



SERVICE MANUAL

Nordic Mobile Telephone

ap4112

This service manual is for the maintenance of ap4112 equipment.

The performance figures quoted are typical and are subject to normal manufacturing and service tolerances.

The right is reserved to alter the equipment described in the manual in the light of future technical development.

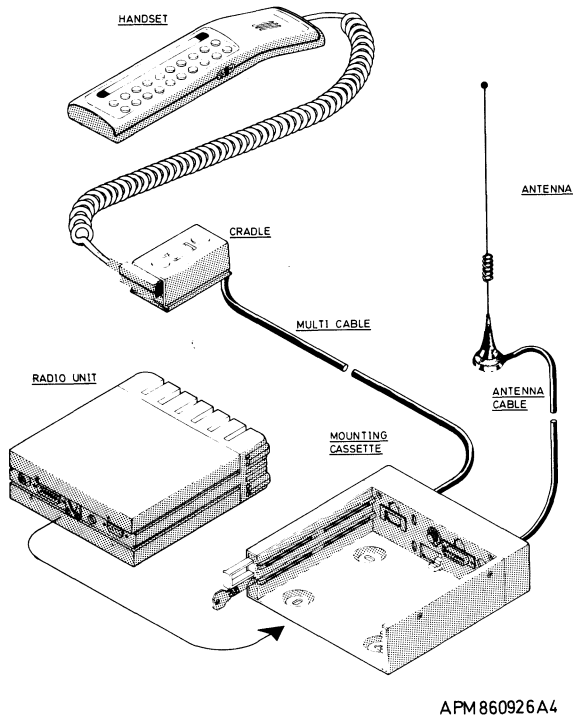
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General information

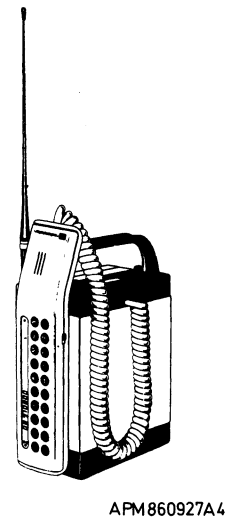
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Introduction

MOBILE INSTALLATION



PORTABLE VERSION



The mobile telephone ap4112 is designed for maximum operating convenience. Thereby the operator can concentrate on the driving. To increase driving safety further, the control board (the handset) besides being equipped with the ordinary microphone, has been provided with a built-in microphone, for semi-hands free operation.

The ap4112 is a fully duplex operated radiotelephone, working in the UHF NMT-band.

A portable kit, which contains the carrying case, NiCd battery and the antenna, is available. Switching from mobile to totally portable operation is easy as the transceiver is attached to the mounting bracket with a snap-lock.

Despite the small size of the transceiver it has a built-in duplex filter. The transceiver is built up with modules, either directly plugged to the system board, unit 1 (U1) or via plug terminated cables.

It is possible to provide the mobile telephone with external equipment, connected to a separate DIN-connector. E.g. external microphone, loudspeaker, telephone-answering unit (with interface) or scrambler.

With external microphone, an ext. push-to-talk switch must be mounted.

Technical data

1. GENERAL

Frequency range	: Transmitter	: 890.0125MHz to 914.9875MHz
	Receiver	: 935.0125MHz to 959.9875MHz
Principle		: Digital frequency synthesizer
RF - Bandwidth		: 25MHz
Channel spacing		: 1000 channels/25kHz spacing (1999 channels/12.5kHz spacing)
Channel switching time		: $\leq 40\text{ms}$ for 1000 channels $\leq 20\text{ms}$ for 1 channel
Mode of operation		: Duplex, internal filter
Duplex separation		: 45MHz
Operation temperature		: -25°C to $+55^{\circ}\text{C}$ -30°C to $+60^{\circ}\text{C}$ but specifications not guaranteed.
Frequency stability		: Better than $\pm 2.5\text{ppm}$ for the specified temperature and supply voltage variations. During operation better than $\pm 1\text{ppm}$.
Vibration test		: According to NMT Doc 900-3 §1.3.10.
Supply voltage		: 12V DC chassis neg. nom. 13.2V
Supply voltage variations		: 10.8 to 15.6V
Power consumption for NMT		: Standby: 13.2V $\leq 0.23\text{A}$ Tx 6W : 13.2V $\leq 3.0\text{A}$
Antenna impedance		: 50ohms
Line input		: 75mV_{rms} for $\pm 3\text{kHz}$ dev. at 1kHz
Line output		: $450\text{mV}_{\text{rms}}$ for $\pm 3\text{kHz}$ dev. at 1kHz received
Mic. input		: $100\text{mV}_{\text{rms}}$ for $\pm 3\text{kHz}$ dev. at 1kHz

2. FOR "SEMI-HANDS FREE" OPERATION

Loudspeaker	: Built into the handset. Option: External 4ohms.
Audio output (regulated from control unit)	: Max. 2.0W at 5% distortion in 4ohms at 13.2V supply voltage.
Microphone	: 1kohm condenser microphone built into the handset. Amplifier in handset.

3. FOR "HANDSET" OPERATION

Output from handset receiver	: The loudness rating in receiving mode will be 9dB \pm 2dB. According to NMT Doc 900-3 §2.6.4.
Maximum sound level of handset earpiece	: 26dB PA
Vol. regulated from handset (nominal level adjusted internally in radio)	: -10dB and +15dB from nominal level.
Earpiece level from radio unit	: 200mV RMS at 1kHz tone \pm 3kHz deviation 1120mV RMS at max. vol. 48mV RMS at min. volume.
The De-emphasis is located in the radio unit.	
Handset microphone sensitivity (1kHz condenser microphone with amplifier and filter)	: The loudness rating in transmitting mode will be 3.0dB \pm 2dB according to NMT Doc 900-3 §2.5.5.
Stability loss	: >15dB
Line level from handset	: 100mV RMS at 1kHz tone \pm 3kHz deviation on transmitter.
The pre-emphasis is located in the radio unit.	
A 5ohm loudspeaker is located in the handset	

4. RECEIVER

Sensitivity	: <1uV _{emf} Typ 0.6uV for 20dB sinad psophometric
RF carrier detector level	: 0.8uV _{emf}
Co-channel rejection	: NMT method : >-8dB and <0dB

Adjacent channel rej.	: 25kHz NMT method	: >70dB normal test conditions
	: 12.5kHz NMT method	: >26dB normal test conditions
Spurious and image rej.	: NMT method	: >70dB in duplex. Image 90dB
Intermodulation rej.	: NMT method	: >67dB
Blocking	: NMT method	: >90dBuV _{emf}
Spurious emissions	: Antenna	: <2nW 100kHz to 1000MHz
	: Cabinet	: <20nW 1000kHz to 4000MHz
De-emphasis		: Following 6dB per octave curve from 0.3 to 3kHz.
Harmonic distortion		: NMT method: <5%
<u>Audio frequency</u>		
Intermodulation		: NMT method: <-20dB
Hum and noise		: NMT method: <-40dB RMS Psophometric NMT method: <-20dB Peak
AM suppression		: NMT method: >30dB
Receiver audio muting (data signals)		: >50dB
Interference in the Ø-signal		: <-10dB rel. to Ø-signal
Intermodulation in the Ø-signal		: <-10dB rel. to Ø-signal
Expansion linearity		: <±1dB
Expander attack time		: 3ms
Expander recovery time		: 13.5ms
Receiver idle noise		: <-55dB PA

5. TRANSMITTER

Power output	: 6W ±2dB nominal
	: 6W +2-3dB from -25°C to +55°C and between 10.8 and 15.6V
Power reduction for NMT	: Power reduced to -8dB ±3dB Power reduced to -18dB ±3dB
Carrier rise time	: 1-3ms
Carrier fall time	: <1ms

Spurious emissions

:

	0.1MHz to 16Hz	1GHz to 4GHz
TX operating	<0.25uW	<1uW
Stand-by	<2uW	<20uW

Adjacent channel power

: <-70dB below carrier power at $\pm 25\text{kHz}$

Frequency deviation

: Max. $\pm 4.7\text{kHz}$ (supervisory $\pm 300\text{Hz}$)

Pre-emphasis

: Following 6dB per octave curve from
0.3 to 3kHz

Harmonic distortion

: <5% at $\pm 3\text{kHz}$ deviation and 1kHz mod. frequency

Audio intermodulation : NMT method

: <-20dB

Hum and noise in "handset" operation

(residual mod.) : NMT method

: <-40dB RMS Psophometric

: NMT method

: <-20dB Peak

Transmitter audio muting

: >40dB

Interference in the \emptyset -signal

: <-10dB rel. to \emptyset -signal

Intermodulation in the \emptyset -signal

: <-10dB rel. to \emptyset -signal

Compression linearity

: < $\pm 1\text{dB}$

Compressor attack time

: 3 $\pm 2\text{ms}$

Compressor recovery time

: 13.5 $\pm 6.5\text{ms}$

Description of the simplified block diagram

The radio contains a full duplex transmitter/receiver, a system board with a data modem and a microprocessor.

The system board communicates with the base station via the modem which converts digital information to an FFSK (Fast Frequency Shift Keying) signal and the reverse. It also communicates with a uP in the handset and with circuits in the radio.

When a call has been established the base station transmits a 4kHz supervisory (pilot) signal together with the speech. The tone is looped back by the mobile radio. At the Base Station (BS) the received tone is evaluated. A poor signal/noise ratio gives automatic switching to a more close BS or in the worst case disconnection of the call.

References

1. Teletechnik, 1982, No. 1
2. NMT DOC. 1-4

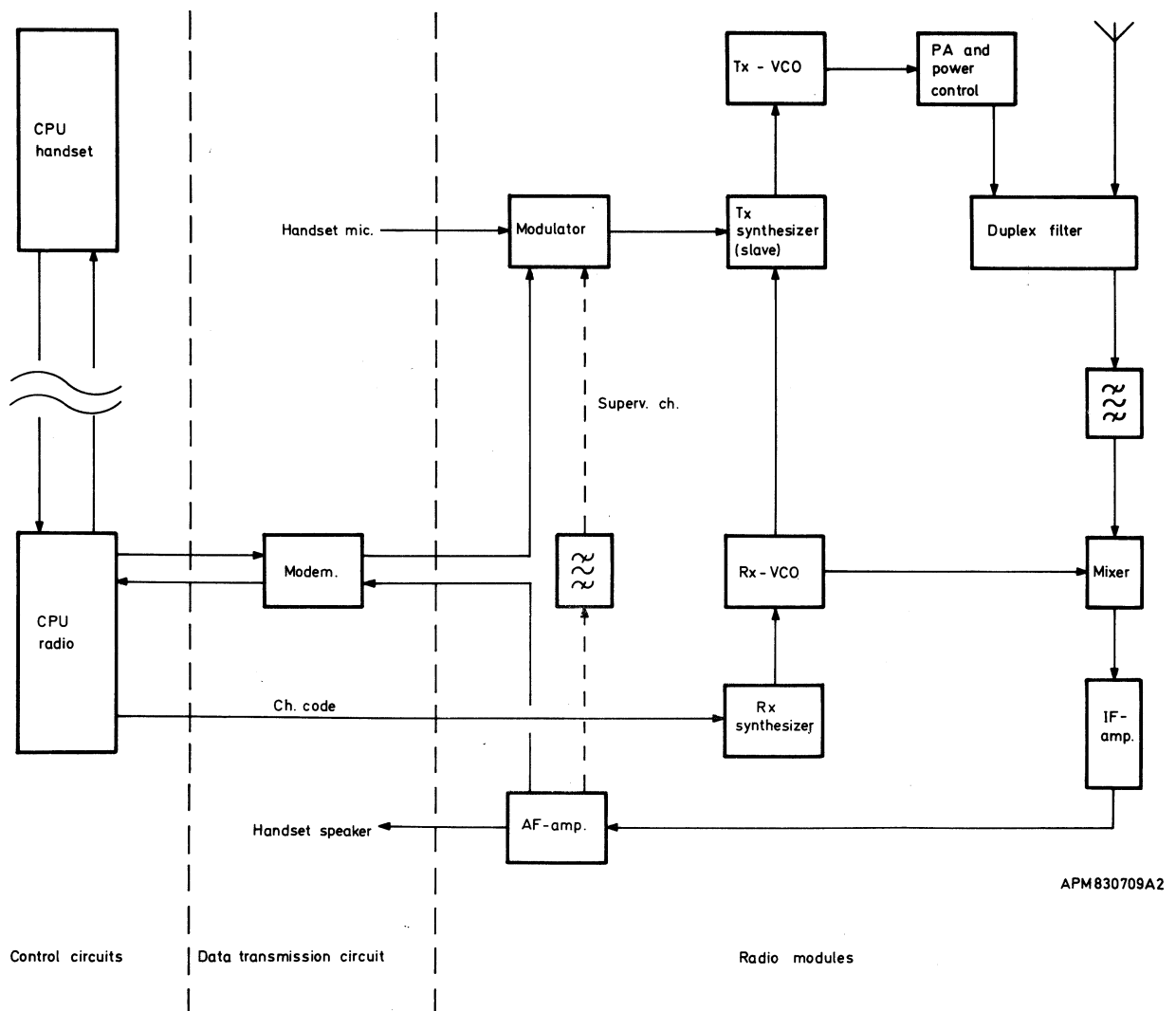


Fig. 1 Simplified block diagram

Installation instructions

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Survey of installation kits

The radio unit can be installed in two different types of mounting cassettes:

1. A simple mounting tray for permanent installation.
2. A mounting cassette with quick lock (Especially useful when the mobile telephone is used frequently with the portable kit).

1. MOUNTING TRAY KIT:

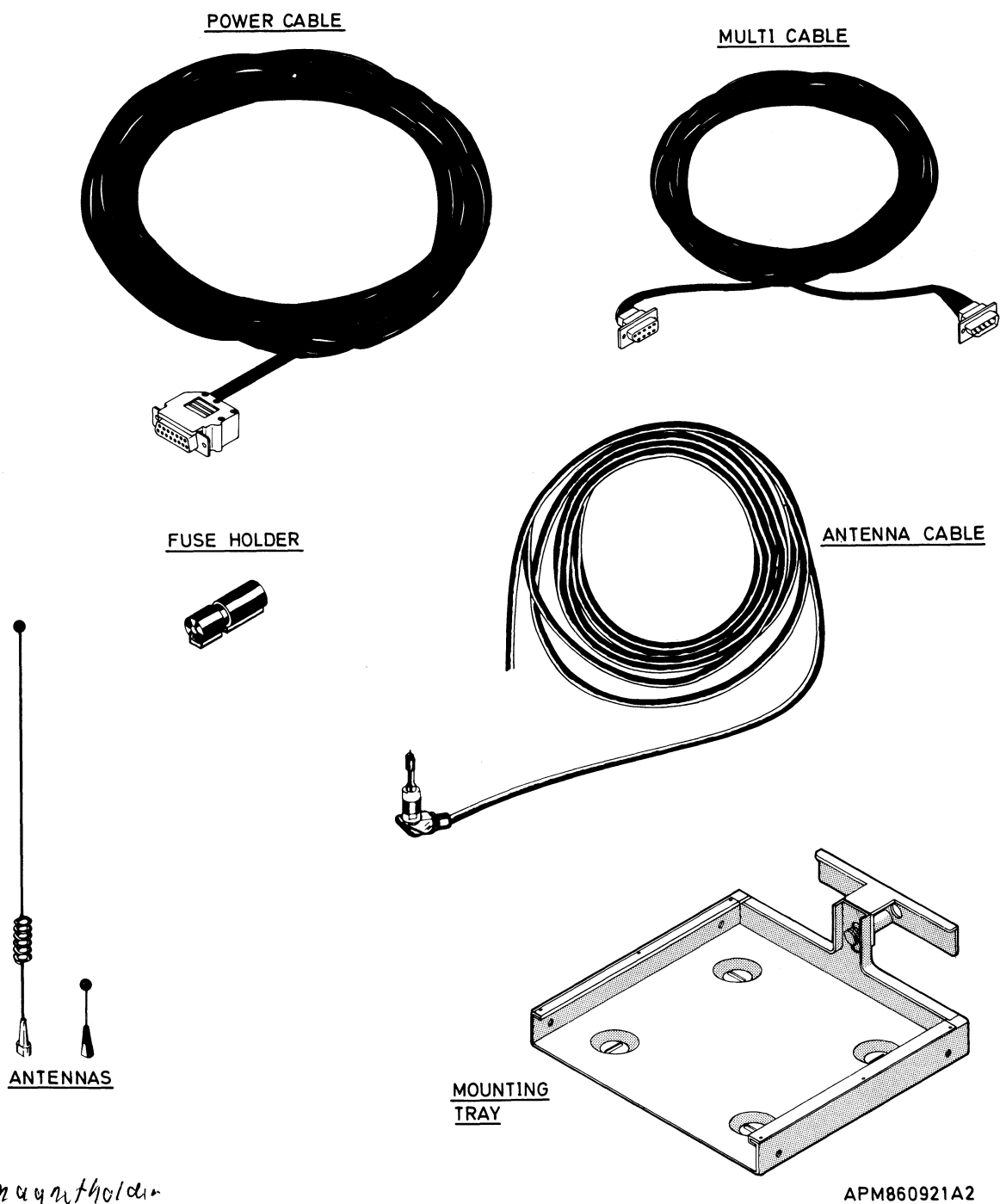
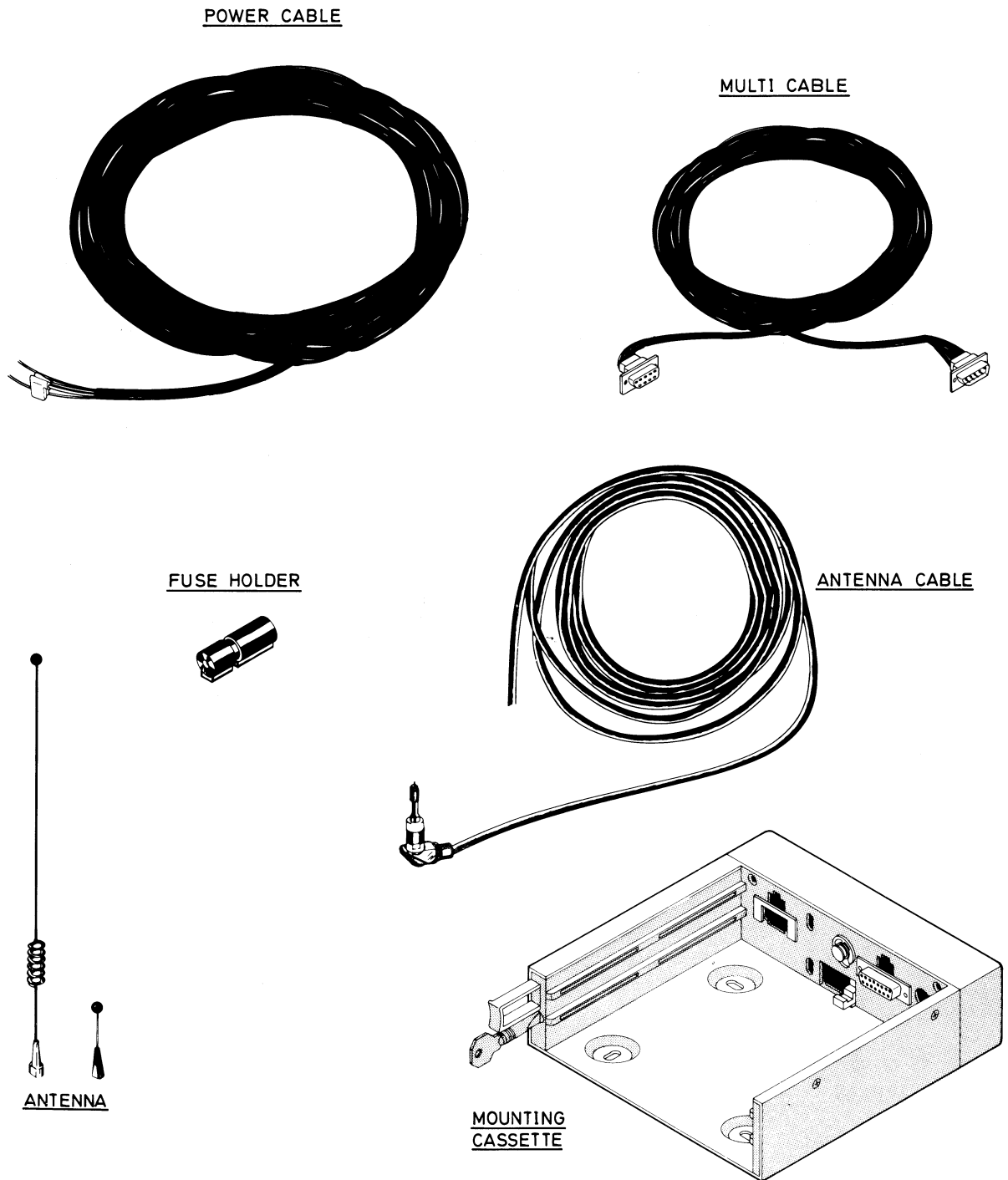


Fig. 1 Mounting tray kit

The kit furthermore includes:

- a Fuse
- Cable shoes
- Grommets
- Screws and washers

2. MOUNTING CASSETTE KIT:



+ mounting holder

Fig. 2 Mounting cassette kit

The kit furthermore includes:

- a Fuse
- Cable straps
- Cable shoes
- Grommets
- Screws and washers

Antenna

The mobile telephone can be used with several different types of antennas.

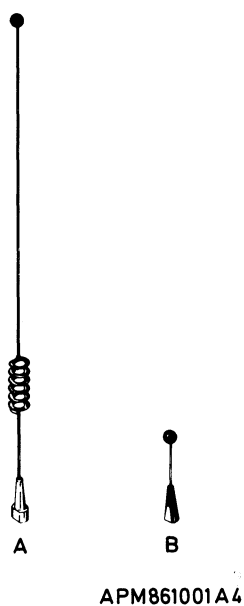


Fig. 3 Antenna survey

Type A delivers +4dB more than type B.

A special antenna mounted on a magnetic antennaholder, is available as an option.

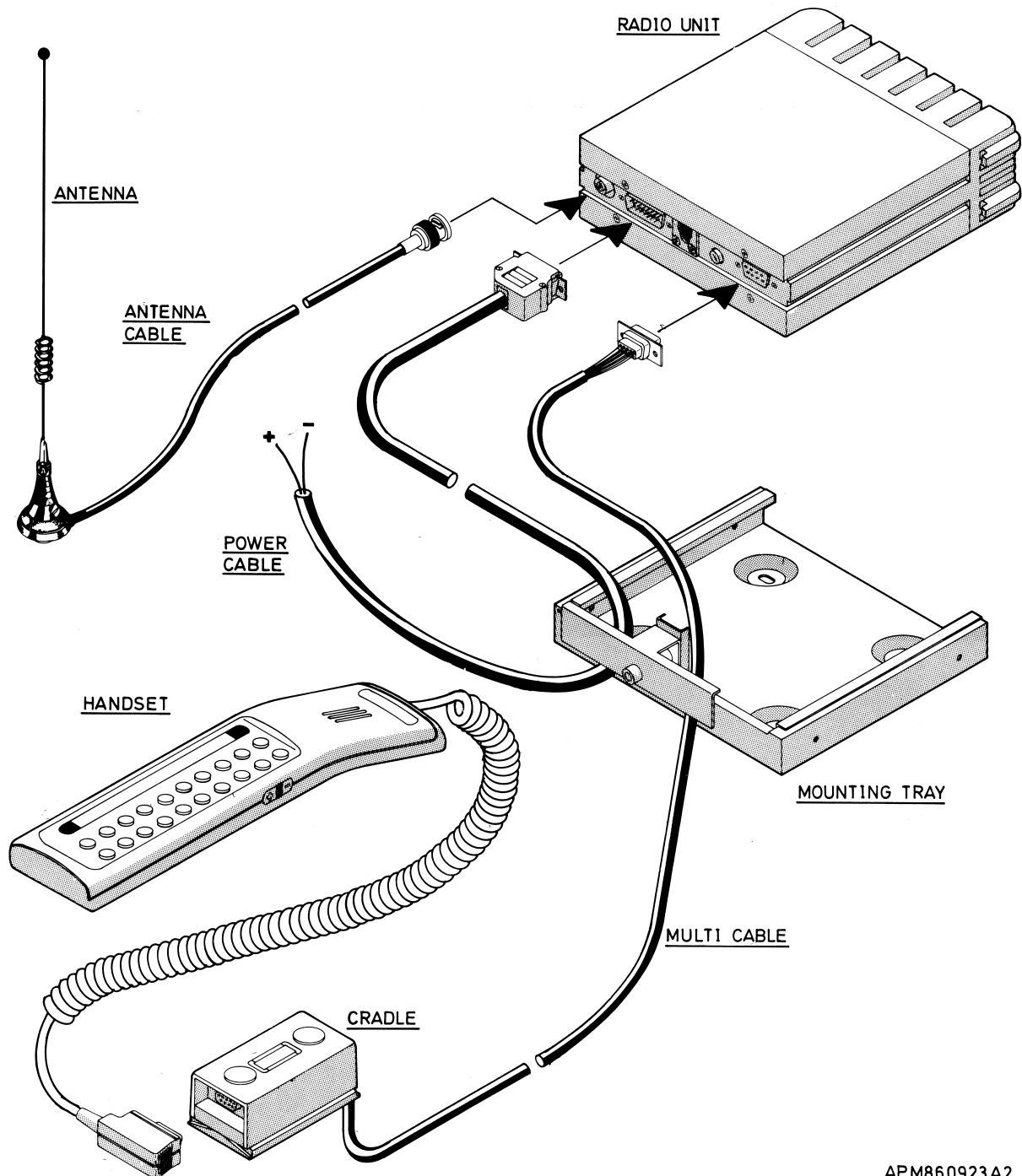


Fig. 4 Antenna with magnetic socket

Note: If the mobile telephone is to be mounted in yachts or ships, we recommend the use of special antennas for ships.

Cable connections

1. CABLE CONNECTIONS WHEN THE RADIO UNIT IS USED TOGETHER WITH THE MOUNTING TRAY:

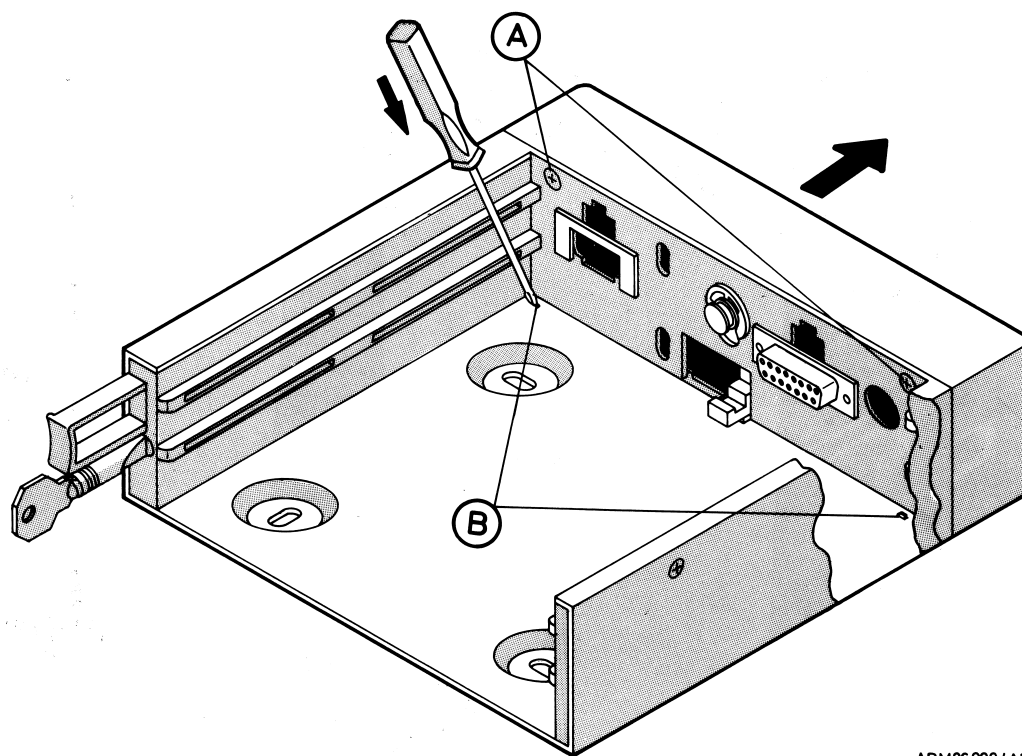


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Fig. 5 Cable connections, mounting tray kit

Note: If the radio unit is installed near the handset, the handset can be connected directly on the radio unit, without the use of the multicable between the radio unit and the magnetic base.

2. MOUNTING CASSETTE:



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Fig. 6 Removal of the rear cover

Access to the connectors of the mounting cassette is made as follows:

- Remove the two screws (A) .
- Using two small screwdrivers, press out carefully the two clamps (B) .
- Remove the cover.

Cable connections when the radio unit is used together with the mounting cassette:

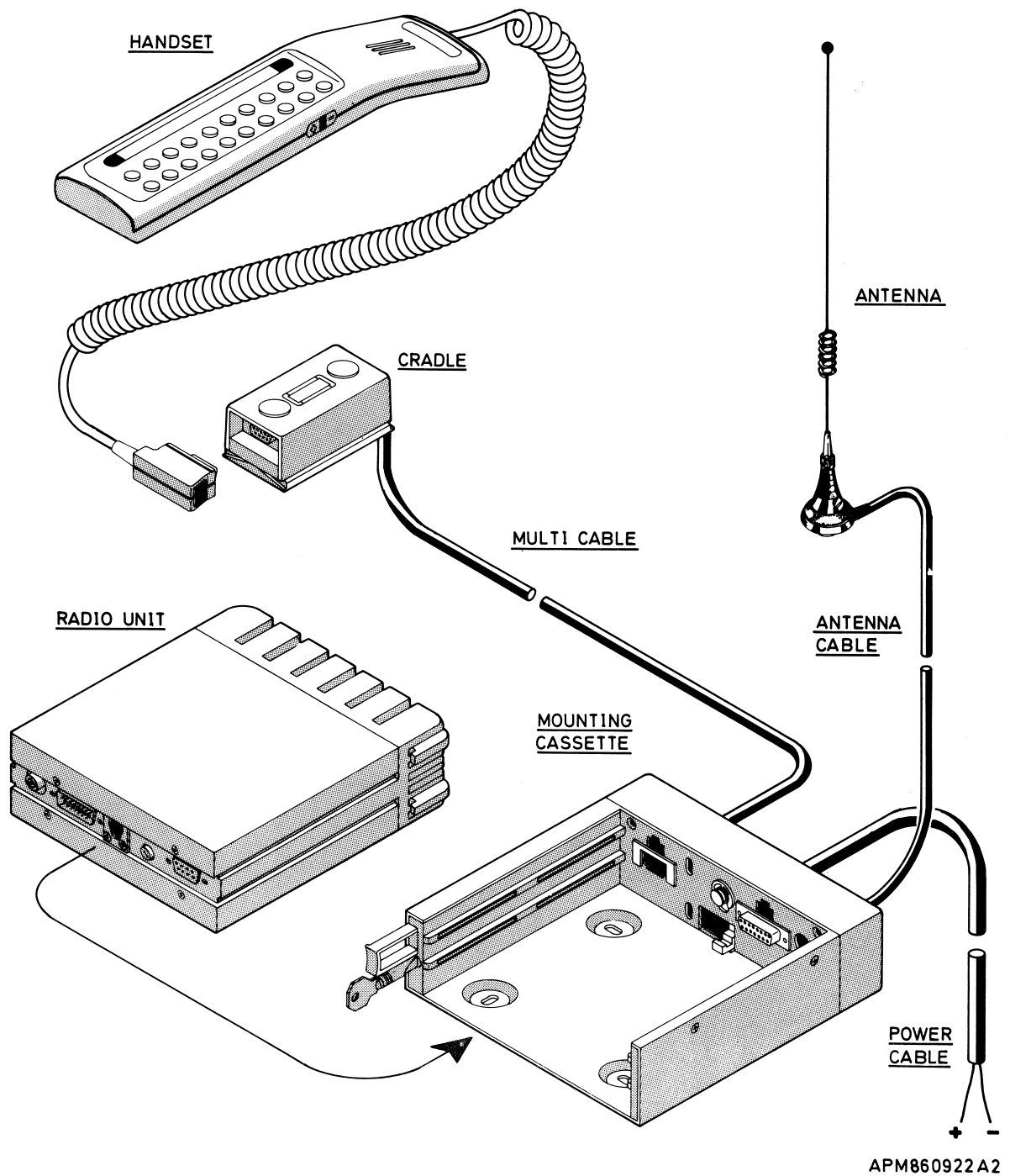


Fig. 7a Cable connections, mounting cassette

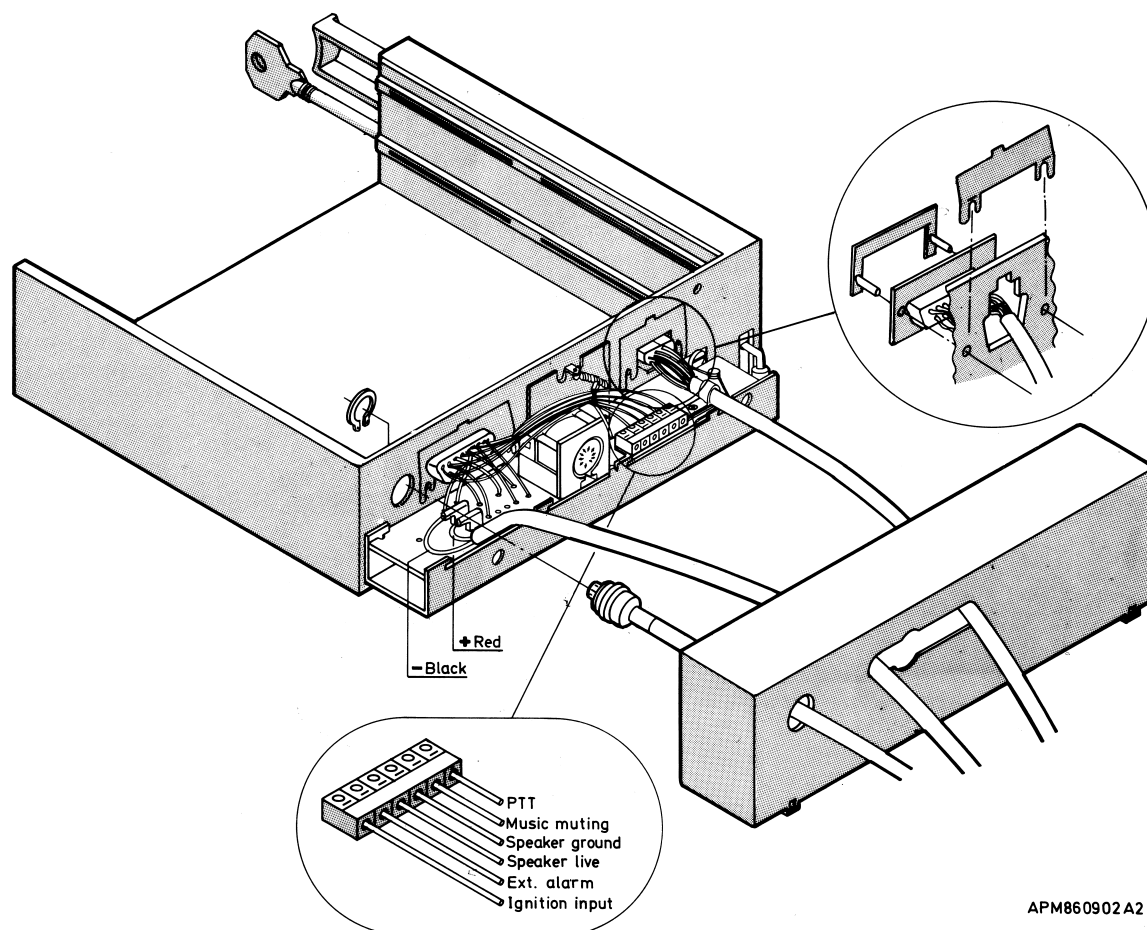
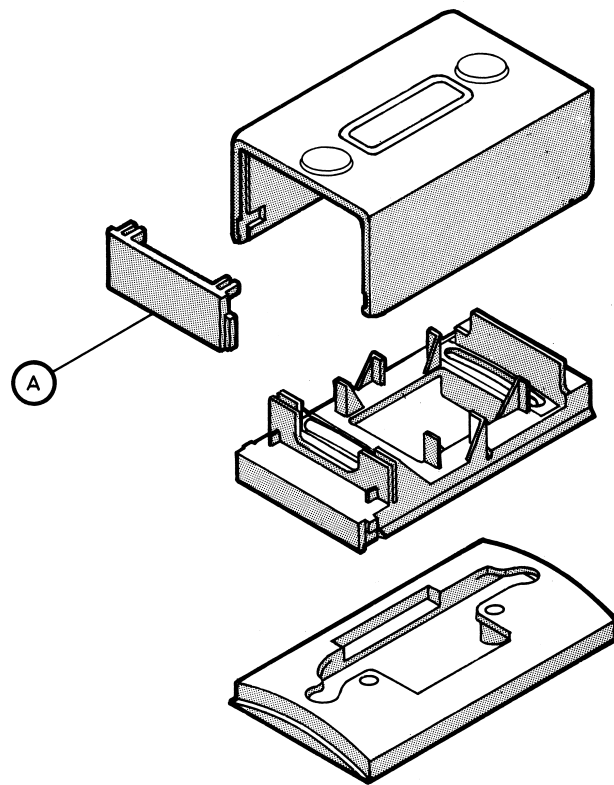


Fig. 7b Cable connections, rear view of the mounting cassette

Magnetic base

The magnetic base acts as a holder for the handset. It may also serve as a junction between the handset and the radio unit.

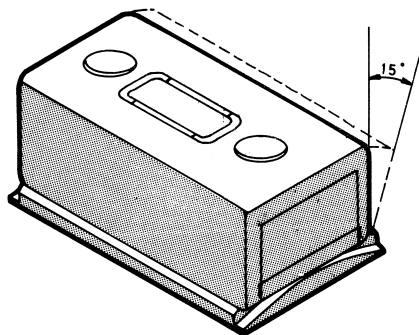
To provide the most convenient installation the magnetic base can be positioned in different angles. See figure 9.



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Fig. 8 Magnetic base

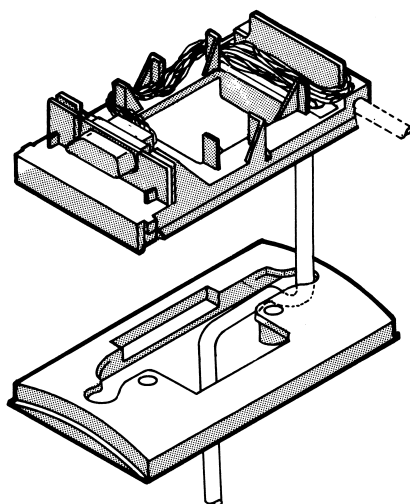
Note: If the magnetic base is not serving as a junction between the handset and the radio unit the small cover (A) should be mounted.



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Fig. 9 Mounting positions, magnetic base

When using the magnetic base as a junction the cabling inside the cable should be positioned in one of the following ways:

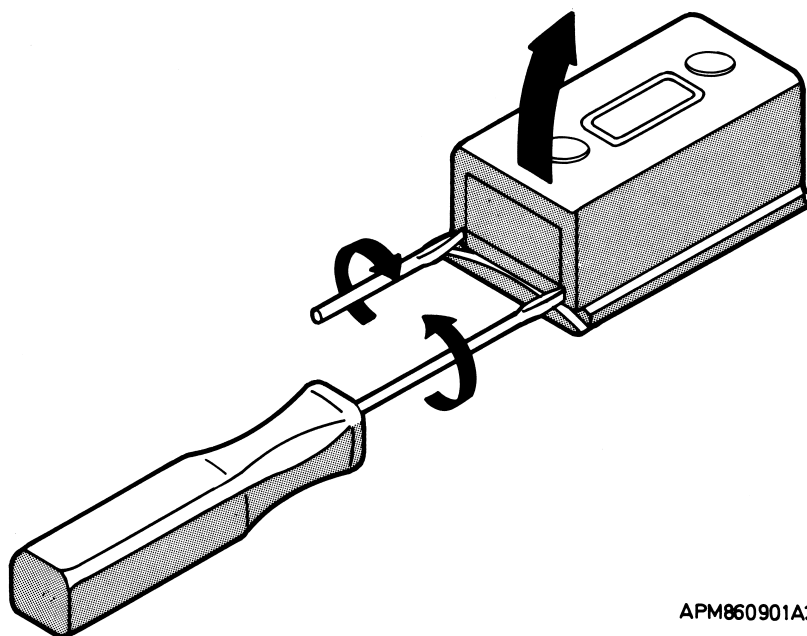


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Fig. 10 Strain relief in magnetic base

Disassembling of the magnetic base:

- Insert two screwdrivers as shown on the figure and turn them around very carefully.



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- lift up the cover.

Coding of telephone number and code lock

1. TELEPHONE NUMBER CODING

The phone number is coded into an EEPROM via the Service Interface Unit. The Service Interface Unit is connected to the radio and the handset.

Turn the power on by pressing the "ON" button.

If there has been a RAM failure in the radio, an error message will appear on the display. To overcome this, just switch the set off and on again.

The phone number is built up by 7 digits of which the first is the country code.

1. Enter **4** . The display will then respond with **4** .
2. Enter **→** . The display will then respond with a flashing **→** .
3. Enter **0** . The display will then respond with "PUSH BUTTON".
4. Push the PROG button on the service unit. The display will then respond with "ENTER NUMBER". *sg + sidsle scia*
5. Enter the 7 digits of the new telephone number. The display will then respond with "ACCEPTED <entered number>".
6. After a few seconds the display will respond with "ENTER PASSWORD".
Enter the 3 digits of the new password. The display will then respond with "ACCEPTED <entered password>". After a few seconds the display will be cleared and the mobile station is ready for use. *ved i aktivering af 0644 # display viser -*

2. BASIC CHANNEL BAND

The basic channel band must be coded into the radio according to the following procedure:

- Connect the service interface unit to the radio and the handset.
- Press **9** , **→** , **0** . The display will now respond with "PUSH BUTTON".
- Press the button marked "PROG" on the service interface unit. The display will now respond with "ENTER BC-LO".
- Enter the low range of the basic channel band (4 digits). The word "ACCEPTED" will be displayed, and after that the display will show "ENTER BC-HI".
- Enter the high range of the basic channel band (4 digits). The word "ACCEPTED" will be displayed. After a few seconds the display is cleared. The mobile telephone is ready when it has been switched off and on again.

Note: Even though the keyed number is out of range, the word "ACCEPTED" will appear on the display and the keyed number is stored.

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TELEINSPEKTIONEN
Landmobil sektion
9.6.1989.

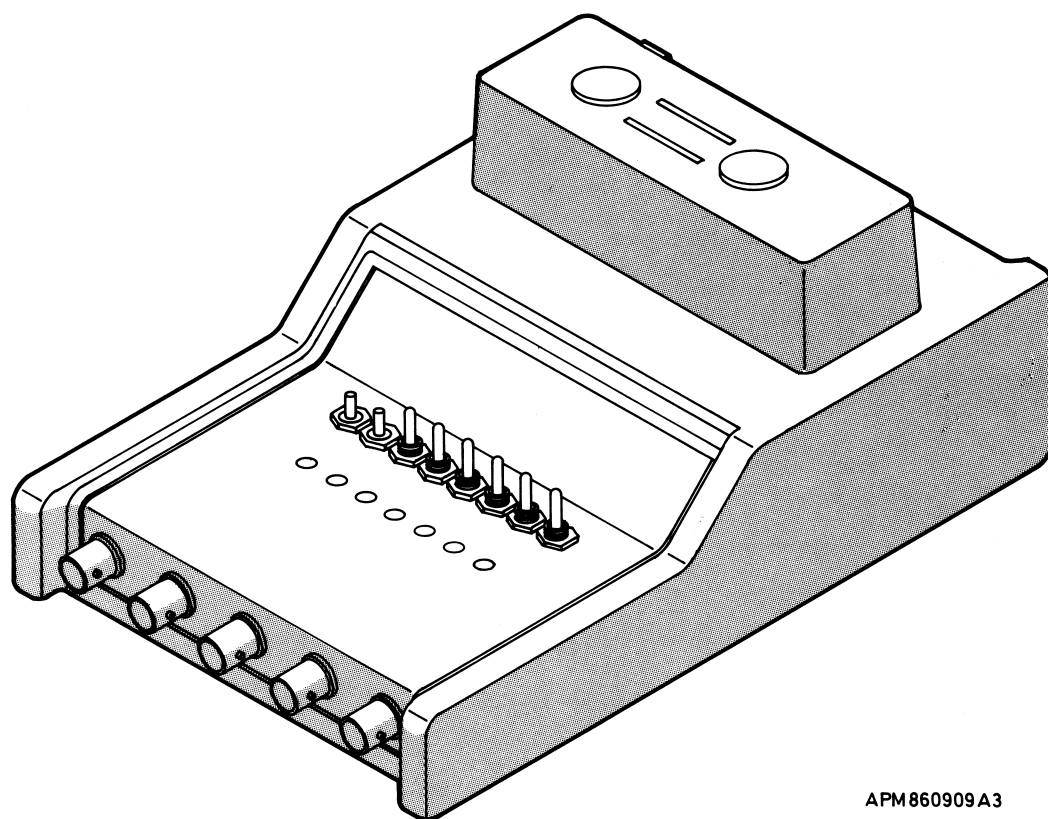
Indkodning af telefonnumre
i NMT-900 radiotelefonanlæg

Biltelefonnr.	Z+X1-X6 Indkodning	Biltelefonnr.	Z+X1-X6 Indkodning
30 10 XX XX	5 10 XX XX	30 55 XX XX	5 55 XX XX
30 11 XX XX	5 11 XX XX	30 56 XX XX	5 56 XX XX
30 12 XX XX	5 12 XX XX	30 57 XX XX	5 57 XX XX
30 13 XX XX	5 13 XX XX	30 58 XX XX	5 58 XX XX
30 14 XX XX	5 14 XX XX	30 59 XX XX	5 59 XX XX
30 15 XX XX	5 15 XX XX	30 60 XX XX	5 60 XX XX
30 16 XX XX	5 16 XX XX	30 61 XX XX	5 61 XX XX
30 17 XX XX	5 17 XX XX	30 62 XX XX	5 62 XX XX
30 18 XX XX	5 18 XX XX	30 63 XX XX	5 63 XX XX
30 19 XX XX	5 19 XX XX	30 64 XX XX	5 64 XX XX
30 20 XX XX	5 20 XX XX	30 65 XX XX	5 65 XX XX
30 21 XX XX	5 21 XX XX	30 66 XX XX	5 66 XX XX
30 22 XX XX	5 22 XX XX	30 67 XX XX	5 67 XX XX
30 23 XX XX	5 23 XX XX	30 68 XX XX	5 68 XX XX
30 24 XX XX	5 24 XX XX	30 69 XX XX	5 69 XX XX
30 25 XX XX	5 25 XX XX	30 70 XX XX	5 70 XX XX
30 26 XX XX	5 26 XX XX	30 71 XX XX	5 71 XX XX
30 27 XX XX	5 27 XX XX	30 72 XX XX	5 72 XX XX
30 28 XX XX	5 28 XX XX	30 73 XX XX	5 73 XX XX
30 29 XX XX	5 29 XX XX	30 74 XX XX	5 74 XX XX
30 30 XX XX	5 30 XX XX	30 75 XX XX	5 75 XX XX
30 31 XX XX	5 31 XX XX	30 76 XX XX	5 76 XX XX
30 32 XX XX	5 32 XX XX	30 77 XX XX	5 77 XX XX
30 33 XX XX	5 33 XX XX	30 78 XX XX	5 78 XX XX
30 34 XX XX	5 34 XX XX	30 79 XX XX	5 79 XX XX
30 35 XX XX	5 35 XX XX	30 80 XX XX	5 80 XX XX
30 36 XX XX	5 36 XX XX	30 81 XX XX	5 81 XX XX
30 37 XX XX	5 37 XX XX	30 82 XX XX	5 82 XX XX
30 38 XX XX	5 38 XX XX	30 83 XX XX	5 83 XX XX
30 39 XX XX	5 39 XX XX	30 84 XX XX	5 84 XX XX
30 40 XX XX	5 40 XX XX	30 85 XX XX	5 85 XX XX
30 41 XX XX	5 41 XX XX	30 86 XX XX	5 86 XX XX
30 42 XX XX	5 42 XX XX	30 87 XX XX	5 87 XX XX
30 43 XX XX	5 43 XX XX	30 88 XX XX	5 88 XX XX
30 44 XX XX	5 44 XX XX	30 89 XX XX	5 89 XX XX
30 45 XX XX	5 45 XX XX	30 90 XX XX	5 90 XX XX
30 46 XX XX	5 46 XX XX	30 91 XX XX	5 91 XX XX
30 47 XX XX	5 47 XX XX	30 92 XX XX	5 92 XX XX
30 48 XX XX	5 48 XX XX	30 93 XX XX	5 93 XX XX
30 49 XX XX	5 49 XX XX	30 94 XX XX	5 94 XX XX
30 50 XX XX	5 50 XX XX	30 95 XX XX	5 95 XX XX
30 51 XX XX	5 51 XX XX	30 96 XX XX	5 96 XX XX
30 52 XX XX	5 52 XX XX	30 97 XX XX	5 97 XX XX
30 53 XX XX	5 53 XX XX	30 98 XX XX	5 98 XX XX
30 54 XX XX	5 54 XX XX	30 99 XX XX	5 99 XX XX

3. CODE LOCK

The code lock no. is stored in the EEPROM. When delivered all Radios have been given the code 1,2,3,4. This can be changed according to customer requirements with the following procedure:

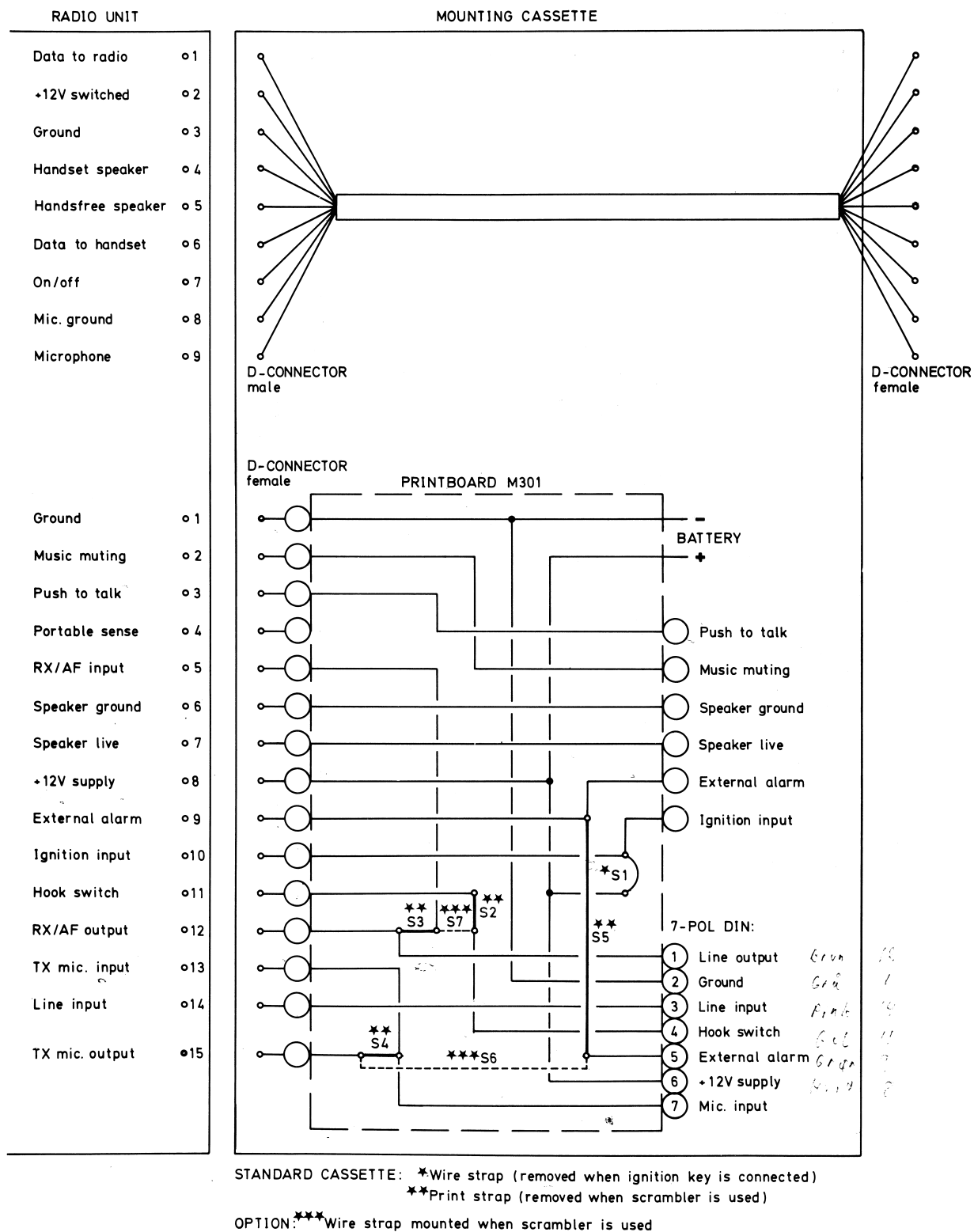
1. Enter **5** . The display will respond with **5** .
2. Enter **→** . The display will respond with a flashing **→** .
3. Enter **0** . The display will respond with "ENTER CODE".
4. Enter the 4 digits for the new lock code. The display will then respond with "ACCEPTED <entered code>".



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Fig. 11 Front of the programming box

Wiring diagram



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Fig. 12 Wiring diagram

CPH860902/0

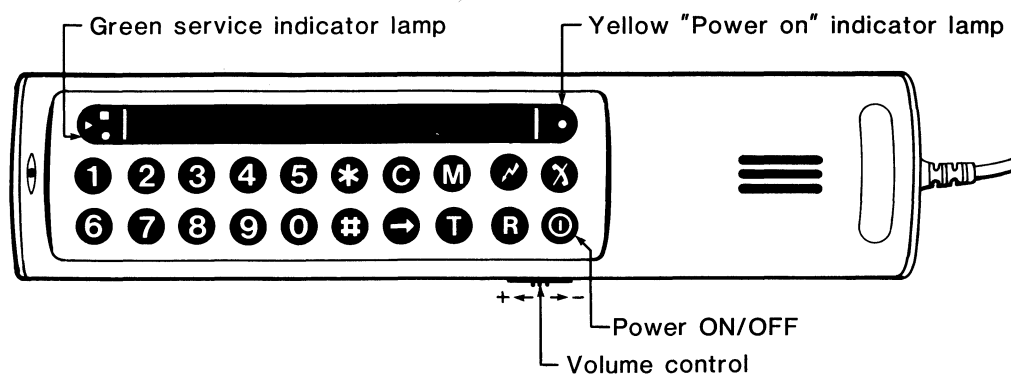
Detailed operation instructions ap4112 NMT

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1. TURNING ON THE SET

The set is turned on and off by means of the push-button marked: ①

PRESS ONCE TO TURN POWER ON
PRESS AGAIN TO TURN POWER OFF



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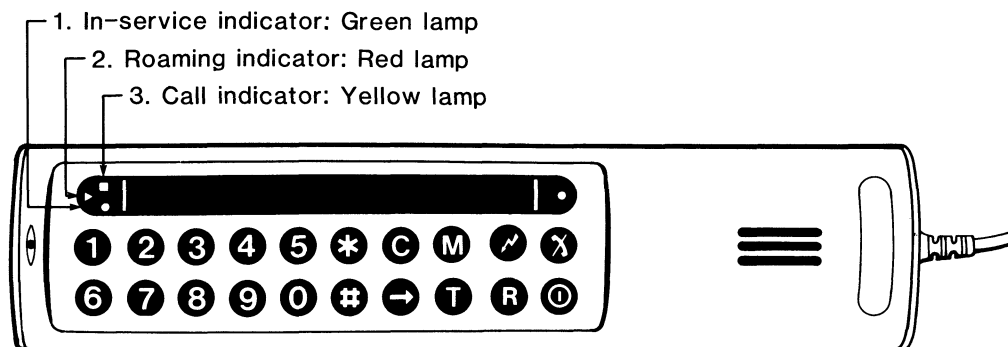
When power has been turned on, the yellow "power on" lamp on the right side of the handset display will be lit, and for 5 seconds the mobile phone number and the version number are displayed.

After a short while the green service indicator lamp will be lit. This indicates that you are within reach of a base station and your set is ready to receive calls.

It is not possible to turn the power off, when a call is in progress.

2. SERVICE INDICATORS

Three indicator lamps are located on the left side of the display.



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A. In-Service Indicator

The green in-service indicator lamp is lit when the radio has been locked to a calling channel. The radio may now receive calls from the base station and a call can be made from the mobile phone. The green indicator lamp may turn off due to one of the following reasons:


- 1) The radio is calling and therefore switched to a conversation channel. The green light will turn on again when the conversation is terminated and the set will return to the calling channel.
- 2) The radio has been called and has therefore switched to a conversation channel. The green lamp will turn off just before the attention signal is heard.

When the conversation is terminated, the radio will return to the calling channel and the green lamp will be lit again.

- 3) The radio is out of range of a base station, meaning that no useful calling channel is available.
- 4) When the radio is switched on, the green lamp will be delayed in activation because the set will first scan the available channels to find the best calling channel. When the radio has been locked to the calling channel, the green indicator lamp will light.

B. Roaming Failure Indicator

The red indicator lamp is lit when the mobile radio for some reason does not have proper contact with the base station. In this situation you will not be able to receive a call because your position is not known by the mobile telephone exchange. The lamp will turn on for the following reasons:

The mobile station has tried to inform the base station about its presence in the area. If the base station does not answer or answers incorrectly, the red roaming indicator lamp will be turned on. The mobile phone cannot receive a call in this condition. It is therefore necessary that the mobile phone starts a new roaming procedure. This is done by pressing the  button.



When the roaming procedure has been finished, the speaker gives an malfunction alarm, and the button is pressed again to terminate the call.

C. Call Indicator lamp

The yellow call indicator lamp will begin flashing after the radio has received a call. The flashing will continue until the call has been answered or the set has been turned off. The call is answered by lifting the handset.

Special conditions

In some cases both the red and green indicator lamps will be lit at the same time. The set is then locked to an appropriate calling channel, but the mobile number has not been updated at the base station.

Press  or lift the handset. When the malfunction signal is heard, press  or replace the handset. This will initiate the necessary roaming-updating procedure that will inform the fixed network about your new position.

3. TONE SIGNALS FOR SERVICE CONDITIONS

A. Incoming Calls

An incoming call is signalled by alternating tones in sequence. There are approx. five secs. between each signal. If the call is not answered at the sixth ringing signal, it will be disconnected by the exchange.

B. Error Indication Signal

This tone consists of two beeps three times and indicates that an operational error has occurred in the system. Cancel the call and try again.

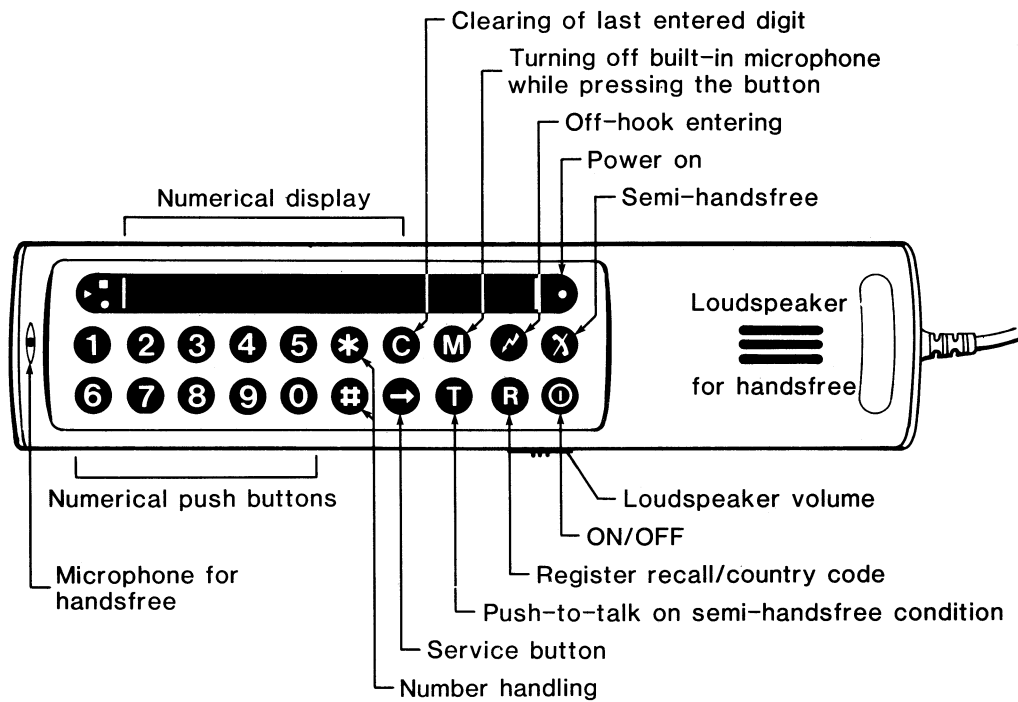
C. Function Tone

The function tone is a short beep which is heard when the push-buttons on the handset controller are being pressed. The tone indicates that the function of the button has been carried out. The function tone can also be disconnected by programming. (See section 9 "Programming of Ringing, Alarm and light").

NOTE: When making a call you will hear either the standard ringing or the busy signal with which you are familiar, transmitted by the exchange.

4. KEYS AND DISPLAY

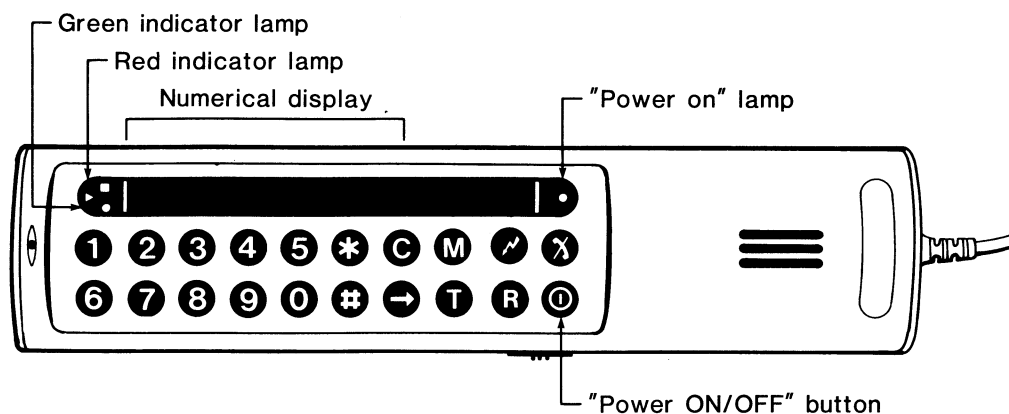
The following figure shows all the buttons and the display on the handset, the different functions will be discussed in the following direction for use.



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5. MAKING A CALL

Turn the set on. The Power ON lamp on the right side of the display will be lit.



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Before initiating the call, check the indicator lamps on the left side of the display.

A green light indicates that your set is in contact with a mobile radio base station and that you can make or receive calls.

NOTE:

The length of time required to establish contact with a base station will vary according to the number of free channels in the traffic area and other factors. A short waiting time may be necessary

A red light on the display indicates that the radio is not in proper contact with the base station. (for further details, see section 2, "Service indicators", point B).

The country code must be changed when you move from one country to another.



The country code can be changed by means of the following procedure:

Press **→**. An arrow will now flash in the right part of the display. While the arrow is flashing the country code can be changed when you press **R**. The arrow will disappear after 10 seconds or when you press **→** again.

A. Making a call with the handset on the magnetic base (on-hook dialling)

Enter the subscriber number (max 20 digits) by means of the numerical push-buttons.

The number entered is shown on the display enabling you to check whether you have entered it correctly. If more than 16 digits are entered, press **M** to see the first part of the number.

When number entering is completed, lift the handset to initiate your call. (For semi hands-free operation press  after entering). Upon lifting the handset, the green light will switch off. When the number has been send to the exchange, it will disappear from the display. It is, however, retained in the last called number memory, "0", .

When your conversation is over, the call is terminated when the handset is replaced on its magnetic base.

If a number cannot be accepted by the exchange, you will receive a loud "error indication" tone. Replace the handset and try once more.

(For fault condition see section 2 "service indicator").


B. Making a call with the handset off the magnetic base (off-hook dialling)

After checking the indicator lamps, lift the handset.


The set will now react as if the handset was still on the magnetic base.

Then enter the subscriber number digit by digit by means of the keyboard.

The number entered will be shown on the display enabling you to check the entered number before it is transmitted.



When the number entering is completed the call is initiated by  being pressed. When the number has been send to the exchange, the number will disappear from the display. The number is retained in the last called number memory if a repeated call is necessary.

The call can be terminated by pressing  or simply by replacing the handset on the magnetic base.

If the number cannot be accepted by the exchange, you will receive a loud "error indication" tone. Then press  to terminate the call. In this case it is necessary to repeat the call sequence.





C. Repeated calls

If a call set-up has been unsuccessful, it is possible to initiate a new call to the same subscriber in an easy way. To use this facility the following routines can be used:


Press 0, , then check the number on the display. Lift the handset or press  to initiate the repeated call. If successful, the conversation and termination can be done in the normal way.

(For fault conditions see section 2 "service indicators").

D. Clearing an incorrect number or digit

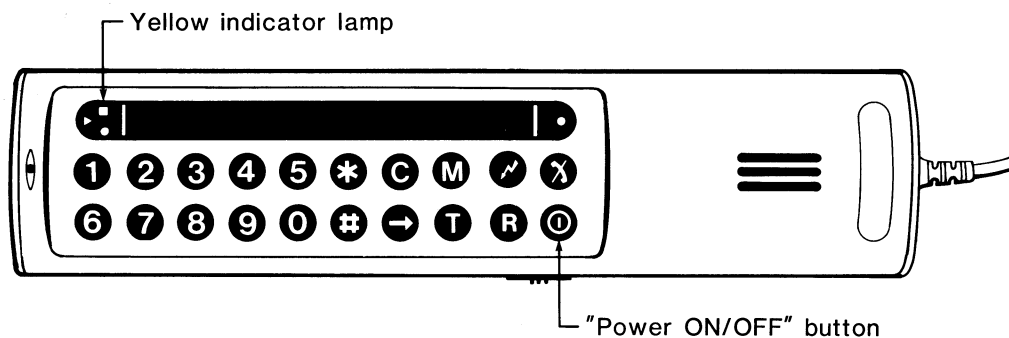
If a number has been entered incorrectly, cancel the complete number by pressing  ,  or the button  twice. If the last entered digit is entered incorrectly, you can cancel this by pressing  .

6. ANSWERING A CALL

Provided that your mobile telephone is turned ON (press ), a call to your mobile telephone set is indicated by two signals:

1. A loud alternating tone from the radio.
2. A flashing, yellow light on the left side of the display.

The green indicator lamp on the display will switch off when your set has been called.



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To answer the call, simply lift the handset from its magnetic base, and both the alternation tone and the yellow light will turn off.

When your conversation is over, terminate the connection by replacing the handset on its magnetic base.

If a call is not answered within a limited number of ringing signals, it will be disconnected and the ringing signal will cease. The yellow light, however, will continue to flash, indicating that there has been a call to your set while you were away from the telephone.

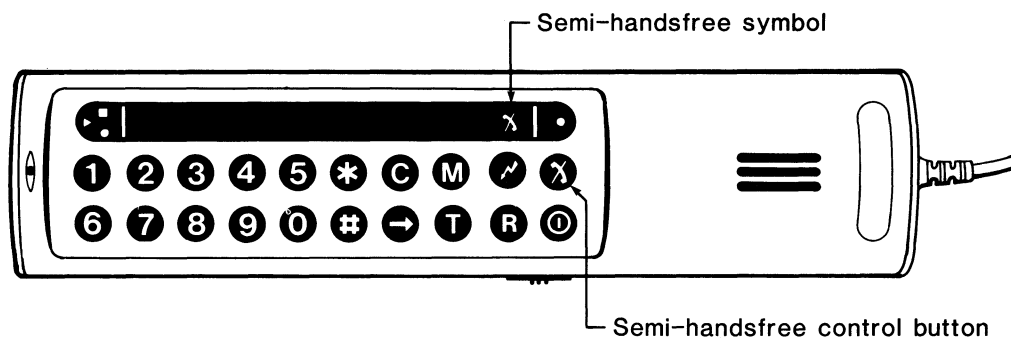
When the set is no longer in use and you wish to discontinue operation completely, press **⓪**. The set is now switched off.

The set can not be switched off in conversation mode.

7. SEMI-HANDSFREE OPERATION

Your mobile telephone is equipped for operation in a semi-handsfree mode, allowing you to set up calls before lifting the handset. This enables you to put off lifting the handset to speak or using the push-to-talk switch to carry out the conversation (press **⌘** or the optional PTT-switch when you want to speak), until your call has been answered.

NOTE: The optional PTT-switch can only be used together with an optional microphone.



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8. ABBREVIATED ENTERING

The mobile telephone is equipped with an electronic memory which simplifies the entering of frequently called numbers as well as the re-entering of engaged numbers.

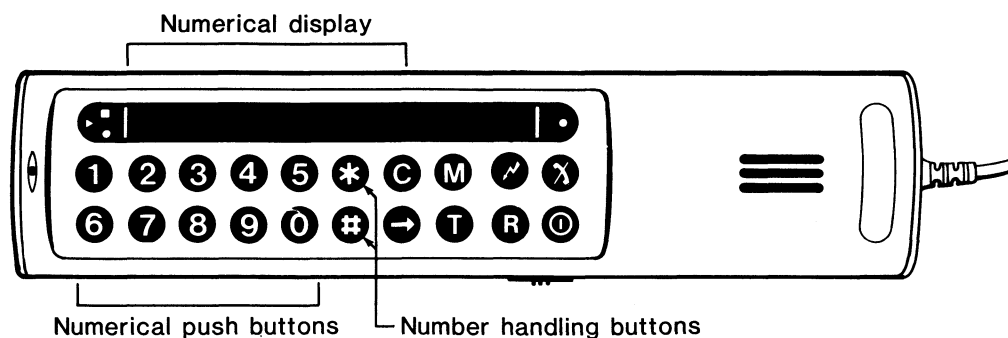
A. Abbreviated entering and encoding of frequently called numbers (short numbers)

Up to 99 frequently called numbers may be stored in the telephone memory for abbreviated entering, using a 2-digit code number. The abbreviated entering facility is particularly useful for storing long, international numbers, where entering accuracy is especially important.

Each telephone number that you wish to store may contain a maximum of 20 digits. The full number is retrieved from the memory by a 2-digit abbreviated code, running from 01 to 99.

The short number "99" is reserved for emergency call "000" or "90000" depending on which country code the mobile radio is coded for.

The short number "00" is reserved for entering a new phone number during conversation. The procedure for this feature is included in article G of this section (subscriber procedure).



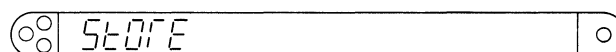
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B. Storing a number in the memory

EXAMPLE I

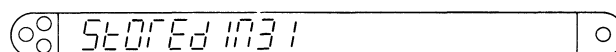
Enter the subscriber number 01324678 and press **→** , **1** .

The display now shows:

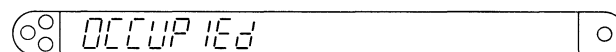


Enter the short number e.g. 31 **#** .

The display now shows:



If the location was occupied
the display shows:



Press **C** for entering the new number in another location or press **#** and the subscriber number 01324678 will replace the previously stored number. The whole number or part of it can be stored, e.g. country and area code, whereas you enter the rest of the number.

EXAMPLE II (Another way of storing a number).

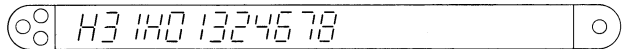
Enter the Short number by pressing * 31 * .

The display will now show:



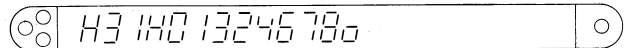
Enter the subscriber number 01324678 by using the keyboard.

The display now shows:



Press the button marked # to enter the number into the memory.

The display now shows:



Press the button marked * to close the memory and clear the display. The subscriber number has now been stored in your telephone memory and is accessible by entering short number 31 followed by # .

If a subscriber number contains more than 12 digits, the code indication shown (H31H in the example above) will disappear from the display, digit by digit, to accommodate the full subscriber number up to 20 digits. Press M to see the remaining part of the number.

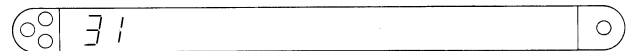
C. Recalling a stored number by entering an abbreviated number

Once again the subscriber number 01324678 and associated code number 31 are taken as examples.

EXAMPLE

Enter 31 by the keyboard.

The display will show:



Press the button marked # .

The display now shows:




The associated subscriber number has now appeared on the display, allowing you to check the number for accuracy before lifting the handset to transmit.

In addition to storing complete subscriber numbers, the abbreviated entering facility may also be used to store other pieces of information such as frequently used country or area codes, or the exchange number of a firm to which various extensions are added. For such numbers the remaining part of the subscriber number is entered from the numerical keyboard after the information stored is recalled from the memory.

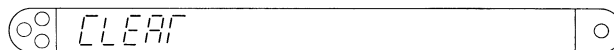
When the full number is shown on the display, it is ready for transmission.


D. Cancelling a number in the memory

EXAMPLE I

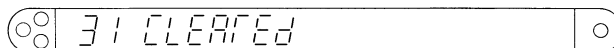
The subscriber number can be cancelled by  ,  being pressed.

The display now shows:





Press 31  .

The display now shows:

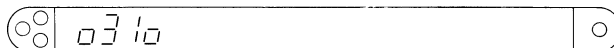



or in another way:

EXAMPLE II (Another way of cancelling a number).

To cancel subscriber number 01324678 enter  31  .

The display now shows:



Press the button marked  .

The display is erased and the subscriber number is removed from the memory.

A stored number may also be removed from the memory by entering a new number in its location.

E. Checking the contents of the memory

You may wish to check the memory for many reasons:

To determine whether a particular subscriber number is correct.

To check whether a certain short number is free, etc.

EXAMPLE



Check the memory contents for abbreviated number 31:

Enter 31  ,  .

The display now shows:

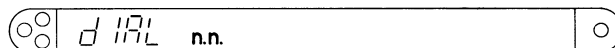


The arrow is flashing on the display.

You can now step forward through the memory by pressing  to check the next abbreviated number or backward by pressing  .

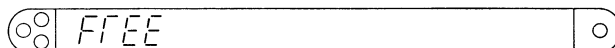
If you press **#** or ***** and keep the button pressed

the display shows:



n.n. is the short number you have stepped to. After release of the button the stored number is displayed. If there is no number stored in a place

the display will show:



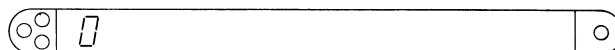
F. Recalling the last called number

The telephone is equipped with a second electronic memory which simplifies re-entering of the last called number. When a call is terminated, the number entered is automatically stored in this memory. If the call must be repeated due to an engaged condition or for other reasons, it does not need to be re-entered, but is simply recalled from the memory by entering **0** , **#** .

EXAMPLE

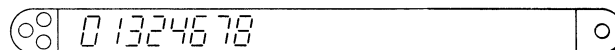
To recall the last called number 01324678 enter 0 on the numerical keyboard.

The display will now show:

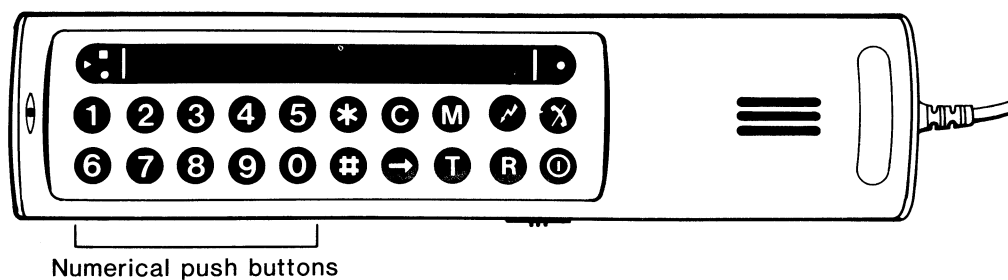


Press the button marked **#** .

The stored number will be recalled and shown on the display:



The call may now proceed in the normal way, the handset being lifted (or the semi-handsfree button being pressed).



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G. Subscriber procedure

It is possible to enter new digits during conversation by using the keyboard. When you want to use this feature, you just enter the digits into the handset by using the keyboard while in conversation mode.

When you terminate the call, the number entered is transferred into the short number memory position 00.

To make the new call you just recall the number by pressing 0 , 0 , # . Then the number is shown on the display and the call can be initiated if you lift the handset or press ^ .

It is also possible to store the number anywhere in the memory by 0 , 0 , # , → , 1 , nn # being pressed (the display should be clean before you press any key). (nn is the abbreviated number, under which the phone number is stored).

NOTE: The contents of 0 , # (Last number called) and 0 , 0 , # (scratch pad) will be erased when the radio is switched off.

9. PROGRAMMING OF RINGING, ALARM AND LIGHT

The following functions can be programmed in the mobile telephone by using the handset:

a) Ringing signal

Here are 3 possibilities:

- Low ringing (RINGING LO).
- A low ringing twice and thereafter a loud ringing (RINGING HI DELAY).
- Loud ringing (RINGING HI).

The selected function is remembered after the mobile telephone has been switched ON/OFF.

b) External alarm

Here are 3 possibilities:

- No external alarm (HORN OFF).
- External alarm after internal alarm twice (HORN ON DELAY).
- External alarm on (HORN ON).

