage on and off.

FREQUENCY CONTROL MODULE
FC801

The Frequency Control module FC801 is used in equipment with maximum 4 channels and are programmed with the data input for the programmable divider in the Frequency Synthesizer. The module contains a 4 x 6 diode matrix and 4 DIL switches each programming one channel. When using FC801 a maximum of 6 bits can be controlled and each channel has fixed spacing between the RX-TX frequencies.

FREQUENCY CONTROL MODULE
FC802

The Frequency Control module FC802 is used in equipment with maximum 12 channels and a PROM (Programmable Read Only Memory) contains the data input for the programmable divider in the Frequency Synthesizer. The module contains the PROM, a channel selector decoder and a PROM controller.
The decoder is combined with four diodes to decode the channel selector's 12 outputs to 4 lines for the PROM.
The PROM size is 32 x 8 bit and does not load neither the input nor the output when its power is switched off.
The PROM controller includes an address change sensor, a sequencer and an oscillator which mainly controls the PROM power and the PROM output latches.
The address change sensor starts the sequencer whenever there is an address change and keeps the PROM power switch activated after the address change long enough for the output latches to store the new FS programming code. When the FS code is latched the PROM power is switched off again.


PORTABLE RADIOTELEPHONE CQP810US
FUNTIONAL BLOCK DIAGRAM
D402.999
CONTROL HEAD CP808
CQP 810Us
RECEIVER
SYNTHESIZER
TRANSMITTER
TONE MODULE TQ 802 / TQ 803
BATTERY
ANT MATCH

 Storno

PROGRAMMING

FC801

The Frequency Control module FC801 programs the divider in PL801 and maximum 4 channels can be programmed. The FC801 consists of 4 switches - one for each channel - and 24 diodes arranged as a 4 x 6 bit matrix.

DEFINITIONS

f_{ant}=	Channel frequency, transmit or receive
f_{VCO}=	VCO frequency, FG811 or FG812
f_{XO}=	Mixer oscillator frequency, XO811 or XO817
f_{REF}=	Reference frequency
N_{MIN}=	Minimum division ratio of the divider fixed programmed to 256
N_{PROG}=	Division ratio programmed on FC801
f_s=	$f_{VCO} - f_{XO}$
$1.6 \leq$	$f_s < 3.2$ (MHz)

$$N = \frac{f_s}{f_{REF}}$$

$$N_{PROG} = N - N_{MIN}$$

CHANNEL SPACING

12.5 kHz and 25 kHz:

N_{MIN}= 256

f_{REF}= 0.00625 MHz

20 kHz: (when using 10.24 MHz ref.)

N_{MIN}= 160

f_{REF}= 0.01000 MHz

20 kHz: (5.12 MHz ref. Xtal)

N_{MIN}= 320

f_{REF}= 0.005 MHz

TRANSMITTER CHANNELS

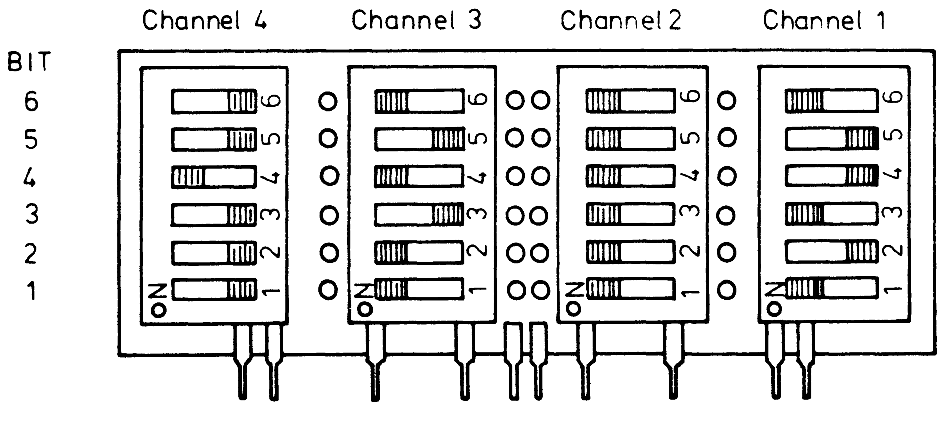
f_{VCO}= f_{ANT}

$$N_{PROG} = \frac{f_{VCO} - f_{XO}}{f_{REF}} - N_{MIN}$$

RECEIVER CHANNELS

f_{VCO}= f_{ANT} - 21.4

$$N_{PROG} = \frac{f_{VCO} - f_{XO}}{f_{REF}} - N_{MIN}$$



CQP814US - CQP813US

12.5/20 kHz

6 5	4	3	21	21	BIT
			00	10	LSB
0 0	0	0	0	2	
	0	1	4	6	
	1	0	8	10	
	1	1	12	14	
0 1	0	0	16	18	
	0	1	20	22	
	1	0	24	26	
	1	1	28	30	
1 0	0	0	32	34	
	0	1	36	38	
	1	0	40	42	
	1	1	44	46	
1 1	0	0	48	50	
	0	1	52	54	
	1	0	56	58	
	1	1	60	62	
MSB			N	N	

N= 0 - 62

Ex.: 46= 1 0 1 1 1 0

B	MSB				LSB	
I	6	5	4	3	2	1
T	1	0	1	1	1	0
SW	OFF	ON	OFF	OFF	OFF	ON

Switch programming

1= OFF

0= ON

CQP812US

25 kHz

6 5 4	3	2	1	1	BIT
			0	1	LSB
0 0 0	0	0	0	4	
	0	1	8	12	
	1	0	16	20	
	1	1	24	28	
0 0 1	0	0	32	36	
	0	1	40	44	
	1	0	48	52	
	1	1	56	60	
0 1 0	0	0	64	68	
	0	1	72	76	
	1	0	80	84	
	1	1	88	92	
0 1 1	0	0	96	100	
	0	1	104	108	
	1	0	112	116	
	1	1	120	124	
1 0 0	0	0	128	132	
	0	1	136	140	
	1	0	144	148	
	1	1	152	156	
1 0 1	0	0	160	164	
	0	1	168	172	
	1	0	176	180	
	1	1	184	188	
1 1 0	0	0	192	196	
	0	1	200	204	
	1	0	208	212	
	1	1	216	220	
1 1 1	0	0	224	228	
	0	1	232	236	
	1	0	240	244	
	1	1	248	252	
MSB			N	N	

N= 0 - 252

Ex.: 236= 1 1 1 0 1 1

B	MSB					LSB
I	6	5	4	3	2	1
T	1	1	1	0	1	1
SW	OFF	OFF	OFF	ON	OFF	OFF

EXAMPLE

Channel	TX Frequency	RX frequency	N_{PROG}	Bit Program
1	155.000	165.000	128	1 0 0 0 0 0
2	155.100	165.100	144	1 0 0 1 0 0
3	155.125	165.125	148	1 0 0 1 0 1
4	155.150	165.150	152	1 0 0 1 1 0

Channel Spacing= 25 kHz

Reference Frequency= 0.00625 MHz

Synthesizer freq. (f_s)= 2.4 MHz

N_{MIN}= 256

Calculation of transmitter mixer oscillator frequency XO817

$f_{XO} = f_{ANT} - f_s$

$f_{XO} = 155.000 - 2.4 = \underline{152.6\ MHz}$

Calculation of receiver mixer oscillator frequency XO811

$f_{XO} = f_{ANT} - 21.4 - f_s =$

$165.000 - 21.4 - 2.4 = \underline{141.2\ MHz}$

Note: To avoid selfquieting certain N's must be avoided. See 60.562 page 4 for details

Calculation of N_{PROG}

Channel 1

$$N_{PROG} = \frac{155.000 - 152.6}{0.00625} - 256 = \underline{128}$$

Channel 2

$$N_{PROG} = \frac{155.100 - 152.6}{0.00625} - 256 = \underline{144}$$

Channel 3

$$N_{PROG} = \frac{155.125 - 152.6}{0.00625} - 256 = \underline{148}$$

Channel 4

$$N_{PROG} = \frac{155.150 - 152.6}{0.00625} - 256 = \underline{152}$$

PROGRAMMING

FC802

To calculate the PROM data the following information must be available:

List of receiver frequencies
List of transmitter frequencies
Channel spacing
List of recommended crystal frequencies

For each radio set a worksheet should be completed with the programming data for each channel.

The procedure for using the worksheet is:

1. Complete list of transmitter channel frequencies.
2. Complete list of receiver channel frequencies.
3. Find highest and lowest transmitter frequencies.
4. Find highest and lowest receiver frequencies.
5. Select receiver mixer crystal frequency from list of standard crystals.
6. Select transmitter mixer crystal frequency from list of standard cyrstal.
7. Note channel spacing and reference frequency.
8. Use receiver formula to calculate divisor N for all receiver channels.
9. Check receiver divisor N for possible self-quieting.
10. Use transmitter formula to calculate divisor N for all transmitter channels.
11. Use converting table to find programming data HEX CODES for each channel.

After completion of the worksheet the next steps are:

1. Enter Prom addresses and corresponding data (N) on the Prom Programmer (DATA I/O); refer to Programmer Operating Instructions.
2. Insert the channel stop if less than 12 channels are programmed, refer to fig. 1.

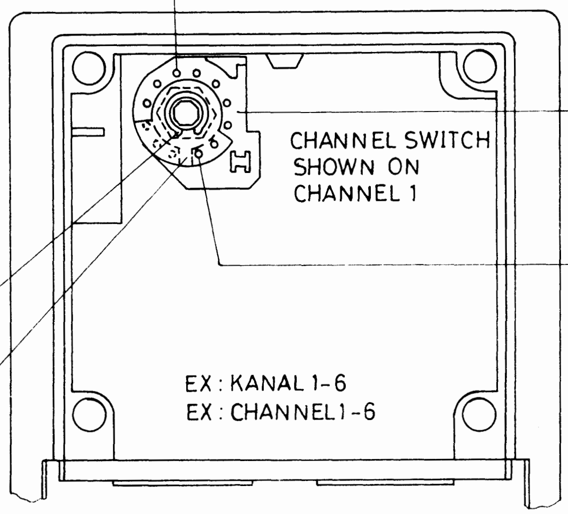
PROGRAMMING EQUIPMENT

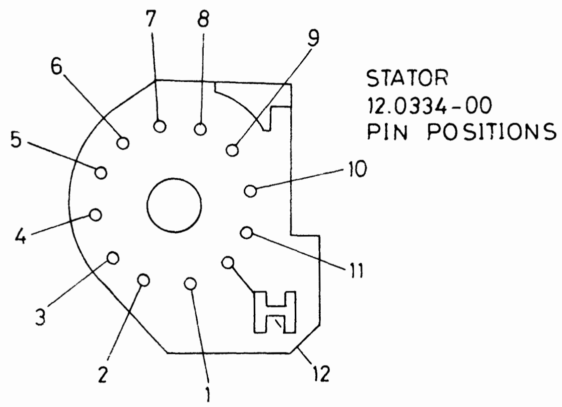
The Prom Programming Unit must be approved by the PROM manufacturer and STORNO as for example DATA I/O SYSTEM 19.

The programmer consists of the following items:

Programmer DATA I/O SYSTEM 19.
Programming PAK, interchangeable.
Socket adaptor
or Universal programming pack
DATA I/O UNIPAK (adaptable for more than 200 types of PROM devices).

Operating instructions for the programmer is supplied by the vendor.





KANAL
CHANNEL

STIFT I POS.
PIN IN POS.

			1	2	3	4	5	6	7	8	9	10	11	12
1			X	X										
1 - 2			X		X									
1 - 3			X			X								
1 - 4			X				X							
1 - 5			X					X						
1 - 6			X						X					
1 - 7			X							X				
1 - 8			X								X			
1 - 9			X									X		
1 - 10			X										X	
1 - 11			X											X
1 - 12														

CHANNEL SWITCH STOP CQP800

D403.036

PROGRAMMING WORKSHEET
FOR CQP810US WITH FC802

Customer:

RECEIVER						TRANSMITTER				
CHAN-NEL	A FREQUENCY MHz	L H	N DEC	N HEX	PROM ADDRESS (HEX)	B FREQUENCY MHz	L H	N DEC	N HEX	PROM ADDRESS (HEX)
1					10					00
2					11					01
3					12					02
4					13					03
5					14					04
6					15					05
7					16					06
8					17					07
9					18					08
10					19					09
11					1A					0A
12					1B					0B

RECEIVER MIXER CRYSTAL FREQ. (XO811): C=________

TRANSMITTER MIXER CRYSTAL FREQ. (XO817) D=________

FORMULA: $N_{DEC} = \frac{(A - 21.4) - C}{F}$

FORMULA: $N_{DEC} = \frac{B - (D \times 3)}{F}$

CHANNEL SPACING:	REFERENCE CRYSTAL (PL801):	REFERENCE FREQUENCY:
10 kHz	5.120000 MHz	F= 0.005
20 kHz	10.240000 MHz	F= 0.01
12.5/25 kHz	6.400000 MHz	F= ~~0.0625~~ 0,00625

LIST OF REFERENCE CRYSTALS (PL801)

TYPE	FREQUENCY, MHz	PART No.
12.5/25 kHz	6.400000	19J706587P1
20 kHz	10.24000	19J706587P2
20 kHz +	5.12000	19J706587P3

+10 kHz step

ALTERNATIVE SOLUTIONS IF THE RECEIVER IS SELFQUIETING:

1. SELECT ANOTHER RX MIXER CRYSTAL FREQUENCY

Least Significant Digit (LSD) of Hex Code

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
4	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158
5	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190
6	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222
7	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254
8	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286
9	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318
A	320	322	324	326	328	330	332	334	336	338	340	342	344	346	348	350
B	352	354	356	358	360	362	364	366	368	370	372	374	376	378	380	382
C	384	386	388	390	392	394	396	398	400	402	404	406	408	410	412	414
D	416	418	420	422	424	426	428	430	432	434	436	438	440	442	444	446
E	448	450	452	454	456	458	460	462	464	466	468	470	472	474	476	478
F	480	482	484	486	488	490	492	494	496	498	500	502	504	506	508	510

Most Significant Digit of Hex Code.

N-Numbers.

The conversion table is for the purpose of programming CQP800US only and not a normal Decimal-to-Hex table.

Fig. xx N-to hex code conversion table.

SELFQUIETING

Spurious signals generated in the synthesizer may fall within the RF or IF passband and cause selfquieting of the receiver.
The following table show which combinations of reference frequencies and division ratios that shall be avoided.

If a standard list crystal results in a unwanted division ratio the nearest higher or lower crystal frequency is selected. If this does not solve the problem it is necessary to calculate a new crystal frequency, refer to Calculation of Synthesizer Frequencies for CQP810US.

Reference Crystal Frequency	PLL Reference Frequency	Channel Spacing	Division ratio to be avoided
6.400 MHz	6.25 kHz	12.5/25 kHz	214, 300, 400, 428, 480
5.120 MHz	5.0 kHz	20 kHz	214, 296, 428
10.240 MHz	10.0 kHz	20 kHz	186, 214

LIST OF STANDARD CRYSTAL OSCILLATOR FREQUENCIES
CQP810US

FREQUENCY COVERAGE	FREQUENCY COVERAGE	CRYSTAL OSCILLATOR FREQ. (MHz)	
1. (MHz)	2. (MHz)	TRANSMITTER XO817	RECEIVER XO811
146.000 - 146.775		47.86667	122.2000
146.000 - 147.575		48.13333	123.0000
146.775 - 148.350	146.000 - 148.350	48.39167	123.7750
147.575 - 149.150	146.775 - 149.150	48.65833	124.5750
148.350 - 149.925	147.550 - 149.925	48.91667	125.3500
149.150 - 150.725	148.350 - 150.725	49.18333	126.1500
149.925 - 151.500	149.125 - 151.500	49.44167	126.9250
150.725 - 152.300	149.925 - 152.300	49.70833	127.7250
151.500 - 153.075	150.700 - 153.075	49.96667	128.5000
152.300 - 153.875	151.500 - 153.875	50.23333	129.3000
153.075 - 154.650	152.275 - 154.650	50.49167	130.0750
153.875 - 155.450	153.075 - 155.450	50.75883	130.8750
154.650 - 156.225	153.850 - 156.225	51.01667	131.6500
155.650 - 157.025	154.650 - 157.025	51.28333	132.4500
156.225 - 157.800	155.425 - 157.800	51.54167	133.2250
157.025 - 158.600	156.225 - 158.600	51.80833	134.0250
157.800 - 159.375	157.000 - 159.375	52.06667	134.8000
158.600 - 160.175	157.800 - 160.175	52.33333	135.6000
159.375 - 160.950	158.575 - 160.950	52.59167	136.3750
160.175 - 161.750	159.375 - 161.750	52.85833	137.1750
160.950 - 162.525	160.150 - 162.525	53.11667	137.9500
161.750 - 163.325	160.950 - 163.325	53.38333	138.7500
162.525 - 164.100	161.725 - 164.100	53.64167	139.5250
163.325 - 164.900	162.525 - 164.900	53.90833	140.3250
164.100 - 165.675	163.300 - 165.675	54.16667	141.1000
164.900 - 166.475	164.100 - 166.475	54.43333	141.9000
165.675 - 167.250	164.875 - 167.250	54.69167	142.6750
166.475 - 168.050	165.675 - 168.050	54.95833	143.4750
167.250 - 168.825	166.450 - 168.825	55.21667	144.2500
168.050 - 169.625	167.250 - 169.625	55.48333	145.0500
168.825 - 170.400	168.025 - 170.400	55.74167	145.8250
169.625 - 171.200	168.825 - 171.200	56.00833	146.6250
170.400 - 171.975	169.600 - 171.975	56.26667	147.4000
171.200 - 172.775	170.400 - 172.775	56.53333	148.2000
171.975 - 173.550	171.175 - 173.550	56.79167	148.9750
172.775 - 174.350	171.975 - 174.350	57.05833	149.7750
173.550 - 175.125	172.750 - 175.125	57.31667	150.5500

The list of standard crystal frequencies is used for selecting and ensuring correct use of crystals in the CQP810US. The two Frequency Control modules, FC801 and FC802, have different frequency capabilities and have influence on the selection of crystal oscillator frequencies.

The FC801 has the following inherent limitations:

1. Limited bandwidth with 12.5 kHz channel spacing.
2. Limited bit control (6).
3. 4 channels only.
4. Fixed RX-TX frequency spacing for the channels, the spacing determined by the crystal frequencies.

When selecting a crystal frequency, Frequency Coverage 1 is the preferred column. Frequency Coverage 2 is used if the channel frequencies are placed such that they cannot be covered by the preferred column. In these cases a special procedure for adjusting the VCO control voltage is necessary; refer to adjustment procedure.

It is advantageous to chose a crystal frequency as high as possible because this will reduce the stand-by current of the synthesizer circuitry.

20 kHz CHANNEL SPACING CRYSTALS

Standard crystal frequencies can be used in 20 kHz channel spacing sets if the lower frequency limit of Frequency Coverage 1 does not end on 5 kHz, i.e. xxx.xx0 MHz.
Exampel: 50.75833 MHz can be used because the lower limit is 155.450 MHz.

If no standard crystal frequency can be selected the procedures for calculating the correct crystal is used, refer to Synthesizer Frequency Calculation.

SYNTHESIZER FREQUENCY CALCULATION

CQP810US

DEFINITIONS

f_{TX}= Transmit frequency (MHz)
f_{RX}= Receive frequency (MHz)
f_{VCO}= Synthesizer VCO frequency (MHz)
f_{XO}= Mixer oscillator frequency (MHz)
f_{REF}= Reference frequency (MHz)
N= Programmable divider ratio
N_{MIN}= Minimum programmable divider ratio
N_{MAX}= Maximum programmable divider ratio
f_S= Synthesizer input frequency
f_X= Crystal frequency of XO8xx
N_{PROG}= Programmed divider ratio

GENERAL FORMULAS

The output signal frequency of the synthesizer, F_{VCO}, is determined by the frequency of the crystal oscillator and the division ratio used in the programmable divider. The formula for calculating the VCO frequency is:

(1) $F_{VCO} = f_{XO} + N \times f_{REF}$

The division ratio, N, is:

(2) $N = N_{MIN} + N_{PROG}$

The synthesizer input frequency, F_S, is:

(3) $F_S = N \times f_{REF}$; $F_S = f_{VCO} - f_{XO}$

For proper synthesizer functioning F_S shall fulfil:

(4) $1.6 \leq f_S < 3.2$ (MHz)

When using crystals from covarage 2 fs less than 1.6 MHz may be used provided a special adjustment prodedure is followed (see 60.564).

The maximum frequency synthesizer bandwidth is 1.5 MHz which corresponds to the 1.5 MHz bandwidth of the receiver.

The programmable divider ratio is set by applying a binary code to the control lines.
The binary code is obtained from the Frequency Control module and comes either from a PROM (FC802) or a diode matrix (FC801).

The synthesizer frequency, F_S, should be chosen for easy programming of the FC and such that (4) is fulfilled. It is only neccessary to know the minimum divider ratio, N_{MIN} and the transmit and receiver frequency to calculate the crystal frequencies.
(Normally a crystal from the standard list will be used).

TRANSMITTER

Equation (1) yields:

(5) $f_{XO} = f_{VCO} - N \times f_{REF}$

As the transmitter VCO is oscillating on the transmit frequency f_{TX}.

(6) $f_{XO817} = f_{TX} - N \times f_{REF}$

f_{REF} is as follows:

12.5 kHz channel spacing:	0.00625
20 kHz channel spacing:	0.0100
25 kHz channel spacing:	0.00625
"10" kHz channel spacing:	0.005

The crystal frequency is 1/3 of the XO817's output frequency and thus (6) yields:

(7) $$f_{CRYSTAL} = \frac{f_{TX\ MIN} - N_{MIN} \times f_{REF}}{3}$$

RECEIVER

The receiver VCO in FG811 is oscillating on the injection frequency and is 21.4 MHz below the receive frequency F_{RX}
Equation (1) yields:

$$f_{XO811} = f_{VCO} - N \times f_{REF}$$

$$f_{VCO} = f_{RX} - 21.4$$

$$f_{XO811} = f_{RX} - 21.4 - N \times f_{REF} \quad (8)$$

The crystal frequency is found by inserting the minimum receive frequency $f_{RX\ MIN}$ and the corresponding N_{MIN}.
Equation (8) yields:

$$f_{XO811} = f_{RX\ MIN} - N_{MIN} \times f_{REF} - 21.4 \text{ (MHz)} \quad (9)$$

Note: To avoid receiver selfquieting certain division ratios must be avoided. (see 60.562 P4)

VEHICLE ADAPTOR MN803 AND MN804

The vehicle adaptors MN803 and MN804 are designed to hold a STORNOPHONE 800 U radiotelephone when used in a mobile installation. Both adaptors also contain a facility for the BU800 battery to be trickle charged from the vehicles storage battery, and a connection for a mobile antenna, Futhermore an optional, external loudspeaker with a built-in 2 watt AF amplifier, type LS801, may be connected to the units.

Operating the CQP800U with an MN803 installation is locally on the radiotelephone by using its built-in controls. When using MN804 the operation is by means of an external microphone, MC704, external switches SU809, and loudspeaker LS801.

The electrical connections between the adaptor and the CQP800 U is by means of a multiwire cable connecting to the socket on the CQP800 U.

The simplified diagram shows the elements necessary to charge the battery through the multiwire cable and, at the same time pass the RF and AF signals.

MODE OF OPERATION

Charging Circuit

The DC converter has floating input potential in order to operate with both + (positive) and -(negative) chassis installations. It operates as a blocking oscillator and consists of transformer T1 and transistor Q2 which has a high current amplification factor (β), when saturated.

The oscillator configuration has a constant current charateristic which, together with resistors R11, R16, R17, and R18, produce 55 mA of charging current for the BU 800 battery.

Transistor Q1 and the resistors R1, R2, and R3 compensate input voltage fluctuations, and diode E1, together with an externally mounted fuse, protects the unit against incorrect supply voltage polarity. The network, E2, R9, R10, and C5 protects Q2 from transient spikes.

Zener diode E7 ensures that the output voltage does not exceed the maximum allowable input voltage to CQP800 if the battery is removed during operation.

