



Sailor

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INSTRUKTIONSBOG FOR
SAILOR RT 2048

INSTRUCTION BOOK FOR
SAILOR RT 2048

INSTRUKTIONSBUCH FÜR
SAILOR RT 2048

INSTRUCTIONS POUR
SAILOR RT 2048

INSTRUCCIONES PARA
SAILOR RT 2048



A/S S. P. RADIO · AALBORG · DENMARK

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1. INTRODUCTION

The SAILOR RT2048 VHF radiotelephone has been designed to comply with the increasing demands of a highly technological product, which means high quality, small size, etc.

The SAILOR RT2048 is furthermore designed to fit into the SAILOR Compact 2000 module programme.

The SAILOR RT2048 can either be installed and operated as an independent unit, or in combination with other elements of the Compact 2000 programme. These include a Duplex VHF radiotelephone, a coast telephone station with a 400W PEP SSB transmitter and an SSB receiver with built-in FM and AM bands, and a scrambler which ensures complete communication secrecy.

The SAILOR VHF RT2048 has, by means of the latest technology in casting technique, been constructed to withstand the most extreme conditions experienced in small, semi-open boats. Inside, the printed circuits, which have made possible a combination of compactness and exceptional performance, are coated with a special moisture repellent lacquer.

In the design of this VHF radiotelephone, S. P. Radio have taken into account all the circumstances it will be exposed to in day-to-day operation. However, even a product of this high quality requires regular servicing and maintenance, and we recommend a close observance of the directions contained in the instruction book.

S. P. Radio is one of Europe's leading producers of maritime radio communication equipment - a position which has been maintained by means of constant and extensive product development. We have a world-wide network of dealers with general agencies in fifty countries. All our dealers are well-trained and able to service all SAILOR products.



1.1. GENERAL DESCRIPTION

SAILOR VHF RT2048 is an all solid state constructed microcomputer controlled VHF radiotelephone, intended for ship/ship and ship/shore communication.

SAILOR VHF RT2048 can operate in both simplex and semi-duplex mode.

SAILOR VHF RT2048 includes all 55 international and U.S. VHF marine channels, and is as standard prepared for up to 10 private channels, selected as simplex or semi-duplex channels in the frequency band 154.4 - 163.75 MHz.

SAILOR VHF RT2048 is equipped with flexible scanning facilities or additional 30 private channels in the above mentioned frequency band.

SAILOR VHF RT2048 has built-in dual watch facility, which enables the operator to listen out on two channels simultaneously (the selected channel and a programmable preference channel - normally channel 16).

SAILOR VHF RT2048 is provided with a quick select channel, normally channel 16.

SAILOR VHF RT2048 is provided with continuous turn-style operation of SQ and AF level for optimum resolution.

SAILOR VHF RT2048 is provided with a push-button keyboard offering an attractive tactile feeling and a safe finger-guide in the metal front. Besides, the keyboard is fitted with night-illumination of the lettering from behind.

SAILOR VHF RT2048 has a high efficient LED read-out of channel number and other indications for optimum reading under all conditions.

SAILOR VHF RT2048 is a modern transceiver with an all synthesized frequency generation based on a single crystal.

SAILOR VHF RT2048 has a built-in 12W AF power amplifier, which delivers 6W into the large built-in loudspeaker.

SAILOR VHF RT2048 is for 12V DC supply. Voltage change-over from 24V to 12V is easily done by the power supply N420.

SAILOR VHF RT2048 has an extremely low standby current consumption, typically below 100 mA.

SAILOR VHF RT2048 is housed in a corrosion resistant metal cabinet with a green nylon finish.

SAILOR VHF RT2048 can be delivered with a built-in selcall decoder, which will decode a selective call CA or all ships call CQ.

1.2. TECHNICAL DATA

Fulfils the international CEPT regulations.

GENERAL

All international maritime VHF channels.

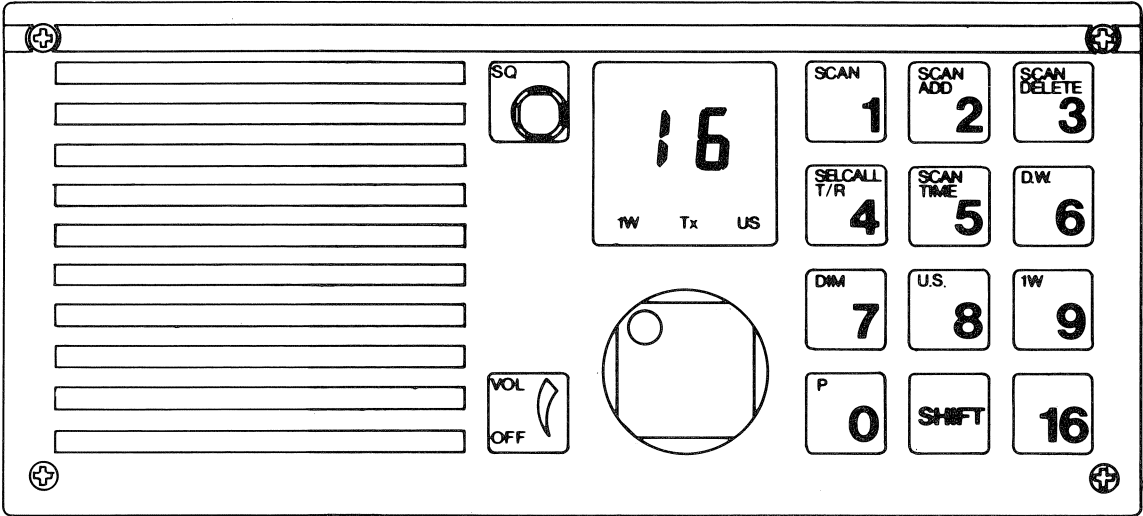
Private channels:	10, may be extended to 40
Operation:	Simplex and semi-duplex
Modulation:	G3EJN (Phase)
Antenna impedance:	50 ohm
Frequency stability:	+10 ppm (Spec. vers. +5 ppm)
Temperature range:	-20°C to +55°C
Nominal power supply:	13.2V DC
Power supply variation:	12V DC -10% to +30%
(with data according to international standards)	
Power consumption:	Standby = 0.1A
	Transmit = 5 A
Dimensions:	Height: 98 mm
	Width: 225 mm
	Depth: 160 mm
Weight:	3.1 kg

RECEIVER

Frequency range simplex:	154.40 - 159.15 MHz
Frequency semi-duplex:	159.00 - 163.75 MHz
Sensitivity:	0.25 uV PD at 12 dB SINAD
AF output power:	6 Watt/4 ohm
Telephone output:	0.5V RMS/200 ohm
Distortion:	Less than 5%
Scanning facilities:	Flexible scanning programme, with possibility for all international channels and 10 private channels.
Accessory:	Selcall decoder according to CCIR

TRANSMITTER

Frequency range normal:	154.40 - 159.15 MHz
Frequency range special:	159.00 - 163.75 MHz
RF output power:	25 Watt +0 to -0.5 dB
Reduced RF output:	0.5 to 1 Watt
Distortion:	Less than 5%



1.3. CONTROLS



Indication of ON/OFF/VOL turn-style knob operation.



Squelch sensitivity control knob with turn-style operation.





Quick selection of the call and distress channel 16.



Digits from 1 to 0



Activates the functions marked in orange on the keyboard. Whenever the keyboard is in "shift-mode" it will be indicated by "cornerbars" in the display  



Selects scanning programme.



Adds a channel to the scanning table.



Deletes a channel from the scanning table.



Selects the scan time from 1 to 99 seconds. The time chosen is the listening time on one of the secondary channels receiving a signal.



Selects the dual watch facility.



Selects 1W reduced power output.

1.3. CONTROLS cont.:



Selects the VHF channels used in the USA.



The intensity of the LED-indicators can be controlled in four steps. The keyboard illumination is switched on and off.



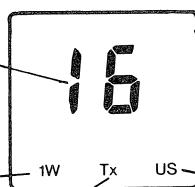
Tests the selcall decoder and resets the selcall decoder after a call.



Selects the standard private channels.

READ-OUT

Channel Read-Out All international maritime channels are shown by the two digits, when the channel has been keyed in. Selection of a standard private channel will be indicated with a **P-**.



Reduced Power

In harbour areas or in the close vicinity of another vessel, transmissions should be with reduced power. When the display shows 1W, the transmitter output power is reduced from 25W to 1W. Where two stations are close together, this reduction can improve communication quality.

Transmitting

Whenever the handset switch is depressed, and the transmitter output power level has reached an appropriate level, the "TX" will appear.

US-Channels

In the USA a number of the international duplex channels are used as simplex channels. Ships sailing in American waters must therefore be able to select these channels as simplex channels. The appearance of "US" on the display indicates that this mode of operation is in use.

1.4. PRINCIPLE OF OPERATION

FREQUENCY GENERATION

All the internal frequencies are referenced to a crystal oscillator, running on 14.85 MHz.

The 14.85 MHz is divided by 4 in the REFERENCE DIVIDER, to generate a 3.7125 MHz signal, which is the input to the PLL-reference divider and clock-signal for the microcomputer.

The local oscillator signal for the first mixer in the receiver and the transmit signal are generated in a phase-locked loop (PLL). To generate the needed frequencies, which are specified as follows:

$139.1 \text{ MHz} \leq f_{L01} \leq 148.45 \text{ MHz}$; $154.5 \text{ MHz} \leq f_{TX \text{ NORMAL}} \leq 159.15 \text{ MHz}$

$159.0 \text{ MHz} \leq f_{TX \text{ SPECIAL}} \leq 163.75 \text{ MHz}$

a bandshift is performed in the VCO.

The loop reference frequency - and so the resolution - is 12.5 kHz, derived by dividing the reference divider output with 297.

The VCO output frequency is divided down to 12.5 kHz after the dual-modulus principle with a PRESCALER dividing with 32/33.

The phase detector output controls the CHARGE PUMPE feeding the loop filter integrator.

If there is a difference in phase/frequency between the inputs to the phase detector. An error current from the charge pumpe will be integrated in the loop filter, producing the needed voltage for the VCO.

RECEIVER

The antenna signal is fed to the RX AMPLIFIER through the RX/TX relay.

The bandpass filters around the RX amplifier are tuned by means of capacitor diodes, which are controlled by a DC-voltage derived from the VCO control voltage in the PLL.

The received signal is converted to the first intermediate frequency on 15.3 MHz in the FIRST MIXER, using the VCO signal from the RX BUFFER AMPLIFIER as local oscillator signal.

The signal is filtered and amplified before down-conversion to 450 kHz in the SECOND MIXER. The crystal oscillator signal is used as local oscillator signal.

After filtering in the SECOND IF FILTER, the signal is amplified and detected.

The AF signal is passed through a mute switch before undergoing appropriate amplification and filtering to get the right frequency response.

Besides, the detected output is filtered in the SQUELCH FILTER before it is amplified, detected, and compared with a reference level to get a logical level for the microcomputer, which controls the mute circuit.

The telephone amplifier and the AF power amplifier produce the wanted output levels for the earpiece and the loudspeaker.

TRANSMITTER

The signal from the microphone is passed through a PRE-EMPHASIS network before appropriate amplification and compression in the AF AMPLIFIER COMPRESSOR.

This signal is filtered before it is fed to the VCO, where the modulation of the transmitter signal takes place.

As the VCO oscillates direct on the transmitting frequency in TX-mode, the signal only has to be amplified. This is done in the TX BUFFER AMPLIFIER and the TX POWER AMPLIFIER.

1.4. PRINCIPLE OF OPERATION cont.:

The power supply for the TX power amplifier is regulated by a feed-back loop via the POWER SENSE circuit to maintain constant output power level. Switching between full and reduced output power level is made by means of the PA-REGULATOR.

To reduce the level of harmonic components in the output signal it is passed through a HARMONIC FILTER before it is led to the antenna via the RX-TX-RELAY.

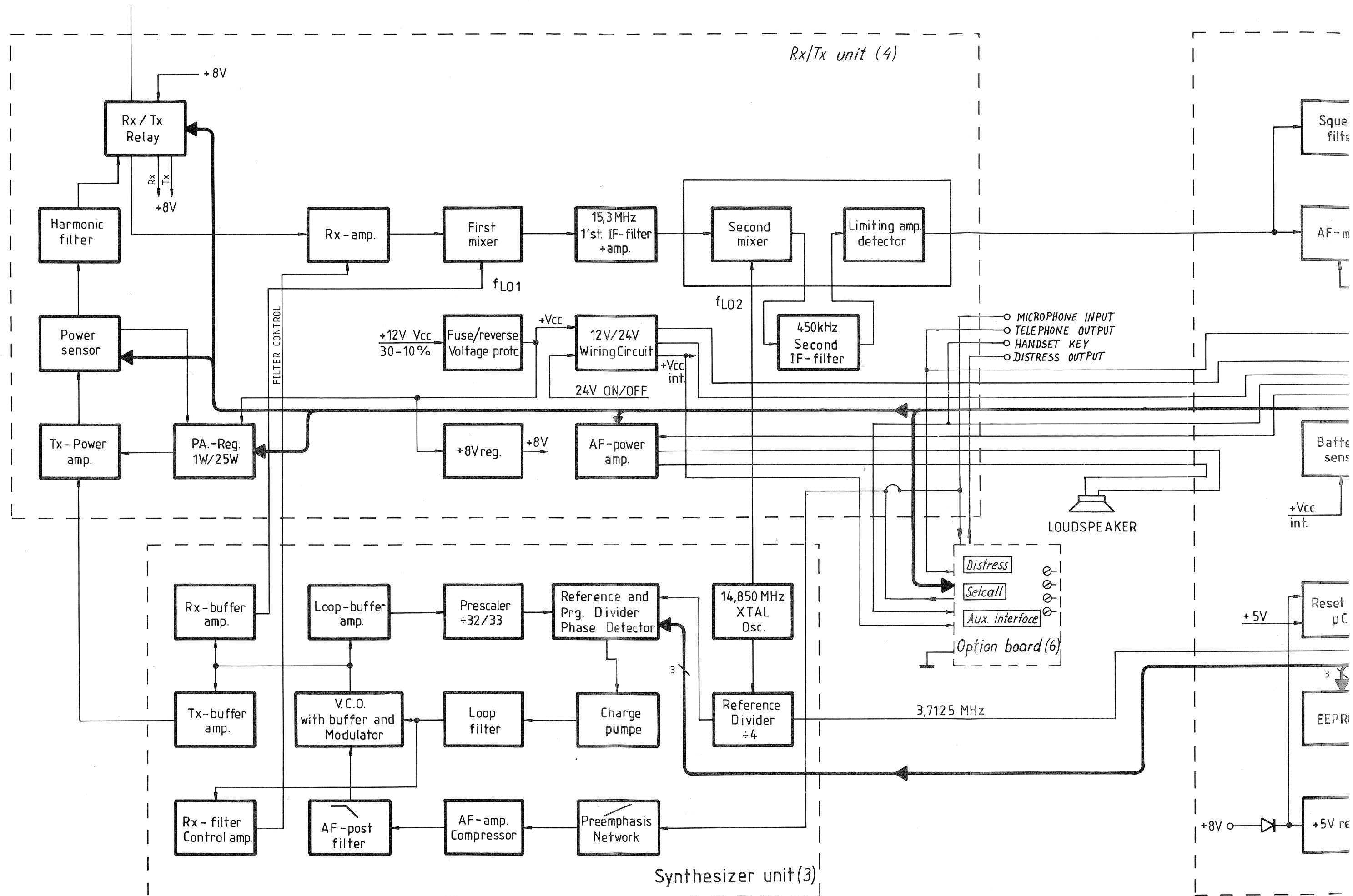
MICROCOMPUTER

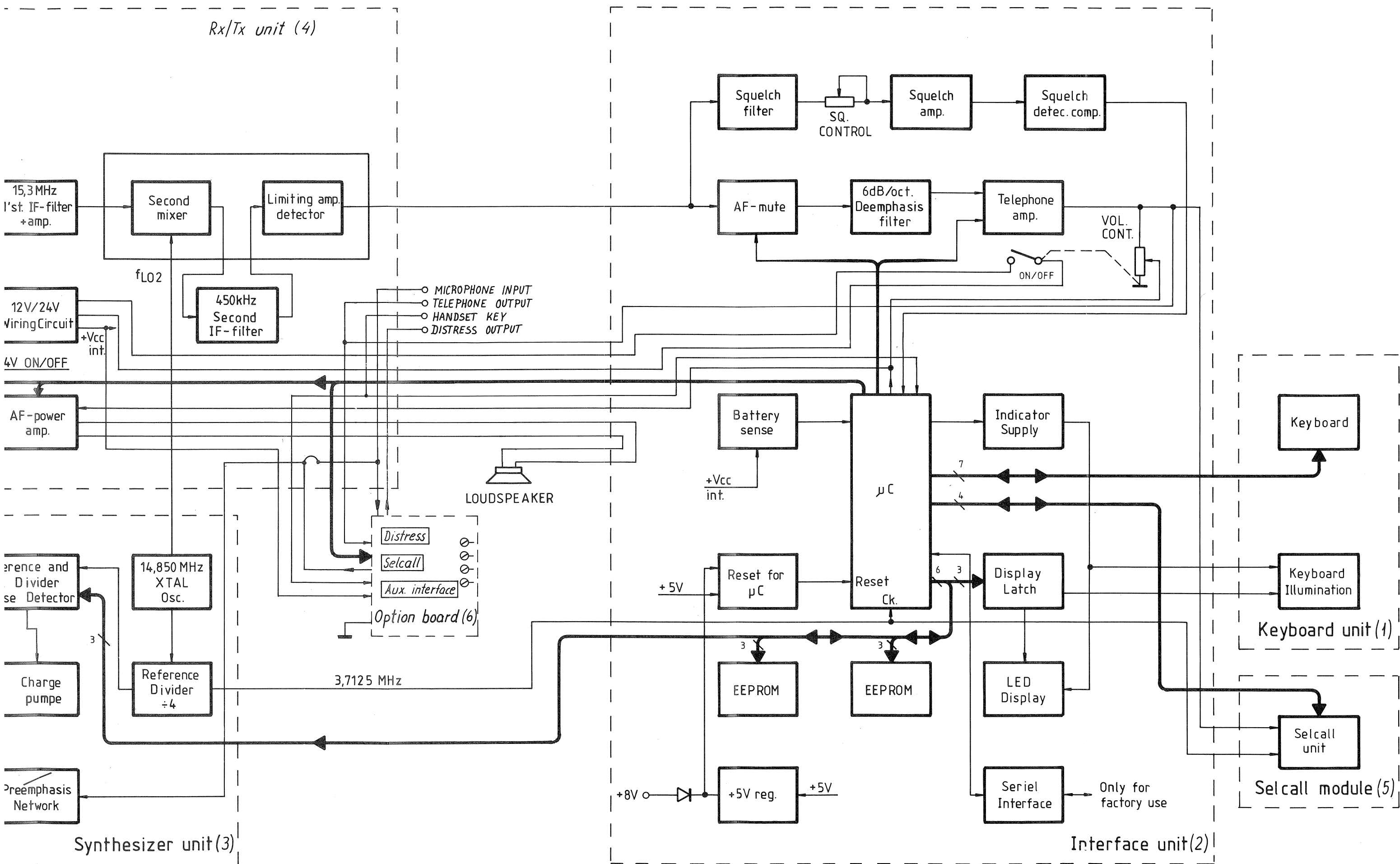
The microcomputer on the interface unit is taking care of various functions, among these the user interface, which means reading of the keyboard and readout to the LED-display via the DISPLAY-LATCHES.

Moreover the computer calculates the appropriate division figures for the PLL, controls the transmitter power level, the AF mute circuits, and reads and writes to the EEPROM's.

When a selcall unit is installed, the microcomputer also controls the selcall switch capacitor filter.

The serial interface is only for factory production use.





BLOCK DIAGRAM RT 2048

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- 2. INSTALLATION
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 - 2.7. SPECIAL OPTIONS
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 - 2.9. STANDARD FREQUENCY TABLE

2. INSTALLATION

Before installation of a SAILOR VHF RT2048 the following points must be observed:

1. Which facilities have to be enabled?
Selcall, private channels, US-mode, dual watch, scanning facilities, etc. The procedure how to enable the facilities is described in the manual: INSTRUCTIONS FOR IDENTITY AND SERVICE PROGRAMMING OF SAILOR VHF RT2048.
This manual will only be delivered to dealers and general agents, where it must be at the disposal of trained service people in the service workshop.
2. In what way the VHF RT2048 has to be installed?
In the section MOUNTING POSSIBILITIES, the installation of VHF RT2048 is described either as an independent unit or in combination with the other elements of the Compact 2000 programme.
3. Handset.
Installation of handset, see the section HANDSET.
4. External loudspeaker.
An external loudspeaker 4-8 ohm/6W can be connected to the power connector J1, pin 1 and 6, see the section POWER CONNECTOR + EXT. LOUDSPEAKER.
5. Special options:
Remote alarm for selcall, AF to information decoder, AUX I and AUX II information, etc. are available, see the section SPECIAL OPTIONS.

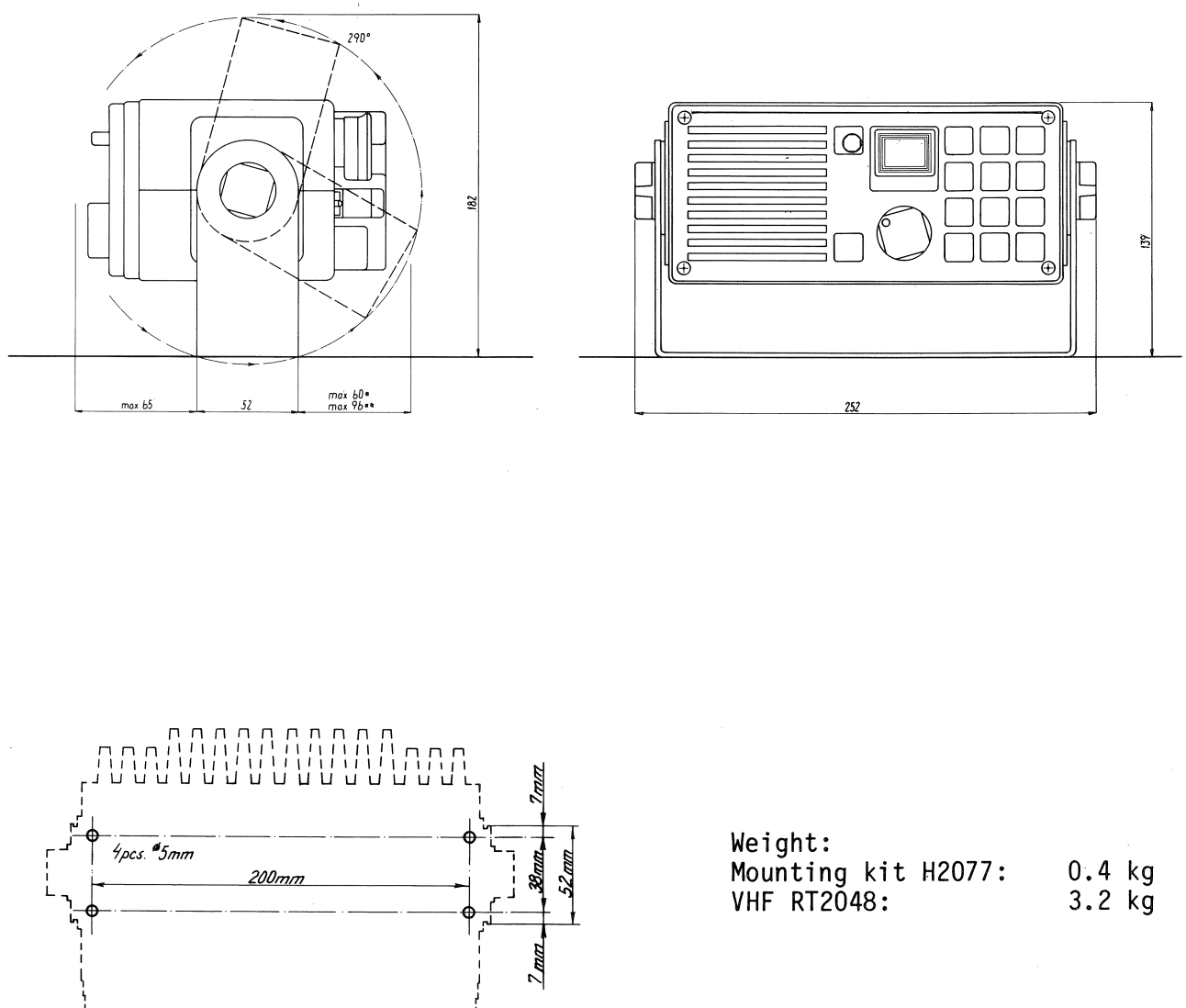
2.1. MOUNTING POSSIBILITIES

The VHF RT2048 cabinet is designed in a module called a mini 1/4 box. For this module we can supply a wide variety of installation brackets etc. which will be described below. We have made a drawing including dimensions and drilling plan for each type and we kindly ask you to look at the drawing for the type in question.

H2077 MULTI-PURPOSE MOUNTING BRACKET

This mounting bracket is as standard delivered together with RT2048. It permits a wide variety of installation possibilities such as tabletop, bulkhead or deckhead. It is easy to remove the set by unscrewing the two buttons of H2077.

H2077



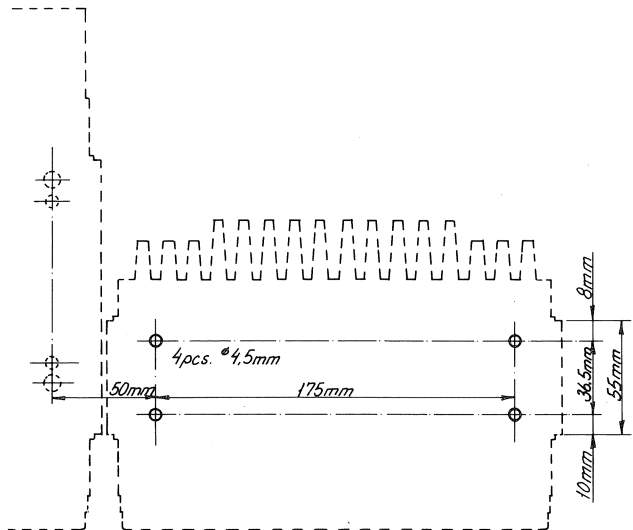
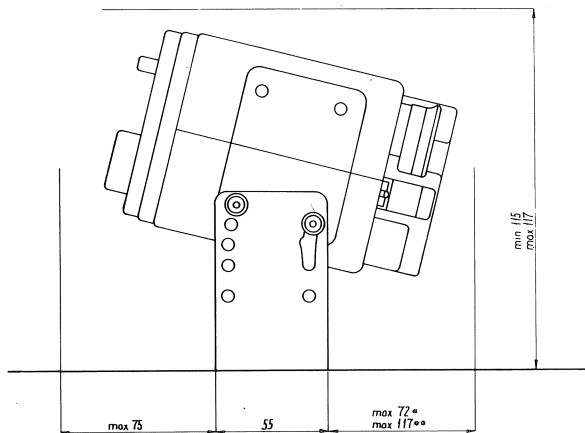
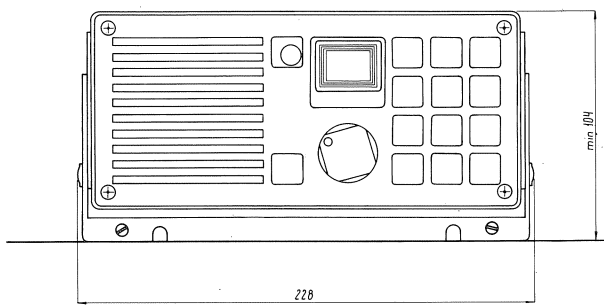
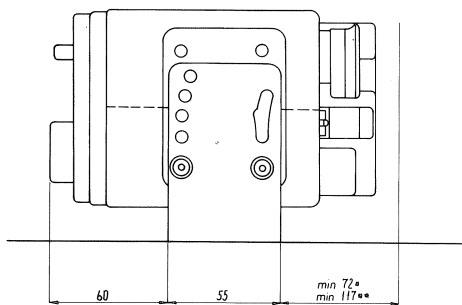
RT2048 A 4-0-25572
4-0-25571
4-0-25668

2.1. MOUNTING POSSIBILITIES cont.:

H2067 MOUNTING BRACKET FOR TABLETOP, BULKEHAD OR DECKHEAD MOUNTING FOR MINI
1/4 BOX

This mounting bracket is used when RT2048 is to be mounted next to other SAILOR units in the Compact 2000 programme mounted in H2055 mounting brackets. For example when installing the RT2048 next to the scrambler CRY2001 it is possible to tilt both units in the same angle.

H2067



Weight:
Mounting kit H2067: 0.5 kg
VHF RT2048: 3.2 kg

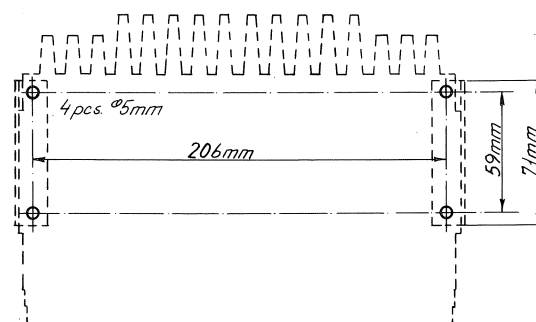
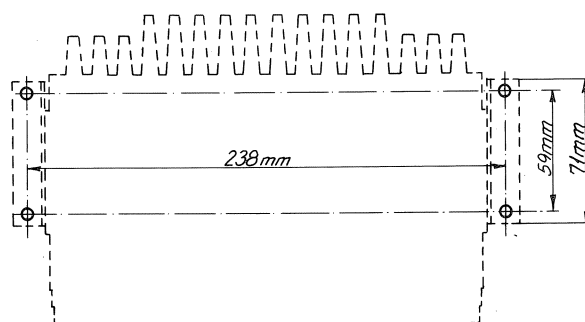
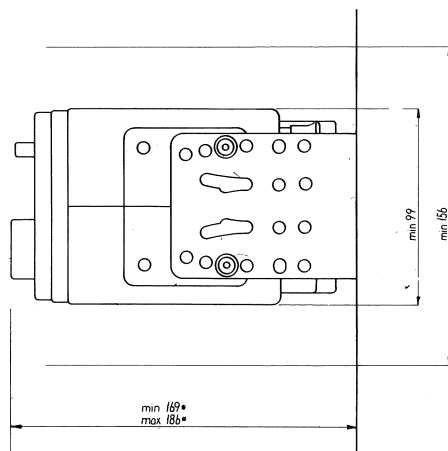
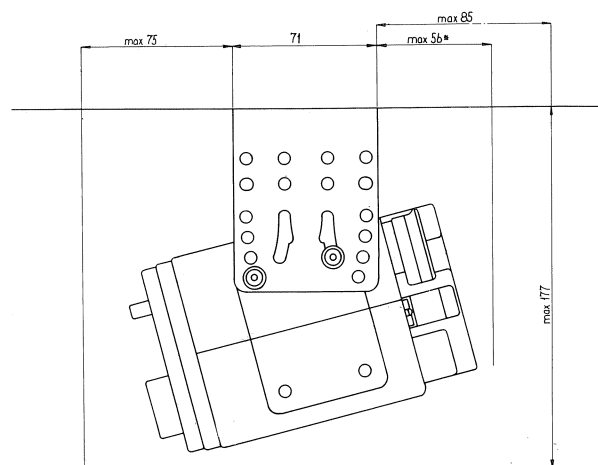
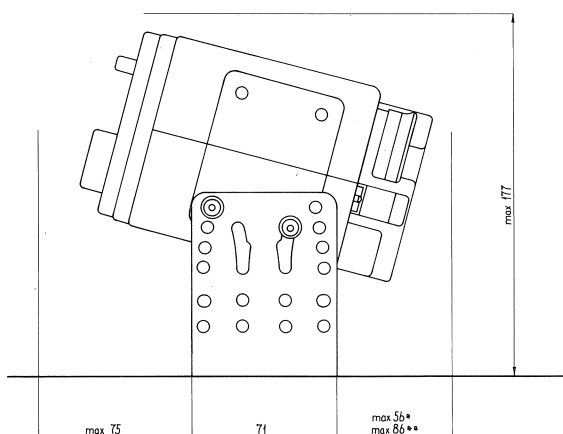
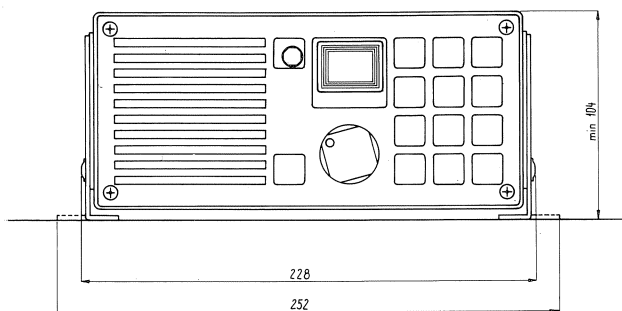
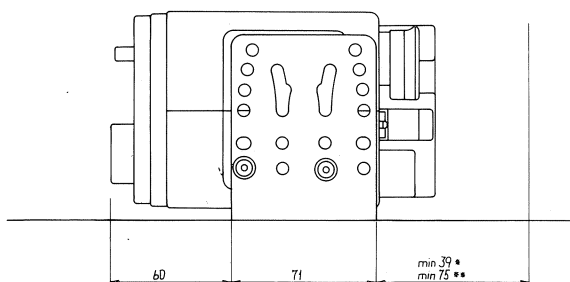
RT2048 A	4-0-25574	4-0-25573
	4-0-25575	4-0-25659A

2.1. MOUNTING POSSIBILITIES cont.:

H2057 ANGLE HINGES FOR TABLETOP, BULKHEAD OR DECKHEAD MOUNTING FOR MINI 1/4 BOX

H2057 is designed for stationary installation. It offers a lot of mounting possibilities using the different holes in the angle hinges when tilting the VHF.

H2057



* Dimensions when using a right-angled VHF plug.
** Dimensions when using a standard VHF plug.

