PERSONAL RADIOTELEPHONE
STORNOPHONE 4000 MK II
CQP411X Z
146 - 174 MHz

Service Coordination.

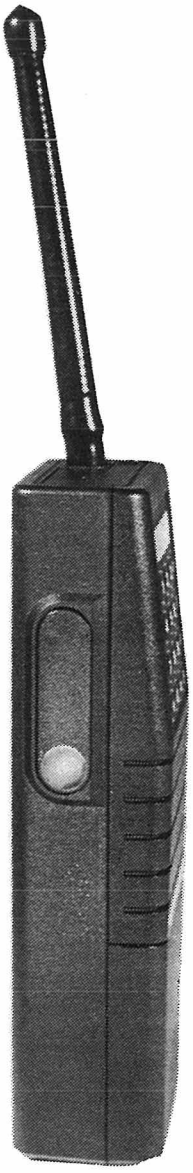
Date: 04.87.
Edition: 1.
Publication no: 8314.411M-00

61.336-E1

CQP4000 MK II
HARDWARE
MANUAL

STORNOPHONE 4000 MK II

The operation of the CQP4000 automatic is fully controlled by microprocessor.



Local controlled personal radio for simplex operation with all necessary indicators located in a liquid crystal display.

The construction of the electronic keyboard is using the most modern laminated film technology.

CHAPTER
CHAPITRE
KAPITEL

1

Storno

GENERAL SPECIFICATIONS

CQP4000 MK II

Guaranted performance specifications unless otherwise noted.

TYPE CQP		4332	4333	4334	4112	4113	4114	4552	4662	4663	4664
Freq. & splits	MHz	66-88			146-174			350-380 370-400	400-440 430-470		
Channel spacing	kHz	25	20	12.5	25	20	12.5	25	25	20	12.5
No. of channels		max. 2 or max. 10									
Service		Simplex or semi duplex									
Frequency Stability	kHz			±1	10		±1.5		±2.5		±1.5
Operating temperature	deg.C	-25 to +60									
Antenna impedance	ohm	50									
Battery	V/ mAh	7.2 V Nominal 450 mAh 7.2 V Nominal 750 mAh						6 ni-cad cells 6.1 V to 8.6 V at extreme conditions			
Cur. drain: OFF RX (stby) RX (.5 WAF) TX (2 W)	mA	1.5 30 190 1200						+ Additional standby current: CG4001 1.3 CG4003 1.3 TQ4001 1.5 TQ4002 - TQ4008 2.0			
Operator control		LS ON/OFF and squelch cancel Tone transmission X10 Tone select; controls left tone digit on LCD X1 Tone select; controls right tone digit on LCD V+ Volume "UP" V- Volume "DOWN" C Channel select ON/OFF and LCD light									
Display		Channel, TX, LS, Call, Tone codes									
Dimensions	mm	Hight= 195 Width= 72,5 Depth= 36/44 (with 450 mA/h Batt. Hight= 195 Width= 72,5 Depth= 44 (with 750 mA/h Batt.									
Weight	kg.	0.6 with 450 mA/h Batt., 0.66 with 750 mA/h Batt..									

The equipment described above meets or exceeds all applicable CEPT, FTZ, Swiss and Swedish specifications.

+ For further information see tone module specifications

RECEIVER SPECIFICATIONS

CQP4000 MK II

Guaranted performance specifications unless otherwise noted.

TYPE CQP		4332	4333	4334	4112	4113	4114	4552	4662	4663	4664
Sensitivity 20 dB SINAD (CEPT)	uV EMF	0.75		1	0.75		1	1			1.5
RF bandw.	MHz	2.5 (No degradation w. centertuning)									
AF outp. pwr.	W	0.25 CEPT method.									
Aud. bandw.	Hz	300-3000	300-3000	300-2550	300-3000	300-3000	300-2550	300-3000	300-3000	300-2700	300-2550
Aud. resp.		-6 dB/oct. phase modulation characteristics.									
Tolerance	dB	+1 -3	+1* -3	+1 -3	+1* -3		+1 -3			+1* -3	+1 -3
Hum & noise	dB	-45 (CEPT, weighted)									
Adj. ch. sel.	dB	-70		-60	-70		-60	-70			-60
Cond. spur.	dBm	-57									
Rad. spurius	nW	2 (-57 dBm to resonant substitution dipole)									
AF distort.	%	2 EIA, 10 CEPT method									
Blocking	dB/uV	90									
Intermodul.	dB	CEPT= 70, Sweden= 70, FTZ= 66 & 80									
Spurius rej.	dB	-70 (CEPT method)									
Co-chan. rej.	dB	8									
Sq. sens.	dB	10-12 (dB SINAD at line Output)									
Squelch tail	mS	10 (EIA)									
RX att. time	mS	50 (EIA)									
Recovery tm.	mS	75						100			
Group delay	uS	Less than 50									

* Tolerance on response from 400 to 2700 Hz is +1, -1.5 dB.
The equipment described above meets or exceeds all applicable CEPT, FTZ, Swiss and Swedish specifications.

TRANSMITTER SPECIFICATIONS

CQP4000 MK II

Guaranted performance specifications unless otherwise noted.

TYPE CQP		4332	4333	4334	4112	4113	4114	4552	4662	4663	4664
RF outp. pwr.	W	0.1W or 2W -adjustable to 1W : ± 1.5 dB for -10/+40 deg. C +2/-3 dB for -25/+55°C									
Duty cycle	%	20% at 25 deg. C ambient : TX= 1 mn, standby/RX= 4 mn									
RF bandwith	MHz	2.5 (No degradation)									
Mod. BW	Hz	300-3000	300 - 3000	300-2550	300-3000	300 - 3000	300-2550	300-3000	300-3000	300 - 3000	300-2550
Mod. resp.		+6 dB/oct. phase modulation characteristics at 6000 Hz att: ≥6 dB rel. to 1 kHz value.									
Tolerance	dB	+1 -3	+1+ -3	+1 -3		+1+ -3	+1 -3			+1+ -3	+1 -3
Max. dev.	kHz	5	4	2.5	5	4	2.5	5	5	4	2.5
Resid. mod.	dB	-40 (Weighted, ref. to 60% dev.)									
Adjacent Chan. power	dB/C	-70		-60	-70	-60		-70			-60
Cond. spur.	dBm	-37									
Radia. spur.	nW	200 (-37 dBm to resonant substition dipole)									
Attack time	mS	30						50			
Group delay	uS	Less than 50									
TX stability		10:1 VSWR, all phase angles									
Audio sensitivity	mV	5 mV ±3 dB									
Aud. dist.	%	5									

+ Tolerance of response from 400 to 2700 Hz is +1, -1.5 dB.
The equipment described above meets or exceeds all applicable CEPT, FTZ, Swiss and Swedish specifications.

CQP4000 MK II

NOMENCLATURE

DIGIT 1, 2, 3	4	5	6	7	8	9	10	11	12
PRODUCT CODE	FREQUENCY RANGE MHz TX	FREQUENCY RANGE MHz RX	CHANNEL SPACING kHz	RADIO TYPE	TRANSMITTER OUTPUT POWER WATT		FREQUENCY CAPACITY	CONTROL	MARK VERSION
C Q P 4	1 146-174	1 146-174	2 25	Z MK II	0 1.0	1	A MAX. 2	0 STANDARD WITH TONE SW. (8 KEY)	A STAS EXP TONE FREQ. STAB.
	3 66-88	3 66-88	3 20		0 2.0	2	B MAX. 10	P WITHOUT TONE SW. (5 KEY)	B STAS EXP IMPROVED FREQ. STAB.
	6 400-470	6 400-470	4 12.5				C AUTOMATIC MAX. 99		C CANADA
	5 350-410	5 350-410							D DANMARK
	7 174-225	7 174-225							E U.K
									F FRANCE
									G GERMANY
									M STEL
									S SWEDEN
									U USA
									Z SWITZERLD.

CQP4000 MK II

STRUCTURED OPTIONS

A TX freq. split MHz	B RX freq. split MHz	C Chan. guard	D Signal option	E Firmware Package	H Field Customizing
L 146-174 68-88 174-200 400-440	L 146-174 68-88 174-200 400-440	0 None	0 None	A 2 chan.	0 None
M 174-200	M 200-225	A Enc. /Dec. / Reject filter	A 5T ZVEI/CCIR enc. /dec.	B 10 chan.	A Prom. progr. kit
H 200-225 430-470	H 200-225 430-470	B Enc.	B 5T ZVEI/CCIR enc. /dec. Grp. call dec. 885/970 Hz	C Unprogrammed Automatic	
		C Enc. /Dec. / Reject filter 5T enc. ZVEI/CCIR	C 5T ZVEI/CCIR enc. /dec. Grp. call dec. 2400/2800 Hz	D SAS CAMUS special (Automatic)	
			D 5T EEA enc. /dec. Grp. call dec. 1055 Hz	E BA2004 - special (Automatic)	
			E 5T ZVEI/CCIR enc. /dec. Grp. call dec. 885/970 Hz + CG enc.	F AF2004 - special (Automatic)	
			F 5T ZVEI/CCIR enc. /dec. Grp. call dec. 2400/2800 Hz + CG enc.	G 2200 Standard (Automatic)	
			G 5T EEA enc. /dec. Grp. call dec. 1055 Hz + CG enc.	H CAMUS Std. (Automatic)	
			H 5T ZVEI/CCIR enc. /dec. Grp. call dec. 1981 Hz	I Unprogrammed Binary	
				J ZVEI Binary	
				K EEA Binary	

CHAPTER
CHAPITRE
KAPITEL

2

Storno

GENERAL DESCRIPTION

CQP4000 MK II

The CQP4000 MK II is a personal radiotelephone with transmitter, receiver, controls and display loudspeaker, microphone and battery.
Although being handheld and compact in size the radio can be programmed with up to 10 channels and optionally, be equipped with sequential tone encoder/decoder, CTCSS (channel guard) encoder, or CTCSS (channel guard) encoder/decoder.

The mechanical construction of the radio is a screened enclosure in the form of a cast chassis and a metallized plastic front as lid.

A moulded plastic house is attached to the chassis to provide mechanical protection and hold the battery. All controls and indicators are integrated in a keypad/display field on the radio front except for the transmit button which is on the left side of the radio. The electrical circuitry of the radio is built on printed wiring boards: an RF-board containing the transmitter and receiver, a control logic board and, optionally, a thick film fone module.

The RF-board comprises the frequency synthesizer, the transmitter exciter and power amplifier, the receiver RF circuits and IF-circuits, the voltage regulator, and is available in different versions according to frequency band and channel spacing.

The control logic board (CL) comprises the receiver AF amplifier, the transmitter modulation processor, the microcontroller and the display.
The tone module is a thick-film add-on module designed to be plugged into a sucket on the CL-board.

ANTENNAS

The CQP4000 is designed for a 50-ohm antenna which is screwed onto the top of the radio. The following types are available:

- whip antenna, AN4xx1
- rubber antenna, AN4xx2
- a preadjusted resonant helical antenna AN4xx3

BATTERIES

The battery is designed to snap into a compartment at the bottom of the radio and is a selfcontained nickel-cadmium (Ni-Cd) pack:
Two battery packs are available:

- a 450 mA battery, BU4003
- a 750 mA battery, BU4004

CARRYING DEVICES

The following devices are available for carrying the radio:

- a carrying strap in leather with eyelets, CK4003
- two carrying cases in stout leather, CK4012 and CK4013, one for each battery version of the CQP4000 MK II

MECHANICAL DESCRIPTION

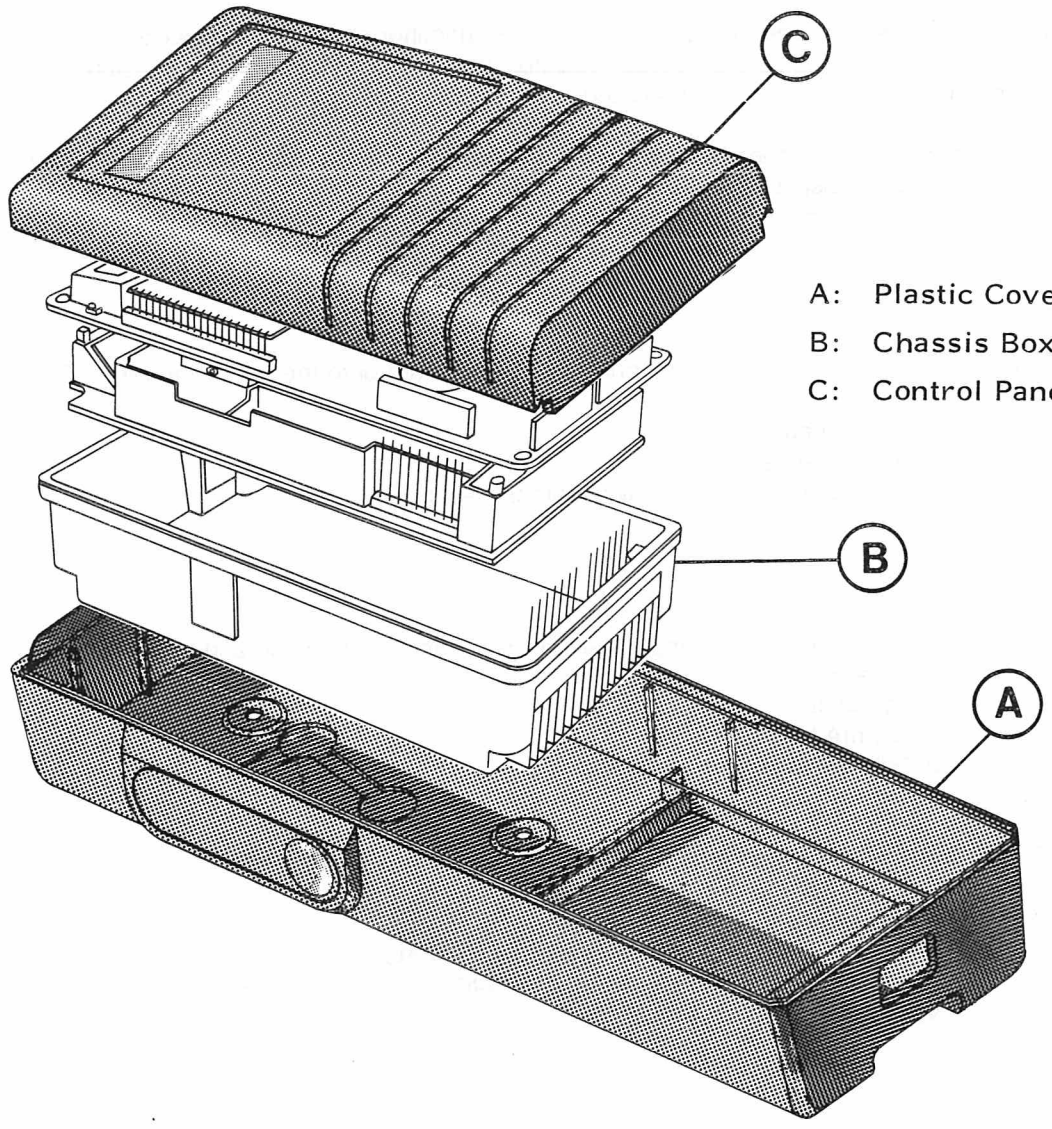
CQP4000 MK II

CHASSIS BOX

The chassis box is a tin plated zink casting provided with an antenna socket and a sealing gasket for transmit button which activates a combined battery/test connector is attatched to the chassis and potted for weather protection. Inside the bottom is a plate with fingers pressing against the solder side of the RF-board and thus obtains the necessary ground connections.

The RF and CL boards are kept in position with 4 screws which attach the chassis box to the front part. In the chassis bottom are two threaded inserts for attatching the rear part of the plastic cover.
The plastic cover has a battery compartment which will accept two types of batteries. The battery snaps into position by means of a snap lock. The battery is released by pressing in the snap lock.

An 18-posittion battery and test connector is placed inside the battery compartment. 5 of the connector pins are used for connection to the battery. The others are used for automatic or manual testing.



MECHANICAL DISCRIPTION CQP4000 MK II
STORNO VERSION

M405. 350

CHAPTER
CHAPITRE
KAPITEL

3

Storno

Storno

CIRCUIT DESCRIPTION

CQP4xxx

RECEIVER

The receiver is a dual conversion superheterodyne receiver with a first IF of 21.4 MHz (45 MHz for RF4774) and second IF of 455 kHz. All receiver circuitry except the AF amplifier is placed on the RF board.

RECEIVER FRONT END

The receiver front-end consists of a 2-resonator input filter, an RF amplifier, a 2-resonator intermediate filter and a mixer.

IF AND DEMODULATOR

The mixer output is fed through a matching circuit to the crystal filter.
The crystal filter output is fed to the dual gate MOSFET which overcomes the noise figure of the following stages and provides constant load to the crystal filter.

The following integrated circuit includes crystal oscillator and active mixer, second IF amplifier, quadrature discriminator and schmitt trigger for squelch.

SQUELCH

The squelch circuit is a separate thick film module. The AF signal from the quadrature detector is fed to an active high-pass filter where noise above 7 kHz is extracted.
Via the squelch potentiometer, adjusted for 10-12 dB SINAD, the signal is fed to an amplifier to obtain the right level for the detector.

The detector output is connected to the schmitt-trigger, part of the preamplifier circuit, which gives the necessary hysteresis and well-defined output signal.

PREAMPLIFIER

The last stage of the IF integrated circuit is an AF preamplifier. Its output can be adjusted to 110 mV by a potentiometer.

AUDIO AMPLIFIER

The line level of the AF preamplifier is fed to the audio amplifier situated on the CL board (see the chapter about CL description).

TRANSMITTER

The transmitter consists of an exciter and a power amplifier.
The VCO (voltage controlled oscillator) drives the exciter directly. The exciter contains wideband stages and delivers input to the power amplifier. All stages, including the VCO operate at carrier frequency.
The power amplifier includes the output stage, a low-pass filter and a power control circuit.
The power amplifier is connected to the low-pass filter via a diode antenna switch.

EXCITER

In the exciter, the VCO signal, 1 mV is amplified to 0.5 Watt.
The exciter consists of three wide band stages covering the whole band. The RF bandwidth is limited by the VCO.
The exciter needs no adjustment.

POWER AMPLIFIER

The power amplifier consists of a single broadband stage.
The antenna is matched to the power amplifier by tuning the antenna or by using a wide band antenna.

A power control circuit protects the RF output from temperature or voltage variations and keeps it relatively constant.
The output power level can be set with a potentiometer over a 2:1 range.

TX AUDIO PROCESSOR

The modulation signal is delivered from the TX audio processor situated on the CL board (see chapter of CL description).

WARNING: The transmitter PA-transistors contain Beryllium. It is dangerous to cut, to file or to dissed those transistors because the beryllium oxide is poisonous when absorbed.

FREQUENCY SYNTHESIZER

The frequency synthesizer circuits are:
- Prescaler
- PLL unit
- Ref. crystal oscillator
- TX and RX VCO (voltage controlled oscillator)
- Save switch

PRESCALER

The prescaler is a high speed counter which divides by a fixed ratio: P
Under control of the PLL circuit, it can be set to divide by the fixed ratio plus one: P+1
The prescaler has a low power consumption from 4 to 7 mA.

PLL AND ASSOCIATED CIRCUITS

The circuitry consist of:
- three programmable dividers
- control logic for the prescaler
- phase detector with lock detector

1. The R divider divides the output of the crystal oscillator in order to give channel spacing. Its output is fed into the phase detector.

2. The N divider divides the output of the prescaler. The ratio stored in the N divider must be the one giving N output equal R output. Its output is fed into the phase detector.

3. The A divider is controlled by the control logic. The ratio of the A divider makes the prescaler divide by P+1 if necessary. The A divider can not start with a zero.

4. The phase detector compares the outputs of the R and the N divider.
   The phase/lock detector two outputs are:
   - out of lock/lock signal to the CL board, indication whether or not the two inputs (R and N outputs) are equal.
   - DC level controlling the VCO through a band-pass filter and a save switch.

REFERENCE CRYSTAL OSCILLATOR

This crystal oscillator supplies clock signals to the microprocessor on the CL board and gives the reference frequency to the PLL circuit through the R divider.

TX AND RX VCO

The voltage controlled oscillator (VCO) is a FET oscillator. The frequency is controlled by two varicaps, one in the RX VCO circuit and one in the TX VCO circuit. The varicaps DC voltage is delivered from the PLL circuit.
The TX VCO contains another varicap used for frequency modulation. The modulation signal comes from the microphone amplifier placed on the CL board.
As buffer between the VCO and the PLL circuits, the following circuits are used:

- the mixer injection buffer for the RX VCO
- the exciter for the TX VCO

SAVE SWITCH

In order to reduce power consumption in standby, the save circuits disconnects:

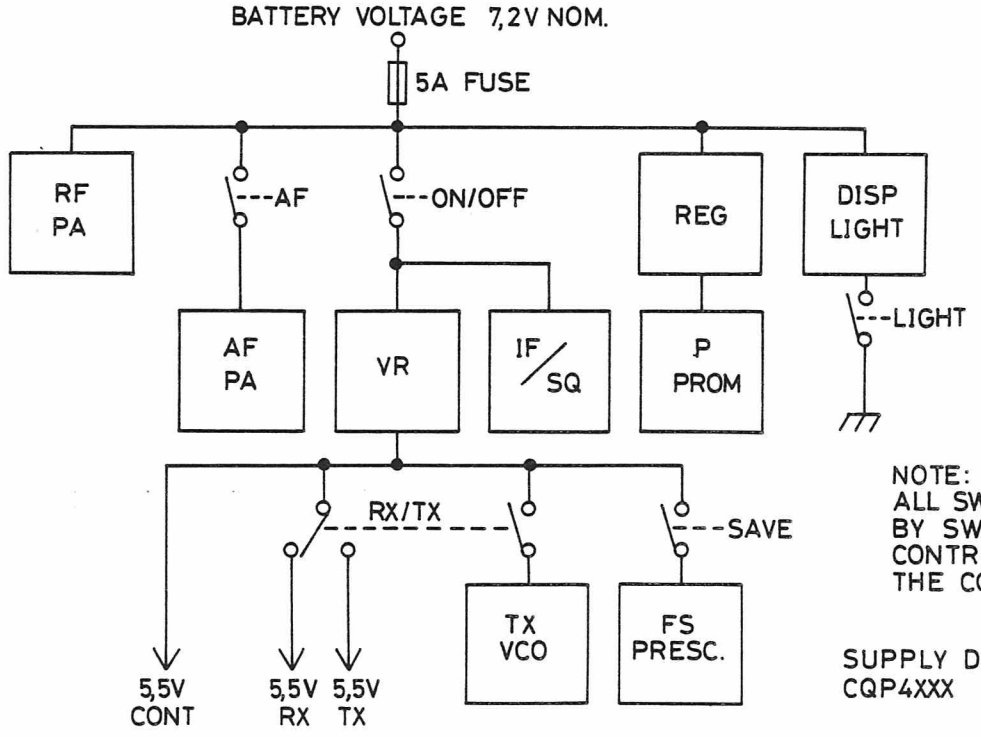
- DC control level to the VCO
- power to the prescaler

The save circuit is controlled by the microprocessor from the CL board.
It is not connected to TX VCO.
This function does not exist in the 200 MHz RF4774 radio set.

POWER SUPPLY

The 7.2 V battery voltage is distribuated for different purposes through a 5 A fuse:

- directly to the RF power amplifier
- to the audio output amplifier through a switch transistor
- to the IF/squelch circuits and the 5.5 V voltage regulator through the on/off switch transistor
- to the personality PROM through a separate regulator
- to the LED's for the LCD display-back-light.



SUPPLY DISTRIBUTION SYSTEM CQP4XXX D403.635

BATTERY OPERATING TIME

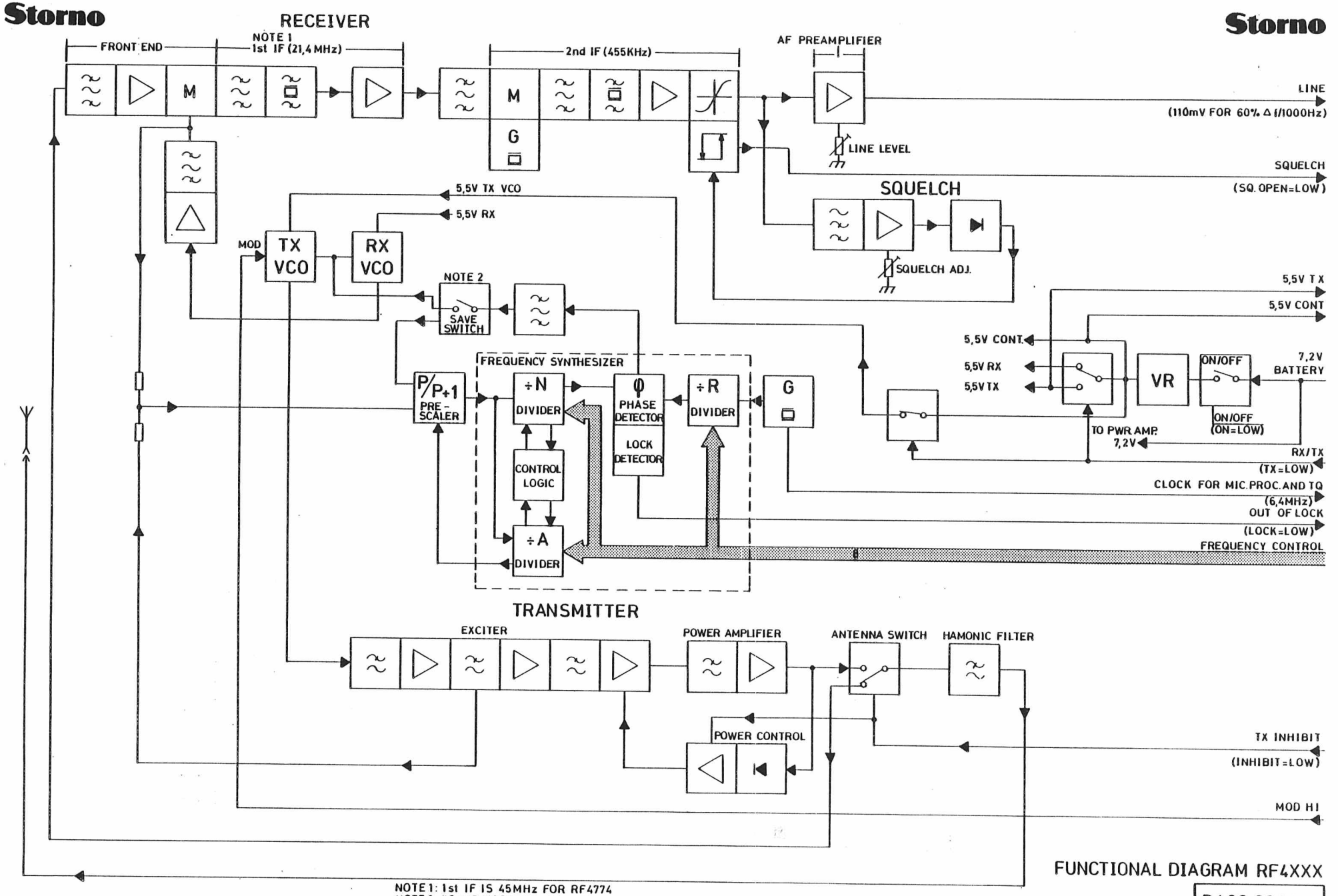
Trans-mit	Recei-ve	Stand-by	Operation - Standard (hours) 2 W PA		1 W PA		Operation - Automatic (hours) 2 W PA		1 W PA	
			BU4001	BU4002	BU4001	BU4002	BU4001	BU4002	BU4001	BU4002
2%	5%	93%	8, 9	15, 0	10, 7	17, 1	7, 6	12, 6	8, 7	14, 4
5%	5%	90%	6, 1	10, 3	8, 4	14, 1	5, 6	9, 3	7, 3	12, 1
5%	10%	85%	5, 7	9, 6	7, 7	12; 9	5, 3	8, 9	6, 8	11, 3
10%	5%	85%	4, 0	6, 7	6, 3	10, 4	3, 9	6, 5	5, 7	9, 6
10%	10%	80%	3, 8	6, 4	5, 3	9, 8	3, 8	6, 3	5, 4	9, 1

VOLTAGE REGULATOR

A 5.5 V stabilized voltage regulator is designed around an adjustable shunt regulator IC, with low drop-out voltage, high temperature stability and short circuit protection.
Regulated 5.5 V is continuously applied to the IF-squelch and synthesizer circuits, to the RX/TX switch-circuit controlled by the control logic, and through a current save switch to the pre-scaler in the RF synthesizer.

The RX/TX switching is performed, where possible, by switching only the bias currents to the involved circuits.

Storno



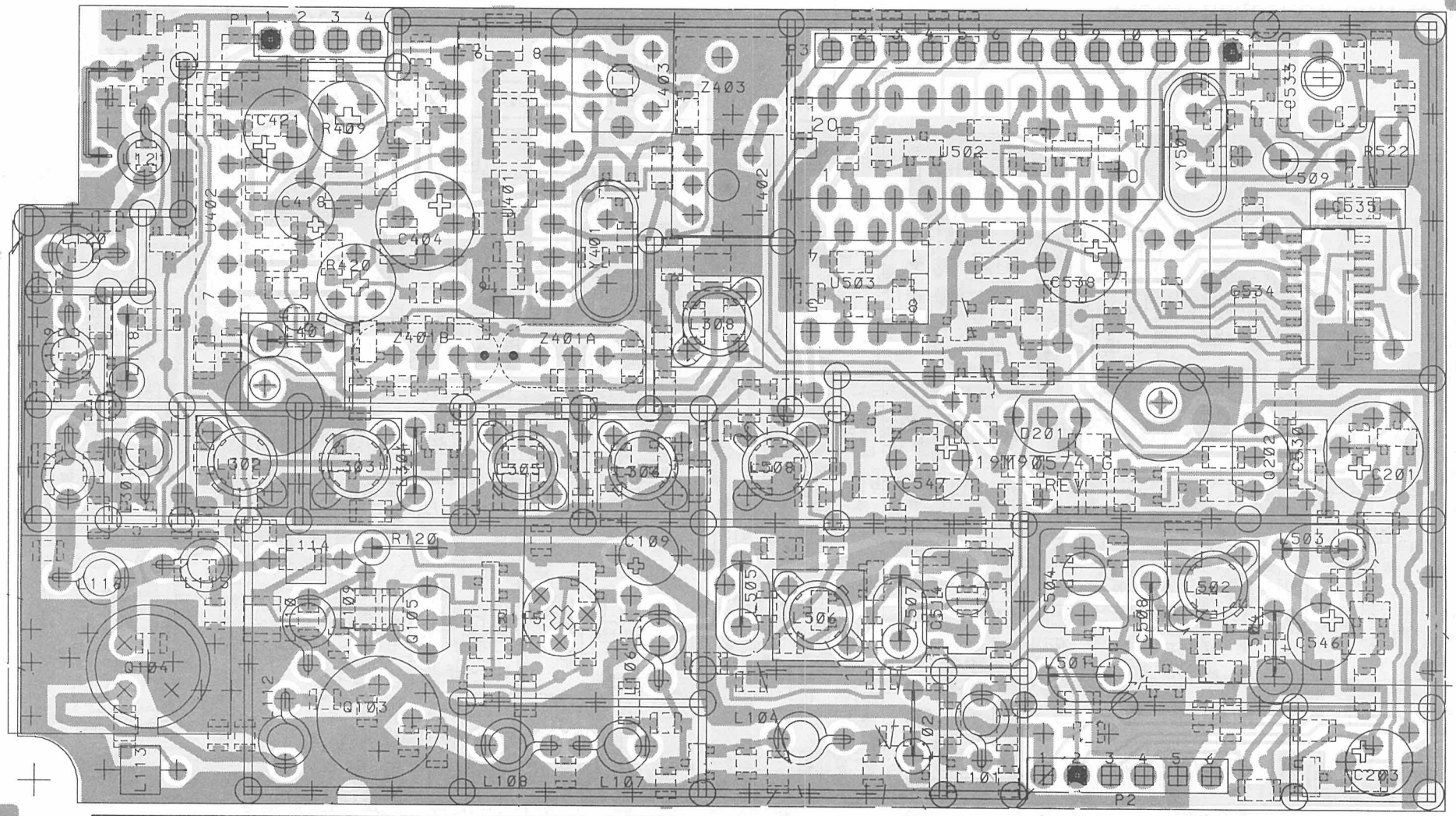
NOTE 1: 1st IF IS 45MHz FOR RF4774
NOTE 2: "SAVE MODE" IS NOT INCORPORATED IN RF4774

FUNCTIONAL DIAGRAM RF4XXX

D403.634/3

Storno

Storno



	MODULE CODE NO.	MOUNTED BOARD CODE NO.
25 kHz	J707428G1	M905741G1
20 kHz	J707428G2	M905741G1
12, 5 kHz	J707428G3	M905741G1