Temperature Characteristics

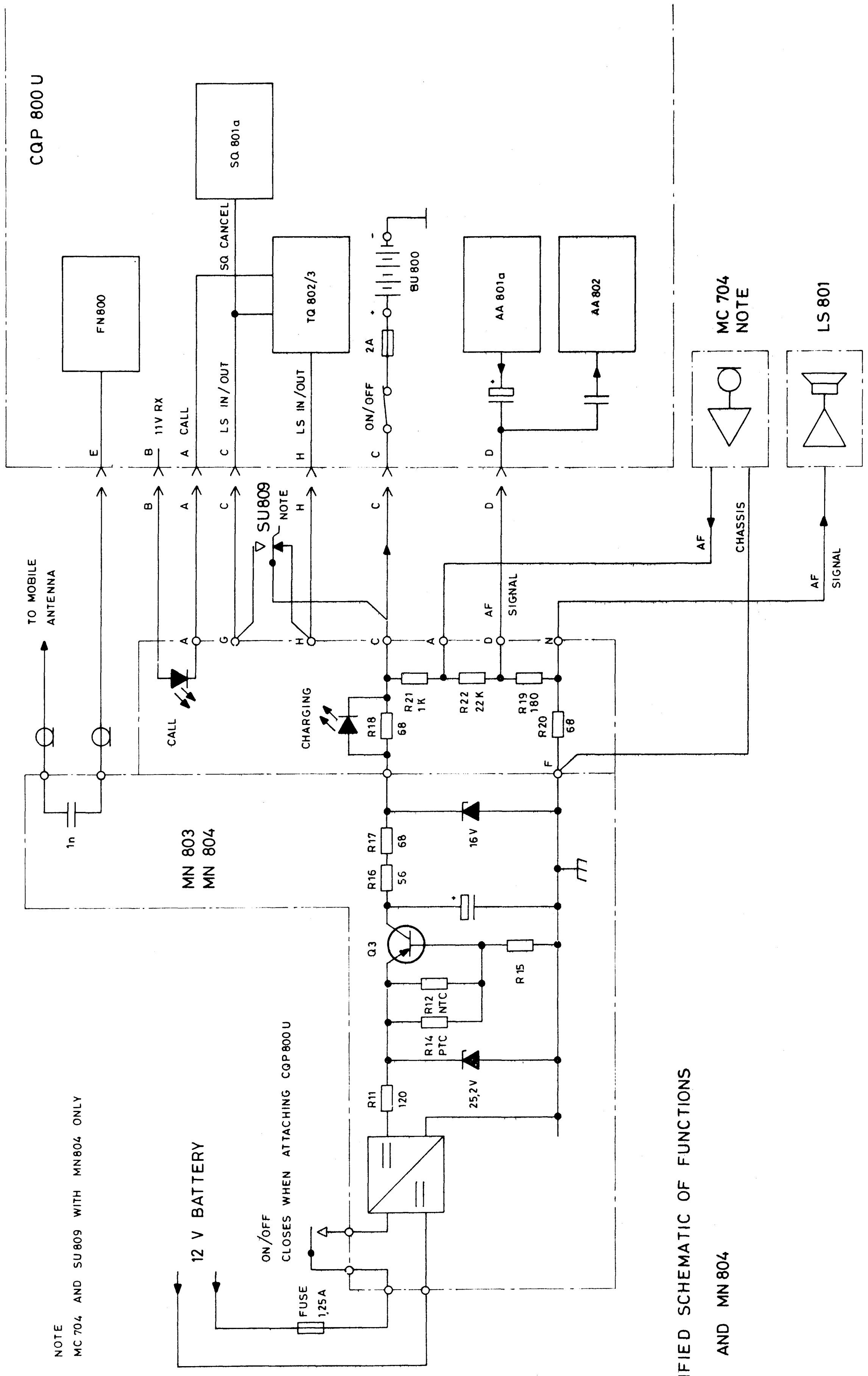
For battery protection reasons the charging current must be reduced at high or low ambient temperatures. The decreasing regulation, when cold, is performed by a PTC resistor and, when hot, by the NTC resistor R12. At temperatures outside the working range the PTC and NTC resistances decrease, respectively, and the base current of transistor Q3 is reduced and this brings it out of the saturated condition. The consequences are an increased Q3 emitter voltage and an increased voltage across the zener diode, which begins to conduct and gradually takes over the constant current from the DC converter. The net effect is the charging current being decreased.

Charging Indicator.

In series with the charging circuit a light emitting diode, LED E6, is inserted to indicate the charging current flow.

Call Indicator

In systems using selective calling a green LED call indicator, E8, is mounted on the front of the MN803/ MN804, and it will be controlled by the tone receiver.



SIMPLIFIED SCHEMATIC OF FUNCTIONS

MN 803 AND MN 804

Storno

Loudspeaker LS801

When mounting the external loudspeaker two resistors, R19 and R20, attenuate the CQP800 U audio level to match the amplifier input sensitivity of LS801.

Microphone MC704

When using MN804 and MC704 two resistors, R21 and R22, attenuates the microphone output to a suitable level for the CQP800 U.

SQ / LS Switch SU809.

The switch, 02, which can be used with MN804 only, mount on the steering coloumn and operates the squelch cancel function, and the LS in/out function if selective calling is used.

TECHNICAL SPECIFICATIONS

Supply Voltage, nominal

13.6 V

Supply Voltage Range.

min. 10.5 V

max. 16.0 V

Supply Voltage Polarity

+ (plus) or - (minus)
on chassis

Current Consumption

Typical values : 160220 mA
10.5 V supply : 220 mA
16,0 V supply : 160 mA

Charging Current

Typical value in the temperature range
+ 10°C to + 40°C,
with battery BU 802:
560 mA

Temperature range

Working range with normal charging current:
+ 10°C to + 45°C
Working range with reduced charging current:
- 25°C to + 70°C.

Dimensions

Unit overall: 148 x 75 x 40 mm
Printed circuit board: 92x 58 x 20 mm

Weight

0,46 Kg

MICROPHONE MC704

GENERAL

Microphone MC704 is designed for mobile operation with radiotelephones of series 600 and 700. It consists of an amplifier type AA705 and a microphone cartridge in a plastic housing, a cable for connecting, to the radio unit, and a mounting bracket.

Amplifier AA705

The microphone amplifier serves as bandpass filter for the audio frequency band 300 Hz - 3000 Hz and amplifies the signals from the microphone to a suitable level.

The amflifier consists of three transistors, Q1,Q2, and Q3 all DC-coupled. The gain is determined by the feed-back circuit R1,R2,R11 and C9, and with potentiometer R1 the gain can be adjusted to a suitable microphone sensitivity.

The RC-circuit C2,C3,R4,R6, and R3 form in association with the feedback amplifier an active highpassfilter which attenuates all frequencies below 300 Hz.

Resistor R11 and capacitor C9 in the feedback loop cut off frequencies above 3 kHz, and C7 stabilises the closed loop gain.

A number of capacitors, C4,C5,C6,C8,C10, and resistor R5 serves to filter and bypass RF.

Specifications

Supply Voltage

9 - 24 V

Current Consumption

9mA ± 2mA (9V)

32mA ± 5mA (24V, R_L = 600 ohm)

Output Level

Nominal: - 17 dBm

Maximum: + 3 dBm

Distortion at + 3 dBm

Less than 3%

Gain

Maximum: 58 dB ± 4 dB

Minimum: 39 dB ± 4 dB

LOUDSPEAKER AND AMPLIFIER
LS801

General

LS801 is a loudspeaker housed in an enclosure together with an integrated a.f. power amplifier. The amplifier has an internal potentiometer for sensitivity adjustment and all connections are established through a 4-conductor non-screened cable. The loudspeaker is mainly intended for use with vehicle adaptor MN801.

Mode of Operation

The a.f. amplifier employes an integrated circuit and various types of passive components. As the amplifier has to be used in both + and - chassis installations, a differential input circuit is constructed by means of Transformer T1.

The gain is adjustable with potentiometer R1, and resistor R2 sets the minimum sensitivity which is 1.1 Volt. Resistor R3 is inserted in order to gain some amplification if R1 accidentally fails. Capacitor C1 blocks the DC voltage which is present on the signal input line.

Technical Specifications

Supply Voltage

13.6 V nominal.

Supply Voltage Range

10.5 V - 16.0 V

Supply Voltage Polarity

+ or - on chassis

Current Consumption at 13.6 V

Output power 3.0 W: < 500 mA.
Output power 0 W (stand-by): < 15 mA.

Maximum Output Power (distortion < 10%)

Supply voltage 10.5 V: 2 Watts
Supply voltage 13.6 V: 3 Watts
Supply voltage 16.0 V: 4.5 Watts

Distortion

< 5% measured at 13.6 V and 2 W

Sensitivity for Maximum Output

Adjustable 0.11 V - 1.1 V

Frequency Response (-3 dB)

400 Hz - 3000 Hz

Input Impedance

600 Ω

Load Impedance (loudspeaker)

4 Ω

Temperature Range

-25°C - +50°C

Mechanical Dimensions

Unit overall 126 x 126 x 63 mm.
Subunit (amplifier board) 78 x 38 x 22 mm.

Weight

530 g.

Storno

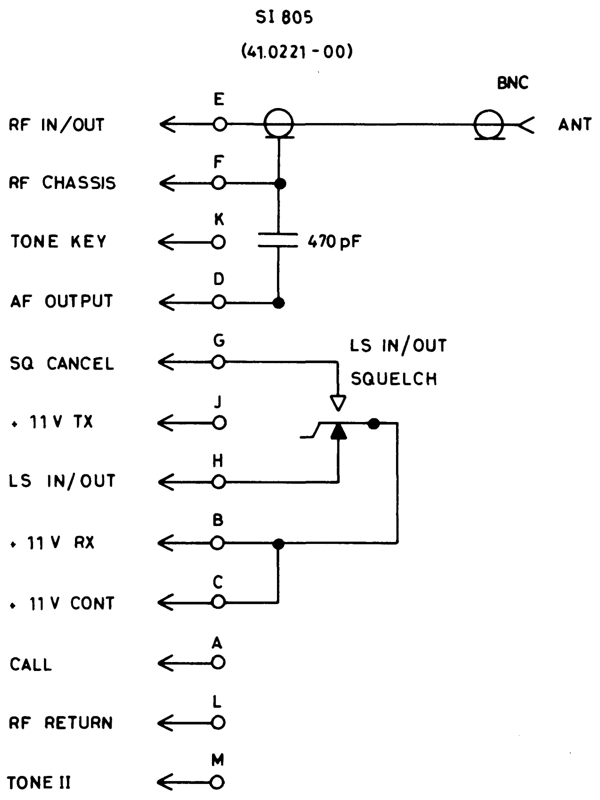
TEST ADAPTOR

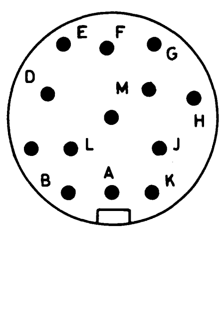
SI805

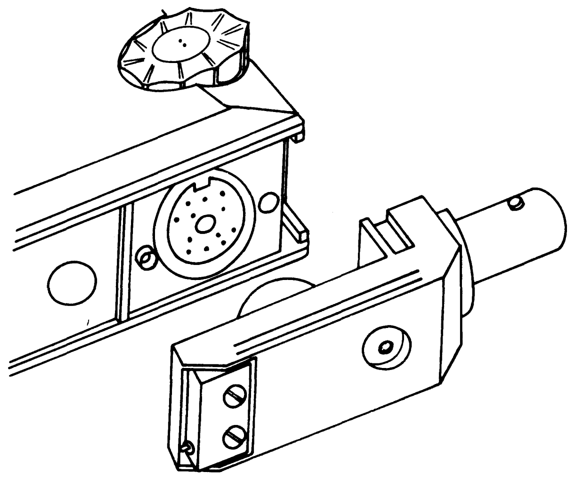
SI805 is a measuring adaptor to be used in conjunction with Test Set TS-C35 and CQP800U personal radiotelephones.

When the SI805 is plugged into the CQP800's control unit socket the following is obtained:

- a 50 ohm interface via a BNC connector
- a switch for LS in/out - Squelch on/off - SR
- the CQP800U is switched into remote control mode which is suitable for TS-C35. The internal loudspeaker, though, remains in function (strap D-M).
- the CQP800U receiver is supplied from the TS-C35 via strap C-B.







TROUBLESHOOTING

CQP810US

When troubleshooting the fault should as early as possible be localized to one of the three main parts of the CQP800US.

1. Synthesizer
2. Receiver
3. Transmitter

1. Synthesizer

As described in the circuit description the frequencies are generated in the synthesizer part of the CQP800US. The frequency synthesis is based on a phase-locked-loop. This makes the troubleshooting somewhat complicated, because a malfunction of any one part of the loop will prevent the entire loop from functioning. So it is not always easy to spot the faulty part right away.
The procedure shown, is one way of getting round the loop, in a systematic way. A simplified block diagram of the synthesizer part of the radio is as shown.

The numbers in circles show the order in which the signals are measured during troubleshooting.

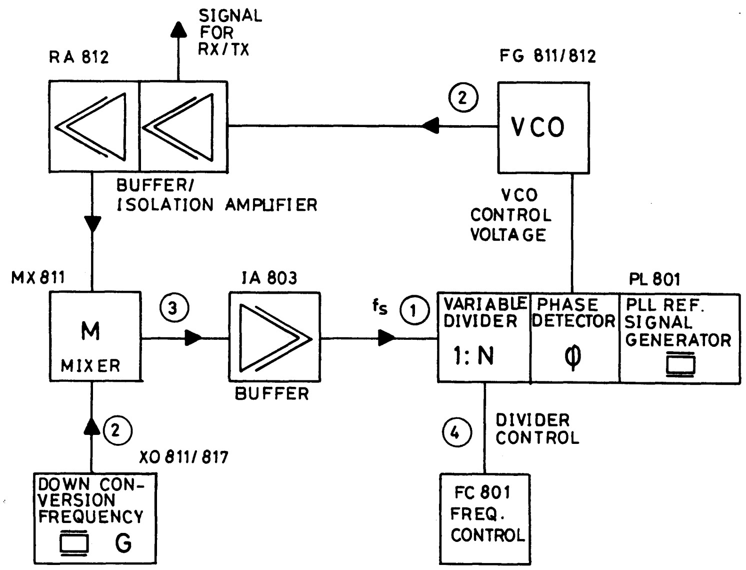
Note:
It should be noted that RA812 and MX811 are in dc-series so that it may be difficult to localize a fault in one of the two modules.

2. Receiver

The receiver part of the synthesized CQP810US is the same as the receiver of the crystal controlled version. During troubleshooting the signal is followed from the antenna input and the normal signal path through the radio.

3 Transmitter

The transmitter signal path is through a buffer-stage and the two PA-stages. During troubleshooting the signal is followed along the normal signal path.
The modulation signal is applied both to the VCO (FG812) and to the down convertion oscillator (XO817). To make the synthesizer function properly the frequency deviation on the two oscillators must be equal. When trouble shooting the modulation signal the path is followed in reverse order, from the oscillators to the microphone input.



FUNCTIONAL DIAGRAM FS810.
D402.908

TROUBLESHOOTING FOR CQP810US RECEIVER

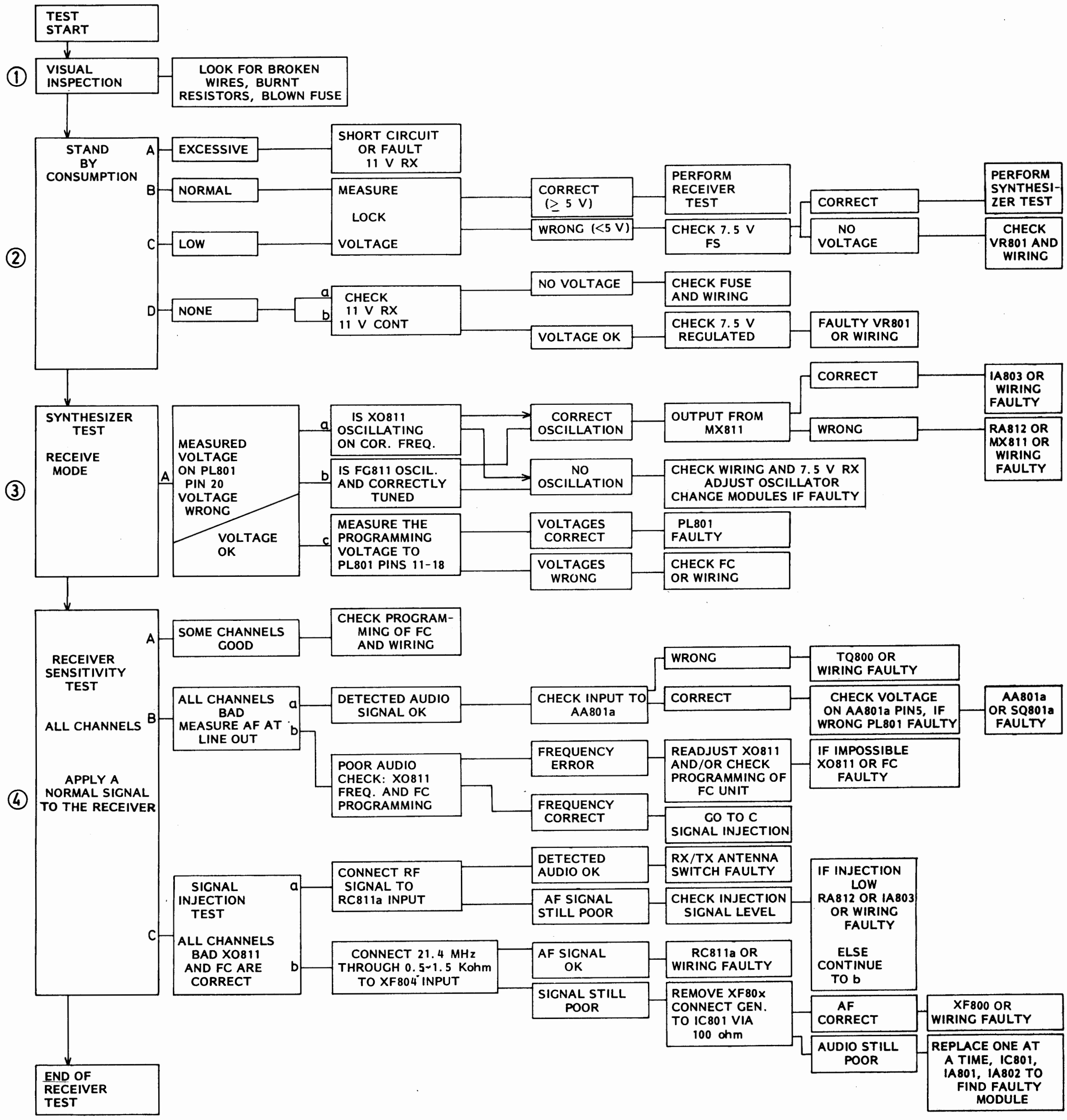


Fig. 2. Receiver trouble shooting

TROUBLESHOOTING FOR CQP810US TRANSMITTER

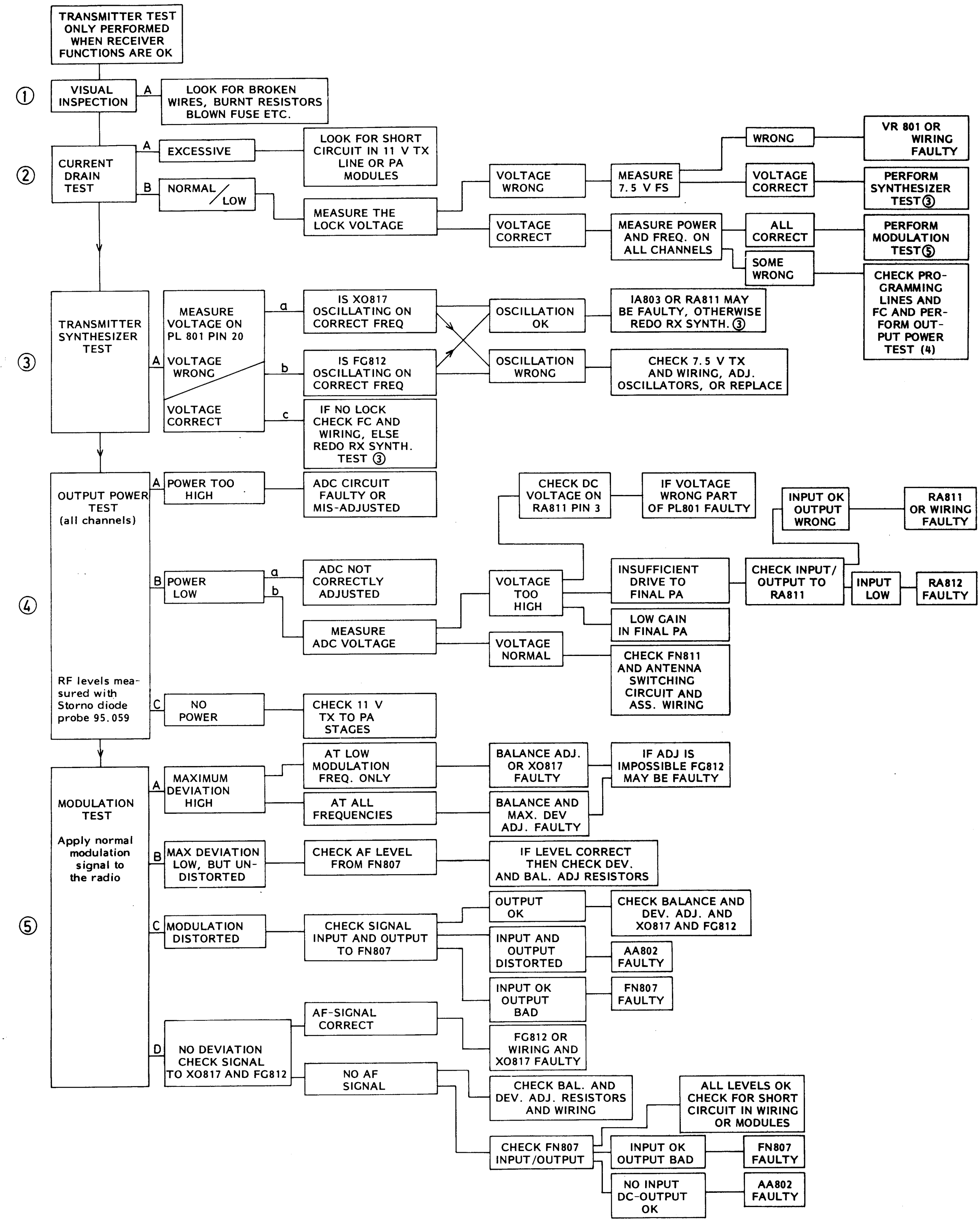


Fig. 3. Transmitter trouble shooting

ADJUSTMENT PROCEDURE

CQP810S/CQP810US

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

Control unit C35	Code 95B0363-03 including
Test cable SI801	Code 19B0027
Test cable adaptor SI803	Code 41.0206
Measuring adaptor SI805	Code 41.0221-01
Loudspeaker 25 ohm	Code 97.5039
Antenna alignment unit TS-D37	Code 95B0555
Test adaptor for CB812	Code 95B0579
RF test probe	Code 95.0059
DC ampere meter	10 mA/100 mA/1 A
DC voltmeter	Z_{in}= >0.5 Mohm
AC voltmeter	Z_{in}= >2 Mohm//50 pF
FM signal generator	146 - 174 MHz
AF generator	Z_{out}= 600 ohm
RF wattmeter	0 - 3 W
Deviation meter	
Distortion meter	
Oscilloscope	DC - 5 MHz
Power supply	0 - 20 V/1 A Preset current limiter 0 - 1 A
Frequency counter	
Trimming tools	17.5006-00 17.0035-00 17.0053-00 17.0056-00

OPERATING CONTROL UNIT C35

The control unit and test cable C35 are designed for testing and adjusting STORNOPHONE 800/800US. The instruments connect to the unit and remain connected during the 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.
AUDIO MONITOR	BNC connector for external 25 ohm loudspeaker.

CONNECTIONS ON THE FRONT PANEL

RF PROBE	Jacks for RF probe.
DCVM	Jacks for DC voltmeter.
AF PROBE	BNC connector for AF probe. Probe consists 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 the AF voltmeter, distortion meter and oscilloscope.
MOD INPUT	BNC connector for the 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 to the LS/MICR switch.
TONE KEY	For radios with sequential tone transmitter (CQP810US).
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 between the LINE OUT and LS/MICR.
ACVM	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.

SELECTORS

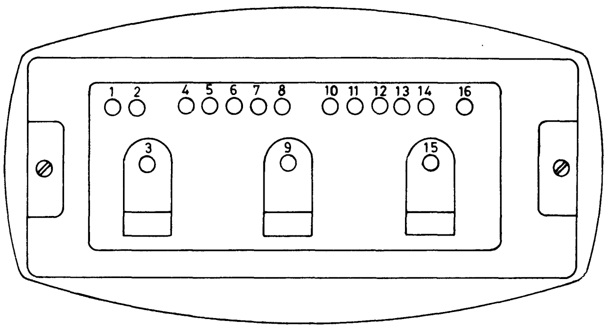
DCVM switch — 6-position DC voltmeter switch.

1. SUPPLY voltage.
2. RX +7.5 V stabilized RX voltage.
3. RC receiver converter test point.
4. PLL out of lock voltage.
5. ADC voltage
6. RF PROBE

AMPLITUDE — BFO output attenuator.