Weight: Mounting kit H2057: 0.4 kg
VHF RT2048: 3.2 kg

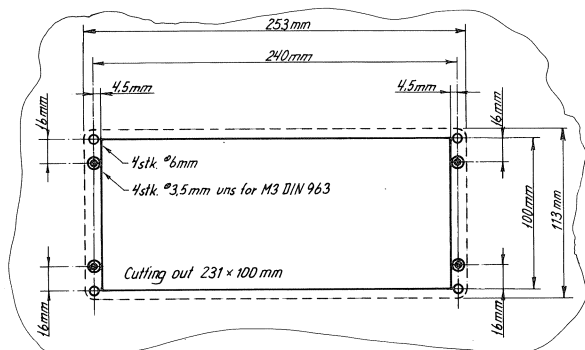
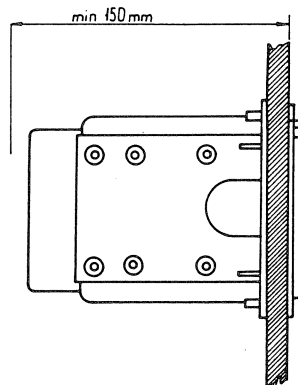
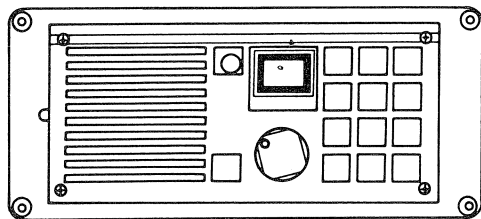
2.1. MOUNTING POSSIBILITIES cont.:

H2063 CONSOLE MOUNTING KIT FOR 1/4 BOX

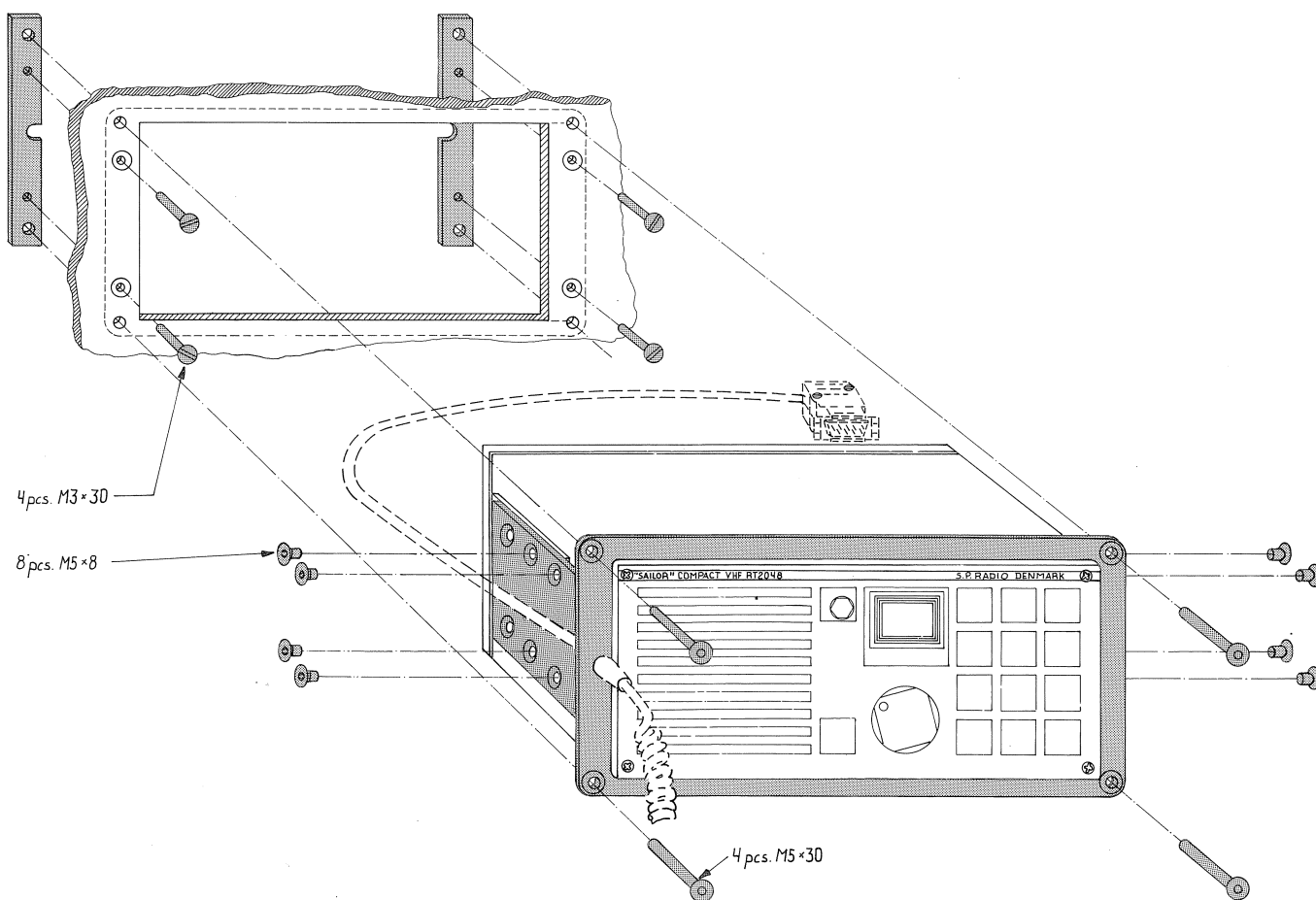
This mounting kit is used for console flush mounting of 1/4 box and mini 1/4 box.

Free distance must be kept to allow free air circulation, ambient temperature max. 40°C.

H2063



Weight:
 Mounting kit H2063: 1.0 kg
 VHF RT2048: 3.2 kg



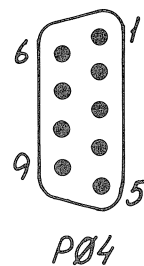
RT2048 A 4-0-25663
 4-0-24703
 4-0-25657

RT2048 A 4-0-25666
4-0-25665 4-0-25664

2.2. HANDSET

The handset can be placed anywhere near the VHF set. The cable is five-cored and connected to the rear of the VHF through a 9-pole Sub-D connector. Installation of the cable, see the drawings of the mounting brackets. The cable grommet must be placed in the most convenient groove in the mounting bracket.
If more than one handset is needed, please see the section SPECIAL INSTALLATION WITH 2 OR 3 MICROTELEPHONES.

2.3. MICROTELEPHONE CONNECTOR



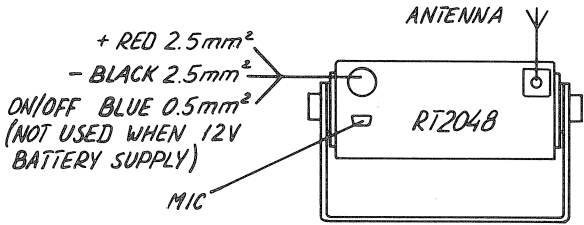
- Pin No. 1 Telephone
- Pin No. 2 GND
- Pin No. 3 GND
- Pin No. 4 Mic
- Pin No. 5 Key
- Pin No. 6 Spare
- Pin No. 7 Distress CRY*
- Pin No. 8 "Serial input"
- Pin No. 9 +13V internal

*only active when option board pcb is installed.

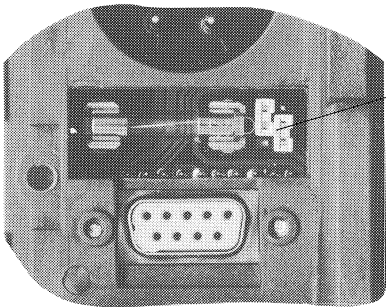
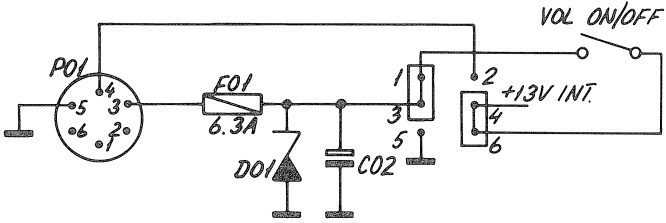
2.4. POWER SUPPLY

The standard power supply for RT2048 is 12V DC. For 24V DC supply an external power supply N420 (a 24V DC to 13.2V DC serial regulator) can be used.
For 110V AC, 127V AC, 220V AC, or 237V AC operation an external power supply N163S must be used together with N420.

12V OPERATION

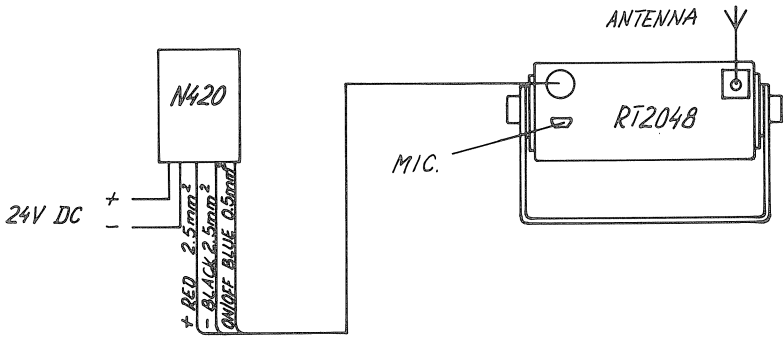


BLOCK DIAGRAM OF STRAPPING FOR 12V DC

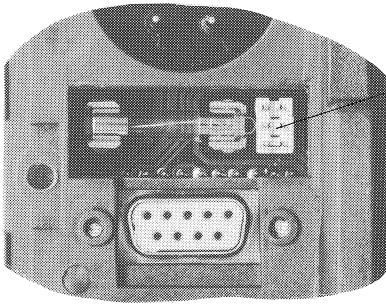
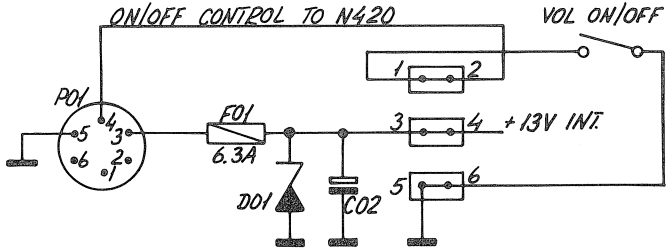


Strap for connection to external supply (12V)

24V OPERATION



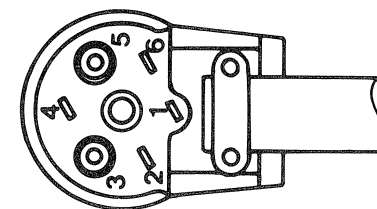
BLOCK DIAGRAM OF STRAPPING FOR 24V DC



Strap for connection to N420 (24V)

2.5. POWER CONNECTOR + EXT. LOUDSPEAKER

VIEW FROM MOUNTING SIDE



J01

Pin No. 1 Ext. loudspeaker
Pin No. 2 Ext. mute*
Pin No. 3 +12V power supply
Pin No. 4 on/off for 24V supply
Pin No. 5 -12V power supply
Pin No. 6 Ext. loudspeaker

*only active when option board pcb is installed.

If necessary a 4-8 ohm/6W external loudspeaker can be connected to pin No. 1 and pin No. 6 in the power connector J 01 (observe that there is DC voltage on both wires).

External loudspeakers SAILOR H2054 and H2074 are available.

2.6. ANTENNAS

All common 50 ohm antennas, which cover the used frequency range with a reasonable standing wave ratio, maximum 1.5, are available.

The antenna is connected to the set by means of a 50 ohm coaxial cable with low loss, e.g. RG213U. At the cable end a PL259 plug is mounted.

The antenna must be placed as high and clear as possible. The horizontal distance to metal parts must be at least one metre.

S. P. Radio has an antenna of the necessary specifications available. The mentioned antenna is characterized by small external dimensions. For further particulars see special brochure VHF AERIALS.

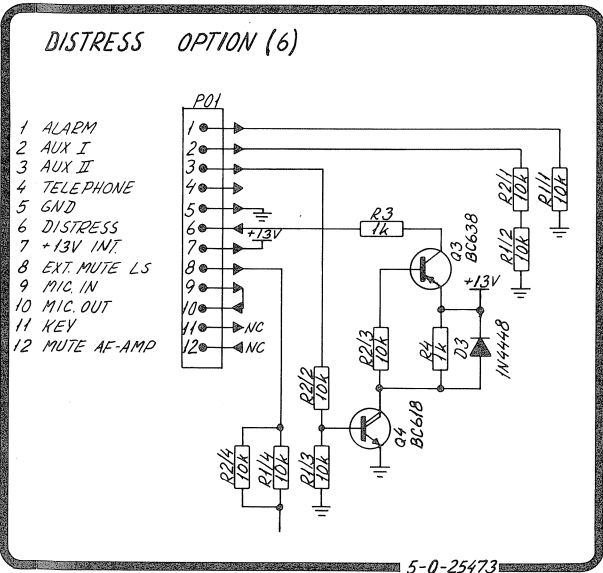
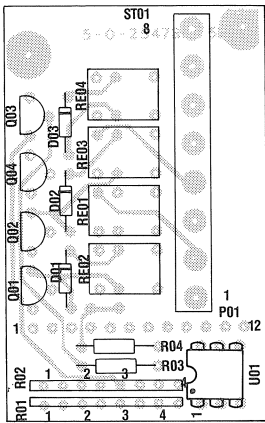
2.7. SPECIAL OPTIONS

With a small modification in RT2048 the following options are available:

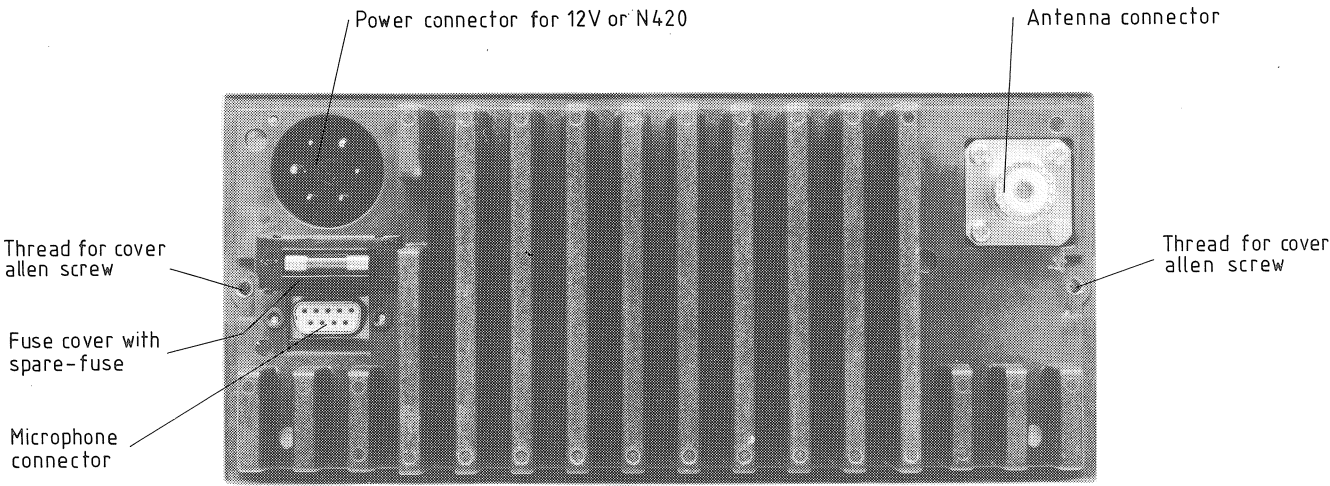
1. K-switch function (used on river boats in Germany). Can be enabled by means of the identity programming. US-button is changed to K-switch.
2. With DISTRESS OPTION installed
S.P. No. 625661
 - a. Distress output to CRY2001/2002.

2.7. SPECIAL OPTIONS cont.:

3. With SELCALL OPTION installed
S.P. No. 625660
- a. SELCALL RELAY, when the selcall has accepted a CQ or an individual call signal, the selcall relay will turn on and short circuit two wires, which can be used for remote alarm. Max. contact load: 100V AC/24V DC - 2A.
 - b. AF TO INFORMATION DECODER, the circuit giving AF signals to the information decoder is turned on when the set has accepted a CQ or an individual call signal. The circuit is turned on/off by the microprocessor.
4. With AUX INTERFACE OPTION installed
S.P. No. 625473
(AUX1, AUX2 and MUTE functions) (Distress and Selcall functions are also mounted)
- a. AUX2, when information on certain channels is wanted, i.e. controlling a watch keeping receiver, the AUX2 information can be used, a relay is controlled from the microprocessor. Max. contact load: 100V AC/24V DC - 2A.
 - b. AUX1, when function code in Prom 1 is enabled, AUX1 is free programmable on all international channels ("0" or "1"). Standard programming on international channels is "0". Max. contact load: 100V AC/24V DC-2A.
 - c. MUTE, makes it possible to mute AF power amplifier from external equipment. Activated by a make function between pin 5 and pin 8 in P1 on option board.



2.8. REAR VIEW OF VHF RT2048



2.9. STANDARD FREQUENCY TABLE

CHANNEL	TRANSMITTING FREQUENCY (MHz)	RECEIVING FREQUENCY (MHz)	
		US MODE (A.-CHANNELS)	INT'L MODE (INT.-CHANNELS)
01	156.050	156.050	160.650
02	156.100		160.700
03	156.150		160.750
04	156.200		160.800
05	156.250	156.250	160.850
06	156.300		156.300
07	156.350	156.350	160.950
08	156.400		156.400
09	156.450		156.450
10	156.500		156.500
11	156.550		156.550
12	156.600		156.600
13	156.650		156.650
14	156.700		156.700
15	156.750		156.750
16	156.800		156.800
17	156.850		156.850
18	156.900	156.900	161.500
19	156.950	156.950	161.550
20	157.000		161.600
21	157.050	157.050	161.650
22	157.100	157.100	161.700
23	157.150	157.150	161.750
24	157.200		161.800
25	157.250		161.850
26	157.300		161.900
27	157.350		161.950
28	157.400		162.000
60	156.025		160.625
61	156.075		160.675
62	156.125		160.725
63	156.175	156.175	160.775
64	156.225		160.825
65	156.275	156.275	160.875
66	156.325	156.325	160.925
67	156.375		156.375
68	156.425		156.425
69	156.475		156.475
70	156.525		156.525
71	156.575		156.575
72	156.625		156.625
73	156.675		156.675
74	156.725		156.725
77	156.875		156.875
78	156.925	156.925	161.525
79	156.975	156.975	161.575
80	157.025	157.025	161.625
81	157.075	157.075	161.675
82	157.125	157.125	161.725
83	157.175	157.175	161.775
84	157.225		161.825
85	157.275		161.875
86	157.325		161.925
87	157.375		161.975
88	157.425	157.425	162.025
WX1	Inhibit		162.550
WX2	Inhibit		162.400
WX3	Inhibit		162.475
WX4	Inhibit		161.650

CONTENTS

- 3. SERVICE
 - 3.1. MAINTENANCE
 - 3.2. ALIGNMENT INSTRUCTIONS
 - 3.3. PROPOSAL FOR NECESSARY MEASURING INSTRUMENTS
 - 3.4. TEST PROBE
 - 3.5. ADJUSTMENT PROCEDURE
 - 3.5.1 ADJUSTMENT OF SYNTHESIZER UNIT
 - 3.5.2. ADJUSTMENT OF RX/TX UNIT
 - 3.6. TROUBLE SHOOTING
 - 3.7. REPLACEMENT OF COMPONENTS
 - 3.8. REPLACEMENT OF MODULES
 - 3.9. NECESSARY ADJUSTMENTS AFTER REPLACEMENT OF MODULE
 - 3.9.1. REPLACEMENT OF RX/TX UNIT
 - 3.9.2. REPLACEMENT OF SYNTHESIZER UNIT
 - 3.10. PIN CONFIGURATIONS

3. SERVICE

3.1. MAINTENANCE

PREVENTIVE MAINTANANCE

If SAILOR RT2048 has been installed in a proper way the maintenance can be reduced to an overhaul at each visit of the service staff. Then inspect the set, the antenna, cables, and plugs for mechanical damages, salt deposits, corrosion, and any foreign material. Owing to its traditional structure, the SAILOR RT2048 has a long lifetime, but it must always be carefully checked at intervals not exceeding 12 months - dependent on the conditions under which the set is working. The set must be brought to the service workshop to be tested.

Along with each set a TEST-SHEET is delivered in which all the measurements, made in the test department of the factory, are listed. If the control measurings made in the service workshop should not show the same values as those listed in the test-sheet, the set must be adjusted as specified in the ADJUSTMENT PROCEDURE.

3.2. ALIGNMENT INSTRUCTIONS

INTRODUCTION

The measuring values indicated in paragraph 2 of CIRCUIT DESCRIPTION AND SCHEMATIC DIAGRAMS are typical values and as indicated it will be necessary to use instruments in absolute conformity with the below list:

3.3. PROPOSAL FOR NECESSARY MEASURING INSTRUMENTS

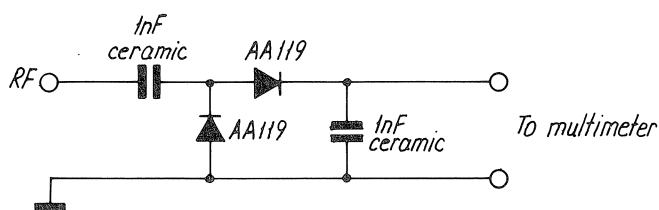
VHF Signal Generator type TF2015	MARCONI
FM Modulation Meter type TF2303	MARCONI
Distortion Analyzer type TF2337A	MARCONI
AF Voltmeter type VT-121	TRIO
Tone Generator type PM5107	PHILIPS
Electronic Multimeter type PM2505	PHILIPS
RF Directional Wattmeter Model 43	BIRD
50W Load with 30 dB Attenuator type 8321	BIRD
Frequency Counter:	
Frequency range	>175 Mhz
Sensitivity	<100 mV
Impedance	>1 Mohm and 50 ohm
Accuracy	$<1 \cdot 10^{-6}$

3.3. PROPOSAL FOR NECESSARY MEASURING INSTRUMENTS cont.:

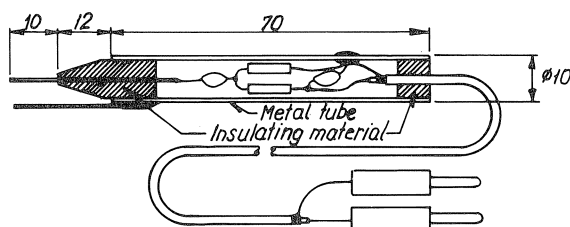
We can also recommend one of the new communication test sets introduced by several instruments manufacturers.

From S. P. Radio this high quality product will be tested and adjusted by means of a CMT communication tester from Rohde and Schwarz.

3.4. TEST PROBE



LAYOUT OF THE PROBE



All measurements made by means of a test probe will be relative measurements. For quantitative measurements the diode probe should be calibrated by means of a signal generator at a certain impedance level (50 ohm) as a function of frequency.

3.5. ADJUSTMENT PROCEDURE

3.5.1. ADJUSTMENT OF SYNTHESIZER UNIT

Alignment of Frequency Generator and RF-Levels.

1. Connect a frequency counter to the TX-driver output of J4.
2. Select channel 6 and key the transmitter.
3. Connect a DC-voltmeter to the point between R50 and R95 and adjust L9 until the reading is 2.0V.
4. Adjust the frequency on C77 until the counter read-out is 156.300000 MHz ± 150 Hz.
5. Connect a power meter to the TX-driver output at J4 and adjust the output level to minimum at R98.
6. Now the windings on coils L14, L13, and L12, L11, L10 are moved a little bit to obtain maximum output at J4.
7. If the output level is below 200 mW, the level is raised by means of R98 until the power meter reading is 200 mW.
8. Release the transmitter key; the set should still be on channel 6.
9. Connect a DC-voltmeter to the point between R50 and R95 and adjust C78 until the reading is 2.0V.
10. Check the RF-output level from the RX-buffer amplifier at J3. The level should be 5 mW -1 dB, $+3$ dB.

Alignment of Modulation Circuitry.

1. Connect a modulation meter to the TX-driver output at J4, and a distortion meter to the AF-output part on the modulation meter.
2. Connect tone generator and AF-voltmeter between pin 4 in the connector for handset and ground, pin 3.
3. Select channel number 6 and key the transmitter.
4. Turn potentiometer R97 fully clockwise.
5. Set the tone generator to a frequency of 1000 Hz and output level to 100 mV_{RMS}
6. Adjust R96 to nominal modulation: $f = \pm 3$ kHz and check that distortion is less than 5%
7. Raise tone generator output level to 1.0 V_{RMS}
8. Adjust R97 to maximum deviation: $f = \pm 4.8$ kHz.

3.5.1. ADJUSTMENT OF SYNTHESIZER UNIT cont.:

Alignment of RX-Filter Control Amplifier

1. The receiver must be tuned up according to the TUNE-UP PROCEDURE.
2. Select channel 28.
3. Connect signal generator to antenna connector J04.
4. Connect test probe to pin 16 at U03 on the RX/TX board.
5. Set signal generator frequency to 162.000 MHz and output level to -30 dBm.
6. Adjust R95 until maximum output level from the test probe is reached.

3.5.2. ADJUSTMENT OF RX/TX UNIT

Alignment of Internal Power Supply

1. Select channel 6.
2. Select 1W output level and key the transmitter.
3. Connect a DC-voltmeter to the test point at the output of U01.
4. Adjust the output voltage to 8V \pm 50 mV by means of potentiometer R04.

Alignment of RF and IF Amplifier

1. Select channel 6.
2. Connect signal generator to antenna connector J04.
3. Connect test probe to pin 16 on U03.
4. Set signal generator frequency to 156.300 MHz and the output level to -30 dBm.
5. Adjust transformers TR01, TR02, and coils L10, L11, L12, and L09 to maximum deflection on the TP-meter.

Alignment of Detector and AF-Output Level

1. Select channel 6.
2. Connect signal generator to antenna connector J04.
3. Connect frequency counter between pin 3 of U03 and frame through a 10 μ F capacitor.
4. Set signal generator level to -30 dBm (no modulation).
5. Set signal generator frequency until frequency counter shows 450.0 kHz \pm 100 Hz.

3.5.2. ADJUSTMENT OF RX/TX UNIT cont.:

6. Set modulation on signal generator to nominal modulation fm = 1 kHz, f = ± 3 kHz.
7. Connect AF-voltmeter to the AF output at pin 11 on U03.
8. Adjust coil L06 to maximum deflection on the AF-voltmeter.
9. Adjust potentiometer R20 to 250 mV_{RMS} ± 10 mV_{RMS} on AF-voltmeter.
10. Connect distortion analyzer to the telephone output at pin 1 on P04.
11. Make sure that distortion is minimum by slightly tuning transformer TR01.
12. Check that distortion is below 5%.

Control of Receiver Sensitivity

1. Select channel 6.
2. Connect signal generator to antenna connector J04.
3. Connect distortion analyzer to the telephone output at pin 1 on P04.
4. Set signal generator to best sensitivity.
5. Check that the sensitivity is better than 0.5 μ V EMF for 12 dB SINAD.
6. Repeat on channel 28.

Alignment of Transmitter Output Level

1. Connect RF-power meter and a 50 ohm 25 Watt load resistor to antenna connector J04.
2. Select channel 6 and key the transmitter.
3. Adjust potentiometer R21 until the reading is 25 Watt.
4. Set the output level to 1W.
5. Adjust potentiometer R19 until the reading is 0.8 Watt.

3.6. TROUBLE-SHOOTING

Trouble-shooting should only be performed by persons with sufficient technical knowledge, who have the necessary measuring instruments at their disposal, and who have carefully studied the operation principles and structure of SAILOR RT2048.

The first thing to check is whether the fault is somewhere in the antenna circuit, the power source, the handset, or in the transmitter - receiver unit.

In order to help you during trouble-shooting, the section 5. CIRCUIT DESCRIPTION contains diagrams, principal descriptions, and drawings showing the location of the individual components. Typical values for the DC and AC voltages are indicated in the diagrams, and also the test points are indicated in the diagrams.

SAILOR RT2048 has a number of trimming cores and trimmers, which must not be touched unless adjustments as specified in section 3.5. ADJUSTMENT PROCEDURE can be made.

When measuring in the units, short-circuits must be avoided as the transistors would then be spoiled.

3.7. REPLACEMENT OF COMPONENTS

When replacing transistors, diodes, resistors, capacitors and similar components you must use a small "pencil" soldering iron of 30 to 75 Watt rating. The soldering must be performed rapidly to avoid over-heating, and the use of a tin sucker is recommended, as otherwise there is a risk that both the components and the printed circuit will be spoiled.

3.8. REPLACEMENT OF MODULES

If a fault has been found in a module, it may often be worth-while to replace it and then repair it later on.

3.9. NECESSARY ADJUSTMENTS AFTER REPLACEMENT OF MODULE

3.9.1. REPLACEMENT OF RX/TX UNIT

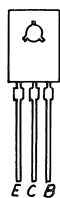
1. If a factory adjusted and tested module has to be inserted, just proceed with point 3.
2. Follow the procedure described in section 3.5.2. ADJUSTMENT OF RX/TX UNIT.
3. Follow the procedure Alignment of RX-filter control amplifier described in section 3.5.1. ADJUSTMENT OF SYNTHESIZER UNIT.

3.9.2. REPLACEMENT OF SYNTHESIZER UNIT

1. If a factory adjusted and tested module has to be inserted, just proceed with point 3.
2. Follow the procedure described in section 3.5.1. ADJUSTMENT OF SYNTHESIZER UNIT.
3. Follow the procedure Alignment of RX-filter control amplifier described in section 3.5.1.

3.10. PIN CONFIGURATIONS

TRANSISTORS



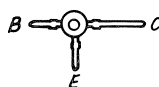
BD234



TIS88A



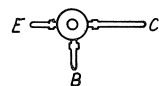
BF199



BFW92A



BC328-25
BC338-25
BC547A
BC547C
BC548B
BC549C
BC558B
BC557C



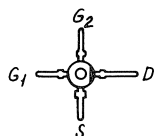
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BC638



2N2369A



BF964



BF509

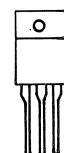


2N4427



J309

INTEGRATED CIRCUIT



LM317T



LM78L05AC

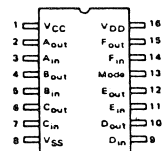


BF245A
BF256A

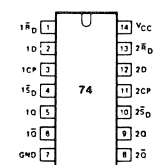


LM317LZ

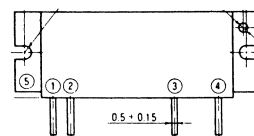
MC14504B



PC74HC74

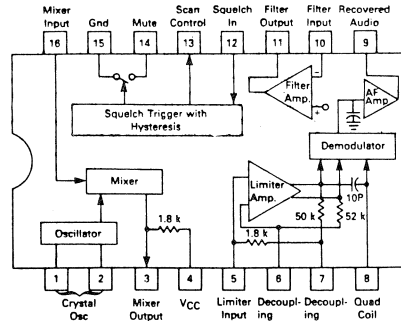
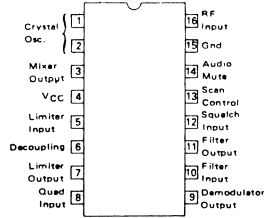


M57710A

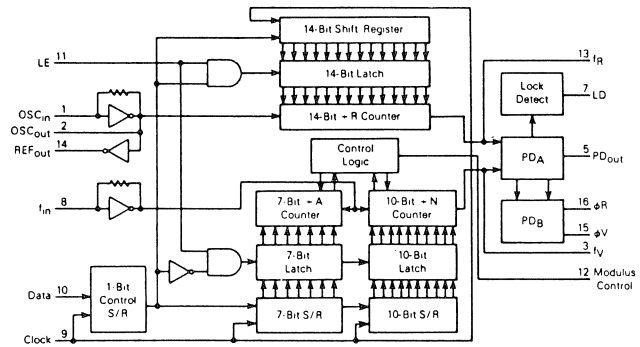
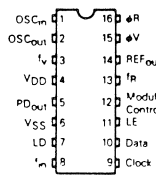


3.10. PIN CONFIGURATIONS cont.:

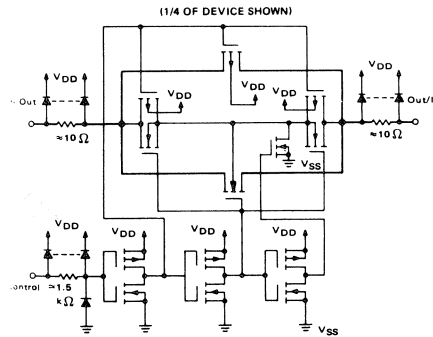
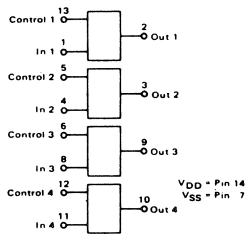
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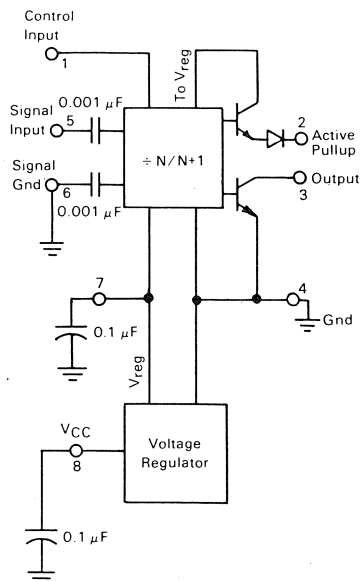
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MC14066B

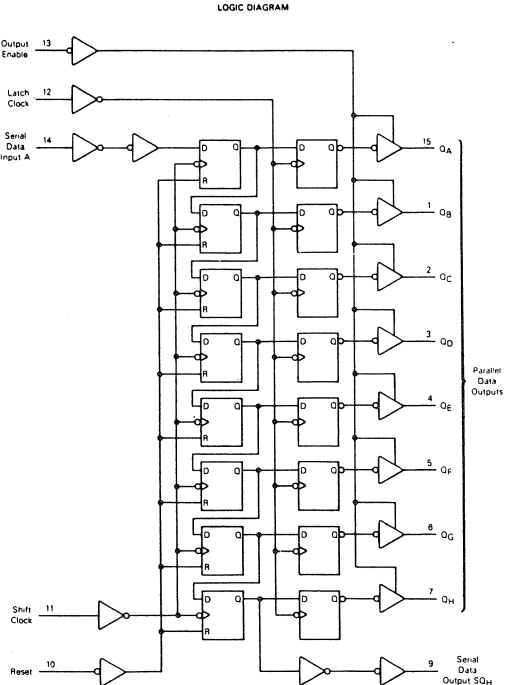
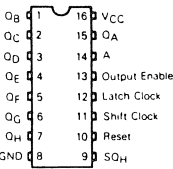