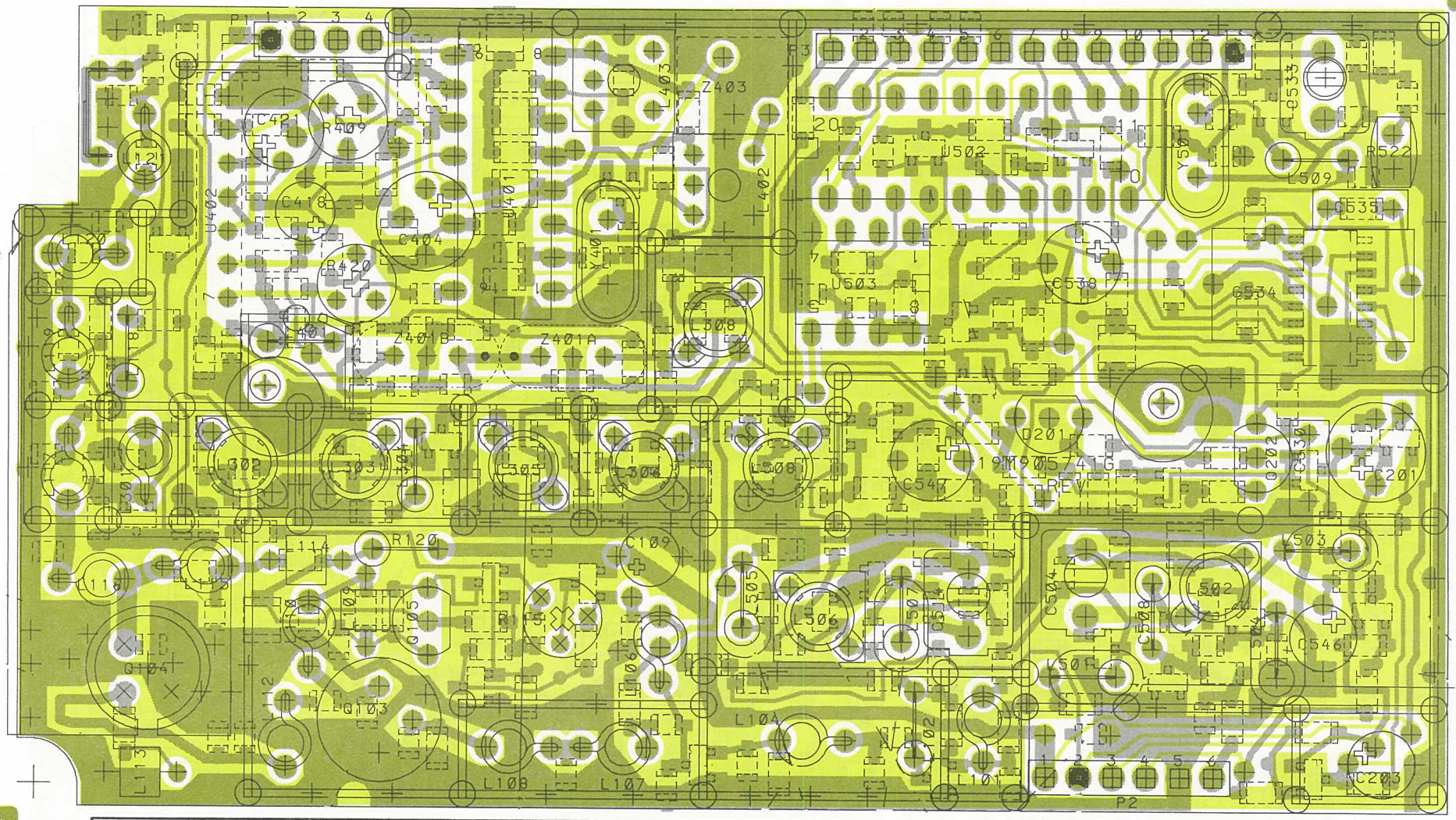
SEE PARTS LISTS

RADIO FREQUENCY-UNIT RF4110
COMPONENT LAYOUT
COMPONENT SIDE
REV. 3

D404. 106/2

Storno

Storno



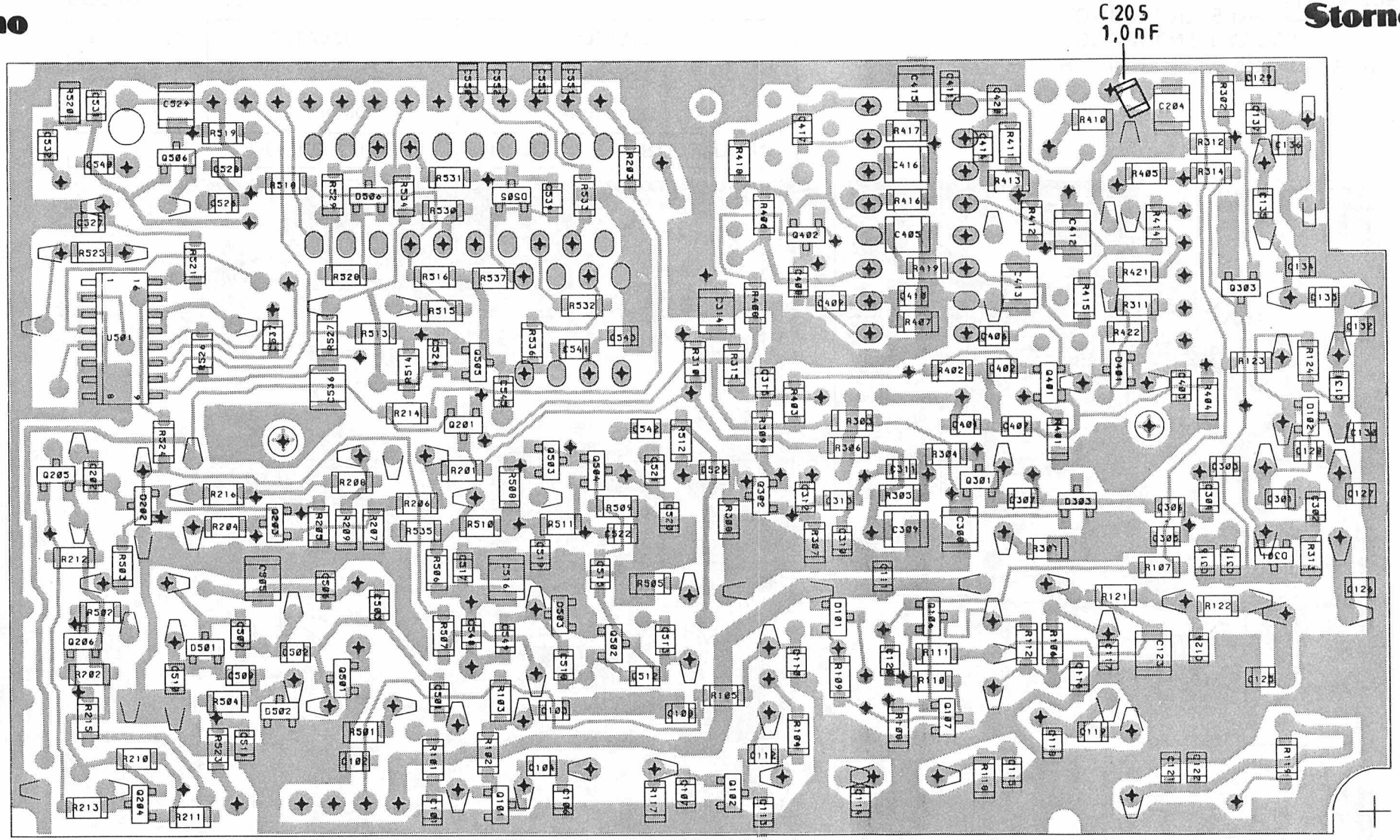
	MODULE CODE NO.	MOUNTED BOARD CODE NO.
25 kHz	J707428G1	M905741G1
20 kHz	J707428G2	M905741G1
12, 5 kHz	J707428G3	M905741G1

SEE PARTS LISTS

RADIO FREQUENCY-UNIT RF4110
COMPONENT LAYOUT
COMPONENT SIDE
REV. 3

D404. 106/2

Storno

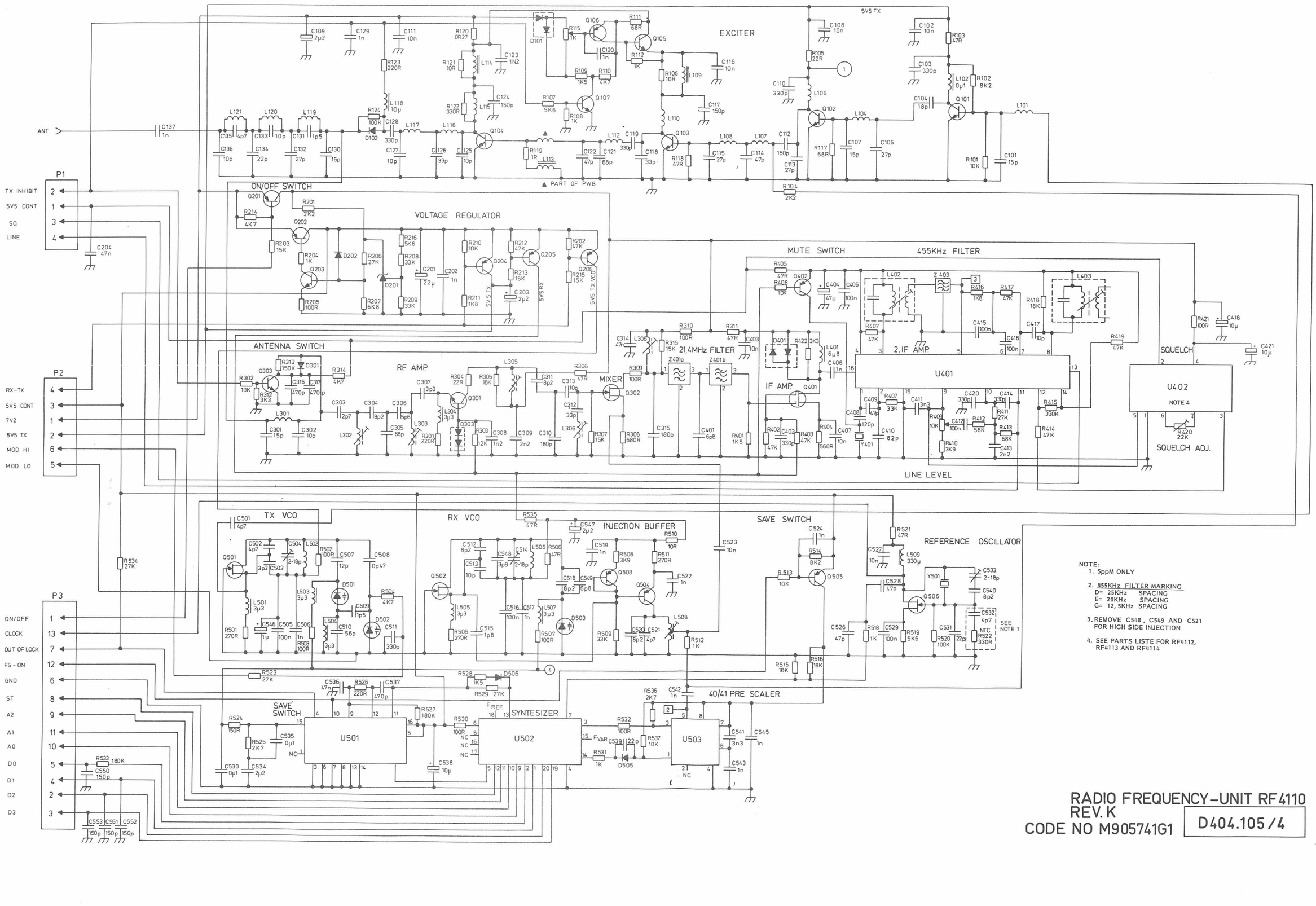


	MODULE CODE NO.	MOUNTED BOARD CODE NO.
25 kHz	J707428G1	M905741G1
20 kHz	J707428G2	M905741G1
12, 5 kHz	J707428G3	M905741G1

SEE PARTS LISTS

RADIO FREQUENCY-UNIT RF4110
COMPONENT LAYOUT
CHIP SIDE
REV. 3

D404.107/2



NOTE:
1. 5ppM ONLY

2. 455KHz FILTER MARKING
   D= 25KHz SPACING
   E= 20KHz SPACING
   G= 12,5KHz SPACING

3. REMOVE C548, C549 AND C521 FOR HIGH SIDE INJECTION

4. SEE PARTS LISTE FOR RF4112, RF4113 AND RF4114

RADIO FREQUENCY-UNIT RF4110
REV. K
CODE NO M905741G1

D404.105/4

Pos.	Code No.	Description	Qt.
C101	J707436P21	CAP,CER,NPO 15P , 5%	1
C102	J707438P14	CAP,CER,CL2 10N , 10%	1
C103	J707436P73	CAP,CER,NPO 330P , 5%	1
C104	J707436P25	CAP,CER,NPO 18P , 5%	1
C106	J707436P33	CAP,CER,NPO 27P , 5%	1
C107	J707436P21	CAP,CER,NPO 15P , 5%	1
C108	J707438P14	CAP,CER,CL2 10N , 10%	1
C109	J707353P5	CAP,ELECT 2U2 ,50V	1
C110	J707436P73	CAP,CER,NPO 330P , 5%	1
C111	J707438P14	CAP,CER,CL2 10N , 10%	1
C112	J707436P65	CAP,CER,NPO 150P , 5%	1
C113	J707436P33	CAP,CER,NPO 27P , 5%	1
C114	J707436P45	CAP,CER,NPO 47P , 5%	1
C115	J707436P33	CAP,CER,NPO 27P , 5%	1
C116	J707438P14	CAP,CER,CL2 10N , 10%	1
C117	J707436P65	CAP,CER,NPO 150P , 5%	1
C118	J707436P37	CAP,CER,NPO 33P , 5%	1
C119	J707436P73	CAP,CER,NPO 330P , 5%	1
C120	J707438P5	CAP,CER,CL2 1N , 10%	1
C121	J707436P53	CAP,CER,NPO 68P , 5%	1
C122	J707436P45	CAP,CER,NPO 47P , 5%	1
C123	J707436P87	CAP,CER,NPO 1N2 , 5%	1
C124	J707436P65	CAP,CER,NPO 150P , 5%	1
C125	J707436P13	CAP,CER,NPO 10P , 5%	1
C126	J707436P37	CAP,CER,NPO 33P , 5%	1
C127	J707436P13	CAP,CER,NPO 10P , 5%	1
C128	J707436P73	CAP,CER,NPO 330P , 5%	1
C129	J707438P5	CAP,CER,CL2 1N , 10%	1
C130	J707436P21	CAP,CER,NPO 15P , 5%	1
C131	J707436P3	CAP,CER,NPO 1P5 ,.25P	1
C132	J707436P33	CAP,CER,NPO 27P , 5%	1
C133	J707436P13	CAP,CER,NPO 10P , 5%	1
C134	J707436P29	CAP,CER,NPO 22P , 5%	1
C135	J707436P9	CAP,CER,NPO 4P7 ,.25P	1
C136	J707436P13	CAP,CER,NPO 10P , 5%	1
C137	J707438P5	CAP,CER.CL2 1N , 10%	1

Pos.	Code No.	Description	Qt.
C201	J707444P8	CAP,TA,SOL 22U , 16V	1
C202	J707438P5	CAP,CER,CL2 1N , 10%	1
C203	J707444P5	CAP,TA,SOL 2U2 , 35V	1
C204	J707438P22	CAP,CER,CL2 47N , 10%	1
C205	J707438P5	CAP,CER,CL2 1N , 10%	1
C301	J707436P21	CAP,CER,NPO 15P , 5%	1
C302	J707436P13	CAP,CER,NPO 10P , 5%	1
C303	J707436P6	CAP,CER,NPO 2P7 ,.25P	1
C304	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C305	J707436P53	CAP,CER,NPO 68P , 5%	1
C306	J707436P10	CAP,CER,NPO 5P6 ,.25P	1
C307	J707436P7	CAP,CER,NPO 3P3 ,.25P	1
C308	J707436P87	CAP,CER,NPO 1N2 , 5%	1
C309	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C310	J707436P67	CAP,CER,NPO 180P , 5%	1
C311	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C312	J707436P37	CAP,CER,NPO 33P , 5%	1
C313	J707436P13	CAP,CER,NPO 10P , 5%	1
C314	J707438P22	CAP,CER,CL2 47N , 10%	1
C315	J707436P67	CAP,CER,NPO 180P , 5%	1
C316	J707438P3	CAP,CER,CL2 470P , 10%	1
C317	J707438P3	CAP,CER,CL2 470P , 10%	1
C401	J707436P11	CAP,CER,NPO 6P8 ,.25P	1
C402	J707436P73	CAP,CER,NPO 330P , 5%	1
C403	J707438P14	CAP,CER,CL2 10N , 10%	1
C404	J707444P9	CAP,TA,SOL 47U , 6V	1
C405	J707438P26	CAP,CER,CL2 100N , 10%	1
C406	J707438P5	CAP,CER,CL2 1N , 10%	1
C407	J707438P14	CAP,CER,CL2 10N , 10%	1
C408	J707436P63	CAP,CER,NPO 120P , 5%	1
C409	J707436P45	CAP,CER,NPO 47P , 5%	1
C410	J707436P57	CAP,CER,NPO 82P , 5%	1
C411	J707438P8	CAP,CER,CL2 3N3 , 10%	1
C412	J707438P26	CAP,CER,CL2 100N , 10%	1
C413	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C414	J707436P73	CAP,CER,NPO 330P , 5%	1

Pos.	Code No.	Description	Qt.
C415	J707438P26	CAP,CER,CL2 100N , 10%	1
C416	J707438P26	CAP,CER,CL2 100N , 10%	1
C417	J707436P13	CAP,CER,NPO 10P , 5%	1
C418	J707444P7	CAP,TA,SOL 10U , 16V	1
C420	J707436P73	CAP,CER,NPO 330P , 5%	1
C421	J707444P7	CAP,TA,SOL 10U , 16V	1
C501	J707436P9	CAP,CER,NPO 4P7 ,.25P	1
C502	J707436P7	CAP,CER,NPO 3P3 ,.25P	1
C503	J707436P7	CAP,CER,NPO 3P3 ,.25P	1
C504	J707475P1	CAP,VAR,FILM 2.0/18 PF	1
C505	J707438P26	CAP,CER,CL2 100N , 10%	1
C506	J707438P5	CAP,CER,CL2 1N , 10%	1
C507	J707809P14	CAP,CER,NPO 12P , 5%	1
C508	J707483P1	CAP,PHEN 0P47, 5%	1
C509	J707436P3	CAP,CER,NPO 1P5 ,.25P	1
C510	J707436P49	CAP,CER,NPO 56P , 5%	1
C511	J707436P73	CAP,CER,NPO 330P , 5%	1
C512	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C513	J707436P13	CAP,CER,NPO 10P , 5%	1
C514	J707475P1	CAP,VAR,FILM 2.0/18 PF	1
C515	J707436P4	CAP,CER,NPO 1P8 ,.25P	1
C516	J707438P26	CAP,CER,CL2 100N , 10%	1
C517	J707438P5	CAP,CER,CL2 1N , 10%	1
C518	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C519	J707438P5	CAP,CER,CL2 1N , 10%	1
C520	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C521	J707436P9	CAP,CER,NPO 4P7 ,.25P	1
C522	J707438P5	CAP,CER,CL2 1N , 10%	1
C523	J707438P14	CAP,CER,CL2 10N , 10%	1
C524	J707438P5	CAP,CER,CL2 1N , 10%	1
C526	J707436P45	CAP,CER,NPO 47P , 5%	1
C527	J707438P14	CAP,CER,CL2 10N , 10%	1
C528	J707436P45	CAP,CER,NPO 47P , 5%	1
C529	J707438P26	CAP,CER,CL2 100N , 10%	1
C530	J707412P9	CAP,PYES 100N , 10%	1
C531	J707436P29	CAP,CER,NPO 22P , 5%	1

Pos.	Code No.	Description	Qt.
C532	J707436P9	CAP,CER,NPO 4P7 ,.25P	1
C533	J707475P1	CAP,VAR,FILM 2.0/18 PF	1
C534	J707612P1	CAP,PYES 2U2 , 5%	1
C535	J707412P9	CAP,PYES 100N , 10%	1
C536	J707438P22	CAP,CER,CL2 47N , 10%	1
C537	J707438P3	CAP,CER,CL2 470P , 10%	1
C538	J707353P7	CAP,ELECT 10U ,16V	1
C539	J707436P29	CAP,CER,NPO 22P , 5%	1
C540	J707436P12	CAP,CER,NPO 8P2 ,.25P	1
C541	J707438P8	CAP,CER,CL2 3N3 , 10%	1
C542	J707438P5	CAP,CER,CL2 1N , 10%	1
C543	J707438P5	CAP,CER,CL2 1N , 10%	1
C545	J707438P5	CAP,CER,CL2 1N , 10%	1
C546	J707444P4	CAP,TA,SOL 1U , 35V	1
C547	J707444P5	CAP,TA,SOL 2U2 , 35V	1
C548	J707436P8	CAP,CER,NPO 3P9 ,.25P	1
C549	J707436P11	CAP,CER,NPO 6P8 ,.25P	1
C550	J707436P65	CAP,CER,NPO 150P , 5%	1
C551	J707436P65	CAP,CER,NPO 150P , 5%	1
C552	J707436P65	CAP,CER,NPO 150P , 5%	1
C553	J707436P65	CAP,CER,NPO 150P , 5%	1
D101	J707389P1	DIO,SI,SIG BAV 99	1
D102	J707391P1	DIO,SI,SIG BAT 18	1
D201	J707448P1	IC,LIN,VR,VAR 431	1
D202	J707390P1	DIO,SI,SIG BAV 74	1
D301	J707391P1	DIO,SI,SIG BAT 18	1
D303	J707389P1	DIO,SI,SIG BAV 99	1
D401	J707389P1	DIO,SI,SIG BAV 99	1
D501	J707397P1	DIO,SI,CAP BBY 40	1
D502	J707397P1	DIO,SI,CAP BBY 40	1
D503	J707397P1	DIO,SI,CAP BBY 40	1
D505	J707390P1	DIO,SI,SIG BAV 74	1
D506	J707390P1	DIO,SI,SIG BAV 74	1
L101	J707426P1	COIL FIX	1
L102	A700024P1	COIL,RF,FIX 0.1UH , 10%	1
L104	J707426P5	COIL FIX	1

Pos.	Code No.	Description	Qt.
L106	J707426P7	COIL FIX	1
L107	J707426P2	COIL FIX	1
L108	J707426P2	COIL FIX	1
L109	J707339G1	COIL FIX ASM	1
L110	J707426P7	COIL FIX	1
L112	J707426P2	COIL FIX	1
L113	J707339G1	COIL FIX ASM	1
L114	J707339G1	COIL FIX ASM	1
L115	J707426P4	COIL FIX	1
L116	J707426P1	COIL FIX	1
L117	J707426P1	COIL FIX	1
L118	J707486P4	COIL,RF,FIX 10UH , 10%	1
L119	J707426P5	COIL FIX	1
L120	J707426P4	COIL FIX	1
L121	J707426P4	COIL FIX	1
L301	J707426P6	COIL FIX	1
L302	J707422P2	COIL,RF,VAR 4-1/2T	1
L303	J707422P2	COIL,RF,VAR 4-1/2T	1
L304	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L305	J707422P2	COIL,RF,VAR 4-1/2T	1
L306	J707422P2	COIL,RF,VAR 4-1/2T	1
L308	J707422P3	COIL,RF,VAR 9-1/2T	1
L401	J707486P3	COIL,RF,FIX 6.8UH , 10%	1
L402	J707431P1	COIL,RF,VAR 455KHZ, 25%	1
L403	J707431P1	COIL,RF,VAR 455KHZ, 25%	1
L501	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L502	J707422P1	COIL,RF,VAR 2-1/2T	1
L503	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L504	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L505	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L506	J707422P1	COIL,RF,VAR 2-1/2T	1
L507	J707486P2	COIL,RF,FIX 3.3UH , 10%	1
L508	J707375P1	COIL,RF,VAR 4-1/2T TAP	1
L509	J707486P5	COIL,RF,FIX 330UH , 10%	1
P001	J707962G1	PLG ASM	1
P002	J707962G2	PLG ASM	1

Pos.	Code No.	Description	Qt.
P003	J707962G3	PLG ASM	1
Q101	J707388P1	TSTR,NPN,SI BFR 53	1
Q102	J707388P1	TSTR,NPN,SI BFR 53	1
Q103	J706145P1	TSTR,NPN,SI BFW 16A	1
Q104	J707868P1	TSTR,NPN,SI RF-PWR,4.0W	1
Q105	J707673P1	TSTR,NPN,SI BC 368	1
Q106	J707387P1	TSTR,PNP,SI BCW 30	1
Q107	J707386P1	TSTR,NPN,SI BCW 32	1
Q201	J707387P1	TSTR,PNP,SI BCW 30	1
Q202	J707435P1	TSTR,PNP,SI BC 369	1
Q203	J707386P1	TSTR,NPN,SI BCW 32	1
Q204	J707432P1	TSTR,PNP,SI BCX 18	1
Q205	J707387P1	TSTR,PNP,SI BCW 30	1
Q206	J707387P1	TSTR,PNP,SI BCW 30	1
Q301	J707418P1	TSTR,NPN,SI BFS 17	1
Q302	J707419P1	TSTR,JFET,SI BF511	1
Q303	J707386P1	TSTR,NPN,SI BCW 32	1
Q401	J707433P1	TSTR,MFET,SI BF 989	1
Q402	J707387P1	TSTR,PNP,SI BCW 30	1
Q501	J707419P1	TSTR,JFET,SI BF511	1
Q502	J707419P1	TSTR,JFET,SI BF511	1
Q503	J707387P1	TSTR,PNP,SI BCW 30	1
Q504	J707430P1	TSTR,PNP,SI BF 569	1
Q505	J707387P1	TSTR,PNP,SI BCW 30	1
Q506	J707419P1	TSTR,JFET,SI BF511	1
R101	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R102	J707385P822	RES,MFLM,1/8W 8K2 , 5%	1
R103	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R104	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R105	J707385P220	RES,MFLM,1/8W 22R , 5%	1
R106	J707385P100	RES,MFLM,1/8W 10R , 5%	1
R107	J707385P562	RES,MFLM,1/8W 5K6 , 5%	1
R108	J707385P102	RES,MFLM,1/8W 1K0 , 5%	1
R109	J707385P152	RES,MFLM,1/8W 1K5 , 5%	1
R110	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R111	J707385P680	RES,MFLM,1/8W 68R , 5%	1

Pos.	Code No.	Description	Qt.
R112	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R115	J707478P4	RES,VAR,DEPC 1KO , 25%	1
R117	J707385P680	RES,MFLM,1/8W 68R , 5%	1
R118	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R119	J707385P910	RES,MFLM,1/8W 1RO , 20%	1
R120	J707945P1	RES,WW R27, 5%	1
R121	J707385P100	RES,MFLM,1/8W 10R , 5%	1
R122	J707385P331	RES,MFLM,1/8W 330R , 5%	1
R123	J707385P221	RES,MFLM,1/8W 220R , 5%	1
R124	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R201	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R202	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R203	J707385P153	RES,MFLM,1/8W 15K , 5%	1
R204	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R205	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R206	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R207	J707385P682	RES,MFLM,1/8W 6K8 , 5%	1
R208	J707385P333	RES,MFLM,1/8W 33K , 5%	1
R209	J707385P333	RES,MFLM,1/8W 33K , 5%	1
R210	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R211	J707385P182	RES,MFLM,1/8W 1K8 , 5%	1
R212	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R213	J707385P153	RES,MFLM,1/8W 15K , 5%	1
R214	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R215	J707385P153	RES,MFLM,1/8W 15K , 5%	1
R216	J707385P562	RES,MFLM,1/8W 5K6 , 5%	1
R301	J707385P221	RES,MFLM,1/8W 220R , 5%	1
R302	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R303	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R304	J707385P220	RES,MFLM,1/8W 22R , 5%	1
R305	J707385P183	RES,MFLM,1/8W 18K , 5%	1
R306	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R307	J707385P153	RES,MFLM,1/8W 15K , 5%	1
R308	J707385P681	RES,MFLM,1/8W 680R , 5%	1
R309	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R310	J707385P101	RES.MFLM,1/8W 100R , 5%	1

Pos.	Code No.	Description	Qt.
R311	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R312	J707385P332	RES,MFLM,1/8W 3K3 , 5%	1
R313	J707385P154	RES,MFLM,1/8W 150K , 5%	1
R314	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R315	J707385P153	RES,MFLM,1/8W 15K , 5%	1
R401	J707385P152	RES,MFLM,1/8W 1K5 , 5%	1
R402	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R403	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R404	J707385P561	RES,MFLM,1/8W 560R , 5%	1
R405	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R406	J707385P683	RES,MFLM,1/8W 68K , 5%	1
R407	J707385P333	RES,MFLM,1/8W 33K , 5%	1
R408	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R409	J707478P10	RES,VAR,DEPC 10K , 25%	1
R410	J707385P392	RES,MFLM,1/8W 3K9 , 5%	1
R411	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R412	J707385P563	RES,MFLM,1/8W 56K , 5%	1
R413	J707385P683	RES,MFLM,1/8W 68K , 5%	1
R414	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R415	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R416	J707385P182	RES,MFLM,1/8W 1K8 , 5%	1
R417	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R418	J707385P183	RES,MFLM,1/8W 18K , 5%	1
R419	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R420	J707478P12	RES,VAR,DEPC 22K , 25%	1
R421	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R422	J707385P332	RES,MFLM,1/8W 3K3 , 5%	1
R501	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R502	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R503	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R504	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R505	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R506	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R507	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R508	J707385P392	RES,MFLM,1/8W 3K9 , 5%	1
R509	J707385P333	RES.MFLM,1/8W 33K , 5%	1

Pos.	Code No.	Description	Qt.
R510	J707385P100	RES,MFLM,1/8W 10R , 5%	1
R511	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R512	J707385P102	RES,MFLM,1/8W 1K0 , 5%	1
R513	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R514	J707385P822	RES,MFLM,1/8W 8K2 , 5%	1
R515	J707385P183	RES,MFLM,1/8W 18K , 5%	1
R516	J707385P183	RES,MFLM,1/8W 18K , 5%	1
R518	J707385P102	RES,MFLM,1/8W 1K0 , 5%	1
R519	J707385P562	RES,MFLM,1/8W 5K6 , 5%	1
R520	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R521	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R523	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R524	J707385P151	RES,MFLM,1/8W 150R , 5%	1
R525	J707385P272	RES,MFLM,1/8W 2K7 , 5%	1
R526	J707385P221	RES,MFLM,1/8W 220R , 5%	1
R527	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R528	J707385P152	RES,MFLM,1/8W 1K5 , 5%	1
R529	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R530	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R531	J707385P102	RES,MFLM,1/8W 1K0 , 5%	1
R532	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R533	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R534	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R535	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R536	J707385P272	RES,MFLM,1/8W 2K7 , 5%	1
R537	J707385P103	RES,MFLM,1/8W 10K , 5%	1
U401	J707449P1	IC,LIN,IF-AMP 3357	1
U501	J707434P2	IC,DIG,MUX 4053	1
U502	J707337P1	IC,PLL,SYN 145146	1
U503	J707374P1	IC,PLL,PRESC 8793	1
0002	M905740P1R3	BD PW	1
		NON ELECTRONICAL PARTS	
	L855385P1	SPRING ANTENNA	1
	A701332P4	WASH,INS DIA 8.64NAT	1
	J706281P6	CORE,SCREW FERR, U 10	6

Pos.	Code No.	Description	Qt.

Storno

Pos.	Code No.	Description	Qt.
A001	M905741G1	RF4110 CPNT BD.	1
R522	J707406P1	RES THERM. NTC 330R 20% **G3 ONLY**	1
U402	M905766G1	SQ 4002 MIC.MOD **G1/G2 ONLY**	1
U402	M905766G2	SQ 4003 MIC.MOD **G3 ONLY**	1
Z401	J707310P1	FLT 21,4 MHZ **G1 ONLY**	1
Z401	J707310P2	FLT 21,4 MHZ **G2 ONLY**	1
Z401	J707310P3	FLT 21,4 MHZ **G3 ONLY**	1
Z403	J707446P1	FLT 455 KHZ **G1 ONLY**	1
Z403	J707446P3	FLT 455 KHZ **G2 ONLY**	1
Z403	J707446P4	FLT 455 KHZ **G3 ONLY**	1
0002	J706804P2	WASHER, INSULATION	2

Pos.	Code No.	Description	Qt.

CHAPTER
CHAPITRE
KAPITEL

4

Storno

Storno

CL4001/CL4002

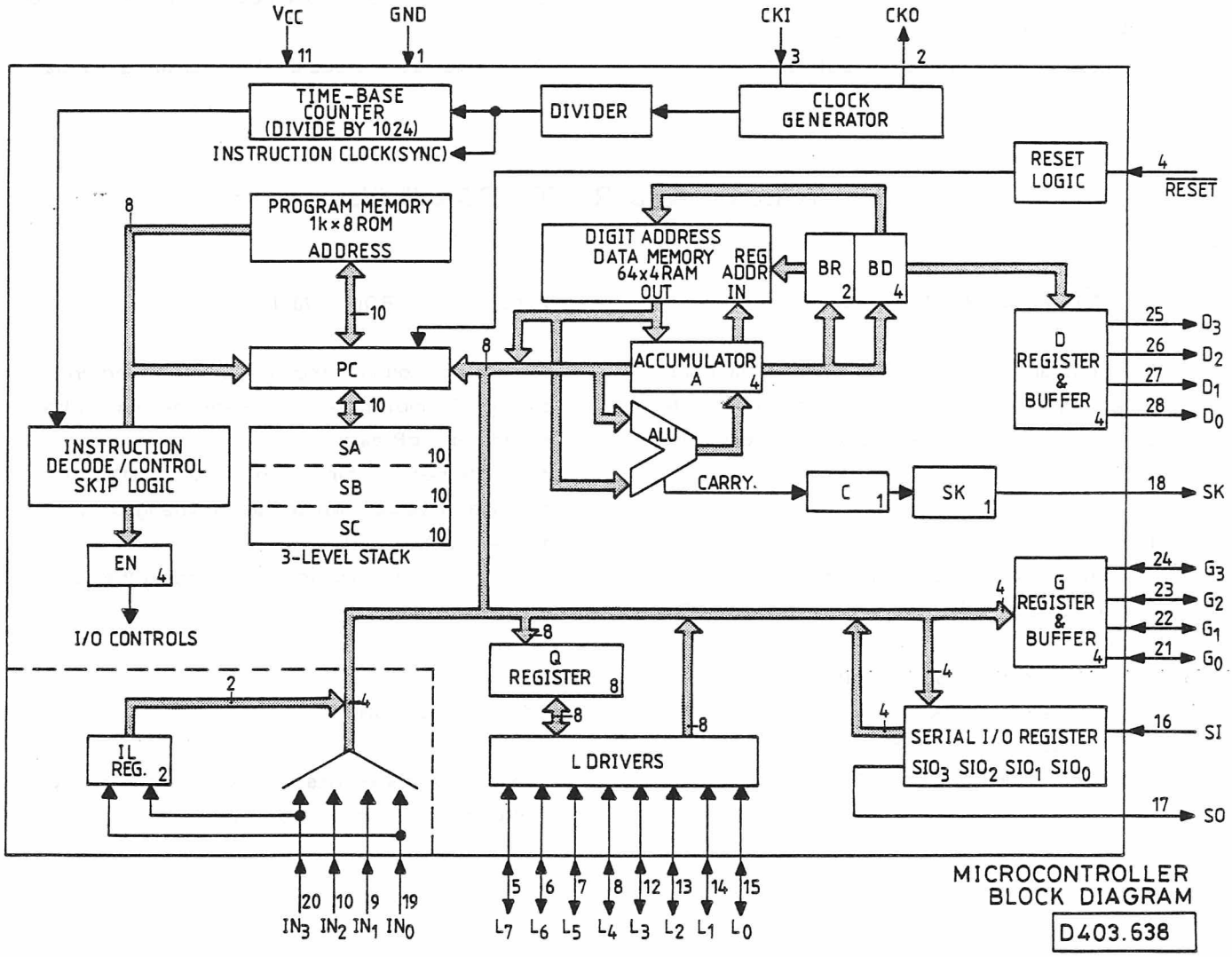
CONTROL LOGIC BOARD

The control board assume all the control functions of the radio. The different circuits are as follows:

- Central control functions
  - microcontroller
  - personality PROM
- Volume and RX/TX control
- Audio power amplifier
- TX audio processor
- Display control
- Tone control
- Other functions

CL4001 and CL4002 are nearly similar physically, there is one more latch driver to control the display in CL4002. But their functions are different due to the software programming.
(see programming manual).