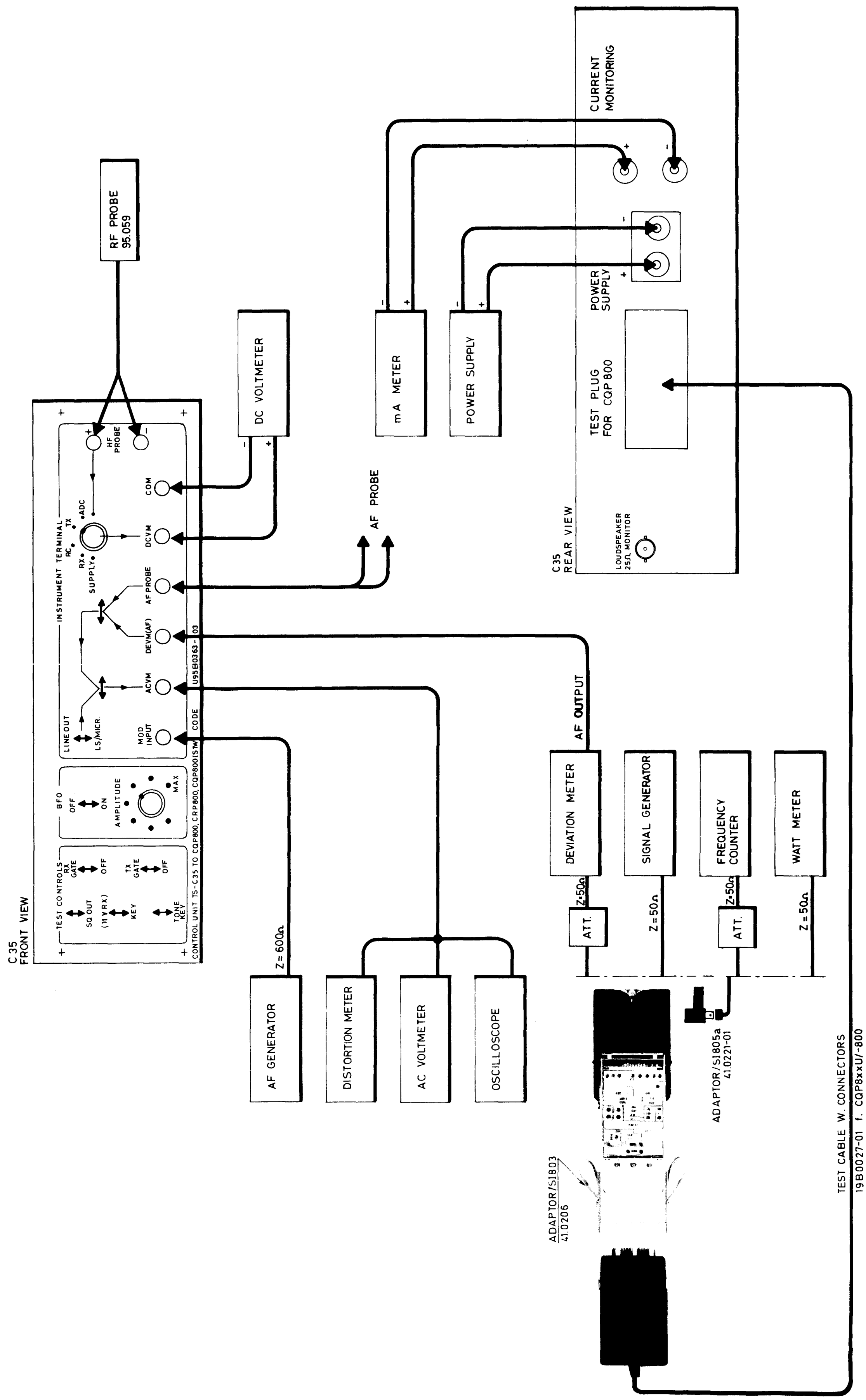
LIST OF TEST POINTS

Test Point	Function
1	PLL out of lock voltage.
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 (CQP810U only)
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 signal input
15	DC ground (connected to point 3)
16	Discriminator and receiver line output



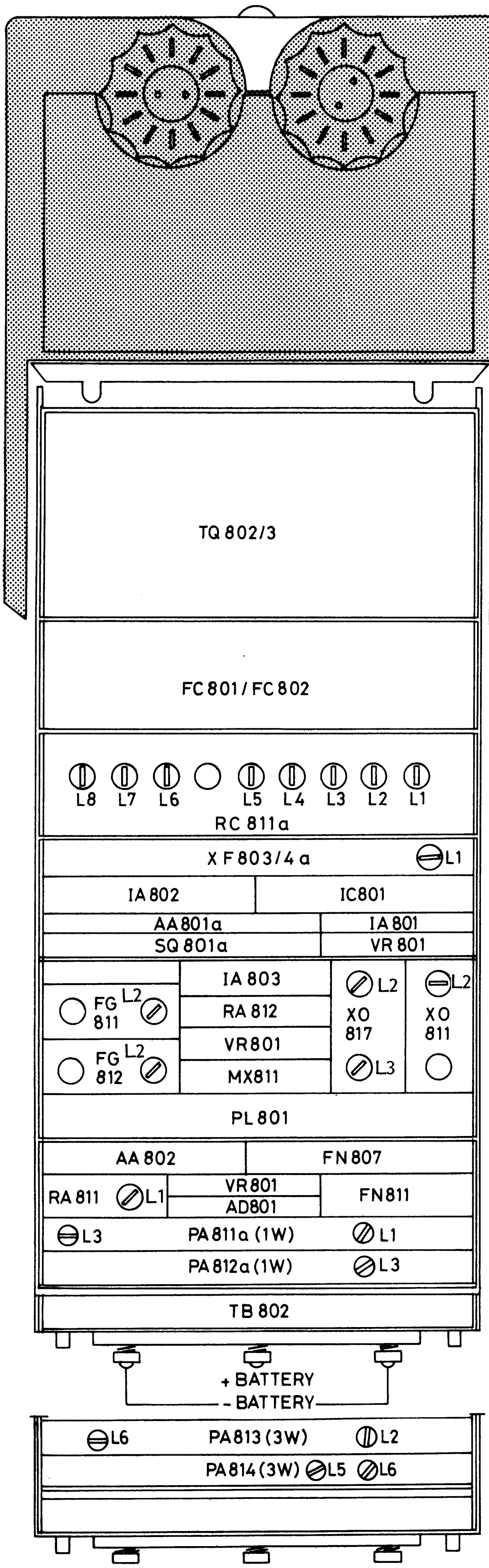
BOTTOM VIEW

Fig. 1. CQP800 TEST POINT LOCATION



STORNOPHONE 800US TEST SET-UP

D403.128



ADJUSTABLE COMPONENTS
CQP810 US

D403.124

TEST SET-UP AND LOCATION OF COMPONENTS

The Control Unit C35, the Test Cable SI801 and Adaptor SI803 is connected to the CQP810US under test. A BNC Adaptor SI805 is used for connecting various instruments to the multiwire socket. The SI805 Adaptor switches the CQP800US to remote mode when plugged into the socket and disables the loudspeaker. An external loudspeaker for monitoring the receiver signal is connected to the MONITOR socket at the rear of Control Unit C35. The microswitch on the SI805 is the LS IN/OUT Sq. cancel button.

TRANSMITTER ADJUSTMENT

Before starting adjustment of the transmitter, check the value of the resistor R_{14}.

approx. 6.8 Kohm for 0.1 to 0.5 W output power
approx. 3.9 Kohm for 1 W output power
approx. 3.3 Kohm for 1.5 W output power
approx. 3.9 Kohm for 3 W output power

CHECKING SUPPLY VOLTAGE AND CURRENT DRAIN

1. Select the channel closest to the center frequency.
   Set the DCVM to SUPPLY.
   Connect a wattmeter to the multiwire socket via adaptor SI805.
   Adjust the power supply voltage to 11 V.
   Set the current limiter to 1 A.
   Key the transmitter.
   Read the current drain on the mA meter.
   Current drain without output:
   approx. 70 mA.
   Current drain with output:
   less than 800 mA.

   Set the TX GATE switch to OFF.
   Read the current drain.
   Requirement: less than 70 mA.
   Set the TX GATE switch to ON.
   Connect a voltmeter, 10 V range, to RA811 pin 3.
   Read the TX stabilized voltage.
   Requirement: 7.5 V ±0.15 V.
   Connect a voltmeter, 10 V range, to IA803 pin 5.
   Read the FS stabilized voltage.
   Requirement: 7.5 V ±0.15 V.

ADJUSTMENT OF TX-VCO

2. Select the channel slosest to the TX center frequency.
   The frequency control module FC801/802 shall be programmed according to the instructions in "Channel Programming".
   Set the tuning slug in FG812 in the outer position.
   Connect a DC-coupled oscilloscope (1 V/div. -0.1 - 1 ms/div.) to the DCVM terminal on C35.
   Set the DCVM switch to TX. The oscilloscope is thereby connected to the lock-indication voltage from the synthesizer.
   KEY the transmitter.
   Adjust the tuning slug in FG812 slowly inwards to obtain a steady trace at $\geq$5 V on the oscilloscope.

Note: There is a possibility for obtaining a false lock at frequencies 15-20 MHz from the correct frequency.

Connect a DC voltmeter to PL801 pin 2.
For frequencies using crystals selected from coverage 1:
Adjust the tuning slug in FG812 to obtain a voltage reading of 2.5 V ±0.2 V.

For frequencies using crystal selected from coverage 2:

Select the channel with the lowest TX frequency and adjust the tuning slug in FG812 to obtain a voltage reading of 1.75 V ±0.15 V. Adjust the tuning slug in FG812 to obtain a voltage reading of 1.75 V ±0.15 V. Check on the oscilloscope that the loop stays in lock during the adjustment (steady trace at ≥5 V). Disconnect the voltmeter.

3. Connect a DC voltmeter to DCVM on the C35 control unit.
   Set the DCVM switch to ADC.
   Set the tuning slug in RA811 in the center position.

   Adjust the following coils for maximum current drain:
   L1 and L3 in PA 811a
   L3 in PA812a
   L2 and L6 in PA 813
   L5 and L6 in PA 814
4. Adjust the tuning slug in L1 in RA811 for minimum ADC voltage.
   To ease the adjustment it may be necessary to detune L3 in PA811a to increase the ADC voltage, in order to get a clear minimum.
5. Repeat the adjustment under 4, for minimum ADC voltage and max. output power until no further improvement is possible.
6. If the output power is less than the rated value it may be increased by placing a resistor in parallel with R14. The two PA stages shall be readjusted for maximum output power after each change of resistance. The power output shall be within ±1 dB of the value required for the set.
   Check the power output on all channels.
   The ADC voltage shall be less than 10 V.
   Typical current consumption:

   1 W: 330 mA
   3 W: 730 mA

TRANSMITTER FREQUENCY ADJUSTMENT

7. Connect a frequency counter through an attenuator to the antenna connector.
   KEY the transmitter.
   Adjust L2 in XO817 to the channel frequency.
   Requirement at 25°C: $\pm 0.5 \times 10^{-6}$.

CHECKING AND ADJUSTMENT OF MODULATOR

8. 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).
   Select the channel having the highest transmitting frequency.
   KEY the transmitter.
   Set the AF generator to 1000 Hz and adjust the output level for 10 mV.
   Find the frequency in the range 300 - 3 kHz that produces the gratest frequency deviation.
   At that frequency select a resistance value for R3 (FG812 DEV.) that gives a frequency deviation just below the maximum permissible:

12.5 kHz =	2.5 kHz
20 kHz=	4.0 kHz
25 kHz=	5.0 kHz

9. Increase the AF level to 20 mV.
   Slowly decrease the AF frequency to 100 Hz. If during this the deviation exceeds the maximum permissible decrease the value of R2 until the deviation is below or at the max. dev.
   Set the AF signal to 10 mV. Check that the max. freq. dev. at all frequencies between 0.1 - 3 kHz is below or at max. dev.
   Set the tone generator output to 0.7 x Δf max. at 1000 Hz.
   12.5 kHz: 0.7 x Δf max. = ±1.75 kHz.
   20.0 kHz: 0.7 x Δf max. = ±2.8 kHz.
   25.0 kHz: 0.7 x Δf max. = ±3.5 kHz.

10. Check the total harmonic distortion THD at the output of the deviation meter.

    Requirement: THD <5% (without de-emphasis).

RECEIVER ADJUSTMENT

Before starting the adjustment of the receiver, check the value of the discriminator bandwidth resistor (R6, between pin 1 and pin 3, IA802)

CQP813(U)S: 5.6 Kohm
CQP814(U)S: 27 Kohm

The frequency control module FC801/802 shall be programmed according to the instructions in "Channel Programming".

Select the channel closest to the center RX frequency. Set the tuning slug in FG811 in the outer position.

SUPPLY VOLTAGE AND CURRENT DRAIN

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 RX-VCO

4. Connect a DC-coupled oscilloscope (1 V/div. -0.1 -1 ms/div.) to the DCVM terminals on the C35 control unit.
   Set the DCVM switch to TX, the oscilloscope is thereby connected to the lock-indication voltage from the synthesizer.
   Adjust the tuning slug in FG811 slowly inwards to obtain a steady trace at ≥5 V on the oscilloscope. This indicates that the synthesizer PLL is locked. Note that it may be possible to obtain a false lock on the image frequency. Before continuing the adjustment check that the receiver is working on the correct frequency.
   Connect a DC voltmeter to PL801 pin 2.
   For frequencies using crystals selected from coverage 1:
   Adjust the tuning slug in FG811 to obtain a voltage reading of 2.5 ±0.2 V.
   For frequencies using crystals selected from coverage 2:
   Select the channel with the lowest RX frequency and adjust the tuning slug in FG811 to obtain a voltage reading of 1.75 V ±0.15 V.
   Check on the oscilloscope that the loop has remained in lock during the adjustment (steady trace at ≥5 V on the oscilloscope).
   Disconnect the voltmeter.
5. Set the tuning slugs in L3 and L4 to the inner position.
   Set the DCVM switch to RC.
   Select the channel closest to the center of the RX frequency range.
   Adjust L7 and L8 in RC811a for maximum DC voltage.
6. Set the signal generator to the selected channel frequency.
   Modulate the generator with 1 kHz to a deviation of 0.7 x Δf.max.
   ±3.5 kHz for 25 kHz channel spacing.
   ±2.8 kHz for 20 kHz channel spacing.
   ±1.75 kHz for 12.5 kHz channel spacing.

   Set the SQ OUT and the LINE OUT - LS/MICR switches down.
   Set ACVM switch to LS/MICR.

   The level from the signal generator is set to obtain a SINAD of 12 dB, with the volume switch in position II.

   During the adjustment the signal generator level should be adjusted to maintain a SINAD of approx. 12 dB.

   L4 in RC811a is adjusted for maximum sensitivity.

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

L3, in RC811a
L2, in RC811a
L1, in RC811a
L5, in RC811a

Repeat the adjustment of L7 and L8 for maximum DC voltage.
Adjust L6 in RC811a for minimum distortion.
Set the RX GATE switch to OFF or stop FG811 (remove it from the set).

Increase the level from the signal generator until a rise in the RC voltage is seen.
Adjust the L1, L2, L3, L4, and L5 for maximum DC voltage.
Set the RX GATE switch to ON.

7. Set the signal generator level to approx. 100 uV e.m.f.
Adjust L1 in XF800 for mimimum distortion.
Check adjustment of L6 in RC811a.

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 receiver's rated audio output power with 12 dB signal + noise + distortion + 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 dB= 50, 50 -6 dB= 25%).

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

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

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

RECEIVER SENSITIVITY, RECEIVER SELFQUIETING AND RECEIVER FREQUENCY

RECEIVER SENSITIVITY

8. The sensitivity must be minimum 1.0 uV e.m.f.
   Typical value: 0.5 uV e.m.f.
   Changing the supply voltage from 9.9 V to 13 V should not influence on the sensitivity obtained at 11 V.
   If more than one channel is provided, the sensitivity check should be repeated on all channels.

SELFQUIETING CHECK

Disconnect the signal generator.
Set the volume control to II.
Set the SQ OFF switch down.
Note the AF output level (reference).
Select all channels in turn and note the change in AF output level.

Requirement:
The AF output level on any channel must not be less than 3 dB below the reference level.

OSCILLATOR FREQUENCY ADJUSTMENT

9. Set the generator to the receiver frequency using the frequency counter.
   Remove the signal generator modulation and set the output to 100 uV 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.
   Do not touch L1.
   When the adjustment is completed, turn the BFO OFF.

MEASURING AND SETTING RECEIVER AUDIO LEVEL

CHECKING RECEIVER AUDIO LINE OUTPUT

Modulate the signal generator with 1 kHz and 0.7 x Δf max.

±3.5 kHz for 25 kHz channel spacing
±2.8 kHz for 20 kHz channel spacing
±1.75 kHz for 12.5 kHz channel spacing

10. Set the signal generator output to 100 uV e.m.f.
    Switch the ACVM to LINE OUT.
    Read the AF Line voltage (-17 dBm).
    Requirement: 110 mV +0/-1 dB.
    If necessary change resistor value (R8) in parallel with R7 (IA802, pin 5 - 6) until 110 mV is obtained.
    The graph (fig. 4) indicates the value of the resistor, which should be the closest higher standard value.

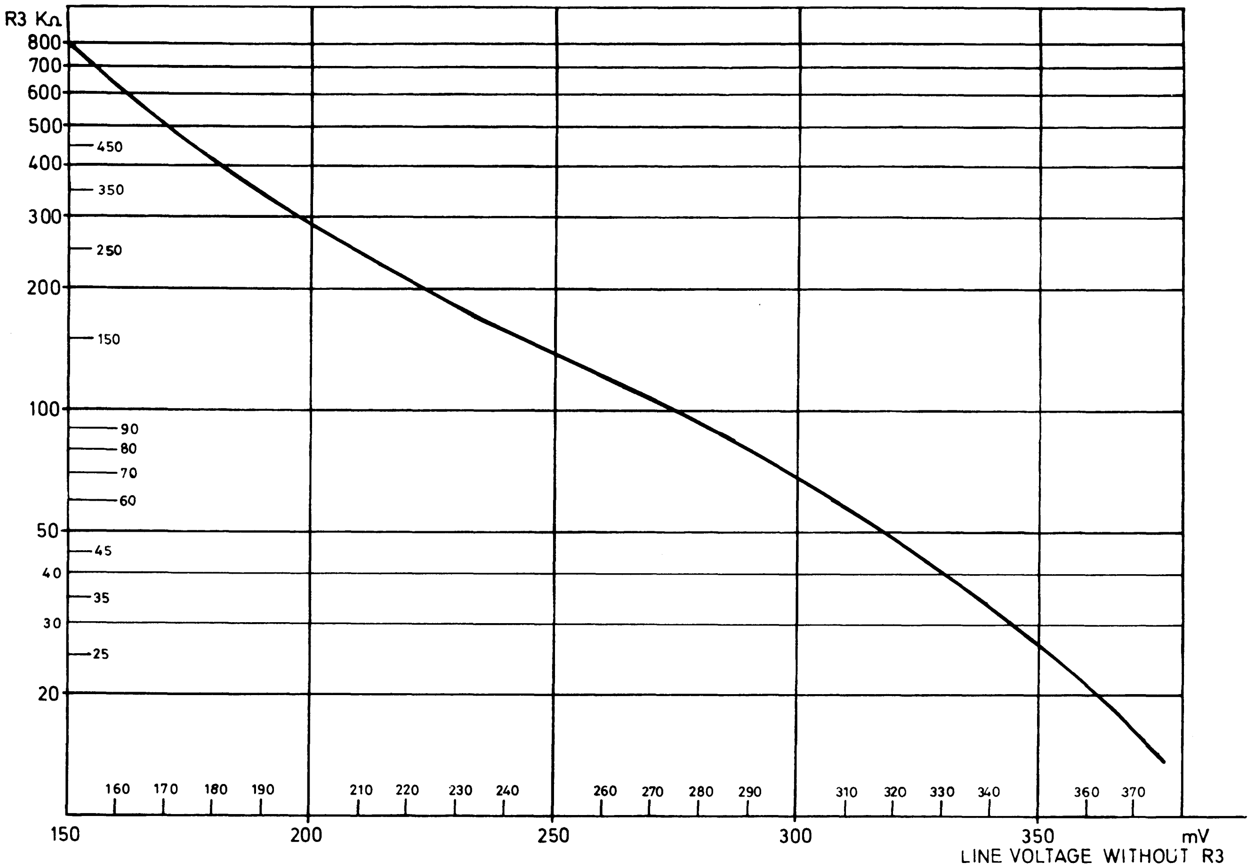


Fig. 4. Value of R3 (line voltage -17 dBm)

CHECKING THE AF FREQUENCY RESPONSE AND DISTORTION

11. Set the signal generator output to approx. 100 uV e.m.f.
    Set LINE OUT - LS/MICR switch down.
    Turn the volume switch to the 3rd position (III).
    Read the AF voltage on the ACVM (reference).
    Set the modulation frequency to 300 Hz.
    AF voltage: +9 dB ±2 dB rel. to 1000 Hz.
    Set the modulation frequency to 3000 Hz.
    AF voltage: -10 dB ±2 dB rel. to 1000 Hz.
    Turn the volume switch to the 4th position (IIII).
    Check the total harmonic distortion (THD) at 1000 Hz.
    Requirement: CQP813US, THD= <7%
    CQP814US, THD= <8%

ADJUSTMENT AND CHECKING OF THE SQUELCH FUNCTION

12. Modulate the signal generator with 1 kHz and 0.7 x Δf max.
    Set the volume to the 4th position (IIII).
    Set the SQ OUT switch up.
    Increase the RF-generator output until the signal opens the squelch.
    Requirement: 10 to 12 dB SINAD.
    Decrease the value of R5 if SINAD is less than 10 dB.
    Increase the value of R5 if SINAD is more than 12 dB.

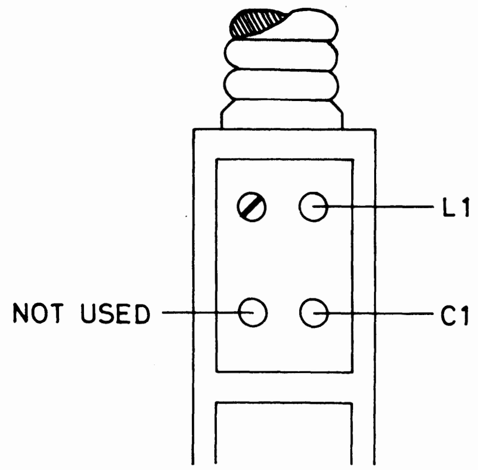
CHECKING THE OVERALL RECEIVER CURRENT DRAIN

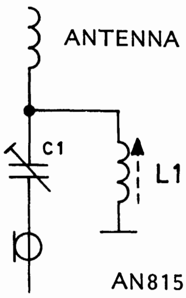
13. Set the DCVM switch to SUPPLY.
    Set the supply voltage to 11 V.
    Disconnect the signal generator.
    Read the current drain on the mA meter.
    Requirement: <18 mA + current drain of tone equipment.
    Set the SQ OUT switch down.
    Set the volume switch to the 4th position (IIII).
    Read the current drain on the mA meter.
    Requirement: <100 mA.

ANTENNA MATCHING ADJUSTMENT

ANTENNA NETWORK ADJUSTMENT IN CP808,
LOCAL MODE

1. Assemble the radio set with cabinet sheath and loudspeaker panel in position.
2. Screw antenna AN816 or AN815 in position.
3. Clip antenna alignment unit TS-D37, code 95B0555, in remote control multisocket.
4. Raise hinged cover "A" on control head CP808 and remove rubber gasket, thus giving access to the matching network's variable components.
5. Power equipment by means of a battery (f.ex. BU807) and hold in normal operating position.
   Key transmitter.
6. Adjust C1/L1 (beginning with C1) for maximum indication on TS-D37, Repeat C1/L1 adjustment until no further increase in TS-D37 indication can be obtained.
7. This completes the antenna network adjustment. Replace gasket and snap cover "A" back into position.





AN815 AND AN816
MATCHING NETWORK

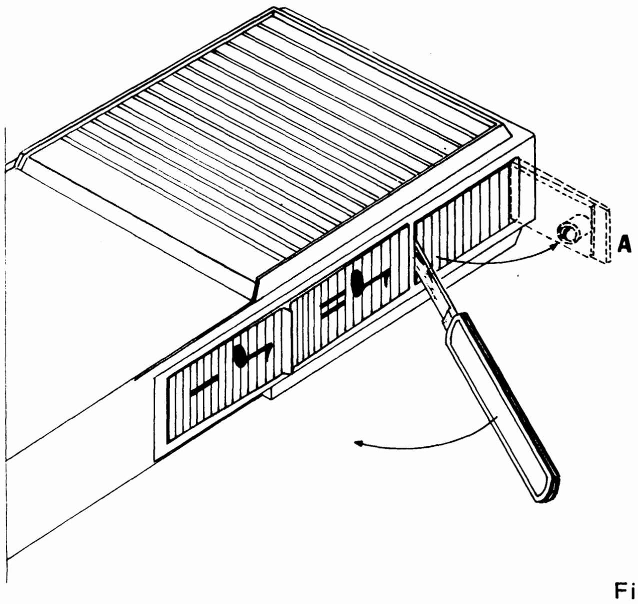


Fig. 6. Antenna matching network in CP808

ANTENNA NETWORK ADJUSTMENT IN CB812, REMOTE MODE

1. Assemble the station with Control Unit CB812.
2. Screw antenna AN815 or AN816 in position, see fig. 7.
3. Replace the back cover on CB812 with the test adaptor, 95B0579.
   Clip the antenna alignment unit TS-D37 onto the multisocket dummy on the test adaptor. Key the transmitter.
4. Adjust C1/L1 (beginning with L1) for maximum indication on TS-D37.
   Repeat the adjustment of L1/C1 until no further increase in the deflection can be obtained.
5. This completes the antenna network adjustment, and the original back cover and chassis connection to the clip is restored.