MC12015



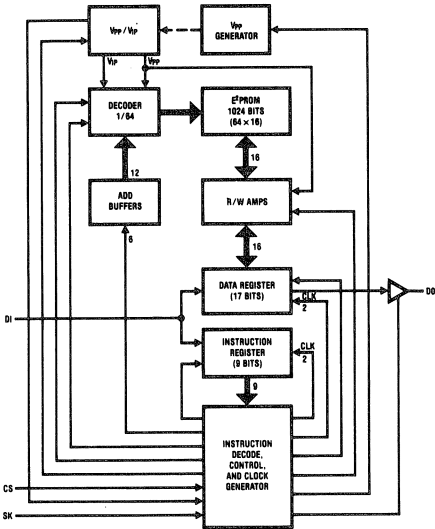
3.10. PIN CONFIGURATIONS cont.:

MC74HC595

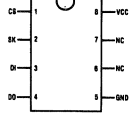


93C46 EEPROM

Block and Connection Diagrams

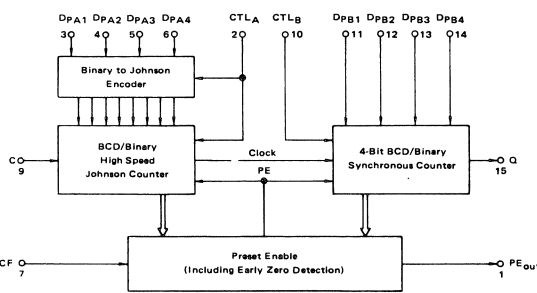
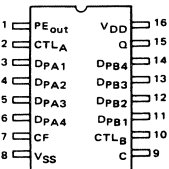


Dual-In-Line Package



- Pin Names
- CS: Chip Select
 - SK: Serial Data Clock
 - DI: Serial Data Input
 - DO: Serial Data Output
 - V_{CC}: Power Supply
 - GND: Ground
 - NC: Not Connected

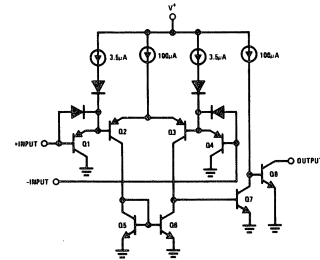
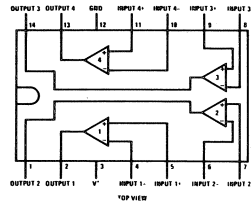
MC14569B



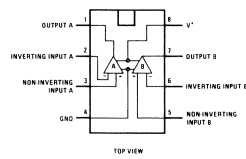
V_{DD} = Pin 16
V_{SS} = Pin 8

3.10. PIN CONFIGURATIONS cont.:

LM339

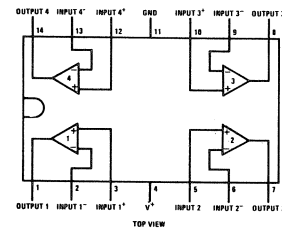


LM393

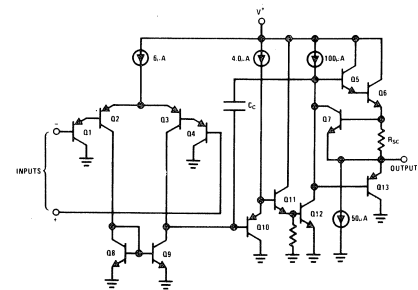
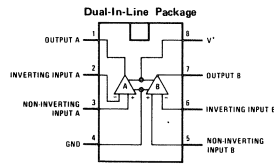


LM324

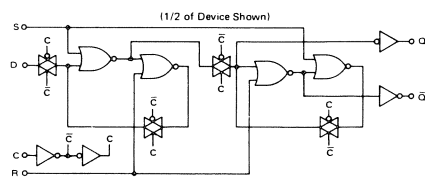
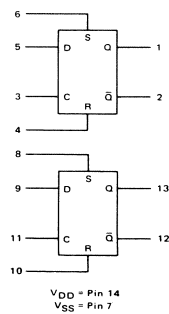
Dual-In-Line and Flat Package



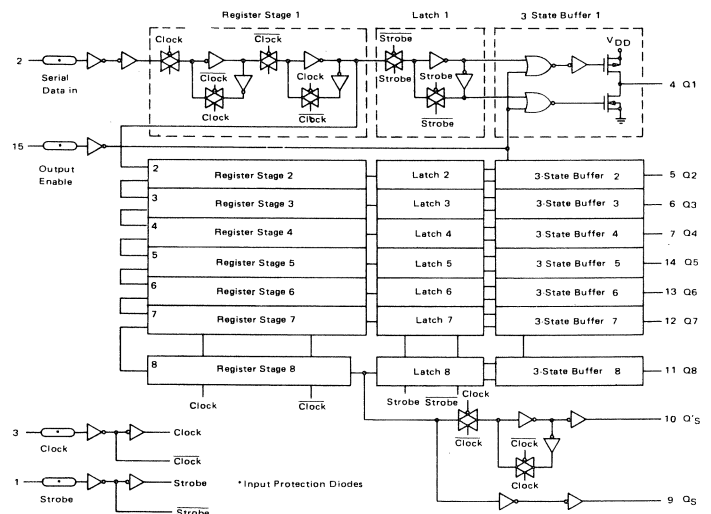
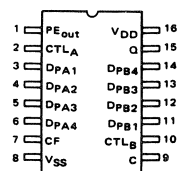
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MC14013B



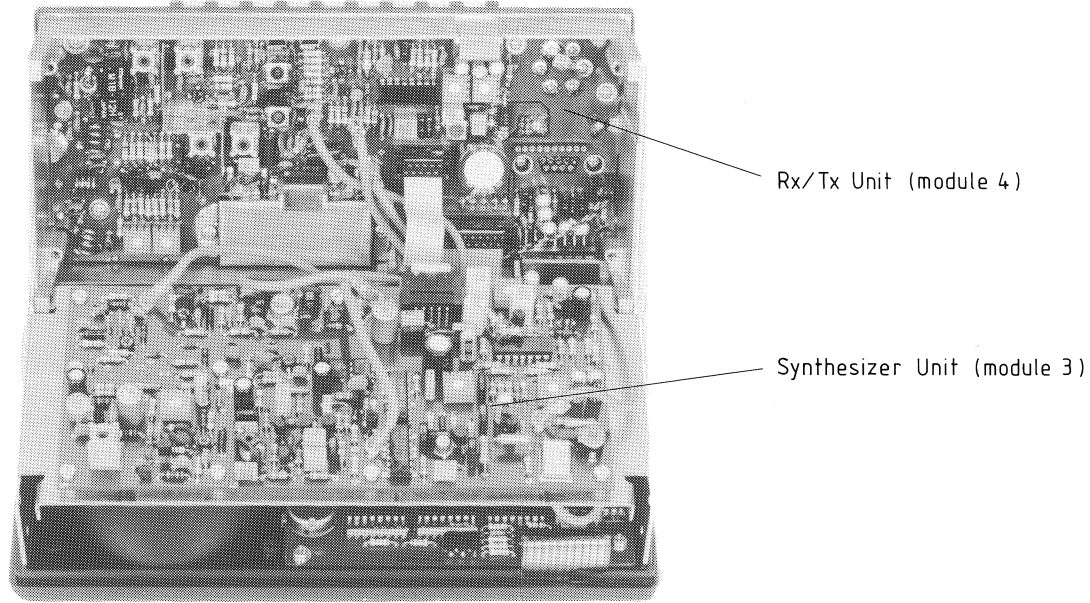
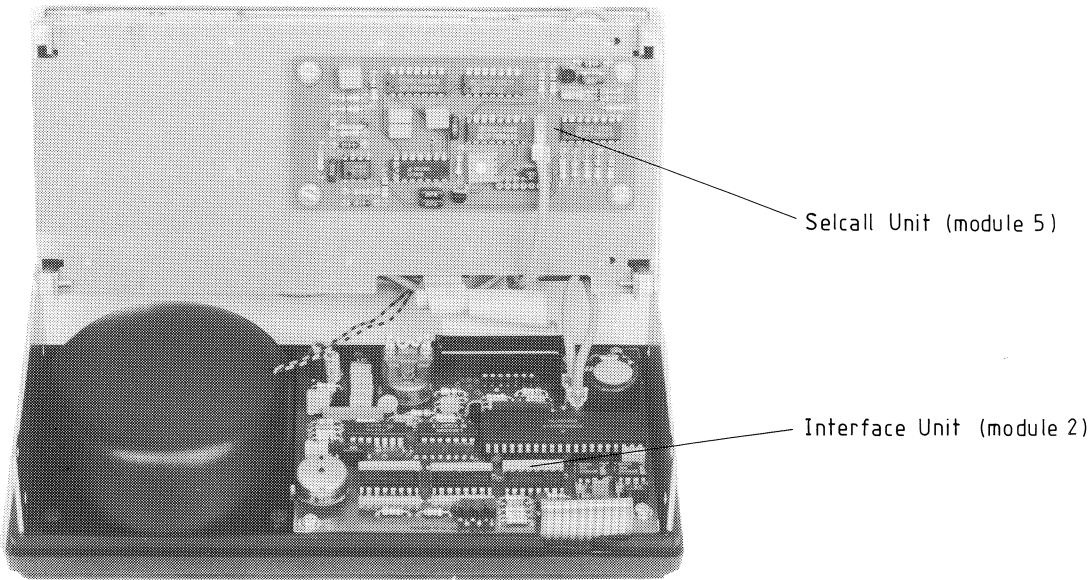
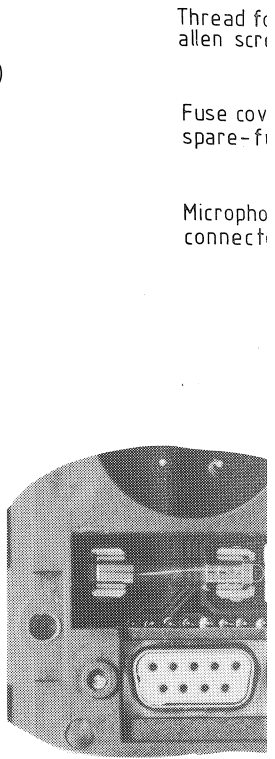
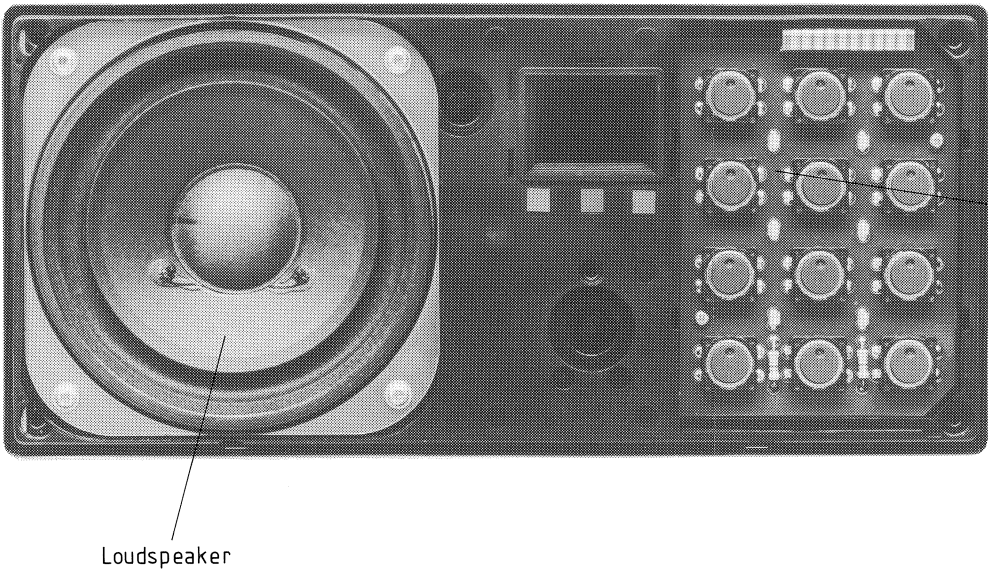
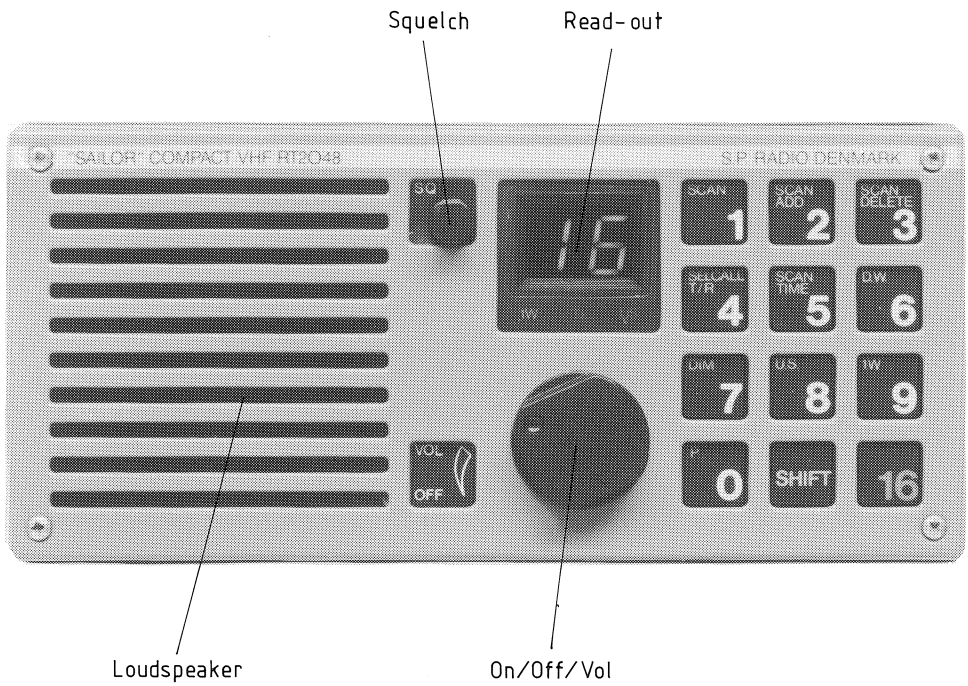
MC14094B



CONTENTS

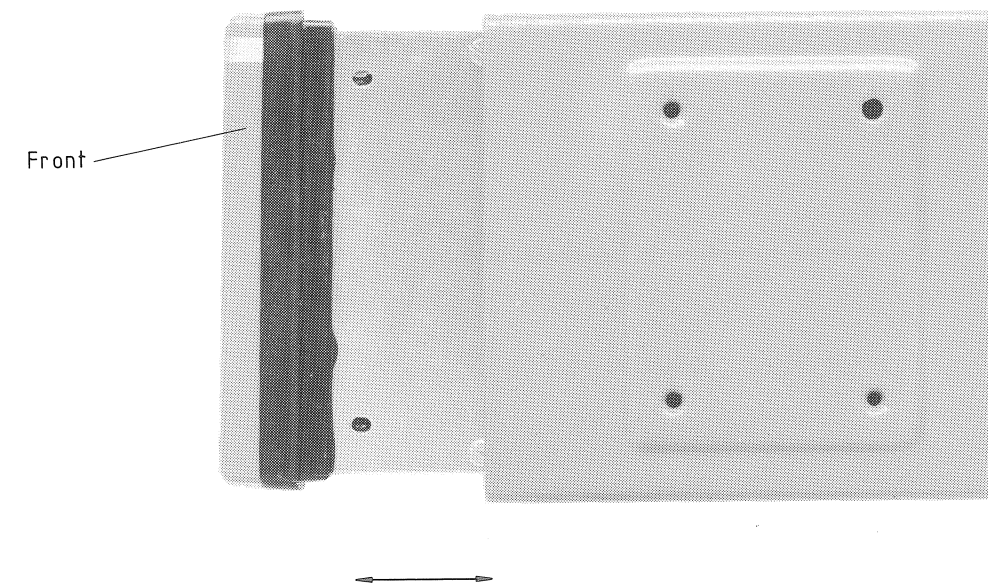
- 4. MODULE LOCATION
- 4.1. MECHANICAL DISASSEMBLING

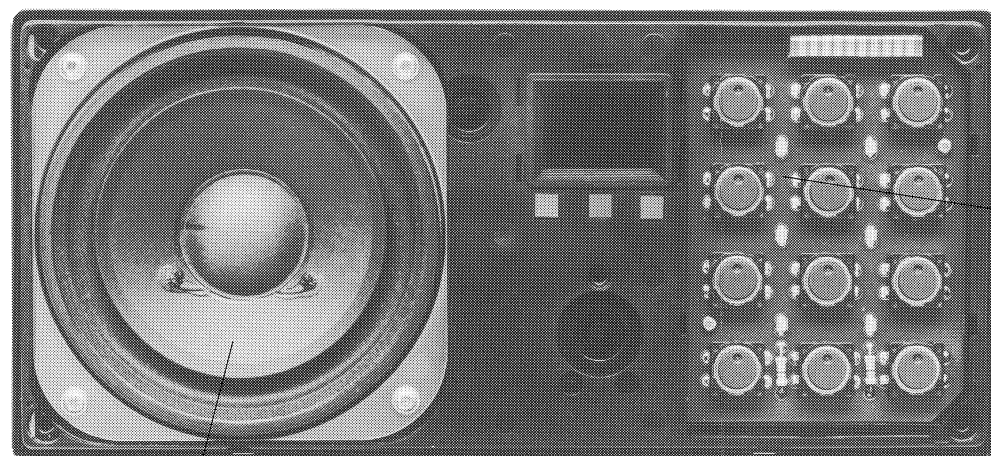
4. MODULE LOCATION



4.1. MECHANICAL DISASSEMBLING RT2048

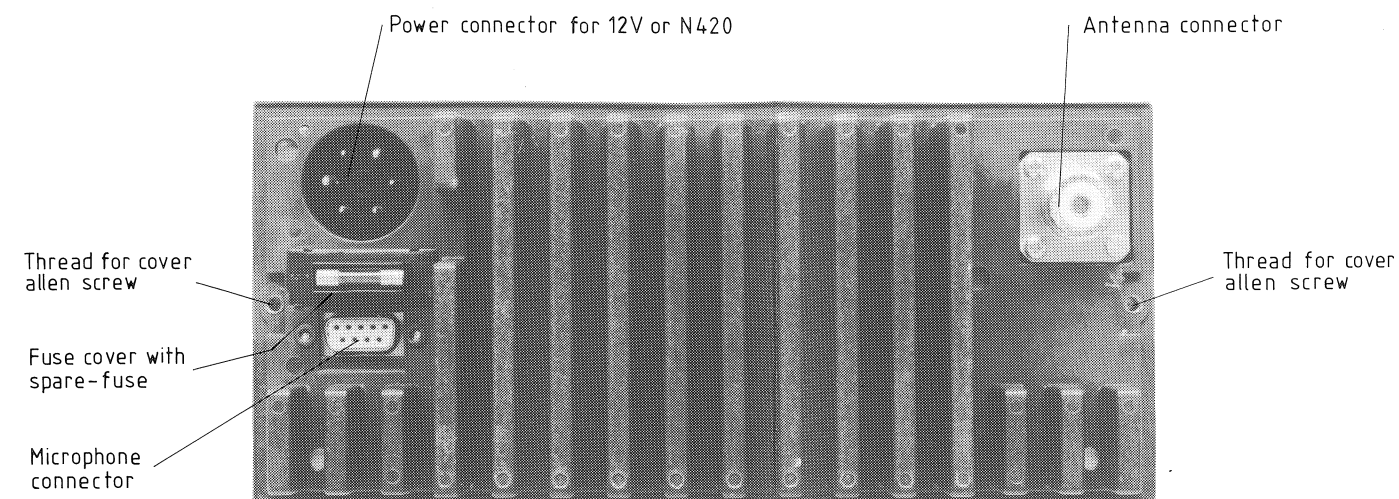
To disassemble the RT2048 remove the two allen screws with the black covers on the rear of the set and pull the frontplate and kabinet from each other.





Loudspeaker

Keyboard (module 1)



Power connector for 12V or N420

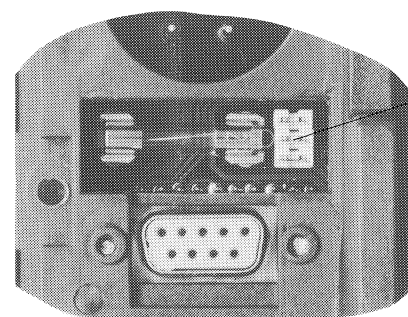
Antenna connector

Thread for cover allen screw

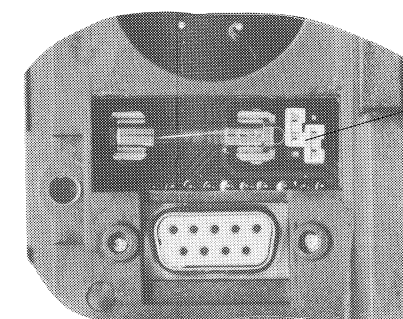
Thread for cover allen screw

Fuse cover with spare-fuse

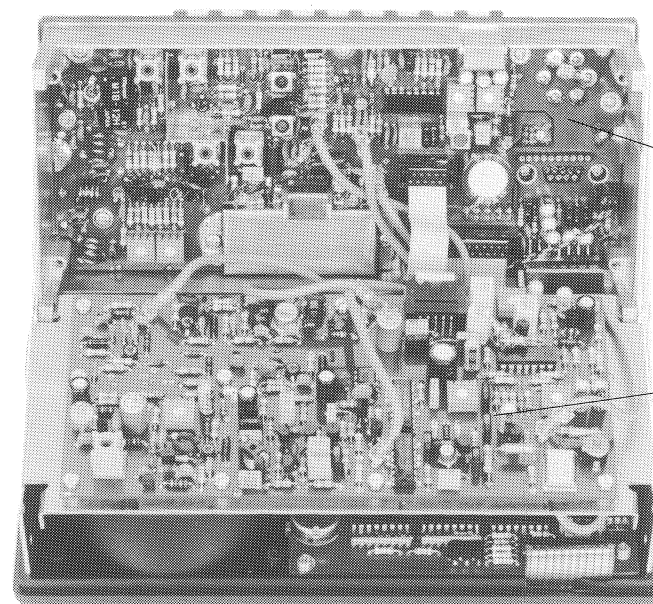
Microphone connector



Strap for connection to N420 (24V)

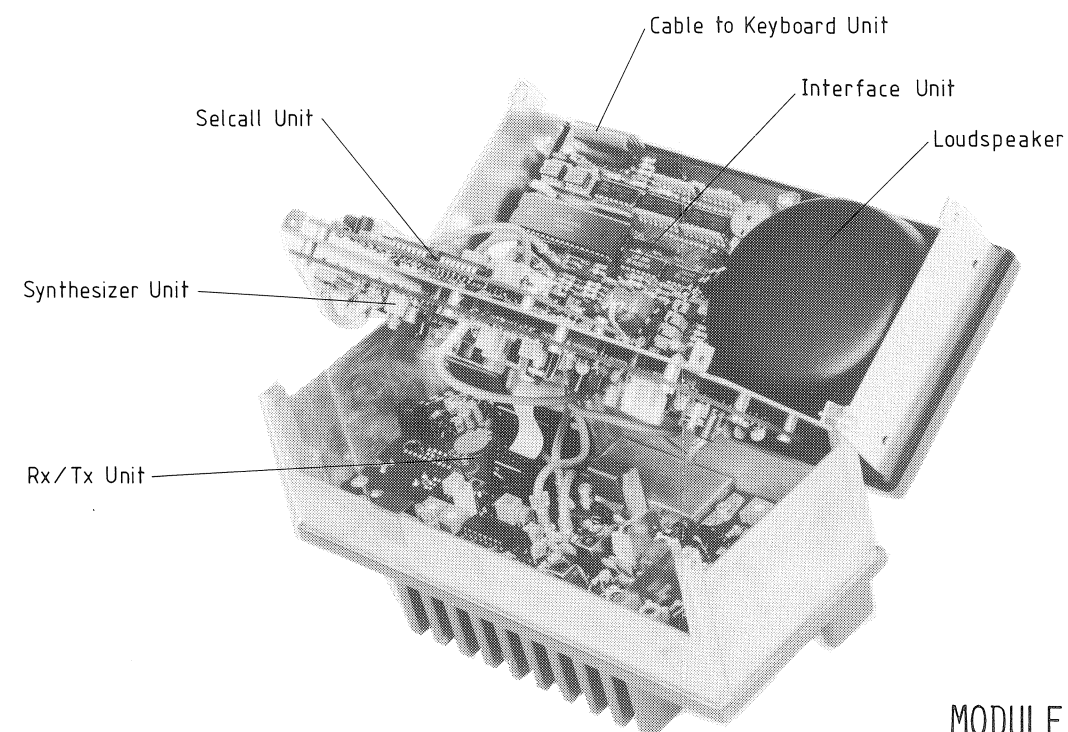


Strap for connection to external supply (12V)



Rx/Tx Unit (module 4)

Synthesizer Unit (module 3)



Cable to Keyboard Unit

Interface Unit

Loudspeaker

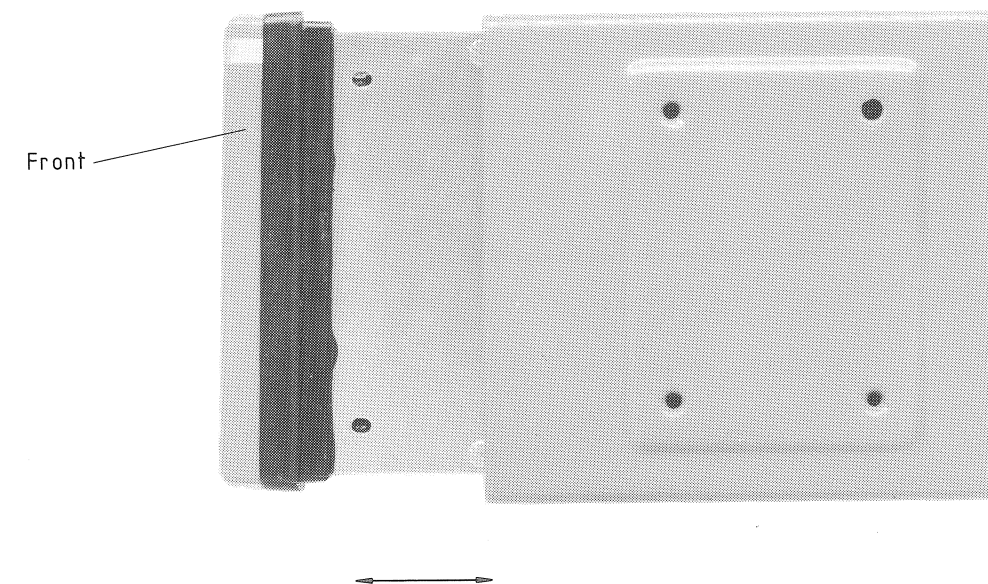
Selcall Unit

Synthesizer Unit

Rx/Tx Unit

4.1. MECHANICAL DISASSEMBLING RT2048

To disassemble the RT2048 remove the two allen screws with the black covers on the rear of the set and pull the frontplate and kabinet from each other.



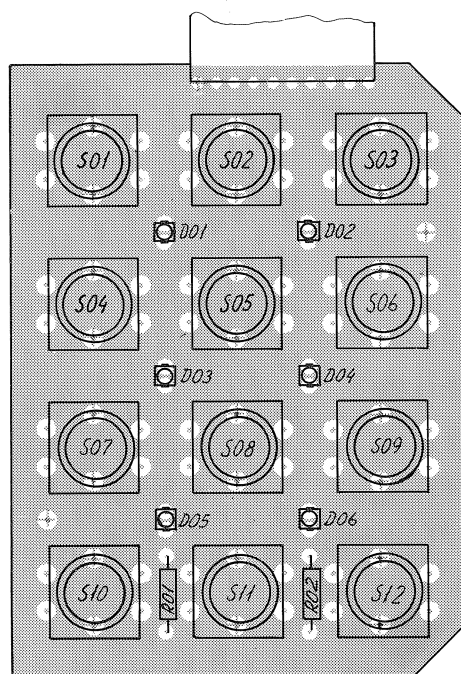
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- 5. CIRCUIT DESCRIPTION AND SCHEMATIC DIAGRAMS
 - 5.1. KEYBOARD UNIT (MODULE 1)
 - 5.2. INTERFACE UNIT (MODULE 2)
 - 5.3. SYNTHESIZER UNIT (MODULE 3)
 - 5.4. RX/TX UNIT (MODULE 4)
 - 5.5. SELCALL UNIT (MODULE 5) OPTIONAL
 - 5.6. INTERCONNECTION CABLE DIAGRAM

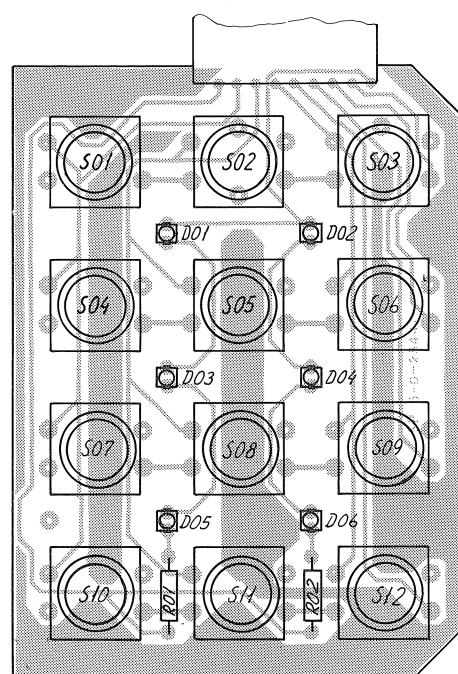
5. CIRCUIT DESCRIPTION

5.1. KEYBOARD UNIT (MODULE 1)

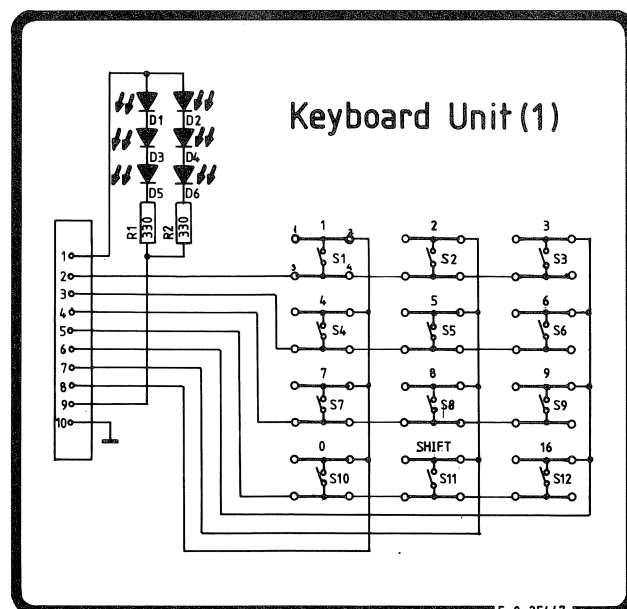
The keyboard unit comprises the 3 point 4 push button matrix, which is used for all the entries from the front panel e.g. channel selection, 1W etc. Besides the LED-diodes for keyboard illumination is placed on this board.



View from component side
with upper side tracks.



View from component side
with lower side tracks.



5.2. INTERFACE UNIT (MODULE 2)

5.2.1. +5V POWER SUPPLY

The internal power supply for the logic circuitries is generated from the internal +8V power supply, by means of the integrated voltage regulator U09. The input voltage for U09 is fed to pin 3 via D01, which secures an appropriate voltage decay on C12 when the set is switched off.

5.2.2. BATTERY SENSE/RESET CIRCUIT

When the set is switched on, U07/1 which is coupled as a comparator will generate an appropriate reset signal for the microcomputer U03. U07/2 is configured as a comparator circuit sensing the level of the internal +13V supply voltage. When this voltage drops below a certain level determined by R27, R20, R54, and D11 a "voltage low" signal is generated on pin 1. This action is detected by the microcomputer U3 which in turn will block the key function.

5.2.3. INDICATOR SUPPLY

The LED read-out intensity is controlled by means of a four-step voltage supply. Transistor Q02 acts as the emitter follower buffer transistor. The base voltage level of this transistor, and so the output voltage, is controlled by means of U08/4 and the programming resistors R07, R49, R47, and R55.

5.2.4. DISPLAY LATCHES

The display segments and the display power supply control inputs are buffered by means of three serial to parallel registers included in the integrated circuits U04, U05 and U06. The information is latched-in by means of the internal serial data bus controlled by the microcomputer.

5.2.5. READ-OUT

The information read-out is made by means of two seven-segment LED-displays D06, D07 and three individual diodes for 1W, TX and US-mode D03, D10, and D12.

5.2.6. EEPROM-MEMORIES

The two IC's U01 and U02 constitute the internal programmable memory. These circuits are controlled by the microcomputer via the internal serial bus. The memories are used for set identification codes, private channel programming etc.

5.2.7. MICROCOMPUTER

All the internal control signals are supplied by the microcomputer U03, either by means of the internal serial bus or by individual control signals

5.2. INTERFACE UNIT (MODULE 2) cont.:

like the key function, power level etc. Besides the microcomputer reads the keyboard information via the connector J01.

When a selcall unit is installed via J02, the control functions for this module and the alarm generation are created by the microcomputer. The audible alarm is coupled to the loudspeaker by means of resistors R26, R40, and R46.

5.2.8. SERIAL INTERFACE

For use in the factory production, a serial interface to the microcomputer is implemented by means of U07/4 and transistor Q01.

5.2.9. SQUELCH

The AF signal from the discriminator amplifier on RX/TX board is fed to the active squelch filter around U08/2, which is a highpass filter with a roll-off frequency of 45 kHz. The signal is amplified about 6-8 dB.

The amplitude of the noise signal is adjustable from the front panel by means of the squelch potentiometer R10.

Q05 amplifies the signal to the squelch detector. If there is a noise signal (without carrier at the receiver), the detector generates a DC voltage at pin 9 on U08/3. When this voltage increases to 0.6V, which is the same as the voltage at pin 10 on U08/3, the comparator output goes low and the squelch mute message is generated via Q08.

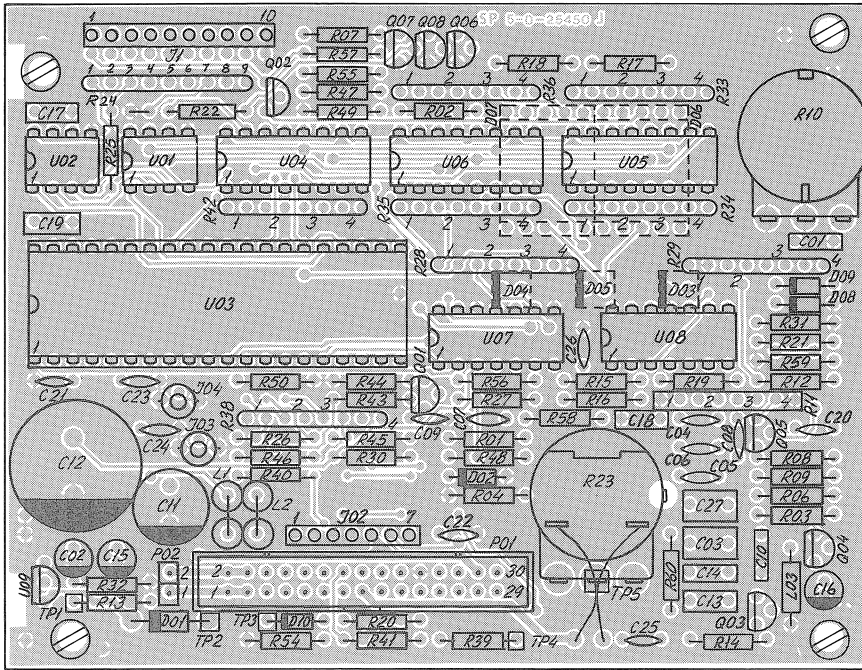
The microcomputer U03 detects the message and generates the appropriate mute signals for the AF amplifiers.