CONTROL FUNCTIONS



MICROCONTROLLER

The microcontroller is a mask programmed microprocessor containing an accumulator, several registers and a 1 K byte ROM. The controlling program is stored in the ROM.

Internally, the microcontroller has:

- a 64 x 4 bits RAM:
  containing informations on volume setting, RX/TX mode, tones (if TQ or CG are used). Diverse counters used for the CL board are contained in the RAM.
- 8 bidirectional lines L0 to L7:
  these are 8 outputs addressing the personality PROM, the synthesizer and the display circuits.
  4 of the lines are used for input informations.
- 4 bidirectional lines G0 to G3:
  these are only used as output control lines.
- 4 output lines D0 to D3:
  these are used for display scanning, radio ON/OFF and selection functions.
- serial input and output register:
  the output can be synchronized with the carry signal.
- 4 interrupt lines:
  which are build up in two interrupt levels.

PERSONALITY PROM

All informations related to the individual radio are programmed into a 256x4 bipolar PROM. These are informations such as: channel frequencies, channel spacing and tone options.

To reduce power consumption, the PROM is only turned on when addressed by the microcontroller.

For further details see the Programming manual.

VOLUME AND RX/TX CONTROL

OUTPUT EXPANDER/SIPO (U901)

The sipo is an 8 bits register. The informations are serially clocked in. By selecting the register, the information is transferred to the 8 serial lines.

Output lines:

- 1 line selecting volume control (O8)
- 3 lines addressing the volume control (O5, O6, O7)
- 1 line selecting audio amplifier (O3).
- 1 line selecting RX/$\overline{TX}$ mode (O4).
- 1 line selecting microphone (O2).
- 1 line for tone transmit (O1).

VOLUME CONTROL (U702)

The volume control circuit is built around an analog FET multiplexer. The volume control has 8 steps of 5 dB each.
When the radio is turned on, volume setting has the default value 4 which can be changed by activating the key-board.
The output of the multiplexer is fed to the audio amplifier.

RX/TX FUNCTIONS

The CL board switches from RX to TX mode by 3 informations coming from the SIPO.

By means of O4, Q901 is turned on delivering 5.5 V for the transmit part of the RF board. The transmit symbol on the display is turned on by the same process.

O1 turns on Q801 delivering +5.5 V to the electret microphone when the PTT key is depressed.

O2 is only active when the tone key is pressed. O2 delivers 5.5 V to the transmit part of the tone module (TQ or CG).

AUDIO POWER AMPLIFIER

(U701 with associated components)

The audio power amplifier is a 500 mW amplifier containing a deemphasis circuit, an amplifier and a band-pass filter avoiding low and high frequencies (300-3000 Hz) to pass through to the loudspeaker.
U701 is only under power when selected by the microcontroller via the SIPO.

TX AUDIO PROCESSOR

(U801, Q802, Q803, Q804 and associated components)

When the microcontroller switches the RF board from RX to TX mode, 5.5 V is delivered to the TX audio processor.
The audio processor contains the following circuits:

- a microphone amplifier with an input high-pass filter. The gain of the amplifier is fixed and can only be changed by replacing R805.

- an active deemphasis circuit:
  built around Q802, Q803 and Q804.
  The circuit output is delivered to the potentiometer R812, by which the maximum deviation can be adjusted.

- an active limiter combined with low-pass filter avoiding harmonics from microphone signals.
  The upper limit of the circuit, 3000 Hz, can be modified to 2550 Hz by cutting the resistor R818.
  The output of the limiter is fed to the TX VCO on the RF board.

DISPLAY, TONE AND OTHER FUNCTIONS

DISPLAY CONTROL

The LCD display contains 3 seven-segment digits and 5 separate symbols. It is illuminated by 4 green LED's.

Three IC's are used to latch the data and drive the LCD-display.
A clock generator gives approximately 40 Hz pulses for the display.
The display drivers are controlled directly by the microcontroller (4 lines).

TONE CONTROL

The tone sequence from the TQ module is delivered to the deemphasis circuit. The channel guard frequency is delivered directly to the limiter through a potentiometer, R824, for channel guard deviation adjustment. The deviation must be 500 Hz without microphone signal.

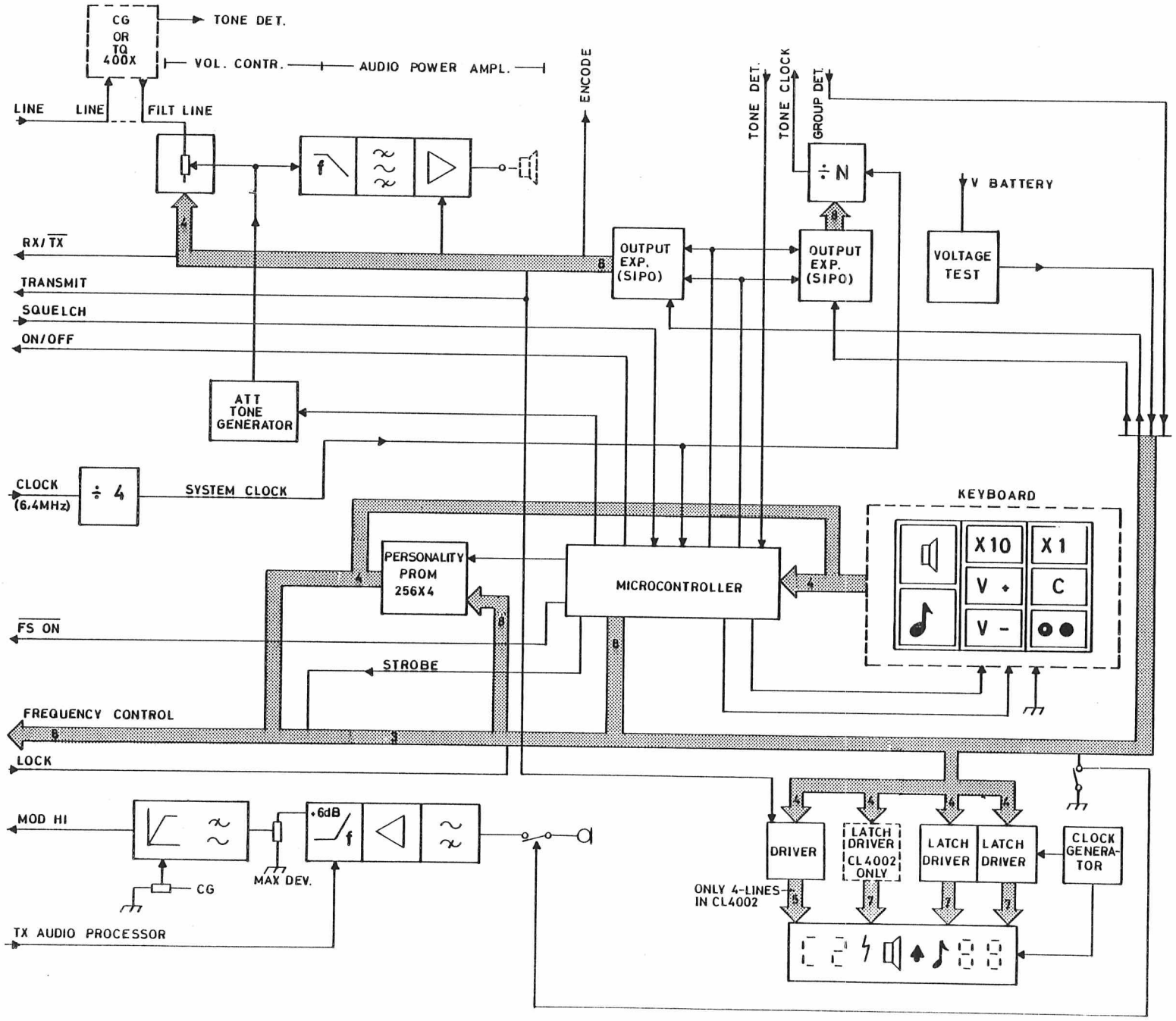
OTHER FUNCTIONS

These are:

- ON/OFF
- Transmit signal
- Frequency synthesizer control
- Lock detect function
- Tone detect
- Battery control

Storno

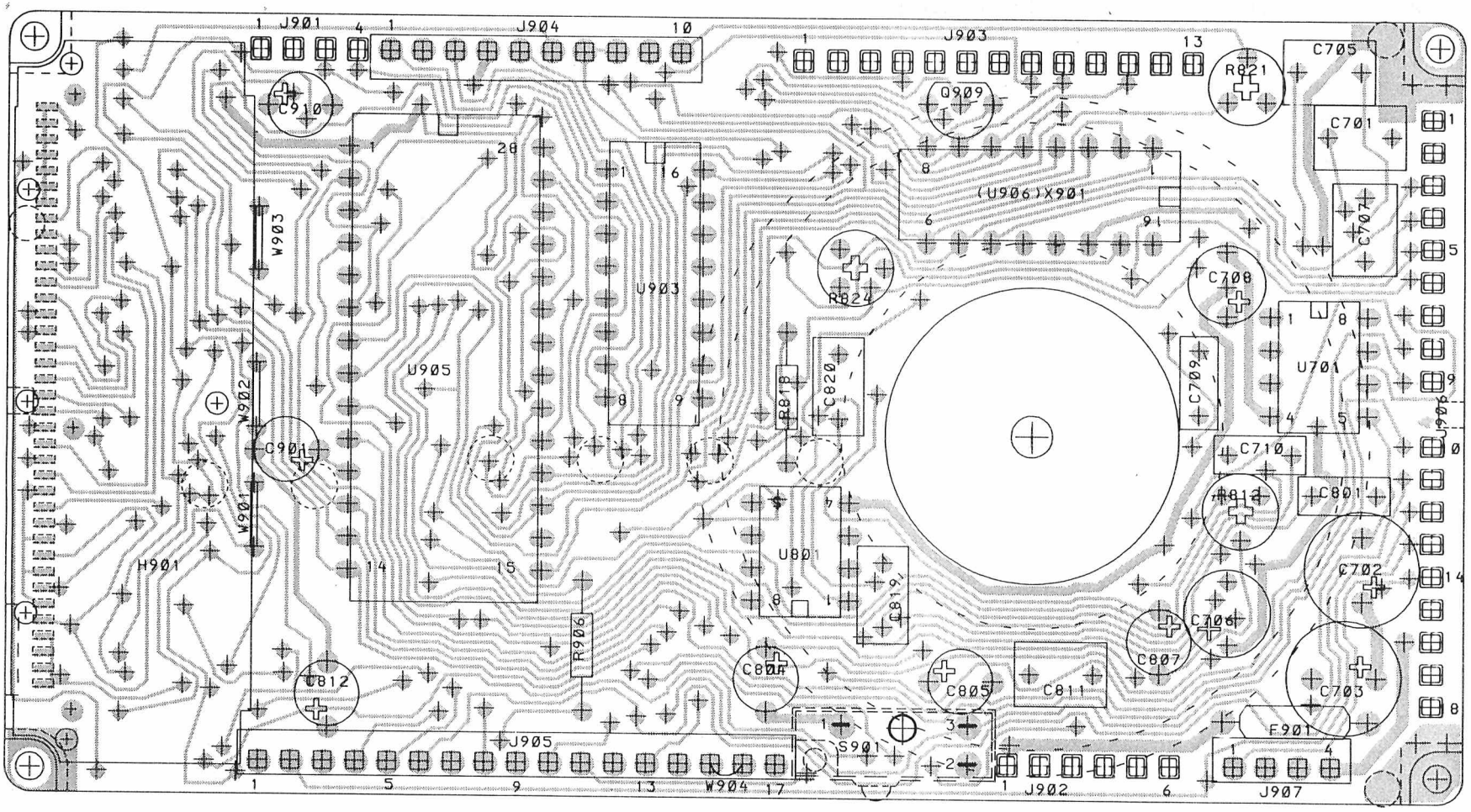
Storno



FUNCTIONAL DIAGRAM
CL4001/CL4002

D403.633

Storno



CODE NO. FOR MOUNTED BOARD

M905465G2-VHF/UHF

(M905465G1-VHF)

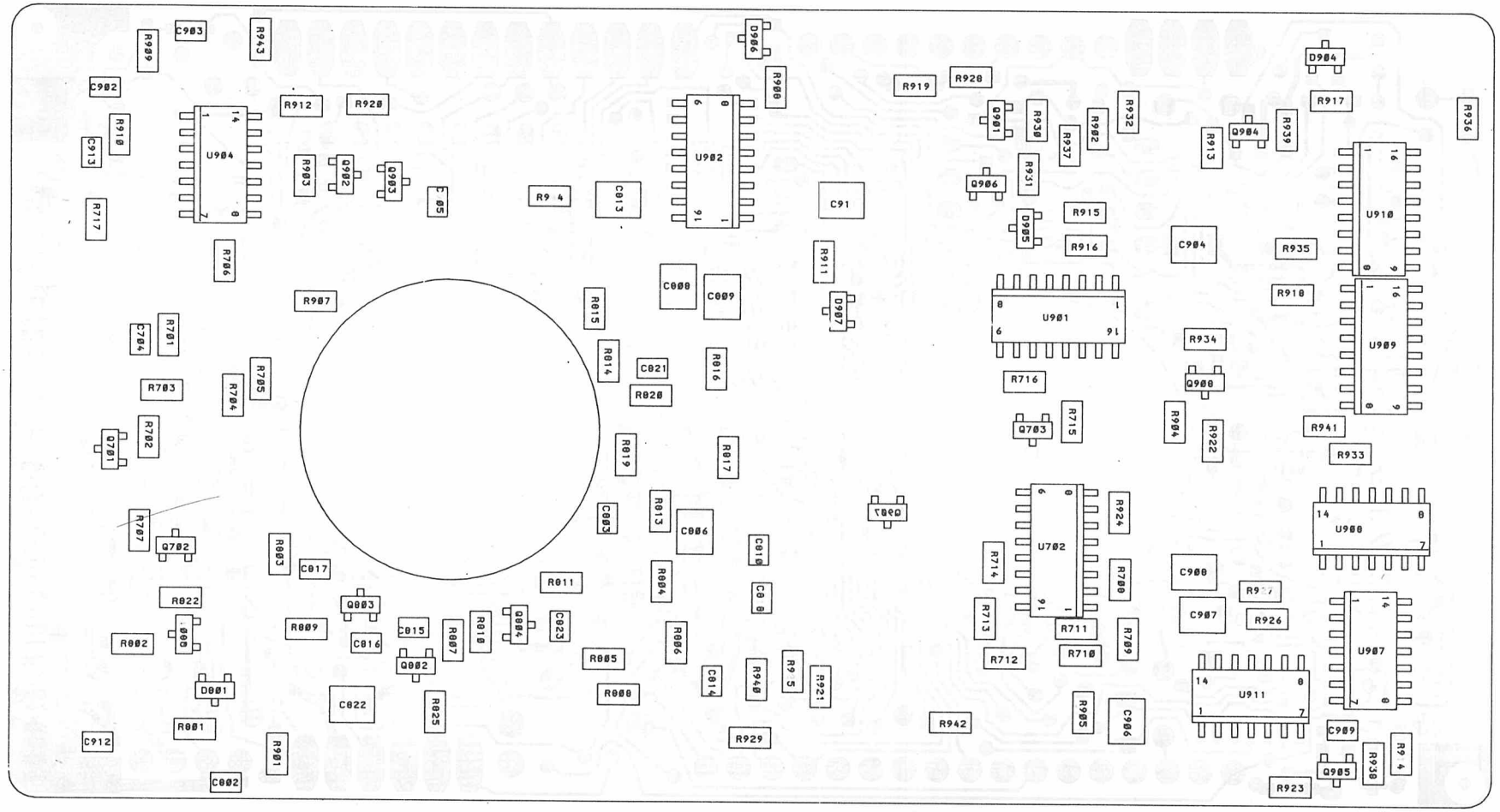
CONTROL LOGIC CL4001

COMPONENT LAYOUT

D403.760/2

Storno

Storno



CODE NO. FOR MOUNTED BOARD

M905465G2-VHF/UHF

(M905465G1-VHF)

CONTROL LOGIC CL4001

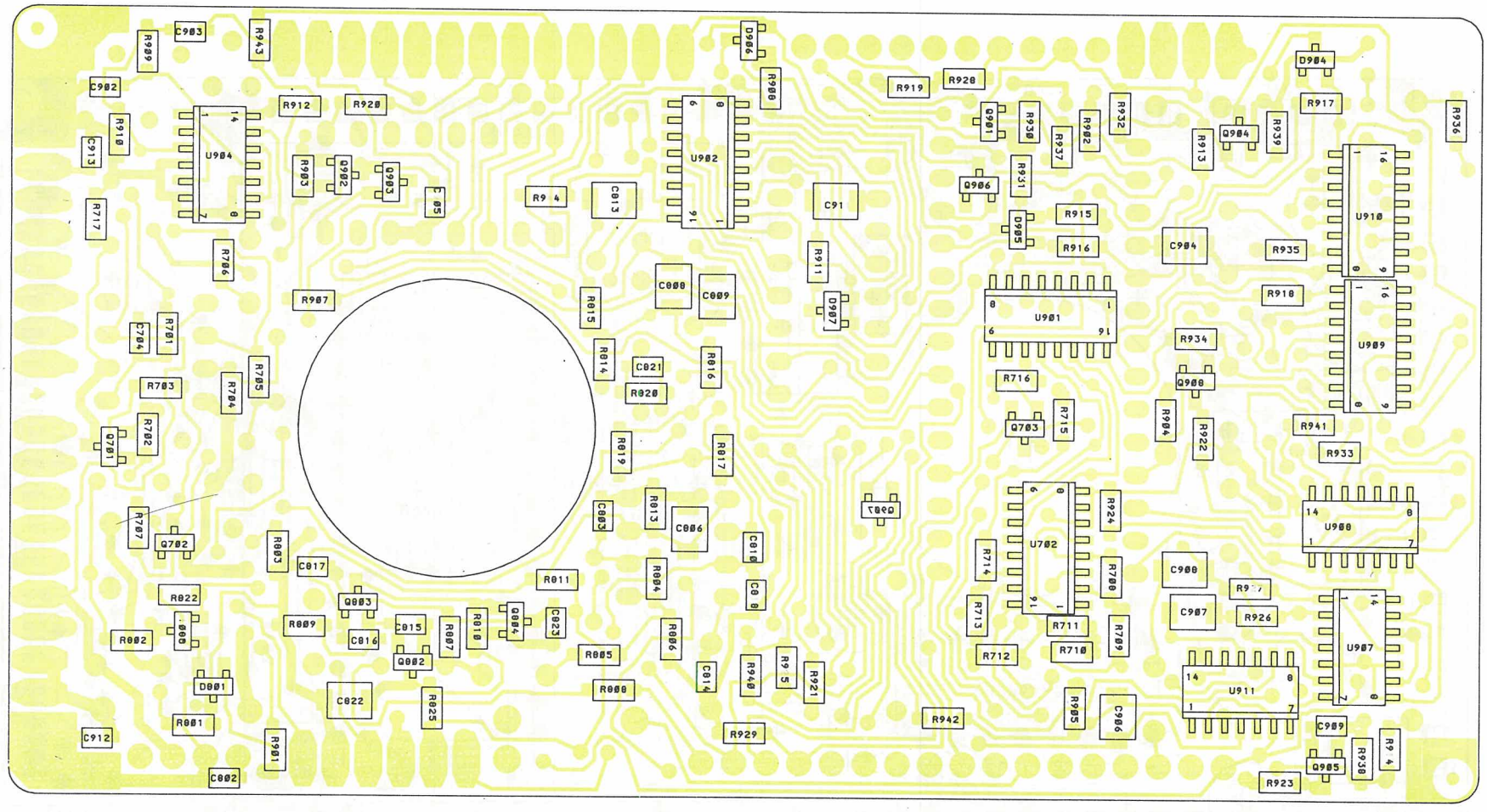
COMPONENT LAYOUT

CHIP SIDE

D403.761/2

Storno

Storno



CODE NO. FOR MOUNTED BOARD

M905465G2-VHF/UHF

(M905465G1-VHF)

CONTROL LOGIC CL4001

COMPONENT LAYOUT

CHIP SIDE

D403.761/2

Storno

Storno

CONTROL LOGIC CL4001

REV. H | D403.759/2

NOTE 1:
ON G2 THE MICROCONTROLLER IS MOUNTED ON THICK FILM SUBSTRATE

CODE NO. MOUNTED BOARD
M905465G1 VHF
M905465G2 UHF

Pos.	Code No.	Description	Qt.
H901	J707230P1	DIS,LIQ CRY CUSTOM	1
S901	J707133P3	SW,PUSH PLNGR AU	1
0002	M905465G1	CPNT BD CL4001	1
A001	M905465G1	CPNT BD CL4001	
C701	J707412P10	CAP,PYES 150N , 10%	1
C702	J707444P17	CAP,TA,SOL 47U , 10V	1
C703	J707444P17	CAP,TA,SOL 47U , 10V	1
C704	J707438P5	CAP,CER,CL2 1N , 10%	1
C705	J707412P10	CAP,PYES 150N , 10%	1
C706	J707353P9	CAP,ELECT 47U ,16V	1
C707	J707412P10	CAP,PYES 150N , 10%	1
C708	J707444P8	CAP,TA,SOL 22U , 16V	1
C709	J707412P3	CAP,PYES 10N , 10%	1
C710	J707412P3	CAP,PYES 10N , 10%	1
C801	J707412P3	CAP,PYES 10N , 10%	1
C802	J707436P73	CAP,CER,NPO 330P , 5%	1
C803	J707436P73	CAP,CER,NPO 330P , 5%	1
C804	J707444P8	CAP,TA,SOL 22U , 16V	1
C805	J707444P3	CAP,TA,SOL 0U47, 35V	1
C806	J707438P26	CAP,CER,CL2 100N , 10%	1
C807	J707353P4	CAP,ELECT 1U0 ,50V	1
C808	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C809	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C810	J707436P61	CAP,CER,NPO 100P , 5%	1
C811	J707412P5	CAP,PYES 22N , 10%	1
C812	J707353P7	CAP,ELECT 10U ,16V	1
C813	J707438P22	CAP,CER,CL2 47N , 10%	1
C814	J707436P73	CAP,CER,NPO 330P , 5%	1
C815	J707436P61	CAP,CER,NPO 100P , 5%	1
C816	J707436P61	CAP,CER,NPO 100P , 5%	1

Storno

Pos.	Code No.	Description	Qt.
C817	J707436P61	CAP,CER,NPO 100P , 5%	1
C818	J707436P61	CAP,CER,NPO 100P , 5%	1
C819	J707412P3	CAP,PYES 10N , 10%	1
C820	J707412P1	CAP,PYES 4N7 , 10%	1
C821	J707436P73	CAP,CER,NPO 330P , 5%	1
C822	J707436P87	CAP,CER,NPO 1N2 , 5%	1
C823	J707436P61	CAP,CER,NPO 100P , 5%	1
C901	J707353P4	CAP,ELECT 1U0 ,50V	1
C902	J707438P14	CAP,CER,CL2 10N , 10%	1
C903	J707436P61	CAP,CER,NPO 100P , 5%	1
C904	J707438P22	CAP,CER,CL2 47N , 10%	1
C905	J707438P14	CAP,CER,CL2 10N , 10%	1
C906	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C907	J707438P22	CAP,CER,CL2 47N , 10%	1
C908	J707438P22	CAP,CER,CL2 47N , 10%	1
C909	J707438P14	CAP,CER,CL2 10N , 10%	1
C910	J707353P7	CAP,ELECT 10U ,16V	1
C911	J707438P22	CAP,CER,CL2 47N , 10%	1
C912	J707438P3	CAP,CER,CL2 470P , 10%	1
C913	J707436P61	CAP,CER,NPO 100P , 5%	1
C914	J707438P14	CAP,CER,CL2 10N , 10%	1
C915	J707436P61	CAP,CER,NPO 100P , 5%	1
D801	J707390P1	DIO,SI,SIG BAV 74	1
D904	J707390P1	DIO,SI,SIG BAV 74	1
D905	J707390P1	DIO,SI,SIG BAV 74	1
D906	J707390P1	DIO,SI,SIG BAV 74	1
D907	J707390P1	DIO,SI,SIG BAV 74	1
F901	J707468P11	FUSE,CTG 5.0 A F	1
J901	J706434P3	CONN,PWB,FEM RECP,4 PINS	1
J902	J706434P3	CONN,PWB,FEM RECP,6 PINS	1
J903	J706434P3	CONN,PWB,FEM RECP,13 PIN	1
J904	J707442P2	CONN,PWB,FEM 10-CKT	1
J905	J707442P3	CONN,PWB,FEM 17-CKT	1
J906	J706434P3	CONN,PWB,FEM RECP,18 PIN	1
J907	J707442P1	CONN,PWB,FEM 04-CKT	1
Q701	J707432P1	TSTR,PNP,SI BCX 18	1

Pos.	Code No.	Description	Qt.
Q702	J707386P1	TSTR,NPN,SI BCW 32	1
Q703	J707386P1	TSTR,NPN,SI BCW 32	1
Q801	J707387P1	TSTR,PNP,SI BCW 30	1
Q802	J707386P1	TSTR,NPN,SI BCW 32	1
Q803	J707386P1	TSTR,NPN,SI BCW 32	1
Q804	J707387P1	TSTR,PNP,SI BCW 30	1
Q901	J707432P1	TSTR,PNP,SI BCX 18	1
Q902	J707387P1	TSTR,PNP,SI BCW 30	1
Q903	J707429P1	TSTR,NPN,SI BCX 20	1
Q904	J707386P1	TSTR,NPN,SI BCW 32	1
Q905	J707387P1	TSTR,PNP,SI BCW 30	1
Q906	J707386P1	TSTR,NPN,SI BCW 32	1
Q907	J707386P1	TSTR,NPN,SI BCW 32	1
Q908	J707386P1	TSTR,NPN,SI BCW 32	1
Q909	J707674P1	TSTR,PNP,SI BC 558A/B	1
R701	J707385P910	RES,MFLM,1/8W 1RO , 20%	1
R702	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R703	J707385P471	RES,MFLM,1/8W 470R , 5%	1
R704	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R705	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R706	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R707	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R708	J707385P182	RES,MFLM,1/8W 1K8 , 5%	1
R709	J707385P122	RES,MFLM,1/8W 1K2 , 5%	1
R710	J707385P681	RES,MFLM,1/8W 680R , 5%	1
R711	J707385P391	RES,MFLM,1/8W 390R , 5%	1
R712	J707385P181	RES,MFLM,1/8W 180R , 5%	1
R713	J707385P121	RES,MFLM,1/8W 120R , 5%	1
R714	J707385P680	RES,MFLM,1/8W 68R , 5%	1
R715	J707385P820	RES,MFLM,1/8W 82R , 5%	1
R716	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R717	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R801	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R802	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R803	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R804	J707385P474	RES,MFLM,1/8W 470K , 5%	1

Storno

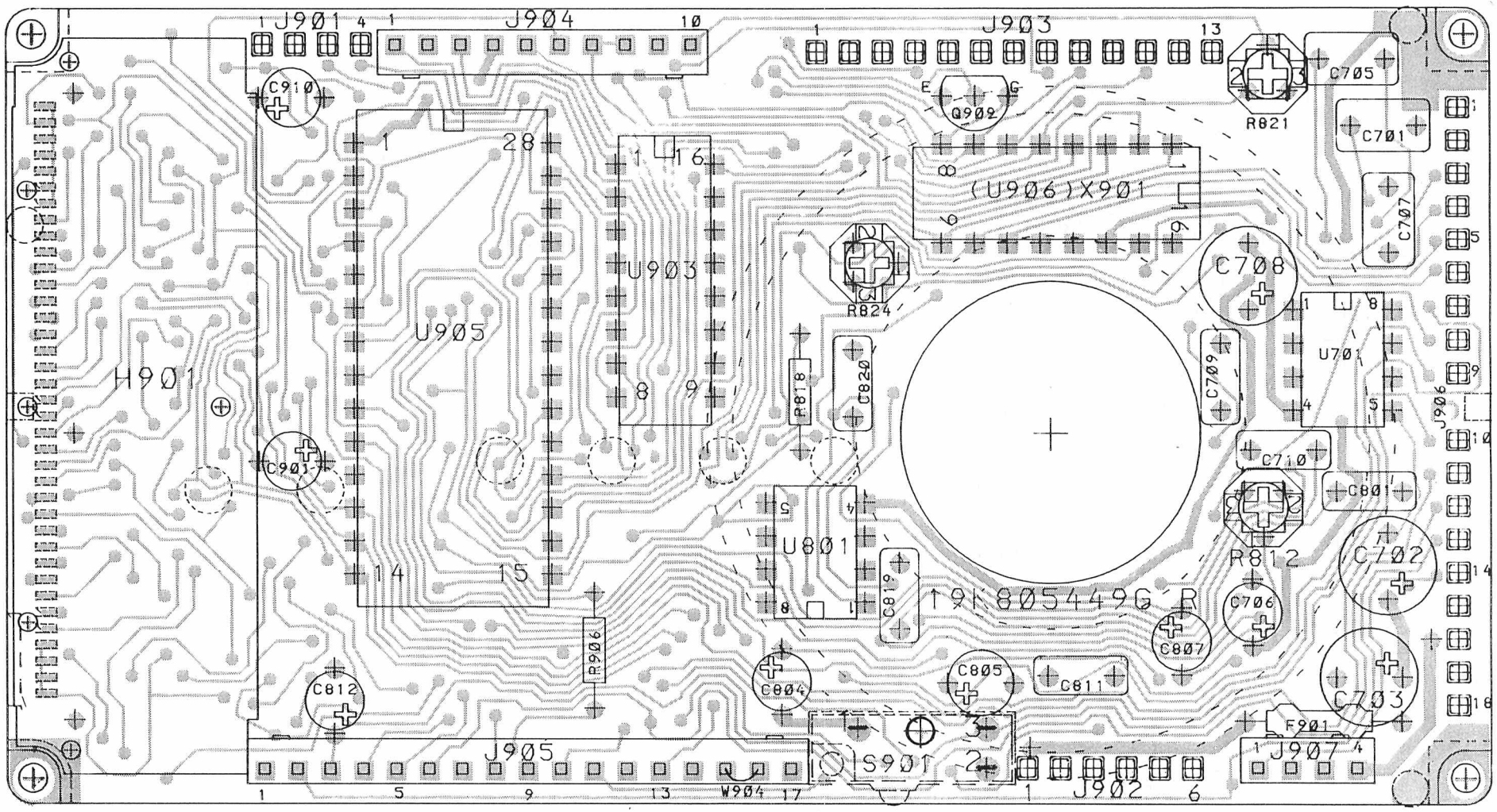
Pos.	Code No.	Description	Qt.
R805	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R806	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R807	J707385P563	RES,MFLM,1/8W 56K , 5%	1
R808	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R809	J707385P562	RES,MFLM,1/8W 5K6 , 5%	1
R810	J707385P392	RES,MFLM,1/8W 3K9 , 5%	1
R811	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R812	J707478P8	RES,VAR,DEPC 4K7 , 25%	1
R813	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R814	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R815	J707385P823	RES,MFLM,1/8W 82K , 5%	1
R816	J707385P124	RES,MFLM,1/8W 120K , 5%	1
R817	J707385P683	RES,MFLM,1/8W 68K , 5%	1
R818	J707476P58	RES,DEPC,0.1W 560K , 10%	1
R819	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R820	J707385P154	RES,MFLM,1/8W 150K , 5%	1
R821	J707478P12	RES,VAR,DEPC 22K , 25%	1
R822	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R824	J707478P6	RES,VAR,DEPC 2K2 , 25%	1
R825	J707385P220	RES,MFLM,1/8W 22R , 5%	1
R901	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R902	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R903	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R904	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R905	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R906	J707476P51	RES,DEPC,0.1W 150K , 5%	1
R907	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R908	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R909	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R910	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R911	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R912	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R913	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R914	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R915	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R916	J707385P104	RES,MFLM,1/8W 100K , 5%	1