When the mobile telephone has been switched ON/OFF, it returns automatically to HORN ON DELAY.

c) Keyboard beeper

Here are 2 possibilities:

- BEEP ON.
- BEEP OFF.

The selected function is remembered after the mobile telephone has been switched ON/OFF.

d) Light in display - mobile installations

Here are 2 possibilities:

- Instant light (LIGHT ON).
- Light in display for 30 seconds when a button is pressed or a call is received. (LIGHT AUT.).

The selected function is remembered after the mobile telephone has been switched ON/OFF.

e) Light in display - portable installations

Here are 2 possibilities:

- No light (LIGHT OFF).
- Light in display for 30 seconds when a button is pressed or a call is received. (LIGHT AUT).

The selected function is remembered after the mobile telephone has been switched ON/OFF.

f) Reduced power level in portable installations

Here are 2 possibilities:

- The radio has the possibility of using all three power out levels (HI EFFECT).
- The radio only has the possibility of using the medium and low power out levels (LO EFFECT).

When the mobile telephone has been switched ON/OFF it automatically returns the HI EFFECT function.

Programming:

The status of ringing is shown when **→**, **3** are being pressed.

The status can be changed by ***** being pressed.

Next functions (Ext. alarm, etc.) can be shown by **#** being pressed.

10. COUNT THE TIME YOU CALL

The mobile telephone has two counters to count the call time. These will be shown when

→ and **5** are pressed.

The display will now show two counters, one with five digits to count the time for the actual call and one with six digits to accumulate the total call-time.

If you call up the counter during a phone call the first counter will continuously be updated.

The second counter will be updated when you make the next call.

The displayed time can be switched off by **C** being pressed.

The counter can be switched to zero by you pressing **→** and **8** followed by your lock code. If your lock code is correct, the counter will be cleared.

Note: If the telephone is registered as a "Pay-phone" by the PTT, the display will show two counters, one with six digits to registrate the price for the actual call or the last call and one with seven digits to accumulate the total price for the registered calls.

11. ELECTRONIC LOCK

An electronic lock is available to prohibit unauthorized access to the mobile telephone. The lock operates on the basis of a 4-digit code (your personal key number) which is programmed into the set by help of the service interface unit.

The mobile telephone can be locked at two levels.

A. Locking level 1

This level allows calls only for the Nordic countries with the following exceptions:

Denmark: It is not possible to call any number which begins with: 0014 - 0017 or

04 31 11 11

04 32 11 11

04 33 11 11

04 36 11 11

04 37 11 11

Sweden : It is not possible to call any number which begins with 000.

Norway : It is not possible to call any number which begins with 0115.

Finland: It is not possible to call any number which begins with 92022 or 92027.

B. Locking level 2

This level allows only emergency calls and the selected amount of short numbers which are programmed into the radio.

Emergency numbers which are allowed:

Denmark and

Finland : 000

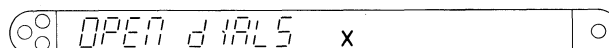
Sweden : 90000 and 90XYZ


Norway : Numbers which begins with 000,001,002 or 003.


Selection of short numbers:



Press  ,  .

The display will now show:









The press of  increases the number of short dial numbers which it is possible to use at locking level 2.


The press to  decreases the number of short dial numbers.






The function  ,  cannot be activated if the mobile telephone is locked at level 2.

LOCK FUNCTION

The lock function at level 1 is activated when you press  ,  ,  ,  ,  .




An L is displayed when the first two  's are pressed indicating that lock is in progress.

When the last  is pressed the display is cleared, but a FLASHING key indicates that the telephone is locked at level 1.

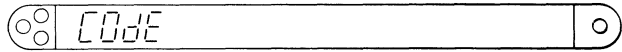
The lock function at level 2 is activated when you press  ,  ,  ,  ,  .



A key on the display indicates that the telephone is locked at level 2.


To unlock

With  on the display, press  and .

On the display is shown:







Now you enter the secret 4-digit keyword and, if correct, the  disappears on the fourth entry. Each digit entered is shown on the display as .

If the keyword is wrong, the display is cleared on the fourth entry, but the mobile remains locked. the sign  is still shown on the display.



Light in handset

The handset has built-in light, and it is possible for the user to decide whether this light is to be permanently on, or whether it is to be switched off automatically 30 seconds after the last key has been pressed.

The function is changed when you press , . When ,  are pressed either "LIGHT ON" or "LIGHT AUT" appears on the display for approx. 2 seconds. If the light switches off automatically a call for the mobile station will cause the light to turn on for 30 seconds as if a key had been pressed.

Field strength display

There is often a large difference in signal strength within a small area. It is therefore desirable for the user to get an indication of the quality of the reception conditions. If the reception conditions are poor, the antenna position may be shifted slightly to see whether they improve.

It is possible to show signal strength on the display by keying in , . Then "signal-n" appears on the display, where n = (0, 1, 2, 3), which indicate:

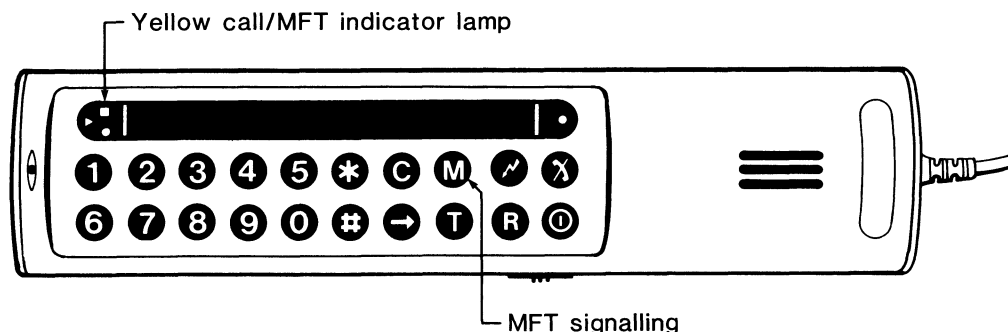
- 0 = very poor signal (signal < -2dBuV)
- 1 = poor signal (-2dBuV < signal < 10dBuV)
- 2 = good signal (10dBuV < signal < 20dBuV)
- 3 = very good signal (20dBuV < signal)

The display is updated approx. every 1/2 second, and the hyphen of "signal-n" will flash when the display is updated.

The function only works when the radio is locked on a channel.

12. MFT SIGNALLING

It is possible to transmit simple data information from the mobile phone by the use of the handset. This feature is called MFT (Multi Frequency Transmission) signalling.



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Subscriber procedure

The subscriber procedure can be done in one of the following ways:

Example 1:

The mobile phone must be in conversation mode.

Press **→**, **M** to initiate the MFT situation. The yellow indicator will be constantly switched on when the MFT function in the MTX is activated.

Enter the digits in question by the keyboard. The digits are transmitted in digital form from the mobile to the MTX and converted to MFT signals (dual tones) in the MFT converter situated in the MTX.

A flash in the call indicator confirms the transmission of each digit entered.

When the data transmission required is finalized, press **→**, **M** again. Then the mobile phone will return to conversation mode.

Terminate the call in the normal way.

Example 2:

The mobile phone must be in conversation mode.

Press the number of digits you will transmit then press **→**, **M**.

The yellow indicator switches on and then flashes to indicate the transmission of each digit. After the data transmission the mobile phone automatically returns to stand-by mode, ready for a new call.

13. TIME OUT

In three cases the mobile telephone may switch itself off:

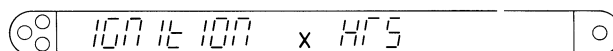
- a) If conversation has taken place on a channel with very poor signal strength (less than -2dBuV) for more than 30 seconds, the call is automatically cleared and the radio switches itself off. This function is controlled both by software as well as by hardware.
- b) If the mobile station receives more than 30 seconds FFSK (in conversation mode) the call is automatically cleared and the radio is switched off. This function is controlled by the software.
- c) If the transmitter is on unadvisedly the mobile telephone will switch off immediately. This is to ensure that the telephone will not block the network because of a fault.

Furthermore it is possible to connect the mobile telephone to the ignition switch of the car. The mobile telephone will then switch itself off if the ignition has been turned off for more than the number of hours which has been programmed into the software of the radio.

Programming the time out duration:

Press  , .

The display will now show:






Pressing  increases the number of hours.

Pressing  decreases the number of hours.





























The duration can be varied from 0 to 24 hours. If 0 hours has been selected, the function is disabled.

14. LIST OF SERVICE KEY FUNCTIONS

All the functions mentioned below have already been discussed earlier in this chapter in detail. This serves as a listing of the functions.

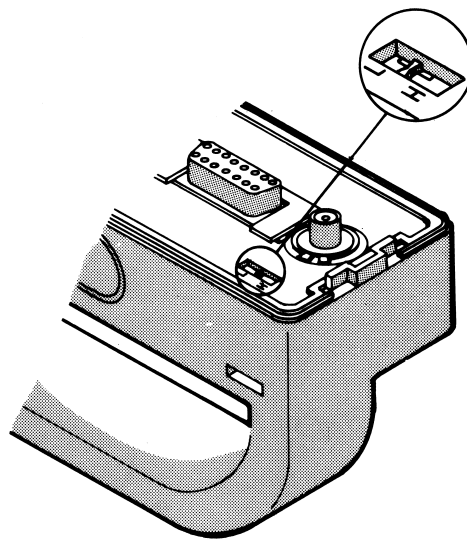
All these functions are activated by  (service key) being pressed first, and then some other key. When the service key is pressed, an arrow begins to flash on the display to indicate that the function of the keyboard has been changed. If no other key is pressed within 10 seconds, the arrow will stop flashing, and the keyboard changes back to normal state. Changing back to normal state may also be activated by  or  being pressed. All of these functions cease after 10 seconds with no keys pressed.

The following functions may be activated by means of the service key:

-  ,  = Field strength display
-  ,  = Short dial number function
-  ,  =
-  ,  = Status line (acoustic signals and light)
-  ,  =
-  ,  = Time counter
-  ,  = Locking function
-  ,  = Programming of number of short dial numbers in lock level 2
-  ,  = Zeroing time counters
-  ,  = Programming of ignition timer
-  ,  = Erase line
-  ,  = Light
-  ,  = Scrolling through short dial numbers downwards
-  ,  = Scrolling through short dial numbers upwards

15. PORTABLE KIT

A small switch marked "L" and "H" is mounted on the handle of the portable kit.



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This switch enables/disables the ignition time out function (see section 13 of this chapter).

Position "H" : Enables the time out function (similar with the ignition OFF mode of a car).

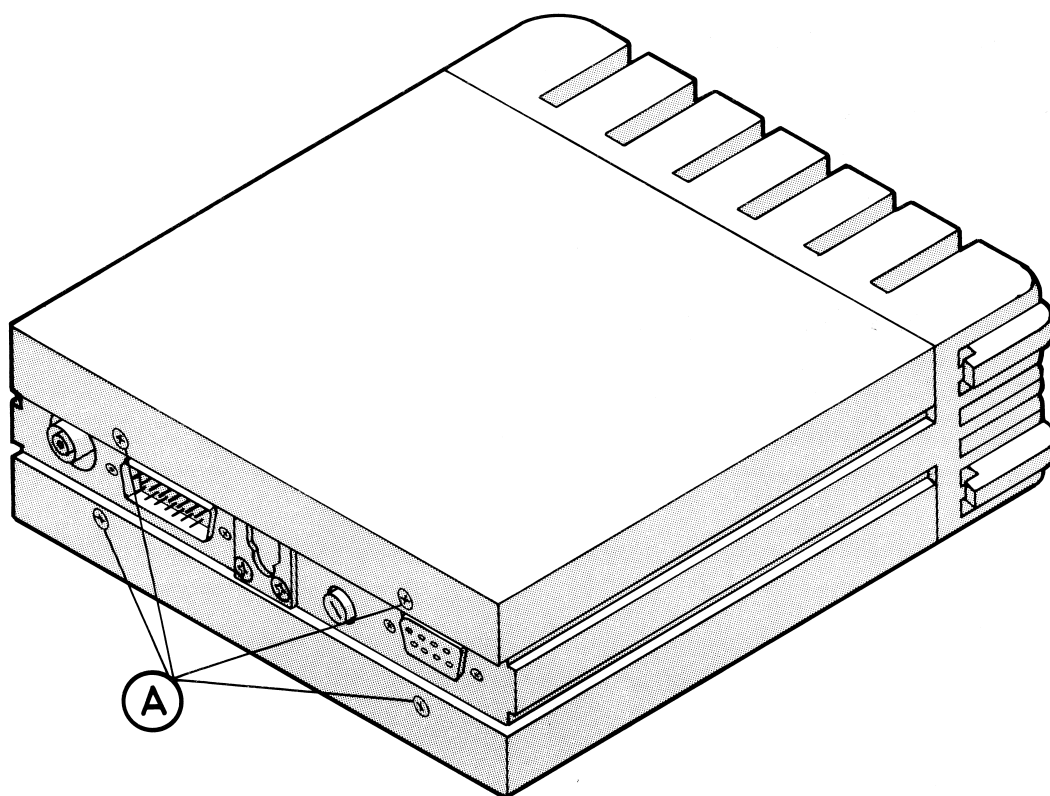
Position "L" : Disables the time out function (similar with the ignition ON mode of a car).

The transceiver

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Disassembling of the transceiver

1. Removing of the cover



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Fig. 1 Transceiver

- Remove the screws (A) . Two screws for top cover and two for bottom cover.

2. Replacement of the transceiver part U2, U3 and U4

The units are provided with connector sockets for direct plug-in connection to the system board U1.

Before removing U3 and U4 remove the coaxial cables.

U2, U3 and U4 can now be lifted out carefully. See fig. 2. (B) (C) and (D) .

3. Removing the system board U1. See fig. 3

- Remove the four screws (E) from the connectors.
- Disconnect the coaxial cable from the Duplex filter (F) .
- Remove the two lock rings (G) .

The system board can now be lifted out.

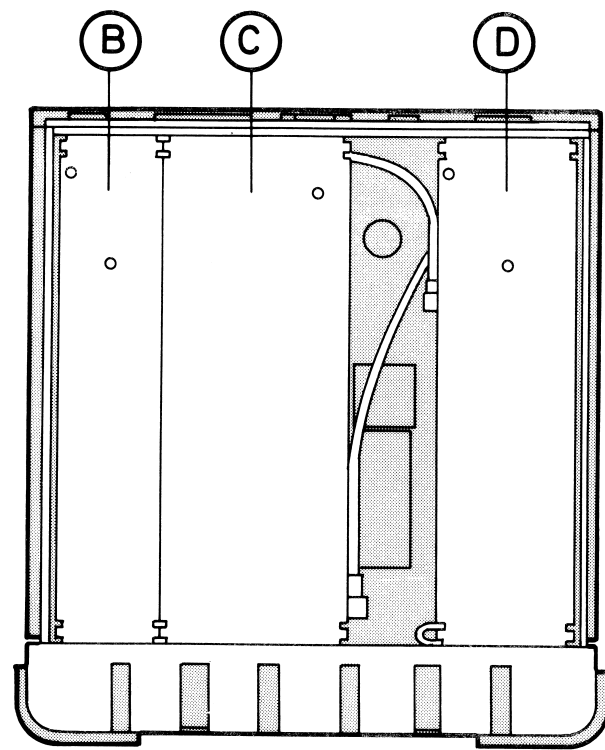
4. Removing the PA-stage U5. See fig. 4

- Remove the two screws (H) .
- Remove the two screws (I) .
- Remove the coaxial cable from the Duplex filter.
- Remove the clip-on power transistor.

Now the PA-stage can be pulled out.

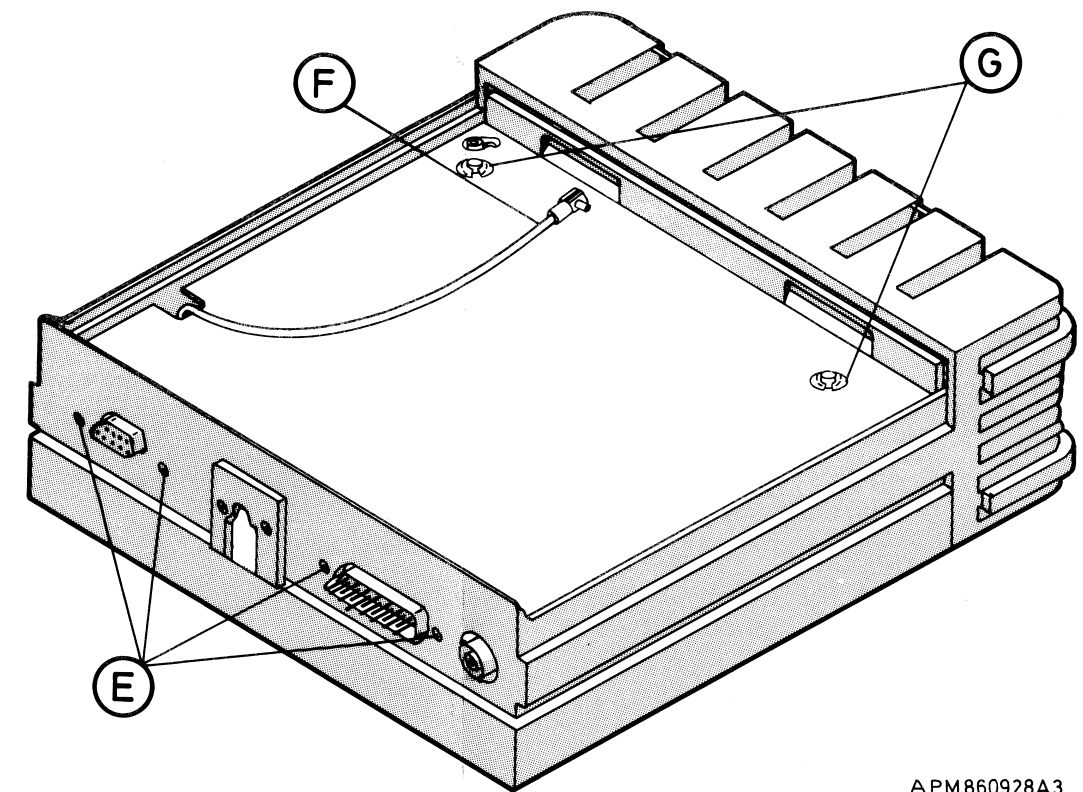
5. Removing the Duplex filter U6. See fig. 4

- Remove the four screws (J) .
- Remove the coaxial cable to the antenna-connector.
- Disconnect the coaxial cable on U1. See fig. 3. (F) .



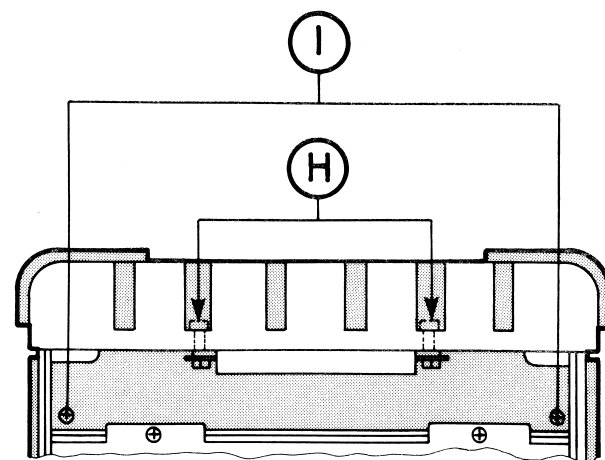
APM860924A3

Fig. 2



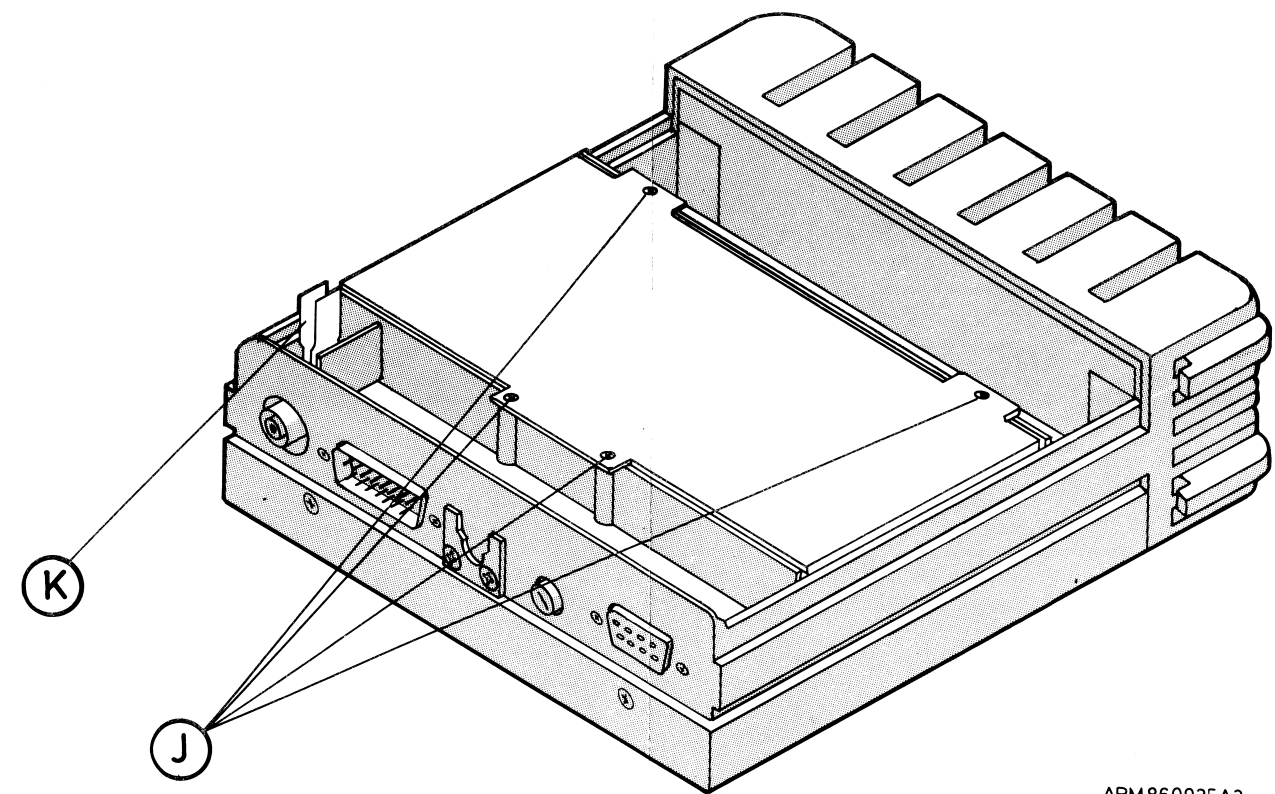
APM860928A3

Fig. 3



APM860929A3

Fig. 4



APM860925A2

Fig. 4

Description of the transceiver

In the following chapters the transceiver block diagram will be explained.

Please remember the following notes:

- The battery voltage is shown as +13.2V.
This is the voltage used during checking and adjusting.
- The units have been given unit numbers U1, U2 etc.
- Most interconnections are made via the motherboard U1. These interconnections are shown in the wiring diagrams.

The following remarks are intended as a guide to the use of the diagram. The arrows in the block diagram indicate the signal paths through the circuits. The block diagram is divided into six sections.

The radio unit contains many functions of an ordinary mobile radio for a closed net.

Examples: Channel selection, squelch and volume control. The difference is that this radio is fully remote controlled. All these functions are controlled by a built-in microprocessor mounted on the system board and fed with information from the handset, the radio and the MTX (telephone exchange for mobile telephones). The information is treated according to a program stored in an EPROM. The result is commands to the handset, the radio and MTX. For communication with the MTX, the radio speech path is used. As this is of limited bandwidth it cannot be used directly for data transmission. Therefore the data stream is converted to audio type signals in a MODEM (modulator/demodulator).

The transceiver consists of four radio modules, a duplex filter and a system motherboard. All modules are mainly mounted with SMD-components (Surface Mounted Devices).

CAUTION: When a module has to be repaired, the requirements for SMD-handling must be observed.

DESCRIPTION OF THE BLOCK DIAGRAM

The block diagram is divided into six sections and contains:

- U1 the system board.
- U2 the IF/AF amplifier.
- U3 the RX and Synthesizer.
- U4 the TX and AF amplifier.
- U5 the PA-stage.
- U6 the Duplex filter.
- U7 the Supply filter.

The systemboard unit 1 contains the CPU which controls almost every part of the mobile telephone. The CPU works according to the software program stored in the EPROM. It also receives and sends information to the MTX via the FFSK modem. Via different I/O ports it controls the RX-synthesizer (gives data information about the channel number).

The CPU also controls the different driver stages for external relays (alarm etc.) and control the output power of the PA-stage.

The code-in EPROM contains information about the mobile telephone's subscriber number, codelock etc. The RAM contains information such as short dial numbers.

Finally the systemboard contains a hardware time-out circuit which turns off the radio if the CPU fails to do it, and amplifiers for earpiece and loudspeaker.

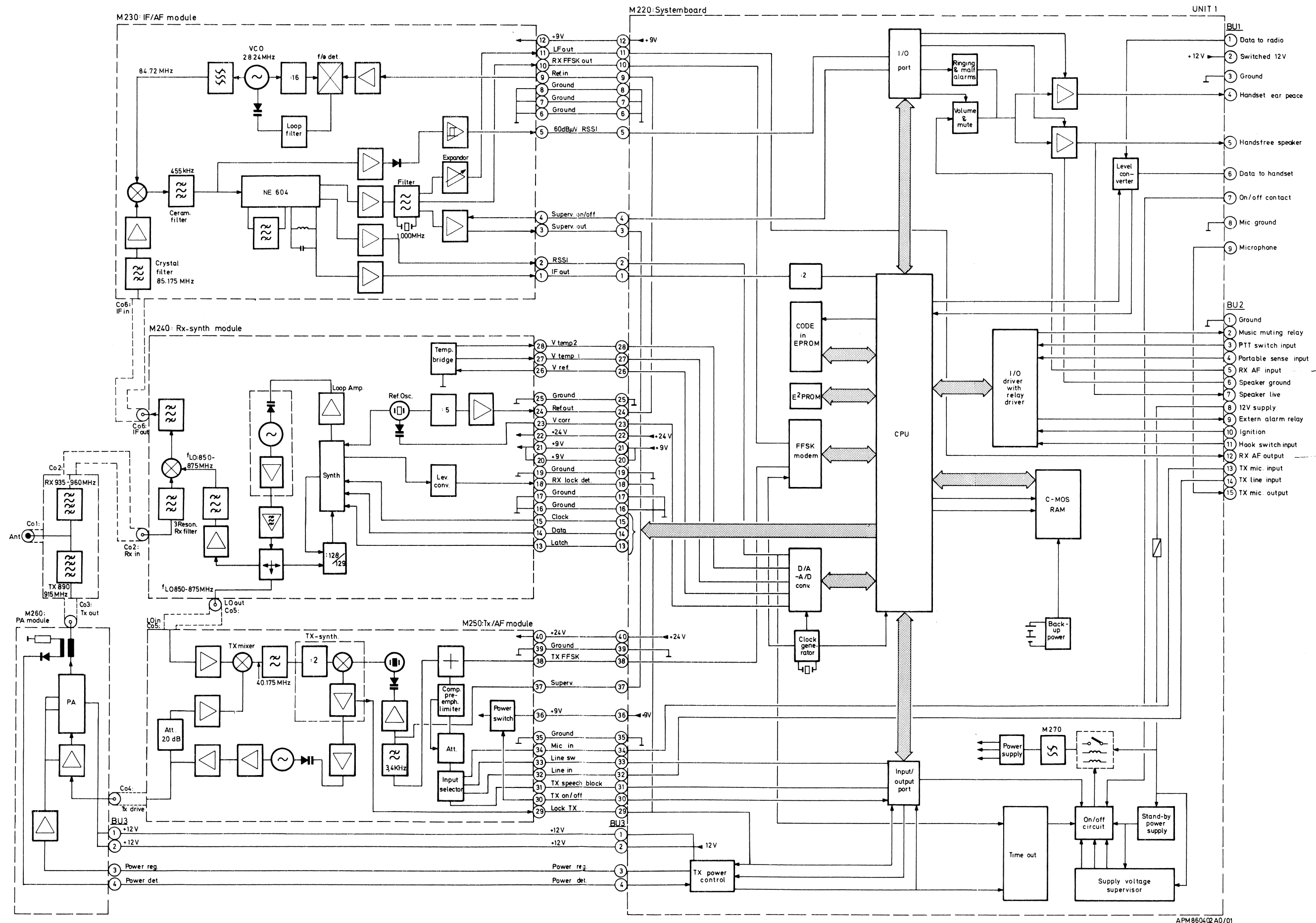
The antenna signal received is fed through the duplex filter to the RX-synthesizer unit 3. Here it is converted to the first IF-signal at 85.175MHz. The synthesizer is controlling the RX-VCO which works in the area 849.8375MHz to 874.8125MHz. As a reference the RX-synthesizer IC is provided with a 8.825MHz reference oscillator.

The IF signal is then fed to unit 2 IF/AF amplifier. Here it is converted to the second IF at 455kHz before it is detected and fed to the AF-amplifier. The AF signal is then amplified on unit 1 before it is fed to the loudspeaker or earpiece in the handset. The supervisory signal is fed from the detector and via a bandpass filter to the TX-unit so that it is transmitted back to the base station and MTX.

The microphone signal from the handset is looped through BU2 where a scrambler or telephone answering device can be inserted on the line. The AF signal is then fed to the TX/AF amplifier where it modulates the reference oscillator for the TX-synthesizer.

The TX-synthesizer controls the TX-VCO works at a frequency from 890.0125MHz to 914.9875MHz. The output of the VCO is fed to the PA-stage unit 5, and to a mixer where it is mixed with a reference signal from the RX-synthesizer. This locks the TX-synthesizer to the RX-synthesizer so that the duplex separation will always be 45MHz.

The PA-stage unit 5 amplifies the TX-signal before it is fed to the duplex filter. The PA-stage works with 3 different output levels controlled by the CPU on unit 1.



APM8604Q2 A0/01

Description of unit 1, System board

The systemboard contains several functions besides acting as a motherboard and interconnection board for some of the other units of the transceiver.

Here the systemboard is divided into four sections: ON/OFF circuits.

Power supply.

Computer section.

Other circuits.

ON/OFF circuits

The ON/OFF circuit is mounted with a bistable relay, which means that the circuit only leads current through the coil when turning the radio ON or OFF.

The capacitor C2 is either charged via Q5 (turn-ON) or discharged via Q3 (turn-OFF). To switch ON the radio some conditions must be fulfilled. The supply voltage must be above 10V (monitored by IC7/1) and below 17V (monitored by IC6/2) as all inputs on IC5/1 must be low to switch ON the radio. R19/C13 ensure that the switch ON function cannot be activated if the radio is already ON. Turn OFF can be activated by the hardware time-out circuit or if any of the inputs of IC5/2 is high. This will happen if the supply voltage is above 17V (monitored by IC6/2) or below 7V (monitored by IC6/1) and if both inputs on IC3/2 are high, or if the reset input on IC4/2 is low for more than 1 μ s.

When pressing the ON/OFF button on the handset, the timer-in IC4/1 is started, leading to the start of the second timer IC4/2. If the first timer runs out before the second, IC3/2 will activate the turn-OFF of the radio. As the CPU is informed (by data from the handset) about an ON/OFF contact being pushed, it can decide whether to let the turn-OFF procedure run out or reset the second timer via Q1, thus preventing the turn-OFF.

The CPU can also force the radio OFF via Q1, R17 and C11.

The hardware time-out circuit is incorporated to secure turn-OFF of the radio if the CPU fails. Both the CPU and the hardware time-out circuit monitors the transmitter activity and the received carrier indicator. If the transmitter is on while no carrier is present, the CPU will turn off the radio after 30 seconds while the hardware circuit will turn off the radio 2 seconds later (after 32 seconds) if the CPU fails.

Power supply

The seven voltages on U1 are the following:

+14V is the external supply to the ON/OFF circuit.

+13V is like the +14V, but limited by a zener diode not to exceed 15V.

+12V is like the +14V, but after the relay.

+9V is derived from +12V and regulated by a low-drop regulator.

+5V is derived from +12V and regulated by a low-drop regulator. A large number of capacitors and resistors are added on strategic places to prevent noise on the supply line from the digital circuits from interfering with the radio circuits.

+3V is the back-up voltage for the RAM.

+2.5V is used to ensure the right DC-voltage on the C-MOS switches in the audio path.

Computer section

The microcomputer, an 80C31, is running at 11.0592MHz. The restored address lines are led from the address latch to the program memory, the RAM, the I/O ports, and the address decoder for the RAM and the ports.

The serial link to the handset is a 12V open collector link, with the pull-up resistors located in the receivers and the open collectors placed in the transmitters. The circuit on U1 may prevent transmission from the handsets to the radio unit during power-up. When the processor is ready, an output port will enable this datalink, thus preventing critical timing in the turn-on phase of the radio set.

The TX power control is established by a DC-loop to control the PA-stage U5 to reduce the transmitting power to medium or low power.

Other circuits

The EEPROM contains information such as the mobile telephone's subscriber number, lock code etc. IC205 is an integrated modem. The modem receives a clock frequency of 5.529MHz derived from the CPU-clock. The outputs are two interrupt pulses, one during reception (always active) and another during transmission (controlled by the CPU). The interrupts from the modem have a frequency of 1.2kHz and are important for the correct operation of the software.

Audio control

The audio signal received from module U2 pin 1 is looped through the connector BU2.12, enabling the insertion of various external equipment (descrambler, telephone answering unit, data communication equipment, a.o.). The audio signal returned on BU2.5 is then fed to the volume attenuator. The attenuator is made like an ordinary potentiometer, using a C-MOS switch to change between the various outputs of a chain divider.

On the output of the volume attenuator, the two alarm oscillators are added to the signal.

The malfunction oscillator has a frequency of 1400Hz, while the ringing oscillator is between 700 and 1300Hz.

The sum of the audio signal received and the two oscillators is led to two amplifiers, one for the handset earpiece, the other for the semi-handsfree speaker.

The microphone and line audio paths are conducted directly to U4 pin 32 and 34.

TX/PA-control

In order to control the transmitting power, a DC-loop is established, where the transmitting power can be controlled.

The detector voltage from the PA-module unit 5 is applied to a comparator and a servo-loop. The comparator in IC13/2 will tell the CPU whether the transmitter is active or not, while the servo-loop will control the transmitted power. IC13/1 compares the voltage from the detector in unit 5 with the control voltage applied on its inverted input.

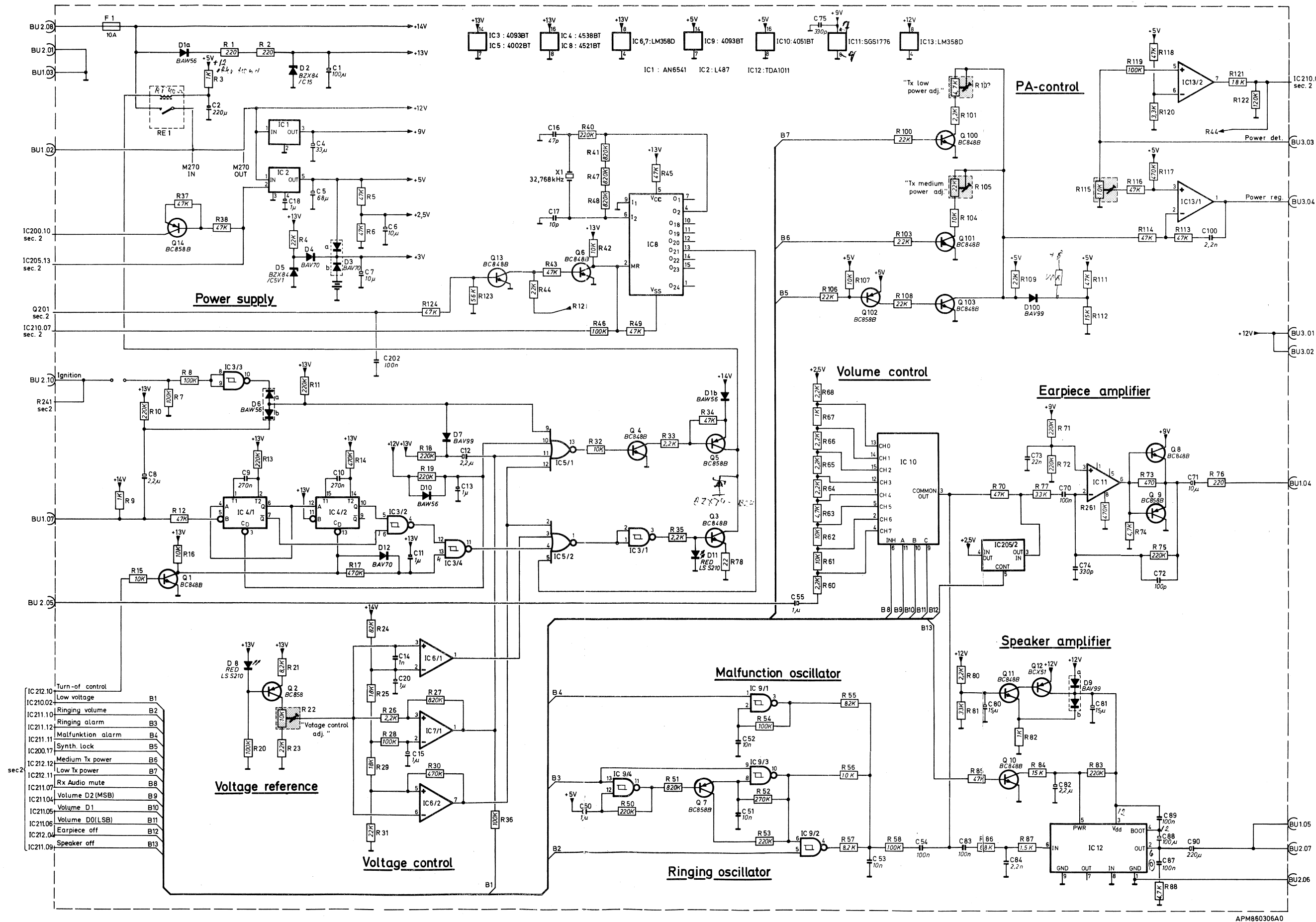
The control voltage is a product of the voltage divider including R110 to R112, and the three loads controlled by Q100, Q101 and Q102/103. The divider will adjust its voltage as a function of the temperature on R110. This will select the output power between high, medium and low power. For this reason, R110 is located in the PA-module cooling block.

The limiting effect of Q103 will stop the transmitter completely, and will come into action if any of the two synthesizers in unit 3 or unit 4 is out of lock.

Car installation interface

The two external relays for external alarm circuits and for music muting, are driven by Q207 to Q210. Both driver circuits are protected against spikes from the relays, and are limited to a current of approx. 100mA each.

Fig. 6 Component location, system board, unit 1





Description of unit 2, IF- and AF-amplifier

The 85.175MHz IF signal is fed via two crystal filters and a buffer with a gain of approximate 17dB to the second mixer.

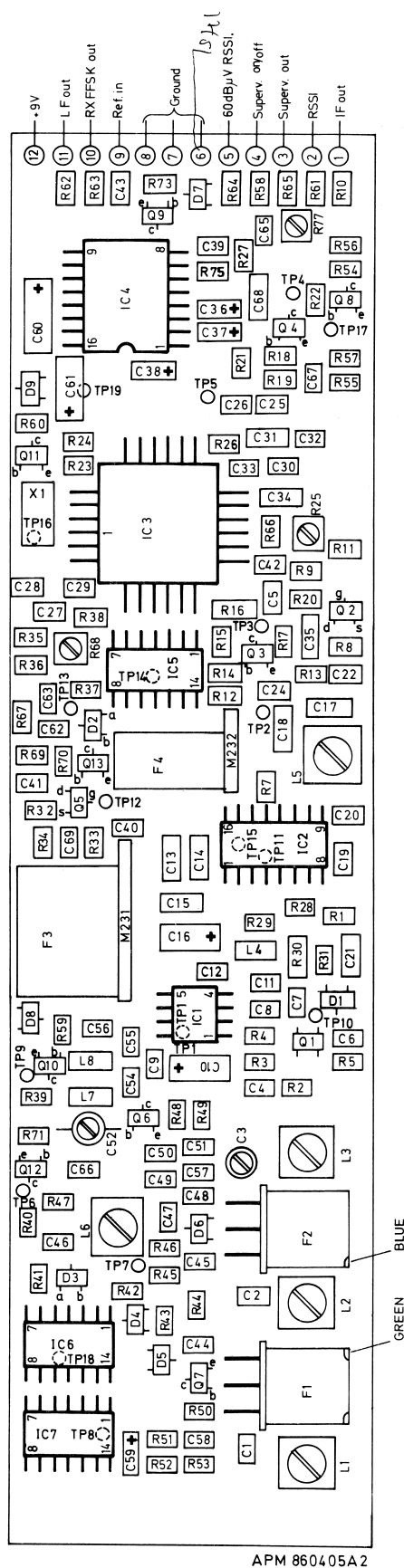
The second input of the mixer is a frequency of 84.72MHz from the VCO. The VCO provides a frequency of 28.24MHz. The VCO frequency is then tripled at the collector of the VCO transistor. The VCO frequency is also divided by 16 before it is sent back to the phase detector, where it is compared with the VCXO reference signal from the RX-synthesizer module (unit 3). The phase detector sends a DC control voltage to the VCO.

The 455kHz IF output signal from the 2nd mixer is sent via a crystal filter to an integrated IF-amplifier, limiter, quadrature detector and field strength measurement circuit (IC2).

The recovered audio signal is fed to a 2nd order high-pass filter where it is split up and led into a switch capacitor filter. The speech signal is led via a deemphasis circuit and a 3400Hz low pass filter to an expander before it is sent to the AF amplifier on the system board.

The audio signal recovered is also led through a 4kHz band-pass filter from which the 4kHz supervisory signal is derived.

The 60dBuV detector circuit is connected to the output of the 455kHz ceramic filter. The IF signal is amplified and detected by the diode (D2). The level of the signal controls a Schmitt-trigger which is directly connected to the CPU on the system board (unit 1).



Där tillägg RX Del som kört
 för skydd mot mycket
 störförbindelser till den 6
 och blivande

08.10.10 Induktionskretsen
 för att förhindra att
 den blir störd av en 12

Fig. 9 Component location, IF- and AF-amplifier, unit 2, version 1-3

CPH860904/1

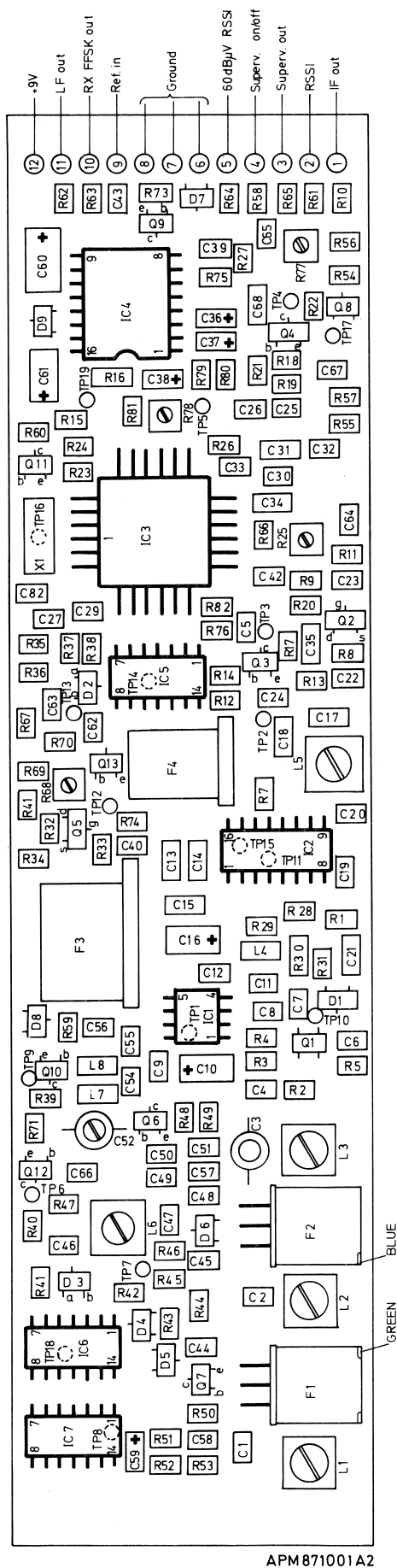
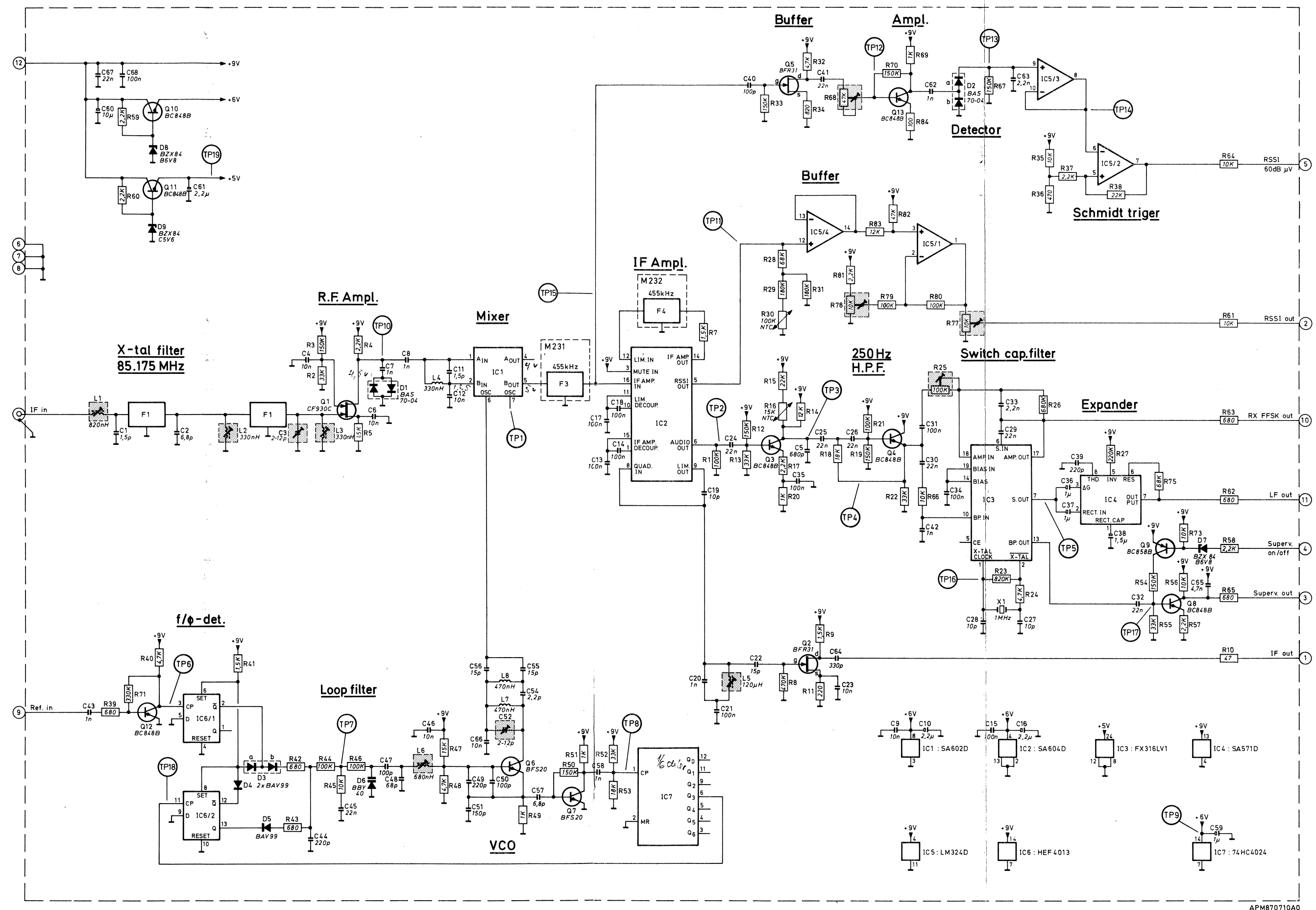


Fig. 11 Component location, IF- and AF-amplifier, unit 2, version 4

CPH860904/0



Description of unit 3, RX synthesizer

RX-synthesizer

The RX-synthesizer unit can be divided into 3 main parts. These are:

1. Front end
2. Synthesizer
3. Reference oscillator

The front end converts the antenna signal received from the duplex filter to the first intermediate frequency (IF) at 85.175MHz with approximate 16dB gain.

The synthesizer section consists of a VCO, a prescaler, the synthesizer itself, and a loop filter. The VCO consists of a 985MHz resonator and works within the range of 849.8375MHz (first channel - IF) to 874.8125MHz in steps of 25kHz (12.5kHz if interleaved channels are used). The output of the VCO is via a buffer fed to the front end circuit to the TX slave loop in the TX/AF module, and to the prescaler. The prescaler divides the VCO frequency by either 128 or 129 controlled by the synthesizer (Pin 6 low: 129, Pin high: 128). The synthesizer is fed with data information on pin 12-14 about the division ratios corresponding to the selected channels. After the VCO signal has been divided, it is fed to an internal comparator together with a signal from the VCXO reference oscillator. The output from the comparator is fed from the synthesizer via a loop filter to the VCO for frequency correction and to the VCO gain compensation circuit. The loop-filter is based on the integrator IC6. D2 charges C11 more quickly in order to speed up the switching time. The VCO gain compensation circuit compensates for the nonlinearity in the VCO gain (the gain falls when the frequency rises). When the VCO gain starts to decrease, D5 opens and the voltage at Q6 base increases. This means that the current which controls the phase detector gain increases, so that the open loop voltage gain is kept constant. The RX lock detects output of the synthesizer (pin 4) is low (active state) when the PDA output on pin 1 is between 1 and 4V.

The reference oscillator is built around an unbuffered inverter. It provides a frequency of 8.825MHz. The output of the oscillator is fed to the synthesizer and via a divider (divide by 5) to the IF/AF module.

A temperature measuring bridge is introduced and information about the temperature of the crystal is sent to the CPU on the system board. The CPU sends back a correction voltage for the VCXO.

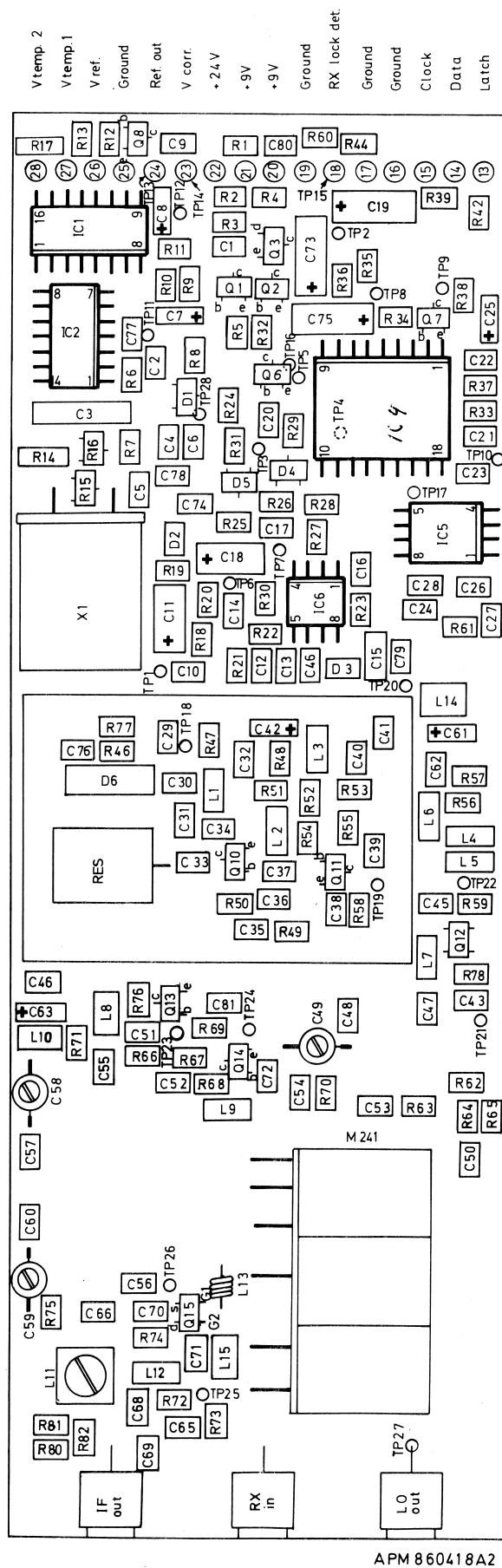
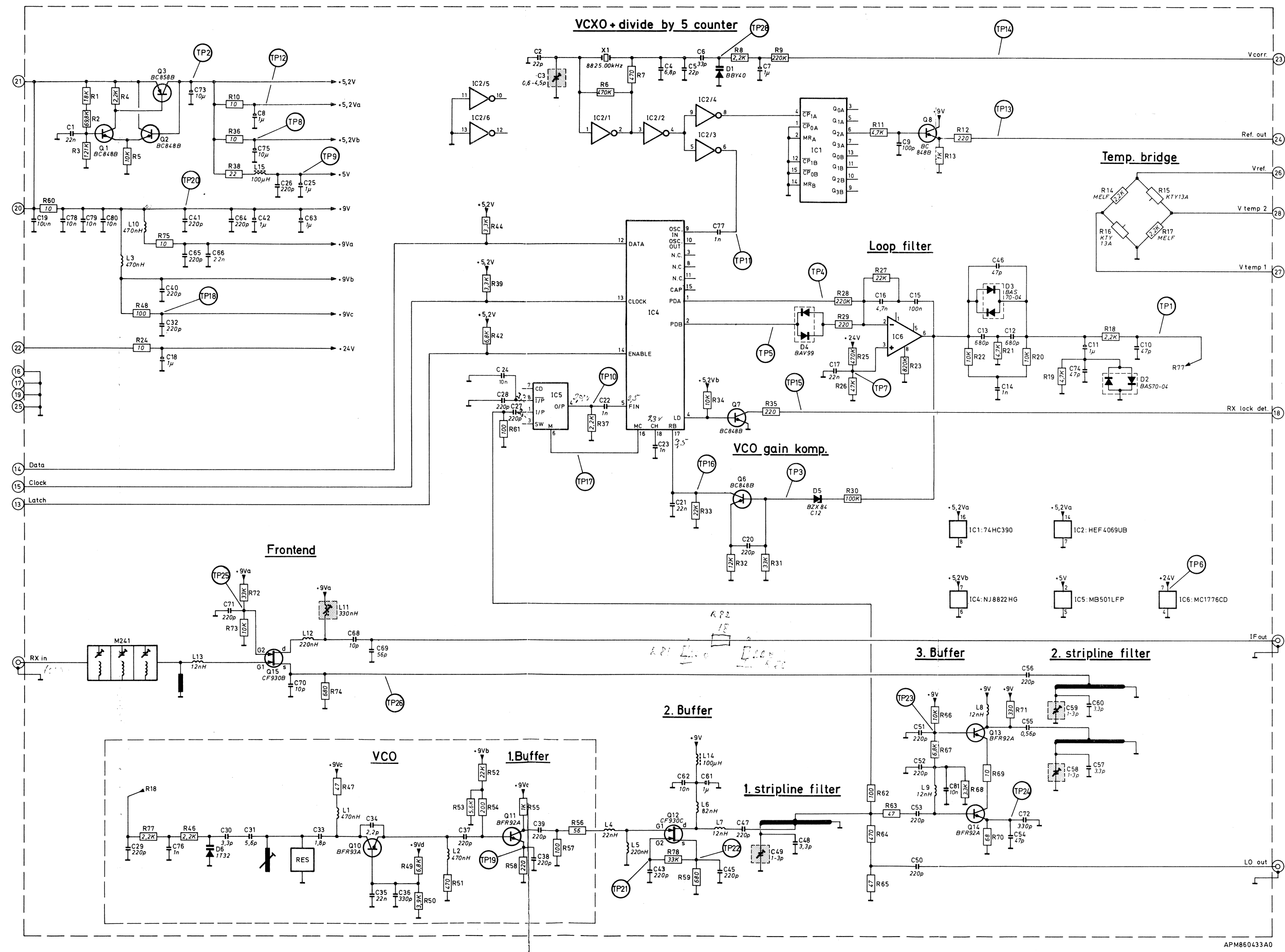


Fig. 13 Component location, RX synthesizer, unit 3



Description of unit 4, TX/AF amplifier

TX/AF module

The different audio signals are fed to the input selector.

The selected audio signal for modulation is led through a limiter (Q13 and IC3/2) and a 2:1 compressor circuit (IC3/1) to a fast limiter D7, and to the switch capacitor and low-pass filter.

The combined signal is added together with the supervisory signal and fed via a buffer to the reference oscillator, which it modulates so that the output frequency includes half the deviation ($\Delta f/2$) specified for the NMT-system. The signal from the reference oscillator is fed to the TX-synthesizer, which controls the VCO.

The output of the synthesizer is a DC voltage together with the audio signal. This signal is amplified before it meets the VCO, so that it gives the VCO the correct deviation (Δf).

The output of the VCO is fed to the PA-module but also via an attenuator and a buffer back to the TX-mixer. The TX-mixer mixes the signal from the TX-VCO with the signal from the VCO at the RX-synthesizer module. The difference frequency ($40.175\text{MHz} \pm \Delta f$) is divided by 2 before it is fed to the phase comparator of the synthesizer where it is compared with the signal from the reference oscillator to lock the TX-VCO to the reference oscillator.

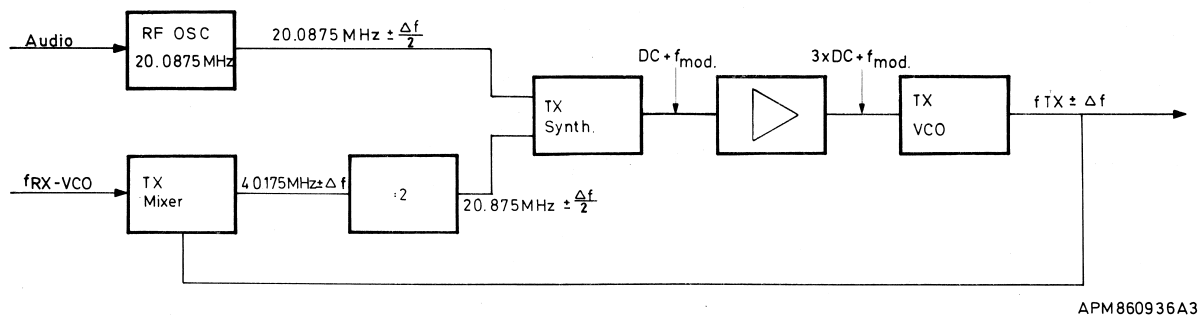


Fig. 15 Schematic block diagram, TX/AF amplifier, unit 4

Due to this, the RX-synthesizer controls the TX-synthesizer with regard to channel selection and ensures correct duplex separation (45MHz).

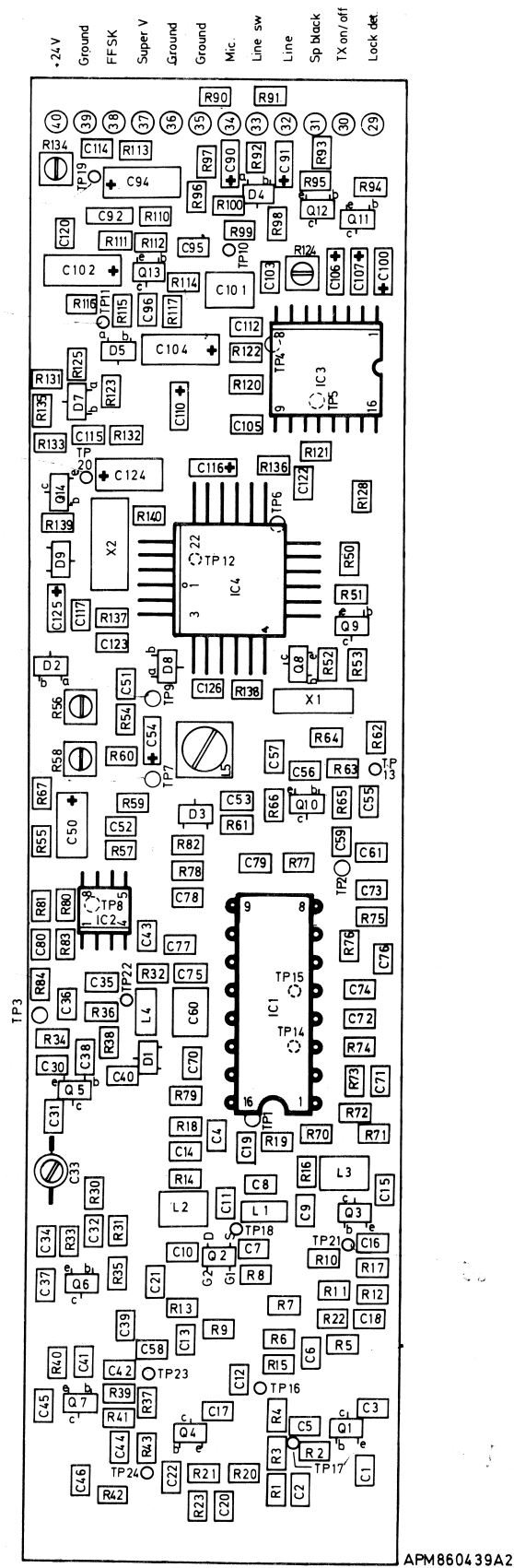


Fig. 16 Component location, TX/AF amplifier, unit 4

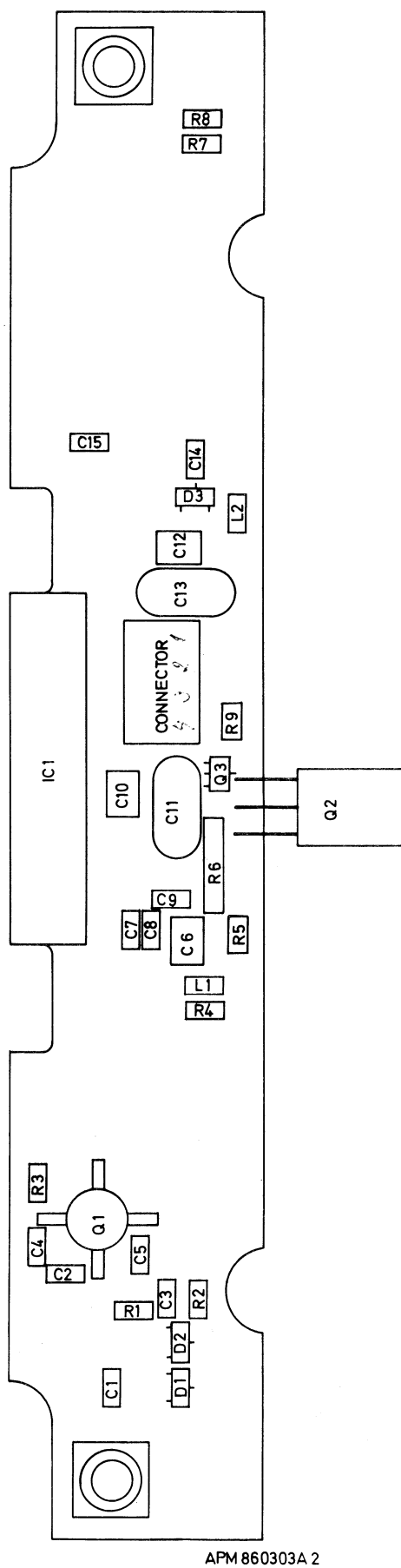


Fig. 18 Component location, PA-stage, unit 5

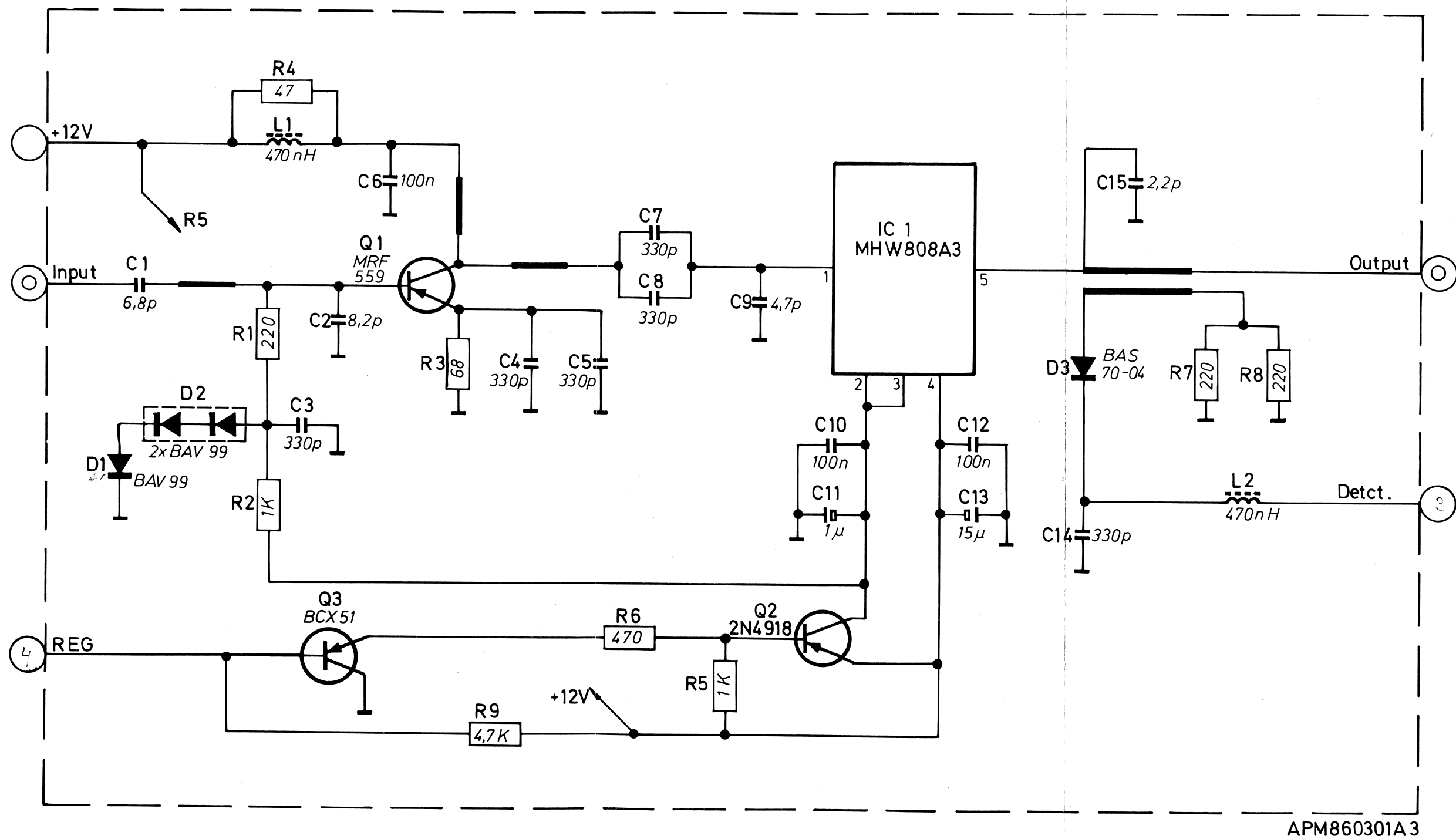


Fig. 19 Circuit diagram, PA-stage, unit 5

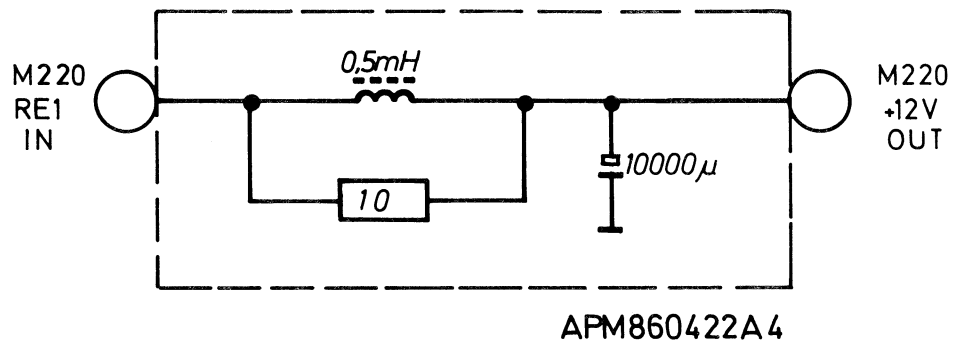


Fig. 20 Circuit diagram, Power supply filter, unit 7

WARNING

Certain semiconductor devices used in this equipment contain Beryllium Oxide. If inhaled, dust from this oxide can be toxic.

No danger can arise from normal handling but no attempt should be made to tamper with these devices.

They should not be discarded with industrial or domestic waste.

Metal Oxide Silicon Devices.

The field effect transistors and C-MOS integrated circuits used in this equipment are made of metal oxide silicon devices. Because they have an extremely high input impedance, they are susceptible to damage when subjected to high transient voltages or static electrical charges.

To eliminate the possibility of damage the following precautions must be taken:

1. Device leads must always be in contact with a conductive material to avoid the building-up of static charges.
2. Soldering iron tips, tools and metal parts of test equipment used during servicing must be grounded.
3. To avoid transient voltage spikes, devices must not be inserted or removed with power connected.
4. Signals must not be applied to integrated circuits in the absence of power supplies to the devices.

Service instructions

1. GENERAL INFORMATION

In this transceiver the SMD technology has been introduced. This means that repairs at component level is not allowed without the use of special tools. If any of the modules has been exchanged a performance test should be made. If any components have been exchanged the "Detailed module adjustments instruction" should be followed first and then the performance check.

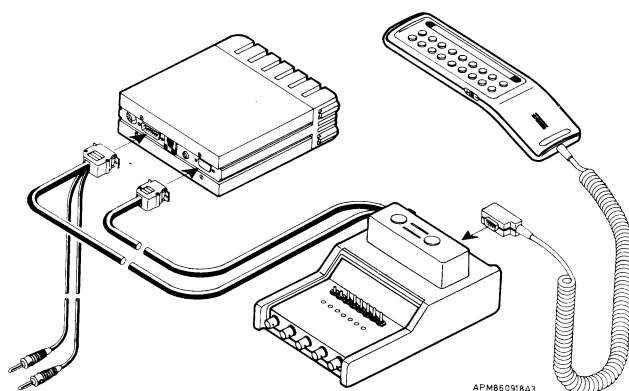
New modules as well as replacement modules have been tested and preadjusted in order to make a "quick performance test" of the transceiver.

For testing the transceiver a Service Interface Unit (SIU) can be used. The SIU can test the handset and the transceiver separately and together.

For fault finding and adjustments of the entire mobile telephone the following test equipment is recommended:

DESCRIPTION	TYPE NO.	ORDERING NUMBER
Handset		
Service Interface Unit	ap4009	9506 100 10720
Test cables BNC-MCX		9506 100 70660
Power supply	7-15V DC, 20A	
Digital multimeter	e.g. Philips PM 2521	
Oscilloscope	e.g. Philips PM 3217	
Radio communication test set	(e.g. Marconi 2955) or:	
Signal generator	e.g. Marconi 2022	
Deviation meter	e.g. HP8901A	
Function generator	e.g. Philips PM 5109S	
Frequency counter	e.g. Philips PM 6668	
Sinad meter	e.g. Finstrument M73	
AC Millivoltmeter	e.g. Philips PM 2521	
Dummy load	50ohms/25W	


2. CONNECTING THE SERVICE INTERFACE UNIT TO THE TRANSCEIVER AND HANDSET





3. USER'S INSTRUCTION FOR THE SERVICE INTERFACE UNIT (SIU) AND THE TRANSCEIVER SOFTWARE





































Connect the SIU cables to the connectors on the radio unit and connect the handset to the SIU. Connect the black and red power cables to the power supply and set the voltage to 13.2V DC. This is the set-up for test and service of the mobile telephone, using the ap4009 service interface unit, and the built-in software.

When you apply power to the test set-up, you will hear a click, and it may look as if the set switches on and then off again. This action occurs because the radio CPU must have time to check if all the prefunctions are all right, then the CPU returns the radio to standby mode.

Push the button  on the handset. The telephone number and the software version will be shown on the display.

To get access to the software use these keys on the handset keyboard , ; look at them as a key and a keyhole. Now, what you have to do is simply select which key you want to unlock the keyhole with. You have ten different keys, from 0 to 9.

This is the way you select the part of the software that you need:

<u>Press</u>	<u>and</u>	<u>you are in this mode</u>
"  "  "  "		Normal operation.
"  "  "  "		Payphone programming.
"  "  "  "		PTT mode.
"  "  "  "		Test of call probability.
"  "  "  "		CPU manual control.
"  "  "  "		Programming the telephone number and the password.
"  "  "  "		Programming the lock code.
"  "  "  "		Resetting all abbreviated numbers.
"  "  "  "		Resetting all time counters.
"  "  "  "		Display software version.
"  "  "  "		Programming the basic channel band.
"  "  "  "		Initialize temperature table. (not software version 1).

NOTE: If the display doesn't show the correct indication format, disconnect and reconnect the power. This action will reset and restart the program.

4. EXPLANATION OF THE SOFTWARE FUNCTIONS

"  "  "  ":

This is the normal operation of the mobile telephone, it will work just as if no selection has been made.

"  "  "  ":

This is the function where the mobile telephone is switched between the PAY-PHONE function and the NOT PAY-PHONE function and vice versa (the function toggles).

NOT PAY-PHONE function: In this mode the time counters will count the actual call-time (shown by 5 digits in the display) and the accumulated call-time (shown by 6 digits in the display).

PAY-PHONE function: In this mode the mobile telephone receives information from the MTX about the charge for the actual call. This is shown in the display when **→**, **5** are pressed. The 6 digits to the left shows the price for the actual call (last call if the conversation has been terminated), and the 7 digits to the right shows the accumulated price for the calls.

The prices shown will be approximate figures.

The prices shown will be in the following currency units: Denmark: øre

Norway : øre

Sweden : øre

Soumi : Pennian

The maximum accumulated price which can be shown is 4294967 units.

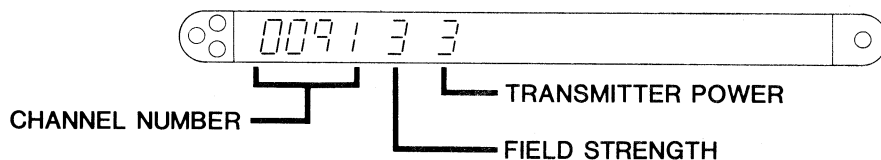
NOTE 1: To use the PAY-PHONE function the mobile telephone must be registered as a PAY-PHONE by the PTT.

If the mobile telephone is coded as a PAY-PHONE but the telephone's subscriber number is not registered in the MTX as a PAY-PHONE number, it will not be possible to make a call from the mobile telephone and vice versa.

NOTE 2: The time counters (or price counters) are automatically reset when a telephone number is coded into the mobile telephone.

" **1** " **→** " **0** ":

This is the PTT mode, which is a monitoring mode. The indication on the display will be:



APM870106A4

A flashing of the display indicates that information is being constantly updated.

You can use this mode to see if major functions of the radio are working, and if the location you are in will be a good place for making a call.

The parameters to be used are:

Field strenght : 0 = less than -2dBuV
 1 = -2dBuv to 10dBuV
 2 = 10dBuv to 20dBuV
 3 = more than 20dBuV

Transmitter power level: 1 = low power
 2 = medium power
 3 = high power

" **2** " **→** " **0** ":

This is the test of call probability. A feature required by the PTT.

It enables the radio to start its scanning on max. sensivity. The display will only show 2.

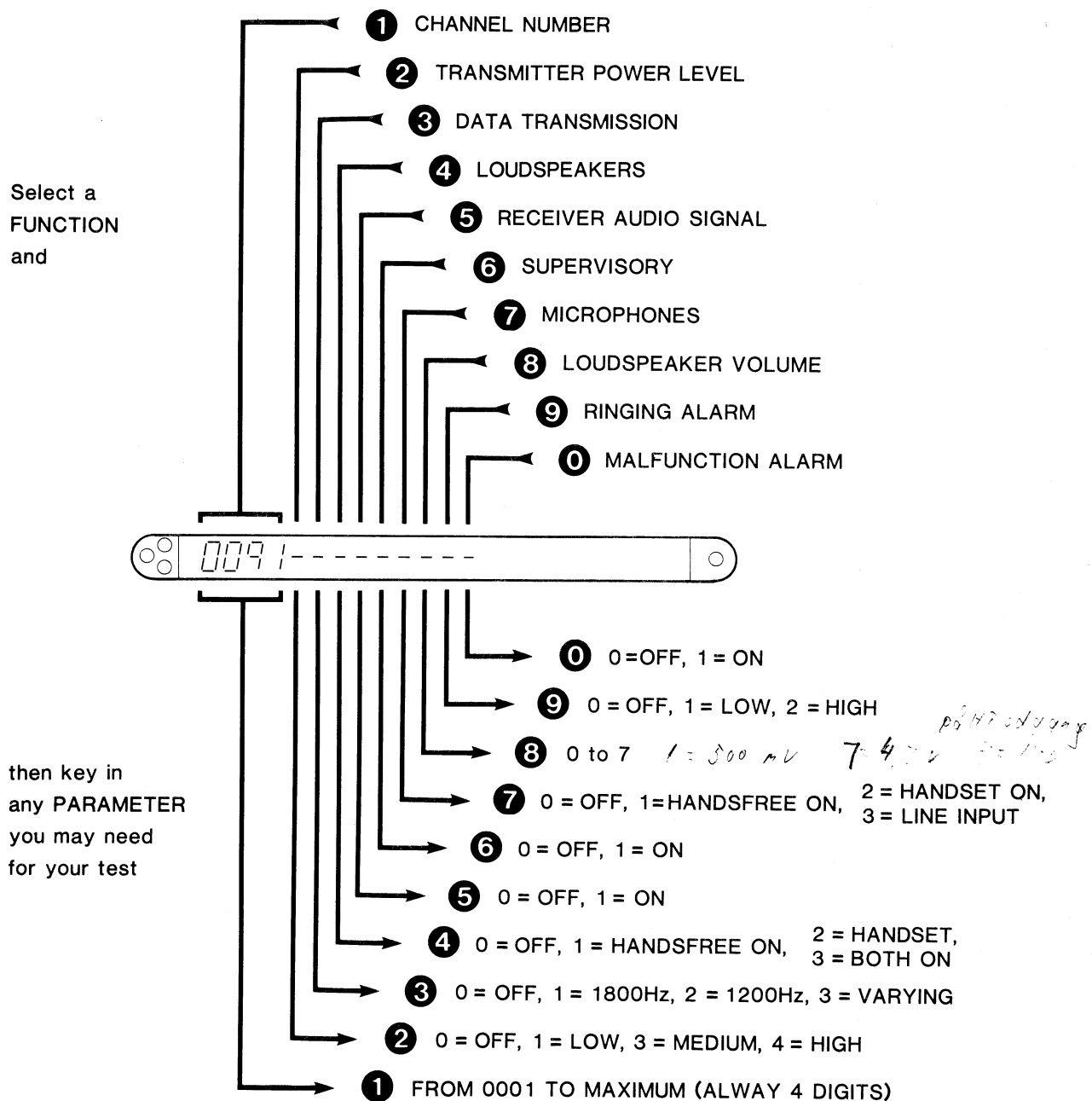
" 3 " → " 0 ":

This is the test and service mode of operation. In this mode the CPU allows the radio to be controlled by the handset keyboard.