5.2.10. AF FILTER/AMPLIFIER

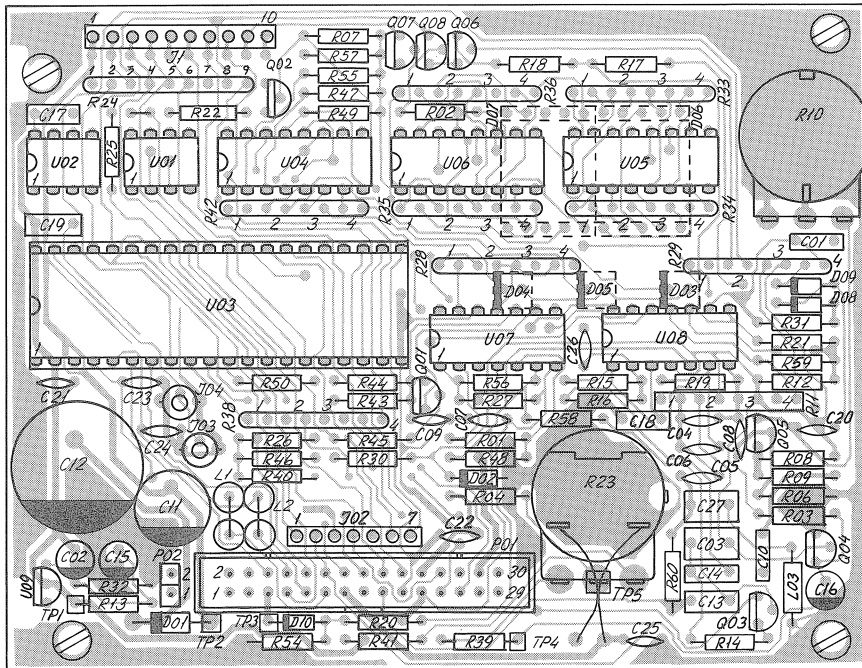
The AF signal is led to the active filter around U08/1. The filter provides a frequency response of -6 dB/oct. in the range of 0.3 to 3 kHz, and limits the signals outside this range.

Q04 is an emitter follower buffer amplifier, which supplies the earphone and the AF power amplifier. The uC controls the mute function via Q06 and Q03. When Q06 is off the DC voltage at pin 3 and 1 is 8V and therefore Q04 is off.

The loudspeaker level is adjustable by means of the volume control R23.

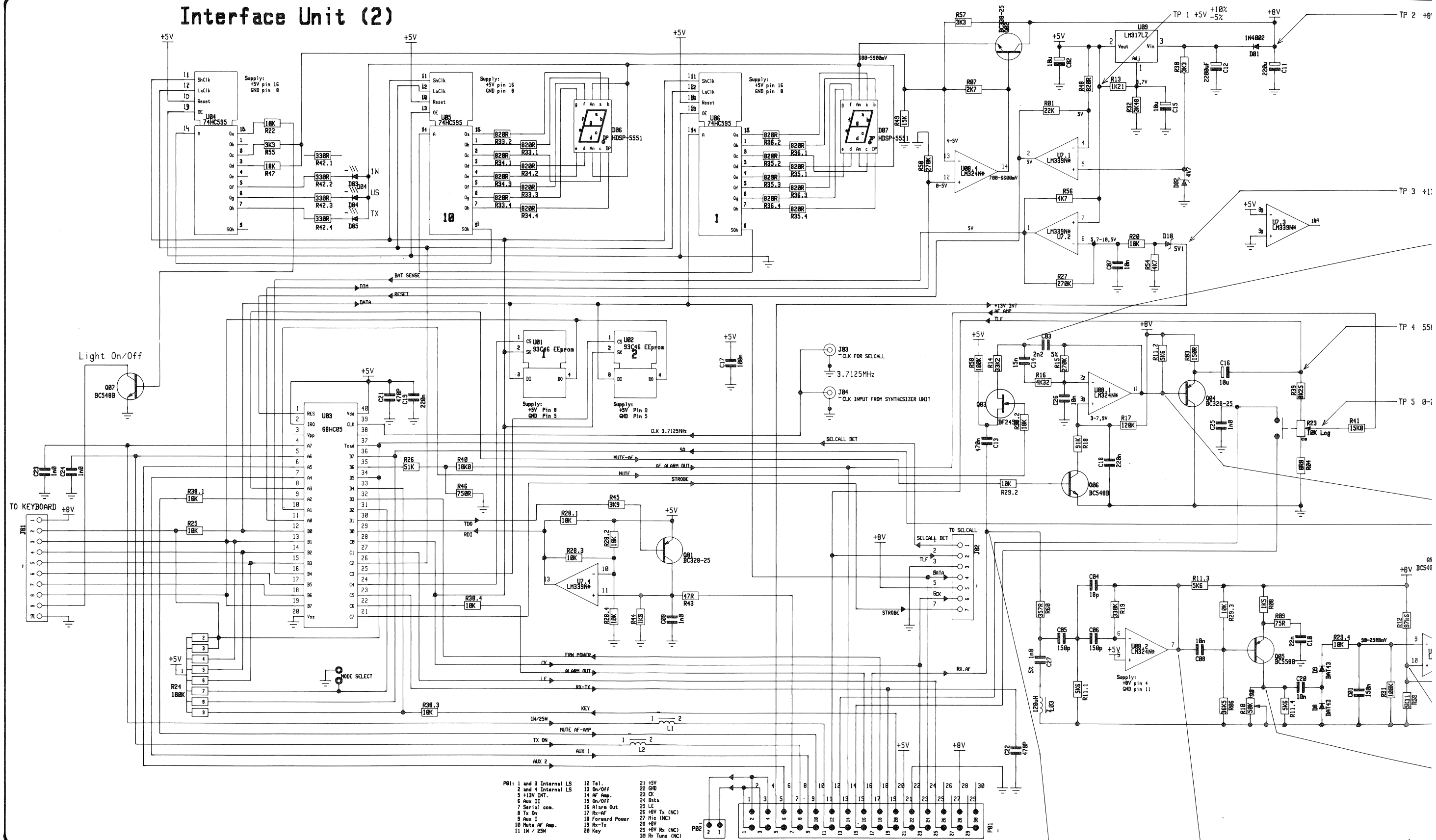


View from component side with upper side tracks.



View from component side with lower side tracks.

Interface Unit (2)

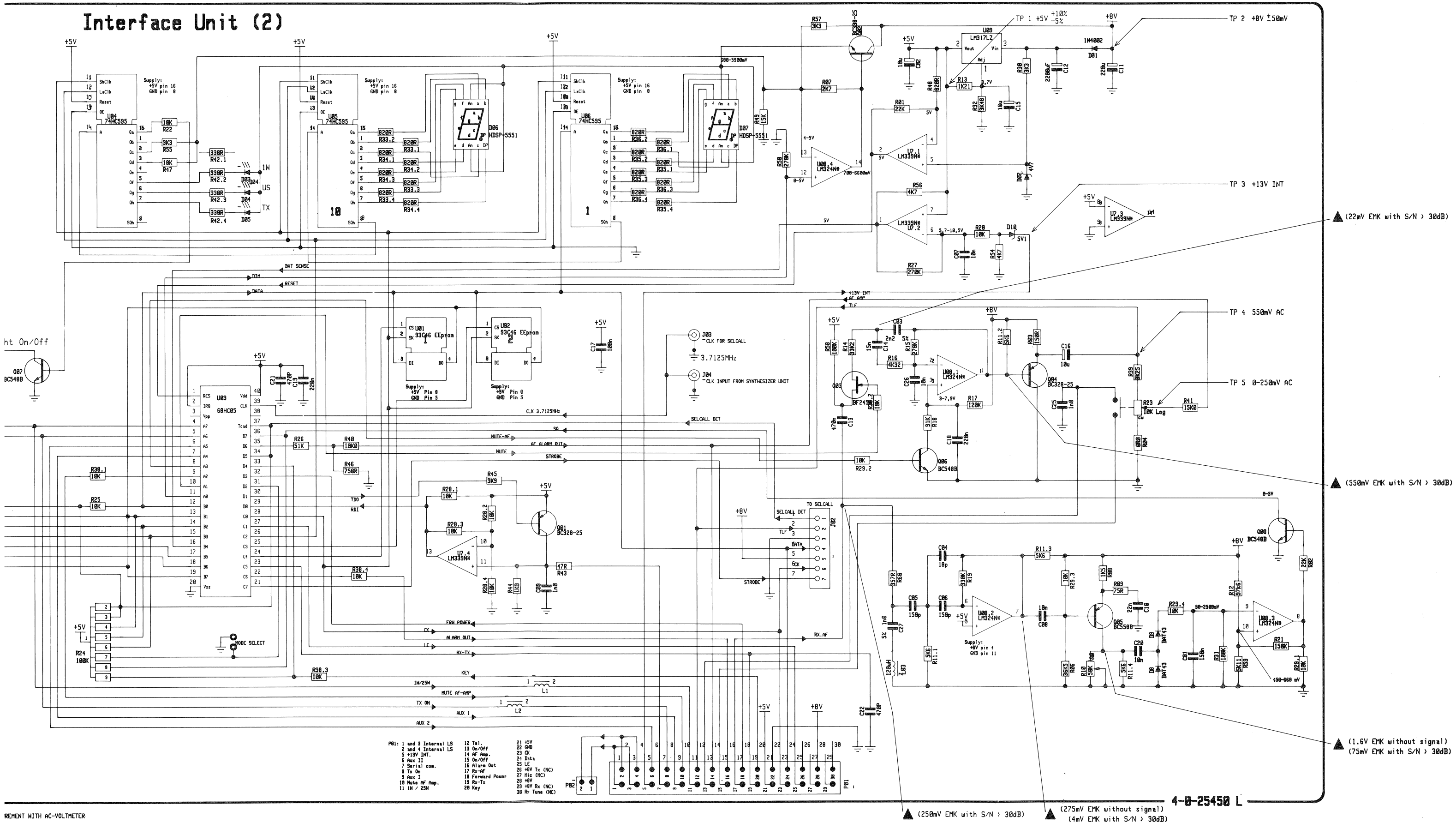


APPROX MEASUREMENT WITH AC-VOLTMETER

(250mV EMK with S/N > 30dB) (275mV EMK without signal) (4mV EMK with S/N > 30dB)

4-0-25450 L

Interface Unit (2)



REMENT WITH AC-VOLTMETER

Rettet den 25.10.91 MAJ

SCHEMATIC DIAGRAM INTERFACE UNIT (MODULE 2)

5.3. SYNTHESIZER UNIT (MODULE 3)

5.3.1. VCO with Buffer

The voltage controlled oscillator, built around the Field Effect Transistor Q18, is oscillating either on the transmitting frequency or on the first receiver local oscillator frequency, which means the receiving frequency less 15.3 MHz. To reach this function, the oscillator is implemented with a bandshift by means of the bandswitch diode D6 and the two capacitors C47 and C78.

In transmit mode, where the diode D6 is reverse biased, the oscillating frequency is mainly determined by C48, L9, C49, C51, and D9.

In receiving mode the oscillator resonance frequency is lowered 15.3 MHz by switching D6 on and thus putting C47 and C78 in parallel with C48.

The oscillating frequency is varied by means of the control voltage fed to the capacitor diode D9.

The output voltage from the VCO is taken via a capacitive tap C52, C53 on the source of Q18 and fed to the common buffer amplifier, built around Q15. The power gain of this stage is adjusted by means of potentiometer R98. The gain is adjusted so that the output level from the TX buffer amplifier is 200 mW measured at the output connector J4.

5.3.2. Loop Buffer Amplifier

The output from the common VCO buffer is fed to the divider chain via the stage around Q7, which secures the needed amplification and the reverse isolation between the digital parts and the VCO.

The amplifier is a fixed tuned broad band amplifier with L1, C24, and R47 forming a low Q tuned circuit.

5.3.3. 32/33 Prescaler

The integrated circuit U4 is a two modulus prescaler based on the ECL technique.

From the control logic in the programmable divider U3 pin 12, a high or low level is led to the prescaler U4 pin 1. A high level at U4 pin 1 causes the prescaler to divide by 33 and in turn a low level at pin 1 sets it up for dividing by 32.

The resistor R20 and the diode D4 work as a speed-up and overdrive protection circuit.

5.3.4. Reference/Programmable Divider and Phase Detector

The integrated circuit U3 comprises both a programmable divider for the reference input and a programmable divider with control logic for use in conjunction with a dual modulus prescaler. Besides, the IC includes two phase detectors and a lock detector of which only one of the phase detectors is in use, the output pins located at pin 15 and pin 16.

Both dividers are programmed via the serial bus from the microcomputer. The coding structure of the serial data stream includes the needed information for the on-chip decoder to detect the kind of the reached division figures. The reference division ratio is constant as the input of 3.7125 MHz is derived from the X-tal oscillator.

5.3. SYNTHESIZER UNIT cont.:

In the beginning of a counting period the prescaler U4 starts dividing by 33. After a few counts the modulus control pin changes level and the prescaler will finish the dividing cycles with a division ratio of 32, ending up with the correct total division ratio.

The pulse frequency out of the reference divider is 12.5 kHz. If the VCO frequency is correct the pulse frequency from the variable divider is also 12.5 kHz and in phase with the pulse from the reference divider. The on-chip phase detector compares the phase of the two pulses. If they are out of phase the detector creates correction pulses to the Charge Pumpe for correction of the VCO frequency/phase.

However, the synthesizer circuit is made with a small constant phase error, forced by the current drawn through R58, to avoid phase detector non linearities to degrade the loop performance. So the phase detector is sending small correction pulses to transistor Q4 with a frequency of 12.5 kHz.

5.3.5. Charge Pumpe

The charge pumpe, mainly consisting of Q4, Q5, and D2, converts the pulse with modulated phase detector outputs of U3 pin 15 and 16 to a DC current flowing into or out of the loop amplifier.

Assume that the VCO frequency has decreased from its nominal value. The phase detector will produce a negative correction pulse on pin 16, turning Q5 on, resulting in current being drawn out of the loop amplifier.

This action will cause the output voltage to increase, thus increasing the VCO frequency to the nominal value.

An increase in VCO frequency from its nominal value will in turn cause a correction pulse on pin 15, turning Q4 off, resulting in current flowing into the loop amplifier through the diode D2. This means the output voltage will decrease, forcing the VCO frequency to decrease.

Because of the current drawn through R58, a small correction pulse of about 500 nsec will always be present at pin 15 on U3 with a frequency of 12.5 kHz.

5.3.6. Loop Amplifier/Filter

The loop amplifier is realized as a discrete operational amplifier with transistors Q10 and Q11 forming the input differential pair and Q8, Q9 the output stage.

The loop dynamic performance is mainly controlled via the feed-back components in the loop amplifier, this means capacitors C29, C30, C31 and R49. The output from the loop amplifier is further filtered in a low pass filter formed by C36, L2, C34, and C35, to reduce the level of the reference frequency sidebands on the VCO output.

5.3.7. RX Buffer Amplifier

When receiving, the bandswitch diode D8 is turned on, and the output from the VCO buffer amplifier is further amplified in a single tuned amplifier formed around Q16 with L8, C70, and C73 forming the tuned circuit. The output is attenuated and impedance matched by means of resistors R93 and R94. The typical output level at connector J3 will be 5 mW.

5.3. SYNTHESIZER UNIT cont.:

5.3.8. TX Buffer Amplifier

When the set changes to transmit mode, the band switch diode D7 will be turned on and the output from the VCO buffer amplifier will be fed to the two stage amplifier circuit.

The level is amplified to about 30 mW in Q14 and the final stage with Q13 boosts the level to about 200 mW measured at connector J4.

The first stage is working as a class A amplifier with the base on Q14 biased through R80, D7, R79, and R86. The output stage is working as a class C amplifier with a small base bias through resistors R72 and R73.

5.3.9. X-Tal Oscillator

The oscillator is of a Colpitt type and the oscillator transistor Q1 is oscillating by means of a 14.850 MHz crystal X1.

The trimmer capacitor C77 is for fine adjustment of the oscillator frequency.

RF signal for the second mixer in the receiver is taken from the collector of transistor Q1, connector J1.

The oscillator signal is buffered and amplified in transistors Q2 and Q3 before it is fed to the reference divider.

5.3.10. Reference Divider

The fixed divide by four reference divider U2 divides the X-tal oscillator frequency down to 3.7125 MHz before it is fed to the microcomputer via connector J2 and the phase locked loop reference divider included in U3.

5.3.11. RX Filter Control Amplifier

This variable slope DC amplifier made by means of an operational amplifier U1 converts the VCO control voltage to an appropriate control voltage for the variocap. diode tuned filters in the receiver front-end.

The maximum output voltage is adjusted by means of potentiometer R95.

5.3.12. Preemphasis Network

Capacitor C18 in conjunction with R35 and R96 introduces the needed 6 dB/oct. response of the AF input signal. The input sensitivity is adjusted by means of R96.

5.3.13. AF Amplifier/Compressor

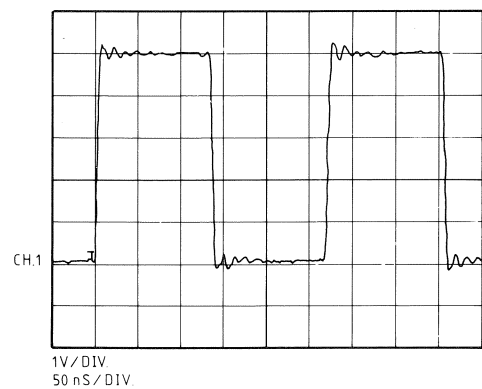
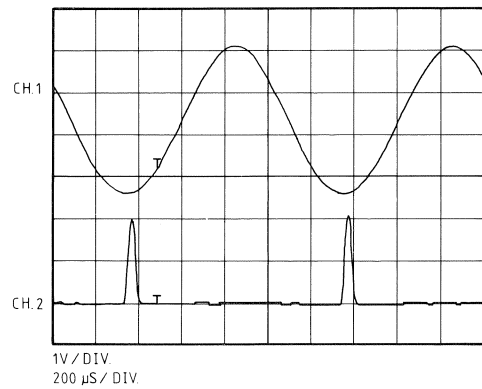
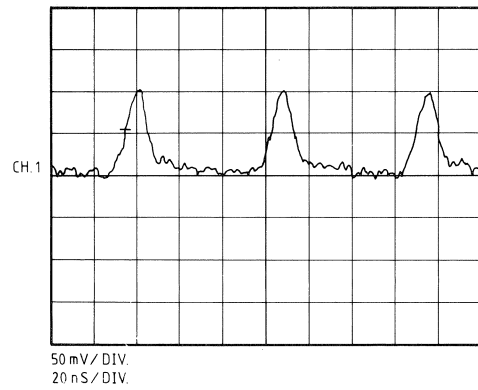
This circuit, formed around two operational amplifiers in U1, comprises both an amplifying and voltage limiting function. Amplifier No. 3 is a fixed voltage amplifier, the output of which is sensed by means of the comparator made by amplifier No. 2. When the peak output voltage exceeds a certain level, adjusted by means of potentiometer R97, the comparator will turn on transistor Q6, which in turn will charge capacitor C14. So the gate-source voltage on transistor Q17, acting as a variable resistor, will decrease and also the AC resistance between pin 10 on U1 and ground, which in turn will reduce the input level to the amplifier.

The rise-time of the compressor is mainly determined by resistors R38, R31, and capacitor C14. The decay-time by C14 and R30.

5.3.14. AF Post Filter

SYNTHESIZER (MODULE 3)

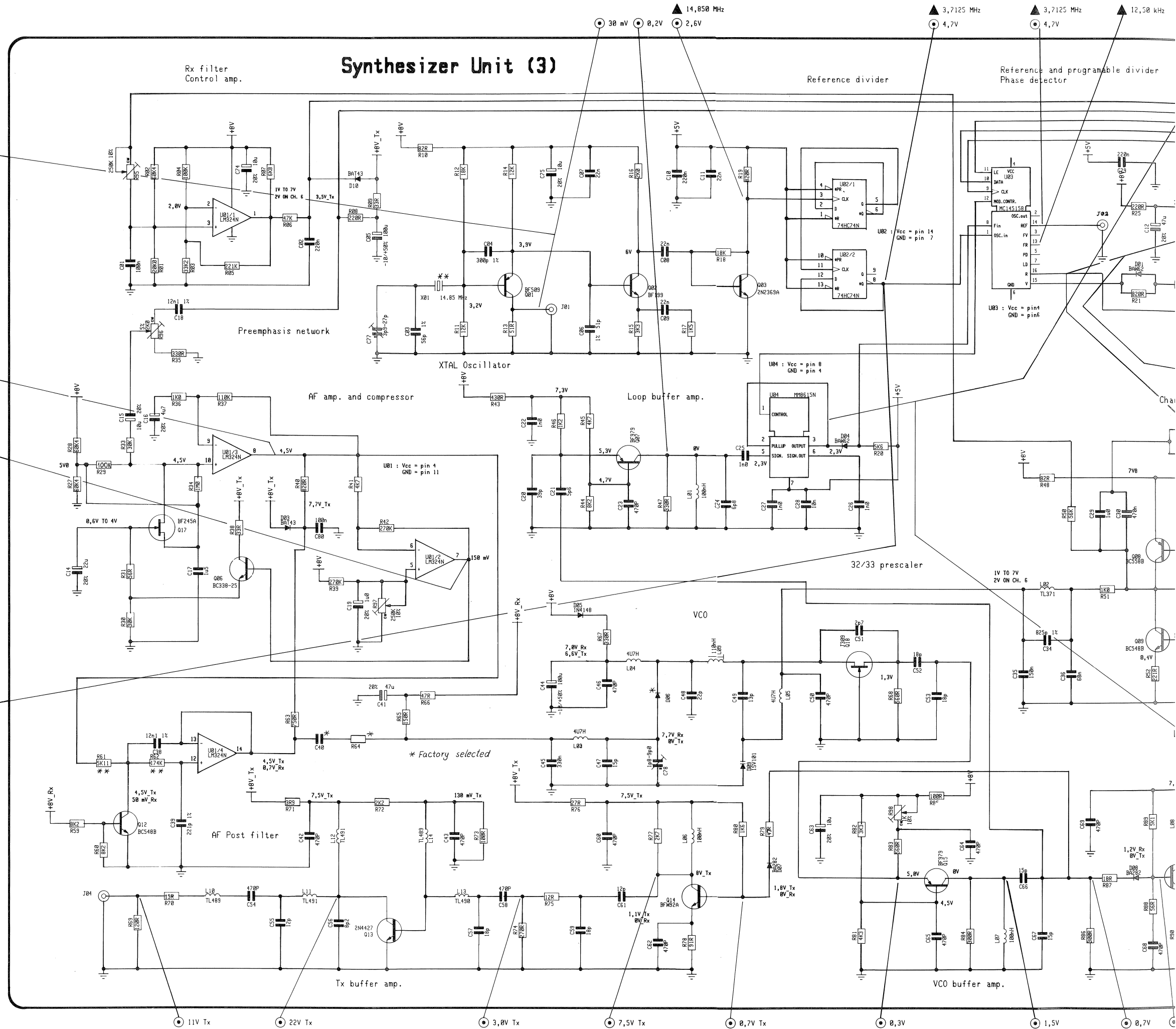
RT2048 D
4-6-25451 G



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** US VERSION ONLY
R61 = 4k75      (SP 03.468)
R62 = 270k      (SP 03.465)
XC1 = 5PPM C1075 (SP 39.841)

```



⊙ APPROX. MEASUREMENTS WITH TEST PROBE.
△ APPROX. MEASUREMENTS WITH VOLTMETER.

5.4. RX/TX UNIT (MODULE 4)

The RX/TX unit comprises the following circuits:

- The receiver including detector
- AF power amplifier
- RF power amplifier
- Harmonic filter
- RF power control
- 8V power supply

5.4.1. RECEIVER FRONT-END

The RF amplifier covers the frequency range 154.400 MHz to 163.600 MHz and consists of the low noise Dual Gate Si-Mos-FET Q11 surrounded by two high Q double-tuned bandpass filters.

From the aerial the signal is led through the aerial relay to the receiver input bandpass filter. The input bandpass filter as well as the intermediate bandpass filter are controlled by a DC voltage on the tuning diodes. This DC voltage derives from the RX VCO control voltage and secures an optimum filter response in the whole frequency range of the receiver. The two bandpass filters create the necessary attenuation of unwanted signals.

5.4.2. FIRST MIXER

The balanced mixer has good large signal properties, securing good intermodulation characteristic.

The mixer transistors Q08 and Q09 are of the J-FET type.

The signal is led to the balanced input transformer TR2 and then to the gates of the J-FETs, which are switched by injecting the first LO signal into the sources. The mixed signals are fed to the balanced output transformer TR1 where the wanted signal on 15.3 MHz is selected by the tune circuit consisting of TR1 and C75.

R06 and R01 create the necessary impedance matching the IF crystal filter.

5.4.3. CRYSTAL FILTER

The receiver adjacent channel selectivity is maintained by means of the crystal filter FL2 in co-operation with the ceramic filter FL1.

R57 and R39 give the impedance matching the crystal filter output.

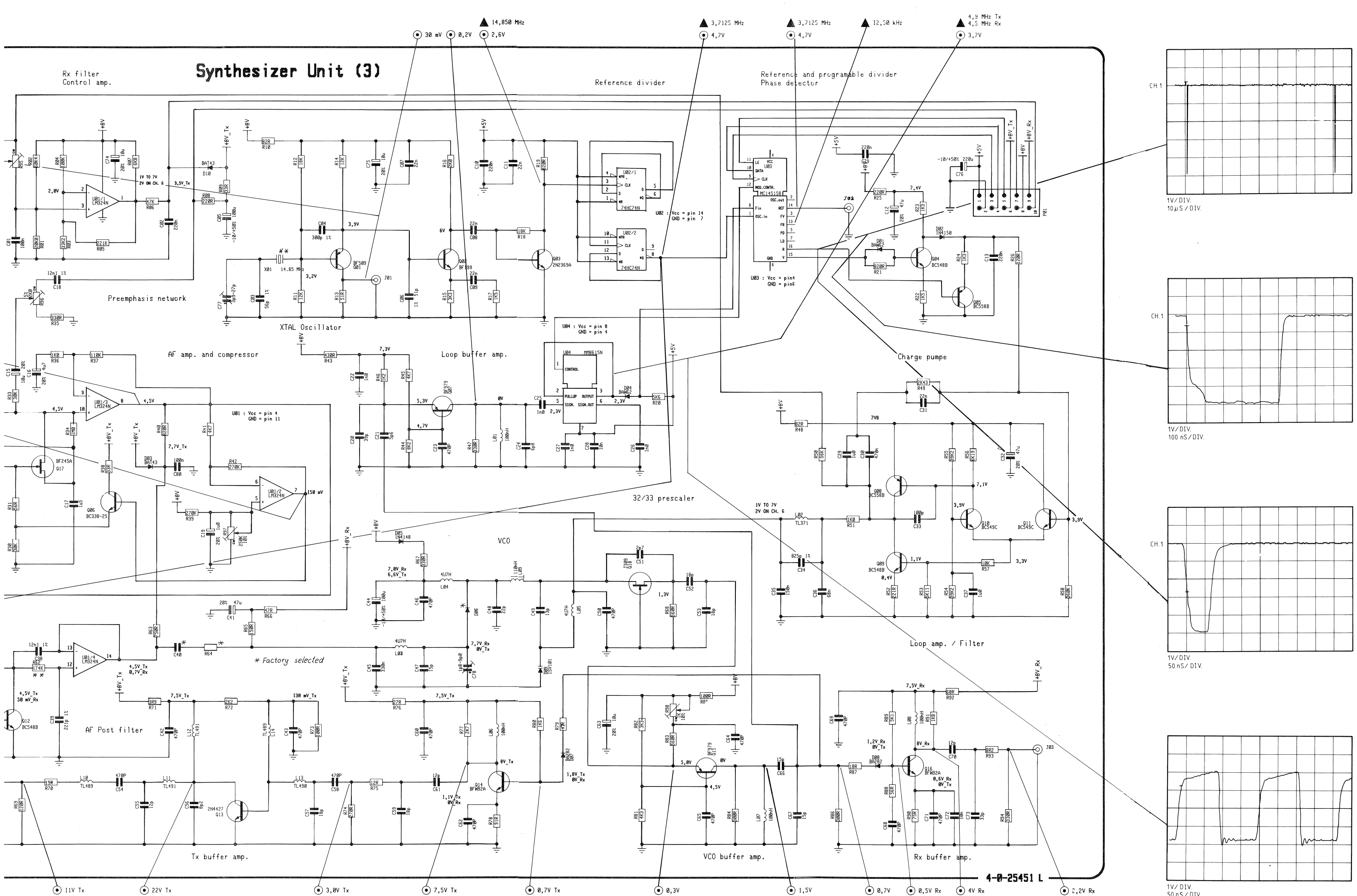
5.4.4. IF AMPLIFIER

The transistor Q10 amplifies the signal to the 2nd mixer, which has a tuned drain circuit consisting of L04 and C32.

R34 creates the impedance matching the 2nd mixer.

5.4.5. SECOND MIXER, CERAMIC FILTER, DETECTOR AND AF AMPLIFIER

The second LO signal 14.850 MHz is amplified in Q02 before it is delivered to the mixer.



SCHEMATIC DIAGRAM SYNTHESIZER (MODULE 3)

5.4. RX/TX UNIT (MODULE 4)

The RX/TX unit comprises the following circuits:

- The receiver including detector
- AF power amplifier
- RF power amplifier
- Harmonic filter
- RF power control
- 8V power supply

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R34 creates the impedance matching the 2nd mixer.

5.4.5. SECOND MIXER, CERAMIC FILTER, DETECTOR AND AF AMPLIFIER

The second LO signal 14.850 MHz is amplified in Q02 before it is delivered to the mixer.

5.4. RX/TX UNIT cont.:

The signal out of the mixer (450 kHz) is fed through the ceramic filter to the limiter amplifier and discriminator in U03.

The phase shift network to the quadrangular discriminator consisting of R11, L06, C33, and a 10 pF capacitor inside the IC.

AF output is led through a lowpass filter consisting of R36 and C74, which removes the high frequencies (450 kHz).

An internal operational amplifier amplifies the AF signal to 250 mV, which is adjusted by R20.

5.4.6. AF POWER AMPLIFIER

The AF power amplifier is capable of delivering 6 Watt in the internal loudspeaker (4 ohm) and 6 Watt in an external loudspeaker 4 ohm.

The gain of 34 dB is fixed by the resistors R07, R08 and R09.

The AF power amplifier is muted (pin 11, 0 = off, 1 = on) about 1.25 sec. after the squelch is closed.

5.4.7. RF POWER AMPLIFIER

The power amplifier covering the frequency range 154.4 MHz to 163.6 MHz consists of a module with 50 ohm terminations and 2 amplifiers. The first amplifier is the driver which has a gain of up to 12 dB, depending on the driver voltage from Q01. The input is about 200 mW.

The second amplifier has a gain of 10 dB.

5.4.8. HARMONIC FILTER

The harmonic filter is realized as a seventh order Chebyscher filter, which at the same time will provide the necessary attenuation of the harmonic generated by the power amplifier and a low insertion loss at the carrier frequency.

The output is fed to the antenna relay.

5.4.9. RF POWER CONTROL

The power adjustment loop consists of Q04, Q03, Q05 and Q01.

Q04 is the power detector which together with Q03 forms a differential circuit.

The differential circuit controls Q05 and Q01 which are made as a Darlington transistor.

C22, R17, and R15 make a feed-back in order to slow down the loop.

Q12 controls the on/off function through the differential resistor R18.

Q06 is the power indicator transistor which gives the microcomputer information about power on the output from the RF power amplifier.

This information is active about 0.3 Watt.

Q13 controls the 1 Watt/25 Watt change-over transistor Q07.

If the power is lower than about 15 Watt in the 25 Watt position the power indicator transistor Q06 will make a smooth change-over to 1 Watt position through resistor R61.

The 25 Watt adjustment is done on R21 and the 1 Watt adjustment is done on R19. The 25 Watt has to be adjusted first because it has influence on the adjustment of 1 Watt.

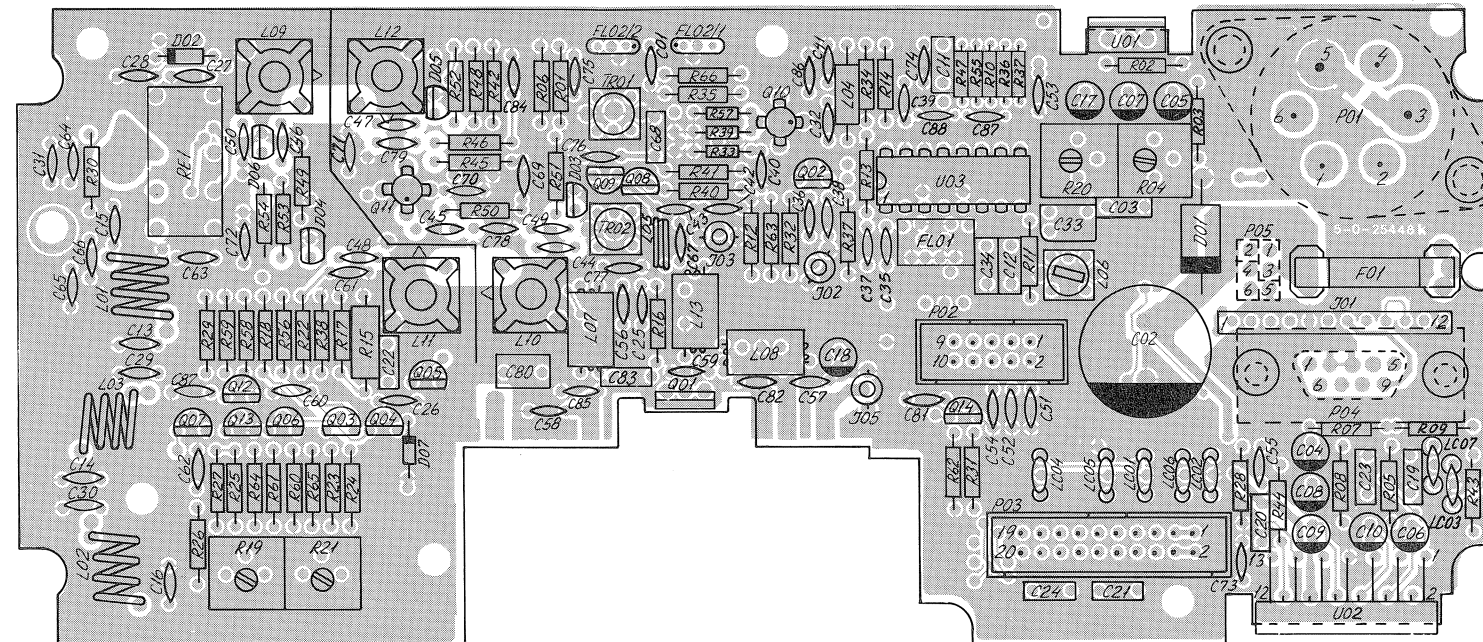
5.4. RX/TX UNIT cont.:

5.4.10. 8V POWER SUPPLY

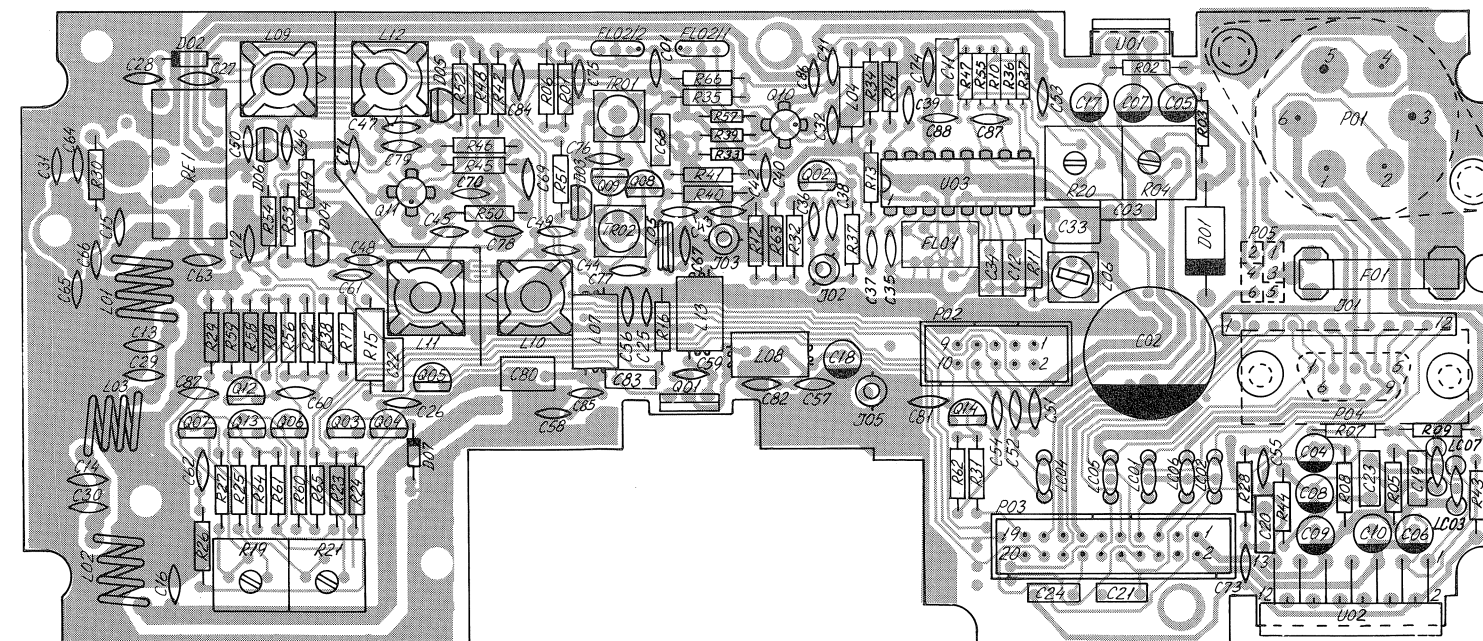
The regulator U01 is supplied from the internal 13V supply.

The adjustment of the voltage is done on resistor R04.

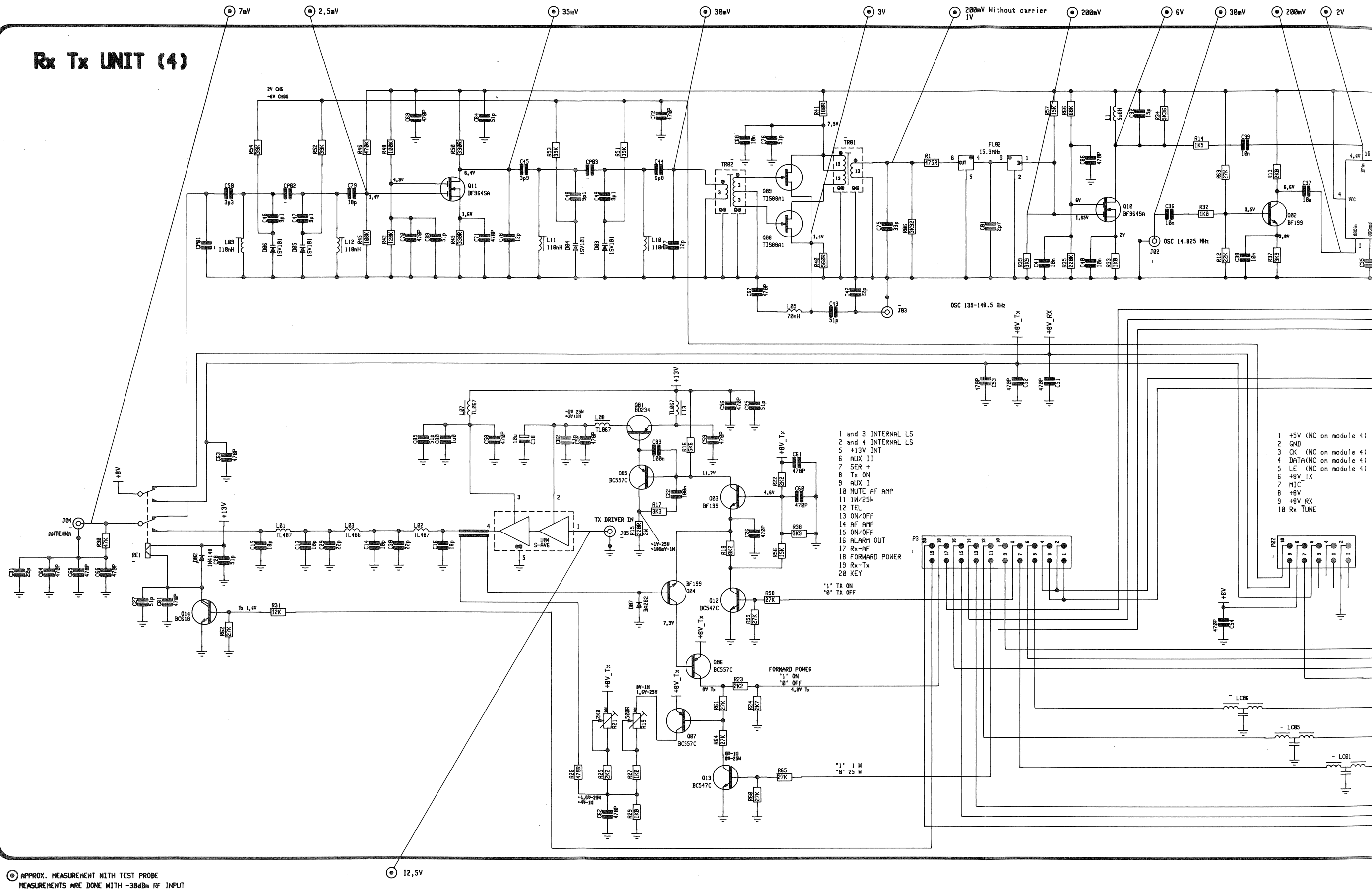
The 8V supply is divided into 2 more supplies in the antenna relay, the 8V TX supply and the 8V RX supply.



View from component side with upper side tracks.



View from component side with lower side tracks.



- 1 and 3 INTERNAL LS
- 2 and 4 INTERNAL LS
- 5 +13V INT
- 6 AUX II
- 7 SER +
- 8 Tx ON
- 9 AUX I
- 10 MUTE AF AMP
- 11 1W/25W
- 12 TEL
- 13 ON/OFF
- 14 AF AMP
- 15 ON/OFF
- 16 ALARM OUT
- 17 Rx-AF
- 18 FORWARD POWER
- 19 Rx-Tx
- 20 KEY