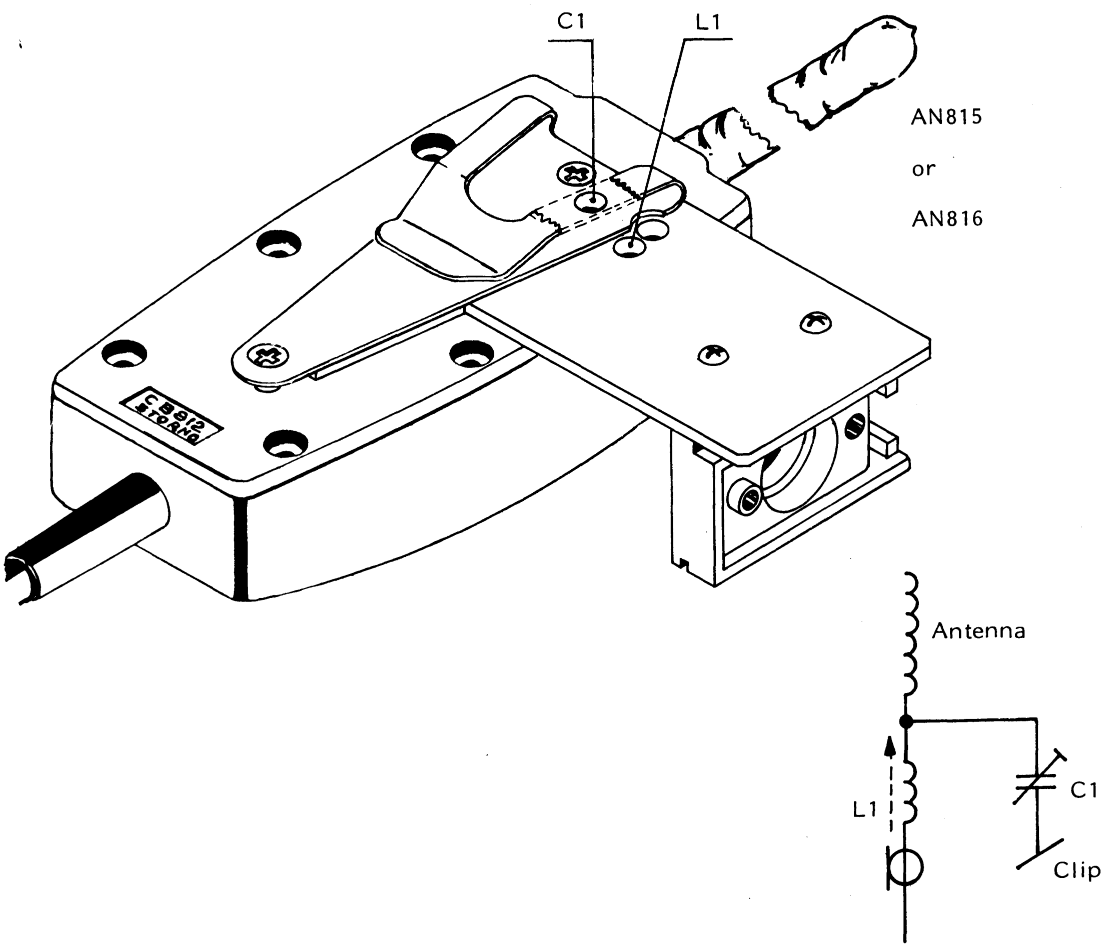
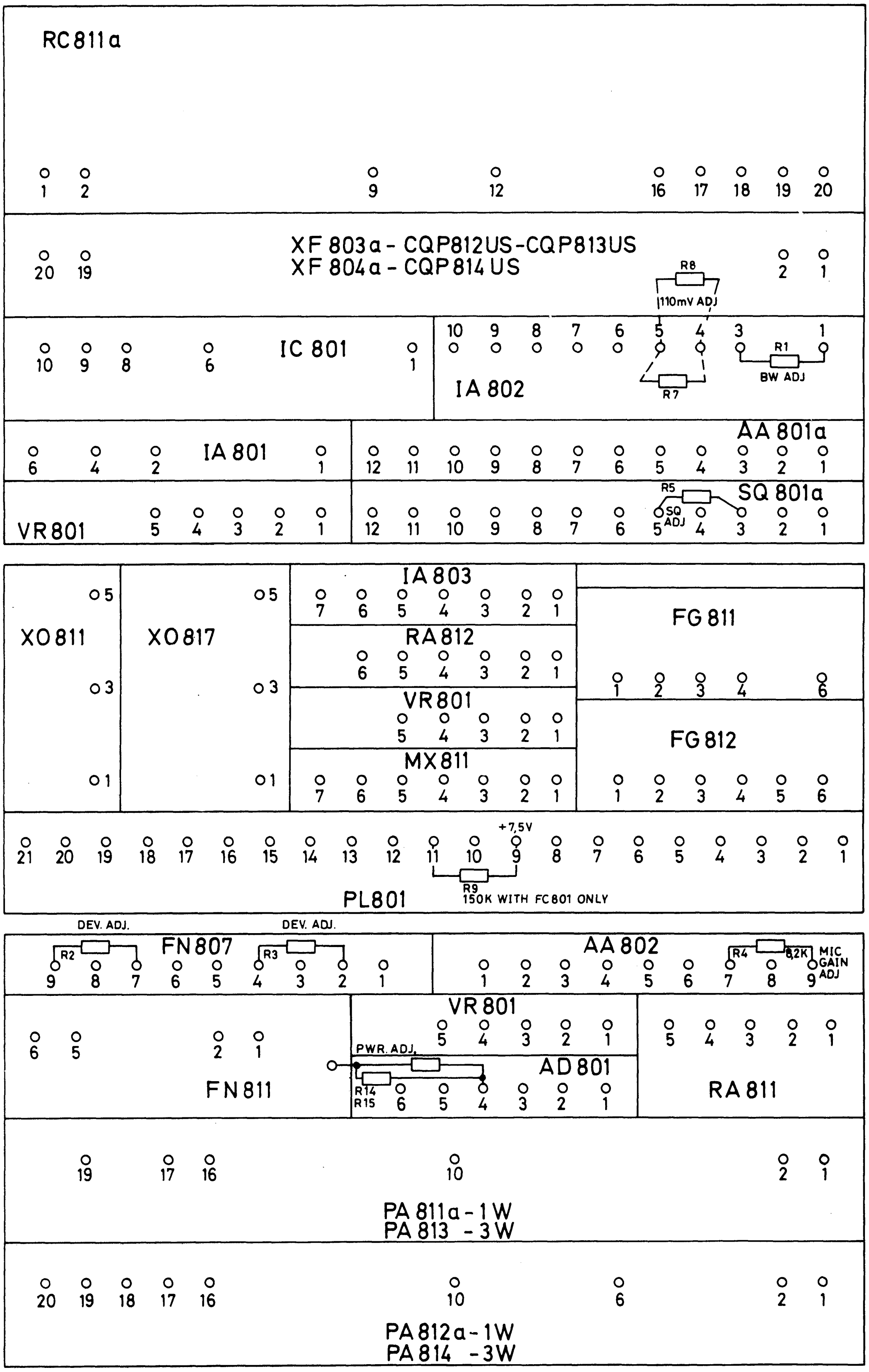


Fig. 7.



PIN LOCATION AND ADJUSTABLE RESISTORS
CQP810US

D403.122

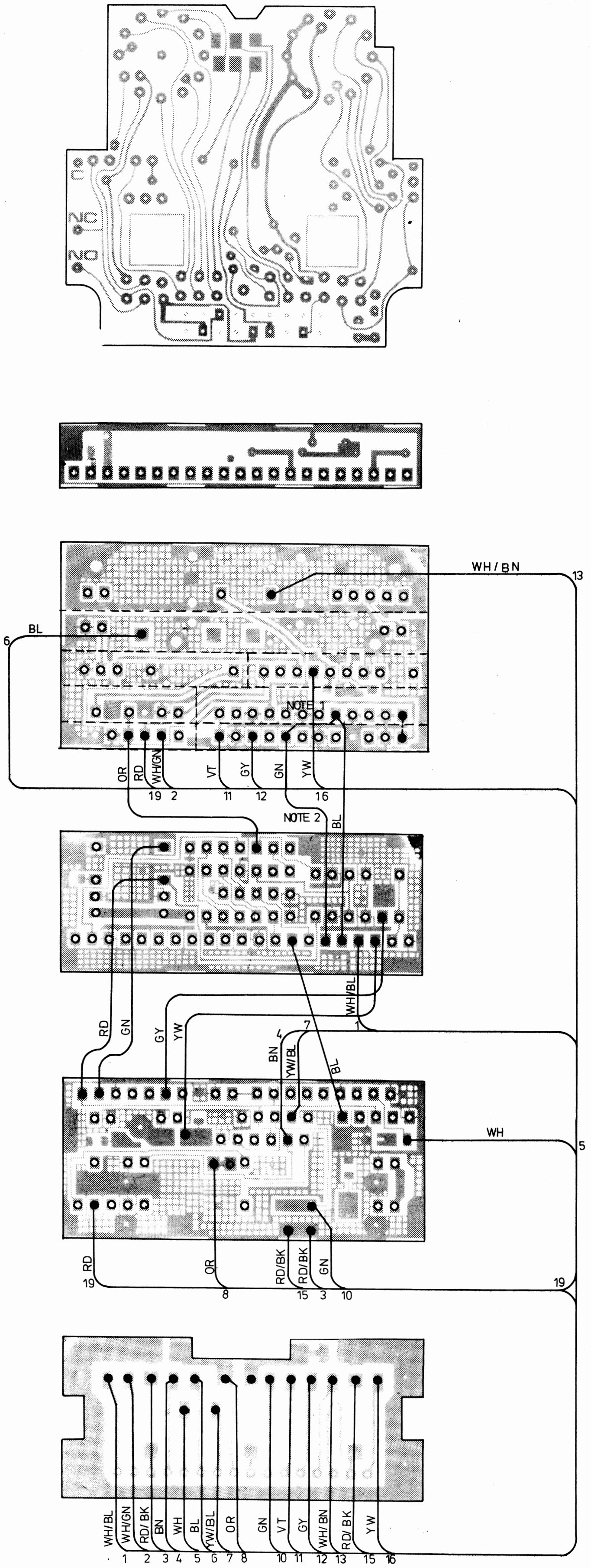
SUMMARY
TRANSMITTER ADJUSTMENT
CQP810US

	TEST	ADJUST	INSTRUMENT	READING
1.	Supply voltage	Power supply	Voltmeter	11 V
2.	TX VCO	FG812 tuning slug tuning slug	DC voltmeter oscilloscope	2.5 V ±0.2 V (1.75 V ±0.15 V)
3.	Current drain	PA811a - L1, L3 PA812a - L3 PA813 - L2, L6 PA814 - L5, L6	mA meter	Maximum
4.	ADC Voltage	RA811 - L1	Voltmeter	Minimum
5.	ADC Voltage Power output	PA811a - L1, L3 PA812a - L3 PA813 - L2, L6 PA814 - L5, L6	Voltmeter Wattmeter	Minimum Maximum
6.	ADC Voltage Power output Current consumption		Voltmeter Wattmeter mA meter	<10 V requirement ±1 dB all channels 1 W: 330 mA 3 W: 730 mA
7.	7.5 V TX		Voltmeter	+7.5 V ±2%
8.	Frequency	XO817-L2	frequency counter	$f_{ant} \pm 0.5 \times 10^{-6}$
9.	10 mV AF 1 kHz Modulation 31 mV AF 1-0.1 kHz	R2	AF generator Deviation meter Distortion meter	Dev. $\leq \Delta$fmax. Dev. $\leq \Delta$fmax.
10.	Modulation distortion	Check	AF generator Deviation meter Distortion meter	0.7 x Δf max., f mod= 1 kHz THD= <7%
11.	Antenna network	C1, L1	TS-D37 code 95B0555	Maximum indication

SUMMARY
RECEIVER ADJUSTMENT
CQP810US

	TEST	ADJUST	INSTRUMENT	READING
1.	Supply voltage	Power supply	DC voltmeter	11 V
2.	Current drain	Check	mA meter	<100 mA
3.	+7.5 V RX	Check	Voltmeter	+7.5 V ± 2%
4.	RX VCO	FG811 tuning slug	DC voltmeter oscilloscope	2.5 V ±0.2 V (1.75 V ±0.15 V)
5.		RC811a - L7, L8	Voltmeter	Maximum DC voltage
6.	Sensitivity	RC811a - L4, L3, L2 L1, L5 L6 L1, L2, L3, L4, L5	RF generator DC voltmeter Distortion meter DC voltmeter	 Maximum Minimum Maximum
7.		XF800 - L1	RF generator (high output)	Minimum distortion
8.	Sensitivity	Check		<1.0 uV e.m.f.
9	Frequency	XO811 - L2	RF generator 21.4 MHz BFO oscilloscope	zero beat
10.	AF Line output	IA802 (R7)	RF generator AC voltmeter	110 mV +0/-1 dB (-17 dBm)
11.	AF response	Volume to 3rd position (III)	RF generator (high output) AC voltmeter	300 Hz: +9 ±2 dB 1000 Hz 0 dB 3000 Hz: -10 ±2 dB
12	Distortion	Check	Distortion meter	CQP813: <7% CQP814: <8%
13	Squelch	R5	RF generator	opens at 10 - 12 dB SINAD
14	Current drain	Volume to pos. 4 (IIII)	mA meter	no signal, Sq. off <18 mA no signal, SQ. on <100 mA

Storno

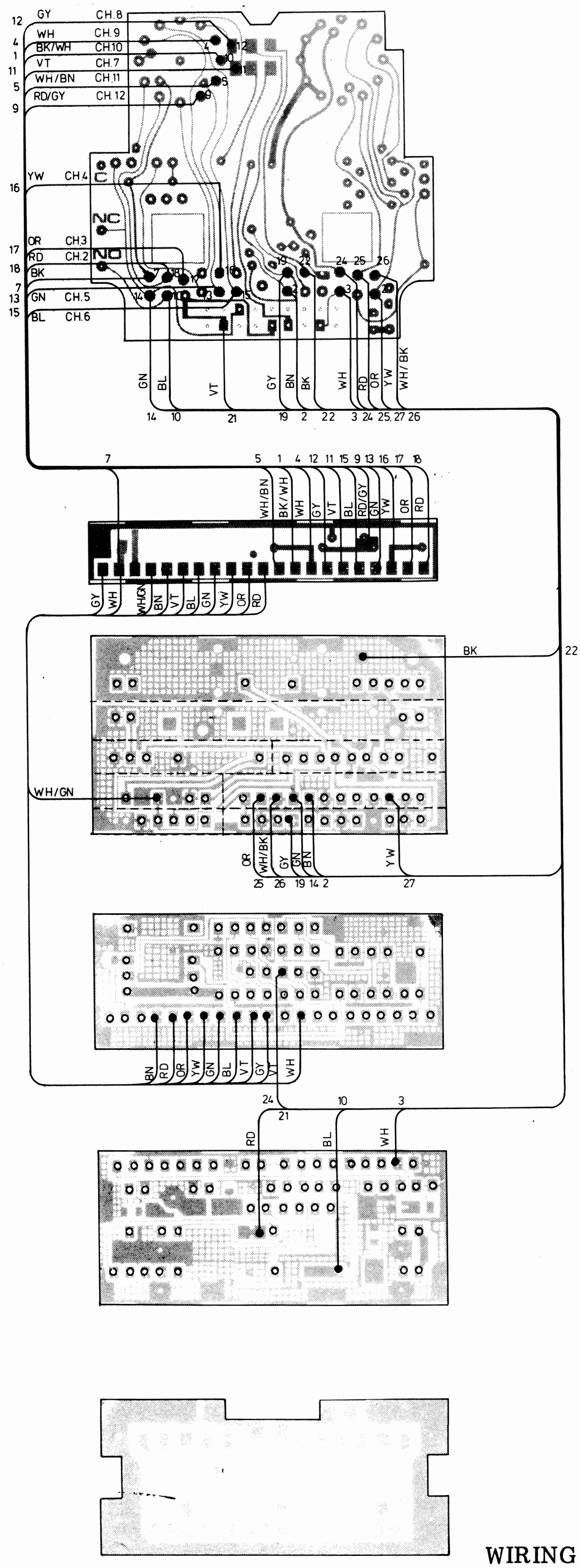


NOTE 1:
REMOVE STRAPS.

NOTE 2:
GN TO BE MOUNTED IN SETS WITHOUT TONE EQUIPMENT (TONE RECEIVER)

WIRING DIAGRAM CQP810US
TB - TX - FS - RX

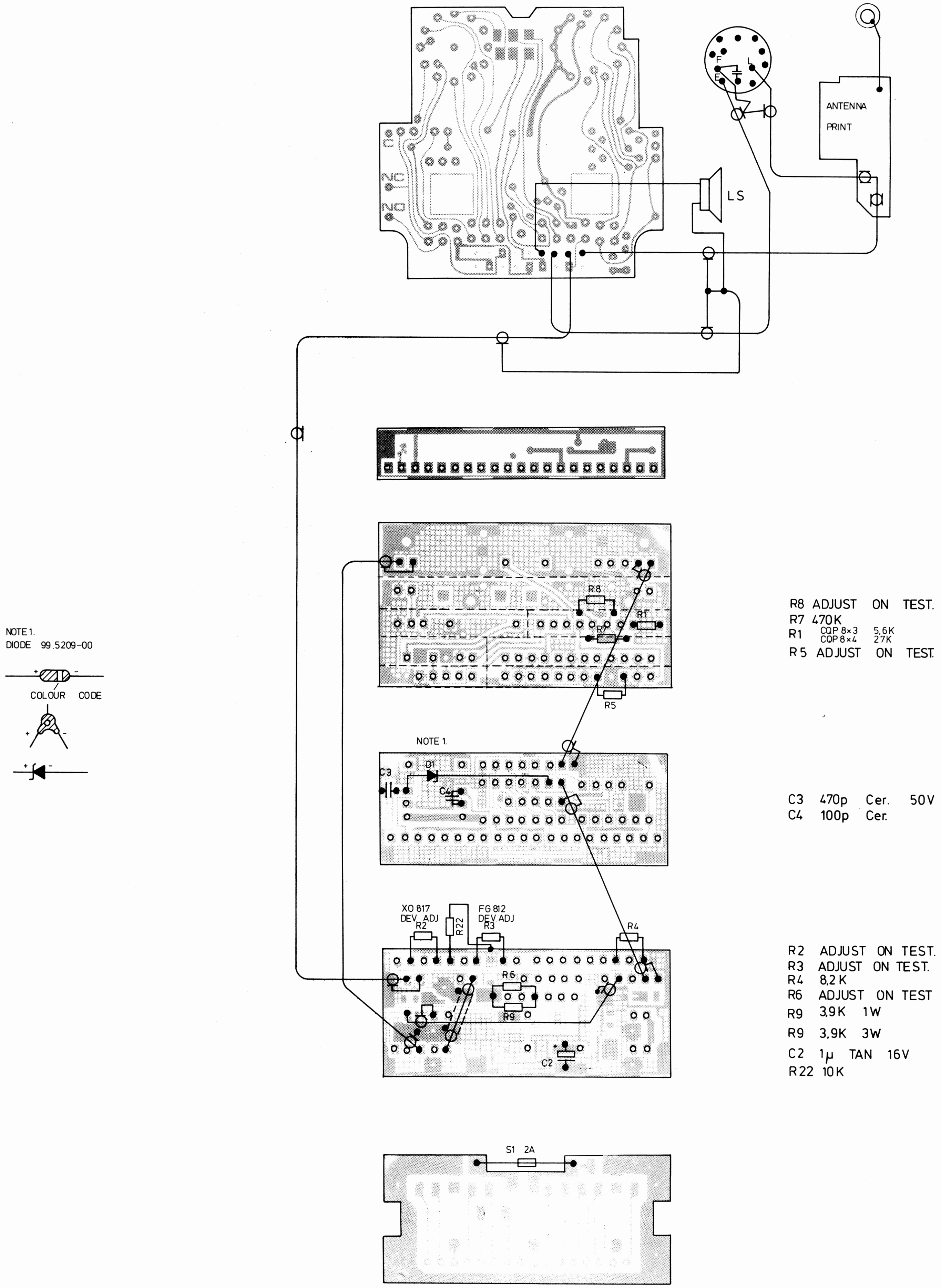
D403.140



WIRING DIAGRAM CQP810US
CP - FC - RX - FS - TX

D403.141

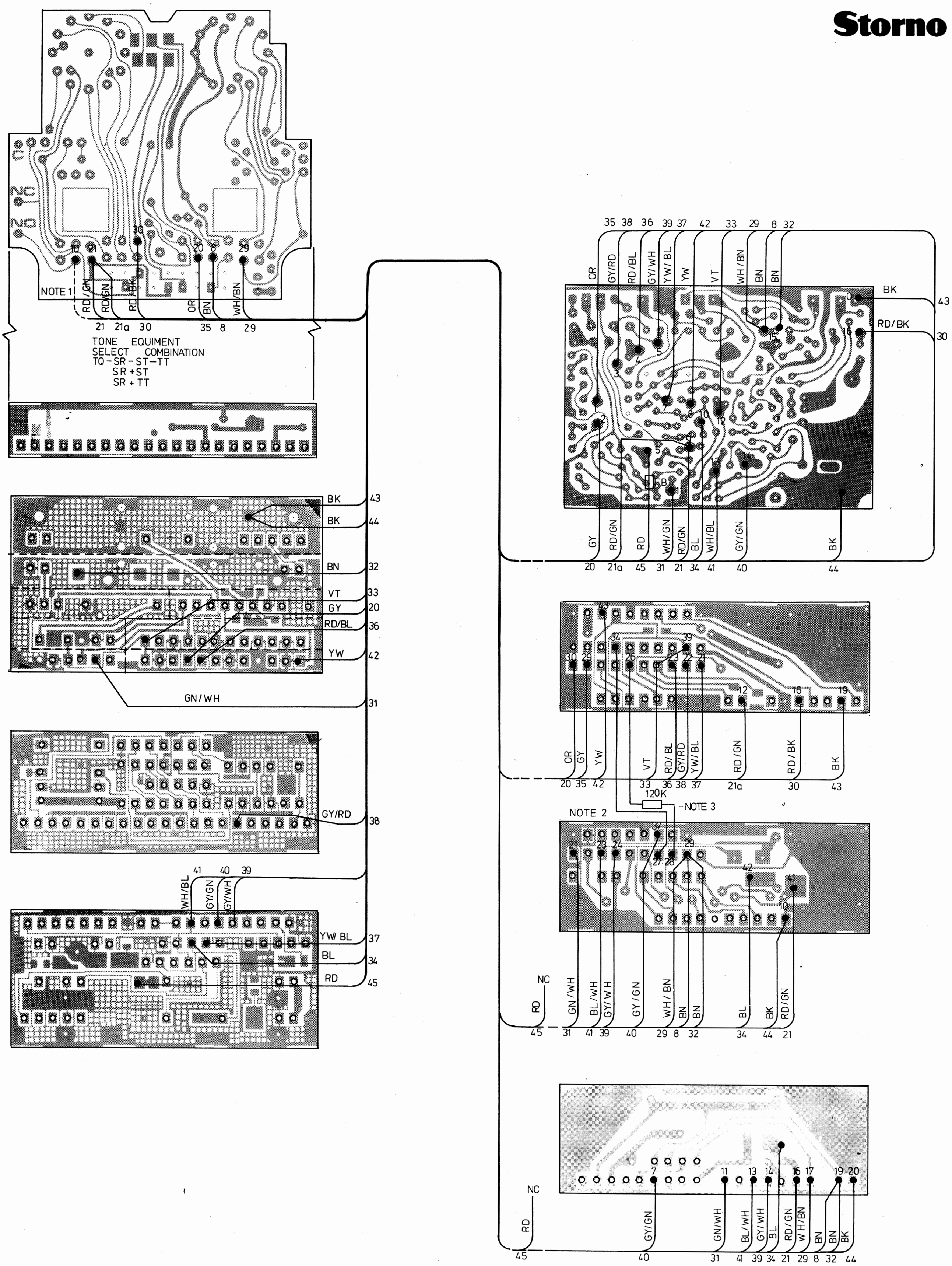
Storno



WIRING DIAGRAM CQP810US

D403.142

Storno



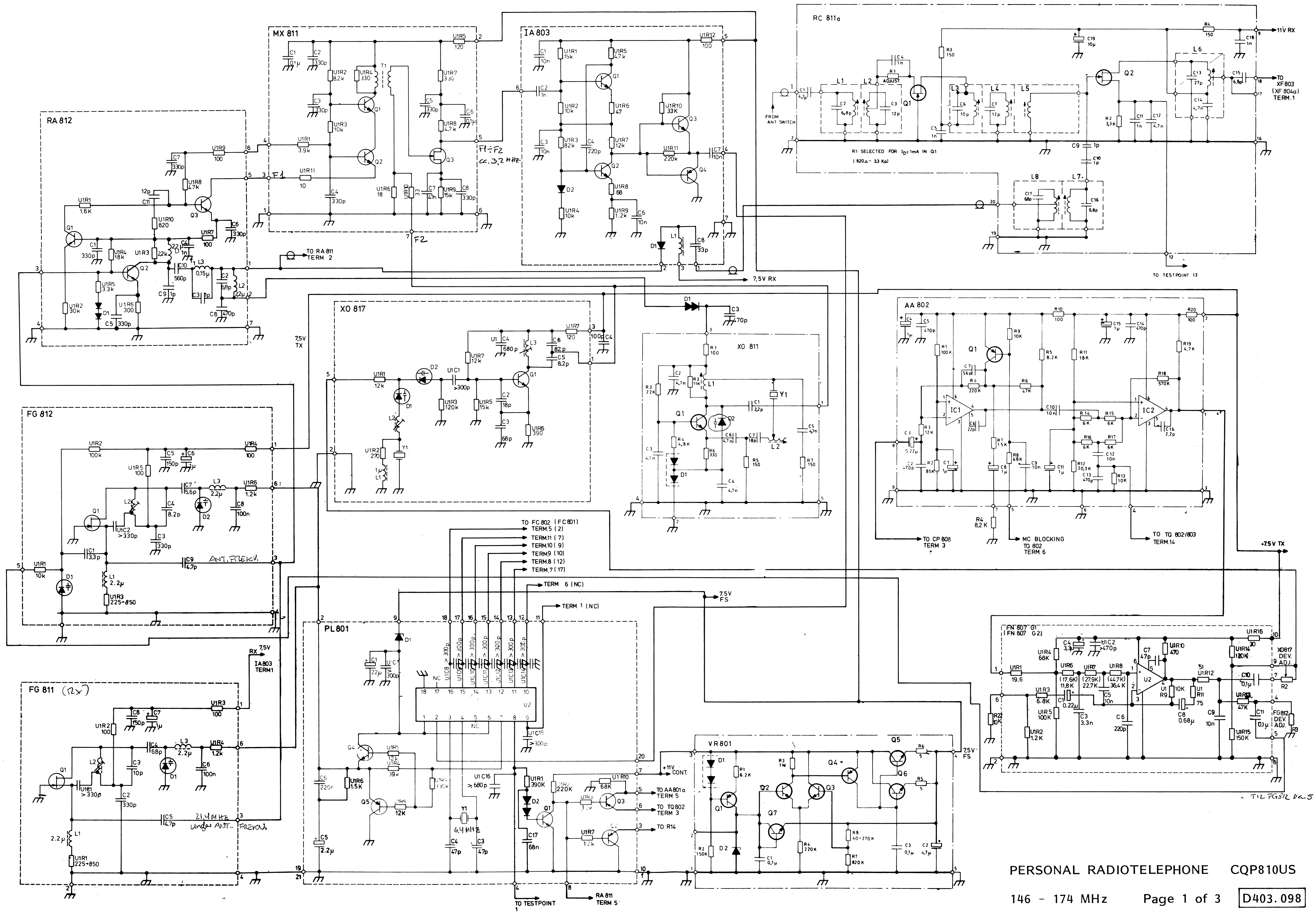
NOTE 1: WHEN ST 801/2 IS TO BE USED FOR IDENTIFICATION THE BROWN WIRE AT TERMINAL 8 CP808 SHOULD BE MOVED TO TERMINAL 10.