The operator can select one or more functions of the radio to be performed, simply by selecting one or more of the 10 functions and write in the parameters needed for the test that the operator wants to perform.

The following figure is a guidance to this:

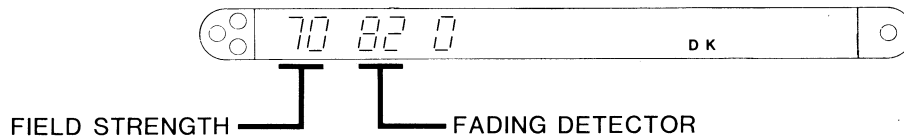
Select a FUNCTION and then key in any PARAMETER you may need for your test.



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NOTE: If you have used the manual control for the CPU, the only way you can return to normal operation is to turn the radio OFF and then ON again.

Pressing **#** makes the display indicate field strength and fading detector.



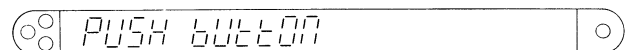
APM871023A4

Pressing ***** disables/enables (the function toggles when ***** is pressed) the frequency control system. When the control system is disabled, the radio will ignore any incoming signals from the antenna input and use its own temperature table to correct the reference oscillator.

" **4** " **→** " **0** ":

This is the function where the telephone number can be coded into the mobile telephone.

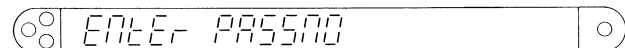
When you have selected this, the display will show:



Now, press the button marked "PROG" on the SIU. The display will now show:



You can now enter the telephone number (7 digits). The word ACCEPTED will be displayed together with the entered number. The display will now show:



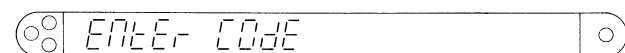
You can now enter the password (3 digits). The word ACCEPTED will be displayed together with the entered pass-word. After a few seconds the display is cleared and the mobile station is ready.

NOTE: If the digit "0" is included in the password use the button "**#**" instead of "**0**".

" **5** " **→** " **0** ":

This is the function where you put in the lock code.

When this function is selected, the display will show:



You can now enter the lock code (4 digits). The word ACCEPTED will be displayed, and the code just entered will be shown for a few seconds.

" **6** " **→** " **0** ":

This will, when selected, delete all abbreviated numbers that are stored in the memory at one time.

" **7** " **→** " **0** ":

This function will reset all time counters.

" **8** " **→** " **0** ":

This will show you the software version.

" 9 " → " 0 ":

This is the function where the basic channel band (number of available channels) is to be coded into the radio unit.

When this function is selected, the display will show:

○ ○ | PUSH BUTTON | ○

Now, press the button marked "PROG" on the SIU. The display will now show:

○ ○ | ENTER BC-LO | ○

You can now enter the low range of the basic channel band (lowest available channel number) (4 digits). The word ACCEPTED will be displayed, and after that the display will show:

○ ○ | ENTER BC-HI | ○

You can now enter the high range of the basic channel band (highest available channel number) (4 digits). The word ACCEPTED will be displayed. After a few seconds the display is cleared.

The mobile station is ready when it has been switched OFF and ON again.

NOTE: If the keyed number is out of range, the word ACCEPTED will appear on the display but the keyed number is not stored.

" * " → " 0 " : (Not valid in software version 1).

This is the function where the temperature correction table for the crystal (X1) on unit 3 is cleared (Must be cleared only when the crystal X1 on unit 3 or the entire unit 3 has been replaced).

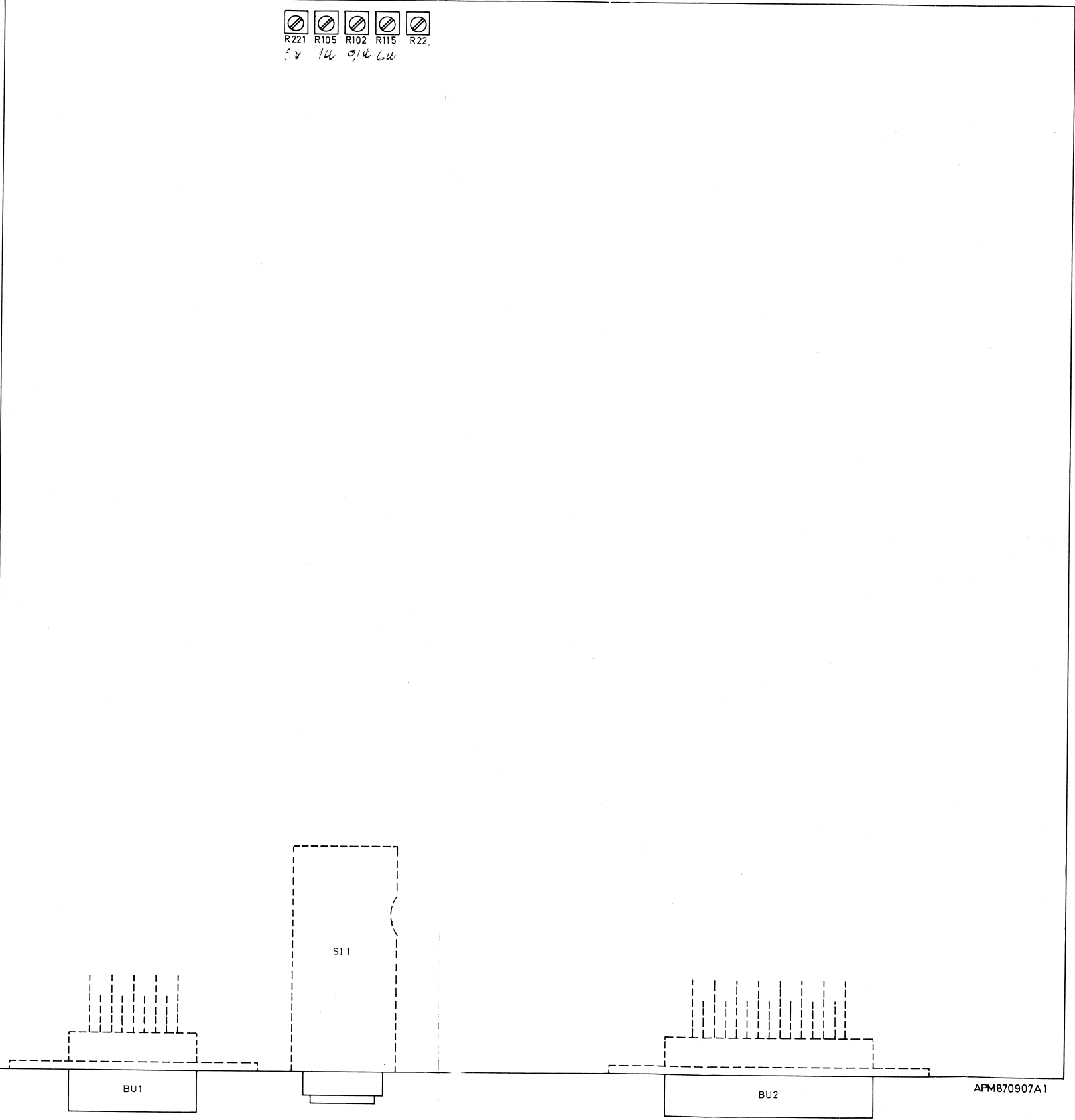
When this function is selected, the display will show:

○ ○ | ENTER CODE | ○

Now enter the digits "1937" and the temperature control system will be initialized.

Vigilant red Appa Rx 549 kHz

Unit 1



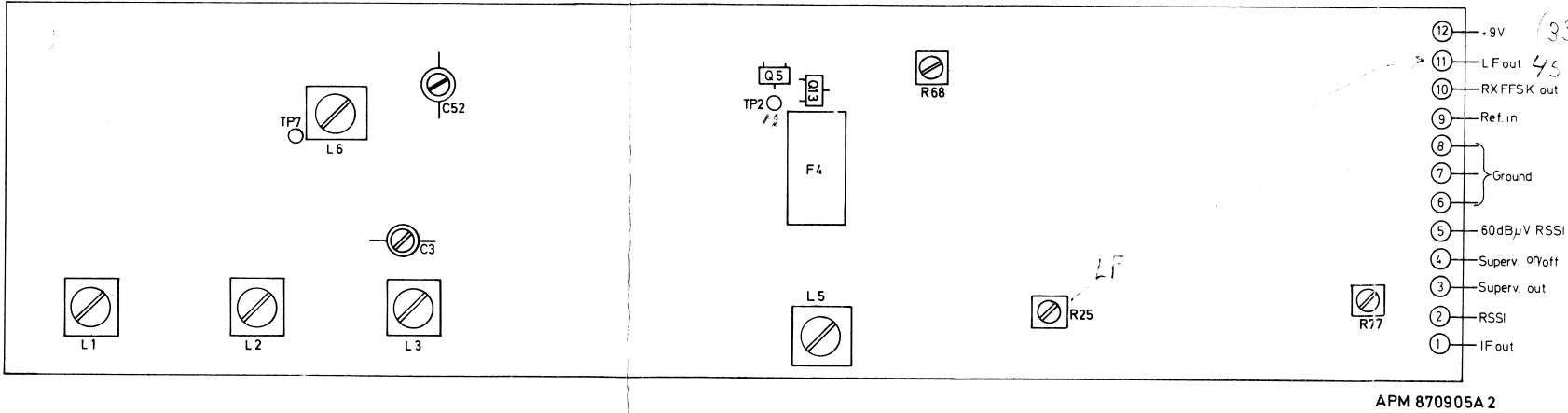
REFER IN ALL CASES TO THE TESTPROCEDURES PAGES 45 TO 51

Unit 1, System board: R22 Voltage control adjustment
R115 Power TX high
R105 Power TX medium
R102 Power TX low

Fig. 21 Adjustment locations

REFER IN ALL CASES TO THE TESTPROCEDURES PAGES 45 TO 51

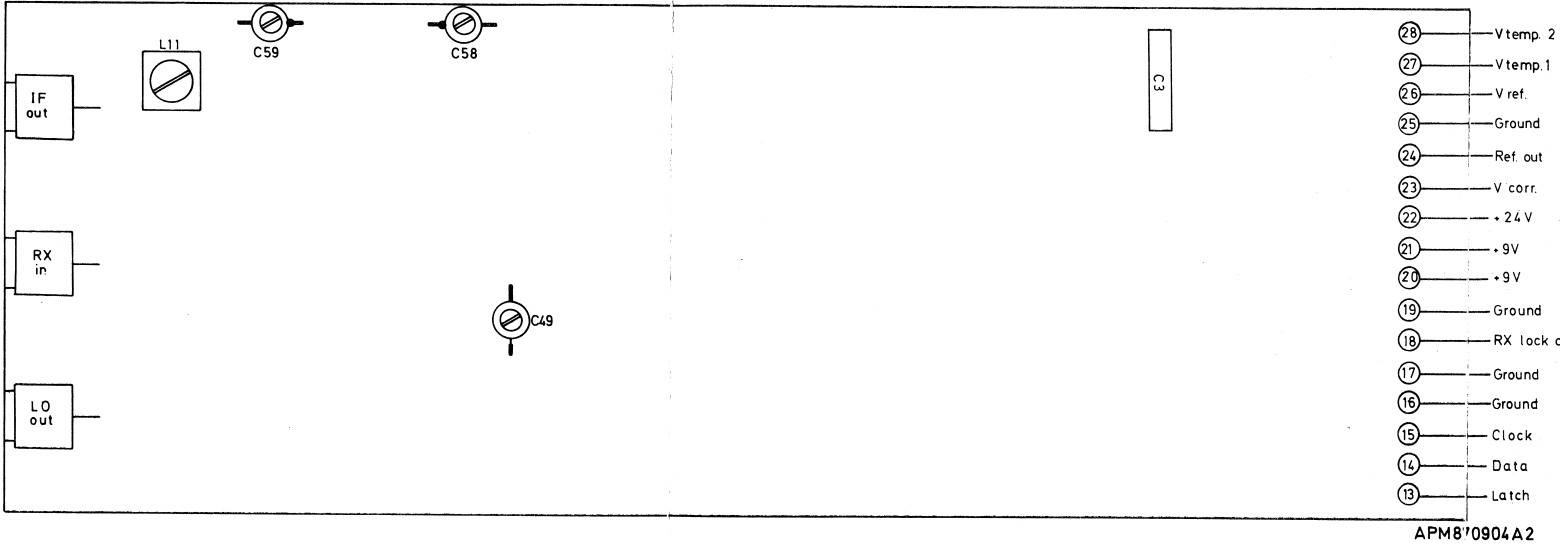
Unit 2



Unit 2, IF/AF amplifier:

- | | |
|------|--|
| R25 | FFSK output voltage range |
| R68 | 60dBuV switch adjustment |
| R77 | RSSI level adjustment |
| C3 | Crystal filter adjustment (Not adjustable) |
| C52 | VCO output adjustment |
| L1-3 | Crystal filter adjustment (Not adjustable) |
| L5 | AF level adjustment |
| L6 | Loop filter adjustment |

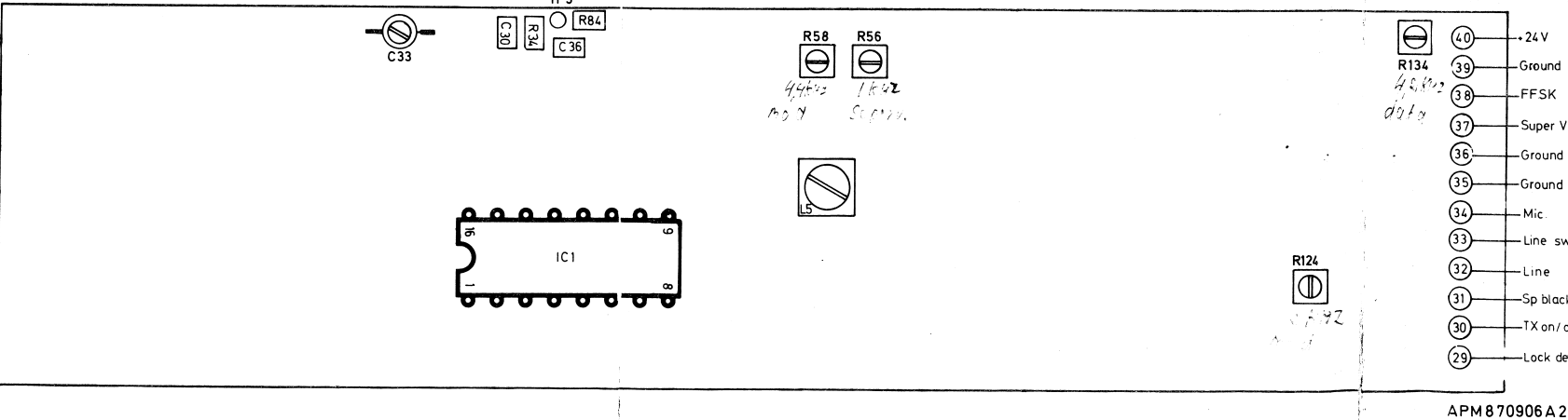
Unit 3



Unit 3, RX synthesizer:

- | | |
|--------|--------------------------------|
| C49 | 1. Stripline filter adjustment |
| C58-59 | 2. Stripline filter adjustment |
| L11 | IF output adjustment |

Unit 4



Unit 4, TX/AF amplifier:

- | | |
|------|-----------------------------------|
| R56 | Supervisory level adjustment |
| R58 | Max modulation deviation |
| R124 | Microphone sensitivity adjustment |
| R134 | FFSK level adjustment |
| L5 | Reference osc. adjustment |

Fig. 22 Adjustment locations

5. TEST AND ADJUSTMENT OF THE TRANSCEIVER (TUNING INSTRUCTION)

As you go through this test, the procedure will ask you to select some functions of the radio; this is described earlier in this section. The numbers in () refer to the keys on the handset keyboard.

For the location of adjusting elements and testpoints on the units refer in all cases to fig. 21 and fig. 22 on pages 42 and 44.

Before you make any tests, you have to make sure that the voltage reference is correct.

MEASUREMENT CONDITIONS.

The following measurements have to be carried out with an ambient temperature of 18-25°C and a humidity of 50-90% r.h.

The supply voltage from the power supply should be 13.2V \pm 0.5V stabilised unless other values are specified.

1. Voltage reference adjustment

- Introduce a short circuit between the input and the output of the power supply filter (U7) while the following voltage tests and adjustments are carried out.
- Turn R22 on the systemboard (U1) fully counter clockwise.
- Apply 10.4V \pm 0.1V from the power supply.
- Adjust R22 so that the radio clicks (the radio turns ON).
- Check that the radio turns itself off when the voltage is:
 - a. Above 19.0V
 - b. Below 6.0V
- Apply 13.2V from the power supply.
- Connect a precise voltmeter to IC216, pin 7 on the systemboard (U1).
- Check that the voltage is 5.000V \pm 20mV.
- If not, adjust R221 on the systemboard (U1).

Test and adjustments - unit 1

Five adjustments are located on unit 1.

The voltage reference adjustments have been described, and the power out adjustments are described in the transmitter performance test.

Detailed adjustment procedure for unit 2

Crystal filter

The crystal filters are factory adjusted, and in normal conditions they will not require further adjustment on-site. If repair is made which necessitates readjustment, we strongly recommend that the unit is returned to the manufacturer for the adjustments to be made.

VCO loopfilter

- Connect a voltmeter to TP7 on unit 2.
- Check that the voltage is 4.0V DC $\pm 0.1V$.
- If not, adjust L6.

VCO

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz and a level of 1.1mV EMF (-52dBm).
- Connect an oscilloscope to TP12 on unit 2.
- Select channel 500 (1 0500). *Verify for maximum output*
- Adjust C52 for maximum output.

IF output

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz and a level of not less than 0.1mV EMF (-73dBm).
- Connect an oscilloscope to the IF-out terminal (pin 1) on unit 2.
- Select channel 500 (1 0500).
- Adjust L5 for maximum output.

Switch capacitor filter

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz, 1kHz modulation, 3kHz deviation, and a level of not less than 0.1mV EMF (-73dBm).
- Connect an AC voltmeter to the LF out terminal (pin 11) on unit 2.
- Select channel 500 (1 0500).
- Check that the voltage is 450mV RMS. *out 1V for full range*
- If not, adjust R25. *check for max on dip for max output*

Continue the adjustment procedure by making a performance test.

Detailed adjustment procedure for unit 3

Buffer chain adjustment (1 strip-line filter).

- Disconnect the coaxcable from unit 3 to unit 4 (LO out).
- Connect a millivoltmeter terminated in 50 ohms via a circulator to the LO output on unit 3.
- Connect an RF-signal generator to the antenna input and provide a signal of 947.4875MHz and a level of 100uV EMF (-73dBm).
- Select channel 500 (1 0500). *220mV*
- Adjust C49 for maximum output (-1 ±3dBm).
- Check the output level at the extreme channels (935.0125MHz/ch. 1 and 959.9875MHz/ch. 1000). The output level may fall by approximately 2dB. If the level falls more, the unit should be repaired or changed.

Front-end and 2nd stripline filter

- Disconnect the coaxcable from unit 3 to unit 2 (IF out).
- Connect a spectrum analyzer to the IF-OUT connector on unit 3.
- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz and a level of 1mV EMF (-53dBm).
- Select channel 500 (1 0500).
- Adjust C58, C59 and L11 for maximum output.

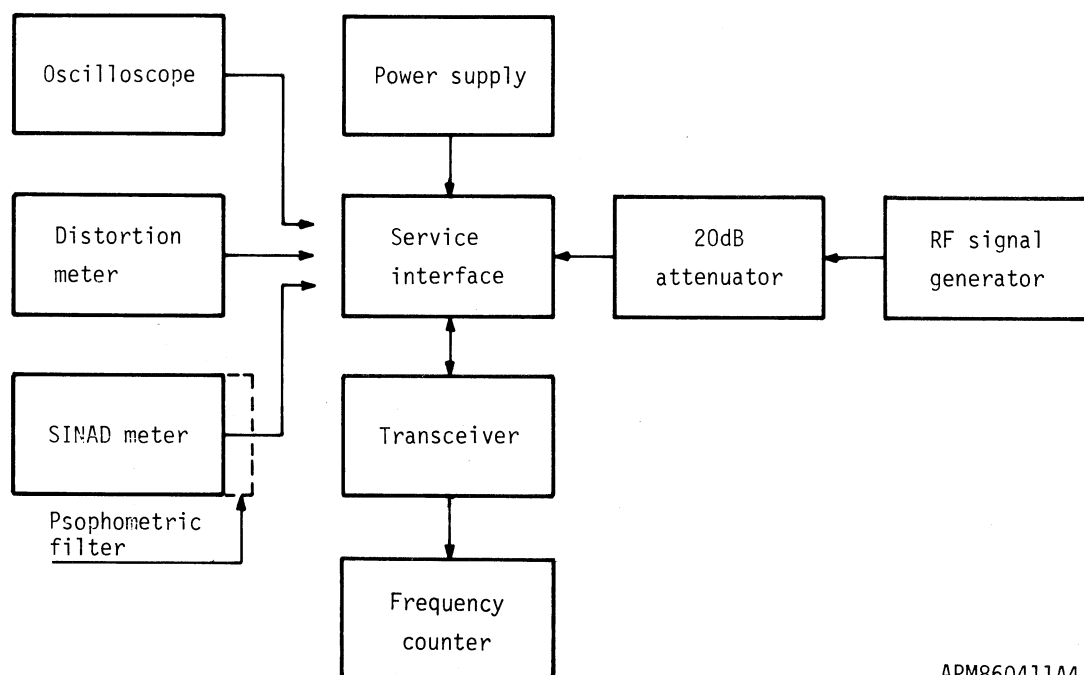
Continue the adjustment procedure by making a performance test.

Receiver performance test

The receiver performance test is divided into four steps:

1. Tuning of the frequency.
2. Sensitivity.
3. Field strength.
4. Distortion.

The test set-up for the receiver performance is shown in this figure:



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As you go through this test, the procedure will ask you to select some functions of the radio, which is described on page 17 and 18 in this chapter. The numbers in () refer to the keys on the handset keyboard.

Step 1: Tuning of frequency


This adjustment should be carried out right after the radio has been switched ON (no warm-up period).

- Connect a frequency counter to the LO out connector at the RX synthesizer module (unit 3).
- No signal generator or antenna should be connected to the radio unit.
- Remove the TX/AF module (unit 4).
- Switch the radio ON.
- Select channel 500 (1 0500).
- Check that the frequency is 862.3125MHz \pm 200Hz.
- If not, adjust C3 on the RX synthesizer module (unit 3).
- Replace the TX/AF module (unit 4).

Step 2: Sensitivity

- Connect a signal generator to the RF input, and set the output frequency to 947.4875MHz with a frequency modulation of 1kHz and a deviation of 3kHz.
- Make a grounding connection between the metal cover of unit 2 (IF/AF module) and the chassis of the radio.
- Connect a SINAD meter to the SIU BNC-connector marked with a small loudspeaker.
- Select channel 500 (1 0500).
- Select Handset earpiece (4 2).
- Select Loudspeaker volume 4 (8 4).
- Select AF signal ON (5 1).
- Adjust the output level of the signal generator until you have audio in the loudspeaker, then reduce the signal level to 20dB sinad. The level should now be $\leq 1.0\text{uV}_{\text{emf}}$ with the psophometric filter used.
- Select channel 1 (1 0001) and then channel 1000 (1 1000), making the same measurements. The level must not exceed 1.0uV.
- If only one of the extreme channels is failing, change the RX synthesizer module (unit 3).
- If both extreme channels are failing connect the signal generator to the IF input at the IF/AF module (unit 2).
- Connect the SINAD meter to the SIU's Line out connector.
- Connect the RF generator to the IF input on unit 2.
- Set the signal generator to 85.175MHz, 1kHz modulation and 3kHz deviation.
- Adjust the signal generator's output amplitude for 20dB sinad.
- If the output amplitude of the signal generator exceeds $1.4\text{uV}_{\text{emf}}$ for 20dB sinad the IF/AF module (unit 2) should be changed or repaired.

Step 3: Field strength

- Connect the signal generator to the RF input.
- Set the signal generators output frequency to 935.0125MHz, 1kHz modulation, 3kHz deviation and the output level to 10uV_{emf} .
- Select channel 1 (1 0001).
- Press the button  on the handset.
- Adjust R77 on the IF/AF module (unit 2) until the first two digits show approx. 6B (HEX).
- Increase the RF level until the last digit changes from 0 to 1. This level must be in the area of $0.4\text{mV}_{\text{emf}}$ - $2.5\text{mV}_{\text{emf}}$.
- If the level reached is outside the area mentioned, adjust R68 on the IF/AF module (unit 2). Optimum is when the last digit shifts from 0 to 1 at $1.0\text{mV}_{\text{emf}}$.
- Decrease the RF-level 20dB. The last digit should then shift from 1 to 0.
- If not, change or repair the IF/AF module (unit 2).

NOTE: Be careful if the signal generator generates spikes. These can be omitted if the signal generator is disconnected from the radio, while the attenuator on the signal generator is operated.

Step 4: Distortion

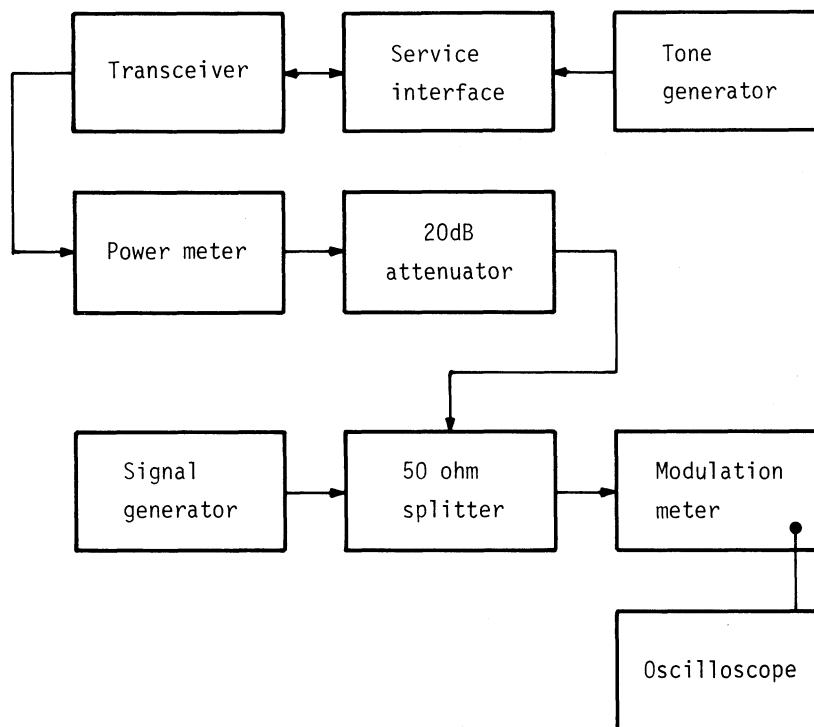
- Set the output level of the signal generator to $1.0\text{mV}_{\text{emf}}$.
- Check the distortion. The distortion must be less than 5%.

Transmitter performance test

The transmitter performance test is divided into four steps:

1. VCO lock.
2. Transmitter frequency.
3. Modulation levels.
4. Transmitter power level.

The test set-up for transmitter performance:



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(Remember that the voltage during tests is always 13.2V DC).

Step 1: VCO lock

- Connect an oscilloscope to TP3 on unit 4.
- Select channel 500 (1 0500).
- Select low power out (2 1).
- Check that the VCO is locked. This is indicated by a DC-voltage (12V) at TP3. If the VCO is not locked a clipped signal with a level of approx. 22Vpp can be found at TP3.
- Adjust C33 on unit 4 until the VCO is locked and a level of 12V DC is found at TP3.

Step 2: Transmitter frequency

This check should be done when the radio unit is not warmed up.

- Connect a frequency counter to the antenna connector on the radio unit.
- Select channel 500 (1 0500).

- Select low power (2 1).
- Check that the frequency is 902.4875MHz \pm 100Hz.
- If not, adjust L5 on the TX/AF module (unit 4).

Step 3: Modulations

- Select handsfree loudspeaker ON (4 1).
- Select microphone ON (7 1).
- Select data transmission OFF (3 0).
- Select supervisory OFF (6 0).
- Select channel 500 (1 0500).
- Connect the tone generator to the Mic. input at the SIU, and set the tone generator to 1kHz and the level to 1V RMS.
- Check that the transmitter deviation is 4.4kHz.
- If not, adjust R58 on the TX/AF module (unit 4).
- Adjust the tone generator for 1kHz, 100mV.
- Check that the transmitter deviation is 3kHz.
- If not, adjust R124 on the TX/AF module (unit 4).
- Disconnect the tone generator from the SIU.
- Select microphone OFF (7 0).
- Select data transmission ON, 1800Hz (3 1).
- Check that the transmitter deviation is 4.2kHz.
- If not, adjust R134 on the TX/AF module (unit 4).
- Select data transmission OFF (3 0).
- Select supervisory ON (6 1).
- Connect the tone generator to the RF signal generator and modulate the signal by 4kHz with 1kHz deviation.
- Check that the transmitter deviation is 1kHz.
- If not, adjust R56 on the TX/AF module (unit 4).

Step 4: Transmitter power level

- Set the frequency of the signal generator to 947.4875MHz (channel 500).
(The power level can be tested without the receiver receiving a signal, but then the radio switches itself off after 30 sec.).
- Select channel 500 (1 0500).
- Select transmitter power level high (2 4).
- Adjust R115 on the system board (unit 1) until the power meter reads 6W. If this is impossible, adjust R115 until the power just starts to decrease (otherwise it is impossible to tune the other power levels).
- Select medium power (2 3).
- Adjust R105 on the systemboard (unit 1) until the watt meter reads 1 watt.
- Select low power (2 1).
- Adjust R102 until the watt meter reads 0.1 watt.

NOTE: When the PA-stage (unit 5) has been changed, the power levels must be adjusted.

Service demands and hints

REPAIR OF THE SYSTEM BOARD (UNIT 1)

If the system board or the EEPROM (IC218) have been changed the reference oscillator (C3) on the RX synthesizer unit (unit 3) must be readjusted.

REPAIR OF THE RX SYNTHESIZER UNIT (UNIT 3)

If the RX synthesizer unit (unit 3) or the crystal X1 have been changed the EEPROM (IC218) on the system board (unit 1) must either be erased or replaced by a new (and empty) one, and the reference oscillator (C3) on the RX synthesizer must be readjusted.

How to erase the EEPROM is described on page 41 in this chapter.

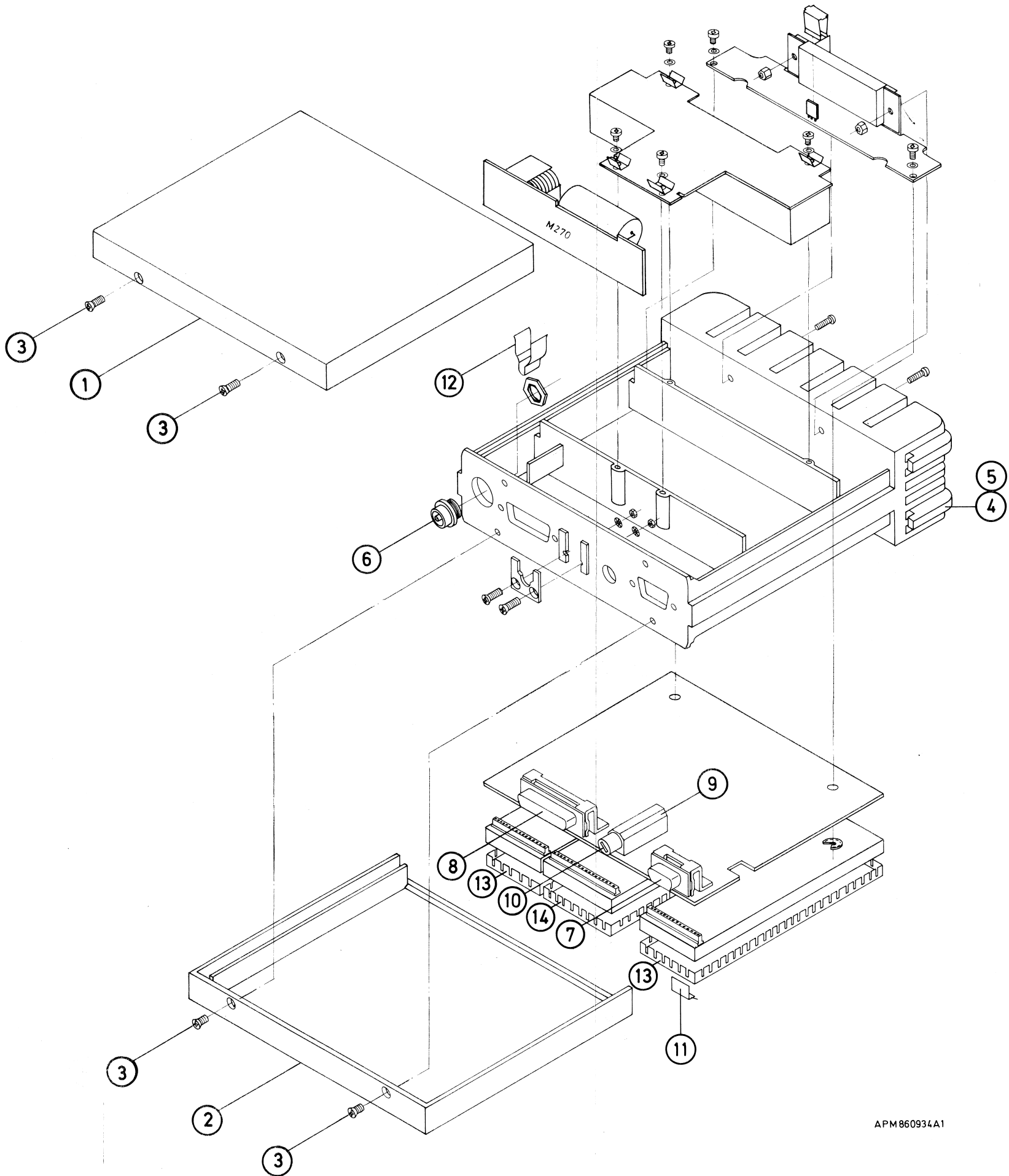
ERROR CODES

In some cases a fault will cause an error code in the display. The following codes can occur:

- ERROR : Will be shown if there is a lack of information in the RAM when the mobile telephone is switched on. Typically, defects are the back-up battery or the RAM-IC.
- ERROR 1 : Will be shown if the transceiver fails to understand the information which is send on the serial line from the handset (or the service interface unit). The fault is located in either the serial data receiver or the CPU on the system-board (unit 1).
- SYNTESE ERROR: Will be shown if the receiver-synthesizer is not locked within a certain limit of time after loading. The fault is located in the Receiver synthesizer circuit or its CPU-interface.

Mechanical parts

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Top for chassis, black	1	3508 101 20730
1.	Top for chassis, white	1	3508 101 21430
2.	Bottom for chassis, black	1	3508 101 20680
2.	Bottom for chassis, white	1	3508 101 21420
3.	Screw M4x6mm	2	2522 179 07148
4.	Foot	4	3508 101 50790
5.	Hammer drive screw	4	3508 100 00380
6.	BNC socket	1	3508 100 55380
7.	9-pole connector	1	3508 100 55390
8.	.15-pole connector	1	3508 100 55400
9.	Fuseholder	1	3508 100 66020
10.	Cap for fuseholder	1	3508 100 66030
	Fuse, 10A	1	2422 086 01161
11.	Spring for grounding	1	3508 101 21580
12.	Spring for IC's on systemboard	1	3508 101 01660
13.	Cover for unit 2/4	2	3508 101 02110
14.	Cover for unit 3	1	3508 101 02120



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Electrical parts

UNIT NO	DESCRIPTION	ORDERING NUMBER
1	Systemboard, unit 1	
2	IF/AF-amplifier, unit 2	
3	RX and synthesizer, unit 3	
4	TX/AF amplifier, unit 4	
5	PA-stage, unit 5	
6	Duplex filter	
7	Power supply filter	

UNIT 1 - SYSTEMBOARD

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

INTEGRATED CIRCUITS

IC1	3508 100 16230	AN-6541
IC2	9337 082 60682	L487
IC3,9	9333 731 30112	HEF4093BT
IC4	9335 079 70112	HEF4538BT
IC5	9333 726 00112	HEF4002BT
IC6-7,13-14,216	9335 716 80602	LM358D
IC8	9334 067 70112	HEF4521BT
IC10	9333 729 40112	HEF4051BT
IC11	3508 100 16280	MC1776CD
IC12	9335 871 80112	TDA1011
IC200	3508 100 16240	80C31
IC202	3508 100 16390	4464
IC203	9337 154 70112	74HC373T
IC204	9337 135 00112	74HC139T
IC205	9333 729 70112	HEF4066BT
IC206	9337 142 60112	74HC04T
IC207	9337 143 10112	74HC32T
IC208	9337 133 80112	74HC74T
IC209	3508 100 16370	STC9120
IC210	9333 731 90112	HEF4512BT
IC211-213	9333 733 70112	HEF4724BT
IC214,217	9334 069 60112	HEF40106BT
IC215	9337 681 40112	PCF8591
IC219	9333 732 50112	HEF4520BT

NUMBER	ORDERING NUMBER	TYPE
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TRANSISTORS

Q1,3-4,6,8,10-11,13, 100-101,103,202-205, 208,210-213,215	9335 896 30215	BC848B
Q2,5,7,9,14, 102,201,206	9335 897 90215	BC858B
Q12	9332 722 80115	BCX51
Q207,209	9336 630 90115	BCX56-10

DIODES

D1,6	9330 989 90215	BAW56
D2	9333 882 60215	BZX84-C15
D3-4,12	9331 849 10215	BAV70
D5	9331 373 90215	BZX84-C5V1
D7,9,100,202-203	9332 153 70215	BAV99
D8,11,201	3508 100 10180	LS S210
D204-205	9333 883 30215	BZX84-C30

RELAY

RE1	3508 100 60050	6V 1 shiftset
-----	----------------	---------------

CRYSTALS

X1	4008 103 01070	32.768kHz
X2	3508 100 50240	11059.2kHz

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

CAPACITORS

C1,88	2222 036 85101	100U	20%	16V	Electrolytic
C2,90	2222 036 66221	220U	20%	25V	Electrolytic
C4	2222 122 54339	33U	20%	10V	Electrolytic
C5	3508 100 30130	47U	20%	6.3V	Tantal
C6-7,71,214,229	3508 100 30120	10U	20%	10V	Tantal
C8,12,82	3508 100 30110	2U2	20%	16V	Tantal
C9-10	3508 100 30820	270N	10%		Ceramic
C11,223,225	3508 100 30730	1U0	20%	35V	Tantal
C13,15,18,20,50, 55,210,212,228	3508 100 30100	1U0	20%	10V	Tantal

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
C14,203,219,231	2222 580 16614	1N0	10%		Ceramic
C16	2222 861 12479	47P	5%		Ceramic
C17	2222 861 12109	10P	5%		Ceramic
C51-53	2222 580 16627	10N	10%		Ceramic
C54,70,83,87,89, 202,205,207,209, 217,224,226,230	3508 100 30740	100N	10%		Ceramic
C72,227	2222 861 12101	100P	5%		Ceramic
C73,206,208,213, 216,218	2222 580 16632	22N	10%		Ceramic
C74-75	2222 861 12331	330P	5%		Ceramic
C80-81,204	3508 100 30320	15U	20%	16V	Tantal
C84,100	2222 580 16618	2N2	10%		Ceramic
C200	2222 861 12569	56P	5%		Ceramic
C201	2222 861 12339	33P	5%		Ceramic
C222	3508 100 30830	6U8	20%	25V	Tantal

RESISTORS

R1-2	3508 100 20170	220	5%	0.1W	
R3,9,67,82,223,252	3508 100 20250	1K0	5%	0.1W	
R4,23,31,44,100, 103,106,108-109, 216,218,224,238, 244,246,248	3508 100 20410	22K	5%	0.1W	
R5-6,12,34,37-38, 43,45,49,85,111, 113-114,116,118, 124,229,265	3508 100 20450	47K	5%	0.1W	
R7-8,20,28,36,46, 54,58,119,201,204, 210,212,220,227, 241,243,245,247, 250	3508 100 20490	100K	5%	0.1W	
R10-11,13,18-19, 40,50,53,71-72, 75,83,226	3508 100 20530	220K	5%	0.1W	
R14,17,30,117, 240,261	3508 100 20570	470K	5%	0.1W	
R15-16,32,42,56, 61-62,104,107,207, 215,225,228,253, 260	3508 100 20370	10K	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R21	3508 100 20360	8K2	5%	0.1W	Trim potm.
R22,115	3508 100 22090	10K			
R24,55	3508 100 20480	82K	5%	0.1W	
R25,29,121	3508 100 20400	18K	5%	0.1W	
R26,33,35,60,64- 66,68,80,101,236, 249	3508 100 20290	2K2	5%	0.1W	
R27,41,47-48,51, 239	3508 100 20600	820K	5%	0.1W	
R52	3508 100 20540	270K	5%	0.1W	
R57,84,112	3508 100 20390	15K	5%	0.1W	
R63,74,211,214	3508 100 20330	4K7	5%	0.1W	
R70,77,81	3508 100 20430	33K	5%	0.1W	
R73	3508 100 20210	470	5%	0.1W	
R76	3508 100 20170	220	5%	0.1W	
R78	3508 100 20050	22	5%	0.1W	
R86	3508 100 20350	6K8	5%	0.1W	
R87	3508 100 20270	1K5	5%	0.1W	
R88,234-235	3508 100 20690	4R7	5%	0.1W	
R89	3508 100 20420	27K	5%	0.1W	
R90	3508 100 20320	3K9	5%	0.1W	
R102	3508 100 22130	4K7			
R105	3508 100 22100	22K			
R120	3508 100 20310	3K3	5%	0.1W	
R122,205,222,242	3508 100 20500	120K	5%	0.1W	
R123	3508 100 20460	56K	5%	0.1W	
R208-209	3508 100 20010	10	5%	0.1W	
R217	3508 100 21450	33K2	1%		
R219	3508 100 20440	39K	5%	0.1W	
R230	3508 100 20090	47	5%	0.1W	
R231	3508 100 20230	680	5%	0.1W	
R232,251	3508 100 20510	150K	5%	0.1W	
R237	3508 100 21460	56K2	1%		
R262	3508 100 20350	6K8	5%	0.1W	

UNIT 2 - IF/AF AMPLIFIER

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

INTEGRATED CIRCUITS

IC1	9337 488 50602	SA602D
IC2	9337 488 70602	SA604D LP
IC3	3508 100 16290	FX316LV1
IC4	9337 725 30602	SA571D
IC5	9336 355 90112	LM324D
IC6	9333 726 60112	HEF4013BT
IC7	3508 100 16210	74HC4024D

TRANSISTORS

Q1	3508 100 11080	CF930C GAAS
Q2,5	9331 634 90215	BFR31 N-FET
Q3-4,8,10-13	9335 896 30215	BC848B
Q6-7	9330 921 11215	BFS20
Q9	9335 897 90215	BC858B

DIODES

D1-2	3508 100 10050	BAS70-04
D3-5	9332 153 70215	BAV99
D6	9335 053 10215	BBY40
D7-8	9336 711 30215	BZX84-B6V8 2%
D9	9331 374 00215	BZX84-C5V6 5%

COILS

L2-3	3508 100 40280	0.33UH
L4	3508 100 40300	330NH 5%
L5	3508 100 40250	120UH
L6	3508 100 40270	0.68UH
L7-8	3508 100 40190	470NH 5%

CRYSTAL

X1	3508 100 50180	1.000MHz 0.1%
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NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
<u>CAPACITORS</u>					
C1,11	2222 861 12158	1P5	0.25		Ceramic
C2,40,57	2222 861 12688	6P8	0.25		Ceramic
C3,52	3508 100 30300	2-12P			Trim
C4,6,9,12,23, 46,66	2222 580 16627	10N	10%		Ceramic
C5	3508 100 30410	680P	5%		Ceramic
C7-8,20,42	3508 100 30420	1N0	5%		Ceramic
C10,16,61	3508 100 30110	2U2	20%	16V	Tantal
C13-15,17-18,21, 31,34-35,68	3508 100 30740	100N	10%		Ceramic
C19	3508 100 30230	10P	5%		Ceramic
C22	2222 861 12159	15P	5%		Ceramic
C24-26,29-30,32, 41,45,67,69	2222 580 16632	22N	10%		Ceramic
C27-28	2222 861 12109	10P	5%		Ceramic
C33,63	2222 580 16618	2N2	10%		Ceramic
C36-37,59	3508 100 30100	1U0	20%	10V	Tantal
C38	3508 100 30290	1U5	20%	6.3V	Tantal
C39,44,49	2222 861 12221	220P	5%		Ceramic
C43,58,62	2222 580 16614	1N0	10%		Ceramic
C47,50	2222 861 12101	100P	5%		Ceramic
C48	2222 861 12689	68P	5%		Ceramic
C51	2222 861 12151	150P	5%		Ceramic
C54	3508 100 30020	2P2	0.25		Ceramic
C55-56	3508 100 30250	15P	5%		Ceramic
C60	3508 100 30120	10U	20%	10V	Tantal
C64	2222 861 12331	330P	5%		Ceramic
C65	2222 580 16623	4N7	10%		Ceramic
<u>RESISTORS</u>					
R1,21,44,46	3508 100 20490	100K	5%	0.1W	
R2	3508 100 22140	47K			Trim potm.
R3,12,19,33, 50,54,67,70	3508 100 20510	150K	5%	0.1W	
R4,17,57-60	3508 100 20290	2K2	5%	0.1W	
R5,7,9,34,41	3508 100 20270	1K5	5%	0.1W	
R8	3508 100 20570	470K	5%	0.1W	
R10	3508 100 20090	47	5%	0.1W	
R11	3508 100 20170	220	5%	0.1W	
R13,22,52,55	3508 100 20430	33K	5%	0.1W	
R14	3508 100 20380	12K	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R15,28,37	3508 100 20410	22K	5%	0.1W	NTC
R16	3508 100 21330	15K	20%		
R18	3508 100 20400	18K	5%	0.1W	
R20,35-36,49, 51,69	3508 100 20250	1K0	5%	0.1W	Trim potm.
R23	3508 100 20600	820K	5%	0.1W	
R24,32,40,48	3508 100 20330	4K7	5%	0.1W	
R25	3508 100 22110	100K			
R26	3508 100 20590	680K	5%	0.1W	
R27	3508 100 20530	220K	5%	0.1W	NTC
R29,31	3508 100 20520	180K	5%	0.1W	
R30	3508 100 21340	100K	20%		
R38,47	3508 100 20390	15K	5%	0.1W	Trim potm.
R39,42-43,62- 63,65	3508 100 20230	680	5%	0.1W	
R45,56,61,64, 66,73	3508 100 20370	10K	5%	0.1W	
R53	3508 100 20420	27K	5%	0.1W	Trim potm.
R68,77	3508 100 22090	10K			
R71	3508 100 20550	330K	5%	0.1W	
R75	3508 100 20470	68K	5%	0.1W	

UNIT 3 - RX SYNTHESIZER

NUMBER	ORDERING NUMBER	TYPE
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INTEGRATED CIRCUITS

IC1	9337 147 20112	74HC390T
IC2	9333 730 00112	HEF4069UBT
IC4	3508 100 16550	NJ8822
IC5	3508 100 16310	MB501LFP
IC6	3508 100 16280	MC1776CD

TRANSISTORS

Q1-2,6-8	9335 896 30215	BC848B
Q3	9335 897 90215	BC858B
Q10	3508 100 11110	BFR93A
Q11,13-14	9335 515 60215	BFR92A
Q12	3508 100 11080	CF930C
Q15	3508 100 11120	CF930B

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

DIODES

D1	9335 053 10215	BBY40
D2-3	3508 100 10050	BAS70-04
D4	9332 153 70215	BAV99
D5	9331 374 60215	BZX84-C10
D6	3508 100 10300	1T32-T8

COILS

L1-3,10,15	3508 100 40190	470NH 5%
L4	3508 100 40170	22NH 20%
L5-6,12	3508 100 40240	220NH 10%
L7-9	3508 100 40230	12NH
L11	3508 100 40280	0.33UH
L13	3508 102 51100	12NH

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
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CAPACITORS

C1,17,21,35,66	2222 580 16632	22N	10%		Ceramic
C2,5	2222 861 12229	22P	5%		Ceramic
C3	3508 100 30780	0.6-4.5P	5%		Trim
C4	2222 861 12478	4P7	0.25		Ceramic
C6	2222 861 12339	33P	5%		Ceramic
C7-8,25,42,61,63	3508 100 30100	1U0	20%	10V	Tantal
C9	2222 861 12101	100P	5%		Ceramic
C10,46,54,74	2222 861 12479	47P	5%		Ceramic
C11,18	3508 100 30730	1U0	20%	35V	Tantal
C12-13,23	3508 100 30410	680P	5%		Ceramic
C14,22,44,76-77	2222 580 16614	1N0	10%		Ceramic
C15	3508 100 30740	100N	10%		Ceramic
C16	2222 580 16623	4N7	10%		Ceramic
C19,73,75	3508 100 30120	10U	20%	10V	Tantal
C20,26-29,32, 37-41,43,45,47, 50-53,64-65,71	2222 861 12221	220P	5%		Ceramic
C24,62,78-81	2222 580 16627	10N	10%		Ceramic
C30	3508 100 30030	3P3	0.25		Ceramic
C31	3508 100 30060	5P6	0.25		Ceramic
C33	3508 100 30140	1P8	0.25		Ceramic
C34	3508 100 30020	2P2	0.25		Ceramic

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
C36	2222 861 12331	330P	5%		Ceramic
C48,57,60	2222 861 12338	3P3	0.25		Ceramic
C49,58-59	3508 100 30430	1-3P			Trim
C55	2222 861 12567	0.56P	0.25		Ceramic
C56	2222 861 12221	220P	5%		Ceramic
C68,70	2222 861 12109	10P	5%		Ceramic
C69	2222 861 12569	56P	5%		Ceramic
C72	2222 580 16607	330P	10%		Ceramic

RESISTORS

R1	3508 100 20400	18K	5%	0.1W	
R2	3508 100 21080	69K8	1%		
R3	3508 100 21090	121K	1%		
R4,8,18,37,46,77	3508 100 20290	2K2	5%	0.1W	
R5,53	3508 100 20340	5K6	5%	0.1W	
R6,25	3508 100 20570	470K	5%	0.1W	
R7,51,64	3508 100 20210	470	5%	0.1W	
R9,28	3508 100 20530	220K	5%	0.1W	
R10,24,36,60, 69,75-76	3508 100 20010	10	5%	0.1W	
R11,19,21	3508 100 20330	4K7	5%	0.1W	
R12,29,35,54,58	3508 100 20170	220	5%	0.1W	
R13,55	3508 100 20250	1K0	5%	0.1W	
R14,17	3508 100 21300	2K2	1%		
R15-16	3508 100 21360	KTY13A			Temp. sensor
R20,22,34,66,73	3508 100 20370	10K	5%	0.1W	
R23	3508 100 20600	820K	5%	0.1W	
R26	3508 100 20450	47K	5%	0.1W	
R27,33,52	3508 100 20410	22K	5%	0.1W	
R30	3508 100 20490	100K	5%	0.1W	
R31,72,78	3508 100 20430	33K	5%	0.1W	
R32	3508 100 20380	12K	5%	0.1W	
R38	3508 100 20030	15	5%	0.1W	
R39,44,68	3508 100 20310	3K3	5%	0.1W	
R42,49,67	3508 100 20350	6K8	5%	0.1W	
R47,63,65	3508 100 20090	47	5%	0.1W	
R48,57,61-62	3508 100 20130	100	5%	0.1W	
R50	3508 100 20320	3K9	5%	0.1W	
R56	3508 100 20100	56	5%	0.1W	
R59,74	3508 100 20230	680	5%	0.1W	
R70	3508 100 20110	68	5%	0.1W	
R71	3508 100 20190	330	5%	0.1W	
R80-81	3508 100 20180	270	5%	0.1W	
R82	3508 100 20040	18	5%	0.1W	

UNIT 4 - TX/AF AMPLIFIER

NUMBER	ORDERING NUMBER	TYPE
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INTEGRATED CIRCUITS

IC1	3508 100 16110	OM843
IC2	3508 100 16300	TL062CD
IC3	9337 725 30602	SA571D
IC4	3508 100 16290	FX316LV1

TRANSISTORS

Q1,3-4,6-7	9335 515 60215	BFR92A
Q2	3508 100 11080	CF930C
Q5,9,11-12,14	9333 477 30215	BFT92
Q8	9335 897 90215	BC858B
Q10	9330 921 11215	BFS20
Q13	9331 634 90215	BFR31

DIODES

D1	9331 849 20215	BBY31
D2,4-5,7	9330 989 90215	BAW56
D3	9335 053 10215	BBY40
D9	9331 374 00215	BZX84-C5V6

COILS

L1,4	3508 100 40190	470NH 5%
L2-3	3508 100 40020	10UH
L5	3508 100 40220	2.2UH
L6	3508 100 40170	22NH 20%

CRYSTAL

X1	3508 100 50250	20087.5kHz HC43/U
X2	3508 100 50180	1.000MHz 0.1%

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
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CAPACITORS

C1-2,4-6,12-13,20, 22,32,34,36,38,41- 42,46,58	2222 580 16607	N33	10%		Ceramic
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NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
C3,10,17	2222 861 12108	1P0	0.25		Ceramic
C7,11,14,16,18- 19,21,39,44,55, 70-71,115	2222 580 16627	10N	10%		Ceramic
C8-9	2222 861 12478	4P7	0.25		Ceramic
C15,30	2222 861 12688	6P8	0.25		Ceramic
C31	3508 100 30400	2P2	0.25		Ceramic
C33	3508 100 30430	1-3P			Trim
C35,60,101	3508 100 30740	100N	10%		Ceramic
C37,40,45	2222 861 12228	2P2	0.25		Ceramic
C43,72,74,76	2222 861 12479	47P	5%		Ceramic
C50,124	3508 100 30110	2U2	20%	16V	Tantal
C51,75,77-79,95- 96,112,114,122	2222 580 16632	22N	10%		Ceramic
C52,56-57	2222 861 12151	150P	5%		Ceramic
C54,90-92,106- 107,110,116,125	3508 100 30100	1U0	20%	10V	Tantal
C59	2222 861 12229	22P	5%		Ceramic
C61,80	2222 861 12101	100P	5%		Ceramic
C73	2222 580 16623	4N7	10%		Ceramic
C94,102,104	3508 100 30120	10U	20%	10V	Tantal
C100	3508 100 30290	1U5	20%	6.3V	Tantal
C103,105	2222 861 12221	220P	5%		Ceramic
C117,123	2222 861 12109	10P	5%		Ceramic
C120	3508 100 30410	680P	5%		Ceramic
C126	2222 580 16618	2N2	10%		Ceramic

RESISTORS

R1-2,21,23,31, 33,36,39-40,125, 138-139	3508 100 20310	3K3	5%	0.1W	
R3,20,35,38,51, 54,64,84,94-95	3508 100 20370	10K	5%	0.1W	
R4,15,37,123	3508 100 20230	680	5%	0.1W	
R5,18,22,30,62, 82,113	3508 100 20130	100	5%	0.1W	
R6	3508 100 20110	68	5%	0.1W	
R8,34,42,65	3508 100 20210	470	5%	0.1W	
R9,41,52,60-61, 78-79,96-98,140	3508 100 20330	4K7	5%	0.1W	
R10,43,66,75	3508 100 20190	330	5%	0.1W	
R11	3508 100 20350	6K8	5%	0.1W	
R12,53,77	3508 100 20290	2K2	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
R13, 110-111, 114, 128, 135	3508 100 20450	47K	5%	0.1W	
R14, 67, 72-73	3508 100 20250	1K0	5%	0.1W	
R16-17	3508 100 20170	220	5%	0.1W	
R19	3508 100 20150	150	5%	0.1W	
R32	3508 100 20090	47	5%	0.1W	
R50, 63, 70-71, 92- 93, 99-100, 120, 122	3508 100 20410	22K	5%	0.1W	
R55	3508 100 20470	68K	5%	0.1W	
R56	3508 100 22140	47K			Trim. potm.
R57, 59, 90-91, 115, 117, 133	3508 100 20490	100K	5%	0.1W	
R58	3508 100 22100	22K			Trim. potm.
R74	3508 100 20300	2K7	5%	0.1W	
R76	3508 100 20220	560	5%	0.1W	
R80, 83, 131	3508 100 20430	33K			Trim. potm.
R81	3508 100 20390	15K	5%	0.1W	
R112	3508 100 20510	150K	5%	0.1W	
R116	3508 100 20590	680K	5%	0.1W	
R121	3508 100 20500	120K	5%	0.1W	
R124	3508 100 22140	47K			Trim. potm.
R132	3508 100 20320	3K9	5%	0.1W	
R134	3508 100 22100	22K			Trim. potm.
R136	3508 100 20530	220K	5%	0.1W	
R137	3508 100 20600	820K	5%	0.1W	

UNIT 5 - PA STAGE

NUMBER	ORDERING NUMBER	TYPE
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INTEGRATED CIRCUIT

IC1	3508 100 16220	MHW808A3
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TRANSISTORS

Q1	3508 100 11070	MRF559
Q2	9331 234 20682	2N4918
Q3	9332 722 80115	BCX51

NUMBER	ORDERING NUMBER	TYPE
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DIODES

D1-2	9332 153 70215	BAV99
D3	3508 100 10050	BAS70-04

COILS

L1-2	3508 100 40190	470NH
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NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
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CAPACITORS

C1	2222 861 12688	6P8	0.25		Ceramic
C2	2222 861 12828	8P2	0.25		Ceramic
C3-5,7-8	2222 580 16607	330P	10%		Ceramic
C6,10,12	3508 100 30740	100N	10%		Ceramic
C9	2222 861 12478	4P7	0.25		Ceramic
C11	2222 122 56108	1UF	+20%	25V	Electrolytic
C13	2222 122 55159	15U	+20%	16V	Electrolytic
C14	2222 580 16627	10N	10%		Ceramic
C15	2222 861 12228	2P2	0.25		Ceramic

RESISTORS

R1,7-8	3508 100 20170	220	5%	0.1W
R2,5	3508 100 20250	1K0	5%	0.1W
R3	3508 100 20110	68	5%	0.1W
R4	3508 100 20090	47	5%	0.1W
R6	2322 186 13471	470	5%	0.4W
R9	3508 100 20330	4K7	5%	0.1W

UNIT 7 - POWER SUPPLY FILTER

<u>NUMBER</u>	<u>ORDERING NUMBER</u>	<u>TYPE</u>
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COIL

L1	3508 102 51110	
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<u>NUMBER</u>	<u>ORDERING NUMBER</u>	<u>VALUE</u>	<u>TOL (%)</u>	<u>VOLT/WATT</u>	<u>DESCRIPTION</u>
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CAPACITORS

C1	2222 014 15103	10000UF	-10+50%	16V	Electrolytic
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RESISTORS

R1	2322 186 13109	10	5%	0.4W	
R110	2112 660 00005				Q63100-P330-C11

Handset

CONTENTS	PAGE
Disassembling of the handset	5
Description of the handset	8
Block diagram, handset	9
Keyboard test	10
Handset, Loudspeaker and Microphone	10
Display illumination test	11
Component location, handset	12
Circuit diagram, handset	13
Component location, RF filter	14
Circuit diagram, RF filter	15
Mechanical parts	16
Electrical parts	19

WARNING

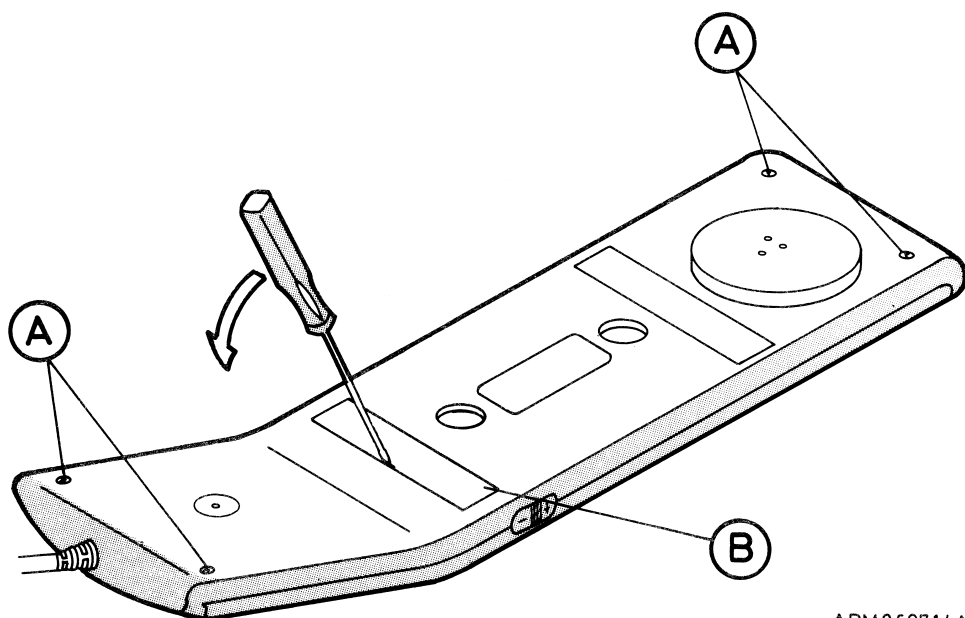
The relay RE002 contains mercury. Vapours from mercury is very toxic and is injurious to health if inhaled.

No danger can arise from normal handling but no attempt should be made to tamper with this device.

When discarding mercury relays, they should be handled as chemical waste.

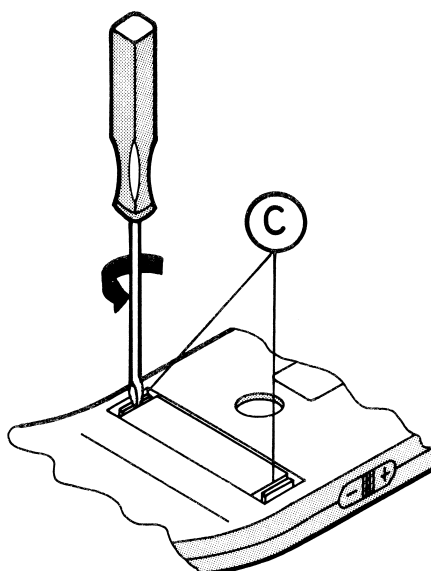
Disassembling of the handset

- 1.- Remove the four screws (A) . See fig. 1.
- Remove (B) the plastic phone number cover with a small screwdriver or a pincette.
- Press the two clips (C) out. See fig. 2.
- The 2 handset parts can now be separated.



APM860714A3

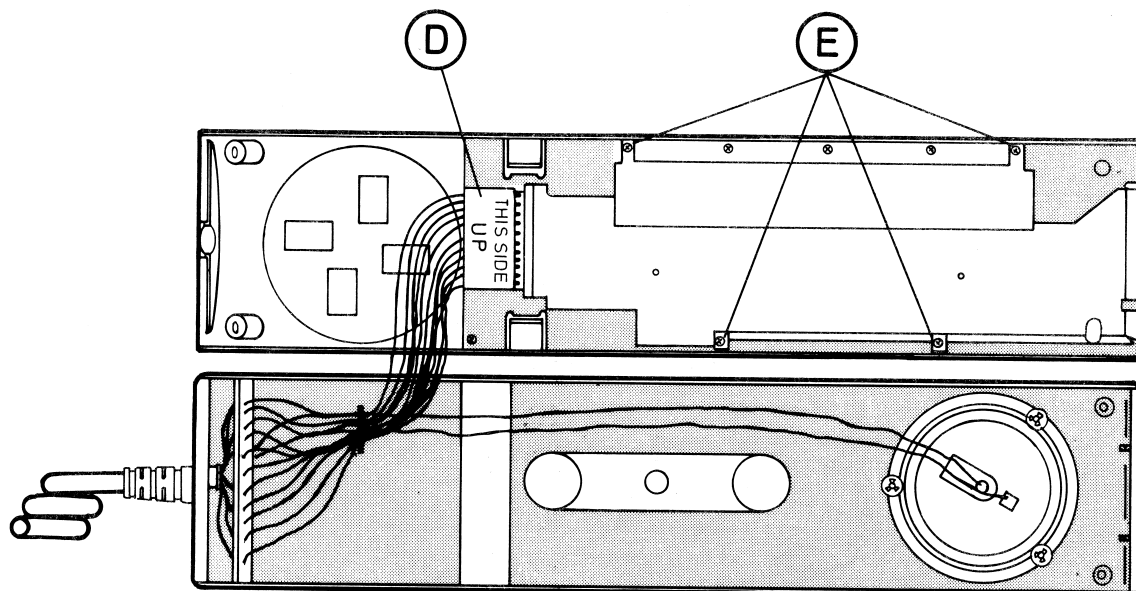
Fig. 1



APM860715A4

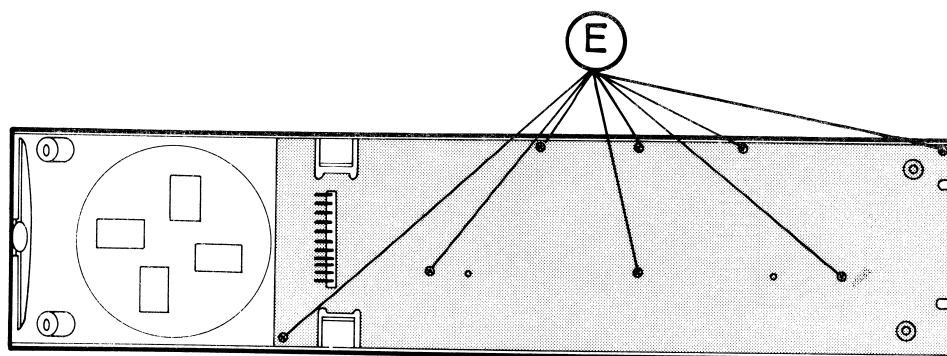
Fig. 2

- 2.- Remove the plug (D) . See fig. 3.
- Remove the twelve screws (E) . See fig. 4.
 - The print board can now be pulled out.



APM860716A3

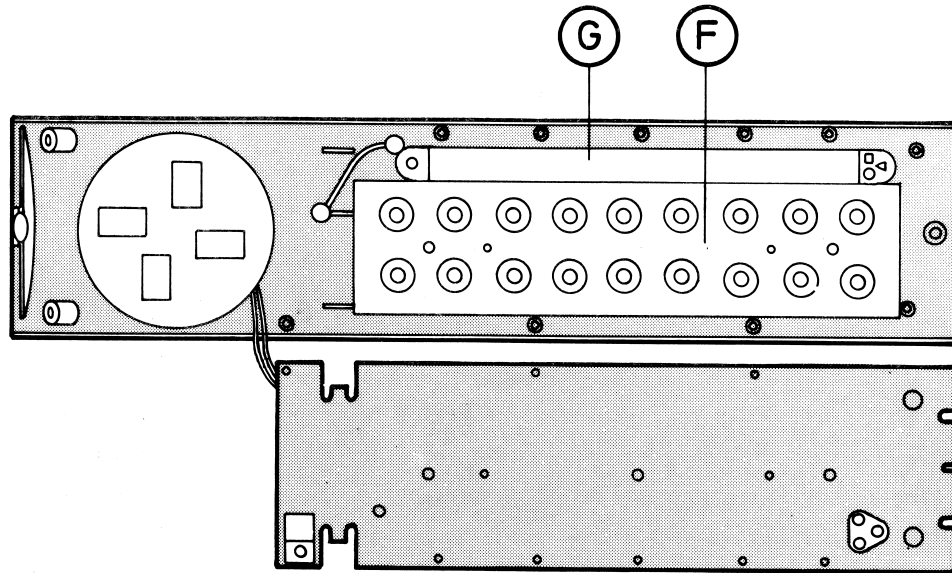
Fig. 3



APM860717A4

Fig. 4

- 3.- The rubber cushion (F) can now be pulled out.
- The keyboard contains twenty separate buttons, which can now be pulled out one by one.
 - The display (G) can now be lifted out.



APM860916A3

Fig. 5

Description of the handset

HANDSET.

The handset contains keyboard, display and one printed circuit board. Besides the normal loudspeaker and microphone, it also contains a separate loudspeaker and microphone for handsfree operation.

The control part is provided with a maskprogrammed 80C49 microprocessor.

The handset is supplied with +12V DC from the power circuit in the radio unit.

When the OFF mode is entered the handset is in stand-by mode, the display is empty and all the LEDs are off in order to reduce the current consumption. When the handset is switched ON the microprocessor will register the event, the capacitor C9 discharges and the reset circuit D15, R56 and C6 will reset the microprocessor. A character is sent on the data-line to the transceiver and a feedback network in the handset receives the data back for verifying.

If the power ON condition is accepted, the handset will be active by showing the phone number on the display for approximately four seconds. The yellow LED lights to indicate power ON and the country code lights up. When the mobile phone is ready for a call, the green LED is switched ON. The loudspeaker volume is at the same level as before the mobile telephone was switched off the last time. The information to change the volume up or down is sent from the handset to the transceiver as digital signals. This is controlled by activating the volume button "+" or "-".

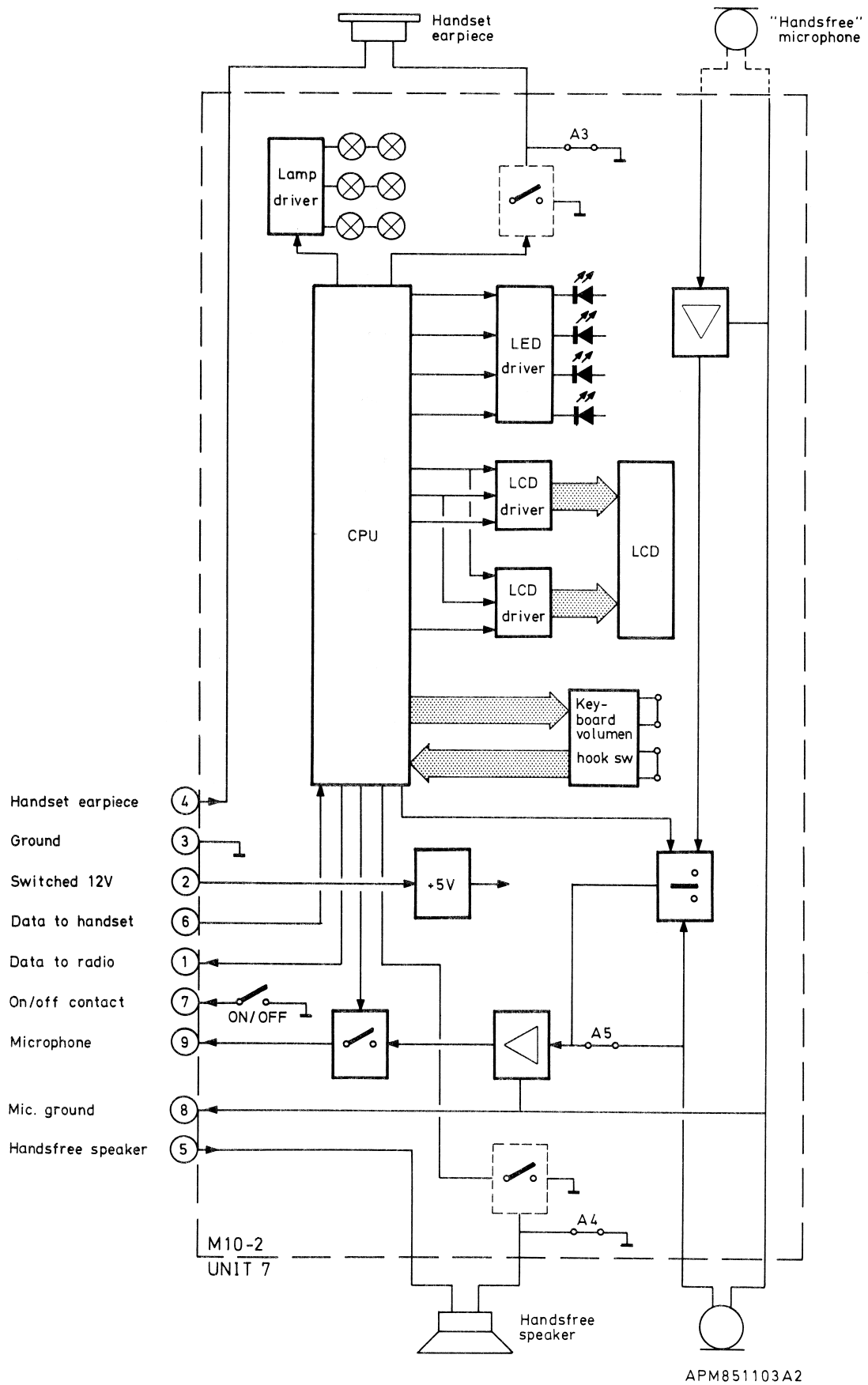


Fig. 6 Block diagram, handset

HANDSET TEST USING THE SERVICE INTERFACE UNIT (SIU)

Connect the 15-pole cable to the 15-pole connector on the SIU and connect the handset to the 9-pole connector on the SIU. Then connect the red and black power cable to a power supply of 13.2V DC. (Disregard the 9-pole cable).

If the four LEDs in the right side of the SIU are flashing, one after the other, you have to disconnect the power and reconnect it again. This action will reset and restart the program.

Display test:

Press the SIU "PROG" button. All symbols, all segments of the digits, all country codes and all function symbols are shown in the display. All LEDs on the handset are illuminated.

The display will remain like this for 5 seconds; after that only the yellow LED, indicating power on, will light.

Keyboard test:

Press the keys one by one, from left to right, starting with the top row.

The display will show two conditions of each key, when pressed and released. The keys and their corresponding indication are listed in the table.

<u>KEY</u>	<u>INDICATION</u>	<u>KEY</u>	<u>INDICATION</u>
①	1-d 1-U	⑧	13-d 13-U
②	2-d 2-U	⑨	14-d 14-U
③	3-d 3-U	⑩	15-d 15-U
④	4-d 4-U	#	16-d 16-U
⑤	5-d 5-U	→	17-d 17-U
*	6-d 6-U	T	18-d 18-U
C	7-d 7-U	R	19-d 19-U
M	8-d 8-U	⓪	ON-OFF
^	9-d 9-U	Volume +	24-d 24-U
λ	10-d 10-U	Volume -	25-d 25-U
⑥	11-d 11-U	Off cradle	26U
⑦	12-d 12-U	On cradle	26-d

Handset loudspeaker and microphones.

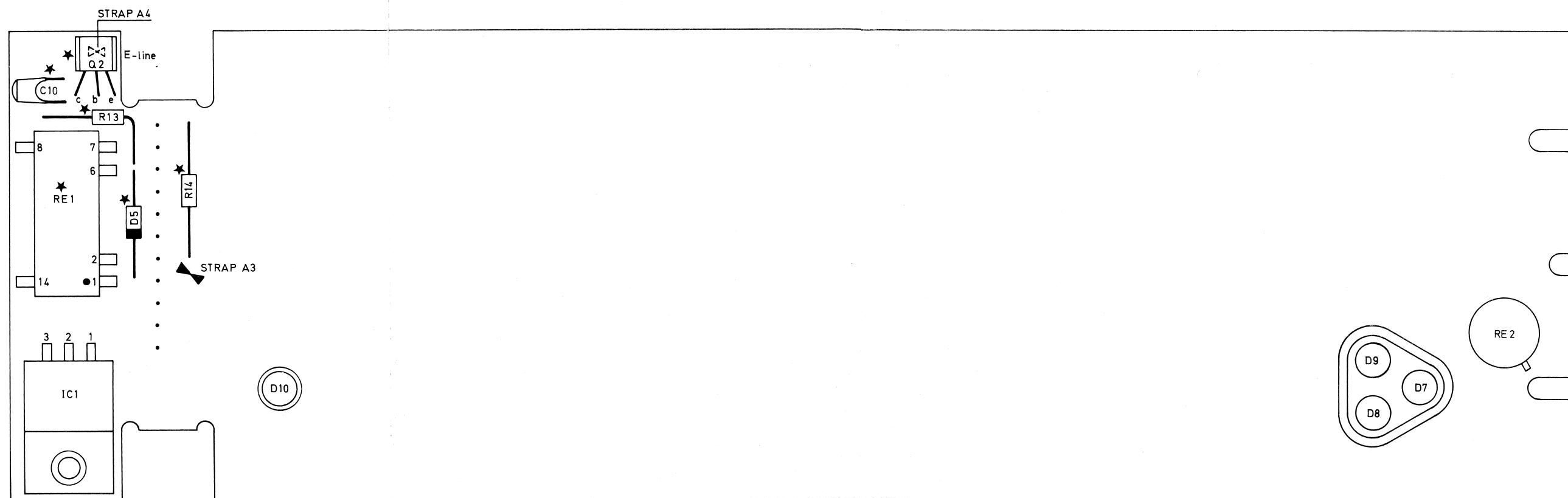
The test for the two loudspeakers is very easy. Connect a tone generator to the BNC connector on the SIU marked with a small loudspeaker. The BNC is connected to the handset speaker, and the tone from the generator should be audible.