Pos.	Code No.	Description	Qt.
R917	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R918	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R919	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R920	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R921	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R922	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R923	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R924	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R925	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R926	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R927	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R928	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R929	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R930	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R931	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R932	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R933	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R934	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R935	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R936	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R937	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R938	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R939	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R940	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R941	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R942	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R943	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R944	J707385P223	RES,MFLM,1/8W 22K , 5%	1
U701	J707451P1	IC,LIN,AF-AMP 820	1
U702	J707434P1	IC,DIG,MUX 4051	1
U801	J707450P1	IC,LIN,OP-AMP 358	1
U901	J707243P1	IC,DIG,REG 4094	1
U902	J707243P1	IC,DIG,REG 4094	1
U903	J707322P1	IC,DIG,CNTR 4569	1
U904	J707242P2	IC,DIG,FF-D 4013	1
U905	J708019P2	IC,UP,4-BIT COP324C-LXN	1

Storno

Pos.	Code No.	Description	Qt.
U907	J707242P1	IC,DIG,FF-D 4013	1
U908	J707464P1	IC,DIG,GATE 4070	1
U909	J707264P1	IC,DIG,DECO 4543	1
U910	J707264P1	IC,DIG,DECO 4543	1
U911	J707464P1	IC,DIG,GATE 4070	1
W901	A700134P9	WIRE,MM AWG 0.500 AWG24	
W902	A700134P9	WIRE,MM AWG 0.500 AWG24	
W903	A700134P9	WIRE,MM AWG 0.500 AWG24	
W904	A700134P9	WIRE,MM AWG 0.500 AWG24	
X901	J706356P4	SOC,IC,L-PRF 16 CKT	1
0002	M905466P1R6	BD PW	1

Storno



CODE NO. FOR MOUNTED BOARD

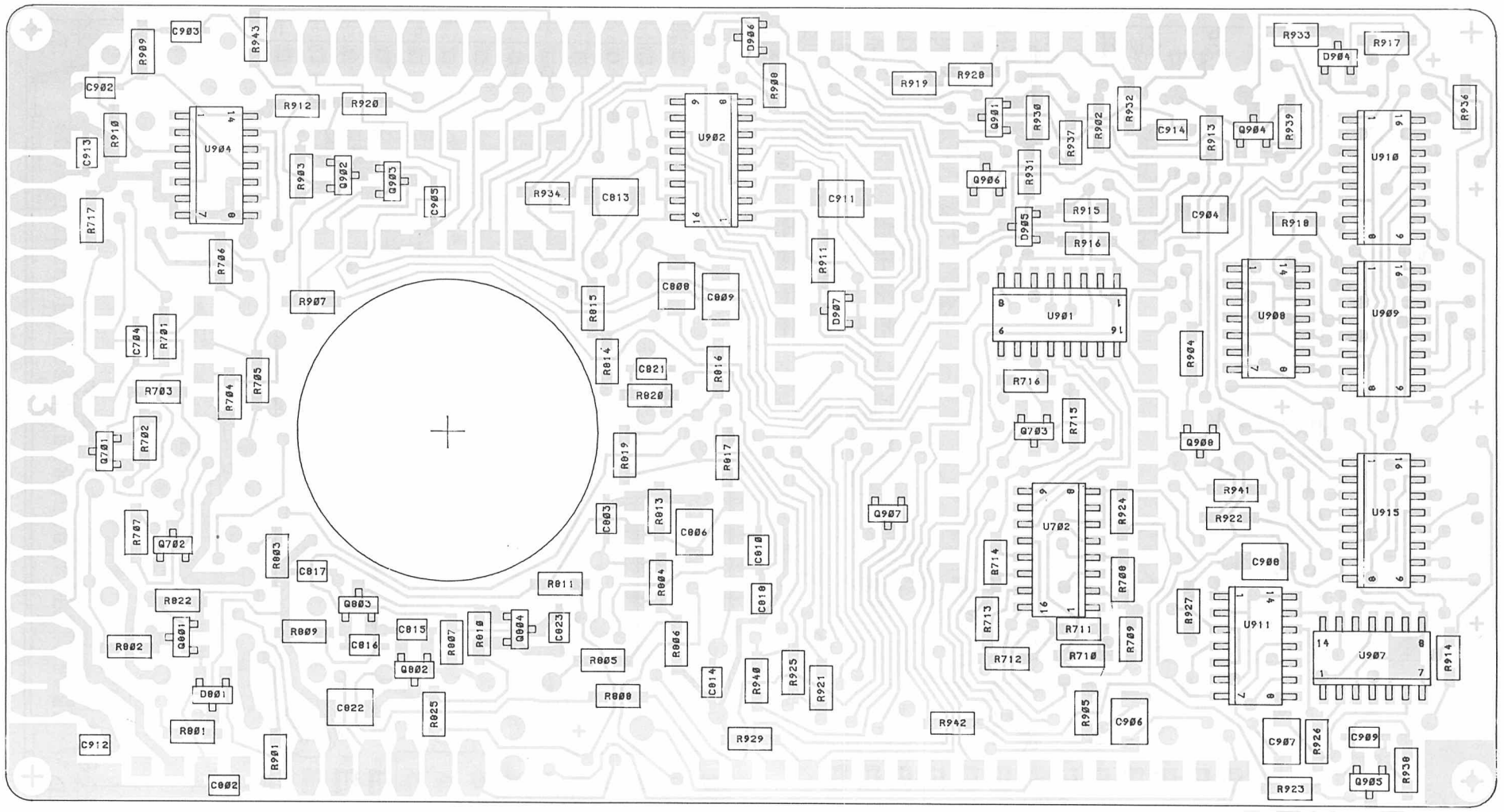
M905679G2-VHF/UHF

(M905679G1-VHF)

COMPONENT BOARD FOR CONTROL LOGIC CL4002
COMPONENT LAYOUT - COMPONENT SIDE

D403.824/3

Storno



CODE NO. FOR MOUNTED BOARD

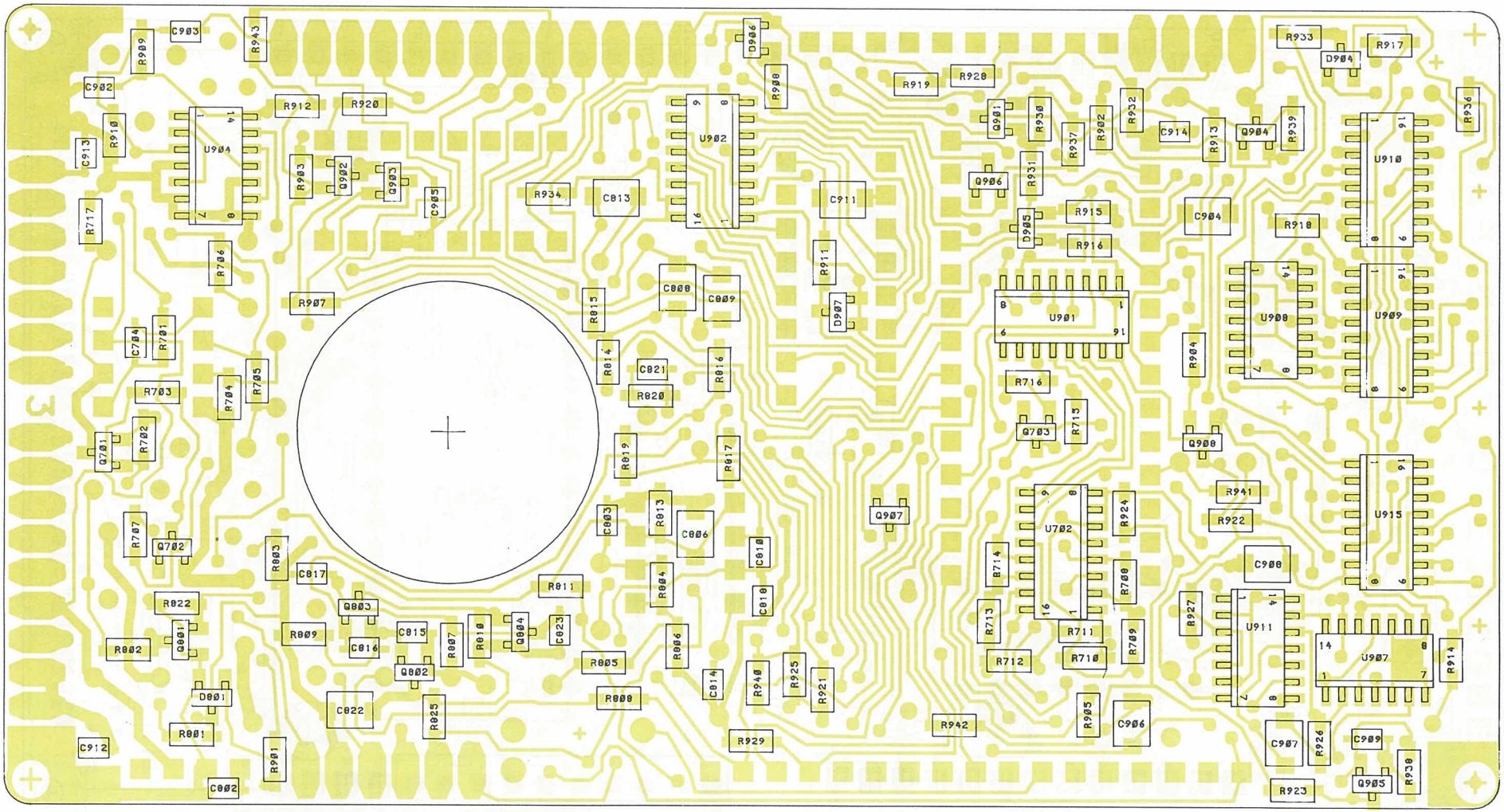
M905679G2-VHF/UHF

(M905679G1-VHF)

COMPONENT BOARD FOR CONTROL LOGIC CL4002
COMPONENT LAYOUT - CHIP SIDE

D403.825/3

Storno



CODE NO. FOR MOUNTED BOARD

M905679G2-VHF/UHF

(M905679G1-VHF)

COMPONENT BOARD FOR CONTROL LOGIC CL4002
COMPONENT LAYOUT - CHIP SIDE

D403.825/3

Storno

Storno

CONTROL LOGIC CL 4002

REV.D D403.823/5

NOTE 1:
ON G2 THE MICROCONTROLLER IS MOUNTED ON THICK FILM SUBSTRATE.

CODE NO. FOR MODULE
K805449G2-VHF/UHF
(K855449G1-VHF)

Pos.	Code No.	Description	Qt.
H901	J707230P1	DIS,LIQ CRY CUSTOM	1
S901	J707133P3	SW,PUSH PLNGR AU	1
0002	M905679G2	CPNT BD-CL4002	1
002	M905679G2	COMPONENT BOARD CL4002	
C701	J707412P10	CAP,PYES 150N , 10%	1
C702	J707444P17	CAP,TA,SOL 47U , 10V	1
C703	J707444P17	CAP,TA,SOL 47U , 10V	1
C704	J707438P5	CAP,CER,CL2 1N , 10%	1
C705	J707412P10	CAP,PYES 150N , 10%	1
C706	J707353P9	CAP,ELECT 47U ,16V	1
C707	J707412P10	CAP,PYES 150N , 10%	1
C708	J707444P8	CAP,TA,SOL 22U , 16V	1
C709	J707412P3	CAP,PYES 10N , 10%	1
C710	J707412P3	CAP,PYES 10N , 10%	1
C801	J707412P3	CAP,PYES 10N , 10%	1
C802	J707436P73	CAP,CER,NPO 330P , 5%	1
C803	J707436P73	CAP,CER,NPO 330P , 5%	1
C804	J707444P8	CAP,TA,SOL 22U , 16V	1
C805	J707444P3	CAP,TA,SOL 0U47, 35V	1
C806	J707438P26	CAP,CER,CL2 100N , 10%	1
C807	J707353P4	CAP,ELECT 1U0 ,50V	1
C808	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C809	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C810	J707436P61	CAP,CER,NPO 100P , 5%	1
C811	J707412P5	CAP,PYES 22N , 10%	1
C812	J707353P7	CAP,ELECT 10U ,16V	1
C813	J707438P22	CAP,CER,CL2 47N , 10%	1
C814	J707436P73	CAP,CER,NPO 330P , 5%	1
C815	J707436P61	CAP,CER,NPO 100P , 5%	1
C816	J707436P61	CAP,CER,NPO 100P , 5%	1
C817	J707436P61	CAP,CER,NPO 100P , 5%	1
C818	J707436P61	CAP,CER,NPO 100P , 5%	1
C819	J707412P3	CAP,PYES 10N , 10%	1
C820	J707412P1	CAP,PYES 4N7 , 10%	1
C821	J707436P73	CAP,CER,NPO 330P , 5%	1

Storno

Pos.	Code No.	Description	Qt.
C822	J707436P87	CAP,CER,NPO 1N2 , 5%	1
C823	J707436P61	CAP,CER,NPO 100P , 5%	1
C901	J707353P4	CAP,ELECT 1U0 ,50V	1
C902	J707438P14	CAP,CER,CL2 10N , 10%	1
C903	J707436P61	CAP,CER,NPO 100P , 5%	1
C904	J707438P22	CAP,CER,CL2 47N , 10%	1
C905	J707438P14	CAP,CER,CL2 10N , 10%	1
C906	J707436P93	CAP,CER,NPO 2N2 , 5%	1
C907	J707438P22	CAP,CER,CL2 47N , 10%	1
C908	J707438P22	CAP,CER,CL2 47N , 10%	1
C909	J707438P14	CAP,CER,CL2 10N , 10%	1
C910	J707353P7	CAP,ELECT 10U ,16V	1
C911	J707438P22	CAP,CER,CL2 47N , 10%	1
C912	J707438P3	CAP,CER,CL2 470P , 10%	1
C913	J707436P61	CAP,CER,NPO 100P , 5%	1
C914	J707438P14	CAP,CER,CL2 10N , 10%	1
C915	J707436P61	CAP,CER,NPO 100P , 5%	1
D801	J707390P1	DIO,SI,SIG BAV 74	1
D904	J707390P1	DIO,SI,SIG BAV 74	1
D905	J707390P1	DIO,SI,SIG BAV 74	1
D906	J707390P1	DIO,SI,SIG BAV 74	1
D907	J707390P1	DIO,SI,SIG BAV 74	1
F901	J707468P11	FUSE,CTG 5.0 A F	1
J901	J706434P3	CONN,PWB,FEM RECP	4
J902	J706434P3	CONN,PWB,FEM RECP	6
J903	J706434P3	CONN,PWB,FEM RECP	13
J904	J707442P2	CONN,PWB,FEM 10-CKT	1
J905	J707442P3	CONN,PWB,FEM 17-CKT	1
J906	J706434P3	CONN,PWB,FEM RECP	18
J907	J707442P1	CONN,PWB,FEM 04-CKT	1
Q701	J707432P1	TSTR,PNP,SI BCX 18	1
Q702	J707386P1	TSTR,NPN,SI BCW 32	1
Q703	J707386P1	TSTR,NPN,SI BCW 32	1
Q801	J707387P1	TSTR,PNP,SI BCW 30	1
Q802	J707386P1	TSTR,NPN,SI BCW 32	1
Q803	J707386P1	TSTR,NPN,SI BCW 32	1

Pos.	Code No.	Description	Qt.
Q804	J707387P1	TSTR,PNP,SI BCW 30	1
Q901	J707432P1	TSTR,PNP,SI BCX 18	1
Q902	J707387P1	TSTR,PNP,SI BCW 30	1
Q903	J707429P1	TSTR,NPN,SI BCX 20	1
Q904	J707386P1	TSTR,NPN,SI BCW 32	1
Q905	J707387P1	TSTR,PNP,SI BCW 30	1
Q906	J707386P1	TSTR,NPN,SI BCW 32	1
Q907	J707386P1	TSTR,NPN,SI BCW 32	1
Q908	J707386P1	TSTR,NPN,SI BCW 32	1
Q909	J707674P1	TSTR,PNP,SI BC 558A/B	1
R701	J707385P910	RES,MFLM,1/8W 1R0 , 20%	1
R702	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R703	J707385P471	RES,MFLM,1/8W 470R , 5%	1
R704	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R705	J707385P273	RES,MFLM,1/8W 27K , 5%	1
R706	J707385P470	RES,MFLM,1/8W 47R , 5%	1
R707	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R708	J707385P182	RES,MFLM,1/8W 1K8 , 5%	1
R709	J707385P122	RES,MFLM,1/8W 1K2 , 5%	1
R710	J707385P681	RES,MFLM,1/8W 680R , 5%	1
R711	J707385P391	RES,MFLM,1/8W 390R , 5%	1
R712	J707385P181	RES,MFLM,1/8W 180R , 5%	1
R713	J707385P121	RES,MFLM,1/8W 120R , 5%	1
R714	J707385P680	RES,MFLM,1/8W 68R , 5%	1
R715	J707385P820	RES,MFLM,1/8W 82R , 5%	1
R716	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R717	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R801	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R802	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R803	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R804	J707385P474	RES,MFLM,1/8W 470K , 5%	1
R805	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R806	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R807	J707385P563	RES,MFLM,1/8W 56K , 5%	1
R808	J707385P472	RES,MFLM,1/8W 4K7 , 5%	1
R809	J707385P562	RES,MFLM,1/8W 5K6 , 5%	1

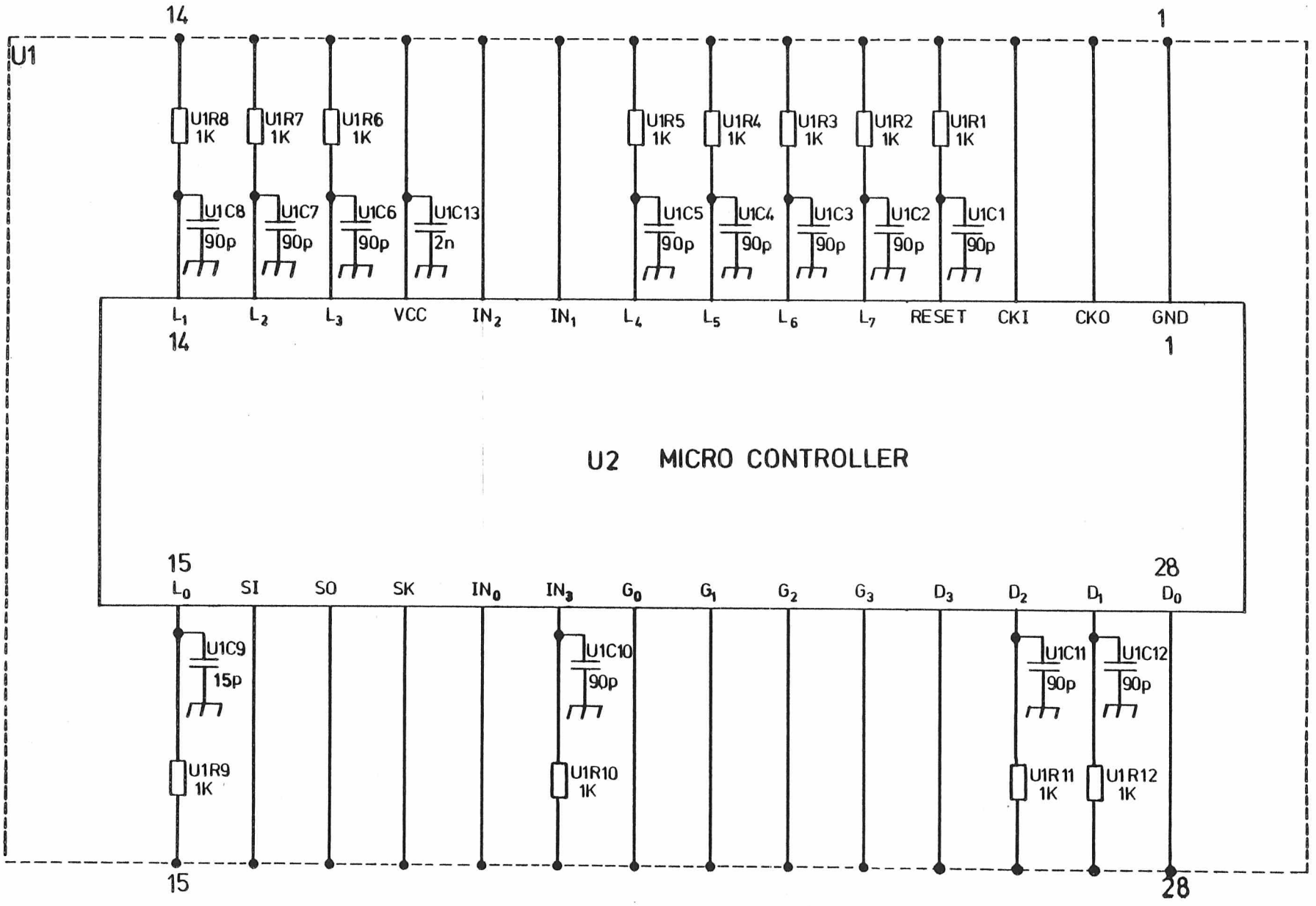
Storno

Pos.	Code No.	Description	Qt.
R810	J707385P392	RES,MFLM,1/8W 3K9 , 5%	1
R811	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R812	J707478P8	RES,VAR,DEPC 4K7 , 25%	1
R813	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R814	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R815	J707385P823	RES,MFLM,1/8W 82K , 5%	1
R816	J707385P124	RES,MFLM,1/8W 120K , 5%	1
R817	J707385P683	RES,MFLM,1/8W 68K , 5%	1
R818	J707476P58	RES,DEPC,0.1W 560K , 10%	1
R819	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R820	J707385P154	RES,MFLM,1/8W 150K , 5%	1
R821	J707478P12	RES,VAR,DEPC 22K , 25%	1
R822	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R824	J707478P6	RES,VAR,DEPC 2K2 , 25%	1
R825	J707385P220	RES,MFLM,1/8W 22R , 5%	1
R901	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R902	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R903	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R904	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R905	J707385P334	RES,MFLM,1/8W 330K , 5%	1
R906	J707476P51	RES,DEPC,0.1W 150K , 5%	1
R907	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R908	J707385P222	RES,MFLM,1/8W 2K2 , 5%	1
R909	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R910	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R911	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R912	J707385P101	RES,MFLM,1/8W 100R , 5%	1
R913	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R914	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R915	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R916	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R917	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R918	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R919	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R920	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R921	J707385P473	RES,MFLM,1/8W 47K , 5%	1

Pos.	Code No.	Description	Qt.
R922	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R923	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R924	J707385P184	RES,MFLM,1/8W 180K , 5%	1
R925	J707385P123	RES,MFLM,1/8W 12K , 5%	1
R926	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R927	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R928	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R929	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R930	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R931	J707385P102	RES,MFLM,1/8W 1KO , 5%	1
R932	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R933	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R934	J707385P223	RES,MFLM,1/8W 22K , 5%	1
R936	J707385P271	RES,MFLM,1/8W 270R , 5%	1
R937	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R938	J707385P224	RES,MFLM,1/8W 220K , 5%	1
R939	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R940	J707385P104	RES,MFLM,1/8W 100K , 5%	1
R941	J707385P103	RES,MFLM,1/8W 10K , 5%	1
R942	J707385P473	RES,MFLM,1/8W 47K , 5%	1
R943	J707385P473	RES,MFLM,1/8W 47K , 5%	1
U701	J707451P1	IC,LIN,AF-AMP 820	1
U702	J707434P1	IC,DIG,MUX 4051	1
U801	J707450P1	IC,LIN,OP-AMP 358	1
U901	J707243P1	IC,DIG,REG 4094	1
U902	J707243P1	IC,DIG,REG 4094	1
U903	J707322P1	IC,DIG,CNTR 4569	1
U904	J707242P2	IC,DIG,FF-D 4013	1
U905	M905852G1	INT CKT ASM	1
U907	J707242P1	IC,DIG,FF-D 4013	1
U908	J707464P1	IC,DIG,GATE 4070	1
U909	J707264P1	IC,DIG,DECO 4543	1
U910	J707264P1	IC,DIG,DECO 4543	1
U911	J707464P1	IC,DIG,GATE 4070	1
U912	J707264P1	IC,DIG,DECO 4543	1
W904	A700134P9	WIRE,MM AWG 0.500 AWG24	1

Storno

Pos.	Code No.	Description	Qt.
X901	J706356P4	SOC,IC,L-PRF 16 CKT	1
0002	M905680P1R4	BD PW	1

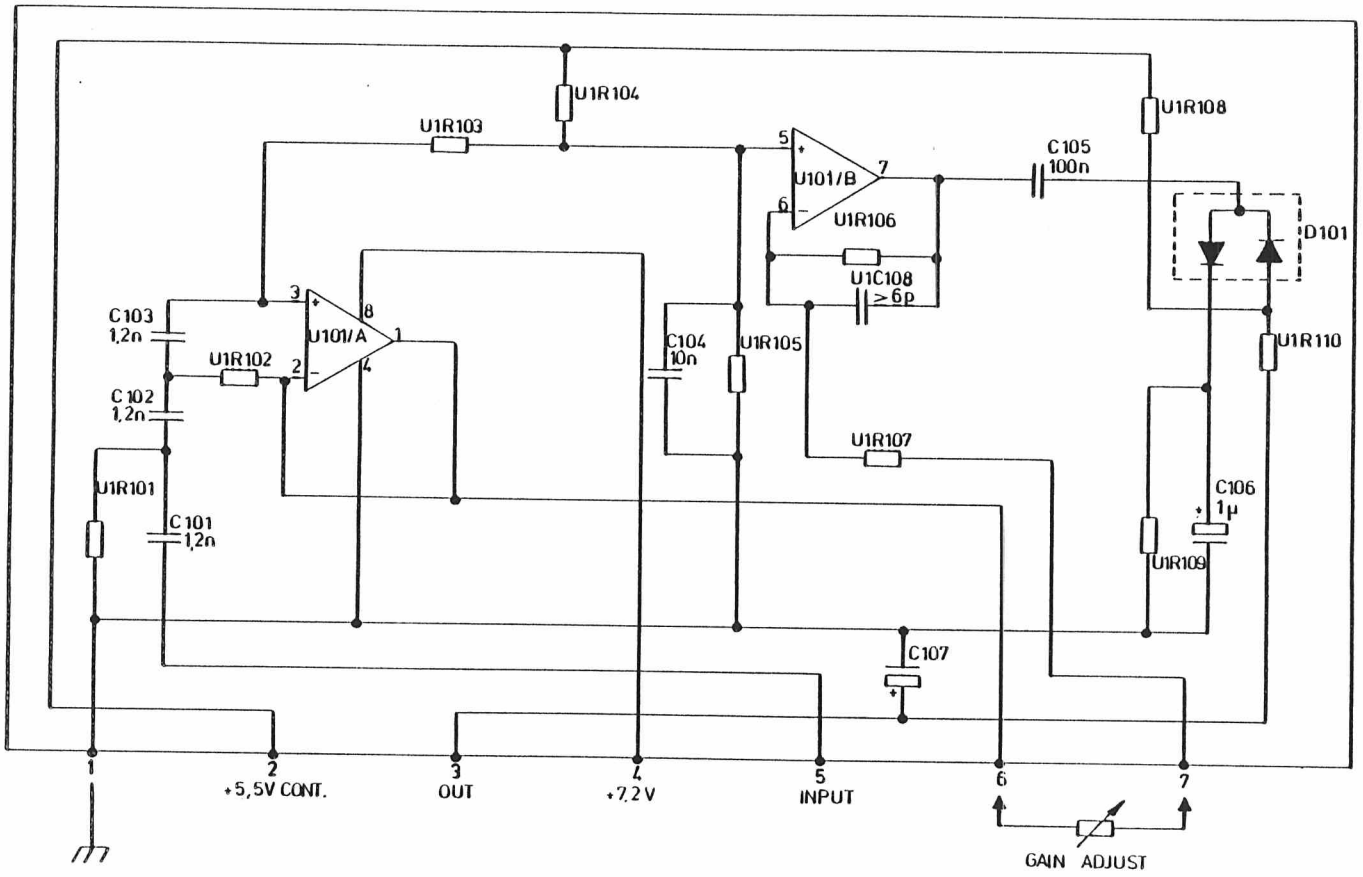


CQP4XXX
INTEGRATED CIRCUIT U905

U905, CODE NO. M905852G1: USED IN CL4002
U905, CODE NO. M905852G2: USED IN CL4001 ONLY IN UHF

D403.758/2

Storno



COMP. NO.	SQ4002 25/20KHz CH. SPAC. VALUE	SQ4003 12,5KHz CH. SPAC. VALUE
R101	8,2K	12K
R102	1.27K	1,8K
R 103	330K	4,70K
R 104	100K	10 0K
R 105	100K	10 0K
R 106	25K	77K
R 107	3K	3K
R 108	82K	82K
R 109	8,2K	8,2K
R 110	1,2K	1,2K
C 107	0,47µ	1 µ

SQUELCH UNIT SQ4002/SQ4003

CODE NO. M905766G1: SQ4002

CODE NO. M905766G2: SQ4003

D404.585

CHAPTER
CHAPITRE
KAPITEL

5

Storno

MISCELLANEOUS

ANTENNAS

WHIP ANTENNA AN661

This antenna is for the frequency band 400-470 MHz

RUBBER ANTENNA AN4xx2

The AN4112 is a wide band conductive rubber antenna.
The AN4332 is a rubber antenna existing in two versions: AN4332: (low band) for 68-76 MHz and AN4332-H (high band) for 75-88 MHz.

PREADJUSTED, RESONANT HELECAL ANTENNA AN4xx3

This antenna exists in five versions, A to E, fitted for five sub-bands in the 146 to 174 MHz frequency band.
The adjustment to the sub-band is done by cutting the length.

SUB-BAND DESIGNATION	RANGE
A	145-155 MHz
B	150-160 MHz
C	155-165 MHz
D	160-170 MHz
E	165-175 MHz

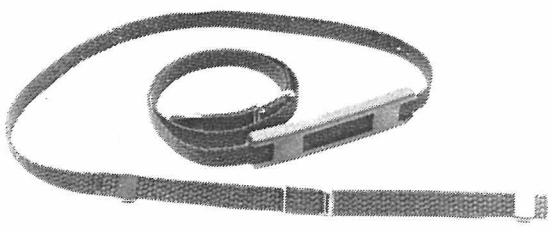
OTHER ACCESSORIES

CARRYING STRAP CK4003

The carrying strap is delivered as a kit containing:

1. Strap (leather)
2. Buckles
3. Clamps
5. Shoulder protector

It is possible to cut the strap to any length and therefore to use it as a wrist-strap.



CARRYING CASES CK4012 AND CK4013

The two carrying cases are in black leather. CK4012 is used with BU4003 and CK4013 is used with BU4004. The display and the keypad are accessible through a transparent window in the case as well as there are four rows of holes for the loudspeaker. A separate flap allows the battery to be changed without removing the radio from the case.
The carrying cases may be used together with the carrying strap.

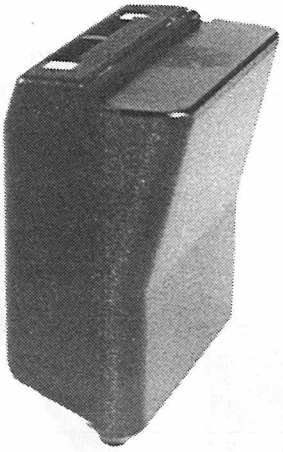
CK4013 (shown here)

DISPLAY AND KEYPAD COVER

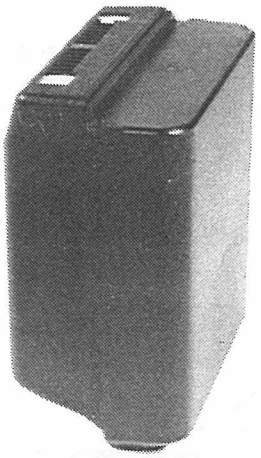
A plastic cover to protect the display and keypad from being scratched by tools, etc. is available.

BU4003/BU4004

BATTERY UNIT



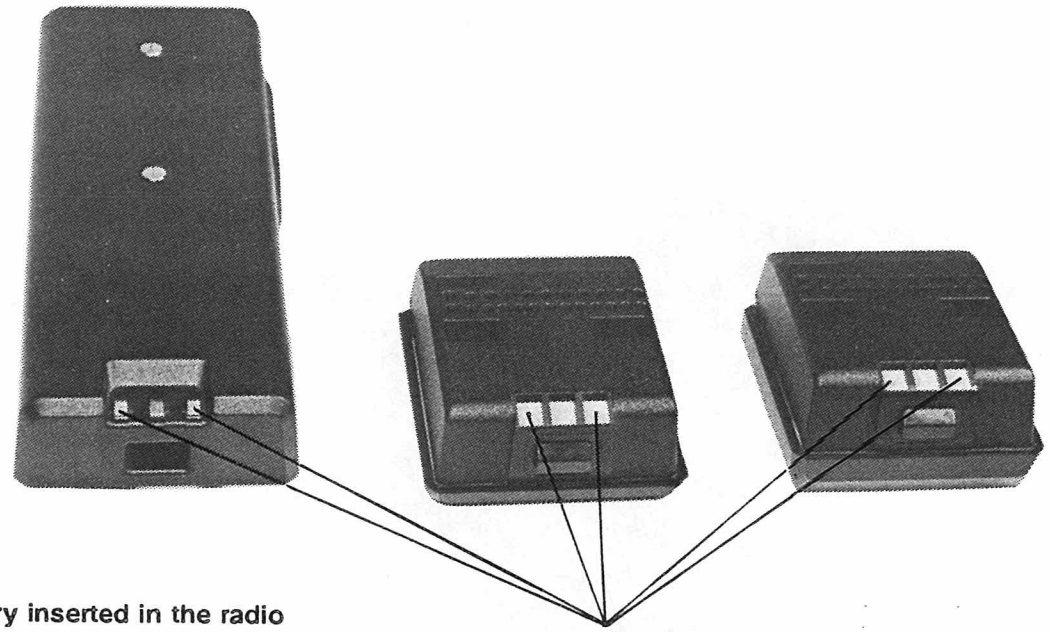
BU4003 : 450 mAh



BU4004 : 750 mAh

The battery unit consists of 6 pcs. 2/3 AF NiCd-cells connected in series.

The battery pack has two sets of terminals, one set for supplying the radio and a set for charging. This to enable the unit to be charged separately or when installed in the radio.