NOTE 2: SHORT CIRCUIT FOR AUTOMATIC RECEIPT.

NOTE 3: FOR SR 801/2 AND ST 801/2 A RESISTOR, 120KΩ 5 % 1/10 W IS INSTALLED. 80.5074-00

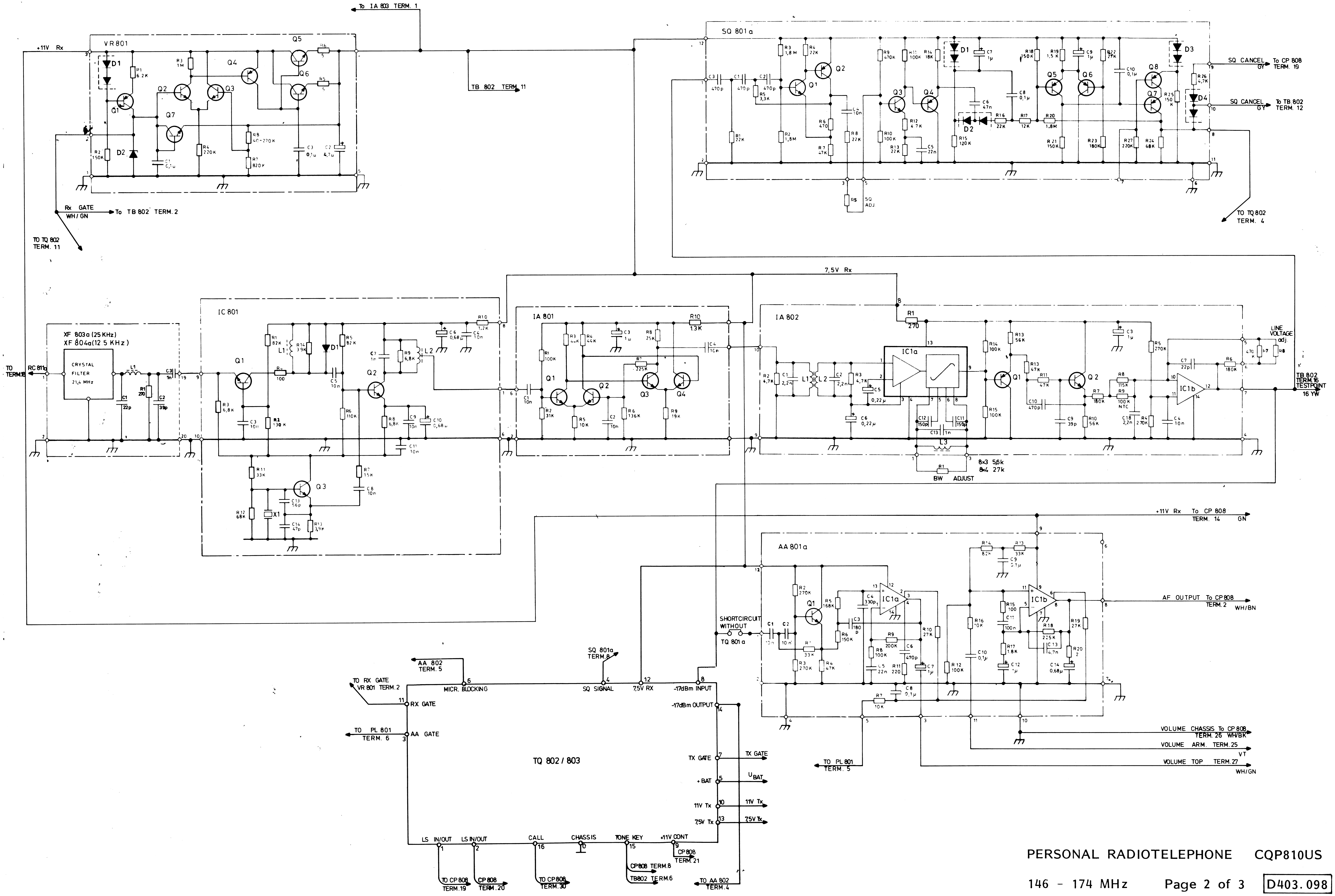
TONE EQUIPMENT WIRING CQP810US

D403.143



PERSONAL RADIOTELEPHONE CQP810US

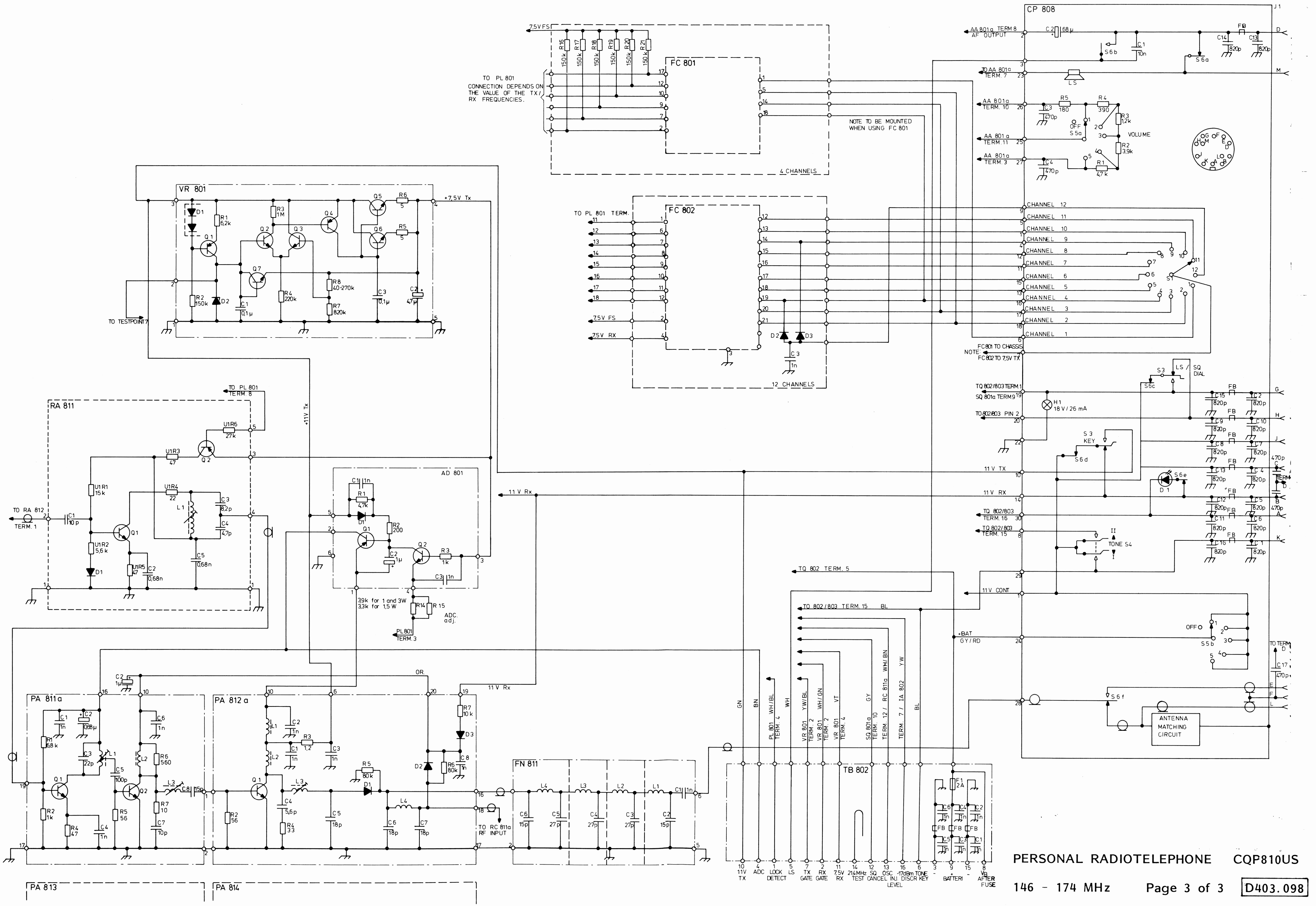
146 - 174 MHz Page 1 of 3 D403.098



PERSONAL RADIOTELEPHONE CQP810US

146 - 174 MHz

 D403.098

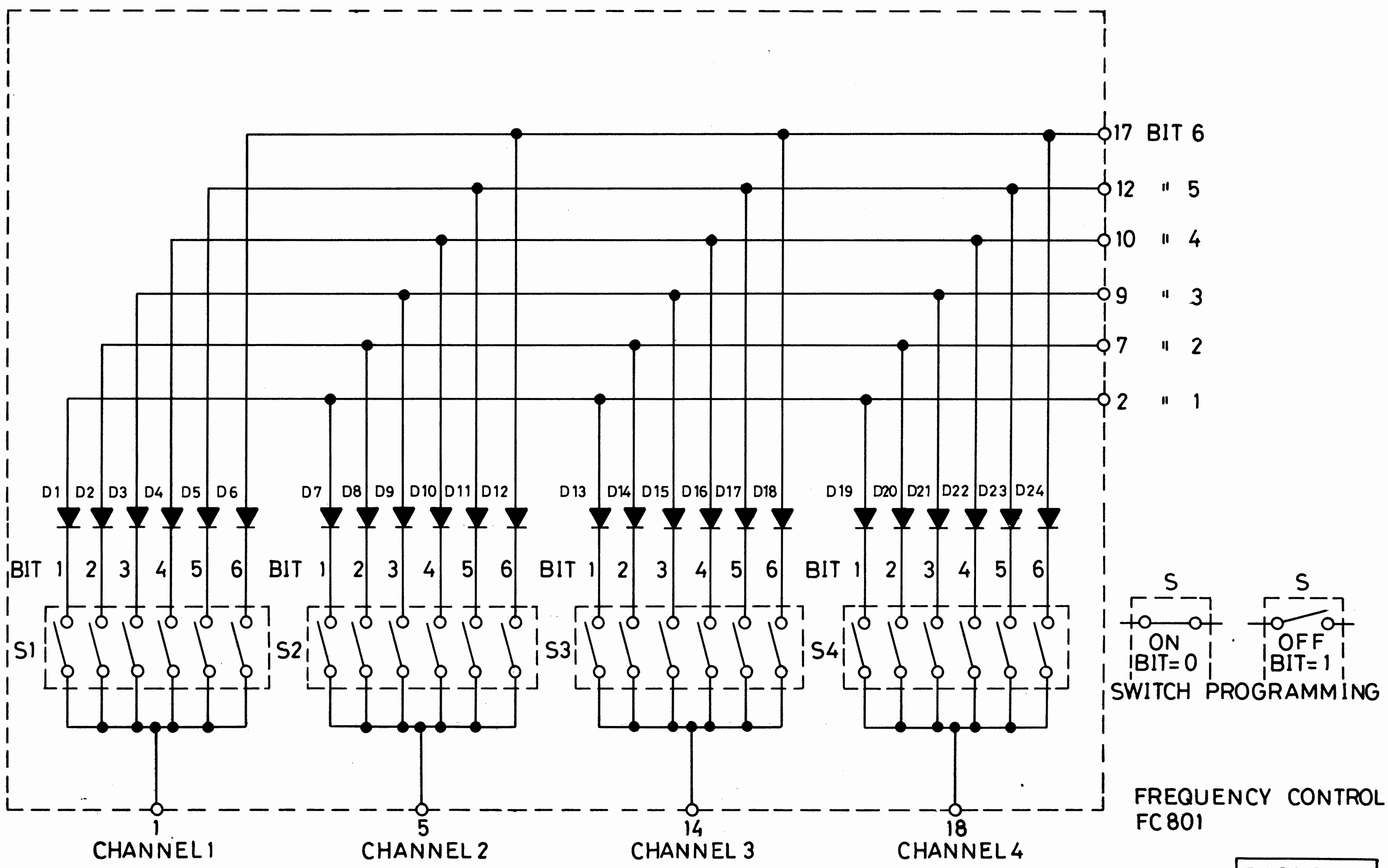


PERSONAL RADIOTELEPHONE CQP810US

146 - 174 MHz

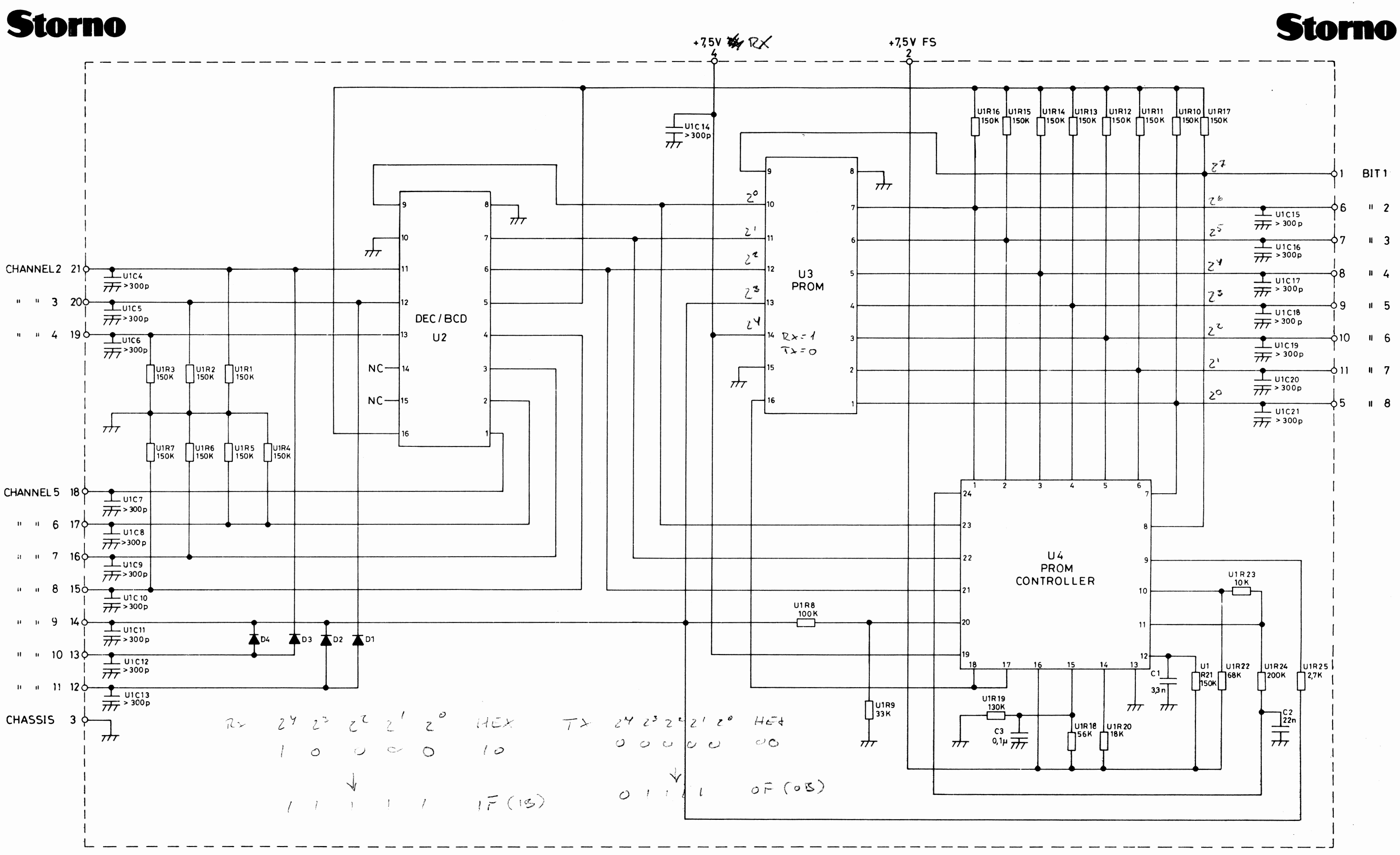
D403.098

Storno



FREQUENCY CONTROL
FC 801

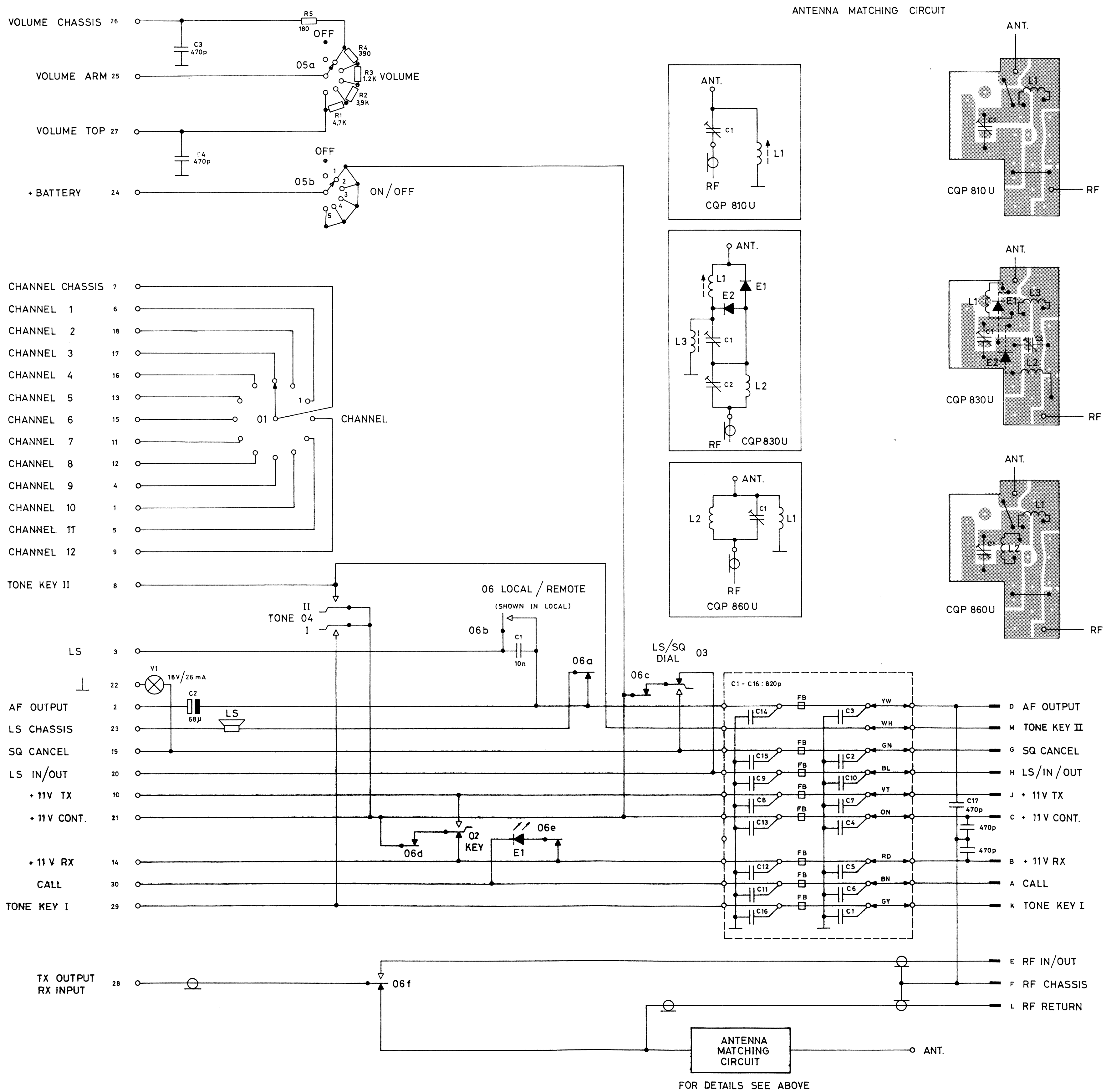
D403.035



FREQUENCY CONTROL FC 802

D403.034

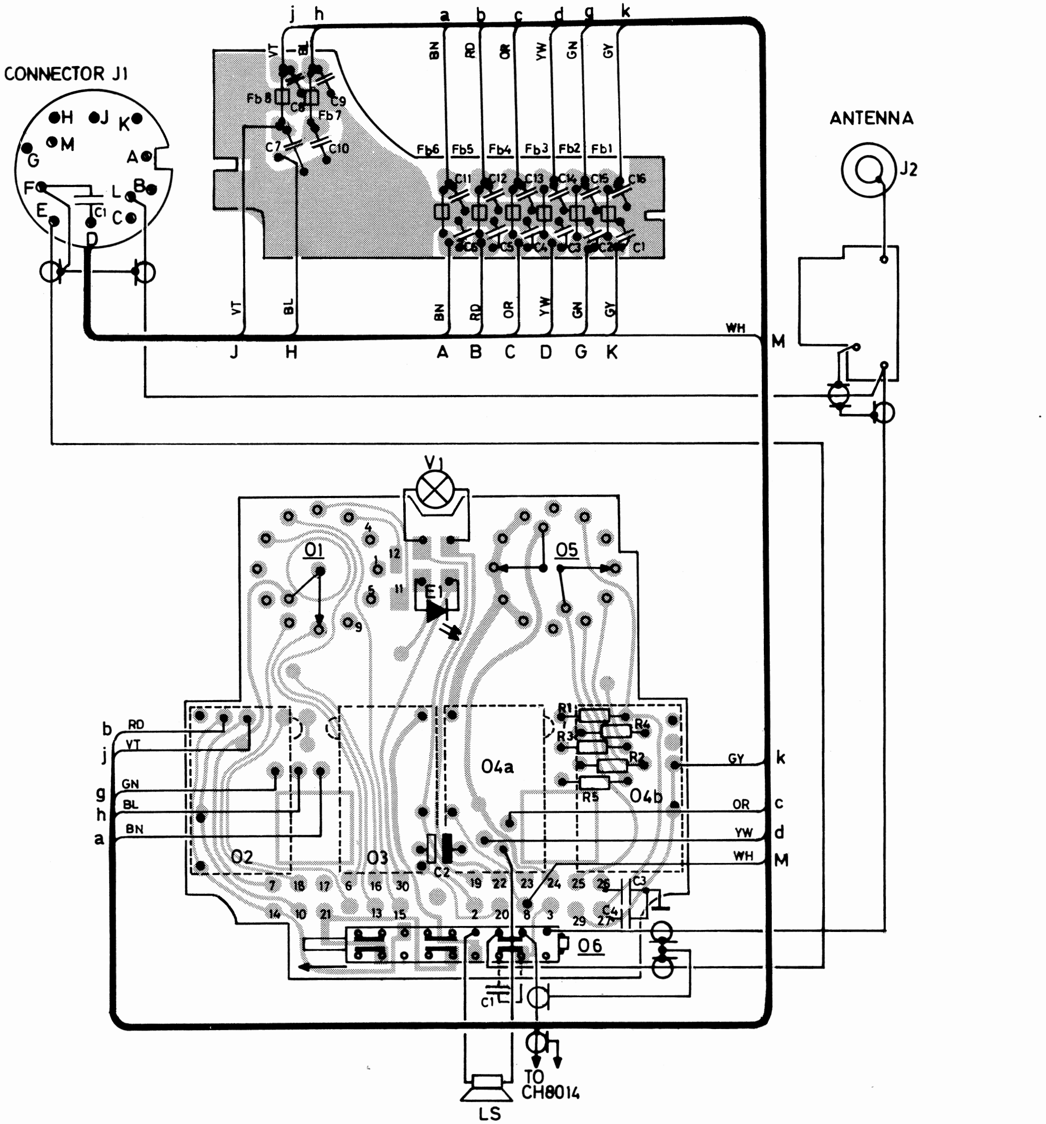
Storno



CONTROL HEAD CP808

D 402.595/1

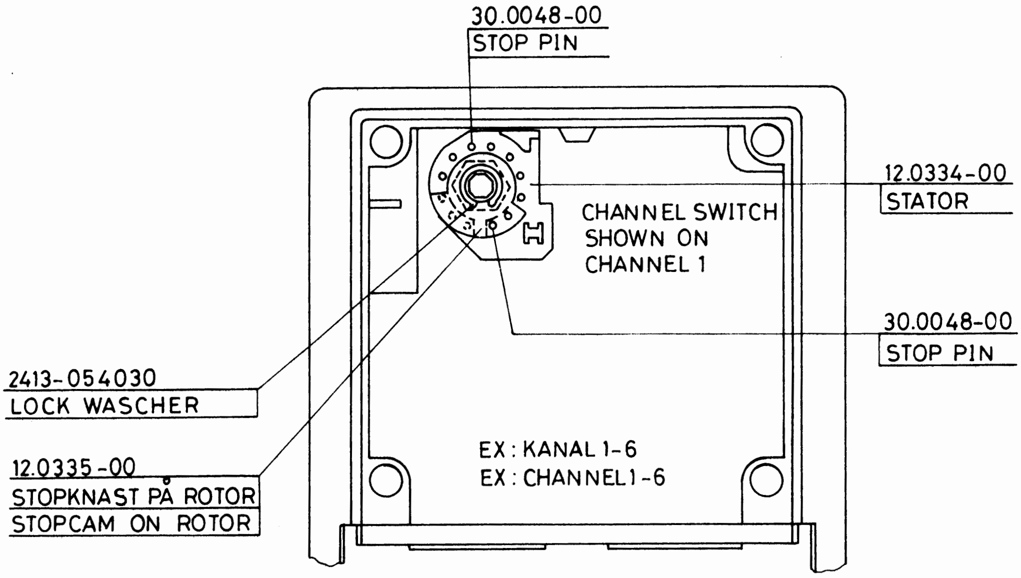
Storno

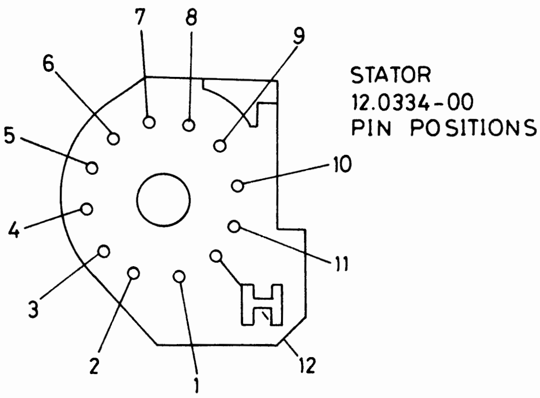


CONTROL HEAD CP808

D402.469/2

Storno





KANAL
CHANNEL

STIFT I POS.
PIN IN POS.

			1	2	3	4	5	6	7	8	9	10	11	12
1			X	X										
1 - 2			X		X									
1 - 3			X			X								
1 - 4			X				X							
1 - 5			X					X						
1 - 6			X						X					
1 - 7			X							X				
1 - 8			X								X			
1 - 9			X									X		
1 - 10			X										X	
1 - 11			X											X
1 - 12														

CHANNEL SWITCH STOP CQP 800

D 403.036

Storno

TYPE	Nº	CODE	DATA	
		10.3375	Control Head CP808	
		15.0314-01	Switch, p.c.b. assembly	
	C1	74.5280	10nF 20% ceram CP	50V
	C2	73.5106	68uF 20% tantal	16V
	C3	74.5312	470pF-20/+80% ceram PL	63V
	C4	74.5312	470pF-20/+80% ceram PL	63V
	R1	80.5057	4.7kohm 5% carbon film	1/10W
	R2	80.5056	3.9kohm 5% carbon film	1/10W
	R3	80.5050	1.2kohm 5% carbon film	1/10W
	R4	80.5044	390ohm 5% carbon film	1/10W
	R5	80.5040	120ohm 5% carbon film	1/10W
	02	47.5092	Microswitch, Key	
	03	47.5092	Microswitch, LS/SQ	
	04	47.5092	Microswitch, Tone	
	06	47.5092	Microswitch, Tone	
		15.0315	Filter, p.c.b. assembly	
	C1-16	74.5314	820pF 20% ceramic	
	Fb	65.5109	Ferrite bead	
	01	47.0626	Rotary switch 1x12	
	05	47.0627	Rotary switch 2x6	
	E1	99.5339	LD 30/11 LED	
	V1	92.5115	Lamp, 18V/26mA	