Remove the tone generator from the BNC connector marked with a small speaker to the BNC connector marked with a large speaker, then the tone should be audible in the handsfree speaker.

The handset microphones can be tested by an oscilloscope, connected to the BNC connector marked with a microphone symbol. You select the handset microphone by pressing 1 on the keyboard. The handsfree microphone can only be tested with a transceiver being used. If you want to mute both microphones, press 5.

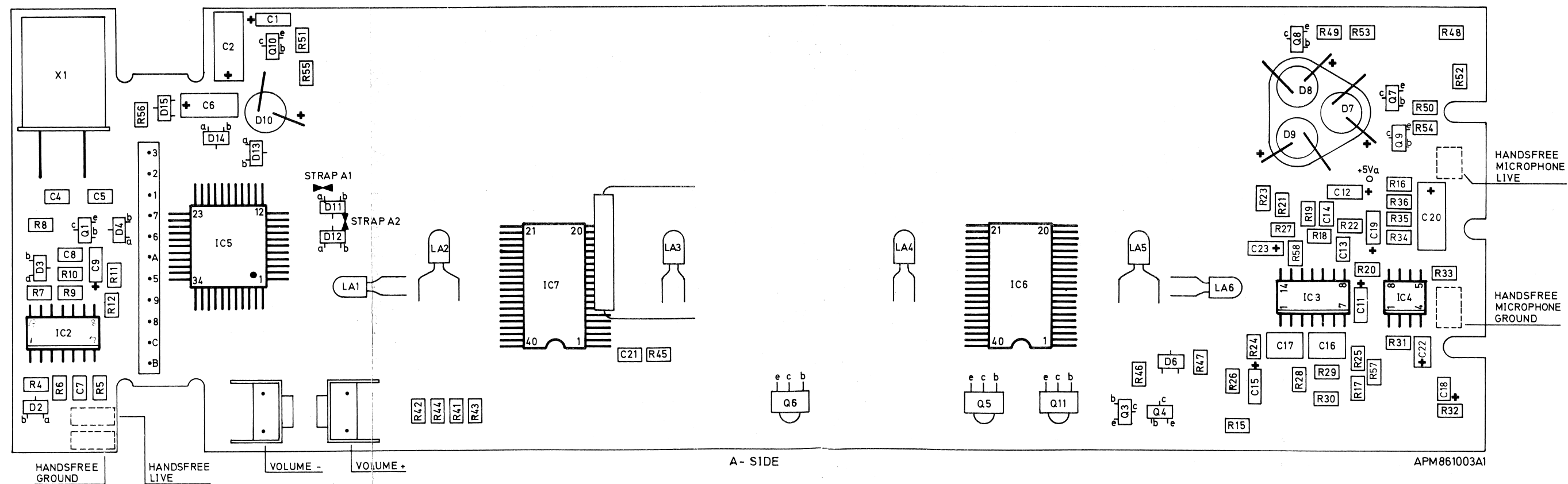
Display illumination test.

This test is very simple. Press the key marked * on the keyboard and press the key marked C
The first will switch the light on and the other will switch the light off.



*OPTION: 9506 100 70260

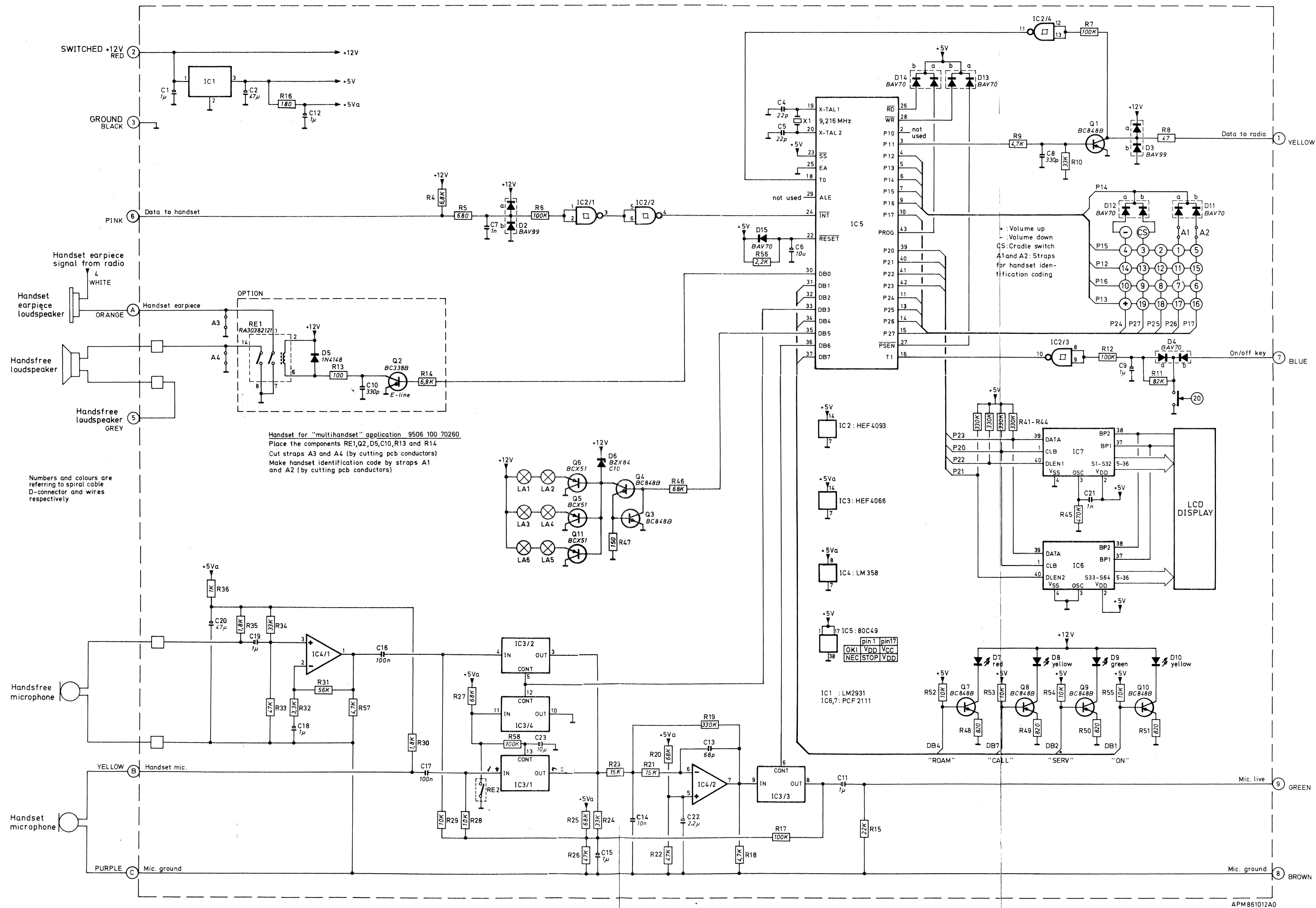
B-SIDE



A- SIDE

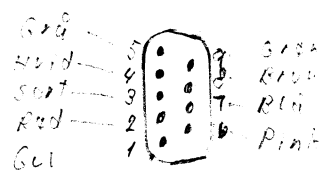
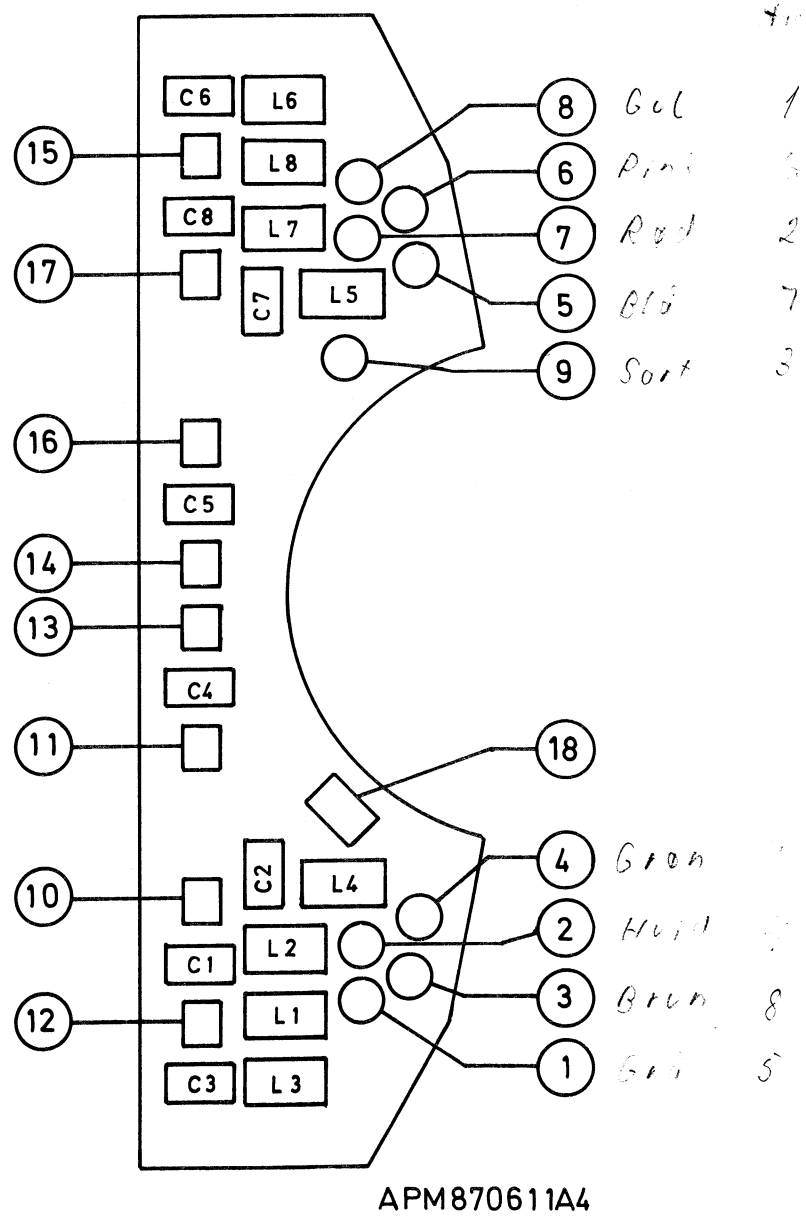
APM861003A1

Fig. 7 Component location, handset



APM861012A0

Print set for components



Hand-drawn diagram of component

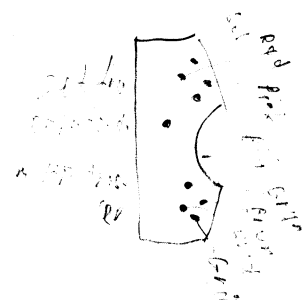
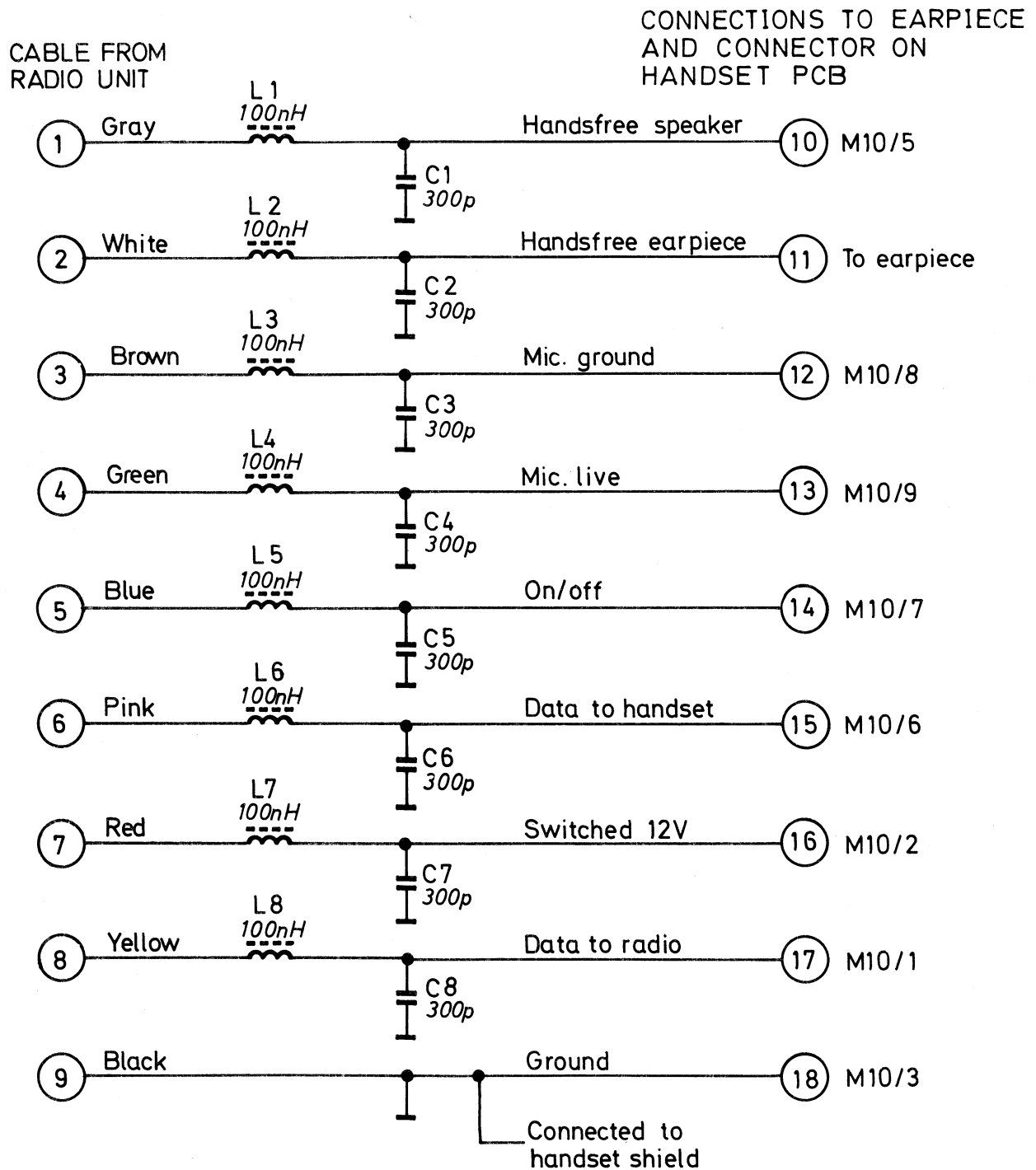


Fig. 9 Component location, RF filter

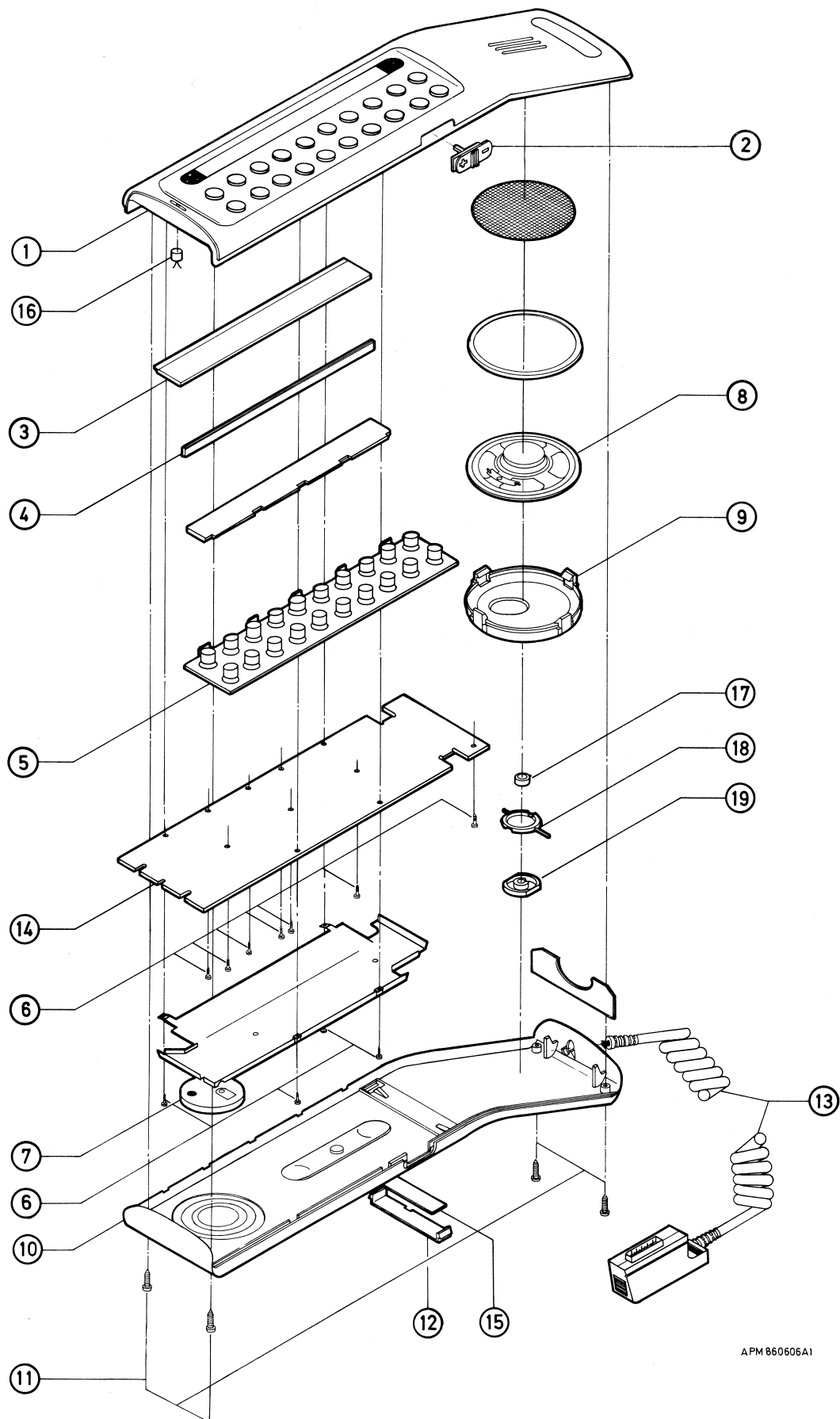


APM870610A3

Fig. 10 Circuit diagram, RF filter

Mechanical parts

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Top cover, black with Philips logo	1	3508 101 51660
1.	Top cover, white with Philips logo	1	3508 101 51670
2.	Knob for volume	1	3508 101 50570
3.	LCD display	1	3508 100 10060
4.	Zebrastrip multicable	1	3508 100 03110
5.	Keyboard	1	3508 101 50700
6.	Screw	1	3508 100 00190
7.	Loudspeaker, piezoelectric	1	3508 100 80150
8.	Semi-handsfree loudspeaker, 8ohm 1W	1	3508 100 80170
9.	Cover for loudspeaker	1	3508 101 52790
10.	Underpart, black	1	3508 101 51460
10.	Underpart, white	1	3508 101 51600
11.	Screw	4	3508 101 21470
12.	Window for typesign.	1	3508 101 51410
13.	Spiral cord, black	1	3508 100 03100
13.	Spiral cord, white	1	3508 100 03150
14.	Handset print complete	1	8208 244 01131
15.	Label for customers data	1	3508 100 06250
16.	Microphone	1	3508 102 12020
17.	Microphone	1	3508 102 11150
18.	Holder for microphone	1	3508 101 51720
19.	Microphone suspension	1	3508 101 51710



APM 860606A1

Fig. 11 Exploded view, handset

CPH860905/2

Electrical parts

NUMBER	ORDERING NUMBER	TYPE
<u>INTEGRATED CIRCUITS</u>		
IC1	3508 100 16930	L4805CV
IC2	9333 731 30112	HEF4093BT
IC3	9333 729 70112	HEF4066BT
IC4	9335 716 80602	LM358D
IC5	3508 102 70800	80C49
IC6-7	9336 051 40112	PCF2111T
<u>TRANSISTORS</u>		
Q1,3-4,7-10	9335 896 30215	BC848B
Q5-6,11	9332 722 80115	BCX51
<u>DIODES</u>		
D2-3	9332 153 70215	BAV99
D4,11-15	9331 849 10215	BAV70
D6	9331 374 60215	BZX84-C10
D7	8208 130 10070	CQV56-6
D8,10	8208 130 10080	CQV58-6
D9	8208 130 10090	CQV59-6
<u>CRYSTAL</u>		
X1	3508 100 50150	9.216MHz
<u>LAMPS</u>		
LA1-6	2422 533 00298	5V/60mA
<u>SWITCHES</u>		
RE2	3508 100 60090	Mecury relay
Cradle switches	9300 885 80112	Reed contact RI-22AAA
Volume up/down	3508 100 65030	KHH15952

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
<u>CAPACITORS</u>					
C1	3508 100 31060	100N	10%	50V	Ceramic
C2,20	3508 100 30130	47U	20%	6.3V	Tantal
C4-5	2222 861 12229	22P	5%		Ceramic
C6	3508 100 30120	10U	20%	10V	Tantal
C7,21	3508 100 30420	1N0	5%		Ceramic
C8	2222 580 16607	N33	10%		Ceramic
C9,11-12,18-19,23	3508 100 30100	1U0	20%	10V	Tantal
C13	2222 861 12689	68P	5%		Ceramic
C14	2222 580 16627	10N	10%		Ceramic
C15	3508 100 30290	1U5	20%	6.3V	Tantal
C16-17	3508 100 30740	100N	10%		Ceramic
C22	3508 100 30110	2U2	20%	16V	Tantal

RESISTORS

R4	3508 100 20350	6K8	5%	0.1W	
R5	3508 100 20230	680	5%	0.1W	
R6-7,12,17, 28-29,58	3508 100 20490	100K	5%	0.1W	
R8	3508 100 20090	47	5%	0.1W	
R9,18,57	3508 100 20330	4K7	5%	0.1W	
R10,24,34	3508 100 20430	33K	5%	0.1W	
R11	3508 100 20480	82K	5%	0.1W	
R15	3508 100 20410	22K	5%	0.1W	
R16	3508 100 20160	180	5%	0.1W	
R19,41-44	3508 100 20550	330K	5%	0.1W	
R20,25,46	3508 100 20470	68K	5%	0.1W	
R21,23	3508 100 20390	15K	5%	0.1W	
R22,26,33	3508 100 20450	47K	5%	0.1W	
R27,52-55	3508 100 20370	10K	5%	0.1W	
R30,35	3508 100 20280	1K8	5%	0.1W	
R31	3508 100 20460	56K	5%	0.1W	
R32	3508 100 20310	3K3	5%	0.1W	
R36	3508 100 20250	1K0	5%	0.1W	
R45	3508 100 20570	470K	5%	0.1W	
R47	3508 100 20150	150	5%	0.1W	
R48-51	3508 100 20240	820	5%	0.1W	
R56	3508 100 20290	2K2	5%	0.1W	

RF-Filter f/handset

<u>NUMBER</u>	<u>ORDERING NUMBER</u>	<u>TYPE</u>
---------------	------------------------	-------------

COILS

L1-8	3508 100 40320	100NH
------	----------------	-------

<u>NUMBER</u>	<u>ORDERING NUMBER</u>	<u>VALUE</u>	<u>TOL (%)</u>	<u>VOLT/WATT</u>	<u>DESCRIPTION</u>
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CAPACITORS

C1-8	2222 580 16607	N33	10%		Ceramic
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Portable kit - ap4000 series

CONTENTS	PAGE
Introduction	3
L/H switch	4
Charging	4
Assembling-disassembling	5
Wiring diagram and circuit diagram, Portable cassette	9,10
Wiring diagram and circuit diagram, Battery pack	11,13
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Introduction

The portable for the ap4000 series is built-up by four major modules:

- Portable cassette
- Battery pack
- Radio unit
- Handset

This chapter only deals with the portable cassette and the battery pack.

The portable cassette serves as:

- a. Handle for the ap4000 series portable.
- b. Magnetic base for handset.
- c. Interconnecting box for the radio.
- d. Connection between antenna connector on the radio and the antenna.
- e. Connection between radio and battery pack.

The battery pack contains:

- a. Batteries, 2x6V DC packs.
- b. Charging circuit.
- c. Indicators for battery performance.

The internal battery charger contains 2 battery charging circuits, one for each 6V DC battery pack. A relay switches the batteries from the charging state to the supplying state. 2 LED's are shown on the diagram (a red and a green one). The red LED is used as an indicator for external power supply, while the green LED is used as a zenerdiode in connection with Q4, and has no indicator function.

CAUTION: It is not recommendable to store uncharged AP 4001 battery packs for long periods as there is a risk that they may start leaking. It is therefore recommendable to recharge the unused (stored) batteries once every 3rd month.

L/H switch

For the use of the L/H switch please refer to the OPERATING INSTRUCTIONS.

Charging

The battery can be charged in three ways:

1. By means of a battery charger (standard accessory).
2. By means of a cigarette lighter cord (Standard accessory).
3. By means of a power supply (optional).

If the battery is quite flat it will take approximately 10 hours to recharge it fully.

CAUTION: Avoid charging at temperatures below 0°C, as this may shorten battery life unless the charging current is accurately controlled as in the case with the cigarette lightercord or the ap battery charger.

The battery should always be used until the indicator pointer is in the red zone (or the radio turns off). Then it should be charged to maximum. This is because this type of battery retains its capacity best when charging and discharging are utilized fully. If the battery yields too little power for no apparent reason, repeated charging and discharging might restore full capacity.

CAUTION: The red LED only lights when the battery is charged from an external power supply or cigarette lighter plug.

It does not light when the small battery charger is used.

Note: If the battery becomes flat (too low voltage) during a call, the telephone will switch off automatically. Before this happens a tone will cut into the conversation to give a warning of the imminent interruption.

Assembling - disassembling

The ap4000 series portable cassette and battery pack are mounted on the radio as shown on fig. 1.

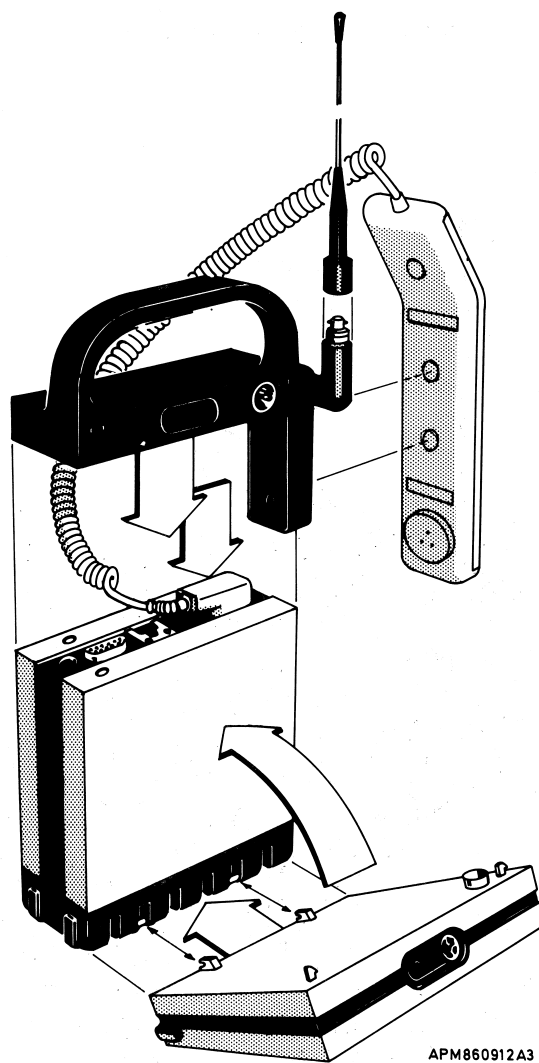


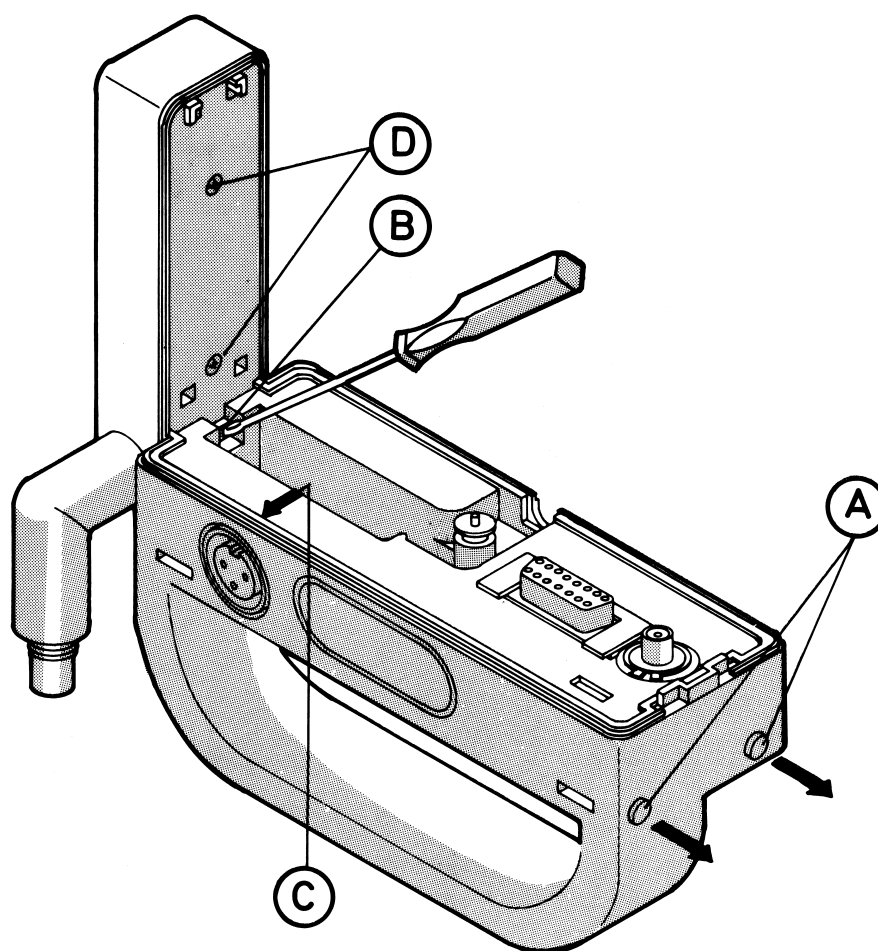
Fig. 1 Assembling of ap4000 portable

Dismantling is done as follows: First press the button on the battery. Then release the handle by pressing the oblong release button in the middle of the handle. CPH860906/0

Disassembling of the portable cassette (handle).

Refer to fig. 2.

- Remove the caps and screws (A) .
- While pressing the lock (B) by help of a screwdriver, you pull out the plastic slightly and carefully at (C) (so that it passes the connector) and while pressing the oblong release button you remove carefully the handle from the chassis.
- For access to the magnetic base remove the screws (D) .



APM860906A3

Fig. 2 Disassembling of the portable cassette

Disassembling of the battery pack.

Refer to fig. 3 and 4.

- Remove the screws (A) .
- To remove the charging circuit remove the screws (B) . By reassembling please note the insulating washer between the transistors Q2/Q3 and the metal cover.

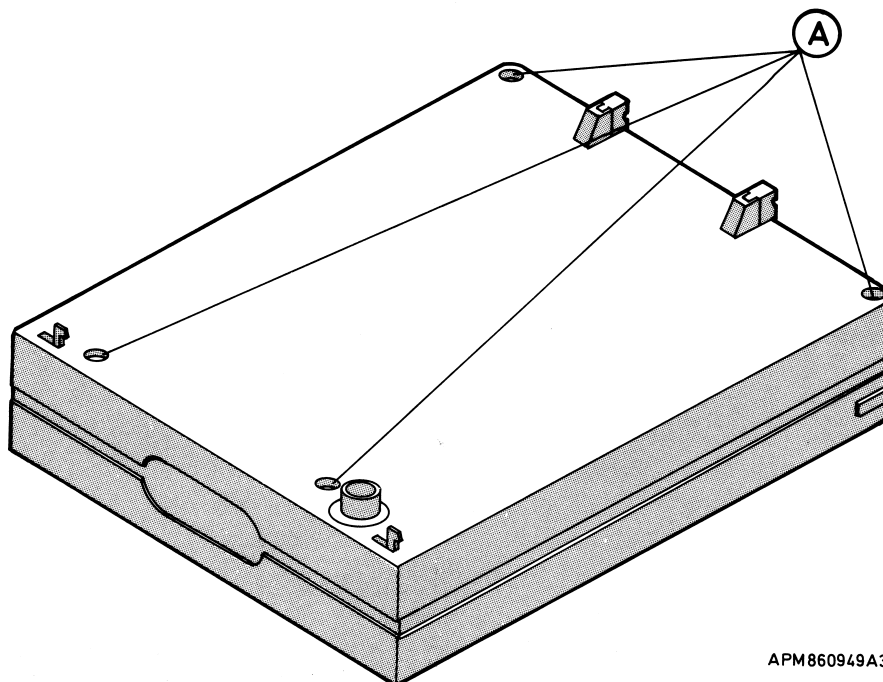


Fig. 3 Disassembling of the battery pack

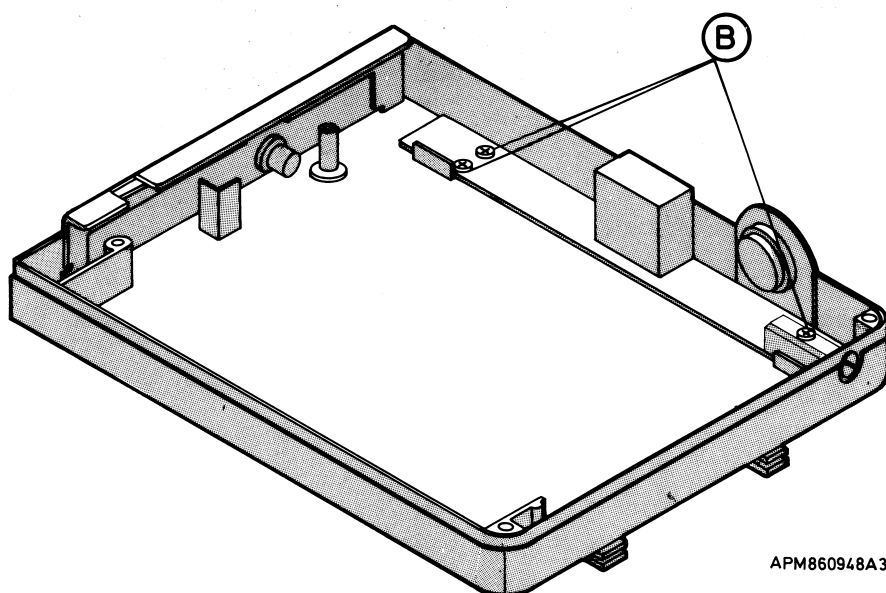
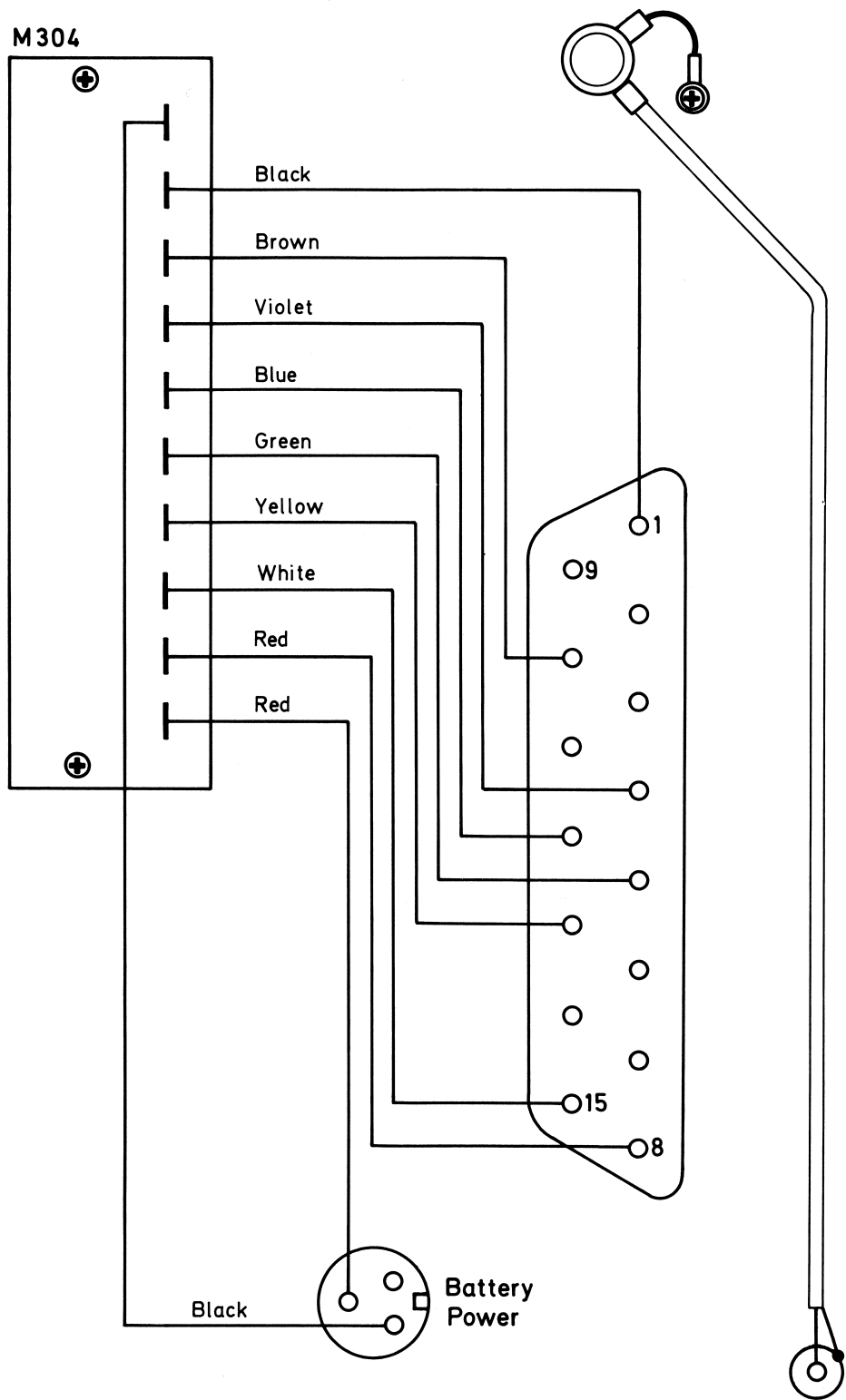


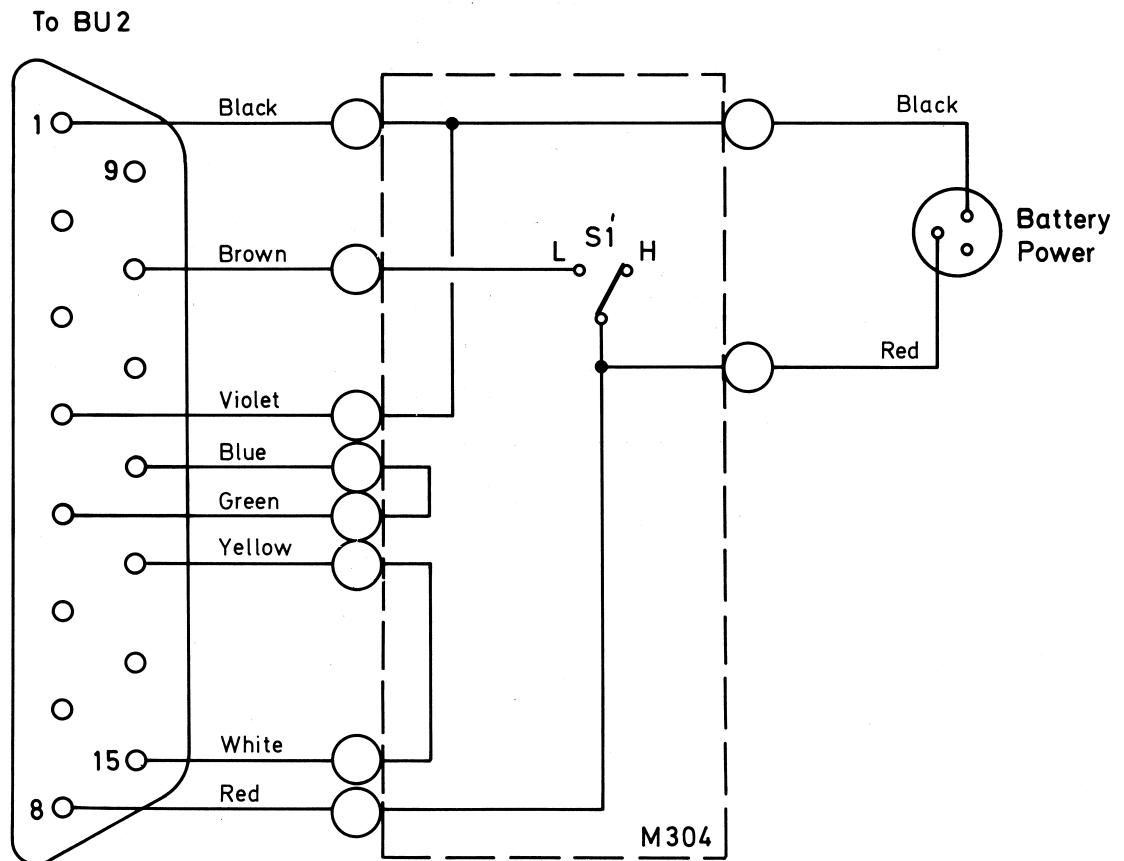
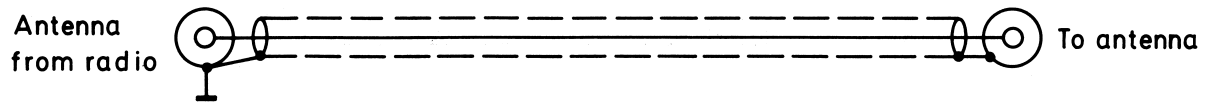
Fig. 4 Removing the charging circuit



APM860511A3

Fig. 5 Wiring diagram, portable cassette

CPH860906/0



APM860510A3

CHARGER / SUPPLY CONNECTOR:

1. CURRENT CHARGER NOM 400mA
2. EXT. SUPPLY NOM. 12V 4.6A
3. GROUND

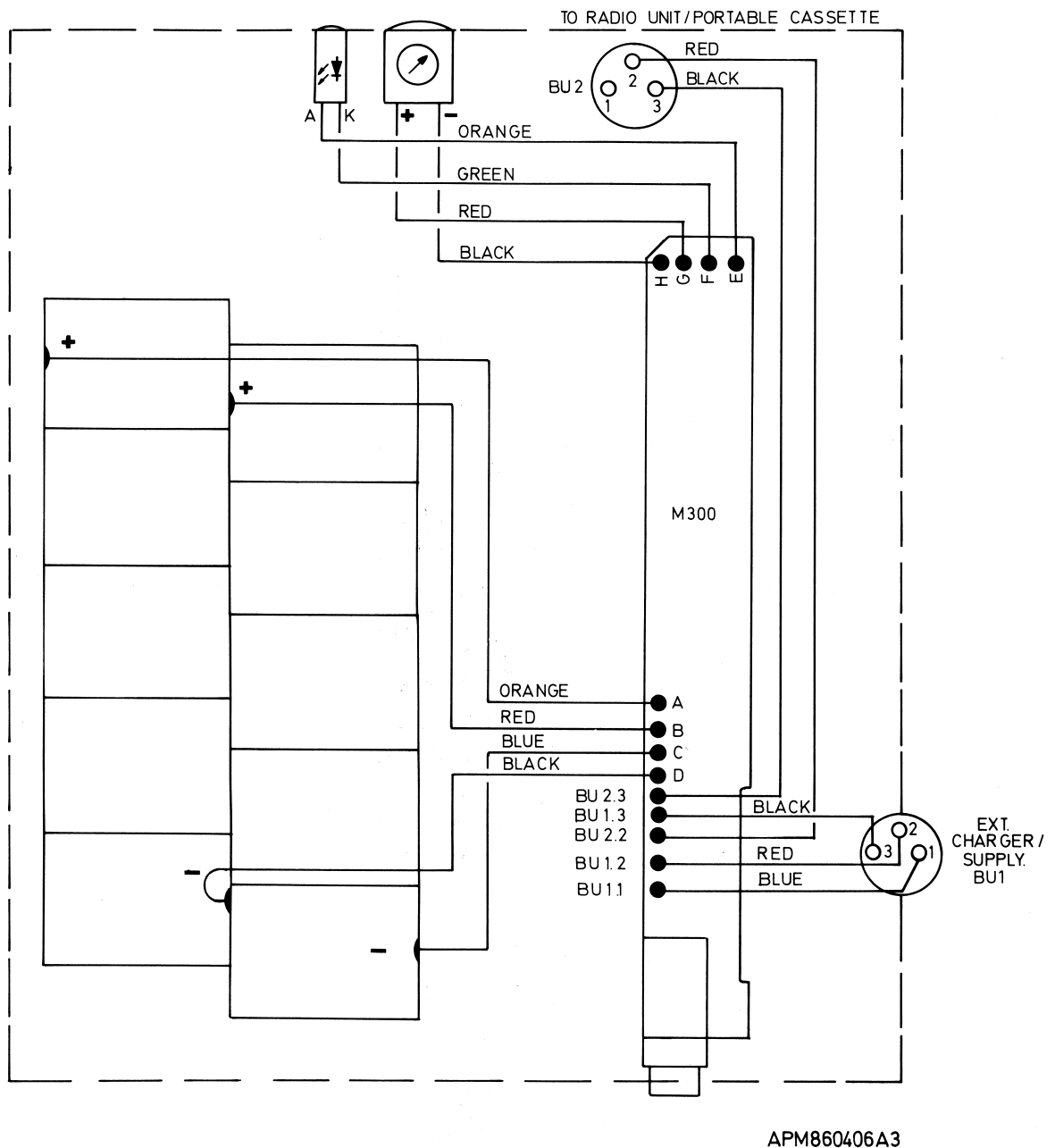


Fig. 7 Wiring diagram, battery pack

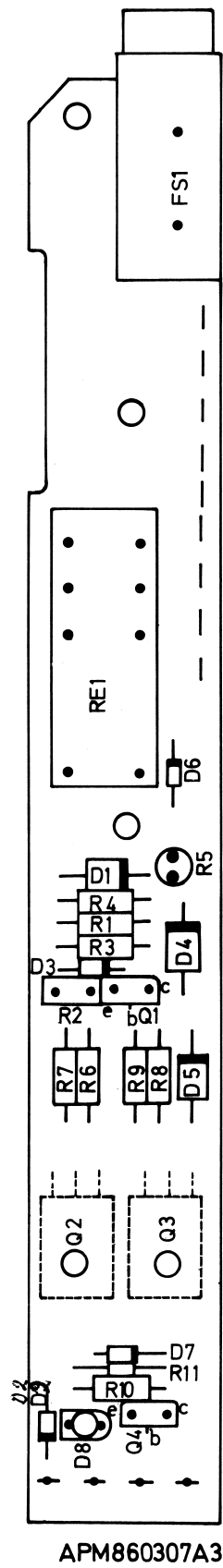
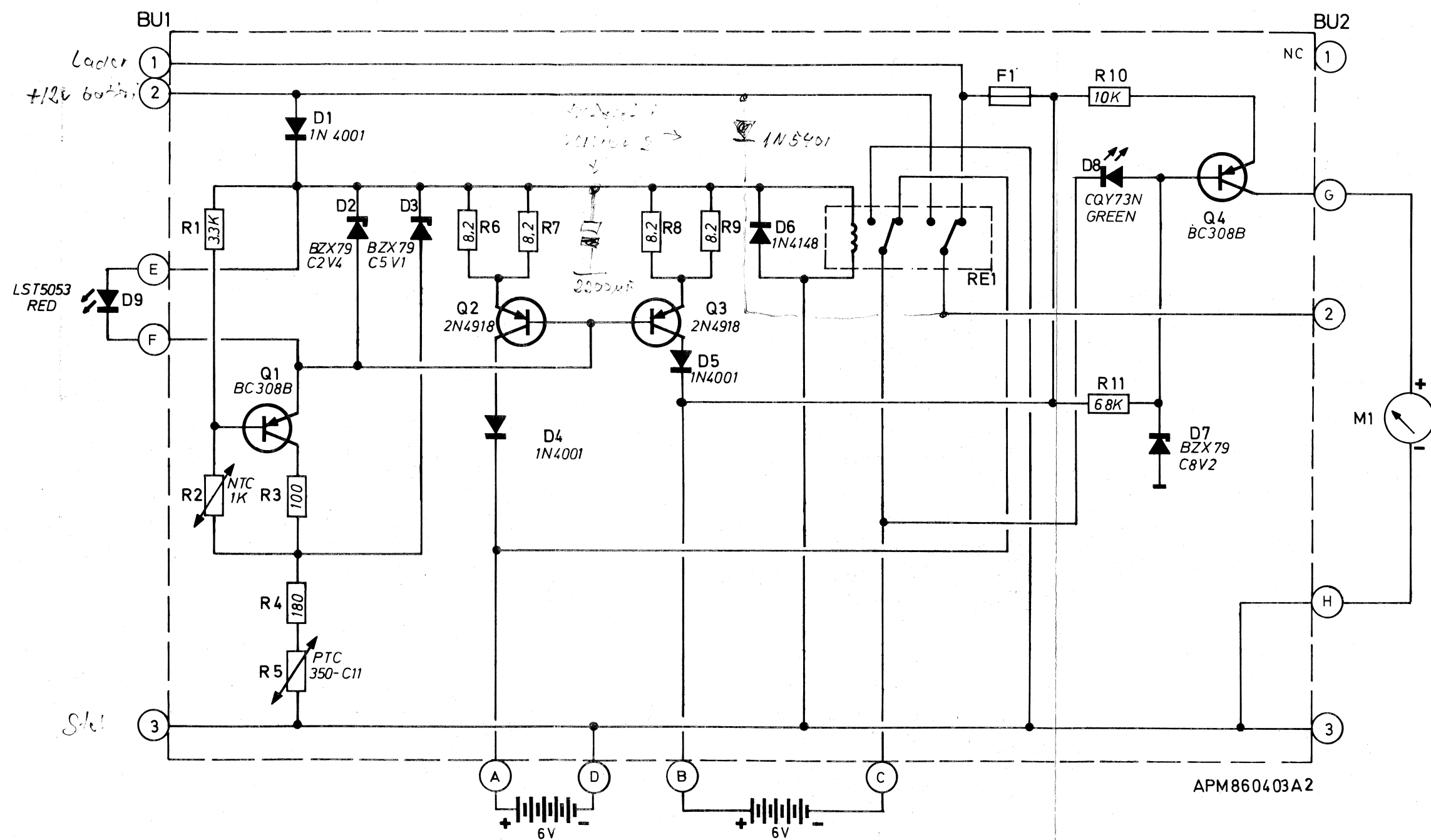


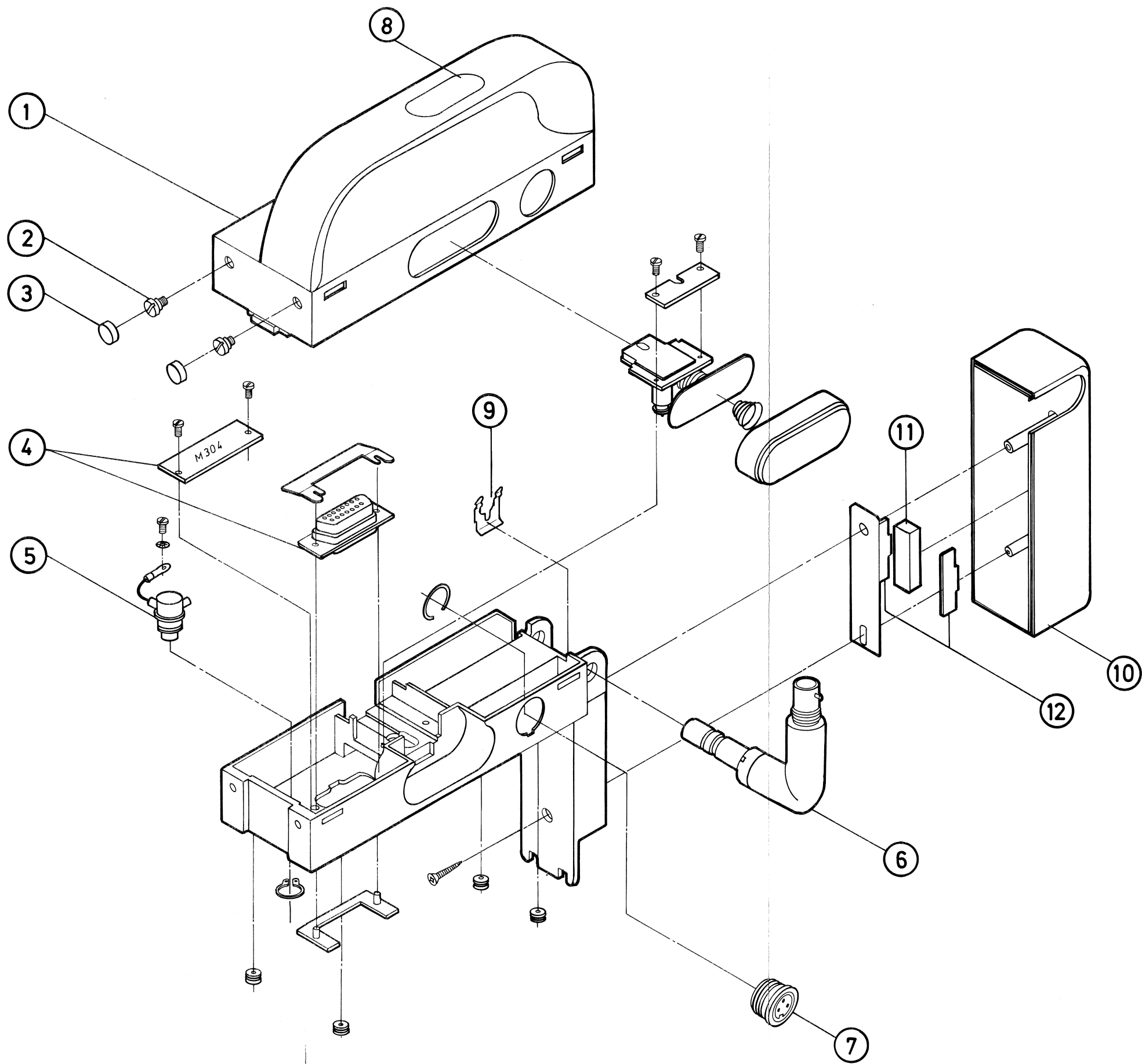
Fig. 8 Component location, charging circuit



Mechanical parts

PORTABLE CASSETTE:

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Handle	1	3508 101 50900
2.	Screw for handset	2	3508 101 21290
3.	Cap plug black	2	3508 101 51200
4.	Terminalboard M304	1	3508 102 21200
5.	Antenna plug male	1	3508 100 55450
6.	Antenna angle	1	8208 244 00111
7.	3 pole connector	1	3508 100 55430
8.	Sign: ap radiotelefon	1	3508 100 04490
8.	Sign: Philips	1	3508 100 04530
9.	Plate spring	1	3508 100 21760
10.	Cover for magnetic base	1	3508 101 52130
11.	Magnet	1	3508 100 00750
12.	Pole plate	2	3508 101 21660



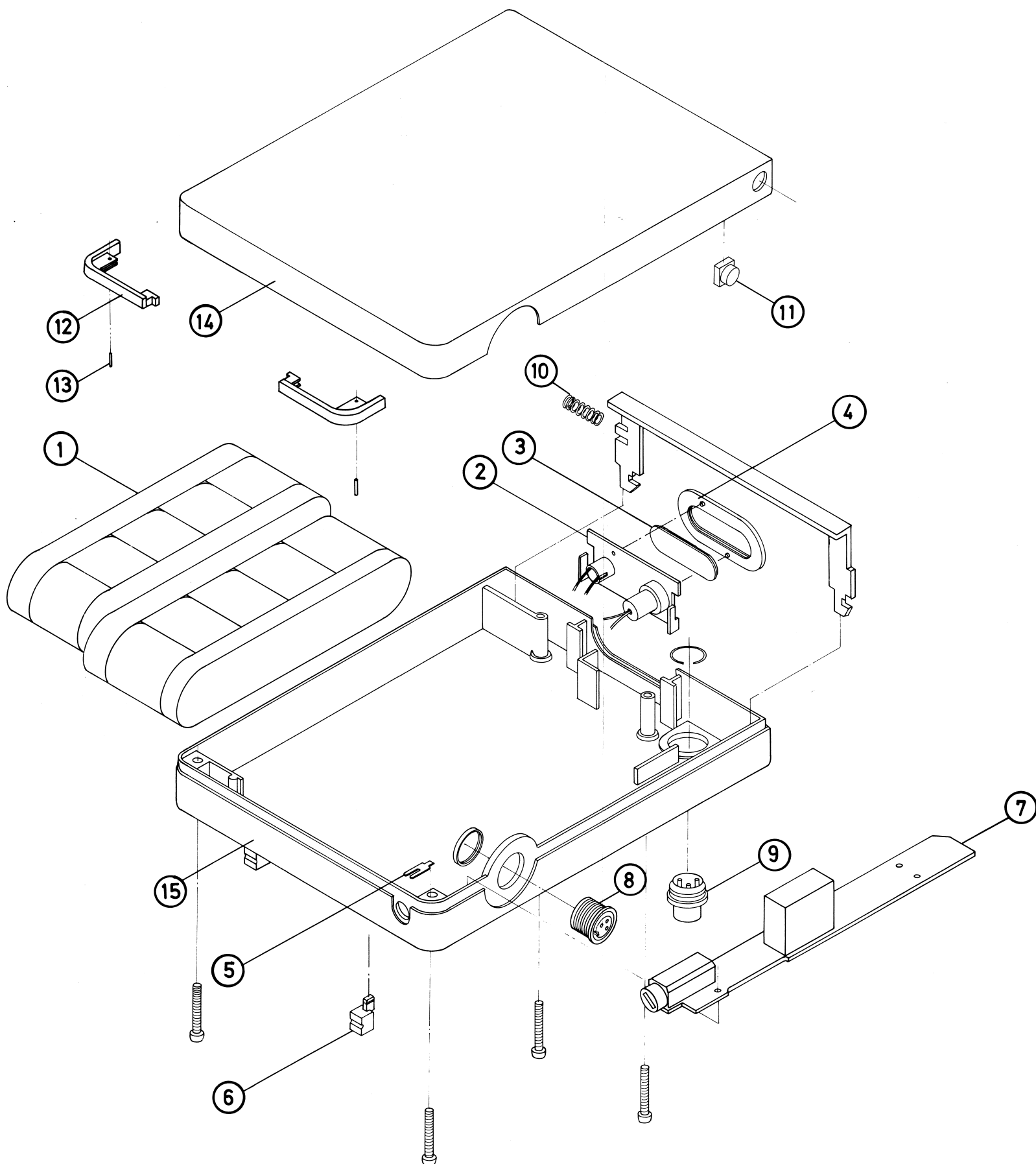
APM870317A1

BATTERY PACK:

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Battery. See Note 1:	1	3508 102 11780
1.	Battery-High temperature. See Note 2:	1	3508 100 80340
2.	Holder with indicator and control lamp	1	8208 244 00121
3.	Pane for indicator and control lamp	1	3508 101 51110
4.	Pane holder black	1	3508 101 51140
5.	Holder spring	2	3508 101 21160
6.	Lock part, black	2	3508 101 52020
7.	Charging circuit, complete	1	8208 244 00081
8.	3-pole connector, female	1	3508 100 55460
9.	3-pole connector, male	1	3508 100 55440
10.	Spring	1	3508 101 21340
11.	Button	1	3508 101 51180
12.	Bottom part	2	3508 101 52800
13.	Clamp pin	2	2522 677 01015
14.	Front part, Black	1	3508 101 20990
14.	Front part, White	1	3508 101 21130
15.	Rear part, Black	1	3508 101 21000
15.	Rear part, White	1	3508 101 21120

Note 1: This battery type is recommended for temperatures between -25°C and $+55^{\circ}\text{C}$.

Note 2: This battery type is recommended for temperatures between 0°C and $+70^{\circ}\text{C}$.



APM860702A1

Electrical parts

BATTERY PACK:

NUMBER	ORDERING NUMBER	TYPE
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TRANSISTORS

Q1,4	3508 100 11130	BC308B
Q2-3	9331 234 20682	2N4918

DIODES

D1,4-5	9330 635 30113	1N4001
D2	9334 146 80113	BZX79-C2V4
D3	9331 177 20113	BZX79-C5V1
D6	9330 839 90113	1N4148
D7	9331 177 70113	BZX79-C8V2
D8	9335 478 20682	LED CQY73N

RELAY

RE1	3508 100 60080	12V 2 shiftset
-----	----------------	----------------

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

RESISTORS

R1	2322 186 13332	3K3	5%	0.4W	
R2	2322 642 62102	1K0	10%	0.5W	NTC
R3	2322 186 13101	100	5%	0.4W	
R4	2322 186 13181	180	5%	0.4W	
R5	3508 100 21380	350			PTC
R6-9	2322 186 13828	8R2	5%	0.4W	
R10	2322 186 13103	10K	5%	0.4W	
R11	2322 186 13683	68K	5%	0.4W	

Service interface unit ap4009

CONTENTS	PAGE
Description of the service interface unit	3
Component location	4
Circuit diagram, test adaptor	5
Circuit diagram, test board	7

Description of the service interface unit

With this service unit it is possible to test a radio and a handset, or one of those alone, see service instructions.

The service unit makes it possible to monitor the Roaming, Service and Call system lamps. It also contains circuits for external device indication and activation such as Music mute, External alarm and Hook switch, push-to-talk, Portable sense and Ignition switch. Moreover it is possible to disconnect the microphone or the loudspeaker from the handset. There are 2 cables from the service unit, one with a 9-pole connector and one with a 15-pole connector and 2 power wires. At the rear of the service unit there are a 15-pole male connector and a 7-pole DIN connector and a bush connection. The 2 cables can be used in different ways depending on the test to be done. The 15-pole male connector is used when a handset is to be tested. The DIN connector is intended to be used with an external device such as a telephone answering machine.

At the front plate there are 2 push buttons and 6 switches with the following function starting from left:

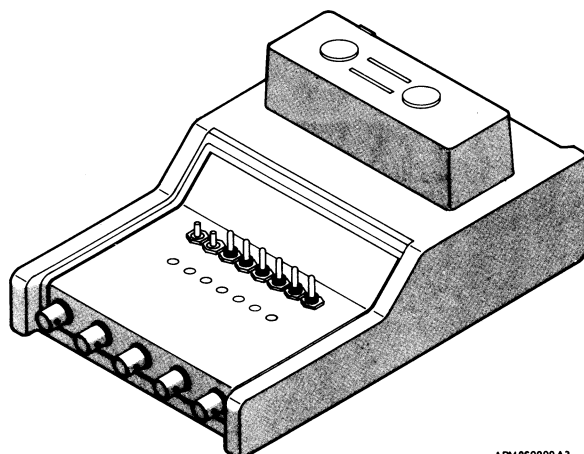
On/off is used to test the radio alone, PROG is used to program a new telephone number, or to reset the system lamps during test. To test a handset this button is used to restart the service interface if it should fail. The next 4 switches are used to activate different inputs to the radio such as HOOK on/off for external device, PORTable sense is used in portable equipment, PUSH-TO-TALK is used in handsfree conversation and IGNITION is used to monitor the ignition key in a car. The last 2 switches are used to disconnect the microphone or the loudspeaker in the handset. Furthermore there are 7 LED's, indicating the status of the output signals from the radio. The system lamps left to right are:

Power on, Music mute, External alarm, Data transmission from radio to handset and the three systems lamps with the same indication as in the handset.

On the front of the service unit there are 5 BNC connectors used for input and output from the radio and from left to right they are:

Earpiece LF output, Loudspeaker output, Handset microphone output, Line input to the radio and Line output from the radio.

The DIN connector at the rear plate has the same line signal as above and the HOOK switch input and External alarm output. The HOOK input is also connected to a bush on the rear plate.



APM860909A3

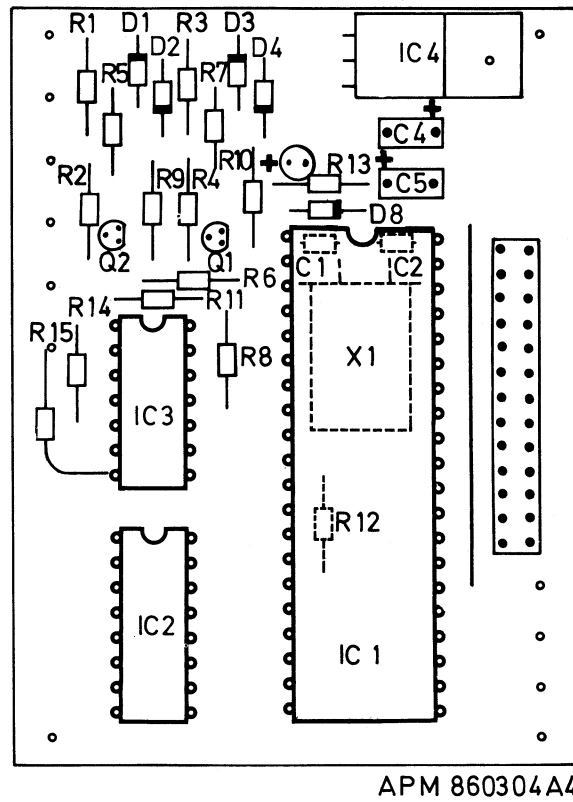


Fig. 1 Component location, test adaptor

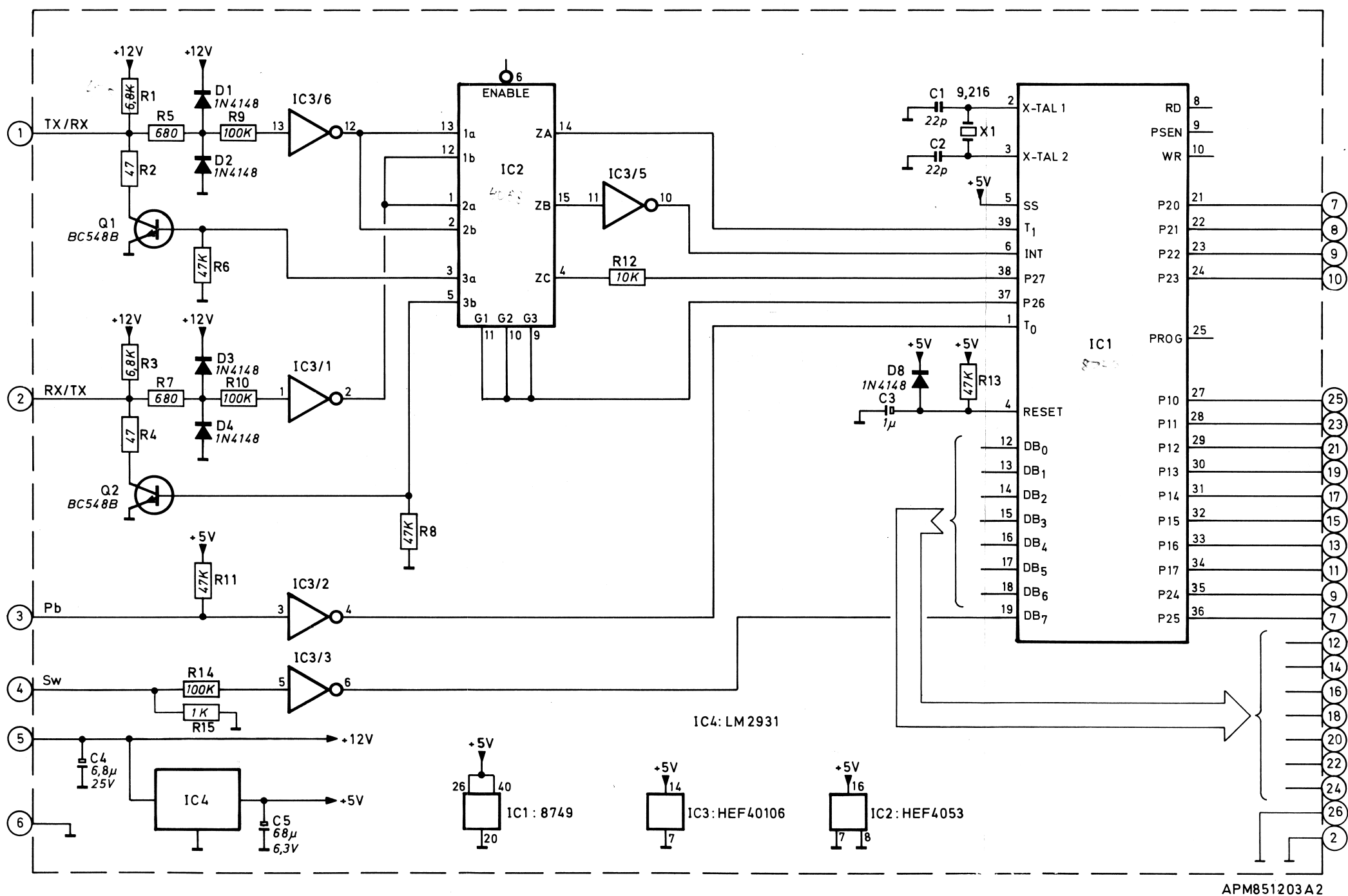


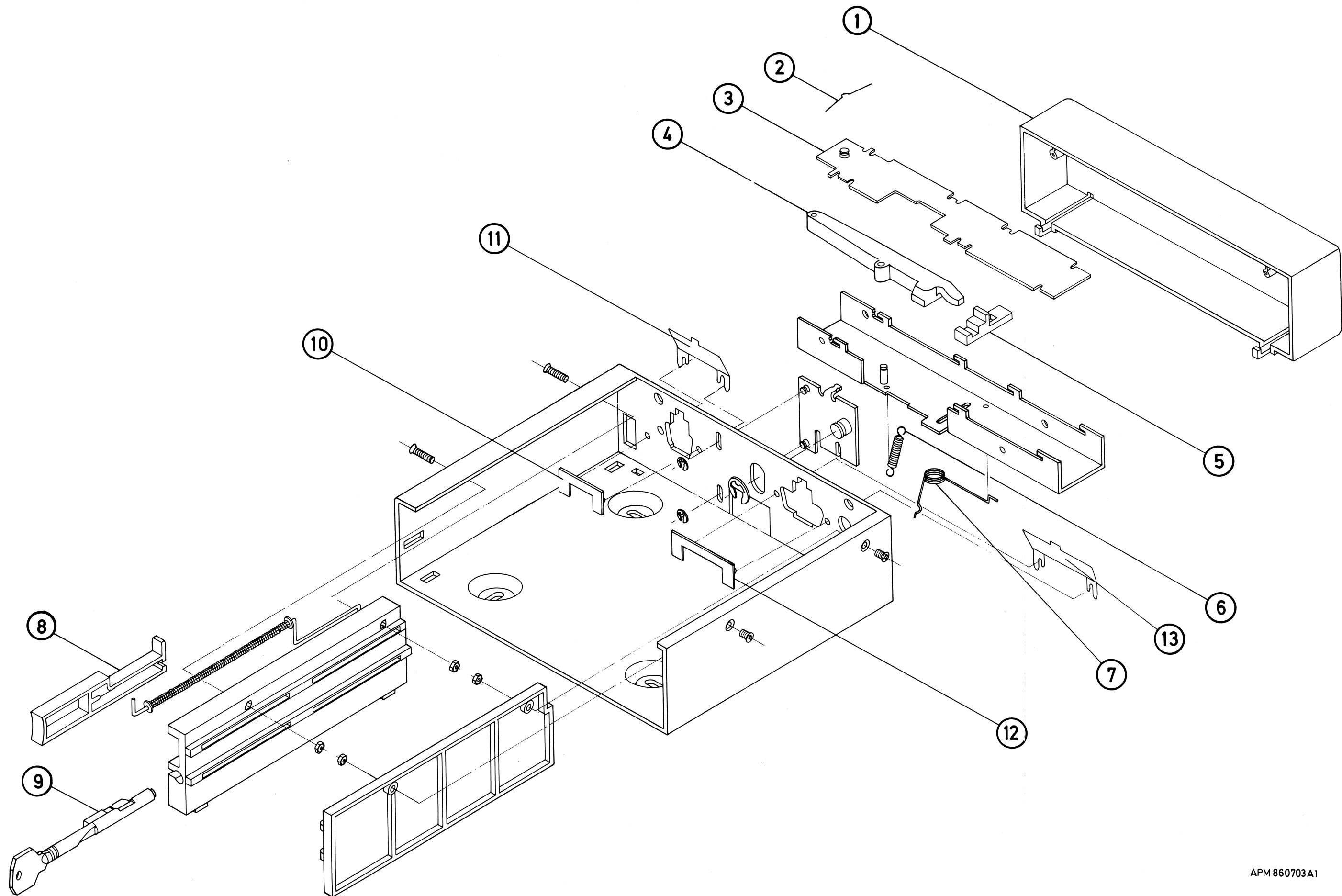
Fig. 2 Circuit diagram, test adaptor

Mounting cassettes

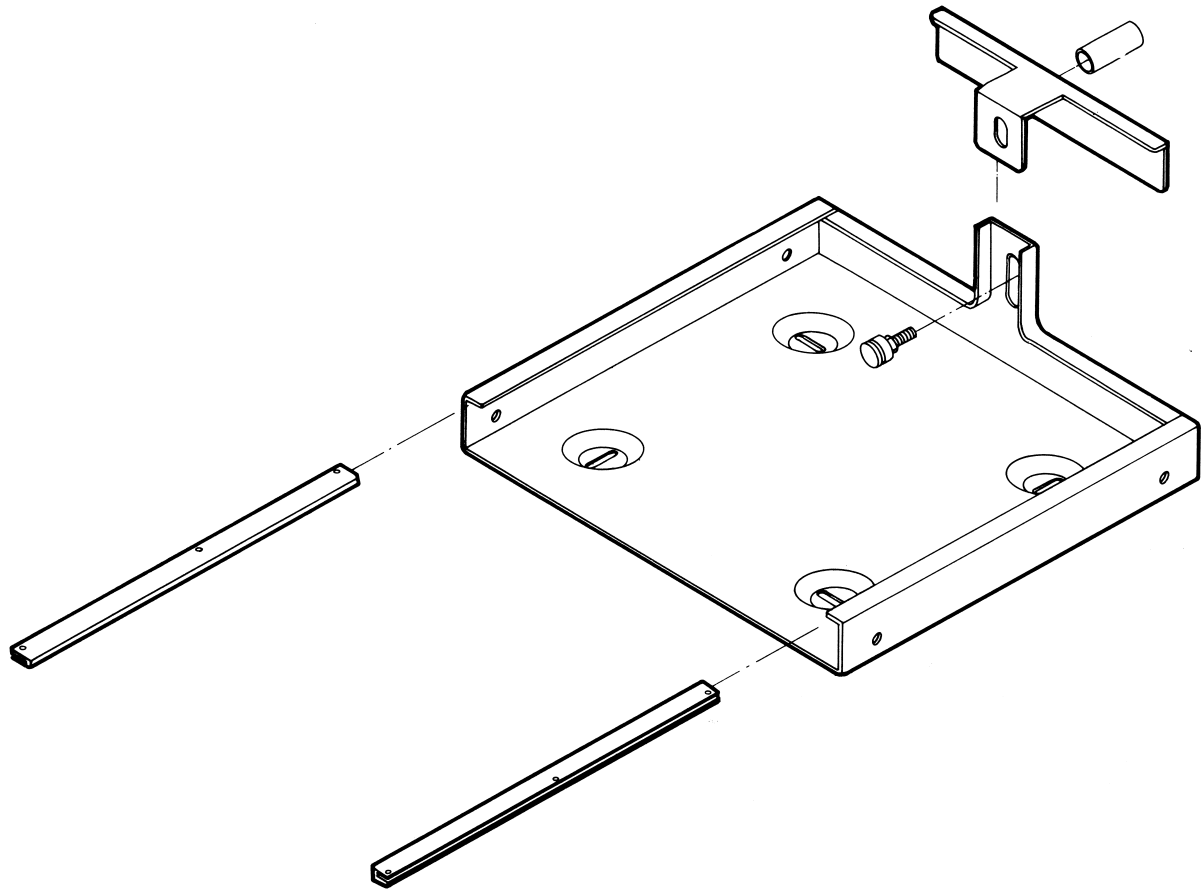
CONTENTS	PAGE
Mechanical parts	2
Exploded view, Mounting cassette	3
Exploded view, Mounting tray	5

Mechanical parts

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Cover	1	3508 101 50860
2.	Spring for PCB	1	3508 101 02040
3.	Print M301	1	3508 102 20980
4.	Lever arm	1	3508 101 50840
5.	Slide valve	1	3508 101 50850
6.	Spring for lock plate	1	3508 101 02000
7.	Spring	1	3508 101 02010
8.	Button	1	3508 101 50870
9.	Lock with key	1	3508 100 00230
10.	Connector lock plate	1	3508 102 00190
11.	Spring for lock plate	1	3508 101 21520
12.	Connector lock plate	1	3508 102 00200
13.	Spring for lock plate	1	3508 101 21380
	BNC connector for mounting cassette (mule)		3508 100 55420
	- - - tray -		2411 027 07178



APM 860703A1



APM860801A2

Fig. 2 Exploded view, mounting tray

CPH860908/0



PRCS-Service

Philips Radio Communication Systems (Copenhagen)

CONCERNING

AP 4002 PORTABLE KIT

88.06

Shortly, a new improved antenna angle for the portable cassette will be introduced.

The new antenna angle has three positions and can be turned 180 degrees; see the figure.

A new and better plate spring will also be introduced (ordering number 3508 101 02850).