Battery inserted in the radio

Charging terminals

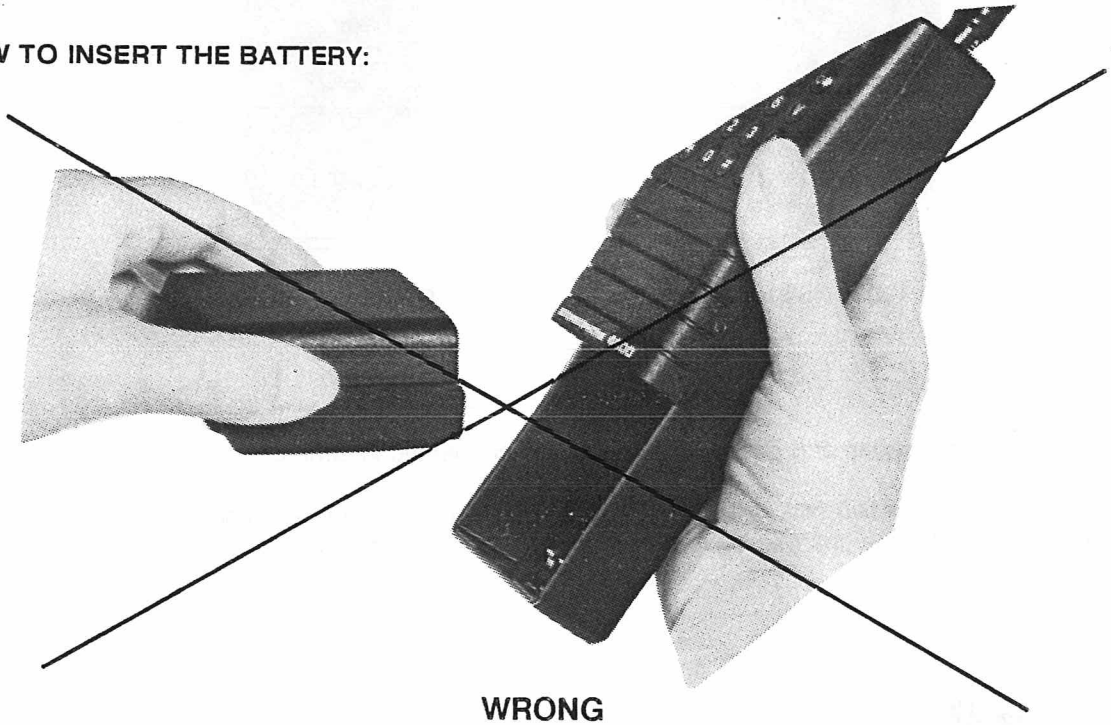
Because of the big area of the charging terminals, a diode is connected between the positive terminal and the battery in order to avoid short circuit hazard when handling the battery. Furthermore, because the battery shall supply the charging unit in case of mains drop out, a 470 Ohm resistor is coupled parallel to the diode.

The third terminal (the one in the middle) at the charging inlet is for another version of the battery. A coil is included in the battery to meet UHF-absorption problems.

A coil included in the battery to meet UHF-absorption problems.

Notice:
A new battery may not be at full capacity until it has been charged/discharged 3 to 4 times.
If a battery is not going to be used for a period of time, discharge it, and remove it from the radio.
When using it again, follow the procedure for new batteries.

HOW TO INSERT THE BATTERY:



WRONG

BATTERY OPERATING TIME

Below you will find typical operating times at 20°C.
Note that a lower temperatures, the operating time will be shorter.

STANDARD MK II VERSION:

DUTY CYCLE %				VHF-TYPES				UHF-TYPES			
				450 mAh		750 mAh		450 mAh		750 mAh	
TRANSMIT	RECEIVE	STANDBY	TIME	1 W	2 W	1 W	2 W	1 W	2 W	1 W	2 W
2	5	93	HRS	8	7	14	12	8	7	13	12
5	5	90	HRS	6	5	10	8	6	5	9	8
5	10	85	HRS	6	5	10	8	5	4	9	7
10	5	85	HRS	4	3	7	5	4	3	6	5
10	10	80	HRS	4	3	7	5	4	3	6	5

AUTOMATIC MK II VERSION:

DUTY CYCLE %				VHF-TYPES				UHF-TYPES			
				450 mAh		750 mAh		450 mAh		750 mAh	
TRANSMIT	RECEIVE	STANDBY	TIME	1 W	2 W	1 W	2 W	1 W	2 W	1 W	2 W
2	5	93	HRS	8	7	14	12	8	7	13	12
5	5	90	HRS	6	5	10	8	6	5	9	8
5	10	85	HRS	6	5	10	8	5	4	9	7
10	5	85	HRS	4	3	7	5	4	3	6	5
10	10	80	HRS	4	3	7	5	4	3	6	5

The normal self-discharge of a battery is approx. 1 pct. of the battery capacity per day. This value is increased to approx. 4 to 5 pct. when the battery is mounted in a switched-off radio.

SPECIFICATION

BU4003

Capacity
450 mAh nominal at 25°C

Voltage
7.2 V nominal at 25°C

Charging current
Max. 150 mA.

Charging temperature
10°C - 45°C

Discharge temperature
-25°C - + 60°C

Storage temperature
-40°C - + 60°C

Internal resistance at 25°C
DC resistance: 0.4 Ohm max.
AC resistance: 0.3 Ohm max.

Mechanical dimensions
Length: 71.5 mm Width: 72.5 mm Height: 28 mm Weight: 150 g.

BU4004

Capacity
750 mAh nominal at 25°C

Voltage
7.2 V nominal at 25°C

Charging current
Max. 250 mA.

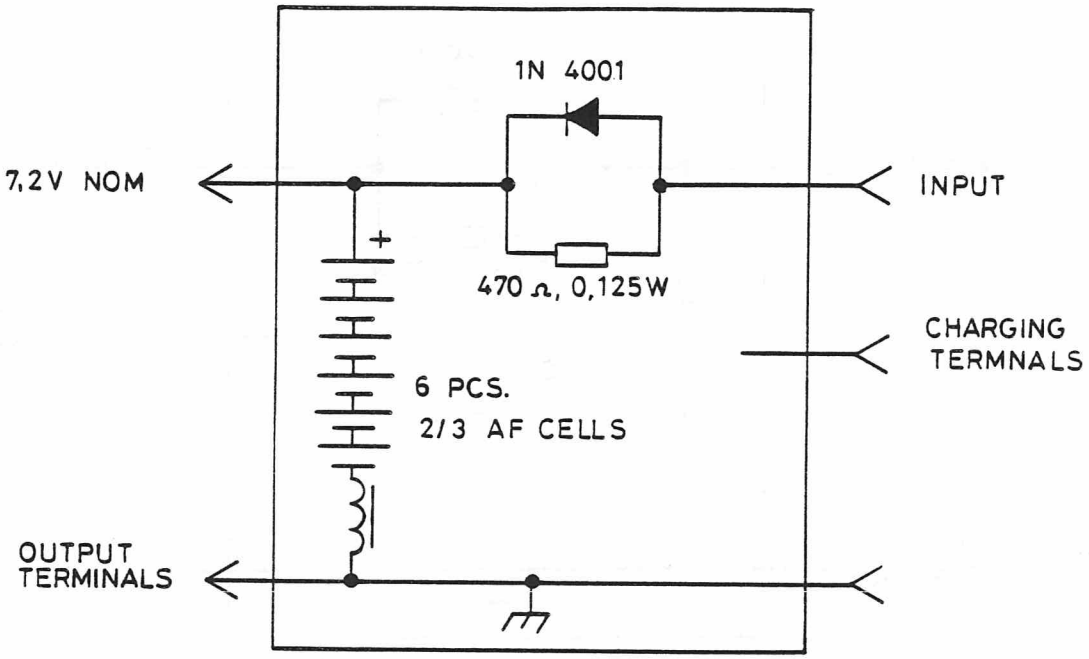
Charging temperature
10°C -45°C

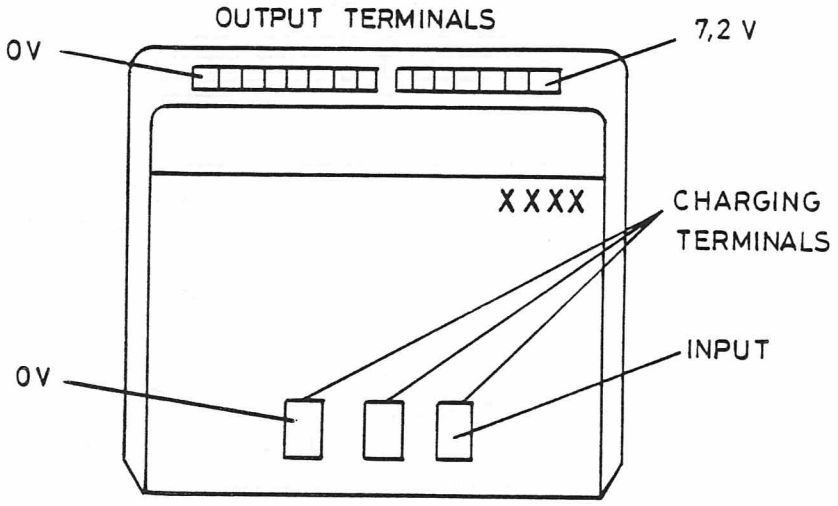
Discharge temperature
-25°C - + 60°C

Storage temperature
-40°C - + 60°C

Internal resistance at 25°C
DC resistance: 0.225 Ohm max.
AC resistance: 0.17 Ohm max.

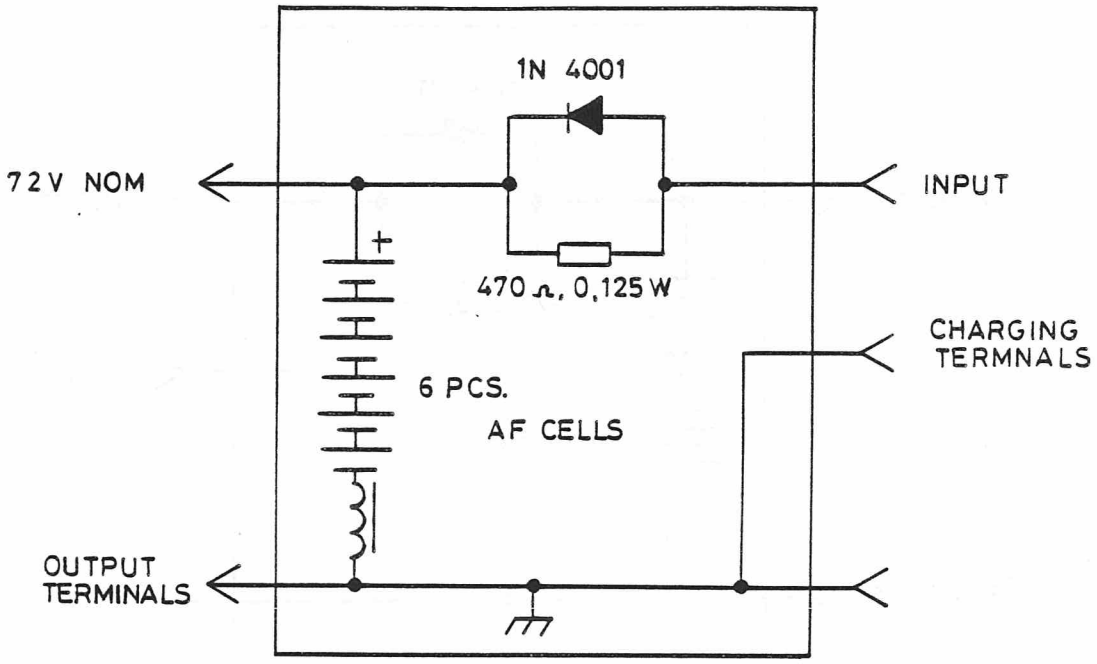
Mechanical dimensions
Length: 71.5 mm Width: 72.5 mm Height: 36 mm Weight: 250 g.

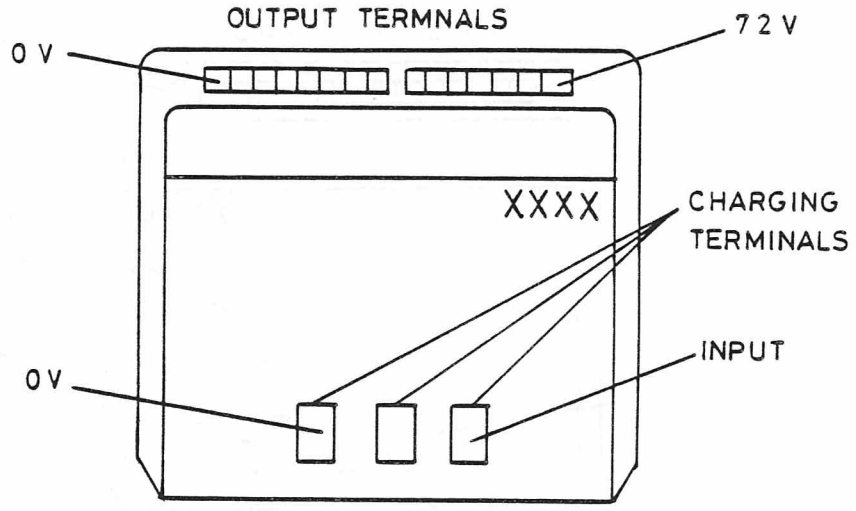




BATTERY UNIT BU 4003

CODE NO. L856034G1 D404.670





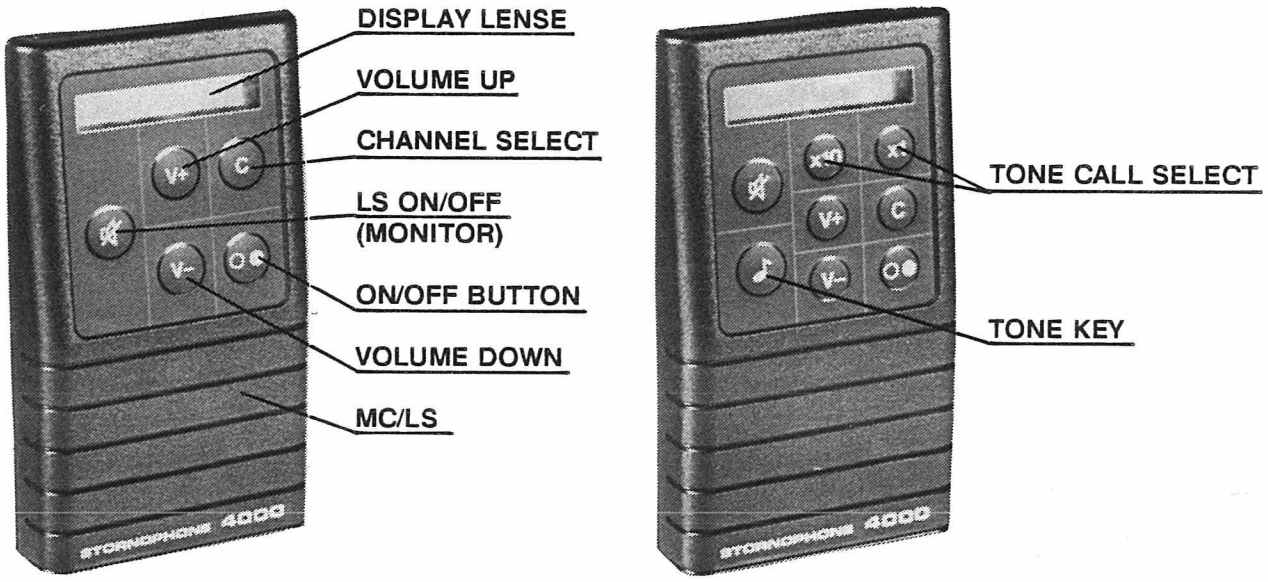
BATTERY UNIT BU 4004

CODE NO. L856035G1 D404.671

CP4003

CONTROL PANEL

The CP4003 is a control panel designed for CQP4000 MK II, 2 or 10 channels versions (with CL4001). CP4003 includes the front part of the cabinet assembled with a 5 (2 ch.) or 8 (10 ch.) button laminated keypad, display- lense, loudspeaker and microphone. Electrical connections are made by two flexible tails.



for Mechanical Parts see the general Mechanical Parts List MPL405.346.

SPECIFICATION

Keyboard
4 x 2 Matrix contact resistance (1 separate) $\leq$100 Ohm

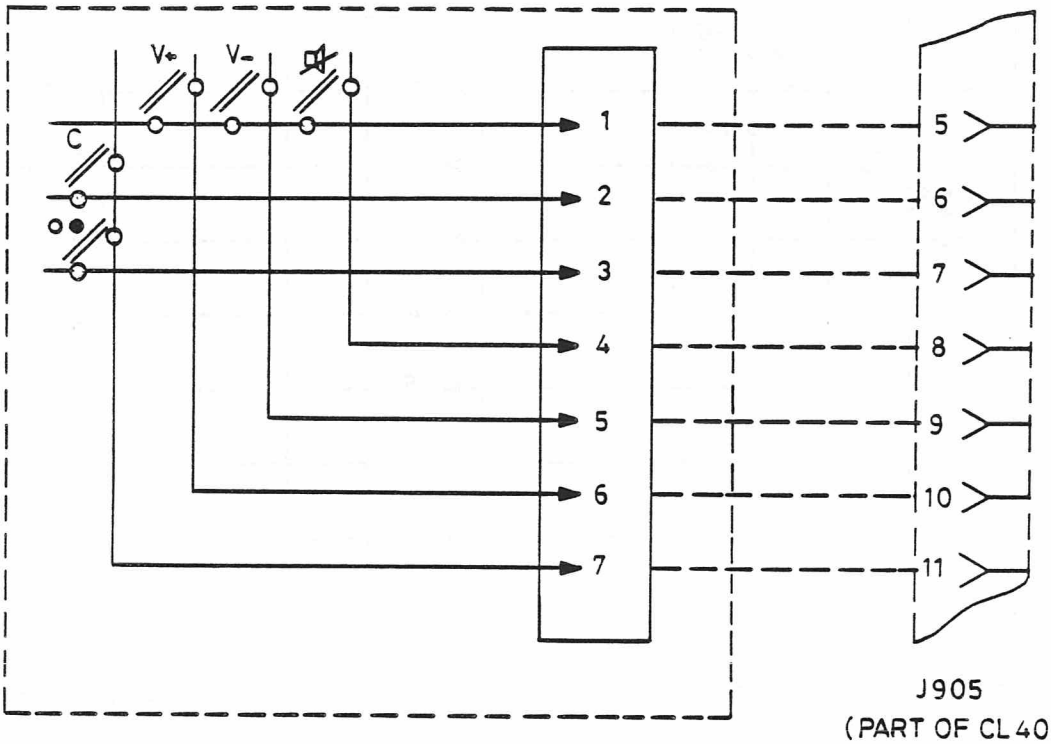
Loudspeaker
Impedance: 8 Ohm nom.
Power: 500 mW
Microphone: (Electret type)

Load impedance
2 kOhm nom. (connected to max. 10 V DC)

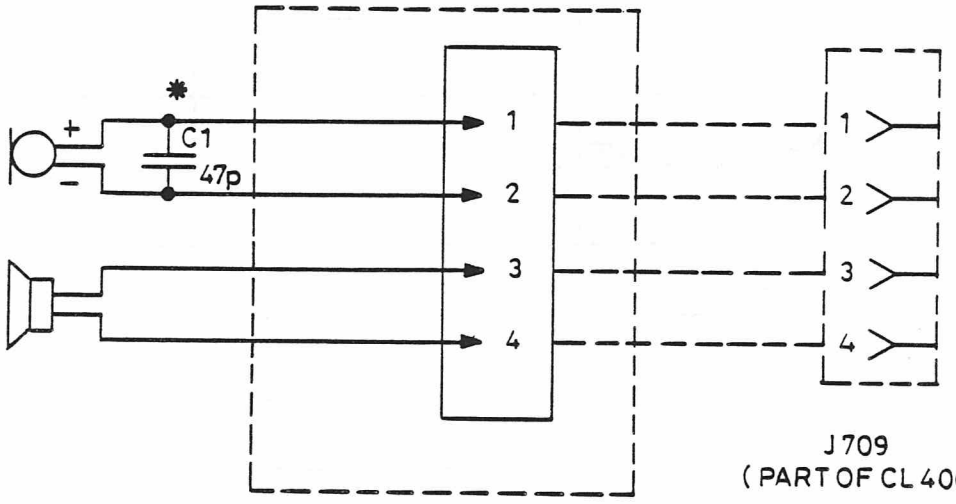
Output voltage
5 mV RMS nom.

Temperature range
Operating -25^{o}C to 60^{o}C
Storage -40^{o}C to 70^{o}C
Other environmental spec. ref. to complete equipment spec. for CQP4000.

Mechanical dimensions
L x W x H: 125.5 x 72 x 25 mm
Weight: 105 g.



J905
(PART OF CL4001)

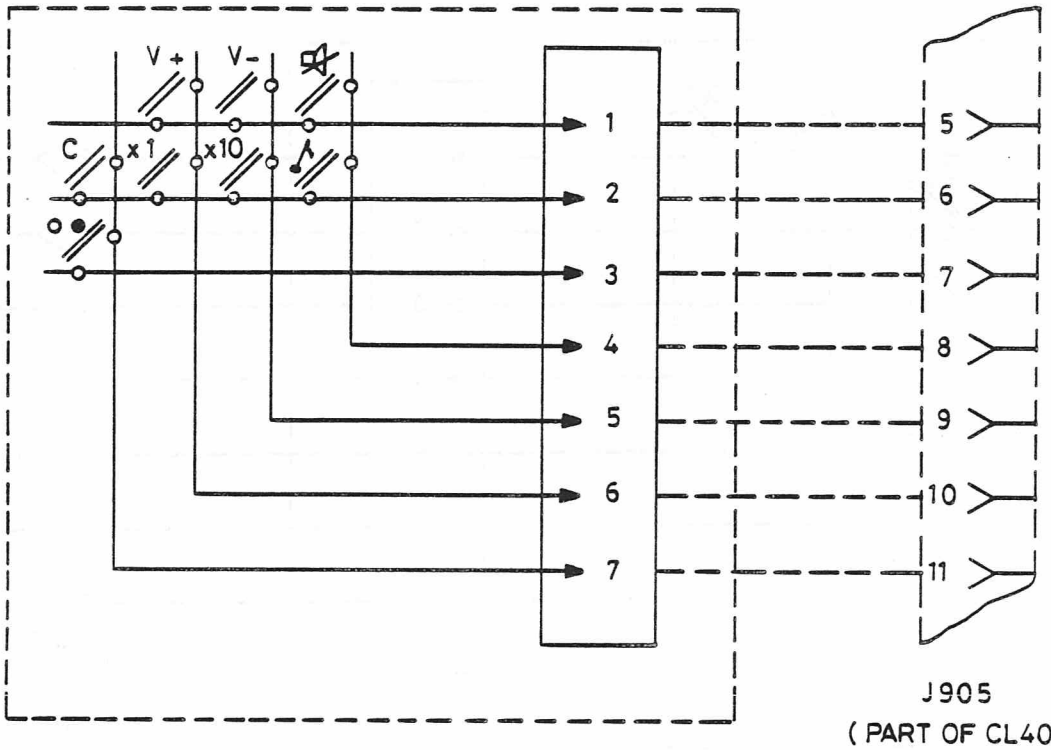


J709
(PART OF CL4001)

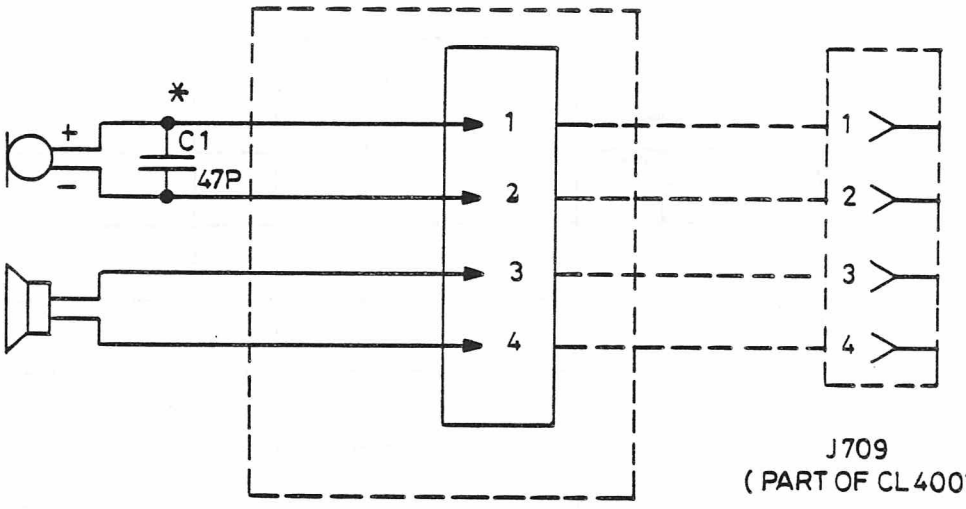
* C1 A700007P45 CAP, CER, NP0 47P, 5%

CONTROL PANEL CP4003
5-KEY

CODE NO. L856029G1 | D404.666



J905
(PART OF CL4001)



J709
(PART OF CL4001)

* C1 A700007P45 CAP, CER, NP0 47P, 5%

CONTROL PANEL CP4003
8-KEY

CODE NO. L856029G2 D404. 667

CU4001/CU4002

BATTERY CHARGERS

Both the 2 and 6 outlet chargers are mains operated. They are designed for automatic charging of NiCd batteries (450 mAh and 750 mAh).
Each outlet will accept a complete radio with battery or a battery alone.
The chargers are available in a standard version and UK version with a special mains plug containing fuses.

The chargers are fully automatic, and the charging time is approximately:

450 mAh battery 5 hours
750 mAh battery 9 hours

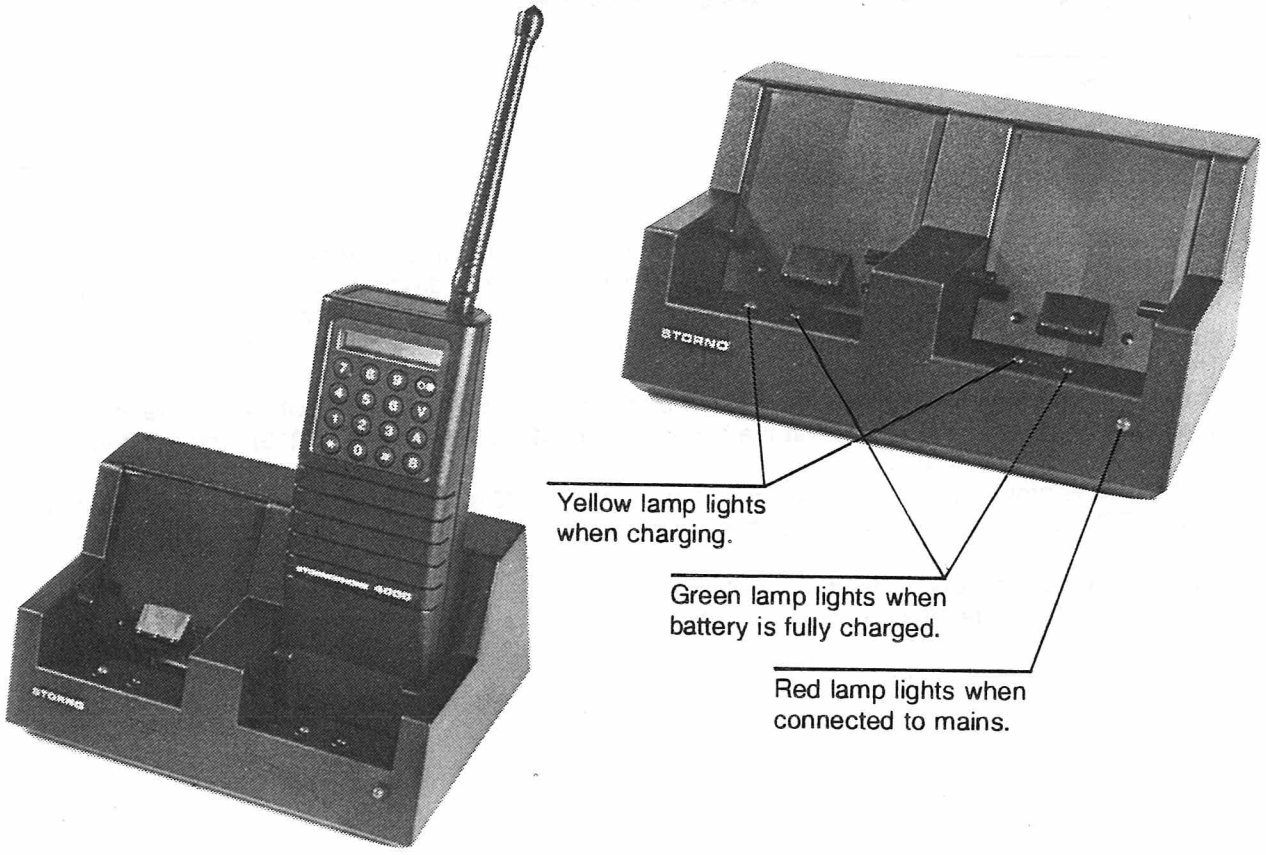
A red light emitting diode placed in the cabinet front indicates that the charging unit is connected to mains power supply.

The charging current is 120 mA. After nominal charging time (5 or 9 hours) the charger automatically switches to trickle charge with a charging current of 38 mA, thereby avoiding an overload condition that could damage the battery.

The battery contains a coding terminal, which automatically programs the charger for the right charging time so that the charger need not be adjusted to charge the two different battery types.
CU4001 is designed with two outlets, each provided with two LED-indicators.

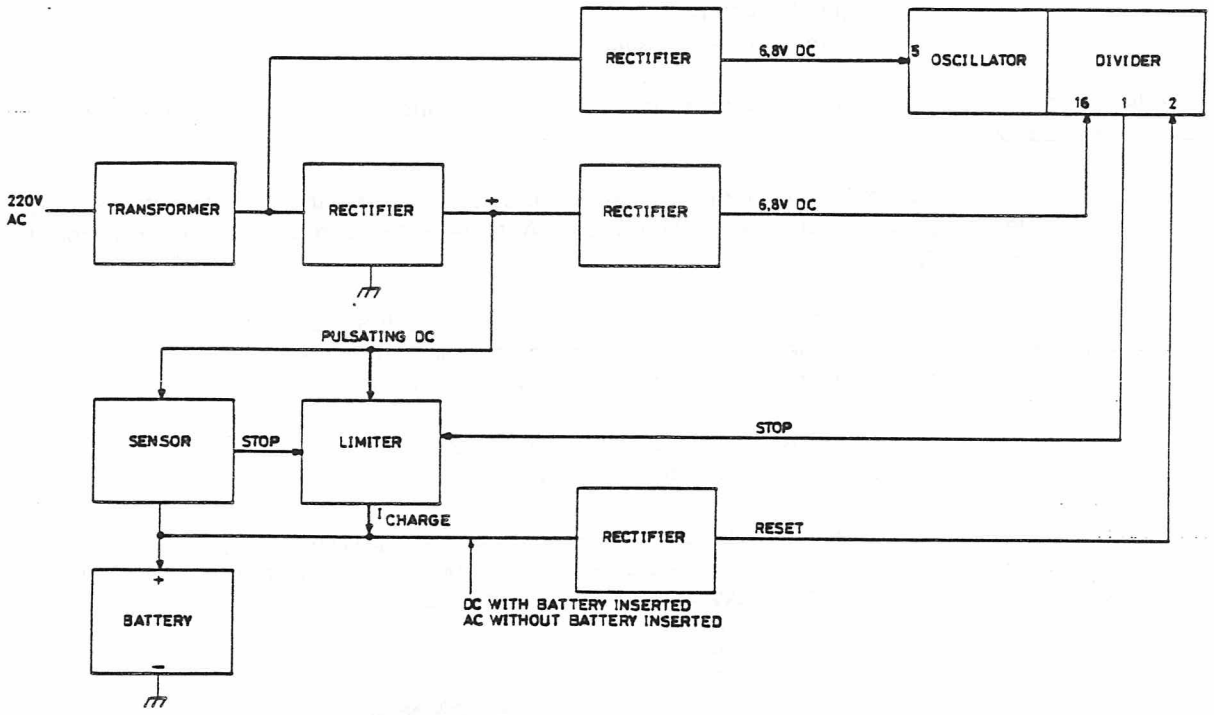
- Yellow LED - charging in progress
- Green LED - charging completed

CU4002 is a position units consisting of the same basic parts as the 2 position charger CU4001.
3 component boards with mains transformer and 3 cabinets are placed side by side on one common bottom plate. The boards are therefore functionally identical to the 2 position charger.



CIRCUIT DESCRIPTION

The charger comprises identical circuits, one for each outlets.
The charging current is a rectified alternating current (100/120 Hz). The output AC voltage from the mains transformer is rectified and fed to the battery through a current limiting circuitry consisting of a zener diode (D201-D301) and a power transistor (Q201-Q301) providing a constant peak voltage drop across two series coupled resistors (R203/211-204, R303/311-304). R204/304 is short circuited during the predetermined periode of quick charging. R203/211, R303/311 thereby determine the quick charge rate. The standby charge rate is determined by the series combination of the three resistors.



BLOCK DIAGRAM CU4001/CU4002
D403.314/2

The timing circuit U201-U301, consists of a clock pulse oscillator and a divider for each outlet. The oscillator is only supplied from the mains transformer (Pin 5). The divider is supplied from the mains transformer and from the inserted battery (Pin 16), in order to maintain information of the elapsed quich charge time and to stop oscillation in case of mains drop-out.
The output voltage is limited to 11.5 V peak.
The proper functioning of the timer is ensured by a resetting circuitry sensing whether there is an alternating voltage or a DC voltage at the battery outlet (Q203, D206, R212, R213). The reset input of the frequency divider is at pin 2.
Each outlet is provided with a yellow LED-indicator (H201-H301) to show charging is in process and a green LED (H202-H302) to show that battery is ready after the predetermined quick charging time.

When a 750 mAh battery is inserted into the charger an extra contact strip in the battery connects a capacitor (C202) in the charger to ground whereby the oscillator frequency is lowered to prolong the charging time.
The charger is short-circuit protected.