	LS	97.5037	Loudspeaker	
	J1	41.0218	12-pin Connector, female	
	C17	74.5312	470pF-20+80% ceram PL	63V
	C18	74.5312	470pF-20+80% ceram PL	63V
	C19	74.5312	470pF-20+80% ceram PL	63V
CQP810U		15.0313	Antenna Matching Network	146-174MHz
	C1	78.5046	2-18pF trimmer N350	300V
	L1	61.1359	RF coil	
CQP830		15.0329	Antenna Matching network	68-88MHz
	C1	78.5046	2-18pF trimmer N350	300V
	C2	78.5046	2-18pF trimmer N350	300V
	L1	61.1363	RF coil	
	L2	62.0954	RF coil	
	L3	61.5015	3.3uH 20% RF choke	0.7A
	E1	99.5187	BA243 Diode	
	E2	99.5187	BA243 Diode	
CQP860U		15.0327	Antenna Matching Network	420-470MHz
	C1	78.5046	2-18pF trimmer N350	300V
	L1	62.0948	RF coil	
	L2	62.0947	RF coil	

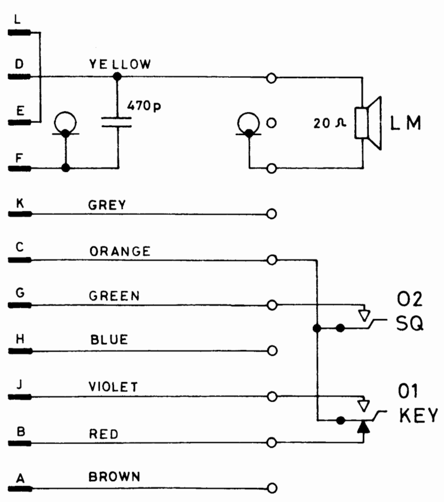
Storno

TYPE	Nº	CODE	DATA

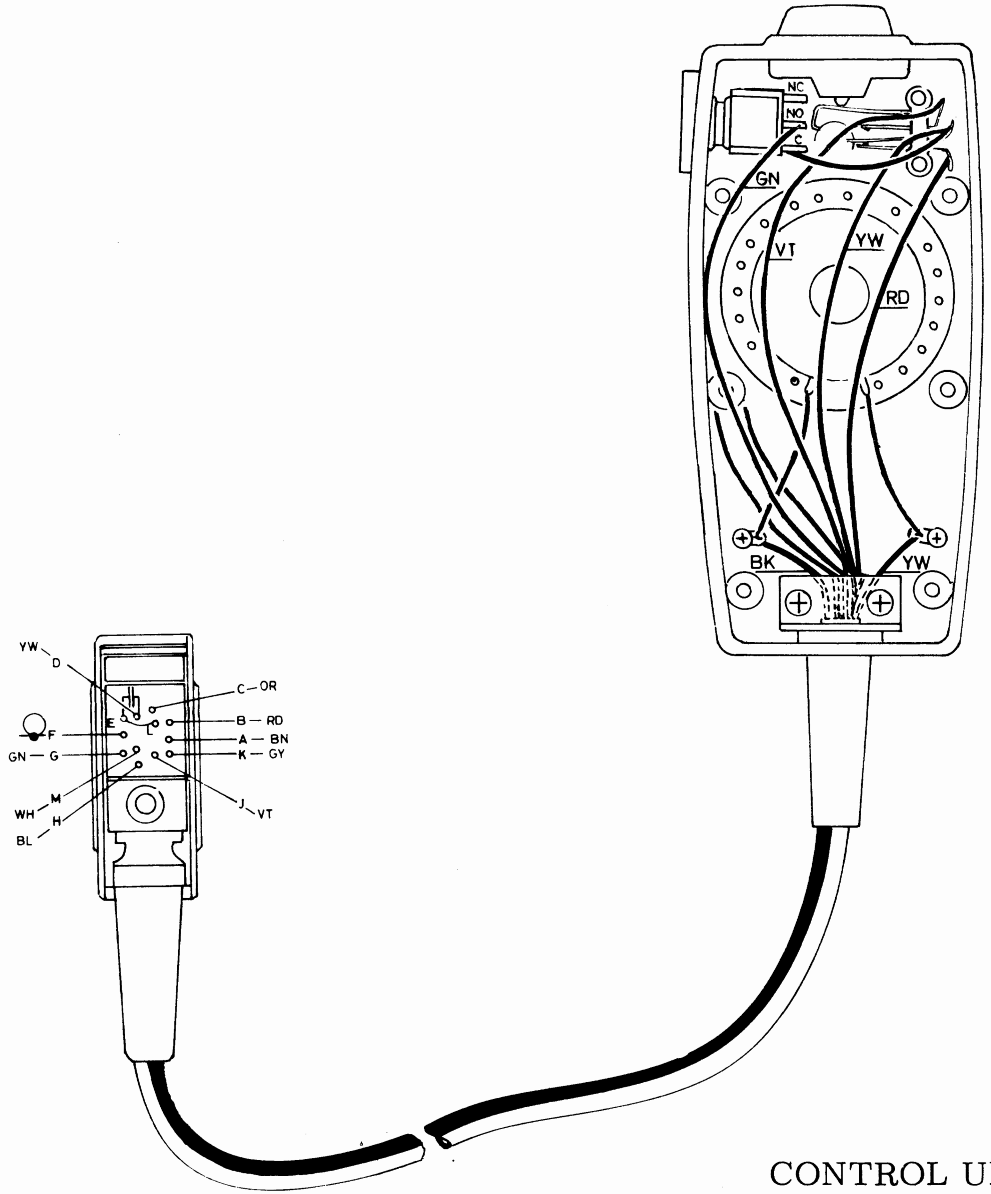
CONTROL HEAD CP808

X402.575

Storno



CB 804



CONTROL UNIT CB804

D402.525/2

Storno

TYPE	Nº	CODE	DATA
CB804		10.3602	Control Unit
	01	47.5033	Switch, Key
	02	47.0635	Switch, SQ
	LM	96.5086	Microphone, dynamic 20 Ohm

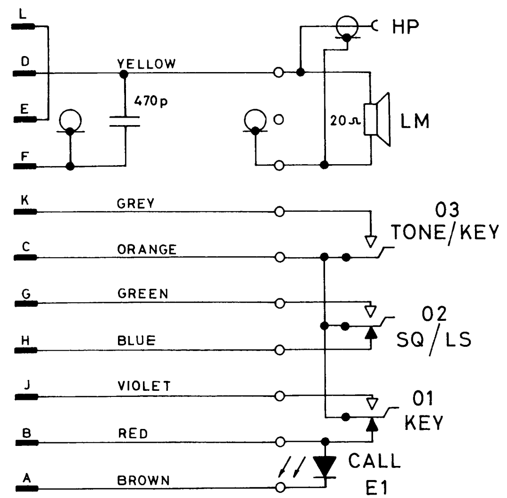
Storno

TYPE	Nº	CODE	DATA

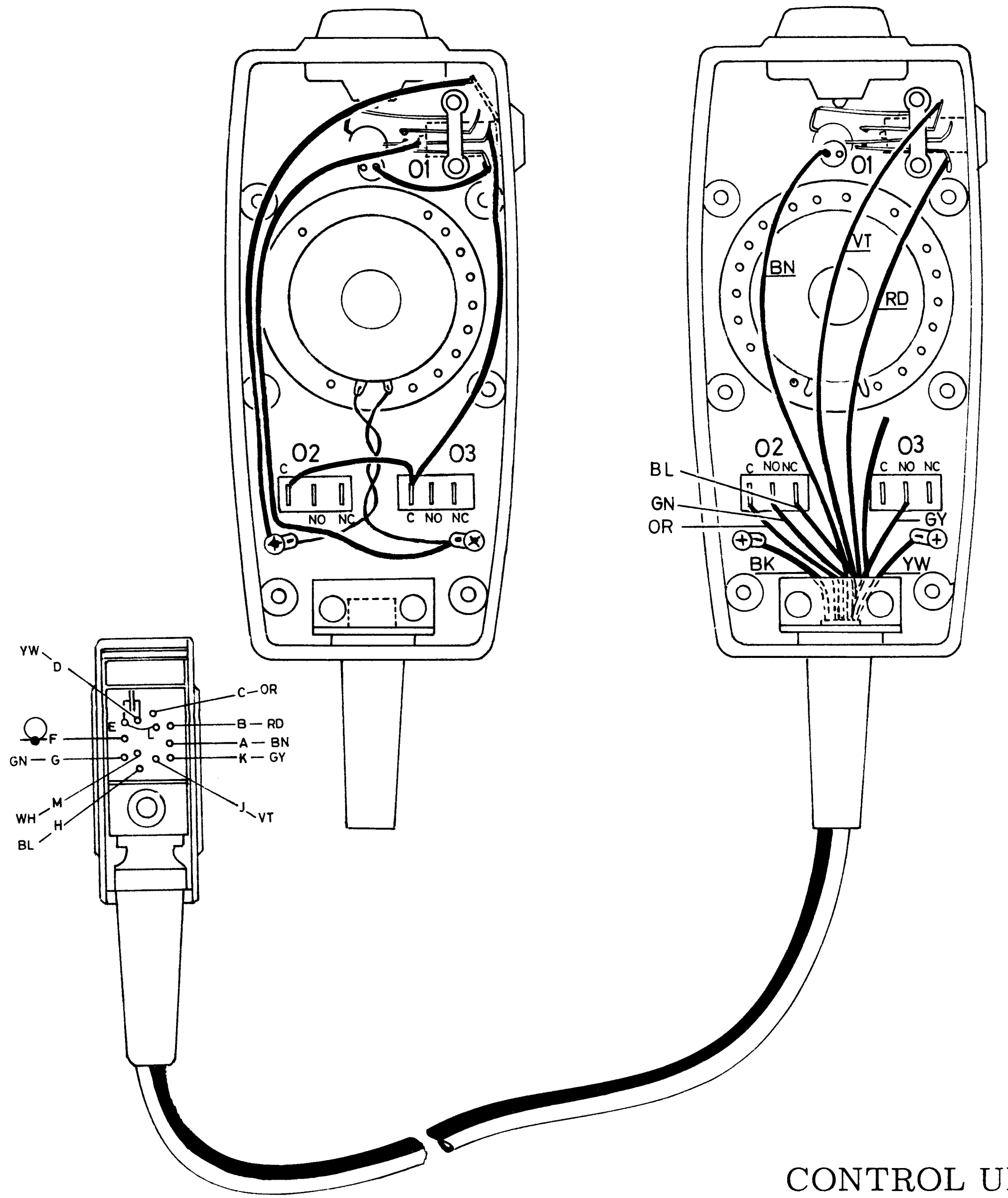
CONTROL UNIT CB804

X402.564

Storno



CB 805



Storno

CONTROL UNIT CB805

D 402.526/3

Storno

TYPE	Nº	CODE	DATA
CB805		10.3603	Control Unit
	01	47.5033	Switch, Key
	02	47.0635	Switch, SQ/LS
	03	47.0635	Switch, Tone Key
	LM	96.5086	Microphone, dynamic 20 Ohm

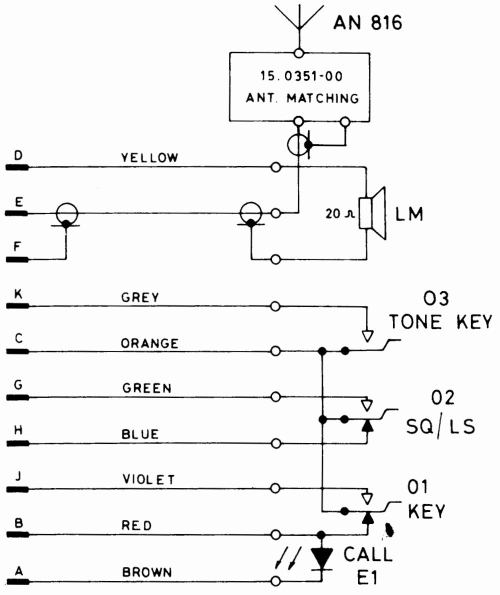
Storno

TYPE	Nº	CODE	DATA

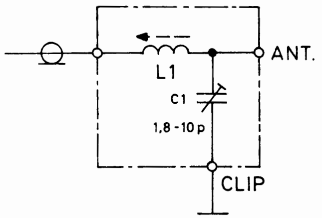
CONTROL UNIT CB805

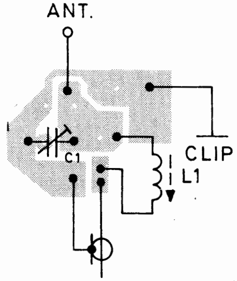
X402.565

Storno

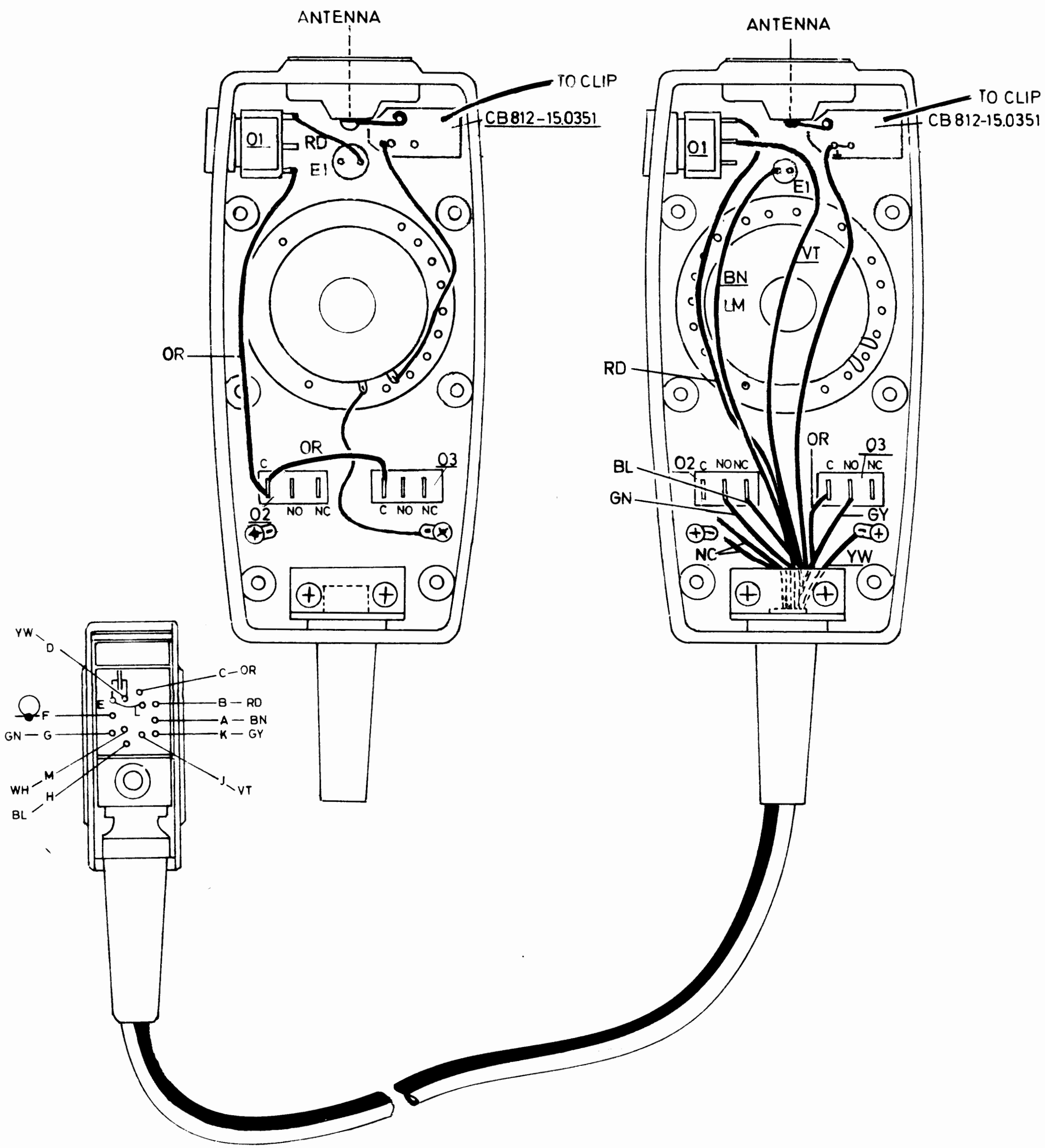


CB 812 (146 - 174 MHz)





ANTENNA MATCHING NETWORK



Storno

CONTROL UNIT CB812

D 402.528

Storno

TYPE	Nº	CODE	DATA
CB812		10.3605	Control Unit (146 - 174 MHz)
	01	47.0635	Switch, Key
	02	47.0635	Switch, LS/SQ
	03	47.0635	Switch, Tone Key
	E1	99.5339	Light Emitting Diode
	LM	96.5086	Microphone, dynamic 20 Ohm
		15.0531	Antenna Matching Network
	C1	78.5048	1.8-10pF 300V
	L1	61.1371	Coil