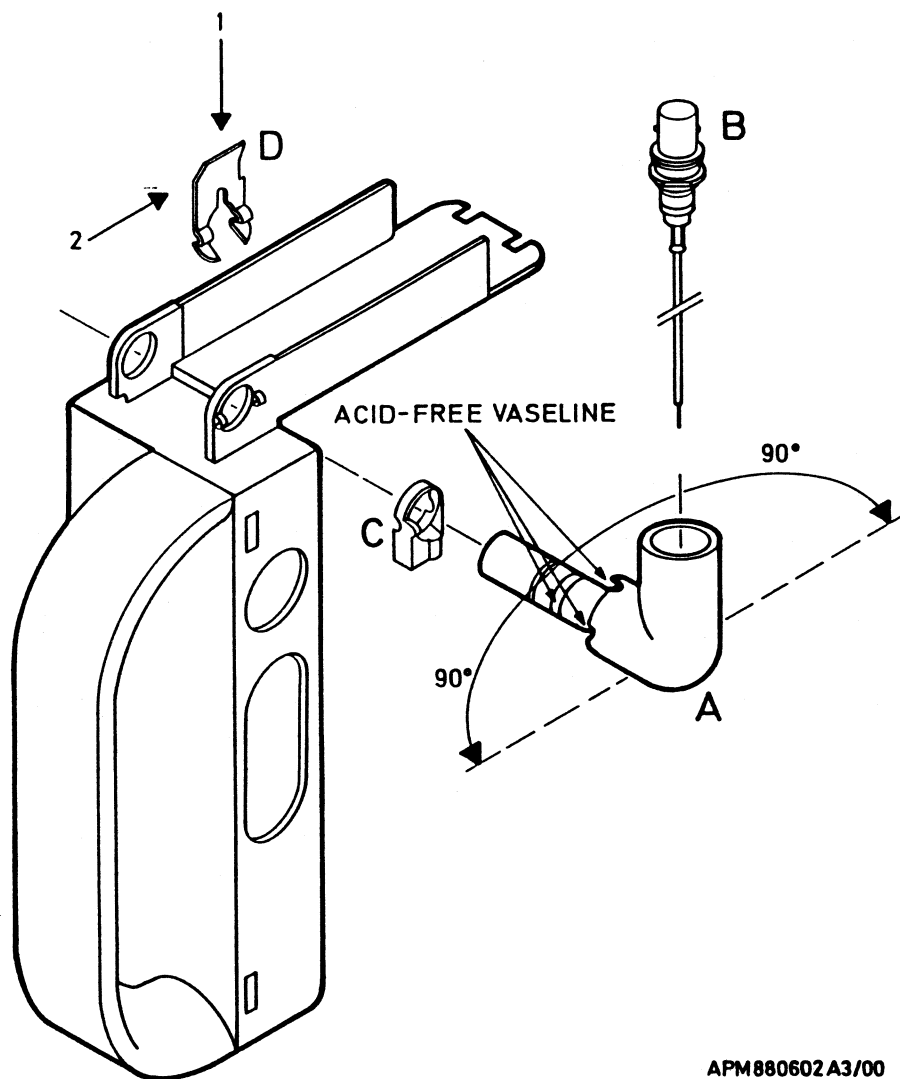
The new parts will be carried by Philips Service as soon as the present stock has been used.

The antenna angle service kit 8208 244 00111 will be updated with new parts, including the plate spring.

PROCEDURE TO CHANGE THE ANTENNA ANGLE.

Before mounting the new antenna angle you must supply the points shown on the figure with acid-free Vaseline grease.

- Follow the description in the service manual chapter "Portable kit" page 6: Disassembling of the portable cassette.
- Remove the locking ring and ground screw from the transceiver antenna connector.
- Remove the benzing ring and grounding spring or, in the latest version, the plate spring.
- Cut the coax cable.
- Remove the antenna angle.
- Insert the new antenna angle, marked A, into the plastic ring, marked C.
- Slide the new antenna angle into the holes in the bracket.
- Mount the antenna connector with coax cable, marked B on the figure, into the antenna angle and route the coax cable through the hole in the side of the antenna angle shaft.
- Mount the new plate spring marked D.
- Before mounting the transceiver antenna connector on the bracket: Wind up the coax cable on the angle shaft and make sure that the antenna angle is able to move 180 degrees without breaking the cable when the connector is installed.



APM880602 A3/00

Portable kit, version 2 - ap4000 series

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Wiring diagram and circuit diagram, Battery pack, version 2	11,13
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Electrical parts	19

Introduction

The portable for the ap4000 series is built-up by four major modules:

- Portable cassette
- Battery pack
- Radio unit
- Handset

This chapter only deals with the portable cassette and the battery pack.

The portable cassette serves as:

- a. Handle for the ap4000 series portable.
- b. Magnetic base for handset.
- c. Interconnecting box for the radio.
- d. Connection between antenna connector on the radio and the antenna.
- e. Connection between radio and battery pack.

The battery pack contains:

- a. Batteries, 2x6V DC packs.
- b. Charging circuit.
- c. Indicators for battery performance.

The internal battery charger contains 2 battery charging circuits, one for each 6V DC battery pack. A relay switches the batteries from the charging state to the supplying state. 2 LED's are shown on the diagram (a red and a green one). The red LED is used as an indicator for external power supply, while the green LED is used as a zenerdiode in connection with Q4, and has no indicator function.

CAUTION: It is not recommendable to store uncharged AP 4001 battery packs for long periods as there is a risk that they may start leaking. It is therefore recommendable to recharge the unused (stored) batteries once every 3rd month.

L/H switch

For the use of the L/H switch please refer to the OPERATING INSTRUCTIONS.

Charging

The battery can be charged in three ways:

1. By means of a battery charger (standard accessory).
2. By means of a cigarette lighter cord (Standard accessory).
3. By means of a power supply (optional).

If the battery is quite flat it will take approximately 14 hours to recharge it fully.

CAUTION: Avoid charging at temperatures below 0°C, as this may shorten battery life unless the charging current is accurately controlled as in the case with the cigarette lightercord or the optional power supply.

The battery should always be used until the indicator pointer is in the red zone (or the radio turns off). Then it should be charged to maximum. This is because this type of battery retains its capacity best when charging and discharging are utilized fully. If the battery yields too little power for no apparent reason, repeated charging and discharging might restore full capacity.

CAUTION: The red LED only lights when the battery is charged from an external power supply or cigarette lighter plug. It does not light when the small battery charger is used.

Note: If the battery becomes flat (too low voltage) during a call, the telephone will switch off automatically. Before this happens a tone will cut into the conversation to give a warning of the imminent interruption.

Assembling - disassembling

The ap4000 series portable cassette and battery pack are mounted on the radio as shown on fig. 1.

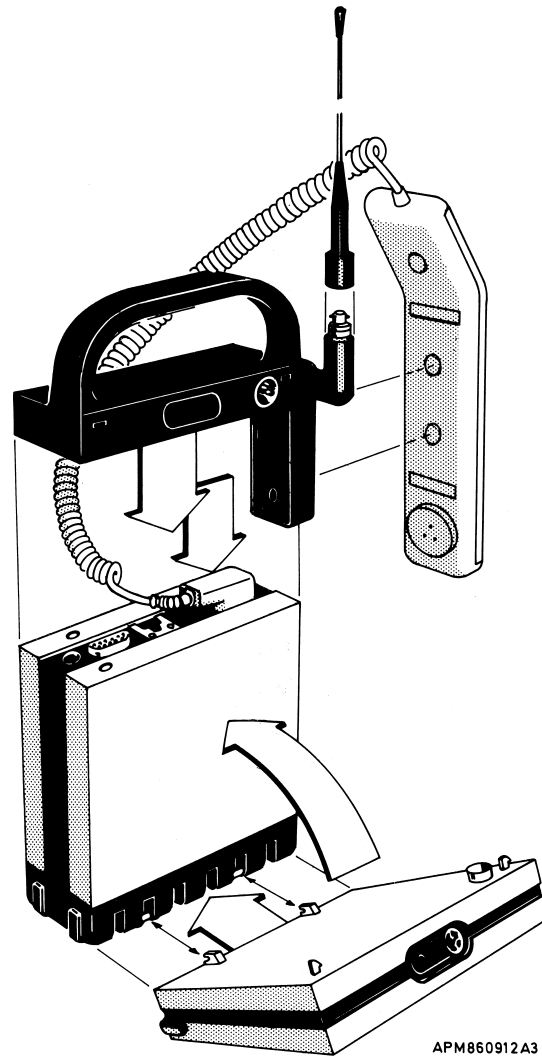


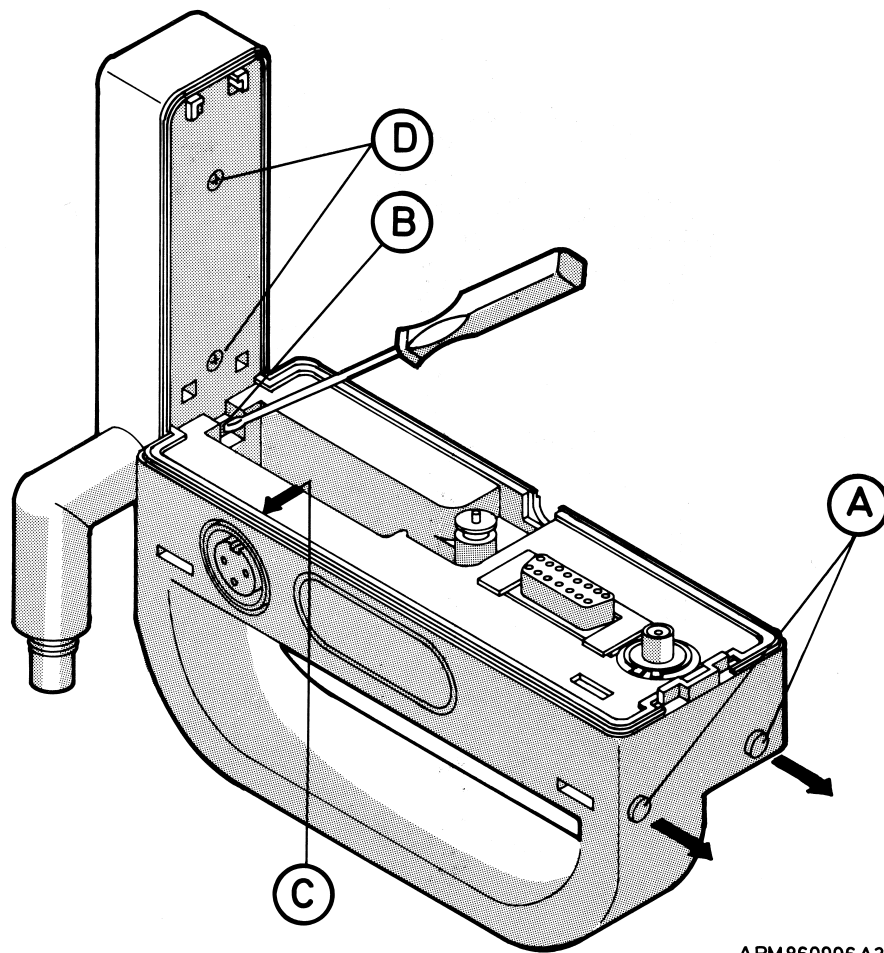
Fig. 1 Assembling of ap4000 portable

Dismantling is done as follows: First press the button on the battery. Then release the handle by pressing the oblong release button in the middle of the handle. CPH860906/0

Disassembling of the portable cassette (handle).

Refer to fig. 2.

- Remove the caps and screws (A) .
- While pressing the lock (B) by help of a screwdriver, you pull out the plastic slightly and carefully at (C) (so that it passes the connector) and while pressing the oblong release button you remove carefully the handle from the chassis.
- For access to the magnetic base remove the screws (D) .



APM860906A3

Fig. 2 Disassembling of the portable cassette

Disassembling of the battery pack.

Refer to fig. 3 and 4.

- Remove the screws (A) .
- To remove the charging circuit remove the screws (B) . By reassembling please note the insulating washer between the transistors Q2/Q3 and the metal cover.

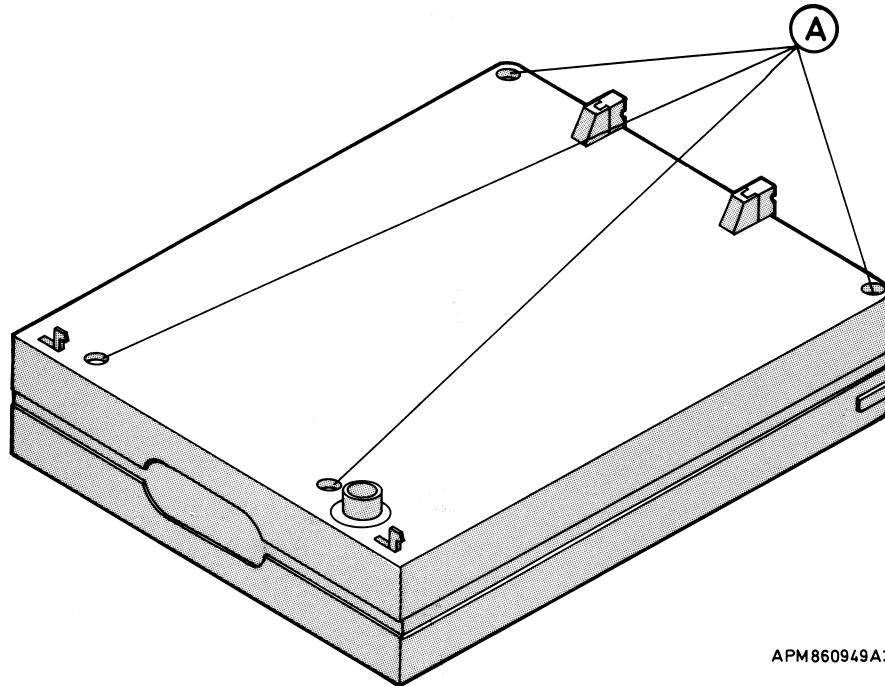


Fig. 3 Disassembling of the battery pack

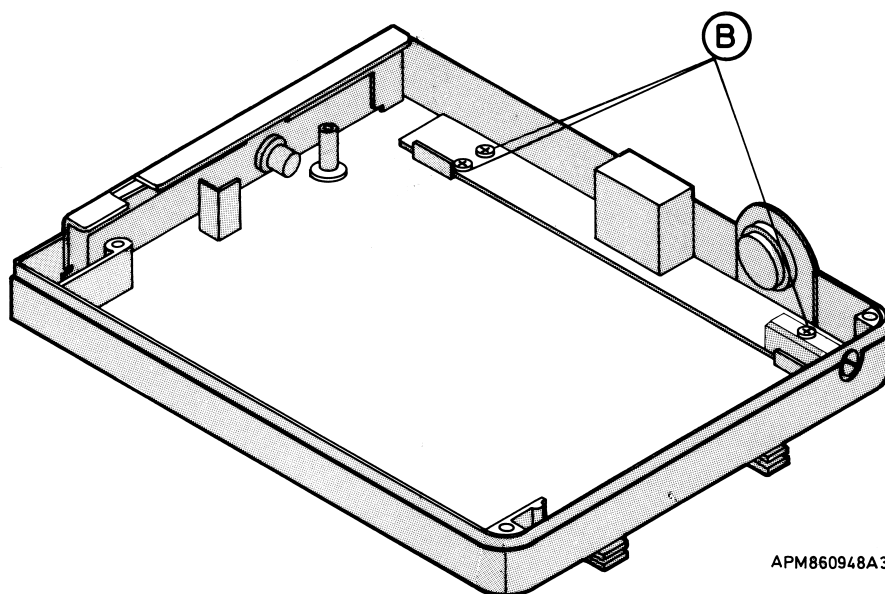
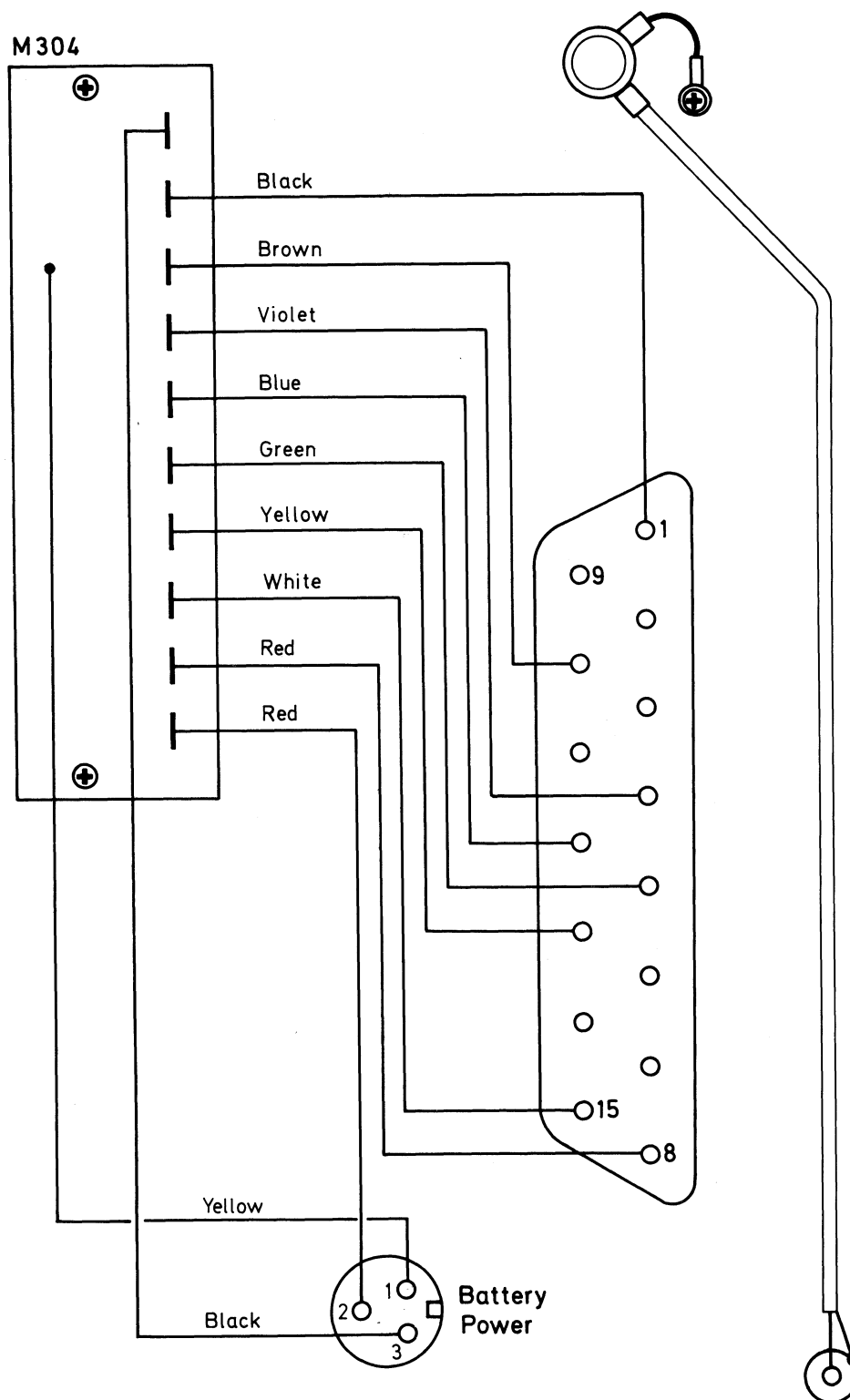


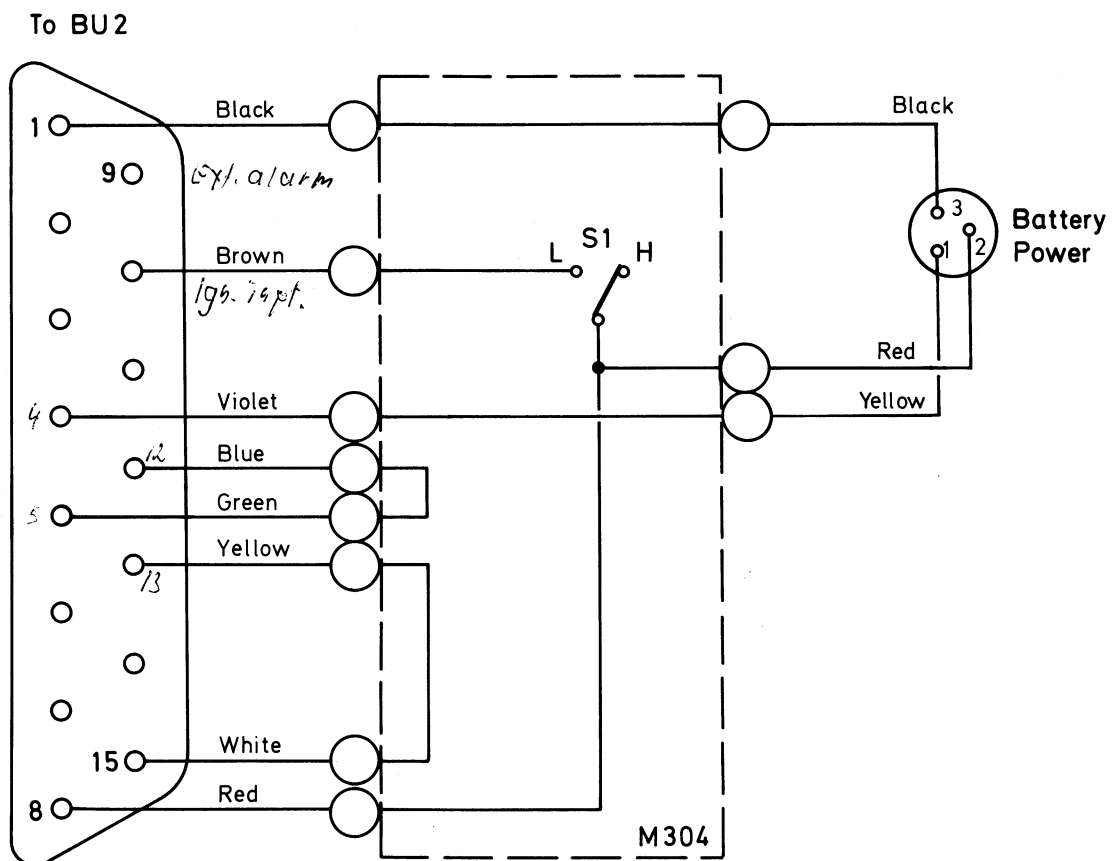
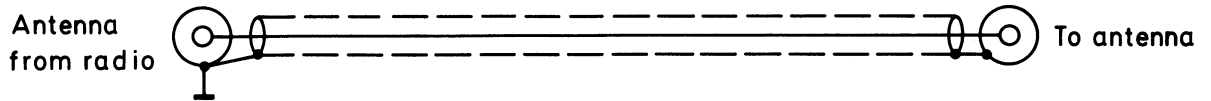
Fig. 4 Removing the charging circuit



APM861203A3

Fig. 5 Wiring diagram, portable cassette, version 2

CPH861206/0



APM861205A3

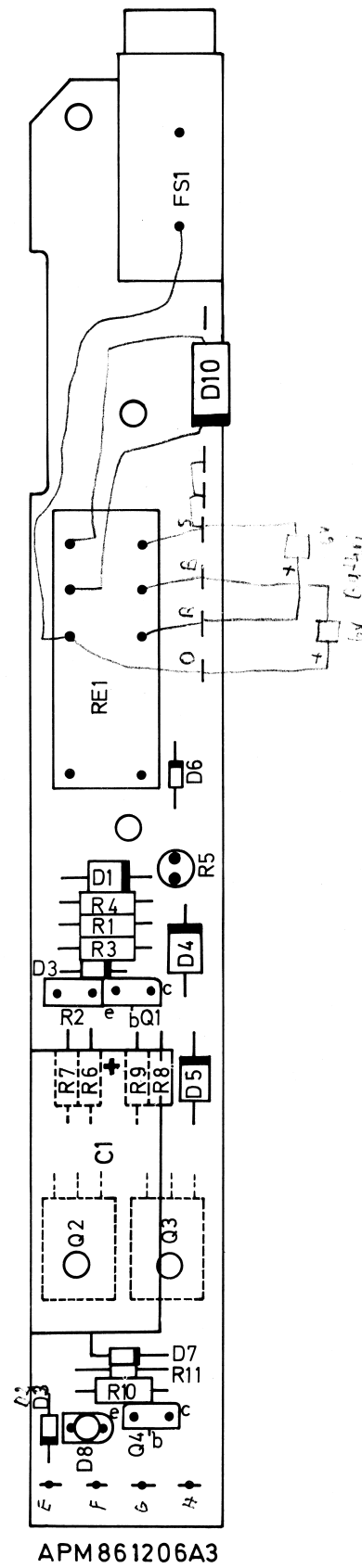


Fig. 8 Component location, charging circuit, version 2

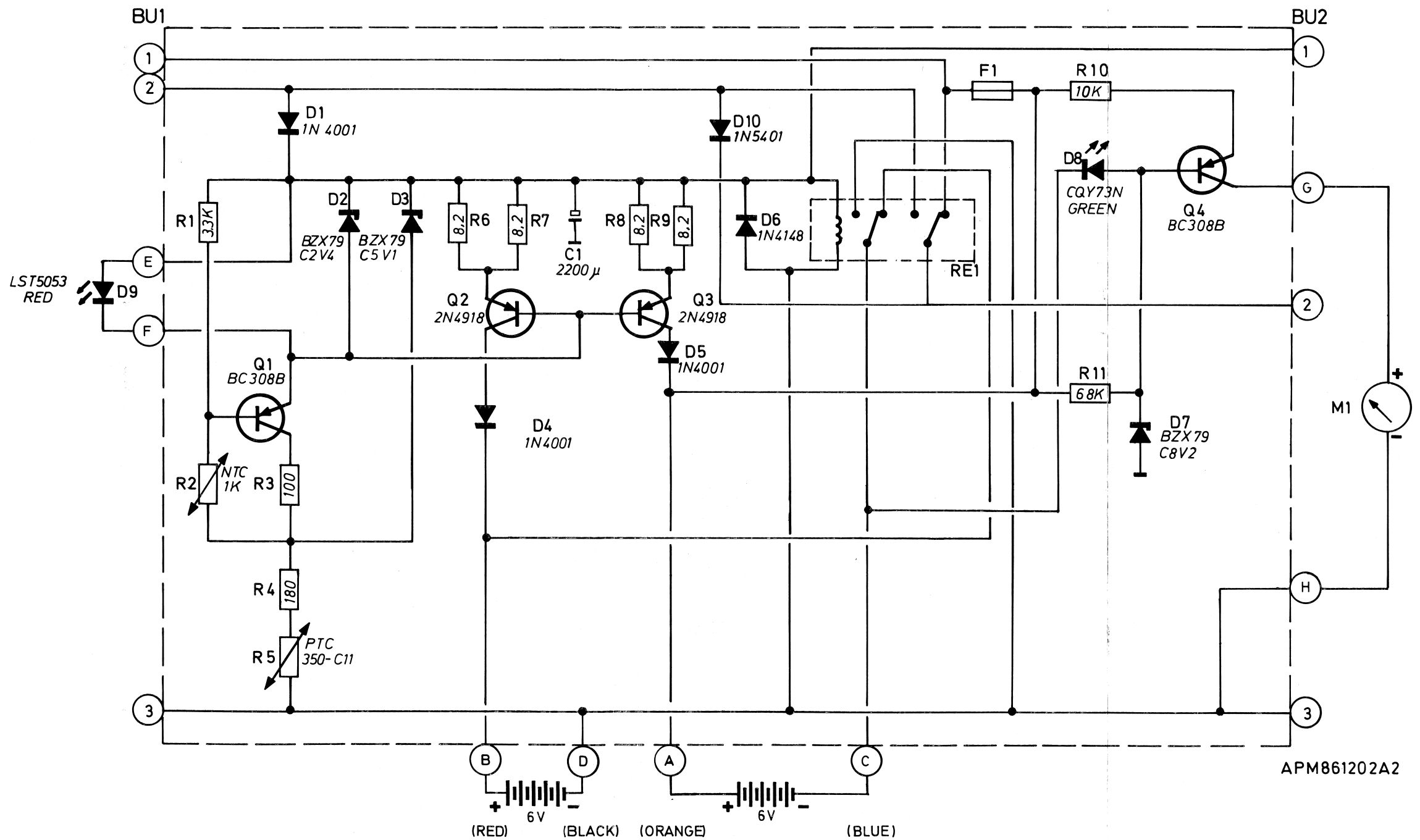
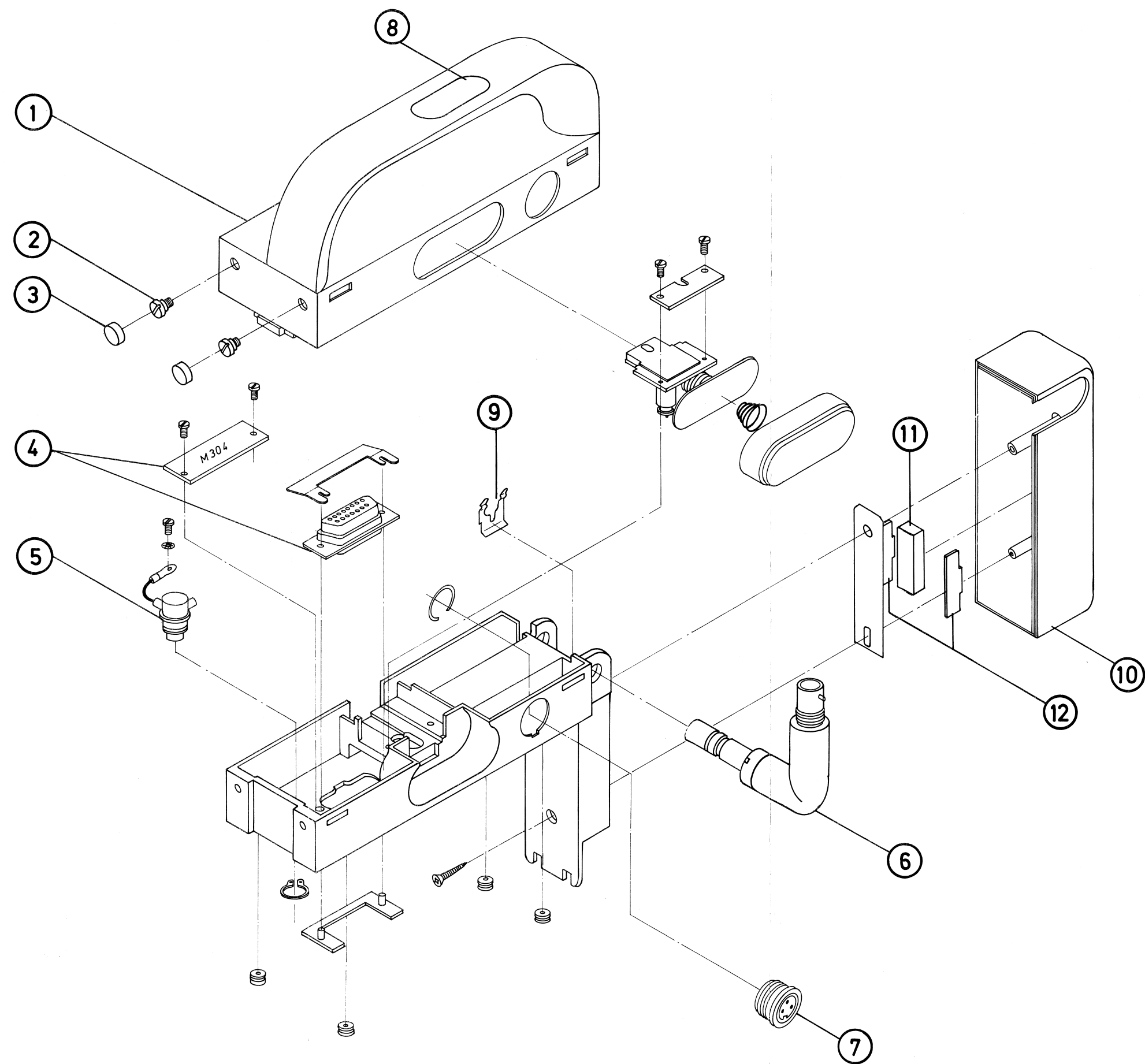


Fig. 9 Circuit diagram, charging circuit, version 2

Mechanical parts

PORTABLE CASSETTE:

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Handle	1	3508 101 50900
2.	Screw for handset	2	3508 101 21290
3.	Cap plug black	2	3508 101 51200
4.	Terminalboard M304	1	3508 102 21920
5.	Antenna plug male	1	3508 100 55450
6.	Antenna angle	1	8208 244 00111
7.	3 pole connector	1	3508 100 55430
8.	Sign: ap radiotelefon	1	3508 100 04490
8.	Sign: Philips	1	3508 100 04530
9.	Platespring	1	3508 101 21760
10.	Cover for magnetic base	1	3508 101 52130
11.	Magnet	1	3508 100 00750
12.	Pole plate	2	3508 101 21660



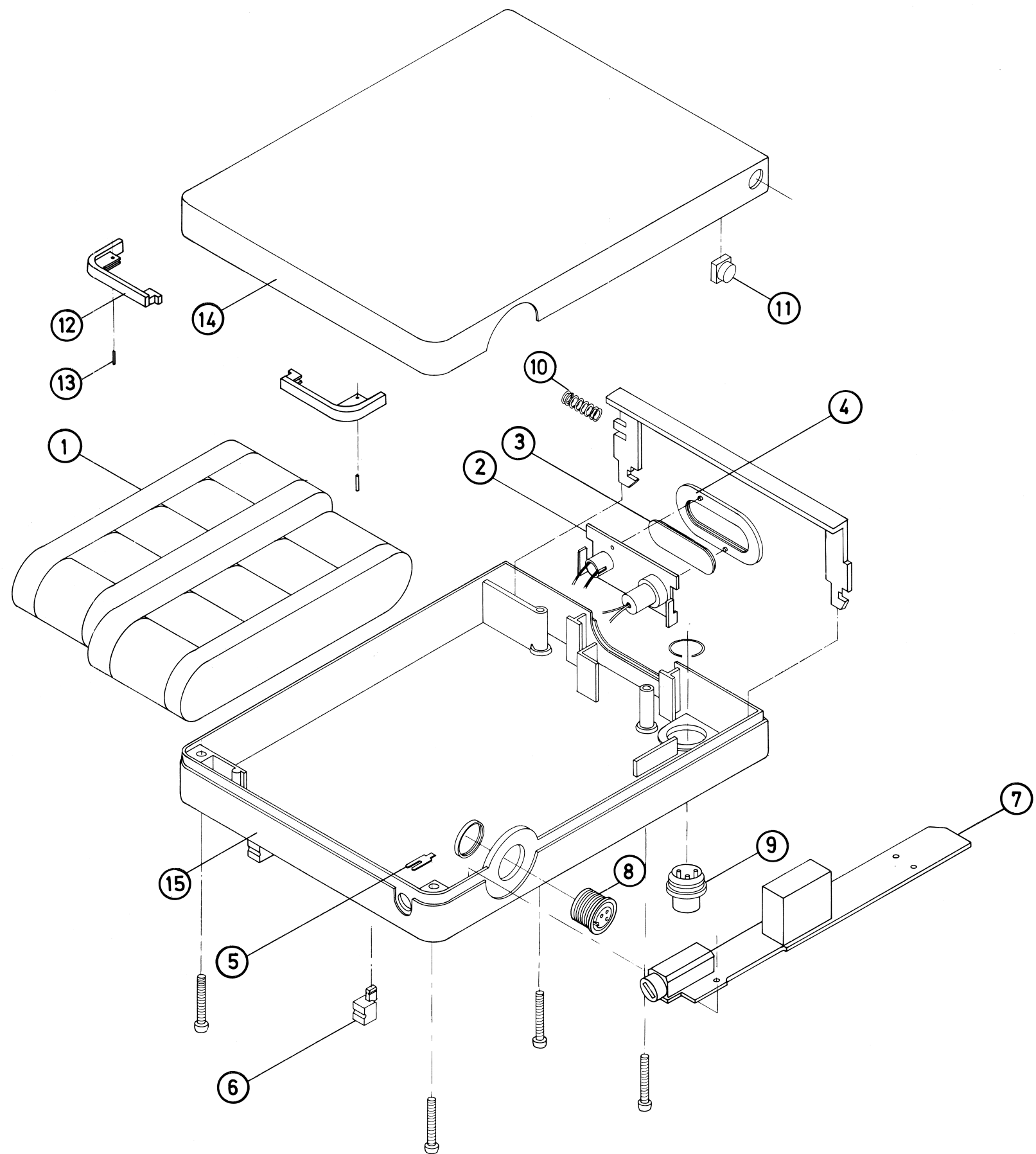
APM870317A1

BATTERY PACK:

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Battery. See Note 1:	1	3508 102 11780
1.	Battery-High temperature. See Note 2:	1	3508 100 8034Q
2.	Holder with indicator and control lamp	1	8208 244 00121
3.	Pane for indicator and control lamp	1	3508 101 51110
4.	Pane holder black	1	3508 101 51140
5.	Holder spring	2	3508 101 21160
6.	Lock part, black	2	3508 101 52020
7.	Charging circuit, complete	1	8208 244 00081
8.	3-pole connector, female	1	3508 100 55460
9.	3-pole connector, male	1	3508 100 55440
10.	Spring	1	3508 101 21340
11.	Button	1	3508 101 51180
12.	Bottom part	2	3508 101 52800
13.	Clamp pin	2	2522 677 01015
14.	Front part, Black	1	3508 101 20990
14.	Front part, White	1	3508 101 21130
15.	Rear part, Black	1	3508 101 21000
15.	Rear part, White	1	3508 101 21120

Note 1: This battery type is recommended for temperatures between -25°C and $+55^{\circ}\text{C}$.

Note 2: This battery type is recommended for temperatures between 0°C and $+70^{\circ}\text{C}$.



APM860702A1

Electrical parts

BATTERY PACK:

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

TRANSISTORS

Q1,4	3508 100 11130	BC308B
Q2-3	9331 234 20682	2N4918

DIODES

D1,4-5	9330 635 30113	1N4001
D2	9334 146 80113	BZX79-C2V4
D3	9331 177 20113	BZX79-C5V1
D6	9330 839 90113	1N4148
D7	9331 177 70113	BZX79-C8V2
D8	9335 478 20682	LED CQY73N
D10	9332 116 80682	1N5401

RELAY

RE1	3508 100 60080	12V 2 shiftset
-----	----------------	----------------

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	---------	-----------	-------------

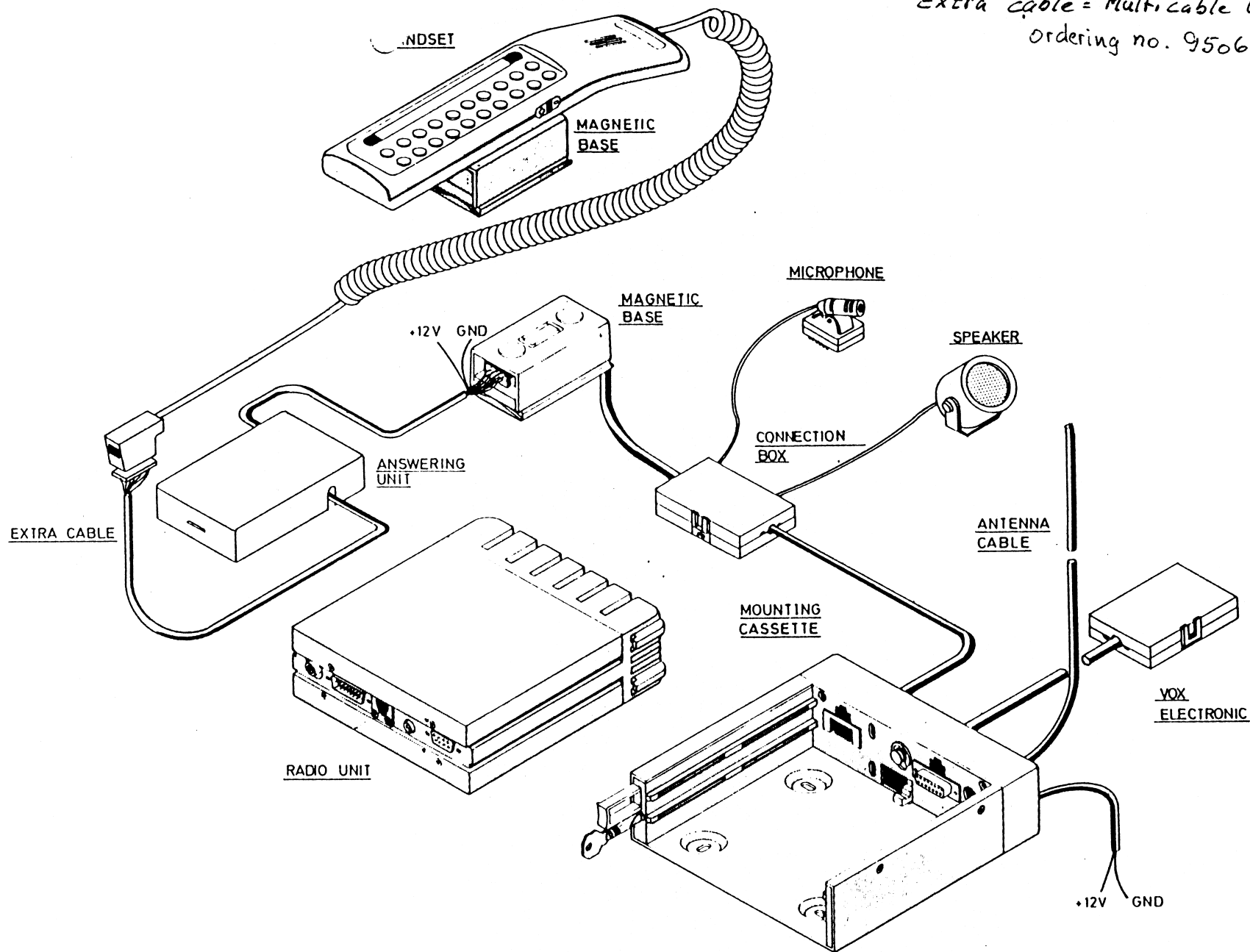
CAPACITORS

C1	2222 032 15222	2200U	5%	16V	Electrolytic
----	----------------	-------	----	-----	--------------


RESISTORS

R1	2322 186 13332	3K3	5%	0.4W	NTC
R2	2322 642 62102	1K0	10%	0.5W	
R3	2322 186 13101	100	5%	0.4W	
R4	2322 186 13181	180	5%	0.4W	
R5	3508 100 21380	350			PTC
R6-9	2322 186 13828	8R2	5%	0.4W	
R10	2322 186 13103	10K	5%	0.4W	
R11	2322 186 13683	68K	5%	0.4W	

Extra cable = Multicable w/ lug 1.5m
 Ordering no. 9506 100 70420



APM880603A2 /00

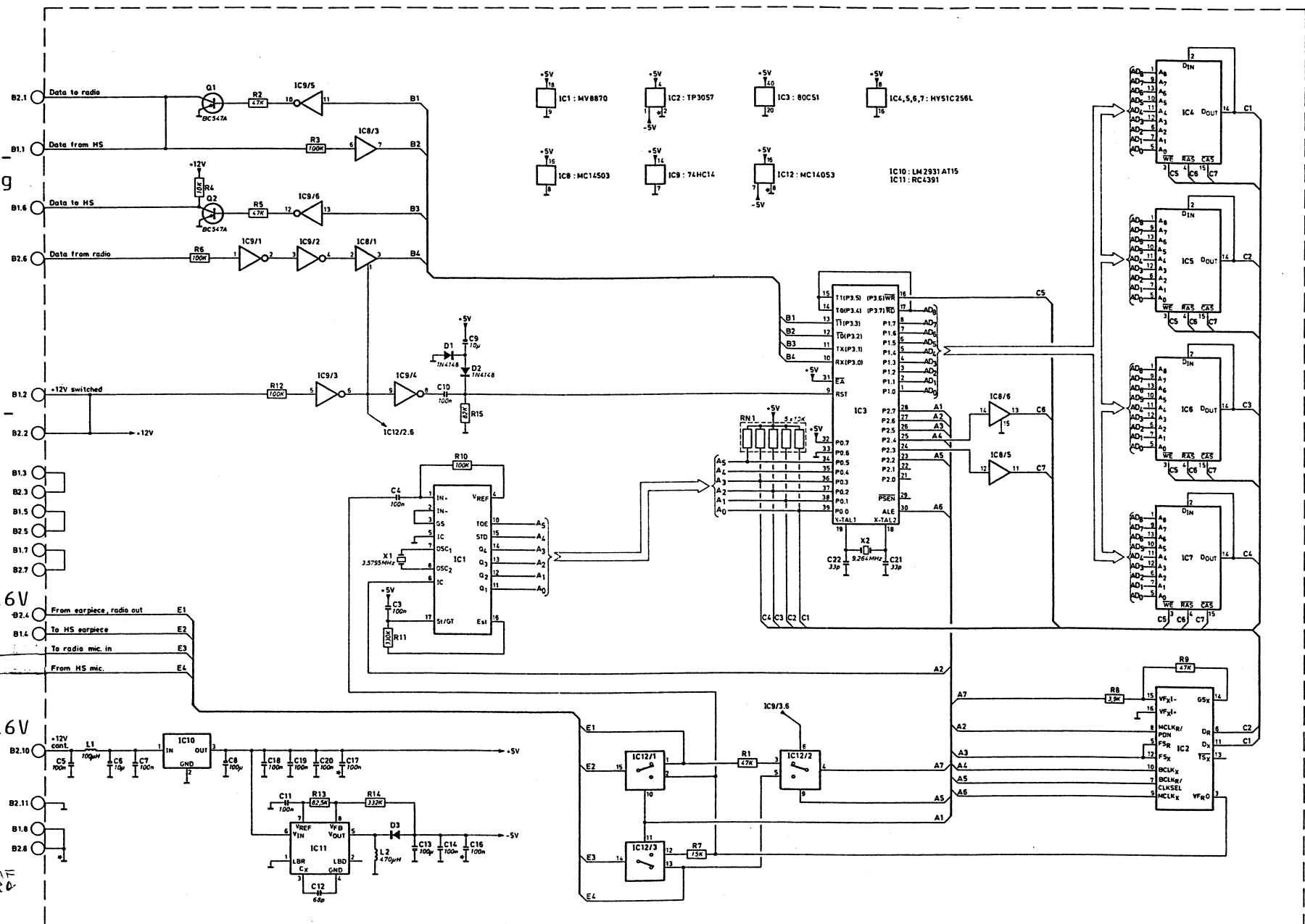
	KOBLINGSTEGNING FOR AP 4111, 4015, 4016	APM880603A2							
Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.	Part No. K.F.

NOTE 1:
Modstand og kondensatore bør anbringes i kabling af hensyn til udskiftning af digianswer

NOTE 2:
Hvis digianswer skal anvendes sammen med stjerner i handset skal IC 3 være mærket "83C154-309"

10uF/16V
B2.9
1K
B1.9
10uF/16V

kondensatorer og modstand mærkes bør 4112 kører med både digianswer og vox





PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning

AP 4015

89.06

A version 3 of the software for the telephone answering unit AP 4015 has been developed. The difference from the earlier version is that the version 3 is capable of handling DTMF signals to be transmitted.

The version 3 software can be ordered from Philips Service DK, and later from Concern Service.

The software is marked M83C154-319.

The order number by Philips Service DK is:

8208 248 00479.

The order number by Concern Service will be issued later.



PRCS-Service

Philips Radio Communication Systems (Copenhagen)

CONCERNING

AP 4015

88.04

Fault : The telephone answering unit AP 4015 will not record your voice message together with handsets displaying *** as field strength indication.

Problem : The AP 4015 contains a micro processor 80C51-131 used in the introduction phase of the AP 4015.

Repair : Replace the old micro processor with a new one 83C154-309 ordering number: 8208 248 00477.

For DTMF signalling H 83C 154-319 8208-248-00479

New AP 4015's are today mounted with software version 2 (83C154-309) this software must be used if the above mentioned problem occur.

Software version 3 is on its way and when this version is available you will be informed. All version 1 and 2 software must then be changed to version 3.

ap4015 Telephone answering unit

CONTENTS	PAGE
Introduction	2
Technical data	3
Installation (including disassembling)	4
Operating instructions	7
Description of the telephone answering unit	9
Component location	10
Circuit diagram	11

Introduction

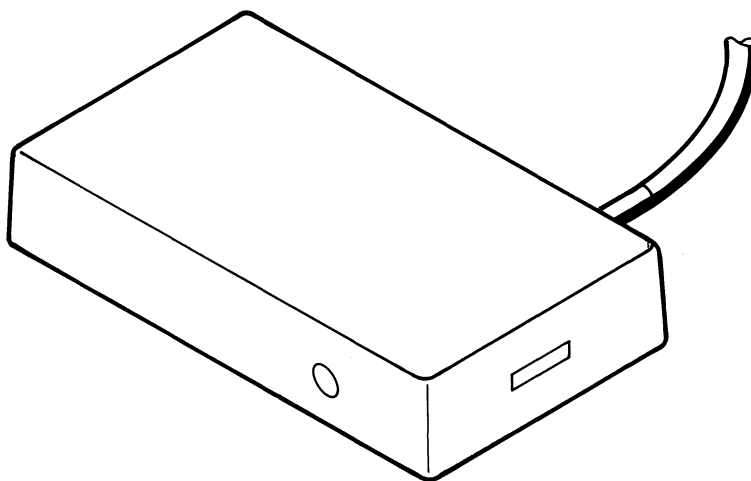
The ap4015 is a telephone answering unit for the ap4000 series.

The telephone answering unit uses a digital memory instead of a conventional taperecorder. This makes it much more suitable for use in cars since it has no moving parts which could be sensitive to vibrations, climatic conditions etc.

The ap4015 consists of only one unit which is inserted between the handset and the transceiver and is operated from the handset of the mobile telephone.

The ap4015 is able to store an answering message with a duration of 16 seconds. Furthermore it will store a telephone number given by caller. The requirement is that the caller uses a push-button telephone (with Dual Tone Multi Frequency signalling).

The ap4015 is able to store up 9 numbers of 16 digits each.



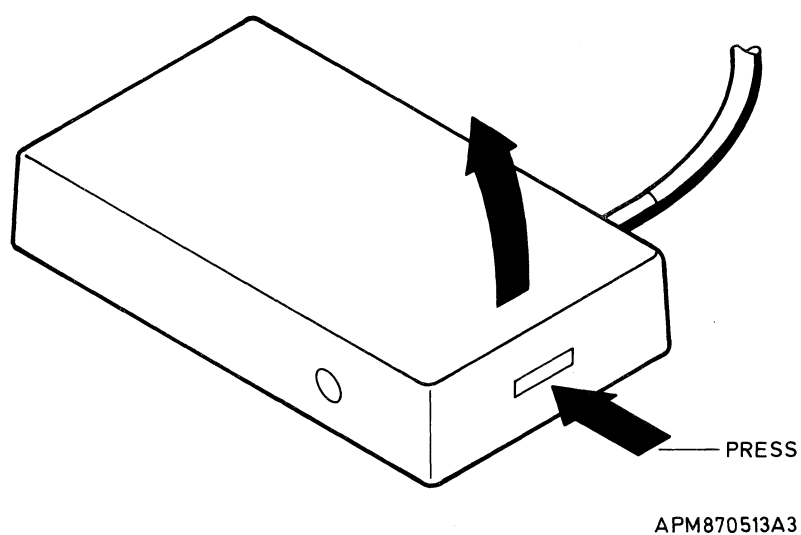
APM870512 A3

Technical data

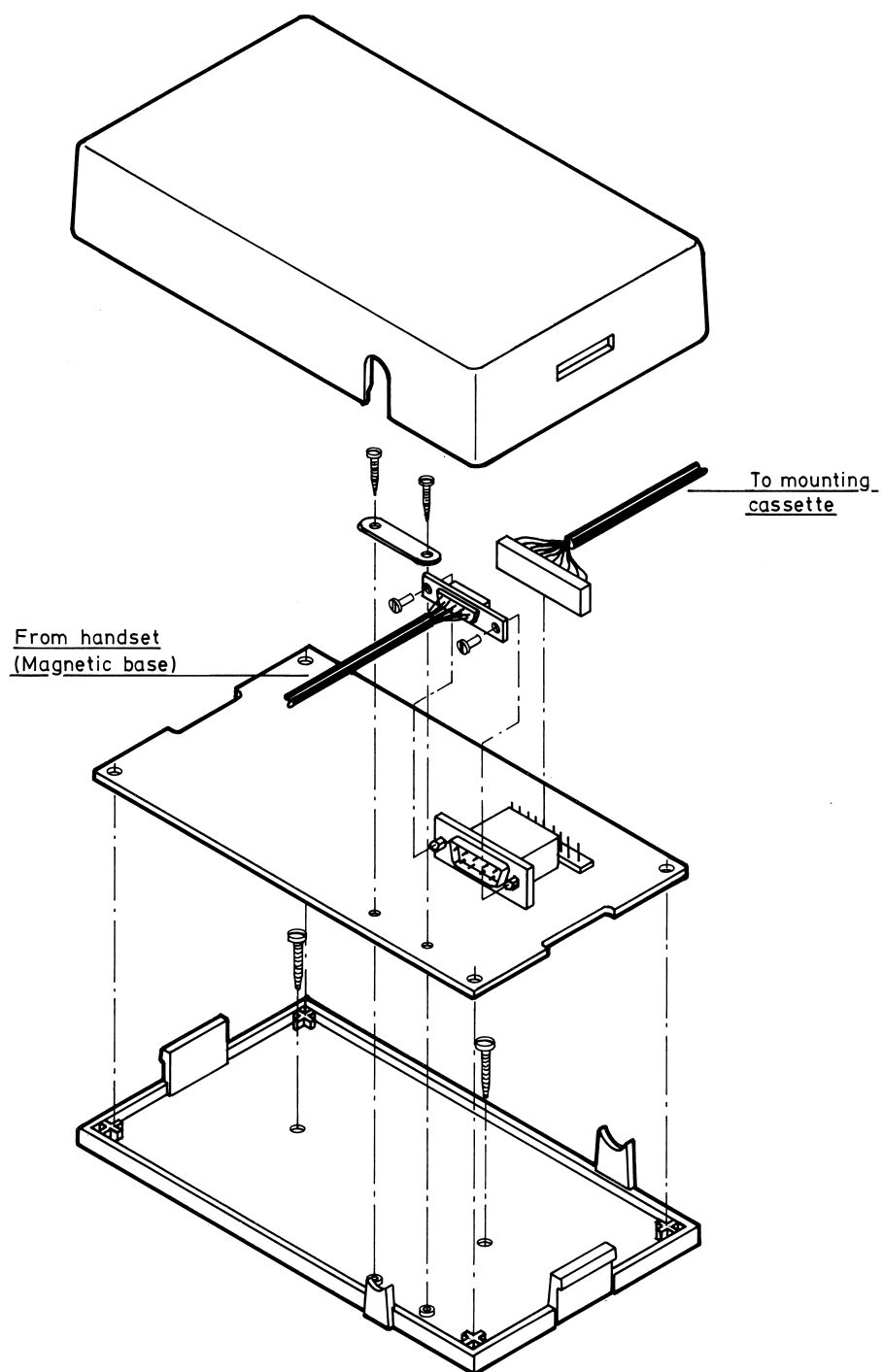
Recorded speech duration	: Maximum 16 seconds
Number of incoming numbers for registration	: Maximum 9
Current consumption	: Stand-by : 6mA On-line/recording/play: 50mA
Supply voltage	: 7-15.6V
Operation temperature	: -25 ⁰ C to +55 ⁰ C -30 ⁰ C to +70 ⁰ C but specifications not guaranteed
Storage temperature	: -50 ⁰ C to +75 ⁰ C
Earpiece level	: 1200mV RMS
<u>DTMF:</u>	
Earpiece input area	: -50dBm0 to 0dBm0
Signal to noise	: >=10dB
Frequency accept limit	: +/-1.5%
Tone reaction time	: 40ms

Installation

- Open the box by pressing in one of the slides in the box.

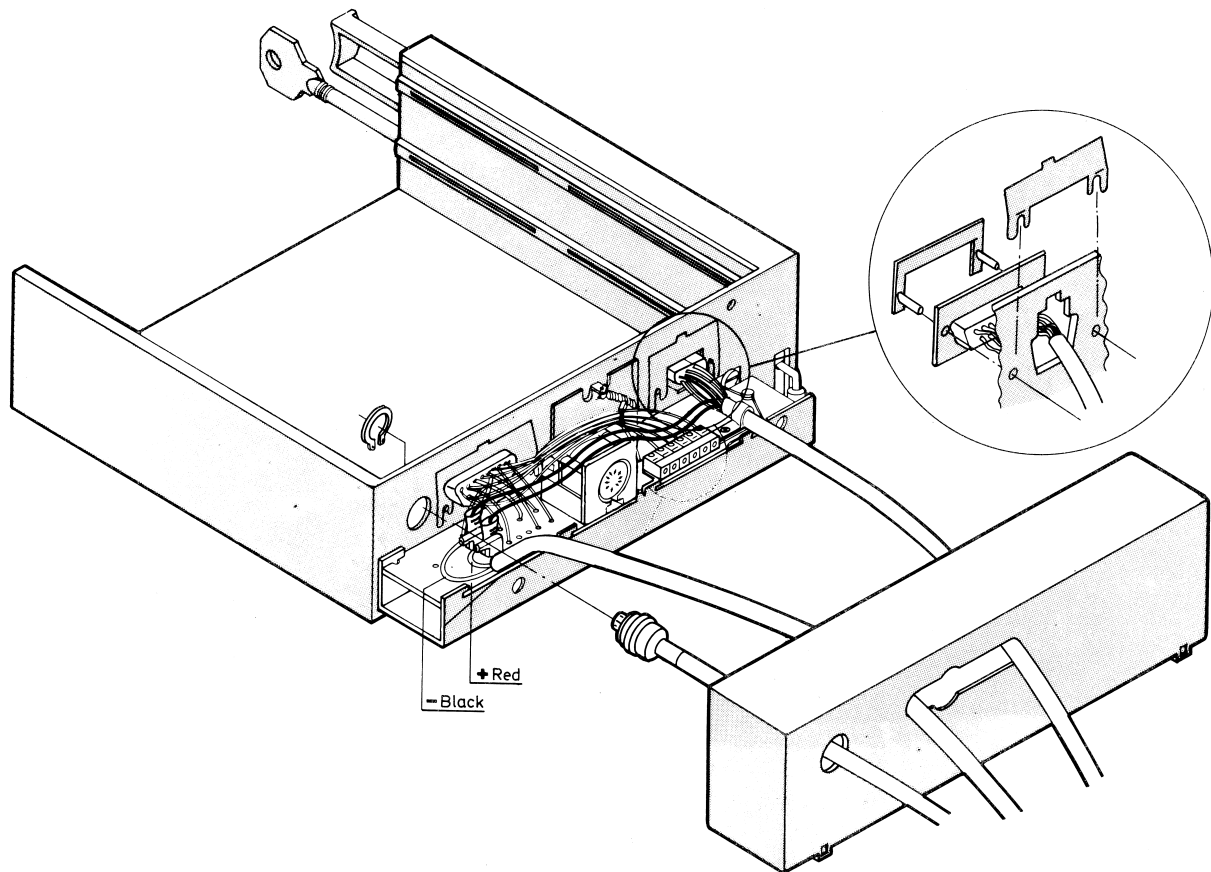


- Remove the printboard.
- Mount the ap4015 (bottom part) near the transceiver using the two enclosed screws.
- Mount the multicable coming from the handset (magnetic base) on the print of the ap4015 telephone answering unit instead of the usual place in the mounting cassette.



APM870407A2

- Mount the multicable from the ap4015 in the mounting cassette.
- Connect the power supply cables in the mounting cassette.
- Replace the cover on the ap4015.



APM870515 A2

Operating instructions

The ap4015 telephone answering unit is operated from the handset of the mobile telephone.

Activation of the telephone answering unit

The ap4015 is activated by pressing **→** , **4** . When **→** , **4** are pressed the ap4015 gives one of three possible messages in the display:

- a) "No speech" - There is no message recorded. The ap4015 will not be replying calls until you have recorded a message.
- b) "Tel_ans on" - The ap4015 is ready for use and will be replying a call after 5 seconds ringing unless the call has been answered manually by lifting handset or pressing **⌂** .
- c) "X Calls" - The ap4015 has received X calls (1 to 9). If 9 calls have been recorded the ap4015 is switched off by the next call.

NOTE: If no button has been pressed for 10 seconds the ap4015 will automatically leave the **→** , **4** mode.

Recording a message

Press **→** , **4** , **T** . The display will read "REC READY". Now press **T** and keep it down while speaking your message into the handset microphone (max. 16 seconds).

The display will read "RECORDING" while the **T** - button is pressed.

When the recording is finished the ap4015 automatically replays the recorded message for a check.

The ap4015 thereafter returns to the "Tel ans on" mode.

If **→** , **4** , **T** , **T** are pressed the recorded message will be erased and the display will read "No speech".

Checking the recorded message

If the ap4015 is in the **→** , **4** mode the recorded message can be played by pressing **0** . A further press on **0** will stop the play-back.

Receiving a call with an ap4015 mounted

If the ap4015 contains a recorded message, it is switched on ("Tel ans on"), and there are less than 9 numbers registered in the memory, the ap4015 will answer the call after 5 seconds ringing.

If the handset is lifted or **⌂** is pressed within the 5 seconds ringing the ap4015 will not answer the call.

When the ap4015 is replying a call the display will read "Tel_ans_on_line".

Recall of numbers registered

Activate the ap4015 (press \rightarrow , 4). If the display reads " X calls" you can recall the numbers by pressing $\#$. As long as $\#$ is being pressed, the display shows the number in the row (1=first incoming number, 9=last incoming number) and the time since the call was registered (hours and minutes).

A further press on $\#$ shows the next number in the row.

If none of the digits A, B, C, or D are included in the registered telephone number, the number can be sent directly by lifting the handset or by pressing \rightarrow .

Erasing numbers registered

Activate the ap4015 (press \rightarrow , 4). Find the number you want to erase by pressing $\#$. The selected number is erased by pressing $*$.

De-activation of telephone answering unit

The ap4015 can be switched off by pressing \rightarrow , 4 , M . The display will read "tel_ans_OFF".

Description of the telephone answering unit

The heart of the ap4015 is the mask-programmed microprocessor IC3.

This IC listens to the data communication between the transceiver and the handset and simulates communication between handset and transceiver.

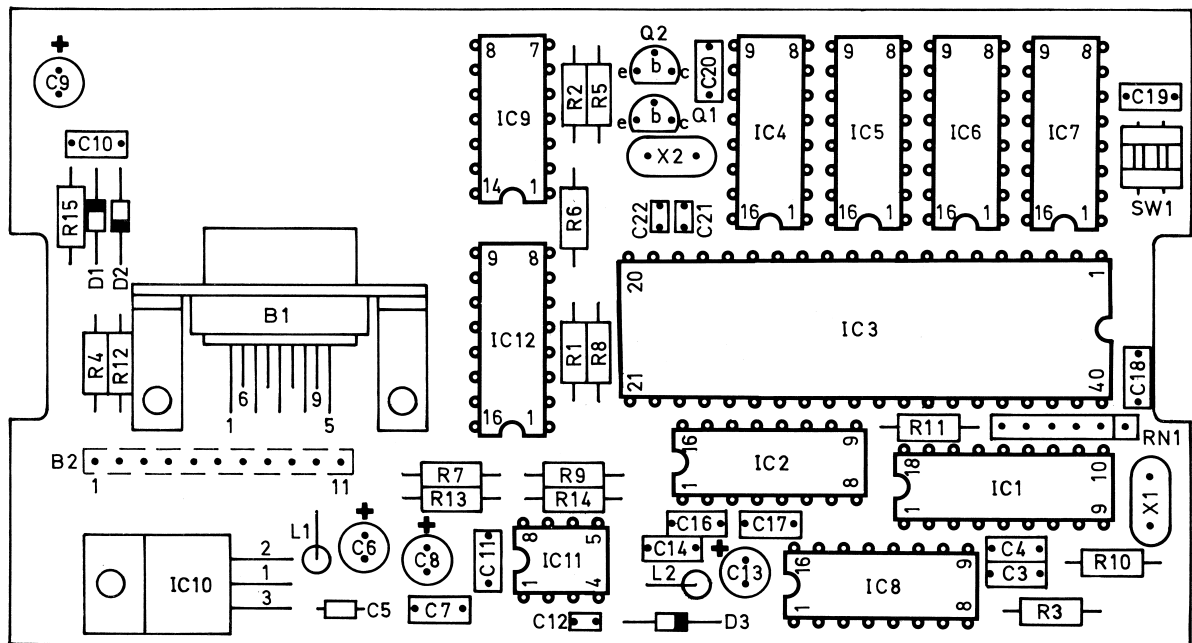
The A/D-D/A conversion is made by IC2. The master clock pulse for the internal anti-aliasing filter comes from IC3 and is fed to pin 9 of IC2.

The DTMF signalling is received by IC1. Since the signal for the earpiece may vary 25dB between minimum and maximum volume a microprocessor controlled AGC has been introduced. The earpiece signal is therefore fed to IC2 and IC3 before it reaches IC1.

The Speech memory consists of IC4-7 which are 4 pcs. 256kHz C-MOS DRAM's.

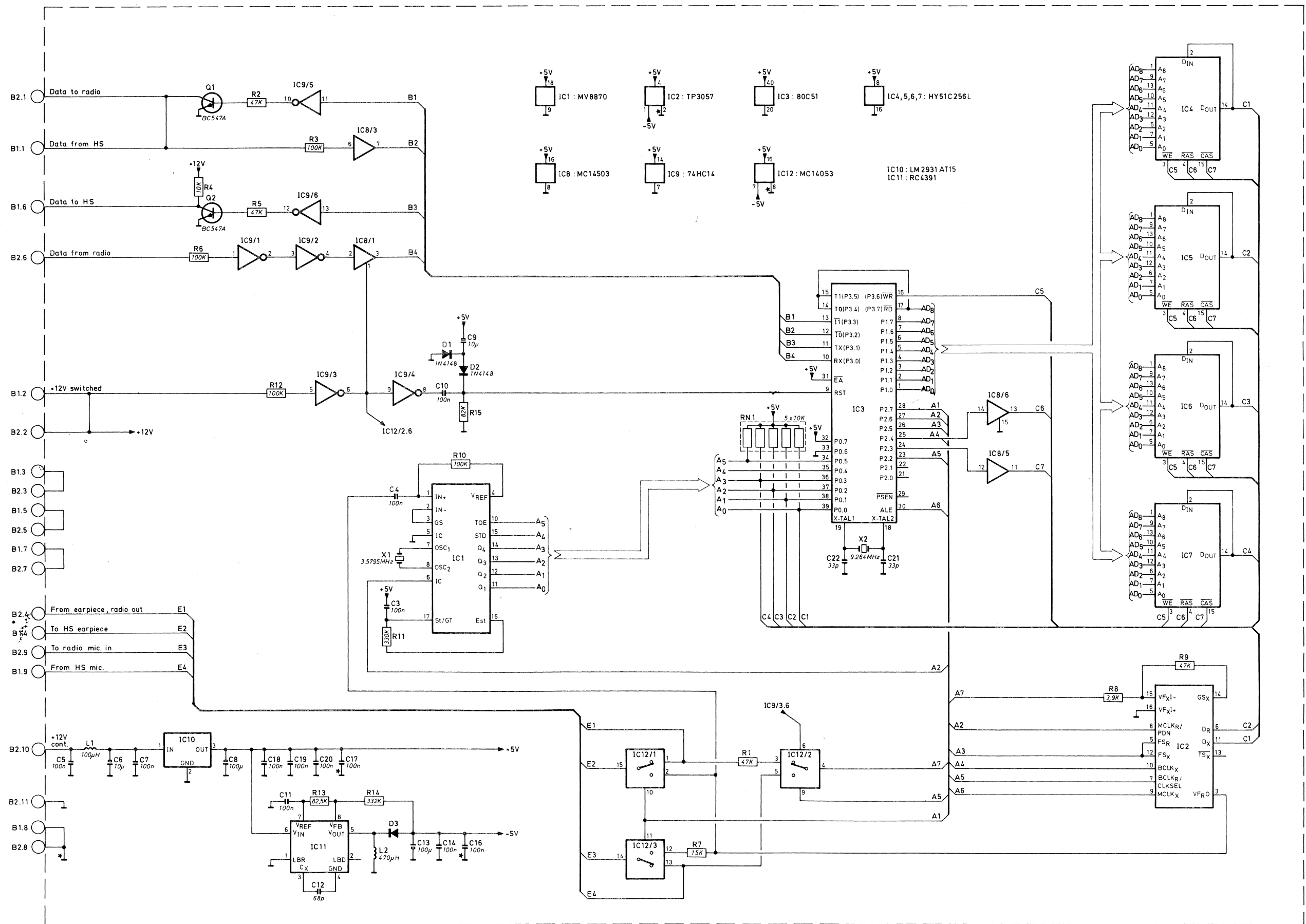
The reset circuit provides IC3 via C10 with a short reset pulse every time the mobile telephone is switched on.

This reset-pulse does not influence the speech-memory.



APM870406A3

Ges. Lampe bzw. Indikator optisch
mit elektronischer Schaltung, Lampe für
Mensch abgelesen werden

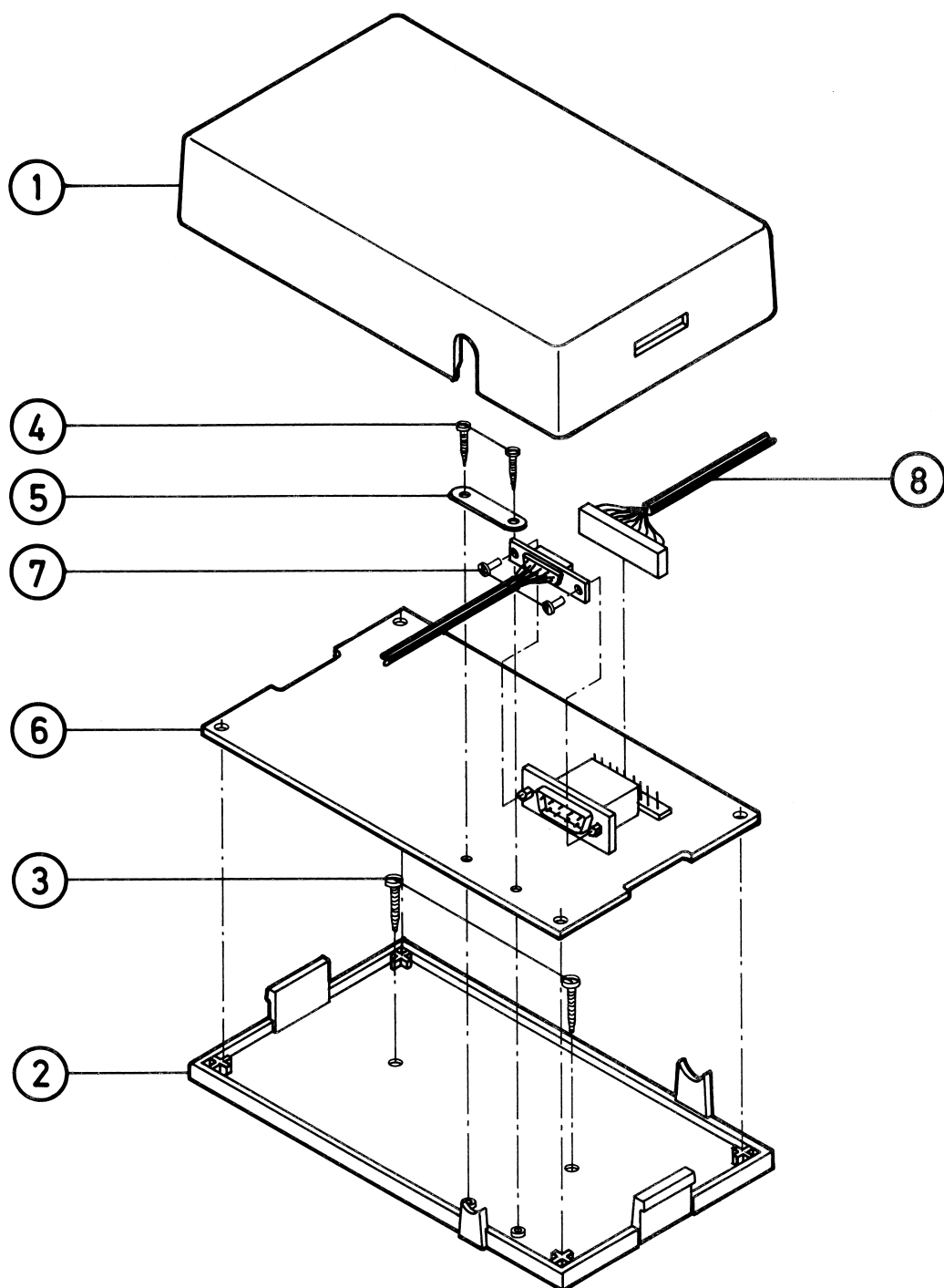


APM870405A0

Fig. 2 Circuit diagram, Digianswer

Mechanical parts

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>ORDERING NUMBER</u>
1,2.	Mounting box	1	8208 248 00469
3.	Screws for mounting box	2	8208 248 00470
4.	Screws for wire relief	2	8208 248 00471
5.	Wire relief	1	8208 248 00472
6.	Exchange print board NEC 126	1	8208 248 00473
7.	Screws for DP9 female	2	8208 248 00474
8.	Cable SP130 AP 4003/4015	1	8208 248 00476



APM880403A2/00

Fig. 3 Exploded view, digianswer

Electrical parts

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

INTEGRATED CIRCUITS

IC1	8208 248 00451	MV8870
IC2	8208 248 00452	TP3057J
IC3	8208 248 00477	83C154/309
IC4-7	8208 248 00478	HY51C256L
IC8	8208 248 00435	MC14503
IC9	8208 248 00454	74HC14
IC10	8208 248 00455	LM2931AT-5.0
IC11	8208 248 00456	RV4391NB
IC12	8208 248 00432	MC14053

TRANSISTORS

TR1-2	9331 976 30112	BC547
-------	----------------	-------

DIODES

D1-2	9330 869 90113	1N4148
------	----------------	--------

COILS

L1	8208 248 00457	100uH/100mA
L2	8208 248 00458	470uH/50mA

CRYSTALS

X1	8208 248 00409	3.579545MHz
X2	8208 248 00459	9.264MHz

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	---------	-----------	-------------

CAPACITORS

C3,19-20	8208 248 00406	100N	+-5%	63V	
C4-5,7,10-11, 14,16-18	8208 248 00402	100N	+80/-20%	50V	
C6,9	8208 248 00466	10U	+-20%	25V	

NUMBER	ORDERING NUMBER	VALUE	TOL (%)	VOLT/WATT	DESCRIPTION
C8,13	8208 248 00467	100U	+20%	6.3V	
C12	8208 248 00468	68P	+2%	100V	
C21-22	8208 248 00403	33P	+2%	100V	

RESISTORS

R1-2,5,7,9	2322 186 13473	47K	5%	0.4W	
R3,6,10,12	2322 186 13104	100K	5%	0.4W	
R4	2322 186 13103	10K	5%	0.4W	
R8	2322 186 13392	3K9	5%	0.4W	
R11	2322 186 13334	330K	5%	0.4W	
R13	8208 248 00464	82K5	1%	0.4W	
R14	8208 248 00465	332K	1%	0.4W	
R15	2322 186 13823	82K	5%	0.4W	
RN1	8208 248 00463	5x10K	SIL		

AP 4016 Voice Operated Handsfree

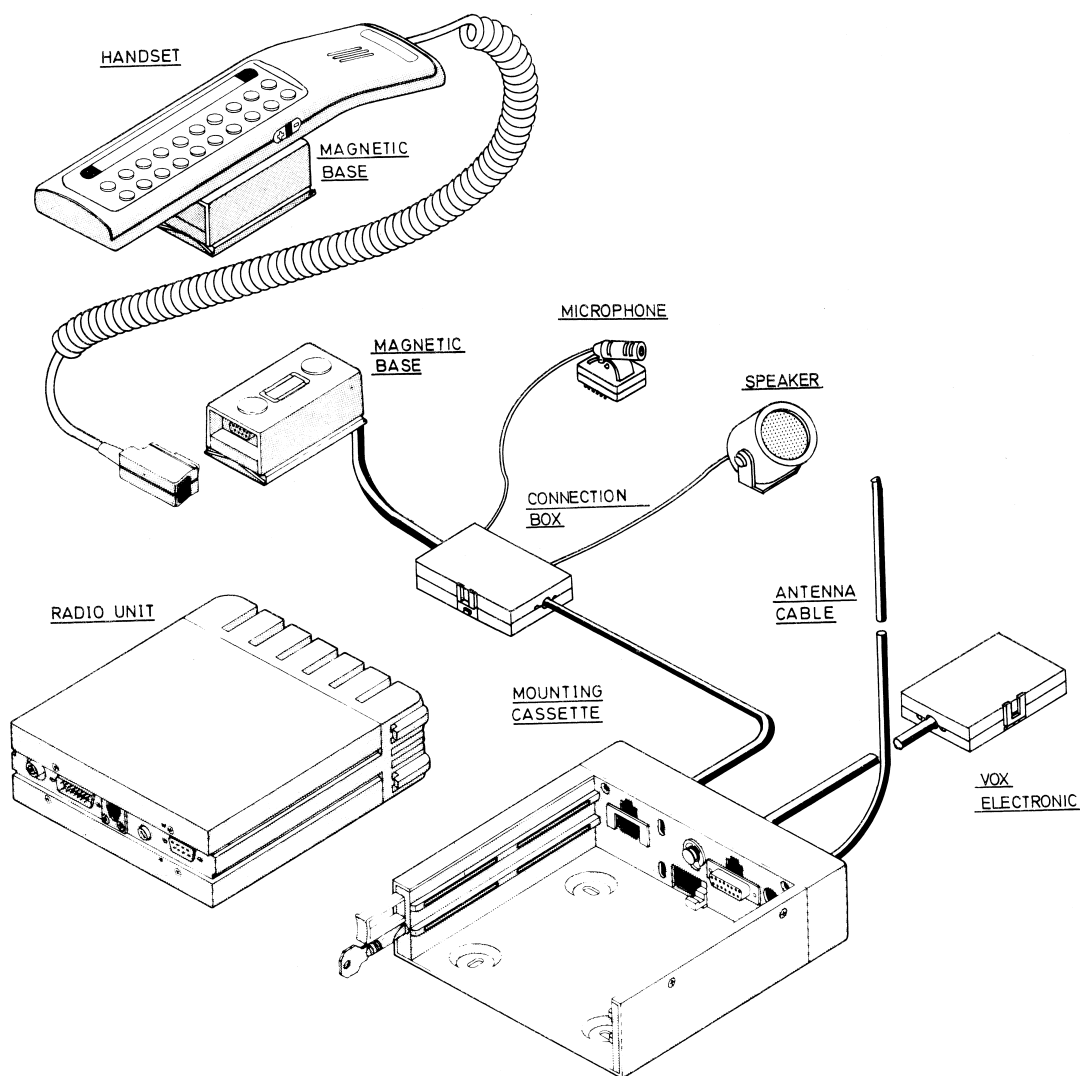
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Mechanical parts	21
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Introduction

The AP 4016 Voice Operated Handsfree kit (VOX kit) is an option for the mobile telephones AP 4111 and AP 4112. The VOX kit makes real handsfree operation possible by means of an external microphone and an external loudspeaker.