- ```

1 +5V (NC on module 4)
2 GND
3 CK (NC on module 4)
4 DATA (NC on module 4)
5 LE (NC on module 4)
6 +8V_TX
7 MIC_
8 +8V
9 +8V_RX
10 Rx_TUNE

```

5.5. SELCALL UNIT (MODULE 5)

The input to the selcall is taken from the telephone output. The signal is first amplified and limited in U04/2 and then it passes the bandpass filter. Finally the signal is rectified and compared with a reference level in the comparator U04/1.

3.7125 MHz is divided in the programmable counter U06. The output of this is divided by 2 and turned into a square wave in the flip-flop U03/2. The outputs of the flip-flop is connected to the switches U02. The frequency, at which the switches around the capacitors C03 and C04 are working, determines the resonance frequency of the filter. Thus by changing the dividing figure to U06, it is possible to change the resonance frequency of the filter.

With R01 it is possible to fine adjust the resonance frequency of the filter (see the adjustment procedure).

| Figure No. | f(nominal)<br>(Hz) | U06 input |    |    |    |   |   |   |   | U03 output<br>(Hz) |
|------------|--------------------|-----------|----|----|----|---|---|---|---|--------------------|
|            |                    | 14        | 13 | 12 | 11 | 6 | 5 | 4 | 3 |                    |
| 1          | 1124               | 0         | 1  | 1  | 0  | 0 | 1 | 1 | 1 | 18022              |
| 2          | 1197               | 0         | 1  | 1  | 0  | 0 | 0 | 0 | 0 | 19336              |
| 3          | 1275               | 0         | 1  | 0  | 1  | 1 | 0 | 1 | 0 | 20625              |
| 4          | 1358               | 0         | 1  | 0  | 1  | 0 | 1 | 0 | 1 | 21838              |
| 5          | 1446               | 0         | 1  | 0  | 1  | 0 | 0 | 0 | 0 | 23203              |
| 6          | 1540               | 0         | 1  | 0  | 0  | 1 | 0 | 1 | 1 | 24750              |
| 7          | 1640               | 0         | 1  | 0  | 0  | 0 | 1 | 1 | 0 | 26518              |
| 8          | 1747               | 0         | 1  | 0  | 0  | 0 | 0 | 1 | 0 | 28125              |
| 9          | 1860               | 0         | 0  | 1  | 1  | 1 | 1 | 1 | 0 | 29940              |
| 0          | 1982               | 0         | 0  | 1  | 1  | 1 | 0 | 1 | 0 | 32004              |
| R          | 2110               | 0         | 0  | 1  | 1  | 0 | 1 | 1 | 1 | 33750              |

When the radio is switched on the dividing figure, corresponding to the first figure in the selcall number, is shifted out on port B0 on the uC at the interface unit which is connected to the input of U07.

U07 is a serial to parallel shift register which converts the signal to the dividing figure U06. If the correct tone is received the output of the comparator U4/1 goes low. This output is connected to the uC's SEL-DET. pin. When the tone disappears again the uC will put out the dividing figure corresponding to the next figure in the selcall number.

If all five tones are received correctly, the port C06 (EXT. ALARM) on the uC goes high. This port is connected to pin 1 on the connector to the option board at the RX/TX unit. At the same time the uC will send out an alarm tone from D06 via the volume control and power amplifier to the loudspeaker. The alarm tone lasts for 10 secs after an individual call, and after an all call it lasts until the selcall has been reset.

If the SELCALL T/R button is activated the alarm circuits and indicators are tested.



5.5. SELCALL UNIT (MODULE 5)

The input to the selcall is taken from the telephone output. The signal is first amplified and limited in U04/2 and then it passes the bandpass filter. Finally the signal is rectified and compared with a reference level in the comparator U04/1.

3.7125 MHz is divided in the programmable counter U06. The output of this is divided by 2 and turned into a square wave in the flip-flop U03/2. The outputs of the flip-flop is connected to the switches U02. The frequency, at which the switches around the capacitors C03 and C04 are working, determines the resonance frequency of the filter. Thus by changing the dividing figure to U06, it is possible to change the resonance frequency of the filter.

With R01 it is possible to fine adjust the resonance frequency of the filter (see the adjustment procedure).

| Figure No. | f(nominal)<br>(Hz) | U06 input |    |    |    |   |   |   |   | U03 output<br>(Hz) |
|------------|--------------------|-----------|----|----|----|---|---|---|---|--------------------|
|            |                    | 14        | 13 | 12 | 11 | 6 | 5 | 4 | 3 |                    |
| 1          | 1124               | 0         | 1  | 1  | 0  | 0 | 1 | 1 | 1 | 18022              |
| 2          | 1197               | 0         | 1  | 1  | 0  | 0 | 0 | 0 | 0 | 19336              |
| 3          | 1275               | 0         | 1  | 0  | 1  | 1 | 0 | 1 | 0 | 20625              |
| 4          | 1358               | 0         | 1  | 0  | 1  | 0 | 1 | 0 | 1 | 21838              |
| 5          | 1446               | 0         | 1  | 0  | 1  | 0 | 0 | 0 | 0 | 23203              |
| 6          | 1540               | 0         | 1  | 0  | 0  | 1 | 0 | 1 | 1 | 24750              |
| 7          | 1640               | 0         | 1  | 0  | 0  | 0 | 1 | 1 | 0 | 26518              |
| 8          | 1747               | 0         | 1  | 0  | 0  | 0 | 0 | 1 | 0 | 28125              |
| 9          | 1860               | 0         | 0  | 1  | 1  | 1 | 1 | 1 | 0 | 29940              |
| 0          | 1982               | 0         | 0  | 1  | 1  | 1 | 0 | 1 | 0 | 32004              |
| R          | 2110               | 0         | 0  | 1  | 1  | 0 | 1 | 1 | 1 | 33750              |

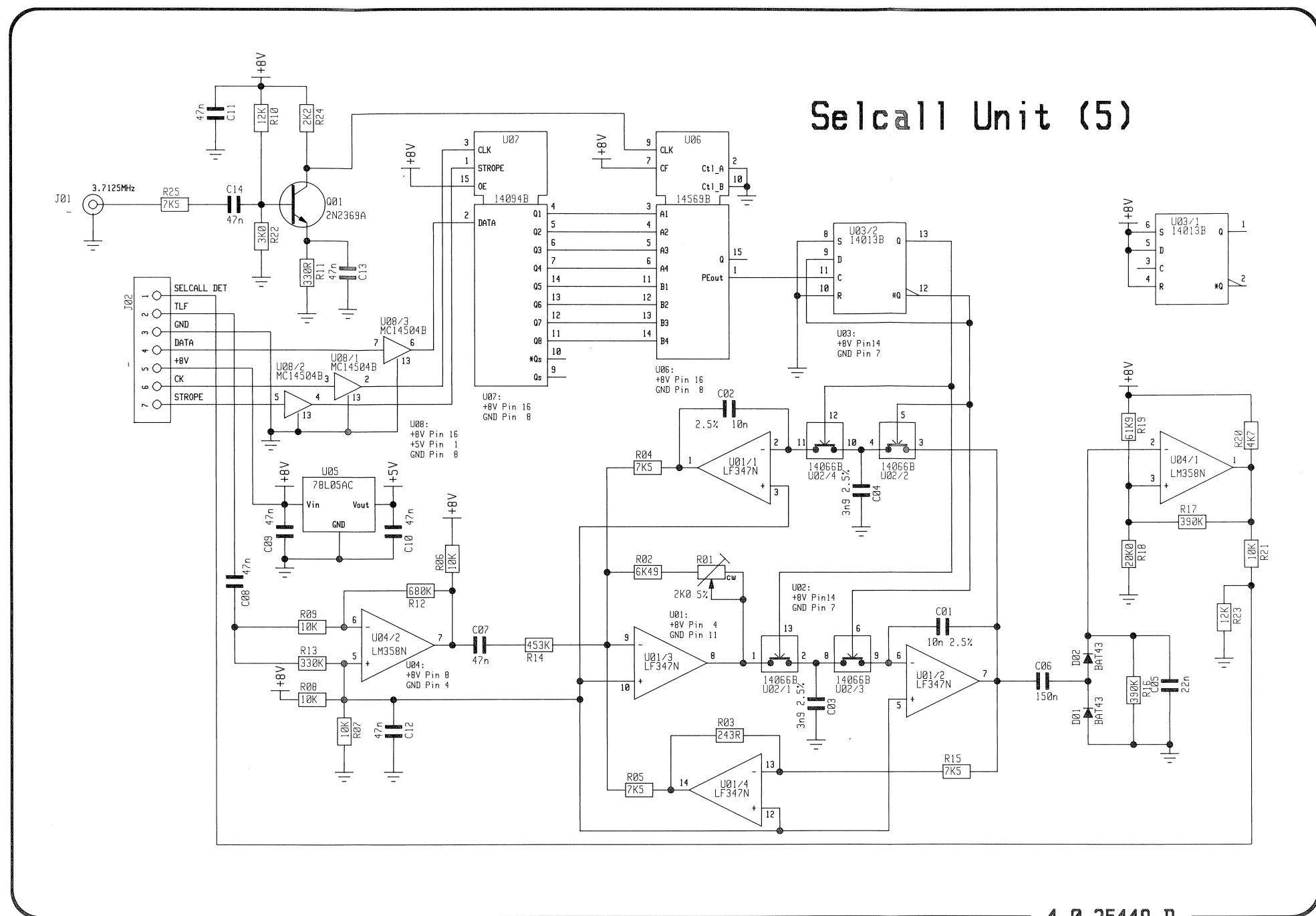
When the radio is switched on the dividing figure, corresponding to the first figure in the selcall number, is shifted out on port B0 on the uC at the interface unit which is connected to the input of U07.

U07 is a serial to parallel shift register which converts the signal to the dividing figure U06. If the correct tone is received the output of the comparator U4/1 goes low. This output is connected to the uC's SEL-DET. pin. When the tone disappears again the uC will put out the dividing figure corresponding to the next figure in the selcall number.

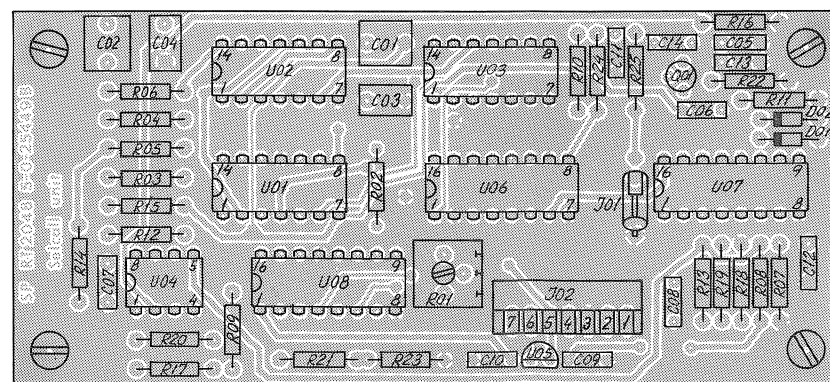
If all five tones are received correctly, the port C06 (EXT. ALARM) on the uC goes high. This port is connected to pin 1 on the connector to the option board at the RX/TX unit. At the same time the uC will send out an alarm tone from D06 via the volume control and power amplifier to the loudspeaker. The alarm tone lasts for 10 secs after an individual call, and after an all call it lasts until the selcall has been reset.

If the SELCALL T/R button is activated the alarm circuits and indicators are tested.

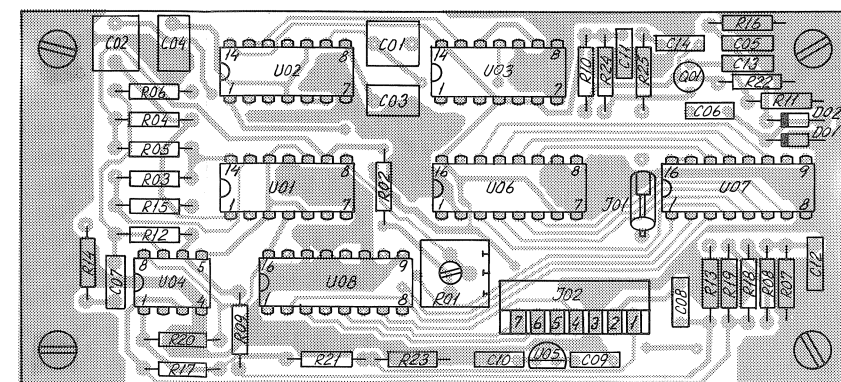




4-0-25449 D

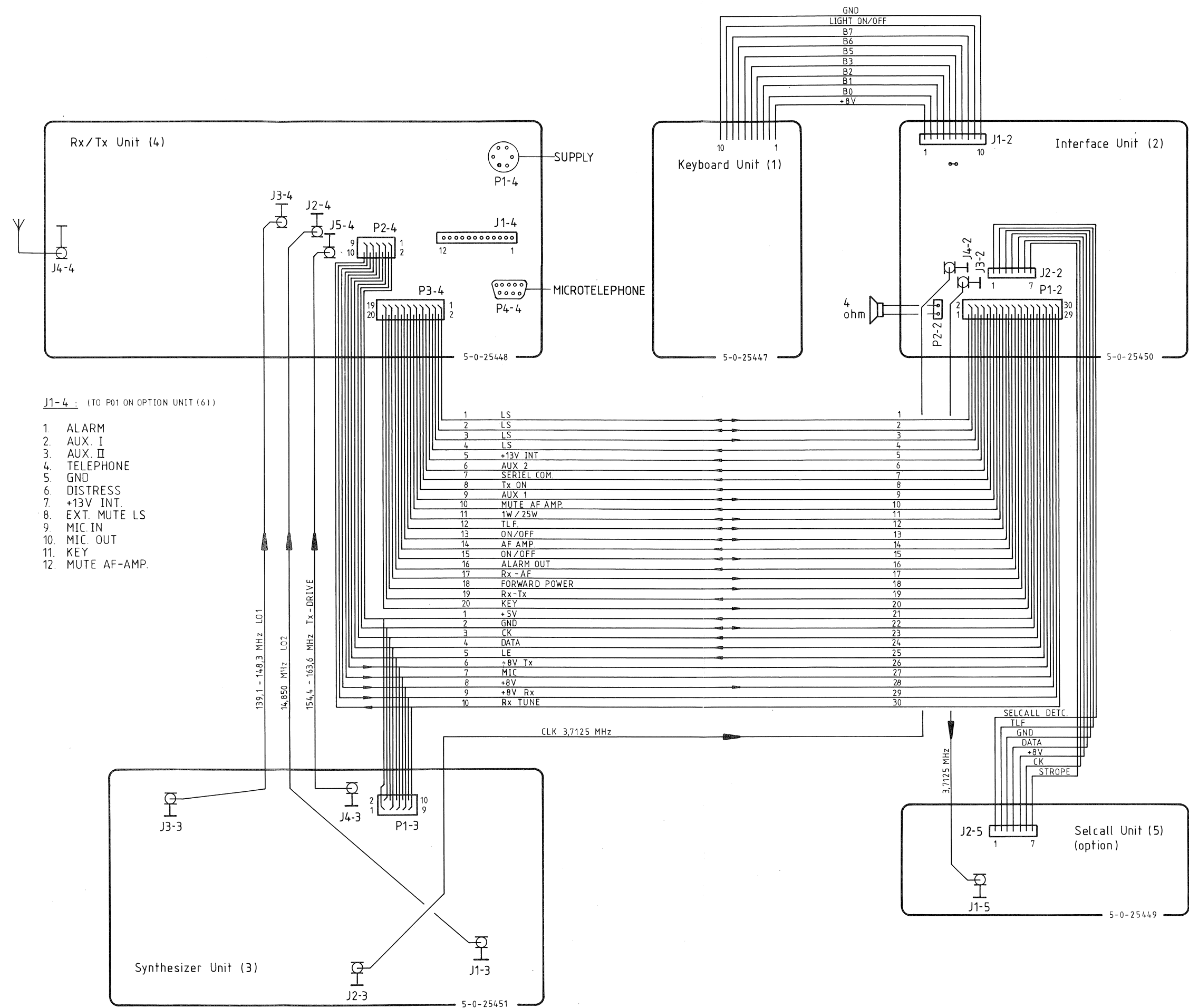


View from component side with upper side tracks.



View from component side with lower side tracks.

5.6. INTERCONNECTION CABLE DIAGRAM



RT2048 B 4-0-25568C



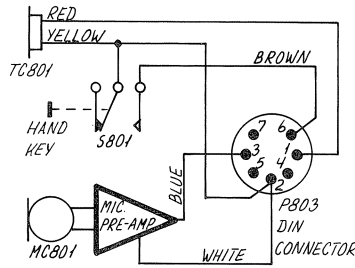
## CONTENTS

- 6. MICROTELEPHONE INSTALLATION
  - 6.1. SPECIAL INSTALLATION WITH 2 MICROTELEPHONES
  - 6.2. SPECIAL INSTALLATION WITH 3 MICROTELEPHONES
  - 6.3. MECHANICAL DIMENSIONS FOR HANDSET

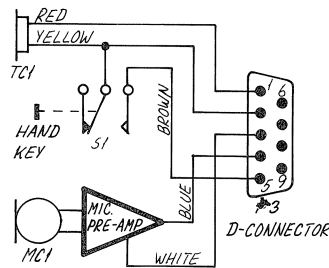


## 6. MICROTELEPHONE INSTALLATION

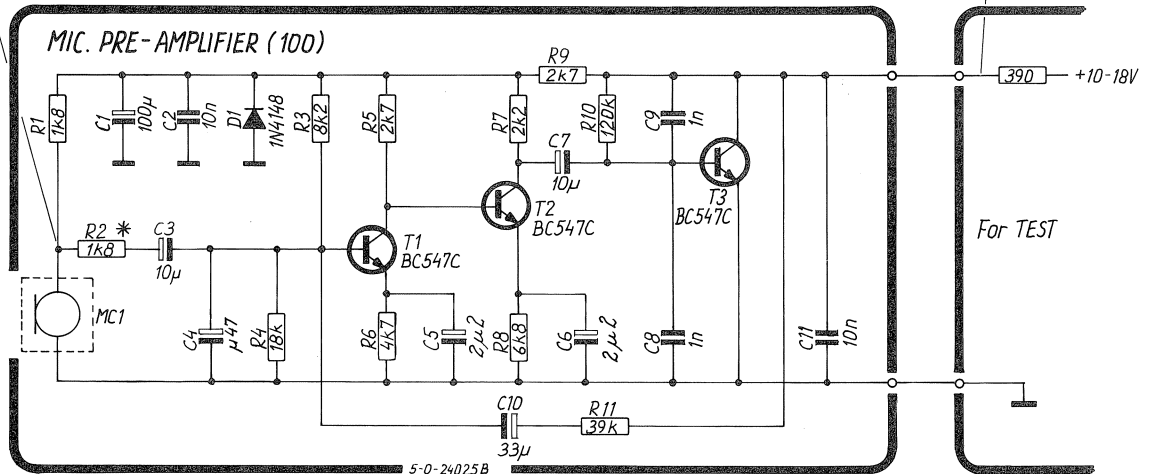
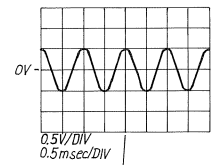
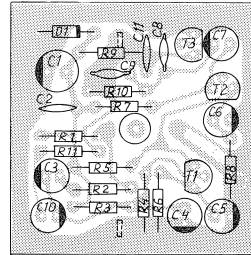
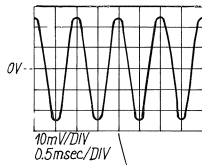
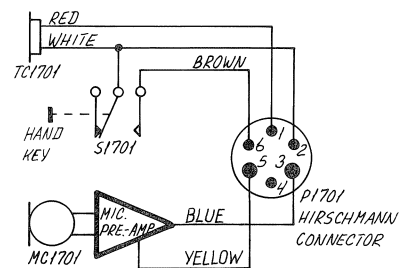
VHF RT2047 and T2031



SCRAMBLER CRY2001, RT2048 and RE2100



SHORTWAVE S130X



\* In orange marked microtelephone cartridge R2 is changed from 1k8 to 5k6 ohm.

(D)

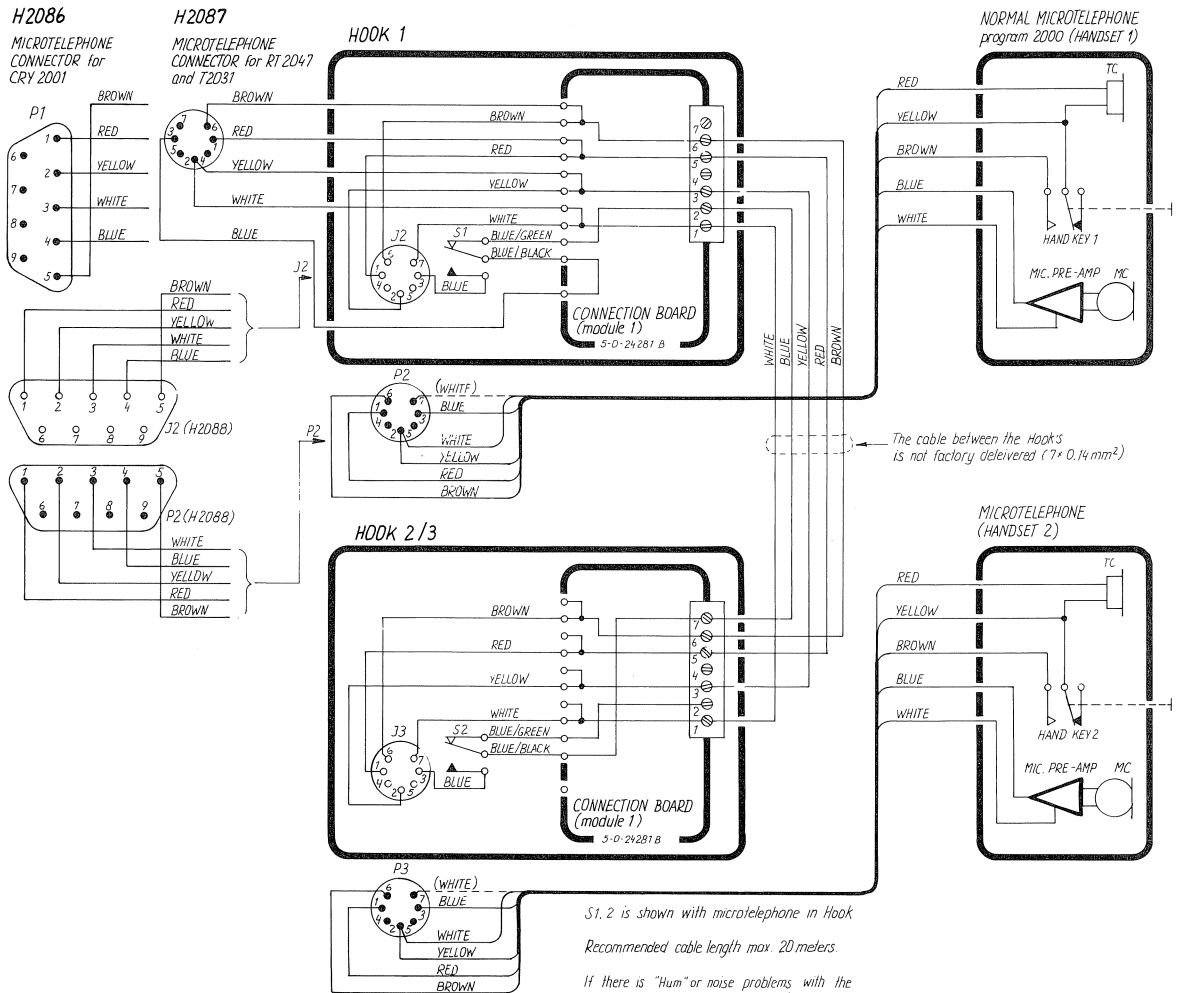
| POSITION | DESCRIPTION            | MANUFACTURER            | TYPE          | S.P. NUMB             |        |
|----------|------------------------|-------------------------|---------------|-----------------------|--------|
|          | MICROTELEPHONE         | WITH ELECTRET MIC. AMP. | ESPERA        | PRINT NR.5-0-24025B   | 600875 |
| C1       | CAPACITOR ELECTROLYTIC | 100uF 20% 10V           | *ERO          | EKI 00 BB 310 C       | 14.607 |
| C2       | CAPACITOR CERAMIC      | 10nF -20/+80% 50V       | *KCK          | HE70S3YF103Z          | 15.170 |
| C3       | CAPACITOR ELECTROLYTIC | 10uF 20% 35V            | *ERO          | EKI 00 AA 210 F       | 14.512 |
| C4       | CAPACITOR ELECTROLYTIC | 0.47uF 20% 50V          | ERO           | EKI 00 AA 047 H       | 14.504 |
| C5       | CAPACITOR ELECTROLYTIC | 10uF 20% 35V            | *ERO          | EKI 00 AA 210 F       | 14.512 |
| C6       | CAPACITOR ELECTROLYTIC | 10uF 20% 35V            | *ERO          | EKI 00 AA 210 F       | 14.512 |
| C7       | CAPACITOR ELECTROLYTIC | 10uF 20% 35V            | *ERO          | EKI 00 AA 210 F       | 14.512 |
| C8       | CAPACITOR CERAMIC      | 1nF 10% 100V            | *PHILIPS      | 2222 630 03102        | 16.149 |
| C9       | CAPACITOR CERAMIC      | 1nF 10% 100V            | *PHILIPS      | 2222 630 03102        | 16.149 |
| C10      | CAPACITOR ELECTROLYTIC | 33uF 20% 16V            | *ERO          | EKI 00 AA 233 D       | 14.518 |
| C11      | CAPACITOR CERAMIC      | 10nF -20/+80% 50V       | *KCK          | HE70S3YF103Z          | 15.170 |
| D1       | DIODE                  | 1N4148                  | *ITT          | 1N4148                | 25.131 |
| MC1      | MICROPHONE ELECTRET    | WM-034BY                | MATSUSHITA    | WM-034BY              | 46.012 |
| R1       | RESISTOR               | 1.8 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.707 |
| R2       | RESISTOR               | 1.8 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.707 |
| R3       | RESISTOR               | 8.2 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.723 |
| R4       | RESISTOR               | 18 KOHM 5% 0.33W        | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.732 |
| R5       | RESISTOR               | 2.7 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.711 |
| R6       | RESISTOR               | 4.7 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.717 |
| R7       | RESISTOR               | 2.2 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.709 |
| R8       | RESISTOR               | 6.8 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.721 |
| R9       | RESISTOR               | 2.7 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.711 |
| R10      | RESISTOR               | 120 KOHM 5% 0.33W       | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.753 |
| R11      | RESISTOR               | 39 KOHM 5% 0.33W        | BEYSCHLAG     | MBA 0204-00-BX-5%     | 01.740 |
| S1       | MICROSWITCH            | E62-10H PDT             | CHERRY        | E62-10H PDT           | 44.025 |
| T1       | TRANSISTOR             | BC547C                  | SGS           | BC547C                | 28.068 |
| T2       | TRANSISTOR             | BC547C                  | SGS           | BC547C                | 28.068 |
| T3       | TRANSISTOR             | BC547C                  | SGS           | BC547C                | 28.068 |
| TC1      | TELEPHONE CARTRIDGE    | 200 OHM                 | S.E.K. (KIRK) | 0113.2518 (0113.2510) | 46.010 |

RT2047, RT2048, RE2100,  
T2031, CRY2001 4-6-24025B  
4-0-24293D 4-0-24025D



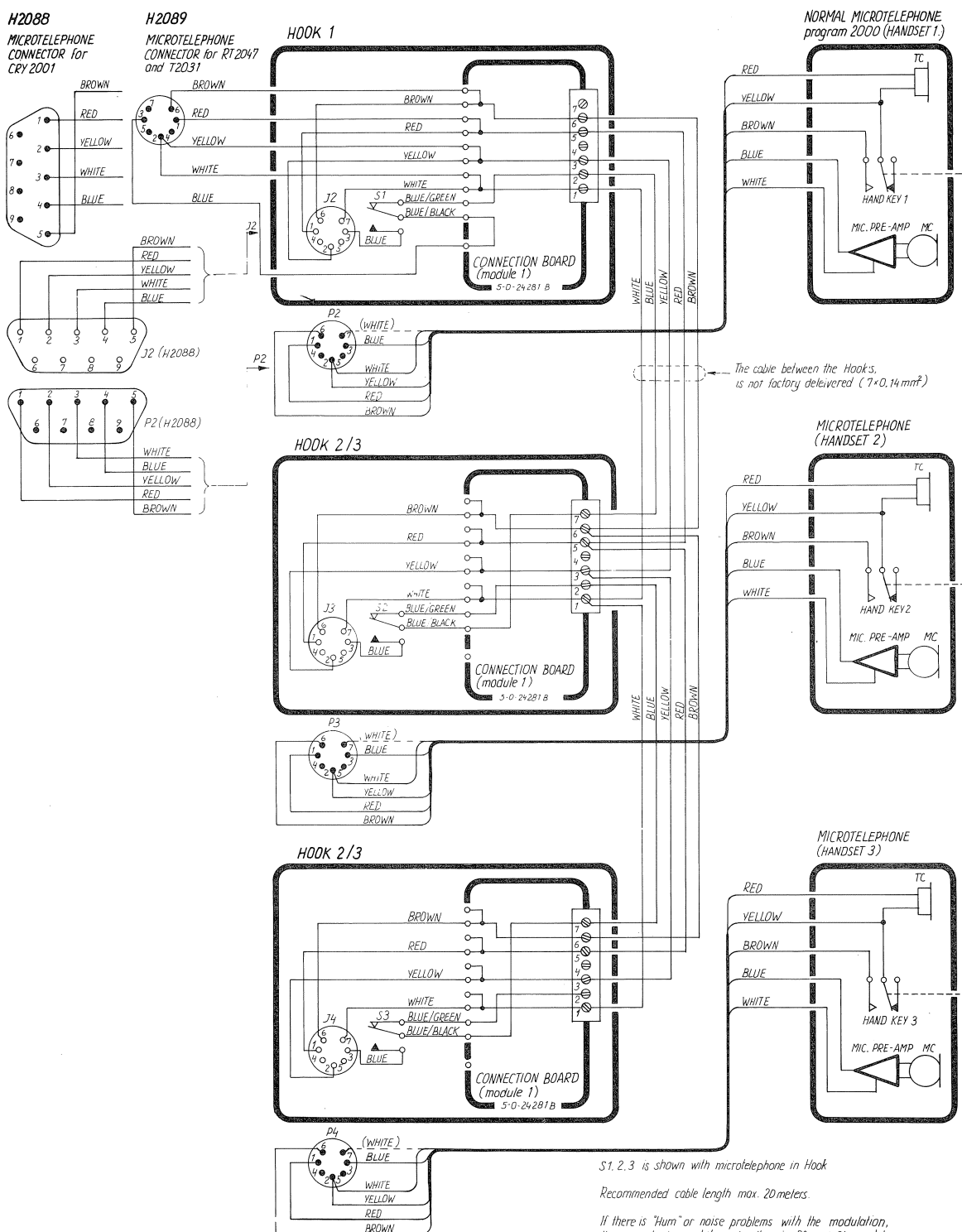
# 6.1. SPECIAL INSTALLATION WITH 2 MICROTELEPHONES: H2086 FOR SCRAMBLER CRY2001, RT2048 AND RE2100 H2087 FOR VHF RT2047 AND SSB T2031

## MICROTELEPHONE ONE WITH PREFERENCE



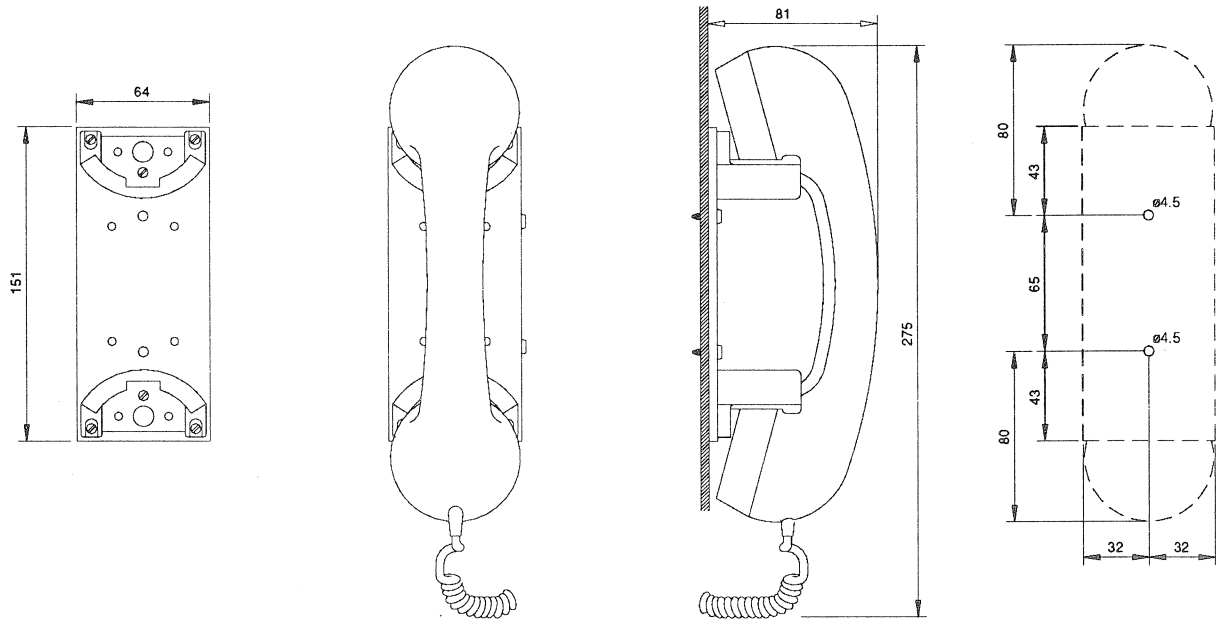
## 6.2. SPECIAL INSTALLATION WITH 3 MICROTELEPHONES: H2088 FOR SCRAMBLER CRY2001, RT2048 AND RE2100 H2089 FOR VHF RT2047 AND SSB T2031

### MICROTELEPHONE ONE WITH PREFERENCE

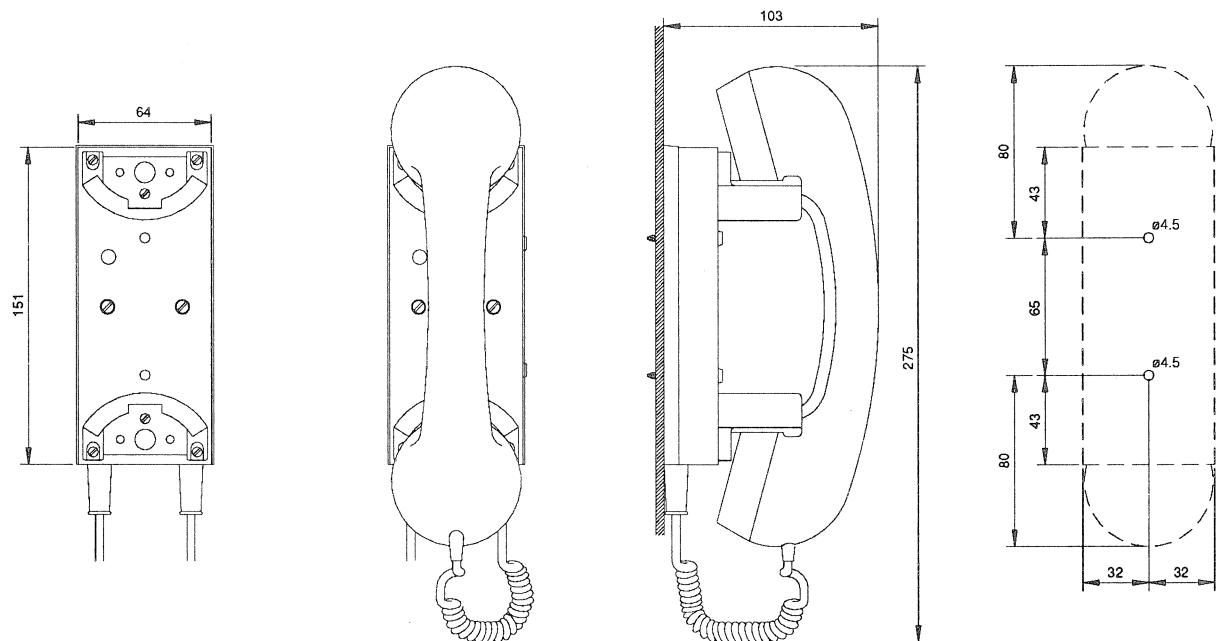


CRY2001, RT2047, T2031, RT2048, RE2100  
-0-24804A

### 6.3. MECHANICAL DIMENSIONS FOR HANDSET



### MECHANICAL DIMENSIONS FOR HANDSET HOLDER WITH MICROSWITCH







## CONTENTS

### 7. PARTS LIST



| POSITION | DESCRIPTION                              | MANUFACTURER          | TYPE                                  | S.P. NUMBER |
|----------|------------------------------------------|-----------------------|---------------------------------------|-------------|
|          | SIMPLEX / SEMIDUPLEX VHF RT2048 STANDARD | FSPERA                | VHF RT2048 (STANDARD)<br>SAILOR GREEN | 602048      |
| VARIOUS  | MINI 1/4 BOX CABINET                     | SAILOR GREEN          | 225435 GRØN RILSAN<br>ALUMINIUM       | 141.751     |
| VARIOUS  | KEYBOARD FOIL RT2048                     | ESPERA                | 1-0-25434C                            | 225434      |
| VARIOUS  | POWER CABLE WITH PLUG                    | ESPERA                | 503758 POWERKABEL                     | 503758      |
| VARIOUS  | MICROTELEPHONE WITH                      | CRADLE CRY2001/RT2048 | ESPERA                                | 3-0-25772   |
| VARIOUS  | AERIAL PLUG                              | PL259                 | * RODAN                               | 725772      |
| VARIOUS  | OPERATION INSTRUCTIONS                   | RT2048                | PL259/LODDE/BAKELIT INDL.             | 78.502      |
| VARIOUS  | SERVICE AND SALES AGENTS                 | ADDRESSES WORLD WIDE  | S.P. RADIO A/S                        | B2048       |
| VARIOUS  | MANUAL RT2048 ENGLISH                    |                       | S.P. RADIO A/S                        | F1000GB     |
|          |                                          |                       | S.P. RADIO A/S                        | M2048GB     |

| POSITION | DESCRIPTION           |                      | MANUFACTURER | TYPE               | S.P. NUMBER |
|----------|-----------------------|----------------------|--------------|--------------------|-------------|
|          | KEYBOARD MODULE       | RT2048               | ESPERA       | 5-0-25447          | 625447      |
| D1-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| D2-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| D3-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| D4-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| D5-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| D6-1     | DIODE LIGHT EMITTING  | SUB MINIATURE YELLOW | H.P.         | HLMP-7019          | 25.649      |
| J1-1     | INTERCONNECTION CABLE | 10 POLES L=60mm      | MOLEX        | 3-0-25465B         | 56.003      |
| R1-1     | RESISTOR MF           | 330 OHM 5% 0.4W      | PHILIPS      | 2322 181 53331     | 01.187      |
| R2-1     | RESISTOR MF           | 330 OHM 5% 0.4W      | PHILIPS      | 2322 181 53331     | 01.187      |
| S1-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S2-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S3-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S4-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S5-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S6-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S7-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S8-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S9-1     | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S10-1    | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S11-1    | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |
| S12-1    | SWITCH KEYBOARD       | 12x12mm              | ALPS         | SKHCAD (KHC 10904) | 43.601      |

| POSITION | DESCRIPTION             | MANUFACTOR              | TYPE           | S.P. NUMBER               |
|----------|-------------------------|-------------------------|----------------|---------------------------|
|          | INTERFACE MODULE        | RT2048                  | ESPERA         | 5-0-25450J                |
|          |                         |                         |                | 625450                    |
| VARIOUS  | INTEGRATED CIRCUIT      | CPU PROGRAMMED (C1078)  | MOTOROLA       | SP. SPEC: C1078B          |
| VARIOUS  | CONNECTION CABLE FOR    | VOLUME CONTROL RT2048   | AFD.32         | ZC No: <99679>            |
| VARIOUS  | SOCKET                  | 1/10" SIL 10 POLES      | PREC1-DIP      | 3-0-25466                 |
|          |                         |                         |                | 311-91-110                |
| C1-2     | CAPACITOR MKT           | 150nF 5% 50VDC          | ERO            | MKT 1826-415/06 4-G       |
| C2-2     | CAPACITOR ELECTROLYTIC  | 10uF 20% 35VDC          | ERO            | EKI 00 AA 210 F MOE       |
| C3-2     | CAPACITOR POLYPROPYLENE | 2n2F 5% 100VDC          | * ERO          | KP 1830-222/01-4-GW       |
| C4-2     | CAPACITOR CERAMIC       | 18pF 5% NPO 500VDC      | NKE            | DT 360 758S CH 180 J 500V |
|          |                         |                         |                | FLAT PACK                 |
| C5-2     | CAPACITOR CERAMIC       | 150pF 2% N150 100VDC    | PHILIPS        | 2222 683 34151            |
| C6-2     | CAPACITOR CERAMIC       | 150pF 2% N150 100VDC    | PHILIPS        | 2222 683 34151            |
| C7-2     | CAPACITOR CERAMIC       | 10nF -20/+80% CL2 50VDC | NKE            | DT 350 758L F 103 Z 50V   |
|          |                         |                         |                | FLAT PACK                 |
| C8-2     | CAPACITOR CERAMIC       | 10nF -20/+80% CL2 50VDC | NKE            | DT 350 758L F 103 Z 50V   |
|          |                         |                         |                | FLAT PACK                 |
| C9-2     | CAPACITOR CERAMIC       | 1n0F 10% CL2 500VDC     | NKE            | DT 360 758L B 102 K 500V  |
|          |                         |                         |                | FLAT PACK                 |
| C10-2    | CAPACITOR MKT           | 22nF 5% 100VDC          | PHILIPS        | 2222 370 89223            |
| C11-2    | CAPACITOR ELECTROLYTIC  | 220uF -20/+50% 16VDC    | ERO            | EKM 00 CC 322 D G5        |
| C12-2    | CAPACITOR ELECTROLYTIC  | 2200uF 20% 16VDC        | * SAMHWA ELEC. | SV-2200uF-16WV            |
| C13-2    | CAPACITOR MKT           | 470nF 5% 63VDC          | PHILIPS        | 2222 370 79474            |
| C14-2    | CAPACITOR MKT           | 15nF 5% 63VDC           | PHILIPS*       | 2222 370 89153            |
| C15-2    | CAPACITOR ELECTROLYTIC  | 10uF 20% 35VDC          | ERO            | EKI 00 AA 210 F MOE       |
| C16-2    | CAPACITOR ELECTROLYTIC  | 10uF 20% 35VDC          | ERO            | EKI 00 AA 210 F MOE       |
| C17-2    | CAPACITOR MKT           | 0.1uF 10% 63VDC         | PHILIPS        | 2222 370 78104            |
| C18-2    | CAPACITOR MKT           | 220nF 5% 63VDC          | PHILIPS*       | 2222 370 79224            |
| C19-2    | CAPACITOR MKT           | 220nF 20% 63VDC         | ERO            | MKT 1826-422/06 6-G       |
| C20-2    | CAPACITOR CERAMIC       | 10nF -20/+80% CL2 50VDC | NKE            | DT 350 758L F 103 Z 50V   |
|          |                         |                         |                | FLAT PACK                 |
| C21-2    | CAPACITOR CERAMIC       | 470pF 10% 500VDC        | NKE            | DT35-0465 758L 471BK 500V |
|          |                         |                         |                | FLAT PACK                 |
| C22-2    | CAPACITOR CERAMIC       | 470pF 10% 500VDC        | NKE            | DT35-0465 758L 471BK 500V |
|          |                         |                         |                | FLAT PACK                 |
| C23-2    | CAPACITOR CERAMIC       | 1n0F 10% CL2 500VDC     | NKE            | DT 360 758L B 102 K 500V  |
|          |                         |                         |                | FLAT PACK                 |
| C24-2    | CAPACITOR CERAMIC       | 1n0F 10% CL2 500VDC     | NKE            | DT 360 758L B 102 K 500V  |
|          |                         |                         |                | FLAT PACK                 |
| C25-2    | CAPACITOR CERAMIC       | 1n0F 10% CL2 500VDC     | NKE            | DT 360 758L B 102 K 500V  |
|          |                         |                         |                | FLAT PACK                 |
| C27-2    | CAPACITOR POLYPROPYLENE | 1nF 5% 10VDC            | ERO            | KP 1830-210/01-4-GW       |
| C26-2    | CAPACITOR CERAMIC       | 10nF -20/+80% CL2 50VDC | NKE            | DT 350 758L F 103 Z 50V   |

| POSITION | DESCRIPTION           | MANUFACTOR                | TYPE        | S.P. NUMBER              |
|----------|-----------------------|---------------------------|-------------|--------------------------|
|          |                       |                           |             |                          |
| D1-2     | DIODE RECTIFIER       | 1N4002 100V/1A            | THOMSON     | FLAT PACK                |
| D2-2     | DIODE ZENER           | 4V7 2% 0.4W               | PHILIPS     | 1N4002 (03/04/05/06/07)  |
| D3-2     | DIODE LIGHT EMITTING  | REDSQUARE 5x5mm           | TFK         | RZX79B4V7                |
| D4-2     | DIODE LIGHT EMITTING  | YELLOW SQUARE 5x5mm       | # TFK       | TL5H 5301                |
| D5-2     | DIODE LIGHT EMITTING  | REDSQUARE 5x5mm           | TFK         | TL5Y 5301                |
| D6-2     | DISPLAY 7SEGMENT LED  | HDSP-5551 RED             | HP          | TL5H 5301                |
| D7-2     | DISPLAY 7SEGMENT LED  | HDSP-5551 RED             | HP          | TL5Y 5301                |
| D8-2     | DIODE SCHOTTKY        | BAT 43                    | THOMSON-CSF | HDSP-5551                |
| D9-2     | DIODE SCHOTTKY        | BAT 43                    | THOMSON-CSF | BAT43                    |
| D10-2    | DIODE ZENER           | 5.1V 2% 0.4W              | * PHILIPS   | BAT43                    |
|          |                       |                           |             | BZX79B5V1                |
| J1-2     | SOCKET                | 10 POLES F.RIBBON CABLE   | MOLEX       | 52011-1010               |
| J2-2     | SOCKET                | 7 POLES F.RIBBON CABLE    | MOLEX       | 52011-0710               |
| J3-2     | SOCKET COAX           | VERTICAL FOR PCB MOUNT.   | TAIKO       | TMP-J01X-V6              |
| J4-2     | SOCKET COAX           | VERTICAL FOR PCB MOUNT.   | TAIKO       | TMP-J01X-V6              |
| L1-2     | FERRITE BEAD INDUCTOR | DOUBLE BEAD CORE          | MURATA      | BL02RN2-R62T2            |
| L2-2     | FERRITE BEAD INDUCTOR | DOUBLE BEAD CORE          | MURATA      | BL02RN2-R62T2            |
| L3-2     | CHOKO FIXED           | 120uH 10%                 | FASTRON     | MICC-121K-02             |
| P1-2     | MULTIPLUG             | 2x15 POLES PCB VERSION    | 3M          | 3531-6002 / 7630-6002 JL |
| P2-2     | PLUG                  | 1/10" SIL SQ.PINS 2 POLES | AMP         | 0-826629-2               |
|          |                       |                           |             | (0-826647-2)             |
| P3-2     | PLUG                  | 1/10" SIL SQ.PINS 2 POLES | AMP         | 0-826629-2               |
|          |                       |                           |             | (0-826647-2)             |
| Q1-2     | TRANSISTOR AF         | BC328-25 PNP TO-92        | PHILIPS     | BC328-25                 |
| Q2-2     | TRANSISTOR AF         | BC338-25 NPN TO-92        | PHILIPS     | BC338-25                 |
| Q3-2     | TRANSISTOR J FET      | N CHANNEL 8F245A          | * PHILIPS   | BF245A                   |
| Q4-2     | TRANSISTOR AF         | BC328-25 PNP TO-92        | PHILIPS     | BC328-25                 |
| Q5-2     | TRANSISTOR AF         | BC558B                    | PHILIPS     | BC558B                   |
| Q6-2     | TRANSISTOR AF         | BC548B NPN TO-92          | PHILIPS     | BC548B                   |
| Q7-2     | TRANSISTOR AF         | BC548B NPN TO-92          | PHILIPS     | BC548B                   |
| Q8-2     | TRANSISTOR AF         | BC548B NPN TO-92          | PHILIPS     | BC548B                   |