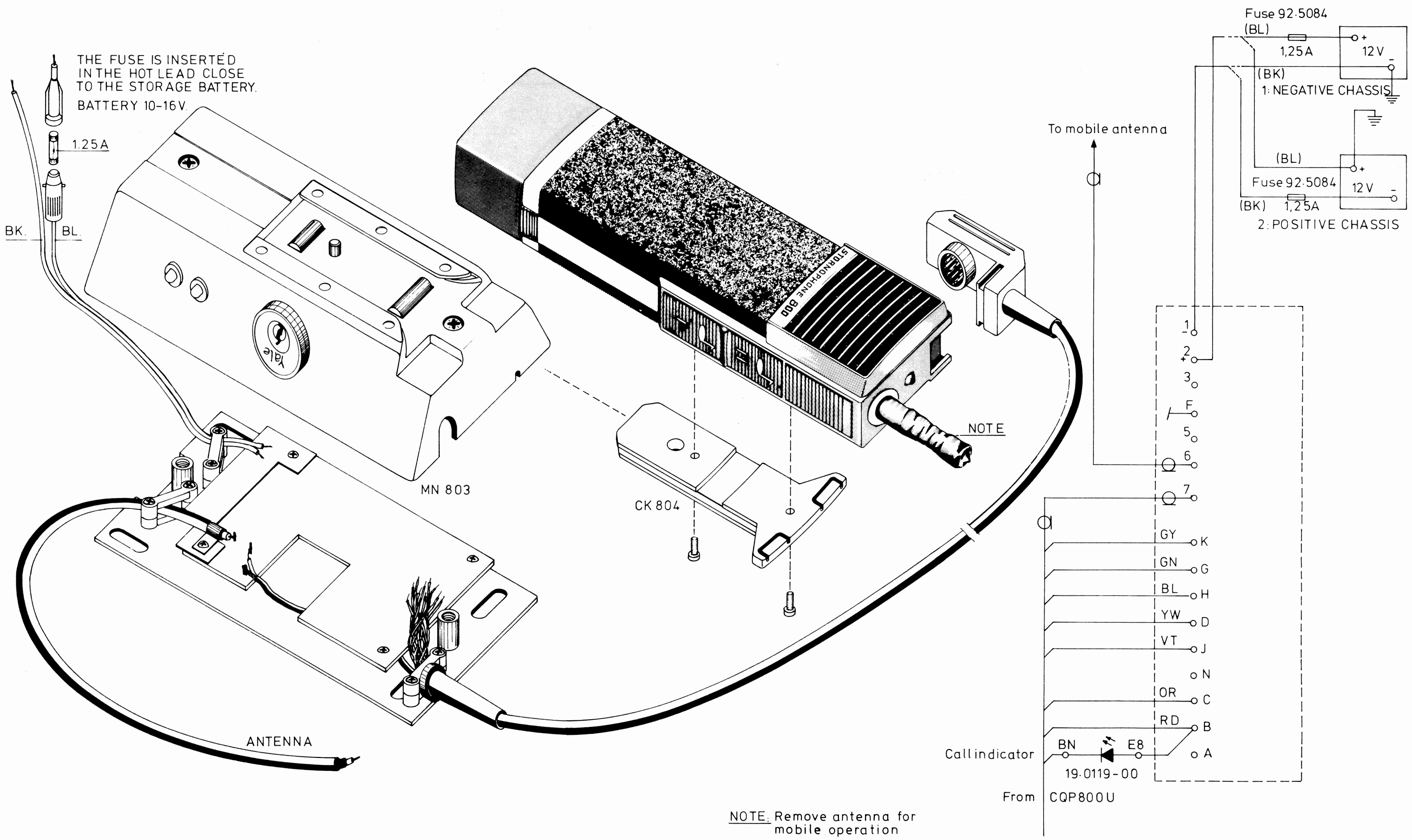
Storno

TYPE	Nº	CODE	DATA

CONTROL UNIT CB812

X402.566

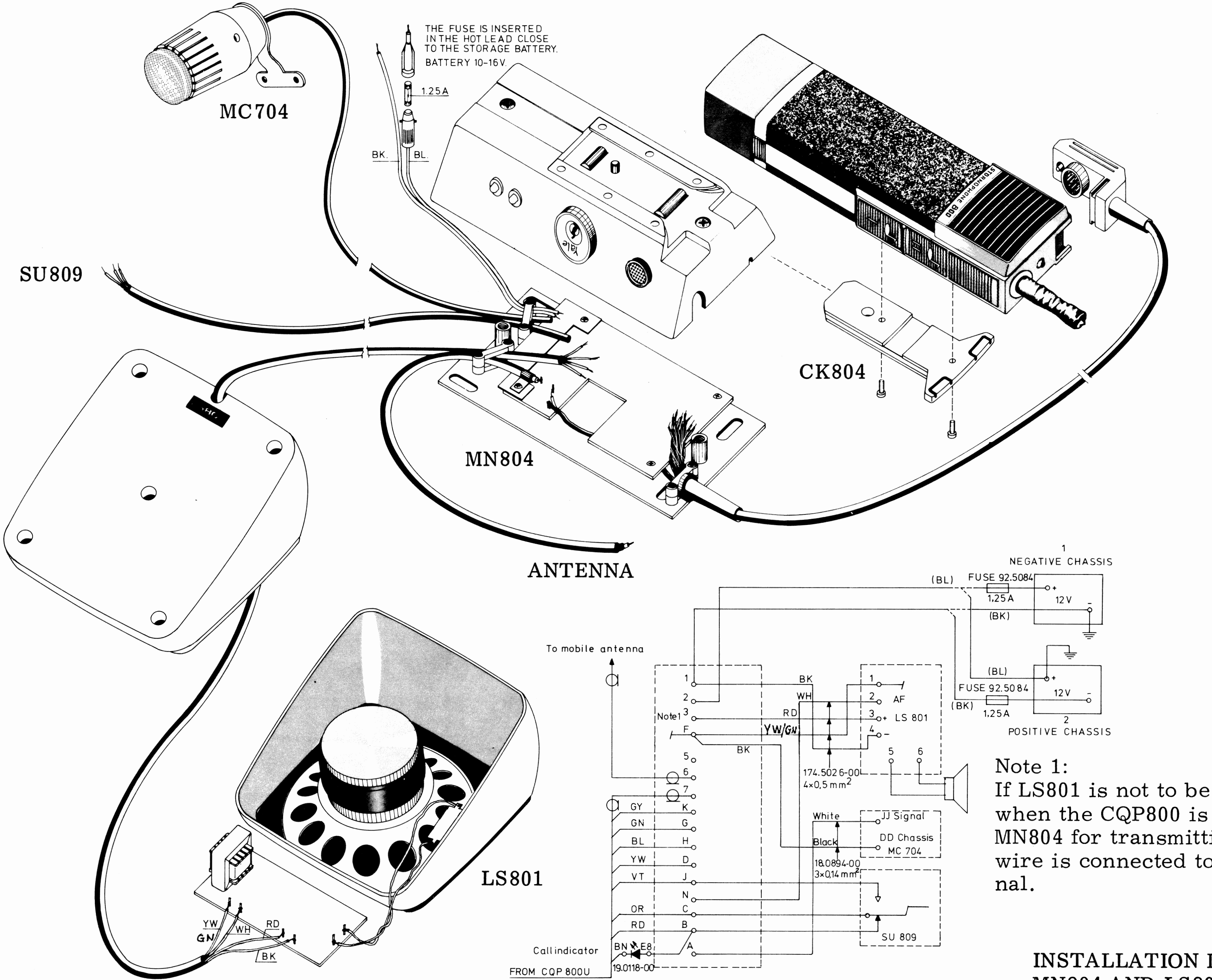
Storno



INSTALLATION DIAGRAM FOR MN 803

D402.600/1

Storno

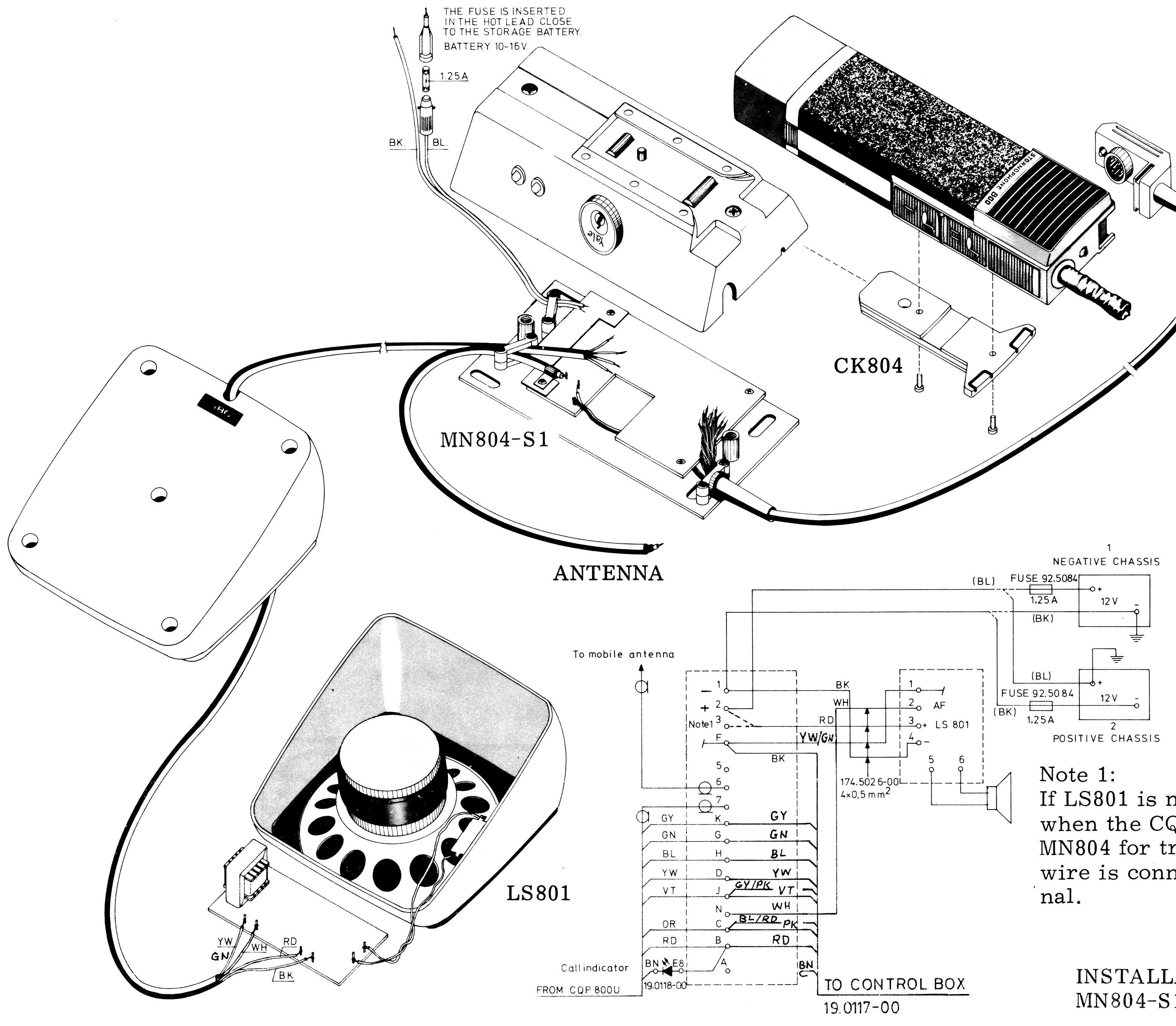


Note 1:
If LS801 is not to be disconnected when the CQP800 is removed from MN804 for transmitting, the red wire is connected to the (+) terminal.

INSTALLATION DIAGRAM FOR MN804 AND LS801

D 402.599/2

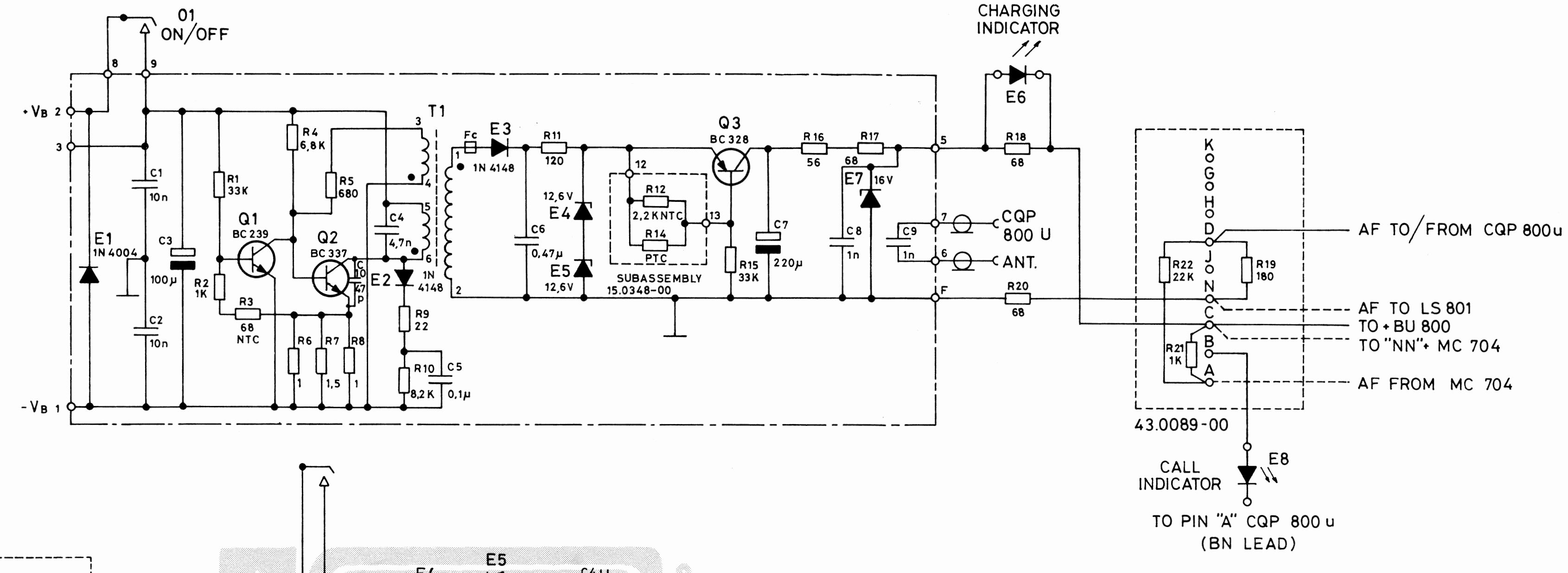
Storno

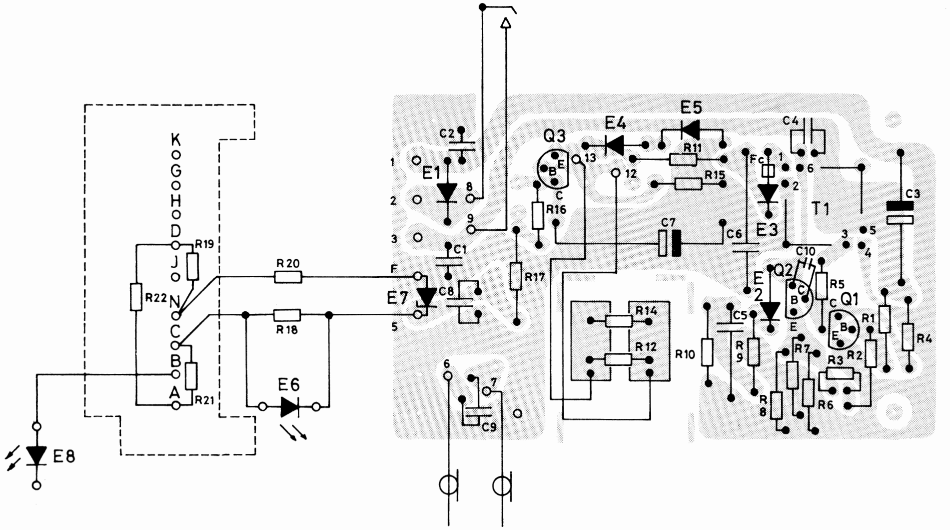


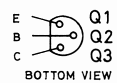
Note 1:
If LS801 is not to be disconnected when the CQP800 is removed from MN804 for transmitting, the red wire is connected to the (+) terminal.

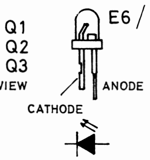
INSTALLATION DIAGRAM FOR MN804-S1 & LS801

D402. 697







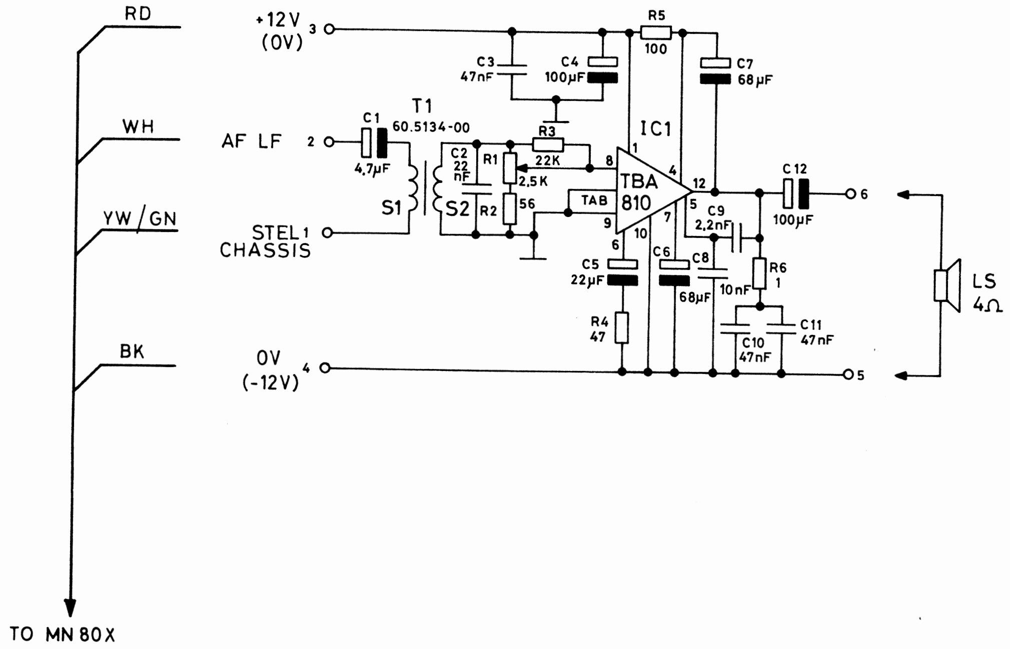


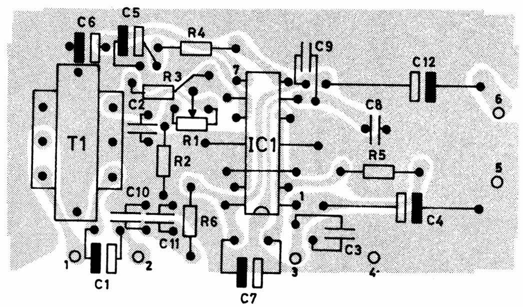
VEHICLE ADAPTOR MN803

D 402.593/2

Storno

Storno





LOUDSPEAKER LS801

D402.423/1

Storno

TYPE	Nº	CODE	DATA
		97.0017	LS801 Loudspeaker with amplifier
	C1	73.5126	4.7 µF 20% tantal 35 V
	C2	76.5071	22 nF 10% polyest FL 50 V
	C3	76.5072	47 nF 10% polyest FL 50 V
	C4	73.5071	100 µF -10/+50% elco 40 V
	C5	73.5127	22 µF 20% tantal 16 V
	C6	73.5106	68 µF 20% tantal 16 V
	C7	73.5106	68 µF 20% tantal 16 V
	C8	76.5070	10 nF 10% polyest FL 50 V
	C9	76.5059	2.2 nF 10% polyest FL 50 V
	C10	76.5072	47 nF 10% polyest FL 50 V
	C11	76.5072	47 nF 10% polyest FL 50 V
	C12	73.5071	100 µF -10/+50% elco 40 V
	R1	86.5067	2.5 KΩ 20% potentiometer lin. 0.1 W
	R2	80.5234	56 Ω 5% carbon film 1/8 W
	R3	80.5265	22 KΩ 5% " " 1/8 W
	R4	80.5233	47 Ω 5% " " 1/8 W
	R5	80.5237	100 Ω 5% " " 1/8 W
	R6	80.5213	1.0 Ω 5% " " 1/8 W
	T1	60.5134	AF Transformer 600 Ω
	IC1	14.5104	TBA810 AF amplifier
	LS1	97.5035	Loudspeaker