The VOX kit consists of:

- a box (connection unit) which is to be mounted near the dashboard (magnetic base) with connections for external microphone and loudspeaker.
- a box (VOX electronic unit) which is to be mounted near the mounting cassette.
- a small print which is to be mounted in the transceiver.
- an external microphone.
- an addition for the operating manual.
- an installation instruction.



APM 870622A2

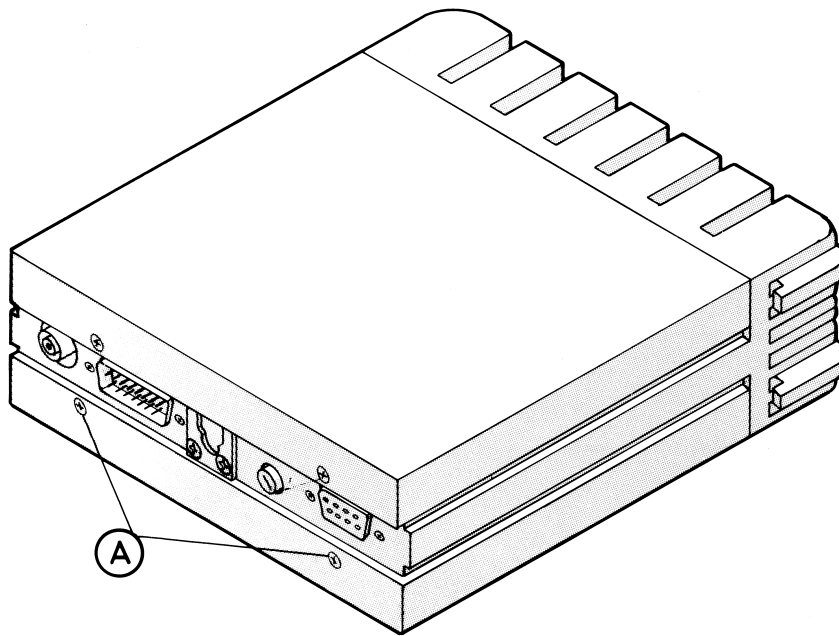
Fig. 1 Survey of the mobile telephone with VOX kit

CPH870901/0

Installation instructions

INSTALLATION OF THE INTERFACE UNIT

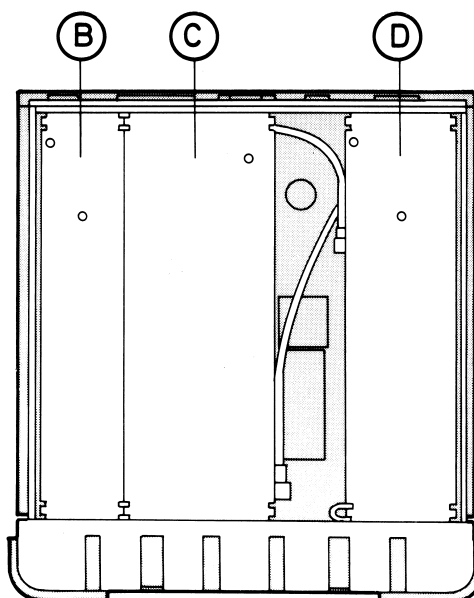
- Remove the screws (A) to get access to the transceiver.



APM 870618A2

Fig. 2 Transceiver

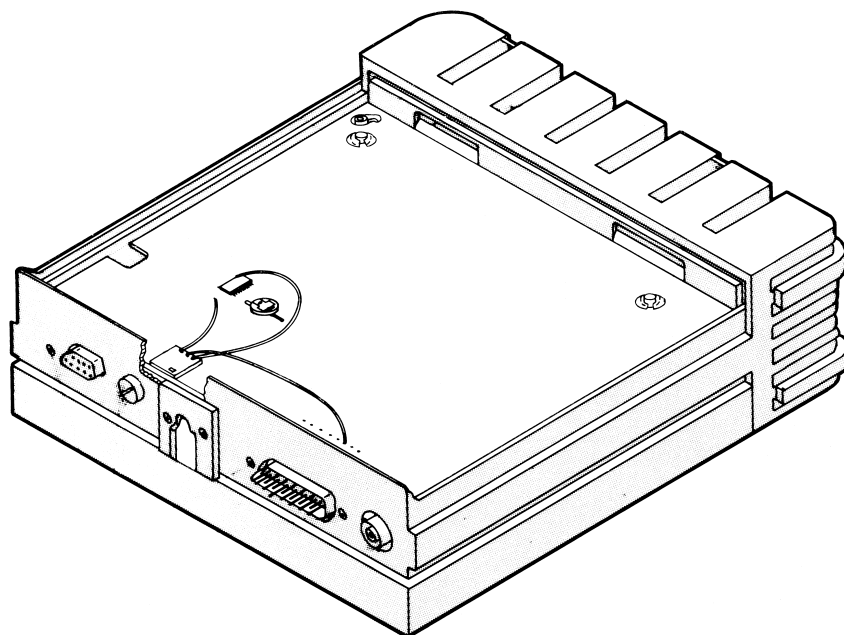
- Remove the coaxial cables.
- Lift out the units (B), (C), and (D) carefully.



APM860924A3

Fig. 3 Unit location

- Place the interface unit as shown on fig. 4.*



APM 870617A3

Fig. 4 Placing the interface unit

450MHz telephones:

- Connect the wires from the interface unit exactly as shown on fig. 5.
- Remove R221 on the systemboard, unit 1.*
- Shift (update) the EPROM (IC220 on unit 1) if the software version is: AP 4111: 4 or lower.
AP 4151: 2 or lower.

900MHz telephones:

- Connect the wires from the interface unit exactly as shown on fig. 6.
- Remove R248 on the systemboard, unit 1.
- Shift (update) the EPROM (IC201 on unit 1) if the software version is 1.

Later software versions for the above mentioned telephones will contain the changes necessary for the VOX operation.

In case of other types of 450MHz mobile telephones please refer to the service manual for the mobile telephone in question.

* If the systemboard's printboard for the 450MHz telephones is marked 3508 101 6124.X the VOX interface unit should not be mounted. Nor should R221 be removed. The printboard's number is found underneath the TX-synthesizer (unit 4).

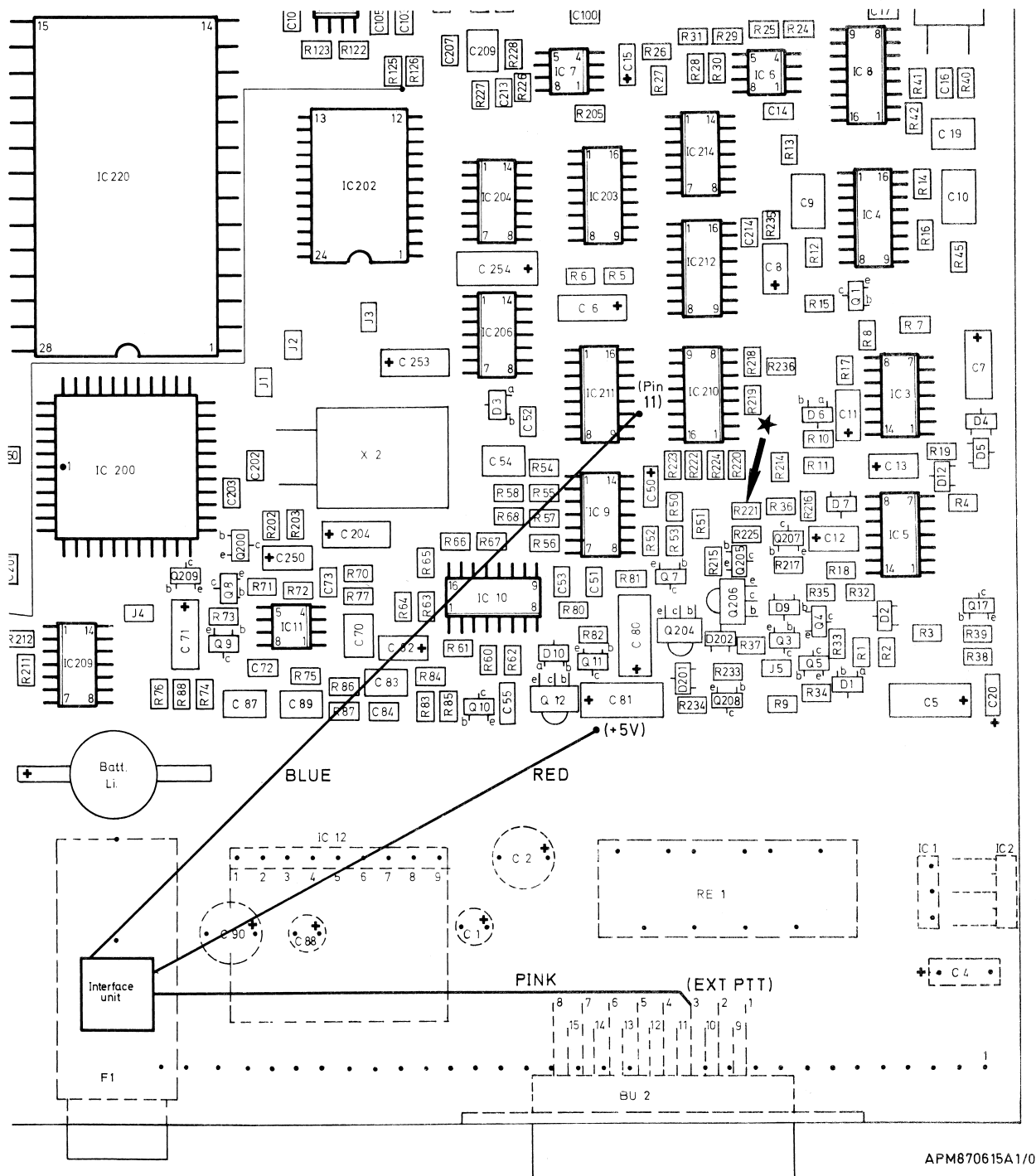
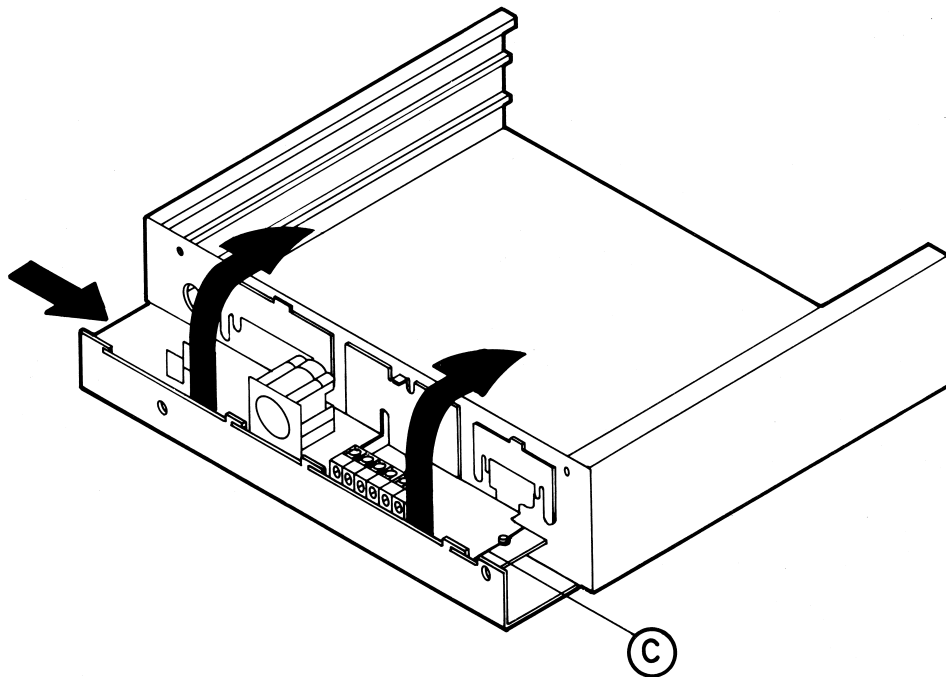


Fig. 5 Component location, system board, unit 1, AP 4111

CPH870901/0

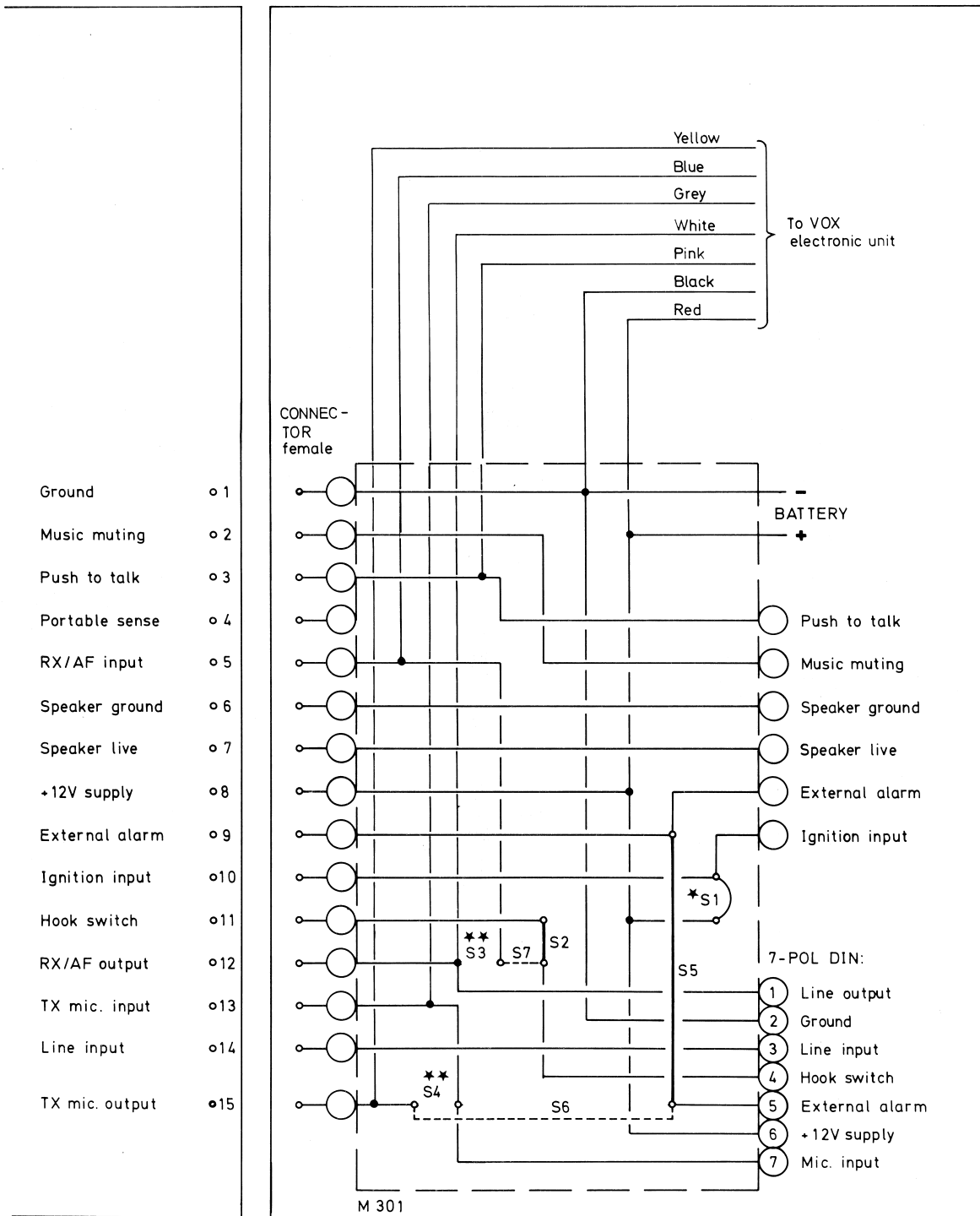
INSTALLATION OF THE VOX ELECTRONIC UNIT

- Disassemble the mounting cassette.
- Remove the power supply cable.
- Loosen the strain relief of the 9 pole D-connector.
- Remove the clip (C) on the print M-301 (see fig. 7).
- Slide the print to the right and lift it up (see fig. 7).
- Remove the two print straps S3 and S4 see fig. 8 and fig. 9.
- Connect the 7 wires from the VOX electronic unit to the print M-301 see fig. 8 and fig. 9.
- Replace the print in the mounting cassette.
- Reassemble the mounting cassette.



APM870607A2

Fig. 7 Removal of the print M-301



STANDARD CASSETTE: *Wire strap (removed when ignition key is connected)
 **Print strap (removed when VOX is used)

APM870613A2/01

Fig. 8 Wiring diagram

CPH870901/0

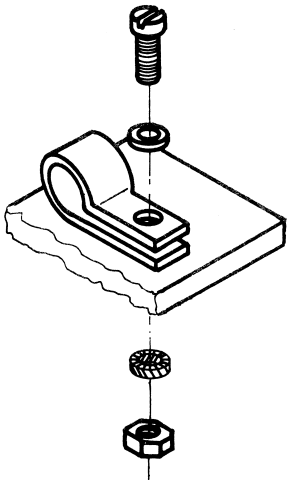
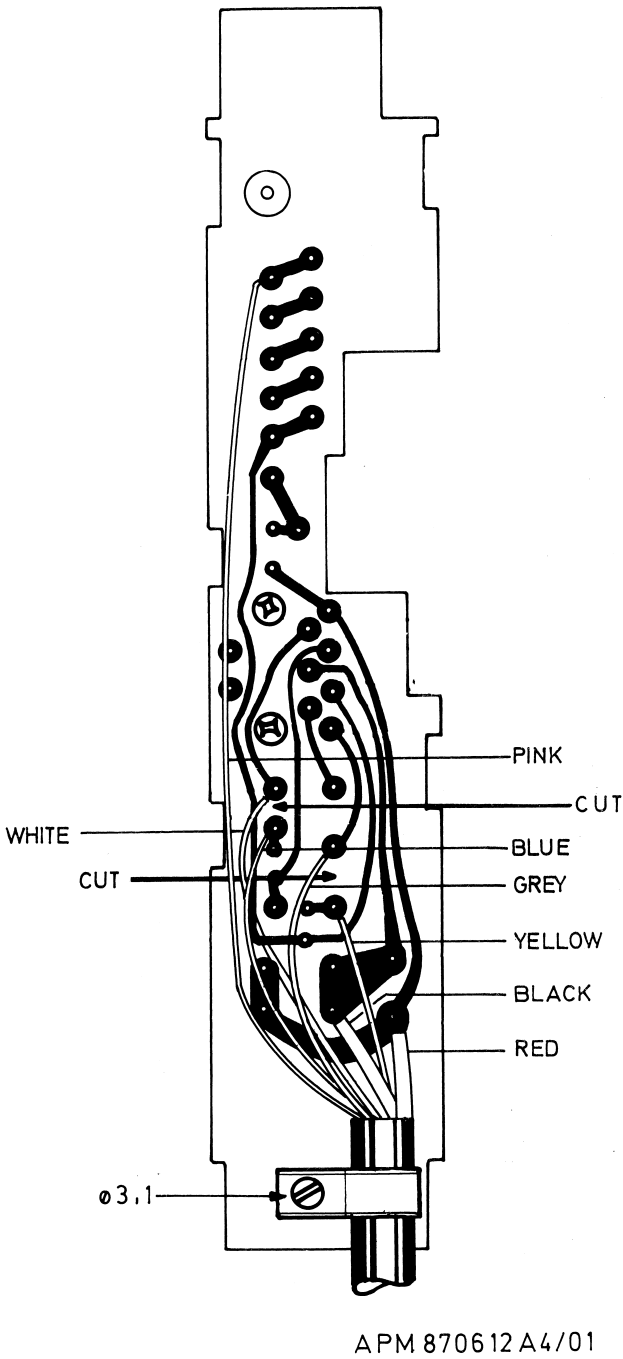


Fig. 9 Connections from the VOX electronic unit to the mounting cassette

INSTALLATION OF THE CONNECTION UNIT TO THE HANDSET CONNECTION CABLE

- Disassemble the magnetic base.
- Remove the handset connection cable from the magnetic base.
- Connect the handset connection cable to the connection unit.
- Mount the connection unit in a suitable place in the car (under the dashboard).
- Mount the cable with the 9 pole D-connector from the connection unit in the magnetic base.

LOCATION AND CONNECTION OF LOUDSPEAKER AND MICROPHONE

Microphone : Place the microphone on the steering column, the dashboard, or near the sun visor so that it is pointed a little downwards against the driver.

To obtain maximum efficiency of the microphone it should be mounted in such a way that there is some free space behind it.

Route the microphone cable to the connection unit and connect it to the MIC connector (see fig. 16).

Loudspeaker: Place the loudspeaker under or on the dashboard so that it is pointed towards the driver. The loudspeaker should not be pointed directly at the microphone. The minimum distance between the location of the microphone and the loudspeaker should be 50cm to avoid acoustic feedback.

Route the loudspeaker cable to the connection unit and connect it to the live terminal and GND terminal of the LS connector (see fig. 16).

Adjustment : R15 should be normally turned fully clockwise when the enclosed type of microphone is used.

If acoustic feedback appears try to do as follows:

- Start motor.
- Set-up conversation in VOX-mode. (Do not call a "Speech machine" e.g. Weather report)
- Turn R15 anti-clockwise while speaking.
Stop when the "receiver" claims about decreased speech level.
- Turn R15 a little back again.



Operating instructions

The Voice Operated Handsfree makes it possible to operate the mobile telephone in 3 modes:


1. Normal conversation (using the handset).
2. Real handsfree conversation (VOX-mode).
3. Semi-handsfree conversation (Push-To-Talk mode).

The VOX-mode is made to have a higher priority than the semi-handsfree mode).



Activation of VOX-mode:

- The  button is pressed with a telephone number in the display and the handset still placed on the magnetic base.
- The  button is pressed during normal conversation.




De-activation of VOX-mode:

- Press  (returns the mobile telephone into normal conversation mode).
- The call is terminated.

Activation of semi-handsfree mode:

- Press  when the mobile telephone is in the VOX-mode. (The PTT-mode is activated as soon as the  button is pressed).

De-activation of the semi-handsfree mode:

- Press  with the handset on the magnetic base. The mobile telephone returns to the VOX-mode.
- Lift the handset off the magnetic base. The mobile telephone returns into normal handset conversation mode.
- Press  with the handset off the magnetic base. The mobile telephone returns to normal handset conversation mode (one more press on  gives VOX-mode).
- The call is terminated.

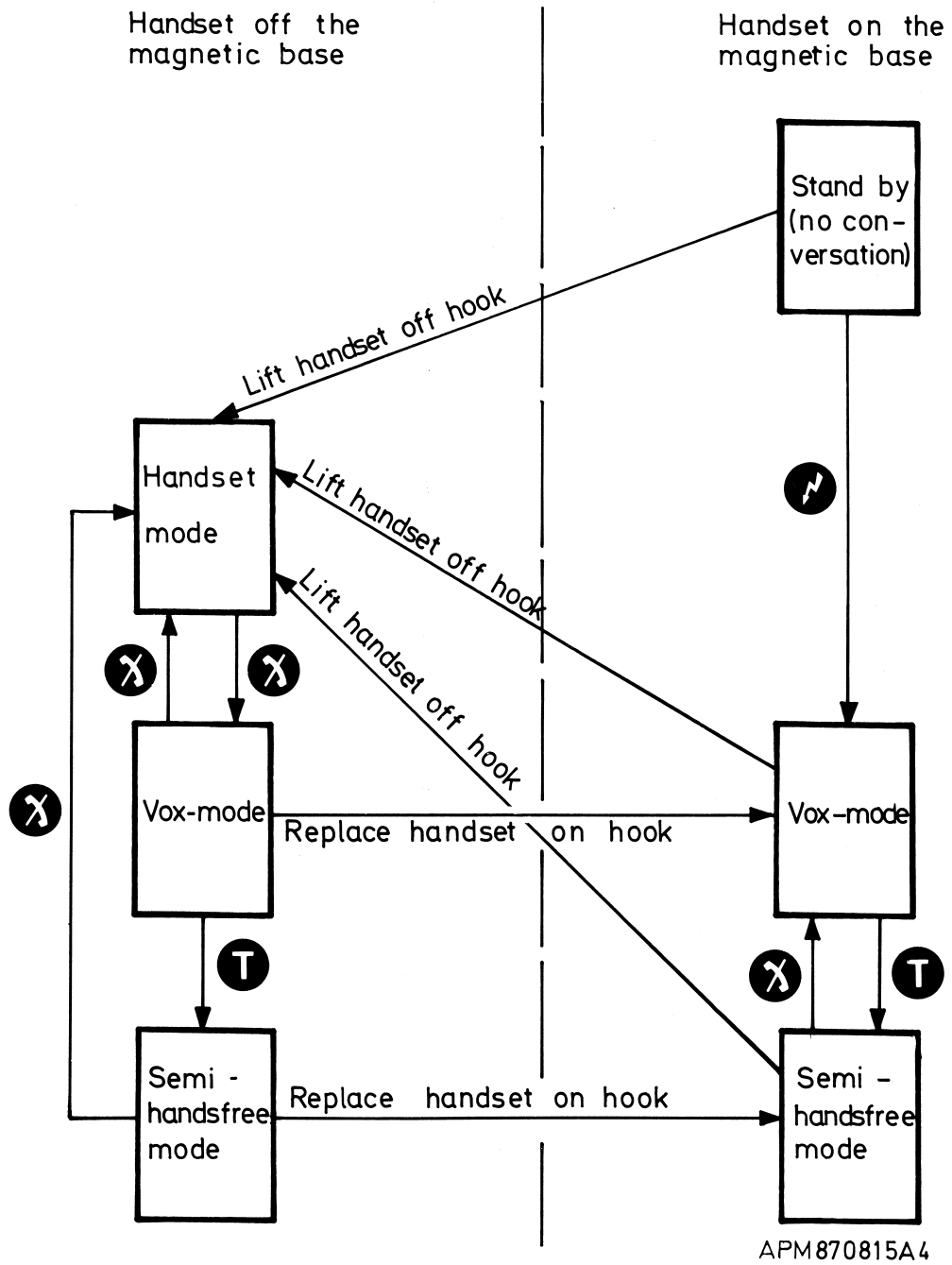


Fig. 10

Technical description

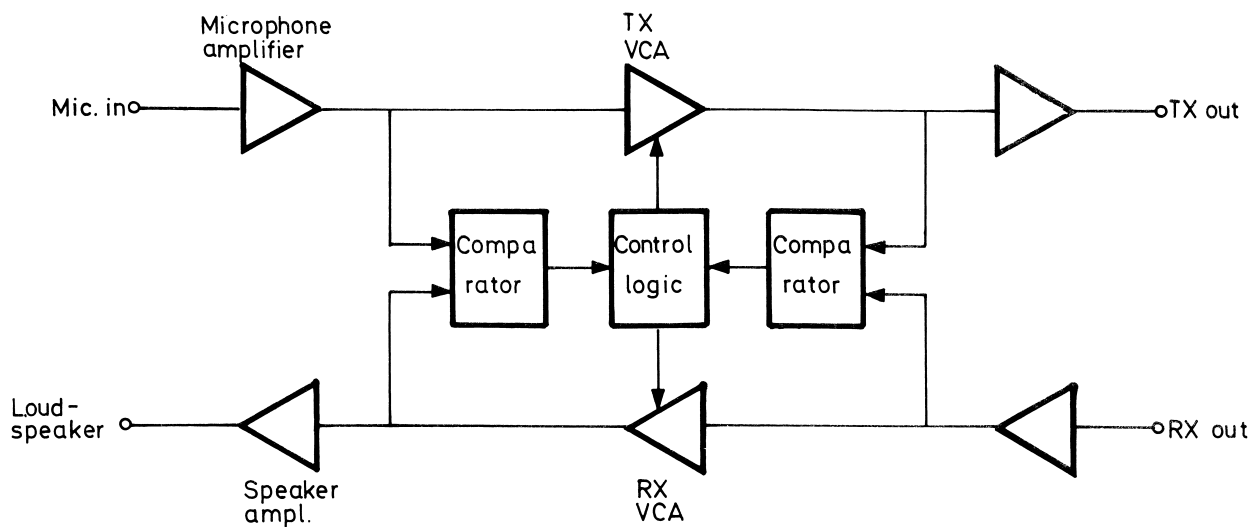
VOX circuit

The VOX circuit is based on the two ICs T6420-2 and T6421. These ICs use a "three-state" principle to avoid acoustic feed-back between the microphone and the loudspeaker.

Mode	Attenuation	
	Microphone	Loudspeaker
You are listening	-50dB	0dB
You are speaking	0dB	-50dB
Idle mode	-25dB	-25dB

Circuit description:

The audio signal from the microphone is fed via an amplifier to the Transmit Voltage Controlled Amplifier (TxVCA). The TxVCA gain is dependent on the voltage which arrives at the TCH input from the control logic. The signal is then fed via an amplifier to the transmitter part of the transceiver. The audio signal from the transceiver is fed through a similar circuit. The audio signals is also fed to a control logic circuit where the signal lines are compared and the two voltage controlled amplifiers are controlled.



APM870812A 4

Fig. 11 Schematic block diagram

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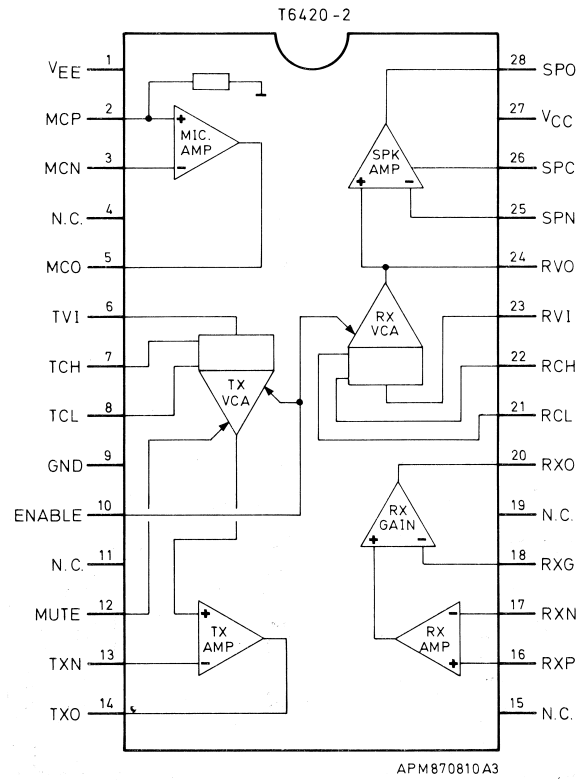


Fig. 12 T6420-2 internal block diagram

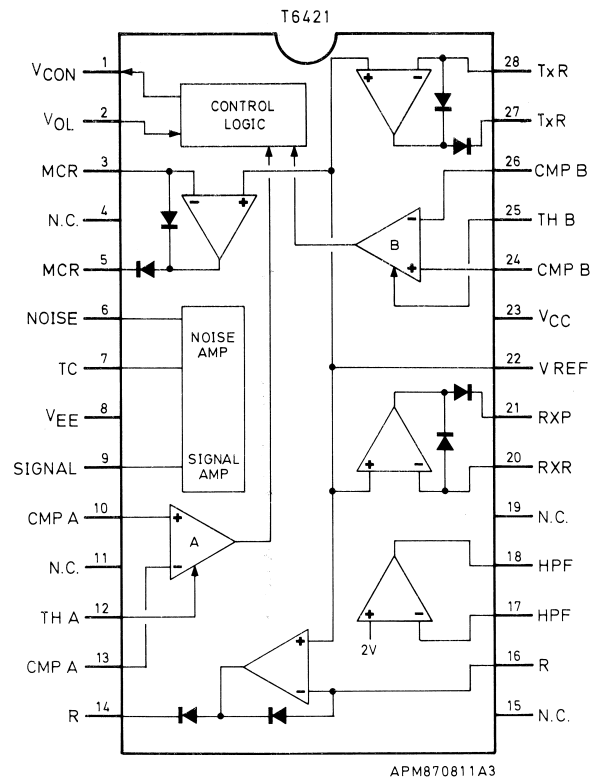


Fig. 13 T6421 internal block diagram

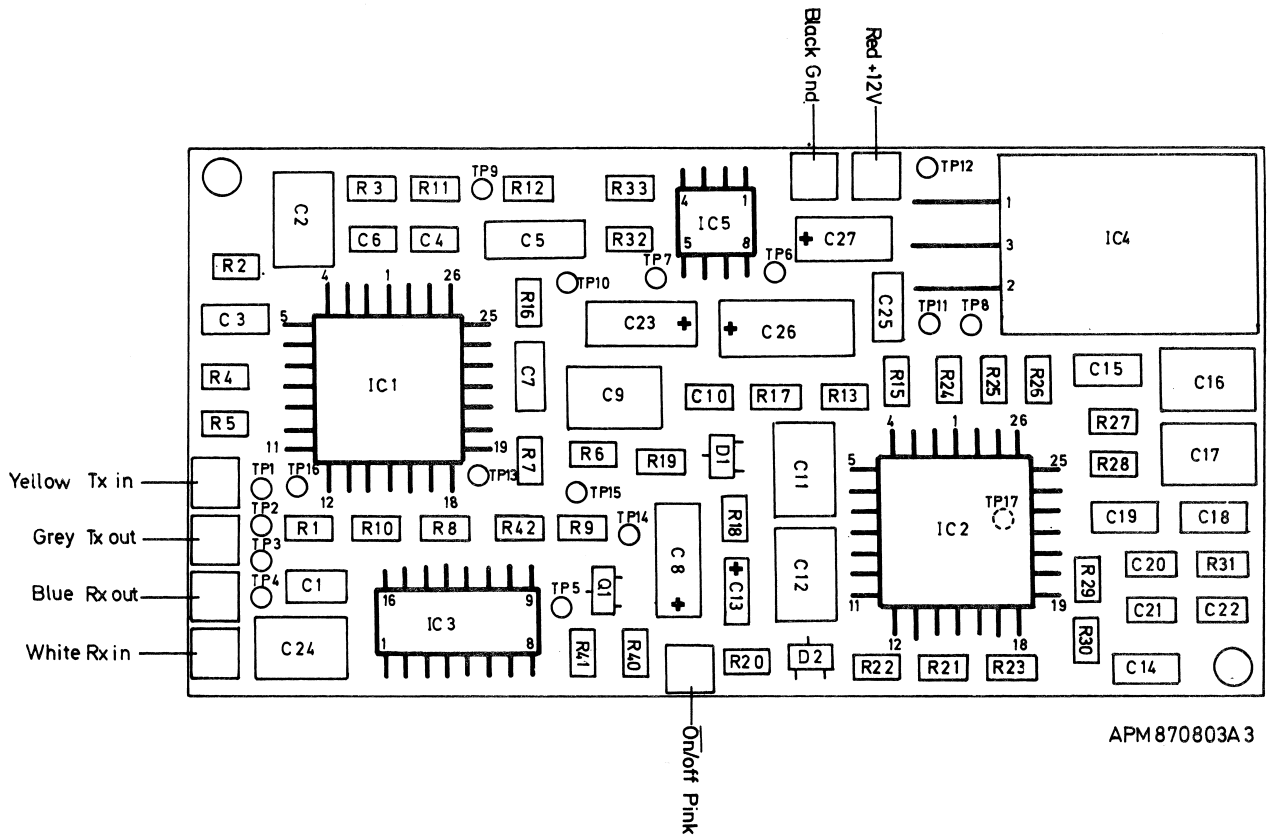
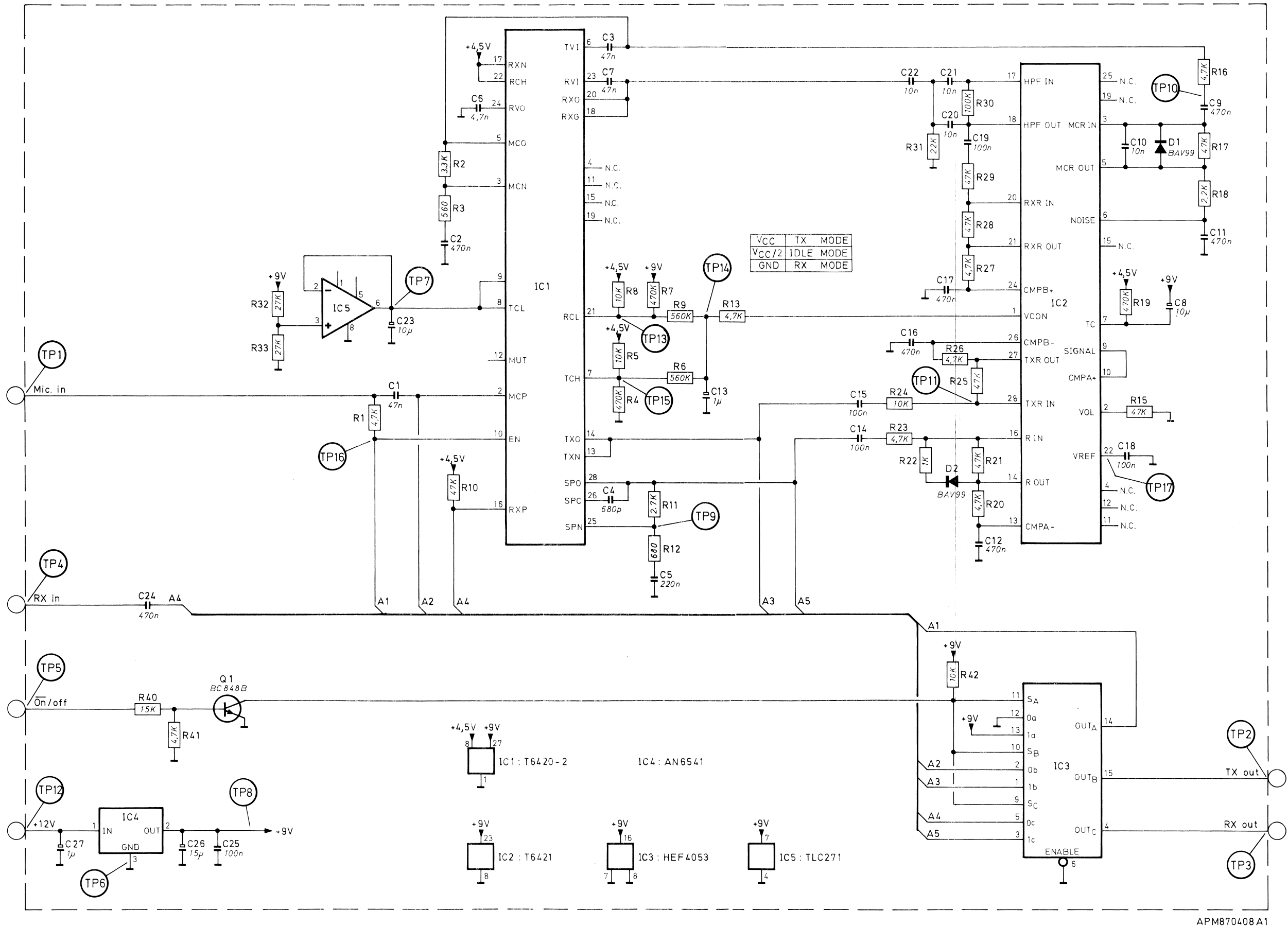
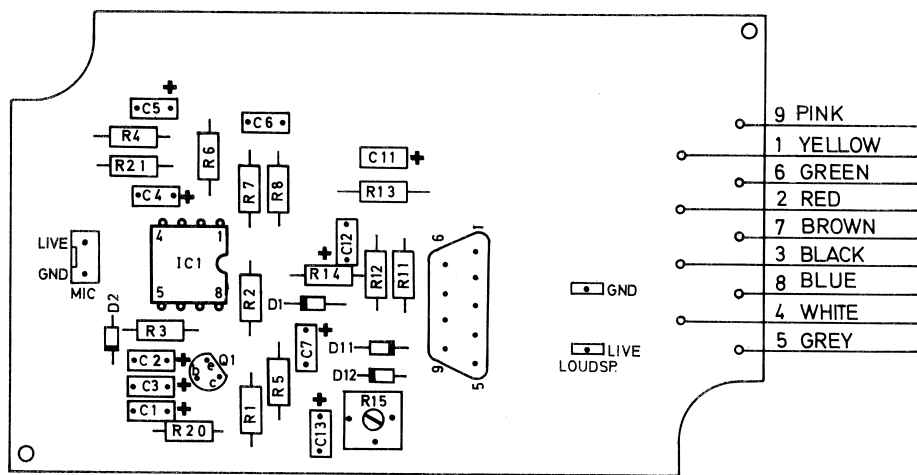


Fig. 14 Component location, VOX electronic unit



APM870408A1



APM 870626A4 / 01

Fig. 16 Component location, connection unit

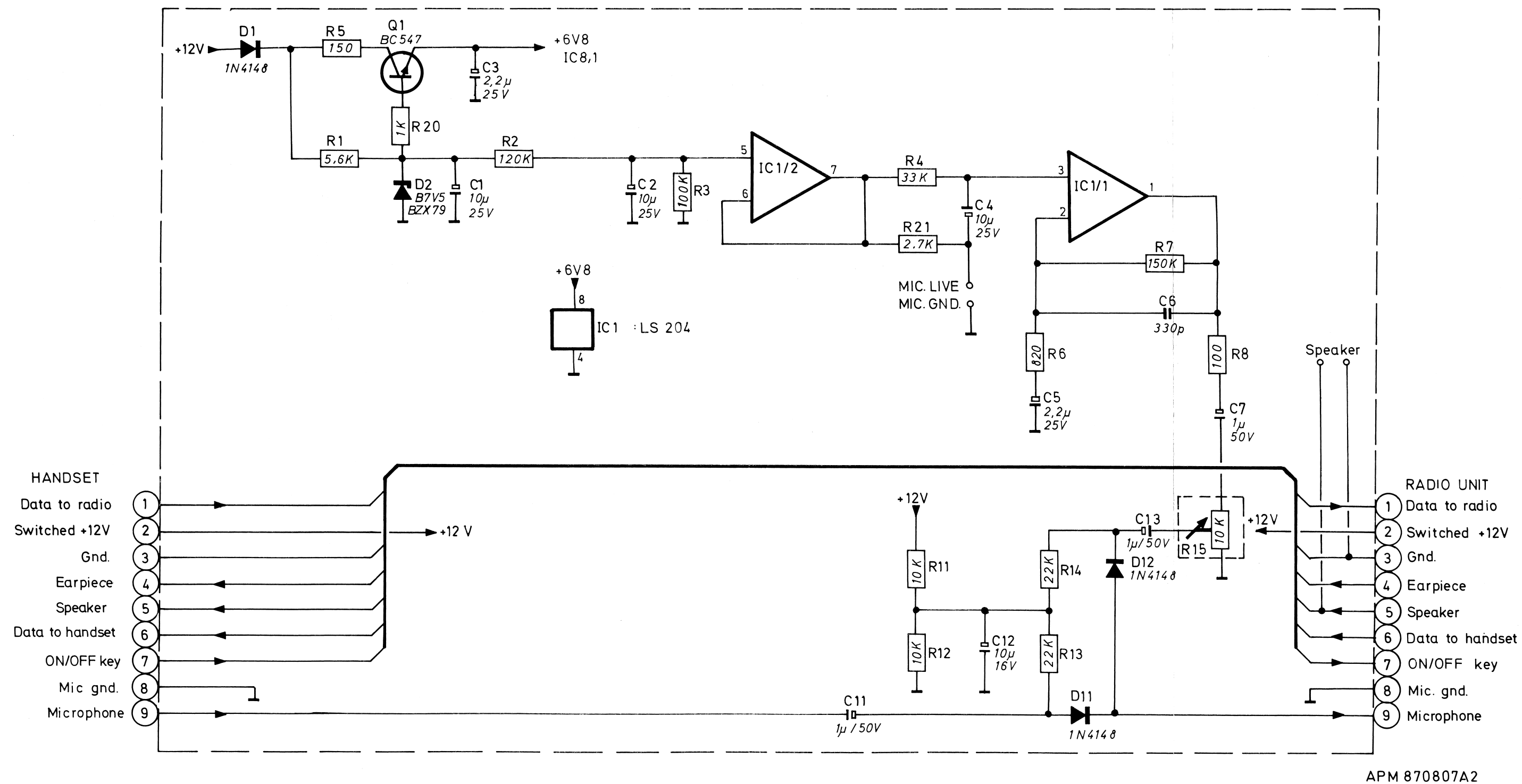


Fig. 17 Circuit diagram, connection unit

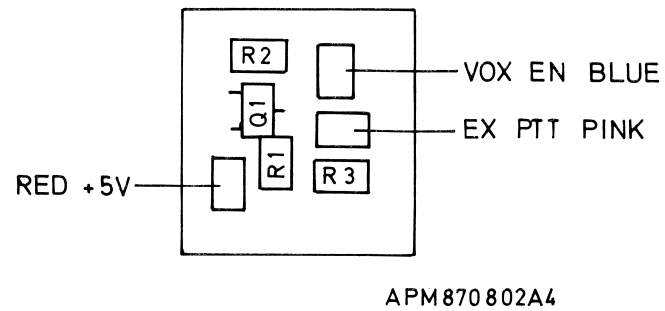


Fig. 18 Component location, interface unit

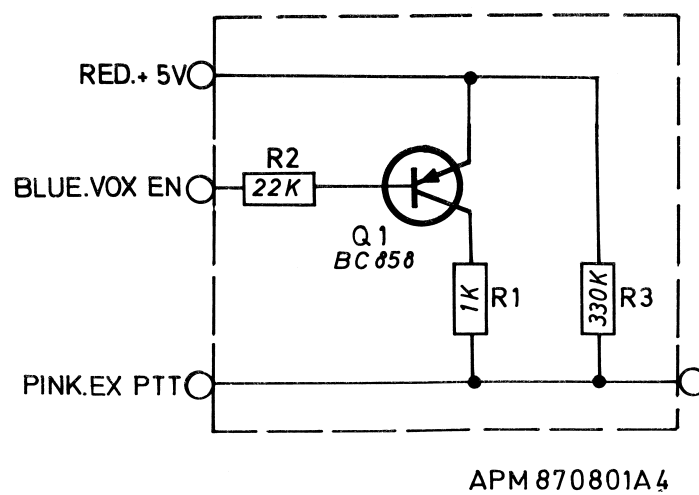


Fig. 19 Circuit diagram, interface unit

Mechanical parts

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Microphone	1	3508 102 13160
2.	Mounting box	2	3508 101 52850
3.	Connection unit complete	1	8208 244 04051
4.	VOX electronic unit complete	1	8208 244 04041
5.	VOX interface unit	1	8208 244 04031
6.	EPROM for AP 4111		8208 244 00131
7.	EPROM for AP 4112		8208 244 01111
8.	EPROM for AP 4151		8208 244 00621
9.	Loudspeaker	1	2422 264 00085

Electrical parts

VOX ELECTRONIC UNIT

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

INTEGRATED CIRCUITS

IC1	3508 100 16810	XR-T6420-2
IC2	3508 100 16800	XR-T6421
IC3	9333 729 60112	HEF4053
IC4	3508 100 16230	AN-6541
IC5	3508 100 16120	TLC271CD

TRANSISTOR

Q1	9335 896 30215	BC848B
----	----------------	--------

DIODES

D1-2	9332 153 70215	BAV99
------	----------------	-------

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

CAPACITORS

C1,3,7	2222 581 16636	47N	10%		Ceramic
C2,9,11-12, 16-17,24	3508 100 31500	470N	10%	63V	Ceramic
C4	3508 100 30410	680P	5%		Ceramic
C5	3508 100 31070	220N	10%		Ceramic
C6	2222 580 16623	4N7	10%		Ceramic
C8,23	3508 100 30120	10U	20%	10V	Tantal
C10,20-22	2222 580 16627	10N	10%		Ceramic
C13	3508 100 30100	1U0	20%	10V	Tantal
C14-15,18-19,25	3508 100 30740	100N	10%		Ceramic
C26	3508 100 30320	15U	20%	20V	Tantal
C27	3508 100 30730	1U0	20%	35V	Tantal

RESISTORS

R1,13,16,20, 23,26-27,41	3508 100 20330	4K7	5%	0.1W	
-----------------------------	----------------	-----	----	------	--

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R2	3508 100 20310	3K3	5%	0.1W	
R3	3508 100 20220	560	5%	0.1W	
R4,7,19	3508 100 20570	470K	5%	0.1W	
R5,8,24,42	3508 100 20370	10K	5%	0.1W	
R6,9	3508 100 20580	560K	5%	0.1W	
R10,15,17,21, 25,28-29	3508 100 20450	47K	5%	0.1W	
R11	3508 100 20300	2K7	5%	0.1W	
R12	3508 100 20230	680	5%	0.1W	
R18	3508 100 20290	2K2	5%	0.1W	
R22	3508 100 20250	1K0	5%	0.1W	
R30	3508 100 20490	100K	5%	0.1W	
R31	3508 100 20410	22K	5%	0.1W	
R32-33	3508 100 20420	27K	5%	0.1W	
R40	3508 100 20390	15K	5%	0.1W	

CONNECTION UNIT

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

INTEGRATED CIRCUIT

IC1	3508 100 16920	LS204CB
-----	----------------	---------

TRANSISTOR

Q1	9335 101 60682	BC548B
----	----------------	--------

DIODES

D1,11-12	9330 839 90113	1N4148
D2	9331 668 40113	BZX79-B7V5

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

CAPACITORS

C1-2,4	2022 019 00158	10U	20%	25V	Electrolytic
C3,5	3508 100 31210	2U2	20%	25V	Electrolytic
C6	2222 680 58331	330P	20%	100V	Ceramic
C7	2022 019 00159	1U0	20%		Electrolytic
C11,13	2020 002 90256	1U0	20%	50V	Electrolytic
C12	2020 002 90262	10U	20%	16V	Electrolytic

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

RESISTORS

R1	2322 180 73562	5K6	5%	0.2W	Metalfilm
R2	2322 180 73124	120K	5%	0.2W	Metalfilm
R3	2322 180 73104	100K	5%	0.2W	Metalfilm
R4	2322 180 73333	33K	5%	0.2W	Metalfilm
R5	2322 180 73151	150	5%	0.2W	Metalfilm
R6	2322 180 73821	820	5%	0.2W	Metalfilm
R7	2322 180 73154	150K	5%	0.2W	Metalfilm
R8	2322 180 73101	100	5%	0.2W	Metalfilm
R11-12	2322 180 73103	10K	5%	0.2W	Metalfilm
R13-14	2322 180 73223	22K	5%	0.2W	Metalfilm
R15	2111 369 00085	10K	20%	0.5W	Trim
R20	2322 180 73102	1K0	5%	0.2W	Metalfilm
R21	2322 180 73272	2K7	5%	0.2W	Metalfilm

INTERFACE UNIT

NUMBER	ORDERING NUMBER	TYPE
--------	-----------------	------

TRANSISTOR

Q1	9335 897 90215	BC858B
----	----------------	--------

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
--------	-----------------	-------	--------	-----------	-------------

RESISTORS

R1	3508 100 20250	1K0	5%	0.1W	SMD
R2	3508 100 20410	22K	5%	0.1W	SMD
R3	3508 100 20550	330K	5%	0.1W	SMD



PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning	AP 4112-3	89.08
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A budget version of the mobile telephone AP 4112 has been developed.

This supplement deals only with this version called AP 4112-3.

Replace the list of contents pages 0-1, 0-2 by the new one enclosed with this supplement.
Place the chapter about AP 4112-3 as chapter 12 in the Service Manual.

The budget model

CONTENTES	PAGE
The transceiver	3
Spareparts, transceiver	3
Disassembling of the handset	5
Description of the handset	8
Block diagram, handset	9
Keyboard test	10
Handset, loudspeaker and microphone	10
Display illumination test	11
Component location, handset	13
Circuit diagram, handset	15
Mechanical parts	16
Electrical parts	19

The transceiver

The transceiver of the budget model is an AP4112-3. Because of traffic safety this model is also capable of operating with the VOX kit AP4016. The telephone is equipped with an 18-key handset and will not operate with the standard 20-key handset.

The telephone will not operate with the telephone answering unit nor will it operate as transportable. Technically the operation of the transceiver is identical to the operation of the standard AP4112. Therefore for service and repair refer to chapter 4 of this manual.

Spareparts for the budget model are generally the same as spareparts for the standard model.

Spareparts for the budget model exclusively will be listed below.

Spareparts, transceiver.

<u>DESCRIPTION</u>	<u>ORDERING NUMBER</u>
Top for chassis, brown	3508 101 22470
Bottom for chassis, brown	3508 101 22480
IC 201 EPROM	8208 244 01271

WARNING

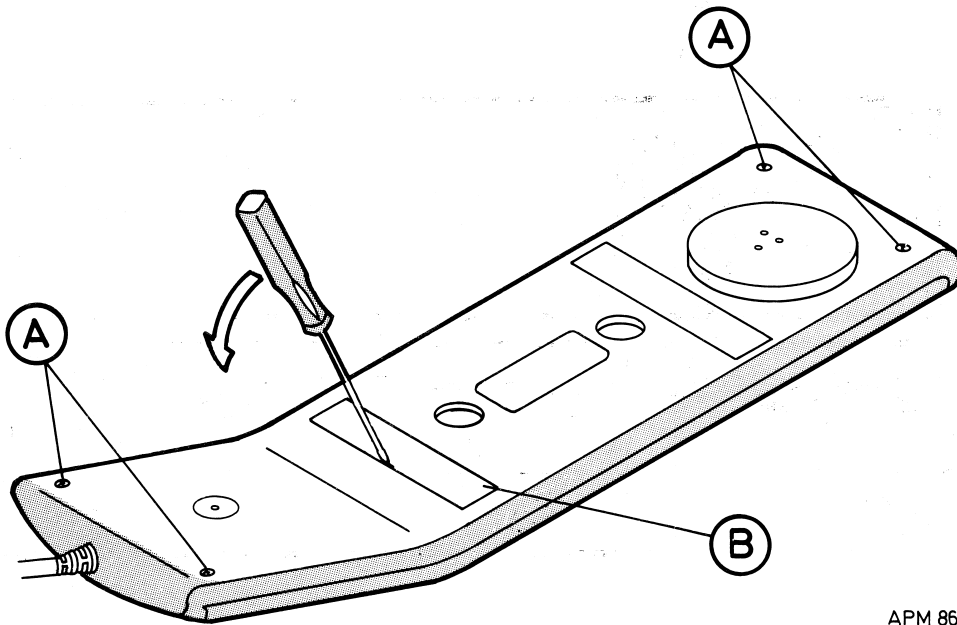
The relay RE002 contains mercury. Vapours from mercury is very toxic and is injurious to health if inhaled.

No danger can arise from normal handling but no attempt should be made to tamper with this device.

When discarding mercury relays, they should be handled as chemical waste.

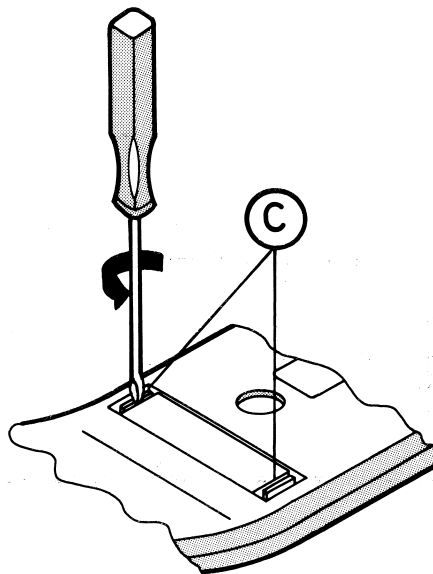
Disassembling of the handset

1. - Remove the four screws (A). See fig. 1.
- Remove (B) the plastic phone number cover with a small screwdriver or a pincette.
- Press the two clips (C) out. See fig. 2.
- The 2 handset parts can now be separated.



APM861215A3

Fig. 1



APM861221A4

Fig. 2

2. - Remove the plug (D) . See fig. 3.
- Remove the six screws (E) . See fig. 4.
- The print board can now be pulled out.

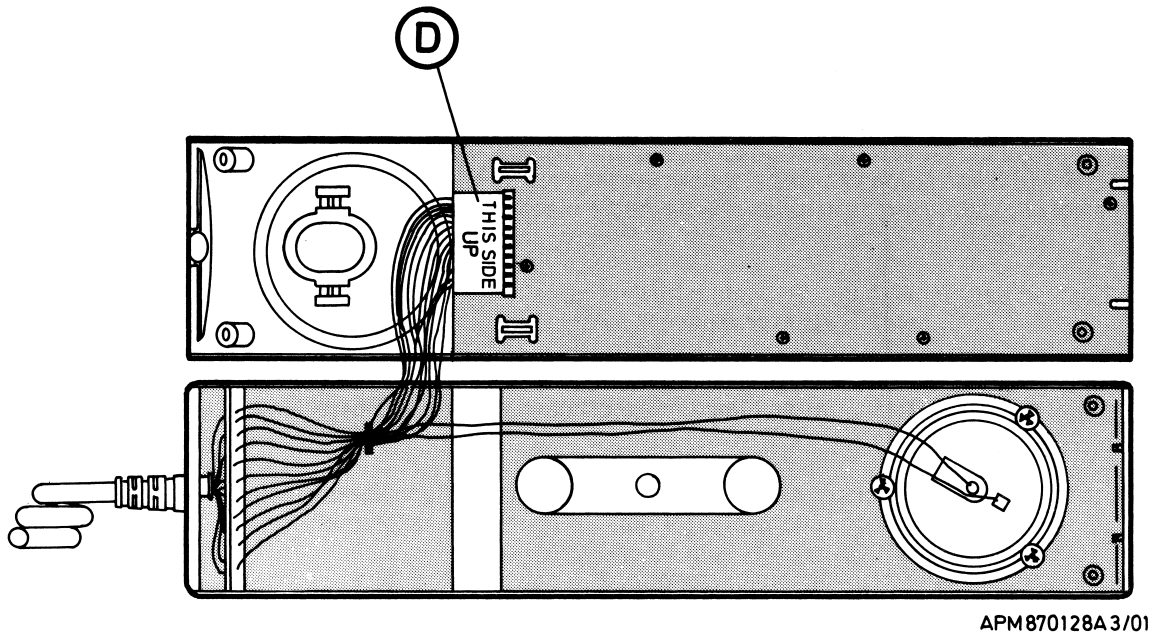


Fig. 3

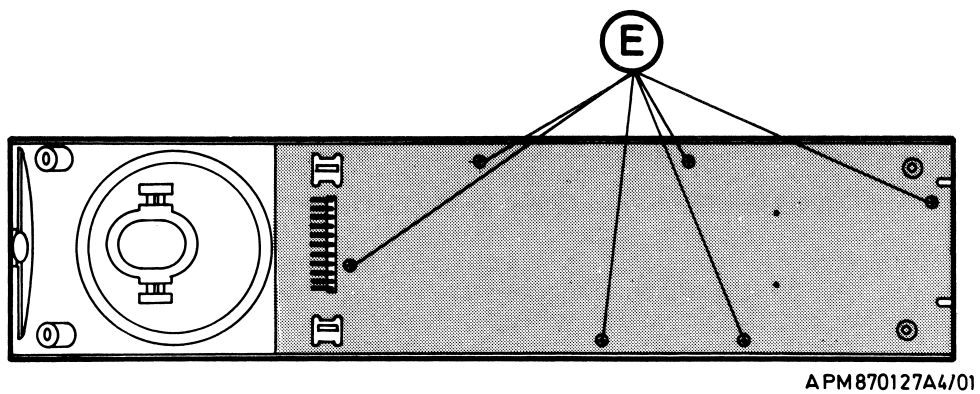
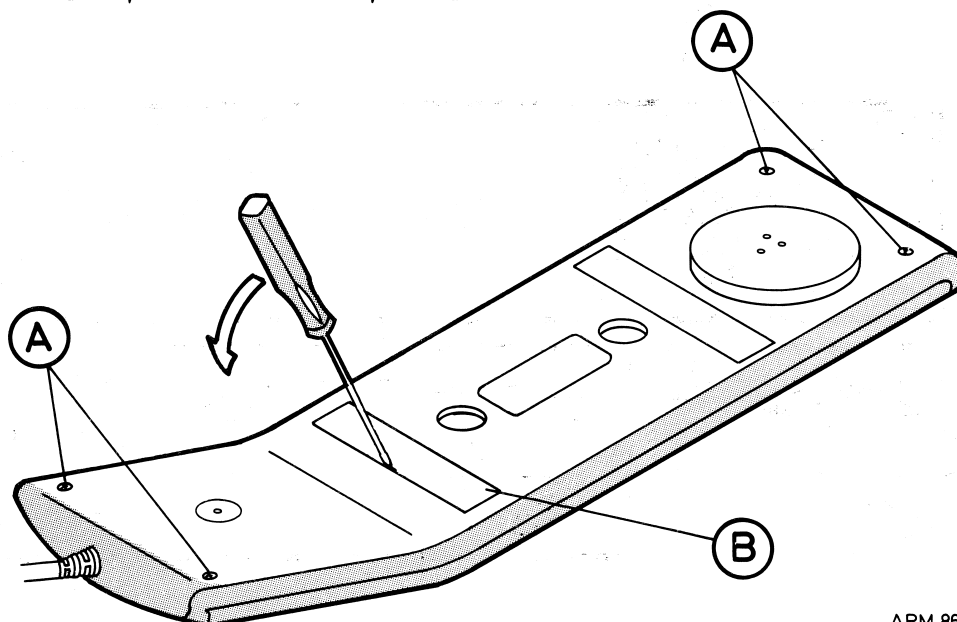


Fig. 4

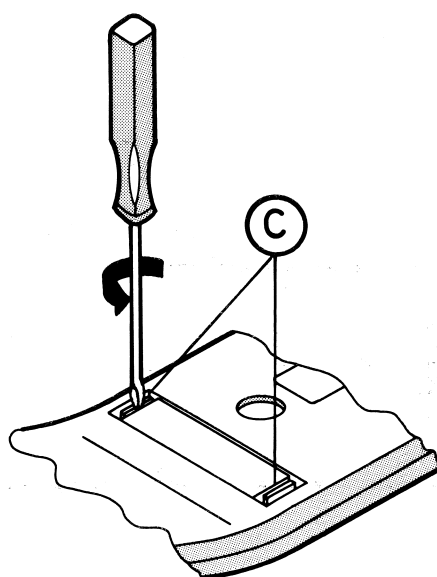
Disassembling of the handset

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- The 2 handset parts can now be separated.



APM 861215A3

Fig. 1



APM861221A4

Fig. 2

2. - Remove the plug (D) . See fig. 3.
- Remove the six screws (E) . See fig. 4.
- The print board can now be pulled out.

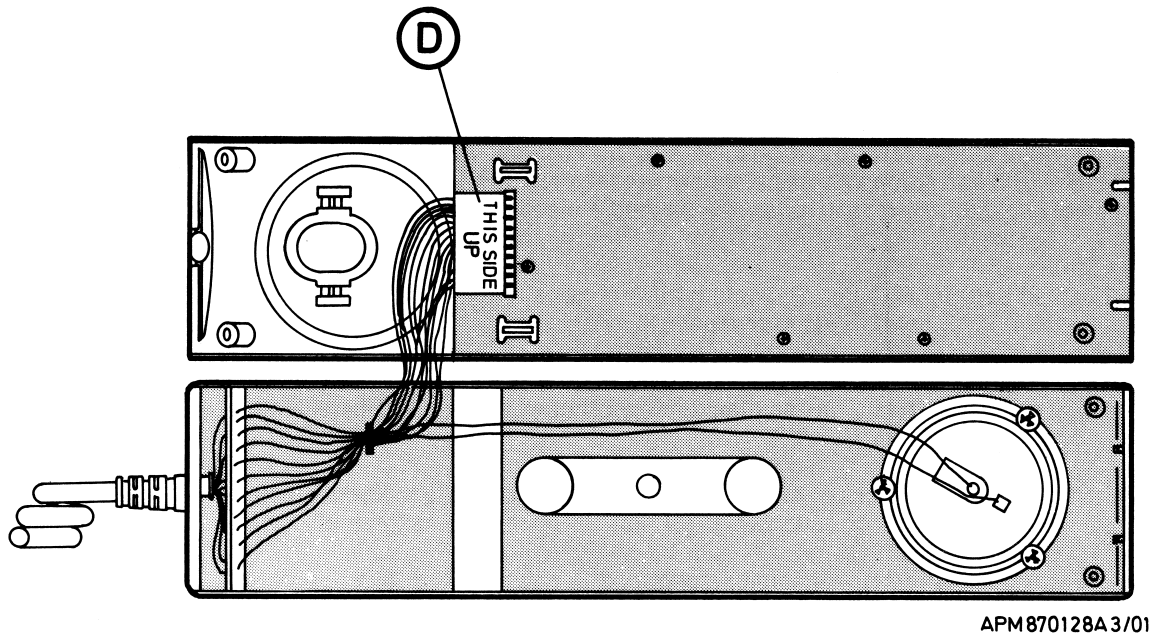


Fig. 3

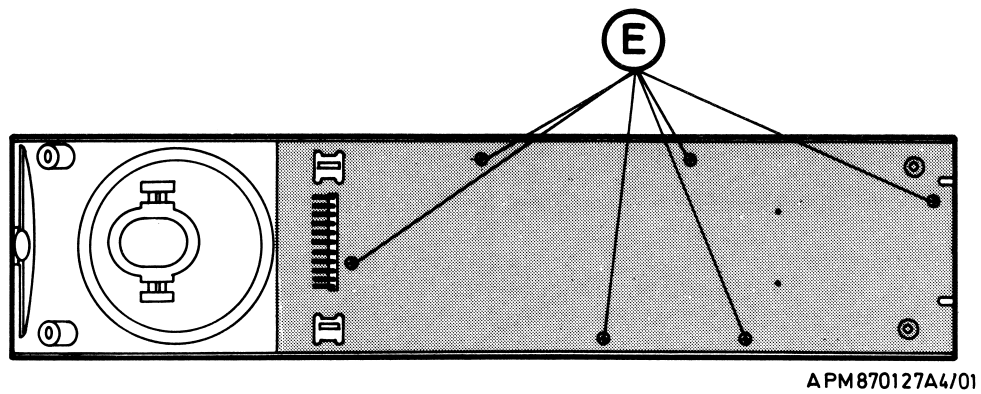


Fig. 4

3. - Remove the screws (F) .
- The display can now be removed from the print board.

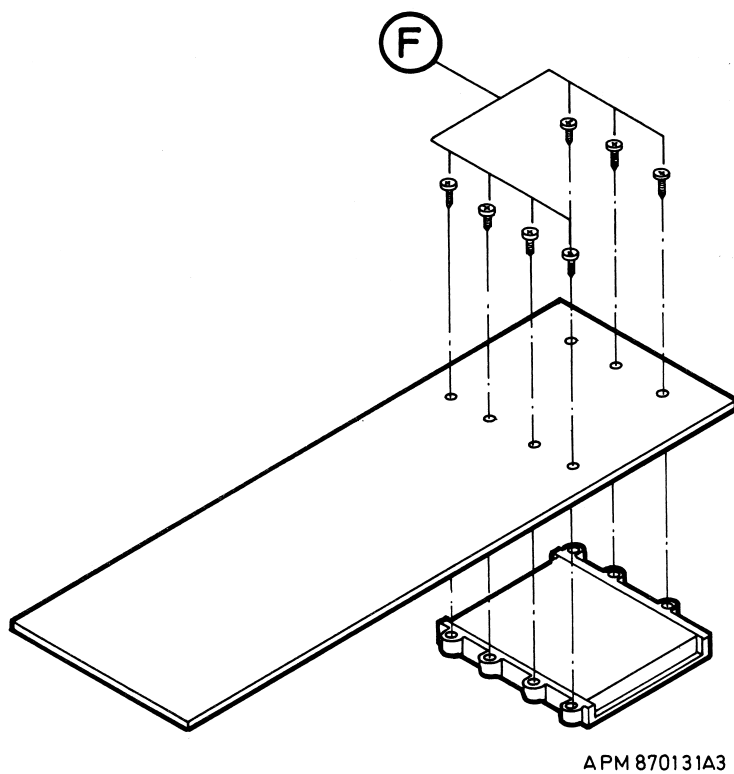


Fig. 5

Description of the handset

HANDSET.

The handset contains keyboard, display and one printed circuit board. And besides the normal loudspeaker and microphone, a separate loudspeaker and microphone for handsfree operation.

The control part is provided with a maskprogrammed 80C49 microprocessor.

The handset is supplied with +12V DC from the power circuit in the radio unit.

When the OFF mode is entered the handset is in stand-by mode, the display is empty and all the LEDs are off in order to reduce the current consumption. When the handset is switched ON the microprocessor will registrate the event, the capacitor C9 discharges and the reset circuit D15, R56 and C6 will reset the microprocessor. A character is sent out on the dataline to the transceiver and a feedback network in the handset receives the data back for verifying.

If the power ON condition is accepted, the handset will be active by showing the phone number on the display for approximately four seconds. The yellow LED lights to indicate power ON, and the country code lights up. When the mobile phone is ready for call, the green LED is switched ON.

The loudspeaker volume is at the same level as before the mobile telephone was switched off the last time. The information to change the volume up or down, is in digital signalling sent from the handset to the transceiver. This is controlled by activating the volume button "+" or "-".

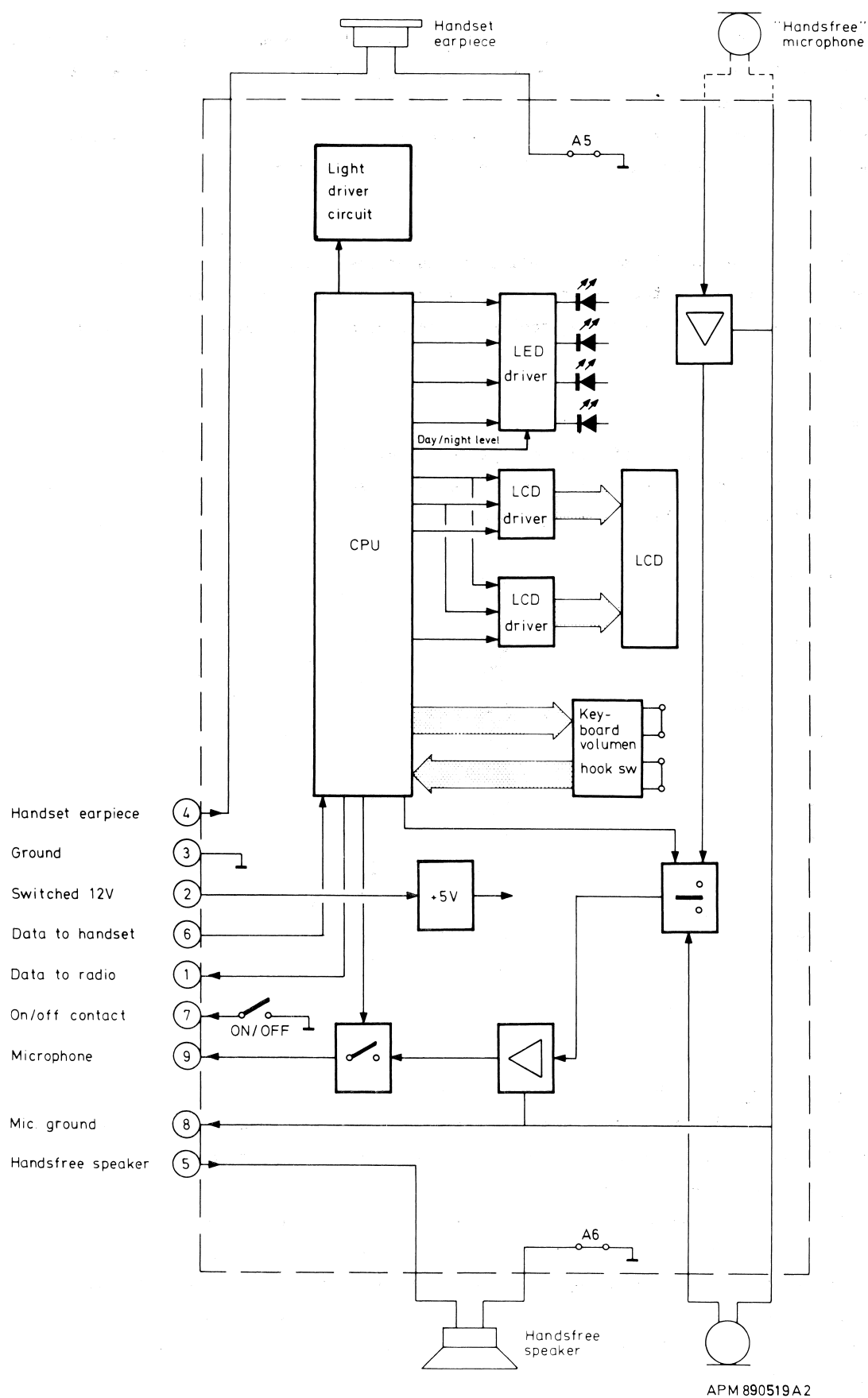


Fig. 6 Block diagram, handset

HANDSET TEST USING THE SERVICE INTERFACE UNIT (SIU)

Connect the 15-pole cable to the 15-pole connector on the SIU and connect the handset to the 9-pole connector on the SIU. Then connect the red and black power cable to a power supply of 13.2V DC. (Disregard the 9-pole cable).

If the four LEDs on the right side of the SIU are flashing, one after the other, you have to disconnect the power and reconnect it again. This action will reset and restart the program.

Display test:

Press the SIU "PROG" button. All symbols, all segments of the digits, all country codes and all function symbols are shown on the display. All LEDs on the handset are illuminated.

The display will remain like this for 5 seconds; after that only the yellow LED, indicating power on, will light.

Keyboard test:

Press the keys one by one, from left to right, starting with the top row.

The display will show two conditions of each key, when pressed and released. The keys and their corresponding indication are listed in the table.

<u>KEY</u>	<u>INDICATION</u>	<u>KEY</u>	<u>INDICATION</u>
①	1-d 1-U	⑧	13-d 13-U
②	2-d 2-U	⑨	14-d 14-U
③	3-d 3-U	⑩	15-d 15-U
④	4-d 4-U	Ⓜ	16-d 16-U
⑤	5-d 5-U	➡	19-d 19-U
✱	6-d 6-U	Ⓜ	20-d 20-U
Ⓒ	7-d 7-U	Ⓜ	ON-OFF
Ⓜ	9-d 9-U	Volume +	24-d 24-U
✕	10-d 10-U	Volume -	25-d 25-U
⑥	11-d 11-U	Off cradle	26U
⑦	12-d 12-U	On cradle	26-d

Handset loudspeaker and microphones.