OPERATING PROCEDURES

Plug into a mains uotlet which is ensured against being switched off. If a battery remains inserted in a switched-off charger for an extended period of time, e.g. a week-end, the battery will be discharged.
When the charger has been plugged in, a red lamp lights up.
Insert the battery in the charger. When it is correctly inserted, the yellow lamp will light up - indicating that the charging process has started.
When the charging period is completed, the green lamp will light up. The battery is now charged and ready for use. The battery can safely be left in the charger for as long as you wish. Trickle charging does not harm it.

TECHNICAL SPECIFICATIONS

NOTE:
All charge currents are mean values.

Supply voltage
220/240 V AC, + 10%, -15% 50/60 Hz. Mains transformer primary is strapped to either 220 V or 240 V nom.

Input current
Max. 45 mA

Input power
Max. 11 W

Temperature range
10^{o}C to 35^{o}C

IMPORTANT
Do not charge batteries at temperatures below 10^{o}C or above 35^{o}. Therefore, avoid placing the charger in direct sunlight or near heat sources.
Allow batteries to obtain room temperature before charging if the battery temperature is outside the range of 10^{o}C to 35^{o}C.

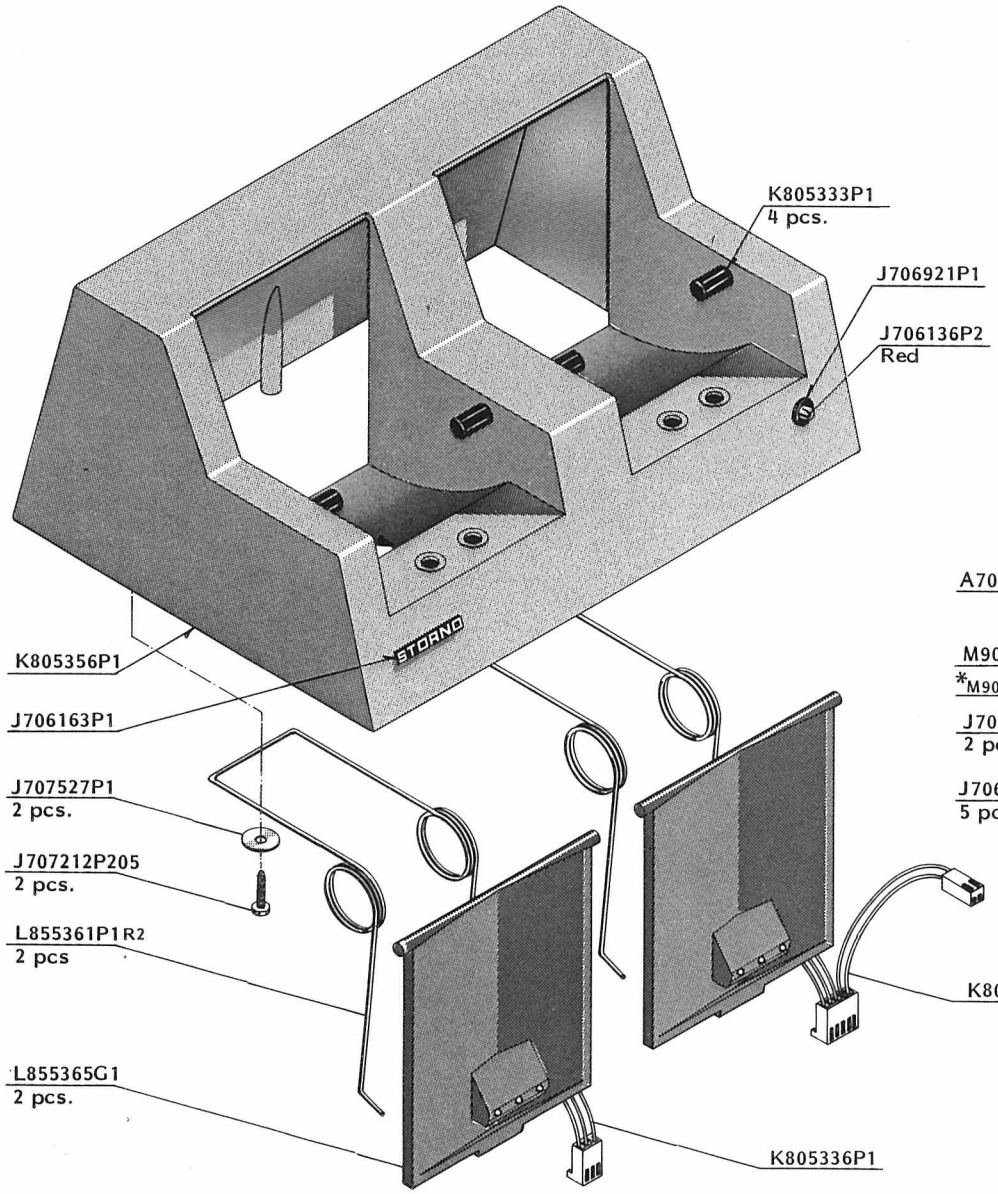
Output voltage
$U_{max.}$ = 11.5 V peak

Quick charge current at 220 V
mininum: 105 mA, typical: 120 mA, maximum: 135 mA

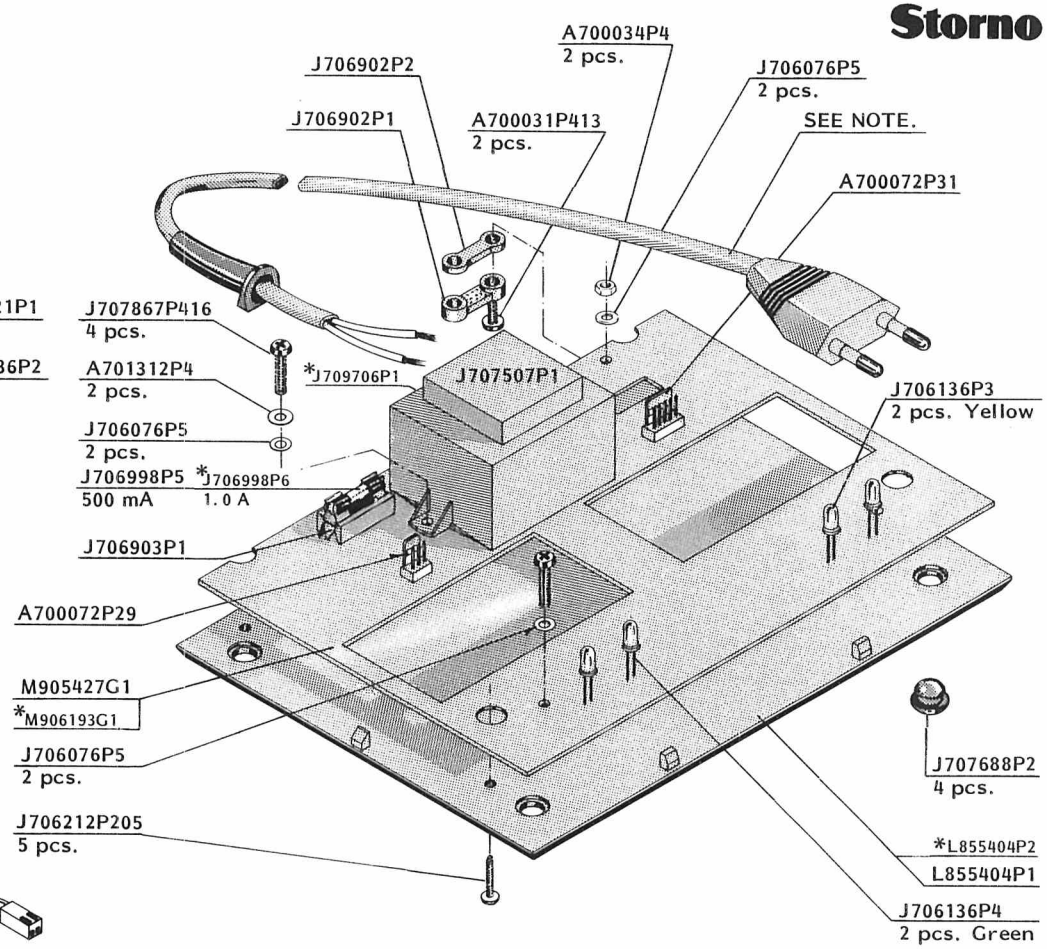
Standby charge rate at 220 V
mininum: 34 mA, typical: 38 mA, maximum: 42 mA

Short-circuit
maximum 80 mA (mean value)

Storno



Storno



Note:
Wire with plug(220V) J707524G1
Wire without plug(240V) K805337G1
Plug for 240V. J706978P1

*Items to be used only with CU4001-7696

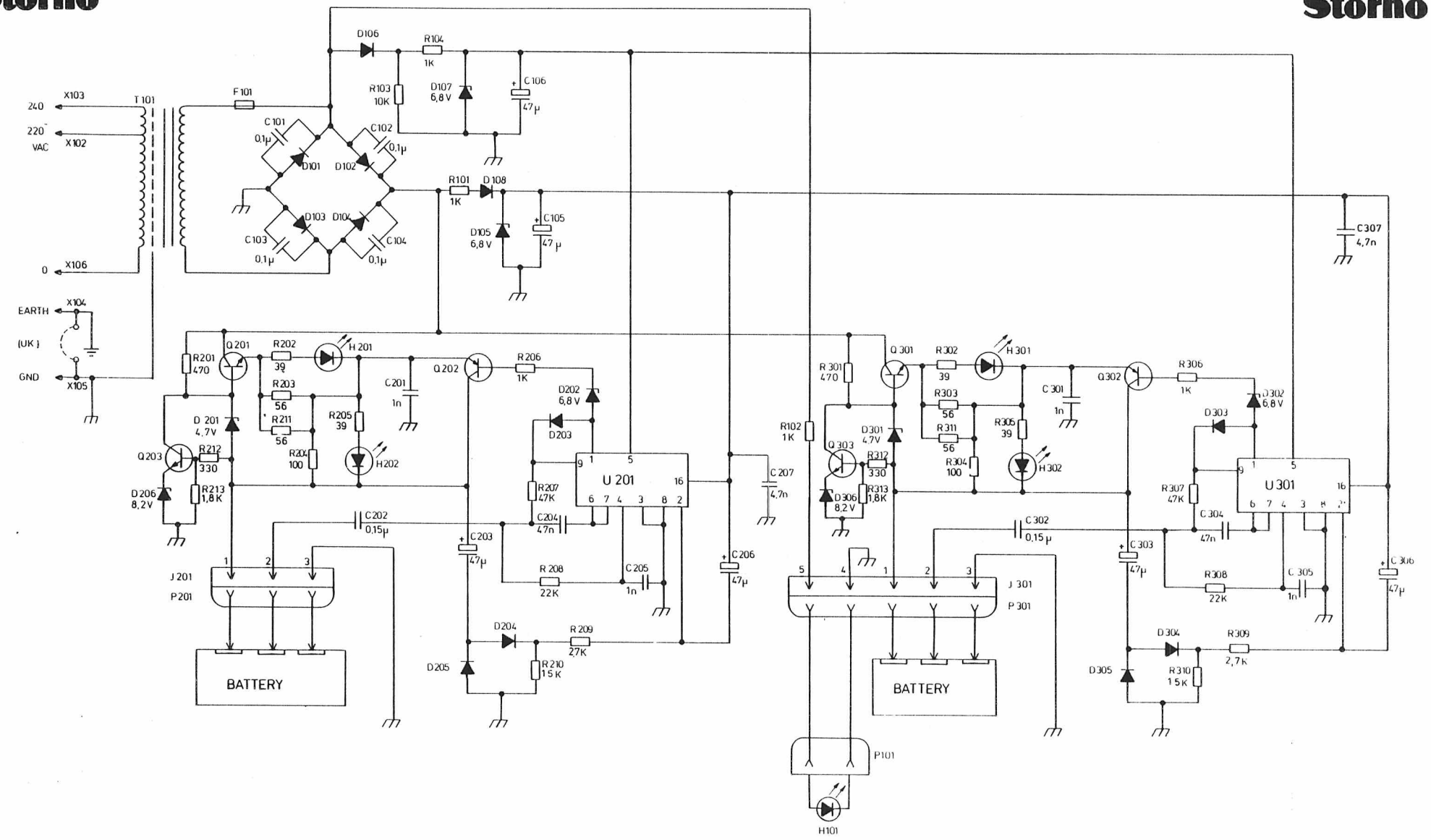
MECHANICAL LAYOUT & PART NUMBERS
SCHEMA MECANIQUE & NUMEROS DE PIECES
MECHANISCHE ZEICHNUNG & TEILENUMMERN

CU4001 (220V) Code No.M905550G1
CU4001 (240V) Code No.M905550G2
CU4001-7696 Code No.M905550G4

M405.161/3

Storno

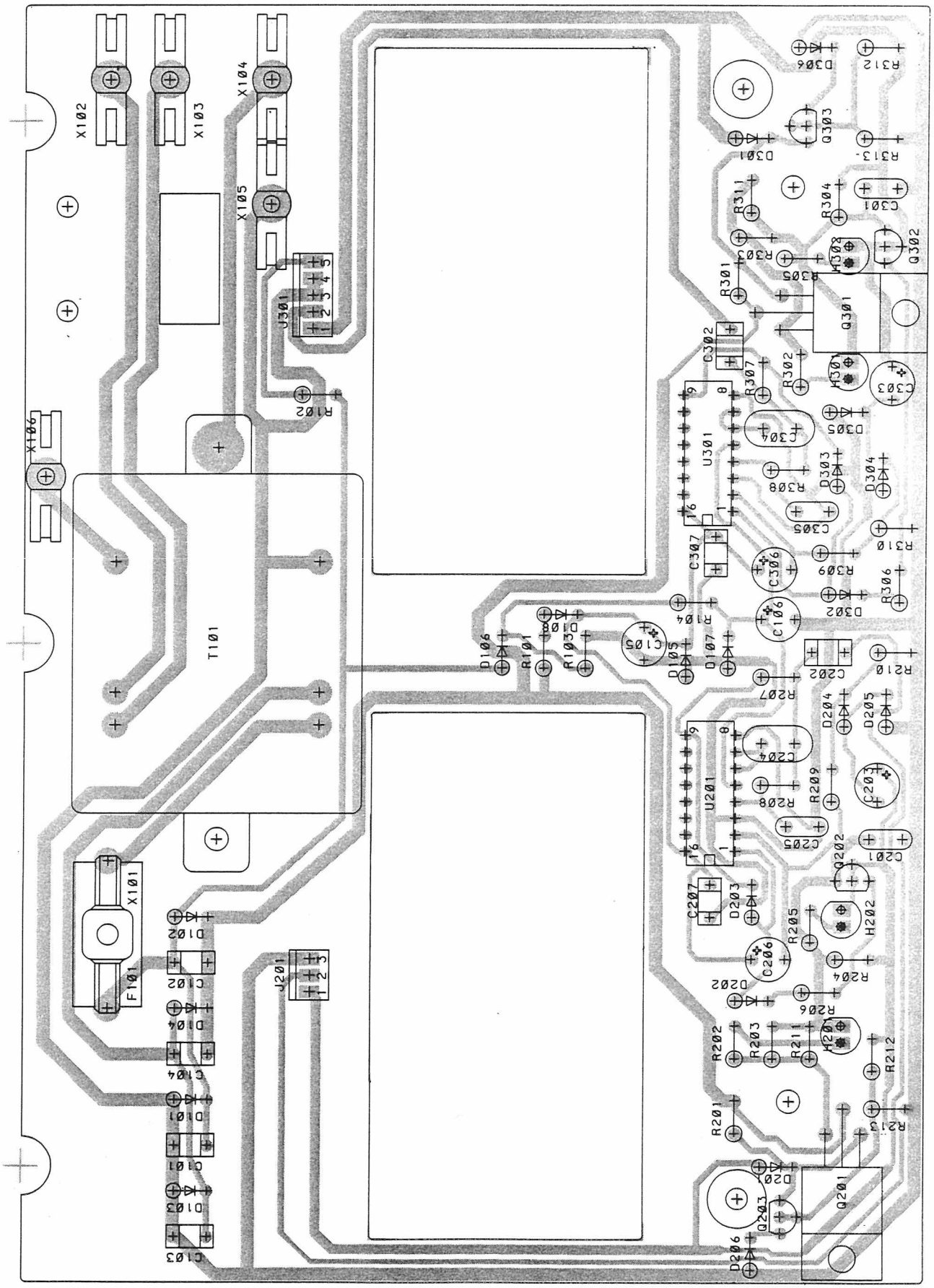
Storno



CHARGING UNIT CU4001

D 403.293

Storno



CHARGING UNIT CU4001
COMPONENT LAYOUT

D403.310

DATE: 3/26/1987

Pos	Code No	Description	Qt
C101	J707412P9	CAP PYES 100N 10%	1
C102	J707412P9	CAP PYES 100N 10%	1
C103	J707412P9	CAP PYES 100N 10%	1
C104	J707412P9	CAP PYES 100N 10%	1
C105	J707353P9	CAP ELECT 47U 16V	1
C106	J707353P9	CAP ELECT 47U 16V	1
C201	J707412P9	CAP PYES 100N 10%	1
C202	J707412P10	CAP PYES 150N 10%	1
C203	J707353P4	CAP ELECT 1U0 50V	1
C204	A702059P11	CAP PYES 47N 5%	1
C205	A700233P7	CAP CER CL2 1N 20%	1
C206	J707353P4	CAP ELECT 1U0 50V	1
C207	J707412P1	CAP PYES 4N7 10%	1
C301	J707412P9	CAP PYES 100N 10%	1
C302	J707412P10	CAP PYES 150N 10%	1
C303	J707353P4	CAP ELECT 1U0 50V	1
C304	A702059P11	CAP PYES 47N 5%	1
C305	A700233P7	CAP CER CL2 1N 20%	1
C306	J707353P4	CAP ELECT 1U0 50V	1
C307	J707412P1	CAP PYES 4N7 10%	1
D101	J706100P1	DIO SI SIG 1N4001	1
D102	J706100P1	DIO SI SIG 1N4001	1
D103	J706100P1	DIO SI SIG 1N4001	1
D104	J706100P1	DIO SI SIG 1N4001	1
D105	J707514P4	DIO SI ZENR 6V8 5% 0.4W	1
D106	J707513P1	DIO SI SIG 1N4148	1
D107	J707514P4	DIO SI ZENR 6V8 5% 0.4W	1
D108	J707513P1	DIO SI SIG 1N4148	1
D201	J707514P1	DIO SI ZENR 4V7 5% 0.4W	1
D202	J707514P4	DIO SI ZENR 6V8 5% 0.4W	1
D203	J707513P1	DIO SI SIG 1N4148	1
D204	J707513P1	DIO SI SIG 1N4148	1
D205	J707513P1	DIO SI SIG 1N4148	1
D206	J707514P5	DIO SI ZENR 8V2 5% 0.4W	1
D301	J707514P1	DIO SI ZENR 4V7 5% 0.4W	1
D302	J707514P4	DIO SI ZENR 6V8 5% 0.4W	1
D303	J707513P1	DIO SI SIG 1N4148	1

Pos	Code No	Description	Qt
D304	J707513P1	DIO SI SIG 1N4148	1
D305	J707513P1	DIO SI SIG 1N4148	1
D306	J707514P5	DIO SI ZENR 8V2 5% 0.4W	1
F101	J706998P5	FUSE CTG 0.500A T	1
H201	J706136P3	DIO OPTO YW CQV23-6	1
H202	J706136P4	DIO OPTO GN CQV25-6	1
H301	J706136P3	DIO OPTO YW CQV23-6	1
H302	J706136P4	DIO OPTO GN CQV25-6	1
J201	A700072P29	CONN PWB MALE03-CKT	1
J301	A700072P31	CONN PWB MALE05-CKT	1
Q201	A700054P1	TSTR NPN SI BD 201	1
Q202	J707435P1	TSTR PNP SI BC 369	1
Q203	J707511P1	TSTR NPN SI BC 548A/B	1
Q301	A700054P1	TSTR NPN SI BD 201	1
Q302	J707435P1	TSTR PNP SI BC 369	1
Q303	J707511P1	TSTR NPN SI BC 548A/B	1
R101	A702110P37	RES DEPC 1/4W 1K0 5%	1
R102	A702110P37	RES DEPC 1/4W 1K0 5%	1
R103	A702110P49	RES DEPC 1/4W 10K 5%	1
R104	A702110P37	RES DEPC 1/4W 1K0 5%	1
R201	A702110P33	RES DEPC 1/4W 470R 5%	1
R202	A702110P20	RES DEPC 1/4W 39R 5%	1
R203	A702110P21	RES DEPC 1/4W 47R 5%	1
R204	A702110P25	RES DEPC 1/4W 100R 5%	1
R205	A702110P20	RES DEPC 1/4W 39R 5%	1
R206	A702110P37	RES DEPC 1/4W 1K0 5%	1
R207	A702110P57	RES DEPC 1/4W 47K 5%	1
R208	A702110P53	RES DEPC 1/4W 22K 5%	1
R209	A702110P42	RES DEPC 1/4W 2K7 5%	1
R210	A702110P61	RES DEPC 1/4W 100K 5%	1
R211	A702110P21	RES DEPC 1/4W 47R 5%	1
R212	A702110P31	RES DEPC 1/4W 330R 5%	1
R213	A702110P40	RES DEPC 1/4W 1K8 5%	1
R301	A702110P33	RES DEPC 1/4W 470R 5%	1
R302	A702110P20	RES DEPC 1/4W 39R 5%	1
R303	A702110P21	RES DEPC 1/4W 47R 5%	1
R304	A702110P25	RES DEPC 1/4W 100R 5%	1

DATE: 3/26/1987

Pos	Code No	Description	Qt
R305	A702110P20	RES DEPC 1/4W 39R 5%	1
R306	A702110P37	RES DEPC 1/4W 1KO 5%	1
R307	A702110P57	RES DEPC 1/4W 47K 5%	1
R308	A702110P53	RES DEPC 1/4W 22K 5%	1
R309	A702110P42	RES DEPC 1/4W 2K7 5%	1
R310	A702110P61	RES DEPC 1/4W 100K 5%	1
R311	A702110P21	RES DEPC 1/4W 47R 5%	1
R312	A702110P31	RES DEPC 1/4W 330R 5%	1
R313	A702110P40	RES DEPC 1/4W 1K8 5%	1
T101	J707507P1	TRANSFORMER MAINS 6VA	1
U201	A700029P214	IC DIG CNTR 4521	1
U301	A700029P214	IC DIG CNTR 4521	1
X101	J706903P1	FUSE HOLDER 5.0X20.0MM	1
X102	J706904P1	TERM SLD TAB 2X10MM	1
X103	J706904P1	TERM SLD TAB 2X10MM	1
X104	J706904P1	TERM SLD TAB 2X10MM	1
X105	J706904P1	TERM SLD TAB 2X10MM	1
X106	J706904P1	TERM SLD TAB 2X10MM	1
	M905428P1R2	BD PW	1

Pos	Code No	Description	Qt

SE4005

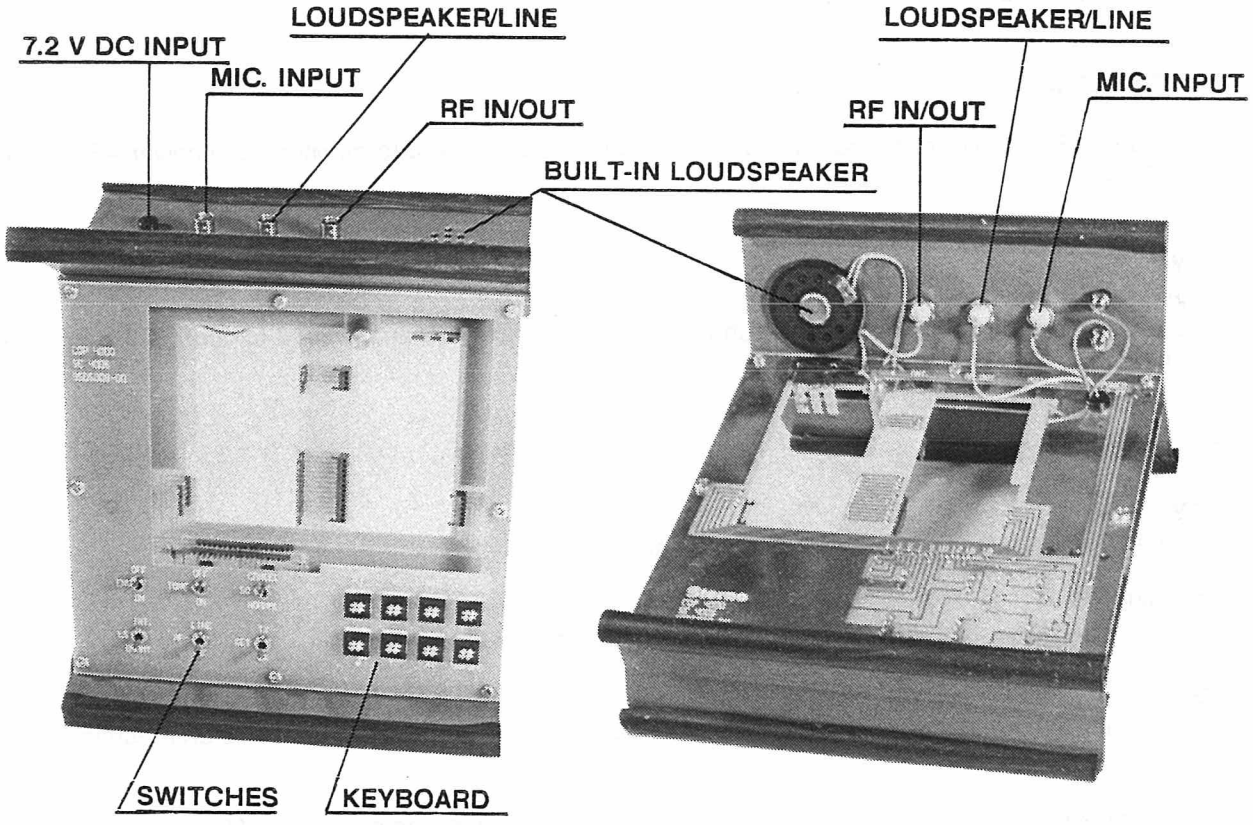
SERVICE EQUIPMENT

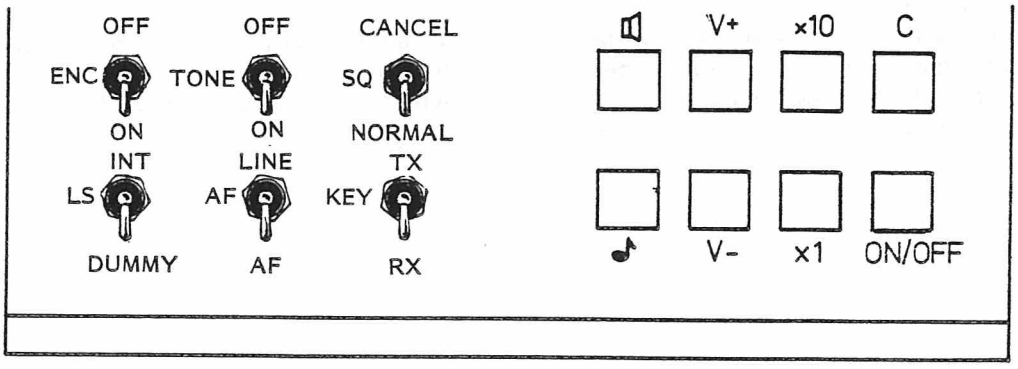
The Service Equipment is designed to hold and operate the RF board and CL board of a STORNOPHONE 4000 during test and alignment.

When the boards are inserted in the Service Equipment both sides of the boards are accessible for measurements and adjustments.

The normal test instruments can be connected to the Service Ewuipment which also has a built-in loudspeaker for audio tests.

On the top a keyboard and six toggle switches are used to operate the radio.





SERVICE EQUIPMENT SE4005

M405. 343

POWER SUPPLY

Two banana sockets, one red and one black, connect to the external power supply which should be + 7.2 V.

AF OUT

A BNC connector is used to connect an AF voltmeter or a distortion meter for measuring the receiver AF output. Both the line output (nominal 110 mV) an the loudspeaker output can be measured, depending on the setting of the AF-LINE switch.

AF IN

A BNC connector is used to connect an AF generator for external modulation of the transmitter. The service equipment has a built-in attenuator and the nominal modulation sensitivity as measured at the generator output is 110 mV/1 kHz.

LOUDSPEAKER

The Service Equipment has a built in loudspeaker which can be used to monitor the receiver AF output when the LS switch is set to INT.

KEYBOARD

The keyboard comprises the normal 8 buttons found on the CP4003 and is used to operate the RF and CL boards under test.

TOGGLE SWITCHES

KEY
switches bettween receive mode RX and transmit mode TX.

AF-LINE
switches the AF out cable between the line output and the loudspeaker output.

LS
switches the AF receiver output between the internal loudspeaker INT and a built-in 8 ohm dummy load.

SQ
switches between the normal SQUELCH function and the unsquelched condition CANCEL.

EN and TONE
are switches which when manipulated as described below key the transmitter and continuously modulate it with the first tone of the tone receiver code. The EN switch should always be in OFF posittion (in ON position part of the keyboard is blocked). The TONE switch should be in ON position for selection of the customer designed program and in OFF position for selection of the built-in service program.

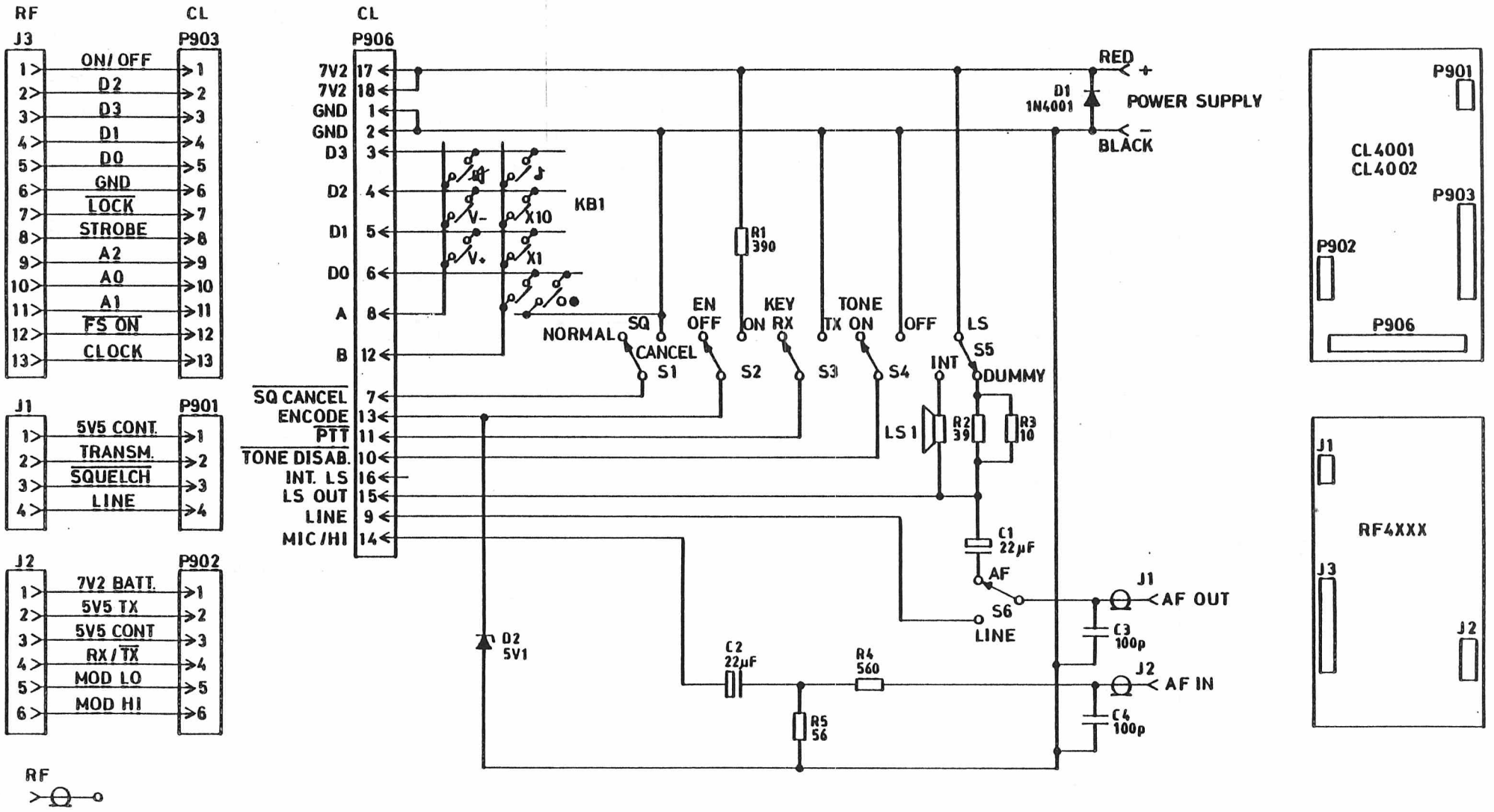
The following procedure sets up the tone test mode:

1. Turn radio OFF
2. Set KEY to RX
3. Set EN to OFF
4. Set TONE to ON
5. Turn radio ON
6. Set TONE to OFF
7. Set KEY to TX
8. Set TONE to ON
9. Set EN to ON

The radio will now be in transmit mode and continuously modulated with a frequency which is the first tone of THE TONE RECEIVER TELEGRAM code.