| R1-2     | RESISTOR MF           | 22k OHM 5% 0.4W           | PHILIPS     | 2322 181 53223           |
| R2-2     | RESISTOR MF           | 22k OHM 5% 0.33W          | PHILIPS     | 2322 180 73223           |
| R3-2     | RESISTOR MF           | 150 OHM 5% 0.4W           | PHILIPS     | 2322 181 53151           |
| R4-2     | RESISTOR              | 0 OHM                     | * PHILIPS   | 2322 181 90018           |
| R6-2     | RESISTOR MF           | 36k5 OHM 1% 0.6W          | PHILIPS     | 2322 156 13653           |
| R7-2     | RESISTOR MF           | 2k7 OHM 5% 0.4W           | PHILIPS     | 2322 181 53272           |
| R8-2     | RESISTOR MF           | 1k5 OHM 5% 0.4W           | PHILIPS     | 2322 181 53152           |
| R9-2     | RESISTOR MF           | 75 OHM 5% 0.4W            | PHILIPS     | 2322 181 53759           |
| R10-2    | POTENTIOMETER         | 50k OHM 20% 50mW LOG      | NOBLE       | 779-9013                 |
| R11-2    | RESISTOR ARRAY        | 4x5k6 OHM 5% 1/4W         | MURATA      | RG SD Y 562J             |
| R12-2    | RESISTOR MF           | 97k6 OHM 1% 0.6W          | * PHILIPS   | 2322 156 19763           |
| R13-2    | RESISTOR MF           | 1k21 OHM 1% 0.6W          | PHILIPS     | 2322 156 11212           |
| R14-2    | RESISTOR MF           | 33k2 OHM 1% 0.6W          | * PHILIPS   | 2322 156 13323           |

| POSITION | DESCRIPTION    |                      | MANUFACTURER | TYPE                | S.P. NUMBER |
|----------|----------------|----------------------|--------------|---------------------|-------------|
| R15-2    | RESISTOR MF    | 270k OHM 1% 0.6W     | * PHILIPS    | 2322 156 12704      | 03.465      |
| R16-2    | RESISTOR MF    | 4k32 OHM 1% 0.6W     | * PHILIPS    | 2322 156 14322      | 03.415      |
| R17-2    | RESISTOR MF    | 120k OHM 5% 0.4W     | PHILIPS      | 2322 181 53124      | 01.252      |
| R18-2    | RESISTOR MF    | 91k OHM 5% 0.4W      | PHILIPS      | 2322 181 53913      | 01.248      |
| R19-2    | RESISTOR MF    | 330k OHM 1% 0.6W     | PHILIPS      | 2322 156 13304      | 03.270      |
| R20-2    | RESISTOR MF    | 10k OHM 5% 0.4W      | PHILIPS      | 2322 181 53103      | 01.225      |
| R21-2    | RESISTOR MF    | 150k OHM 5% 0.4W     | PHILIPS      | 2322 181 53154      | 01.254      |
| R22-2    | RESISTOR MF    | 10k OHM 5% 0.4W      | PHILIPS      | 2322 181 53103      | 01.225      |
| R23-2    | POTENTIOMETER  | 10k OHM 10% 0.1W LOG | NOBLE        | V90-10155-D         | 08.257      |
| R24-2    | RESISTOR ARRAY | 8x100k OHM 5% 1/8W   | MURATA       | RG LD 8 X 104 J     | 08.655      |
| R25-2    | RESISTOR MF    | 10k OHM 5% 0.4W      | PHILIPS      | 2322 181 53103      | 01.225      |
| R26-2    | RESISTOR MF    | 51k OHM 1% 0.6W      | * PHILIPS    | 2322 156 15103      | 03.462      |
| R27-2    | RESISTOR MF    | 270k OHM 1% 0.6W     | * PHILIPS    | 2322 156 12704      | 03.465      |
| R28-2    | RESISTOR ARRAY | 4x10k OHM 5% 1/8W    | PANASONIC    | EXBF8V103G (4X10K)  | 08.615      |
| R29-2    | RESISTOR ARRAY | 4x10k OHM 5% 1/8W    | PANASONIC    | EXBF8V103G (4X10K)  | 08.615      |
| R30-2    | RESISTOR MF    | 3k3 OHM 5% 0.4W      | PHILIPS      | 2322 181 53332      | 01.212      |
| R31-2    | RESISTOR MF    | 100k OHM 5% 0.4W     | PHILIPS      | 2322 181 53104      | 01.250      |
| R32-2    | RESISTOR MF    | 3k48 OHM 1% 0.6W     | PHILIPS      | 2322 156 13482      | 03.400      |
| R33-2    | RESISTOR ARRAY | 4x820 OHM 5% 0.25W   | PANASONIC    | EXBF8V821G (4X820R) | 08.601      |
| R34-2    | RESISTOR ARRAY | 4x820 OHM 5% 0.25W   | PANASONIC    | EXBF8V821G (4X820R) | 08.601      |
| R35-2    | RESISTOR ARRAY | 4x820 OHM 5% 0.25W   | PANASONIC    | EXBF8V821G (4X820R) | 08.601      |
| R36-2    | RESISTOR ARRAY | 4x820 OHM 5% 0.25W   | PANASONIC    | EXBF8V821G (4X820R) | 08.601      |
| R38-2    | RESISTOR ARRAY | 4x10k OHM 5% 1/8W    | PANASONIC    | EXBF8V103G (4X10K)  | 08.615      |
| R39-2    | RESISTOR MF    | 8k25 OHM 1% 0.6W     | * PHILIPS    | 2322 156 18252      | 03.423      |
| R40-2    | RESISTOR MF    | 10k OHM 1% 0.6W      | * PHILIPS    | 2322 156 11003      | 03.427      |
| R41-2    | RESISTOR MF    | 15k OHM 1% 0.6W      | PHILIPS      | 2322 156 11503      | 03.429      |
| R42-3    | RESISTOR ARRAY | 4x330 OHM 5% 1/4W    | MURATA       | RG SD 4 Y 331J      | 08.608      |
| R43-2    | RESISTOR MF    | 47 OHM 5% 0.4W       | PHILIPS      | 2322 181 53479      | 01.166      |
| R44-2    | RESISTOR MF    | 1k OHM 5% 0.4W       | PHILIPS      | 2322 181 53102      | 01.200      |
| R45-2    | RESISTOR MF    | 3k9 OHM 5% 0.4W      | PHILIPS      | 2322 181 53392      | 01.214      |
| R46-2    | RESISTOR MF    | 750 OHM 5% 0.4W      | PHILIPS      | 2322 181 53751      | 01.196      |
| R47-2    | RESISTOR MF    | 18k OHM 5% 0.4W      | PHILIPS      | 2322 181 53183      | 01.231      |
| R48-2    | RESISTOR MF    | 820 OHM 5% 0.4W      | PHILIPS      | 2322 181 53821      | 01.197      |
| R49-2    | RESISTOR MF    | 15k OHM 5% 0.4W      | PHILIPS      | 2322 181 53153      | 01.229      |
| R50-2    | RESISTOR MF    | 270k OHM 1% 0.6W     | * PHILIPS    | 2322 156 12704      | 03.465      |
| R54-2    | RESISTOR MF    | 4k7 OHM 5% 0.4W      | PHILIPS      | 2322 181 53472      | 01.216      |
| R55-2    | RESISTOR MF    | 3k3 OHM 5% 0.4W      | PHILIPS      | 2322 181 53332      | 01.212      |
| R56-2    | RESISTOR MF    | 4k7 OHM 5% 0.4W      | PHILIPS      | 2322 181 53472      | 01.216      |
| R57-2    | RESISTOR MF    | 3k3 OHM 5% 0.4W      | PHILIPS      | 2322 181 53332      | 01.212      |
| R58-2    | RESISTOR MF    | 100k OHM 5% 0.4W     | PHILIPS      | 2322 181 53104      | 01.250      |
| R59-2    | RESISTOR MF    | 5k11 OHM 1% 0.6W     | * PHILIPS    | 2322 156 15112      | 03.414      |
| R60-2    | RESISTOR MF    | 357 OHM 1% 0.6W      | * PHILIPS    | 2322 156 13571      | 02.204      |
| U1-2     | EEPROM         | 1k BIT SERIAL        | OKI          | MSM16811RS          | 32.708      |
| U2-2     | EEPROM         | 1k BIT SERIAL        | OKI          | MSM16811RS          | 32.708      |

| POSITION | DESCRIPTION        |                           | MANUFACTURER | TYPE       | S.P. NUMBER |
|----------|--------------------|---------------------------|--------------|------------|-------------|
| U3-2     | SOCKET             | DIL 2x20 POLES            | * AMP        | 641606-3   | 30.935      |
| U4-2     | INTEGRATED CIRCUIT | 8 BIT SHIFT REG.SERIAL IO | NATIONAL     | MM74HC595N | 34.502      |
| U5-2     | INTEGRATED CIRCUIT | 8 BIT SHIFT REG.SERIAL IO | NATIONAL     | MM74HC595N | 34.502      |
| U6-2     | INTEGRATED CIRCUIT | 8 BIT SHIFT REG.SERIAL IO | NATIONAL     | MM74HC595N | 34.502      |
| U7-2     | INTEGRATED CIRCUIT | QUAD VOLTAGE COMPERATOR   | TEXAS*       | LM339N     | 31.075      |
| U8-2     | QUAD OP.AMP.       | 324                       | TEXAS        | LM324N     | 31.065      |
| U9-2     | VOLTAGE REGULATOR  | ADJUSTABLE Io=100mA       | TEXAS        | TL317CLP   | 31.145      |

| POSITION | DESCRIPTION            |                           | MANUFACTOR | TYPE                                      | S.P. NUMBER |
|----------|------------------------|---------------------------|------------|-------------------------------------------|-------------|
|          | SYNTESE MODULE         | RT2048                    | ESPERA     | 5-C-25451G                                | 625451      |
| C1-3     | CAPACITOR MKT          | 0.1uF 10% 63VDC           | NORTON     | NORMOUNT V1300 0.8x12mm                   | 95.512      |
| C2-3     | CAPACITOR MKT          | 220nF 10% 63VDC           | PHILIPS    | 2222 370 78104                            | 11.136      |
| C3-3     | CAPACITOR POLYSTYRENE  | 56pF 1% 630V              | PHILIPS    | 2222 370 78224                            | 11.095      |
| C4-3     | CAPACITOR POLYSTYRENE  | 300pF 1% 630VDC           | #PHILIPS   | 2222 431 85609                            | 10.394      |
| C5-3     | CAPACITOR ELECTROLYTIC | 100uF -10/+50% 25VDC      | PHILIPS    | 2222 431 83001                            | 10.414      |
| C6-3     | CAPACITOR POLYSTYRENE  | 51pF 1% 630V              | ERO        | EKM 00 CC 310 E G5                        | 14.610      |
| C7-3     | CAPACITOR MKT          | 22nF 10% 100VDC           | #PHILIPS   | 2222 431 85109                            | 10.393      |
| C8-3     | CAPACITOR MKT          | 22nF 10% 100VDC           | PHILIPS    | 2222 370 88223                            | 11.175      |
| C9-3     | CAPACITOR MKT          | 22nF 10% 100VDC           | PHILIPS    | 2222 370 88223                            | 11.175      |
| C10-3    | CAPACITOR MKT          | 220nF 10% 63VDC           | PHILIPS    | 2222 370 78224                            | 11.095      |
| C11-3    | CAPACITOR MKT          | 22nF 10% 100VDC           | PHILIPS    | 2222 370 88223                            | 11.175      |
| C12-3    | CAPACITOR ELECTROLYTIC | 47uF 20% 25VDC            | ERO        | FKI 00 BB 247 E MOE                       | 14.524      |
| C13-3    | CAPACITOR MKT          | 220nF 5% 63VDC            | PHILIPS*   | 2222 370 79224                            | 11.182      |
| C14-3    | CAPACITOR ELECTROLYTIC | 22uF 20% 35VDC            | ERO        | EKI 00 BB 222 F MOE                       | 14.516      |
| C15-3    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO        | EKI 00 AA 210 F MOE                       | 14.512      |
| C16-3    | CAPACITOR ELECTROLYTIC | 4.7uF 20% 50VDC           | ERO        | EKI 00 AA 147 H MOE                       | 14.510      |
| C17-3    | CAPACITOR MKT          | 1u5F 10% 50VDC            | ERO        | MKT 1826 515/05 5-G                       | 11.191      |
| C18-3    | CAPACITOR POLYSTYRENE  | 12nF 1% 63VDC             | * PHILIPS  | 2222 443 41213                            | 10.796      |
| C19-3    | CAPACITOR ELECTROLYTIC | 1uF 20% 50VDC             | ERO        | EKI 00 AA 110 H MOE                       | 14.506      |
| C20-3    | CAPACITOR CERAMIC      | 39pF 5% NPO 50VDC         | NKE        | DT 350 758L CH 390 J 50V<br>FLAT PACK     | 15.085      |
| C21-3    | CAPACITOR CERAMIC      | 5p6F +/-0.25pF NPO 500VDC | NKE        | DT35-0465 758S CH 5R6 C<br>500V FLAT PACK | 15.015      |
| C22-3    | CAPACITOR CERAMIC      | 1n0F 10% CL2 500VDC       | NKE        | DT 360 758L B 102 K 500V<br>FLAT PACK     | 15.160      |
| C23-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK    | 16.095      |
| C24-3    | CAPACITOR CERAMIC      | 6p8F +/-0.25pF NPO 100VDC | PHILIPS    | 2222 683 09688                            | 15.325      |
| C25-3    | CAPACITOR CERAMIC      | 1n0F 10% CL2 500VDC       | NKE        | DT 360 758L R 102 K 500V<br>FLAT PACK     | 15.160      |
| C26-3    | CAPACITOR CERAMIC      | 1n0F 10% CL2 500VDC       | NKE        | DT 360 758L B 102 K 500V<br>FLAT PACK     | 15.160      |
| C27-3    | CAPACITOR CERAMIC      | 1n0F 10% CL2 500VDC       | NKE        | DT 360 758L B 102 K 500V<br>FLAT PACK     | 15.160      |
| C28-3    | CAPACITOR CERAMIC      | 10nF -20/+80% CL2 50VDC   | NKE        | DT 350 758L F 103 Z 50V<br>FLAT PACK      | 15.170      |
| C29-3    | CAPACITOR MKT          | 1uF 5% 63VDC              | PHILIPS    | 2222 370 79105                            | 11.190      |
| C30-3    | CAPACITOR MKT          | 470nF 5% 63VDC            | PHILIPS    | 2222 370 79474                            | 11.187      |
| C31-3    | CAPACITOR MKT          | 22nF 5% 100VDC            | PHILIPS    | 2222 370 89223                            | 11.189      |
| C32-3    | CAPACITOR ELECTROLYTIC | 47uF 20% 25VDC            | ERO        | EKI 00 BB 247 E MOE                       | 14.524      |

| POSITION | DESCRIPTION            |                           | MANUFACTOR | TYPE                                   | S.P. NUMBER |
|----------|------------------------|---------------------------|------------|----------------------------------------|-------------|
| C33-3    | CAPACITOR CERAMIC      | 100pF 5% NPO 50VDC        | NKE        | DT 360 758L CH 101 J 50V<br>FLAT PACK  | 15.136      |
| C34-3    | CAPACITOR POLYSTYRENE  | 825pF 1% 63VDC            | PHILIPS    | 2222 443 48251                         | 10.755      |
| C35-3    | CAPACITOR MKT          | 150nF 5% 50VDC            | ERO        | MKT 1826-415/06 4-G                    | 11.181      |
| C36-3    | CAPACITOR MKT          | 68nF 5% 63VDC             | PHILIPS    | 2222 370 79683                         | 11.178      |
| C37-3    | CAPACITOR MKT          | 1uF 10% 63VDC             | PHILIPS    | 2222 370 78105                         | 11.137      |
| C38-3    | CAPACITOR POLYSTYRENE  | 12nF 1% 63VDC             | * PHILIPS  | 2222 443 41213                         | 10.796      |
| C39-3    | CAPACITOR POLYSTYRENE  | 221pF 1% 63VDC            | PHILIPS    | 2222 443 42211                         | 10.727      |
| C41-3    | CAPACITOR ELECTROLYTIC | 47uF 20% 25VDC            | ERO        | EKI 00 BB 247 E MOE                    | 14.524      |
| C42-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C43-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C44-3    | CAPACITOR ELECTROLYTIC | 100uF -10/+50% 25VDC      | ERO        | EKM 00 CC 310 E G5                     | 14.610      |
| C45-3    | CAPACITOR MKT          | 330nF 5% 63VDC            | PHILIPS*   | 2222 370 79334                         | 11.184      |
| C46-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C47-3    | CAPACITOR CERAMIC      | 15pF 5% N150 500VDC       | NKE        | DT 350 758L PH 150 J 500V<br>FLAT PACK | 16.115      |
| C48-3    | CAPACITOR CERAMIC      | 22pF 5% N150 500VDC       | KCK        | RT-HW SK PH 220 J<br>AMMO PACK         | 15.062      |
| C49-3    | CAPACITOR CERAMIC      | 13pF 5% N150 50VDC        | NKE        | DT 340 758S PH 130 J 50V<br>FLAT PACK  | 15.051      |
| C50-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C51-3    | CAPACITOR CERAMIC      | 2p7F +/-0.25pF N150 50VDC | NKE        | DT 330 758S PJ 2R7 C 50V<br>FLAT PACK  | 15.001      |
| C52-3    | CAPACITOR CERAMIC      | 18pF 5% NPO 500VDC        | NKE        | DT 360 758S CH 180 J 500V<br>FLAT PACK | 15.060      |
| C53-3    | CAPACITOR CERAMIC      | 18pF 5% NPO 500VDC        | NKE        | DT 360 758S CH 180 J 500V<br>FLAT PACK | 15.060      |
| C54-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C55-3    | CAPACITOR CERAMIC      | 12pF 5% NPO 500VDC        | NKE        | DT350465 758S CH 120J 500<br>FLAT PACK | 15.575      |
| C56-3    | CAPACITOR CERAMIC      | 8p2F +/-0.25pF NPO 500VDC | NKE        | DT 350 758L CH 8R2 C 500V<br>FLAT PACK | 15.030      |
| C57-3    | CAPACITOR CERAMIC      | 18pF 5% NPO 500VDC        | NKE        | DT 360 758S CH 180 J 500V<br>FLAT PACK | 15.060      |
| C58-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C59-3    | CAPACITOR CERAMIC      | 18pF 2% NPO 100VDC        | PHILIPS    | 2222 683 10189                         | 15.330      |
| C60-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE        | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |

| POSITION | DESCRIPTION            |                           | MANUFACTURER | TYPE                                   | S.P. NUMBER |
|----------|------------------------|---------------------------|--------------|----------------------------------------|-------------|
| C61-3    | CAPACITOR CERAMIC      | 12pF 2% NPO 100VDC        | PHILIPS      | 2222 683 10129                         | 15.328      |
| C62-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C63-3    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO          | EK1 00 AA 210 F MOE                    | 14.512      |
| C64-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C65-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C66-3    | CAPACITOR CERAMIC      | 15pF 2% NPO 100VDC        | PHILIPS      | 2222 683 10159                         | 15.329      |
| C67-3    | CAPACITOR CERAMIC      | 15pF 2% NPO 100VDC        | PHILIPS      | 2222 683 10159                         | 15.329      |
| C68-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C69-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C70-3    | CAPACITOR CERAMIC      | 12pF 2% NPO 100VDC        | PHILIPS      | 2222 683 10129                         | 15.328      |
| C71-3    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK | 16.095      |
| C72-3    | CAPACITOR CERAMIC      | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK   | 15.170      |
| C73-3    | CAPACITOR CERAMIC      | 33pF 2% NPO 100VDC        | PHILIPS      | 2222 683 10339                         | 15.333      |
| C74-3    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO          | EK1 00 AA 210 F MOE                    | 14.512      |
| C75-3    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO          | EK1 00 AA 210 F MOE                    | 14.512      |
| C76-3    | CAPACITOR ELECTROLYTIC | 220uF -20/+50% 16VDC      | ERO          | EKM 00 CC 322 D G5                     | 14.640      |
| C77-3    | CAPACITOR TRIMMING     | 3.9-27pF PTFE             | DAU          | 107.3901.027                           | 17.110      |
| C78-3    | CAPACITOR TRIMMING     | 1.8-9pF PTFE              | DAU          | 117 1991 009 B021                      | 17.090      |
| C79-3    | CAPACITOR MKT          | 220nF 10% 63VDC           | PHILIPS      | 2222 370 78224                         | 11.095      |
| C80-3    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS      | 2222 370 78104                         | 11.136      |
| D1-3     | DIODE                  | BAW62 HIGH SPEED          | PHILIPS      | BAW62-143                              | 25.350      |
| D2-3     | DIODE                  | 1N4150                    | PHILIPS      | 1N4150                                 | 25.140      |
| D3-3     | DIODE SCHOTTKY         | BAT 43                    | THOMSON-CSF  | BAT43                                  | 27.600      |
| D4-3     | DIODE                  | BAW62 HIGH SPEED          | PHILIPS      | BAW62-143                              | 25.350      |
| D5-3     | DIODE                  | 1N4148 HIGH SPEED         | PHILIPS      | 1N4148-143                             | 25.131      |
| D6-3     | DIODE SWITCH           | FACTORY SELECTED MPN 3700 | ESPERA       | C1082A / 0-0-25550                     | 725550      |
| D7-3     | DIODE SWITCH           | BA282                     | ITT          | BA282                                  | 25.390      |
| D8-3     | DIODE SWITCH           | BA282                     | ITT          | BA282                                  | 25.390      |
| D9-3     | DIODE CAPASITANCE      | 13pF/9VDC                 | TOSHIBA      | 1SV101 in matched group                | 26.135      |
| D10-3    | DIODE SCHOTTKY         | BAT 43                    | THOMSON-CSF  | BAT43                                  | 27.600      |
| J1-3     | SOCKET COAX            | HORISONTAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-A2                            | 78.517      |
| J2-3     | SOCKET COAX            | HORISONTAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-A2                            | 78.517      |
| J3-3     | SOCKET COAX            | HORISONTAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-A2                            | 78.517      |
| J4-3     | SOCKET COAX            | HORISONTAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-A2                            | 78.517      |
| L1-3     | CHOKER                 | 0.10uH 5%                 | WEST CAP     | 1A1003M-5% / TAPED                     | 20.099      |
| L3-3     | CHOKER                 | 4u7H 10%                  | FASTRON      | MICC-4R7K-02                           | 20.137      |
| L4-3     | CHOKER                 | 4u7H 10%                  | FASTRON      | MICC-4R7K-02                           | 20.137      |

| POSITION | DESCRIPTION          |                       | MANUFACTURER  | TYPE               | S.P. NUMBER |
|----------|----------------------|-----------------------|---------------|--------------------|-------------|
| L5-3     | CHOKER               | 4u7H 10%              | FASTRON       | MICC-4R7K-02       | 20.137      |
| L6-3     | CHOKER               | 0.10uH 5%             | WEST CAP      | 1A1003M-5% / TAPED | 20.099      |
| L7-3     | CHOKER               | 0.10uH 5%             | WEST CAP      | 1A1003M-5% / TAPED | 20.099      |
| L8-3     | CHOKER               | 0.10uH 5%             | WEST CAP      | 1A1003M-5% / TAPED | 20.099      |
| L9-3     | COIL RF              | 0.11uH ADJUSTABLE     | TOKO          | E526HN-100117      | 38.409      |
| P1-3     | PLUG PCB             | 2x5 POLES RIGHT ANGLE | 3M            | 7610-5002-JL       | 78.252      |
| Q1-3     | TRANSISTOR           | BF509                 | AEG*          | BF509              | 28.203      |
| Q2-3     | TRANSISTOR RF        | BF199                 | PHILIPS       | BF199              | 28.178      |
| Q3-3     | TRANSISTOR RF SWITCH | 2N2369A               | MOTOROLA      | 2N2369A            | 28.315      |
| Q4-3     | TRANSISTOR AF        | BC548B NPN TO-92      | PHILIPS       | BC548B             | 28.076      |
| Q5-3     | TRANSISTOR AF        | BC558B                | PHILIPS       | BC558B             | 28.100      |
| Q6-3     | TRANSISTOR AF        | BC338-25 NPN TO-92    | PHILIPS       | BC338-25           | 28.058      |
| Q7-3     | TRANSISTOR RF        | LOW POWER PNP BF979   | TELEFUNKEN AG | BF979              | 28.251      |
| Q8-3     | TRANSISTOR AF        | BC558B                | PHILIPS       | BC558B             | 28.100      |
| Q9-3     | TRANSISTOR AF        | BC548B NPN TO-92      | PHILIPS       | BC548B             | 28.076      |
| Q10-3    | TRANSISTOR           | BC549C                | PHILIPS*      | BC549C             | 28.082      |
| Q11-3    | TRANSISTOR           | BC549C                | PHILIPS*      | BC549C             | 28.082      |
| Q12-3    | TRANSISTOR AF        | BC548B NPN TO-92      | PHILIPS       | BC548B             | 28.076      |
| Q13-3    | TRANSISTOR           | 2N4427                | MOTOROLA*     | 2N4427             | 28.330      |
| Q14-3    | TRANSISTOR RF        | BFW92A                | TFK           | BFW92A             | 29.160      |
| Q15-3    | TRANSISTOR RF        | LOW POWER PNP BF979   | TELEFUNKEN AG | BF979              | 28.251      |
| Q16-3    | TRANSISTOR RF        | BFW92A                | TFK           | BFW92A             | 29.160      |
| Q17-3    | TRANSISTOR J FET     | N CHANNEL BF245A      | * PHILIPS     | BF245A             | 29.714      |
| Q18-3    | TRANSISTOR JFET      | N-CHAN. J309          | * SILICONIX   | J309               | 29.724      |
| R1-3     | RESISTOR MF          | 20k OHM 5% 0.6W       | * PHILIPS     | 2322 156 12003     | 03.452      |
| R2-3     | RESISTOR MF          | 60k4 OHM 1% 0.6W      | * PHILIPS     | 2322 156 16043     | 03.238      |
| R3-3     | RESISTOR MF          | 33k2 OHM 1% 0.6W      | * PHILIPS     | 2322 156 13323     | 03.232      |
| R4-3     | RESISTOR MF          | 100k OHM 1% 0.6W      | * PHILIPS     | 2322 156 11004     | 03.477      |
| R5-3     | RESISTOR MF          | 221k OHM 1% 0.6W      | * PHILIPS     | 2322 156 12214     | 03.483      |
| R6-3     | RESISTOR MF          | 47k OHM 5% 0.4W       | PHILIPS       | 2322 181 53473     | 01.241      |
| R7-3     | RESISTOR MF          | 6k8 OHM 5% 0.4W       | PHILIPS       | 2322 181 53682     | 01.220      |
| R8-3     | RESISTOR MF          | 220 OHM 5% 0.4W       | PHILIPS       | 2322 181 53221     | 01.183      |
| R9-3     | RESISTOR MF          | 33 OHM 5% 0.4W        | PHILIPS       | 2322 181 53339     | 01.162      |
| R10-3    | RESISTOR MF          | 82 OHM 5% 0.4W        | PHILIPS       | 2322 181 53829     | 01.172      |
| R11-3    | RESISTOR MF          | 12k OHM 5% 0.4W       | PHILIPS       | 2322 181 53123     | 01.227      |