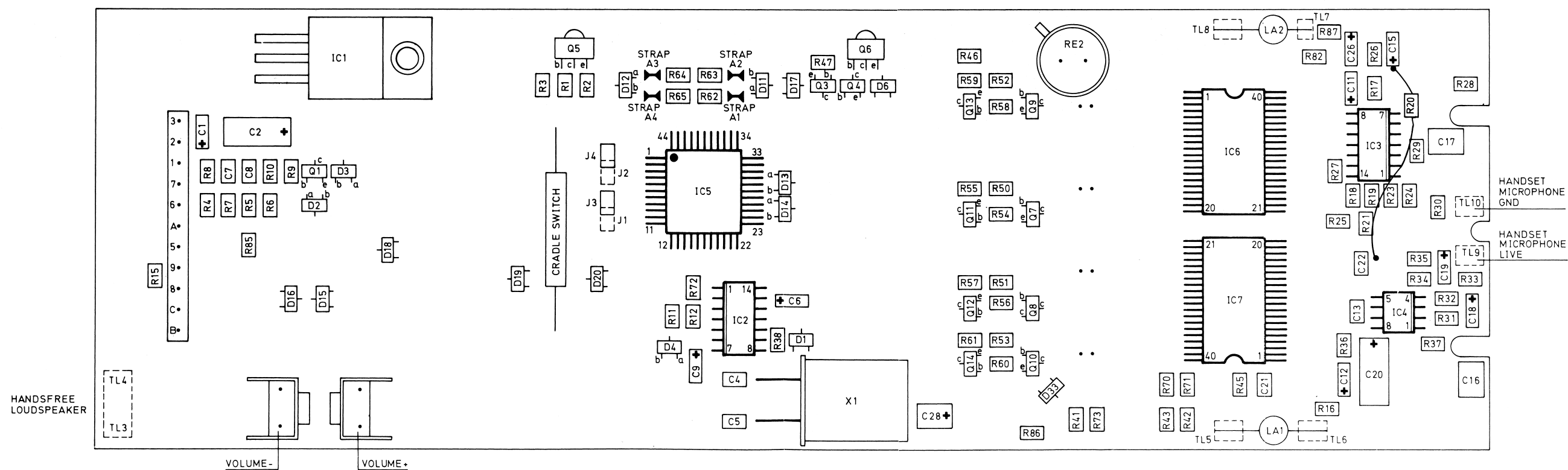
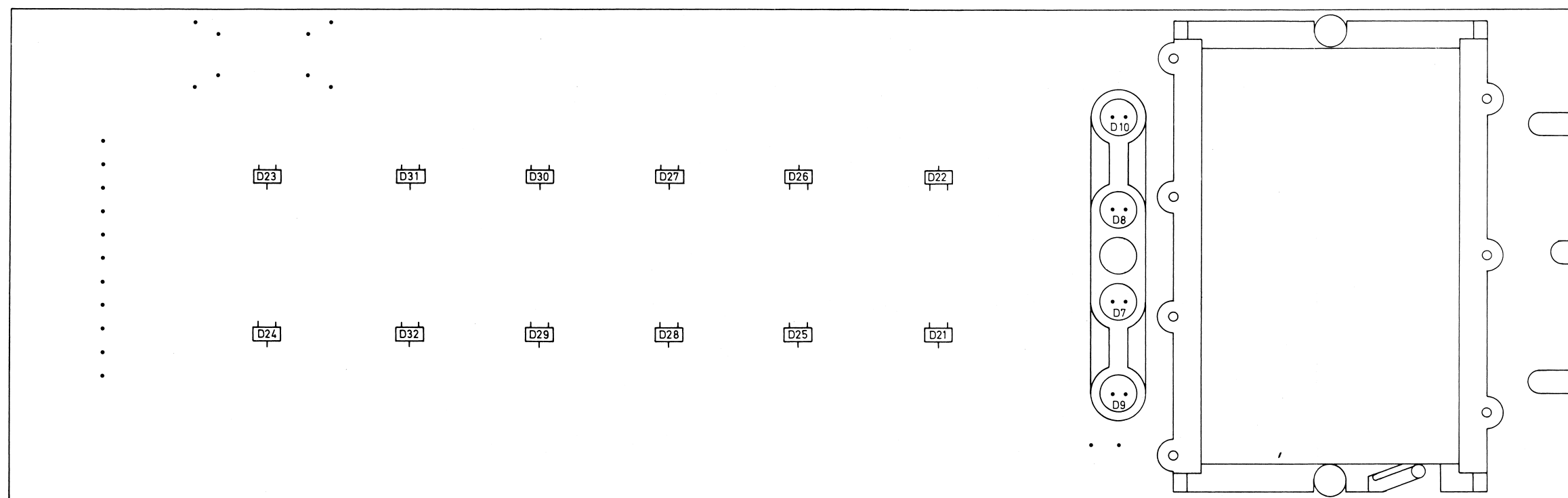
The test for the two loudspeakers are very easy. Connect a tone generator to the BNC connector on the SIU marked with a small loudspeaker. The BNC is connected to the handset speaker, and the tone from the generator should be audible.

Remove the tone generator from the BNC connector marked with a small speaker to the BNC connector marked with a large speaker, then the tone should be audible in the handsfree speaker.

The handset microphones can be tested by an oscilloscope, connected to the BNC connector marked with a microphone symbol. You select the handset microphone by pressing 1 on the keyboard. The handsfree microphone can only be tested with a transceiver being used. If you want to mute both microphones, press 5.

Display illumination test.

This test is very simple. Press the key marked * on the keyboard and press the key marked C .
The first will switch the light on and the other will switch the light off.



APM890520 A1/0

Fig. 7 Component location, handset

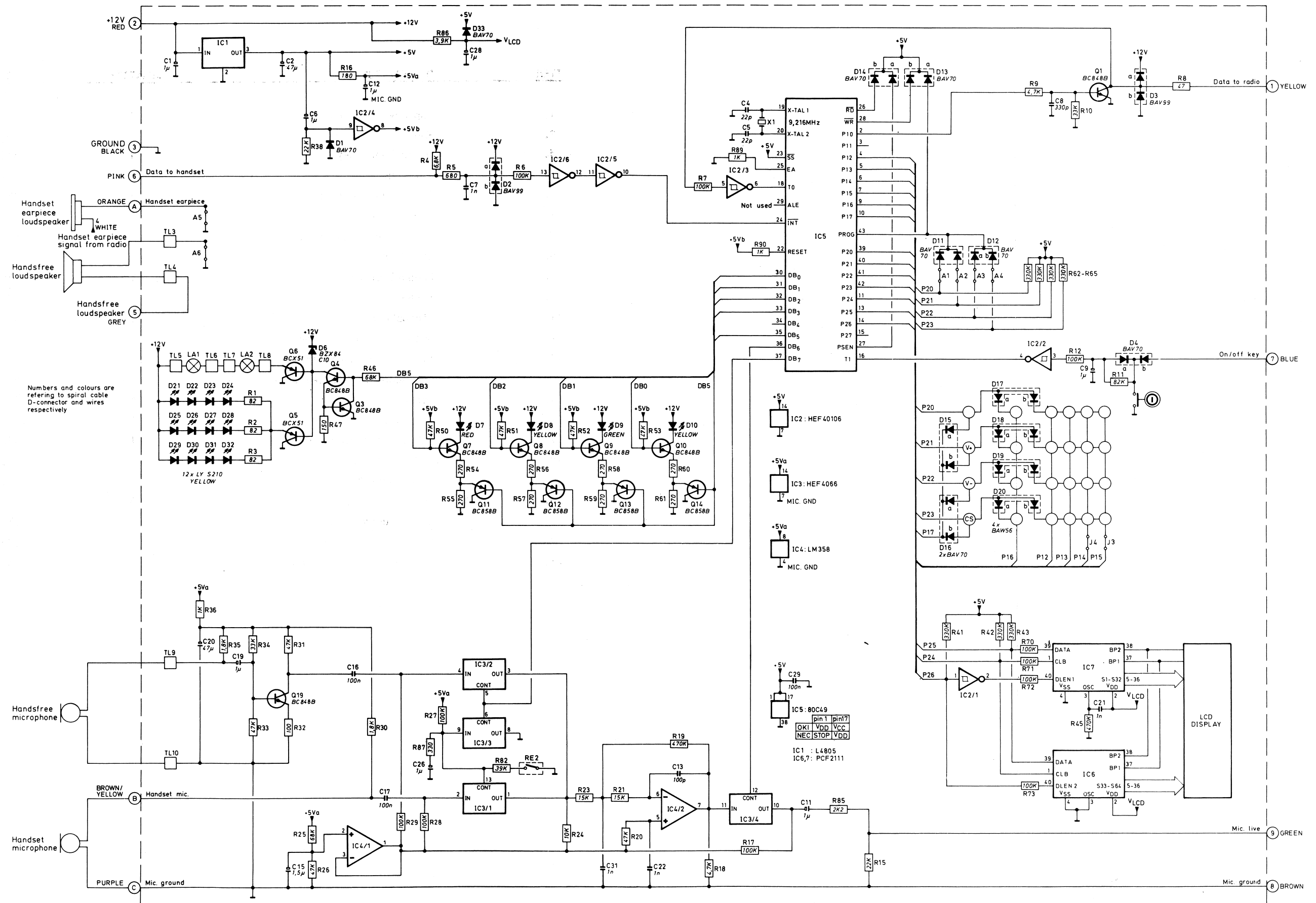
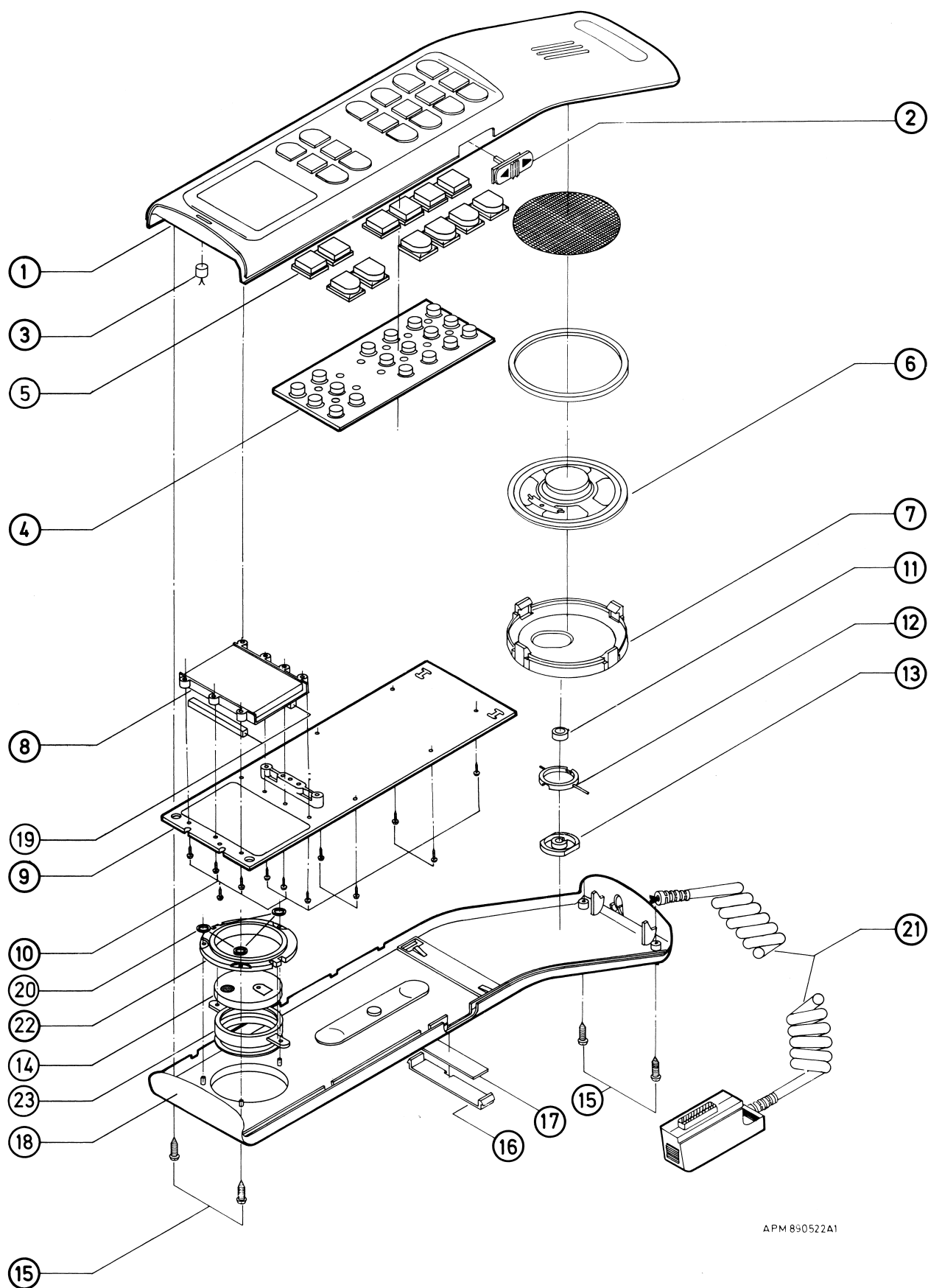


Fig. 8 Circuit diagram, handset

MECHANICAL PARTS

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Top cover, brown	1	3508 101 53850
2.	Knob for volume	1	5322 413 31577
3.	Microphone assy	1	5322 242 72642
4.	Silicone mat	1	5322 218 80607
5.	Set of pushbuttons	1	3508 101 53860
6.	Loudspeaker, 8ohm 1W	1	5322 240 30523
7.	Cover for loudspeaker	1	5322 462 41445
8.	LCD display	1	5322 130 90695
9.	Handset print	1	8208 244 01261
10.	Screw	13	5322 502 80049
11.	Microphone	1	5322 242 10068
12.	Holder for microphone	1	5322 405 50423
13.	Microphone suspension	1	5322 418 40611
14.	Loudspeaker, piezoelectric	1	5322 280 10215
15.	Screw	4	5322 502 21115
16.	Window for typesign.	1	5322 459 10892
17.	Label for customer data	1	5322 455 21441
18.	Underpart, brown	1	3508 101 53820
19.	Interconnector	2	5322 466 61853
20.	Quicklock 2mm	3	5322 417 60209
21.	Spiral cord, black	1	5322 321 23457
22.	Cover for earpiece	1	5322 462 41452
23.	Loudspeaker suspension	1	5322 418 40612



APM 890522A1

ELECTRICAL PARTS

NUMBER	ORDERING NUMBER	TYPE
<u>INTEGRATED CIRCUIT</u>		
IC1	5322 209 61291	L4805CV
IC 2	5322 209 14486	HEF40106BT
IC 3	9337 144 20112	74HC4066T
IC 4	5322 209 82941	LM358D
IC 5	5322 209 61305	80C49
IC 6-7	5322 209 82942	PCF2111T
<u>TRANSISTORS</u>		
Q 1-4, 7-10, 19	5322 130 41982	8C848B
Q 5-6	4822 130 60139	8CX51
Q 11-14	5322 130 41983	8C858B
<u>DIODES</u>		
D 1, 4-5, 11-16, 33	5322 130 34331	BAV70
D 2-3	5322 130 34337	BAV99
D 6	4822 130 33698	8ZX84-C10
D 7	5322 130 81575	LED RED
D 8, 10	5322 130 81576	LED YELLOW
D 9	5322 130 81577	LED GREEN
D 17-20	5322 130 30691	BAW56
D 21-32	5322 130 81571	LED YELLOW
<u>CRYSTAL</u>		
X 1	5322 242 72621	9.216MHz
<u>LAMPS</u>		
LA 1-2	5322 134 50038	5V/60mA
<u>SWITCHES</u>		
RE 2	5322 280 30054	MERCURY RELAY
CRADLE SWITCH	5322 280 20401	REED CONTACT RI-22AAA
VOLUME UP/DOWN	5322 276 12624	KHH10952

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	DESCRIPT
--------	-----------------	-------	--------	----------

CAPACITORS

C 1, 6, 9, 11-12, 19, 26, 28	5322 124 10938	1U0		TANTAL
C 2, 20	5322 124 10916	47U	20%	TANTAL
C 4-5	5322 122 32658	22P	5%	CERAMIC
C 7, 21, 31	4822 122 31746	1N0	5%	CERAMIC
C 8, 10	4822 122 33805	330P	10%	CERAMIC
C 13	5322 122 32531	100P	5%	CERAMIC
C 15	5322 124 10915	1U5	20%	TANTAL
C 16-17, 22, 29	4822 122 33496	100N	10%	CERAMIC

RESISTORS

R 1-3	4822 111 91507	82R	5%	
R 4, 14	4822 116 90464	6K8	5%	
R 5	4822 116 90463	680R	5%	
R 6-7, 12, 17, 27-29, 70-73	4822 111 91518	100K	5%	
R 8	4822 111 91652	47R	5%	
R 9, 18	4822 111 91532	4R7	5%	
R 10, 34	4822 116 81017	33K	5%	
R 11	4822 116 81389	82K	5%	
R 13, 32	4822 116 90441	100R	5%	
R 15, 38	4822 111 91523	22K	5%	
R 16	4822 116 90438	180R	5%	
R 19, 45	4822 116 90447	470K	5%	
R 20, 26, 31 33, 50-53	4822 111 91661	47K	5%	
R 21, 23	4822 111 91498	15K	5%	
R 24	4822 111 91517	10K	5%	
R 25, 46	4822 116 90347	68K	5%	
R 30, 35	4822 116 81383	1K8	5%	
R 36, 89-90	4822 111 91516	1K0	5%	
R 41-43, 62-65	4822 116 90345	330K	5%	
R 47	4822 116 80879	150R	5%	
R 54-61	4822 116 80882	270R	5%	
R 82	4822 116 90445	39K	5%	
R 85	3508 100 20020	10R	5%	
R 86	4822 111 91527	3K9	5%	
R 87	48 111 91501	330R	5%	



PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning

AP4112

89.11

This supplement concerns new modules in the transceiver, placed in the service manual no. 9506 100 80030.

A new manufacturing method called FMS, has been introduced in the production of the mobile telephone. The consequence is, that a few changes has been made on some of the modules in the transceiver.

! The function of the modules are still the same !

Small differences occur in the component locations, but the main difference is that some of the small coax connectors have been removed. This means that most of the coax cables between the modules are soldered, which gives the transceiver a higher reliability.

If it becomes necessary to replace an ordinary module with a FMS module or vice versa, please move the coax cables from modules with plugs to modules without plugs (FMS). If this, for any reason, is impossible, coax cables with plugs can be ordered (see mechanical spare part list for FMS).

The FMS produced modules are introduced in transceivers with serial numbers from 050001.

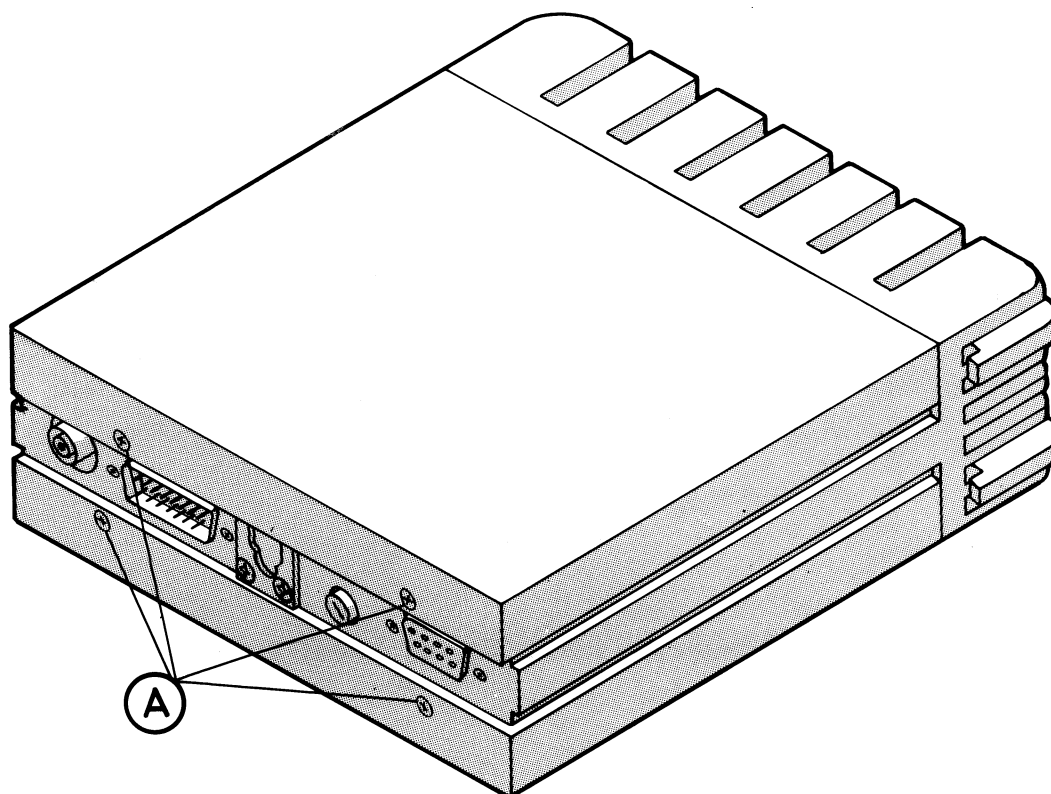
Please place this additional chapter in section 13, and replace the index side.

The transceiver

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Disassembling of the transceiver.

1. Removing the cover.



APM860919A2

Fig. 1 Transceiver.

- Remove the screws (A). Two screws for the top and two for the bottom cover.

2. Removing the transceiver modules M230, M240 and M250. See fig. 2 (B), (C), (D).

The units are provided with connector sockets for plug-in connection to the system board M220.

Removing M230:

- Desolder the coax cable (IF out) on M240.
- Now, carefully lift up M230.

Removing M240:

- Desolder the coax cables (If out), (RXin) and (LO out).
- Now, carefully lift up M240.

Removing M250:

- Desolder the coax cable (LO out) on M240.
- Carefully lift up M250.
- Now, desolder the coax cable on the bottom of M250.

3. Removing the system board M220. See fig. 3.

- First remove the three units M230, M240 and M250.
- Desolder the PTC resistor (F) placed on the heat zinc.
- Remove the four screws (E) from the connectors.
- Remove the two locking rings (G).
- Remove the clip (K) (fig. 5).
- Desolder the supply filter M270 (see sect. 6 below).
- The system board can now be lifted out.

4. Removing the PA stage M460. See fig. 4.

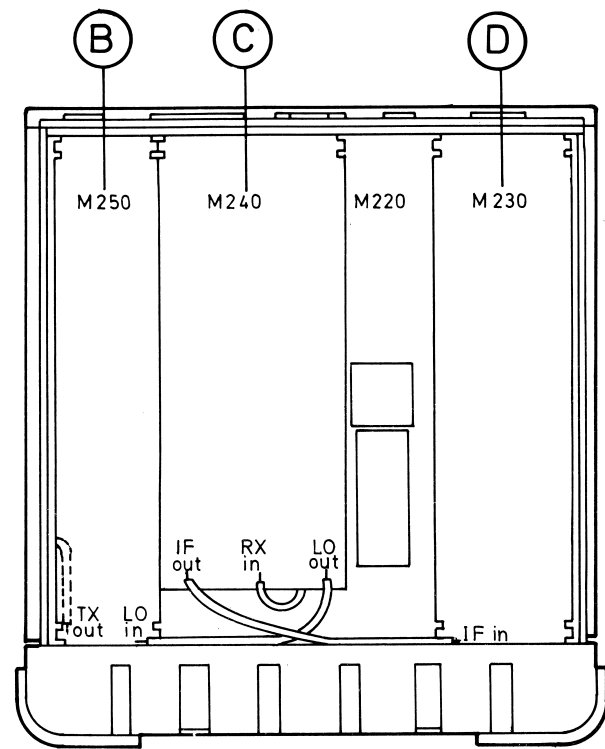
- Desolder the coax cables from the Duplex filter and M250 at the PA stage.
- Remove the screws (I) and (H).
- Remove the clip (L).
- Now the PA-stage can be pulled out.

5. Removing the Duplex filter. See fig. 5.

- Remove the four screws (J).
- Remove the coax cable to the antenna connector.
- Desolder the coax cable on M260.
- Desolder the coax cable on M240.
- Now, lift up the Duplex filter.

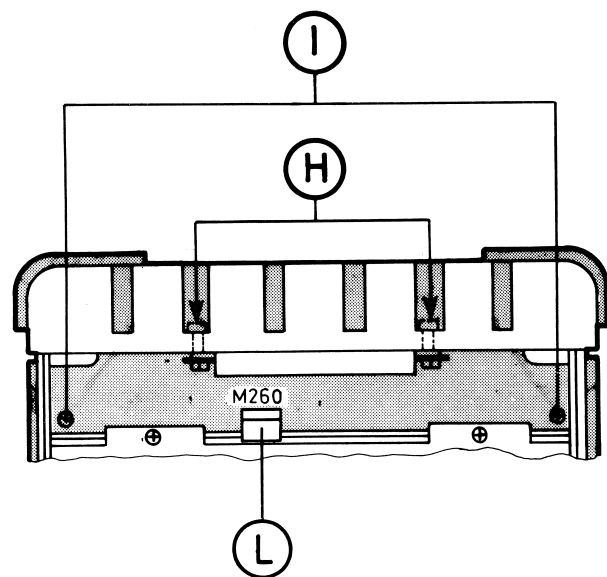
6. Removing the supply filter M270. See fig. 5.

- Remove the four screws (J).
- Lift up the duplex filter.
- Desolder the three wires from the supply filter on M220.
(Notice their location).
- Now, lift up the supply filter.



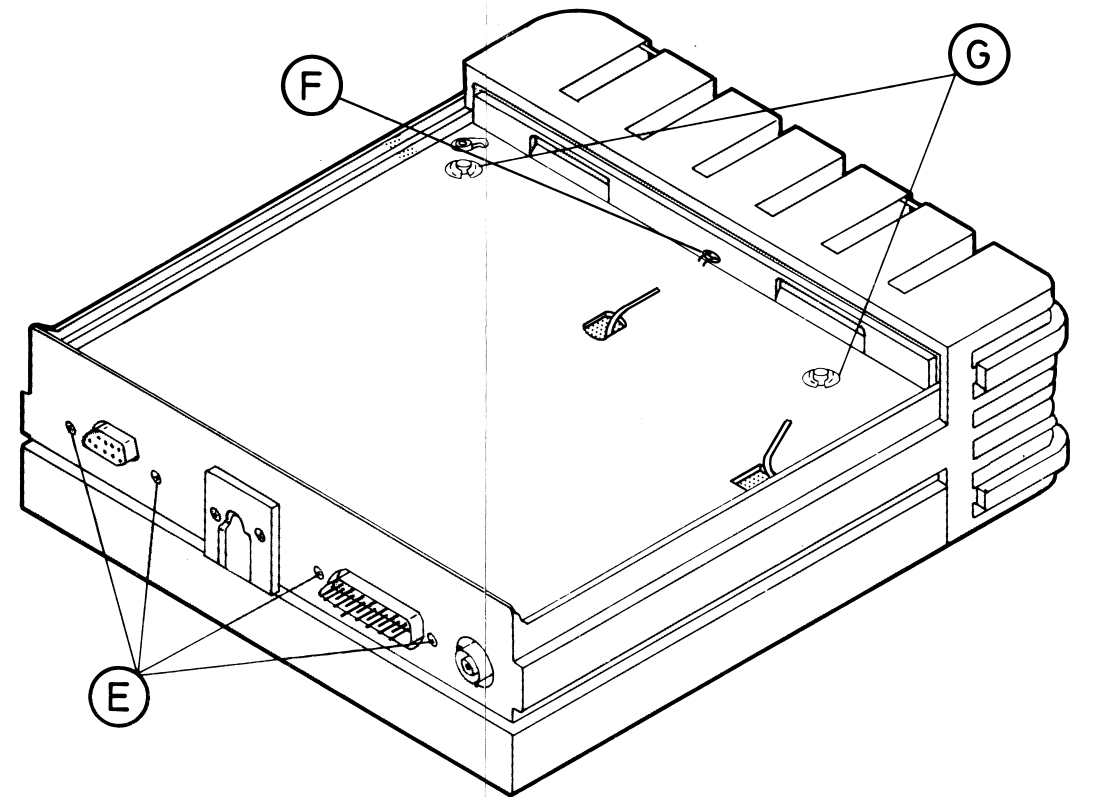
APM891023A3/00

Fig. 2



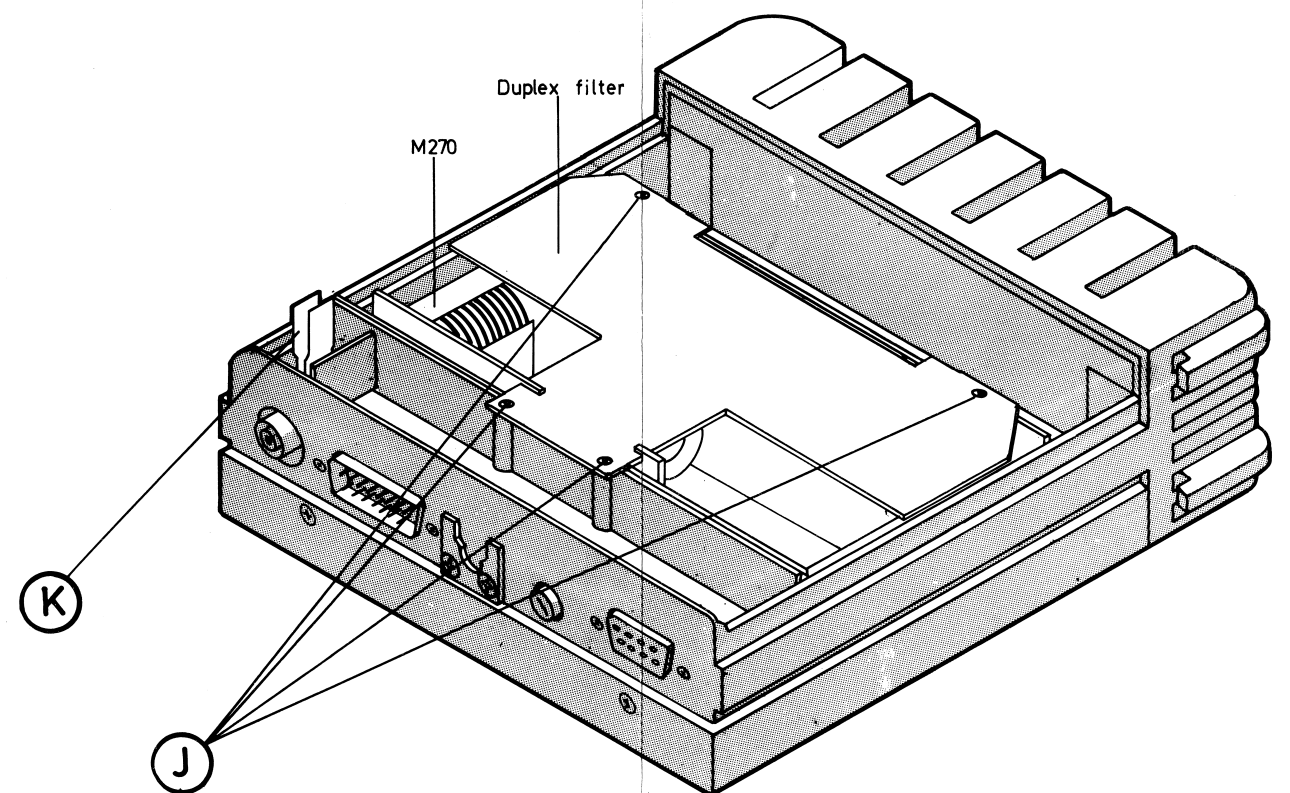
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Fig. 4



APM891018A3/00

Fig. 3



APM8910 21A2 /00

Fig. 5

Description of the transceiver.

In the following chapters the transceiver block diagram will be explained.

Please remember the following notes:

- The battery voltage is shown as +13,2V. This is the voltage used during checking and adjusting.
- The units have been given numbers M220, M230, etc.
- Most interconnections are made via the mother board M220. These interconnections are shown in the wiring diagrams.

The following remarks are intended as a guide to the use of the diagram. The arrows on the block diagram indicate the signal paths through the circuits.

The mobile telephone contains many functions of an ordinary mobile radio for a closed net.

Examples: Channel selection, squelch and volume control. The difference is that this mobile telephone is fully remote controlled. All these functions are controlled by a built-in microprocessor mounted on the system board and fed with information from the handset, the transceiver and the MTX. The information is treated according to a program stored in an EPROM. The result is commands to the handset, the transceiver and the MTX. For communication with the MTX, the mobile telephone speech path is used. As this is of limited bandwidth it cannot be used directly for data transmission. Therefore the data stream is converted to audio type signals in a MODEM.

The transceiver consist of four modules, a duplex filter and a system mother board. All modules are mounted mainly with SMD components.

Description of the block diagram.

The block diagram is divided into six sections and contains:

- The system board M220.
- The IF/AF amplifier M230.
- The RX Synthesizer M240.
- The TX/AF amplifier M250.
- The PA-stage M260.
- The duplex filter.
- The supply filter M270.

The system board M220 contains the CPU which controls almost every part of the mobile telephone. The CPU works according to the software stored in the EPROM. It also receives and sends information to the MTX via the FFSK modem. Via different I/O ports it controls the RX-synthesizer (gives information about channel number etc.).

The CPU also controls the different driver stages for external relays (alarm etc.) and controls the output power of the PA-stage.

The EEPROM contains information about the mobile telephones subscriber number, code lock etc. The RAM contain information such as short dial numbers.

Finally the system board contains amplifiers for earpiece and loudspeaker and a time out circuit which turn off the mobile telephone, if the CPU fails to do it.

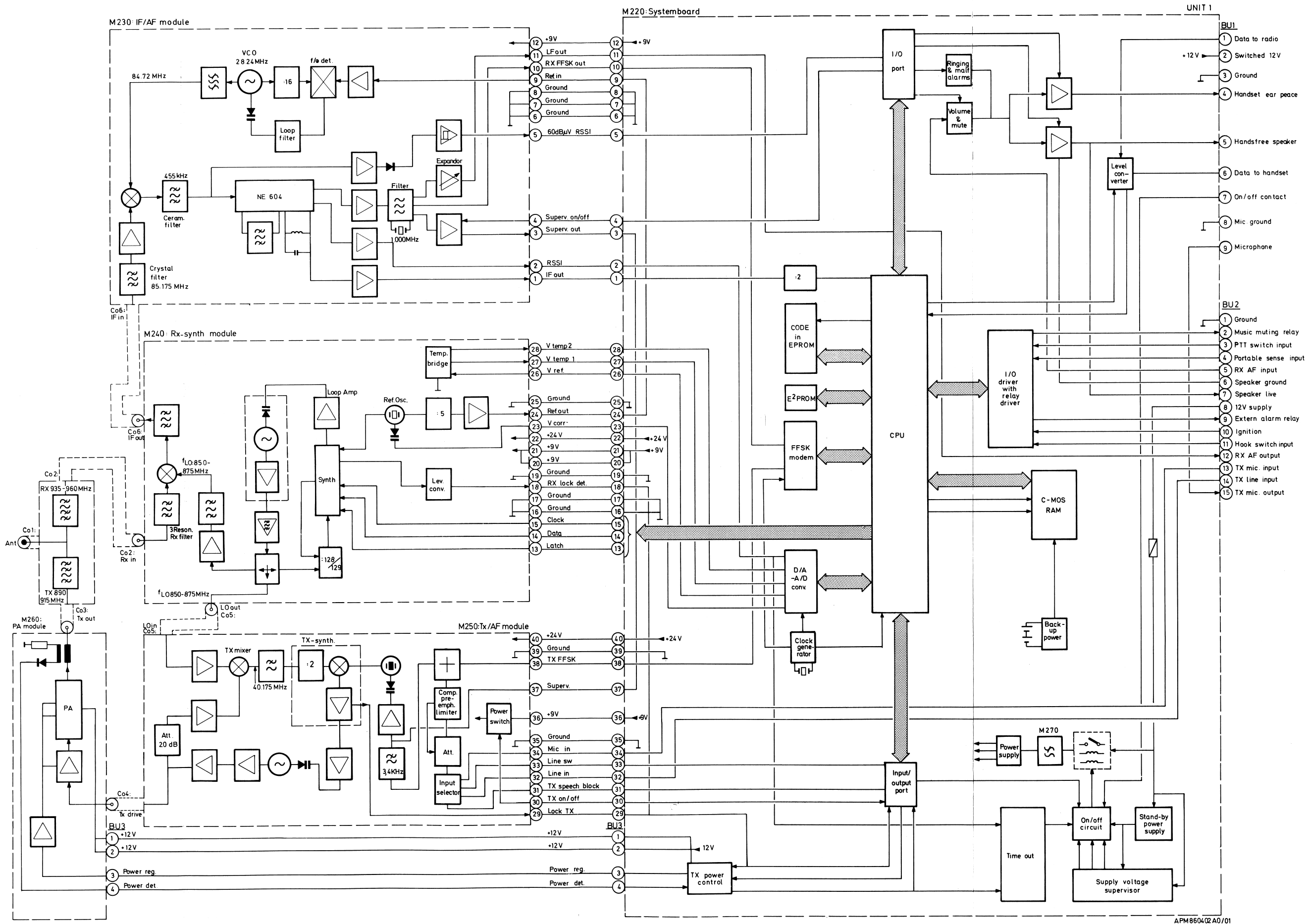
The antenna signal received is fed through the duplex filter to the RX-synthesizer M240. Here it is converted to the first IF-signal at 85.175MHz. The synthesizer is controlling the RX-VCO which works in the area 849.8375MHZ to 874.8125MHZ. As a reference the RX-synthesizer IC is provided with a 8.825MHz reference oscillator.

The IF-signal is then fed to the IF/AF amplifier M230. Here it is converted to the second IF at 455kHz before it is detected and fed to the AF-amplifier. The AF-signal is amplified in M220 and then fed to the loudspeaker or the earpiece in the handset. The supervisory is fed from the detector and via a bandpass filter to the TX-unit so that it is transmitted back to the base station and the MTX.

The microphone signal from the handset is looped through BU2 where a scrambler or a telephone answering device can be inserted on the line. The microphone signal is then fed to the TX/AF amplifier where it modulates the reference oscillator for the TX-synthesizer.

The TX-synth. controls the TX-VCO which works at a frequency from 890.0125MHz to 914.9875MHz. The output of the VCO is fed to the PA-stage M260, and to a mixer where it is mixed with a reference signal from the RX-synthesizer. This locks the TX-synth. to the RX-synth. so that the duplex separation will always be 45MHz.

The PA-stage M260 amplifies the TX-signal before it is fed to the duplex filter. The PA-stage works with 3 different output levels controlled by the CPU on the system board.



Description of the system board M220-I.

The system board contains several functions besides acting as a motherboard and interconnection board for some of the other units of the transceiver.

Here the systemboard is divided into four sections:

- ON/OFF circuits.
- Power supply.
- Computer section.
- Other circuits.

ON/OFF circuits

The ON/OFF circuit is mounted with a bistable relay, which means that the circuit only leads current through the coil when turning the radio ON or OFF.

The capacitor C2 is either charged via Q5 (turn-ON) or discharged via Q3 (turn-OFF). To switch ON the radio some conditions must be fulfilled. The supply voltage must be above 10V (monitored by IC7/1) and below 17V (monitored by IC6/2) as all inputs on IC5/1 must be low to switch ON the radio. R19/C13 ensure that the switch ON function cannot be activated if the radio is already ON. Turn OFF can be activated by the hardware time-out circuit or if any of the inputs of IC5/2 is high. This will happen if the supply voltage is above 17V (monitored by IC6/2) or below 7V (monitored by IC6/1 and if both inputs on IC3/2 are high, or if the reset input on IC4/2 is low for more than 1us.

When pressing the ON/OFF button on the handset, the time-in IC4/1 is started, leading to the start of the second timer IC4/2. If the first timer runs out before the second, IC3/2 will activate the turn-OFF of the radio. As the CPU is informed (by data from the handset) about an ON/OFF contact being pushed, it can decide whether to let the turn-OFF procedure run out reset the second timer via Q1, thus preventing the turn-OFF. The CPU can also force the radio OFF via Q1, R17 and C11.

The hardware time-out circuit is incorporated to secure turn-OFF of the radio if the CPU fails. Both the CPU and the hardware time-out circuit monitors the transmitter activity and the received carrier indicator. If the transmitter is on while no carrier is present, the CPU will turn off the radio after 30 seconds while the hardware circuit will turn off the radio 2 seconds later (after 32 seconds) if the CPU fails.

Power supply

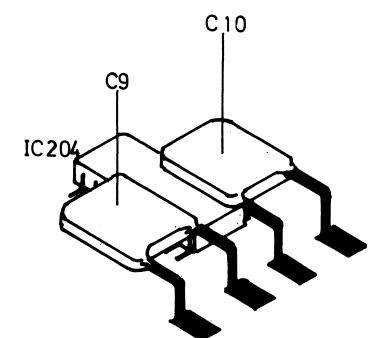
The seven voltage on M220 are the following:

- + 14V is the external supply to the ON/OFF circuit.
- + 13V is like the +14V, but limited by a zener diode not to exceed 15V.
- + 12 is like the +14V, but after the relay.
- + 9V is derived from +12V and regulated by a low-drop regulator.
- + 5V is derived from +12V and regulated by a low-drop regulator. A large number of capacitors and resistors are added on strategic places to prevent noise on the supply line from the digital circuits from interfering with the radio circuits.
- + 3V is the back-up voltage for the RAM.
- + 2.5V is used to ensure the right DC-voltage on the C-MOS switches in the audio path.

Computer section

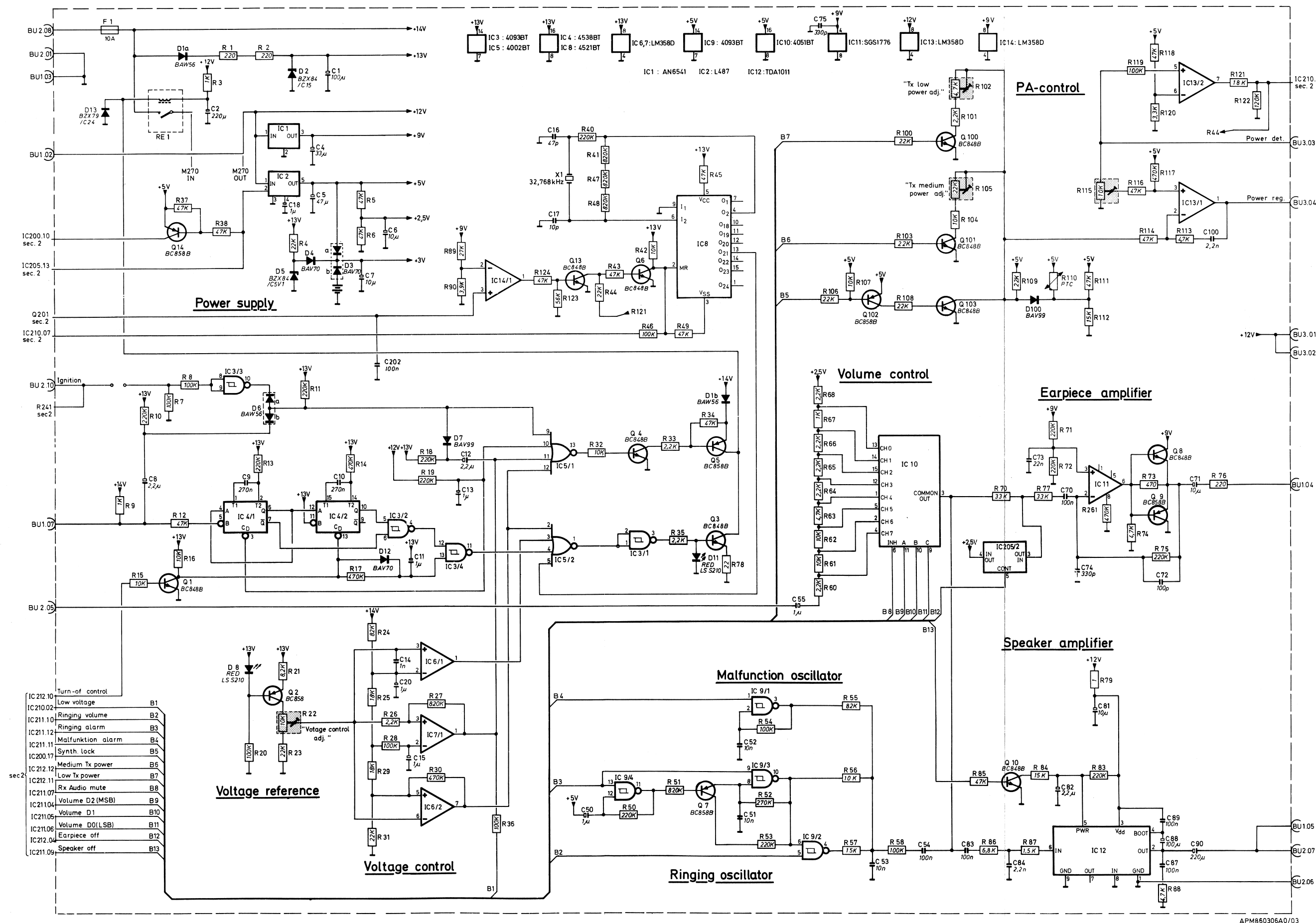
The microcomputer, an 80C31, is running at 11.0592MHz. The restored address lines are led from the address latch to the program memory, the RAM, the I/O ports, and the address decoder for the RAM and the ports.

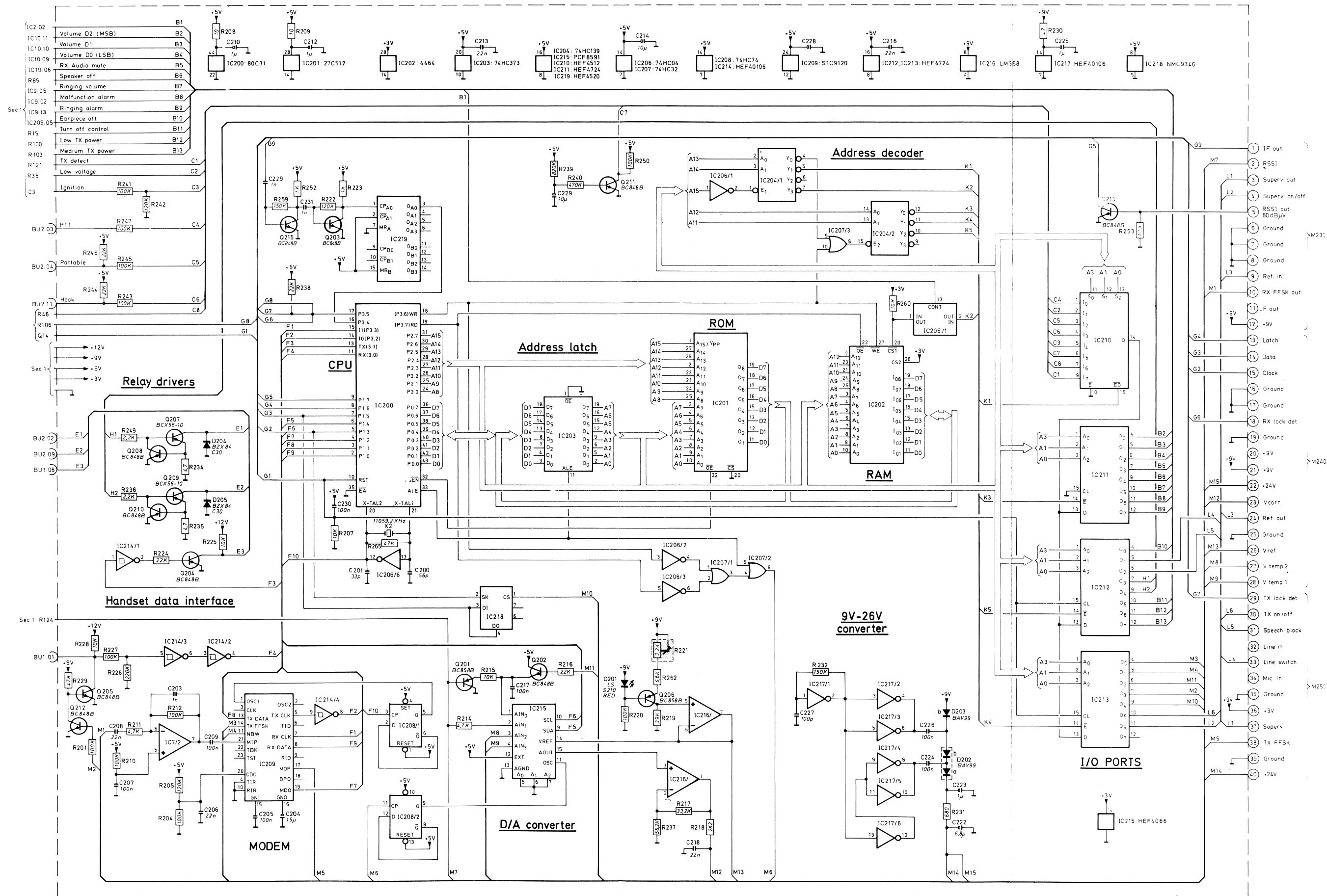
The serial link to the handset is a 12V open collector link, with the pull-up resistors located in the receivers and the open collectors placed in the transmitters. The circuit on M220 may prevent transmission from the handsets to the radio unit during power-up. When the processor is ready, an output port will enable this



ONLY WHEN C9,C10 ARE LEADED

Fig. 7 Component location, system board M220





APM860401A0/0

Description of the IF- and AF amplifier M230.

The 85.175MHz IF signal is fed via two crystal filters and a buffer with a gain of approximate 17dB to the second mixer.

The second input of the mixer is a frequency of 84.72MHz from the VCO provides a frequency of 28.24MHz. The VCO frequency is then tripled at the collector of the VCO transistor. The VCO frequency is also divided by 16 before it is sent back to the phase detector, where it is compared with the VCO reference signal from the RX-synthesizer modul M240. The phase detector sends a DC control voltage to the VCO.

The 455kHz IF output signal from the 2nd mixer is sent via a crystal filter to an integrated IF-amplifier, limiter, quadrature detector and field strength measurement circuit (IC2).

The recovered audio signal is fed to a 2nd order high-pass filter where it is split up and led into a switch capacitor filter. The speech signal is led via a deemphasis circuit and a 3400Hz low-pass filter to an expander before it is sent to the AF amplifier on the system board.

The audio signal recovered is also led through a 4kHz band-pass filter from which the 4 kHz supervisory signal is derived.

The 60dBuV detector circuit is connected to the output of the 455kHz ceramic filter. The IF signal is amplified and detected by the diode (D2). The level of the signal controls a Schmitt-trigger which is directly connected to the CPU on the system board.

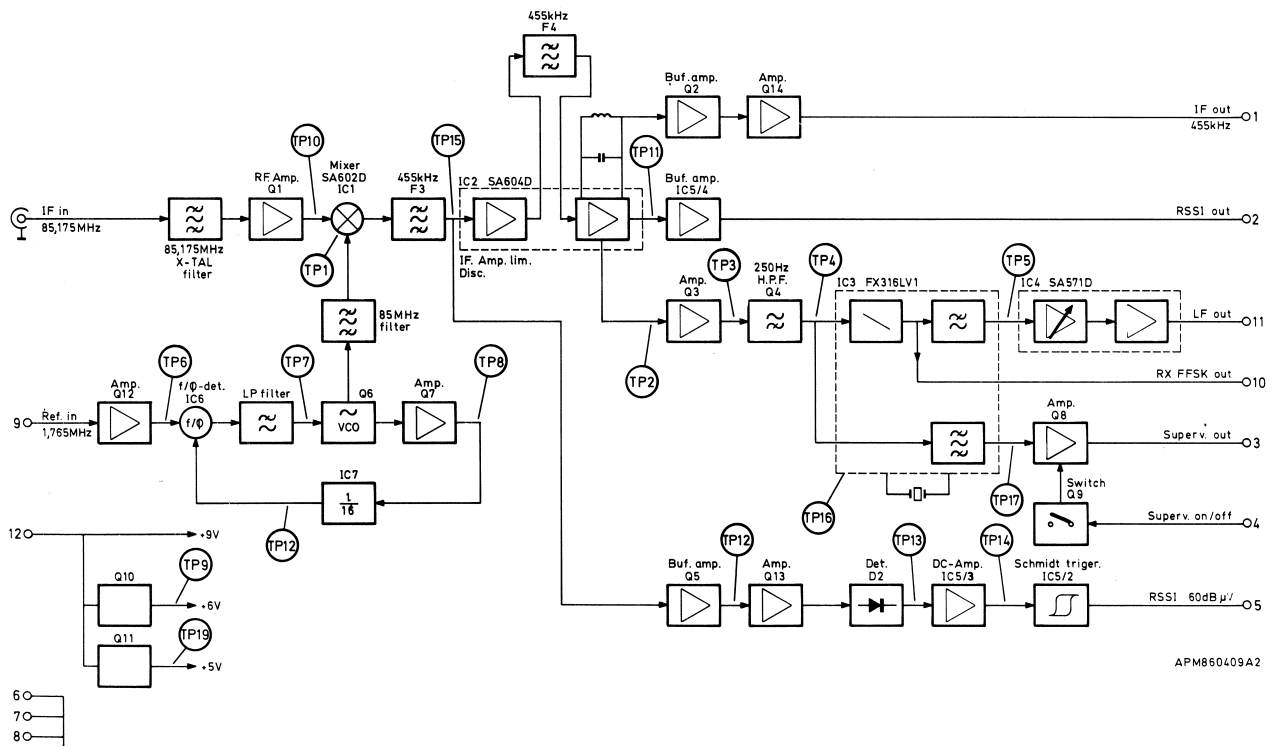


Fig. 10 Block diagram, IF/AF amplifier

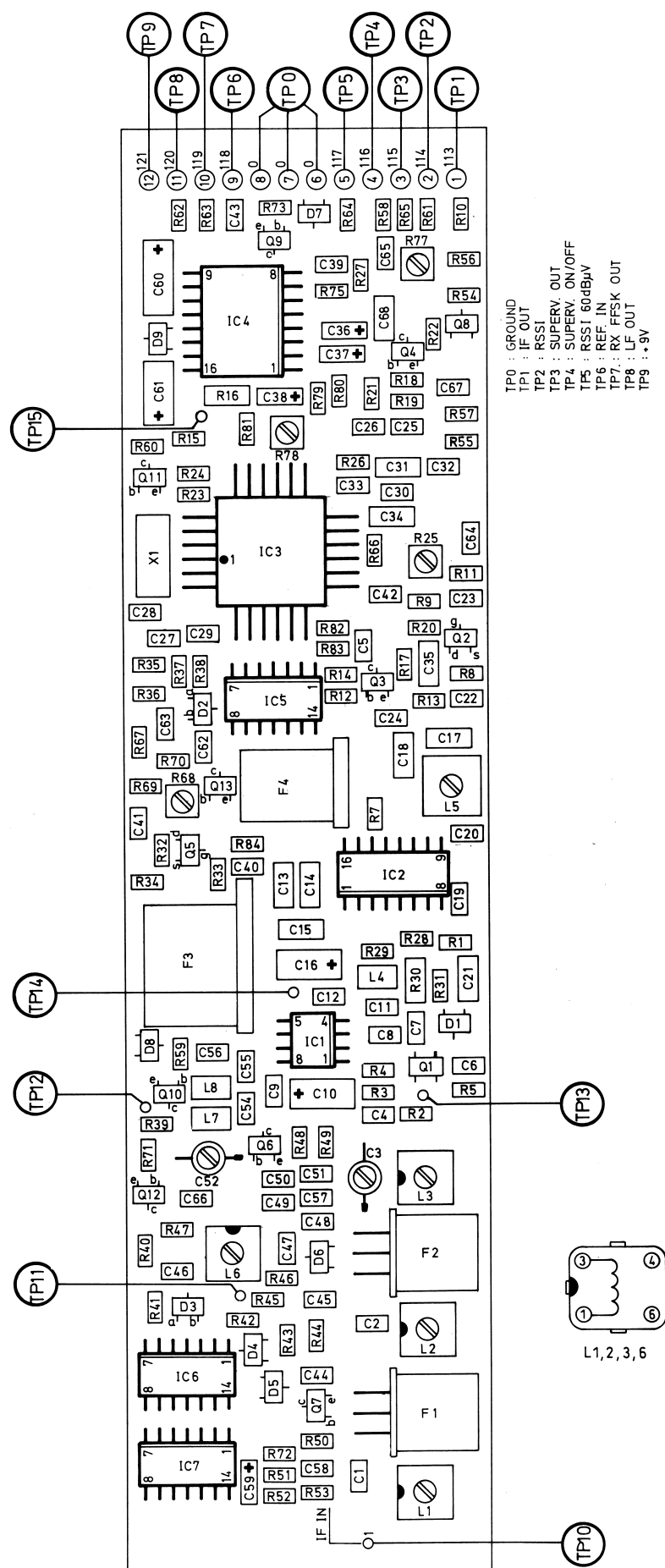
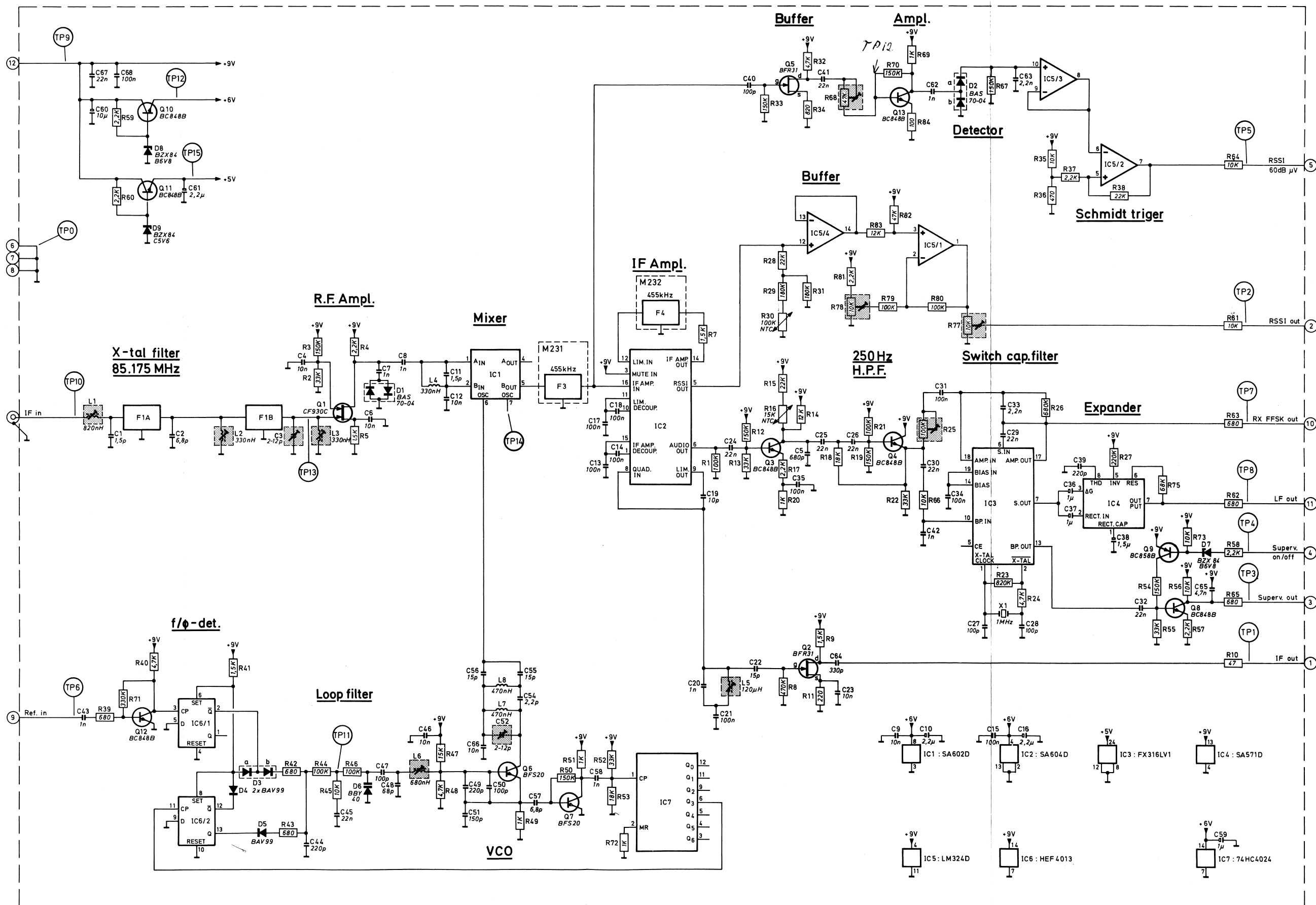


Fig. 11 Component location, IF/AF amplifier M230

APM880930A2/01



APM880928A0/01

Description of the RX synthesizer M240-I.

RX-synthesizer

The RX-synthesizer unit can be divided into 3 main parts. These are:

1. Front end
2. Synthesizer
3. Reference oscillator

The front end converts the antenna signal received from the duplex filter to the duplex filter to the first intermediate frequency (IF) at 85.175MHz with approximate 16dB gain.

The synthesizer section consists of a VCO, a prescaler, the synthesizer itself, and a loop filter. The VCO consists of a 985MHz resonator and work within the range of 849.8375MHz to 874.8125MHz in steps of 25kHz (12.5kHz if interleaved channels are used). The output of the VCO is via a buffer fed to the front end circuit to the TX slave loop in the TX/AF module, and to the prescaler. The prescaler divides the VCO frequency by either 128 or 129 controlled by the synthesizer (Pin 6 low: 129, Pin high: 128). The synthesizer is fed with data information on pin 12-14 about the division ratios corresponding to the selected channels. After the VCO signal has been divided, it is fed to an internal comparator together with a signal from the VCXO reference oscillator. The output from the comparator is fed from the synthesizer via a loop filter to the VCO for frequency correction and to the VCO gain compensation circuit. The loop-filter is based on the integrator IC6. D2 changes C11 more quickly in order to speed up the switching time. The VCO gain compensation circuit compensates for the unlinearity in the VCO gain (the gain fall when the frequency rises). When the VCO gain starts to decrease, D5 opens and the voltage at Q6 base increases. This means that the current which controls the phase detector gain increases, so that the open loop voltage gain is kept constant. The RX lock detects output of the synthesizer (pin 4) is low (active state) when the PDA output on pin 1 is between 1 and 4V.

The reference oscillator is built around an unbuffered inverter. It provides a frequency of 8.825MHz. The output of the oscillator is fed to the synthesizer and via a divider (divide by 5) to the IF/AF module. A temperature measuring bridge is introduced and information about the temperature of the crystal is sent to the CPU on the system board. The CPU sends back a correction voltage for the VCXO.

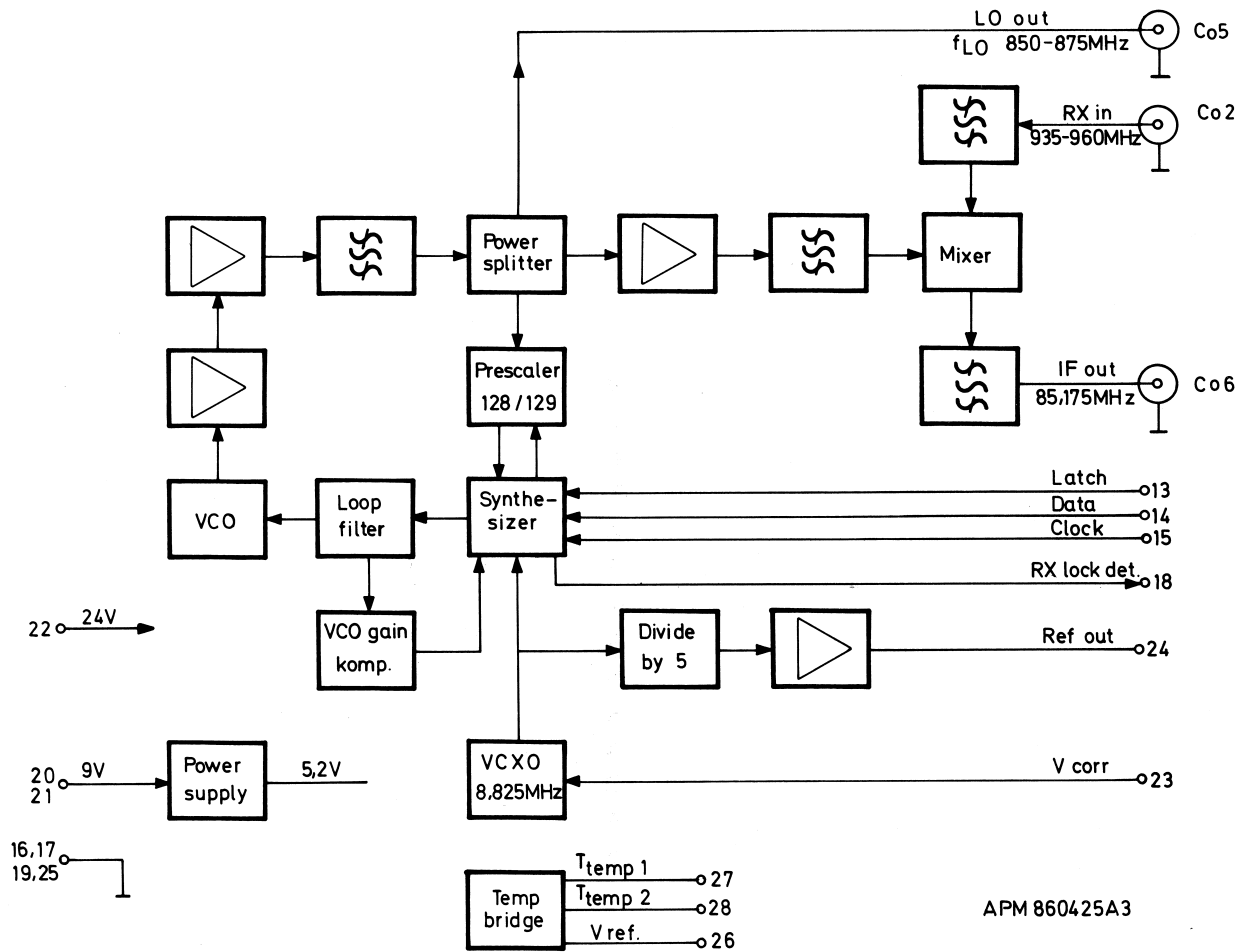
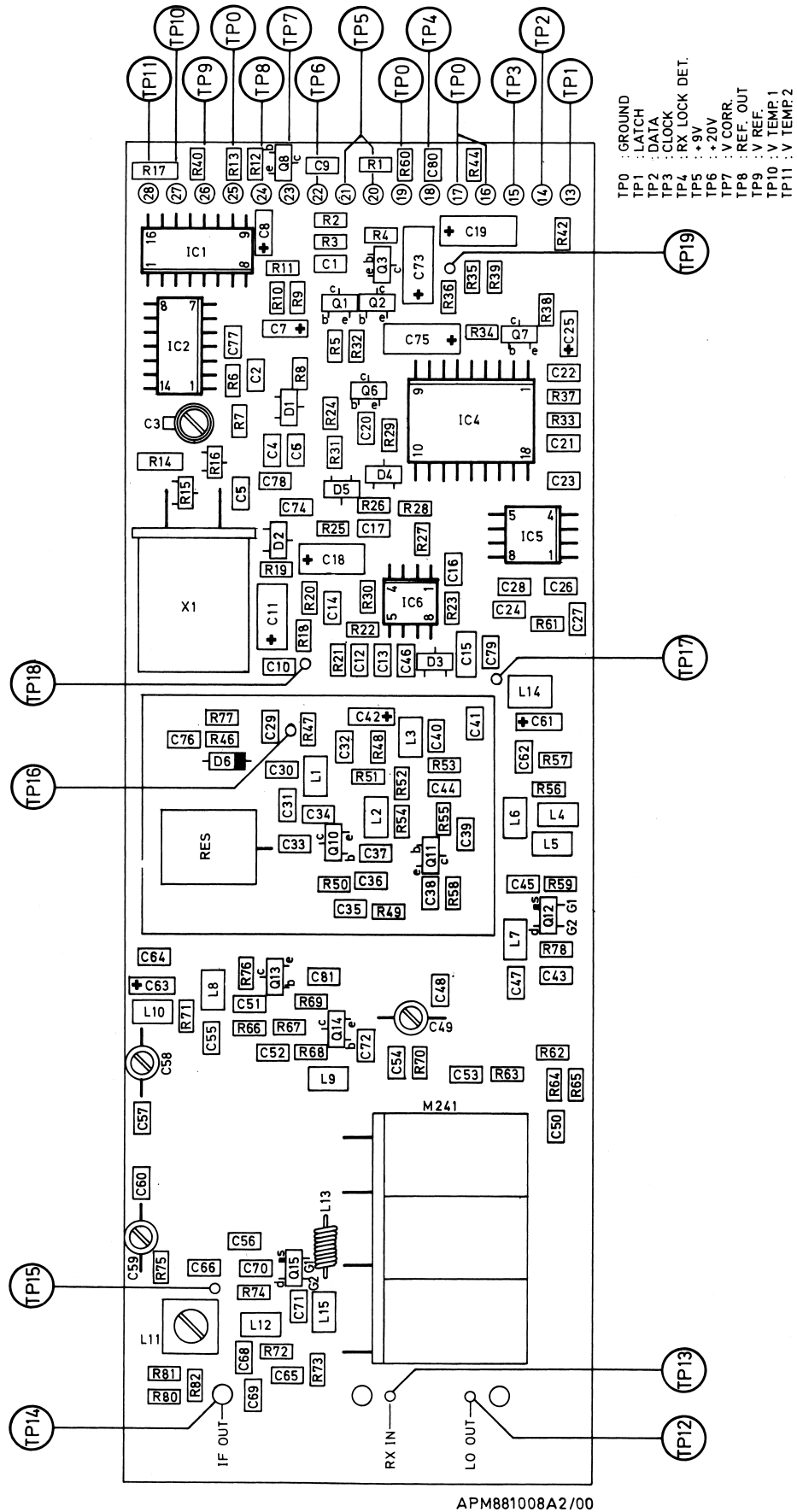


Fig. 13 Block diagram, RX synthesizer



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Fig. 14 Component location, RX synthesizer M240

Description of the TX/AF amplifier M250-I.

The TX/AF amplifier contains three circuit blocks:

1. A power supply switch.
2. An audio processing circuit.
3. A transmitter PLL circuit (incl. buffers).

1. Power supply switch (Q8 and Q9).

The power supply switch ensure that the transmitter PLL (Phase Lock Loop) is only activated when necessary. In TX mode, a high level from the CPU is sent to the power supply switch, which then supplies the TX-PLL. The audio circuits are constantly power supplied.

2. Audio circuits.

There are four different AF inputs to the audio circuits.

- a) Line.
- b) Microphone.
- c) Supervisory.
- d) FFSK signal.

The switching between microphone and line input is made with a diode shift network. The selected audio signal is led through an AGC an compressor circuit (Q13 and IC3). After that any FFSK signal is added and the signals are send through a lowpass filter (3,4KHz) and a stop band filter (4KHz) in order to fulfil the NMT specification. At last the supervisory signal (4KHz) is added.

3. TX-PLL circuit.

Via a buffer, the summary AF-signal is sent to the reference oscillator, which it modulates to half the specification ($\Delta f/2$).

The output from the reference oscillator is fed to the TX-synth. The output from the TX-synth is a DC + modulation which controls the VCO.

The output from the VCO is fed to the PA module but also via an attenuator and a buffer back to the TX-mixer. The TX-mixer mixes the signal from the TX-VCO with the signal from the VCO in the RX-synth. module. The difference frequency (40,175 MHz) is divided by 2 before it is fed to the phase comparator of the synthesizer where it is compared with the signal from the reference oscillator to lock the TX-VCO to the reference oscillator.

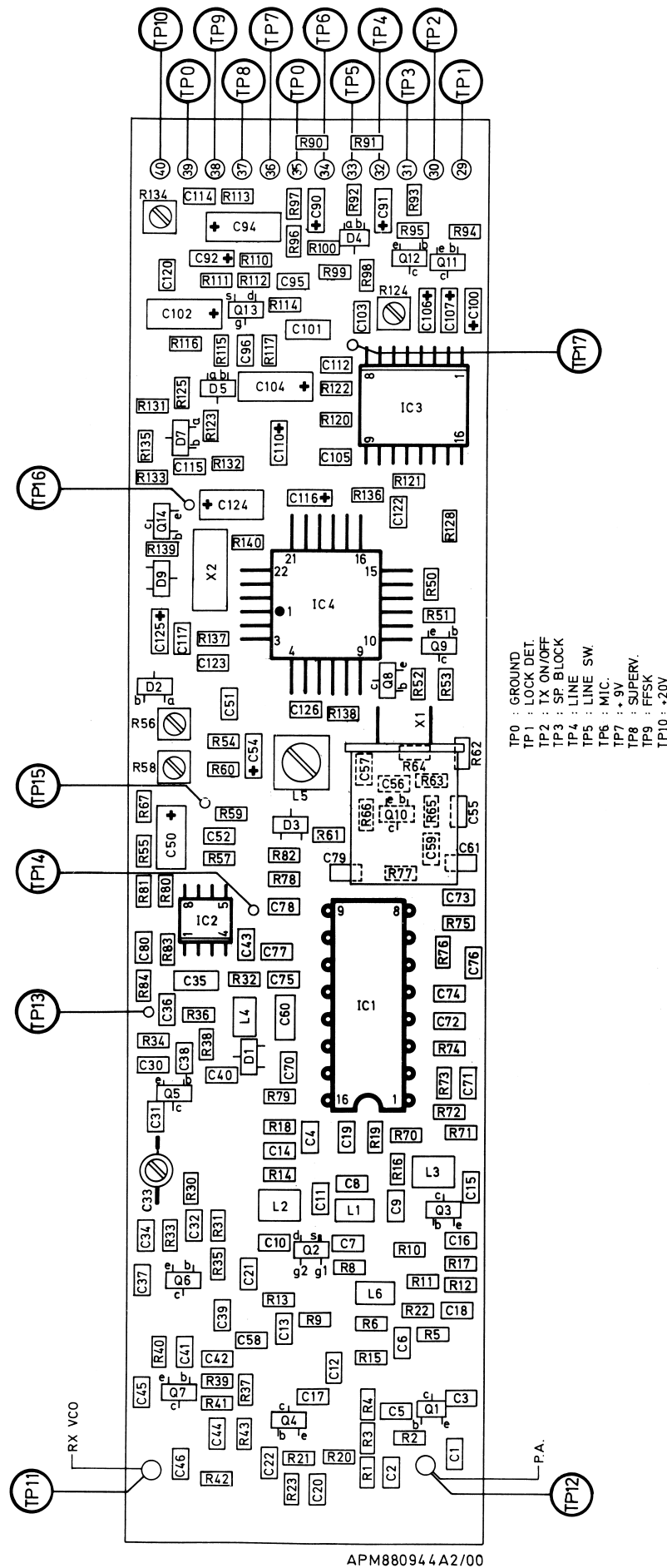
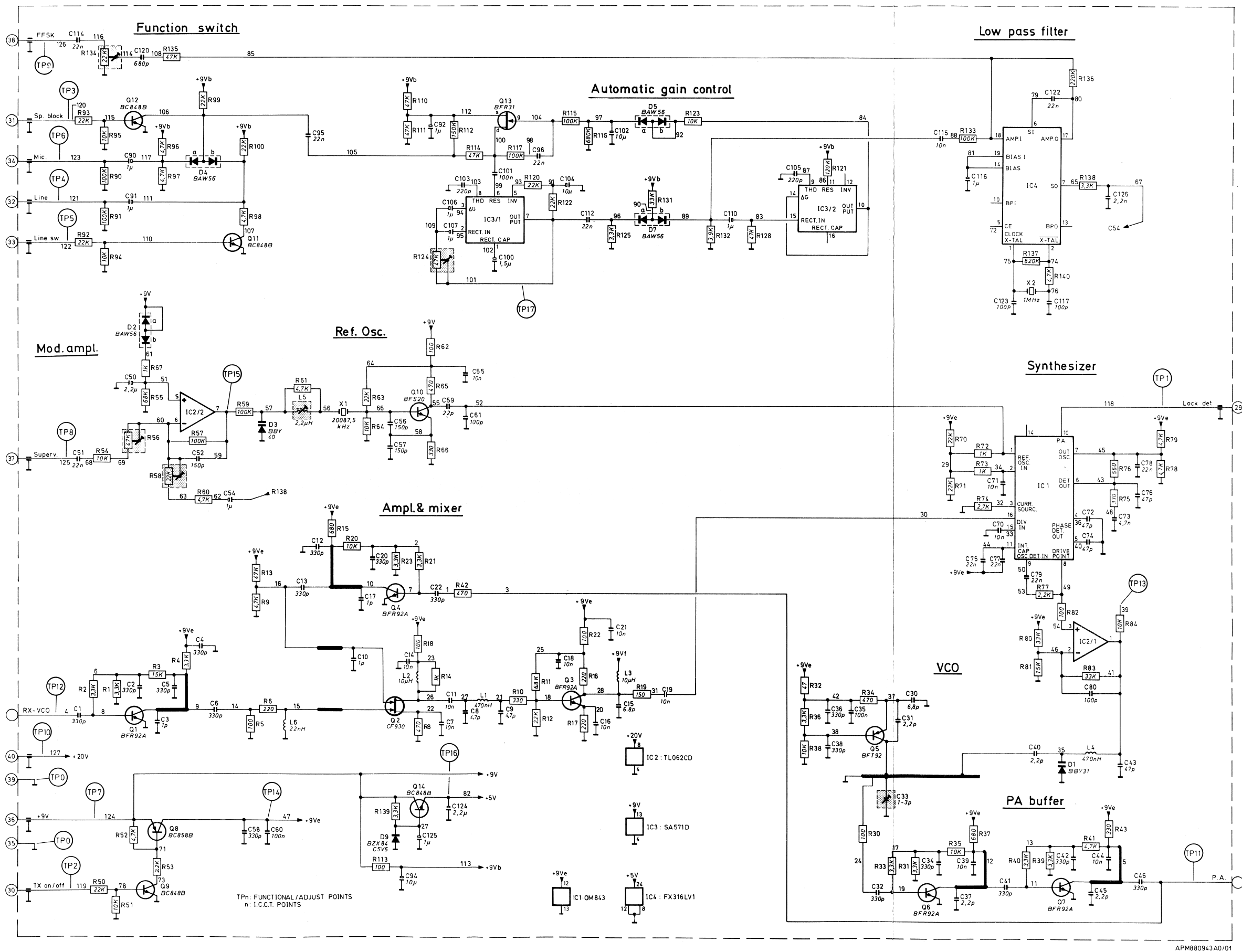


Fig. 17 Component location, TX/AF amplifier M250



Description of the PA-stage M260-I.

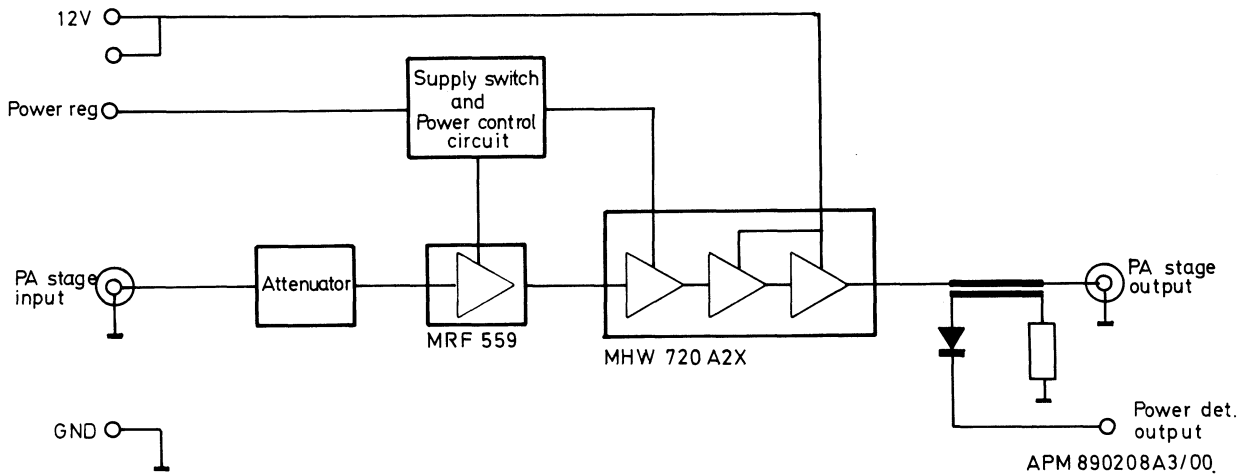


Fig. 19 Schematic block diagram, PA-stage M260.