Storno

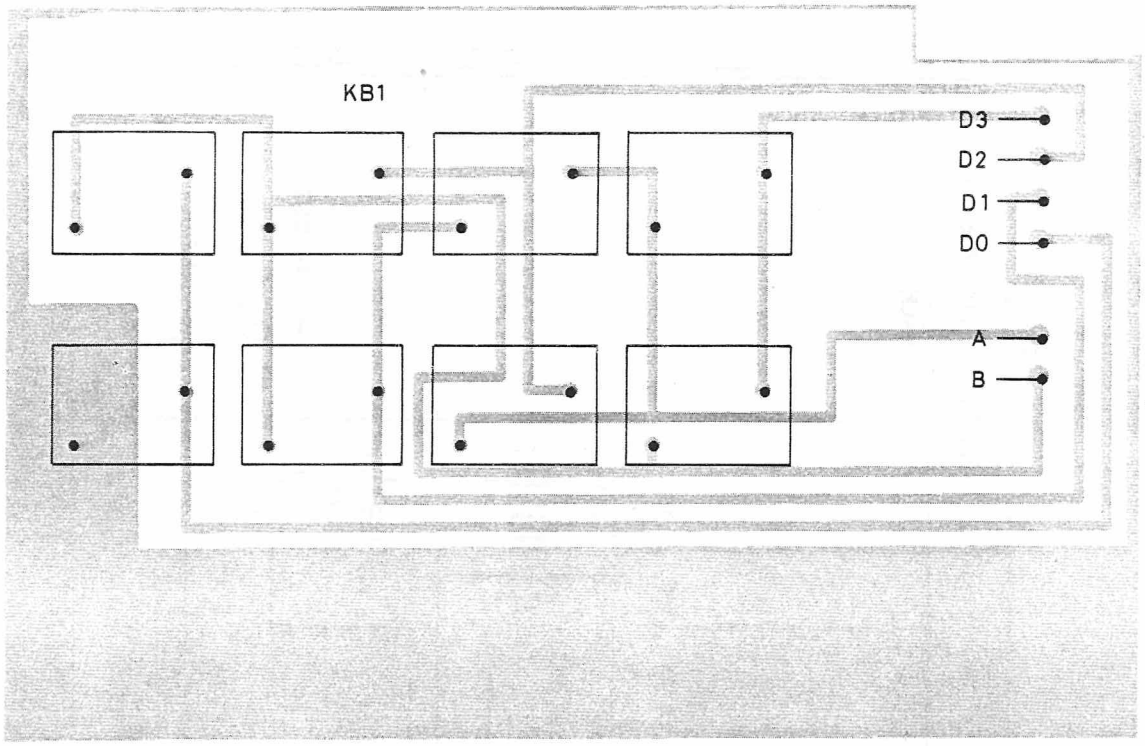
Storno

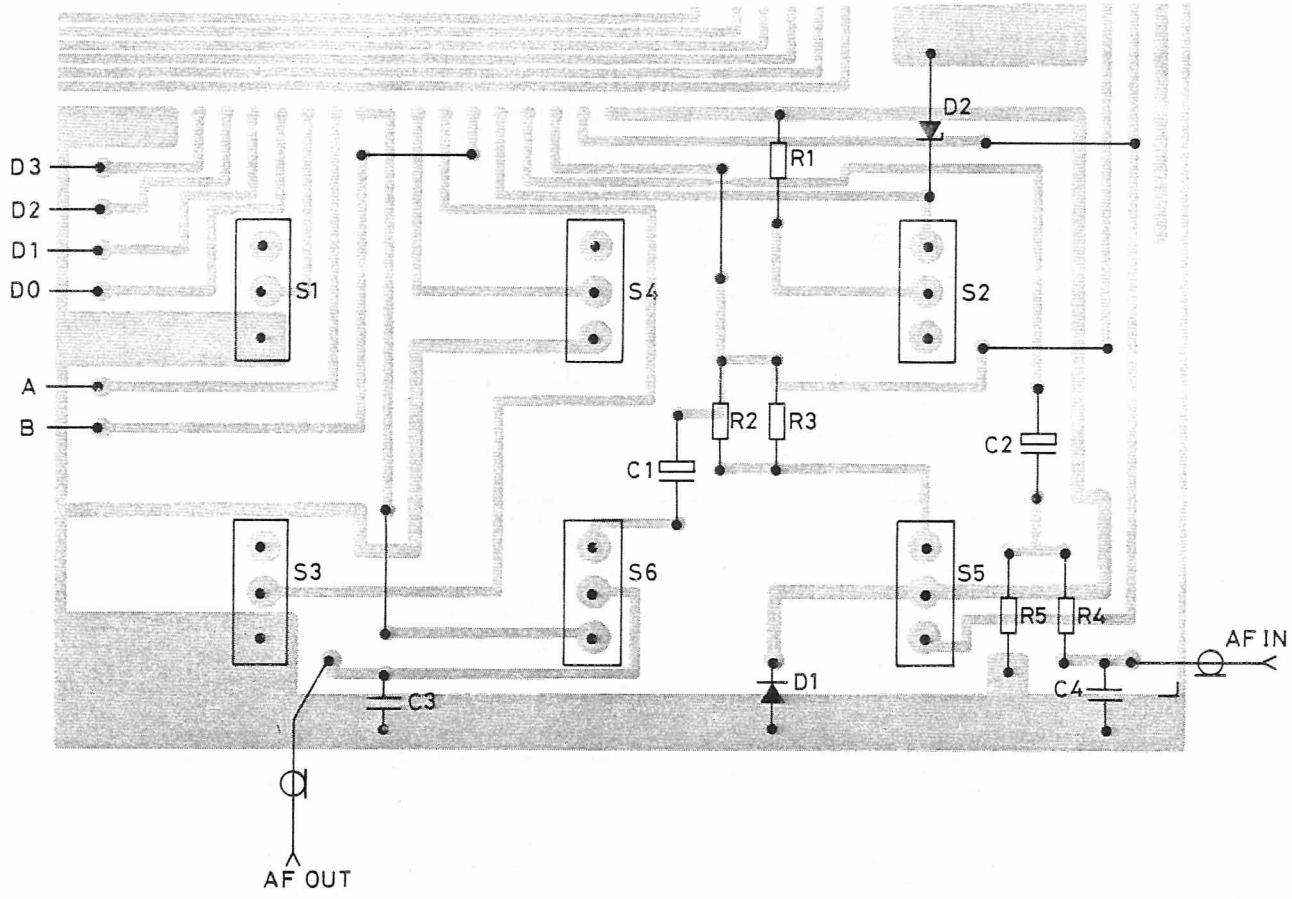


STORNOPHONE 4000
SERVICE EQUIPMENT SE4005

CODE NO. 95D5008-00 | D404.015

Storno





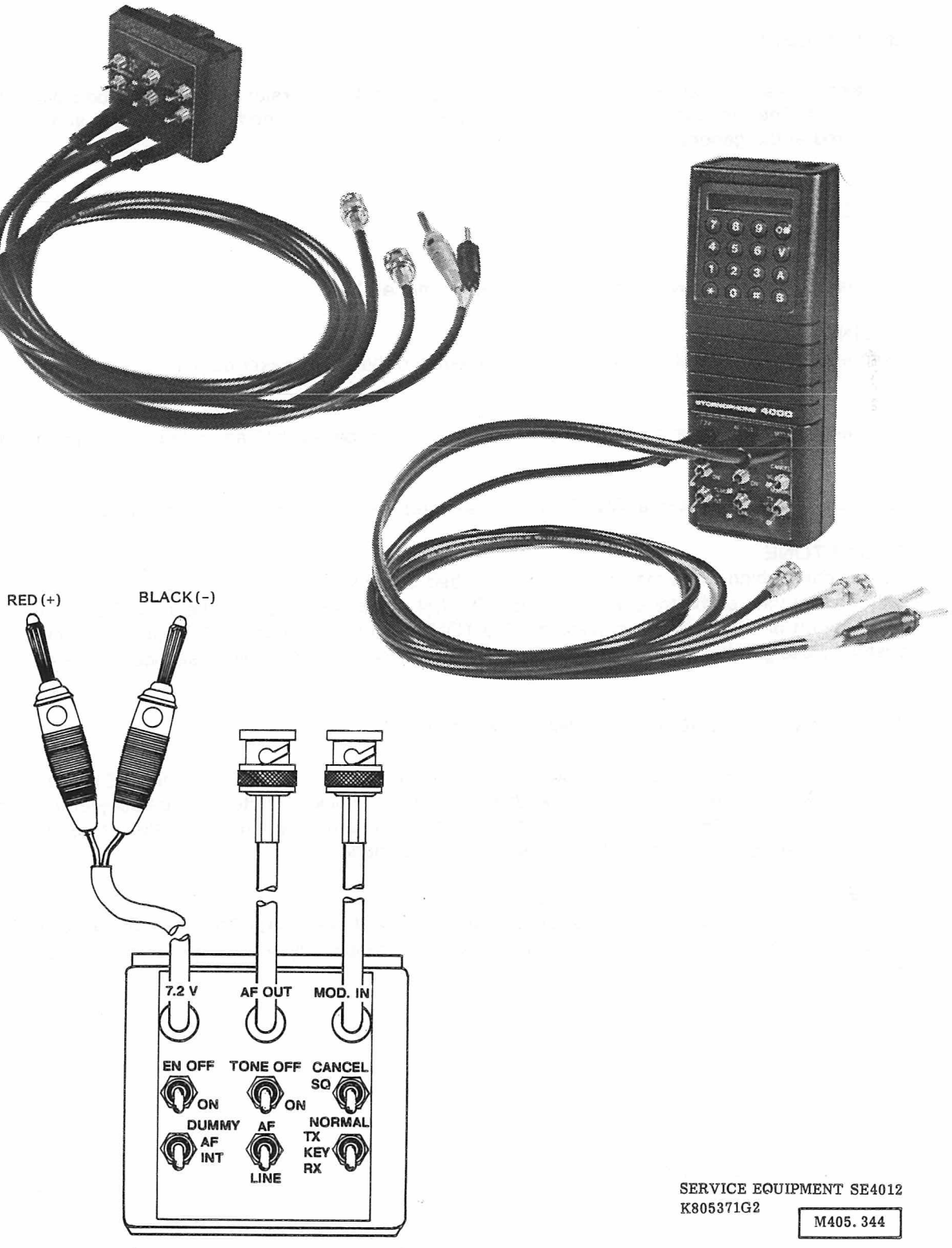
STORNOPHONE 4000
SERVICE EQUIPMENT SE4005
COMPONENT LAYOUT

CODE NO. 95D5008-00 | D404.017

SE4012

TEST ADAPTOR

The test adaptor is designed with the same dimension as a battery and fits into the battery compartment. The adaptor can be used to connect various test instruments to the radio and has built-in toggle switches to operate the radio during test and when adjusting the circuitry.



SERVICE EQUIPMENT SE4012
K805371G2

M405. 344

7.2 V CABLE

A cable terminated in two banana plugs, one red and one black, connects to the external power supply whose nominal output voltage should be +7.2 V.

AF OUT CABLE

A coaxial cable terminated in a BNC plug is used to measure the receiver AF output, either the line output (nominal 110 mV) or the loudspeaker output, dependent on the setting of the AF-LINE switch.

MOD. IN CABLE

A coaxial cable terminated in a BNC plug connects to an AF generator for external modulation of the transmitter. The test adaptor has a built-in 11: 1 attenuator and the nominal modulation sensitivity as measured at the generator output is 110 mV/1 kHz.

TOGGLE SWITCHES

KEY
switches bettween receive mode RX and transmit mode TX.

AF-LINE
switches the AF out cable between the line output and the loudspeaker output.

LS
switches the AF receiver output between the internal loudspeaker INT and a built-in 8 ohm dummy load.

SQ
switches between the normal SQUELCH function and the unsquelched condition CANCEL.

EN and TONE
are switches which when manipulated as described below key the transmitter and continuously modulate it with the first tone of the tone receiver code. The EN switch should always be in OFF posittion (in ON position part of the keyboard is blocked). The TONE switch should be in ON position for selection of the customer designed program and in OFF position for selection of the built-in service program.

IMPORTANT FOR USE WITH CQP4000 MK II AUTOMATIC

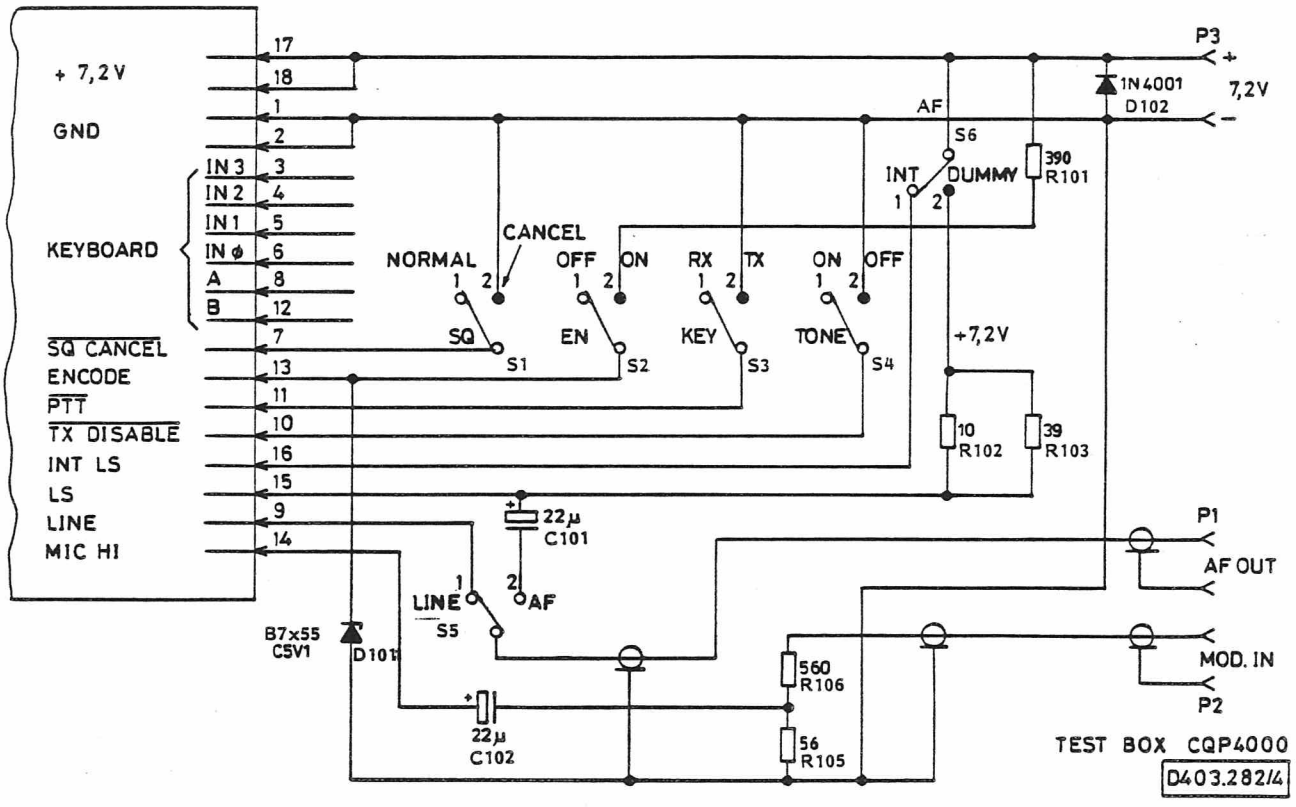
Before removing the testadaptor or switching off the supply voltage make sure the KEY switch is in position RX. If not, the CL-board can be damaged and the back-up battery will be subject to excessive current drain. Also the main program of the radio may be harmed and it should always be ensured that the radio is operating progerly after having been in service mode.

NOTE
When the test adaptor is used in conjunction with CQP4000 MK II AUTOMATIC the operation of the radio is performed from the keyboard in service mode which is enabled by setting the EN and TONE switches to OFF and turn the radio ON.

The following procedure sets up the tone test mode:

1. Turn radio OFF
2. Set KEY to RX
3. Set EN to OFF
4. Set TONE to ON
5. Turn radio ON
6. Set TONE to OFF
7. Set KEY to TX
8. Set TONE to ON
9. Set EN to ON

The radio will now be in transmit mode and continuously modulated with a frequency which is the first tone of THE TONE RECEIVER TELEGRAM code.



CHAPTER
CHAPITRE
KAPITEL

6

Storno

ADJUSTMENT PROCEDURE

CQP4110

This adjustment procedure applies to the following types of STORNOPHONE 4000 radios:

CQP4112: 146-174 MHz - 25 kHz channel spacing
CQP4113: 146-174 MHz - 20 kHz channel spacing
CQP4114: 146-174 MHz - 12.5 kHz channel spacing

Before making adjustments to the radio circuit, read the type label and note the channel frequencies and the tone system coding.
Also check the personality PROM and its data against the type label information.

MEASURING INSTRUMENTS

The following measuring instruments are necessary for making service and adjustments to the CQP4110:

RF Signal Generator	146-174 MHz
AF Voltmeter	Z_i >0.5 Mohm
Multimeter	20 Kohm/V
Distortion meter	
Deviation meter	
Watt meter	0-2.5 W
AF Generator 50 Hz-5 kHz	$Z_{out} \geq 600$ ohm
Frequency counter	5-200 MHz/50 mV
Power Supply	6-10 V/2 A
Signal Sampler	Storno D52
RF diode probe	Storno 95.0059-00
RF coil tuning tool	Storno 17.0053-00
Ref. oscillator tuning tool	Storno 19J707496G1
Test adaptor	SE4002 19K805371G1
Service kit	SE4003 19J707744G1
Consisting of service cabinet and antenna adaptor	
Extension cables	CC4001 19J707704G1

DISMANTLING OF CQP4000

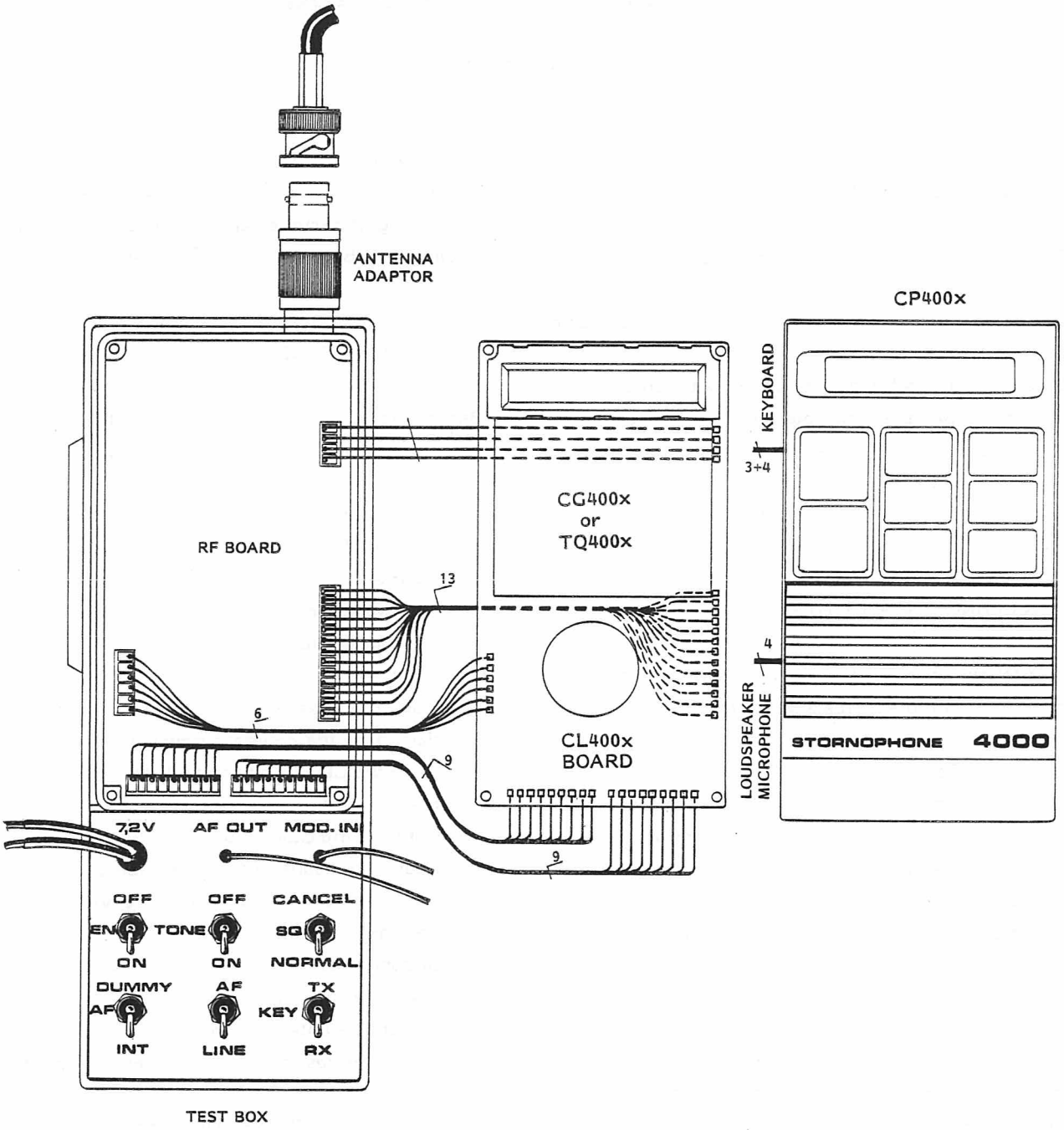
Before the CQP4000 can be adjusted the radio must be dismantled for access to all test points and adjustable components.

- Remove the battery, if inserted.
- Remove the two rear screws holding the cabinet.
- Remove the chassis box.
- Remove the four corner screws holding the front.
- Open the chassis box, carefully, without damaging the contact fingers on the rim.
- Take the CL400x board and the RF4110 board apart.
- Connect the CL400x board to the RF4110 board by means of the extension cables.
- Insert the chassis box in the service cabinet and firmly press the RF board to the bottom of the chassis box to establish good ground connections.
- Attach the antenna adaptor.
- Insert the test box in the battery compartment.
- The STORNOPHONE 4000 is now prepared for adjustment.

TRANSMITTER ADJUSTMENT

Refer to transmitter test setup.
Set the power supply voltage to 7.2 V.
Turn the radio on in receive mode and measure the current consumption.

Requirement: less than 30 mA.
Connect the voltmeter to the +5.5 V test point.
Read the 5.5 V regulated voltage.



TEST SETUP
STORNOPHONE 4000

D403.279/3

1. SYNTHESIZER REFERENCE FREQUENCY ADJUSTMENT

Connect the frequency counter to P3 pin 13-CLOCK.
Read the reference frequency.
Check the reference crystal's frequency (6.4 MHz or 6.5 MHz).
Adjust C533 for f_{nom} ±10 Hz.

Note:
The final adjustment of the reference frequency is performed later with closed chassis box.

2. TRANSMITTER VCO ADJUSTMENT

Set the ADC potentiometer to minimum, anti-clockwise.
Key the transmitter and read the current drain.
Requirement: less than 1 A.
Connect the voltmeter to P3 pin 7, OUT OF LOCK signal.
Adjust C504 for 0 V steady ready reading on the voltmeter. Connect the voltmeter to TP4.

Adjust C504 for a reading of 3 Volts. Adjust C504 so that the reading for each channel is inside the tuning range, 1 - 4 V. The channel with the lowest frequency has the lowest voltage reading.

3. TRANSMITTER POWER OUTPUT ADJUSTMENT

Connect the wattmeter to the antenna connector.
Adjust ADC potentiometer R115 for rated output power according to the type designation.
Note:
The current drain at rated output power must not exceed 1 A.

4. TRANSMITTER FREQUENCY ADJUSTMENT

Connect the wattmeter to the antenna connector through the signal sampler.
Connect the frequency counter to the signal sampler.
Key the transmitter and read the frequency.
Adjust C533 for correct frequency. (C533 is fine adjusted later with closed chassis box).
Requirement: F_{nom} ±0.2 ppm (30 Hz at 150 MHz)
Deenergize the transmitter.
Select next channel
Key the transmitter and check for correct output frequency for each channel.

NOTE:
Adjustment of the transmitter frequency which also adjusts the receiver for correct frequency is done later when the chassis box is closed.

5. TRANSMITTER MODULATION ADJUSTMENT

Connect the deviation meter to the signal sampler.
Connect the AF generator to MOD IN on the test box.
Set the AF generator frequency to 1000 Hz and the output as follows:
1100 mV with test box (11:1 built-in attenuator)

Vary the AF frequency between 100 Hz and 3000 Hz and find peak deviation. Check the frequency for both + and - deviation. At the frequency producing peak deviation adjust R812 for maximum system deviation.

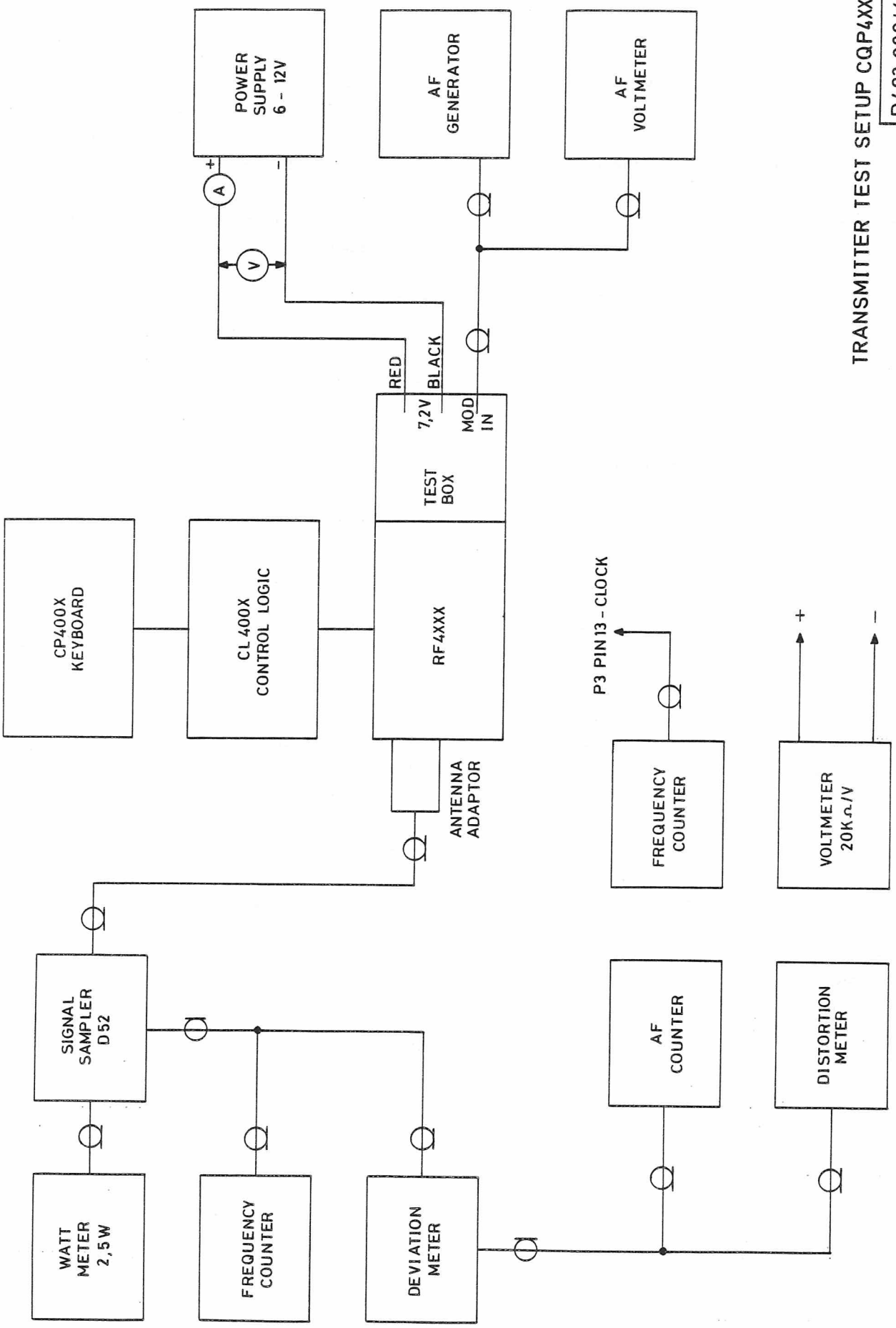
CQP4112: ±5 kHz
CQP4113: ±4 kHz
CQP4114: ±2.5 kHz

Set the AF generator frequency to 1000 Hz.
Reduce the AF generator output until a deviation of 0.7 x maximum deviation is obtained:

CQP4112: ±3.5 kHz
CQP4113: ±2.8 kHz
CQP4114: ±1.75 kHz

Typical generator output is 100 mV.

TRANSMITTER TEST SETUP CQP4XXX D403.280/4



RECEIVER ADJUSTMENT

Refer to receiver test setup.

1. RECEIVER VCO ADJUSTMENT

Connect the voltmeter to P3 pin 7, OUT OF LOCK signal.
Preset coil L508 as follows:
High end of band: 2/3 out of coil.
Low end of band: Fully down in coil form.
Set SQ switch to cancel.
Adjust C514 for 0 V steady reading on the voltmeter. Connect the voltmeter to TP4.
Adjust C514 for a reading of 3 Volts. Adjust C514 so that the reading for each channel is inside the tuning range, 1 - 4 V.
The channel with the lowest frequency has the lowest voltage reading.

2. RECEIVER INJECTION SIGNAL ADJUSTMENT

Connect the diode probe and the voltmeter to TP2.
Adjust L508 for maximum voltmeter reading, 0.2 V ±0.1 V. (L508 is readjusted together with the front-end).

3. IF SIGNAL ADJUSTMENT

Connect the signal generator to the antenna connector and set it to the channel frequency.

Modulate the signal generator with 1000 Hz to 0.7 x maximum system deviation.
CQP4112: ±3.5 kHz
CQP4113: ±2.8 kHz
CQP4114: ±1.75 kHz

Set the signal generator output to 100 mV.

Connect the diode probe and the voltmeter to TP3.
Reduce the signal generator output until voltage reading is less than 1 V.

Adjust L402 and L308 for maximum voltmeter reading.
Connect the AF voltmeter to AF OUT. Set the signal generator output to 100 mV.
Adjust L403 for maximum voltmeter reading.

ALTERNATIVE PROCEDURE
Connect the distortion meter to AF OUT.
Adjust L403 for minimum distortion.

4. AF LINE LEVEL ADJUSTMENT

Connect the AF voltmeter to the AF OUT (J906 pin 14.
Set signal generator as described in paragraph 3.
Adjust R409 for a voltmeter reading of 110 mV ±5 mV.

5. FRONT-END ADJUSTMENT

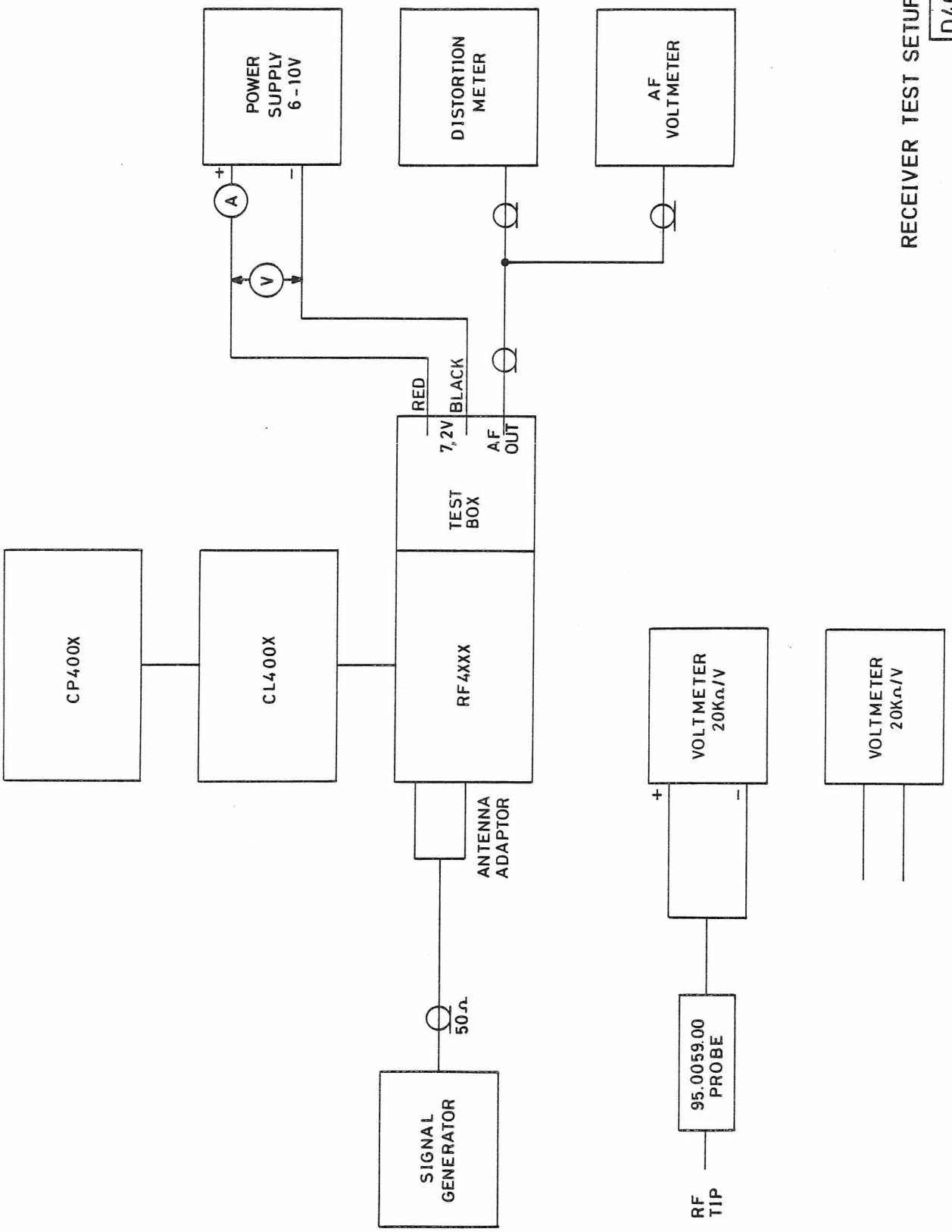
Connect the signal generator to the antenna connector and set its frequency to the channel frequency.

Modulate the signal generator as described in paragraph 3. Adjust the generator output to approx. 12 dB SINAD.
Connect a distortion meter to AF OUT.
Set the LS-LINE switch on the test box to LINE.
Set the SQ switch to cancel.