| R12-3    | RESISTOR MF          | 18k OHM 5% 0.4W       | PHILIPS       | 2322 181 53183     | 01.231      |
| R13-3    | RESISTOR MF          | 51 OHM 5% 0.4W        | PHILIPS       | 2322 181 53519     | 01.167      |
| R14-3    | RESISTOR MF          | 12k OHM 5% 0.4W       | PHILIPS       | 2322 181 53123     | 01.227      |
| R15-3    | RESISTOR MF          | 3k3 OHM 5% 0.4W       | PHILIPS       | 2322 181 53332     | 01.212      |
| R16-3    | RESISTOR MF          | 2k0 OHM 5% 0.4W       | PHILIPS       | 2322 181 53202     | 01.207      |
| R17-3    | RESISTOR MF          | 1k5 OHM 5% 0.4W       | PHILIPS       | 2322 181 53152     | 01.204      |
| R18-3    | RESISTOR MF          | 18k OHM 5% 0.4W       | PHILIPS       | 2322 181 53183     | 01.231      |
| R19-3    | RESISTOR MF          | 820 OHM 5% 0.4W       | PHILIPS       | 2322 181 53821     | 01.197      |
| R20-3    | RESISTOR MF          | 5k6 OHM 5% 0.4W       | PHILIPS       | 2322 181 53562     | 01.218      |

| POSITION | DESCRIPTION |                  | MANUFACTUR | TYPE           | S.P. NUMBER |
|----------|-------------|------------------|------------|----------------|-------------|
| R21-3    | RESISTOR MF | 820 OHM 5% 0.4W  | PHILIPS    | 2322 181 53821 | 01.197      |
| R22-3    | RESISTOR MF | 1k5 OHM 5% 0.4W  | PHILIPS    | 2322 181 53152 | 01.204      |
| R23-3    | RESISTOR MF | 1k3 OHM 1% 0.6W  | * PHILIPS  | 2322 156 11302 | 03.402      |
| R24-3    | RESISTOR MF | 1k3 OHM 1% 0.6W  | * PHILIPS  | 2322 156 11302 | 03.402      |
| R25-3    | RESISTOR MF | 220 OHM 5% 0.4W  | PHILIPS    | 2322 181 53221 | 01.183      |
| R26-3    | RESISTOR MF | 120 OHM 5% 0.4W  | PHILIPS    | 2322 181 53121 | 01.177      |
| R27-3    | RESISTOR MF | 60k4 OHM 1% 0.6W | * PHILIPS  | 2322 156 16043 | 03.238      |
| R28-3    | RESISTOR MF | 60k4 OHM 1% 0.6W | * PHILIPS  | 2322 156 16043 | 03.238      |
| R29-3    | RESISTOR MF | 100k OHM 5% 0.4W | PHILIPS    | 2322 181 53104 | 01.250      |
| R30-3    | RESISTOR MF | 30k OHM 5% 0.4W  | PHILIPS    | 2322 181 53303 | 01.236      |
| R31-3    | RESISTOR MF | 56 OHM 5% 0.4W   | PHILIPS    | 2322 181 53569 | 01.168      |
| R33-3    | RESISTOR MF | 30k OHM 5% 0.4W  | PHILIPS    | 2322 181 53303 | 01.236      |
| R34-3    | RESISTOR MF | 1M0 OHM 5% 0.4W  | PHILIPS    | 2322 181 53105 | 01.275      |
| R35-3    | RESISTOR MF | 330 OHM 5% 0.4W  | PHILIPS    | 2322 181 53331 | 01.187      |
| R36-3    | RESISTOR MF | 1k0 OHM 5% 0.4W  | PHILIPS    | 2322 181 53102 | 01.200      |
| R37-3    | RESISTOR MF | 110k OHM 5% 0.4W | PHILIPS    | 2322 181 53114 | 01.251      |
| R38-3    | RESISTOR MF | 33 OHM 5% 0.4W   | PHILIPS    | 2322 181 53339 | 01.162      |
| R39-3    | RESISTOR MF | 270k OHM 5% 0.4W | PHILIPS    | 2322 181 53274 | 01.260      |
| R40-3    | RESISTOR MF | 820 OHM 5% 0.4W  | PHILIPS    | 2322 181 53821 | 01.197      |
| R41-3    | RESISTOR MF | 4k7 OHM 5% 0.4W  | PHILIPS    | 2322 181 53472 | 01.216      |
| R42-3    | RESISTOR MF | 270k OHM 5% 0.4W | PHILIPS    | 2322 181 53274 | 01.260      |
| R43-3    | RESISTOR MF | 430 OHM 5% 0.4W  | * PHILIPS  | 2322 181 53431 | 01.190      |
| R44-3    | RESISTOR MF | 8k2 OHM 5% 0.4W  | PHILIPS    | 2322 181 53822 | 01.222      |
| R45-3    | RESISTOR MF | 4k7 OHM 5% 0.4W  | PHILIPS    | 2322 181 53472 | 01.216      |
| R46-3    | RESISTOR MF | 1k2 OHM 5% 0.4W  | PHILIPS    | 2322 181 53122 | 01.202      |
| R47-3    | RESISTOR MF | 330 OHM 5% 0.4W  | PHILIPS    | 2322 181 53331 | 01.187      |
| R48-3    | RESISTOR MF | 82 OHM 5% 0.4W   | PHILIPS    | 2322 181 53829 | 01.172      |
| R49-3    | RESISTOR MF | 2k43 OHM 1% 0.6W | * PHILIPS  | 2322 156 12432 | 03.396      |
| R50-3    | RESISTOR MF | 56k OHM 5% 0.4W  | PHILIPS    | 2322 181 53563 | 01.243      |
| R51-3    | RESISTOR MF | 1k0 OHM 5% 0.4W  | PHILIPS    | 2322 181 53102 | 01.200      |
| R52-3    | RESISTOR MF | 221 OHM 1% 0.6W  | * PHILIPS  | 2322 156 12211 | 03.384      |
| R53-3    | RESISTOR MF | 5k11 OHM 1% 0.6W | * PHILIPS  | 2322 156 15112 | 03.414      |
| R54-3    | RESISTOR MF | 39k2 OHM 1% 0.6W | PHILIPS    | 2322 156 13923 | 03.439      |
| R55-3    | RESISTOR MF | 39k2 OHM 1% 0.6W | PHILIPS    | 2322 156 13923 | 03.439      |
| R56-3    | RESISTOR MF | 6k19 OHM 1% 0.6W | * PHILIPS  | 2322 156 16192 | 03.399      |
| R57-3    | RESISTOR MF | 10k0 OHM 1% 0.6W | * PHILIPS  | 2322 156 11003 | 03.427      |
| R58-3    | RESISTOR MF | 360k OHM 5% 0.4W | PHILIPS    | 2322 181 53364 | 01.263      |
| R59-3    | RESISTOR MF | 8k2 OHM 5% 0.4W  | PHILIPS    | 2322 181 53822 | 01.222      |
| R60-3    | RESISTOR MF | 8k2 OHM 5% 0.4W  | PHILIPS    | 2322 181 53822 | 01.222      |
| R61-3    | RESISTOR MF | 5k11 OHM 1% 0.6W | * PHILIPS  | 2322 156 15112 | 03.414      |
| R62-3    | RESISTOR MF | 174k OHM 1% 0.6W | PHILIPS    | 2322 156 11744 | 03.255      |
| R63-3    | RESISTOR MF | 750 OHM 5% 0.4W  | PHILIPS    | 2322 181 53751 | 01.196      |
| R65-3    | RESISTOR MF | 150 OHM 5% 0.4W  | PHILIPS    | 2322 181 53151 | 01.179      |
| R66-3    | RESISTOR MF | 47 OHM 5% 0.4W   | PHILIPS    | 2322 181 53479 | 01.166      |

| POSITION | DESCRIPTION        |                           | MANUFACTURER | TYPE            | S.P. NUMBER |
|----------|--------------------|---------------------------|--------------|-----------------|-------------|
| R67-3    | RESISTOR MF        | 330 OHM 5% 0.4W           | PHILIPS      | 2322 181 53331  | 01.187      |
| R68-3    | RESISTOR MF        | 560 OHM 5% 0.4W           | PHILIPS      | 2322 181 53561  | 01.193      |
| R69-3    | RESISTOR MF        | 120 OHM 5% 0.4W           | PHILIPS      | 2322 181 53121  | 01.177      |
| R70-3    | RESISTOR MF        | 15 OHM 5% 0.4W            | PHILIPS      | 2322 181 53159  | 01.154      |
| R71-3    | RESISTOR MF        | 3R9 OHM 5% 0.4W           | PHILIPS      | 2322 181 53398  | 01.139      |
| R72-3    | RESISTOR MF        | 2k2 OHM 5% 0.4W           | PHILIPS      | 2322 181 53222  | 01.208      |
| R73-3    | RESISTOR MF        | 100 OHM 5% 0.4W           | PHILIPS      | 2322 181 53101  | 01.175      |
| R74-3    | RESISTOR MF        | 270 OHM 5% 0.4W           | PHILIPS      | 2322 181 53271  | 01.185      |
| R75-3    | RESISTOR MF        | 12 OHM 5% 0.4W            | PHILIPS      | 2322 181 53129  | 01.152      |
| R76-3    | RESISTOR MF        | 27 OHM 5% 0.4W            | PHILIPS      | 2322 181 53279  | 01.160      |
| R77-3    | RESISTOR MF        | 2k7 OHM 5% 0.4W           | PHILIPS      | 2322 181 53272  | 01.210      |
| R78-3    | RESISTOR MF        | 91 OHM 5% 0.4W            | PHILIPS      | 2322 181 53919  | 01.174      |
| R79-3    | RESISTOR MF        | 47 OHM 5% 0.4W            | PHILIPS      | 2322 181 53479  | 01.166      |
| R80-3    | RESISTOR MF        | 1k6 OHM 5% 0.4W           | PHILIPS      | 2322 181 53162  | 01.205      |
| R81-3    | RESISTOR MF        | 4.3k OHM 5% 0.4W          | * PHILIPS    | 2322 181 53432  | 01.215      |
| R82-3    | RESISTOR MF        | 3k3 OHM 5% 0.4W           | PHILIPS      | 2322 181 53332  | 01.212      |
| R83-3    | RESISTOR MF        | 560 OHM 5% 0.4W           | PHILIPS      | 2322 181 53561  | 01.193      |
| R84-3    | RESISTOR MF        | 300 OHM 5% 0.4W           | PHILIPS      | 2322 181 53301  | 01.186      |
| R85-3    | RESISTOR MF        | 100 OHM 5% 0.4W           | PHILIPS      | 2322 181 53101  | 01.175      |
| R86-3    | RESISTOR MF        | 300 OHM 5% 0.4W           | PHILIPS      | 2322 181 53301  | 01.186      |
| R87-3    | RESISTOR MF        | 18 OHM 5% 0.4W            | PHILIPS      | 2322 181 53189  | 01.156      |
| R88-3    | RESISTOR MF        | 56 OHM 5% 0.4W            | PHILIPS      | 2322 181 53569  | 01.168      |
| R89-3    | RESISTOR MF        | 5k1 OHM 5% 0.4W           | PHILIPS      | 2322 181 53512  | 01.217      |
| R90-3    | RESISTOR MF        | 75 OHM 5% 0.4W            | PHILIPS      | 2322 181 53759  | 01.171      |
| R91-3    | RESISTOR MF        | 1k8 OHM 5% 0.4W           | PHILIPS      | 2322 181 53182  | 01.206      |
| R92-3    | RESISTOR MF        | 68 OHM 5% 0.4W            | PHILIPS      | 2322 181 53689  | 01.170      |
| R93-3    | RESISTOR MF        | 8R2 OHM 5% 0.4W           | PHILIPS      | 2322 181 53828  | 01.147      |
| R94-3    | RESISTOR MF        | 330 OHM 5% 0.4W           | PHILIPS      | 2322 181 53331  | 01.187      |
| R95-3    | PRESET CERMET      | 250k OHM 10% 0.5W         | * BOURNS     | 3386P-1-254     | 07.895      |
| R96-3    | PRESET CERMET      | 2k0 OHM 5% 0.5W           | BOURNS       | 3386P-1-202-11  | 07.887      |
| R97-3    | PRESET CERMET      | 250k OHM 10% 0.5W         | * BOURNS     | 3386P-1-254     | 07.895      |
| R98-3    | PRESET CERMET      | 1k0 OHM 10% 0.5W          | BOURNS       | 3386P-1-102     | 07.886      |
| U1-3     | QUAD OP. AMP.      | 324                       | TEXAS        | LM324N          | 31.065      |
| U2-3     | INTEGRATED CIRCUIT | DUAL D-FF POS. TRIG.      | TEXAS        | SN74HC74N       | 34.501      |
| U3-3     | INTEGRATED CIRCUIT | SERIAL INPUT PLL SYNTHES. | MOTOROLA     | MC145158P2      | 33.492      |
| U4-3     | INTEGRATED CIRCUIT | MC12015P                  | MOTOROLA*    | MC12015P        | 32.850      |
| X1-3     | CRYSTAL C1074      | 14.850MHz 10ppm NC18C     | NDK          | SP. SPEC. C1074 | 39.839      |
| L2-3     | COIL               | TL371                     | S.P. RADIO   | 6-0-23687       | 400371      |
| L10-3    | CHOKE TL489        |                           | ESPERA       | 6-0-25459       | 400489      |
| L11-3    | CHOKE TL491        |                           | ESPERA       | 6-0-25461       | 400491      |
| L12-3    | CHOKE TL491        |                           | ESPERA       | 6-0-25461       | 400491      |
| L13-3    | CHOKE TL489        |                           | ESPERA       | 6-0-25459       | 400489      |
| L14-3    | CHOKE TL490        |                           | ESPERA       | 6-0-25460       | 400490      |



| POSITION | DESCRIPTION            |                           | MANUFACTURER  | TYPE                      | S.P. NUMBER |
|----------|------------------------|---------------------------|---------------|---------------------------|-------------|
|          | RX/TX MODULE           | RT2048                    | ESPERA        | 5-0-25448J                | 625448.     |
|          | SHUNT CONNECTOR        | FEMALE 2 POLES            | SAMTEC        | SNT-100-BK-G              | 78.325      |
|          | FUSECLIP               | FOR 20x5mm FUSELINK       | # LITTEL FUSE | 111501                    | 78.396      |
| C1-4     | CAPACITOR CERAMIC      | 2p7F +/-0.25pF NPO 100VDC | PHILIPS       | 2222 683 C9278            | 15.320      |
| C2-4     | CAPACITOR ELECTROLYTIC | 1000uF 20% 35VDC          | SAMHWA ELEC.  | SV-1000uF-35WV            | 14.655      |
| C3-4     | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C4-4     | CAPACITOR ELECTROLYTIC | 4.7uF 20% 50VDC           | ERO           | EKI 00 AA 147 H MOE       | 14.510      |
| C5-4     | CAPACITOR ELECTROLYTIC | 22uF 20% 25VDC            | ERO           | EKI 00 AA 222 E MOE       | 14.514      |
| C6-4     | CAPACITOR ELECTROLYTIC | 22uF 20% 25VDC            | ERO           | EKI 00 AA 222 E MOE       | 14.514      |
| C7-4     | CAPACITOR ELECTROLYTIC | 33uF 20% 16VDC            | ERO           | EKI 00 AA 233 D MOE       | 14.518      |
| C8-4     | CAPACITOR ELECTROLYTIC | 33uF 20% 16VDC            | ERO           | EKI 00 AA 233 D MOE       | 14.518      |
| C9-4     | CAPACITOR ELECTROLYTIC | 33uF 20% 16VDC            | ERO           | EKI 00 AA 233 D MOE       | 14.518      |
| C10-4    | CAPACITOR ELECTROLYTIC | 33uF 20% 16VDC            | ERO           | EKI 00 AA 233 D MOE       | 14.518      |
| C11-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| R12-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C13-4    | CAPACITOR CERAMIC      | 10pF 5% NPO 500VDC        | NKE           | DT 350 758L CH 100 J 500V | 15.565      |
|          |                        |                           |               | FLAT PACK                 |             |
| C14-4    | CAPACITOR CERAMIC      | 10pF 5% NPO 500VDC        | NKE           | DT 350 758L CH 100 J 500V | 15.565      |
|          |                        |                           |               | FLAT PACK                 |             |
| C15-4    | CAPACITOR CERAMIC      | 18pF 5% NPO 500VDC        | NKE           | DT 360 758S CH 180 J 500V | 15.060      |
|          |                        |                           |               | FLAT PACK                 |             |
| C16-4    | CAPACITOR CERAMIC      | 18pF 5% NPO 500VDC        | NKE           | DT 360 758S CH 180 J 500V | 15.060      |
|          |                        |                           |               | FLAT PACK                 |             |
| C17-4    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO           | EKI 00 AA 210 F MOE       | 14.512      |
| C18-4    | CAPACITOR ELECTROLYTIC | 10uF 20% 35VDC            | ERO           | EKI 00 AA 210 F MOE       | 14.512      |
| C19-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C20-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C21-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C22-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C23-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C24-4    | CAPACITOR MKT          | 0.1uF 10% 63VDC           | PHILIPS       | 2222 370 78104            | 11.136      |
| C25-4    | CAPACITOR CERAMIC      | 51pF 5% NPO 50VDC         | NKE           | DT 360 758S CH 510 J 50V  | 15.110      |
|          |                        |                           |               | FLAT PACK                 |             |
| C26-4    | CAPACITOR CERAMIC      | 470pF 10% 500VDC          | NKE           | DT35-0465 758L 471BK 500V | 16.095      |
|          |                        |                           |               | FLAT PACK                 |             |
| C27-4    | CAPACITOR CERAMIC      | 51pF 5% NPO 50VDC         | NKE           | DT 360 758S CH 510 J 50V  | 15.110      |
|          |                        |                           |               | FLAT PACK                 |             |
| C28-4    | CAPACITOR CERAMIC      | 51pF 5% NPO 50VDC         | NKE           | DT 360 758S CH 510 J 50V  | 15.110      |
|          |                        |                           |               | FLAT PACK                 |             |
| C29-4    | CAPACITOR CERAMIC      | 22pF 5% NPO 500VDC        | KCK           | RT-HM60 SK CH 220 J       | 15.080      |
|          |                        |                           |               | AMMO PACK                 |             |
| C30-1    | CAPACITOR CERAMIC      | 22pF 5% NPO 500VDC        | KCK           | RT-HM60 SK CH 220 J       | 15.080      |

| POSITION | DESCRIPTION           |                           | MANUFACTURER | TYPE                                                | S.P. NUMBER |
|----------|-----------------------|---------------------------|--------------|-----------------------------------------------------|-------------|
| C31-4    | CAPACITOR CERAMIC     | 22pF 5% NPO 500VDC        | KCK          | AMMO PACK<br>RT-HM60 SK CH 220 J                    | 15.080      |
| C32-4    | CAPACITOR CERAMIC     | 15pF 5% NPO 500VDC        | NKE          | AMMO PACK<br>DT 360 758L CH 150 J 500V<br>FLAT PACK | 15.590      |
| C33-4    | CAPACITOR POLYSTYRENE | 221pF 1% 63VDC            | PHILIPS      | 2222 443 42211                                      | 10.727      |
| C34-4    | CAPACITOR MKT         | 0.1uF 10% 63VDC           | PHILIPS      | 2222 370 78104                                      | 11.136      |
| C35-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C36-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C37-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C38-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C39-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C40-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C41-4    | CAPACITOR CERAMIC     | 10nF -20/+80% CL2 50VDC   | NKE          | DT 350 758L F 103 Z 50V<br>FLAT PACK                | 15.170      |
| C42-4    | CAPACITOR CERAMIC     | 22pF 5% N150 500VDC       | KCK          | RT-HM SK PH 220 J<br>AMMO PACK                      | 15.062      |
| C43-4    | CAPACITOR CERAMIC     | 51pF 5% NPO 50VDC         | NKE          | DT 360 758S CH 510 J 50V<br>FLAT PACK               | 15.110      |
| C44-4    | CAPACITOR CERAMIC     | 6p8F +/-0.5pF N150 50VDC  | NKE          | DT 330 758S PH 6R8 D 50V<br>FLAT PACK               | 15.020      |
| C45-4    | CAPACITOR CERAMIC     | 3p9F +/-0.25pF N150 50VDC | NKE          | DT 330 758S PJ 3R9 C 50V<br>FLAT PACK               | 15.003      |
| C46-4    | CAPACITOR CERAMIC     | 9p1F +/-0.5pF N150 50VDC  | NKE          | DT 340 758L PH 9R1 D 50V<br>FLAT PACK               | 15.033      |
| C47-4    | CAPACITOR CERAMIC     | 9p1F +/-0.5pF N150 50VDC  | NKE          | DT 340 758L PH 9R1 D 50V<br>FLAT PACK               | 15.033      |
| C48-4    | CAPACITOR CERAMIC     | 9p1F +/-0.5pF N150 50VDC  | NKE          | DT 340 758L PH 9R1 D 50V<br>FLAT PACK               | 15.033      |
| C49-4    | CAPACITOR CERAMIC     | 9p1F +/-0.5pF N150 50VDC  | NKE          | DT 340 758L PH 9R1 D 50V<br>FLAT PACK               | 15.033      |
| C50-4    | CAPACITOR CERAMIC     | 3p3F +/-0.25pF N150 500V  | NKE          | DT 350 758L PJ 3R3 C 500V<br>FLAT PACK              | 16.103      |
| C51-4    | CAPACITOR CERAMIC     | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK              | 16.095      |
| C52-4    | CAPACITOR CERAMIC     | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V<br>FLAT PACK              | 16.095      |
| C53-4    | CAPACITOR CERAMIC     | 470pF 10% 500VDC          | NKE          | DT35-0465 758L 471BK 500V                           | 16.095      |

| POSITION | DESCRIPTION       |                     | MANUFACTURER | TYPE                                   | S.P. NUMBER |
|----------|-------------------|---------------------|--------------|----------------------------------------|-------------|
| C54-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C55-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C56-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C57-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C58-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C59-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C60-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C61-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C62-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C63-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C64-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C65-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C66-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C67-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C68-4    | CAPACITOR MKT     | 10nF 20% 100VDC     | PHILIPS      | 2222 370 38103                         | 11.168      |
| C69-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C70-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C71-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C72-4    | CAPACITOR CERAMIC | 470pF 10% 500VDC    | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C73-4    | CAPACITOR CERAMIC | 1n0F 10% CL2 500VDC | NKE          | FLAT PACK<br>DT 360 758L B 102 K 500V  | 15.160      |
| C74-4    | CAPACITOR CERAMIC | 180pF 5% N150 50VDC | KCK          | RT-HE95-SK PH 181 J                    | 15.149      |
| C75-4    | CAPACITOR CERAMIC | 33pF 5% N750 500VDC | NKE          | AMMO PACK<br>DT350465 758L UJ 330J 500 | 16.064      |

| POSITION | DESCRIPTION              |                         | MANUFACTURER | TYPE                                   | S.P. NUMBER |
|----------|--------------------------|-------------------------|--------------|----------------------------------------|-------------|
| C76-4    | CAPACITOR CERAMIC        | 51pF 5% NPO 50VDC       | NKE          | FLAT PACK<br>DT 360 758S CH 510 J 50V  | 15.110      |
| C77-4    | CAPACITOR CERAMIC        | 12pF 5% N150 500VDC     | NKE          | FLAT PACK<br>DT 350 758L PH 120 J 500V | 16.114      |
| C78-4    | CAPACITOR CERAMIC        | 12pF 5% N150 500VDC     | NKE          | FLAT PACK<br>DT 350 758L PH 120 J 500V | 16.114      |
| C79-4    | CAPACITOR CERAMIC        | 18pF 5% N150 50VDC      | NKE          | FLAT PACK<br>DT 340 758S PH 180 J 50V  | 15.061      |
| C80-4    | CAPACITOR MKT            | 1uF 10% 63VDC           | PHILIPS      | 2222 370 78105                         | 11.137      |
| C81-4    | CAPACITOR CERAMIC        | 470pF 10% 500VDC        | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C82-4    | CAPACITOR CERAMIC        | 51pF 5% NPO 50VDC       | NKE          | FLAT PACK<br>DT 360 758S CH 510 J 50V  | 15.110      |
| C83-4    | CAPACITOR MKT            | 0.1uF 10% 63VDC         | PHILIPS      | 2222 370 78104                         | 11.136      |
| C84-4    | CAPACITOR CERAMIC        | 51pF 5% NPO 50VDC       | NKE          | FLAT PACK<br>DT 360 758S CH 510 J 50V  | 15.110      |
| C85-4    | CAPACITOR CERAMIC        | 51pF 5% NPO 50VDC       | NKE          | FLAT PACK<br>DT 360 758S CH 510 J 50V  | 15.110      |
| C86-4    | CAPACITOR CERAMIC        | 470pF 10% 500VDC        | NKE          | FLAT PACK<br>DT35-0465 758L 471BK 500V | 16.095      |
| C87-4    | CAPACITOR CERAMIC        | 10pF 5% NPO 500VDC      | NKE          | FLAT PACK<br>DT 350 758L CH 100 J 500V | 15.565      |
| C88-4    | CAPACITOR CERAMIC        | 1nF 10% 50VDC CL2       | NKE          | FLAT PACK<br>DT 340 758L B 102 K 50V   | 16.160      |
| C89-4    | CAPACITOR CERAMIC        | 51pF 5% NPO 50VDC       | NKE          | FLAT PACK<br>DT 360 758S CH 510 J 50V  | 15.110      |
| D1-4     | DIODE TRANSIENT ABSORBER | 18V                     | MOTOROLA*    | 1N6277A                                | 26.765      |
| D2-4     | DIODE                    | 1N4148 HIGH SPEED       | PHILIPS      | 1N4148-143                             | 25.131      |
| D3-4     | DIODE CAPASITANCE        | 13pF/9VDC               | TOSHIBA      | 1SV101 in matched group                | 26.135      |
| D4-4     | DIODE CAPASITANCE        | 13pF/9VDC               | TOSHIBA      | 1SV101 in matched group                | 26.135      |
| D5-4     | DIODE CAPASITANCE        | 13pF/9VDC               | TOSHIBA      | 1SV101 in matched group                | 26.135      |
| D6-4     | DIODE CAPASITANCE        | 13pF/9VDC               | TOSHIBA      | 1SV101 in matched group                | 26.135      |
| D7-4     | DIODE SWITCH             | BA282                   | ITT          | BA282                                  | 25.390      |
| F1-4     | FUSE                     | 6.3AF 250V 5x20mm       | ELU          | 179 020 6.3AF                          | 45.571      |
| FL1-4    | CERAMIC FILTER           | Fc=450kHz BW=20kHz      | MURATA       | SFP 450DR                              | 41.512      |
| FL2-4    | CRYSTAL FILTER           | Fc=15.3MHz              | * NDK        | SP. SPEC: C1076 (15N15R)               | 40.029      |
| J1-4     | SOCKET                   | 1/10" STL 12 POLES      | EURO DIP     | BL 12 0 Z                              | 78.805      |
| J2-4     | SOCKET COAX              | VERTICAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-V6                            | 78.518      |
| J3-4     | SOCKET COAX              | VERTICAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-V6                            | 78.518      |
| J4-4     | ANTENNA JACK (FEMALE)    | SO239                   | KAJ V HANSEN | SO239                                  | 78.504      |
| J5-4     | SOCKET COAX              | VERTICAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-V6                            | 78.518      |