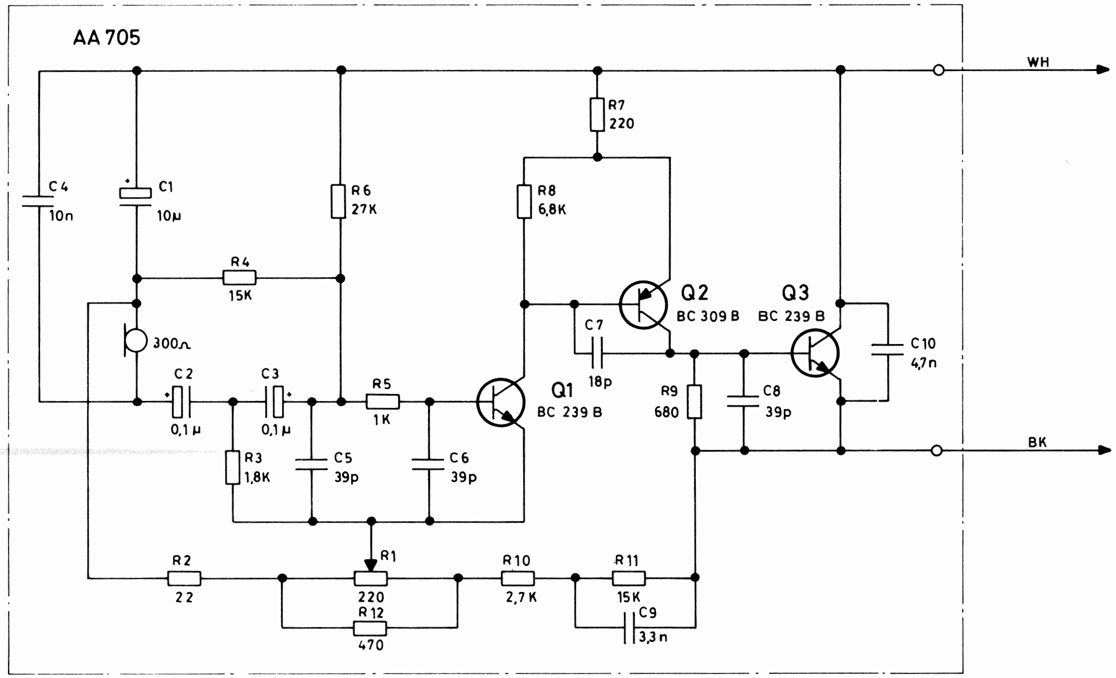
Storno

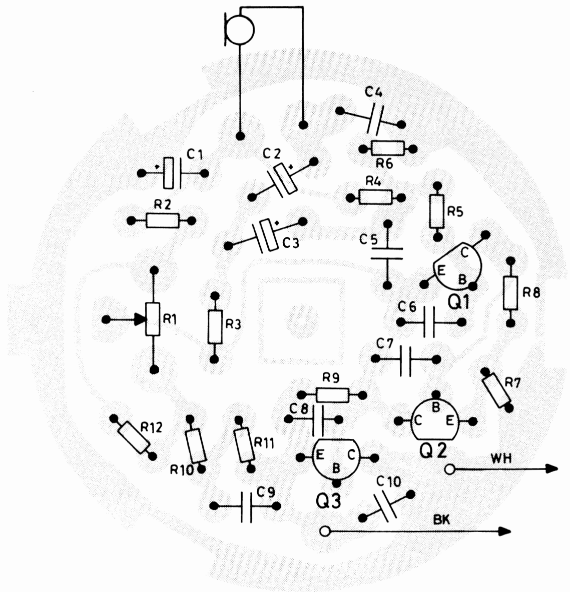
TYPE	Nº	CODE	DATA

LOUDSPEAKER WITH AMPLIFIER LS801

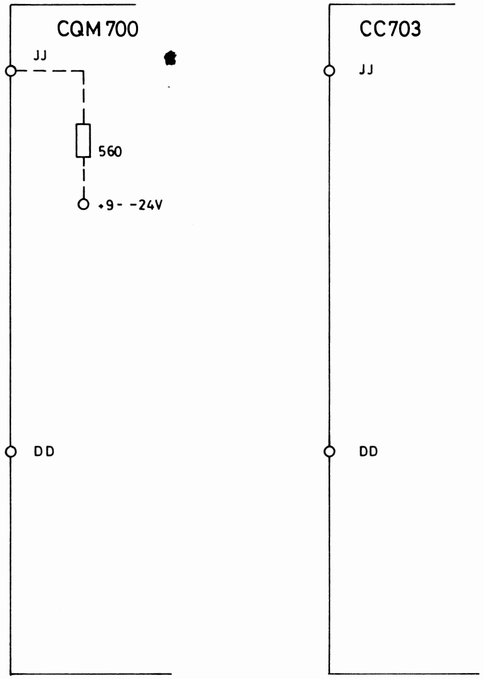
X402.432

Storno

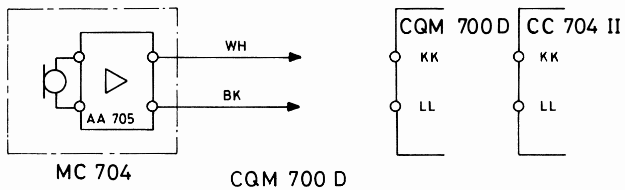




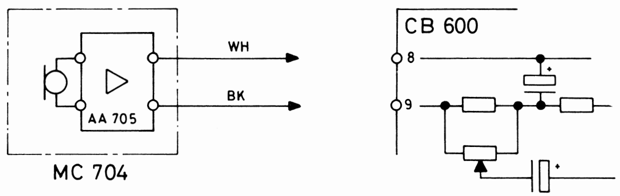
Storno



CQM 700 a



CQM 700 D

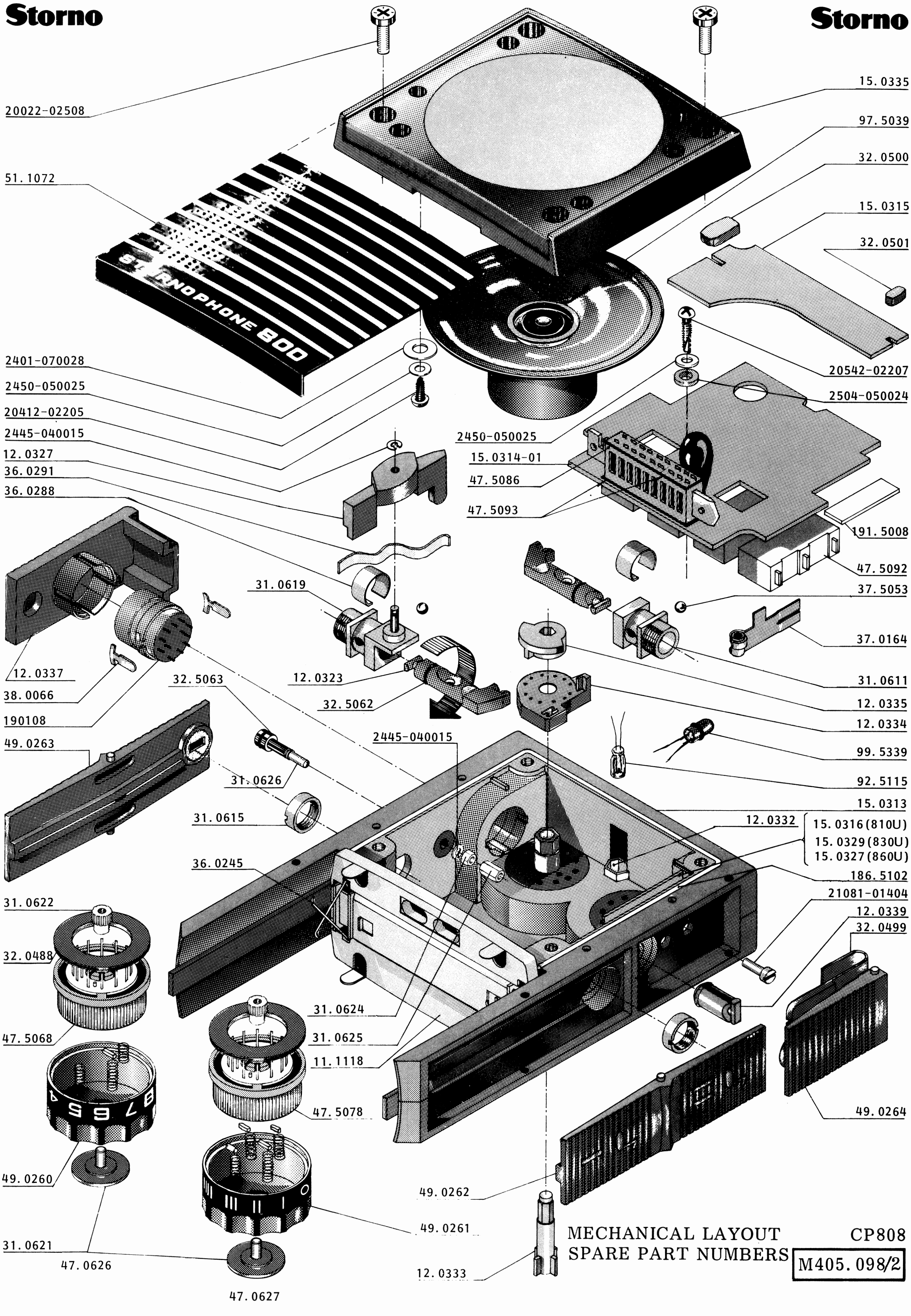


CQM 600

MICROPHONE MC 704
W. AMPLIFIER AA 705
D402.666

Storno

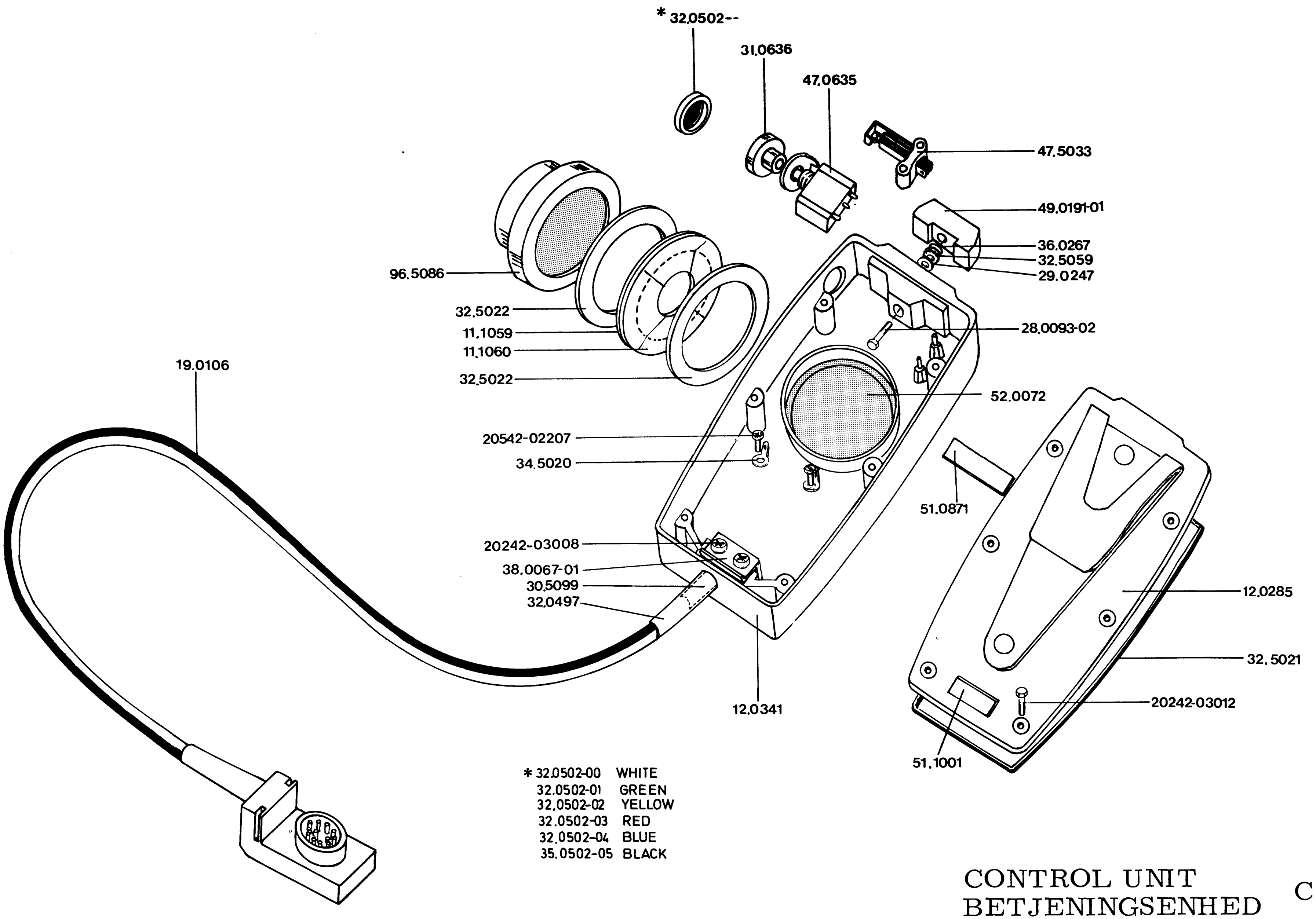
Storno



MECHANICAL LAYOUT
SPARE PART NUMBERS

CP808

M405.098/2

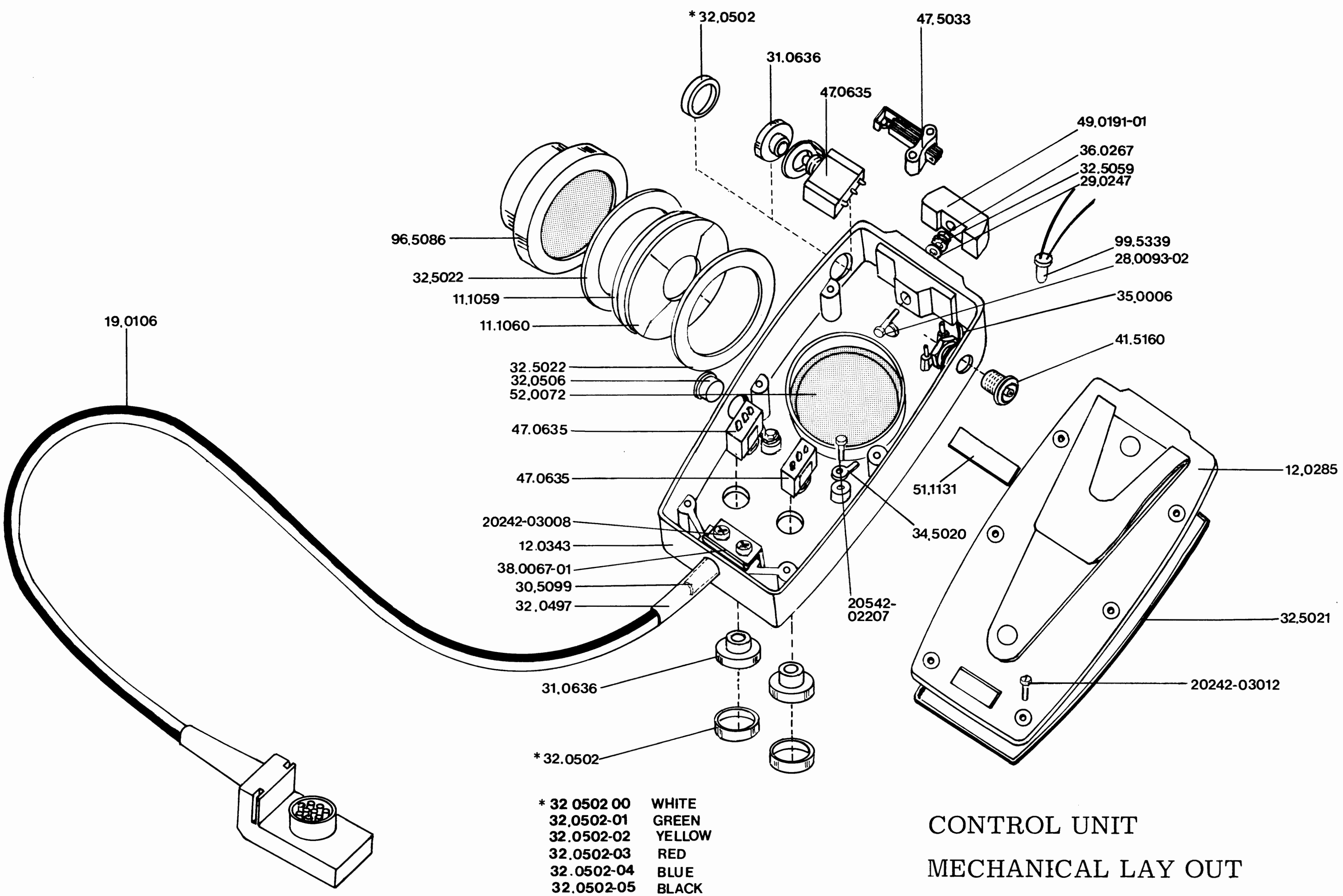


* 32,0502-00	WHITE
32,0502-01	GREEN
32,0502-02	YELLOW
32,0502-03	RED
32,0502-04	BLUE
35,0502-05	BLACK

CONTROL UNIT
BETJENINGSENHED

CB804

M405.086/2

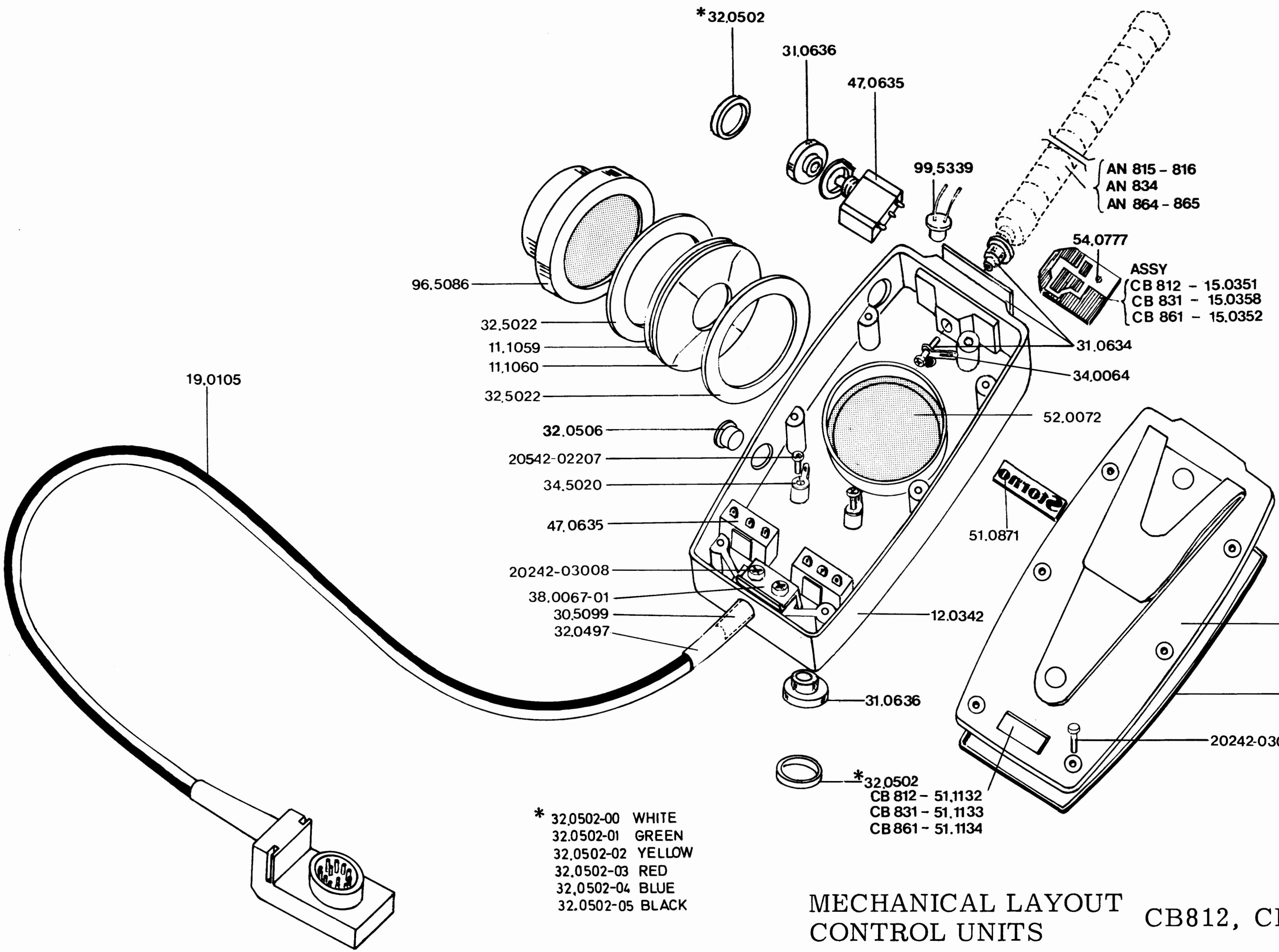


* 32 0502 00	WHITE
32,0502-01	GREEN
32,0502-02	YELLOW
32,0502-03	RED
32,0502-04	BLUE
32,0502-05	BLACK

CONTROL UNIT MECHANICAL LAY OUT

CB805

M405.084/2



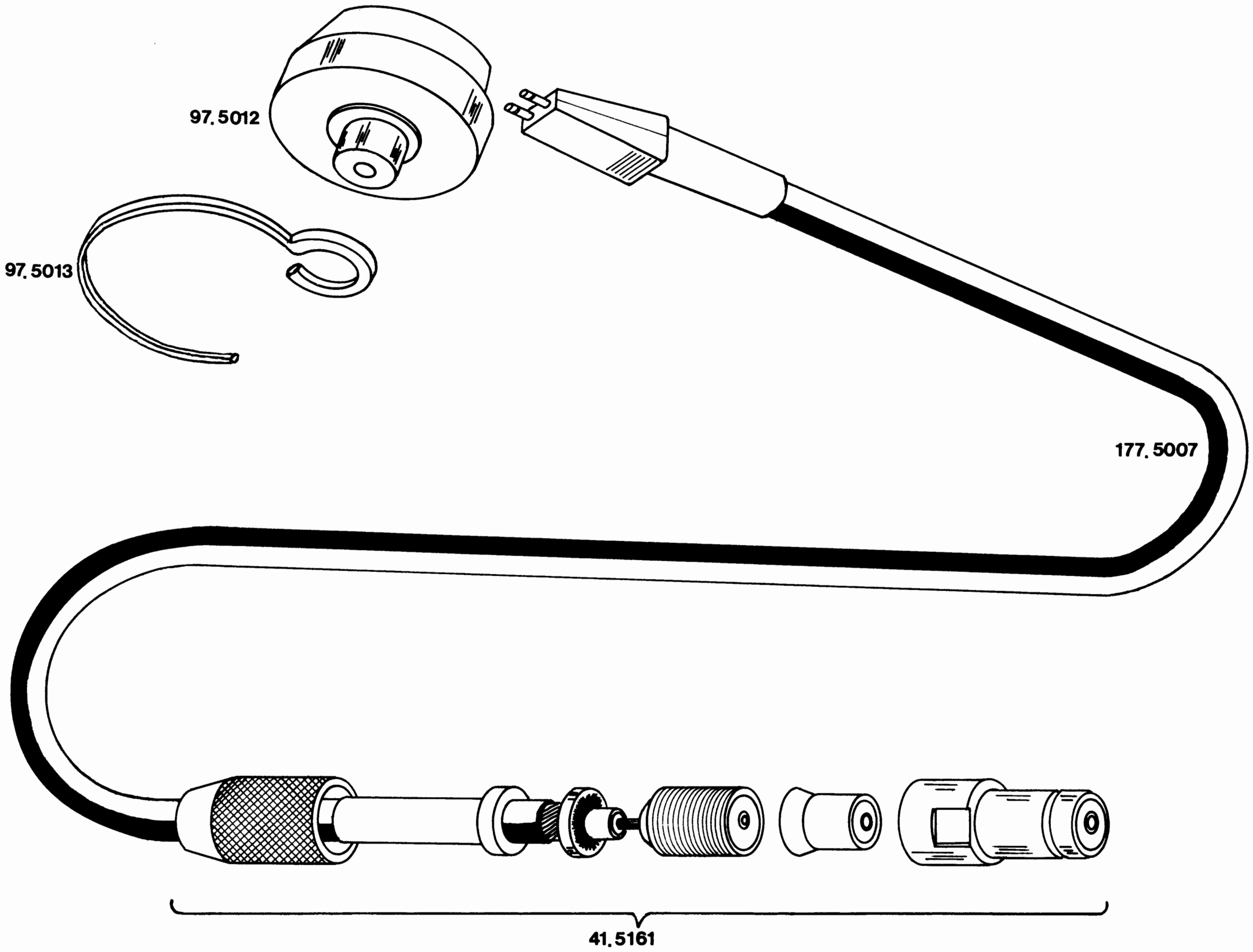
* 32.0502-00 WHITE
32.0502-01 GREEN
32.0502-02 YELLOW
32.0502-03 RED
32.0502-04 BLUE
32.0502-05 BLACK

MECHANICAL LAYOUT
CONTROL UNITS

CB812, CB831, CB861

M405.090

Storno

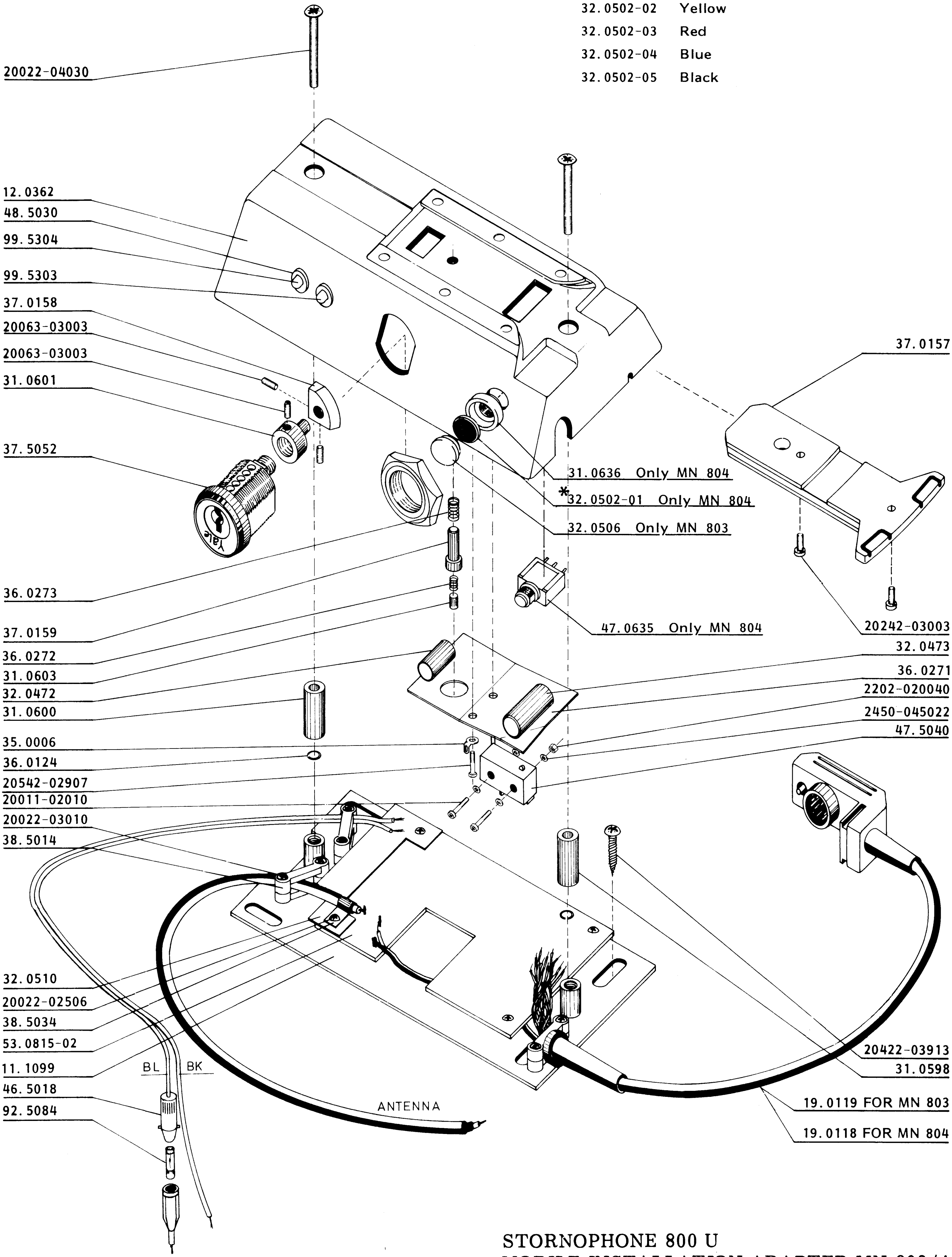


EARPHONE HP801

M405.079

*32.0502-01	Green
32.0502-02	Yellow
32.0502-03	Red
32.0502-04	Blue
32.0502-05	Black

Storno

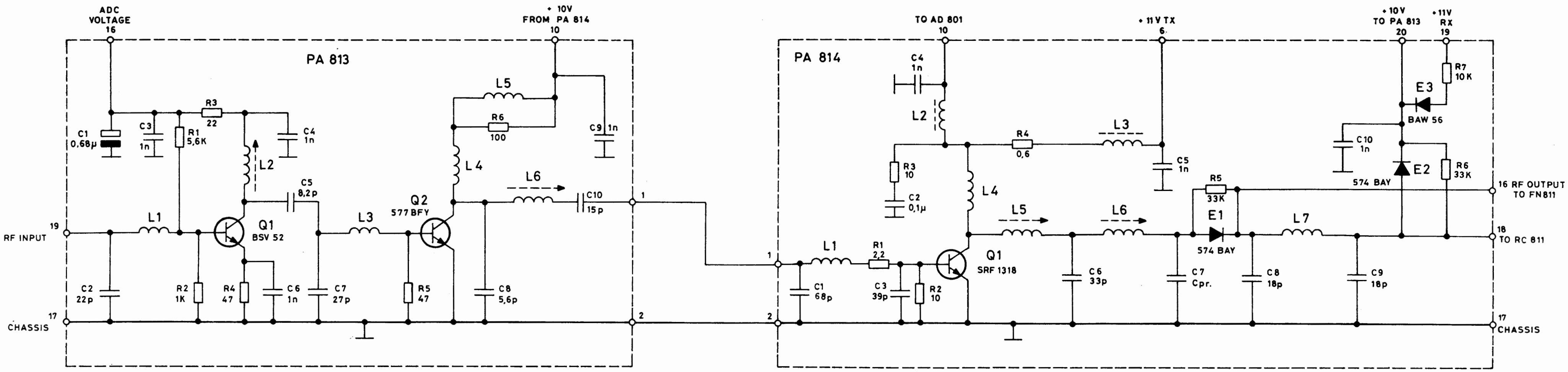


STORNOPHONE 800 U
MOBILE INSTALLATION ADAPTER MN 803/4

M405.093/2

Storno

Storno



STORNOPHONE 800 CQP 810, CQP 810U
3W TRANSMITTER

D 402.551