Adjust the following coils for minimum distortion.
L306, L305, L303, L302 and L508.
As the sensitivity increases during the adjustment decrease the signal generator output to maintain 12 dB SINAD.

Repeat the adjustments until no further improvement is possible.

RECEIVER TEST SETUP CQP4XXX D403.281/4



Check the 12 dB SINAD on all channels.

Requirement: 12 dB SINAD for less than 0.45 uV.

6. SQUELCH ADJUSTMENT

Turn the squelch potentiometer R420 completely anticlockwise to close the squelch.
Open squelch by setting SQ switch to cancel.

Set the signal generator output to the value giving.12 dB SINAD.
Close squelch by setting SQ switch to normal.
Slowly turn R420 clockwise to the point where the squelch just opens.
Vary the signal generator output slowly up and down to obtain the opening and closing level of the squelch.

Squelch opening level: 12 dB SINAD
Squelch closing level: 6-10 dB SINAD

FREQUENCY ADJUSTMENT

The reference oscillator frequency controls both the transmitter and receiver frequencies and final adjustment must be done with the chassis box properly assembled.
Turn the radio off and remove the test box.
Assemble the radio but use the service cabinet to hold the chassis box.
Connect the test box and turn the radio on.
Connect a frequency counter to the signal sampler, refer to transmitter test setup.

Key the transmitter.
Adjust, through the hole in the rear of the service cabinet, the reference oscillator, C533 for nominal frequency.
Requirement:

$F = F_{nom} \pm 0.2$ ppm (30 Hz at 150 MHz).

Switch to next channel. Verify the frequency for all channels. (Channel switching is not possible while transmitting).

ADJUSTMENT OF TONEMODULE

CQP4000

The tone module is available in different versions as tabulated below:

TYPE	TONE SYSTEM	CODE	ENC	DEC	GRP+	CG
TQ4001	ZVEI/CCIR	M905368G1	x	x		
TQ4002	ZVEI/CCIR	M905368G2	x	x	x	
TQ4003	ZVEI/CCIR	M905368G3	x	x	x	
TQ4004	EEA	M905368G4	x	x	x	
TQ4005	ZVEI/CCIR	M905368G5	x	x	x	x
TQ4006	ZVEI/CCIR	M905368G6	x	x	x	x
TQ4007	EEA	M905368G7	x	x	x	x
TQ4008	ZVEI/CCIR	M905368G8	x	x	x	

+The GRP option requires the group tone to be strapped on the TQ4000 module to one of the following tones: 885/970 Hz, 2400/2800 Hz, or 1055 Hz.

Connect the deviation meter to the signal sampler and an AF counter to the deviation meter's AF output.
Don't apply external modulation to the radio.

The following procedure sets up the tone test mode:

1. Turn radio OFF
2. Set KEY to RX
3. Set EN to OFF
4. Set TONE to ON
5. Turn radio ON
6. Set TONE to OFF
7. Set KEY to TX
8. Set TONE to ON
9. Set EN to ON

The radio will now be in transmit mode and continuously modulated with a frequency which is the first tone of the tone receiver telegram code.

Check the deviation for being from 70-100% of maximum system deviation.

CQP4xx2: ±3.5-5.0 kHz
CQP4xx3: ±2.8-4.0 kHz
CQP4xx4: ±1.75-2.5 kHz

Read the frequency at the AF output of the deviation meter.

The frequency should be the first tone of the decoder code.

Adjust, if necessary, the frequency with C113 on the TQ400x board for correct frequency according to the following table.

CCIR-EEA		ZVEI	
Nominal freq. Hz	Adjustment Freq. Hz	Nominal Freq. Hz	Adjustment Freq. Hz
1124	1120.6	1060	1057.9
1197	1202.1	1160	1159.9
1275	1271.5	1270	1271.5
1358	1363.2	1400	1406.7
1446	1453.1	1530	1537.6
1540	1537.6	1670	1673.8
1640	1632.5	1830	1836.5
1747	1739.9	2000	2003.5
1860	1862.4	2200	2203.9
1981	1973.6	2400	2404.2
2110	2098.9	2600	2592.8
2247	2241.2	2800	2813.4
1055	1057.9	885	887.5
		970	972.3

CHANNEL GUARD TONE ADJUSTMENT

Connect the deviation meter to the signal sampler and an AF counter to the deviation meter's AF output. Don't apply external modulation to the radio.
Set ENC switch to OFF.
Set TONE switch to OFF.
Set KEY switch to TX.

Adjust R824 on CL4001 for specified deviation.

Read the frequency at the AF output of the deviation meter.

Adjust C305 on the TQ400x module for specified channel guard tone.

Tolerance: f_{CG} ±0.015 Hz

ALL CALL ADJUSTMENT

When ALL CALL is programmed the TQ-module must be modified. Capacitor C209 is removed and replaced by an electrolytic capacitor 10 uF/ 6 V, part nr. A700045P3; refer to D403.283 for location and polarization.

GROUP TONE FREQUENCY ADJUSTMENT

Connect the signal generator to the antenna input. Modulate the generator with an external Tone test set e.g. TSG13 set to the group tone frequency so that a deviation of 33% of maximum system deviation is obtained.

CQP4xx2: ±1.65 kHz
CQP4xx3: ±1.32 kHz
CQP4xx4: ±0.825 kHz

Group tones:

885 Hz
970 Hz
1055 Hz
2400 Hz
2800 Hz
1981 Hz (special).

Modulation level - 47 dBm

Connect a AF voltmeter to the AF OUT.

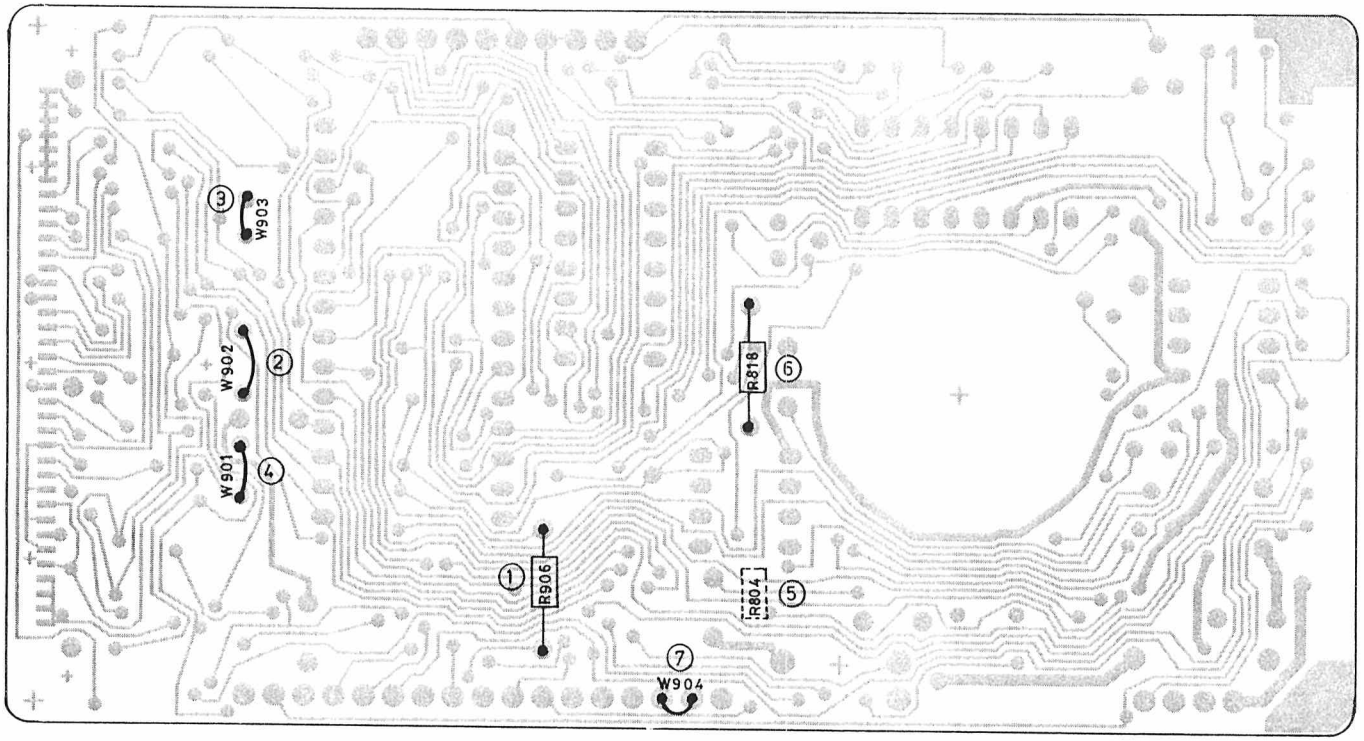
Connect a voltmeter to TP201 on the TQ400x board.

Read the AF line level (AF OUT).
AF out= 35 mV ±5 mV.

Adjust R821 on the CL400x board for maximum voltage on the multimeter (5 V p.p ±0.5 V).

Storno

Storno



① REMOVE FOR NO ACCOUSTIC FEED-BACK AND NO ALARM TONE

② CUT TO DISABLE LEFT TONE DIGIT ON DISPLAY (X10)

③ CUT TO DISABLE RIGHT TONE DIGIT ON DISPLAY (X1)

④ CUT TO DISABLE ♪ - SYMBOL ON DISPLAY

⑤ R804 ON CHIP SIDE

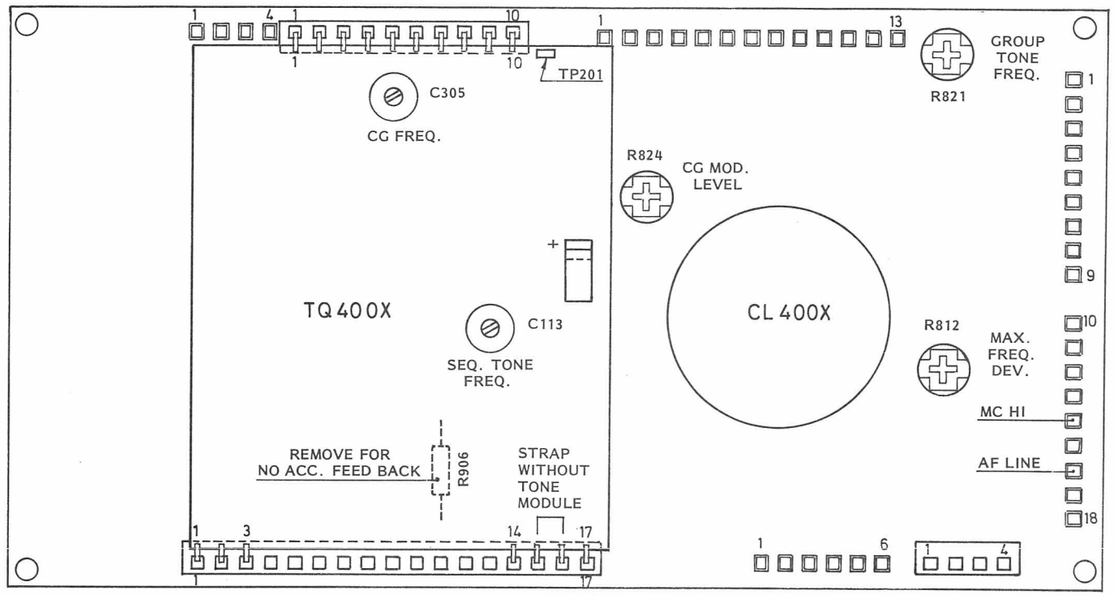
STANDARD	MIC. SENSIVITY	: 330K
+6dB	— " —	: 680K
-6dB	— " —	: 150K

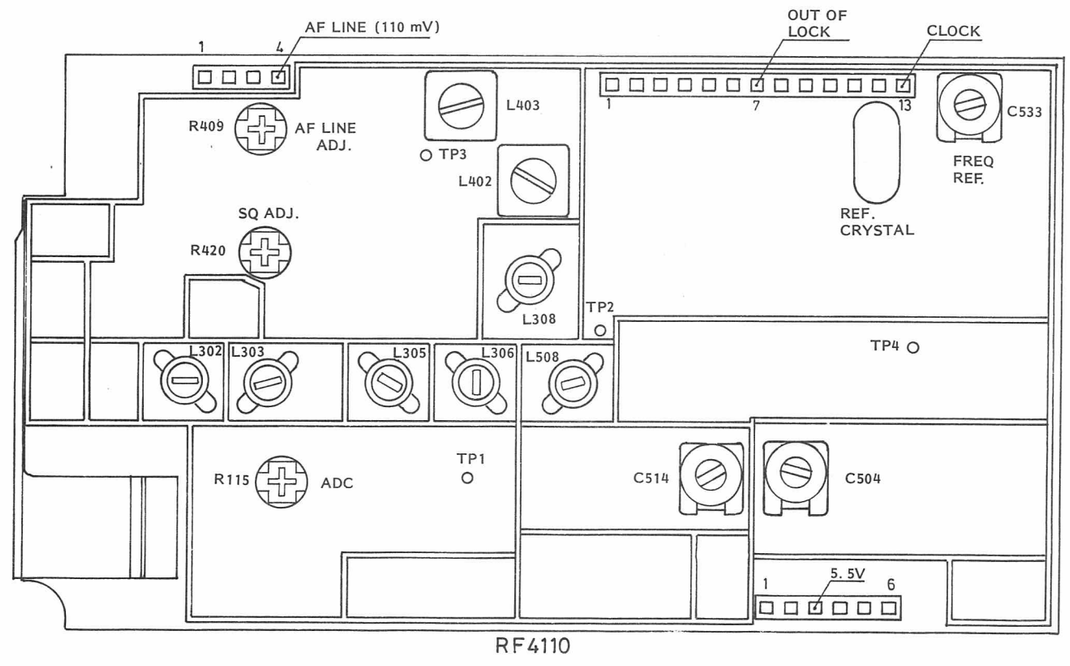
⑥ CUT FOR 12,5 KHz CHANNELSPACING AND SWEDEN (MOD. RESPONSE).

⑦ REMOVE IF TONE OPTION IS USED

CONTROL LOGIC CL 4001
STRAPPING INSTRUCTION

D403.383/2



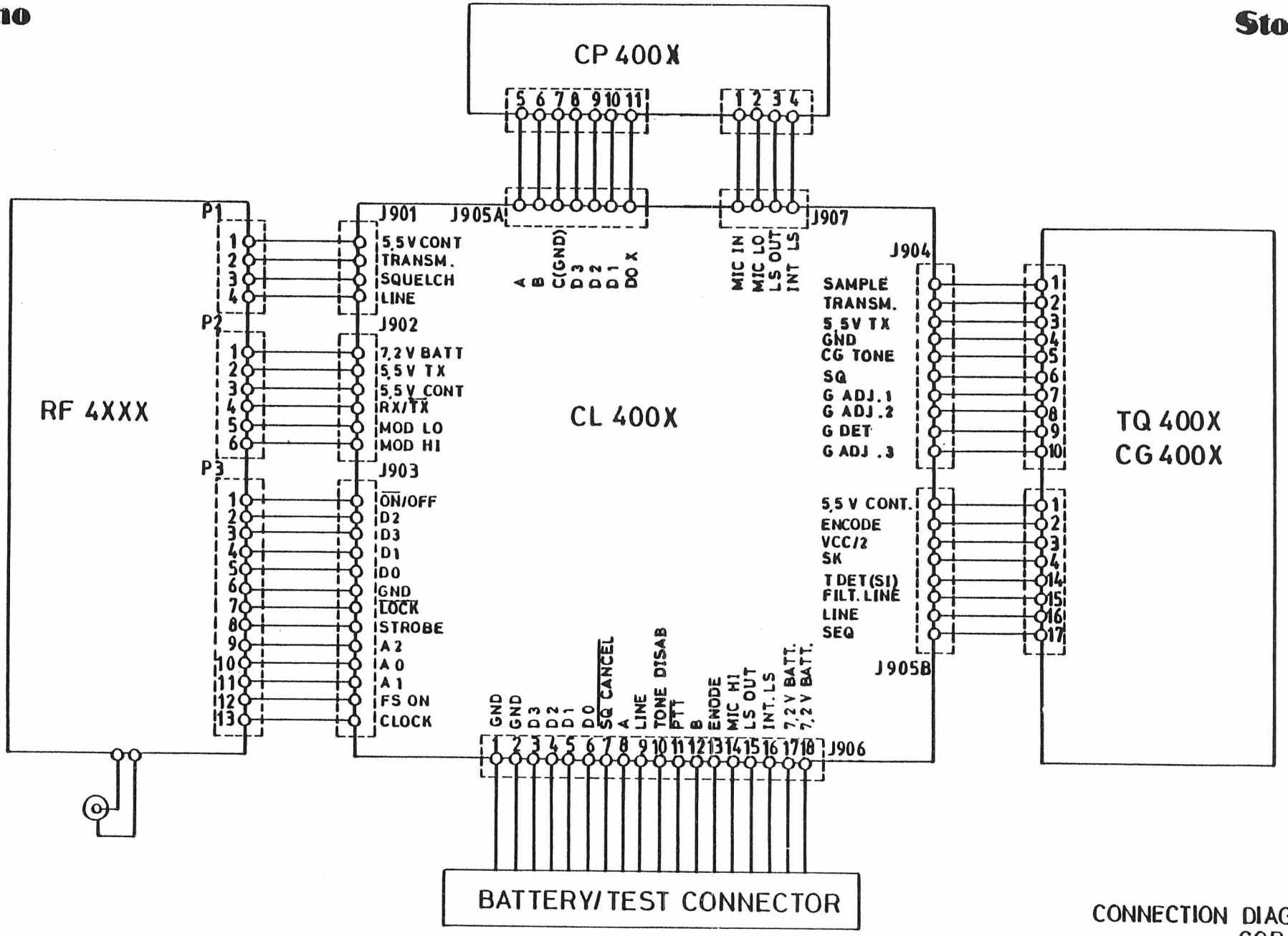


RF4110

TEST POINTS & ADJUSTABLE COMPONENTS
TQ400X,CL400X,RF4110

D403.283/3

Storno



CONNECTION DIAGRAM
CQP 4000

D403.304/2

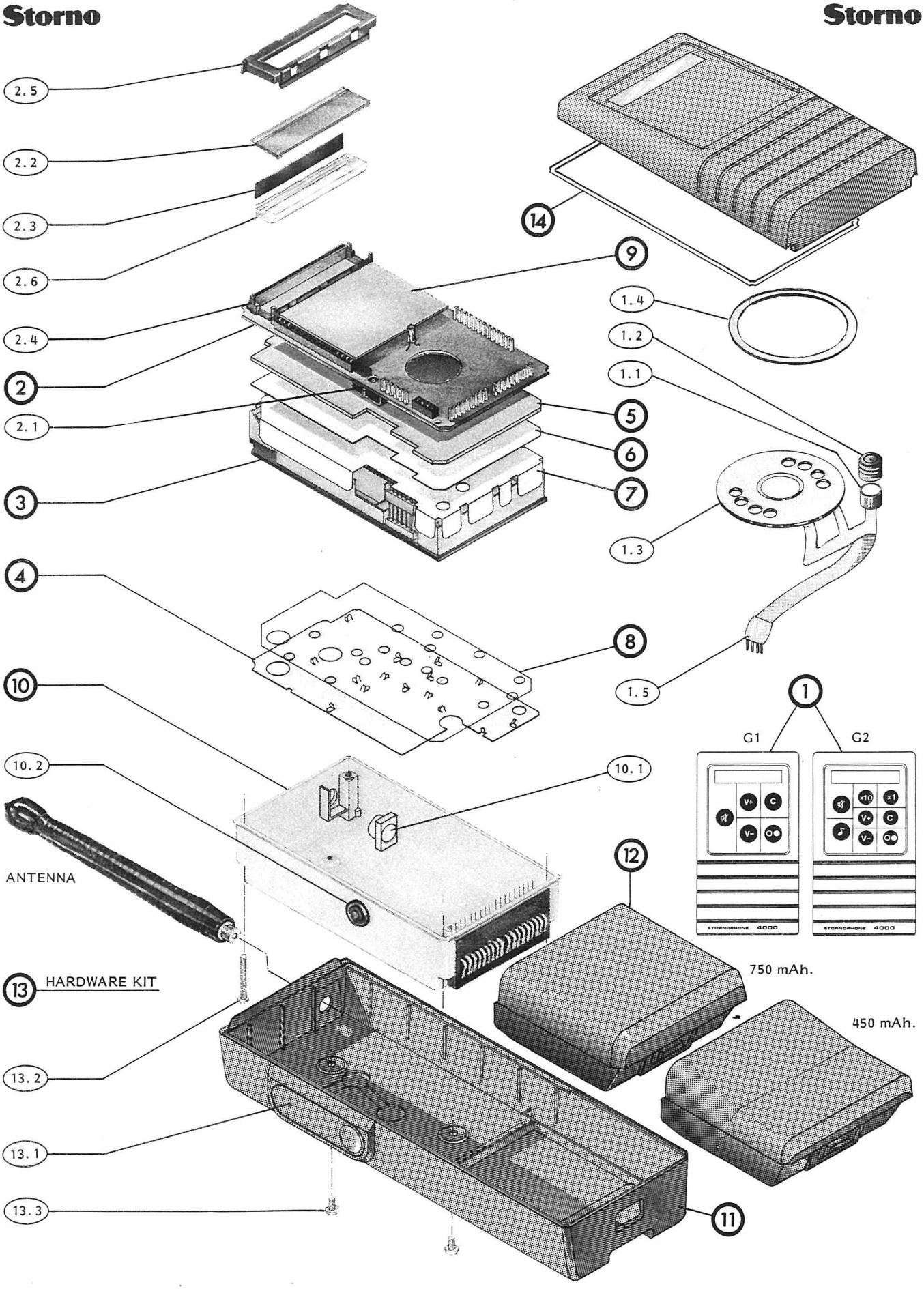
CHAPTER
CHAPITRE
KAPITEL

7

Storno

Storno

Storno



MECHANICAL LAYOUT AND PART NUMBERS
FOR CQP4000 MK II STORNO VERSION

M405.346

DATE: 3/10/1987

Pos	Code No	Description	Qt
1	L856029G1	CP4003 Without Tone Assembled	1
	L856029G2	CP4003 With Tone Assembled	1
1.1	A701301P2	Microphone	1
1.2	J707235P1	Gasket Microphone	1
1.3	J708879P1	Loudspeaker perm. Magnet 8R 0.15 W	1
1.4	J709325P1	Gasket for Loudspeaker	1
1.5	L855800P1	Cpnt. Board Flex.	1
2	K805331G1	CL4001-2CH. For 160 MHz & 80 MHz Asm	1
	K805331G2	CL4001-2CH. For UHF Asm.	1
	K805449G1	CL4002-10CH.For 160 MHz & 80 MHz Asm	1
	K805449G2	CL4002-10CH. For UHF	1
2.1	J707133P3	Micro Switch	1
2.2	J707230P1	display	1
2.3	J707458P1	Conn. Cond. Rubber Zeb. StriP	1
2.4	L855331P1	Housing display	1
2.5	L855332P1	Cover display	1
2.6	K805332G1	Display Asm.	1
3	J707428G1	RF 4112	1
	J707428G2	RF 4113	1
	J707428G3	RF 4114	1
	J707942G1	RF 4332	1
	J707942G2	RF 4333	1
	J707942G3	RF 4334	1
	J707801G1	RF 4662 H	1
	J707801G2	RF 4663 H	1
	J707801G3	RF 4664 H	1
	J707801G4	RF 4662 L	1
	J707801G5	RF 4663 L	1
	J707801G6	RF 4664 L	1
4	L855419P2	Plate Grounding Asm. UHF	1
	J707959G1	Plate Grounding Asm. 80 MHz.	1
	J708035G1	Plate Grounding Asm. 160 MHz.	1
5	J708184P1	Insulation Foam For UHF & 160 MHz.	1

Pos	Code No	Description	Qt
6	J708218P1	Insulation Foil	1
7	M905648P2	Shield For UHF	1
	M905943P2	Shield For 160 MHz. & 80 MHz.	1
8	L855532P1	Insulation Plate For 160 MHz.	1
	L855532P2	Insulation Plate For UHF	1
	L855532P3	Insulation Plate For 80 MHz.	1
9	M905368G1-G8	TQ4001-TQ4008 Assembled	1
	M905581G1-G3	CG4001-CG4003 Assembled	1
10	L855356G1	Chassis CH4001 Assembled	1
10.1	K805297P1	Antenna connector	1
10.2	K805306P1	Gasket PTT.	1
11	K805922G1	Cabinet CA4005	1
12	L856034G1	Battery Unit BU4003 450 mAh.	1
	L856035G1	Battery Unit BU4004 750 mAh.	1
13	J707463G3	Hardware kit	1
13.1	M906391P1	Button PTT.	1
13.2	A700031P220	Screw Pan Head M2x20	4
13.3	J707518P1	Screw Pan Head M2.5x4	2
	J707586P1	Gasket Adj. Brown	1
14	K805870P1	Insulation Foil	1

MECHANICAL PARTS LIST
FOR CQP4000 MK II STORNO VERSION

MPL 405.346

COLOUR CODE/CODE DES COULEURS/FARBKODE

0	BK	BLACK	NOIR	SCHWARZ
1	BN	BROWN	MARRON	BRAUN
2	RD	RED	ROUGE	ROT
3	OR	ORANGE	ORANGE	ORANGE
4	YW	YELLOW	JAUNE	GELB
5	GN	GREEN	VERT	GRÜN
6	BL	BLUE	BLEU	BLAU
7	VT	VIOLET	VIOLET	VIOLET
8	GY	GREY	GRIS	GRAU
9	WH	WHITE	BLANC	WEISS

GRAPHICAL SYMBOLS USED IN CIRCUIT DIAGRAMS

Resistors(R)

Resistor

Resistor with fixed tap

Variable resistor

Resistor with movable tap (Potentiometer).

Varistor (voltage-dependent resistor)

Temperature-dependent resistor with negative temperature coefficient

Light-emitting diode (photosensitive resistor)

Temperature dependent resistor with positive temperature-coefficient.

Resistor with preset adjustment

Capacitors(C)

Capacitor

Variable capacitor

Trimmer capacitor

Feedthrough capacitor

Electrolytic capacitor polarized

Polarized capacitor general

Electrolytic capacitor non-polarized

Coils(L)

RF coil, air core

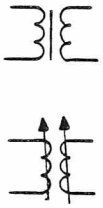
Coupled RF coils, air core

RF coil with adjustable core

Coil with tap.

Helical-coil.

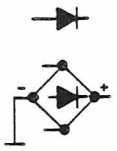
Transformers(T)



Transformer with iron core

Transformer with adjustable RF cores

Diodes(D)



Diode

Bridge rectifier

Series-connected stabilizer diodes within one case

Light-emitting diode

Zener diode (unidirectional)

Zener diode (bidirectional)

Tunnel diode

Backward diode

Varactor diode

Controlled rectifier, PNPN (N-thyristor)

Controlled rectifier, NPNP (P-thyristor)

Zener diode-programable.

Transistors(Q)

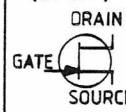
Transistor, PNP

Transistor, NPN

Light-sensitive transistor PNP

Unipolar transistor with N-type base

Junction Field Effect Transistors (JFET)



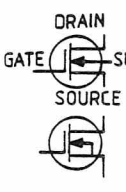
N-channel JFET

P-channel JFET

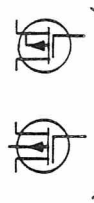
N-channel dual gate JFET

P-channel dual gate JFET

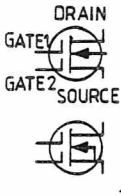
Insulated Gate Field Effect Transistors (IGFET or MOS)



N-channel IGFET (MOS)



P-channel IGFET (MOS)



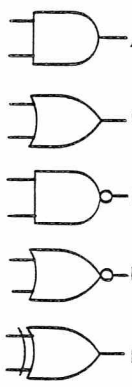
N-channel dual gate IGFET (MOS)

P-channel dual gate IGFET (MOS)

Integrated Circuits(U)

Several integrated circuits contained within one case are designated by one common number followed by an identifying letter (a, b, c, etc.). Thus, circuits U1A, U1B and U1C are contained within one case.

Gates



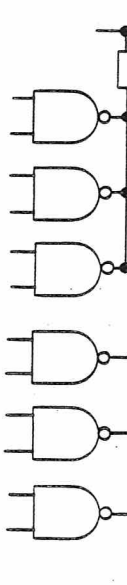
AND gate.

OR gate.

NAND gate.

NOR gate.

Exclusive OR gate.



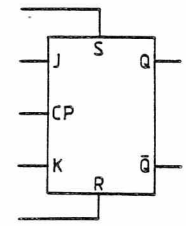
Wired OR (combined OR outputs) (presentation at top is used in detailed diagrams; presentation below is used in functional diagrams)

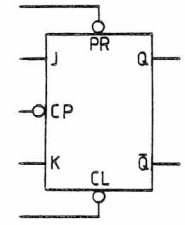
GRAPHICAL SYMBOLS USED IN CIRCUIT DIAGRAMS

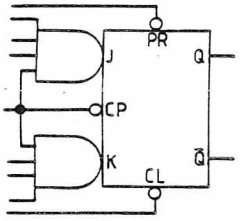
Flip-flops

Abbreviations used:

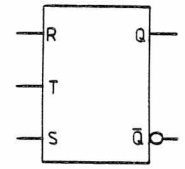
S =Set
R =Reset
CP=Clock pulse
PR=Preset
CL=Clear
T =Toggle

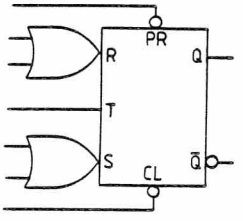




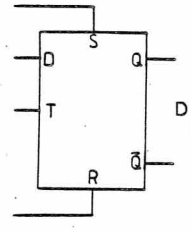


J-K Flip-Flops



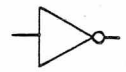


R-S Flip-Flops

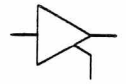


D Flip-Flop

Inverters

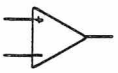


Inverter

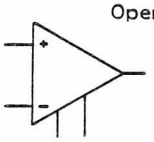


Three-state driver

Operational Amplifiers



Operational amplifiers.



Relays(K)

Single-coil relay

Dual-coil relay

Polarized relay

Slow-acting relay

Slow-release relay

Relay with change-over contacts

Contacts

Open contact (make)

Closed contact (break)

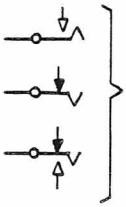
Change-over contact

Change-over contact centre off

Make-before-break

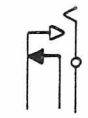
Switches and Keys(S)

On/Off switch



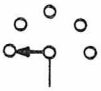
Locking keys or switches: push on, push off

Non-Locking self-releasing keys or switches



Make-before-break

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



Rotary switch.

ON/OFF switch electrically controlled.
(Not a relay)

Lamps(V)

Indicator Lamp.

Neon Lamp

Fuses and Cut-outs(F)

Fuse

Circuit breaker

Batteries(B)

Battery one cell

Battery multi cell

Feedthrough Filters(Z)

Feedthrough filter

Ferrite Beads(FB)

Ferrite bead

Crystals(Y)

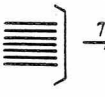
Crystal

Cables and Wires(W)

Usual conductor.

Three conductors

Eight conductors.



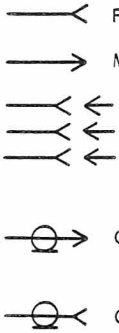
Shift from multiple-line to single-line presentation.

Screened cable.

Coaxial cable.

GRAPHICAL SYMBOLS USED IN CIRCUIT DIAGRAMS

Connectors(J and P)



Female (socket) connector.

Male (plug) connector

Multi-wire connector.

Coaxial plug.

Coaxial socket.

Loudspeakers(LS)

Loudspeaker.

Loudspeaker-Microphone.

Telephones(TEL)

Telephone.

Single headphone. (Earphone).

Double headphone.

Microphones(M)

Microphone.

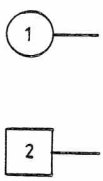
Meters etc.

Indicating instrument.

Balancing instrument. (Galvanometer).

Basic letters see DESIGN STANDARD 10.02.31 section 12.

Test Points



DC test point.

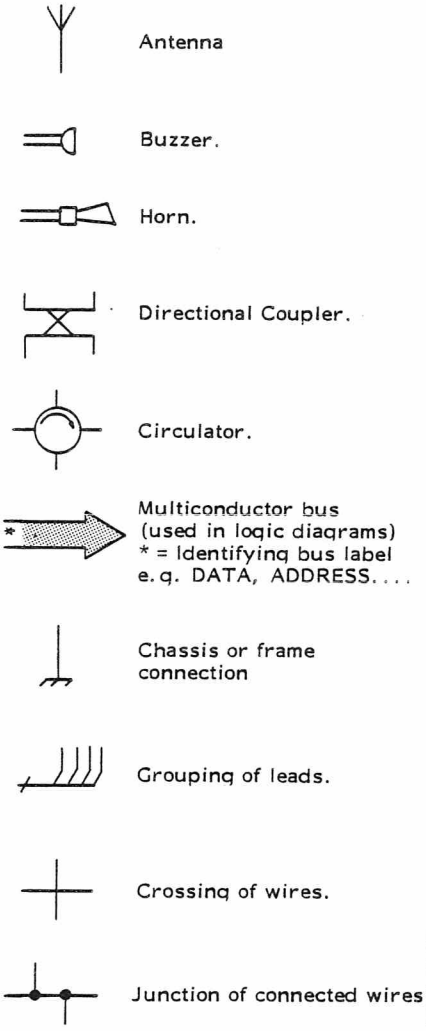
AC test point.

Replaceable Connections(W)

Cross-field connection. (jumper).

Strap.

Miscellaneous



Antenna

Buzzer.

Horn.

Directional Coupler.

Circulator.

Multiconductor bus (used in logic diagrams) * = Identifying bus label e.g. DATA, ADDRESS....

Chassis or frame connection

Grouping of leads.

Crossing of wires.

Junction of connected wires