| L1-4     | CHOKE TL 487             |                         | ESPERA       | 6-0-25457                              | 400487      |
| L2-4     | CHOKE TL 487             |                         | ESPERA       | 6-0-25457                              | 400487      |
| L3-4     | CHOKE TL486              |                         | ESPERA       | 6-0-25456A                             | 400486      |

| POSITION | DESCRIPTION             |                           | MANUFACTOR      | TYPE                     | S.P. NUMBER   |
|----------|-------------------------|---------------------------|-----------------|--------------------------|---------------|
| L4-4     | CHOKE                   | 5u6H 10%                  | * FASTRON       | SMCC-5R6K-02             | 20.139        |
| L5-4     | CHOKE TL488             | 70nH                      | ESPERA          | 6-0-25458                | 400488        |
| L6-4     | COIL                    | 568uH ADJUSTABLE          | SUMIDA ELEC.CO. | P-75P / 2175-2239-1025   | 38.432        |
| L7-4     | COIL                    | TL067                     | S.P.RADIO       | 6-0-20854A               | 400067        |
| L8-4     | COIL                    | TL067                     | S.P.RADIO       | 400067-20.053            | 400067        |
| L9-4     | COIL RF                 | 0.11uH ADJUSTABLE         | TOKO            | 6-0-20854A               | 400067-20.053 |
| L10-4    | COIL RF                 | 0.11uH ADJUSTABLE         | TOKO            | E526HN-100117            | 38.409        |
| L11-4    | COIL RF                 | 0.11uH ADJUSTABLE         | TOKO            | E526HN-100117            | 38.409        |
| L12-4    | COIL RF                 | 0.11uH ADJUSTABLE         | TOKO            | E526HN-100117            | 38.409        |
| L13-4    | COIL                    | TL067                     | S.P.RADIO       | 6-0-20854A               | 400067        |
| LC1-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | 400067-20.053            | 18.550        |
| LC2-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| LC3-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| LC4-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| LC5-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| LC6-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| LC7-4    | EMI SUPPRESSION FILTER  | Fo=70MHz                  | MURATA          | DST 310 91 Y5S 222 M     | 18.550        |
| P1-4     | PLUG                    | 6 POLES                   | HIRSCHMANN      | 973 887-100              | 78.315        |
| P2-4     | PLUG                    | 2x5 POLES                 | 3M              | UDEN FRÆSNING I BEN      | 78.251        |
| P3-4     | PLUG                    | 2x10 POLES                | 3M              | 3654-6002 / 7610-6002 JL | 78.250        |
| P4-4     | SOCKET SUB D 9 POLES    | PCB VERSION 2x 4-40 NUT   | NS TECH         | 3592-6002 / 7620-6002 JL | 78.164        |
| P5-4     | PLUG                    | 1/10" DIL SQ.PINS 6 POLES | AMP             | DMS-9S8TS-"E"            | 78.340        |
| Q1-4     | TRANSISTOR              | BD234                     | PHILIPS         | 826656-3                 | 29.070        |
| Q2-4     | TRANSISTOR RF           | BF199                     | PHILIPS         | BD234                    | 28.178        |
| Q3-4     | TRANSISTOR RF           | BF199                     | PHILIPS         | BF199                    | 28.178        |
| Q4-4     | TRANSISTOR RF           | BF199                     | PHILIPS         | BF199                    | 28.178        |
| Q5-4     | TRANSISTOR              | BC557C                    | * PHILIPS       | BC557C                   | 28.092        |
| Q6-4     | TRANSISTOR              | BC557C                    | * PHILIPS       | BC557C                   | 28.092        |
| Q7-4     | TRANSISTOR              | BC557C                    | * PHILIPS       | BC557C                   | 28.092        |
| Q8-4     | TRANSISTOR N-CHAN. JFET | TIS88A1                   | MOTOROLA        | TM 00 044 -1             | 29.735        |
| Q9-4     | TRANSISTOR N-CHAN. JFET | TIS88A1                   | MOTOROLA        | TM 00 044 -1             | 29.735        |
| Q10-4    | TRANSISTOR MOSFET       | DUAL GATE N-CHAN.BF964SA  | TEK             | BF964SA                  | 28.240        |
| Q11-4    | TRANSISTOR MOSFET       | DUAL GATE N-CHAN.BF964SA  | TEK             | BF964SA                  | 28.240        |
| Q12-4    | TRANSISTOR AF           | NPN BC547C T0-92          | PHILIPS         | BC547C                   | 28.068        |
| Q13-4    | TRANSISTOR AF           | NPN BC547C T0-92          | PHILIPS         | BC547C                   | 28.068        |
| Q14-4    | TRANSISTOR DARLINGTON   | NPN BC618                 | MOTOROLA        | BC618                    | 28.107        |
| R1-4     | RESISTOR MF             | 475 OHM 1% 0.6W           | * PHILIPS       | 2322 156 14751           | 03.393        |
| R2-4     | RESISTOR MF             | 1k3 OHM 1% 0.6W           | * PHILIPS       | 2322 156 11302           | 03.402        |
| R3-4     | RESISTOR MF             | 221 OHM 1% 0.6W           | * PHILIPS       | 2322 156 12211           | 03.384        |
| R4-4     | PRESET CERMET           | 50 OHM 10% 0.5W           | * BOURNS        | 3386P-1-500              | 07.882        |

| POSITION | DESCRIPTION   |                  | MANUFACTURER | TYPE           | S.P. NUMBER |
|----------|---------------|------------------|--------------|----------------|-------------|
| R5-4     | RESISTOR MF   | 2R7 OHM 5% 0.4W  | PHILIPS      | 2322 181 53278 | 01.135      |
| R6-4     | RESISTOR MF   | 3k92 OHM 1% 0.6W | PHILIPS      | 2322 156 13922 | 03.409      |
| R7-4     | RESISTOR MF   | 3k92 OHM 1% 0.6W | PHILIPS      | 2322 156 13922 | 03.409      |
| R8-4     | RESISTOR MF   | 97k6 OHM 1% 0.6W | * PHILIPS    | 2322 156 19763 | 03.471      |
| R9-4     | RESISTOR MF   | 97k6 OHM 1% 0.6W | * PHILIPS    | 2322 156 19763 | 03.471      |
| R10-4    | RESISTOR MF   | 18k OHM 5% 0.33W | PHILIPS      | 2322 180 73183 | 02.502      |
| R11-4    | RESISTOR MF   | 43k OHM 5% 0.4W  | PHILIPS      | 2322 181 53433 | 01.240      |
| R12-4    | RESISTOR MF   | 22k OHM 5% 0.4W  | PHILIPS      | 2322 181 53223 | 01.233      |
| R13-4    | RESISTOR MF   | 2k0 OHM 5% 0.4W  | PHILIPS      | 2322 181 53202 | 01.207      |
| R14-4    | RESISTOR MF   | 1k5 OHM 5% 0.4W  | PHILIPS      | 2322 181 53152 | 01.204      |
| R15-4    | RESISTOR PMF  | 220 OHM 5% 2W    | PHILIPS      | 2322 194 13221 | 04.183      |
| R16-4    | RESISTOR MF   | 5k6 OHM 5% 0.4W  | PHILIPS      | 2322 181 53562 | 01.218      |
| R17-4    | RESISTOR MF   | 3k3 OHM 5% 0.4W  | PHILIPS      | 2322 181 53332 | 01.212      |
| R18-4    | RESISTOR MF   | 8k2 OHM 5% 0.4W  | PHILIPS      | 2322 181 53822 | 01.222      |
| R19-4    | PRESET CERMET | 500 OHM 10% 0.5W | * BOURNS     | 3386P-1-501    | 07.885      |
| R20-4    | PRESET CERMET | 50k 10% 0.5W     | * BOURNS     | 3386P-1-503    | 07.892      |
| R21-4    | PRESET CERMET | 2k0 OHM 5% 0.5W  | BOURNS       | 3386P-1-202-11 | 07.887      |
| R22-4    | RESISTOR MF   | 2k2 OHM 5% 0.4W  | PHILIPS      | 2322 181 53222 | 01.208      |
| R23-4    | RESISTOR MF   | 2k2 OHM 5% 0.4W  | PHILIPS      | 2322 181 53222 | 01.208      |
| R24-4    | RESISTOR MF   | 2k7 OHM 5% 0.4W  | PHILIPS      | 2322 181 53272 | 01.210      |
| R25-4    | RESISTOR MF   | 2k2 OHM 5% 0.4W  | PHILIPS      | 2322 181 53222 | 01.208      |
| R26-4    | RESISTOR MF   | 470 OHM 5% 0.4W  | PHILIPS      | 2322 181 53471 | 01.191      |
| R27-4    | RESISTOR MF   | 1k0 OHM 5% 0.4W  | PHILIPS      | 2322 181 53102 | 01.200      |
| R28-4    | RESISTOR MF   | 1k8 OHM 5% 0.4W  | PHILIPS      | 2322 181 53182 | 01.206      |
| R29-4    | RESISTOR MF   | 1k0 OHM 5% 0.4W  | PHILIPS      | 2322 181 53102 | 01.200      |
| R30-4    | RESISTOR MF   | 47k OHM 5% 0.4W  | PHILIPS      | 2322 181 53473 | 01.241      |
| R31-4    | RESISTOR MF   | 12k OHM 5% 0.4W  | PHILIPS      | 2322 181 53123 | 01.227      |
| R32-4    | RESISTOR MF   | 1k0 OHM 5% 0.4W  | PHILIPS      | 2322 181 53102 | 01.200      |
| R33-4    | RESISTOR MF   | 1k0 OHM 5% 0.4W  | PHILIPS      | 2322 181 53102 | 01.200      |
| R34-4    | RESISTOR MF   | 5k36 OHM 1% 0.6W | PHILIPS      | 2322 156 15362 | 03.418      |
| R35-4    | RESISTOR MF   | 220k OHM 5% 0.4W | PHILIPS      | 2322 181 53224 | 01.258      |
| R36-4    | RESISTOR MF   | 3k9 OHM 5% 0.33W | PHILIPS      | 2322 180 73392 | 02.486      |
| R37-4    | RESISTOR MF   | 3k9 OHM 5% 0.4W  | PHILIPS      | 2322 181 53392 | 01.214      |
| R38-4    | RESISTOR MF   | 3k9 OHM 5% 0.4W  | PHILIPS      | 2322 181 53392 | 01.214      |
| R39-4    | RESISTOR MF   | 3k9 OHM 5% 0.33W | PHILIPS      | 2322 180 73392 | 02.486      |
| R40-4    | RESISTOR MF   | 560 OHM 5% 0.4W  | PHILIPS      | 2322 181 53561 | 01.193      |
| R41-4    | RESISTOR MF   | 180 OHM 5% 0.4W  | PHILIPS      | 2322 181 53181 | 01.181      |
| R42-4    | RESISTOR MF   | 120k OHM 5% 0.4W | PHILIPS      | 2322 181 53124 | 01.252      |
| R43-4    | RESISTOR MF   | 100k OHM 5% 0.4W | PHILIPS      | 2322 181 53104 | 01.250      |
| R44-4    | RESISTOR MF   | 100k OHM 5% 0.4W | PHILIPS      | 2322 181 53104 | 01.250      |
| R45-4    | RESISTOR MF   | 100k OHM 5% 0.4W | PHILIPS      | 2322 181 53104 | 01.250      |
| R46-4    | RESISTOR MF   | 470k OHM 5% 0.4W | PHILIPS      | 2322 181 53474 | 01.266      |
| R47-4    | RESISTOR MF   | 56k OHM 5% 0.33W | PHILIPS      | 2322 180 73563 | 02.514      |
| R48-4    | RESISTOR MF   | 100k OHM 5% 0.4W | PHILIPS      | 2322 181 53104 | 01.250      |

| POSITION | DESCRIPTION        |                          | MANUFACTURER    | TYPE              | S.P. NUMBER |
|----------|--------------------|--------------------------|-----------------|-------------------|-------------|
| R49-4    | RESISTOR MF        | 330 OHM 5% 0.4W          | PHILIPS         | 2322 181 53331    | 01.187      |
| R50-4    | RESISTOR MF        | 330 OHM 5% 0.4W          | PHILIPS         | 2322 181 53331    | 01.187      |
| R51-4    | RESISTOR MF        | 39k OHM 5% 0.4W          | PHILIPS         | 2322 181 53393    | 01.239      |
| R52-4    | RESISTOR MF        | 39k OHM 5% 0.4W          | PHILIPS         | 2322 181 53393    | 01.239      |
| R53-4    | RESISTOR MF        | 39k OHM 5% 0.4W          | PHILIPS         | 2322 181 53393    | 01.239      |
| R54-4    | RESISTOR MF        | 39k OHM 5% 0.4W          | PHILIPS         | 2322 181 53393    | 01.239      |
| R55-4    | RESISTOR MF        | 120k OHM 5% 0.33W        | PHILIPS         | 2322 180 73124    | 02.522      |
| R56-4    | RESISTOR MF        | 15k OHM 5% 0.4W          | PHILIPS         | 2322 181 53153    | 01.229      |
| R57-4    | RESISTOR MF        | 15k OHM 5% 0.33W         | PHILIPS         | 2322 180 73153    | 02.500      |
| R58-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R59-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R60-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R61-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R62-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R63-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R64-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R65-4    | RESISTOR MF        | 27k OHM 5% 0.4W          | PHILIPS         | 2322 181 53273    | 01.235      |
| R66-4    | RESISTOR MF        | 68k OHM 5% 0.4W          | PHILIPS         | 2322 181 53683    | 01.245      |
| R67-4    | RESISTOR MF        | 56k OHM 5% 0.33W         | PHILIPS         | 2322 180 73563    | 02.514      |
| RE1-4    | RELAY              | 12VDC 2SH 1.25A          | MEISEI          | M1B-12-H          | 21.030      |
| TR1-4    | TRANSFORMER        | 2u7H ADJUSTABLE          | TOKO            | F292MNS-3342BQE   | 38.431      |
| TR2-4    | TRANSFORMER        | Fr=157MHz ADJUSTABLE     | SUMIDA ELEC.CO. | S-7GD / 0237-1756 | 38.430      |
| U1-4     | VOLTAGE REGULATOR  | POSITIVE ADJUSTABLE 1.5A | MOTOROLA        | LM317T            | 31.055      |
| U2-4     | INTEGRATED CIRCUIT | AF POWER AMPLIFIER       | PHILIPS         | TDA1515A          | 31.489      |
| U3-4     | INTEGRATED CIRCUIT | NBFM IF SYSTEM           | PHILIPS         | MC 3361 N         | 31.325      |
| U4-4     | INTEGRATED CIRCUIT | VHF POWER AMPL.25W       | * TOSHIBA       | S-AV6             | 32.450      |

| POSITION                  | DESCRIPTION          |                           | MANUFACTURER | TYPE                | S.P. NUMBER |
|---------------------------|----------------------|---------------------------|--------------|---------------------|-------------|
| SELCALL MODULE (OPTIONAL) |                      | RT2048                    | ESPERA       | 5-0-25449B          | 625449      |
| C1-5                      | CAPACITOR KP         | 10nF 2.5% 63VDC           | EVOX*        | PFR 103H TA18       | 13.407      |
| C2-5                      | CAPACITOR KP         | 10nF 2.5% 63VDC           | EVOX*        | PFR 103H TA18       | 13.407      |
| C3-5                      | CAPACITOR KP         | 3.9nF 2.5% 63VDC          | EVOX*        | PFR 392H TA18       | 13.402      |
| C4-5                      | CAPACITOR KP         | 3.9nF 2.5% 63VDC          | EVOX*        | PFR 392H TA18       | 13.402      |
| C5-5                      | CAPACITOR MKT        | 22nF 10% 100VDC           | PHILIPS      | 2222 370 88223      | 11.175      |
| C6-5                      | CAPACITOR MKT        | 150nF 5% 50VDC            | ERO          | MKT 1826-415/06 4-G | 11.181      |
| C7-5                      | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C8-5                      | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C9-5                      | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C10-5                     | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C11-5                     | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C12-5                     | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C13-5                     | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| C14-5                     | CAPACITOR MKT        | 47nF 10% 63VDC            | EVOX*        | MMK5 473K63 TA18    | 11.644      |
| D1-5                      | DIODE SCHOTTKY       | BAT 43                    | THOMSON-CSF  | BAT43               | 27.600      |
| D2-5                      | DIODE SCHOTTKY       | BAT 43                    | THOMSON-CSF  | BAT43               | 27.600      |
| J1-5                      | SOCKET COAX          | HORIZONTAL FOR PCB MOUNT. | TAIKO        | TMP-J01X-A2         | 78.517      |
| J2-5                      | SOCKET               | 7 POLES F.RIBBON CABLE    | MOLEX        | 52011-0710          | 78.280      |
| Q1-5                      | TRANSISTOR RF SWITCH | 2N2369A                   | MOTOROLA     | 2N2369A             | 28.315      |
| R1-5                      | PRESET CERMET        | 2k0 OHM 5% 0.5W           | BOURNS       | 3386P-1-202-11      | 07.887      |
| R2-5                      | RESISTOR MF          | 6k49 OHM 1% 0.6W          | * PHILIPS    | 2322 156 16492      | 03.412      |
| R3-5                      | RESISTOR MF          | 243 OHM 1% 0.6W           | * PHILIPS    | 2322 156 12431      | 03.385      |
| R4-5                      | RESISTOR MF          | 7k50 OHM 1% 0.6W          | * PHILIPS    | 2322 156 17502      | 03.448      |
| R5-5                      | RESISTOR MF          | 7k50 OHM 1% 0.6W          | * PHILIPS    | 2322 156 17502      | 03.448      |
| R6-5                      | RESISTOR MF          | 10k OHM 5% 0.4W           | PHILIPS      | 2322 181 53103      | 01.225      |
| R7-5                      | RESISTOR MF          | 10k OHM 5% 0.4W           | PHILIPS      | 2322 181 53103      | 01.225      |
| R8-5                      | RESISTOR MF          | 10k OHM 5% 0.4W           | PHILIPS      | 2322 181 53103      | 01.225      |
| R9-5                      | RESISTOR MF          | 10k OHM 5% 0.4W           | PHILIPS      | 2322 181 53103      | 01.225      |
| R10-5                     | RESISTOR MF          | 12k OHM 5% 0.4W           | PHILIPS      | 2322 181 53123      | 01.227      |
| R11-5                     | RESISTOR MF          | 330 OHM 5% 0.4W           | PHILIPS      | 2322 181 53331      | 01.187      |
| R12-5                     | RESISTOR MF          | 680k OHM 5% 0.4W          | PHILIPS      | 2322 181 53684      | 01.270      |
| R13-5                     | RESISTOR MF          | 330k OHM 5% 0.4W          | PHILIPS      | 2322 181 53334      | 01.262      |
| R14-5                     | RESISTOR MF          | 453k OHM 1% 0.6W          | * PHILIPS    | 2322 156 14534      | 03.516      |
| R15-5                     | RESISTOR MF          | 7k50 OHM 1% 0.6W          | * PHILIPS    | 2322 156 17502      | 03.448      |
| R16-5                     | RESISTOR MF          | 390k OHM 5% 0.4W          | PHILIPS      | 2322 181 53394      | 01.264      |
| R17-5                     | RESISTOR MF          | 390k OHM 5% 0.4W          | PHILIPS      | 2322 181 53394      | 01.264      |
| R18-5                     | RESISTOR MF          | 20k0 OHM 1% 0.6W          | * PHILIPS    | 2322 156 12003      | 03.452      |
| R19-5                     | RESISTOR MF          | 61k9 OHM 1% 0.6W          | * PHILIPS    | 2322 156 16193      | 03.239      |
| R20-5                     | RESISTOR MF          | 4k7 OHM 5% 0.4W           | PHILIPS      | 2322 181 53472      | 01.216      |
| R21-5                     | RESISTOR MF          | 10k OHM 5% 0.4W           | PHILIPS      | 2322 181 53103      | 01.225      |
| R22-5                     | RESISTOR MF          | 3k0 OHM 5% 0.4W           | PHILIPS      | * 2322 181 53302    | 01.211      |

| POSITION | DESCRIPTION           |                    | MANUFACTOR | TYPE           | S.P. NUMBER |
|----------|-----------------------|--------------------|------------|----------------|-------------|
| R23-5    | RESISTOR MF           | 12k OHM 5% 0.4W    | PHILIPS    | 2322 181 53123 | 01.227      |
| R24-5    | RESISTOR MF           | 2k2 OHM 5% 0.4W    | PHILIPS    | 2322 181 53222 | 01.208      |
| R25-5    | RESISTOR MF           | 7k50 OHM 1% 0.6W   | * PHILIPS  | 2322 156 17502 | 03.448      |
| U1-5     | INTEGRATED CIRCUIT    | LF347N             | #NATIOPNAL | LF347N         | 31.530      |
| U2-5     | INTEGRATED CIRCUIT    | QUAD ANALOG SWITCH | MOTOROLA   | MC14066BCP     | 33.232      |
| U3-5     | DUAL TYPE D FLIP-FLOP | MC14013BCP         | SIGNETICS* | HEF4013BP      | 33.056      |
| U4-5     | DUAL OP AMP           | LM358N             | TEXAS      | LM358P         | 31.100      |
| U5-5     | VOLTAGE REGULATOR     | 5V 5% 0.1A         | MOTOROLA*  | MC78L05ACP     | 31.135      |
| U6-5     | INTEGRATED CIRCUIT    | MC14569BCP         | * MOTOROLA | MC14569BCP     | 33.449      |
| U7-5     | INTEGRATED CIRCUIT    | MC14094BCP         | NAT.*      | CD4094BCN      | 33.305      |
| U8-5     | IC CMOS               | HEX LEVEL SHIFTER  | MOTOROLA   | MC 14504 BCP   | 33.282      |

| POSITION | DESCRIPTION              |                           | MANUFACTOR   | TYPE                | S.P. NUMBER |
|----------|--------------------------|---------------------------|--------------|---------------------|-------------|
|          | SELCALL ALARM (MODULE 6) | SPECIAL OPTION FOR RT2048 | ESPERA       | 4-0-25660/5-0-25473 | 625660      |
| D1       | DIODE HIGH SPEED         | 1N4448                    | PHILIPS      | 1N4448              | 25.147      |
| P1       | PLUG                     | 1/10" SIL 12 POLES        | * SAMTEC     | TS-112-T-AA         | 78.328      |
| Q1       | TRANSISTOR DARLINGTON    | NPN BC618                 | MOTOROLA     | BC618               | 28.107      |
| R1/4     | RESISTOR ARRAY           | 4x10k OHM 5% 1/8W         | PANASONIC    | EXBF8V103G (4X10K)  | 08.615      |
| RE1      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D          | 21.300      |
| RE2      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D          | 21.300      |

| POSITION | DESCRIPTION                |                           | MANUFACTOR | TYPE                | S.P. NUMBER |
|----------|----------------------------|---------------------------|------------|---------------------|-------------|
|          | DISTRESS OUTPUT (MODULE 6) | SPECIAL OPTION FOR RT2048 | ESPERA     | 4-0-25661/5-0-25473 | 625661      |
| D3       | DIODE HIGH SPEED           | 1N4448                    | PHILIPS    | 1N4448              | 25.147      |
| P1       | PLUG                       | 1/10" SIL 12 POLES        | * SAMTEC   | TS-112-T-AA         | 78.328      |
| Q3       | TRANSISTOR                 | BC638                     | AEG*       | BC638               | 28.117      |
| Q4       | TRANSISTOR DARLINGTON      | NPN BC618                 | MOTOROLA   | BC618               | 28.107      |
| R1/4     | RESISTOR ARRAY             | 4x10k OHM 5% 1/8W         | PANASONIC  | EXBF8V103G (4X10K)  | 08.615      |
| R2/4     | RESISTOR ARRAY             | 4x10k OHM 5% 1/8W         | PANASONIC  | EXBF8V103G (4X10K)  | 08.615      |
| R2/2     | RESISTOR ARRAY             | 4x10k OHM 5% 1/8W         | PANASONIC  | EXBF8V103G (4X10K)  | 08.615      |
| R2/3     | RESISTOR ARRAY             | 4x10k OHM 5% 1/8W         | PANASONIC  | EXBF8V103G (4X10K)  | 08.615      |
| R3       | RESISTOR MF                | 1k0 OHM 5% 0.4W           | PHILIPS    | 2322 181 53102      | 01.200      |
| R4       | RESISTOR MF                | 1k0 OHM 5% 0.4W           | PHILIPS    | 2322 181 53102      | 01.200      |

| POSITION | DESCRIPTION              |                           | MANUFACTOR   | TYPE               | S.P. NUMBER |
|----------|--------------------------|---------------------------|--------------|--------------------|-------------|
|          | AUX INTERFACE (MODULE 6) | SPECIAL OPTION FOR RT2048 | ESPERA       | 5-0-25473          | 625473      |
| D1       | DIODE HIGH SPEED         | 1N4448                    | PHILIPS      | 1N4448             | 25.147      |
| D2       | DIODE HIGH SPEED         | 1N4448                    | PHILIPS      | 1N4448             | 25.147      |
| D3       | DIODE HIGH SPEED         | 1N4448                    | PHILIPS      | 1N4448             | 25.147      |
| P1       | PLUG                     | 1/10" SIL 12 POLES        | * SAMTEC     | TS-112-T-AA        | 78.328      |
| Q1       | TRANSISTOR DARLINGTON    | NPN BC618                 | MOTOROLA     | BC618              | 28.107      |
| Q2       | TRANSISTOR DARLINGTON    | NPN BC618                 | MOTOROLA     | BC618              | 28.107      |
| Q3       | TRANSISTOR               | BC638                     | AEG*         | BC638              | 28.117      |
| Q4       | TRANSISTOR DARLINGTON    | NPN BC618                 | MOTOROLA     | BC618              | 28.107      |
| R1/4     | RESISTOR ARRAY           | 4x10k OHM 5% 1/8W         | PANASONIC    | EXBF8V103G (4X10K) | 08.615      |
| R2/4     | RESISTOR ARRAY           | 4x10k OHM 5% 1/8W         | PANASONIC    | EXBF8V103G (4X10K) | 08.615      |
| R3       | RESISTOR MF              | 1k0 OHM 5% 0.4W           | PHILIPS      | 2322 181 53102     | 01.200      |
| R4       | RESISTOR MF              | 1k0 OHM 5% 0.4W           | PHILIPS      | 2322 181 53102     | 01.200      |
| RE1      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D         | 21.300      |
| RE2      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D         | 21.300      |
| RE3      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D         | 21.300      |
| RE4      | RELAY                    | 12VDC 1SH. 2A.            | MILTRONIC AB | OUC-S-112D         | 21.300      |
| U1       | OPTO COUPLER             | CNY17-2                   | TOSHIBA      | CNY 17-2           | 32.530      |