The PA-stage is supplied directly from the battery through the supply filter M270. The PA stage contains a combined switch and power regulator circuit (Q2 and Q3) which is controlled by external circuitry on the computer board M220.

The TX-RF signal is preamplified in Q1 and power amplified in IC1.

The output is led through a directional coupler which monitor the forward transmitted power. The monitor voltage (DC) is connected to the power regulation circuit on the system board M220. The PA-stage output is led to the antenna connector through the TX part of the duplex filter.

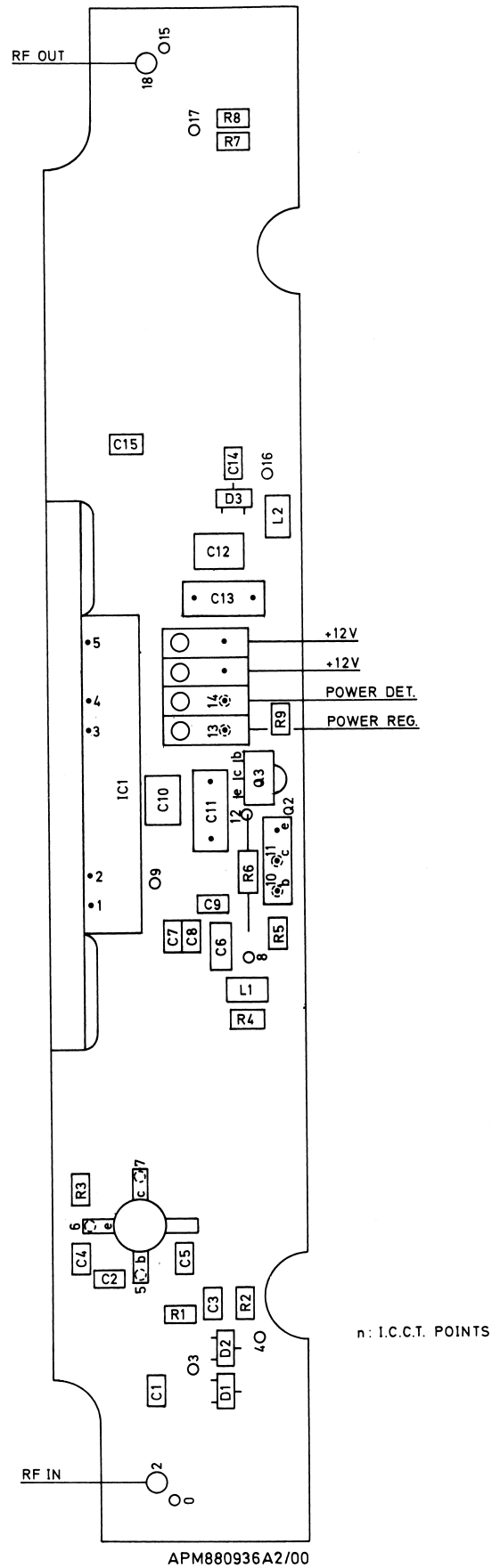


Fig. 20 Component location, PA-stage M260

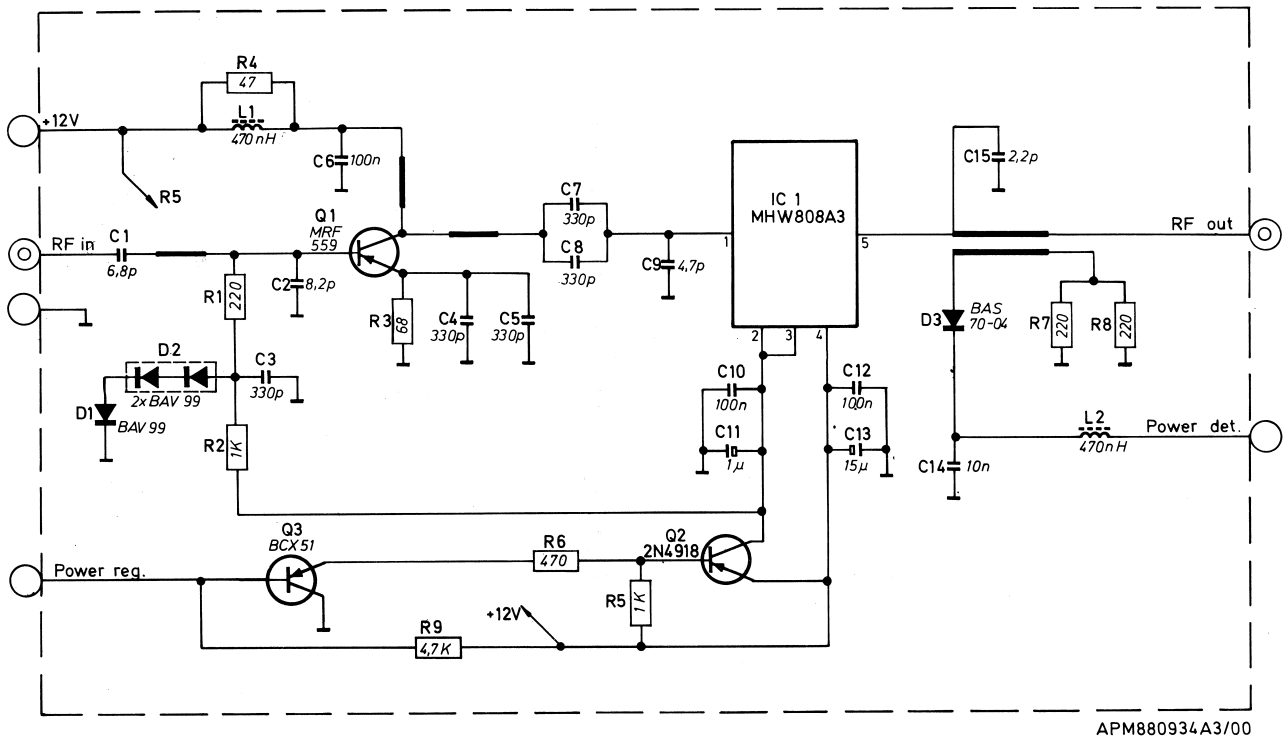


Fig. 21 Circuit diagram, PA-stage M260

Warning

Certain semiconductor devices used in this equipment contain Beryllium Oxide. If inhaled, dust from this oxide can be toxic.

No danger can arise from normal handling but no attempt should be made to tamper with these devices.

They should not be discarded with industrial or domestic waste.

Metal oxide silicon devices

The field effect transistors and C-MOS integrated circuits used in this equipment are metal oxide silicon devices. Because they have an extremely high input impedance, they are susceptible to damage when subjected to high transient voltages or static electrical charges.

To eliminate the possibility of damage the following precautions must be taken:

1. Device leads must always be in contact with a conductive material to avoid the building-up of static charges.
2. Soldering iron tips, tools and metal parts of test equipment used during servicing must be grounded.
3. To avoid transient voltage spikes, devices must not be inserted nor removed with power connected.
4. Signals must not be applied to integrated circuits in the absence of power supplies to the devices.

Service instructions.

1. General information.

In this transceiver the SMD technology has been introduced. This means that repairs at component level is not allowed without the use of special tools. If any of the modules has been replaced the "Detailed module adjustment instruction" should be followed first and then the performance check made.

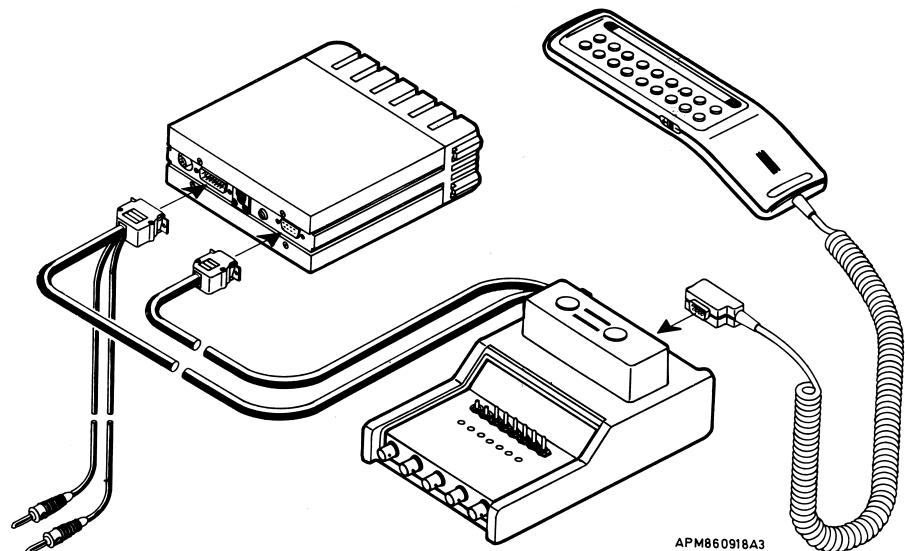
New modules as well as replacement modules have been tested and preadjusted in order to make a "Quick performance test" of the transceiver.

For testing the transceiver a Service Interface Unit (SIU) can be used. The SIU can test the handset and the transceiver separately and together.

For fault finding and adjustments of the entire mobile telephone the following test equipment is recommended:

DESCRIPTION	TYPE NUMBER	ORDERING NUMBER
Handset		
Service interface unit	AP4009	9506 100 10720
Test cables BNC-MCX		9506 100 70660
Power supply	7-15V DC, 20A	
Digital multimeter	e.g. PM 2521	
Oscilloscope	e.g. PM 3217	
Radio communication test set	e.g. Marconi 2955 or:	
Signal generator	e.g. Marconi 2022	
Deviation meter	e.g. HP 8901A	
Function generator	e.g. PM 5109S	
Frequency counter	e.g. PM 6668	
Sinad meter	e.g. Finstrument M73	
AC milivoltmeter	e.g. PM 2521	

2. Connecting the service interface unit to the transceiver and handset.



3. User's instruction for the service interface unit and the transceiver software.

Connect the SIU cables to the connectors on the transceiver unit and connect the handset to the SIU.

Connect the black and red power cables to the power supply and set the voltage to 13,2V DC

This is the setup for test and service of the mobile telephone, using the AP4009 SIU, and the built-in software.

When you apply power to the test setup, you will hear a click and it may look as if the set switches on and then off again. This action occurs because the transceiver CPU must have time to check if all the prefunctions are all right and then the CPU turns the mobile telephone off.

Press **0** on the handset. The telephone number and the regional/national status will be shown on the display.

To get access to the software, use these keys on the handset **→** , **0** . Look at them as a key and a keyhole. Now, what you have to do is to select which key you want to unlock the keyhole with.

The following facilities are available:

Enter

0 , **→** , **0** .
1 , **→** , **0** .
2 , **→** , **0** .
3 , **→** , **0** .
4 , **→** , **0** .
5 , **→** , **0** .
6 , **→** , **0** .
7 , **→** , **0** .
8 , **→** , **0** .
9 , **→** , **0** .
, **→** , **0** .
***** , **→** , **0** .

Mode

Normal operation.
PTT.
Call probability.
Forced control.
Prgm. telephone number and password.
Prgm. locking code.
Erasing short dial numbers.
Reset time counters.
Display software version.
Prgm. basic channel band.
Toggle payphone / not payphone.
Initialize temperature table.

Note: If the display does not show the correct indication format, disconnect and reconnect the power. This will reset and restart the program.

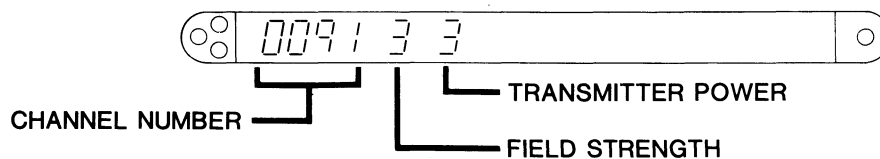
4. Explanation of the software functions.

0 Normal operation

This is the normal operation of the mobile telephone, and it will work as if no selection has been made.

1 PTT mode.

This is a monitoring mode. The indication on the display will be:



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A flashing of the display indicates that information is being updated.

You can use this mode to see if major functions of the mobile telephone are working, and if the location you are in will be a good place for making a call.

The parameters to be used are:

Field strength: 0 = less than -2dBuV
 1 = -2dBuV to 10dBuV
 2 = 10dBuV to 20dBuV
 3 = more than 20dBuV

Transmitter power level: 0 = low power
 1 = medium power
 2.3 = high power

Note: Power level is information received from the MTX.

② Measurement of probability of calls.

This is a feature required by the PTT. It enables the mobile telephone to start its scanning on max. sensitivity. The display will only show 2.

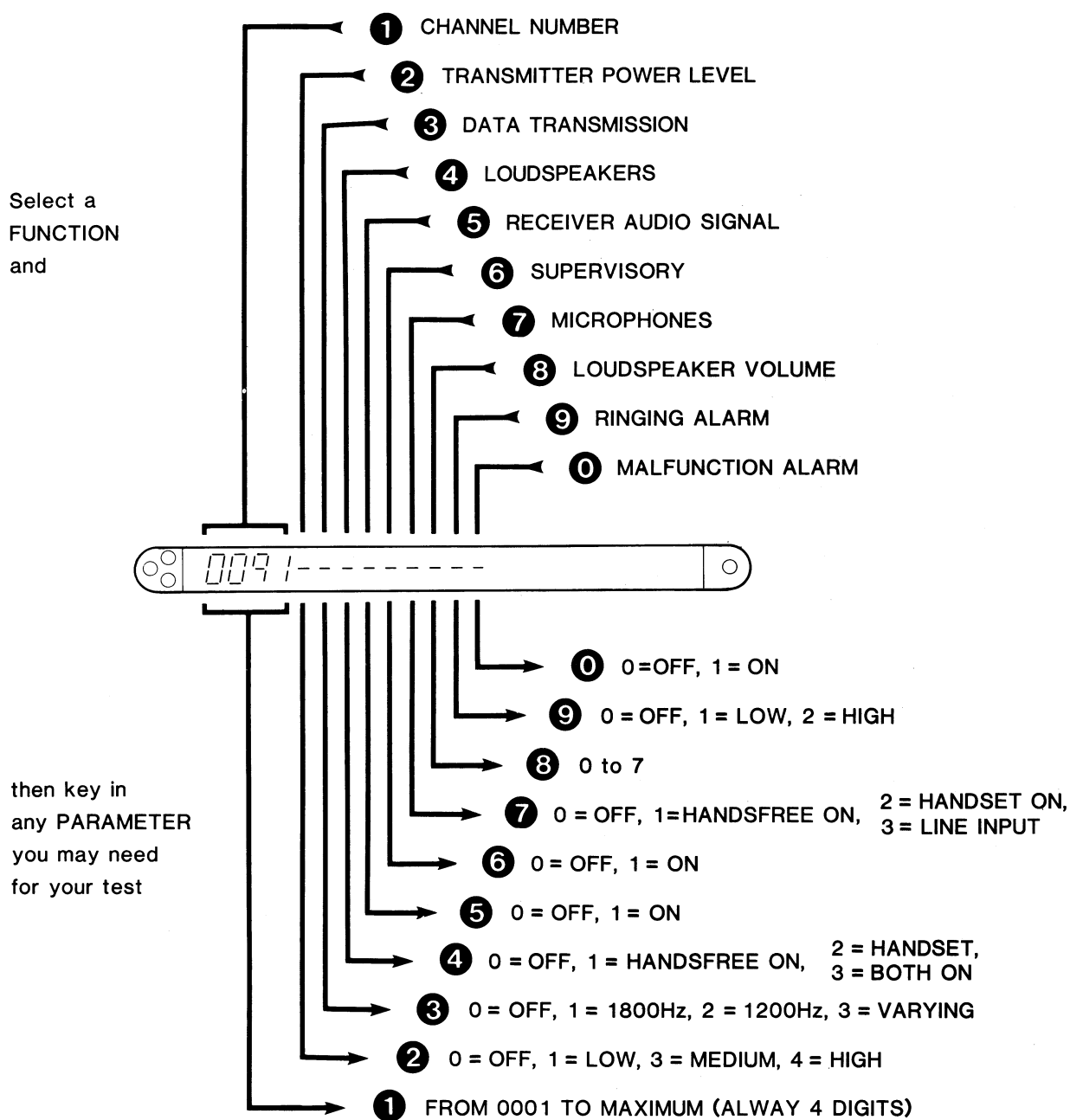
③ Forced control of the mobile telephone.

This is the test and service mode. In this mode the CPU allows the transceiver to be controlled by the handset keyboard.

The operator can select one or more functions of the mobile telephone to be performed, by selecting one of the functions and write in the parameters needed for the test

The following figure is a guidance to this:

Select a FUNCTION and then key in any PARAMETER you may need for the test.

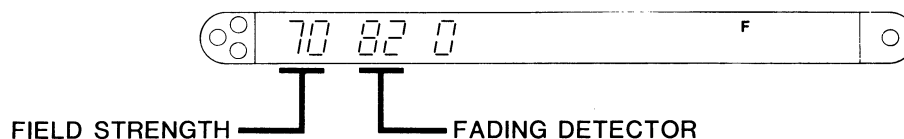


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Note: If you have used the forced control of the CPU, the only way you can return to normal operation is to turn the mobile telephone OFF and ON again.



Field strength and fading Indicator.

Pressing  makes the display indicate field strength and fading detector.




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Disable frequency control system.

Pressing  disables/enables (the function toggle when  is pressed) the frequency control system. When the control system is disabled, the transceiver will ignore any incoming signals from the antenna input and use its own temperature table to correct the reference oscillator.

Programming field strength levels.

Connect an RF-signal generator to the antenna input. Load the channel number into the mobile telephone. Press .

The display will show: "PUSH BUTTON"

Press the PROG button on the SIU.

The display will show: "FS -2dBu"

Set the signal generator output to -115dBm and press .

The display will now show a hexadecimal number. (calculated in the transceiver).

Press .

The display will show: "FS 10dBu"

Set the signal generator output to -103dBm and press .

The display will show a new hexadecimal number

Continue this way until all 4 levels (-2, 10, 18 and 20 dBuV) (-115, -103, -95 and -93 dBm) have been programmed.

Note: If no field strength levels have been programmed or if an error has occurred during the programming, the display will show "FS ERROR" instead of the telephone number when the mobile telephone is turned on.

④ Programming telephone number and password.

This is the function where the telephone number can be coded into the mobile telephone.

The display will show: "PUSH BUTTON"

Press the PROG button on the SIU.

The display will show: "ENTER NO"

Now enter the telephone number (7 digits).

The display will show: "ACCEPTED (the 7 digits)"

After a few seconds the display will show: "ENTER PASSNO"

Now enter pass number (3 digits).

The display will show: "ACCEPTED (the pass number)".

After a few seconds the display is cleared and the mobile telephone is ready for use.

⑤ Programming new locking code.

In this mode the personal lock code can be programmed.

The display will show: "ENTER CODE"

Enter the lock code (4 digits)

The display will show: "ACCEPTED (the 4 digits)"

After a few seconds the display is cleared and the code number is stored in the mobile telephone.

⑥ Erasing short dial numbers.

This function will, when selected, delete all abbreviated numbers that are stored in the memory at one time.

⑦ Resetting time counters.

This function will reset all time counters.

⑧ Software version.

This function will show the software version on the display.

⑨ Programming basic channel band.

This is the function where the basic channel band (number of available channels) is to be coded into the mobile telephone.

When selected the display will show: "PUSH BUTTON"

Press PROG on the SIU.

The display will show: "ENTER BC-LO"

Enter the low range of the basic channel band (0460).

The display will show: "ACCEPTED"

After a few seconds the display will show: "ENTER BC-HI"

Enter the high range of the basic channel band (0540).

The display will show: "ACCEPTED"

After a few seconds the display will be cleared. The mobile telephone is ready when it has been switched OFF and ON again.

Note: If the keyed number is out of range, the word ACCEPTED will appear on the display but it is not stored.

* Initialize temperature table.

This is the function where the temperature table for the crystal X1 on M440 is cleared.!!This must be cleared ONLY when the crystal X1 on M440 or the entire M440 has been replaced

When the function is selected the display will show: "ENTER CODE"

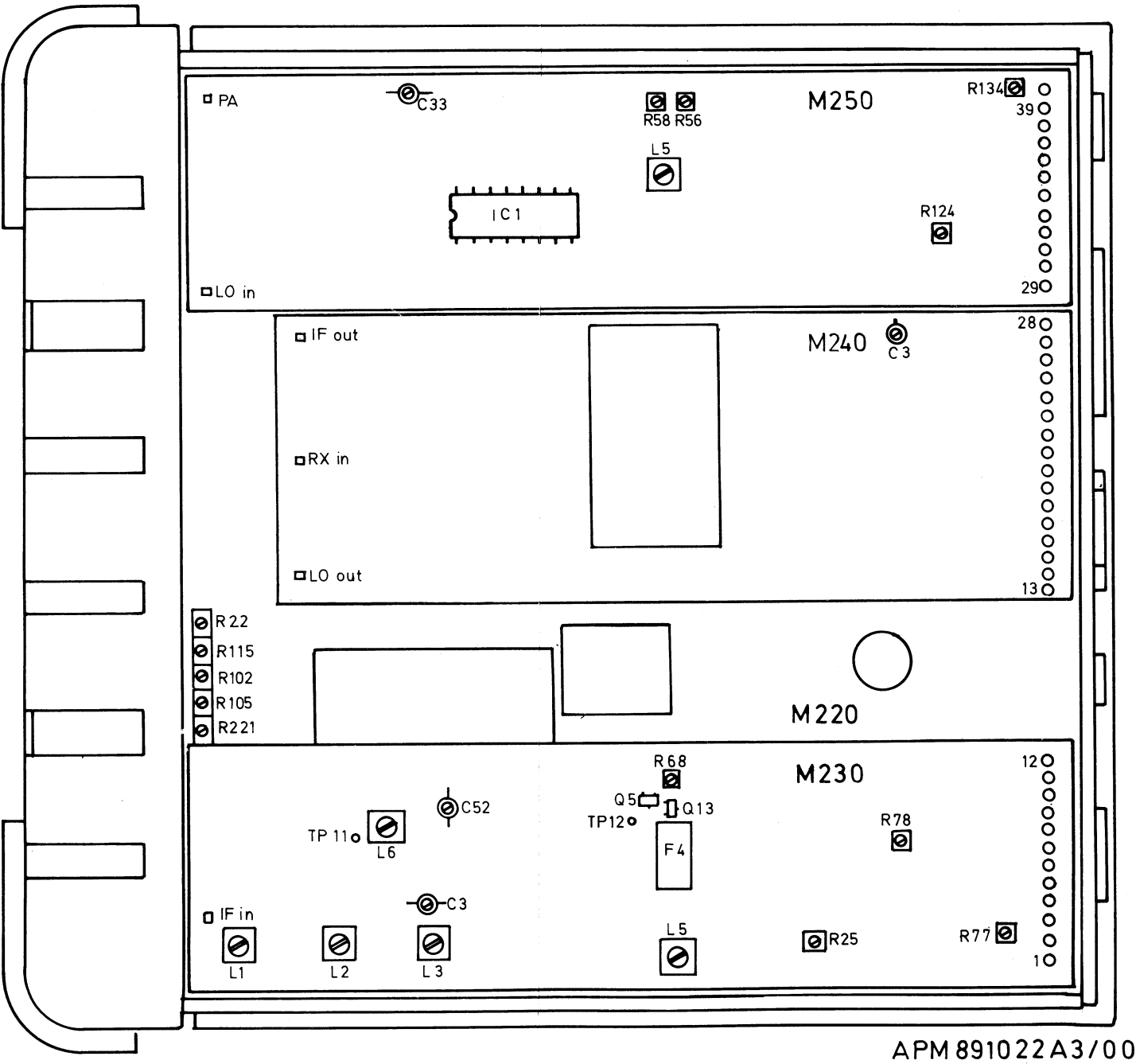
Now enter the digits "1,9,3,7" and the temperature control system will be initialized.

+ Payphone / not payphone.

If the mobile telephone is registered as a PAYPHONE, it must be programmed as such in order to make a call.

The key sequence + , ← , 0 will toggle between PAYPHONE and NOT PAYPHONE.

Note: When the telephone number is programmed, the telephone is automatically set to NOT PAYPHONE



Pin configuration on fig. 22.

40	+24V	
39	Ground	
38	FFSK	
37	Supervisory	
36	+9V	
35	Ground	
34	Microphone	M250
33	Line switch	
32	Line	
31	Speech block	
30	TX on/of	
29	Lock det.	
28	V temp. 2	
27	V temp. 1	
26	V ref.	
25	Ground	
24	Ref. out	
23	V correction	
22	+24V	
21	+9V	M240
20	+9V	
19	Ground	
18	RX lock det.	
17	Ground	
16	Ground	
15	Clock	
14	Data	
13	Latch	
12	+9V	
11	LF out	
10	RX FFSK out	
9	Ref. in	
8	Ground	
7	Ground	M230
6	Ground	
5	RSSI 60dBuV	
4	Superv. on/off	
3	Superv. ou	
2	RSSI out	
1	IF out	

Fig. 22 Adjustment location

Test and adjustments of the transceiver.

As you go through this test, the procedure will ask you to select some functions of the mobile telephone; this is described earlier in this section. The numbers in () refer to the keys on the handset keyboard.

Before making any tests, make sure that the voltage reference is correct.

MEASUREMENT CONDITIONS.

The following measurements have to be carried out with an ambient temperature of 18-25°C and a humidity of 50 - 90% r.h.

The supply voltage should be 13.2V \pm 0.5V stabilised unless other values are specified.

Test points and adjustment locations can be seen on fig. 21.

Voltage reference adjustment.

- Turn R22 on M220 fully counter clockwise.
- Apply 10,4V \pm 0,1V from the power supply.
- Adjust R22 so that the mobile telephone clicks (the radio turns on).
- Check that the mobile telephone turns itself off when the voltage is above 19V and below 6V.
- Apply 13,2V from the power supply.
- Connect a precise voltmeter to pin 26 on M240 (Vref).
- Check that the voltage is 5.000V \pm 20mV.
- If not, adjust R221 on M220.

M220 System board.

Five adjustments are located on M220.

The voltage reference adjustments have been described above, and the power out adjustments are described in the transmitter performance test.

M230 IF/AF amplifier.

VCO loop filter.

- Connect a voltmeter to TP11 on M230.
- Check that the voltage is 4.0V DC \pm 0,1V.
- If not, adjust L6.

VCO.

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz, -52dBm.
- Select channel 500 (1 0500).
- Connect an oscilloscope to the base of Q13 on M230.
- Adjust C52 for max. output.

IF output.

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz, -73dBm.
- Select channel 500 (1 0500).
- Connect an oscilloscope to the IF out terminal (pin 1) on M230.
- Adjust L5 for max. output.

Switch capacitor filter.

- Connect an RF signal generator to the antenna input and provide a signal of 947.4875MHz, 1KHz mod., 3kHz dev. and -73dBm.
- Select channel 500 (1 0500).
- Connect an AC voltmeter to the LF out terminal (pin 11) on M230.
- Check that the voltage is 450mV RMS.
- If not, adjust R25.

M240 RX synthesizer.

See receiver performance test.

M250 TX/AF amplifier.

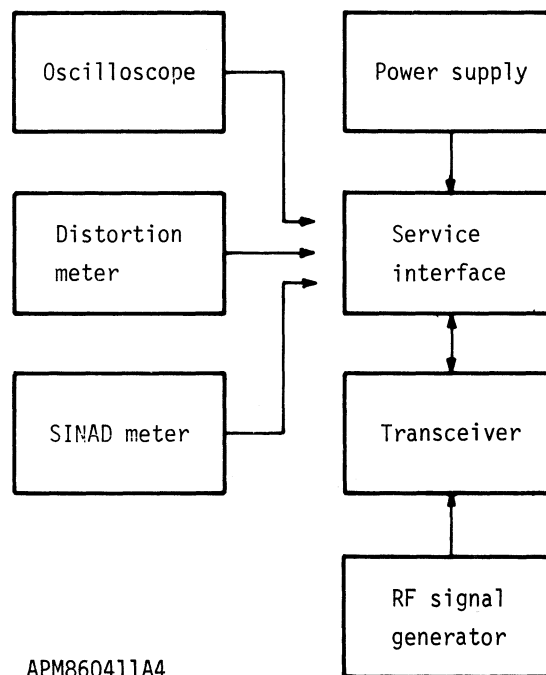
See transmitter performance test.

Receiver performance test.

The receiver performance test is divided into four steps:

1. Receiver frequency.
2. Sensitivity.
3. Field strength.
4. Distortion.

The test set-up for the receiver performance is shown in this figure:



CAUTION: Make sure, never to transmit directly into the RF signal generator!
! Remember that the voltage during the test is always 13,2V DC !

1. Receiver frequency.


- This check should be made when the mobile telephone is not warmed up.
- Set the signal generator to 947.4875MHz, 50mV and connect it to the antenna input.
- Select channel 500 (1 0500).
- Check that the frequency on the IF out connector at the RX/Synth. module M240 is 85,175MHz +/-500Hz.
- If not, adjust C3 on the RX/Synth. module M240.

2. Sensitivity.

- Set the signal generator to 947.4875MHz, 1KHz mod. and 3KHz dev. and connect it to the antenna input.
- Make a grounding connection between the metal cover of M230 (IF/AF module) and the chassis of the transceiver.
- Connect a SINAD meter to the SIU BNC-connector marked with a small loudspeaker.
- Select channel 500 (1 0500).

- Select handset earpiece (4 2).
- Select loudspeaker volume 4 (8 4).
- Select AF signal ON (5 1).
- Adjust the output level of the signal generator until you have audio in the loudspeaker, then reduce the signal level to 20dB SINAD. The level should be -113dBm with the psophometric filter used.
- Select lowest channel: 1 (1 0001) and then highest channel: 1000 (1 1000) (443,525MHz), making the same measurements. The level must not exceed -113dBm.

3. Field strength.

- Connect the signal generator to the antenna input.
- Set the signal generator to 947.4875MHz, 1KHz mod., 3KHz dev. and -93dBm.
- Select channel 500 (1 0500).
- Press  on the handset.
- Adjust R77 on the IF/AF module M230 until the first two digits show approx. 6B (HEX).
- Increase the RF level until the last digit shifts from 0 to 1. This level must be -55dBm to -39dBm.
- If the level is outside this, adjust R68 on the IF/AF module M230. Optimum is a shift at -47dBm.
- Decrease the RF level 20dB.
- The last digit should then shift from 1 to 0.
- If not, change or repair the IF/AF module M230.

Note: Be careful if the signal generator generates spikes. These can be omitted if the signal generator is disconnected from the transceiver, while the attenuator on the signal generator is operated.

4. Distortion.

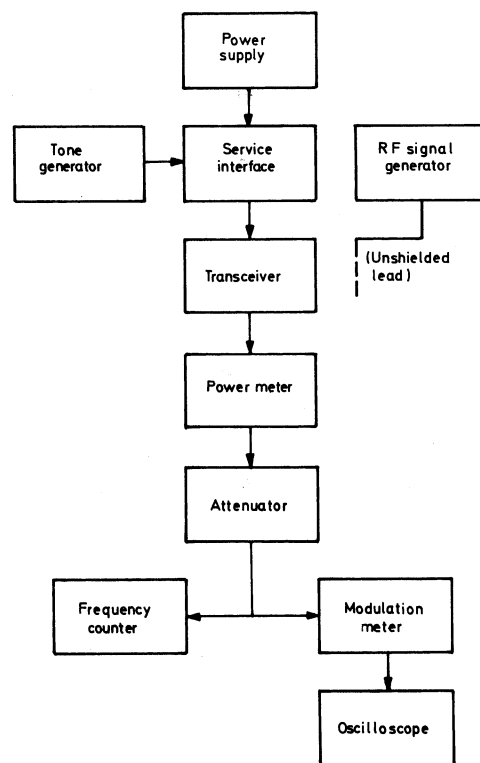
- Set the output level of the signal generator to -53dBm.
- Check the distortion. The distortion must be less than 5%.

Transmitter performance test.

The transmitter performance test is divided into four steps:

1. VCO lock.
2. Transmitter frequency.
3. Modulation levels.
4. Transmitter power levels.

The test set-up for transmitter performance:



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! Remember that the voltage during the test is always 13,2V DC !

1. VCO lock.

- Connect a DC voltmeter to TP13 on M250.
- Select channel 500 (1 0500).
- Select low power out (2 1).
- Check that the VCO is locked. This is indicated by a DC-voltage (9-12V) at TP13.
- If not, adjust C33 on M450 until the VCO is locked and a level of 9-12V DC is found at TP13.

2. Transmitter frequency.

- This check should be made when the mobile telephone is not warmed up.
- Connect via a 20dB attenuator, a frequency counter to the antenna connector on the transceiver.
- Select channel 500 (1 0500).
- Select low power (2 1).
- Check that the frequency is 902.4875MHz +/-100Hz.
- If not, adjust L5 on the TX/AF module M250.

3. Modulation levels.

- Select handsfree loudspeaker ON (4 1).
- Select microphone ON (7 1).
- Select data transmission OFF (3 0).
- Select supervisory OFF (6 0).
- Select channel 500 (1 0500).
- Select low power (2 1).
- Set the tone generator to 1KHz, 1V RMS and connect it to the mic. input on the SIU.
- Check that the transmitter deviation is 4,4KHz.
- If not, adjust R58 on the TX/AF module M250.
- Set the tone generator to 1KHz, 100mV RMS.
- Check that the transmitter deviation is 3KHz.
- If not, adjust R124 on the TX/AF module M250.
- Disconnect the tone generator from the SIU.
- Select microphone OFF (7 0).
- Select data transmission ON, 1800 Hz (3 1).
- Check that the transmitter deviation is 4,2KHz.
- If not, adjust R134 on the TX/AF module M250.
- Select data transmission OFF (3 0).
- Select supervisory ON (6 1).
- Set the RF signal generator to: 4KHz tone, 1KHz deviation.
- Check that the transmitter deviation is 1KHz.
- If not, adjust R56 on the TX/AF module M250.

4. Transmitter power level.

- Set the signal generator to 947.4875MHz (Channel 500). (The power level can be tested without receiving a signal, but then the mobile telephone switches itself off after 30 seconds).
- Select channel 500 (1 0500).
- Select high power (2 4).
- Check that output power is 6W.
- If not, adjust R115 on the system board M220. If this is impossible, adjust R115 until the power just begins to decrease (otherwise it is impossible to adjust the other power levels).
- Select medium power (2 3).
- Check that the output power is 1W.
- If not, adjust R105 on the system board M220.
- Select low power (2 1).
- Check that the output power is 100mW.
- If not, adjust R102 on the system board M220.
-

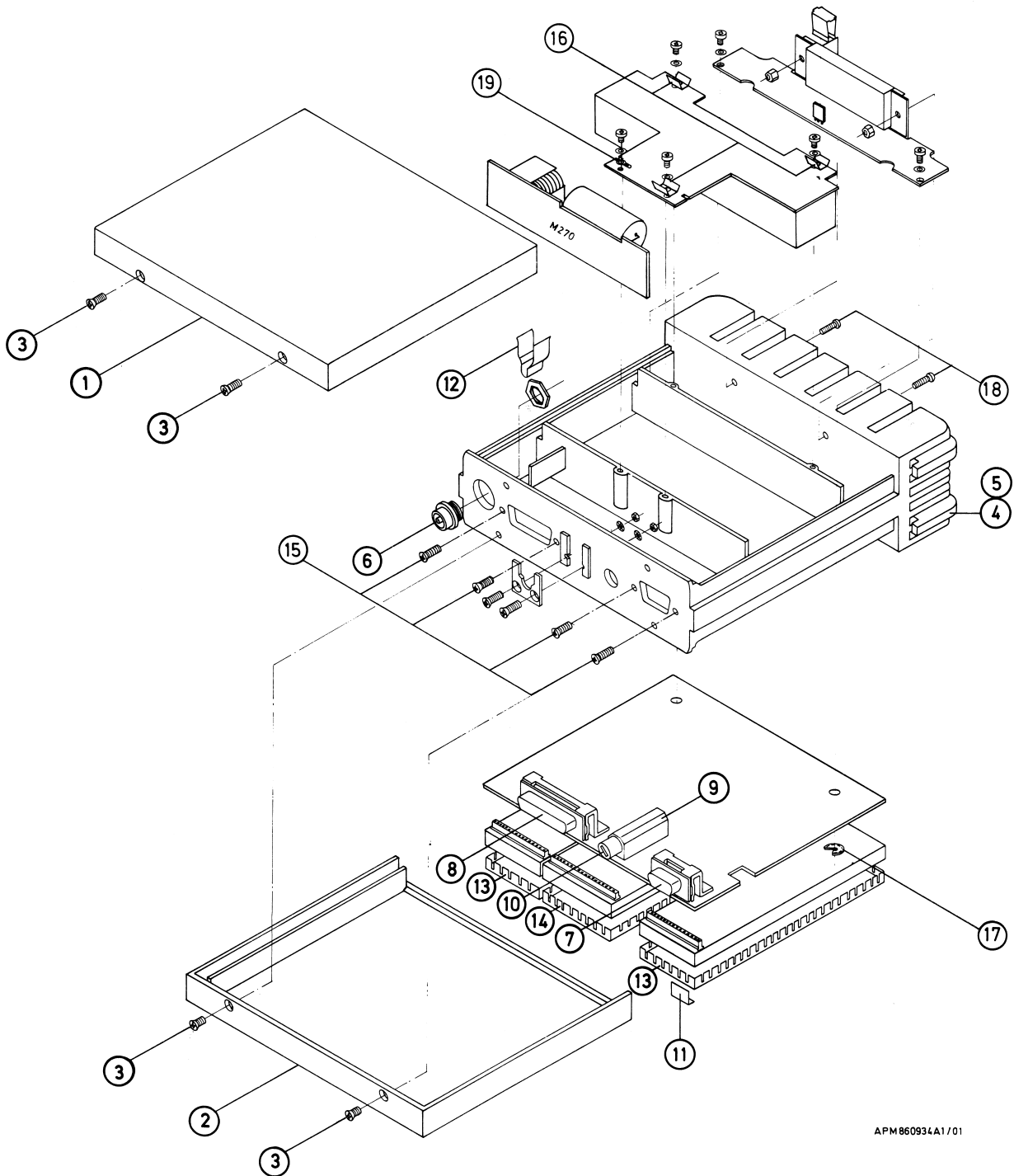
Note: When the PA-stage M260 has been exchanged, the power level must be adjusted.

MECHANICAL SPAREPARTS LIST

Notice when receiving spare parts from Concern Service they may appear with different marking than the original components in the equipment.

Nevertheless the value and function of the components are equivalent to that of the components mounted in the equipment by the factory.

Item	Ordering number	Description	Quantity	Remark
1	5322 466 92378	TOP FOR CHASSIS BLACK	1	
1	5322 466 92385	TOP FOR CHASSIS WHITE	1	
2	5322 466 82519	BOTTOM FOR CHASSIS BLACK	1	
2	5322 466 82523	BOTTOM FOR CHASSIS WHITE	1	
3	5322 502 13342	SCREW M4X6	4	
4	5322 462 50447	FOOT FOR CHASSIS BLACK	4	
5	5322 503 90075	HAMMER-DRIVE SCREW 3/16X00	4	
6	5322 264 10237	ANTENNA CONNECTOR BNC-MCX	1	
7	5322 266 40164	FILTER CONNECTOR 9 POL FEMALE		
8	5322 265 40913	FILTER CONNECTOR 15POL MALE	1	
9	5322 256 30414	FUSEHOLDER 445763	1	
10	5322 256 30415	COVER F/FUSEHOLDER 445764	1	
11	5322 492 70305	FRAME SPRING NICKEL (BRIGHT)	1	
12	5322 278 90617	SPRING F/IC MOTHERBOARD		
13	5322 462 50439	COVER F/SHIELD CAN M230/M250	2	
14	5322 462 50441	COVER F7SHIELD CAN M240	1	
15	5322 502 13343	SCREW M2,5X6MM UHJX BLACK	4	
16	5322 290 60822	EARTH CONNECTION F/DUPLEXFILT.	1	
17	5322 532 11842	BENZING RING 4MM	2	
18	5322 502 13347	SCREW M2,5X6MM UNBRACO BLACK	2	
19	5322 290 34028	SOLDERLUG 3,2X5,5X12X0,3MM	1	
	5322 310 31356	LITHIUMCELLE SERVICE PACK	1	
	5322 532 11836	CURVED WASHER STEEL M2,5		
	5322 417 60209	QUICKLOCK 2MM		
	5322 253 40055	FUSE 10A TIME-LAG 5X20MM		
	5322 310 31346	4 POL. CONN.GOLD F/M PA/SYS.		
	5322 320 11078	COAXCABLE M230/M240	1	
	5322 320 11079	COAXCABLE M240/M250	1	
	5322 320 11081	COAXCABLE M250/M260	1	
	5322 320 11074	COAXCABLE M230/240 W/PLUG	1	
	5322 320 11075	COAXCABLE M240/250 W/PLUG	1	
	5322 320 11076	COAXCABLE M250/260 W/PLUG	1	
	5322 405 50444	CLAMP NICKEL BRIGHT F/PA-MODUL	1	



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Fig. 23 Exploded view, transceiver

ELECTRICAL SPARE PARTS LIST

Notice when receiving spare parts from Concern Service they may appear with different marking than the original components in the equipment.

Nevertheless the value and function of the components are equivalent to that of the components mounted in the equipment by the factory.

System board, M220

Item	Ordering number	Description	Remark
	5322 216 80198	SYSTEMBOARD M 220 SERV.PACK	
Capacitors			
C-001	4822 124 21912	ELCO 100U +-20% 16V	
C-002	4822 124 41393	ELCO 220U +-20% 25V	
C-004	4822 124 40963	ELCO SOL 33U +-20% 10V	
C-005	5322 124 10916	TANTAL SMD 47U 6,3V 20% CASE D	
C-006	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-007	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-008	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-009	5322 126 10236	CAP SMD X7R 270N 10% 1812	
C-010	5322 126 10236	CAP SMD X7R 270N 10% 1812	
C-011	5322 124 10917	TANTAL SMD 1U0 35V 20% CASE B	
C-012	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-013	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-014	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-015	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-016	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-017	5322 122 32448	CAP SMD NP0 10P 5% 0805	
C-018	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-020	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-050	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-051	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-052	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-053	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-054	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-055	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-070	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-071	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-072	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-073	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-074	5322 122 31863	CAP SMD NP0 330P 5% 0805	
C-075	5322 122 31863	CAP SMD NP0 330P 5% 0805	

Item	Ordering number	Description	Remark
C-081	5322 124 10921	TANTAL SMD 10U 25V CASE D	
C-082	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-083	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-084	4822 122 33127	CAP SMD X7R 2,2N 10% 0805	
C-087	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-088	4822 124 21912	ELCO 100U +-20% 16V	
C-089	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-090	4822 124 41393	ELCO 220U +-20% 25V	
C-100	4822 122 33127	CAP SMD X7R 2,2N 10% 0805	
C-200	5322 122 32661	CAP SMD NP0 56P 5% 0805	
C-201	5322 122 32659	CAP SMD NP0 33P 5% 0805	
C-202	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-203	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-204	5322 124 10935	TANTAL SMD 15UF 16V 20% CASE D	
C-205	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-206	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-207	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-208	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-209	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-210	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-212	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-213	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-214	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-216	4822 122 33543	CAP SMD X7R 22N 10% 0805	
C-217	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-218	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-219	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-222	5322 124 10937	TANTAL SMD 6U8 25V 20% CASE D	
C-223	5322 124 10917	TANTAL SMD 1U0 35V 20% CASE B	
C-224	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-225	5322 124 10917	TANTAL SMD 1U0 35V 20% CASE B	
C-226	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-227	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-228	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-229	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-230	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-231	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
Diodes			
D-001	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-002	5322 130 33662	DIODE SMD BZX84-C15 5% SOT-23	
D-003	5322 130 34331	DIODE SMD BAV70 2XCOM C SOT-23	
D-004	5322 130 34331	DIODE SMD BAV70 2XCOM C SOT-23	

Item	Ordering number	Description	Remark
D-005	5322 130 32835	DIODE SMD BZX84-C5V1 5% SOT-23	
D-006	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-007	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-008	5322 130 81573	LED SMD 3X1,2MM LS S210 RED	
D-011	5322 130 81573	LED SMD 3X1,2MM LS S210 RED	
D-012	5322 130 34331	DIODE SMD BAV70 2XCOM C SOT-23	
D-013	4822 130 34398	DIODE ZENER BZX79-C24 24V 5%	
D-100	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-201	5322 130 81573	LED SMD 3X1,2MM LS S210 RED	
D-202	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-203	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-204	5322 209 61328	DIODE SMD BZX84-C30 5% SOT-23	
D-205	5322 209 61328	DIODE SMD BZX84-C30 5% SOT-23	
Integrated circuits			
IC001	5322 209 61276	IC AN-6541 9V REGULATOR	
IC002	5322 209 70337	IC L487 VOLTAGE REGULATOR	
IC003	5322 209 11147	IC SMD HEF4093BT 4X2INP S-NAND	
IC004	5322 209 11261	IC SMD HEF4538BT 2 X MULTIVIB.	
IC005	5322 209 11988	IC SMD HEF4002BT DUAL NOR GATE	
IC006	5322 209 82941	IC SMD LM358D DUAL OP-AMP	
IC007	5322 209 82941	IC SMD LM358D DUAL OP-AMP	
IC008	5322 209 11461	IC SMD HEF4521BT 24ST FREQ DIV	
IC009	5322 209 11147	IC SMD HEF4093BT 4X2INP S-NAND	
IC010	5322 209 11446	IC SMD HEF4051BT 8CH AN MULTIP	
IC011	5322 209 11926	IC SMD MC1776CD SO-8	
IC012	4822 209 80506	IC TDA1011 AF-AMP 2-6W	
IC013	5322 209 82941	IC SMD LM358D DUAL OP-AMP	
IC014	5322 209 82941	IC SMD LM358D DUAL OP-AMP	
IC200	5322 209 61277	IC SMD 80C31 C-MOS CONTR.	
IC201	5322 209 11958	IC SMD 27C512 EPROM SERV.PACK	
IC202	5322 209 11928	IC SMD 4464 S-RAM 200NS-25/+85	
IC203	5322 209 71555	IC SMD 74HC373T 8X3-ST D-LATCH	
IC204	5322 209 11994	IC SMD 74HC139T 2X2-4 LINE DEC	
IC205	5322 209 14542	IC SMD HEF4066BT 4X BILAT SWIT	
IC206	4822 209 60449	IC SMD 74HC04T HEX INVERTER	
IC207	5322 209 60429	IC SMD 74HC32T 4X2INP OR-GATE	
IC208	5322 209 71589	IC SMD 74HC74T 2XD-FLIP FLOP	
IC209	5322 209 12039	IC SMD STC 9120 MSK MODEM	
IC210	5322 209 11991	IC SMD HEF4512BT 8INP MULTIPLX	
IC211	5322 209 11992	IC SMD HEF4724BT 8-BIT ADR.LAT	
IC212	5322 209 11992	IC SMD HEF4724BT 8-BIT ADR.LAT	
IC213	5322 209 11992	IC SMD HEF4724BT 8-BIT ADR.LAT	

Item	Ordering number	Description	Remark
IC214	5322 209 14486	IC SMD HEF40106BT HEX INVERTIN	
IC215	5322 209 11998	IC SMD PCF8591 8-BIT A/D D/A	
IC216	5322 209 82941	IC SMD LM358D DUAL OP-AMP	
IC217	5322 209 14486	IC SMD HEF40106BT HEX INVERTIN	
IC218	5322 209 11959	IC SMD NMC9346 SERV.PACK	
IC219	5322 209 14484	IC SMD HEF4520BT DUAL BIN.COUN	
Transistors			
Q-001	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-002	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-003	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-004	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-005	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-006	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-007	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-008	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-009	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-010	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-013	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-014	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-100	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-101	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-102	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-103	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-201	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-202	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-203	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-204	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-205	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-206	5322 130 41983	TRANS SMD BC858B PNP	SOT-23
Q-207	5322 130 60597	TRANS SMD BCX56-10 NPN	SOT-89
Q-208	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-209	5322 130 60597	TRANS SMD BCX56-10 NPN	SOT-89
Q-210	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-211	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-212	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-213	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Q-215	5322 130 41982	TRANS SMD BC848B NPN	SOT-23
Resistors			
R-001	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-002	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-003	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-004	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-005	4822 111 91661	RES SMD 47K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-006	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-007	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-008	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-009	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-010	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-011	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-012	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-013	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-014	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-015	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-016	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-017	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-018	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-019	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-020	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-021	4822 111 91655	RES SMD 8K2 5% 0,1W 0805	
R-022	5322 100 11556	TRIM.POTM LIN SMD 10K EVM7J	
R-023	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-024	4822 116 81389	RES SMD 82K 5% 0,1W 0805	
R-025	4822 111 91521	RES SMD 18K 5% 0,1W 0805	
R-026	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-027	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-028	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-029	4822 111 91521	RES SMD 18K 5% 0,1W 0805	
R-030	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-031	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-032	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-033	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-034	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-035	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-036	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-037	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-038	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-040	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-041	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-042	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-043	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-044	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-045	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-046	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-047	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-048	4822 116 90348	RES SMD 820K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-049	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-050	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-051	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-052	4822 116 81028	RES SMD 270K 5% 0,1W 0805	
R-053	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-054	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-055	4822 116 81389	RES SMD 82K 5% 0,1W 0805	
R-056	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-057	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-058	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-060	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-061	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-062	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-063	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-064	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-065	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-066	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-067	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-068	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-070	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-071	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-072	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-073	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-074	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-075	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-076	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-077	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-078	4822 116 90467	RES SMD 22R 5% 0,1W 0805	
R-079	5322 116 81931	RES SMD 1R0 10% 0,1W 0805	
R-083	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-084	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-085	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-086	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-087	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-088	4822 116 90462	RES SMD 4R7 5% 0,1W 0805	
R-089	4822 116 90342	RES SMD 27K 5% 0,1W 0805	
R-090	4822 111 91527	RES SMD 3K9 5% 0,1W 0805	
R-100	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-101	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-102	5322 100 11555	TRIM.POTM LIN SMD 4K7 EVM7J	
R-103	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-104	4822 111 91517	RES SMD 10K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-105	5322 100 11571	TRIM.POTM LIN SMD 22K EVM7J	
R-106	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-107	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-108	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-109	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-110	5322 116 40167	RES PTC Q63100-P330-C11 VIOLET	
R-111	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-112	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-113	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-114	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-115	5322 100 11556	TRIM.POTM LIN SMD 10K EVM7J	
R-116	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-117	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-118	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-119	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-120	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-121	4822 111 91521	RES SMD 18K 5% 0,1W 0805	
R-122	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-123	4822 111 91535	RES SMD 56K 5% 0,1W 0805	
R-124	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-201	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-204	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-205	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-207	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-208	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-209	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-210	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-211	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-212	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-214	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-215	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-216	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-217	5322 116 81951	RES SMD 33K2 1% 0805	
R-218	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-219	4822 116 90445	RES SMD 39K 5% 0,1W 0805	
R-220	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-221	4822 100 11563	TRIM.POTM LIN SMD 2K2 EVM7J	
R-222	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-223	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-224	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-225	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-226	4822 116 80881	RES SMD 220K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-227	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-228	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-229	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-230	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-231	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-232	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-234	4822 116 90462	RES SMD 4R7 5% 0,1W 0805	
R-235	4822 116 90462	RES SMD 4R7 5% 0,1W 0805	
R-236	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-237	5322 116 81952	RES SMD 56K2 1% 0805	
R-238	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-239	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-240	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-241	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-242	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-243	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-244	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-245	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-246	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-247	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-249	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-250	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-251	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-252	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-253	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-260	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-261	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-262	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-265	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
Relay			
RE001	5322 280 80612	RELAY 6V 1 SHIFTSET	
Crystals			
X-001	5322 242 72875	CRYSTAL 32,768 KHZ	
X-002	5322 242 72627	CRYSTAL 11059.2KHZ	
VOX INTERFACE PRINT			
Q-001	5322 130 41983	TRANS SMD BC858B PNP SOT-23	
R-001	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-002	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-003	4822 116 90345	RES SMD 330K 5% 0,1W 0805	

IF/AF amplifier, M230-I

Item	Ordering number	Description	Remark
	5322 216 80248	IF/AF FMS MODULE SERV.P M230-I	
Capacitors			
C-001	5322 126 10225	CAP SMD NP0 1,5P 0,25 0805	
C-002	5322 122 32269	CAP SMD NP0 6,8P 0,25 0805	
C-003	5322 125 50421	TRIM CAP SMD 2-12PF	
C-004	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-005	5322 122 32592	CAP SMD NP0 680P 5% 0805	
C-006	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-007	5322 126 10359	CAP SMD NP0 1,0N 5% 0805	
C-008	5322 126 10359	CAP SMD NP0 1,0N 5% 0805	
C-009	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-010	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-011	5322 126 10225	CAP SMD NP0 1,5P 0,25 0805	
C-012	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-013	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-014	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-015	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-016	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-017	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-018	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-019	5322 122 32448	CAP SMD NP0 10P 5% 0805	
C-020	5322 126 10359	CAP SMD NP0 1,0N 5% 0805	
C-021	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-022	5322 122 32481	CAP SMD NP0 15P 5% 0805	
C-023	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-024	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-025	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-026	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-027	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-028	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-029	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-030	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-031	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-032	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-033	4822 122 33127	CAP SMD X7R 2,2N 10% 0805	
C-034	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-035	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-036	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-037	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-038	5322 124 10915	TANTAL SMD 1U5 6,3V 20% CASE A	

Item	Ordering number	Description	Remark
Resistors			
R-001	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-002	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-003	5322 116 30364	RES SMD NTC 15K 20% 1206	
R-004	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-005	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-006	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-007	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-008	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-009	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-010	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-011	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-012	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-013	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-014	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-015	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-016	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-017	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-018	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-019	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-020	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-021	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-022	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-023	5322 116 30365	RES SMD NTC 100K 20% 1206	
R-024	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-025	5322 100 11554	TRIM.POTM LIN SMD 100K EVM7J	
R-026	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-027	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-028	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-029	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-030	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-031	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-032	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-033	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-034	5322 116 81947	RES SMD 40K2 1% 0805	
R-035	5322 116 81947	RES SMD 40K2 1% 0805	
R-036	5322 116 81936	RES SMD 20K 1% 0805	
R-037	5322 116 81939	RES SMD 64K9 1% 0805	
R-038	5322 116 81943	RES SMD 178K 1% 0805	
R-039	5322 116 81942	RES SMD 121K 1% 0805	
R-040	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-041	4822 116 80881	RES SMD 220K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
IC004	5322 209 61334	IC SMD SA571D COMPANDER	
IC005	5322 209 83125	IC SMD LM324D 4XLOW P. OP-AMP	
IC006	5322 209 14477	IC SMD HEF4013BT 2XD-FLIP FLOP	
IC007	5322 209 61274	IC SMD 74HC4024D ASYNC.COUNT.	
Coils			
L-002	5322 157 60227	COIL SMD 0,33UH TYPE: 5CB ADJ.	
L-003	5322 157 60227	COIL SMD 0,33UH TYPE: 5CB ADJ.	
L-004	5322 157 60228	COIL SMD 330NH 5%	
L-005	5322 157 60225	COIL SMD 120UH TYPE: 5CD ADJ.	
L-006	5322 157 60226	COIL SMD 0,68UH TYPE: 5CB ADJ.	
L-007	5322 157 60221	COIL SMD 470NH 5%	
L-008	5322 157 60221	COIL SMD 470NH 5%	
Transistors			
Q-001	5322 130 61761	TRANS SMD S943T GAAS SOT143	
Q-002	5322 130 44787	TRANS SMD BFR31 N-FET SOT-23	
Q-003	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-004	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-005	5322 130 44787	TRANS SMD BFR31 N-FET SOT-23	
Q-006	5322 130 42718	TRANS SMD BFS20 NPN SOT-23	
Q-007	5322 130 42718	TRANS SMD BFS20 NPN SOT-23	
Q-008	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-009	5322 130 41983	TRANS SMD BC858B PNP SOT-23	
Q-010	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-011	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-012	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-013	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Resistors			
R-001	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-002	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-003	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-004	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-005	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-007	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-008	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-009	4822 116 90458	RES SMD 1K5 5% 0,1W 0805	
R-010	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-011	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-012	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-013	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-014	4822 116 81382	RES SMD 12K 5% 0,1W 0805	
R-015	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-016	5322 116 30364	RES SMD NTC 15K 20%	

Item	Ordering number	Description	Remark
R-085	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-086	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-087	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-088	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-089	4822 116 90467	RES SMD 22R 5% 0,1W 0805	
R-090	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-091	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-092	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-093	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-094	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-095	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-096	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-097	5322 116 81944	RES SMD 348K 1% 0805	
R-098	5322 116 81946	RES SMD 16K2 1% 0805	
R-099	5322 100 11546	TRIM.POTM. LIN SMD 4K7 EVM7M	
R-100	5322 116 81938	RES SMD 39K2 1% 0805	
R-101	5322 116 81938	RES SMD 39K2 1% 0805	
R-102	5322 116 81935	RES SMD 19K6 1% 0805	
R-103	5322 116 81934	RES SMD 19K1 1% 0805	
R-104	5322 116 81933	RES SMD 17K8 1% 0805	
R-105	5322 100 11546	TRIM.POTM. LIN SMD 4K7 EVM7M	
R-106	5322 116 81938	RES SMD 39K2 1% 0805	
R-107	5322 116 81938	RES SMD 39K2 1% 0805	
R-108	5322 116 81935	RES SMD 19K6 1% 0805	
R-109	5322 116 81937	RES SMD 20K5 1% 0805	
R-110	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-111	5322 116 81945	RES SMD 374K 1% 0805	
R-112	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-113	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-115	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-116	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-117	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-118	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-119	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-120	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-121	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-122	5322 116 30364	RES SMD NTC 15K 20% 1206	
R-123	5322 116 30365	RES SMD NTC 100K 20% 1206	
R-124	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-125	5322 116 40162	RES PTC Q63100-P240-C11 RED	
Coils			
L-001	5322 157 60213	COIL SMD 820NH 5K ADJUSTABLE	
L-002	5322 157 60213	COIL SMD 820NH 5K ADJUSTABLE	

Item	Ordering number	Description	Remark
R-058	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-059	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-060	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-061	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-062	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-063	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-064	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-065	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-066	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-067	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-068	5322 100 11569	TRIM.POTM LIN SMD 47K EVM7J	
R-069	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-070	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-071	4822 116 90345	RES SMD 330K 5% 0,1W 0805	
R-072	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-073	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-075	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-077	5322 100 11556	TRIM.POTM LIN SMD 10K EVM7J	
R-078	5322 100 11556	TRIM.POTM LIN SMD 10K EVM7J	
R-079	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-080	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-081	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-082	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-083	4822 116 81382	RES SMD 12K 5% 0,1W 0805	
R-084	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
Crystal			
X-001	5322 242 72872	CER RESONATOR CSB1000JT1	

RX synthesizer, M240-I

Item	Ordering number	Description	Remark
	5322 216 80249	RX/SYNTH.FMS SERV.PACK M240-I	
Capacitors			
C-001	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-002	5322 122 32658	CAP SMD NP0 22P 5% 0805	
C-003	5322 125 60152	CAP TRIM SMD 2-4,5PF VERTIKAL	
C-004	5322 122 32269	CAP SMD NP0 6,8P 0,25 0805	
C-005	5322 122 32658	CAP SMD NP0 22P 5% 0805	
C-006	5322 122 32659	CAP SMD NP0 33P 5% 0805	
C-007	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-008	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-009	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-010	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-011	5322 124 10917	TANTAL SMD 1U0 35V 20% CASE B	
C-012	5322 122 32592	CAP SMD NP0 680P 5% 0805	
C-013	5322 122 32592	CAP SMD NP0 680P 5% 0805	
C-014	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-015	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-016	5322 126 10223	CAP SMD X7R 4,7N 10% 0805	
C-017	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-018	5322 124 10917	TANTAL SMD 1U0 35V 20% CASE B	
C-019	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-020	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-021	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-022	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-023	5322 122 32592	CAP SMD NP0 680P 5% 0805	
C-024	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-025	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-026	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-027	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-028	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-029	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-030	5322 126 10227	CAP SMD HIGH-Q 3,3P 0,25 0805	
C-031	5322 126 10228	CAP SMD HIGH-Q 5,6P 0,25 0805	
C-032	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-033	5322 126 10229	CAP SMD HIGH-Q 1,8P 0,25 0805	
C-034	5322 126 10226	CAP SMD HIGH-Q 2,2P 0,25 0805	
C-035	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-036	5322 122 31863	CAP SMD NP0 330P 5% 0805	
C-037	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-038	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-039	4822 122 33575	CAP SMD NP0 220P 5% 0805	

Item	Ordering number	Description	Remark
C-040	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-041	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-042	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-043	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-044	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-045	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-046	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-047	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-048	5322 122 32286	CAP SMD NP0 3,3P 0,25 0805	
C-049	5322 125 50422	TRIM CAP SMD 1-3PF MODIFIED	
C-050	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-051	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-052	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-053	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-054	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-055	5322 122 33083	CAP SMD NP0 0,56P 0,25 0805	
C-056	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-057	5322 122 32286	CAP SMD NP0 3,3P 0,25 0805	
C-058	5322 125 50422	TRIM CAP SMD 1-3PF MODIFIED	
C-059	5322 125 50422	TRIM CAP SMD 1-3PF MODIFIED	
C-060	5322 122 32286	CAP SMD NP0 3,3P 0,25 0805	
C-061	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-062	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-063	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-064	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-065	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-066	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-068	5322 122 32448	CAP SMD NP0 10P 5% 0805	
C-069	5322 122 32661	CAP SMD NP0 56P 5% 0805	
C-070	5322 122 32448	CAP SMD NP0 10P 5% 0805	
C-071	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-072	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-073	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-074	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-075	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-076	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-077	5322 126 10222	CAP SMD X7R 1,0N 10% 0805	
C-078	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-079	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-080	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-081	5322 122 34098	CAP SMD X7R 10N 10% 0805	

Item	Ordering number	Description	Remark
Diodes			
D-001	5322 130 80119	DIODE SMD BBY40 CAP SOT-23	
D-002	5322 130 81569	DIODE SMD BAS70-04 2XSC SOT-23	
D-003	5322 130 81569	DIODE SMD BAS70-04 2XSC SOT-23	
D-004	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-005	4822 130 33698	DIODE SMD BZX84-C10 5% SOT-23	
D-006	5322 130 81578	DIODE SMD 1T32-T8 CAP	
Integrated circuits			
IC001	5322 209 11997	IC SMD 74HC390T 2XDECADE COUNT	
IC002	5322 209 14482	IC SMD HEF4069UBT 6 X INVERTER	
IC004	5322 209 61283	IC SMD NJ8822 FREQUENCY SYNTH	
IC005	5322 209 61279	IC SMD MB501LFP 2MODUL PRESCAL	
IC006	5322 209 11926	IC SMD MC1776CD SO-8	
Coils			
L-001	5322 157 60221	COIL SMD 470NH 5%	
L-002	5322 157 60221	COIL SMD 470NH 5%	
L-003	5322 157 60221	COIL SMD 470NH 5%	
L-004	5322 157 60218	COIL SMD 22NH 20%	
L-005	5322 157 60218	COIL SMD 22NH 20%	
L-006	5322 157 60224	COIL SMD 220NH 10%	
L-007	5322 157 60223	COIL SMD 12NH	
L-008	5322 157 60223	COIL SMD 12NH	
L-009	5322 157 60223	COIL SMD 12NH	
L-010	5322 157 60221	COIL SMD 470NH 5%	
L-011	5322 157 60227	COIL SMD 0,33UH TYPE: 5CB ADJ.	
L-012	5322 157 60224	COIL SMD 220NH 10%	
L-013	5322 157 60249	COIL AIR 12NH 6 TURNS 0,4 CU	
L-014	5322 157 60212	COIL SMD 100UH	
L-015	5322 157 60221	COIL SMD 470NH 5%	
Transistors			
Q-001	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-002	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-003	5322 130 41983	TRANS SMD BC858B PNP SOT-23	
Q-006	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-007	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-008	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-010	5322 130 60705	TRANS SMD BFR93A NPN SOT-23	
Q-011	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-012	5322 130 61761	TRANS SMD S943T GAAS SOT143	
Q-013	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-014	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-015	5322 130 61763	TRANS SMD S942T GAAS SOT143	

Item	Ordering number	Description	Remark
Resistors			
R-001	4822 111 91521	RES SMD 18K 5% 0,1W 0805	
R-002	5322 116 81941	RES SMD 69K 1% 0805	
R-003	5322 116 81942	RES SMD 121K 1% 0805	
R-004	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-005	4822 111 91534	RES SMD 5K6 5% 0,1W 0805	
R-006	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-007	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-008	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-009	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-010	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-011	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-012	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-013	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-014	5322 116 81948	RES SMD 2K2 1% MELF	
R-015	5322 116 30366	TEMP. SENSOR KTY13A	
R-016	5322 116 30366	TEMP. SENSOR KTY13A	
R-017	5322 116 81948	RES SMD 2K2 1% MELF	
R-018	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-019	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-020	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-021	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-022	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-023	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-024	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-025	4822 116 90447	RES SMD 470K 5% 0,1W 0805	
R-026	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-027	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-028	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-029	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-030	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-031	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-032	4822 116 81382	RES SMD 12K 5% 0,1W 0805	
R-033	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-034	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-035	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-036	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-037	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-038	4822 116 81118	RES SMD 15R 5% 0,1W 0805	
R-039	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-040	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-042	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-044	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-046	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-047	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-048	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-049	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-050	4822 111 91527	RES SMD 3K9 5% 0,1W 0805	
R-051	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-052	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-053	4822 111 91534	RES SMD 5K6 5% 0,1W 0805	
R-054	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-055	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-056	4822 116 90451	RES SMD 56R 5% 0,1W 0805	
R-057	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-058	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-059	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-060	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-061	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-062	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-063	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-064	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-065	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-066	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-067	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-068	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-069	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-070	4822 116 80887	RES SMD 68R 5% 0,1W 0805	
R-071	4822 111 91501	RES SMD 330R 5% 0,1W 0805	
R-072	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-073	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-074	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-075	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-076	4822 116 90457	RES SMD 10R 5% 0,1W 0805	
R-077	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-078	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-080	4822 116 80882	RES SMD 270R 5% 0,1W 0805	
R-081	4822 116 80882	RES SMD 270R 5% 0,1W 0805	
R-082	5322 116 81929	RES SMD 18R 5% 0,1W 0805	
Crystal			
X-001	5322 242 72629	CRYSTAL 8825.00KHZ HC43	

TX/AF amplifier, M250-I

Item	Ordering number	Description	Remark
	5322 216 80251	TX/AF FMS SERV.PACK M250-I	
Capacitors			
C-001	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-002	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-003	5322 122 32447	CAP SMD NP0 1,0P 0,25 0805	
C-004	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-005	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-006	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-007	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-008	5322 122 32287	CAP SMD NP0 4,7P 0,25 0805	
C-009	5322 122 32287	CAP SMD NP0 4,7P 0,25 0805	
C-010	5322 122 32447	CAP SMD NP0 1,0P 0,25 0805	
C-011	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-012	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-013	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-014	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-015	5322 122 32269	CAP SMD NP0 6,8P 0,25 0805	
C-016	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-017	5322 122 32447	CAP SMD NP0 1,0P 0,25 0805	
C-018	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-019	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-020	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-021	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-022	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-030	5322 122 32269	CAP SMD NP0 6,8P 0,25 0805	
C-031	5322 126 10346	CAP SMD N750 2,2P 0,25 0805	
C-032	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-033	5322 125 50422	TRIM CAP SMD 1-3PF MODIFIED	
C-034	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-035	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-036	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-037	5322 122 33063	CAP SMD NP0 2,2P 0,25 0805	
C-038	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-039	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-040	5322 122 33063	CAP SMD NP0 2,2P 0,25 0805	
C-041	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-042	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-043	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-044	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-045	5322 122 33063	CAP SMD NP0 2,2P 0,25 0805	
C-046	4822 122 33805	CAP SMD X7R 330P 10% 0805	

Item	Ordering number	Description	Remark
C-050	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-051	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-052	5322 122 33538	CAP SMD NP0 150P 5% 0805	
C-054	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-055	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-056	5322 122 33538	CAP SMD NP0 150P 5% 0805	
C-057	5322 122 33538	CAP SMD NP0 150P 5% 0805	
C-058	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-059	5322 122 32658	CAP SMD NP0 22P 5% 0805	
C-060	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-061	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-070	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-071	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-072	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-073	5322 126 10223	CAP SMD X7R 4,7N 10% 0805	
C-074	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-075	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-076	5322 122 32452	CAP SMD NP0 47P 5% 0805	
C-077	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-078	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-079	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-080	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-090	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-091	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-092	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-094	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-095	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-096	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-100	5322 124 10915	TANTAL SMD 1U5 6,3V 20% CASE A	
C-101	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-102	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-103	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-104	5322 124 10919	TANTAL SMD 10U 10V CASE C	
C-105	4822 122 33575	CAP SMD NP0 220P 5% 0805	
C-106	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-107	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-110	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-112	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-114	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-115	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-116	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-117	5322 122 32531	CAP SMD NP0 100P 5% 0805	

Item	Ordering number	Description	Remark
C-120	5322 122 32592	CAP SMD NP0 680P 5% 0805	
C-122	4822 122 33343	CAP SMD X7R 22N 10% 0805	
C-123	5322 122 32531	CAP SMD NP0 100P 5% 0805	
C-124	5322 124 10934	TANTAL SMD 2U2 16V 20% CASE B	
C-125	5322 124 10938	TANTAL SMD 1U0 16V CASE A	
C-126	4822 122 33127	CAP SMD X7R 2,2N 10% 0805	
Diodes			
D-001	5322 130 34689	DIODE SMD BBY31 CAP SOT-23	
D-002	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-003	5322 130 80119	DIODE SMD BBY40 CAP SOT-23	
D-004	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-005	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-007	5322 130 30691	DIODE SMD BAW56 2XCOM A SOT-23	
D-009	4822 130 80125	DIODE SMD BZX84-C5V6 5% SOT-23	
Integrated circuits			
IC001	5322 209 11922	IC OM843 SYNTHESE COSTUM DESIG	
IC002	5322 209 61337	IC SMD TL062CD LOW-POWER AMPL.	
IC003	5322 209 61334	IC SMD SA571D COMPANDER	
IC004	5322 209 61278	IC SMD FX316LV1 SWITCHED CAP	
Coils			
L-001	5322 157 60221	COIL SMD 470NH 5%	
L-002	5322 157 60211	COIL SMD 10UH	
L-003	5322 157 60211	COIL SMD 10UH	
L-004	5322 157 60221	COIL SMD 470NH 5%	
L-005	5322 157 60222	COIL SMD 2,2UH ADJUSTABLE	
L-006	5322 157 60218	COIL SMD 22NH 20%	
Transistors			
Q-001	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-002	5322 130 61761	TRANS SMD S943T GAAS SOT143	
Q-003	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-004	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-005	5322 130 44711	TRANS SMD BFT92 PNP SOT-23	
Q-006	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-007	5322 130 60647	TRANS SMD BFR92A NPN SOT-23	
Q-008	5322 130 41983	TRANS SMD BC858B PNP SOT-23	
Q-009	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-010	5322 130 42718	TRANS SMD BFS20 NPN SOT-23	
Q-011	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-012	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Q-013	5322 130 44787	TRANS SMD BFR31 N-FET SOT-23	
Q-014	5322 130 41982	TRANS SMD BC848B NPN SOT-23	
Resistors			
R-001	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-002	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-003	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-004	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-005	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-006	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-008	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-009	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-010	4822 111 91501	RES SMD 330R 5% 0,1W 0805	
R-011	4822 116 90464	RES SMD 6K8 5% 0,1W 0805	
R-012	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-013	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-014	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-015	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-016	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-017	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-018	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-019	4822 116 80879	RES SMD 150R 5% 0,1W 0805	
R-020	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-021	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-022	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-023	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-030	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-031	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-032	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-033	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-034	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-035	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-036	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-037	4822 116 90463	RES SMD 680R 5% 0,1W 0805	
R-038	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-039	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-040	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-041	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-042	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-043	4822 111 91501	RES SMD 330R 5% 0,1W 0805	
R-050	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-051	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-052	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-053	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-054	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-055	4822 116 90347	RES SMD 68K 5% 0,1W 0805	
R-056	5322 100 11569	TRIM.POTM LIN SMD 47K EVM7J	
R-057	4822 111 91518	RES SMD 100K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-058	5322 100 11572	TRIM.POTM. LIN SMD 22K EVM7M	
R-059	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-060	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-061	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-062	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-063	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-064	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-065	4822 116 90446	RES SMD 470R 5% 0,1W 0805	
R-066	4822 111 91501	RES SMD 330R 5% 0,1W 0805	
R-067	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-070	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-071	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-072	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-073	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-074	4822 111 91449	RES SMD 2K7 5% 0,1W 0805	
R-075	4822 111 91501	RES SMD 330R 5% 0,1W 0805	
R-076	4822 111 91533	RES SMD 560R 5% 0,1W 0805	
R-077	4822 111 91522	RES SMD 2K2 5% 0,1W 0805	
R-078	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-079	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-080	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-081	4822 111 91498	RES SMD 15K 5% 0,1W 0805	
R-082	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-083	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-084	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-090	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-091	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-092	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-093	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-094	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-095	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-096	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-097	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-098	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
R-099	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-100	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-110	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-111	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-112	4822 116 90459	RES SMD 150K 5% 0,1W 0805	
R-113	4822 116 90441	RES SMD 100R 5% 0,1W 0805	
R-114	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-115	4822 111 91518	RES SMD 100K 5% 0,1W 0805	

Item	Ordering number	Description	Remark
R-116	4822 116 81032	RES SMD 680K 5% 0,1W 0805	
R-117	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-120	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-121	4822 116 90442	RES SMD 120K 5% 0,1W 0805	
R-122	4822 111 91523	RES SMD 22K 5% 0,1W 0805	
R-123	4822 111 91517	RES SMD 10K 5% 0,1W 0805	
R-124	5322 100 11569	TRIM.POTM LIN SMD 47K EVM7J	
R-125	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-128	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-131	4822 116 81017	RES SMD 33K 5% 0,1W 0805	
R-132	4822 111 91527	RES SMD 3K9 5% 0,1W 0805	
R-133	4822 111 91518	RES SMD 100K 5% 0,1W 0805	
R-134	5322 100 11572	TRIM.POTM. LIN SMD 22K EVM7M	
R-135	4822 111 91661	RES SMD 47K 5% 0,1W 0805	
R-136	4822 116 80881	RES SMD 220K 5% 0,1W 0805	
R-137	4822 116 90348	RES SMD 820K 5% 0,1W 0805	
R-138	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-139	4822 111 91526	RES SMD 3K3 5% 0,1W 0805	
R-140	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	
Crystals			
X-001	5322 242 72628	CRYSTAL 20087.5KHZ HC43/U	
X-002	5322 242 72872	CER RESONATOR CSB1000JT1	

PA-stage, M260-I

Item	Ordering number	Description	Remark
	5322 216 80252	PA-MODULE FMS 4112	
Capacitors			
C-001	5322 122 32269	CAP SMD NP0 6,8P 0,25 0805	
C-002	5322 122 33244	CAP SMD NP0 8,2P 0,25 0805	
C-003	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-004	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-005	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-006	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-007	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-008	4822 122 33805	CAP SMD X7R 330P 10% 0805	
C-009	5322 122 32287	CAP SMD NP0 4,7P 0,25 0805	
C-010	4822 122 33496	CAP SMD X7R 100N 10% 1206	
C-011	4822 124 20944	ELCO SOL 1UF +20% 25V	
C-012	4822 122 33495	CAP SMD X7R 100N 10% 1206	
C-013	4822 124 20977	ELCO SOL 15U +20% 16V	
C-014	5322 122 34098	CAP SMD X7R 10N 10% 0805	
C-015	5322 122 33063	CAP SMD NP0 2,2P 0,25 0805	
Diodes			
D-001	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-002	5322 130 34337	DIODE SMD BAV99 2XSERIE SOT-23	
D-003	5322 130 81569	DIODE SMD BAS70-04 2XSC SOT-23	
Integrated circuit			
IC001	5322 209 61275	IC MHW808A3 POWER MODUL	
Coils			
L-001	5322 157 60221	COIL SMD 470NH 5%	
L-002	5322 157 60221	COIL SMD 470NH 5%	
Transistors			
Q-001	5322 130 61759	TRANSISTOR MRF559 0,5W 900MHZ	
Q-002	5322 130 41866	TRANSISTOR 2N4918 PNP	
Q-003	4822 130 60139	TRANS SMD BCX51 PNP SOT-89	
Resistors			
R-001	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-002	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-003	4822 116 80887	RES SMD 68R 5% 0,1W 0805	
R-004	4822 111 91652	RES SMD 47R 5% 0,1W 0805	
R-005	4822 111 91516	RES SMD 1K0 5% 0,1W 0805	
R-006	4822 116 52425	RES METALF 470R 5% 0,4W	
R-007	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-008	4822 116 90339	RES SMD 220R 5% 0,1W 0805	
R-009	4822 111 91532	RES SMD 4K7 5% 0,1W 0805	

Supply filter, M270-I

Item	Ordering number	Description	Remark
	5322 157 60272	SUPPLY FILTER	
Capacitor			
C-001	5322 124 22332	ELCO 10000UF -10+50% 16V	
Coil			
L-001	5322 157 60335	COIL F/SUPPLY FILTER	
Resistor			
R-001	4822 116 52332	RES METALF 10R 5% 0,4W	
Duplex filter			
	5322 157 60526	DUPLEX FILTER FMS SERV.P.	